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Ichthyoplankton of the Gulf of Alaska Near Kodiak Island, April–May 1984

by
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INTRODUCTION

This report describes a cooperative U.S.-U.S.S.R. ichthyoplankton survey (designated 1SH84) conducted off the Alaskan coast in the Gulf of Alaska from April 7 to May 4, 1984. Prior reports concerned with the ichthyoplankton of this area include Dunn et al. (1984) and Kendall and Dunn (1985). In addition, the abundances and distributions of many of the species reported here have also been examined through cooperative surveys conducted at various times off the coasts of Washington, Oregon, and northern California (Bates 1984; Clark 1984, 1986; Clark and Kendall 1985; Kendall and Clark 1982a, 1982b).

METHODS AND MATERIALS

The objectives of the work on the Soviet research vessel *Shantar*, as had been previously reported by Dunn (1986), were to investigate the dynamics of walleye pollock spawning by means of ichthyoplankton surveys in two areas of the Gulf of Alaska. The first area surveyed was bounded to the northeast by Montague and Middleton Islands and to the southwest by Afognak Island and Portlock Bank (Figures 1 and 2). This survey sought evidence of concentrations of spawning walleye pollock (*Theragra chalcogramma*) as would be indicated by sizable levels of egg and larval catches. Earlier ichthyoplankton surveys and the local knowledge of fishermen suggested that such concentrations might be expected. The second survey was of the shelf region southwest of Shelikof Strait to the Shumagin Islands. The purposes of this survey were to monitor the distribution of the larvae resulting from walleye pollock spawning in Shelikof Strait and to determine if any significant spawning had occurred to the southwest of Kodiak Island as had been observed through ichthyoplankton surveys in earlier years (Dunn et al. 1984).

A grid of 221 stations was established by Soviet ichthyologists and Dr. Kendall of the NWAFC. However, biological samples from only 157 stations -- these being from stations G001A-G073A and stations G093A-G179A -- were retained by the U.S. sampling party for subsequent analysis.

The Soviet research vessel Shantar, with Dr. E. Moiseev serving as chief scientist, occupied the 157 stations (Figure 1) basically from northeast to southwest over a period extending from 7 April to 4 May. Hydrographic and biological (neuston and bongo) samples were obtained at each station, with the exception that hydrographic sampling was not conducted at the first six stations. Hydrographic samples were obtained to standard depths of 0, 10, 20, 30, 50, 75, 100, 150, 200, 250, 300, 400, 500, and 600 m as water depth permitted. Temperature, salinity, and dissolved oxygen determinations were made aboard ship from these samples. Computer character files detailing hydrographic values for stations G006A through G221A are maintained in the NWAFC ichthyoplankton data system. Results of these measurements will be reported elsewhere.

The neustonic layer was sampled with a 0.3 m high by 0.5 m wide Sameoto sampler (Sameoto and Jaraszynski 1969) fitted with a 0.505 um mesh net. Two neuston samplers were towed simultaneously at each station, with one deployed to port and the other to starboard, for 10 min at a standard speed of 2.0 knots (1.0 m/sec). A standard MARMAP bongo tow (Smith and Richardson 1977) using 60 cm diameter samplers with 0.505 um mesh nets was made with a maximum of 285 m of wire out at each station as depth permitted. Flowmeters in the mouth of the nets were used to determine the volume of water filtered. Typically, the Soviets retained one of the paired neuston and bongo samples and the Americans retained the other.

The American samples were processed by the Polish Plankton Sorting Center in Szczecin, Poland, where displacement plankton volumes were determined (for bongo samples) and all fish eggs and larvae removed. The fish eggs were counted and staged to developmental periods (Matarese, pers. comm.) and the larvae were identified, counted, and measured. Upon the return of sorted specimens to the NWAFC, egg counts were verified and identifications made by Ann Matarese and Debbie Blood, and larval identifications and counts were verified by Beverly Vinter. Identifications were made to the lowest taxonomic level possible, and in some cases "types" of unidentified eggs or larvae have been established.

The number of eggs or larvae in a sample was converted to standardized catch (Smith and Richardson 1977), describing the observed number of animals per 10 m^2 of sea surface area for a bongo sample and number per 1,000 m^3 for a neuston sample. The abundance of a taxa was expressed as the logarithm of the total number of eggs or larvae within the survey area; the calculation of a total was based on the Sette and Ahlstrom census as discussed by Richardson (1981). Walleye pollock egg staging data have been entered into the ichthyoplankton data system but results will not be reported here.

A hierarchical analysis of variance was designed for the analysis of larval length data. The factors in the design were:

$$X_{ijk} = MU + A_i + b_{ij} + e_{ijk}$$

where

X_{ijk}	measured length of a larva
MU	the mean length for all larvae within both regions of the survey area
A_i	regional increment, a fixed increment to mean larval length for fish from the ith region
b_{ij}	station increment, a random increment to mean larval length for fish from the jth sample of the ith region
e_{ijk}	within-sample increment, a random increment to the length of the kth fish from the jth sample of the ith region.

The northeast region included stations G001A-G073A and the southwest region included stations G096A-G179A (Fig. 1). This division of the survey area effectively defined a regional factor, A_i, fixed at two levels with each representing an increment to the overall mean length. The overall variability in larval lengths was further partitioned into a station component of variance, since mean larval length varies randomly among stations within a region, and a within-sample component of variance, representing the combined effects of measurement error, differential larval growth within the same parcel of seawater, and age related differences in size.

Larval lengths were measured on from 1 to a targeted maximum of 50 animals, depending on the size of the catch. Catch size must be sufficiently large for the adequate characterization of a length frequency. For this reason the data selected for this analysis were restricted to only those samples for which at least 20 animals were measured.

Since the number of measured larvae vary from catch to catch, the possibility exists that the variance ratio test, or F statistic, may be affected by any potential nonnormality or variance heterogeneity in the data (Snedecor and Cochran 1967). However, since the station and within-sample increments to the regional mean length, b_{ij} and e_{ijk}, were both random variables, samples sizes can be balanced by treating the data as a target population which may itself be sampled. Equal sample sizes were obtained, both for samples within a region and for larval measurements within a sample, by means of a FORTRAN IV program written for this purpose which randomly subsampled the data without replacement and performed the ANOVA calculations.

The regional and the station components of the total variability in larval lengths measurements were tested for significance. A regional F statistic was calculated as the quotient of regional mean square and the station mean square; a station F statistic was calculated as the quotient of the station mean square and the error mean square.

RESULTS

Table 1 shows the station position, GMT date and time of occupancy, polygonal station area (Sette and Ahlstrom 1948), and standard haul factor for each station occupied. Table 2 summarizes the catches of fish eggs and Table 3 summarizes the catches of larvae for neuston and bongo tows in terms of percent occurrence and logarithmic abundance. A total of 64 taxa were found comprising 14 taxa of eggs, 54 taxa of larvae, and 7 taxa of juveniles (of which 3 were myctophids). Figures 3-6 illustrate the rank abundances of egg and larval catches in bongo and neuston tows using several measures of abundance. The abundance measures for juvenile fish are considered to have little meaning due to the ability of these fish to avoid the net opening during a tow and are not reported. Figures 7-36 show the geographic distribution, abundance at each station, and larval length frequencies for the more abundant taxa. Results of recurrent group analysis at the 0.4 affinity level are shown in Figure 37 for bongo and neuston catches.

Relative Abundances

The rank order of abundance among the taxa depends on the measure of abundance examined. Three numerical measures of abundance for each net were used: total numbers caught, logarithmic abundance, mean number per 1,000 m^3 (for neuston) and mean number per 10 m^2 (for bongo). Percent occurrence was also determined.

In the neuston net (Fig. 3), egg catches were dominated by *Theragra chalcogramma* and *Hippoglossoides elassodon* with respect to the numbers caught and the logarithm of number in area. Of secondary importance in the ranking of logarithmic abundances were Microstomus pacificus, teleost type A, Glyptocephalus zachirus, and Sebastolobus spp. The ranking of mean number per 1000 m^3 was dominated by Hippoglossoides elassodon with approximately 90 animals per 1000 m^3; Theragra chalcogramma and Microstomus pacificus followed with approximately 60-70 animals per standard volume filtered. Theragra chalcogramma occurred in greater than 50% of collections, and approximately 20% of collections contained eggs of Hippoglossoides elassodon, Glyptocephalus zachirus, teleost type A, and Microstomus pacificus.

The larval catches in the neuston net (Fig. 4) were dominated by Theragra chalcogramma, Hexagrammos decagrammus, Ammodytes hexapterus, and Lyconectes aleutensis according to the three measures of numerical abundance. The mean number of larvae for Theragra chalcogramma was approximately 170 animals per standard volume filtered. Hexagrammos decagrammus occurred in approximately 40% of all hauls while Theragra chalcogramma, Lyconectes aleutensis, and Ammodytes hexapterus trailed with approximately 10-20% occupancy.

In the bongo net (Fig. 5), eggs of Theragra chalcogramma, Hippoglossoides elassodon and Glyptocephalus zachirus dominated the catches with respect to the numerical measures of abundance. The mean number of eggs for Theragra chalcogramma was approximately 50 animals per 10 m^2 column of seawater. Theragra chalcogramma occurred in approximately 60% of collections; Hippoglossoides elassodon occurred in approximately 40%; Glyptocephalus zachirus occurred in approximately 20%; and Microstomus pacificus and pleuronectids occurred in approximately 8%.

Larvae in the bongo net (Fig. 6) were predominately those of Theragra chalcogramma, Ammodytes hexapterus, Gadus macrocephalus, Atheresthes stomias, and Stenobrachius leucopsarus. These animals also had the highest percent occurrences, with values of approximately 60%, 80%, 25%, 35%, and 25%, respectively. The mean number of eggs for Theragra chalcogramma was approximately 60 animals per standard volume filtered.

Areal Distributions and Larval Sizes

While this is not intended to be a definitive report on these data, certain features of spatial distributions and larval size frequency contributions for the more abundant taxa will be mentioned. The lengths of larvae are expressed in terms of standard length (SL) and SD denotes the standard deviation of length measurements. For purposes of this report, abundances will be qualitatively characterized as modest if standardized catches were generally less than 100 eggs or larvae per 10 m^2, moderate if between 100 and 300, and high if one or more stations have values greater than 300.

The description of spatial distributions was facilitated by partitioning the survey area into a number of geographic regions based loosely on depth and current patterns. The northeastern group of stations (Fig. 1) occurred over three regions: the offshore areas influenced by the Alaska stream; an inshore area influenced by an extension of this current, the Kenai current, flowing across Amatuli Trough toward Cook Inlet and Shelikof Strait; and the inshore areas of the Kenai Penninsula and Montague Island. The southwestern group of stations occurred over four regions: the offshore areas of the Gulf of Alaska, the shallows associated with the Chirikof and Trinity Islands; Shelikof Strait; the inshore regions of the Alaska Penninsula and the Sutwik and Semidi Islands.

Teleost type A (Fig. 7) -- Unidentified fish eggs of this type were collected in moderate to high numbers at offshore stations in 17% of neuston tows and 1% of bongo tows.

Bathylagus pacificus (Fig. 8) -- Larvae of the Pacific blacksmelt occurred at 9% of bongo collections and were found at offshore stations in low numbers. Larval sizes ranged from 6.8 mm to 10.8 mm, and apparently have a single mode at approximately 8 mm. No eggs of this bathylagid were found.

Leuroglossus schmidti (= *Bathylagus schmidti*) (Fig. 9) -- Larvae of the northern smoothtongue occurred in 12% of bongo collections. Larvae were collected in low numbers at stations located offshore and associated with the Kenai extension. Sizes ranged from 7.1 to 27.0 mm. The size distribution was positively skewed with a mode at about 9 mm and a mean of 10.8 mm (SD = 4.1). In addition, four eggs of this bathylagid were collected in bongo tows at two locations.

Stenobrachius leucopsarus (Fig. 10) -- Larvae and juveniles of the northern lanternfish occurred at 28% and 7% of bongo collections, respectively. Larvae were principally collected at offshore stations in low numbers. Larval sizes ranged from 3.4 to 7.0 mm with a mean of 5.1 mm (SD = 0.8). Sizes of juveniles ranged from 20.2 to 98.0 mm with a mean of 26.3 mm (SD = 15.6).

Protomyctophum thompsoni (Fig. 11) -- Larvae and juveniles of the northern flashlightfish (also known as the bigeye lanternfish) occurred in 13% and 2% of bongo tows, respectively. Larvae were principally obtained at offshore stations in low numbers and ranged from 4.8 to 17.5 mm in length. The size distribution for this myctophid was slightly skewed to the right, with a mode at approximately 9 mm and a mean of 9.5 mm (SD = 2.8). Juveniles ranged from 22.1 to 28.5 mm in length.

Gadus macrocephalus (Fig. 12) -- Larvae of the Pacific cod occurred in 25% of bongo tows. This gadid was found in low numbers mainly in the shallow areas of the Kenai extension and Portlock Bank, near the Chirikof and Trinity

Islands, and along the Alaska Pennisula. Larval sizes ranged from 2.9 to 9.0 mm with a mean of 4.5 mm (SD = 0.8).

Theragra chalcogramma (Figs. 13-16) -- Both eggs and larvae of walleye pollock were collected in neuston and bongo tows: eggs occurred in approximately 55% of both neuston and bongo collections and larvae occurred in 17% of neuston and 58% of bongo collections. Eggs and larvae were found in bongo tows throughout the survey area, but highest abundances (several stations with >100/m^2) occurred in Shelikof Strait, near Amatuli Trough, and near Montague Island. Samples elsewhere generally contained few eggs and larvae (<100/m^2). The highest egg catch occurred in a bongo tow offshore to the northeast of Amatuli Trough, and this catch apparently indicates a very localized area of substantial spawning. Highest abundances of larvae were in lower Shelikof Strait where several bongo samples contained >1000 larvae/10m^2. Larval sizes ranged in bongo tows from 2.8 to 8.8 mm with a mean of 4.7 mm (SD = 0.6).

Sampling of the northeastern region (Amatuli Trough) was conducted from 7 April to 17 April and sampling of the southwestern region (Shelikof Strait) was conducted from 20 April to 4 May. If peak spawning in both areas occurs in early April, then eggs in the northeastern region may have been sampled closer to the time of maximal spawning than were eggs in the southeastern region and, since sampling was conducted over different intervals of the annual spawning cycle, egg catches may have been larger, in general, for the northeastern region. In addition, if the date of peak spawning was the same in both regions, then larval catches from the southwestern region may have been reduced by mortality over a longer period of time.

Neither eggs nor larvae were found in substantial numbers near the shelf break to the south of Kodiak Island. These areas were sampled from 21 April to 4 May. The generally small catches that were obtained for this region may have resulted, in part, from a reduction in the rate of egg production toward the end of the spawning season, and not solely from a smaller magnitude of seasonal production. Catches can be quite large if this region is sampled near the time of peak spawning. Moderate to high cates (from) 10,000 to >100,000 eggs/10m^2) were previously found along the shelf edge in this region (Dunn et al., 1984). These catches were obtained in mid-April 1978, 1981, and 1982. Surveys in this region at other times found only low levels of egg abundance. Although larvae were also ubiquitous in this region, catches were consistent with the background levels of other regions and only a limited area to the east of the Chirikof-Trinity assemblage of islands had moderate catches.

An hierarchical analysis of variance was performed on the walleye pollock length data. Data from stations with fewer than 20 larvae in the catch were ignored in the analysis. A total of 1,217 larvae from 27 samples were selected: 264 larvae from 6 samples were obtained from the northeastern survey area and 953 larvae from 21 collections were obtained from the southwestern survey area. These data were subsampled at random without replacement for 6 stations per region and 20 larvae per station. Such subsampling was replicated 15 times and analyzed separately (Table 4).

Larval lengths were not significantly different between the two regions surveyed. Larval lengths were significantly different among stations in a region. It is concluded that the magnitude of regional increments were zero and that variability in larval lengths arises from both station-to-station and within-sample variability. Thus there is no evidence for a difference in time of spawning between the two regions.

Hexagrammos decagrammus (Fig. 17) -- Larvae of the kelp greenling occurred in 39% of neuston and 3% of bongo collections. This hexagrammid was found throughout the survey area in moderate to high numbers, but was not consistently found to the extreme northeast of the area surveyed. Larval sizes ranged from 9.4 to 14.7 mm in bongo collections; neuston tows had a greater range of from 7.0 to 24.0 mm with a mean length of 12.3 mm (SD = 2.4).

Cottidae (Fig. 18) -- Unidentified sculpin larvae were collected in 30 bongo hauls in low numbers in the areas of the Kenai extension, the Chirikof and Trinity Islands, and the Alaska Penninsula. Sizes ranged from 3.7 to 10.3 mm with a mode of approximately 6 mm.

Hemilepidotus hemilepidotus (Fig. 19) -- Larvae of the red Irish lord occurred in 10% of neuston and 2% of bongo collections at widely scattered locations thoughout the survey area. Larval sizes in neuston samples ranged from 8.8 to 18.4 mm. The size distribution was only slightly skewed and had a mean of 12.4 mm (SD = 1.7).

Hemilepidotus spinosus (Fig. 20) -- Larvae of the brown Irish lord occurred in 9% of neuston collections and 1% of bongo collections. Larvae were found at widely scattered locations throughout the survey area, but occurred in moderate numbers offshore. Larval sizes for this cottid ranged from 6.0 to 11.0 mm, with a mean of 8.5 mm (SD = 1.3). One animal captured in a bongo sample was quite small at 4.0 mm in length.

Cyclopteridae (Fig. 21) -- Unidentified larvae of lumpfish and snail-fish occurred 14% of bongo collections at inshore stations throughout the survey area. Sizes ranged from 2.5 to 7.0 mm.

Lumpenus maculatus (Fig. 22) -- Larvae and juveniles of the daubed shanny occurred in 11% and 1% of bongo collections respectively, but were not found in neuston catches. Larval abundances were low. The size distribution for this stichaeid ranged from 9.0 to 17.0 mm. The skewness of the catch curve was slightly positive, with a mode at 11 mm and a mean of 12.1 mm (SD = 1.8). The one juvenile that was collected was 71 mm in length.

Lyconectes aleutensis (Fig. 23) -- Larvae of the dwarf wrymouth occurred in 14% of neuston and 4% of bongo tows; juveniles were taken in two neuston hauls. Abundances were low and most animals were associated with nearshore or intermediate depths. Larval sizes ranged from 10.5 to 24.5 mm in neuston collections and over a slightly smaller range of 12.0 to 16.8 mm in bongo collections. Skewness of the size distribution for this cryptacanthodid was somewhat greater than for most other taxa, with a mode of 11 mm and a mean of 14.6 mm (SD = 2.4).

Ammodytes hexapterus (Figs. 24-25) -- Larvae of the Pacific sand lance occurred in 81% of bongo and 11% of neuston collections. Abundances were moderate to high throughout the survey area. The highest levels of abundance occurred between the Semidi and Trinity Islands and off Montague Island. Larval sizes in bongo catches ranged from 3.0 to 19.3 mm with a mean of 10.5 mm (SD = 2.9); the range was slightly reduced in neuston catches, but with the mean and mode still at 10 mm. The size distribution for neuston collections was bimodal, with modes at 7 and 14 mm.

Pleuronectidae (Figs. 26-27) -- Unidentified eggs of flatfishes occurred in 8% of both bongo and neuston collections and were found principally in the region of the Semidi-Trinity group of islands.

Atheresthes stomias (Fig. 28) -- Larvae of arrowtooth flounder occurred in 34% of bongo collections. The animals were in low abundance and collected primarily at offshore stations. Larval sizes for this pleuronectid ranged from 4.5 to 18.5 mm. The length frequency distribution had a mode at 8 and a mean of 9.3 mm (SD = 2.3). No eggs were found.

Glyptocephalus zachirus (Figs. 29-30) -- Eggs of the rex sole occurred in 19% of neuston and 23% of bongo collections and were found at stations located furthest offshore, as well as a few nearshore stations, and in low to moderate numbers. No larvae of this pleuronectid were found.

Hippoglossoides elassodon (Figs. 31-32) -- Eggs of the flathead sole occurred in 40% of bongo and 26% of neuston collections throughout the inshore regions in low to moderate numbers, and were particularly abundant in the vicinity of Portlock Bank and Amatuli trough. Although the occurrence of eggs was greater for bongo collections, the neuston tows yielded the highest values for standardized catch. No larvae of this pleuronectid were found.

