Northwest and Alaska Fisheries Center

National Marine Fisheries Service

U.S. DEPARTMENT OF COMMERCE

NWAFC PROCESSED REPORT 85-10

Ichthyoplankton off Washington, Oregon, and Northern California April–May 1983

April 1985

This report does not constitute a publication and is for information only. All data herein are to be considered provisional.

NOTICE

This document is being made available in .PDF format for the convenience of users; however, the accuracy and correctness of the document can only be certified as was presented in the original hard copy format.

Inaccuracies in the OCR scanning process may influence text searches of the .PDF file. Light or faded ink in the original document may also affect the quality of the scanned document.

Ichthyoplankton off Washington, Oregon, and Northern California

April-May 1983

By

Jay B. Clark and Arthur W. Kendall, Jr.

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 C15700
Seattle, Washington 98115

April 1985

Ichthyoplankton off Washington, Oregon, and Northern California

April-May 1983

By Jay B. Clark and Arthur W. Kendall, Jr.

INTRODUCTION

This report describes the fifth in a series of cooperative U.S.-U.S.S.R. ichthyoplankton surveys conducted off the U.S. west coast from 48°-40°N. Similar reports, based on previous cruises since April-May 1980, have already been produced (Kendall and Clark 1982a, 1982b, Clark 1984, Bates 1984). 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. It is planned 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.

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 (Figure 1). Stations were more closely spaced near shore than off shore. The Soviet Research vessel EQUATOR with Dr. M. Stepanenko serving as

chief scientist occupied these stations basically from north to south from 23 April to 15 May 1983. At each station hydrographic casts at standard depths (0, 10, 20, 30, 50, 75, 100, 150, 200, 250, 300, 400, 500, 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 Jaraszynski 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 each station. Flow-meters 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 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; the larvae were identified, counted and measured. 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. 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 log 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 (the Soviets added stations south of 40°N which they processed). Data associated with these stations are listed in Table 1. A summary of the catches of fish eggs and larvae are presented in Tables 2 and 3. Totals of 32 taxa of eggs and 67 taxa of larvae were found. Figures 2-5 illustrate the rank abundances of egg and larval catches in bongo and neuston tows for the cruise using several measures of abundance. Figures 6-28 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 neuston samples are shown in Figure 29, and from bongo samples in Figure 30.

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, log 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 neuston net, egg catches were dominated by Bothidae in two of the abundance measurements and by *Trachipterus altivelis* in the remaining two measurements. *Engraulis mordax*, *Icichthys lockingtoni*, and *Microstomus pacificus* were also abundant, depending on what measurement was used (Figure 2). For eggs caught in the bongo net, Bothidae, *Trachipterus altivelis*, Myctophidae, and *Engraulis mordax* each ranked highest in one of the four measures of abundance (Figure 4).

The larval catches in the neuston net had *Hemilepidotus spinosus*, *Colalabis saira*, *Anoplopoma fimbria*, and *Sebastes* spp. each leading a measure

of abundance. In the bongo net, Stenobrachuis leucopsarus dominated all four abundance measurements. Also abundant were Diaphus theta, Bathylagus ochotensis, and Sebastes spp. (Figure 5).

Distributions

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

Engraulis mordax (Figures 6-9) - Eggs of the northern anchovy were collected in both the neuston and bongo nets, occurring mainly nearshore in waters off the Columbia River and the southern half of Washington. Richardson (1981) used eggs of this spawning to estimate biomass of the population. This distribution was further north than observed in April-May 1980 (Kendall and Clark 1982a) when the eggs were mainly found off the central Oregon coast. Larvae of the northern anchovy were found primarily in bongo net, occurring throughout the survey area in small numbers over the continental slope. Their lengths ranged from 2.5-26.5 ($\bar{x}$=8.0) mm SL.

Bathylagus ochotensis (Figure 10) - Larvae of this deep-sea smelt were collected in bongo tows throughout the offshore waters of Oregon and California. Their lengths ranged from 1.5-35.0 ($\bar{x}$=9.9) mm SL, which is similar to the results seen in April-May 1980 (Kendall and Clark 1982a).

Myctophidae (Figure 11) - Unidentified eggs of lanternfishes were collected offshore in bongo tows in the southern two-thirds of the survey area. The distribution of the eggs was similar to the patterns found April-May 1980 and in May-June 1981 (Kendall and Clark 1982a, Clark 1984). Lanternfish have small eggs (0.75-0.85 mm diameter) and appear fragile, so more eggs may have been caught but ruptured or squeezed through the 0.505 mm mesh of the bongo net.

Diaphus theta (Figure 12) - Larvae of this myctophid were found in bongo tows widely distributed off Columbia River to the southern extent of the survey area. Their lengths ranged from 2.5-8.0 ($\bar{x}$=4.9) mm SL.

Stenobrachius leucopsarus (Figure 13) - These lanternfish larvae dominated the catch in the bongo tows, placing first in all four measurements of abundance. They were found throughout the survey area, occurring at 81% of the stations. They ranged in size from 2.5-36.4 ($\bar{x}$=6.2) mm SL.

Tarletonbeania crenularis (Figure 14) - Larvae of this lanternfish were collected in bongo nets in moderate numbers throughout the survey area. Lengths ranged from 2.7-18.5 ($\bar{x}$=6.3) mm SL.

Cololabis saira (Figure 15) - Saury larvae occurred offshore in neuston tows, primarily off the Oregon and California coastlines. They were widely distributed and ranged in size from 3.3-70.0 ($\bar{x}$=26.6) mm SL. Eggs of the saury were collected in a bongo tow at one of the southernmost stations towards the end of the survey.

Trachipterus altivelis (Figure 16) - Eggs of king-of-the-salmon were taken in both neuston and bongo catches throughout the survey area. In neuston tows eggs occurred more frequently (45%) and generally in larger numbers than in the bongo net.

Sebastes spp. (Figures 19 and 20) - Unidentified rockfish larvae were found in both neuston and bongo tows primarily in continental shelf waters. They occurred throughout the north-south extent of the survey area in both nets. The larvae were considerably larger in the neuston net than in the bongo net (neuston $\bar{x}$=22.6, bongo $\bar{x}$=9.2 mm SL).

Anoplopoma fimbria (Figure 21) - Sablefish larvae were in neuston catches scattered throughout the northern two-thirds of the survey area. The larvae ranged in length from 7.2-38.0 ($\bar{x}$=16.0) mm SL.

Hemilepidotus spinosus (Figure 22) - Larvae of the brown Irish lord were collected in 10 neuston tows widely scattered in the nothern half of the survey area. They occurred from nearshore stations to those well beyond the edge of the shelf. Their modal length was 14 mm SL ($\bar{x}$=16.0 mm SL), with some indication of a bimodal length distribution with several fish longer than 20 mm collected.

Scorpaenchthys marmoratus (Figure 23) - Cabezon larvae occurred throughout the survey area, mainly at nearshore stations in the neuston net. Most larvae were 7-11 ($\bar{x}$=9.3) mm SL.

Bothidae (Figures 24-25) - Eggs of lefteye flounders, probably mainly Citharichthys spp. were abundant in both neuston and bongo catches mainly over the continental shelf along the entire coast.

Lyopsetta exilis (Figure 26) - Eggs of slender sole occurred nearshore all along the coast in the bongo net.

Microstomis pacificus (Figure 27-28) - Dover sole eggs occurred primarily in neuston and bongo tows near the edge of the shelf throughout the survey area. They were slightly further offshore than slender sole eggs.

Community Structure

Recurrent group analysis at a 0.4 affinity level of the neuston catches showed four small groups, three of which were interconnected (Figure 29). Groups seemed to be aligned mainly in an onshore-offshore pattern as was indicated in an earlier study of the area (Richardson et al. 1980). Bothidae,

Citharichthys spp., Engraulis mordax and Psettichthys melanostictus was one group of nearshore associates. Clupea harengus and Ammodytes hexapterus formed another nearshore group while the most offshore group consisted of Trachipterus altevelis and Cololabis saira. Anoplopoma fimbria was not a member of any group but had associates in the most offshore group and the intermediate group.

In bongo catches an extremely complex pattern emerged (Figure 30). There was basically an inshore group consisting of Engraulis mordax and Bothidae and Citharichthys spp. eggs, with several less frequently caught taxa. There were also two highly interconnected offshore groups consisting of several pleuronectids and myctophids, in addition to representatives of other families. A number of rarely caught taxa also formed pairs of associated taxa.

ACKNOWLEDGMENTS

We wish to thank the Soviet scientists, officers and crew aboard the Soviet research vessel EKVATOR (EQUATOR) for their cooperative help at sea. Also we wish to thank S. Leopold and R. Francis who served as American scientists aboard the cruise, Jim Peacock and his staff for drafting, Darlene Blythe and her staff for word processing, and Ethel Zweifel and her staff for printing and binding.

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 April-May 1981. NWAFC Proc. Rep. 84-11, 46 p.

Kendall, A. W. Jr., and J. B. Clark. 1982a. Ichthyoplankton off Washington, Oregon, and Northern California April-May 1980. NWAFC Proc. Rep. 82-11, 44 p.

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.

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.

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.

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

Smith, P. E., and S. L. Richardson (editors). 1977. Standard techniques for pelagic fish egg and larvae surveys. FAO Fish. Tech. Pap. 175, 100 p.

List of Tables

Table 1.--Data associated with bongo and neuston tows during cruise 1EQ83, April-May 1983.

Table 2.--Fish eggs collected in bongo and neuston tows during cruise 1EQ83, April-May 1983.

Table 3.--Fish larvae collected in bongo and neuston tows during cruise 1EQ83, April-May 1983.

List of Figures

Figure 1.--Station locations and cruise track for cruise 1EQ83, April-May 1983.

Figure 2.--Rank abundance of fish eggs caught in neuston tows during cruise 1EQ83, April-May 1983.

Figure 3. Rank abundance of fish larvae caught in neuston tows during cruise 1EQ83, April-May 1983.

Figure 4.--Rank abundance of fish eggs caught in bongo tows during cruise 1EQ83, April-May 1983.

Figure 5.--Rank abundance of fish larvae caught in bongo tows during cruise 1EQ83, April-May 1983.

Figure 6.--Distribution of eggs of Engraulis mordax from neuston tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 1000 m^3.

Figure 7.--Distribution of eggs of Engraulis mordax from bongo tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 10 m^2.

Figure 8.--Distribution and lengths of larvae of Engraulis mordax from neuston tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 1000 m^3.

Figure 9.--Distribution and lengths of larvae of Engraulis mordax from bongo tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 10 m^2.

Figure 10.--Distribution and lengths of larvae of Bathylagus ochotensis from bongo tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 10 m^2.

Figure 11.--Distribution of Myctophidae eggs from bongo tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 10 m^2.

Figure 12.--Distribution and lengths of larvae of Diaphus theta from bongo tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 10 m^2.

Figure 13.--Distribution and lengths of larvae of Stenobrachius leucopsarus from bongo tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 10 m^2.

Figure 14.--Distribution and lengths of larvae of Tarletonbeania crenularis from bongo tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 10 m^2.

Figure 15.--Distribution and lengths of larvae of Cololabis saira from neuston tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 1000 m^3.

Figure 16.--Distribution of eggs of Trachipterus altevelis from neuston tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 1000 m^3.

Figure 17.--Distribution of eggs of Trachipterus altevelis from bongo tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 10 m^2.

Figure 18.--Distribution of eggs of Icichthys lockingtoni during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 1000 m^3.

Figure 19.--Distribution and lengths of larvae of Sebastes spp. from neuston tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 1000 m^3.

Figure 20.--Distribution and lengths of larvae of Sebastes spp. from bongo tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 10 m^2.

Figure 21.--Distribution and lengths of larvae of Anoplopoma fimbria from neuston tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 1000 m^3.

Figure 22.--Distribution and lengths of larvae of Hemilepidotus spinosus from neuston tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 1000 m^3.

Figure 23.--Distribution and lengths of larvae of Scorpaenichthys marmoratus from neuston tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 1000 m^3.

Figure 24.--Distribution of eggs of Bothidae from neuston tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 1000 m^3.

Figure 25.--Distribution of eggs of Bothidae from bongo tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 10 m^2.

Figure 26.--Distribution of eggs of Lyopsetta exilis from bongo tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 10 m^2.

Figure 27.--Distribution of eggs of Microstomus pacificus from neuston tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 1000 m^3.

Figure 28.--Distribution of eggs of Microstomus pacificus from bongo tows during cruise 1EQ83, April-May 1983. Abundance expresses as numbers per 10 m^2.

Figure 29.--Results of recurrent group analysis on neuston catches (both fish eggs and larvae) from cruise 1EQ83, April-May 1983, at an affinity level of 0.4. Taxa in rectangles are members of recurrent groups. Lines connect taxa with affinities outside their groups. Numbers in parentheses following taxa names are the numbers of occurrences of the taxa.

Figure 30.--Results of recurrent group analysis on bongo catches (both fish eggs and larvae) from cruise 1EQ83, April-May 1983. Format as for Figure 29.

STATION	POSITION LAT. N.	LONG. W.	DATE YYMMDD	AREA KM2	NEUSTON STATIONS TIME GMT	NEUSTON STATIONS STANDARD HAUL FACTORS* A	NEUSTON STATIONS STANDARD HAUL FACTORS* B	BONGO STATIONS TIME GMT	BONGO STATIONS STANDARD HAUL FACTORS* A	BONGO STATIONS STANDARD HAUL FACTORS* B
G001A	48 0.9	124 51.0	83 423	934.	1650	0.027	18.134	1710	4.928	14.494
G002A	48 0.6	125 11.0	83 423	1040.	1905	0.028	18.384	1930	5.788	4.522
G003A	48 0.9	125 34.0	83 423	1274.	2300	0.022	14.477	2312	7.445	4.230
G004A	47 59.7	125 55.0	83 424	1926.	340	0.020	13.108	408	7.847	3.616
G005A	48 0.0	126 17.0	83 424	2395.	750	0.019	12.989	810	8.613	4.006
G006A	47 40.1	125 17.0	83 424	1452.	1240	0.021	13.743	1300	7.047	3.489
G007A	47 39.8	124 56.0	83 424	959.	1455	0.019	12.938	1515	7.233	6.516
G008A	47 40.0	124 36.0	83 424	886.	1650	0.021	13.822	1700	6.653	19.568
G009A	47 20.0	124 26.0	83 424	868.	1950	0.015	9.884	1956	8.280	34.499
G010A	47 19.8	124 47.0	83 424	1024.	2215	0.019	12.562	2235	8.240	3.905
G011A	47 20.0	125 10.0	83 425	1338.	220	0.018	12.272	240	8.477	3.980
G012A	47 20.0	125 41.0	83 425	3819.	735	0.019	12.522	758	7.639	3.917
G013A	47 20.0	126 40.0	83 425	5649.	1250	0.018	11.736	1320	8.005	3.924
G014A	47 20.0	127 39.0	83 425	5645.	1750	0.020	13.063	1815	7.815	3.775
G015A	46 40.0	128 45.0	83 426	6009.	215	0.043	28.851	235	7.410	3.820
G016A	46 40.0	127 46.0	83 426	5362.	655	0.038	25.521	715	7.846	3.790
G017A	46 40.5	126 49.0	83 426	5280.	1125	0.022	14.735	1155	7.799	3.842
G018A	46 39.5	125 51.0	83 426	5053.	1810	0.028	18.654	1835	7.680	3.783
G019A	46 40.0	125 0.0	83 427	1821.	110	0.036	24.096	135	7.921	3.845
G020A	46 40.0	124 38.0	83 427	1122.	625	0.027	17.737	640	7.443	6.003
G021A	46 40.0	124 15.0	83 427	882.	940	0.034	22.866	950	7.570	18.465
G022A	47 0.0	124 16.0	83 427	712.	1155	0.031	20.468	1210	6.523	27.180
G023A	47 0.0	124 38.0	83 427	998.	1330	0.033	21.929	1340	7.675	9.715
G024A	47 0.0	125 0.0	83 427	1695.	1520	0.040	26.380	1540	7.929	3.868
G025A	46 20.0	124 54.0	83 427	1893.	1955	0.032	21.168	2010	8.144	3.860
G026A	46 20.0	124 33.0	83 427	1015.	2140	0.029	19.134	2155	6.643	5.582
G027A	46 20.0	124 11.0	83 427	760.	2340	0.024	15.907	2352	6.897	23.782
G028A	46 0.0	124 4.0	83 428	546.	240	0.027	17.992	250	7.451	13.547
G029A	45 59.8	124 21.0	83 428	983.	425	0.024	16.221	440	7.669	6.185
G030A	46 0.0	124 47.0	83 428	1746.	700	0.024	16.265	723	6.938	3.288
G031A	46 0.0	125 37.0	83 428	4818.	1545	0.027	18.016	1610	7.808	3.790
G032A	46 0.0	126 36.0	83 428	5557.	2050	0.027	17.731	2110	7.910	3.995
G033A	46 0.3	127 33.0	83 429	5414.	200	0.030	20.098	223	7.471	3.793
G034A	46 0.0	128 31.0	83 429	5717.	700	0.027	17.743	718	7.909	3.877
G035A	45 20.0	128 33.0	83 429	5666.	1150	0.030	19.836	1215	8.506	3.993
G036A	45 20.0	127 37.0	83 429	5629.	1635	0.023	15.665	1700	8.788	4.050
G037A	45 20.0	126 40.0	83 429	5503.	2125	0.031	20.468	2140	8.521	4.000
G038A	45 19.6	125 44.0	83 430	5488.	215	0.030	19.844	235	8.216	3.988
G039A	45 40.0	124 45.0	83 430	1928.	650	0.033	21.695	725	8.450	4.024
G040A	45 40.0	124 23.0	83 430	981.	900	0.028	18.468	915	7.724	5.478
G041A	45 40.0	124 2.0	83 430	554.	1040	0.020	13.589	1050	6.403	11.233
G042A	45 20.0	124 6.0	83 5 1	853.	55	0.027	17.761	105	7.349	9.931
G043A	45 20.3	124 27.0	83 5 1	1057.	310	0.029	19.106	330	8.569	3.949
G044A	45 20.0	124 48.0	83 5 1	1892.	805	0.026	17.156	820	7.893	4.048
G045A	45 0.0	124 48.0	83 5 1	1998.	1100	0.035	23.136	1125	8.361	4.139
G046A	45 0.0	124 26.0	83 5 1	1043.	1330	0.028	18.500	1350	6.762	3.799
G047A	44 59.7	124 5.0	83 5 1	589.	1715	0.024	15.824	1725	8.515	24.328
G048A	44 40.0	124 10.0	83 5 1	682.	1930	0.027	17.691	1940	6.305	18.014
G049A	44 40.0	124 31.0	83 5 1	1038.	2227	0.025	16.477	2240	8.178	6.704
G050A	44 40.0	124 53.0	83 5 2	1993.	150	0.030	20.166	210	8.640	4.134
G051A	44 40.0	125 48.0	83 5 2	5201.	745	0.030	19.922	810	8.336	3.721
G052A	44 40.0	126 44.0	83 5 2	5528.	1300	0.037	24.727	1320	8.550	3.995
G053A	44 40.0	127 40.0	83 5 2	5438.	1800	0.024	16.112	1830	8.902	4.083
G054A	44 40.0	128 35.0	83 5 2	5299.	2250	0.028	18.993	2309	8.112	4.016
G055A	44 0.0	128 34.0	83 5 3	5517.	325	0.035	23.554	350	7.652	3.924
G056A	44 0.0	127 39.0	83 5 3	5307.	815	0.033	21.904	835	8.647	4.098
G057A	44 0.0	126 44.0	83 5 3	5304.	1250	0.034	22.605	1310	8.465	4.089
G058A	44 0.5	125 51.0	83 5 3	5225.	1730	0.030	20.253	1800	8.208	3.927
G059A	44 20.0	124 54.0	83 5 3	1436.	2205	0.034	22.460	2220	9.328	4.164
G060A	44 20.0	124 33.0	83 5 3	1000.	2355	0.035	23.177	10	8.243	10.568
G061A	44 19.8	124 12.0	83 5 4	687.	145	0.028	18.703	152	4.928	12.635
G062A	44 0.2	124 13.0	83 5 4	550.	2000	0.031	20.660	2015	6.139	11.583
G063A	44 0.0	124 33.0	83 5 4	1003.	2200	0.037	24.751	2215	7.455	6.213

* "A" converts catch to catch per 10^2, "B" converts catch to catch per 1000 m^3 (see Smith and Richardson 1977).

