DISTRIBUTION AND ASSEMBLAGES OF DECAPOD CRUSTACEANS

FROM THE CONTINENTAL SHELF OF THE SOUTH ATLANTIC BIGHT:

1977 - 1979 MARMAP INVESTIGATIONS[1/]

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ABSTRACT

A total of 82 species and 9587 individuals of decapod crustaceans were collected by otter trawl within six depth strata of 9-18 m, 19-27 m, 28-55 m, 56-110 m, 111-183 m and 184-366 m during 1977-1979. Ten species (Sicyonia brevirostris, Metapenaeopsis goodei, Mesopenaeus tropicalis, Trachypenaeus constrictus, Solenocera atlantidis, Ovalipes stephensoni, Portunus spinicarpus, Portunus spinimanus, Portunus gibbesii and Munida pusilla) comprised about 92% of all individuals collected. Collections were grouped by cluster analysis according to bathymetric location as well as time of day. Distribution of species assemblages was also related to time of day. A bathymetric gradient in distribution did not consist of discrete faunal zones but existed as a continuum of overlapping distributions across the continental shelf. The most distinct changes in faunal composition occurred near the shelf break, although species associated with the sponge-coral "live" bottom habitat were distinct from other species characteristic of the open-shelf sand habitat. The number of species and abundance of individuals was highest for strata encompassing depths of 28-110 m and during Summer 1978 and 1979. Unusual thermal conditions apparently affected these estimates during other sampling periods.

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INTRODUCTION

The present study is a continuation of ecological investigations on decapod crustaceans collected from the continental shelf of the South Atlantic Bight. Our current knowledge of this fauna results mostly from annotated check lists and systematic reviews, such as those by Chace (1972) on natantians of the Caribbean region and by Williams (1965) on decapods of the Carolinas. Ecological studies on multi-species assemblages of Decapoda have lagged far behind their systematic counterparts. Wenner and Read (1981) reviewed much of the existing literature on decapod crustaceans from the Carolinean shelf province between Cape Hatteras, North Carolina and Cape Canaveral, Florida. In the present paper, we provide a description of assemblages of epibenthic decapod crustaceans collected from the South Atlantic Bight in both open shelf and sponge-coral habitats, as well as an assessment of species abundance, richness and spatial distributions.

MATERIALS and METHODS

Data Collection

Samples of decapod crustaceans were collected during four cruises made from 1977 - 1979 (Table 1). Collections were made utilizing a systematic sampling design in which 180 pre-selected stations were located along seven transects between depths of 12-143 m in the area from Cape Fear, North Carolina to Cape Canaveral, Florida. One additional collection was made at depths > 143 m. The transects intersected the coastline at equidistant latitudes within the study area and extended to the 183 m depth contour. Stations along transects were also proportionately allocated by area within six depth strata of 9-18 m, 19-27 m, 28-55 m, 56-110 m, and 111-183 m. This generally resulted in more stations being allocated to the more extensive inshore sampling strata. Sampling effort within each depth stratum varied somewhat from cruise to cruise due to mechanical difficulties and bad weather.

All collections were made with a standard Marine Resources Monitoring Assessment and Prediction (MARMAP) trawl (3/4 scale #36 Yankee) with cod-end liner (Wilk and Silverman, 1976) towed for 0.5-h at 6.5 km/h from the R/V Dolphin. Bottom water temperature and salinity were measured, and expendable or mechanical bathythermograph casts were made after each trawl collection. The location (latitude and longitude), depth, bottom temperature and time of each collection are found in Appendix I.

All decapod crustaceans collected in successful tows were preserved in 10% seawater-formalin and taken to the laboratory where they were transferred to 40% isopropanol, identified to species or the lowest possible taxon, and counted. Although most collections of decapod crustaceans were made on the open shelf, an area with smooth sand bottom (Struhsaker, 1969), the trawl occasionally traversed small areas of "broken" relief which supported a rich sessile invertebrate fauna. Because these sponge-coral (Powles and Barans, 1980) or "live bottom" (Struhsaker, 1969) areas are important habitats for decapod crustaceans, (Wenner et al. MS in review), we have included data collected on decapods from these habitats in our analysis. Collections were considered to be in the sponge-coral habitat if the catch contained sponges, corals, and associated fish species (Wenner at al., 1979).

Data Analysis

The following index of abundance (Musick and McEachran, 1972; Elliott, 1977) was calculated to determine relative abundance of numerically dominant species within depth zones:

$$\text{Index of Abundance} = 1/n \sum_{1}^{n} \ln (x + 1)$$

where x = number of individuals of a given species within a depth zone and n = total number of collections in a depth zone.

Table 1. Monthly designation of seasonal cruises and number of trawl stations occupied per depth zone for each cruise.

Season	Cruise	Dates	Depth Zones (m) 9-18	19-27	28-55	56-110	111-183	184-366
Winter	DP-7801	Jan 5 - Jan 23	8	6	14	--	2	---
Summer	DP-7703	Aug 16 - Sept 2	7	11	11	2	1	---
Summer	DP-7807	Sept 6 - Sept 20	22	9	18	6	5	1
Summer	DP-7904	Aug 7 - Aug 27	22	9	17	5	5	---

Numerical classification (cluster analysis) was applied to pooled data from all cruises to determine species associations and distributional patterns. Prior to analysis, the data were reduced by elimination of species which occurred in only one or two collections over all sampling periods. Similarly, stations were eliminated from analysis if they contained only one species after data reduction.

After data reduction, numerical classification analysis was performed on data from remaining collections using the program COMPAH (Boesch, 1977). Algorithms used included a combination of log transformation [$\log_{10}(x + 1)$] of species abundance, the Bray-Curtis similarity measure, and flexible sorting with $\beta = -0.25$ (Clifford and Stephenson, 1975; Boesch, 1977). Preliminary analysis of the data using both Bray-Curtis and Canberra metric similarity coefficients resulted in clearer delineation of groups with the Bray-Curtis coefficient, despite its inherent deficiencies. In particular, the Bray-Curtis measure is influenced by numerically abundant species which largely determine inter-collection (normal) resemblance, while dense occurrences largely determined inter-species (inverse) resemblance (Boesch, 1977). The use of a logarithmic transormation in conjunction with the Bray-Curtis measure tends to reduce the importance (or influence) of the more abundant species.

Post-clustering techniques of nodal analysis (Williams and Lambert, 1961; Lambert and Williams, 1962) were used to relate normal and inverse classifications so that collection groups were described in terms of their constituent species and species groups were described in terms of their occurrence in collections. Nodal analyses were interpreted in terms of constancy (a measure of how consistently species are found in a site group) and fidelity (a measure of how restricted species are to a site group). Constancy has a value of one when all species in the species group occur in any collection in the site group. The fidelity index ranges from values greater than two, which indicates species that are rarely found outside of a particular site group, to less than one, which suggests a "negative" association (i.e., passive exclusion or active avoidance) of species with respect to a particular site group (Boesch, 1977).

The decapod community was further described in terms of number of species and abundance of individuals. We chose not to use the once popular Shannon index (H') (Pielou, 1975) as a measure of diversity in view of its recent criticism by Hurlbert (1971) and Peet (1975). The Shannon index (H') is biased and approximates the true population diversity only if the sample is sufficiently large to be an accurate representation of the population (Pielou, 1966 a, b; Peet, 1975). We consider our sample estimates of the decapod population to be minimal with respect to both the number of species and the number of individuals and believe that the gear utilized was selective toward the capture of larger epibenthic decapod crustaceans.

Study Area and Hydrographic Profile

The open shelf is characterized by a bottom consisting predominantly of sand and mud which occupies more than 90% of the shelf's surface area (George and Staiger, 1978). Struhsaker (1969) considered the open shelf habitat "to extend from about the 10-fathom depth curve out to the beginning of the 'shelf break' (at about 25 to 35 fathoms)". Interspersed throughout the near-shore open shelf habitat are areas of low to moderate relief with attached sponges, soft corals and hard corals. Areas of dense invertebrate growth often occur over sandy bottoms which are underlain at various depths by rock. The presence of sessile organisms is apparently related to the presence of rock close to the sediment surface (Powles and Barans, 1980). Further offshore, at the shelf-slope break, is the rocky outcrop habitat which is an area with high relief interspersed with smooth mud-bottom areas.

Hydrographic conditions on the continental shelf in the South Atlantic Bight are influenced by several factors: the proximity of the Gulf Stream with its frequent meanders and eddies; river runoff; seasonal heating and cooling; and bottom topography. In addition, the winds and tides can also significantly modify circulation patterns, especially near shore or where density gradients are weak (Blanton and Atkinson, 1978). The Carolina capes, with their shoals, are effective in trapping Gulf Stream eddies. A topographic irregularity southeast of Charleston, S.C., known as the "Charleston Bump", produces semi-permanent offshore meanderings of the Gulf Stream and upwelling of deeper waters near the shelf break in the area of deflection. This large upwelling, in addition to cyclonic eddies, supplies nutrients to the outer shelf waters (Bishop, Yoder and Paffenhofer, 1980).

The northward-moving Gulf Stream is an important warming influence on temperature conditions of the shelf, and is especially notable in winter near the shelf break. A warm band of relatively constant temperature and salinity is observed year-round at middle shelf depths near the bottom. This area of the shelf from 33-40 m is generally the most thermally stable (Miller and Richards, 1979). However, the inner shelf and coastal waters are subject to considerable seasonal fluctuation.

A counter-current is also a prevalent feature of the continental shelf water, especially during summer. This is a geostrophic southward flow of water which appears to be seasonal. Flow is maximum in summer, but in late fall and early winter the broad continuous flow no longer exists. Rather it is restricted to narrow bands, mainly in nearshore areas in the vicinity of river mouths (O. Pashuk, Marine Resources Research Institute, Charleston, S.C., pers. comm.).

Temperature and salinity differed not only between the winter and summer seasons but also annually between summer cruises. During Summer 1977, active upwelling of deep-water occurred near the shelf break southeast of Charleston, S.C. A stranded intrusion of colder upwelled water was also observed close to shore near bottom off Daytona Beach, and a large Gulf Stream eddy was found in Long Bay (Figs. 1 & 2). In addition, warm and saline Gulf Stream waters intruded onshore near the bottom off Savannah, Georgia. The salinity was maximum in the semi-enclosed eddies at middle shelf depths (28-55 m stratum) just south of Cape Fear and just north of Cape Canaveral. Across the shelf, salinities were most stable in the 28-55 m stratum. We observed little vertical stratification of temperature and salinity over most of the nearshore (9-18 m) stratum. Further offshore, the shelf waters were strongly stratified. The salinity patterns of shelf waters during Summer 1977 differed from the normal summer pattern in that highly saline Gulf Stream water (> 36^{o}/oo) predominated on the shelf.

During the Summers of 1978 and 1979, hydrographic conditions of temperature and salinity differed from those observed in Summer 1977. The bottom isotherms generally followed isobaths except in the areas south of Cape Fear where a Gulf Stream eddy was located (Figs. 3-6). Salinities were much lower inshore than those observed in Summer 1977. Waters with bottom salinities < 36^{o}/oo occupied almost the entire coastal and inner shelf area of the South Atlantic Bight, with exception of the area near the northern part of Florida. Upwelling again occurred close to the shelf break off Charleston and in shallow depth strata north of Cape Canaveral. Minimum salinities were located in these areas of upwelling where colder and fresher North Atlantic Central water occurred. Bottom temperatures were highest at nearshore stations and gradually decreased across the shelf from the nearshore stratum of the shelf break. Beyond the shelf break, temperatures dropped sharply and were lowest in the 184-366 m stratum.

Temperature conditions in Winter 1978 were not abnormally severe. A cold band of water < 10°C was located on the shelf but was confined to a small narrow area off Georgia (Fig. 7). A warm band of water > 18°C was located near bottom at depths of 28-55 m along the entire area between Cape Fear and Cape Canaveral. Further off-shore near the shelf break, bottom temperatures were highly variable. Beyond the shelf break, bottom water temperature minima of 8-9°C were observed. In contrast to high salinity conditions on the shelf during Summer 1977, salinities < 36^{o}/oo were observed near bottom over the entire inner shelf in Winter 1978 (Fig. 8). At mid-shelf depths, salinities were usually > 36^{o}/oo whereas near the shelf break salinity conditions were variable due to upwelling and Gulf Stream intrusions. Beyond the shelf break, salinity was fairly stable.

Species Composition

A total of 82 identifiable species of decapod Crustacea comprising 9587 individuals from 24 families were collected during the four cruises (Table 2). The most diverse families were the Majidae and Portunidae with 17 and 9 identifiable species, respectively. The penaeoid shrimps consisting of the families Sicyoniidae, Penaeidae, and Solenoceridae were the most abundant decapods collected and constituted about 75% of the total number of Decapoda in our collections.

The number of decapod species in MARMAP collections, on which the current study is based, represents only a small percentage (28%) of the 291 decapod crustaceans known to reside in Carolinean Shelf waters (Herbst, Williams and Boothe, 1978). This low number of species is probably related to the biased collection of large decapod species by the trawl as well as the concentration of our sampling effort on the open shelf. A list of the species, grouped by family, along with collection numbers associated with their occurrence in our samples, is given in Appendix II.

Ten species which comprised about 92% of all individuals collected were: the penaeoid shrimps Sicyonia brevirostris, Metapenaeopsis goodei, Mesopenaeus tropicalis, Trachypenaeus constrictus, and Solenocera atlantidis; the portunid crabs Ovalipes stephensoni, Portunus spinicarpus, Portunus spinimanus and Portunus gibbesii; and the galatheid Munida pusilla. Although many of the remaining 72 species of Decapoda were regularly collected, they were not abundant.

