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Taxonomic Composition, Seasonal Distribution, and Abundance of Ichthyoplankton in the Nearshore Zone of the Kodiak Archipelago, Alaska

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TAXONOMIC COMPOSITION, SEASONAL DISTRIBUTION, AND ABUNDANCE OF ICHTHYOPLANKTON IN THE NEARSHORE ZONE OF THE KODIAK ARCHIPELAGO, ALASKA

by

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INTRODUCTION

This report summarizes the results of an ichthyoplankton survey conducted on the continental shelf and in four major bays of the Kodiak Archipelago. Results concerning the shelf survey alone were presented previously (Dunn et al., MS 1980) as were those concerning the bays alone (Rogers et al., MS 1979). The objectives of this survey were to determine the taxonomic, spatial and seasonal distribution of planktonic eggs and larvae of fish of the Kodiak area to help evaluate if, when, and where petroleum exploration and development could proceed to avoid impact to the fisheries resources of the area. Some understanding of the factors influencing the observed distributions was also sought.

The current state of knowledge of ichthyoplankton of the Kodiak area was reviewed in detail by Dunn et al. (MS 1980) and Rogers et al. (MS 1979). Briefly, insufficient work had previously been conducted to describe the ichthyoplankton community of the Kodiak area. Dunn et al. (MS 1980) list only six studies which even mentioned eggs and larvae of fish in the general vicinity of Kodiak Island.

METHODS

Details of field and laboratory procedures are given in Dunn et al. (MS 1980) and Rogers et al. (MS 1979). Gear and methods for the two studies were identical so the results obtained could be compared directly, without need for adjustments. Plankton was sampled at selected stations with Sameoto neuston nets and 60cm bongo nets equipped with 0.505mm mesh nets. Bongo net tows followed standard MARMAP procedures (Smith and Richardson, 1977). In the bays 26 stations were sampled on each of 12 cruises (five spring, five summer, one fall and one winter). Offshore about 90 stations were sampled on each of five cruises (one in each season except two in fall). Abundances of fish eggs and larvae were reported as numbers per 10 m^2 of sea surface. Larvae of selected species were measured to the nearest 0.1 mm SL using a scale on a microscope stage.

Planktonic early stages of over 110 taxa of fishes were collected in the survey. In the proposal for this study a list of possible species to be studied was given. However, upon examination of the bay and shelf bongo and neuston collections, it was found that some species listed in the proposal were too rare for more detailed study, while some species not listed in the proposal were quite abundant members of the ichthyoplankton community of the Kodiak area (Tables 1-4). From the total list of taxa collected, 30 were selected as being abundant enough in the bay or shelf collections to analyze their distribution using analysis of variance. For the analysis of variance we selected

inshore taxa from the bongo catches that ranked in the 20 most abundant larval taxa. From the neuston catches, those larvae that ranked in the 10 most abundant taxa were analyzed. The three most abundant egg taxa from each gear type were also analyzed. For the analysis of variance of offshore taxa, those that were present in the bongo catches with an estimated total abundance in the survey area of $>10^{10}$ during at least one cruise and for the neuston catches those taxa that occurred at more than 35 stations on at least one cruise, were selected. The taxa dealt with in this report as well as those originally proposed for study are listed in Table 5.

To compare abundance of the selected taxa by season and location, data were subjected to analysis of variance (ANOVA) using BMD program 02V (Dixon, 1973). To homogenize the variances, since they were highly correlated with the means, the catches expressed as numbers per 10 m^2 of surface area were transformed to $\log_{10}$ (x+1). The factorial design for the bay study included 10 time periods (cruises) and 4 bays. Five stations within each bay were considered replicates (Fig. 2). Missing values were estimated by appropriate methods in Snedecor and Cochran (1971). The shelf survey area was subdivided into 16 adjacent areas of equal size (Fig. 1). Four stations within each of these areas were randomly chosen as data points, and considered replicates. Thus for the shelf area the factors were 5 time periods (cruises) and 16 areas. Values for missing data points were estimated from nearby data points (in time and place). The ANOVA was applied only to those cruises in which the considered taxon was collected.

The co-occurrence of larval fish in the shelf samples was investigated using REGROUP and a support program CONNEX (Fager, 1957). This program considers joint occurrences but does not deal with abundance. After trying several affinity levels, a level of 0.4 was chosen as demonstrating the most reasonable grouping of larval fish.

RESULTS AND DISCUSSION

Analysis of Variance

We found that the waters of the shelf and bays of the Kodiak area held a complex, diverse ichthyoplankton assemblage. Although several egg and larval types could not be identified to species, over 110 taxa were collected during this study. Among these, 30 taxa were considered abundant enough in shelf or bay samples, or both, to warrant further analysis. The following section details the results of analysis of variance performed on these taxa. These taxa and where significant differences were found with time or location are listed in Table 6. Where significant differences in abundance were found, they are

discussed on a taxon by taxon basis in the following section. Mean catches by area, time and gear for the taxa discussed in the following section are given in the Appendix.

Osmeridae - smelts

Smelt larvae identified only to family level were caught year-round in the inshore bay area. They were collected in 8 out of 10 cruises but occurred in large numbers only during summer. In the offshore area smelt larvae were identified to species level when possible (when >30mm SL); smaller larvae which could be identified only to family level are reported only from the summer cruise. Larvae occurred in both neuston and bongo tows but were far more abundant in bongo tows for both the inshore and offshore areas. They occurred in over 20% of the bongo tows during the summer offshore cruise. Inshore, the highest cruise abundance for both bongo and neuston catches occurred during the 15-21 Aug cruise. During summer when larvae identified as osmerids were collected in the offshore area there was a large difference in abundance in bongo tows between the bays and the offshore area, over 170 times more larvae were caught inshore (21-29 Jul) than were caught offshore (19 Jun-9 Jul). Differences in abundance between bays occurred in mid June and late August when catches in Izhut Bay ranked highest. Larvae were more abundant at the shorewardmost stations especially near Izhut and Chiniak bays, and along the easternmost parts off Kodiak Island than at other offshore stations.

Mallotus villosus - capelin

Capelin larvae were identified only from the offshore cruises and in all seasons but summer when osmerid larvae which were too small for specific identification were abundant. Larvae were collected in both neuston and bongo tows but were much more abundant in bongo catches where they occurred in over 38% of the tows during three out of the four cruises in which they occurred. The highest abundance occurred during fall 1978 but larvae were also abundant in winter. Larvae were widespread but concentrated over the northeast part of Kodiak Island over Portlock and North Albatross banks.

Larvae enter the plankton in summer and remain there until the following spring. In fall their mean lengths in bongo tows were 22mm SL, in winter 40mm SL, and in spring 41mm SL. We did not catch larvae longer than 55mm SL.

Leuroglossus schmidti - Northern smoothtongue

Northern smoothtongue eggs and larvae were primarily collected in bongo tows in the offshore region only. Eggs occurred during every season but spring, and larvae occurred year-round. Eggs occurred primarily in fall when in 1977 they were found in 12.1% of the bongo tows and in 1978 in 28.4% of the bongo tows. The highest mean abundance of eggs occurred during the fall 1978 cruise. Larvae were found in greatest amounts during winter when they occurred in over 19% of the bongo tows. Eggs were found offshore near the shelf edge while larvae were slightly more widespread although also found well offshore. During summer, larvae occurred in more eastern areas over Stevenson Entrance.

Stenobrachius leucopsarus - Northern lampfish

Northern lampfish larvae were in small numbers year-round in offshore waters, but not at all in bays. Larvae were collected only in bongo tows where in summer they occurred in 27% of the tows. More larvae occurred during summer than during other seasons. About equal catches of larvae were made during spring and winter and the lowest catches were during fall. There were differences in abundance among offshore areas, as larvae were more abundant in the eastern portion of the study area and over Kiliuda Trough.

Theragra chalcogramma - Walleye pollock

Walleye pollock eggs were collected year-round in both neuston and bongo samples and in both offshore waters and in bays. Larvae were collected primarily in bongo tows in spring from both inshore and offshore areas. The highest cruise abundance for eggs and larvae in the inshore area occurred during the 21 Apr-1 May cruise. In the offshore area, the highest cruise abundance for both eggs and larvae was during the spring cruise. During spring cruises four times more eggs and larvae occurred in the bays than offshore.

The overall mean abundance of eggs in the inshore areas was greatest in Kaiugnak Bay and least in Izhut Bay. In the offshore areas, eggs occurred in greatest concentrations toward the southern end of Kodiak Island near Shelikof Strait and around the Kiliuda Trough - Horsehead Basin area. For walleye pollock larvae, the overall mean abundance was greatest in Chiniak Bay and least in Kaiugnak Bay. The highest concentration of larvae in the offshore areas was near Shelikof Strait.

Sebastes spp. - Rockfishes

Rockfish larvae were caught during summer and fall in offshore waters, and in late spring and summer in the bays. They were primarily collected in bongo samples, where they occurred in more than 50% of the tows in the offshore summer cruise. The highest mean abundance in the inshore area occurred during the 15-21 Aug cruise, and offshore it occurred during the summer cruise. Larvae were collected in greatest amounts in Izhut and Chiniak bays and to a lesser extent in Kiliuda and Kaiugnak bays. There were also differences in mean abundance among the offshore areas where larvae were most abundant off the easternmost portions of Kodiak Island over North Albatross and Portlock banks.

Hexagrammos decagrammus - Kelp greenling

Kelp greenling larvae were caught year-round in offshore waters, and in all seasons but summer in the bays. They were primarily found in neuston samples, where they occurred in more than 50% of the tows in three of the five offshore cruises. The highest cruise abundance in the inshore area occurred during the 21 Apr-1 May cruise, and offshore it occurred during the spring cruise, although they were nearly as abundant in winter. They were similar in abundance among the four bays, but among the offshore areas, they were most abundant in waters over the Horsehead Basin and Chiniak Trough areas. From the larval lengths it appears that kelp greenling enter the plankton in fall and winter and remain there until the following summer.

Hexagrammos lagocephalus - Rock greenling

Rock greenling larvae were caught in the neuston net in the two fall offshore cruises and they occurred throughout the summer and fall in neuston catches in the bays. Offshore they were most abundant off Izhut Bay and the abundances in bays and offshore in fall were comparable. Rock greenling probably spawn mainly in bays in the Kodiak area, therefore their seasonal appearance is earlier there than offshore. Larvae as small as 5.5mm were taken in bays during late summer, whereas in fall, larvae in both inshore and offshore areas averaged between 11-12mm.

Hexagrammos octogrammus - Masked greenling

Larvae of masked greenling were caught primarily in the neuston net, in summer and fall in the bays and in all cruises offshore except spring. They were most abundant in late summer-early fall in the bays and most abundant in fall offshore. They were uniform in abundance among the bays and offshore areas, however the abundances were rather low. In offshore waters the

smallest larvae were taken in the fall, and the largest in the summer. In the bays, larvae during summer ranged from 4.5-10mm and during fall they ranged from 6.5-14.5mm.

Hexagrammos stelleri - Whitespotted greenling

Whitespotted greenling larvae occurred in all offshore cruises in both bongo and neuston tows and occurred in neuston tows in the bays in fall through early spring. In the bays they were most abundant in fall and winter, and offshore in fall. Offshore they were most abundant in the southern areas, whereas inshore they were most abundant in Izhut and Chiniak bays. In offshore waters the mean lengths increased from 10-12mm in fall through winter and spring to 51mm in summer. In bay areas, the smallest larvae (~5.0mm) also occurred in fall. During winter and spring larvae ranged from 8.0-30.5mm.

Pleurogrammus monopterygius - Atka mackerel

Atka mackerel larvae occurred primarily in offshore samples in both neuston and bongo tows in all seasons except summer. A few were caught in neuston tows in the bays in fall and winter. The areas of abundance offshore were near the edge of the shelf over Middle Albatross Bank. In bongo catches they were also abundant off Chiniak Bay. Mean lengths of Atka mackerel increased from about 10mm in fall to 14mm in winter, in both the inshore and offshore areas. By spring, 18mm larvae were caught in the offshore area only.

