**Northwest and Alaska Fisheries Center**

National Marine Fisheries Service

**U.S. DEPARTMENT OF COMMERCE**

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## Ichthyoplankton off Washington, Oregon and Northern California May-June 1982

December 1986

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# Ichthyoplankton off Washington, Oregon, and Northern California

May-June 1982

by

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## INTRODUCTION

This is the seventh report of a series describing cooperative U.S.-U.S.S.R ichthyoplankton surveys conducted off the U.S. west coast from 48°-40°N. Similar reports, based on cruises occurring since April-May 1980, have already been produced (Kendall and Clark 1982a, 1982b, Bates 1984, Clark 1984, Clark and Kendall 1985, and Clark 1986). These surveys are designed to determine seasonal and spatial distribution of ichthyoplankton as background information for more detailed studies on early life history of fishes of the area. The initial plans were to conduct two such surveys each year, at different times of the year, so that after several years the complete annual cycle of fish egg and larval occurrence will be documented. These will be the first large-scale ichthyoplankton surveys of the area to sample all seasons. Results from these surveys eventually will be compared to those of the CalCOFI program off California and Baja California to the south, and to several smaller-scale surveys conducted previously off Washington and Oregon. In the meantime, we plan to present a data report such as this for each cruise, as soon as feasible. Because this cruise was conducted at the same time of year as one in 1981 (1P081, Clark 1984), sampling plans were modified. Bongo tows were taken at only 49 of the usual 124 stations. Also neuston samples were preserved in 80% ethanol, rather than the usual formaldehyde solution, for analysis of larval otoliths.

## METHODS AND MATERIALS

A grid of 124 stations laid out off the Washington, Oregon, and northern California coasts extended from 3 miles (5.6 km) to 200 miles (370 km) from shore (Figures 1 and 2). Stations were more closely spaced nearshore than offshore. The Soviet Research vessel POSEYDON with Dr. Artemov serving as chief scientist occupied these stations basically from north to south from 3 May to 1 June 1982. At each station hydrographic casts at standard depths (0, 10, 20, 30, 50, 75, 100, 150, 200, 250, 300, 400, 500, and 600 m) were made as water depth permitted. Temperature, salinity, oxygen, phosphate, and silicate determinations were made aboard ship with these samples. Results of these measurements will be reported elsewhere. Paired neuston tows using 0.3 m high by 0.5 m wide Sameoto samplers (Sameoto and Jaroszynski 1969) with 0.505 mm mesh nets were made at 2.0 knots (1.03 m/sec) for 10 min at each station. A standard MARMAP bongo tow (Smith and Richardson 1977) with 60 cm, 0.505 mm mesh nets was made with a maximum of 300 m of wire out at 49 of the stations. Flowmeters in the mouths of the nets were used to determine the volume of water filtered by each net. The Soviets retained one of the paired neuston and bongo samples, while the Americans retained the other. The American neuston samples were preserved at sea in 80% ethanol to allow analysis of larval fish otoliths. These samples were sorted and the fish larvae were identified and measured at NWAFC and Southwest Fisheries Center (SWFC). Crab larvae were also removed from the neuston samples for a study conducted by Dr. Richard Methot, SWFC (Dunn 1986). The American bongo 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 later identified and counted by Ann C. Matarese at NWAFC. Identifications were made to the lowest taxonomic

level possible, and in some cases "types" of unidentified eggs or larvae were established in hopes that with further study their identity could be established. Beverly Vinter at NWAFC checked larval identifications for both the bongo and neuston samples. Counts of fish eggs and larvae in the samples were converted to numbers per 10 $m^2$ of surface area for the bongo samples and numbers per 1,000 $m^3$ for the neuston samples. The logarithm of the number of eggs or larvae in the survey area is based on the Sette and Ahlstrom census as used by Richardson (1981).

## RESULTS

The station pattern (Figures 1 and 2) was occupied as planned (the Soviets added stations south of 40°N which they processed and results are not included in this report). Data associated with the 124 stations are listed in Tables 1 and 2. Results from the bongo tows must be evaluated with regard to the limited number of samples (49) collected on this cruise. A summary of the catches of fish eggs, juveniles, and larvae is presented in Tables 3 and 4. Totals of 23 taxa of eggs and 48 taxa of larvae were found. Figures 3-5 illustrate the rank abundances of egg and larval catches in bongo and neuston tows for the cruise using several measures of abundance. Figures 6-24 show the geographic distribution, abundance at each station, and length frequencies of larvae of the more abundant taxa. Results of recurrent group analysis of eggs and larvae from bongo samples are shown in Figure 25.

## RELATIVE ABUNDANCES

The rank order of abundance among the taxa depends on the measure of abundance examined. Four measures of abundance for each net were used: total numbers caught, percent occurrence, logarithm of number in survey area, and mean number per 1,000 $m^3$ (for neuston) and mean number per 10 $m^2$ (for bongo).

In the bongo net, egg catches were dominated by Myctophidae according to three of the abundance criteria, and Lyopsetta exilis based on percent occurrence (Figure 4). Similar results were found during the May-June 1981 cruise (Clark 1984). The eggs from the neuston net are being stored at the Southwest Fisheries Center in La Jolla, California (the ethanol preservative used for the neuston samples obliterates many of the characters needed to identify fish eggs).

Larval catches in the neuston net were dominated by Sebastes spp. for three of the four abundance measures. Also abundant were Hemilepidotus spinosus and Anoplopoma fimbria (Figure 3). In the bongo net Stenobrachius leucopsarus ranked first by two measures, and second in the others. Also abundant were Diaphus theta, Sebastes spp. and Myctophidae (Figure 5).

## DISTRIBUTIONS

While this is not intended to be a definitive report on these data, certain outstanding features of distribution of the more abundant taxa will be mentioned.

Bathylagus ochotensis (Figure 6) - Larvae of this deep-sea smelt were found in bongo catches distributed throughout the continental shelf waters along with a few scattered offshore locations in the southern half of the survey area. The larvae ranged in length from 4.0-21.5 ($\bar{x}$ = 9.9) mm SL and occurred at 53% of the stations occupied.

Myctophidae (Figures 7 and 8) - The bongo net caught unidentified eggs and larvae of lanternfishes in low percentages of the stations sampled (10% for eggs, 4% for larvae). One station offshore of northern California accounted for the majority of lanternfish eggs and larvae caught.

Diaphus theta (Figure 9) - Larvae of this myctophid were found in a small number of bongo catches primarily in the southern third of the survey area. They ranged from 2.8-7.5 ($x$ = 3.3) mm SL.

Stenobrachius leucopsarus (Figure 10) - This lanternfish larvae dominated the catch in the bongo nets in numbers caught and in occurrence (61% of the stations). They were found throughout the survey area and ranged in size from 3.0-10.1 ($x$ = 6.0) mm SL. The size was consistent with results found in April-May 1980 (Kendall and Clark 1982a) and in May-June 1981 (Clark 1984).

Tarletonbeania crenularis (Figures 11 and 12) - Larvae and juveniles of this lanternfish were found scattered throughout the survey area. The larvae were found in moderate numbers in the bongo catches and ranged in size from 3.5-13.0 ($\bar{x}$ = 6.4) mm SL. The juveniles were collected in the neuston catches in considerable numbers and ranged in size from 21.5-77.0 ($\bar{x}$ = 39.2) mm SL.

Cololabis saira (Figure 13) - Saury larvae were found in neuston catches off the Oregon and California coasts in small numbers.

Sebastes spp. (Figures 14 and 15) - Rockfish larvae were found in both the neuston and bongo catches. No attempt was made to identify the species caught. Catches in the neuston were found scattered throughout the survey area, while the larvae in the bongo were mainly found in the continental shelf waters. The rockfish larvae in the neuston net were larger than in the bongo net ($\bar{x}$ neuston = 13.1, $\bar{x}$ bongo = 4.7 mm SL), a result similar to that noticed in May-June 1981 (Clark 1984) and April-May 1980 (Kendall and Clark 1982a).

Anoplopoma fimbria (Figure 16) - Sablefish larvae were only collected in neuston tows throughout the northern half of the survey area. The larvae ranged in length from 10.7-41.2 ($\bar{x}$ = 17.3) mm SL.

Hemilepidotus spinosus (Figure 17) - Larvae of the brown Irish lord were in neuston catches scattered in the shelf waters of the survey area and offshore from the Washington coast; lengths ranged from 11.0-37.0 ($\bar{x}$ = 15.8) mm SL.

Ronquilus jordani (Figure 18) - Larvae of the northern ronquil were found in neuston catches along the continental shelf. They occurred at 7% of the stations and ranged in length from 8.5-25.5 ($\bar{x}$ = 44.8) mm SL.

Ammodytes hexapterus (Figure 19) - Pacific sand lance larvae were found in neuston catches primarily in Washington and Oregon shelf waters. Length ranged from 28.0-55.5 ($\bar{x}$ = 44.8) mm SL.

Icichthys lockingtoni (Figure 20) - Eggs of medusafish occurred in 24% of the bongo collections, primarily in the southern half of the survey area.

Bothidae (Figure 21) - Unidentified eggs of lefteye flounders were found in bongo samples from the northern end of the survey area to Coos Bay, Oregon at the nearshore stations.

Glyptocephalus zachirus (Figure 22) - Rex sole eggs were found at nearshore stations throughout the survey area in the bongo samples.

Lyopsetta exilis (Figure 23) - Eggs of slender sole were found in bongo catches throughout the survey area at the nearshore stations. Similar results were noticed in May-June 1981 (Clark 1984).

Microstomus pacificus (Figure 24) - Dover sole eggs were collected in bongo tows all along the coast, mainly just off the continental shelf.

## COMMUNITY STRUCTURE

Recurrent group analysis at the 0.4 affinity level of neuston catches showed only one group whose members had more than five occurrences. This group was composed of Ronquilus jordani and Ophiodon elongatus. Platichthys stellatus

and Psettichthys melanostictus had affinity levels greater than 0.40 with each other. Taxonomic groupings in the neuston collections in other spring cruises on this series have been quite variable (Clark 1984; Clark and Kendall 1985; Kendall and Clark 1982a). Apparently the several species that utilize the neuston as larvae and juveniles at this time of year respond to interannual variations in the environment in different ways that effect their co-occurrence with other species.

In bongo catches a more complex pattern was seen (Figure 25). It basically broke down into offshore and nearshore groups. The offshore groups consisted of many myctophids and bathylagids, and the nearshore groups were made up mainly of flatfish eggs.

## ACKNOWLEDGEMENTS

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NEUSTON SUMMARY

| STATION | POSITION LAT. N. | LONG. W. | DATE YYMMDD | AREA KM2 | TIME GMT | STANDARD HAUL FACTORS * A | B |
|---|---|---|---|---|---|---|---|
| G001A | 48 0.1 | 124 50.0 | 82 5 3 | 920. | 1002 | 0.019 | 12.759 |
| G002A | 47 59.7 | 125 11.5 | 82 5 3 | 890. | 1355 | 0.020 | 13.665 |
| G003A | 48 2.5 | 125 28.6 | 82 5 3 | 1224. | 1715 | 0.019 | 12.633 |
| G004A | 48 0.0 | 125 51.0 | 82 5 3 | 2042. | 2025 | 0.020 | 13.521 |
| G005A | 48 0.2 | 126 12.0 | 82 5 3 | 1985. | 2358 | 0.018 | 12.175 |
| G006A | 47 40.0 | 125 14.1 | 82 5 4 | 1876. | 635 | 0.021 | 14.208 |
| G007A | 47 40.0 | 124 52.0 | 82 5 4 | 884. | 915 | 0.020 | 13.658 |
| G008A | 47 40.0 | 124 35.5 | 82 5 4 | 735. | 1108 | 0.018 | 12.025 |
| G009A | 47 20.0 | 124 25.1 | 82 5 4 | 802. | 1400 | 0.017 | 11.006 |
| G010A | 47 20.0 | 124 44.0 | 82 5 4 | 917. | 1630 | 0.018 | 12.055 |
| G011A | 47 20.0 | 125 5.0 | 82 5 4 | 1827. | 2257 | 0.020 | 13.470 |
| G012A | 47 20.0 | 126 4.0 | 82 5 5 | 5352. | 520 | 0.018 | 11.720 |
| G013A | 47 20.0 | 127 3.0 | 82 5 5 | 4857. | 1043 | 0.018 | 12.098 |
| G014A | 47 20.0 | 127 40.8 | 82 5 5 | 3760. | 1419 | 0.018 | 11.918 |
| G015A | 46 37.0 | 128 47.0 | 82 5 5 | 5231. | 2155 | 0.019 | 12.361 |
| G016A | 46 37.0 | 127 46.4 | 82 5 6 | 5471. | 255 | 0.016 | 10.906 |
| G017A | 46 37.0 | 126 49.0 | 82 5 6 | 5319. | 750 | 0.017 | 11.447 |
| G018A | 46 36.8 | 125 51.0 | 82 5 6 | 5129. | 1243 | 0.016 | 10.512 |
| G019A | 47 0.0 | 125 0.0 | 82 5 6 | 2194. | 1856 | 0.018 | 11.803 |
| G020A | 47 0.0 | 124 38.0 | 82 5 6 | 988. | 2115 | 0.018 | 11.736 |
| G021A | 46 59.0 | 124 16.3 | 82 5 6 | 755. | 2315 | 0.019 | 12.842 |
| G022A | 46 40.0 | 124 15.0 | 82 5 7 | 733. | 130 | 0.017 | 11.296 |
| G023A | 46 40.0 | 124 30.1 | 82 5 7 | 865. | 316 | 0.017 | 11.629 |
| G024A | 46 40.0 | 124 51.0 | 82 5 7 | 1680. | 540 | 0.017 | 11.389 |
| G025A | 46 20.0 | 124 54.0 | 82 5 7 | 2136. | 900 | 0.017 | 11.517 |
| G026A | 46 18.2 | 124 30.9 | 82 5 7 | 966. | 1205 | 0.016 | 10.887 |
| G027A | 46 19.5 | 124 10.7 | 82 5 7 | 722. | 1412 | 0.018 | 12.009 |
| G028A | 46 0.0 | 124 4.6 | 82 5 7 | 734. | 1716 | 0.017 | 11.405 |
| G029A | 46 0.0 | 124 25.5 | 82 5 7 | 973. | 1943 | 0.018 | 11.931 |
| G030A | 46 0.0 | 124 47.4 | 82 5 7 | 1806. | 2350 | 0.018 | 12.134 |
| G031A | 46 0.0 | 125 46.3 | 82 5 8 | 5132. | 715 | 0.017 | 11.594 |
| G032A | 46 0.0 | 126 45.1 | 82 5 8 | 5484. | 1300 | 0.018 | 12.261 |
| G033A | 46 0.0 | 127 45.0 | 82 5 8 | 5343. | 1940 | 0.019 | 12.895 |
| G034A | 45 59.9 | 128 42.7 | 82 5 9 | 5301. | 113 | 0.019 | 12.498 |
| G035A | 45 20.0 | 128 32.0 | 82 5 9 | 5255. | 645 | 0.020 | 13.012 |
| G036A | 45 19.6 | 127 36.8 | 82 5 9 | 5201. | 1205 | 0.017 | 11.156 |
| G037A | 45 20.0 | 126 41.0 | 82 5 9 | 5205. | 1705 | 0.017 | 11.117 |
| G038A | 45 20.0 | 125 45.0 | 82 5 9 | 5081. | 2207 | 0.018 | 11.725 |
| G039A | 45 40.0 | 124 46.5 | 82 510 | 2000. | 350 | 0.022 | 14.849 |
| G040A | 45 40.0 | 124 25.0 | 82 510 | 969. | 710 | 0.016 | 10.440 |
| G041A | 45 40.0 | 124 5.0 | 82 510 | 741. | 910 | 0.016 | 10.726 |
| G042A | 45 19.1 | 124 6.7 | 82 510 | 773. | 1140 | 0.018 | 12.017 |
| G043A | 45 19.9 | 124 26.0 | 82 510 | 974. | 1347 | 0.018 | 11.942 |
| G044A | 45 20.0 | 124 48.0 | 82 510 | 1845. | 1633 | 0.021 | 13.736 |
| G045A | 45 0.0 | 124 49.0 | 82 510 | 1974. | 2006 | 0.016 | 10.739 |
| G046A | 45 0.0 | 124 29.0 | 82 510 | 991. | 2205 | 0.017 | 11.567 |
| G047A | 44 59.2 | 124 7.3 | 82 511 | 724. | 17 | 0.020 | 13.079 |
| G048A | 44 40.0 | 124 12.0 | 82 511 | 761. | 228 | 0.018 | 11.998 |
| G049A | 44 40.0 | 124 32.0 | 82 511 | 987. | 433 | 0.019 | 12.876 |
| G050A | 44 20.0 | 124 55.0 | 82 511 | 2014. | 803 | 0.016 | 10.442 |
| G051A | 44 20.0 | 124 34.0 | 82 511 | 1004. | 1025 | 0.016 | 10.640 |
| G052A | 44 20.6 | 124 12.1 | 82 511 | 758. | 1245 | 0.019 | 12.842 |
| G053A | 44 40.0 | 124 53.0 | 82 511 | 1913. | 2254 | 0.018 | 12.266 |
| G054A | 44 40.0 | 125 49.0 | 82 512 | 5154. | 500 | 0.021 | 14.106 |
| G055A | 44 40.0 | 126 44.5 | 82 512 | 5304. | 1000 | 0.016 | 10.608 |
| G056A | 44 40.0 | 127 41.0 | 82 512 | 5326. | 1516 | 0.017 | 11.067 |
| G057A | 44 40.0 | 128 37.0 | 82 512 | 5167. | 2042 | 0.017 | 11.374 |
| G058A | 44 2.9 | 128 34.4 | 82 513 | 5634. | 140 | 0.019 | 12.689 |
| G059A | 44 0.0 | 127 40.5 | 82 513 | 5581. | 630 | 0.019 | 12.363 |
| G060A | 44 0.0 | 126 45.2 | 82 513 | 5560. | 1145 | 0.017 | 11.355 |
| G061A | 44 0.0 | 125 50.0 | 82 513 | 5481. | 1635 | 0.017 | 11.035 |
| G062A | 44 0.0 | 124 54.0 | 82 513 | 1761. | 2158 | 0.018 | 12.326 |
| G063A | 44 0.6 | 124 38.2 | 82 514 | 1001. | 46 | 0.018 | 11.968 |

Table 1.--Data associated with neuston tows during cruise 1P082, May-June 1982.

