NORTHWEST & ALASKA FISHERIES CENTER PROCESSED REPORT

ICHTHYOPLANKTON OF THE EASTERN BERING SEA

by
Kenneth D. Waldron
and
Beverly M. Vinter

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2725 Montlake Boulevard East
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FINAL REPORT (RU 380)

Environmental Assessment of the Alaskan Continental Shelf

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*Resource Ecology and Fisheries Management Division, Northwest and Alaska Fisheries Center, National Marine Fisheries Service, NOAA, 2725 Montlake Boulevard East, Seattle, WA 98112

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ABSTRACT

Samples of ichthyoplankton collected with bongo and neuston nets at 64 locations in the eastern Bering Sea during 16 April - 15 May 1977 contained 24,611 fish eggs and 14,171 fish larvae. Pollock (Gadidae) accounted for 97% of the eggs and 59% of the larvae with the remainder divided among 18 families of which the 8 most numerous were, in order of decreasing abundance, Hexagrammidae, Cottidae, Pleuronectidae, Ammodytidae, Osmeridae, Scorpaenidae, Stichaeidae, and Bathylagidae.

There were no marked differences in distribution and abundance of pollock eggs and larvae between 1976 and 1977, though eggs appeared to have been more abundant in 1976 and larvae more abundant in 1977. Comparison of bongo and neuston net catches indicated that almost all pollock larvae and a majority or pollock eggs were more than 0.25 m below the sea surface. However, larval hexagrammids and cottids were caught almost entirely with neuston nets in the upper 0.25 m of water, and more of these two groups were caught in 1977 than in 1976.

Repetitive sampling at 24 locations showed that both pollock eggs and larvae were more abundant during late April and least abundant in mid-April. An estimated 7.829×10^{12} pollock eggs and 7.498×10^{12} pollock larvae were present in a survey area of 9.57×10^{10} m^2 during 19-27 April 1977.

ICHTHYOPLANKTON OF THE SOUTHEASTERN BERING SEA

I. INTRODUCTION

The objective of RU-380, as set forth in the work statement, was to conduct a survey of icthyoplankton in a portion of the Bering Sea during spring of 1977, a continuation of the project begun in 1976. Because the survey was to be made during the spring it was of special interest to make a preliminary present-day assessment of pollock eggs and larvae.

During 1977, walleye pollock (Theragra chalcogramma) eggs and larvae were present generally from the 100 m to beyond the 2,000 m isobath along the outer edge of the continental shelf and slope from the Alaska Peninsula and Aleutian Islands to the vicinity of the Pribilof Islands. Within this area, eggs were most abundant north of Unimak Island and in the vicinity of Unalaska Island, while larval pollock were most abundant in the vicinity of, and northwest of Umnak and Unalaska Islands, somewhat to the west of the center of abundance of pollock eggs.

With respect to vertical distribution of pollock eggs, greater numbers were caught with neuston nets, which sampled only the upper 0.25 m of the water column, than with bongo nets. However, when neuston and bongo catches are standardized in numbers per unit surface area it appears that there were more pollock eggs in the water column below about 0.25 m depth than were present in the upper 0.25 m depth. With respect to pollock larvae, many more were taken in the bongo than in the neuston nets, indicating a distribution in which maximum numbers were below the upper 0.25 m.

Larvae and eggs of 19 families were caught and these could be identified as belonging to 26 genera or species plus 18 unnamed types identified only to family or given a letter designation within the family.

The 1976 survey covered a larger area than did that of 1977, and sampling locations differed; however, during both years a major portion of the area containing high densities of pollock eggs and larvae was included within the surveys. Differences in the distribution of eggs and larvae during the two sampling periods were not extensive although the average catch of pollock eggs was greatest in 1976, whereas, the average catch of pollock larvae was greatest in 1977. Larvae of 5 families of fish not present in the 1976 samples were found in small numbers in the 1977 collections. Members of some families were much more abundant in the 1977 samples than those from 1976, especially sculpins of the genus *Hemilepidotus* and greenlings of the genus *Hexagrammos*.

The implications of this assessment with respect to oil and gas development in the St. George and Bristol Bay basin are that widespread alterations to environmental conditions during spring could result in mortalities of pollock eggs and larvae, and could not only significantly reduce year-class strength in the dominant fishery, but could also alter existing predator-prey relations in the ecosystem. Environmental changes, limited to the surface layer after spawning has commenced, would be more damaging to pollock eggs than to pollock already in larval stages; but changes extending to deeper layers (i.e., below 1 m depth) would affect both pollock eggs and larvae to a greater extent than would any strictly surface effects.

The general scope of this survey, conducted by the Resource Ecology Task of the NMFS Northwest and Alaska Fisheries Center (NWAFC), was to identify regions inhabited by eggs and larvae of commercially valuable fish in the eastern Bering Sea. Because of limited allocations of vessel time and money, the study could be of only limited scope and restricted to study of a single species during a single time period; thus, only limited results could be expected, and it is not possible to extrapolate the data to other species or time periods.

The specific objective of this study was to continue a present-day assessment of pollock eggs and larvae in a portion of the southeastern Bering Sea, a project which was begun during 1976. An additional objective for the 1977 study was to examine short-term variations in abundance and distribution of pollock eggs and larvae within the survey area.

Pollock constitute the largest commercial fishery in the eastern Bering Sea, contributing roughly 83% of the fish catch. Limited historical data (Musienko 1963; Serobaba 1968) indicated that the major spawning ground of this species largely overlaps the St. George Basin, one of the important areas to be considered in the development of petroleum resources of the Bering Sea. Since eggs and larval stages of fish may be damaged by changes in the environment caused by petroleum developmental activities, it was felt essential to assess this part of the biota.

II. CURRENT STATE OF KNOWLEDGE

Information concerning ichthyoplankton in the Bering Sea is sparse and based mainly on investigations carried out by Soviet and Japanese scientists. Until inception of NOAA's Outer Continental Shelf Environmental Assessment Program (OCSEAP) there were very few investigations of ichthyoplankton in the eastern Bering Sea by marine biologists of the United States. In some instances, if not in most, analyses of collections made by U.S. biologists have not typically resulted in scientific publications, but generally have been summarized in the form of "in-house" processed reports that have limited distribution.

Publications concerning many of the collections made by Japanese fishery scientists are in the form of station and cruise summaries with a listing of eggs and larvae captured at various locations (Faculty of Fisheries, Hokkaido University (1957-1962, 1964, 1967-1970)). Most of these reports cover collections made only during the summer. Kashkina (1970) included much of the above Japanese data in a report on the distribution of fish eggs and larvae in the Bering Sea during the summer season. More recently these data were included in a report on spawning of pollock in the eastern Bering Sea (Maeda and Hirakawa 1977).

In addition to Kashkina (1970), Soviet scientists have published other articles concerned specifically with distribution and abundance of eggs and larvae of particular fish, e.g., pollock - Serobaba 1968, 1971, 1974 and yellowfin sole - Fadeev 1970; Kashkina 1965b.

Prior to 1976 there were only two available reports by U.S. scientists concerning ichthyoplankton in the Bering Sea, one by Aron (1960) and the other an unpublished "in-house" report by Dunn and Naplin (1973) describing collections made in 1971. A more recent report concerns abundance and distribution of pollock larvae, as well as other species, during the spring of 1976 (Waldron 1977).

The foregoing reports indicated that pollock spawn during the spring, generally from about March to June, in an area over the outer continental shelf to beyond the continental slope. Maeda and Hirakawa (1977) have recently reported that during summer, pollock larvae are found in small numbers westward almost to longitude 180°. All reports suggest that the greatest concentrations of eggs and larvae occur between the Pribilof Islands and the Aleutian Islands-Alaska Peninsula. Some of the reports do not clearly indicate the methods used in making collection nor the methods and units used to standardize actual numbers collected, and interpretation of these results is difficult or impossible.

III. STUDY AREA

The area within which the study was conducted during 1977 was more limited than that covered during 1976 and most samples were collected south of the Pribilof Islands. The 1977 survey was conducted between lat. 58°N and the Alaska Peninsula-Aleutian Islands, and between long. 163° and 174°W. Figure 1 shows the total area included in the survey, the station pattern, and the number of times individual stations were sampled, and Table 1 shows station data.

IV. SOURCES, METHODS, AND RATIONALE OF DATA COLLECTION

A. Station Pattern

Collection of ichthyoplankton, in particular eggs and larvae of pollock, was the primary mission during the cruise and so it was not necessary to adopt a compromise station pattern designed to serve other missions, as was the case during 1976. The station pattern was based on historical information which indicated the maximum abundance of pollock eggs and larvae to the north and northwest of Unimak Island. Stations were spaced closely in the area expected to contain the greatest abundance of pollock eggs and larvae (stations 1-24 in Fig. 1), and farther apart in the surrounding area. Further, it was planned to collect repetitive samples at some of the central core of a station in order to gain information about changes in catch during a relatively short time period and the number of times samples were collected at each station is indicated in Figure 1. A fire which damaged a generator aboard the NOAA vessel Miller Freeman forced cancellation of a fourth sampling at stations 1-24.

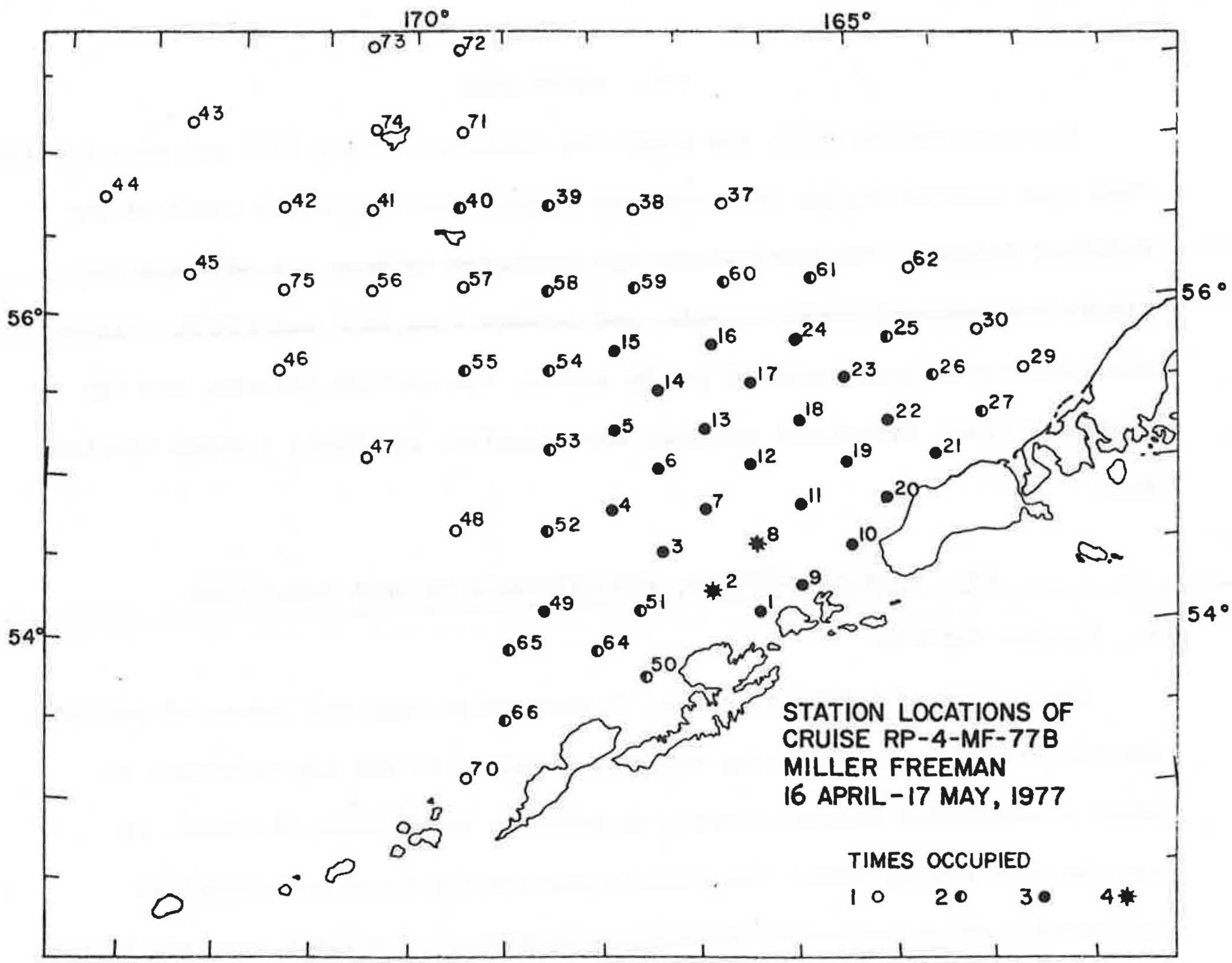


Figure 1.-- Station locations in the eastern Bering Sea for Miller Freeman cruise RP-4-MF-77B, 16 April - 17 May 1977.

TABLE 1.--Station data from cruise RP-4-MF77B-Legs V and VI, _Miller Freeman_ 16 April - 15 May, 1977

Sta. No. 1/	Position 2/ Lat. N.	Long. W.	Date/ Time 3/	Day/ Night 4/	Data 5/	Temperature 6/ Surf.	Bot.	Net Dep. 7/	SHF(A) 8/	SHF(B) 9/
	° '	° '	April							
01-1	54 12.5	166 15.1	16/1429	N/D	N B C	3.60	3.52	206	6.549	3.187
02-1	54 21.6	166 44.0	16/1815	D	N B X	3.8	4.0	215	5.730	2.663
03-1	54 37.2	167 15.0	16/2205	D	N B C	3.04	3.56	206	4.992	2.422
04-1	54 51.4	167 46.1	17/0149	D	N B X	3.6	3.8	175	3.919	2.238
05-1	55 22.0	167 42.5	17/0503	D/N	B C	2.57	3.26	107	3.043	2.856
06-1	55 07.4	167 16.5	17/0800	N	N B X	3.5	3.6	142	4.059	3.106
07-1	54 52.2	166 46.9	17/1043	N	N B C	3.10	3.45	179	5.528	3.097
08-1	54 36.8	166 15.6	17/1410	N	N B X	3.7	4.3	215	5.910	2.750
09-1	54 22.6	165 46.3	16/1118	N	N B X	3.6	3.9	123	4.775	3.888
10-1	54 36.5	165 15.6	16/0800	N	N B C	3.19	3.70	70	4.771	6.818
11-1	54 52.0	165 46.3	17/1651	D	N B C	3.25	3.79	125	5.199	4.145
12-1	55 06.7	166 16.5	17/1959	D	N B X	3.5	4.5	93	4.341	4.678
13-1	55 22.4	166 45.8	17/2224	D	N B C	2.77	3.60	128	5.251	4.105
14-1	55 36.7	167 15.5	18/0154	D	N B X	3.3	4.3	126	5.499	4.354
15-1	55 51.8	167 42.6	18/0406	D/N	N B C	2.18	3.60	119	5.044	4.253
16-1	55 52.3	166 43.6	18/0730	N	N B X	2.2	4.0	108	6.003	5.538
17-1	55 37.3	166 14.3	18/1010	N	N B C	2.49	3.99	109	5.104	4.697
18-1	55 22.5	165 44.5	18/1304	N	N B X	3.2	4.5	114	4.997	4.400
19-1	55 07.1	165 14.6	18/1519	N/D	N B C	2.70	3.70	102	5.380	5.293
20-1	54 52.2	164 50.2	18/1752	D	N B X	3.6	3.5	62	5.203	8.403
21-1	55 06.8	164 15.6	18/2015	D	N B X	4.1	3.6	34	4.338	12.708
22-1	55 21.0	164 44.9	18/2228	D	N B C	2.72	3.91	100	5.727	5.709
23-1	55 37.6	165 14.8	19/0127	D	N B X	4.1	4.3	100	5.817	5.847
24-1	55 52.4	165 46.3	19/0350	D	N B C	2.55	4.30	105	6.381	6.057
25-1	55 52.0	164 43.6	19/0724	N	N B X	3.0	4.2	70	5.982	8.491
26-1	55 36.9	164 15.4	19/0930	N	N B C	2.71	3.72	87	6.958	7.992
27-1	55 21.8	163 45.0	19/1211	N	N X	2.8	3.2	-	-	-
39-1	56 44.5	168 30.1	23/0036	D	N B C	1.98	2.54	96	5.598	5.812
40-1	56 44.7	169 29.1	22/2028	D	N B X	1.1	0.7	66	4.860	7.393
49-1	54 15.7	168 29.0	26/2128	D	N B C	3.78	3.34	220	6.347	2.883
50-1	53 49.8	167 29.1	21/2053	D	N B X	3.9	3.8	226	6.991	3.098
51-1	54 14.5	167 30.3	22/0002	D	N B X	3.7	3.7	213	6.152	2.887
52-1	54 45.0	168 31.2	22/0451	D	N B X	4.1	4.3	213	6.298	2.958
53-1	55 15.6	168 30.4	22/0752	N	N B X	4.0	3.8	214	6.121	2.867
54-1	55 45.4	168 29.4	22/1043	N	N B X	3.0	3.9	136	5.641	4.162

TABLE 1.--Station data from cruise RP-4-MF77B-Legs V and VI, Miller Freeman 16 April - 15 May, 1977 (cont.).

Sta. No. 1/	Position 2/ Lat. N.	Long. W.	Date/ Time 3/	Day/ Night 4/	Data 5/	Temperature 6/ Surf.	Bot.	Net Dep. 7/	SHF(A) 8/	SHF(B) 9/
	° '	° '	April							
55-1	55 45.1	169 29.8	22/1419	N/D	N	-	-	-	-	-
58-1	56 15.3	168 31.1	23/0421	D	N B C	2.31	3.46	178	5.874	3.298
59-1	56 15.1	167 29.2	23/0821	N	N B C	2.49	3.74	108	5.893	5.466
60-1	56 14.5	166 30.0	23/1143	N	N B C	2.42	4.14	101	5.675	5.619
61-1	56 14.8	165 30.8	23/1610	D	N B X	2.5	3.0	78	5.235	6.651
64-1	54 00.5	167 58.9	26/1801	D	N B X	4.1	3.9	214	6.476	3.024
65-1	54 00.7	168 57.0	27/0059	D	N B X	4.6	4.0	219	6.064	2.766
66-1	53 34.9	168 58.2	27/0429	D	N B X	4.5	4.5	217	6.230	2.877
01-2	54 13.5	166 14.6	26/1057	N	N B C	3.91	3.28	216	6.694	3.107
02-2	54 23.3	166 44.0	26/0840	N	N B X	4.0	4.2	214	6.191	2.896
03-2	54 38.7	167 14.0	26/0537	D/N	N B C	3.93	3.58	218	6.529	2.993
04-2	54 52.9	167 43.1	26/0303	D	N B X	4.2	4.0	219	6.804	3.114
05-2	55 22.0	167 41.1	25/2335	D	N B C	3.16	3.45	147	6.765	4.597
06-2	55 08.0	167 16.7	25/2037	D	N B X	3.7	3.8	151	5.959	3.937
07-2	54 52.7	166 45.5	25/1724	D	N B C	3.44	3.66	189	6.541	3.459
08-2	54 37.4	166 15.3	25/1507	D	N B X	4.0	3.8	215	6.280	2.921
09-2	54 23.6	165 44.8	25/1240	N	N B X	4.5	5.3	130	5.684	4.374
10-2	54 36.9	165 17.1	25/0956	N	N B C	3.69	3.57	73	5.494	7.554
11-2	54 52.1	165 45.5	25/0657	N	N B C	3.29	3.63	131	5.837	4.470
12-2	55 07.3	166 15.5	25/0432	D	N B X	3.8	4.5	141	6.377	4.530
13-2	55 22.5	166 45.9	25/0059	D	N B C	3.23	3.67	131	5.779	4.405
14-2	55 36.2	167 15.6	24/2235	D	N B X	3.8	4.3	129	5.963	4.612
15-2	55 52.1	167 44.2	24/1937	D	N B C	2.66	3.54	123	5.501	4.485
16-2	55 52.3	166 46.2	24/1625	D	N B X	3.0	4.3	129	5.592	4.333
17-2	55 37.2	166 16.2	24/1340	N	N B C	2.80	3.98	109	5.907	5.438
18-2	55 23.0	165 46.4	24/1145	N	N B X	3.8	4.3	115	5.870	5.108
19-2	55 06.9	165 14.0	24/0816	N	N B C	3.53	3.68	103	6.031	5.886
20-2	54 52.5	164 50.3	24/0612	N	N B X	4.0	3.4	65	5.731	8.781
21-2	55 06.9	164 17.3	24/0352	D	N B X	3.2	3.5	46	4.539	9.907
22-2	55 19.7	164 47.4	24/0001	D	N B C	3.22	3.80	94	5.502	5.869
23-2	55 37.5	165 15.4	23/2122	D	N B X	3.5	4.0	100	5.583	5.605
24-2	55 52.7	165 45.3	23/1832	D	N B C	2.61	4.29	80	5.987	7.459

TABLE 1.--Station data from cruise RP-4-MF77B-Legs V and VI, Miller Freeman 16 April - 15 May, 1977 (cont.).

Sta. No. 1/	Position Lat. N. 2/	Position Long. W.	Date/ Time 3/	Day/ Night 4/	Data 5/	Temperature Surf. 6/	Temperature Bot.	Net Dep. 7/	SHF(A) 8/	SHF(B) 9/
	° '	° '	May							
01-3	54 12.4	166 15.3	04/1038	N	N B C	4.03	3.31	215	6.615	3.072
02-3	54 21.1	166 42.2	04/0833	N	N B X	4.3	3.8	216	6.121	2.839
02-4	54 23.0	166 41.5	15/0918	N	N B X	5.1	4.5	212	6.456	3.043
03-3	54 38.4	167 12.9	04/0513	D/N	N B C	4.00	3.56	223	5.421	2.426
04-3	54 52.5	167 43.3	04/0234	D	N B X	4.5	4.5	214	5.680	2.657
05-3	55 22.1	167 42.0	10/0617	N	N B C	3.93	3.35	136	5.672	4.184
06-3	55 06.3	167 16.7	05/1630	D	N B X	5.1	4.7	131	4.059	3.106
07-3	54 52.7	166 44.7	05/1232	N	N B C	3.71	3.53	159	4.860	3.051
08-3	54 37.4	166 14.8	05/0934	N	N B X	5.0	4.3	217	5.797	2.673
08-4	54 36.9	166 15.2	15/1125	N	N	-	-	-	-	-
09-3	54 22.7	165 44.8	04/1327	N/D	N	-	-	-	-	-
09-4	54 22.3	165 44.2	05/0703	N	N B X	5.0	4.0	101	5.810	5.757
10-3	54 37.3	165 15.7	07/0902	N	N B C	3.91	3.75	74	4.782	6.458
11-3	54 52.7	165 46.2	07/0602	N	N B C	4.04	3.53	120	5.038	4.195
12-3	55 06.3	166 16.7	06/2210	D	N B X	4.3	4.0	121	4.814	3.993
13-3	55 22.2	166 45.8	05/2216	D	N B X	5.0	3.7	130	4.182	3.207
14-3	55 35.8	167 14.3	10/0348	D	N B X	4.4	4.2	123	5.748	4.670
15-3	55 51.2	167 42.1	10/1310	N/D	N B C	3.39	3.39	120	5.495	4.581
16-3	55 51.8	166 43.4	10/0119	D	N B X	3.7	4.4	119	5.988	5.045
17-3	55 37.1	166 14.5	09/2159	D	N B C	3.50	3.73	117	5.785	4.962
18-3	55 22.2	165 44.5	07/0101	D	N B X	4.1	4.2	104	5.147	4.929
19-3	55 07.2	165 16.1	09/0247	D	N B C	4.12	3.65	105	5.540	5.298
20-3	54 52.3	164 50.4	08/0750	N	N B X	6.0	7.5	60	5.485	9.220
21-3	55 06.6	164 16.9	08/1021	N	N B X	5.5	5.4	41	4.520	11.015
22-3	55 20.0	164 45.3	09/0002	D	N B C	4.01	3.71	91	4.900	5.370
23-3	55 37.3	165 13.7	09/0612	N	N B X	5.4	4.3	100	5.184	5.207
24-3	55 52.5	165 45.4	09/1845	D	N B C	3.58	3.89	101	5.360	5.322
25-2	55 52.0	164 43.3	09/0823	N	N B X	4.3	4.0	86	5.075	5.882
26-2	55 36.8	164 14.1	08/2044	D	N B C	3.53	3.53	90	5.124	5.706
27-2	55 21.3	163 45.2	08/1302	N/D	N B X	4.0	4.0	56	4.068	7.292
29-1	55 37.1	163 16.4	08/1539	D	N B X	3.5	3.5	60	5.488	9.151
30-1	55 52.6	163 45.7	08/1752	D	N B C	3.38	2.90	89	5.650	6.355
37-1	56 46.2	166 30.4	10/2345	D	N B C	2.88	2.55	63	5.495	8.665
38-1	56 43.5	167 30.0	11/0346	D	N B X	3.6	4.5	79	5.552	7.014
39-2	56 44.7	168 30.5	11/0705	N	N B C	2.90	2.78	83	4.696	5.651

TABLE 1.--Station data from cruise RP-4-MF77B-Legs V and VI, Miller Freeman
16 April - 15 May, 1977 (cont.).

