RESULTS OF MARMAP OTTER TRAWL INVESTIGATIONS IN THE SOUTH ATLANTIC BIGHT. I. FALL 1973[1]

Charles A. Wenner, Charles A. Barans,

Bruce W. Stender and Frederick H. Berry

Marine Resources Research Institute
South Carolina Wildlife and Marine Resources Department
Charleston, South Carolina 29412

Technical Report Number 33

March 1979

[1]This work is a result of research sponsored by the National Marine Fisheries Service (MARMAP Program Office) under Contract Number 6-35147 and by the South Carolina Wildlife and Marine Resources Department. MARMAP Contribution Number 161.

ABSTRACT

Estimates of the standing stock, distribution and relative abundance of groundfish in the South Atlantic Bight were obtained from seventy-five otter trawls made during the fall of 1973 in depths from 9 to 366 m from Cape Fear, North Carolina to Cape Canaveral, Florida. The stratified mean catch/tow for total groundfish was 37 kg/tow, however rare collections of large batoid elasmobranchs such as Dasyatis centroura, D. americanus and Myliobatis freminvillei made a significant contribution to the catches.

A general trend of a decrease in the number of species per tow was observed; species diversity was compared to trawl catches in the Gulf of Mexico and the Middle Atlantic continental shelf. The use of numerical classification showed a major faunal change at the shelf break (~ 60 m) with a broad separation of the fauna into shallow and deepwater components. Typical species of the inshore sand bottom demersal fish community were Synodus foetens, Diplectrum formosum, Stephanolepis hispidus, Aluterus schoepfi, Balistis capriscus and Prionotus carolinus. Distribution maps, abundance and standing stock estimates are provided for the numerically dominant sand bottom demersal as well as pelagic species.

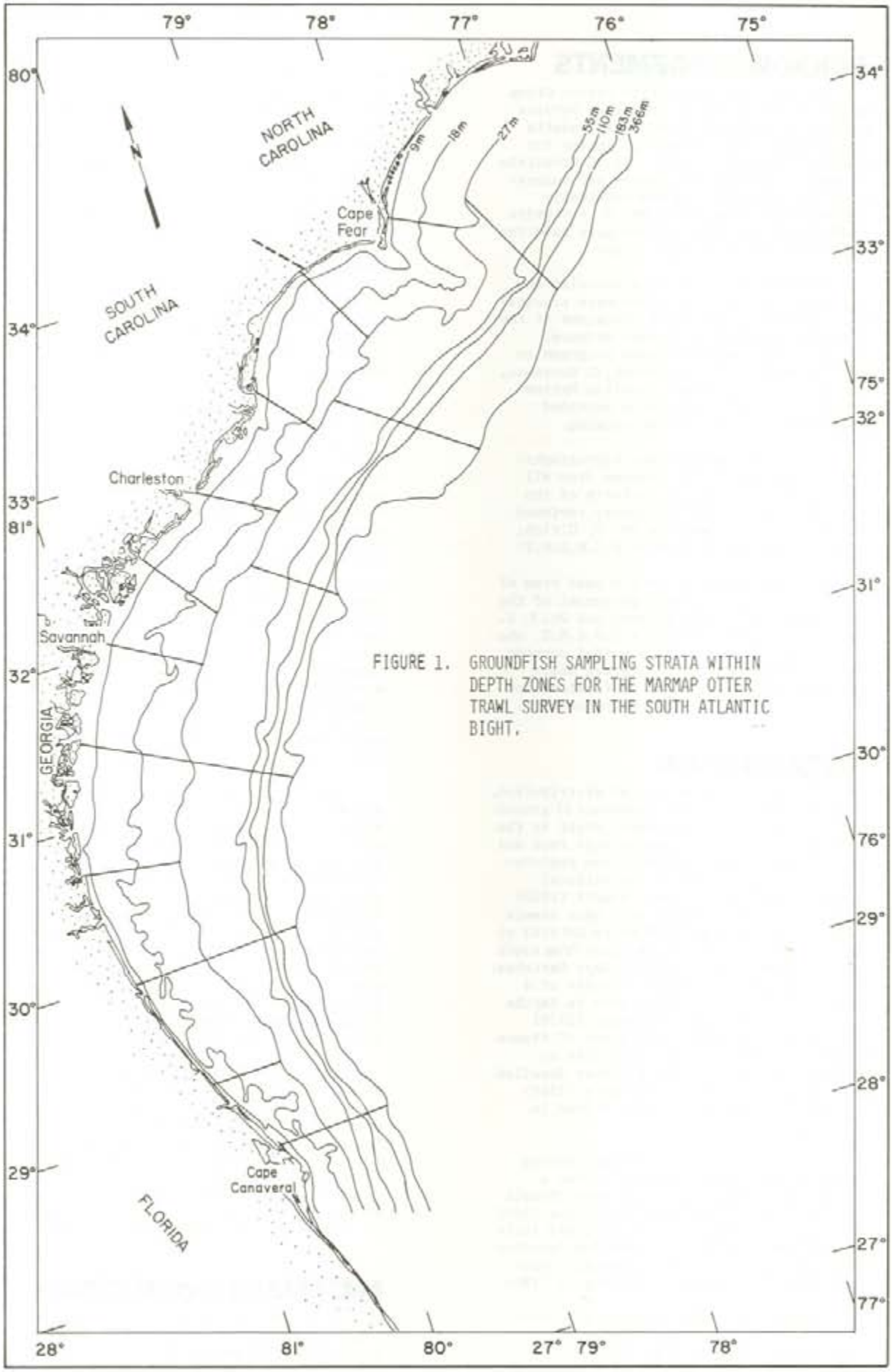

FIGURE 1. GROUNDFISH SAMPLING STRATA WITHIN DEPTH ZONES FOR THE MARMAP OTTER TRAWL SURVEY IN THE SOUTH ATLANTIC BIGHT.

strata were a southward projection of the MARMAP strata utilized by the Northeast Center of the National Marine Fisheries Service for sampling groundfish populations off the Middle Atlantic and New England States. The strata were subdivisions of six depth zones (9-18 m; 19-27 m; 28-55 m; 56-110 m; 111-183 m; 184-366 m). The 9-18 m depth zone was the equivalent to Struhsaker's (1969) coastal habitat whereas the 19-27 m and the 28-55 m were equivalent to his open shelf habitat. The 56-110 m and the 111-183 m zones were his shelf edge habitat and lower shelf habitat.

A total of 75 0.5-h otter trawls (Appendix I) were made with a 3/4 scale version of a Yankee No. 36 trawl (Wilk and Silverman 1976) from the R/V Dolphin (a 32.6 m converted tug) at a speed of 6.5 km/h. The net had a 16.5 m footrope, an 11.9 m headrope and a 1.3 cm stretch mesh codend liner. Only successful trawls with negligible net damage in nonlive bottom habitats were included in the analysis. A station was designated as live bottom when the catch contained a predominance or significant amount of certain fish species that are known to associate closely with coral reefs (Table 1) and large amounts of sponges and/or corals. These stations were separated out and not included here. Fishes were sorted by species or lowest possible taxonomic group; each species was counted, measured and weighed. Each species catch less than 0.45 kg was assigned 0.1 kg for the analysis because of field conditions and limited scales. Size was recorded to the nearest cm as total length (TL), fork length (FL) or disc width (DW).

Hydrographic observations, temperature, salinity, dissolved oxygen, were taken at the end of each trawl with Niskin bottles and reversing thermometers.

Since a relatively small number of trawls was utilized to characterize the groundfishes of the South Atlantic Bight, strata boundaries were collapsed within depth zones. This resulted in the six previously described zones which were each treated as a large stratum for the biomass estimates.

The stratified mean catch/tow (Cochran 1977) was calculated by the expression:

$$\bar{y}_{st} = \frac{1}{N} \sum_{h=1}^{k} \{N_h \bar{y}_h\}$$

where $\bar{y}_{st}$ = stratified mean catch/tow

N = total area

N_h = area of h_{th} zone

$\bar{y}_h$ = mean catch/tow in the h_{th} zone

k = number of zones in the set

The estimated population variance of the mean catch/tow was also calculated by (Clarke and Brown 1977):

$$s^2 = \frac{1}{N} \sum_{h=1}^{k} \{N_h \bar{y}_h^2\} - N\bar{y}_{st}^2 + \sum_{h=1}^{k} s_h^2 \{(N_h - 1) + \frac{(N_h - N)}{N} \frac{(N_h - n_h)}{n_h}\}$$

where s^2 = estimated population variance

s_h^2 = variance of the h_{th} zone

n_h = number of tows in the h_{th} zone

Because previous investigators have shown that trawl catches are usually distributed as a negative binomial, a $\ln(x + 1)$ transformation was made on the data (Taylor 1953; Roessler 1965; Elliott 1973). The mean catch/tow ($\bar{y}_h$) of the transformed data was estimated for each depth zone following the methodology of Bliss (1967):

$$E(\bar{y}_h) = \exp(\bar{y}_h + s_h^2/2)$$

where $E(\bar{y}_h)$ = the estimated (retransformed) mean catch/tow in the h^{th} depth zone, $\bar{y}_h$ and s_h^2, both expressed in logarithmic units, are the zone mean and its variance. The same methodology was applied to obtain the stratified mean catch/tow from transformed data for the whole study area. Also, since large elasmobranchs such as Dasyatis spp. and large catches of pelagic fishes such as Decapterus punctatus contribute significantly to the variance of the catches, estimates were made on only demersal bony fishes as well as total biomass. Biomass estimates were expanded by the area swept method (Rohr and Gutherz 1977) using

$$SS_{tot} = \sum_{h=1}^{k} (\bar{P}_h)(A_h)$$

where SS_{tot} = total standing stock

$\bar{P}_h$ = average population expressed as number or kg per hectare in the h^{th} zone

A_h = total area of the h^{th} zone

The sweep of the "3/4 Yankee trawl" was 8.748 m (T. Azarovitz, N.M.F.S., Woods Hole, Mass., personal communication) and 3.241 km was the distance covered during a standard trawl. It should be noted that all estimates are minimum estimates because the sampling efficiency of our gear with regard to the South Atlantic Bight fish fauna is unknown.

After removal of the pelagic fishes and squids, diversity indices were calculated on only the demersal fishes for each tow by H' (Pielou 1975) and species richness (Margalef 1968). We acknowledge that diversity indices have come under severe scrutiny in the recent literature (see Peet 1975). These indices were calculated in the present study to compare to values from the available literature for fishes from other habitats.

Clustering techniques were utilized to compare the similarity between assemblages of organisms (normal analysis) and to compare similarity in the distribution pattern of species (inverse analysis)

Table 1. Fish species known to occur in reef areas that were used in conjunction with catches of sponges and corals to determine "live bottom" stations that were excluded in this analysis.

Apogon pseudomaculatus

Archosargus probatocephalus

Chaetodon aya

Chaetodon ocellatus

Chaetodon sedentarius

Chaetodon striatus

Chromis enchrysurus

Holocanthus bermudensis

Holocanthus ciliaris

Holocentrus bullisi

Epinephelus drummondhayi

Mycteroperca interstitialis

Mycteroperca microlepis

Mycteroperca phenax

(Boesch 1977). The Canberra metric coefficient was used in the analysis. The data were log transformed and the sorting strategy was flexible with B = -0.25 (see Boesch 1977 and Clifford and Stephenson 1975 for a detailed discussion of the methods). Only benthic fish species which were collected at 3 or more trawl stations were included in the analysis. Examination of species and site groups to determine suitability of the groups and misclassifications was done by nodal analysis (Boesch 1977). Constancy (the number of stations in a site-group in which a given species occurs) and fidelity (the comparison of the frequency of occurrence of a species within a site-group to the overall frequency of occurrence in the whole study area) were examined. A species-group is rated high in constancy if found in all stations in a site-group, and a species-group is rated high in fidelity if found in only one site-group.

An index of relative abundance (Musick and McEachran 1972) for each depth zone was calculated for some of the most abundant and widely distributed species by the following expression:

$$\text{Index of Relative Abundance} = \frac{1}{n} \epsilon \ln (x+1)$$

where n = number of trawls in a depth zone

x = number of individuals or weight of a given species for each tow in a depth zone

RESULTS and DISCUSSION

Hydrography

Bottom water temperatures were generally higher at the shelf edge with lower temperatures nearshore and in the deeper water on the upper continental slope (Fig. 2). Water temperatures off Cape Fear were lower than those in the South Atlantic Bight. Bottom salinities were lowest inshore especially off Georgia and northern Florida (Fig. 3). For a more detailed description of the oceanographic conditions of the region see Mathews and Pashuk (1977).

Biomass

Arithmetic and geometric mean values for the catch/tow ($\overline{y}_h$) of total groundfish weight (total groundfish weight includes the weights of demersal bony fish, elasmobranchs, pelagic fishes and squids) by depth zone are in Table 2 whereas those for demersal bony fishes are in Table 3.

The frequencies of untransformed trawl catches approximated a negative binomial distribution which tended towards normality after a ln (weight + 1) transformation. Analysis of variance showed a significant difference in mean catches of demersal bony fishes between depth zones (Table 4). Linear contrasts by the Scheffe method (Guenther 1964) isolated significant differences between treatment means (Table 5). The shallower depth strata (9-18 m; 19-26 m) had significantly greater mean catch/tow values for demersal bony fishes at the 90% level than the deeper strata.

The stratified mean catch/tow for total untransformed groundfish weight is 37.180 kg/tow with the 90% confidence limits (CL) being 26.897 (lower) and 47.463 (upper). The Bliss (1967) estimation of the stratified mean catch/tow on the transformed data gives a mean value of 37.592 kg/tow with 90% confidence limits of 29.183 (lower) and 48.089 (upper). The use of the transformation in the above analysis reduces the variance of the stratified mean catch/tow from 2878 to 1.611.

The analysis of the catches with pelagic species, squid and elasmobranchs removed from the data shows that this reduces the variance of the untransformed catch/tow by 51% whereas the variance of the transformed data is reduced by 22%. The stratified mean catch/tow of untransformed demersal bony fish is 18.958 (lower 90% CL = 11.597; upper 90% CL = 26.318) kg/tow. The estimate of the transformed data gives a mean of 15.781 (lower 90% CL = 12.538; upper 90% CL = 19.800) kg/tow.

The use of 2.835 hectares as the area swept during a standard 30 minute tow gave the following density estimates in kg/ha:

		lower 90% CL	upper 90% CL
total groundfish - untransformed	13.115	9.487	16.742
total groundfish - transformed	13.225	10.294	16.963
demersal bony fish - untransformed	6.692	4.095	9.288
demersal bony fish - transformed	5.566	4.423	6.984

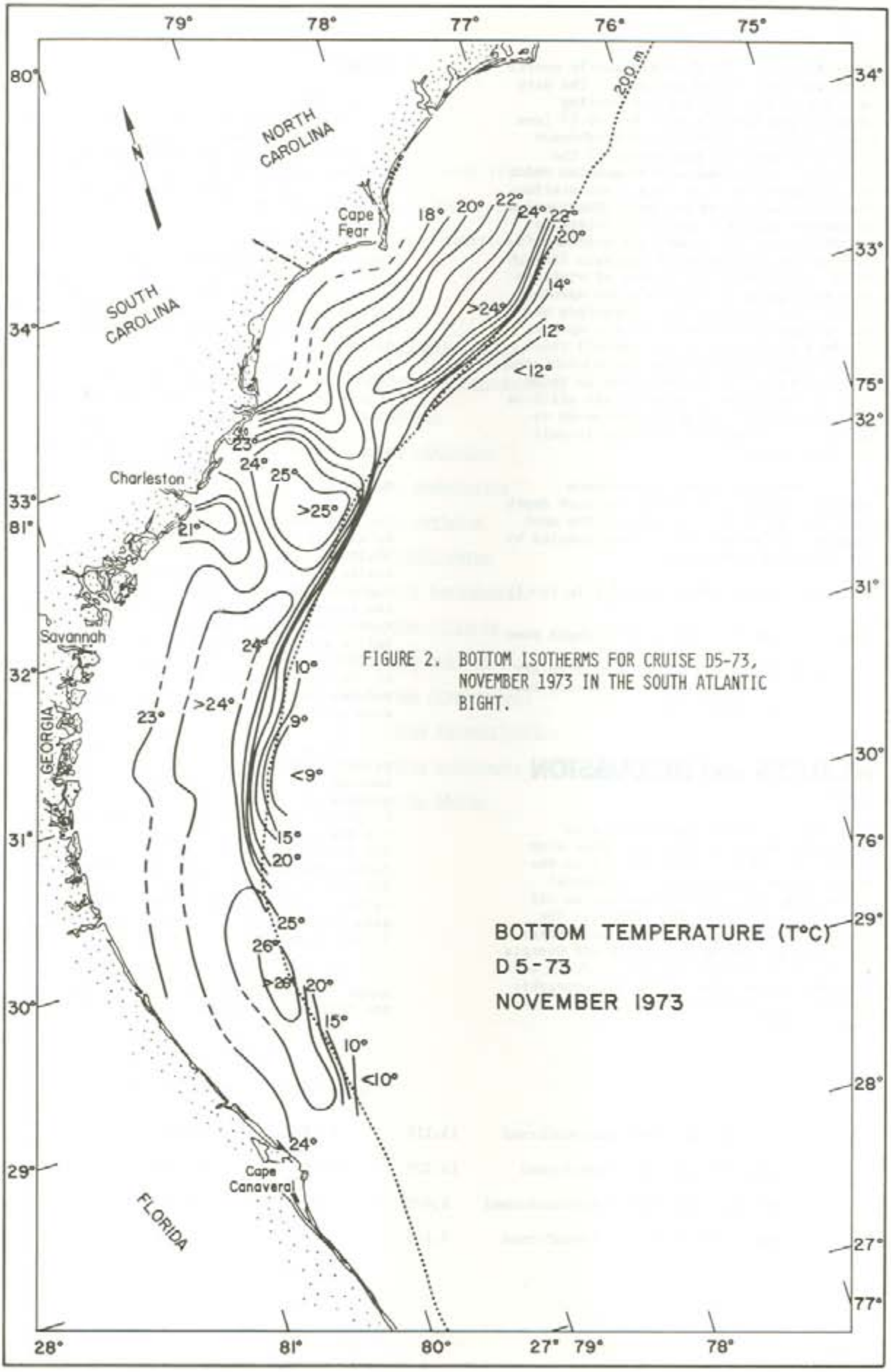

FIGURE 2. BOTTOM ISOTHERMS FOR CRUISE D5-73, NOVEMBER 1973 IN THE SOUTH ATLANTIC BIGHT.

BOTTOM TEMPERATURE (T°C)
D 5-73
NOVEMBER 1973

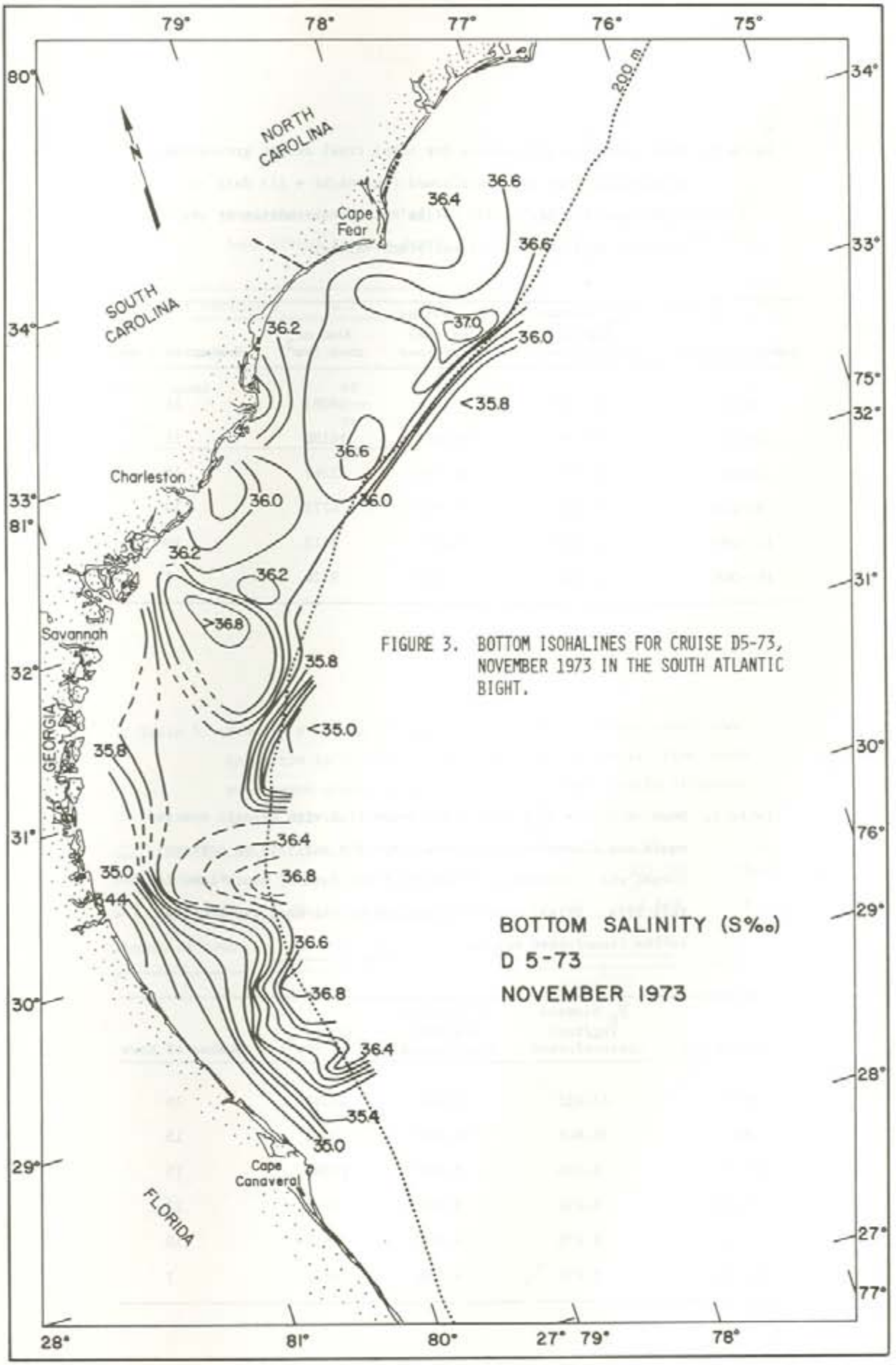

FIGURE 3. BOTTOM ISOHALINES FOR CRUISE D5-73, NOVEMBER 1973 IN THE SOUTH ATLANTIC BIGHT.

Table 2. Mean catch/tow ($\bar{y}_h$) values for total trawl caught groundfish on untransformed and transformed {ln(weight + 1)} data by depth zone for fall 1973. Bliss' (1967) estimation of the mean was applied to the transformed values.

Depth Zone (m)	$\bar{y}_h$ biomass (kg/tow) untransformed	$\bar{y}_h$ biomass (kg/tow) transformed	Area of zone (km^2)	Number of tows
9-18	64.732	77.416	18083	16
19-27	59.496	66.027	16100	15
28-55	17.273	16.626	22367	15
56-110	17.159	16.960	4775	12
111-183	24.486	25.094	3615	10
184-366	9.332	9.967	9724	7

Table 3. Mean catch/tow ($\bar{y}_h$) values for groundfish with pelagic species, squid and elasmobranchs removed from the analysis on untransformed and transformed {ln(weight + 1)} data by depth zone for fall 1973. Bliss' (1967) estimation of the mean was applied to the transformed values.

Depth Zone (m)	$\bar{y}_h$ biomass (kg/tow) untransformed	$\bar{y}_h$ biomass (kg/tow) transformed	Area of zone (km^2)	Number of tows
9-18	33.035	33.307	18083	16
19-27	37.848	34.650	16100	15
28-55	5.550	5.647	22367	15
56-110	5.151	5.389	4775	12
111-183	6.277	6.360	3615	10
184-366	3.837	4.160	9724	7

Table 4. Analysis of variance of the mean catch/tow in kg of demersal bony fishes between depth zones. *Significant at the 90% level.

Source of Variation	d.f.	Sums of Squares	Mean Square	F
Between zones	5	33.848	6.769	7.65*
Among zones	69	61.084	0.885	
Total	74	94.932		

Table 5. Scheffe's multiple range comparison of the transformed mean catch/tow in the six depth zones. The horizontal line below treatments groups those that are not significantly different at the 90% level.

depth zone (m)	9-18	19-27	28-55	56-110	111-183	184-366
$\bar{x}$ (ln[kg + 1])	2.786	3.026	1.764	1.537	1.549	1.258
Number of tows	16	15	15	12	10	7

When utilizing trawl survey data to obtain accurate estimates of the standing stock of groundfish in an area, some estimate of the gear's effectiveness in sampling the groundfish community must be known (see Edwards 1968). Presently data are not available for groundfish vulnerability to our trawl. Therefore, both the above density and the standing stock estimates in Table 6 should be viewed as minimum estimates.

Groundfish density estimates for the sand bottom habitat were generally lower than published accounts for areas off the east coast of the United States and the Gulf of Mexico (Table 7). Comparable density estimates were obtained from Moore et al.'s (1970) data for the continental shelf off the Texas coast.

Demersal Bony Fishes

The fall 1973 groundfish survey (effort = 37.5 hr) in the South Atlantic Bight resulted in the collection of 17,599 demersal bony fishes belonging to 157 species in 46 families (Table 8). The most numerically abundant family of demersal bony fishes was the Sparidae which included five species. The majority of the sparids were Stenotomus aculeatus (98.1% of the total number). The second most numerically abundant family was the Gadidae (Urophycis regius and 3 specimens of two other species), and the Synodontidae ranked third with six species. Ranking of demersal bony fish species by numbers and weight for November 1973 are in Table 9.

When abundance was examined for individual depth zones, it was noted that the sparid, Stenotomus aculeatus, ranked first numerically in the 9-18 m and the 19-27 m depth zones. It comprised 48% of the total weight of demersal bony fishes in these two zones. In the intermediate depth zones (28-55 m, 56-110 m), the ubiquitous sand bottom species (Stephanolepis hispidus, Synodus foetens, Diplectrum formosum, Synodus poeyi, Prionotus carolinus) predominated in the catches. Trawls in deeper water of the continental shelf and upper continental slope showed the spotted hake, Urophycis regius, to be the most abundant species (Tables 10 and 11).

Southern Porgy: Stenotomus aculeatus

The sparid fish, Stenotomus aculeatus, occurred in 32% of the 75 successful trawls made in the South Atlantic Bight during the fall 1973 groundfish survey. This species ranked first in both total number (n = 7969) and weight (540.111 kg) of the demersal bony fish species. Southern porgy were collected from Cape Fear (- 33.8°N) to Cape Canaveral (- 28.8°N) in depths from 9 to 140 m and temperatures from 16.7° to 25.0°C (Fig. 4). Stenotomus aculeatus was most abundant both in numbers and biomass in the 19-27 m depth zone where it occurred in 13 of 15 otter trawls (Fig. 5A). The only record for this species in depths greater than 40 m during this survey was a collection of 215 individuals weighing 5.4 kg in 140 m. Southern porgy ranged in size from 9 to 20 cm FL (Fig. 5B) with an overall mean size of 15 cm FL. There was no indication of size differences between depth zones.

Stratified mean catch/tow values and standing stock estimates were based on trawls made in the three inshore depth zones. Untransformed data gave a mean of 150.64 (LCL = 19.34; UCL = 281.95) individuals per tow with a mean weight of 10.385 (LCL = 1.214; UCL = 19.556) kg per tow. Bliss approximations of the log transformed data gave a mean of 73.20 (LCL = 40.52; UCL = 131.61) individuals per tow with a mean weight of 4.029 (LCL = 2.585; UCL = 6.054) kg per tow. Standing stock estimates calculated from these data are in Table 12.

Spotted hake: Urophycis regius

The spotted hake, Urophycis regius, occurred in only 18% of the 75 trawls made during the fall 1973 groundfish survey. It ranked second in total number (n = 1544) and fourth in weight (62.121 kg) of the demersal bony fish species. Although this species had a wide latitudinal distribution from ~ 33.3°N to ~ 29°N (Fig. 6), U. regius was limited to the two deepest zones (Fig. 5C). Spotted hake were collected in depths from 112 m to 306 m in temperatures from 8.6° to 27.6°C. The average size ranged from 3 to 29 cm TL with a mean of 17 cm TL (Fig. 5D). There appeared to be no relationship between size and depth of capture for spotted hake. Since analysis of variance showed no significant differences in transformed number ($F = 0.74$, df = 1,15) and weight ($F = 0.094$, df = 1,15)/tow in these two strata, they were treated as a single stratum for standing stock estimates.