Table 1.--Data associated with bongo and neuston tows during cruise 1EQ83, April-May 1983.

STATION	POSITION LAT. N.	LONG. W.	DATE YYMMDD	AREA KM2	NEUSTON STATIONS TIME GMT	NEUSTON STATIONS STANDARD HAUL FACTORS* A	NEUSTON STATIONS STANDARD HAUL FACTORS* B	BONGO STATIONS TIME GMT	BONGO STATIONS STANDARD HAUL FACTORS* A	BONGO STATIONS STANDARD HAUL FACTORS* B
G064A	44 0.0	124 54.0	83 5 5	1822.	5	0.024	15.684	13	7.353	9.427
G065A	43 40.3	124 57.0	83 5 5	1821.	220	0.078	52.279	235	8.778	4.045
G066A	43 39.8	124 37.0	83 5 5	950.	405	0.073	48.935	425	8.970	4.040
G067A	43 40.0	124 18.0	83 5 5	618.	600	0.058	38.868	615	7.601	8.638
G068A	43 20.0	124 30.0	83 5 5	808.	900	0.042	28.309	910	8.097	9.639
G069A	43 20.2	124 51.0	83 5 5	1055.	1645	0.064	42.531	1710	8.399	3.907
G070A	43 20.0	125 12.0	83 5 5	2296.	1945	0.038	25.390	2010	7.930	3.776
G071A	43 20.2	126 6.0	83 5 6	5330.	100	0.025	16.407	120	8.040	3.775
G072A	43 19.5	127 1.0	83 5 6	5580.	620	0.022	14.913	640	8.016	3.854
G073A	43 20.2	127 57.0	83 5 6	5669.	1215	0.031	20.941	1240	7.767	3.752
G074A	43 19.6	128 51.0	83 5 6	5526.	1755	0.027	18.111	1830	7.628	3.685
G075A	42 40.0	128 51.0	83 5 6	5354.	2305	0.024	15.829	2335	7.939	3.609
G076A	42 40.0	127 57.0	83 5 7	5410.	415	0.025	16.846	440	7.463	3.588
G077A	42 40.0	127 3.0	83 5 7	5321.	915	0.024	16.019	940	7.486	3.634
G078A	42 39.5	126 9.0	83 5 7	5307.	1445	0.028	18.727	1520	7.801	3.769
G079A	43 0.0	125 15.0	83 5 7	2072.	1930	0.025	16.735	1950	7.482	3.722
G080A	43 0.0	124 55.0	83 5 7	1019.	2130	0.023	15.559	2150	7.833	3.859
G081A	43 0.0	124 34.0	83 5 8	683.	615	0.023	15.391	627	6.110	7.936
G082A	42 40.4	124 33.0	83 5 8	669.	1240	0.023	15.373	1255	6.741	10.533
G083A	42 39.7	124 54.0	83 5 8	1047.	1515	0.024	16.073	1535	6.775	3.604
G084A	42 40.0	125 14.0	83 5 8	1847.	1800	0.025	16.671	1820	8.020	3.730
G085A	42 20.5	125 13.0	83 5 8	2100.	2030	0.026	17.247	2053	8.253	3.875
G086A	42 19.6	124 53.0	83 5 8	972.	2235	0.024	15.966	2255	8.002	3.884
G087A	42 20.0	124 32.0	83 5 9	793.	50	0.024	15.841	100	7.042	7.412
G088A	42 0.0	124 25.0	83 5 8	766.	1715	0.029	19.654	1730	6.555	7.712
G089A	42 0.0	124 43.0	83 5 9	916.	1940	0.030	19.841	2005	8.667	3.886
G090A	42 0.3	125 3.0	83 5 9	1968.	2225	0.029	19.140	2245	7.748	3.725
G091A	42 0.2	125 57.0	83 510	5117.	345	0.025	16.756	405	7.235	3.564
G092A	42 0.0	126 50.0	83 510	5280.	845	0.024	15.855	905	8.444	3.770
G093A	42 0.0	127 43.0	83 510	5443.	1340	0.022	14.704	1400	7.379	3.708
G094A	42 0.0	128 38.0	83 510	5559.	1930	0.028	18.787	1945	7.548	3.755
G095A	41 20.2	128 30.0	83 510	5845.	2345	0.031	20.780	5	8.522	3.856
G096A	41 20.1	127 36.0	83 511	5624.	500	0.022	14.660	520	7.562	3.671
G097A	41 20.2	126 43.0	83 511	5534.	1015	0.024	16.122	1035	7.628	3.758
G098A	41 20.1	125 49.0	83 511	5593.	1600	0.023	15.109	1620	7.379	3.565
G099A	41 40.3	124 55.0	83 511	1794.	2140	0.024	16.024	2200	7.097	3.548
G100A	41 40.2	124 35.0	83 511	1035.	2345	0.024	15.869	5	8.893	3.867
G101A	41 40.0	124 14.0	83 512	651.	130	0.024	15.722	135	4.011	23.597
G102A	41 20.2	124 16.0	83 512	1002.	1215	0.030	19.698	1225	6.531	11.458
G103A	41 20.0	124 36.0	83 512	909.	1445	0.027	18.102	1505	8.635	4.192
G104A	41 19.6	124 54.0	83 512	1907.	1725	0.029	19.126	1750	8.470	3.798
G105A	41 0.1	124 53.0	83 512	1865.	1940	0.031	20.672	2000	7.798	3.804
G106A	41 0.7	124 35.0	83 512	1042.	2135	0.023	15.035	2155	7.156	3.560
G107A	41 0.3	124 14.0	83 512	678.	2345	0.048	31.718	2350	7.358	12.263
G108A	40 40.2	124 24.0	83 513	728.	640	0.026	17.293	645	5.977	19.923
G109A	40 40.5	124 43.0	83 513	1028.	925	0.025	16.957	945	8.464	3.865
G110A	40 40.3	125 3.0	83 513	2170.	1235	0.027	18.210	1255	8.196	3.759
G111A	40 40.0	125 55.0	83 513	5325.	1735	0.024	16.277	1750	7.655	3.527
G112A	40 40.0	126 47.0	83 513	5552.	2245	0.024	16.202	2305	7.898	3.761
G113A	40 39.8	127 39.0	83 514	5533.	435	0.025	16.602	455	7.852	3.585
G114A	40 40.2	128 31.0	83 514	5442.	1015	0.024	15.831	1040	7.914	3.937
G115A	40 0.0	128 20.0	83 514	5646.	1545	0.025	16.436	1605	6.975	3.614
G116A	39 59.8	127 27.0	83 514	5581.	2105	0.026	17.596	2130	7.806	3.789
G117A	39 59.9	126 35.0	83 515	5422.	215	0.027	17.679	240	7.322	3.589
G118A	40 0.0	125 43.0	83 515	4918.	720	0.023	15.244	740	6.985	3.564
G119A	40 20.2	125 7.0	83 515	2196.	1050	0.026	17.362	1115	7.920	3.864
G120A	40 20.0	124 47.0	83 515	1125.	1305	0.039	26.049	1325	7.719	3.747
G121A	40 20.0	124 27.0	83 515	740.	1455	0.028	18.883	1510	8.975	6.551
G122A	40 0.0	124 11.0	83 515	774.	1750	0.026	17.191	1805	8.071	4.139
G123A	40 0.1	124 31.0	83 515	1013.	2040	0.025	16.655	2100	7.149	3.522
G124A	40 0.2	124 51.0	83 515	1608.	2325	0.024	16.157	2350	7.771	3.631

* "A" converts catch to catch per 10^2, "B" converts catch to catch per 1000 m^3 (see Smith and Richardson 1977).

Table 1.--Data associated with bongo and neuston tows during cruise 1EQ83, April-May 1983.

STAGE: EGG

SPECIES	NEUSTON OCCUR. %	NEUSTON LOG NO. IN AREA	BONGO OCCUR. %	BONGO LOG NO. IN AREA
UNIDENTIFIED	1.61	7.4533	5.65	10.4762
TELEOST TYPE A	6.45	8.3321		
DISINTEGRATED	12.90	8.3218	6.45	10.5439
BATHYLAGIDAE			28.23	11.3235
BATHYLAGUS SPP.			19.35	11.1060
CHAULIODUS MACOUNI	2.42	7.8119	14.52	10.9651
MYCTOPHIDAE			15.32	12.3831
PLEURONECTIDAE	8.87	7.9645	9.68	10.6476
GLYPTOCEPHALUS ZACHIRUS	18.55	8.3683	26.61	10.9376
HIPPOGLOSSOIDES ELASSODON	1.61	6.8888		
ISOPSETTA ISOLEPIS			0.81	8.6628
LYOPSETTA EXILIS	3.23	6.9458	27.42	11.4914
MICROSTOMUS PACIFICUS	28.23	9.2429	29.03	11.1162
PLATICHTHYS STELLATUS			0.81	9.6345
PSETTICHTHYS MELANOSTICTUS	1.61	6.5526	1.61	9.0679
MERLUCCIUS PRODUCTUS			10.48	10.3329
CITHARICHTHYS SPP.	7.26	7.9481	8.06	10.2788
BATHYLAGUS OCHOTENSIS			7.26	10.5124
ICICHTHYS LOCKINGTONI	29.03	9.4069	16.13	10.8141
SEBASTOLOBUS SPP.	4.84	8.7093		
ICOSTEUS AENIGMATICUS	14.52	9.0583	15.32	11.0428
TRACHIPTERUS ALTIVELIS	45.16	9.9961	33.87	11.3724
COLOLABIS SAIRA			0.81	11.0675
ENGRAULIS MORDAX	8.06	9.3885	3.23	11.4989
BOTHIDAE	26.61	9.9598	29.03	11.6844
PLEURONICHTHYS COENOSUS	0.81	6.3002		
PLEURONICHTHYS DECURRENS	2.42	6.9989	2.42	9.1110
MICROSTOMA MICROSTOMA			0.81	9.6420
TRACHIPTERIDAE	0.81	7.2006		
TELEOST TYPE F	1.61	7.1212		
MYCTOPHIDAE B			1.61	10.6869
PLEURONICHTHYS VERTICALIS			0.81	9.6147

Table 2.--Fish eggs collected in bongo and neuston tows during cruise 1EQ83, April-May 1983.

S AG	RV E	OC JR	US ON LC N , IN AR	CC %	B GC OG NO N RE
	PE IE				
N1 EN IF D				2 62	9. 45
IS NT GR EI		.8	4 35	11 29	1. 59
LL EA HA NC S AL IS		.4	7 59		
SI RI NE				3 23	9. 16
A1 YL GU PA IF CU				14 62	0. 62
HA LI DU MA OU E				13 71	0. 71
YC OP ID				5 65	0. 75
IA HU T TA				41 74	2. 49
TE OB AC US LE CO AI S		.6	7 25	30 65	2. 68
AF ET NB IN C EN AI S				45 16	1. 57
RC OM CT HL C DC RI				23 69	1. 76
RC OM CT HL T DM OI				8 37	0. 31
IC OG DU PF XI JS				5 65	9. 79
HE AG A IA OG AM				0 31	9. 55
EE ST P.	2 .7		9 29	45 77	1. 07
ED GR MM E CA RA IU	1 .9		8 30		
PF OD E OM AT S		.4	7 14	0 31	9. 69
NC LO DM FI BR A	3 .4		9 35	2 62	9. 33
O1 ID E				0 31	8. 62
R1 DI S P.				0 31	8. 20
R1 DI S E RF NG DN				3 23	9. 74
R1 DI S E NE TR LI		.8	7 43	2 62	9. 15
EM LE ID US HE IL II TU		8	6 40		
AC LI JS SF EL JS				0 31	8. 46
GC ID E				0 31	8. 62
YC OP ER AE				13 71	0. 09
OM UI JS OF AN		.2	8 30	4 13	0. .2
MM DY ES ED PT RU		.6	7 74	1 61	9. 21
I1 AR CH YS ST SM US				1 61	9. 91
TH RE TH E S OM AS				3 23	0. 78
LY TO EP LL Z CH US				27 62	0. 61
IF OG DS II S LA OI N				0 31	8. 68
SC SE TA SC EP S				7 76	0. 68
EF DO SE A IL NE A				0 31	8. 29
YC SE TA XI IS				37 10	1. 46
IC OS DM E F CI IC E				10 68	0. 11
AF PH S ET LU		.6	6 58	8 16	0. 11
LA IC TH E S EL AT E				4 14	9. 63
SE TI ITI S EL AO IC US		8	6 05	8 17	0. 43
EF UC CU PF DU TU		.8	7 13	0 31	9. 28
I1 AR CH YS SP .				12 10	0. 75
A1 YL GU OC OT AS E		.4	7 42	55 65	2. 60
EL MP AE AE				6 65	0. 14
CC PA AI TH S AR RA US	2 .9		8 59	0 31	9. .4
C1 HT S OC IN TO		8	7 28	8 17	0. 9
AM AN CT F TT RI				15 62	1. .8
AN EN A E ND DA				12 0	0. 66
AM AN CT E S P.				4 14	0. 24
I1 AR CH YS SO DI IS				3 23	9. 7
EM LE ID US SP AO IS		.0	8 58		
EE ST .OI S PP				22 68	1. 63
CC TE S NI MA IC E				3 23	0. 61
RA HI TE IS LT JE S				3 23	0. 65
OF ET A RI NI		.6	6 99	0 31	9. .4
OL LA IS AI A	4 .7		9 32	0 31	9. 63
ES ID DP RI GE S				10 68	0. 29
RC RO EL US SP .				0 31	9. 55
NC AU IS OF AX		.0	8 32	19 65	0. 76
LE RO IC HY C EN US				0 31	8. 70
AM AN CT E F GA IS				1 61	9. 27
R1 DI S E AM I				2 62	9. 50
EL MP NE SF .				2 62	0. 17
RC MO IY S AR IN A				0 31	8. 99
AF CE IN E F PL TI IS				0 31	8. 99
O1 US AS R				0 31	8. 44
AC LI JS OL OI ES				1 61	9. 68
PF DI DA				4 13	0. 14

Ta l 3 — Fi h la va l ol e te 1 o go ar l eu t 1 ov u n u n c u se l 8 ,

Ap il -M y 9 3.

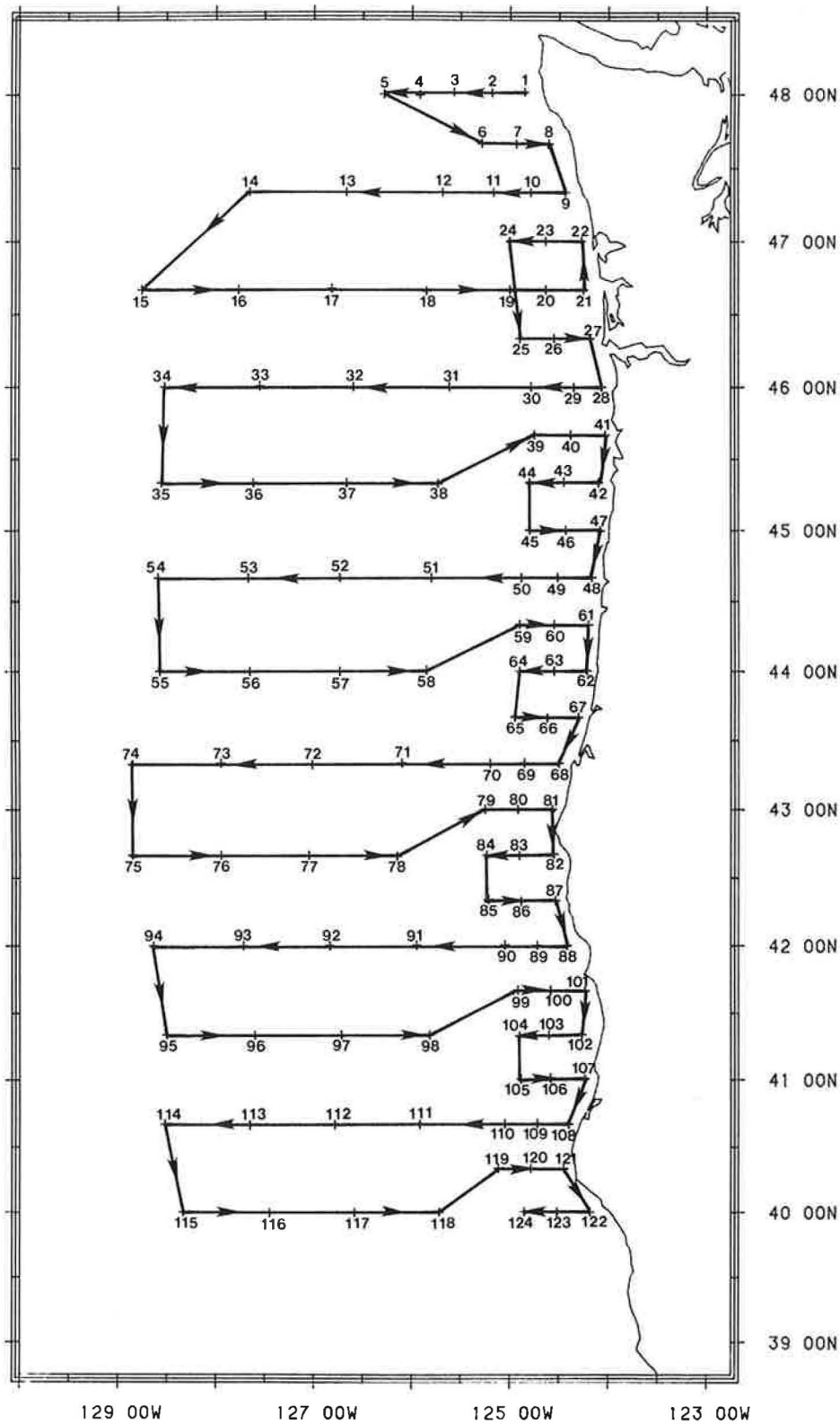

Figure 1.--Station locations and cruise track for cruise 1EQ83, April-May 1983.