Sta. No. 1/	Position Lat. N. 2/	Position Long. W.	Data/ Time 3/	Day/ Night 4/	Data 5/	Temperature Surf. 6/	Temperature Bot.	Net Dep. 7/	SHF(A) 8/	SHF(B) 9/
	° '	° '	May							
40-2	56 44.7	169 29.5	11/1051	N	N B X	2.6	2.4	60	5.238	8.783
41-1	56 44.5	170 29.9	12/0429	D	N B C	2.43	2.23	91	5.698	6.243
42-1	56 45.6	171 30.8	12/0840	N	N B X	3.3	4.0	111	6.051	5.434
43-1	57 14.7	172 30.5	12/1250	N/D	N B C	2.05	1.77	99	5.643	5.731
44-1	56 44.5	173 32.2	12/1731	D	N B X	4.0	4.0	218	6.598	3.024
45-1	56 17.6	172 31.5	12/2229	D	N B C	3.20	3.52	210	6.515	3.100
46-1	55 44.4	171 31.3	13/1102	N	N B X	4.1	4.3	206	6.295	3.058
47-1	55 14.6	170 28.5	13/1538	D	N B C	3.45	3.59	211	7.208	3.417
48-1	54 45.6	169 28.5	14/1651	D	N B C	4.15	3.55	216	6.675	3.096
49-2	54 14.9	168 30.8	03/1932	D	N B C	3.82	3.43	218	6.479	2.974
49-3	54 17.8	168 30.8	14/2147	D	N B C	4.28	3.49	213	6.076	2.856
50-2	53 50.4	167 28.8	15/0328	D	N B X	5.8	4.0	213	7.654	3.592
51-2	54 15.4	167 29.2	15/0609	N	N B X	5.0	4.9	215	6.849	3.192
52-2	54 45.6	168 29.6	03/2324	D	N B X	4.5	4.6	214	6.294	2.936
53-2	55 14.2	168 29.2	14/1213	N	N B C	4.05	3.56	212	6.014	2.844
54-2	55 44.8	168 29.5	10/1013	N	N B X	4.2	3.6	136	5.870	4.322
55-2	55 45.7	169 27.7	13/2045	D	N B X	5.2	4.3	220	6.894	3.136
56-1	56 14.3	170 29.6	13/0621	N	N B	-	-	102	5.661	5.560
57-1	56 15.9	169 29.3	14/0105	D	N B X	3.8	3.5	212	7.615	3.594
58-2	56 15.0	168 29.9	14/0641	N	N B C	3.94	3.23	167	6.365	3.810
59-2	56 14.8	167 29.9	10/1633	D	N B C	3.20	3.94	121	6.109	5.047
60-2	56 15.1	166 31.4	10/2006	D	N B C	3.38	3.93	106	6.320	5.963
61-2	56 14.4	165 30.3	09/1558	D	N B X	3.7	3.7	67	5.650	8.392
62-1	56 15.9	164 27.8	09/1054	N	N B X	3.3	3.1	73	4.185	5.729
64-2	54 02.9	167 57.9	15/0109	D	N B X	5.8	4.1	212	7.074	3.331
65-2	53 59.8	168 58.3	03/1635	D	N B X	9.8	5.2	215	5.812	2.701
66-2	53 34.3	169 00.1	03/1341	N/D	N B X	4.1	3.9	213	5.633	2.650
70-1	53 12.9	169 24.7	03/1002	N	N B C	3.81	3.34	215	6.252	2.906
71-1	57 14.4	169 30.1	11/1340	D	N B C	0.09	0.38	56	5.285	9.470
72-1	57 44.0	169 30.8	11/1710	D	N B X	2.9	1.4	54	4.989	9.306
73-1	57 44.6	170 32.2	11/2135	D	N B C	-0.04	-0.91	64	5.877	9.232
74-1	57 14.7	170 28.9	12/0058	D	N B X	1.5	1.7	42	5.139	12.222
75-1	56 13.6	171 29.2	13/0241	D	N B X	3.5	3.8	209	6.565	3.135

Footnotes for Table 1

1/ Station number includes the pre-assigned number of the location plus the number designating the number of times that location was sampled, e.g. 14-2 indicates location 14 and the second set of samples obtained at that location.

2/ Position: The stated position is that for the bongo samples, except in those instances when a bongo tow was not taken due to rough seas and then the position is that listed for the neuston tow.

3/ Date and time are both GMT. Time listed is for the beginning of the bongo tow.

4/ Day/Night. A sample was classed as being taken at night or during the day based upon the time of sunrise and sunset as listed for latitude 56°N in the Tide Tables.

D = Day, ½ hour after sunrise to ½ hour before sunset.
N = Night, ½ hour after sunset to ½ hour before sunrise.
D/N = dusk, ½ hour before sunset to ½ hour after sunset.
N/D = dawn, ½ hour before sunrise to ½ hour after sunrise.

5/ Data: N = neuston sample, B = a bongo sample, C = a CTD cast, and X = an XBT cast.

6/ Temperature in degrees Celsius as measured by either XBT or CTD.

7/ Net Dep. = Net Depth. This is the calculated depth of the net with the maximum amount of wire out for that tow, and is based on the average tangent of wire angles measured at 10 m of wire intervals (see Kramer et al. 1972).

8/ SHF(A) = Standard Haul Factor to convert observed catch of the 505-bongo net to catch per 10 m^2 (see Kramer et al. 1972).

9/ SHF(B) = Standard Haul Factor to convert observed catch of the 505-bongo net to catch per 1,000 m^3 (see Kramer et al. 1972).

Certain stations in the original pattern submitted to OCSEAP were deleted during the cruise, and this accounts for the absence of stations 28, 31-36, and 63. Stations 64-66 and 70-75 were added to extend the pattern into areas of interest based upon information gained during the cruise.

During 1977 none of the stations were in the ice field, in contrast to 1976, when ice cover persisted in the survey area until the end of May; thus, it was possible to occupy stations in a more orderly manner than during 1976.

B. Nets and collecting methods

Plankton was collected following general procedures established by the NMFS Marine Resources Monitoring Assessment and Prediction (MARMAP) Field Group for use of bongo and neuston nets, except that certain modifications were made in equipment specifications and towing procedures.

Two types of samples were collected, (a) an integrated tow from the surface to near bottom, or to a nominal depth of 200 m in deep water, using bongo nets, and (b) a surface sample nominally from the upper 0.16-0.25 m with a neuston net.

Bongo net frames, constructed of aluminum, were 0.60 m inside diameter rather than 0.61 m as suggested by MARMAP. One net was constructed of 0.505 mm mesh (=505 bongo) and the other of 0.333 mm mesh (=333 bongo). Both had a 1:10 mouth area to open mesh area ratio, somewhat larger than that used for standard MARMAP tows, and this was done to permit more efficient filtering of water with a high phytoplankton content. Cod ends were socks attached by the method described by Kramer et al. (1972, p. 9). A close estimate of volume of water filtered was obtained by means of a hydrodynamically shaped, calibrated mechanical flowmeter with digital read-out mounted in the center of the mouth of each bongo net.

During the tow, depressing force was provided by a spherical weight, a 10-inch metal trawl net float filled with lead to a weight of 45.4 kg.

Three different neuston nets were used during the cruise: (1) a Sameoto type sampler with a mouth opening of 0.4 x 0.4 m (Sameoto and Jaroszynski 1969); (2) a sampler, similar to the Sameoto sampler, constructed by vessel personnel to replace the original which was lost at sea, and this had a mouth opening 0.32 m high by 0.47 m wide--materials on hand dictated the mouth size; and (3) a MARMAP neuston net with an opening of 0.5 x 1.0 m. Neuston nets were constructed of 0.505 mm mesh in the case of the Sameoto type sampler and its replacement, and 0.471 mm mesh for the MARMAP sampler.

Wire angles during the bongo tows were measured with a telemetering inclinometer having one indicator visible to the tow observers on deck and a second indicator in the wheelhouse visible to the helmsman. The wheelhouse indicator showed deviation from a zero point, which was set to correspond to a wire angle of 45^{o}, and this permitted maintenance of the desired wire angle through close control of the vessel speed.

Bongo nets were towed over a double oblique path from the surface to within about 10 m of bottom or a desired maximum depth of 212 m with 300 m of wire out. Actual maximum depth varied, depending upon wire angle, up to 226 m depth (see Table 1). Desired vessel speed during tows was 2.0 knots (1.03 m/sec), but actual speed probably varied between 1.5 and 2.5 knots (0.77 and 1.28 m per second) because there was no means of accurately measuring vessel speed.

With the vessel underway at about 2.0 knots, the bongo array was lowered to depth at a rate of 50 m of wire per minute, held at that depth for 30 sec to permit stabilization of the nets and the wire angles, and then retrieved at a rate of 20 m of wire per minute. During retrieval wire angle was maintained as closely as possible to 45^{o} by control of vessel speed. After the nets were out of the water they were rinsed thoroughly to concentrate the catch in the sock and plankton was preserved in 1.9% formaldehyde buffered with sodium tetraborate (50 ml of 37% formaldehyde solution and 20 ml saturated solution of sodium tetraborate in a one liter jar of plankton in sea water).

For neuston samples the net was lowered to the surface of the water while the vessel was underway at about 2.0 knots and enough wire paid out so that the net frame was submersed about one-half its depth. The 0.40 m Sameoto sampler and the replacement 0.47 m sampler had towing characteristics which placed the net well away from the side of the vessel, and appeared to be much more effective than the MARMAP sampler. In order to position the MARMAP sampler away from the side of the vessel it was usually necessary to make a slow turn to starboard, the side from which the net was towed. Duration of tow was 10 min after the net frame reached the desired depth. Neuston collections were handled in the same manner as were the bongo collections.

Although preliminary field plans requested CTD lowerings at all stations, we were informed by the Project Office that such requirements were excessive and to substantially reduce the number. This has prevented determining changes in flow during repetitive grid sampling. At approximately half the stations an XBT was dropped and surface and bottom temperatures were read from the trace. At the remaining half of the stations a CTD cast was made to measure salinity and temperature. In shallow water the CTD cast was to within a few meters of bottom and over deeper water the maximum depth of the cast was 300 m.

Records from the CTD were processed by NOAA's Pacific Marine Environmental Laboratory, Seattle, after completion of the cruise.

C. Standardization

Procedures used to standardize plankton data were adapted from those used in the California Cooperative Oceanic Fisheries Investigations (Kramer et al. 1972).

Standardization of catches was based upon two different measures: (a) numbers per standard volume filtered per meter of depth sampled, usually referred to as numbers per unit surface area, and (b) numbers per standard volume. When sampling encompasses the vertical distribution of eggs or larvae in the water column, then numbers per unit of water strained per unit of depth sampled will give a better representation of total numbers present than will numbers per unit volume. Computations to derive a standard haul factor (SHF) are described by Kramer et al. (1972, p. 31). The 1977 data have been standardized by SHF(A) to numbers per 10 square meters surface area (No./10 m^2), or by SHF(B) to numbers per 1,000 cubic meters (No./1,000 m^3, the latter being used only for neuston net catches.

Standardization to No./10 m^2 can also be used for tows which do not encompass the entire depth range of the organisms to be studied, as was the case with neuston nets. Numbers thus obtained represent only that portion of the vertical distribution present to the depth sampled which during this survey varied from 0.16 to 0.25 m depending on the net used. Because the 505-bongo and the neuston catches could both be standardized as No./10 m^2 they can be examined to show the percentage of the bongo catch which was taken in the upper few centimeters of the water column.

Neuston nets used in this survey were not equipped with flowmeters so the following assupmtions were made in order to estimate the volume of water strained during the tow:

—vessel speed during all tows was 2 knots, or 61 m/min;

—net mouth was submerged half its depth, either 0.16 m, 0.20 m, or 0.25 m, depending upon the sampler in use, and the resulting cross-sectional mouth areas were, respectively, 0.75 m^2, 0.080 m^2, or 0.25 m^2; and

—with these assumptions the calculated amount of water filtered during a 10 min tow by the three different neuston nets used and their respective standardization factors were as follows:

Net	Vol. (m^3)	SHF(A)	SHF(B)
Replacement Sameoto (=BBS-47)	45.9	0.0349	21.80
Sameoto sampler (=S-40)	48.8	0.0410	20.49
MARMAP sampler (=M-1)	152.5	0.0164	6.537

Bongo nets were equipped with flowmeters so it was possible to compute an individual SHF for each tow, and these are shown in Table 1.

D. Sorting

Measurement of volume of plankton, and removal of the fish eggs and fish larvae from samples were done through a contract with Texas Instruments, Inc., Dallas, Texas. Before shipment to the contractor about 10% of the samples were sorted for fish eggs and larvae at the NWAFC, the eggs and larvae counted, and then returned to their respective samples. These pre-sorted samples then provided an independent measure of quality control and served as a means of evaluating thoroughness of sorting by the contractor. Comparison of the counts obtained during the pre-sorting at NWAFC with those obtained by the contractor showed that the contractor's counts were well within the allowable error as set forth in the contract.

E. Identification

Fish eggs and larvae were identified by ichthyoplanktologists at the NWAFC. About 99.5% of the actual catch of larvae was identified to at least the family level, 95% to genus, and 82% to species. The 0.5% which could not be identified to family consisted mainly of badly damaged specimens. Identification of eggs was simplified by the fact that many species of fish with planktonic larvae have demersal eggs (e.g., Cottidae and Hexagrammidae) and so there were fewer types of eggs than of larvae. About 98% of the eggs was identified to species with the remaining 2% consisting mainly of 1 genus and about 0.1% of unidentified eggs.

F. Definitions

Common and scientific names of fish mentioned in this report are listed in Table 2, and are those recommended by the American Fisheries Society (Bailey et al. 1970).

Length of specimens is "standard length", measured from the anterior margin of the snout to the tip of the notochord, or to the posterior margin of the hypural in larger specimens.

The term "positive station" is used to denote a station at which the item being discussed, i.e., eggs or larvae, was captured as opposed to a station at which that item was absent.

"Day" or "daytime" is from one-half hour after official sunrise to one-half hour before sunset. "Night" is from one-half hour after sunset to one-half hour before sunrise. "Dawn" and "dusk" are, respectively, one-half hour before to one-half hour after sunrise and sunset.

Table 2.--List of scientific and common names

OSMERIDAE	Smelts
Mallotus villosus	Capelin
BATHYLAGIDAE	Deepsea smelt
Bathylagus pacificus	Slender blacksmelt
Bathylagus schmidti	Northern smoothtongue
MYCTOPHIDAE	Lanternfish
*Stenobrachius leucopsarus[1/]	Lampfish
GADIDAE	Codfishes, cods
Gadus macrocephalus	Pacific cod
Theragra chalcogramma	Walleye pollock or pollock
ZOARCIDAE	Eelpouts
*MACROURIDAE	Rattails
SCORPAENIDAE	Scorpionfishes
Sebastes sp.	Rockfishes
HEXAGRAMMIDAE	Greenlings
Hexagrammos sp.	Greenlings
Hexagrammos lagocephalus	Rock greenling
Hexagrammos octogrammus	Masked greenling
Hexagrammos stelleri	Whitespotted greenling
Pleurogrammus monopterygius	Atka mackerel
ANOPLOPOMATIDAE	Sablefishes
Anoplopoma fimbria	Sablefish
COTTIDAE	Sculpins
Hemilepidotus sp.	Irish lords
Hemilepidotus hemilepidotus	Red Irish lord
Hemilepidotus jordani	Yellow Irish lord
Hemilepidotus papilio	Butterfly sculpin

Table 2 (Cont'd)

Icelinus borealis	Northern sculpin
*Psychrolutes paradoxus	Tadpole sculpin
AGONIDAE	Poachers
*Hypsagonus quadricornis	Fourhorn poacher
CYCLOPTERIDAE	Lumpfishes and snailfishes
*Aptocyclus ventricosus	Smooth lumpsucker
*Nectoliparis pelagicus	Tadpole snailfish
BATHYMASTERIDAE	Ronquils
Bathymaster signatus	Searcher
Ronquilus jordani	Northern ronquil
ANARHICHADIDAE	Wolffishes
*Anarhichas orientalis	Bering wolffish
STICHAEIDAE	Pricklebacks
Chirolophis polyactocephalus	Decorated warbonnet
Lumpenus maculatus	Daubed shanny
PTILICHTHYIDAE	Quillfishes
*Ptilichthys goodei	Quillfish
PHOLIDAE	Gunnels
ZAPRORIDAE	Prowfishes
*Zaprora silenus	Prowfish
AMMODYTIDAE	Sand lances
Ammodytes hexapterus	Pacific sand lance
PLEURONECTIDAE	Righteye flounders, flounders
Atheresthes 2/	Arrowtooth flounders
Atheresthes evermanni	Kamchatka flounder
Atheresthes stomias	Arrowtooth flounder

Table 2 (Cont'd)

Hippoglossoides	Flathead soles
Hippoglossoides elassodon	Flathead sole
Hippoglossoides robustus	Bering flounder
Hippoglossus stenolepis	Pacific halibut
*Lepidopsetta bilineata	Rock sole
Limanda aspera	Yellowfin sole
Pleuronectes quadrituberculatus	Alaska plaice or plaice
Reinhardtius hippoglossoides	Greenland halibut, Greenland turbot 3/

1/ Asterisk * indicates species caught in 1977 but not in 1976.

2/ For convenience in this report, the genus Atheresthes will be referred to as arrowtooth flounders, and the genus Hippoglossoides as flathead soles.

3/ The common name Greenland halibut is accepted by the American Fisheries Society and is widely used in international publications on fishes. However, the "official" market name both in United States and Canada is Greenland turbot.

V. RESULTS

During the survey, samples were collected at 64 locations in the area from lat. 58°N south to the Aleutian Islands-Alaska Peninsula, and from long. 163°W westward to 174°W (Fig. 1). Of these locations, 21 were sampled one time, 18 two times, 23 three times, and 2 four times between 16 April and 15 May 1977 for a total of 134 stations distinct in time and/or location. A total of 134 neuston, 131 505-bongo, and 131 333-bongo samples were collected. Rough seas prevented collection of bongo samples on three occasions.

Fish eggs and larvae were sorted and identified from the 134 neuston samples and from the 131 505-bongo samples, and the displacement volume of the total catch from these nets was measured. Combined actual catches of larvae totaled 14,171 of which 9,654 (68%) were caught in the 505-bongo net and 4,517 (32%) were caught in the neuston net. Of 24,611 eggs collected, 10,392 (42%) were caught in the 505-bongo net and 14,219 (58%) in the neuston net. Fish larvae were present in 126 (96%) of the 505-bongo samples (1-841 per sample) and in 126 (94%) of the neuston samples (1-625 per sample). Fish eggs were present in 123 (94%) of the 505-bongo samples (1-1,741 per sample) and in 113 (84%) of the neuston samples (1-1,809 per sample).

Eggs from only 2 families, Gadidae and Pleuronectidae, were identified and these were present in both the 505-bongo and the neuston samples. Only 26 eggs (0.1%) could not be assigned to at least family.

Fish larvae from 19 families were identified in the combined bongo and neuston catches and made up 89% of the total catch (Table 3); 74 larvae (0.5%) remain unidentified, and these are mainly badly damaged specimens. In the 505-bongo catches 18 families were present but in the neuston catches only 14 families were represented. Within the 18 families in the bongo

Table 3.-- Ichthyoplankton, eastern Bering Sea, 16 April-15 May 1977. Catch by taxa.

Taxa	505-bongo net					Neuston net					
	Obs. No. 1/	No./ 10 m²	%2/	No. + Samp.3/	% + Samp.4/	Obs. No.	No./ 10 m²	No./ 1,000 m³	% 5/	No. + Samp.	% + Samp.
FISH LARVAE											
OSMERIDAE (409)											
Mallotus villosus	20	118	0.2	8	6.1	389	13.8	6,713	7.6	15	11.2
BATHYLAGIDAE (116)											
Bathylagus pacificus	82	521	0.9	38	29.0	0	-	-	-	-	-
Bathylagus schmidti	34	203	0.4	25	19.0	0	-	-	-	-	-
MYCTOPHIDAE (17)											
Stenobrachius leucopsarus	17	108	0.2	12	9.2	0	-	-	-	-	-
GADIDAE (8,398)											
Theragra chalcogramma	8,044	48,509	84.1	90	68.7	266	10.6	5,333	6.1	27	20.1
Unidentified Gadidae	88	448	0.8	15	11.5	0	-	-	-	-	-
MACROURIDAE (1)											
Unidentified Species	1	6	+	1	0.8	0	-	-	-	-	-
SCORPAENIDAE (366)											
Sebastes sp.	338	2,121	3.7	41	31.3	28	1.0	571	0.7	14	10.4
HEXAGRAMMIDAE (1,820)											
Hexagrammos sp.	12	75	0.1	11	8.4	475	17.7	9,499	10.8	92	68.7
Hexagrammos (A)	0	-	-	-	-	428	16.0	8,425	9.7	82	61.2
Hexagrammos (B)	0	-	-	-	-	217	8.5	4,206	4.8	60	44.8
Hexagrammos (C)	0	-	-	-	-	155	5.9	2,957	3.4	52	38.8
Pleurogrammus monopterygius	7	38	0.1	5	3.8	526	20.0	10,753	12.2	77	57.5
COTTIDAE (1,574)											
Hemilepidotus hemilepidotus	8	47	0.1	5	3.8	384	14.9	7,773	8.8	41	30.6
Hemilepidotus jordani	15	87	0.2	11	8.4	897	35.6	17,939	20.4	46	34.33
Hemilepidotus papilio	8	47	0.1	8	6.1	183	7.2	3,738	4.3	25	18.7
Icelinus borealis	3	17	+	2	1.5	0	-	-	-	-	-
Psychrolutes paradoxus	4	27	0.1	3	2.3	0	-	-	-	-	-
Cottidae A	18	94	0.2	8	6.1	0	-	-	-	-	-
Cottidae B	8	45	0.1	4	3.1	0	-	-	-	-	-
Cottidae C	1	5	+	1	0.8	0	-	-	-	-	-
Cottidae E	1	5	+	1	0.8	0	-	-	-	-	-
Cottidae G	2	11	+	2	1.5	5	0.1	61	0.1	2	1.5
Cottidae H	3	17	+	3	2.3	0	-	-	-	-	-
Cottidae K	9	51	0.1	5	3.8	0	-	-	-	-	-
Cottidae L	1	6	+	1	0.8	0	-	-	-	-	-
Cottidae M	7	43	0.1	4	3.1	0	-	-	-	-	-
Cottidae N	0	-	-	-	-	3	+	20	+	2	1.5
Cottidae O	0	-	-	-	-	11	0.2	72	0.1	2	1.5
Cottidae Unidentified	1	7	+	1	0.8	2	+	14	+	2	1.5
AGONIDAE (31)											
Hypsagonus quadricornis	1	5	+	1	0.8	0	-	-	-	-	-
Unidentified Agonidae	13	71	0.1	9	6.9	17	0.3	112	0.1	2	1.5
CYCLOPTERIDAE (29)											
Aptocyclus ventricosus	0	-	-	-	-	3	0.1	66	0.1	2	1.5
Nectoliparis pelagicus	8	51	0.1	6	4.6	0	-	-	-	-	-
Unidentified Cyclopteridae	18	100	0.2	14	10.7	0	-	-	-	-	-
BATHYMASTERIDAE (108)											
Unidentified Bathymasteridae	12	84	0.2	5	3.8	96	3.5	1,776	2.0	33	24.6
ANARHICHADIDAE (5)											
Anarhichas orientalis	0	-	-	-	-	5	0.1	63	0.1	5	3.7
ANOPLOPOMATIDAE (3)											
Anoplopoma fimbria	1	7	+	1	0.8	2	0.1	44	0.1	1	0.7

Table 3.-- Ichthyoplankton, eastern Bering Sea, 16 April-15 May 1977. Catch by taxa.

Taxa	505-bongo net Obs. No. 1/	No./ 10 m^2	% 2/	No. + Samp. 3/	% + Samp. 4/	Neuston net Obs. No.	No./ 10 m^2	No./ 1,000 m^3	% 5/	No. + Samp.	% + Samp.
STICHAEIDAE (361)											
Chirolophis polyactocephalus	10	58	0.1	9	6.9	305	11.5	5,922	6.7	32	23.9
Lumpenus maculatus	8	43	0.1	7	5.3	0	-	-	-	-	-
Stichaeidae E	9	49	0.1	5	3.8	0	-	-	-	-	-
Stichaeidae F	0	-	-	-	-	23	0.8	420	0.5	10	7.5
Stichaeidae G	0	-	-	-	-	1	+	7	+	1	0.7
Stichaeidae, Not typed	2	10	+	2	1.5						
PTILICHTHYIDAE (1)											
Ptilichthys goodei	1	5	+	1	0.8	0	-	-	-	-	-
PHOLIDAE (3)											
Unidentified Pholidae	3	15	+	2	1.5	0	-	-	-	-	-
ZAPRORIDAE (7)											
Zaprora silenus	2	13	+	2	1.5	5	0.2	102	0.1	2	1.5
AMMODYTIDAE (410)											
Ammodytes hexapterus	400	1,908	3.3	32	24.4	10	0.3	162	0.2	5	3.7
PLEURONECTIDAE (419)											
Atheresthes sp.	131	801	1.4	47	35.9	0	-	-	-	-	-
Hippoglossus stenolepis	7	44	0.1	7	5.3	3	0.1	34	+	3	2.2
Lepidopsetta bilineata	157	892	1.6	40	30.5	4	0.1	26	+	1	0.7
Reinhardtius hippoglossoides	117	710	1.2	45	34.4	0	-	-	-	-	-
UNIDENTIFIED FISH LARVAE (96)	22	132	0.2	10	7.6	74	2.2	1,124	1.3	21	15.7
TOTAL FISH LARVAE (14,171)	9,654	57,653				4,517	170.8	87,932			
FISH EGGS											
GADIDAE (23,925)											
Theragra chalcogramma	10,193	57,913	98.1	121	92.4	13,732	428.9	216,905	97.3	111	82.8
PLEURONECTIDAE (660)											
Hippoglossoides sp.	154	885	1.5	17	13.0	403	9.4	4,799	2.2	23	17.2
Pleuronectes quadrituberculatus	29	153	0.3	11	8.4	74	2.0	1,070	0.5	11	8.2
UNIDENTIFIED FISH EGGS (26)	16	97	0.2	9	6.9	10	0.4	214	0.1	5	3.7
TOTAL FISH EGGS(24,611)	10,392	59,048		131		14,219	440.7	222,988		134	

1/ Obs. No. = Observed number. This is the actual number caught in the nets.
2/ % = Percentage of the total for the 505-bongo net calculated from standardized No./10 m^2.
3/ No. + Samp. = Number of positive samples. This is the number of samples which contained specimens for a taxa.
4/ % + Samp. = Percentage of positive samples. Total samples for 505-bongo are 131 and for neuston 134.
5/ % = Percentage of total for neuston net calculated from standardized No./1,000 m^3.

catches, 21 taxa were identified to species, 3 to genus only, and in addition there were 14 identifiable types assigned arbitrary letter designations. Within the 14 families present in the neuston catches, 12 taxa were identifiable to species, 2 to genus only, and an additional 6 were assigned arbitrary letter designations within either a genus or a family. Further study may permit designation of a specific or a generic name for some of the types, especially in the families Hexagrammidae, Cottidae, and Stichaeidae.