The untransformed mean catch/tow was 90.7 (LCL = 14.2; UCL = 167.0) individuals with a mean weight of 3.648 (LCL = 0.756; UCL = 6.540) kg/tow. The Bliss approximation of the transformed data gave a mean of 4.62 (LCL = 2.716; UCL = 7.870) kg/tow. The same methodology gave unrealistically inflated values for the mean number/tow ($\bar{\chi}$: 241, LCL = 74; UCL = 792). Standing stock estimates for the spotted hake in the South Atlantic Bight during the fall 1973 are in Table 13.

Tomtate: Haemulon aurolineatum

A total of 1236 Haemulon aurolineatum weighing 59.922 kg were collected during the fall 1973 groundfish survey from off Cape Fear (~ 33.8°N) to the northern Florida (~ 29.5°N) (Fig. 7). Tomtate ranked third in total number and fifth in total weight of demersal bony fishes trawled in the South Atlantic Bight. This species was found in depths from 15 m to 42 m and in temperatures from 17.1° to 24.8°C. Although H. aurolineatum was ranked among the dominant demersal species, 95% of the total number and 96% of the

Table 6. Minimum standing crop estimates of groundfish in the South Atlantic Bight, November 1973. All values should be expanded by 10^4; units are in metric tons. LCL and UCL = lower and upper 90% confidence limits respectively.

	Mean	LCL	UCL
total groundfish-untransformed	9.79	7.08	12.50
total groundfish-transformed	9.88	7.69	12.67
demersal bony fish-untransformed	5.00	3.06	6.93
demersal bony fish-transformed	4.16	3.30	5.21

Table 7. Density estimates for trawl caught groundfish from the Gulf of Mexico and the east coast of the United States. None of these data have been adjusted for availability or vulnerability to sampling gear (see Edwards 1968 for discussion of these factors).

Geographic Area	Density (kg/ha)	Trawl gear	Reference
Gulf of Maine[1]	18.5-55.9	#36 Yankee	Clarke and Brown 1977
George's Bank[1]	11.4-36.1	#36 Yankee	Clarke and Brown 1977
Southern New England[1]	13.9-71.4	#36 Yankee	Clarke and Brown 1977
Middle Atlantic Bight[1]	7.0-55.3	#36 Yankee	Clarke and Brown 1977
South Atlantic Bight sand bottom	13.1	3/4 Yankee	Present Study
South Atlantic Bight live bottom	27.3	URI 60/80 highrise	Powles and Barans In Press
Gulf of Mexico Louisiana[2]	9.9-46.3	13.7 m flat	Moore et al. 1970
Gulf of Mexico Texas[2]	6.3-13.3	13.7 m flat	Moore et al. 1970

[1]Calculated from unweighted stratified mean catch/tow for each year; the standard trawl had a sweep of about 12.2 m (Edwards 1968) and travelled 3.241 km; swept area was calculated to be 3.954 ha; these are maximum and minimum values.

[2]Calculated from the data presented in Table 3 of Moore et al. (1970) and represent their minimum and maximum values. The swept area = 6.7 m (trawl sweep) x 5560 m (distance) = 3.723 ha.

Table 8. Ranking of families of demersal bony fishes by numerical abundance during the fall 1973 groundfish survey in the South Atlantic Bight.

Family	Number of Individuals	Weight (kg)	Number of Species
Sparidae	8116	570.5	5
Gadidae	1547	62.7	3
Synodontidae	1485	66.8	6
Haemulidae	1240	60.4	4
Balistidae	928	162.3	7
Serranidae	797	62.9	9
Sciaenidae	605	58.3	9
Bothidae	665	37.0	20
Triglidae	482	30.9	16
Lutjanidae	432	26.0	2
Ophidiidae	427	18.9	9
Percichthyidae*	112	1.8	1
Argentinidae	98	1.0	2
Scorpaenidae	97	5.4	9
Ariidae	83	11.0	1
Batrachoididae	69	2.6	2
Ephippidae	69	6.9	1
Chlorophthalmidae	50	0.5	1
Ogcocephalidae	43	2.3	6
Caproidae	40	4.5	2
Congridae	31	0.7	1
Ostraciidae	30	6.8	1
Gerreidae	20	0.7	3
Tetraodontidae	19	5.1	7
Mullidae	18	1.0	1
Triacanthodidae	13	0.2	1
Muraenidae	10	1.1	1
Polymixiidae	8	0.1	1
Rachycentridae	8	117.9	1
Uranoscopidae	8	0.7	2
Diodontidae	7	1.9	1
Cynoglossidae	6	0.6	3
Macrorhamphosidae	6	0.1	1
Merluccidae	6	0.2	1
Ophichthidae	6	1.0	4
Gobiidae	4	0.2	2
Priacanthidae	3	0.3	2
Carangidae	2	0.2	1
Pomacentridae	2	0.1	1
Antennariidae	1	0.1	1
Blennidae	1	0.1	1
Dactylopteridae	1	0.1	1
Gobiesocidae	1	0.1	1
Moridae	1	0.1	1
Muraenesocidae	1	0.1	1
Syngnathidae	1	0.1	1
GRAND TOTAL	17599	1332.3	157

*The family Percichthyidae is an assemblage of unrelated groups. Although Synagrops bella is probably not referable to this family, it is herein placed in this group until a published revision of this assemblage is available (G. D. Johnson, personal communication).

Table 9. Ranking by total number and total weight for demersal bony fishes (elasmobranchs, pelagic species and squid excluded) for 75 trawls made during the R/V Dolphin November, 1973 groundfish survey in the South Atlantic Bight.

Species	Total Number	Percent of Total Catch	Cumulative Percent	Number of Occurrences
Stenotomus aculeatus	7969	45.3		24
Urophycis regius	1544	8.8	54.1	14
Haemulon aurolineatum	1236	7.0	61.1	10
Stephanolepis hispidus	731	4.1	65.2	39
Synodus foetens	642	3.7	68.9	49
Synodus poeyi	585	3.3	72.2	21
Rhomboplites aurorubens	395	2.2	74.4	11
Diplectrum formosum	354	2.0	76.4	37
Syacium papillosum	304	1.7	78.1	27
Micropogonias undulatus	303	1.7	79.8	11

Species	Total Weight	Percent of Total Catch	Cumulative Percent	Number of Occurrences
Stenotomus aculeatus	540.111	40.6		24
Rachcentron canadum	117.937	8.9	49.5	5
Aluterus schoepfi	114.410	8.6	58.1	26
Urophycis regius	62.121	4.7	62.8	14
Haemulon aurolineatum	59.922	4.5	67.3	10
Synodus foetens	54.982	4.1	71.4	49
Stephanolepis hispidus	32.540	2.4	73.8	39
Micropogonias undulatus	27.716	2.1	75.9	11
Diplectrum formosum	27.357	2.1	78.0	37
Centropristis striata	26.456	2.0	80.0	14

Table 10. Ten most numerically abundant demersal bony fish species by depth zone for R/V Dolphin fall 1973 groundfish survey in the South Atlantic Bight. N_1 = number of occurrences; N = total trawls in depth zone.

Depth zone (m)	Species	Total Number	Percent of Total in Depth Zone	N_1/N
9-18	Stenotomus aculeatus	3349	66.5	6/16
	Synodus foetens	291	5.8	16/16
	Micropogonias undulatus	236	4.7	6/16
	Leiostomus xanthurus	179	3.6	4/16
	Stephanolepis hispidus	91	1.8	9/16
	Ophidion holbrooki	79	1.6	5/16
	Arius felis	77	1.5	3/16
	Aluterus schoepfi	76	1.5	7/16
	Prionotus scitulus	62	1.2	8/16
	Diplectrum formosum	55	1.1	9/16
19-27	Stenotomus aculeatus	4391	57.3	13/15
	Haemulon aurolineatum	1184	15.5	6/15
	Stephanolepis hispidus	381	5.0	14/15
	Rhomboplites aurorubens	375	4.9	7/15
	Diplectrum formosum	211	2.8	15/15
	Synodus foetens	199	2.6	14/15
	Centropristis striata	105	1.4	7/15
	Ophidion holbrooki	105	1.4	8/15
	Ophidion beani	78	1.0	10/15
	Centropristis ocyurus	58	0.8	6/15
28-55	Stephanolepis hispidus	243	29.6	10/15
	Synodus foetens	107	13.1	13/15
	Diplectrum formosum	86	10.5	12/15
	Synodus poeyi	75	9.1	6/15
	Prionotus carolinus	64	7.8	5/15
	Haemulon aurolineatum	51	6.2	3/15
	Aluterus schoepfi	29	3.5	8/15
	Ophidion beani	22	2.7	4/15
	Trachinocephalus myops	21	2.6	9/15
	Syacium papillosum	19	2.3	6/15

Table 10 (continued)

Depth zone (m)	Species	Total Number	Percent of Total in Depth Zone	N_1/N
56-110	Synodus poeyi	329	26.1	11/12
	Syacium papillosum	240	19.0	10/12
	Serranus phoebe	133	10.6	7/12
	Prionotus carolinus	74	5.9	3/12
	Pagrus pagrus	59	4.7	1/12
	Synodus foetens	45	3.6	6/12
	Trachinocephalus mylops	41	3.2	7/12
	Centropristis ocyurus	27	2.1	5/12
	Micropogonias undulatus	25	2.0	1/12
	Porichthys porosissimus	22	1.7	5/12
111-183	Urophycis regius	1049	48.9	8/10
	Stenotomus aculeatus	215	10.0	1/10
	Citharichthys arctifrons	188	8.8	5/10
	Synodus poeyi	171	8.0	1/10
	Saurida brasiliensis	157	7.3	2/10
	Glassanodon pygmaeus	87	4.0	6/10
	Synagrops bella	61	2.8	8/10
	Porichthys porosissimus	22	1.0	1/10
	Pontius longispinus	20	0.9	2/10
	Halieutichthys aculeatus	17	0.8	2/10
184-366	Urophycis regius	493	72.7	5/7
	Chlorophthalmus agassizi	49	7.2	4/7
	Synagrops bella	47	6.9	5/7
	Citharichthys arctifrons	36	5.3	2/7
	Prionotus alatus	32	4.7	1/7
	Parahollardia lineata	11	1.6	1/7
	Helicolenus dactylopterus	3	0.4	1/7
	Mystriophis punctifer	1	0.2	1/7
	Trachyscorpia cristulata	1	0.2	1/7

Table 11. Ten most important demersal bony fish species by weight for each depth zone for R/V Dolphin fall 1973 groundfish survey in the South Atlantic Bight. N_1 = number of occurrences; N = total trawls in area.

Depth zone (m)	Species	Total Weight(kg)	Percent of Total in Depth Zone	N_1/N
9-18	Stenotomus aculeatus	229.864	43.5	6/16
	Rachycentron canadum	103.875	19.7	3/16
	Aluterus schoepfi	56.347	10.7	7/16
	Synodus foetens	24.241	4.6	16/16
	Leiostomus xanthurus	21.066	4.0	4/16
	Micropogonias undulatus	16.729	3.2	6/16
	Calamus leucosteus	12.801	2.4	2/16
	Arius felis	10.079	1.9	3/16
	Centropristis striata	6.751	1.3	7/16
	Stephanolepis hispidus	6.243	1.2	9/16
19-27	Stenotomus aculeatus	304.047	53.6	13/15
	Haemulon aurolineatum	58.361	10.3	6/15
	Aluterus schoepfi	30.846	5.4	11/15
	Rhomboplites aurorubens	22.626	4.0	7/15
	Stephanolepis hispidus	22.021	3.9	14/15
	Centropristis striata	19.705	3.5	7/15
	Synodus foetens	16.631	2.9	14/15
	Diplectrum formosum	15.469	2.7	15/15
	Calamus leucosteus	7.711	1.4	3/15
	Micropogonias undulatus	6.804	1.2	2/15
28-55	Aluterus schoepfi	27.217	32.7	8/15
	Rachycentron canadum	10.433	12.5	1/15
	Diplectrum formosum	9.273	11.1	12/15
	Synodus foetens	9.019	10.8	13/15
	Prionotus carolinus	4.836	5.8	5/15
	Stephanolepis hispidus	3.676	4.4	10/15
	Aluterus monoceros	3.275	3.9	2/15
	Syacium papillosum	2.668	3.2	6/15
	Trachinocephalus myops	1.608	1.9	9/15
	Haemulon aurolineatum	1.461	1.8	3/15

Table 11 (continued)

Depth zone (m)	Species	Total Weight (kg)	Percent of Total in Depth Zone	N_1/N
56-110	Syacium papillosum	13.090	22.5	10/12
	Prionotus carolinus	6.550	10.6	3/12
	Synodus foetens	5.091	8.2	6/12
	Pagrus pagrus	4.082	6.6	1/12
	Serranus phoebe	3.675	5.9	7/12
	Micropogonias undulatus	3.629	5.9	1/12
	Calamus leucosteus	3.175	5.1	1/12
	Trachinocephalus myops	2.668	4.3	7/12
	Rhomboplites aurorubens	1.915	3.1	3/12
	Synodus poeyi	1.808	2.9	11/12
111-183	Urophycis regius	38.876	61.9	8/10
	Stenotomus aculeatus	5.448	8.7	1/10
	Antigonia capros	4.536	7.2	1/10
	Sphoeroides pachygaster	2.268	3.6	2/10
	Neomerinthe hemingwayi	1.461	2.3	2/10
	Synodus poeyi	1.361	2.2	1/10
	Porichthys porosissimus	1.007	1.6	2/10
	Synagrops bella	0.800	1.3	8/10
	Glassanodon pygmaeus	0.600	1.0	6/10
	Saurida brasiliensis	0.554	0.9	2/10
184-366	Urophycis regius	23.145	86.2	5/7
	Prionotus alatus	1.361	5.1	1/7
	Synagrops bella	0.854	3.2	5/7
	Chlorophthalmus agassizi	0.400	1.5	4/7
	Citharichthys arctifrons	0.200	0.7	2/7
	Helicolenus dactylopterus	0.200	0.7	2/7
	Mystriophis punctifer	0.100	0.4	1/7
	Parahollardia lineata	0.100	0.4	1/7
	Trachyscorpia cristulata	0.100	0.4	1/7

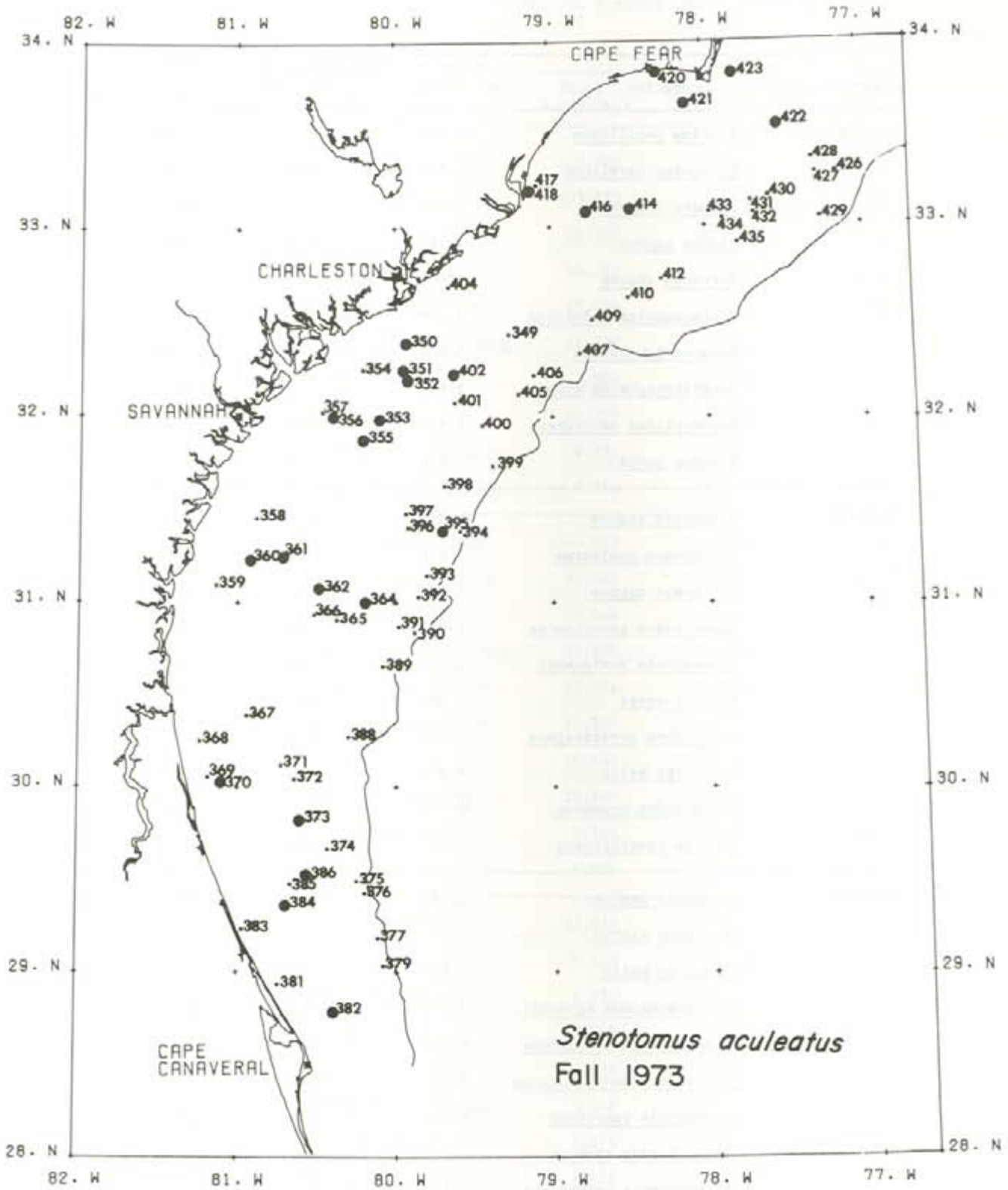

FIGURE 4. DISTRIBUTION OF SOUTHERN PORGY, STENOTOMUS ACULEATUS, IN THE SOUTH ATLANTIC BIGHT DURING FALL 1973. LARGE DOTS = SPECIES; SMALL DOTS = SPECIES ABSENT.

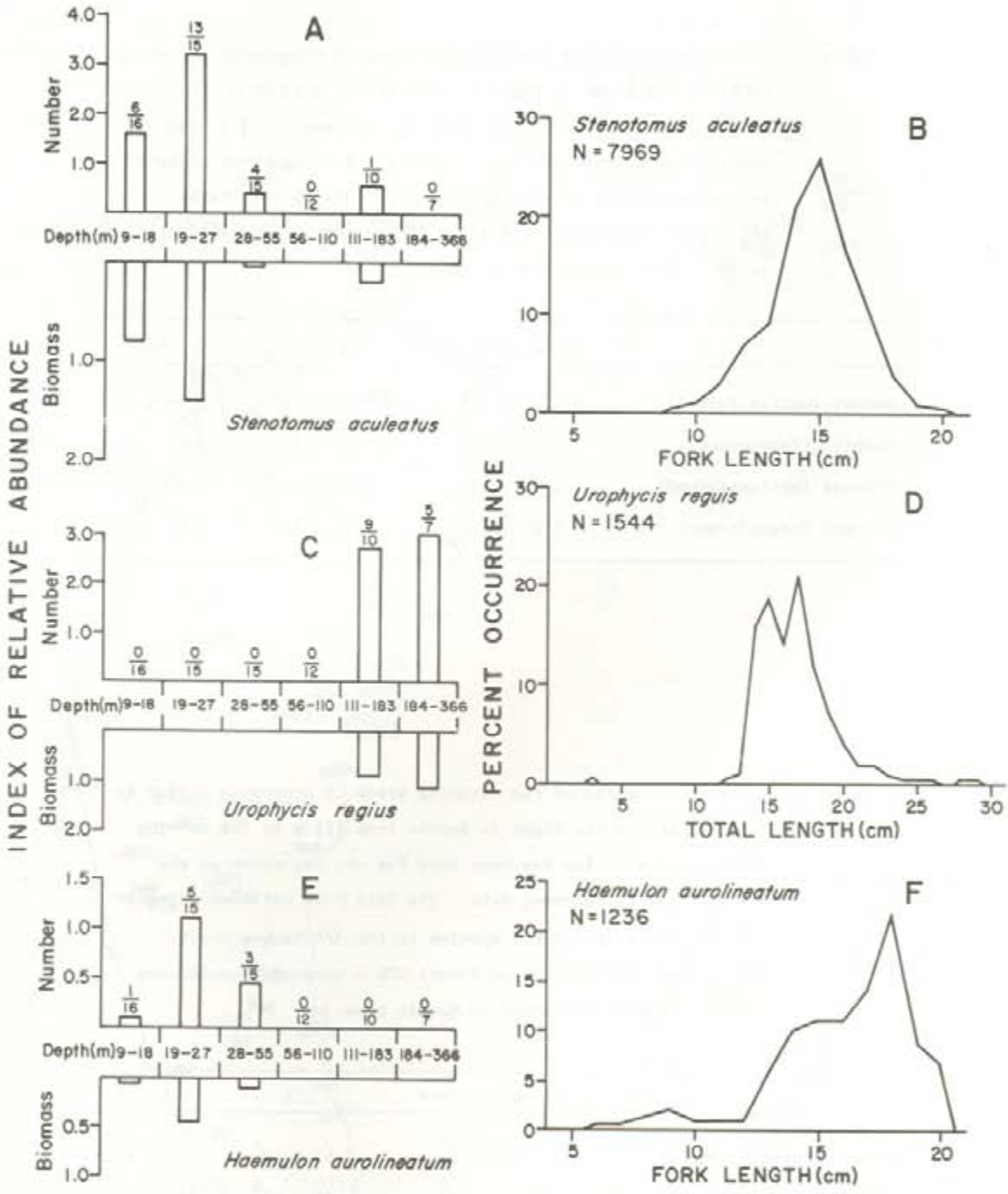

FIGURE 5. INDEX OF RELATIVE ABUNDANCE OF (A) STENOTOMUS ACULEATUS, (C) UROPHYCIS REGIUS AND (E) HAEMULON AUROLINEATUM BY DEPTH ZONE FOR THE FALL 1973 GROUNDFISH SURVEY IN THE SOUTH ATLANTIC BIGHT. NUMERATOR IN FRACTION = NUMBER OF TRAWLS IN DEPTH ZONE WITH SPECIES; DENOMINATOR = TOTAL TRAWLS IN ZONE. LENGTH FREQUENCY DISTRIBUTION OF (B) STENOTOMUS ACULEATUS, (D) UROPHYCIS REGIUS AND (F) HAEMULON AUROLINEATUM.

Table 12. Minimum estimates of the standing stock of Stenotomus aculeatus in the South Atlantic Bight in depths from 9 to 55 m. The Bliss approximation has been used for the estimates on the natural log transformed data. The data have not been adjusted for vulnerability of the species to the 3/4 Yankee trawl. LCL = lower 90% confidence limit; UCL = upper 90% confidence limit. Biomass expressed in metric tons.

	Standing Stock	LCL	UCL
number (untransformed)	3.00×10^8	0.39×10^8	5.62×10^8
number (transformed)	1.46×10^8	0.81×10^8	2.63×10^8
biomass (untransformed)	2.07×10^4	0.24×10^4	3.90×10^4
biomass (transformed)	0.80×10^4	0.52×10^4	1.21×10^4

Table 13. Minimum estimates of the standing stock of Urophycis regius in the South Atlantic Bight in depths from 111 m to 366 m. The Bliss approximation has been used for the estimates on the natural log transformed data. The data have not been adjusted for vulnerability of the species to the 3/4 Yankee trawl. LCL = lower 90% confidence limit; UCL = upper 90% confidence limit. Biomass expressed in metric tons.

	Standing Stock	LCL	UCL
number (untransformed)	4.27×10^7	0.67×10^7	7.86×10^7
number (transformed)	1.13×10^8	0.34×10^8	37.30×10^8
biomass (untransformed)	1.72×10^3	0.36×10^3	3.08×10^3
biomass (transformed)	2.17×10^3	1.27×10^3	3.70×10^3

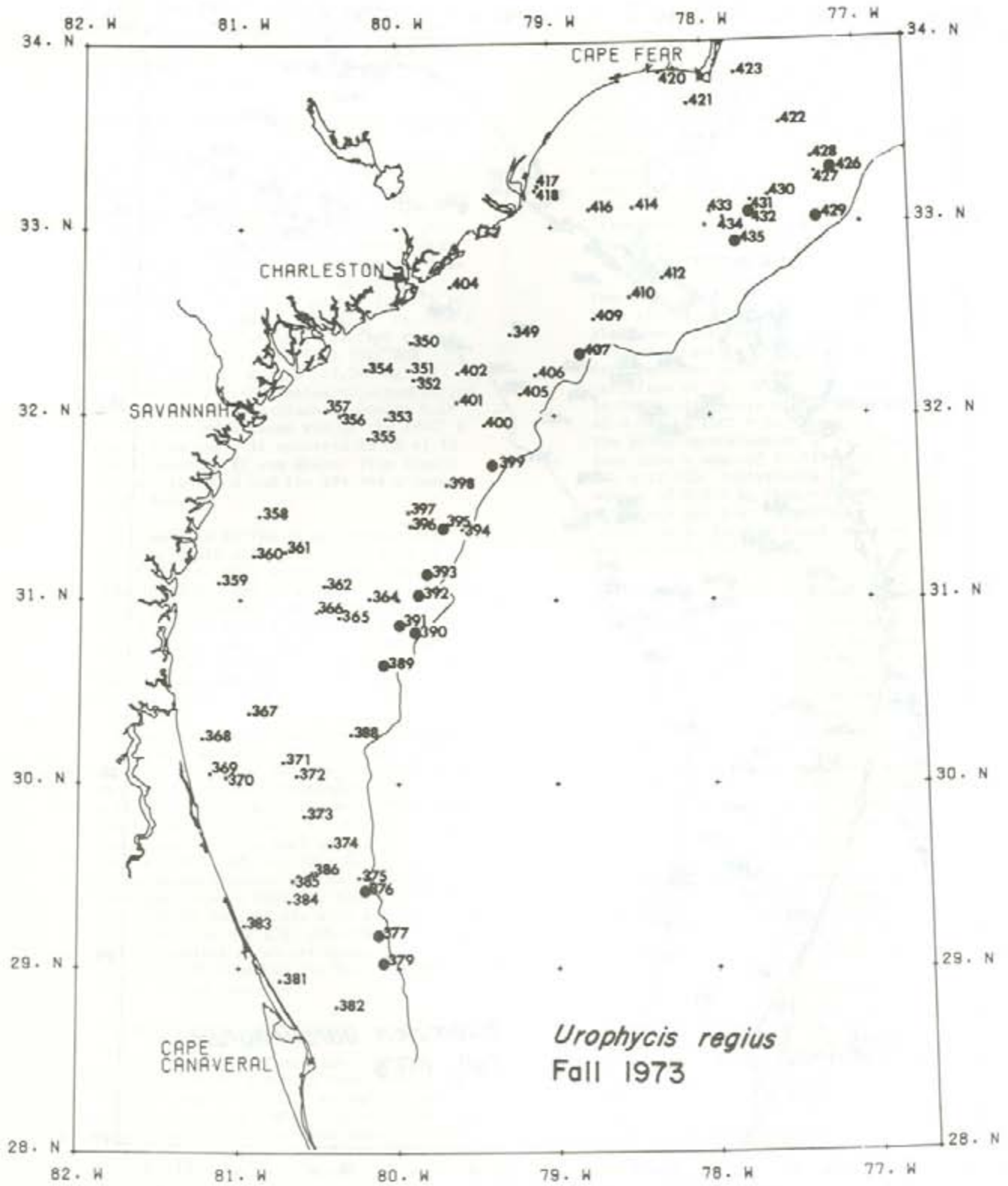

FIGURE 6. DISTRIBUTION OF SPOTTED HAKE, UROPHYCIS REGIUS, IN THE SOUTH ATLANTIC BIGHT DURING FALL 1973. LARGE DOTS = SPECIES PRESENT; SMALL DOTS = SPECIES ABSENT.

