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Distribution of Ichthyoplankton in the Eastern Bering Sea During June and July 1979

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by

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INTRODUCTION

Over the past several years ichthyoplankton surveys have been made in the eastern Bering Sea by the Northwest and Alaska Fisheries Center (NWAFC) for a variety of purposes (Waldron and Favorite, 1977; Waldron and Vinter, 1978; Waldron, 1978). The main objective in these studies was to assess walleye pollock (*Theragra chalcogramma*) eggs and larvae to determine spawning times and locations and to identify areas of high walleye pollock larval abundances. During the 1979 trawl and hydroacoustic survey of the adult walleye pollock population in the eastern Bering Sea, ichthyoplankton samples were taken to measure growth rates of field-caught larval walleye pollock by enumerating daily growth increments of the otolith. These results have been presented elsewhere (Walline, 1980). This report describes the distribution and abundance of the ichthyoplankton caught on the 1979 trawl and hydroacoustic survey of the eastern Bering Sea.

Besides those surveys by the NWAFC previously mentioned, only a few investigations of the Bering Sea ichthyoplankton have been made. The reports of Kashkina (1970) and Maeda and Hirakawa (1977) include much of the Japanese data from cruises made by the Faculty of Fisheries, Hokkaido University, and Musienko (1963) reports on ichthyoplankton collected by the Bering Sea Expedition of 1958-1959.

These reports and the results from 41 other ichthyoplankton cruises in the eastern Bering Sea by U.S., Russian, and Japanese biologists are summarized by Waldron (1979). He emphasizes the difficulty in comparing these data because the surveys were conducted during different seasons using different nets and types of tows. Although the present survey was limited in time and area, the gear and methods used were identical to those of Waldron and Favorite (1977) and Waldron and Vinter (1978). These are the surveys to which the results can most easily be compared. It provides preliminary indications of spawning times and locations for some of the other commercially important species in the eastern Bering Sea.

METHODS

Ichthyoplankton was collected from the Bering Sea on a cruise of the NOAA research vessel Miller Freeman from 1 June to 23 July 1979. The main objective of the cruise was to carry out a trawl and hydroacoustic survey of the adult walleye pollock population in the eastern Bering Sea, so the cruise track was intended to cover the entire shelf area between depths of 90-460 m once. This allowed samples of ichthyoplankton to be taken from widely separated areas of the eastern Bering Sea (Fig. 1, Table 1), but allowed only limited time series observations at single locations. The cruise was divided into three legs: I (1 Jun-7 Jun), II (16 Jun-2 Jul), and III (8 Jul-23 Jul). Ichthyoplankton sampling was the primary mission on Leg I. The dates listed demarcate only the periods during which ichthyoplankton sampling occurred.

Plankton was collected using the procedures described by the National Marine Fisheries Service Resources Monitoring Assessment and Prediction (MARMAP) Field Group. The slight modifications employed are described in Waldron and Vinter (1978).

Surface samples were collected using a modified Sameoto neuston sampler with a mouth opening of 30 x 50 cm and a net mesh of 505 um towed for 10 min at 2-3 knots. Plankton from deeper layers was collected with paired 0.6 m open bongo nets, one with 505 um mesh and the other with 333 um mesh. Double oblique tows were made from the surface to slightly more than 200 m depth, or to within 5-10 m of bottom in shallower water. Both of these tows and at least one CTD (Conductivity, Temperature, Depth) cast for salinity, temperature, and depth were made at nearly every station. On Leg I two stations were occupied for 48-h each. At the first, 8 bongo and 8 neuston tows were made, and at the second, 8 neuston and 15 bongo tows were made.

Both nets were equipped with calibrated mechanical flowmeters with digital readout. The data from the flowmeters was used to standardize the catches using procedures adapted from Kramer et al. (1972). For each haul a standard haul factor (SHFA) was calculated to convert catch to catch per 10 m^2 surface area and another (SHFB) to convert catch to catch per 1000 m^3 (Table 1).

Sorting of fish eggs and larvae from neuston and 505-bongo samples was done through a contract with Texas Instruments, Inc., Dallas, Texas. The quality of sorting by this contractor had been evaluated previously and found to be acceptable (Waldron and Vinter, 1978). No samples from the present cruise were sorted to check thoroughness of sorting.

Eggs and larvae were identified at the NWAFC using criteria developed inhouse from numerous published and unpublished sources. Only 10 of 1479 eggs and 4 of 16,292 larvae were unidentified.

Common and scientific names used are those recommended by the American Fisheries Society.

RESULTS

Ichthyoplankton samples were taken at 114 locations covering a large part of the eastern Bering Sea (Fig. 1). Several locations were sampled more than once, resulting in a total of 130 neuston samples and 126 505-bongo samples. At the two diel stations (Fig. 1), replicate bongo tows were made and therefore these two locations are over-represented in the catch totals.

A total of 136 casts were made for salinity, temperature, and depth. Temperatures in the upper mixed layer, where most of the larvae were caught, ranged from about 6°C to just over 8°C. Bottom temperatures were less variable, being everywhere about 3.7°C. The complete data set is available from NWAFC (Arthur W. Kendall, Jr.).

A combined total of 16,292 larvae were caught, of which 83% were caught in the neuston net. Just over 90% of the 1479 eggs were also caught in the neuston net.

Eggs from two families, Gadidae and Pleuronectidae, were present in both the bongo and neuston samples. In addition 6 eggs from the family Macrouridae were present in the bongo samples. Ten eggs could not be identified.

Fish larvae from 17 families occurred in the samples. All

17 were represented in the 5Ø5-bongo samples, but only 14 in the neuston samples. Within the bongo catches, 21 taxa were identified to species and 4 to genus only. Twenty-five of the taxa represented in the neuston catch were identified to species and 4 to genus only (Table 2).

The larval catch for the bongo net is dominated by three taxa, walleye pollock, *Sebastes* spp., and *Bathymaster* spp., which account for 79% of the total catch. Two taxa, *Bathymaster* spp., and *Lyconectes aleutensis*, make up 82% of all larvae caught in the neuston net. Eggs of two species, walleye pollock and *Limanda aspera*, are the most abundant eggs in both nets and make up 89% of all eggs caught.

Distribution of eggs

Both bongo and neuston catches show maximum concentrations of walleye pollock eggs at the stations farthest inshore (Figs. 2 and 3). However, at no station were eggs nearly as abundant as during the 1976 or 1977 surveys. Comparison of the numbers caught per 1Ø m^2 in the neuston and bongo nets confirms previous findings that only a small percentage of walleye pollock eggs occur in the upper Ø.25 m of the water column.

All of the *Limanda aspera* eggs were taken at two locations, the inshore diel station (VØ9A-V16A) and the station S11A which was the station nearest the inshore diel station.

Distribution of larvae: 5Ø5-bongo

Sampling on this cruise was not done on a random basis. On Leg I stations were chosen in an attempt to find concentrations of larval walleye pollock. The two diel stations were established on the basis of the occurrence of larval walleye pollock in preliminary bongo tows. Therefore, the numbers of walleye pollock in Table 2 may not be completely representative of their numbers in the survey area, especially since at the two diel stations multiple bongo and neuston tows were made. However, in preparing the maps of the distribution of larval walleye pollock (and other species) only the first bongo and neuston catches at a location are plotted. Nearly all samples were taken at night, except at the diel stations, so numbers plotted can be compared without considering the problem of diel variations in avoidance.

The highest concentrations of larval walleye pollock encountered during this survey occurred at stations near the center of Bristol Bay (Fig. 4) as might have been expected. However, it was unexpected to find walleye pollock larvae occurring at deep-water stations occupied on a transect to Adak and at stations far to the north of the Pribilof Islands. The numbers are lower than those encountered during the 1976 and 1977 surveys and the larvae are larger. The size varied greatly between stations, even those as close as the two diel stations, indicating a complex spawning pattern (Walline, 198Ø).

The second most abundant taxon of larvae in the bongo samples was *Bathymaster* spp. It occurred nearly everywhere in the survey area except at some of the stations farthest inshore and at some of the deep-water stations in the center of the Bering Sea (Fig. 5).

Sebastes spp. is the only other taxon of which more than 100 specimens were taken in the 505-bongo nets. It occurred over the whole area except at the most inshore stations (Fig. 6). It occurred in somewhat greater numbers at the Bristol Bay stations.

Only a few pleuronectid larvae were caught. Flatfish larvae of species caught in spring surveys would probably be large enough to easily avoid the bongo net or would have become demersal by the time of year this survey was made (Table 3). However, 41 specimens of *Hippoglossoides elassodon* were caught while none were caught in the 1976 and 1977 surveys.

Distribution of larvae: Neuston

The only taxa to occur in significant numbers in both the bongo and neuston nets was *Bathymaster* spp. This was the most abundant taxon in the neuston samples, with as many as 1,865 (50/10 m^2) in a single sample (S42A). It was present over the entire survey area (Fig. 7).

The second most abundant species was *Lyconectes aleutensis*. This species occurred only at stations on the shelf (Fig. 8). None were caught near Adak or in the central Bering Sea.

The distributions of *Hexagrammos decagrammus* and *Anoplopoma fimbria* are similar in that both occur at many stations in low numbers (Figs. 9 and 10).

Ammodytes hexapterus occurred at 21 locations with most at the inner stations in Bristol Bay (Fig. 11).

Finally, the areal distribution of the two cottids, Hemilepidotus hemilepidotus and Hemilepidotus jordani are similar but the former occurs at more stations and is more abundant (Figs. 12 and 13).

DISCUSSION

There are several obvious differences in the results of this summer survey compared with the surveys made earlier in the year during 1976 and 1977. The lengths of many of the larvae occurring in both seasons has increased by the summer (Table 3). An exception to this trend are the hexagrammids which seem to have the same length frequency distributions in the early spring as in the summer.

The abundance of various species of ichthyoplankton also undergoes changes. Walleye pollock eggs and larvae are both less abundant. By June the peak spawning of pollock has passed. Flatfish larvae seem generally less abundant in summer, but this could result from increased avoidance by the larger larvae, especially those of species such as Lepidopsetta bilineata, and Atheresthes stomias whose spawning periods have passed by summer. Some species are more abundant in summer. The widespread occurrence of Bathymaster spp. larvae during this survey is the most striking example. Among taxa of possible commercial importance, larvae of Anoplopoma fimbria, Sebastes spp. and eggs of Limanda aspera were more abundant during this summer survey. The Limanda aspera eggs were taken in hauls in Bristol Bay in

June and indicate the initiation of spawning. Because these stations were occupied only at the start of the survey, the peak of spawning activity for this species was not delineated.

