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Patterns in Distribution and Abundance of Ichthyoplankton Off Washington, Oregon, and Northern California (1980 to 1987)

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ERRATA NOTICE

Patterns in distribution and abundance of ichthyoplankton off Washington, Oregon, and northern California (1980 to 1987)

by

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1. ABSTRACT

This study discusses the early life history of fish in coastal waters of the northeast Pacific Ocean. It is based on plankton and hydrographic data collected off Washington, Oregon, and northern California during the 1980s. Ten research cruises were conducted during this period with cooperative ventures by the U.S. Northwest and Alaska Fisheries Center (NWAFC), now the Alaska Fisheries Science Center, in Seattle, and the Soviet Pacific Research Institute (TINRO) in Vladivostok. The objectives of this study were (1) to document patterns in occurrence, distribution and abundance of ichthyoplankton species in the neuston and water column of the sampling area, (2) to identify and describe the occurrence and distribution of multispecies assemblages of ichthyoplankton in this region, and (3) to relate spatial andtemporal patterns in the ichthyoplankton to the oceanography of the sampling area. These were the first large-scale ichthyoplankton surveys to be conducted in this region.

The study area extended from the Strait of Juan de Fuca off Washington to northern California, between 40°N and 48°N and 3 to 200 miles offshore. Although the study was designed to sample during all seasons of the year, six of the ten cruises were conducted during spring months. Sampling during summer, autumn and winter months was limited. During each cruise, plankton sampling for fish eggs and larvae, and hydrographic casts for determination of temperature and salinity, were carried out at all stations. Neuston samplers and bongo nets were used to sample the plankton in the surface layer and water column, respectively. Oblique tows to 200 m, or 5 m from the bottom in water less than 200 m deep were carried out with the bongo samplers. Fish eggs and larvae were removed from the plankton samples, identified to the lowest taxonomic level possible, counted and measured.

Results and conclusions from this study are presented in four

major sections in the report: (1) Temperature and salinity patterns and upwelling indices - temperature and salinity patterns are described for each sampling cruise, and monthly coastal upwelling indices are presented for each year of the study and compared with monthly means for the years 1946 to 1989; (2) Taxonomic composition and abundance of ichthyoplankton - records of occurrence and abundance of all taxa of fish eggs and larvae in the neuston and bongo samples are given. Dominant taxa are identified and seasonal and interannual variation in their abundance is documented; (3) Summary of information on dominant taxa - for each of the dominant taxa, temporal and spatial patterns in their occurrence and abundance during the study period are described and length frequency distributions of larvae are given. Reference is made to previous investigations of ichthyoplankton in this and adjacent regions, and conclusions are made regarding spawning, early life history and recruitment patterns; (4) Multispecies spatial patterns in the ichthyoplankton and relationships with the environment - these patterns were investigated independently for eggs and larvae in the neuston and water column using the multivariate technique of numerical classification. The patterns are described, multispecies assemblages of ichthyoplankton are identified, and their occurrence and distribution are related to the oceanography of the sampling area.

New information is available from this study on the distribution and abundance of many species of fish eggs and larvae in the plankton off the U.S. west coast. This is particularly true for many of the seldom studied mesopelagic taxa. Overall, knowledge of the spawning and early life history patterns of fish species off Washington, Oregon and northern California has been increased. For some species (e.g. Engraulis mordax and Citharichthys spp.), the El Niño meteorological and oceanographic event of 1982/1983 is reflected in changed patterns in abundance and distribution of their eggs and larvae. These patterns are described in Chapter 3 of the results dealing with the dominant taxa individually. Investigation of multispecies spatial patterns among the fish eggs and larvae has led to the identification of four geographically distinct ichthyoplankton assemblages in the plankton of the study area. They include: 1) a coastal assemblage that is restricted to coastal and continental shelf waters and is most prominent off Washington and northern Oregon during winter and spring; 2) a slope/transitional assemblage that occurs largely along the shelf edge and slope; 3) a Columbia River plume assemblage that is associated with the Columbia River plume during summer; and 4) an oceanic assemblage that prevails in deep water beyond the shelf edge and for which northern and southern components are apparent during winter and spring. In addition, a unique assemblage of larval species is present in the neuston. It is associated primarily with the shelf and slope region but certain species, such as Cololabis saira, Anoplopoma fimbria and Sebastes spp., are also distributed throughout the oceanic zone. In general, the boundaries to the ichthyoplankton assemblages are fluid. Seasonal variation in occurrence and abundance of species within assemblages is strong. The occurrence and distribution of these assemblages reflects temporal variation and spatial structure in the oceanographic environment. Adaptation of spawning patterns among the various fish taxa in this region to the prevailing oceanographic conditions is apparent. Co-evolution among the fishes' spawning strategies within the complex and variable marine ecosystem may have given rise to the high degree of structure observed in the ichthyoplankton spatial patterns and to the multispecies assemblages.

2. INTRODUCTION

The present study concerns the early life history of fish in coastal waters of the northeast Pacific Ocean. It is based on plankton and hydrographic data collected off the coasts of Washington, Oregon and northern California, during the 1980s. The ten research cruises carried out during this period were cooperative ventures by the U.S. Northwest and Alaska Fisheries Center (NWAFC), now the Alaska Fisheries Science Center, in Seattle and the Soviet Pacific Research Institute (TINRO) in Vladivostok. The purpose of these cruises was to document patterns in occurrence, distribution and abundance of ichthyoplankton species in coastal waters of the northeast Pacific. They were the first large-scale ichthyoplankton surveys to be carried out in this region.

Prior to this study, most investigations of ichthyoplankton in the temperate zone of the northeast Pacific have been confined to waters off Oregon and restricted on a spatial or temporal scale. A list of publications dealing with ichthyoplankton in this region is given in Table 1. Included are details of sampling coverage, sampling gear used, and kinds of data reported.

Prior to 1972, data on ichthyoplankton in the northeast Pacific were sparse. Their main focus of the few studies from this area which presented ichthyoplankton data was pelagic invertebrates or adult and juvenile fishes, and data on ichthyoplankton were largely ancillary (Aron, 1958, 1959, 1960, 1962; Le Brasseur, 1965, 1970; Day, 1971). Subsequently, several studies investigated the ichthyoplankton of this region. Waldron (1972) examined the distribution of fish larvae during spring 1967 off Washington and Oregon, out to 550 km offshore. Richardson (1973) documented species composition, relative abundance and the distribution of dominant taxa in the ichthyoplankton off Oregon and southern Washington during the summer of 1969. An eleven-year study (1960-

1970) of interannual variation in the occurrence and abundance of larval fish in Yaquina Bay off Oregon was carried out by Pearcy and Myers (1974). Laroche (1976) and Misitano (1977) conducted ichthyoplankton surveys in the vicinity of the Columbia River estuary and reported on species composition and abundance in the ichthyoplankton. From ichthyoplankton surveys carried out during the summer of 1975 and 1976, Richardson (1980) determined the spawning biomass of anchovy and associated their spawning with the Columbia River Plume. Pearcy et al. (1977) and Laroche and Richardson (1979) reported on the distribution and abundance of larvae and juveniles of several species of flatfish off Oregon. Most of the above studies were restricted in terms of sampling coverage to periods of less than a year, and discussion of distribution patterns was limited.

Ahlstrom and Stevens (1976) reported specifically on ichthyoplankton distributions over an extensive area of the northeast Pacific, including coastal, shelf and deep water (as far out as 145°W longitude) from off northwest Washington to southern Baja California. This study deals specifically with larval fish species caught in the neuston. The NWAFC/TINRO ichthyoplankton cruises carried out off the U.S. west coast during the 1980s were also extensive, both spatially and temporally, and they were the first surveys to document distribution of egg and larval species in both the neuston and the water column. Preliminary results from these surveys are presented in the following NWAFC Processed Reports; Kendall and Clark (1982a, 1982b), Clark (1984, 1986a, 1986b), Bates (1984), Clark and Kendall (1985), Clark and Savage (1988) and Savage (1989a, 1989b). Based on the same data, an investigation of the distribution and abundance of eggs and larvae of five species of flatfish off Washington, Oregon and northern California was carried out by Urena (1989).

Since Richardson and Pearcy's (1977) investigation of coastal and oceanic fish larvae along a transect of stations off Yaquina

Bay, Oregon, several studies have dealt with the identification and distribution of species assemblages in the ichthyoplankton of this region. The most important of these is Richardson et al.'s (1980) study of larval fish assemblages off the Oregon coast between the Columbia River and Cape Blanco, during winter-spring months of 1972 to 1975. They documented the persistant occurrence of three major species assemblages - coastal, transitional and oceanic - in the area and associated them with adult spawning location and current circulation patterns. Their use of the pattern-recognition technique of numerical classification to analyse spatial patterns in the larval fish data was a new innovation for ichthyoplankton studies. Mundy (1984), Boehlert et al. (1985) and Shenker (1988) also deal with the occurrence of ichthyoplankton assemblages off the Oregon coast and interpret the distributional patterns ecologically. Another study which addresses the relationship between ichthyoplankton distribution patterns and environmental conditions is Brodeur et al.'s (1985) investigation of the distribution and abundance of fish larvae in the upwelling zone off Oregon during anomalous El Niño conditions.

The aim of the present study is to further the understanding of the spawning patterns and early life history of fish in coastal and offshore waters west of Washington, Oregon and northern California. The sampling methods and coverage allow the investigation of occurrence, distribution and abundance of fish eggs and larvae in both the neuston and the water-column over a large geographic area and over a period of seven years. Of particular interest is the occurrence, nature and distribution of species assemblages and how they may be related to environmental factors. Results are compared with those of previous studies off Oregon that documented ichthyoplankton species assemblages on a more limited basis. The distributional patterns are related to the occurrence and spawning strategies of the adult fish plus the oceanography of the sampling area.

Although all the ichthyoplankton data collected during the 1980 to 1987 west coast surveys are presented and discussed in this report, two related papers which focus on part of these data have been completed. The neuston data were the basis for a study of neustonic ichthyoplankton in the northern region of the California Current ecosystem (Doyle, in press). This paper provides a more thorough investigation of the occurrence, abundance and distribution of fish eggs and larvae in the neuston than is given in the present report. Doyle et al. (in press) used larval data from the bongo collections to investigate multispecies assemblages of fish larvae off the west coast and compare them with assemblages of fish larvae off the U.S. east coast. Discussion of the nature and possible origins of the larval fish assemblages is included in this paper.

3. STUDY AREA

The survey area extends from 48°N off northwest Washington to 40°N south of Cape Mendocino off northern California and from 3 to 200 miles (4.8 to 322 km) offshore (Fig. 1). A narrow continental shelf characterizes the coastal region. Off Washington and northern Oregon, the shelf width is less than 70 km, whereas off southern Oregon and northern California it narrows to less than 30 km, reaching a minimum of approximately 10 km off Cape Mendocino. A series of submarine canyons transect the shelf and slope off Washington and northern California. These canyons are largely absent off Oregon where rocky submarine banks are found along the shelf. A grid of 125 (maximum) stations was occupied during most cruises, and stations were more closely spaced in the shelf and slope zone than in deep water west of the 1000 m isobath.

The oceanography of the survey area is characterized by the California Current system, a typical eastern boundary current regime (Hickey, 1979, 1989). The main California Current is slow, meandering, broad, and indistinct and it proceeds southwards along the U.S. west coast (Fig. 2). Sub-components of the California Current include the northward-flowing California Undercurrent and Davidson Current (Hickey, 1989). The California Undercurrent consists of a jet-like poleward flow with a subsurface maximum. Its core appears to be confined to the continental slope. The northerly flowing Davidson Current that prevails on the coastal side of the California Current during winter is a seasonal surface current (Fig. 2).

Coastal surface currents in this region are primarily wind-driven and display strong seasonal variability (Huyer et al., 1975; Hickey, 1979; Strub et al., 1987). Spring and autumn transitions in prevailing winds and associated coastal currents are driven by large-scale changes in atmospheric pressure systems over the North Pacific. In winter, southerly winds result in the northward flowing Davidson Current, onshore Ekman transport of surface water, and downwelling close to the coast. A transition from southerly to northerly winds occurs during spring, and by summer prevailing conditions include a southward flowing coastal current, offshore Ekman transport, and upwelling of cold oceanic water close to the coast. The autumn transition from northerly to southerly winds leads back to the winter conditions.

The intensity of Ekman transport and associated upwelling is variable along the coast. Mean monthly upwelling indices (derived from geostrophic wind stress - Bakun, 1973) for four locations along the 125°W meridian, from northern Washington to northern California, show that the extent and intensity of upwelling increases from north to south in the study area (Fig. 3). Off Washington and northern Oregon, the upwelling season is confined largely to summer while winter is characterized by vigorous downwelling. Along the northern California coast, winter downwelling is weaker and less extensive and summer upwelling indices are considerably higher than off Washington and northern Oregon. The region of maximum upwelling along the U.S. west coast is between Cape Blanco off southern Oregon and Point Conception, southern California, with a local maximum at Cape Mendocino (Parrish et al., 1981).

The oceanography of waters off the U.S. northwest coast is modified significantly by the Columbia River (Hickey and Landry, 1989). The Columbia River is the largest point source of freshwater flow into the eastern Pacific Ocean and its water forms a low-salinity plume that extends outwards from the river mouth above a shallow (<20 m) halocline (Fiedler and Laurs, 1990). The extent and orientation of the plume is variable and subject to seasonal changes in runoff and coastal circulation patterns. The peak period of runoff is June and river discharge is usually at a minimum during September and October (Fig. 4), (Landry et al., 1989).

4. MATERIALS AND METHODS

4(a). Sampling schedule and procedure

During the years 1980 to 1987, ten research cruises were carried out in the study area. Although intended to sample during all seasons of the year, most cruises were conducted during spring months and coverage of summer, autumn and winter months was limited. Complete coverage of the 125 stations was not achieved on every sampling occasion. Table 2 gives the number of stations sampled for ichthyoplankton during each cruise along with the cruise dates and the vessel used. Stations occupied during each cruise are plotted in Figures 5a-j.

During each cruise, plankton sampling for fish eggs and larvae and hydrographic casts for determination of temperature, salinity, oxygen and, in some instances, nutrient concentrations were carried out at all stations. The water samples were collected at standard depths of 0, 10, 20, 30, 50, 75, 100, 150, 200, 250, 300, 400, 500 and 600 m as water depth permitted. Paired neuston tows, using Sameoto samplers (Sameoto and Jaroszynski, 1969) with 0.3 m high by 0.5 m wide frames and 0.505 mm mesh netting, were conducted for 10 minutes at each station, at a speed of 2.0 knots to sample the upper 15 cm of the water column. Following standard MARMAP procedures, oblique tows to approximately 200 m depth, or 5 m from the bottom in water less than 200 m deep, were carried out at each station using 60 cm frame bongo samplers with 0.505 mm mesh nets (Smith and Richardson, 1977). Flowmeters in the mouth of the neuston and bongo samplers were used to determine the volume of water filtered by each net. One of each of the paired neuston and bongo samples were retained by the Americans and the other by the Soviets. The American plankton samples were processed by the Polish Plankton Sorting Center in Szczecin, Poland. Fish eggs and larvae were removed from the samples, identified to the lowest taxonomic level possible, counted and measured. Identifications were later checked by biologists at the Northwest and Alaska Fisheries Center. Counts of fish eggs and larvae were converted to numbers per 10 m^2 of surface area for the bongo samples and numbers per 1000 m^3 for the neuston samples.

4(b). Data analysis

Average distribution plots were constructed for the dominant taxa of eggs and larvae in the neuston and water column. A grid of 74 squares was superimposed on the sampling area. For each of these squares, the abundance of the particular taxon was summed over the ten sampling periods and divided by the total number of stations in each square, to give mean abundance estimates.

The multivariate analytical technique of numerical classification was used to examine spatial patterns in the ichthyoplankton data. This technique involves grouping similar entities based on numerical data such as, in this instance, species abundance at a range of stations (Clifford and Stephenson, 1975; Boesch, 1977; Gauch, 1982). Normal and inverse classsifications were carried out on the data sets i.e. both the species and stations were classified into groups. Only the dominant ichthyoplankton taxa, which contributed significantly to the overall spatial patterns, were included in this analysis. Taxa occurring in less than approximately 5% of the samples for a particular data set were removed. In addition, the data were log-transformed prior to analysis.

The first step in the numerical classification procedure comprises the calculation of correlation coefficients for each pair of species or stations, for the species and station grouping respectively. The Bray-Curtis dissimilarity measure (Bray and Curtis, 1957), used extensively in marine ecological studies (Boesch, 1977), was the one chosen here.

It is expressed as:

$$D_{jk}=\frac{\sum_{n=1}^{i}|X_{nj}-X_{nk}|}{\sum_{n=1}^{i}(X_{nj}+X_{nk})}$$

where D_{jk} = dissimilarity between stations j and k

i = number of species

X_{nj} = abundance of n^{th} species at station j

X_{nk} = abundance of n^{th} species at station k

This is followed by a clustering technique which leads to the construction of dendrograms showing the relationship between individual, and groups of, species or stations. Various clustering strategies are available but those most widely used are agglomerative and hierarchical in nature (Clifford and Stephenson, 1975; Boesch, 1977). In this instance the "flexible sorting" strategy (Lance and Williams, 1967) was used to fuse entities (stations and species). Each entity begins as an individual element and the most similar pair (those with the lowest dissimilarity coefficient value) are joined first. Subsequently, either another pair is formed, or a single entity is added to a pair that has already been formed. This process continues with larger groups being fused at increasingly higher values of dissimilarity until the entire population of entities is joined in one cluster and the dendrogram is complete. With use of the flexible sorting strategy, a "cluster intensity coefficient" (which can range in value from -1.0 to 1.0) is included in the algorithm. This coefficient affects the structure of the dendrogram in that it influences whether or not an individual entity will act as the nucleus of a new group or join a pre-existing one. A value of -0.25 has become the standard where the flexible sorting strategy is used (Clifford and Stephenson, 1975; Boesch, 1977) and this was the value chosen here.

After completion of the classification of species and stations for a particular data set, the original abundance data were rearranged according to the order that species and stations appeared in the dendrograms. Groups of species and stations were selected based on the arrangement of entities in the dendrograms and their distinction in terms of occurrence and levels of abundance of species and geographical distribution. Mean levels of abundance for each species, in a constituent species group, were then calculated for each station group. In this manner, the station groups were characterised according to the occurrence and abundance of groups of species. Subsequently, the station groups were plotted on a map of the sampling area with a view to identifying the occurrence of geographically distinct ichthyoplankton assemblages.

The ichthyoplankton data sets at the Alaska Fisheries Science Center reside in binary computer files on the Burroughs mainframe computer (B7900). Numerical classification of the data sets and plots of the resulting station groups were carried out using custom-designed clustering programs (written in FORTRAN) which are available on the Burroughs system.

5. RESULTS AND CONCLUSIONS

5(a). Temperature and salinity patterns and upwelling indices

Temperature and salinity patterns

Horizontal patterns of temperature and salinity are illustrated for each of the ten cruises in Figures 6 to 15. Contours are drawn for surface temperature, integrated temperature, and surface salinity. The integrated temperature values were calculated from data representing the entire water column or, in deep water the upper 200 m, and weighted according to sampling depth. These values are representative of the water sampled by the bongo nets, in which most of the ichthyoplankton occurs.

Cruise TK80

Horizontal patterns of temperature and salinity during March/April 1980 were typical for spring off the U.S. northwest coast. Along the shelf, both at the surface (Fig. 6a) and throughout the water column (Fig. 6b), temperature decreased from north to south. Conversely, in the oceanic zone water temperature increased in a southerly direction. The occurrence of colder water along the coast off southern Oregon and northern California, in comparison with the Washington and northern Oregon shelf, was due to the early occurrence of upwelling along this section of the coast. This cold oceanic water is also noticeable in the surface salinity contours (Fig. 6c) which show that highest salinity values occurred here. Further north off Washington and northern Oregon, the Columbia River outflow was manifest in reduced salinities. At this time of year, the plume is oriented northwards and remains mainly over the shelf (Fig. 6c).

Cruise PO80

The August 1980 data is representative of summer conditions off the west coast when temperature increases in an offshore direction and water is coldest along the entire coast (Figs. 7a and b). Upwelling of cold oceanic water along the shelf causes this pattern and results in water temperatures of 7-11°C at the surface in the coastal zone. Temperatures of 15-18°C prevailed at the surface throughout most of the oceanic zone (Fig. 7a). The occurrence of the coldest water was most extensive along the southern Oregon and northern California coast where upwelling is most intense. The low-salinity water of the Columbia River plume is deflected in an offshore and slightly southerly direction during summer (Fig. 7c) due to the occurrence of northerly winds and offshore Ekman transport at this time of year.

Cruise PO81

Temperatures during this cruise were slightly higher overall than those for cruise TK80 as sampling was carried out during May (Figs. 8a and b). The typical spring pattern was apparent, however, with temperatures increasing in a southerly direction in the oceanic zone and in a northerly direction along the shelf. Again, the commencement of upwelling of cold oceanic water from Cape Blanco southwards is indicated by the minimum temperatures which were prevalent along this section of the coast. Surface salinity contours show that the Columbia River plume was oriented along the Washington and northern Oregon coasts in the usual spring pattern (Fig. 8c). Its influence was more extensive on this occasion, however, with salinity values less than 29 ppt extending from northern Washington to just north of Cape Blanco. River discharge is at a maximum during May and June (Fig. 4).

Cruise DA81

During October/November 1981, temperatures at the surface ranged from 11 to 15°C and lowest values were recorded along the southern Washington and northern Oregon coast where Columbia River plume water occured (Fig. 9a). Integrated values show that throughout the water column, temperatures were highest along the entire shelf indicating that upwelling of cold oceanic water had ceased (Fig. 9b). Columbia River discharge is minimal during autumn (Fig. 4) and this is reflected in the surface salinity contours (Fig. 9c) which show minimum salinity values of 29-30 ppt restricted to a small area off Washington, just north of the river mouth. The extension of the 32 ppt contour into the oceanic zone, however, resembles the summer offshore orientation of the plume caused by offshore Ekman transport (Fig. 7c).

Cruise PO82

Horizontal temperature patterns during May of 1982 (Figs. 10a and b) were similar to those observed during May 1981 (Figs. 8a and b), but values were lower overall by about 1°C. Temperatures were particularly low (<9°C) along the shelf and slope between Cape Blanco and Cape Mendocino indicating that upwelling was stronger and more extensive on this occasion than during the same period in 1981. The occurrence of maximum salinities (>33 ppt) was also more extensive (Fig. 10c), reflecting the occurrence of upwelled oceanic water along the southern section of the coast. The orientation of the low-salinity Columbia River plume water off Washington and northern Oregon was more offshore and southerly during May 1982 (Fig. 10c) in comparison with May 1981 (Fig. 8c). This is indicative of the commencement of offshore Ekman transport.

Cruise EQ83

The spring of 1983 was unusual in that temperatures were higher than normal throughout the sampling area, particularly along the shelf, and no coastal upwelling was apparent even along the southern Oregon and northern California coasts (Figs. 11a-c). These unusual conditions were associated with the strong El Niño-Southern Oscillation (ENSO) event which took place during the autumn of 1982 through late summer of 1983 in the Pacific Ocean (Brodeur et al., 1985). A surface layer of high temperature, offshore water was advected onshore along the western coast of North America resulting in unusually high sea-levels, enhanced poleward transport, an increase in depth of the thermocline, and a reduction in coastal upwelling and southward transport of cold water (Lynn, 1983; Simpson, 1983; Smith and Huyer, 1983). The low-salinity water of the Columbia River plume remained very close to the coast, essentially off Washington, during spring of this year (Fig. 11c).

Cruise MF83

Temperature patterns during autumn of 1983 were similar to those observed during autumn of 1981 (Figs. 9 and 12) with warmest water occurring throughout the water column, along the coast (Fig. 12b). A different pattern of salinity contours was apparent, however, and the restriction of the Columbia River plume to the shelf off Washington and northern Oregon (Fig. 12c) reflects the absence of significant offshore Ekman transport that year.

Cruises PO84 and BA85

For March/April 1984 (Fig. 13) and April/May 1985 (Fig. 14), temperature and salinity patterns were again typical of spring conditions in the sampling area and comparable to patterns observed during cruises TK80, PO81, and PO82 (Figs. 6, 8, and 10).

Temperatures increased from north to south except along the coast where cold, upwelled water was apparent off southern Oregon and northern California. The Columbia River plume extended along the shelf off Washington and northern Oregon.

Cruise MF87

Temperature and salinity patterns for January 1987 were somewhat similar to spring conditions with a southward increase in water temperature (Figs. 16a and b), and a northward and coastal orientation of the Columbia River plume (Fig. 16c). There was an absence of cold, upwelled water along the coast south of Cape Blanco, however, and the amount of river discharge, and associated reduction in salinities, was minimal.

Upwelling indices

For each year of the survey, mean monthly upwelling indices for four locations along the 125°W meridian (northern Washington to northern California) are plotted together with mean values over the years 1946 to 1989 in Figures 16 to 22. The indices are derived from geostrophic wind stress (Bakun, 1973) and are expressed as the volume of water (m^3) which is transported offshore in one second, for 100m of coastline.

During 1980, upwelling indices were largely similar to the 1946 to 1989 values off Washington and Oregon, except for an unusually high negative value in February (Fig. 16a-c). Off northern California, indices were significantly higher than normal in May and August (Fig. 16d) suggesting stronger upwelling. In 1981, values were slightly higher than the mean during July off Washington and Oregon (Figs. 17a-d) and significantly higher than the mean from April to July off northern California (Fig. 16d). It seems that offshore transport and upwelling intensity was greater than usual off northern California during 1980 and 1981. May seems to have been an anomalous month during 1982. For each of the four locations along the coast, upwelling indices were significantly higher than usual (Fig. 18) and the May value was the annual peak for the Oregon and northern California coasts (Figs. 18b-d). This unusually strong upwelling, for this time of year, is reflected in the horizontal patterns of temperature and salinity for cruise PO82 (Fig. 10).

The El Niño event of 1983 is reflected in the annual pattern of upwelling indices for that year (Fig. 19). Off Washington and Oregon, index values were significantly depressed during the summer, and at 42°N were below the mean during all months of the year (Figs. 19a-c). Off northern California, at 39°N, values were significantly below the norm during the first half of the year but similar to mean values from June through December. It seems that for this section of the coast, the commencement of upwelling was significantly later than usual whereas further north, upwelling was weak and totally diminished from spring through autumn.

The annual upwelling pattern was back to normal in 1984 at all four locations (Fig. 20). Index values were slightly higher than the mean, however, in July off Washington and Oregon, and in June through September off northern California at 39°N. During both 1985 and 1987, upwelling indices were very similar to the 1946 to 1989 mean values, for all months of the year (Figs. 21 and 22).

5(b). Taxonomic composition and abundance of ichthyoplankton

Table 3 gives the total number of the different taxonomic categories (families, genera and species) identified for eggs and larvae in the neuston and bongo samples, over all sampling periods. A greater diversity of taxa, both for eggs and larvae, was encountered in the bongo samples than in the neuston. In addition, a higher number of larval taxa was recorded than egg taxa; 23 families of larvae as compared with 17 of eggs in the neuston and 38 of larvae as compared with 19 of eggs in the bongo samples. The significantly lower number of genera and species recorded for eggs than for larvae is due, to a certain extent, to difficulties with egg taxonomy. Although there are still problems with the identification to species of several groups of larvae, e.g. the rockfish, *Sebastes* spp., taxonomy at the egg-stage is more difficult and there are many instances when eggs can only be identified to family level (Matarese *et al.*, 1990). The lower diversity of taxa among eggs may also be attributed to the fact that many of the fish species concerned are demersal spawners, or in the case of rockfishes are viviparous, and therefore do not appear in the plankton until the eggs hatch into free-swimming larvae, e.g. the hexagrammids, cottids, *Ammodytes hexapterus* and *Ronquilus jordani*.

Tables 4-7 list all taxa identified for each stage (eggs and larvae) and gear (neuston and bongo) type, along with their percentage occurrence and mean abundance in all samples collected. For each category, only a small proportion, usually less than a third of the taxa recorded, contributed significantly to total abundance of fish eggs or larvae. Many species, particularly in the bongo samples, were rare. In general, these rare taxa occurred in less than 1%, and in some instances less than 0.1%, of all samples collected.

The dominant taxa, which together account for greater than 80%

of total abundance of eggs or larvae in the neuston or bongo samples, are listed in Table 8. A total of 32 species in 19 families are included along with four categories identified to genus level only; Bathylagus spp., Sebastes spp., Sebastolobus spp. and Citharichthys spp. In addition, many eggs belonging to the families Bathylagidae, Myctophidae, Paralichthyidae and Pleuronectidae were not identified beyond the family level, as was the case with osmerid larvae. It is important to note that the genus Sebastes spp. consists of a multispecies complex; about 40 species are known among the adults from the study area.

The association of the dominant taxa, as eggs and/or larvae, with the different sampling gears is also documented in Table 8. The anchovy, Engraulis mordax, is the only species that was prominent both as eggs and larvae in the neuston and bongo samples. Osmerids, bathylagids, myctophids, and Sebastolobus spp. were prominent only in the bongo samples, being either rare or absent in the neuston. In contrast, Cololabis saira, Anoplopoma fimbria, the hexagrammids, and most of the cottids were associated almost exclusively with the neuston. Ammodytes hexapterus and Ronquilus jordani were prominent only in the neuston. They were common in the bongo samples but were taken in much lower numbers and less frequently than in the neuston (Tables 5 and 7). Apart from C. saira which spawns in the epipelagic zone, the latter group of species occurred only as larvae in the neuston samples. The hexagrammids, cottids, A. hexapterus, and R. jordani are demersal spawners and A. fimbria is a bathypelagic spawner, thus their eggs are rare in the surface zone. Eggs of the deep water species Chauliodus macouni were prominent in the neuston and bongo samples but as larvae only in the bongo samples, whereas Tactostoma macropus was associated primarily with the neuston and only in the egg stage. The offshore species, Trachipterus altivelis and Icosteus aenigmaticus, were among the dominant taxa in both the neuston and bongo samples but only as eggs. The medusa fish, Icichthys lockingtoni and members of the families Paralichthyidae and Pleuronectidae, were prominent in the bongo samples both as eggs and larvae but in the neuston only as eggs. Their larvae were largely absent from the neuston (Table 5).

Levels of relative abundance among the dominant taxa, for each of the stage and gear categories, are given in Tables 8 to 11. Data from the ten sampling periods were combined to calculate the percentage of total egg or larval abundance accounted for by the individual taxa.

For fish eggs in the neuston, the family Paralichthyidae was extremely abundant, accounting for approximately 56% of all eggs caught in the samples (Table 9). The other flatfish family, Pleuronectidae, was ranked second in terms of abundance and its constituent species together accounted for almost 20% of eggs in the neuston. Of the remaining taxa, Engraulis mordax, Trachipterus altivelis and Sebastolobus spp. were the only ones that accounted for greater than 1% of total egg abundance. The most abundant taxa of larvae in the neuston included Hemilepidotus spinosus, Hexagrammos decagrammus, Sebastes spp., Cololabis saira, and Anoplopoma fimbria, each of which accounted for greater than 10% of total larval abundance (Table 10). Engraulis mordax, Tarletonbeania crenularis, Scorpaenichthys marmoratus, and Ammodytes hexapterus also figured prominently in the neuston samples, accounting for between 3 and 6% of all larvae caught.

The offshore, deep water taxa including the bathylagids and myctophids were most abundant in the bongo samples and together comprised approximately 40% of total egg abundance and just above 60% of total larval abundance (Tables 11 and 12). The myctophids were more numerous than the bathylagids. The most important species of larvae were Bathylagus ochotensis among the bathylagids, and Diaphus theta, Stenobrachius leucopsarus, and Tarletonbeania crenularis among the myctophids. Stenobrachius leucopsarus was extremely abundant and accounted for 38.9% of all larvae caught

(Table 12). Although poorly represented as larvae, paralichthyid and pleuronectid eggs figured prominently in the bongo samples accounting for approximately 24% and 20%, respectively, of total abundance (Table 11). Engraulis mordax was also prominent, both as eggs and larvae, and larval Sebastes spp. again accounted for approximately 10% of all larvae caught. Osmerid larvae also contributed significantly to total larval abundance and comprised 3% of all larvae in the bongo samples.

Tables 13 to 16 give some insight into seasonal variation in abundance of the dominant species in the ichthyoplankton of the study area. Mean abundance of total and the dominant taxa of eggs and larvae in neuston and bongo samples are given in Tables 12-15a for each of the ten sampling periods and the ten data sets are arranged in order of the timing of the sampling cruises. Relative abundance values for the dominant ichthyoplankton taxa, expressed as percentage of total abundance, are given for the same data sets in Tables 13-16b. Seasonal coverage is limited as six of the ten sampling cruises took place during spring and the remaining four were spread over summer, autumn and winter. Nevertheless, some seasonal trends are apparent. These tables are referred to in greater detail in the next section which deals with the dominant taxa individually.

For fish larvae occurring in the neuston, it is important to consider diel variation in catches as some species are only occasionally abundant in the neuston (Doyle, in press). The pattern of diel variation in catches of total fish larvae differs significantly between the neuston and bongo samplers (Fig. 23). There is very little variation over 24 hours for the bongo samples, whereas in the neuston, catches were considerably lower during daylight hours than at night. Between 0800 hrs and 1900 hrs, catches in the neuston were always less than 3% of total catch, while from 2000 hrs to 0600 hrs, catches per hour ranged from 5% to 12% of the total larval fish catch (Fig. 23a). Two factors may contribute to this diel pattern: (1) Vertical migration of larvae into the neuston at night causes an increase in catches during darkness, and (2) enhanced avoidance of the neuston sampler during daylight reduces catches during the day. One of both of these factors may operate among the individual species of larval fish in the neuston. The patterns of occurrence of these species in the neuston are examined and interpreted in the next section.

5(c). Summary of information on dominant taxa

ENGRAULIDAE

Engraulis mordax

The northern anchovy, *Engraulis mordax*, is a small, pelagic schooling fish which occurs along the west coast of North America from Baja California to British Columbia (Hart, 1973; Eschmeyer *et al*., 1983; Matarese *et al*., 1989). It is of commercial importance primarily off central and southern California where it is used mainly for reduction to fish meal. Three subpopulations exist; the northern subpopulation extends from British Columbia to north of San Francisco, the central one occurs off southern California, and the southern one off Baja California. The central and southern subpopulations are much larger than the northern one. Off California, northern anchovy spawn during all months of the year but with a definite peak in February to April (Lasker and Smith, 1977). The northern subpopulation is known to spawn during the summer and early fall (Laroche and Richardson, 1980; Richardson, 1981). Eggs and larvae are pelagic.