Lepidopsetta bilineata (Fig. 33) -- Larvae of the rock sole occurred in 14% of bongo tows and three larvae were also taken in two neuston hauls. These pleuronectids were found in low to moderate numbers at shallow-water stations of the Kenai Peninsula, Amatuli Trough, the Chirikof and Trinity Islands, and the Alaska Penninsula. The size of larvae ranged from 3.2 to 8.0 mm, with a mode at 5 mm and a mean of 4.67 mm (SD = 0.9).

Microstomus pacificus (Figs. 34-35) -- Eggs of the Dover sole occurred in 14% of neuston and 9% of bongo tows. Eggs were located at offshore stations with those furthest offshore having the highest standardized catches. No larvae of this pleuronectid were found.

Hippoglossus stenolepis (Fig. 36) -- Larvae of the Pacific halibut were taken at 14% of bongo and 1% of neuston stations. Larval sizes ranged from 12.5 to 20.2 mm, with a mean of 15.5 mm (SD = 2.0) and a broad mode at 14 mm. No eggs of this pleuronectid were found.

Community Structure

Regroup analysis (Fager 1957) was performed on combined egg and larval data. Analysis of the bongo data at an affinity level of 0.4 revealed three groups whose members had more than five occurrences (Fig. 37a). The largest group contained the gadids *Theragra chalcogramma* and *Gadus macrocephalus*, the perciform *Ammodytes hexapterus* and the pleuronectid *Hippoglossoides elassodon*. The distributions of these animals tended to be more or less ubiquitous, and they occurred in the greatest numbers in the regions of Shelikof Strait and Amatuli Trough. *Theragra chalcogramma* and *Ammodytes hexapterus* were similar in their ubiquity; however, the highest catches of the former were found in Shelikof Strait and off Montague Island, while those of the latter were associated with the shallows of the Montague and Middleton Islands and the Sutwik-Semidi-Chirikof-Trinity assemblage of islands. Another recurrent group was composed of the larvae of the myctophid *Stenobrachius leucopsarus* and the pleuronectid *Atheresthes stomias*. The final grouping contained eggs of the pleuronectids *Microstomus pacificus* and *Glyptocephalus zachirus*. This third grouping occurred more strictly offshore than the second grouping.

Regroup analysis on combined egg and larval data for neuston collections at an affinity level of 0.4 revealed three groups whose members had more than five occurrences (Figure 37b). The groupings were composed of the gadid *Theragra chalcogramma* and the pleuronectid *Hippoglossoides elassodon*; the scorpaeniform *Hexagrammos decagrammus* and the cryptacanthodid *Lyconectes aleutensis*; and the pleuronectid *Microstomus pacificus* and unidentified type A teleosts. The respective geographic distributions of these groupings tended to be associated with the waters of Shelikof Strait and Amatuli Trough, the shallows of the Chirikof and Trinity Islands and Portlock Bank, and offshore waters.

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Figure 28.--Distribution and size frequency distribution of larvae of Atheresthes stomias from bongo tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 10 m^2.

Figure 29.--Distribution of eggs of Glyptocephalus zachirus from bongo tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 10 m^2.

Figure 30.--Distribution of eggs of Glyptocephalus zachirus from neuston tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 1000 m^3.

Figure 31.--Distribution of eggs of Hippoglossoides elassodon from bongo tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 10 m^2.

Figure 32.--Distribution of eggs of Hippoglossoides elassodon from neuston tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 1000 m^3.

Figure 33.--Distribution and size frequency distribution of larvae of *Lepidopsetta bilineata* from bongo tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 10 m^2.

Figure 34.--Distribution of eggs of *Microstomus pacificus* from bongo tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 10 m^2.

Figure 35.--Distribution of eggs of *Microstomus pacificus* from neuston tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 1000 m^3.

Figure 36.--Distribution and size frequency distribution of larvae of *Hippoglossus stenolepis* from bongo tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 10 m^2.

Figure 37.--Results of recurrent group analysis at an affinity level of 0.4 on bongo catches (above) and neuston catches (below) for both fish eggs and larvae from cruise 1SH84, April-May 1984. Those taxa whose names are contained in a rectangle are members of a recurrent group. A line connects a recurrent group with the name of a taxon outside of the group having an affinity level of 0.4. The number in parentheses following a taxon name is the number of occurrences of that taxon.

STATION	POSITION LAT. N.	LONG. W.	DATE YYMMDD	AREA KM2	NEUSTON STATION SUMMARY TIME GMT	STANDARD HAUL FACTORS A	B	BONGO STATION SUMMARY TIME GMT	STANDARD HAUL FACTORS A	B
G001A	59 21.0	145 49.0	84 4 7	575.	635	0.028	18.635	700	4.938	[illegible]
G002A	59 35.5	145 56.0	84 4 7	859.	935	0.041	27.640	1055	5.949	1.107
G003A	59 51.0	145 56.0	84 4 7	719.	1255	0.027	17.718	1325	3.856	4.591
G004A	60 2.1	146 18.0	84 4 7	628.	1545	0.022	14.817	1615	3.781	8.793
G005A	59 56.0	146 45.0	84 4 7	647.	1810	0.031	20.827	1832	4.129	9.832
G006A	59 43.0	146 36.0	84 4 7	714.	2140	0.034	22.456	2200	14.661	16.660
G007A	59 33.6	146 30.0	84 4 8	755.	15	0.031	20.720	35	5.146	5.198
G008A	59 16.5	146 9.0	84 4 8	731.	435	0.037	24.930	500	6.367	3.136
G009A	59 10.5	146 36.0	84 4 8	704.	815	0.035	23.021	835	5.945	2.858
G010A	59 23.3	146 48.0	84 4 8	716.	1115	0.028	18.583	1135	5.523	3.130
G011A	59 37.0	147 0.0	84 4 8	685.	1510	0.029	19.392	1600	6.141	3.232
G012A	59 50.5	147 11.0	84 4 8	668.	1850	0.031	20.436	2007	4.362	3.280
G013A	59 44.4	147 37.0	84 4 9	690.	45	0.035	23.246	115	4.823	5.671
G014A	59 31.5	147 25.0	84 4 9	727.	340	0.026	17.543	555	3.768	1.231
G015A	59 52.0	148 15.0	84 4 9	603.	2020	0.032	21.590	2100	4.666	4.810
G016A	59 37.4	148 5.0	84 410	718.	1	0.037	24.754	30	7.737	10.746
G017A	59 25.5	147 51.0	84 410	747.	300	0.026	17.598	330	4.873	5.021
G018A	59 18.0	147 13.0	84 410	702.	656	0.027	18.288	730	4.507	2.908
G019A	59 5.0	147 2.0	84 410	753.	1100	0.030	19.767	1125	5.843	2.907
G020A	58 58.5	147 28.0	84 410	730.	1500	0.028	18.915	1600	6.988	3.106
G021A	59 12.0	147 39.0	84 410	749.	1925	0.038	25.409	1953	5.835	3.039
G022A	58 52.5	147 53.0	84 410	757.	2330	0.037	24.423	2355	6.353	2.928
G023A	59 6.0	148 6.0	84 411	791.	230	0.037	24.659	300	6.340	5.711
G024A	59 20.0	148 18.0	84 411	752.	515	0.034	22.357	540	5.326	5.606
G025A	59 33.0	148 29.0	84 411	688.	800	0.034	22.588	825	4.754	5.057
G026A	59 46.4	148 41.0	84 411	702.	1100	0.034	22.657	1130	5.845	3.919
G027A	59 40.0	149 7.0	84 411	871.	1415	0.027	18.019	1500	5.792	3.348
G028A	59 27.0	148 55.0	84 411	716.	1746	0.035	23.398	1815	5.289	3.005
G029A	59 14.0	148 44.0	84 411	734.	2055	0.036	24.002	2125	5.171	4.204
G030A	59 0.0	148 32.0	84 412	754.	2355	0.034	22.646	20	5.640	2.848
G031A	58 46.5	148 20.0	84 412	758.	250	0.027	18.239	320	6.814	2.937
G032A	58 32.0	148 10.0	84 412	781.	610	0.031	20.863	625	5.640	2.712
G033A	58 19.0	147 58.0	84 412	771.	920	0.029	19.327	935	6.045	2.699
G034A	57 59.0	148 12.0	84 412	697.	1240	0.027	17.957	1300	6.408	2.873
G035A	58 13.0	148 24.0	84 412	727.	1530	0.025	16.840	1515	6.279	2.898
G036A	58 26.5	148 35.0	84 412	704.	1815	0.028	18.575	1832	5.020	4.183
G037A	58 40.0	148 47.0	84 412	781.	2030	0.035	23.258	2045	5.920	[illegible]
G038A	58 54.0	148 59.0	84 413	773.	400	0.029	19.054	415	6.318	2.840
G039A	59 8.0	149 10.0	84 413	753.	653	0.031	20.996	710	5.179	1.314
G040A	59 21.5	149 22.0	84 413	717.	920	0.026	17.252	935	4.600	1.107
G041A	59 28.5	149 59.0	84 413	643.	1215	0.023	15.137	1230	4.976	4.694
G042A	59 15.5	149 48.0	84 413	698.	1515	0.026	17.657	1530	5.207	3.381
G043A	59 2.0	149 37.0	84 413	780.	1757	0.042	28.202	1815	6.175	2.911
G044A	58 48.0	149 25.0	84 413	737.	2115	0.031	20.390	2130	2.955	2.517
G045A	58 34.0	149 13.0	84 414	714.	30	0.035	23.610	15	6.469	6.882

Table 1.--Data associated with bongo and neuston tows during cruise 1SH84, April-May 1984.

STATION	POSITION LAT. N.	LONG. W.	DATE YYMMDD	AREA KM2	NEUSTON STATION SUMMARY TIME GMT	STANDARD HAUL FACTORS A	STANDARD HAUL FACTORS B	BONGO STATION SUMMARY TIME GMT	STANDARD HAUL FACTORS A	STANDARD HAUL FACTORS B
G046A	58 21.0	149 2.0	84 414	764.	255	0.033	22.183	310	6.330	5.754
G047A	58 6.0	148 50.0	84 414	745.	553	0.027	18.123	610	6.535	2.851
G048A	57 53.0	148 39.0	84 414	702.	822	0.028	18.549	838	6.117	2.780
G049A	57 47.0	149 6.0	84 414	701.	1100	0.028	18.649	1330	6.534	2.970
G050A	58 1.0	149 17.0	84 414	751.	1615	0.029	19.334	1630	6.580	3.557
G051A	58 15.0	149 28.0	84 414	711.	1825	0.027	17.833	1835	5.388	6.908
G052A	58 28.5	149 39.0	84 414	726.	2043	0.029	19.132	2100	6.148	4.693
G053A	58 42.0	149 50.0	84 415	723.	420	0.027	17.826	435	5.970	4.358
G054A	58 56.0	150 2.0	84 415	749.	658	0.028	18.475	718	5.926	3.425
G055A	59 9.5	150 13.0	84 415	737.	955	0.023	15.285	1015	5.549	3.964
G056A	59 3.5	150 40.0	84 415	719.	1220	0.039	25.835	1235	5.841	6.081
G057A	58 50.0	150 28.0	84 415	746.	1455	0.027	18.238	1510	5.807	1.467
G058A	58 36.0	150 15.0	84 415	754.	1710	0.029	19.476	1725	5.136	5.972
G059A	58 22.5	150 5.0	84 415	691.	1910	0.032	21.055	1923	5.105	10.210
G060A	58 9.0	149 54.0	84 415	777.	2155	0.031	20.356	2215	5.649	4.215
G061A	57 54.5	149 42.0	84 416	702.	25	0.034	22.509	40	4.211	4.089
G062A	58 2.5	150 20.0	84 416	725.	400	0.029	19.612	415	6.314	3.567
G063A	58 16.5	150 30.0	84 416	752.	647	0.028	18.998	705	5.476	10.951
G064A	58 30.5	150 43.0	84 416	762.	901	0.028	18.499	920	5.461	6.001
G065A	58 44.0	150 54.0	84 416	751.	1135	0.027	17.943	1150	5.782	4.072
G066A	58 58.0	151 5.0	84 416	718.	1410	0.026	17.073	1425	5.986	4.306
G067A	58 51.5	151 31.0	84 416	764.	1620	0.028	18.762	1635	5.194	7.115
G068A	58 38.0	151 20.0	84 416	734.	1935	0.033	22.317	1950	7.361	3.456
G069A	58 24.5	151 9.0	84 416	741.	2230	0.035	23.474	2245	5.057	6.092
G070A	58 10.5	150 58.0	84 417	773.	105	0.026	17.478	120	5.954	7.261
G071A	58 18.5	151 36.0	84 417	707.	355	0.029	19.014	410	5.439	8.773
G072A	58 32.5	151 47.0	84 417	698.	645	0.031	20.825	702	5.232	3.535
G073A	58 45.5	151 58.0	84 417	694.	900	0.030	19.871	920	3.503	1.272
G096A	57 34.0	155 20.0	84 420	754.	405	0.031	20.840	420	6.542	3.015
G097A	57 20.1	155 3.0	84 420	708.	645	0.031	20.506	702	6.571	3.302
G098A	57 11.5	154 44.0	84 420	657.	940	0.030	19.873	950	6.611	15.739
G099A	56 44.5	154 34.0	84 420	973.	1245	0.029	19.022	1300	4.039	26.027
G100A	56 50.0	154 46.0	84 420	644.	1410	0.029	19.627	1425	3.997	18.167
G101A	57 1.0	155 6.0	84 420	852.	1700	0.029	19.507	1715	6.594	3.643
G102A	57 13.0	155 25.0	84 420	776.	1925	0.029	19.580	1938	6.086	3.813
G103A	57 24.0	155 43.0	84 420	675.	2205	0.034	22.723	2220	6.633	3.159
G104A	57 14.0	156 0.0	84 421	653.	40	0.039	26.222	55	4.738	3.433
G105A	57 3.0	155 46.0	84 421	787.	400	0.045	29.947	415	4.844	3.047
G106A	56 50.0	155 27.0	84 421	923.	638	0.030	20.206	605	6.216	3.017
G107A	56 39.0	155 7.0	84 421	745.	930	0.030	20.285	945	6.209	12.935
G108A	56 28.5	155 0.0	84 421	767.	1155	0.028	18.427	1210	4.869	21.169
G109A	56 15.0	154 29.0	84 421	904.	1555	0.030	19.702	1610	7.576	10.823
G110A	56 3.0	154 10.0	84 421	839.	1818	0.029	19.302	1850	6.126	5.169
G111A	55 52.0	153 51.0	84 421	843.	2235	0.034	22.985	2300	5.517	2.811
G112A	56 1.0	153 28.0	84 422	785.	220	0.027	17.700	250	5.508	2.977

Table 1 Continued.--Data associated with bongo and neuston tows during cruise 1SH84, April-May 1984.

STATION	POSITION LAT. N.	LONG. W.	DATE YYMMDD	AREA KM2	NEUSTON STATION SUMMARY TIME GMT	STANDARD HAUL FACTORS A	B	BONGO STATION SUMMARY TIME GMT	STANDARD HAUL FACTORS A	B
G113A	56 13.4	153 48.0	84 422	843.	2215	0.028	18.963	2245	4.517	2.895
G114A	56 24.4	154 8.0	84 423	1000.	120	0.028	18.523	140	3.060	7.461
G115A	56 38.5	153 40.0	84 423	953.	520	0.030	20.137	547	4.158	6.229
G116A	56 24.0	153 27.0	84 423	929.	755	0.038	25.105	818	4.590	8.196
G117A	56 13.0	153 7.0	84 423	842.	1105	0.032	21.339	1120	6.270	2.876
G118A	55 40.5	154 11.0	84 423	811.	1650	0.028	18.466	1705	5.193	2.558
G119A	55 53.5	154 33.0	84 423	803.	2000	0.033	21.821	2015	5.604	2.802
G120A	56 5.0	154 45.0	84 424	824.	215	0.029	19.132	230	4.595	13.516
G121A	56 16.0	155 10.0	84 424	832.	405	0.028	18.544	420	3.608	22.552
G122A	56 28.2	155 29.0	84 424	848.	627	0.031	20.896	638	4.483	8.966
G123A	56 40.0	155 53.0	84 424	822.	825	0.029	19.069	838	5.924	3.444
G124A	56 51.5	156 8.0	84 424	581.	1030	0.029	19.136	1045	6.466	2.994
G125A	57 0.0	156 13.0	84 424	463.	1255	0.025	16.695	1305	6.164	4.499
G126A	56 56.0	156 20.0	84 424	339.	1455	0.026	17.625	1505	6.532	4.733
G127A	56 47.0	156 34.0	84 424	439.	1650	0.022	14.844	1700	6.083	4.440
G128A	56 42.0	156 28.0	84 424	543.	1832	0.026	17.423	1845	6.918	4.046
G129A	56 30.1	156 9.0	84 424	798.	2120	0.035	23.047	2135	6.051	3.010
G130A	56 18.0	155 50.0	84 425	826.	345	0.024	16.185	400	5.337	7.517
G131A	56 6.0	155 31.0	84 425	737.	602	0.029	19.220	615	5.208	12.702
G132A	55 55.0	155 12.0	84 425	885.	814	0.030	20.019	827	4.894	11.123
G133A	55 41.8	154 52.0	84 425	850.	1145	0.035	23.120	1200	4.638	2.521
G134A	55 30.2	154 30.0	84 428	788.	617	0.029	19.470	645	5.704	2.716
G135A	55 32.0	155 13.0	84 428	674.	1230	0.030	19.792	1315	4.701	2.292
G136A	55 41.1	155 25.0	84 428	806.	1600	0.031	20.762	1615	4.081	3.345
G137A	55 56.0	155 46.0	84 429	869.	145	0.023	15.111	200	5.387	10.773
G138A	56 8.0	156 11.0	84 429	905.	420	0.027	18.063	435	6.999	4.117
G139A	56 19.0	156 30.0	84 429	899.	719	0.032	21.619	805	6.842	3.801
G140A	56 31.0	156 45.0	84 429	695.	1025	0.033	22.058	1120	5.649	1.183
G141A	56 40.0	156 55.0	84 429	751.	1340	0.028	18.682	1350	4.819	8.167
G142A	56 21.0	157 10.0	84 429	773.	1705	0.028	18.650	1725	5.772	1.213
G143A	56 27.2	157 30.0	84 429	674.	1942	0.028	18.433	1955	5.636	6.631
G144A	56 8.4	157 2.0	84 429	752.	2310	0.034	22.573	2325	5.421	7.126
G145A	55 57.5	156 33.0	84 430	918.	300	0.026	17.084	315	6.631	3.332
G146A	55 45.0	156 15.0	84 430	952.	527	0.030	19.984	620	6.468	3.218
G147A	55 33.0	155 55.0	84 430	938.	842	0.033	22.243	900	6.812	3.806
G148A	55 20.8	155 35.0	84 430	856.	2210	0.031	20.358	2225	6.345	3.050
G149A	55 9.5	155 56.0	84 5 1	832.	15	0.030	19.918	30	8.214	4.416
G150A	55 22.0	156 16.0	84 5 1	889.	320	0.029	19.396	335	5.961	3.569
G151A	55 34.0	156 35.0	84 5 1	836.	605	0.025	16.909	618	5.992	3.366
G152A	55 46.0	156 54.0	84 5 1	869.	855	0.030	19.773	910	6.295	7.153
G153A	55 59.0	157 13.0	84 5 1	782.	1145	0.027	18.112	1200	5.494	6.213
G154A	56 10.5	157 32.0	84 5 1	859.	1420	0.028	18.664	1435	5.034	4.661
G155A	56 1.0	157 54.0	84 5 1	819.	1645	0.028	18.991	1655	5.792	6.895
G156A	55 48.0	157 35.0	84 5 1	905.	1910	0.033	22.083	1924	5.179	5.630
G157A	55 36.0	157 16.0	84 5 1	865.	2145	0.029	19.502	2200	6.200	7.381
G158A	55 23.5	156 57.0	84 5 2	879.	20	0.028	18.591	35	3.962	8.057
G159A	55 11.0	156 38.0	84 5 2	862.	300	0.027	18.275	315	6.030	2.911

Table 1 Continued.--Data associated with bongo and neuston tows during cruise 1SH84, April-May 1984.

