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Ichthyoplankton off Washington, Oregon and Northern California April–May 1980

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NOTICE

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April - May 1980

By

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INTRODUCTION

This report describes the first in a series of cooperative U.S.-U.S.S.R. ichthyoplankton surveys conducted off the U.S. west coast from 48°-40°N. 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 125 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 TIKHOOKAENSKIY with Dr. M. Stepanenko serving as chief scientist occupied these stations basically from north to south from 20 April to 15 May 1980. 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 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 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 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 14 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 26 taxa of eggs and 65 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 6-23 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 24, and from bongo samples 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, 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, Engraulis mordax, Microstomus pacificus, and Trachypterus altivelis, depending on the measurement used (Figure 2). In the bongo net, eggs of Myctophidae were most abundant according to two measurements, and Bothidae and Lyopsetta exilis according to the other two (Figure 4).

Larval catches in the neuston net were dominated by Anoplopoma fimbria according to three measurements, and by Hemilepidotus spinosus based on the other (Figure 3). Engraulis mordax, Scorpaenichthys marmoratus, Sebastes sp., and Cololabis saira were also abundant members of the neuston community. In the bongo net, Stenobrachius leucopsarus larvae dominated the catches based on all four measurements (Figure 5). Also abundant were Osmeridae, Bathylagus ochotensis, Diaphus theta, and Sebastes sp. larvae.

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.

Engraulis mordax (Figure 6) - Eggs of the northern anchovy, representing the spawning products of the northern subpopulation were collected in neuston tows mainly near the Oregon coast, presumably in waters of the Columbia River Plume. Other studies have analysed data on eggs and larvae of this subpopulation, which were collected in summer to determine spawning biomass (Richardson 1981) and larval growth rates (Methot 1981). We collected these eggs near the end of April, 6 wk before the beginning date of the spawning season used by Richardson (1981). It is not known whether anchovies started spawning earlier than normal in 1980 or what triggers the onset of spawning in this subpopulation.

Osmeridae (Figure 7) - Small unidentified smelt larvae ranging from 4.0-15.2 mm SL were taken in bongo tows near shore mainly in the northern half of the survey area. Osmerid larvae dominated the nearshore assemblage in late spring-early summer off Yaquina Bay, Oregon, as reported by Richardson and Pearcy (1977).

Bathylagus ochotensis (Figure 8) - Larvae of this deep-sea smelt were widely distributed off shore in bongo tows, occurring at 50% of the stations sampled. Their lengths ranged from 4.6-26.7 ($\bar{x}$ = 9.9) mm SL.

Myctophidae (Figure 9) - Unidentified eggs of lanternfishes were collected in bongo tows in offshore waters mainly in the southern two-thirds of the survey area. These eggs are small (0.75-0.85 mm diameter) and appear fragile, so many more may have been caught but ruptured or squeezed through the 0.505 mm mesh of the net.

Stenobrachius leucopsarus (Figure 10) - These larvae occurred in bongo catches at 74% of the stations sampled. They were abundant throughout the survey area and ranged in size from 2.5-9.0 ($\bar{x}$ = 5.8) mm SL. They also dominated the myctophid larval fauna off Oregon in winter-spring, as reported

by Richardson et al. (1980) and off 51°-42°N in April-May, as reported by Waldron (1972).

Cololabis saira (Figure 11) - Saury larvae occurred off shore in neuston tows in the southern part of the survey area. They had a wide range of lengths from 5.6-56.0 ($\bar{x}$ = 11.7) mm SL. They were also quite abundant in the neuston collections from May 1972 reported by Ahlstrom and Stevens (1977), but their area of abundance was mainly south of that observed in the present study.

Icichthys lockingtoni (Figure 12) - Eggs of medusafish were widely distributed, but in rather low abundance in neuston collections. Young of this species occur widely in the northern two-thirds of the CalCOFI area (Ahlstrom et al. 1976), but have only been reported from off Oregon or Washington by Waldron (1972) as four specimens of questioned identity.

Sebastes sp. (Figures 13 and 14) - Rockfish larvae were abundant in both neuston and bongo catches. No attempt was made to identify the species caught. In neuston tows they were not found as far off shore as in bongo tows. In both nets they occurred throughout the north-south extent of the survey area. In the neuston net they were considerably larger than in the bongo net ($\bar{x}$ neuston = 20.9, $\bar{x}$ bongo = 5.9 mm SL), a result similar to that found by Ahlstrom and Stevens (1977).

Anoplopoma fimbria (Figure 15) - Sablefish larvae were widely distributed in neuston catches. Their pattern of distribution and abundance was quite patchy. They ranged in length from 6.3-37.0 ($\bar{x}$ = 14.2) mm SL. Ahlstrom and Stevens (1977) indicated a similar pattern of patchy distribution in their collections.

Hemilepidotus spinosus (Figure 16) - Larvae of the brown Irish lord were collected in the neuston net, mainly just off the continental shelf. They ranged from 3.1-30.6 ($\bar{x}$ = 15.8) mm SL.

Scorpaenichthys marmoratus (Figure 17) - Cabezon larvae occurred widely, but rather near shore in neuston collections. They ranged from 4.1-35.0 ($\bar{x}$ = 8.7) mm SL.

Bothidae (Figure 18 and 19) - Eggs of unidentified lefteye flounders (probably mainly Citharichthys sp.) were found near shore in the northern half of the survey area in both neuston and bongo catches.

Lyopsetta exilis (Figures 20-22) - Eggs and larvae of slender sole were collected near shore. In the neuston net, eggs were collected mainly in the southern half of the survey area, while in the bongo net they occurred all along the coast. The larvae, in bongo catches, seemed to be concentrated off Oregon, and ranged from 2.9-16.0 ($\bar{x}$ = 7.0) mm SL. This pattern of occurrence may indicate that 1) spawning progresses northward with the season and 2) the eggs rise toward the surface as they develop. The larvae were frequently part of the offshore assemblage off Oregon in March-April, as reported by Richardson et al. (1980).

Microstomus pacificus (Figure 23) - Dover sole eggs were collected in neuston tows all along the coast, mainly just off the continental shelf. They were further off shore than slender sole eggs or larvae.

Community Structure

Recurrent group analysis at a 0.4 affinity level of neuston catches showed three independent groups (Figure 24). Each group had complex relations of association among its members. The groups were basically aligned in an offshore-onshore pattern. The offshore group contained the most species and included larvae of Anoplopoma fimbria, Sebastes sp., Hemlepidotus spinosus, and Scorpaenichthys marmoratus. Eggs of Microstomus pacificus, Icichthys

lockingtoni, and Trachypterus altivelis were also part of this group. A nearshore group that was found mainly off Oregon included eggs of a number of flatfish and Engraulis mordax. A group of larvae closely associated with the coast included Ammodytes hexapterus, Ophiodon elongatus, and Parophrys vetulus.

In bongo catches an even more complex pattern emerged (Figure 25). It basically broke down into two groups--an offshore group with many mesopelagic members and a nearshore group that was heavily represented by flatfish eggs and larvae. Within this pattern a variety of species associations exist. In the offshore group Stenobrachius leucopsarus larvae had the greatest number of affinities, and in the nearshore group Psettichthys melanostictus eggs and larvae had the greatest number of affinities.

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Figure 24.--Results of recurrent group analysis on neuston catches (both fish eggs and larvae) from 1TK80, April-May 1980, 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 that taxon.

Figure 25.--Results of recurrent group analysis on bongo catches (both fish eggs and larvae) from 1TK80, April-May 1980. Format as for Figure 24.

STATION	POSITION LAT. N.	LONG. W.	DATE YYMMDD	BONGO STATIONS AREA KM2	TIME GMT	STANDARD HAUL FACTORS* A	B	NEUSTON STATIONS TIME GMT	STANDARD HAUL FACTORS* A	B
G001A	48 0.0	124 49.2	80 420	761.	1844	4.624	17.986	1821	0.033	21.936
G002A	48 0.0	125 11.2	80 420	967.	2115	5.601	4.198	2115	0.027	18.260
G003A	48 0.0	125 34.0	80 421	1395.	110	5.626	3.610	140	0.026	17.560
G004A	48 0.5	125 55.5	80 421	2153.	655	7.777	3.524	655	0.025	16.945
G005A	48 0.0	126 17.5	80 421	3780.	1250	7.147	3.361	1230	0.028	18.942
G006A	47 40.0	125 15.8	80 423	1561.	1447	8.454	3.842	1432	0.024	16.159
G007A	47 39.5	124 56.0	80 423	996.	1745	8.086	7.402	1705	0.024	16.073
G008A	47 40.0	124 33.5	80 423	719.	2304	5.211	18.023	2250	0.025	16.418
G009A	47 20.0	124 25.0	80 424	738.	148	3.318	23.571	130	0.025	16.401
G010A	47 20.0	124 46.0	80 424	1071.	420	7.064	5.050	400	0.026	17.458
G011A	47 20.0	125 13.0	80 424	1463.	730	8.057	3.560	715	0.028	18.468
G012A	47 20.0	125 45.2	80 423	3698.	1120	8.777	4.001	1050	0.024	16.110
G013A	47 20.0	126 43.0	80 423	5622.	540	7.849	3.700	527	0.030	20.277
G014A	47 20.0	127 40.0	80 421	5236.	2250	8.408	3.872	2207	0.024	15.984
G015A	47 0.0	124 59.6	80 424	1767.	1105	8.342	3.790	1045	0.026	17.239
G016A	46 59.8	124 38.0	80 424	924.	1716	7.610	9.692	1700	0.031	20.334
G017A	47 0.5	124 16.1	80 424	650.	1940	5.558	24.380	1921	0.025	16.889
G018A	46 40.0	124 14.0	80 424	790.	2235	7.084	17.474	2220	0.025	16.335
G019A	46 40.0	124 36.0	80 425	1019.	400	7.722	6.877	340	0.025	16.997
G020A	46 40.0	124 57.0	80 425	1789.	740	7.485	3.493	705	0.028	18.623
G021A	46 40.0	125 50.3	80 422	5542.	2255	8.293	3.819	2237	0.023	15.095
G022A	46 40.0	126 59.0	80 422	5448.	1730	8.418	3.884	1720	0.025	16.786
G023A	46 40.0	127 49.8	80 422	4987.	1216	9.149	4.187	1125	0.032	21.139
G024A	46 40.3	128 46.0	80 422	4745.	650	7.703	3.619	611	0.027	17.725
G025A	46 20.0	124 52.7	80 425	1974.	1246	8.212	3.685	1241	0.025	16.708
G026A	46 20.0	124 31.0	80 425	985.	1555	8.309	6.621	1540	0.027	18.013
G027A	46 20.5	124 9.5	80 425	656.	1945	4.499	24.739	1930	0.027	18.246
G028A	46 0.0	124 3.1	80 425	696.	2320	7.459	15.405	2306	0.026	17.306
G029A	46 0.0	124 25.0	80 426	963.	205	7.541	5.758	150	0.026	17.569
G030A	46 0.0	124 46.0	80 426	1930.	500	7.569	3.510	439	0.027	18.047
G031A	46 0.0	125 42.0	80 426	5041.	1355	7.527	3.561	1342	0.027	17.727
G032A	46 0.0	126 39.0	80 426	5394.	1930	8.333	3.868	1909	0.026	17.605
G033A	46 0.0	127 35.0	80 427	5204.	30	7.071	3.372	23	0.025	16.460
G034A	46 0.0	128 31.0	80 427	5637.	715	8.254	3.726	700	0.027	17.683
G035A	45 40.0	124 39.0	80 428	1660.	1215	8.257	3.740	1200	0.024	16.291
G036A	45 40.0	124 22.7	80 428	870.	1435	8.138	5.565	1420	0.027	17.936
G037A	45 40.0	124 1.8	80 428	568.	1648	7.877	13.911	1637	0.030	20.060
G038A	45 19.1	124 5.0	80 429	655.	445	8.578	10.810	430	0.026	17.150
G039A	45 20.0	124 26.0	80 429	1057.	725	7.767	3.613	705	0.029	19.125
G040A	45 20.5	124 47.0	80 429	1971.	1040	7.812	3.608	1025	0.028	18.667
G041A	45 20.0	125 43.0	80 428	4993.	615	7.840	3.574	555	0.026	17.636
G042A	45 20.0	126 39.0	80 428	5360.	110	7.731	3.633	50	0.025	16.424
G043A	45 20.0	127 36.0	80 427	5914.	2028	7.237	3.400	2010	0.025	16.740
G044A	45 18.3	128 50.0	80 427	6226.	1355	8.066	3.860	1340	0.023	15.579
G045A	45 0.0	124 47.8	80 429	1915.	1335	7.500	3.639	1320	0.030	20.064
G046A	45 0.0	124 26.0	80 429	1008.	1550	7.985	3.764	1535	0.030	20.131
G047A	44 59.8	124 5.2	80 429	636.	1805	7.794	11.089	1750	0.030	19.705
G048A	44 40.1	124 10.0	80 430	657.	105	6.878	13.587	48	0.025	16.650
G049A	44 40.0	124 31.0	80 430	915.	330	7.224	5.420	400	0.024	15.821
G050A	44 40.5	124 52.0	80 430	1772.	850	7.987	3.618	805	0.027	17.765
G051A	44 40.0	125 46.8	80 430	5234.	1435	8.573	3.870	1428	0.024	15.754
G052A	44 40.0	126 43.0	80 430	5509.	2030	8.338	3.778	2015	0.027	18.226
G053A	44 40.0	127 40.0	80 5 1	5277.	0	7.462	3.502	140	0.025	16.859
G054A	44 40.0	128 34.0	80 5 1	5495.	715	8.036	3.683	700	0.030	19.709
G055A	44 20.0	124 52.0	80 5 2	2305.	2055	6.979	3.319	2035	0.026	17.234
G056A	44 20.0	124 31.0	80 5 3	979.	220	5.527	7.458	200	0.030	20.064
G057A	44 20.0	124 11.0	80 5 3	572.	415	5.530	14.207	400	0.022	14.747
G058A	44 0.5	124 13.0	80 5 3	579.	700	7.802	10.990	640	0.024	15.677
G059A	44 0.0	124 32.8	80 5 3	1018.	952	7.846	6.517	940	0.026	17.290
G060A	43 51.2	124 52.0	80 5 2	1663.	1300	7.875	3.701	1245	0.023	15.376
G061A	44 0.0	125 48.0	80 5 2	5248.	730	7.717	3.611	700	0.028	18.879
G062A	44 0.0	126 45.0	80 5 2	5525.	120	7.684	3.651	50	0.027	18.107
G063A	43 56.2	127 40.0	80 5 1	5318.	2030	8.261	3.701	2015	0.025	16.967

Table 1.--Data associated with bongo and neuston tows during cruise 1TK80, April-May 1980.