Engraulis mordax eggs and larvae were prominent in both neuston and bongo samples collected during the present study (Tables 4-8). Although on average they occurred in less than 6% of the samples collected, mean abundance levels were relatively high; approximately 32 eggs and 10 larvae per 1000 m^3 in the neuston and 6 eggs and 13 larvae per 10 m^2 in the water column (Tables 4-7). The percentage of total abundance which anchovy eggs and larvae accounted for in the neuston and water column ranged from 3% to 7% (Tables 9-12).

Among the individual cruises, anchovy eggs and larvae were recorded primarily during late spring, summer and autumn months (Tables 13a-16a). Interannual variation in their occurrence and levels of abundance, however, was considerable. Although extensive sampling was carried out during spring of 1980 to 1985 (Table 2, Fig. 5), 1980 and 1983 were the only years when spring sampling yielded significant numbers of eggs and larvae. During cruise TK80 (April/May), eggs were particularly abundant in the neuston (Table 13a and b) and well represented in the water column (Table 15a and b). Larvae, however, were scarce in the neuston (Table 14a, b) and were absent in the bongo samples (Table 16a). The mean abundance of anchovy eggs was at a maximum in the neuston during the spring cruise EQ83 (Table 13a) and eggs were also abundant in the water column (Table 15a), accounting for almost 18% of all eggs recorded on this occasion (Table 15b). Larvae were less abundant but still well represented in both the neuston and bongo samples during this cruise (Tables 14a, b and 16a, b). Of the spring-sampling cruises in 1981, 1982, 1984 and 1985, only PO81 yielded any anchovy - no larvae were recorded and eggs were taken in low numbers in the neuston (Table 13a and b).

Anchovy eggs and larvae were abundant in the neuston during cruise PO80 in August of 1980 (Table 13a and 14a). Eggs were less abundant in the water column (Table 15a) but larval abundance was at a maximum (Table 16a) and anchovy accounted for 66% of all larvae caught in the bongo samples (Table 16b). In late autumn of 1981 (cruise DA81), no eggs were taken but larvae were abundant in the neuston (Table 14a, b) and scarce in the water column (Table 16a, b). Records of anchovy eggs and larvae during the autumn and winter cruises, MF83 and MF87, were very sparse (Tables 13a, 14a, and 15a).

Anchovy larvae taken during these surveys ranged from 2.5 to 37 mm in length, but most were between 5 and 15 mm (Figure 24 and Table 17). A seasonal increase in mean larval length is obvious in the bongo data. A difference of 2.2 mm in mean larval length between spring and summer sampling is significant and suggests a period of larval growth. However, the occurrence of many small larvae (<3 mm) in the bongo samples both during spring and summer sampling, along with the abundance of eggs, indicates continued spawning over these months. This seems to be true at least for the year 1980 when eggs were taken during April/May and August. On average, larvae in the neuston were larger than those in the water column and larvae less than 3 mm in length were restricted to the bongo samples (Fig. 24). This suggests that hatching occurs in the water column and that larvae, particularly the larger ones, migrate vertically into the neuston.

Diel variation in catches shows that anchovy larvae were most abundant in the neuston samples at night during hours of darkness (Fig. 52a). Apart from one sample taken at 17 hrs, the percentages of the total catch of anchovy (over 24 hrs) taken during 6 to 21 hrs local time were very low. It seems that the larvae may migrate into the surface layers after dusk and return to deeper layers in the water column at dawn. Avoidance of the sampling gear, however, particularly by the larger larvae, during daylight hours may also contribute to the observed pattern in diel variation of catches.

Mean distribution plots for anchovy eggs and larvae in the neuston and water column are presented in Figures 54a, 55a, 56a, and 57a. These distribution plots were constructed by superimposing a grid of 74 squares on the sampling area. For each of these squares, the abundance of the selected dominant taxa were summed over the ten sampling periods and divided by the total number of stations in each square, to give mean abundance estimates. In general, abundance of anchovy eggs and larvae are highest off Washington and Oregon and particularly offshore of the Columbia River estuary. In both the neuston and water column, eggs appear to be concentrated closer to the coast, in the shelf and slope region (Figs. 54a and 56a) whereas larvae can be more widely distributed with occurrences sometimes extending into deep water beyond the shelf edge (Figs. 55a and 57a).

In the spring of 1980 (April/May), eggs were concentrated mainly along the northern Oregon coast in both the neuston (Fig. 54b) and water column (Fig. 56b). In August of the same year, eggs were recorded primarily in the neuston and their distribution extended further offshore than in the spring but was still centered in the vicinity of the Columbia River estuary (Fig. 54c). Larvae were more widely distributed, and in both the neuston and water column were recorded in deep water as well as over the shelf and slope off Washington and northern Oregon (Figs. 55b and 57b). Records of larvae off southern Oregon and northern California were sparse, however. It seems that larval dispersal occurred in an offshore and, to a lesser extent, southerly direction from the apparent spawning area close to the Columbia River estuary. In the late autumn of 1981 (Oct.-Nov.), large anchovy larvae were abundant in the neuston (Tables 14a and 17) and they were concentrated close to the coast off the southern tip of Washington and along northern Oregon (Fig. 54c).

During April-May 1983, eggs were restricted to coastal and shelf stations off southern Washington and the northern-most part of Oregon, close to the Columbia River estuary (Figs. 54d and 56d). Larvae, however, had a more southerly distribution. In the neuston, they were concentrated mainly along the mid Oregon coast (Fig. 55d) while in the water column their distribution extended from northern Washington to Cape Mendocino off northern California (Fig. 57d). These patterns of distribution suggest that larvae had drifted in a southerly direction along the coast.

The above data indicate that anchovy eggs and larvae are prominent in the ichthyoplankton of this area, both in the neuston and the water column. The apparently greater abundance of the pelagic eggs in the neuston than in the water column may be due to flotation of the eggs to the surface. The smallest larvae (<4 mm), however, were restricted in their occurrence to the bongo samples suggesting that larvae migrate out of the neuston on hatching.

Larval size distribution data and diel variation in neuston catches suggest that there is a tendency for larvae, particularly the larger ones, to migrate vertically into the neuston at night and return to deeper levels in the water column at dawn.

The seasonal variation in occurrence and abundance of eggs and larvae indicates that spawning may occur from April to October with the peak period being in the summer, probably from June to August. Interannual variation in the timing and extent of spawning is apparent, however, and the occurrence of high levels of abundance of eggs in April/May 1980 and of eggs and larvae in April/May 1983 suggests that spawning commenced earlier than usual in these years, particularly so in 1983. Richardson (1973, 1977) and Richardson et al. (1980) did not find anchovy larvae in the plankton off the Oregon coast during spring months of the years 1969, 1971, 1972, 1974 and 1975. June was the first month in which they were recorded during these years. In 1973, however, Richardson et al. (1980) found low numbers of them in plankton samples collected during March and April. Brodeur et al. (1985) also documented the early occurrence of anchovy larvae in the plankton off Oregon during 1983 and concluded that the warm inshore waters which resulted from the strong El-Niño event (meteorological and oceanographic anomaly) of 1983 provided a substantial spatial and temporal expansion of the spawning habitat for *Engraulis mordax*.

The temperature data presented here (Figs. 6, 8, 10, 11, 13, and 14) show that throughout the survey area, water temperatures were significantly higher during the spring of 1983 than spring of other years. These higher temperatures may have caused both a northerly migration of anchovy into this region and an early commencement of spawning that year. Off southern California during spring of the same year, spawning activity of the central subpopulation of northern anchovy was marked by an extended spawning range (to the north) and faster egg maturation (Fiedler, 1984).

The abundance of anchovy eggs in the study area during spring 1980 is more difficult to explain. It seems that spawning also commenced earlier than normal that year but temperatures were not unusually high during this period.

The scarcity of anchovy larvae during autumn 1983 (cruise MF83) contrasts with their occurrence in significant numbers, particularly in the neuston, during autumn 1981 (cruise DA81). Given the early commencement of spawning during 1983, it is probable that spawning was diminished during the summer of that year and had ceased by autumn, resulting in the scarcity of larvae in the region by late autumn.

Spawning of the northern subpopulation of northern anchovy seems to occur mainly in coastal waters off southern Washington and northern Oregon, an area which is influenced strongly by Columbia River runoff. It is also apparent that during the summer, spawning and drift of larvae extend further offshore, into deep water beyond the shelf edge, than in spring when eggs and larvae are largely confined to a narrow band of coastal water. This pattern fits in with the seasonal variation in orientation of the Columbia River plume which in turn is related to the seasonal variation in longshore flow of coastal waters. In general, plume water is advected northward and remains close to the coast during winter and early spring whereas during the summer the plume is advected offshore and southwards (Landry et al., 1989; Fiedler and Laurs, 1990). Richardson (1980) concludes that anchovy spawning off the Pacific northwest coast is associated with warm, near-surface waters of the Columbia River plume. Results from the present study concur with this conclusion.

OSMERIDAE

Smelts belonging to the family Osmeridae are small, silvery, shallow-water fishes. Most are entirely marine but some are anadromous or occur in freshwater. Schooling is a characteristic behaviour and they spawn demersal eggs in coastal waters, on beaches or on stream bottoms. Off the U.S. west coast, six species of smelt are found; the whitebait smelt, Allosmerus elongatus, the surf smelt, Hypomesus pretiosus, the capelin, Mallotus villosus, the night smelt, Spirinchus starksi, the long-fin smelt, Spirinchus thaleichthys and the eulachon, Thaleichthys pacificus (Hart, 1973; Eschmeyer et al., 1983). Occasionally, the arctic species Osmerus mordax is recorded. Its distribution, however, is essentially from British Columbia northwards. Apart from larval capelin, eggs or larvae of the above species cannot presently be identified (Matarese et al., 1989).

During the present study, only larvae were recorded and they were identified to family. They occurred mainly in the bongo samples (Table 8) accounting for just over 3% of all larvae caught in this gear (Table 12). Mean abundance in the water column was 5.8 larvae per 10 m^2 and they were taken in approximately 5% of all bongo samples collected (Table 7). Larvae were also present in the neuston but were much less abundant in these samples (Tables 5 and 10).

Smelt larvae were recorded primarily during winter and spring months (Tables 14a and 16a). They were most abundant during April-May 1985 (cruise BA85), in the bongo samples. Levels of abundance were also high in January 1987 and in April/May 1980. Mean larval size was lowest during the latter three sampling periods (Table 18). It seems that the annual peak in spawning may occur in late winter and early spring. Spring sampling in the years 1981 to 1984 also yielded smelt larvae but numbers were low in comparison with spring of 1980 and 1985. Larvae were recorded during August of 1980 suggesting that spawning may continue throughout the summer months - abundance levels, however, were low. On average, the few larvae that occurred in neuston samples were larger than those taken in the water column (Table 18, Fig. 25). There may be some vertical migration of the larvae, particularly the larger ones, into the surface layers.

The distribution of osmerid larvae was confined to coastal and shelf waters along the Washington and Oregon coast and as far south as Cape Mendocino off northern California (Fig. 59a). Highest levels of abundance were recorded most frequently off Washington and northern Oregon, close to the Columbia River estuary (Figs. 59 b-f)). There may be some association between smelt spawning and the Columbia River plume during spring. High concentrations of smelt larvae may also occur, however, off southern Oregon and northern California (Figs. 58 and 59d).

Most previous studies of fish larvae off the Oregon coast have found that smelt larvae are by far the most abundant taxa occurring in inshore and coastal waters, usually accounting for greater than 50% of all larvae caught in this zone (Laroche, 1976; Richardson and Pearcy, 1977; Richardson et al., 1980; Mundy, 1984). Smelt have been found in the ichthyoplankton during all months of the year but peaks in abundance were common in spring and early summer months. Mundy (1984) recorded highest levels of abundance of recently-hatched larvae during February to May. These studies indicate that most spawning takes place during spring off Oregon. Concurrent with observations during the present study, Laroche (1976) and Misitano (1977) documented high concentrations of smelt larvae and juveniles in the vicinity of the Columbia River mouth and estuary. Osmerid larvae are scarce in CalCOFI ichthyoplankton collections (Stevens et al., 1987, 1988, 1990).

Interannual variation in abundance of smelt larvae was also observed during previous studies. Richardson et al. (1980) found levels of abundance to be unusually high during spring of 1975, compared to levels in spring of 1972 to 1974. Mundy (1984) also documented a significant degree of interannual variation in abundance of smelt larvae off Oregon during 1969 to 1972. Brodeur et al. (1985) found smelt larvae to be rare off Oregon during April to September 1983, in association with a decrease in abundance of other inshore taxa in that year when anomalous oceanographic conditions prevailed due to the El Niño phenomenon. The scarcity of osmerid larvae along the Washington and Oregon coasts during cruise EQ83 may also reflect this association. However, larvae were similarly scarce during spring of 1981 (cruise PO81) in this region.

BATHYLAGIDAE

Deep sea smelts are small, mesopelagic fishes found in the midwaters of all major oceans (Hart, 1973; Eschmeyer et al., 1983). Five species are known to occur off Washington, Oregon and northern California; Bathylagus milleri, B. ochotensis, B. pacificus, B. wesethi and Leuroglossus stilbius (Matarese et al., 1989). Although important in the food web, they are of no commercial or recreational importance. Eggs and larvae are pelagic.

Bathylagid eggs are difficult to identify to species, particularly prior to the development of the embryo, and most of those caught in the west coast ichthyoplankton collections were assigned to family Bathylagidae or the genus Bathylagus spp. (Tables 4 and 6). Very few bathylagid eggs were encountered in the neuston (Tables 4 and 13a). In the bongo samples, however, they were abundant (Tables 6, 8 and 15a) and total bathylagids accounted for approximately 8% of all eggs collected by this gear (Table 11). Some of the eggs in the bongo collections were identified to the species Bathylagus milleri, B. ochotensis, and B. wesethi (Table 6). Bathylagus ochotensis was the most frequently recorded species (Tables 6 and 15a). Larval taxonomy is more complete and most bathylagid larvae collected were identified as B. ochotensis or B. pacificus. As for the eggs, larvae were most abundant in the bongo samples (Tables 7 and 16a). Bathylagus ochotensis was most common, accounting for 7.3% of all larvae in the bongo collections (Table 12). Bathylagus pacificus, comprised just under 1% of larvae in the bongo samples. The species B. milleri and Leuroglossus stilbius were also encountered in these collections but they were rare (Table 7).

Bathylagid eggs and larvae occurred in the plankton during all seasons over the seven year sampling period. They were most abundant, however, during winter and spring months and were rare in collections taken during cruise PO80, in late summer (Tables 15 and 16).

Peak levels of egg abundance occurred during the January cruise of 1987 (MF87) when bathylagid eggs in total accounted for approximately 25% of all eggs caught, at a mean abundance of about 47 eggs per $10m^2$ (Tables 15a and b). They were also relatively abundant during early spring of 1984. During April/May of 1980 to 1983, and 1985, abundance of bathylagid eggs was relatively low. Levels were at a minimum during late summer of 1980. In late autumn of 1981 and 1983, numbers of bathylagid eggs were higher than during the late spring months but lower than the winter and early spring records. Most of the unidentified bathylagid eggs are likely to belong to the species B. ochotensis.

Abundance of bathylagid larvae, mostly B. ochotensis and to a lesser extent B. pacificus, was at a peak during early spring of 1984 (Table 16a). Levels of abundance were also consistently high during the later spring months of 1980 to 1985. As with the eggs, larvae were rare in the late summer collections of 1980. They were also scarce, however, during the late autumn of 1981 and early winter of 1983. In January of 1987, bathylagid larvae were moderately abundant in the bongo collections.

The above patterns of seasonal variation in occurrence and abundance of bathylagid eggs and larvae indicate that spawning occurs primarily during winter and spring months. It may commence in late autumn and extend into early summer but the peak period appears to be winter and early spring. Larval size distribution data also support this conclusion; minimum and mean larval sizes were smallest during early spring and winter cruises (Tables 19 and 20). The majority of larvae for both species, however, were less than 15 mm in length (Figs. 26 and 27). Interannual variation in bathylagid abundance appeared to be minimal. Bathylagus ochotensis larvae were significantly more abundant during April/May 1983 than during the same months of 1980, 1981, 1982 and 1985 (Table 16a). Egg abundance, however, did not vary significantly among the latter sampling periods (Table 15a). Perhaps levels of larval survival were higher for B. ochotensis early in spring of 1983 as a result of the El Niño warming effect of that year.

Bathylagid eggs and larvae were widely distributed and occurred in coastal and shelf waters as well as in deep water (Figs. 60, 61, and 62). On the whole, levels of abundance were low throughout the sampling area but mean levels of abundance of total bathylagid eggs and B. ochotensis larvae were slightly higher in the southern sector off southern Oregon and northern California (Figs. 60 and 61). In contrast, larvae of B. pacificus seem to be more prominent off Washington and northern Oregon (Fig. 62). It seems that spawning is widespread in the study area for both bathylagid species but that deep water off southern Oregon and northern California is the most favourable spawning area for B. ochotensis, whereas B. pacificus may have a more northerly spawning distribution, centered off Washington and Oregon.

Bathylagid larvae belonging to the species B. milleri, B. ochotensis, B. pacificus, and Leuroglossus stilbius have been recorded previously off Oregon, mainly in deepwater (Richardson, 1973; Richardson and Pearcy, 1976; Richardson et al., 1980). As with the results presented, B. ochotensis was found to be by far the most abundant species, B. pacificus was common and the other two species were rare. Richardson et al. (1980), who documented the occurrence of larval fish assemblages off Oregon during spring of 1972 to 1975, found that B. ochotensis and B. pacificus larvae were extraordinarily abundant in spring of 1973 and sparse in the other years. This degree of interannual variation in larval abundance was greater than that observed during this study. B. ochotensis and B. pacificus are also common in the ichthyoplankton in deep water off central, southern and Baja California and B. ochotensis is the most abundant of the two species in this region (Loeb et al., 1983; Stevens et al., 1987, 1988, 1990).

CHAULIODONTIDAE

Viperfishes are small, slender deep sea fishes that occur in all oceans. One species, the Pacific viperfish, Chauliodus macouni, occurs off the U.S. west coast, its range extending from off Baja California to the Bering Sea. It is essentially bathypelagic and has been recorded as deep as approximately 4200 m (Fitch and Lavenberg, 1968; Matarese et al., 1989). Larvae, however, are epipelagic.

Eggs of C. macouni were common in both the neuston and water column, occurring in approximately 10% of the neuston samples collected (Table 4) and 21% of the bongo samples (Table 6). Levels of abundance were low, however,and C. macouni did not contribute significantly to total egg abundance (Tables 9 and 11). Chauliodus macouni larvae were absent from neuston samples but occurred in 13.5% of all bongo samples collected (Table 7). Larval abundance was also low overall and accounted for less than 1% of all larvae recorded in the bongo catches (Table 12).

Eggs and larvae of C. macouni were taken during all seasons and all cruises (Tables 13a-16a). Levels of abundance were consistently low throughout the sampling periods. Eggs, however, were slightly more abundant during autumn and winter cruises than in spring and summer (Tables 13a, 15a). It seems that spawning occurs year-round but may be heightened during late autumn and winter months. Larvae ranged in length from 7 to 54 mm and were fairly evenly represented throughout this range (Fig. 28). Numbers of larvae collected plus minimum, mean and maximum larval lengths did not vary to any great extent among cruises or seasons (Table 21).

Overall, the distribution of C. macouni eggs and larvae ranged from off Washington to northern California and was essentially in deep water beyond the shelf (Figs. 63a, 64a, and 65a). Records were sparse close to the coast. Distribution patterns during individual cruises indicate that eggs and larvae tend to be sparse off Washington in comparison with occurrences off Oregon and northern California (Figs. 63 b-d, 64 b-g, and 65 b-f). Spawning activity may be most intense in the southern sector of the sampling area.

Chauliodus macouni larvae have been recorded previously in deep water off Oregon (Richardson, 1973; Richardson and Pearcy, 1977; Richardson et al., 1980) and they are common in CalCOFI ichthyoplankton collections taken off central and southern California (Loeb et al., 1983).

MELANOSTOMIDAE

Family Melanostomidae comprises the scaleless dragonfishes which are distributed widely in the bathypelagic and mesopelagic realm of the world's oceans. Members of this family occurring off the U.S. west coast include the genus Eustomias spp. and the species Bathophilus flemingi, Opostomias mitsuii, and Tactostoma macropus (Hart, 1973; Eschmeyer et al., 1983; Matarese et al., 1989).

Tactostoma macropus, the longfin dragonfish, was the only species recorded during the present study. Its eggs were abundant during August 1980 (cruise P080) but were absent from samples collected during all other cruises (Tables 13a and 15a). They were more abundant in the neuston than in the bongo samples suggesting that the eggs may accumulate in the neuston due to positive buoyancy. A few larvae also occurred in some of the bongo samples on this occasion. The only other record of T. macropus larvae from this survey was the occurrence of a single specimen in one of the bongo samples collected during October/November 1981 (cruise P081).

These patterns in occurrence suggest that Tactostoma macropus may have a short spawning period, confined to summer months - July, August and September perhaps - off the U.S. west coast. Fisher and Pearcy (1983) concluded that the spawning period for this species off Oregon is during the summer. There have also been records of T. macropus larvae in the plankton off the Oregon coast during spring and autumn months. Richardson (1973) found several of them in Isaacs Kidd midwater trawl hauls during the months May to October of 1969 and Richardson et al. (1980) recorded a single specimen during March 1973. These were too sparse, however, to indicate the occurrence of significant levels of spawning during these months. Tactostoma macropus larvae have been taken in very low numbers in ichthyoplankton samples collected during CalCOFI surveys off central, southern and Baja California (Stevens et al., 1987, 1988, 1990).

The distribution of T. macropus eggs in the neuston and water column during August (Figs. 66 and 67) indicates that spawning occurs along the continental slope and throughout the oceanic zone.

MYCTOPHIDAE

The lanternfishes are small mesopelagic and bathypelagic fish that are abundant in all oceans. They usually occur at moderate depths but some are taken at substantial depths (below 1000 m). Most species have gasbladders and undertake vertical migrations resulting in their occurrence close to the surface at night. Many species are known among a total of 32 genera. In the northeast Pacific, 20 species occur (Matarese et al., 1989). Only a few of these are common in the ichthyoplankton off the coasts of Washington, Oregon and northern California. In order of abundance, the three most common species are the northern lampfish Stenobrachius leucopsarus, the California headlightfish Diaphus theta and the blue lanternfish Tarletonbeania crenularis (Richardson, 1973; Richardson and Pearcy, 1977; Richardson et al., 1980; Mundy, 1984; Brodeur et al., 1985 and Boehlert et al., 1985). Also frequently recorded but much less abundant are the species Protomyctophum crockeri, P. thompsoni, Lampanyctus regalis and L. ritteri. In addition to the above species, there were rare occurrences during the present study of larvae of the species Ceratoscopelus townsendii, Diogenichthys atlanticus, Symbolophorus californiensis and Loweina rara (Table 7). All of these species are common in CalCOFI ichthyoplantkon collections (Loeb et al., 1983; Stevens et al., 1987, 1988, 1990).

Myctophids are oviparous and presumably all produce planktonic eggs (Moser et al., 1984). Myctophid eggs are difficult to identify, even to family level, and eggs of only two species (not included in above lists) have been described. Matarese et al. (1989) have identified several types of myctophid eggs two of which they consider likely to belong to the genera Diaphus and Stenobrachius. In general, myctophid eggs have been scarce in plankton samples and this has been attributed to the small size of the eggs - most are considered to be less than 1 mm in diameter - and to the fragility of the chorion, resulting in extrusion of the eggs through the plankton net meshes (Moser et al., 1984). Nevertheless, approximately 33% of all eggs collected in bongo samples during the present study were assigned to the family Myctophidae (Table 11). Myctophid eggs occurred in approximately 14% of the bongo samples and were the most abundant taxa with a mean abundance of approximately 60 eggs under 10 m^2 of sea surface

(Table 6). They were absent from the neuston, however, apart from a single record (Table 4). Myctophids were also by far the most abundant taxa of larvae in the bongo samples and the species S. leusopsarus, D. theta and T. crenularis accounted for 38.9%, 10.6% and 4.3%, respectively, of total larval abundance (Tables 7 and 11). It is likely, therefore, that the myctophid eggs identified in these collections belong primarily to the latter three species and mostly to S. leucopsarus.

The occurrence of myctophid eggs in the bongo samples was confined to the spring cruises and mean levels of abundance were high for those six sampling periods (Table 15a). Except for cruise EQ83, when abundance was significantly lower than during the other spring cruises, myctophids were by far the most abundant taxa of fish eggs recorded accounting for approximately 42-62% of total egg abundance (Table 15b). The absence of myctophid eggs from samples collected during summer, autumn and winter months suggests that spawning of the species concerned is seasonal, occurring predominantly during spring. Lack of data from late winter, early spring, summer and early autumn, however, precludes reliable demarkation of their spawning seasons. The lower mean level of egg abundance in the spring of 1983 suggests that spawning may have been reduced in this year, compared to other years.

The average pattern of distribution of myctophid eggs is shown in Figure 69a. In general, records were sparse in the northern sector of the sampling area, off the Washington coast and also in coastal and shelf waters as far south as Cape Mendocino. Highest densities occurred essentially in deepwater off Oregon and northern California and particularly in the vicinity of Cape Blanco. On the whole, distributions during the individual spring cruises reflected this pattern (Figs. 69 b-g). In May/June of 1982, however, occurrence was more localised and almost all the myctophid eggs were collected at a single station, in deep water southwest of Cape Blanco (Fig. 69d). These patterns of distribution indicate that the main area of spawning for the dominant myctophid species in this region is in deep water off southern Oregon and northern California. Records of eggs were particularly scarce in the area off Washington and northern Oregon which is strongly influenced by the Columbia River plume during spring (Figs. 6c-14c). These deep water species may avoid spawning in water of reduced salinity. It is also possible that the reduced levels of spawning in this region is associated with the northerly decrease in water temperature that occurs during spring, particularly in deep water (Figs. 6-15). Spawning seems to be most intense in the warmer water that prevails off southern Oregon and northern California. If this is true, it is difficult to interpret the apparent reduction in spawning (low egg abundance) during April/May 1983 when temperatures were higher throughout the sampling area due to the El Niño event of that year.

Diaphus theta

In the northeast Pacific, the California headlightfish is known to occur from off Baja California to the Bering Sea (Hart, 1973; Eschmeyer et al., 1983; Matarese et al., 1989). It also occurs in the tropical mid-Pacific. Larvae of D. theta were abundant in bongo samples collected during this survey (Tables 7 and 12), accounting for 10.6% of total larval abundance, but were rarely recorded in the neuston (Table 5). They were most abundant during spring cruises but also occurred in samples collected during summer, autumn and winter cruises (Table 16a). Among the spring cruises, abundance during March/April of 1984 was low. Sampling during April/May of 1981, 1982, 1983, and 1985 yielded very high numbers whereas during April/May 1980 abundance was moderate and similar to the levels recorded in late summer of that year. This seasonal variation in larval abundance suggests that Diaphus theta spawns primarily during late spring and perhaps early summer but the season may extend from early spring to late summer. Length distribution data for the larvae supports this claim (Table 22, Fig. 29). Small larvae, less than 10 mm in length, were abundant during spring months and mean larval length increased dramatically from summer to winter (Table 22). All specimens collected during January of 1987 were greater than 20 mm in length, many of them being juveniles, indicating that they were spawned several months previously, probably during spring or summer of 1986.

The average distribution pattern for D. theta larvae was similar to that documented for myctophid eggs (Fig. 69a). Highest levels of abundance occurred in deep water off southern Oregon and northern California and larvae were scarce in coastal and shelf waters, and in the oceanic zone off Washington and northern Oregon. This was also the pattern observed during most individual cruises (Figs. 69 b-g). In May/June of 1982, however, when sampling coverage was reduced (Fig. 5f), extremely high numbers of larvae were recorded at one station in deep water, southwest of Cape Blanco and occurrences were rare elsewhere. As this was also the station where myctophid eggs were exceptionally abundant on this occasion (Fig. 67d), it is likely that these eggs belonged to the species D. theta. It appears that the preferred region of spawning for this species in the study area is beyond the shelf edge off southern Oregon and northern California. During April/May 1983, larvae were unusually common in shelf waters, particularly south of Cape Blanco (Fig. 69e). Due to the El Niño event of that year, upwelling was diminished and temperatures were considerably higher than normal along this section of the coast (Figs. 11a and b). Spawning of D. theta may have occurred closer to shore than usual because of these warmer conditions in 1983. It is also likely, however, that the onshore Ekman transport which still prevailed during spring of 1983 (Figs. 19c and d) resulted in the anomalous occurrence of these larvae in shelf waters.

Protomyctophum crockeri and Protomyctophum thompsoni

The California flashlightfish (P. crockeri) and the northern flashlightfish (P. thompsoni) were both common as larvae in bongo samples collected during all cruises (Table 16a) and occurred in approximately 24% and 12%, respectively, of all samples (Table 7). They were much less abundant, however, than the three major myctophid species and accounted for only 1.68% (P. crockeri) and 0.69% (P. thompsoni) of total larval abundance (Table 12). Both species were rare in the neuston (Table 5).

Levels of abundance of P. crockeri and P. thompsoni larvae did not vary significantly among seasons (Table 16a) indicating that these species spawn throughout the year and have no clearly defined spawning period. Larval sizes for these species also showed no significant seasonal variation (Tables 23 and 24). All larvae caught for both species were less than 20 mm in length and predominantly 10 mm or less (Figs. 30 and 31).

Larval distribution patterns differed slightly between these species and reflected the distributional ranges of the adults. Protomyctophum crockeri occurs from off Baja California to northern Washington (Matarese et al., 1989), its centre of distribution being in California waters (Loeb et al., 1983). Protomyctophum thompsoni, however, is more northerly in its distribution, occurring from off central California to the Bering Sea (Matarese et al., 1989). Larvae of both species were widely distributed in the sampling area but the pattern for P. crockeri was characterized by sparser records off Washington (Figs. 70 a-f) whereas for P. thompsoni, fewer records were taken off northern California (Figs. 71 a-k).

Tarletonbeania crenularis

The blue lanternfish occurs from Mexican waters to the Bering Sea, as well as in the tropical mid-Pacific (Hart, 1973; Matarese et al., 1989). Its larvae were abundant in the water column (bongo samples) during most cruises (Tables 7 and 16a) and unlike the other myctophid species, larvae and juveniles were prominent in the neuston (Tables 5 and 14a). Tarletonbeania crenularis accounted for approximately 4% of total larval abundance in the bongo samples (Table 12) and approximately 3% in the neuston (Table 10). They were considerably less abundant than the myctophids S. leucopsarus and D. theta but more abundant than the Protomyctophum species. Juvenile T. crenularis were very abundant, however, in the neuston and high numbers of them were caught in neuston samples during all cruises (Table 25). Some specimens were large enough to be adults.

Seasonal variation in abundance of larvae in the water column was not pronounced. During three of the spring cruises - PO84, BA85, and EQ83 - larval abundance was significantly higher than during the other sampling periods (Table 16a). There may be a slight peak in spawning during spring months. The occurrence of small larvae in the bongo samples during all cruises indicates that spawning takes place throughout the year (Table 25).

The association of larvae and juveniles of blue lanternfish with the neuston appears to be related to a behavioral pattern of diel vertical migration. Very few specimens were recorded in neuston samples during daylight hours whereas at night, levels of abundance in the neuston tended to be high (Fig. 53b). All specimens taken in the neuston were longer than 20 mm whereas most larvae in the bongo samples were less than 20 mm (Figs. 32a and b). It seems that larger larvae, and in particular juveniles and adults, migrate to the surface at night. Shenker (1988) found T. crenularis juveniles and adults to be abundant in night-time neuston samples but absent in the daytime samples off Newport, Oregon during July 1984. In an extended CalCOFI cruise during May 1972, neuston samples collected off Washington, Oregon and California occasionally yielded high numbers of T. crenularis juveniles and adults (Ahlstrom, 1976). The latter study, however, did not distinguish between day and night collections.

Larvae and juveniles of T. crenularis in the neuston and water column were widely distributed throughout the sampling area, occurring over the shelf and in deep water (Figs. 72 a-k, and 73 a-k). On average, levels of abundance were slightly higher in the southern half of the sampling area off southern Oregon and northern California. Interannual variation in distribution patterns does not appear to be significant.

Stenobrachius leucopsarus

The northern lampfish, S. leucopsarus, is the most abundant species of myctophid in the northeast Pacific and occurs from southern California waters to the Bering Sea (Smoker and Pearcy, 1970). Its larvae accounted for approximately 40% of all larvae caught in the bongo samples during the present study (Table 12) making it by far the most abundant species occurring in the water column. These larvae occurred in 56% of the bongo samples taken and had a mean abundance of approximately 71 larvae per 10 m^2 of sea surface (Table 7). They were scarce in the neuston (Tables 5, 10, and 14a).

Although larvae were taken during all cruises, seasonal variation in abundance was quite dramatic. Numbers were extremely high during spring months, moderately high during the summer cruise and low during autumn and winter (Table 16a). Mean larval size was lowest for cruise MF87 in January 1987 indicating that these larvae were recently hatched (Table 26). A maximum size of only 5.2 mm was recorded on this occasion and was considerably lower than for the other cruises. Mean size was consistently low during the spring months and increased from late summer to late autumn. The vast majority of larvae caught were less than 10 mm in length (Fig. 33).

Smoker and Pearcy (1970) studied the reproduction of S. leucopsarus off Oregon over a period of four years and found that maturation of gonads begins in October and spawning occurs between

December and March, the occurrence of ripe females declining in March and April. Further south in Monterey Bay, California, Fast (1960) documented the occurrence of ripe females throughout the year and found that spawning occurred from November through August but was most intense from late winter through early summer. Seasonal variation in larval abundance and size documented here indicate that *S. leucopsarus* spawns primarily from late winter to late spring throughout the study area. Spawning, however, may continue through the summer and occur to a very limited extent during autumn.

