OBSERVATIONS ON COMPOSITION, SEASONALITY AND DISTRIBUTION OF ICHTHYOPLANKTON FROM MARMAP CRUISES IN THE SOUTH ATLANTIC BIGHT IN 1973[1]

Howard Powles and Bruce W. Stender

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

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Introduction

In 1972, the United States National Marine Fisheries Service (NMFS) initiated the Marine Resources Monitoring, Assessment, and Prediction (MARMAP) program. This program is designed to survey the living marine resources of the waters adjacent to the United States in a standardized, coherent manner. In 1973, the Marine Resources Research Institute (MRRI) of the South Carolina Wildlife and Marine Resources Department, through a long-term contract agreement with NMFS, assumed responsibility for MARMAP activities in the South Atlantic Bight of the United States. Both an ichthyoplankton survey (MARMAP Survey I) and a groundfish survey (MARMAP Survey II) of the continental shelf and slope waters of the South Atlantic Bight - from Cape Fear, North Carolina, to Cape Canaveral, Florida - were begun in 1973.

The major objectives of the MRRI-MARMAP ichthyoplankton program are those of MARMAP Survey I as a whole (Anon., 1973):

1. Detection of the presence of designated species in the area of interest;
2. Determination of the distribution and abundance of fish eggs and larvae;
3. Estimation of the location of the spawning grounds of specified species;
4. Estimation of the size of spawning populations of designated species;
5. Forecasting the year-class strength of designated species;
6. Detection of anomalous biological and environmental conditions.

In its initial phases, the MRRI program has been designed around large-scale survey cruises with widely-spaced stations, covering the whole South Atlantic Bight region two or three times per year. Such cruises should be sufficient for achievement of objectives 1, 2, 3, and 6. Smaller-scale, species-specific studies with increased sampling density in both time and space will probably be necessary for achievement of objectives 4 and 5. The present extensive surveys should provide information necessary for designing such studies.

Limited information on occurrence, abundance, and distribution of planktonic young fishes in the South Atlantic Bight has been published. The present decade is the third in which large-scale ichthyoplankton investigations have been carried out in the region. A survey of the South Atlantic Bight was made by the Brunswick Laboratory of the Bureau of Commercial Fisheries (forerunner of the National Marine Fisheries Service) on nine cruises of the M/V Theodore N. Gill in 1953 and 1954 (Anderson and Gehringer, 1959, and earlier reports). Gulf IA and Gulf III high speed samplers and a continuous plankton recorder were used on these surveys. Young fishes were also collected from surface waters with dipnets and from stomach contents of predatory pelagic fishes. Studies of the early life history stages of several ecologically and commercially important groups of fishes were published based on collections from this survey (e.g. the Mugilidae, by Anderson, 1957, 1958; fishes of the genus *Caranx*, by Berry, 1959). In 1967 and 1968, the Sandy Hook Laboratory of the Bureau of Commercial Fisheries surveyed the ichthyoplankton of the South Atlantic Bight on four cruises of the R/V Dolphin, using a Gulf V high speed sampler for subsurface tows and a 1-meter ring net for surface tows (Clark *et al.*, 1970). Fahay (1975) has listed families and species of fishes caught in the surface net tows and has summarized identification methods for and distributions of selected species.

The present MRRI-MARMAP ichthyoplankton survey adds a quantitative dimension to these earlier studies in that the gear (the bongo sampler and Boothbay neuston net) and methods (in particular, the oblique plankton haul from bottom to surface) employed are designed specifically for quantitative assessment of ichthyoplankton and ichthyoneuston numbers. Further, gear and methods are standard throughout the MARMAP program so results should be comparable between areas and also from year to year within the same area.

The present report summarizes preliminary results from the first year of the MRRI-MARMAP ichthyoplankton survey. Three survey cruises were made in 1973, one each in winter (D2-73), spring (D3-73), and fall (D5-73). Preliminary results for each cruise summarized here include area covered, composition by families of the ichthyoplankton and ichthyoneuston catches, composition by genera and species of selected families, geographic distribution of larvae and juveniles of selected families, and distribution in relation to temperature and salinity.

Cruise D4-73, a neuston gear test cruise, is not discussed in this report. This cruise was undertaken to assess the relative effects of time of day, towing speed, net configuration (4.9 m vs. 8.5 m net lengths), and other variables on catches of the Boothbay neuston net. Results of this cruise are in manuscript (Eldridge et al. MS, 1975) and are to be published.

Methods

The R/V Dolphin, a 33 meter (109 foot) steel tug converted for oceanographic and fisheries research, was used on all cruises.

Standard MARMAP methods were used for collection of young fishes. A bongo sampler, consisting of two nets each of mouth diameter 60 cm (mesh sizes 0.505 mm and 0.333 mm), was hauled in a double oblique pattern from 2 m above the bottom or from 200 m depth in water deeper than this. Towing speed was 0.8 m/sec (1.5 knots). Towing wire angle was maintained as close to 45° as possible through use of an inclinometer with readout on the ship's bridge. The sampler was streamed at 50 m/min and hauled at 20 m/min. A General Oceanics flowmeter, mounted in the center of the 0.505 mm net mouth, was used to estimate volume filtered. Samples from the 0.505 mm net were analyzed, while samples from the 0.333 mm net were preserved for other studies.

A Boothbay neuston sampler (mouth opening 1 m high by 2 m wide; mesh size 0.947 mm; net length 8.5 m) was towed for 10 minutes at 2.6 m/sec (5 knots), with the net mouth half in the water (thus giving a sampling depth of 0.5 m). On certain stations (noted in the text), 15-minute tows at 1.8 m/sec (3.5 knots) were made.

Nets were washed down thoroughly after every tow. Samples were fixed by immersing the net codend in 20% formalin immediately after washing down. Collections were then preserved in 5% buffered formalin.

Standardized catches (catch per 100 m^2 sea surface area) were calculated for both neuston and bongo nets to facilitate comparison of catches in different areas and by different samplers. Catches standardized to unit surface area rather than to volume strained were used for both types of tow following MARMAP standard procedure (Jossi and Marak, MS, 1975). Standardization of results to unit surface area was first recommended by Ahlstrom (1948) for expressing ichthyoplankton abundance throughout the water column. For neuston tows, standardized catches were calculated by dividing the number of individuals caught by the area sampled (length of tow x 2 m); this area is approximately 3100 m^2 for the 10-minute tows at 2.6 m/sec and for the 15-minute tows at 1.8 m/sec. For bongo tows, standardized catch was computed by the following formula:

$$S = \frac{N}{V} \times D_{max} \times 100$$

S = standardized catch (number/100 m^2)
N = number of individuals in the tow
V = volume filtered on the tow (m^3)
D_{max} = maximum depth reached by the tow (m)

Surface temperatures were taken by bucket thermometer, and surface salinity samples were drawn from a bucket. Bottom temperatures were taken by reversing thermometers. Salinity values were determined by a Beckman RS-7B conductivity salinometer at MRRI.

Young fishes were removed from plankton and neuston samples using magnifying loupes at magnifications of 3X. The specimens were then identified to as low a taxonomic level as possible, counted, measured (minimum and maximum total lengths), and stored for further study of priority groups. In almost all cases, all fishes from a sample were identified and enumerated. Thirteen large winter neuston samples were split with a Burrell plankton splitter (Burrell et al., 1974) and an aliquot of 1/2 - 1/16 was sorted for young fishes.

Nomenclature in this report follows Bailey et al. (1970), with two exceptions: the family Monacanthidae has been retained (fishes of this group are classified as Balistidae by Bailey et al., 1970), and the genus Stephanolepis as distinct from the genus Monacanthus has been retained, following Berry and Vogele (1961). These exceptions reflect attempts to classify young fishes to the lowest possible taxonomic level rather than taxonomic decisions on our part.

MRRI — MARMAP DOLPHIN CRUISE D2-73

Introduction

The initial cruise with the R/V Dolphin lasted from 13 February through 23 March, 1973. The primary objective of this cruise was the investigation of the distribution and abundance of fish eggs, larvae, and juveniles. Seventy-three stations were made with both a 1 x 2 m Boothbay neuston net and a 60 cm bongo sampler. Sixty-seven stations were sampled by the R/V Dolphin and six with the cooperation of the National Marine Fisheries Service by the

R/V Oregon II. Stations were located every thirty minutes of latitude and longitude from off Cape Fear, North Carolina (latitude 34°N), to off Delray Beach, Florida (latitude 26°30'N), and from 10 m depth to the approximate axis of the Florida Current (Figure 1).

The results from the bongo and neuston tows are summarized separately below, with a comparison of the two nets and preliminary day-night observations following results of the individual samplers.

Bongo Collections

Volumes filtered ranged from 40 m^3 to 347 m^3, depending on the duration of the tow which varied with bottom depth (Figure 2). Between 40 and 130 m^3 were filtered on 49.3% of all tows while 39.7% of the tows filtered between 230 and 310 m^3. Total volume filtered for the bongo tows was 12,427 m^3 for this cruise. This figure provides an index of bongo sampling effort and thus aids in comparing total bongo catches from cruise to cruise.

The number of fish caught per station ranged from 0 (on 4 stations) to 250, with a total catch of 2,479. The modal class on a logarithmic base was that of 32-63 specimens per station (Figure 3). The number of taxa caught per station varied from 0 to 32, with the majority (91.8%) of stations having less than 18 taxa (Figure 4).

A. Catch composition. In the catch of 2,479 fish, represented are 12 orders composed of 48 families (Table 1). Unidentified larvae accounted for 14.04% of the total catch.

The most abundant orders of young fish in the bongo samples were Perciformes (735 specimens in 26 families), Myctophiformes (473 specimens, 3 families), Clupeiformes (465 specimens, 2 families), Pleuronectiformes (160 specimens, 2 families), and Gadiformes (145 specimens, 4 families). These composed 79.78% of the specimens caught by the bongo 0.505 net.

The most abundant families in the catch were Clupeidae (456 specimens), Myctophidae (247 specimens), Sciaenidae (223 specimens), Bothidae (127 specimens), Gobiidae (75 specimens), and Labridae (69 specimens) (Table 2). These six families accounted for 48.29% of the total catch.

The most widely-occurring families of the total catch were Myctophidae (present on 44 of the 73 stations), Bothidae (40), Clupeidae (35), Gobiidae (33), and Labridae (30) (Table 2).

Generic and specific identifications were made for eleven families. Three of these families were represented by more than 50 fish, and subfamilial breakdown has been given below for these three families - Sciaenidae, Bothidae, and Clupeidae.

1). Sciaenidae. Of the 223 sciaenids, composing 9.00% of the total catch, 212 specimens were *Leiostomus xanthurus* (95.07% of the Sciaenidae), 8 were *Micropogon undulatus* (3.59% of the Sciaenidae), and 3 remained questionable at the generic level (1.35% of the Sciaenidae).

2). Bothidae. Of the 127 bothid specimens, composing 5.12% of the total catch, 44 were *Bothus* sp. (34.65% of the Bothidae), 1 was *Paralichthys* sp. (0.79% of the Bothidae), 3 were *Syacium* sp. (2.36% of the Bothidae), and 79 remained questionable at the generic level (62.20% of the Bothidae).

3). Clupeidae. Of the 456 clupeids, composing 18.39% of the total catch, 77 were *Brevoortia* sp. (16.89% of the Clupeidae), 39 were *Etrumeus teres* (8.55% of the Clupeidae), and 340 remained unidentified at the generic level (74.56% of the Clupeidae).

B. Distribution. The distributions of several major families in samples from the bongo and neuston nets (discussed later) have been compared with the distributions of surface temperature and salinity. Over the survey area of D2-73, the surface temperature varied from 9.8 to 25.8°C (Figure 5). Surface salinity varied from 26.9 to 36.5 ‰ (Figure 6). In the winter in the area covered, surface waters with temperatures ≥ 20° or with salinities ≥ 36.0 ‰ are characteristic of Florida Current waters. For this cruise, 21 stations had temperatures < 20°C, and 22 had salinities < 36.0 ‰. Florida Current waters were present over the outer continental shelf and continental slope throughout the survey area and extended to the shoreline south of Cape Canaveral.

Because of the unavailability of complete station data from the stations completed by the Oregon II, standardized catches could not be calculated for the six southernmost stations. Presence or absence of specimens has been indicated for these stations on the distribution maps. Also, in all of the following families, very few larvae were caught on the most inshore station of each transect. However, this may be a result of the sampling technique instead of actual distribution since the bongo net is towed for only about five minutes in shallow water.

1). Clupeidae (Figure 7). All stations on which standardized catches of > 1000 fish per 100 m^2 were obtained were in Florida Current waters, with a surface salinity > 36.0 ‰. Clupeids were present on 47.9% of all stations.

2). Myctophidae (Figure 8). Stations on which > 100 myctophids per 100 m^2 were caught were in waters of surface temperature > 20°C. There seemed to be two centers of myctophid abundance, both offshore (depth > 200 m) - one off South Carolina along 33°30'N latitude and another off Florida from 30°30'N latitude south through the sampling area.

3). Sciaenidae (Figure 9). Sciaenids were concentrated in waters < 200 m deep in the northwestern section of the area sampled. Specimens were present on only three stations outside this area, one of which was in water > 200 m deep. One station off North Carolina yielded a standardized catch of 3492.9 fish.

4). Bothidae (Figure 10). Bothids were present uniformly through the area sampled and occurred on 54.8% of the stations. All stations on which > 100 bothids per 100 m^2 were obtained were in water > 40 m deep.

5). Gobiidae (Figure 11). On the transects north of 32°N latitude, gobies were present only on stations with a depth of > 40 m and a salinity > 36.0 °/oo. On and below 32°N latitude, this tendency did not hold true; gobies were uniformly distributed throughout the southern area sampled.

6). Labridae (Figure 12). Catches of wrasses were essentially restricted to the offshore stations. All stations on which labrids were caught, except for one with a standardized catch of 9.0 fish, were in depths > 40 m. Most specimens were captured in waters of surface salinity > 36.0 °/oo.

Neuston Tows

Of the 73 neuston tows, fishes were caught in all but one. The number of young fishes per station varied from 0 to 53,138. The distribution of total catch among the stations (Figure 13) was roughly lognormal, with 20 stations falling into the modal class of 32-63.

The number of taxa caught per station varied from 0 to 37. Considering the distribution of the number of taxa caught per station (Figure 14), 49.3% of the tows caught 4-9 taxa and 35.6% caught 10-19 taxa.

A. Catch composition. In the neuston tows, 66,927 fish larvae and juveniles, representing 13 orders and 60 families, were caught (Table 3). Of this total, 1.11% of the fish remain unidentified. The distribution of the total catch among the families (Figure 15) showed that 60.0% of the total number of families were represented by < 32 specimens. One family, the Sciaenidae, accounted for 66.74% of the total catch, due to one extremely large catch of 44,350 fish off North Carolina.

The four most abundant orders were Perciformes (49,821 specimens, composed of 31 families), Clupeiformes (8,302 specimens, 2 families), Gadiformes (3,906 specimens, 4 families), and Pleuronectiformes (2,285 specimens, 2 families). These four orders represented 96.09% of the total neuston catch (Table 3).

The majority of the total catch (90.68%) was composed of the five most abundant families. These were Sciaenidae (44,664 specimens, 66.74% of the total catch), Clupeidae (7,921 specimens, 11.84%), Gadidae (3,891 specimens, 5.81%), Bothidae (2,131 specimens, 3.18%), and Mullidae (2,083 specimens, 3.11%) (Table 4).

The most widely-occurring families in the total neuston catch were Carangidae (present on 42 stations), Mugilidae (40), Exocoetidae (33), Tetraodontidae (33), Gadidae (32), and Bothidae (31) (Table 4).

Generic and specific identifications were made in 35 families. The subfamilial breakdowns for 10 of the more important and abundant families have been compiled in Tables 5 through 14 and are discussed in the following sections. The remaining 25 families had less than 170 specimens collected or had the majority of the catch unidentified.

1). Sciaenidae. The sciaenid catch was composed of two species, Leiostomus xanthurus (44,514 specimens, 99.66% of the family catch at 14 stations) and Micropogon undulatus (138 specimens, 0.31% of the family catch at 5 stations). Specimens of L. xanthurus from one station off North Carolina accounted for 99.01% of all sciaenids caught and 66.07% of the entire neuston catch. Twelve specimens of sciaenids were not identified below the family level.

2). Clupeidae (Table 5). The most abundant and widely-occurring clupeid genus was Brevoortia, composing 94.33% of the clupeids. Other genera and species taken were Etrumeus teres, Sardinella sp., Sardinella anchovia, and Harengula sp.; specimens tentatively assigned to Jenkinsia and to Etrumeus teres were also taken.

3). Gadidae (Table 6). Urophycis regius was the most abundant species, composing 72.05% of the Gadidae. Urophycis sp. accounted for 19.40% of the total gadid neuston catch, Urophycis floridanus for 1.23%, and 7.32% remained unidentified below the familial level.

4). Bothidae (Table 7). The catch of the fourth most abundant family was composed of seven genera. The most abundant genus was Paralichthys, composing 36.31% of the bothids, followed by Cyclopsetta, accounting for 26.23%. Unidentified bothids made up 25.62% of the catch.

5). Monacanthidae (Table 8). In the

Monacanthidae, 96.75% of the fish obtained were in the genus Stephanolepis. Of the total catch, 85.45% were identified as Stephanolepis sp., 11.16% as Stephanolepis hispidus (the most widely-occurring species, found on 20 of the 25 stations where monacanthids were taken), 1.84% as Monacanthus ciliatus, 1.13% as unidentified Monacanthidae, 0.28% as Aluterus scriptus, and 0.14% as Stephanolepis setifer.

6). Scombridae. Only two scombrid genera were identified: Scomber, with 682 specimens (98.70% of the scombrid catch, taken at 7 stations), and Auxis, with five specimens (0.72% of the scombrid catch, taken at 2 stations). Unidentified scombrids accounted for 0.58% of the family catch.

7). Carangidae (Table 9). Among the jacks, 91.09% of the total catch was composed of two genera: Decapterus, with 49.19% of the carangids (present on 13 stations), and Seriola, with 41.90% of the carangids (present on 24 of the total 42 stations on which jacks were caught). Only 1.79% of the total carangid catch was not identified further than family. The remaining 7.10% was composed of four genera - Trachurus, Trachinotus, Caranx, and Selar.

8). Tetraodontidae. Of the 401 tetraodontids, 352 were identified as Sphoeroides sp. Fishes of this genus were taken at 21 stations.

9). Mugilidae (Table 10). The majority (81.15%) of specimens of this family were Mugil cephalus. Mugil curema represented 6.28% of the Mugilidae, specimens of Mugil of questionable specific identity represented 12.29%, and 0.27% remained as Mugilidae.

10). Stromateidae (Table 11). The stromateid catch was composed of four genera and five species. Unidentified stromateids accounted for 19.88% of the catch. Peprilus triacanthus (with 62.57% of Stromateidae) was the most abundant species followed by Nomeus gronovii (11.70%), Ariomma regulus (2.34%), Peprilus sp. (1.75%), Psenes cyanophrys (1.17%), and Psenes pellucidus (0.58%).

B. Distribution.

1). Sciaenidae (Figure 16). Catches of Sciaenidae were concentrated inshore and in the northwestern section of the sampling area. Only 3 of the 15 stations on which sciaenids were caught were in depths > 200 m. One station off North Carolina had 1431.0 fish per 100 m^2, while all other stations had < 10 per 100 m^2.

2). Clupeidae (Figure 17). All stations with > 10 fish per 100 m^2 were in waters with a surface temperature of < 20° C. Clupeids were found in 41.1% of the tows, with 80% of these being inshore of the 200 m curve.

3). Gadidae (Figure 18). All stations with > 10 gadids per 100 m^2 had surface salinities > 36.0 °/oo. Gadids were found in the northwestern section of the sampling area, with none caught south of 29°30'N latitude. Between 32°N latitude and 29°30'N latitude, they were found only in waters < 200 m deep, but from 32°N latitude north, there was no apparent relation between depth and distribution.

4). Bothidae (Figure 19). The two stations with > 10 bothids per 100 m^2 were in waters with a surface temperature < 20° C. Bothids were found on 42.5% of all stations, and 61.3% of these were in water shallower than 200 m.

5). Mullidae (Figure 20). Mullids were found on 41.1% of the neuston stations. All but two of these (with catches of 0.03 and 0.48 fish per 100 m^2) were stations with surface temperature > 20°C. All stations with mullids, except for two (standardized catch of 0.03 and 0.16) were in depths > 40 m.

6). Carangidae (Figure 21). Carangids were present in 57.5% of the neuston tows. Their distribution was uniform with respect to latitude; 78.6% of positive stations were in depths > 40 m.

7). Mugilidae (Figure 22). This family was present in 54.8% of the tows. Catches were widespread over the survey area. The two stations with standardized catches of one or more fish had surface salinities > 36.0 °/oo.

8). Scombridae (Figure 23). Most of the scombrid larvae were taken in the northern part of the survey area and in waters > 20 m deep. The majority of the scombrid catch was from waters with a surface salinity > 36.0 °/oo.

Comparison of the Bongo and Neuston Catches

All of the 12 families ranking in the top five with respect to occurrence or abundance in either neuston or bongo tows have been compared on the basis of their relative rank in the catches of the 2 types of gear (Table 12).

A. Catch composition. Of the 12 families, four were approximately equally important in catches of the two nets. These were the Bothidae, Carangidae, Clupeidae, and Sciaenidae. Those with higher ranks in the bongo than in the neuston catches were Gobiidae, Labridae, and Myctophidae. Families with higher ranks in the neuston were the Exocoetidae (with no specimens caught in the bongo net), Gadidae, Mugilidae, Mullidae, and Tetraodontidae. Standardized catches were generally several orders of magnitude greater in the bongo than in the neuston tows.

B. Distribution. For most of the families listed above (Section A), relative ranks in the neuston and bongo catches with respect to frequency of occurrence were similar to those with respect to numbers caught (Table 12). Thus, for example, specimens of Bothidae occurred with approximately the same frequency in neuston and bongo nets, specimens of Gobiidae occurred more frequently in bongo than in neuston tows, and specimens of Gadidae occurred more frequently in neuston than in bongo tows. The only exception was the carangids which were approximately equally ranked in neuston and bongo tows with respect to abundance, but which occurred in a higher proportion of neuston tows than of bongo tows.

Three families (the Bothidae, Clupeidae, and Sciaenidae) each ranked similarly in the neuston and bongo catches with respect to both abundance and occurrence, are discussed in the following section with respect to their distribution in the bongo and neuston tows. The number of stations in which specimens of the family were present in either or both nets was 53 for Bothidae, 47 for Clupeidae, and 25 for Sciaenidae. The percentage of these stations at which specimens were present in both nets was 34.0% for Bothidae (18 stations of the total 53), 38.3% for Clupeidae (18 of 47), and 24.0% for Sciaenidae (6 of 25).

1). Bothidae (Figures 10 & 19). In the neuston, there were two stations where > 10 fish per 100 m^2 were obtained. In the bongo, 16 stations had > 100 bothids per 100 m^2. One station (34°N, 76°30'W) was in these ranges in both neuston and bongo samples. Half of the 16 bongo stations with high catches were stations where bothids were also caught in the neuston. Generally, there appeared to be no particular pattern in the distribution of stations at which bothids occurred in either or both nets.

2). Clupeidae (Figure 7 & 17). There were 3 stations where the neuston catch was > 10 clupeids per 100 m^2, and 5 where the bongo catch was > 1000 fish per 100 m^2. No stations had both a high neuston and a high bongo catch, but on all three of the stations with high neuston catches, clupeids were present in the bongo samples. At two of the five stations with high bongo catches of clupeids, clupeids were also present in the neuston tows. Occurrence in either as opposed to both nets followed no pattern.

3). Sciaenidae (Figures 9 & 16). There was one station where the neuston catch was > 10 sciaenids per 100 m^2. This was also the only station where > 1000 sciaenids per 100 m^2 were found in the bongo samples. Presence in either as opposed to both nets followed no pattern in the sciaenids.

Day-Night Observations

Preliminary observations were made on differences in catches of several families with the time of day of sampling, categories being day, night, dusk, and dawn. (Time of tow = start time; Dawn = 1 hr on either side of sunrise; Dusk = 1 hr on either side of sunset.) Because of the unavailability of data from the Oregon II cruise, the six southernmost stations were considered taken at an unknown time.

A. Bongo tows. Of the total number of tows, 9.6% were at dawn, 35.6% during the day, 11.0% at dusk, 35.6% at night, and 8.2% (6 Oregon II stations) at an unknown time. Concerning the total volume filtered, 9.7% was filtered at dawn, 38.5% during the day, 11.8% at dusk, 30.2% at night, and 9.8% at an unknown time. Of the total catch, 3.71% of all specimens were taken at dawn, 29.08% during the day, 5.04% at dusk, 53.62% at night, and 8.55% at an unknown time. Thus, although equal amounts of sampling effort were expended by day and by night, more fishes were taken by night, suggesting some degree of gear avoidance by day. However, there were no apparent diel differences in bongo catches of the most abundant families - Clupeidae, Myctophidae, Sciaenidae, Bothidae, Gobiidae, and Labridae.

B. Neuston tows. Of the neuston stations, 12.3% were made at dawn, 31.5% during the day, 8.2% at dusk, 39.8% at night, and 8.2% at an unknown time. Of the total catch, 6.36% was taken at dawn, 3.78% during the day, 2.48% at dusk, 86.53% at night, and 0.85% at an unknown time. The high percentage of the catch taken at night was primarily due to one station at night off North Carolina at which 79.40% of the total neuston catch was obtained. If this station was omitted from the calculations, then 30.85% of the total catch was captured at dawn, 18.32% during the day, 12.02% at dusk, 34.69% at night, and 4.12% at an unknown time. As with the bongo samples, equal effort was expended by day and by night, but more fishes (about twice as many) were taken by night, suggesting either gear avoidance by day or diel vertical migration.