The composition of the summer ichthyoplankton is different from that encountered in spring. Some larvae occurred in this survey which were never encountered during the previous surveys. A few *Pleuronectes quadrituberculatus* larvae were caught but no eggs were taken. The low numbers caught (7 total) imply that the center of distribution was not located, but the results tend to confirm the spawning dates of May to mid-June found by Musienko (1970) and Waldron and Favorite (1977). *Hippoglossoides elassodon* larvae, which did not occur in the 1976-1977 surveys, were the most abundant flatfish larvae on this survey and were present at 12 stations. The number of eggs was much lower than in earlier surveys, indicating that the spawning season was nearly completed.

Some species occurring in earlier surveys were not found during this summer survey. Larvae of the smelt *Mallotus villosus* did not occur, but only two stations were occupied in the area near Unimak Pass where they were found during the 1977 survey. No Pholidae larvae were caught in 1979 and the species of larval Cottidae and Stichaeidae differed from those of the spring surveys.

Finally, the distribution of some of the species has changed by the summer. An example is the distribution of walleye pollock eggs. As Waldron and Favorite (1977) point out, the center of abundance for walleye pollock eggs differs for all surveys taken so far, but comparison of the distribution of eggs depicted in Figure 2 with the distribution shown in earlier surveys shows that walleye pollock eggs are restricted to an area much farther inshore in summer. This confirms suggestions made by Serobaba (1968) that walleye pollock spawning proceeds from the shelf break onshore as the season progresses and the water warms.

Since these surveys were not made during a single year, environmental conditions were not constant. A warming trend from 1976-1979 made the 1979 the warmest of the years being compared in this discussion. This would tend to accentuate differences observed as the season would be more advanced for a given date in 1979 as compared to 1976 or 1977. To overcome this shortcoming and those discussed earlier would require a more regular and systematic sampling program such as that outlined by Waldron (1979). However, even the massive program of 8,000-10,000 samples he describes would not address problems of annual variations in the composition and abundance of the ichthyoplankton. In the present survey, for example, more bathymasterid larvae were caught than in all 43 surveys reviewed by Waldron (1979) combined. This is not likely to be the result of previous surveys having been mistimed with respect to maximum abundances of bathymasterid larvae since 55% of sampling effort in these surveys took place in the same months as this 1979 survey. To develop an understanding of why such events occur requires sampling intensively on smaller scales and attempting to relate changes in ichthyoplankton abundance to changes in the physical and biological environment. This work has barely begun in the eastern Bering Sea.

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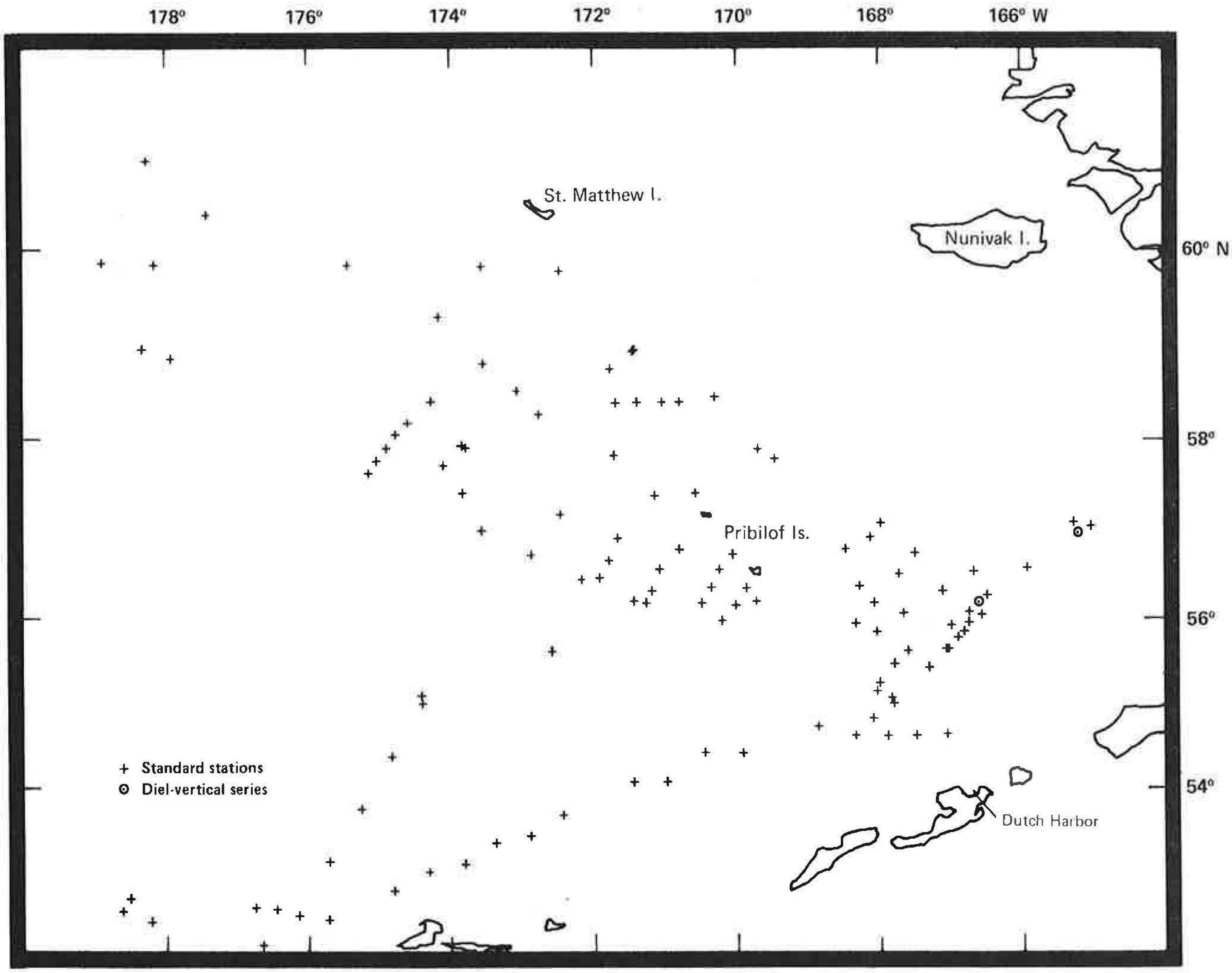

Figure 1. Distribution of sampling stations for ichthyoplankton, RV Miller Freeman, Cruise 3MF79, 1 Jun-23 Jul 1979.

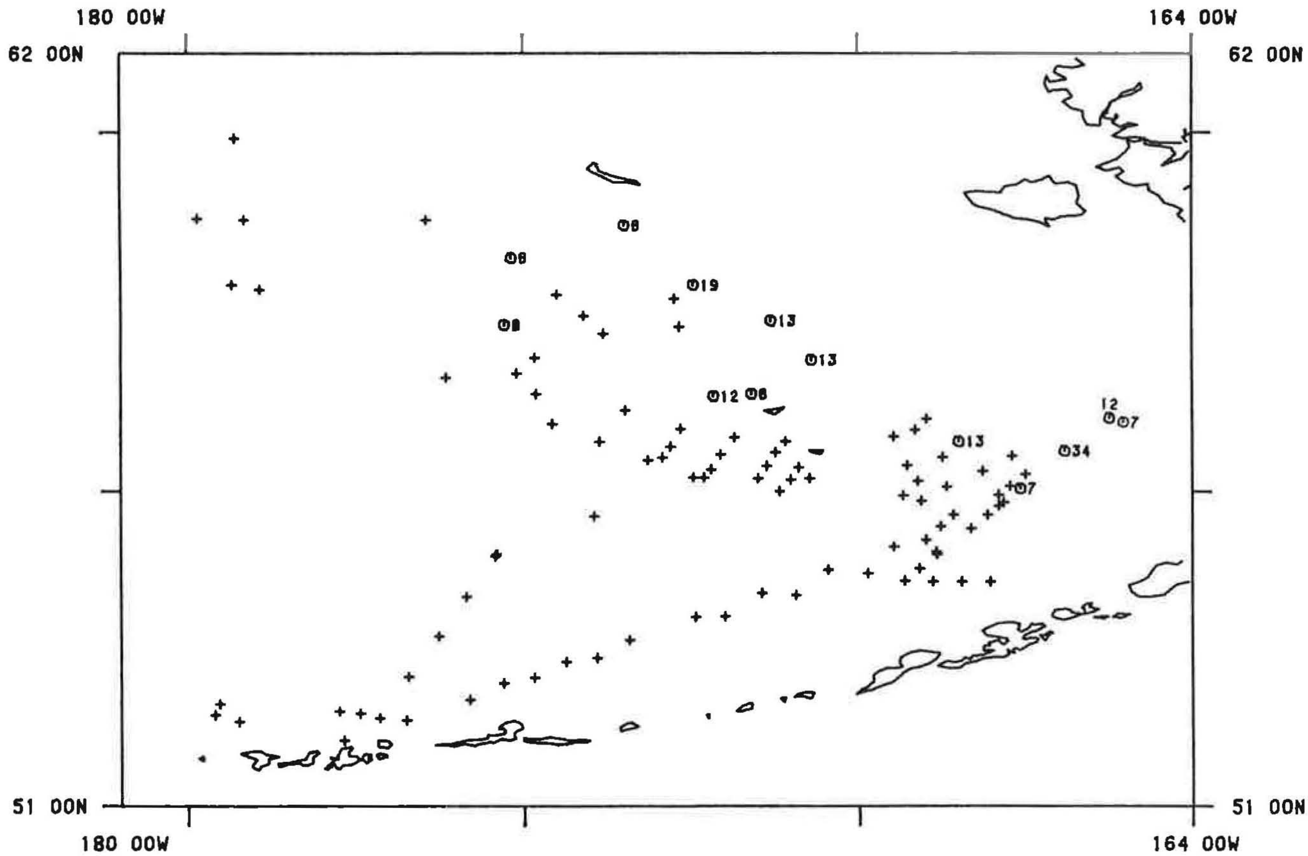

Figure 2. Distribution and abundance as No./10 m^2 of eggs of <u>Theragra chalcogramma</u> in bongo collections from the eastern Bering Sea, 1 June-23 July 1979. Crosses show station locations where catch was zero.