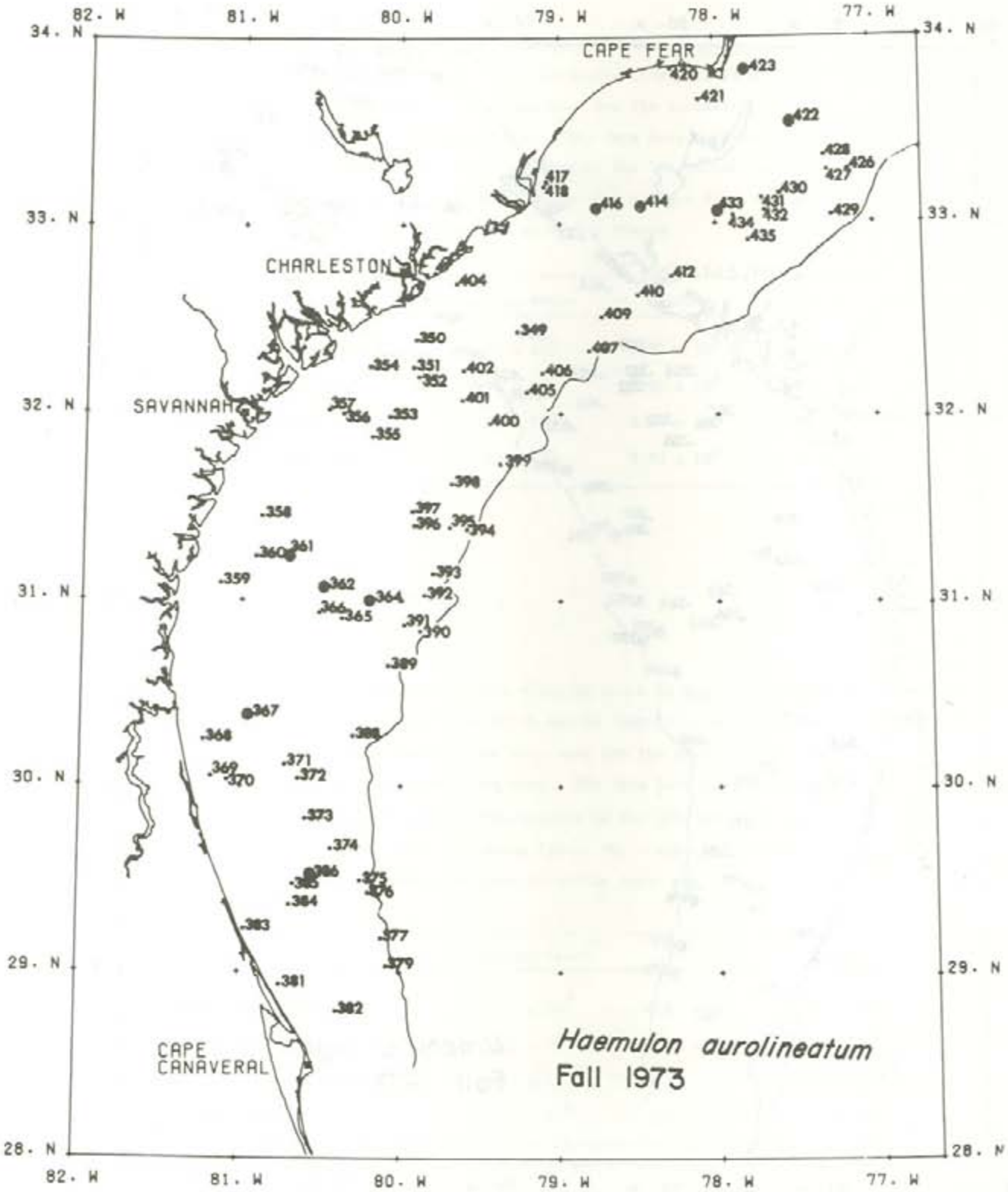

FIGURE 7. DISTRIBUTION OF TOMTATE, HAEMULON AUROLINEATUM, IN THE SOUTH ATLANTIC BIGHT DURING FALL 1973. LARGE DOTS = SPECIES PRESENT ; SMALL DOTS = SPECIES ABSENT.

total weight of tomtate were taken in two trawls in the 19-27 m depth zone. Because of these catches, the index of abundance for this species was highest in the 19-27 m depth zone where it was caught in 6 of 15 trawls (Fig. 5E). Haemulon aurolineatum were found in only 24% of the trawls made in its depth range. The mean size for this species was 16 cm FL with a range from 6 to 20 cm FL (Fig. 5F).

Planehead filefish: Stephanolepis hispidus

One of the most widely distributed fishes encountered during the fall sand bottom groundfish survey was the planehead filefish, Stephanolepis hispidus, which was collected throughout the survey area in the four shallower depth zones. This species was found from north of Cape Fear (~ 33.8°N) to the region near Cape Canaveral (~ 28.8°N) in depths from 14 to 86 m and temperatures from 17.1° to 25.6°C (Fig. 8). The planehead filefish ranked fourth in total number (n = 731) and seventh in total weight (32.540 kg) of demersal bony fish species collected during this survey. Its maximum abundance both in numbers and biomass was in the 19-27 m depth zone where it occurred in 14 of 15 trawls whereas it was absent from trawls in the 111-183 m and the 184-366 m zones (Fig. 9A).

Analysis of the length frequencies in the four depth zones failed to show any trend of size with depth. The frequency distribution seems to indicate 4 or 5 modes (Fig. 9B), however, until aging is done on this species, little more can be said of the distribution. The smallest individuals collected were 2 cm TL whereas the largest specimen was 25 cm TL. The overall mean size was 11 cm TL.

Catches for estimates of the stratified mean values per tow were analyzed for the four shallower depth zones where this species was found. Examination of the untransformed data gave a stratified mean catch/tow of 14.3 (LCL = 7.9; UCL = 20.8) individuals with a mean weight of 0.593 (LCL = 0.055, UCL = 1.131) kg per tow. Bliss approximations of the transformed data gave a mean value of 13.0 (LCL = 9.0; UCL = 18.4) individuals with a mean weight of 0.410 (LCL = 0.270; UCL = 0.566) kg per tow. Standing stock estimates for planehead filefish in the South Atlantic Bight are in Table 14.

Inshore lizardfish: Synodus foetens

The inshore lizardfish, Synodus foetens, ranked fifth by total number (n = 642) and sixth by total weight (54.982 kg) of demersal bony fishes caught in the sand bottom habitat during this survey. This widely occurring species was taken in trawls from Cape Fear, North Carolina (~ 34°N) to Cape Canaveral, Florida (~ 28.5°N) (Fig. 10) in temperatures from 16.4° to 26.2°C. Synodus foetens had its maximum abundance, both in numbers and weight, in the 9-18 m depth zone where it was found in all 16 trawls. The index of abundance decreased with increasing depth (Fig. 9C). This species was represented by only a single capture of 5 individuals at 112 m in the two deepest zones.

Analysis of the fork lengths of S. foetens from the fall survey failed to show any trends for different size lizardfish to inhabit different depth strata. Length frequency distribution (Fig. 9D) seemed to indicate 4 or 5 different modal size groups that may represent year classes. This interpretation, however, is tentative until this species is subjected to age and growth analysis. Inshore lizardfish ranged from 4 to 38 cm FL with an overall mean of 19 cm FL.

Since this species is of minor importance and occurs rarely in depths greater than 110 m, only trawls made in the four shallower zones will be considered in the following catch statistics. Analysis of untransformed data gave a stratified mean catch/tow of 11.759 (LCL = 8.958; UCL = 14.560) individuals with a mean weight/tow of 0.993 kg (LCL = 0.743; UCL = 1.243 kg). The Bliss approximation of the transformed data gave a mean of 13.354 (LCL = 10.097; UCL = 17.565) individuals/tow with a mean weight of 0.977 kg (LCL = 0.778; UCL = 1.198 kg) per tow. Standing stock estimates for S. foetens based on these data are in Table 15.

Offshore lizardfish: Synodus poeyi

Synodus poeyi was collected from south of Cape Fear (~ 33°N) to Cape Canaveral, Florida (~ 28.8°N) (Fig. 11) in depths from 20 to 136 m and temperatures from 18.5° to 25.5°C. Offshore lizardfish ranked sixth in total number (n = 585) and 29th in total weight (4.069 kg) of demersal bony fishes during the fall 1973 survey. This species was most abundant in the 56-110 m depth zone where it occurred in 9 of 10 trawls. It was absent both in the shallowest (9-18 m) and the deepest (184-366 m) zone (Fig. 9E).

Length frequency distribution of S. poeyi showed no size differences between strata. The average size for trawl caught S. poeyi was 8 cm FL with a range from 3 to 15 cm FL (Fig. 9F).

Analysis of untransformed trawl data from the four midshelf strata showed S. poeyi to have a stratified mean catch/tow of 6.7 (LCL = 1.8; UCL = 11.7) individuals with a mean weight of 0.019 kg (LCL = 0.019; UCL = 0.052 kg) per tow. The Bliss approximation of the transformed data gave a mean of 4.0 (LCL = 2.7; UCL = 5.7) individuals per tow with a weight of 0.051 (LCL = 0.027; UCL = 0.074) kg/tow. Estimated values of the standing stock of S. poeyi in the four midshelf depth zones of the South Atlantic Bight are in Table 16.

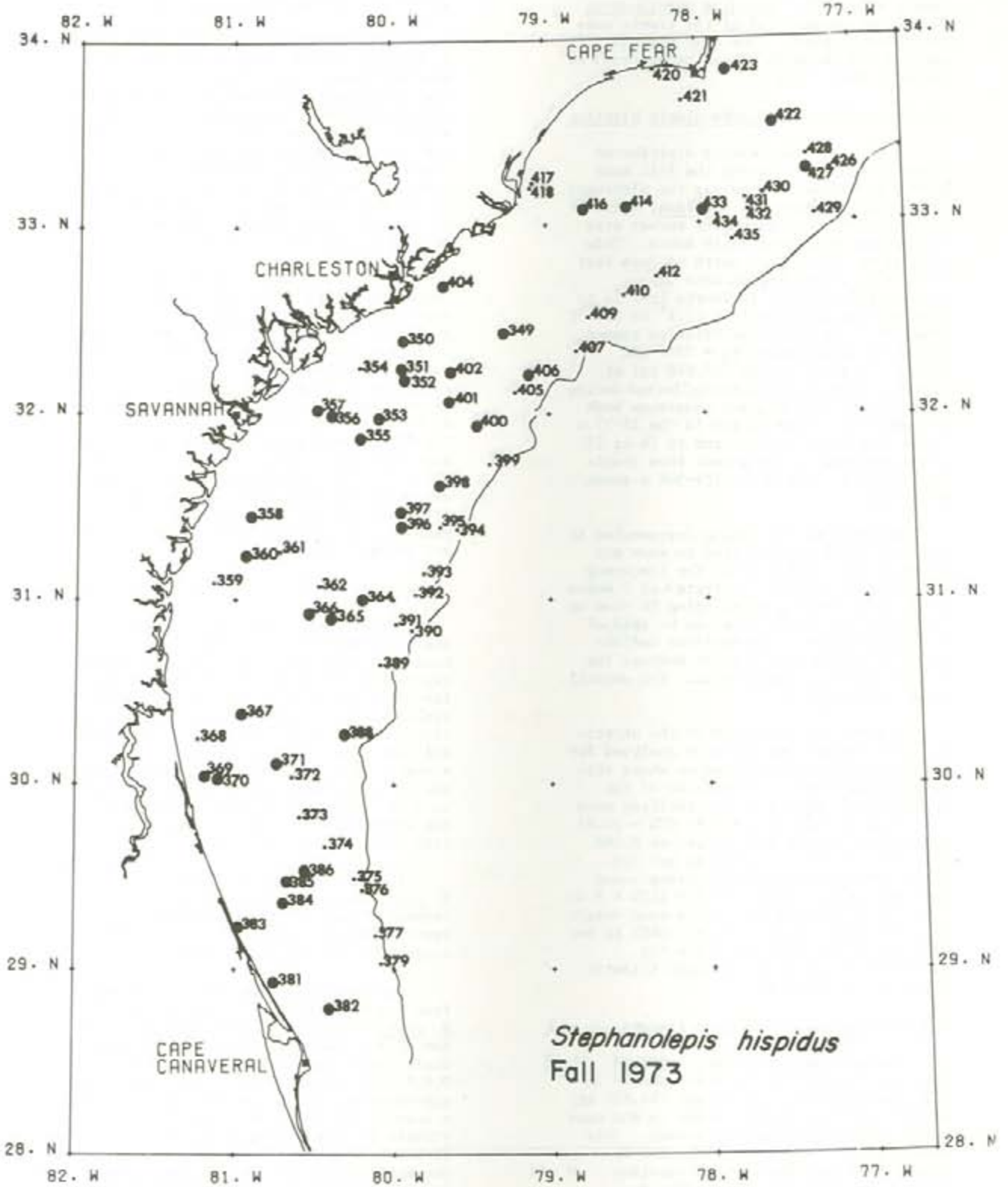

FIGURE 8. DISTRIBUTION OF PLANEHEAD FILEFISH, STEPHANOLEPIS HISPIDUS, IN THE SOUTH ATLANTIC BIGHT DURING FALL 1973. LARGE DOTS = SPECIES PRESENT; SMALL DOTS = SPECIES ABSENT.

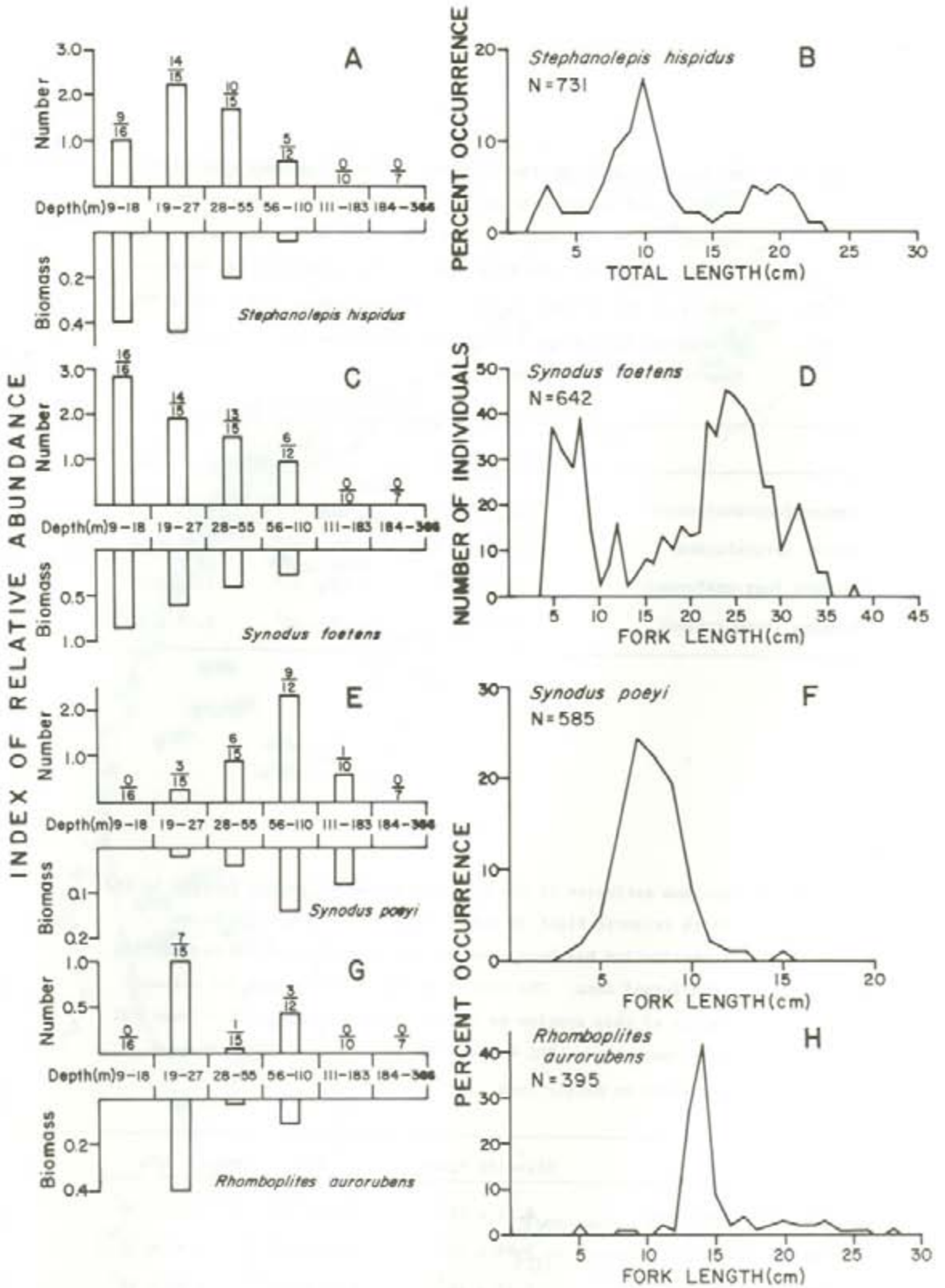

FIGURE 9. INDEX OF RELATIVE ABUNDANCE OF (A) STEPHANOLEPIS HISPIDUS, (C) SYNODUS FOETENS, (E) SYNODUS POEYI AND (F) RHOMBOPLITES AURORUBENS FOR THE FALL 1973 GROUNDFISH SURVEY IN THE SOUTH ATLANTIC BIGHT. NUMERATOR IN FRACTION = NUMBER OF TRAWLS IN DEPTH ZONE WITH SPECIES; DENOMINATOR = TOTAL TRAWLS IN ZONE. LENGTH FREQUENCY DISTRIBUTION OF (B) STEPHANOLEPIS HISPIDUS, (D) SYNODUS FOETENS, (F) SYNODUS POEYI AND (H) RHOMBOPLITES AURORUBENS.

Table 14. Minimum estimates of the standing stock of Stephanolepis hispidus in the South Atlantic Bight in depths from 9 to 110 m. The Bliss approximation has been used for the estimates on the natural log transformed data. The data have not been adjusted for vulnerability of the species to the 3/4 Yankee trawl. LCL = lower 90% confidence limit; UCL = upper 90% confidence limit. Biomass expressed in metric tons.

	Standing Stock	LCL	UCL
number (untransformed)	3.10×10^7	1.70×10^7	4.50×10^7
number (transformed)	2.80×10^7	1.96×10^7	3.99×10^7
biomass (untransformed)	1.28×10^3	0.12×10^3	2.45×10^3
biomass (transformed)	0.89×10^3	0.58×10^3	1.22×10^3

Table 15. Minimum estimates of the standing stock of Synodus foetens in the South Atlantic Bight in depths from 9 to 110 m. The Bliss approximation has been used for the estimates on the natural log transformed data. The data have not been adjusted for vulnerability of this species to the 3/4 Yankee trawl. LCL = lower 90% confidence limit; UCL = upper 90% confidence limit. Biomass expressed in metric tons.

	Standing Stock	LCL	UCL
number (untransformed)	2.54×10^7	1.94×10^7	3.15×10^7
number (transformed)	2.89×10^7	2.18×10^7	3.80×10^7
biomass (untransformed)	2.15×10^3	1.61×10^3	2.69×10^3
biomass (transformed)	2.11×10^3	1.68×10^3	2.59×10^3

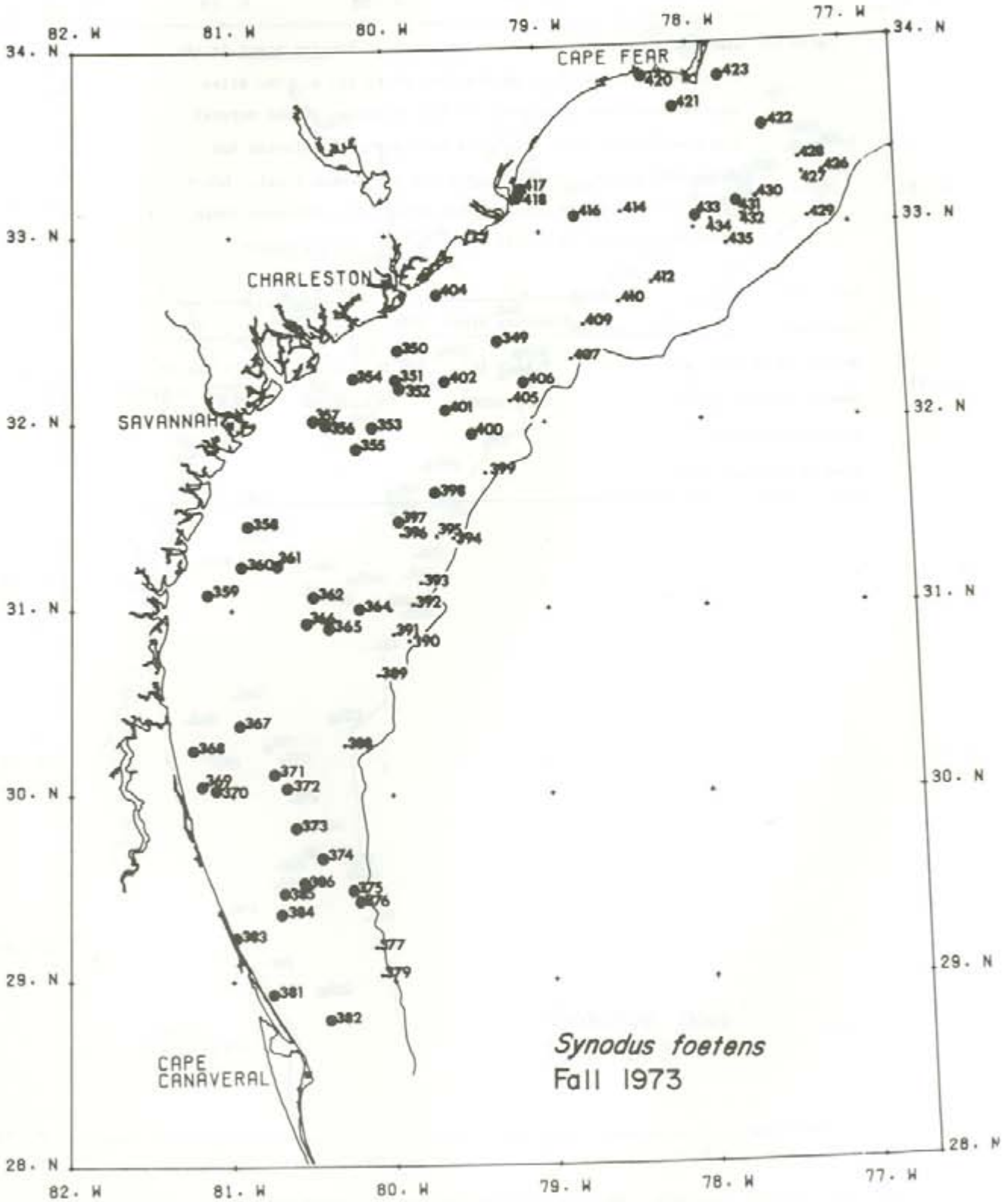

FIGURE 10. DISTRIBUTION OF INSHORE LIZARDFISH, SYNODUS FOETENS, IN THE SOUTH ATLANTIC BIGHT DURING FALL 1973. LARGE DOTS = SPECIES PRESENT; SMALL DOTS = SPECIES ABSENT.

Table 16. Minimum estimate of the standing stock of Synodus poeyi in the South Atlantic Bight in depths from 19 to 183 m. The Bliss approximation has been used for the estimates of the natural log transformed data. The data have not been adjusted for vulnerability of this species to the 3/4 Yankee trawl. LCL = lower 90% confidence limit; UCL = upper 90% confidence limit. Biomass expressed in metric tons.

	Standing Stock	LCL	UCL
number (untransformed)	1.11×10^7	0.29×10^7	19.3×10^7
number (transformed)	0.66×10^7	0.44×10^7	9.45×10^7
biomass (untransformed)	85	33	138
biomass (transformed)	84	45	122

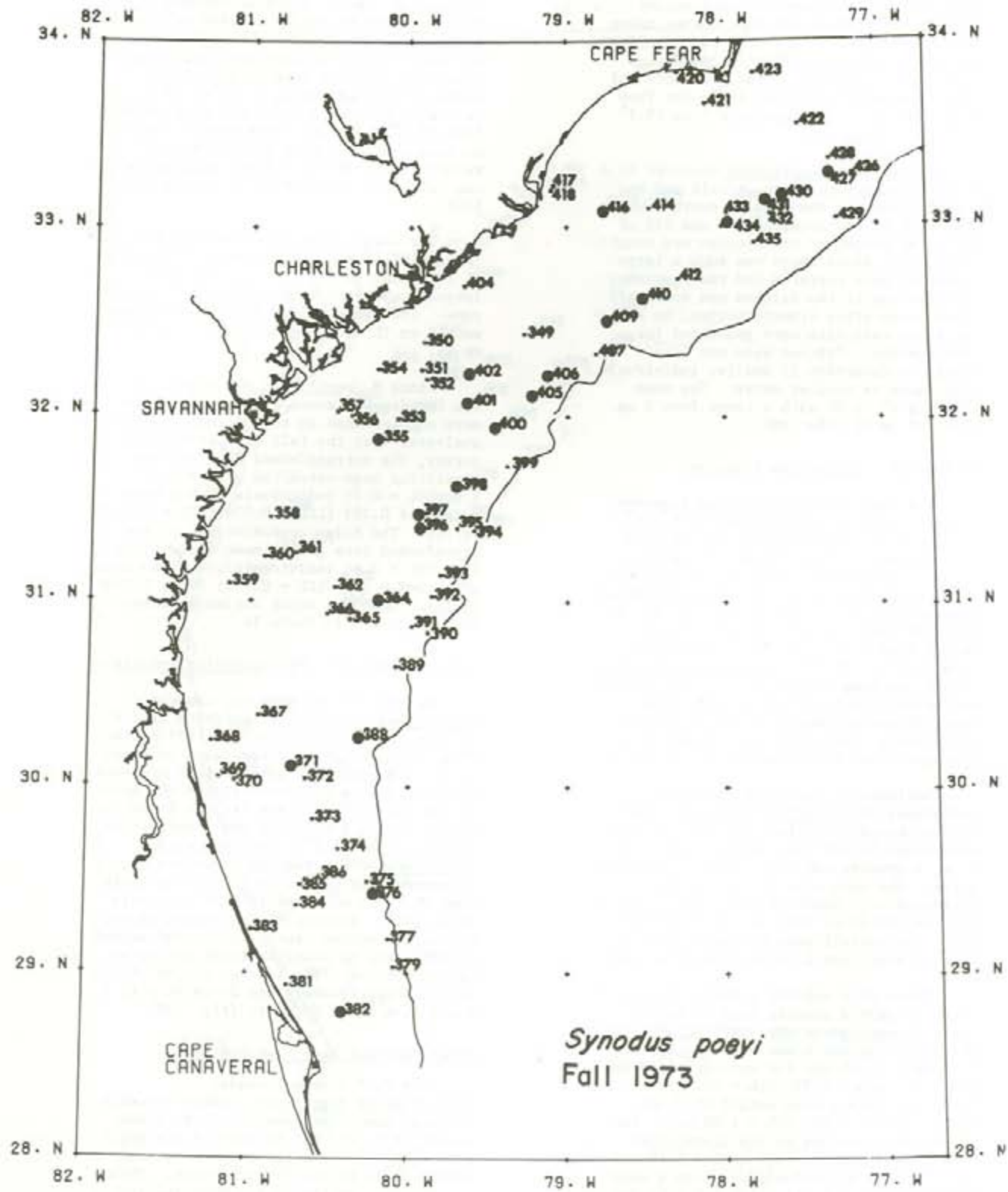

FIGURE 11. DISTRIBUTION OF OFFSHORE LIZARDFISH, SYNODUS POEYI, IN THE SOUTH ATLANTIC BIGHT DURING FALL 1973. LARGE DOTS = SPECIES PRESENT; SMALL DOTS = SPECIES ABSENT.

Vermilion snapper: Rhomboplites aurorubens

The vermilion snapper, Rhomboplites aurorubens, ranked seventh by total number (n = 395) and eleventh by total weight (24.641 kg) of demersal bony fishes taken in the sand bottom habitat. The species was widely distributed being found from Cape Fear (~ 33.5°N) to the area north of Cape Canaveral (~ 29.5°N) in depths from 20 m to 86 m and temperatures from 19.7° to 25.7°C (Fig. 12).

Rhomboplites aurorubens occurred in a greater percentage of the trawls and was most abundant in the 19-27 m depth zone where 95% of the total number and 92% of the total weight of the species was caught (Fig. 9G). Since there was such a large number of zero captures and the frequency distribution of the catches was so highly skewed even after transformation, no standing stock estimates were generated for this species. Catches were not large enough to determine if smaller individuals were found in shoaler water. The mean size was 15 cm FL with a range from 5 cm FL to 28 cm FL (Fig. 9H).

Sand perch: Diplectrum formosum

The sand perch, Diplectrum formosum, ranked eighth in total number (n = 354) and ninth in weight (27.357 kg) of sand bottom demersal bony fishes during this survey. This species had a wide latitudinal distribution (Fig. 13) being collected from south of Cape Fear (~ 33.5°N) to the area off Cape Canaveral (~ 28.8°N) in depths from 9 to 58 m and temperatures from 19.7° to 25.2°C. Diplectrum formosum had its maximum abundance, both in numbers and weight, in the 19-27 m depth zone where it was collected in all 15 trawls (Fig. 14A). Sand perch were found in only a single trawl in depths greater than 55 m.