In the Sciaenidae, Micropogon undulatus was found only in night samples (total of 138 larvae). For Leiostomus xanthurus, 9 of the total 15 positive stations were at night. In the clupeids, 5 Etrumeus teres were found at dusk with the remaining 413 found at night. Of the 2131 bothids, none were caught during the day, some were caught at dusk and dawn, and most were taken at night. Of the 2083 Mullidae, 12 were captured at night. Catches of Gadidae, Carangidae, and Mugilidae seemed to follow no diel pattern.

The significance of these observations is uncertain at present, but they are presented for their interest and for comparison with future observations on diel catch difference.

Table 1. <u>Composition of Catch of Bongo .505 Net, Cruise D2-73</u>

Order/Family	Number Caught	% of Total	Rank	Catch/ 1000 m^3*	Number of Occurrences	% of Total Stations	Rank
Anguilliformes	42	1.69		3.38	27	37.0	
Atheriniformes	1	0.04		0.08	1	1.4	
Atherinidae	1	0.04	46	0.08	1	1.4	42
Beryciformes	5	0.20		0.40	4	5.5	
Holocentridae	3	0.12	36	0.24	3	4.1	33
Melamphaeidae	2	0.08	38	0.16	1	1.4	42
Clupeiformes	465	18.75		37.42	39	53.4	
Clupeidae	456	18.39	1	36.39	35	47.9	3
Engraulidae	9	0.36	25	0.72	8	11.0	23
Gadiformes	145	5.85		11.67	41	56.2	
Bregmacerotidae	31	1.25	14	2.49	20	27.4	9
Carapidae	7	0.28	29	0.56	5	6.8	26
Gadidae	30	1.21	16	2.41	10	13.7	18
Ophidiidae	51	2.06	7	4.10	17	23.3	11
Gasterosteiformes	2	0.08		0.16	1	1.4	
Syngnathidae	2	0.08	38	0.16	1	1.4	42
Lophiiformes	7	0.28		0.56	7	9.6	
Antennariidae	5	0.20	31	0.40	5	6.8	26
Myctophiformes	473	19.08		38.06	56	76.7	
Myctophidae	247	9.96	2	19.89	44	60.3	1
Paralepididae	48	1.94	9	3.86	20	27.4	9
Synodontidae	39	1.57	13	3.14	22	30.1	6
Perciformes	735	29.65		59.15	63	86.3	
Acanthuridae	10	0.40	24	0.80	7	9.6	24
Apogonidae	7	0.28	29	0.56	5	6.8	26
Bathyclupeidae	1	0.04	46	0.08	1	1.4	42
Blenniidae	4	0.16	33	0.32	4	5.5	30
Callionymidae	18	0.73	19	1.45	4	5.5	30
Chaetodontidae	2	0.08	38	0.16	2	2.7	36
Carangidae	31	1.25	14	2.49	17	23.3	11
Gempylidae	12	0.48	23	0.97	12	16.4	17
Gobiidae	75	3.03	5	6.04	33	45.2	4
Labridae	69	2.78	6	5.55	30	41.1	5
Lutjanidae	47	1.90	10	3.78	13	17.8	15
Mugilidae	2	0.08	38	0.16	2	2.7	36
Mullidae	3	0.12	36	0.24	1	1.4	42
Pomacentridae	2	0.08	38	0.16	1	1.4	42
Priacanthidae	2	0.08	38	0.16	2	2.7	36
Rachycentridae	1	0.04	46	0.08	1	1.4	42
Scaridae	44	1.77	12	3.54	22	30.1	6
Sciaenidae	223	9.00	3	17.94	16	21.9	13
Scombridae	16	0.65	21	1.29	9	12.3	20
Scorpaenidae	14	0.56	22	1.13	9	12.3	20
Serranidae	46	1.86	11	3.70	15	20.5	14
Sparidae	9	0.36	25	0.72	3	4.1	33
Sphyraenidae	4	0.16	33	0.32	3	4.1	33
Stromateidae	20	0.81	17	1.61	9	12.3	20
Triglidae	20	0.81	17	1.61	10	13.7	18
Uranoscopidae	2	0.08	38	0.16	2	2.7	36
Pleuronectiformes	160	6.45		12.88	43	58.9	
Bothidae	127	5.12	4	10.22	40	54.8	2
Cynoglossidae	18	0.73	19	1.45	13	17.8	15
Salmoniformes	76	3.07		6.12	30	41.1	
Gonostomatidae	50	2.02	8	4.02	21	28.8	8
Melanostomiatidae	2	0.08	38	0.16	2	2.7	36
Sternoptychidae	9	0.36	25	0.72	5	6.8	26
Tetraodontiformes	20	0.81		1.61	12	16.4	
Balistidae	5	0.20	31	0.40	2	2.7	36
Monacanthidae	4	0.16	33	0.32	4	5.5	30
Tetraodontidae	9	0.36	25	0.72	6	8.2	25
Others	348	14.04		28.00	51	69.9	
TOTAL	2479	100.00		199.48	73	100.0	

* Volumes strained from 6 *Oregon II* stations estimated.

Table 2. Fifteen Most Abundant Families in Bongo .505 Catch Cruise D2-73

Numbers caught (N = 2479)

1. Clupeidae 456
2. Myctophidae 247
3. Sciaenidae 223
4. Bothidae 127
5. Gobiidae 75
6. Labridae 69
7. Ophidiidae 51
8. Gonostomatidae 50
9. Paralepididae 48
10. Lutjanidae 47
11. Serranidae 46
12. Scaridae 44
13. Synodontidae 39
14. Bregmacerotidae 31
14. Gadidae 31

Occurrences (N = 73)

1. Myctophidae 44
2. Bothidae 40
3. Clupeidae 35
4. Gobiidae 33
5. Labridae 30
6. Scaridae 22
6. Synodontidae 22
8. Gonostomatidae 21
9. Bregmacerotidae 20
9. Paralepididae 20
11. Ophidiidae 17
11. Carangidae 17
13. Sciaenidae 16
14. Serranidae 15
15. Cynoglossidae 13
15. Lutjanidae 13

Table 3. Composition of Catch of Neuston Net, Cruise D2-73

Order/Family	Number Caught	% of Total	Rank	Number of Occurrences	% of Total Stations	Rank
Anguilliformes	49	0.07		17	23.3	
Atheriniformes	151	0.23		34	46.6	
Atherinidae	1	<0.01	50	1	1.4	49
Belonidae	11	0.02	35	6	8.2	25
Exocoetidae	106	0.16	19	33	45.2	3
Hemiramphidae	32	0.05	24	10	13.7	18
Beryciformes	1	<0.01		1	1.4	
Holocentridae	1	<0.01	50	1	1.4	49
Clupeiformes	8302	12.40		31	42.5	
Clupeidae	7921	11.84	2	30	41.1	7
Engraulidae	381	0.57	11	11	15.1	17
Elopiformes	25	0.04		2	2.7	
Elopidae	25	0.04	27	2	2.7	42
Gadiformes	*3906	5.84		33	45.2	
Bregmacerotidae	2	<0.01	45	2	2.7	42
Carapidae	1	<0.01	50	1	1.4	49
Gadidae	*3891	5.81	3	32	43.8	5
Ophidiidae	11	0.02	35	1	1.4	49
Gasterosteiformes	175	0.26		26	35.6	
Centriscidae	19	0.03	30	5	6.8	33
Syngnathidae	156	0.23	15	25	34.2	9
Lophiiformes	*27	0.04		15	20.5	
Antennariidae	*26	0.04	26	14	19.2	15
Lophiidae	1	<0.01	50	1	1.4	49
Myctophiformes	304	0.45		31	42.5	
Myctophidae	203	0.30	13	16	21.9	13
Paralepididae	2	<0.01	45	2	2.7	42
Synodontidae	95	0.14	20	14	19.2	15
Perciformes	*49,821	74.44		70	95.9	
Acanthuridae	1	<0.01	50	1	1.4	49
Apogonidae	1	<0.01	50	1	1.4	49
Blenniidae	*117	0.17	18	8	11.0	21
Bramidae	2	<0.01	45	2	2.7	42
Callionymidae	3	<0.01	44	2	2.7	42
Carangidae	506	0.76	9	42	57.5	1
Chaetodontidae	6	0.01	41	3	4.1	41
Coryphaenidae	62	0.09	21	17	23.3	12
Dactylopteridae	8	0.01	39	5	6.8	33
Gempylidae	2	<0.01	45	2	2.7	42
Gerreidae	20	0.03	29	5	6.8	33
Gobiidae	19	0.03	30	8	11.0	21
Kyphosidae	1	<0.01	50	1	1.4	49
Labridae	36	0.05	22	5	6.8	33
Mugilidae	366	0.55	12	40	54.8	2
Mullidae	*2,083	3.11	5	30	41.1	7
Pomacentridae	5	0.01	43	4	5.5	39
Pomatomidae	28	0.04	25	6	8.2	25
Priacanthidae	11	0.02	35	6	8.2	25
Scaridae	8	0.01	39	1	1.4	49
Sciaenidae	44,664	66.74	1	15	20.5	14

* Include estimates from samples which were split before sorting.

Table 3 (continued). Composition of catch of neuston net, Cruise D2-73

Order/Family	Number Caught	% of Total	Rank	Number of Occurrences	% of Total Stations	Rank
Scomberesocidae	12	0.02	33	6	8.2	23
Scombridae	691	1.03	8	10	13.7	18
Scorpaenidae	23	0.04	27	8	11.0	21
Serranidae	34	0.05	23	6	8.2	23
Sparidae	767	1.15	6	8	11.0	21
Sphyraenidae	141	0.21	17	6	8.2	23
Stromateidae	171	0.26	14	18	24.7	11
Triglidae	12	0.02	33	5	6.8	33
Uranoscopidae	13	0.02	32	6	8.2	23
Xiphiidae	6	0.01	41	5	6.8	33
Pleuronectiformes	2285	3.41		32	43.8	
Bothidae	2131	3.18	4	31	42.5	6
Cynoglossidae	154	0.23	16	10	13.7	18
Salmoniformes	10	0.01		4	5.5	
Gonostomatidae	1	<0.01	50	1	1.4	49
Malacosteidae	1	<0.01	50	1	1.4	49
Sternoptychidae	1	<0.01	50	1	1.4	49
Tetraodontiformes	1125	1.68		46	63.0	
Balistidae	2	<0.01	45	2	2.7	42
Diodontidae	5	0.01	43	4	5.5	39
Monacanthidae	708	1.06	7	25	34.2	9
Ostraciidae	9	0.01	38	6	8.2	25
Tetraodontidae	401	0.60	10	33	45.2	3
Others	746	1.11		47	64.4	
TOTAL	*66,927			73		

* Include estimates from samples which were split before sorting.

Table 4. Fifteen Most Abundant Families in Neuston Catch Cruise D2-73

Numbers caught (N = 66,927)

1. Sciaenidae 44,664
2. Clupeidae 7,921
3. Gadidae 3,891
4. Bothidae 2,131
5. Mullidae 2,083
6. Sparidae 767
7. Monacanthidae 708
8. Scombridae 691
9. Carangidae 506
10. Tetraodontidae 401
11. Engraulidae 381
12. Mugilidae 366
13. Myctophidae 203
14. Stromateidae 171
15. Syngnathidae 156

Occurrences (N = 73)

1. Carangidae 42
2. Mugilidae 40
3. Exocoetidae 33
3. Tetraodontidae 33
5. Gadidae 32
6. Bothidae 31
7. Mullidae 30
7. Clupeidae 30
9. Monacanthidae 25
9. Syngnathidae 25
11. Stromateidae 18
12. Coryphaenidae 17
13. Myctophidae 16
14. Sciaenidae 15
15. Antennariidae 14
15. Synodontidae 14

Table 5. Young Clupeidae from Neuston Collections, Cruise D2-73

Genus/Species	Number Caught	% of Total	Number of Stations
Brevoortia sp.	7472	94.32	21
Etrumeus teres	418	5.28	8
Clupeidae cf. *Etrumeus teres*	2	.03	2
Harengula sp.	1	.01	1
Jenkinsia sp. ?	6	.08	1
Sardinella sp.	20	.25	3
Sardinella anchovia	2	.03	2
Unidentified	0	.00	0
TOTAL	7921	100.00	30

Table 6. Young Gadidae from Neuston Collections, Cruise D2-73

Genus/Species	Number Caught	% of Total	Number of Stations
Urophycis sp.	755	19.40	5
Urophycis floridanus	48	1.23	11
Urophycis regius	2803	72.05	25
Unidentified	285	7.32	6
TOTAL	3891	100.00	32

Table 7. Young Bothidae from Neuston Collections, Cruise D2-73

Genus/Species	Number Caught	% of Total	Number of Stations
Bothus sp.	69	3.24	13
Bothus ocellatus	135	6.34	5
Citharichthys sp. ?	23	1.08	4
Citharichthys dinoceros ?	1	.05	1
Cyclopsetta sp.	548	25.72	4
Cyclopsetta sp. ?	9	.42	4
Cyclopsetta fimbriata	2	.09	1
Monolene sessilicauda	1	.05	1
Paralichthys sp.	761	35.70	3
Paralichthys sp. ?	1	.05	1
Paralichthys albigutta	3	.14	2
Paralichthys dentatus	7	.33	2
Paralichthys lethostigma	2	.09	1
Scophthalmus aquosus	1	.05	1
Syacium sp.	22	1.03	4
Unidentified	546	25.62	12
TOTAL	2131	100.00	31

Table 8. Young Monacanthidae from Neuston Collections, Cruise D2-73

Genus/Species	Number Caught	% of Total	Number of Stations
Aluterus scriptus	2	.28	2
Monacanthus ciliatus	13	1.84	3
Stephanolepis sp.	605	85.45	5
Stephanolepis hispidus	79	11.16	20
Stephanolepis setifer	1	.14	1
Unidentified	8	1.13	1
TOTAL	708	100.00	25

Table 9. Young Carangidae from Neuston Collections, Cruise D2-73

Genus/Species	Number Caught	% of Total	Number of Stations
Caranx sp.	4	.79	4
Decapterus sp.	247	48.79	13
Decapterus punctatus	2	.40	2
Selar crumenophthalmus	1	.20	1
Seriola sp.	212	41.90	24
Trachinotus sp.	1	.20	1
Trachinotus carolinus	1	.20	1
Trachinotus falcatus	7	1.38	3
Trachinotus falcatus ?	2	.40	2
Trachurus lathami	19	3.75	3
Trachurus lathami ?	1	.20	1
Unidentified	9	1.79	7
TOTAL	506	100.00	42

Table 10. Young Mugilidae from Neuston Collections, Cruise D2-73

Genus/Species	Number Caught	% of Total	Number of Stations
Mugil sp.	1	.27	1
Mugil cephalus	297	81.16	29
Mugil cephalus ?	4	1.09	2
Mugil curema	23	6.28	16
Mugil curema ?	40	10.93	3
Unidentified	1	.27	1
TOTAL	366	100.00	40

Table 11. Young Stromateidae from Neuston Collections, Cruise D2-73

Genus/Species	Number Caught	% of Total	Number of Stations
Ariomma regulus	4	2.34	1
Nomeus gronovii	20	11.70	3
Peprilus sp.	3	1.75	2
Peprilus triacanthus	107	62.58	5
Psenes cyanophrys	2	1.17	2
Psenes pellucidus	1	.58	1
Unidentified	34	19.88	8
TOTAL	171	100.00	18

Table 12. Comparison of Ranks of Most Abundant Families in Bongo .505 and Neuston Catches, Cruise D2-73

Family	ABUNDANCE Rank in Bongo	ABUNDANCE Rank in Neuston	OCCURRENCE Rank in Bongo	OCCURRENCE Rank in Neuston
Bothidae	4	4	2	6
Carangidae	14	9	11	1
Clupeidae	1	2	3	7
Exocoetidae	not present	19	not present	3
Gadidae	14	3	18	5
Gobiidae	3	30	4	21
Labridae	8	27	5	33
Mugilidae	38	12	36	2
Mullidae	38	5	42	7
Myctophidae	2	13	1	13
Sciaenidae	3	1	13	14
Tetraodontidae	25	10	25	3