The abundance of the dominant species changed by depth zone for each season sampled. Sicyonia brevirostris was the most abundant decapod collected, occurring

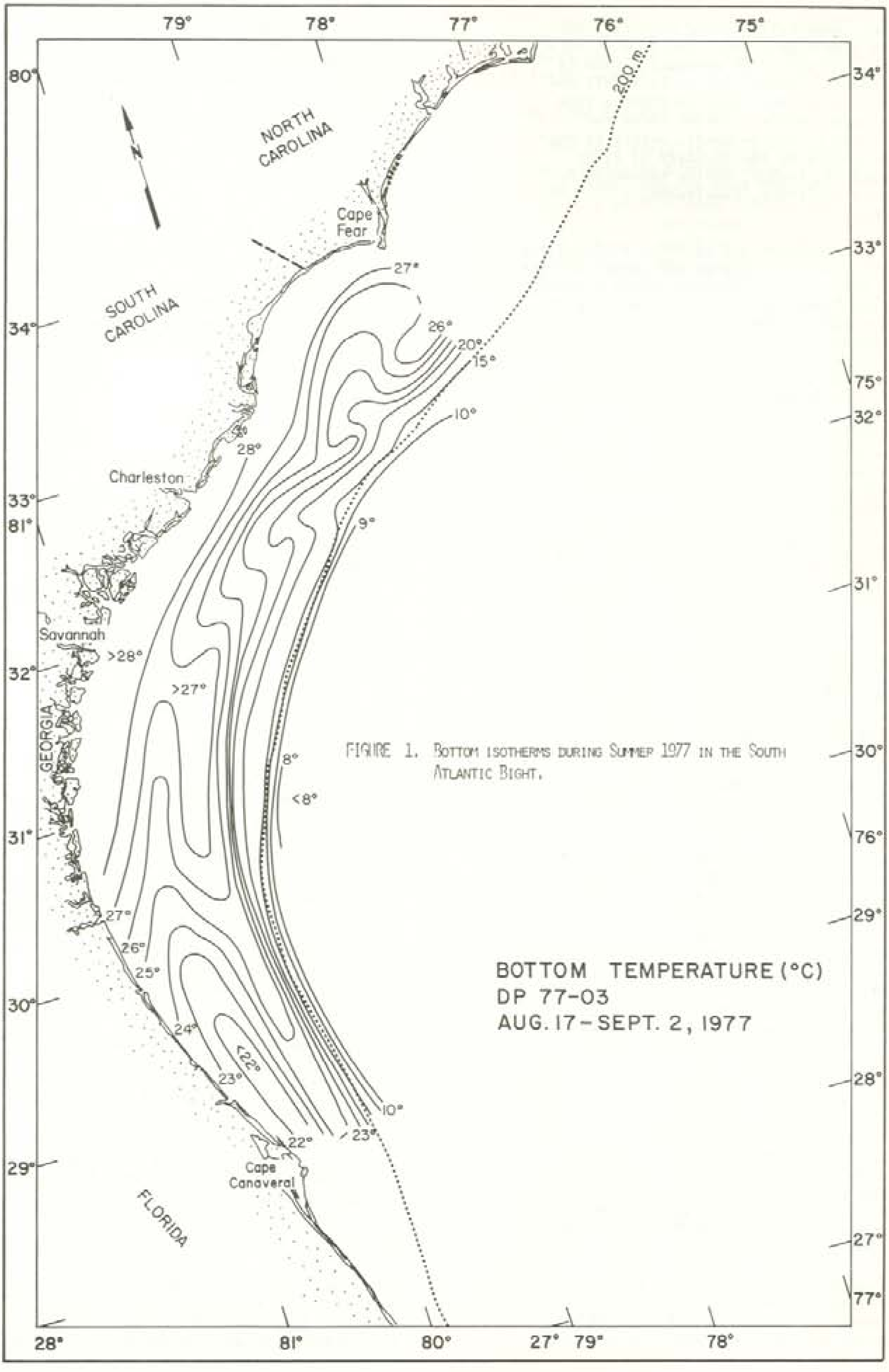

FIGURE 1. Bottom isotherms during Summer 1977 in the South Atlantic Bight.

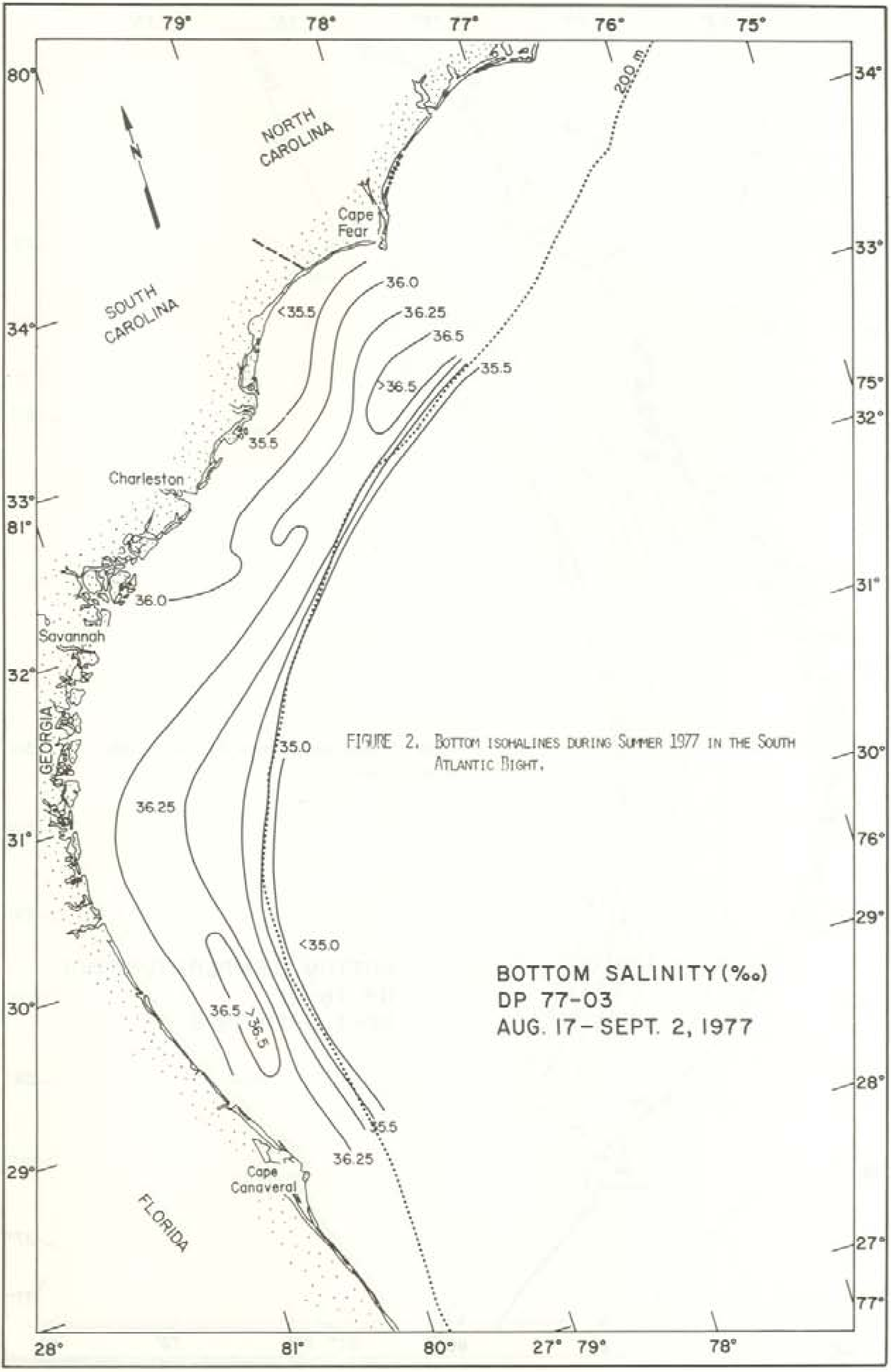

FIGURE 2. Bottom isohalines during Summer 1977 in the South Atlantic Bight.

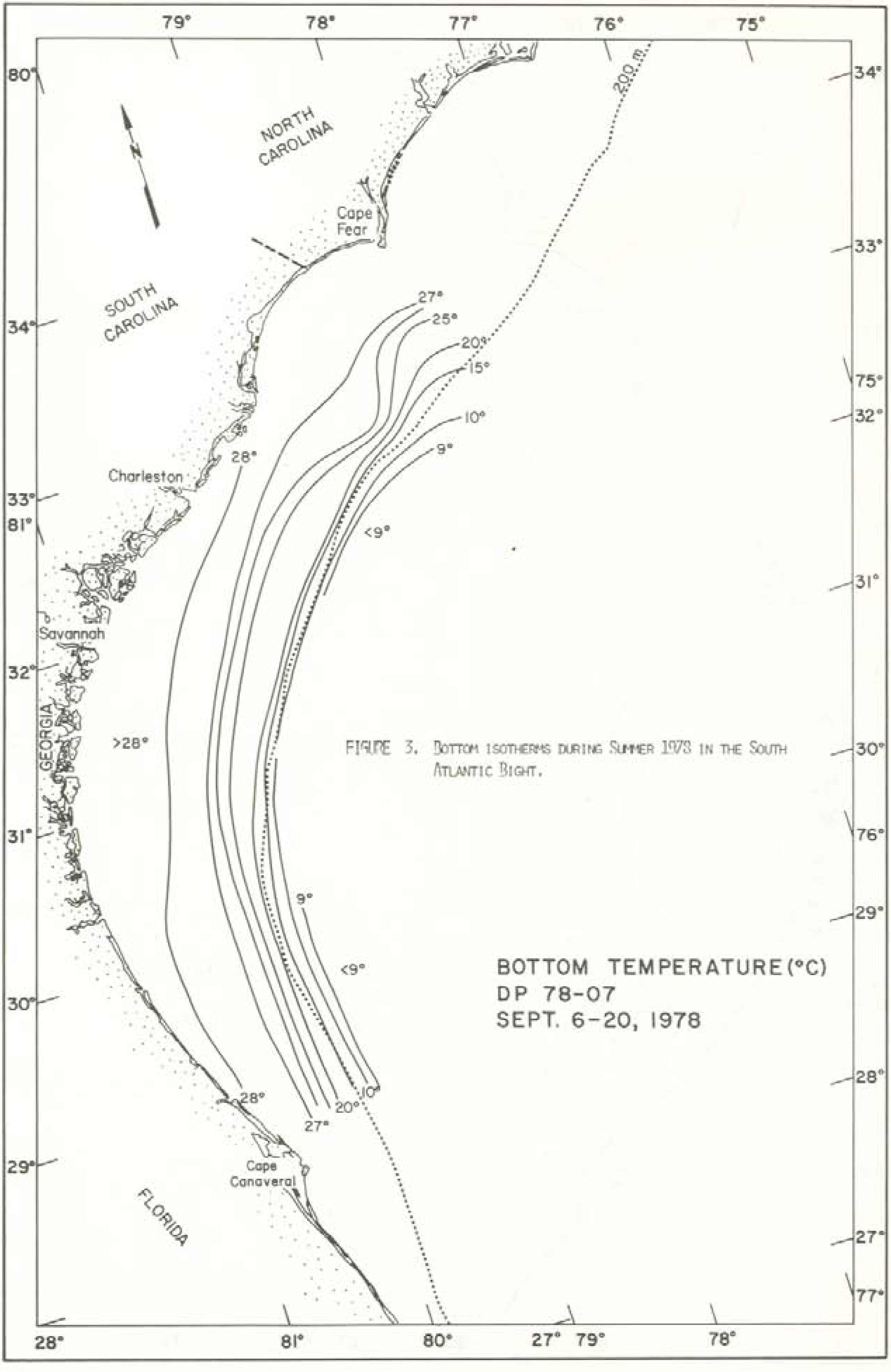

FIGURE 3. Bottom isotherms during Summer 1978 in the South Atlantic Bight.

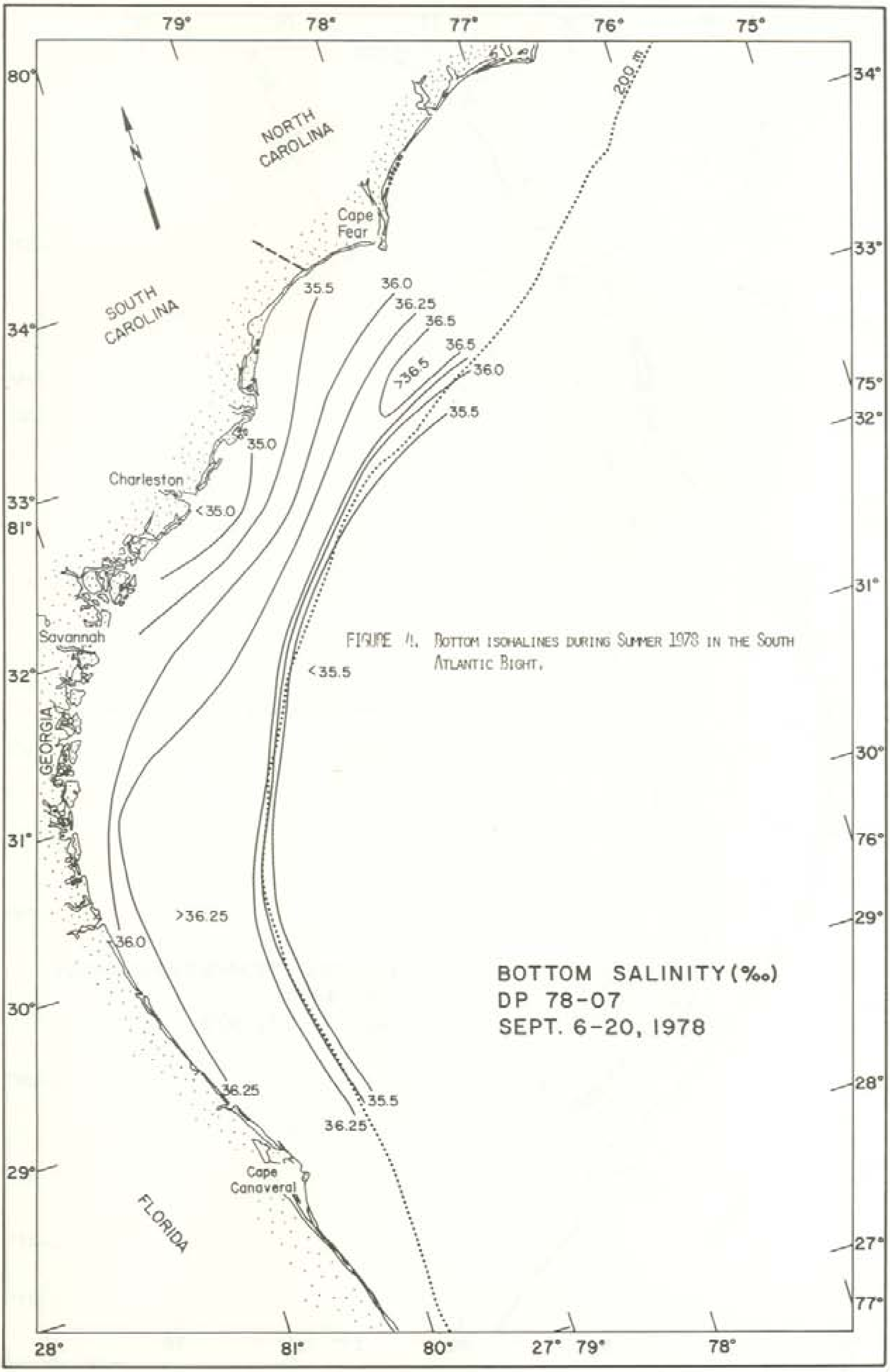

FIGURE 4. Bottom isohalines during Summer 1978 in the South Atlantic Bight.