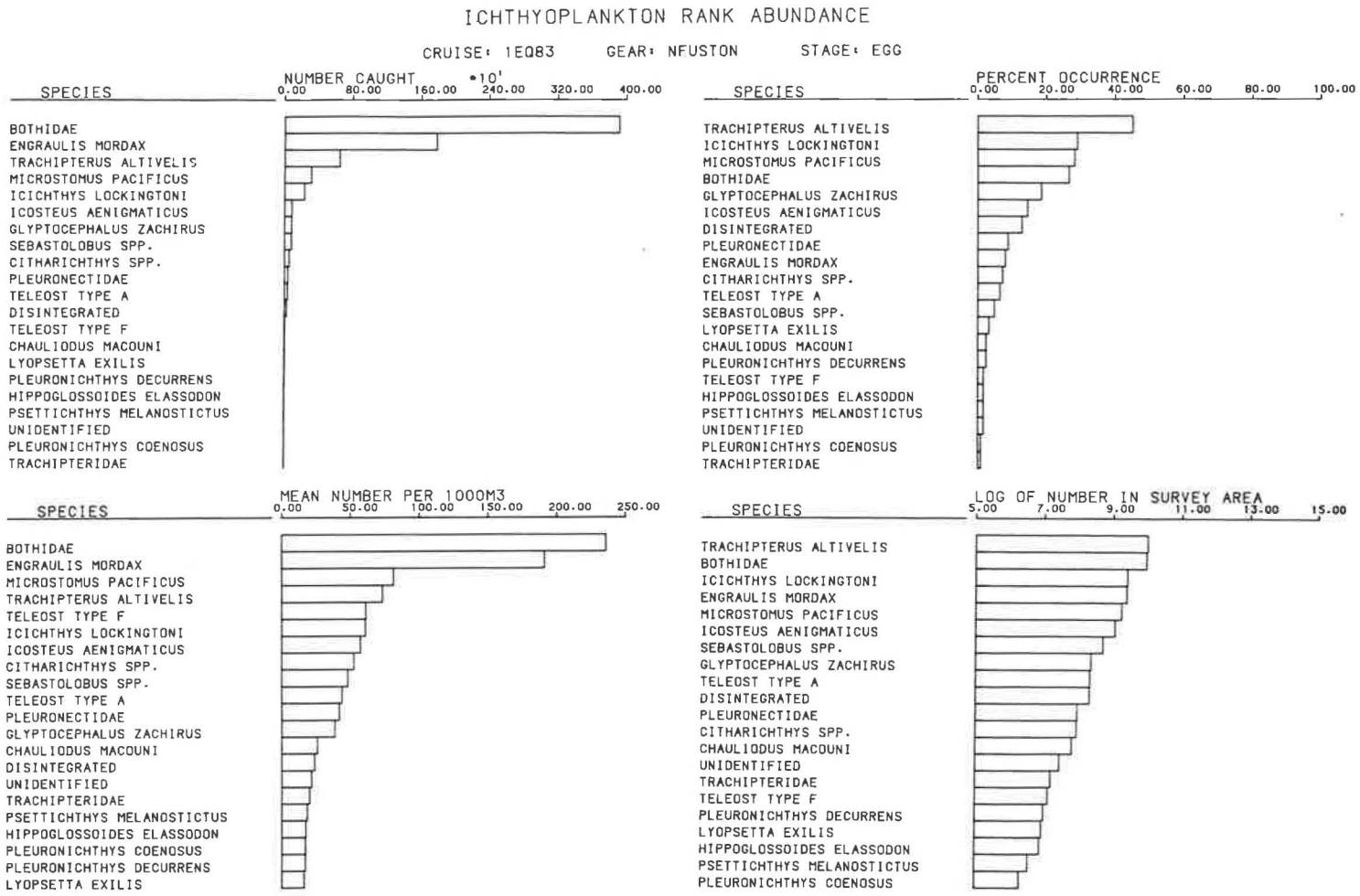

Figure 2.--Rank abundance of fish eggs caught in neuston tows during cruise 1EQ83, April-May 1983.

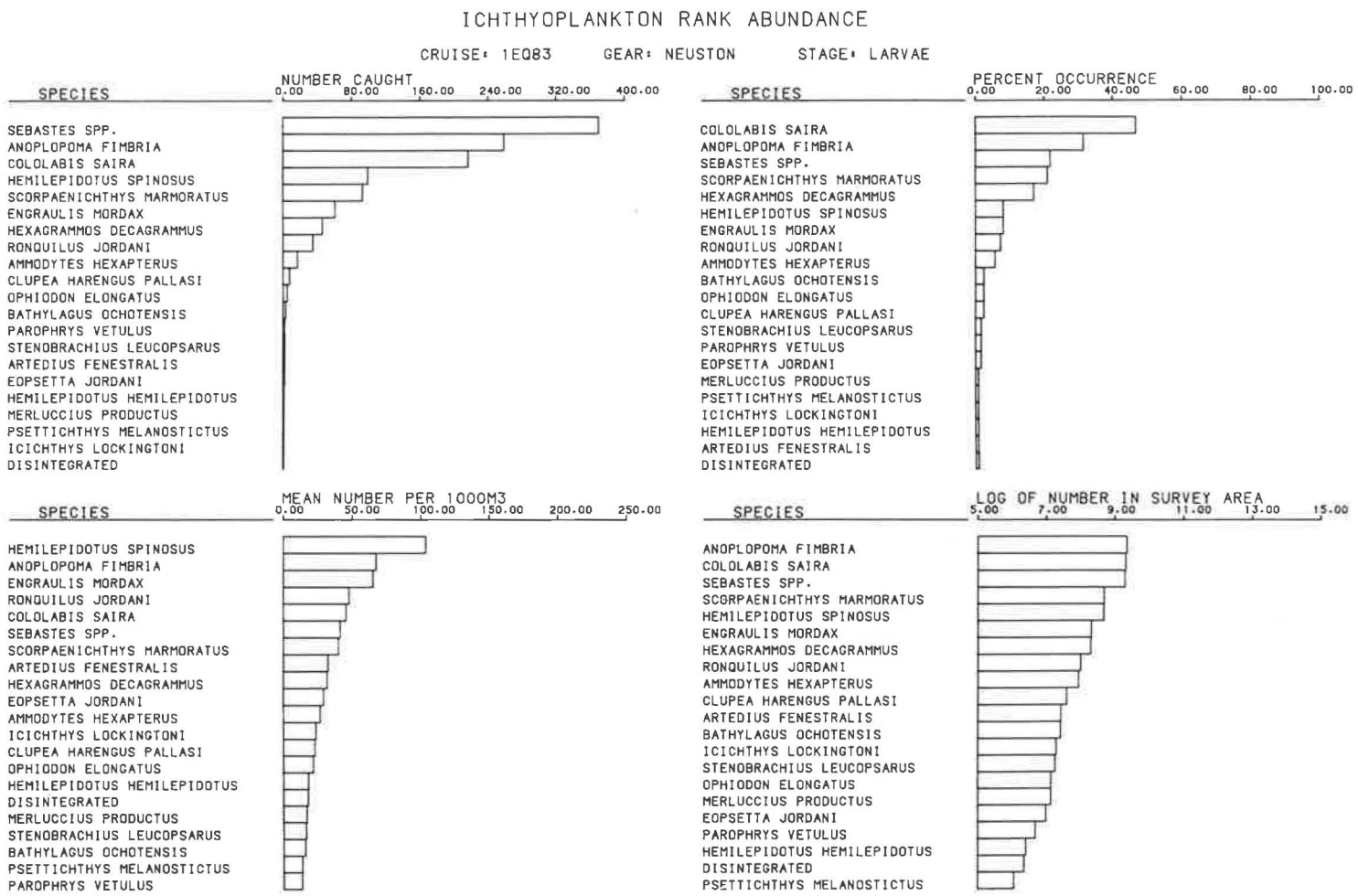

Figure 3. Rank abundance of fish larvae caught in neuston tows during cruise 1EQ83, April-May 1983.

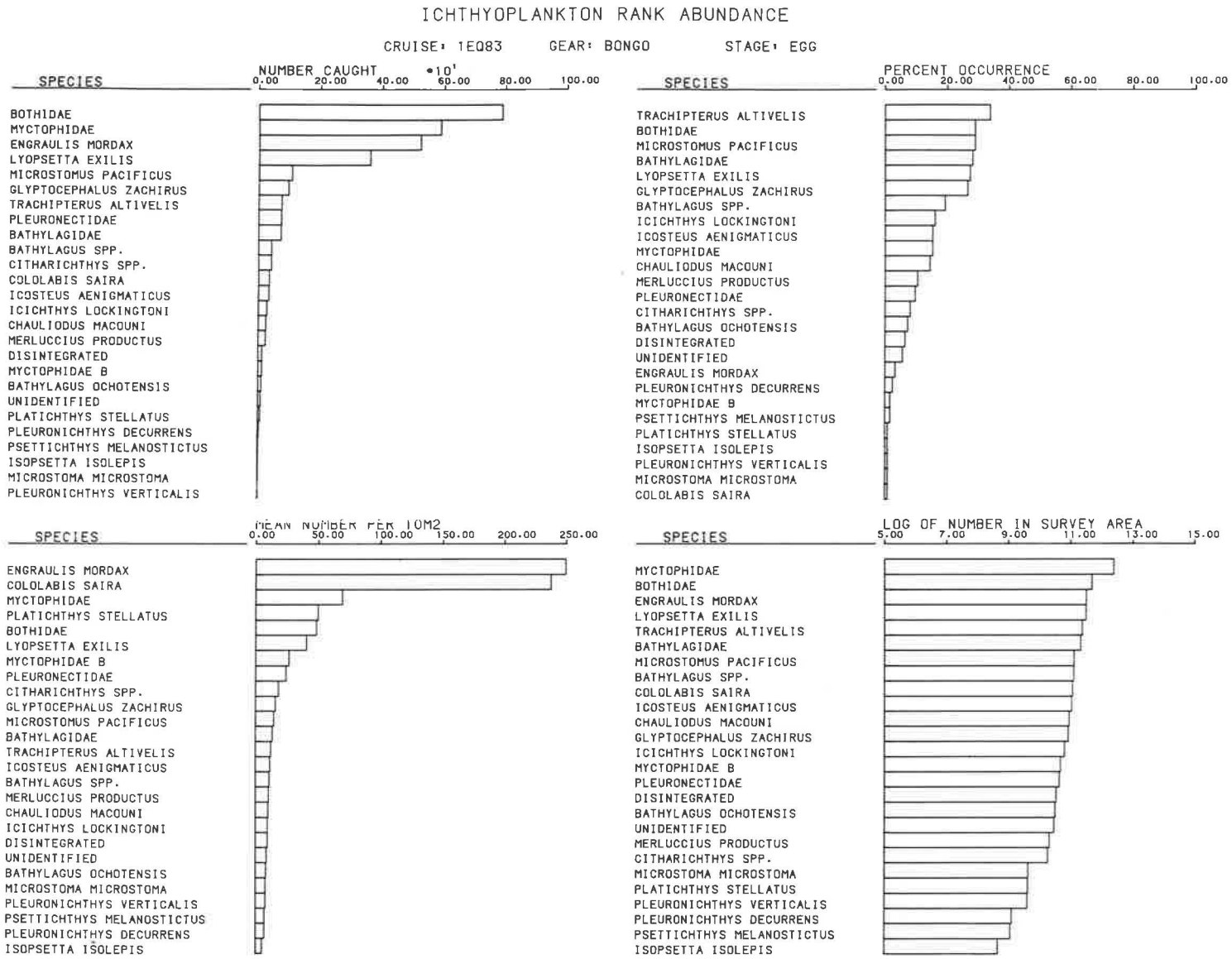

Figure 4.--Rank abundance of fish eggs caught in bongo tows during cruise 1EQ83, April-May 1983.

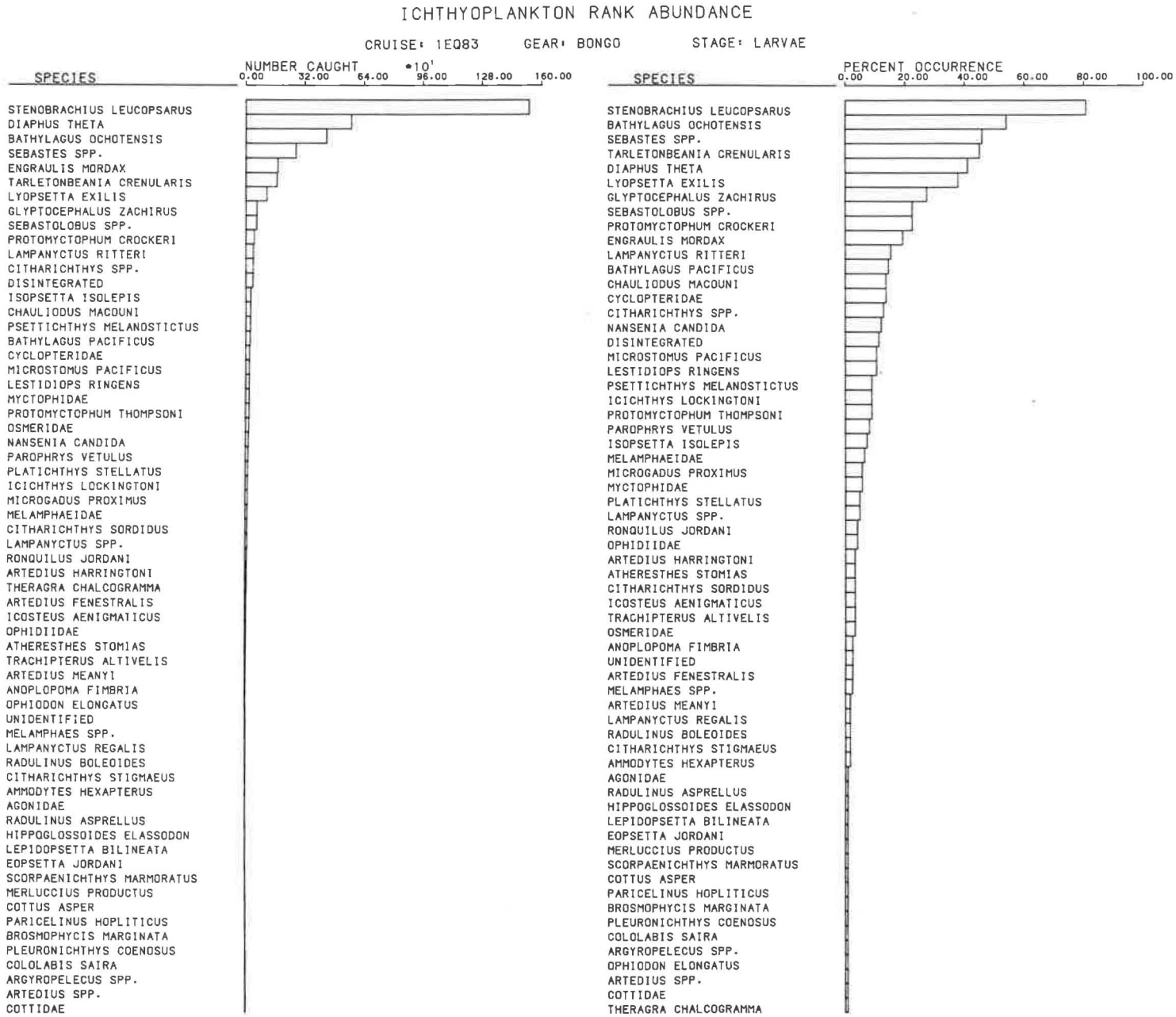

Figure 5.--Rank abundance of fish larvae caught in bongo tows during cruise 1EQ83, April-May 1983.

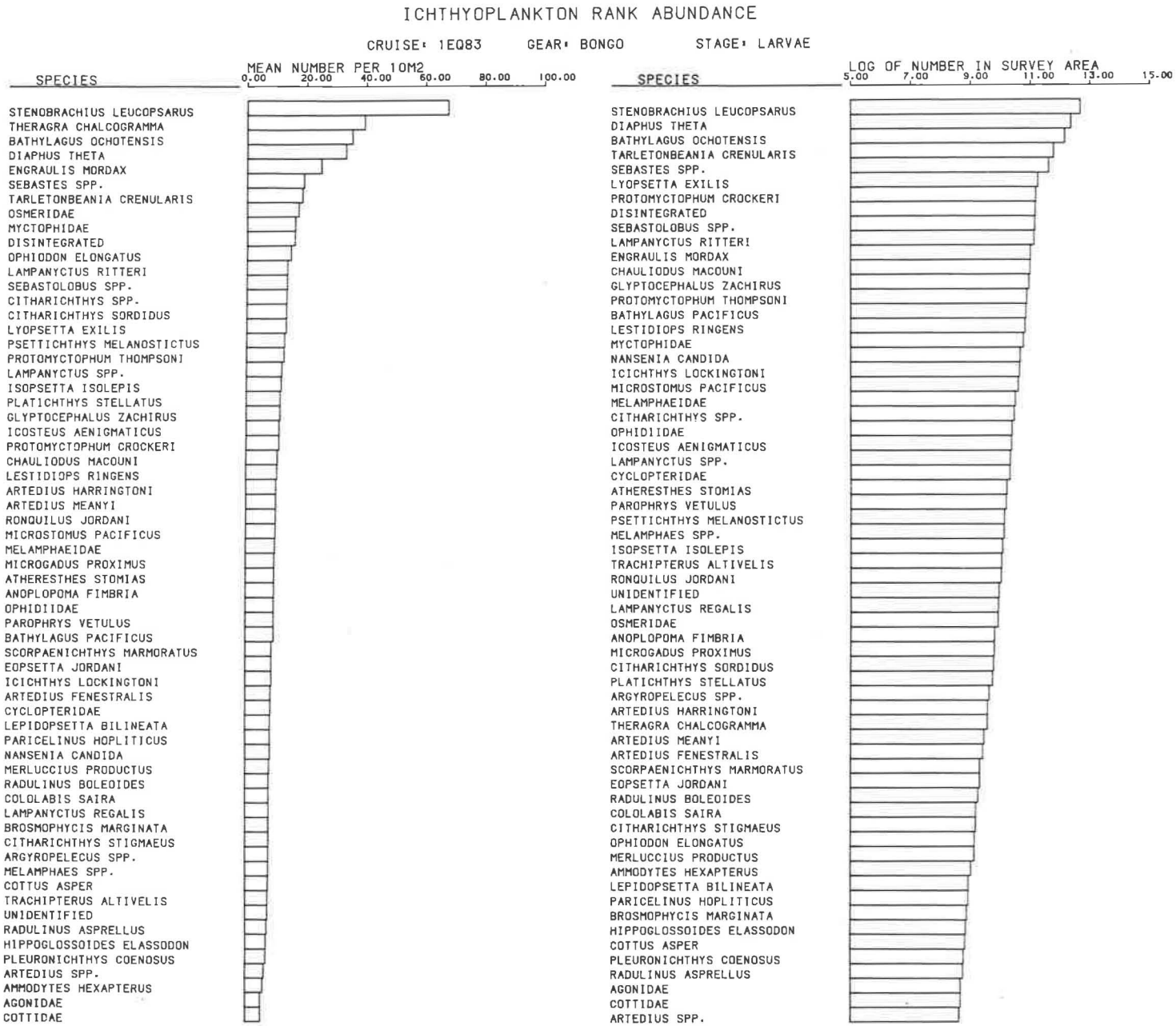

Figure 5.--Rank abundance of fish larvae caught in bongo tows during cruise 1EQ83, April-May 1983.