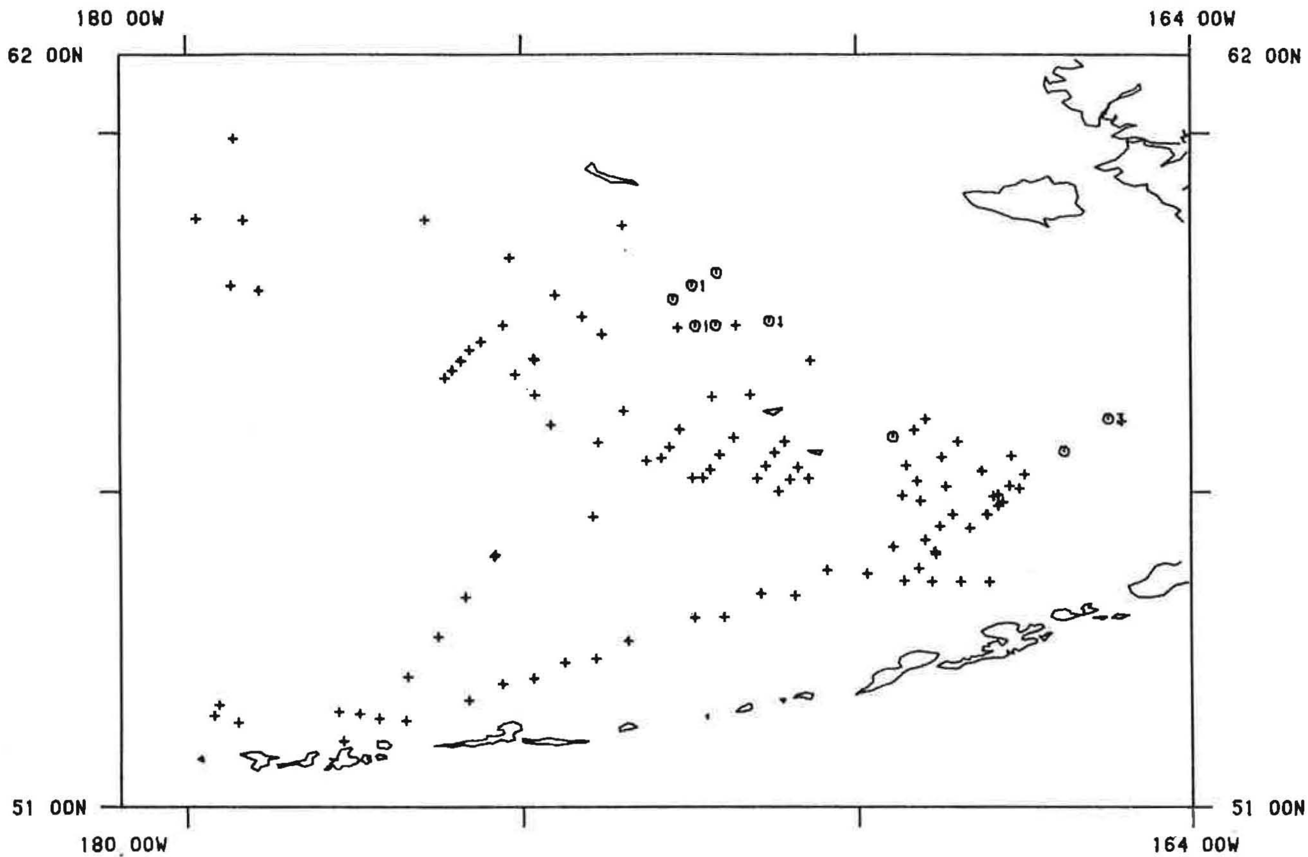

Figure 3. Distribution and abundance as No./10 m^2 of eggs of <u>Theragra chalcogramma</u> in neuston collections from the eastern Bering Sea, 1 June-23 July 1979. Crosses show station locations where catch was zero and circles without numbers show locations where catch was less than 0.5/10 m^2.

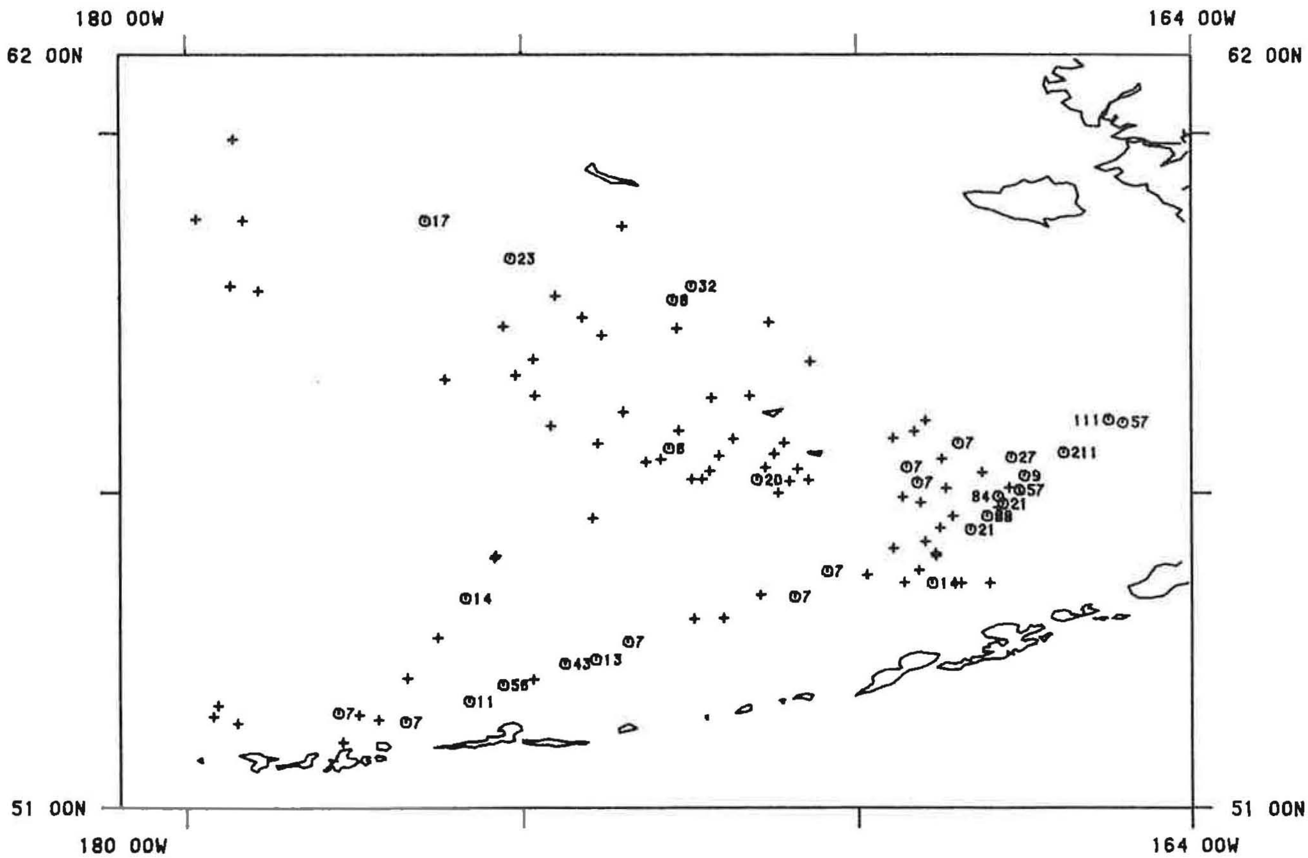

Figure 4. Distribution and abundance as No./10 m^2 of larvae of Theragra chalcogramma in bongo collections from the eastern Bering Sea, 1 June-23 July 1979. Crosses show station locations where catch was zero.

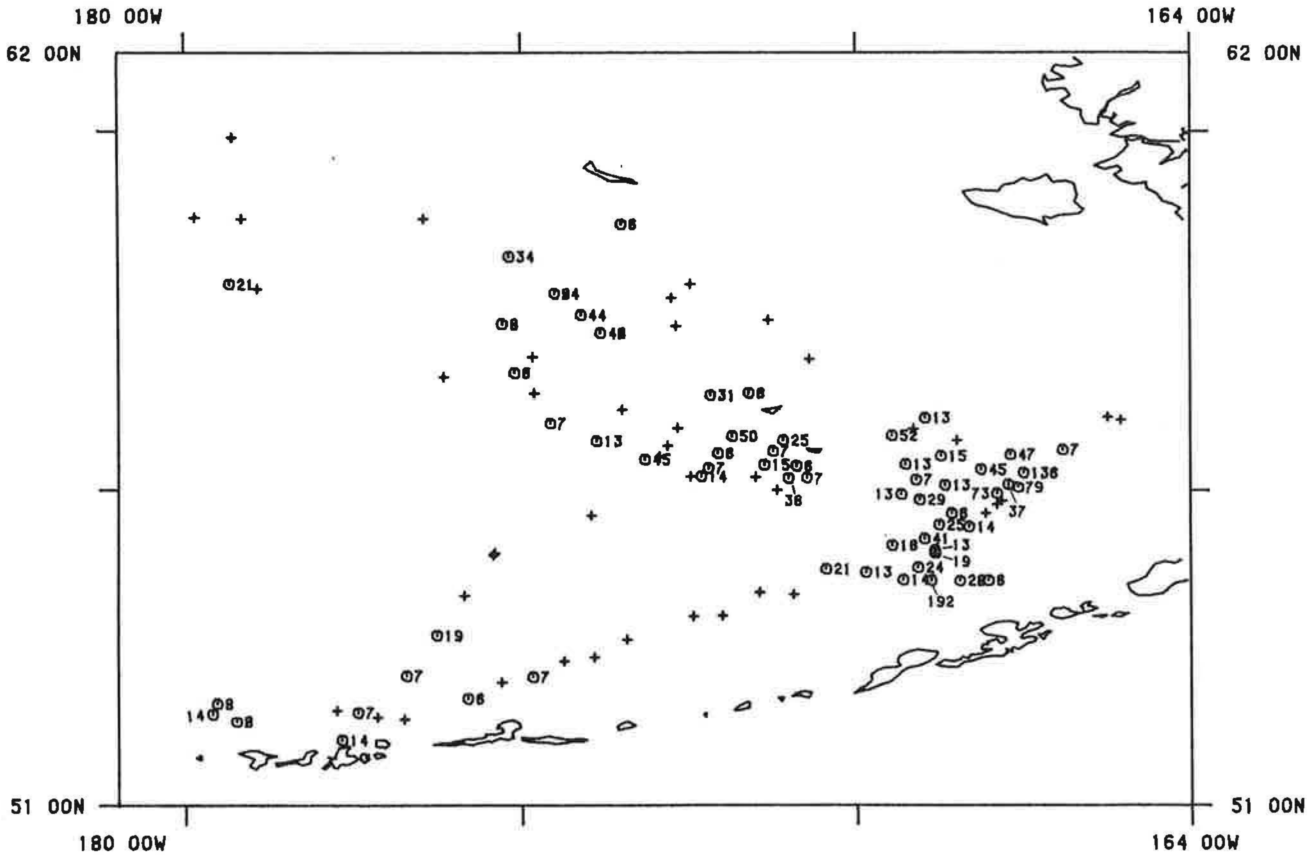

Figure 5. Distribution and abundance as No./10 m^2 of larvae of *Bathymaster* spp. in bongo collections from the eastern Bering Sea, 1 June-23 July 1979. Crosses show station locations where catch was zero.