Analysis of the length frequency distributions of Diplectrum formosum showed that although juveniles less than 10 cm FL were found in all three strata from 9 to 55 m, a greater number occurred in shoaler water. The mean size of sand perch increased with depth (9-18 m: $\bar{X} \pm (S_{\bar{X}} \cdot t.05)$ = 12±2 cm; 19-27 m: 15±1 cm; 28-55 m: 19±1 cm). The overall mean size was 16 cm FL with a range from 2 to 24 cm FL (Fig. 14B).

Since this species occurred in only 1 trawl in depths greater than 55 m, the three deepest zones were not included in the following catch analysis. The stratified mean catch/tow for untransformed data was 7.37 (LCL = 4.55; UCL = 10.19) individuals/tow with a mean weight of 0.588 kg/tow (LCL = 1.25; UCL = 1.80 kg). The Bliss approximation of the transformed data gave a mean of 7.56 (LCL = 5.49; UCL = 10.29) individuals/tow with a mean weight of 0.563 kg/tow (LCL = 0.416; UCL = 0.726 kg). The standing stock of Diplectrum formosum based on these data for the South Atlantic Bight are in Table 17.

Dusky flounder: Syacium papillosum

Syacium papillosum was a widely occurring species during the fall 1973 groundfish cruise. It ranked ninth by numbers (n = 304) and 14th by weight (19.492 kg) in the demersal bony fishes of the sand bottom habitat. Dusky flounder were collected from south of Cape Fear (~ 33.3°N) to north of Cape Canaveral (~ 29°N) (Fig. 15) in depths from 12 to 110 m and temperatures from 18.5° to 26.2°C. This species had its maximum abundance both in numbers and weight in the 56-110 m depth zone where it was collected in eight of 10 trawls (Fig. 14C).

The length frequency distribution (Fig. 14D) showed the presence of 3 to 8 cm TL juveniles in the fall. These were largely collected in the 56 to 110 m depth zone. The average size for all specimens was 18 cm TL with a range from 3 to 30 cm TL.

Since S. papillosum was absent from the two deepest zones (111-366 m), these were not included in the following catch analysis. For the fall 1973 groundfish survey, the untransformed data yielded a stratified mean catch/tow of 2.8 (LCL = 0.9; UCL = 4.7) individuals with a mean weight of 0.203 (LCL = 0.078; UCL = 0.328) kg/tow. The Bliss approximation of the transformed data gave a mean of 1.9 (LCL = 1.4; UCL = 2.6) individuals/tow with a mean weight of 0.186 (LCL = 0.113; UCL = 0.264) kg/tow. Standing stock estimates based on these data are in Table 18.

Atlantic croaker: Micropogonias undulatus

A total of 303 Atlantic croaker, Micropogonias undulatus, weighing 27.716 kg were taken during the fall 1973 cruise (Fig. 16). Croaker ranked tenth in total number and eighth in total weight of demersal bony fishes collected during the sand bottom survey. This species was found in depths from 9 m to 110 m and temperatures from 16.5° to 25.5°C. Micropogonias undulatus had its maximum abundance both in numbers and weight in the 9-18 m depth zone where it occurred in 6 of 16 trawls (Fig. 14E). Because of the skewed distribution of catches caused by the infrequent occurrences, no standing stock estimates were generated. The average length of the trawl caught croakers was 21 cm TL with a range from 18 to 29 cm TL (Fig. 14F).

Other Demersal Bony Fish Species

The Gulf Stream flounder, Citharichthys arctifrons, ranked eleventh in total number of demersal bony fishes caught (n = 225) but because of its small size ($\bar{X}$TL(cm): 5, range 2-11) it contributed little to the total biomass. This species was limited in its distribution to the 111-183 m and the 184-366 m depth zones where it occurred in 6 of 10 and 2 of 7 trawls respectively. The depth range was 112 to 285 m. Colvocoresses and Musick

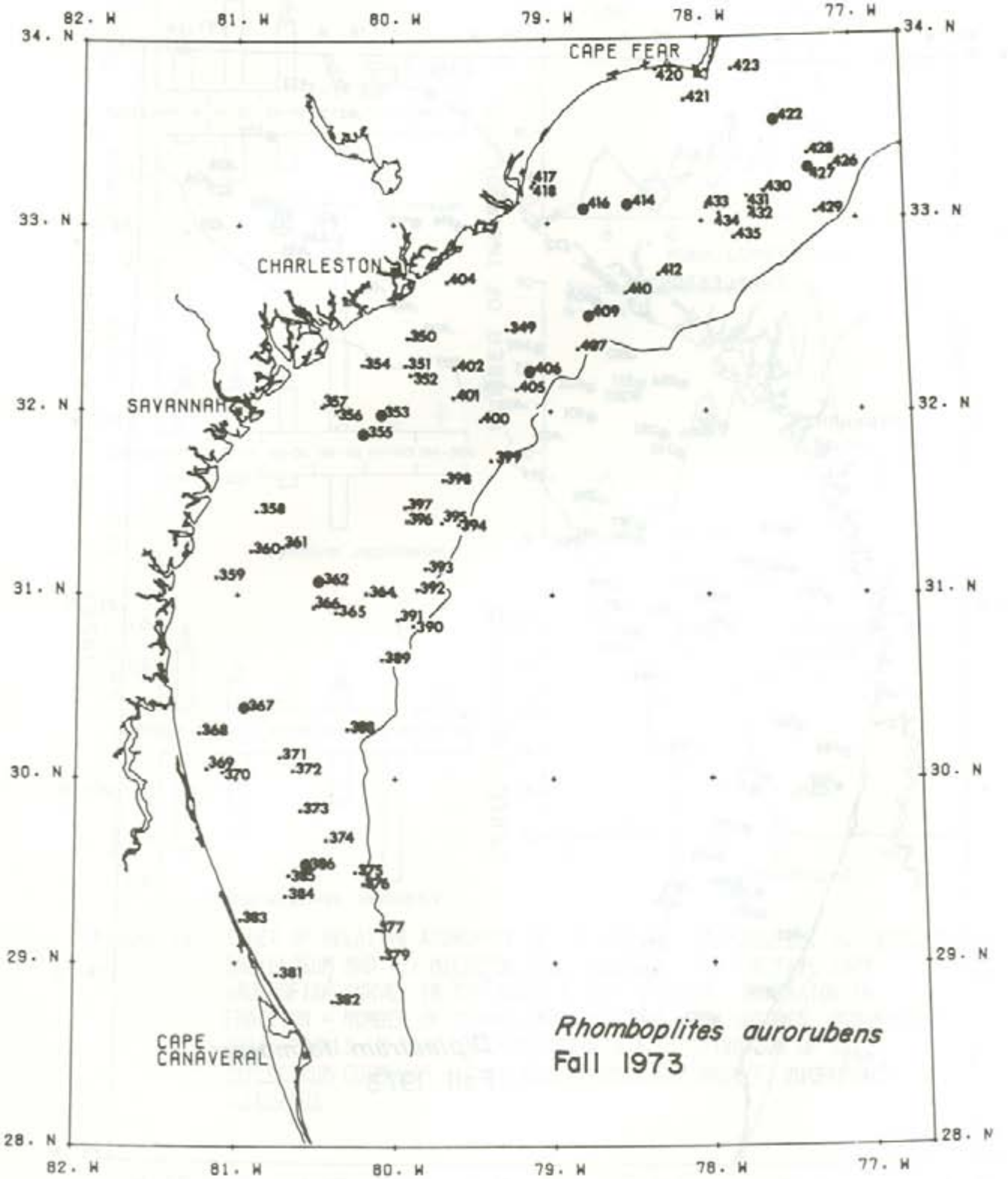

FIGURE 12. DISTRIBUTION OF VERMILION SNAPPER, RHOMBOPLITES AURORUBENS, IN THE SOUTH ATLANTIC BIGHT DURING FALL 1973. LARGE DOTS = SPECIES PRESENT; SMALL DOTS = SPECIES ABSENT.

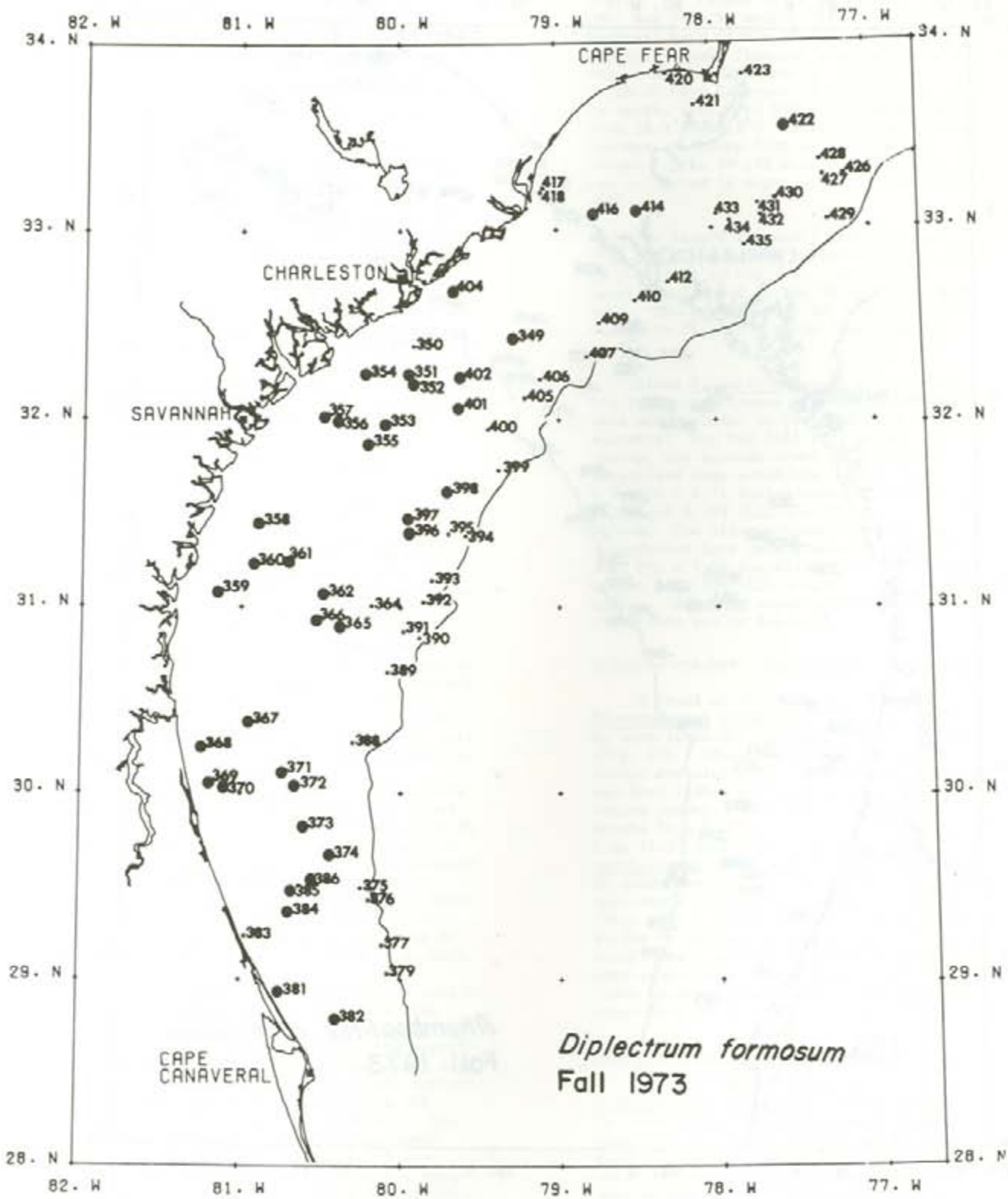

FIGURE 13. DISTRIBUTION OF SAND PERCH, DIPLECTRUM FORMOSUM, IN THE SOUTH ATLANTIC BIGHT DURING FALL 1973. LARGE DOTS = SPECIES PRESENT; SMALL DOTS = SPECIES ABSENT.

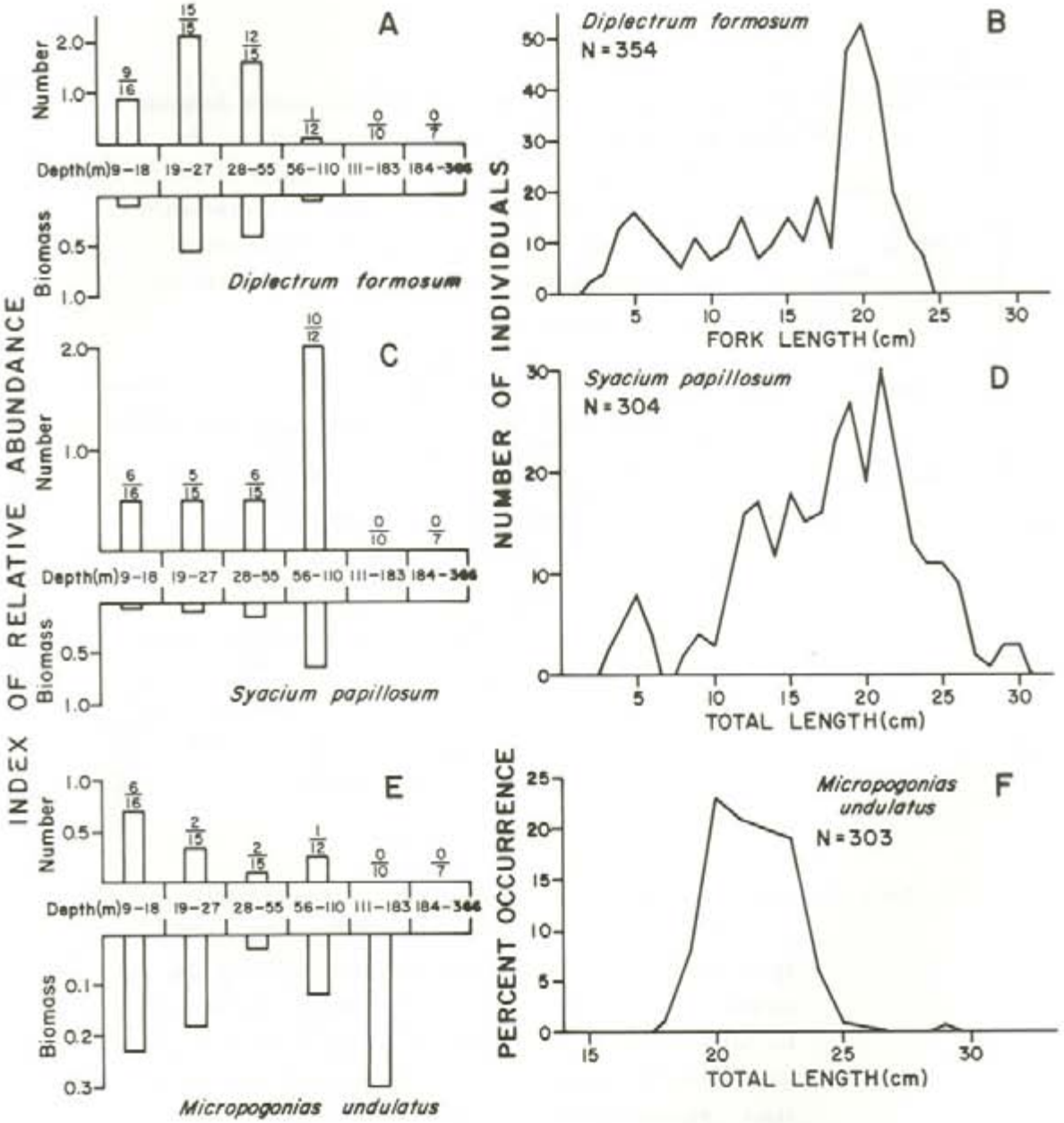

FIGURE 14. INDEX OF RELATIVE ABUNDANCE OF (A) DIPLECTRUM FORMOSUM, (C) SYACIUM PAPILLOSUM AND (E) MICROPOGONIAS UNDULATUS FOR THE FALL 1973 GROUNDFISH SURVEY IN THE SOUTH ATLANTIC BIGHT. NUMERATOR IN FRACTION = NUMBER OF TRAWLS IN DEPTH ZONE WITH SPECIES; DENOMINATOR = TOTAL TRAWLS IN ZONE. LENGTH FREQUENCY DISTRIBUTION OF (B) DIPLECTRUM FORMOSUM, (D) SYACIUM PAPILLOSUM AND (F) MICROPOGONIAS UNDULATUS.

Table 17. Minimum estimate of the standing stock of Diplectrum formosum in the South Atlantic Bight in depths from 9 to 55 m. The Bliss approximation has been used for the estimates on the natural log transformed data. The data have not been adjusted for vulnerability of this species to the 3/4 Yankee trawl. LCL = lower 90% confidence limit; UCL = upper 90% confidence limits. Biomass expressed in metric tons.

	Standing Stock	LCL	UCL
number (untransformed)	1.47×10^7	0.91×10^7	2.03×10^7
number (transformed)	1.51×10^7	1.09×10^7	2.05×10^7
biomass (untransformed)	1.17×10^3	0.72×10^3	1.63×10^3
biomass (transformed)	1.12×10^3	0.83×10^3	1.45×10^3

Table 18. Minimum estimates of the standing stock of Syacium papillosum in the South Atlantic Bight in depths from 9 to 110 m. The Bliss approximation has been used for the estimates on the natural log transformed data. The data have not been adjusted for vulnerability of this species to the 3/4 Yankee trawl. LCL = lower 90% confidence limit; UCL = upper 90% confidence limit. Biomass expressed in metric tons.

	Standing Stock	LCL	UCL
number (untransformed)	6.10×10^6	1.91×10^6	10.28×10^6
number (transformed)	4.13×10^6	2.94×10^6	5.61×10^6
biomass (untransformed)	4.38×10^2	1.67×10^2	7.10×10^2
biomass (transformed)	4.02×10^2	2.43×10^2	5.71×10^2

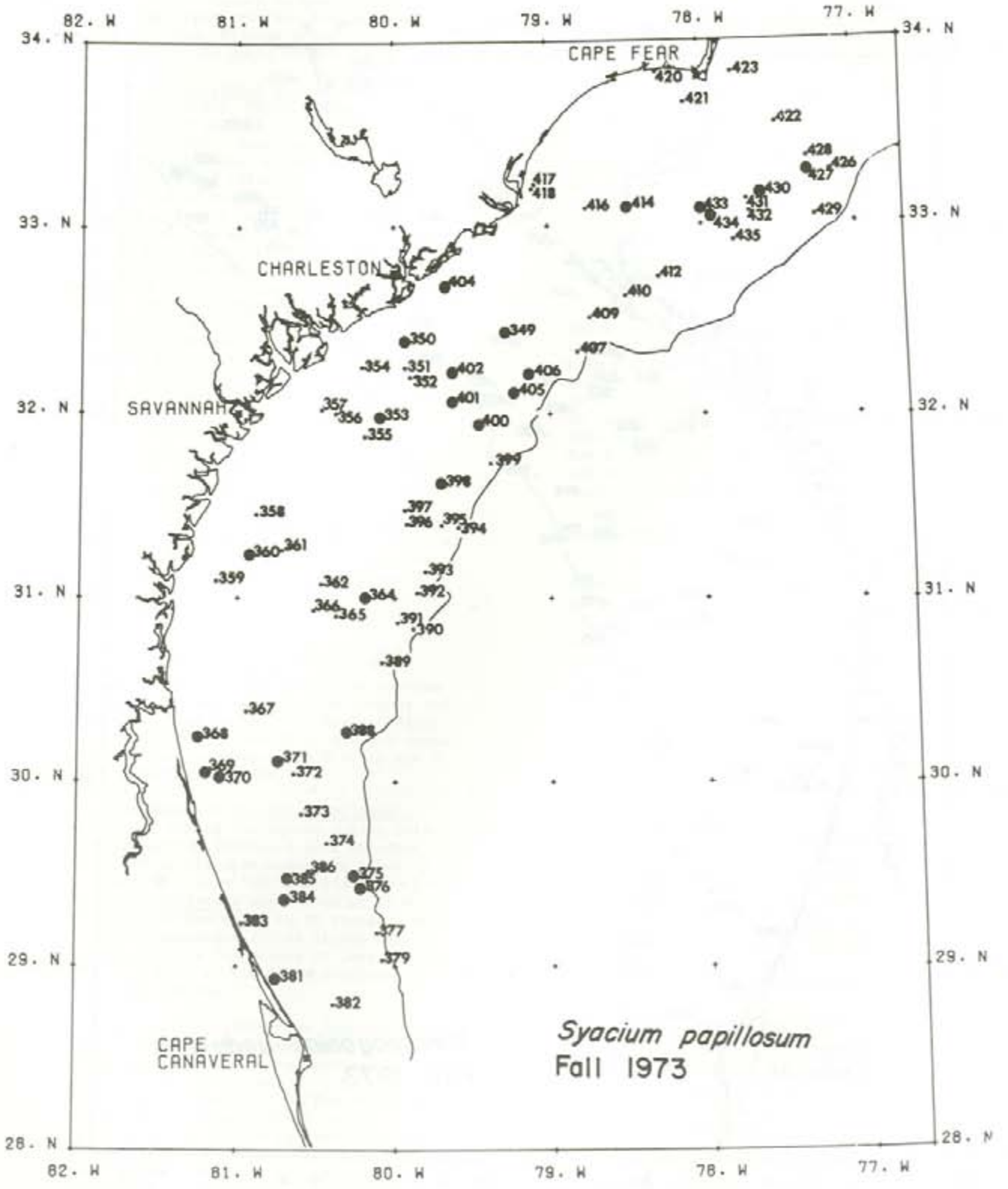

FIGURE 15. DISTRIBUTION OF DUSKY FLOUNDER, SYACIUM PAPILLOSUM, IN THE SOUTH ATLANTIC BIGHT DURING FALL 1973. LARGE DOTS = SPECIES PRESENT; SMALL DOTS = SPECIES ABSENT.

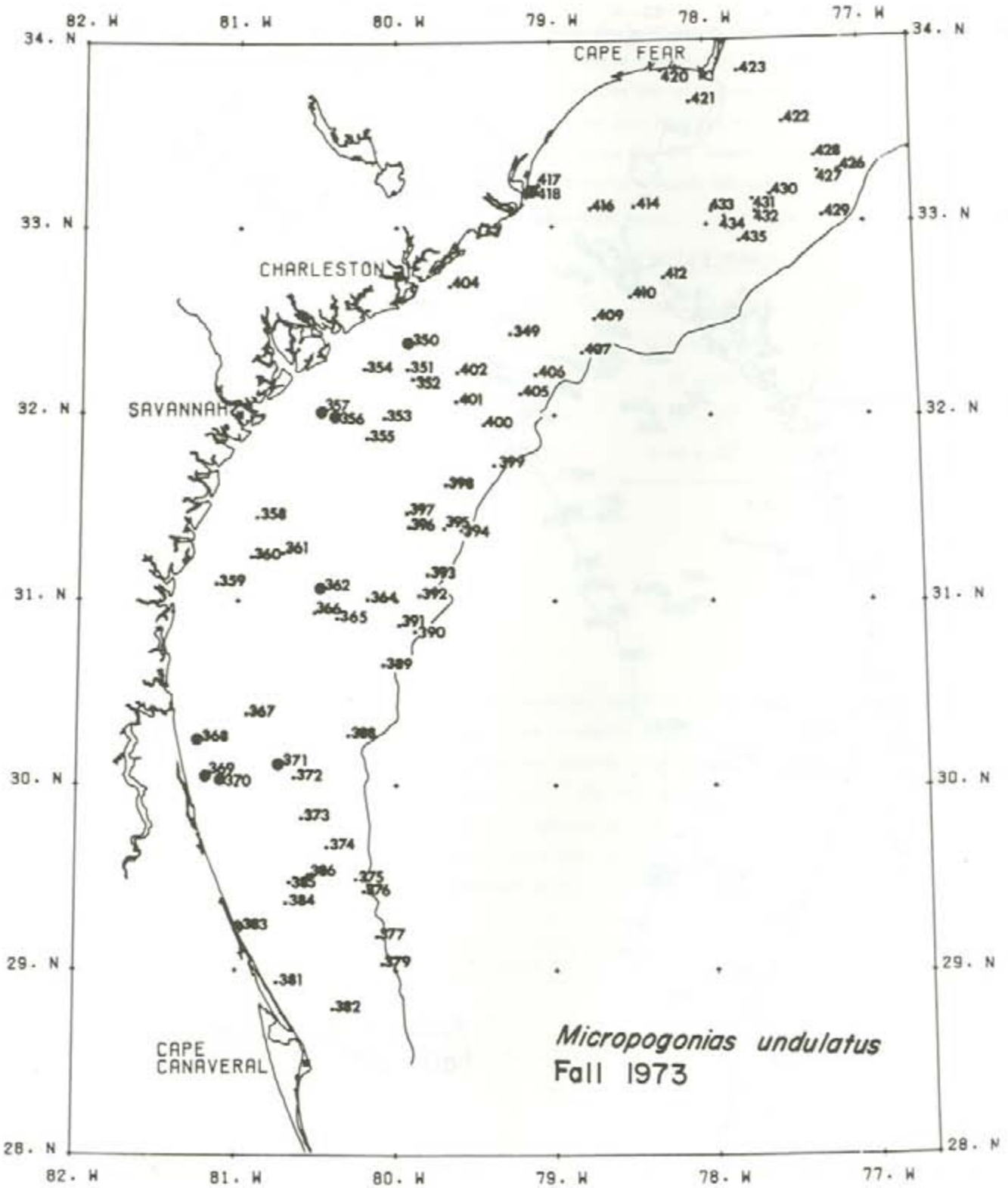

FIGURE 16. DISTRIBUTION OF ATLANTIC CROAKER, MICROPOGONIAS UNDULATUS, IN THE SOUTH ATLANTIC BIGHT DURING FALL 1973. LARGE DOTS = SPECIES PRESENT; SMALL DOTS = SPECIES ABSENT.

(MS) listed this species as a member of the upper continental slope fish assemblage in otter trawl collections in the Middle Atlantic Bight. From these results C. arctifrons appears to have a consistent distribution pattern from Hudson Canyon to Cape Canaveral, Florida being found for the most part on the upper continental slope.

Spot, Leiostomus xanthurus, and northern searobin, Prionotus carolinus were tied for twelfth in numerical abundance (n = 190). Spot ranked thirteenth (22.527 kg) in total weight whereas P. carolinus ranked fifteenth (14.200 kg). All but one of the trawls which collected L. xanthurus were in depths less than 25 m. However, one tow at 110 m resulted in the capture of 8 spot. Although spot are generally considered an inshore and estuarine species, Struhsaker (1969) indicated that L. xanthurus migrated to the shelf-edge and lower shelf during winter. Thus this trawl may have represented a group of spot that had initiated this offshore movement rather than being a permanent part of the fish community at these depths.

Prionotus carolinus was much more widespread in its distribution occurring in all depths except the 184-366 m stratum. Although it was collected from 9 to 113 m (16.9-24.9°C), P. carolinus was found most consistently in trawls made in the 19-27 m depth zone (9 of 15 trawls). Struhsaker (1969) reported P. carolinus as being a coastal and open-shelf species with occasional catches on the shelf edge.

A total of 189 Ophidion holbrooki were collected during the fall, 1973 groundfish survey. Although this species was found as deep as 84 m, the largest and most consistent catches of this ophidioid were in the 9-18 m and 19-27 m depth zones where it was represented in 5 of 16 and 8 of 15 trawls respectively.

Although 159 Saurida brasiliensis were taken during the survey making this numerically the fifteenth most abundant fish, 98% of the specimens were taken in tows at 136 m (n = 104) and 155 m (n = 53). Two S. brasiliensis were taken at 24 m. The average size was 7 cm FL (range: 5-11 cm FL). Struhsaker (1969) listed this species as rare (occurring in less than 10% of the trawls) on the lower continental shelf (60-100 fms).

One hundred fifty-four Centropristis striata were taken in the 9-18 m and 19-27 m depth zones. Black sea bass were collected in 7 of 16 and 7 of 15 trawls in these zones respectively. The average size was 22 cm TL (range: 11-37 cm TL). The total weight of 26.456 kg ranked sea bass tenth by weight of trawl caught demersal bony fishes. Because of the highly skewed nature of the catches even after transformation and the fact that the species is relatively invulnerable to the 3/4 Yankee trawl in the South Atlantic Bight, standing stock estimates were not even attempted.