STATION	POSITION LAT. N.	LONG. W.	DATE YYMMDD	AREA KM2	NEUSTON STATION SUMMARY TIME GMT	STANDARD HAUL FACTORS A	STANDARD HAUL FACTORS B	BONGO STATION SUMMARY TIME GMT	STANDARD HAUL FACTORS A	STANDARD HAUL FACTORS B
G160A	54 59.0	156 19.0	84 5 2	864.	910	0.035	23.261	600	1.410	2.506
G161A	54 47.5	156 40.0	84 5 2	817.	1225	0.029	19.605	945	5.725	2.726
G162A	55 0.0	157 0.0	84 5 2	859.	1540	0.027	18.283	1330	6.831	3.134
G163A	55 12.5	157 19.0	84 5 2	862.	105	0.027	18.175	1645	5.797	9.058
G164A	55 25.0	157 38.0	84 5 2	844.	335	0.025	16.878	1928	5.501	8.732
G165A	55 37.0	157 56.0	84 5 2	844.	603	0.030	19.692	2145	5.817	5.386
G166A	55 49.5	158 16.0	84 5 3	870.	843	0.027	18.199	15	5.722	6.502
G167A	55 39.0	158 37.0	84 5 3	852.	1200	0.028	18.917	225	4.045	5.121
G168A	55 26.5	158 18.0	84 5 3	827.	1425	0.025	16.461	455	5.423	1.715
G169A	55 14.5	157 59.0	84 5 3	835.	1655	0.029	19.075	638	5.176	8.088
G170A	55 2.0	157 40.0	84 5 3	823.	545	0.032	21.454	925	5.431	9.699
G171A	54 50.0	157 21.1	84 5 3	855.	930	0.032	21.546	1240	6.448	3.071
G172A	54 39.0	157 42.0	84 5 3	878.	1315	0.029	19.127	1550	6.535	3.097
G173A	54 51.5	158 1.0	84 5 4	843..	1635	0.027	18.018	120	6.377	7.165
G174A	55 4.0	158 20.0	84 5 4	842.	1905	0.029	19.250	350	5.871	3.812
G175A	55 16.0	158 39.0	84 5 4	839.	2130	0.028	18.580	616	6.471	3.762
G176A	55 28.0	158 58.0	84 5 4	881.	5	0.033	22.080	905	6.026	5.579
G177A	55 5.5	159 1.0	84 5 4	821.	210	0.029	19.440	1215	5.649	8.691
G178A	54 53.0	158 42.0	84 5 4	881.	440	0.031	20.473	1135	5.207	7.132
G179A	54 40.5	158 23.0	84 5 4	864.	645	0.032	21.130	1710	5.515	2.703

Table 1 Continued.--Data associated with bongo and neuston tows during cruise 1SH84, April-May 1984.

STAGE: EGG	CRUISE: 1SH84 GEAR: 1 NEUSTON OCCUR. %	LOG NO. IN AREA	CRUISE: 1SH84 GEAR: 2 BONGO OCCUR. %	LOG NO. IN AREA
SPECIES				
UNIDENTIFIED	2.21	6.8741	1.95	9.3893
TELEOST TYPE A	16.91	8.3042	0.65	8.5958
TELEOST TYPE E			0.65	8.5850
DISINTEGRATED	1.47	6.8610	1.30	9.0229
LEUROGLOSSUS SCHMIDTI			1.30	9.2397
THERAGRA CHALCOGRAMMA	53.68	8.9642	58.44	12.0368
MACROURIDAE			1.95	9.4820
PLEURONECTIDAE	8.09	7.8441	8.44	10.2053
GLYPTOCEPHALUS ZACHIRUS	19.12	8.2190	23.38	10.6501
HIPPOGLOSSOIDES ELASSODON	26.47	8.9455	39.61	11.3623
ISOPSETTA ISOLEPIS			0.65	8.5894
LYOPSETTA EXILIS			2.60	9.2307
MICROSTOMUS PACIFICUS	14.71	8.5419	9.09	10.1452
PLATICHTHYS STELLATUS			1.30	9.0756
PLEURONECTES QUADRITUBERCULATU	1.47	6.6662	0.65	8.5374
SEBASTOLOBUS SPP.	6.62	8.0726	2.60	9.3792

Table 2.--Fish eggs collected in bongo and neuston tows during cruise 1SH84, April-May 1984.

STAGE: LARVAE	CRUISE: 1SH84		CRUISE: 1SH84	
	GEAR: 1 NEUSTON		GEAR: 2 BONGO	
	OCCUR. %	LOG NO. IN AREA	OCCUR. %	LOG NO. IN AREA
SPECIES				
UNIDENTIFIED	2.21	7.0138	0.65	8.7109
DISINTEGRATED	8.09	7.8530	2.60	9.4505
MALLOTUS VILLOSUS	3.68	7.6570	0.65	8.7890
BATHYLAGUS PACIFICUS			9.09	10.0457
LEUROGLOSSUS SCHMIDTI			12.34	10.3092
STENOBRACHIUS LEUCOPSARUS			27.92	10.8328
PROTOMYCTOPHUM THOMPSONI			12.99	10.0749
GADIDAE			1.30	9.6042
GADUS MACROCEPHALUS			25.32	10.8887
MICROGADUS PROXIMUS			0.65	8.6192
THERAGRA CHALCOGRAMMA	16.18	9.0407	57.79	12.4939
MACROURIDAE			2.60	9.2709
SEBASTES SPP.			1.30	9.0029
HEXAGRAMMOS SPP.	0.74	7.2182		
HEXAGRAMMOS DECAGRAMMUS	38.97	8.8165	2.60	9.3057
HEXAGRAMMOS LAGOCEPHALUS			0.65	8.7685
HEXAGRAMMOS STELLERI	0.74	7.0262		
OPHIODON ELONGATUS	1.47	6.6210		
PLEUROGRAMMUS MONOPTERYGIUS	0.74	6.3380		
ANOPLOPOMA FIMBRIA	3.68	7.2942	1.30	8.9987
COTTIDAE	0.74	6.3554	19.48	10.3775
ARTEDIUS HARRINGTONI			1.95	9.1657
GYMNOCANTHUS A			3.90	9.4264
HEMILEPIDOTUS HEMILEPIDOTUS	10.29	8.1639	1.95	9.0868
HEMILEPIDOTUS JORDANI	4.41	7.3942		
LEPTOCOTTUS ARMATUS			0.65	8.7868
MALACOCOTTUS ZONURUS 1			1.95	9.1161
MYOXOCEPHALUS SPP.			0.65	8.5783
MYOXOCEPHALUS B			1.30	8.8388
RADULINUS SPP.			0.65	8.8485
TRIGLOPS SPP.			0.65	8.5783
AGONIDAE			5.19	9.5262
AGONIDAE C			4.55	9.6619
CYCLOPTERIDAE			13.64	10.3799
BATHYMASTER SPP.	0.74	6.2907	0.65	8.6424
PTILICHTHYS GOODEI			0.65	8.7294
STICHAEIDAE	2.21	7.1292	0.65	8.6331
LUMPENELLA LONGIROSTRIS			0.65	8.5748
LUMPENUS SAGITTA			1.30	8.8179
LUMPENUS MACULATUS			11.04	10.0849
LYCONECTES ALEUTENSIS	13.97	8.5163	3.90	9.4091
PHOLIS SPP.			3.25	9.4907
ZAPRORA SILENUS	2.21	7.4972	5.84	9.7362
AMMODYTES HEXAPTERUS	11.03	8.7438	80.52	11.9985
CITHARICHTHYS STIGMAEUS			0.65	8.4858
ATHERESTHES STOMIAS	0.74	6.5439	34.42	10.8543
LEPIDOPSETTA BILINEATA	1.47	6.7160	14.29	10.4597
LYOPSETTA EXILIS			0.65	8.5002
PLATICHTHYS STELLATUS			0.65	8.7085
HIPPOGLOSSUS STENOLEPIS	1.47	6.6554	13.64	9.9839
ZOARCIDAE			0.65	9.0095
POROCLINUS ROTHROCKI			2.60	9.2119
HEMILEPIDOTUS SPINOSUS	8.82	7.9000	1.30	8.8997
ARTEDIUS MEANYI			1.30	8.8935
ANOPLARCHUS SPP.			3.90	9.4442
PSETTICHTHYS 2			0.65	8.9157

Table 3.--Fish larvae collected in bongo and neuston tows during cruise 1SH84, April-May 1984.

Table 4.--Summary of 15 replicates for a mixed model hierarchical ANOVA on length measurements of walleye pollock larvae, Theragra chalcogramma, from collections obtained from 7 April to 4 May during the cruise 1SH84.

ANOVA replicate number	Regional mean square	Station mean square	Error mean square	Error standard deviation	Regional F*	Station F**
1	8.74	18.40	1.33	1.15	0.47	13.87
2	0.22	2.41	0.37	0.61	0.09	6.44
3	1.13	5.54	0.76	0.87	0.20	7.28
4	0.34	8.87	0.85	0.92	0.04	10.41
5	13.63	17.57	0.69	0.83	0.78	25.45
6	4.65	4.57	0.82	0.91	1.02	5.54
7	0.81	2.59	0.36	0.60	0.31	7.12
8	1.89	5.34	0.89	0.94	0.35	6.00
9	0.21	3.17	0.35	0.59	0.07	9.03
10	0.55	3.72	0.33	0.58	0.15	11.20
11	28.70	20.83	0.80	0.89	1.42	25.44
12	24.38	22.75	1.70	1.31	1.07	13.34
13	0.04	2.47	0.39	0.62	0.02	6.13
14	10.21	20.38	0.82	0.91	0.50	24.70
15	14.36	12.74	0.89	0.94	1.13	14.33

*The critical F value at the 5% probability level for the regional effect, using 1 and 5 degrees of freedom, was 6.94.

**The critical F value at the 5% probability level for the station effect, using 5 and 19 degrees of freedom, was 2.10.

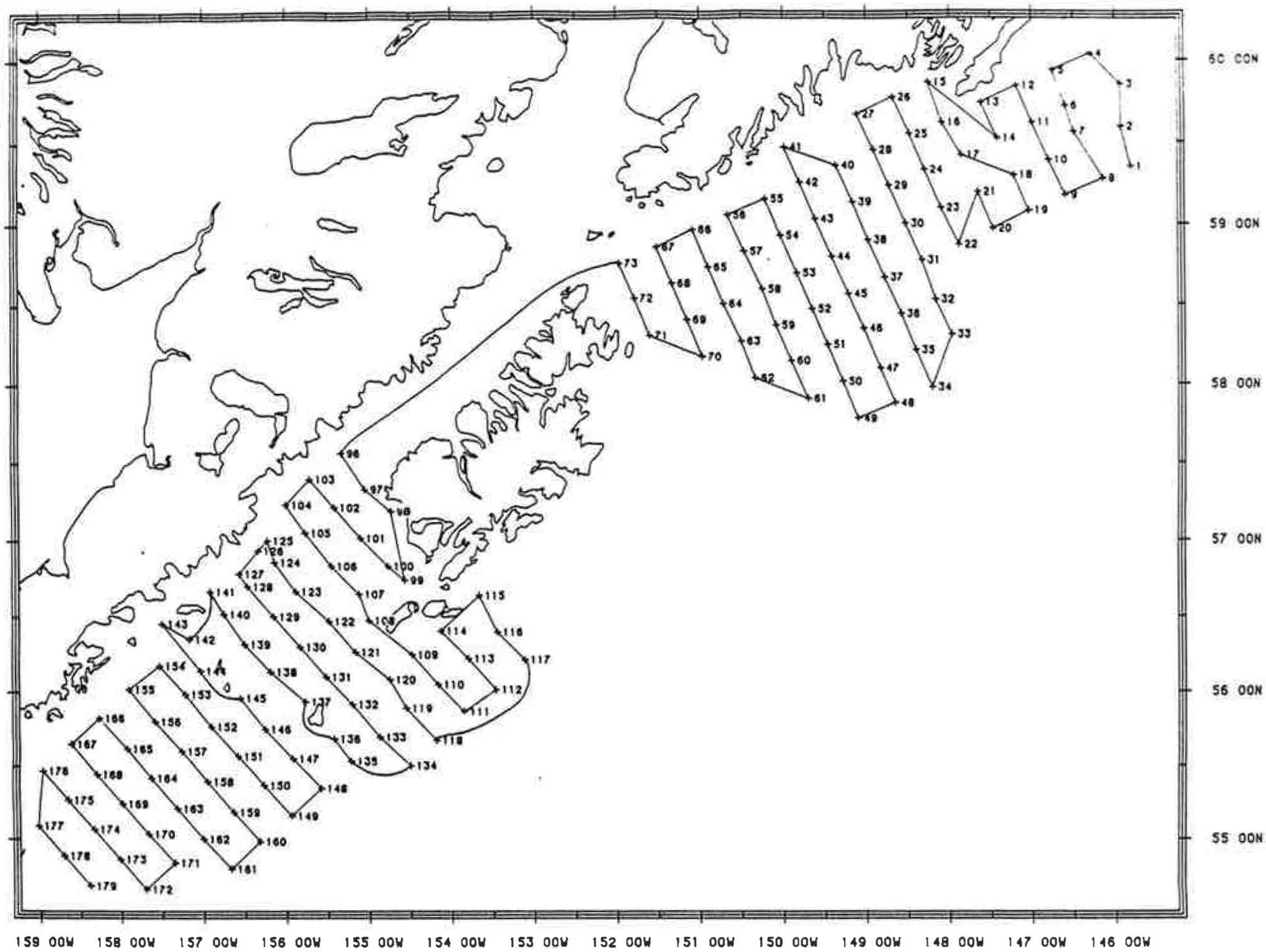

Figure 1.--Station locations and cruise track for cruise 1SH84, April-May 1984.

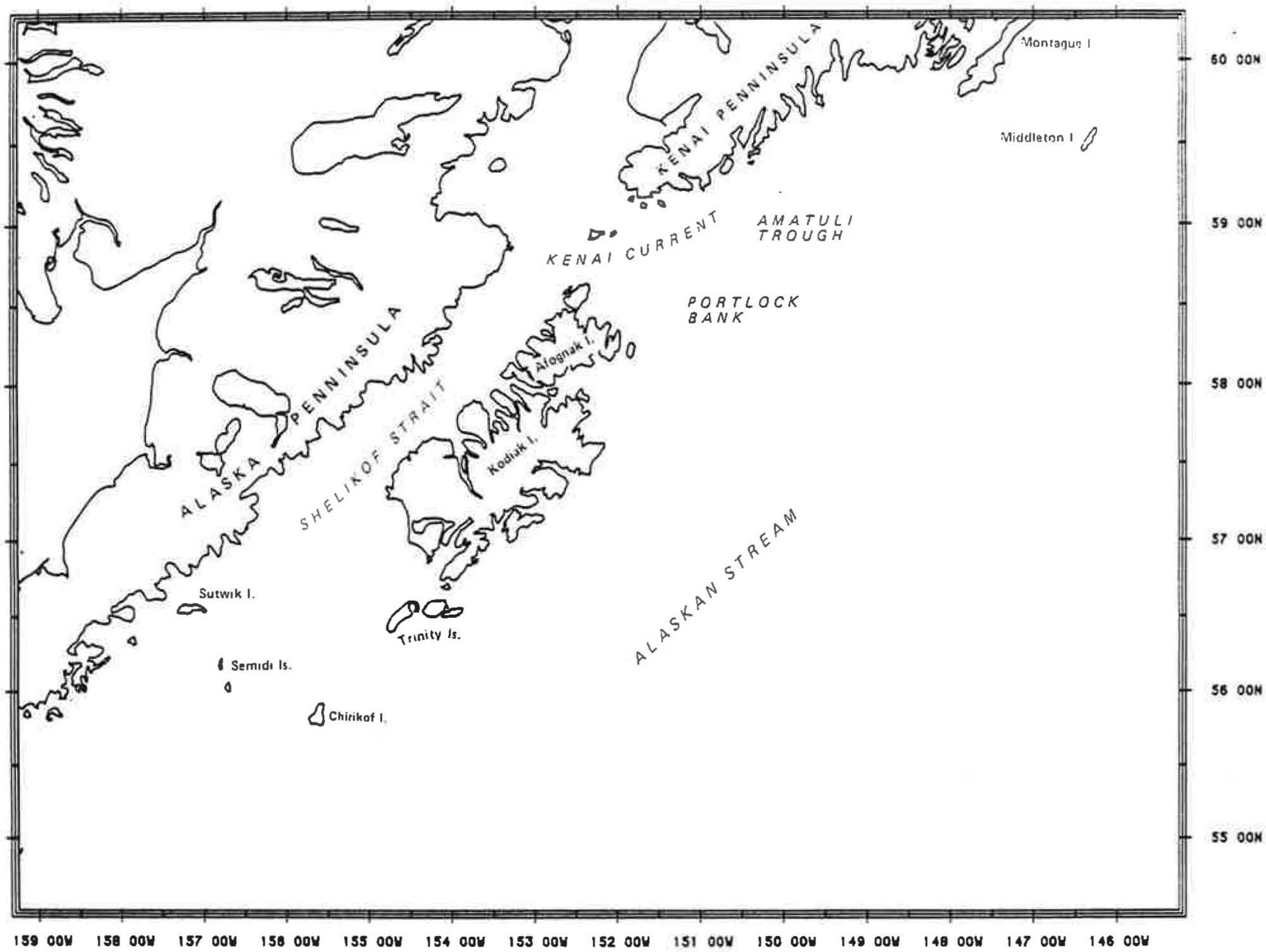

Figure 2.--Locations of some prominent geographical and oceanographic features.

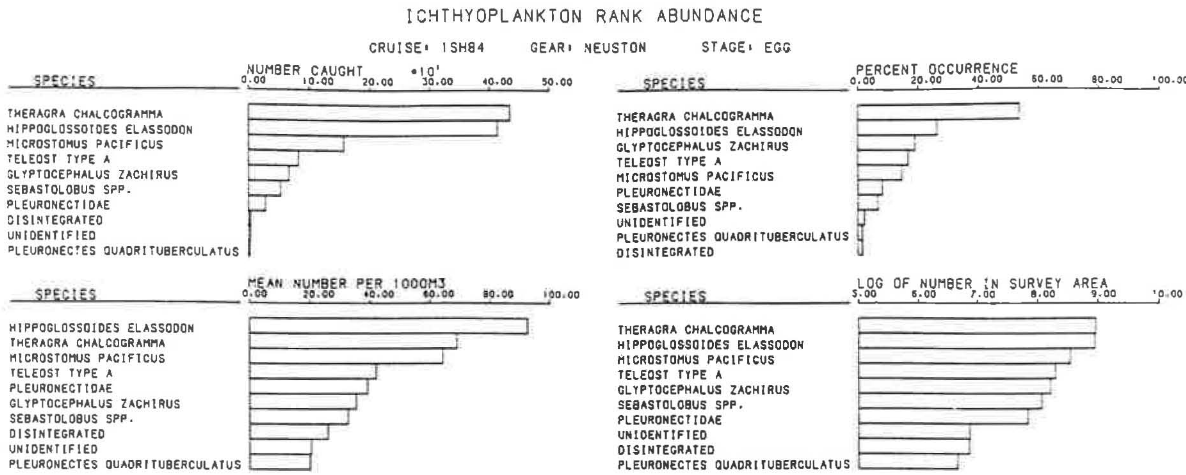

Figure 3.--Rank abundance of fish eggs caught in neuston tows during cruise 1SH84, April-May 1984.