	POSITION		DATE	BONGO STATIONS				NEUSTON STATIONS			
						STANDARD HAUL FACTORS*			STANDARD HAUL FACTORS*	
STATION	LAT. N.	LONG. W.	YYMMDD	AREA KM2	TIME GMT	A	B	TIME GMT	A	B
G064A	44 0.0	128 35.0	80 5 1	5141.	1250	7.426	3.600	1235	0.027	18.034
G065A	43 40.0	124 57.0	80 5 3	1368.	1340	7.301	3.480	1322	0.028	18.927
G066A	43 40.0	124 33.0	80 5 3	915.	1655	7.845	3.607	1640	0.028	18.448
G067A	43 39.0	124 17.0	80 5 3	409.	1922	7.699	8.587	1907	0.026	17.374
G068A	43 20.0	124 28.0	80 5 4	664.	15	7.151	10.488	2350 **	0.025	16.483
G069A	43 20.0	124 49.0	80 5 4	952.	315	7.780	3.662	200	0.024	16.244
G070A	43 20.0	125 9.0	80 5 4	1228.	650	7.824	3.635	630	0.025	16.388
G071A	43 20.0	125 33.0	80 5 4	3839.	1120	8.298	3.852	1106	0.031	20.724
G072A	43 20.0	126 40.0	80 5 4	5086.	1630	7.704	3.551	1623	0.029	19.249
G073A	43 20.0	127 34.0	80 5 4	5082.	2230	7.943	3.674	2200	0.027	17.914
G074A	43 20.0	128 38.0	80 5 5	5503.	400	7.906	3.683	330	0.024	15.858
G075A	42 56.0	125 8.0	80 5 6	1324.	440	7.933	3.692	430	0.028	18.867
G076A	43 0.0	124 52.0	80 5 6	926.	715	8.037	3.635	700	0.027	17.896
G077A	43 0.0	124 32.0	80 5 6	546.	1220	7.905	10.235	1207	0.025	16.823
G078A	42 39.7	124 33.0	80 5 6	606.	1940	7.607	9.458	1927	0.026	17.007
G079A	42 40.0	124 53.0	80 5 7	991.	800	7.217	3.363	740	0.028	18.623
G080A	42 40.0	125 13.0	80 5 7	1242.	1118	7.964	3.687	1055	0.026	17.298
G081A	42 40.0	125 48.0	80 5 6	4451.	110	7.687	3.595	200	0.026	17.201
G082A	42 48.0	126 42.5	80 5 5	4299.	1925	7.440	3.464	1910	0.025	16.492
G083A	42 52.0	127 13.5	80 5 5	4733.	1520	8.410	3.868	1503	0.032	21.633
G084A	42 40.0	128 29.0	80 5 5	6700.	910	8.454	3.789	855	0.032	21.081
G085A	42 20.0	125 12.3	80 5 7	1864.	1418	7.110	3.461	1405	0.030	19.950
G086A	42 20.0	124 52.0	80 5 7	1029.	1725	8.931	4.013	1635	0.025	16.388
G087A	42 20.0	124 32.0	80 5 7	655.	2020	7.229	6.730	2010	0.026	17.110
G088A	41 59.8	124 22.0	80 5 8	654.	520	5.819	12.543	500	0.016	10.954
G089A	42 0.0	124 42.0	80 5 8	1033.	821	7.994	3.685	810	0.026	17.340
G090A	42 0.0	125 2.0	80 5 8	1794.	1200	7.918	3.712	1145	0.025	16.921
G091A	42 0.0	125 55.0	80 5 8	5255.	1720	8.242	3.731	1705	0.025	16.748
G092A	42 0.0	126 47.0	80 5 8	6691.	2230	8.498	3.830	2215	0.020	13.180
G093A	42 0.0	127 38.0	80 5 9	6044.	340	7.298	3.420	320	0.026	17.299
G094A	42 0.0	128 31.0	80 5 9	4494.	1025	7.700	3.582	1000	0.029	19.064
G095A	41 40.0	124 59.0	80 511	1991.	0	7.100	3.357	2340**	0.025	16.697
G096A	41 40.2	124 33.0	80 511	1104.	230	6.579	3.183	210	0.028	18.619
G097A	41 40.0	124 14.0	80 511	528.	450	7.962	18.730	435	0.021	14.323
G098A	41 20.0	124 15.0	80 511	769.	815	7.430	9.480	758	0.023	15.587
G099A	41 20.0	124 35.0	80 510	946.	1733	7.697	3.525	1720	0.027	17.837
G100A	41 20.3	124 54.0	80 510	1818.	2045	7.289	3.378	2030	0.030	20.049
G101A	41 20.0	125 48.0	80 510	5169.	735	7.526	3.436	715	0.029	19.317
G102A	41 4.0	126 32.0	80 510	4546.	200	7.347	3.486	145	0.028	18.985
G103A	41 20.0	127 25.0	80 5 9	5425.	2130	7.688	3.484	2115	0.027	18.256
G104A	41 20.0	128 15.0	80 5 9	5054.	1610	7.725	3.561	1555	0.029	19.212
G105A	41 0.0	124 51.0	80 511	1813.	1238	7.949	3.599	1226	0.030	20.324
G106A	41 0.0	124 32.2	80 511	964.	1458	8.111	3.741	1446	0.030	19.777
G107A	41 0.0	124 15.0	80 511	588.	2220	7.476	10.451	2200	0.029	19.033
G108A	40 40.0	124 23.0	80 512	621.	140	6.773	26.764	140	0.023	15.574
G109A	40 40.0	124 43.0	80 512	984.	450	8.419	3.881	435	0.026	17.285
G110A	40 40.0	125 2.0	80 512	2034.	805	8.478	3.873	740	0.024	15.836
G111A	40 40.0	125 54.7	80 512	4863.	1316	8.144	3.793	1302	0.023	15.605
G112A	40 40.0	126 44.0	80 512	4406.	1845	7.903	3.643	1830	0.025	16.380
G113A	40 40.0	127 36.0	80 513	5321.	45	7.436	3.514	28	0.029	19.141
G114A	40 40.0	128 28.0	80 513	4871.	545	7.477	3.511	525	0.023	15.403
G115A	40 20.0	125 6.0	80 514	2185.	1435	7.658	3.587	1424	0.027	17.777
G116A	40 20.0	124 55.5	80 514	931.	1746	8.127	3.720	1708	0.026	17.306
G117A	40 19.5	124 27.0	80 515	866.	215	6.171	3.197	155	0.022	14.462
G118A	40 0.0	124 11.0	80 515	652.	1338	8.100	3.786	1323	0.026	17.454
G119A	40 0.0	124 29.0	80 515	949.	1045	7.274	3.445	1030	0.027	18.213
G120A	40 0.5	124 48.0	80 515	868.	655	6.765	3.288	635	0.025	16.734
G121A	40 0.0	125 0.2	80 514	1740.	1005	8.307	3.747	950	0.028	18.699
G122A	40 0.0	126 10.0	80 514	5183.	435	7.162	3.373	420	0.025	16.372
G123A	40 0.0	127 1.0	80 513	5065.	2030	7.892	3.641	2010	0.028	18.715
G124A	40 0.0	127 52.0	80 513	5602.	1605	8.386	3.797	1550	0.028	18.495
G125A	40 0.0	128 44.0	80 513	4628.	1120	8.457	3.823	1105	0.032	21.509

* "A" CONVERTS CATCH TO CATCH PER $10M^2$, "B" CONVERTS CATCH TO CATCH PER $1000M^3$ (SEE SMITH AND RICHARDSON 1977).

** DATE FOR NEUSTON TOW 1 DAY PREVIOUS TO THAT SHOWN.

Table 1 (Continued)

STAGE: EGG

SPECIES	NEUSTON OCCUR. %	NEUSTON LOG NO. IN AREA	BONGO OCCUR. %	BONGO LOG NO. IN AREA
UNIDENTIFIED	3.20	7.5989	10.40	10.8996
TELEOST TYPE A	5.60	7.9103		
TELEOST TYPE C			0.80	9.1621
DISINTEGRATED	1.60	7.2397	1.60	9.7738
ENGRAULIS MORDAX	6.40	9.0336	10.40	11.2971
ARGENTINIDAE			3.20	10.0635
BATHYLAGIDAE			24.80	11.1776
BATHYLAGUS OCHOTENSIS			12.80	11.2479
CHAULIODUS MACOUNI	8.00	8.1518	16.00	10.9931
MYCTOPHIDAE	0.80	6.4252	20.80	12.8463
COLOLABIS SAIRA	1.60	7.2511	4.00	10.2437
TRACHYPTERUS ALTIVELIS	32.80	8.8982	27.20	11.1032
ICOSTEUS AENIGMATICUS	9.60	8.5173	22.40	11.1104
ICICHTHYS LOCKINGTONI	32.00	9.1080	20.00	11.0585
TETRAGONURUS CUVIERI	1.60	6.7854	2.40	10.1562
BOTHIDAE	22.40	9.3209	20.80	11.4264
CITHARICHTHYS SP.	7.20	7.8843	3.20	9.6984
PLEURONECTIDAE	13.60	8.7211	15.20	11.1703
GLYPTOCEPHALUS ZACHIRUS	16.00	8.6560	20.00	10.5977
HIPPOGLOSSOIDES ELASSODON	1.60	6.9053	1.60	9.2564
ISOPSETTA ISOLEPIS	4.00	7.2399	3.20	10.1933
LYOPSETTA EXILIS	13.60	8.1777	38.40	11.6110
MICROSTOMUS PACIFICUS	25.60	9.4599	23.20	10.8773
PLATICHTHYS STELLATUS	2.40	7.1637	1.60	9.5910
PLEURONICHTHYS COENOSUS	1.60	6.7099	0.80	8.4999
PLEURONICHTHYS DECURRENS	0.80	6.1390		
PSETTICHTHYS MELANOSTICTUS	7.20	7.6005	5.60	9.8201

Table 2.--Fish eggs collected in bongo and neuston tows during cruise 1TK80, April-May 1980.

STAGE: LARVAE

SPECIES	NEUSTON OCCUR. %	NEUSTON LOG NO. IN AREA	BONGO OCCUR. %	BONGO LOG NO. IN AREA
UNIDENTIFIED			12.00	10.8719
DISINTEGRATED	2.40	7.3433	11.20	10.5885
ENGRAULIS MORDAX	0.80	6.9470		
OSMERIDAE			8.80	10.8486
NANSENIA CANDIDA	0.80	7.1628	4.80	10.4584
ARGENTINA SIALIS			0.80	9.6366
BATHYLAGUS OCHOTENSIS	1.60	7.2449	49.60	11.8050
BATHYLAGUS PACIFICUS			12.80	10.8505
CYCLOTHONE SP.			0.80	8.7277
ARGYROPELECUS SP.			0.80	9.8402
CHAULIODUS MACOUNI			17.60	10.8795
MYCTOPHIDAE			6.40	11.3501
DIAPHUS THETA			9.60	11.6741
LAMPANYCTUS SP.			5.60	10.5664
LAMPANYCTUS RITTERI			4.00	10.3235
STENOBRACHIUS SP.			0.80	9.6719
STENOBRACHIUS LEUCOPSARUS	3.20	7.7725	74.40	12.5679
SYMBOLOPHORUS CALIFORNIENSE	0.80	7.3261	1.60	9.8986
TARLETONBEANIA CRENULARIS			12.80	10.7618
PROTOMYCTOPHUM CROCKERI			24.00	11.2627
PROTOMYCTOPHUM THOMPSONI			9.60	10.8689
NOTOLEPIS RISSOI			0.80	9.5926
LESTIDIOPS RINGENS			4.80	10.5070
GADUS MACROCEPHALUS			0.80	8.6430
MICROGADUS PROXIMUS			8.00	10.2207
THERAGRA CHALCOGRAMMA			0.80	8.7480
COLOLABIS SAIRA	20.80	9.2262		
TRACHYPTERUS ALTIVELIS			0.80	9.6428
MELAMPHAEIDAE			5.60	10.5822
SCORPAENIDAE			1.60	8.8674
SEBASTES SP.	23.20	9.3014	37.60	11.5381
SEBASTES PAUCISPINUS			0.80	9.6614
SEBASTOLOBUS SP.			4.80	10.4420
ANOPLOPOMA FIMBRIA	44.00	9.7089		
HEXAGRAMMOS DECAGRAMMUS	18.40	8.2576		
HEXAGRAMMOS LAGOCEPHALUS	2.40	7.6311		
OPHIODON ELONGATUS	7.20	8.0326		
COTTIDAE			0.80	8.4999
ARTEDIUS 1	1.60	6.9741	3.20	9.6586
HEMILEPIDOTUS HEMILEPIDOTUS	6.40	8.0522		
HEMILEPIDOTUS SPINOSUS	18.40	9.3905	1.60	9.6613
ICELINUS SP.			0.80	8.7996
LEPTOCOTTUS ARMATUS	0.80	6.1019		
RADULINUS SP.	0.80	6.2153		
SCORPAENICHTHYS MARMORATUS	26.40	8.6329	0.80	8.6549
ICELUS SP.			0.80	8.8009
AGONIDAE			0.80	8.8716
AGONIDAE A			1.60	9.3469

Table 3.--Fish larvae collected in bongo and neuston tows during cruise 1TK80, April-May 1980.

STAGE: LARVAE

SPECIES	NEUSTON OCCUR. %	NEUSTON LOG NO. IN AREA	BONGO OCCUR. %	BONGO LOG NO. IN AREA
CYCLOPTERIDAE	1.60	6.6247	5.60	9.9826
RONQUILUS JORDANI	5.60	7.6173	3.20	9.5735
CHIROLOPHIS SP.			1.60	9.1712
LYCONECTES ALEUTENSIS	0.80	7.2829		
ICOSTEUS AENIGMATICUS			1.60	9.6722
AMMODYTES HEXAPTERUS	9.60	8.5337	0.80	9.0715
ICICHTHYS LOCKINGTONI	0.80	6.5651	3.20	10.2098
CITHARICHTHYS SP.			1.60	9.4519
CITHARICHTHYS SORDIDUS	0.80	7.0310	0.80	9.1524
CITHARICHTHYS STIGMAEUS	3.20	7.5293	4.00	9.8677
EMBASSICHTHYS BATHYBIUS			1.60	9.9493
EOPSETTA JORDANI	0.80	7.0191		
GLYPTOCEPHALUS ZACHIRUS			5.60	9.8975
ISOPSETTA ISOLEPIS			6.40	9.8929
LYOPSETTA EXILIS			23.20	11.0020
MICROSTOMUS PACIFICUS			2.40	9.7758
PAROPHRYS VETULUS	4.80	7.6584	5.60	9.6517
PLATICHTHYS STELLATUS			6.40	9.5938
PSETTICHTHYS MELANOSTICTUS	0.80	6.5275	9.60	10.0794

Table 3 (Continued)

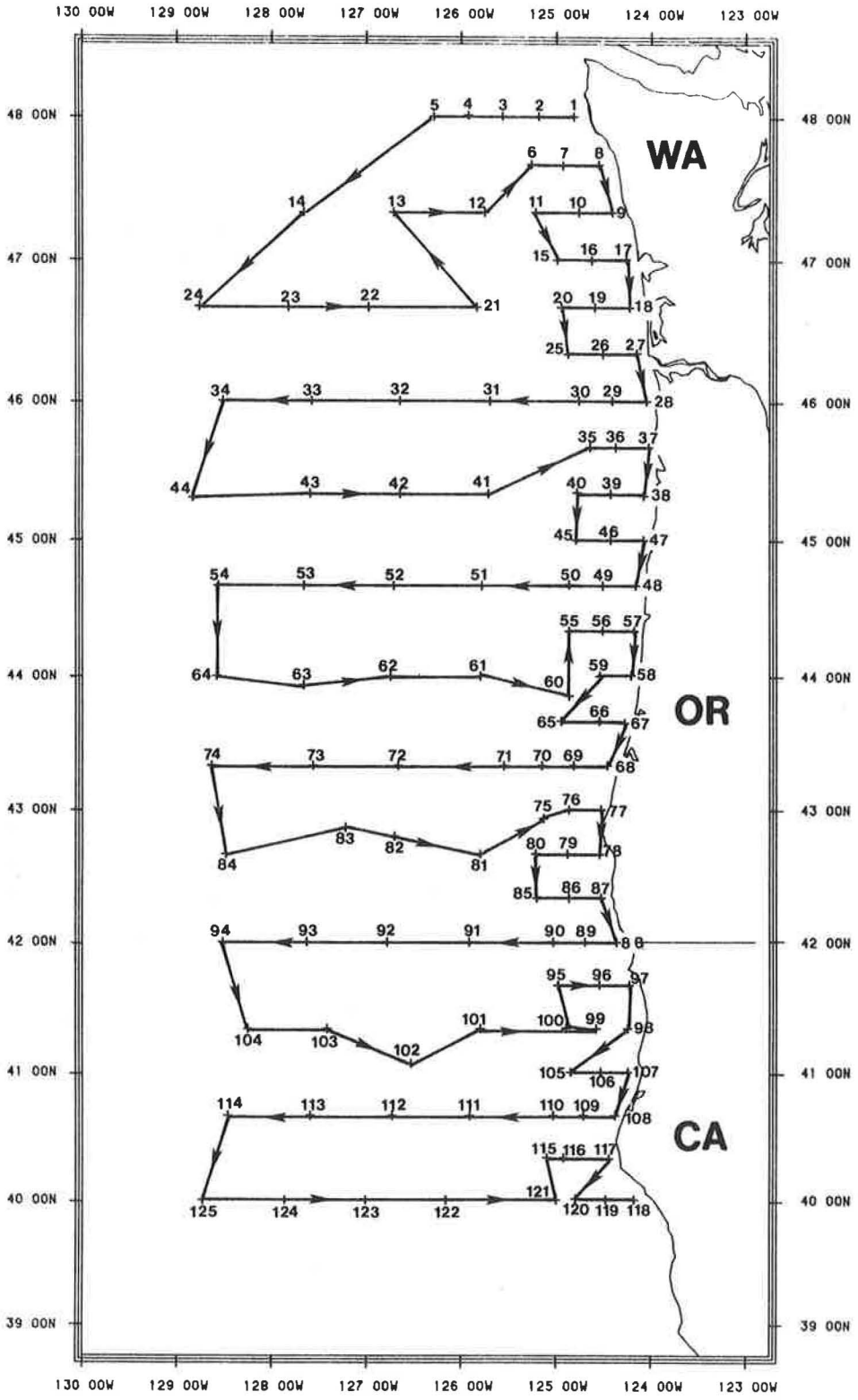

Figure 1.--Station locations and cruise track for cruise 1TK80, April-May 1980.