Cottidae - Sculpins

Thirty-eight species of marine sculpins are reported from the Kodiak Shelf area (Science Applications, Inc., MS 1977). They occur primarily in shallow water and several are abundant in the intertidal zone. The larvae of many of these can only be identified to genus and in some cases can only be "typed." Larval sculpins were numerically important in the bays of Kodiak Island and larvae of at least 25 species were collected. Most sculpins were collected in greatest abundance with the bongo net; however, catches of Myoxocephalus types A and B and Hemilepidotus spp. were relatively high in neuston samples. Other sculpins of relative numerical importance were Cottidae type L (believed to include species of Artedius, Clinocottus, and/or Oligocottus), Cottidae type I (possibly Icelinus and/or Icelus species), Icelinus spp. and Gymnocanthus spp.

In the offshore bongo tows, sculpins were analyzed as a group and were more abundant in summer than during other seasons. Areas of abundance shifted from cruise to cruise and probably reflected different areas and seasons of abundance for larvae of various species in this family.

Hemilepidotus spp. - Irish lords

Irish lord larvae were caught offshore in both bongo and neuston tows and occurred over a wide area. Four species in this genus are found in the Gulf of Alaska, and are not separated in our samples until they reach a large size (>12mm). They were caught in the neuston net from all the offshore cruises and in the bongo net from all but the summer cruise. A few were caught in neuston tows in the bays, during one spring cruise and during the fall and winter cruises. In both nets the maximum abundance offshore occurred during the fall 1977 cruise and they were also abundant in the fall 1978 cruise. In the bays the maximum abundance was in the fall also. Areas of abundance in the offshore cruises were just off Kiliuda Bay and near the edge of the shelf off Chiniak Trough.

Myoxocephalus Types

Three species of Myoxocephalus occur in the Northeast Pacific, M. jaok, plain sculpin, M. polyacanthocephalus, great sculpin, and M. niger, warthead sculpin (Howe and Richardson, MS 1978). We recognized larvae of two distinct types (called A and B) from samples taken in the bays. Type A resembled larval great sculpin described briefly by Blackburn (1973) from Skagit Bay, Washington, and adults are very abundant in Kodiak bays (Harris and Hartt, MS 1977). Identification to species for type B is not possible at present.

Larval Myoxocephalus types occurred primarily during spring and type B was more abundant than type A. Averaged over all times, there were no significant differences between bays for catches of both Myoxocephalus types.

Cyclopteridae - Lumpfishes and Snailfishes

Snailfish and lumpfish larvae were analyzed at the family level in the bay samples and occurred primarily in bongo catches. Larvae were found in all seasons except fall and the highest mean catch over all bays occurred in late April. The catches were uniform among bays.

Bathymasteridae - Ronquils

Ronquil larvae collected in bays were identified only to family whereas those collected offshore were identified as either members of the genus Bathymaster, searchers, or as Ronquilus jordani, northern ronquil. In the bays ronquil larvae were caught in both gear types in April through August and occurred in 46% of the bongo tows and 17% of the neuston tows. In bongo samples, larvae were most abundant in spring during late May and

early June and most abundant in Izhut Bay. In neuston samples they were evenly abundant among bays and cruises.

Bathymaster spp. - Searchers

The genus Bathymaster contains three species of ronquils, B. caeruleofaciatus, B. leurolepis, and B. signatus, reported from the Gulf of Alaska. Information on the taxonomy and life history of members of this genus is limited and at present we are unable to distinguish larvae of the three species. Searcher larvae were caught in the offshore sampling area in all seasons, but were found in abundance only in the summer in bongo nets, where they occurred at 93% of the stations sampled. The variation of mean abundance with time (cruise) differed for both bongo and neuston catches, but areal catches were different only for bongo catches in the summer, when they were greater over Portlock and North Albatross banks than to the west.

Ronquilus jordani - Northern ronquil

Larvae of northern ronquil were caught only in the offshore sampling area in bongo nets in the summer, where they occurred at 24% of the stations. There was no difference in abundance among various areas sampled.

Lumpenus maculatus - Daubed shanny

Larvae of daubed shanny were collected in bongo nets in the inshore area from late March through early June 1978, where peak abundance occurred from Apr 10-17. This species was more abundant in Kaiugnak and Chiniak bays than in either Izhut or Kiliuda bays.

Lumpenus medius - Stout eelblenny

Larvae of stout eelblenny were taken in bongo nets in the inshore area in winter, spring and early summer. Peak abundance occurred in late March-early April, and the mean catch was highest in Kiliuda Bay and lowest in Izhut Bay.

Ammodytes hexapterus - Pacific sand lance

Larvae of Pacific sand lance occurred in the four bays in bongo nets primarily from early March through mid-June. In offshore waters, they were caught primarily in bongo nets in winter through summer. In the bays, abundance of sand lance larvae differed by time period, but no differences in abundance among bays was observed. Peak abundance occurred in late March-early May in the four bays. In the offshore sampling area the

catches were largest in the spring when they were caught in nearly 68% of the tows. Mean catches were generally larger in the nearshore areas as opposed to offshore areas. From the length frequency distribution of the larvae it appears that sand lance enter the plankton in winter and remain there until the following summer in the offshore area, but dissappear from inshore plankton catches in late June.

Unidentified Pleuronectid Eggs

Unidentified flatfish eggs were caught in neuston and bongo nets in bays as well as offshore. The majority of these were early and middle stage eggs about 1 mm in diameter, and are most likely of four possible species: starry flounder (Platichthys stellatus), sand sole (Psettichthys melanostictus), English sole (Parophrys vetulus) or butter sole (Isopsetta isolepis).

In bays, unidentified flatfish eggs were collected in the neuston sampler from early March through mid-August. The largest catches occurred in late June and early July. Catches also differed among bays with larger mean catches in Kiliuda Bay than in the other bays. Catches of unidentified flatfish eggs in bongo nets in the bays were made from late March through late August. Differences were found in catches among bays and sampling periods. Maximum catches occurred in mid-July and early August, and the highest overall mean catch of eggs was in Kiliuda Bay. In the offshore area, unidentified flatfish eggs were collected in bongo and neuston nets in spring and summer primarily in the nearshore areas.

Glyptocephalus zachirus - Rex sole

Rex sole eggs and larvae were rarely found in inshore samples; however, they were caught in the summer in the offshore area in both neuston and bongo nets. Rex sole eggs occurred in bongo nets at 26% of the stations sampled and in neuston nets at 27% of the stations in the offshore area, but the mean catch was much larger in the bongo nets. Rex sole eggs were mainly over the slope area and abundance of eggs differed among areas. Rex sole larvae were taken primarily in bongo nets and they occurred at 32% of the stations sampled. Differences in abundance of larvae among areas were not detected, but larvae tended to occur primarily over slope waters.

Hippoglossoides elassodon - Flathead sole

Eggs and larvae of flathead sole were caught in bays and in the offshore sampling area in both bongo and neuston nets. In bays, flathead sole eggs were caught in neuston nets from late March through late August and in bongo nets from late March to early August. The largest catches in the neuston net occurred in

mid-June, and the abundance of eggs in the neuston samples did not differ among bays. The largest catches of eggs in the bongo net occurred in late April to May 1, and the mean catch in Kaiugnak Bay was larger than in the other three bays. Flathead sole eggs in offshore areas occurred mainly in bongo nets (1% of the stations in winter, 11% in spring, and 29% of the stations in summer). Abundance of eggs differed among time periods (largest catches occurring in the summer) but not among areas.

Larvae of flathead sole were caught in bays primarily in bongo nets from from late April to early November. Differences in abundance of larvae occurred among sampling periods, with the largest catches in late May - early June. Catches of larvae did not vary significantly among bays. In the offshore area, larvae were caught only in the summer and mainly in bongo nets in which they occurred at 46% of the stations sampled.

Isopsetta isolepis - Butter sole

Butter sole eggs were not specifically identified from bay areas, but may be included in "unidentified" flatfish eggs from that area. In the offshore cruises, only late stage butter sole eggs were identified. They were caught primarily in bongo nets during spring and summer, and the largest mean catches were in the latter time period. In summer most eggs were caught over Middle Albatross Bank. Butter sole larvae, however, were found in bongo catches in the bays as well as in the offshore zone. In the bays, they were in greatest abundance in late July and mean catches were greatest in Kaiugnak Bay. In the offshore area, catches of larvae were made in summer only, when they were in 18% of the tows. Abundance of larvae among areas differed as they occurred primarily over the slope area and northwest of the Trinity Islands.

Lepidopsetta bilineta - Rock sole

Rock sole larvae were caught primarily in bongo nets in bays and in the offshore sampling area from late March through early August. In the bays the largest catches were in Chiniak and Kaiugnak bays. Differences occurred among sampling periods in the bays and the peak of abundance was in late April - early May. In the offshore area, rock sole larvae were caught in spring at 35% of the stations and summer at 27% of the stations, but differences were not found in mean catches between the two sampling periods. Larvae occurred primarily over the mid-shelf areas. Because rock sole spawn demersal eggs, they were not collected in our sampling gear.

Limanda aspera - Yellowfin sole

Yellowfin sole larvae were collected mainly in the bays from late July through late August. Differences in catches occurred among sampling periods, with a peak in early August. No yellowfin sole larvae were collected in Izhut Bay and mean catches were highest in Kaiugnak Bay. In the offshore area, yellowfin sole eggs were caught only in the summer in both the neuston and bongo nets. They were concentrated primarily nearshore.

Microstomus pacificus - Dover sole

Dover sole eggs and larvae were primarily in the bongo nets in the offshore sampling area. Eggs were caught in summer at 35% of the stations although a few eggs occurred in neuston nets in the spring. Differences in abundance of eggs in summer occurred among sampling areas; these eggs were usually between the 200m - 2000m contour. Larvae of dover sole were caught primarily in bongo nets and only in summer when they were collected at 20% of the stations sampled. Catches did not differ among areas.

Psettichthys melanostictus - Sand sole

Larvae of sand sole were caught in bays as well as in the offshore sampling area. Late stage eggs of sand sole were identified only from the offshore areas in the summer where they occurred at only 1% of the stations. Catches of larvae in bays occurred from late May through late August. The largest mean catches were in late July, whereas abundance did not differ among bays. In the offshore area, sand sole larvae were collected only in the summer when they were caught at 41% of the stations. Catches tended to be greater over Middle and North Albatross banks than in other areas.

Structure of Shelf Larval Fish Community

Since we caught over 110 taxa of larval fish in the plankton during the shelf cruises off Kodiak, an important question was which of these taxa co-occur, and thus may influence each others' survival through such factors as competition for food or predation. To determine which species co-occurred we used recurrent group analysis (using a computer program called REGROUP). This procedure has previously been used for a variety of community structure studies (Fager and Longhurst, 1968; Fager and McGowen, 1963; Kendall, 1975; Loeb, 1979; Venrick, 1971).

For the analysis of the shelf ichthyoplankton data, an affinity level of 0.4 was selected. The data were analyzed by

each gear and cruise separately, and then with all data combined. Only groups in which at least one taxon occurred five or more times in a particular gear-cruise combination were included.

In the neuston tows from the fall cruises of both years (1977 and 1978) similar groups of species were present. These consisted of larvae of several species of hexagrammids and Hemilepidotus spp. Mallotus villosus and Bathymaster spp. were associates of some of the group members in fall 1978. In the bongo catches no similar groups were found in 1977 but in 1978 a group composed of Hemilepidotus spp. and Bathymaster spp. was present.

In winter in neuston catches there was the same basic group (hexagrammids and Hemilepidotus spp.) as in fall. In bongo catches in winter Hemilepidotus spp. and Hexagrammos decagrammus formed the only recurrent group.