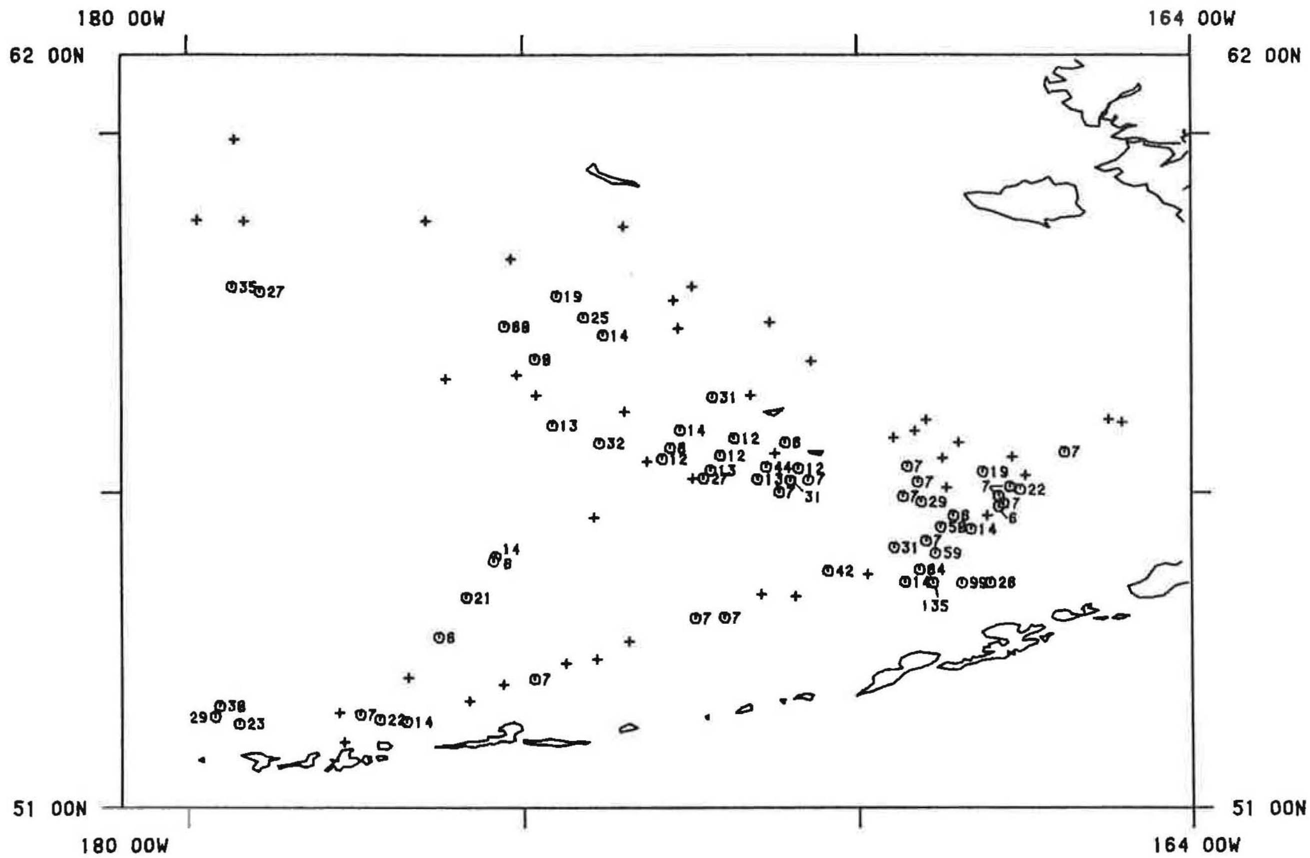

Figure 6. Distribution and abundance as No./10 m^2 of larvae of Sebastes spp. in bongo collections from the eastern Bering Sea, 1 June-23 July 1979. Crosses show station locations where catch was zero.

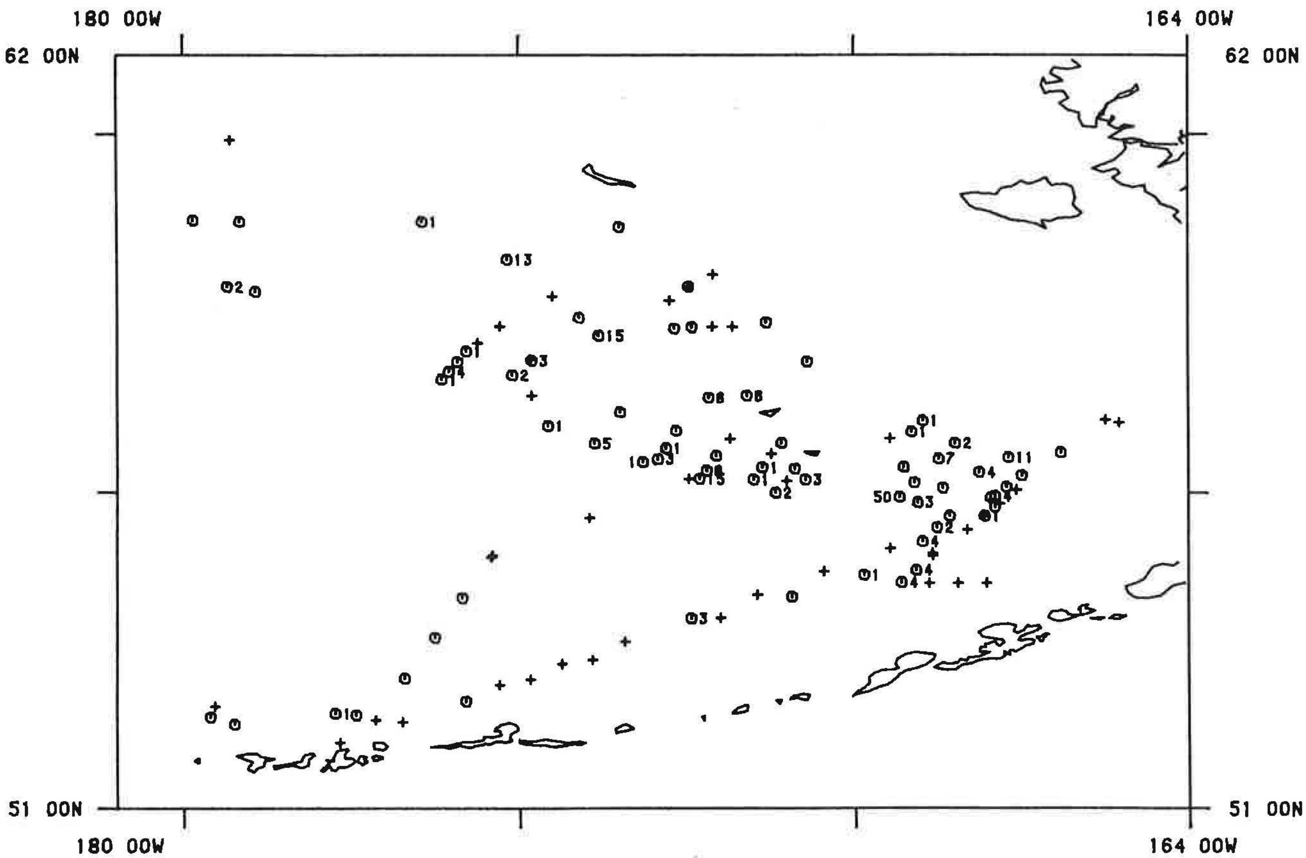

Figure 7. Distribution and abundance as No./10 m^2 of larvae of <u>Bathymaster</u> spp. in neuston collections from the eastern Bering Sea, 1 June–23 July 1979. Crosses show station locations where catch was zero and circles without numbers show locations where catch was less than 0.5/10 m^2.