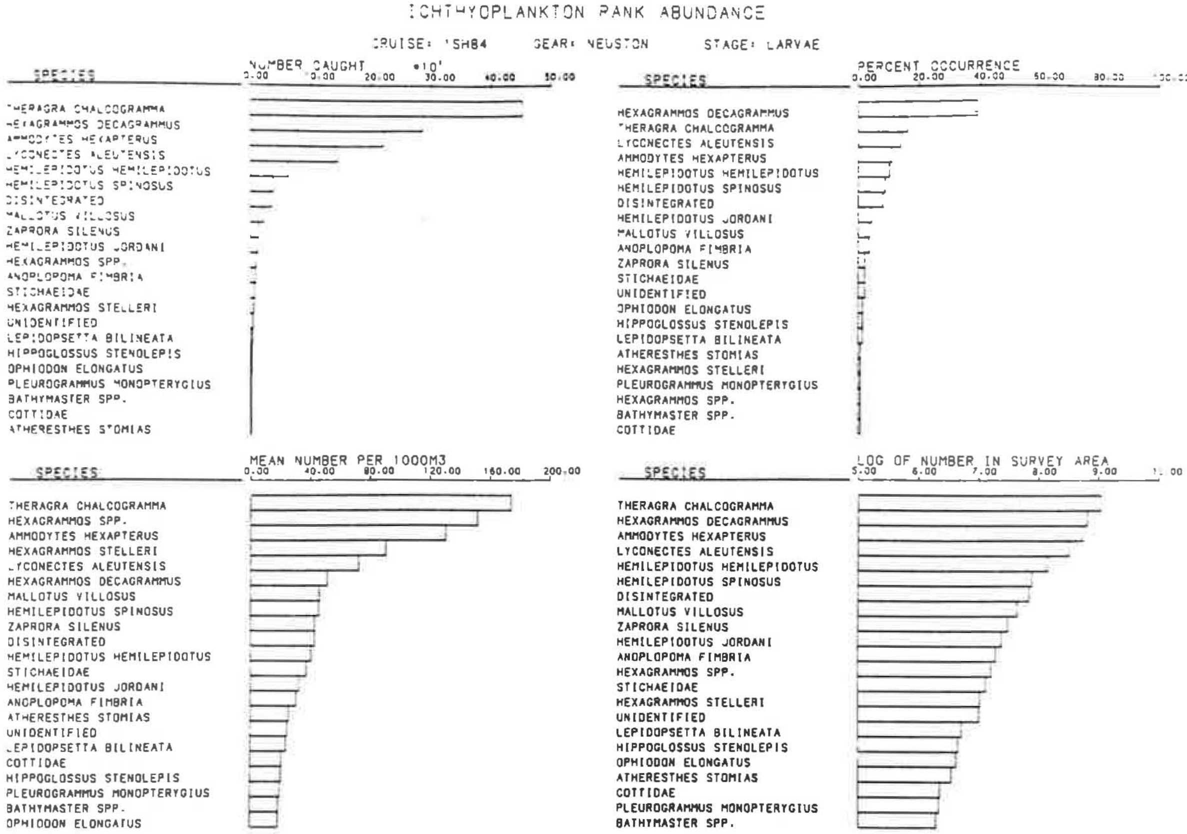

Figure 4.--Rank abundance of fish larvae caught in neuston tows during cruise 1SH84, April-May 1984.

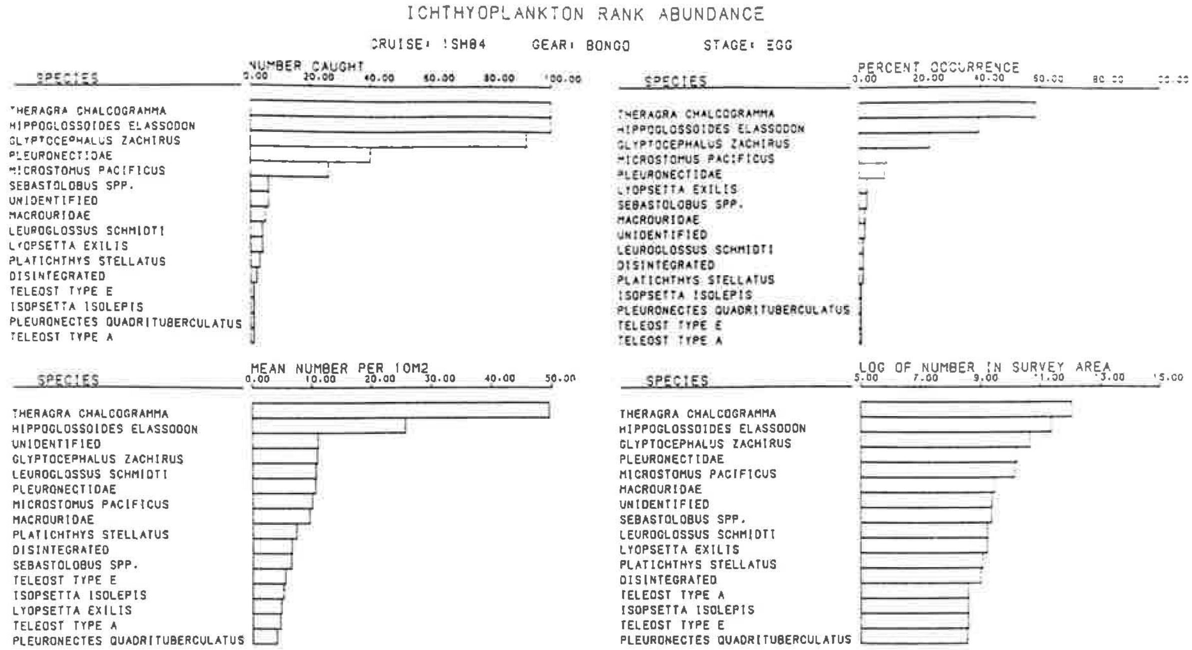

Figure 5.--Rank abundance of fish eggs caught in bongo tows during cruise 1SH84, April-May 1984.

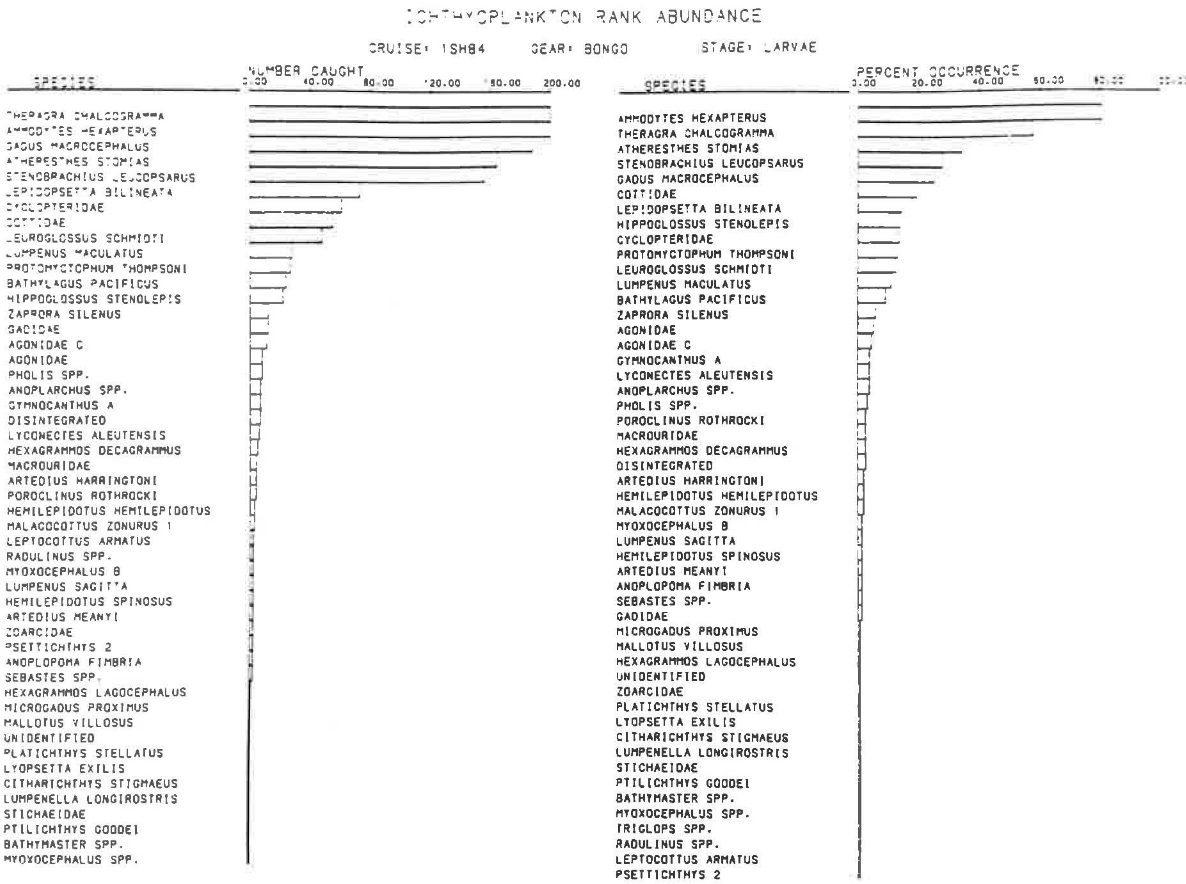

Figure 6.--Rank abundance of fish larvae caught in bongo tows during cruise 1SH84, April-May 1984.

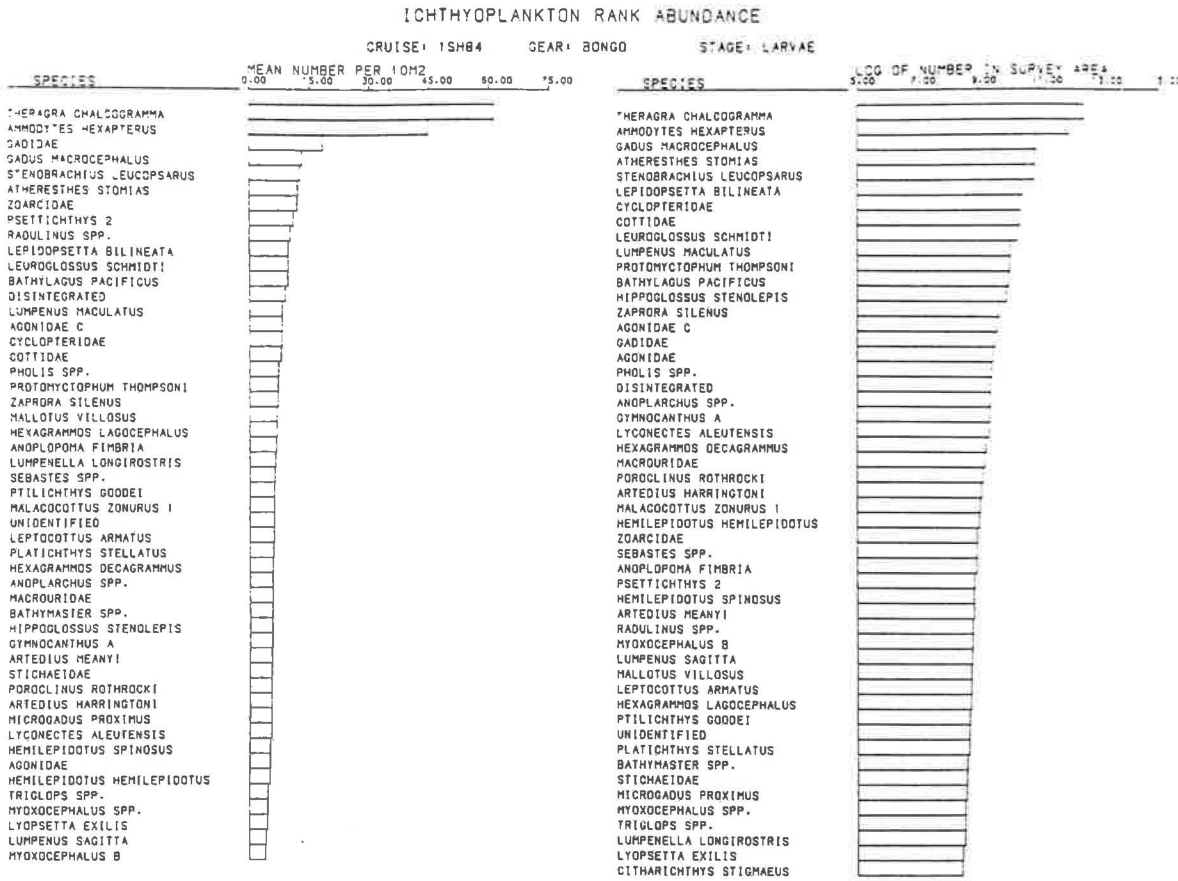

Figure 6 Continued.--Rank abundance of fish larvae caught in bongo tows during cruise 1SH84, April-May 1984.

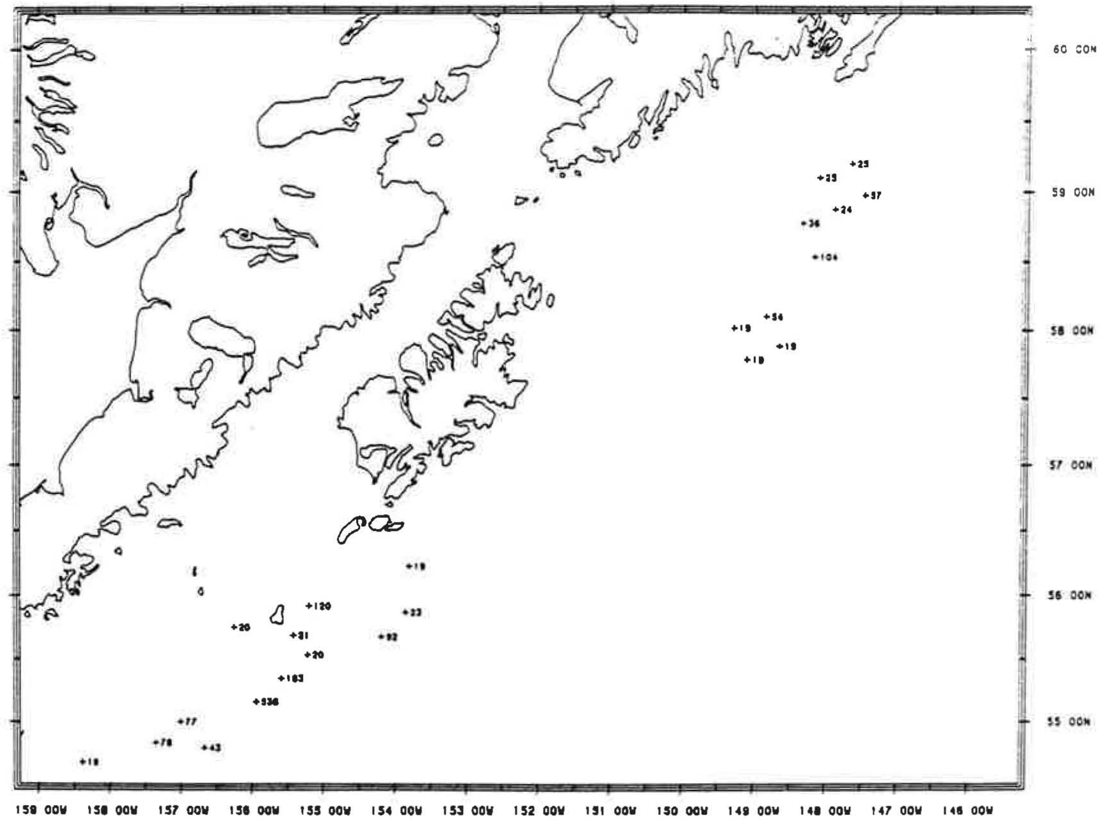

Figure 7.--Distribution of eggs of teleost type A from neuston tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 1000 m^3.

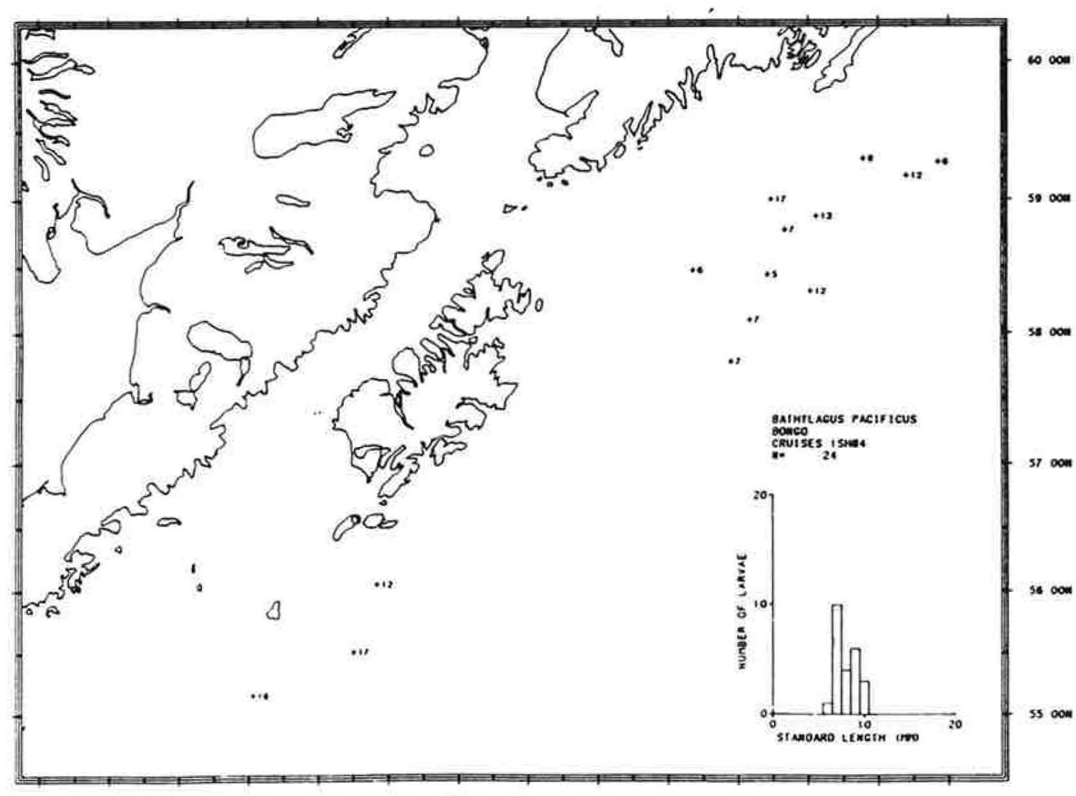

Figure 8.--Distribution and size frequency distribution of larvae of Bathylagus pacificus from bongo tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 10 m^2.

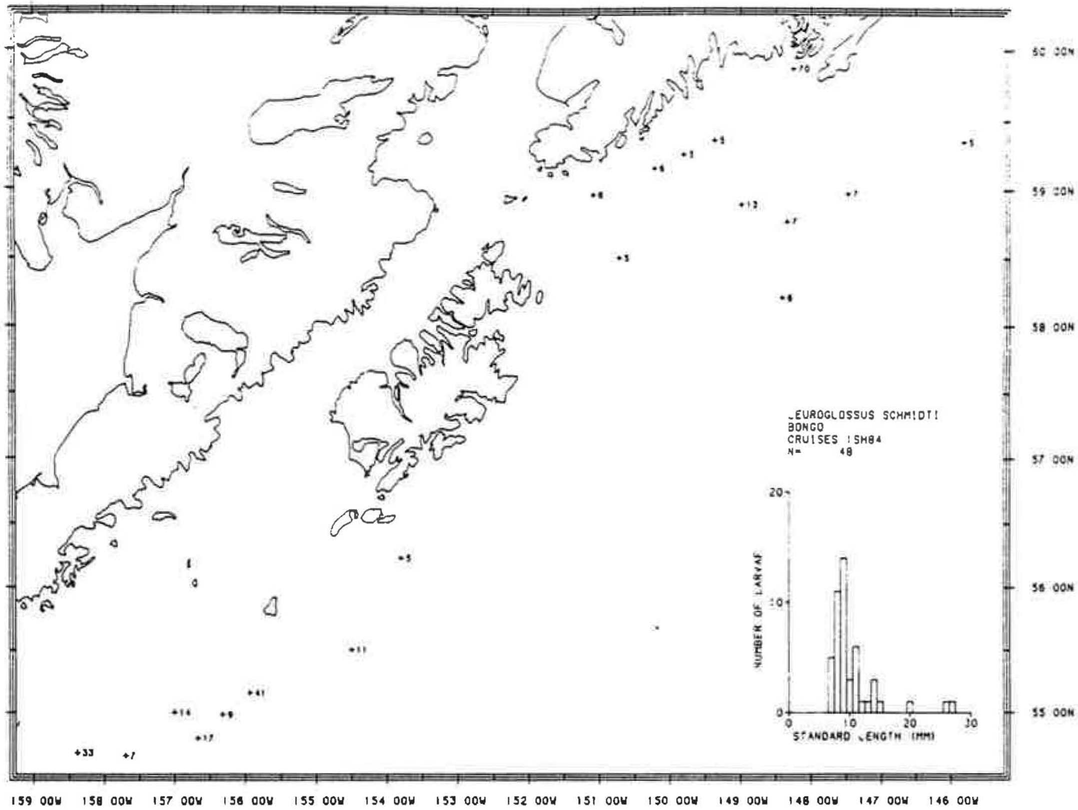

Figure 9.--Distribution and size frequency distribution of larvae of Leuroglossus schmidti from bongo tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 10 m^2.