*"A" converts catch to catch per $10m^2$, "B" converts catch to catch per 1,000 $m^3$ (see Smith and Richardson 1977).

NEUSTON SUMMARY

| STATION | POSITION LAT. N. | LONG. W. | DATE YYMMDD | AREA KM2 | TIME GMT | STANDARD HAUL FACTORS* A | B |
|---|---|---|---|---|---|---|---|
| G064A | 43 59.1 | 124 15.1 | 82 514 | 869. | 326 | 0.018 | 11.873 |
| G065A | 43 40.0 | 124 20.0 | 82 514 | 747. | 557 | 0.018 | 12.036 |
| G066A | 43 40.0 | 124 37.0 | 82 514 | 953. | 750 | 0.020 | 13.037 |
| G067A | 43 40.0 | 124 57.0 | 82 514 | 1871. | 1015 | 0.020 | 13.105 |
| G068A | 43 18.6 | 124 29.8 | 82 514 | 788. | 2350 | 0.019 | 12.456 |
| G069A | 43 0.1 | 124 34.2 | 82 515 | 630. | 206 | 0.020 | 13.088 |
| G070A | 43 0.0 | 124 52.1 | 82 515 | 964. | 400 | 0.019 | 12.579 |
| G071A | 43 0.1 | 125 12.0 | 82 515 | 2122. | 610 | 0.021 | 14.281 |
| G072A | 43 20.0 | 125 9.0 | 82 515 | 2281. | 1001 | 0.018 | 11.685 |
| G073A | 43 19.6 | 124 49.2 | 82 515 | 972. | 1420 | 0.018 | 11.680 |
| G074A | 43 20.0 | 126 5.0 | 82 516 | 5401. | 640 | 0.019 | 12.599 |
| G075A | 43 20.2 | 126 59.4 | 82 516 | 5517. | 1158 | 0.022 | 14.430 |
| G076A | 43 20.0 | 127 56.5 | 82 516 | 5893. | 1800 | 0.023 | 15.036 |
| G077A | 43 20.0 | 128 55.8 | 82 516 | 6357. | 2347 | 0.017 | 11.343 |
| G078A | 42 40.0 | 128 55.0 | 82 517 | 5960. | 520 | 0.020 | 13.037 |
| G079A | 42 40.0 | 127 58.0 | 82 517 | 5610. | 1100 | 0.024 | 16.193 |
| G080A | 42 40.0 | 127 3.0 | 82 517 | 5630. | 1605 | 0.021 | 14.136 |
| G081A | 42 40.0 | 126 8.0 | 82 517 | 5575. | 2122 | 0.022 | 14.473 |
| G082A | 42 40.0 | 125 12.2 | 82 518 | 2024. | 244 | 0.021 | 13.771 |
| G083A | 42 40.0 | 124 51.0 | 82 518 | 973. | 800 | 0.020 | 13.352 |
| G084A | 42 40.0 | 124 34.5 | 82 518 | 626. | 2239 | 0.019 | 12.753 |
| G085A | 42 20.0 | 125 10.3 | 82 519 | 2098. | 255 | 0.022 | 14.545 |
| G086A | 42 20.0 | 124 49.4 | 82 519 | 943. | 528 | 0.021 | 14.117 |
| G087A | 42 20.0 | 124 32.0 | 82 519 | 724. | 820 | 0.023 | 15.166 |
| G088A | 42 0.4 | 124 23.6 | 82 519 | 707. | 1120 | 0.020 | 13.389 |
| G089A | 42 0.0 | 124 42.3 | 82 519 | 972. | 1350 | 0.020 | 13.570 |
| G090A | 42 0.0 | 125 3.0 | 82 520 | 2039. | 915 | 0.025 | 16.397 |
| G091A | 42 0.0 | 125 57.0 | 82 520 | 5227. | 1715 | 0.019 | 12.409 |
| G092A | 42 0.0 | 126 51.0 | 82 520 | 5413. | 2239 | 0.019 | 12.438 |
| G093A | 42 0.0 | 127 44.0 | 82 521 | 5381. | 400 | 0.021 | 13.689 |
| G094A | 42 0.0 | 128 37.0 | 82 521 | 5530. | 850 | 0.018 | 12.084 |
| G095A | 41 20.0 | 128 15.1 | 82 521 | 5226. | 1410 | 0.018 | 12.236 |
| G096A | 41 20.0 | 127 23.0 | 82 521 | 5128. | 2017 | 0.020 | 13.002 |
| G097A | 41 20.0 | 126 32.0 | 82 522 | 5098. | 120 | 0.021 | 13.902 |
| G098A | 41 20.0 | 125 42.5 | 82 522 | 4773. | 630 | 0.018 | 12.298 |
| G099A | 41 39.9 | 124 55.0 | 82 522 | 1872. | 1320 | 0.016 | 10.343 |
| G100A | 41 40.0 | 124 35.2 | 82 522 | 946. | 1530 | 0.022 | 14.569 |
| G101A | 41 40.0 | 124 17.0 | 82 522 | 739. | 2045 | 0.021 | 13.880 |
| G102A | 41 20.3 | 124 16.8 | 82 524 | 742. | 1400 | 0.021 | 13.789 |
| G103A | 41 20.0 | 124 32.0 | 82 524 | 854. | 2205 | 0.022 | 14.505 |
| G104A | 41 20.0 | 124 51.0 | 82 528 | 1596. | 1230 | 0.023 | 15.088 |
| G105A | 41 0.0 | 124 55.5 | 82 528 | 2019. | 1600 | 0.021 | 13.891 |
| G106A | 41 0.0 | 124 34.0 | 82 528 | 1065. | 1815 | 0.023 | 15.010 |
| G107A | 40 59.7 | 124 14.1 | 82 529 | 668. | 110 | 0.020 | 13.382 |
| G108A | 40 40.0 | 124 27.0 | 82 529 | 925. | 400 | 0.019 | 12.659 |
| G109A | 40 40.0 | 124 46.0 | 82 529 | 1021. | 631 | 0.019 | 12.977 |
| G110A | 40 40.0 | 125 6.5 | 82 529 | 1999. | 1010 | 0.022 | 14.610 |
| G111A | 40 40.0 | 125 56.7 | 82 529 | 5223. | 1640 | 0.022 | 14.642 |
| G112A | 40 40.0 | 126 48.0 | 82 529 | 5322. | 2158 | 0.020 | 13.539 |
| G113A | 40 40.0 | 127 39.0 | 82 530 | 5272. | 445 | 0.021 | 13.822 |
| G114A | 40 40.0 | 128 30.0 | 82 530 | 5061. | 1000 | 0.019 | 12.450 |
| G115A | 40 0.0 | 128 13.0 | 82 530 | 5194. | 1530 | 0.023 | 15.466 |
| G116A | 40 0.0 | 127 23.0 | 82 530 | 5251. | 2035 | 0.018 | 12.098 |
| G117A | 40 0.0 | 126 32.3 | 82 531 | 5323. | 200 | 0.019 | 12.537 |
| G118A | 40 0.0 | 125 40.0 | 82 531 | 3928. | 710 | 0.017 | 11.622 |
| G119A | 40 20.0 | 125 13.0 | 82 531 | 2106. | 1050 | 0.018 | 11.855 |
| G120A | 40 20.1 | 124 52.1 | 82 531 | 1046. | 1255 | 0.015 | 10.254 |
| G121A | 40 20.0 | 124 32.0 | 82 531 | 997. | 2150 | 0.018 | 12.046 |
| G122A | 40 0.0 | 124 11.0 | 82 6 1 | 910. | 405 | 0.018 | 11.816 |
| G123A | 40 0.0 | 124 31.0 | 82 6 1 | 1029. | 710 | 0.019 | 12.848 |
| G124A | 40 0.0 | 124 50.5 | 82 6 1 | 1480. | 945 | 0.020 | 13.063 |

*"A" converts catch to catch per $10m^2$, "B" converts catch to catch per 1,000 $m^3$ (see Smith and Richardson 1977).

Table 1.--Data associated with neuston tows during cruise 1P082, May-June 1982.

1P082 BONGO SUMMARY

| STATION | POSITION LAT. N. | LONG. W. | DATE YYMMDD | AREA KM2 | TIME GMT | STANDARD HAUL FACTORS* A | D |
|---|---|---|---|---|---|---|---|
| G001A | 47 59.6 | 124 50.1 | 82 5 3 | 1829. | 1145 | 6.485 | 12.236 |
| G002A | 47 59.7 | 125 13.2 | 82 5 3 | 1780. | 1426 | 5.852 | 3.526 |
| G003A | 48 2.5 | 125 28.6 | 82 5 3 | 2124. | 1733 | 6.673 | 4.700 |
| G004A | 48 1.3 | 125 52.1 | 82 5 3 | 3036. | 2110 | 7.268 | 3.304 |
| G005A | 48 0.1 | 126 14.2 | 82 5 4 | 9048. | 13 | 6.128 | 2.946 |
| G006A | 47 19.7 | 124 25.8 | 82 5 4 | 1507. | 1430 | 5.698 | 24.774 |
| G007A | 47 20.2 | 124 44.4 | 82 5 4 | 1895. | 1652 | 5.799 | 4.496 |
| G008A | 47 20.1 | 125 5.9 | 82 5 4 | 7573. | 2315 | 6.037 | 2.959 |
| G009A | 47 20.0 | 127 42.3 | 82 5 5 | 23813. | 1435 | 6.886 | 3.173 |
| G010A | 46 40.0 | 124 15.9 | 82 5 7 | 1354. | 149 | 2.559 | 14.217 |
| G011A | 46 40.4 | 124 31.5 | 82 5 7 | 1664. | 335 | 6.229 | 6.291 |
| G012A | 46 40.0 | 124 53.2 | 82 5 7 | 6739. | 555 | 6.889 | 3.189 |
| G013A | 46 0.0 | 124 5.5 | 82 5 7 | 1526. | 1734 | 2.894 | 8.267 |
| G014A | 46 0.2 | 124 26.4 | 82 5 7 | 2114. | 2002 | 5.053 | 4.043 |
| G015A | 46 0.5 | 124 48.5 | 82 5 8 | 6680. | 5 | 5.804 | 2.887 |
| G016A | 46 0.6 | 126 45.9 | 82 5 8 | 24986. | 1317 | 6.144 | 3.057 |
| G017A | 46 0.2 | 128 43.0 | 82 5 9 | 23476. | 129 | 6.252 | 2.935 |
| G018A | 45 19.0 | 124 7.6 | 82 510 | 1670. | 1150 | 4.536 | 6.048 |
| G019A | 45 20.2 | 124 26.6 | 82 510 | 2064. | 1405 | 7.533 | 3.233 |
| G020A | 45 20.6 | 124 48.8 | 82 510 | 7754. | 1649 | 7.226 | 3.330 |
| G021A | 44 41.0 | 124 11.9 | 82 511 | 1667. | 244 | 2.968 | 8.994 |
| G022A | 44 40.0 | 124 32.1 | 82 511 | 2081. | 450 | 5.138 | 4.587 |
| G023A | 44 40.8 | 124 53.2 | 82 511 | 10018. | 2315 | 6.799 | 3.383 |
| G024A | 44 40.8 | 127 42.0 | 82 512 | 29260. | 1531 | 6.246 | 3.092 |
| G025A | 43 59.8 | 124 53.3 | 82 513 | 7559. | 2215 | 5.627 | 8.445 |
| G026A | 44 1.5 | 124 33.8 | 82 514 | 1905. | 130 | 6.909 | 5.356 |
| G027A | 43 57.6 | 124 16.3 | 82 514 | 1548. | 345 | 5.559 | 7.412 |
| G028A | 43 19.0 | 124 31.0 | 82 515 | 1446. | 5 | 4.156 | 7.841 |
| G029A | 43 20.0 | 125 9.6 | 82 515 | 7911. | 1034 | 7.265 | 3.527 |
| G030A | 43 19.3 | 124 46.8 | 82 515 | 2064. | 1450 | 8.431 | 3.498 |
| G031A | 43 20.0 | 127 0.7 | 82 516 | 23197. | 1215 | 6.437 | 3.155 |
| G032A | 42 40.7 | 125 12.6 | 82 518 | 7410. | 258 | 6.995 | 3.109 |
| G033A | 42 40.1 | 124 51.2 | 82 518 | 1883. | 2041 | 7.834 | 3.251 |
| G034A | 42 40.4 | 124 35.0 | 82 518 | 1301. | 2255 | 5.529 | 6.826 |
| G035A | 42 0.8 | 124 23.8 | 82 519 | 1386. | 1133 | 5.012 | 8.793 |
| G036A | 42 1.3 | 124 42.2 | 82 519 | 2068. | 1400 | 5.926 | 2.919 |
| G037A | 42 0.8 | 125 3.3 | 82 520 | 7249. | 1005 | 7.469 | 3.048 |
| G038A | 42 1.9 | 126 53.0 | 82 520 | 20559. | 2257 | 8.073 | 3.204 |
| G039A | 41 21.6 | 128 16.3 | 82 521 | 17814. | 1430 | 6.059 | 2.669 |
| G040A | 41 18.9 | 124 16.6 | 82 524 | 1766. | 1420 | 6.836 | 8.545 |
| G041A | 41 20.0 | 124 32.0 | 82 528 | 1958. | 905 | 6.925 | 2.861 |
| G042A | 41 20.4 | 124 51.1 | 82 528 | 6800. | 1245 | 7.243 | 2.874 |
| G043A | 40 40.5 | 124 27.4 | 82 529 | 1896. | 417 | 5.496 | 9.642 |
| G044A | 40 40.5 | 124 46.2 | 82 529 | 2174. | 705 | 7.366 | 3.031 |
| G045A | 40 40.5 | 125 6.8 | 82 529 | 9047. | 1030 | 7.272 | 2.956 |
| G046A | 40 40.5 | 126 48.4 | 82 529 | 22268. | 2209 | 6.834 | 3.121 |
| G047A | 40 0.5 | 124 12.3 | 82 6 1 | 1759. | 425 | 6.766 | 2.981 |
| G048A | 39 59.8 | 124 32.5 | 82 6 1 | 2239. | 725 | 7.159 | 3.168 |
| G049A | 39 59.9 | 124 51.4 | 82 6 1 | 6357. | 1000 | 8.494 | 3.453 |

*"A" converts catch to catch per $10m^2$, "B" converts catch to catch per 1,000 $m^3$ (see Smith and Richardson 1977).

Table 2.--Data associated with bongo tows during cruise 1P082, May-June 1982.

STAGE: EGG

| SPECIES | BONGO OCCUR. % | BONGO LOG NO. IN AREA |
|---|---|---|
| UNIDENTIFIED | 10.20 | 10.7696 |
| DISINTEGRATED | 8.16 | 10.4210 |
| BATHYLAGIDAE | 12.24 | 11.0533 |
| BATHYLAGUS SPP. | 16.33 | 10.8401 |
| CHAULIODUS MACOUNI | 18.37 | 11.0877 |
| MYCTOPHIDAE | 10.20 | 12.9621 |
| THERAGRA CHALCOGRAMMA | 2.04 | 8.6449 |
| PLEURONECTIDAE | 14.29 | 10.2159 |
| GLYPTOCEPHALUS ZACHIRUS | 51.02 | 11.3267 |
| ISOPSETTA ISOLEPIS | 4.08 | 9.4873 |
| LYOPSETTA EXILIS | 59.18 | 11.7341 |
| MICROSTOMUS PACIFICUS | 36.73 | 11.3497 |
| PAROPHRYS VETULUS | 2.04 | 8.6449 |
| PSETTICHTHYS MELANOSTICTUS | 8.16 | 9.7333 |
| CITHARICHTHYS SPP. | 12.24 | 10.3319 |
| ICICHTHYS LOCKINGTONI | 24.49 | 11.5644 |
| NANSENIA CANDIDA | 2.04 | 10.1824 |
| ARGENTINA SIALIS | 2.04 | 10.0331 |
| SEBASTOLOBUS SPP. | 2.04 | 9.6440 |
| ICOSTEUS AENIGMATICUS | 10.20 | 11.1207 |
| TRACHIPTERUS ALTIVELIS | 28.57 | 11.4475 |
| BOTHIDAE | 32.65 | 11.8855 |
| NANSENIA CRASSA | 2.04 | 9.7485 |

STAGE: JUVENILE

| SPECIES | NEUSTON OCCUR. % | NEUSTON LOG NO. IN AREA | DONGO OCCUR. % | DONGO LOG NO. IN AREA |
|---|---|---|---|---|
| STENODRACHIUS LEUCOPSARUS | | | 8.16 | 10.5117 |
| TARLETONBEANIA CRENULARIS | 17.74 | 9.0625 | | |
| SEBASTES SPP. | 6.45 | 8.0614 | | |
| HEXAGRAMMOS DECAGRAMMUS | 1.61 | 6.5065 | | |
| AGONIDAE | | | 2.04 | 9.6668 |
| AMMODYTES HEXAPTERUS | | | 2.04 | 9.3752 |
| SYMBOLOPHORUS CALIFORNIENSE | 2.42 | 7.8409 | | |

Table 3.--Fish eggs (top, bongo only) and juvenile fish (bottom) collected in bongo and neuston tows during cruise 1P082, May-June 1982.