Actual catch, standardized catch, percent composition, number of stations at which a taxon occurred, and the percent occurrence for each net by species or type are shown in Table 3 for both eggs and larvae. Actual catch by station and type of net is shown in Appendix Tables 1 and 2. In the combined 505-bongo and neuston catches 9 families made up 96% of the larvae with 59% contributed by a single species, pollock (83% of the 505-bongo and 6% of the neuston). Eggs of a single species, again pollock, made up 97% of the total catch of eggs.

The nine families that comprised 96% of the catch of larvae are shown in Table 4 for the 505-bongo and the neuston catches. Only one family was common to the first five families for both nets and this was Gadidae, represented almost entirely by pollock. One family, Bathylagidae, was present only in the 505-bongo catch, and 98% of both the Ammodytidae and Pleuronectidae were also taken in the 505-bongo net, while 99% of the Hexagrammidae were caught in the neuston nets.

Cursory examination indicated that number of larvae per sample was affected by time of sampling. Most commonly differences in day and night catches of planktonic animals are attributed to increased escapement during the day due to greater visual perception of the net, and/or migration of animals out of

Table 4.--Rank of the most abundant families of fish larvae in the 505-bongo and neuston nets.

Type of net	Rank in net	Total ranking	Family	Actual catch (No.)	Percentage of catch
Bongo	1	1	Gadidae	8,044	83.3
	2	4	Pleuronectidae	412	4.3
	3	5	Ammodytidae	400	4.1
	4	7	Scorpaenidae	338	3.5
	5	9	Bathylagidae	116	1.2
			Total for net	9,310	96.4
Neuston	1	2	Hexagrammidae	1,801	39.9
	2	3	Cottidae	1,485	32.9
	3	6	Osmeridae	389	8.6
	4	8	Stichaeidae	329	7.3
	5	1	Gadidae	266	5.9
			Total for net	4,270	94.5

the stratum being sampled. In order to examine this more systematically, samples were categorized as having been collected during the day, night, or dawn and dusk. Mean catch of total larvae and standard deviation is shown in Table 5 together with ratios expressing relationships between catches made at different times. Briefly, Table 5 shows little difference in mean 505-bongo catch in relation to time of sampling, however, neuston catches show a marked affect of time of sampling with larger mean catches being taken at night, or at dawn and dusk. One effect of this is to make it rather meaningless to contour number of larvae in neuston samples, since the contours represent time of sampling rather than numbers of larvae. Because of this effect some neuston catches will be shown as standardized numbers at a station with no contouring, except that in the case of pollock eggs, which do not dodge or migrate appreciably, contours will be shown.

Variation in surface and bottom water temperature (see Table 1) show little change in temperature regime during the survey. There was a slight warming trend in surface water between 16 April and 15 May, e.g., at Station 2 and 8 the following change was noted:

	Station 2		Station 8	
Date	Surface	Bottom	Surface	Bottom
16 April	3.8 C	4.0 C	-	-
17 April	-	-	3.7 C	4.3 C
25 April	-	-	4.0	3.8
26 April	4.0	4.2	-	-
4 May	4.3	3.8	-	-
5 May	-	-	5.0	4.3
15 May	5.1	4.5	-	-

Table 5.-- Day-night differences in mean catch of total fish larvae with bongo and neuston nets, 16 April - 15 May 1977.

Net	No. in standardized catches			Ratios of mean catches		
	Day	Night	D&D[1/]	Night/Day	Night/D&D	Day/D&D
Bongo (No./10 m^2)						
Mean	460	425	262	0.92	1.62	1.76
Std. dev.	1,011	710	374	-	-	-
Sample size	74	47	10	-	-	-
Neuston (No./1,000 m^3)						
Mean	207	1,181	1,115	5.71	1.06	0.19
Std. dev.	394	1,909	988	-	-	-
Sample size	74	49	10	-	-	-

1/ D&D is used to show catches made at dawn or dusk.

VI. DISCUSSION

Three families-Gadidae, Pleuronectidae, and Salmonidae support the major commercial fisheries for fin-fish in the eastern Bering Sea, and because salmon are anadromous, their larvae or fry are seldom taken in the course of plankton sampling in the open ocean. Cod and flounders are thus the two most commercially valuable marine fish in the eastern Bering Sea. Larvae of cods and flounders together accounted numerically for 89% of the 505-bongo but only 6% of the neuston catches, whereas eggs of these two families accounted for 99.9% of both the 505-bongo and the neuston catches.

A. Gadidae

Because larvae of pollock made up the greatest part of the catch, discussion will focus on this species, and will be concerned almost entirely with the bongo catches, which accounted for 96% of the pollock larvae. The discussion of eggs will also focus on those of pollock which made up over 97% of the total egg catch, but in contrast to larvae the egg catch was fairly evenly divided between the two types of gear, with slightly more being caught by the neuston nets.

1. Temporal and areal variation in distribution and abundance of pollock eggs and larvae.

The station pattern followed during the cruise was planned to cover a major part of pollock spawning grounds in the southeastern Bering Sea. A central core of 24 stations (Stations 1-24, Fig. 1) was sampled three times, and surrounding stations were sampled once or twice to determine the amount of temporal variation. These stations have been grouped to show distribution and abundance during the following time-area periods:

16-19 April; stations 1-24	19-27 April; stations 1-66
23-26 April; stations 1-24	3-15 May ; stations 1-75
4-10 May ; stations 1-24	

The major comparisons have been made between 19-27 April and 3-15 May, and both eggs and larvae of pollock showed changes in abundance and distribution with time.

Neuston nets caught more pollock eggs (13,772) than did the 505-bongo nets (10,193), with average catch per sample of 103 and 78 eggs, respectively. Observed catches with neuston nets did not differ greatly between April and May, with averages of 137 and 115 eggs respectively, but there was considerable difference between the bongo catch for April and May--154 and 53 eggs, respectively.

Mean and standard deviation of the observed and standardized catch of pollock eggs in the 505-bongo and neuston nets and the number of samples containing pollock, i.e., positive stations, are shown in Table 6. On the basis of this table it appears that eggs were most abundant during 19-27 April and least abundant during 16-19 April. However, there were fewer positive stations during the period of high abundance than during preceding or succeeding periods. Bongo and neuston samples show the same general temporal variation.

Distribution of pollock eggs during 19-27 April and 3-15 May are shown in Figure 2 for bongo and neuston catches. The largest catches were made at stations along the eastern section of the survey area, and it can be assumed that the concentration continued northeastward from these stations. A second area of high abundance was around two stations just west of Unimak Pass, with more eggs caught in this area during April than in May. Little difference can be seen between the distribution shown by bongo or neuston catches, except that during May there was a considerable area in the west-central section of the survey in which eggs were absent from the neuston catches.

Table 6.--Mean and standard deviation of observed and standardized catches of pollock eggs with 505-bongo and neuston nets, with number of positive stations and standardized neuston catch as a percentage of standardized bongo catch.

	Bongo net					Neuston net					
	Observed no.		No./10 m^2			Observed no.		No./10 m^2			
Dates	Mean	Std. dev.	Mean	Std. dev.	Pos. 1/ sta.	Mean	Std. dev.	Mean	Std. dev.	% of bongo	Pos. 1/ sta.
16-19 April	32	59	172	325	23/24	15	34	0.6	1.4	0.01	17/23
19-27 April	154	358	910	2,113	37/41	137	328	5.6	13.5	0.62	38/43
23-26 April	123	272	712	1,541	21/24	162	378	6.7	15.5	0.94	22/24
3-15 May	47	117	249	585	60/65	111	306	2.6	6.7	0.77	56/68
4-10 May	68	180	350	888	23/24	153	434	2.7	7.1	0.76	22/24

1/ Positive stations shown with total samples, e.g., for 16-19 April, of 24 samples collected with the bongo net 23 contained pollock eggs.

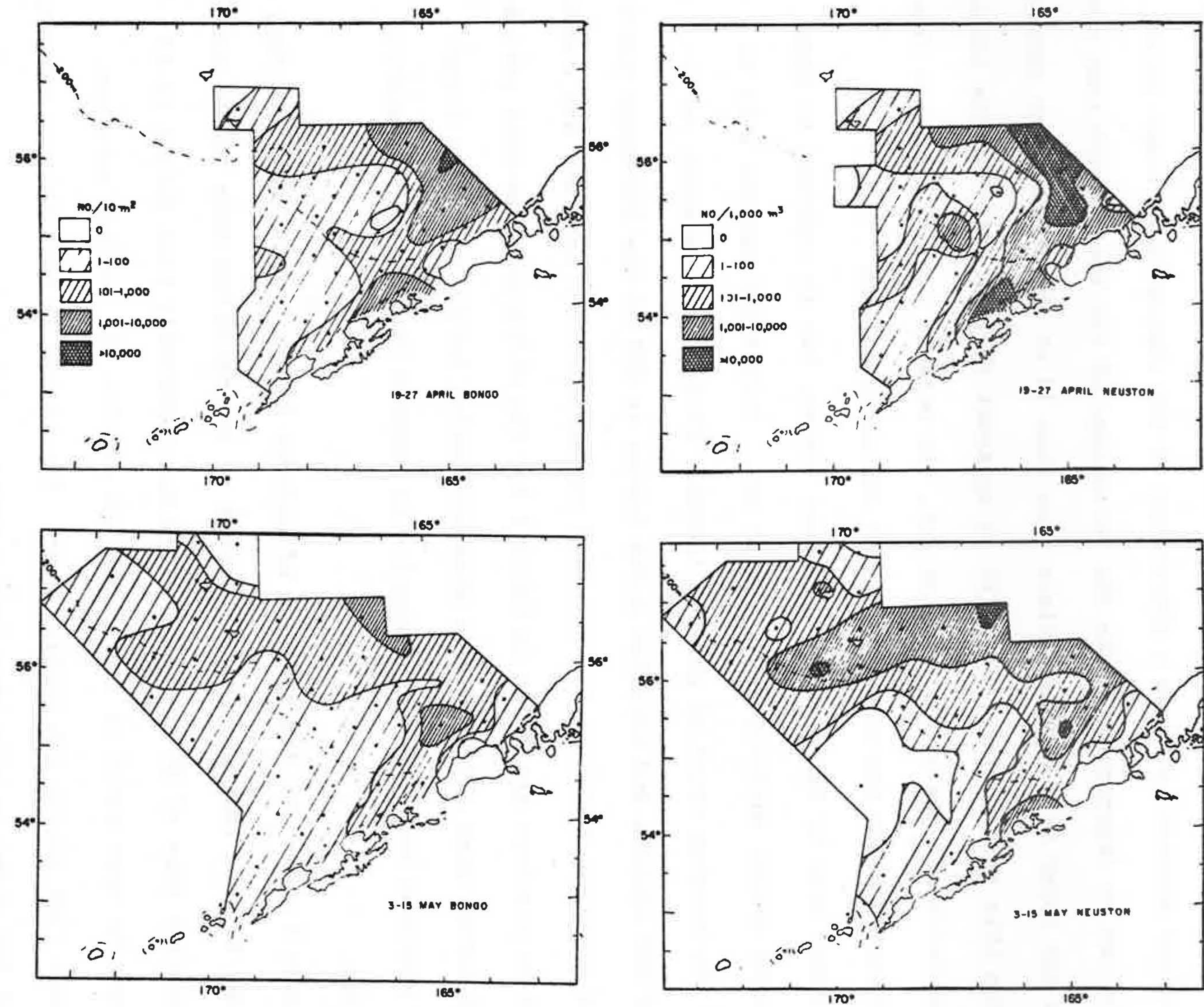


Figure 2.-- Distribution and relative abundance of pollock eggs in the eastern Bering Sea, Miller Freeman cruise MF-77B, 16 April - 15 May 1977.

When bongo and neuston catches are standardized at No./10 m^2 it is possible to gain an insight into the amount of total eggs that are present in the immediate surface layer of the water column. Table 6 also shows the standardized neuston catch as a percentage of the standardized bongo catch, and this can be interpreted to be the percentage of the bongo catch that was made in the upper 0.16-0.25 m. Since less than 1% of the bongo catch apparently came from this thin surface layer, it is apparent that in spite of the large observed catch of eggs by the neuston net, the bulk of pollock eggs are likely to be situated below the upper 0.25 m of the water column.

Pollock were by far the most abundant larvae, but in contrast to eggs, were caught almost entirely in the bongo net. Only brief mention will be made of the neuston catch of pollock larvae. Pollock were present in 90 (69%) of the samples and totalled 8,044 larvae or 84% of the 505-bongo catch. Mean and standard deviation for observed and standardized catches, and number of positive stations are shown in Table 7 for the different time-area periods. Although larvae were slightly more abundant during April, they were found at more stations and with less variation in numbers from station to station during May.

Figure 3 shows the distribution of pollock larvae during April and May, and it can be seen that a substantial part of the catch was made to the west of the central core of 24 stations. This was especially true during 19-27 April when the mean catch of larval pollock outside the central core was three times that within the central core. The change in distribution between April and May seems to have been from a pattern of high localized abundance to one of widespread moderate abundance. There is no evidence in these results

Table 7.-- Mean and standard deviation of observed and standardized catches of pollock larvae with 505-bongo nets, and number of positive stations.

	Observed		No./10 m^2		
	Mean	Std. dev.	Mean	Std. dev.	Pos. sta. 1/
16-19 April	56	106	300	574	13/24
19-27 April	108	209	695	1,372	27/41
23-26 April	64	140	407	905	14/24
3-15 May	34	45	194	251	50/66
4-10 May	53	54	282	297	22/24
Total bongo samples	61	132	370	848	90/131

1/ Positive stations shown with total samples,e.g., for 16-19 April, of 24 samples collected with the bongo net 13 contained pollock larvae.

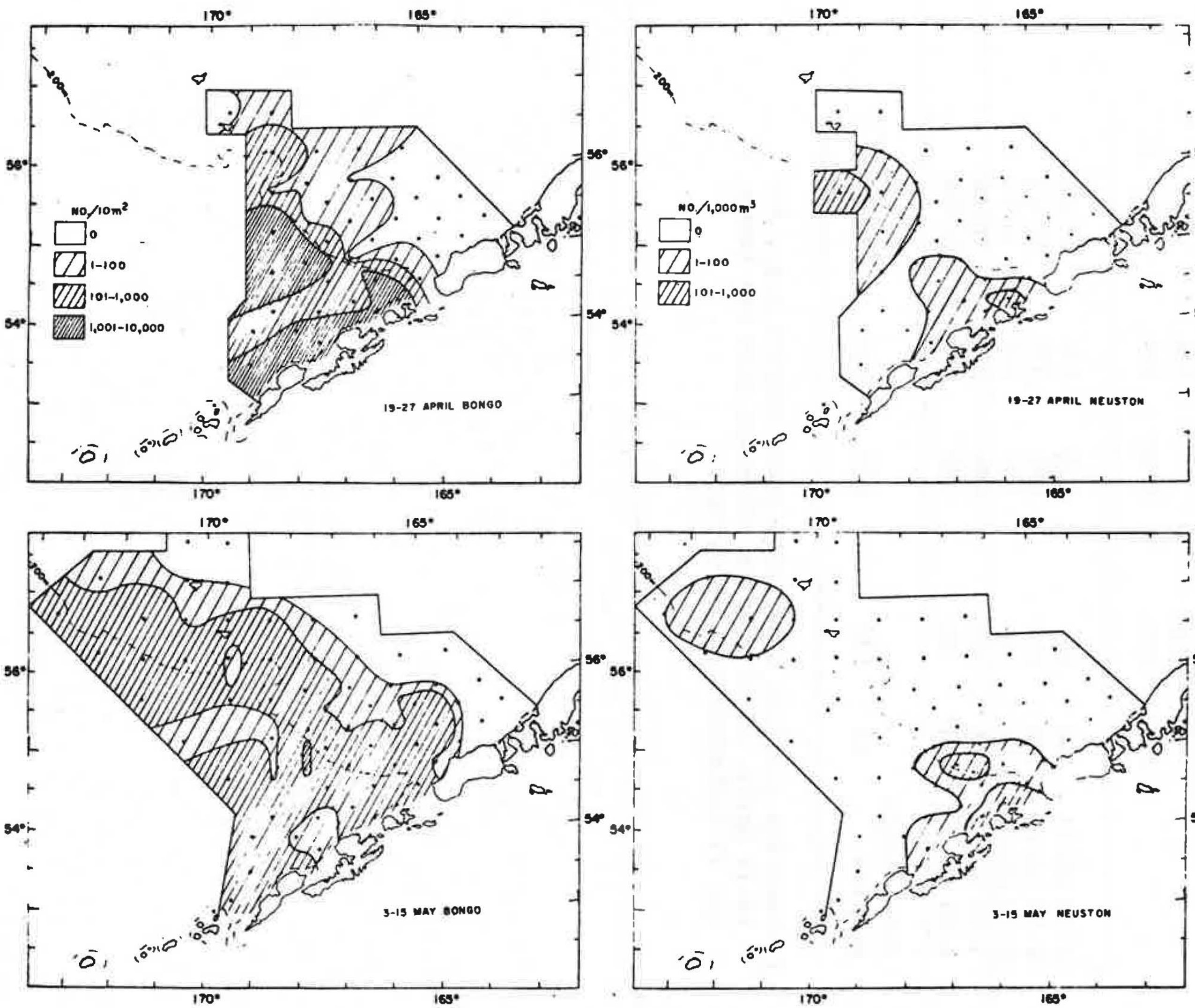


Figure 3.-- Distribution and relative abundance of pollock larvae in the eastern Bering Sea, Miller Freeman cruise MF-77B, 16 April - 15 May 1977.

that the high concentrations of larvae present in April drifted across the survey area with a water mass. During 19-27 April the number of pollock larvae exceeded 1,000/10 m^2 at 9 stations whereas this level of abundance was found at only one station during May.

2. Estimate of total pollock eggs and larvae

Total pollock eggs and larvae in the water column for the area included in the survey were estimated for different time periods and groups of stations following the method described by Houde (1976). The area was divided into polygons by erecting perpendicular bisectors to lines between adjacent stations and the areas thus formed were then measured with a planimeter. An assumption was made that density of eggs or larvae within a polygon was represented by the standardized number at the single station within each polygon. Numbers of eggs or larvae for each polygon were then estimated by multiplying the area by the number of eggs or larvae per unit area, in this case the number per square meter. Total eggs or larvae were obtained by summing the values for all polygons sampled during a particular time period. The numbers for five different time periods or groups of stations are shown in Table 8.

3. Pollock lengths

Of the 8,044 pollock larvae caught, standard lengths of 43% or 3,472 were measured. Length ranged from 3.1 to 11.8 mm, with an overall mean and standard deviation of 7.15 and 1.27 mm.

In order to detect growth of larvae, samples were grouped by time periods similar to those used earlier to examine changes in distribution and abundance. For larvae from the central core of 24 stations mean length increased 2.4 mm (5.5 to 8.0 mm) between samples collected 16-18 April and those collected

Table 8.-- Estimates of total numbers of pollock eggs and larvae present in the water column during different time periods and areas of Miller Freeman cruise MF-77B, 16 April-15 May 1977.

Dates	Stations	Area (m^2) ($x10^{10}$)	Eggs ($x10^{12}$)	Larvae ($x10^{12}$)
16-19 April	1-24	4.404	0.539	1.274
19-27 April	1-66	9.570	7.829	7.498
23-26 April	1-24	4.404	2.761	1.843
3-15 May	1-75	19.782	4.252	3.645
4-10 May	1-24	4.404	1.441	1.332

3-9 May. When samples around the central core are included the same general trend is present with an increase of 1.5 mm (6.6 - 8.1 mm) from samples collected 21-27 April to those collected 3-15 May. Figure 4 shows the size distribution for different time periods.

In order to detect areal differences in length, samples were grouped by blocks measuring 2^o of longitude by 1^o of latitude (roughly 75x60 nautical miles). Comparison of four such groupings for samples collected during April and six groupings for May show no marked differences in size composition within the months, although as shown above there were differences between months. One interpretation of this is that pollock larvae throughout the area covered by the survey were spawned at about the same time.

A notable exception to this similarity in size were pollock larvae collected at Station 9 just north of Akun Island and to a lesser extent those collected at adjacent Station 1 northwest of Akutan Island. One sample from Station 9 collected 16 April had a mean length of 4.0 mm and a few pollock collected at Station 1 averaged 3.9 mm length, while all other pollock from that time period ranged between 5.4 and 6.9 mm. Subsequent samples from Station 9 collected 25 April and 4 May also contained a few larvae of 3-4 mm length, a size almost completely absent from other samples.

4. Comparison of pollock eggs and larvae in 1976 and 1977

With data for 2 years for about the same season and general area a rough comparison can be made between the two sets of data. Only 505-bongo data have been used because the samples were collected in an identical manner in the 2 years, while neuston samples were collected with different nets. Also, it should be emphasized that the areas of coverage and the number of samples differed for the 2 years.

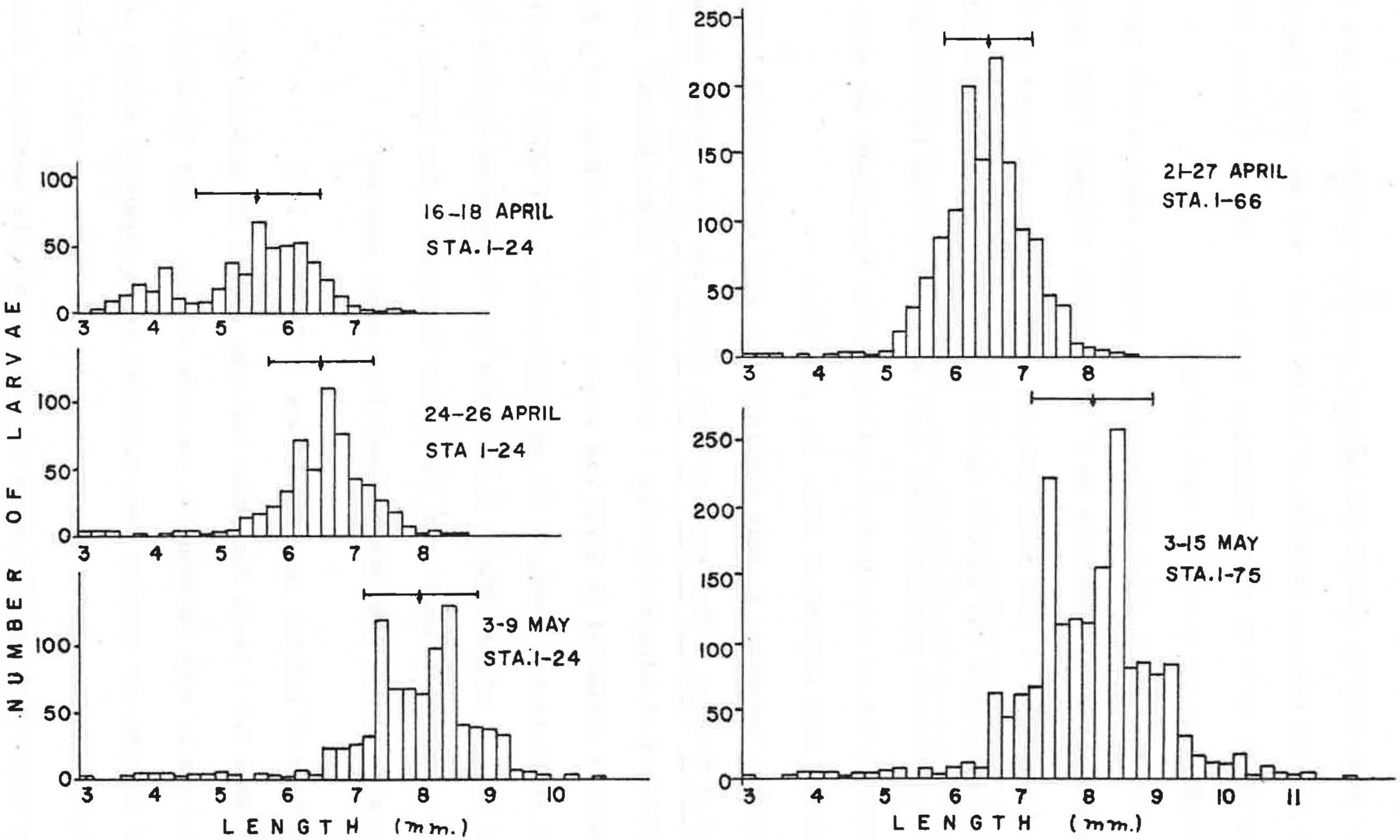


Figure 4.-- Length frequencies of pollock larvae from the eastern Bering Sea, Miller Freeman cruise MF-77B, 16 April - 15 May 1977.

Mean and standard deviation for catches of pollock eggs and larvae are shown in Table 9 for 1976 and 1977. The statistics are for samples collected in the general area of the 1977 survey, i.e., some of the more northerly samples from 1976 have not been included and only positive stations were included in the computations. In brief, during 1976, eggs were more abundant than in 1977, but the reverse was true of larvae, i.e., more larvae were present during 1977.

