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Ichthyoplankton off Washington, Oregon, and Northern California, April-May 1985

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by

David S. Savage

Resource Assessment and Conservation Engineering Division
Northwest and Alaska Fisheries Center
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
7600 Sand Point Way NE, BIN C 15700, Building 4
Seattle, Washington 98115

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INTRODUCTION

This is the ninth 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. The cruise described here took place aboard the Soviet research vessel Mys Babyshkina, and is designated 1BA85. Similar reports, based on cruises occurring since April-May 1980, have already been produced (Kendall and Clark 1982a, 1982b, Bates 1984, Clark 1984, 1986a, 1986b, Clark and Kendall 1985, and Clark and Savage 1988). These surveys were designed to determine the seasonal and spatial distribution of ichthyoplankton as background information for more detailed studies of the 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 would be documented. These are 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.

METHODS AND MATERIALS

A grid of 124 stations laid out off the Washington, Oregon, and northern California coasts extended from 3 miles (5.6km) to 200 miles (370 km) from shore (Figure 1). Stations were more closely spaced nearshore than offshore. The Soviet research vessel Mys Babyshkina, with Dr. M. Stepanenko serving as chief scientist, occupied these stations from north to south from 19 April to 11 May 1985. At each station hydrographic casts to 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 minutes at each station. A standard MARMAP bongo tow (Smith and Richardson 1977) with 60 cm diameter frames, and 0.505 mm mesh nets with a maximum of 300 m of wire out was made at each station. 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 bongo and neuston samples, while the Americans retained the other. American samples were fixed in formalin at sea, but sorted fish larvae were later transferred to 70% ethanol for storage to inhibit bone deterioration. 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 were removed. The fish eggs were later identified and counted by Ann C. Matarese and Deborah Blood 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. Deborah Blood, Bill Rugen, and David Savage 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 (Figure 1) was occupied as planned. Data associated with the 124 stations are listed in Tables 1a and 1b. A summary of the catches of fish eggs, larvae, and juveniles is presented in Tables 2, 3a, 3b and 4. Totals of 26 taxa of eggs and 68 taxa of larvae were found. Figures 2-7 illustrate the rank abundances of egg and larval catches in bongo and neuston tows for the cruise using several measures of abundance. Figures 8-29 show the geographic distribution, abundance at each station and length frequencies of larvae and eggs of the more abundant taxa. Results of recurrent group analysis (Fager 1957) of eggs and larvae from bongo and neuston samples are shown in

figures 30 and 31.

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 number caught, percent occurrence, logarithm of number in survey area, 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 in all abundance criteria except for percent occurrence (Figure 5), which was dominated by Trachipterus altivelis. Eggs of Lyopsetta exilis caught in the bongo ranked second in both total number caught and percent occurrence. In the neuston net, all egg abundance criteria except for number caught per 1,000 m^3 were dominated by Trachipterus altivelis. Catch per 1,000 m^3 was highest in the Teleost Type A.

Larval and juvenile catches in the bongo net were dominated by Stenobrachius leucopsarus (Figures 3b and 4). Larval catches of Stenobrachius leucopsarus dominated all abundance criteria in the bongo net, except for catch per 10 m^2, which was dominated by Osmeridae. Juvenile catches of Stenobrachius leucopsarus in the bongo dominated all abundance criteria. These results are similar to the May-June 1981 cruise (Clark 1984) and the March-April 1984 cruise (Clark and Savage 1988).

In the neuston net, catches of larvae were dominated by Hemilepidotus spinosus in the total number caught and the logarithm of the number in the survey area (Figure 6).

Hexagrammos decagrammus larvae were found in highest concentration per 1,000 m^3. Larvae of Anoplopoma fimbria dominated the percent occurrence abundance criterion. Juvenile catches in the neuston net were led in all criteria by Tarletonbeania crenularis.

Distributions

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

Bathylagidae (Figure 8) - Blacksmelt eggs were found offshore in bongo tows throughout the survey area south of 47°N. Eggs were found at 20% of the stations occupied.

Bathylagus ochotensis (Figure 9) - Popeye blacksmelt larvae from bongo tows were distributed in the highest concentrations offshore in the southern half of the survey area, although they were found as far north as the mouth of the Columbia River. Popeye blacksmelt larvae ranged from 4.5-22.0 ($\bar{x}$ = 8.9) mm SL with a percent occurrence of 36%.

Myctophidae (Figure 10) - Eggs of lanternfishes were found in bongo samples taken in the southern two-thirds of the survey area. Eggs occurred at 27% of the stations occupied.

Diaphus theta (Figure 11) - California headlightfish larvae caught in bongo tows were found predominately offshore in the southern half of the survey area. The larvae had a size range of 2.5-42.0 ($\bar{x}$ = 4.2) mm SL and occurred at 24% of the stations occupied.

Stenobrachius leucopsarus (Figure 12) - Northern lanternfish larvae sorted from bongo catches were found in high concentrations throughout the survey area. The larvae ranged in length from 2.5-27.0 ($\bar{x}$ = 5.9) mm SL and were found at 61% of the stations occupied.

Tarletonbeania crenularis (Figure 13) - Blue lanternfish larvae from the bongo were most abundant offshore south of the Columbia River, but were found in lower concentrations at two nearshore stations off of Washington. The larvae had a length range of 3.4-18.0 ($\bar{x}$ = 7.1) mm SL and occurred at 34% of the stations occupied.

Trachipterus altivelis (Figures 14 and 15) - Eggs of the king-of-the-salmon sorted from both bongo and neuston net catches were distributed throughout the survey area at both nearshore and offshore stations. Concentrations were highest in the southern half of the survey area for both the bongo and the neuston net. King-of-the-salmon eggs were found at 51% of the neuston stations occupied and 39% of the bongo stations occupied.

Sebastes species (Figures 16 and 17) - Rockfish larvae from from bongo tows were found in highest concentrations in the northern half of the survey area, whereas rockfish larvae from neuston tows were found in highest concentrations in the southern half of the survey grid. Rockfish larvae from the bongo ranged from 3.0-16.0 ($\bar{x}$ = 6.0) mm SL with a percent occurrence of 35%, whereas larvae from the neuston were considerably larger with a range of 4.8-54.3 ($\bar{x}$ = 29.3) mm SL and a percent

occurrence of 17%.

Anoplopoma fimbria (Figure 18) - Sablefish larvae from neuston tows were most abundant in the northern third of the survey grid, although they occurred throughout the sampling area. The larvae had a length range of 9.5-34.7 ($\bar{x}$ = 17.6) mm SL and were found at 51% of the stations occupied.

Ophiodon elongatus (Figure 19) - Lingcod larvae caught in the neuston net were found at one nearshore station on each of nine transects. The highest concentration of larvae was found at the nearshore station at 44°-25'N. The larvae ranged from 11.0-45.0 ($\bar{x}$ = 16.5) mm SL with a percent occurrence of 7%.

Hexagrammos decagrammus (Figure 20) - Kelp greenling larvae were found in neuston samples predominately in coastal regions throughout the survey area, with the highest abundances occurring north of the Columbia River. The larvae ranged in length from 9.8-55.0 ($\bar{x}$ = 23.9) mm SL and occurred at 37% of the stations occupied.

Hemilepidotus spinosus (Figure 21) - Brown Irish lord larvae caught in neuston tows were found in coastal regions throughout the survey area, and were particularly abundant between 46°N and 48°N. The larvae ranged from 5.1-55.0 ($\bar{x}$ = 23.9) mm SL and were found at 24% of the stations occupied.

Scorpaenichthys marmoratus (Figure 22) - Cabezon larvae from neuston tows were seen at nearshore stations north of 46°-30'N and south of 44°-30'N. Larvae ranged in length from 5.0-31.0 ($\bar{x}$ = 11.0) mm SL with a percent occurrence of 10%.

Icosteus aenigmaticus (Figure 23) - Eggs of the ragfish were sorted from neuston samples collected in the northern half of the survey area and also at station 110 , which is located at the southern end of the station grid. Eggs were found at 15% of the stations occupied.

Icichthys lockingtoni (Figure 24) - Medusafish eggs from neuston tows were found throughout the survey area and were particularly abundant at nearshore stations south of 43°-30'N. The eggs occurred at 39% of the stations occupied.

Pleuronectidae (Figures 25 and 26) - Righteye flounder eggs were collected in both bongo and neuston tows exclusively at coastal stations. Eggs were found mainly north of 44°N, although eggs were collected at neuston station 101 (41°-39.4'N, 124°-14.1'N). Righteye flounder eggs were found at 8% of the bongo stations and 7% of the neuston stations occupied.

Lyopsetta exilis (Figure 27) - Slender sole eggs were sorted from bongo tows taken at coastal stations throughout the survey area. Egg abundances were highest in the northern half of the survey area. Slender sole eggs occurred at 32% of the stations occupied.

Microstomus pacificus (Figures 28 and 29) - Dover sole eggs were caught in bongo and neuston tows in coastal regions throughout the survey area. Abundance criteria were higher for eggs caught in the neuston than for those from the bongo. Dover sole eggs were found at 21% of the neuston stations and 15% of the bongo stations occupied.

COMMUNITY STRUCTURE

Recurrent group analysis at the 0.4 affinity level for neuston catches showed three groups whose members had five or more occurrences (Figure 30). The first group was composed of Anoplopoma fimbria, Trachipterus altivelis, and Icichthys lockingtoni. The second group was composed of Hexagrammos decagrammus and Microstomus pacificus. The third group was composed of Ammodytes hexapterus and Lyconectes aleutensis. Groups in the neuston catches were aligned mainly in an onshore-offshore pattern, as was indicated in an earlier study of the area (Richardson et al. 1980). The first group mentioned above contained predominately offshore associates. The second group had a nearshore distribution for the most part.

In the bongo catches a much more complex pattern emerged (Figure 31). There were five groups whose members had more than five occurrences. The central group of the community consisted of six myctophid members and Bathylagus ochotensis. Stenobrachius leucopsarus, with 80 occurrences, was the most abundant species of the group and the survey. The main group was distributed mostly offshore. Chauliodus macouni had a greater than .400 affinity with all species in the main group except Protomyctophum crockeri. All major groups except the group containing Pleuronectidae and Isopsetta isolepis had affinities with the central group. Pleuronectidae and Isopsetta isolepis were found mostly nearshore.

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LITERATURE CITED

Bates, R. D. 1984. Ichthyoplankton off Washington, Oregon, and Northern California October-November 1981. NWAFC Proc. Rep. 84-12, 41 p.

Clark, J. B. 1984. Ichthyoplankton off Washington, Oregon, and Northern California May-June 1981. NWAFC Proc. Rep. 84-11, 46 p.

Clark, J. B. 1986a. Ichthyoplankton off Washington, Oregon, and Northern California May-June 1982. NWAFC Proc. Rep. 86-01, 44 p.

Clark, J. B. 1986b. Ichthyoplankton off Washington, Oregon, and Northern California November-December 1983. NWAFC Proc. Rep. 86-14, 43 p.

Clark, J. B., and A. W. Kendall, Jr. 1985. Ichthyoplankton off Washington, Oregon, and Northern California April-May 1983. NWAFC Proc. Rep. 85-10, 48 p.

Clark, J. B., and D. S. Savage. 1988. Ichthyoplankton off Washington, Oregon, and Northern California March-April 1984. NWAFC Proc. Rep. 88-09, 57 p.

Fager, E. W. 1957. Determination and analysis of recurrent groups. Ecology 38:586-595.

Kendall, A. W. Jr., and J. B. Clark. 1982b. Ichthyoplankton off Washington, Oregon, and Northern California August 1980. NWAFC Proc. Rep. 82-12, 43 p.

Kendall, A. W. Jr., and A. C. Matarese. 1987. Biology of eggs, larvae, and epipelagic juveniles of sablefish, Anoplopoma fimbria, in relation to their potential use in management. Mar. Fish. Rev. 49:1-13.

Richardson, S. L., J. L. LaRoche, and M. D. Richardson. 1980. Larval fish assemblages and associations in the northeast Pacific Ocean along the Oregon coast, winter-spring 1972-1975. Estuar. and Coast. Mar. Sci. 11:671-699.

Richardson, S.L. 1981. Spawning biomass and early life of northern anchovy, Engraulis mordax, in the northern subpopulation off Oregon and Washington. Fish. Bull., U.S. 78:855-876.

Sameoto, D. D., and L. O. Jarozynski. 1969. Otter surface sampler: a new neuston net. J. Fish. Res. Board Canada. 25:2240-2244.

Smith, P. E., and S. L. Richardson (editors). Standard techniques for pelagic fish egg and larvae surveys. FAO Fish. Tech. Pap. 175, 100 p.

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Figure 31.--Results of recurrent group analysis on bongo catches (both fish eggs and larvae) from cruise 1BA85, April-May 1985, at an affinity level of 0.400. Taxa in rectangles 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.

1BA85 NEUSTON AND BONGO STATION SUMMARY

STATION	POSITION LAT (N)	POSITION LONG (W)	DATE YYMMDD	POLYGONAL AREA KM2	TIME GMT	NEUSTON TOW STANDARD HAUL FACTORS* A	NEUSTON TOW STANDARD HAUL FACTORS* B	TIME GMT	BONGO TOW STANDARD HAUL FACTORS* A	BONGO TOW STANDARD HAUL FACTORS* B
G001A	48 0.1	124 50.0	850419	921	2320	0.025	16.587	2305	6.743	16.858
G002A	48 0.8	125 11.6	850420	1090	0152	0.023	15.394	0130	8.459	6.220
G003A	48 0.3	125 32.6	850420	1231	0449	0.022	14.389	0427	10.425	6.683
G004A	48 0.1	125 56.2	850420	1540	0747	0.023	15.253	0720	8.924	4.002
G005A	48 0.0	126 16.1	850420	1861	1040	0.021	14.018	1012	8.618	3.935
G006A	47 40.0	125 16.5	850420	1404	1620	0.024	15.894	1545	8.429	3.780
G007A	47 40.2	124 56.2	850420	956	1915	0.023	15.381	1858	7.272	6.672
G008A	47 40.0	124 34.2	850420	858	2243	0.023	15.105	2235	7.919	24.747
G009A	47 20.0	124 25.4	850421	820	0124	0.025	16.486	0113	8.645	23.364
G010A	47 20.0	124 47.6	850421	1034	0510	0.022	14.531	0435	8.502	3.900
G011A	47 20.3	125 10.3	850421	1315	0911	0.020	13.435	0842	7.543	3.575
G012A	47 20.0	125 41.0	850421	3590	1234	0.025	16.876	1207	8.170	3.697
G013A	47 19.4	126 40.1	850421	5942	1724	0.022	14.823	1655	8.623	3.902
G014A	47 20.0	127 39.2	850421	5517	2310	0.022	14.883	2246	7.889	3.570
G015A	46 39.8	128 45.4	850422	5766	0719	0.024	16.313	0653	7.971	3.851
G016A	46 40.0	127 45.7	850422	5248	1250	0.023	15.294	1225	8.441	3.802
G017A	46 40.0	126 49.1	850422	4948	1821	0.022	14.671	1752	8.434	3.923
G018A	46 40.0	125 50.0	850422	4766	2343	0.023	15.633	2314	7.325	3.407
G019A	47 0.0	125 0.0	850423	1798	0441	0.025	16.449	0412	5.227	2.600
G020A	47 0.0	124 37.7	850423	1111	0656	0.028	18.465	0640	8.723	10.027
G021A	47 0.2	124 16.5	850423	705	0910	0.024	16.083	0857	5.148	19.799
G022A	46 39.8	124 15.0	850423	879	1243	0.022	14.991	1232	6.324	18.599
G023A	46 40.3	124 37.5	850423	945	1520	0.021	13.834	1505	7.884	7.168
G024A	46 40.1	124 59.8	850423	1636	2350	0.023	15.515	2323	9.411	4.258
G025A	46 19.7	124 54.0	850424	1915	0530	0.024	16.154	0504	7.678	3.554
G026A	46 20.3	124 33.0	850424	1025	1141	0.022	14.734	1125	7.456	6.598
G027A	46 20.0	124 11.0	850424	783	1350	0.021	14.029	1335	5.901	16.392
G028A	46 0.3	124 4.0	850424	585	2114	0.022	14.588	2104	6.911	11.916
G029A	46 0.0	124 20.0	850424	1036	2308	0.021	14.018	2253	8.086	7.350
G030A	46 0.0	124 47.0	850425	1588	0217	0.022	14.879	0151	7.918	3.649
G031A	46 0.0	125 38.1	850425	4532	0720	0.022	14.819	0653	7.830	3.575
G032A	46 0.0	126 36.0	850425	5100	1328	0.020	13.297	1302	8.684	4.020
G033A	46 0.4	127 34.0	850425	5115	1909	0.021	14.013	1841	8.216	3.839
G034A	46 0.0	128 31.0	850425	5183	0025	0.021	13.812	0002	9.664	4.276
G035A	45 20.0	128 33.0	850426	5862	0537	0.024	16.256	0510	7.308	3.513
G036A	45 20.0	127 37.0	850426	5708	1105	0.022	14.357	1034	8.190	3.809
G037A	45 20.0	126 40.0	850426	5901	1617	0.021	13.841	1548	7.934	3.707
G038A	45 20.0	125 44.0	850426	5547	2126	0.022	14.580	2100	8.274	3.885
G039A	45 39.1	124 45.2	850427	1980	0246	0.022	14.646	0220	8.617	3.935
G040A	45 39.6	124 22.8	850427	914	0506	0.021	14.060	0450	7.227	5.475
G041A	45 39.9	124 2.0	850427	630	0702	0.022	14.514	0651	4.918	10.036
G042A	45 19.5	124 6.3	850427	866	1015	0.021	13.923	1001	7.255	9.069
G043A	45 20.0	124 27.2	850427	987	1318	0.020	13.530	1250	7.619	3.577
G044A	45 20.0	124 48.0	850427	1925	1622	0.021	14.187	1552	7.884	3.719
G045A	45 0.0	124 47.9	850427	2184	1908	0.021	14.144	1840	8.260	3.789
G046A	44 59.8	124 25.9	850427	994	2131	0.021	14.203	2107	7.671	3.636
G047A	44 59.8	124 5.5	850427	686	2331	0.021	14.222	2320	7.018	11.895
G048A	44 40.0	124 10.5	850428	745	0158	0.023	15.450	0150	6.368	12.487
G049A	44 39.9	124 31.0	850428	1101	0418	0.021	13.901	0403	6.898	5.563
G050A	44 40.1	124 53.2	850428	1831	0709	0.022	14.337	0644	8.310	3.760
G051A	44 40.0	125 48.0	850428	5510	1225	0.022	14.991	1158	8.893	3.988
G052A	44 40.1	126 44.2	850428	5656	1743	0.020	13.363	1717	8.008	3.673
G053A	44 40.0	127 40.0	850428	5576	2252	0.021	13.875	2224	7.895	3.573
G054A	44 39.9	128 35.2	850429	5712	0418	0.021	13.957	0350	7.652	3.576
G055A	43 59.2	128 34.5	850429	5264	0928	0.020	13.576	0900	6.958	3.394
G056A	44 0.0	127 38.9	850429	5275	1455	0.024	15.772	1427	6.842	3.338
G057A	44 0.0	126 44.0	850429	5629	2027	0.020	13.274	2002	6.990	3.313
G058A	43 59.5	125 49.0	850430	5238	0112	0.024	15.899	0040	7.914	3.664
G059A	44 19.9	124 53.6	850430	2083	0642	0.024	15.821	0615	8.145	3.788
G060A	44 19.7	124 33.5	850430	1012	1050	0.020	13.583	1037	7.392	9.357
G061A	44 20.3	124 13.6	850430	817	1256	0.022	14.772	1240	6.812	15.481
G062A	44 0.3	124 12.1	850430	588	1508	0.021	13.834	1459	5.477	15.214

"A" CONVERTS CATCH TO CATCH PER 10M2, "B" CONVERTS CATCH TO CATCH PER 1000M3
(SEE SMITH AND RICHARDSON 1977)

Table 1a.--Data associated with neuston and bongo tows during cruise 1BA85, April-May 1985.