Northern lampfish larvae were well distributed throughout the sampling area and occurred in coastal and shelf waters as well as in deep water (Fig. 74a). As for the other dominant myctophid species, highest densities were recorded in deep water off southern Oregon and northern California. Comparing distribution patterns among the different spring sampling periods (Figs. 74b, d, e, f, h, and i), it seems that during 1983 (Fig. 74f) there was a more northerly distribution in larvae than usual. In the oceanic zone, larvae were most abundant off Washington and northern Oregon in contrast with the usual situation of larval densities being at a peak in the southern part of the sampling area. In addition, larvae were taken closer to shore than usual and were common at the coastal stations along the Oregon and California shelf. This slightly anomalous distribution pattern may be related to the prevalence of warmer water in the area during spring of 1983, causing a northerly shift in spawning, and the shoreward transport of larvae by anomalous onshore Ekman transport. These conditions were associated with the El Niño event of that year.

SCOMBERESOCIDAE

Cololabis saira

Sauries are oceanic, epipelagic, schooling fishes found mostly in temperate waters of the Pacific and Atlantic (Hart, 1973; Eschmeyer et al., 1983). A single species, Cololabis saira, Pacific saury occurs in the northeast Pacific from Mexico to the Gulf of Alaska (Matarese et al., 1989). The Pacific saury is generally found offshore in shelf waters, in schools near the surface. It is fished commercially in the western Pacific. Eggs are epipelagic and are usually attached to seaweed or other flotsam by adhesive filaments. Larvae are relatively large, active and pelagic.

During the 1980-1987 west coast ichthyoplankton surveys, Pacific saury were prominent in the neuston but only as larvae (Table 8). Previous studies of ichthyoplankton off the U.S. west coast for which bongo nets were the sampling gear did not record any saury larvae. Low numbers of saury larvae, however, have been taken in CalCOFI bongo ichthyoplankton collections (Stevens et al., 1987, 1988, 1990). Shenker (1988) found saury larvae to be common but not abundant in neuston samples collected along a transect off Newport, Oregon during April through July 1984. Larvae occurred in 31% of the neuston samples collected during this study and accounted for 10% of total larval abundance (Table 5 and 10). Eggs were also recorded in the neuston but they occurred in only 1% of the samples and overall abundance was low (Tables 4 and 9). Saury eggs were rare and larvae were absent in the bongo samples (Tables 6 and 7).

In the late summer of 1980 (cruise P080), mean abundance of saury eggs in the neuston was relatively high (Table 13a). Most of the eggs on this occasion, however, were caught at a single station off the north Oregon coast and low numbers were taken at only three other stations off Washington and northern Oregon (Fig. 75). Other records of saury eggs in the neuston included sparse occurrences in the spring of 1980 and in the spring and autumn of 1981 (Table 13a). Previous records of saury eggs off the west coast are similar; Ahlstrom (1976), during an extended CalCOFI cruise from off Washington to Baja California, recorded very few eggs in either the neuston or the bongo samples except for one of the neuston hauls which yielded a large cluster of eggs.

Saury larvae occurred in neuston samples during all cruises and levels of abundance were high on most occasions (Table 14a). Abundance was generally low during late spring and summer. Poor sampling coverage during summer, autumn and winter, however, prevents accurate description of the annual pattern in larval abundance. Small larvae (less than 10 mm in length) were recorded during all seasons (Table 25) suggesting that spawning may occur throughout the year. Mean and maximum larval sizes were high, however, and many juveniles were caught (Table 25, Fig. 34). Larvae were significantly larger in late autumn of 1983 and it is likely that all these larvae were spawned much earlier in the year. The spawning season of Cololabis saira is known to be long and to extend from winter to autumn with a peak occurring from February to July (Matarese et al., 1989). The present records do not contradict this pattern.

There is some evidence for interannual variation in timing or intensity of spawning over the course of the surveys. Larval abundance during April/May 1985, May 1981, and May 1982 was considerably lower than levels recorded during other spring sampling periods (Table 13a).

Larvae were recorded throughout the sampling area, in shelf and deep water but there was a definite trend of increasing abundance from north to south (Fig. 76a). In general, records were sparse and levels of abundance were low off Washington and northern Oregon and at a maximum levels in deep water off southern Oregon and northern California, particularly west of Cape Mendocino.

In the spring of 1980 and 1981, occurrences of saury larvae were confined almost entirely to southern Oregon and northern

California, from Cape Blanco southwards (Figs. 76b and c). When spring records of abundance were at a peak in April/May 1983 and March/April 1984, the distribution of larvae extended further northwards mainly to northern Oregon but with a few occurrences off Washington (Figs. 76e and h). In both instances, numbers of larvae were high in shelf waters off Oregon and southern Califonia, as well as in deep water. Levels of abundance were again highest off Oregon and northern California during late autumn 1981 (Fig. 75d) and 1983 (Fig. 75f) but there were slightly more records off Washington on these occasions. During January 1987, occurrences were scattered mainly off Oregon but highest numbers of larvae were caught in deep water west of Cape Mendocino (Fig. 75i).

The above patterns of distribution suggest that spawning may occur only to a limited extent off Washington and perhaps northern Oregon in comparison with southern Oregon and northern California. It also appears that spawning takes place in shelf and deep water.

Diel variation in catches of saury larvae in the neuston (Fig. 53c) indicate that sampler avoidance may cause a slight reduction in daytime catches. Catches were marginally lower during daylight hours than during hours of darkness. There is no evidence to suggest that larvae migrate out of the neuston during the day, as there were no records of larvae in the bongo samples.

TRACHIPTERIDAE

Trachipterus altivelis

The ribbon-fishes, family Trachipteridae, are elongate, laterally compressed fishes which occur in the epi- and mesopelagic zones of most oceans. In the eastern temperate Pacific, the species Trachipterus altivelis (the king-of-the-salmon) is common and occurs off the U.S. west coast. Its range actually extends from Chile to the Gulf of Alaska. The king-of-the-salmon has pelagic eggs and larvae and spawning may occur throughout the year (Matarese et al., 1989).

Trachipterus altivelis eggs were abundant in the neuston and, to a lesser extent, the bongo samples during the present study. They occurred in 40% of neuston samples taken and had a mean abundance of approximately 38 larvae/10 m^2 (Table 4). Although they occurred in almost 33% of bongo samples, mean abundance was relatively low at approximately 4.3 larvae/10 m^2 (Table 6). In the neuston, T. altivelis eggs accounted for 5.19% of total egg abundance (Table 9) and in the bongo samples for 2.35% (Table 11). Larvae of this species were absent from the neuston (Table 5) and scarce in the water column (Table 7).

In both the neuston and the bongo samples, T. altivelis eggs were recorded during each cruise (Tables 13a and 15a). Levels of abundance were in general high during spring, autumn and winter cruises and were considerably higher in the neuston than in the bongo samples. During late summer of 1980, numbers of eggs in the neuston samples were low and they were scarce in the bongo samples. In the neuston, peak levels of egg abundance were recorded during spring 1983 and 1985 and in late autumn of 1981. Levels of abundance in the bongo samples remained more uniform among the spring, autumn and winter cruises. This pattern in seasonal variation of egg abundance suggests that T. altivelis spawns throughout the year but that spawning activity may be reduced during summer months. The degree of interannual variation in levels of egg abundance recorded in the neuston during spring months also suggests that timing and intensity of spawning off the west coast may vary from year to year.

The average distribution pattern for T. altivelis eggs in the neuston suggests that spawning is widespread but may be greatest in deep water off Oregon, north of Cape Blanco (Fig. 77a). The mean abundance of eggs was significantly higher in this region than elsewhere. There is also a patch off Cape Mendocino where mean abundance of _T. altivelis_ eggs was higher than average. Abundance was at a minimum in most of the coastal and shelf zone, particularly off Washington and northern Oregon, and also in some of the deep water area off southern Oregon and northern California.

In the spring of 1980 and 1981, abundance of _T. altivelis_ eggs was relatively uniform throughout the sampling area apart from a paucity of records in deep water off northern California (Figs. 77b and c). During October/November 1981, eggs were very abundant in the vicinity of Cape Mendocino and to a lesser extent over the shelf slope just north of Cape Blanco (Fig. 77d). They were scarce elsewhere on this occasion. During spring of 1983, eggs were most abundant off northern Oregon suggesting a northward shift in peak spawning (Fig. 77e). In autumn of the same year (cruise MF83), the absence of _T. altivelis_ eggs extended from Washington to the coastal and shelf zone off northern Oregon (Fig. 77f). From Cape Blanco southwards, eggs occurred in shelf and deep water. _Trachipterus altivelis_ eggs were more evenly distributed throughout the sampling area during spring 1984 and 1985 (Figs. 77g and h). Levels of abundance were not uniform, however, and highest numbers occurred at several deep water stations off Oregon, close to the shelf edge in 1984 but in deep water beyond the shelf in 1985. Numbers were also high off Cape Mendocino during spring 1985. Numbers of eggs were low throughout the sampling area during January 1987 and highest numbers occurred at several deep water stations off Oregon (Fig. 77i).

On average, the distribution of _T. altivelis_ eggs throughout the sampling area was more uniform for the water column than the neuston (Fig. 78a). Spatial variation in occurrence and abundance among the individual sampling periods bore some similarity, however, to the neuston patterns (Figs. 78 b-i).

The patterns of egg distribution observed here indicate that

T. altivelis spawns in shelf and deep water off Washington, Oregon and northern California. There may be some preference for certain areas, however, such as deep water off northern Oregon and the shelf slope region off Cape Mendocino. In addition, there seems to be occasions when *T. altivelis* avoids spawning off Washington and in the shelf zone off northern Oregon. This may be related to the influence of the Columbia River runoff and associated reduction in water salinity in this area, particularly during late autumn to spring (Figs. 6-14c). The general association of peak densities of eggs with the southern section of the sampling area also suggests a relationship between spawning and temperature. During spring, temperatures are highest in the deepwater zone off Oregon and northern California (Figs. 6-14). The apparent northerly extension of spawning during spring 1983 may be related to the increase in water temperature in the sampling area during that year (Fig. 11).

The occurrence of higher numbers of *T. altivelis* eggs in the neuston compared to the water column suggests that the pelagic eggs may float to the surface. The paucity of records of larvae for this species seems unusual given the abundance of their eggs in the plankton. Previous studies of fish larvae off the U.S. west coast, mainly Oregon, also yielded very few records of *T. altivelis* larvae (Richardson, 1973; Richardson *et al.*,1980). Larvae identified to family Trachipteridae have been taken frequently, usually in low numbers, in CalCOFI ichthyoplankton collections (Stevens *et al.*, 1987, 1988, 1990).

SCORPAENIDAE

In the northeast Pacific, family Scorpaenidae comprises the rockfishes belonging to the genus *Sebastes* and the thornyheads of the genus *Sebastolobus*.

Sebastes spp.

Up to 70 species of rockfish are known to occur in the northeast Pacific, approximately 40 of which are known in the study area. They are largely demersal in habit and are most abundant in offshore waters of the outer continental shelf and slope to approximately 300 m. Some pelagic and inshore species also occur. The range for most of these rockfish species extends from California to the Bering Sea. A multispecies rockfish fishery exists off the west coast and is of major economic importance. A high proportion of the catches from bottom-trawl surveys off the U.S. west coast comprises rockfish species (Weinberg et al., 1984; Coleman, 1988) and the following is a list of the dominant species for the Washington, Oregon and California region, ranked in order of abundance:

Sebastes alutus	Pacific Ocean perch
Sebastes zacentrus	Sharpchin rockfish
Sebastes crameri	Darkblotched rockfish
Sebastes proriger	Redstripe rockfish
Sebastes pinniger	Canary rockfish
Sebastes flavidus	Yellowtail rockfish
Sebastes brevispinus	Sivergray rockfish
Sebastes diploproa	Splitnose rockfish
Sebastes saxicola	Stripetail rockfish
Sebastes paucispinus	Boccacio
Sebastes goodei	Chilipepper

Two pelagic species are also numerically dominant in this region and are fished commercially - S. entomelas, the widow rockfish and S. jordani, the shortbelly rockfish. The catch composition off Washington and Oregon differs from that off California, in terms of relative abundance of species, suggesting considerable change in habitat between the California shelf and the Washington/Oregon region. In the north, off Washington and Oregon, catches are largely dominated by yellowtail, widow and canary rockfish and Pacific ocean perch, whereas further south, stripetail rockfish, boccacio and chilipepper are the dominant species.

In terms of reproductive strategy, rockfish are unusual in that they are viviparous, giving birth to live young. Fertilization is internal and eggs hatch prior to extrusion. New born larvae are from 3.8 to 7.5 mm in length and are similar in stage of development to first-feeding larvae of other oviparous scorpaenids (Matarese et al., 1989). Although Sebastes larvae are abundant in the ichthyoplankton of the northeast Pacific (Richardson, 1973; Richardson and Pearcy, 1977; Ahlstrom, 1976; Richardson et al., 1980; Loeb et al., 1983; Mundy, 1984; Brodeur et al., 1985; Shenker, 1988; Stevens et al., 1987, 1988, 1990), the specific identity of most cannot presently be determined (Matarese et al., 1989). In the present study, rockfish larvae have been identified to genus level only - Sebastes spp. It is presumed, however, that the relative abundance of larval species reflects the relative abundance of the adults and that the dominant species listed above are well represented as larvae in the west coast ichthyoplankton collections.

Sebastes larvae were abundant in both sampling gears and accounted for approximately 12% of total larval abundance in the neuston (Table 10) and 10% in the water column (Table 12). They occurred in 18% of the neuston samples (Table 5) and almost 44% of the bongo samples (Table 7).

Small larvae (less than 5 mm in length) were taken during all cruises and mean larval length for the bongo samples remained low during all seasons (Table 28, Fig. 35b). It seems that rockfish spawning occurs throughout the year. The main spawning period, however, may be from late winter through to summer as levels of abundance recorded during late autumn (cruises DA81 and MF83) were significantly lower than during the other sampling periods (Tables 14a and 16a). Interannual variation in larval abundance during spring was considerable and varied between the different sampling gears. In the neuston, Sebastes larvae were much more abundant in spring 1980 and 1983 than in spring of the other years (Table 14a). It is not possible to interpret this variation in larval abundance, however, as an indication of interannual variation in reproductive activity because larvae in the neuston were essentially large and well-developed (Table 28, Fig. 35a) and would have been born weeks to months prior to being caught in the neuston gear. In addition, the occurrence and abundance of Sebastes larvae in neuston collections may be controlled mainly by larval behaviour. It seems that large larvae migrate vertically into the surface layer, particularly at night. Diel variation in catches suggest that very few larvae occur in the neuston during the day (Fig. 53d) - most Sebastes larvae were caught in the neuston during hours of darkness. Avoidance of the sampling gear by the large larvae during daylight hours may, however, also contribute to the paucity of Sebastes larvae in daytime neuston samples.

Mean larval size in the bongo samples was consistently low and remained below 6 mm for all cruises except EQ83 (Table 28, Fig. 35b). Interannual variation in larval abundance for the bongo collections, therefore, may be indicative of interannual changes in spawning patterns. Mean larval abundance was considerably higher in spring of 1982 and, in particular 1984, than for the other spring sampling periods (Table 16a) and may reflect differences from year to year in the timing or amount of larval production by adults of certain rockfish species.

The average distribution patterns for Sebastes spp. larvae in the neuston and water column was similar with highest densities of larvae coinciding mainly with the shelf edge and slope area off Washington, Oregon and northern California (Figs. 79a and 80a). This pattern is similar to the distribution of many of the adult populations of rockfish species along the west coast and therefore suggests that, on the whole, larvae remain relatively close to where they were born. There was little interannual or seasonal variation in larval distribution patterns and highest levels of abundance were consistently recorded in the vicinity of the shelf edge and slope for both the neuston (Figs. 79 b-h) and the bongo samples (Figs. 79 b-i). There were some occasions, however, when records of larvae in the oceanic zone were more numerous than usual.

Considering that Sebastes spp. larvae in the study area belong to a multispecies complex, it is difficult to draw conclusions about reproductive patterns of the adult populations. Nevertheless, it seems that most of the rockfish species in this area produce larvae over an extended period from winter to summer, with a peak in production occurring perhaps during spring. Larvae are on the whole most abundant in areas where the adult populations are known to occur suggesting that larval drift is minimal. Large larvae and juveniles appear to migrate to the neuston at night.

Sebastolobus spp.

Thornyheads of the genus Sebastolobus are similar in body shape and habitat to the rockfishes but unlike the latter, they lack a gasbladder. Three species occur in the northeast Pacific but only two in the study area. Sebastolobus alascanus, the shortspine thornyhead, and S. altivelis, the longspine thornyhead, are found from southern California to the Bering Sea whereas S. macrochir occurs only in the Bering Sea and its larvae are unknown (Matarese et al., 1989). The former two species are common from the outer shelf to depths of approximately 1500 m along the U.S. west coast and both are fished commercially. Thornyheads are oviparous and eggs are extruded in gelatinous masses which float to the surface. Eggs and young larvae are difficult to identify to species and have been assigned to Sebastolobus spp. in this study. Previous records of Sebastolobus larvae off the U.S. northwest coast have been confined to a few occurrences in ichthyoplankton samples taken offshore of Oregon (Richardson, 1973; Richardson and Pearcy, 1977; Richardson et al., 1980; Brodeur et al., 1985). Off

California, they have been taken frequently in CalCOFI collections (Stevens et al., 1987, 1988, 1990).

Thornyhead eggs and larvae were caught in neuston and bongo samples during the present survey (Tables 4-7). In general, occurrences were sparse and only eggs were abundant. The overall high levels of abundance of eggs (Tables 4 and 9), however, arose from the occurrence during spring of 1981 of very high numbers of eggs in two samples (Table 13a and Fig. 81b).

Eggs were recorded during spring months only (Tables 13a and 15a) indicating that spawning may be confined to this season. Low numbers of larvae were also taken in the bongo samples primarily during spring months but they were also present during summer and late autumn cruises (Table 16a).

The distribution of Sebastolobus eggs was confined mainly to the shelf and slope zone with records being almost entirely absent from the oceanic zone (Figs. 81 and 82). The highly clumped distribution of eggs can be attributed to the spawning strategy of releasing eggs in gelatinous masses. Larvae, although low in numbers, were more widely distributed and occurred in deep water beyond the shelf slope as well as in the coastal and shelf zone (Fig. 82).

It seems that along the U.S. west coast, thornyheads spawn during spring over the continental shelf and slope and that larvae subsequently become widely distributed in coastal and oceanic water. The scarcity of larvae in the ichthyoplankton seems unusual given that adult populations are abundant in this region.

ANOPLOPOMATIDAE

Anoplopoma fimbria

The sablefish, A. fimbria, is the most common and abundant member of the family Anoplopomatidae occurring in the northeast Pacific. It is the target of both foreign and domestic fisheries and commercial catches contribute significantly to the fisheries economy along the Canadian and U.S. west coasts (Hart, 1973; Eschmeyer et al., 1983). The other species which occurs in the northeast Pacific is the skillfish Erilepis zonifer. It is found in deeper water than the sablefish, however, and is not caught commercially. Eggs or larvae of the latter species have not been recorded in the study area.

The distributional range of sable fish in the northeast Pacific is from Baja California to the Bering Sea and it is a semi-demersal fish which occurs mainly on the outer continental shelf and upper slope (Hart, 1973; Matarese et al., 1989). In general, spawning takes place at depths greater than 200 m and in various parts of the northeast Pacific occurs from late fall through early spring (Mason et al., 1983; Kendall and Matarese, 1987). The spawning season seems to be short and the peak period appears to take place earlier in the year in the southern part of the range (December off California) and becomes progressively later towards the north (May off the Aleutian Islands). Estimates of birth dates, by otolith increment analysis, of larval and juvenile sablefish off Washington and Oregon indicate that peak spawning in this area occurs in early March (Boehlert and Yoklavich, 1985).

Sablefish eggs are pelagic but have been found to occur deeper than 200 m and small sablefish larvae (<10 mm) are rare in field collections, indicating that spawning and hatching takes place at depths greater than 200 m (Kendall and Matarese, 1987). Mason et al. (1983), in their study of sablefish reproduction and early life history off the Pacific coast of Canada, concluded that egg descent during embryological development is probable with hatching occurring predominantly at depths exceeding 400 m. Larvae and early juveniles (10-80 mm length) of sablefish appear to be obligate neustonic animals, being found almost exclusively at the sea surface. It is presumed, therefore, that as the yolk-sac is absorbed the larvae swim to the surface (Kendall and Matarese, 1987). Previous records of sablefish in the ichthyoplankton off the U.S. west coast have been sparse where oblique tows to 200 m has been the method of sampling used (Richardson and Pearcy, 1977; Richardson et al., 1980; Stevens et al., 1987, 1988, 1990). In studies where neuston sampling was carried out, postlarval and juvenile sablefish were found to be abundant during spring and early summer months (Ahlstrom, 1976; Shenker, 1988).

Because sablefish eggs are bathypelagic, they were not caught in any of the regular neuston and bongo samples collected during the west coast ichthyoplankton surveys of the 1980s (Tables 4 and 6). In spring of 1984 and January of 1987, however, extra tows to 400 m depth were carried out and low numbers of sablefish eggs were obtained. Bongo tows to 400 m at 12 stations along the shelf edge in March/April 1984 yielded a total of 5 eggs and 9 recently-hatched larvae (Clark and Savage, 1988). A total of 47 sablefish eggs and no larvae were caught in 27 Tucker trawls (to 400 m) carried out along 3 transects off Washington, Oregon and northern California during January 1987 (Savage, 1989b). Most of the eggs occurred at stations which coincided with the shelf edge on the latter occasion. The above records confirm that sablefish spawn at depths below 200 m, and possibly below 400 m given that numbers of eggs caught were so low, mainly along the shelf edge and upper slope, during winter and to a lesser extent during late spring. It is likely that the peak spawning period, which may occur from February to March, was missed by the present sampling regime.

Occurrences of sablefish larvae in the bongo samples were sparse and numbers were very low (Table 7). In the neuston, however, sablefish larvae were dominant accounting for approximately 16% of total larval abundance (Table 10). They occurred in 22% of the neuston samples and had a mean abundance of approximately 26 larvae/1000 m^3 (Table 5). Anoplopoma fimbria was the second most abundant larval species in the neuston. Occurrences of larvae were confined to spring months (Table 14a) indicating that the spawning period does not extend into the summer and autumn. As larvae occurring in the neuston were on the whole well developed postlarvae, with mean lengths ranging from 11 to 23 mm (Table 29, Fig. 36), most of them would have been spawned several weeks to months prior to being caught indicating that spawning is likely to take place primarily in late winter to early spring. Abundance of larvae was at a peak for cruise TK80 and also very high for cruises BA85 and EQ83 (Table 14a) when sampling was carried out over the months April to May (Table 2, Fig. 3). Larval abundance was significantly lower, but still high, during the March/April cruise in 1984 when mean larval length was at its lowest (Table 29). During late spring (May) of 1981 and 1982, however, levels of abundance were low and minimum, mean and maximum larval sizes were highest (Table 27). The peak period of larval abundance, therefore, appears to occur consistently from mid-April to mid-May suggesting that the peak period of spawning is short and probably occurs in February to March. Spawning may commence, however, as early as December and continue into May, or June at the latest, given the occurrence and size-distribution of larvae documented here.

The observed pattern of diel variation in catches of sablefish larvae in the neuston suggests that avoidance of the sampling gear may contribute to the reduced abundance of larvae during the day (Fig. 53e). Catches were consistently high during hours of darkness and well below average during daylight hours. The low numbers of larvae in the bongo samples indicates that vertical migration may contribute to a limited extent to the reduced catches in the neuston during the daytime.

Sablefish larvae occurred throughout the sampling area but densities were highest in deep water off Washington and to a lesser extent off Oregon as far south as Cape Blanco (Fig. 83a). South of Cape Blanco, records were in general poor. During April/May of 1980, 1983 and 1985, when levels of larval abundance were highest, this pattern prevailed (Figs. 83b, e, and g). Although some of the highest densities of larvae were recorded over deep water in the oceanic zone on these occasions, high levels of abundance were most common in the vicinity of the shelf and slope, particularly off Washington and northern Oregon. If, as is considered to be the case, spawning occurs primarily in deep water (below 2-300 m) along the upper continental slope (Kendall and Matarese, 1987), vertical migration of larvae into the surface layers would be expected to result in this pattern. The occurrence of many larvae in coastal and oceanic waters as well indicates that larval dispersal also occurs on the horizontal scale in both an offshore and onshore direction.

Earlier in spring, in March/April of 1984, sablefish larvae were more evenly distributed throughout the sampling area than on other occasions (Fig. 83f). In contrast, during late spring (May) of 1981 and 1982, occurrences of larvae were restricted almost entirely to the northern area off Washington and northern Oregon (Figs. 83c and d). The seasonal progression from south to north in occurrence and abundance of larvae suggests that there is a northerly progression in spawning along the U.S. west coast. This concurs with previous observations of sablefish reproduction in the northeast Pacific (Mason et al., 1983; Kendall and Matarese, 1987).

HEXAGRAMMIDAE

Hexagrammids or greenlings are endemic to the north Pacific Ocean and are moderately-sized, demersal fish which occur mostly in the coastal zone, close to shore (Hart, 1973; Eschmeyer et al., 1983). Spawning is demersal and egg masses usually adhere to a substratum of rocks or seaweed where they may be guarded by the male fish. An epipelagic juvenile stage occurs in most species. Nine species in five genera are known from the northeast Pacific (Matarese et al., 1989). Of these, six have been found to occur as larvae in the ichthyoplankton off Washington, Oregon and northern California during the present study; *Oxylebius pictus*, *Ophiodon elongatus*, *Pleurogrammus monopterygius*, *Hexagrammos decagrammus*, *H. lagocephalus* and *H. stelleri*. No eggs were taken and the larvae occurred almost exclusively in the neuston (Tables 4-7). Only three of these species were prominent in the catches - *Ophiodon elongatus*, *Hexagrammos decagrammus*, and *H. lagocephalus* - the remaining three being rare both in neuston and bongo samples.

Ophiodon elongatus

The lingcod is harvested commercially, and also taken as a sport fish, along the U.S. west coast (Eschmeyer et al., 1983). It occurs from Baja California to the Gulf of Alaska in coastal and shelf waters from the intertidal zone down to a maximum of 475 m (Matarese et al., 1989). A spawning migration to shallow water (<20 m) takes place and eggs are deposited in crevices under rocks where they adhere to each other in large thick masses. Spawning occurs between December and April and the larvae are pelagic.

Lingcod larvae occurred in 4% of the neuston samples collected, had a mean abundance of approximately 3 larvae/1000 m^3 and accounted for almost 2% of total larval fish abundance in the neuston (Tables 5 and 10). Their occurrence in bongo samples was rare (Table 7). The larvae were recorded during all spring sampling periods but levels of abundance were significant only during spring of 1980, 1982, 1984 and 1985 (Table 14a). Densities were at a peak in spring of 1985. They were absent or rare in the neuston during late summer, autumn and winter cruises. Larval sizes ranged from 8 to 45 mm and mean sizes were mostly greater than 14 mm (Table 30, Fig. 37) indicating well-developed postlarvae. Obviously, larvae migrate to the neuston on hatching. Catches were significantly higher during nighttime sampling than in daylight hours (Fig. 53f) suggesting that avoidance of the sampling gear occurs. The occurrence of highest numbers of postlarvae during the months March to May indicates that most spawning occurs during late winter and early spring. Interannual variation in larval abundance was significant among the spring sampling periods. It is not possible to conclude, however, that this reflected variation in timing or extent of spawning from year to year as sampling did not take place in nearshore waters (< approx. 5 km from shore) where most newly-hatched larvae are likely to occur.

The distribution of lingcod larvae was restricted to coastal and shelf waters (Fig. 84a). During April/May 1985, when highest numbers were recorded, larvae occurred mostly at stations closest to the coast from Washington to northern California (Fig. 84b). At one nearshore station off northern Oregon, the density of larvae was extremely high. Richardson and Pearcy (1977) and Richardson et al. (1980) found Ophiodon elongatus larvae to be abundant in bongo samples taken in the coastal zone (2-46 km) off Oregon, mainly during March and Shenker (1988) recorded them in abundance in neuston samples off Yaquina Bay during the months April and May. It seems that offshore dispersal of lingcod larvae does occur and is likely to be influenced significantly by wind and surface circulation patterns. Lingcod larvae are rare in CalCOFI ichthyoplankton collections (Stevens et al., 1987, 1988, 1990).

Given that lingcod spawn in such shallow water (<20 m), it is presumed that a sampling program incorporating the nearshore zone (to intertidal level) is necessary to provide a more accurate assessment of larval abundance and distribution patterns than is provided here.

Hexagrammos decagrammus

The kelp greenling occurs intertidally and in coastal waters from Baja California to the Bering Sea (Hart, 1973). It is not fished commercially but is taken as a sport fish. Spawning is known to occur from October to November and as for lingcod, eggs adhere together in masses and are attached to rocks.

Larvae of this species were the most abundant among the hexagrammids with a mean abundance of 15 larvae/1000 m^3 and occurrences in 19% of the neuston samples (Table 5). They accounted for just over 9% of total larval abundance in the neuston and were ranked fourth in terms of dominance in this sampling gear (Table 10). Occurrences were from late autumn through to late spring with an absence of larvae during the late summer cruise (Table 14a). Specimens ranged in length from 6 to 57 mm and included some juveniles in the >40 mm size range (Fig. 38). Larval sizes were smallest by far during autumn and winter cruises (Table 31) and abundance was at a peak during the January 1987 cruise. In addition, abundance of larvae decreased and mean larval size increased from early to late spring; March to May. This seasonal pattern suggests that peak spawning occurs in December but that it may extend from October to March or perhaps occasionally April.

The distributional range for kelp greenling larvae extended much further offshore than for lingcod larvae and there were records in the immediate oceanic zone beyond the shelf edge (Fig. 85a). Larvae were absent, however, from most of the oceanic zone south of 45°N but occurred throughout most of the deep water zone off Washington. Given the shallow water habitat and spawning location of the adults, offshore larval drift would appear to be extensive.

There is some evidence of a northerly progression in spawning from variation in larval distribution patterns among individual cruises. In October/November 1981 (cruise DA81), when mean larval size was at a minimum, indicating that larvae were newly hatched, occurrences of larvae were confined to several coastal stations from 42°N south and most were caught in the vicinity of Cape Mendocino (Fig. 85c). In January 1987, when larval abundance was at a peak and mean larval size was still relatively small, the occurrence of H. decagrammus larvae extended along the entire coast and high larval densities were recorded off Washington and Oregon, as well as off northern California (Fig. 85f). By early spring, e.g. March/April 1984, records of larvae south of Cape Blanco were sparse and relatively high larval densities were restricted to the coastal and shelf zone off Washington and northern Oregon (Fig. 85d). In April/May of 1985, a further northerly shift in occurrence and abundance of larvae was apparent with most records and highest numbers taken in the coastal and shelf zone off Washington and northern Oregon (Fig. 85e). The occurrence of larvae also extended furthest offshore during the latter occasion, indicating an offshore as well as a northerly progression in larval occurrence from winter to spring. This is probably associated with the transition from onshore to offshore Ekman transport which takes place along the coast during spring.

Previous records of greenling larvae (identified to Hexagrammos spp. only but probably comprising H. decagrammus mostly) off Oregon include the occurrence of low numbers during spring, in bongo samples from the coastal and offshore (to 56 km) zones (Richardson and Pearcy, 1977; Richardson et al., 1980). Larvae identified as Hexagrammidae have been taken in CalCOFI ichthyoplankton collections but numbers have been very low (Stevens et al., 1987, 1988, 1990). Shenker (1988) found large larvae and juveniles to be abundant in the neuston, along a 50 km transect, off Yaquina Bay, Oregon during April and May 1984. He concludes that the young are obligate inhabitants of the neuston and that their mobility (being rapid swimmers) contributes to their dispersal or aggregation.

Visual avoidence of the sampling gear by the larvae does not appear to affect catches of kelp greenling larvae in the neuston to the extent that it does for lingcod larvae. The difference between day and night catches of H. decagrammus larvae in the neuston was not pronounced (Fig. 53g).

Hexagrammos lagocephalus

The rock greenling is similar in range and habitat to the kelp greenling and its eggs are attached in masses to rocks or holdfasts in areas of strong currents (Matarese et al., 1989). It is known to spawn intermittantly from June to August off the Aleutian islands (Simenstad, 1971) but further south its life history is undocumented.

Overall, larval abundance for this species in the neuston was low at a mean value of 1.6 larvae/1000 m^3 and it occurred in only 5% of the neuston samples (Table 5), accounting for less than 1% of total larval abundance in this gear (Table 10). The seasonal pattern of occurrence of larvae was similar to that for rock greenling with larvae occurring in autumn, winter and spring collections (Table 14a). Variation in abundance, however, was different in that very few larvae were taken during spring months. Most larvae were caught during the late autumn or winter cruises and, as for H. decagrammus, abundance was at a peak in January 1987 (Table 14a). Mean larval size was also smallest during the latter cruises (Table 32) suggesting that spawning occurs during late autumn to winter, probably from October to January. The few larvae caught during spring were all well developed postlarvae or young juveniles, ranging from 15 to 38 mm, indicating that they were probably spawned during winter months. Most larvae caught were under 20 mm in length (Fig. 39).

The distribution of larvae in the sampling area (Fig. 59) suggests that offshore transport of larvae is considerable. Off

Washington and northern Oregon, occurrences of larvae were as common in deep water of the oceanic zone as they were in coastal or shelf waters. Larvae occurred closer to the coast in the vicinity of Cape Mendocino.

In general, catches of H. lagocephalus larvae in the neuston were higher during hours of darkness than during the day (Fig. 53h). Enhanced visual avoidence of the neuston net by the postlarvae and young juveniles, during daylight, is likely to contribute to this pattern although there may also be some migration out of the surface zone during the day.

COTTIDAE

Cottids or sculpins are a large, circumboreal family of bottom dwelling fish that are most common in nearshore and intertidal regions (Hart, 1973; Eschmeyer et al., 1983). Most species are benthic as juveniles and adults and planktonic as larvae. Demersal, adhesive eggs are generally spawned in shallow water and guarded by the adult fish.

Sculpins are most numerous in the north Pacific and up to a 100 species in 45 genera are known to occur along the U.S. west coast (Matarese et al., 1989). Larval cottids are common in the ichthyoplankton but the early life histories of most species are poorly known. Only one species, the cabezon Scorpaenichthys marmoratus, is commercially fished off California. Many species of sculpin, however, contribute significantly to the recreational fishery in Washington, Oregon and northern California.