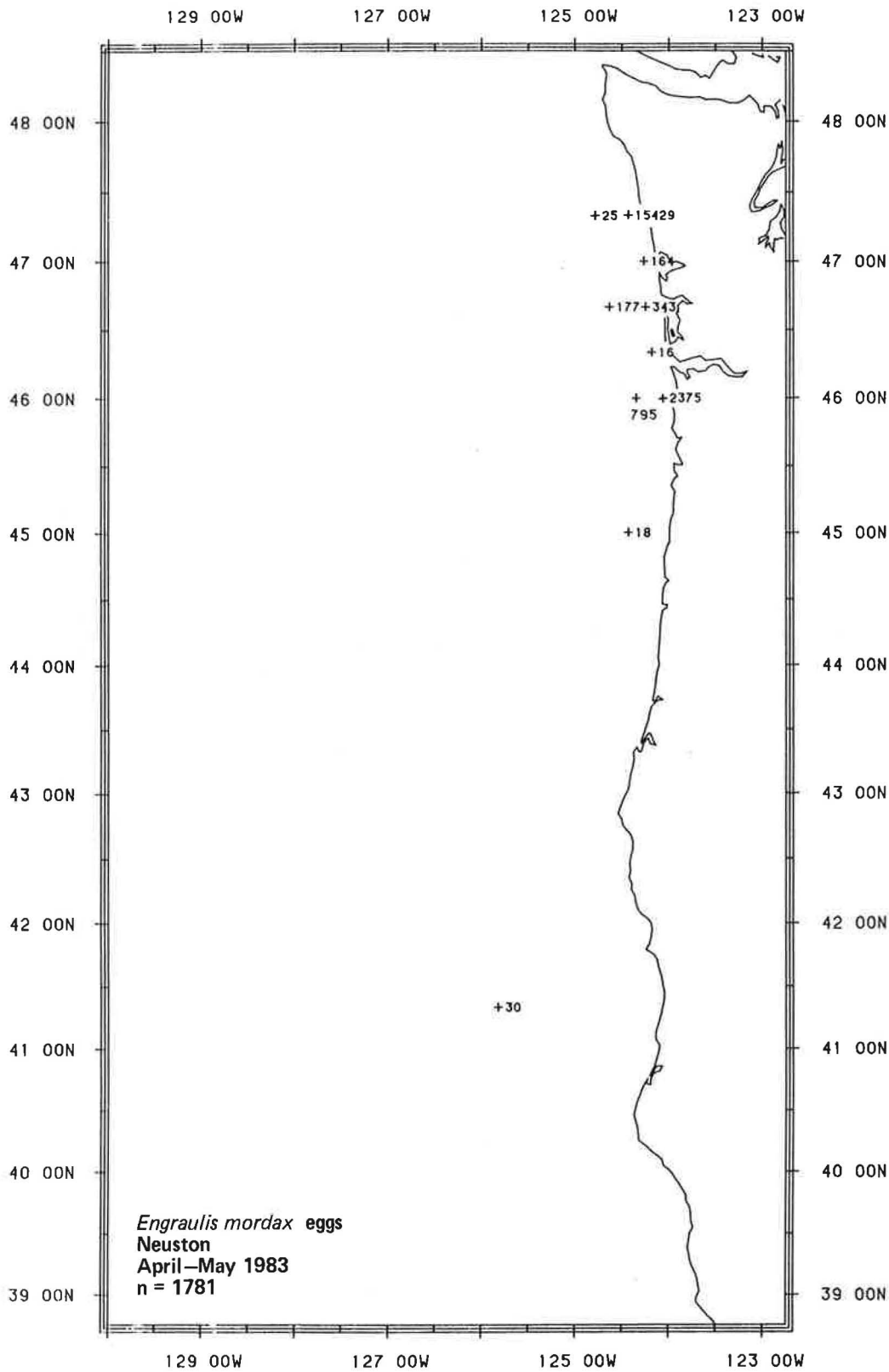

Figure 6.--Distribution of eggs of Engraulis mordax from neuston tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 1000 m^3.

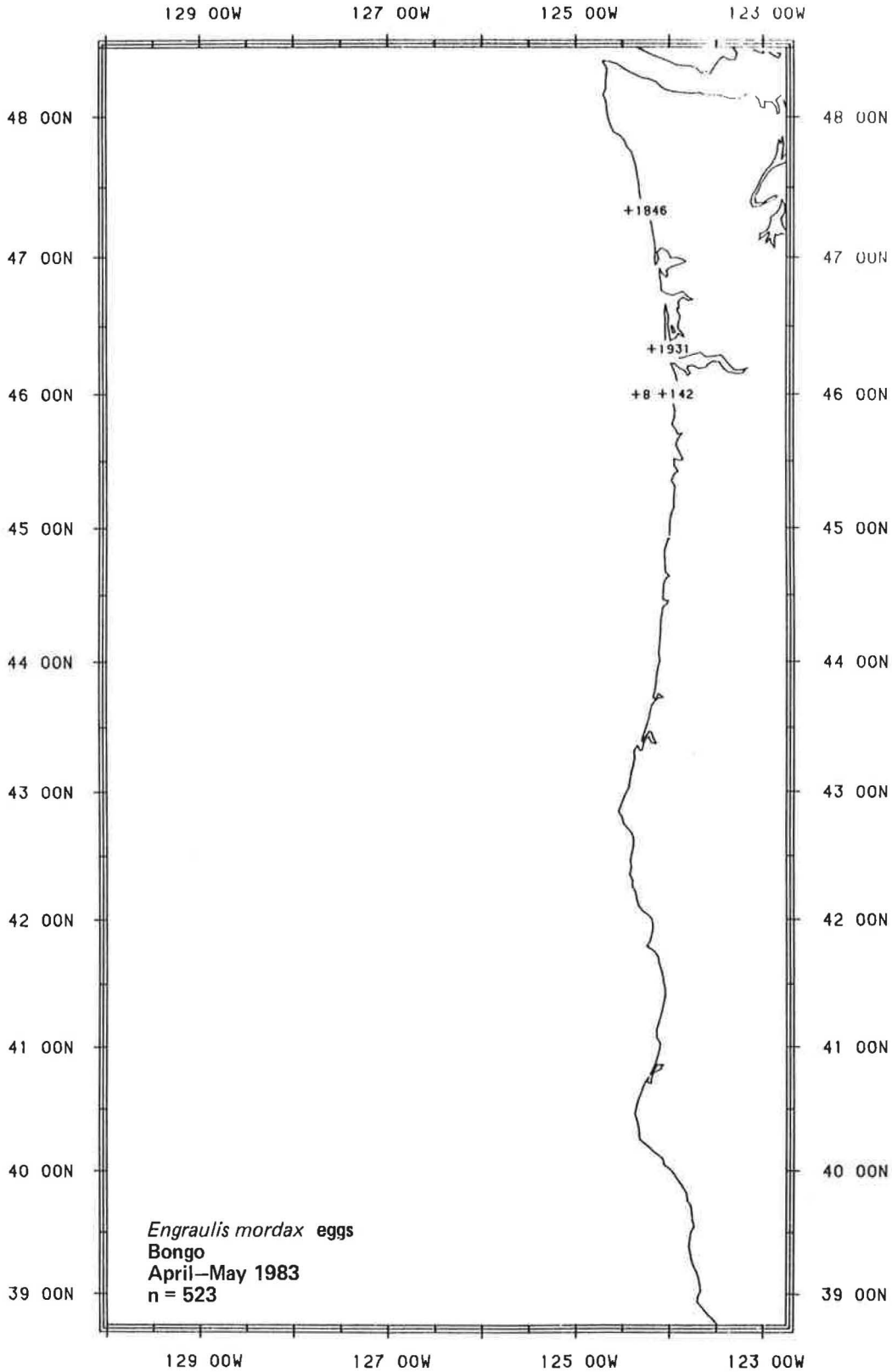

Figure 7.--Distribution of eggs of Engraulis mordax from bongo tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 10 m^2.

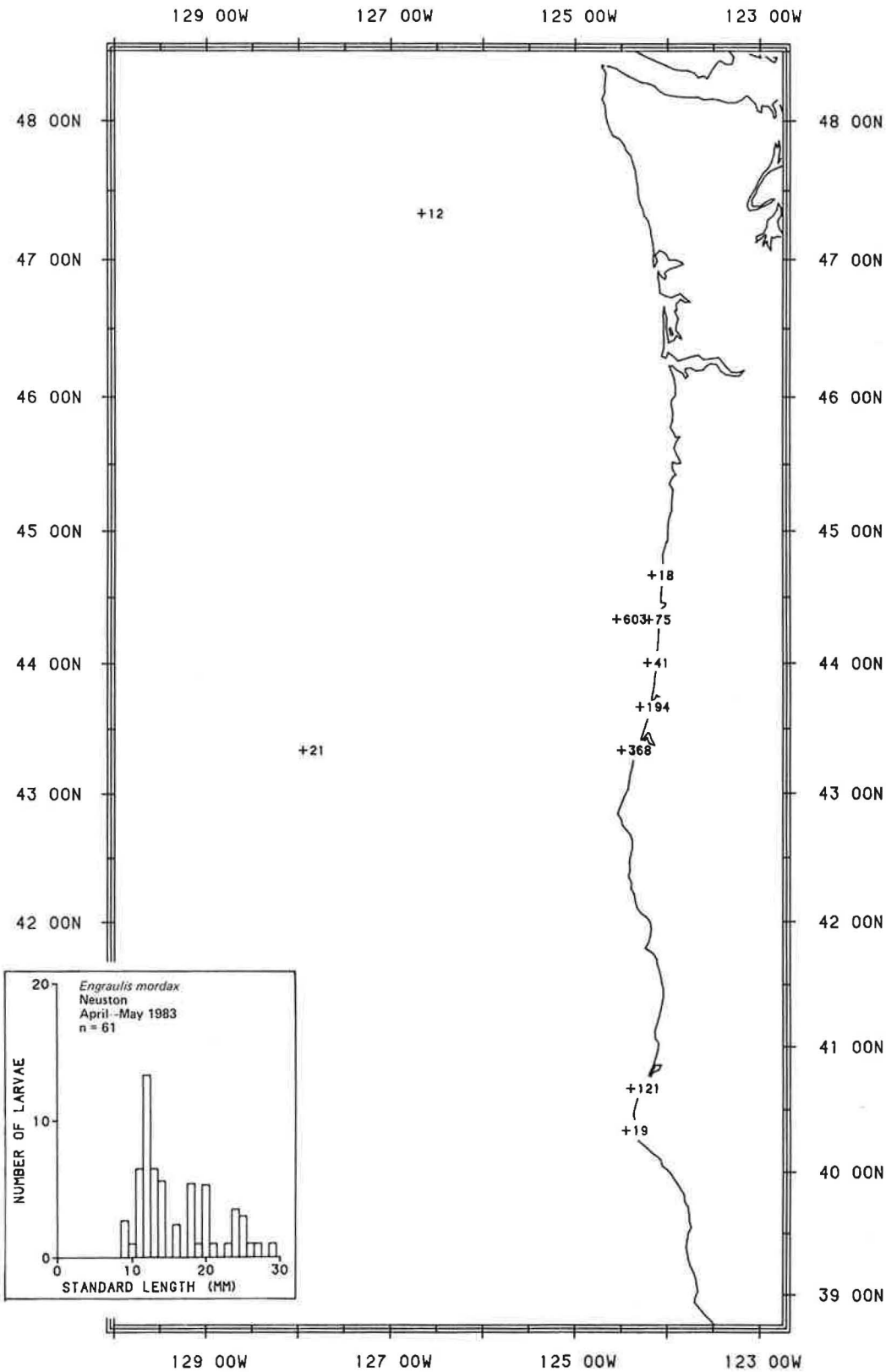

Figure 8.--Distribution and lengths of larvae of Engraulis mordax from neuston tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 1000 m^3.

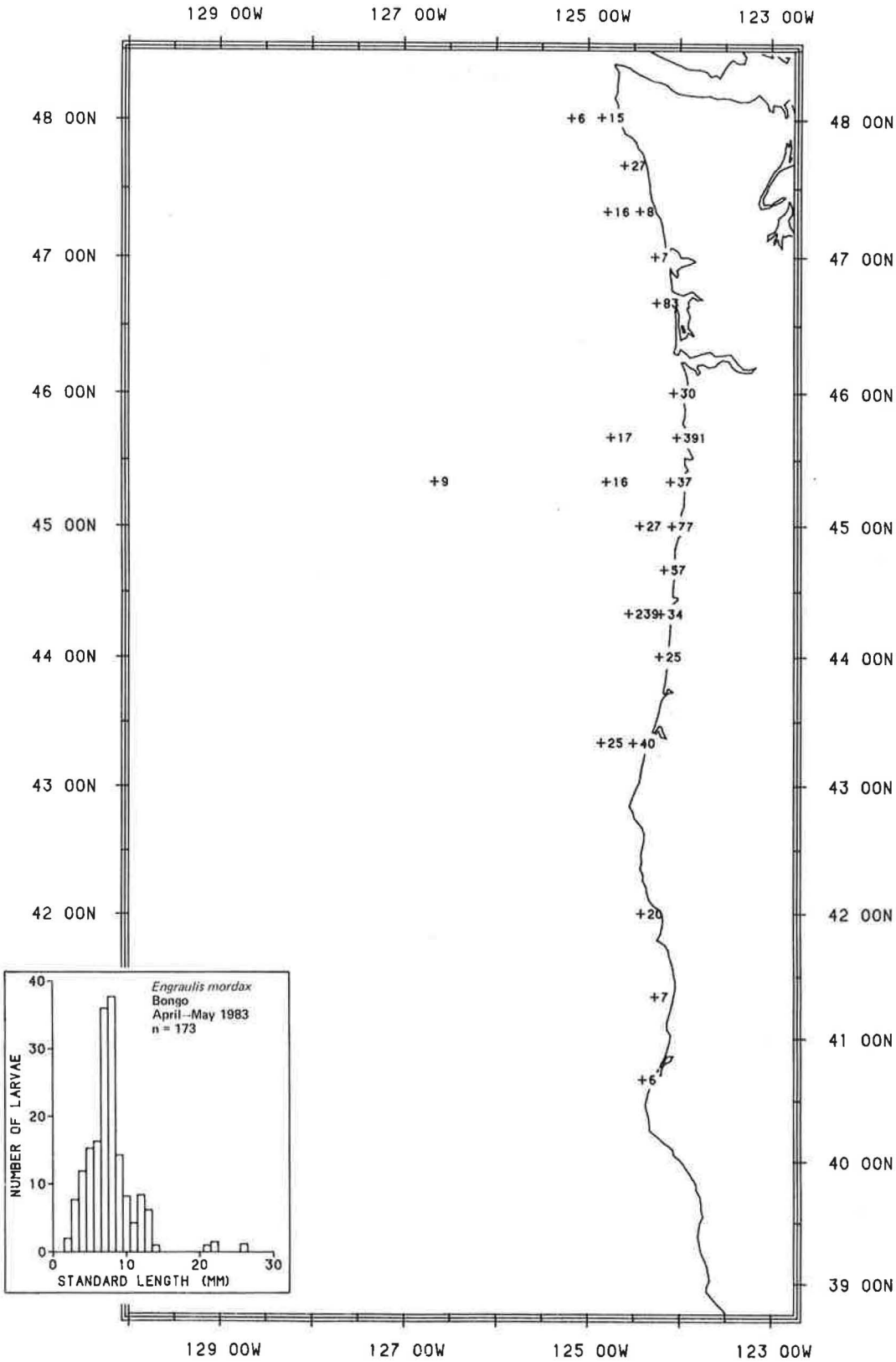

Figure 9.--Distribution and lengths of larvae of Engraulis mordax from bongo tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 10 m^2.

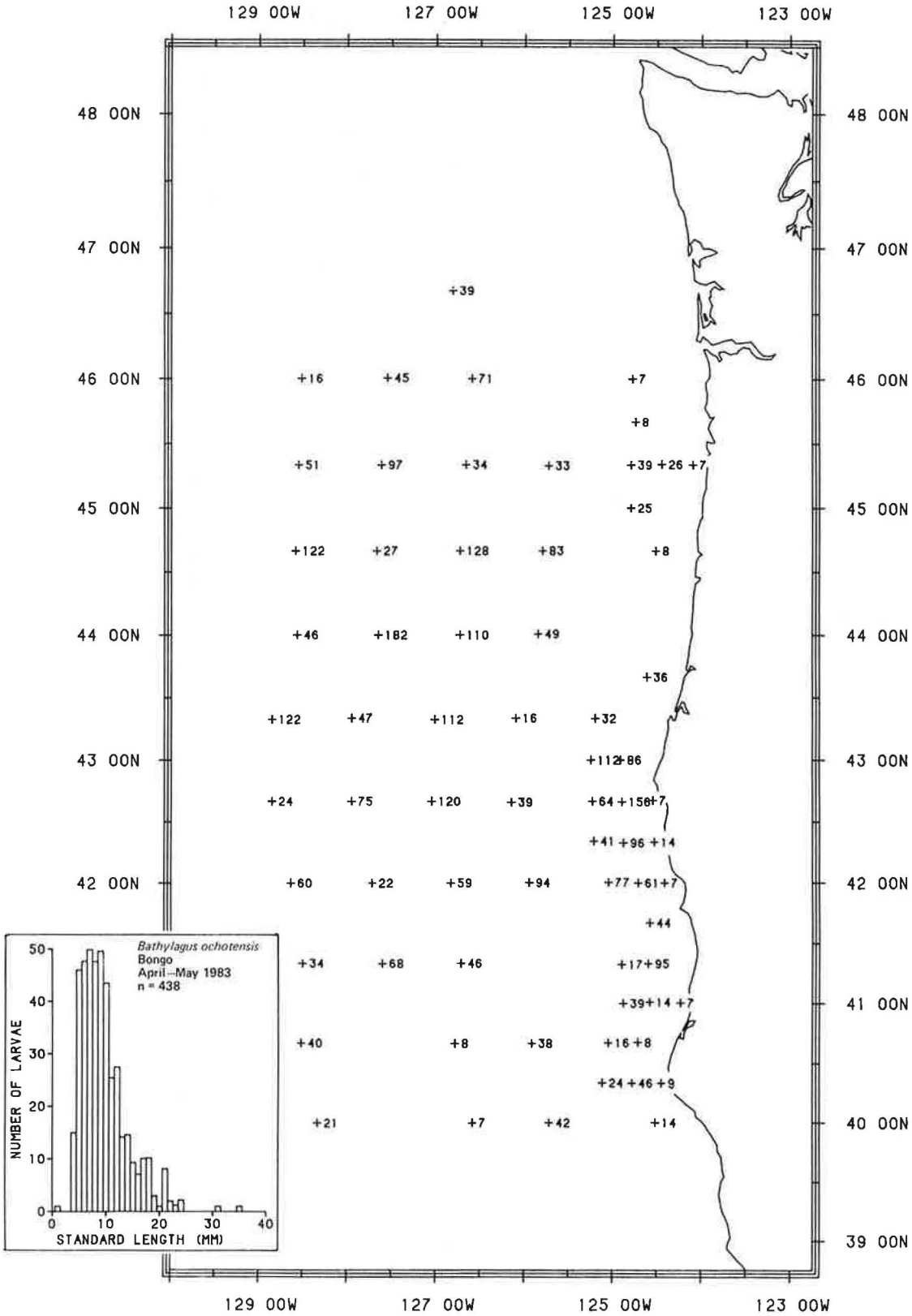

Figure 10.--Distribution and lengths of larvae of Bathylagus ochotensis from bongo tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 10 m^2.