The orange filefish, Aluterus schoepfi, ranked seventeenth in total number caught (n = 145) but because of its large mean size of 42 cm TL (range: 6-55 cm TL), it ranked third in total weight of demersal bony fishes (114.410 kg). Aluterus schoepfi was collected in depths from 9 to 42 m (16.9-25.7°C). It occurred in 7 of 16, 11 of 15 and 8 of 15 trawls in the three inshore strata and was not taken in deeper water.

The tattler, Serranus phoebe, was collected in the 56-110 m (5 of 12 tows) and the 111-183 m (4 of 10 tows) depth zones. The depth range was 75 to 136 m (16.1-25.8°C) and the mean size was 8 cm TL (range: 4-18 cm TL). Struhsaker (1969) lists this as a common member of the shelf edge fauna.

Two species of commercial interest which were taken in small numbers during this survey in the sand bottom habitat were the pink porgy, Pagrus pagrus (n = 68), and the red snapper, Lutjanus campechanus (n = 37). Pagrus were taken at 4 stations at depths from 26 to 84 m. Their average size was 14 cm FL (range: 12-23 cm FL). Red snapper were taken at 9 stations in depths from 10 to 26 m (16.4-24.4°C). The mean size was 8 cm FL (range: 3-16 cm FL).

Elasmobranchs

A total of eight elasmobranch species from four families were collected during the fall 1973 groundfish survey in the South Atlantic Bight. Although there were only 139 individuals collected, their total weight of 671.421 kg made up 25% of the total groundfish weight. The index of relative abundance showed that the largest catches by weight were in the 9-18 m depth zone whereas they were numerically most important in the 184-366 m depth zone (Fig. 17A). Eighty-nine percent of the total elasmobranch weight was taken in depths less than 28 m.

The numerically most abundant elasmobranch species was the clear nose skate, Raja eglanteria, whose 67 individuals comprised 48.2% of the total elasmobranch catch (Table 19). Clear nose skates were taken in depths from 9 to 88 m (16.4-26.2°C) and had maximum catches in the 9-18 m depth zone (Fig. 17C) where 98% of the total number and weight of this species was taken.

Rosette skates, Raja garmani, were collected in all trawls made in the deepest zone (184-366 m) and in four of ten trawls in the 111-183 m zone (Fig. 17D). This species was confined to the upper part of the continental slope in depths from 126 to 329 m (7.9-27.2°C).

Six roughtailed stingrays, Dasyatis centroura, were taken in six trawls in depth from 16 to 35 m (19.7-24.8°C) (Fig. 17B). These six individuals had an average weight of 91 kg.

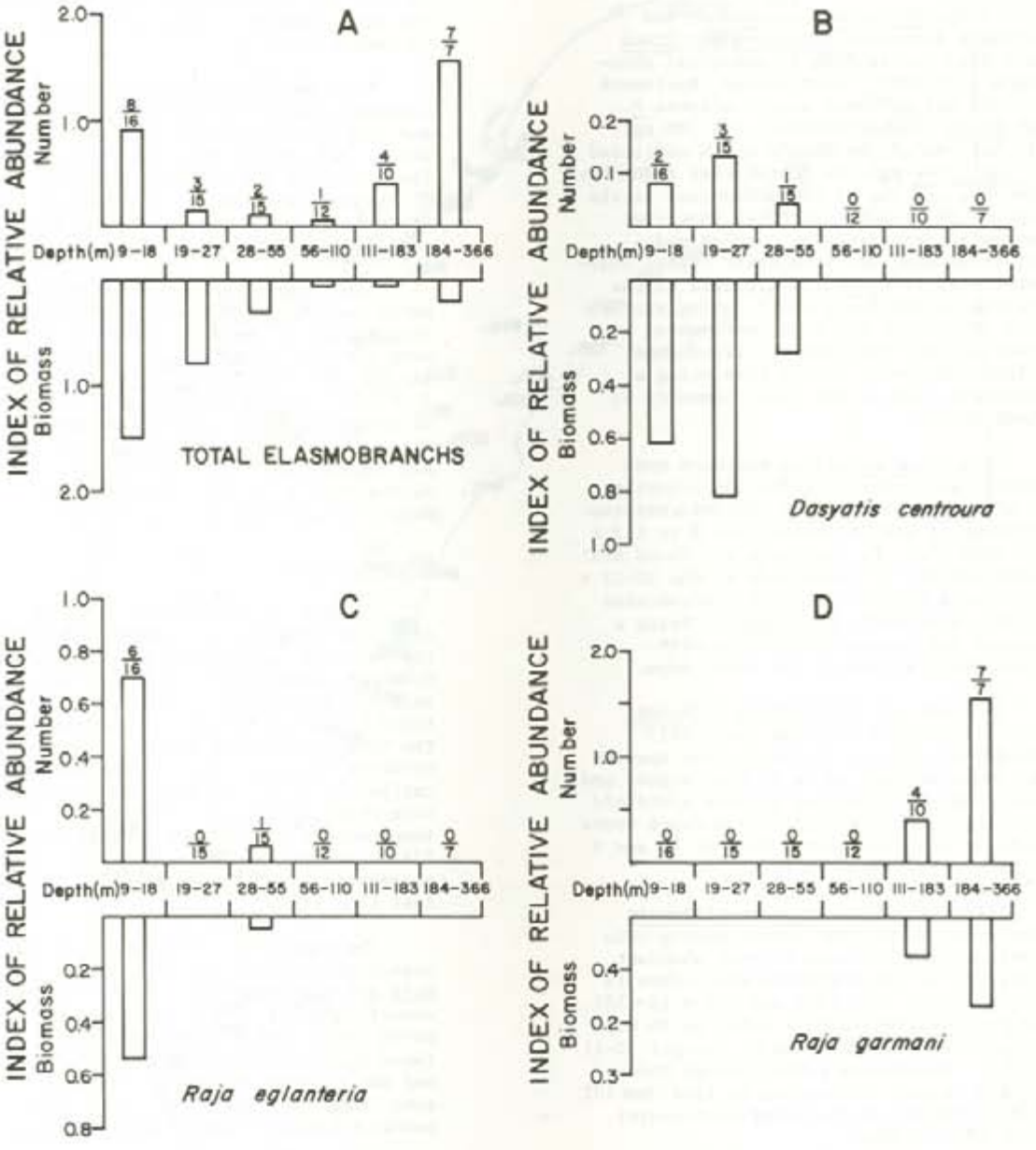

FIGURE 17. INDEX OF RELATIVE ABUNDANCE OF (A) TOTAL ELASMOBRANCHS, (B) DASYATIS CENTROURA, (C) RAJA EGLANTERIA AND (D) RAJA GARMANI FOR THE FALL 1973 GROUNDFISH SURVEY IN THE SOUTH ATLANTIC BIGHT. NUMERATOR IN FRACTION = NUMBER OF TRAWLS IN DEPTH ZONE WITH TAXON; DENOMINATOR = TOTAL NUMBER OF TRAWLS IN ZONE.

Table 19. Ranking of elasmobranch species by total number and total weight for R/V Dolphin 1973 fall groundfish survey in the South Atlantic Bight. N_1 = number of occurrences in the 75 successful trawls.

Rank	Species	Total Number	Percent of Total Elasmobranchs	N_1
1	Raja garmani	67	48.2	11
2	Raja eglanteria	40	28.8	7
3	Myliobatis freminvillei	11	7.9	3
4	Dasyatis americana	10	7.2	4
5	Dasyatis centroura	6	4.3	6
6	Rhinobatis lentiginosus	3	2.2	2
7	Gymnura micrura	1	0.7	1
8	Rajidae	1	0.7	1
	Total Number	139		

Rank	Species	Total Weight(kg)	Percent of Total Elasmobranchs	N_1
1	Dasyatis centroura	546.586	81.4	6
2	Myliobatis freminvillei	63.958	9.5	3
3	Dasyatis americana	29.938	4.5	4
4	Raja eglanteria	22.227	3.3	7
5	Gymnura micrura	5.443	0.8	1
6	Raja garmani	2.261	0.3	11
7	Rhinobatis lentiginosus	0.554	0.1	2
8	Rajidae	0.454	0.1	1
	Total Weight	671.421		

Bull nosed rays, Myliobatis freminvillei, were collected in four trawls just south of Cape Fear in depths of 9 to 15 m (16.4-17.5°C).

It is fortunate that many of these large rays are not more abundant in our trawl survey. The extraction of a large ray (~ 200 kg) from the sorting box and lifting it with the boom over the side for release makes for exciting watches. I hope that readers can picture a 200 kg D. centroura 10 feet off the deck, swinging from side to side of a vessel rolling in 3 m seas, with two people hanging on to tag lines for dear life. Such episodes are not uncommon.

Pelagic Fishes

A total of 53,220 pelagic fishes with a total weight of 541.246 kg representing 35 species in 15 families were collected incidentally to bottom trawling operations in the South Atlantic Bight during the fall 1973 groundfish survey. The most abundant families were the Clupeidae, Engraulidae and Carangidae both in total number and weight (Table 20). The Clupeidae were represented by four species (Sardinella anchovia, Etrumeus teres, Opisthonema oglinum and Harengula pensacolae), the Engraulidae by four species (Anchoa lyolepis, A. cubana, A. hepsetus and Anchoviella perfasciata) and the Carangidae by eleven species (Decapterus punctatus, Decapterus sp., Caranx crysos, C. bartholomaei, C. hippos, Chloroscombrus chrysurus, Vomer setapinnis, Trachurus lathami, Selene vomer, Seriola zonata and S. fasciata). Listings of the dominant pelagic species by numbers and weight for the entire survey area are in Table 21 whereas those by zones are in Tables 22 and 23.

Catch per unit effort by number (CPUE-N) and weight (CPUE-W) for pelagic fish by depth zone are

Depth Zone	CPUE-N	CPUE-W (kg)
9-18	856	5.2
19-27	1518	8.4
28-55	530	5.5
56-110	343	10.1
111-183	467	12.8
184-366	3	0.100

It is fully realized that catches of pelagic fishes by benthic otter trawls do not give accurate absolute estimates of the abundance of these species. However, they probably do reflect the relative abundance of these species and present a reasonably accurate picture of their distribution patterns.

Catches of pelagic fishes were dominated by coastal species. In waters on the edge of the continental shelf and on the upper continental slope, mesopelagic forms such as myctophids, gonostomatids and sternoptychids were found. Although the trawl net spends a greater period of time in the pelagic realm during set and retrieval in deeper waters, catches of pelagic species were lower in the deeper strata (Fig. 18A). This is not surprising as productivity is lower in offshore waters which is under the influence of nutrient poor Gulf Stream water. This lower productivity is reflected by the decreased abundance of surface pelagics which rely on zooplankton and phytoplankton as a food source.

Round scad: Decapterus punctatus

Decapterus punctatus, the most widely distributed and abundant carangid, ranked first in total weight (233.320 kg) and second in total number (n = 13134) of pelagic fishes during the fall 1973 groundfish survey. Round scad were collected from Cape Fear (~ 33.8°N) to northern Florida (~ 29.5°N) (Fig. 19) in trawls made in depths from 13 to 86 m. The largest catches were in the midshelf depth zones (19-27 m; 28-55 m) where 63.8% of the total number and 47% of the total weight of D. punctatus were found (Fig. 18B). The average size of trawl caught round scad was 11 cm FL with a range from 2 to 19 cm FL (Fig. 18D).

Stratified mean catch/tow values and minimum standing stock estimates were based on trawls made in the four shallowest depth zones where D. punctatus was collected. Untransformed data gave a mean of 216.3 (LCL = 95.9; UCL = 336.7) individuals/tow with a mean weight of 3.156 (LCL = 0.944; UCL = 5.368) kg/tow. Bliss approximations of the transformed data resulted in a mean of 261.2 (LCL = 145.0; UCL = 469.7) individuals/tow with a mean weight of 2.133 (LCL = 1.485; UCL = 2.950) kg/tow. Standing stock estimates based on these data are in Table 24.

Spanish sardine: Sardinella anchovia

A total of 22,423 Spanish sardine with a weight of 105.341 kg were taken from south of Cape Fear (~ 33.7°N) to Cape Canaveral, Florida (~ 28.9°N) (Fig. 20) during the fall 1973 groundfish survey. Sardinella anchovia ranked first in total number and third in total weight of pelagic fishes. This species was found primarily in the inshore and midshelf depth zones, where it occurred in 48% of the 46 trawls made in depths less than 56 m. The largest catches both in numbers and weight were in the 19-27 m and the 28-55 m depth zones (Fig. 18C).

Spanish sardine showed a trend for smaller fishes to be found in shallower depth zones (Fig. 18E). The size frequency

Table 20. Rankings of families of pelagic fishes by numbers and weight for fall 1973 groundfish survey in the South Atlantic Bight.

Rank	Family	Total Number	Percent of Pelagic Catch	Number of Species
1	Clupeidae	26904	50.6	4
2	Carangidae	13417	25.2	11
3	Engraulidae	12411	23.3	4
4	Stromateidae	195	0.4	2
5	Pomatomidae	124	0.2	1
6	Scombridae	94	0.2	2
7	Ariommidae	21	-	3
8	Echeneidae	12	-	1
9	Sphyraenidae	12	-	1
10	Myctophidae	10	-	1
11	Gonostomatidae	9	-	1
12	Nomeidae	5	-	1
13	Fistulariidae	3	-	1
14	Sternoptychidae	2	-	1
15	Gempylidae	1	-	1
	Total	53220	99.9	35

Rank	Family	Total Weight(kg)	Percent of Pelagic Catch
1	Carangidae	242.813	44.9
2	Clupeidae	212.437	39.2
3	Engraulidae	27.303	5.0
4	Scombridae	14.815	2.7
5	Pomatomidae	14.362	2.7
6	Echeneidae	13.454	2.5
7	Stromateidae	12.294	2.3
8	Ariommidae	2.314	0.4
9	Fistulariidae	0.554	0.1
10	Myctophidae	0.200	-
11	Sphyraenidae	0.200	-
12	Sternoptychidae	0.200	-
13	Gempylidae	0.100	-
14	Gonostomatidae	0.100	-
15	Nomeidae	0.100	-
			99.8

Table 21. Rankings by numbers and weights for pelagic species taken incidentally to bottom trawls in the South Atlantic Bight during fall 1973.

Species	Total Number	% of Total Catch	Number of Occurrences
Sardinella anchovia	22423	42.1	23
Decapterus punctatus	13134	24.7	31
Anchoa lyolepis	7053	13.3	9
Etrumeus teres	4473	8.4	3
Anchoa cubana	3160	5.9	7
Anchoa hepsetus	2097	3.9	3
Chloroscombrus chrysurus	129	0.2	6
Peprilus triacanthus	129	0.2	5
Pomatomus saltatrix	124	0.2	4
Anchoviella perfasciata	101	0.2	3
Other Species	273	0.5	

Species	Total Weight(kg)	% of Total Catch	Number of Occurrences
Decapterus punctatus	233.320	43.1	31
Etrumeus teres	106.796	19.7	3
Sardinella anchovia	105.341	19.4	23
Scomber japonicus	14.715	2.7	3
Pomatomus saltatrix	14.362	2.7	4
Anchoa hepsetus	14.204	2.6	3
Echeneis naucrates	13.454	2.5	6
Peprilus triacanthus	9.826	1.8	5
Anchoa lyolepis	7.991	1.5	9
Anchoa cubana	4.808	0.9	7
Other Species	16.428	3.0	

Table 22. Top five numerically abundant pelagic fish species for R/V Dolphin 1973 fall groundfish survey by depth zone. N_1 = number of occurrences; N = total number of trawls in zone.

Depth zone (m)	Species	Total Number	Percent of Total in zone	N_1/N
9-18	Anchoa lyolepis	6946	50.7	8/16
	Anchoa cubana	3160	23.1	7/16
	Anchoa hepsetus	2097	15.3	3/16
	Decapterus punctatus	698	5.1	4/16
	Sardinella anchovia	169	1.2	7/16
19-27	Sardinella anchovia	18744	82.3	9/15
	Decapterus punctatus	3913	17.2	12/15
	Anchoa lyolepis	107	0.5	1/15
	Echeneis naucrates	4	-	2/15
	Caranx bartholomaei	2	-	2/15
28-55	Decapterus punctatus	4489	56.4	11/15
	Sardinella anchovia	3452	43.4	6/15
	Echeneis naucrates	3	-	1/15
	Ariomma regulus	2	-	2/15
	Fistularia villosa	2	-	1/15
56-110	Decapterus punctatus	4034	98.1	4/12
	Sardinella anchovia	58	1.4	1/12
	Etrumeus teres	12	0.3	1/12
	Trachurus lathami	3	0.1	2/12
	Ariomma regulus	1	-	1/12
111-183	Etrumeus teres	4461	95.6	2/10
	Scomber japonicus	89	1.9	1/10
	Peprilus triacanthus	47	1.0	2/10
	Peprilus alepidotus	46	1.0	1/10
	Ariomma bondi	16	0.3	2/10
184-366	Gonostomatidae	9	40.9	1/7
	Myctophidae	7	31.8	1/7
	Ariomma melanum	2	9.1	1/7
	Sternoptychidae	2	9.1	2/7
	Peprilus triacanthus	1	4.5	1/7

Table 23. Top five pelagic fish species by weight for R/V Dolphin 1973 fall groundfish survey by depth zone. N_1 = number of occurrences; N = total number of trawls in zone.

Depth zone (m)	Species	Total Weight(kg)	Percent of Total in zone	N_1/N
9-18	Decapterus punctatus	19.151	23.1	4/16
	Pomatomus saltatrix	14.362	17.3	4/16
	Anchoa hepsetus	14.204	17.1	3/16
	Anchoa lyolepis	7.891	9.5	8/16
	Peprilus triacanthus	7.358	8.9	2/16
19-27	Sardinella anchovia	76.327	60.6	9/15
	Decapterus punctatus	41.346	32.8	12/15
	Echeneis naucrates	6.904	5.5	2/15
	Seriola zonata	0.454	0.4	1/15
	Caranx bartholomaei	0.200	0.2	2/15
28-55	Decapterus punctatus	53.780	64.7	11/15
	Sardinella anchovia	24.431	29.4	6/15
	Echeneis naucrates	4.082	4.9	1/15
	Fistularia villosa	0.454	0.5	1/15
	Ariomma regulus	0.200	0.2	2/15
56-110	Decapterus punctatus	119.043	98.4	4/12
	Sardinella anchovia	1.361	1.1	1/12
	Trachurus lathami	0.200	0.2	2/12
	Ariomma regulus	0.100	0.1	1/12
	Etrumeus teres	0.100	0.1	1/12
111-183	Etrumeus teres	106.696	83.5	2/10
	Scomber japonicus	14.515	11.4	1/10
	Peprilus triacanthus	2.368	1.9	2/10
	Ariomma bondi	1.914	1.5	2/10
	Peprilus alepidotus	1.814	1.4	1/10
184-366	Sternoptychidae	0.200	28.6	2/7
	Ariomma melanum	0.100	14.3	1/7
	Gonostomatidae	0.100	14.3	1/7
	Myctophidae	0.100	14.3	1/7
	Peprilus triacanthus	0.100	14.3	1/7

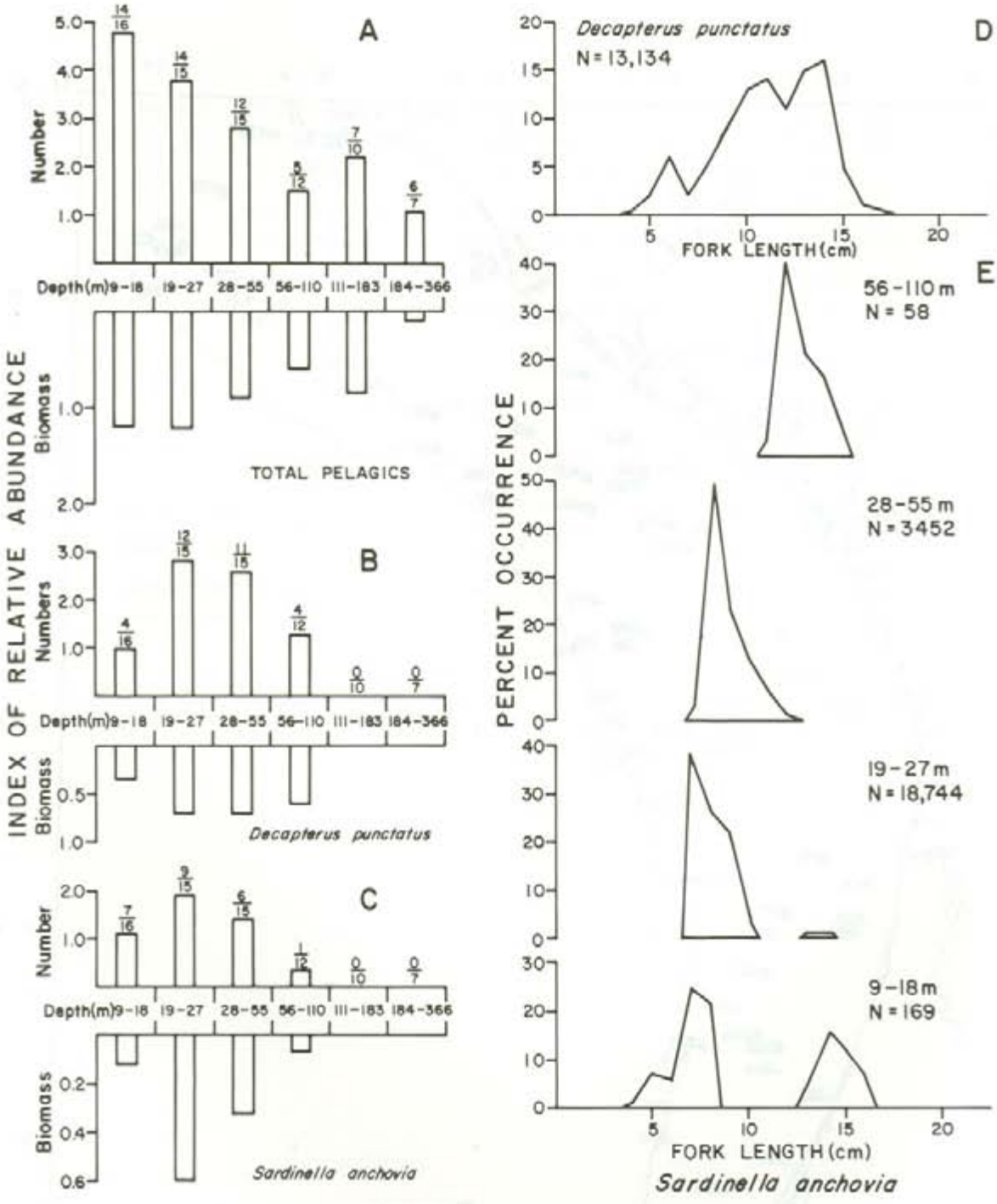

FIGURE 18. INDEX OF RELATIVE ABUNDANCE OF (A) TOTAL PELAGIC SPECIES, (B) DECAPTERUS PUNCTATUS, (C) SARDINELLA ANCHOVIA BY DEPTH ZONE FOR THE FALL 1973 GROUNDFISH SURVEY IN THE SOUTH ATLANTIC BIGHT. NUMERATOR = NUMBER OF TRAWLS IN DEPTH ZONE WITH TAXON; DENOMINATOR = TOTAL NUMBER OF TRAWLS IN ZONE. LENGTH FREQUENCY DISTRIBUTION OF (D) DECAPTERUS PUNCTATUS AND (E) SARDINELLA ANCHOVIA BY DEPTH ZONE.

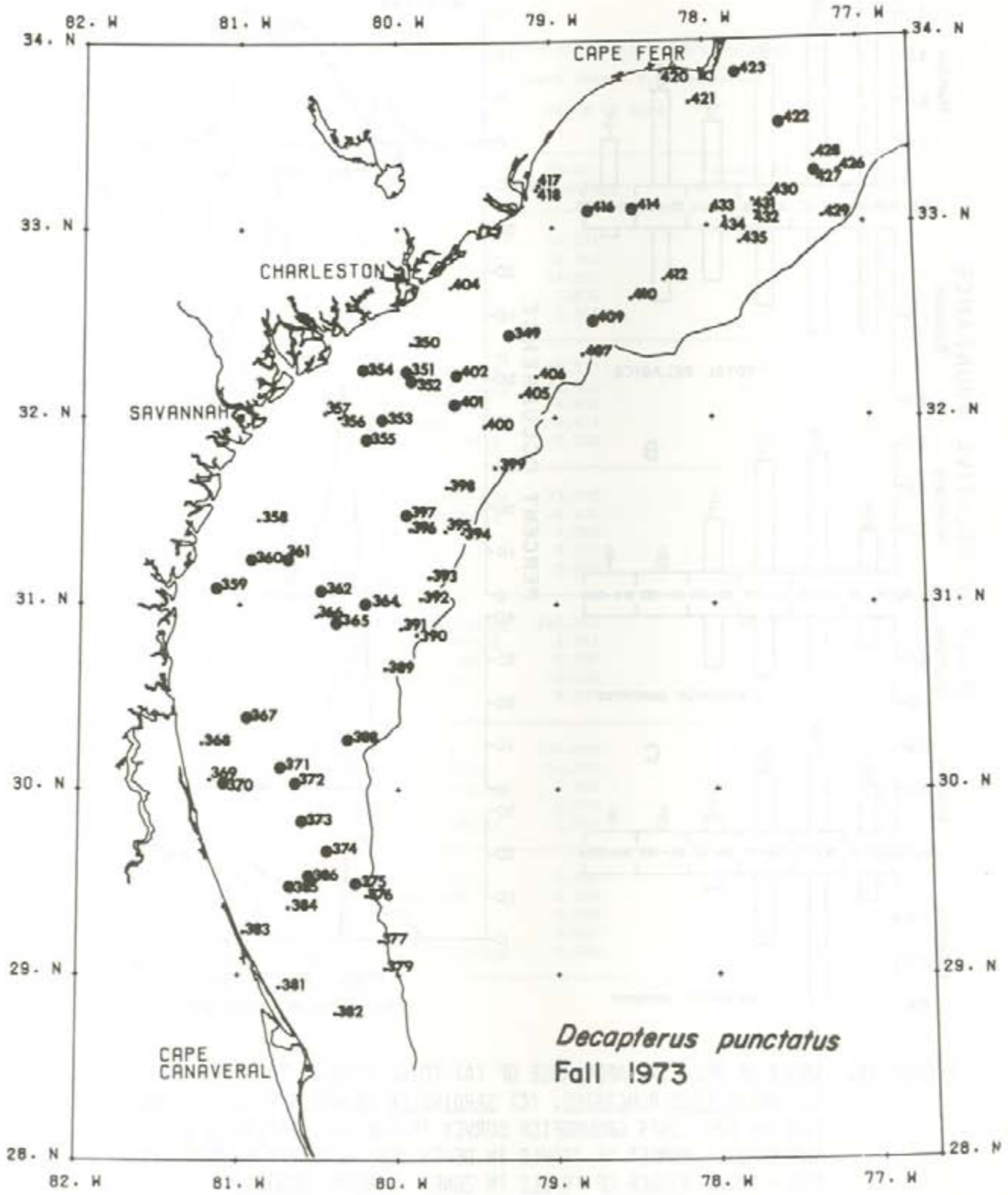

FIGURE 19. DISTRIBUTION OF ROUND SCAD, DECAPTERUS PUNCTATUS, IN THE SOUTH ATLANTIC BIGHT DURING FALL 1973. LARGE DOTS = SPECIES PRESENT; SMALL DOTS = SPECIES ABSENT.

Table 24. Minimum estimates of the standing stock of Decapterus punctatus in the South Atlantic Bight from the fall 1973 groundfish survey in depths from 9 to 110 m. The Bliss approximation has been used on the natural log transformed data. The data have not been adjusted for vulnerability of the species to the 3/4 Yankee trawl. LCL and UCL = upper and lower 90% confidence limits respectively. Biomass expressed in metric tons.