In spring in the neuston catches a group similar to that found in fall and winter was present. It consisted of two species of Hexagrammos and Hemilepidotus spp. Lyconectes aleutensis and Pleurogrammus monopterygius were associates of some members of this group. A second group composed of Ammodytes hexapterus and Stichaeidae was also present in the neuston catches. In the bongo catches in spring a group consisting of Ammodytes hexapterus and Lepidopsetta bilineata was found with Hemilepidotus spp. and Gymnocanthus A. as associates. A second group composed of Cyclopteridae and Pholis spp. was present in bongo catches.

In summer the ichthyoplankton community was more complex than in other seasons as reflected by both the bongo and neuston catches. In neuston catches two groups were found with some association between the groups. Altogether eight species were grouped with each other in some way. The larger group consisted of Bathymaster spp., Lyconectes aleutensis and Ammodytes hexapterus. The other group included Sebastes spp. and Hemilepidotus spp. Associated with the larger group were Hexagrammos decagrammus, Hemilepidotus hemilepidotus, and Myoxocephalus spp. In bongo catches in summer an even more complex community was evident when four groups were found and 13 species were grouped. Lepidopsetta bilineata and Radulinus asprellus formed a group not associated with any other taxa. The rest of the taxa and groups were associated with each other. The largest group was composed of Bathymaster spp., Sebastes spp., Hippoglossoides elassodon and Psettichthys melanostictus. Several other taxa were associated with Bathymaster spp. (e.g., Stenobrachius leucopsarus, Cottidae, and Ronquilus jordani). Two pleuronectids, Microstomus pacificus and Glyptocephalus zachirus, which formed a recurrent group, were associated with Bathymaster spp. and Sebastes spp.

When REGROUP was applied to all collections together, regardless of cruise or gear (804 samples were used), two

recurrent groups were recognized. One of these groups basically represented taxa found in neuston catches in fall, winter, and spring and the other represented taxa found in bongo catches mainly offshore in summer. Members of the neustonic group were three hexagrammids (Hexagrammos decagrammus, Hexagrammos stelleri, Pleurogrammus monopterygius) and Hemilepidotus spp. Two other species of Hexagrammos (H. lagocephalus and H. octogrammus) were associated with Hexagrammos stelleri and Mallotus villosus was associated with Hemilepidotus spp. The summer-subsurface group consisted of Sebastes spp., Bathymaster spp. and Hippoglossoides elassodon. Three pleuronectids were associated with members of this group: Glyptocephalus zachirus and Microstomus pacificus with Sebastes spp. and Psettichthys melanostictus with Bathymaster spp. and Hippoglossoides elassodon.

Relationship of Distribution of Young Stages to Environmental Parameters

It is of interest to determine the environmental parameters that influence the occurrence and abundance of early stages of fish. Studies that have used correlation techniques to investigate the abundance of eggs and larvae of fish in relation to such factors as water temperatures, salinity, depth and zooplankton abundance have found few significant relationships (e.g., Houde et al., MS 1979). This probably is due to at least two major characteristics of the distribution of these stages: 1) The distribution of young pelagic stages is to some extent the result of where their parents spawned them, or in the case of nesting species, where the nests were. This influences both the time and area of occurrence. 2) These stages start out completely passive - drifting with the currents - and become more capable of directing their movements with growth and development. Thus, in this study which was conducted within a relatively small area in regard to the overall distribution of the species we studied, and in an area of rather uniform hydrographic conditions, no strong correlations of egg and larval abundance with environmental parameters would be expected. For instance, although the hexagrammids probably nest in specific areas that could be characterized with regard to bottom depth and topography as well as hydrographic and biological conditions, by the time the larvae hatch and assume their neustonic habits, they will have drifted away from the nesting areas. Since the larvae remain in the neuston for several months, they may be found many kilometers from where the adults nested. Laboratory studies have shown that eggs and larvae of fish are tolerant of temperature and salinity conditions beyond the range of these conditions associated with their occurrence in the field (e.g., Alderdice and Forrester, 1968, 1971a, 1971b; Alderdice and Velsen, 1971). The temperature and salinity ranges on the shelf off Kodiak were quite narrow, and probably within the tolerance limits of all the taxa we encountered.

The distribution of several taxa taken in shelf collections was related to distance from shore. Larvae of some species that spawn nearshore or in bays were caught primarily in nearshore waters. These included smelt, sand lance, Myoxocephalus spp., walleye pollock, pricklebacks and yellowfin sole. Eggs and larvae of other species that are primarily oceanic in distribution - e.g. northern smoothtongue, northern lampfish, Atka mackerel, rex sole, dover sole, flathead sole, and rockfish - were taken offshore in waters with characteristics of the Alaska stream. Abundances of larvae were comparable between inshore and offshore study areas for several taxa including greenlings, ronquils, sand sole, butter sole, and rock sole.

CONCLUSIONS

The bays and shelf of the Kodiak area are used by a wide variety of fishes during their planktonic stages. We found no area or season that was not used by several species during these critical young stages. Most species in the area spawn demersal eggs, the notable exceptions being walleye pollock and all but one flatfish. Nearly all species, however, spend considerable time, up to several months, as larvae and prejuveniles in the plankton. During this time they disperse widely from the area where they were spawned, and at the end of this time, assume the habits of juveniles or adults.

These life history features make it difficult to provide general statements about the effects of environmental perturbations on year-class strength and recruitment of particular species. With the knowledge we now have, we could predict what the likely constituents of the ichthyoplankton community would be in a given area at a given time. The effects in the Kodiak area of chronic or catastrophic events associated with petroleum development on fish population as a result of impingement on their early stages cannot be predicted from present knowledge because 1) we do not know the relative importance of spawning in this area to recruitment of the species throughout their range and 2) we do not know the effects of various levels and types of pollutants on individual eggs and larvae of fish of the area.

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	4MF77-Fall 1977		4DI78-Spring 1978		2MF78-Summer 1978		1WE78-Fall 1978		1MF79-Winter 1979	
eggs	occur-rences	mean density no./1000^3	occur-rences	mean density no./1000^3	occur-rences	mean density no./1000^3	occur-rences	mean density no./1000^3	occur-rences	mean density no./1000^3
Leuroglossus schmidti							2	19		
Theragra chalcogramma	14	25	23	415	3	14	1	14	1	21
Pleuronectidae			15	119	21	390				
Hippoglossoides elassodon			7	42	17	59				
Isopsetta isolepis			2	25	5	83				
Microstomus pacificus			1	22	38	245				
Platichthys stellatus			1	43	1	52				
Pleuronectes quadrituberculatus			2	18						
Glyptocephalus zachirus					29	47				
Limanda aspera					18	2155				
Psettichthys melanostictus					3	23				
larvae										
Osmeridae					2	2859	24	81	12	32
Mallotus villosus	10	48	6	49						
Bathylagus sp.					1	372				
Myctophidae	1	19	1	14						
Stenobrachius sp.					1	20				
Protomyctophum thompsoni	1	18								
Gadidae					2	92				
Theragra chalcogramma	3	21			3	23				
Sebastes spp.					15	59	1	17	1	15
Hexagrammidae	3	55	5	105			2	16	6	37
Hexagrammos sp.	13	33	8	51	3	73	8	39		
Hexagrammos decagrammus	56	142	75	659	62	66	31	154	74	382
Hexagrammos lagocephalus	40	79					39	88		
Hexagrammos octogrammus	39	37			5	25	39	84	11	21
Hexagrammos stelleri	71	110	33	42	5	59	71	348	29	34
Ophiodon elongatus					7	25				
Pleurogrammus monopterygius	37	413	28	208			36	739	42	348
Anoplopoma fimbria					13	22				
Cottidae			2	26	1	12				
Gymnocanthus sp.			1	36						
Gymnocanthus A			1	14						
Hemilepidotus spp.	60	998	32	581	5	29	52	773	51	409
Hemilepidotus hemilepidotus			2	22	15	37				
Hemilepidotus jordani					5	54				
Icelinus borealis					1	15				
Myoxocephalus sp.					13	50				
Myoxocephalus B.			1	35						
Myoxocephalus G.			1	28						
Cyclopteridae			1	76						
Aptocyclus ventricosus	3	21								
Bathymasteridae	2	28			1	13				
Bathymaster sp.			1	17	44	1946	17	34	5	17
Ronquilus jordani					3	15				
Stichaeidae			2	31	2	85				
Anoplarchus insignis					1	21				
Chirolophis polyactocephalus			5	92						
Stichaeus punctatus					3	15				
Lyconcetes aleutensis			15	108	30	74				
Pholis sp.					1	16				
Pholis laeta					1	19				
Zapora silenus			2	153						
Ammodytes hexapterus			5	38	20	236				
Glyptocephalus zachirus					2	28				
Hippoglossoides elassodon					2	14				
Lepidopsetta bilineata			1	17	4	18				
Microstomus pacificus					5	20				
Psettichthys melanostictus					2	17				

Table 1. Number of occurrences and mean density (number/1000 m^3) of fish eggs and larvae collected in neuston tows during the five OCSEAP plankton cruises. (From Dunn et al. MS 1980)

taxon	4MF77 Fall 1977	4DI78 Spring 1978	2MF78 Summer 1978	1WE78 Fall 1978	1MF79 Winter 1979
eggs					
Bathylagidae					8.85
Leuroglossus schmidti	9.90		9.21	10.91	9.65
Theragra chalcogramma	9.60	12.10	8.54	8.76	9.86
Macrouridae	9.28		10.50	9.73	
Pleuronectidae		10.66	11.00		
Atheresthes stomias					9.47
Glyptocephalus zachirus			10.25		
Hippoglossoides elassodon		10.36	11.31		8.56
Isopsetta isolepis		8.47	9.97		
Limanda aspera			10.53		
Lyopsetta exilis			8.88		
Microstomus pacificus			10.80		
Platichthys stellatus		8.91	8.87		
Psettichthys melanostictus			8.27		
Unidentified	9.18	8.50	9.57	10.77	9.97
larvae					
Clupea harengus pallasi			8.87		
Osmeridae			11.35		
Mallotus villosus	10.34	9.01		11.25	10.67
Bathylagus milleri			8.91		
Bathylagus pacificus		8.98	9.30		9.07
Leuroglossus schmidti	9.49	8.82	9.42	9.38	10.10
Myctophidae			8.22		
Stenobrachius sp.			10.23		
Stenobrachius leucopsarus		9.67	10.12	9.29	9.75
Stenobrachius nannochir			8.62		
Protomyctophum crockeri			8.60		
Protomyctophum thompsoni	9.12		8.58	9.33	9.04
Gadidae			9.30		
Gadus macrocephalus		8.86	8.43		
Theragra chalcogramma	8.92	10.67	9.84		
Macrouridae		8.95	8.58		8.52
Sebastes sp.			11.73	8.97	
Hexagrammos sp.		8.86			8.58
Hexagrammos decagrammus	8.97	9.52	8.57	8.80	9.92
Hexagrammos lagocephalus	8.41				
Hexagrammos octogrammus	8.97			9.06	
Hexagrammos stelleri	9.28	8.12	8.92	9.63	8.94
Pleurogrammus monopterygius	9.36	8.80		10.38	9.63
Cottidae		9.86	10.37	8.23	8.85
Artedius sp.			9.07		
Artedius 1			9.16	8.94	
Artedius 2			8.10		
Clinocottus sp.			8.17		
Dasycottus setiger		8.91	9.10		
Gymnocanthus A		9.93			
Hemilepidotus spp.	11.16	10.06		11.01	10.49
Hemilepidotus hemilepidotus			8.22		
Icelinus borealis	8.29	7.89	9.81		
Malacocottus zonurus 1					8.55
Myoxocephalus sp.		8.34			
Myoxocephalus B.		9.54			
Myoxocephalus G.		9.06			9.07
Radulinus asperellus		9.35			
Triglops sp.		8.37			9.07
Agonidae		9.02	9.57		
Cyclopteridae		9.72	9.61	8.60	
Liparus florae			8.46		
Trichodon trichodon					8.02
Bathymaster sp.		8.97	11.74		
Ronquilus jordani			10.01		
Stichaeidae		9.95	9.54		
Chirolophis polyactocephalus		9.22			
Lumpenella longirostris			8.71		
Lumpenus sagitta		9.45			
Stichaeus punctatus			8.16		
Lyconectes aleutensis		8.85	9.41		8.71
Pholis sp.		9.21	8.46		
Zaprora silenus			9.06		
Ammodytes hexapterus		11.42	8.71		9.18
Pleuronectidae			8.17		
Atheresthes stomias		9.71			9.52
Glyptocephalus zachirus			10.18		
Hippoglossoides elassodon			10.37		
Isopsetta isolepis			10.05		
Lepidopsetta bilineata		10.41	9.98		
Microstomus pacificus			10.10		
Platichthys stellatus			8.93		
Psettichthys melanostictus			10.54		
Hippoglossus stenolepis		8.56	8.51		