Distribution of pollock eggs and larvae in 505-bongo catches during 1976 is shown in Figure 5 while Figure 6 shows the distribution for two time periods during 1977. Superimposed on the 1977 figures are outlines of the major features of the 1976 distribution. When compared with the distribution for 1976 the center of abundance of pollock eggs during 19-27 April 1977 was farther to the east and south than in 1976, while the 1977 center of larval abundance was displaced southwesterly of the 1976 area of high abundance. During 3-15 May 1977 the same difference between 1976 and 1977 persisted although the contrast in larval distribution was not as great as during April.

In spite of the differences noted it seems that the surveys during both 1976 and 1977 encompassed the areas containing high numbers of pollock eggs. It appears that the 1976 survey may not have included areas with greatest abundance of pollock larvae, in particular the area northwest of Akutan, Unalaska, and Umnak Islands. Also, it is clear that monitoring abundance of pollock eggs and larvae by collecting samples at a few stations is not feasible until more is known about seasonal and areal changes in their distribution.

Table 9.--Mean and standard deviation of catches of pollock eggs and larvae during 1976 and 1977. 1/

Life history stage	Year	Observed catch Mean	Observed catch Std. dev.	Standardized catch (No./10 m^2) Mean	Standardized catch (No./10 m^2) Std. dev.	No. samples
Eggs	1976	220	479	1,125	2,478	27
	1977	85	231	479	1,337	120
Larvae	1976	55	56	304	308	21
	1977	89	152	539	979	90

1/ Data are for 505-bongo net samples which contained at least 1 egg or 1 larva.

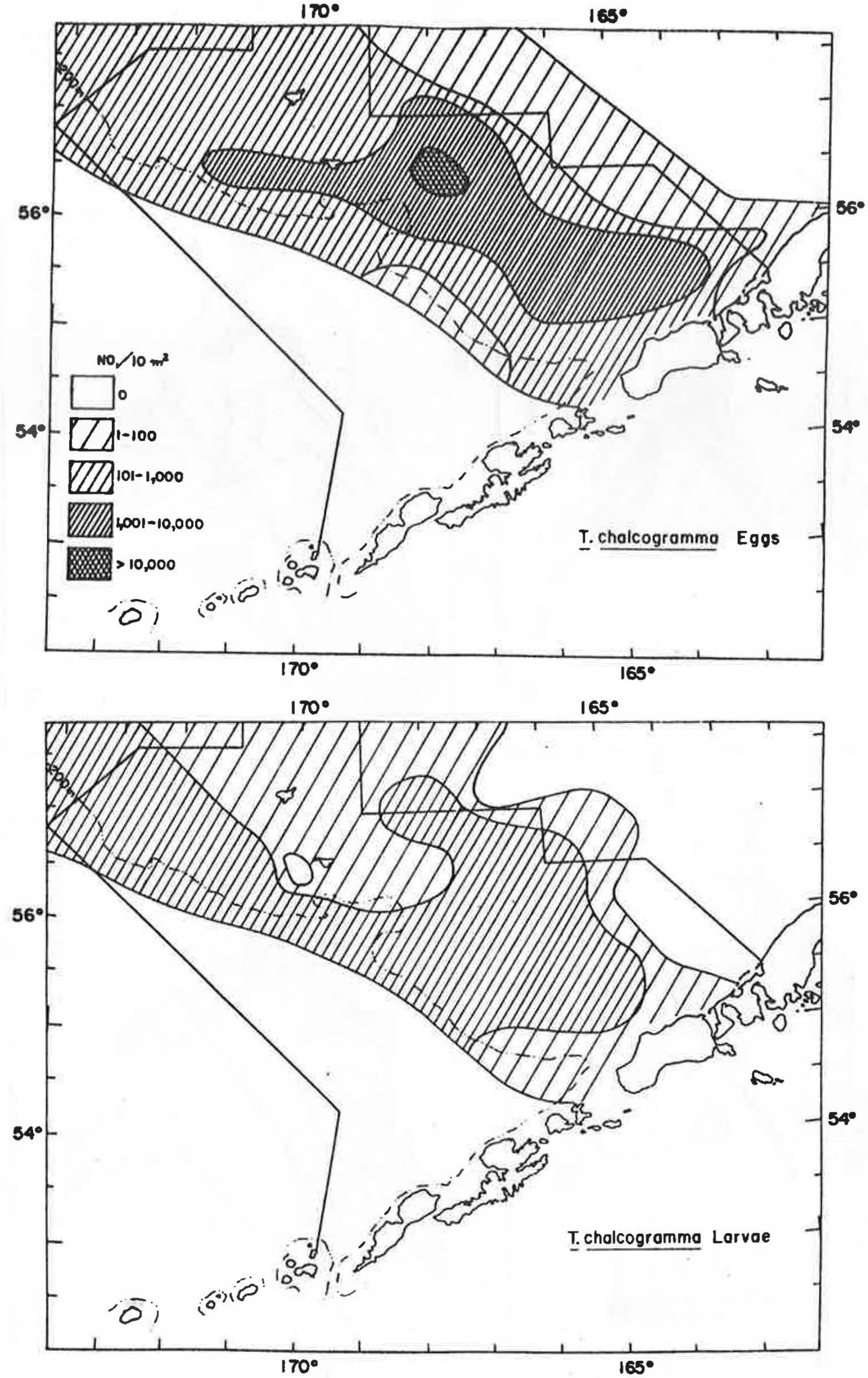


Figure 5.-- Distribution and relative abundance of pollock eggs and larvae in the eastern Bering Sea, Miller Freeman cruise MF-76A, 26 April - 31 May 1977.

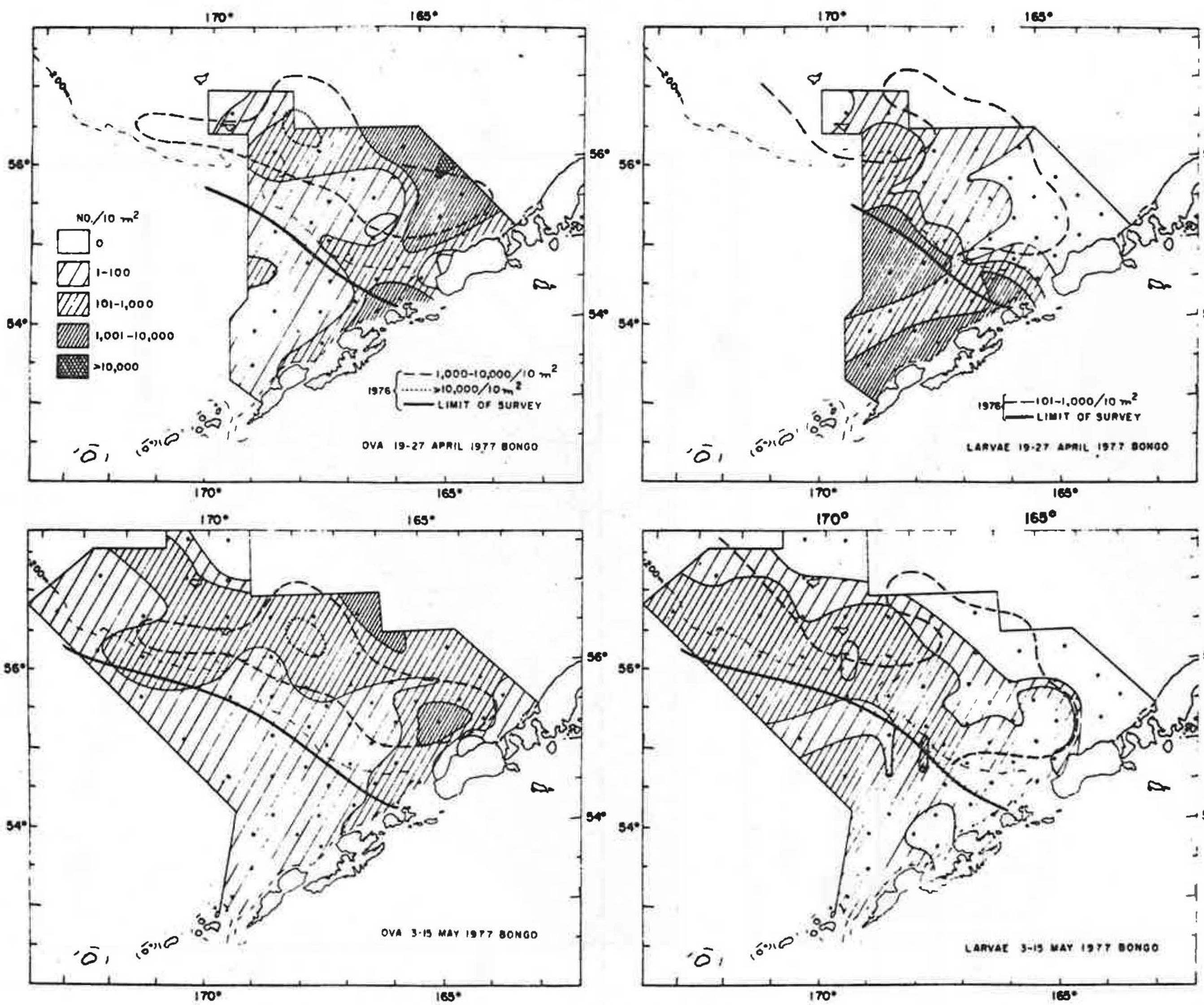


Figure 6.-- Distribution and relative abundance of pollock eggs and larvae in the eastern Bering Sea, Miller Freeman cruise MF-77B, 16 April - 15 May 1977 with an outline of the distribution and relative abundance of pollock eggs and larvae during 26 April - 31 May 1976.

Mean length of larval pollock collected during 1977 was slightly greater than for samples collected during 1976--6.8 mm for 1976, and 7.2 mm for 1977 (Fig. 7). Range in length for 1976 was 4.2-10.2 mm as compared to the range for 1977 of 3.1-11.8 mm. During 1977 there was a group of small larvae with a mean length of 4.0 mm collected at 1977 Station 9, an area that was not sampled in 1976, and this size group did not appear in any of the 1976 samples.

B. Pleuronectidae

During the 1977 survey larvae of righteye flounders were fourth in overall abundance and second most abundant in the 505-bongo catches.

Flounder eggs were second in abundance to those of pollock and were in fact almost the only eggs taken other than pollock eggs.

Identification of flatfish larvae to species is more feasible than for some other families of fish in the Bering Sea, generally because many have been described in literature. Flatfish eggs and larvae collected during the present survey included five groups which could be identified to either genus or species. Where two species of a genus have overlapping ranges as adults and where adequate descriptions of the larvae are not available, no attempt was made to carry identification to species. In this category are the arrowtooth flounders (Atheresthes sp.) with two species, A. stomias, the arrowtooth flounder, a predominantly eastern Bering Sea fish, and A. evermanni, the Kamchatka flounder, a predominantly western Bering Sea fish, with ranges overlapping in the vicinity of the Pribilof Islands.

The flathead soles (Hippoglossoides sp.), depending upon the author, are considered to contain either two species, or one species with two sub-species in the eastern Bering Sea. If there are considered to be two species, then these are H. elassodon, the flathead sole, and H. robustus, the Bering flounder.

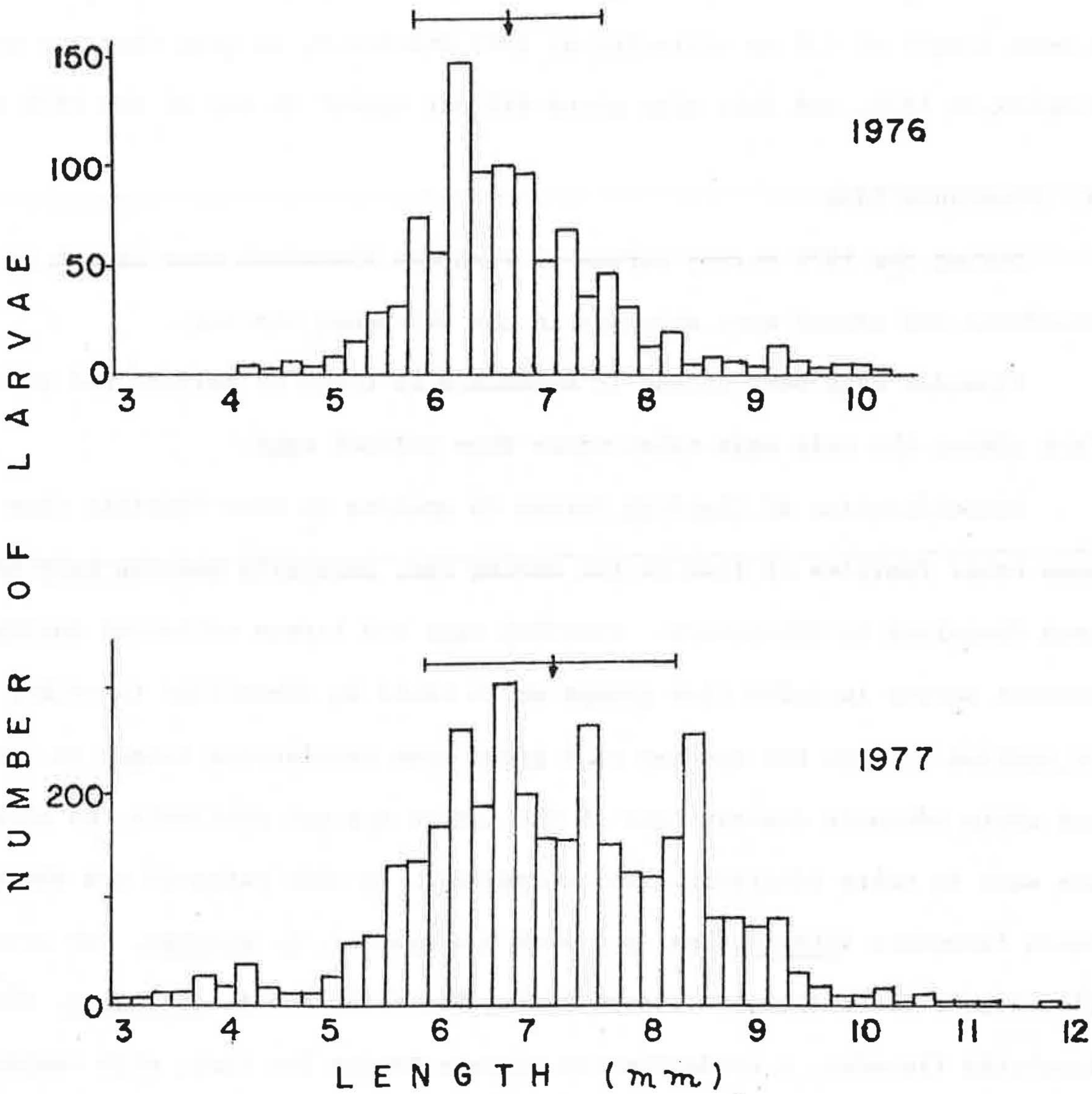


Figure 7.-- Length frequencies of pollock larvae from the eastern Bering Sea during 26 April - 31 May 1976 and 16 April - 15 May 1977.

In our collections this group is represented only by eggs, and are classified only to genus.

1. *Lepidopsetta bilineata*

The most numerous flatfish larvae were those of *Lepidopsetta bilineata*, the rock sole, and 157 specimens were present in 40 (31%) of the 505-bongo samples; none were caught in the neuston nets. Rock sole larvae were caught over the continental shelf where water depths were between 100 and 200 m, and were distributed from the Alaska Peninsula-Aleutian Islands northwestward to the Pribilof Islands (Fig. 8). The rock sole larvae taken were generally small, averaging about 4.5 mm in length. Approximately the same numbers of this species were caught in April and May, with slightly more caught during the May portion of the cruise.

An interesting fact, unexplained at present, is that no rock sole larvae were found in samples collected from this same general area during April and May, 1976.

Eggs of this species are considered to be non-planktonic and were not found in samples for either net.

2. *Atheresthes* sp.

Arrowtooth flounder were the second most abundant flatfish larvae caught, and 131 specimens were present in 47 (36%) of the 505-bongo samples; as with rock sole, no arrowtooth flounder larvae were caught in the neuston nets. Slightly more arrowtooth flounder larvae were caught during April than during May. Arrowtooth flounder larvae were found, for the most part, in samples taken along or beyond the continental slope where water depth was greater than 200 m, although in May a few larvae were taken at stations as shallow

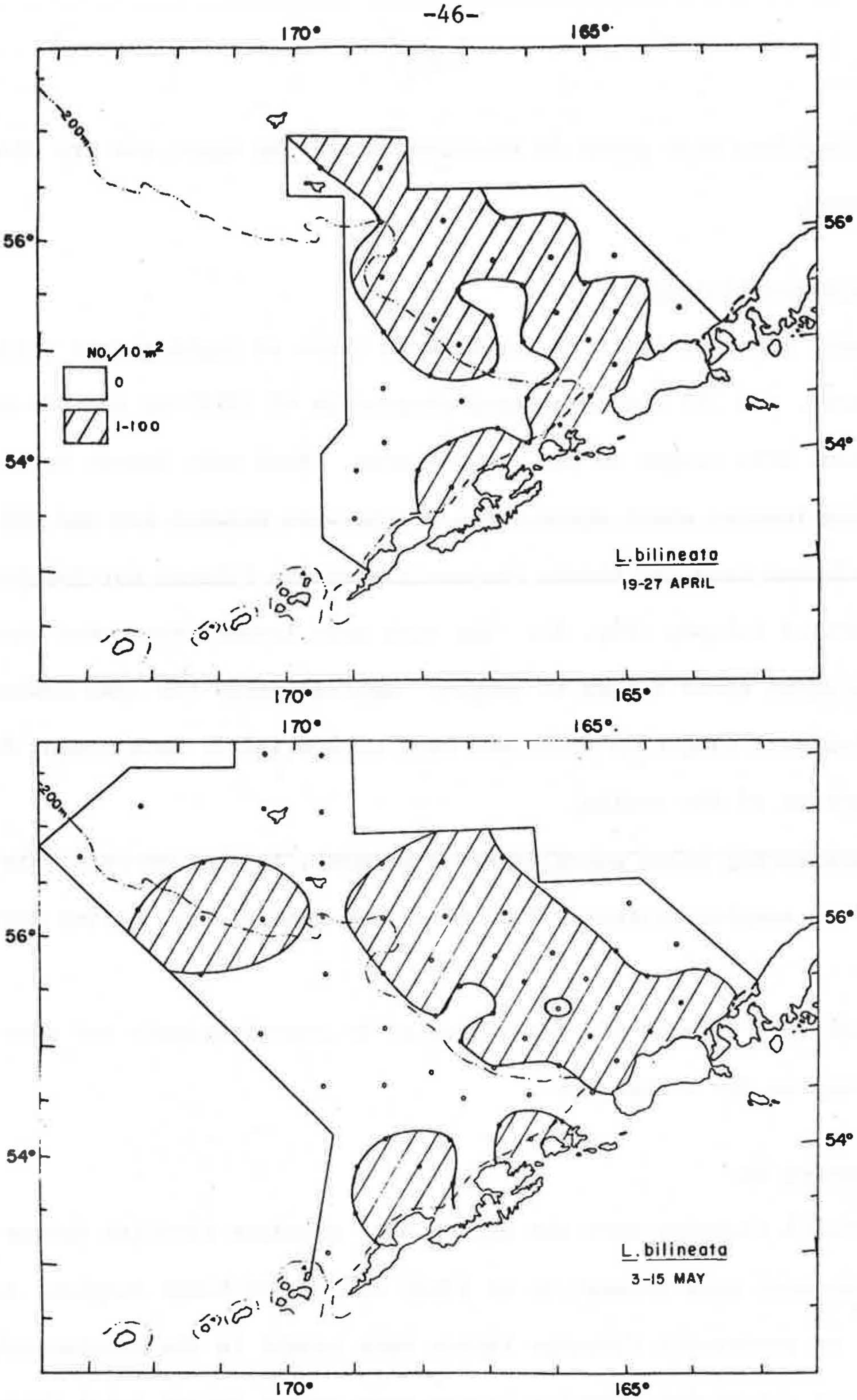


Figure 8.-- Distribution and relative abundance of larvae of <u>Lepidopsetta bilineata</u> in the eastern Bering Sea, <u>Miller Freeman</u> cruise MF-77B, 16 April - 15 May 1977.

as 100 m. During both April and May arrowtooth flounder larvae were caught from the vicinity of the Aleutian Islands northwestwards to near the Pribilof Islands (Fig. 9).

Arrowtooth flounder larvae ranged in length from 8 to 10 mm.

No eggs identifiable as those of arrowtooth flounder were caught.

3. Reinhardtius hippoglossoides

Greenland turbot were the third most abundant flatfish larvae caught, and 117 specimens were present in 45 (34%) of the 505-bongo samples; none were caught with neuston nets. Catch per station of this species was about the same for both the April and May samples, though there were more caught during May because of a greater total number of samples collected.

Greenland turbot larvae were found in about the same locations as were arrowtooth flounder, i.e., along or beyond the continental slope where water depth was greater than 200 m, although in May, as was the case with arrowtooth flounder, some larvae of Greenland turbot were caught over the continental shelf in waters as shallow as 100 m (Fig. 10). Greenland turbot larvae were distributed from near the Aleutian Islands northwestward to north of St. George Island in the Pribilof Islands, a somewhat wider distribution than for arrowtooth flounder. Larvae of this species were large, ranging from 16 to 22 mm in length.

No eggs identifiable as those of Greenland turbot were caught.

4. Hippoglossus stenolepis

The only other flounder caught was a few larvae of Pacific halibut, and 10 specimens were found in 10 samples--7 (5%) of the 505-bongo and 3 (2%) of the neuston samples. It is probably unusual to catch Pacific halibut

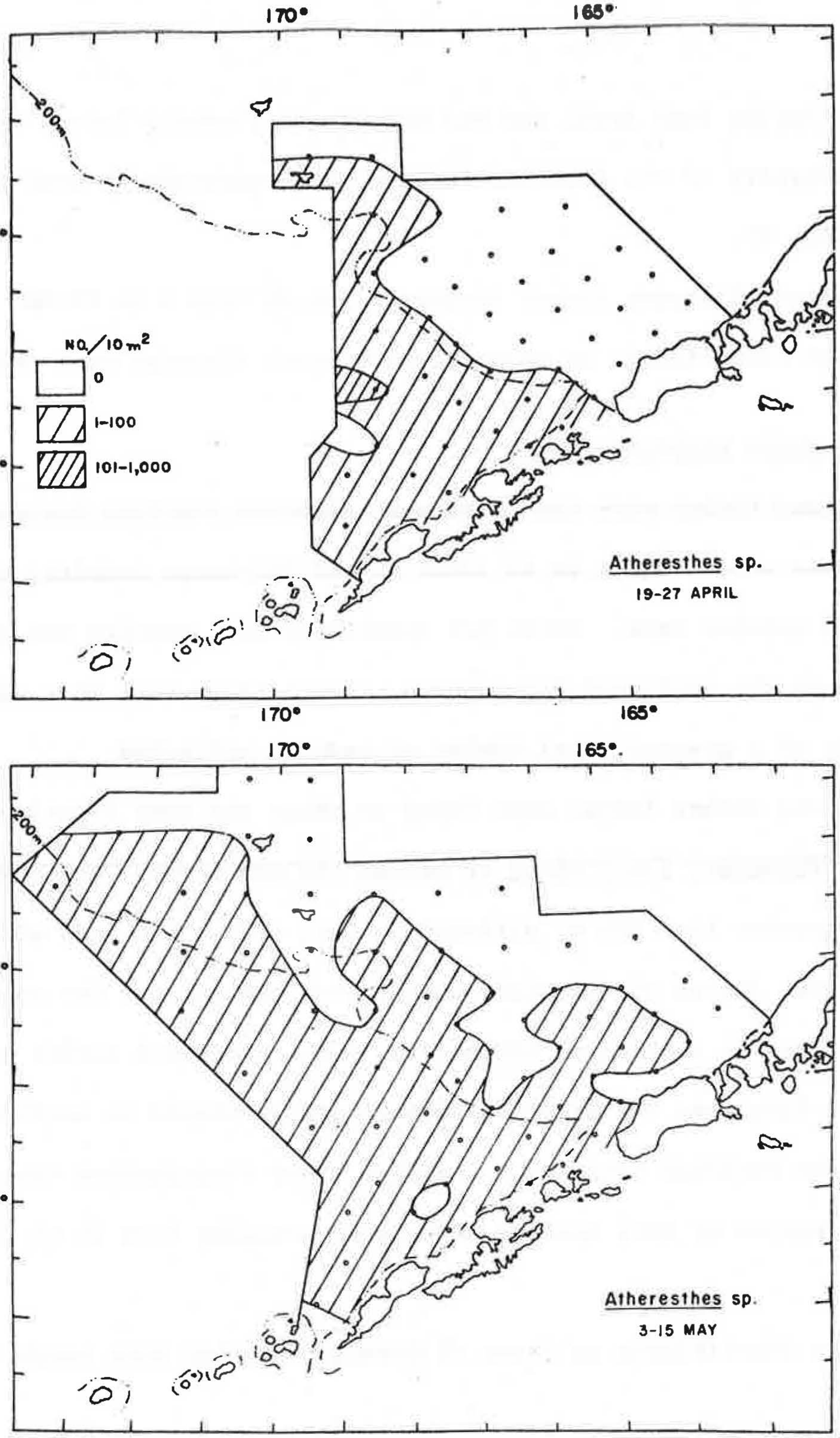


Figure 9.-- Distribution and relative abundance of larvae of Atheresthes sp. in the eastern Bering Sea, Miller Freeman cruise MF-77B, 16 April-15 May 1977.