STAGE: LARVAE

| SPECIES | NEUSTON OCCUR. % | NEUSTON LOG NO. IN AREA | BONGO OCCUR. % | BONGO LOG NO. IN AREA |
|---|---|---|---|---|
| UNIDENTIFIED | 0.81 | 6.2547 | 2.04 | 9.7485 |
| DISINTEGRATED | 5.65 | 7.4047 | 16.33 | 10.8910 |
| OSMERIDAE | 0.81 | 6.8587 | 12.24 | 10.4661 |
| BATHYLAGUS PACIFICUS | | | 20.41 | 11.1010 |
| CHAULIODUS MACOUNI | | | 12.24 | 10.7979 |
| MYCTOPHIDAE | 0.81 | 6.2983 | 4.08 | 12.0070 |
| DIAPHUS THETA | | | 14.29 | 12.8734 |
| STENOBRACHIUS LEUCOPSARUS | | | 61.22 | 12.8302 |
| TARLETONBEANIA CRENULARIS | 0.81 | 6.4631 | 32.65 | 11.3984 |
| PROTOMYCTOPHUM CROCKERI | | | 22.45 | 11.3987 |
| PROTOMYCTOPHUM THOMPSONI | | | 8.16 | 10.8209 |
| GADUS MACROCEPHALUS | | | 4.08 | 9.7068 |
| MICROGADUS PROXIMUS | 0.81 | 6.1785 | 4.08 | 9.6117 |
| THERAGRA CHALCOGRAMMA | | | 2.04 | 8.5395 |
| SEBASTES SPP. | 22.58 | 8.9325 | 57.14 | 12.0113 |
| HEXAGRAMMOS DECAGRAMMUS | 14.52 | 8.0718 | | |
| OPHIODON ELONGATUS | 6.45 | 7.6334 | | |
| PLEUROGRAMMUS MONOPTERYGIUS | 1.61 | 7.0983 | | |
| ANOPLOPOMA FIMBRIA | 22.58 | 8.6807 | | |
| ARTEDIUS HARRINGTONI | | | 10.20 | 9.7359 |
| LEPTOCOTTUS ARMATUS | 0.81 | 6.4653 | | |
| RADULINUS ASPRELLUS | | | 4.08 | 9.1321 |
| AGONIDAE | 0.81 | 6.2579 | 4.08 | 9.5153 |
| CYCLOPTERIDAE | | | 18.37 | 10.6601 |
| DATHYMASTER SPP. | | | 2.04 | 9.6601 |
| RONQUILUS JORDANI | 7.26 | 8.0831 | 6.12 | 10.0199 |
| STICHAEIDAE | | | 4.08 | 9.4635 |
| AMMODYTES HEXAPTERUS | 7.26 | 7.8830 | 2.04 | 9.0178 |
| CITHARICHTHYS STIGMAEUS | 2.42 | 7.0311 | 2.04 | 9.7335 |
| GLYPTOCEPHALUS ZACHIRUS | | | 10.20 | 10.8988 |
| HIPPOGLOSSOIDES ELASSODON | | | 4.08 | 9.2256 |
| ISOPSETTA ISOLEPIS | | | 20.41 | 10.5437 |
| LYOPSETTA EXILIS | | | 51.02 | 11.1538 |
| MICROSTOMUS PACIFICUS | | | 4.08 | 10.3143 |
| PAROPHRYS VETULUS | 1.61 | 6.4394 | 6.12 | 9.5970 |
| PLATICHTHYS STELLATUS | 0.81 | 6.0940 | 2.04 | 8.9339 |
| PSETTICHTHYS MELANOSTICTUS | 0.81 | 6.0940 | 6.12 | 9.6857 |
| SCORPAENIDAE | | | 2.04 | 10.1824 |
| BATHYLAGUS OCHOTENSIS | 2.42 | 7.7273 | 53.06 | 11.7555 |
| MELAMPHAEIDAE | | | 4.08 | 9.9348 |
| SCORPAENICHTHYS MARMORATUS | 9.68 | 7.8605 | | |
| ICICHTHYS LOCKINGTONI | | | 6.12 | 10.6332 |
| LAMPANYCTUS RITTERI | | | 6.12 | 10.5948 |
| LAMPANYCTUS SPP. | | | 6.12 | 10.6289 |
| HEMILEPIDOTUS SPINOSUS | 13.71 | 8.7917 | | |
| SEBASTOLOBUS SPP. | | | 4.08 | 9.8848 |
| TRACHIPTERUS ALTIVELIS | | | 2.04 | 10.1824 |
| COLOLABIS SAIRA | 11.29 | 8.5244 | | |
| LESTIDIOPS RINGENS | | | 6.12 | 10.9400 |
| ARGYROPELECUS SPP. | | | 4.08 | 10.3173 |
| CYCLOTHONE SPP. | | | 2.04 | 9.7335 |
| LEUROGLOSSUS STILBIUS | | | 2.04 | 9.7335 |
| ARTEDIUS MEANYI | | | 4.08 | 9.3378 |
| MELAMPHAES SPP. | | | 2.04 | 10.0331 |
| PARICELINUS HOPLITICUS | | | 4.08 | 10.5072 |
| BATHRAGONUS SWANI | | | 2.04 | 9.1193 |
| CHITONOTUS PUGETENSIS | | | 2.04 | 9.1193 |
| COTTUS ASPER | 0.81 | 6.2065 | | |

Table 4.--Fish larvae collected in bongo and neuston tows during cruise 1P082, May-June 1982.

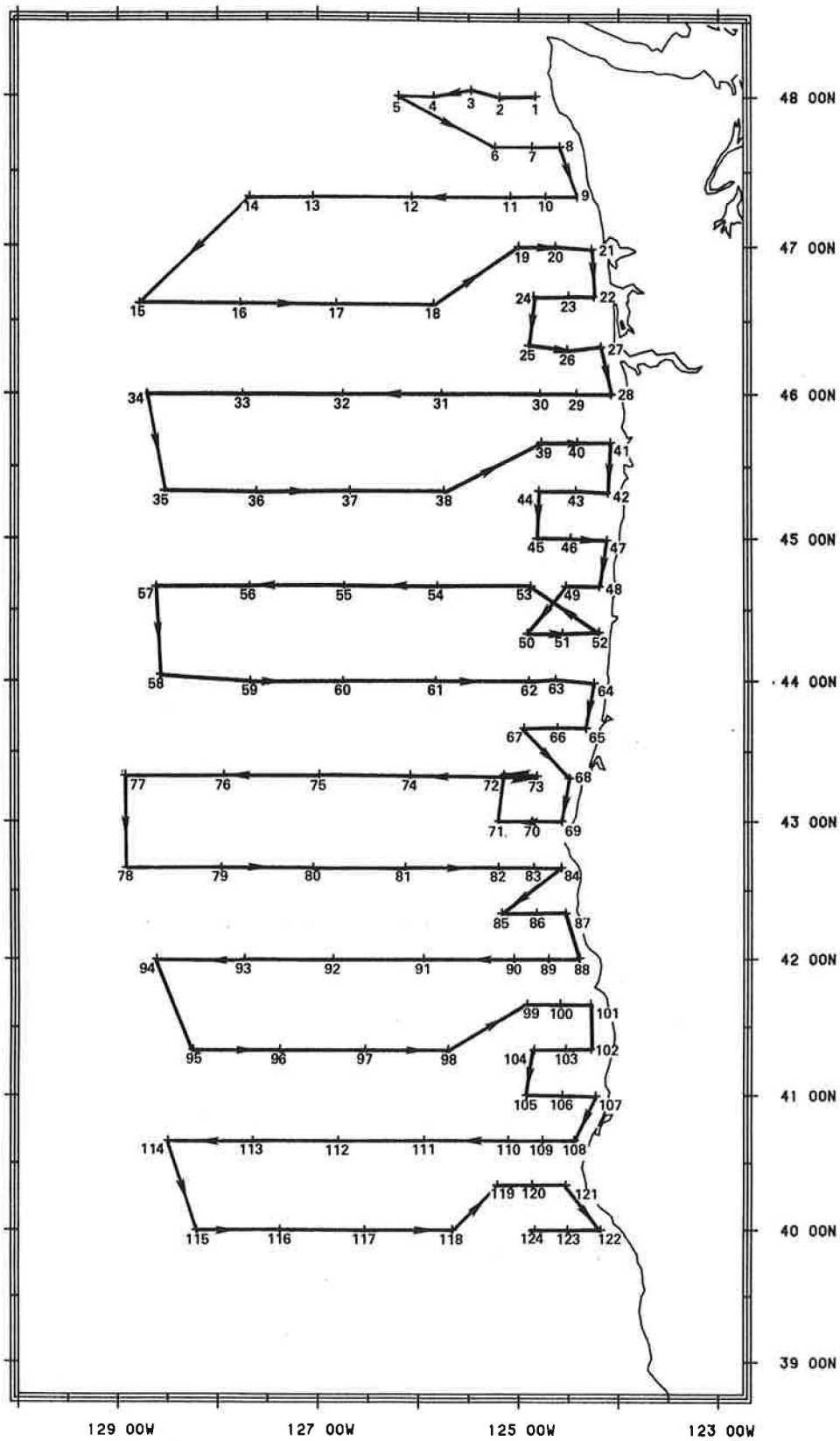


Figure 1.--Neuston station locations and cruise track for cruise 1P082, May-June 1982.

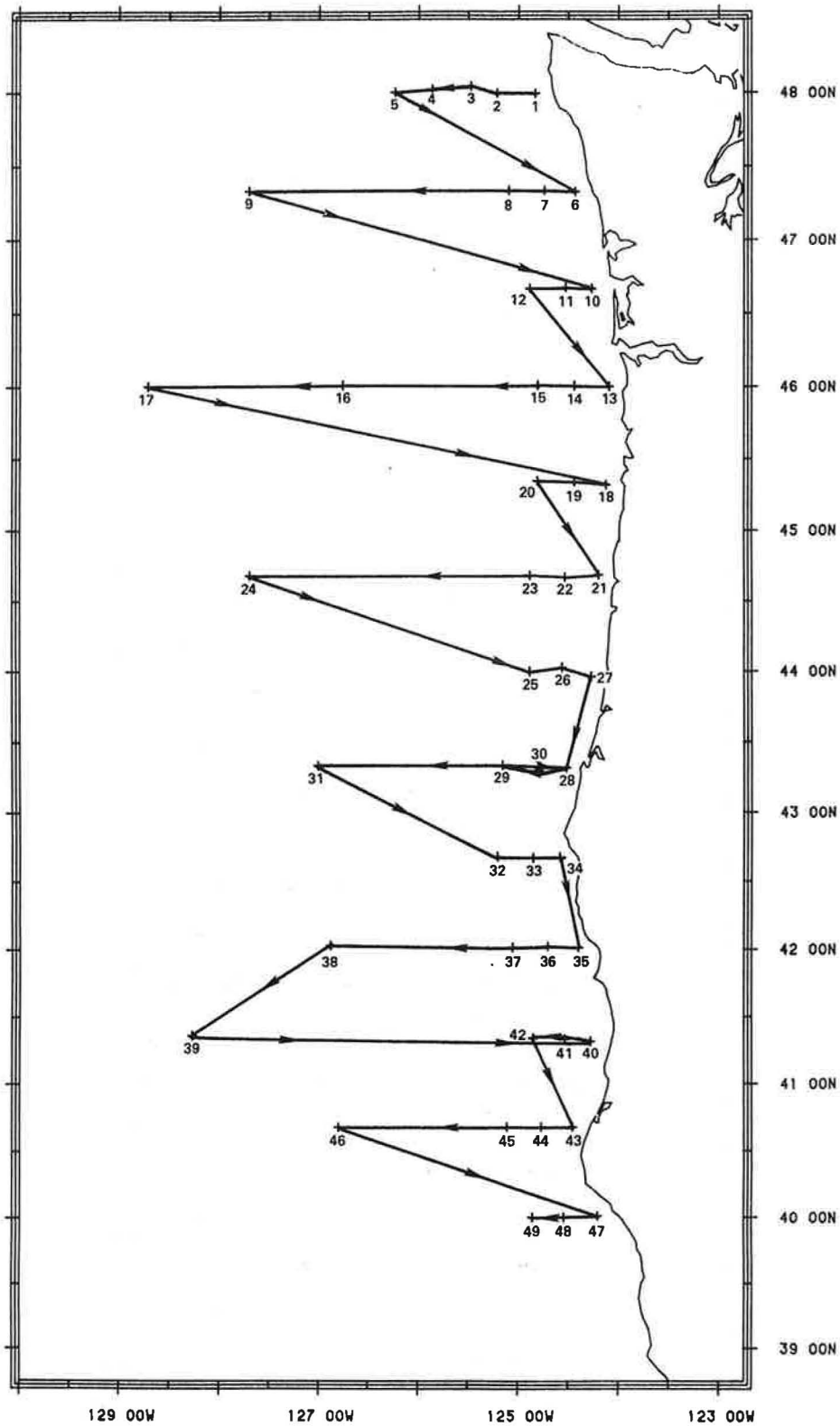


Figure 2.--Bongo station locations and cruise track for cruise 1P082, May-June 1982.

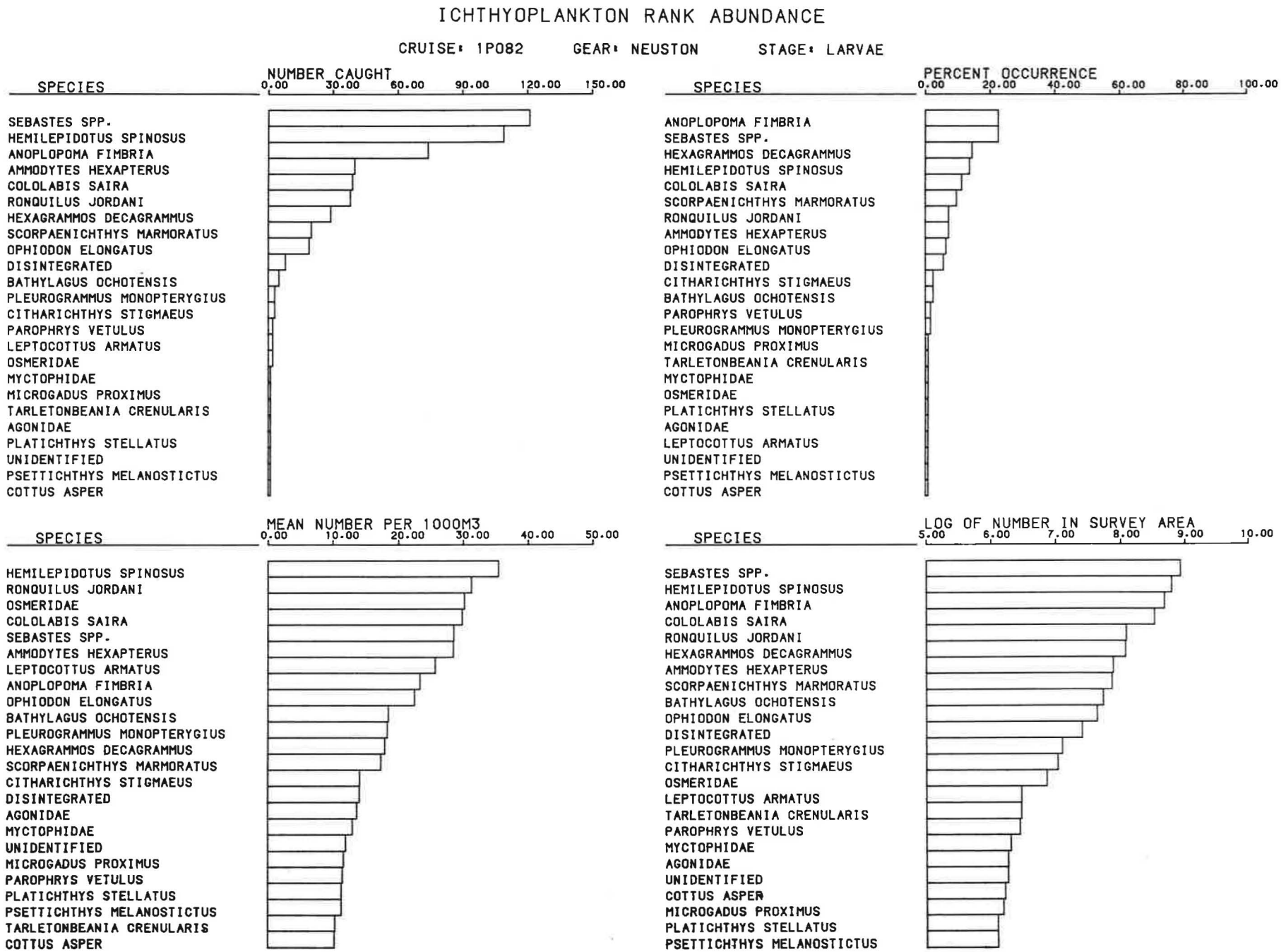


Figure 3.--Rank abundance of fish larvae caught in neuston tows during cruise 1P082, May-June 1982.