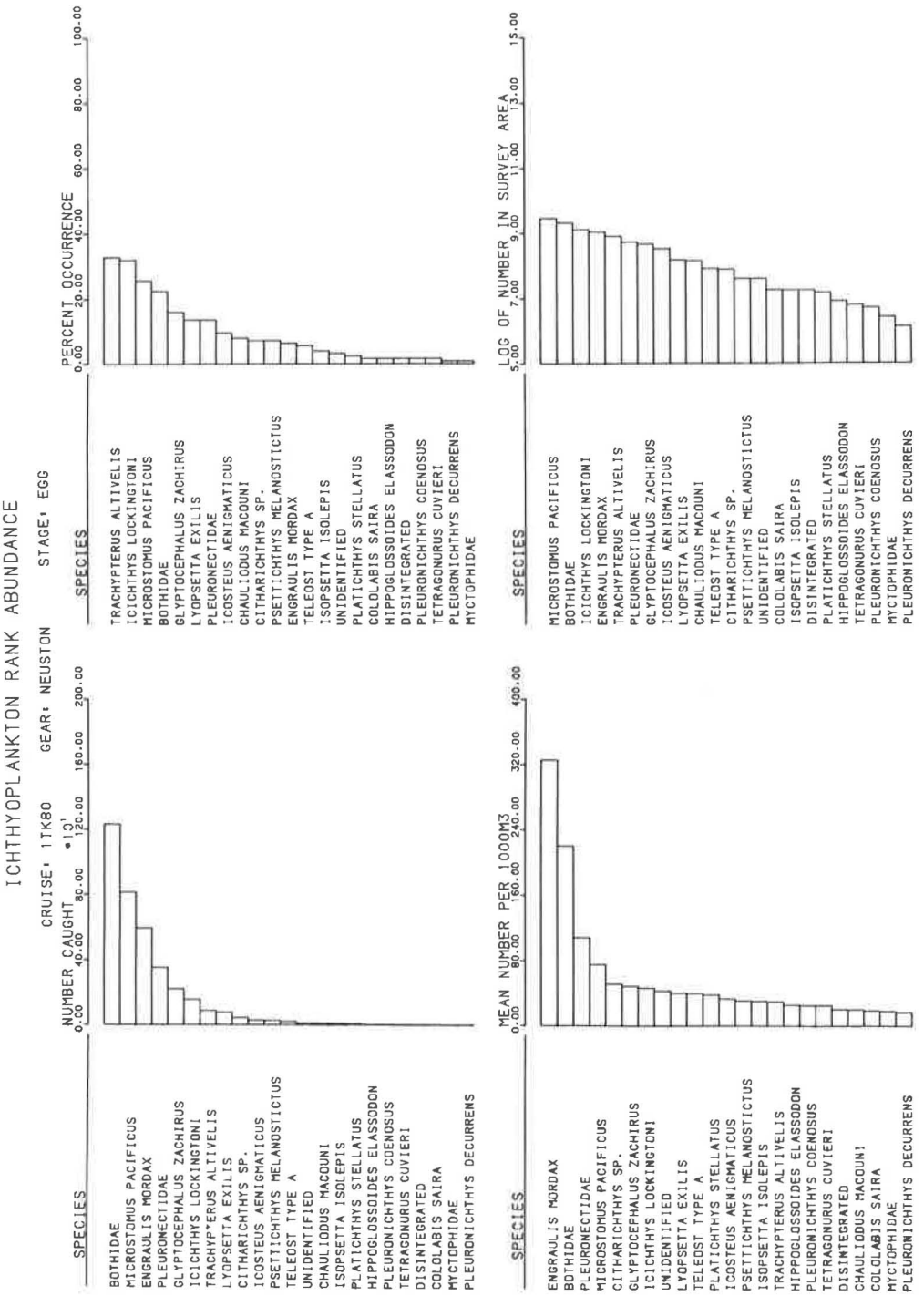

Figure 2.--Rank abundance of eggs caught in neuston tows during cruise 1TK80, April-May 1980.

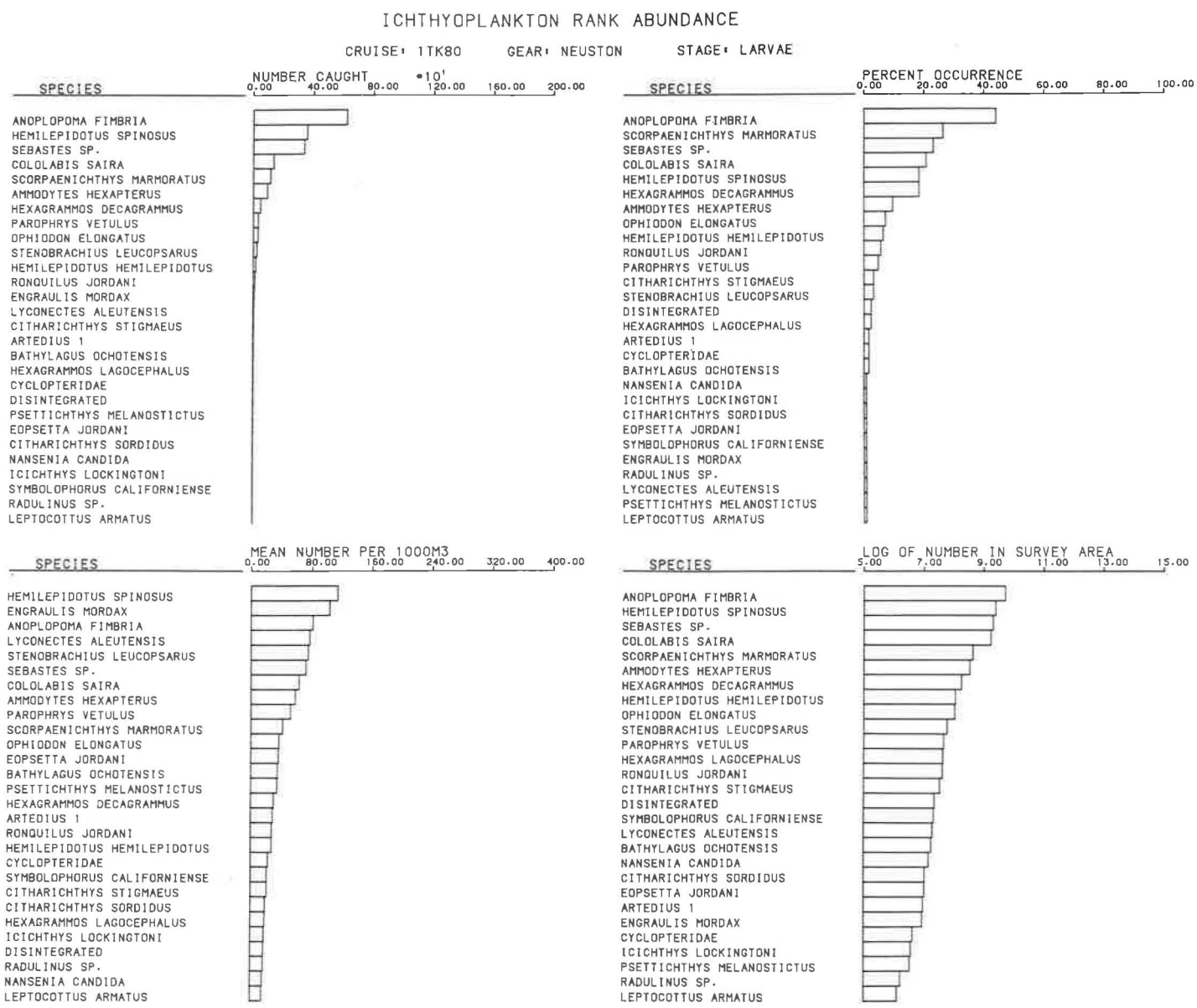

Figure 3.--Rank abundance of larvae caught in neuston tows during cruise 1TK80, April-May 1980.

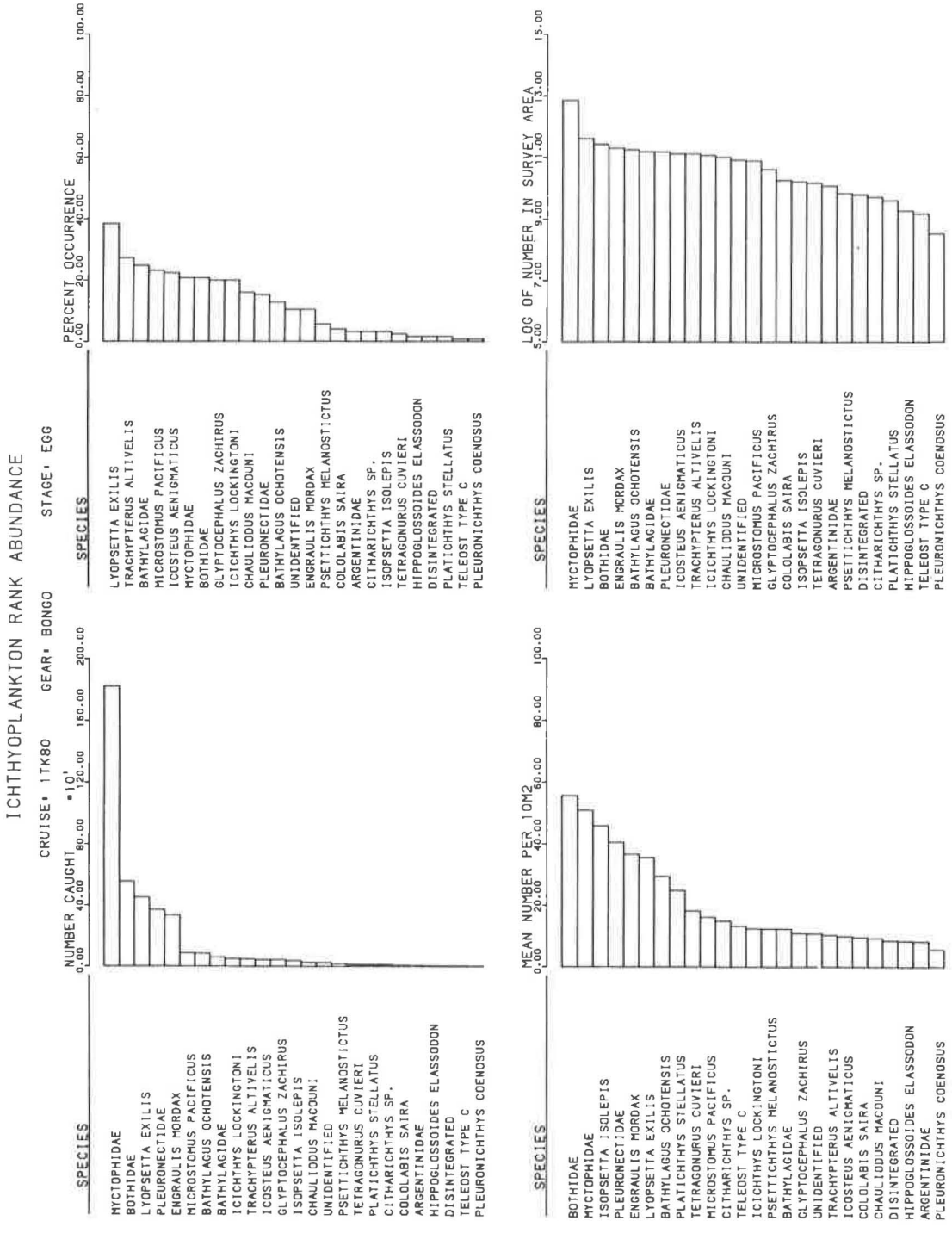

Figure 4.--Rank abundance of eggs caught in bongo tows during cruise 1TK80, April-May 1980.

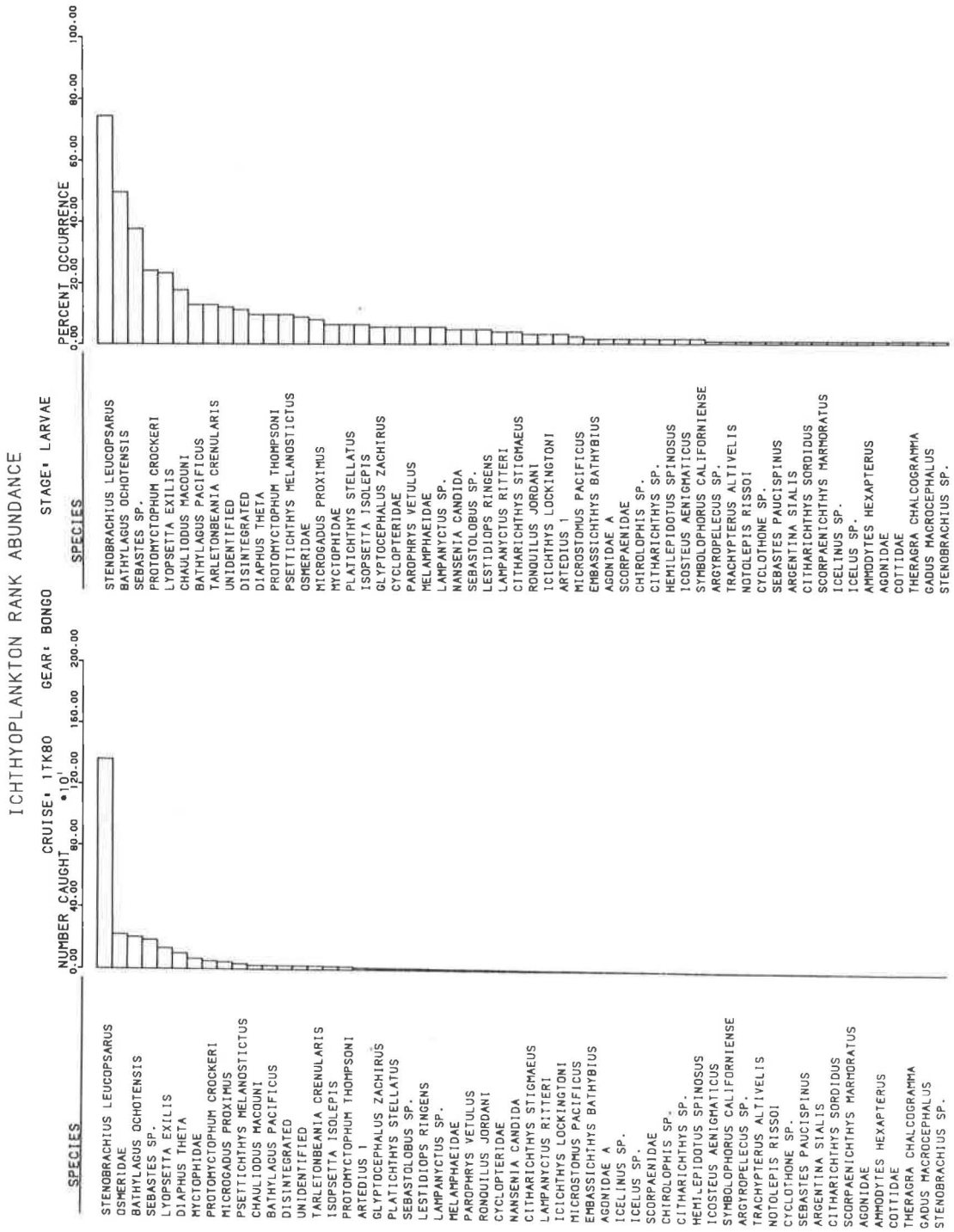

Figure 5.--Rank abundance of larvae caught in bongo tows during cruise 1TK80, April-May 1980.