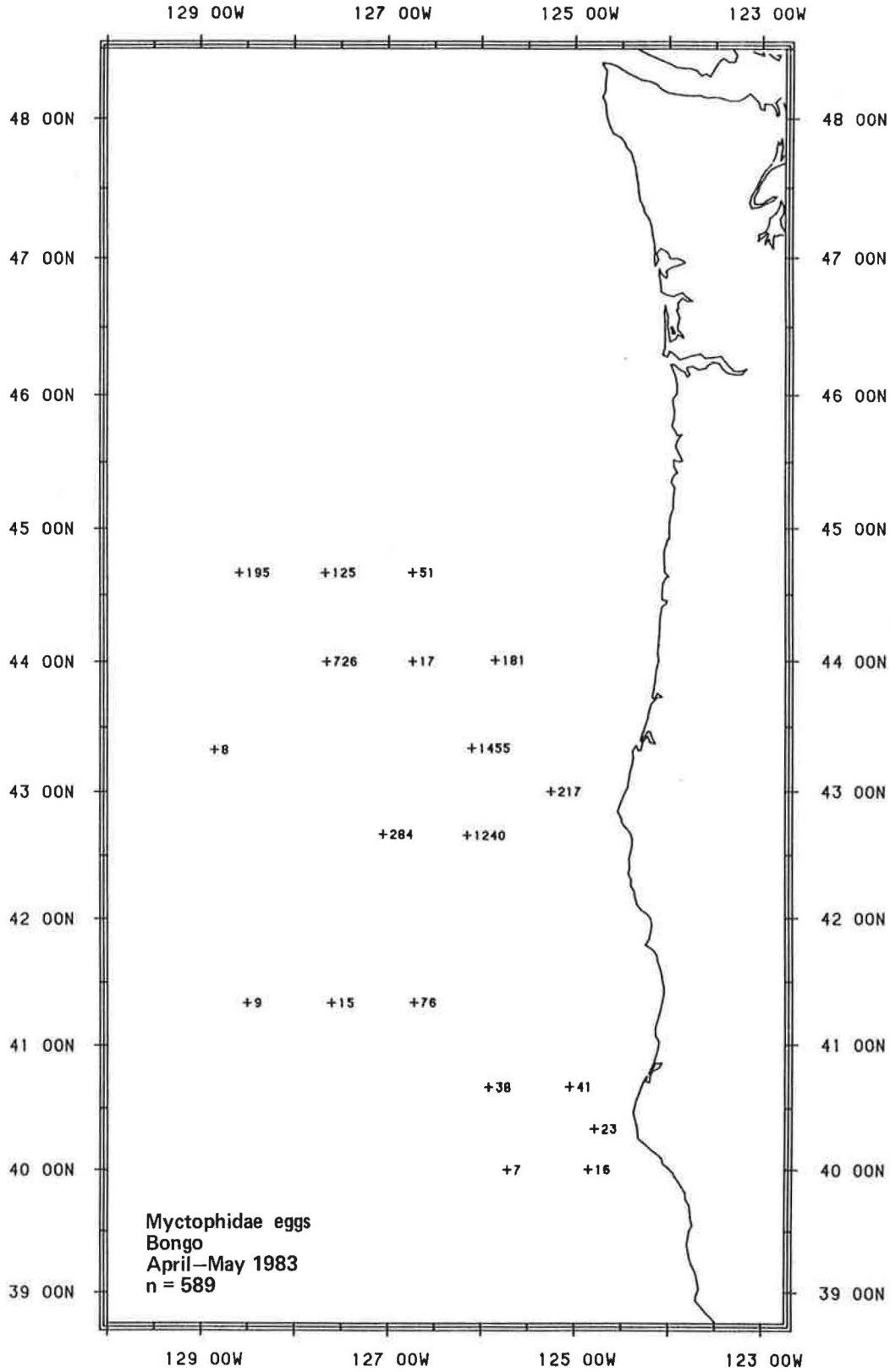

Figure 11.--Distribution of Myctophidae eggs from bongo tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 10 m^2.

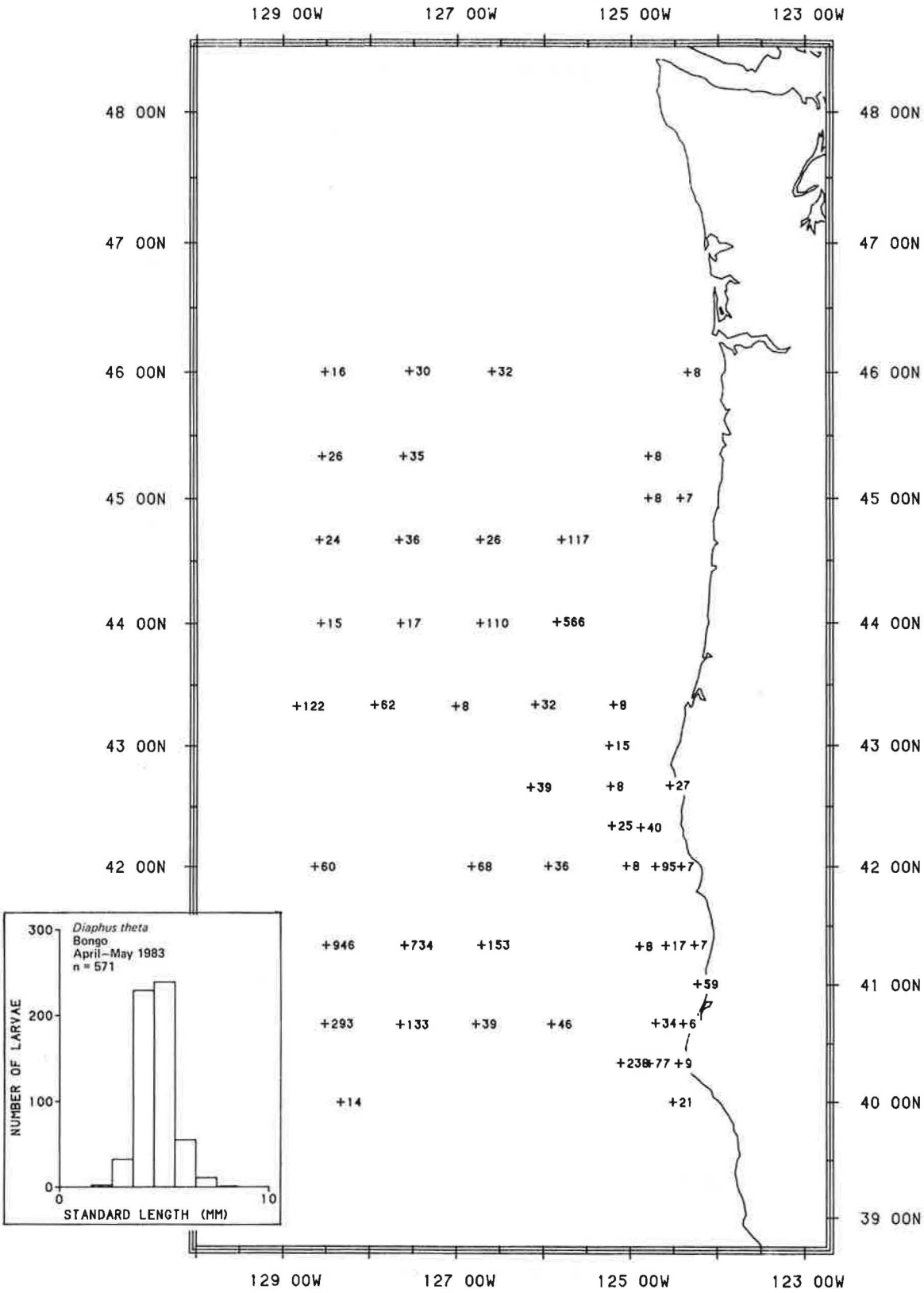

Figure 12.--Distribution and lengths of larvae of Diaphus theta from bongo tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 10 m^2.

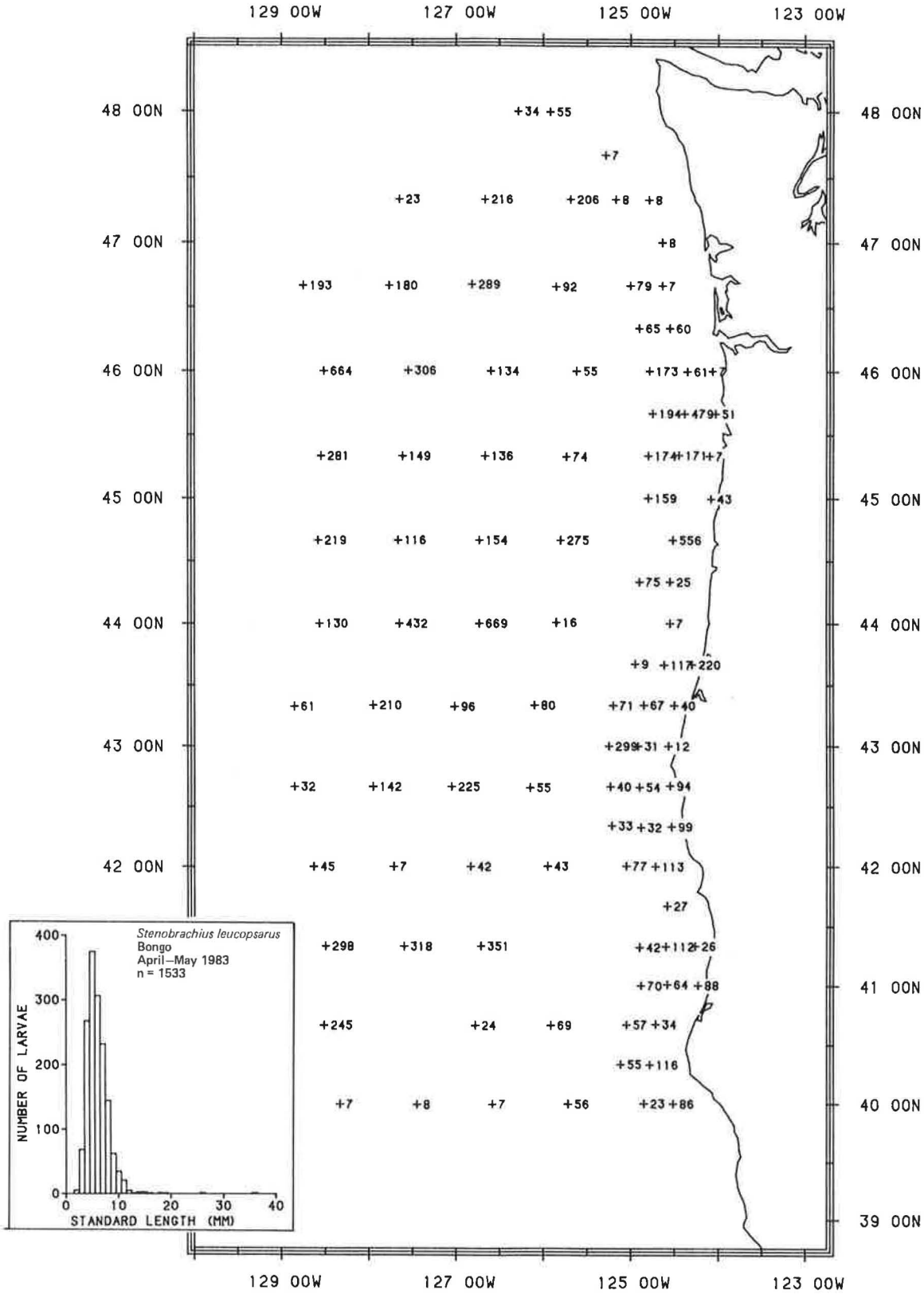

Figure 13.--Distribution and lengths of larvae of Stenobrachius leucopsarus from bongo tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 10 m^2.

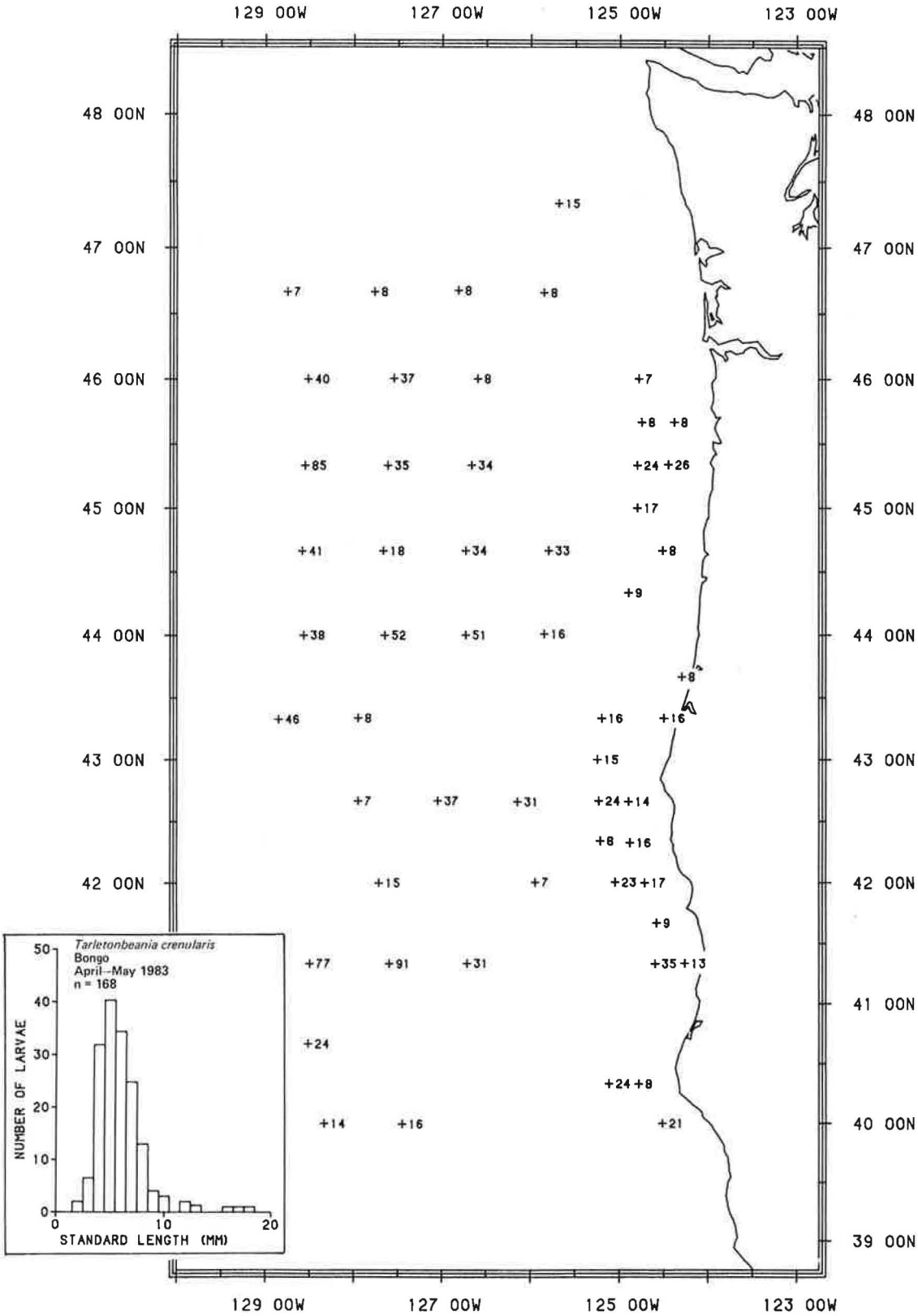

Figure 14.--Distribution and lengths of larvae of Tarletonbeania crenularis from bongo tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 10 m^2.

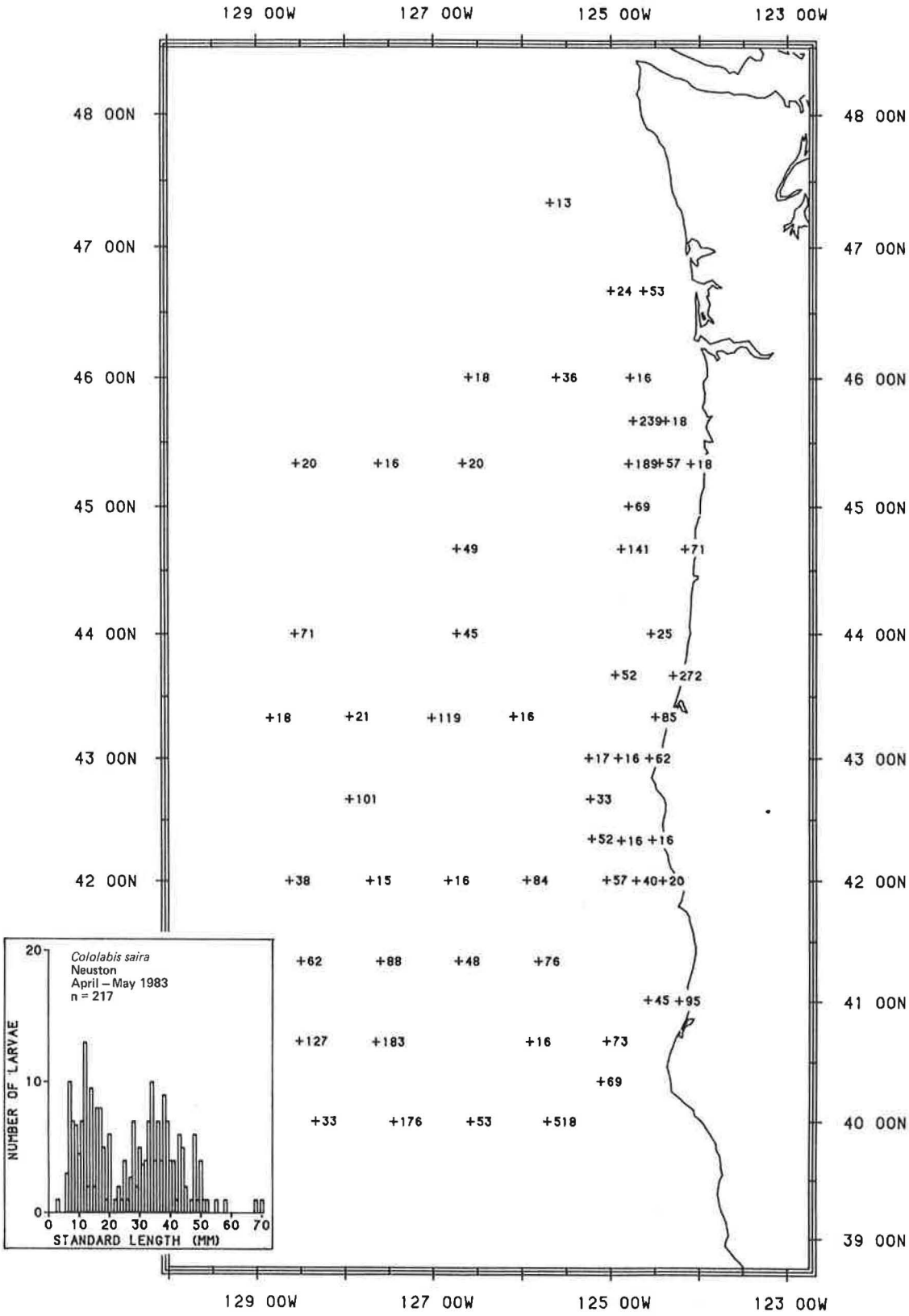

Figure 15.--Distribution and lengths of larvae of Cololabis saira from neuston tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 1000 m^3.