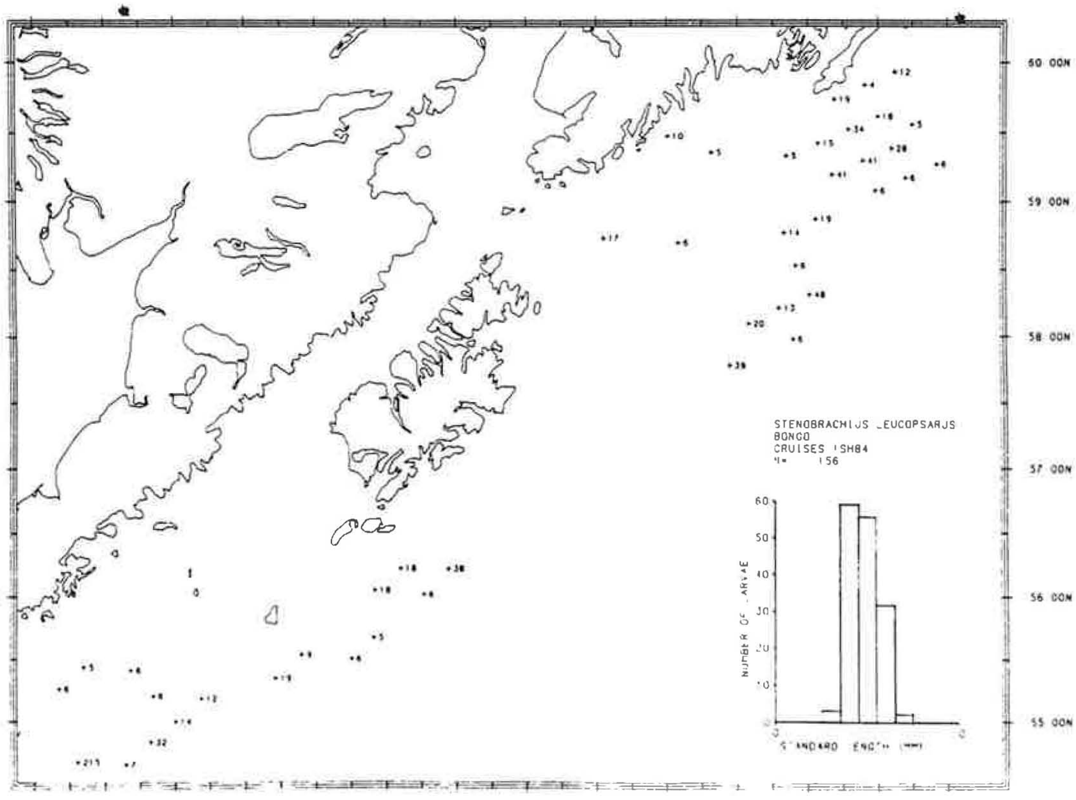

Figure 10.--Distribution and size frequency distribution of larvae of Stenobrachius leucopsarus from bongo tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 10 m^2.

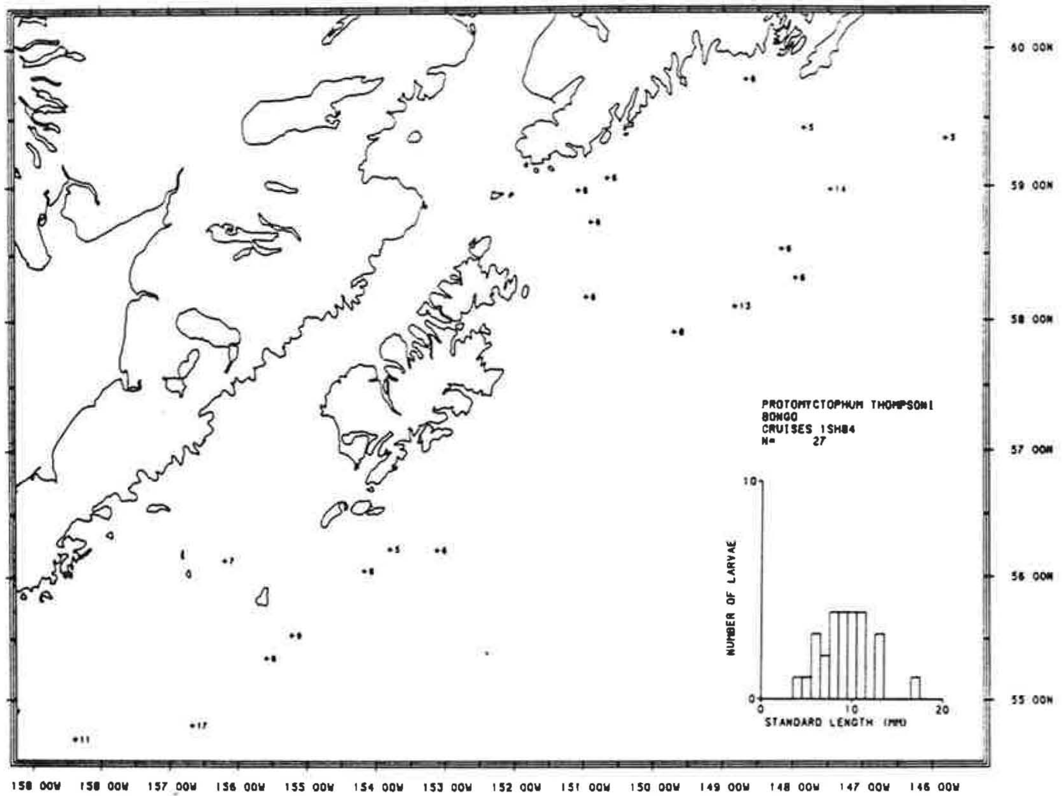

Figure 11.--Distribution and size frequency distribution of larvae of Protomyctophum thompsoni from bongo tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 10 m^2.

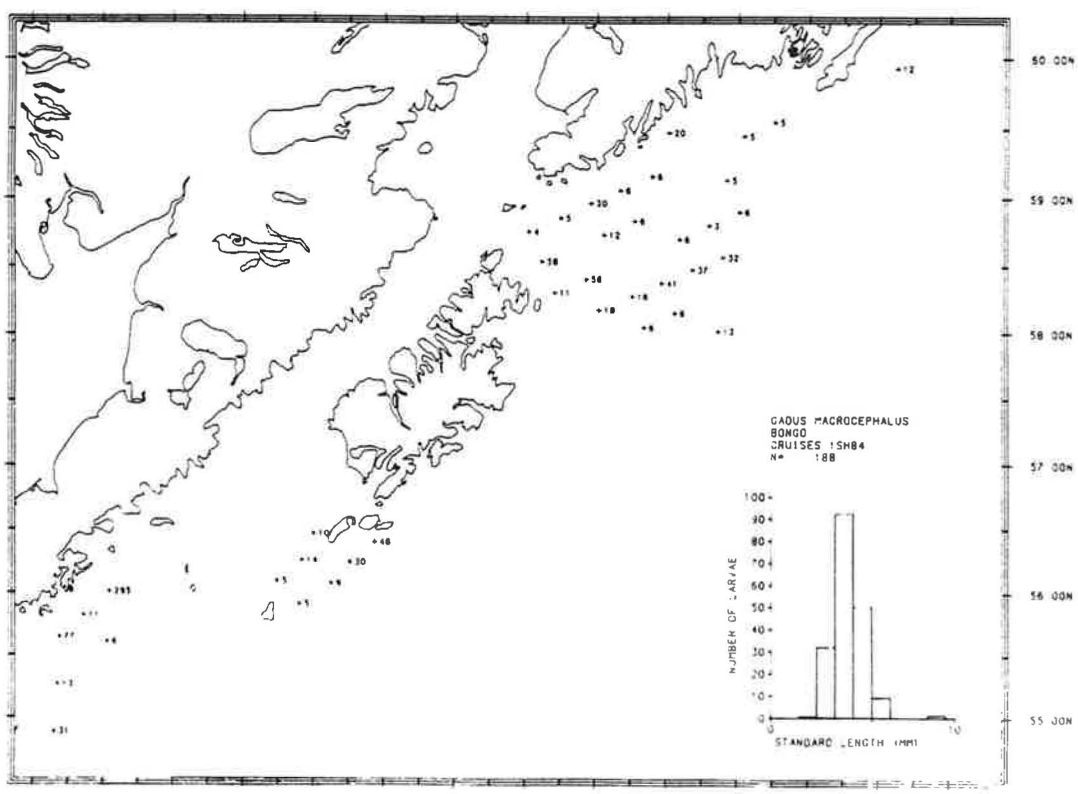

Figure 12.--Distribution and size frequency distribution of larvae of Gadus macrocephalus from bongo tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 10 m^2.

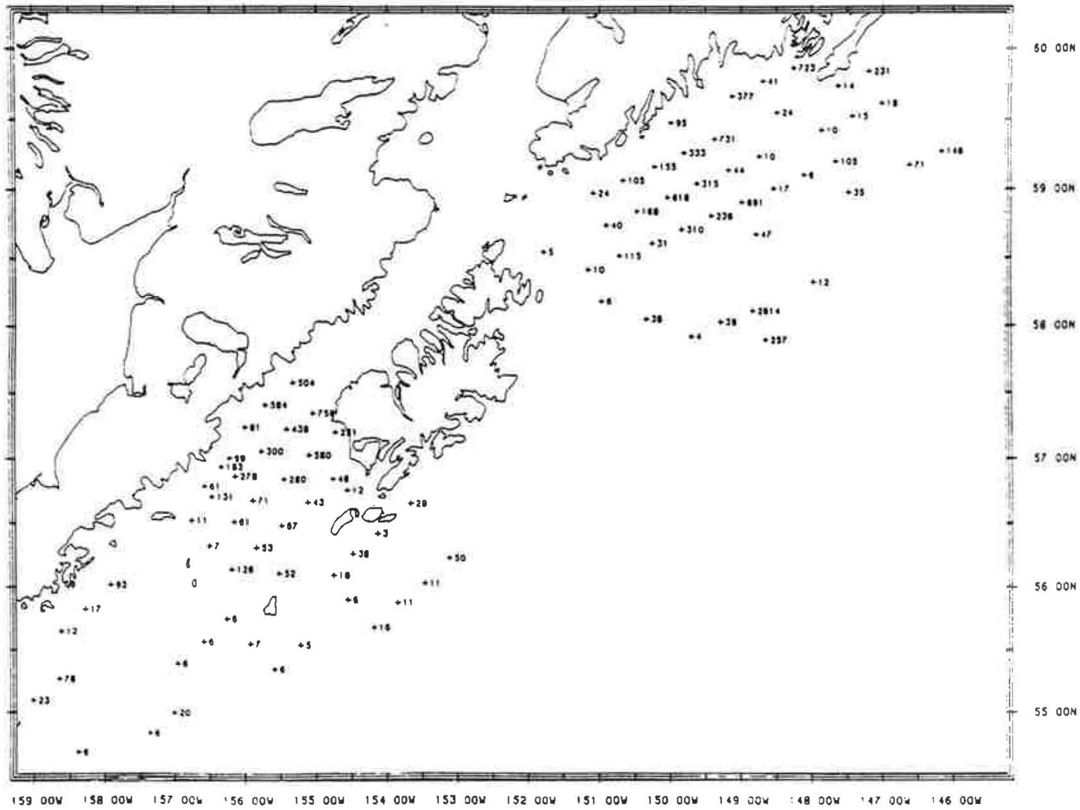

Figure 13.--Distribution of eggs of Theragra chalcogramma from bongo tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 10 m^2.

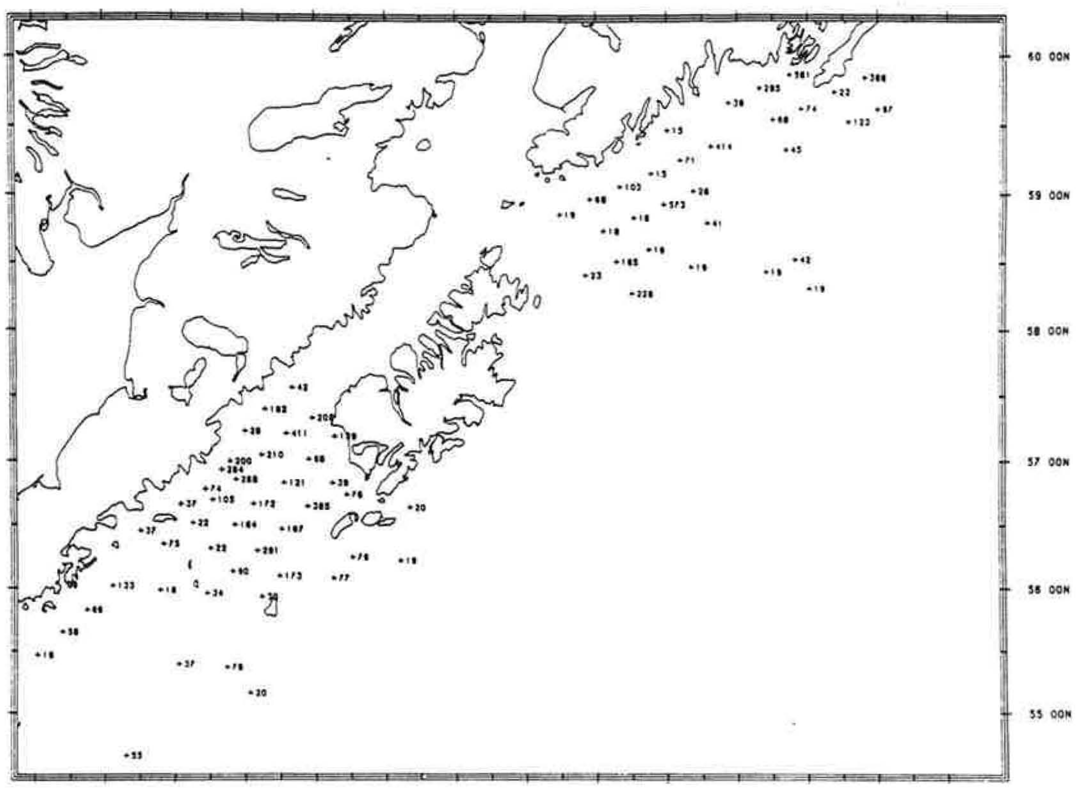

Figure 14.--Distribution of eggs of Theragra chalcogramma from neuston tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 1000 m^3.

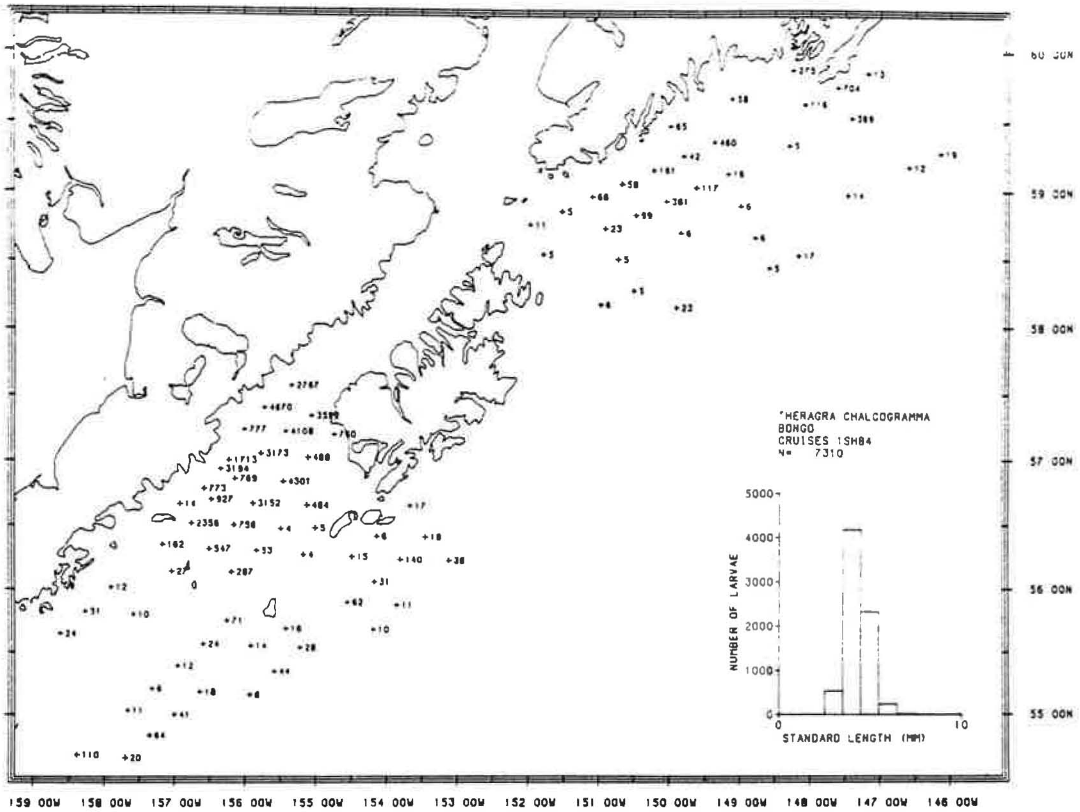

Figure 15.--Distribution and size frequecy distribution of larvae of Theragra chalcogramma from bongo tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 10 m^2.

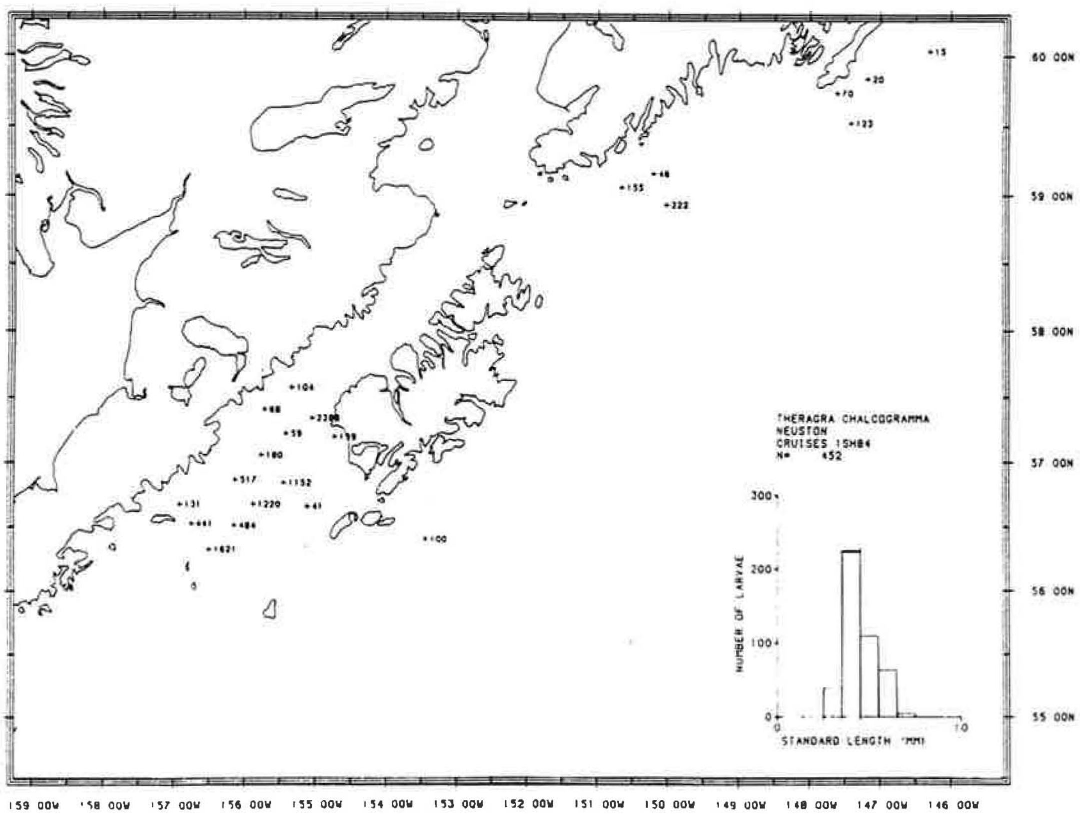

Figure 16.--Distribution and size frequency distribution of larvae of Theragra chalcogramma from neuston tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 1000 m^3.