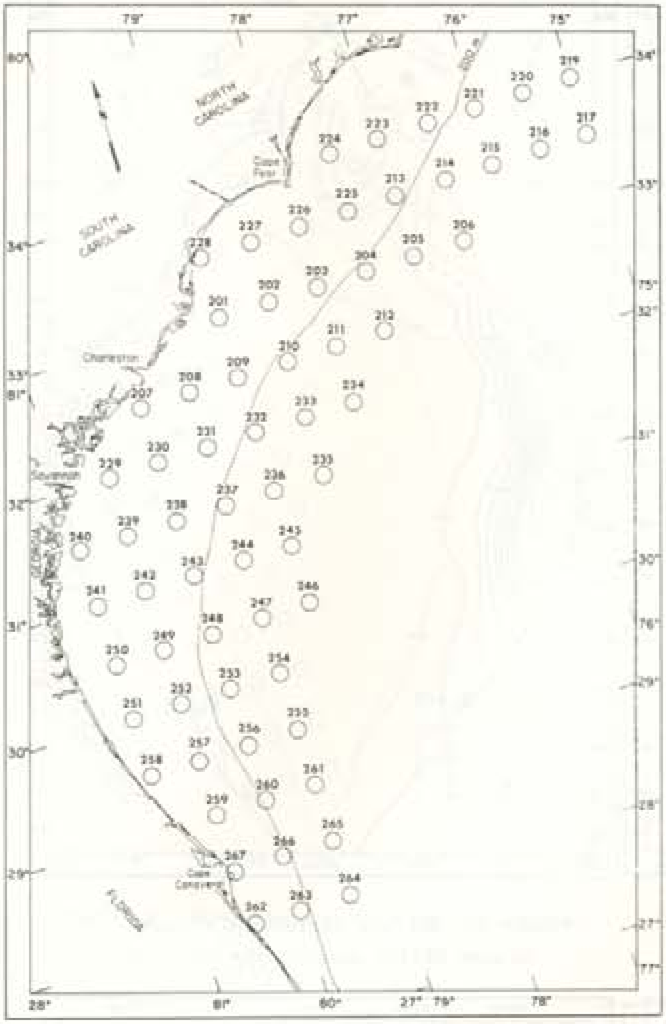


Figure 1. Station locations for MRRI-MARMAP Dolphin Cruise D2-73

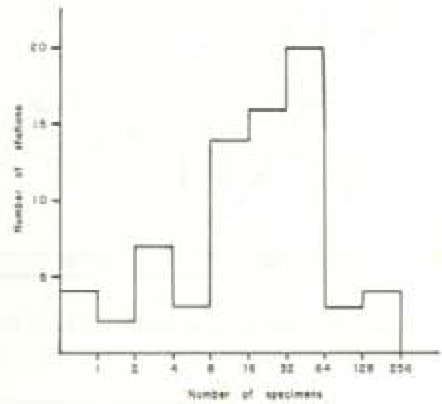


Figure 3. Distribution of young fishes among bongo .505 tows, Cruise D2-73

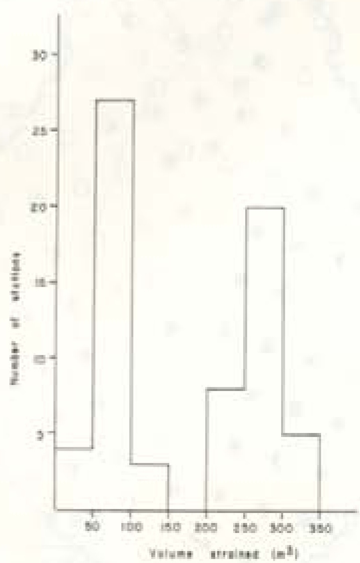


Figure 2. Distribution of volumes strained among bongo .505 tows, Cruise D2-73

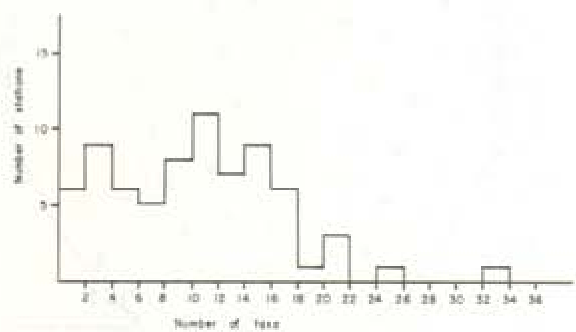


Figure 4. Distribution of taxa among bongo .505 tows, Cruise D2-73

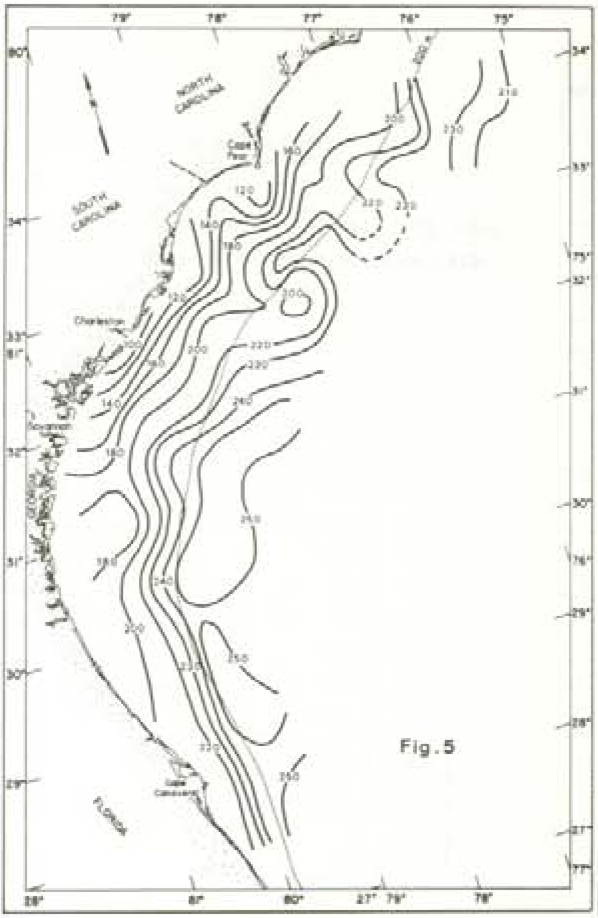


Figure 5. Surface temperatures (°C), Cruise D2-73

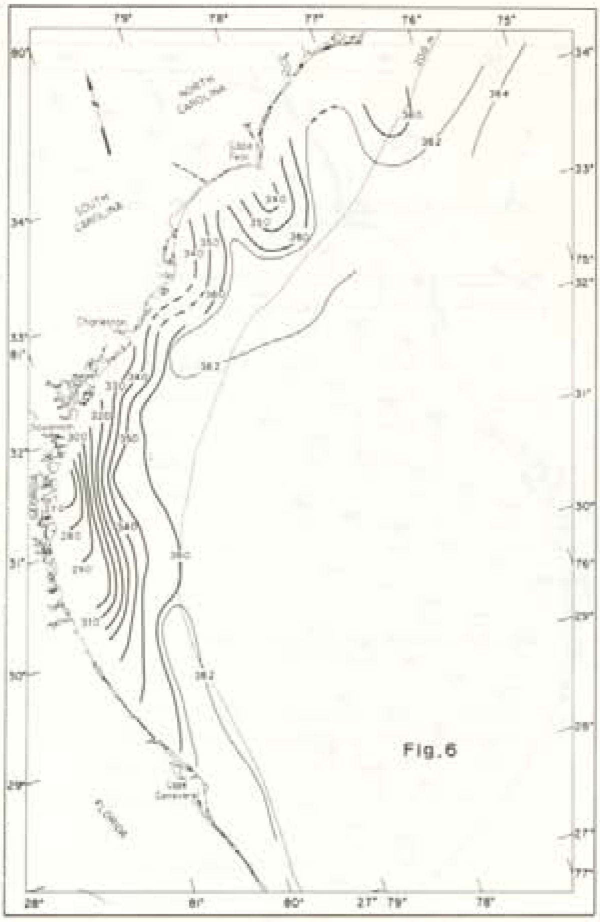


Figure 6. Surface salinities (°/oo), Cruise D2-73

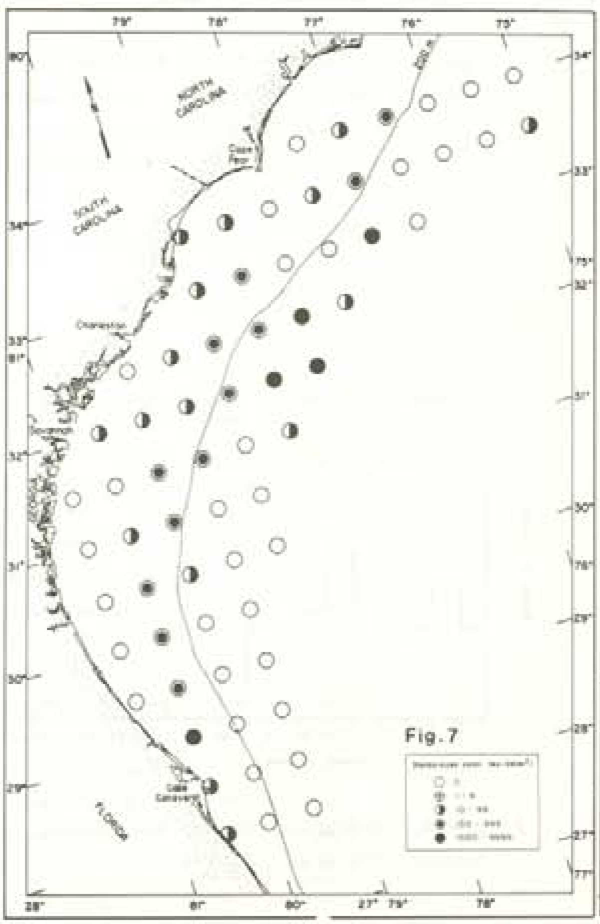


Figure 7. Distribution of young Clupeidae, bongo .505 net, Cruise D2-73

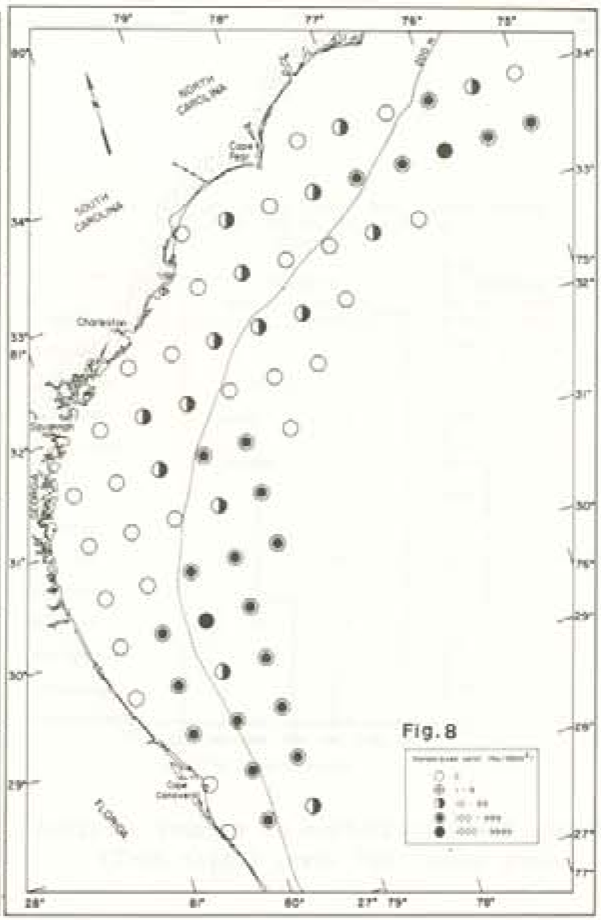


Figure 8. Distribution of young Myctophidae, bongo .505 net, Cruise D2-73

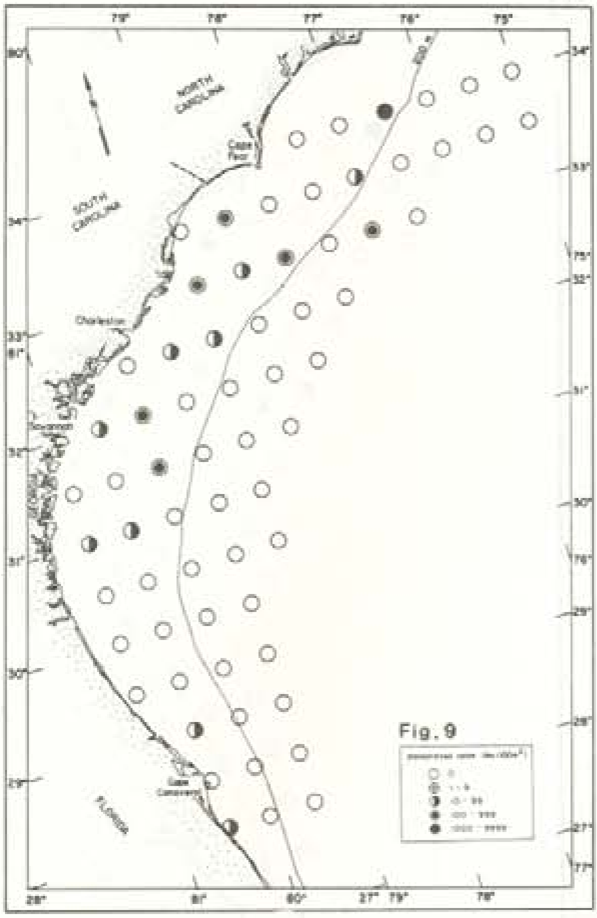


Figure 9. Distribution of young Sciaenidae, bongo .505 net, Cruise D2-73

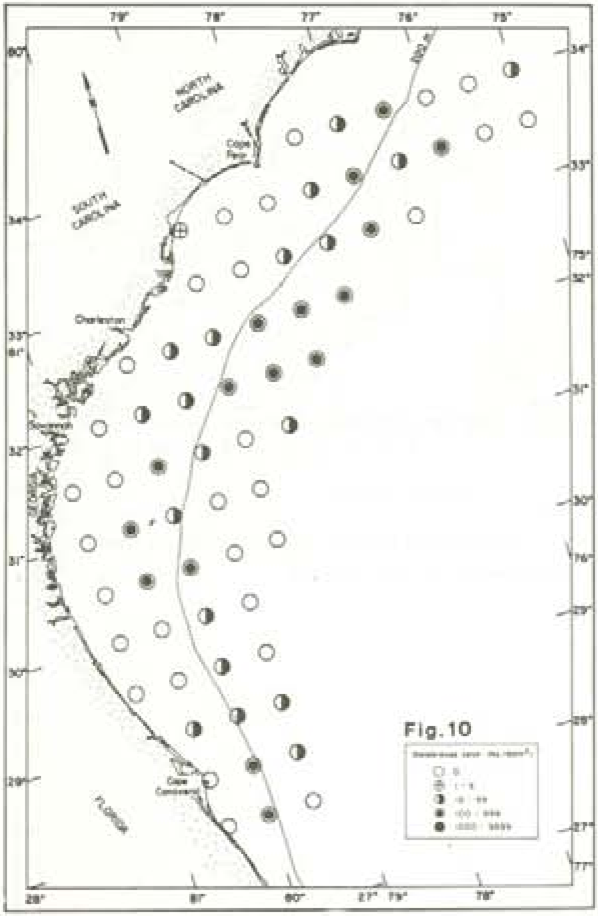


Figure 10. Distribution of young Bothidae, bongo .505 net, Cruise D2-73

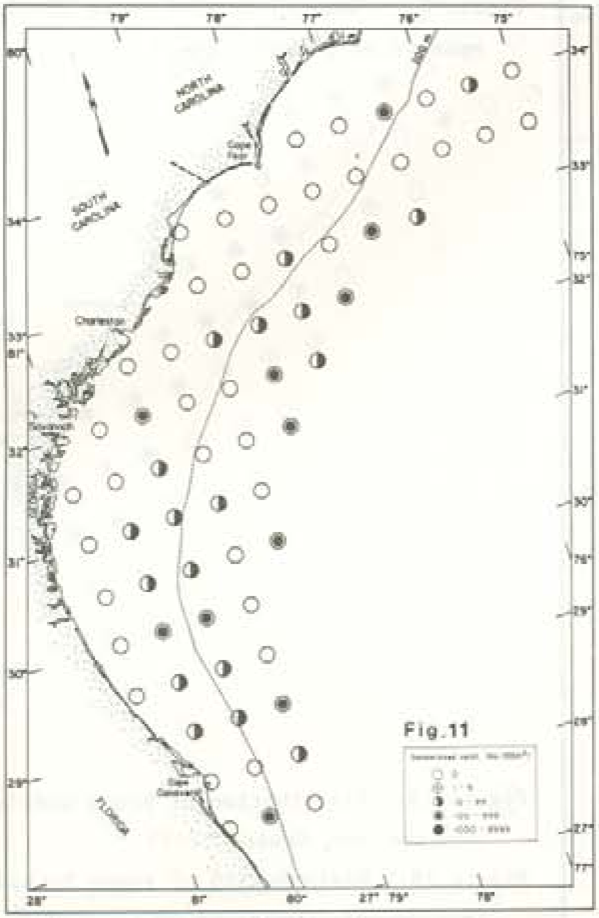


Figure 11. Distribution of young Gobiidae, bongo .505 net, Cruise D2-73

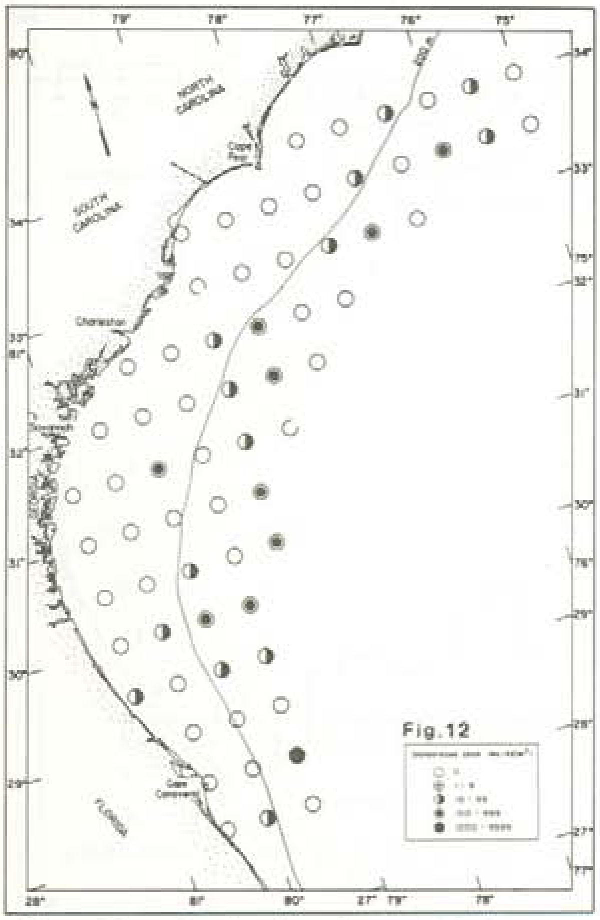


Figure 12. Distribution of young Labridae, bongo .505 net, Cruise D2-73

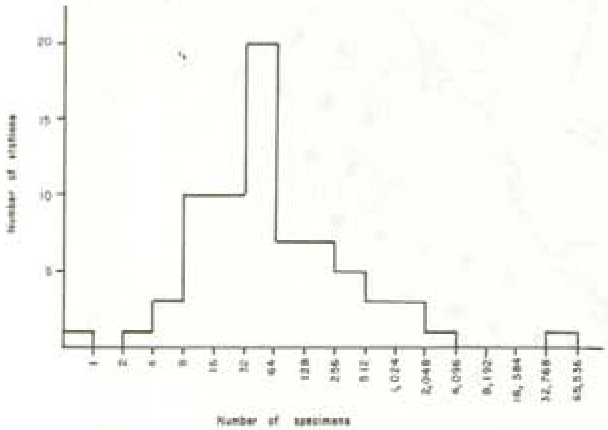


Figure 13. Distribution of young fishes among neuston tows, Cruise D2-73

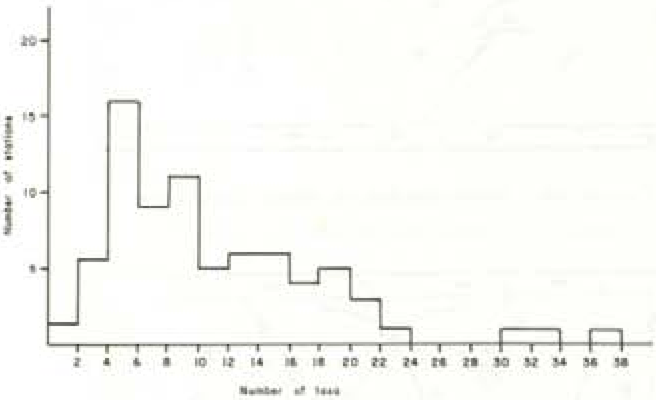


Figure 14. Distribution of taxa among neuston tows, Cruise D2-73

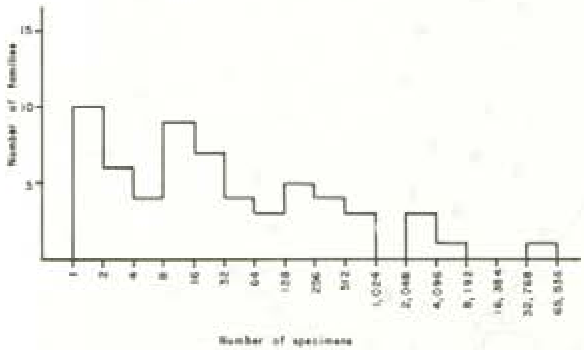


Figure 15. Distribution of young fishes among families, Cruise D2-73

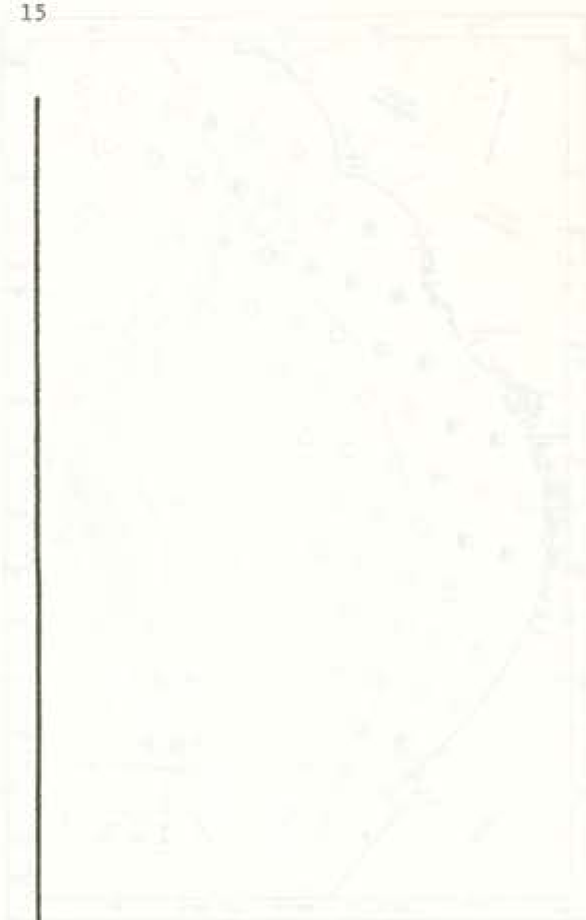


Figure 16. Distribution of young Sciaenidae, neuston net, Cruise D2-73

Figure 17. Distribution of young Clupeidae, neuston net, Cruise D2-73

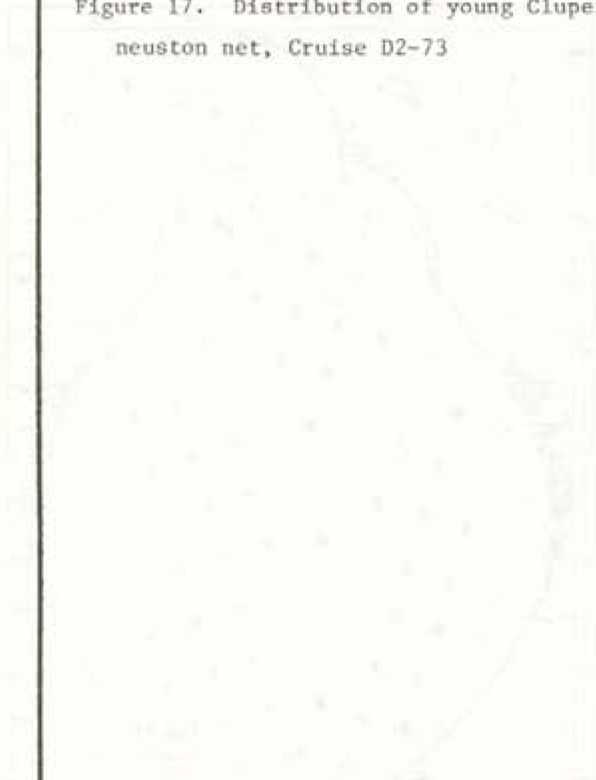


Figure 18. Distribution of young Gadidae, neuston net, Cruise D2-73

Figure 19. Distribution of young Bothidae, neuston net, Cruise D2-73

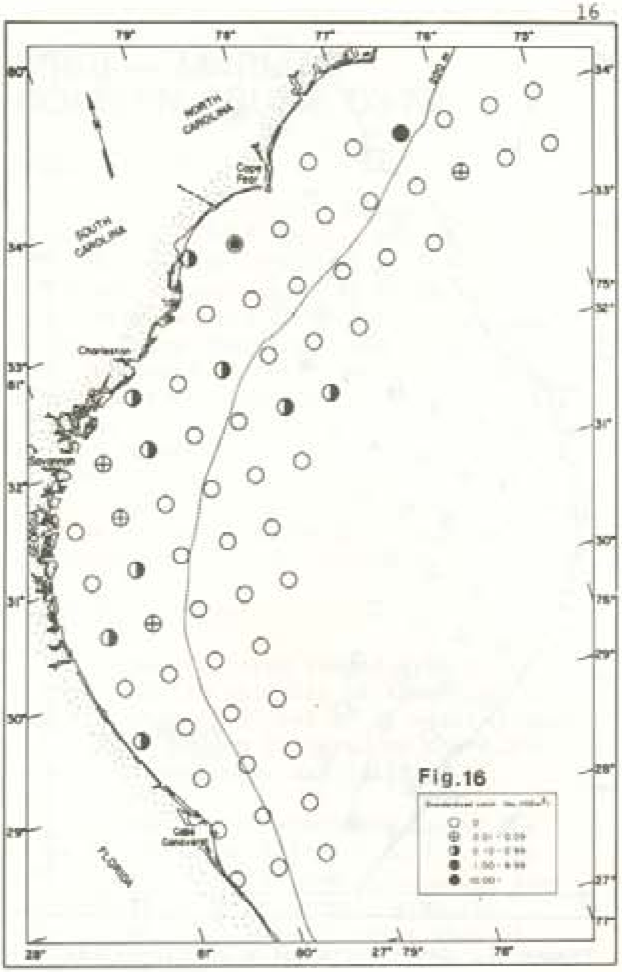


Fig.16

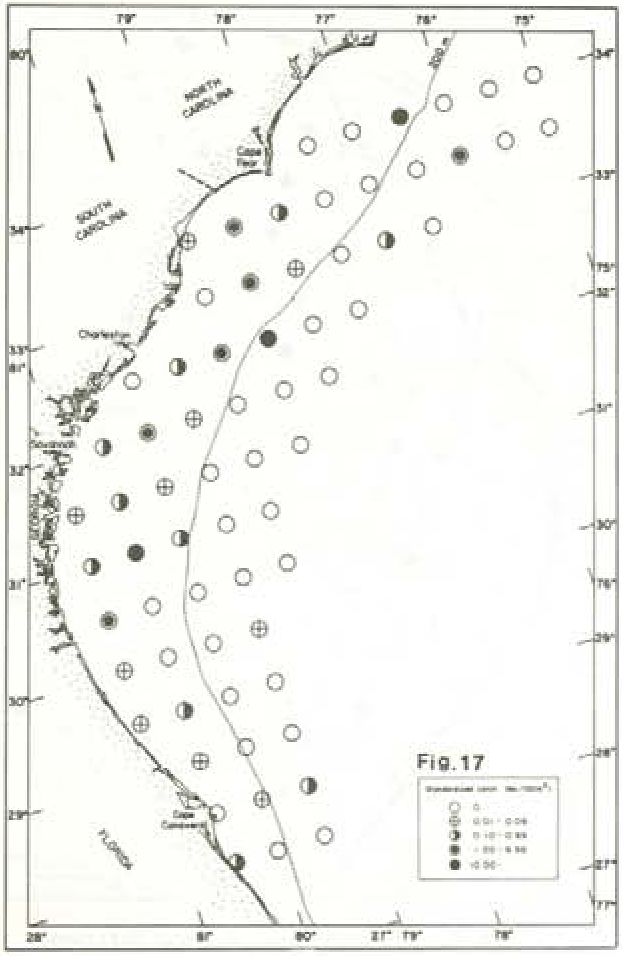


Fig.17

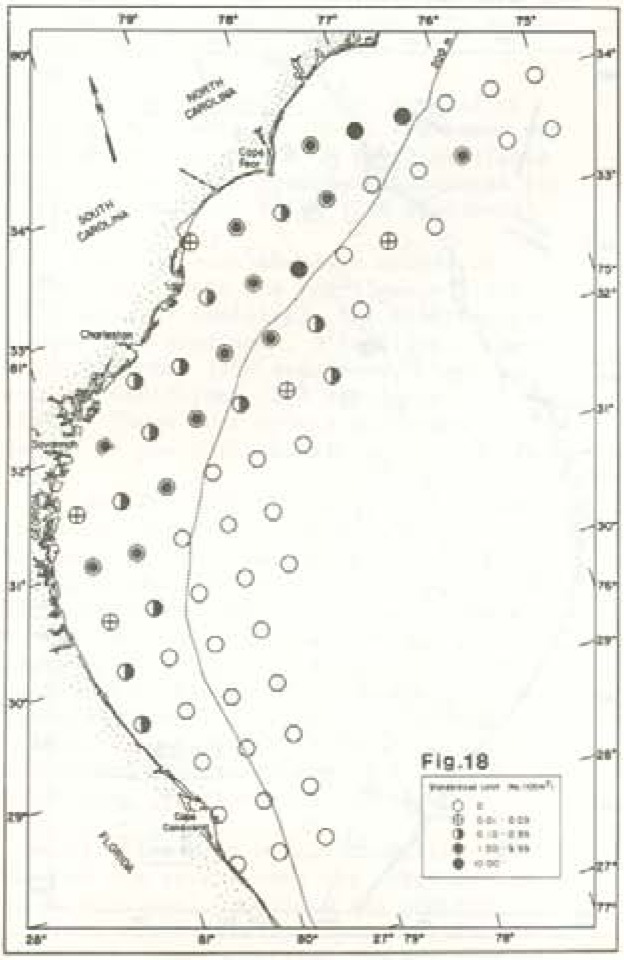


Fig.18

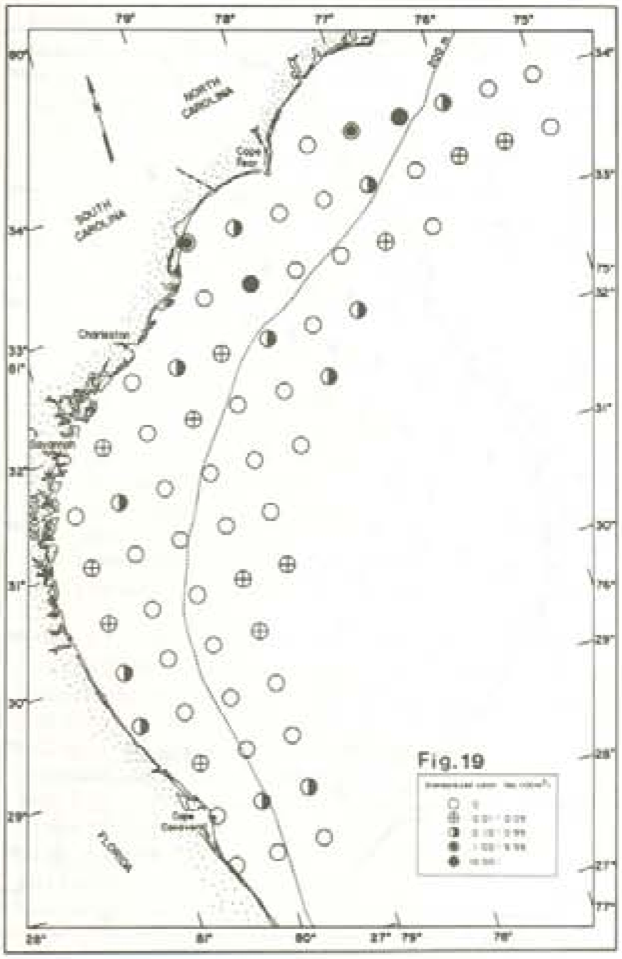


Fig.19

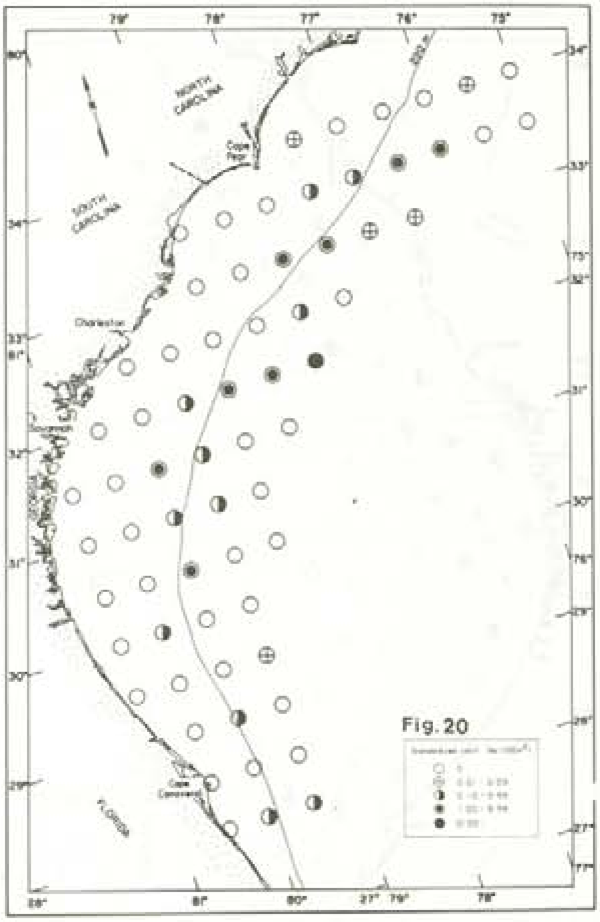


Figure 20. Distribution of young Mullidae, neuston net, Cruise D2-73

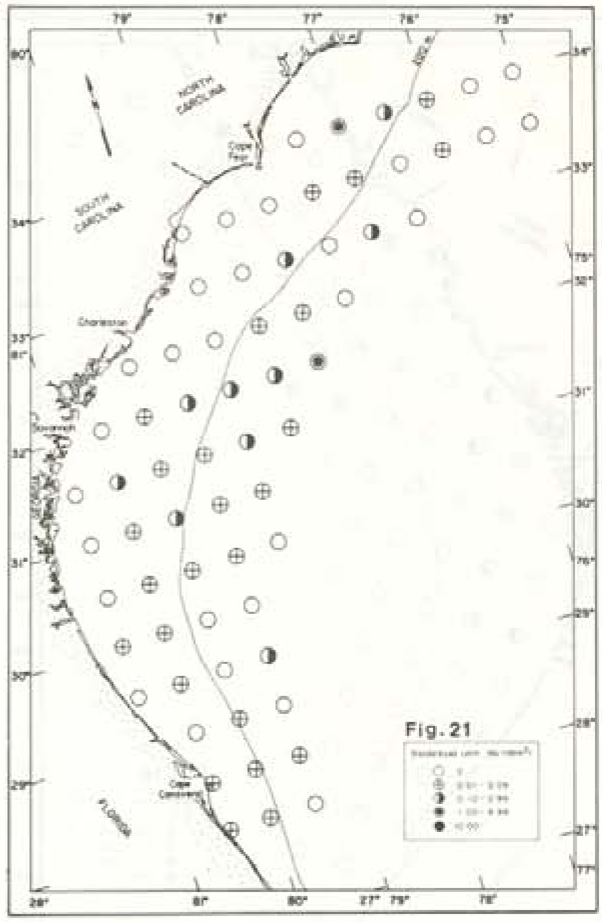


Figure 21. Distribution of young Carangidae, neuston net, Cruise D2-73

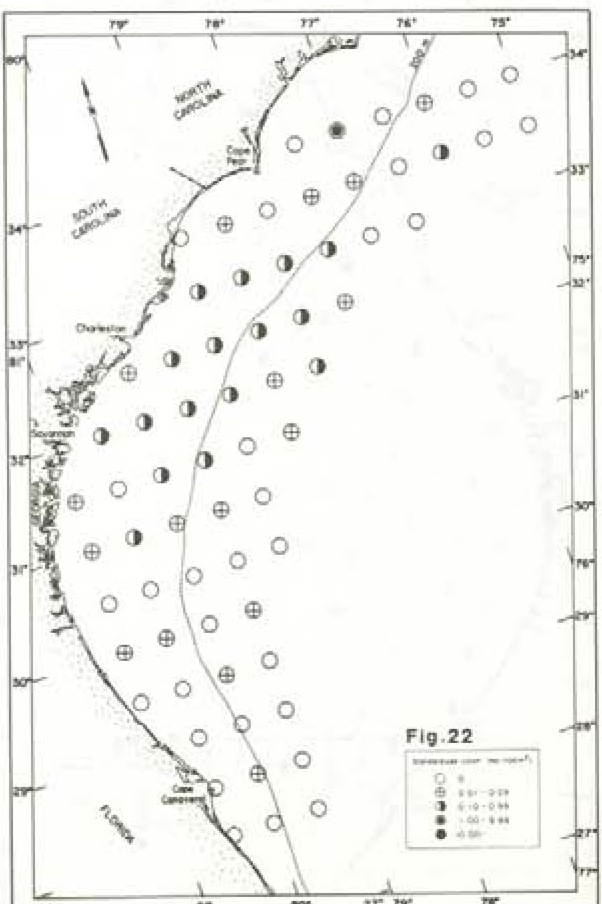


Figure 22. Distribution of young Mugilidae, neuston net, Cruise D2-73

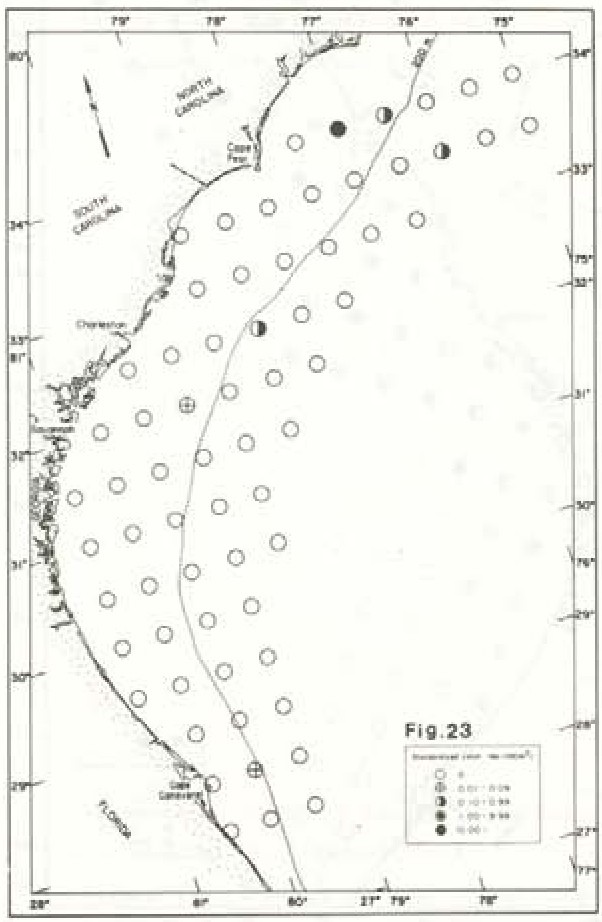


Figure 23. Distribution of young Scombridae, neuston net, Cruise D2-73

MRRI — MARMAP DOLPHIN CRUISE D3-73

Introduction

Dolphin Cruise D3-73 took place in late spring, 1973, between May 15 and May 27. The primary objective of the cruise was again investigation of ichthyoplankton and ichthyoneuston distribution and abundance. Forty-four bongo and neuston tows were conducted in continental shelf and slope waters between Cape Fear, North Carolina and Brunswick, Georgia. Stations were at intervals of 30' latitude and longitude between latitudes 31°N and 34°N and between 10 m depth and the axis of the Florida Current (Figure 24). Depths in the area sampled were 10-5400 m.

Bongo Collections

Volumes filtered ranged from 37 m^3 to 379 m^3, and the majority of tows (24) filtered volumes of 37-149 m^3 of water (Figure 25). Total volume filtered by the 0.505 mm net on the cruise was 7,118 m^3.

The numbers of specimens caught per bongo station ranged from 6 to 774. The distribution of total specimens among tows was approximately lognormal, with the modal class (13 stations) being that of 64-127 specimens (Figure 26). The numbers of taxa taken per station ranged from 2 to 46. The majority of bongo tows (23) caught between 8 and 19 taxa (Figure 27).

A. Catch composition. A total of 5,095 young fishes caught in the bongo net included 13 orders and 49 families (Table 13). Unidentified specimens accounted for 5.85% of the total catch (298 specimens).

The four most abundant orders of young fishes were the Perciformes (2392 specimens, 27 families), the Pleuronectiformes (970 specimens, 3 families), the Myctophiformes (560 specimens, 3 families), and the Gadiformes (378 specimens, 3 families). These four orders accounted for 84.40% of the total bongo catch (Table 13).

The five most abundant families in the total catch were the Bothidae (552 specimens), Labridae (509 specimens), Cynoglossidae (392 specimens), Serranidae (356 specimens), and Ophidiidae (329 specimens) (Table 14). These five families together accounted for 41.96% of the total catch. Other fishes of commercial or sport fishery interest included the Carangidae (271 specimens, 5.32% of the catch), Scombridae (187 specimens, 3.67%), and Sciaenidae (13 specimens, 0.26%).

The five most widely-occurring families on the cruise were the Labridae (taken on 34 stations), Bothidae (34 stations), Gobiidae (29 stations), Cynoglossidae (29 stations), and Ophidiidae (28 stations). Fishes of the family Carangidae occurred on 27 stations, Serranidae on 26, Scombridae on 18, and Sciaenidae on 1.

Subfamilial identifications have been summarized below for three priority families:

1). Pomatomidae. Sixty-seven specimens of *Pomatomus saltatrix* were taken at eight stations.

2). Scombridae. Specimens of five scombrid genera were identified (Table 15), with the genus *Auxis* contributing 140 specimens (74.88%). The genus *Scomberomorus* ranked next in abundance, with 36 specimens (19.25%); of these, *S. cavalla* accounted for 35, *S. regalis* for 1. *Euthynnus alleteratus*, *Euthynnus pelamis*, and *Thunnus* sp. were also taken.

3). Bothidae. Four genera of Bothidae were taken on the cruise (Table 16). *Syacium* was the most abundant, with 250 specimens (45.28%), *Bothus* next with 146 (26.45%). *Cyclopsetta* (14 specimens) and *Paralichthys* (15 specimens) were also taken.

B. Distribution. Distribution patterns of young fishes have in several cases been compared with the positions of surface isotherms and isohalines. Salinities of 35.5 °/oo and temperatures of 24°C or higher were considered characteristic of Florida Current water, while lower salinities and temperatures were considered characteristic of continental shelf waters. Minimum surface temperatures inshore were < 20°C off Charleston and in Long Bay; coastal temperatures increased to 21°-22°C off Cape Fear and to 24°C off Savannah (Figure 28). Maximum surface temperatures were greater than 27°C and were found furthest offshore. The 24° isotherm generally followed the shelf break with intrusions over the shelf off Savannah and Cape Fear. Coastal salinities were at a minimum (< 31.0 °/oo) between Savannah and Charleston and increased northward to a maximum (34.0 °/oo) off Cape Fear (Figure 29). The 36.0 °/oo isohaline tended to follow the shelf break. Thus, Florida Current water was found on the outer shelf and upper slope, while shelf water with its lower temperature and salinity values was present over the shelf.

1). Myctophidae (Figure 30). Highest catches (> 1000/100 m^2) of young myctophids were made furthest offshore in deep oceanic waters, as would be expected for a mesopelagic fish family. Progressively lower catches were made with decreasing depth, and few or no specimens were taken at stations in shelf waters. All stations with high catches (> 100/100 m^2) had surface salinities of $\geq$ 36.0 °/oo.

2). Scombridae (Figure 31). Highest catches of young scombrids were made at stations on the outer shelf and slope, and catches on inner shelf stations were low or zero. No young scombrids were taken on stations furthest offshore on latitude 31°30'N and between latitudes 33°N and 34°N. All stations with catches of > 100/100 m^2 had surface salinities of > 36.0 °/oo, and 14 of 18 stations with scombrids were in water of surface temperature > 24°C.

3). Carangidae (Figure 32). Young jacks were present throughout the north-south range and the depth range sampled, although their abundance was lower close inshore and well offshore than in intermediate areas. A band of relatively low catches (< 100/100 m^2) followed the shelf break (200 m contour), and separated two bands of high catches, one on the shelf and one on the upper slope. No relation of catches to surface temperature or salinity was apparent.

4). Serranidae (Figure 33). Distribution of young serranids was remarkably similar to that of young carangids. No serranids were taken on stations furthest inshore or offshore, but specimens were present throughout the north-south extent of the survey area. Two bands of high catches (> 100/100 m^2), one inside the 50 m contour and one outside the 200 m contour, were separated by a band of relatively low catches. There was no apparent relation of standardized catches to surface temperature or salinity.

5). Bothidae (Figure 34). Young bothid flatfishes were abundant in a broad band along the outer continental shelf and upper slope. Low or zero catches were made furthest inshore and offshore. Highest catches (> 1000/100 m^2) were made in salinities of ≥ 36.0 °/oo; most stations with standardized catches of > 100/100 m^2 had surface temperatures of ≥ 24°C.

Neuston Tows

Neuston catches ranged from 7 to 966 specimens per tow. The distribution of catches among stations (Figure 35) was roughly lognormal except for an excess of tows with catches higher than 512 specimens. The modal class of the distribution (13 stations) was that of 64 to 127 specimens per tow.

Numbers of taxa identified ranged from 5 to 49 per station. Numbers of taxa were fairly evenly distributed among stations (Figure 36); most collections (28) contained between 8 and 23 taxa.

A. Catch composition. A total of 9,916 specimens taken in neuston hauls included 13 orders and 56 families (Table 17).

The four most abundant orders in the total neuston catch were the Perciformes (7465 specimens, 31 families), the Tetraodontiformes (624 specimens, 5 families), the Atheriniformes (468 specimens, 3 families), and the Clupeiformes (363 specimens, 2 families). These four orders accounted for 89.95% of the total catch (Table 17).

The five most abundant families were the Mugilidae (2252 specimens), Pomatomidae (1299 specimens of Pomatomus saltatrix), Carangidae (784 specimens), Mullidae (561 specimens), and Scombridae (539 specimens) (Table 18). These 5 families accounted for 54.81% of the total catch. Other families of commercial or sport fishery interest were the Serranidae (278 specimens, 2.80% of the catch), Coryphaenidae (248 specimens, 2.50%), Sciaenidae (44 specimens, 0.44%), and Bothidae (188 specimens, 1.90%).

The five most widely-occurring families were the Carangidae (taken at 39 stations), Mugilidae (34 stations), Tetraodontidae (31 stations), Exocoetidae (30 stations), and Monacanthidae (30 stations). Scombridae were taken at 21 stations, Coryphaenidae at 20, Pomatomidae at 15, Sciaenidae at 5, and Bothidae at 21 (Table 18).

The subfamilial compositions of three families of fishery interest are summarized below:

1). Scombridae. Of the seven genera represented (Table 19), Auxis, with 464 specimens (86.08% of the scombrid catch), was most abundant. Specimens of Auxis occurred at 7 stations. Next most abundant genus was Scomberomorus, with 30 specimens (5.57%); 25 were S. cavalla (4.64%, 2 stations), 5 S. maculatus (0.93%, 1 station). Thunnus sp. were the most widely-distributed of the scombrids (5.01%, 10 stations).