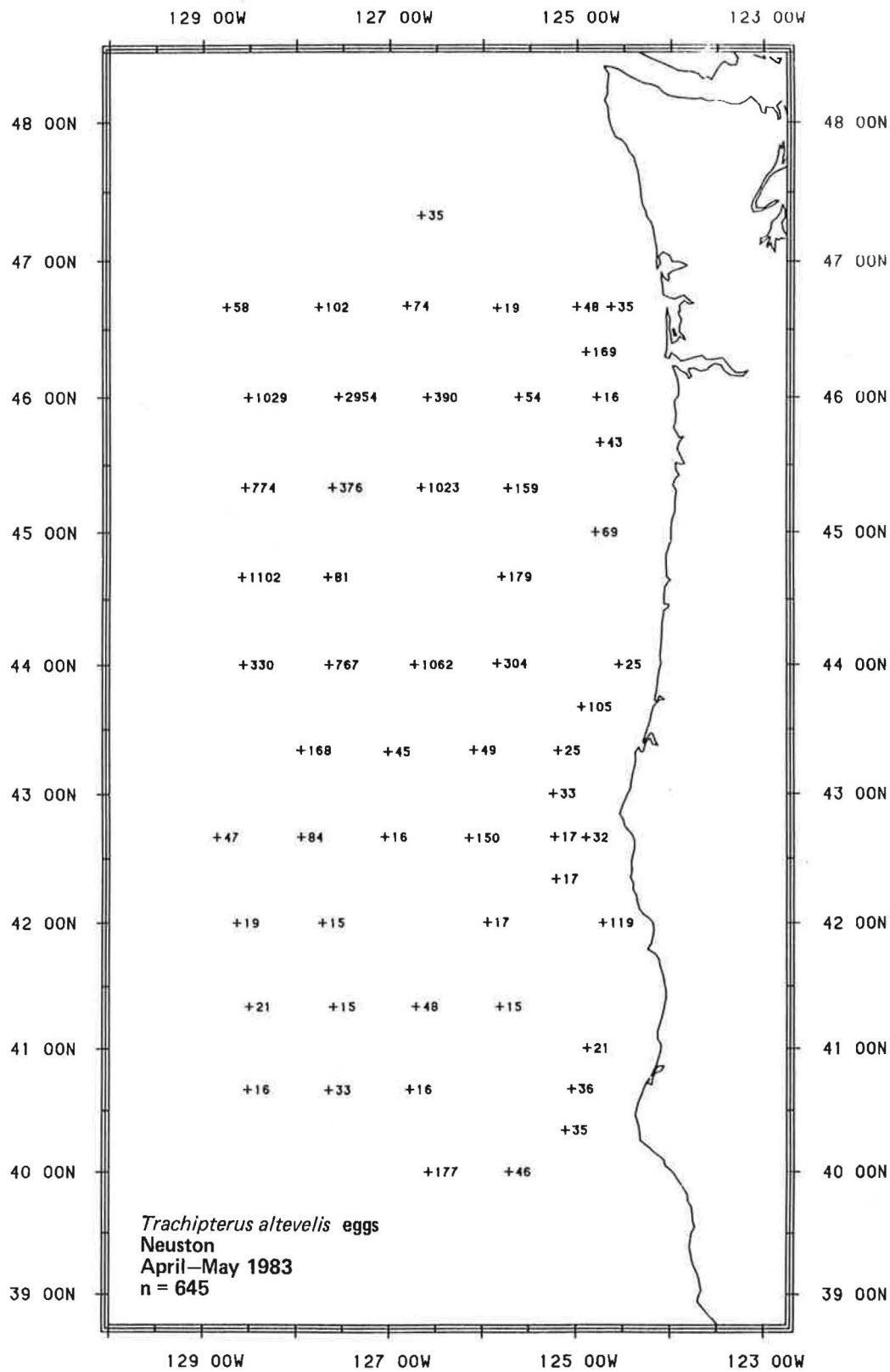

Figure 16.--Distribution of eggs of Trachipterus altevelis from neuston tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 1000 m^3.

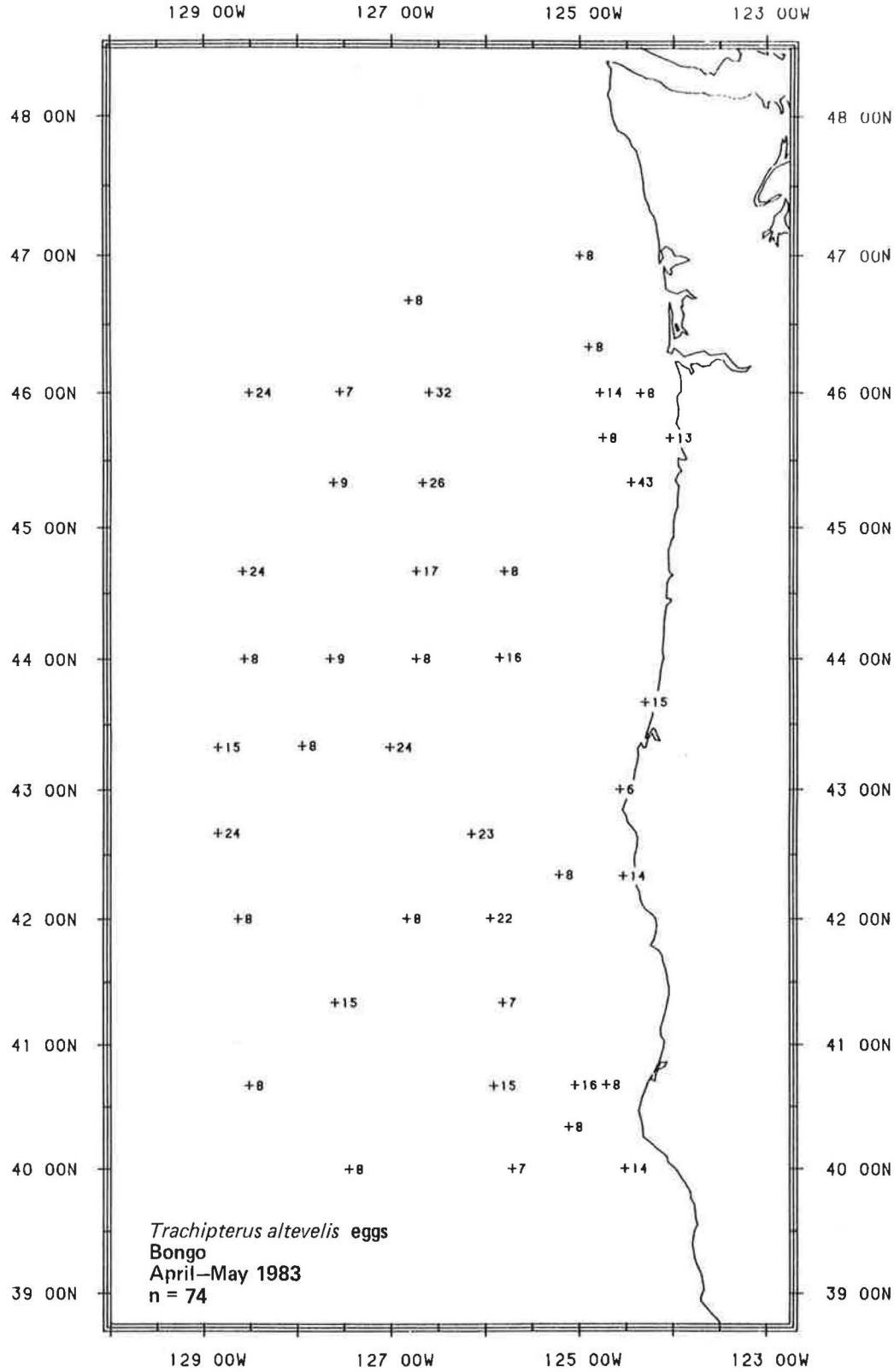

Figure 17.--Distribution of eggs of Trachipterus altevelis from bongo tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 10 m^2.

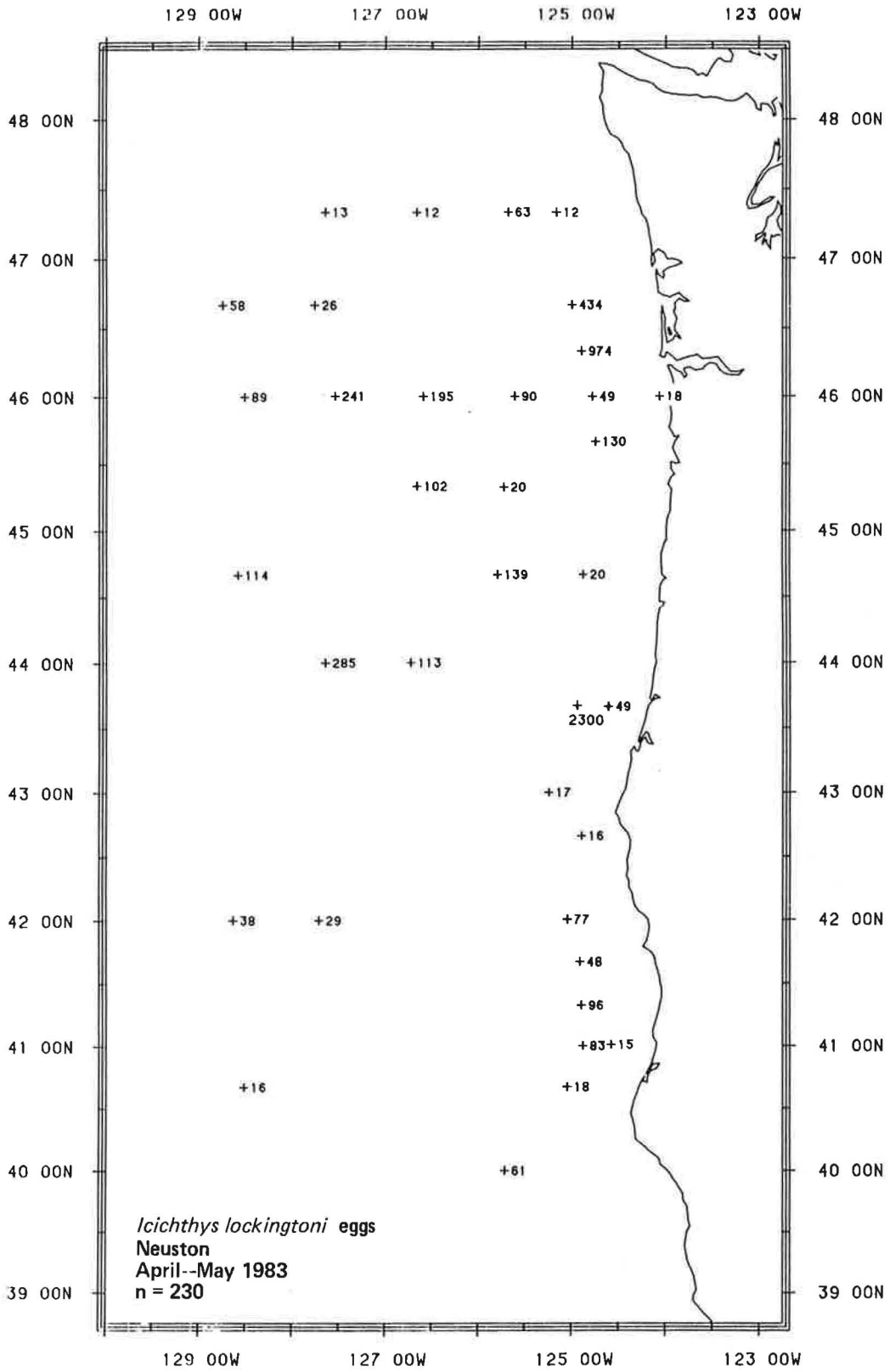

Figure 18.--Distribution of eggs of Icichthys lockingtoni during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 1000 m^3.

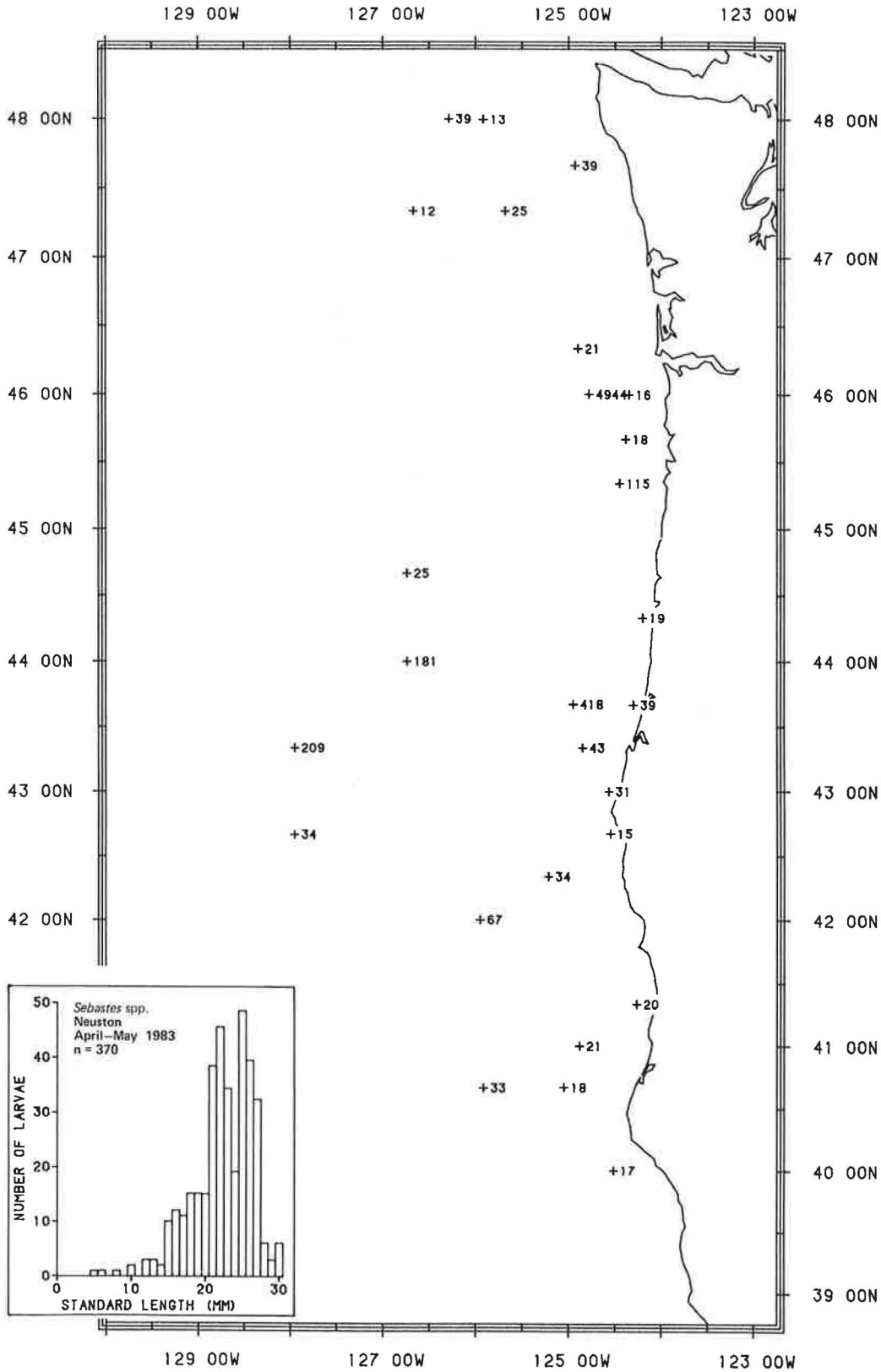

Figure 19.--Distribution and lengths of larvae of Sebastes spp. from neuston tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 1000 m^3.

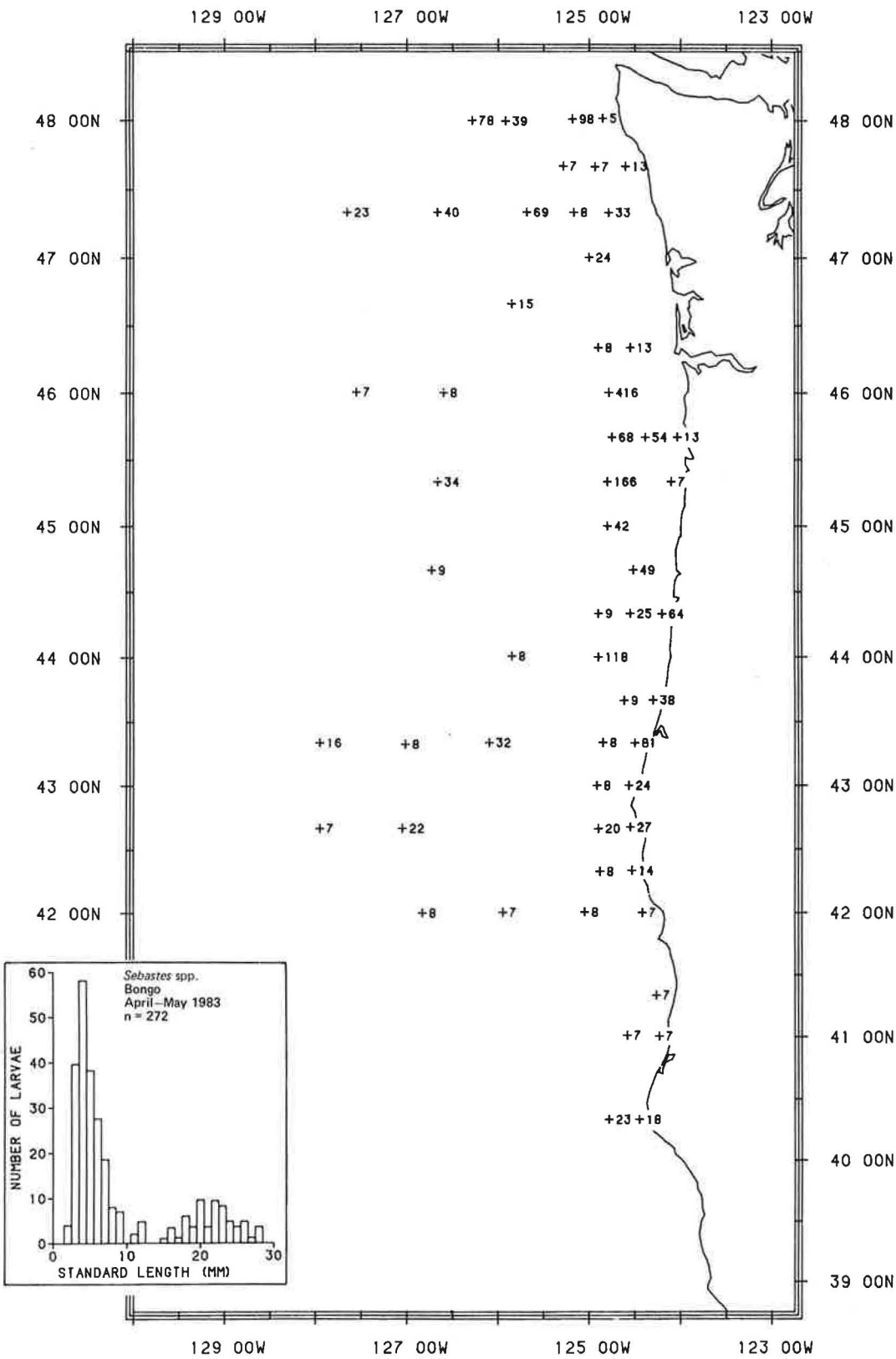

Figure 20.--Distribution and lengths of larvae of Sebastes spp. from bongo tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 10 m^2.