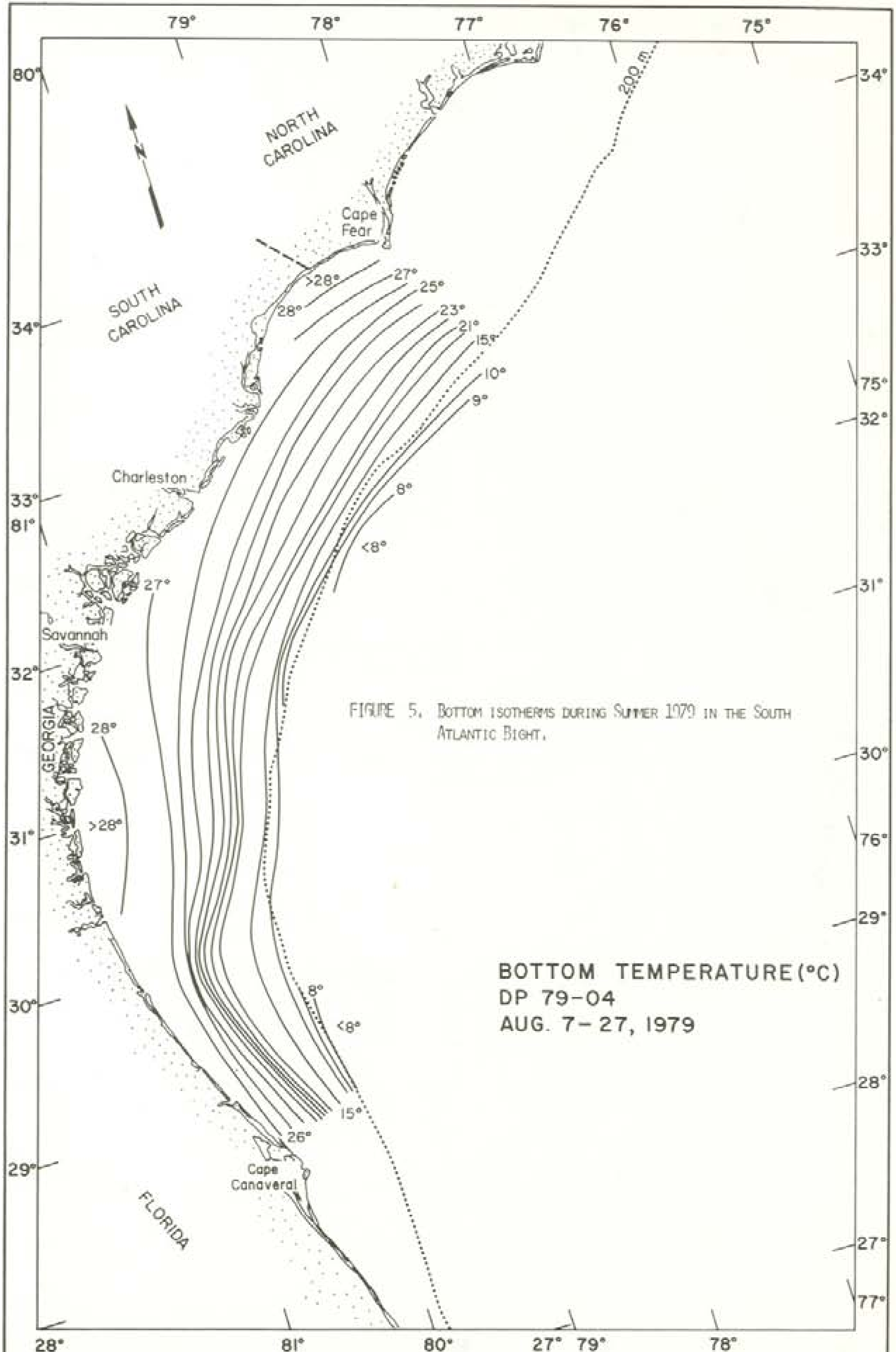

FIGURE 5. BOTTOM ISOTHERMS DURING SUMMER 1979 IN THE SOUTH ATLANTIC BIGHT.

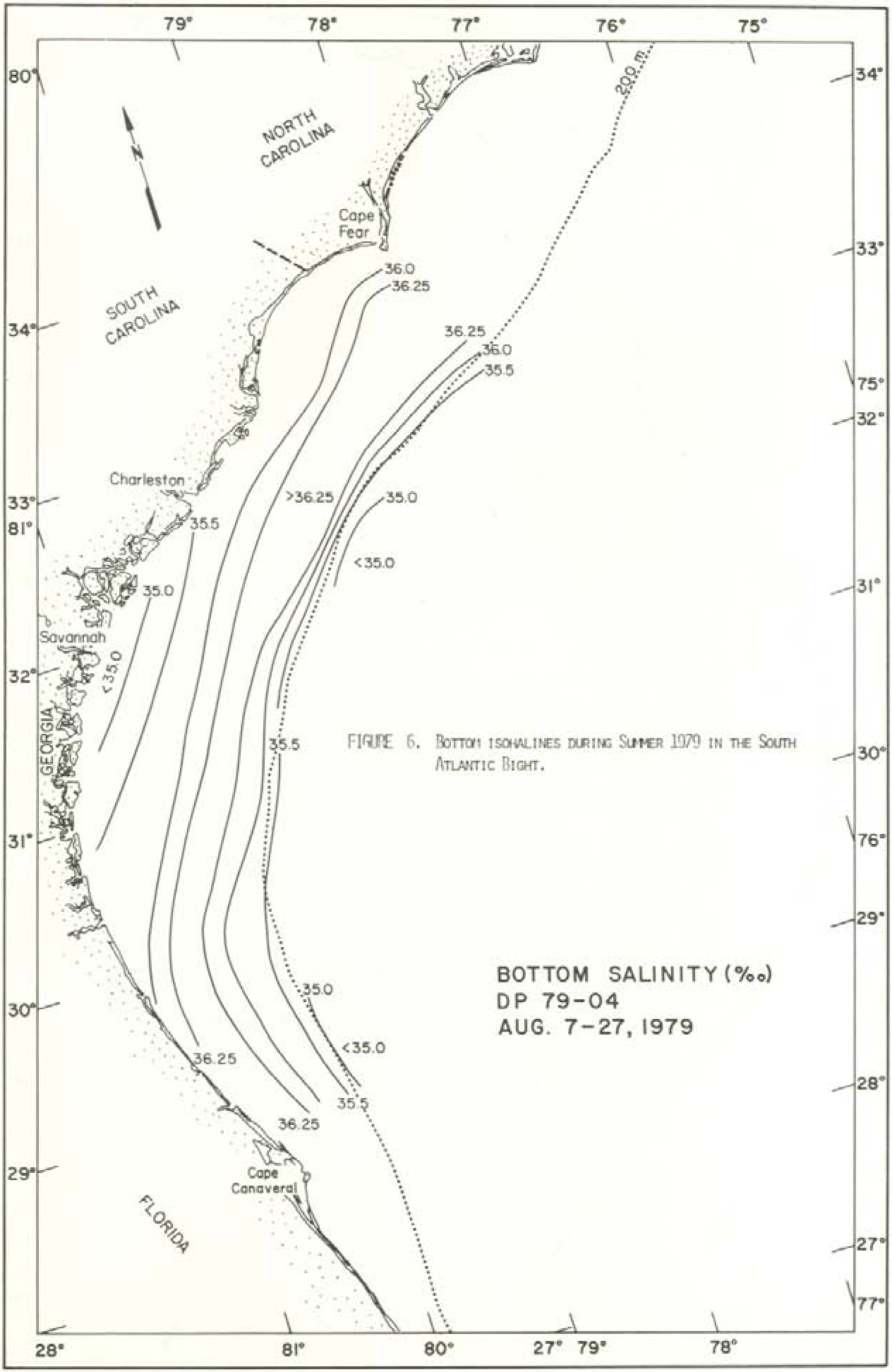

FIGURE 6. Bottom isohalines during Summer 1979 in the South Atlantic Bight.

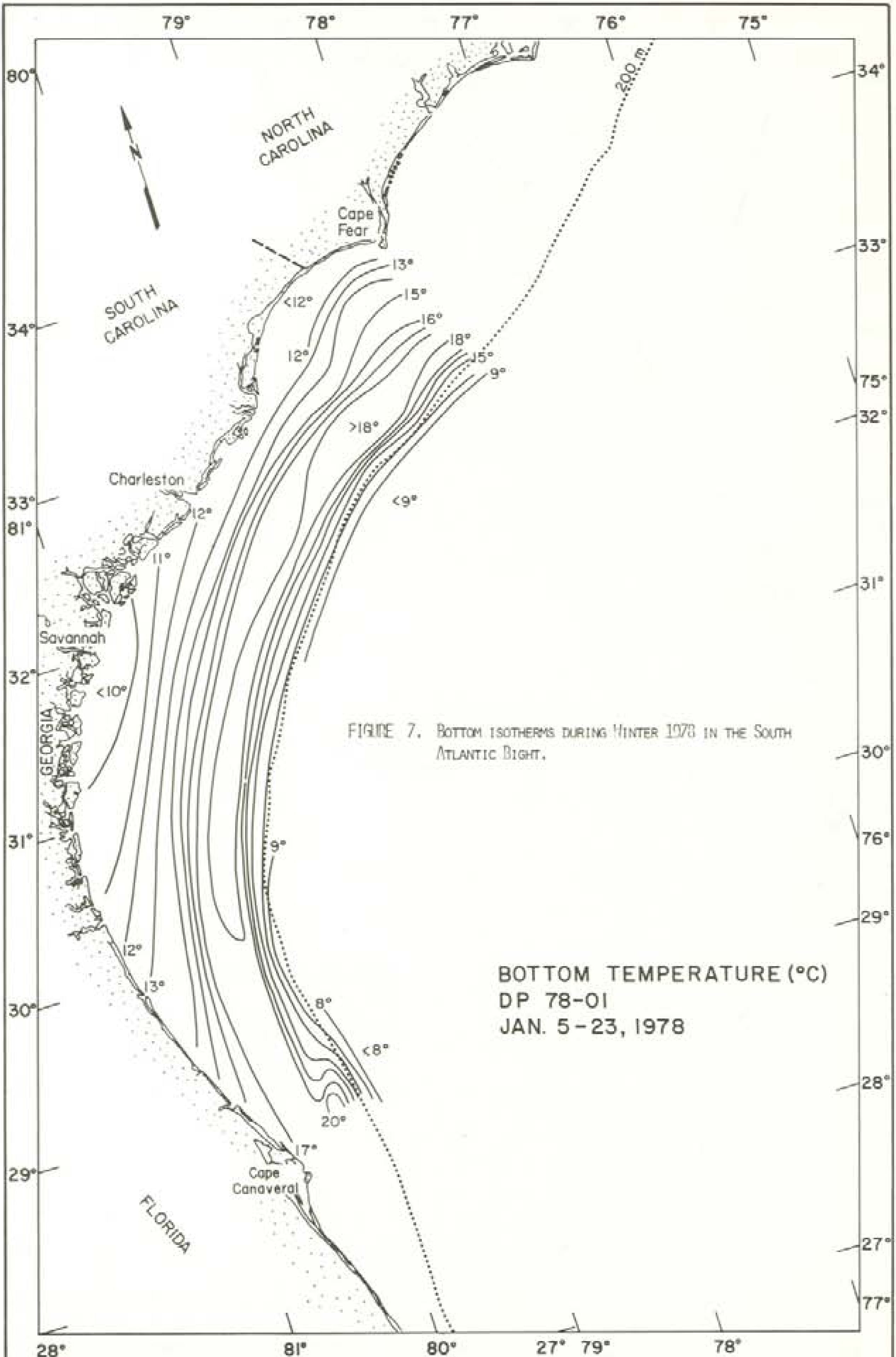

FIGURE 7. Bottom isotherms during Winter 1978 in the South Atlantic Bight.