2). Bothidae. Five identified bothid genera accounted for 69.16% of the total catch; unidentified bothids accounted for the remaining 30.84% (Table 20). Bothus was the most abundant (23.94%) and the most frequently-occurring (15 stations). Paralichthys, the next most abundant genus, accounted for 17.02% and occurred at 4 stations, while Syacium made up 12.77% and occurred at 7 stations.

3). Mugilidae. Mugil curema made up almost the entire catch of Mugilidae, 2246 of a total of 2252 specimens. One specimen identified as Mugil cephalus and five Mugil identified to the genus level were caught.

B. Distribution.

1). Carangidae (Figure 37). Neuston-caught young carangids were widespread over the survey area, although somewhat fewer were taken on stations furthest offshore and furthest inshore than on stations between. Carangids occurred over a relatively wide range of surface temperatures (21.3°C to 27.5°C) and salinities (30.4 ‰ to 36.3 ‰).

2). Mugilidae (Figure 38). Young mugilids were widespread in shelf and upper slope waters. Stations furthest offshore, in depths of ≥ 450 m, had few mugilids. Neuston catches were higher at and south of 33°N latitude than north of this. Most stations with catches of ≥ 0.1/100 m^2 specimens had surface temperatures of ≤ 25°C.

3). Pomatomidae (Figure 39). Catches of young Pomatomus saltatrix of ≥ 0.1/100 m^2 were taken in only 9 neuston tows. All but 2 were on the outer continental shelf (50-200 m). Two stations with catches of 170 and 10 specimens were at depths > 200 m. Twenty-nine stations, most in shallow or deep water, had no specimens of P. saltatrix.

4). Scombridae (Figure 40). Young scombrids were caught almost exclusively in outer shelf and slope waters (≥ 100 m). Most (436 specimens, 80.89%) were taken at a single station (32°30'N, 77°30'W). All stations at which scombrids occurred, except one far inshore off northern Georgia, had surface salinities of ≥ 35.5 ‰.

5). Serranidae (Figure 41). Although not frequently caught (14 stations), serranids were widely-distributed over the survey area. A concentration of five stations with catches of ≥0.1/100 m^2 occurred in 10-50 m depth on and south of 32°30'N latitude. One of these five stations contributed 69.78% (194 specimens) of the total catch. Young serranids occurred over a wide range of surface temperatures (21.3°C to 27.2°C) and salinities (32.6 ‰ to 36.3 ‰).

6). Bothidae (Figure 42). Young bothids were widely-distributed over the survey area and, therefore, over a wide range of surface temperatures (21.3°C to 27.2°C) and salinities (32.5 ‰ to 36.3 ‰).

Comparison of Bongo with Neuston Catches

A. Catch composition. The following families were relatively much more abundant in the bongo catch than in the neuston catch: the Bothidae (ranking 1st in the bongo catch, 16th in the neuston catch), Labridae (2nd and 24th), Cynoglossidae (3rd and 18th), Ophidiidae (5th and 20th), and Gobiidae (7th and 22nd). The following families were, on the other hand, relatively more abundant in the neuston catch than in the bongo catch: the Mugilidae (ranking 1st in the neuston samples, 15th in the bongo samples), Pomatomidae (2nd and 17th), Mullidae (4th in the neuston samples, no specimens identified from the bongo samples), Exocoetidae (6th and 39th), and Tetraodontidae (7th and 22nd). Several of the more abundant families had approximately equal levels of abundance in samples from the two types of gear: the Serranidae (ranking 4th overall in the bongo catch, 9th in the neuston catch), Carangidae (8th and 3rd), Scombridae (9th and 5th), and Myctophidae (6th and 11th). Although several families were relatively more abundant in the neuston catch than in the bongo catch, bongo net standardized catches were in general several orders of magnitude greater than neuston net standardized catches.

B. Distribution. Distribution patterns from bongo and from neuston samples were different for several families. In the Carangidae, agreement was only fair on a station-to-station basis (i.e., few stations with high bongo catches had high neuston catches, and vice versa), and many stations with neuston catches of the young did not yield bongo sampler catches. The distribution of positive neuston tows extended further offshore than that of positive bongo catches. The two-banded pattern of carangid abundance in bongo tows was not so obvious in the neuston distribution picture. For the Scombridae, the general distribution pattern was similar in samples from the two types of gear, with catches of young being mainly confined to outer shelf and slope waters, but again agreement between the samplers was only fair on a station-to-station basis. Young scombrids were taken at more stations in bongo tows than in neuston tows. For the Serranidae, two bands of abundance, one in shelf waters and one in slope waters, were apparent from the neuston catches as well as from bongo catches, but station-to-station agreement between the samplers was not particularly good. Young Serranidae were taken in fewer neuston than bongo tows, but positive neuston tows were distributed further offshore than positive bongo tows. Finally, for the Bothidae, catches of young were widespread over the survey area in the two samplers. Positive bongo tows were more abundant than positive neuston tows for the bothids.

Day-Night Observations

Preliminary observations were made on the diel differences in catch of the major families in the bongo and in the neuston tows.

A. Bongo tows. Of the total number of stations, 18.2% were at dawn, 50.0% during the day, 2.3% at dusk, and 29.5% at night. In terms of percent of the total volume strained, 16.9% was filtered at dawn, 55.8% during the day, 1.2% at dusk, and 26.1% at night. Of the total bongo catch, 11.46% was taken at dawn, 31.76% during the day, 11.46% at dusk, and 50.95% at night. There appeared to be no outstanding diel differences in the bongo catch of any of the most abundant families - Myctophidae, Scombridae, Carangidae, Serranidae, and Bothidae. Yet, since more than half the total specimens were caught at night, while some 30% of the sampling effort was expended at night, there appeared to be some overall avoidance of the bongo sampler during daylight.

B. Neuston tows. Of the total number of stations, 6.8% were at dawn, 47.7% during the day, 9.1% at dusk, and 36.4% at night. Considering the total catch, 9.42% was taken at dawn, 35.18% during the day, 19.21% at dusk, and 36.19% at night. Thus, in contrast to the bongo net catches, there appeared to be little diel variation in total neuston net catches. The Serranidae displayed a diel difference in catch; although most were taken at night, some were captured at dusk and dawn, but none of the 278 serranid larvae was found during the day. The other most abundant families (Carangidae, Mugilidae, Pomatomidae, Scombridae, and Bothidae) showed no diel differences in catch.

Table 13. Composition of Catch of Bongo .505 Net, Cruise D3-73

Order/Family	Number Caught	% of Total	Rank	Catch/ 1000 m^3	Number of Occurrences	% of Total Stations	Rank
Anguilliformes	75	1.47		10.54	24	54.5	
Atheriniformes	3	0.06		0.42	2	4.5	
Atherinidae	1	0.02	44	0.14	1	2.3	39
Exocoetidae	2	0.04	39	0.28	1	2.3	39
Beryciformes	2	0.04		0.28	1	2.3	
Holocentridae	2	0.04	39	0.28	1	2.3	39
Clupeiformes	233	4.57		32.73	25	56.8	
Clupeidae	68	1.33	16	9.55	15	34.1	16
Engraulidae	164	3.22	10	23.04	16	36.4	15
Elopiformes	1	0.02		0.14	1	2.3	
Gadiformes	378	7.42		53.10	35	79.5	
Bregmacerotidae	19	0.37	28	2.67	10	22.7	24
Carapidae	5	0.10	35	0.70	3	6.8	34
Ophidiidae	329	6.46	5	46.22	28	63.6	5
Gasterosteiformes	1	0.02		0.14	1	2.3	
Syngnathidae	1	0.02	44	0.14	1	2.3	39
Lophiiformes	22	0.43		3.09	12	27.3	
Antennariidae	2	0.04	39	0.28	2	4.5	39
Myctophiformes	560	10.99		78.67	31	70.5	
Myctophidae	326	6.40	6	45.80	26	59.1	7
Paralepididae	32	0.63	22	4.50	14	31.8	18
Synodontidae	120	2.36	13	16.86	21	47.7	12
Perciformes	2392	46.95		336.05	43	97.7	
Acanthuridae	14	0.27	29	2.00	9	20.5	26
Apogonidae	11	0.22	31	1.55	6	13.6	31
Blenniidae	29	0.57	24	4.07	9	20.5	26
Bramidae	1	0.02	44	0.14	1	2.3	39
Callionymidae	84	1.65	14	11.80	25	56.8	9
Carangidae	271	5.32	8	38.07	27	61.4	6
Chaetodontidae	2	0.04	39	0.28	2	4.5	35
Coryphaenidae	2	0.04	39	0.28	2	4.5	35
Gempylidae	10	0.20	32	1.40	8	18.2	29
Gerreidae	6	0.12	33	0.84	1	2.3	39
Gobiidae	293	5.75	7	41.16	29	65.9	3
Kyphosidae	1	0.02	44	0.14	1	2.3	39
Labridae	509	9.99	2	71.51	34	77.3	1
Lutjanidae	24	0.47	26	3.37	9	20.5	26
Mugilidae	74	1.45	15	10.40	11	25.0	22
Pomacentridae	29	0.57	24	4.07	11	25.0	22
Pomatomidae	67	1.32	17	9.41	8	18.2	29
Priacanthidae	4	0.08	36	0.56	4	9.1	32
Scaridae	42	0.82	19	5.90	17	38.6	14
Sciaenidae	13	0.26	30	1.83	1	2.3	39
Scombridae	187	3.67	9	26.27	18	40.9	13
Scorpaenidae	40	0.79	20	5.62	15	34.1	16
Serranidae	356	6.99	4	50.01	26	59.1	7
Sphyraenidae	3	0.06	38	0.42	1	2.3	39
Stromateidae	122	2.39	12	17.14	23	52.3	10
Triglidae	164	3.22	10	23.04	23	52.3	10
Uranoscopidae	6	0.12	33	0.84	4	9.1	32
Pleuronectiformes	970	19.04		136.27	37	84.1	
Bothidae	552	10.83	1	77.55	34	77.3	1
Cynoglossidae	392	7.69	3	55.07	29	65.9	3
Soleidae	24	0.47	26	3.37	10	22.7	24
Salmoniformes	75	1.47		10.54	20	45.5	
Argentinidae	1	0.02	44	0.14	1	2.3	38
Gonostomatidae	40	0.79	20	5.62	13	29.5	19
Sternoptychidae	4	0.08	36	0.56	2	4.5	35
Tetraodontiformes	85	1.67		11.94	22	50.0	
Balistidae	1	0.02	44	0.14	1	2.3	39
Monacanthidae	52	1.02	18	7.30	13	29.5	19
Tetraodontidae	32	0.63	22	4.50	13	29.5	19
Others	298	5.85		41.86	41	93.2	
TOTAL	5095	100.00		715.79	44	100.0	

Table 14. Fifteen Most Abundant Families in Bongo .505 Catch, Cruise D3-73

Numbers caught (N = 5095)	Occurrences (N = 44)
1. Bothidae 552	1. Labridae 34
2. Labridae 509	1. Bothidae 34
3. Cynoglossidae 392	3. Gobiidae 29
4. Serranidae 356	3. Cynoglossidae 29
5. Ophidiidae 329	5. Ophidiidae 28
6. Myctophidae 326	6. Carangidae 27
7. Gobiidae 293	7. Myctophidae 26
8. Carangidae 271	7. Serranidae 26
9. Scombridae 187	9. Callionymidae 25
10. Engraulidae 164	10. Stromateidae 23
10. Triglidae 164	11. Triglidae 23
12. Stromateidae 122	12. Synodontidae 21
13. Synodontidae 120	13. Scombridae 18
14. Callionymidae 84	14. Scaridae 17
15. Mugilidae 74	15. Engraulidae 16

Table 15. Young Scombridae from Bongo .505 Collections, Cruise D3-73

Genus/Species	Number Caught	% of Total	Number of Stations
Auxis sp.	140	74.88	14
Euthynnus alleteratus	5	2.67	4
Euthynnus pelamis	1	0.53	1
Scomberomorus cavalla	35	18.72	6
S. regalis	1	0.53	1
Thunnus sp.	4	2.14	4
Unidentified	1	0.53	1
TOTAL	187	100.00	19

Table 16. Young Bothidae from Bongo .505 Collections, Cruise D3-73

Genus/Species	Number Caught	% of Total	Number of Stations
Bothus sp.	146	26.45	24
Cyclopsetta sp.	14	2.54	7
Paralichthys oblongus	15	2.72	4
Syacium sp.	250	45.28	19
Unidentified	127	23.01	23
TOTAL	552	100.00	34

Table 17. Composition of Catch of Neuston Net, Cruise D3-73

Order/Family	Number Caught	% of Total	Rank	Number of Occurrences	% of Total Stations	Rank
Anguilliformes	24	0.24		12	27.27	
Atheriniformes	468	4.72		30	68.18	
Belonidae	3	0.03	46	2	4.55	45
Exocoetidae	425	4.29	6	30	68.18	4
Hemiramphidae	40	0.40	28	11	25.00	23
Beryciformes	83	0.84		5	11.36	
Holocentridae	83	0.84	21	5	11.36	38
Clupeiformes	363	3.66		25	56.82	
Clupeidae	222	2.24	12	17	38.64	12
Engraulidae	141	1.42	17	17	38.64	12
Elopiformes	1	0.01		1	2.27	
Elopidae	1	0.01	50	1	2.27	48
Gadiformes	91	0.92		10	22.73	
Bregmacerotidae	1	0.01	50	1	2.27	48
Gadidae	2	0.02	47	2	4.55	45
Ophidiidae	88	0.89	20	7	15.91	35
Gasterosteiformes	13	0.13		11	25.00	
Fistulariidae	1	0.01	50	1	2.27	48
Syngnathidae	12	0.12	41	10	22.72	26
Lophiiformes	16	0.16		9	20.45	
Antennariidae	16	0.16	37	9	20.45	27