1BA85 NEUSTON AND BONGO STATION SUMMARY

STATION	POSITION LAT (N)	POSITION LONG (W)	DATE YYMMDD	POLYGONAL AREA KM2	NEUSTON TOW TIME GMT	NEUSTON TOW STANDARD HAUL FACTORS* A	NEUSTON TOW STANDARD HAUL FACTORS* B	BONGO TOW TIME GMT	BONGO TOW STANDARD HAUL FACTORS* A	BONGO TOW STANDARD HAUL FACTORS* B
G063A	43 59.7	124 32.7	850430	955	1739	0.020	13.119	1723	7.825	6.631
G064A	43 59.9	124 54.0	850430	1999	2013	0.020	13.644	2001	6.899	8.213
G065A	43 40.0	124 57.0	850430	1774	2335	0.020	13.349	2309	7.220	3.471
G066A	43 40.0	124 37.4	850501	991	0141	0.021	13.871	0118	7.611	3.368
G067A	43 40.0	124 17.6	850501	638	0542	0.021	13.677	0530	7.673	8.526
G068A	43 19.9	124 30.7	850501	866	0845	0.020	13.209	0830	7.117	9.618
G069A	43 20.0	124 50.4	850501	1015	1126	0.020	13.548	1100	7.706	3.635
G070A	43 20.0	125 12.6	850501	2453	1418	0.022	14.965	1346	7.402	3.576
G071A	43 19.7	126 6.0	850501	5207	2003	0.019	12.600	1937	7.822	3.690
G072A	43 20.0	127 1.0	850502	5552	0111	0.020	13.257	0046	8.168	3.630
G073A	43 20.2	127 57.3	850502	5495	0709	0.021	14.117	0643	7.854	3.722
G074A	43 20.0	128 52.0	850502	5602	1256	0.021	13.698	1230	7.808	3.648
G075A	42 40.0	128 50.9	850502	5269	1906	0.022	14.518	1834	7.913	3.663
G076A	42 40.1	127 55.1	850504	5076	0007	0.024	15.894	2343	7.821	3.588
G077A	42 39.9	127 3.5	850503	5238	0530	0.021	14.333	0505	9.470	4.266
G078A	42 40.0	126 9.0	850503	5179	1040	0.025	16.865	1011	8.026	3.934
G079A	43 0.0	125 20.0	850503	1963	1603	0.023	15.464	1535	8.059	3.748
G080A	43 0.0	124 56.1	850503	1192	1855	0.023	15.450	1824	7.434	3.574
G081A	42 59.7	124 34.3	850503	802	2058	0.022	14.605	2046	7.421	10.165
G082A	42 40.0	124 33.3	850504	788	0402	0.023	15.226	0340	6.986	8.317
G083A	42 40.1	124 54.4	850504	864	0648	0.021	14.305	0623	7.736	3.666
G084A	42 40.0	125 14.0	850504	2002	0935	0.020	13.304	0908	7.105	3.384
G085A	42 20.0	125 10.3	850504	2125	1243	0.022	14.844	1215	7.880	3.648
G086A	42 20.0	124 51.9	850505	1103	1438	0.021	13.927	1410	7.391	3.571
G087A	42 13.3	124 32.7	850504	813	1746	0.021	13.901	1728	7.632	5.963
G088A	42 0.3	124 24.1	850505	729	1701	0.021	14.087	1643	6.928	9.490
G089A	42 0.1	124 43.2	850505	951	1957	0.021	13.838	1923	10.064	4.554
G090A	42 0.0	125 3.0	850506	2258	2249	0.021	13.779	2224	8.748	4.013
G091A	41 59.5	125 58.0	850506	5363	0413	0.021	14.214	0347	8.735	3.882
G092A	42 0.4	126 50.7	850506	5490	0927	0.020	13.284	0900	8.319	3.906
G093A	42 0.2	127 43.0	850506	5451	1441	0.022	14.551	1414	7.895	3.672
G094A	41 59.8	128 38.3	850506	5683	2121	0.021	13.957	2056	9.181	4.136
G095A	41 20.0	128 30.3	850507	5574	0237	0.021	14.129	0210	8.973	4.079
G096A	41 20.2	127 36.1	850507	5255	0806	0.022	14.323	0741	7.591	3.581
G097A	41 20.0	126 43.0	850507	8341	1256	0.028	18.688	1230	8.424	3.936
G098A	41 20.1	125 51.5	850507	5512	1914	0.022	14.563	1847	7.726	3.714
G099A	41 40.0	124 55.0	850508	2137	0020	0.026	17.159	2356	8.366	3.965
G100A	41 40.0	124 30.3	850508	998	0241	0.023	15.455	0216	9.213	4.095
G101A	41 39.4	124 14.1	850508	544	0606	0.022	14.974	0559	6.484	15.437
G102A	41 20.2	124 15.6	850508	991	0851	0.020	13.349	0840	6.629	9.608
G103A	41 20.0	124 36.0	850508	1121	1227	0.021	14.281	1200	7.078	3.504
G104A	41 20.0	124 54.8	850508	1833	1410	0.023	15.482	1345	8.556	3.889
G105A	41 0.1	124 53.4	850508	1972	1716	0.020	13.243	1648	7.784	3.707
G106A	40 59.9	124 35.0	850508	1006	2135	0.020	13.092	2110	8.405	3.946
G107A	40 59.1	124 14.2	850509	653	0453	0.024	15.801	0445	7.222	12.670
G108A	40 38.6	124 25.4	850509	725	0720	0.021	13.897	0714	7.413	20.592
G109A	40 39.9	124 43.1	850509	952	0949	0.019	12.402	0921	9.207	4.185
G110A	40 39.8	125 3.9	850509	2275	1230	0.025	16.391	1206	8.539	3.795
G111A	40 40.1	125 54.9	850509	5224	1732	0.021	14.313	1706	8.744	4.011
G112A	40 40.0	126 47.0	850509	5231	2253	0.021	14.246	2228	8.462	3.936
G113A	40 40.1	127 37.0	850510	5456	0340	0.025	16.566	0315	8.165	3.833
G114A	40 40.0	128 31.3	850510	5699	0910	0.023	15.326	0843	7.822	3.834
G115A	40 0.0	128 19.2	850510	5330	1428	0.024	16.210	1358	8.677	4.017
G116A	39 59.8	127 27.0	850510	5329	1915	0.021	14.003	1848	8.157	3.812
G117A	40 0.0	126 35.0	850510	5469	0020	0.022	14.742	2355	9.646	4.326
G118A	40 0.6	125 44.1	850511	5145	0526	0.022	14.461	0500	8.519	4.057
G119A	40 19.5	125 6.9	850511	1824	0935	0.021	14.246	0908	8.605	4.059
G120A	40 20.3	124 47.1	850511	1025	1156	0.021	13.695	1130	8.843	4.094
G121A	40 20.0	124 27.0	850511	803	1346	0.022	14.785	1333	7.480	8.904
G122A	40 0.0	124 11.0	850511	1018	1631	0.021	13.812	1618	9.476	9.572
G123A	40 0.5	124 31.5	850511	1045	1952	0.021	14.289	1923	7.350	3.621
G124A	40 0.0	124 51.0	850511	1734	2242	0.021	14.313	2217	8.018	3.695

* "A" CONVERTS CATCH TO CATCH PER 10M2, "B" CONVERTS CATCH TO CATCH PER 1000M3 (SEE SMITH AND RICHARDSON 1977)

Table 1b.--Data associated with neuston and bongo tows during cruise 1BA85, April-May 1985 continued.

STAGE: EGG

SPECIES	NEUSTON OCCUR. %	NEUSTON LOG NO. IN AREA	BONGO OCCUR. %	BONGO LOG NO. IN AREA
UNIDENTIFIED	0.81	6.3435	8.06	11.4664
TELEOST TYPE A.	2.42	8.0992	0.81	8.7931
MICROSTOMA MICROSTOMA			0.81	8.9571
BATHYLAGIDAE			20.16	11.2876
BATHYLAGUS SPP.			10.48	10.7397
CHAULIODUS MACOUNI			16.13	11.1658
MYCTOPHIDAE			26.61	12.8753
THERAGRA CHALCOGRAMMA	1.61	7.2623		
COLOLABIS SAIRA			0.81	9.6596
TRACHIPTERUS ALTIVELIS	50.81	9.7897	38.71	11.7257
MELAMPHAEIDAE			0.81	9.2956
SEBASTOLOBUS SPP.			0.81	9.6466
ICOSTEUS AENIGMATICUS	15.32	8.6948	14.52	11.1623
ICICHTHYS LOCKINGTONI	38.71	9.4576	17.74	11.2094
BOTHIDAE	4.03	8.1766	4.03	10.3918
PLEURONECTIDAE	7.26	8.2223	8.06	11.0948
GLYPTOCEPHALUS ZACHIRUS	11.29	8.0284	15.32	10.6744
HIPPOGLOSSOIDES ELASSODON	1.61	6.8597		
ISOPSETTA ISOLEPIS			0.81	8.8323
LYOPSETTA EXILIS	14.52	8.1635	31.45	11.4300
MICROSTOMUS PACIFICUS	20.97	9.0949	15.32	10.7988
PAROPHRYS VETULUS	1.61	6.7306	2.42	9.4110
PLATICHTHYS STELLATUS	2.42	6.7759	0.81	8.7931
PLEURONICHTHYS DECURRENS	1.61	7.3260	0.81	9.1083
PSETTICHTHYS MELANOSTICTUS	1.61	6.7306		
HIPPOGLOSSUS STENOLEPIS			1.61	9.8218

Table 2.--Fish eggs collected in bongo and neuston tows during cruise 1BA85, April-May 1985.

STAGE: LARVAE

SPECIES	NEUSTON OCCUR. %	NEUSTON LOG NO. IN AREA	BONGO OCCUR. %	BONGO LOG NO. IN AREA
UNIDENTIFIED	0.81	6.2888	0.81	9.2220
DISINTEGRATED	1.61	6.5039	4.03	10.5200
CLUPEA HARENGUS PALLASI			0.81	8.7923
OSMERIDAE			4.84	11.3103
NANSENIA CANDIDA			0.81	9.6351
BATHYLAGIDAE			1.61	10.0542
BATHYLAGUS SPP.			1.61	10.1269
BATHYLAGUS MILLERI			0.81	9.6292
BATHYLAGUS OCHOTENSIS	0.81	7.0390	36.29	11.9000
BATHYLAGUS PACIFICUS			16.13	10.9051
ARGYROPELECUS SLADENI			0.81	9.6707
CHAULIODUS MACOUNI			5.65	10.4275
MYCTOPHIDAE			9.68	11.0089
DIAPHUS THETA			24.19	12.4884
LAMPANYCTUS SPP.			7.26	11.0597
LAMPANYCTUS REGALIS			1.61	10.0947
LAMPANYCTUS RITTERI			1.61	10.0420
STENOBRACHIUS LEUCOPSARUS	1.61	7.1055	61.29	12.7817
TARLETONBEANIA CRENULARIS	4.84	7.5833	33.87	11.8457
PROTOMYCTOPHUM CROCKERI			19.35	11.2339
PROTOMYCTOPHUM THOMPSONI			19.35	11.1353
LOWEINA RARA			0.81	9.5249
LESTIDIOPS RINGENS			11.29	10.9633
GADUS MACROCEPHALUS			0.81	9.0835
MICROGADUS PROXIMUS			3.23	10.1124
THERAGRA CHALCOGRAMMA			0.81	8.7928
OPHIDIIDAE			1.61	10.1346
COLOLABIS SAIRA	4.03	7.8105		
TRACHIPTERUS ALTIVELIS			1.61	9.7732
MELAMPHAEIDAE			1.61	10.3135
MELAMPHAES SPP.			1.61	9.9725
MELAMPHAES LUGUBRIS			4.03	10.3034
SEBASTES SPP.	16.94	8.9128	34.68	11.6173
SEBASTES PAUCISPINUS			1.61	9.9642
SEBASTOLOBUS SPP.			10.48	10.8332
ANOPLOPOMA FIMBRIA	50.81	9.3918	1.61	9.9352

Table 3a.--Fish larvae collected in bongo and neuston tows during cruise 1BA85, April-May 1985.

STAGE: LARVAE

SPECIES	NEUSTON OCCUR. %	NEUSTON LOG NO. IN AREA	BONGO OCCUR. %	BONGO LOG NO. IN AREA
HEXAGRAMMIDAE	1.61	7.3387		
HEXAGRAMMOS SPP.	0.81	6.8373		
HEXAGRAMMOS DECAGRAMMUS	37.10	8.9466		
HEXAGRAMMOS LAGOCEPHALUS	0.81	7.0252		
OPHIODON ELONGATUS	7.26	8.4623	0.81	9.1431
ARTEDIUS SPP.			0.81	9.7538
ARTEDIUS FENESTRALIS	0.81	6.2306	3.23	9.5396
ARTEDIUS HARRINGTONI			5.65	9.7415
ARTEDIUS MEANYI			0.81	8.6064
HEMILEPIDOTUS HEMILEPIDOTUS	8.06	8.0319		
HEMILEPIDOTUS SPINOSUS	24.19	9.6670	3.23	9.9104
LEPTOCOTTUS ARMATUS	0.81	6.2580		
RADULINUS ASPRELLUS	0.81	6.1169	3.23	9.4085
SCORPAENICHTHYS MARMORATUS	10.48	8.0117	0.81	9.1675
AGONIDAE			0.81	8.8323
CYCLOPTERIDAE	2.42	6.8617	15.32	10.4357
LIPARIS PULCHELLUS			0.81	8.6765
RONQUILUS JORDANI	0.81	6.1791	1.61	9.6589
STICHAEIDAE			0.81	8.4913
POROCLINUS ROTHROCKI			0.81	8.9863
LYCONECTES ALEUTENSIS	4.03	8.3100	0.81	8.9648
PHOLIS SPP.			0.81	9.1083
ICOSTEUS AENIGMATICUS			1.61	9.9183
AMMODYTES HEXAPTERUS	2.42	7.3587	1.61	9.4019
ICICHTHYS LOCKINGTONI			1.61	9.9163
PLEURONECTIDAE			1.61	9.2693
ATHERESTHES STOMIAS			0.81	9.4673
ISOPSETTA ISOLEPIS			4.03	10.1807
LYOPSETTA EXILIS			3.23	10.0758
MICROSTOMUS PACIFICUS			2.42	9.4190
PAROPHRYS VETULUS	1.61	6.5983	0.81	8.7923
PLATICHTHYS STELLATUS			0.81	8.9074
PSETTICHTHYS MELANOSTICTUS			0.81	8.8507

Table 3b.--Fish larvae collected in bongo and neuston tows during cruise 1BA85, April-May 1985 continued.

STAGE: JUVENILE

SPECIES	NEUSTON OCCUR. %	NEUSTON LOG NO. IN AREA	BONGO OCCUR. %	BONGO LOG NO. IN AREA
NANSENIA CANDIDA			1.61	9.9813
BATHYLAGUS OCHOTENSIS			0.81	9.6009
CHAULIODUS MACOUNI			0.81	8.9963
MYCTOPHIDAE	0.81	6.1898		
DIAPHUS THETA			2.42	10.1106
LAMPANYCTUS RITTERI			0.81	9.6408
STENOBRACHIUS LEUCOPSARUS			10.48	10.6174
TARLETONBEANIA CRENULARIS	18.55	9.1245		
PROTOMYCTOPHUM CROCKERI			1.61	9.2160
SEBASTES SPP.			0.81	8.9571
XENERETMUS LATIFRONS	0.81	6.3146		
AMMODYTES HEXAPTERUS	5.65	7.7241		

Table 4.--Juvenile fish collected in bongo and neuston tows during cruise 1BA85, April-May 1985.

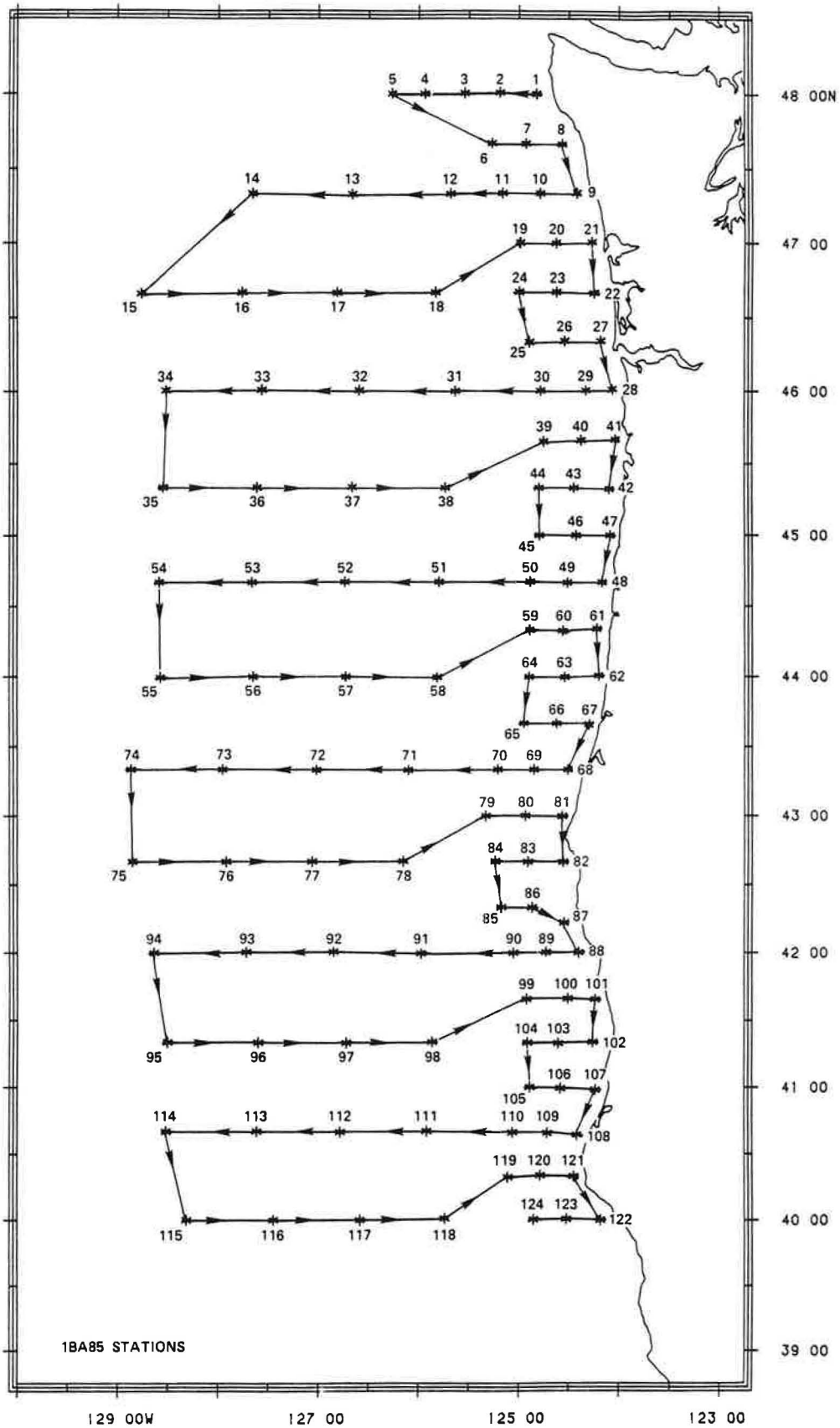

Figure 1.--Bongo and neuston station locations and cruise track for cruise 1BA85, April-May 1985.