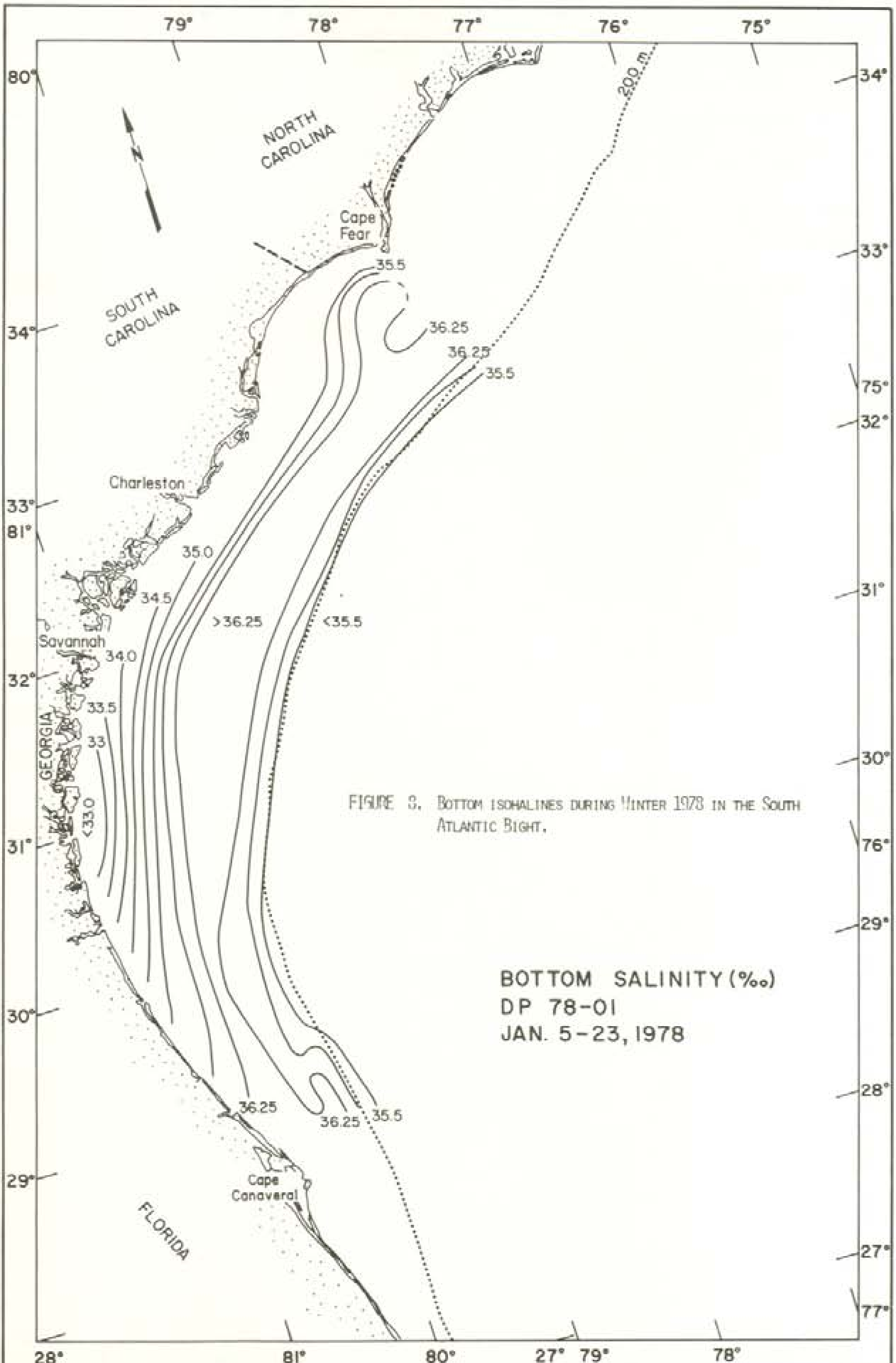

FIGURE 8. BOTTOM ISOHALINES DURING WINTER 1978 IN THE SOUTH ATLANTIC BIGHT.

TABLE 2. Decapod crustaceans collected on the continental shelf between Cape Fear, N.C. and Cape Canaveral, Florida for all seasons and cruises combined. Species are ranked according to abundance.

Species	Number Station Occurrences	Total Number Specimens	Depth (M) Min.	Depth (M) Max.	Temperature (°C) Min.	Temperature (°C) Max.
Sicyonia brevirostris	53	3469	13	117	12.35	28.25
Metapenaeopsis goodei	20	1859	22	77	14.15	27.83
Mesopenaeus tropicalis	12	1134	33	132	13.16	23.51
Trachypenaeus constrictus	29	751	13	25	11.52	28.51
Ovalipes stephensoni	69	453	13	137	8.95	28.51
Munida pusilla	2	341	77	91	18.82	19.93
Portunus spinicarpus	12	225	64	137	8.26	23.51
Portunus spinimanus	51	207	12	44	13.50	28.25
Solenocera atlantidis	13	187	15	123	14.42	25.68
Portunus gibbesii	37	168	13	44	13.50	28.25
Scyllarus chacei	17	127	22	77	17.91	27.66
Stenorhynchus seticornis	8	75	33	77	16.88	26.60
Processa vicina	4	60	35	77	18.82	25.68
Processa tenuipes	3	42	73	91	16.88	19.93
Parapenaeus longirostris	2	41	128	143	8.26	8.50
Callinectes sapidus	17	38	13	20	26.12	28.30
Calappa flammea	26	33	13	44	17.91	28.51
Portunus ordwayi	12	29	22	77	16.88	27.25
Porcellana sayana	6	21	31	73	16.88	25.68
Galathea rostrata	4	20	31	77	16.88	27.24
Tozeuma serratum	3	19	15	91	13.10	19.93
Leptochela papulata	2	18	71	77	18.82	23.51
Processa nr. tenuipes	1	18	77	77	18.82	18.82

Species	Number Station Occurrences	Total Number Specimens	Depth (M) Min.	Max.	Temperature (°C) Min.	Max.
Pilumnus sayi	10	18	12	40	16.73	27.91
Libinia emarginata	10	15	13	43	20.80	28.47
Penaeus duorarum	11	13	13	22	11.52	28.24
Stenocionops spinimana	5	10	40	137	8.95	24.96
Mithrax forceps	1	10	31	31	22.59	22.59
Mithrax pleuracanthus	4	9	18	37	22.59	28.17
Pseudomedaeus agassizii	3	9	31	73	16.88	27.24
Pachycheles rugimanus	2	9	31	40	22.59	23.00
Synalpheus townsendi	1	8	31	31	22.59	22.59
Stenocionops furcata coelata	8	8	33	77	17.25	27.32
Rochinia crassa	3	8	40	143	8.50	21.40
Porcellana sigsbeiana	1	7	137	137	8.95	8.95
Sicyonia laevigata	1	7	33	33	23.23	23.23
Petrochirus diogenes	6	6	24	91	16.88	27.00
Podochela sidneyi	6	6	18	77	16.88	27.99
Cancer irroratus	4	6	128	152	8.26	14.87
Pontophilus brevirostris	1	6	143	143	8.50	8.50
Podochela gracilipes	2	5	73	77	16.88	18.82
Dromidia antillensis	5	5	15	77	16.88	28.10
Pylopagurus corallinus	4	5	40	77	18.01	21.40
Alpheus normanni	1	5	33	33	23.23	23.23
Sicyonia typica	4	4	14	77	18.82	27.35
Anasimus latus	2	4	71	77	18.82	23.51
Metoporhaphis calcarata	3	4	33	77	18.82	23.23

Species	Number Station Occurrences	Total Number Specimens	Depth (M) Min.	Max.	Temperature (°C) Min.	Max.
Arenaeus cribrarius	4	4	16	18	27.50	28.06
Myropsis quinquespinosa	2	4	121	143	8.50	15.78
Portunus floridanus	1	4	77	77	18.82	18.82
Periclimenes nr. yucatanicus	1	3	77	77	18.82	18.82
Parthenope fraterculus	2	3	73	77	16.88	18.82
Pilumnus floridanus	3	3	15	73	10.22	22.59
Podochela riisei	2	3	38	42	20.60	27.32
Scyllarus depressus	1	3	91	91	19.93	19.93
Synalpheus minus	1	2	21	21	26.66	26.66
Cronius tumidulus	1	2	33	33	23.23	23.23
Penaeus setiferus	1	2	14	14	27.36	27.36
Libinia dubia	2	2	15	15	10.22	28.25
Collodes trispinosus	2	2	38	42	20.60	25.68
Lobopilumnus agassizii	2	2	31	33	22.59	23.23
Calappa angusta	2	2	16	38	25.68	27.91
Iliacantha subglobosa	1	2	77	77	18.82	18.82
Persephona mediterranea	2	2	14	18	27.04	27.46
Parthenope granulata	2	2	16	25	27.83	28.02
Parthenope agonus	2	2	73	77	17.15	18.82
Palicus sica	1	1	38	38	25.68	25.68
Mithrax acuticornis	1	1	31	31	22.59	22.59
Macrocoeloma camptocerum	1	1	37	37	27.24	27.24
Glyptoplax smithii	1	1	33	33	23.23	23.23
Leander tenuicornis	1	1	91	91	19.93	19.93

Species	Number Station Occurrences	Total Number Specimens	Depth (M) Min.	Depth (M) Max.	Temperature (°C) Min.	Temperature (°C) Max.
Pyromaia arachna	1	1	143	143	8.50	8.50
Bythocaris nana	1	1	143	143	8.50	8.50
Solenocera necopina	1	1	128	128	8.26	8.26
Osachila semilevis	1	1	69	69	18.01	18.01
Acanthocarpus alexandri	1	1	152	152	10.56	10.56
Cancer borealis	1	1	152	152	10.56	10.56
Neopanope sayi	1	1	13	13	26.12	26.12
Glyptoxanthus erosus	1	1	40	40	23.00	23.00
Ranilia muricata	1	1	40	40	23.66	23.66
Pagurus carolinensis	1	1	73	73	16.88	16.88
Scyllarides nodifer	1	1	40	40	20.62	20.62

in 27% of the 181 collections (Fig. 9). Although rock shrimp were caught over a wide range of depths, they were most abundant within strata of 28-55 and 56-110 m (Fig. 9A). They were collected only at depths of 19-27 m and 28-55 m during the winter but were more abundant during winter than during summer at these same depths. Considering all cruises, rock shrimp abundance was greatest during summer 1978 when the average number of individuals collected per tow was 34 (Table 3). Sicyonia brevirostris was also caught predominantly at night, dusk or dawn (Table 4) -- a phenomenon which has been noted by Anderson (1976), Lunz (1957), Joyce (1965), and Cobb et. al (1973). Cobb et al. (1973) suggested that S. brevirostris buries into the substrate during the day, thus avoiding predation and capture by fishing gear.

Metapenaeopsis goodei, which ranked second in relative abundance, was collected at depths between 22 and 77 m but was most abundant in the intermediate depth strata of 28-55 and 56-110 m (Fig. 9B). Catches were highest during the summer (Table 3), an observation which agrees with Wheeler's (1937) remarks on the distribution of M. goodei from Bermuda. In addition, M. goodei was collected only in tows made at night, dusk or dawn (Table 4). Perez Farfante (1971) found that most specimens were caught at sunset or night, and Wheeler (1937) noted that their availability to trawls might be affected by the lunar cycle as well.

Mesopenaeus tropicalis was caught at depths of 33-132 m on the outer shelf and upper continental slope; however, these shrimp were most abundant at 56-110 m (Fig. 9C). Relative abundance was also greatest during the summer (Table 3). Shrimp were caught only at night, dusk or dawn (Table 4) which is a behavior pattern similar to that observed in other Penaeoidea, especially the commercially important species of Penaeus (Fuss and Ogren, 1966; Salomon, 1968; Perez Farfante, 1969).

Trachypenaeus constrictus was collected only at depths shallower than 28 m and relative abundance was greatest in the shallowest depth stratum of 9-18 m (Fig. 9D). The relative abundance of T. constrictus was greatest in winter in the inner shelf depth strata. Catches tended to be similar between cruises except for Summer 1978 when more individuals were collected (Table 3). Trachypenaeus constrictus was collected only at night, dusk and dawn (Table 4). Increased nocturnal activity has been suggested by Williams (1965) who noted that juvenile stages of this species were common in surface plankton tows made at night on flood tides.

Solenocera atlantidis was collected at depths of 15-123 m but was most abundant in water deeper than 28 m (Fig. 9E). Catches were highest in summer (Table 3), and shrimp were present only in collections at night, dusk or dawn (Table 4).

The portunid crabs, Portunus spinimanus and Portunus gibbesii, had overlapping bathymetric distributions. Both species were collected in strata which encompassed depths from 9-55 m (Fig. 10 A, B). Abundances were similar between strata, between winter-summer catches (Table 3) and between day-night catches (Table 4). Williams (1965) noted that these crabs frequently co-occur in the Carolinean province. The other numerically abundant portunids, Portunus spinicarpus and Ovalipes stephensoni, cooccurred only in the deeper strata (Fig. 10 C, D). Ovalipes stephensoni was ubiquitous on the continental shelf and was found from 13-137 m. Little difference in relative abundance with depth was found during summer collections, but abundance increased in the 111-183 m stratum in winter. Catches were greatest in summer (Table 3), but we noted no apparent relation between catches and time of day (Table 4).

The galatheid, Munida pusilla, was collected only in the 56-110 m stratum during summer (Fig. 10E). Catches were also limited to night, dawn or dusk (Table 4).

The relative abundance of these ten species in our collections changed with depth. Trachypenaeus constrictus was most abundant in the shallowest strata, 9-18 m but was replaced as the dominant species by Portunus spinimanus in the 19-27 m stratum (Fig. 11). At depths of 28-55 m and 56-110 m, the rock shrimp, Sicyonia brevirostris, constituted most of the catch, while at the greatest depths sampled (111-183 m), Mesopenaeus tropicalis dominated the decapod fauna.