Table 17 (continued). Composition of catch of neuston net, Cruise D3-73

Order/Family	Number Caught	% of Total	Rank	Number of Occurrences	% of Total Stations	Rank
Myctophiformes	266	2.68		18	40.91	
Myctophidae	224	2.26	11	12	27.27	21
Synodontidae	42	0.42	26	11	25.00	23
Perciformes	7465	75.28		44	100.00	
Apogonidae	30	0.30	29	5	11.63	38
Blenniidae	304	3.06	8	22	50.00	8
Callionymidae	30	0.30	29	8	18.18	29
Carangidae	784	7.91	3	39	88.64	1
Chaetodontidae	21	0.21	33	6	13.64	36
Coryphaenidae	248	2.50	10	20	45.45	11
Dactylopteridae	14	0.14	39	5	11.36	38
Gempylidae	13	0.13	40	5	11.36	38
Gerreidae	118	1.19	18	24	54.55	7
Gobiidae	82	0.83	22	14	31.82	18
Istiophoridae	23	0.23	32	8	18.18	29
Kyphosidae	18	0.18	36	8	18.18	29
Labridae	44	0.44	24	10	22.73	26
Lutjanidae	19	0.19	34	8	18.18	29
Mugilidae	2252	22.71	1	34	77.27	2
Mullidae	361	3.68	4	29	65.91	6
Pomacentridae	182	1.84	16	12	27.27	21
Pomatomidae	1299	13.10	2	15	34.09	15
Priacanthidae	6	0.06	44	3	6.82	44
Rachycentridae	1	0.01	50	1	2.27	48
Scaridae	42	0.42	26	8	18.18	29
Sciaenidae	44	0.44	24	5	11.36	38
Scombridae	539	5.43	5	21	47.73	9
Scorpaenidae	49	0.49	23	16	36.36	14
Serranidae	278	2.80	9	14	31.82	18
Sparidae	15	0.15	38	6	13.64	36
Sphyraenidae	19	0.19	34	9	20.45	27
Stromateidae	205	2.07	13	15	34.09	15
Triglidae	202	2.04	14	15	34.09	15
Uranoscopidae	11	0.11	42	8	18.18	29
Xiphiidae	10	0.10	43	7	15.91	35
Pleuronectiformes	312	3.15		23	52.27	
Bothidae	188	1.90	16	21	47.73	9
Cynoglossidae	118	1.19	18	11	25.00	23
Soleidae	6	0.06	44	5	11.36	38
Salmoniformes	3	0.03		2	4.54	
Gonostomatidae	2	0.02	47	1	2.27	48
Malacosteidae	1	0.01	50	1	2.27	48
Tetraodontiformes	624	6.29		43	97.73	
Balistidae	28	0.28	31	14	31.82	18
Diodontidae	2	0.02	47	2	4.55	45
Monacanthidae	200	2.02	15	30	68.18	4
Ostraciidae	1	0.01	50	1	2.27	48
Tetraodontidae	391	3.94	7	31	70.45	3
Others	187	1.88		27	61.36	
TOTAL	9916	100.00		44	100.00	

Table 18. Fifteen Most Abundant Families in Neuston Catch, Cruise D3-73

Numbers caught (N = 9916)

1. Mugilidae 2252
2. Pomatomidae 1299
3. Carangidae 784
4. Mullidae 561
5. Scombridae 539
6. Exocoetidae 425
7. Tetraodontidae 391
8. Blenniidae 304
9. Serranidae 278
10. Coryphaenidae 248
11. Myctophidae 224
12. Clupeidae 222
13. Stromateidae 205
14. Triglidae 202
15. Monacanthidae 200

Occurrences (N = 44)

1. Carangidae 39
2. Mugilidae 34
3. Tetraodontidae 31
4. Exocoetidae 30
4. Monacanthidae 30
6. Mullidae 29
7. Gerreidae 24
8. Blenniidae 22
9. Scombridae 21
9. Bothidae 21
11. Coryphaenidae 20
12. Clupeidae 17
12. Engraulidae 17
14. Scorpaenidae 16
15. Pomatomidae 15
15. Stromateidae 15
15. Triglidae 15

Table 19. Young Scombridae from Neuston Collections, Cruise D3-73

Genus/Species	Number Caught	% of Total	Number of Stations
Auxis sp.	464	86.08	7
Euthynnus alletteratus	2	0.37	1
Euthynnus pelamis	6	1.11	4
Sarda sp.	9	1.67	2
Scomber sp.	1	0.19	1
Scomberomorus cavalla	25	4.64	2
S. maculatus	5	0.93	1
Thunnus sp.	27	5.01	10
TOTAL	539	100.00	21

Table 20. Young Bothidae from Neuston Collections, Cruise D3-73

Genus/Species	Number Caught	% of Total	Number of Stations
Bothus sp.	45	23.94	13
Citharichthys sp.	19	10.11	9
Cyclopsetta sp.	10	5.32	6
Paralichthys sp.	31	16.49	4
P. oblongus	1	0.53	1
Syacium sp.	24	12.77	7
Unidentified	58	30.84	2
TOTAL	188	100.00	21

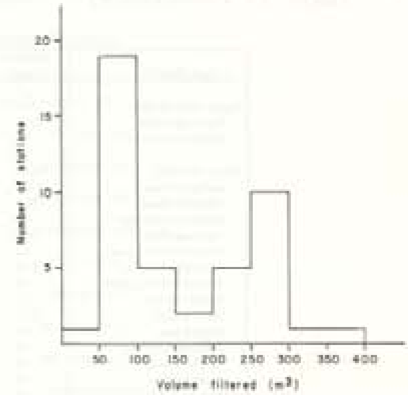


Figure 25. Distribution of volumes strained among bongo .505 tows, Cruise D3-73

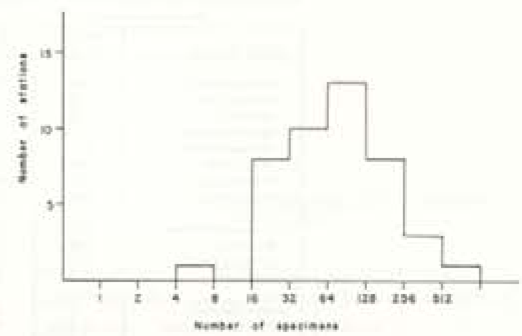


Figure 26. Distribution of young fishes among bongo .505 tows, Cruise D3-73

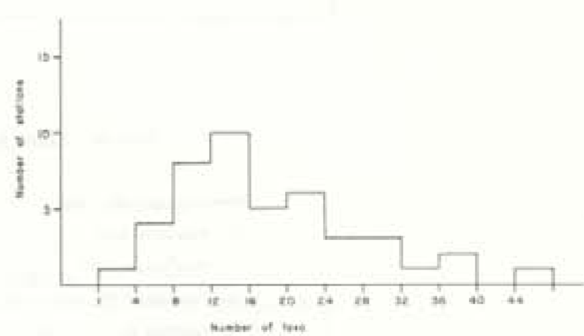


Figure 27. Distribution of taxa among bongo .505 tows, Cruise D3-73

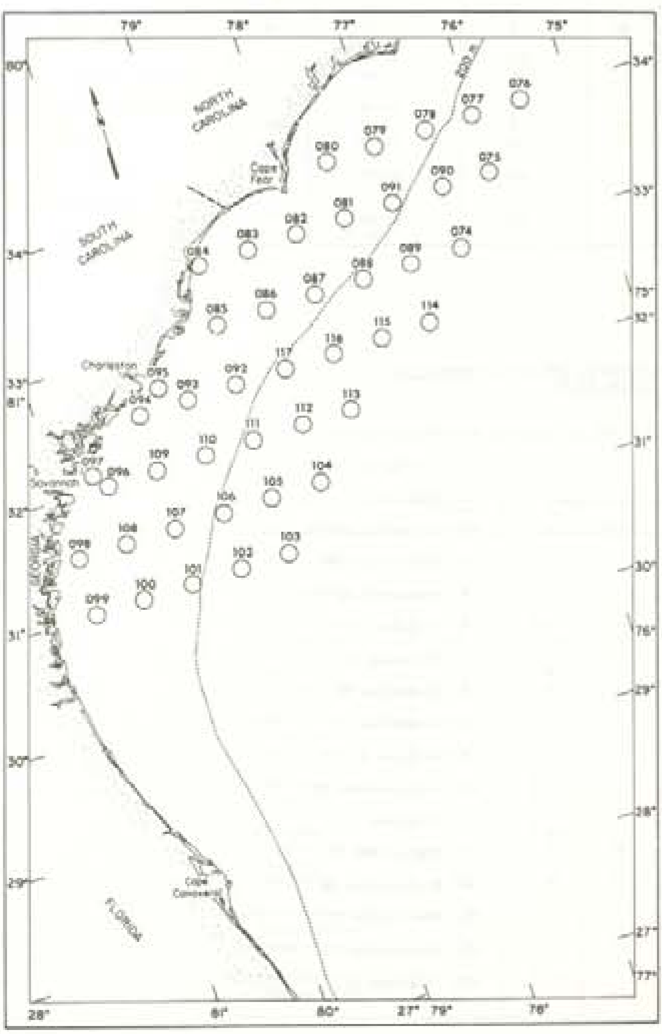


Figure 24. Station locations for MRRI-MARMAP *Dolphin* Cruise D3-73

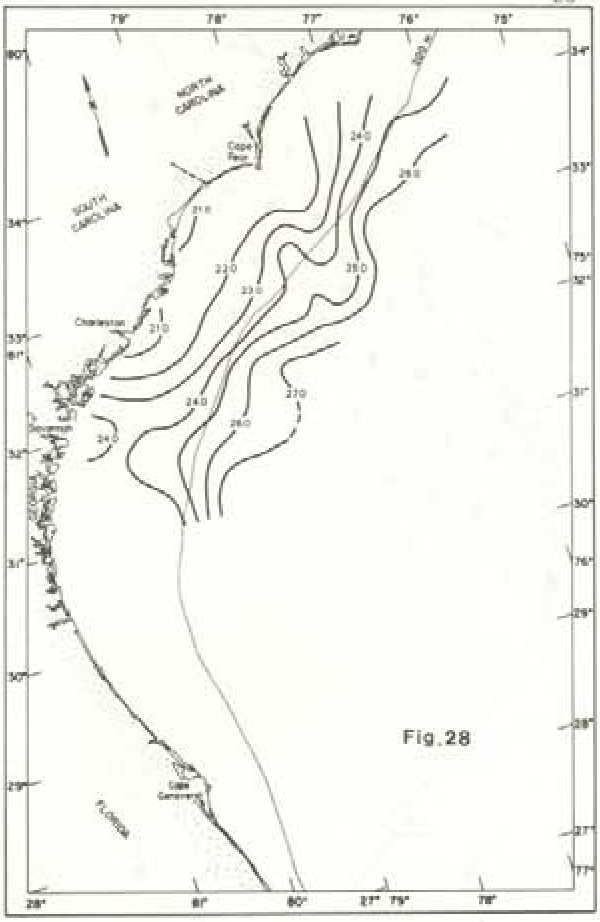


Figure 28. Surface temperatures (°C), Cruise D3-73

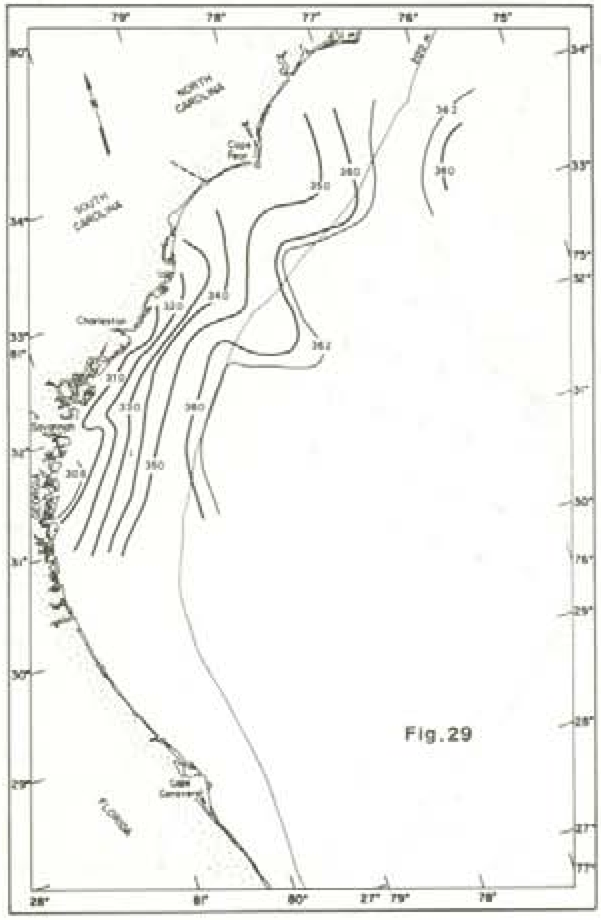


Figure 29. Surface salinities (°/oo), Cruise D3-73

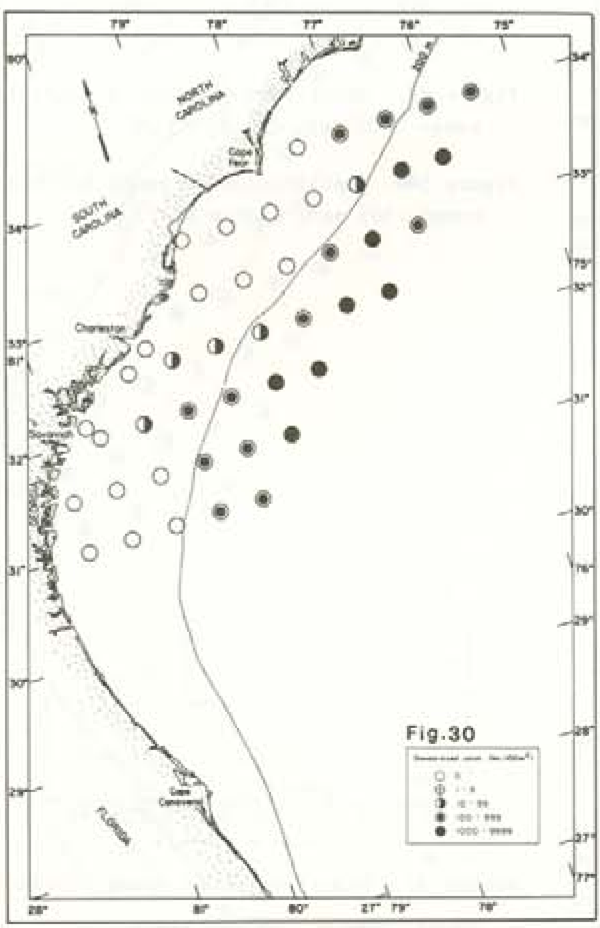


Figure 30. Distribution of young Myctophidae, bongo .505 net, Cruise D3-73

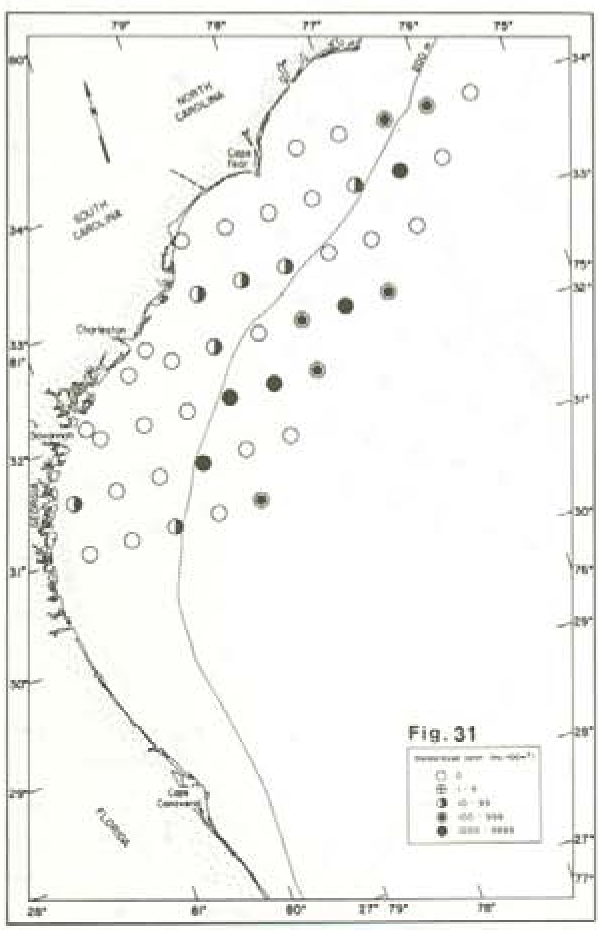
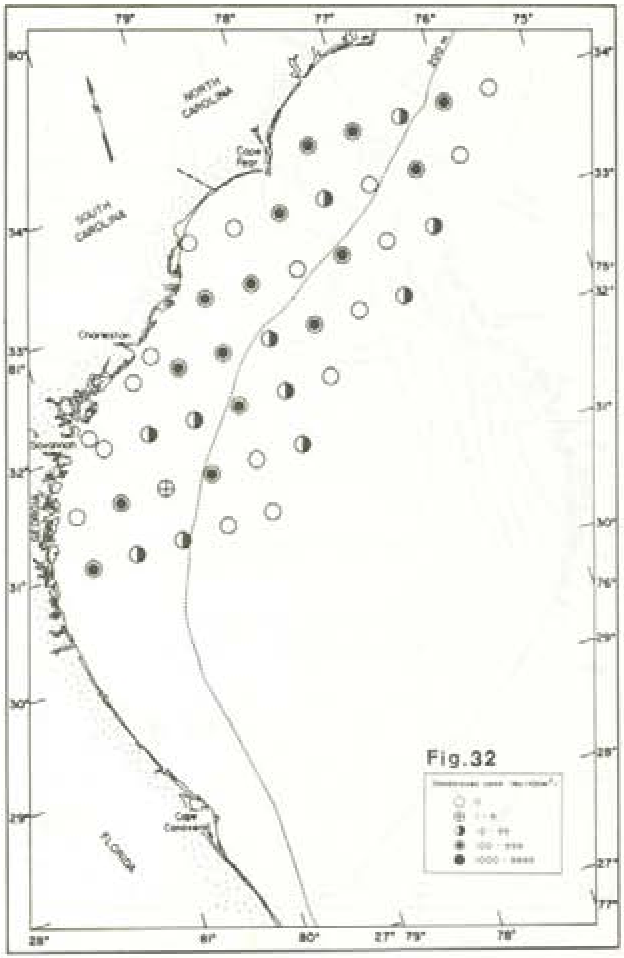
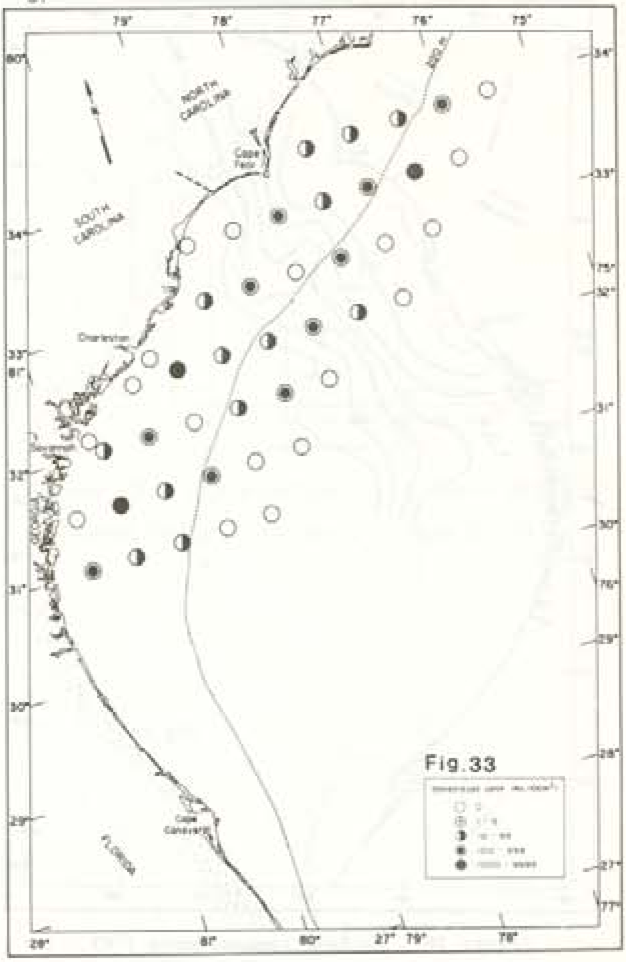


Figure 31. Distribution of young Scombridae, bongo .505 net, Cruise D3-73





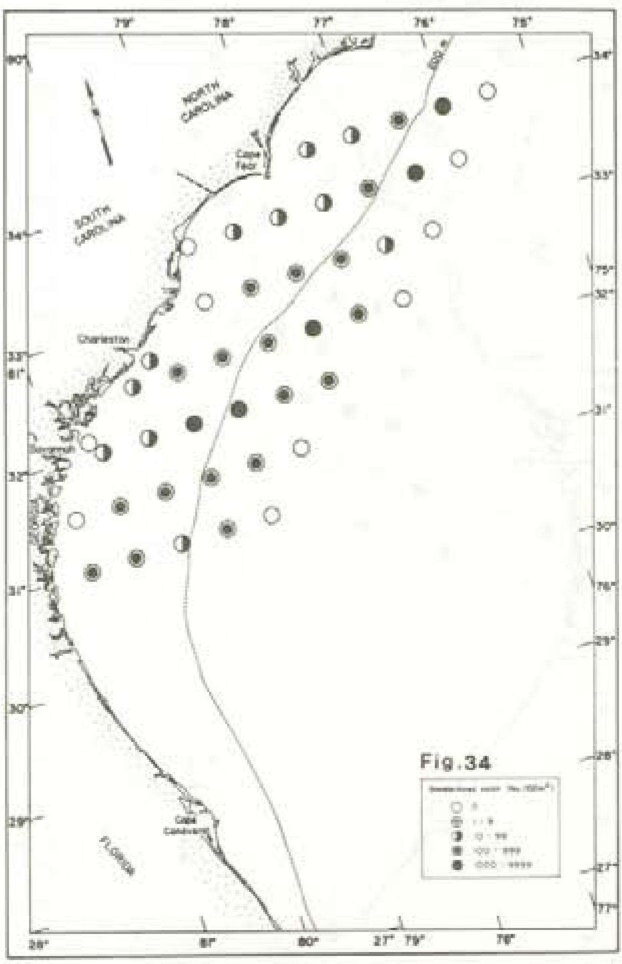


Figure 32. Distribution of young Carangidae, bongo .505 net, Cruise D3-73

Figure 33. Distribution of young Serranidae, bongo .505 net, Cruise D3-73

Figure 34. Distribution of young Bothidae, bongo .505 net, Cruise D3-73

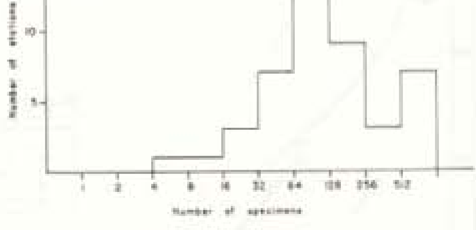


Figure 35. Distribution of young fishes among neuston tows, Cruise D3-73

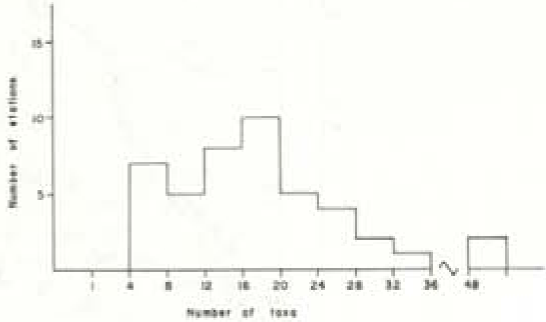


Figure 36. Distribution of taxa among neuston tows, Cruise D3-73

Figure 37. Distribution of young Carangidae, neuston net, Cruise D3-73

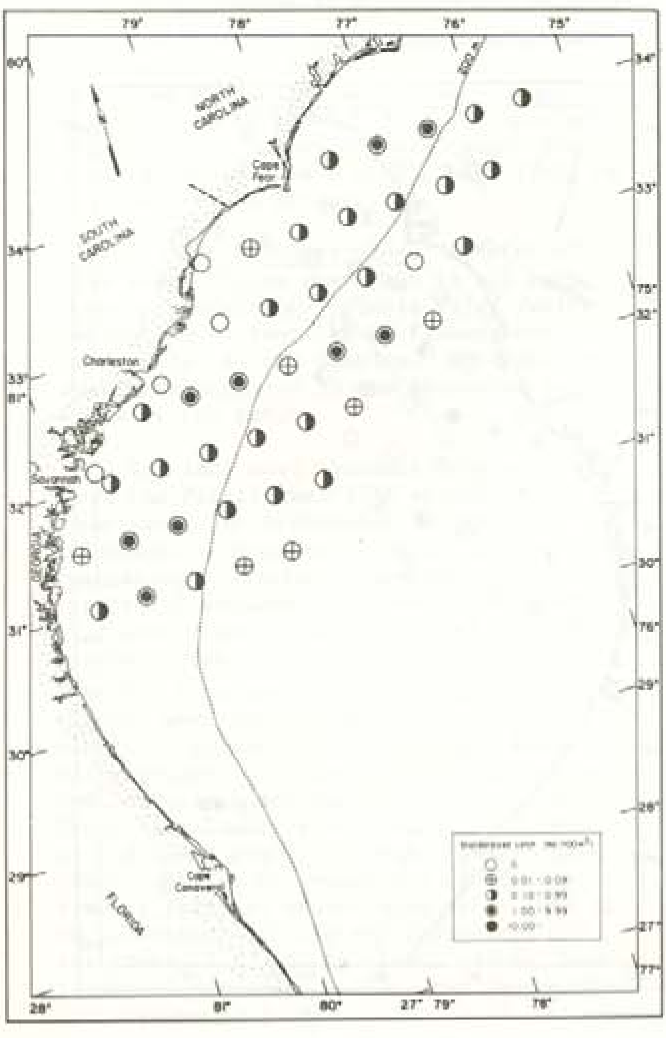
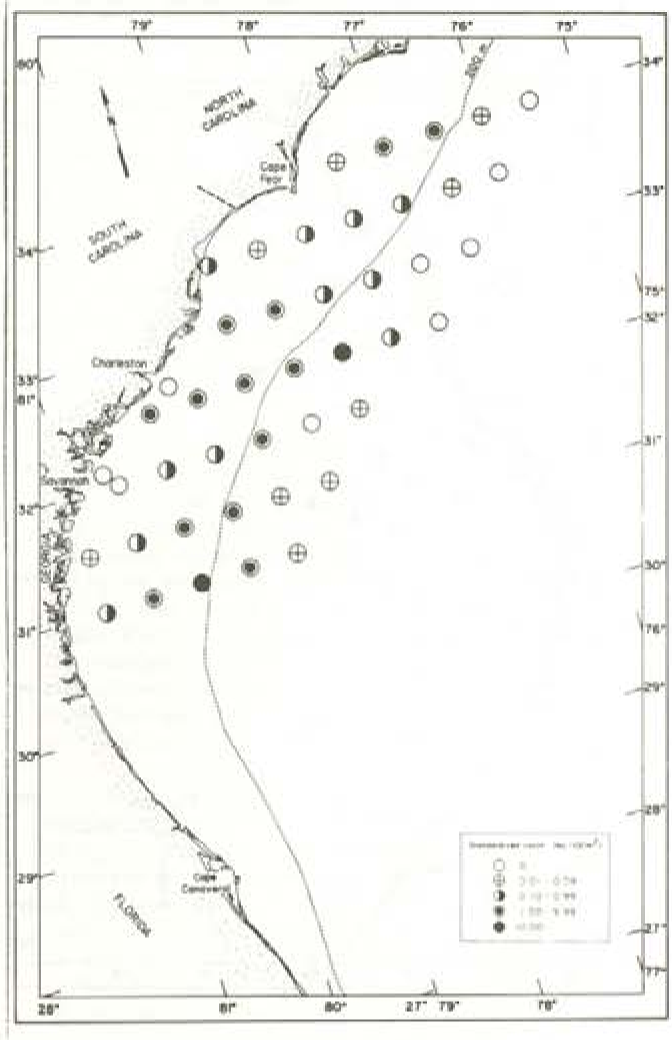