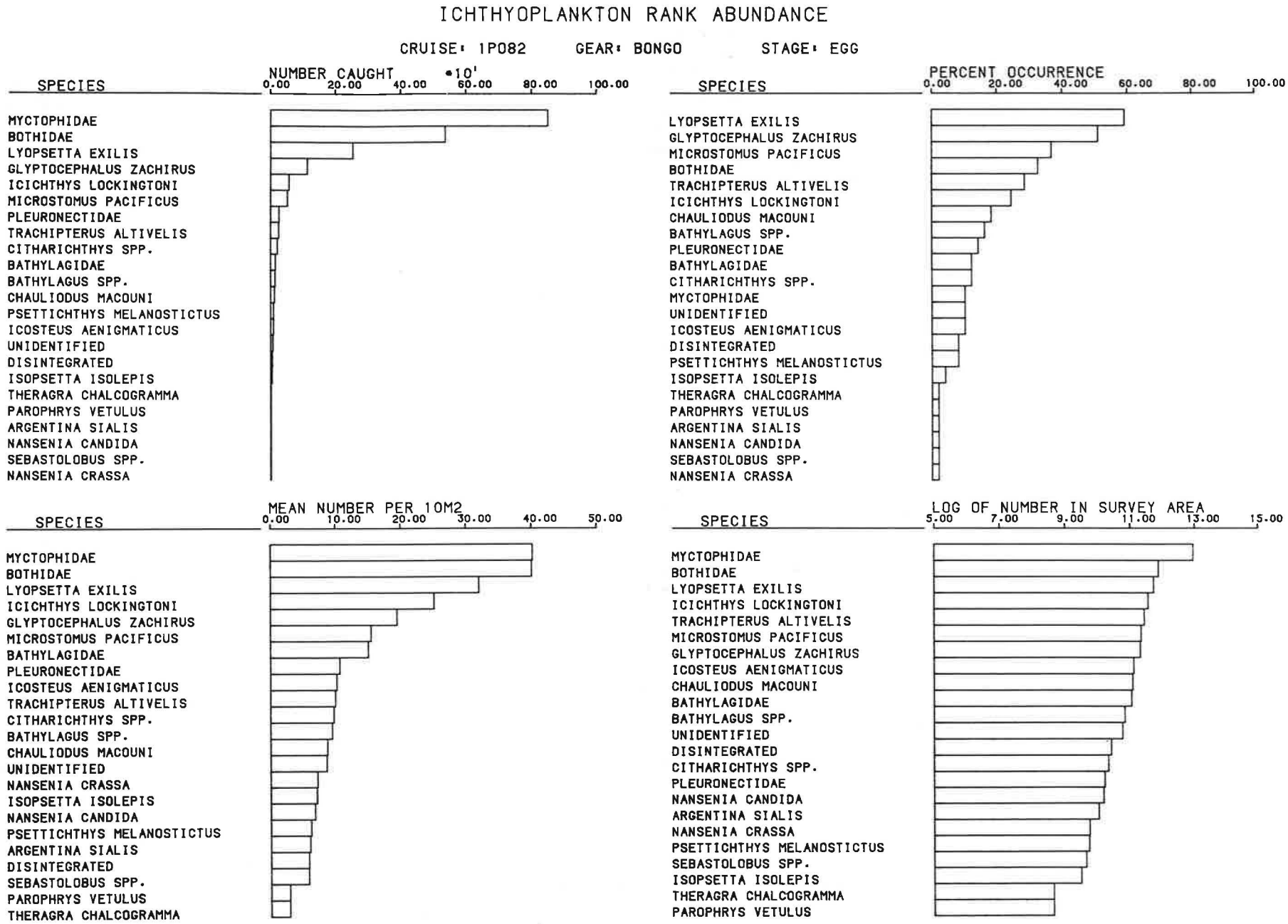


Figure 4.--Rank abundance of fish eggs caught in bongo tows during cruise 1P082, May-June 1982.

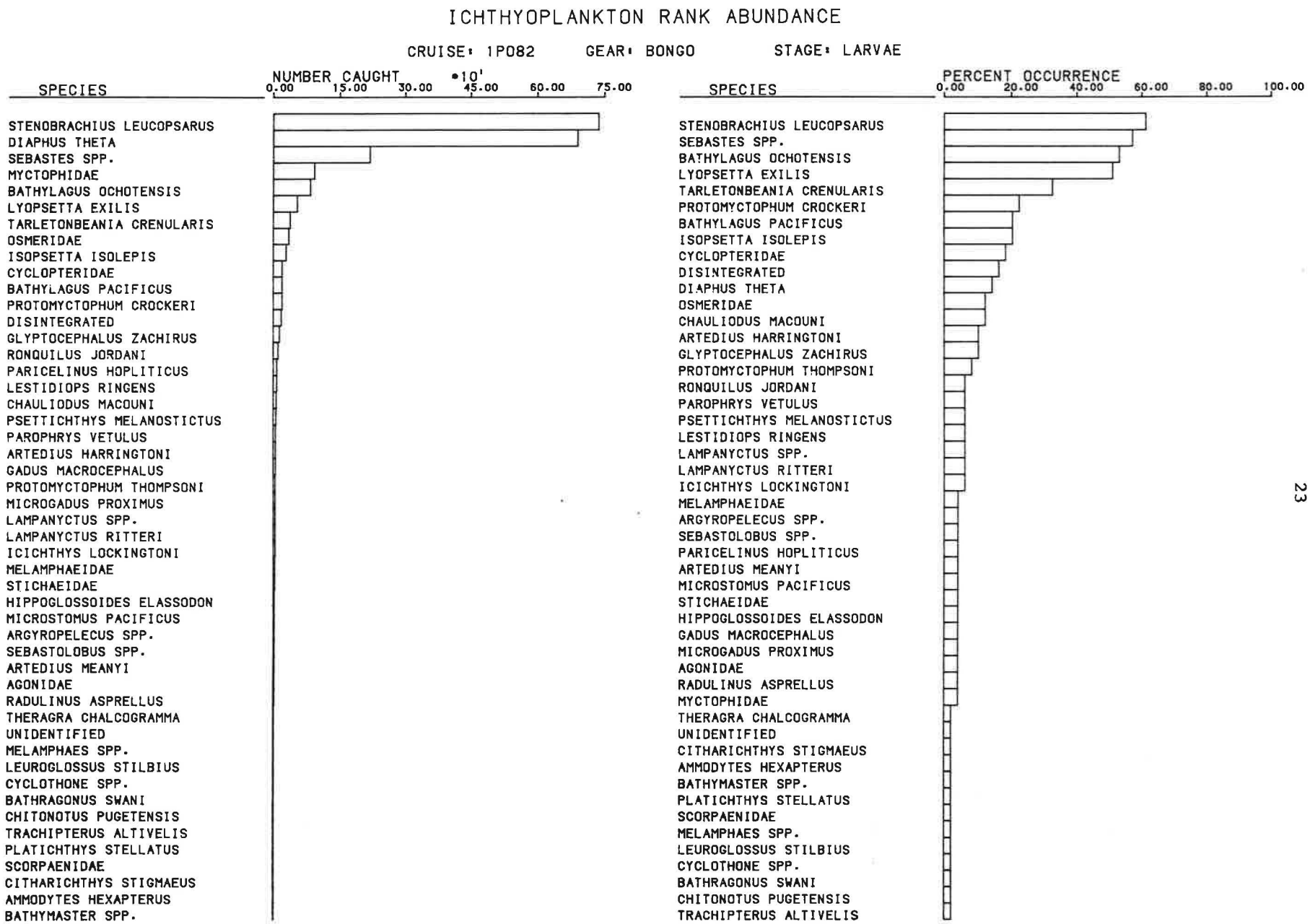


Figure 5.--Rank abundance of fish larvae caught in bongo tows during cruise 1P082, May-June 1982.

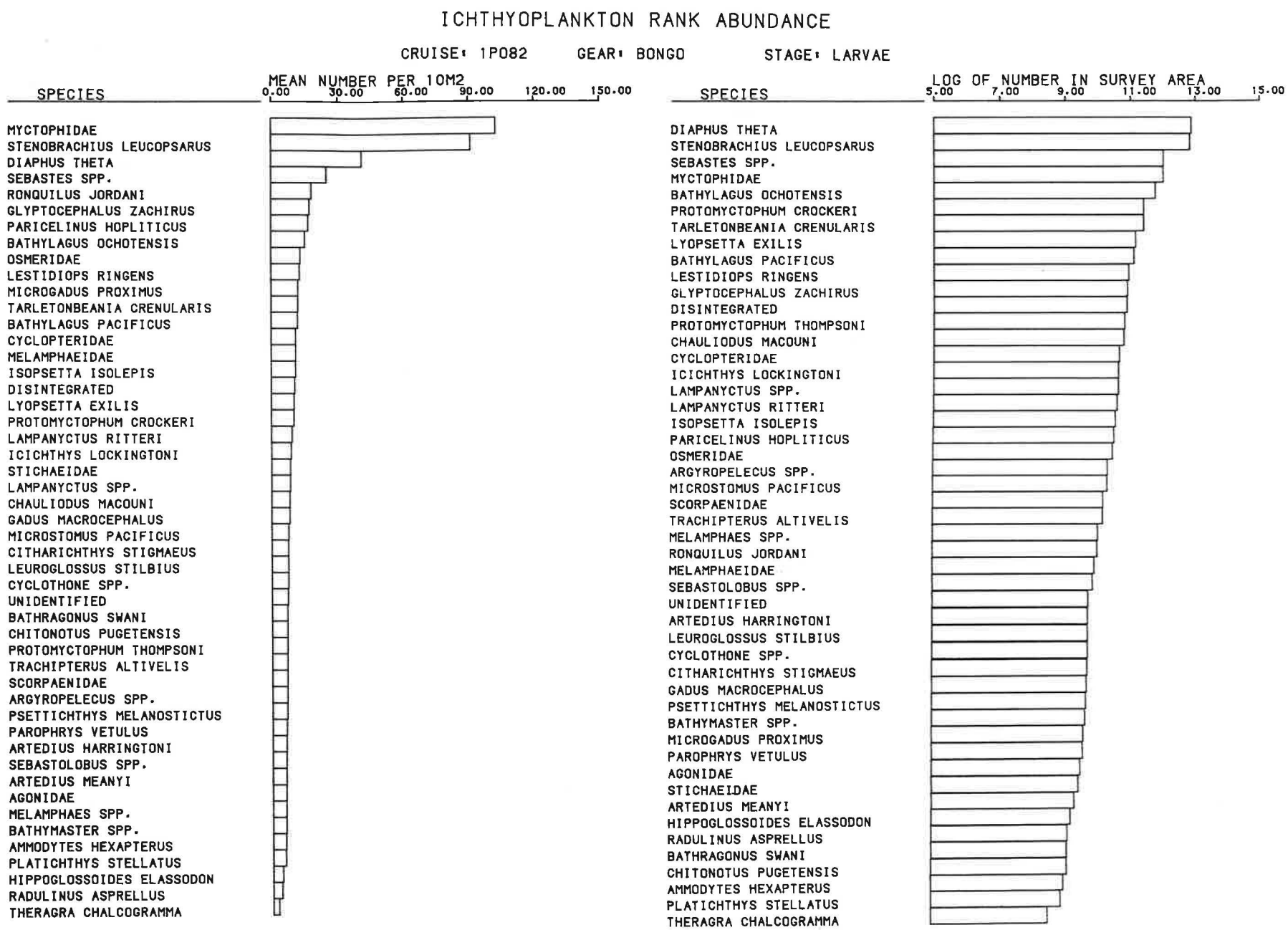


Figure 5.--Rank abundance of fish larvae caught in bongo tows during cruise 1P082, May-June 1982.

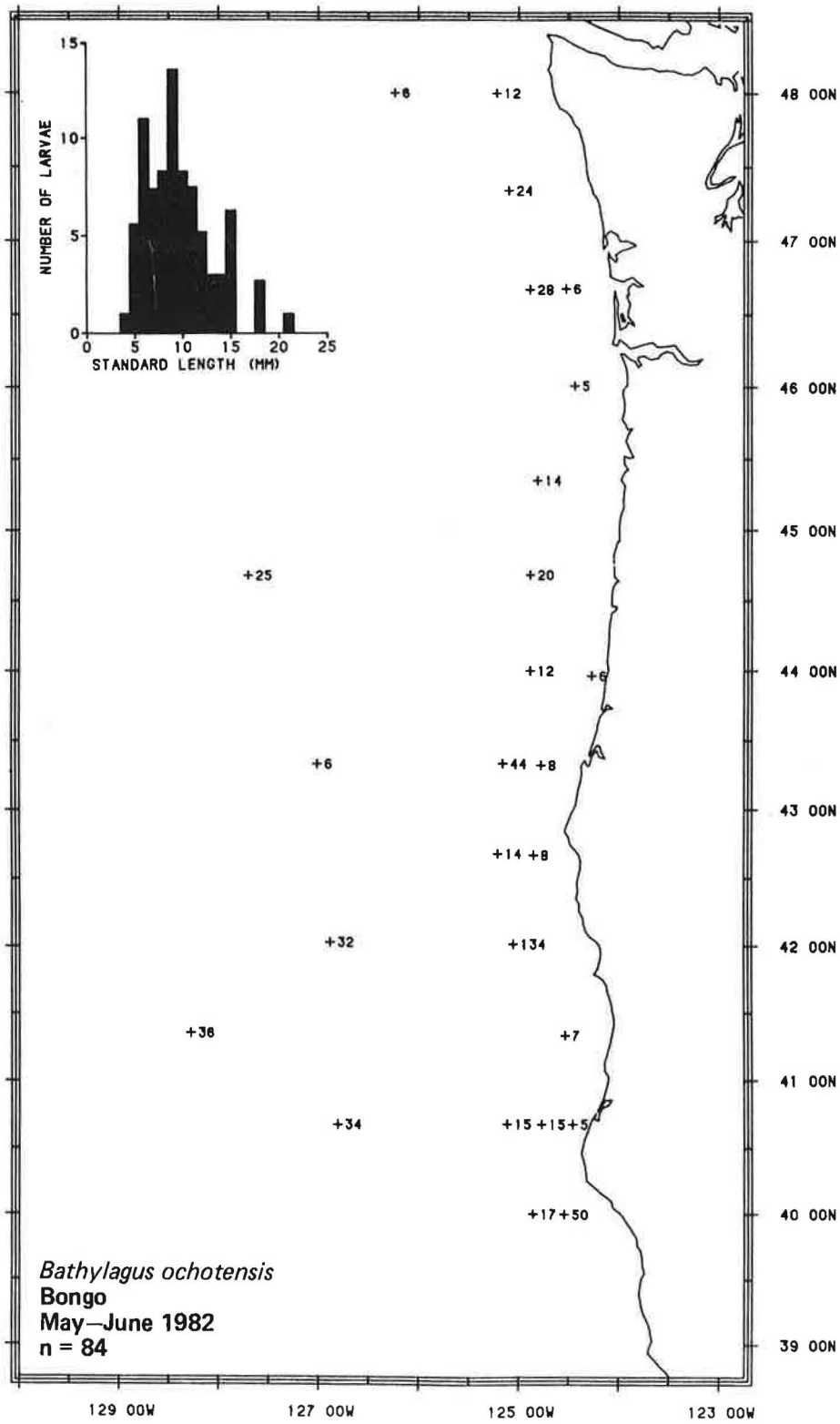


Figure 6.--Distribution and length of Bathylagus ochotensis from bongo tows during cruise 1P082, May-June 1982. Abundance expressed as numbers per 10 $m^2$.

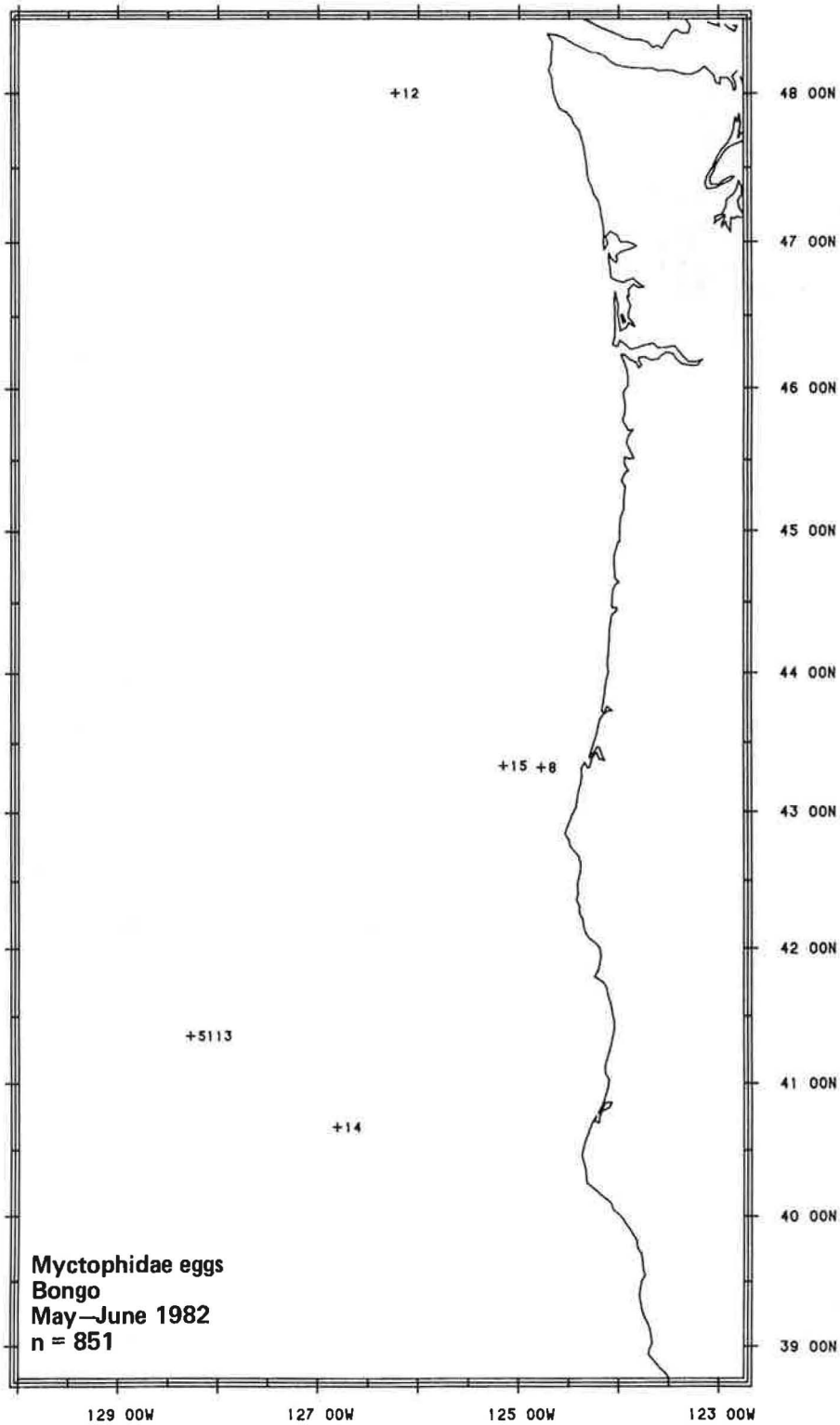


Figure 7.--Distribution of Myctophidae eggs from bongo tows during cruise 1P082, May-June 1982. Abundance expressed as numbers per 10 $m^2$.