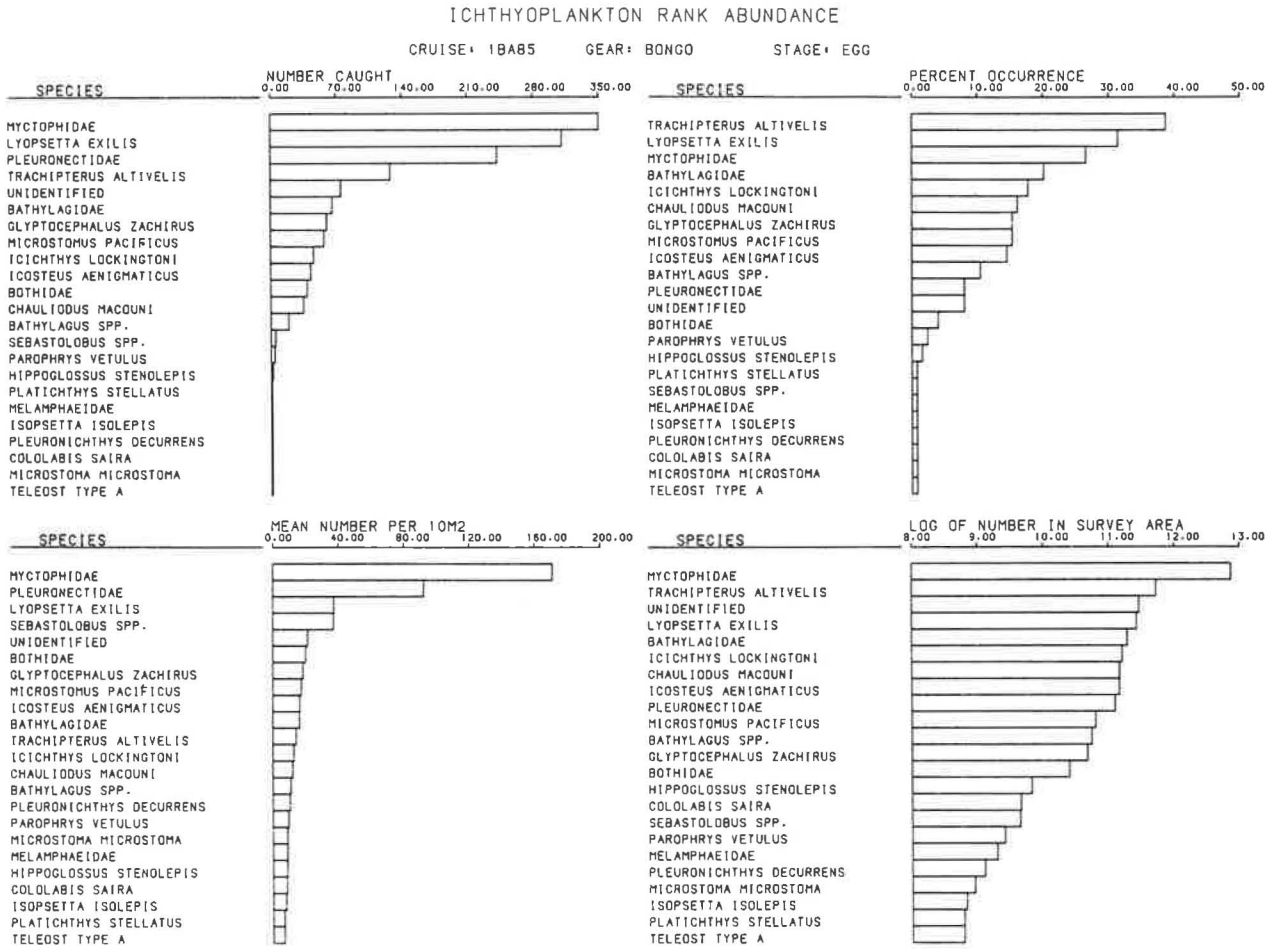

Figure 2.--Rank abundance of fish eggs caught in bongo tows during cruise 1BA85, April-May 1985.

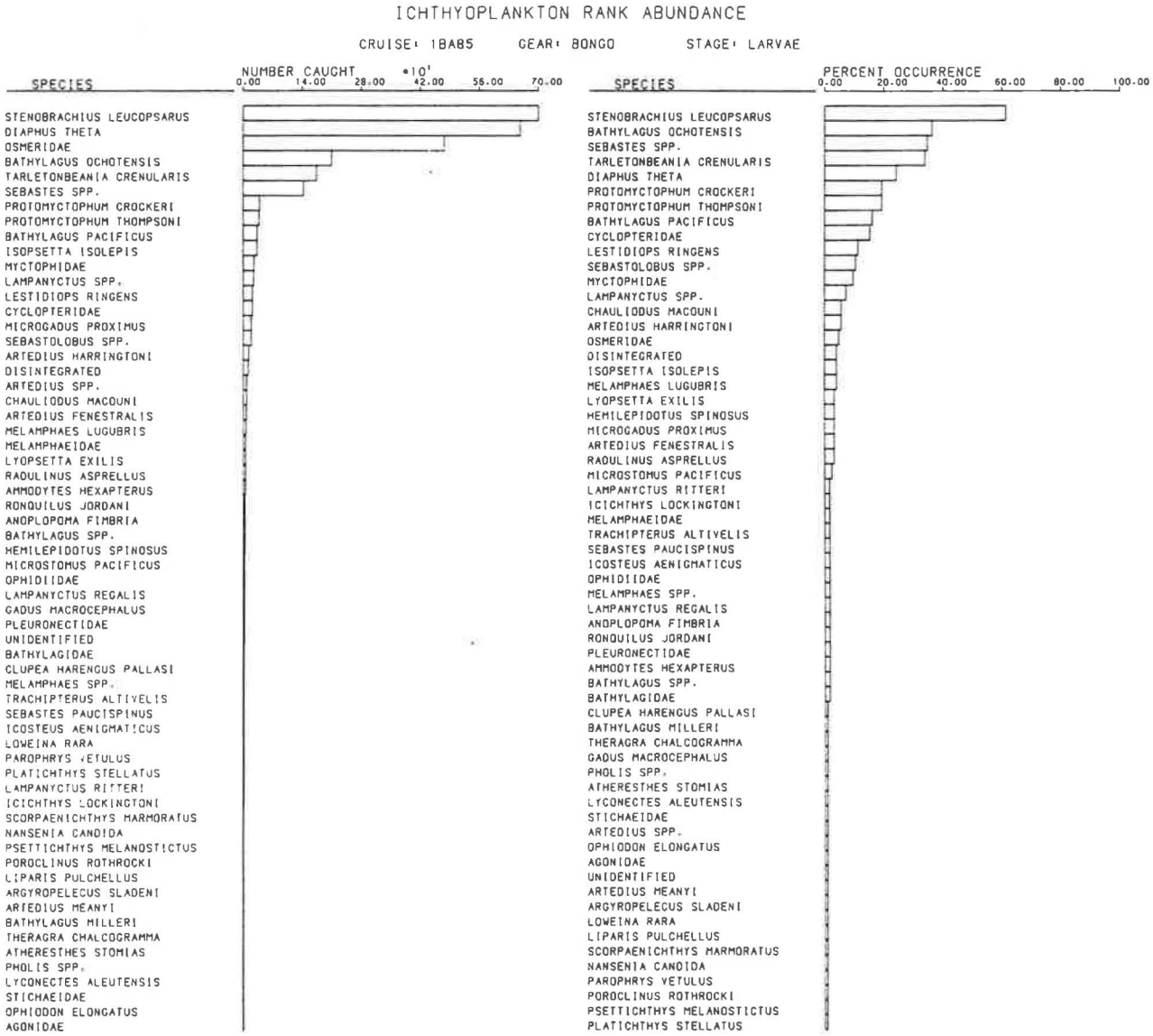

Figure 3a.--Rank abundance of fish larvae caught in bongo tows during cruise 1BA85, April-May 1985.

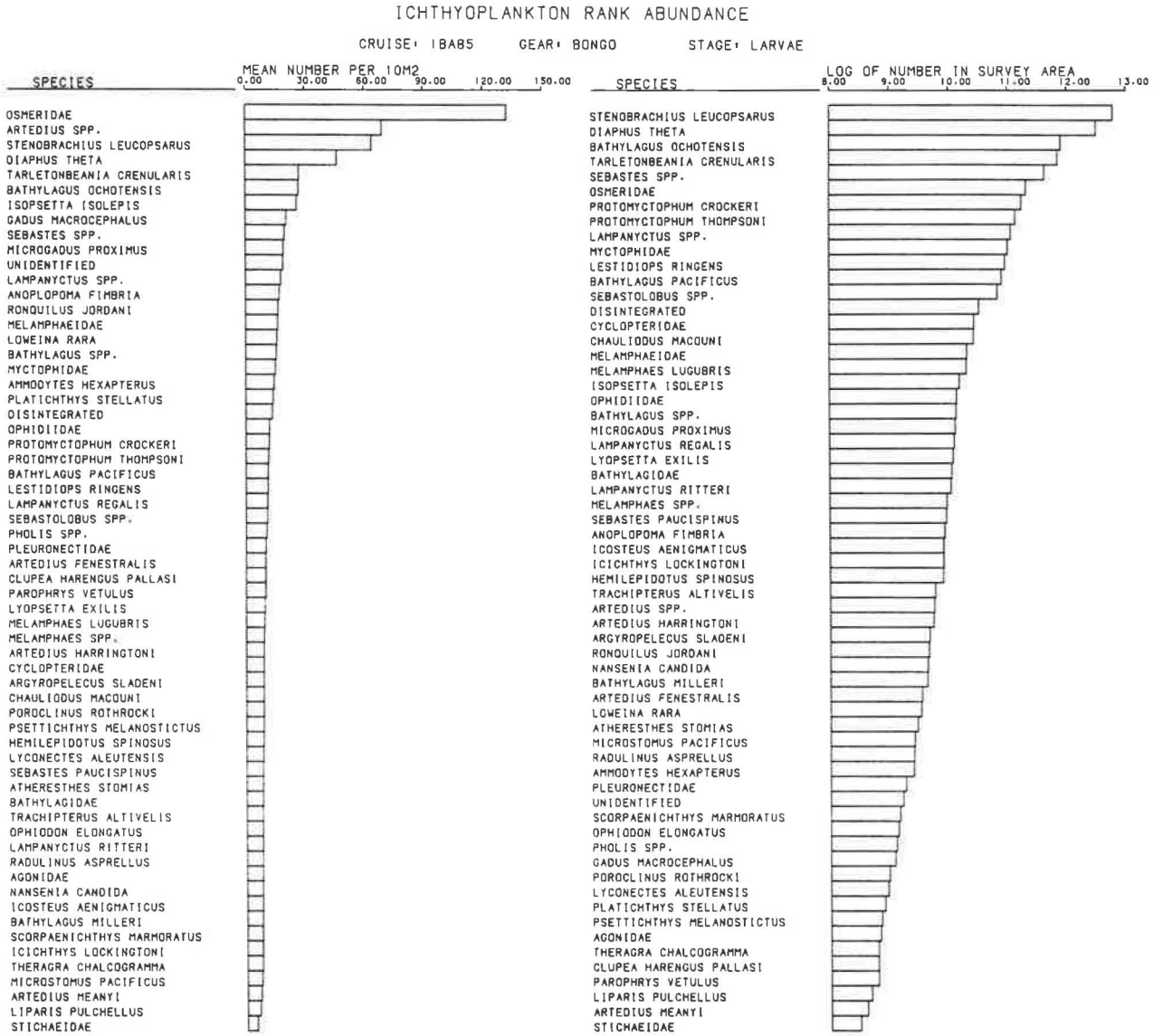

Figure 3b.--Rank abundance of fish larvae caught in bongo tows during cruise 1BA85, April-May 1985 continued.

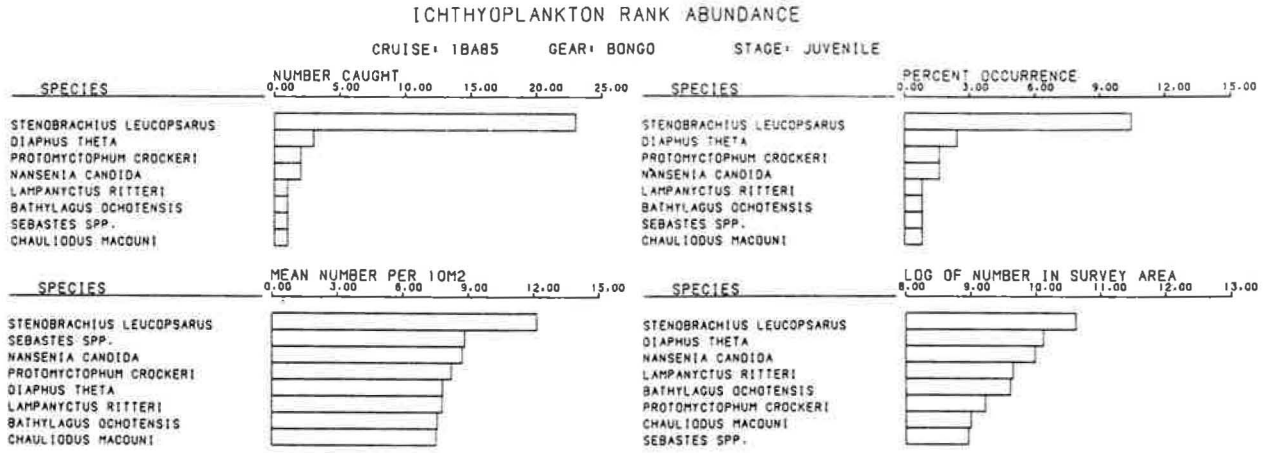

Figure 4.--Rank abundance of juvenile fish caught in bongo tows during cruise 1BA85, April-May 1985.

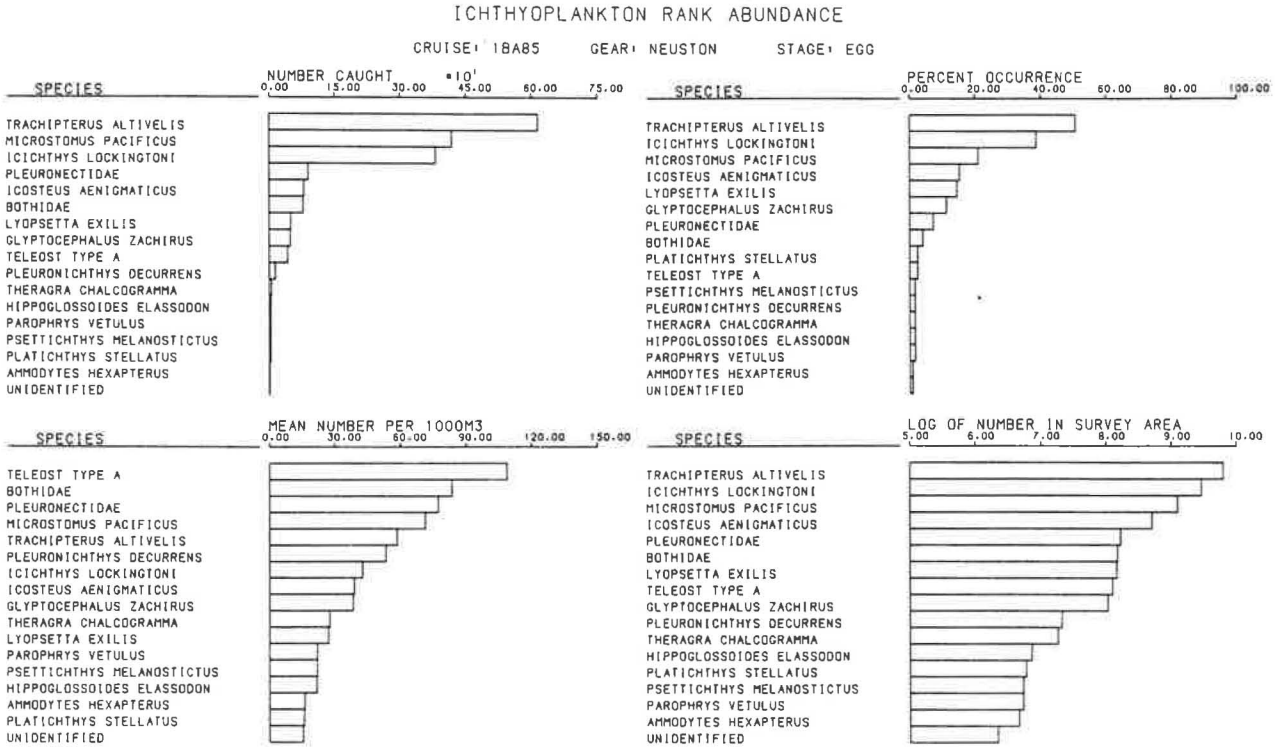

Figure 5.--Rank abundance of fish eggs caught in neuston tows during cruise 1BA85, April-May 1985.

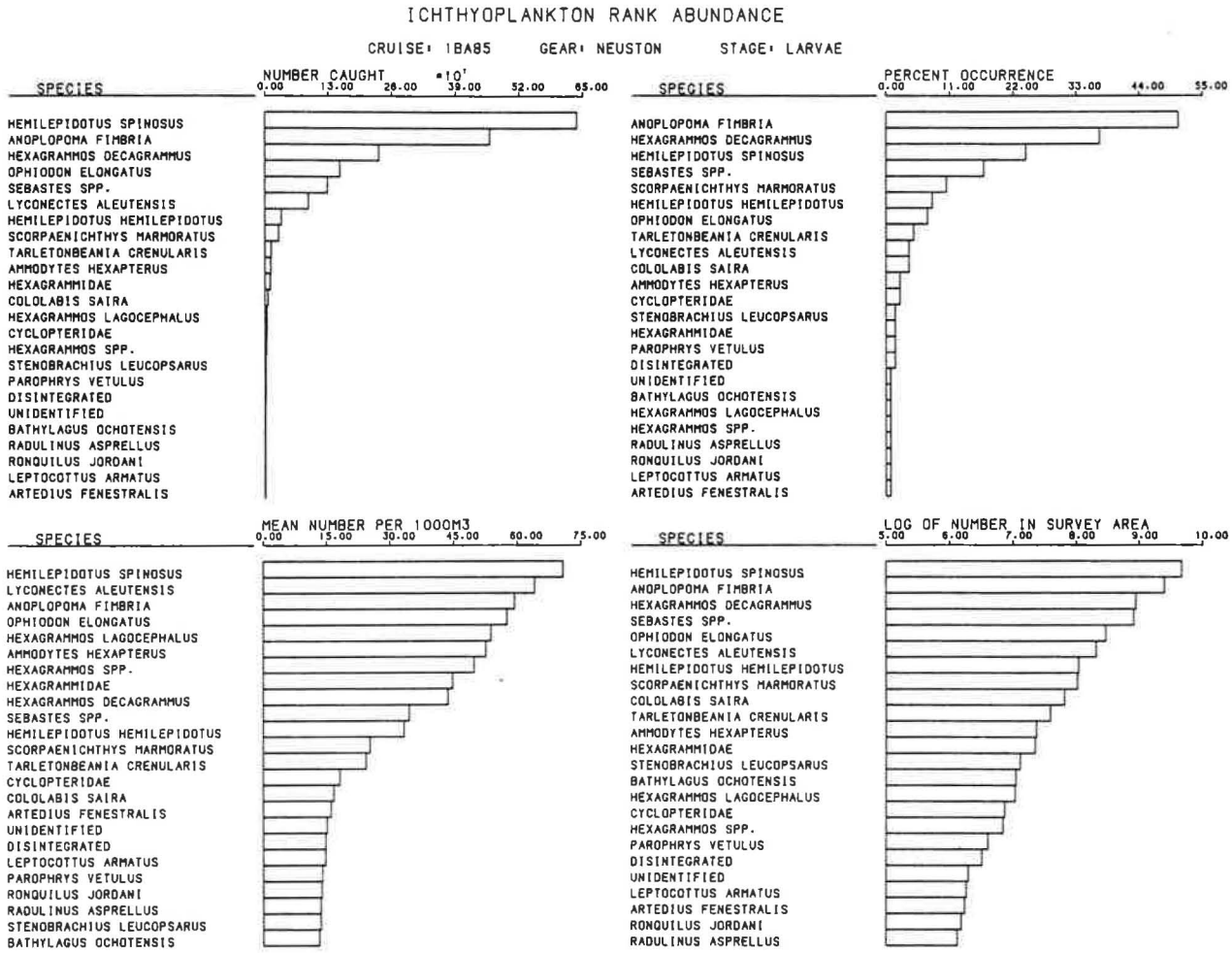

Figure 6.--Rank abundance of fish larvae caught in neuston tows during cruise 1BA85, April-May 1985.