Figure 38. Distribution of young Mugilidae, neuston net, Cruise D3-73



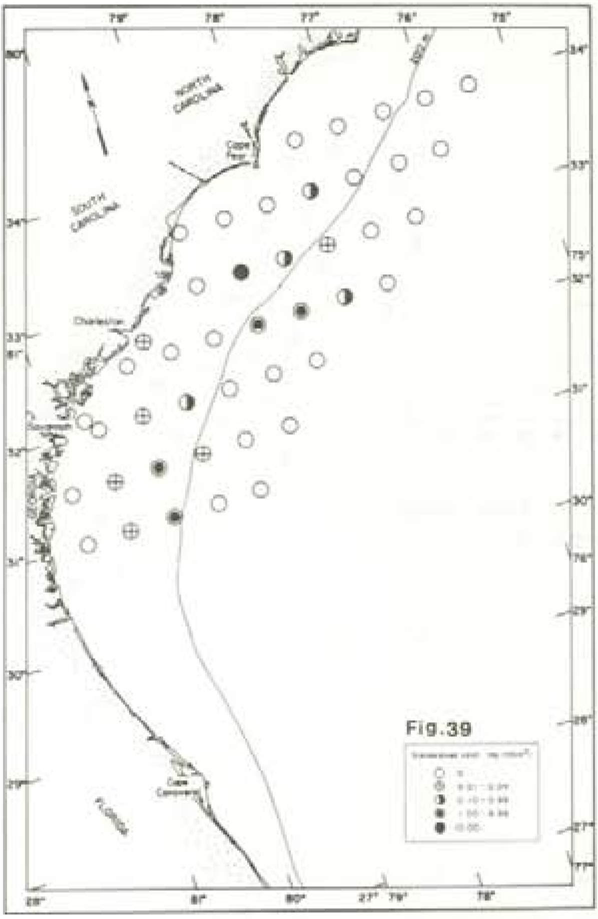


Figure 39. Distribution of young Pomatomus saltatrix, neuston net, Cruise D3-73

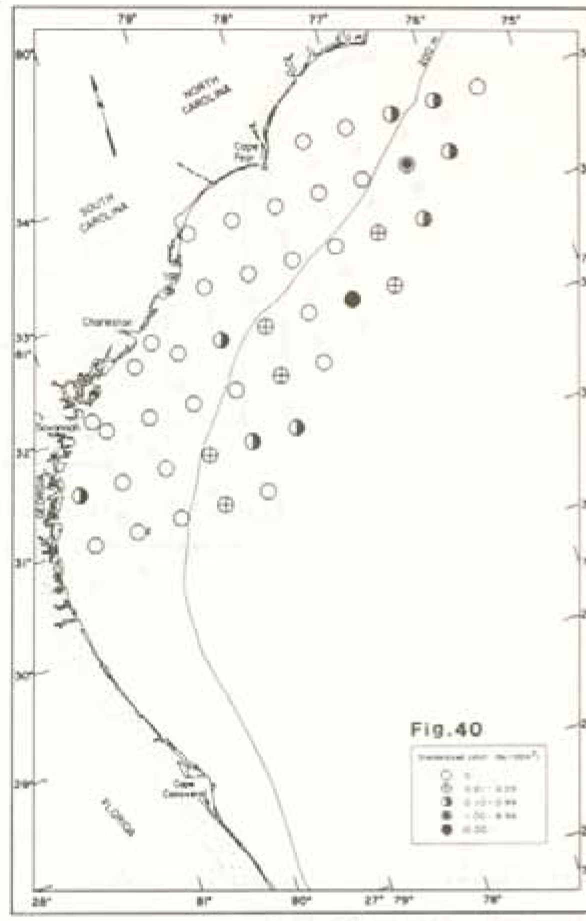


Figure 40. Distribution of young Scombridae, neuston net, Cruise D3-73

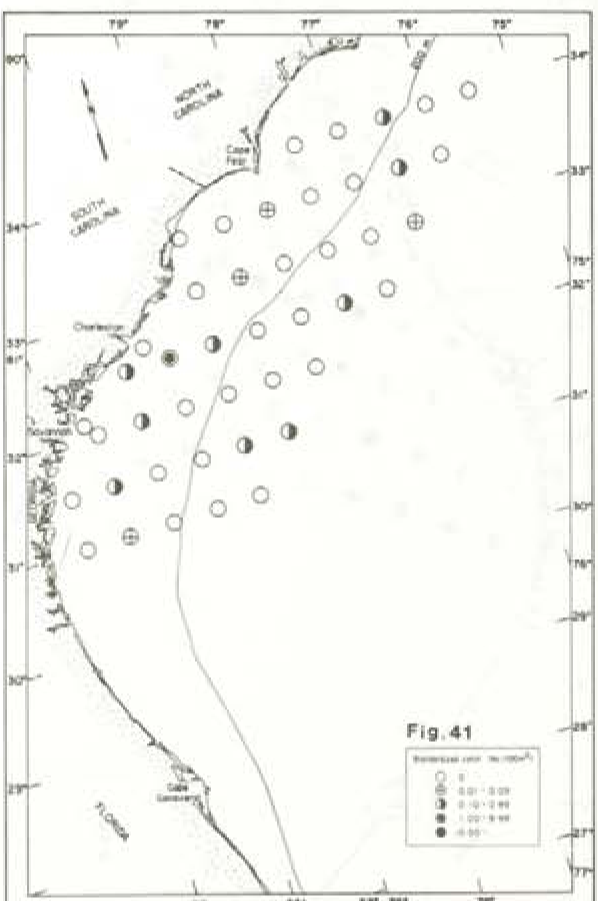


Figure 41. Distribution of young Serranidae, neuston net, Cruise D3-73

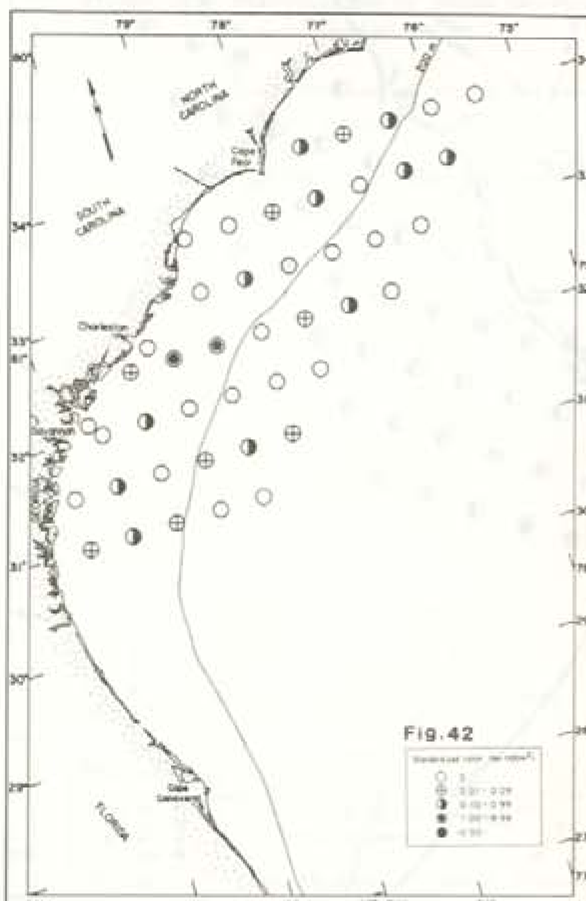


Figure 42. Distribution of young Bothidae, neuston net, Cruise D3-73

MRRI — MARMAP DOLPHIN CRUISE D5-73

Introduction

Dolphin Cruise D5-73 was made during fall, 1973, between October 23 and November 16. The cruise covered continental shelf and upper slope waters between latitude 29°N (Cape Canaveral, Florida) and latitude 33°45'N (Cape Fear, North Carolina) (Figure 43). Depths ranged from 10 m to 320 m. Twenty-seven bongo sampler tows and 41 neuston tows were made during the cruise. For the purposes of a concurrent groundfish survey, stations were selected randomly with a set number in each of six depth strata, based on the sampling scheme recommended by MARMAP (Anon., 1974). Stations for ichthyoplankton sampling were selected from among the groundfish stations in such a way as to approximate a grid and to give even coverage of the area surveyed.

Bongo Tows

A total of 27 bongo tows was made, in 26 of which young fishes were caught. Volumes filtered ranged from 74 m^3 to 336 m^3, depending on the duration of the tow, which varied with station depth. Most tows filtered volumes of 74 m^3 to 150 m^3 (Figure 44). A total of 4564 m^3 was filtered on bongo tows of Cruise D5-73.

Number of specimens caught per station ranged from 0 to 143, the modal class in the distribution (plotted on a logarithmic base) being that of 32 to 63 specimens (Figure 45). Number of taxa caught per station ranged from 0 to 25, with 12-15 as the modal class (Figure 46).

A. Catch composition. A total of 1136 young fishes was taken in all bongo tows on Cruise D5-73 (Table 21). Twelve orders and 40 families of fishes were represented in the samples. Unidentified specimens numbered 55 and accounted for 4.84% of the catch.

The four most abundant orders taken were the Perciformes (718 specimens, 23 families), the Pleuronectiformes (121 specimens, 2 families), the Gadiformes (85 specimens, 4 families), and the Myctophiformes (82 specimens, 4 families). These four orders accounted for 88.56% of all specimens taken.

The five most abundant families in the samples were the Callionymidae (168 specimens), Triglidae (157 specimens), Bothidae (117 specimens), Sciaenidae (117 specimens), and Ophidiidae (63 specimens) (Table 22). These five families accounted for 54.76% of the total number of young fishes taken. Other families of commercial or sport fishery interest whose young were taken in the plankton included the Carangidae (37 specimens, 3.26% of the total catch), Scombridae (1 specimen, 0.09%), and Serranidae (60 specimens, 5.28%).

The five most widely-occurring families on the cruise were the Bothidae (caught on 19 stations), Ophidiidae (16 stations), Gobiidae (16 stations), Triglidae (16 stations), and Myctophidae (13 stations). The catches of three families of fishery interest have been summarized by genus or species in the following section.

1). Scombridae. The only scombrid taken was identified as *Auxis* sp. This larva was taken between the 100 and 200 m contours at latitude 29°30'N.

2). Sciaenidae. Of the sciaenid catch, 48.73% could not be identified, mainly due to the small size of the larvae (Table 23). *Cynoscion nothus* was the most abundant sciaenid species, contributing 32 specimens (27.35%) to the total catch. *Micropogon undulatus* was next most abundant, with 21 specimens (17.95% of the sciaenid catch).

3). Bothidae. Young *Bothus* made up 34.20% of the bothid catch, *Syacium* 29.91%, and *Cyclopsetta* 0.85% (Table 24). Unidentified bothids made up the remaining 35.04% of the catch.

B. Distribution. On Cruise D5-73, surface temperatures inshore ranged from 14°C in the northern area to 24°C in the southern area. Maximum surface temperatures of 26°-27°C were recorded on stations furthest offshore, from the southern limit of the survey area almost to its northern limit (Figure 47). Isotherms generally followed the trend of the coast, with some irregularities. Surface salinities were high (≥ 35.0 ‰) over most of the area surveyed (Figure 48). Two areas of low salinity, both inshore, were present, one off the Santee River north of Charleston (centered approximately on latitude 33°N, longitude 79°20'W), the other between Cape Canaveral and southern Georgia (latitudes 29°30' - 31°00'N).

1). Myctophidae (Figure 49). Catches of young myctophids were concentrated on offshore stations. Highest catches (≥ 100/100 m^2) and 9 of the 13 positive stations were made outside the 100 m curve. All positive stations had surface temperatures > 24°C and surface salinities > 36.0 ‰. Young myctophids were taken from northern to southern limits of the area surveyed, but highest catches (≥ 100/100 m^2) were made between latitudes 29°30'N and 32°00'N, off northern Florida and Georgia.

2). Serranidae (Figure 50). Young serranids were taken in outer shelf waters between northern and southern limits of the area surveyed. None were taken on stations of depth ≤ 20 m. All positive stations had surface salinities of > 35.5 ‰, while 10 of the 12 positive stations had surface temperatures of > 24°C.

3). Sciaenidae (Figure 51). Young sciaenids were taken in shelf waters throughout the survey area, although standardized catches were relatively low or zero on stations in depths of ≤ 20 m. Most positive stations (9 of 10) had surface salinities of > 35.5 °/oo.

4). Triglidae (Figure 52). Catches of young triglids were essentially restricted to inner shelf waters; 13 of the 15 positive stations were at depths < 40 m. Triglids were caught from northern to southern limits of the area surveyed. All positive stations but three had surface temperatures of < 24°C.

5). Bothidae (Figure 53). Catches of young bothid flatfishes were widely-distributed with depth and with latitude over the area surveyed. Low or zero catches were made on stations furthest inshore; bothids were caught on only two of the seven stations located in < 20 m depth, and standardized catches on these two were relatively low, 10.0-99.9/100 m^2.

Neuston Tows

A total of 41 neuston tows was made, 40 of which contained young fishes. Neuston tows were made on all stations at which bongo tows were made and on 14 other stations (Figure 43). Standard MARMAP 10-minute tows, at 2.6 m/sec (5 knots), were made on 29 stations; on the remaining 12 stations, 15-minute tows were made at 1.8 m/sec (3.5 knots). Distance covered, and thus fishing effort, was equal on the two types of tow. Sampler avoidance at the two towing speeds was probably insignificantly different; Eldridge et al. (MS, 1975) found that catches of most young fishes in the Boothbay net were not correlated with towing speed over a range of 1 to 3 m/sec (2 to 6 knots). Only catches of Exocoetidae and of the stromateid Psenes maculatus correlated with towing speed over this range.

Neuston catches of young fishes ranged from 0 to 344 specimens per tow (Figure 54). The majority of neuston tows (22) caught between 8 and 31 specimens. Numbers of taxa taken in the neuston tows ranged from 0 to 37, with the majority of tows (24) taking between 4 and 11 taxa (Figure 55).

A. Catch composition. A total of 2797 young fishes was taken in the neuston tows on Cruise D5-73, with 13 orders and 55 families of fishes represented in the catches (Table 25). Unidentified specimens numbered 83 and accounted for 2.97% of the catch.

The four most abundant orders in the neuston catch were the Perciformes (1644 specimens, 30 families), the Tetraodontiformes (502 specimens, 5 families), the Pleuronectiformes (161 specimens, 3 families), and the Atheriniformes (143 specimens, 4 families). These four orders made up 87.59% of the total catch.

The five most abundant families in the total neuston catch were the Monacanthidae (459 specimens), Triglidae (377 specimens), Carangidae (301 specimens), Callionymidae (188 specimens), and Scaridae (169 specimens) (Table 26). These five families accounted for 53.41% of the catch. Other families of sport or commercial fishery interest whose young were taken in the neuston tows included the Coryphaenidae (40 specimens), Pomatomidae (50 specimens of Pomatomus saltatrix), Sciaenidae (92 specimens), and Serranidae (41 specimens).

The five most commonly-occurring families in the catch were the Monacanthidae (caught at 30 stations), Carangidae (26 stations), Gerreidae (23 stations), Syngnathidae (22 stations), and Exocoetidae (21 stations) (Table 26).

1). Sciaenidae. Unidentified sciaenids made up 34.80% of the catch, and the most abundant identified species was Micropogon undulatus (28 specimens, 30.43% of the catch of the family) (Table 27). Specimens of four genera of Sciaenidae - Cynoscion, Leiostomus, Menticirrhus, and Micropogon - were identified from the neuston catch.

2). Monacanthidae. Four genera and eight species of Monacanthidae were identified from the neuston samples (Table 28). Specimens of Stephanolepis dominated the monacanthid catch, making up 94.98%: S. hispidus contributed 77.55% (356 specimens); Stephanolepis sp., 16.34% (75 specimens); and Stephanolepis setifer, 1.09% (5 specimens). Specimens of Aluterus, Amanses, and Monacanthus were also taken.

3). Scombridae. The single specimen of the family Scombridae taken, identified as Scomberomorus cavalla, was caught in 40 m depth southeast of Cape Fear.

4). Bothidae. Bothus sp. (39 specimens, 25.66% of the bothid catch) and Syacium sp. (30 specimens, 19.74% of the bothid catch) were identified from the neuston samples. The remaining 83 specimens of Bothidae (54.60%) were not identified.

B. Distribution.

1). Carangidae (Figure 56). Neuston catches of young jacks were highest at stations on the outer shelf north of 30°N latitude. Twenty-three of the 26 positive stations had surface salinities of ≥ 36.0 °/oo, as had all stations with standardized catches of ≥ 0.1/100 m^2. Fifteen of the 16 stations with standardized catches of ≥ 0.1/100 m^2 had surface temperatures of ≥ 24°C.

2). Monacanthidae (Figure 57). Neuston catches of young monacanthids were widespread over the survey area with respect to depth and latitude. Generally low or zero catches were, however, made on stations at depths of ≤ 20 m.

3). Sciaenidae (Figure 58). Neuston-caught sciaenids were patchily distributed in shelf waters over the survey area, occurring on 7 stations. All positive stations were in depths of < 100 m, while all but one were in depths > 20 m.

4). Triglidae (Figure 59). Catches of young triglids were confined to shelf waters in the central part of the survey area, off Georgia and South Carolina (latitudes 31°N to 33°N). Seven of the eight positive stations were in depths of ≤ 40 m, and all had surface salinities of < 35.8 °/oo.

5). Bothidae (Figure 60). No young Bothidae were taken in neuston tows south of 30°N latitude, on the most northerly transect at 33°45'N latitude, nor at depths of < 20 m. Two of the 13 positive stations were outside the 100 m contour. All but one of the positive stations had surface salinities of ≥ 36.0 °/oo, and all but four had surface temperatures of ≥ 24°C.

Comparison of Bongo and Neuston Catches

A. Catch composition. Differences between composition of the neuston and bongo catches were not as striking as on earlier cruises at least with respect to families which were abundant in the catch of one or the other sampler. One family, the Ophidiidae, ranked considerably higher in the bongo catch than in the neuston catch. Four families ranked considerably higher in the neuston catch than in the bongo catch - the Monacanthidae (1st in the neuston catch, 29th in the bongo), Gerreidae (7th and 34th), Exocoetidae (8th in the neuston, no specimens in the bongo catch), and Pomatomidae (11th in the neuston, 25th in the bongo). Many of the more abundant families were of approximately equal importance in the catches of the two samplers, for example, the Callionymidae (ranking 1st in the bongo sampler catch, 4th in the neuston net catch), Triglidae (2nd in the bongo, 2nd in the neuston), Carangidae (9th and 3rd), Bothidae (3rd and 6th), Sciaenidae (3rd and 9th), Gobiidae (6th and 14th), and Serranidae (7th and 15th).

B. Distribution patterns. Catches of young Bothidae, Triglidae, and Sciaenidae were sufficiently high in both bongo and neuston tows to permit comparison of the distribution patterns of young fishes caught by the two gears. From this comparison, some idea of the relative effectiveness of the two types of gear in catching the young of these families can be obtained. For the Sciaenidae, the distributions of positive bongo stations and positive neuston stations were generally similar; positive stations were widely-scattered throughout the survey area. Sciaenids were taken in 10 bongo tows and in 7 neuston tows, but only on 3 stations were specimens taken in both bongo and neuston tows. Catches of the Triglidae were essentially restricted to inner shelf waters in both bongo and neuston samplers; triglids were, however, taken in the southern part of the survey area (south of 31°N latitude) in the bongo sampler, where no neuston catches were made. Triglids were taken in 15 bongo tows and in 9 neuston tows; specimens were taken in both samplers on 5 stations. Distributions of bongo and neuston catches of young Bothidae were essentially similar; catches were widespread over the survey area in waters of depth > 20 m. Bothids were taken in 19 bongo tows (70.5% of all bongo stations) and in 13 neuston tows (31.7% of all neuston tows). Specimens occurred in both bongo and neuston tows on 6 stations.

Day-Night Observations

The most abundant families in the bongo and neuston catches were scanned for diel differences in catches.

A. Bongo tows. Of the total number of stations, 7.4% were sampled at dawn, 40.7% during the day, 11.2% at dusk, and 40.7% at night. This represents 4.7% of the total volume filtered sampled at dawn, 47.8% during the day, 10.2% at dusk, and 37.3% at night. Of the total catch, 6.87% was taken at dawn, 29.93% during the day, 19.01% at dusk, and 44.19% at night. Thus, although day and night levels of sampling effort were equal, more fishes were taken at night, suggesting gear avoidance during daylight. However, individual families - Serranidae, Myctophidae, Sciaenidae, Triglidae, and Bothidae - showed no outstanding diel differences in the bongo catch.

B. Neuston tows. Of the total number of stations, 12.2% occurred at dawn, 39.0% during the day, 9.8% at dusk, and 39.0% at night. Of the total neuston catch, 20.70% of all specimens were taken at dawn, 19.56% during the day, 9.51% at dusk, and 50.23% at night. In contrast to Cruise D3-73, more fishes were taken at night than during the day (with effort equal day and night), suggesting gear avoidance during daylight or diel vertical migration.

Diel differences were observed in three of the most abundant families. No bothids nor triglids were taken during the day. For both families, most specimens were taken at night with some being captured at dusk and dawn. For the Sciaenidae, only 2 of the 92 specimens (both from the same station) were taken during the day, the remainder taken at dusk, dawn, or night. Monacanthidae and Carangidae showed no outstanding diel difference in catch.