Species Assemblages and Distributional Patterns

Cluster analysis grouped the 115 stations which remained following data reduction into 7 site groups based on their faunal composition (Fig. 12). Group 1 consisted of 24 collections which were occupied only at night, dusk, or dawn and which were located at inner to mid-shelf depths. Site groups 2, 3, 4, and 5 were faunistically more similar to each other than to other site groups. Depths for collections represented in site groups 2 and 3 overlapped considerably. Collections in these groups were made mostly during the day, although a few collections were also made during the night, at dawn or dusk. Collections in site groups 4 and 5 encompassed a wide range of overlapping depths with many extending onto the upper slope. Their distinctiveness as site groups is probably related to the distinctiveness of the

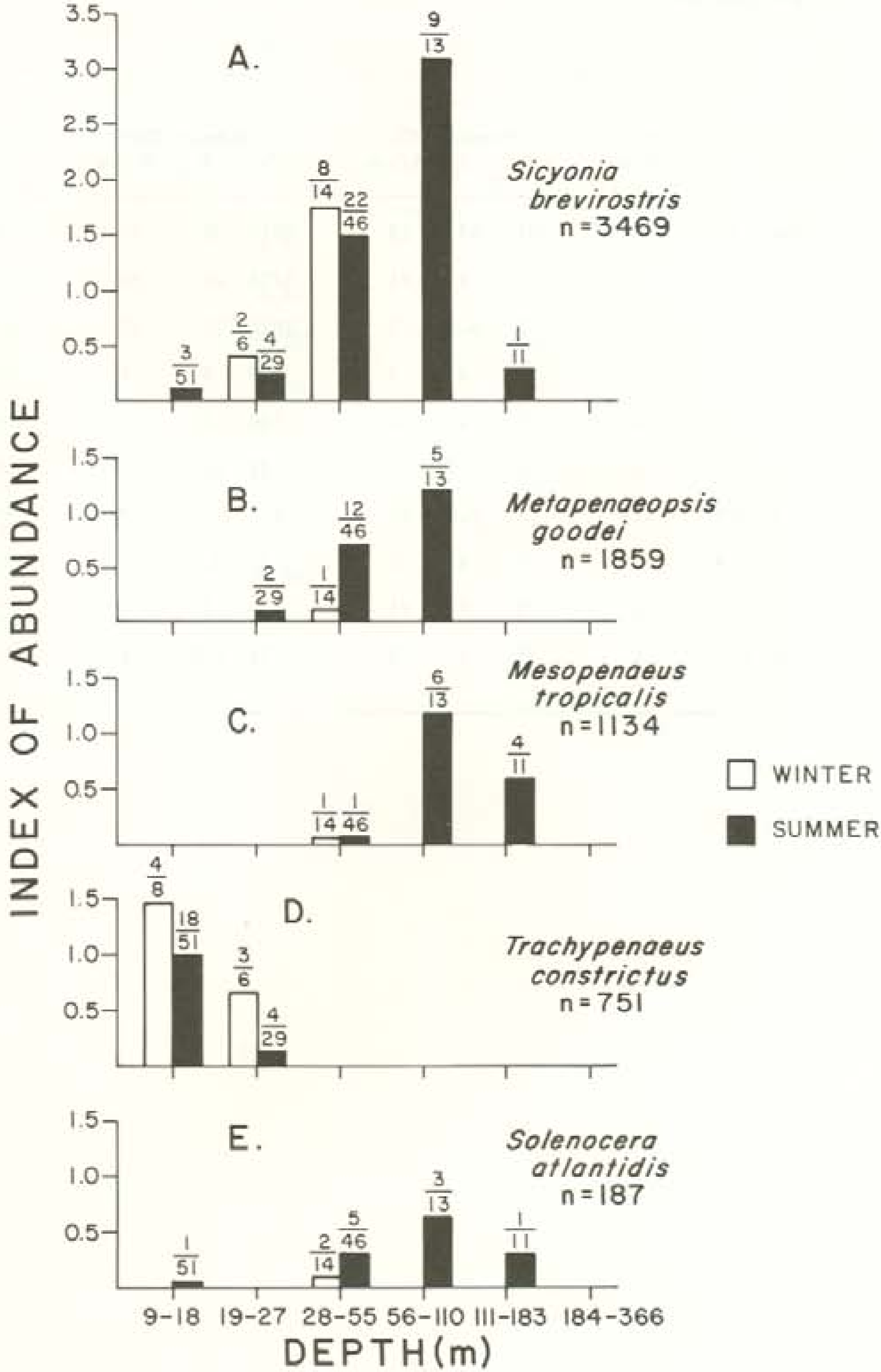

FIGURE 9. INDEX OF RELATIVE ABUNDANCE BY DEPTH ZONE AND SEASON FOR NUMERICALLY DOMINANT PENAEOIDEA: A. SICYONIA BREVIROSTRIS; B. METAPENAEOPSIS GOODEI; C. MESOPENAEUS TROPICALIS; D. TRACHYPENAEUS CONSTRICTUS; E. SOLENOCERA ATLANTIDIS. FRACTION ABOVE EACH DEPTH ZONE IS THE RATIO OF COLLECTIONS IN WHICH INDIVIDUALS WERE CAPTURED TO TOTAL NUMBER OF SUCCESSFUL COLLECTIONS MADE IN THAT DEPTH ZONE.

TABLE 3. Catch statistics (N = total number, % = percent of catch by cruise, and number per tow) for numerically dominant decapod crustaceans collected in 1977-1979 MARMAP groundfish cruises.

Species	Winter 1978			Summer 1977			Summer 1978			Summer 1979		
	N	%	N/tow	N	%	N/tow	N	%	N/tow	N	%	N/tow
Sicyonia brevirostris	294	51	9	591	67	18	2010	32	34	574	28	10
Metapenaeopsis goodei	5	0.8	<1	18	2	<1	1721	29	29	115	6	2
Mesopenaeus tropicalis	1	0.2	<1	2	0.2	<1	1026	17	17	105	5	2
Trachypenaeus constrictus	141	24	4	82	9	3	377	6	6	151	7	3
Ovalipes stephensoni	17	3	<1	37	4	1	100	2	2	299	15	5
Munida pusilla	0	-	-	0	-	-	31	0.5	<1	310	15	5
Portunus spinicarpus	5	0.9	<1	2	0.2	<1	178	3	3	40	2	<1
Portunus spinimanus	55	9	2	37	4	1	33	0.5	<1	82	4	1
Solenocera atlantidis	2	0.3	<1	21	2	<1	134	2	2	30	1	<1
Portunus gibbesii	39	0.7	1	35	4	1	31	0.5	<1	63	3	1

TABLE 4. Index of abundance by day and night, dusk or dawn collections of ten numerically dominant species of decapod crustaceans collected in 1977-1979 MARMAP investigations. n/N indicates ratio of number of collections containing species to the total number of collections during the designated time of day.

Species	Night, Dusk, Dawn Index of Abundance	n/N	Day Index of Abundance	n/N
Sicyonia brevirostris	1.32	42/100	0.24	11/81
Metapenaeopsis goodei	0.54	20/100	0	0/81
Mesopenaeus tropicalis	0.25	12/100	0	0/81
Trachypenaeus constrictus	0.73	29/100	0	0/81
Solenocera atlantidis	0.30	13/100	0	0/81
Ovalipes stephensoni	0.56	41/100	0.51	28/81
Portunus spinicarpus	0.25	10/100	0.22	2/81
Portunus spinimanus	0.38	29/100	0.31	22/81
Portunus gibbesii	0.28	21/100	0.25	14/81
Munida pusilla	0.09	2/100	0	0/81

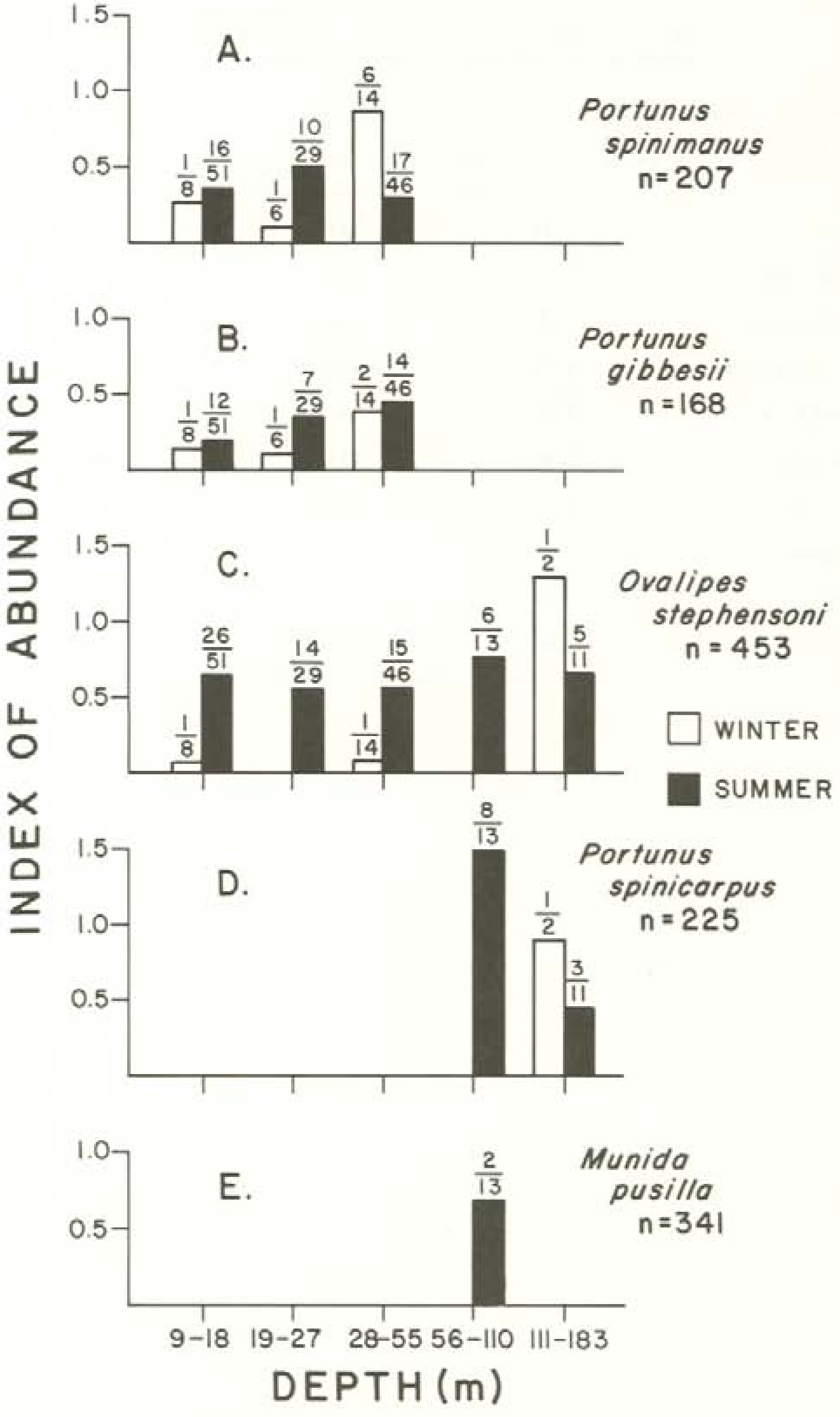

FIGURE 10. INDEX OF RELATIVE ABUNDNACE FOR PEPTANTIA COLLECTED: A. *PORTUNUS SPINIMANUS*; B. *PORTUNUS GIBBESII*; C. *OVALIPES STEPHENSONI*; D. *PORTUNUS SPINICARPUS*; E. *MUNIDA PUSILLA*. SEE LEGEND OF FIGURE 9 FOR EXPLANATION.

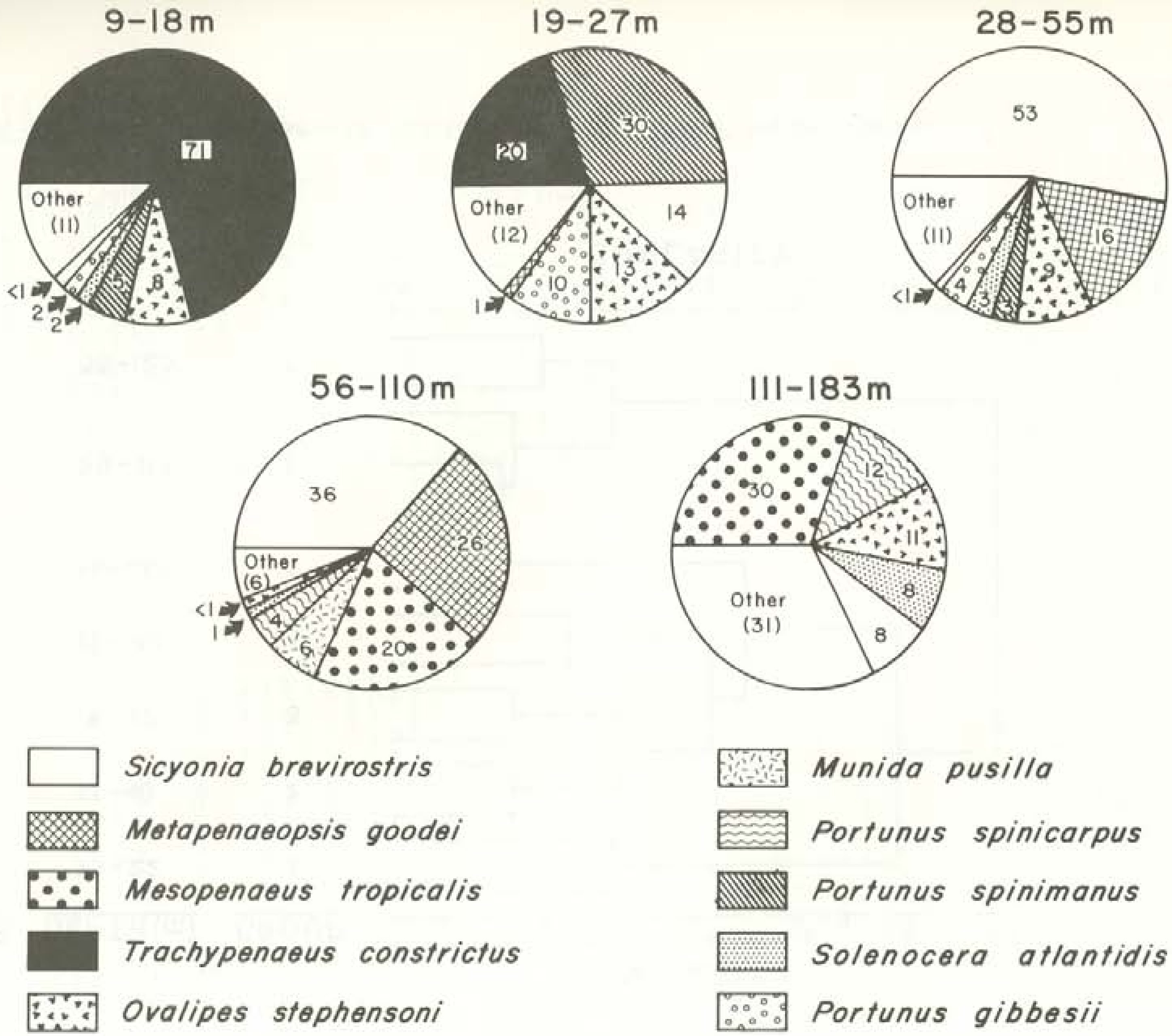

FIGURE 11. PERCENT TOTAL ABUNDANCE OF TEN NUMERICALLY DOMINANT DECAPOD CRUSTACEANS IN FIVE DEPTH ZONES SAMPLED WITH OTTER TRAWLS. NUMBERS INSIDE PIE DIAGRAMS INDICATE PERCENT OF TOTAL DECAPOD FAUNA WITHIN EACH DEPTH ZONE CONTRIBUTED BY INDIVIDUALS OF THE TEN DOMINANT SPECIES.