	Standing Stock	LCL	UCL
number (untransformed)	4.68×10^8	2.07×10^8	7.28×10^8
number (transformed)	5.65×10^8	3.13×10^8	10.16×10^8
biomass (untransformed)	6.83×10^3	2.04×10^3	11.61×10^3
biomass (transformed)	4.61×10^3	3.21×10^3	6.38×10^3

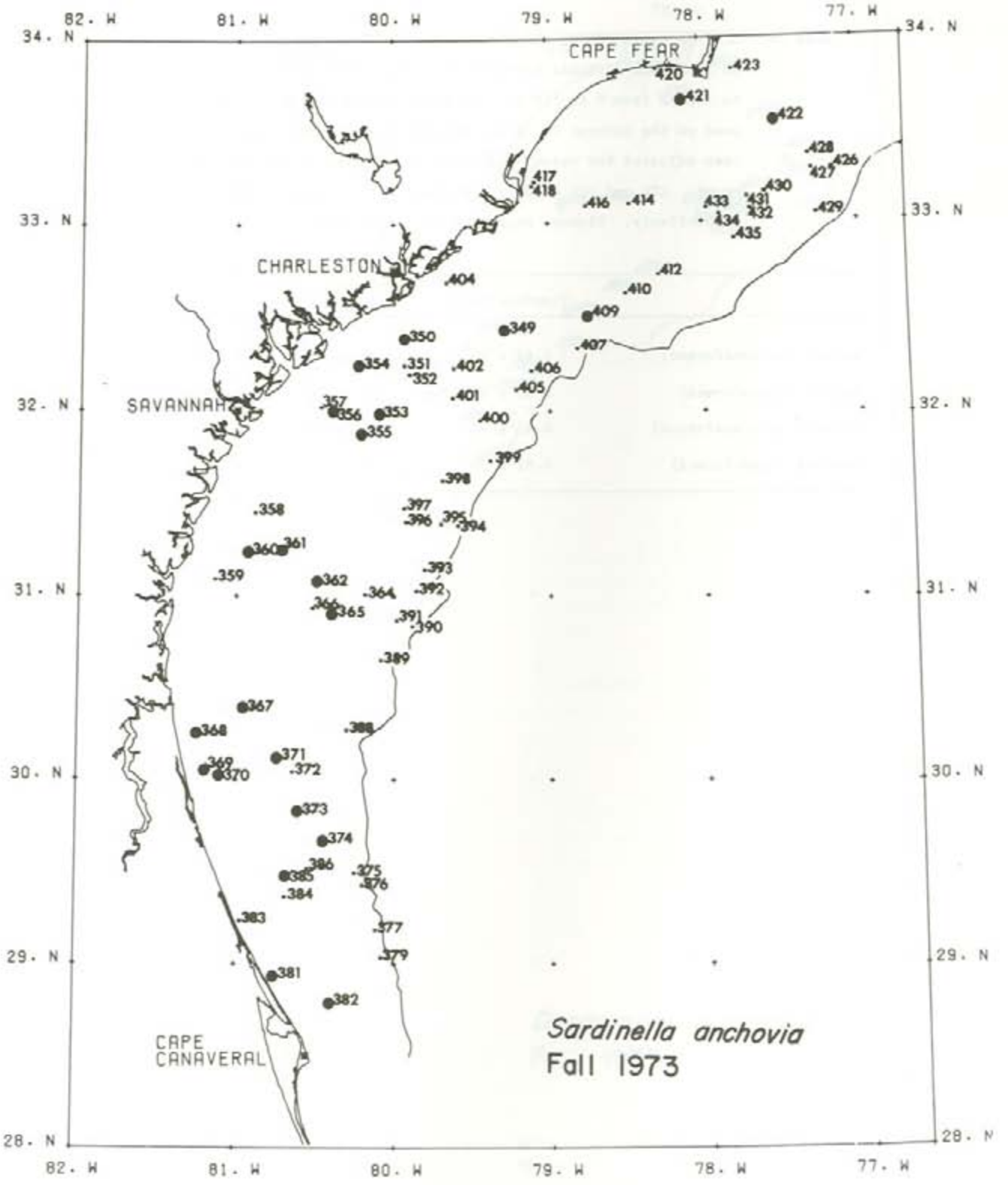

FIGURE 20. DISTRIBUTION OF SPANISH SARDINE, SARDINELLA ANCHOVIA, IN THE SOUTH ATLANTIC BIGHT DURING FALL 1973. LARGE DOTS = SPECIES PRESENT; SMALL DOTS = SPECIES ABSENT.

distributions were bi-modal in the 9-18 m and the 19-27 m depth zone. This was probably a case where the adults were found at all depths with juveniles being concentrated in the shallower depth zones. The average size for S. anchovia was 8 cm FL with a range from 2 to 17 cm FL.

Round herring: Etrumeus teres

Round herring, Etrumeus teres, was the other pelagic clupeid collected in significant numbers during the course of this survey. However, it was taken in only 2 of 75 tows, one of which resulted in a catch of 4460 individuals weighing 106.596 kg at station 73389 located off the northern coast of Florida. The average size of E. teres was 3.1 cm FL with a range from 2 to 18 cm FL. Due to the occurrence of this species in only two tows, no catch nor standing stock analyses were done.

Engraulidae

The three dominant engraulids, Anchoa lyolepis, A. cubana and A. hepsetus, were taken almost exclusively in the shallowest depth zone (9-18 m). Anchoa lyolepis was collected in 8 of 16 trawls in this zone. The mean catch/tow of the dusky anchovy was 434.1 (extremes: 0-2617) individuals/tow with a mean weight of 0.493 (extremes: 0-3.232) kg/tow. This was the only engraulid taken outside of the inshore zone. A trawl in 20 m resulted in the collection of 107 individuals weighing 0.1 kg. The average size of A. lyolepis was 5 cm FL with a range from 3 to 7 cm FL.

The Cuban anchovy, Anchoa cubana, was collected only in the 9-18 m depth zone where it was found in 7 of 16 trawls. The mean catch/tow of A. cubana was 197 (extremes: 0-1766) individuals/tow with a mean weight of 0.300 (extremes: 0-2.288) kg/tow. The average size of A. cubana was 6 cm FL with a range from 4 to 7 cm FL.

The striped anchovy, Anchoa hepsetus, also occurred only in the 9-18 m zone where it was taken in 3 of 16 trawls. The mean catch/tow of A. hepsetus was 131 (extremes: 0-2053) individuals/tow with a mean weight of 0.880 (extremes: 0-13.650) kg/tow. The average size of A. hepsetus was 9 cm FL with a range from 5 to 12 cm FL.

Cephalopods

During the fall 1973 groundfish survey in the South Atlantic Bight a total of 14,065 squid weighing 159.276 kg were collected in bottom trawls. Squids made up 16.5% of the total number and 5.9% of the total weight of all groundfish taken during the survey. Squid were abundant and widely distributed in all depth zones (Fig. 21A). Greater than 99% of the total squid catch was long-fin squid (Loliginidae). Only 38 Illex illecebrosus weighing 3.651 kg were taken in depths from 155 to 285 m on the upper part of the continental slope. These had an average size of 17 cm mantle length with a range from 11 to 23 cm.

Because of questionable field identifications of the long-fin squid, especially small individuals, all Loliginidae (Loligo sp., L. plei, L. pealei and Loliguncula brevis) have been lumped together for standing stock estimates and length frequencies. Analysis of untransformed data gave a stratified mean catch/tow of 239 (LCL = 113; UCL = 367) individuals/tow with a mean weight of 1.868 (LCL = 1.020; UCL = 2.716) kg/tow. Bliss (1967) approximations of the transformed data gave an estimated mean of 359 (LCL = 242; UCL = 532) individuals/tow with a mean weight of 1.495 (LCL = 1.170; UCL = 1.869) kg/tow. Minimum standing stock estimates based on these values for the South Atlantic Bight for the fall 1973 survey are in Table 25.

The length frequency distribution of long-fin squid (Fig. 21B) showed that in the shallow depths, catches were largely made up of small individuals. Although individuals over 10 cm mantle length were found in all zones, most large specimens were found in depths greater than 56 m.

Demersal Fish Diversity

The total number of demersal fish species (demersal bony fish plus elasmobranchs) taken during this survey was greatest in the two inshore zones and lowest in the deepest zone (184-366 m) (Table 26). The highest value of the mean number of benthic species/tow was found in the 19-27 m zone and lowest in the deepest zone (Table 26). The overall average for the entire survey was 12.4 species/tow with a range from 2 to 30 species. Plots of number of benthic species/tow demonstrated a general decrease with depth with the correlation coefficient being significant at the 95% level ($r = -0.39$, $df = 74$). The coefficient of determination ($r^2 \times 100\%$) indicated that 15.6% of the variability in the number of species caught/tow was associated with changes in depth (Fig. 22A).

Demersal fish diversity values calculated by the Shannon-Weaver diversity index (H') and species richness (S-1/ln N) followed the same general trend as the average number of species/tow with a tendency for lower values in deeper water (Figs. 22B and C). Ranges for diversity values for the six zones were:

Depth Zone (m)	H'(bits/individual)
9-18	0.280-3.783
19-27	0.113-3.855
28-55	1.009-3.410
56-110	1.378-3.506
111-183	0.571-2.639
184-366	0.296-1.921

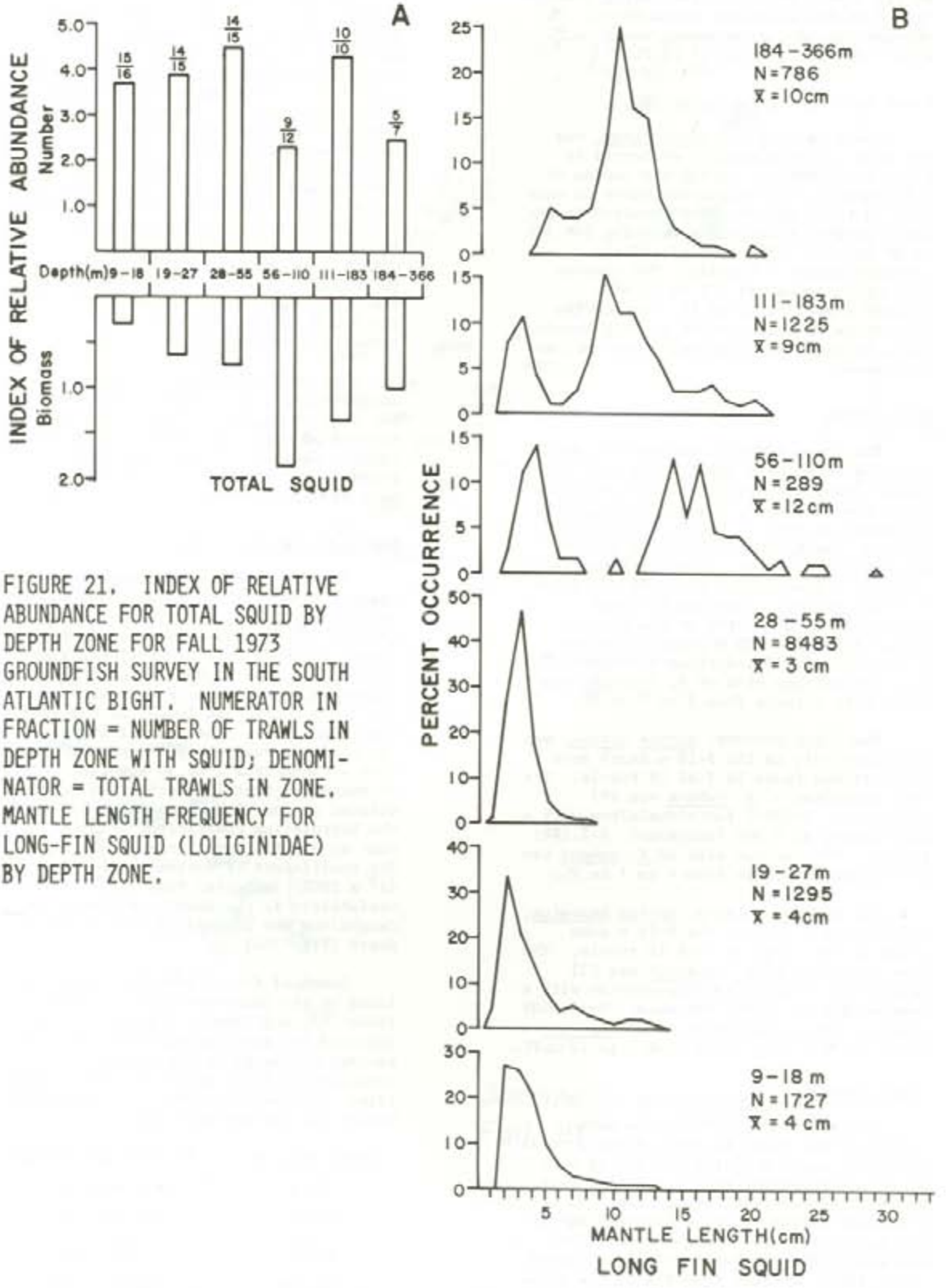

FIGURE 21. INDEX OF RELATIVE ABUNDANCE FOR TOTAL SQUID BY DEPTH ZONE FOR FALL 1973 GROUNDFISH SURVEY IN THE SOUTH ATLANTIC BIGHT. NUMERATOR IN FRACTION = NUMBER OF TRAWLS IN DEPTH ZONE WITH SQUID; DENOMINATOR = TOTAL TRAWLS IN ZONE. MANTLE LENGTH FREQUENCY FOR LONG-FIN SQUID (LOLIGINIDAE) BY DEPTH ZONE.

Table 25. Minimum estimates of the standing stock of short fin squid (Loliginidae) in the South Atlantic Bight in depths from 9 to 366 m. The Bliss approximation has been used for the estimates on the natural log transformed data. The data have not been adjusted for vulnerability to the 3/4 Yankee trawl. LCL and UCL = lower and upper 90% confidence limit. Biomass expressed in metric tons.

	Standing Stock	LCL	UCL
number (untransformed)	6.31×10^8	2.97×10^8	9.67×10^8
number (transformed)	9.45×10^8	6.38×10^8	14.02×10^8
biomass (untransformed)	4.92×10^3	2.69×10^3	7.15×10^3
biomass (transformed)	3.94×10^3	3.08×10^3	4.92×10^3

Table 26. Total number of demersal species (demersal bony fish plus elasmobranch species), mean number of demersal species/tow and mean number of individuals/tow for sand bottom habitat in the South Atlantic Bight during fall 1973.

Depth zone (m)	Total Number of Demersal Species	Mean Number of Demersal Species/tow	Mean Number of Individuals/tow
9-18	80	15.9	319
19-27	81	18.1	511
28-55	46	9.0	55
56-110	61	12.2	105
111-183	48	9.2	215
184-366	14	4.6	105

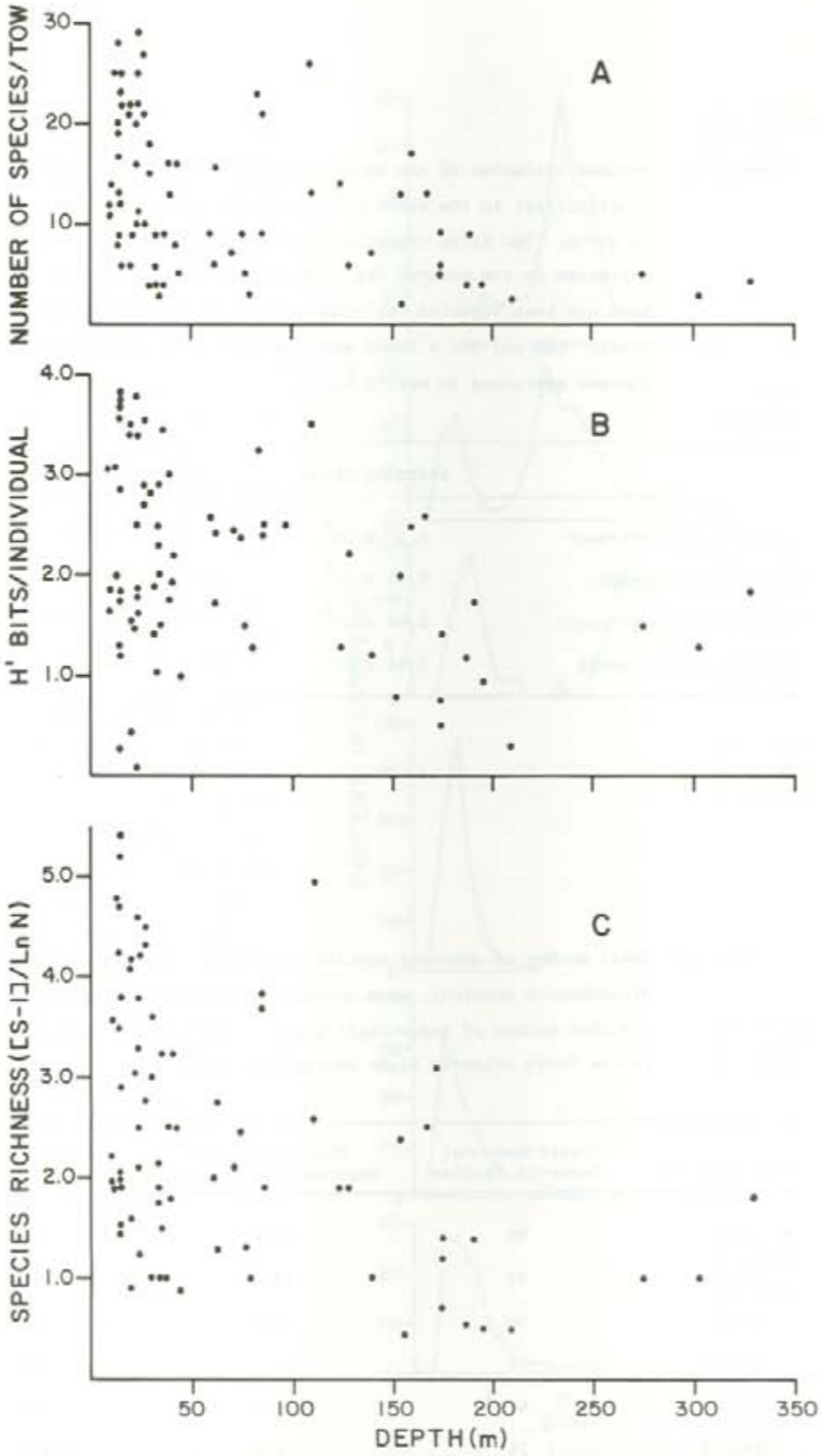

FIGURE 22. SCATTERPLOTS OF THE NUMBER OF DEMERSAL FISH SPECIES/TOW (A), SHANNON-WEAVER DIVERSITY VALUES OF DEMERSAL FISH (B) AND SPECIES RICHNESS FOR DEMERSAL FISH (C) AGAINST DEPTH FOR THE SAND BOTTOM HABITAT IN THE SOUTH ATLANTIC BIGHT DURING SPRING 1973. DEMERSAL FISH INCLUDES ELASMOBRANCH AND BONY FISHES ASSOCIATED WITH THE BOTTOM.

Extremely low diversity values generally resulted from depressed evenness values (J') resulting from large numbers of a single species in a trawl rather than species richness. Mean diversity per depth zone and cumulative diversity were not calculated because of the low mean number of species/tow in a stratum when compared to the total number of species in that stratum indicating that tows were not homogeneous enough in species composition to allow pooling. Values of H',J' and richness for all stations included in this survey are in Appendix IV.

Comparisons of the diversity of benthic fishes from the Gulf of Mexico and the Middle Atlantic Bight with the present study are difficult to generalize from because of lack of uniformity of sampling gear. Colvocoresses and Musick (MS) found a total of 76 species of fishes in #36 Yankee otter trawl collections (footrope length 24.3 m) during the fall 1973 groundfish survey in the Middle Atlantic Bight. Their use of cluster analysis divided the stations into 7 groups which were largely separated by depth. The number of species/tow for these groups were:

Station Group	Mean Station Depth (m)	Mean Number of Species/Tow
I	31	6.7
II	39	9.9
III	73	10.5
IV	101	3.8
V	102	3.6
VI	152	8.8
VII	321	7.2

The overall average was about 7 species/tow.

Foell and Musick (MS) collected a total of 43 species (3 to 12 species/tow) with a 13.7 m shrimp trawl in four sampling zones off the New Jersey coast in depths from 39-73 m. Their sampling gave cumulative H' from 1.88 to 2.73 bits/individual. The low diversity values were a result of a combination of low evenness and species richness.

Chittenden and McEachran (1976) in a study of the incidental catch of fishes on the commercial shrimp grounds collected 63 species in depths from 3.5 to 22 m (white shrimp grounds Penaeus setiferus). The mean H' was 1.825 (range: 0.892-2.444) bits/individual for this area. Depths from 22 to 91 m yielded a total of 82 species of fishes with a mean diversity of 2.251 (range: 1.275-2.586) bits/individual. The differences in diversity values for the two grounds resulted from different species richness values rather than differing equitabilities. It should be noted that the trawl durations as well as the trawl types (7.5, 12, 18 m trawls) were variable.

Wohlschlag et al. (1976) collected a total of 131 species of fishes with a 10.7 m flat trawl during the fall of 1976 off the Texas coast. They had an average of 11.8 species/tow for all fall 1976 trawls. On the basis of species similarity in both day and night trawls for stations on their transects in different depths, they placed their stations in three groups: Group I (~ 30 m), Group II (31-90 m) and Group III (~ 91 m). The pooled diversity values for each station group ranged from 1.289 (Group I day tows) to 2.739 (Group II night tows) natural bels (1.860-3.909 bits/individual).

The fall 1973 groundfish survey collected more species of fishes than the other surveys discussed above. A total of 166 species of demersal fishes were taken during this survey. The Middle Atlantic Bight yielded 76 species (Colvocoresses and Musick MS) whereas the Texas coast had from 63-82 (Chittenden and McEachran 1976) and 131 species (Wohlschlag et al. 1976). The difference in the surveys becomes even greater when the 41 species of pelagic fishes is added to the South Atlantic Bight survey. Although the much larger species list could have resulted from differences in gear types and trawling methodologies between surveys, we feel that because of our unique geographic location, the presence of temperate, subtropical and tropical fishes elevates the diversity of fishes in our area to levels greater than other published continental shelf trawl surveys.

Demersal Fish Community Structure

Comparisons of the assemblages of benthic fishes taken in otter trawl collections in the South Atlantic Bight during the fall of 1973 by cluster analysis showed a major division of stations into inshore and offshore components (Fig. 23). The deeper water stations were divided into three site groups: (6) 12 stations near the shelf break; (7) 9 stations on the upper continental slope; (8) 9 stations on the continental slope. In site group 7 a single station from 35 m was misclassified, being assigned to stations occurring in depths from 128 to 174 m. Only five fishes from three species (Prionotus carolinus, Aluterus monoceros and Pagrus pagrus) occurred at this station. This collection (73428) had low similarity with any other station or station groups and was simply added to station group 7.

Inshore stations were assigned to 5 groups which appear to demonstrate a general depth related trend in similarity. When station groups were checked for latitudinal associations, none were apparent. In the South Atlantic Bight from Cape Fear

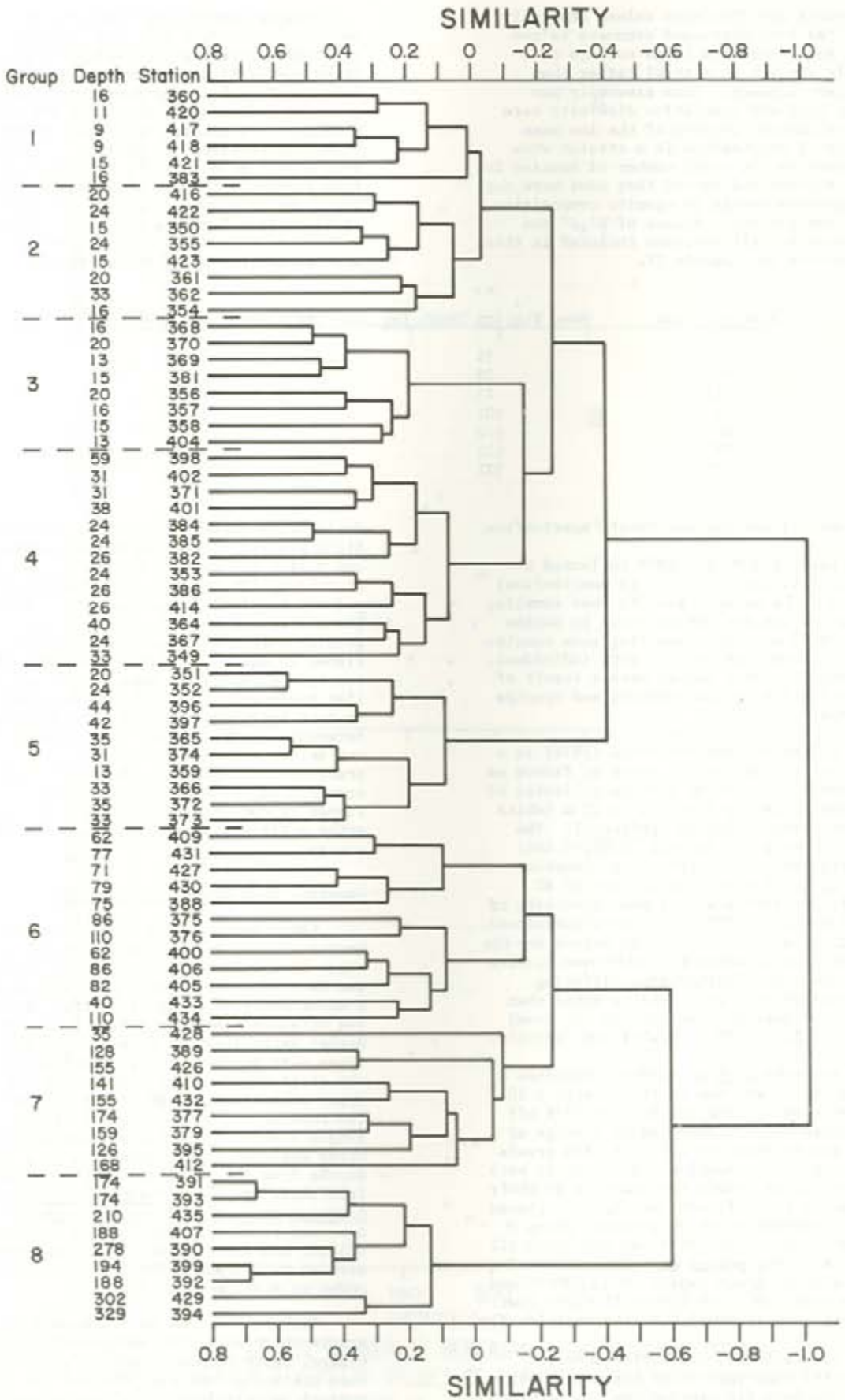

FIGURE 23. STATION CLUSTER (NORMAL ANALYSIS) FOR FALL 1973 SAND BOTTOM STATIONS. CANBERRA-METRIC CORRELATION, LOG TRANSFORMED DATA, FLEXIBLE SORTING WITH $\beta = -0.25$.

to Cape Canaveral, depth was a more important determinant of similarity in faunal assemblages than latitude.

Inverse analysis (species cluster) gave nine groups ranging from 4 to 12 species per group (Fig. 24). Groups VIII and IX contain species that for the most part are associated with the shelf break and upper continental slope. In group VIII, Gymnothorax saxicola (depth range 24 to 128 m), Bellator militaris (depth range 24 to 159 m), Prionotus roseus (depth range 20 to 110 m), Cyclopsetta fimbriata (depth range 24 to 110 m), Lagodon rhomboides (depth range 16 to 126 m), Prionotus stearnsi (depth range 15 to 159 m), Ogcocephalus radiatus (depth range 24 to 159 m) and Kathetostoma albigutta (depth range 38 to 110 m) were eurybathic but most often collected in stations deeper than 70 m.

Species group III contains several species that are associated with the inshore sponge-coral habitat (Struhsaker's live bottom), however they are frequently encountered over sand bottom in the open shelf habitat. Movements of reef fishes to forage off the reef are well documented in the literature (Collette and Talbot 1972).

Species group IV is comprised of fishes (Synodus foetens, Diplectrum formosum, Stephanolepis hispidus, Aluterus schoepfi, Prionotus carolinus) that are widely distributed, frequently encountered and numerically abundant in the open shelf habitat in depths less than 55 m.

Species group VII (Syacium papillosum, Trachinocephalus myops, Synodus poeyi and Bothus ocellatus) are fishes whose depth distribution is from the open shelf to beyond the shelf break.

It is interesting to note that cobia, Rachycentron canadum, is closely associated with the roughtail stingray, Dasyatis centroura. In the Chesapeake Bay, juvenile cobia have been observed to school with cow nose rays, Rhinoptera bonasus J. Smith, Virginia Institute of Marine Science, Gloucester Point, Va., pers. comm.). The association of cobia with large batoid elasmobranchs may be a behavior that is followed throughout life, however, its significance in the life history of Rachycentron canadum is unknown. Cobia may school with rays to find food.

For a site group to be a meaningful entity rather than an artifact of numerical classification techniques, it should have faunal homogeneity with regard to other site groups. For the same reason, a species group should have a consistent distribution pattern among site groups. Nodal analysis (Boesch 1977) showed that the main divisions between shallow and deep water site and species groups were valid for the fall 1973 groundfish survey.