Table 2. Total numbers ($\log_{10}$) of eggs and larvae of each taxon of fish estimated from catches in bongo tows during the five OCSEAP plankton cruises. (From Dunn et al. MS 1980)

	Taxa	Common name	Σ nos./1000 m^3	Occurrence No. of hauls	Occurrence %
	Larvae				
1	Osmeridae	Smelts	77,179	67	23.2
2	Hexagrammos decagrammus	Kelp greenling	33,913	77	26.6
3	Hexagrammos stelleri	Whitespotted greenling	21,014	60	20.7
4	Bathymasteridae	Ronquils	6,955	49	16.9
5	Hexagrammos octogrammus	Masked greenling	4,768	28	9.7
6	Stichaeidae	Pricklebacks	4,032	2	.7
7	Hexagrammos lagocephalus	Rock greenling	2,122	16	5.5
8	Myoxocephalus type A		1,780	22	7.6
9	Myoxocephalus type B		1,551	18	6.2
10	Pleurogrammus monopterygius	Atka mackerel	1,170	6	2.1
11	Lyconectes aleutensis	Dwarf wrymouth	1,030	14	4.8
12	Hemilepidotus spp.		761	7	2.4
13	Ammodytes hexapterus	Pacific sand lance	694	15	5.2
14	Gasterosteus aculeatus	Threespine stickleback	676	10	3.5
15	Oncorhynchus gorbuscha	Pink salmon	641	4	1.4
16	Psettichthys melanostictus	Sand sole	496	5	1.7
17	Icelinus spp.		467	1	.3
18	Cottidae type L		416	6	2.1
19	Leptocottus armatus	Pacific staghorn sculpin	408	7	2.4
20	Scorpaenidae	Rockfishes	359	8	2.8
21	Lepidopsetta bilineata	Rock sole	242	5	1.7
22	Cottidae type I		140	3	1.0
23	Gadus macrocephalus	Pacific cod	129	1	.3
24	Cyclopteridae	Lumpfishes and snailfishes	127	6	2.1
25	Trichodon trichodon	Pacific sandfish	85	2	.7
26	Gadidae	Codfishes	72	3	1.0
27	Agonidae	Poachers	56	1	.3
28	Theragra chalcogramma	Walleye pollock	49	2	.3
29	Hemilepitodus jordani	Yellow Irish lord	48	1	.7
30	Hippoglossoides elassodon	Flathead sole	36	1	.3
31	Chirolophis spp.		34	3	1.0
32	Platichthys stellatus	Starry flounder	31	1	.3
33	Artedius type 1		28	1	.3
34	Isopsetta isolepis	Butter sole	24	1	.3
35	Radulinus asprellus	Slim sculpin	24	1	.3
36	Limanda aspera	Yellowfin sole	24	1	.3
	Eggs				
1	Pleuronectidae	Flatfishes	2,976,469	207	71.6
2	Hippoglossoides elassodon	Flathead sole	21,292	69	23.9
3	Theragra chalcogramma	Walleye pollock	10,585	39	13.5
4	Trichodon trichodon	Pacific sandfish	240	2	.7
5	Glyptocephalus zachirus	Rex sole	47	2	.7
6	Pleuronectes quadrituberculatus	Alaska plaice	24	1	.3

Table 3. Number of positive hauls, percent occurrence (out of 289 hauls), and sum of the nos./1000 m^3 for larval fish and eggs caught by neuston 505u net; numbers summed over all stations, cruises, and bays, Kodiak Archipelago, Alaska, 1978-1979. Listed by order of abundance as indicated by no./1000 m^3.

	Taxa	Common name	Σ no./1000 m^3	Σ no./10 m^2	Occurrence No. of hauls	Occurrence %
	Larvae					
1	Osmeridae	Smelts	530,621	284,150	171	58.6
2	Ammodytes hexapterus	Pacific sand lance	8,088	5,033	112	38.4
3	Bathymasteridae	Ronquils	4,377	3,272	135	46.2
4	Lepidopsetta bilineata	Rock sole	3,747	2,644	119	40.7
5	Lumpenus medius	Stout eelblenny	2,824	1,501	61	20.9
6	Cottidae type L		2,778	1,776	119	40.7
7	Psettichthys melanostictus	Sand sole	2,601	1,371	106	36.3
8	Myoxocephalus type B		1,563	1,360	51	17.5
9	Cottidae type I		1,394	1,322	98	33.6
10	Icelinus spp.		1,049	594	74	25.3
11	Theragra chalcogramma	Walleye pollock	970	804	40	13.7
12	Lumpenus maculatus	Daubed shanny	831	480	41	14.0
13	Scorpaenidae	Rockfishes	755	720	62	21.2
14	Cyclopteridae	Lumpfishes and snailfishes	752	520	81	27.7
15	Isopsetta isolepis	Butter sole	643	411	34	11.6
16	Myoxocephalus type A		534	391	51	17.5
17	Gadidae	Codfishes	445	383	38	13.0
18	Anoplarchus spp.		427	284	43	14.7
19	Limanda aspera	Yellowfin sole	420	195	33	11.3
20	Gymnocanthus spp.		404	339	38	13.0
21	Hippoglossoides elassodon	Flathead sole	404	317	50	17.1
22	Lumpenus sagitta	Snake prickleback	387	299	35	12.0
23	Clinocottus spp.		236	90	22	7.5
24	Agonidae	Poachers	231	233	32	11.0
25	Lumpenella longirostris	Longsnout prickleback	225	258	21	7.2
26	Stichaeidae	Pricklebacks	212	151	19	6.5
27	Hemilepidotus spp.		175	194	17	5.8
28	Gadus macrocephalus	Pacific cod	170	124	7	2.4
29	Radulinus asprellus	Slim sculpin	148	94	31	10.6
30	Leptocottus armatus	Pacific staghorn sculpin	128	60	26	8.9
31	Artedius type 2		88	28	9	3.1
32	Artedius type 1		84	78	12	4.1
33	Lyconectes aleutensis	Dwarf wrymouth	82	67	17	5.8
34	Pholidae	Gunnels	65	51	16	5.5
35	Platichthys stellatus	Starry flounder	65	41	9	3.1
36	Myctophidae	Lanternfishes	65	37	14	4.8
37	Dasycottus setiger	Spinyhead sculpin	58	54	11	3.8
38	Hexagrammos decagrammus	Kelp greenling	51	46	10	3.4
39	Triglops spp.		44	22	6	2.0
40	Chirolophis spp.		39	28	8	2.7
41	Hexagrammos stelleri	Whitespotted greenling	28	21	5	1.7
42	Ptilichthys goodei	Quillfish	24	30	4	1.4
43	Malacocottus sp.		15	19	5	1.7
44	Hemilepidotus jordani	Yellow Irish lord	14	16	4	1.4
45	Enophrys spp.		13	5	3	1.0
46	Hemilepidotus hemilepidotus	Red Irish lord	10	11	3	1.0
47	Delolepis gigantea	Giant wrymouth	7	5	2	.7
48	Poroclinus rothrocki	Whitebarred prickleback	8	3	1	.3
49	Stichaeus punctatus	Arctic shanny	8	3	2	.7
50	Lycodes brevipes	Shortfin eelpout	7	11	2	.7
51	Microgadus proximus	Pacific tomcod	7	8	2	.7
52	Trichodon trichodon	Sandfish	7	2	1	.3
53	Glyptocephalus zachirus	Rex sole	6	2	1	.3
54	Pleurogrammus monopterygius	Atka mackerel	5	7	2	.7
55	Hippoglossus stenolepis	Pacific halibut	5	2	1	.3
56	Psychrolutes ?		5	4	1	.3
57	Cottus spp.		3	1	1	.3
58	Cottidae type 2		3	1	1	.3
59	Hexagrammos octogrammus	Masked greenling	3	1	1	.3
60	Ophiodon elongatus	Lingcod	3	4	1	.3
61	Bathylagidae	Deepsea smelts	2	2	1	.3
	Eggs					
1	Pleuronectidae	Flatfishes	171,727	82,758	218	74.7
2	Theragra chalcogramma	Walleye pollock	2,342	2,127	73	25.0
3	Hippoglossoides elassodon	Flathead sole	1,973	927	49	16.8
4	Glyptocephalus zachirus	Rex sole	17	12	4	1.4
5	Osmeridae	Smelts	58	90	1	.3

Table 4. Number of positive hauls, percent occurrence (out of 292 hauls), and sum of the nos./1000 m^3 and nos./10 m^2 for larval fish and eggs caught by bongo 505u net; numbers summed over all stations, cruises, and bays, Kodiak Archipelago, Alaska, 1978-1979. Listed by order of abundance indicated by no./1000 m^3.

Taxon	Proposal	Inshore (FRI) B	Inshore (FRI) N	Offshore (NWAFC) B	Offshore (NWAFC) N	Primary catches of those taxa in proposal but not to be discussed in detail.
Clupea harengus pallasi	X					(offshore: 2 - summer - bongo)
Mallotus villosus	X			X		
Osmeridae		X	X	X		
Leuroglossus schmidti - eggs				X		
Leuroglossus schmidti - larvae				X		
Stenobrachius leucopsarus				X		
Gadus macrocephalus	X					(offshore: 3 - bongo - spring, 2 - bongo - summer; inshore: 17 - bongo - spring, 4 - neuston - spring)
Theragra chalcogramma - eggs		X	X	X		
Theragra chalcogramma - larvae	X	X		X		
Sebastes spp.	X	X		X		
Hexagrammos spp.	X					(identified to species)
Hexagrammos decagrammus			X		X	
Hexagrammos lagocephalus			X		X	
Hexagrammos octogrammus			X		X	
Hexagrammos stelleri	X		X		X	
Pleurogrammus monopterygius	X			X	X	
Ophiodon elongatus	X					(offshore: 10 at 7 sta. - neuston - summer; inshore: 3 - neuston - spring)
Anoplopoma fimbria	X					(offshore: 19 at 13 sta. - neuston - summer)
Cottidae				X		
Gymnocanthus spp.	X					(offshore: 47 at 17 sta. - bongo - spring; inshore: 106 at 38 sta. - bongo - spring)
Hemilepidotus spp.	X			X	X	
Myoxocephalus spp. (A,B)	X	X				
Trichodon trichodon	X					(offshore: 1 - bongo - winter; inshore: 1 - bongo - winter, 3 - neuston - winter)
Cyclopteridae		X				
Bathymasteridae		X	X			
Bathymaster spp.				X	X	
Ronquilus jordani				X		
Lumpenus maculatus	X	X				
Lumpenus medius		X				
Lyconectes aleutensis	X					(offshore: 87 at 15 sta. - neuston - spring, 125 at 30 sta. - neuston - summer; inshore: 292 at 22 sta. - neuston - summer)
Ammodytes hexapterus	X	X		X		
Pleuronectidae - eggs		X	X			
Atheresthes stomias	X					(offshore: 13 at 8 sta. - bongo - spring, 9 at 7 sta. - bongo - winter)
Glyptocephalus zachirus - eggs				X		
Glyptocephalus zachirus - larvae				X		
Hippoglossoides elassodon - eggs		X	X	X		
Hippoglossoides elassodon - larvae	X	X		X		
Isopsetta isolepis		X		X		
Lepidopsetta bilineata	X	X		X		
Limanda aspera	X	X				
Microstomus pacificus - eggs				X		
Microstomus pacificus - larvae				X		
Psettichthys melanostictus	X	X		X		

Table 5. Taxa dealt with in study of ichthyoplankton of Kodiak (larvae except as indicated).