Table 21. Composition of Catch of Bongo .505 Net, Cruise 05-71

Order/Family	Number Caught	% of Total	Rank	Catch/ 1000 m^3	Number of Occurrences	% of Total Stations	Rank
Anguilliformes	21	1.85		4.60	10	37.0	
Beryciformes	4	0.35		0.87	4	14.8	
Holocentridae	4	0.35	25	0.87	4	14.8	19
Clupeiformes	17	1.50		3.72	8	29.6	
Engraulidae	16	1.41	12	3.51	7	25.9	12
Elopiformes	1	0.09		0.22	1	3.7	
Elopidae	1	0.09	34	0.22	1	3.7	30
Gadiformes	85	7.48		18.62	17	63.0	
Bregmacerotidae	4	0.35	25	0.88	3	11.1	25
Carapidae	2	0.18	30	0.44	2	7.4	26
Gadidae	6	0.53	20	1.31	2	7.4	26
Ophidiidae	63	5.55	5	13.80	16	59.3	2
Gasterusteiformes	6	0.53		1.31	5	18.5	
Syngnathidae	6	0.53	20	1.31	5	18.5	16
Lophiiformes	3	0.26		0.66	3	11.1	
Myctophiformes	82	7.22		17.97	16	59.3	
Chlorophthalmidae	1	0.09	34	0.22	1	3.7	31
Myctophidae	52	4.58	8	11.39	13	48.1	5
Paralepididae	10	0.88	15	2.19	6	22.2	13
Synodontidae	11	0.97	14	2.41	8	29.6	11
Perciformes	718	63.21		157.32	26	96.3	
Acanthuridae	2	0.18	30	0.44	2	7.4	26
Apogonidae	5	0.44	24	1.10	4	14.8	19
Blenniidae	12	1.06	13	2.63	4	14.8	19
Callionymidae	168	14.79	1	36.81	4	14.8	19
Carangidae	37	3.26	9	8.11	11	40.7	8
Ephippidae	2	0.18	30	0.44	1	3.7	31
Gempylidae	7	0.62	18	1.53	4	14.8	19
Gerreidae	1	0.09	34	0.22	1	3.7	31
Gobiidae	62	5.46	6	13.58	16	59.3	2
Grammistidae	1	0.09	34	0.22	1	3.7	31
Labridae	24	2.11	11	5.26	9	33.3	10
Lutjanidae	9	0.79	17	1.97	4	14.8	19
Pomacentridae	1	0.09	34	0.22	1	3.7	31
Pomatomidae	4	0.35	25	0.88	2	7.4	26
Scaridae	29	2.55	10	6.35	12	44.4	6
Sciaenidae	117	10.30	3	25.64	10	37.0	9
Scombridae	1	0.09	34	0.22	1	3.7	31
Scorpaenidae	7	0.62	18	1.53	6	22.2	13
Serranidae	60	5.28	7	13.15	12	44.4	6
Sphyraenidae	6	0.53	20	1.31	5	18.5	16
Stromateidae	2	0.18	30	0.44	1	3.7	31
Triglidae	157	13.82	2	34.40	16	59.3	2
Uranoscopidae	1	0.09	34	0.22	1	3.7	31
Pleuronectiformes	121	10.65		26.51	19	70.4	
Bothidae	117	10.30	3	25.64	19	70.4	1
Cynoglossidae	4	0.35	25	0.88	3	11.1	25
Salmoniformes	13	1.14		2.85	7	25.9	
Gonostomatidae	10	0.88	15	2.19	6	22.2	13
Tetraodontiformes	10	0.88		2.19	8	29.6	
Monacanthidae	3	0.26	29	0.66	2	7.4	26
Tetraodontidae	6	0.53	20	1.31	5	18.5	16
Others	55	4.84		12.05	18	66.7	
TOTAL	1136	100.00		248.90	27	100.0	

Table 22. Fifteen Most Abundant Families in Bongo .505 Catch, Cruise 05-71

Numbers caught (N = 1136)	Occurrences (N = 27)
1. Callionymidae 168	1. Bothidae 19
2. Triglidae 157	2. Ophidiidae 16
3. Bothidae 117	2. Gobiidae 16
3. Sciaenidae 117	2. Triglidae 16
5. Ophidiidae 63	5. Myctophidae 13
6. Gobiidae 62	6. Scaridae 12
7. Serranidae 60	6. Serranidae 12
8. Myctophidae 52	8. Carangidae 11
9. Carangidae 37	9. Sciaenidae 10
10. Scaridae 29	10. Labridae 9
11. Labridae 24	11. Synodontidae 8
12. Engraulidae 16	12. Engraulidae 7
13. Blenniidae 12	13. Paralepididae 6
14. Synodontidae 11	13. Gonostomatidae 6
15. Paralepididae 10	13. Scorpaenidae 6
15. Gonostomatidae 10	

Table 23. Young Sciaenidae from Bongo .505 Collections, Cruise D5-73

Genus/Species	Number Caught	% of Total	Number of Stations
Cynoscion nothus	23	19.66	4
C. nothus ?	9	7.69	2
C. regalis	3	2.56	1
Leiostomus xanthurus	1	0.85	1
L. xanthurus ?	2	1.71	1
Micropogon undulatus	16	13.68	4
M. undulatus ?	5	4.27	2
Menticirrhus sp. ?	1	0.85	1
Unidentified	57	48.73	4
TOTAL	117	100.00	10

Table 24. Young Bothidae from Bongo .505 Collections, Cruise D5-73

Genus/Species	Number Caught	% of Total	Number of Stations
Bothus sp.	40	34.20	13
Cyclopsetta sp.	1	0.85	1
Syacium sp.	35	29.91	12
Unidentified	41	35.04	18
TOTAL	117	100.00	19

Table 25. Composition of Catch of Neuston Net, Cruise D5-73

Order/Family	Number Caught	% of Total	Rank	Number of Occurrences	% of Total Stations	Rank
Anguilliformes	44	1.57		13	31.7	
Atheriniformes	143	5.11		25	61.0	
Atherinidae	1	0.04	46	1	2.4	41
Belonidae	7	0.25	33	5	12.2	28
Exocoetidae	117	4.18	8	21	51.2	5
Hemiramphidae	18	0.64	22	12	29.3	7
Beryciformes	3	0.11		3	7.3	
Holocentridae	3	0.11	41	3	7.3	32
Clupeiformes	40	1.43		12	29.3	
Clupeidae	2	0.07	44	2	4.9	33
Engraulidae	38	1.36	17	10	24.4	9
Elopiformes	14	0.50		4	9.8	
Elopidae	12	0.43	27	4	9.8	29
Gadiformes	40	1.43		8	19.5	
Gadidae	17	0.61	23	2	4.9	33
Ophidiidae	23	0.82	20	6	14.6	25
Gasterosteiformes	45	1.61		22	53.7	
Syngnathidae	45	1.61	13	22	53.7	4
Lophiiformes	5	0.18		4	9.8	
Antennariidae	3	0.11	41	2	4.9	33
Ogcocephalidae	1	0.04	46	1	2.4	41
Myctophiformes	64	2.29		10	24.4	
Myctophidae	55	1.97	10	9	22.0	14
Paralepididae	1	0.04	46	1	2.4	4
Synodontidae	8	0.29	31	4	9.8	29
Perciformes	1644	58.77		40	97.6	
Acanthuridae	11	0.39	30	5	12.2	28
Apogonidae	6	0.21	35	6	14.6	25
Blenniidae	46	1.64	12	10	24.4	9
Callionymidae	188	6.72	4	10	24.4	9
Carangidae	301	10.76	3	26	63.4	2
Chaetodontidae	2	0.07	44	2	4.9	33
Coryphaenidae	40	1.43	16	11	26.8	8
Dactylopteridae	1	0.04	46	1	2.4	41
Gempylidae	7	0.25	33	4	9.8	29
Gerreidae	135	4.83	7	23	56.1	3
Gobiidae	42	1.50	14	8	19.5	20
Kyphosidae	12	0.43	27	9	22.0	14
Labridae	17	0.61	23	8	19.5	20
Lobotidae	1	0.04	46	1	2.4	41
Lutjanidae	1	0.04	46	1	2.4	4
Mugilidae	20	0.72	21	10	24.4	9
Mullidae	17	0.61	23	8	19.5	20
Pomacentridae	30	1.07	18	9	22.0	14
Pomatomidae	50	1.79	11	8	19.5	2
Scaridae	169	6.04	5	9	22.0	1
Sciaenidae	92	3.29	9	7	17.1	2
Scombridae	1	0.04	46	1	2.4	41

Table 25 (continued). Composition of catch of neuston net, Cruise D5-73

Order/Family	Number Caught	% of Total	Rank	Number of Occurrences	% of Total Stations	Rank
Scorpaenidae	13	0.34	26	7	17.1	24
Serranidae	41	1.47	15	10	24.4	9
Sparidae	3	0.11	41	2	4.9	33
Sphyraenidae	8	0.29	31	6	14.6	25
Stromateidae	1	0.04	46	1	2.4	4
Triglidae	377	13.48	2	9	22.0	14
Uranoscopidae	6	0.21	33	5	12.2	28
Xiphiidae	4	0.14	38	2	4.9	33
Pleuronectiformes	161	5.76		14	34.1	
Bothidae	152	5.43	6	13	31.7	6
Cynoglossidae	4	0.14	38	2	4.9	33
Soleidae	1	0.04	46	1	2.4	4
Salmoniformes	9	0.32		5	12.2	
Gonostomatidae	4	0.14	38	2	4.9	33
Tetraodontiformes	502	17.95		30	73.2	
Canthigasteridae	1	0.04	46	1	2.4	41
Balistidae	5	0.18	37	5	12.2	28
Monacanthidae	459	16.41	1	30	73.2	1
Ostraciidae	12	0.43	27	9	22.0	14
Tetraodontidae	25	0.89	19	10	24.4	9
Others	83	2.97		13	31.7	
TOTAL	2797	100.00		41	100.00	

Table 26. Fifteen Most Abundant Families in Neuston Catch, Cruise D5-73

Numbers caught (N = 2797)

1. Monacanthidae 459
2. Triglidae 377
3. Carangidae 301
4. Callionymidae 188
5. Scaridae 169
6. Bothidae 152
7. Gerreidae 135
8. Exocoetidae 117
9. Sciaenidae 92
10. Myctophidae 55
11. Pomatomidae 50
12. Blenniidae 46
13. Syngnathidae 45
14. Gobiidae 42
15. Serranidae 41

Occurrences (N = 41)

1\. Monacanthidae 30
2\. Carangidae 26
3\. Gerreidae 23
4\. Syngnathidae 22
5\. Exocoetidae 21
6\. Bothidae 13
7\. Hemiramphidae 12
8\. Coryphaenidae 11
9\. Engraulidae 10
9\. Blenniidae 10
9\. Callionymidae 10
9\. Mugilidae 10
9\. Serranidae 10
9\. Tetraodontidae 10
15\. Myctophidae 9
15\. Kyphosidae 9
15\. Pomacentridae 9
15\. Scaridae 9
15\. Triglidae 9
15\. Ostraciidae 9

Table 27.* Young Sciaenidae from Neuston Collections, Cruise D5-73

Genus/Species	Number Caught	% of Total	Number of Stations
Menticirrhus americanus	2	2.17	1
Menticirrhus sp. ?	2	2.17	1
Micropogon undulatus	28	30.43	2
Cynoscion nothus ?	16	17.39	1
Leiostomus xanthurus ?	12	13.04	1
Unidentified	32	34.80	5
TOTAL	92	100.00	7

Table 28. Young Monacanthidae from neuston collections, Cruise D5-73

Genus/Species	Number Caught	% of Total	Number of Stations
Aluterus heudeloti	1	0.22	1
A. monoceros	1	0.22	1
A. schoepfi	5	1.09	2
Amanses pullus	2	0.44	2
Monacanthus ciliatus	9	1.96	5
M. tuckeri	2	0.44	2
Stephanolepis hispidus	356	77.55	27
S. setifer	5	1.09	4
Stephanolepis sp.	75	16.34	8
Unidentified	3	0.65	2
TOTAL	459	100.00	30