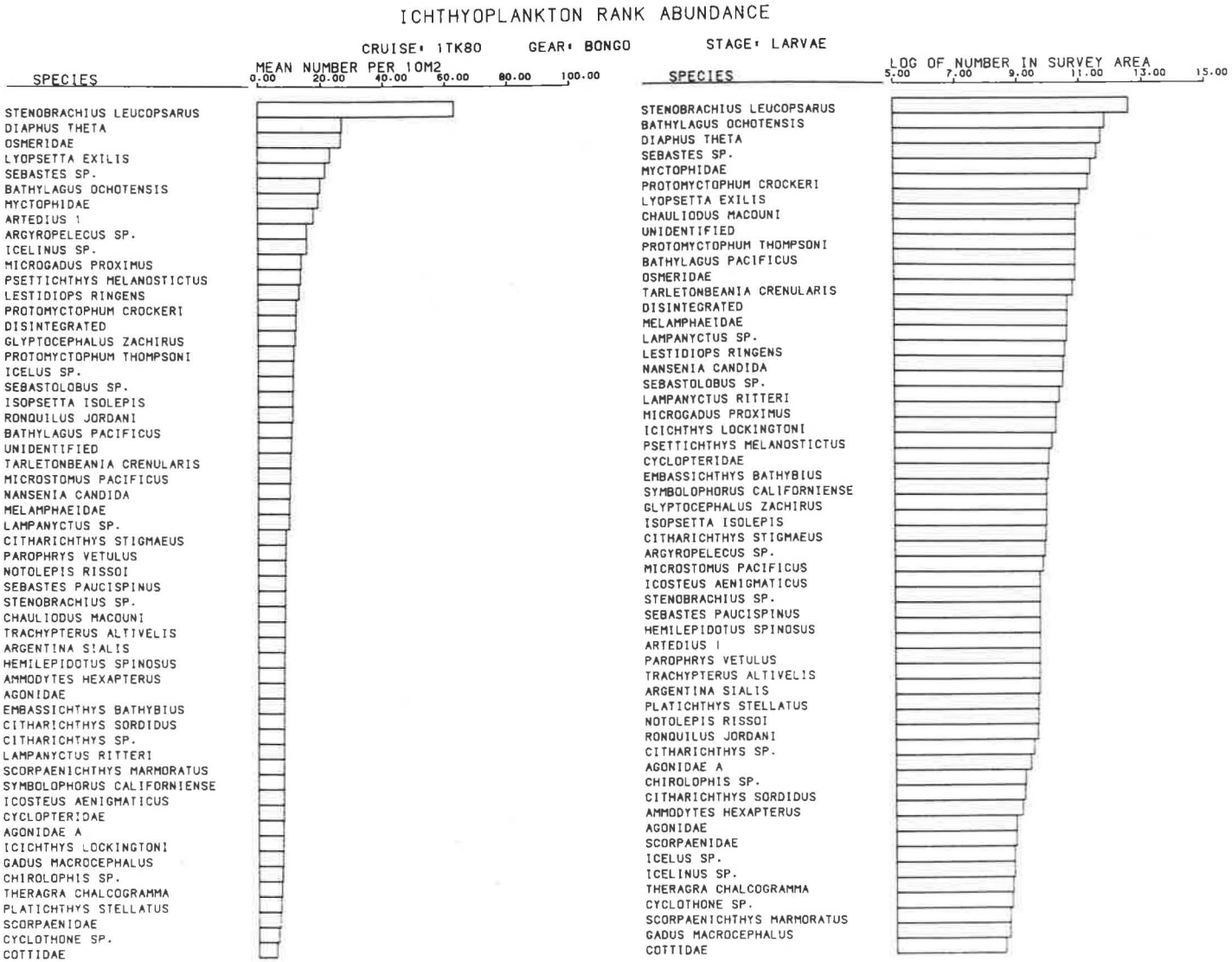

Figure 5 (Continued)

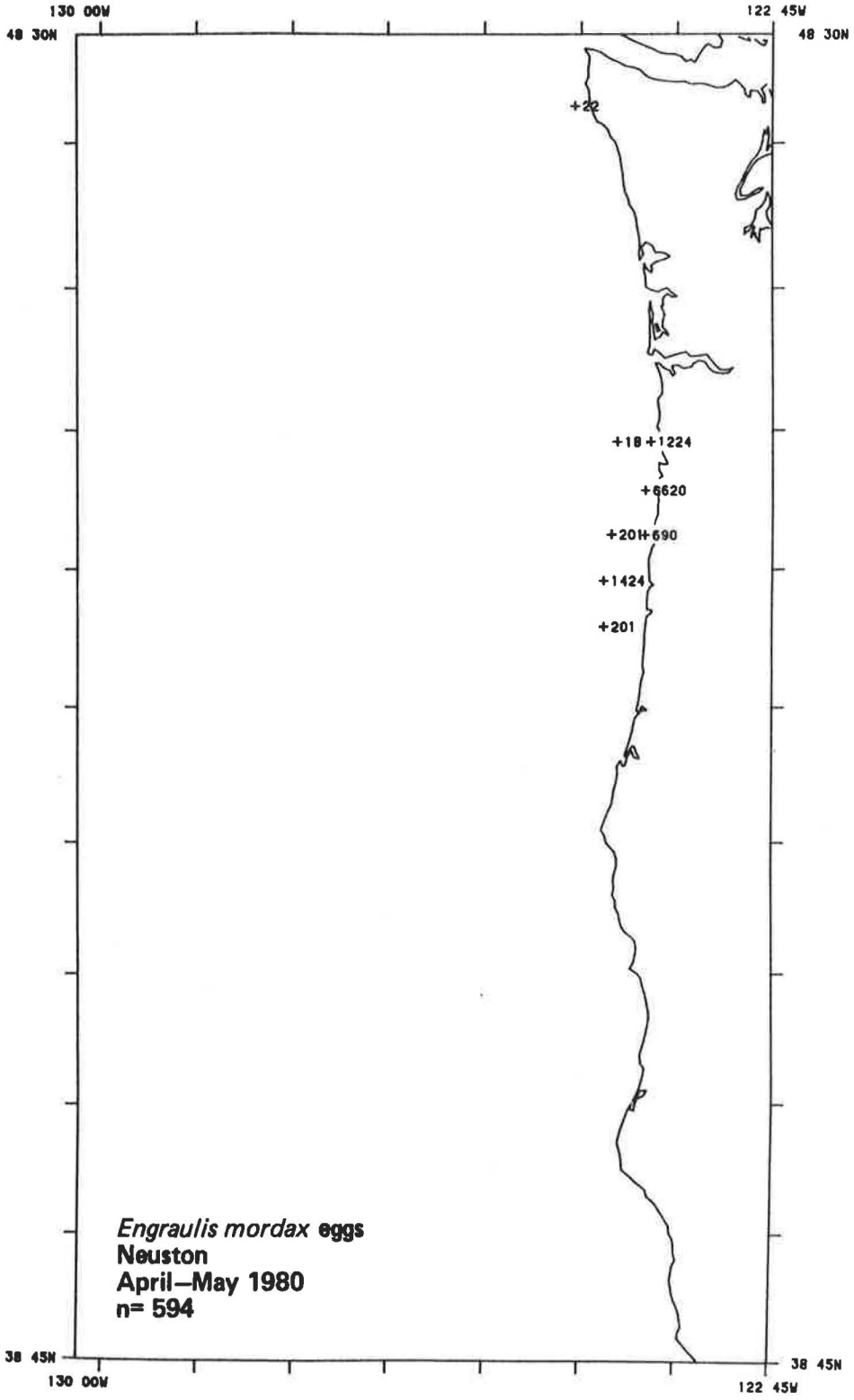

Figure 6.--Distribution of eggs of Engraulis mordax from neuston tows during cruise 1TK80, April-May 1980. Abundance expressed as numbers per 1,000 m^3.

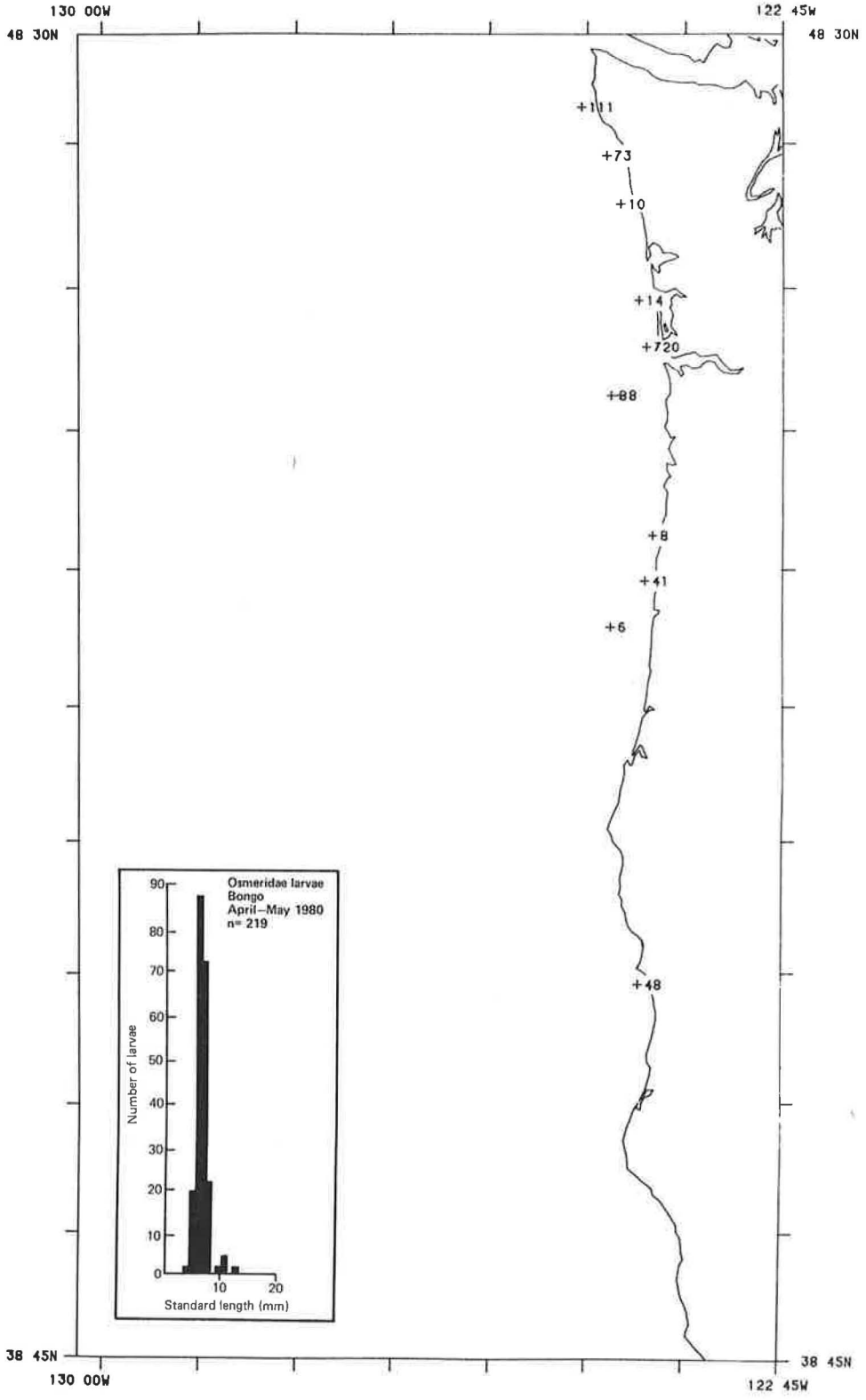

Figure 7.--Distribution of larvae of Osmeridae from bongo tows during cruise 1TK80, April-May 1980. Abundance expressed as numbers per 10 m^2.

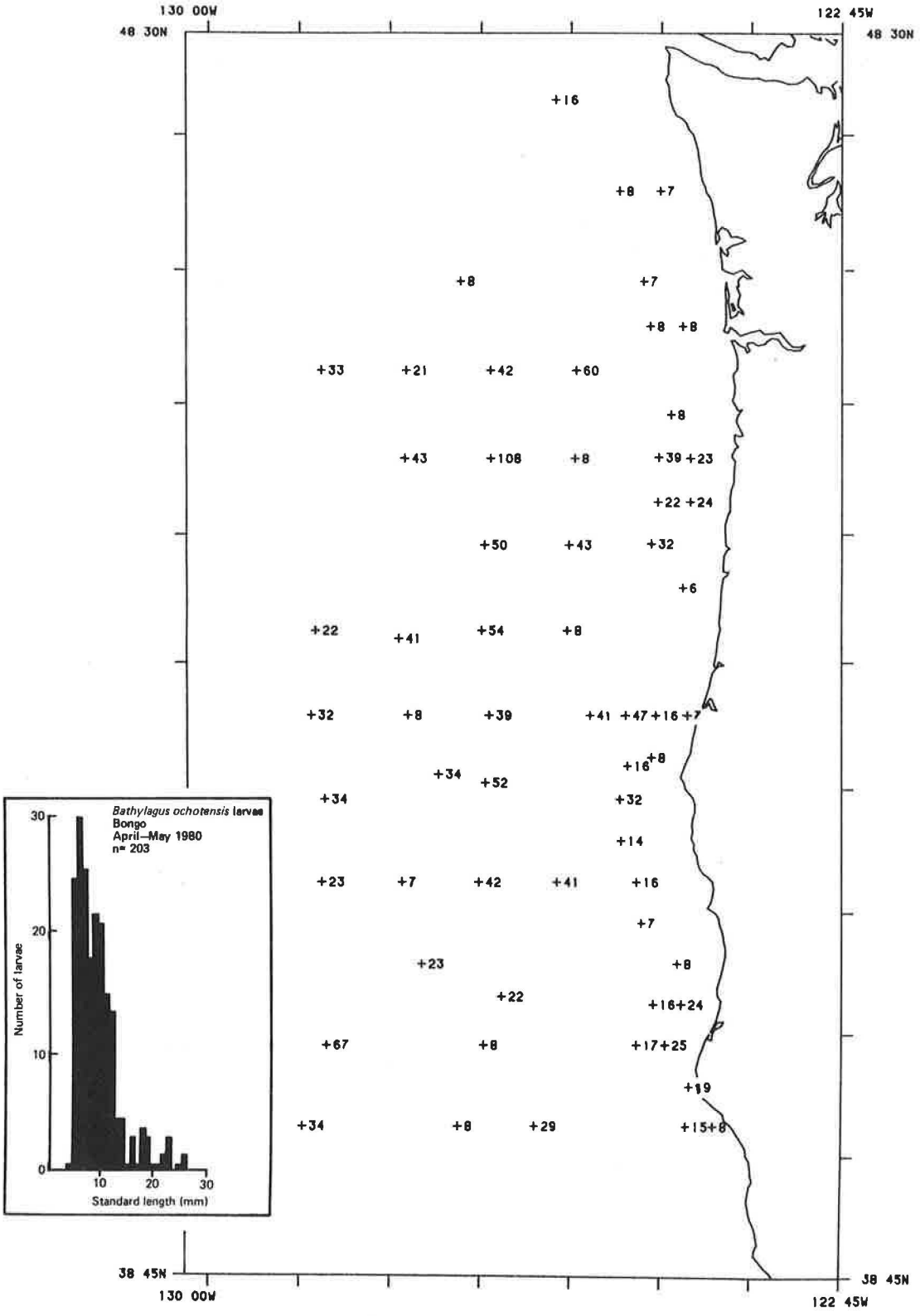

Figure 8.--Distribution and lengths of larvae of Bathylagus ochotensis from bongo tows during cruise 1TK80, April-May 1980. Abundance expressed as numbers per 10 m^2.