NO. STATIONS	DEPTH(m)	GROUP
24	13-22	1
17	17-40	2
12	15-37	3
11	12-143	4
13	14-137	5
22	29-117	6
16	33-123	7

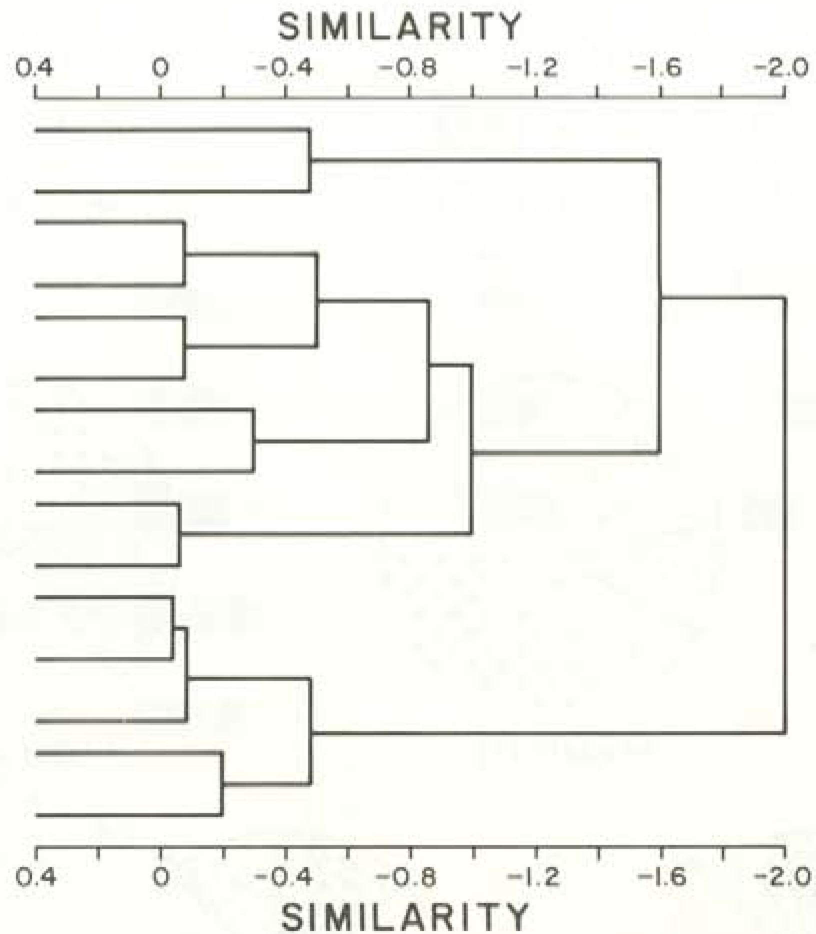

FIGURE 12. NORMAL CLUSTER HIERARCHY OF COLLECTIONS FROM 1977-1979 MARMAP GROUNDFISH SURVEYS.

slope decapod fauna associated with those collections. No specific time of day was associated with these site groups. Site groups 6 and 7 were faunistically distinct from the other groups generated by cluster analysis. These collections were made mostly at night, dusk, or dawn.

The distributions of species in the five species groups shown in Figure 13 were investigated in nodal analyses in which species groups were related to site groups in terms of constancy and fidelity (Fig. 14). Species in group A were neither very constant nor very faithful to any site group, although they were most frequently encountered in collections made on the inner to mid-shelf (site groups 1, 2, and 3). Species in this group, such as Penaeus duorarum and Trachypenaeus constrictus, were collected only at night. Species in group B were not consistently encountered at stations in any site group nor were they restricted in their distribution. Group C species were not consistently collected at any station but were largely restricted to those stations in site group 7. These species were frequently encountered in the sponge-coral habitat. Pseudomedaeus agassizii, Stenocionops furcata coelata, Petrochirus diogenes, Podochela sidneyi and Mithrax pleuracanthus, are found on a variety of bottom types, including rock, mud and sand, whereas Dromidia antillensis, Porcellana sayana, Pylopagurus corallinus and Metoporhaphis calcarata are primarily associated with hard bottoms such as shell, rock or coral (Williams, 1965; Powers, 1977). Several species in group C were collected during both day and night although Porcellana sayana, Metoporhaphis calcarata, and Portunus ordwayi were collected only at night. Group D species were not consistently collected at stations in any site group but were largely restricted to collections in site group 7, which were generally made at night, dusk, or dawn. Species in this group which were collected entirely at night, dusk, or dawn included the shrimps Processa sp., Processa tenuipes, Tozeuma serratum, Processa vicina, and Mesopenaeus tropicalis. The crabs Portunus spinicarpus and Stenorhynchus seticornis also were collected at night with the exception of the one collection which was made during daylight hours. Similarly, Group E consisted of numerically dominant species which were collected almost entirely at night. These species were consistently represented in collections from site group 7 and were highly faithful to collections in this site group, as well.

Faunal assemblages of decapod crustaceans in the South Atlantic Bight have previously been reported to be influenced by seasonality, bathymetry, and bottom type (George and Staiger, 1978; Wenner and Read, 1981). Because of limited seasonal sampling, we were unable to accurately assess any changes in species composition or abundance which might occur during an annual cycle. However, we found that collection of several species was apparently related to time of day. Shrimps of the families Penaeidae, Sicyoniidae, and Solenoceridae most clearly demonstrated this because they were collected almost entirely at night. A bathymetric gradient in distribution, although present, did not consist of discrete faunal zones but, rather, existed as a continuum of overlapping distributions across the continental shelf. The most distinct changes in faunal composition noted in this survey occurred near the shelf break. The species associated with collections made at depths on the upper slope were not usually found in collections made at shallower depths on the continental shelf. In addition, species assemblages associated primarily with the sponge-coral "live" bottom habitat were faunistically distinct from the assemblages characteristic of the open-shelf sand habitat. The broad overlap in species composition noted across the shelf is probably related to substrate homogeneity and the generally uniform hydrothermal conditions which prevailed during the summers of 1978 and 1979. Definite bathymetric patterns noted earlier (Wenner and Read, 1981) may not have been noticeable in our current analysis because of more stable thermal conditions across the shelf in summer when most sampling took place. We also noted no apparent differences in species composition with latitude, which suggests that the fauna in the South Atlantic is relatively homogeneous within the boundaries of our study area. This observation is consistent with those of George and Staiger (1978) and our previous observations (Wenner and Read, 1981) on latitudinal homogeneity of the decapod fauna in this region.

Number of Species and Abundance of Individuals

The number of species and abundance of individuals was related to depth of collection. Both estimates were highest for the strata encompassing depths of 28-110 m and lowest for the 19-27 m and 111-183 m strata (Table 5). The average number of species and individuals per tow showed a similar pattern, being highest in the 56-110 m stratum and lowest at depths of 19-27 m. Much of the high richness observed was attributable to inadvertent collections from the sponge-coral habitat where number of species was generally much higher than on the open shelf at the same depth (Fig. 15). Results of intensive sampling in the sponge-coral habitat with numerous sampling gears confirmed that invertebrate species diversity was much higher than has been reported for the surrounding sand biotope

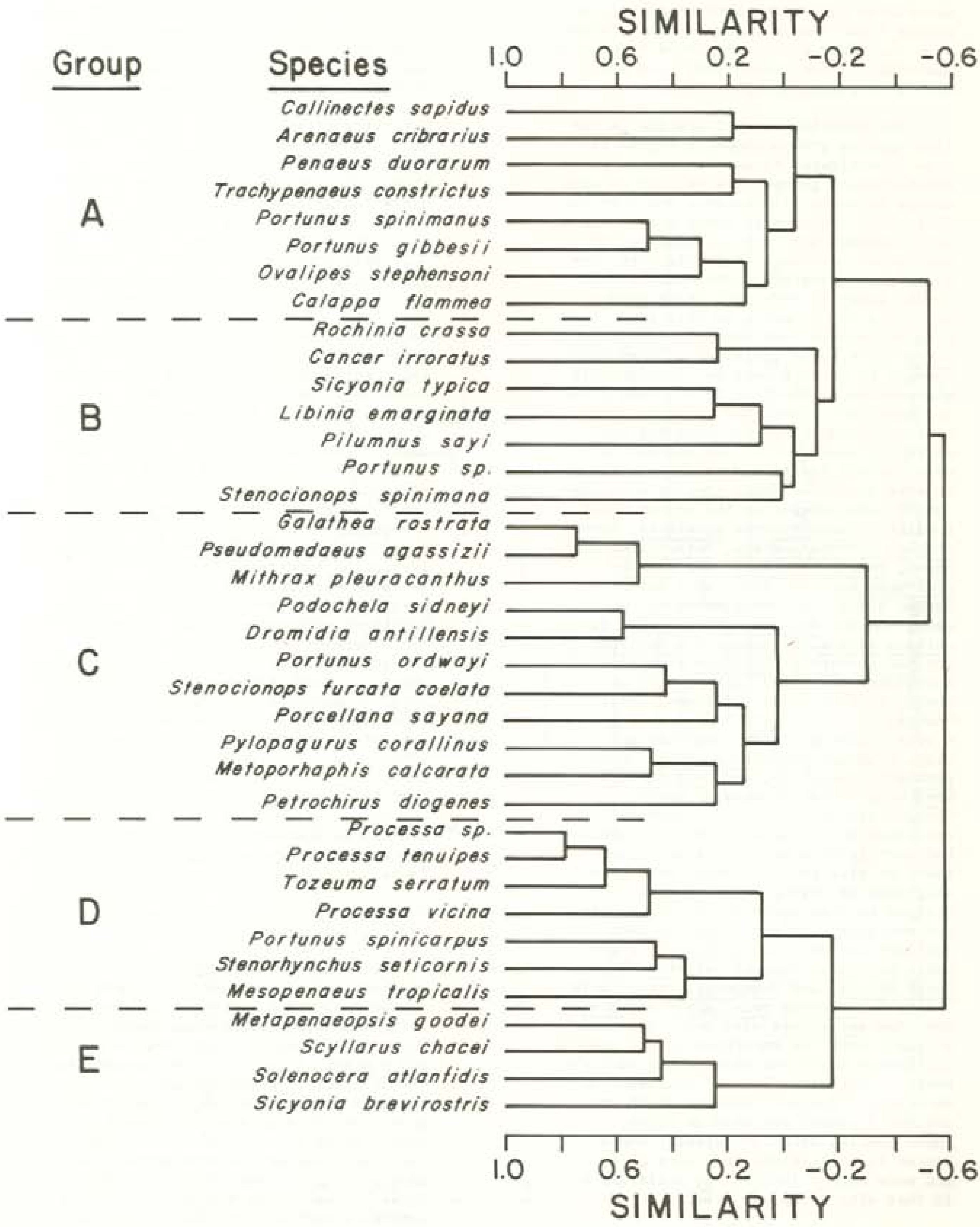

FIGURE 13. INVERSE CLUSTER ANALYSIS OF SPECIES COLLECTED DURING 1977-1979 MARMAP GROUNDFISH SURVEYS.

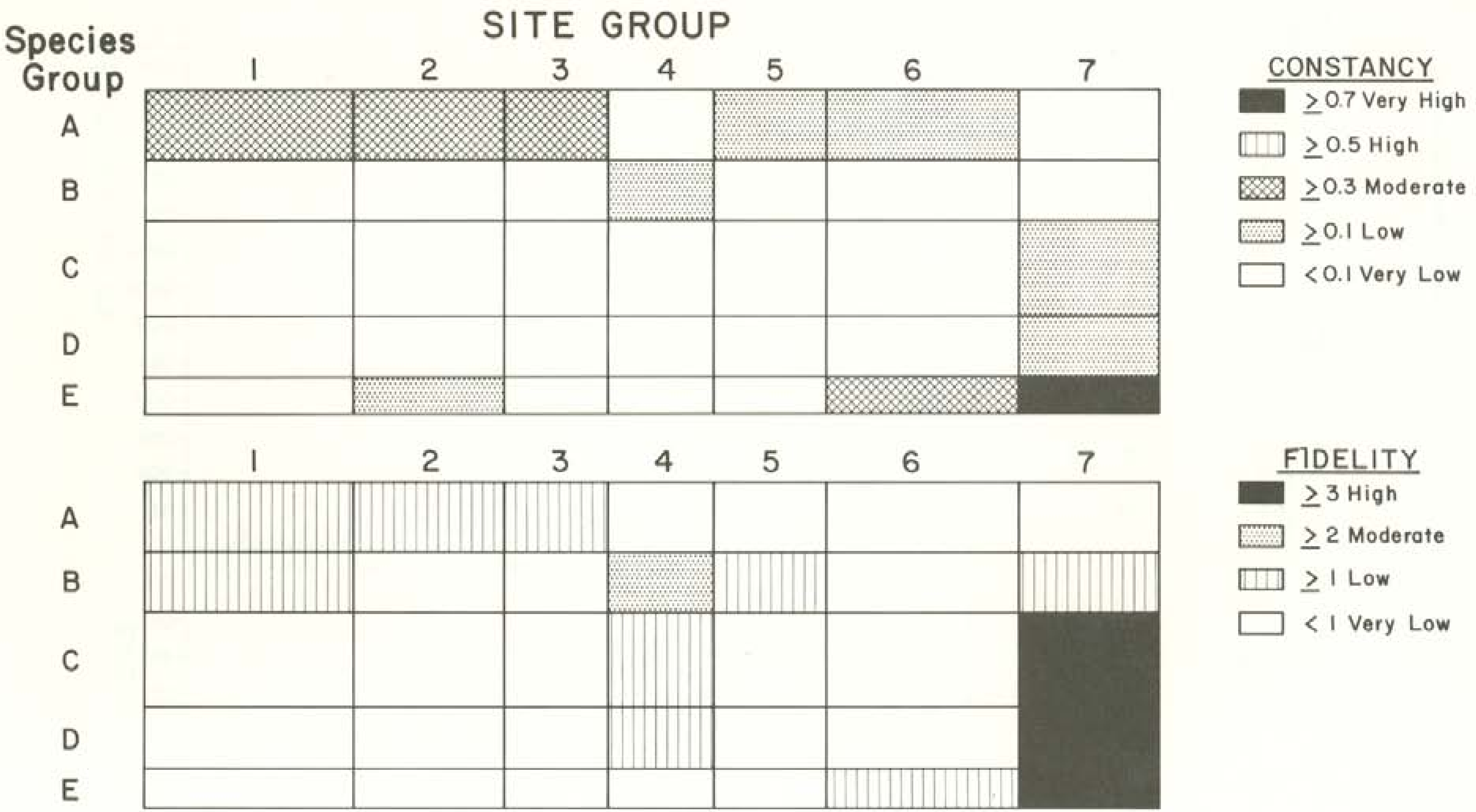

FIGURE 14. NODAL CONSTANCY AND FIDELITY IN A TWO-WAY TABLE OF SPECIES AND SITE GROUPS RESULTING FROM CLUSTER ANALYSIS OF DATA COLLECTED DURING 1977-1979 MARMAP GROUNDFISH SURVEYS.