Species group VIII was made up of 12 species and showed low constancy in site groups 7 and 8 (Fig. 25), low fidelity to site group 8 but high fidelity to site group 7 (Fig. 26). Although having a relatively low repeatibility in catches of benthic fishes from trawls made on the shelf break (40-112 m), species group VIII was highly associated with these depths during the fall of 1973. Species group IX with 6 member species showed its highest fidelity and constancy in site group 8 which had 9 stations in depths from 176-338 m. Although their bathymetric distribution was not limited to trawls within this depth range, the primary habitat for this species group was on the upper continental slope during the fall of 1973.

The numerically dominant fish species in the sand bottom habitat in depth < - 60 m were found in species group V. Species group V has high constancy but low fidelity in site groups 2, 3, 4 and 5 showing that this assemblage of fishes was frequently encountered in trawls made in depths from 13 to 58 m. Because of the frequent occurrence of species group V in different site groups, it was not specifically associated with a group of stations in the sand bottom, open shelf habitat.

The use of numerical classification (cluster analysis) has shown that during the fall of 1973, the benthic ichthyofauna could be broken down into two major groups. These were depth related with the major faunal change occurring at the shelf-break. The associations of benthic fishes were governed more by depth than latitude. The dominant fishes of the inshore (less than 60 m) sand bottom habitat were largely found in a single species group (V) and were widely occurring in trawls from 13 to 58 m (high constancy for those site groups). This was not surprising since the influence of the Gulf Stream provided moderately stable bottom temperatures and the sand bottom habitat was relatively homogeneous throughout the area.

The results of the 3/4 Yankee otter trawl survey in the sand bottom habitat (Strusaker's [1969] coastal, open-shelf, shelf-edge and lower shelf habitat) of the South Atlantic Bight have shown that the groundfish community was relatively diverse with 157 species of demersal bony fish, 8 species of elasmobranchs, 35 species of pelagic fishes and four species of squids. The stratified mean catch/tow for total groundfish based on untransformed data was 37.180 kg/tow with 90% confidence limits of 26.897 and 47.463 kg/tow. Transformed total groundfish weights gave a stratified mean of 37.492 kg/tow with 90% confidence limits of 29.183 and 48.089 kg/tow. Much of the variability in trawl catches resulted from the occasional collections of large batoid elasmobranchs and the incidental occurrences of numerous pelagic individuals. Trawl catches of demersal bony fishes (total groundfish - [elasmobranchs and pelagic fishes and squid]) showed statistically greater mean

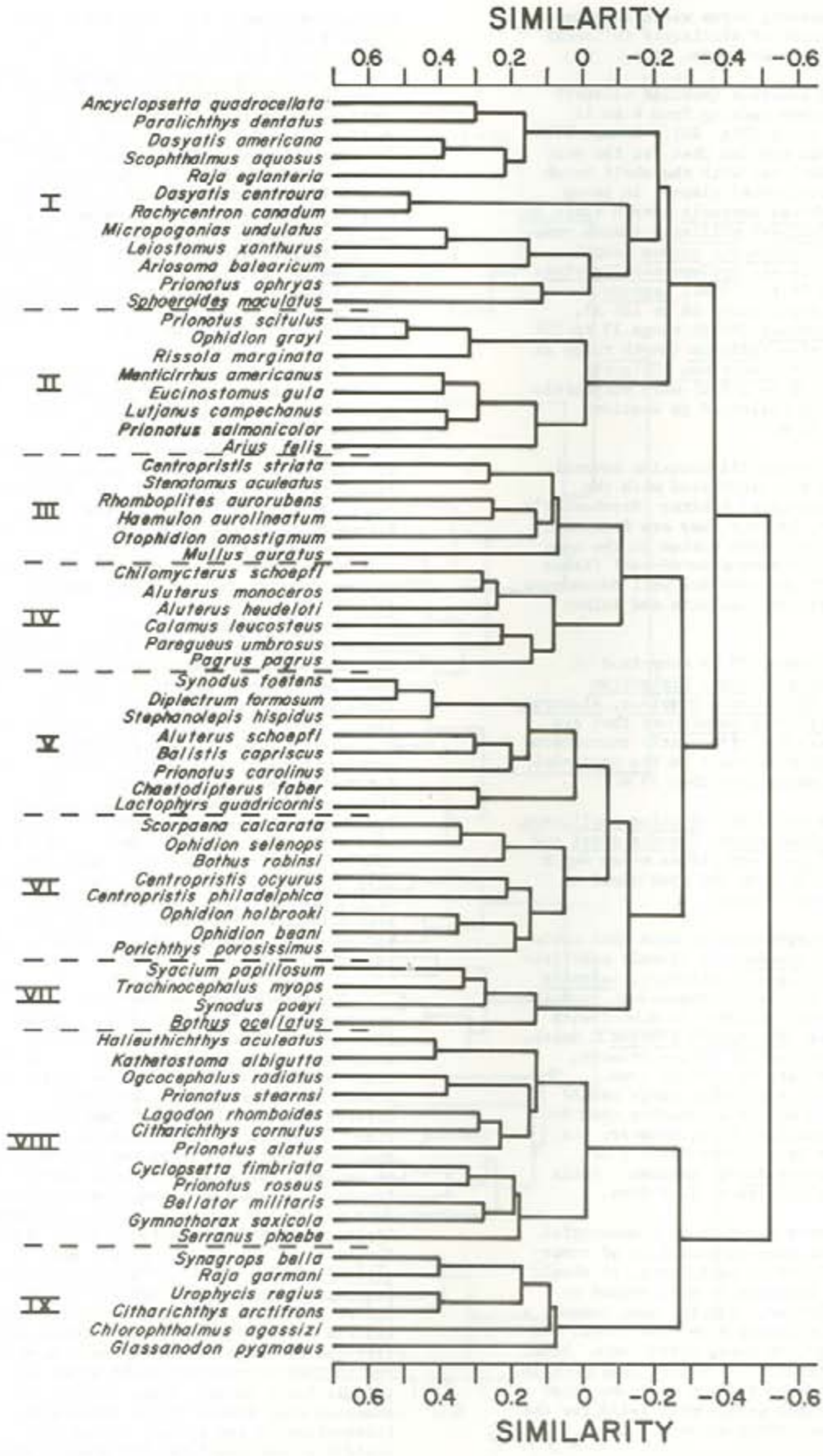

FIGURE 24. SPECIES CLUSTER (INVERSE ANALYSIS) FOR FALL 1973 SAND BOTTOM STATIONS. METHODOLOGY SAME AS FIGURE 5.

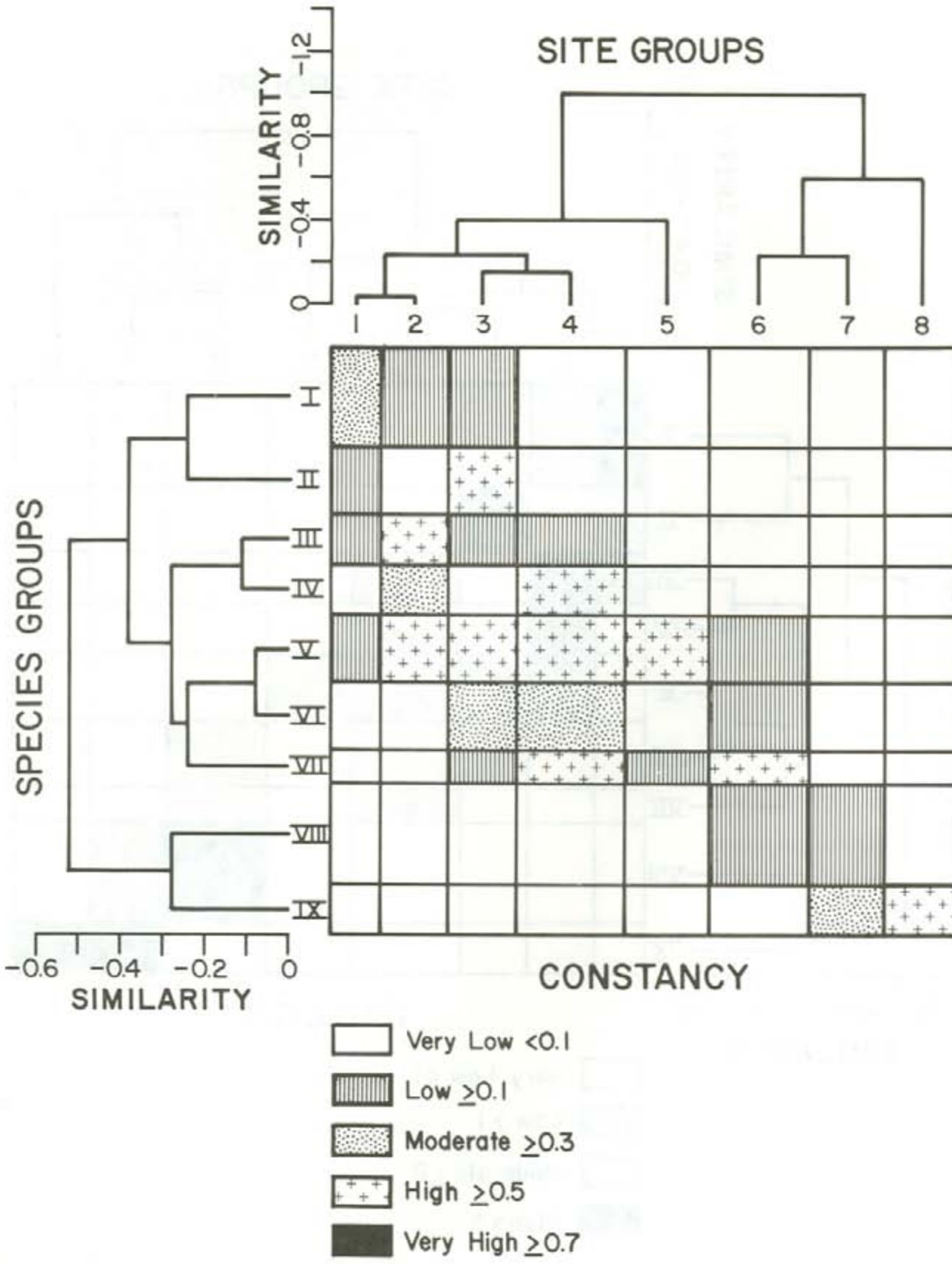

FIGURE 25. NODAL CONSTANCY IN A TWO-WAY TABLE OF SPECIES GROUPS AND SITE GROUPS FOR SAND BOTTOM STATIONS DURING THE FALL OF 1973.

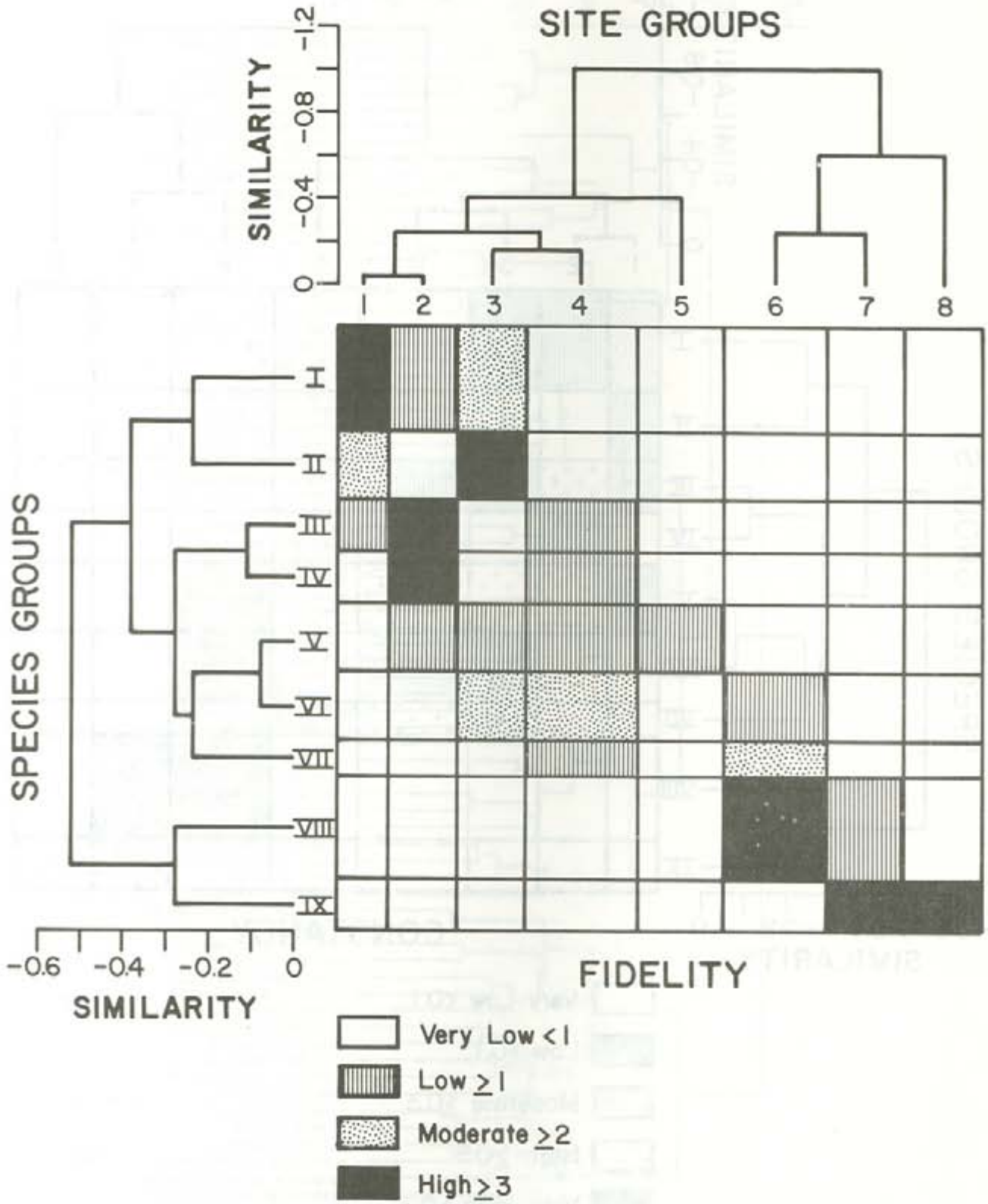

FIGURE 26. NODAL FIDELITY IN A TWO-WAY TABLE OF SPECIES GROUPS AND SITE GROUPS FOR SAND BOTTOM STATIONS DURING THE FALL OF 1973.

values in the 9-18 and 19-27 m depth zones.

The most abundant demersal bony fish species was the southern porgy, Stenotomus aculeatus, which made up 45.3% of the total number and 40.6% of the total weight of demersal bony fish taken during the fall survey. Pelagic fishes were for the most part clupeids, carangids and engraulids, with the round scad, Decapterus punctatus, accounting for 24.7% of the total number and 43.1% of the total pelagic weight. The roughtail stingray, Dasyatis centroura, formed the greatest part of the elasmobranch weight.

When the faunal assemblages of demersal fishes (elasmobranchs and demersal bony fish) were analyzed by cluster analysis, depth was shown to be more important than latitude in determining species distribution patterns.

LITERATURE CITED

Barans, C. A. and V. G. Burrell, Jr. 1976. Preliminary findings of trawling on the continental shelf off the southeastern United States during four seasons (1973-1975). S. C. Mar. Res. Center Tech. Rept. No. 13. 16 p.

Bliss, C. I. 1967. Statistics in biology. Vol. I. McGraw-Hill, Inc., N.Y. 558 p.

Boesch, D. F. 1977. Application of numerical classification in ecological investigations of water pollution. EPA-600/3-77-033 Ecological Research Series. 114 p.

Chittenden, M. E., Jr. and J. D. McEachran. 1976. Composition, ecology, and dynamics of demersal fish communities on the northwestern Gulf of Mexico continental shelf, with a similar synopsis for the entire Gulf. Sea Grant Pub. No. TAMU-SG-76-208. 104 p.

Clarke, S. H. and B. E. Brown. 1977. Changes in biomass of finfishes and squids from the Gulf of Maine to Cape Hatteras, 1963-74, as determined from research vessel survey data. Fish. Bull. 75: 1-21.

Clifford, H. T. and W. Stephenson. 1975. An introduction to numerical classification. Academic Press, N.Y. 229 p.

Cochran, W. C. 1977. Sampling techniques. John Wiley and Sons, N.Y. 428 p.

Collette, B. B. and F. H. Talbot. 1972. Activity patterns of coral reef fishes with emphasis on nocturnal-diurnal changeover, pp. 98-124. In B. B. Collette and S. A. Earle (eds.) Results of the Tektite program: Ecology of coral reef fishes. Natural History Museum, Los Angeles County. Science Bull. 14: 180 pp.

Colvocoresses, J. A. and J. A. Musick. MS. Historical community structure analysis of finfishes. II. NMFS Groundfish survey.

Cummins, R., Jr., J. B. Rivers and P. J. Struhsaker. 1962. Exploratory fishing off the coast of North Carolina, September 1959-July 1960. Comm. Fish. Rev. 24: 1-9.

Edwards, R. L. 1968. Fishery resources of the North Atlantic area. In D. Gilbert (ed.), The future of the fishing industry of the United States, p. 52-60. Univ. Wash. Publ. Fish., New Ser., 4.

Elliott, J. M. 1973. Some methods for the statistical analysis of samples of benthic invertebrates. Freshwater Biol. Ass. U. K. Sci. Publ. No. 25. 148 p.

Foell, E. J. and J. A. Musick. MS. Community structure analysis of fishes in the Middle Atlantic outer continental shelf.

Grosslein, M. D. 1969. Groundfish survey of BCF Woods Hole. Comm. Fish. Rev. 31: 22-35.

Guenther, W. C. 1964. Analysis of variance. Prentice-Hall, Inc., Englewood Cliffs, N.J. 199 p.

Huntsman, G. R. 1976a. Offshore bottom fisheries of the United States South Atlantic Coast. Proc. Colloquim on Snapper-grouper fishery resources of the western central Atlantic Ocean. Fla. Sea Grant Rep. No. 17: 192-221.

Huntsman, G. R. 1976b. Offshore headboat fishing in North Carolina and South Carolina. Marine Fisheries Review 38: 13-23.

Keiser, R. K., Jr. 1976. Species composition, magnitude and utilization of the incidental catch of the South Carolina shrimp fishery. S. C. Mar. Res. Center Tech. Rept. No. 16. 55 p.

Margalef, R. 1968. Perspectives in ecological theory. Univ. of Chicago Press, Chicago, Ill. 111 p.

Mathews, T. D. and O. Pashuk. 1977. A description of oceanographic conditions of the southeastern United States during 1973. S. C. Mar. Res. Center Tech. Rept. No. 19. 112 p.

Moore, D., H. A. Brusher and L. Trent. 1970. Relative abundance, seasonal distribution and species composition of demersal fishes off Louisiana and Texas, 1962-1964. Contrib. Mar. Sci. Univ. Texas 15: 45-70.

Musick, J. A. and J. D. McEachran. 1972. Autumn and winter occurrence of decapod crustaceans in the Chesapeake Bight, U.S.A. Crustaceana 22: 190-200.

Peet, R. K. 1975. Relative diversity indices. Ecology 56: 496-498.

Pielou, E. C. 1975. Ecological diversity. Wiley-Interscience, N.Y. 165 p.

Powell, D. E. 1950. Observations on the commercial fishing potentialities in the offshore waters of North Carolina (January-February 1950). Comm. Fish. Rev. 12: 1-7.

Powles, H. and C. A. Barans. MS. Evaluation of methods for monitoring groundfish of nearshore sponge-coral habitats off the southeastern United States.

Roessler, M. 1965. An analysis of the variability of fish populations taken by otter trawl in Biscayne Bay, Florida. Trans. Amer. Fish. Soc. 94: 311-318.

Rohr, B. H. and E. J. Gutherz. 1977. Biology of the offshore hake, Merluccius albidus. Fish. Bull. 75: 147-158.

Struhsaker, P. 1969. Demersal fish resources: composition, distribution and commercial potential of the continental shelf stocks off southeastern United States. Fish. Ind. Res. 4: 261-300.

Taylor, C. C. 1953. Nature of variability in trawl catches. Fish. Bull. 54: 145-166.

Wilk, S. J. and M. J. Silverman. 1976. Fish and hydrographic collections made by the research vessels Dolphin and Delaware II during 1968-72 from New York to Florida. NMFS-SSRF-697. 159 p.

Wohlschlag, D. E., J. F. Cole, M. E. Dobbs, E. F. Vetter, and R. H. Moore. 1976. Demersal fishes, p. 10-1 to 10-162. In Environmental studies, south Texas outer continental shelf, biology and chemistry. Vol. II. BLM Final Report AA550-CT6-17.

LIST OF APPENDICES

APPENDIX I. Collection data for groundfish trawls in the South Atlantic Bight during fall, 1973.

Collection Number	Latitude	Longitude	Depth (m)	Temperature (°C)	Salinity (PPT)
73349	32°25.5'N	79°16.5'W	33	25.2	36.16
73350	32°23.0'N	79°55.0'W	15	22.6	36.00
73351	32°14.0'N	79°56.0'W	20	23.3	36.22
73352	32°11.0'N	79°54.0'W	24	23.7	36.24
73353	31°59.0'N	80° 5.0'W	24	23.9	36.84
73354	32°14.3'N	80°12.5'W	16	22.4	36.69
73355	31°52.5'N	80°11.5'W	24	23.6	36.71
73356	32° 0.0'N	80°22.5'W	20	22.6	36.42
73357	32° 0.7'N	80°28.0'W	16	22.0	35.78
73358	31°27.0'N	80°53.0'W	15	22.6	35.85
73359	31° 5.5'N	81° 8.2'W	13	22.5	35.36
73360	31°14.2'N	80°55.0'W	16	-	-
73361	31°15.5'N	80°43.0'W	20	23.2	36.01
73362	31° 4.5'N	80°28.2'W	33	24.6	36.12
73364	31° 0.5'N	80°11.0'W	40	24.8	36.07
73365	30°54.2'N	80°22.5'W	35	24.2	36.12
73366	30°56.0'N	80°31.0'W	33	23.9	36.09
73367	32°23.0'N	80°56.5'W	24	23.8	36.24
73368	30°14.8'N	81°14.0'W	16	22.4	34.33
73369	30° 3.1'N	81°11.0'W	13	22.8	34.55
73370	30° 2.0'N	81° 5.0'W	20	23.2	34.84
73371	30° 7.0'N	80°43.5'W	31	24.4	35.66
73372	30° 2.5'N	80°38.5'W	35	24.8	35.37
73373	29°49.5'N	80°35.6'W	33	25.0	35.25
73374	29°40.0'N	80°26.0'W	31	25.7	36.92
73375	29°29.5'N	80°15.0'W	86	26.2	36.68
73376	29°25.6'N	80°12.0'W	110	25.5	36.79
73377	29°11.0'N	80° 7.0'W	174	15.2	36.17
73379	29° 2.0'N	80° 5.0'W	159	24.0	36.48
73381	28°56.0'N	80°44.6'W	15	23.5	-
73382	28°47.5'N	80°23.5'W	26	24.5	35.54
73383	29°14.0'N	80°58.0'W	16	23.3	34.62
73384	29°21.8'N	80°41.2'W	24	24.3	35.63
73385	29°28.5'N	80°40.0'W	24	24.4	35.89
73386	29°31.1'N	80°32.8'W	26	24.7	35.82
73388	30°16.2'N	80°18.0'W	75	25.6	36.93
73389	30°39.0'N	80° 5.0'W	128	16.1	36.31
73390	30°50.0'N	79°53.0'W	278	27.6	36.73
73391	30°52.0'N	79°59.0'W	174	27.2	36.67
73392	31° 1.7'N	79°51.5'W	188	8.0	35.21
73393	31° 8.6'N	79°48.3'W	174	8.6	35.15
73394	31°22.9'N	79°35.6'W	329	7.9	34.97
73395	31°23.5'N	79°42.0'W	126	21.3	35.84
73396	31°24.0'N	79°55.5'W	44	23.7	36.72
73397	31°28.5'N	79°56.2'W	42	23.2	36.66
73398	31°37.5'N	79°41.5'W	59	23.8	36.71
73399	31°44.0'N	79°23.0'W	194	14.1	36.02
73400	31°57.0'N	79°27.0'W	62	24.3	36.23
73401	32° 3.5'N	79°37.5'W	38	23.4	36.12
73402	32°13.0'N	79°37.0'W	31	22.7	36.26
73404	32°41.0'N	79°39.5'W	13	20.2	35.53
73405	32° 6.0'N	79°13.0'W	82	23.8	36.34
73406	32°12.0'N	79° 7.0'W	86	24.9	36.38
73407	32°19.0'N	78°49.0'W	188	14.8	36.12
73409	32°30.0'N	78°44.0'W	62	25.7	36.43
73410	32°37.0'N	78°30.0'W	141	22.1	36.72
73412	32°43.0'N	78°17.0'W	168	16.7	36.39
73414	33° 6.0'N	78°28.0'W	26	22.5	36.43
73416	33° 5.5'N	78°45.0'W	20	19.7	36.58
73417	33°13.5'N	79° 5.0'W	9	16.9	36.08
73418	33°12.0'N	79° 6.0'W	9	16.5	35.71
73420	33°50.0'N	78°16.5'W	11	16.4	36.20
73421	33°39.8'N	78° 5.8'W	15	17.5	36.66
73422	33°33.0'N	77°30.0'W	24	23.8	36.48
73423	33°49.6'N	77°46.8'W	15	17.1	36.26
73426	33°17.0'N	77° 8.7'W	155	17.3	36.52
73427	33°16.7'N	77°16.8'W	71	24.4	36.72
73428	33°21.5'N	77°18.0'W	35	24.9	36.66
73429	33° 2.3'N	77°15.5'W	302	11.6	35.60
73430	33° 9.5'N	77°35.0'W	79	23.3	37.00
73431	33° 8.0'N	77°42.0'W	77	24.1	36.67
73432	33° 4.0'N	77°41.0'W	155	16.7	36.32
73433	33° 4.5'N	77°58.0'W	40	24.7	36.50
73434	32° 2.5'N	77°53.0'W	110	18.5	36.63
73435	[illegible]	[illegible]	210	[illegible]	[illegible]

APPENDIX II. Catches of demersal fish by numbers and weight for individual depth zone for fall 1973 groundfish survey in the South Atlantic Bight. Weights in kg.