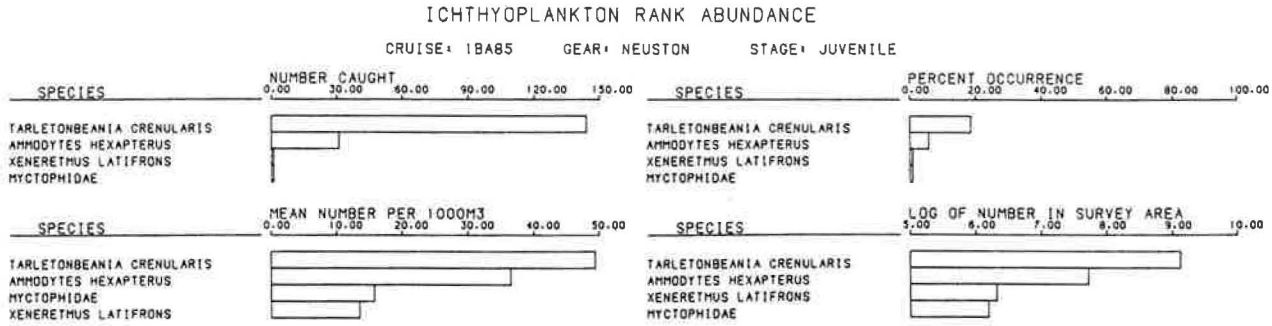

Figure 7.--Rank abundance of juvenile fish caught in neuston tows during cruise 1BA85, April-May 1985.

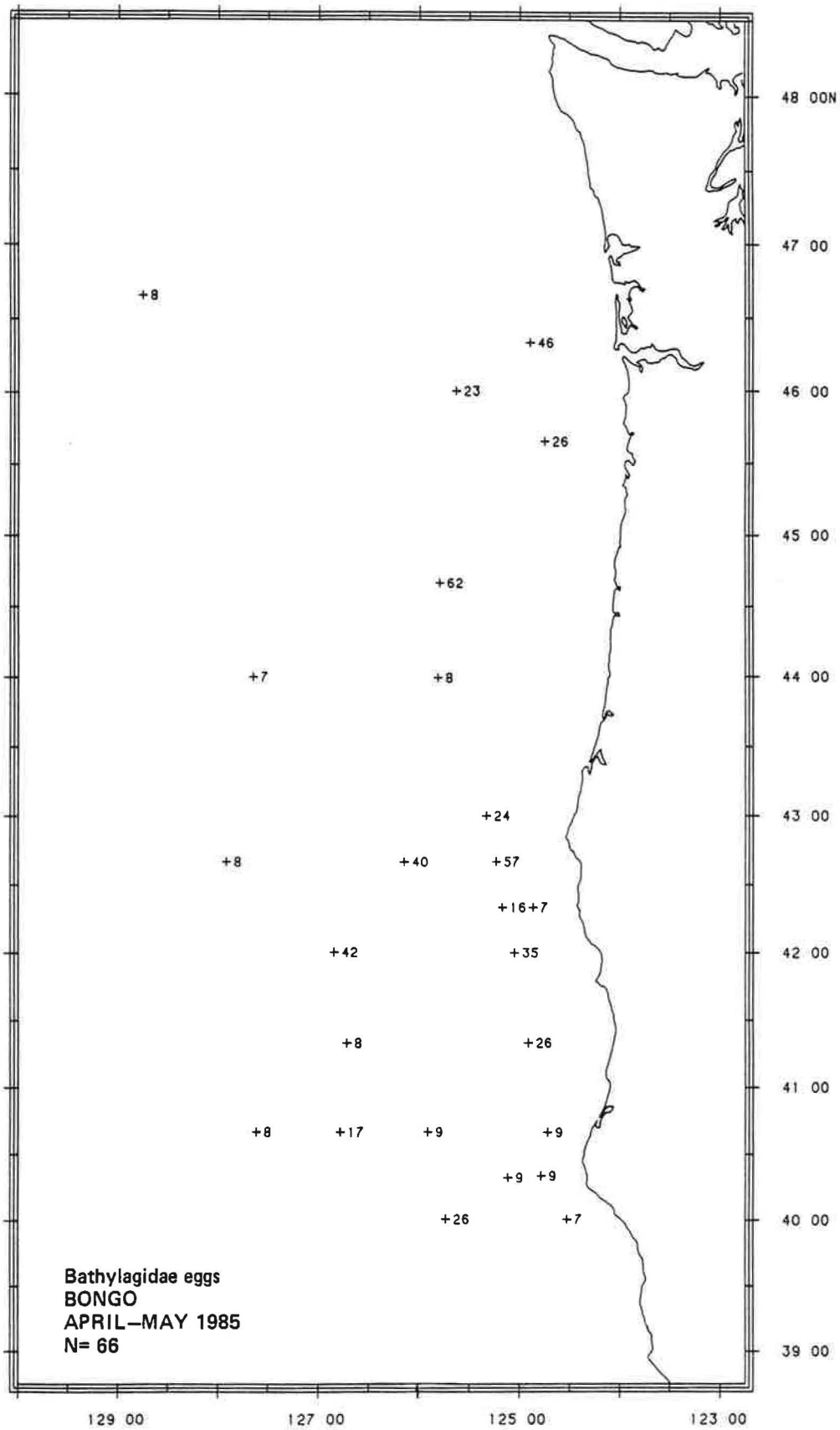

Figure 8.--Distribution of Bathylagidae eggs from bongo tows during cruise 1BA85, April-May 1985. Abundance expressed as number per 10 m^2.

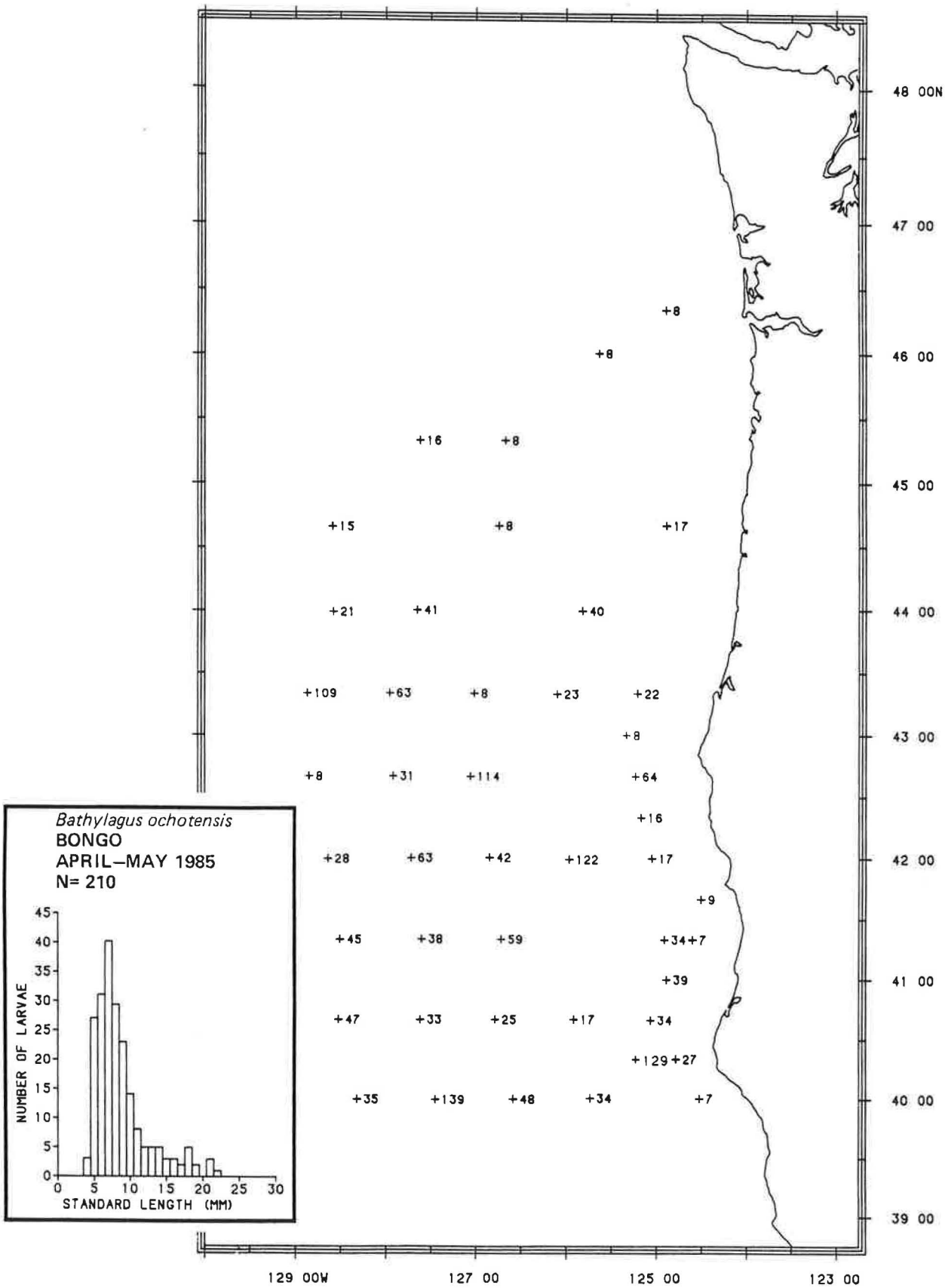

Figure 9.--Distribution of Bathylagus ochotensis larvae from bongo tows during cruise 1BA85, April-May 1985. Abundance expressed as number per 10 m^2.

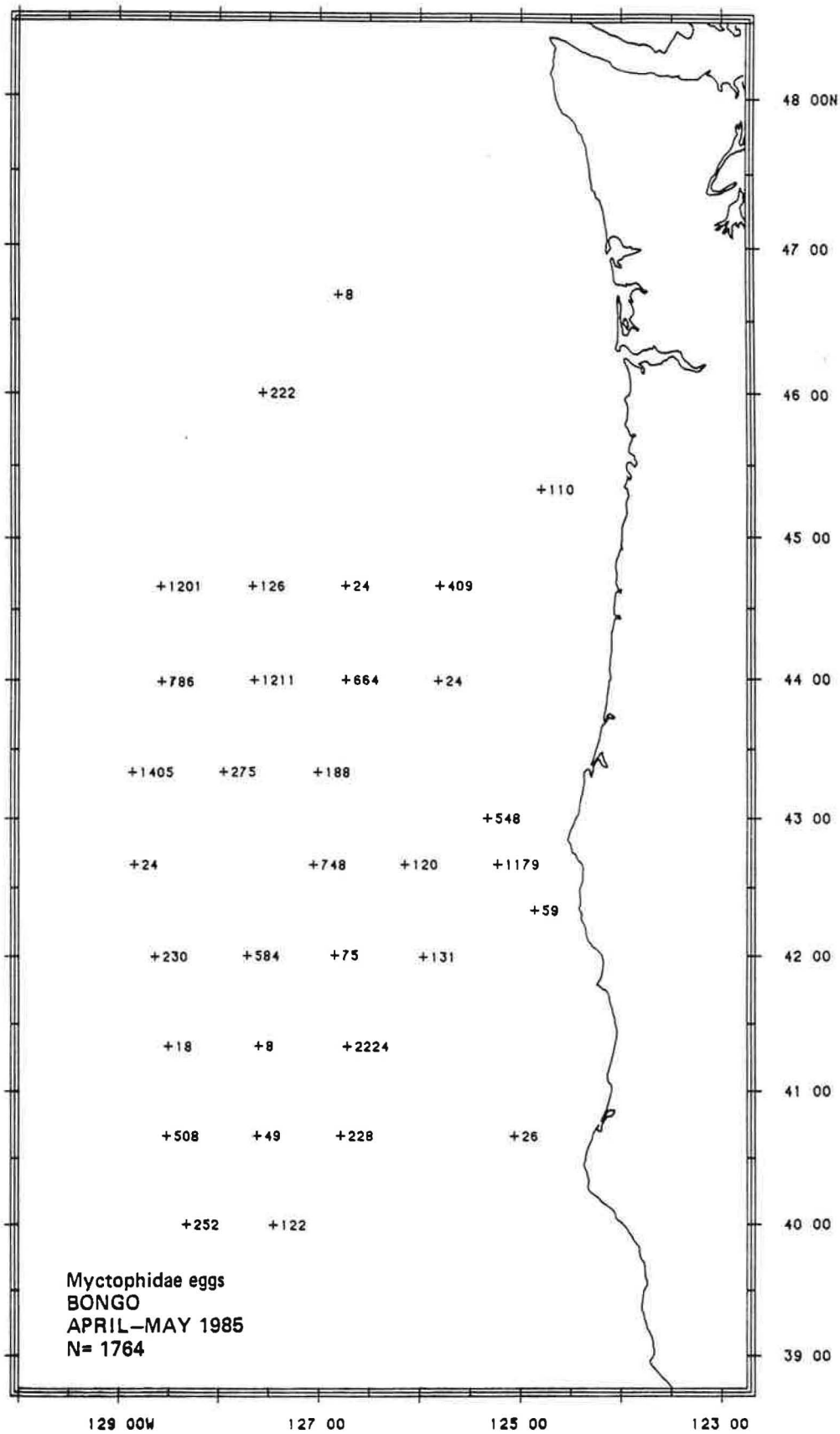

Figure 10.--Distribution of Myctophidae eggs from bongo tows during cruise 1BA85, April-May 1985. Abundance expressed as number per 10 m^2.

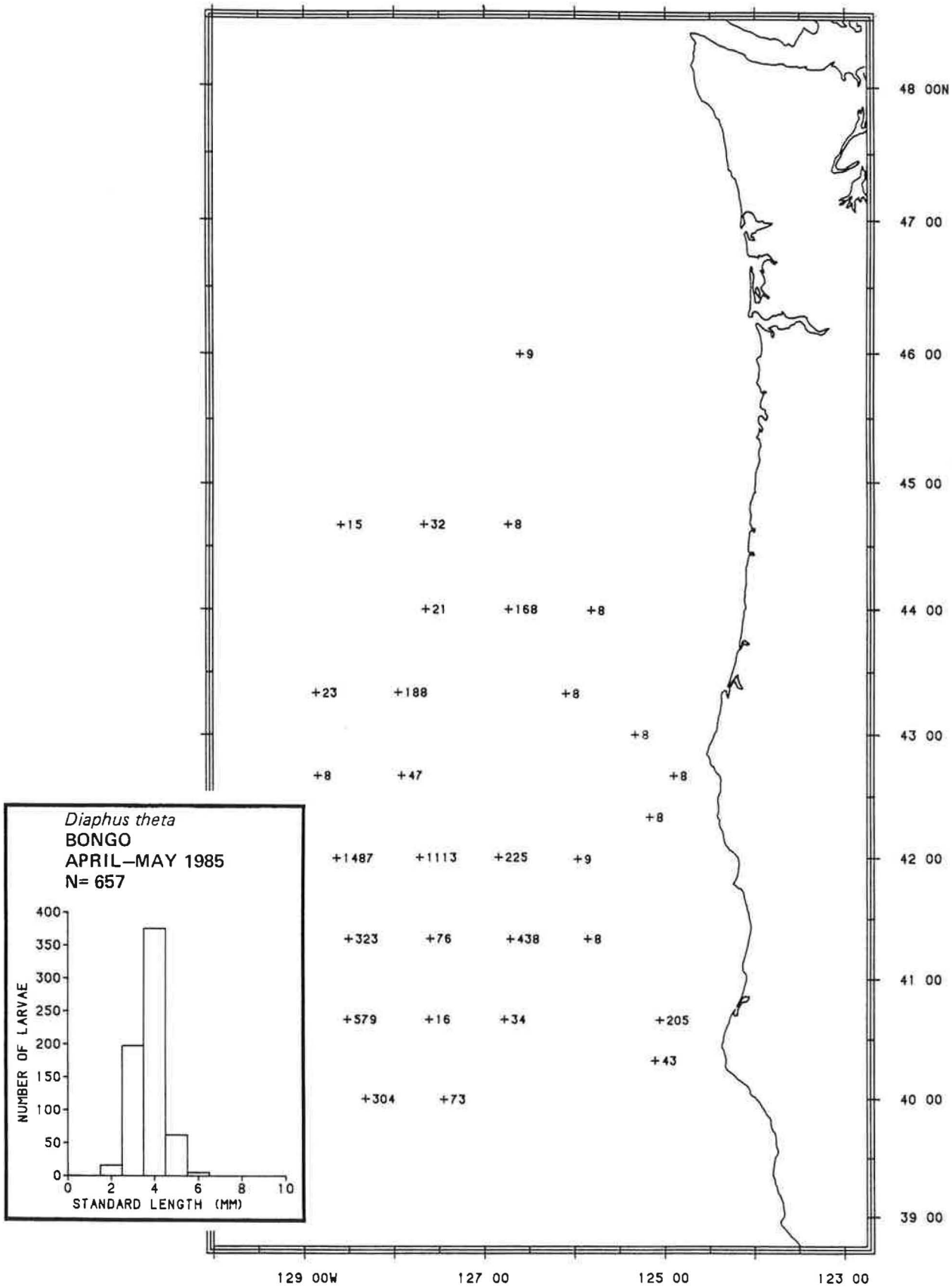

Figure 11.--Distribution of Diaphus theta larvae from bongo tows during cruise 1BA85, April-May 1985. Abundance expressed as number per 10 m^2.