Taxon	net[2]	Inshore (bays) mean log (x+1)	Inshore (bays) variance log (x+1)	Inshore (bays) significant differences[1] bays	Inshore (bays) significant differences[1] cruises	Inshore (bays) significant differences[1] interactions	Offshore (shelf) mean log (x+1)	Offshore (shelf) variance log (x+1)	Offshore (shelf) significant differences[1] areas	Offshore (shelf) significant differences[1] cruises	Offshore (shelf) significant differences[1] interactions
Mallotus villosus	B	- - - - - - - - - - - - - - - - - - - -[3]					.42379	.26627	* *	* *	*
Osmeridae	B	1.09097	.25733	*	* *	*	.32140	.43262	*		
	N	.01995	.01165		*		----------[3]				
Leuroglossus schmidti - eggs	B	----------					.23986	.39267	* *	* *	* *
Leuroglossus schmidti - larvae	B	----------					.09033	.05916	* *	* *	* *
Stenobrachlus leucopsarus	B	----------					.09505	.07669	*	* *	
Theragra chalcogramma - eggs	B	.34088	.23193	*	* *		.10713	.12343	* *	* *	*
	N	.02178	.00445	* *	* *	* *	- - - - - - - - - -				
Theragra chalcogramma - larvae	B	.19031	.01238	* *	* *	* *	.13435	.11739	*	* *	
Sebastes spp.	B	.18137	.09467	* *	* *	* *	.32293	.19730	* *	* *	* *
Hexagrammos decagrammus	N	.04340	.01249		* *	* *	.08299	.01662	* *	* *	* *
Hexagrammos lagocephalus	N	.00543	.00068		* *	* *	.02733	.00098	* *		
Hexagrammos octogrammus	N	.01027	.00238		* *		.00933	.00051		* *	
Hexagrammos stelleri	N	.03531	.00655	*	* *	* *	.03637	.00763	* *	* *	
Pleurogrammus monopterygius	B	----------					.07729	.07493	*		* *
	N	----------					.05960	.02409	* *		* *
Cottidae	B	- - - - - - - - - - - - - - - - - - - -					.16208	.10511	* *	* *	* *
Hemilepidotus spp.	B	----------					.72297	.28342	* *	* *	
	N	----------					.07881	.03243	* *	* *	* *
Myoxocephalus spp. (A)	B	.16853	.08512		* *		----------				
(B)	B	.22846	.14792		* *	*	----------				
Cyclopteridae	B	.20753	.12889		* *		----------				
Bathymasteridae	B	.45177	.15386	*	* *	* *	- - - - - - - - - -				
	N	.00574	.00039				----------				
Bathymaster spp.	B	- - - - - - - - - - - - - - - - - - - -					.89582	.19370	*	* *	*
	N	- - - - - - - - - - - - - - - - - - - -					.05610	.03405		* *	*
Ronquilus jordani	B	- - - - - - - - - - - - - - - - - - - -					.22046	.16811			
Lumpenus maculatus	B	.16531	.08925	* *	* *	* *	----------				
Lumpenus medius	B	.24485	.20905	* *	* *		----------				
Ammodytes hexapterus	B	.60740	.13558		*		.33105	.10624	* *	* *	* *
Pleuronectidae - eggs	B	1.27047	.30945	* *	* *	* *	- - - - - - - - - -				
	N	.39427	.15537	* *	* *		- - - - - - - - - -				
Glyptocephalus zachirus - eggs	B	----------					.27320	.16388	* *		
Glyptocephalus zachirus - larvae	B	----------					.34027	.21884			
Hippoglossoides elassodon - eggs	B	.13134	.06734	* *	* *	* *	.15022	.14860		* *	*
	N	.01645	.00289		* *		----------				
Hippoglossoides elassodon - larvae	B	.11105	.05948		* *		.48065	.27543			
Isopsetta isolepis	B	.06667	.03817	*	* *		.26606	.18301	*		
Lepidopsetta bilineata	B	.44067	.11125	* *	* *	* *	.33258	.19104	* *		* *
Limanda aspera	B	.06361	.03700	*	* *		----------				
Microstomus pacificus - eggs	B	----------					.50162	.30094	* *		
Microstomus pacificus - larvae	B	----------					.20559	.18283			
Psettichthys melanostictus	B	.27934	.11418		* *		.44850	.27264	* *		

1/ * $p<0.05$; * * $p<0.01$
2/ B = bongo; N = neuston
3/ - - - = taxon not identified in these samples; ----- = taxon not abundant enough for analysis.

Table 6. Summary of results of ANOVA on Kodiak Ichthyoplankton Survey.

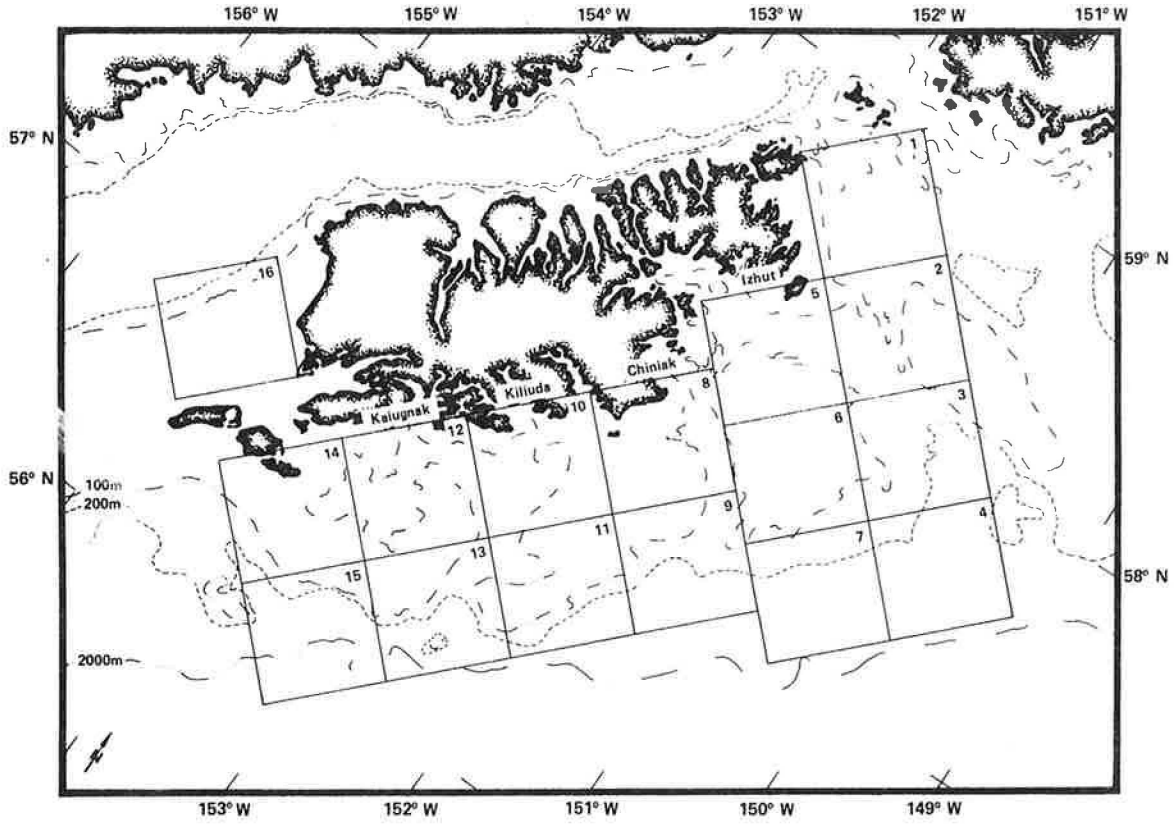

Figure 1. Subareas used for analysis of distribution of ichthyoplankton from the five OCSEAP offshore plankton surveys.

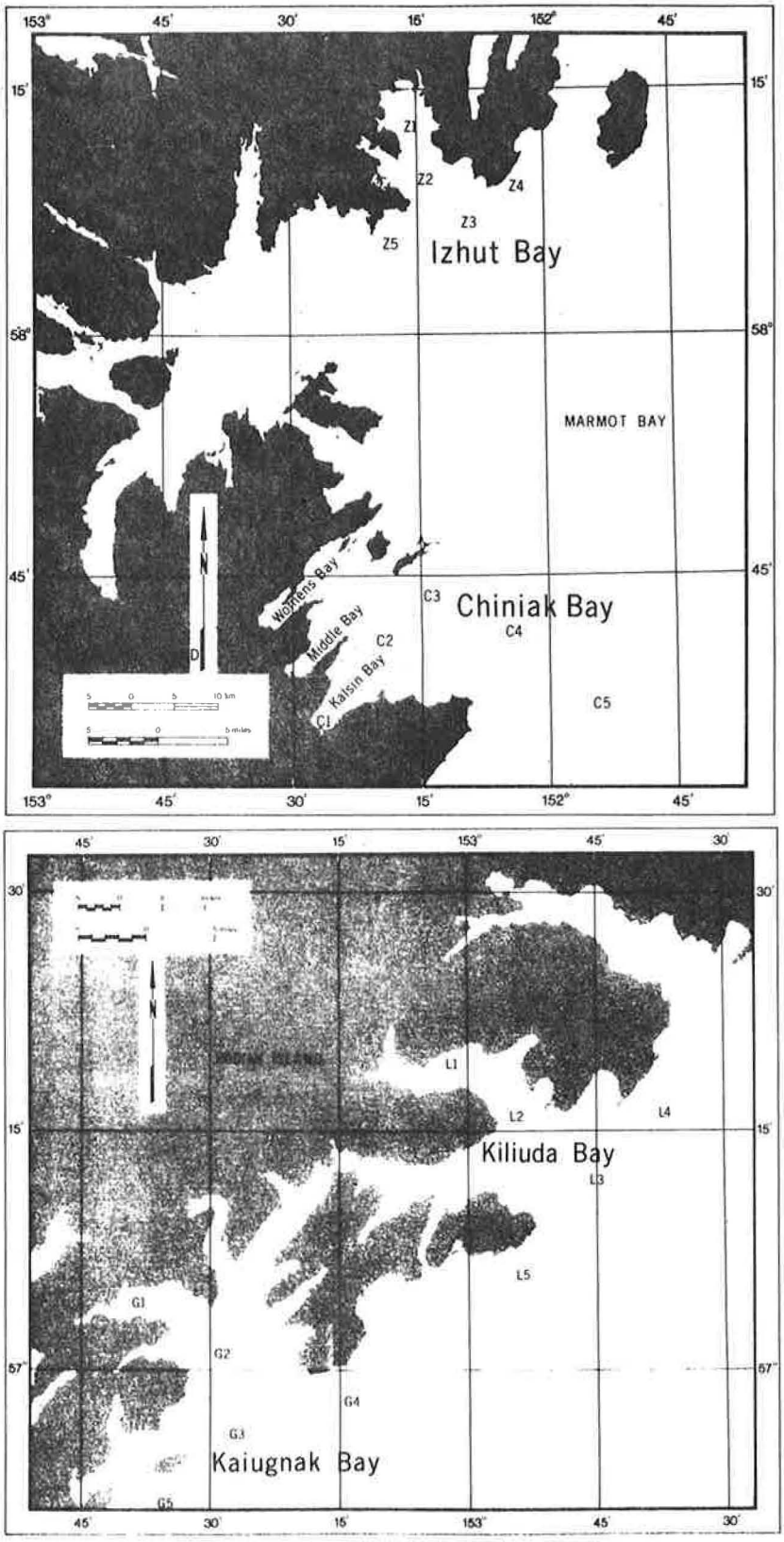

Figure 2. Station locations from OCSEAP plankton survey of bays of Kodiak.