Many species of larval cottids have been found to be common in coastal and shelf waters off Oregon, both in water column collections (Richardson, 1973; Pearcy and Myers, 1974; Laroche, 1976; Richardson and Pearcy, 1977; Richardson et al., 1980; Brodeur et al., 1985) and in the neuston (Shenker, 1988). The species S.

marmoratus and some unidentified cottids are common as larvae in CalCOFI ichthyoplankton collections (Stevens et al., 1987, 1988, 1990). During the present study, a total of 12 species of cottid larvae were identified in bongo and neuston collections combined and some unidentified cottids were also recorded (Tables 5 and 7). No cottid eggs were caught. Although the diversity of species occurring in the bongo samples was greater than in the neuston samples, larval abundance among the most common species was much higher in the neuston. The most abundant species by far were the red Irish lord, Hemilepidotus hemilepidotus, the brown Irish lord, H. spinosus, and the cabezon, Scorpaenichthys marmoratus (Table 5). These were the only species to contribute significantly to total larval abundance. Hemilepidotus spinosus was most abundant and accounted for approximately 25% of all fish larvae caught in the neuston (Table 10). Scorpaenichthys marmoratus accounted for 5% and H. hemilepidotus for only 0.74%.

Hemilepidotus hemilepidotus

The red Irish lord occurs from central California northwards to the Bering Sea in coastal waters from the intertidal zone down to a maximum of approximately 275 m depth (Matarese et al.,1989). Spawning occurs in shallow water, including the intertidal zone, and masses of eggs are deposited on rocks in areas with high current velocities. The spawning season in Puget Sound, Washington, is known to extend from October through to January (Garrison and Miller, 1982) whereas off British Columbia, spawning occurs during March (Hart, 1980).

Larvae of H. hemilepidotus were not very abundant in the ichthyoplankton and occurred in only 3% of the neuston samples (Table 5). They were common, however, in the neuston during late winter and early spring cruises, January to May (Table 14a). None were recorded during late spring (May/June), summer or autumn cruises. Larval length ranged from 6 to 25 mm (Table 33 and Fig.

41). Larvae caught during January 1987 were smallest with lengths ranging from 6 to 11 mm, characteristic of recently hatched larvae (Table 33). During spring cruises, larvae were considerably larger, ranging from 10 to 25 mm in length. These records indicate that spawning occurs primarily in late winter, probably December to January, and may extend into early spring; February/March.

Occurrences of H. hemilepidotus larvae were confined mainly to coastal and shelf waters off Washington and Oregon (Fig. 87). Larvae were absent from the southern-most part of the Oregon coast, south of Cape Blanco, and from northern California waters. Off Washington, the distribution of larvae extended into deep water and there were some records of larvae in the oceanic zone beyond the continental slope. Given that spawning occurs in shallow water, offshore drift of larvae would seem to be considerable. Richardson and Pearcy (1977) also found H. hemilepidotus larvae to be common in the offshore zone, as well as in the coastal zone off Oregon. The absence of larvae from south of Cape Blanco suggests that the spawning range for this species has a southerly limit in the vicinity of the Oregon-California border.

Hemilepidotus spinosus

The distribution of the brown Irish lord extends further south than the red Irish lord and its range is from southern California to the Gulf of Alaska. It is known to occur in shallow water from the intertidal zone down to approximately 100 m depth. Little is known of the early life history and the spawning season has not been previously documented. Larvae have been found, however, in the plankton off Oregon during the months January to March (Richardson and Pearcy, 1977; Richardson et al., 1980). Shenker (1980) also recorded larvae and juveniles in the neuston off Oregon during April to June, 1984.

Brown Irish lord larvae were by far the most abundant species in the neuston during the present study with a mean abundance of 41 larvae/1000 m^3 and comprising approximately 25% of total larval abundance (Tables 5 and 10). There were also occasional occurrences of larvae in the bongo samples (Table 7). The seasonal occurrence of larvae in the neuston was similar to that for red Irish lord larvae with records being confined to winter and spring cruises (Table 14a). Unlike H. hemilepidotus, however, H. spinosus larvae were caught during late spring of 1982 and late autumn of 1983. Mean abundance was at a maximum during January 1987. Levels were also high during March/April 1984, and April/May 1985 and 1980. Numbers seemed anomalously low during April/May 1983. During May of 1982, larvae were moderatlely abundant whereas in May of 1981 they were absent. Larvae were also absent during late summer 1980 and autumn 1981. Mean larval lengths during the late autumn and winter cruises were less than 6 mm indicating that these larvae were newly hatched (Table 34b). In early spring of 1984, mean larval length had increased to approximately 9 mm whereas later in spring of 1980, 1982 and 1983, mean length ranged from 15.8 to 17 mm. The increase in larval size, coupled with a decrease in abundance, from January to May indicates that the spawning season occurs primarily in late winter and early spring, December to February or March perhaps. The presence of some recently hatched larvae during March to May cruises, however, is evidence that spawning continues to a limited extent during late spring. It is possible that the apparent anomaly in abundance of larvae (lower than normal) during spring of 1983 may be related to the unusual oceanographic conditions which prevailed that year.

Hemilepidotus spinosus larvae were taken in coastal, shelf and deep water throughout the sampling area (Fig. 88g). Highest densities occurred, on average along the slope. As for H. hemilepidotus, the distribution of H. spinosus larvae extended furthest into the oceanic zone off Washington. North of the Columbia River estuary, they were widely distributed throughout the coastal, shelf and deep water areas whereas further south, records were more sparse in the oceanic zone.

Interannual and seasonal variations in larval distribution patterns were significant. During April/May of 1980 and 1983 and May/June of 1982, occurrences of larvae were confined almost exclusively to the shelf and some of the deep water zone north of Cape Blanco and highest densities were recorded off Washington (Figs. 88b, d, and c). Earlier in spring during cruises PO84 and BA85, the distribution of larvae extended further south to the Cape Mendocino area although densities were still highest off Washington and Oregon (Figs. 88e and f). In January of 1987, when recently hatched larvae were most abundant, high densities of larvae occurred off southern Oregon and northern California and records were sparse off Washington and northern Oregon (Fig. 88g). This seasonal progression northwards in the distribution of larvae suggests that peak spawning occurs earlier in the southern portion of the sampling region than off Washington and northern Oregon. It is likely that a gradual, northerly progression in spawning of this species occurs along the U.S. west coast.

Although the brown Irish lord is known to occur in shallow water, close to the coast, larval distribution patterns suggest that spawning may also occur in deep water close to the shelf edge and slope. Levels of larval abundance were always highest in this region, even during the peak period of spawning, e.g. January 1987 (Fig. 88g). Larval drift may also bring about the widespread distribution of larvae, particularly as they are so abundant in the neuston and therefore subject to wind-driven surface transport.

The diel variation in abundance of H. spinosus larvae in the neuston indicates that visual avoidance by the larvae of the sampling gear may significantly reduce catches of this species during day-light hours (Fig. 53i). Most larvae were caught in the neuston at night. Shenker (1988) also found H. spinosus larvae to be most abundant in neuston samples taken at night, off Oregon.

Migration of larvae out of the neuston during the day may also occur but numbers of H. spinsosus larvae were very low in the bongo samples. If the larvae remain in a layer just below the neuston, however, they would still not be sampled efficiently by the bongo gear.

Scorpaenichthys marmoratus

The cabezon, which is a commercially important species off California, occurs in coastal waters from Baja California to the Gulf of Alaska. It is usually found close to shore, from the intertidal zone down to a maximum of 75 m depth. Demersal spawning gives rise to masses of eggs which adhere to rocks and algae in shallow water. Nesting sites appear to be restricted to specific areas from intertidal depth to 17 m, which are reused each year, and males tend the eggs (Garrison and Miller, 1982). Spawning is known to occur from November to March off California and from January to May off British Columbia (Matarese et al., 1989). Larvae of S. marmoratus have been recorded previously, in low numbers, in the plankton of the Oregon coastal zone (Pearcy and Myers, 1974; Richardson and Pearcy, 1977; Richardson et al., 1980; Mundy, 1984; Shenker, 1988).

The cabezon was the second most abundant larval cottid in plankton collections taken during the present study and as with the other cottids, it was prominent in the neuston and rare in the bongo samples (Tables 5 and 7). It occurred in 16.5% of the neuston samples (Table 5) and accounted for 5% of total larval abundance for this gear (Table 10). Unlike the other dominant larval cottids, it was taken during every cruise and there was little seasonal variation in larval abundance (Table 14a). Apart from the two spring cruises TK80 and EQ83, when mean levels of abundance were at a maximum and significantly higher than on other occasions, levels of abundance during spring, summer, autumn and winter cruises were comparable. Mean larval sizes were also similar among seasons and recently hatched larvae (3-6 mm length) were taken during all cruises (Table 35). Most larvae were less than 15 mm in length (Fig. 42). These data indicate that spawning may occur throughout the year in the study area as a whole. Multiple spawnings among individual fish is a possibility. O'Connell (1953) and Garrison and Miller (1982) reported that more than one mode of egg sizes are present in ovaries of specimens from California and Puget Sound (Washington), respectively, and suggest that more than one spawning may occur per season.

On average, larvae occurred in coastal, shelf and some deep water areas off Washington, Oregon and northern California (Fig. 89a). As for the other cottid species, the distribution of cabezon larvae extended furthest offshore, west of Washington. Variation in the distribution of larvae was apparent among cruises and a seasonal pattern was discernible. During late autumn and winter cruises (October to January), larvae were caught mainly along the Oregon or northern California coast and were scarce off Washington (Figs. 89e, g, and j). During most of spring, March to mid-May, cabezon larvae were most abundant off Washington and Oregon but their distribution usually extended as far south as northern California (Figs. 89b, f, h, and i). By late spring, e.g. May/June 1981, and in late summer, e.g. August 1980, larvae occurred almost exclusively off Washington and northern Oregon, north of Cape Blanco (Figs. 89d and c). This seasonal variation in larval distributional patterns is evidence for a northerly progression in timing of spawning. It seems that during late autumn and winter, spawning occurs primarily off California (as documented by O'Connell, 1953) and Oregon. By spring, spawning has commenced off the Washington coast but still occurs to a limited extent as far south as northern California. Spawning during late spring and summer months, May to August, seems to be confined mainly to waters off Washington and northern Oregon.

Despite being spawned in very shallow water, it appears that cabezon larvae may drift a considerable distance offshore in the neuston. Although most occurred in shelf waters within approximately 100 km of the coast, some were taken up to 300 km offshore, particularly off Washington. Richardson and Pearcy (1977) found cabezon larvae to be common in bongo samples from the coastal zone off Oregon but absent from what they termed the offshore zone, seaward of 37 km from shore. In a study of the ichthyoplankton along a transect of stations, 2-111 km off the Oregon coast, Shenker (1988) found the youngest cabezon larvae (4-6 mm) to be restricted to nearshore stations up to 15 km from the coast whereas larger larvae and young juveniles occurred along the entire transect.

An unusual pattern of diel variation in catches was apparent for S. marmoratus larvae in the neuston (Fig. 53j). They were most abundant in catches taken from midnight to early afternoon (1400 hrs). Subsequently, hourly catches were reduced to less than 3% of the total catch. There may be a migration of the larvae out of the neuston during the afternoon and a return to the neuston at around midnight.

BATHYMASTERIDAE

The ronquils, family Bathymasteridae, are endemic to the north Pacific Ocean. They are bottom dwelling fish which inhabit rocky, nearshore areas and are of no economic importance (Hart, 1973; Eschmeyer et al., 1983). In general, little is known of their biology and early life history. Four species in two genera, Bathymaster and Ronquilus, occur along the northeast Pacific coast (Matarese et al., 1989). They are demersal spawners and their pelagic larvae are, at times, prevalent in plankton samples from this region. The three Bathymaster species are more northerly in their distribution than Ronquilus, the southern limit being off the Washington coast. They are most common in coastal waters of the Gulf of Alaska and the Bering Sea. Their larvae were rare in neuston and bongo samples collected during the present study (Tables 5 and 7). The northern ronquil, _Ronquilus jordani_, is the most abundant species in the study area and its larvae were common in neuston samples collected during the west coast ichthyoplankton surveys.

Ronquilus jordani

The northern ronquil occurs in coastal waters from central California to the Bering Sea and the spawning season is reported to be from late winter through spring (Hart, 1980; Garrison and Miller, 1982; Matarese, 1990). Larvae have been frequently recorded in bongo samples taken in coastal and offshore waters off Oregon during spring and summer months (Richardson and Pearcy, 1977; Richardson _et al_., 1980; Brodeur _et al_., 1985). Shenker (1988) found larvae and juveniles to be abundant in the neuston off Yaquina Bay, Oregon, from April to July. Bathymasterid larvae are rare in ichthyoplankton samples taken during CalCOFI surveys off California (Stevens _et al_., 1987, 1988, 1990).

Northern ronquil larvae were scarce in the bongo samples taken during the present study (Table 7) but occurred frequently in the neuston (Table 5). Levels of abundance were never high, however, and _R. jordani_ larvae accounted for only 1% of total larval abundance in the neuston (Table 10). They were taken during five of the six spring cruises and also during the summer of 1980 (Table 14a). Their absence from autumn and winter cruises and from the early spring cruise (March/April 1984) suggests that spawning may not commence until late winter, perhaps February. Larval lengths documented during April/May cruises ranged from 5.5 to 25.5 mm (Table 36). Some of the larger larvae, therefore, may have been spawned as early as February. All larvae caught during the summer cruise, PO80, were well developed postlarvae, possibly bordering on being juveniles, with lengths ranging from 22 to 33.5 mm. They were probably spawned during late spring or very early summer.

The occurrence of northern ronquil larvae was confined to coastal and shelf waters, the outer limit of their distribution being in the vicinity of the continental slope (Fig. 90). Occurrences were less frequent off southern Oregon and northern California than off Washington and northern Oregon. This may reflect the distribution of adult populations along the coast.

Diel variation in catches suggests that there may be a migration of larvae out of the neuston from mid-day to dusk. Larvae were absent from samples taken during the period 1200 noon to 2000 hrs (Fig. 53k). Visual avoidance of the sampling gear by the larvae during daylight hours may also have contributed to their absence during this period.

CRYPTOCANTHODIDAE

The wrymouths are bottom-dwelling fish of no economic importance which occur in the north Pacific and north Atlantic Oceans (Hart, 1973; Eschmeyer et al., 1983). They are elongate in shape and frequently bury themselves in the sediment. Two species occur in the northeast Pacific; Delolepis gigantea, the giant wrymouth and Cryptacanthodes aleutensis, the dwarf wrymouth (Matarese et al., 1989). The former occurs in nearshore and shelf waters and the latter in shelf and oceanic waters. Larvae of both were taken in neuston samples during the present study but Delolepis was rare and Cryptacanthodes aleutensis occurred in just over 1% of the samples (Table 5). The only previous records of larvae of these species off the U.S. west coast were by Shenker (1988) who found several specimens in the neuston of Yaquina Bay, Oregon during April 1984.

Cryptacanthodes aleutensis

The dwarf wrymouth occurs from northern California to the Bering Sea where it is epi- and mesobenthal in depths of approximately 50 to 350 m (Matarese *et al.*, 1989). Eggs are demersal and the spawning season is thought to occur during spring and summer (Hart, 1973). Low numbers of dwarf wrymouth larvae were caught in approximately 1% of the neuston samples from this survey and together accounted for exactly 1% of total larval abundance in this gear (Table 10). They were recorded during the January 1987 cruise and during three of the spring cruises - PO84, BA85 and TK80 (Table 14a). Levels of abundance were significant only during the two earliest spring cruises - March/April 1984 and April/May 1985. Larvae caught during January 1987 were smallest with a mean length of 13.3 mm whereas mean larval length ranged from 16.3 to 28.5 mm during the spring cruises (Table 37). These data suggest that the spawning season occurs during late winter and early spring, probably January to March. The minimum length of 10 mm (Fig. 44) documented for these larvae complies with the observation of Matarese *et al*. (1989) that *C*. *aleutensis* larvae hatch at an advanced stage of development.

Most of the dwarf wrymouth larvae taken during the present study occurred at stations in coastal and shelf waters off Washington and northern Oregon just south of the Columbia River estuary (Fig. 91). There were fewer records off southern Oregon and northern California. Given that the species is at the southern limit of its distribution off northern California, spawning populations are likely to be less abundant in the southern portion of the study area than off Washington and parts of Oregon.

ICOSTEIDAE

Icosteus aenigmaticus

The brown ragfish, *I*. *aenigmaticus*, is the only species of this family known to occur in the north Pacific Ocean (Matarese *et al*. 1989). It is found off the U.S. west coast from southern California to the Gulf of Alaska and is epi- and mesopelagic to depths of approximately 730 m. Most records of occurrence are from shallow water but the real center of abundance for the species may be in deep water (Hart, 1973). Spawning is thought to occur during summer and winter off California but it is unclear if spawning is restricted in time or occurs several times per year (Garrison and Miller, 1982). A spawning migration to coastal waters may take place (Fitch and Lavenberg, 1971; Matarese et al., 1989).

Previous records of I. aenigmaticus in the ichthyoplankton off the U.S. west coast include the occurrence of low numbers of larvae in bongo samples taken in deep water off Yaquina Bay, Oregon (Richardson and Pearcy, 1977) and in CalCOFI collections off California (Stevens et al., 1987, 1988, 1990). Eggs of the brown ragfish were relatively abundant both in neuston and bongo samples taken during the present study (Tables 4 and 6) whereas larvae were rare and occurred in very few bongo samples only (Table 7). In the neuston, eggs were found in approximately 10% of the samples collected (Table 4). Thirteen per cent of the bongo samples yielded ragfish eggs (Table 6). The proportion of total egg abundance attributed to I. aenigmaticus was 0.76% in the neuston (Table 9) and 1.13% in the bongo samples (Table 11).

Ragfish eggs were taken mainly during spring cruises (Tables 13a and 15a). Levels of abundance were also relatively high during the winter cruise in January 1987. Eggs were scarce in neuston and bongo samples from the autumn cruise DA81, and low numbers were recorded during late spring, May/June 1981 and May 1982. It seems that spawning takes place mainly from January to May with a peak probably occurring in early spring - March to April. The presence of very few eggs during October/November 1981 suggests that spawning may commence as early as then but only to a very limited extent. The above pattern of seasonal variation in egg abundance is indicative of continuous spawning from late winter through to early summer for this species.

Icosteus aenigmaticus eggs were distributed widely throughout the sampling area both in the neuston and the water column (Figs. 92a and 93a). They occurred in coastal, shelf and deep water. On average, levels of occurrence and abundance were greater off Washington and northern Oregon than from Cape Blanco southwards. This pattern, however, seems to be due to the fact that most sampling was carried out during spring. Distribution patterns for the spring cruises show that the eggs occurred almost exclusively north of Cape Blanco, in the neuston (Figs. 92 b-f) and water column (Figs. 93 b-f). In contrast, during January 1987, ragfish eggs were absent from stations off Washington and northern Oregon and most were taken in the vicinity of Cape Blanco off southern Oregon and Cape Mendocino off northern California (Figs. 92g and 93g). Distributions were also closer to the coast on the latter two occasions than during spring when occurrences extended throughout the oceanic zone off Washington and northern Oregon.

These distributional patterns suggest that in early winter, I. aenigmaticus spawns off southern Oregon and northern California, mainly within approximately 100 km of the coast. A seasonal, northward progression in spawning is apparent and during spring months, spawning seems to occur in coastal, shelf and deep water off Washington and northern Oregon.

The scarcity of larval I. aenigmaticus in the ichthyoplankton samples seems unusual given the frequency of occurrence of eggs in the neuston and water column.

AMMODYTIDAE

Sand lances are elongate and slender, small fishes which are common in coastal and shelf waters of most oceans, at high latitudes. They frequently form great schools and are associated with a substrate of clean sand where on occasion they bury themselves. In the Pacific, only one species occurs - Ammodytes hexapterus.

Ammodytes hexapterus

Pacific sand lance occur along the U.S. and Canadian west coasts from southern California to the Arctic (Hart, 1973; Eschmeyer et al., 1983). They are found from the intertidal zone down to depths of approximately 275 m (Matarese et al., 1989) but are most common in water less than 100 m depth (Garrison and Miller, 1982). Off the U.S. west coast, spawning is known to take place during winter and early spring. Eggs are deposited in the sand and give rise to pelagic larvae. Pacific sand lance larvae have been taken frequently in ichthyoplankton surveys off Oregon (Richardson, 1973; Pearcy and Myers, 1974; Richardson and Pearcy, 1977; Richardson et al., 1980; Mundy, 1984; Shenker, 1988). None, however, have been recorded in CalCOFI ichthyoplankton collections (Stevens et al., 1987, 1988, 1990).

Ammodytes hexapterus larvae were taken in neuston and bongo samples during the present study (Tables 5 and 7) but were most abundant in the neuston where they accounted for approximately 4% of all larvae caught (Table 10). Occurrences were confined to spring months and levels of abundance were highest by far during March/April 1984 (Tables 14a and 16a). During the other spring cruises, when sampling was carried out during April to June, sand lance larvae were scarce in the bongo samples and ranged from being scarce to moderately abundant in the neuston. In the neuston, abundance during cruise TK80 was significantly higher than for the other April/May cruises.

Larvae caught in the neuston were large (Fig. 45) and except for cruise PO84, mean larval length was above 30 mm and some specimens were over 50 mm (Table 38). These large larvae and early juveniles were likely to have been spawned 3-4 months previously. Larval sizes were significantly smaller during the March/April sampling of 1984 when a mean length of 16.9 mm was documented. Mean larval length for A. hexapterus in the bongo samples on this occasion was 12.9 mm and minimum length was 4 mm. The few specimens caught in the bongo samples during other cruises ranged in length from approximately 6 to 30 mm.

The seasonal patterns in larval occurrence and abundance and the size distribution data indicate that A. hexapterus spawns in the sampling area primarily during late winter and early spring. The peak in spawning is likely to occur from February to March. Previous ichthyoplankton studies off Oregon have found sand lance larvae to be present in the ichthyoplankton from January to May with peaks in abundance of small larvae occurring during February to March (Pearcy and Myers, 1974; Richardson and Pearcy, 1977; Richardson et al., 1980; Mundy, 1984). Shenker (1988) found A. hexapterus larvae in low numbers in the neuston from April through June of 1984. Most of these larvae were caught during nighttime sampling. Similarly, larvae occurring in the neuston samples during the present study were taken predominantly during hours of darkness (Fig. 53i). Visual avoidance of the neuston sampler by the larger larvae may be significant. It is also probable that well-developed larvae migrate to the neuston on a diel basis. The common occurrence of smaller A. hexapterus larvae in the bongo samples is evidence for this facultative association of the species with the neuston.

The distribution of Pacific sand lance larvae in the neuston was largely confined to coastal and shelf waters off Washington and northern Oregon (Fig. 94a). Records were sparse off the southern Oregon and northern California coast, south of Cape Blanco. There were also some occurrences of larvae in deep water beyond the shelf edge off northern Washington. Highest levels of larval abundance were recorded close to the Columbia River estuary, particularly during March/April 1984 (Figs. 94 b-d). It would appear that spawning is concentrated mainly in Washington and northern Oregon coastal waters and results in the association of larvae with Columbia River plume water.

Given that A. hexapterus deposits eggs in the substratum, it could be expected that newly hatched and early larvae would have been more abundant in the bongo samples collected during the present study. Very few larvae less than 12 mm in length were caught. It may be that the peak spawning and hatching period of this species was missed by the sampling regime executed here. Perhaps if sampling had been carried out during February, levels of abundance of early larvae would have been higher. Kendall and Dunn (1985) found small sand lance larvae to be abundant in bongo samples taken in the nearshore zone off Kodiak Island, in the Gulf of Alaska, during spring months March to May suggesting that their sampling coincided with larval hatching in that region.

CENTROLOPHIDAE

Medusafish are moderately-sized, soft-bodied and laterally-compressed fish which are common in all temperate and sub-tropical seas. They are so named because the young are usually found in association with jellyfish to whose venomous stinging cells they seem to be immune. One species, Icichthys lockingtoni, occurs in the north Pacific.

Icichthys lockingtoni

The distributional range of this species is from Baja California to the Gulf of Alaska and offshore throughout the north Pacific to Japan (Hart, 1973). It lives comensally in the bell of large jellyfish but large medusafish are thought to live a solitary existence (Fitch and Lavenberg, 1968). Spawning is pelagic and juveniles are abundant off the California coast, usually near the surface (Fitch and Lavenberg, 1968). Very little is known about its biology or early life history.

Previous records of I. lockingtoni in the ichthyoplankton off the U.S. west coast include the occurrence of larvae in bongo collections off Oregon (Richardson and Pearcy, 1977; Richardson et al., 1980; Mundy, 1984; Brodeur et al., 1985) and California (Loeb et al., 1983; Moser et al., 1987; Stevens et al., 1987, 1988, 1990). On the whole, levels of abundance were low. Shenker (1988) also recorded a few medusafish larvae in the neuston off Oregon during sampling in July 1984.

Eggs and larvae of I. lockingtoni were taken in neuston and bongo samples during the present study (Tables 4-7). Eggs were most abundant and occurred in approximately 30% of all neuston samples and 20% of the bongo samples (Tables 4 and 6). They accounted for 6% of total egg abundance in the neuston (Table 9) and 2% in the water column (Table 11). Larvae, however, were rare in the neuston (Table 5) and occurred in low numbers in only 4% of the bongo samples (Table 7). The prominence of eggs in the neuston suggests that the eggs float to the surface layers.

Moderate to high levels of abundance of eggs were recorded in the neuston, and low to moderate levels in the water column, during all cruises (Tables 13a and 15a) suggesting that spawning occurs thoughout the year. Abundance was at a maximum during May 1981 (cruise PO81) in the neuston (Table 13a). The next highest level to this was in October/November of the same year (cruise DA81). Perhaps spawning intensity was greater that year than during the other years of sampling. Some seasonal variation in abundance was also detectable in the neuston. Egg abundance was at a minimum in November/December 1983, and was relatively low in January 1987 and March/April 1984, in comparison with late spring and summer sampling periods (Table 13a). It is possible that a peak in spawning occurs from mid spring through late summer. The paucity of data for summer and autumn months precludes a more definite identification of the peak period of spawning. Interannual and seasonal variation in egg abundance in the bongo samples was less apparent than for the neuston, levels of abundance being considerably lower (Table 15a). Larvae were also present in the bongo samples during all cruises but numbers were highest during late spring, summer and autumn cruises which agrees with the proposed annual pattern in spawning.

In the neuston and water column, medusafish eggs were, on average, widely distributed throughout the sampling area (Figs. 95a and 96a). Particularly in the neuston, where most eggs occurred, densities were higher in the southern sector of the sampling area and highest levels of abundance were generally associated with the shelf edge and slope region off southern Oregon and northern California. This pattern prevailed during most of the individual sampling cruises, both in the neuston (Figs. 95 b-j) and water column (Figs. 96 b-j). There were consistently fewer records of eggs off the Washington coast than off Oregon and northern California. An exception to this pattern occurred during spring of 1983 when a more northerly distribution of eggs was apparent (Fig. 95f). This anomalous pattern may be associated with the increase in water temperatures throughout the sampling area as a result of the El Niño of 1983 (Figs. 11a and b). Seasonal variation in the distributional patterns was apparent to a limited extent. For instance, during the summer cruise (PO80), in both the neuston and water column, eggs were less widely distributed than on other occasions and occurred mainly close to the shelf edge (Figs. 95c and 96c). Perhaps spawning does not occur to any significant extent in the oceanic zone during the summer. During the autumn and winter cruises, MF83 and MF87, the distribution of medusafish eggs was more southerly than during other seasons and there was a distinct absence of records from Washington and northern Oregon (Figs. 95g and j, and 96j) suggesting that spawning does not occur in this area during the colder months of the year. The consistent pattern during all seasons, however, was that highest densities of eggs occurred close to the shelf edge off southern Oregon and northern California. It appears, therefore, that spawning occurs in this area throughout the year.

As for several other species whose eggs are abundant in the ichthyoplankton off the U.S. west coast, e.g. Icosteus aenigmaticus, the paucity of larval records for I. lockingtoni is difficult to explain. They were rare in the neuston during the present study, despite the abundance of eggs in this zone. This suggests that on hatching, the larvae migrate out of the surface layer.

PARALICHTHYIDAE

Citharichthys sordidus and Citharichthys stigmaeus

The paralichthyids are left-eyed flatfish which live demersally in coastal and shelf waters of the Pacific, Atlantic and Indo-Pacific. Two species of paralichthyids are known to occur in the study area; Citharichthys sordidus, the Pacific sanddab, and Citharichthys stigmaeus, the speckled sanddab (Matarese et al., 1989). Prior to Ahlstrom et al. (1984), studies dealing with ichthyoplankton off Washington and Oregon have included the Citharichthys species in the family Bothidae. It is taxonomically correct, however, to include them in the family Paralichthyidae (Matarese, pers. comm.).

Both these species are common in coastal waters of the northeast Pacific from Baja California to the Bering Sea, in the case of C. sordidus, and to the Gulf of Alaska, in the case of C. stigmaeus (Hart, 1973). The Pacific sanddab occurs from inshore to depths of approximately 550 m, whereas the speckled sanddab is most abundant nearshore at depths less than 100 m but has been found as deep as 366 m (Eschmeyer et al., 1983). Citharichthys sordidus is a popular food fish, particularly off California, but C. stigmaeus is of little commercial importance because of its small size - specimens rarely exceed 13 cm in length.

Both species have pelagic eggs and larvae. The Pacific sanddab is known to spawn from March to May in Puget Sound, Washington, and from July to September off California, and it is postulated that there may be two spawnings per season (Matarese et al., 1989). Off California, the speckled sanddab has a spawning period extending from spring through summer. Larvae of C. sordidus and C. stigmaeus have been recorded frequently in bongo samples collected off Oregon but levels of abundance were relatively low and seasonal limits of occurrence were not documented (Richardson, 1973; Pearcy and Myers, 1974; Richardson and Pearcy, 1977; Richardson et al., 1980; Mundy, 1984; Brodeur et al., 1985). These larvae are proportionally more abundant in CalCOFI collections (Loeb et al., 1983; and Moser et al., 1987).

At present, Citharichthys spp. eggs cannot be identified with certainty to species. Based on morphology and size, however, two types of Citharichthys eggs were identified from the west coast ichthyoplankton collections on which this study is based. These are described in Matarese et al. (1989). They are designated here as Citharichthys Type A and Citharichthys Type B. Type A has an average diameter of approximately 0.64 to 0.68 mm and Type B averages 0.78 to 0.88 mm. It is thought that these two types may represent the two species C. sordidus and C. stigmaeus (Matarese, pers. comm.). Early preflexion larvae, less than 6-7 mm standard length, are also not identifiable to species (Matarese et al., 1989) and are assigned to the taxa Citharichthys spp. here. Later stage larvae were identified to species.

Citharichthys eggs were abundant in neuston and bongo collections from the present study (Tables 4 and 6). They were exceptionally abundant in the neuston where they comprised 56% of all fish eggs caught (Table 9). Citharichthys Type A eggs were considerably more abundant than Type B and accounted for approximately 50% of total fish egg abundance in the neuston. In the bongo samples, 23% of all fish eggs caught were Citharichthys

Type A and only 1.4% were Type B eggs (Table 11). The exceedingly high numbers of <u>Citharichthys</u> eggs in the neuston implies that these eggs may be positively buoyant and thus accumulate in the surface layer. Very few <u>Citharichthys</u> larvae were caught in the neuston (Table 5) and levels of larval abundance in the bongo samples were low overall (Tables 7 and 12). It seems that on hatching, <u>Citharichthys</u> larvae migrate out of the surface layers.

Type A and B <u>Citharichthys</u> eggs were present in neuston and bongo samples during all cruises and displayed similar patterns of seasonal and interannual variation in abundance (Tables 13a and 15a). In general, numbers were highest during late spring, summer, autumn and late winter months and lowest during early spring. A high degree of interannual variation in abundance was apparent among the spring sampling periods. For instance, mean levels of abundance of <u>Citharichthys</u> eggs were much higher during spring 1980 to 1983 than in spring 1984 and 1985 (Tables 13a and 15a). In particular, egg abundance in the neuston was exceptionally high for <u>Citharichthys</u> Type A during spring 1983 (cruise EQ83) when levels were approximately four times higher than the other high spring values (Table 13a). Perhaps the magnitude of spawning was unusually high during spring 1983. The low numbers of eggs recorded during March/April 1984 and April/May 1985 suggest that spawning may be less intense in early spring than later in that season.

<u>Citharichthys</u> Type A and B eggs were very abundant, mainly in the neuston, during August 1980, October/November 1981 and January 1987 (Table 13a) which suggests that spawning intensity continues at a high level from late summer through to winter. The low numbers of eggs caught in neuston and bongo samples during November 1983 (Tables 13a and 15a), therefore, seem unusual and may represent reduced spawning activity in late autumn of that year. The 1983 spring and autumn data suggest that the peak in spawning activity occurred earlier than usual that year. As for several

other species, this may have been as a result of the unusually warm conditions which prevailed as a result of the El Niño event of 1983.

If it is taken that 1983 was an unusual year, with an increased intensity of spawning during spring and diminished spawning in autumn, and this year's data is ignored, a more distinct seasonal trend in the spawning pattern of Citharichthys is apparent. Firstly, spawning appears to take place throughout the year. From April onwards, spawning intensity seems to increase from a relatively low level in early spring to a high level in late summer and reaches a peak in late autumn which may be maintained through to late winter (January). Poor sampling coverage during summer and autumn months, however, precludes an accurate description of the annual pattern in spawning. Nevertheless, the data presented here suggest that a peak spawning period of August to January is plausible for the Citharichthys species in this region.

Larval occurrences of Citharichthys species were also extended throughout all seasons but highest numbers were taken during late autumn months (Table 16a) concurring with the annual pattern of spawning proposed here. A peak in abundance of newly-hatched larvae (<5 mm length - identified as Citharichthys spp.) was documented for October/November 1981 (Table 39, Fig. 46). Most of the larvae identified as Citharichthys sordidus and C. stigmaeus were between 5 and 20 mm in length (Figs. 47 and 48). Mean lengths of the specimens identified from the spring cruises were greater, ranging from 23 to 39 mm (Tables 40 and 41).