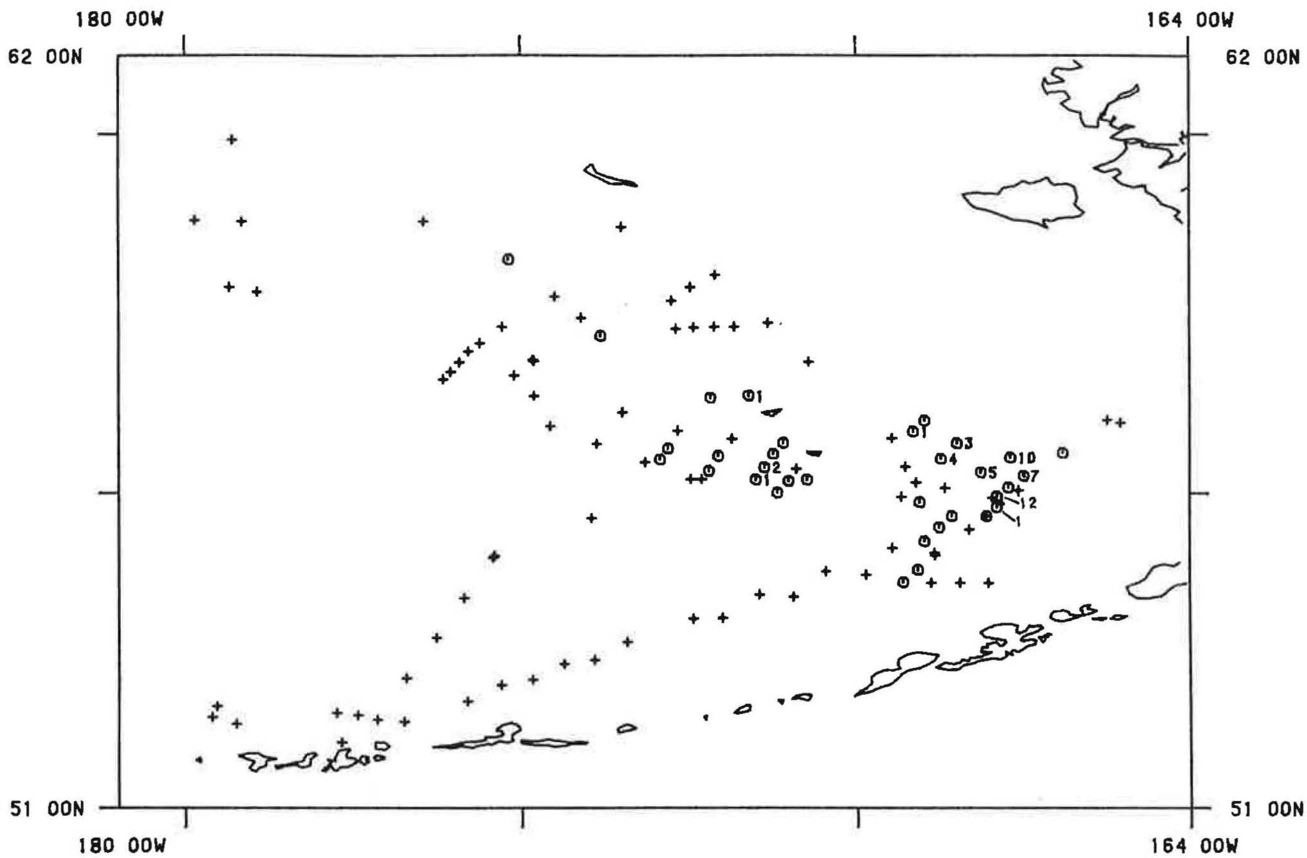

Figure 8. Distribution and abundance as No./1Ø m^2 of larvae of Lyconectes aleutensis in neuston collections from the eastern Bering Sea, 1 June-23 July 1979. Crosses show station locations where catch was zero and circles without numbers show locations where catch was less than Ø.5/1Ø m^2.

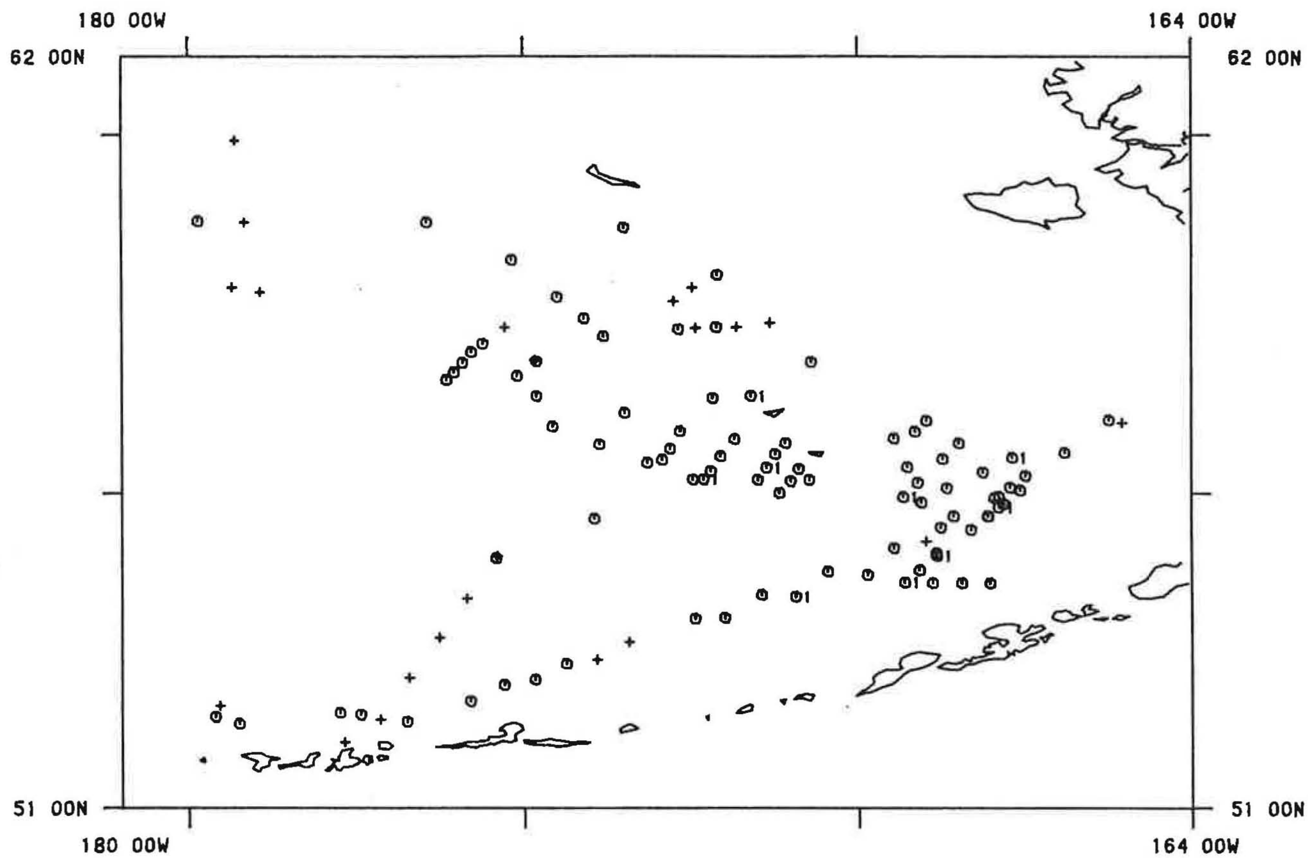

Figure 9. Distribution and abundance as No./1Ø m^2 of larvae of <u>Hexagrammos decagrammus</u> in neuston collections from the eastern Bering Sea, 1 June-23 July 1979. Crosses show station locations where catch was zero and circles without numbers show locations where catch was less than Ø.5/1Ø m^2.

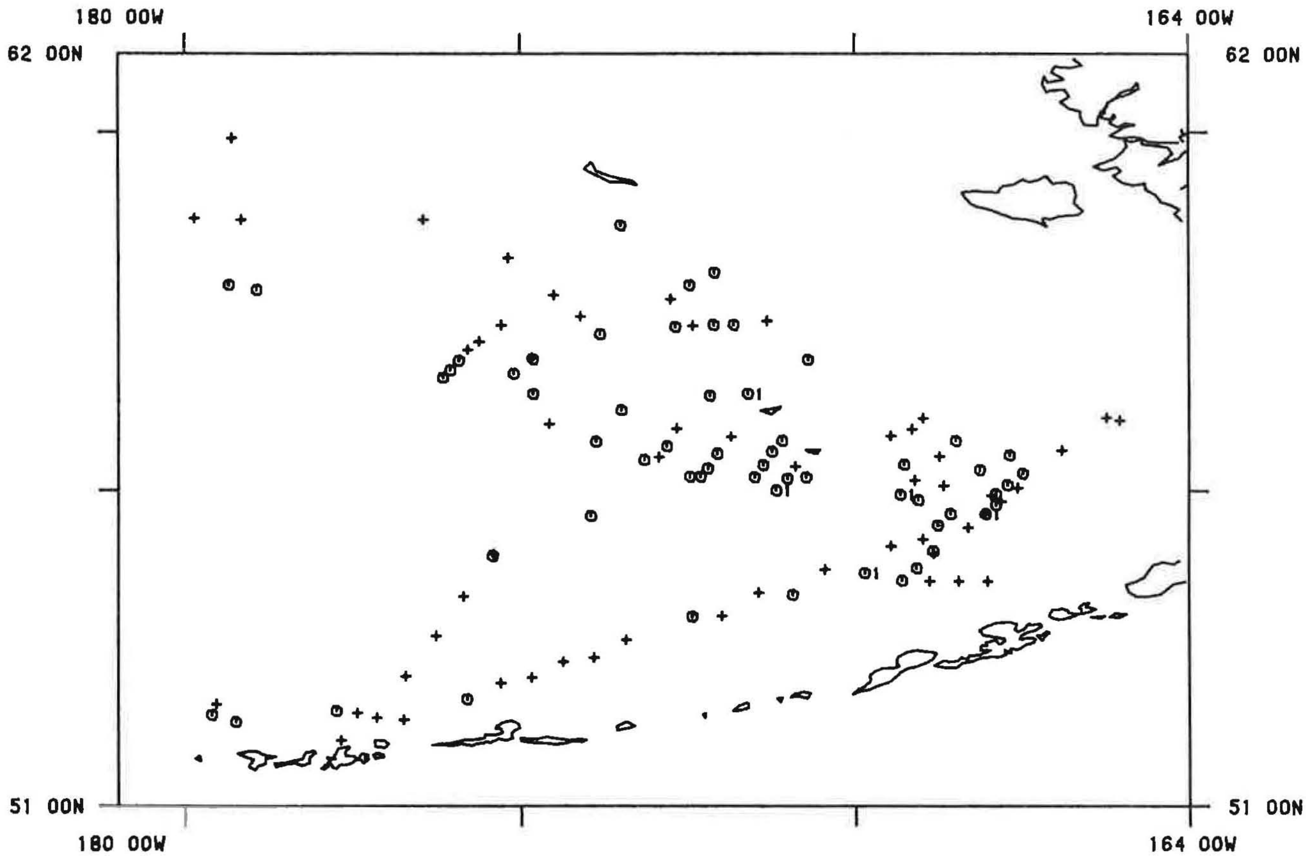

Figure 10. Distribution and abundance as No./10 m^2 of larvae of Anoplopoma fimbria in neuston collections from the eastern Bering Sea, 1 June-23 July 1979. Crosses show station locations where catch was zero and circles without numbers show locations where catch was less than 0.5/10 m^2.