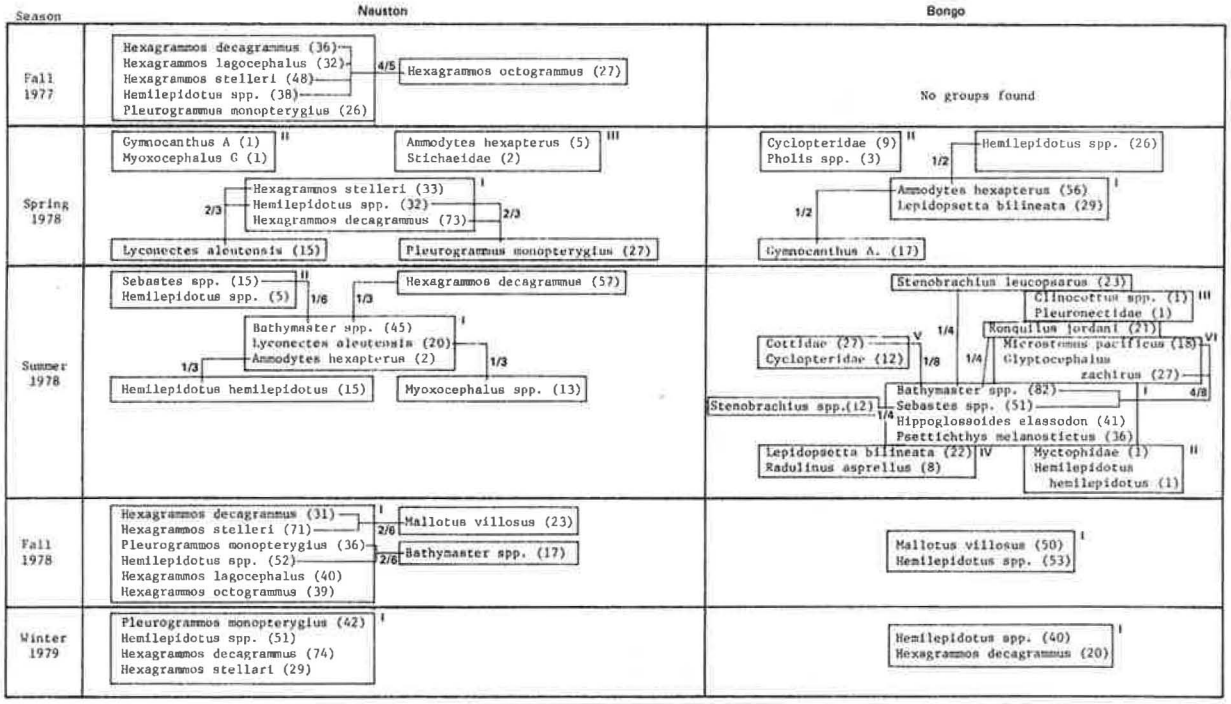

Figure 3. Results of REGROUP of Kodiak ichthyoplankton study of offshore area. Analysis at affinity level of Ø.4, run by cruise and gear. Boxes enclose taxa with affinities of >Ø.4. Lines connect taxa with affinities >Ø.4 that do not have affinities with all in the group (fractions indicate proportions of possible inter-group affinities found). Numbers of occurrences of the taxa are in parentheses after the name. Roman numerals are arbitrarily assigned group numbers.

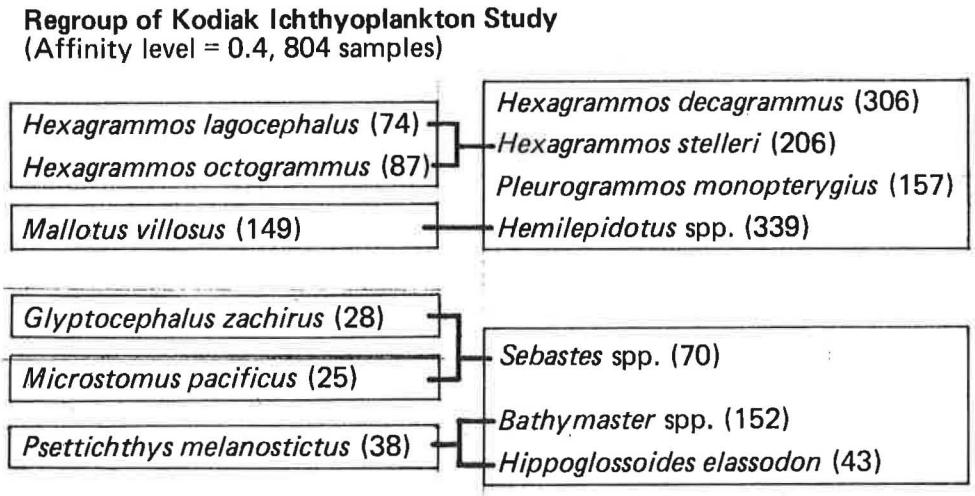

Figure 4. Results of REGROUP of Kodiak ichthyplankton study of offshore area. Analysis at affinity level of Ø.4, run with all cruises and gears combined. Notations as in Figure 3.

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Osmeridae Stage Larvae

Season	Inshore Dates	Inshore Mean ($\#10m^2$) Neuston	Inshore Mean ($\#10m^2$) Bongo	Offshore Dates	Offshore Mean ($\#10m^2$) Neuston	Offshore Mean ($\#10m^2$) Bongo
Fall 1977				31 Oct-14 Nov		
Spring 1978	29 Mar-8 Apr		.1616			
	10-17 Apr	.0021		28 Mar-20 Apr		
	21 Apr-1 May					
	31 May-6 Jun		.0718			
	14-24 Jun	.0693	12.29			
Summer 1978	21-29 Jul	.1843	170.3	19 Jun-9 Jul		1.096
	1-9 Aug	.0084	392.9			
	15-21 Aug	.2320	1348			
Fall 1978	3-13 Nov	.0041	13.51	25 Oct-17 Nov		
Winter 1979	6-16 Mar		2.719	13 Feb-11 Mar		

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Mallotus villosus Stage Larvae

Season	Inshore Dates	Inshore Mean ($\#/10m^2$) Neuston	Inshore Mean ($\#/10m^2$) Bongo	Offshore Dates	Offshore Mean ($\#/10m^2$) Neuston	Offshore Mean ($\#/10m^2$) Bongo
Fall 1977				31 Oct-14 Nov		1.660
Spring 1978	29 Mar-8 Apr					
	10-17 Apr			28 Mar-20 Apr		.0291
	21 Apr-1 May					
	31 May-6 Jun					
	14-24 Jun					
Summer 1978	21-29 Jul			19 Jun-9 Jul		
	1-9 Aug					
	15-21 Aug					
Fall 1978	3-13 Nov			25 Oct-17 Nov		6.011
Winter 1979	6-16 Mar			13 Feb-11 Mar		1.653

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Leuroglossus schmidti Stage Eggs

Season	Inshore Dates	Inshore Mean (#10m^2) Neuston	Inshore Mean (#10m^2) Bongo	Offshore Dates	Offshore Mean (#10m^2) Neuston	Offshore Mean (#10m^2) Bongo
Fall 1977				31 Oct-14 Nov		1.367
Spring 1978	29 Mar-8 Apr					
	10-17 Apr			28 Mar-20 Apr		
	21 Apr-1 May					
	31 May-6 Jun					
	14-24 Jun					
Summer 1978	21-29 Jul			19 Jun-9 Jul		.1131
	1-9 Aug					
	15-21 Aug					
Fall 1978	3-13 Nov			25 Oct-17 Nov		1.783
Winter 1979	6-16 Mar			13 Feb-11 Mar		.2505

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Leuroglossus schmidti Stage Larvae

Season	Inshore Dates	Inshore Mean (#10m^2) Neuston	Inshore Mean (#10m^2) Bongo	Offshore Dates	Offshore Mean (#10m^2) Neuston	Offshore Mean (#10m^2) Bongo
Fall 1977				31 Oct-14 Nov		.2500
Spring 1978	29 Mar-8 Apr					
	10-17 Apr			28 Mar-20 Apr		.0567
	21 Apr-1 May					
	31 May-6 Jun					
	14-24 Jun					
Summer 1978	21-29 Jul			19 Jun-9 Jul		.1832
	1-9 Aug					
	15-21 Aug					
Fall 1978	3-13 Nov			25 Oct-17 Nov		.1612
Winter 1979	6-16 Mar			13 Feb-11 Mar		.5589

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Stenobrachius leucopsarus Stage Larvae

Season	Inshore Dates	Inshore Mean (#10m^2) Neuston	Inshore Mean (#10m^2) Bongo	Offshore Dates	Offshore Mean (#10m^2) Neuston	Offshore Mean (#10m^2) Bongo
Fall 1977				31 Oct-14 Nov		.0878
Spring 1978	29 Mar-8 Apr					
	10-17 Apr			28 Mar-20 Apr		.2134
	21 Apr-1 May					
	31 May-6 Jun					
	14-24 Jun					
Summer 1978	21-29 Jul			19 Jun-9 Jul		.7673
	1-9 Aug					
	15-21 Aug					
Fall 1978	3-13 Nov			25 Oct-17 Nov		.1186
Winter 1979	6-16 Mar			13 Feb-11 Mar		.1447

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Theragra chalcogramma Stage Eggs

Season	Inshore Dates	Inshore Mean (#10m^2) Neuston	Inshore Mean (#10m^2) Bongo	Offshore Dates	Offshore Mean (#10m^2) Neuston	Offshore Mean (#10m^2) Bongo
Fall 1977				31 Oct-14 Nov		.1911
Spring 1978	29 Mar-8 Apr	.2171	3.327			
	10-17 Apr	.2488	6.232	28 Mar-20 Apr		1.572
	21 Apr-1 May	.0625	8.295			
	31 May-6 Jun	.0019	1.174			
	14-24 Jun	.0107	.7315			
Summer 1978	21-29 Jul		.1487	19 Jun-9 Jul		.0325
	1-9 Aug	.0019				
	15-21 Aug		.0838			
Fall 1978	3-13 Nov	.0065	.5547	25 Oct-17 Nov		.0517
Winter 1979	6-16 Mar	.0015	.2097	13 Feb-11 Mar		.0320

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Theragra chalcogramma Stage Larvae

Season	Inshore Dates	Inshore Mean (#10m^2) Neuston	Inshore Mean (#10m^2) Bongo	Offshore Dates	Offshore Mean (#10m^2) Neuston	Offshore Mean (#10m^2) Bongo
Fall 1977				31 Oct-14 Nov		.0213
Spring 1978	29 Mar-8 Apr		.4555			
	10-17 Apr		4.129	28 Mar-20 Apr		.6628
	21 Apr-1 May		7.586			
	31 May-6 Jun		.0937			
	14-24 Jun					
Summer 1978	21-29 Jul		.0353	19 Jun-9 Jul		.4896
	1-9 Aug					
	15-21 Aug					
Fall 1978	3-13 Nov			25 Oct-17 Nov		
Winter 1979	6-16 Mar		.1022	13 Feb-11 Mar		