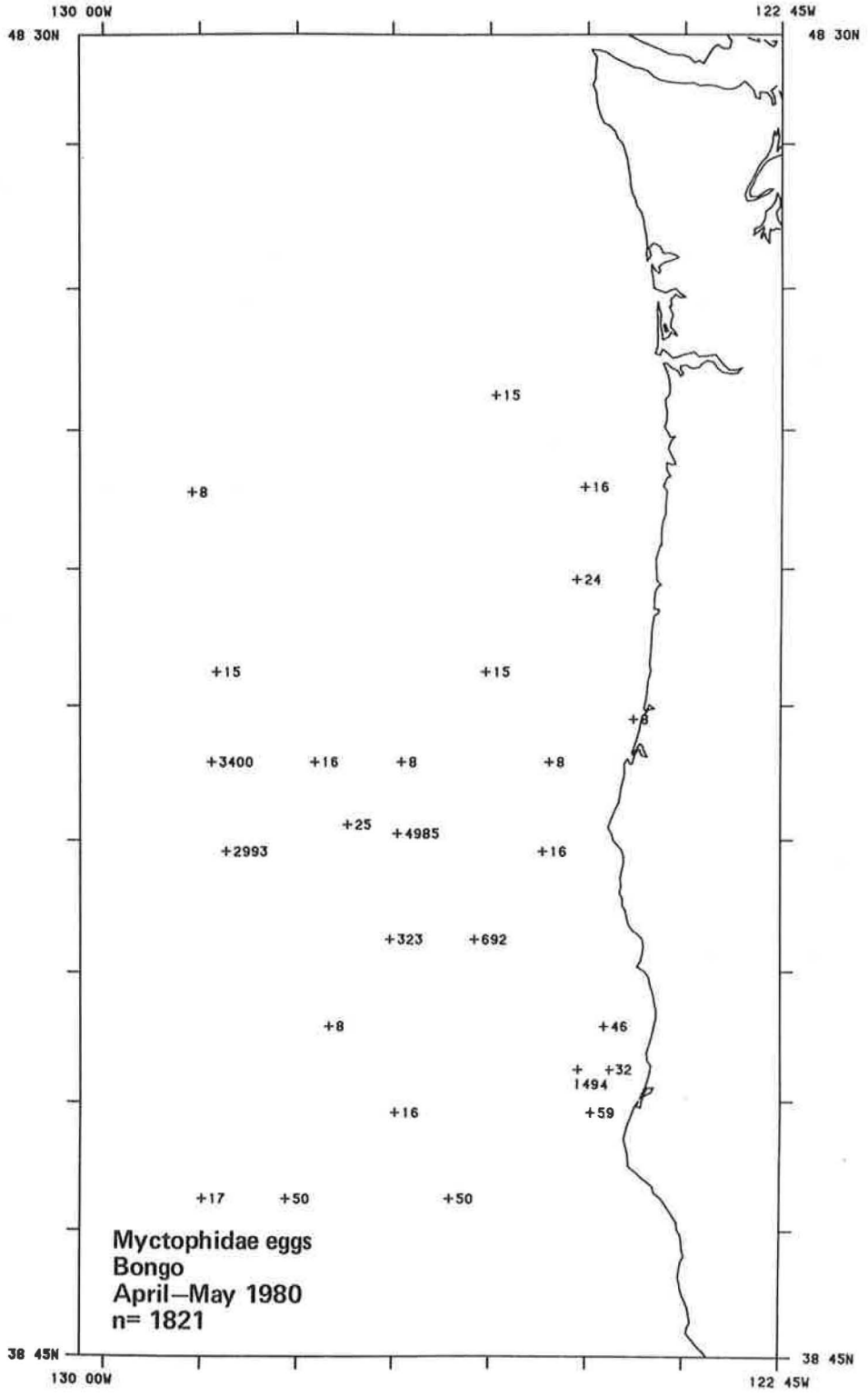

Figure 9.--Distribution of eggs of Myctophidae from bongo tows during cruise 1TK80, April-May 1980. Abundance expressed as numbers per 10 m^2.

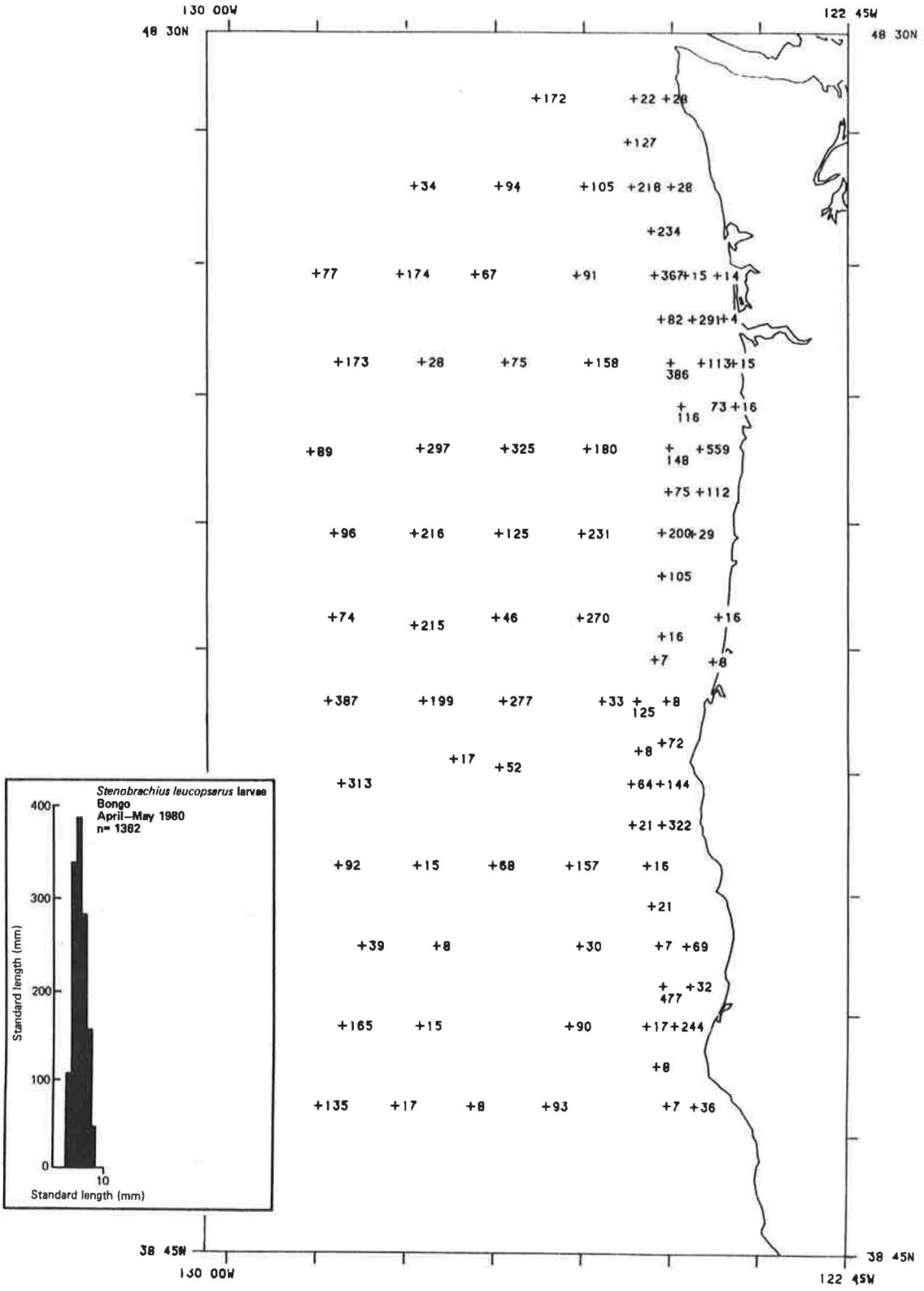

Figure 10.--Distribution and lengths of larvae Stenobrachius leucopsarus from bongo tows during cruise 1TK80, April-May 1980. Abundance expressed as numbers per 10 m^2.

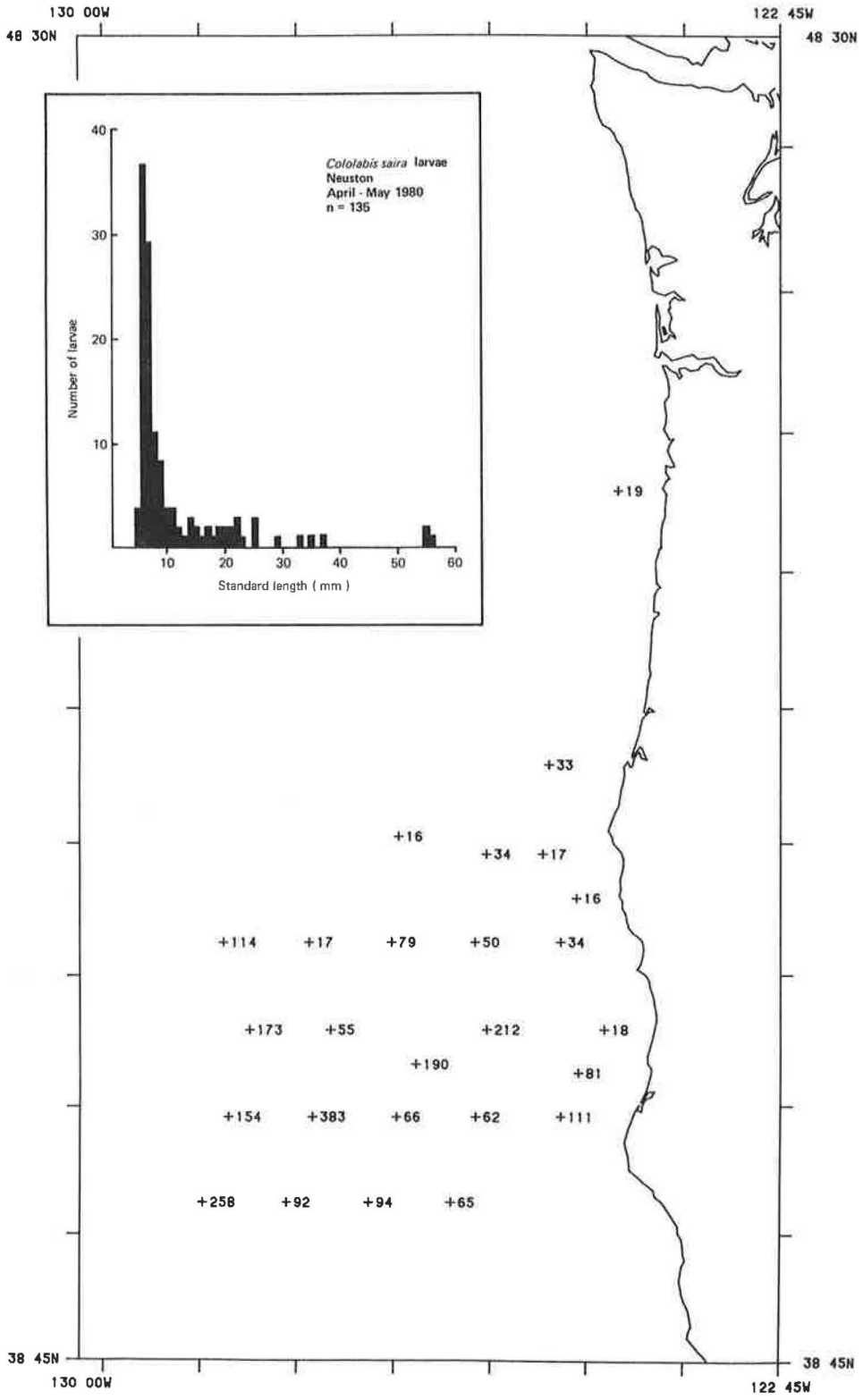

Figure 11.--Distribution and lengths of larvae of Cololabis saira from neuston tows during cruise 1TK80, April-May 1980. Abundance expressed as numbers per 1,000 m^3.

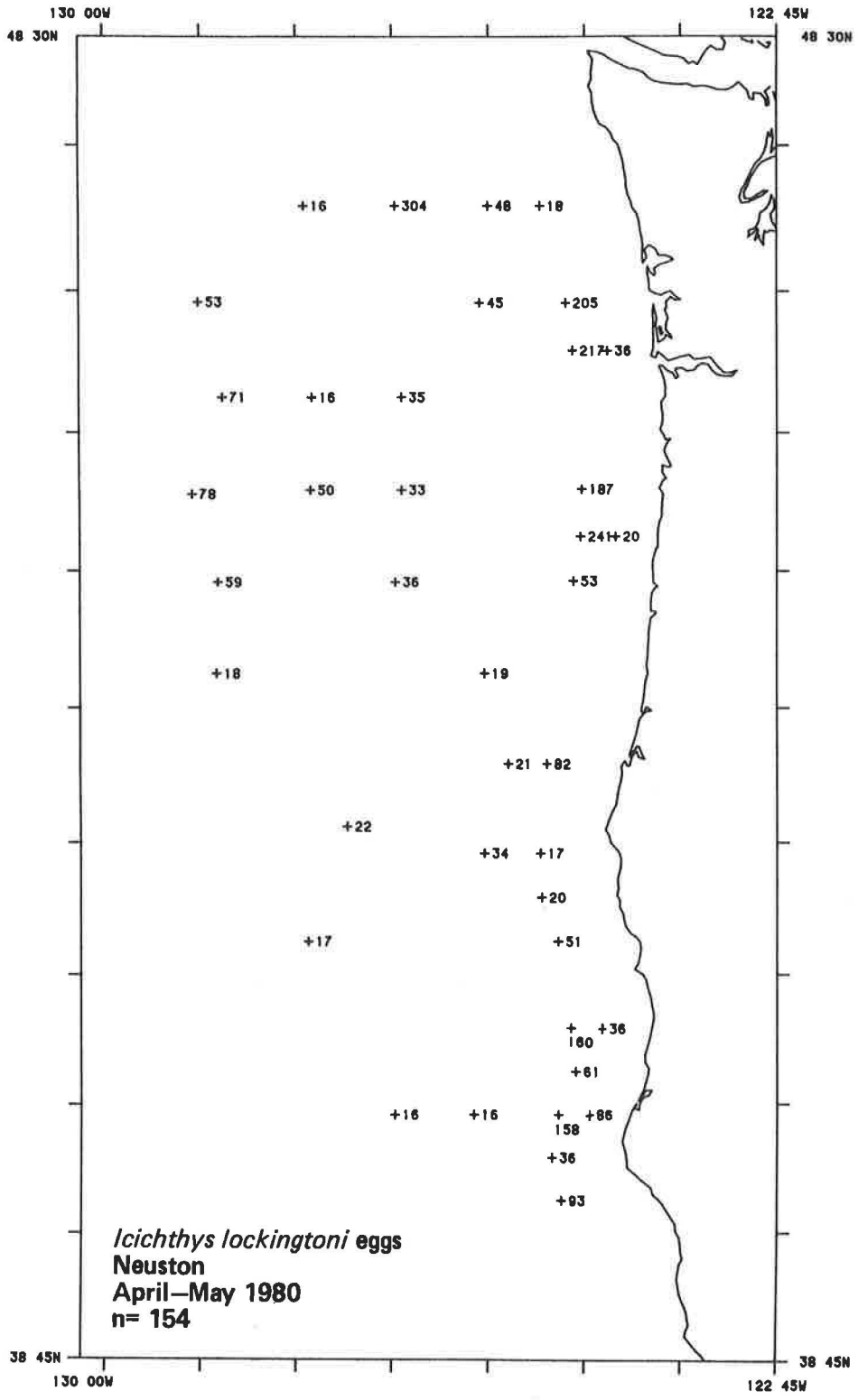

Figure 12.--Distribution of eggs of Icichthys lockingtoni from neuston tows during cruise 1TK80, April-May 1980. Abundance expressed as numbers per 1,000 m^3.