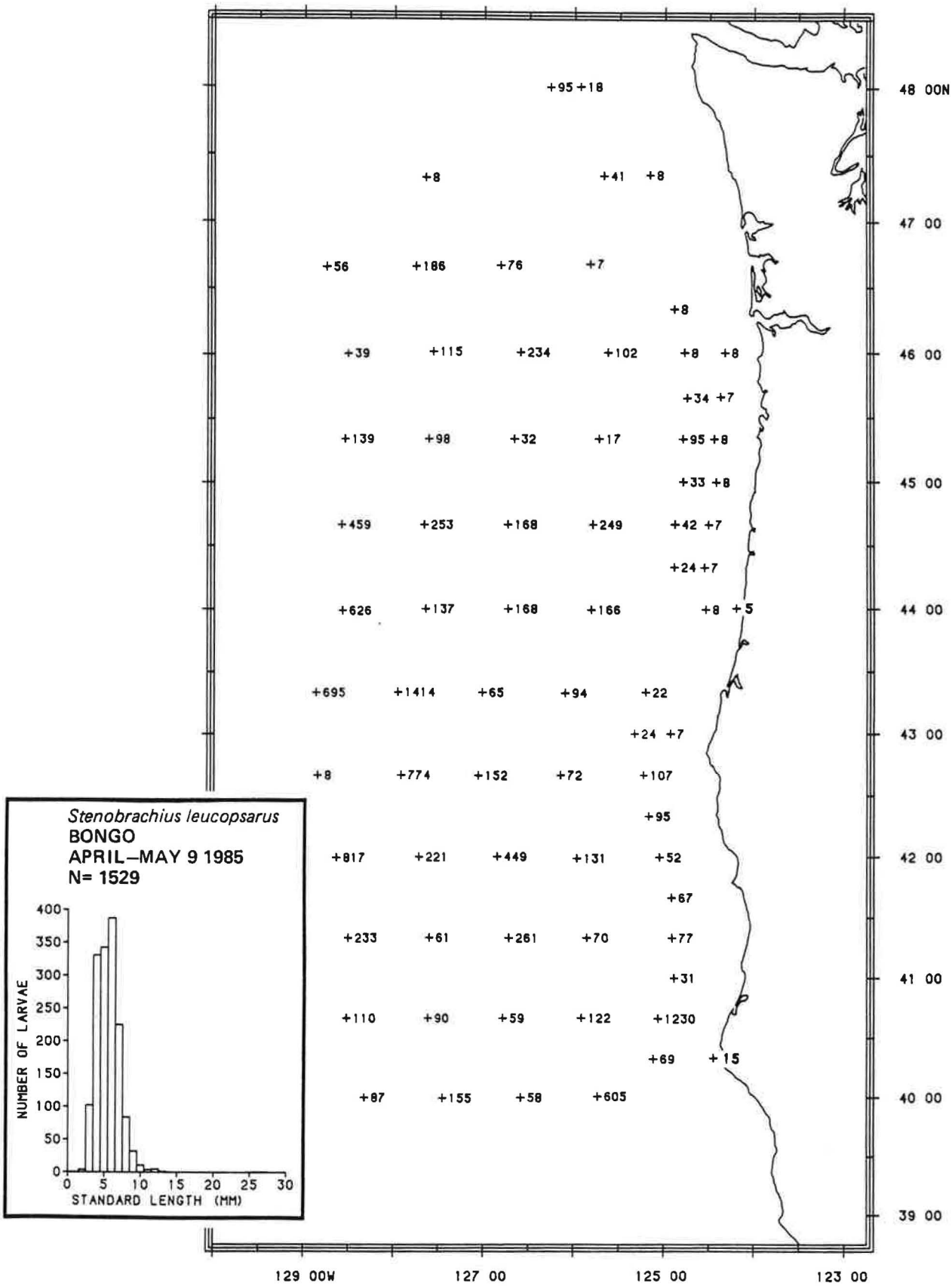

Figure 12.--Distribution of Stenobrachius leucopsarus larvae from bongo tows during cruise 1BA85, April-May 1985. Abundance expressed as number per 10 m^2.

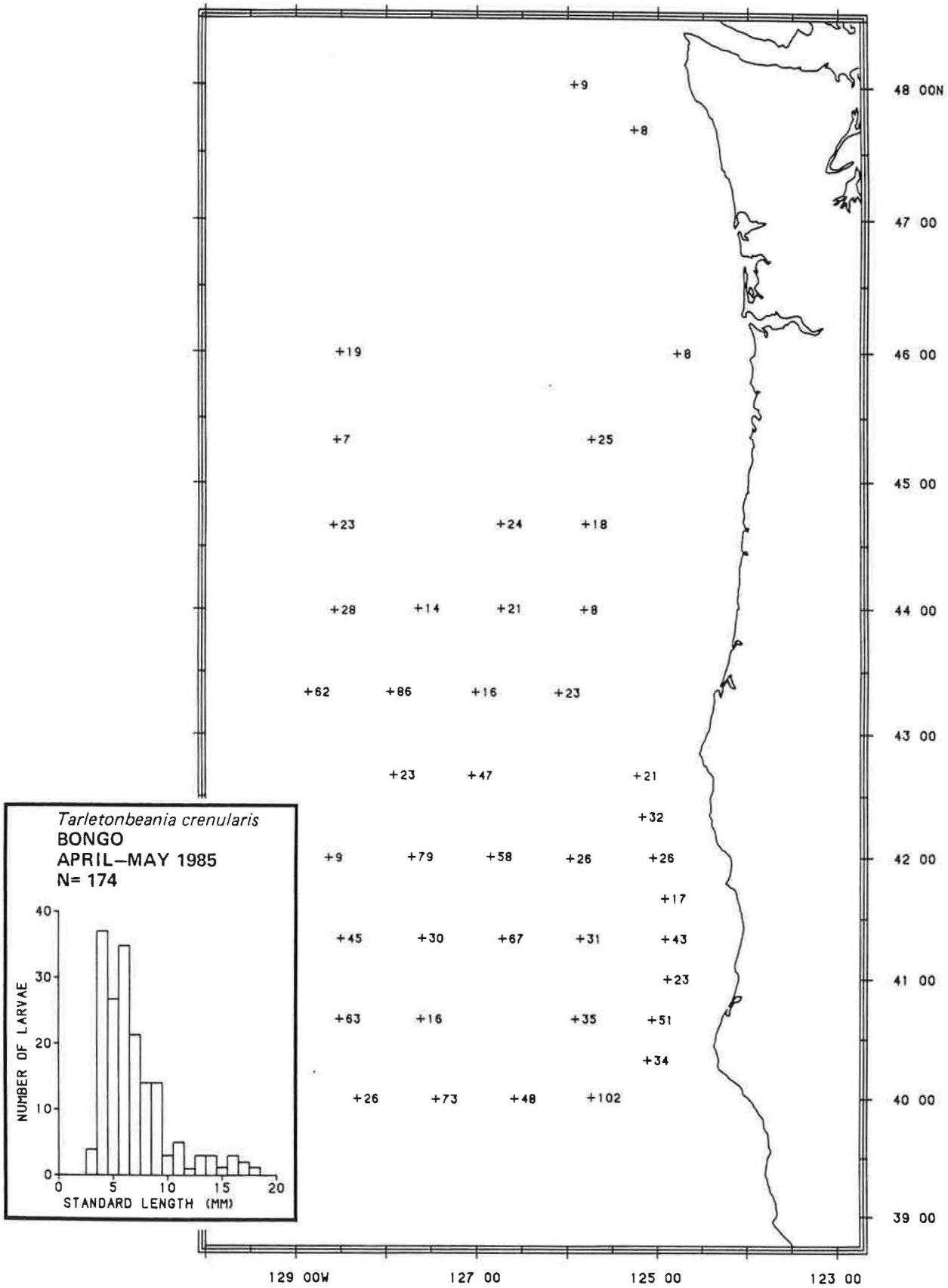

Figure 13.--Distribution of Tarletonbeania crenularis larvae from bongo tows during cruise 1BA85, April-May 1985. Abundance expressed as number per 10 m^2.

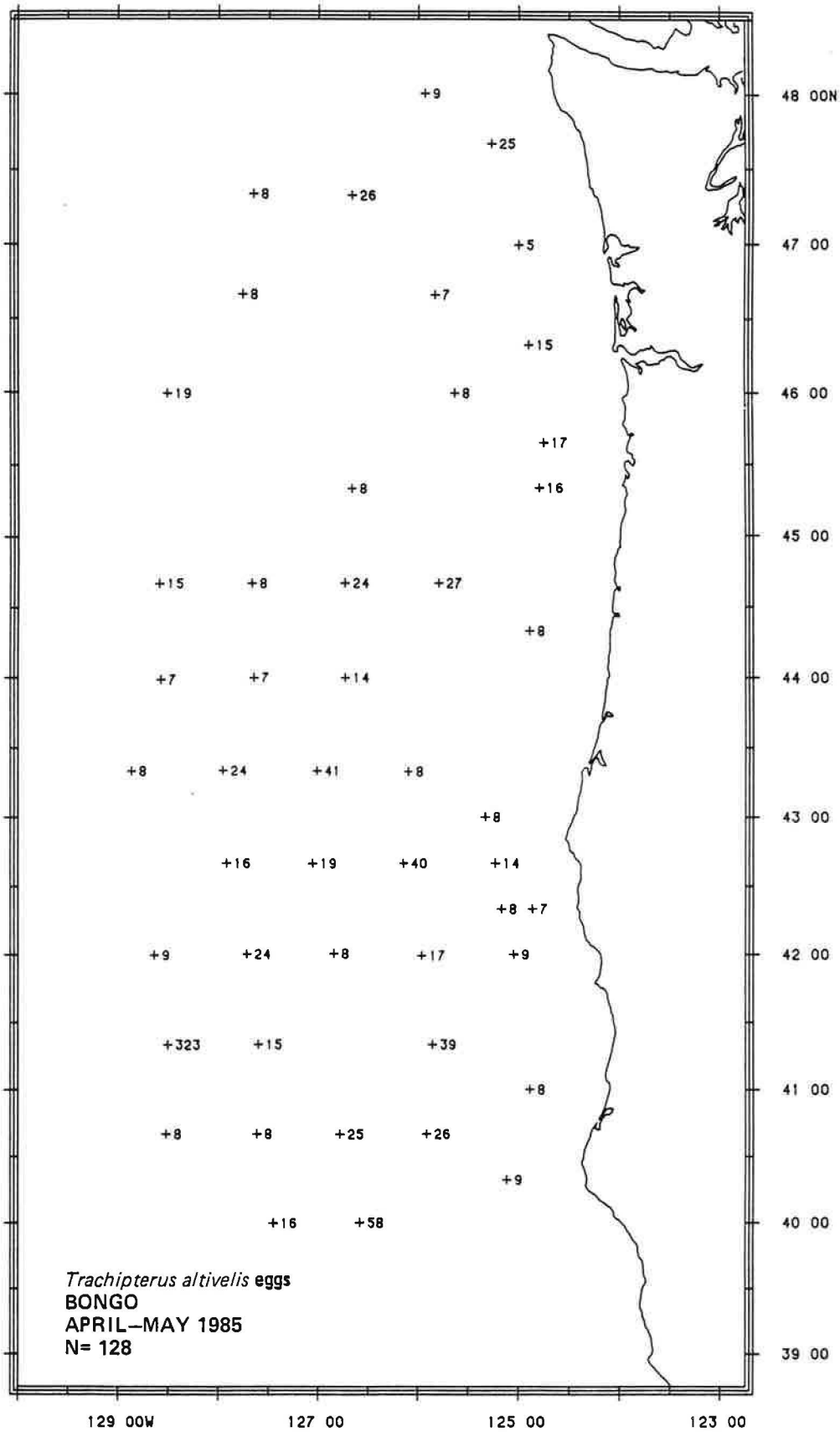

Figure 14.--Distribution of Trachipterus altivelis eggs from bongo tows during cruise 1BA85, April-May 1985. Abundance expressed as number per 10 m^2.

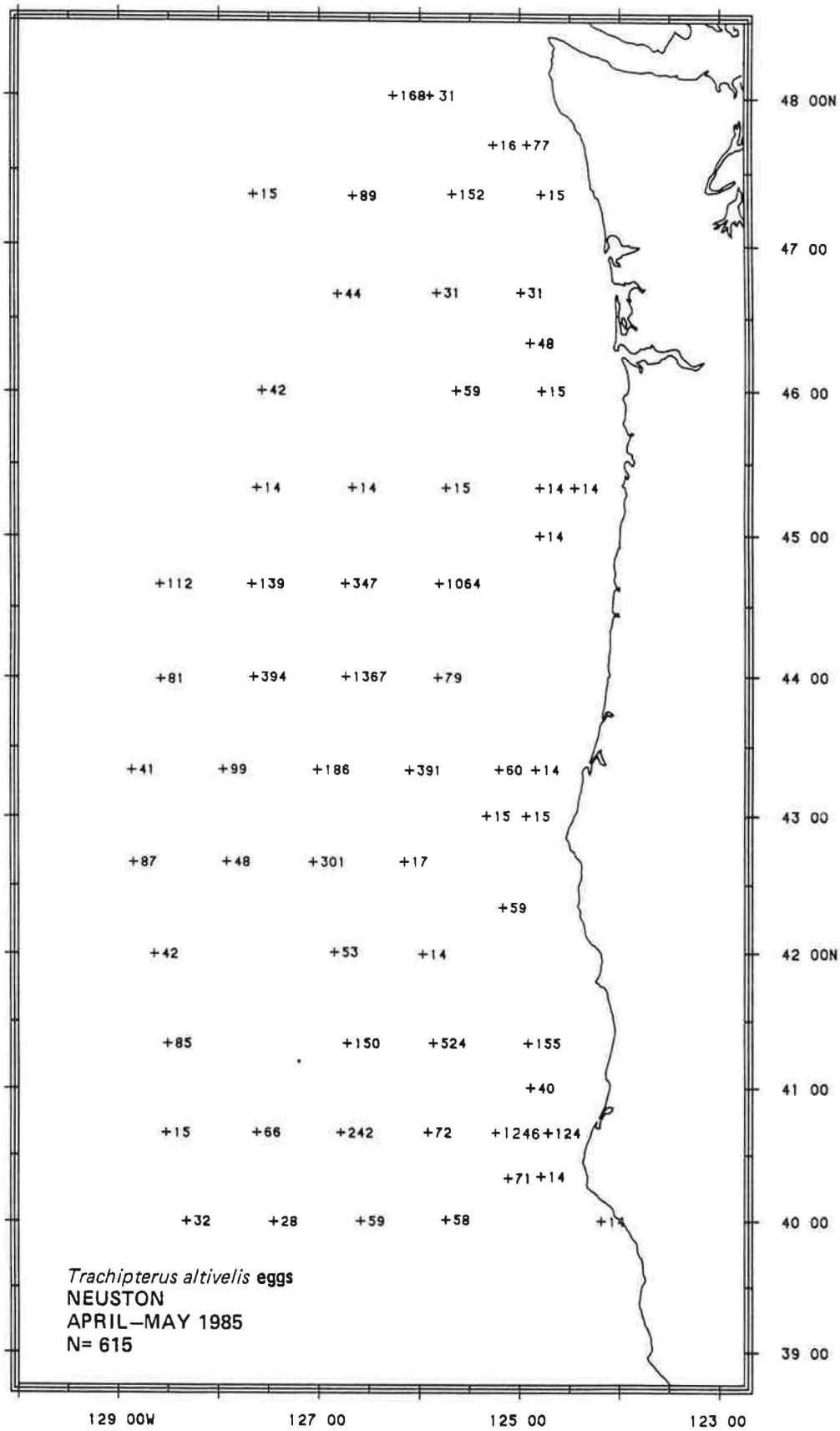

Figure 15.--Distribution of Trachipterus altivelis eggs from neuston tows during cruise 1BA85, April-May 1985. Abundance expressed as number per 1,000 m^3.

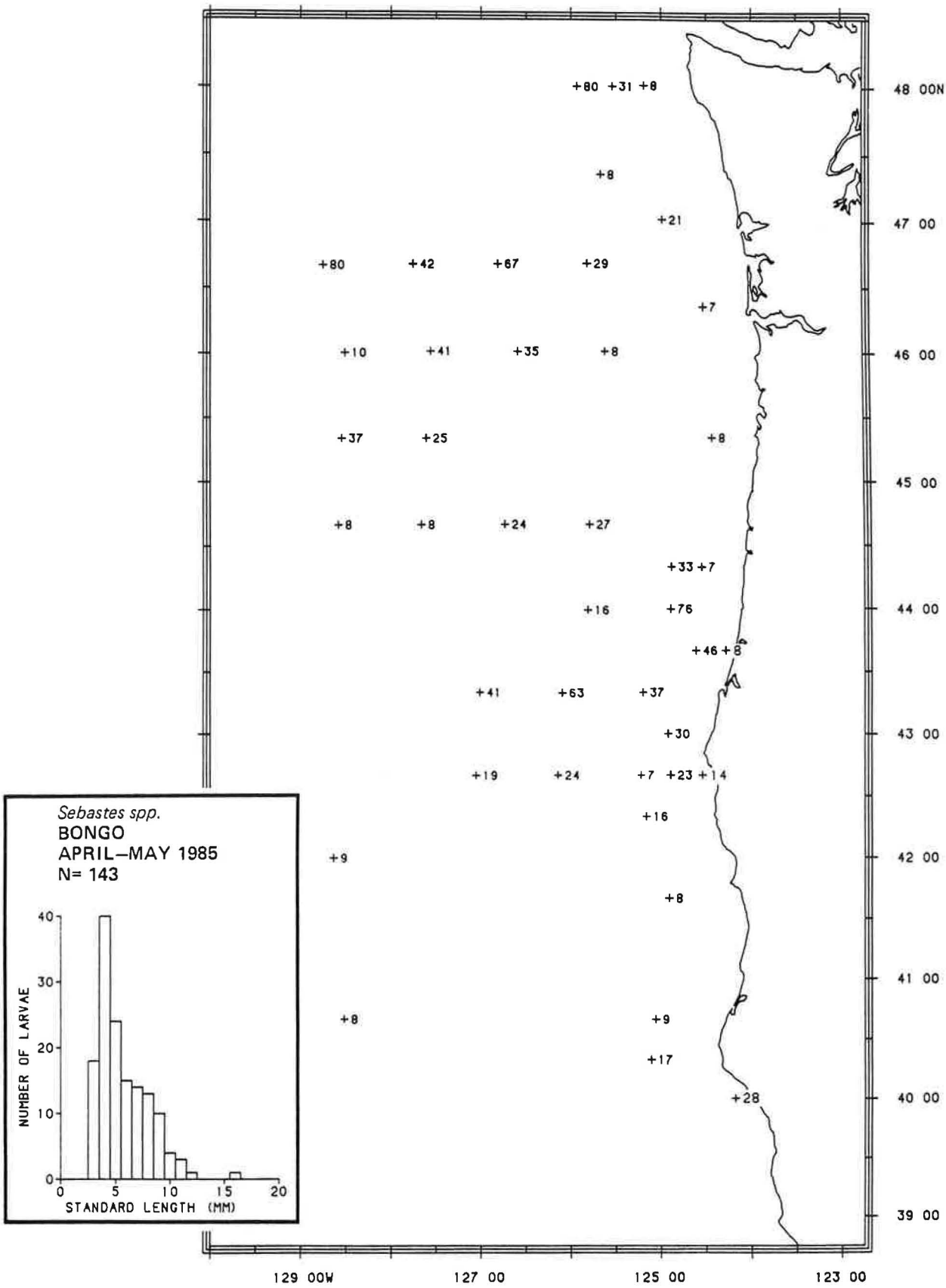

Figure 16.--Distribution of Sebastes spp. larvae from bongo tows during cruise 1BA85, April-May 1985. Abundance expressed as number per 10 m^2.