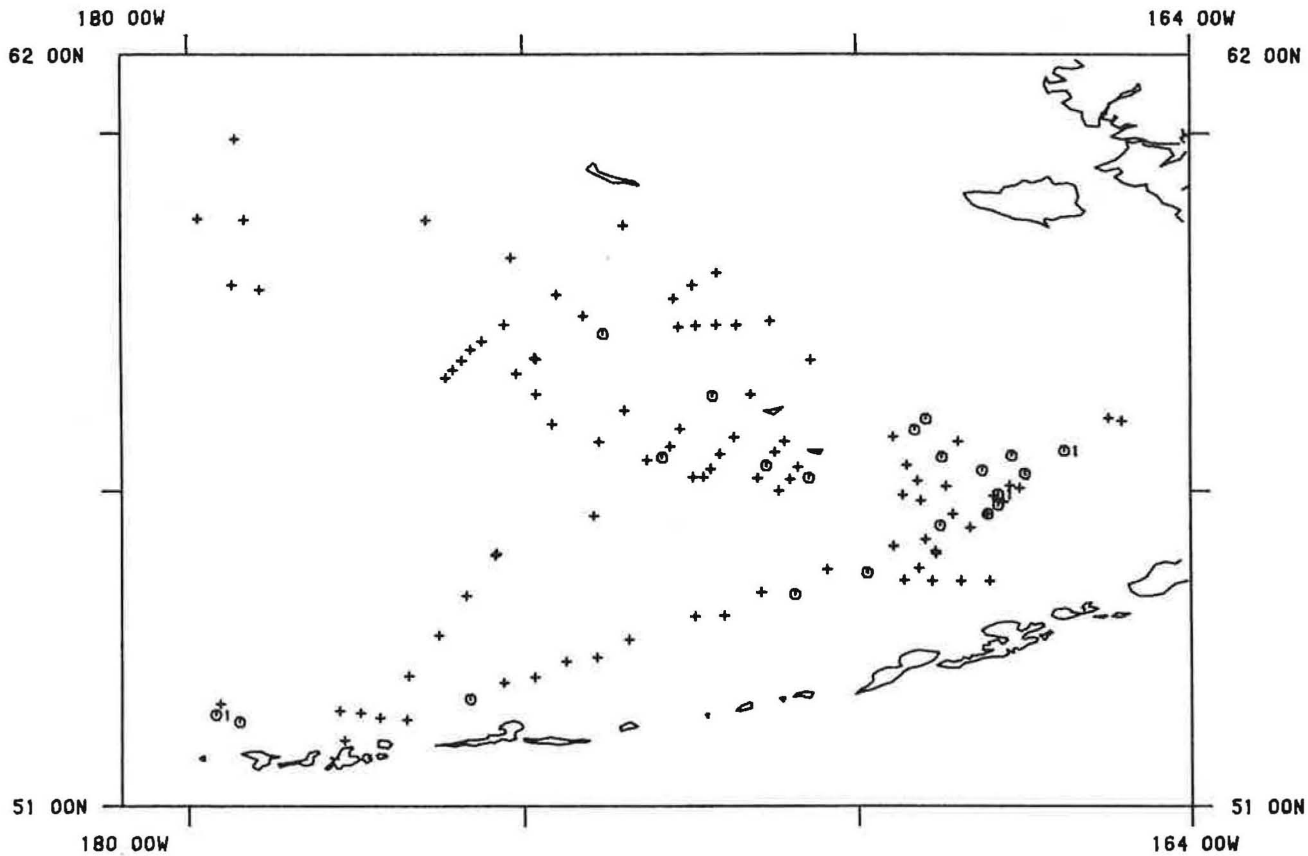

Figure 11. Distribution and abundance as No./10 m^2 of larvae of *Ammodytes hexapterus* in neuston collections from the eastern Bering Sea, 1 June-23 July 1979. Crosses show station locations where catch was zero and circles without numbers show locations where catch was less than 0.5/10 m^2.

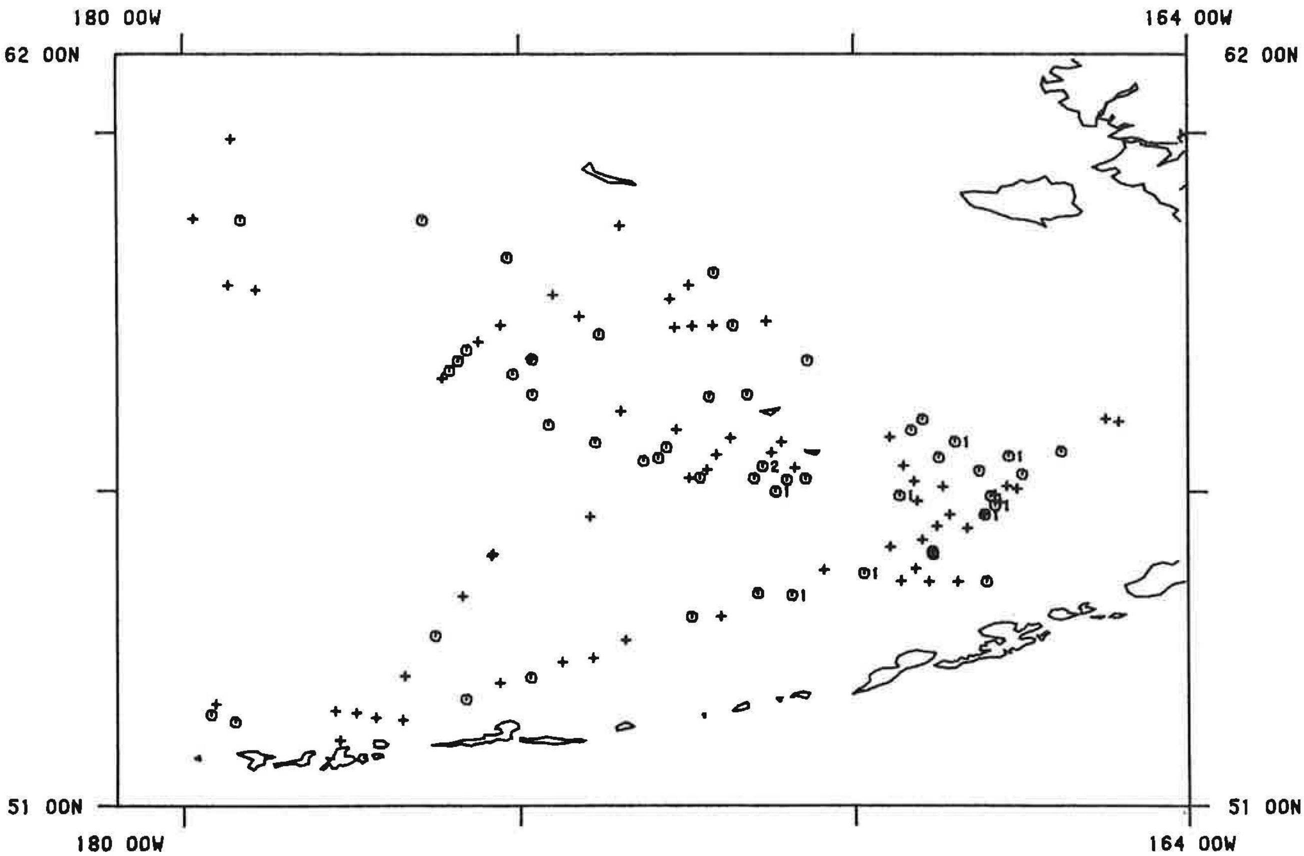

Figure 12. Distribution and abundance as No./1Ø m^2 of larvae of <u>Hemilepidotus hemilepidotus</u> in neuston collections from the eastern Bering Sea, 1 June-23 July 1979. Crosses show station locations where catch was zero and circles without numbers show locations where catch was less than Ø.5/1Ø m^2.

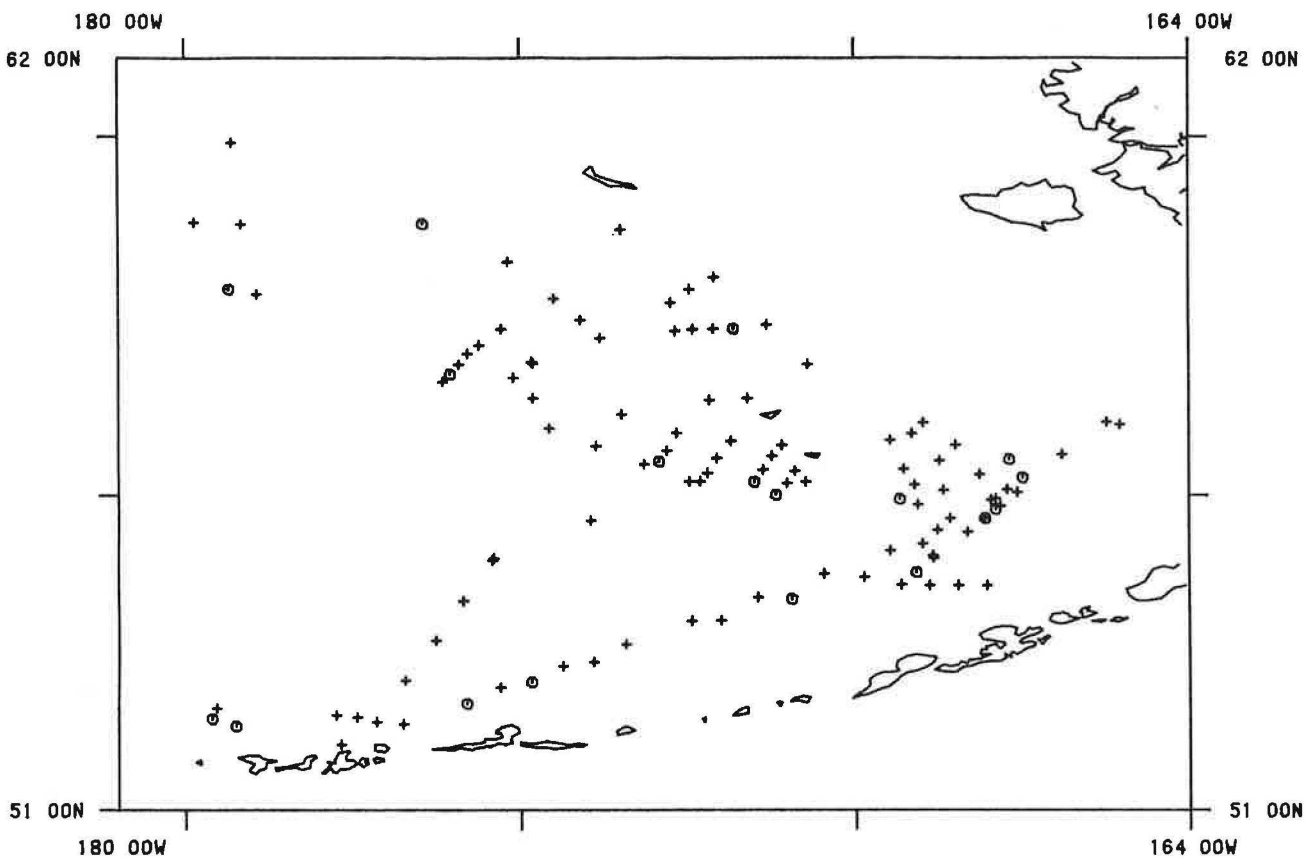

Figure 13. Distribution and abundance as No./1Ø m^2 of larvae of Hemilepidotus jordani in neuston collections from the eastern Bering Sea, 1 June-23 July 1979. Crosses show station locations where catch was zero and circles without numbers show locations where catch was less than Ø.5/1Ø m^2.