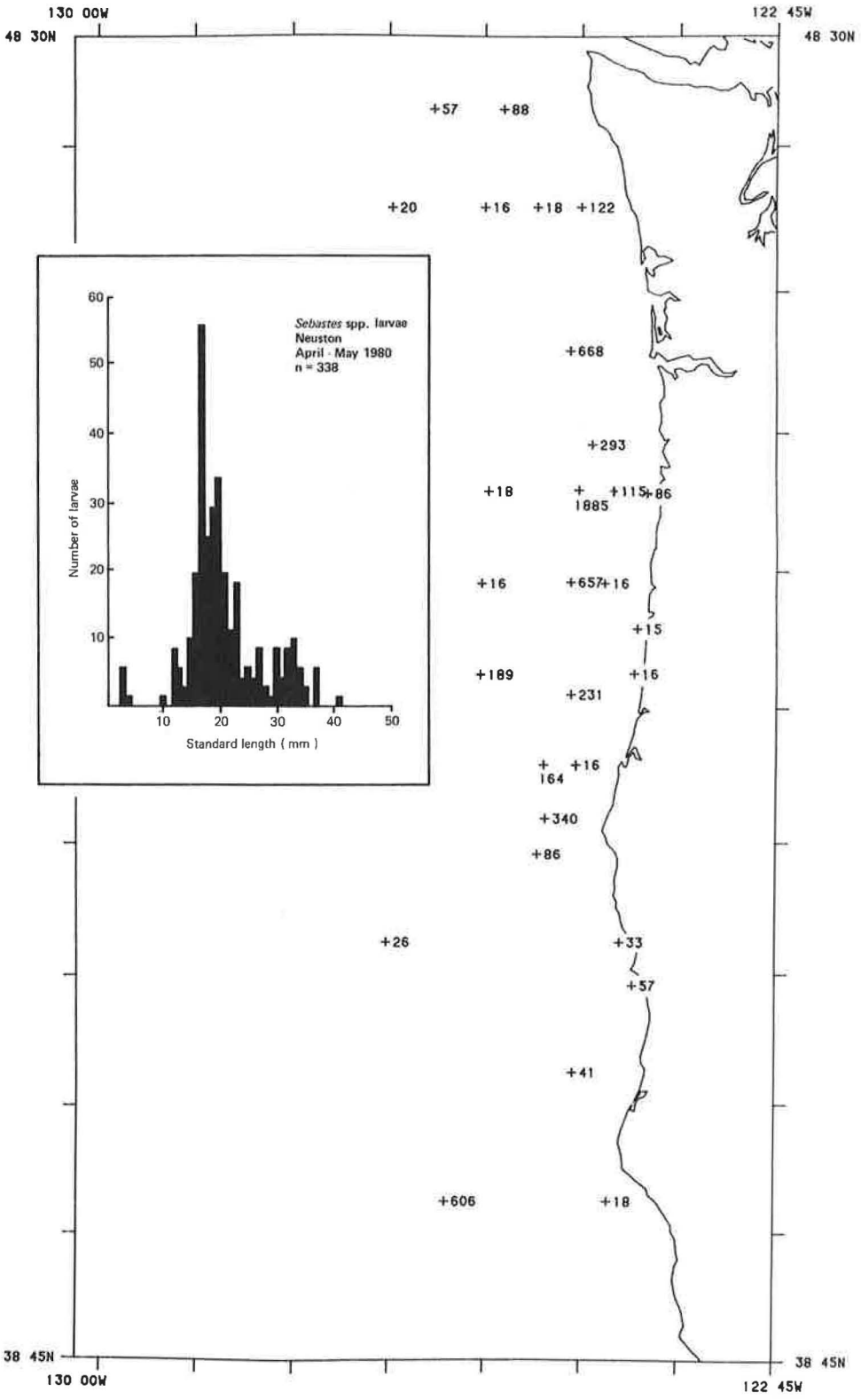

Figure 13.--Distribution and lengths of larvae of Sebastes sp. from neuston tows during cruise 1TK80, April-May 1980. Abundance expressed as numbers per 1,000 m^3.

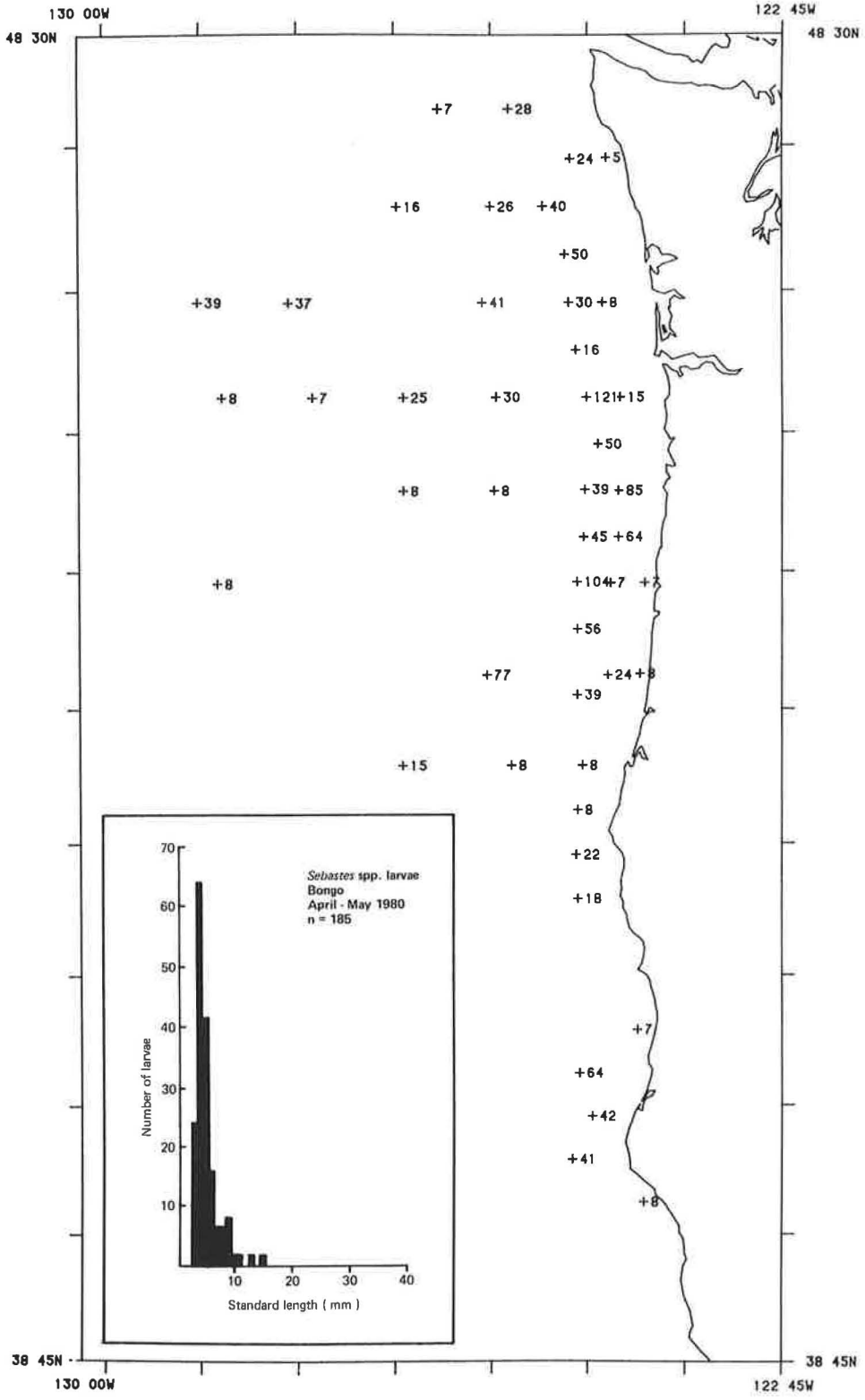

Figure 14.--Distribution and lengths of larvae of Sebastes sp. from bongo tows during cruise 1TK80, April-May 1980. Abundance expressed as numbers per 10 m^2.

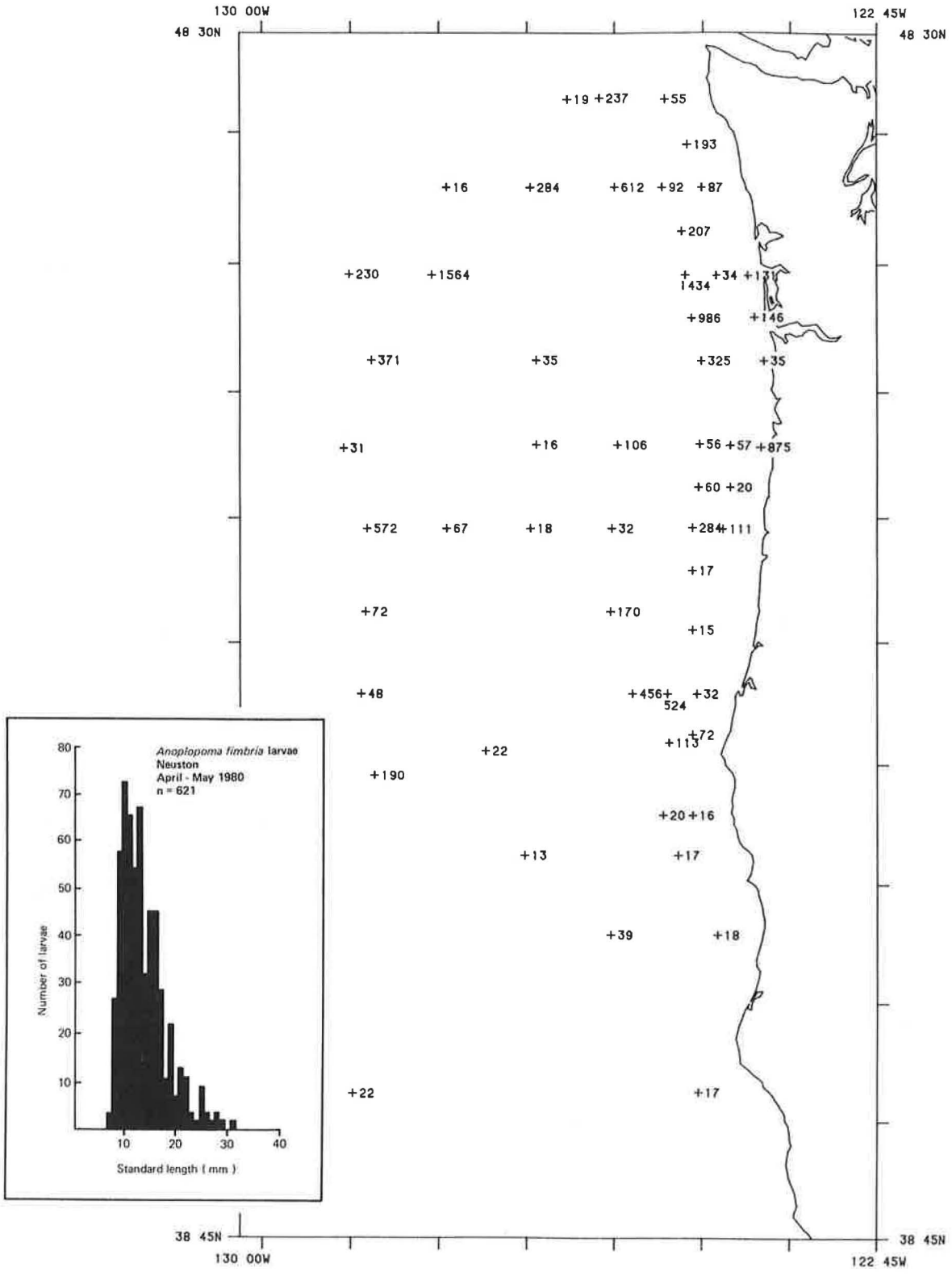

Figure 15.--Distribution and lengths of larvae of Anoplopoma fimbria from neuston tows during cruise 1TK80, April-May 1980. Abundance expressed as numbers per 1,000 m^3.

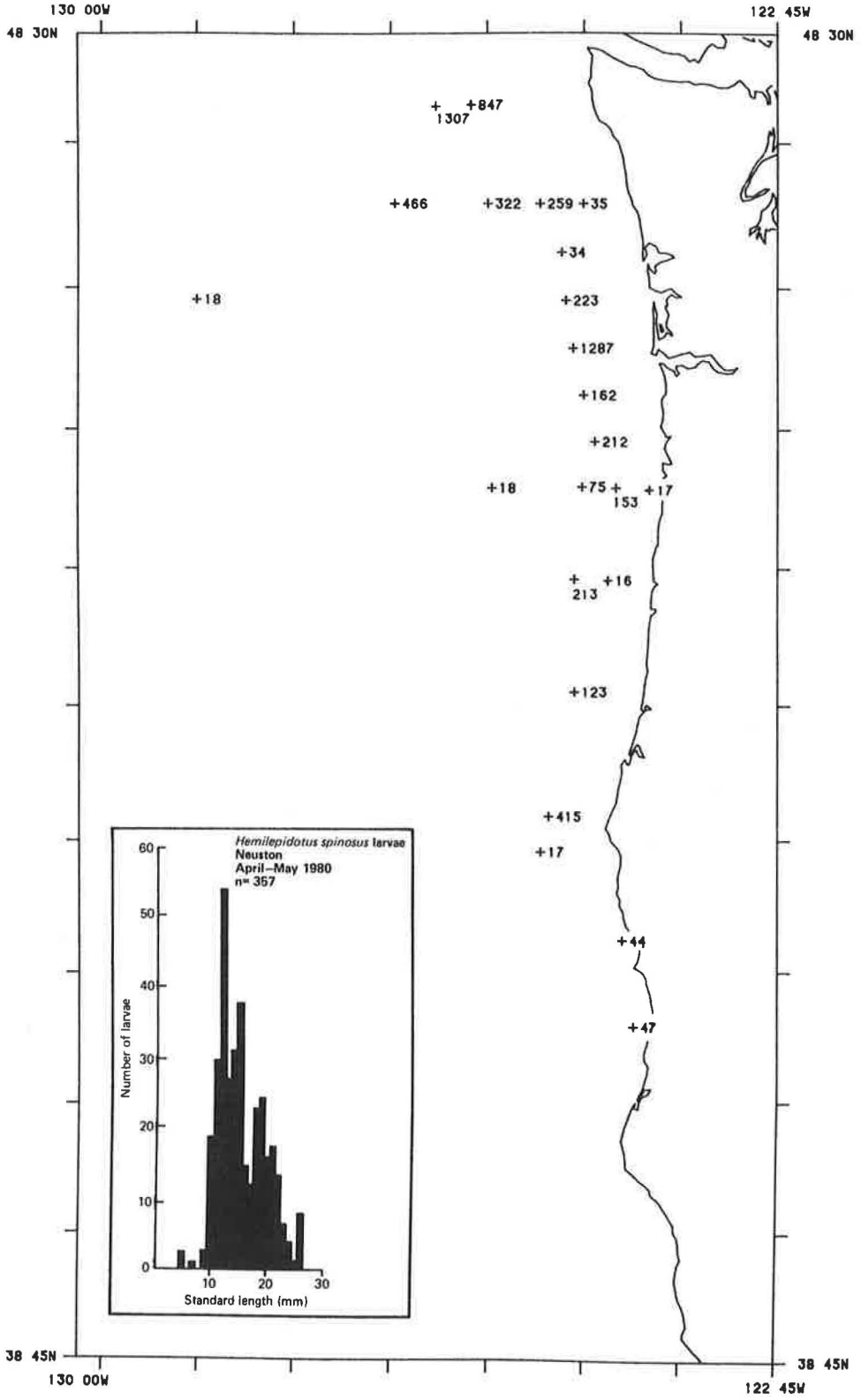

Figure 16.--Distribution and lengths of larvae of Hemilepidotus spinosus from neuston tows during cruise 1TK80, April-May 1980. Abundance expressed as numbers per 1,000 m^3.