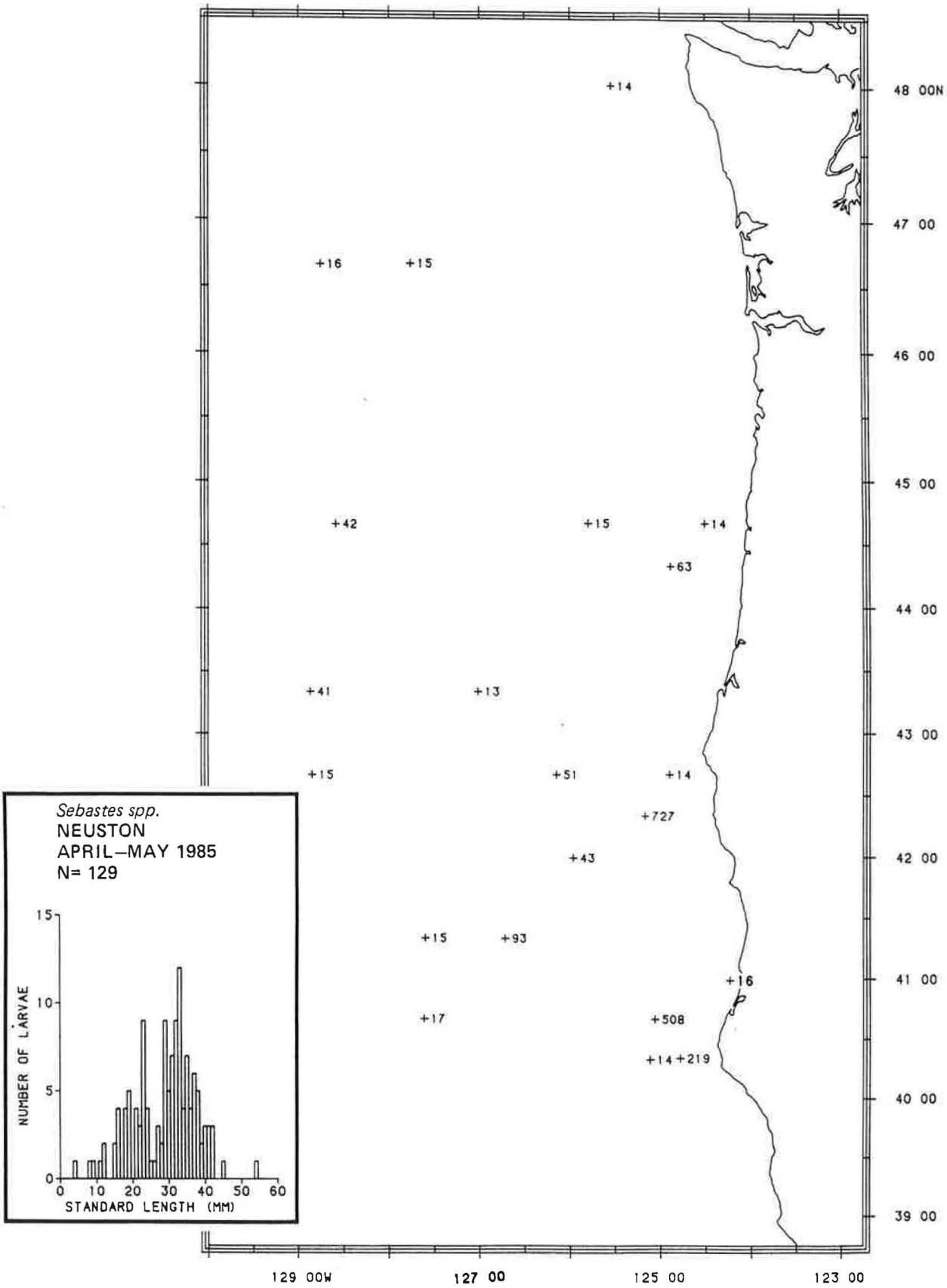

Figure 17.--Distribution of Sebastes spp. larvae from neuston tows during cruise 1BA85, April-May 1985. Abundance expressed as number per 1,000 m^3.

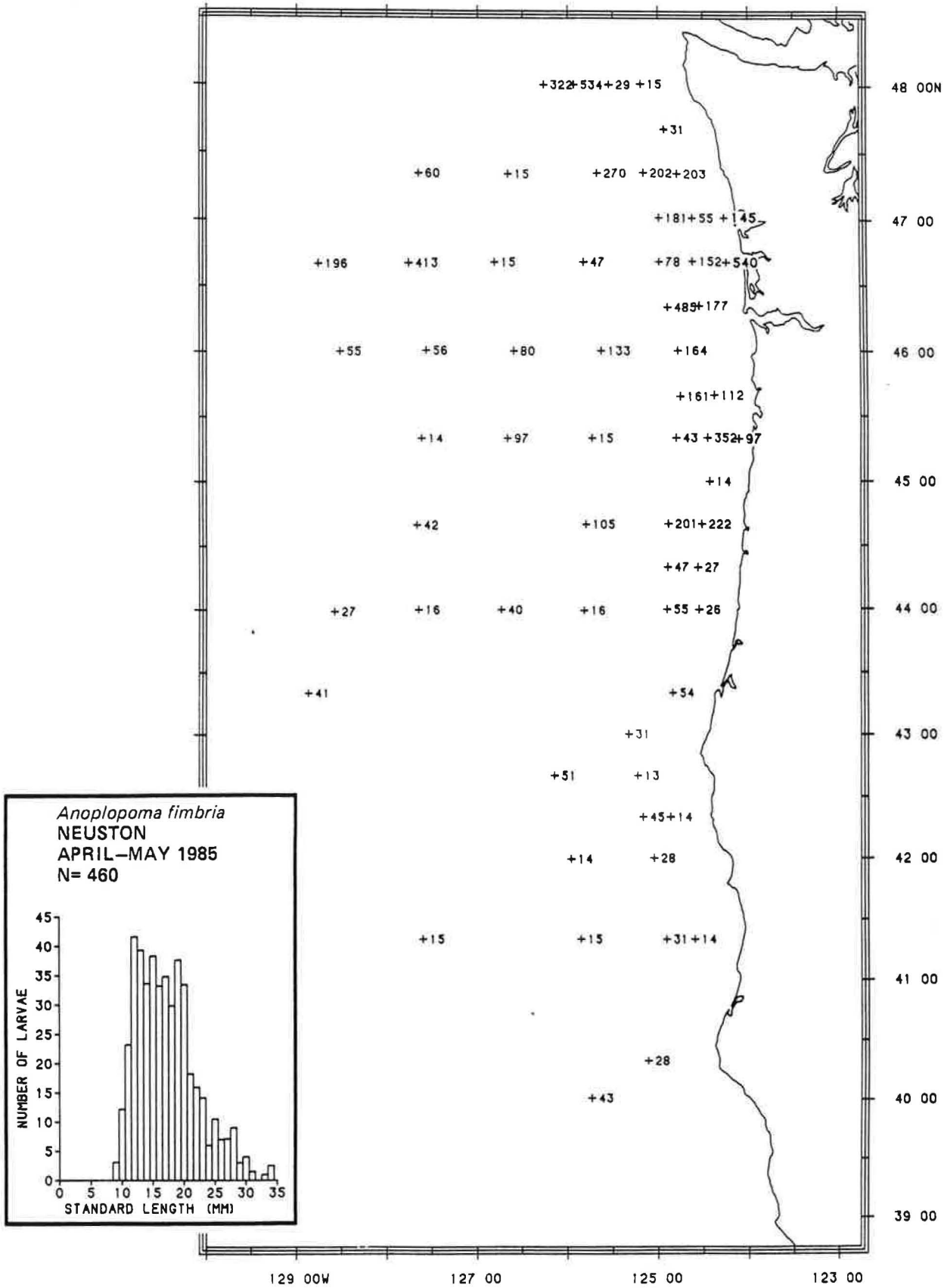

Figure 18.--Distribution of Anoplopoma fimbria larvae from neuston tows during cruise 1BA85, April-May 1985. Abundance expressed as number per 1,000 m^3.

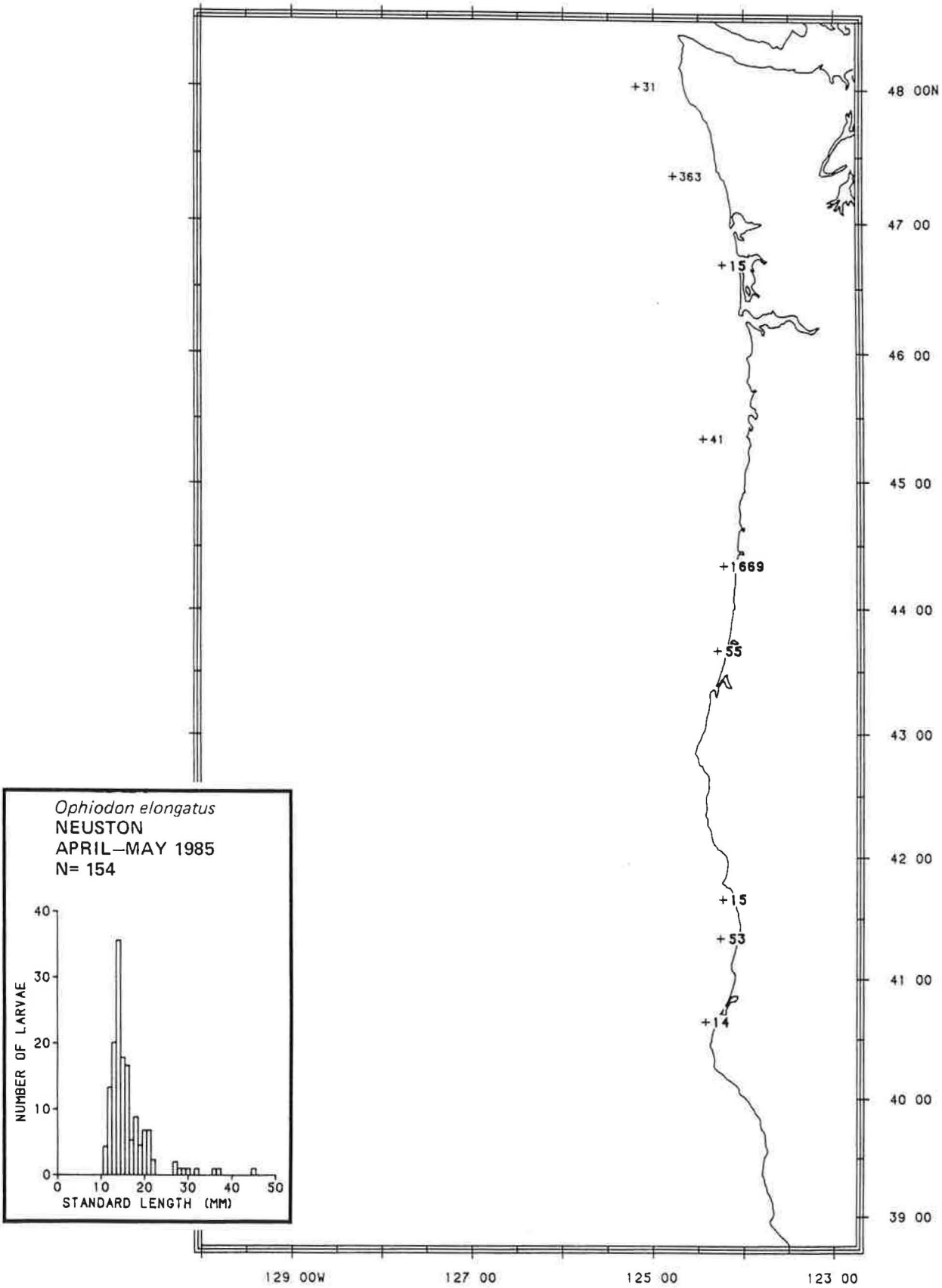

Figure 19.--Distribution of Ophiodon elongatus larvae from neuston tows during cruise 1BA85, April-May 1985. Abundance expressed as number per 1,000 m^3.

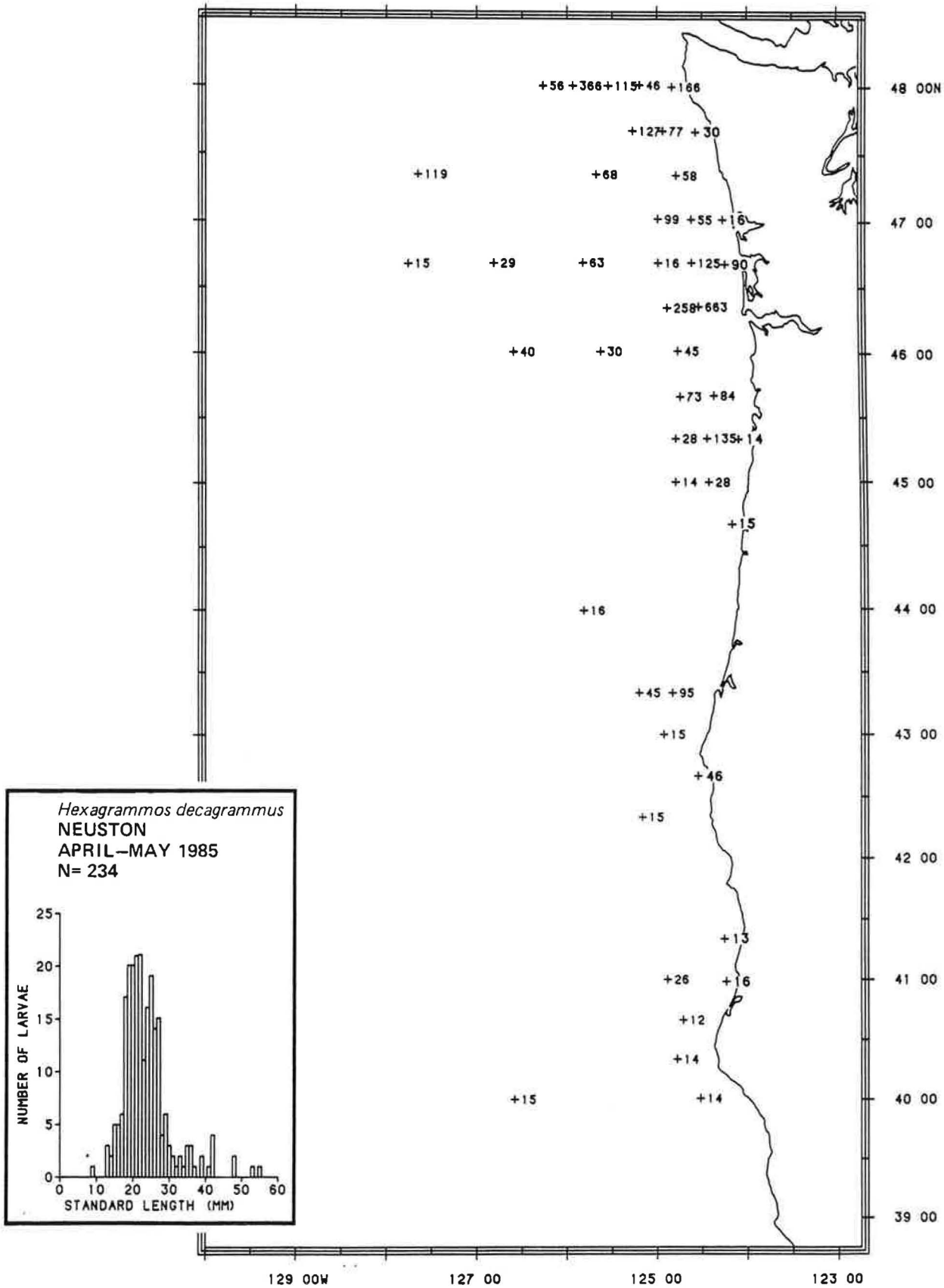

Figure 20.--Distribution of Hexagrammos decagrammus larvae from neuston tows during cruise 1BA85, April-May 1985. Abundance expressed as number per 1,000 m^3.

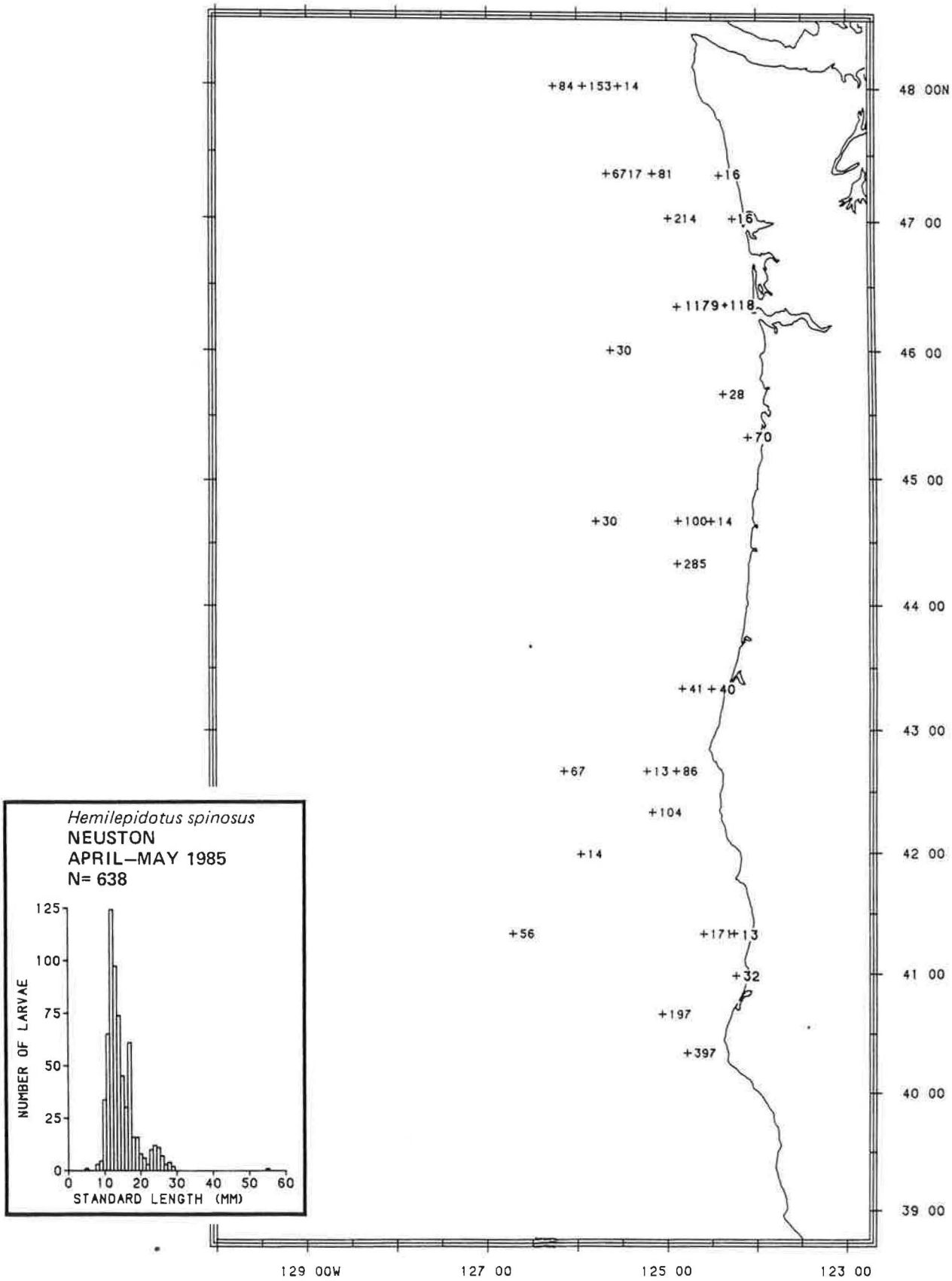

Figure 21.--Distribution of Hemilepidotus spinosus larvae from neuston tows during cruise 1BA85, April-May 1985. Abundance expressed as number per 1,000 m^3.