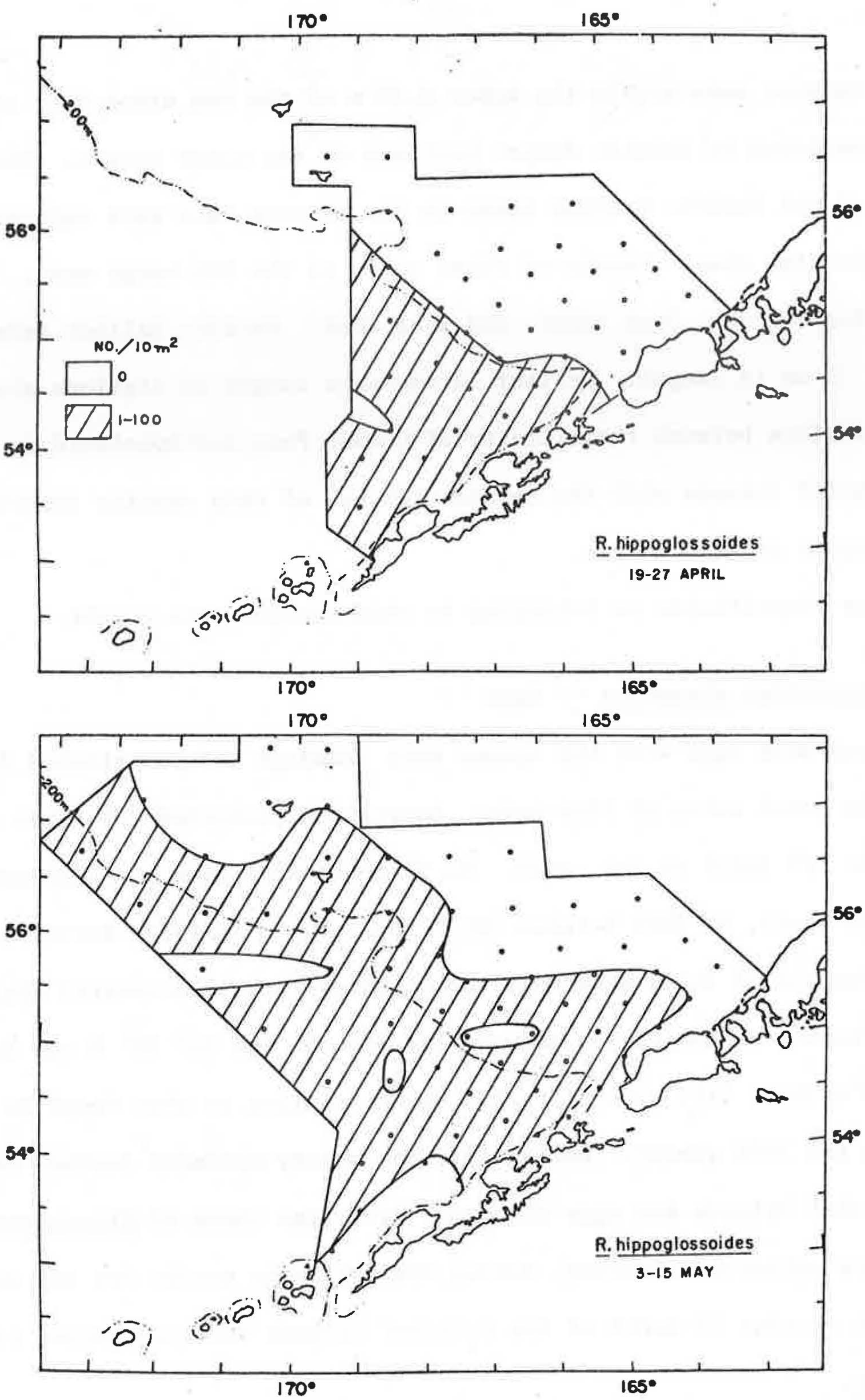


Figure 10.-- Distribution and relative abundance of larvae of Reinhardtius hippoglossoides in the eastern Bering Sea, Miller Freeman cruise MF-77B 16 April - 15 May 1977.

larvae in neuston nets within the upper 0.20 m of the sea since they are usually considered to inhabit deeper portions of the water column. However, all three of the Pacific halibut taken in the neuston nets were captured during night-time tows, whereas of those taken in the 505-bongo nets, 3 were caught during the day, 3 at night, and 1 at dusk. Pacific halibut larvae were 18 to 23 mm in length. Halibut larvae were caught at stations along the continental slope between the vicinity of Unimak Pass northwestward to west of the Pribilof Islands with the neuston catches of this species restricted to the vicinity of Unimak Pass.

No eggs identifiable as belonging to this species were caught.

5. Hippoglossoides elassodon -- Eggs

Flathead sole eggs were the second most abundant and contributed 2.3% (557) of the total catch of fish eggs. Bongo nets collected 28% (154) and neuston nets 72% (403) of the total. No flathead sole eggs were collected during 16-18 April, 9% (28) between 19-27 April, and 91% (509) during 3-15 May 1977. Almost all of these eggs were collected over the continental shelf, with the greatest concentration between lat. 55° 30' and 56° 30' N and long. 165° to 168°W (Fig. 11). The distribution was similar to that found in this area during the 1976 survey. During 1976 the survey extended farther north of the Pribilof Islands and eggs which may have been those of Hippoglossoides robustus were collected; however, during 1977 all eggs except for two doubtful specimens at station 72 north of the Pribilof Islands were considered to be H. elassodon.

No larvae identifiable as flathead sole were found in either the 1976 or 1977 collections.

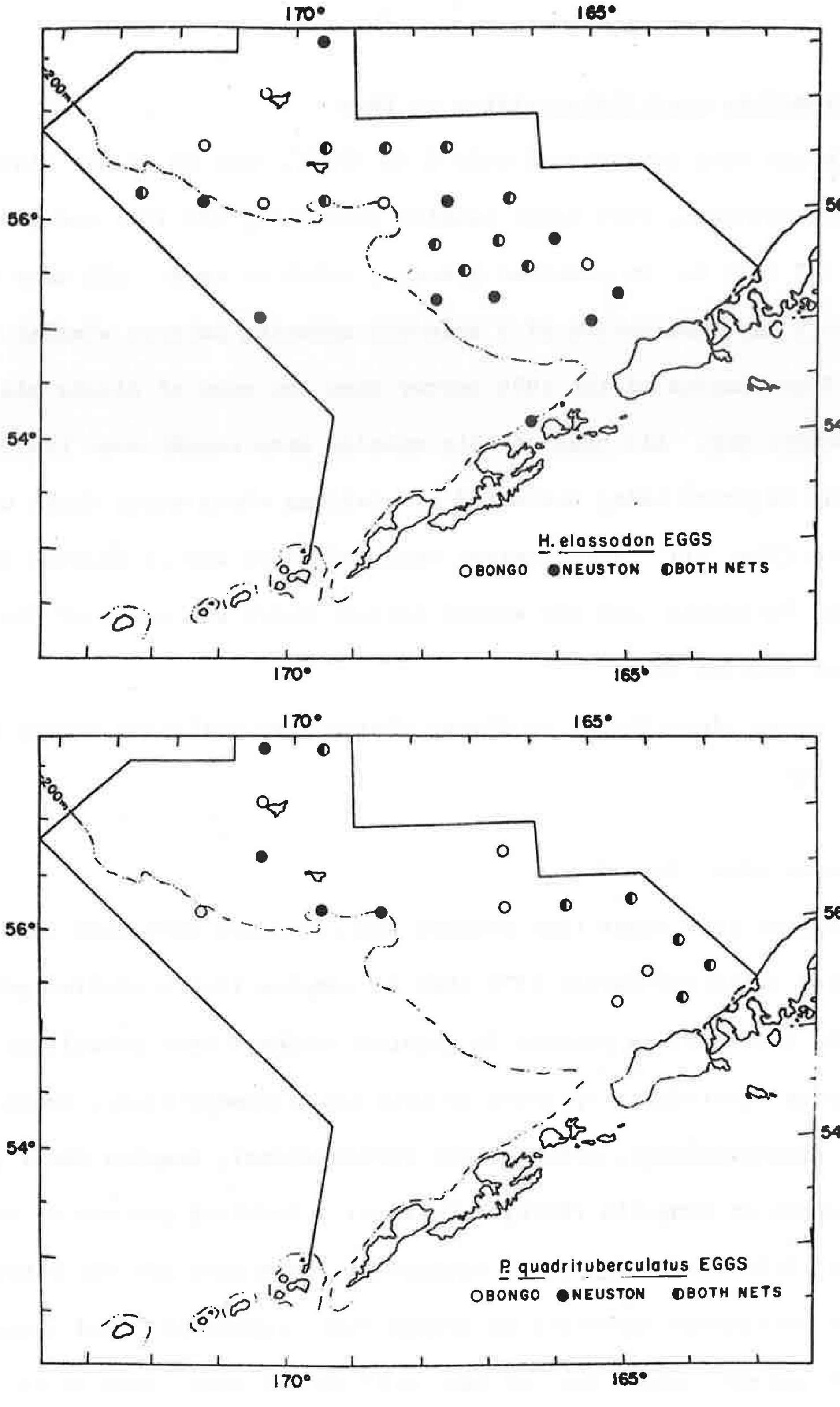


Figure 11.-- Distribution of eggs of Pleuronectidae in the eastern Bering Sea, Miller Freeman cruise MF-77B, 16 April - 15 May 1977.

6. Pleuronectes quadrituberculatus -- Eggs

Although they contributed only 0.4% (103), eggs of Alaska plaice were third most abundant, with bongo samples containing 28% (29) and neuston samples 72% (74) in the combined observed catch of eggs. All were caught during 3-15 May, indicative of a seasonal spawning pattern similar to that deduced from results of the 1976 survey when few eggs of Alaska plaice were caught before May. All eggs of this species were caught over the continental shelf, the majority being collected at stations where water depth was less than 100 m (Fig. 11). The greatest observed catch was at Station 29 near the Alaska Peninsula, and the second largest catch was north of the Pribilof Islands at Station 72.

No larvae identifiable as Alaska plaice were collected during either 1976 or 1977.

C. Larvae of other families

Larvae of fish other than pollock and flounders were more numerous in the samples collected during 1977 than in samples from a similar period of 1976. The two families present in greatest numbers were greenlings (Hexagrammidae) and sculpins (Cottidae), followed by sand lance (Ammodytidae), smelt (Osmeridae), rockfish (Scorpaenidae), pricklebacks (Stichaeidae), deepsea smelt (Bathylagidae), and searchers or ronquils (Bathymasteridae). Rockfish and one of the greenling, Atka mackerel, are of commercial importance and the others are generally considered important as forage fish, especially sand lance and smelt. The 505-bongo net caught most of the rockfish and sand lance larvae, while the neuston net caught most of the others mentioned above, especially the sculpins and greenlings.

1. Hexagrammidae

Hexagrammidae were the second most numerous larvae in the combined bongo and neuston catches, and ranked first in abundance in the neuston catches. The combined catch amounted to 1,820 specimens with 19 (1%) in the bongo samples and 1,801 (99%) in the neuston samples. They were also the most widely distributed larvae with at least one Hexagrammidae being caught at all but two stations, and at those stations (30 and 74) no fish larvae were caught.

Larvae of the genus *Hexagrammos* were the most numerous and 1,275 specimens accounted for 71% of the Hexagrammidae while *Pleurogrammus monopterygius* made up the remaining 29%. More than one species of *Hexagrammos* was present, but because of uncertainties in identification it seems best at present to group them all as a genus. There is some indication that those listed as *Hexagrammos* B and C may be the same species, probably *H. stelleri*, the whitespotted greenling. Most of those listed as *Hexagrammos* sp. are probably *H. superciliosus* or *H. lagocephalus*. According to some authors (Hart 1973; Quast 1960) *H. lagocephalus* is a senior synonym of *H. superciliosus* with a distribution from the western Pacific through the Bering Sea and southward to California. On the other hand, Ruttenberg (1962) separates the two forms with *H. lagocephalus* assigned a western Pacific and western Bering Sea range and *H. superciliosus* given an eastern Bering Sea and eastern Pacific range.

A further obstacle to identification of *Hexagrammos* larvae, the two most likely to occur in the eastern Bering Sea--*H. octogrammus* and *H. stelleri*, apparently produce hybrid forms (Ruttenberg 1962).

Hexagrammos larvae were distributed throughout the survey area during April and May. Only 4 (9%) of the 19-27 April samples did not contain at least one *Hexagrammos*, while 10 (16%) of the 3-15 May samples lacked *Hexagrammos*.

Areas of high abundance were close to Unalaska and Akutan Islands and over the continental shelf where water depth was more than 100 m (Fig. 12).

Average catch of Hexagrammos per positive station was 20 for night and 6 for day samples during 19-27 April, and 13 for night and 8 for day samples during 3-15 May.

Hexagrammos larvae ranged from 9 to 35 mm in length.

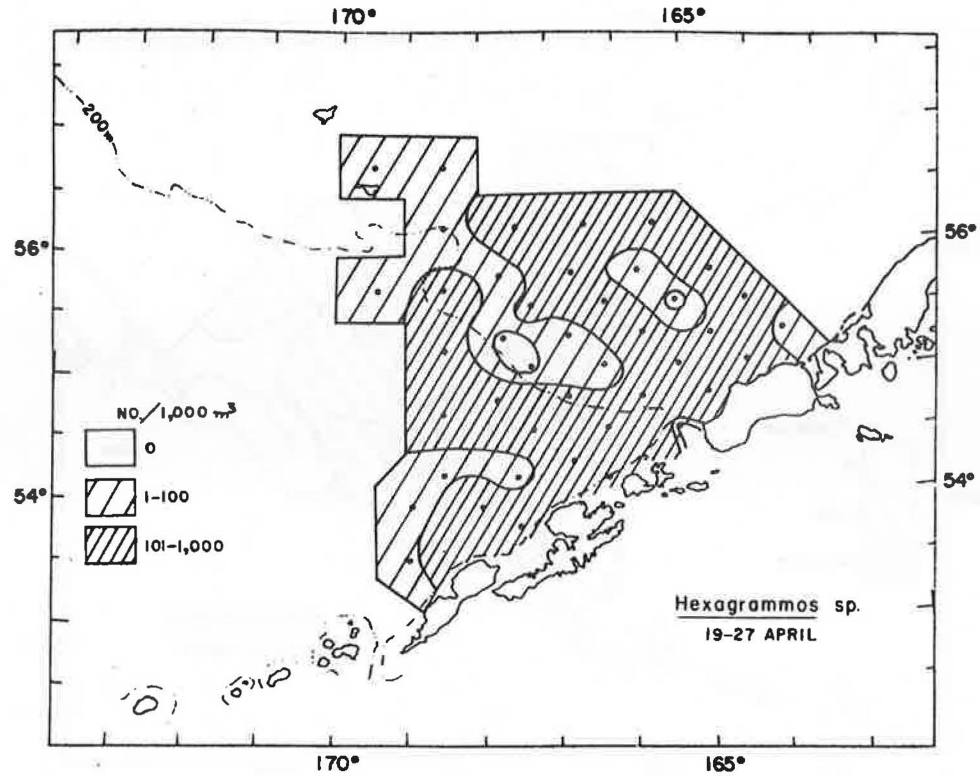
Atka mackerel were the only hexagrammid larvae identified to species with 526 (99%) in neuston and 7 (1%) in bongo samples. Frequency of occurrence in neuston catches was high with 58% of the samples containing Atka mackerel larvae. About the same percentage of day and night samples contained larvae of this species, however, night catches were larger and contained 74% of the larvae while only 26% were caught during daytime. Atka mackerel larvae were caught at stations throughout the survey area in both April and May, over the continental shelf as well as beyond the continental slope (Fig. 13).

There did not seem to be any one area with unusually high abundance, rather pockets of high abundance were interspersed with areas of low to moderate abundance. During April the highest abundance was over the continental shelf at Station 59, with 635 larvae per 1,000 m^3, while in May the greatest abundance was at Station 47 over the outer continental slope with 807 larvae per 1,000 m^3.

Atka mackerel larvae were relatively large, ranging from 12 to 30 mm in length.

2. Cottidae

Sculpins were the third most abundant family in the combined neuston and bongo samples with a total of 1,574 larvae, of which 1,485 (94% were in the



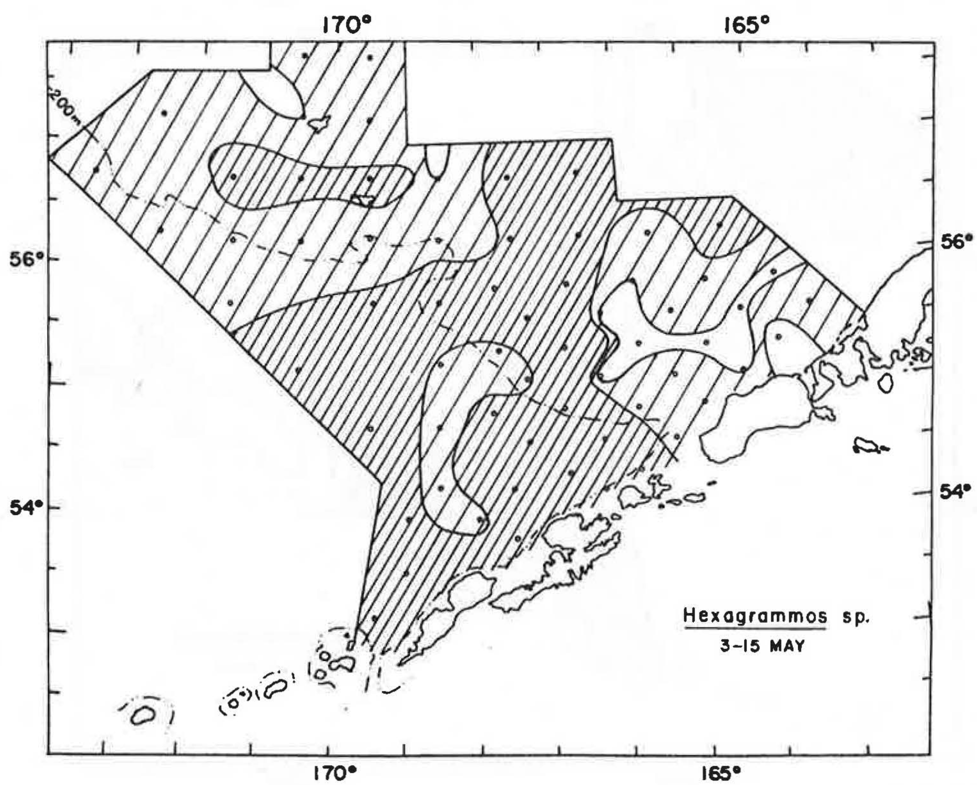


Figure 12.-- Distribution and relative abundance of larvae of Hexagrammos sp. in the eastern Bering Sea, Miller Freeman cruise MF-77B, 16 April - 15 May 1977.

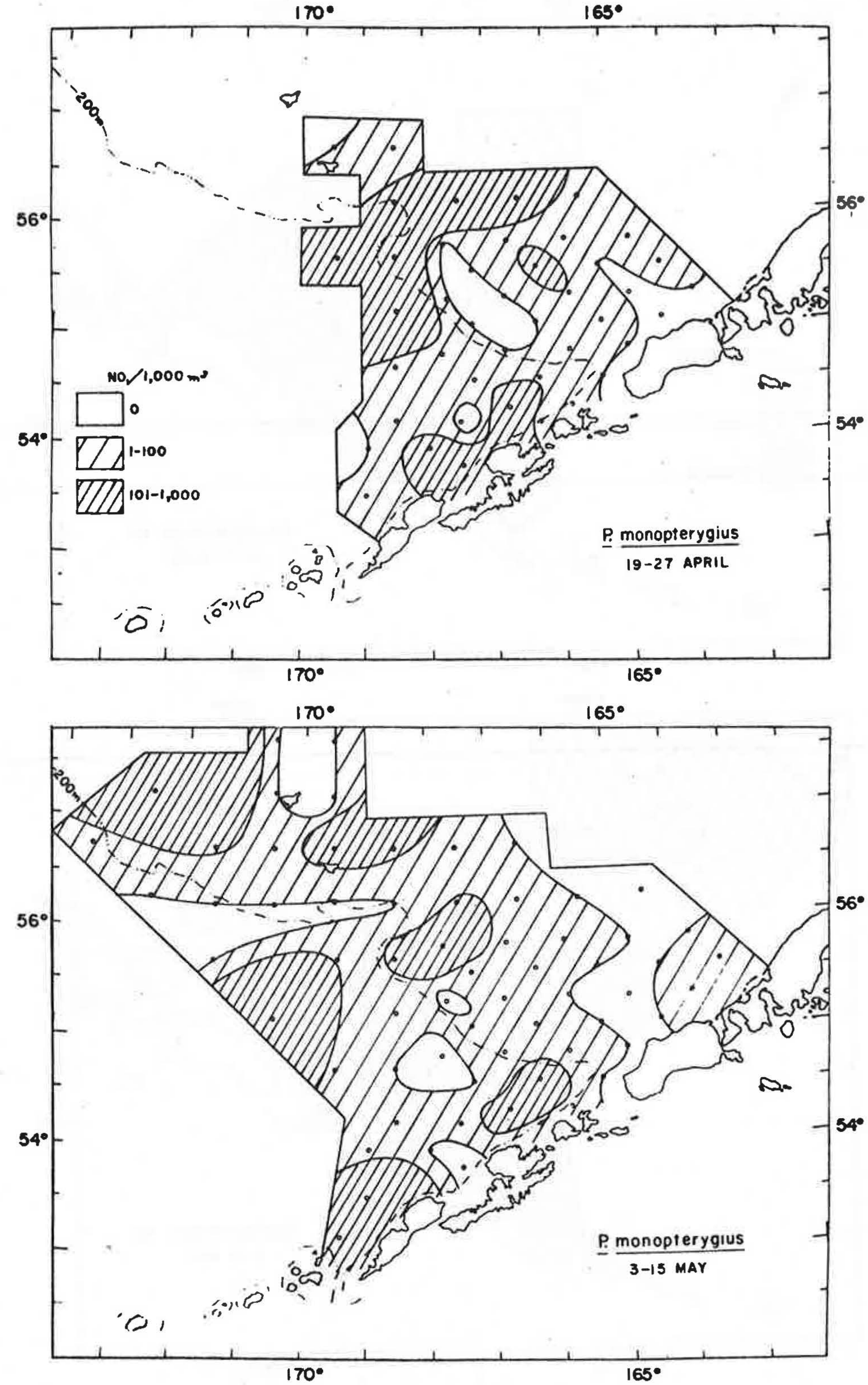


Figure 13.-- Distribution and relative abundance of larvae of *Pleurogrammus monopterygius* in the eastern Bering Sea, *Miller Freeman* cruise MF-77B, 16 April - 15 May 1977.

neuston samples. Larvae of three species of Hemilipidotus accounted for 1,495 of the total sculpin catch with the remaining 79 larvae divided among two species, Psychrolutes paradoxus (4), and Icelinus borealis (3), 11 alphabetically designated types (69) and 3 non-typed sculpins.

Larvae of the genus Hemilepidotus were assigned to three species: H. hemilepidotus, H. jordani, and H. papilio on the basis of a character index that can be used when fin rays can be counted accurately (Schultze and Welander 1934). Most Hemilepidotus larvae were large with a total size range of 8-26 mm, and little difference between species (H. hemilepidotus 8-20 mm. H. jordani 8-21 mm, and H. papilio 10-26 mm).

There were no striking differences in distribution of the three species, shown in Figs. 14 to 16. Because of the large day-night differences in neuston catches, no contours were drawn and only the catch in No./1,000 m^3 at each positive station is shown. Larvae of H. hemilepidotus were collected at stations over the continental shelf and over the continental slope during both April and May. Larvae of H. jordani were mostly on the shelf during April but with some heavy concentrations over the slope, while in May there were few collected over the shelf. Larvae of H. papilio were collected only over the slope during April, and mainly over the slope during May but with a few taken at stations over the continental shelf.

Distribution of P. paradoxus and I. borealis is shown in Figure 23.