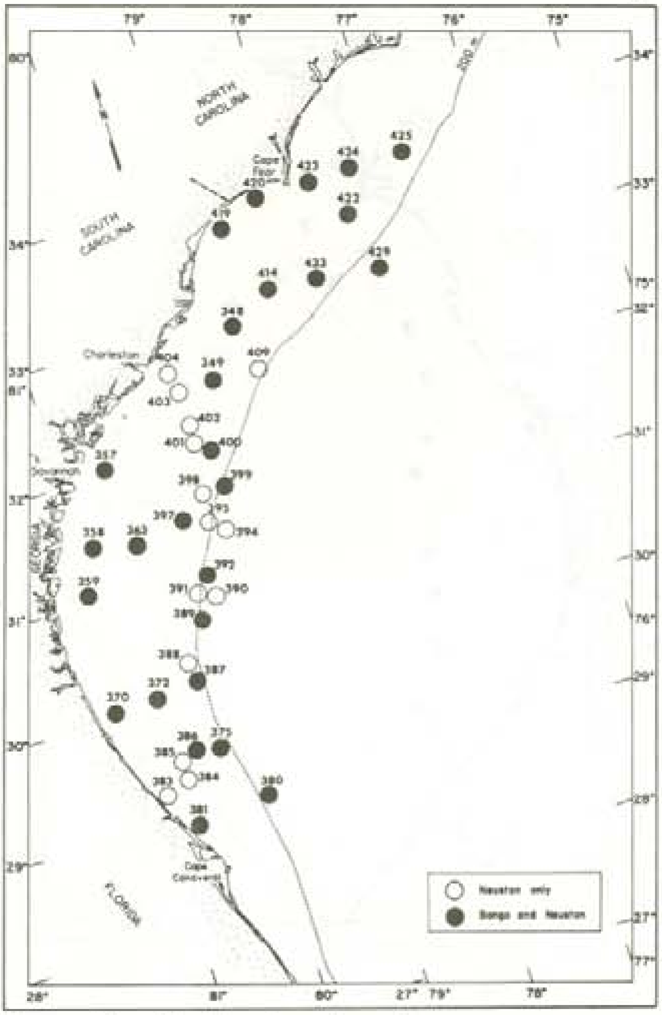


Figure 43. Station locations for MRRI-MARMAP Dolphin Cruise D5-73

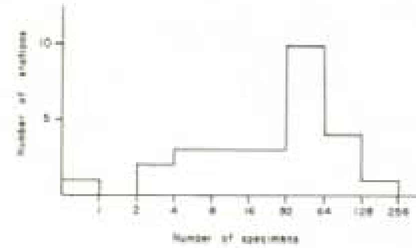


Figure 45. Distribution of young fishes among bongo .505 tows, Cruise D5-73

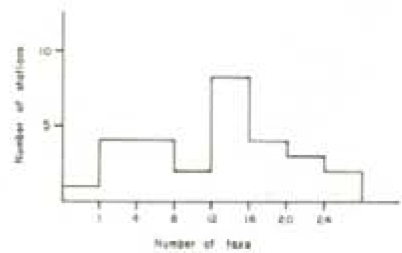


Figure 46. Distribution of taxa among bongo .505 tows, Cruise D5-73

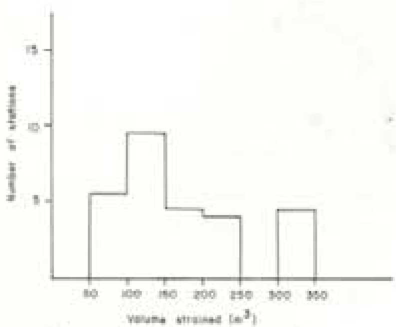


Figure 44. Distribution of volumes strained among bongo .505 tows, Cruise D5-73

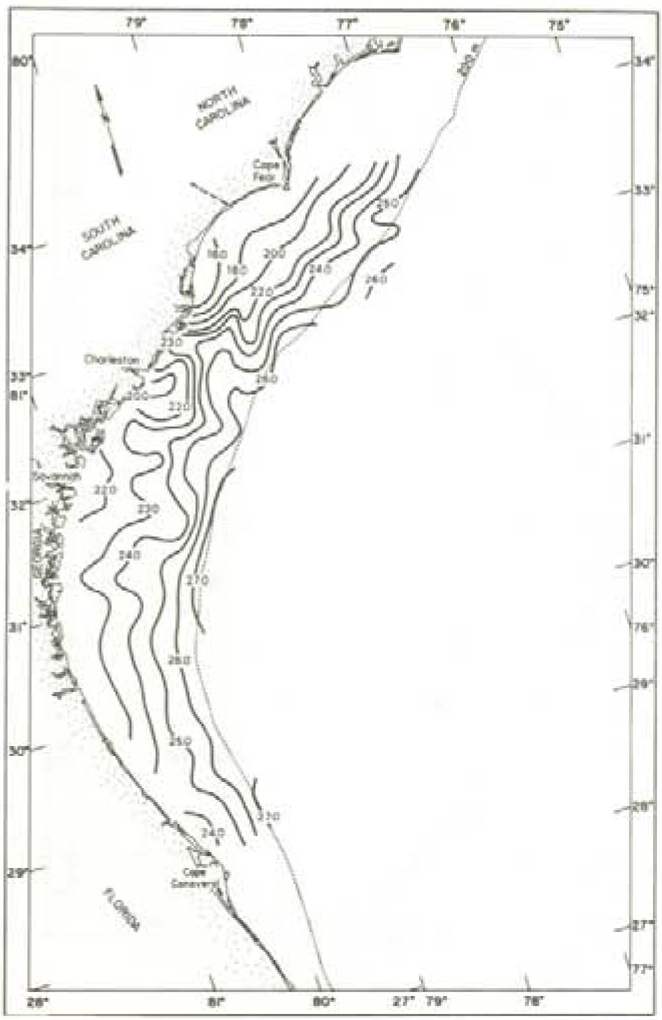


Figure 47. Surface temperatures (°C), Cruise D5-73

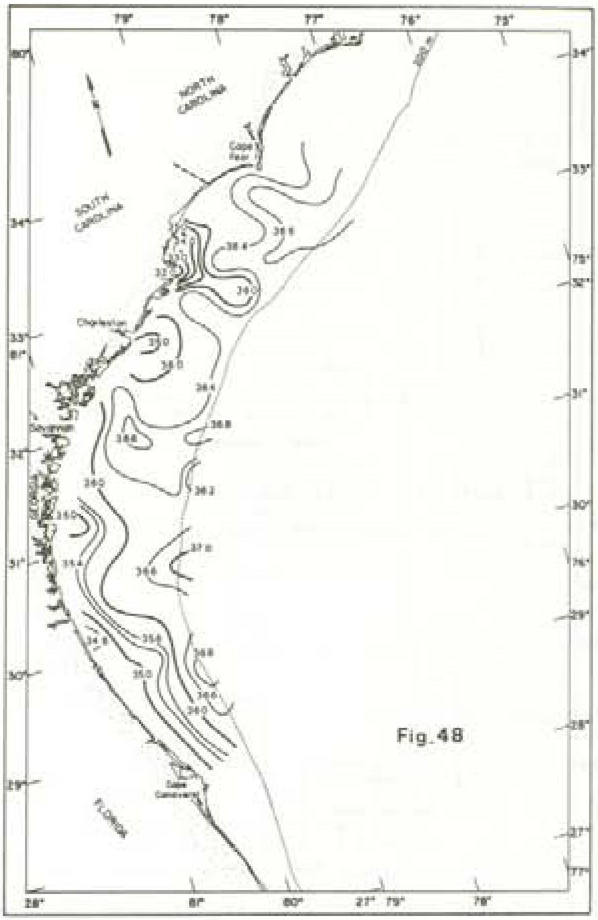


Figure 48. Surface salinities (°/oo), Cruise D5-73

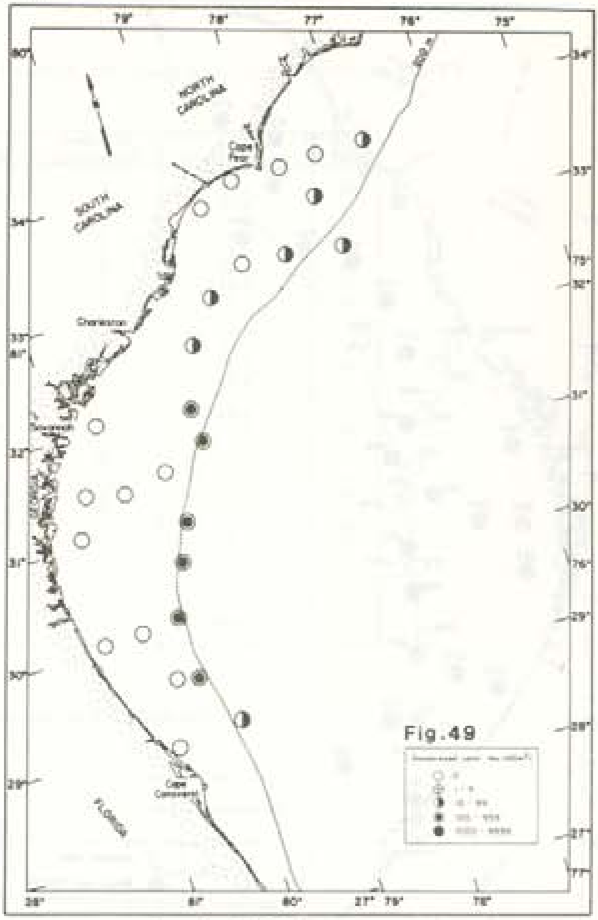


Figure 49. Distribution of young Myctophidae, bongo .505 net, Cruise D5-73

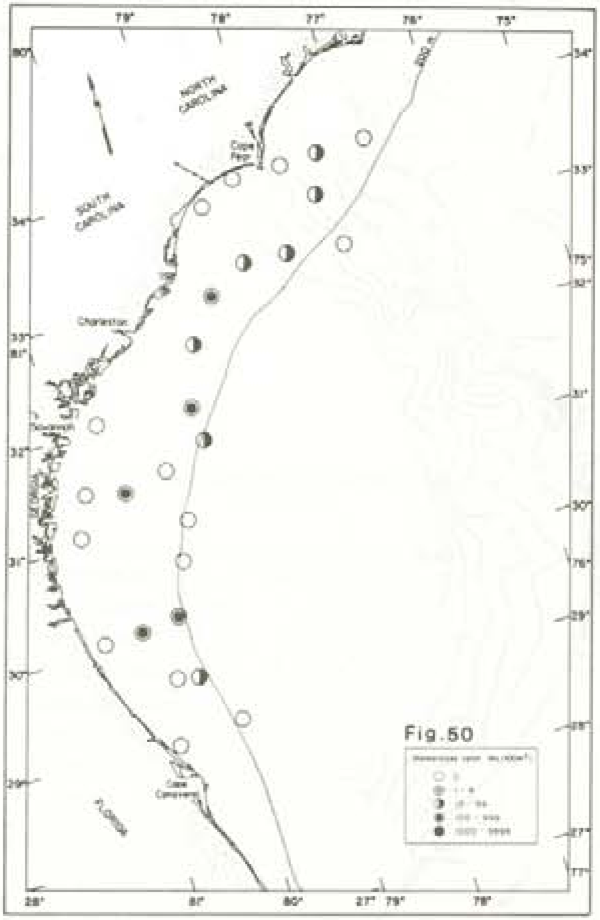


Figure 50. Distribution of young Serranidae, bongo .505 net, Cruise D5-73

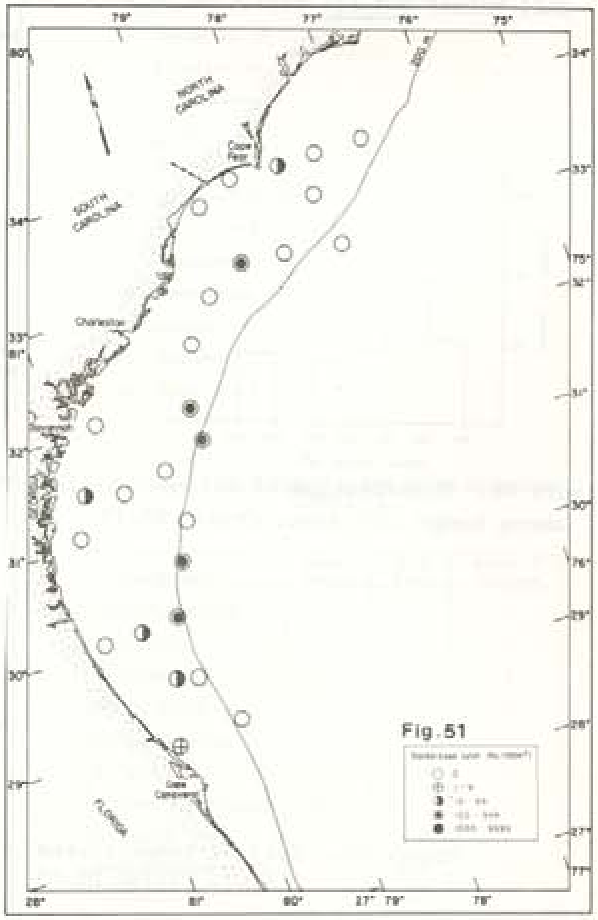


Figure 51. Distribution of young Sciaenidae, bongo .505 net, Cruise D5-73

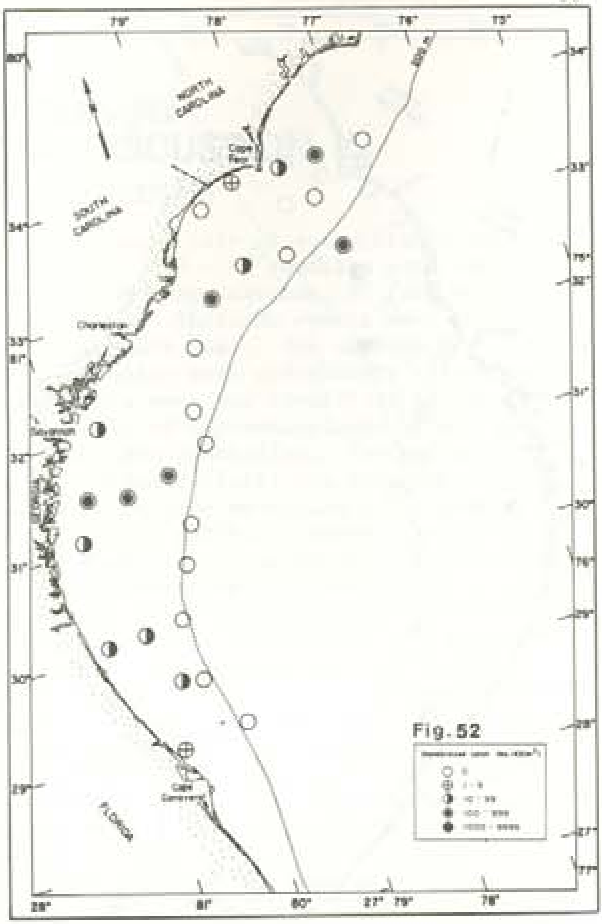


Figure 52. Distribution of young Triglidae, bongo .505 net, Cruise D5-73

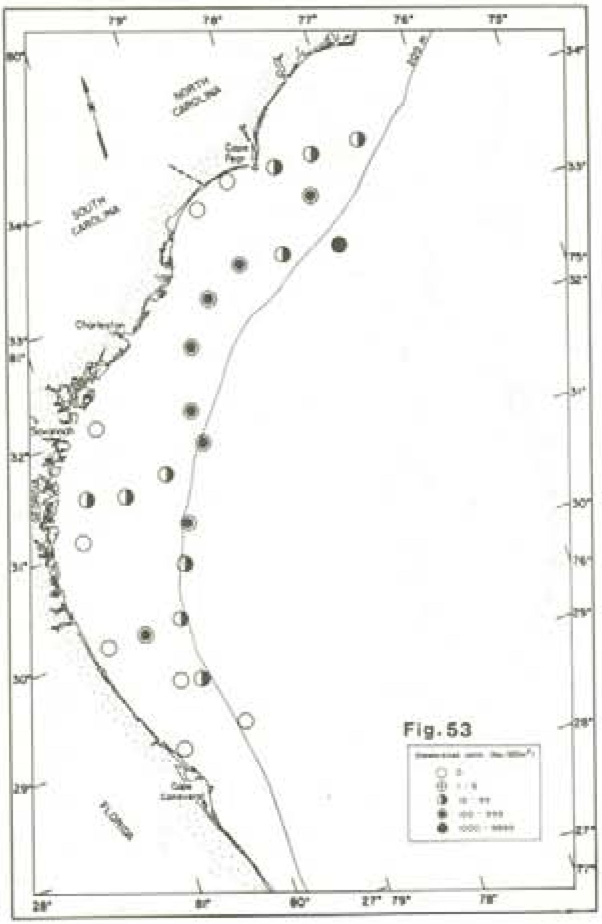


Figure 53. Distribution of young Bothidae, bongo .505 net, Cruise D5-73

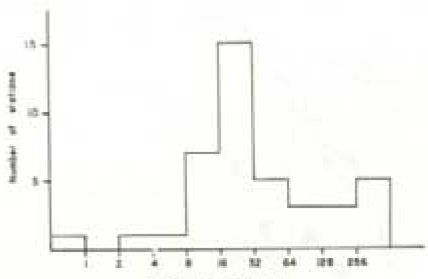


Figure 54. Distribution of young fishes among neuston tows, Cruise D5-73

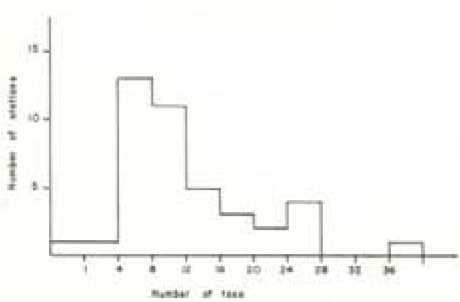


Figure 55. Distribution of taxa among neuston tows, Cruise D5-73

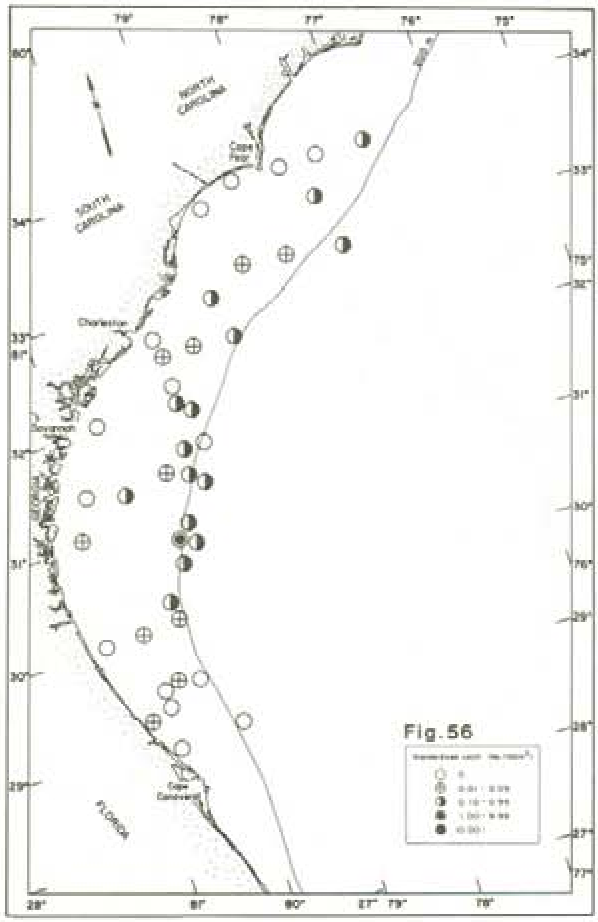


Figure 56. Distribution of young Carangidae, neuston net, Cruise D5-73

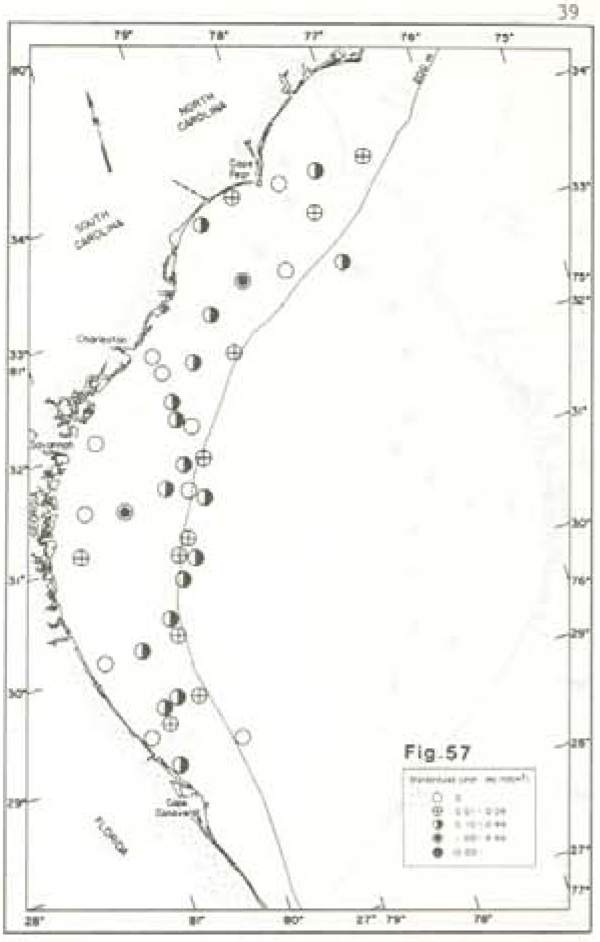


Figure 57. Distribution of young Monacanthidae, neuston net, Cruise D5-73

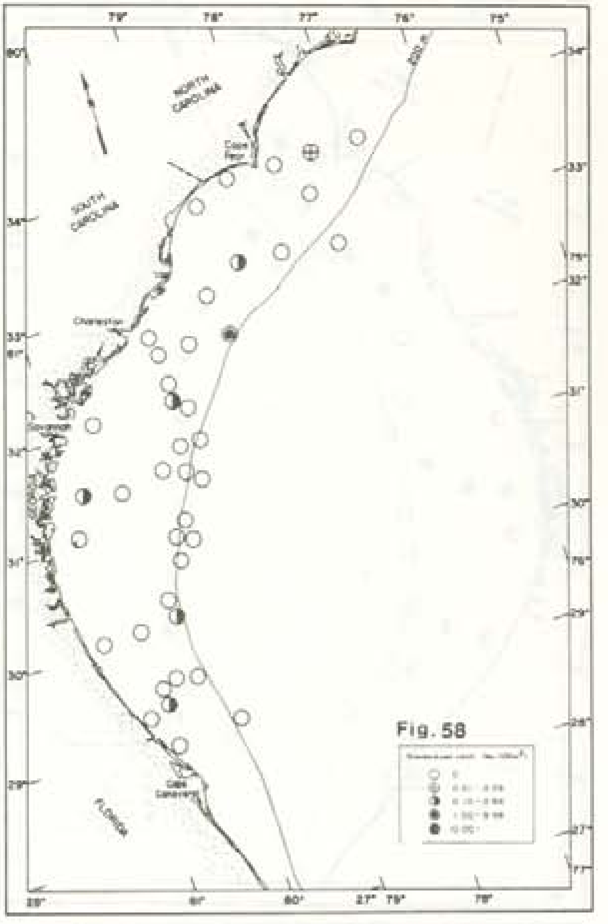


Figure 58. Distribution of young Sciaenidae, neuston net, Cruise D5-73

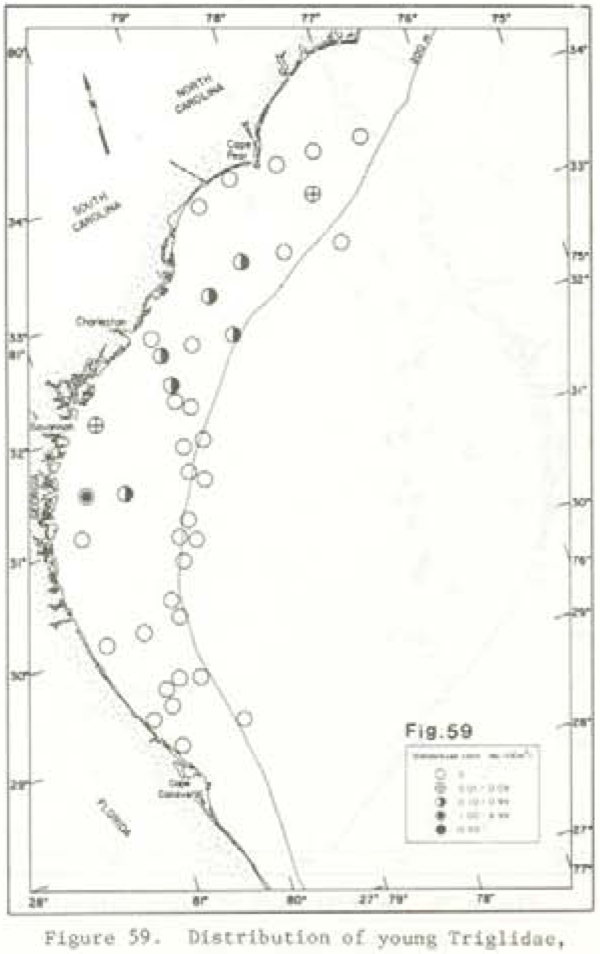


Figure 59. Distribution of young Triglidae, neuston net, Cruise D5-73

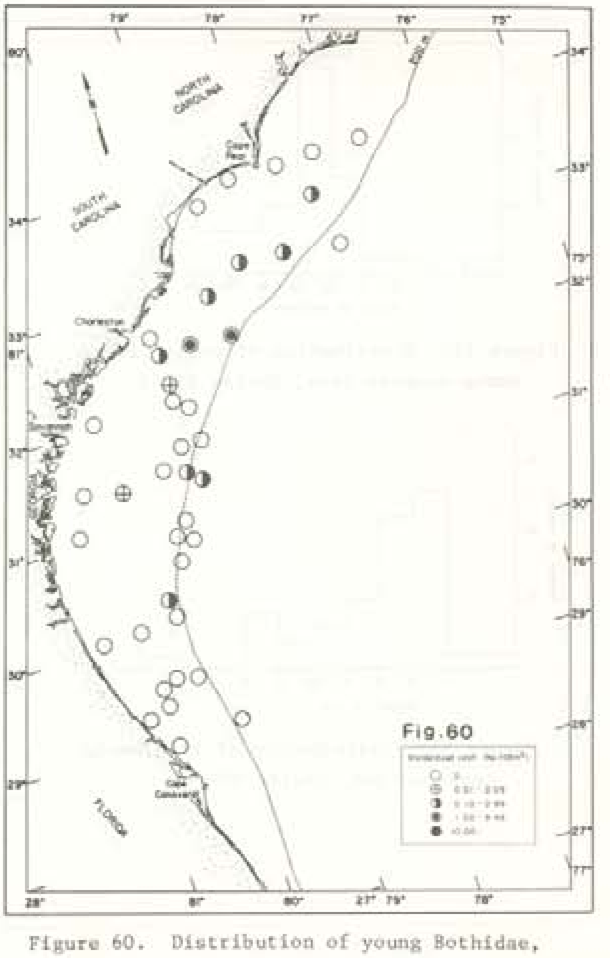


Figure 60. Distribution of young Bothidae, neuston net, Cruise D5-73

SUMMARY AND DISCUSSION

Catch Composition

A wide variety of young fishes was sampled in 1973 - 60 families were identified from bongo catches, 67 from neuston collections. Thirteen orders were represented in each case. The numbers of families taken were undoubtedly higher than this: eels were not identified to family and certain of the mesopelagic groups may not have been identified. The variety of fish families reflects the diversity of environments (the mesopelagic, epipelagic, slope, shelf, neritic, coastal, and estuarine) inhabited by fishes whose larvae and juveniles were sampled. The variety of the catch also reflects the diversity of the shelf and coastal fish faunas of the tropical and warm temperate western North Atlantic. Both tropical and warm temperate assemblages are represented in our collections, the tropical through drift of young fishes into the South Atlantic Bight in the Florida Current, and the warm temperate as the faunal assemblage of the South Atlantic Bight shelf (Briggs, 1974). Ahlstrom (1971) noted that no sampling method produces such a taxonomically and ecologically diverse assemblage of fishes as ichthyoplankton sampling.

The composition of our neuston net catch was similar to that caught by a surface-towed meter net in the South Atlantic Bight (Fahay, 1975). Young fishes of the same families - for example, the Gadidae, Balistidae, Carangidae, Exocoetidae, Monacanthidae, and Mugilidae - predominated in both cases. Fahay (1975) reported a catch of 51 families in the surface meter net.

Seasonality and Distribution

Average catch per station for a given cruise has been used as an index of seasonal abundance in the following discussion. Although not a statistically ideal representation of ichthyoplankton abundance, this index provides an approximation of abundance sufficient for comparison of catches between seasons.

A. Total catches. In the neuston net, abundance of fishes was greatest in winter (1014 per station, 340 excluding the single catch of 44,350 Sciaenidae off North Carolina), lower in spring (225 per station), and lowest in fall (68). Abundance in the bongo net was lowest in winter (38 per station), highest in spring (116), and intermediate in fall (42 per station).

Fahay (1975) obtained highest total catches and greatest catch diversity in spring and summer in the surface meter net, unlike our neuston net catches but similar to our bongo net catches. The discrepancy in seasonal abundance cycle between our neuston and bongo catches and between our neuston catches and those of Fahay (1975) were due in part to several extremely large neuston catches made in winter. Five neuston tows yielded $\geq$ 1024 specimens in winter; no spring or fall tows yielded $\geq$ 1024 specimens. These catches may have been anomalous, due to unusual aggregations of neustonic young fishes.

B. Priority families. Priority families are those of actual or potential fishery importance and of high abundance and widespread distribution in the ichthyoplankton of the South Atlantic Bight. Future taxonomic and ecological studies will focus on members of these families.

1). Bothidae. One of the most consistently abundant groups in the ichthyoplankton catches, the family Bothidae, was among the five most abundant families in the bongo catch in all three seasons and among the ten most abundant in the neuston catch in winter and fall. In bongo tows, abundance of bothids was greatest in spring, least in winter; in neuston tows, peak abundance was in winter.

Bothid young were widely-distributed in all seasons, although low catches were made at stations furthest inshore and offshore. Usually there was no marked relationship between standardized catches and surface water characteristics, but in two cases (bongo tows in spring and neuston tows in fall), higher catches were made in Florida Current water than in shelf water.

Young *Bothus* and *Syacium* together made up 37-71% of the bongo bothid catch and 11-45% of the neuston bothid catch, depending on season. In bongo tows, both were least abundant in winter, most abundant in spring. In neuston catches, *Bothus* were most abundant in winter, less so in the other two seasons; *Syacium* were approximately equally abundant throughout the year. The reasons for these discrepancies are unknown. Bongo catches may represent real abundance and distribution of bothids better than neuston catches, since bothids were consistently a more important part of the bongo catch than of the neuston catch.

Fahay (1975) found *Bothus* to be abundant in surface water and widely-distributed throughout the year in the South Atlantic Bight. He found no *Syacium* in surface tows. Smith *et al.* (1975) noted that spring and fall spawning peaks reported for *Bothus ocellatus* correspond to maximum abundance of larval *Bothus* sp. in the Mid Atlantic Bight (Cape Hatteras to Cape Cod) in May and November. Our peak catch south of Cape Hatteras in May may also result from the spring spawning peak of *B. ocellatus*. *Syacium* larvae are present throughout the year in the Mid Atlantic Bight, with maximum abundance from May to September (Smith *et al.*, 1975);

our bongo data accord well with these observations.

2). Carangidae. Carangids were also consistently abundant in 1973, ranking 1st or 2nd in the neuston catch in all seasons, among the top 10 in the bongo catch in spring and fall. Maximum abundance occurred in spring in catches of both nets, with lower, approximately equal, values in winter and fall. Protracted spawning seasons appear to be characteristic of many species of this family in the South Atlantic Bight. Fishes of the genus Caranx spawn from February to September (Berry, 1959), while Decapterus punctatus and Seriola spp. spawn year-round (Aprieto, 1974). The latter two genera accounted for the majority of young carangids sampled in winter, 1973.

Carangids were widely-distributed in all seasons, although they were less abundant on inshore stations (depth < 20 m) than on shelf and upper slope stations. In winter and spring, presence and abundance of young jacks were not related to surface water characteristics, but in fall highest catches were made in Florida Current water. Berry (1959) found young Caranx to be most abundant in Florida Current water throughout the year in this area. Seriola young may also be most abundant in Florida Current waters, since spawning is offshore (Aprieto, 1974). Decapterus punctatus spawn both inshore and offshore (Aprieto, 1974). Two bands of maximum bongo catches of carangids, one on the shelf and one on the slope, appeared in spring.

3). Clupeidae. Young clupeids were abundant in winter, considerably less so in spring, and rare in fall. Brevoortia spp. and Etrumeus teres dominated the catch of bongo and neuston nets in winter. Exclusively winter catches of young Brevoortia spp. and Etrumeus teres in surface plankton tows were also reported by Fahay (1975). Both are winter spawners in the Gulf of Mexico (Houde and Fore, 1973). Brevoortia tyrannus, the most abundant Brevoortia species of the Atlantic coast, spawns from October to April in the South Atlantic Bight (Reintjes, 1969). In the South Atlantic Bight, our low fall catches suggest that spawning is at a very low level at this time. Peak spawning of summer-spawning clupeids (such as Harengula jaguana and Opisthonema oglinum) is essentially finished by September in the Gulf of Mexico (Houde and Fore, 1973).

Most stations at which clupeid larvae were caught in neuston and bongo nets were over the shelf in winter. Highest bongo catches were, however, in high salinity (> 36.0 $^{o}/oo$) water on the upper slope between Charleston and Savannah, while maximum neuston catches were made on the outer shelf. These observations suggest offshore spawning for the clupeids. Reintjes (1969) notes that B. tyrannus spawn offshore and in the larger sounds and bays; he made large collections of planktonic eggs 65 km off the North Carolina coast. Larvae and juveniles subsequently move to estuarine and coastal nursery grounds.

4). Gadidae. Gadids were rare throughout the year in bongo catches. In neuston catches, they were abundant in winter and rare in spring and fall. Urophycis spp. accounted for most of the winter gadid catch, with U. regius accounting for 72.05% of gadids. Neuston-caught gadids had a northerly continental shelf distribution in winter, few being caught outside the 200 m contour or south of 31°N latitude. Highest catches occurred on the outer shelf in waters of Florida Current characteristics. These observations are consistent with earlier observations of offshore winter (November - March) spawning in Urophycis regius and U. floridanus off North Carolina (Hildebrand and Cable, 1938). Our seasonality and distribution data are similar to those of Fahay (1975); he reports maximum surface net catches of Urophycis regius in winter and distribution in shelf waters north of Cape Canaveral with greatest abundance off North Carolina. Fahay (1975) found other species of Urophycis also to be most abundant in winter.

5). Mugilidae. Young mullets were most abundant in spring and rare in fall in both nets and were much more abundant in neuston catches than in bongo catches. Mugil cephalus predominated in winter, M. curema in spring. Fahay (1975) also found young M. cephalus to be most abundant in winter, M. curema in spring. In both species, however, distribution was over the shelf only in Fahay's (1975) study, in contrast to presence of young mullets in both shelf and slope waters in the present study. M. cephalus have been reported to spawn from September to April and M. curema from March to September, off Georgia (Dahlberg, 1972). In both species, the adult habitat is in coastal and estuarine waters, while spawning occurs in Florida Current waters in the South Atlantic Bight (Anderson, 1957, 1958).

6). Pomatomidae. Abundance of Pomatomus saltatrix was greatest in spring. P. saltatrix was more abundant in neuston catches than in bongo catches. Spring distribution centered on the shelf break and extended throughout the north-south range of the survey area. These observations are in accord with earlier reports of peak spawning in April and May at the shelf edge in the South Atlantic Bight (Clark, 1973). Fahay (1975) found young bluefish in surface tows only in spring and noted their presence throughout the South Atlantic Bight at this season.

7). Sciaenidae. Abundance of young sciaenids was greatest in winter, least in spring, and intermediate in fall. Two species, Leiostomus xanthurus and Micropogon undulatus, together made up the majority of the year's catch (more than 99% of the neuston catch, 64% of the bongo catch), while Cynoscion and Menticirrhus were taken in small numbers. L. xanthurus, which are reported to spawn from December to March off North Carolina (Hildebrand and Cable, 1930), were most abundant in winter tows and were not taken in spring. Presence of this species in fall tows indicates occurrence of some spawning in fall in the South Atlantic Bight. M. undulatus spawn from September to March off North Carolina (Hildebrand and Cable, 1930); abundance was greatest in our neuston collections in winter and bongo collections in fall, confirming the existence of spawning in both seasons in the Bight.

Young sciaenids were concentrated in shelf waters in winter and fall with few positive stations on the upper slope. Distributions were northerly, with most catches made north of Jacksonville, Florida (30°30'N latitude). These observations suggest spawning on the shelf for L. xanthurus and M. undulatus; both are reported to spawn some distance offshore after migration of adults from coastal and estuarine waters (Hildebrand and Cable, 1930). Length-frequency data on L. xanthurus and M. undulatus in South Carolina estuaries (Shealy et al., 1975) also suggest offshore winter spawning and spring recruitment to the estuaries in these species.

Our small catches of Cynoscion and Menticirrhus may have been due to lack of sampling at times and in places of peak spawning. Species of both genera spawn from April to September, with peaks in spring or summer (Bearden, 1963; Dahlberg, 1972; Hildebrand and Cable, 1934; Tabb, 1961). Sampling during summer of 1973 is not reported on in this paper. Species of Cynoscion spawn in shallow estuarine or coastal waters (Dahlberg, 1972; Harmic, 1958), while Menticirrhus spp. probably spawn some distance from shore (Bearden, 1963; Hildebrand and Cable, 1934; Jannke, 1971).

Fahay's (1975) observations of young L. xanthurus in fall and winter accord well with ours, as do the small numbers of Cynoscion and Menticirrhus in his samples. He collected no M. undulatus, which were a significant component of our surface collections of Sciaenidae.

8). Scombridae. Abundance of scombrids in neuston catches was approximately equal in winter and spring, and in bongo catches was highest in spring. Scombrids were rare in both nets in fall. The two dominant genera, Scomber and Auxis, showed different seasonal abundance patterns. Scomber was most abundant in winter, making up 98% of the winter neuston catch of scombrids. Scomber was not taken in bongo tows. Auxis had highest abundance values in spring in both nets and was the dominant scombrid in bongo catches throughout the year. Variety of scombrid genera and species was greatest in spring in both nets.

Most scombrids were taken in shelf and slope waters in the northern part of the survey area in winter, with a large catch of Scomber sp. (640 specimens, 92.62% of the scombrids taken) off Cape Fear, North Carolina, accounting for most of the catch. In spring, scombrid larvae were taken mainly over the slope, with some catches over the shelf; most catches were in Florida Current water. This pattern suggests spring spawning in Florida Current waters off the shelf for Auxis and for the other "southern" scombrids (those other than Scomber).

Klawe (1960) concluded that many species of scombrids spawn in Florida Current waters off Miami, mainly from March to October; our spring distributional picture, occurrence of peak scombrid larval variety in spring, and low catches in fall are in accord with his observations. Scomber scombrus spawns mainly north of Cape Hatteras in shelf waters from April to June (Sette, 1943), so was probably not a major constituent of our Scomber catch. Young S. japonicus have been reported to occur throughout the South Atlantic Bight in winter and spring (Fahay, 1975).

9). Serranidae. Abundance of young serranids was greatest in spring in both neuston and bongo collections. Shelf and slope waters yielded catches of serranids in all three seasons; in winter and spring, there was no apparent relation between distribution and water type, while in fall, water of Florida Current characteristics yielded most specimens. Two bands of maximum bongo catches, one on either side of the shelf break, appeared in spring.

Spawning of serranids probably occurs over much of the South Atlantic Bight shelf. Species of Diplectrum, Centropristis, Epinephelus, and Mycteroperca have been taken over wide ranges of depth and latitude in MRRI-MARMAP groundfish survey trawl samples. The spring peak in abundance of serranids in the plankton and neuston samples coincides with spring peaks in reproductive activity in species of these four genera in areas in or near the South Atlantic Bight. Centropristis striata spawns off North Carolina in May (Kendall, 1972). Diplectrum formosum probably spawns in late spring and summer (May - July) in the Gulf of Mexico (Bortone, 1971). Epinephelus morio shows peak reproductive activity in April and May in the Gulf of Mexico (Moe, 1969), while several species of Epinephelus and Mycteroperca show peaks in gonad activity in April and May on Caribbean reefs (Munro et al., 1973).

pling, overall catch at night was about 1 1/2 times that during the day. However, no outstanding diel differences were observed in the catches of the most abundant families throughout the year. Ahlstrom (1959) stated that most of the young fishes above the thermocline (125 m) off southern California showed definite diel vertical migrations, most as a negative response to light. To minimize diel differences in catch, he suggested a double oblique tow type as opposed to a step oblique pattern; our results with a double oblique tow have indicated some diel difference in total numbers (possibly due to gear avoidance and other factors).

B. Neuston tows. As in the bongo samples, the numbers of fishes from dusk and dawn samples were approximately proportional to the numbers of stations sampled in each period. Over the whole year, there were approximately equal numbers of day and night tows, there being somewhat more night tows in winter, somewhat more day tows in spring, and equal numbers in fall. In winter and fall, many more specimens were taken at night than in the day (in winter about 30 times as many, about 10 times if the one unusually large catch off North Carolina is omitted). In spring, however, approximately equal numbers of fishes were taken during the two periods.

Some diel differences in catch of the major families were observed. Bothidae, Clupeidae, Serranidae, Sciaenidae, and Triglidae were much more prominent in night than in day samples, while Mullidae were more prevalent in day tows. These families may thus be part of the facultative neuston (Hempel and Weikert, 1972), the groups of organisms inhabiting the surface layer only at certain hours of the day. Net avoidance during daylight may, however, account for some of the increased abundance of some groups in night samples, and further studies will be necessary to separate the effects of net avoidance from those of vertical migration. These results are comparable to those of Eldridge et al. (MS, 1975) with the exception that (on a summer neuston test cruise) they took too few sciaenids and triglids to show any significant diel differences. They also showed significant diel differences in catch in individual species of Carangidae; approximately equal numbers of species showed higher day catches, higher night catches, and no diel differences. Our results on Carangidae showed no marked diel difference at the family level, which agrees with the study of Eldridge et al. (1975).

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