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Sebastes spp. Stage Larvae

Season	Inshore Dates	Inshore Mean ($\#/10m^2$) Neuston	Inshore Mean ($\#/10m^2$) Bongo	Offshore Dates	Offshore Mean ($\#/10m^2$) Neuston	Offshore Mean ($\#/10m^2$) Bongo
Fall 1977				31 Oct-14 Nov		
Spring 1978	29 Mar-8 Apr					
	10-17 Apr			28 Mar-20 Apr		
	21 Apr-1 May					
	31 May-6 Jun		.4814			
	14-24 Jun		1.660			
Summer 1978	21-29 Jul		.6173	19 Jun-9 Jul		3.183
	1-9 Aug		2.088			
	15-21 Aug		2.308			
Fall 1978	3-13 Nov			25 Oct-17 Nov		.0577
Winter 1979	6-16 Mar			13 Feb-11 Mar		

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Hexagrammos decagrammus Stage Larvae

Season	Inshore Dates	Inshore Mean (#10m^2) Neuston	Inshore Mean (#10m^2) Bongo	Offshore Dates	Offshore Mean (#10m^2) Neuston	Offshore Mean (#10m^2) Bongo
Fall 1977				31 Oct-14 Nov	.0700	
Spring 1978	29 Mar-8 Apr	.1450				
	10-17 Apr	.1469		28 Mar-20 Apr	.5194	
	21 Apr-1 May	.6185				
	31 May-6 Jun	.1375				
	14-24 Jun	.0321				
Summer 1978	21-29 Jul			19 Jun-9 Jul	.0725	
	1-9 Aug					
	15-21 Aug					
Fall 1978	3-13 Nov	.0162		25 Oct-17 Nov	.0801	
Winter 1979	6-16 Mar	.0712		13 Feb-11 Mar	.3804	

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Hexagrammos lagocephalus Stage Larvae

Season	Inshore Dates	Inshore Mean (#10m^2) Neuston	Inshore Mean (#10m^2) Bongo	Offshore Dates	Offshore Mean (#10m^2) Neuston	Offshore Mean (#10m^2) Bongo
Fall 1977				31 Oct-14 Nov	.0650	
Spring 1978	29 Mar-8 Apr					
	10-17 Apr			28 Mar-20 Apr		
	21 Apr-1 May					
	31 May-6 Jun					
	14-24 Jun					
Summer 1978	21-29 Jul	.0042		19 Jun-9 Jul		
	1-9 Aug	.0043				
	15-21 Aug	.0687				
Fall 1978	3-13 Nov	.0513		25 Oct-17 Nov		
Winter 1979	6-16 Mar			13 Feb-11 Mar		

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Hexagrammos octogrammus Stage Larvae

Season	Inshore Dates	Inshore Mean (#/10m^2) Neuston	Inshore Mean (#/10m^2) Bongo	Offshore Dates	Offshore Mean (#/10m^2) Neuston	Offshore Mean (#/10m^2) Bongo
Fall 1977				31 Oct-14 Nov	.0304	
Spring 1978	29 Mar-8 Apr					
	10-17 Apr			28 Mar-20 Apr		
	21 Apr-1 May					
	31 May-6 Jun					
	14-24 Jun					
Summer 1978	21-29 Jul	.0032		19 Jun-9 Jul	.0294	
	1-9 Aug	.0698				
	15-21 Aug	.1644				
Fall 1978	3-13 Nov	.1447		25 Oct-17 Nov	.0489	
Winter 1979	6-16 Mar			13 Feb-11 Mar	.0054	

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Hexagrammos stelleri Stage Larvae

Season	Inshore Dates	Inshore Mean (#/10m^2) Neuston	Inshore Mean (#/10m^2) Bongo	Offshore Dates	Offshore Mean (#/10m^2) Neuston	Offshore Mean (#/10m^2) Bongo
Fall 1977				31 Oct-14 Nov	.1714	
Spring 1978	29 Mar-8 Apr	.0432				
	10-17 Apr	.0207		28 Mar-20 Apr	.0244	
	21 Apr-1 May	.0392				
	31 May-6 Jun					
	14-24 Jun					
Summer 1978	21-29 Jul			19 Jun-9 Jul	.0058	
	1-9 Aug					
	15-21 Aug					
Fall 1978	3-13 Nov	.8207		25 Oct-17 Nov	.2440	
Winter 1979	6-16 Mar	.1192		13 Feb-11 Mar	.0124	

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Pleurogrammus monopterygius Stage Larvae

Season	Inshore Dates	Inshore Mean (#10m^2) Neuston	Inshore Mean (#10m^2) Bongo	Offshore Dates	Offshore Mean (#10m^2) Neuston	Offshore Mean (#10m^2) Bongo
Fall 1977				31 Oct-14 Nov	.1687	.2475
Spring 1978	29 Mar-8 Apr					
	10-17 Apr			28 Mar-20 Apr	.0947	.0500
	21 Apr-1 May					
	31 May-6 Jun					
	14-24 Jun					
Summer 1978	21-29 Jul			19 Jun-9 Jul		
	1-9 Aug					
	15-21 Aug					
Fall 1978	3-13 Nov			25 Oct-17 Nov	.1809	.2281
Winter 1979	6-16 Mar			13 Feb-11 Mar	.1460	.2669

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Cottidae Stage Larvae

Season	Inshore Dates	Inshore Mean (#10m^2) Neuston	Inshore Mean (#10m^2) Bongo	Offshore Dates	Offshore Mean (#10m^2) Neuston	Offshore Mean (#10m^2) Bongo
Fall 1977				31 Oct-14 Nov		
Spring 1978	29 Mar-8 Apr					
	10-17 Apr			28 Mar-20 Apr		.5968
	21 Apr-1 May					
	31 May-6 Jun					
	14-24 Jun					
Summer 1978	21-29 Jul			19 Jun-9 Jul		1.550
	1-9 Aug					
	15-21 Aug					
Fall 1978	3-13 Nov			25 Oct-17 Nov		.0270
Winter 1979	6-16 Mar			13 Feb-11 Mar		.0643

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Hemilepidotus spp. Stage Larvae

Season	Inshore Dates	Inshore Mean (#10m^2) Neuston	Inshore Mean (#10m^2) Bongo	Offshore Dates	Offshore Mean (#10m^2) Neuston	Offshore Mean (#10m^2) Bongo
Fall 1977				31 Oct-14 Nov	.4131	17.81
Spring 1978	29 Mar-8 Apr					
	10-17 Apr			28 Mar-20 Apr	.1863	.7993
	21 Apr-1 May					
	31 May-6 Jun					
	14-24 Jun					
Summer 1978	21-29 Jul			19 Jun-9 Jul	.0030	
	1-9 Aug					
	15-21 Aug					
Fall 1978	3-13 Nov			25 Oct-17 Nov	.2292	7.805
Winter 1979	6-16 Mar			13 Feb-11 Mar	.1988	1.616

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Myoxocephalus Type A Stage Larvae

Season	Inshore Dates	Inshore Mean (#10m^2) Neuston	Inshore Mean (#10m^2) Bongo	Offshore Dates	Offshore Mean (#10m^2) Neuston	Offshore Mean (#10m^2) Bongo
Fall 1977				31 Oct-14 Nov		
Spring 1978	29 Mar-8 Apr		2.881			
	10-17 Apr		1.364	28 Mar-20 Apr		
	21 Apr-1 May		2.587			
	31 May-6 Jun		.0718			
	14-24 Jun					
Summer 1978	21-29 Jul			19 Jun-9 Jul		
	1-9 Aug					
	15-21 Aug					
Fall 1978	3-13 Nov			25 Oct-17 Nov		
Winter 1979	6-16 Mar		.3741	13 Feb-11 Mar		

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Myoxocephalus Type B Stage Larvae

Season	Inshore Dates	Inshore Mean (#10m^2) Neuston	Inshore Mean (#10m^2) Bongo	Offshore Dates	Offshore Mean (#10m^2) Neuston	Offshore Mean (#10m^2) Bongo
Fall 1977				31 Oct-14 Nov		
Spring 1978	29 Mar-8 Apr		2.600			
	10-17 Apr		2.845	28 Mar-20 Apr		
	21 Apr-1 May		7.662			
	31 May-6 Jun		.4180			
	14-24 Jun		.0565			
Summer 1978	21-29 Jul			19 Jun-9 Jul		
	1-9 Aug					
	15-21 Aug					
Fall 1978	3-13 Nov			25 Oct-17 Nov		
Winter 1979	6-16 Mar		.0718	13 Feb-11 Mar		

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Cyclopteridae Stage Larvae

Season	Inshore Dates	Inshore Mean ($\#10m^2$) Neuston	Inshore Mean ($\#10m^2$) Bongo	Offshore Dates	Offshore Mean ($\#10m^2$) Neuston	Offshore Mean ($\#10m^2$) Bongo
Fall 1977				31 Oct-14 Nov		
Spring 1978	29 Mar-8 Apr		.3343			
	10-17 Apr		.6938	28 Mar-20 Apr		
	21 Apr-1 May		1.943			
	31 May-6 Jun		1.309			
	14-24 Jun		.3847			
Summer 1978	21-29 Jul		1.232	19 Jun-9 Jul		
	1-9 Aug		.5986			
	15-21 Aug		.4623			
Fall 1978	3-13 Nov			25 Oct-17 Nov		
Winter 1979	6-16 Mar		.0718	13 Feb-11 Mar		

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Bathymasteridae Stage Larvae

Season	Inshore Dates	Inshore Mean (#/10m^2) Neuston	Inshore Mean (#/10m^2) Bongo	Offshore Dates	Offshore Mean (#/10m^2) Neuston	Offshore Mean (#/10m^2) Bongo
Fall 1977				31 Oct-14 Nov		
Spring 1978	29 Mar-8 Apr					
	10-17 Apr			28 Mar-20 Apr		
	21 Apr-1 May	.0260	.6596			
	31 May-6 Jun	.0042	22.43			
	14-24 Jun	.0292	8.765			
Summer 1978	21-29 Jul	.0349	2.878	19 Jun-9 Jul		
	1-9 Aug	.0213	6.070			
	15-21 Aug	.0184	2.164			
Fall 1978	3-13 Nov			25 Oct-17 Nov		
Winter 1979	6-16 Mar			13 Feb-11 Mar		

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Bathymaster spp. Stage Larvae

Season	Inshore Dates	Inshore Mean (#/10m^2) Neuston	Inshore Mean (#/10m^2) Bongo	Offshore Dates	Offshore Mean (#/10m^2) Neuston	Offshore Mean (#/10m^2) Bongo
Fall 1977				31 Oct-14 Nov	.0034	
Spring 1978	29 Mar-8 Apr					
	10-17 Apr			28 Mar-20 Apr		.0473
	21 Apr-1 May					
	31 May-6 Jun					
	14-24 Jun					
Summer 1978	21-29 Jul			19 Jun-9 Jul	.6531	58.10
	1-9 Aug					
	15-21 Aug					
Fall 1978	3-13 Nov			25 Oct-17 Nov	.0093	
Winter 1979	6-16 Mar			13 Feb-11 Mar	.0014	

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Ronquilus jordani Stage Larvae

Season	Inshore Dates	Inshore Mean (#/10m^2) Neuston	Inshore Mean (#/10m^2) Bongo	Offshore Dates	Offshore Mean (#/10m^2) Neuston	Offshore Mean (#/10m^2) Bongo
Fall 1977				31 Oct-14 Nov		
Spring 1978	29 Mar-8 Apr					
	10-17 Apr			28 Mar-20 Apr		
	21 Apr-1 May					
	31 May-6 Jun					
	14-24 Jun					
Summer 1978	21-29 Jul			19 Jun-9 Jul		.6614
	1-9 Aug					
	15-21 Aug					
Fall 1978	3-13 Nov			25 Oct-17 Nov		
Winter 1979	6-16 Mar			13 Feb-11 Mar		