Table 5. Total number of species and individuals of decapod Crustacea by depth zone.

Depth Zone (m)	Total Number of Species	Total Number of Individuals
9-18	28	987
19-27	20	264
25-55	46	2862
56-110	40	5258
111-183	19	311

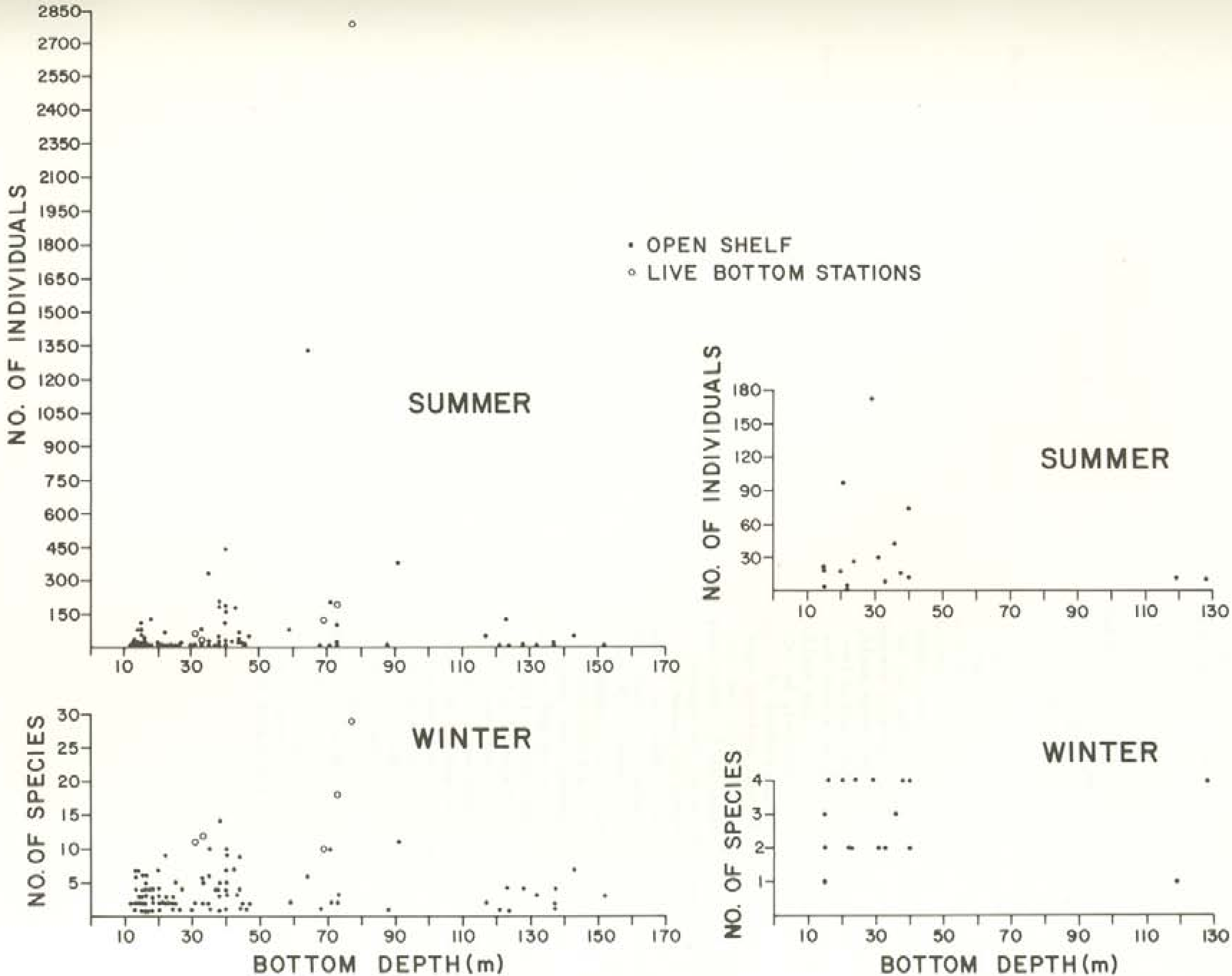

FIGURE 15. SCATTERPLOT OF THE RELATIONSHIP BETWEEN NUMBERS OF DECAPOD CRUSTACEAN SPECIES AND NUMBER OF INDIVIDUALS AGAINST SAMPLING DEPTH FOR SUMMER AND WINTER SURVEYS. (• = COLLECTIONS ON SAND BOTTOM SUBSTRATE, ∘ = COLLECTIONS ON SPONGE-CORAL [illegible])

(Wenner et al., MS). Sediments of the open shelf are homogeneous (Struhsaker, 1969) and apparently do not support the diverse assemblage of decapod species which exist among the eroded depressions, ledges, and epifaunal mats of the sponge-coral reef habitat. These reef areas not only provide refuges for decapod species because of their structural complexity, but the variety of food resources available on heavily fouled rock surfaces is also conducive to inhabitation by a diverse assemblage of decapod species (Felder and Chaney, 1979).

In addition to changes in richness related to depth and habitat complexity, seasonal and annual differences were also observed. Fewest species and individuals were collected in Winter 1978 and Summer 1977 (Table 6). These estimates may be low in winter because of unstable thermal conditions on the inner and outer shelf, compared to the summer when bottom temperatures are least variable across the shelf. Thermal conditions on the shelf during Summer 1977 were unusual, as evidenced by the meandering pattern of isotherms. These unusual patterns were apparently caused by extremely low temperatures during Winter 1977. Apparently, abundance and richness of the decapod fauna had not recovered by Summer 1977 from the harsh thermal conditions of the previous winter. Thermal conditions had moderated somewhat by summer, 1978 and 1979, however. These results suggest that severe thermal conditions could deleteriously affect communities, both in terms of richness of species and abundance of individuals. A decrease in richness may be particularly evident if a large number of "rare" or immigrant species, whose occurrence depends on favorable currents, temperature, and salinity conditions, are present in the study area. We found that 26 of 28 species which were represented in only one collection were collected in either Summer 1978 or Summer 1979. This strongly indicates either unsuitable hydrographic conditions, reduced sampling effort, or both were responsible for the lowered species richness and abundance of decapod crustaceans observed in Summer 1977 and Winter 1978.

Table 6. The total number of species and number of individuals collected by season from 1977 - 1979.

	YEAR	WINTER	SUMMER
Number of Species	1977	---	41
	1978	29	105
	1979	---	88
Number of Individuals	1977	---	879
	1978	579	6197
	1979	---	2027

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LIST OF APPENDICES

APPENDIX I. Station data for MARMAP Groundfish Survey cruises conducted during Summer 1977, Winter 1978, Summer 1978, and Summer 1979 in the South Atlantic Bight.

Winter - 1978

Collection Number	Latitude	Longitude	Depth (m)	Bottom Temperature	Time (EST.)
780003	32°28.4'N	79°27.2'W	20	16.96	2300
780005	32°22.6'N	79°18.9'W	36	17.25	0548
780007	32°17.3'N	79°12.0'W	42	18.74	1100
780008	32°09.4'N	79°03.8'W	119	15.46	1430
780013	32°45.9'N	78°27.8'W	46	18.27	0712
780014	32°48.7'N	78°31.7'W	40	18.48	0942
780015	32°58.5'N	79°39.6'W	29	18.99	0006
780016	33°08.6'N	78°40.5'W	22	14.24	1812
780017	33°12.8'N	78°52.1'W	15	13.10	2042
780018	33°43.7'N	78°18.2'W	15	11.52	0400
780019	33°40.6'N	78°15.6'W	16	13.50	0554
780020	33°32.5'N	78°09.0'W	20	14.67	0842
780021	33°26.7'N	78°04.4'W	24	15.00	1036
780022	33°18.3'N	77°59.1'W	31	15.57	1412
780024	33°12.5'N	77°54.7'W	31	18.44	2000
780025	33°10.6'N	77°53.0'W	34	18.47	2300
780029	31°38.0'N	79°57.2'W	38	17.91	2200
780030	31°41.6'N	80°05.3'W	33	15.59	0000
780035	30°56.7'N	81°10.1'W	15	10.22	1448
780036	30°55.4'N	81°03.0'W	16	10.86	1754
780037	30°53.3'N	80°50.0'W	24	12.38	2024
780041	30°48.5'N	80°19.4'W	40	18.72	0542
780042	30°43.0'N	79°57.6'W	223	9.66	0942
780044	29°53.3'N	80°14.0'W	128	8.26	2224
780048	28°51.6'N	80°30.8'W	22	17.76	2230
780049	28°53.3'N	80°15.8'W	29	21.00	0224
780052	28°54.4'N	80°15.7'W	40	16.58	2200
780055	29°54.7'N	80°43.5'W	29	17.38	1018
780057	29°53.1'N	81°07.9'W	16	13.24	1530
780058	29°49.6'N	81°06.5'W	15	13.23	1718
780059	29°49.9'N	81°08.0'W	15	13.20	1854

Summer - 1977

Collection Number	Latitude	Longitude	Depth (m)	Bottom Temperature	Time (EST.)
770247	32°37.8'N	79°40.0'W	13	28.25	1924
770249	32°29.3'N	79°28.3'W	20	23.76	1330
770250	32°26.7'N	79°25.3'W	23	23.51	1548
770251	32°23.2'N	79°19.5'W	33	22.88	1800
770252	32°20.0'N	79°16.5'W	40	23.66	2100
770253	32°18.9'N	79°12.7'W	40	20.50	0012
770259	31°41.4'N	80°05.5'W	35	27.57	0924
770260	31°46.0'N	80°15.2'W	24	27.00	1130
770261	31°48.0'N	80°21.0'W	20	27.02	1312
770262	31°54.2'N	80°32.0'W	15	28.13	1536
770263	30°57.7'N	81°10.2'W	15	28.25	2318
770264	30°57.2'N	81°04.0'W	16	27.91	0036
770265	30°54.3'N	80°54.0'W	20	26.35	0242
770266	30°54.0'N	80°49.5'W	24	25.51	0454
770267	29°54.2'N	80°39.5'W	35	23.48	1124
770268	29°53.7'N	80°43.5'W	31	23.59	1536
770269	29°51.9'N	80°56.6'W	20	22.23	1805
770270	29°52.5'N	81°09.0'W	15	24.37	2030
770272	28°50.5'N	80°40.5'W	16	22.46	0848
770273	28°53.0'N	80°32.5'W	20	21.83	1124
770274	28°52.8'N	80°26.5'W	22	22.02	1418
770291	28°54.0'N	80°16.0'W	38	24.40	0800
770292	28°55.5'N	80°17.4'W	37	24.84	1030
770293	28°55.6'N	80°08.0'W	68	21.67	1501
770295	29°52.5'N	80°15.4'W	128	13.16	0130
770298	30°44.9'N	80°04.0'W	73	16.15	1524
770300	30°48.0'N	80°24.0'W	38	27.16	1942
770307	33°07.7'N	78°57.8'W	13	27.62	0136
770310	33°33.7'N	78°10.0'W	20	25.58	1206
770311	33°28.0'N	78°05.4'W	24	25.48	1342
770312	33°19.0'N	77°59.5'W	31	25.17	1800
770314	33°10.4'N	77°53.0'W	35	26.60	2242

Summer - 1978

Collection Number	Latitude	Longitude	Depth (m)	Bottom Temperature	Time (EST.)
781041	32°42.5'N	79°37.3'W	13	28.04	1200
781042	32°39.9'N	79°33.8'W	15	27.76	1554
781043	32°38.2'N	79°29.7'W	16	27.56	1812
781044	32°35.6'N	79°24.4'W	22	27.25	2136
781045	32°24.9'N	79°12.8'W	38	24.38	0342
781046	32°21.3'N	79°06.8'W	42	24.00	0718
781047	32°17.7'N	79°00.5'W	88	20.70	1054
781048	32°15.4'N	78°57.7'W	124	12.87	1312
781051	32°40.5'N	78°26.5'W	132	14.12	0506
781052	32°45.2'N	78°29.2'W	40	24.96	0718
781053	32°48.9'N	78°27.7'W	38	26.10	0906
781054	32°48.5'N	78°32.9'W	40	25.49	1206
781055	33°01.2'N	78°44.1'W	22	26.74	1606
781056	33°10.1'N	78°50.9'W	17	27.23	1848
781057	33°14.1'N	78°55.8'W	15	27.35	2018
781058	33°18.9'N	78°59.9'W	14	27.46	2200
781059	33°46.3'N	78°18.4'W	13	27.64	0318
781060	33°42.6'N	78°17.1'W	15	27.56	0548
781061	33°40.5'N	78°16.0'W	16	27.54	0730
781062	33°33.8'N	78°11.3'W	21	27.22	1012
781063	33°27.6'N	78°06.4'W	26	27.22	1248
781064	33°11.6'N	77°53.3'W	33	23.23	1754
781065	33°11.5'N	77°49.8'W	35	22.34	2018
781066	33°08.1'N	77°52.1'W	40	21.93	2342
781067	33°02.5'N	77°48.5'W	117	17.05	0242
781068	33°05.8'N	77°48.2'W	77	18.82	0436
781070	31°32.3'N	79°41.6'W	71	23.51	2300
781071	31°36.3'N	79°52.0'W	44	24.56	0136
781072	31°39.6'N	79°59.3'W	38	25.68	0418
781073	31°42.1'N	80°05.2'W	35	27.10	0624
.781074	31°48.9'N	80°19.1'W	21	27.93	0924
781075	31°51.5'N	80°26.3'W	18	28.17	1124
781076	31°52.4'N	80°29.1'W	18	28.24	1606
781077	31°53.7'N	80°31.9'W	15	28.30	1748
781078	31°54.1'N	30°39.2'W	14	28.19	1948
781079	30°58.5'N	81°08.7'W	15	28.47	0224
781080	30°57.9'N	81°05.0'W	18	28.51	0442
781081	30°56.4'N	81°03.1'W	16	28.51	0618
781082	20°56.1'N	80°57.7'W	18	28.36	0754
781083	30°54.0'N	80°46.3'W	24	28.14	1030
781084	30°49.7'N	80°27.7'W	38	27.32	1436
781085	30°48.2'N	80°18.6'W	40	25.24	1818
781086	30°46.3'N	80°03.4'W	69	18.01	2330
781087	30°42.1'N	80°05.1'W	73	16.88	0406
781090	28°58.4'N	80°04.4'W	121	15.78	2136
781091	28°56.5'N	80°09.4'W	64	17.12	0112
781092	28°55.7'N	80°13.5'W	44	24.31	0406
781093	28°55.6'N	80°15.9'W	37	25.17	0630
781094	28°53.7'N	80°26.4'W	20	27.56	0912
781095	28°50.6'N	80°38.6'W	18	27.99	1154
781096	28°53.1'N	80°41.0'W	16	27.98	1342
781097	29°50.8'N	81°08.5'W	16	28.06	2136
781098	29°50.5'N	81°06.6'W	16	28.02	2318
781099	29°51.0'N	81°03.0'W	18	28.05	0100
781100	29°54.7'N	80°54.8'W	25	27.83	0330
781101	29°54.0'N	80°49.2'W	25	27.60	0618
781102	29°53.6'N	80°40.4'W	33	27.66	0848
781103	29°54.3'N	80°33.7'W	37	27.24	1042
781104	29°54.1'N	80°21.7'W	46	25.96	1300
781105	31°33.7'N	79°35.1'W	137	10.94	2324