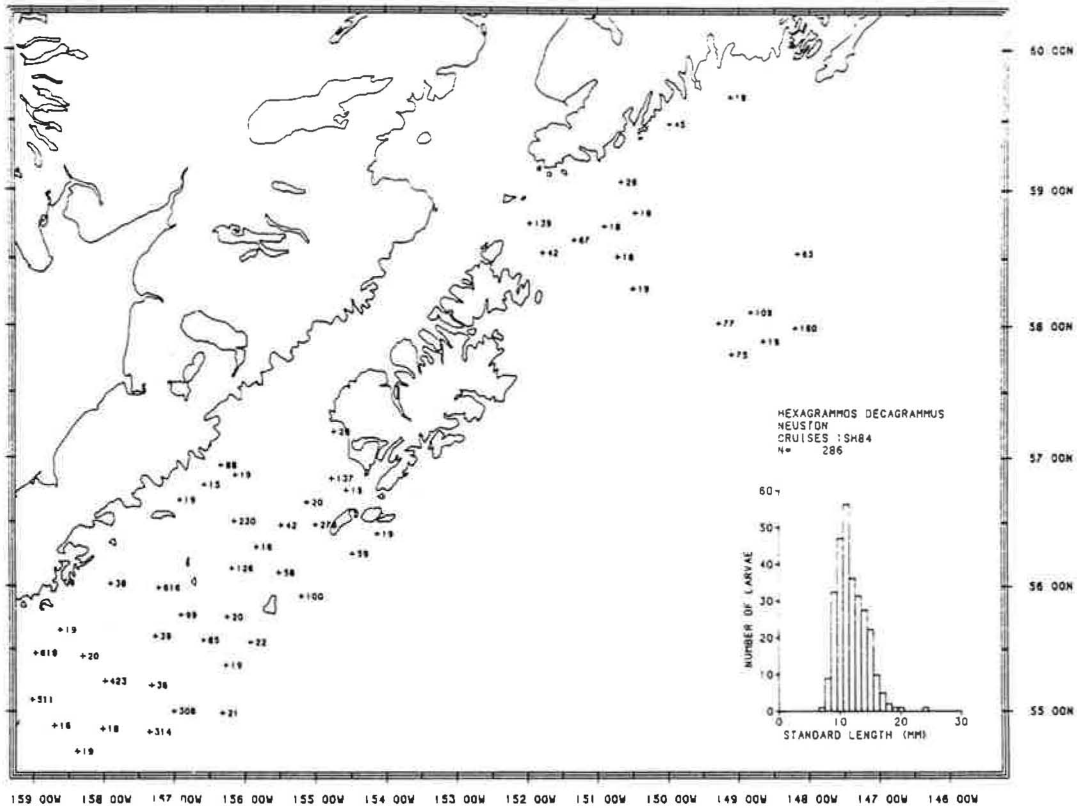

Figure 17.--Distribution and size frequency distribution of larvae of <u>Hexagrammos decagrammus</u> from neuston tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 1000 m^3.

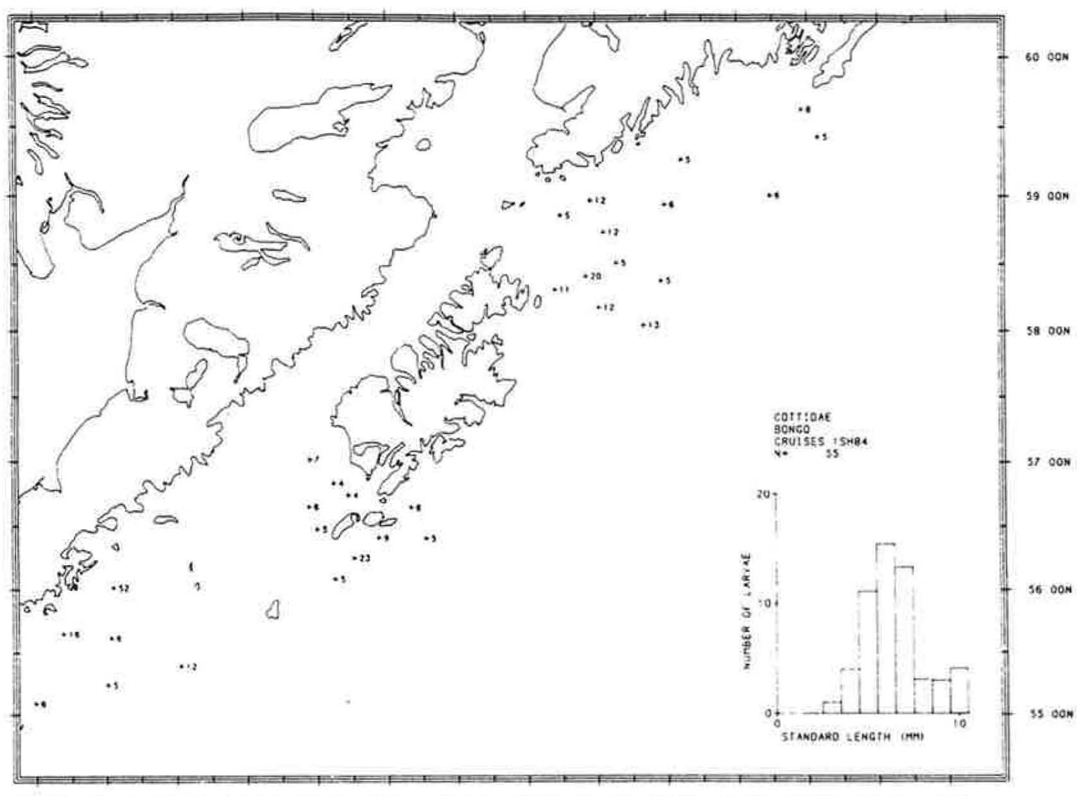

Figure 18.--Distribution and size frequency distribution of larvae of unidentified cottids from bongo tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 10 m^2.

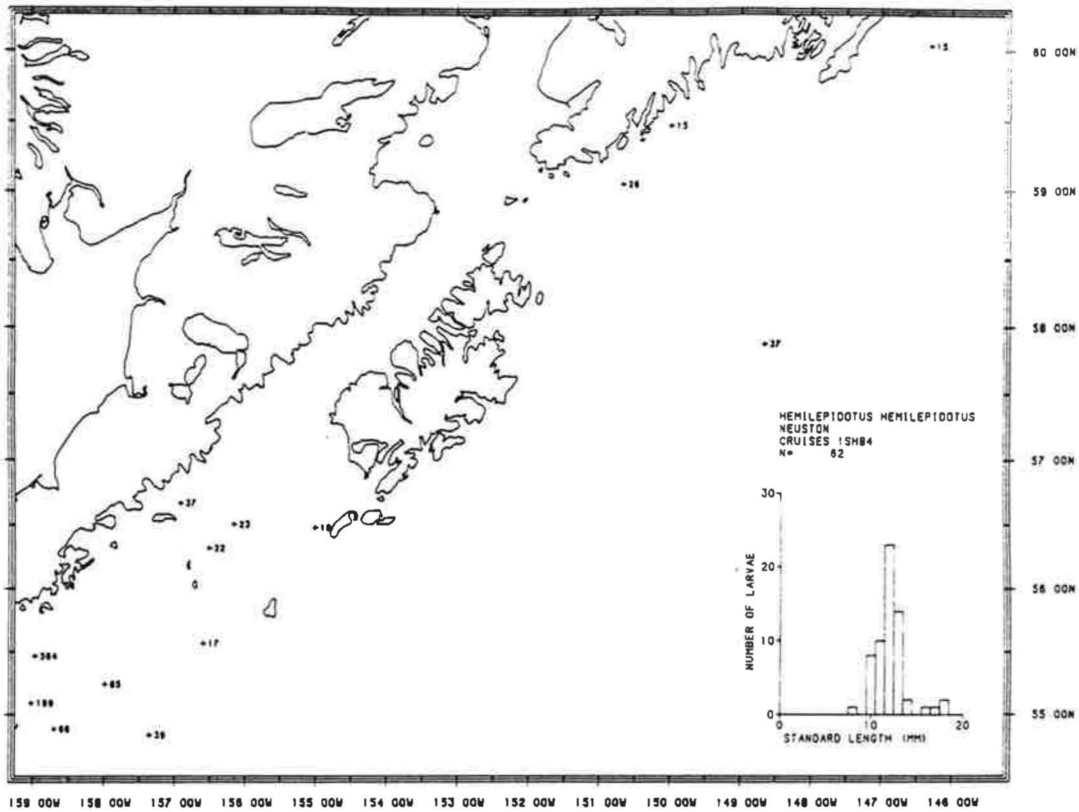

Figure 19.--Distribution and size frequency distribution of larvae of Hemilepidotus hemilepidotus from neuston tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 1000 m^3.

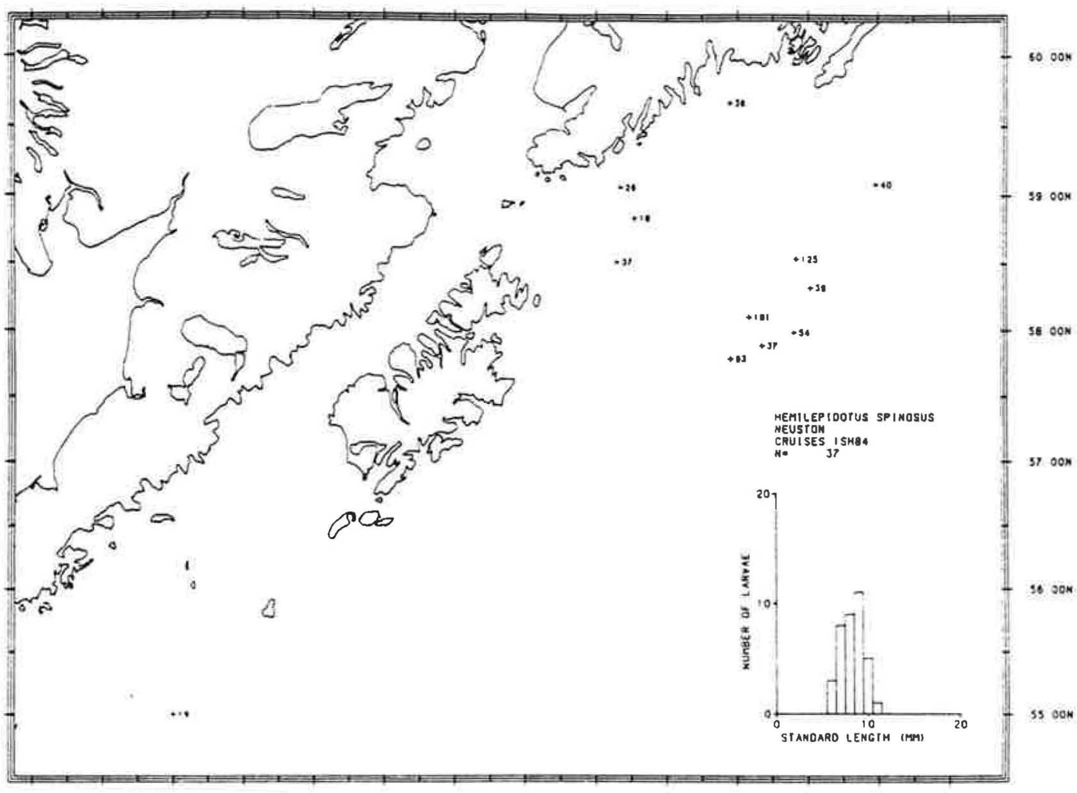

Figure 20.--Distribution and size frequency distribution of larvae of Hemilepidotus spinosus from neuston tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 1000 m^3.

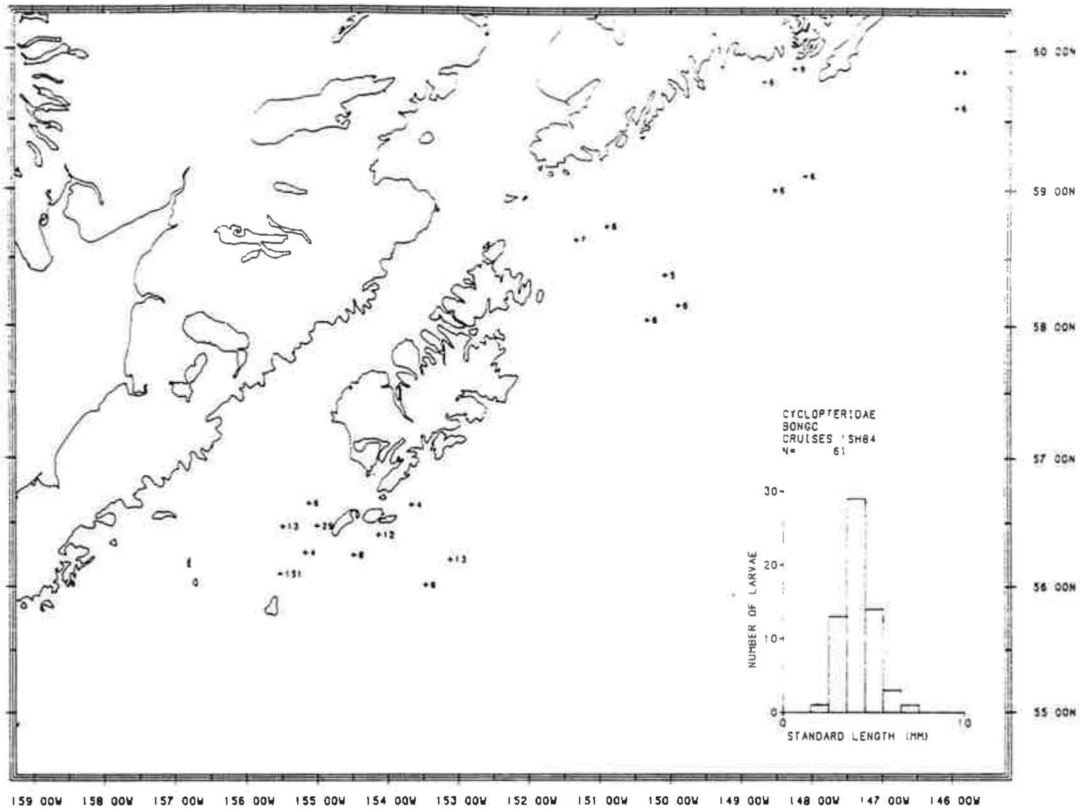

Figure 21.--Distribution and size frequency distribution of larvae of unidentified cyclopterids from bongo tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 10 m^2.

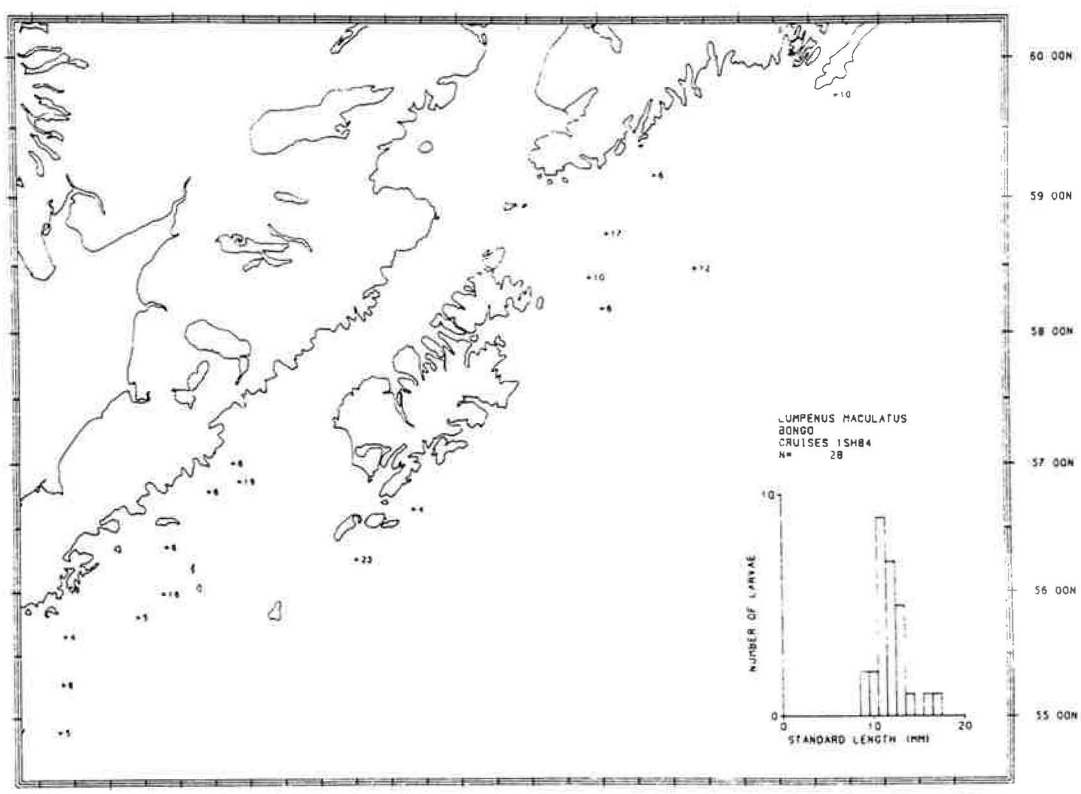

Figure 22.--Distribution and size frequency distribution of larvae of <u>Lumpenus maculatus</u> from bongo tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 10 m^2.

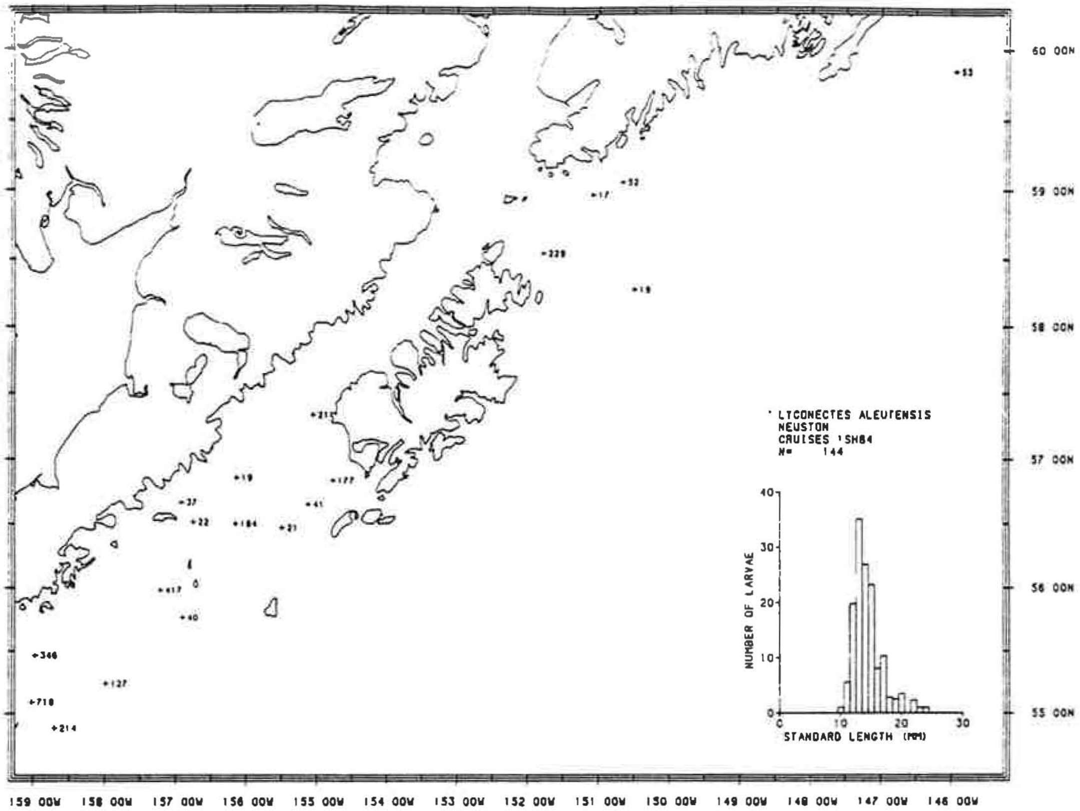

Figure 23.--Distribution and size frequency distribution of larvae of Lyconectes aleutensis from neuston tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 1000 m^3.