Average distribution patterns for Citharichthys Type A eggs in the neuston and water column are given in Figures 97a and 98a, and for Type B in Figures 99a and 100a. Both types of eggs were abundant in the coastal zone and levels of abundance were, in general, higher off Washington and northern Oregon than off southern Oregon and northern California. Occurrences and bundance were very low in the deep water zone beyond the shelf edge. These general patterns of distribution indicate that the *Citharichthys* species spawn in coastal and shelf waters and that the eggs are retained largely within this zone.

Some seasonal and interannual variation in distribution patterns of *Citharichthys* eggs was apparent. During March/April and April/May cruises, Type A and B eggs occurred primarily from Cape Blanco to north Washington and highest densities were recorded along the mid to north Oregon coast (Figs. 97b, h, and i, and 98b and f). An exception was April/May of 1983 when Type A eggs were abundant along the entire coastline of the sampling area and some very high densities were recorded in the neuston between Cape Mendocino and Cape Blanco, as well as off the mid Oregon coast (Figs. 97f and 98g). It seems likely that spawning was more extensive in spring of 1983 than for the other years.

In May/June of 1981 and 1982, levels of abundance of *Citharichthys* Type A eggs were again highest off the central Oregon coast (Figs. 97d, 98d and f) but occurrences extended along the entire coast in 1981, particularly in the neuston (Fig. 97d), implying that spawning progresses southwards in early summer. *Citharichthys* Type B eggs were only sparsely recorded during the May/June cruises (Tables 13a and 15a). In late summer, cruise P080, both Type A and B eggs again occurred along the entire coast from Washington to northern California and levels of abundance were high in the southern portion of the sampling area as well as north of Cape Blanco (Figs. 97c, 98c, 99c, and 100b).

During late autumn and winter, it seems that *Citharichthys* spawning again occurred predominantly north of Cape Blanco in coastal waters off Washington and northern Oregon. Occurrences of Type A and B eggs in the neuston and water column were largely confined to this area during October/November 1981 (Figs. 97e, 98e, 99d, and 100c) and January 1987 (Figs. 97j, 98i, 99h, and 100f). In November/December 1983, when levels of abundance of *Citharichthys* eggs seemed unusually low for this time of year, the eggs were more widely distributed along the coast with records off southern Oregon and northern California as well as further north (Figs. 97g and 98h). This was similar to the pattern observed in spring of this year, which was also considered to be an anomalous period in terms of *Citharichthys* spawning.

The above egg distributional patterns suggest that spawning of *Citharichthys* species occurs throughout the year along the Washington and northern Oregon coasts but that south of Cape Blanco spawning is more seasonal. It seems that off southern Oregon and northern California, spawning takes place to a significant extent only during the summer. In spring of 1983, however, there was evidence for considerable spawning activity in this southern region but, as mentioned previously, such a pattern is considered to be anomalous. During all seasons, it appears that spawning activity is most intense off the northern Oregon coast. Highest densities of eggs were consistently recorded in this area.

The general distribution pattern for *Citharichthys* larvae reflected that of the eggs in that highest densities were associated with the coastal region off Oregon, between the Columbia River mouth and Cape Blanco (Fig. 101a). Occurrences of larvae, however, were more widespread with many records in the deep water zone, particularly for the large specimens identified to species (Figs. 102 a-c, and 103 a-c). It seems that offshore transport of larvae is extensive. Given the low numbers of larvae collected in comparison with the extremely high numbers of eggs, it is possible that the sampling regime employed here may not give a representative picture of the larval populations. Perhaps the majority of the larvae migrate out of the water column at an early stage and by remaining close to the bottom avoid capture by the bongo sampling gear. Their occurrence close to the bottom could also favor their retention in suitable nursery grounds in shallow water.

PLEURONECTIDAE

The pleuronectids, commonly known as right-eye flounders, are the dominant flatfish family in the northeast Pacific. Up to 22 species occur in the study area and many are commercially important. All are demersal in habit and are found usually on sandy or muddy bottoms but the depth range varies considerably among species. Three species account for most of the commercial catches of flatfish off the U.S. west coast; Dover sole, *Microstomus pacificus*, English sole, *Pleuronectes vetulus*, and the petrale sole, *Eopsetta jordani*, and these together with arrowtooth flounder, *Atheresthes stomias*, and rex sole, *Errex zachirus*, are the most abundant pleuronectids in this region.

Pleuronectid eggs and larvae are pelagic (except eggs of *Pleuronectes bilineata* are demersal) and are common in ichthyoplankton collections in the northeast Pacific. The most frequently recorded and most abundant species of larvae in Oregon coastal and offshore waters include *E. zachirus*, *Pleuronectes isolepis* (butter sole), *Eopsetta exilis* (slender sole), *M. pacificus*, *P. vetulus*, *Platichthys stellatus* (starry flounder) and *Psettichthys melanostictus* (sand sole) (Richardson, 1973; Richardson and Pearcy, 1977; Pearcy *et al.*, 1977; Laroche and Richardson, 1979; Richardson *et al.*, 1980; Mundy, 1984; Brodeur *et al.*, 1985; Shenker, 1988). Larvae of these species also occur frequently in CalCOFI ichthyoplankton collections, taken from northern California to southern Baja California (Moser *et al.*, 1987; Stevens *et al.*, 1987, 1988, 1990).

Eggs and larvae representing 16 species of pleuronectids were taken in ichthyoplankton samples during the present study (Tables 4-7). Overall, pleuronectid eggs were very abundant in neuston

(Table 4) and bongo samples (Table 6) and larvae were scarce in the neuston (Table 5) and common in bongo catches (Table 7). The dominant species were E. zachirus, E. exilis, M. pacificus, and P. vetulus. Pleuronectes isolepis, Platichthys stellatus, Psettichthys melanostictus and Pleuronichthys decurrens (curlfin turbot) were also occasionally abundant but the remaining species occurred in less than 1% of all neuston and bongo samples collected (Tables 4-7). Identification to species was not achieved for all eggs and approximately 50% of specimens were identified to family level only. Eggs of the species E. zachirus, E. exilis, and M. pacificus are distinguishable by their large size (diameter around 2 mm) and can always be identified with certainty (Matarese and Blood, pers. comm.). Pleuronectid eggs which are approximately 1 mm in diameter, however, cannot be identified to species prior to the development of the embryo. Included in this category are P. vetulus, P. isolepis, and species of the genera Platichthys and Psettichthys. The unidentified pleuronectid eggs in this study, therefore, may include the latter species primarily.

Total pleuronectid eggs accounted for approximately 20% of all fish eggs caught in neuston samples during the ten sampling periods (Table 9). The unidentified category comprised 10.5%, M. pacificus 5.8% and E. zachirus 1.8% of total egg abundance whereas P. vetulus, E. exilis,and P. melanostictus each accounted for less than 1%. For the bongo samples, pleuronectid eggs also constituted approximately 20% of all fish eggs caught (Table 11). Unidentified pleuronectids and E. exilis each comprised just under 8%, E. zachirus 2%, M. pacificus 1.6% and P. vetulus 0.5% of total egg abundance. In contrast, pleuronectid larvae were much less abundant in the plankton and accounted for less than 4% of total fish larvae in the bongo samples (Table 12). In order of abundance, E. exilis, P. vetulus, E. zachirus and P. isolepis were dominant. Pleuronectids did not contribute significantly to larval abundance in the neuston (Table 11).

As for the Citharichthys species (family Paralichthyidae), the pattern of occurrence and abundance of pleuronectids in the ichthyoplankton samples from the different sampling gears suggests that a high proportion of the eggs accumulate in the surface layer but that on hatching, the larvae migrate out of the neuston. Similarly, the poor representation of larvae in the ichthyoplankton relative to egg abundance implies that the sampling strategy employed during this study may miss a large proportion of the pleuronectid larval populations.

Pleuronectid eggs and larvae occurred in plankton samples taken during all seasons and all cruises (Tables 13a, 15a and 16a). Among individual species, however, occurrences and abundance displayed strong seasonal patterns. Highest levels of abundance were consistently recorded during winter and spring months indicating that this is the peak spawning period for most species. The winter peak in abundance for unidentified pleuronectid eggs, documented during January 1987, was outstanding both in the neuston (Table 13a) and water column (Table 15a) suggesting the occurrence of a major spawning event in late winter. Egg abundance during spring, summer and autumn was moderately high. Among the six spring sampling periods, however, interannual variation in abundance was considerable and the pattern was different between the neuston and the water column. In the summer, also, pleuronectid abundance was high in the neuston but low in the bongo samples. In this instance, the species Psettichthys melanostictus may account for most of these eggs as it was the only one to occur in significant numbers during cruise PO80 (Table 13a).

Average distribution patterns for total pleuronectid eggs, comprising dominant species together with unidentified specimens, display a trend of decreasing abundance from coastal to deep water with highest concentrations in the coastal zone, particularly off Washington and Oregon (Figs. 104a and 105a). Levels of abundance may also be high along the shelf edge and slope area but in deeper waters occurrences tend to be sparse. The along-shore pattern in egg distributions varied among cruises and a seasonal trend is apparent to a certain extent.

During late autumn and winter cruises (DA81, MF83, and MF87), which may coincide with the commencement and peak of the spawning period for some pleuronectid species, eggs were distributed mainly along the coast from southern Washington to Cape Blanco with peaks in abundance occurring consistently off northern Oregon (Figs. 104d, e and h, and 105d, e and f). In contrast, during spring cruises, pleuronectid eggs were usually taken along the coast from northern Washington to northern California with highest levels of abundance occurring mainly off the Washington or northern Oregon coast (Figs. 104b, f and g, and 105b, c, f and g). Sampling during the only summer cruise in August 1980 yielded high concentrations of pleuronectid eggs at one station only, in the neuston, off the northern California coast (Fig. 104c). As mentioned above, it seems likely that the species _P. melanostictus_ accounted for most of the eggs caught on this occasion and therefore its spawning may be very localised, at least during the summer.

The distinction between distributional patterns of unidentified pleuronectid eggs observed during autumn, winter, and spring sampling periods may reflect a difference in species occurrence. Eggs of _Pleuronectes vetulus_, the English sole, were taken primarily during late autumn and winter months whereas eggs of the other dominant pleuronectid species occurred almost exclusively during spring months (Tables 13a and 15a).

Errex zachirus

Rex sole occur from Baja California to the Bering Sea, usually in deep water, down to 850 m (Hart, 1973; Matarese, _et al._, 1989). They are caught commercially but never in large quantities. Spawning fish are found from January to June off Oregon where the peak period of spawning is in March to April (Hosie and Horton, 1977). Rex sole do not appear to have specific spawning sites but the depth location is usually from 100 to 300 m (Pearcy et al., 1977). It appears that off Oregon, rex sole settle to the bottom mainly on the outer continental shelf during the winter when they are approximately one year old (Pearcy et al., 1977).

Rex sole larvae have been taken frequently in ichthyoplankton samples collected off Oregon, particularly during spring months, but levels of abundance are generally low (Richardson, 1973; Richardson and Pearcy, 1977; Pearcy et al., 1977; Richardson et al., 1980; Mundy, 1984; Brodeur et al., 1985; Shenker, 1988). Pearcy et al. (1977) have remarked that the numbers of rex sole larvae occurring in plankton samples does not reflect their abundance as adults in this area and propose that their scarcity may be partially due to their reproductive strategy of producing relatively low numbers of large eggs.

Errex zachirus eggs were moderately abundant in plankton samples collected during the present study. They occurred in 9% of the neuston samples and in 15% of the bongo samples (Tables 4 and 6). In both the neuston and the water column, they accounted for approximately 2% of total fish egg abundance (Tables 9 and 11). In comparison, larvae were scarce in the plankton collections. They were rare in the neuston (Table 5) and occurred in only 6% of the bongo samples (Table 7) where they accounted for approximately 0.5% of total larval fish abundance (Table 12). Their scarcity in the neuston suggests that on hatching the larvae migrate vertically into the water column.

Most rex sole eggs were taken during spring sampling periods when levels of abundance were at a peak (Tables 13a and 15a). They were also present during the summer cruise (PO80) and in January 1987 but numbers were very low. It seems that spawning commences in late winter and continues through to summer with the peak period being probably from March to May. Larvae were also taken primarily during spring (Table 16a). Most larvae caught were less than 20 mm in length (Fig. 49). The few specimens which occurred in samples collected during summer and autumn were mainly very large postlarvae (Table 42). It is likely that most of the well developed postlarvae successfully avoid the sampling gear. Mean larval lengths recorded during spring ranged from 7.9 mm in early spring to 17.3 mm in late spring.

Interannual variation in egg abundance was apparent to a significant extent over the spring sampling periods. In the neuston, where most eggs were caught, levels of abundance were considerably higher during cruises PO84 and TK80 than during the other spring cruises (Table 13a). Given that spring sampling was carried out earlier in 1984 (March/April) than for the other years (April/May, May/June), it seems likely that the peak in abundance of rex sole eggs recorded on this occasion reflected the peak in spawning activity which may occur in early spring. Similarly high levels for April/May 1980, however, may also reflect a peak in spawning activity for that year. It is possible, therefore, that the timing of peak spawning may differ slightly from one year to the next. Although larval abundance was generally low, numbers caught during April/May 1983 were much higher than for the other years (Tables 16a, 32a). Whether or not this actually represents an enhancement in larval survival, or an expansion in the range of occurrence of the larvae, for that year, is difficult to say as overall levels of larval abundance were so low.

The average distribution patterns for rex sole eggs show that occurrences were restricted almost entirely to the shelf and slope with few records in deep water (Figs. 106a and 107a). This pattern concurs well with Pearcy et al.'s (1977) observation that E. zachirus spawns primarily in water of 100-300 m depth. Larvae, although sparsely recorded, were taken more frequently in deep water than for eggs but still occurred predominantly in the shelf and slope zone (Fig. 108).

The observed variation in egg distributional patterns among individual cruises suggests that a southerly progression in spawning of E. zachirus may take place as the spawning season advances. During the early spring cruise, March/April 1984, when levels of abundance were at a peak, rex sole eggs occurred almost exclusively north of Cape Blanco, along the Washington and northern Oregon coast (Figs. 106e and 107f). In contrast, sampling during late spring cruises (May of 1981 and 1982) showed eggs to be distributed mainly off southern Oregon and northern California with few or no occurrences off the Washington coast (Figs. 106c, 107c and d). During the three April/May cruises, the along-shore pattern in distribution varied. In 1983 and 1985, shelf waters off Washington and Oregon, north of Cape Blanco, were the main areas of occurrence of rex sole eggs (Figs. 106d and f, and 107e) whereas during April/May 1980, eggs occurred predominantly off southern Oregon and northern California with peak densities in the vicinity of Cape Mendocino (Figs. 106b and 107b). It appears, therefore, that most spawning of E. zachirus takes place in shelf and slope waters from Cape Blanco northwards. Towards late spring, however, when spawning activity is decreasing, egg distributions indicate that spawning occurs mainly off southern Oregon and northern California.

Eopsetta exilis

The slender sole occurs from Baja California to the Gulf of Alaska in shallow to moderate depths with a maximum range of 25 to 800 m (Hart 1973; Matarese et al., 1989). It is not important commercially because of its small size. Spawning is known to occur in Puget Sound during April (Smith, 1936) and ripe females have been found in the strait of Georgia during late February (Hart, 1973). Larval E. exilis are well represented in ichthyoplankton collections taken off Oregon during spring months (Richardson, 1973; Richardson and Pearcy, 1977; Richardson et al., 1980) and off California they are most abundant in the plankton during April and May (Ahlstrom and Moser, 1975). The slender sole is known to inhabit mainly the outer shelf region (148-195 m depth) off Oregon and to spawn primarily in this zone (Pearcy, 1978; Richardson and Pearcy, 1977; Richardson et al., 1980). Slender sole larvae do not have as long a pelagic life as E. zachirus and metamorphosis is known to occur at the smaller size range of 15.7 to 24.7 mm (Matarese et al., 1989).

Eggs of E. exilis were relatively abundant in plankton samples collected during the present study. In the neuston, they occurred in approximately 6% of the samples taken and accounted for less than 1% of total fish egg abundance (Tables 4 and 9). Overall, they were more abundant in the bongo samples where they occurred in 22% of the samples taken (Table 6) and accounted for almost 8% of total egg abundance (Table 11). Slender sole larvae were absent from the neuston (Table 5) but occurred in 15% of the bongo samples (Table 7). Levels of abundance were relatively low, however, and 1.7% of total larval abundance was accounted for by E. exilis (Table 12). Given the relative abundance of eggs and larvae in the neuston and bongo samples, it seems that a significant proportion of the slender sole eggs float to the surface and then on hatching the larvae return to the water column.

Eopsetta exilis eggs and larvae were abundant in the plankton during spring months only (Tables 13a, 15a and 16a). In addition, low numbers of eggs were taken in January 1987 and August 1980 and larvae were also scarce during the summer cruise. Levels of egg abundance in the bongo samples, where most eggs were caught, were at a peak during cruises TK80, EQ83 and PO82 which extended over the months April and May (Table 15a). Levels were lower but still relatively high during the earliest spring cruises PO84 and BA85 (March to early May) and in late spring of 1981 (May to June). Larval abundance was highest during mid to late spring cruises, from April to June, whereas during early spring and summer cruises, larvae were scarce (Table 16a). From early to late spring, cruises PO84 to PO81, mean larval length increased steadily from 5.8 to 9.3 mm and in August was 15.1 mm (Table 43). Most larvae caught were less than 10 mm in length (Fig. 50).

The above patterns indicate that E. exilis spawns primarily during the months April and May and that larvae are settled out of the plankton by late autumn. Spawning may commence as early as February, however, and continue through to late summer. Levels of egg and larval abundance did not seem to vary significantly on an interannual scale. The difference in levels of abundance among the spring cruises appears to be related to differences in timing of sampling rather than any interannual variation in spawning activity.

The average distribution patterns for E. exilis eggs in the neuston (Fig. 109a) and water column (Fig. 110a) show that the eggs occur largely in shelf and slope waters implying that spawning is confined essentially to this zone. In the water column, where most eggs were caught, highest densities of eggs occurred on average in shelf waters off southern Washington and northern Oregon (Fig. 110a). On the three occasions when eggs were abundant in the neuston, their distribution along the coast varied. In April/May 1980, eggs in the neuston were concentrated mainly along the southern Oregon and northern California coast from Cape Blanco to just south of Cape Mendocino (Fig. 109b). In contrast, eggs were scarce in the neuston from northern Washington to California during March/April 1984, with only one station off central Oregon yielding high densities (Fig. 109c). Eggs were also distributed in the neuston along the entire coastline during April/May 1985, but with relatively high densities confined to shelf waters off Washington and northern Oregon (Fig. 109d). There was less variation among cruises in the patterns of egg distribution in the water column. The consistent pattern was that occurrences extended fairly evenly along the coast from northern Washington to northern California and highest densities were recorded off southern Washington and northern Oregon (Figs. 110 b-g). There were very few occurrences of eggs beyond the shelf and slope region and in general, stations which yielded highest numbers of eggs were in the outer shelf or shelf edge zone.

Apart from the varying patterns of occurrence of eggs in the neuston, seasonal and interannual variation in the distribution of E. exilis eggs was not apparent. The inconsistency in neustonic distributional patterns may be due to the fact that only a portion of the eggs spawned float to the surface, perhaps in an erratic fashion. Otherwise, the patterns of distribution and abundance of slender sole eggs in the water column suggest that this species spawns consistently in shelf and slope waters, mainly close to the shelf edge and predominantly during April and May. Furthermore, spawning intensity seems to be greatest off southern Washington and northern California than at the northern and southern extremities of the sampling area.

Deep water occurrences of E. exilis larvae were more frequent than for the eggs but most larvae were still caught at shelf and slope stations along the Washington, Oregon and northern California coasts (Figs. 111 a-e). The distribution of slender sole larvae extended significantly further offshore during April/May 1983 (Fig. 111e) than on other occasions. Offshore drift of larvae may have been more prominent during spring of this year. In general, however, larvae seem to be retained along the shelf and slope.

Microstomus pacificus

The Dover sole is one of the most important species in the groundfish fishery off the U.S. west coast. It occurs from Baja California to the Bering Sea, from shallow coastal waters to maximum depths of approximately 1000 m (Hart, 1973; Matarese et al., 1989). From previous studies, spawning is known to take place during January and February in Puget Sound, Washington (Smith, 1936), during November through March off Oregon (Harry, 1959; Hagerman, 1952) and from November through April off California (Hagerman, 1952). An offshore spawning migration to deeper water, 330-550 m, is usual in winter (Garrison and Miller, 1982). The pelagic eggs are the largest for all the flatfish species with a diameter of 2.05-2.68 mm (Matarese et al., 1989). Larvae hatch at approximately 6 mm standard length and, like rex sole larvae, remain pelagic for at least a year, generally until they have attained a length of greater than 45 mm (Matarese et al., 1989).

Although adults are very abundant, the incidence of capture of Dover sole larvae in plankton samples collected off the U.S. west coast is poor and Pearcy et al. (1977) attribute this to the reproductive strategy of producing relatively low numbers of large eggs, as for rex sole. It is also possible that the degree of avoidance of sampling gear is significantly higher for these species than for others because of the well-developed nature of the larvae on hatching. Dover sole larvae have been recorded in the plankton off Oregon during all months of the year but peak numbers of early stage larvae usually occur from March to July (Ahlstrom and Moser, 1975; Pearcy et al., 1977). Highest densities of larvae are recorded most frequently at offshore stations, greater than 50 km from shore and they are common in oceanic waters beyond the slope (Richardson and Pearcy, 1977; Pearcy et al., 1977; Richardson et al., 1980). Pearcy et al. (1977) found them to be most abundant in the upper 50 m of the water column.

Microstomus pacificus eggs were most abundant in the neuston during the present study. With a mean abundance of 42 eggs/1000 m^3, they accounted for 5.8% of total fish eggs caught in the neuston samples (Tables 4 and 9). They were common but less abundant in the bongo samples (Table 6) where they comprised 1.6% of total fish egg abundance (Table 11). Larvae were rare in the neuston (Table 5) and occurred in very low numbers in just over 3% of the bongo samples (Table 7). Given the abundance of eggs, the scarcity of Dover sole larvae in these plankton collections seems unusual. A possible explanation would be that the sampling regime employed in this case was unsuitable for obtaining catches of larvae which would be representative of their actual levels of occurrence and abundance in the plankton. Pearcy et al. (1977) caught low numbers of early stage Dover sole larvae (mainly 4-15 mm length) in waters off Oregon using Bongo samplers. In contrast, sampling with a mid-water trawl in the same area yielded relatively high numbers of larvae ranging in size from 8 to 65 mm. It would appear, therefore, that avoidence of the bongo nets is considerable for Dover sole larvae, particularly for the larger ones. The abundance of Dover sole eggs in the neuston relative to the water column suggests that a high proportion of the eggs float to the surface.

Seasonal variation in egg occurrence and abundance indicates that the spawning period for Dover sole in Washington, Oregon and northern California waters is essentially during the spring months March to early June (Tables 13a and 15a). Levels of egg abundance were high during all spring cruises. Apart from these records, a few Dover sole eggs were taken during August 1980 and January 1987 suggesting that spawning may commence at very low levels in late winter and continue through to late summer but probably with a dramatic reduction in activity from June onwards. In the neuston, where most eggs occurred, maximum levels of abundance were recorded during cruises PO84 (March/April) and TK80 (April/May), and minimum levels in the late spring cruise PO81 (May/June) (Table 13a). The peak spawning period, therefore, seems to occur during March and April. Egg densities were high but considerably lower in April/May 1983 and 1985 than in spring of 1984 and 1980 which may reflect some interannual variation in timing or extent of spawning over these years.

The few larvae taken in bongo samples occurred mainly during spring cruises covering the months March to early June (Table 16a) and mean larval lengths ranged from 6.1 to 11.2 mm on these occasions (Table 44). The two specimens caught during August 1980 and January 1987 were well-developed postlarvae, 22.5 and 16 mm in length (Table 44). Most of the spring caught larvae were less than 13 mm long (Fig. 51). Given the length distribution data presented here, it seems that the well-developed larvae which remain pelagic for approximately a year are not caught by the bongo and neuston gear used during this study.

The average distribution patterns for Dover sole eggs in the neuston (Fig. 112a) and water column (Fig. 113a) show that occurrences are largely confined to shelf and slope waters off Washington, Oregon and northern California. On the whole, densities were highest beyond the shelf edge, over the slope, implying that this is where most spawning occurs. This concurs with observations of previous workers with regards spawning locations of Dover sole off the U.S. west coast (Pearcy et al., 1977). Hagerman (1952) suggests that Dover sole spawn in specific sites in offshore water deeper than 400 m.

During individual cruises, Dover sole eggs were consistently taken along the entire coast from northern Washington to the Cape Mendocino area off northern California, in both the neuston (Figs. 112b-f) and the water column (Figs. 113b-f). In most instances, highest levels of abundance occurred at stations close to the shelf edge off the northern most part of Washington and in the vicinity of Cape Blanco, southern Oregon. Highest densities were also recorded in the vicinity of the Columbia River estuary during April/May 1983 (Fig. 112d), and in particular March/April 1984 (Fig. 112e,) and to the north west of Cape Mendocino during April/May 1985 (Fig. 112f). The data presented here do not reveal any significant degree of seasonal or interannual variation in patterns of distribution of Dover sole eggs and it seems that the predominant spawning location is in slope waters, just beyond the shelf edge, particularly off northern Washington and Cape Blanco, Oregon.

Pleuronectes vetulus

English sole forms a major component of catches in the groundfish fishery of the northeast Pacific. The range of this species is from Baja California to the Bering Sea and it is most abundant in shallow coastal waters less than 128 m depth (Hart 1973; Krygier and Pearcy, 1986). It is also known to occur, however, down to depths of 550 m (Matarese et al., 1989). Along the U.S. west coast, the spawning season of English sole is protracted and variable but there is no north-south trend (Garrison and Miller, 1982; Krygier and Pearcy, 1986). This interannual variability has been linked to variation in upwelling intensity and bottom temperatures (Kruse and Tyler, 1983).

Eggs and larvae of English sole are pelagic. The eggs are small (0.8 to 1.05 mm diameter) and larvae hatch out at lengths of 2.3 to 2.8 mm (Matarese et al., 1989). Unlike Dover sole and rex sole, they have a relatively short pelagic phase, with an extreme range of 6 to 22 weeks, and transformation and settlement to a benthic existence is most common at lengths of 20 to 22 mm (Garrison and Miller, 1982; Krygier and Pearcy, 1986). Transforming larvae and early juveniles of English sole are common in estuaries and bays and in the intertidal zone whereas early larval stages are abundant in coastal waters and rarely occur in the inshore zone (Pearcy and Myers, 1974; Krygier and Pearcy, 1986). Larval transport, therefore, is predominantly in an onshore direction. English sole larvae are frequently abundant during late winter and early spring in Oregon coastal waters (Richardson and Pearcy, 1977; Laroche and Richardson, 1979; Richardson et al., 1980; Mundy, 1984; Shenker, 1988). Interannual variation in abundance, however, has been found to be considerable and may be related to interannual variation in ocean conditions (Laroche and Richardson, 1979; Mundy, 1984). Pleuronectes vetulus larvae are also common but less abundant in CalCOFI ichthyoplankton collections (Ahlstrom and Moser, 1975; Loeb et al., 1983).

During the present study, English sole eggs were moderately abundant in neuston and bongo samples and larvae were scarce in the neuston and common in the bongo samples (Tables 4-7). The occurrence of eggs and larvae was restricted to a small proportion of samples collected - usually less than 5%. Levels of egg abundance attributed to P. vetulus here are considered to be an underestimate of actual levels as it is likely that a considerable proportion of the unidentified pleuronectid eggs belong to this species (Tables 9 and 11). English sole larvae, however, accounted for just over 1% of total larval abundance in the bongo samples (Table 12). As for the other dominant flatfish species, the occurrence of a high proportion of English sole eggs in the neuston suggests that many of these pelagic eggs float to the surface.

The patterns of seasonal variation in egg and larval abundance indicate that, at least for the years of sampling, the spawning period for English sole extended from October to May with a late winter peak apparent in January (Tables 13a, 15a, and 16a). The outstanding peak in egg abundance for unidentified pleuronectids in the neuston and water column, which occurred in January 1987, is considered to include a high proportion of P. vetulus eggs (Tables 13a and 15a). For those eggs identified as P. vetulus, numbers were highest in October/November 1981 and January 1987, and moderately high in November/December 1983 and March/April 1984. Later in spring, during the April/May and May/June cruises, P. vetulus eggs were either scarce or absent. English sole larvae were abundant during January 1987 and March/April 1984 and low numbers were taken during the months April to June and October to December of other years (Table 16a). Most larvae caught were less than 10 mm in length (Fig. 52). Mean larval length was at a minimum of 3.7 mm during January 1987, was 7.6 mm in early spring and ranged from 12 to 18.5 mm during mid to late spring (Table 45). These patterns of seasonal variation in egg and larval abundance and larval size indicate that the main spawning period for English sole in the sampling area is late winter to early spring, probably January to March.

Given that sampling was limited to two cruises (PO84, MF87) during the period of peak abundance in eggs and larvae, it is difficult to detect any interannual variation in English sole abundance from the present data set.

The average distribution patterns for eggs in the neuston and water column indicate that English sole spawn almost exclusively in the coastal and shelf zone, primarily along the Washington and Oregon coast (Figs. 114a and 115). The distribution of unidentified pleuronectid eggs, which may include a significant proportion of English sole eggs, displayed a similar pattern (Figs. 104a and 105a). During cruises when abundance was at a peak, the eggs occurred predominantly at the innermost stations along the Washington and Oregon coast from Cape Blanco northwards, with highest densities off the mid Oregon coast (Figs. 114b and c). The distribution of unidentified pleuronectid eggs during January 1987, many of which were likely to be P. vetulus, was very similar (Figs. 104h and 105h). It seems, therefore, that English sole spawn primarily in shallow coastal waters off Washington and Oregon with the area between 44°N and 45°N off mid Oregon being a particularly favourable spawning location.

The distribution of English sole larvae was also largely confined to coastal and shelf waters off Washington and Oregon but occurrences extended into deep water beyond the slope off north west Washington (Figs. 116b and c). Levels of abundance were also highest off the mid to northern Oregon coast (Figs. 111a and b), as for the eggs. It is likely that the larvae taken in plankton samples during this study represent a significant, but perhaps low, proportion of the English sole larval populations which occur along the coast during winter and spring. Given that newly transformed larvae and early juveniles are abundant in bays and estuaries along the U.S. west coast (Pearcy and Myers, 1974; Laroche and Richardson, 1979; Krygier and Pearcy, 1986), it is probable that most spawning occurs in shallow coastal waters and that sampling within 3 miles (4.8 km) from shore would yield higher densities of larvae than those recorded here. During previous studies, highest densities of larvae have been taken within 18 km of the coast with peaks in abundance recorded frequently at stations 2 to 6 km offshore (Richardson and Pearcy, 1977; Laroche and Richardson, 1979; Mundy, 1984).

5(d). Multispecies spatial patterns in the ichthyoplankton and relationships with the environment.

For each of five data sets, spatial patterns in the ichthyoplankton were examined using numerical classification. Data from the six spring cruises (TK80, PO81, PO82, EQ83, PO84 and BA85) were combined into one data set by calculating the mean abundance of the dominant taxa in each square of the grid shown in Appendix Figure 1. A summer data set is represented by cruise PO80 which took place in August 1980. Data from cruises PO81, in October/November 1981, and MF83, in November/December 1983, make up the two autumn data sets. A winter data set is comprised of data from the January 1987 cruise, MF87. Each of these five seasonal data sets were sub-divided into four sub-sets representing eggs and larvae in the neuston and water column. The numerical classification was performed on this total of 20 sub-sets.

Results from the numerical classification are presented in the form of dendrograms showing relationships between individual and groups of species and stations, 2-way coincidence tables relating species groups to station groups in terms of mean abundance of constituent species among station groups, and plots of the station groups on maps of the sampling area.

Spring Data

Three species groups and five stations groups were identified for the dominant egg taxa in the neuston (Fig. 117). The five station groups are geographically distinct and reflect a strong inshore-offshore gradient in species composition and abundance. Station groups 1, 2 and 3 occur in the oceanic zone, with 1 and 2 in the southern sector, and 3 to the north (Fig. 118). Each of these groups is characterized by the mesopelagic species (group 3) including *Icichthys lockingtoni*, *Trachipterus altivelis*, *Icosteus aenigmaticus*, and *Chauliodus macouni* (Table 46, Appendix Table 1).

The difference between these station groups is one of abundance. With the exception of C. macouni, egg densities were highest in station group 3 to the north. Station group 4 along the slope and adjacent deep water contained highest densities of Microstomus pacificus and Sebastolobus spp. eggs, in addition to moderate numbers of other flatfish species (species group 1) and some of the mesopelagic species. The remaining taxa belonging to species groups 1 and 2, mostly paralichthyids and pleuronectids, were most abundant in station group 5 along the coastal zone from northern Washington to Cape Mendocino off northern California. In particular, Citharichthys A and Engraulis mordax eggs were exceptionally abundant in this zone.

For larvae in the neuston, similar patterns in station group distributions are apparent but the coastal and slope station groups (1, 2, and 3) extend further into deep water and there is a north-south division along the shelf (Fig. 120). Species group 1, consisting of the coastal species Ophiodon elongatus, Ronquilus jordani, Ammodytes hexapterus, Hemilepidotus hemilepidotus, and Cryptacanthodes aleutensis, is associated almost exclusively with station groups 2 and 3 along the shelf and slope (Table 47, Appendix Table 2). All, except for O. elongatus were most abundant in the northerly station group 2. Osmerid and Engraulis mordax larvae (species group 3), together with O. elongatus, were most abundant in, and characterized, station group 3 along the southern Oregon and northern California coast. Species group 4 includes the most abundant larval taxa which occurred in all station groups. Peak densities for these species, however, varied among the station groups. Cololabis saira is unique in that its larvae were most abundant in the southern oceanic station group 5. It was also abundant in station group 1 along the continental slope and adjacent deep water. In contrast, the remaining group 4 species were most abundant in the northern section of the sampling area. Peak densities of Sebastes spp. larvae occurred in station groups 2 and 1, and Anoplopoma fimbria larvae were most abundant in groups

2 and 4. Abundance of Hexagrammos decagrammus, and the cottids Scorpaenichthys marmoratus and Hemilepidotus spinosus, was at a peak in station group 2 off the Washington and northern Oregon coast, and in adjacent deep water.