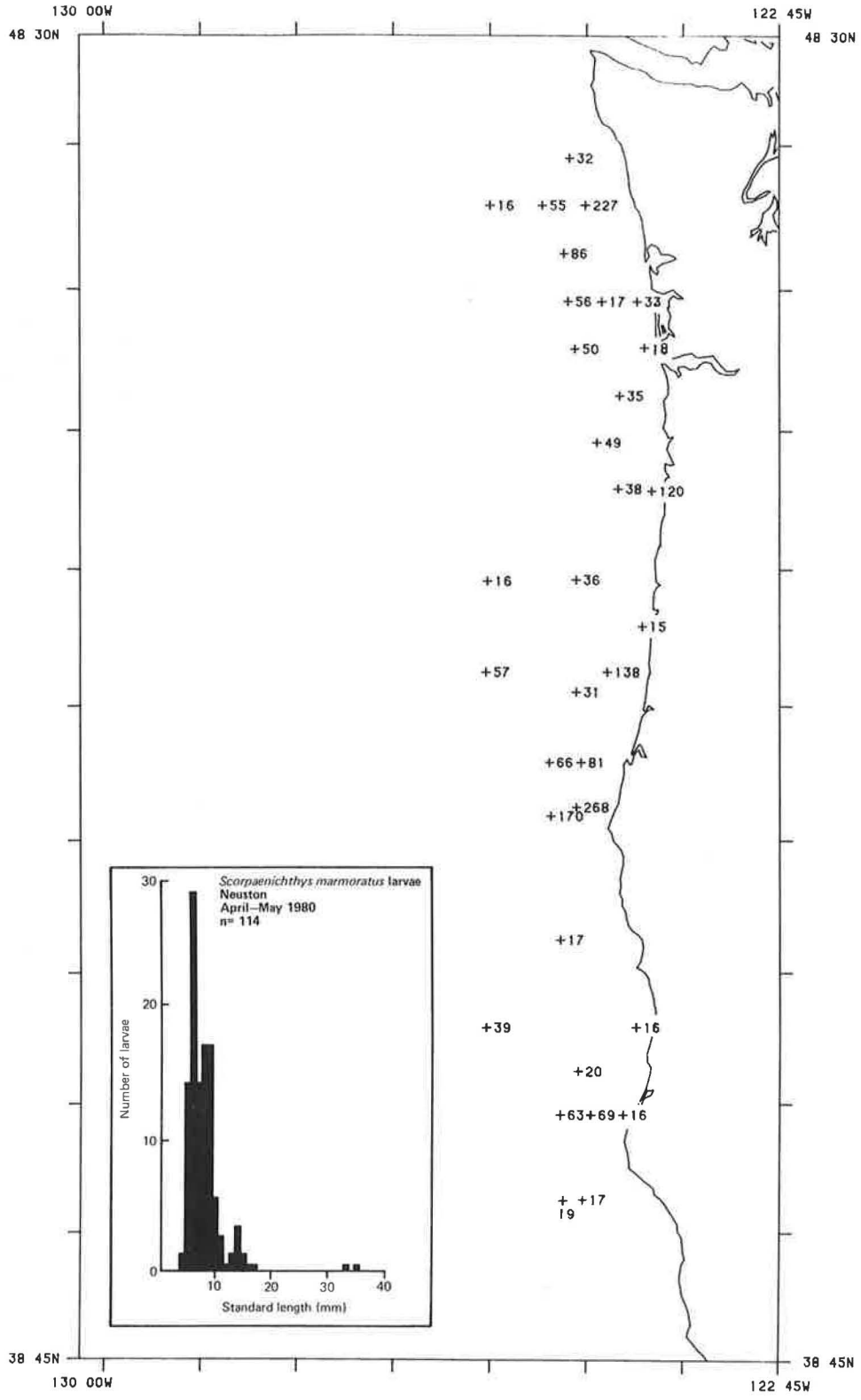

Figure 17.--Distribution and lengths of larvae of Scorpaenichthys marmoratus from neuston tows during cruise 1TK80, April-May 1980. Abundance expressed as numbers per 1,000 m^3.

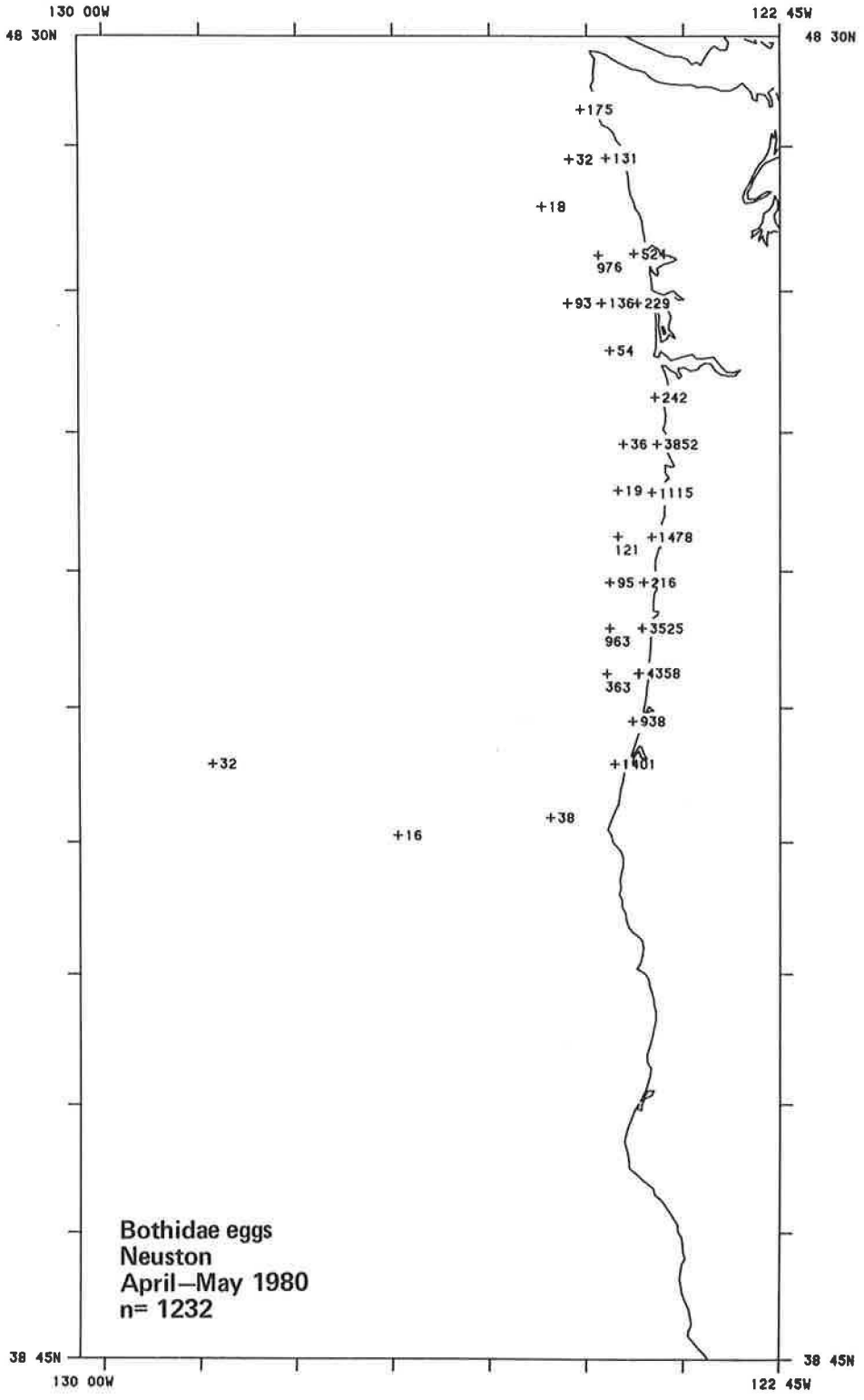

Figure 18.--Distribution of eggs of Bothidae from neuston tows during cruise 1TK80, April-May 1980. Abundance expressed as numbers per 1,000 m^3.

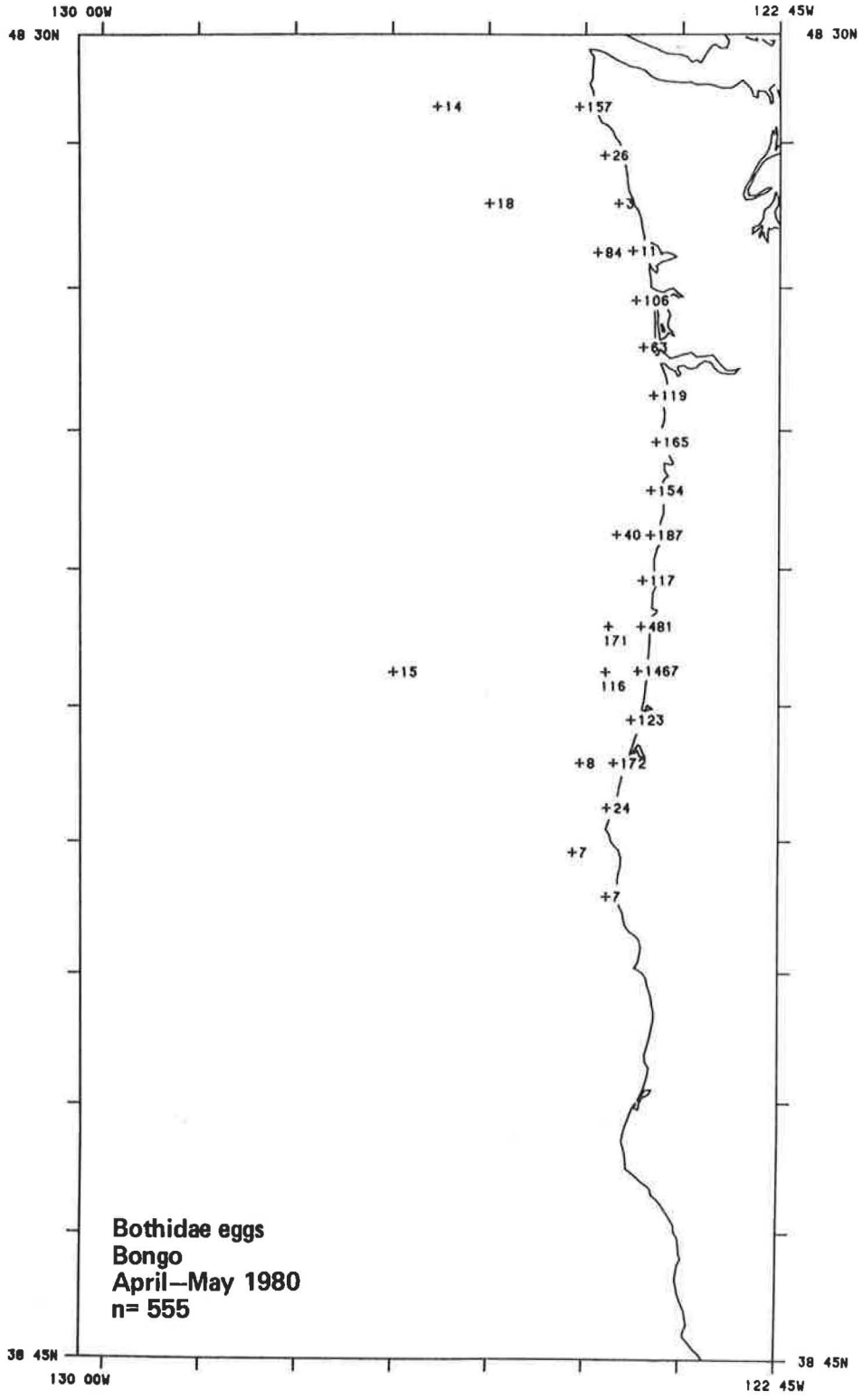

Figure 19.--Distribution of eggs of Bothidae from bongo tows during cruise 1TK80, April-May 1980. Abundance expressed as numbers per 10 m^2.

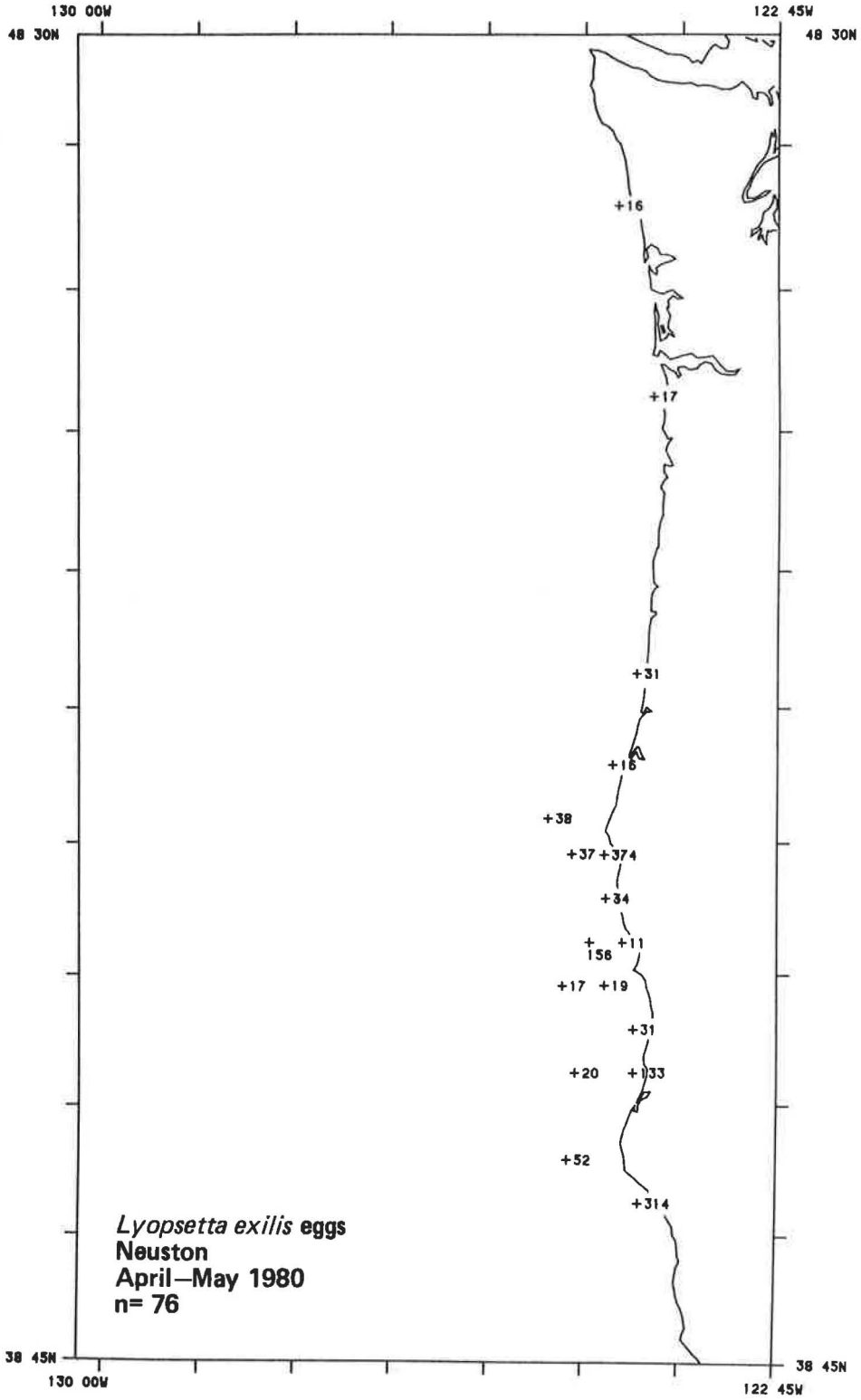

Figure 20.--Distribution of eggs of Lyopsetta exilis from neuston tows during cruise 1TK80, April-May 1980. Abundance expressed as numbers per 1,000 m^3.