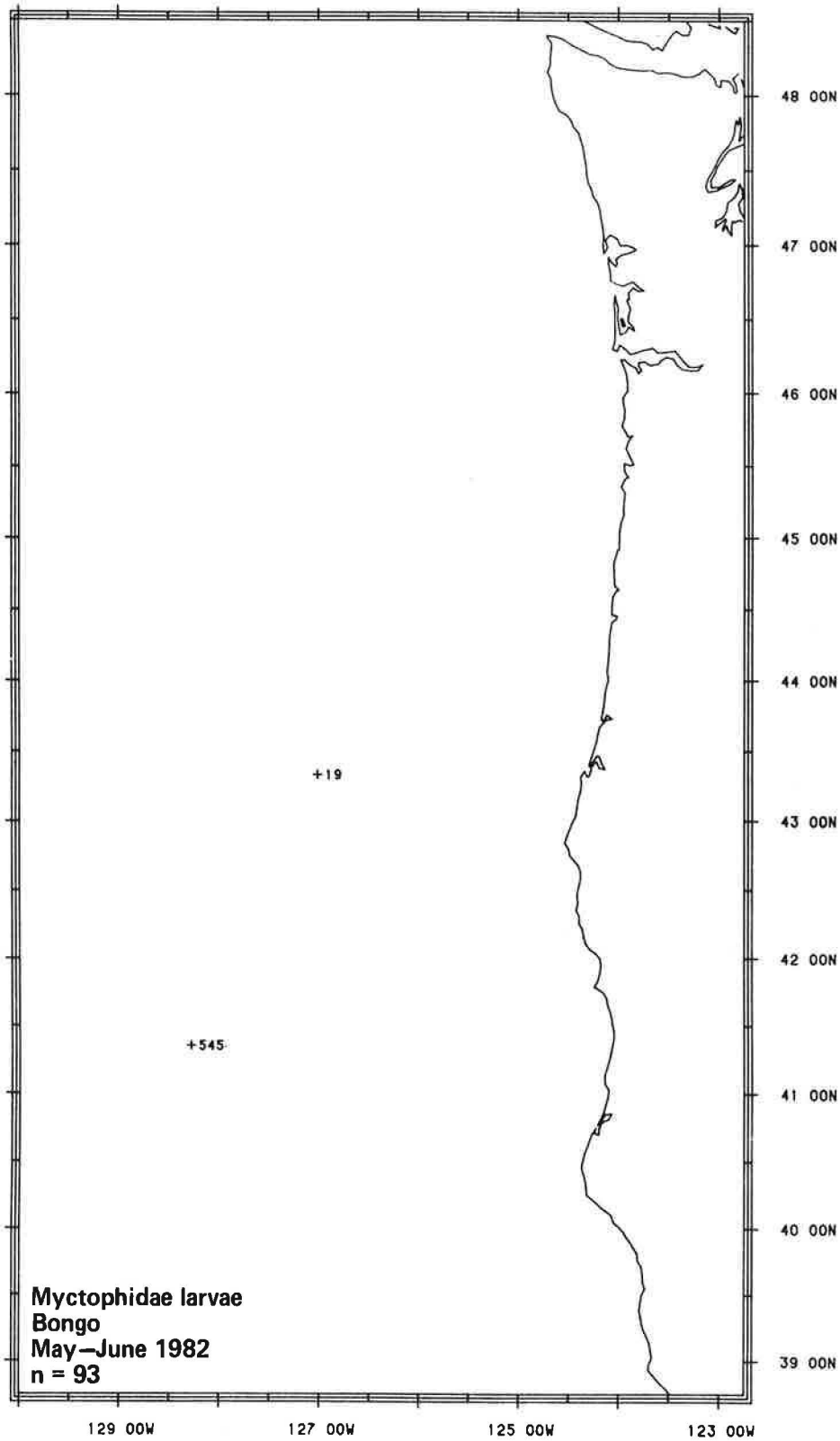


Figure 8.--Distribution and lengths of Myctophidae larvae from bongo tows during cruise 1P082, May-June 1982. Abundance expressed as numbers per 10 $m^2$.

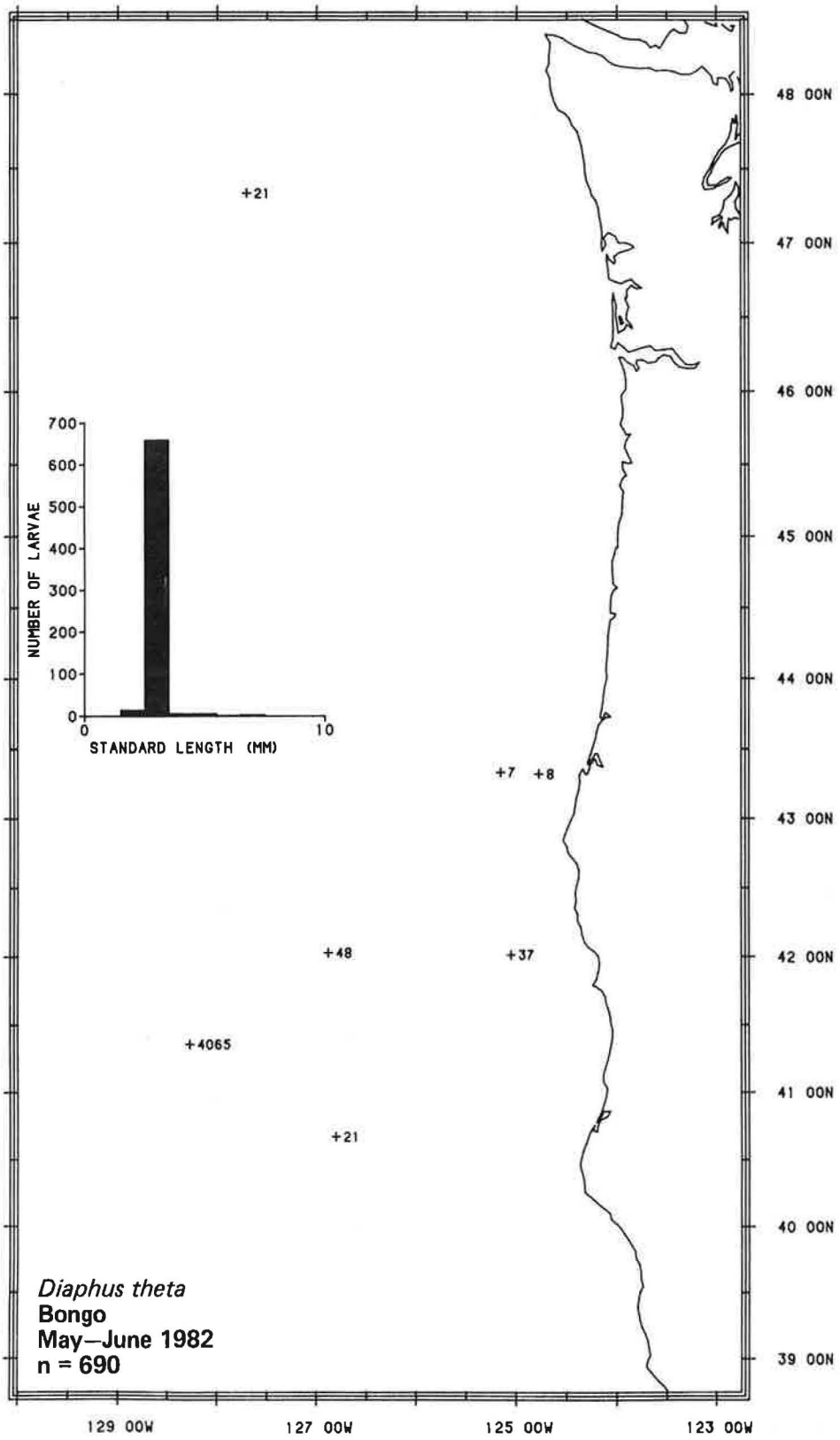


Figure 9.--Distribution and lengths of Diaphus theta larvae from bongo tows during cruise 1P082, May-June 1982. Abundance expressed as numbers per 10 $m^2$.

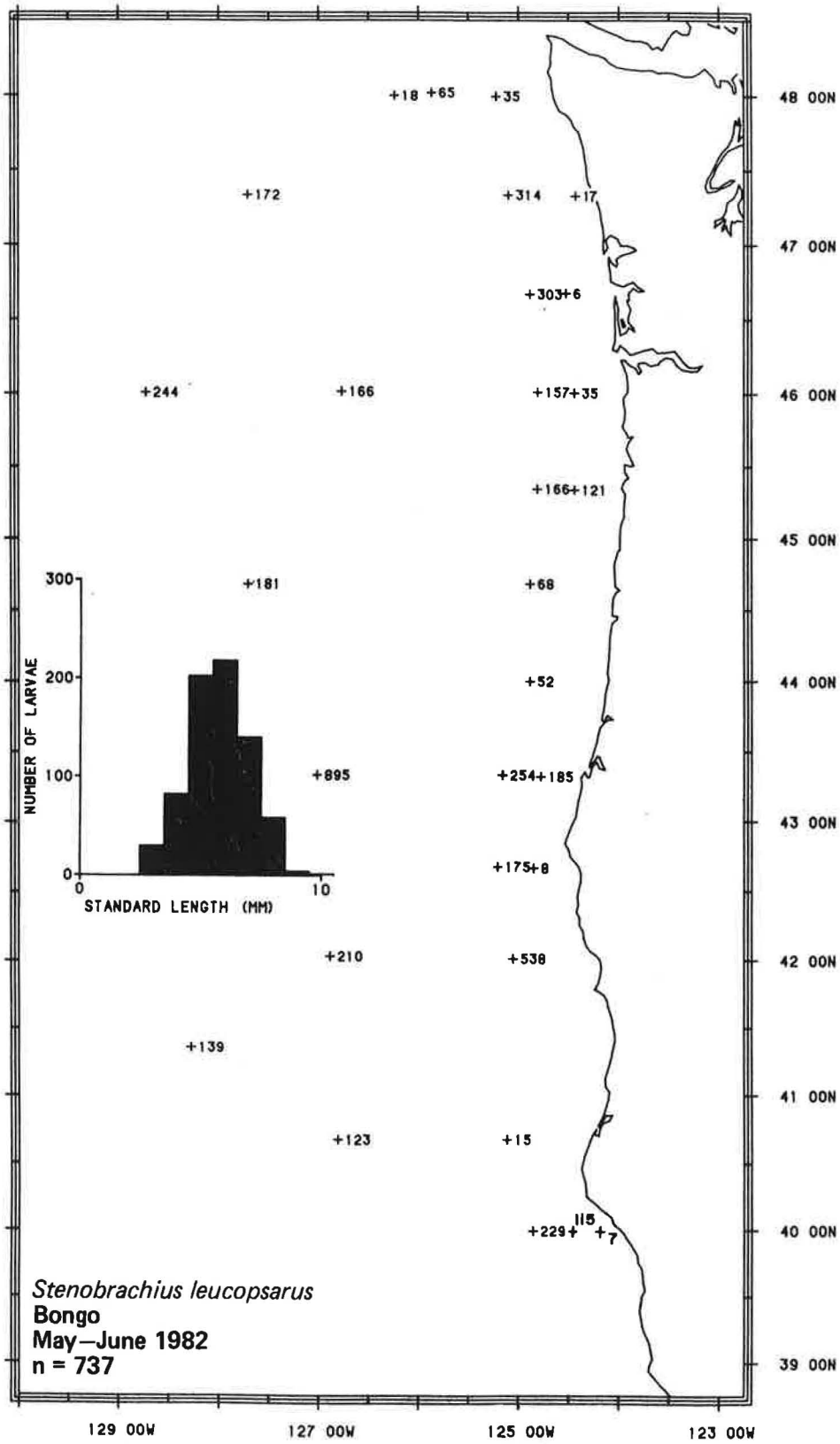


Figure 10.--Distribution and lengths of Stenobrachius leucopsarus from bongo tows during cruise 1P082, May-June 1982. Abundance expressed as numbers per 10 $m^2$.

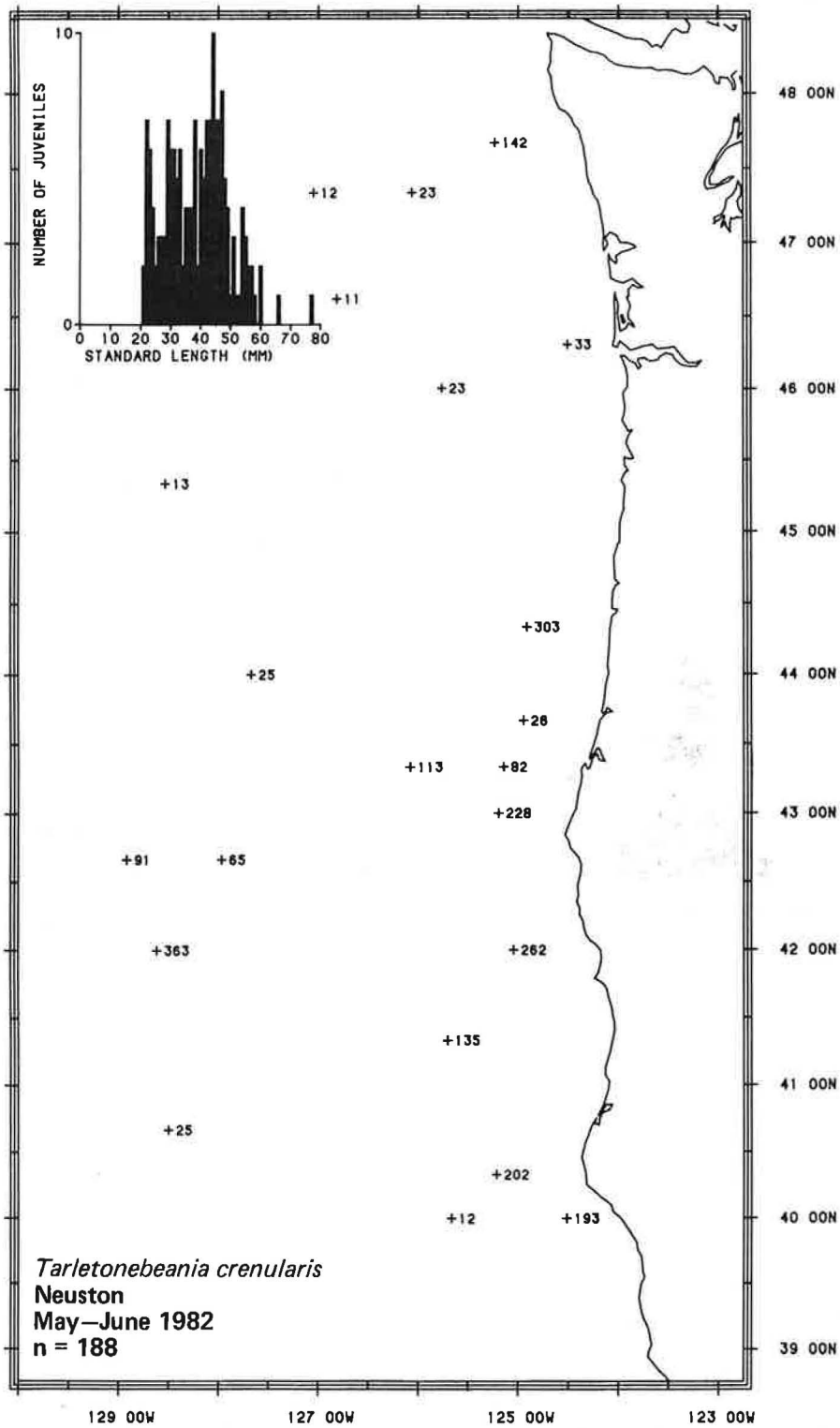


Figure 11.--Distribution and lengths of Tarletonbeania crenularis juveniles from neuston tows during cruise 1P082, May-June 1982. Abundance expressed as numbers per 1,000 $m^3$.