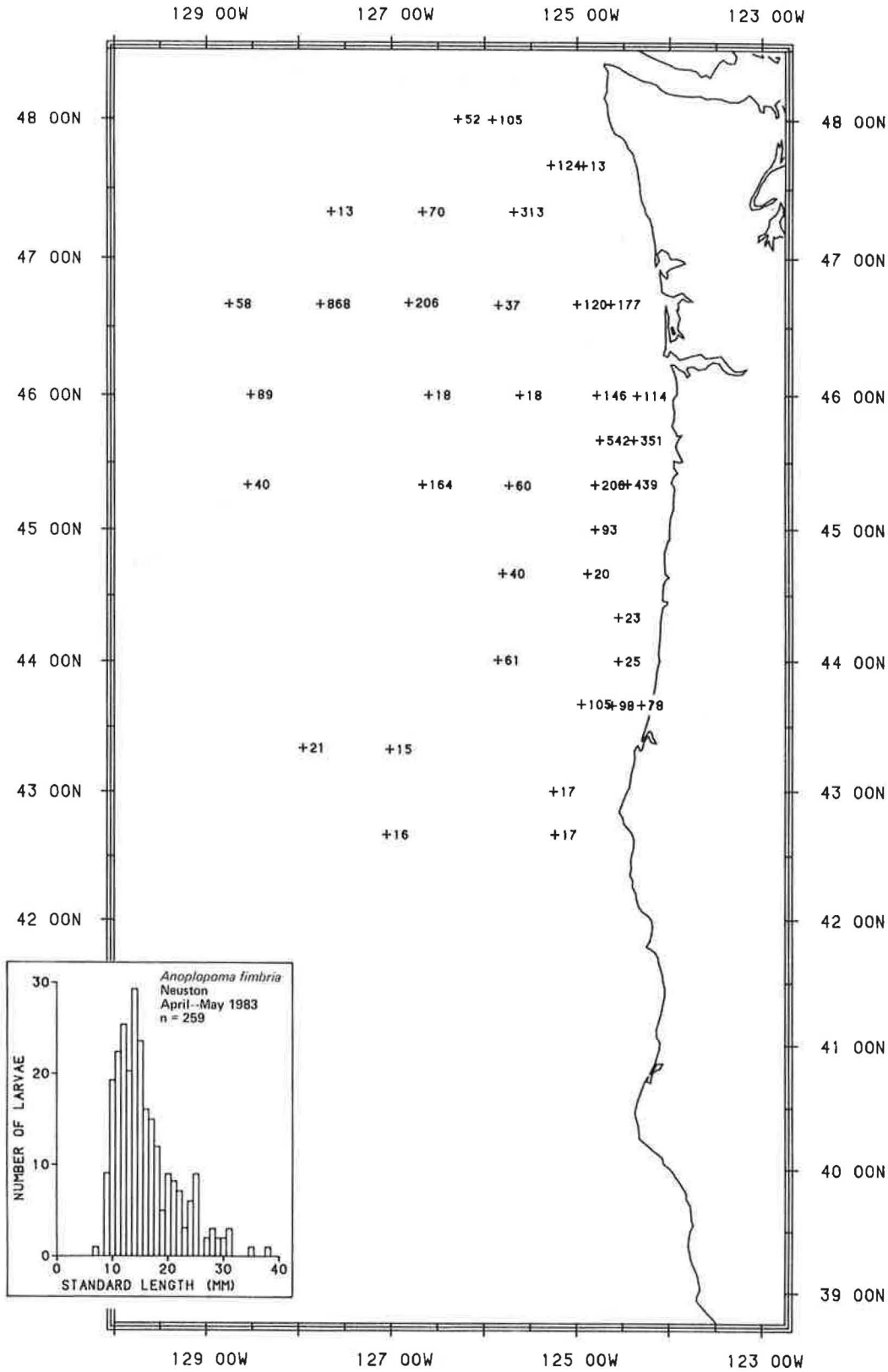

Figure 21.--Distribution and lengths of larvae of Anoplopoma fimbria from neuston tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 1000 m^3.

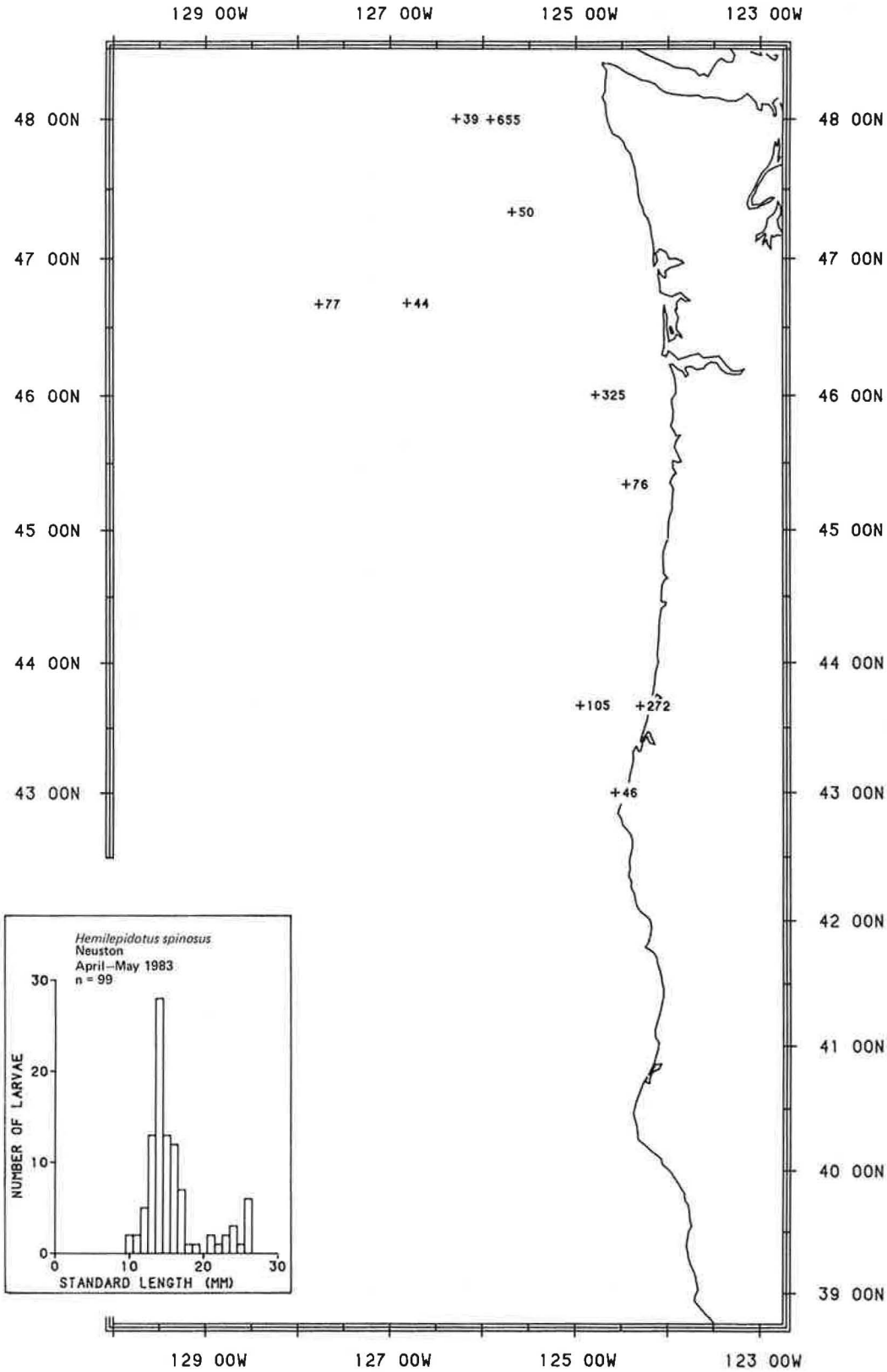

Figure 22.--Distribution and lengths of larvae of Hemilepidotus spinosus from neuston tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 1000 m^3.

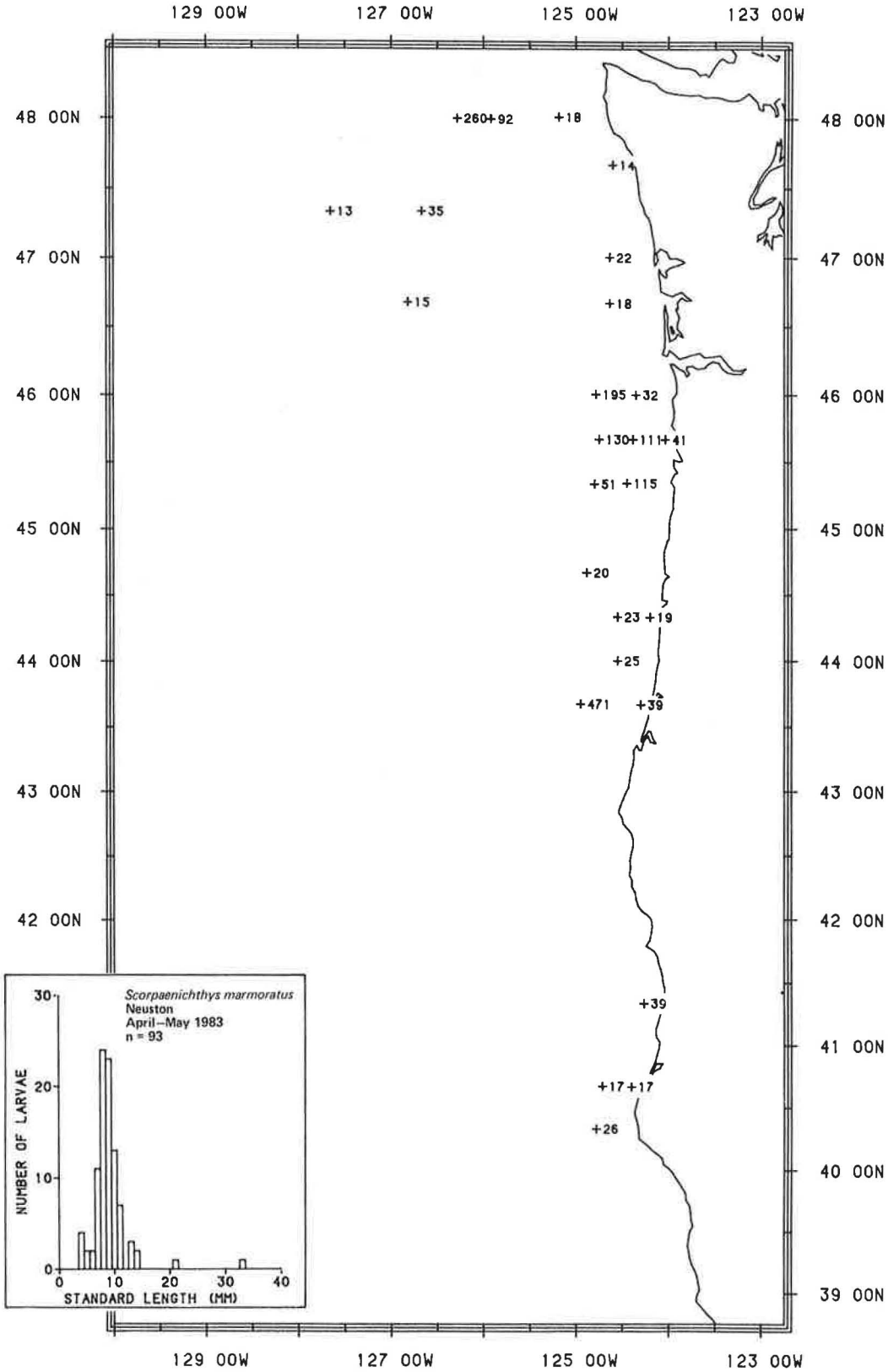

Figure 23.--Distribution and lengths of larvae of Scorpaenichthys marmoratus from neuston tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 1000 m^3.

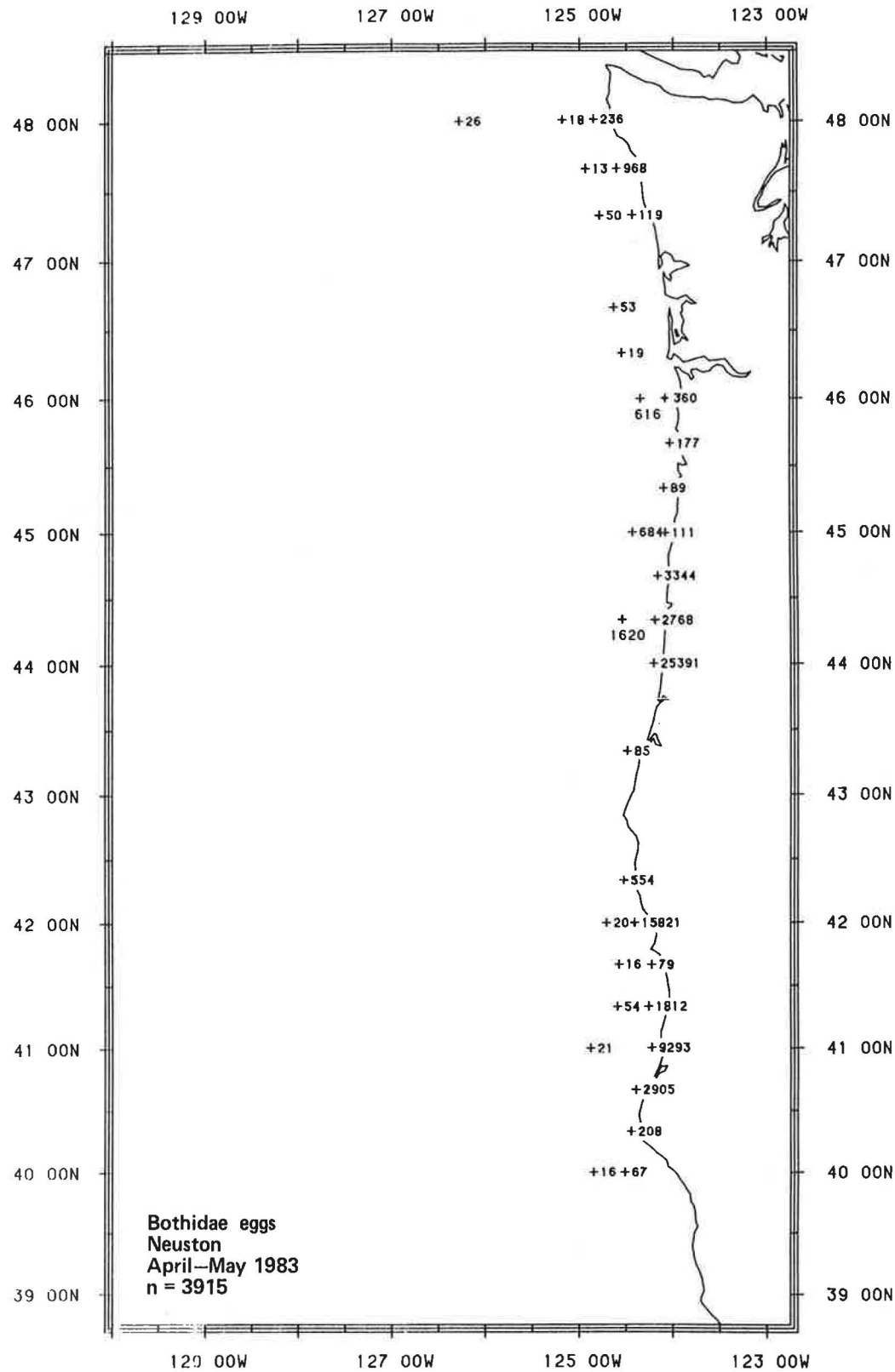

Figure 24.--Distribution of eggs of Bothidae from neuston tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 1000 m^3.

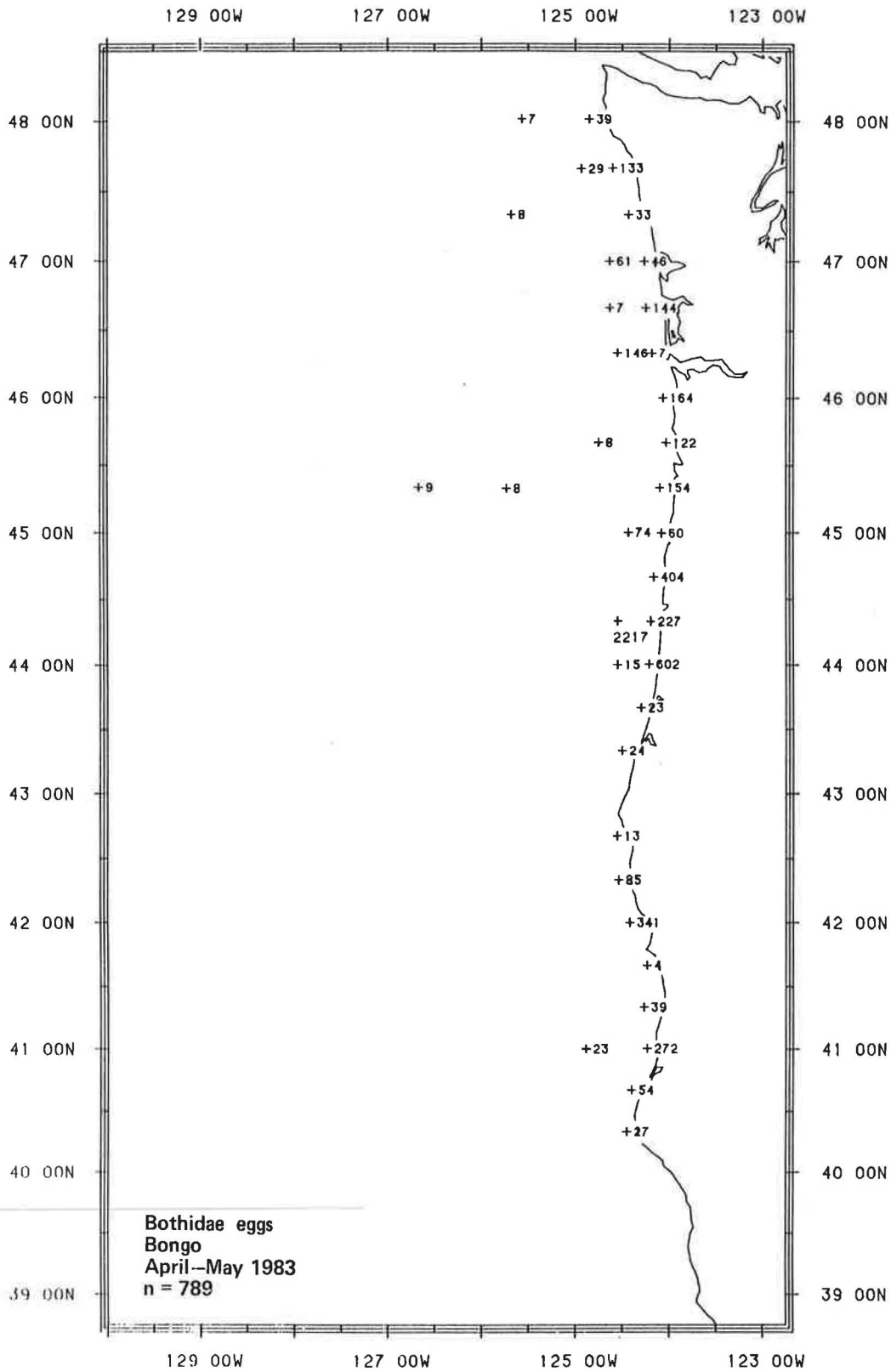

Figure 25.--Distribution of eggs of Bothidae from bongo tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 10 m^2.