Table 1. Station data from cruise MF379 Legs I-III, Miller Freeman 1 June-23 July 1979.

Sta. No.[1/]	Position[2/] Lat. N. °	'	Lon. W. °	'	Date Time[3/]	Standard haul factors[4/] Bongo A	B	Neuston A	B
					June				
S01A	54	37.8	167	1.8	1/0228	6.434	3.122	.025	16.48
S02A	54	37.8	167	27.6	1/0508	7.049	3.324	.022	14.55
S03A	54	37.8	167	53.4	1/0800	7.106	3.355	.019	12.53
S04A	54	38.4	168	18.6	1/1023	6.771	3.217	.032	21.47
S05A	54	49.8	168	5.4	1/1252	7.984	3.685	.026	17.47
S06A	55	3.0	167	49.8	1/1659	6.462	3.017	.027	17.70
S07A	55	27.0	167	19.2	1/2100	7.092	5.536	.024	15.67
S08A	55	39.0	167	4.2	1/2320	7.297	5.947	.027	18.06
S09A	55	50.4	166	49.8	2/0124	6.932	5.770	.025	16.42
V01A	56	2.4	166	34.8	2/0337	7.184	6.315	.026	17.54
V02A	56	3.6	166	34.2	2/1013	7.025	6.138	.019	12.85
V03A	56	3.0	166	36.0	2/1609	6.737	5.958	.032	21.48
V04A	56	3.0	166	34.8	2/2231	6.884	5.926	.022	14.94
V05A	56	3.0	166	36.0	3/0355	6.884	6.118	.024	16.18
V06A	56	3.0	166	33.6	3/0953	7.172	6.349	.030	20.24
V07A	56	2.4	166	35.4	3/1601	7.147	6.258	.026	17.29
V08A	56	3.0	166	35.4	3/2235	7.301	6.377	.026	17.31
V09A	57	2.4	165	2.4	4/0846	6.423	11.191	.025	16.49
V10A	57	3.0	165	2.4	4/1530	6.219	10.327	.028	18.50
V11A	57	3.6	165	1.8	4/2235	6.612	11.012	.025	16.35
V12A	57	3.0	165	2.4	5/0359	6.541	11.054	.024	15.85
V13A	57	3.6	165	1.2	5/0939	6.512	10.861	.031	20.86
V14A	57	3.0	165	0.6	5/1553	6.635	11.133	.022	14.83
V15A	57	3.0	165	2.4	5/2232	7.190	12.035	.036	24.30
V16A	57	3.6	165	3.0	6/0339	6.359	10.612	.023	15.40
S08B	55	39.0	167	3.6	6/1804	7.349	5.999	.021	13.82
S11A	57	4.8	165	14.4	6/0800	6.181	10.429	.028	18.35
S12A	56	36.0	165	54.6	6/1124	6.813	9.366	.030	20.12
S13A	55	10.2	168	28.2	6/2348	7.789	3.651	.023	15.39
S14A	54	48.6	169	27.6	7/0358	7.053	3.362	.020	13.49
S15A	54	27.0	170	27.0	7/0806	7.145	3.380	.021	13.71
S16A	54	4.8	171	26.4	7/1219	6.976	3.317	.027	18.06
S17A	53	42.6	172	25.8	7/1649	7.412	3.428	.021	13.75
S18A	53	21.6	173	22.2	7/2042	7.093	3.351	.022	14.57
S19A	53	1.2	174	18.0	8/0040	8.017	3.647	.024	15.97
S20A	52	5.4	176	40.2	16/0256	7.085	3.256	.021	13.73
S21A	52	25.8	175	44.4	16/0710	6.944	3.282	.022	14.98
S22A	52	45.6	174	48.0	16/1220	5.547	2.716	.024	16.24
S23A	53	6.6	173	50.4	16/1659	6.655	3.109	.024	16.31
S24A	53	25.8	172	54.6	16/2141	6.587	3.073	.022	14.46
S25A	54	5.4	171	0.0	17/0441	7.348	3.440	.024	15.95
S26A	54	25.2	169	56.4	17/0907	6.982	3.270	.025	16.84
S27A	54	45.6	168	51.6	17/1354	6.377	3.085	.038	25.52
S28A	55	5.4	167	50.4	17/1816	6.515	3.047	.019	12.59

Table 1. (cont.)

Sta. No.[1/]	Position[2/] Lat. N. ° '		Lon. W. ° '		Date Time[3/]	Standard haul factors[4/] Bongo A	B	Neuston A	B
S29A	55	39.0	167	3.6	18/0959	-	-	.024	16.31
S30A	55	55.8	166	58.2	19/0625	-	-	.024	16.04
S31A	55	47.4	166	54.0	19/0844	5.588	4.778	.029	19.02
S32A	55	57.0	166	54.0	19/1029	7.159	5.837	.022	14.52
S33A	56	15.6	166	30.0	19/1252	4.935	5.119	.027	17.70
S34A	56	5.4	166	43.8	19/1455	7.315	5.836	.025	16.92
S35A	55	39.0	167	34.8	20/0705	6.395	5.476	.023	15.28
S36A	55	28.8	167	46.2	20/0854	8.301	6.380	.025	16.50
S37A	55	16.2	167	59.4	20/1115	6.874	3.351	.026	17.62
S38A	56	4.8	167	40.8	21/0655	6.614	5.486	.028	18.72
S39A	56	18.6	167	8.4	21/0923	6.488	6.316	.027	18.13
S40A	56	31.8	166	42.0	21/1131	6.858	7.461	.033	21.95
S41A	56	9.6	168	6.6	22/0657	6.977	5.338	.021	13.87
S42A	55	56.4	168	19.8	22/1022	6.650	4.738	.027	17.85
S43A	55	51.6	168	3.6	22/1251	7.163	5.578	.023	15.60
S44A	56	23.4	168	16.2	23/0820	6.549	5.128	.024	15.92
S45A	56	30.6	167	44.4	23/1043	7.416	7.169	.022	14.70
S46A	56	44.4	167	30.0	23/1237	6.561	7.984	.022	14.52
S47A	56	48.6	168	28.2	24/0712	6.538	7.408	.021	13.99
S48A	56	54.6	168	9.0	24/0916	6.275	8.950	.019	12.64
S49A	57	4.2	167	58.8	24/1112	6.601	9.912	.024	16.28
S50A	56	21.6	169	53.4	25/0634	6.103	6.355	.024	16.33
S51A	56	10.8	170	0.6	25/0811	6.059	5.506	.023	15.17
S52A	56	0.0	170	10.8	25/1006	6.888	3.242	.024	16.10
S53A	56	12.0	169	43.8	25/1253	7.042	3.328	.023	15.16
S54A	56	44.4	170	5.4	26/0635	6.151	8.186	.022	14.52
S55A	56	34.8	170	14.4	26/0815	7.078	7.106	.023	15.00
S56A	56	22.8	170	22.2	26/1002	7.270	7.065	.027	17.92
S57A	56	12.0	170	30.0	26/1131	6.624	5.666	.021	14.32
S58A	56	48.0	170	51.0	27/0644	6.232	6.528	.021	13.76
S59A	56	33.0	171	3.6	27/0853	5.885	5.405	.026	17.10
S60A	56	19.8	171	12.0	27/1055	6.686	5.050	.020	13.50
S61A	56	12.6	171	18.6	27/1254	6.791	3.187	.022	14.52
S62A	56	55.2	171	39.6	28/0648	6.766	6.625	.021	14.05
S63A	56	39.6	171	48.6	28/0849	6.331	5.675	.024	16.15
S64A	56	30.0	171	55.8	28/1040	6.233	2.933	.024	16.24
S65A	55	3.0	174	24.0	30/0047	7.039	3.243	.022	14.92
S66A	54	24.0	174	51.0	30/0722	7.031	3.254	.023	15.66
S67A	53	46.8	175	15.6	30/1600	6.391	3.068	.021	14.09
S68A	53	7.8	175	42.6	30/2045	7.426	3.416	.022	14.96
					July				
S69A	52	27.6	176	8.4	1/0602	7.497	3.497	.025	16.76
S70A	52	32.4	176	25.8	1/0808	6.681	3.134	.022	14.90
S71A	52	34.2	176	44.4	1/1353	6.787	3.215	.030	20.19

Table 1. (cont.)

Sta. No.[1/]	Position[2/] Lat. N. °	'	Lon. W. °	'	Date Time[3/]	Standard haul factors[4/] Bongo A	B	Neuston A	B
S72A	52	40.8	178	31.8	2/0755	7.598	3.490	.025	16.64
S73A	52	30.6	178	36.0	2/0928	7.164	3.310	.023	15.47
S74A	52	23.4	178	14.4	2/1409	7.757	3.517	.026	17.46
S75A	55	1.2	174	25.2	8/1730	6.405	3.016	.025	16.76
S76A	55	37.2	172	57.0	8/2333	6.502	3.030	.021	13.86
S77A	56	12.6	171	28.2	9/0512	6.721	3.168	.024	16.19
S78A	56	27.6	172	9.0	9/0906	6.425	3.053	.023	15.19
S79A	56	43.8	172	52.2	9/1210	6.388	5.237	.026	17.07
S80A	56	59.4	173	34.2	9/1526	6.603	3.165	.022	14.42
S81A	57	11.4	172	29.4	10/0514	6.481	6.659	.021	14.10
S82A	57	24.0	171	10.2	10/1046	6.145	7.359	.024	15.83
S83A	57	25.8	170	36.0	10/1310	6.120	9.608	.022	14.77
S84A	57	25.8	173	48.6	11/0653	6.553	4.868	.021	14.20
S85A	57	43.2	174	6.0	11/1105	6.257	6.783	.028	18.52
S87A	57	55.2	169	42.0	12/1055	6.439	10.138	.023	15.63
S88A	57	57.0	173	49.8	13/0448	8.014	5.926	.022	14.63
S89A	57	55.8	173	48.6	13/1324	-	-	.021	14.20
S90A	58	22.8	171	40.8	14/0553	6.687	7.756	.020	13.43
S91A	58	24.0	171	25.2	14/0707	-	-	.013	8.90
S92A	58	24.6	171	6.6	14/0805	-	-	.015	9.69
S93A	58	24.6	170	48.6	14/0900	-	-	.014	9.50
S94A	58	28.2	170	18.6	14/1124	6.414	9.874	.028	18.36
S95A	58	24.6	174	16.8	15/0501	7.509	4.054	.020	13.58
S96A	58	10.8	174	36.6	15/0704	-	-	.015	10.01
S97A	58	3.6	174	46.8	15/0804	-	-	.015	9.91
S98A	57	54.6	174	54.6	15/0904	-	-	.015	10.10
S99A	57	46.2	175	2.4	15/1002	-	-	.015	9.68
S100A	57	39.6	175	9.0	15/1149	7.006	3.250	.024	16.24
S101A	58	46.2	171	45.0	16/0519	6.252	7.291	.023	15.20
S102A	58	57.6	171	28.2	16/0704	-	-	.014	9.49
S103A	59	7.8	171	6.0	16/0830	-	-	.014	9.65
S104A	58	57.6	171	28.2	16/1142	6.405	8.614	.021	13.83
S105A	58	49.8	173	30.0	17/0431	6.463	5.786	.023	15.16
S106A	58	31.8	173	6.0	17/0749	6.260	6.093	.021	14.18
S107A	58	16.8	172	48.6	17/1036	6.845	6.842	.020	13.49
S108A	58	53.4	177	55.2	18/0637	6.815	3.133	.025	16.42
S109A	58	57.6	178	20.4	18/1038	6.931	3.214	.022	14.65
S110A	59	19.8	174	10.8	19/1146	5.694	5.732	.024	16.02
S111A	59	46.2	172	30.0	19/2316	6.122	9.046	.022	14.92
S113A	59	50.4	175	26.4	20/1133	8.340	7.313	.022	14.85
S114A	59	51.6	178	51.0	21/0825	6.861	3.186	.022	14.44
S115A	59	50.4	178	9.0	21/1136	6.598	4.950	.026	17.24
S117A	60	55.2	178	17.4	23/0111	7.014	4.677	.021	14.00