The distinction between the four station groups and three species groups (Fig. 121) is very pronounced for fish eggs occurring in the water column samples during spring (Table 48, Appendix Table 3, Fig. 122). As in the neuston, two station groups (4 and 2), which are associated with the entire coastal and slope regions, respectively, are characterized by the occurrence of various flatfish species and Engraulis mordax. Station group 4 along the coast contained highest numbers of all pleuronectid taxa (except for Microstomus pacificus), the paralichthyids, and Engraulis mordax. The mesopelagic taxa (species group 1) were either absent or rare in this zone. Station group 2 along the slope and adjacent deep water is characterized by peak densities of Microstomus pacificus eggs and low to moderate densities of most of the mesopelagic taxa. The pleuronectids Errex zachirus and Eopsetta exilis were also relatively abundant here. Station group 1 and 3 in the oceanic zone contained the mesopelagic taxa almost exclusively. Peak densities of myctophids, Trachipterus altivelis and Chauliodus macouni eggs occurred in station group 1 to the south of this zone, whereas Icosteus aenigmaticus was most abundant in station group 3 to the north. The bathylagids and Icichthys lockingtoni were relatively evenly distributed among these two station groups.

Four station groups and three species groups were identified for larvae in the water column (Fig. 123). The station groups are geographically distinct and reflect onshore-offshore and north-south gradients in species occurrence and abundance (Table 49, Appendix Table 4, Fig. 124). Mesopelagic taxa are dominant among the larvae in this category and constitute species groups 1 and 2 that are associated essentially with the oceanic station groups 1 and 2. The most abundant taxa belong to species group 2 and include the myctophids Stenobrachius leucopsarus, Diaphus theta, and Tarletonbeania crenularis, as well as the bathylagid Bathylagus ochotensis, and the rockfish Sebastes spp. Except for the rockfish, all these species were most abundant in station group 1 in the southern half of the oceanic zone. Most of the mesopelagic species belonging to species group 1 were also recorded in highest densities here. Exceptions are Bathylagus pacificus and Protomyctophum thompsoni which were slightly more abundant in station group 2 to the north. The coastal station group 4 was most prominent over the shelf off Washington and northern Oregon and is characterized by the occurrence of pleuronectids, paralichthyids, osmerids, and Engraulis mordax. The latter two taxa, along with Pleuronectes vetulus, were most abundant here. Peak densities of Sebastes spp., Errex zachirus and Eopsetta exilis larvae characterize station group 3 occurring along the slope and adjacent deep water. Off Washington, this station group extends into the oceanic zone. The transitional nature of these stations is indicated by the occurrence of low numbers of both the mesopelagic and coastal taxa.

The spatial patterns described here suggest the occurrence of coastal, slope/transitional and oceanic assemblages in the ichthyoplankton off the west coast during spring. These distinct assemblages are manifest for eggs in the neuston and water column and larvae in the water column. Eggs occurring in the neuston are essentially those of species that spawn in the water column; they accumulate at the surface due to positive buoyancy (Doyle, in press).

The coastal assemblage includes pleuronectids, paralichthyids, osmerids and Engraulis mordax. It is associated with the continental shelf throughout the sampling area but is most prominent off Washington and northern Oregon. The slope/transitional assemblage occurs along the slope and adjacent deep water. It is characterized by Sebastes spp. larvae and by eggs and larvae of the pleuronectids Errex zachirus, Eopsetta exilis, and Microstomus pacificus, but also includes mesopelagic species that are moderately abundant in this zone. In the deep water region, beyond the continental slope, the oceanic assemblage is comprised almost exclusively of mesopelagic taxa such as myctophids, bathylagids, Chauliodus macouni, Trachipterus altivelis, Icosteus aenigmaticus, and Icichthys lockingtoni. Sebastes spp. larvae are also common in this assemblage. Although most of these taxa occur throughout the oceanic zone, the division of station groups into northern and southern types reflects a north-south trend in abundance. All species were most abundant in the southern sector except for Bathylagus pacificus, Protomyctophum thompsoni and Icosteus aenigmaticus which were most abundant to the north.

A unique assemblage of larvae is also apparent during spring in the neuston. Species composition is very different from the ichthyoplankton assemblages in the water column. Inshore-offshore and north-south gradients in abundance, however, are evident. Larvae of cottids, hexagrammids, Engraulis mordax, Anoplopoma fimbria, Cololabis saira, Ronquilus jordani, Cryptacanthodes aleutensis, Ammodytes hexapterus and Sebastes spp. constitute this assemblage. Its distribution is confined primarily to the shelf and slope region and peak densities of most species seem to occur off Washington and northern Oregon. In the oceanic zone, most of these species were scarce. The sablefish, A. fimbria, and saury, C. saira, however, were abundant in the northern and southern sectors, respectively, of this zone.

Visual comparison of the occurrence and distribution of the above ichthyoplankton assemblages with the oceanography of the sampling area suggests the following relationships. The onshore-offshore variation in assemblages seems to be controlled essentially by bathymetry. Species belonging to the coastal assemblage, and most of the neustonic assemblage, have adult habitats and spawning grounds that are confined to shallow coastal or shelf waters. Similarly, the definitive species of the slope/transitional assemblage (Sebastes spp. and the deep water flatfish) live as adults along the outer continental shelf and slope, and those of the oceanic assemblage live and spawn primarily in deep water.

It is possible that the reduced abundance of species belonging to the coastal and neustonic assemblages off southern Oregon and northern California may be related to the alongshore variation in upwelling. Offshore transport of surface water, and the associated upwelling of cold oceanic water, commences earlier and is more intense off southern Oregon and northern California than along the Washington and northern Oregon coast (Figs. 3, 6-22). Fish eggs and larvae of coastal species occurring in the plankton, particularly the neuston, of this southern region during spring are therefore at risk of extensive drift offshore, away from the adult habitats and nursery grounds. Spawning and the occurrrence and abundance of fish larvae may be reduced in thi southern coastal region of the sampling area because of this risk.

The north-south trend in abundance of fish eggs and larvae among the mesopelagic assemblage of species in the oceanic zone seems to be related to temperature. Temperatures at the surface, and throughout the water column, increase in a southerly direction during spring (Figs. 6-15). The greater abundance of eggs and larvae of the mesopelagic species observed in the southern part of the oceanic zone suggests that spawning is associated with the warmer water in this region. Conversely, peak densities of the species Bathylagus pacificus, Protomyctophum thompsoni, and Icosteus aenigmaticus in deep water off Washington may reflect an association between spawning and cooler water temperatures for these species.

Summer Data: Cruise P080

The six station groups identified for egg distributions in the neuston reflect an inshore-offshore gradient in abundance of mostly coastal taxa (Figs. 125 and 126, Table 50, Appendix Table 5). Station groups 5 and 6, situated along the inner shelf from Washington to northern California are characterized by high densities of Citharichthys eggs. Psettichthys melanostictus eggs occurred exclusively, and were abundant, at group 5 stations. Citharichthys eggs were also abundant in station group 3 along the outer shelf and slope off Washington and Oregon. This station group is also characterized by peak densities of unidentified pleuronectids, Errex zachirus and Cololabis saira. Station groups 1, 2, and 4 were less distinct geographically than 3, 5, and 6, being distributed along parts of the slope and throughout the oceanic region (Fig. 126). Among the mesopelagic taxa, Tactostoma macropus and Chauliodus macouni were most abundant in station groups 1 and 2, and high densities of Icichthys lockingtoni eggs were confined to station group 1, mainly to the south. Engraulis mordax eggs were associated essentially with the slope and deep water zone off Washington and northern Oregon, at group 4 and some of group 2 stations.

Species diversity was low for larvae in the neuston during the summer cruise (Fig. 127a, Table 51, Appendix Table 6). Engraulis mordax and Sebastes spp. accounted for most of the species caught and there were many stations along the shelf and slope at which larvae were absent (Fig. 128). The six station groups identified from the dendrogram (Fig. 127b) showed some measure of geographical distinctness (Fig. 128). Stations belonging to groups 1 and 2 were scattered along the shelf, slope and adjacent deep water. Sebastes spp. were the only larvae caught at group 1 stations whereas group 2 stations contained, in addition, Scorpaenichthys marmoratus, Cololabis saira, Engraulis mordax, and Ronquilus jordani larvae. Station group 3 occurring offshore of the Columbia River estuary contained highest densities of E. mordax larvae, as well as moderate numbers of S. marmoratus, C. saira, and unidentified scorpaenids. Only five stations constituted group 4 which is characterized by highest densities of osmerid and Sebastes spp. larvae. Apart from one occurring off northern Washington, these stations are located along the shelf off northern California. Group 6 stations along the slope off Washington and shelf off Oregon contained only S. marmoratus larvae. Similarly, C. saira larvae were the only ones recorded at group 5 stations in the deepest water of the oceanic zone.

Egg abundance was low in the bongo samples on this occasion, with paralichthyids and pleuronectids accounting for most that were caught (Table 52, Appendix Table 7). These taxa were most abundant at group 4 stations along the shelf (Fig. 130). Group 6 stations are also located in coastal waters and characterized by the presence of paralichthyids and the pleuronectid Errex zachirus. Station group 5, occurring in the vicinity of the Columbia River estuary, contained mostly Engraulis mordax eggs. Microstomus pacificus eggs occurred almost exclusively at group 7 stations along the outer shelf, close to this estuary. Stations belonging to groups 1, 2, and 3 are scattered throughout the slope and oceanic zones. They are characterized by the occurrence of several mesopelagic taxa of which Tactostoma macropus was most abundant.

Engraulis mordax dominated catches of larvae in the bongo samples during summer (Table 53, Appendix Table 8). These larvae were abundant and occurred almost exclusively at group 1 stations along the slope and adjacent deep water off Washington and northern Oregon (Fig. 132). The myctophids Stenobrachius leucopsarus and Tarletonbeania crenularis were also most abundant at these stations. The mesopelagic taxa were most abundant, but not recorded in high densities, at group 2 stations in the oceanic zone. A mosaic of four station groups (3-6) cover the shelf and slope region from Washington to northern California. Groups 3 and

4 along the slope are characterized by relatively high densities of Sebastes spp. larvae and low densities of various mesopelagic taxa. Larval abundance was at a minimum in station groups 5 and 6, closest to the coast. Sebastes spp. larvae were most numerous here. They occurred along with very low densities of E. mordax, Artedius harringtoni, cyclopterid, and Eopsetta exilis larve at group 5 stations, and were the only larvae taken at group 6 stations.

The above multispecies spatial patterns again indicate the occurrence of a coastal, slope/transitional, and oceanic assemblage in the ichthyoplankton off the west coast. Compared to the situation in spring, however, these assemblages are not as clearly defined spatially and levels of abundance of eggs and larvae are reduced. The coastal assemblage is dominated by Citharichthys spp. eggs and some pleuronectid eggs, mainly Psettichthys melanostictus. Larvae are scarce in the coastal assemblage at this time of year. Most of those caught were Sebastes spp. and there were very low numbers of the cottid Artedius harringtoni and pleuronectids. A slope/transitional assemblage was discernible at intervals along the outer shelf and slope. Unidentified pleuronectid eggs, probably of the species Errex zachirus, Eopsetta exilis, and Microstomus pacificus, were most abundant in this region, along with Sebastes spp. larvae. Low numbers of A. harringtoni, E. exilis, and various mesopelagic taxa of larvae also belonged to this assemblage. Abundance of eggs and larvae in the oceanic assemblage was low in contrast with the spring situation. Relatively low densities of bathylagids, myctophids, Chauliodus macouni, Icichthys lockingtoni, and Sebastes spp. were present. Eggs of the melanostomid Tactostoma macropus were unusually abundant in the neuston of the oceanic zone on this occasion.

The north-south trend in species abundance observed in the above three assemblages during spring is not apparent in the summer 1980 distributional patterns. Larval densities were uniformly low along the shelf and throughout the oceanic region. Temperatures are uniformly cold near the coast during summer and increase in an offshore direction (Figs. 7a and b). The species-poor and low-abundance costal assemblage coincides with the colder water in the shelf zone whereas the oceanic assemblage is associated with the warmest water in the deep water zone. The cold, upwelled water which occurs along the coast at this time of year does not seem to be a favourable environment for spawning by most of the coastal taxa. This relationship, however, is likely to be based on water transport patterns rather than temperature. The offshore Ekman transport which occurs along the coast during the summer is detrimental to larvae of species that recruit their young into coastal habitats. Further evidence for this conclusion is the paucity of the neustonic assemblage of larvae in the coastal zone. The cottids and hexagrammids were entirely absent, except for Scorpaenichthys marmoratus.

The occurrence of high densities of Engraulis mordax eggs and larvae in the neuston and water column, in a geographically distinct region off Washington and northern Oregon during the summer cruise implies the existence of a Columbia River plume assemblage. The anchovy defines this assemblage but larvae of the myctophids Stenobrachius leucopsarus and Tarletonbeania crenularis, and Sebastes spp. are also associated with it. Its distribution, from the slope into the oceanic zone, off southern Washington and northern Oregon, reflects the offshore and southerly extension of the low-salinity Columbia River plume at this time of year (Fig. 7c).

Autumn Data: Cruises DA81 and MF83

Cruise DA81

Three species groups and four station groups were identified from neustonic egg abundance data collected during this cruise

(Fig. 134). These groups are clearly distinguishable on the basis of the abundance and distribution of coastal and mesopelagic taxa (Table 54, Appendix Table 9, Fig. 134). Species groups 1 and 2 consist entirely of pleuronectids and paralichthyids, along with an unidentified Teleost Type F. Their occurrence was confined essentially to station group 4 along the shelf from Washington to northern California. Abundance of the Citharichthys eggs, in particular, was very high at these stations. The pleuronectids identified to species included Pleuronichthys decurrens, Psettichthys melanostictus, and Pleuronectes vetulus. Most of the unidentified pleuronectid eggs probably belonged to these species. The third species group include the mesopelagic taxa Icichthys lockingtoni, Trachipterus altivelis, and Chauliodus macouni. They were distributed throughout station groups 1, 2, and 3 along the slope and in the oceanic zone. Highest densities by far, however, were associated with station group 1 located beyond the shelf edge from southern Washington to northern California, and extending westwards accross approximately half of the oceanic zone.

As before, species composition of larvae in the neuston was completely different to that of the eggs. Two species groups and five station groups are identifiable for this category (Fig. 135). Station groups 1-4 are located primarily along the shelf and slope and are characterized by different combinations of abundance of the dominant larval taxa (Table 55, Appendix Table 10, Fig. 136). Engraulis mordax was by far the most abundant species and it was confined essentially to station groups 3 and 4, mainly along the southern Washington and Oregon shelf. The hexagrammids Hexagrammos lagocephalus and H. decagrammus were most abundant in station group 2 off northern Washington and northern California. Station group 1, occurring mainly along the slope off Oregon, is characterized by highest densities of Cololabis saira and Tarletonbeania crenularis in addition to moderate densities of Scorpaenichthys marmoratus and some Sebastes spp. Most of the oceanic zone is covered by station group 5 in which only Cololabis saira larve were caught.

A similar dichotomy of coastal and oceanic species and station groups, to that observed for eggs in the neuston, was apparent for eggs in the bongo samples (Table 56, Appendix Table 11, Figs. 137 and 138). The coastal species group (2), comprising the pleuronectids and paralichthyids, occurred almost exclusively at station groups 5 and 6 along the shelf. Densities were considerably higher at group 6 stations off Oregon than at group 5 stations off Washington. Along the slope, particularly off Washington, a cluster of stations is characterized by the absence of eggs. The remainder of the sampling area incorporates station groups 1 to 4 which contained the mesopelagic group of species (1) including bathylagids, Chauliodus macouni, Icichthys lockingtoni, and Trachipterus altivelis. Levels of abundance for these taxa were relatively low and within the deep water zone, these station groups are not geographically distinct.

For larvae in the water column, a geographiclly distinct group of 'coastal' stations is again apparent and characterized by coastal taxa (Table 57, Appendix Table 12, Fig. 140). The citharichthyid and Sebastes spp. larvae of species group 2 are associated with station groups 4 and 5 along the shelf and slope off Washington, northern Oregon and northern California. Off Oregon, these groups extend into the oceanic zone. Station groups 1, 2, 3, and 6 scattered throughout the remainder of the sampling area, mainly in the oceanic zone, are characterized by the occurrence of low numbers of a variety of mesopelagic taxa (Table 57). Some Engraulis mordax larvae were caught at several stations off Washington and northern Oregon (Appendix Table 12, Appendix Fig. 3).

Cruise MF83

As for cruise DA81, the classification of stations and species into groups for eggs in the neuston revealed a clear distinction between the occurrence and distribution of coastal and oceanic taxa

(Figs. 141 and 142, Table 58, Appendix Table 13). Species group 1 contains all the flatfish taxa including the pleuronectids Pleuronectes vetulus, Psettichthys melanostictus, and Pleuronichthys decurrens, as well as unidentified pleuronectids and the paralichthyids Citharichthys types A and B. Most of these taxa were confined exclusively to station group 2 along the shelf. Station groups 1, 4, and 5 over the slope and oceanic region off southern Oregon and northern California, and part of the oceanic region off Washington (Fig. 142). They are characterized by the occurrence of the mesopelagic species (species group 2) Icichthys lockingtoni, Trachipterus altivelis, and Chauliodus macouni in varying levels of abundance. Fish eggs were absent from the neuston samples at many stations off Washington and Oregon, mainly along the slope and outer section of the oceanic zone.

For larvae in the neuston, the two species groups identified again reflect the distinction between coastal and more widespread distribution patterns among the constituent species (Figs. 143 and 144, Table 59, Appendix Table 14). Hexagrammos decagrammus, H. lagocephalus, Scorpaenichthys marmoratus, and Sebastes spp., belonging to species group 1, are associated with station groups 2 and 3 along the Washington, mid-Oregon and northern California coast. In contrast, Tarletonbeania crenularis and Cololabis saira, constituting species group 2, occurred throughout station groups 1, 2, and 4. Tarletonbeania crenularis was abundant only in station group 1 throughout the northern section of the oceanic zone whereas C. saira was equally abundant in station groups 1 and 4 in the oceanic region, and less abundant in group 2 stations along the coast.

Species composition and distributions for eggs in the bongo samples were similar to those for eggs in the neuston (Figs. 145 and 146, Table 60 and Appendix Table 15). Pleuronectids and paralichthyids belong to species group 2 which is associated with station group 5 along the Washington, Oregon and northern

California shelf. Low densities of various mesopelagic taxa in species group 1 (including bathylagids, Trachipterus altivelis, Chauliodus macouni, and Icichthys lockingtoni) are associated with station groups 1 to 4 throughout the slope and oceanic region. Again, eggs were absent or at a minimum at slope or oceanic stations in the northern section of the sampling area.

The three species groups and five station groups identified for larvae in the bongo samples (Fig. 147) did not reflect a very clear distinction between coastal and oceanic distributions (Fig. 148, Table 61, Appendix Table 16). Larvae were absent from most of the shelf region, particularly off Washington and northern California. Station group 4, mainly along the Oregon coast, is characterized by highest densities (though low numbers) of Sebastes spp. larvae. The remaining station groups (1, 2, 3, and 5) are distributed throughout the slope and oceanic region. They contained low numbers of various myctophid species, Lestidiops ringens, Sebastes spp., Cyclothone spp., and the paralichthyids Citharichthys spp. and Citharichthys stigmaeus. In contrast to the association of their eggs with the coastal zone, larvae of the Citharichthys species were recorded mostly at oceanic stations.

For most species, levels of abundance of fish eggs and larvae are low during autumn months and the spatial patterns just described indicate the persistance of only the coastal and oceanic assemblages of ichthyoplankton species. The slope/transitional assemblage is not discernible because of the reduced numbers of Sebastes spp. larvae and the absence of eggs and larvae of the deep water flatfish Errex zachirus, Microstomus pacificus, and Eopsetta exilis. The neustonic assemblage of larvae is also reduced and comprised low densities of coastal species (hexagrammids, cottids, and Sebastes spp.) along the shelf, and higher densities of certain myctophids and Cololabis saira in deepwater. During cruise DA81, however, Engraulis mordax larvae were present in abundance in the neustonic assemblage along part of the shelf.

The coastal assemblage is comprised primarily of pleuronectid (Pleuronectes vetulus, Psettichthys melanostictus, and Pleuronichthys decurrens) and Citharichthys eggs, along with low densities of Sebastes spp. larvae. Citharichthys spp. larvae were relatively abundant in this assemblage, however, during cruise DA81. The oceanic assemblage includes eggs and larvae of various mesopelagic taxa, and larvae of the Citharichthys species, in low densities. It is associated with the slope and oceanic zones throughout which levels of occurrence and abundance of these species were relatively uniform and consistently sparse.

The distinction between coastal and oceanic assemblages of ichthyoplankton at this time of year can be related only to the bathymetry of the sampling area. The spatial patterns observed in the ichthyoplankton don't appear to be related to temperature and salinity patterns during these sampling periods. Nevertheless, the offshore extension of the distribution of Citharichthys larvae may be related to offshore Ekman transport, which still prevails to a limited extent at this time of year, as indicated by the seaward orientation of the Columbia River plume (Figs. 9c and 12c). The distribution of the larvae in deep water contrasts with the essentially coastal distribution of Citharichthys eggs, indicating extensive seaward advection of larvae.

Winter Data: Cruise MF87

Pleuronectid and paralichthyid eggs were extremely abundant in the neuston during January 1987. Among the species groups identified, they comprised group 1 which is associated exclusively with station group 4 along the Washington and Oregon shelf (Figs. 149 and 150, Table 62, Appendix Table 17). Most of the pleuronectids were unidentified. Those identified to species included Pleuronectes vetulus, P. isolepis, Platichthys stellatus, Psettichthys melanostictus, and Pleuronichthys decurrens. Levels of abundance of the mesopelagic taxa belonging to species groups 2 and 3 were much lower. They included unidentified bathylagids, Icosteus aenigmaticus, Chauliodus macouni, Icichthys lockingtoni and Trachipterus altivelis. These taxa are associated with station groups 1, 2, and 3 scattered throughout the slope and oceanic zones, and extending onto the shelf off northern California.

Larvae were also relatively abundant in the neuston during this cruise with densities of hexagrammids and cottids at a peak. Four species groups and five station groups were identified from the dendrograms (Fig. 151). The five station groups are geographically distinct and reflect an onshore-offshore trend in abundance of larvae (Fig. 152, Table 63, Appendix Table 18). Groups 1 and 2 cover the shelf and slope regions, with 2 occurring almost exclusively off Oregon. Station group 3 forms a band along the deep water adjacent to the slope and groups 4 and 5 cover the remainder of the oceanic zone, 4 being associated with the southern section. Hexagrammos decagrammus, Hemilepidotus spinosus, and Scorpaenichthys marmoratus (species group 1) were most abundant at group 2 stations along the shelf and slope off Oregon but were also abundant in station groups 1 and 3. Tarletonbeania crenularis was most abundant in station groups 3 and 4 in deep water but was also present, though less abundant, in station group 2. Peak densities of Hexagrammos lagocephalus occurred at group 3 stations beyond the slope but were also present in the coastal station groups 1 and 2. Sebastes spp., Hemilepidotus hemilepidotus, and Leptocottus armatus larvae were associated exclusively with these coastal station groups. Cololabis saira larvae were taken in all station groups except group 2 off Oregon. It was most abundant in the oceanic zone, however, and peak densities occurred at group 5 stations in the northern sector.

A clear division into coastal and oceanic species and station groups is apparent for eggs in the bongo samples (Figs. 153 and 154, Table 64, Appendix Table 19). Species group 3 consisting of pleuronectids and paralichthyids is associated primarily with group

2 stations along the Washington and Oregon coasts. The mesopelagic taxa belonging to species groups 1 and 2 are associated mainly with station group 3 covering most of the slope and oceanic region. Most were also present in low numbers in station group 1, mainly to the north of the oceanic zone, and some at group 2 stations along the coast.

This dichotomy of species and stations into coastal and oceanic groups is also apparent for larvae in the bongo samples (Figs. 155 and 156, Table 65, Appendix Table 20). Station group 3 along the coast is characterized by highest densities of the group 3 species including Osmeridae, Pleuronectes vetulus, Cyclopteridae, Hemilepidotus spinosus, and Hexagrammos decagrammus. The myctophids, bathylagids, Sebastes spp. and Citharichthys species belonging to species groups 1 and 2 were most abundant in station groups 1 and 2 in the slope and oceanic zones. In general, densities were highest at group 1 stations in slope and deep water off Oregon and northern California. In contrast, the species Tarletonbeania crenularis and Protomyctophum thompsoni were considerably more abundant in station group 2 mainly to the north of the oceanic region. Numbers of Sebastes spp. larvae were also relatively high at the coastal stations (group 3) and Citharichthys stigmaeus larvae were present in low densities here.

As for autumn, the spatial patterns discerned in the ichthyoplankton during winter indicate coastal and oceanic assemblages of species. Levels of abundance of eggs and larvae were considerably higher than during summer and autumn and peak densities were recorded for certain coastal species that do most of their spawning during late winter and early spring, e.g. osmerids, the hexagrammids Hexagrammos decagrammus and H. lagocephalus, the cottids Hemilepidotus spinsosus and H. hemilepidotus, and the pleuronectids Pleuronectes vetulus and Platichthys stellatus. The neustonic assemblage of larvae comprising mainly hexagrammids and cottids was priminent in the coastal and slope zones and much of the adjacent deep water.

The coastal assemblage of fish eggs and larvae included high densities of Citharichthys, as well as pleuronectid, eggs in addition to moderate numbers of osmerid, Sebastes spp. and Pleuronectes vetulus larvae. Low numbers of cyclopterid and Citharichthys stigmaeus larvae were also part of this assemblage which extended along the entire shelf off Washington and Oregon but was sparsely represented off northern California. The oceanic assemblage of fish eggs and larvae, which was distributed throughout the slope and deep water zones, consisted essentially of low to moderate densities of bathylagids, myctophids, Chauliodus macouni, Trachipterus altivelis, Icosteus aenigmaticus, and Icichthys lockingtoni, and larvae only of Sebastes spp. and the Citharichthys species. As in autumn, the association of Citharichthys eggs with the coastal assemblage and Citharichthys larvae with the oceanic assemblage indicates that extensive offshore advection of larvae occurs.

Similar to the spring situation, the division of station groups in the deep water zone into northern and southern components reflects a north-south trend in abundance of certain species. All the mesopelagic taxa except for the myctophids Tarletonbeania crenularis and Protomyctophum thompsoni were more abundant to the south of the oceanic zone than in deep water off Washington. This north-south increase in abundance seems to reflect the north-south increase in water temperature during winter (Figs. 15a and b). Spawning may be more intense in the southern sector of the sampling area where water is warmest. Temperature conditions are more uniform along the coast at this time of year and the extension of the coastal assemblage further south than during spring may be related to the absence of coastal upwelling and offshore Ekman transport at this time of year. The northerly extension of the Columbia River plume along the Washington coast during winter (Fig. 15c) does not appear to influence ichthyoplankton distributions or assemblage structure.

Species composition and seasonal variation in occurrence among the ichthyoplankton assemblages (excluding the neustonic assemblage of larvae) identified during the present study are summarized in Table 66. These multispecies assemblages include a coastal, slope/transitional, Columbia River plume and oceanic assemblage. Overlap in species composition does occur among the assemblages indicating that, in general, the assemblages are not sharply defined. In addition, the occurrence and distribution margins of assemblages do vary seasonally. Nevertheless, each of the four assemblages is characterized by a definitive set of species and is geographically distinct. Taxa are considered definitive for a particular assemblage when they occur exclusively, or are most abundant, in that assemblage. Doyle et al. (in press) describe in detail the occurrence, distribution, and oceanographic relationships for these assemblages based on just larval data from the bongo samples. The nature and origin of the larval assemblages are considered in this paper.

The neustonic assemblage of fish larvae identified here includes a unique group of species whose larvae are scarce or absent deeper in the water column, e.g. the hexagrammids, cottids, Cololabis saira, Anoplopoma fimbria, and Cryptacanthodes aleutensis. These larvae are considered to be obligate members of the neuston, occurring permanently at the surface and occuping an exclusively neustonic larval niche. In addition, certain members of this assemblage are species whose larvae are abundant in the water column as well as in the neuston. They include larvae and juveniles of Engraulis mordax, Tarletonbeania crenularis, Sebastes spp., Ronquilus jordani, and Ammodytes hexapterus, and are considered to be facultative members of the neuston. Diel vertical migration of well-developed larvae and juveniles of these species reults in their abundance in the neuston only at night. Eggs of Engraulis mordax, Trachipterus altivelis, Sebastolobus spp., *Icichthys lockingtoni*, *Citharichthys* spp., and all the pleuronectids also constitute an important component of the ichthyoplankton occurring in the neuston. *Citharichthys* and pleuronectid eggs, in particular, were extremely abundant in neuston samples. These eggs are considered "strays" in the neuston as they accumulate passively at the surface due to positive or neutral bouyancy. Based on data from the present study, a detailed account of the occurrence, distribution and categories of neustonic ichthyoplankton off the west coast is given in Doyle (in press).

Previous studies have identified larval fish assemblages off the Oregon coast which correspond to the sub-surface ichthyoplankton assemblages described here. Based on an 18 month survey along a 111 km transect off Yaquina Bay Oregon, Richardson and Pearcy (1977) found a "coastal" assemblage 2 to 28 km offshore and an "offshore" assemblage 37 to 111 km from shore. A grid of stations from the along the shelf and slope area from the Columbia River mouth to Cape Blanco was surveyed by Richardson *et al*. (1980). They documented the occurrence of a "coastal", a "transitional" and an "offshore" assemblage in this region during March-April of 1972 to 1975. These correspond to the spring coastal, slope/transitional, and oceanic assemblages of fish larvae identified in this paper, both in terms of species composition and distribution. Both Richardson and Pearcy (1977) and Richardson et al. (1980) attribute the occurrence of the different larval fish assemblages off Oregon to the spawning location of the adults and to the predominate coastal circulation patterns. They postulate that current patterns, that are predominantly alongshore off the Oregon coast, would help maintain the larvae in zones parallel to the coast. The offshore component of surface drift (Ekman transport) in summer and onshore component of surface drift in winter, associated with wind-induced coastal currents and upwelling and downwelling processes, however, are also important in influencing larval distributions and subsequent recruitment to shelf populations. This is particularly true for those species whose larvae are neustonic.

The coastal assemblage of ichthyoplankton described here and in the above publications is associated with the narrow continental shelf off Washington, Oregon and northern California, where cold temperatures prevail throughout the year and seasonal variation in circulation patterns is strong. The same is true for the unique neustonic assemblage of larvae identified here and described in Doyle (in press). The predominant spawning season for these taxa is from winter to spring when downwelling and onshore Ekman transport prevail. Their larvae are generally scarce or absent in the coastal zone during the peak upwelling season of summer. The spawning patterns that have evolved among the coastal species, therefore, seem to favour retention of their larvae in the shelf zone. Demersal spawning is another characteristic prevalent among the coastal species, particularly those with neustonic larvae, which aids retention of larve in the coastal zone. Osmerids, cottids, hexagrammids, cyclopterids, <u>Ronquilus jordani</u>, and <u>Ammodytes hexapterus</u> deposit their eggs in the substratum or attach them to rocks or seaweed, a strategy which reduces the duration of planktonic drift in their early life history. Further evidence that spawning patterns among the coastal and neustonic assemblage taxa are adapted to prevailing circulation patterns off the west coast is the apparent north-south trend in larval abundance. During spring, larvae belonging to these assemblages are most abundant in the shelf area off Washington and northern Oregon. Further south, the scarcity of larvae is associated with the region of upwelling and offshore transport that commences there earlier in the year.

Parrish <u>et al</u>. (1981) review the reproductive strategies among the coastal fishery species in the entire California Current system and conclude that they show a pattern of correspondence to the major features of surface transport. The southern coastal portion of the west coast survey area, particularly south of Cape Blanco, corresponds to the northern sector of the maximum upwelling region identified by these authors. In this region of vigorous upwelling and strong offshore surface transport, there is a paucity of species with pelagic eggs such as Engraulis mordax, the paralichthyids and pleuronectids (Parrish et al., 1981). In addition, larvae of the demersal spawning osmerids, cyclopterids, hexagrammids and cottids are less abundant along this section of the coast. Thus upwelling and offshore transport help explain the relative scarcity of members of the coastal and neustonic assemblages of ichthyoplankton observed here during the present study.

In agreement with Richardson et al.'s (1980) conclusions, it is proposed here that the distributions of the definitive taxa belonging to the slope/transitional assemblage are primarily related to the bathymetric range of the adults. These taxa, including Sebastes sp., Errex zachirus, Eopsetta exilis, and Microstomus pacificus, live and spawn on the outer coninental shelf and slope off the U.S. west coast (Hart, 1973; Matarese et al., 1989). Peak spawning among these species is also during spring. This means that the prevalent onshore transport at this time of year favours the retention of their larvae close to the nursery areas and adult habitats in slope waters.

The Columbia River plume assemblage identified here is characterized essentially by high densities of Engraulis mordax larvae during summer and is associated with the offshore and southerly extension of low-salinity plume water. Spawning of E. mordax off Oregon is known to be associated with warm, near-surface waters of the Columbia River plume at this time of year (Richardson, 1973; Richardson et al., 1980). Richardson (1973) proposed that a separate spawning stock of the northern anchovy occurs off Oregon, and that the spawning period is correlated with the time when warm plume water is a dominant oceanographic feature in the area. High levels of macrozooplankton biomass have also been observed in association with the Columbia River plume during summer and may reflect high concentrations of phytoplankton and microzooplankton (Brodeur, 1990). The spawning strategy of E. mordax off the U.S. northwest coast, therefore, seems to take advantage of high levels of plankton production that prevail in the plume during summer.

The association of highest densities of larvae of the myctophids Stenobrachius leucopsarus and Tarletonbeania crenularis with the plume in summer suggests a similar relationship with warm surface temperatures or spatial variation in plankton production. There is no evidence to suggest, however, that myctophid spawning is associated with the surface layer or that their larvae are concentrated in this zone. Strong thermohaline and colour (from Coastal Zone Color Scanner data) fronts have been observed in association with the edges of the plume (Fiedler and Laurs, 1990) and may represent a physical boundary that enhances the retention of larvae within the plume.