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Lumpenus maculatus Stage Larvae

Season	Inshore Dates	Inshore Mean (#10m^2) Neuston	Inshore Mean (#10m^2) Bongo	Offshore Dates	Offshore Mean (#10m^2) Neuston	Offshore Mean (#10m^2) Bongo
Fall 1977				31 Oct-14 Nov		
Spring 1978	29 Mar-8 Apr		1.525			
	10-17 Apr		3.261	28 Mar-20 Apr		
	21 Apr-1 May		2.291			
	31 May-6 Jun		.1854			
	14-24 Jun					
Summer 1978	21-29 Jul			19 Jun-9 Jul		
	1-9 Aug					
	15-21 Aug					
Fall 1978	3-13 Nov			25 Oct-17 Nov		
Winter 1979	6-16 Mar			13 Feb-11 Mar		

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Lumpenus medius Stage Larvae

Season	Inshore Dates	Inshore Mean (#10m^2) Neuston	Inshore Mean (#10m^2) Bongo	Offshore Dates	Offshore Mean (#10m^2) Neuston	Offshore Mean (#10m^2) Bongo
Fall 1977				31 Oct-14 Nov		
Spring 1978	29 Mar-8 Apr		3.114			
	10-17 Apr		2.954	28 Mar-20 Apr		
	21 Apr-1 May		2.475			
	31 May-6 Jun		.4497			
	14-24 Jun		.6904			
Summer 1978	21-29 Jul		.1487	19 Jun-9 Jul		
	1-9 Aug					
	15-21 Aug					
Fall 1978	3-13 Nov			25 Oct-17 Nov		
Winter 1979	6-16 Mar		.7653	13 Feb-11 Mar		

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Ammodytes hexapterus Stage Larvae

Season	Inshore Dates	Inshore Mean (#10m^2) Neuston	Inshore Mean (#10m^2) Bongo	Offshore Dates	Offshore Mean (#10m^2) Neuston	Offshore Mean (#10m^2) Bongo
Fall 1977				31 Oct-14 Nov		
Spring 1978	29 Mar-8 Apr		54.33			
	10-17 Apr		23.92	28 Mar-20 Apr		7.939
	21 Apr-1 May		21.02			
	31 May-6 Jun		.6974			
	14-24 Jun		.1722			
Summer 1978	21-29 Jul			19 Jun-9 Jul		.0680
	1-9 Aug					
	15-21 Aug					
Fall 1978	3-13 Nov			25 Oct-17 Nov		
Winter 1979	6-16 Mar		18.63	13 Feb-11 Mar		.0312

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Pleuronectidae Stage Eggs

Season	Inshore Dates	Inshore Mean (#10m^2) Neuston	Inshore Mean (#10m^2) Bongo	Offshore Dates	Offshore Mean (#10m^2) Neuston	Offshore Mean (#10m^2) Bongo
Fall 1977				31 Oct-14 Nov		
Spring 1978	29 Mar-8 Apr	.1765	3.579			
	10-17 Apr	.5223	9.331	28 Mar-20 Apr		
	21 Apr-1 May	.3134	11.73			
	31 May-6 Jun	.3219	29.31			
	14-24 Jun	3.656	97.40			
Summer 1978	21-29 Jul	10.40	175.2	19 Jun-9 Jul		
	1-9 Aug	9.487	181.6			
	15-21 Aug	3.968	86.64			
Fall 1978	3-13 Nov			25 Oct-17 Nov		
Winter 1979	6-16 Mar	.0190		13 Feb-11 Mar		

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Glyptocephalus zachirus Stage Eggs

Season	Inshore Dates	Inshore Mean (#10m^2) Neuston	Inshore Mean (#10m^2) Bongo	Offshore Dates	Offshore Mean (#10m^2) Neuston	Offshore Mean (#10m^2) Bongo
Fall 1977				31 Oct-14 Nov		
Spring 1978	29 Mar-8 Apr					
	10-17 Apr			28 Mar-20 Apr		
	21 Apr-1 May					
	31 May-6 Jun					
	14-24 Jun					
Summer 1978	21-29 Jul			19 Jun-9 Jul		.8759
	1-9 Aug					
	15-21 Aug					
Fall 1978	3-13 Nov			25 Oct-17 Nov		
Winter 1979	6-16 Mar			13 Feb-11 Mar		

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Glyptochephalus zachirus Stage Larvae

Season	Inshore Dates	Inshore Mean (#10m^2) Neuston	Inshore Mean (#10m^2) Bongo	Offshore Dates	Offshore Mean (#10m^2) Neuston	Offshore Mean (#10m^2) Bongo
Fall 1977				31 Oct-14 Nov		
Spring 1978	29 Mar-8 Apr					
	10-17 Apr			28 Mar-20 Apr		
	21 Apr-1 May					
	31 May-6 Jun					
	14-24 Jun					
Summer 1978	21-29 Jul			19 Jun-9 Jul		1.189
	1-9 Aug					
	15-21 Aug					
Fall 1978	3-13 Nov			25 Oct-17 Nov		
Winter 1979	6-16 Mar			13 Feb-11 Mar		

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Hippoglossoides elassodon Stage Eggs

Season	Inshore Dates	Inshore Mean (#/10m^2) Neuston	Inshore Mean (#/10m^2) Bongo	Offshore Dates	Offshore Mean (#/10m^2) Neuston	Offshore Mean (#/10m^2) Bongo
Fall 1977				31 Oct-14 Nov		
Spring 1978	29 Mar-8 Apr	.0028	.0718			
	10-17 Apr	.0077	.3721	28 Mar-20 Apr		.4389
	21 Apr-1 May	.0959	3.351			
	31 May-6 Jun	.0303	.2638			
	14-24 Jun	.1845	.4497			
Summer 1978	21-29 Jul	.0307	.3476	19 Jun-9 Jul		.9027
	1-9 Aug	.0403	.3027			
	15-21 Aug	.0078				
Fall 1978	3-13 Nov			25 Oct-17 Nov		
Winter 1979	6-16 Mar			13 Feb-11 Mar		.0310

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Hippoglossoides elassodon Stage Larvae

Season	Inshore Dates	Inshore Mean (#10m^2) Neuston	Inshore Mean (#10m^2) Bongo	Offshore Dates	Offshore Mean (#10m^2) Neuston	Offshore Mean (#10m^2) Bongo
Fall 1977				31 Oct-14 Nov		
Spring 1978	29 Mar-8 Apr					
	10-17 Apr			28 Mar-20 Apr		
	21 Apr-1 May		.0565			
	31 May-6 Jun		1.521			
	14-24 Jun		.2821			
Summer 1978	21-29 Jul		.8710	19 Jun-9 Jul		2.025
	1-9 Aug		.5118			
	15-21 Aug		.2638			
Fall 1978	3-13 Nov		.0565	25 Oct-17 Nov		
Winter 1979	6-16 Mar			13 Feb-11 Mar		

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Isopsetta isolepis Stage Larvae

Season	Inshore Dates	Inshore Mean (#/10m^2) Neuston	Inshore Mean (#/10m^2) Bongo	Offshore Dates	Offshore Mean (#/10m^2) Neuston	Offshore Mean (#/10m^2) Bongo
Fall 1977				31 Oct-14 Nov		
Spring 1978	29 Mar-8 Apr					
	10-17 Apr			28 Mar-20 Apr		
	21 Apr-1 May					
	31 May-6 Jun					
	14-24 Jun		.0565			
Summer 1978	21-29 Jul		1.525	19 Jun-9 Jul		.8453
	1-9 Aug		.6056			
	15-21 Aug		.0838			
Fall 1978	3-13 Nov			25 Oct-17 Nov		
Winter 1979	6-16 Mar			13 Feb-11 Mar		

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Lepidopsetta bilineata Stage Larvae

Season	Inshore Dates	Inshore Mean (#/10m^2) Neuston	Inshore Mean (#/10m^2) Bongo	Offshore Dates	Offshore Mean (#/10m^2) Neuston	Offshore Mean (#/10m^2) Bongo
Fall 1977				31 Oct-14 Nov		
Spring 1978	29 Mar-8 Apr		1.396			
	10-17 Apr		5.048	28 Mar-20 Apr		1.524
	21 Apr-1 May		33.88			
	31 May-6 Jun		8.627			
	14-24 Jun		2.627			
Summer 1978	21-29 Jul		.2950	19 Jun-9 Jul		.8328
	1-9 Aug		.1161			
	15-21 Aug					
Fall 1978	3-13 Nov			25 Oct-17 Nov		
Winter 1979	6-16 Mar			13 Feb-11 Mar		

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Limanda aspera Stage Larvae

Season	Inshore Dates	Inshore Mean (#10m^2) Neuston	Inshore Mean (#10m^2) Bongo	Offshore Dates	Offshore Mean (#10m^2) Neuston	Offshore Mean (#10m^2) Bongo
Fall 1977				31 Oct-14 Nov		
Spring 1978	29 Mar-8 Apr					
	10-17 Apr			28 Mar-20 Apr		
	21 Apr-1 May					
	31 May-6 Jun					
	14-24 Jun					
Summer 1978	21-29 Jul		.3300	19 Jun-9 Jul		
	1-9 Aug		.8669			
	15-21 Aug		.7424			
Fall 1978	3-13 Nov			25 Oct-17 Nov		
Winter 1979	6-16 Mar			13 Feb-11 Mar		

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Microstomus pacificus Stage Eggs

Season	Inshore Dates	Inshore Mean ($\#/10m^2$) Neuston	Inshore Mean ($\#/10m^2$) Bongo	Offshore Dates	Offshore Mean ($\#/10m^2$) Neuston	Offshore Mean ($\#/10m^2$) Bongo
Fall 1977				31 Oct-14 Nov		
Spring 1978	29 Mar-8 Apr					
	10-17 Apr			28 Mar-20 Apr		
	21 Apr-1 May					
	31 May-6 Jun					
	14-24 Jun					
Summer 1978	21-29 Jul			19 Jun-9 Jul		2.174
	1-9 Aug					
	15-21 Aug					
Fall 1978	3-13 Nov			25 Oct-17 Nov		
Winter 1979	6-16 Mar			13 Feb-11 Mar		

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Microstomus pacificus Stage Larvae

Season	Inshore Dates	Inshore Mean (#10m^2) Neuston	Inshore Mean (#10m^2) Bongo	Offshore Dates	Offshore Mean (#10m^2) Neuston	Offshore Mean (#10m^2) Bongo
Fall 1977				31 Oct-14 Nov		
Spring 1978	29 Mar-8 Apr					
	10-17 Apr			28 Mar-20 Apr		
	21 Apr-1 May					
	31 May-6 Jun					
	14-24 Jun					
Summer 1978	21-29 Jul			19 Jun-9 Jul		.6054
	1-9 Aug					
	15-21 Aug					
Fall 1978	3-13 Nov			25 Oct-17 Nov		
Winter 1979	6-16 Mar			13 Feb-11 Mar		

APPENDIX I

Comparison of Inshore and Offshore Sampling Areas

Taxon Psettichthys melanostictus Stage Larvae

Season	Inshore Dates	Inshore Mean (#10m^2) Neuston	Inshore Mean (#10m^2) Bongo	Offshore Dates	Offshore Mean (#10m^2) Neuston	Offshore Mean (#10m^2) Bongo
Fall 1977				31 Oct-14 Nov		
Spring 1978	29 Mar-8 Apr					
	10-17 Apr			28 Mar-20 Apr		
	21 Apr-1 May					
	31 May-6 Jun		1.105			
	14-24 Jun		1.673			
Summer 1978	21-29 Jul		4.433	19 Jun-9 Jul		1.809
	1-9 Aug		3.956			
	15-21 Aug		3.084			
Fall 1978	3-13 Nov			25 Oct-17 Nov		
Winter 1979	6-16 Mar			13 Feb-11 Mar		