3. Ammodytidae

Sand lance were the fifth most abundant larvae over all and third most abundant in bongo samples. Only 10 specimens were caught with neuston nets and the remaining 400 were found in bongo samples. Most sand lance, 331,

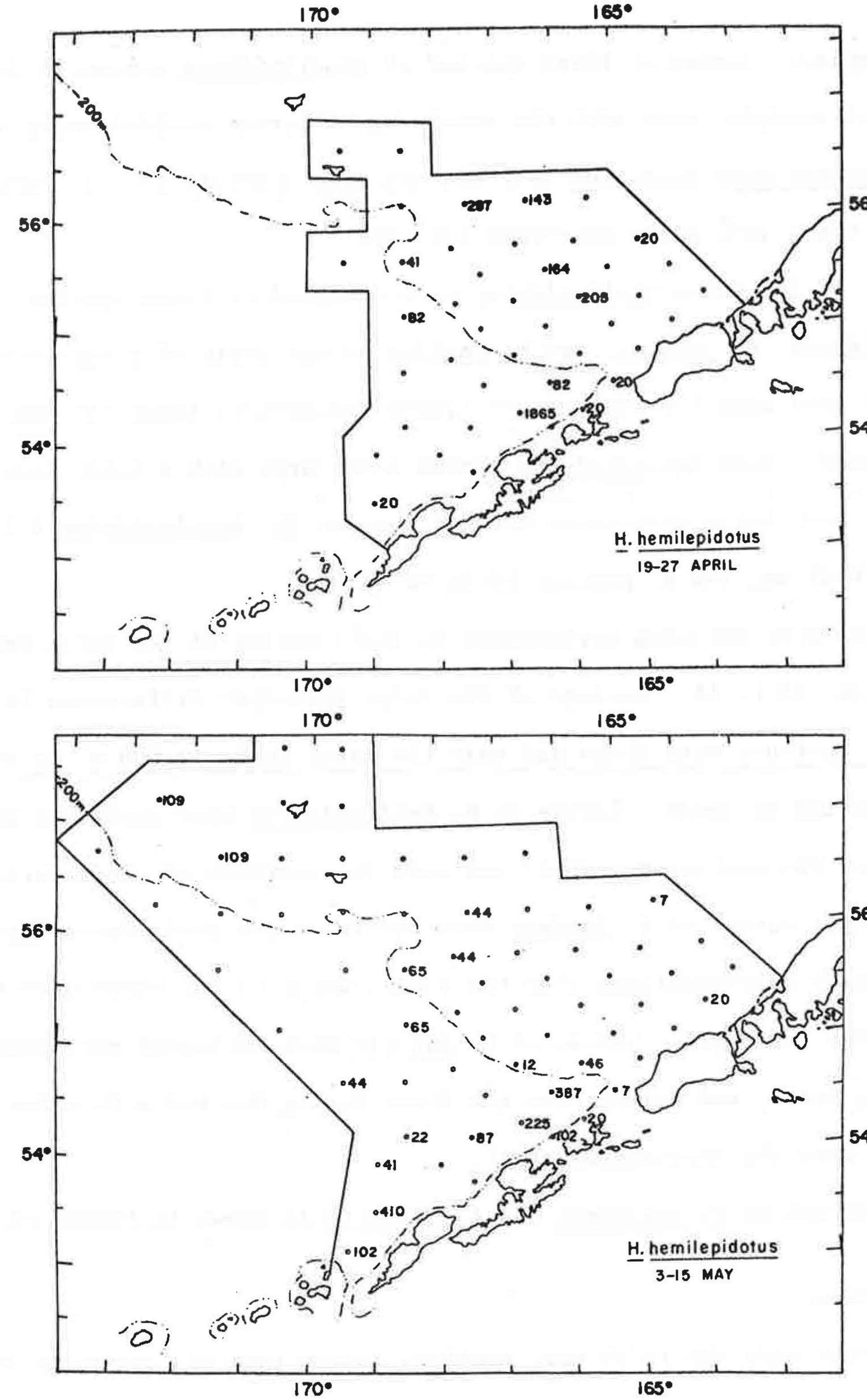


Figure 14.-- Distribution and abundance as No./1,000 m^3 of larvae of Hemilepidotus hemilepidotus in neuston collections from the eastern Bering Sea, Miller Freeman cruise MF-77B, 16 April - 15 May 1977.

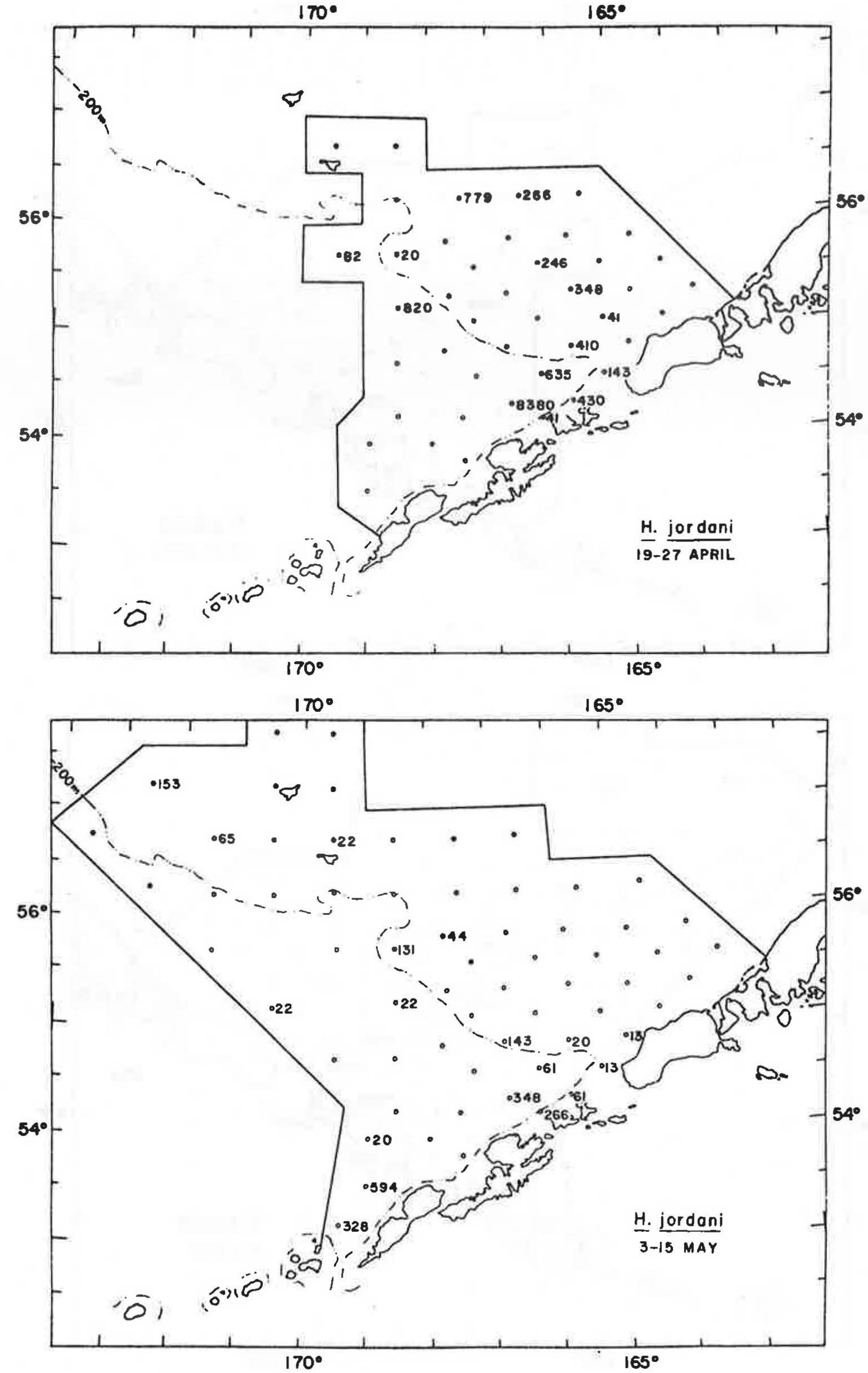


Figure 15.-- Distribution and abundance as No./1,000 m^3 of larvae of <u>Hemilepidotus jordani</u> in neuston collections from the eastern Bering Sea, <u>Miller Freeman</u> cruise MF-77B, 16 April - 15 May 1977.

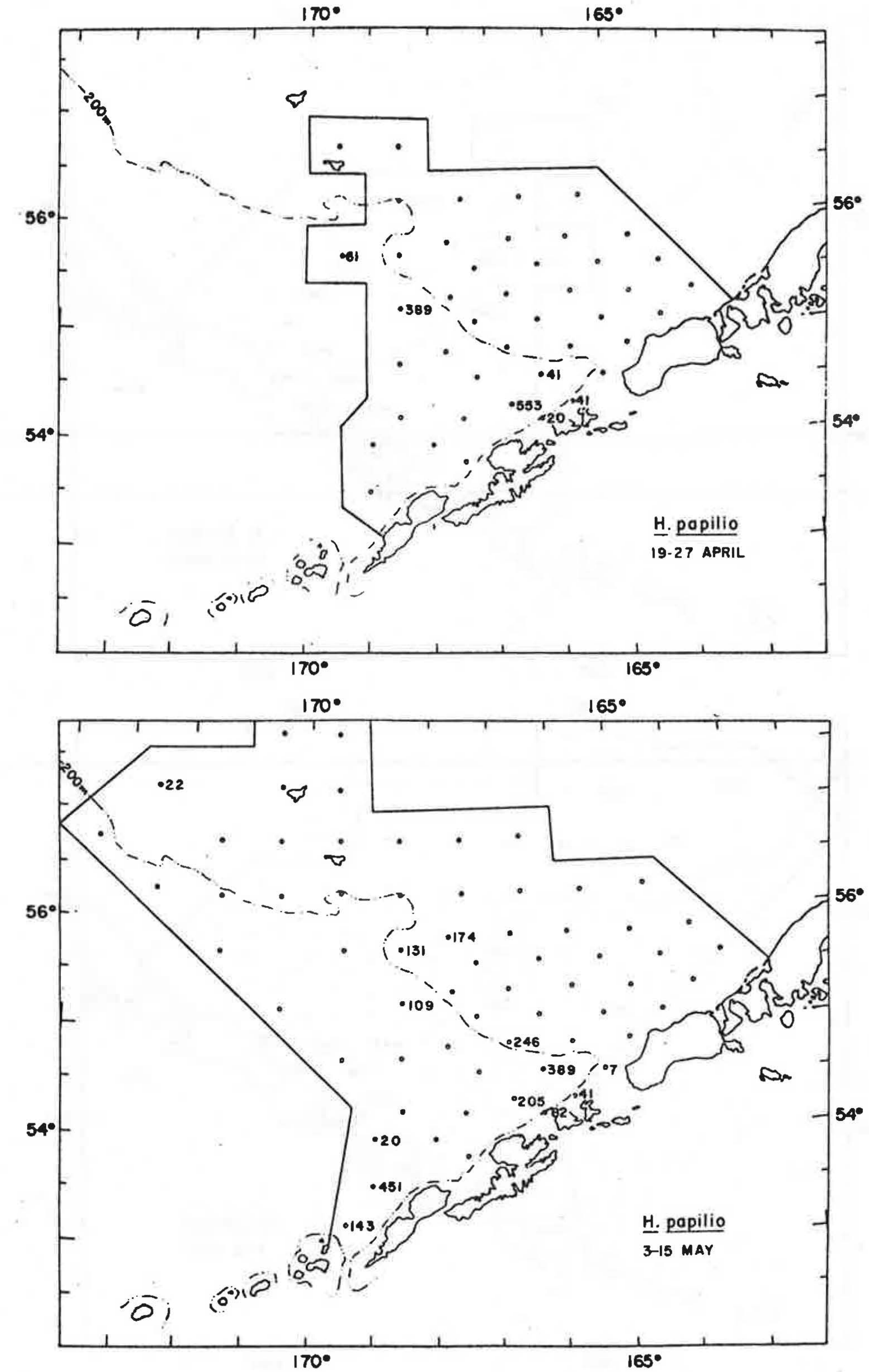


Figure 16.-- Distribution and abundance as No./1,000 m^3 of larvae of Hemilepidotus papilio in neuston collections from the eastern Bering Sea, Miller Freeman cruise MF-77B, 16 April - 15 May 1977.

were caught during April with only 69 taken in the samples collected during May. Distribution of sand lance was quite limited and they were collected mainly in the southeast quadrant of the survey area, with the greatest concentration at Stations 21, 27, and 29, just north of the middle of Unimak Island and the tip of the Alaska Peninsula (Fig. 17 for bongo and Fig. 24 for neuston).

Sand lance larvae ranged from 6.7 to 29 mm in length.

4. Osmeridae

Capelin was the only smelt collected during the cruise, and the 409 specimens, which accounted for 3% of the combined bongo and neuston catch, placed them sixth in overall abundance. Neuston nets caught 389 (95%) of the capelin which were found in relatively few samples--15 (11%) of the neuston and 8 (6%) of the bongo samples. Distribution of capelin was restricted to within about 75 miles of Unimak Island and they were generally found over the continental shelf (Fig. 18).

Most capelin were caught at night (86%) or at dawn (5%) with only 8% of the neuston and 15% of the bongo catch made during daylight.

Capelin were among the largest larvae caught, ranging from 31-65 mm in length.

5. Scorpaenidae

Rockfish, many of which are of commercial importance, were seventh most abundant overall and fourth most abundant in the 505-bongo catches, with 338 larvae in 41 (31%) of the bongo samples and only 28 larvae in 14 (10%) of the neuston samples. Larval rockfish were distributed generally over the continental

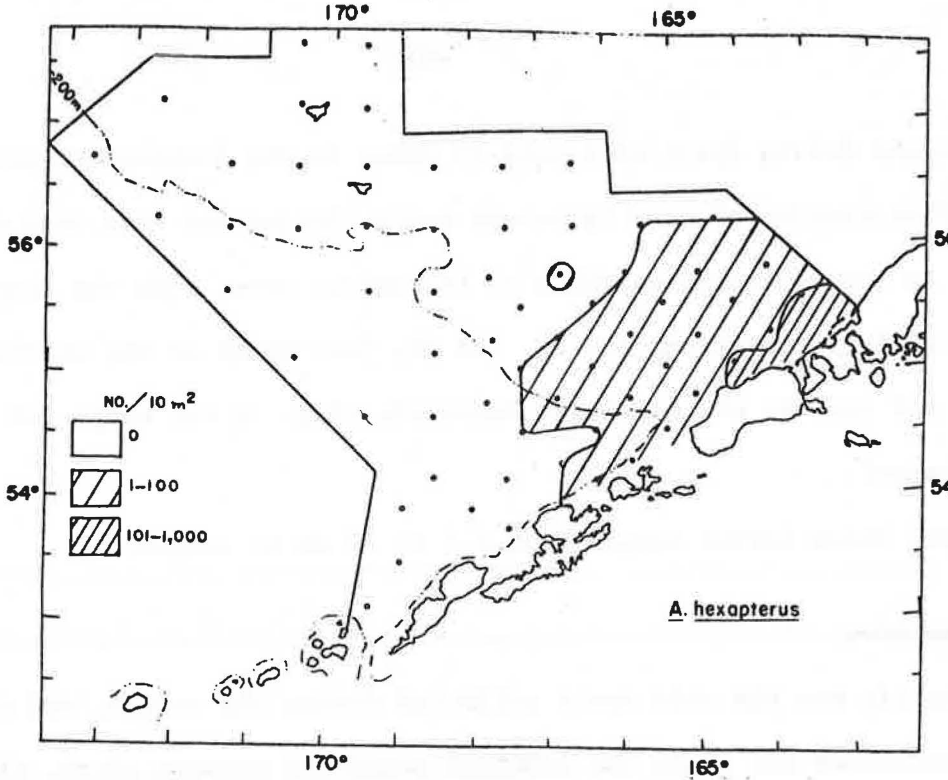


Figure 17.-- Distribution and relative abundance of larvae of Ammodytes hexapterus in the eastern Bering Sea, Miller Freeman cruise MF-77B, 16 April - 15 May 1977. Shown as average catch of combined bongo and neuston nets.

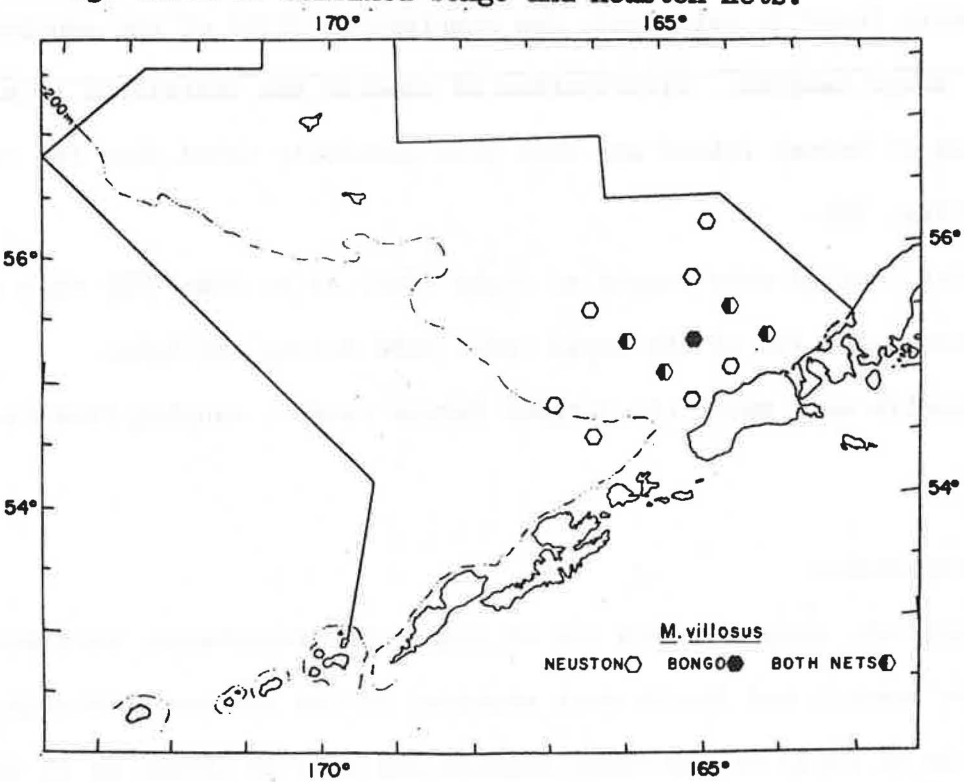


Figure 18.-- Distribution of larvae of Mallotus villosus in the eastern Bering Sea, Miller Freeman cruise MF-77B, 16 April - 15 May 1977.

slope and deeper water, although during May they were found in a few samples collected in water shallower than 200 m (Fig. 19). Areas of high abundance were found between Unimak Pass and Unalaska Island during April and in this same area plus an area west of the Pribilof Islands during May. Rockfish larvae were between 5.0 and 8.3 mm in length during the cruise.

Rockfish are ovoviviparous and so no eggs were collected.

The 14 rockfish larvae caught in the neuston nets were distributed over the same area as were the rockfish caught in the 505-bongo net (Fig. 24).

6. Stichaeidae

Pricklebacks were eighth in abundance in the combined catch with 358 specimens, of which 329 (92%) were found in 34 (25%) of the neuston samples. The remaining 29 were found in 22 (17%) of the bongo samples. Pricklebacks were quite widely distributed, being found over the continental shelf and upper continental slope from the vicinity of Unimak Pass to north of the Pribilof Islands (Fig. 20). Greatest numbers were collected in the vicinity of Unimak Pass and Samalga Pass, with a catch of 78 individuals at Station 66.

Bongo samples contained 8 *Lumpenus maculatus*, while the combined neuston and bongo samples had 310 *Chirolophis polyactocephalus* or 87% of the total pricklebacks, plus 38 specimens divided among four types and two untyped specimens. Identification of *C. polyactocephalus* was made by comparison of adult meristics with meristics obtained from large larvae stained with alizarin red S.

Of the combined catch of pricklebacks 67% were caught at night, 24% at dawn or dusk, and 9% during daytime. Only 6% of the neuston catch was made during daylight as opposed to 33% for the bongo net, indicating a migration to deeper water during daylight, or possibly a more effective escape behavior from the neuston net during daytime.

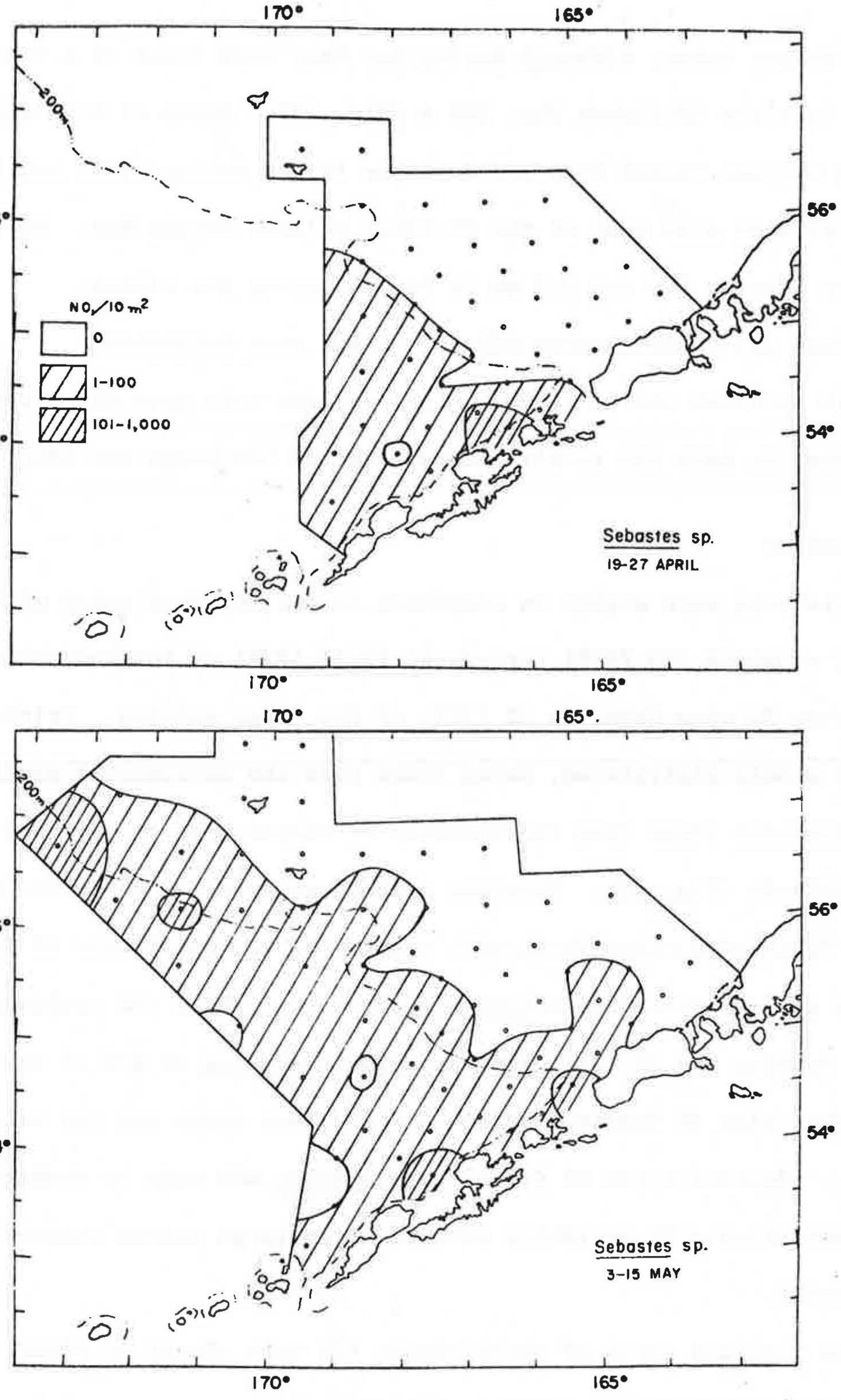


Figure 19.-- Distribution and relative abundance of larvae of Sebastes sp. in the eastern Bering Sea, Miller Freeman cruise MF-77B, 16 April-15 May 1977.

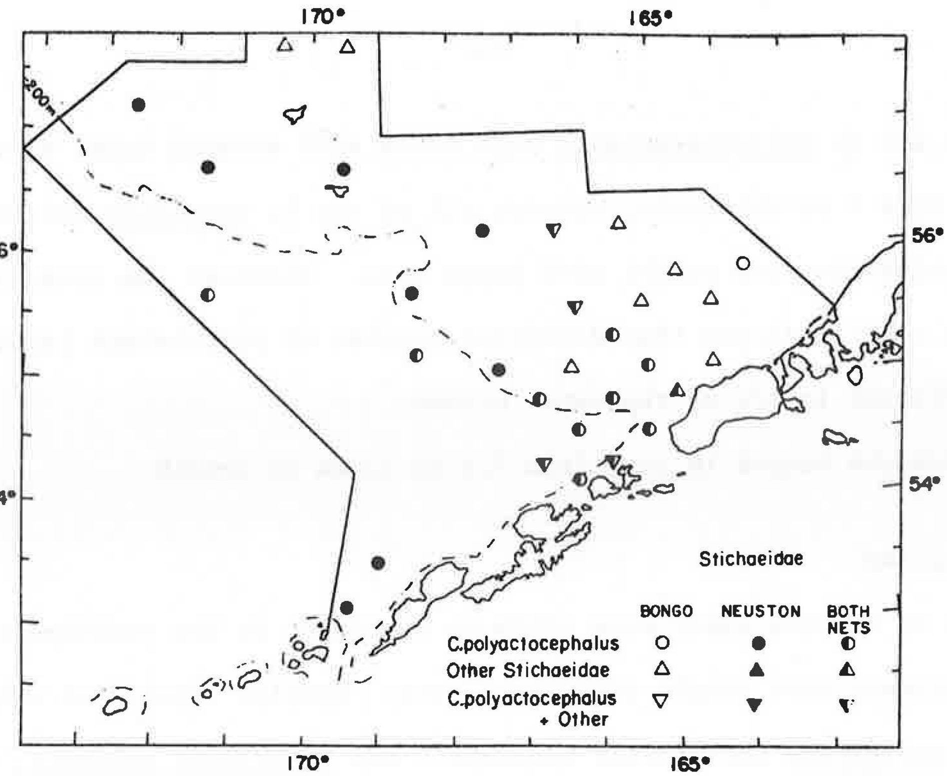


Figure 20.-- Distribution of larvae of Stichaeidae in the eastern Bering Sea, Miller Freeman cruise MF-77B, 16 April - 15 May 1977.