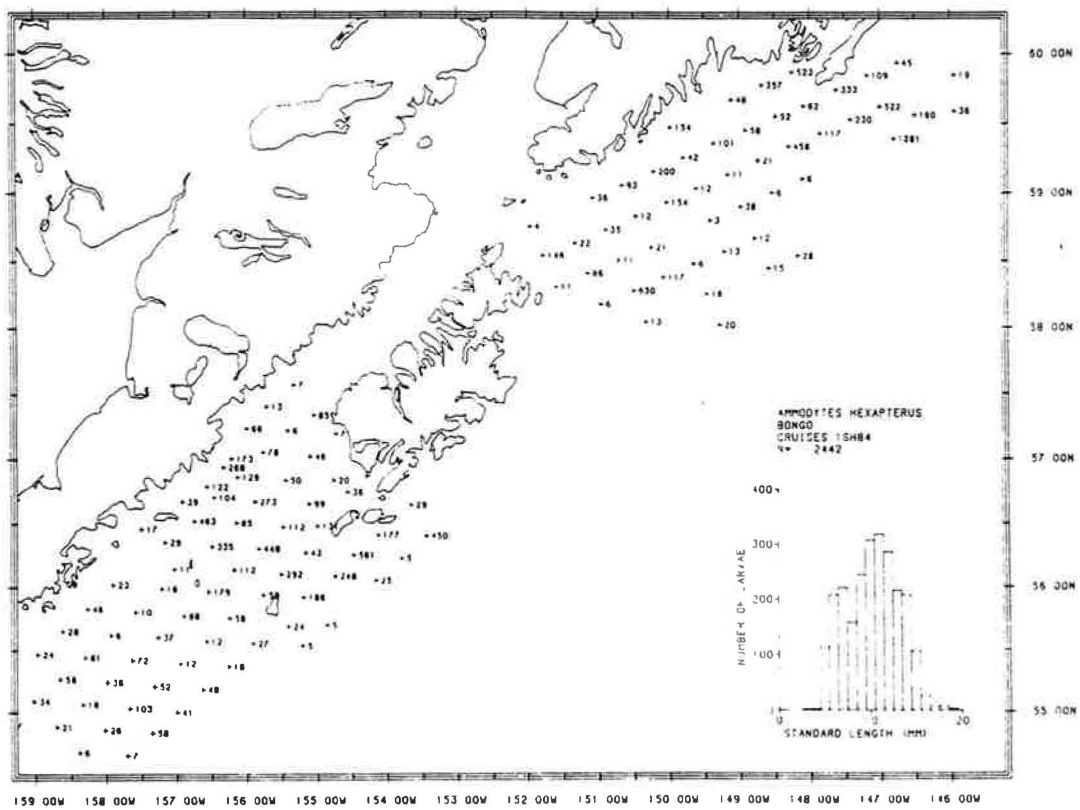

Figure 24.--Distribution and size frequency distribution of larvae of Ammodytes hexapterus from bongo tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 10 m^2.

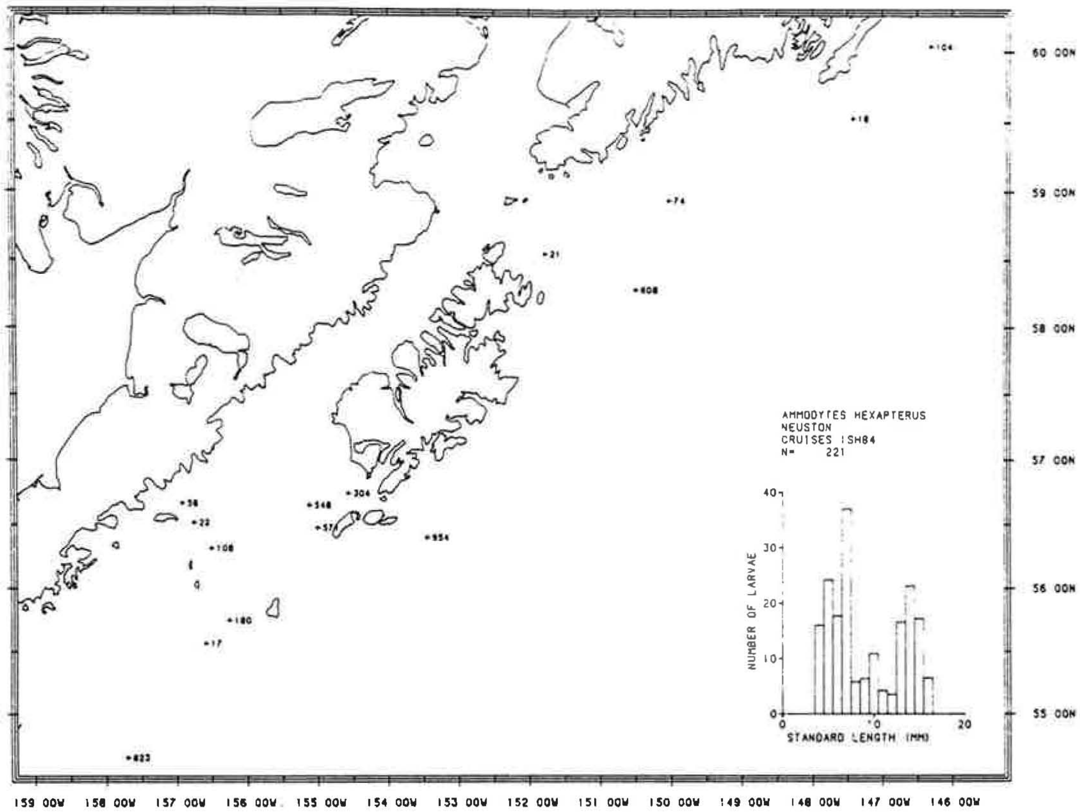

Figure 25.--Distribution and size frequency distribution of larvae of Ammodytes hexapterus from neuston tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 1000 m^3.

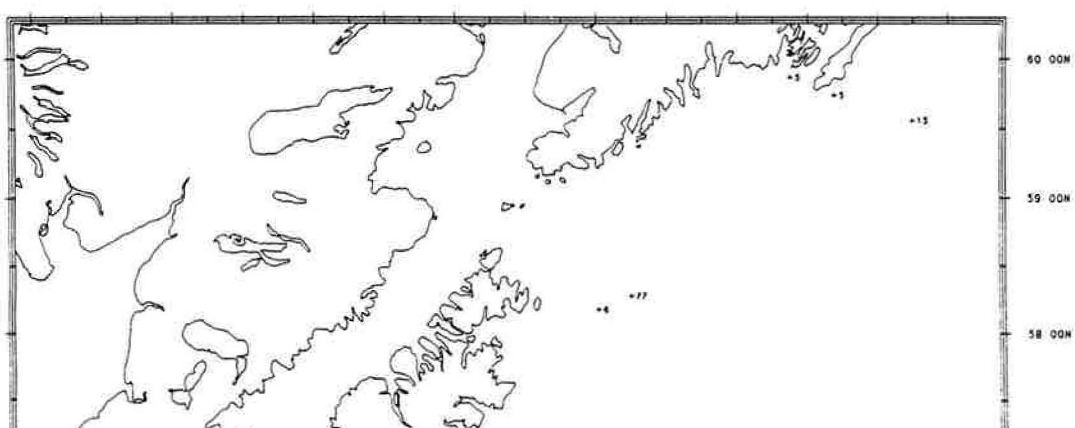

Figure 26.--Distribution of eggs of unidentified pleuronectids from bongo tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 10 m^2.

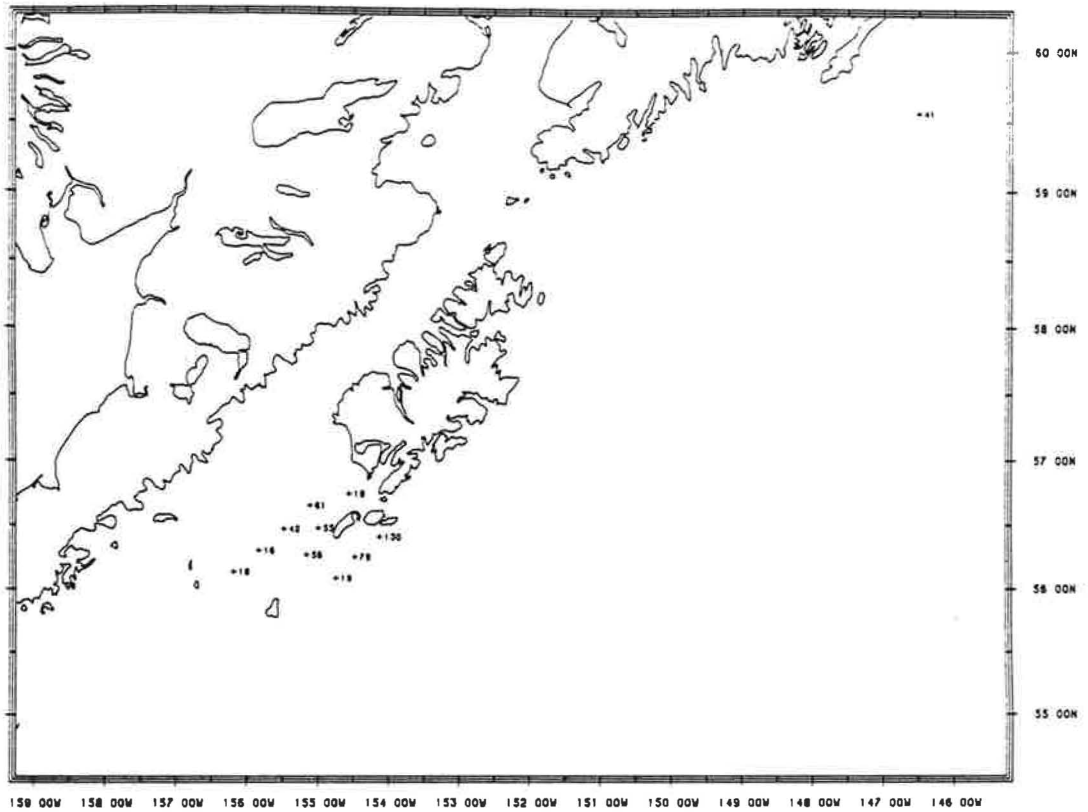

Figure 27.--Distribution of eggs of unidentified pleuronectids from neuston tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 1000 m^3.

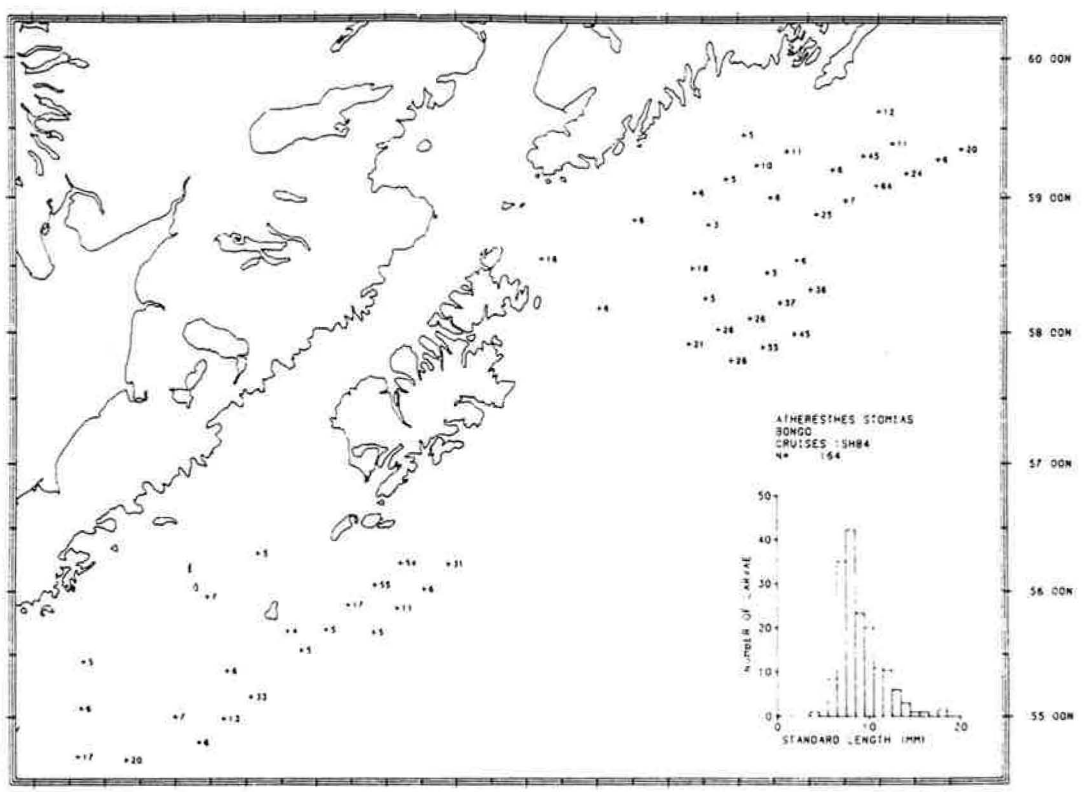

Figure 28.--Distribution and size frequency distribution of larvae of <u>Atheresthes stomias</u> from bongo tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 10 m^2.

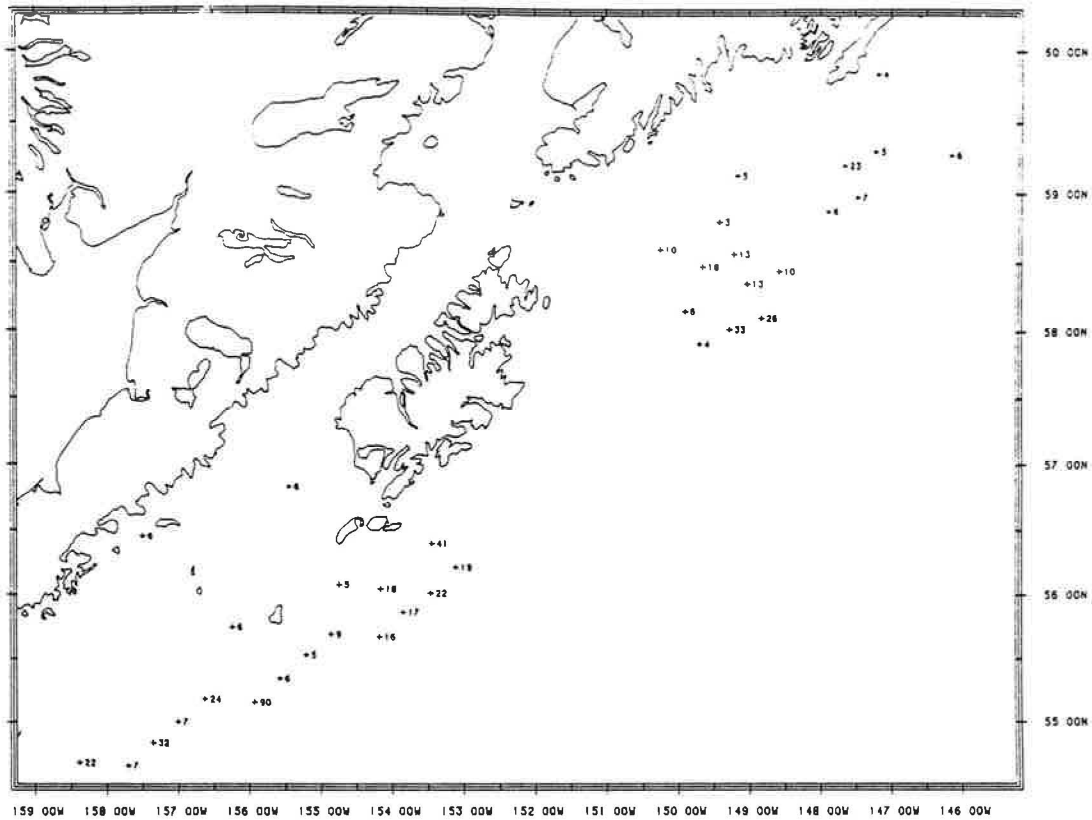

Figure 29.--Distribution of eggs of Glyptocephalus zachirus from bongo tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 10 m^2.

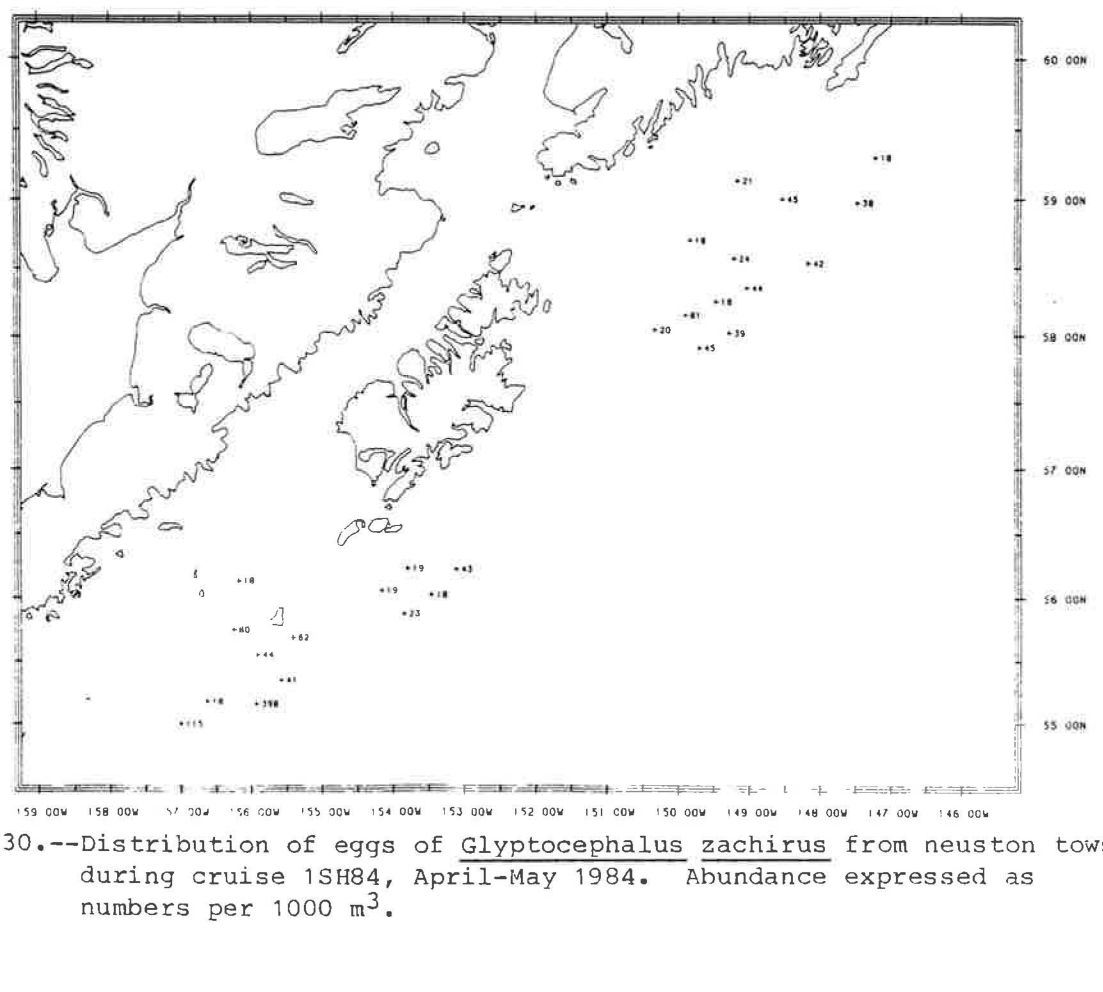

Figure 30.--Distribution of eggs of Glyptocephalus zachirus from neuston tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 1000 m^3.