DEPTH ZONES		9-18		19-27		28-55		56-110		111-183		184-366	
FAMILY	SPECIES	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Rhinobatidae	Rhinobatis lentinginosus	2	0.5			1	0.1						
Rajidae	Raja eglanteria	40	22.2					1	0.5				
	Raja garmani									8	0.8	59	1.5
Dasyatidae	Dasyatis americana	10	29.9										
	Dasyatis centroura	2	296.2	3	182.3	1	68.0						
	Gymnura micrura	1	5.4										
Myliobatidae	Myliobatis freminvillei	11	64.0										
Muraenidae	Gymnothorax saxicola			2	0.6	1	0.1	5	0.3	2	0.1		
Muraenesocidae	Hoplunnis sp.							1	0.1				
Congridae	Ariosoma balearicum	12	0.3	13	0.1	5	0.2	1	0.1				
Ophichthidae	Mystriophis intertinctus			1	0.5								
	Mystriophis punctifer											1	0.1
	Ophichthus ocellatus							1	0.1	2	0.2		
	Xyrias sp.											1	0.1
Argentinidae	Glassanodon pygmaeus									87	0.8		
	Argentina striata									11	0.2		
Synodontidae	Synodus foetens	291	24.2	199	16.6	107	9.0	45	5.1				
	Synodus poeyi			10	0.3	75	0.6	329	1.8	171	1.4		
	Synodus intermedius							13	1.6				
	Trachinocephalus myops	2	0.2	21	0.9	21	1.6	41	2.7				
	Saurida brasieliensis			2	0.1					157	0.6		
	Saurida normani									1	0.1		
Chlorophthalmidae	Chlorophthalmus agassizi									1	0.1	49	0.4
Ariidae	Arius felis	77	10.1	6	0.9								
Batrachoididae	Porichthys porosissimus	3	0.3	14	0.6	7	0.1	22	0.5	22	1.0		
	Opsanus sp.			1	0.1								
Gobiesocidae	Gobiesox strumosus			1	0.1								
Antennariidae	Antennarius scaber			1	0.1								
Ogcocephalidae	Ogcocephalus radiatus			3	0.3	1	0.1	2	0.2	7	0.4		
	Ogcocephalus parvus			1	0.1			3	0.2				
	Ogcocephalus vespertilio							1	0.1				
	Ogcocephalus corniger									1	0.1		
	Halieuthichthys aculeatus							6	0.3	17	0.4		
	Ogcocephalidae					1	0.1						
Gadidae	Urophycis regius							2	0.1	1049	38.9	493	23.1
	Urophycis floridanus									2	0.1		
	Urophycis earlli			1	0.5								
Merluccidae	Merluccius albidus									6	0.2		
Moridae	Laemonema barbatulum									1	0.1		

DEPTH ZONES		9-18		19-27		28-55		56-110		111-183		184-366	
FAMILY	SPECIES	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Ophidiidae	Ophidion holbrooki	79	3.0	105	5.8	1	0.1	4	0.1				
	Ophidion grayi	37	1.1	7	0.2	1	0.1						
	Ophidion beani	24	0.6	78	3.4	22	0.8	11	1.1				
	Ophidion selenops	3	0.1	11	0.6	4	0.1						
	Otophidion omostigmum			15	0.4								
	Rissola marginata	7	0.4	4	0.3								
	Lepophidion jeannae							5	0.2				
	Lepophidion cervinum							3	0.1	4	0.2		
	Ophidiidae	1	0.1							1	0.1		
Polymyxiidae	Polymyxia lowei									8	0.1		
Syngnathidae	Corythoichthys albirostris			1	0.1								
Percichthyidae	Synagrops bella							4	0.1	61	0.8	47	0.9
Serranidae	Anthias asperlinguis											5	0.1
	Diplectrum formosum	55	2.5	211	15.5	86	9.3	2	0.1				
	Centropristis striata	49	6.8	105	19.7								
	Centropristis philadelphica	23	0.5	1	0.1			6	0.4				
	Centropristis ocyurus	5	0.2	58	2.2	3	0.2	27	0.9	7	0.1		
	Centropristis sp.	1	0.1	3	0.1								
	Serranus phoebe							133	3.7	3	0.2		
	Serranus notospilus							12	0.1				
	Serranidae			2	0.1								
Priacanthidae	Priacanthus arenatus	1	0.1	1	0.1								
	Pristigenys alta			1	0.1								
Rachycentridae	Rachycentron canadum	6	103.9	1	3.6	1	10.4						
Carangidae	Alectis crinitus	1	0.1	1	0.1								
Lutjanidae	Lutjanus campechanus	34	1.1	2	0.2			1	0.1				
	Rhomboplites aurorubens			375	22.6	1	0.1	19	1.9				
Gerreidae	Eucinostomus gula	16	0.4										
	Eucinostomus argenteus	2	0.2										
	Gerreidae	2	0.1										
Haemulidae	Orthopristis chrysoptera	2	0.2										
	Haemulon aurolineatum	1	0.1	1184	58.4	51	1.5						
	Haemulon striatum							1	0.1				
	Haemulon sp.			1	0.1								
Sparidae	Stenotomus aculeatus	3349	229.9	4391	304.0	14	0.8	215	5.4				
	Calamus leucosteus	40	12.8	22	7.7	3	3.2						
	Calamus nodosus							1	0.5				
	Lagodon rhomboides	4	0.2	2	0.2			6	0.9	1	0.1		
	Pagrus pagrus			7	0.5	2	0.2	59	4.1				
Sciaenidae	Micropogonias undulatus	236	16.7	39	6.8	3	0.6	25	3.6				
	Leiostomus xanthurus	179	21.1	3	0.6			8	0.9				
	Cynoscion nothus	53	0.5										
	Menticirrhus americanus	19	3.5	2	0.9								
	Menticirrhus saxatilis	1	0.1										
	Larimus fasciatus	5	1.0										
	Equetus lanceolatus			12	1.1								
	Pareques acuminatus	3	0.1										
	Pareques umbrosus	3	0.1	13	0.6					1	0.1		

DEPTH ZONES		9-18		19-27		28-55		56-110		111-183		184-366	
FAMILY	SPECIES	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Mullidae	Mullus auratus	1	0.1	15	0.7	1	0.1	1	0.1				
Ephippidae	Chaetodipterus faber	33	2.9	24	2.6	12	1.4						
Pomacentridae	Pomacentrus sp.							2	0.1				
Uranoscopidae	Astroscopus y-graecum	4	0.3										
	Kathetostoma albigutta					1	0.1	3	0.3				
Blenniidae	Hypsoblennius hentzi			1	0.1								
Gobiidae	Microgobius carri			1	0.1								
	Gobiidae			3	0.1								
Scorpaenidae	Scorpaena calcarata	5	0.3	25	0.8	4	0.3	4	0.1				
	Scorpaena agassizi							15	0.6				
	Scorpaena sp.			6	0.6								
	Pontius longispinus									20	0.2		
	Pontius rathbuni									10	0.5		
	Helicolenus dactylopterus									1	0.1	3	0.2
	Neomerinthe hemingwayi									2	1.5		
	Trachyscorpia cristulata											1	0.1
	Scorpaenidae	1	0.1										
Triglidae	Prionotus scitulus	62	2.8	13	0.5								
	Prionotus salmonicolor	19	2.1	14	2.4			7	0.5				
	Prionotus tribulus	4	0.9	2	0.1	1	0.1						
	Prionotus carolinus	4	0.3	48	2.5	64	4.8	74	6.6				
	Prionotus evolans	1	0.1	3	0.1								
	Prionotus ophryas	1	0.1	2	0.1	1	0.1	4	0.2				
	Prionotus stearnsi	1	0.1					1	0.1	7	0.3		
	Prionotus roseus			38	1.9			9	0.3				
	Prionotus alatus							15	0.6	2	0.1	32	1.4
	Prionotus sp.	1	0.1					1	0.1			1	0.1
	Bellator militaris			6	0.2			12	0.5	1	0.1		
	Bellator egretta							15	0.1				
	Bellator brachychir									5	0.2		
	Peristedion gracile									5	0.1		
	Peristedion thompsoni									1	0.1		
	Triglidae	5	0.2										
Dactylopteridae	Dactylopterus volitans			1	0.1								
Bothidae	Ancyclopsetta quadrocellata	19	3.2	3	1.0	1	0.1	2	0.5				
	Ancyclopsetta dilecta									1	0.1		
	Syacium papillosum	18	1.0	27	1.8	19	2.7	240	13.9				
	Scophthalmus aquosus	14	1.2										
	Paralichthys dentatus	13	3.1	4	1.8								
	Paralichthys albigutta	1	0.1	2	0.9								
	Paralichthys lethostigma	1	0.5										
	Paralichthys squamilentus									1	0.1		
	Etropus rimosus	4	0.2					2	0.1				
	Etropus crossotus	2	0.2					2	0.1				
	Bothus robinsi	1	0.1	11	0.3	5	0.4						
	Bothus ocellatus					1	0.1	7	0.4				
	Citharichthys macrops	1	0.1	2	0.1			1	0.1				

DEPTH ZONES		9-18		19-27		28-55		56-110		111-183		184-366	
FAMILY	SPECIES	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
	Citharichthys cornutus							16	0.3	4	0.1		
	Citharichthys arctifrons							1	0.1	188	0.5	36	0.2
	Citharichthys gymnorhinus							1	0.1				
	Cyclopsetta fimbriata			1	0.1	1	0.5	5	0.3				
	Gastropsetta frontinalis					2	0.2						
	Monolene sessilicauda									2	0.1		
	Bothidae					1	0.1	2	0.2				
Cynoglossidae	Symphurus plagiusa	3	0.3										
	Symphurus urospilus	1	0.1										
	Symphurus sp.	1	0.1									1	0.1
Triacanthodidae	Parahollardia lineata									2	0.1	11	0.1
Balistidae	Stephanolepis hispidus	91	6.2	381	22.0	243	3.7	16	0.5				
	Monacanthus ciliatus	2	0.2										
	Monacanthus sp.			1	0.1								
	Aluterus schoepfi	76	56.3	40	30.8	29	27.2						
	Aluterus monoceros	2	0.1	5	6.0	3	3.3						
	Aluterus heudeloti	1	0.1	7	2.0	6	0.9						
	Balistis capriscus	2	0.2	13	2.2	10	0.7						
Ostraciidae	Lactophrys quadricornis	7	1.5	22	5.2	1	0.1						
Tetraodontidae	Sphoeroides maculatus	3	0.7			1	0.1						
	Sphoeroides spengleri			1	0.1			1	0.1				
	Sphoeroides dorsalis					3	0.5						
	Sphoeroides pachygaster									5	2.3		
	Sphoeroides sp.	1	0.1	1	0.1	1	0.1						
	Lagocephalus laevigatus			1	0.9								
	Tetraodontidae			1	0.1								
Diodontidae	Chilomycterus schoepfi	1	0.1	4	1.6	2	0.2						

APPENDIX III. Collection numbers for fish species taken during the fall 1973 groundfish survey in the South Atlantic Bight.

Family	Species	Collection Numbers For Each Occurrence		
Rhinobatidae	Rhinobatos lentiginosus	73402	73421	
Rajidae	Raja eglanteria	73350	73360	73375
		73417	73418	73420
		73421		
	Raja garmani	73390	73391	73392
		73393	73394	73395
		73399	73407	73429
		73432	73435	
	Rajidae	73350		
Dasyatidae	Dasyatis americana	73381	73417	73418
		73421		
	Dasyatis centroura	73354	73356	73360
		73372	73385	73416
	Gymnura micrura	73421		
Myliobatidae	Myliobatis freminvillei	73418	73420	73421
Muraenidae	Gymnothorax saxicola	73376	73384	73386
		73389	73405	73406
		73433		
Muraenesocidae	Hoplunnis sp.	73376		
Congridae	Ariosoma balearicum	73357	73368	73369
		73370	73371	73372
		73405		
Ophichthidae	Mystriophis intertinctus	73416		
	Mystriophis punctifer	73407		
	Ophichthus ocellatus	73389	73395	73434
	Xyrias sp.	73407		
Clupeidae	Etrumeus teres	73388	73389	73432
	Opisthonema oglinum	73359	73383	
	Sardinella anchovia	73349	73350	73353
		73354	73355	73356
		73360	73361	73362
		73365	73367	73368
		73369	73370	73371
		73373	73374	73381
		73382	73385	73409
		73421	73422	
	Harengula pensacolae	73383		
Engraulidae	Anchoa cubana	73357	73368	73369
		73381	73383	73417
		73421		
	Anchoa hepsetus	73383	73418	73421
	Anchoa lyolepis	73350	73354	73356
		73357	73368	73369
		73381	73417	73421

Family	Species	Collection Numbers For Each Occurrence		
Engraulidae (cont.)	Anchoviella perfasciata	73350	73354	73356
Argentinidae	Argentina striata	73379	73393	
	Glossanodon pygmaeus	73377	73379	73391
		73393	73412	73432
Gonostomatidae	Gonostomatidae	73435		
Sternoptychidae	Sternoptychidae	73394	73399	
Myctophidae	Myctophidae	73377	73407	
Synodontidae	Synodus foetens	73349	73350	73351
		73352	73353	73354
		73355	73356	73357
		73358	73359	73360
		73361	73362	73364
		73365	73366	73367
		73368	73369	73370
		73371	73372	73373
		73374	73375	73376
		73381	73382	73383
		73384	73385	73386
		73397	73398	73400
		73401	73402	73404
		73406	73416	73417
		73418	73420	73421
		73422	73423	73431
		73433		
	Synodus poeyi	73355	73364	73371
		73376	73382	73388
		73396	73397	73398
		73400	73401	73402
		73405	73406	73409
		73410	73416	73427
		73430	73431	73434
	Synodus intermedius	73405	73406	73409
	Trachinocephalus myops	73357	73364	73366
		73367	73370	73371
		73372	73373	73376
		73384	73385	73386
		73388	73396	73398
		73400	73401	73402
		73404	73406	73427
		73433	73434	
	Saurida brasiliensis	73382	73410	73432
	Saurida normani	73412		
Chlorophthalmidae	Chlorophthalmus agassizi	73377	73390	73392
		73394	73399	
Ariidae	Arius felis	73369	73381	73382
		73383		
Batrachoididae	Opsanus sp.	73422		
	Porichthys porosissimus	73356	73357	73370
		73371	73377	73381
		73382	73384	73386
		73395	73400	73404
		73405	73406	73414
		73427	73434	
Gobiesocidae	Gobiesox strumosus	73422		

Family	Species	Collection Numbers For Each Occurrence		
Antennariidae	Antennarius scaber	73386		
Ogcocephalidae	Ogcocephalus parvus	73386	73405	73406
	Ogcocephalus radiatus	73376	73379	73382
		73384	73385	73395
		73410	73432	73433
		73434		
	Ogcocephalus vespertilio	73388		
	Ogcocephalus corniger	73432		
	Halieutichthys aculeatus	73376	73379	73389
		73395	73400	73405
		73426		
	Ogcocephalidae	73374		
Gadidae	Urophycis earlli	73422		
	Urophycis floridanus	73379		
	Urophycis regius	73376	73377	73379
		73389	73390	73391
		73392	73393	73395
		73399	73407	73426
		73432	73435	
Merluccidae	Merluccius albidus	73377	73379	
Moridae	Laemonema barbatulum	73412		
Ophidiidae	Ophidion holbrooki	73353	73356	73357
		73358	73368	73369
		73370	73381	73382
		73384	73385	73386
		73401	73405	73422
	Ophidion grayi	73356	73357	73358
		73364	73368	73369
		73370	73381	73404
		73421		
	Ophidion beani	73353	73356	73357
		73358	73361	73368
		73369	73370	73371
		73381	73382	73384
		73385	73386	73400
		73401	73402	73405
		73406	73414	73416
		73421	73433	
	Ophidion selenops	73349	73353	73356
		73357	73382	73384
		73385	73386	
	Otophidium omostigmum	73353	73386	73414
		73416		
	Rissola marginata	73353	73356	73357
		73358	73370	73404
		73421		
	Lepophidium jeannae	73405	73406	
	Lepophidium cervinum	73376	73377	73395
	Ophidiidae	73379	73417	
Polymyxiidae	Polymixia lowei	73379		

Family	Species	Collection Numbers For Each Occurrence
Caproidae	Antigonia capros	73412
	Antigonia combatia	73412
Fistulariidae	Fistularia villosa	73364 73375
Centriscidae	Macrorhamphosus scolopax	73412
Syngnathidae	Corythoichthys albirostris	73386
Perichthyidae	Synagrops bella	73375 73377 73379 73389 73390 73391 73392 73393 73395 73399 73407 73412 73429
Serranidae	Diplectrum formosum	73349 73351 73352 73353 73354 73355 73356 73357 73358 73359 73360 73361 73362 73365 73366 73367 73368 73369 73370 73371 73372 73373 73374 73381 73382 73384 73385 73386 73396 73397 73398 73401 73402 73404 73414 73416 73422
	Centropristis striata	73350 73352 73353 73355 73357 73368 73370 73386 73404 73416 73420 73421 73422 73423
	Centropristis ocyurus	73353 73362 73375 73376 73381 73382 73384 73386 73395 73398 73400 73402 73405 73416 73421 73422
	Centropristis philadelphica	73357 73358 73369 73375 73376 73381 73382 73400 73406 73421
	Centropristis sp.	73356 73369
	Serranus phoebe	73376 73388 73389 73405 73406 73409 73410 73431 73434
	Serranus notospilus	73375
	Anthias asperilinguis	73412
	Serranidae	73370
Priacanthidae	Priacanthus arenatus	73404 73422
	Pristigenys alta	73416
Pomatomidae	Pomatomus saltatrix	73350 73357 73383 73418
Rachycentridae	Rachycentron canadum	73354 73357 73360 73372 73385
Echeneidae	Echeneis naucrates	73354 73356 73357 73360 73372 73385

Family	Species	Collection Numbers For Each Occurrence		
Carangidae	Alectis crinitus	73354	73422	
	Caranx bartholomaei	73351	73352	
	Caranx crysos	73352	73354	73359
		73360	73385	73418
		73420	73421	
	Caranx hippos	73383		
	Chloroscombrus chrysurus	73358	73368	73373
		73381	73382	73383
	Decapterus punctatus	73349	73351	73352
		73353	73354	73355
		73359	73360	73361
		73362	73364	73365
		73367	73370	73371
		73372	73373	73374
		73375	73385	73386
		73388	73397	73401
		73402	73409	73414
		73416	73422	73423
		73427		
	Decapterus sp.	73409		
	Selene vomer	73420		
	Seriola fasciata	73402		
	Seriola zonata	73386		
	Trachurus lathami	73375	73376	
	Vomer setapinnis	73383		
Lutjanidae	Lutjanus campechanus	73357	73368	73369
		73370	73381	73385
		73400	73404	73420
		73421		
	Rhomboplites aurorubens	73353	73355	73362
		73367	73386	73406
		73409	73414	73416
		73422	73427	
Gerridae	Eucinostomus argenteus	73359	73418	
	Eucinostomus gula	73368	73381	73383
		73421		
	Gerreidae	73369		
Haemulidae	Haemulon aurolineatum	73361	73362	73364
		73367	73386	73414
		73416	73422	73423
		73433		
	Haemulon striatum	73405		
	Haemulon sp.	73353		
	Orthopristis chrysoptera	73357	73418	
Sparidae	Calamus leucosteus	73350	73355	73405
		73416	73422	73423
	Calamus nodosus	73431		

Family	Species	Collection Numbers For Each Occurrence
Sparidae (cont.)	Lagodon rhomboides	73352 73375 73376 73383 73395 73422 73423
	Pagrus pagrus	73397 73405 73422 73428
	Stenotomus aculeatus	73350 73351 73352 73353 73355 73356 73360 73361 73362 73364 73370 73373 73382 73384 73386 73395 73402 73414 73416 73418 73420 73421 73422 73423
Sciaenidae	Cynoscion nothus	73383
	Equetus acuminatus	73420
	Larimus fasciatus	73357 73383
	Leiostomus xanthurus	73350 73356 73357 73376 73382 73383 73418
	Menticirrhus americanus	73356 73357 73368 73369 73381 73383 73421
	Menticirrhus saxatilis	73421
	Micropogonias undulatus	73350 73356 73357 73362 73368 73369 73370 73371 73376 73383 73418
	Pareques lanceolatus	73352 73361 73386
	Pareques umbrosus	73379 73416 73420 73422
Mullidae	Mullus auratus	73354 73355 73362 73370 73376 73416
Ephippidae	Chaetodipterus faber	73350 73353 73356 73361 73368 73369 73370 73381 73383 73384 73385 73402
Pomacentridae	Pomacentrus sp.	73409
Sphyraenidae	Sphyraena borealis	73350 73383
Uranoscopidae	Astroscopus y-graecum	73359 73369 73404
	Kathetostoma albigutta	73376 73400 73401 73405
Blenniidae	Hypsoblennius hentzi	73422
Gobiidae	Microgobius carri	73370
	Gobiidae	73382
Gempylidae	Gempylus serpens	73379
Scombridae	Scomber japonicus	73354 73367 73389
	Scomberomorus maculatus	73383

Family	Species	Collection Numbers For Each Occurrence		
Corpaenidae	Helicolenus dactyloperus	73394	73412	73429
	Neomerinthe hemingwayi	73391	73412	
	Pontinus longispinus	73377	73379	
	Pontinus rathbuni	73412		
	Scorpaena agassizi	73388	73405	
	Scorpaena calcarata	73349	73357	73364
		73371	73381	73382
		73384	73385	73386
		73400	73421	
	Scorpaena sp.	73356	73422	
	Trachyscorpia cristulata	73394		
	Scorpaenidae	73417		
Stromateidae	Peprilus alepidotus	73383	73394	73395
		73418		
	Peprilus triacanthus	73383	73391	73392
		73393	73418	
Ariommidae	Ariomma bondi	73389	73432	
	Ariomma melanum	73390		
	Ariomma regulus	73362	73388	73396
Nomeidae	Cubiceps athenae	73389		
Triglidae	Bellator brachychir	73379	73432	
	Bellator egretta	73405		
	Bellator militaris	73376	73379	73384
		73385	73388	73405
		73406	73434	
	Prionotus alatus	73376	73395	73406
		73407		
	Prionotus carolinus	73349	73352	73353
		73355	73356	73367
		73369	73371	73384
		73385	73386	73398
		73400	73402	73417
		73421	73422	73428
		73433	73434	
	Prionotus evolans	73356	73357	
	Prionotus ophryas	73356	73382	73401
		73405	73406	73417
	Prionotus roseus	73384	73405	73406
		73416	73422	73434
	Prionotus salmonicolor	73368	73369	73370
		73381	73383	73384
		73385	73421	73434
	Prionotus scitulus	73356	73357	73358
		73368	73369	73370
		73381	73384	73386
		73404	73416	73417
		73421		

Family	Species	Collection Numbers For Each Occurrence		
Triglidae (cont.)	Prionotus stearnsi	73376	73379	73410
		73421	73432	
	Prionotus tribulus	73369	73384	73401
	Prionotus sp.	73388	73404	73407
	Peristedion gracile	73395		
	Peristedion thompsoni	73391		
	Triglidae	73358	73381	
Dactylopteridae	Dactylopterus volitans	73353		
Bothidae	Ancylopsetta dilecta	73432		
	Ancylopsetta quadrocellata	73350	73355	73358
		73359	73360	73368
		73381	73382	73385
		73402	73404	73405
		73417	73418	73420
		73421		
	Bothus ocellatus	73398	73409	73427
		73430	73433	
	Bothus robinsi	73364	73371	73382
		73384	73385	73401
		73402	73404	
	Citharichthys arctifrons	73376	73377	73379
		73390	73395	73407
		73410	73432	
	Citharichthys cornutus	73375	73376	73432
		73434		
	Citharichthys gymnorhinus	73406		
	Citharichthys macrops	73381	73400	73422
	Cyclopsetta fimbriata	73376	73406	73422
		73433	73434	
	Etropus crossotus	73381	73383	73406
	Etropus rimosus	73376	73404	73421
	Gastropsetta frontalis	73362	73433	
	Monolene sessilicauda	73412		
	Paralichthys albigutta	73357	73416	
	Paralichthys dentatus	73354	73355	73361
		73368	73404	73416
		73417	73418	73420
		73421		
	Paralichthys lethostigma	73421		
	Paralichthys squamilentus	73412		
	Scophthalmus aquosus	73404	73417	73418
		73421		

Family	Species	Collection Numbers For Each Occurrence		
Bothidae (cont.)	Syacium papillosum	73349	73350	73353
		73360	73364	73368
		73369	73370	73371
		73375	73376	73381
		73384	73385	73388
		73398	73400	73401
		73402	73404	73405
		73406	73414	73427
		73430	73433	73434
	Bothidae	73371	73376	73400
Cynoglossidae	Symphurus plagiusa	73369	73420	73421
	Symphurus urospilus	73358		
	Symphurus sp.	73368	73435	
Triacanthodidae	Parahollardia lineata	73379	73407	
Balistidae	Aluterus heudeloti	73349	73350	73361
		73364	73367	73397
		73422		
	Aluterus monoceros	73350	73364	73382
		73386	73422	73428
	Aluterus schoepfi	73350	73351	73352
		73354	73355	73359
		73364	73365	73366
		73367	73368	73369
		73370	73372	73374
		73384	73385	73386
		73397	73401	73402
		73414	73416	73417
		73422	73423	
Balistidae	Balistes capriscus	73351	73352	73353
		73355	73358	73366
		73369	73371	73372
		73385	73386	73396
		73397	73401	73402
	Monacanthus ciliatus	73404	73423	
	Monacanthus sp.	73352		
	Stephanolepis hispidus	73349	73350	73351
		73352	73353	73355
		73356	73357	73358
		73360	73364	73365
		73366	73367	73369
		73370	73371	73381
		73382	73383	73384
		73385	73386	73388
		73396	73397	73398
		73399	73400	73401
		73402	73404	73406
		73414	73416	73422
		73423	73427	73433
Ostraciidae	Lactophrys quadricornis	73350	73353	73355
		73356	73367	73369
		73384	73385	73401
		73423		
Tetradontidae	Lagocephalus laevigatus	73422		
	Sphoeroides dorsalis	73433		

Family	Species	Collection Numbers For Each Occurrence		
Tetradontidae (cont.)	Sphoeroides maculatus	73357	73402	73417
		73423		
	Sphoeroides spengleri	73386	73431	
	Sphoeroides pachygaster	73410	73432	
	Sphoeroides sp.	73353	73401	73417
	Tetraodontidae	73384		
Diodontidae	Chilomycterus schoepfi	73349	73350	73355
		73372	73386	73422

APPENDIX IV. Diversity values by depth zones for successful sand bottom trawls in the South Atlantic Bight during autumn 1973.

Depth Zone (m)	Collection Number	Depth (m)	Number Of Species	Number of Individuals	H' Bits/Ind.	J' Evenness	Species Richness
9-18	73350	15	17	2498	0.280	0.068	2.045
	73354	16	8	38	1.867	0.622	1.924
	73357	16	25	100	3.765	0.810	5.211
	73358	15	13	56	2.896	0.782	2.981
	73359	13	6	13	2.034	0.787	1.949
	73360	16	9	145	1.328	0.419	1.607
	73368	16	19	104	3.729	0.877	3.875
	73369	13	25	154	3.518	0.757	4.764
	73381	15	23	176	3.620	0.800	4.254
	73383	16	13	381	1.787	0.483	2.019
	73404	13	20	55	3.154	0.729	4.741
	73417	9	14	36	3.095	0.813	3.627
	73418	9	12	142	1.685	0.470	2.219
	73420	11	11	179	1.884	0.544	1.927
	73421	15	28	138	3.783	0.787	5.479
	73423	15	11	884	1.264	0.365	1.474
19-27	73351	20	6	206	0.430	0.166	0.938
	73352	24	11	2909	0.113	0.032	1.253
	73353	24	20	282	2.514	0.581	3.367
	73355	24	16	403	1.776	0.441	2.500
	73356	20	22	154	3.525	0.790	4.169
	73361	20	9	122	1.580	0.498	1.665
	73367	24	10	74	1.579	0.475	2.091
	73370	20	22	154	3.414	0.765	4.169
	73382	26	21	95	3.588	0.817	4.391
	73384	24	25	292	3.424	0.737	4.227
	73385	24	22	93	3.855	0.864	4.633
	73386	26	27	295	2.936	2.753	4.571
	73414	26	10	28	2.748	0.827	2.700
	73416	20	22	961	1.573	0.352	3.057
	73422	24	29	1598	1.881	0.387	3.795
28-55	73349	33	9	65	2.516	0.794	1.916
	73362	33	9	41	2.325	0.733	2.154
	73364	40	13	108	1.795	0.485	2.562
	73365	35	4	17	1.954	0.977	1.058
	73366	33	6	17	2.011	0.778	1.764
	73371	31	15	103	2.834	0.725	3.020
	73372	35	9	12	2.918	0.920	3.219
	73373	33	4	16	1.491	0.745	1.082
	73374	31	4	18	1.233	0.616	1.037
	73396	44	5	88	1.009	0.434	0.893
	73397	42	8	46	2.244	0.748	1.828
	73401	38	16	96	3.000	0.750	3.286
	73402	31	17	79	3.410	0.834	3.661
	73428	35	3	5	1.521	0.960	1.242
	73433	40	13	111	1.955	0.528	2.548
56-110	73375	86	9	61	2.436	0.768	1.946
	73376	110	26	155	3.506	0.746	4.956
	73388	75	9	37	2.418	0.762	2.215
	73398	59	9	53	2.658	0.838	2.015
	73400	62	16	231	2.439	0.609	2.756
	73405	82	23	311	3.238	0.715	3.832
	73406	86	21	233	2.560	0.582	3.669
	73409	62	6	41	1.710	0.661	1.346
	73427	71	7	17	2.704	0.963	2.117
	73430	79	3	7	1.378	0.869	1.027
	73431	77	5	21	1.548	0.667	1.313
	73434	110	13	95	2.564	0.692	2.635

Depth Zone (m)	Collection Number	Depth (m)	Number Of Species	Number of Individuals	H' Bits/Ind.	J' Evenness	Species Richness
111-183	73377	174	9	287	1.484	0.468	1.413
	73379	159	17	174	2.546	0.622	3.101
	73389	128	6	13	2.287	0.885	1.949
	73391	174	6	61	0.758	0.293	1.216
	73393	174	5	196	0.571	0.246	0.757
	73395	126	14	880	1.362	0.357	1.917
	73410	141	7	284	1.201	0.428	1.062
	73412	168	13	104	2.639	0.713	2.583
	73426	155	2	8	0.811	0.811	0.480
	73432	155	13	147	1.996	0.539	2.404
184-366	73390	278	5	53	1.588	0.684	1.007
	73392	188	4	173	1.278	0.639	0.582
	73394	329	4	5	1.921	0.961	1.864
	73399	194	4	209	0.913	0.456	0.561
	73407	188	9	241	1.730	0.545	1.458
	73429	302	3	7	1.378	0.869	1.027
	73435	210	3	47	0.296	0.187	0.519