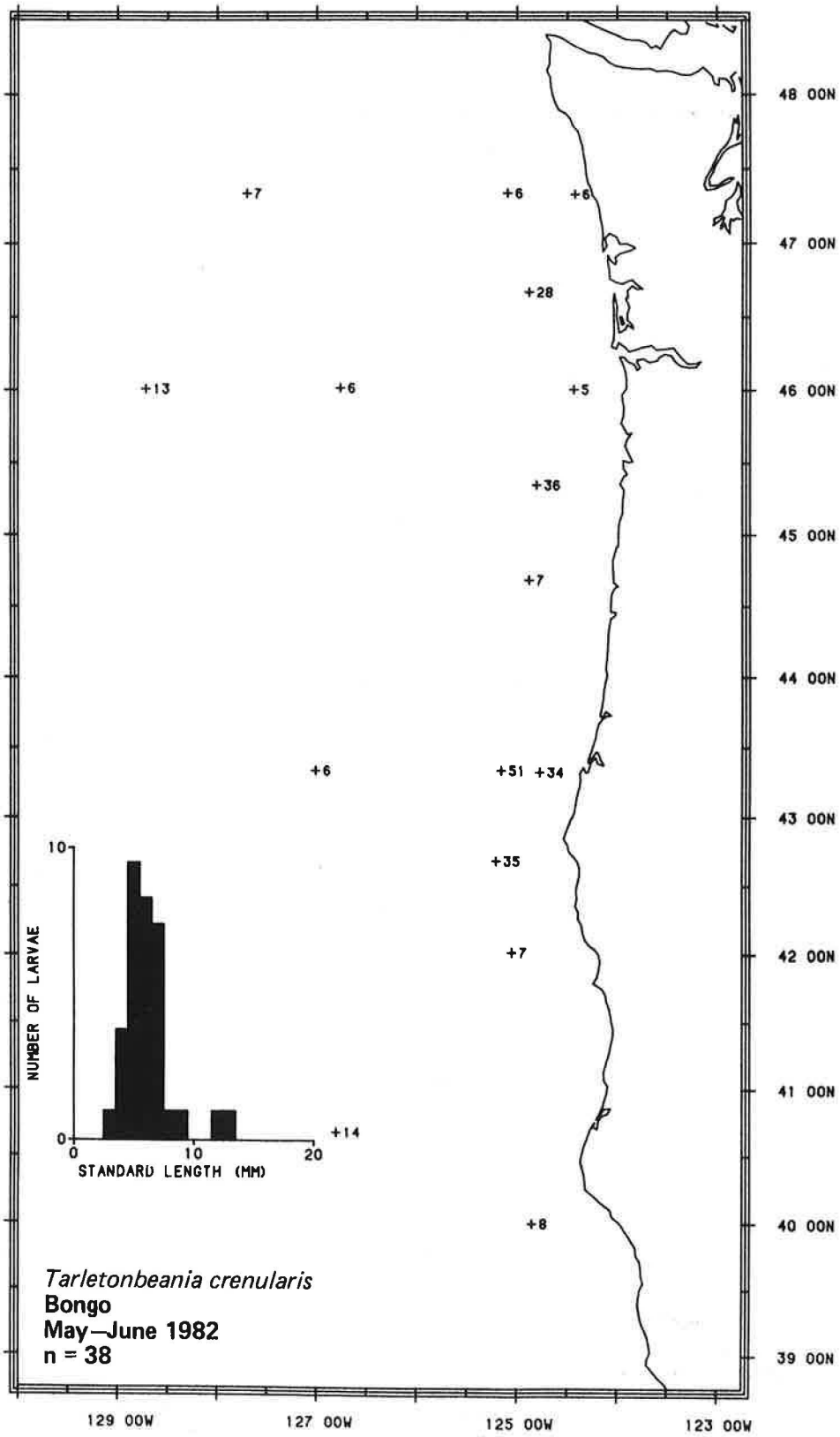


Figure 12.--Distribution and lengths of Tarletonbeania crenularis larvae from bongo tows during cruise 1P082, May-June 1982. Abundance expressed as numbers per 10 $m^2$.

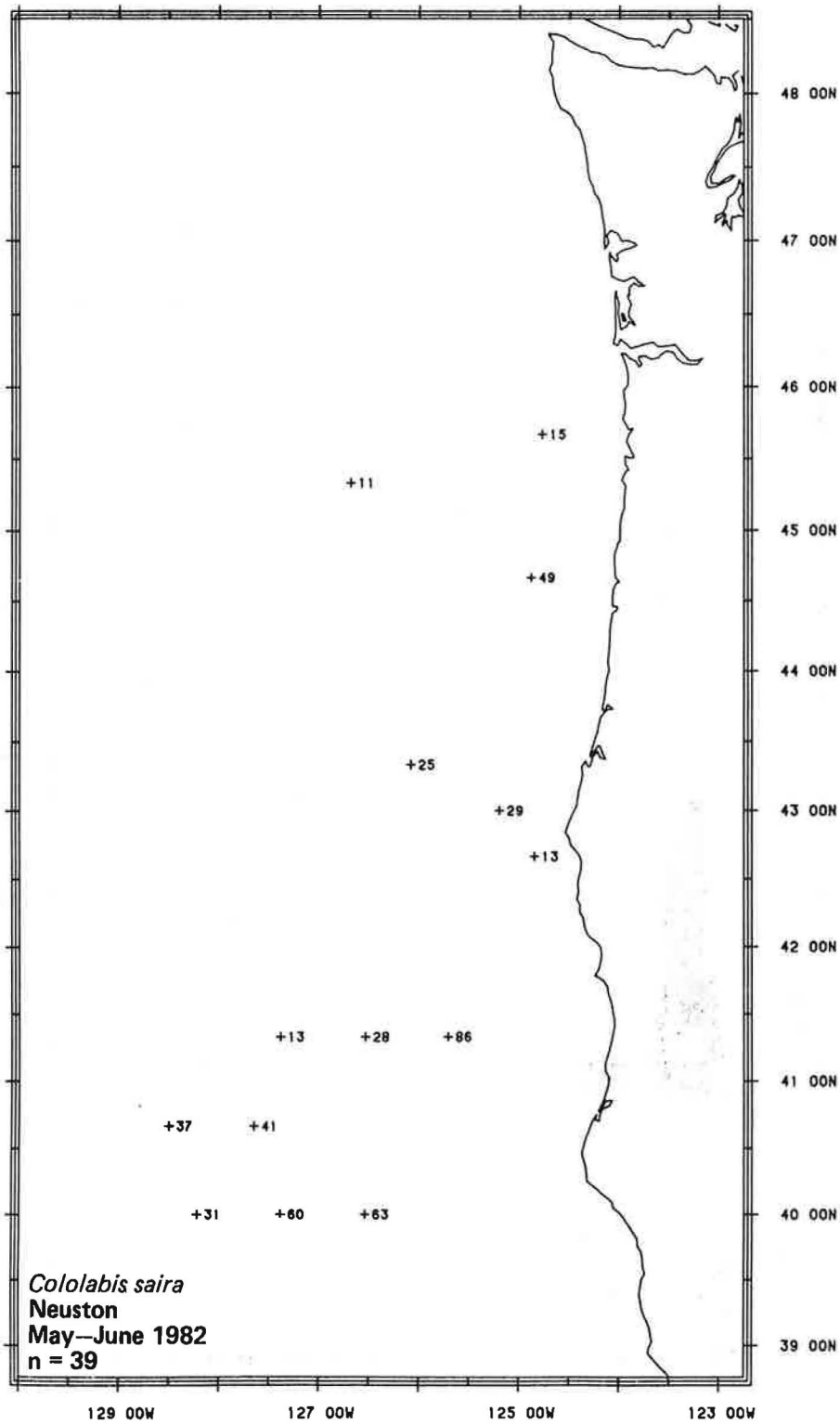


Figure 13.--Distribution and lengths of Cololabis saira larvae from neuston catches during cruise 1P082, May-June 1982. Abundance expressed as numbers per 1,000 $m^3$.

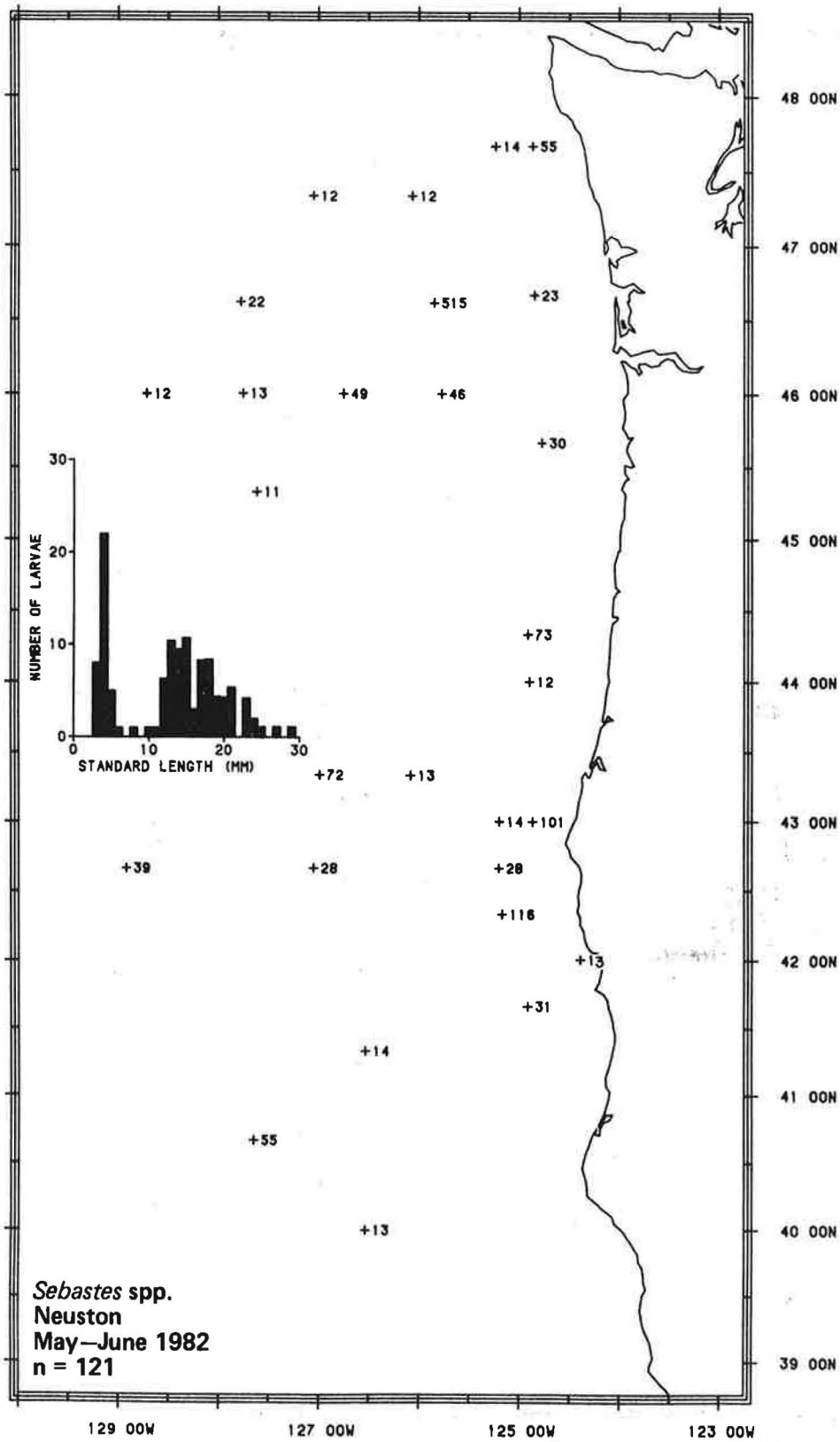


Figure 14.--Distribution and lengths of Sebastes spp. larvae from neuston tows during cruise 1P082, May-June 1982. Abundance expressed as numbers per 1,000 $m^3$.

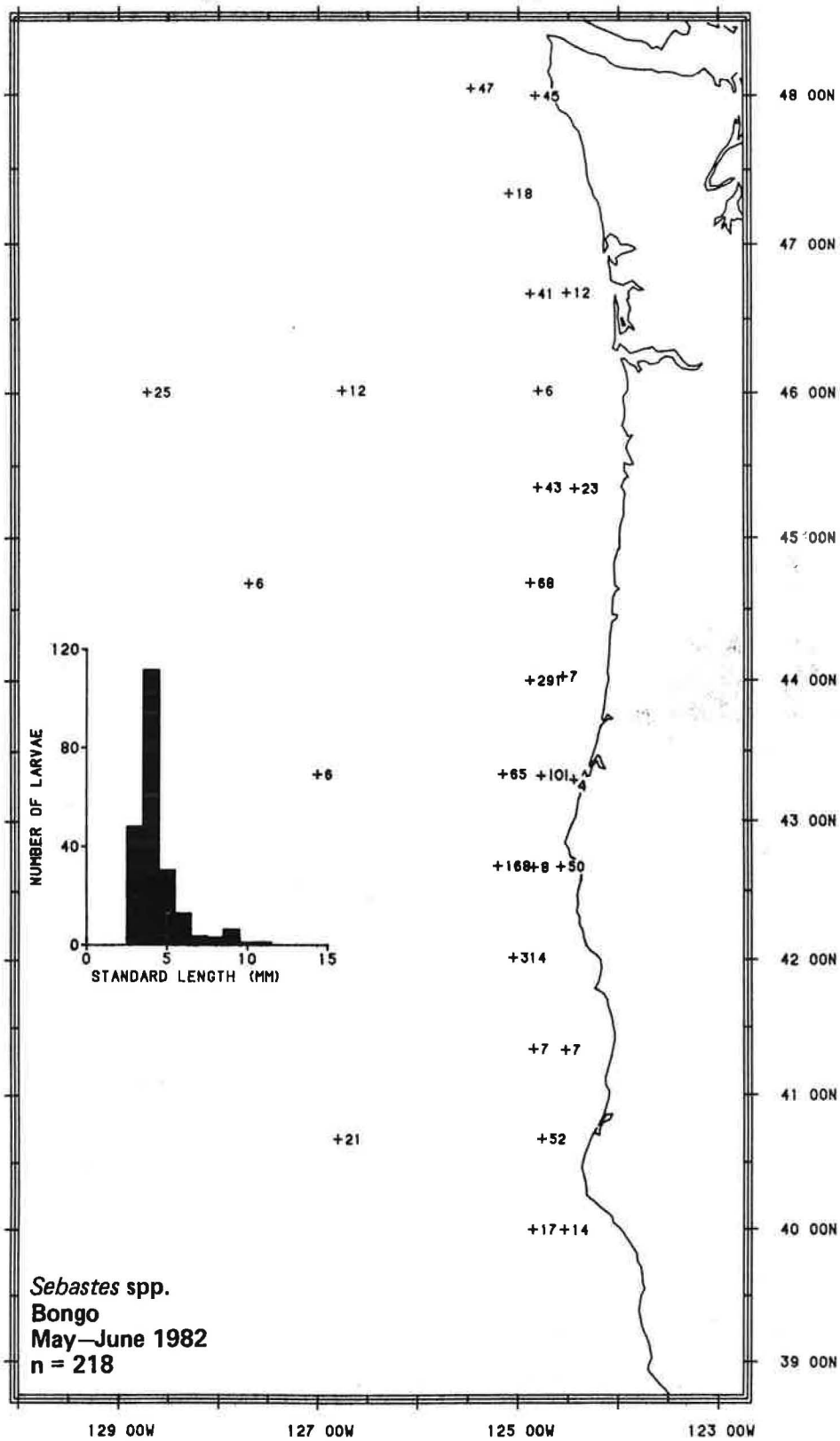


Figure 15.--Distribution and lengths of Sebastes spp. larvae from bongo tows during cruise 1P082, May-June 1982. Abundance expressed as numbers per 10 $m^2$.

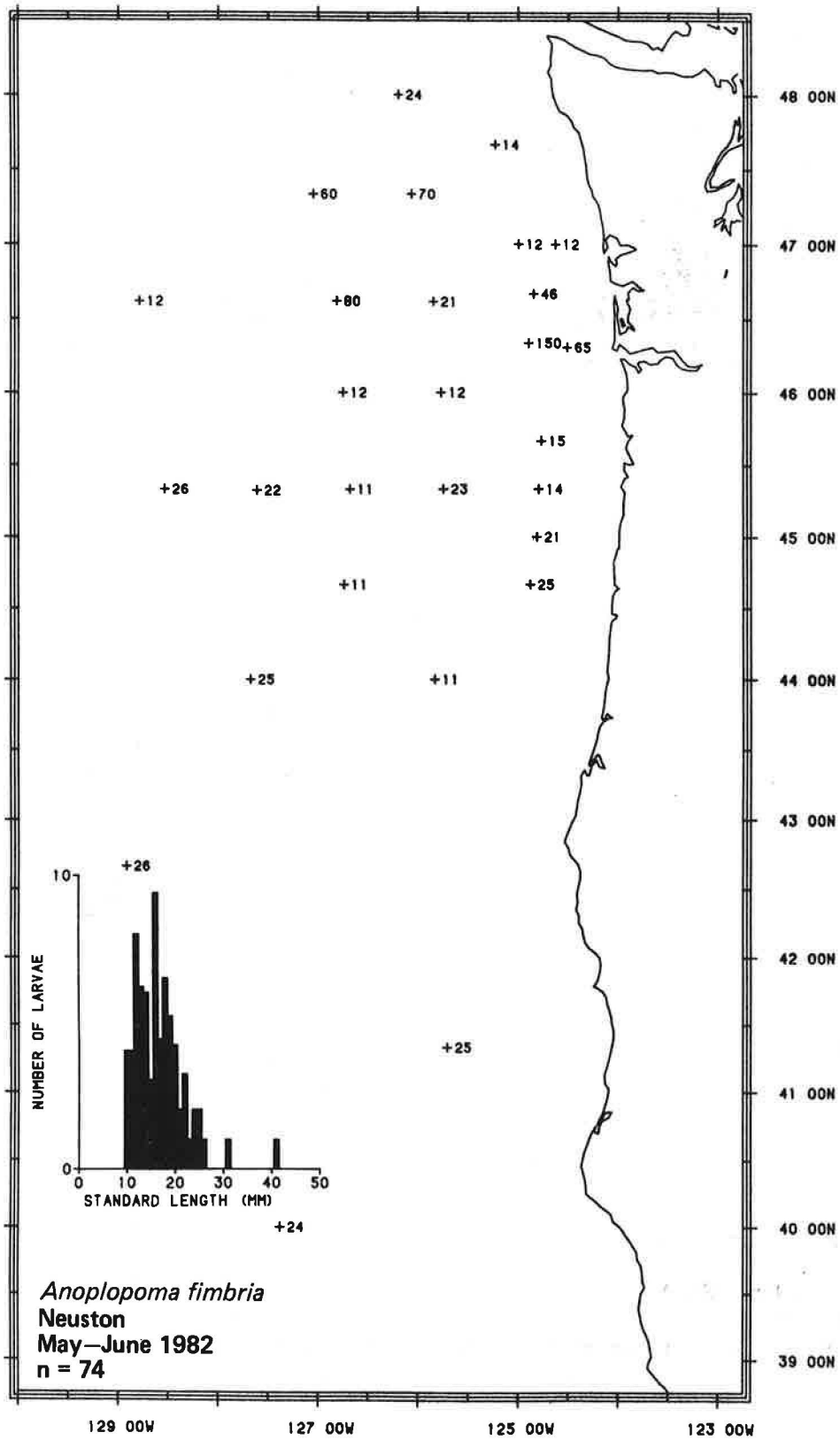


Figure 16.--Distribution and lengths of Anoplopoma fimbria larvae from neuston tows during cruise 1P082, May-June 1982. Abundance expressed as numbers per 1,000 $m^3$.