Year-round spawning is predominant among the oceanic assemblage resulting in the occurrence of their eggs and larvae in the plankton during all seasons. This pattern of spawning reflects the relative stability that characterizes the oceanic zone. In contrast with the coastal zone, seasonal variation in oceanographic conditions, including production in the plankton, is moderate in this essentially oligotrophic realm (Perry et al., 1989). Pearcy (1976) found that over a five-year period, standing stocks of planktonic herbivores, including copepods and euphausiids, were much higher in shelf waters off Oregon than in the oceanic zone. This is due to the high production associated with the summer upwelling along the coast. Here, seasonal variation in herbivore biomass is much greater than in the deep water beyond the shelf. The near steady-state type of production of food organisms in the oceanic zone supports the persistence of larvae throughout the year.

Some of the dominant myctophids and bathylagids display a strong peak in larval abundance during spring. This peak may be related to a spring peak in primary production observed in the oceanic zone off the U.S. northwest coast (Perry et al., 1989). The amplitude of this peak, however, is considerably weaker than seasonal variation in primary production in the coastal zone.

The majority of the mesopelagic species are most abundant in the southern sector of the oceanic zone during winter and spring and their spatial distributions suggest that spawning is associated with the warmest water (>9°C) off the U.S. northwest coast during these seasons. Although the distributional range of most of these species is from Baja California to the Bering Sea (Hart, 1973; Matarese et al., 1989), and spawning is widespread, the preferred spawning area along the west coast appears to be off southern Oregon and northern California. Among these species, Bathylagus ochotensis, Stenobrachius leucopsarus, Tarletonbeania crenularis, and Icichthys lockingtoni belong to a northern complex of larval fish species associated with central California, and Protomyctophum crockeri belongs to a southern complex associated with southern and Baja California (Moser et al., 1987). Their spawning centers are south of our study area, which helps explain the predominance of their larvae off southern Oregon and northern California. In contrast, Protomyctophum thompsoni has a more northerly distribution, its southernmost extreme being off central California (Matarese et al., 1989). Its preferred spawning area is probably off Washington and Oregon and associated with the colder water prevalent in the northern sector of the study area during winter and spring.

The ichthyoplankton assemblages identified off the U.S. west coast in this and previous studies indicate that the spawning patterns of fish species in this region bear common adaptive features. Co-evolution among the spawning strategies of the fish species within the complex and variable marine ecosystem may have given rise to the high degree of structure observed in the ichthyoplankton spatial patterns and to the multispecies assemblages (Doyle *et al.*, in press).

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TABLES AND FIGURES

Table 1. Summary of previous plankton sampling surveys off Washington, Oregon, and northern California, in which ichthyoplankton were recorded, listed in order of years when sampling took place.

Author(s)	Years sampled	Months sampled	General area of survey	Number of stations	Sampling gear and type of tow	Kinds of data reported
LeBrasseur (MS 1965;1970)	1956-59	Jan.-Oct.	Wash., Oregon, and Northern California	ca 76	Vertical and oblique NORPAC nets; 3- and 6- foot IKMT	List of taxa by station and type of gear.
Aron (1958, 1959, 1960, 1962)	1957-58	June-Sept.	Coastal Wash., Oregon, Northern Calif. to 146°	146	3' and 6' IKMT; oblique tows	Plankton volume; distribution, list of adult, juvenile, and larval fishes collected.
Pearcy and Myers (1974)	1960-70	Jan.-Dec.	Yaquina Bay, Or. and coastal waters	5 (393 hauls)	Clarke-Bumpus net, 20-cm bongo (0.571 mm mesh, step oblique)	Seasonal and horizontal distribution, tidal-diel variation, net comparison
Pearcy et al (1977)	1961-69; 1971-75	Jan.-Dec.	Oregon	125	70-cm bongo (0.571 mm), oblique; IKMT	Relative abundance, areal and vertical distribution, growth and seasonality of three species of flatfishes.
Day (1971)	1963	May; Oct.- Nov.	Coastal Washington	32	6' IKMT; oblique and surface tows	Plankton biomass; list of larval fishes collected.
Waldron (1972)	1967	Apr.-May	Wash.-Oregon	58	1-m net (ca 0.5 mm mesh)	List of taxa collected; relative abundance.
Eldridge and Bryan (1972)	1969	Jan.-Dec.	Humboldt Bay, California	5	1-m net (0.57 mm mesh)	List of taxa collected by month, station, density.
Richardson (1973)	1969	May-Oct.	Oregon, SW Wash.	? (287 hauls)	70-cm bongo (0.571 mm mesh, oblique IKMT (oblique) and 1-m net (vertical)	Species composition, dominant taxa, size distribution, gear comparison shallow vs. deep tows.
Mundy (1983)	1969-72	Jan.-Dec.	Off Newport, Oregon	4	20.2 cm bongo (0.571 mm mesh), step-oblique tows	Species composition and relative abundance. Assemblages.
Richardson (1977)	1971-72	Jan.-Aug.	Off Newport, Oregon	12 (287 hauls)	70-cm bongo (0.571 mm) step oblique	List of relative abundance of taxa by station.
Richardson and Pearcy (1977)	1971-72	Jan.-Dec.	Off Newport, Oregon	12 (287 hauls)	70-cm bongo (0.571 mm) step oblique	Species composition; assemblages; vertical distribution.
Ahlstrom and Stevens (1977)	1972	May	Wash., Oregon and California	33	Neuston net; 1-m net (0.505 mm) oblique hauls	List of taxa collected, distribution of selected taxa.

Table 1.--Continued

Author(s)	Years sampled	Months sampled	General area of survey	Number of stations	Sampling gear and type of tow	Kinds of data reported
Richardson et al. (1980)	1972-75	Mar.-Apr.	Oregon	84 (306 samples)	70-cm bongo (0.571 mm mesh, step-oblique and oblique tows	Species composition and abundance. Larval fish assemblages and associations.
Laroche and Richardson (1979)	1972-75	Mar.-Apr.	Oregon	84 (305 samples)	70-cm bongo (0.571 mm mesh, step-oblique and oblique tows. Neuston tows.	Distribution, abundance of Parophrys vetulus. Age and length. Gear comparison.
Misitano (1977)	1973	Jan.-Dec.	Columbia River estuary	7	0.5-m net and 0.9 m IKMT (step oblique tow)	List of taxa collected by station. Length range, density.
LaRoche (1976)	1975	Jan.; March	Columbia River mouth	82	Neuston net (0.505 mm mesh)	List of taxa collected and mean density per station.
Richardson (1980)	1975-76	July	Oregon, SW Washington	70	70-cm bongo (0.571 mm mesh), oblique tows	Spawning biomass of Engraulis mordax; census methods compared.
Grimm and Sztajn-duchert (1978)	1977	Aug.-Sept.	Wash., Oregon, Northern Calif.	31	60-cm bongo (0.505 mm mesh), oblique; Kopenhagen net (0.471 mm)	List of taxa collected by station. Length range; density.
Kendall and Clark (1982a)	1980	Apr.-May	Wash., Oregon, Northern Calif.	125	60-cm bongo (0.505 mm mesh); oblique tows; neuston tows.	Distribution, abundance, and length composition of dominant taxa of eggs and larvae. Community structure.
Kendall and Clark	1980	August	As above	91	As above	As above.
Urena (1989)	1980-83	Apr.-Dec.	As above	825	As above	Distribution and abundance of eggs and larvae of five species of flatfishes.
Clark (1984)	1981	May-June	As above	123	As above	As above
Brodeur (1990)	1981	May-August	Washington-Oregon	88	70 mm bongo (0.571 mm), step oblique tow	List of taxa collected; zooplankton biomass.
Bates (1984)	1981	Oct.-Nov.	As above	125	As above	As above
Clark (1986a)	1982	May-June	Wash., Oregon, Northern Calif.	124 (49 bongo)	As above	As above

Table 1.--Continued

Author(s)	Years sampled	Months sampled	General area of survey	Number of stations	Sampling gear and type of tow	Kinds of data reported
Boehlert et al. (1985)	1982	April, May, July	Oregon	2	Tucker trawl (0.505 mm mesh); stepped oblique tows	Vertical distribution and abundance of fish larvae by taxa; assemblages.
Clark and Kendall (1985)	1983	April-May	As above	124	60-cm bongo (0.505 mm mesh), oblique tows; neuston tows.	Distribution, abundance, length composition of dominant taxa of eggs and larvae. Community structure.
Brodeur, et al. (1985)	1983	Apr.-Sept.	Oregon	4	Bridleless 70-cm bongo and, on two occasions, a 70-cm bongo net (0.333 mm mesh)	Species composition, frequency of occurrence, abundance and distributional patterns.
Clark (1986b)	1983	Nov.-Dec.	Wash., Oregon Northern Calif.	113	60-cm bongo (0.505 mm mesh), oblique tows; neuston tows.	Distribution, abundance, length composition of dominant taxa of eggs and larvae. Community structure.
Clark and Savage (1988)	1984	Mar.-Apr.	As above	124	As above	As above
Shenker (1988)	1984	Apr.-July	Off Newport, Oregon	12	Neuston nets (0.333 mm mesh)	Mean abundance by taxa in day and night tows. Distribution.
Brodeur et al. (1987)	1984	June, July, September	Wash., Oregon Northern Calif.	80	Neuston net (0.505 mm mesh)	List taxa collected and mean abundance per station.
Savage (1989a)	1985	Apr.-May	As above	124	60-cm bongo (0.505 mm mesh), oblique tows; neuston tows.	Distribution, abundance, length composition of dominant taxa of eggs and larvae. Community structure.
Savage (1989b)	1987	January	As above	98	As above plus Tucker trawl tows at selected stations	As above

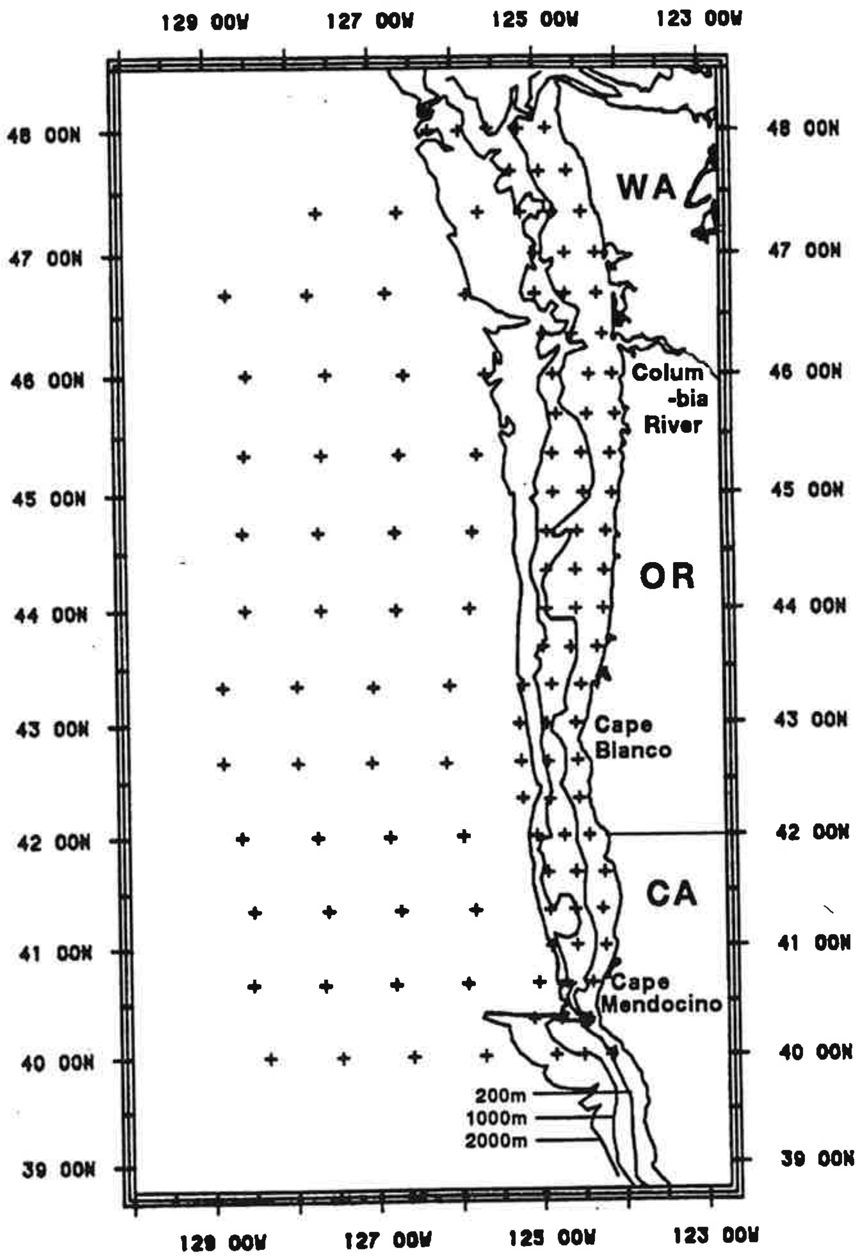


Figure 1. Survey area, bathymetry, and grid of sampling stations.

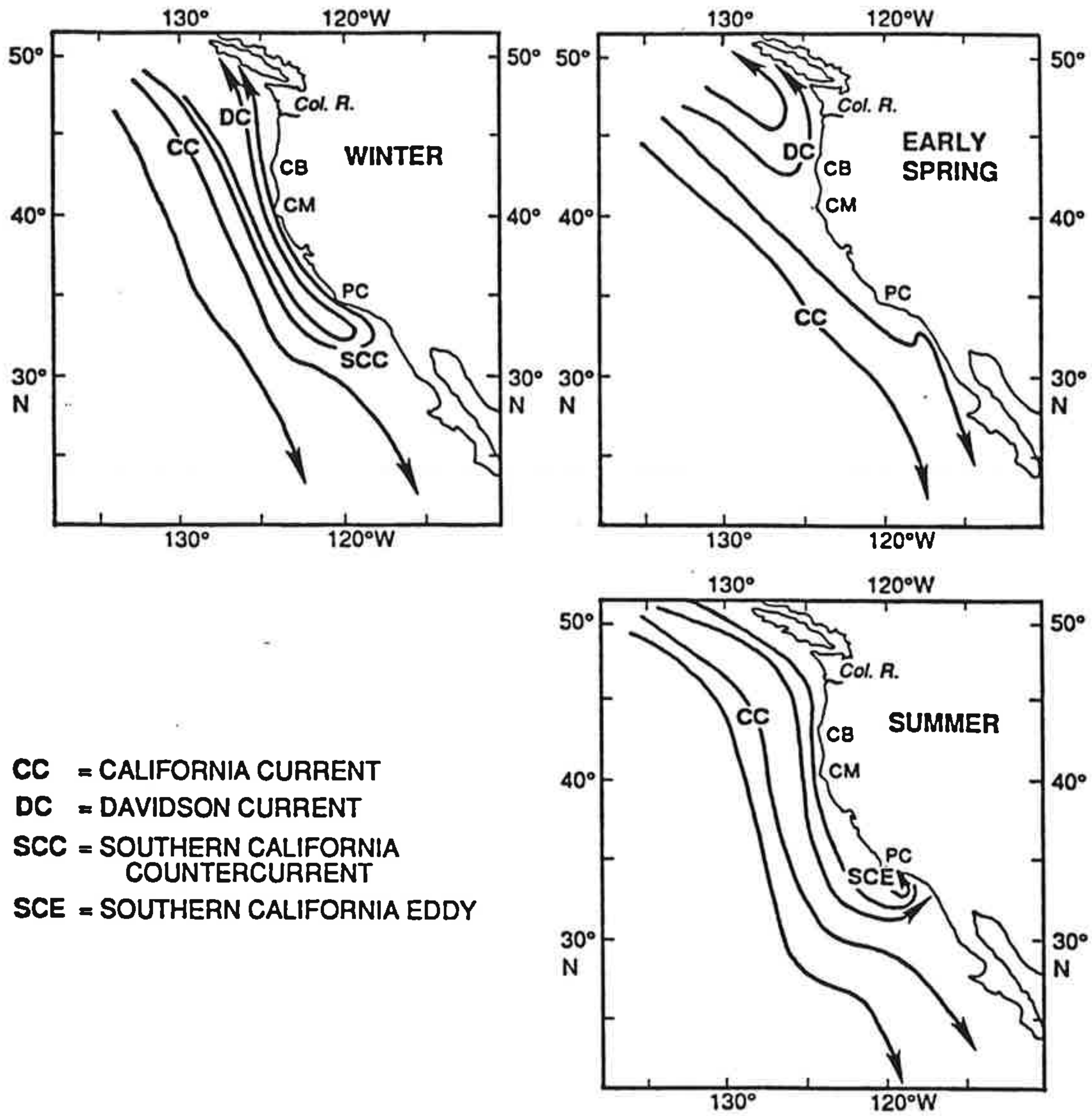


Figure 2. Seasonal variation in deep–ocean boundary currents off the U.S. west coast: Col. R. = Columbia River; CB = Cape Blanco; CM = Cape Mendocino; PC = Point Conception. From Hickey (1989).

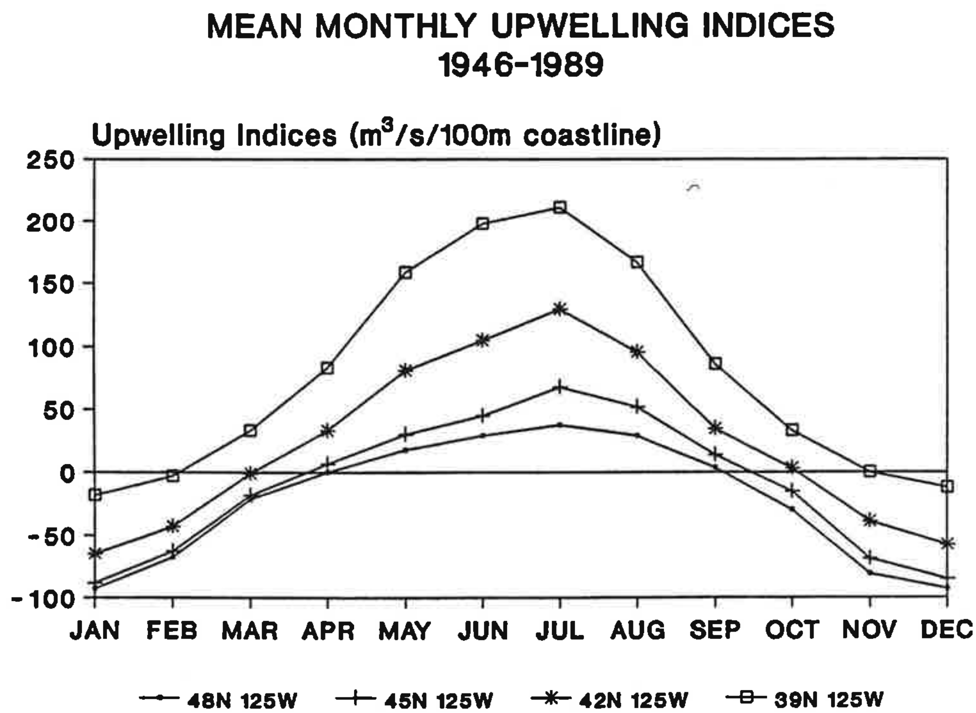


Figure 3. Mean monthly upwelling indices (Bakun, 1973), 1948--1989, for four locations along the west coast.

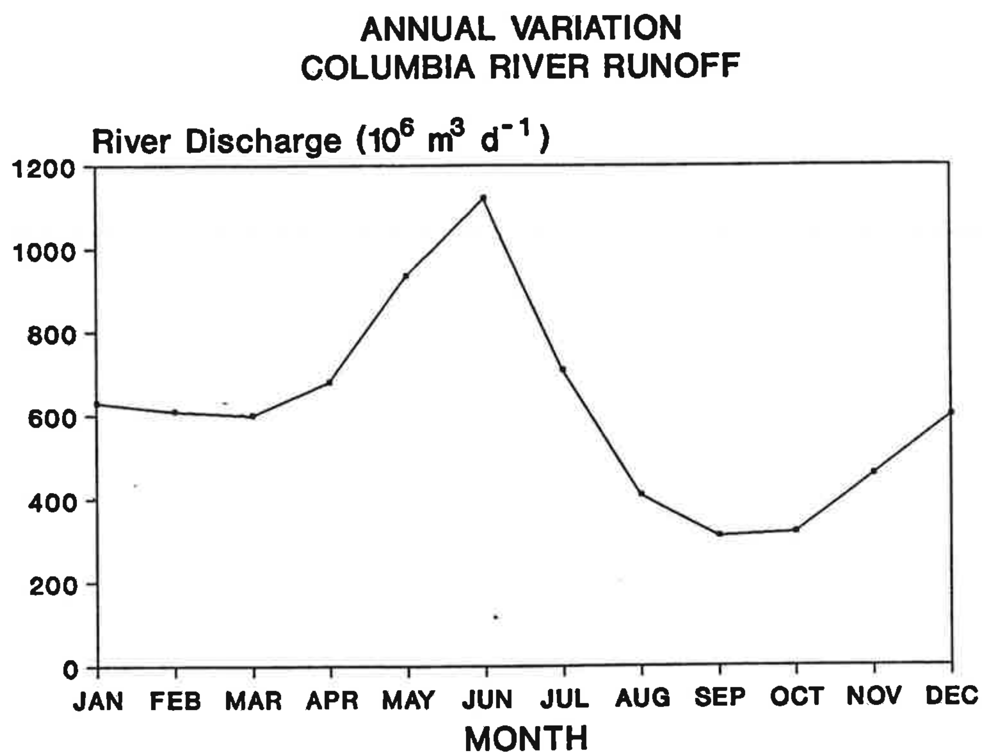
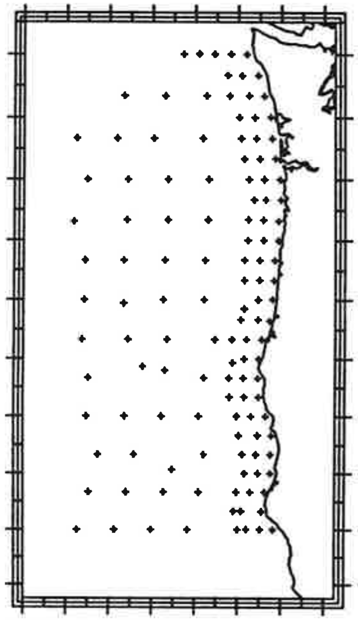


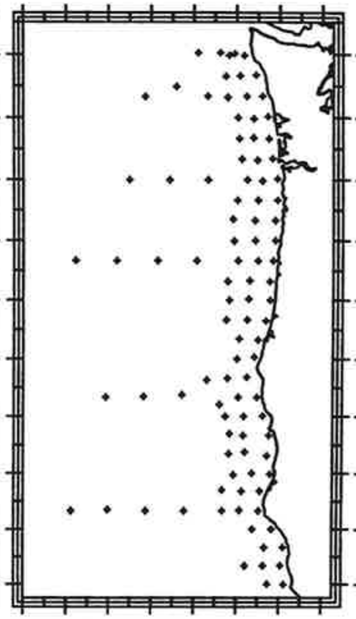
Figure 4. Mean monthly runoff, 1961–1981, for the Columbia River. From Landry et al. (1989).

Table 2. Sampling schedule and number of stations sampled for ichthyoplankton.

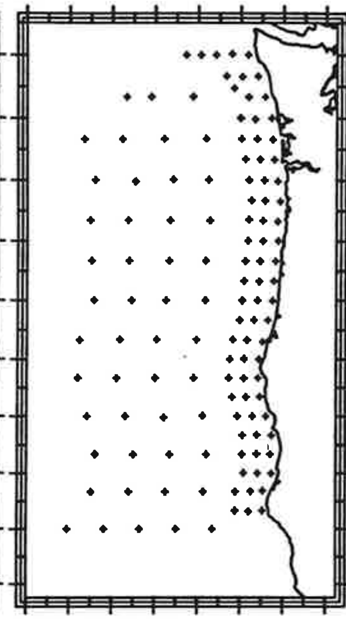
CRUISE	VESSEL	CRUISE DATES	STATIONS OCCUPIED NEUSTON TOWS	STATIONS OCCUPIED BONGO TOWS
TK80	Tikhookeanski U.S.S.R.	Apr 20–May 15, 1980	125	125
PO80	Poseydon U.S.S.R.	Aug 1–20, 1980	91	91
PO81	Poseydon U.S.S.R.	May 9–June 2, 1981	123	123
DA81	Mys Dalniy U.S.S.R.	Oct 24–Nov 19, 1981	125	125
PO82	Poseydon U.S.S.R.	May 3–June 1, 1982	124	49
EQ83	Equator U.S.S.R.	Apr 23–May 15, 1983	124	124
MF83	Miller Freeman U.S.A.	Nov 11–Dec 2, 1983	113	113
PO84	Poseydon U.S.S.R.	Mar 11–Apr 4, 1984	124	124
BA85	Mys Babyshkina U.S.S.R.	Apr 19–May 11, 1985	124	124
MF87	Miller Freeman U.S.A.	Jun 7–31, 1987	88	88
			1161	1086



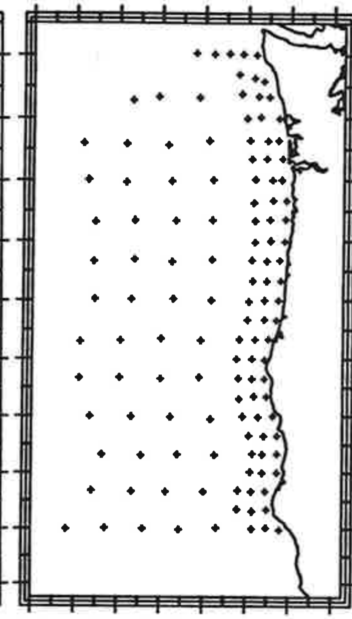
(a) Cruise TK80:
Neuston and Bongo Stations.



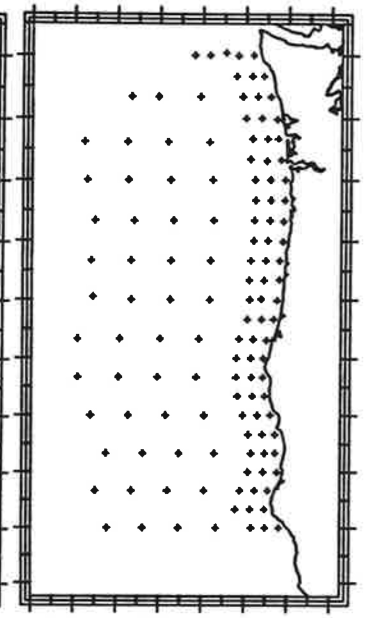
(b) Cruise PO80:
Neuston and Bongo Stations.



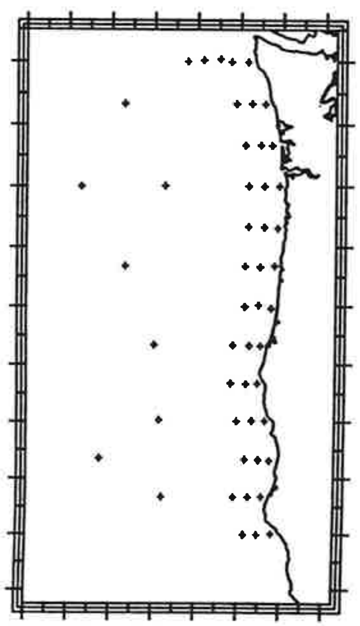
(c) Cruise PO81:
Neuston and Bongo Stations.



(d) Cruise DA81:
Neuston and Bongo Stations.

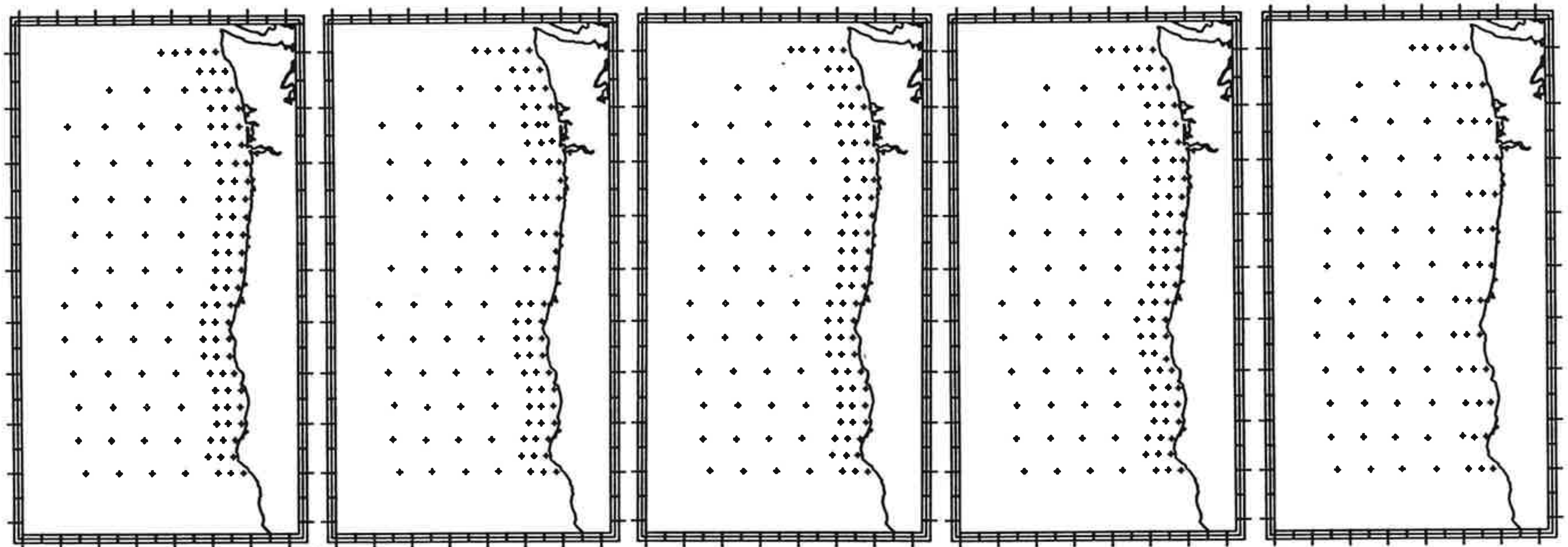


(e) Cruise PO82:
Neuston Stations.



(f) Cruise PO82:
Bongo Stations.

Figure 5. Station positions during individual sampling cruises.



(g) Cruise EQ83:
Neuston and Bongo Stations.

(h) Cruise MF83:
Neuston and Bongo Stations.

(i) Cruise PO84:
Neuston and Bongo Stations.

(j) Cruise BA85:
Neuston and Bongo Stations.

(k) Cruise MF87:
Neuston and Bongo Stations.

Figure 5. continued

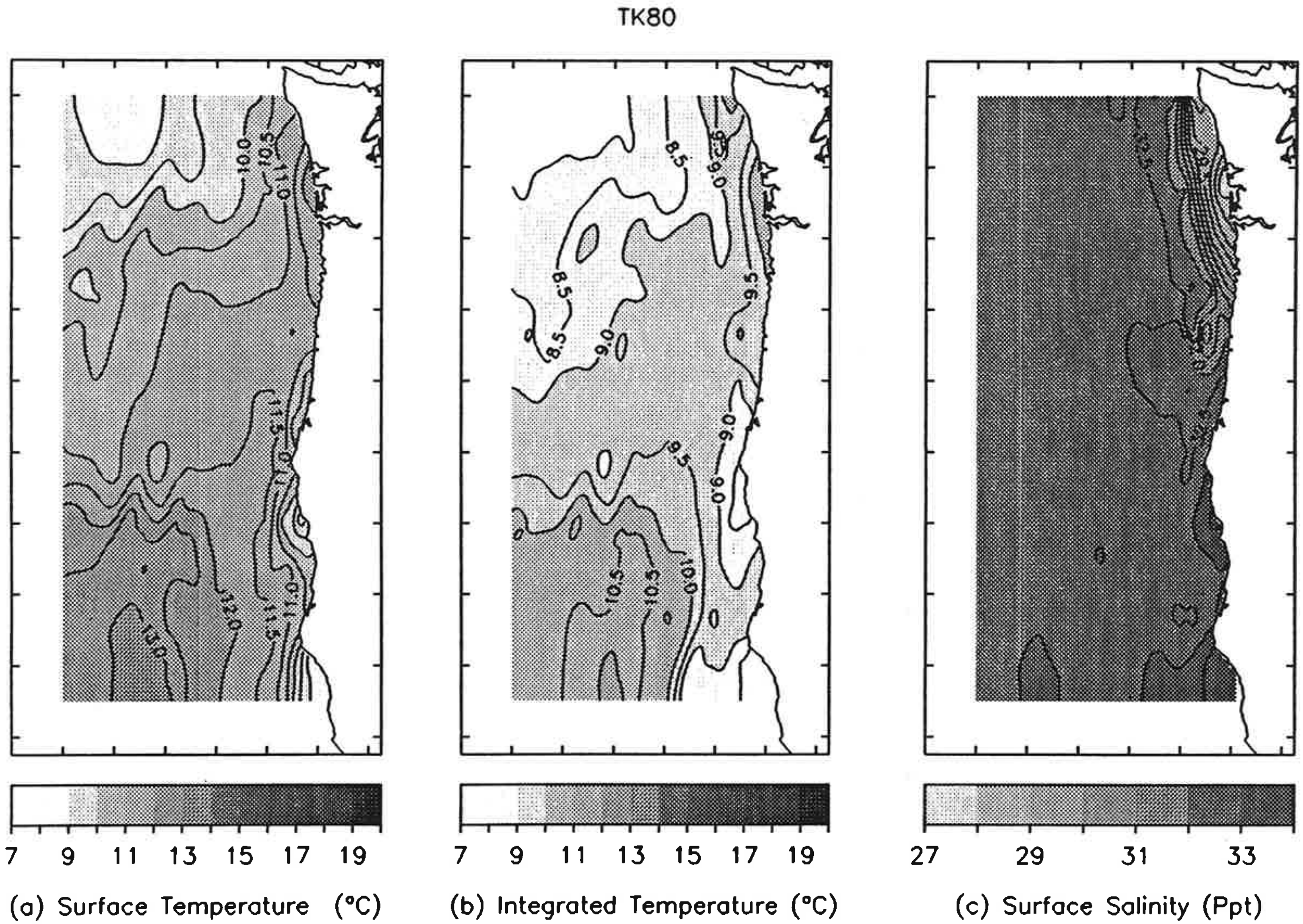


Figure 6. Horizontal patterns of temperature and salinity during April/May 1980 (cruise TK80).