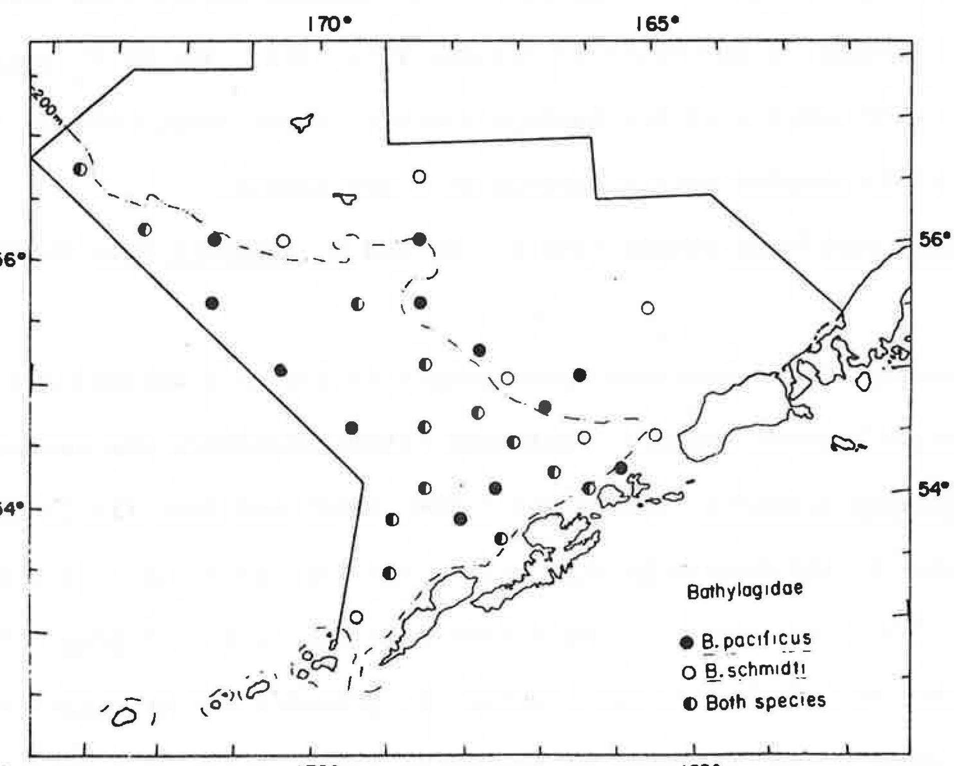


Figure 21.-- Distribution of larvae of Bathylagidae in the eastern Bering Sea, Miller Freeman cruise MF-77B, 16 April - 15 May 1977.

Almost all C. polyactocephalus were taken with neuston nets, as were all of the Type F pricklebacks, whereas all of the L. maculatus and the Type E sticklebacks were caught with bongo nets. Although the numbers were small, this could indicate that different species of prickleback larvae inhabit different layers of the water column.

Pricklebacks ranged in size from 7.5 to 33 mm in length.

7. Bathylagidae

Larvae of deepsea smelt were ninth in abundance in the combined catch and all 116 specimens were caught with bongo nets. Species identified were Bathylagus pacificus, the Pacific blacksmelt and Bathylagus schmidti, the northern smoothtongue. Both species were distributed along the continental slope, with a few on the outer edge of the continental shelf, from near Unimak Pass to the latitude of the Pribilof Islands (Fig. 21). The 82 B. pacificus were caught in 38 samples with a maximum catch of 5 per sample and 34 B. schmidti were caught in 25 samples with a maximum of 4 per sample.

Bathylagus pacificus ranged from 6-9 mm and B. schmidti from 9-80 mm in length.

The taxonomy of the northern smoothtongue is not well defined and the name used varies between authors. Ahlstrom (1969) considers the correct name to be Leuroglossus schmidti, Borodulina (1968, 1969) and Hart (1973) list it as a subspecies L. stilbius schmidti, Miller and Lea (1972) as L. stilbius, while Bailey (1970) and Quast and Hall (1972) list only B. stilbius. The NODC codes used by OCSEAP list two species, B. schmidti and B. stilbius. Borodulina (1968) gives the range of vertebrae for L. stilbius schmidti from the Bering Sea as 49-51 and for L. stilbius stilbius from California waters as 39-42. Our specimens from the Bering Sea had 48-52 myomeres and on this basis were identified as *L. schmidti*, but they are listed in this report as *B. schmidti* in order to conform with OCSEAP taxonomic codes. However, there is considerable evidence that the generic name should be *Leuroglossus* rather than *Bathylagus* (Borodulina 1969).

8. Bathymasteridae

Ronquils or searchers were the tenth most abundant larvae in the combined bongo and neuston catch with 12 (11%) in the bongo samples and 96 (89%) in the neuston samples. All of those in the neuston samples were caught at night or at dawn and dusk, while 3 of those in the bongo samples were caught at night and 9 during the daytime. In spite of their relatively low numbers Bathymasteridae were distributed widely in the southeastern half of the survey area at stations on the continental shelf where water was less than 100 m deep as well as at stations over deep water of the continental slope (Fig. 22).

Bathymasteridae larvae ranged from 28 to 43 mm in length.

9. Miscellaneous species

The remaining 94 identified larvae included 9 families, 5 of which were not present in samples collected during April and May 1976. In addition, 76 badly damaged larvae could not be identified even to order. New families in the 1977 samples were: Macrouridae - unidentified species (1); Anarhichadidae- *Anarhichas orientalis* (5); Ptilichthyidae - *Ptilichthys goodei* (1); Zaproridae - *Zaprora silenus* (7); and Anoplopomatidae - *Anoplopoma fimbria* (3).

The other five families were collected in both 1976 and 1977, but the 1977 samples included species not present in 1976, and these were Agonidae - *Hypsagonus quadricornis* (1); Cyclopteridae - *Aptocyclus ventricosus* (3), and *Nectoliparis pelagicus* (8); and Myctophidae - *Stenobrachius leucopsarus* (17).

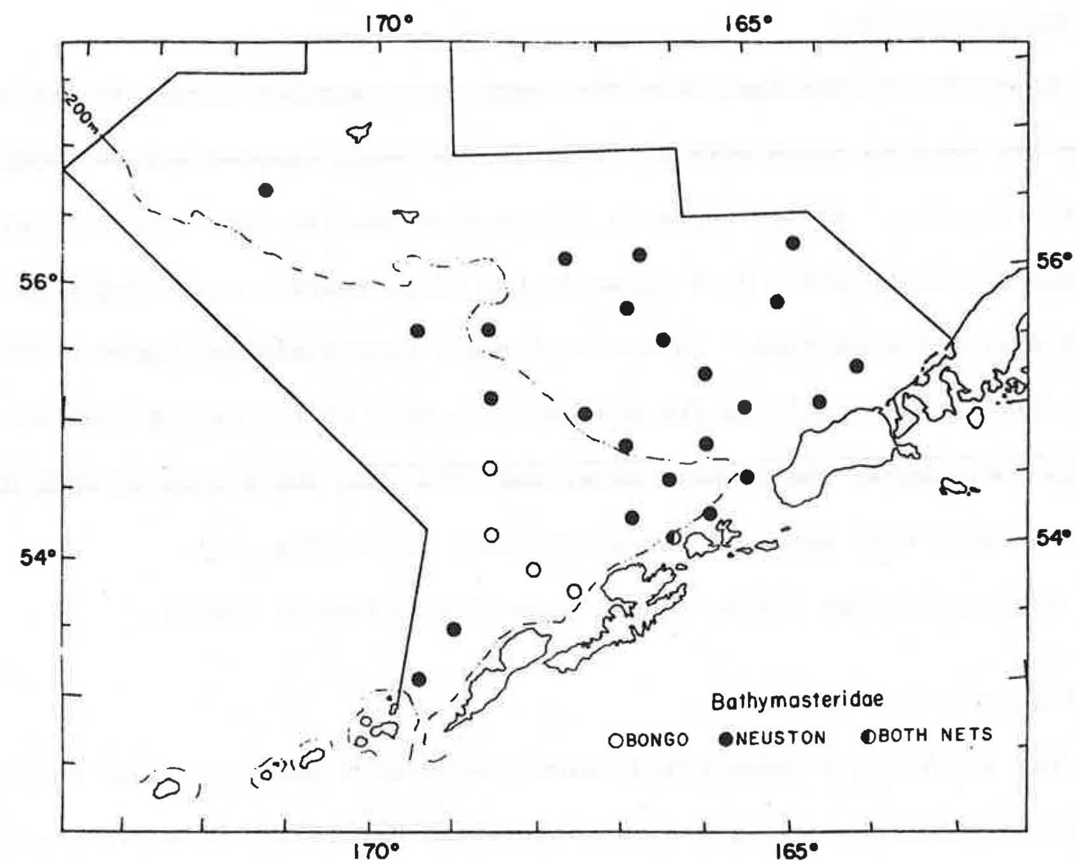


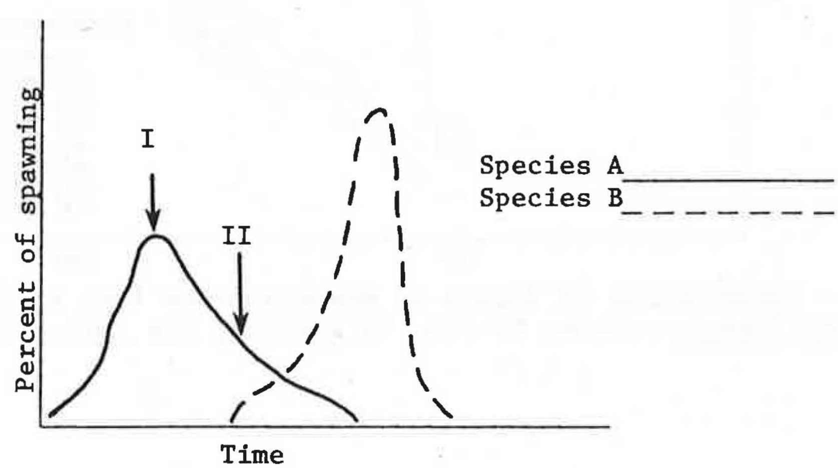
Figure 22.-- Distribution of larvae of Bathymasteridae in the eastern Bering Sea, Miller Freeman cruise MF-77B, 16 April - 15 May 1977.

Other species collected in 1977 but not in 1976 have been included in earlier sections, and these were the sculpins, Cottidae - Psychrolutes paradoxus (4) and Icelinus borealis (3); and Pleuronectidae - Lepidopsetta bilineata (157). The family Pholidae, present in both 1976 and 1977, was represented by three individuals in the 1977 collections.

Distribution of miscellaneous species is shown in Figure 23 for those in bongo samples and Figure 24 for those in neuston samples.

VII. NEED FOR FURTHER STUDY

Surveys confined to a short time period during a single season provide results of limited usefulness. Estimates of annual production of eggs of any species must be based on good knowledge of the spawning cycles of the fish to be studied. To illustrate this point, consider two arbitrary species, (A) and (B), in the figure shown below. If sampling takes place at time I it is evident that estimates of eggs produced will be different than if sampling were at time II, and overall estimates of potential damage to eggs of species I by man-induced environmental changes might be quite distorted. Further, sampling at either time I or II would produce no information about species (B). It is therefore vital to know the duration of spawning, the shape of the spawning cycle with respect to time, and the season in which spawning occurs.



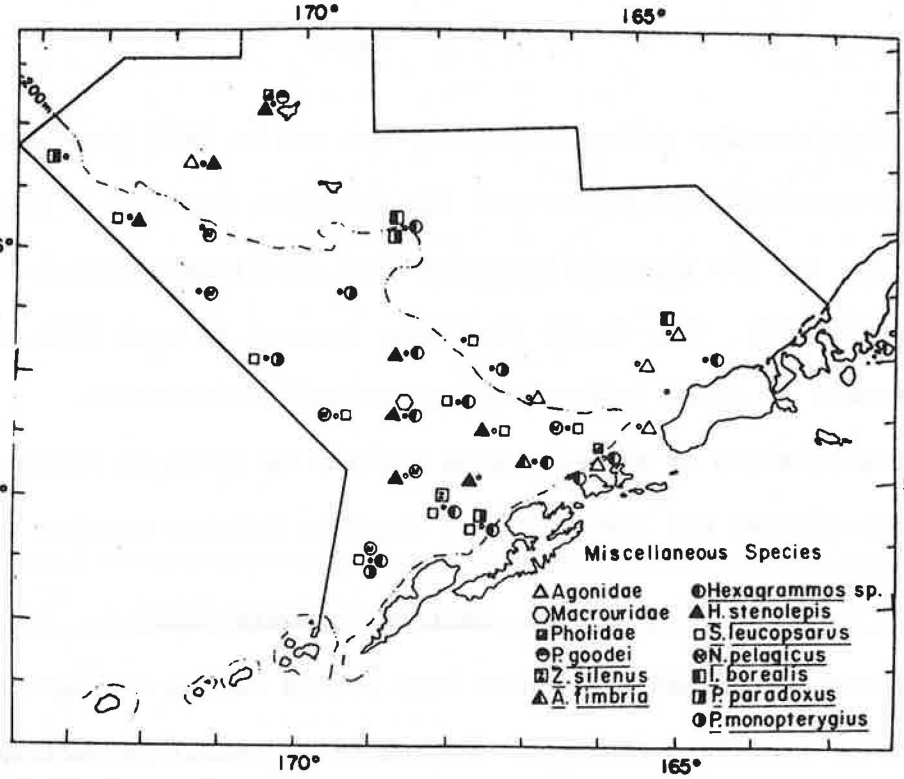


Figure 23.-- Distribution of larvae of miscellaneous taxa in the eastern Bering Sea, Miller Freeman cruise MF-77B, 16 April - 15 May 1977. Bongo net samples.

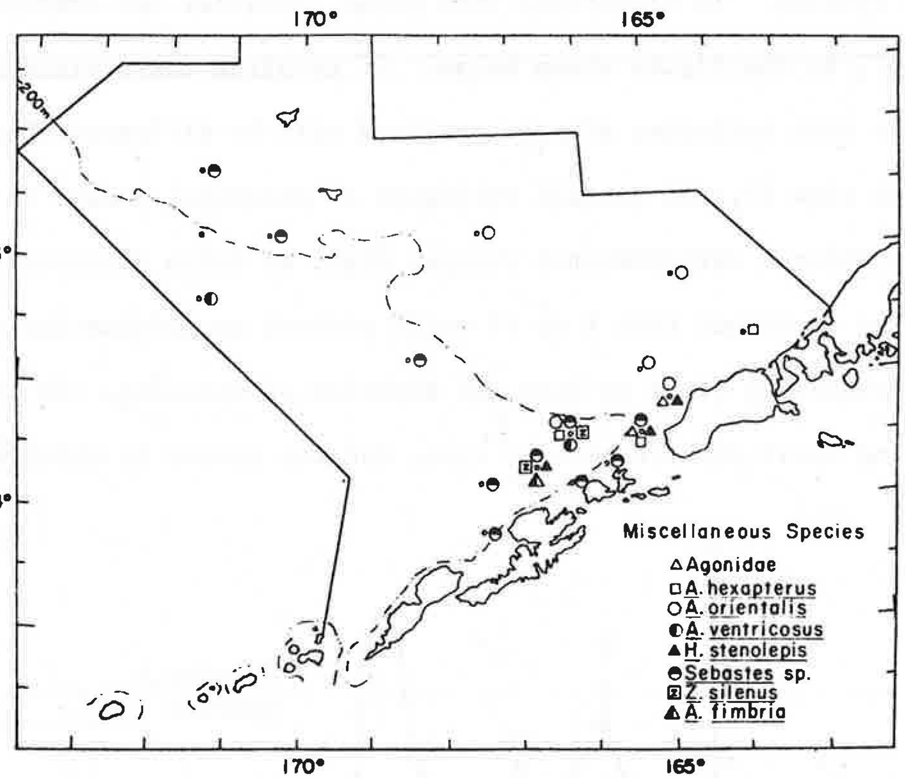


Figure 24.-- Distribution of larvae of miscellaneous taxa in the eastern Bering Sea, Miller Freeman cruise MF-77B, 16 April-15 May 1977. Neuston net samples.

Pollock is presently the most important commercial fin-fish in the Bering Sea, but other species are of value and conceivably could supersede pollock in the future. Estimates of the annual production of eggs and larvae of the other species would require sampling at other times of the year than spring. Yellowfin sole, Pacific herring, and capelin may spawn in late spring through summer, while Pacific halibut and Greenland turbot spawn during winter. Knowledge of the time and extent of spawning for several species of economically and ecologically important fish in the Bering Sea is a basic factor in evaluating environmental damage which may occur at different times of the year.

A schedule of sampling at about monthly intervals over a one year period at a specific series of stations would provide base-line information which then could be used to plan monitoring studies necessary to evaluate environmental damage, or to plan more detailed studies of a particular species of fish. Allocation of a week to ten days of vessel time per month in the eastern Bering Sea would be necessary to carry out such a study, and to determine peak spawning times, sampling must be done during one continuous year. It is likely that any NOAA vessel operating in the area, if equipped with suitable nets and winches, could carry out the sampling in a satisfactory manner.

VIII. CONCLUSIONS

1. There was evidence of high spawning activity for only one species of fish during 16 April - 15 May 1977 and that was pollock. Spawning by pollock had commenced prior to the beginning of the survey, probably at least as early as mid-March, shown by the presence of larvae, and spawning continued during the survey, shown by the presence of eggs.

2. Comparison of neuston and bongo collections standardized to No./10 m^2 indicates that less than 1% of pollock eggs are caught from the upper 0.2 m of the sea.
3. Comparison of data for 1976 and 1977 show that pollock eggs were more abundant during 1976 and larvae more abundant in 1977. Distribution of eggs and larvae did not differ greatly between the two years.
4. Measurement of length showed an increase in mean length of pollock from 5.6 to 8.0 mm over the period from 16-18 April to 3-9 May 1977.
5. Spawning by two other commercially valuable fish, Alaska plaice and flathead sole, had just begun in early May 1977 as shown by the presence of few eggs and no larvae, and this was a pattern similar to that observed in 1976.
6. Spawning by another valuable flatfish, rock sole, had taken place prior to the survey and hatching had begun only recently as shown by collection of only relatively small larvae.
7. Spawning by three other flatfish, Pacific halibut, Greenland turbot, and arrowtooth flounder had been completed a considerable time before mid-April, indicated by the presence of advanced larvae and the absence of eggs in our samples.
8. The most numerous fish larvae were those of pollock, followed by greenlings, sculpins, and flounders. Included in the greenlings were large numbers of Atka mackerel, a commercially valuable greenling. Greenlings were more abundant in 1977 than in 1976.
9. Because sampling was repeated at many of the stations it was possible to note changes in distribution and abundance of the more numerous fish eggs and larvae. The reasons for the changes are not evident from the results of this survey.

10. Time of sampling had a significant effect on number of larvae caught with neuston nets, with more larvae caught at night or dawn and dusk than during daylight, however, time of sampling did not markedly affect the number of larvae caught with the 505-bongo net.
11. Surveys conducted at a single time of year, such as those during 1976 and 1977, are not adequate to show peak spawning time for even a single species. A series of surveys are needed to define the spawning season of a target species, in this case the walleye pollock, and such a series could provide data concerning growth and mortality of the target species. In addition more data would be obtained concerning peripheral species, e.g., size series of larvae needed to define characteristics useful in identification of unknown specimens.

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* A few citations of unpublished references are included because they contain important information not available elsewhere.

X. APPENDIX

Appendix Table 1.-- 505-Bongo net, catch by station and taxa.

Station No.-Occupancy No.	Total Larvae	Theragra chalcogramma	Atheresthes sp.	Reinhardtius hippoglossoides	Lepidopsetta bilineata	Sebastes sp.	Bathylagus pacificus	Bathylagus schmidti	Gadidae - Unidentified	Ammodytes hexapterus	Total Eggs	Theragra chalcogramma - EGGS	Hippoglossoides sp. - EGGS	Other Larvae or Eggs 1/
1-1	182	159	1	-	-	5	1	-	-	-	30	30	-	Hemilepidotus C-2, C. polyactocephalus -1 Hexagrammos sp-1, UFL-12
-2	229	185	4	6	-	27	2	1	-	1	427	427	-	Hemilepidotus A-2, Cottidae K-1
-3	39	27	2	2	1	3	1	-	-	-	58	58	-	Bathymasteridae-2, UFL-1
2-1	277	268	-	-	-	-	-	-	5	-	8	8	-	Hemilepidotus A-2, C. polyactocephalus -1 Hexagrammos sp-1
-2	73	34	3	3	-	22	3	1	4	-	11	11	-	Hemilepidotus C-1, D-1, Hexagrammos sp-1
-3	67	53	1	1	-	6	3	1	2	-	4	4	-	
-4	85	40	5	3	-	24	5	2	-	-	2	2	-	Hemilepidotus A-1, D-1, A. fimbria - 1; S. leucopsarus-2, UFL-1
3-1	122	120	-	-	-	-	-	1	-	-	1	1	-	Hemilepidotus C-1
-2	41	35	1	1	-	-	1	1	-	-	1	1	-	Hemilepidotus D-1, Agonidae-1
-3	46	25	6	4	-	7	-	-	1	-	6	6	-	S. leucopsarus-2, H. stenolepis-1
4-1	64	60	-	-	-	-	-	1	2	-	1	1	-	Hemilepidotus C-1
-2	552	531	7	2	-	3	4	-	4	-	3	3	-	S. leucopsarus-1
-3	215	202	1	7	-	3	2	-	-	-	4	4	-	
5-1	4	4	-	-	-	-	-	-	-	-	11	11	-	
-2	15	14	-	-	1	-	-	-	-	-	6	6	-	
-3	187	170	5	3	-	7	1	-	-	-	10	10	-	S. leucopsarus-1
6-1	19	16	-	-	-	-	-	-	-	-	9	9	-	P. monopterygius-3
-2	36	33	-	-	1	-	-	-	-	-	23	29	-	Cottidae M-1, UFL-1
-3	100	88	7	-	-	1	-	1	2	-	10	10	-	P. monopterygius-1
7-1	355	349	1	1	-	-	-	-	-	2	2	2	-	Hemilepidotus A-2
-2	2	-	-	-	-	-	-	-	-	1	24	24	-	Hemilepidotus C-1
-3	58	47	-	1	-	-	3	-	-	3	19	19	-	Hemilepidotus A-1, Cottidae A-2, C. polyactocephalus - 1
8-1	38	36	1	1	-	-	-	-	-	-	10	10	-	
-2	296	281	2	5	-	-	1	1	-	-	27	27	-	Hemilepidotus C-4, S. leucopsarus-2
-3	71	50	2	7	-	6	2	2	-	-	23	23	-	S. leucopsarus-1, N. pelagicus-1
-4		Bongo Tow Aborted												
9-1	384	304	-	-	5	-	-	-	59	5	132	131	-	Hemilepidotus C-1, Cottidae A-5, K-1, Agonidae-1, Psychrolutes sp.-1, Cyclopteridae -1, Stichaeidae E-1, Egg Type E-1

Appendix Table 1.--505-Bongo net, catch by station and taxa (cont.)

Station No.-Occupancy No.	Total Larvae	Theragra chalcogramma	Atheresthes sp.	Reinhardtius hippoglossoides	Lepidopsetta bilineata	Sebastes sp.	Bathylagus pacificus	Bathylagus schmidti	Gadidae - Unidentified	Ammodytes hexapterus	Total Eggs	Theragra chalcogramma - EGGS	Hippoglossoides sp. - EGGS	Other Larvae or Eggs 1/
9-2	427	391	1	1	5	5	-	-	-	3	678	678	-	Cyclopteridae-4, Cottidae A-1, B-5, G-1, K-5, Stichaeidae E-2, Agonidae-3
-3		Bongo Tow Aborted												
-4	47	26	1	1	-	11	2	-	1	-	121	121	-	Cottidae:B-1, K-1, Agonidae-1, Hexagrammos sp.-1, Cyclopteridae-1
10-1	11	-	-	-	-	-	-	-	-	11	12	12	-	
-2	38	15	-	-	3	-	-	-	-	11	9	9	-	Cyclopteridae-1, Cottidae:A-5, B-1, Agonidae-2
-3	109	69	1	1	-	32	-	1	-	-	55	55	-	Hemilepidotus D-1, Cottidae K-1, Agonidae-2, UFL-1
11-1	7	5	-	-	-	-	-	-	-	2	58	58	-	
-2	1	1	-	-	-	-	-	-	-	-	58	58	-	
-3	47	43	2	1	-	1	-	-	-	-	23	23	-	
12-1	3	1	-	-	-	-	-	-	-	1	-	-	-	L. maculatus-1
-2		No Larvae									-	-	-	
-3	120	116	-	-	1	-	1	-	-	2	15	15	-	
13-1	1	-	-	-	-	-	-	-	-	-	2	2	-	Hemilepidotus C-1
-2	5	5	-	-	-	-	-	-	-	-	1	1	-	
-3	9	4	-	4	-	-	-	-	-	-	5	5	-	Hemilepidotus D-1
14-1	3	3	-	-	-	-	-	-	-	-	3	3	-	
-2	8	7	-	-	-	-	-	-	-	-	4	4	-	Cottidae L-1
-3	14	14	-	-	-	-	-	-	-	-	61	16	45	
15-1	14	14	-	-	-	-	-	-	-	-	14	14	-	
-2	7	5	-	-	2	-	-	-	-	-	15	15	-	
-3	110	101	2	-	6	-	-	-	-	-	37	29	8	Cottidae H-1
16-1	1	-	-	-	-	-	-	-	-	1	7	7	-	
-2	8	-	-	-	6	-	-	-	-	-	42	14	28	Cottidae H-1, UFL-1
-3	8	1	-	-	6	-	-	-	-	-	23	22	1	Cottidae H-1
17-1	2	-	-	-	-	-	-	-	-	-	9	9	-	L. maculatus-2
-2	4	2	-	-	-	-	-	-	-	-	4	4	-	C. polyactocephalus - 2
-3	12	2	-	-	10	-	-	-	-	-	26	3	23	
18-1	8	-	-	-	3	-	-	-	-	3	6	6	-	C.polyactocephalus-1, M. villosus - 1
-2	13	-	-	-	5	-	-	-	-	-	-	-	-	C.polyactocephalus-1, M. villosus - 7
-3	3	2	-	1	-	-	-	-	-	12	4	4	-	

Appendix Table 1.--505-Bongo net, catch by station and taxa (cont.)