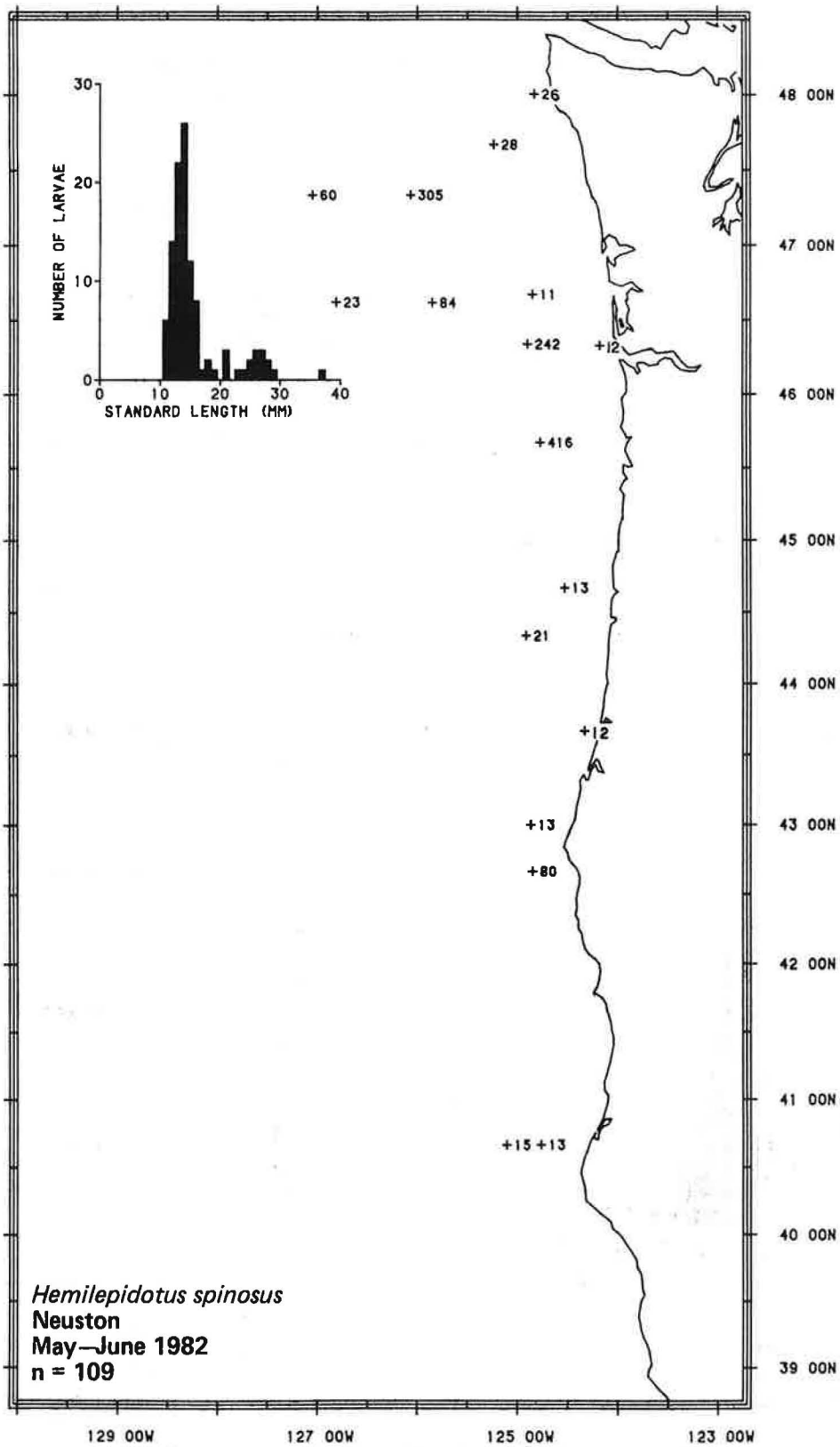


Figure 17.--Distribution and lengths of Hemilepidotus spinosus larvae from neuston tows during cruise 1P082, May-June 1982. Abundance expressed as numbers per 1,000 $m^3$.

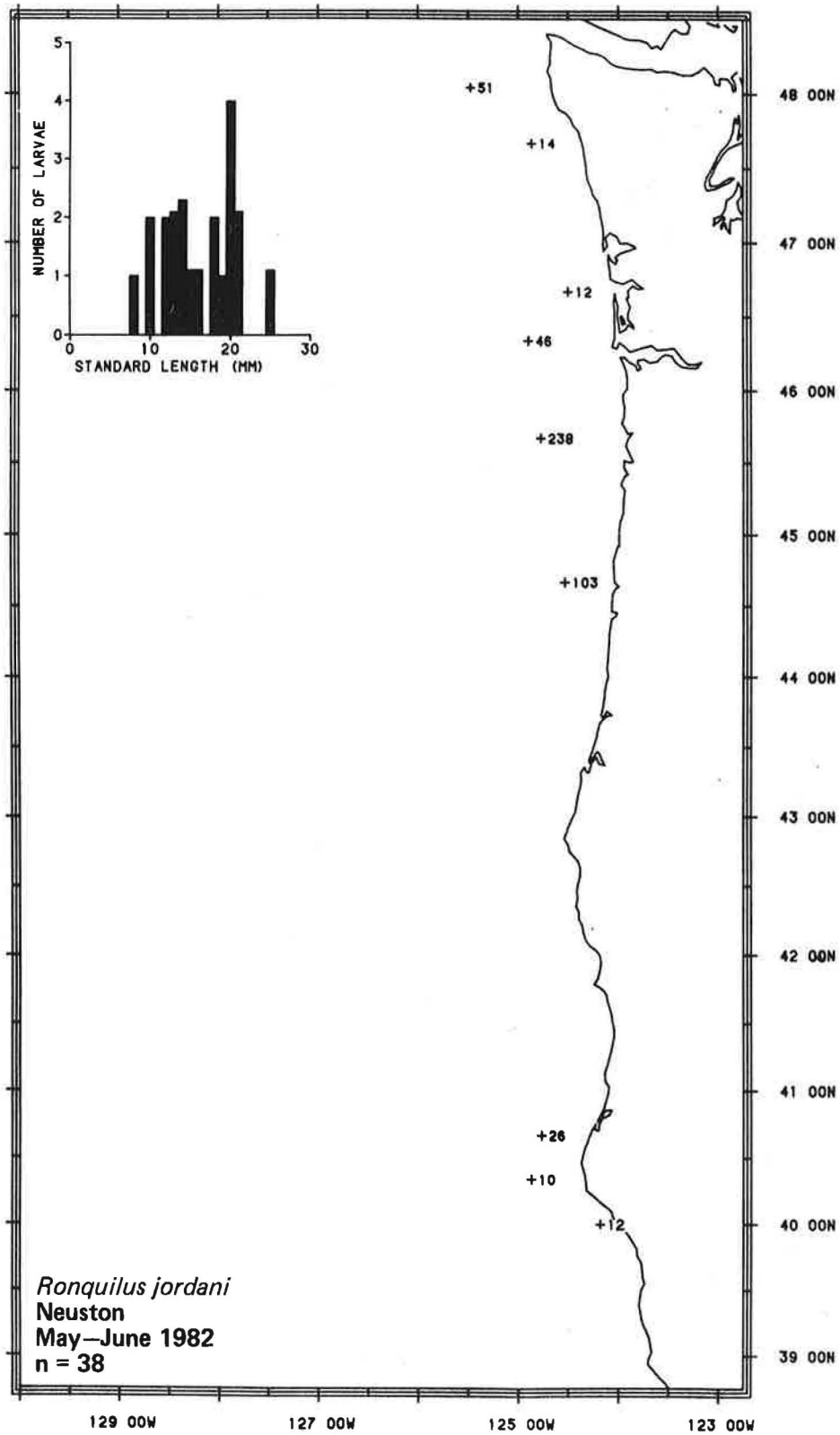


Figure 18.--Distribution and lengths of Ronquilus jordani larvae from neuston tows during cruise 1P082, May-June 1982. Abundance expressed as numbers per 1,000 $m^3$.

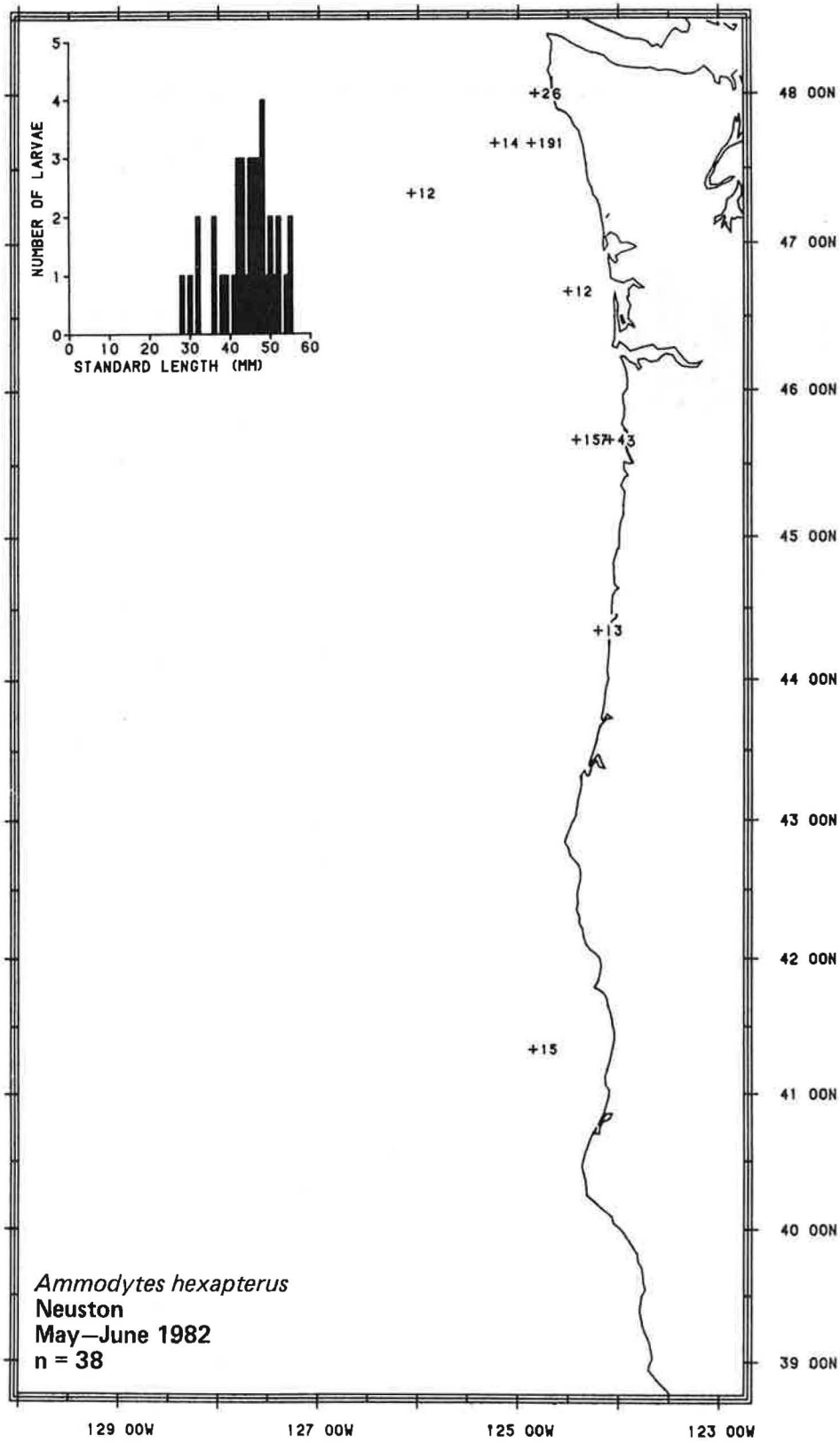


Figure 19.--Distribution and lengths of Ammodytes hexapterus larvae from neuston tows during cruise 1P082, May-June 1982. Abundance expressed as numbers per 1,000 $m^3$.

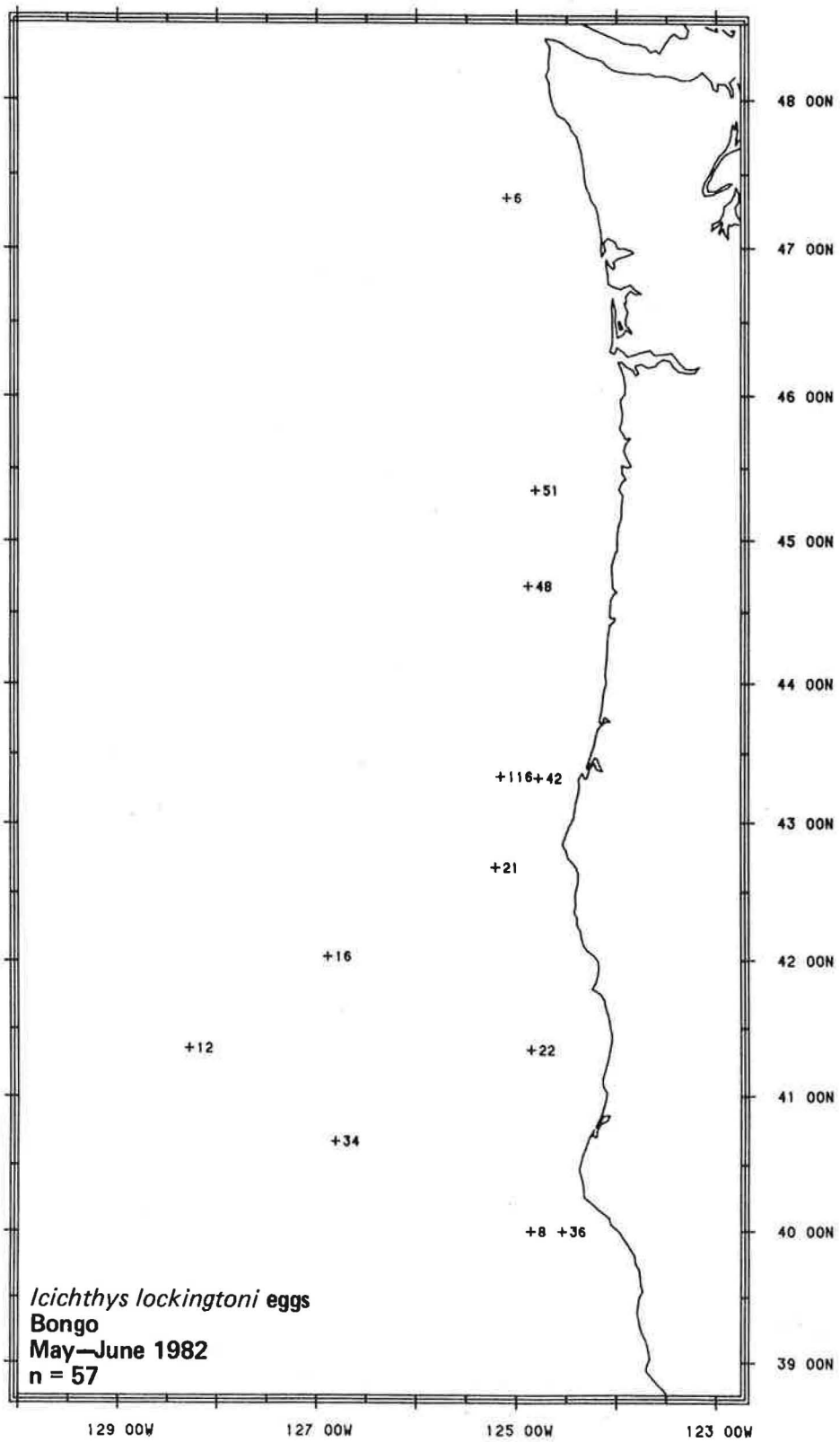


Figure 20.--Distribution of eggs of Icichthys lockingtoni from bongo tows during cruise 1P082, May-June 1982. Abundance expressed as numbers per 10 $m^2$.