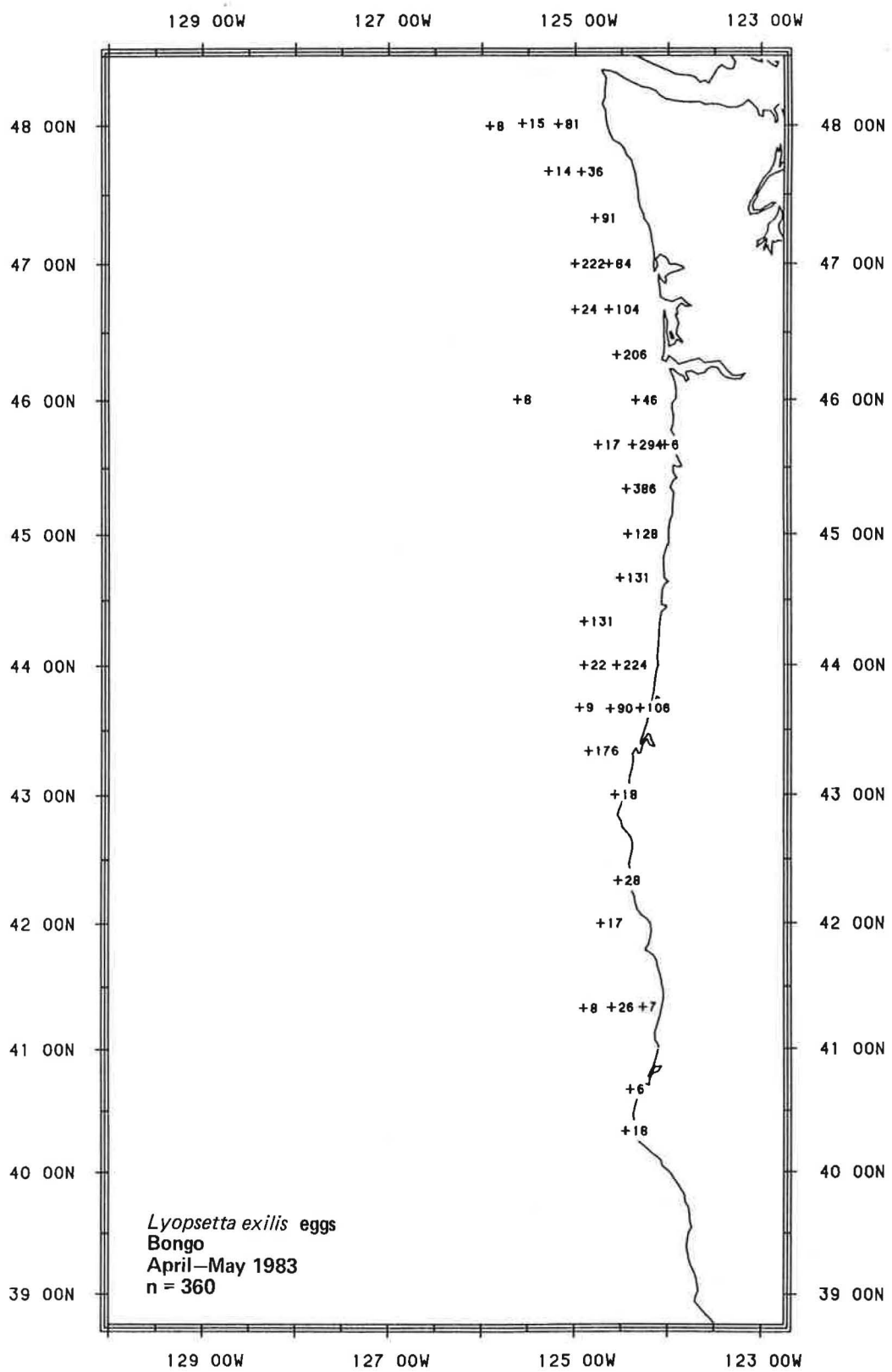

Figure 26.--Distribution of eggs of Lyopsetta exilis from bongo tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 10 m^2.

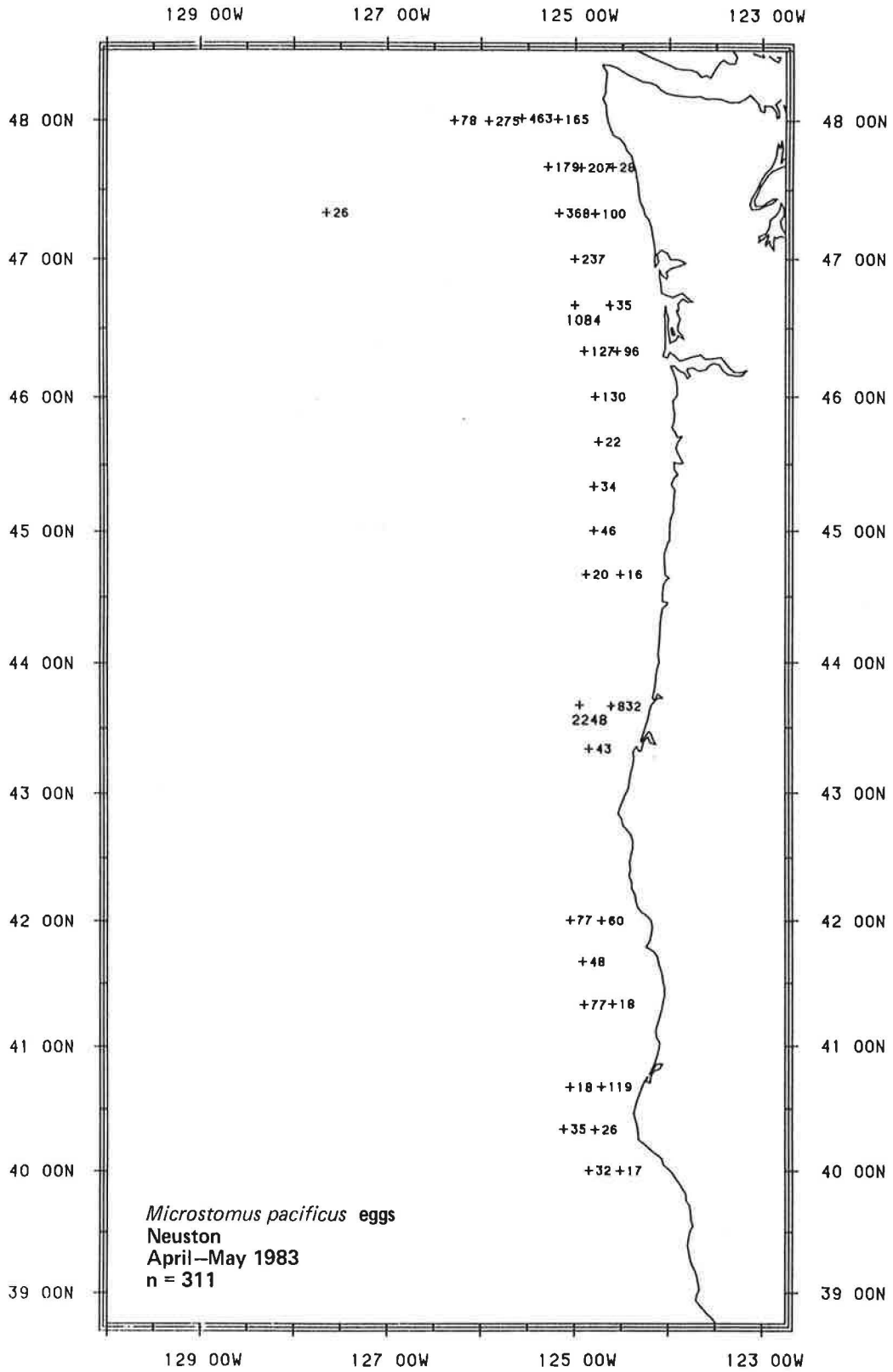

Figure 27.--Distribution of eggs of Microstomus pacificus from neuston tows during cruise 1EQ83, April-May 1983. Abundance expressed as numbers per 1000 m^3.

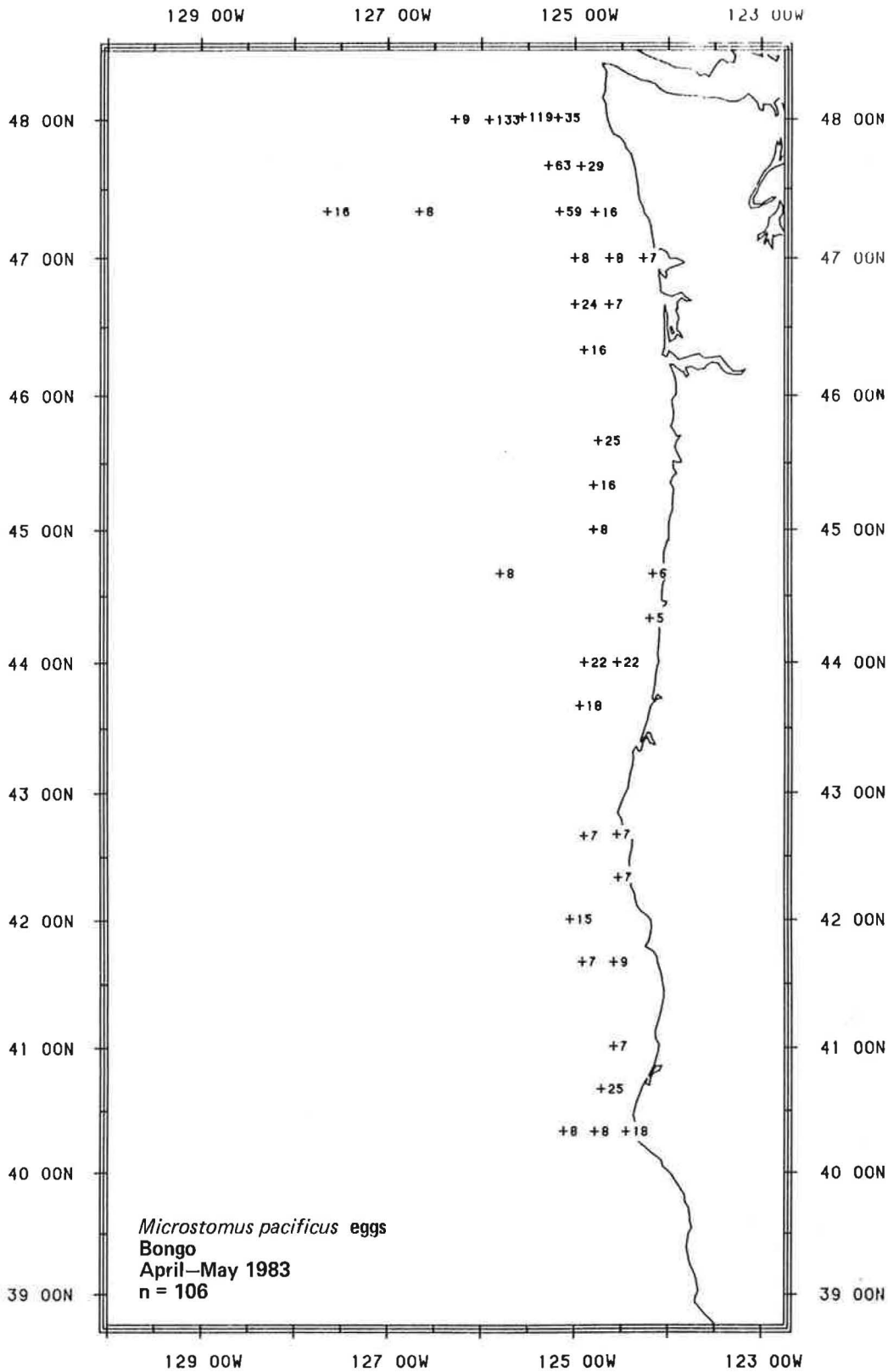

Figure 28.--Distribution of eggs of Microstomus pacificus from bongo tows during cruise 1EQ83, April-May 1983. Abundance expresses as numbers per 10 m^2.

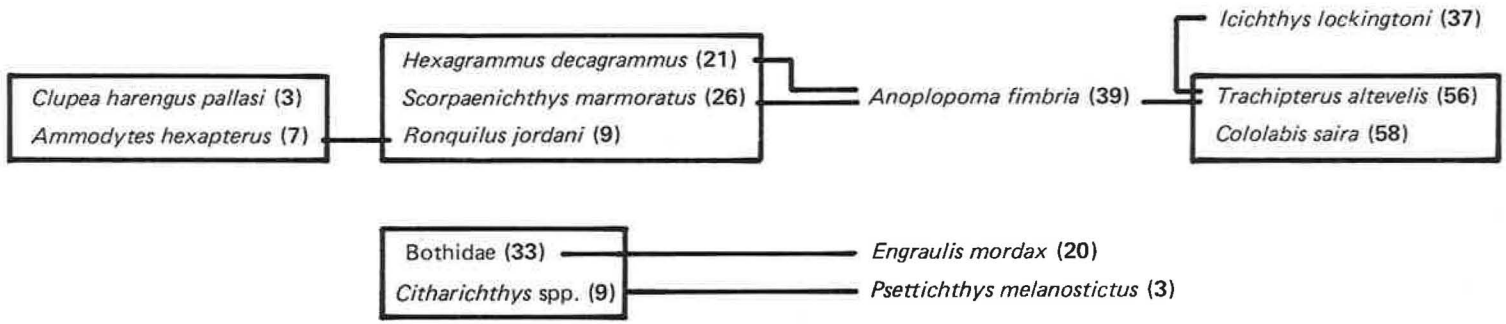

Figure 29.--Results of recurrent group analysis on neuston catches (both fish eggs and larvae) from cruise 1EQ83, April-May 1983, at an affinity level of 0.4. Taxa in rectangles are members of recurrent groups. Lines connect taxa with affinities outside their groups. Numbers in parentheses following taxa names are the numbers of occurrences of the taxa.

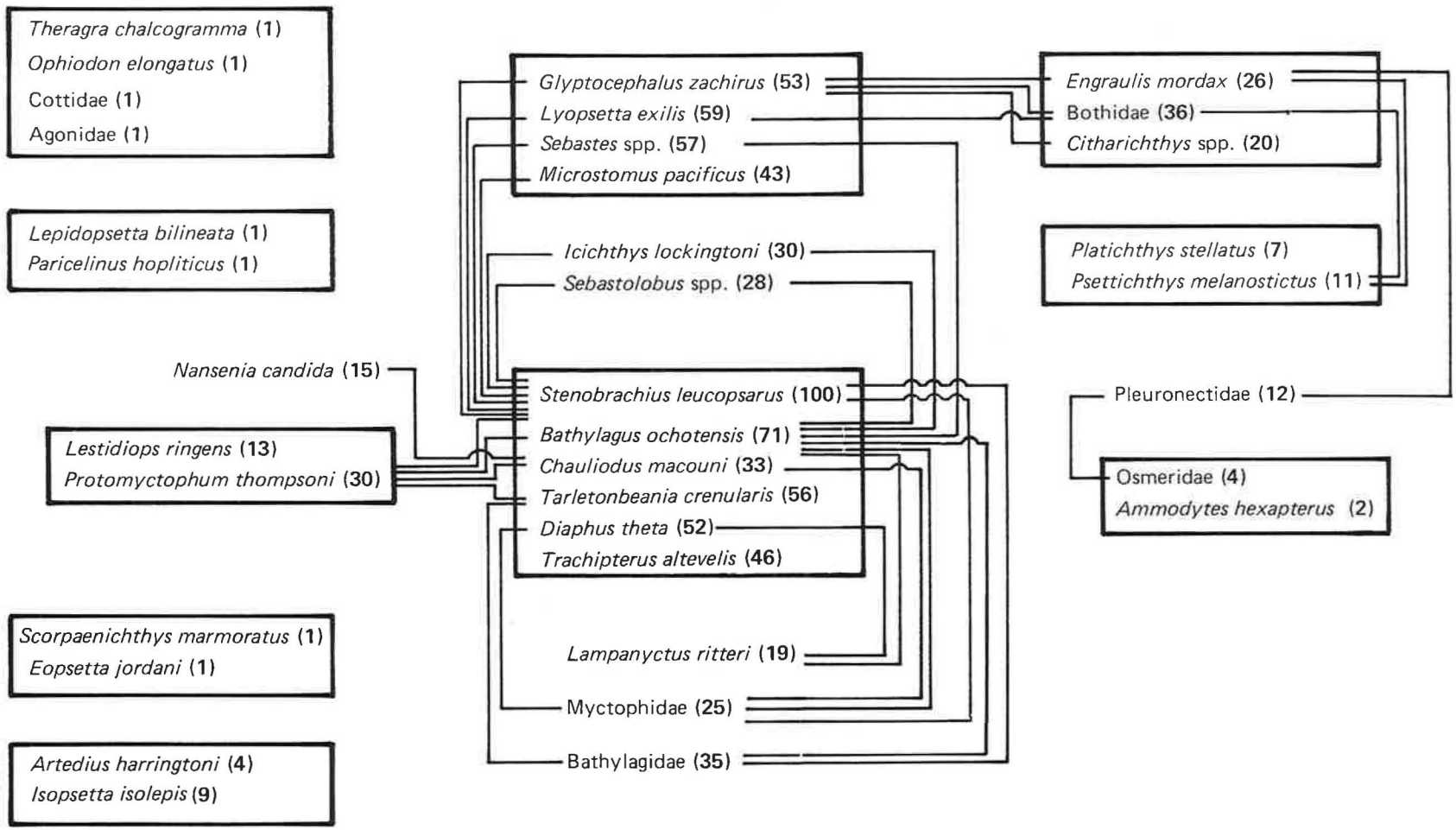

Figure 30.--Results of recurrent group analysis on bongo catches (both fish eggs and larvae) from cruise 1EQ83, April-May 1983. Format as for Figure 29.