Summer - 1979

Collection Number	Latitude	Longitude	Depth (m)	Bottom Temperature	Time (EST.)
790779	32°41.5'N	79°36.2'W	12	25.72	1306
790780	32°40.8'N	79°34.1'W	14	25.64	1512
790781	32°38.3'N	79°30.5'W	16	25.35	1642
790782	32°34.5'N	79°25.1'W	21	24.18	1924
790783	32°23.4'N	79°11.4'W	40	21.06	2300
790784	32°19.9'N	79°07.8'W	45	20.92	0206
790785	32°17.6'N	79°02.1'W	73	17.15	0436
790786	32°13.6'N	78°57.2'W	152	10.56	0700
790789	32°40.6'N	78°27.5'W	123	14.42	2224
790790	32°50.0'N	78°26.6'W	40	20.62	0106

Summer - 1979 (cont.)

Collection Number	Latitude	Longitude	Depth (m)	Bottom Temperature	Time (EST.)
790791	32°48.0'N	78°33.4'W	40	21.40	0342
790792	33°01.4'N	78°44.5'W	23	23.56	0700
790793	33°10.3'N	78°51.7'W	17	25.58	0924
790794	33°04.7'N	78°56.5'W	15	25.92	1230
790795	33°18.6'N	79°00.3'W	13	26.12	1426
790796	33°45.3'N	78°20.1'W	16	28.11	1948
790797	33°42.4'N	78°14.1'W	17	27.74	2312
790798	33°39.4'N	78°14.8'W	18	27.04	0054
790799	33°32.4'N	78°10.6'W	22	26.10	0354
790800	33°27.3'N	78°06.4'W	24	24.94	0736
790802	33°12.5'N	77°55.2'W	31	22.59	1742
790803	33°15.5'N	77°56.0'W	30	22.59	1900
790804	33°11.8'N	77°48.1'W	33	20.84	2224
790805	33°08.3'N	77°51.8'W	42	20.60	0100
790806	33°05.5'N	77°50.1'W	91	19.93	0300
790807	33°02.7'N	77°46.7'W	137	14.87	0706
790820	31°34.9'N	79°51.7'W	43	20.80	0154
790821	31°37.9'N	79°58.4'W	40	21.61	0342
790822	31°40.6'N	80°04.9'W	33	24.02	0530
790823	31°48.4'N	80°19.9'W	21	26.66	0818
790824	31°49.8'N	80°26.7'W	16	26.71	1006
790825	31°50.8'N	80°28.4'W	18	26.88	1248
790826	31°52.7'N	80°31.7'W	16	27.16	1606
790827	31°55.1'N	80°37.2'W	12	27.56	1754
790828	30°57.0'N	81°10.4'W	15	28.22	0200
790829	30°56.8'N	81°07.3'W	15	28.24	0412
790830	30°56.1'N	81°03.3'W	16	28.10	0606
790831	30°54.5'N	80°59.4'W	16	27.76	0800
790832	30°52.6'N	80°47.2'W	26	27.22	1100
790833	30°48.1'N	80°29.0'W	37	24.42	1412
790834	30°47.3'N	80°19.3'W	40	23.00	1712
790835	29°53.6'N	80°22.7'W	44	14.15	0130
790836	29°53.3'N	80°41.9'W	33	20.14	0454
790837	29°53.3'N	80°48.2'W	27	22.57	0706
790838	29°52.0'N	80°55.7'W	24	26.38	0936
790839	29°52.2'N	81°04.7'W	17	27.53	1224
790840	29°52.5'N	81°09.6'W	16	27.47	1406
790841	29°52.5'N	81°13.5'W	14	27.36	1600
790842	28°51.0'N	80°40.0'W	17	26.57	0154
790843	28°50.0'N	80°42.7'W	16	27.50	0600
790844	28°51.7'N	80°26.5'W	20	24.31	0906
790845	28°53.9'N	80°16.6'W	38	16.73	1136
790846	28°55.2'N	80°12.6'W	47	14.31	1448
790847	28°56.2'N	80°09.3'W	59	12.35	1842
790848	28°57.3'N	80°02.8'W	143	8.50	2206
790851	30°50.6'N	80°01.0'W	71	16.80	0842
790852	31°29.6'N	79°38.6'W	137	8.95	1436
790853	31°29.9'N	79°41.7'W	73	16.04	1912

APPENDIX II. Collection numbers associated with capture of decapod crustaceans during MARMAP surveys in Summer 1977, 1978 and 1979 and Winter 1978.

Family	Species	Collection Numbers For Each Occurrence		
Penaeidae	Metapenaeopsis goodei	781044	781065	781066
		781068	781070	781071
		781072	781086	781087
		781091	781100	770252
		770253	790790	790791
		790804	790805	790821
		790835	780025	
	Parapenaeus longirostris	790848	780044	
	Penaeus duorarum	781044	781058	781059
		790782	790796	790829
		790841	790842	780018
		780019	780048	
	Penaeus setiferus	790841		
	Trachypenaeus constrictus	781044	781057	781058
		781059	781078	781079
		781080	781097	781098
		781099	781100	770247
		770263	770264	770270
		790782	790796	790797
		790798	790799	790828
		790829	780003	780016
		780017	780018	780019
		780048	780059	
Sicyoniidae	Sicyonia brevirostris	781044	781045	781065
		781066	781067	781068
		781070	781071	781072
		781086	781087	781091
		781092	781094	781100
		781102	781104	770247
		770252	770253	770264
		770267	770270	770291
		770292	770298	770300
		790784	790790	790791
		790804	790805	790806
		790820	790821	790835
		790836	790837	790845
		790846	790847	790851
		790853	780003	780005
		780016	780024	780025
		780029	780030	780041
		780049	780052	
	Sicyonia laevigata	781064		
	Sicyonia typica	781057	781065	781068
		790780		
Solenoceridae	Mesopenaeus tropicalis	781051	781068	781070
		781086	781087	781090
		770295	790785	790789
		790806	790835	780030

Family	Species	Collection Numbers For Each Occurrence		
	Solenocera atlantidis	781072	781065	781066
		781068	781070	781091
		770252	770270	790789
		790790	790821	780025
		780052		
	Solenocera necopina	780044		
Pasiphaeidae	*Leptochela papulata*	781068	781070	
Palaemonidae	*Leander tenuicornis*	790806		
	Periclimenes nr. *yucatanicus*	781068		
Alpheidae	*Alpheus normanni*	781064		
	Synalpheus minus	790823		
	Synalpheus townsendi	790802		
Hippolytidae	*Bythocaris nana*	790848		
	Tozeuma serratum	781068	790806	780017
Processidae	*Processa* nr. *tenuipes*	781068		
	Processa sp.	781068	781070	781087
		790789	790806	
	Processa vicina	781065	790821	781068
		781072		
Crangonidae	*Pontophilus brevirostris*	790848		
Scyllaridae	*Scyllarides nodifer*	790790		
	Scyllarus chacei	781044	781065	781066
		781068	781072	781086
		781102	770252	770253
		790783	790791	790804
		790805	790821	790836
		780025	780029	
	Scyllarus depressus	790806		
Galatheidae	*Galathea rostrata*	781068	781087	781103
		790802		
	Munida pusilla	781068	790806	
Porcellanidae	*Pachycheles rugimanus*	790802	790834	
	Porcellana sayana	781071	781072	781086
		781087	790790	790802
	Porcellana sigsbeiana	790852		
Paguridae	*Pagurus carolinensis*	781087		
	Pagurus sp.	780035		
	Petrochirus diogenes	781087	770260	790790
		790791	790806	790838
	Pylopagurus corallinus	781068	781086	790790
		790791		
Raninidae	*Ranilia muricata*	770252		

Family	Species	Collection Numbers For Each Occurrence		
Dromiidae	Dromidia antillensis	781042	781068	781087
		781094	790830	
Leucosiidae	Iliacantha subglobosa	781068		
	Myropsis quinquespinosa	781090	790848	
	Persephona mediterranea	781058	790798	
Calappidae	Acanthocarpus alexandri	790786		
	Calappa angusta	781072	770264	
		781044	781063	781066
		781071	781072	781080
		781085	781092	781094
		770247	770251	770260
		770263	770265	770267
		770291	770292	770300
		790793	790794	790804
		790825	790829	790836
		790842	780029	
	Calappa sp.	770266	770270	
	Osachila semilevis	781086		
Portunidae	Arenaeus cribrarius	781096	781097	780199
		790843		
	Callinectes sapidus	781043	781075	781076
		781077	781096	781097
		781098	770247	770261
		770262	770263	790795
		790828	790824	790840
		790842	790843	
	Cronius tumidulus	781064		
	Ovalipes stephensoni	781041	781043	781044
		781047	781051	781052
		781056	781057	781058
		781059	781060	781062
		781065	781066	781070
		781071	781075	781076
		781077	781078	781080
		781081	781082	781083
		781085	781094	781098
		781099	781100	781101
		781102	781103	781105
		770247	770262	770264
		770265	770267	770268
		770269	770270	770273
		770274	770298	790780
		790784	790785	790789
		790796	790797	790798
		790799	790803	790804
		790807	790824	790836
		790837	790838	790839
		790844	790845	790846
		790847	790851	790852
		780008	780018	780049
	Portunus floridanus	781068		
	Portunus gibbesii	781043	781044	781058
		781059	781071	781073
		781074	781078	781084
		781085	781094	781095
		781101	781102	781103
		770247	770251	770259

Family	Species	Collection Numbers For Each Occurrence		
		770262	770264	770267
		770268	770291	770292
		790795	790796	790797
		790799	790820	790837
		790843	790844	790845
		780003	780019	780049
		780052		
	Portunus ordwayi	781044	781064	781068
		781070	781071	781072
		781087	781091	770253
		790790	790791	790804
	Portunus sp.	781079	781104	770266
		770300	790806	790824
	Portunus spinicarpus	781067	781068	781070
		781086	781087	781091
		770293	770295	790806
		790852	790853	780044
	Portunus spinimanus	781058	781059	781062
		781064	781065	781071
		781072	781073	781074
		781075	781084	781085
		781094	781095	781096
		781102	781103	770247
		770249	770261	770262
		770265	770267	770270
		770273	770291	770292
		770307	770314	790779
		790796	790798	790805
		790828	790831	790835
		790836	790837	790838
		790842	790843	790844
		790845	780003	780005
		780019	780024	780029
		780041	780049	780052
Cancridae	Cancer borealis	790786		
	Cancer irroratus	790786	790807	790848
		780044		
	Cancer sp.	770295		
Xanthidae	Glyptoxanthus erosus	790834		
	Lobopilumnus agassizii	781064	790802	
	Neopanope sayi	790795		
	Pilumnus floridanus	781087	790802	780035
	Pilumnus sayi	781042	781064	781065
		770264	790779	790795
		770802	790823	790834
		790845		
	Pseudomedaeus agassizii	781087	781103	790802
Goneplacidae	Glyptoplax smithii	781064		
Palicidae	Palicus sica	781072		
Majidae	Anasimus latus	781068	781070	
	Collodes trispinosus	781072	790805	
	Libinia dubia	770263	780035	

Family	Species	Collection Numbers For Each Occurrence		
	Libinia emarginata	781057	781058	781059
		781065	781072	781079
		781097	790794	790797
		790820		
	Libinia sp.	770265	770307	
	Macrocoeloma camptocerum	781103		
	Metoporhaphis calcarata	781064	781068	790790
	Mithrax forceps	790802		
	Mithrax pleuracanthus	781064	781075	781103
		790802		
	Mithrax acuticornis	790802		
	Podochela gracilipes	781068	781087	
	Podochela riisei	781084	790805	
	Podochela sidneyi	781068	781087	781094
		781095	790791	790805
	Pyromaia arachna	790848		
	Rochinia crassa	770295	790791	790848
	Stenocionops furcata coelata	781064	781068	781071
		781072	781084	770253
		790791	780005	
	Stenocionops spinimana	781048	781051	781052
		781105	790852	
	Stenorhynchus seticornis	781064	781066	781068
		781086	781087	781091
		770267	770314	
Parthenopidae	*Parthenope agonus*	790785	781068	
	Parthenope fraterculus	781068	781087	
	Parthenope granulata	781098	781100	