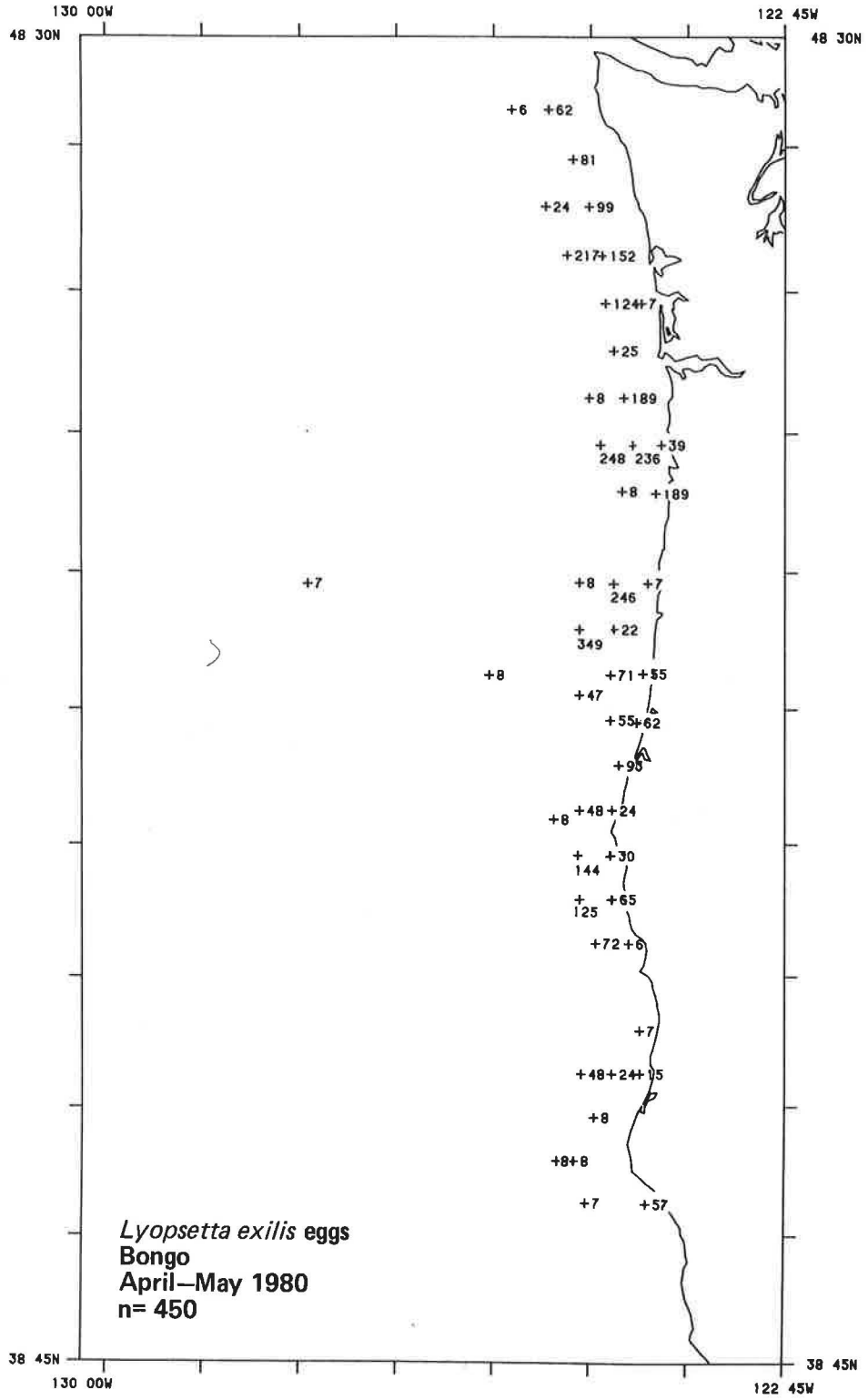

Figure 21.--Distribution of eggs of Lyopsetta exilis from bongo tows during cruise 1TK80, April-May 1980. Abundance expressed as numbers per 10 m^2.

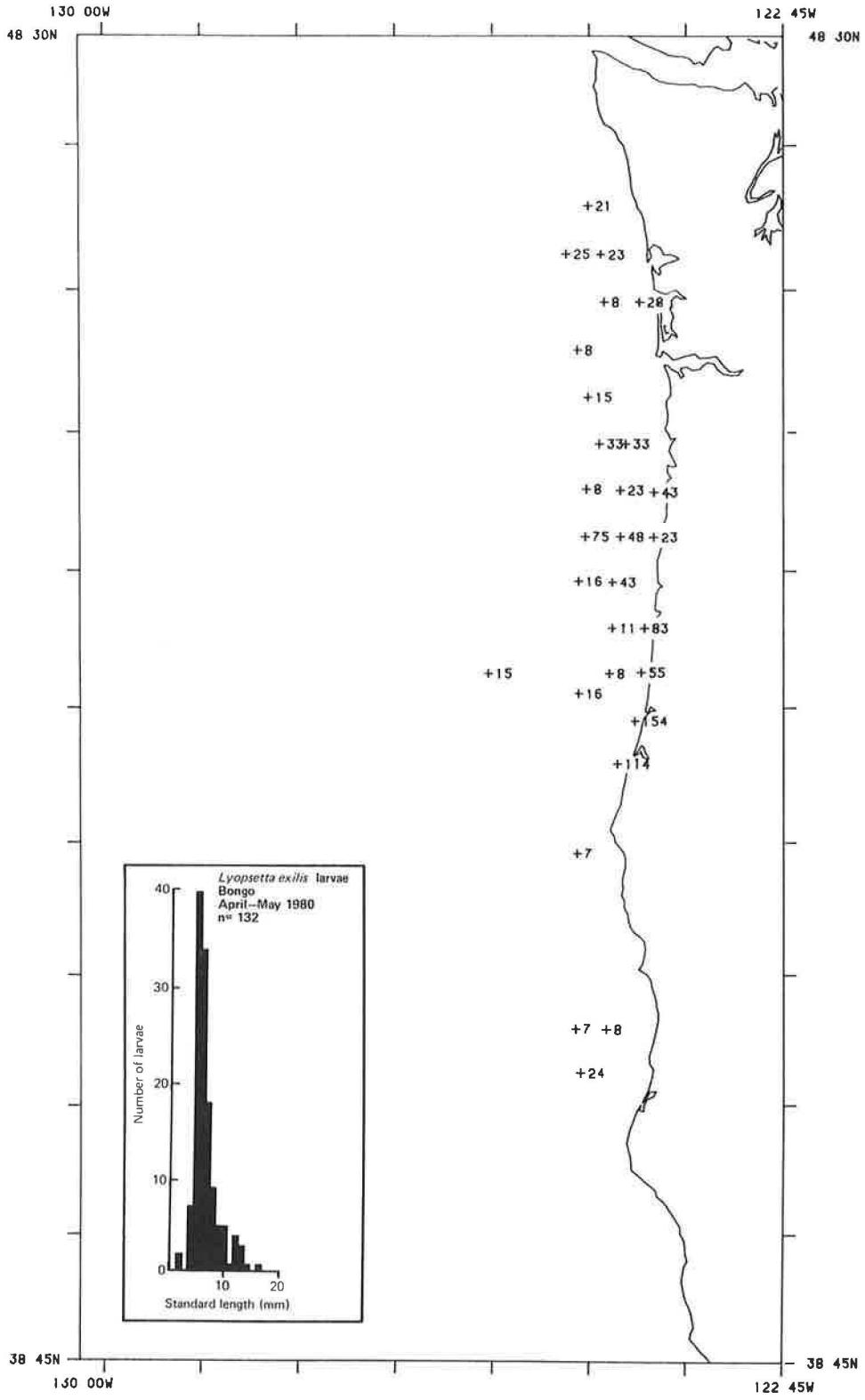

Figure 22.--Distribution and lengths of larvae of Lyopsetta exilis from bongo tows during cruise 1TK80, April-May 1980. Abundance expressed as numbers per 10 m^2.

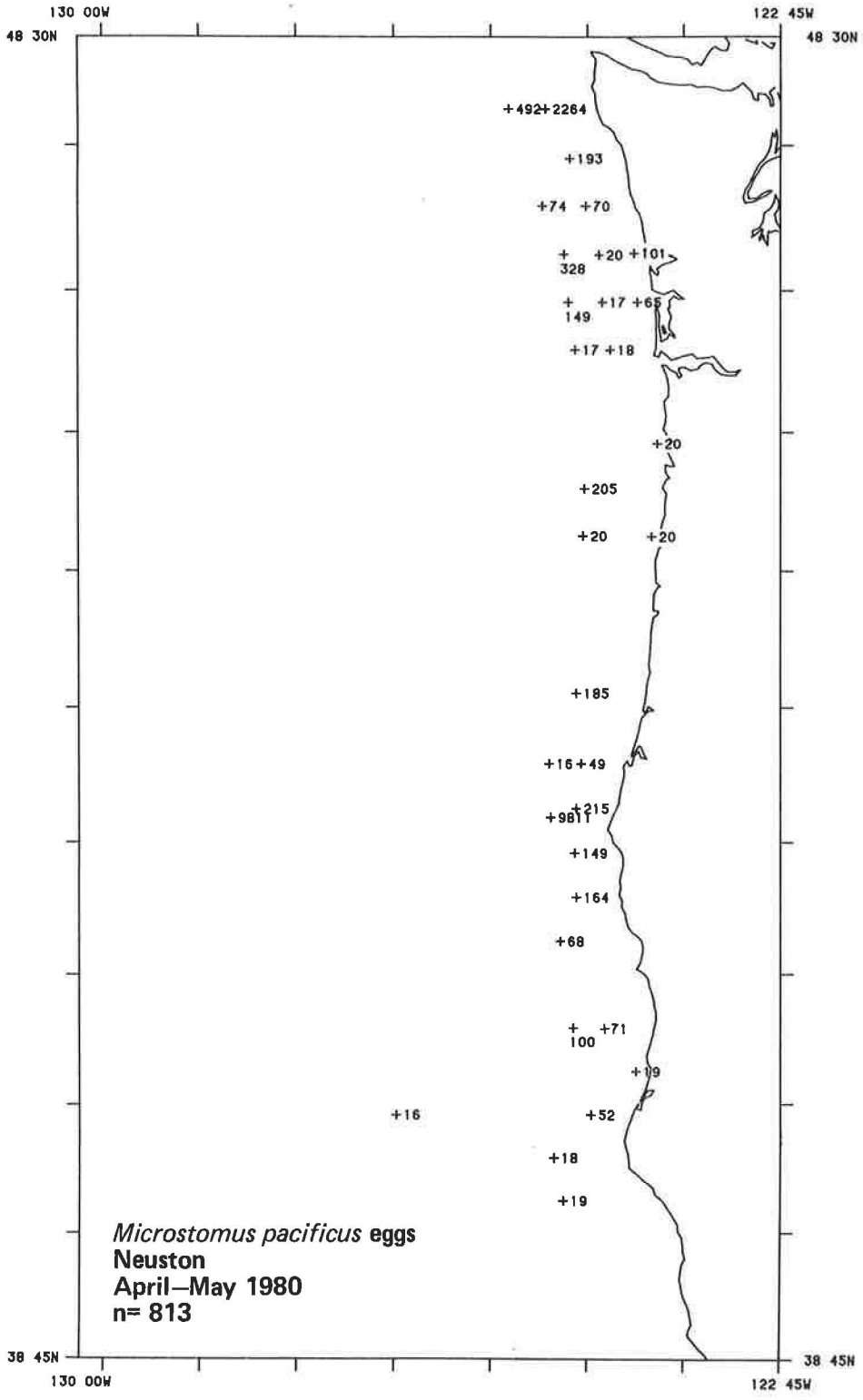

Figure 23.--Distribution of eggs of Microstomus pacificus from neuston tows during cruise 1TK80, April-May 1980. Abundance expressed as numbers per 1,000 m^3.

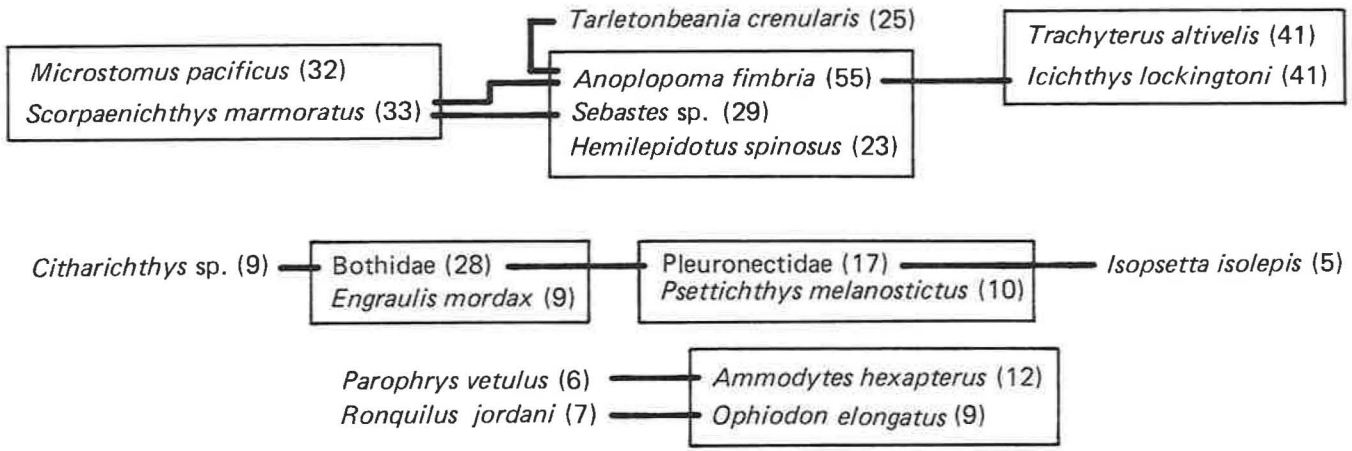

Figure 24.--Results of recurrent group analysis on neuston catches (both fish eggs and larvae) from 1TK80, April-May 1980, at an affinity level of 0.4. Taxa in rectangles are members of recurrent groups. Lines connect taxa with affinities outside their groups. Numbers in parentheses following taxa names are the numbers of occurrences of that taxon.

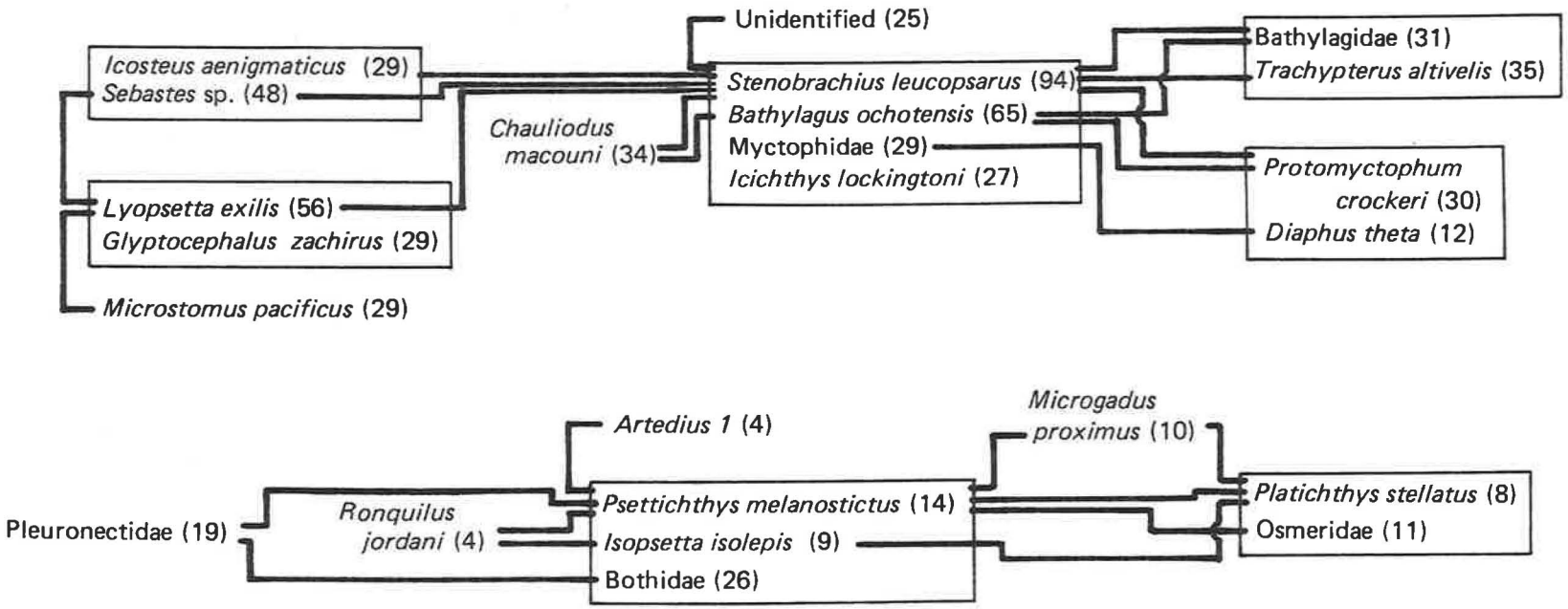

Figure 25.--Results of recurrent group analysis on bongo catches (both fish eggs and larvae) from 1TK80, April-May 1980. Format as for Figure 24.