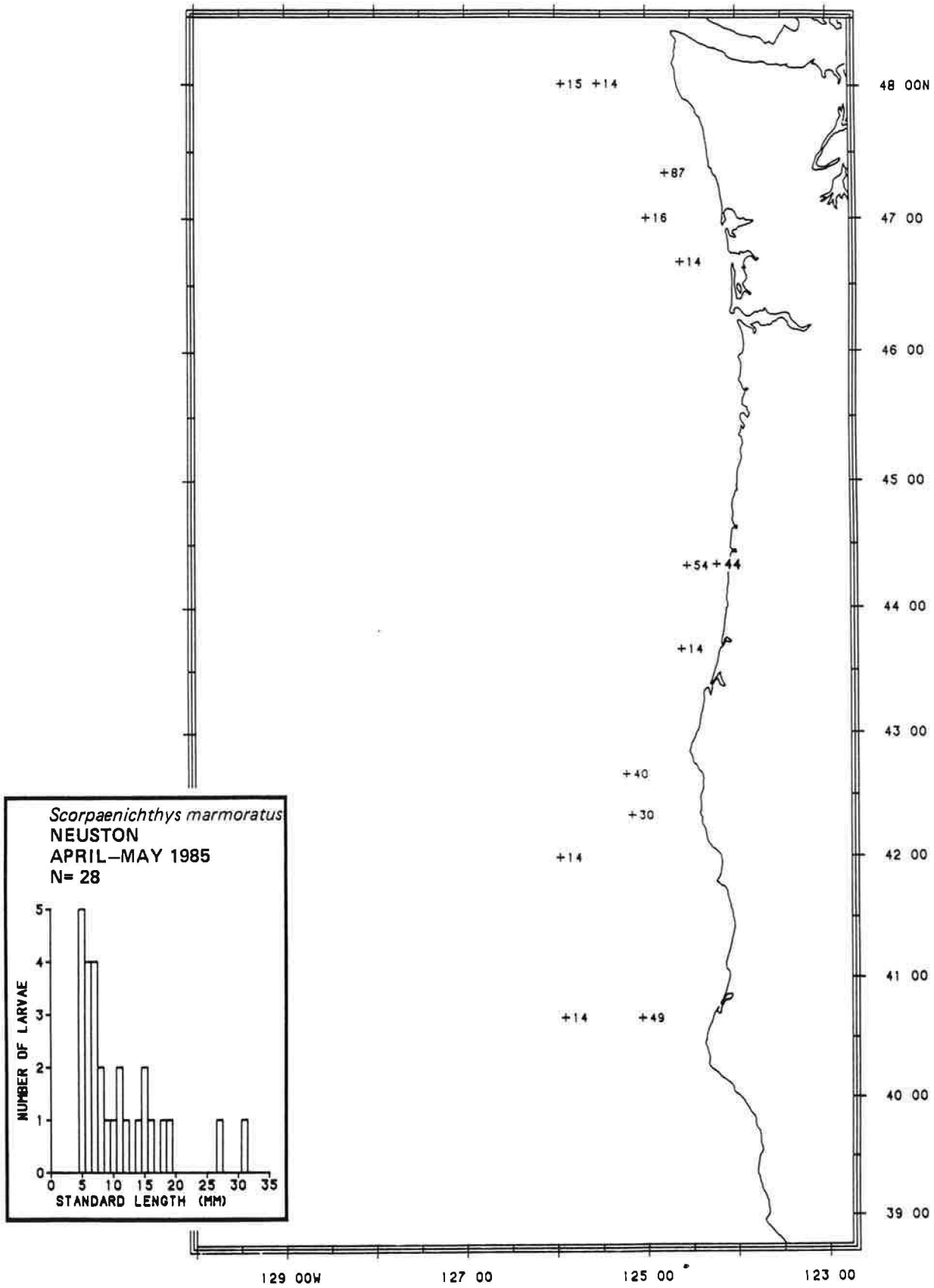

Figure 22.--Distribution of Scorpaenichthys marmoratus larvae from neuston tows during cruise 1BA85, April-May 1985. Abundance expressed as number per 1,000 m^3.

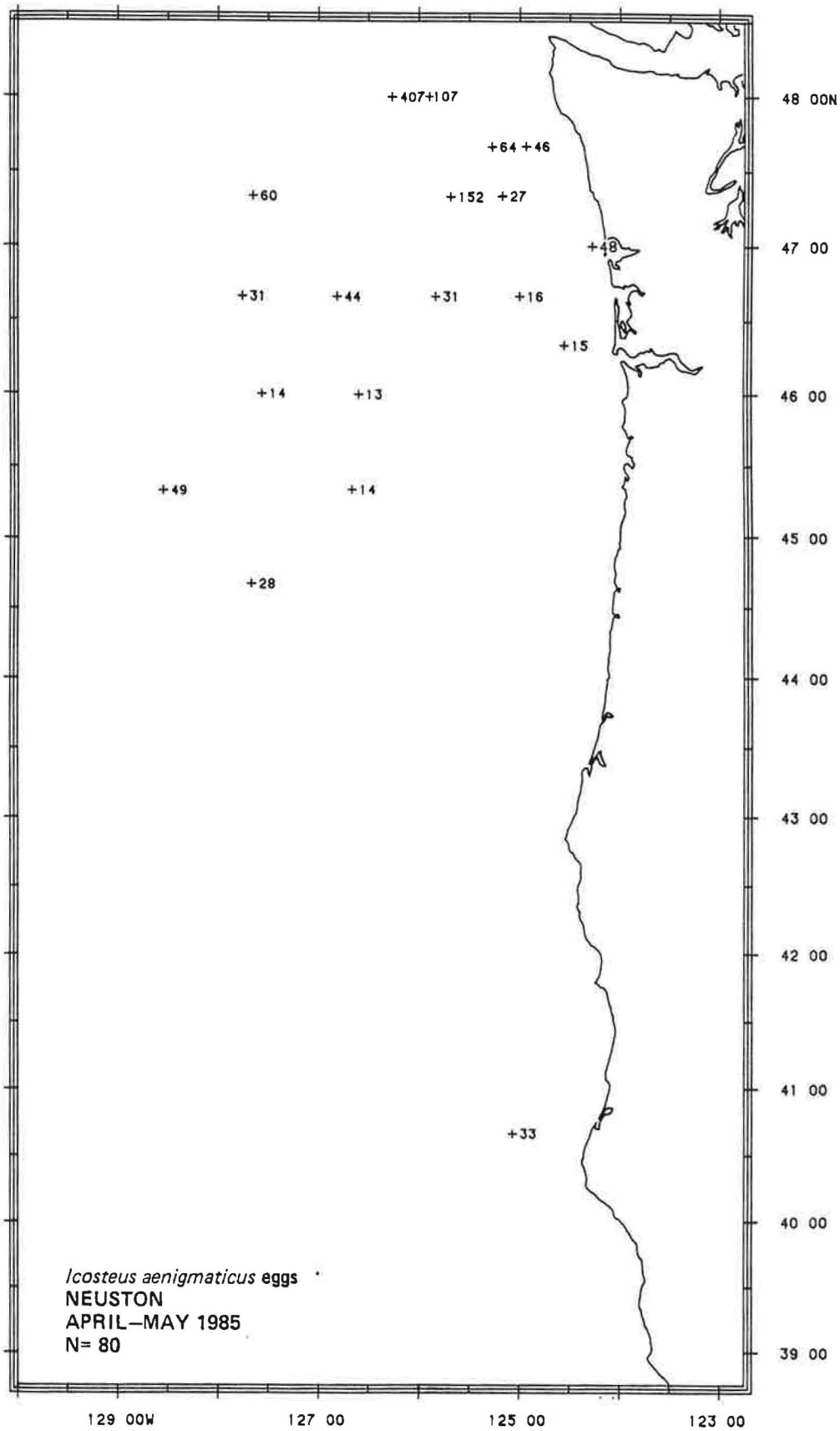

Figure 23.--Distribution of Icosteus aenigmaticus eggs from neuston tows during cruise 1BA85, April-May 1985. Abundance expressed as number per 1,000 m^3.

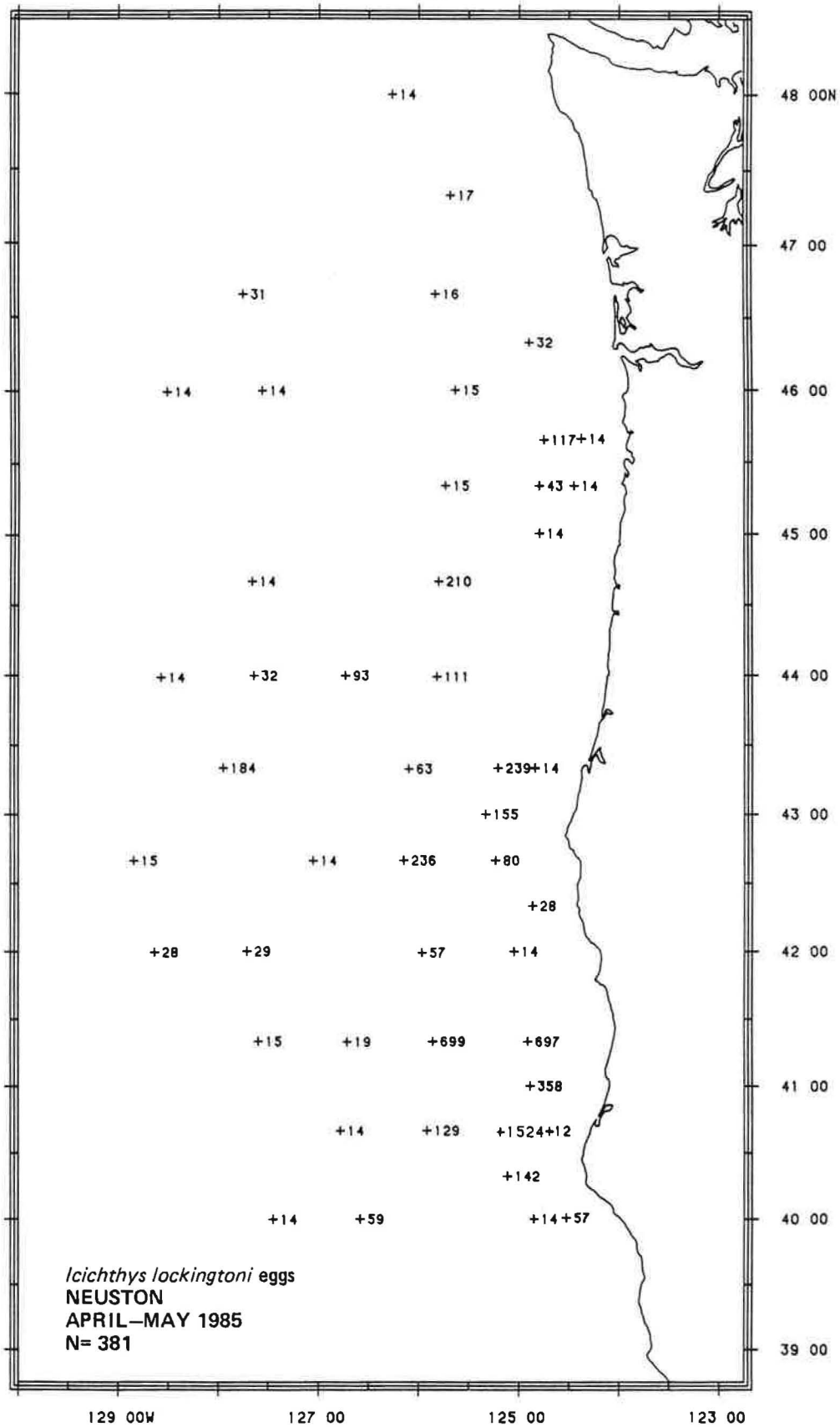

Figure 24.--Distribution of Icichthys lockingtoni eggs from neuston tows during cruise 1BA85, April-May 1985. Abundance expressed as number per 1,000 m^3.

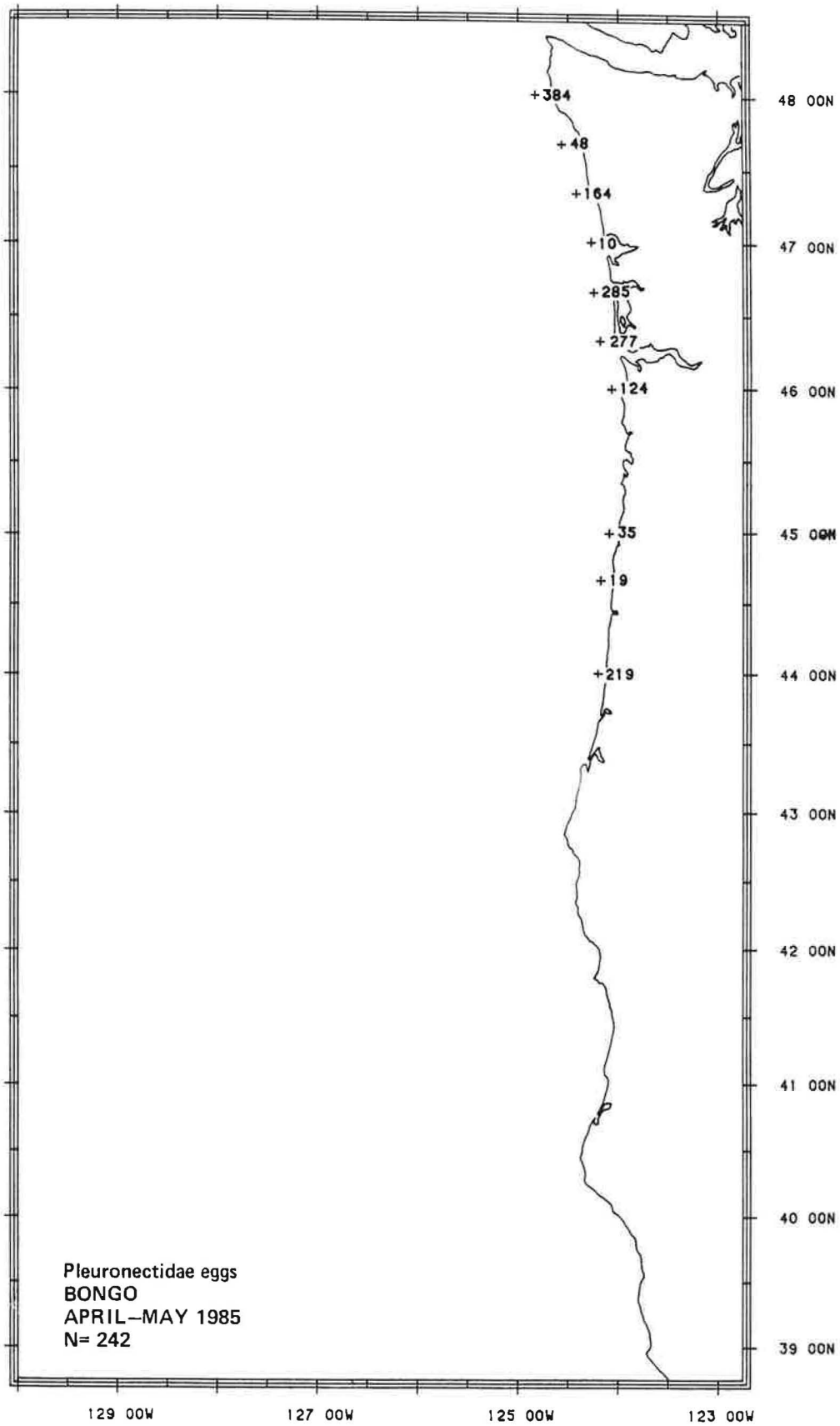

Figure 25.--Distribution of Pleuronectidae eggs from bongo tows during cruise 1BA85, April-May 1985. Abundance expressed as number per 10 m^2.

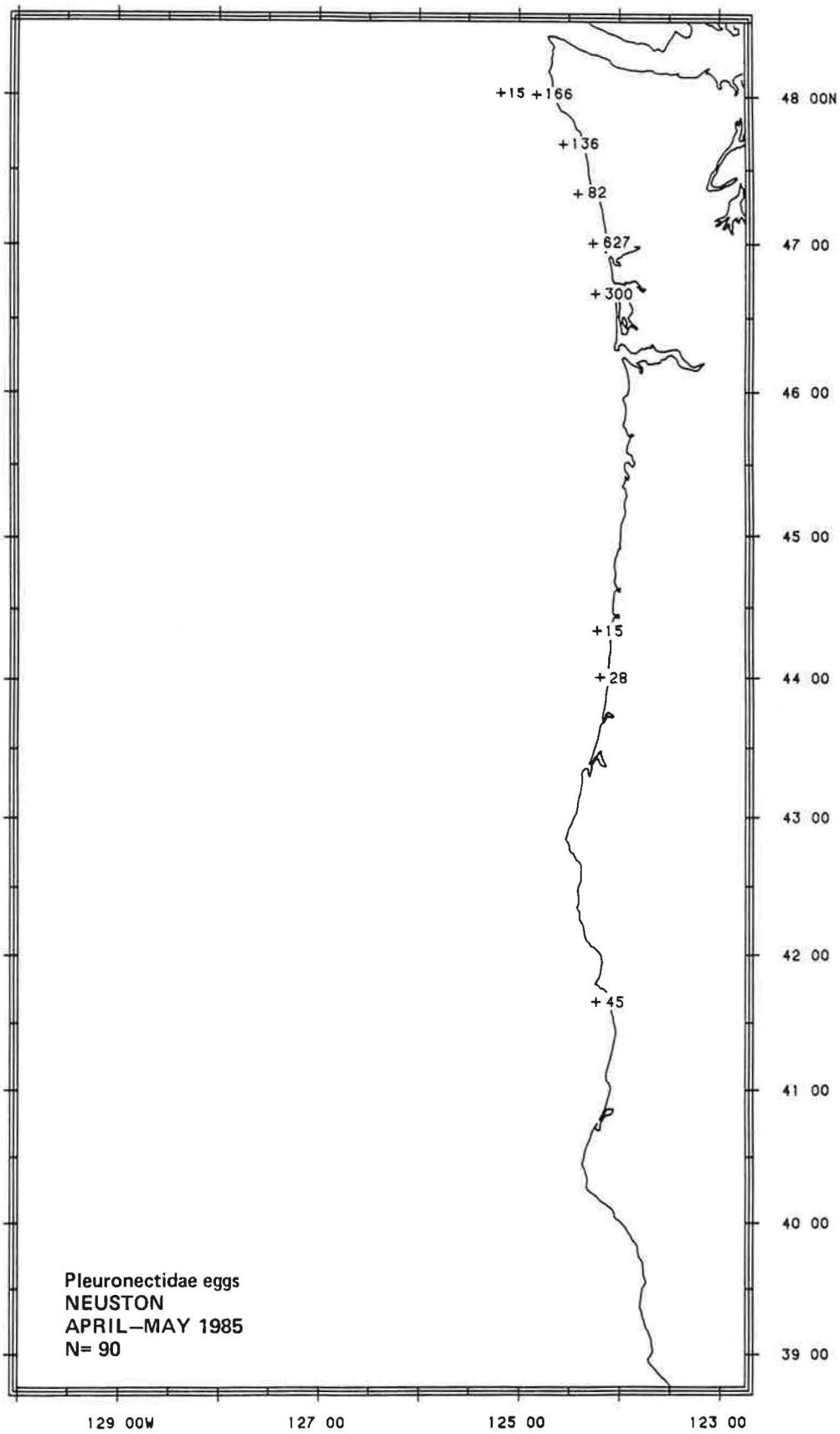

Figure 26.--Distribution of Pleuronectidae eggs from neuston tows during cruise 1BA85, April-May 1985. Abundance expressed as number per 1,000 m^3.