Table 1. (cont.)

1/ No bongo or neuston hauls made at Stns. 86, 112, 116.

2/ Position is at time of first bongo haul at a station, except where bongo haul not made.

3/ Time is for first bongo haul at a station, except where bongo haul not made.

4/ Standard haul factor A converts observed catch to catch per 10 m^2.
Standard haul factor B converts observed catch to catch per 1000 m^3.

Table 2. Ichthyoplankton, eastern Bering Sea, 1 June-23 July 1979. Catch by taxa.

Taxa	505 Bongo Obs. No.[1/]	505 Bongo Mean No./10 m²	505 Bongo %[2/]	505 Bongo No. + Samp.[3/]	505 Bongo % + Samp.[4/]	Neuston net Obs. No.	Neuston net Mean No./10 m²	Neuston net %	Neuston net No. + Samp.	Neuston net % + Samp.
FISH LARVAE										
BATHYLAGIDAE (64)										
Bathylagus pacificus	22	8	1.7	18	15.3	-	-	-	-	-
Leuroglossus schmidti	42	9	3.2	29	24.6	-	-	-	-	-
MYCTOPHIDAE (13)										
Stenobrachius spp.	3	19	0.2	1	0.8	-	-	-	-	-
Stenobrachius leucopsarus (juv.)	9	9	0.7	7	5.9	1	0.03	+	1	0.8
GADIDAE (533)	2	7	0.2	2	1.7	1	0.02	+	1	0.8
Gadus macrocephalus	7	7	0.5	7	5.9	3	0.04	+	2	1.5
Theragra chalcogramma	494	29	37.7	52	44.1	26	0.04	0.2	9	6.9
MACROURIDAE (4)	4	7	0.3	4	3.4	-	-	-	-	-
SCORPAENIDAE (392)										
Sebastes spp.	230	17	17.5	68	57.6	162	0.05	1.1	16	12.3
HEXAGRAMMIDAE (884)										
Hexagrammos spp.	-	-	-	-	-	2	0.04	+	1	0.8
Hexagrammos sp. (juv.)	-	-	-	-	-	1	0.03	+	1	0.8
Hexagrammos decagrammus	4	8	0.3	3	2.5	803	0.11	6.0	102	78.5
Hexagrammos octagrammus	-	-	-	-	-	9	0.03	0.1	8	6.2
Hexagrammos stelleri	1	7	0.1	1	0.8	24	0.04	0.2	12	9.2
Hexagrammos stelleri (juv.)	-	-	-	-	-	4	0.03	+	3	2.3
Pleurogrammus monopterygius	-	-	-	-	-	6	0.03	+	5	3.8
Pleurogrammus monopterygius (juv.)	-	-	-	-	-	33	0.12	0.2	2	1.5
ANOPLOPOMIDAE (309)										
Anoplopoma fimbria	3	6	0.2	3	2.5	306	0.06	2.3	60	46.2
COTTIDAE (136)	1	7	0.1	1	0.8	-	-	-	-	-
Artedius 1	-	-	-	-	-	1	0.02	+	1	0.8
Blepsias bilobus	1	6	0.1	1	0.8	9	0.03	0.1	6	4.6
Hemilepidotus spp.	-	-	-	-	-	17	0.10	0.1	2	1.5
Hemilepidotus hemilepidotus	1	7	0.1	1	0.8	523	0.10	3.9	57	43.8
Hemilepidotus hemilepidotus (juv.)	-	-	-	-	-	7	0.08	+	2	1.5
Hemilepidotus jordani	-	-	-	-	-	37	0.04	0.2	20	15.4
Hemilepidotus jordani (juv.)	-	-	-	-	-	2	0.02	+	2	1.5
Hemilepidotus zapus	-	-	-	-	-	9	0.02	+	8	6.2
Icelus spp.	2	13	0.2	1	0.8	-	-	-	-	-
Malacocottus zonurus 1	9	17	0.7	8	6.8	-	-	-	-	-
Myoxcephalus spp.	-	-	-	-	-	38	0.06	0.2	13	10.0
AGONIDAE (4)	4	6	0.3	4	3.4	-	-	-	-	-
CYCLOPTERIDAE (36)	9	8	0.7	6	5.1	26	0.05	0.2	10	7.7
Nectoliparis pelagicus	1	7	0.1	1	0.8	-	-	-	-	-
BATHYMASTERIDAE (8914)										
Bathymaster spp.	311	19	23.7	68	57.6	8602	0.55	63.7	76	58.5
Bathymaster spp.	-	-	-	-	-	1	0.03	+	1	0.8
STICHAEIDAE (67)	1	0.05	0.1	1	0.8	62	0.05	0.4	20	15.4
Lumpenella longirostris	-	-	-	-	-	2	0.04	+	1	0.8
Lumpenus maculatus	-	-	-	-	-	1	0.02	+	1	0.8
Poroclinus rothrocki	1	7	0.1	1	0.8	-	-	-	-	-
Stichaeus punctatus	-	-	-	-	-	1	0.02	+	1	0.8
CRYPTACANTHODIDAE (2598)										
Lyconectes aleutensis	50	13	3.8	11	9.3	2548	0.32	18.9	38	29.2
ZAPRORIDAE (8)										
Zaprora silensis	5	10	0.4	3	2.5	3	0.04	+	2	1.5
AMMODYTIDAE (221)										
Ammodytes hexapterus	8	21	0.6	2	1.7	213	0.09	1.6	27	20.1
PLEURONECTIDAE (106)										
Atheresthes stomias	19	10	1.4	13	11.0	9	0.07	0.1	3	2.3
Glyptocephalus zachirus	-	-	-	-	-	1	0.03	+	1	0.8
Hippoglossoides elassodon	41	12	3.1	11	9.3	1	0.03	+	1	0.8
Lepidopsetta bilineata	13	8	1.0	10	8.5	2	0.06	+	1	0.8
Pleuronectes quadrituberculatus	5	7	0.4	5	4.2	2	0.06	+	1	0.8
Hippoglossus stenolepis	1	7	0.1	1	0.8	3	0.02	+	3	2.3
Reinhardtius hippoglossoides	8	7	0.6	8	6.8	1	0.02	+	1	0.8
ZOARCIDAE (1)	1	6	0.1	1	0.8	-	-	-	-	-
UNIDENTIFIED FISH LARVAE (4)	1	7	0.1	1	0.8	3	0.03	+	3	2.3
TOTAL FISH LARVAE (16,292)	1,312					13,505				
FISH EGGS										
GADIDAE (910)										
Theragra chalcogramma	97	16	68.3	28	23.7	813	0.34	60.8	20	15.4
MACROURIDAE (6)	6	12	4.2	3	2.5	-	-	-	-	-
PLEURONECTIDAE (553)	1	7	0.7	1	0.8	49	0.05	3.7	11	8.5
Embassichthys bathybius	-	-	-	-	-	2	0.02	0.2	2	1.5
Glyptocephalus zachirus	1	7	0.7	1	0.8	26	0.04	1.9	10	7.7
Hippoglossoides elassodon	3	10	2.1	2	1.7	56	0.08	4.2	14	10.8
Limanda aspera	28	16	19.7	10	8.5	385	0.71	28.8	9	6.9
Microstomus pacificus	-	-	-	-	-	2	0.05	0.2	1	0.8
UNIDENTIFIED FISH EGGS (10)	6	3	4.2	4	3.4	4	0.04	0.3	2	1.5
TOTAL FISH EGGS	142					1,337				

1/ Obs. no. = Observed number. This is the actual number caught in the nets.

2/ % = Percentage of the total number caught in the net.

3/ No. + Samp. = Number of positive samples. This is the number of samples which contain specimens for a taxa.

4/ % + Samp. = Percentage of positive samples. Total samples for bongo were 118 and for neuston 130.

Table 3. Mean and range of standard lengths in mm of some fish larvae caught in recent years during surveys of the eastern Bering Sea. The 'N' in the column for net means data is from neuston samples, the 'B' means the data is from bongo samples.

Taxa	1976-1977 (Waldron and Vinter 1978)		1979		
	Range	Mean	Range	Mean	Net
Ammodytes hexapterus	6.7-29	-	21-48	33	N
Atheresthes stomias	8-10	-	13-23	16	B
Bathylagus pacificus	6-9	-	6-15	10.7	B
Bathymaster spp.	28-43	-	6-44	11.6	N
Hexagrammos spp.	9-35	-	8-37	20	N
Hippoglossoides elassodon	none	-	3-15	5.8	B
Hippoglossus stenolepis	18-23	-	21.9-22.1	22	N
Lepidopsetta bilineata	-	4.5	8.9-12.8	10.6	B
Reinhardtius hippoglossoides	16-22	-	25-35	29.2	B
Sebastes spp.	5-8.3	-	4.2-15.8	8.1	B
Theragra chalcogramma	3.1-11.8	7.2	3.2-34.6	11.3	B