Station No.-Occupancy No.	Total Larvae	*Theragra chalcogramma*	*Atheresthes* sp.	*Reinhardtius hippoglossoides*	*Lepidopsetta bilineata*	*Sebastes* sp.	*Bathylagus pacificus*	*Bathylagus schmidti*	Gadidae - Unidentified	*Ammodytes hexapterus*	Total Eggs	*Theragra chalcogramma* - EGGS	*Hippoglossoides* sp. - EGGS	Other Larvae or Eggs 1/
19-1	15	-	-	-	3	-	-	-	-	12	137	137	-	
-2	15	-	-	-	2	-	-	-	-	8	372	372	-	Cottidae A-1, *M. villosus*-4
-3	92	81	-	3	5	-	-	-	-	1	227	227	-	Stichaedae E-1, Agonidae-1
20-1	11	-	-	-	-	-	-	-	-	11	3	3	-	
-2	15	-	-	-	5	-	-	-	-	4	-	-	-	Cottidae A-2, Stichaeidae E-4
-3	15	5	-	-	8	1	-	-	-	-	10	10	-	Cottidae B-1
21-1	155	-	-	-	3	-	-	-	-	151	3	2	-	UFL-1, UFO-1
-2	74	-	-	-	-	-	-	-	-	73	121	121	-	Cottidae A-1
-3	10	-	-	-	3	-	-	-	-	4	-	-	-	Stichaeidae E-1, *Hexagrammos* sp.-1,UFL-1
22-1	9	-	-	-	-	-	-	-	-	8	248	246	-	*M. villosus*-1, UFO-2
-2	18	-	-	-	2	-	-	-	-	15	1124	1123	-	*M. villosus*-1, UFO-1
-3	83	68	1	4	3	1	-	-	1	1	881	879	-	Cottidae G-1, *Icelinus* sp.-1, Agonidae-1, *P. quadrituberculatus*-1E,UFO-1,UFL-1
23-1	1	-	-	-	-	-	-	-	-	-	36	36	-	*L. maculatus*-1
-2	1	-	-	-	-	-	-	-	-	1	25	25	-	
-3	87	74	1	-	6	-	-	1	2	-	71	68	3	Cottidae E-1, UFL-2
24-1	13	-	-	-	12	-	-	-	-	-	24	24	-	*Hemilepidotus* D-1
-2	11	-	-	-	11	-	-	-	-	-	8	8	-	
-3	3	-	-	-	1	-	-	-	2	-	10	10	-	
25-1		No Larvae									1741	1741	-	
-2	6	-	-	-	-	-	-	-	-	5	16	16	-	Blennoidei-1
26-1	9	-	-	-	-	-	-	-	-	5	682	682	-	*M. villosus*-4
-2	7	-	-	-	-	-	-	-	-	5	63	62	-	Blennoidei-1, *M. villosus*-1,*P.quadrituberculatus*-1E
27-1		Bongo Tow Aborted												
-2	30	-	-	-	5	-	-	-	-	24	55	54	-	*M. villosus*-1, *P.quadrituberculatus*-1E
29-1	21	-	-	-	-	-	-	-	-	21	12	1	-	*P. quadrituberculatus*-11E
30-1	4	-	-	-	-	-	-	-	-	3	59	56	-	C.polyactocephalus-1,P.quadrituberculatus-3E
37-1		No Larvae									235	234	-	*P. quadrituberculatus*-1E
38-1	1	-	-	-	1	-	-	-	-	-	107	88	19	
39-1	8	6	-	-	1	-	-	1	-	-	2	2	-	
-2	32	31	-	-	-	-	-	-	-	-	120	117	3	*Hemilepidotus* C-1

Appendix Table 1.--505-Bongo net, catch by station and taxa. (cont.)

Station No.-Occupancy No.	Total Larvae	Theragra chalcogramma	Atheresthes sp.	Reinhardtius hippoglossoides	Lepidopsetta bilineata	Sebastes sp.	Bathylagus pacificus	Bathylagus schmidti	Gadidae - Unidentified	Ammodytes hexapterus	Total Eggs	Theragra chalcogramma - EGGS	Hippoglossoides sp. - EGGS	Other Larvae or Eggs 1/
40-1	1	-	-	-	-	-	-	-	-	-	1	-	-	Cyclopteridae-1, UFO-1
-2	28	24	-	1	-	-	-	-	-	-	77	76	1	Cottidae:A-1, C-1, M-1
41-1	4	3	-	-	-	-	-	-	-	-	19	19	-	Cyclopteridae-1
42-1	74	67	1	-	-	3	-	-	-	-	16	15	1	Agonidae A-1, Cyclopteridae-1, H.stenolepis-1
43-1	4	3	-	-	-	-	-	-	-	-	9	9	-	Cyclopteridae-1
44-1	81	34	1	4	-	38	1	1	1	-	5	4	-	Psychrolutes sp.-1, Egg-Type P-1
45-1	61	40	2	5	-	5	2	3	1	-	16	15	1	S. leucopsarus-2, H.stenolepis-1
46-1	40	34	1	-	-	1	2	-	-	-	2	2	-	C.polyactocephalus - 1, N. pelagicus -1
47-1	18	4	5	2	-	-	4	-	-	-		No Ova		P. monopterygius-1, S. leucopsarus-2
48-1	56	39	1	5	-	4	3	-	-	-	1	1	-	N. pelagicus-3, S. leucopsarus-1
49-1	39	32	-	-	-	4	3	-	-	-	6	6	-	
-2	136	126	1	2	-	3	1	1	-	-	10	10	-	N. pelagicus-1, H.stenolepis-1
-3	52	29	1	1	-	19	-	-	-	-	4	4	-	Bathymasteridae-2
50-1	841	826	2	2	2	6	1	1	-	-	20	19	-	S. leucopsarus-1, Egg-Type Q-1
-2	37	5	1	-	-	22	2	-	-	-	3	3	-	Psychrolutes sp.-1, Bathymasteridae-4 Hexagrammos sp.-2
51-1	96	92	1	2	-	1	-	-	-	-	1	1	-	
-2	24	11	-	2	-	7	2	-	-	-	3	3	-	Bathymasteridae-1, H. stenolepis-1
52-1	779	745	17	6	-	2	5	-	-	-	23	23	-	Hemilepidotus C-1, Hexagrammos sp-1, Macrouridae-1, H. stenolepis-1
-2	23	13	3	-	-	-	5	2	-	-	3	3	-	
53-1	578	559	8	3	-	1	2	1	-	2	4	4	-	C.polyactocephalus-1, H. stenolepis -1
-2	23	12	1	1	-	6	1	1	-	-	1	1	-	Hexagrammos sp. -1
54-1	13	11	-	-	2	-	-	-	-	-	2	2	-	
-2	29	24	-	2	2	-	1	-	-	-	2	2	-	
55-1		Bongo Tow Aborted												
-2	23	16	-	-	-	3	2	1	-	-	2	2	-	P. monopterygius-1
56-1	102	79	2	2	5	7	-	1	-	-	163	159	4	Cottidae M-3, Cyclopteridae-2, UFL-1
57-1	9	6	-	1	-	-	-	-	-	-	20	17	3	Cottidae M-2
58-1	65	61	1	-	-	-	-	-	-	-	50	50	-	Icelinus sp.-2, Cyclopteridae-1
-2	45	34	2	1	1	2	2	-	-	-	9	4	5	Psychrolutes sp.-2, Hexagrammos sp.-1
59-1	10	9	-	-	1	-	-	-	-	-	62	62	-	
-2	17	14	-	-	3	-	-	-	-	-	49	43	6	

Appendix Table 1.--505-Bongo net, catch by station and taxa . (cont.))

Station No.-Occupancy No.	Total Larvae	*Theragra chalcogramma*	*Atheresthes* sp.	*Reinhardtius hippoglossoides*	*Lepidopsetta bilineata*	*Sebastes* sp.	*Bathylagus pacificus*	*Bathylagus schmidti*	Gadidae - Unidentified	*Ammodytes hexapterus*	Total Eggs	*Theragra chalcogramma* - EGGS	*Hippoglossoides* sp. - EGGS	Other Larvae or Eggs 1/
60-1	3	1	-	-	-	-	-	-	-	-	27	27	-	*Hemilepidotus* C-1, *L. maculatus*-1
-2	11	-	-	-	11	-	-	-	-	-	34	31	2	*P. quadrituberculatus*-1E
61-1		No Larvae									726	726	-	
-2	1	-	-	-	-	-	-	-	-	-	196	193	-	*L. maculatus*-1, *P. quadrituberculatus*-3E
62-1		No Larvae									143	142	-	*P. quadrituberculatus*-1E
64-1	264	239	14	5	-	-	1	-	-	-	1	1	-	*Hemilepidotus* D-1, Cottidae-1, Cyclopteridae-1, *Hexagrammos* sp.-1, *S. leucopsarus*-1
-2	20	2	-	-	1	11	1	-	1	-	5	3	-	Bathymasteridae-3, *Z. silenus*-1, Egg-Type Q-1, Egg-Type N-1
65-1	103	97	1	1	-	2	2	-	-	-	5	5	-	
-2	66	63	1	1	-	-	-	1	-	-	5	5	-	
66-1	239	226	3	3	-	3	2	-	-	-	12	12	-	*Hexagrammos* sp.-1, *S. leucopsarus*-1
-2	176	166	2	-	-	-	2	4	-	-	10	10	-	*N. pelagicus*-1, *P. monopterygius*-1
70-1	27	21	-	-	-	3	-	2	-	-	8	8	-	*Hemilepidotus* D-1
71-1	1	-	-	-	-	-	-	-	-	-	0	-	-	Cyclopteridae-1
72-1	2	-	-	-	-	-	-	-	-	-	5	-	-	*L. maculatus*-1, Cyclopteridae-1, *P. quadrituberculatus*-5E
73-1	1	-	-	-	-	-	-	-	-	-	No	Ova		*L. maculatus*-1
74-1	5	-	-	-	-	-	-	-	-	-	59	57	1	Agonidae-1, Cyclopteridae-1, *P. goodei*-1, Pholidae-2, *P. quadrituberculatus*-1E
75-1	84	54	1	2	3	20	3	-	-	-	27	22	-	*N. pelagicus*-1, Egg Type P-5

1/ Eggs are shown by the letter E after the number.

Appendix Table 2.-- Neuston net, catch by station and taxa.

Station No.-Occupancy No.	Total Larvae	Hexagrammos sp.	Hexagrammos A	Hexagrammos B	Hexagrammos C	Pleurogrammus monopterygius	Hemilepidotus hemilepidotus	Hemilepidotus jordani	Hemilepidotus papilio	Bathymasteridae	Chirolophis polyactocephalus	Theragra chalcogramma	Total Eggs	Theragra chalcogramma - EGGS	Hippoglossoides sp. - EGGS	Other Larvae or Eggs 1/
1-1	165	-	21	36	6	24	-	10	12	1	-	54	33	33	-	Sebastes sp.-1
-2	40	20	3	8	3	1	-	2	1	-	1	-	1351	1351	-	Sebastes sp.-1
-3	58	4	7	5	3	3	5	13	4	5	1	8	60	58	2	
2-1	91	1	2	4	1	-	-	2	-	-	-	81	2	2	-	
-2	625	11	5	10	4	23	91	409	27	17	24	2	16	16	-	Sebastes sp.-2
-3	109	32	10	1	2	9	11	17	10	2	13	-	5	5	-	Sebastes sp.-2
-4	83	17	1	1	-	2	17	5	8	2	20	2	3	3	-	H. stenolepis-1; Z.silenus-2; A. fimbria-2; Stichaeidae A1-2, F-1
3-1	9	1	1	-	-	2	-	1	-	-	-	4	1	1	-	
-2	10	6	1	-	-	2	-	-	-	-	-	1	1	1	-	
-3	9	4	2	1	1	-	-	-	-	-	-	-	1	1	-	UFL-1
4-1	12	2	1	1	-	-	-	-	-	-	-	8	No	Ova		
-2	13	9	1	-	-	3	-	-	-	-	-	-	No	Ova		
-3	7	6	1	-	-	-	-	-	-	-	-	-	No	Ova		
5-1		No	Sample													
-2		No	Larvae										34	25	9	
-3	3	1	-	-	-	-	-	-	-	-	-	-	2	2	-	UFL-2
6-1	47	3	5	1	5	10	3	14	2	1	1	2	5	5	-	
-2		No	Larvae										125	125	-	
-3	5	-	-	3	-	1	-	-	-	-	-	-	No	Ova		UFL-1
7-1	60	2	4	-	1	-	-	9	1	2	17	2	2	2	-	UFL-22
-2	6	5	-	-	-	-	-	-	-	-	-	1	5	5	-	
-3	110	13	17	-	-	1	6	7	12	1	4	11	2	2	-	M. villosus-38
8-1	20	1	-	-	1	-	2	5	-	2	8	1	No	Ova		
-2	121	11	3	8	2	3	4	31	2	-	14	-	10	10	-	Stichaeidae F-7; A. hexapterus-1, A. orientalis-1; Z.silenus-3 M. villosus-31
-3	90	5	3	5	1	13	19	3	19	2	15	2	12	12	-	Sebastes sp.-3
-4	113	20	15	1	-	3	34	12	7	2	13	-	1	1	-	Stichaeidae F-4; A. ventricosus-1 Sebastes sp.-1
9-1	23	4	1	-	4	-	-	9	-	4	-	-	28	28	-	UFL-1
-2	96	8	20	3	15	4	1	21	2	-	9	8	235	235	-	Stichaeidae F-1; UFL-3,Sebastes sp-1

Appendix Table 2.-- Neuston net, catch by station and taxa (cont.)

Station No.-Occupancy No.	Total Larvae	*Hexagrammos* sp.	*Hexagrammos* A	*Hexagrammos* B	*Hexagrammos* C	*Pleurogrammus monopterygius*	*Hemilepidotus hemilepidotus*	*Hemilepidotus jordani*	*Hemilepidotus papilio*	Bathymasteridae	*Chirolophis polyactocephalus*	*Theragra chalcogramma*	Total Eggs	*Theragra chalcogramma* - EGGS	*Hippoglossoides* sp. - EGGS	Other Larvae or Eggs 1/
9-3	79	6	2	2	-	1	1	3	2	-	4	48	77	77	-	UFL-3, *Sebastes* sp.-7
-4	7	6	-	-	-	-	-	-	-	-	-	1	37	37	-	
10-1	14	-	1	3	5	-	-	4	-	-	-	-	20	20	-	*A. hexapterus*-1
-2	13	-	-	-	-	-	1	7	-	-	2	-	4	4	-	Stichaeidae F-3
-3	29	7	2	-	-	-	1	2	1	2	2	3	125	125	-	Cottidae-1; *A.hexapterus*-1; *H. stenolepis*-1; Agonidae B-1, UFL-4, *Sebastes* sp.-1
11-1	1	1	-	-	-	-	-	-	-	-	-	-	33	33	-	
-2	50	8	-	1	2	3	8	20	-	2	5	-	228	228	-	Stichaeidae F-1
-3	17	-	2	2	-	1	7	3	-	-	-	1	17	17	-	Stichaeidae F-1
12-1	5	2	1	2	-	-	-	-	-	-	-	-	No	Ova		
-2	2	1	1	-	-	-	-	-	-	-	-	-	1	1	-	
-3	1	-	-	-	-	1	-	-	-	-	-	-	1	1	-	
13-1	4	-	1	1	1	1	-	-	-	-	-	-	No	Ova		
-2	4	2	1	1	-	-	-	-	-	-	-	-	1	1	-	
-3	42	2	27	8	2	3	-	-	-	-	-	-	6	3	3	
14-1	1	-	-	-	-	1	-	-	-	-	-	-	No	Ova		
-2	5	-	4	-	1	-	-	-	-	-	-	-	4	3	1	
-3	36	5	18	7	2	4	-	-	-	-	-	-	19	10	9	
15-1	1	1	-	-	-	-	-	-	-	-	-	-	7	7	-	
-2	1	1	-	-	-	-	-	-	-	-	-	-	3	3	-	
-3	80	19	21	3	1	19	2	2	8	-	-	-	43	17	26	UFL-5
16-1	108	6	2	5	6	7	47	31	-	3	-	-	3	3	-	UFL-1
-2	8	2	1	1	3	1	-	-	-	-	-	-	13	4	9	
-3	17	1	7	5	-	4	-	-	-	-	-	-	44	18	26	
17-1	77	2	3	3	8	9	20	29	-	2	-	-	No	Ova		UFL-1
-2	68	6	6	4	1	12	8	12	-	3	15	-	No	Ova		*M. villosus*-1
-3	1	-	-	-	-	1	-	-	-	-	-	-	184	11	173	
18-1	55	4	7	3	7	10	-	12	-	3	5	-	2	2	-	*M. villosus*-4
-2	193	19	11	5	7	4	10	17	-	1	19	-	6	6	-	*M. villosus*-100
-3	No	Larvae											8	8	-	
19-1	52	8	2	4	4	4	3	20	-	1	1	-	20	20	-	*M. villosus*-5
-2	30	-	6	2	3	3	-	2	-	-	-	-	221	221	-	Stichaeidae F-1, *M.villosus*-13
-3	3	1	-	-	-	-	-	-	-	-	-	-	1251	1243	8	Cottidae N-1; *A.orientalis*-1

Appendix Table 2.-- Neuston net, catch by station and taxa. (cont.)

Station No.-Occupancy No.	Total Larvae	Hexagrammos sp.	Hexagrammos A	Hexagrammos B	Hexagrammos C	Pleurogrammus monopterygius	Hemilepidotus hemilepidotus	Hemilepidotus jordani	Hemilepidotus papilio	Bathymasteridae	Chirolophis polyactocephalus	Theragra chalcogramma	Total Eggs	Theragra chalcogramma - EGGS	Hippoglossoides sp. - EGGS	Other Larvae or Eggs 1/
20-1	5	2	1	-	-	1	-	-	-	-	-	-	5	5	-	M. villosus-1
-2	13	8	1	2	1	-	-	-	-	-	-	-	8	8	-	Stichaeidae F-1
-3	48	2	-	-	-	-	-	2	-	-	-	-	25	25	-	Stichaeidae F-3, Cottidae,G-3, N-2,0-10,Not Typed-1; H. stenolepis-1; A.orientalis-1; L. bilineata-4;UFL-1;Agonidae A-16 M. villosus-1
21-1	2	-	-	1	1	-	-	-	-	-	-	-	17	16	-	UFO-1
-2	11	8	1	-	2	-	-	-	-	-	-	-	273	272	-	UFO-1
-3	10	-	-	-	-	-	-	-	-	1	-	-	1	1	-	M. villosus-9
22-1	2	-	-	-	-	1	-	-	-	-	-	-	161	161	-	UFL-1
-2	6	-	4	2	-	-	-	-	-	-	-	-	1357	1357	-	
-3	No	Larvae											1823	1809	14	
23-1	1	-	-	-	-	1	-	-	-	-	-	-	11	11	-	
-2	No	Larvae											11	11	-	
-3	6	4	-	-	-	-	-	-	-	-	-	-	199	199	-	Cottidae O-1; UFL-1
24-1	2	1	-	-	-	1	-	-	-	-	-	-	5	5	-	
-2	4	-	1	-	1	2	-	-	-	-	-	-	8	8	-	
-3	2	-	-	-	-	2	-	-	-	-	-	-	86	22	64	
25-1	99	2	8	6	8	4	1	-	-	1	-	-	988	988	-	M. villosus-69
-2	54	5	1	2	1	-	-	-	-	3	-	-	43	43	-	A.orientalis-1; UFL-1;M.villosus-40
26-1	47	-	10	4	10	2	-	-	-	-	-	-	266	266	-	M. villosus-21
-2	No	Larvae											157	157	-	
27-1	14	-	2	7	3	-	-	-	-	-	-	-	4	4	-	A. hexapterus-2
-2	44	6	3	2	1	2	1	-	-	4	-	-	53	46	-	Cottidae G-2; A.hexapterus-5; UFL-2; P.quadrituberculatus-7E M. villosus-16
29-1	4	1	-	-	-	2	-	-	-	-	-	-	27	6	-	UFL-1; P.quadrituberculatus-21E
30-1	No	Larvae											217	213	-	P. quadrituberculatus-4E
37-1	6	1	4	-	1	-	-	-	-	-	-	-	494	494	-	
38-1	12	-	8	-	-	4	-	-	-	-	-	-	104	98	6	
39-1	2	-	-	-	1	1	-	-	-	-	-	-	3	3	-	
-2	6	-	-	-	-	5	-	-	-	-	-	-	118	117	1	UFL-1

Appendix Table 2.-- Neuston net, catch by station and taxa. (cont.)

Station No.-Occupancy No.	Total Larvae	Hexagrammos sp.	Hexagrammos A	Hexagrammos B	Hexagrammos C	Pleurogrammus monopterygius	Hemilepidotus hemilepidotus	Hemilepidotus jordani	Hemilepidotus papilio	Bathymasteridae	Chirolophis polyactocephalus	Theragra chalcogramma	Total Eggs	Theragra chalcogramma - EGGS	Hippoglossoides sp. - EGGS	Other Larvae or Eggs 1/
40-1	1	-	-	1	-	-	-	-	-	-	-	-	No	Ova		
-2	43	4	13	-	-	24	-	1	-	-	1	-	88	87	1	
41-1	18	1	2	2	-	1	-	-	-	-	-	-	38	37	-	UFL-12;P. quadrituberculatus-1E
42-1	32	2	5	-	-	7	5	3	-	2	1	4	3	3	-	Sebastes sp.-3
43-1	54	2	-	1	-	34	5	7	1	-	1	-	9	9	-	Stichaeidae A1-3
44-1	7	2	-	1	-	3	-	-	-	-	-	-	2	2	-	UFL-1
45-1	3	3	-	-	-	-	-	-	-	-	-	-	19	14	4	UFO-1
46-1	5	1	-	-	-	-	-	-	-	-	2	-	14	14	-	A. ventricosus-2
47-1	54	15	-	-	1	37	-	1	-	-	-	-	1	-	1	
48-1	14	5	3	-	-	4	2	-	-	-	-	-	No	Ova		
49-1	5	1	2	-	1	1	-	-	-	-	-	-	4	4	-	
-2	3	-	1	-	-	-	-	-	1	-	-	1	1	1	-	
-3	3	1	-	-	-	1	1	-	-	-	-	-	1	1	-	
50-1	21	5	5	2	-	8	-	-	-	-	-	1	7	7	-	
-2	27	25	-	-	-	-	-	-	-	-	-	1	1	1	-	Sebastes sp.-1
51-1	1	-	-	-	1	-	-	-	-	-	-	-	2	2	-	
-2	20	8	4	-	-	3	4	-	-	-	-	-	No	Ova		Sebastes sp.-1
52-1	13	3	5	-	1	4	-	-	-	-	-	-	8	8	-	
-2	4	3	-	-	-	-	-	-	-	-	-	1	No	Ova		
53-1	104	1	8	-	-	21	4	40	19	7	-	4	2	2	-	
-2	18	4	-	-	-	1	3	1	5	-	-	-	No	Ova		Stichaeidae A1-3,Sebastes sp.-1
54-1	47	3	3	3	-	26	2	1	-	4	1	4	1	1	-	
-2	40	5	8	-	-	7	3	6	6	-	5	-	2	2	-	
55-1	42	-	2	-	1	21	-	4	3	1	-	10	No	Ova		
-2	7	4	1	-	-	2	-	-	-	-	-	-	No	Ova		
56-1	7	3	-	1	-	-	-	-	-	-	-	-	1148	1148	-	Sebastes sp.-3
57-1	1	1	-	-	-	-	-	-	-	-	-	-	88	85	2	P. quadrituberculatus-1E
58-1	10	2	-	1	-	7	-	-	-	-	-	-	11	11	-	
-2	2	2	-	-	-	-	-	-	-	-	-	-	36	35	-	P. quadrituberculatus-1E
59-1	118	9	15	6	2	31	14	38	-	1	-	-	55	54	1	Stichaeidae A1-2
-2	13	1	-	3	1	5	2	-	-	-	-	-	54	47	7	A. orientalis-1

Appendix Table 2. -- Neuston net, catch by station and taxa. (cont.)

Station No.-Occupancy No.	Total Larvae	Hexagrammos sp.	Hexagrammos A	Hexagrammos B	Hexagrammos C	Pleurogrammus monopterygius	Hemilepidotus hemilepidotus	Hemilepidotus jordani	Hemilepidotus papilio	Bathymasteridae	Chirolophis polyactocephalus	Theragra chalcogramma	Total Eggs	Theragra chalcogramma - EGGS	Hippoglossoides sp. - EGGS	Other Larvae or Eggs 1/
60-1	50	1	9	3	4	10	7	13	-	2	1	-	42	42.	-	
-2	8	1	5	-	1	1	-	-	-	-	-	-	64	35	29	
61-1	10	1	-	2	4	3	-	-	-	-	-	-	608	608	-	
-2	4	4	-	-	-	-	-	-	-	-	-	-	697	689	-	P. quadrituberculatus-8E
62-1	70	-	14	7	5	-	1	-	-	3	-	-	239	237	-	P. quadrituberculatus-2E M. villosus-40
64-1	25	4	5	3	-	13	-	-	-	-	-	-	4	4	-	
-2	1	1	-	-	-	-	-	-	-	-	-	-	4	1	-	UFO-3
65-1	1	-	1	-	-	-	-	-	-	-	-	-	4	4	-	
-2	15	2	6	-	-	3	2	1	1	-	-	-	No	Ova		
66-1	16	-	2	2	-	2	1	-	-	-	-	-	No	Ova		UFL-9
-2	181	4	10	2	-	12	20	29	22	4	78	-	2	2	-	
70-1	65	5	2	-	-	13	5	16	7	5	12	-	No	Ova		
71-1	1	-	1	-	-	-	-	-	-	-	-	-	No	Ova		
72-1	1	-	-	-	1	-	-	-	-	-	-	-	23	-	2	P. quadrituberculatus-21E
73-1	2	-	1	1	-	-	-	-	-	-	-	-	10	3	-	P. quadrituberculatus-7E
74-1	No	Larvae											61	61	-	
75-1	1	-	1	-	-	-	-	-	-	-	-	-	90	80	5	P. quadrituberculatus-1E,UFO-4

1/ Eggs are shown by the letter E after the number.