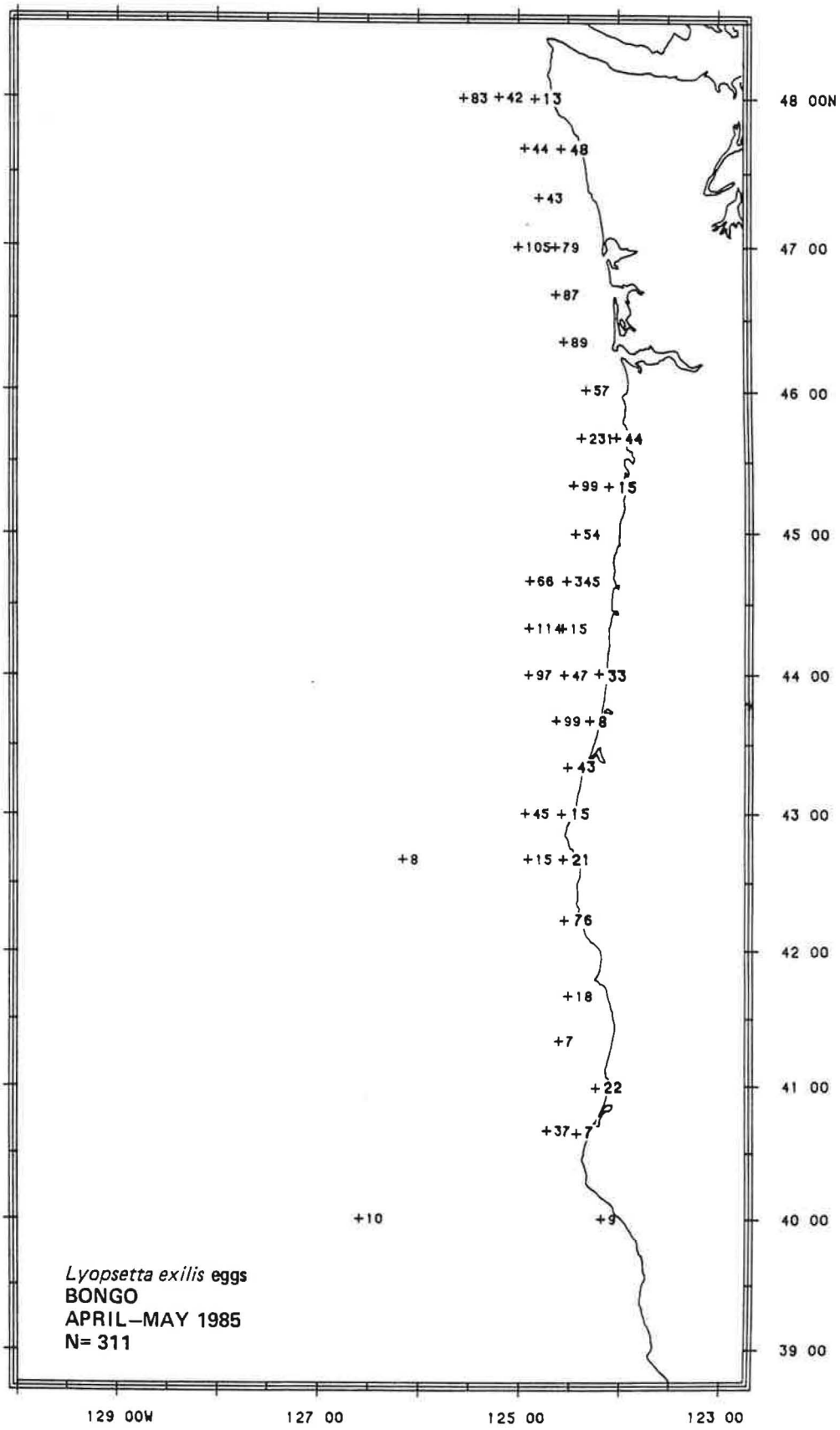

Figure 27.--Distribution of Lyopsetta exilis eggs from bongo tows during cruise 1BA85, April-May 1985. Abundance expressed as number per 10 m^2.

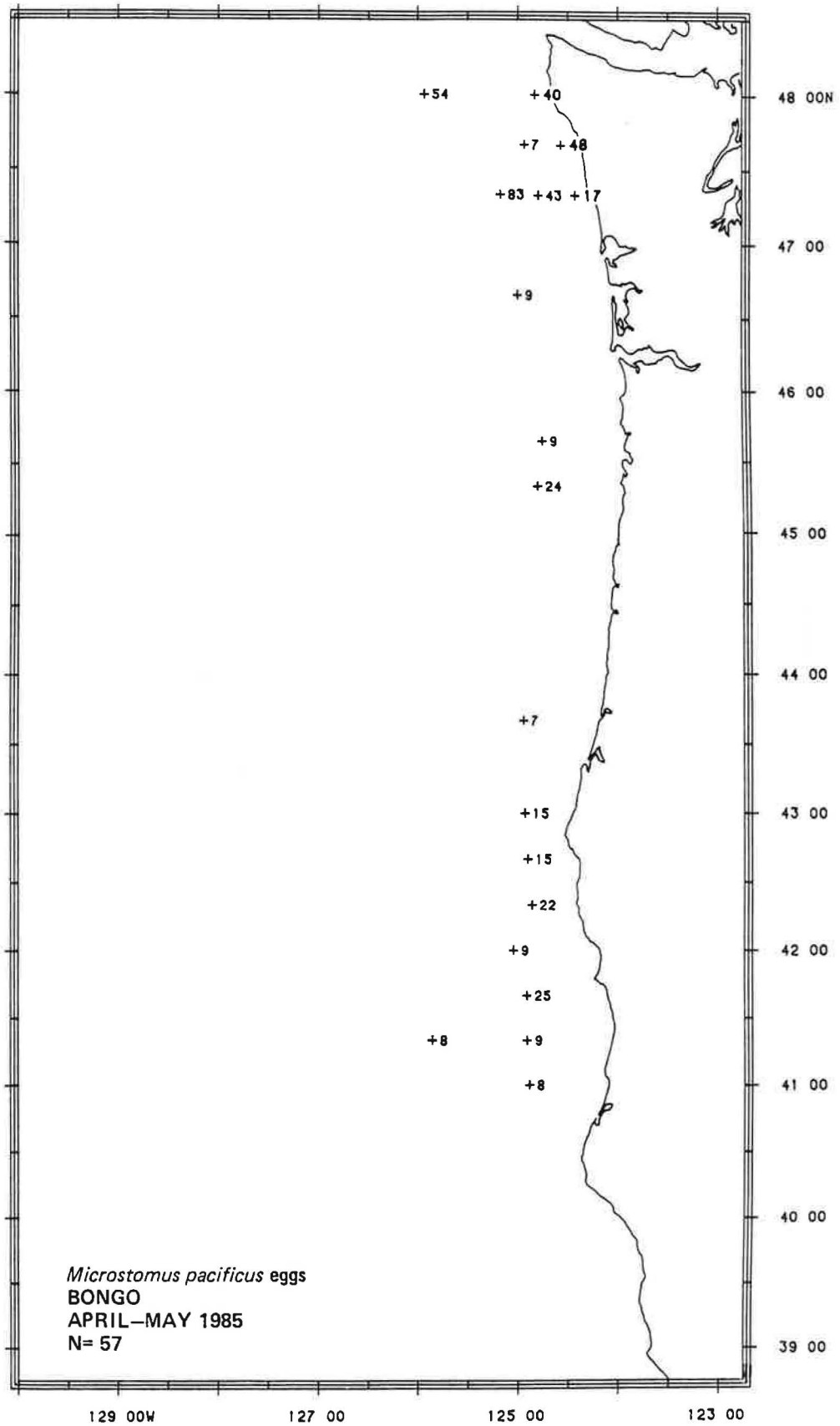

Figure 28.--Distribution of Microstomus pacificus eggs from bongo tows during cruise 1BA85, April-May 1985. Abundance expressed as number per 10 m^2.

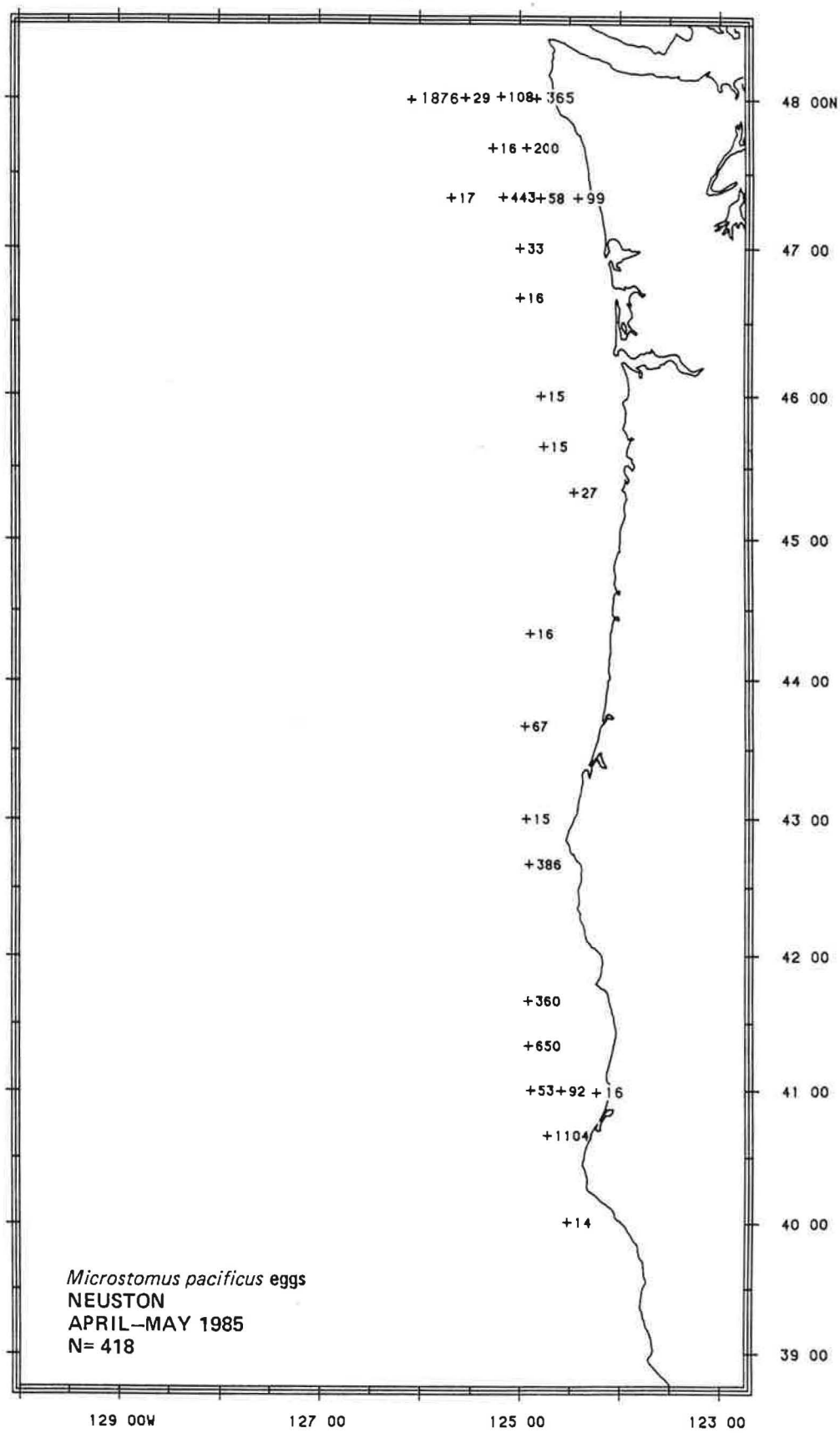

Figure 29.--Distribution of Microstomus pacificus eggs from neuston tows during cruise 1BA85, April-May 1985. Abundance expressed as number per 1,000 m^3.

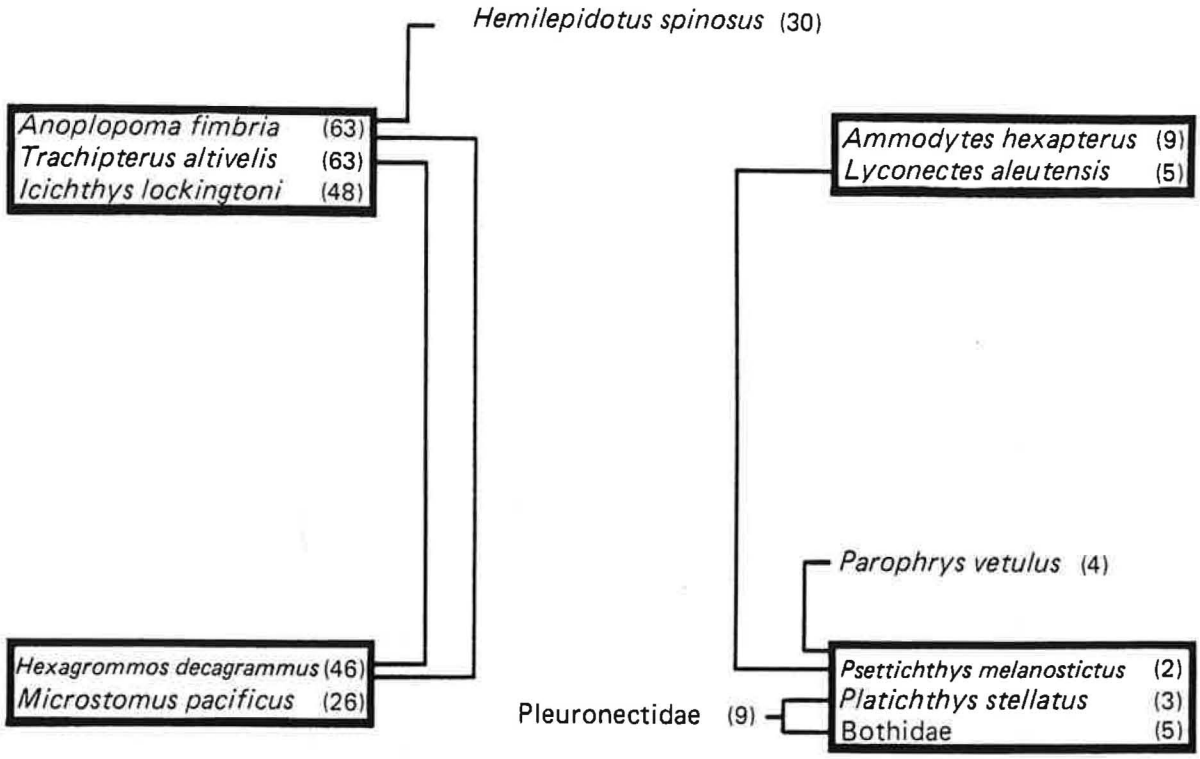

Figure 30.--Results of recurrent group analysis on neuston catches (both fish eggs and larvae) from cruise 1BA85, April-May 1985, at an affinity level of 0.400. Taxa in rectangles are members of recurrent groups. Lines connect taxa with affinities outside their groups. Numbers in parentheses following taxa names are the number of occurrences of the taxa.

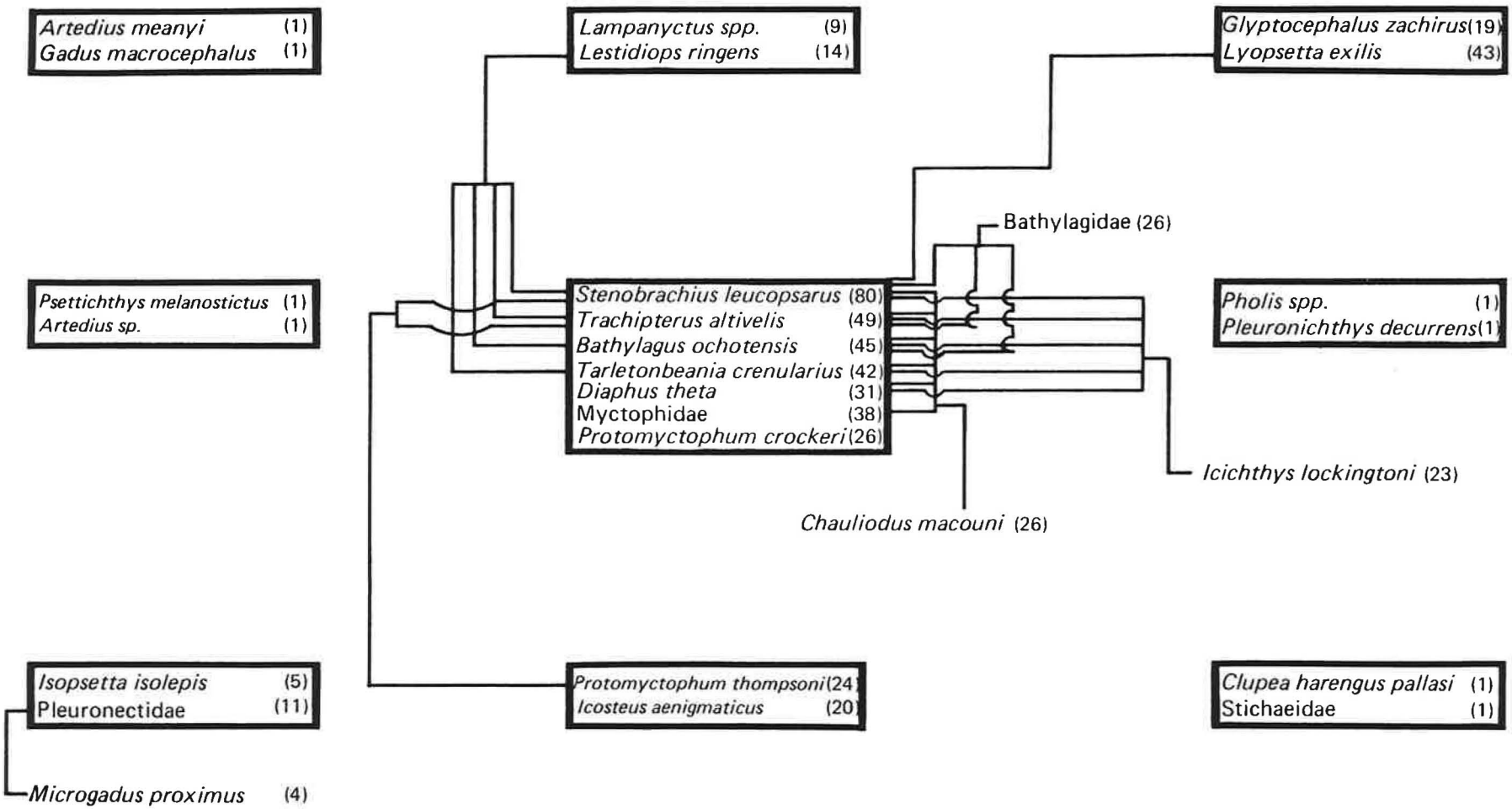

Figure 31.--Results of recurrent group analysis on bongo catches (both fish eggs and larvae) from cruise 1BA85, April-May 1985, at an affinity level of 0.400. Taxa in rectangles are members of recurrent groups. Lines connect taxa with affinities outside their groups. Numbers in parentheses following taxa names are the number of occurrences of the taxa.