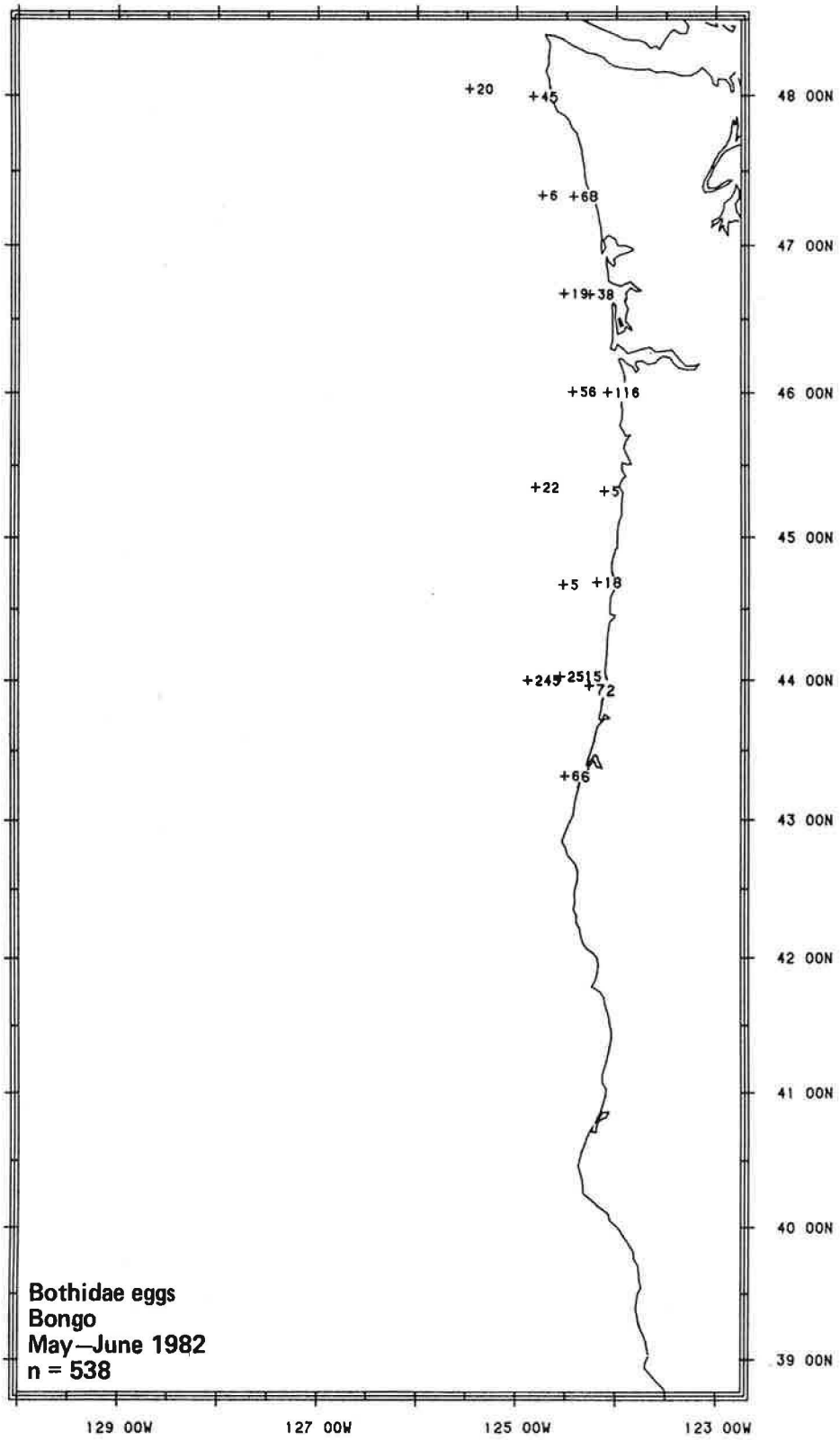


Figure 21.--Distribution of Bothidae eggs from bongo tows during cruise 1P082, May-June 1982. Abundance expressed as numbers per 10 $m^2$.

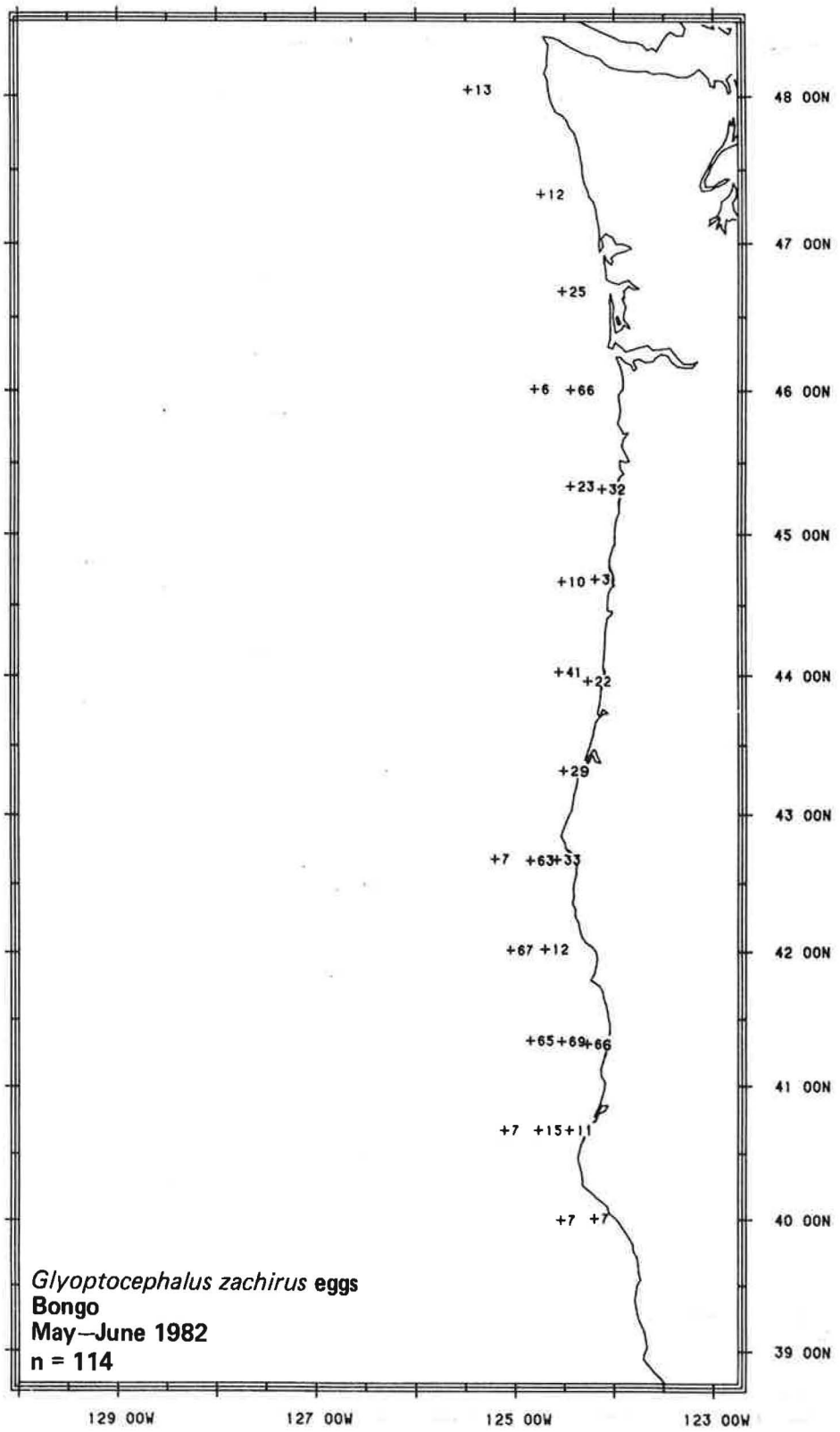


Figure 22.--Distribution of eggs of Glyptocephalus zachirus from bongo tows during cruise 1P082, May-June 1982. Abundance expressed as numbers per 10 $m^2$.

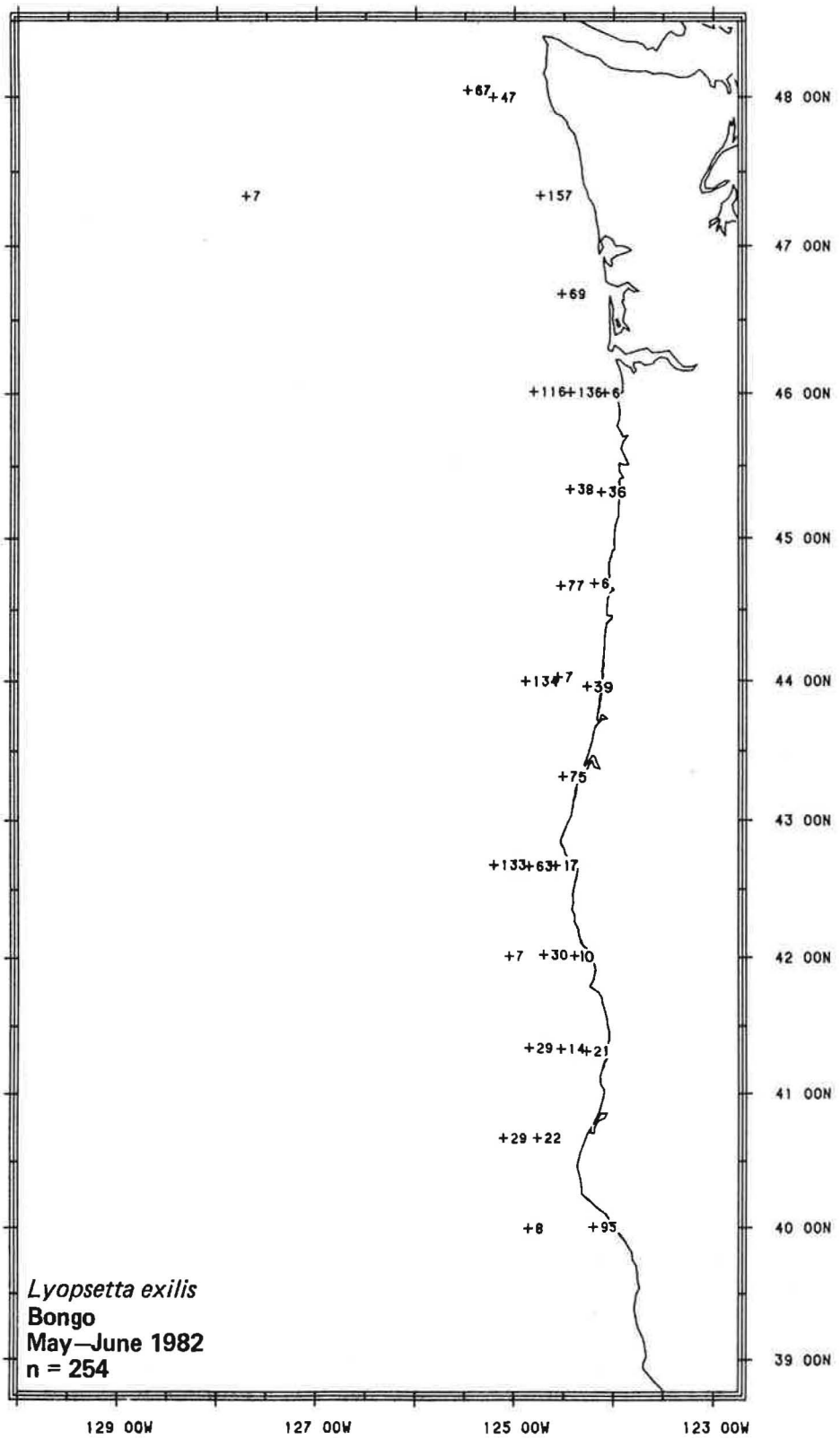


Figure 23.--Distribution of eggs of Lyopsetta exilis from bongo tows during cruise 1P082, May-June 1982. Abundance expressed as numbers per 10 $m^2$.

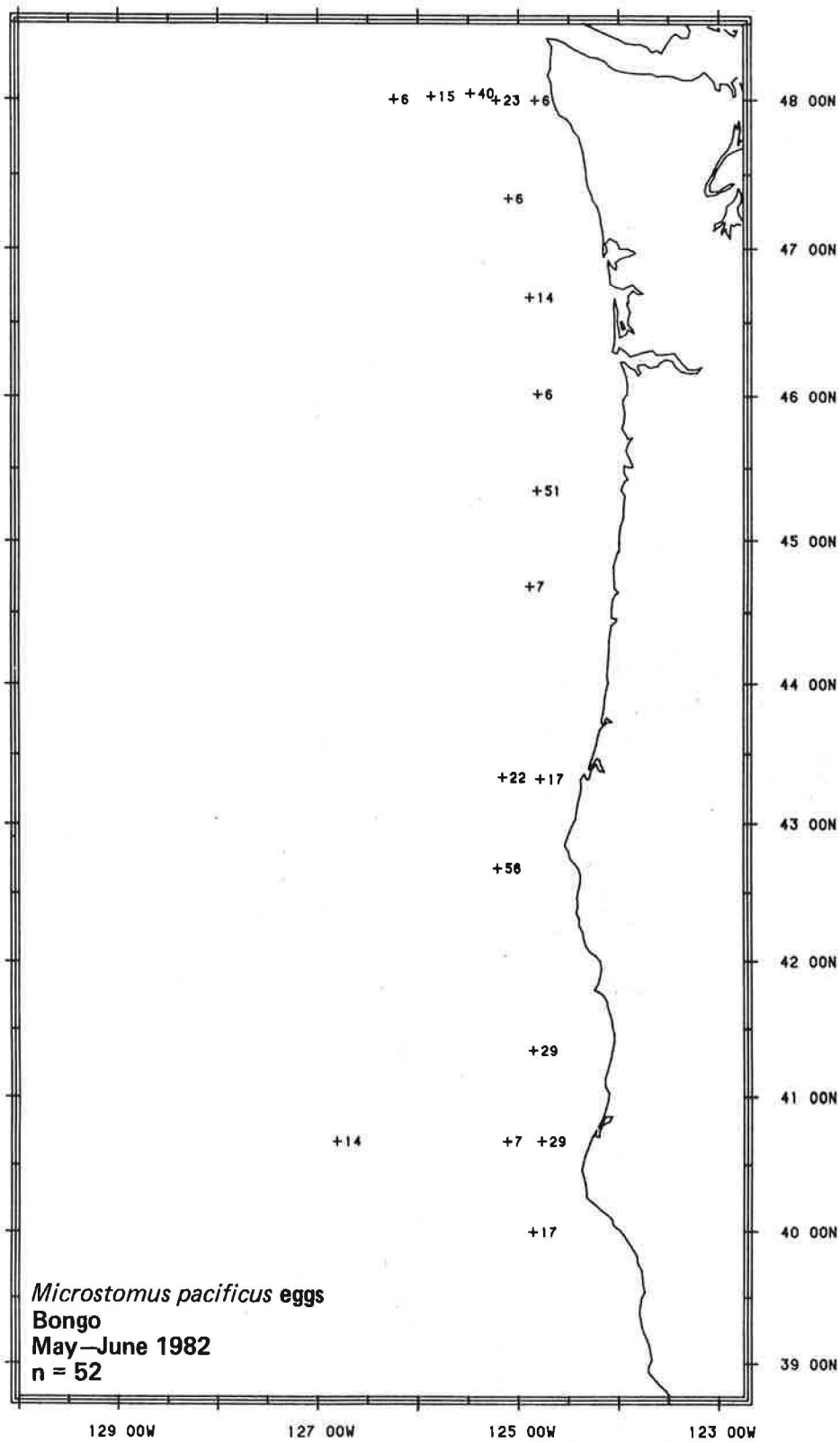


Figure 24.--Distribution of eggs of Microstomus pacificus from bongo tows during cruise 1P082, May-June 1982. Abundance expressed as numbers per 10 $m^2$.

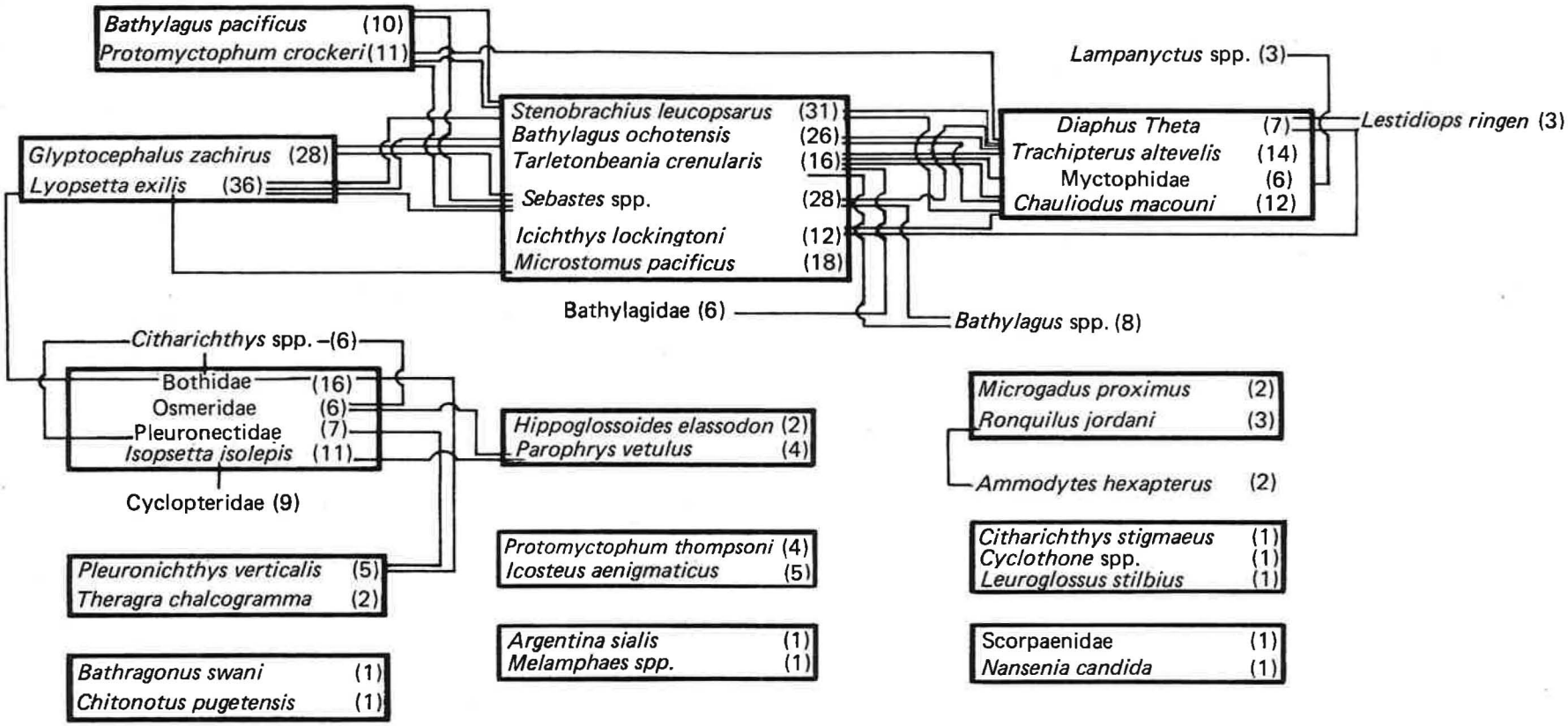


Figure 25.--Results of recurrent group analysis on bongo catches (both fish eggs and larvae) from cruise 1P082, May-June 1982, at an affinity level of 0.4. Taxa in rectangules are members of recurrent groups. Lines connect taxa with affinities outside their groups. Numbers in parentheses following taxa names are the number of occurrences of the taxa.