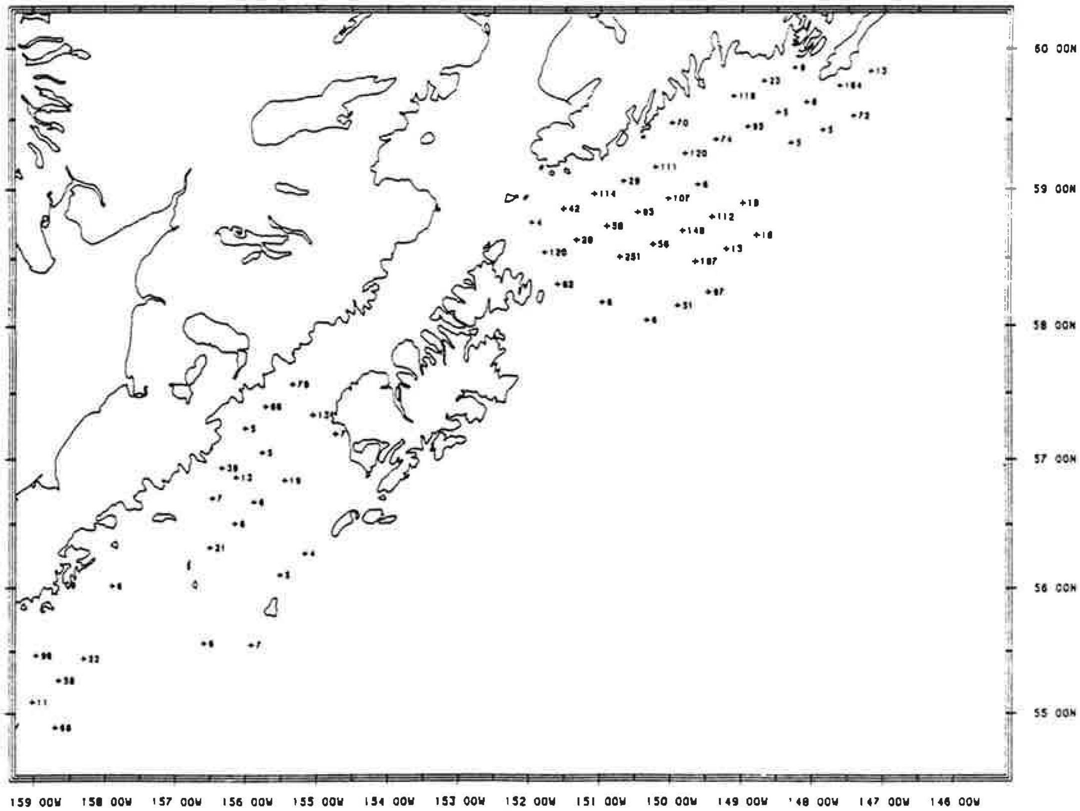

Figure 31.--Distribution of eggs of Hippoglossoides elassodon from bongo tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 10 m^2.

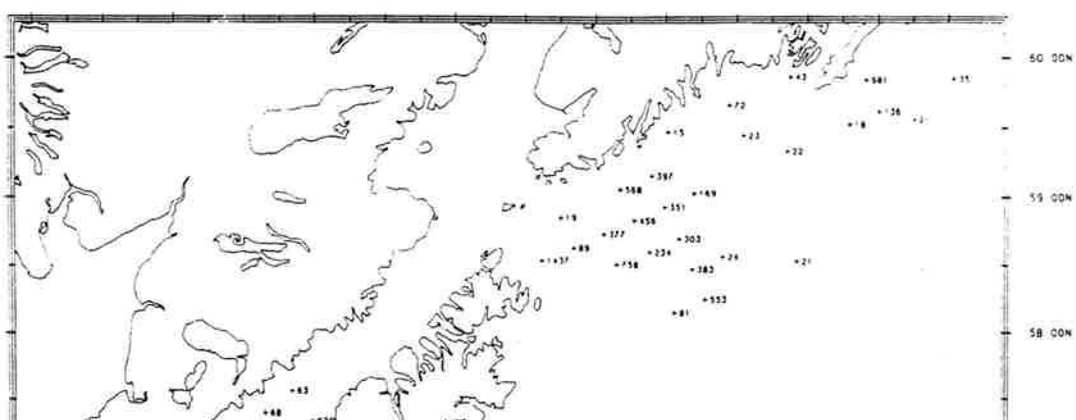

Figure 32.--Distribution of eggs of Hippoglossoides elassodon from neuston tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 1000 m^3.

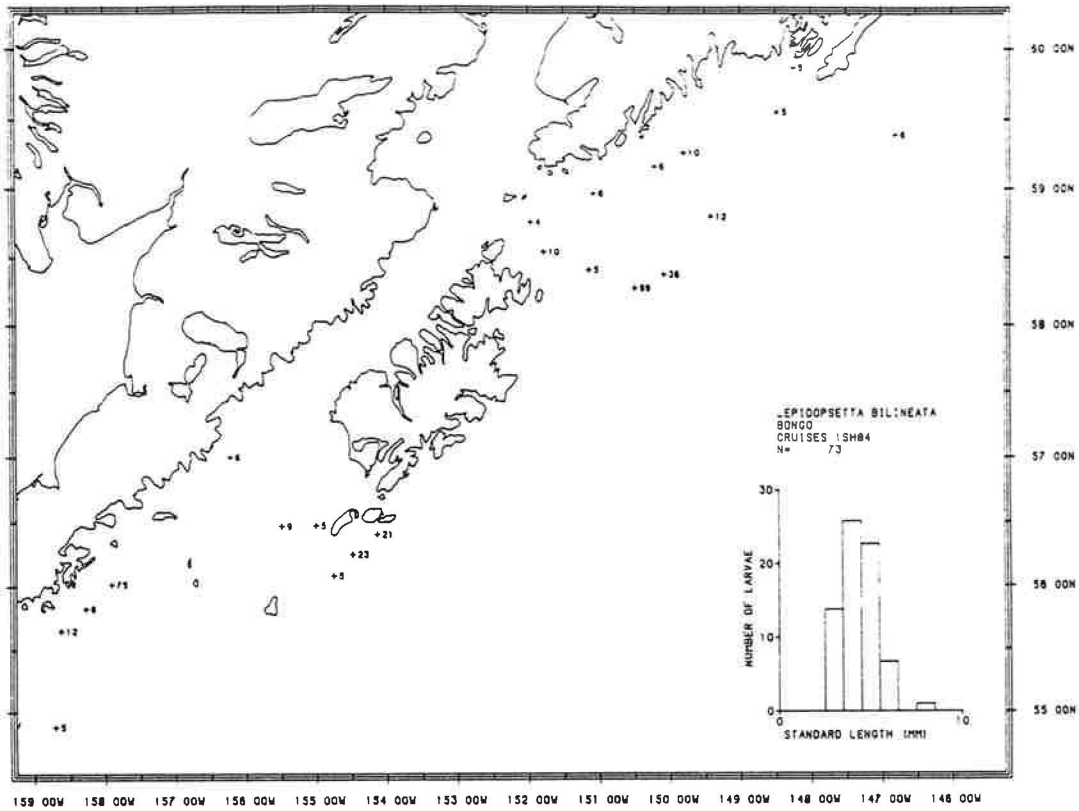

Figure 33.--Distribution and size frequency distribution of larvae of Lepidopsetta bilineata from bongo tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 10 m^2.

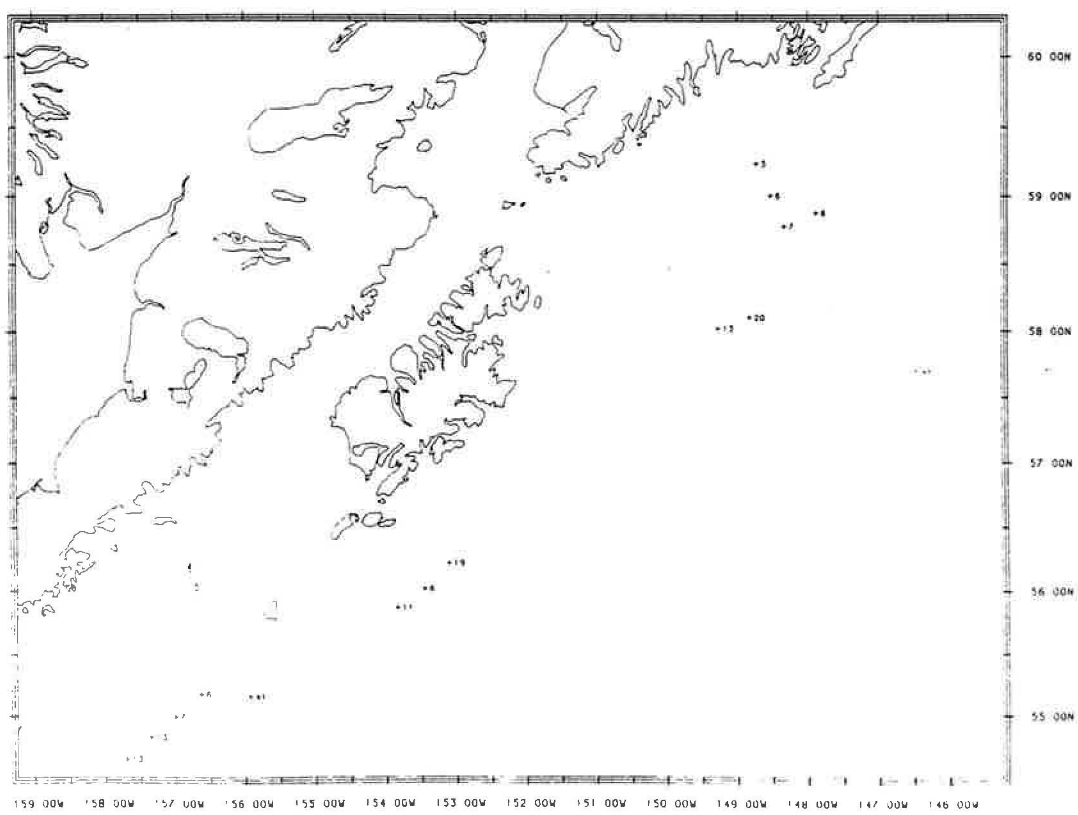

Figure 34.--Distribution of eggs of Microstomus pacificus from bongo tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 10 m^2.

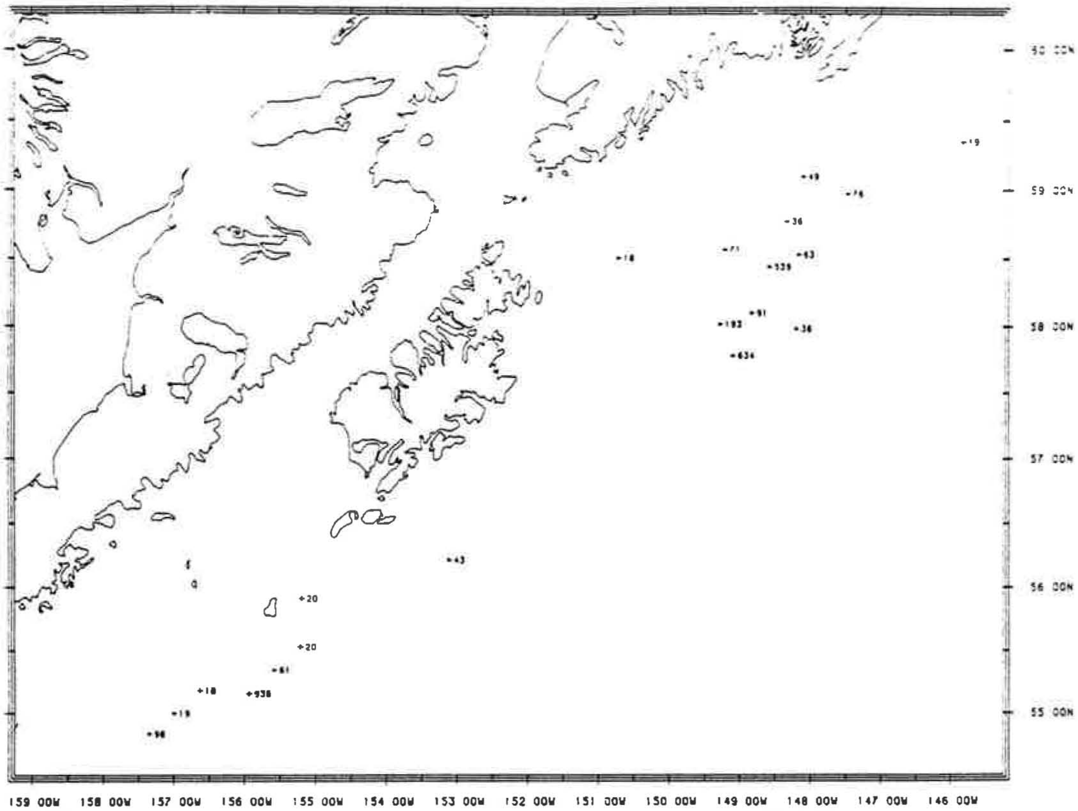

Figure 35.--Distribution of eggs of Microstomus pacificus from neuston tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 1000 m^3.

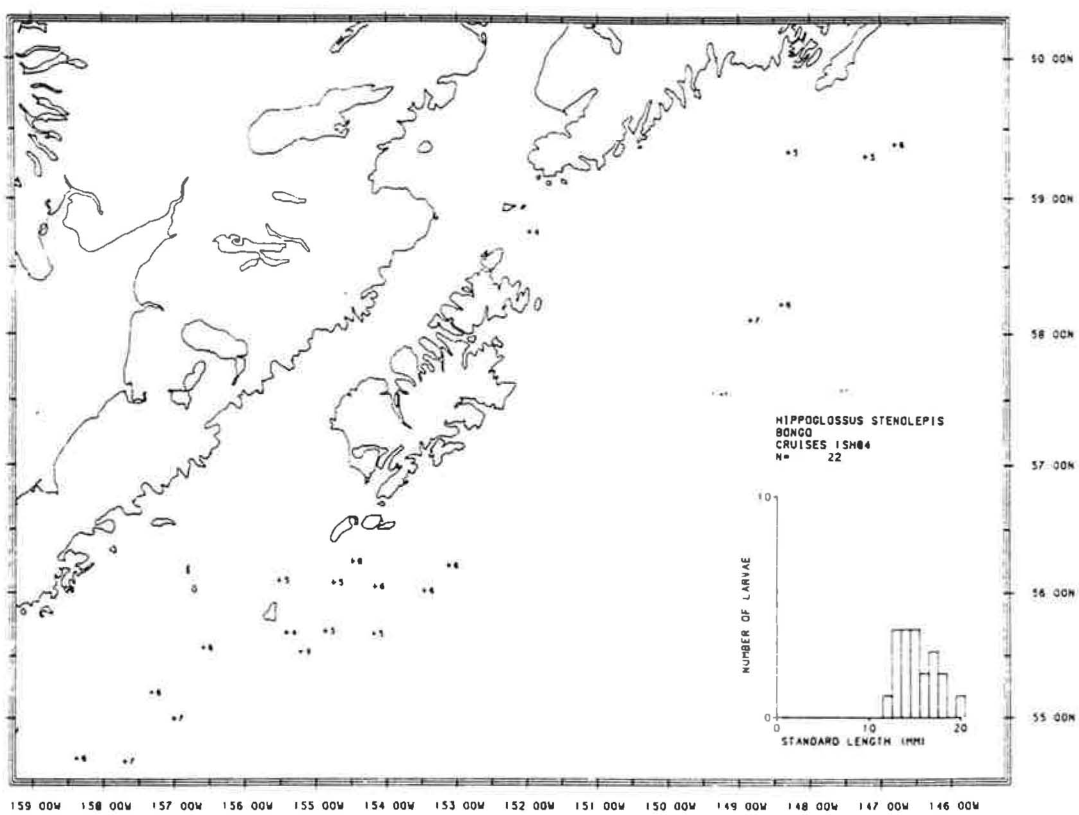

Figure 36.--Distribution and size frequency distribution of larvae of Hippoglossus stenolepis from bongo tows during cruise 1SH84, April-May 1984. Abundance expressed as numbers per 10 m^2.

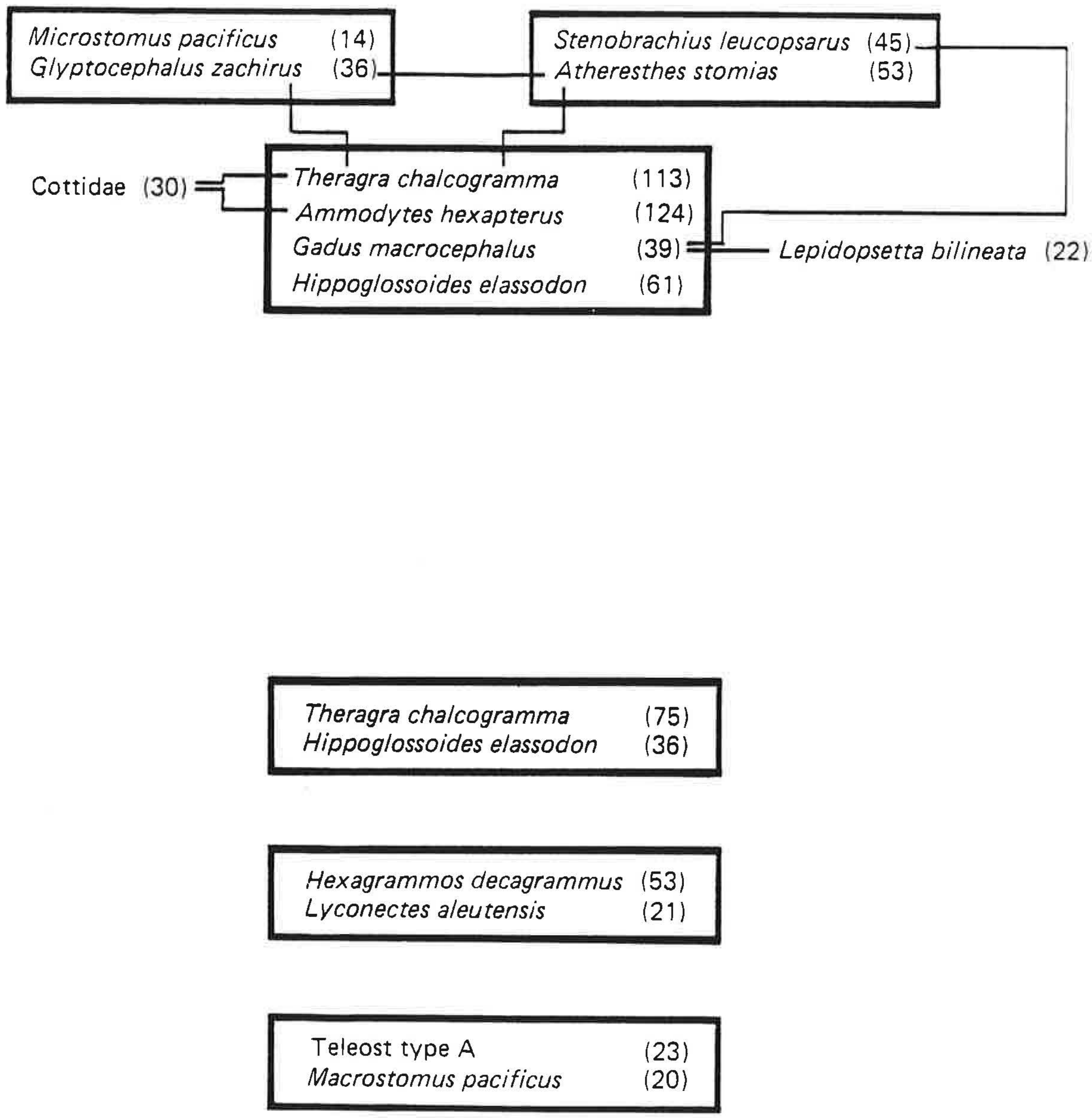

Figure 37.--Results of recurrent group analysis at an affinity level of 0.4 on bongo catches (above) and neuston catches (below) for both fish eggs and larvae from cruise 1SH84, April-May 1984. Those taxa whose names are contained in a rectangle are members of a recurrent group. A line connects a recurrent group with the name of a taxon outside of the group having an affinity level of 0.4. The number in parentheses following a taxon name is the number of occurrences of that taxon.