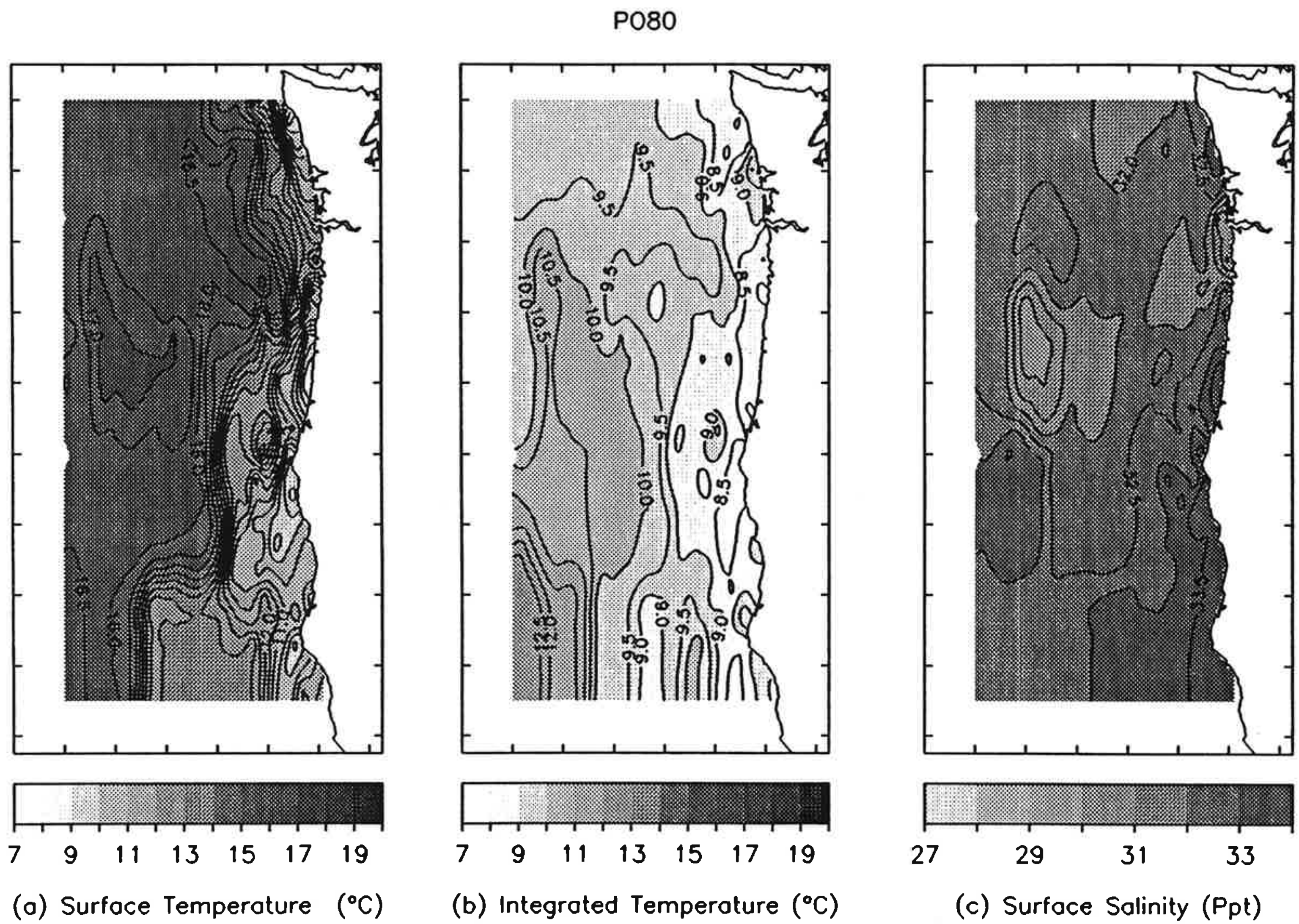


Figure 7. Horizontal patterns of temperature and salinity during August 1980 (cruise PO80).

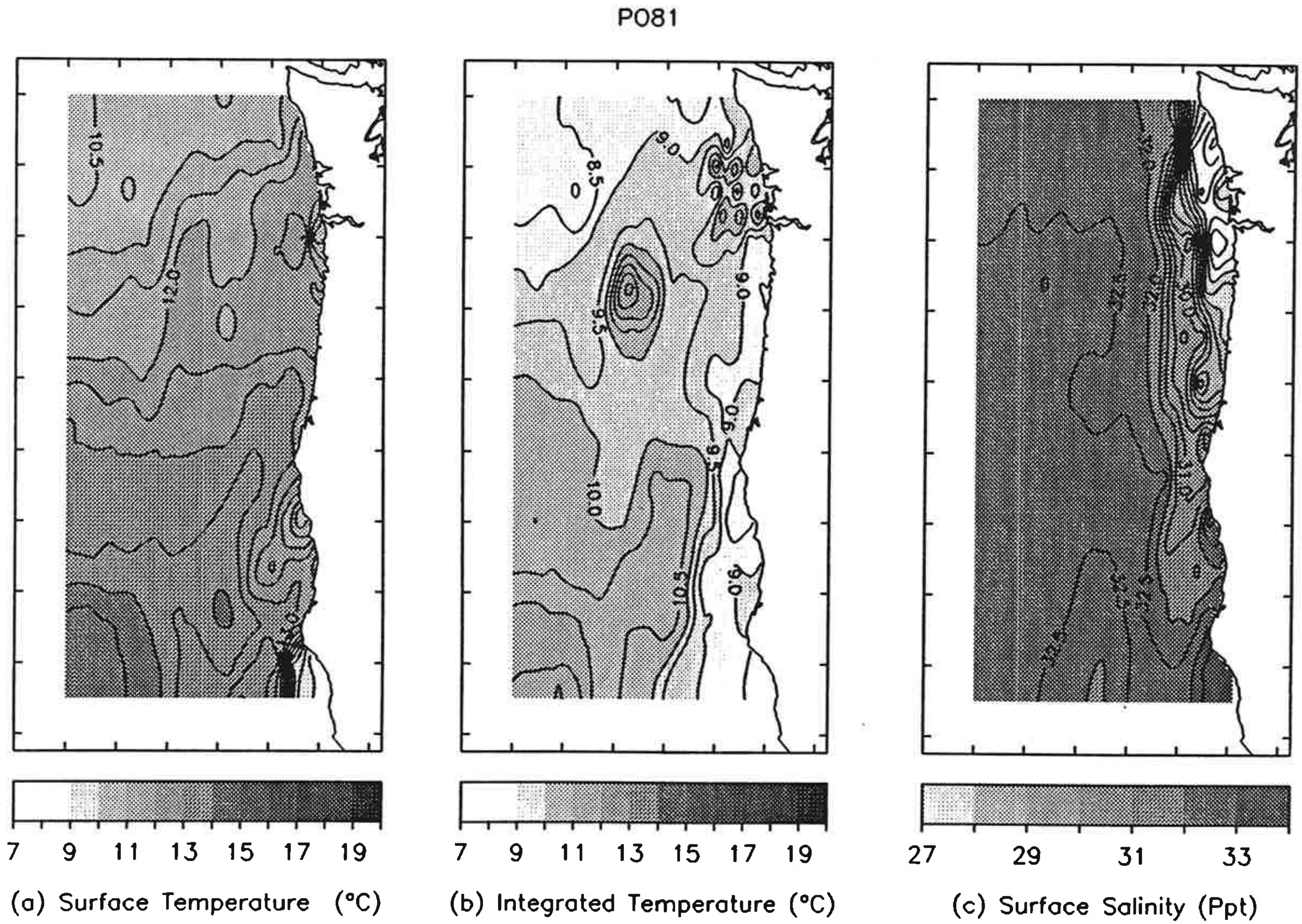


Figure 8. Horizontal patterns of temperature and salinity during May/June 1981 (cruise PO81).

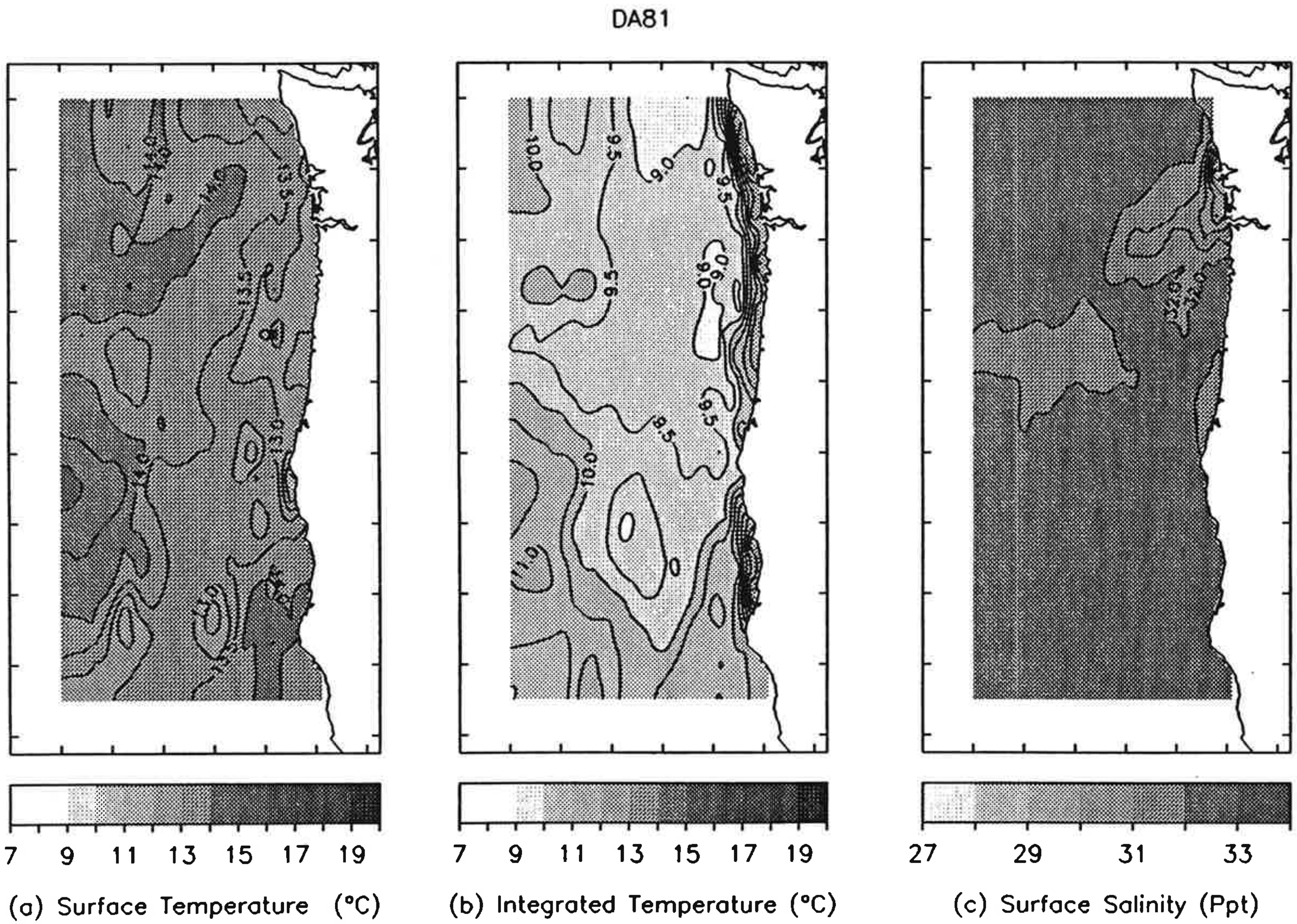


Figure 9. Horizontal patterns of temperature and salinity during October/November 1981 (cruise DA81).

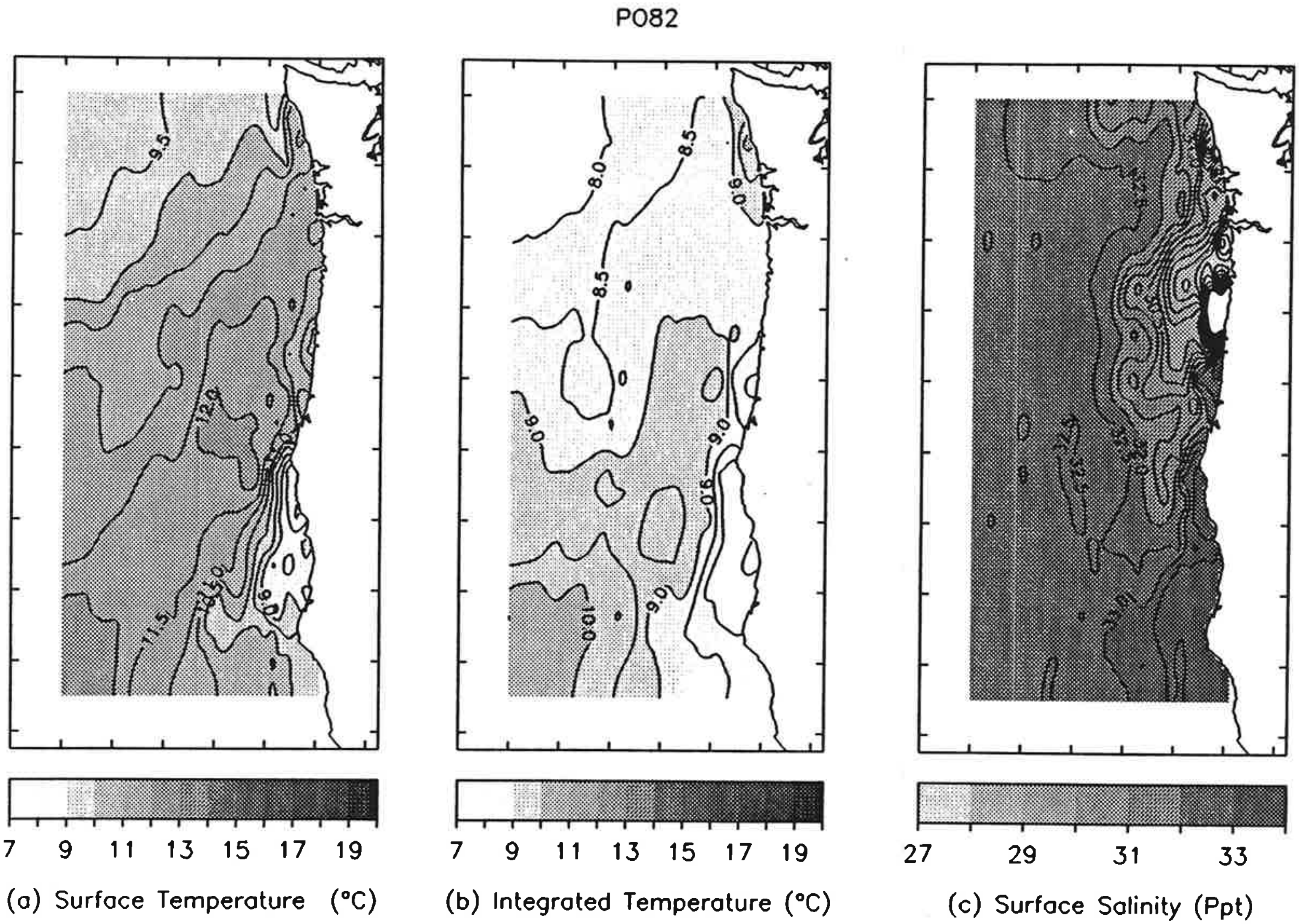


Figure 10. Horizontal patterns of temperature and salinity during May/June 1982 (cruise PO82).

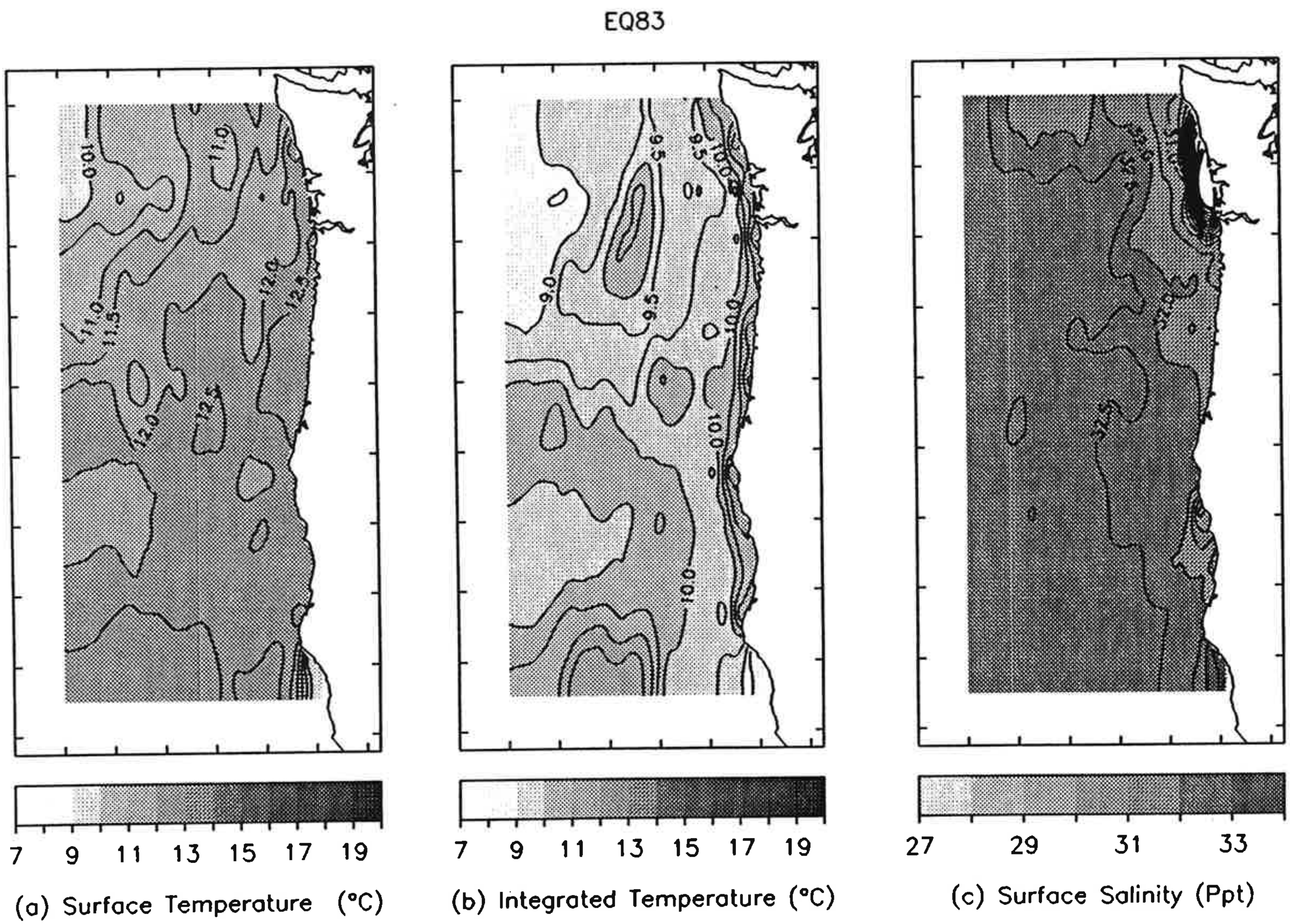


Figure 11. Horizontal patterns of temperature and salinity during April/May 1983 (cruise EQ83).

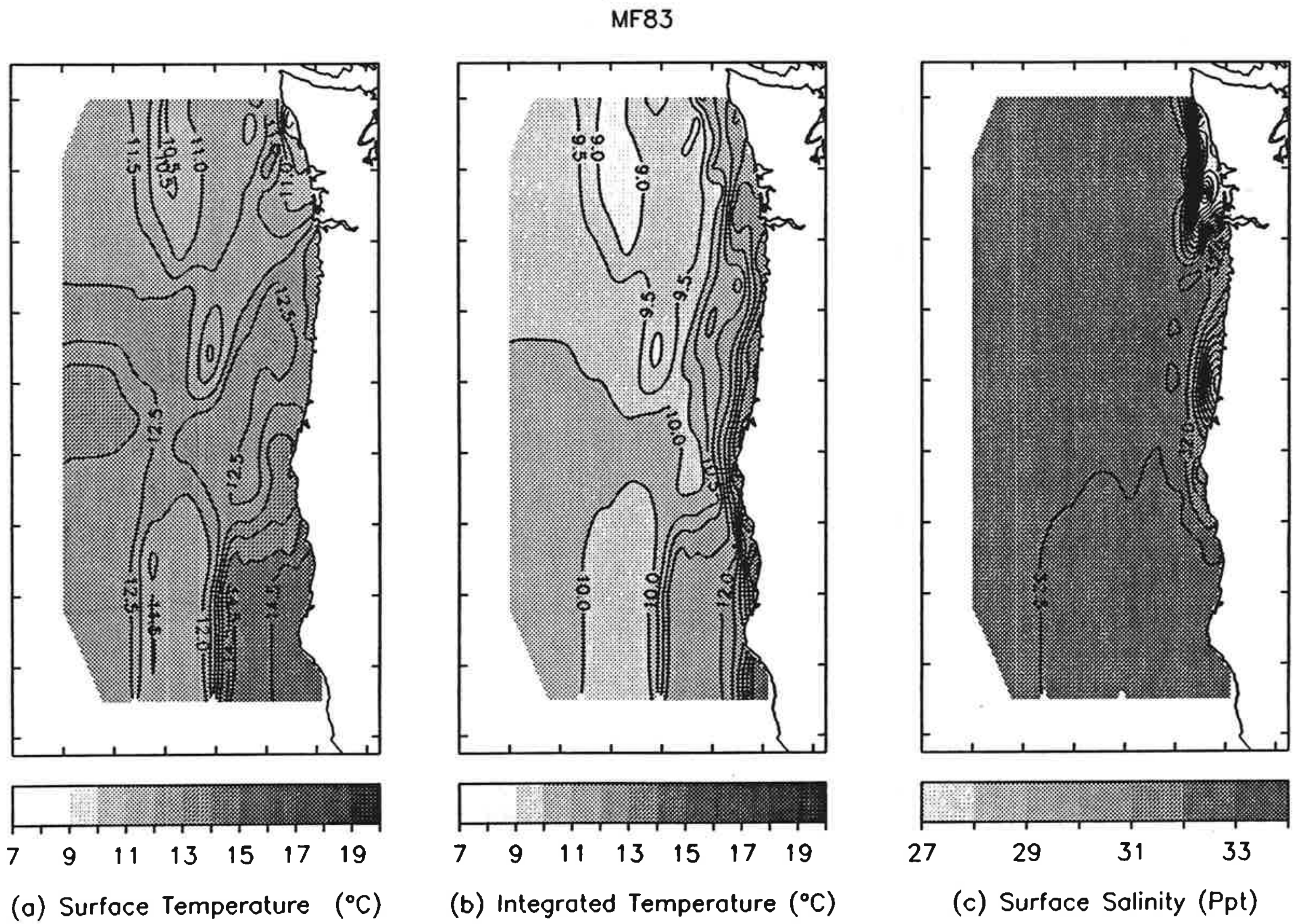


Figure 12. Horizontal patterns of temperature and salinity during November/December 1983 (cruise MF83).

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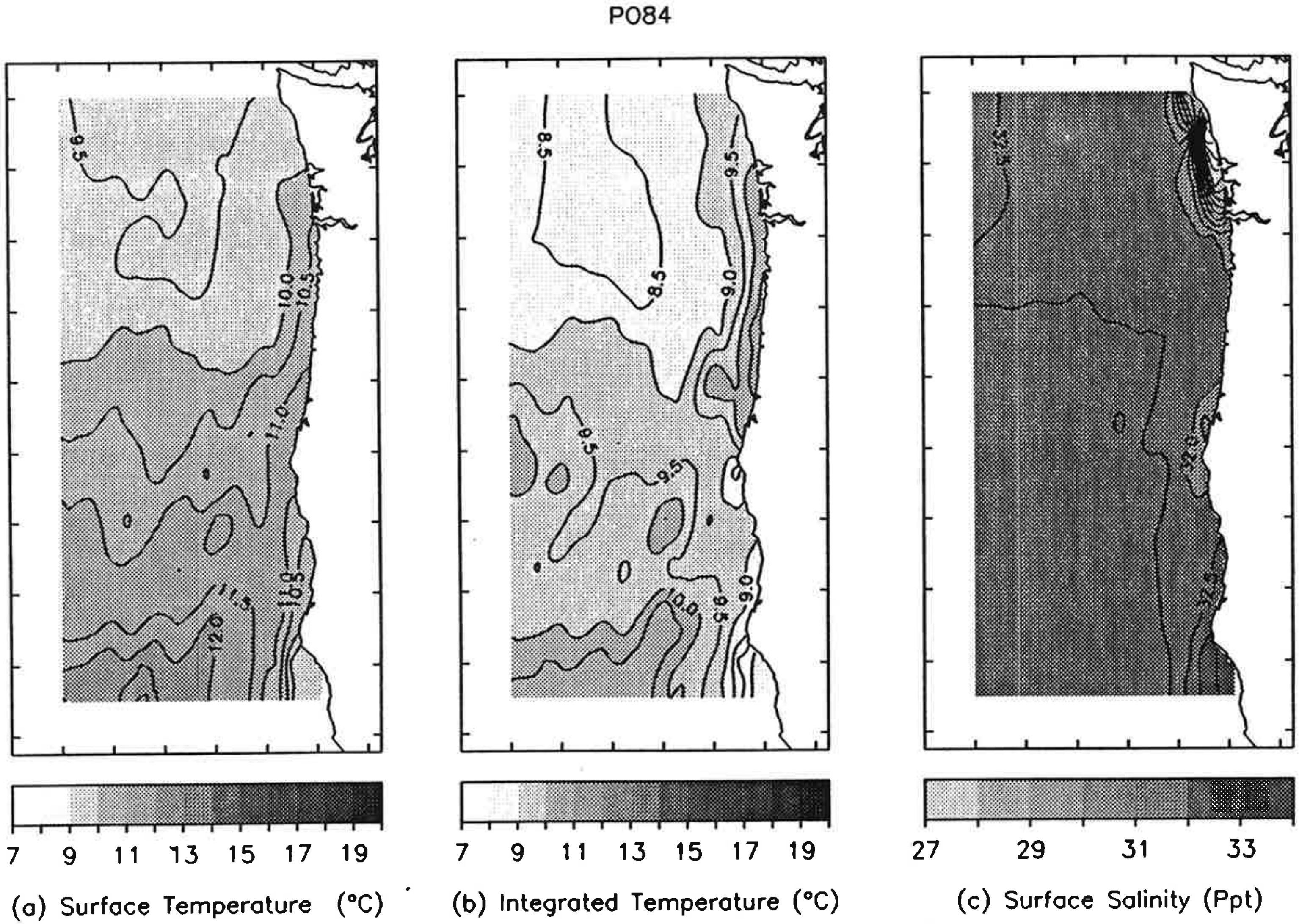

Figure 13. Horizontal patterns of temperature and salinity during March/April 1984 (cruise PO84).

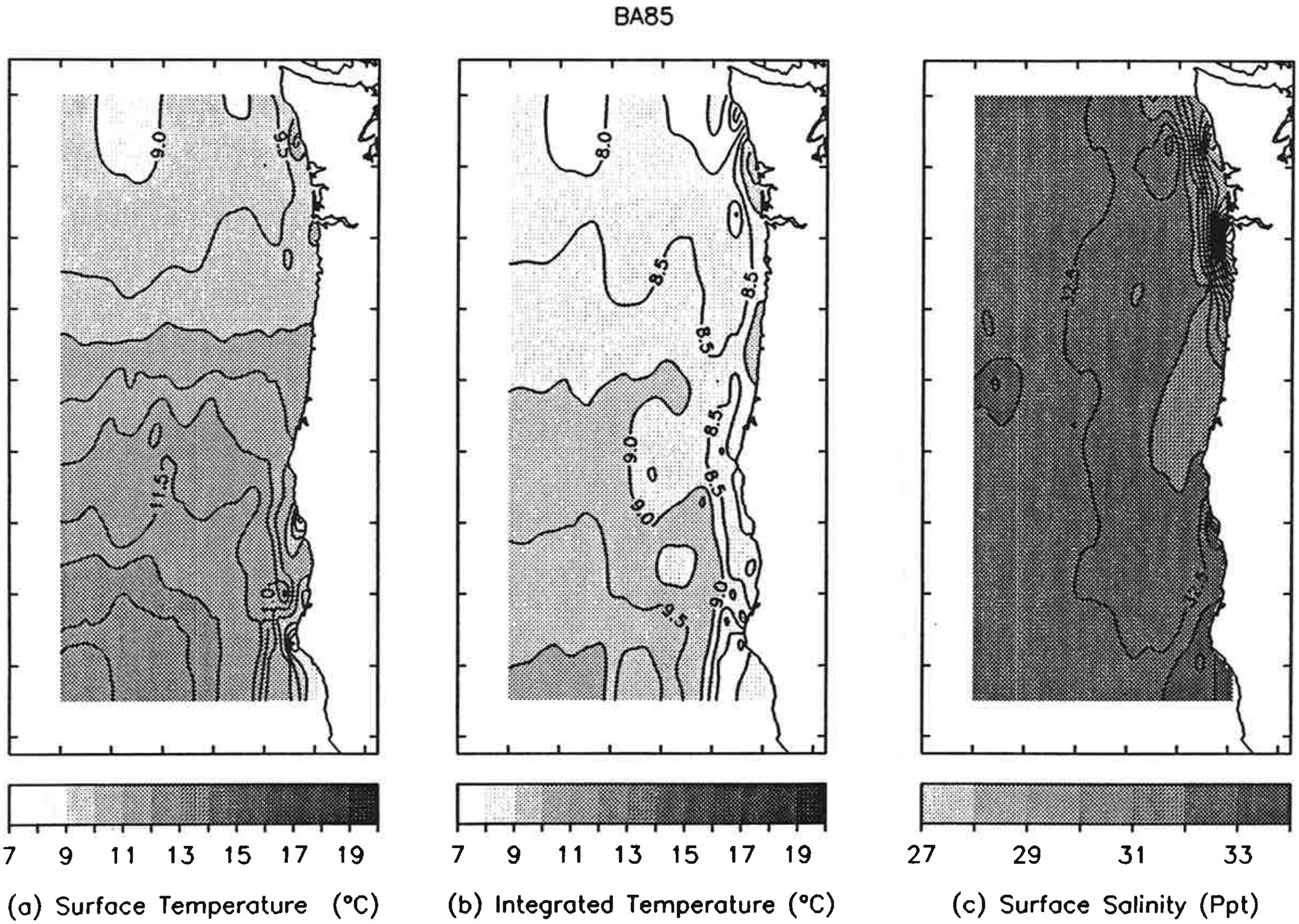

Figure 14. Horizontal patterns of temperature and salinity during April/May 1985 (cruise BA85).

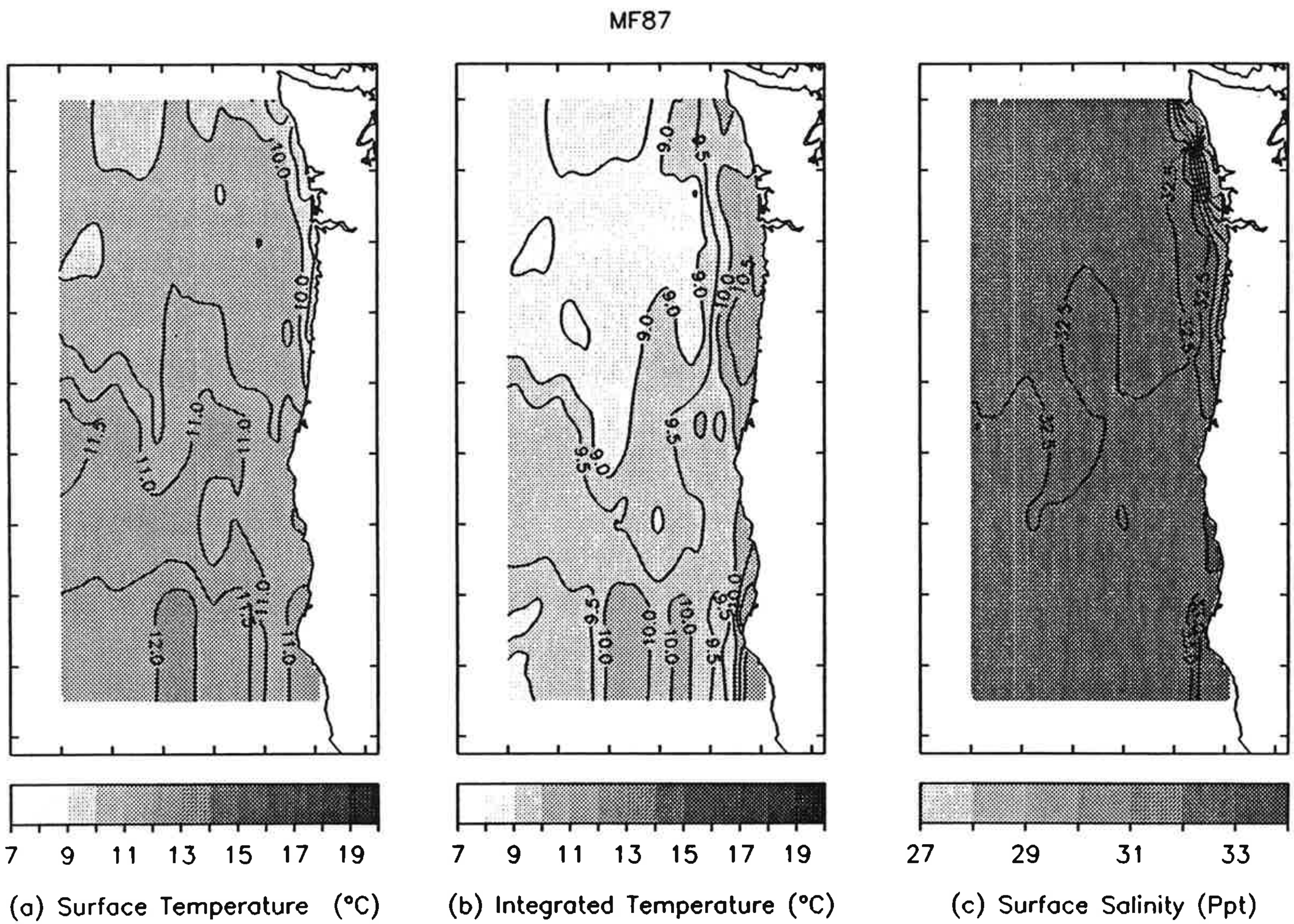

Figure 15. Horizontal patterns of temperature and salinity during January 1987 (cruise MF87).

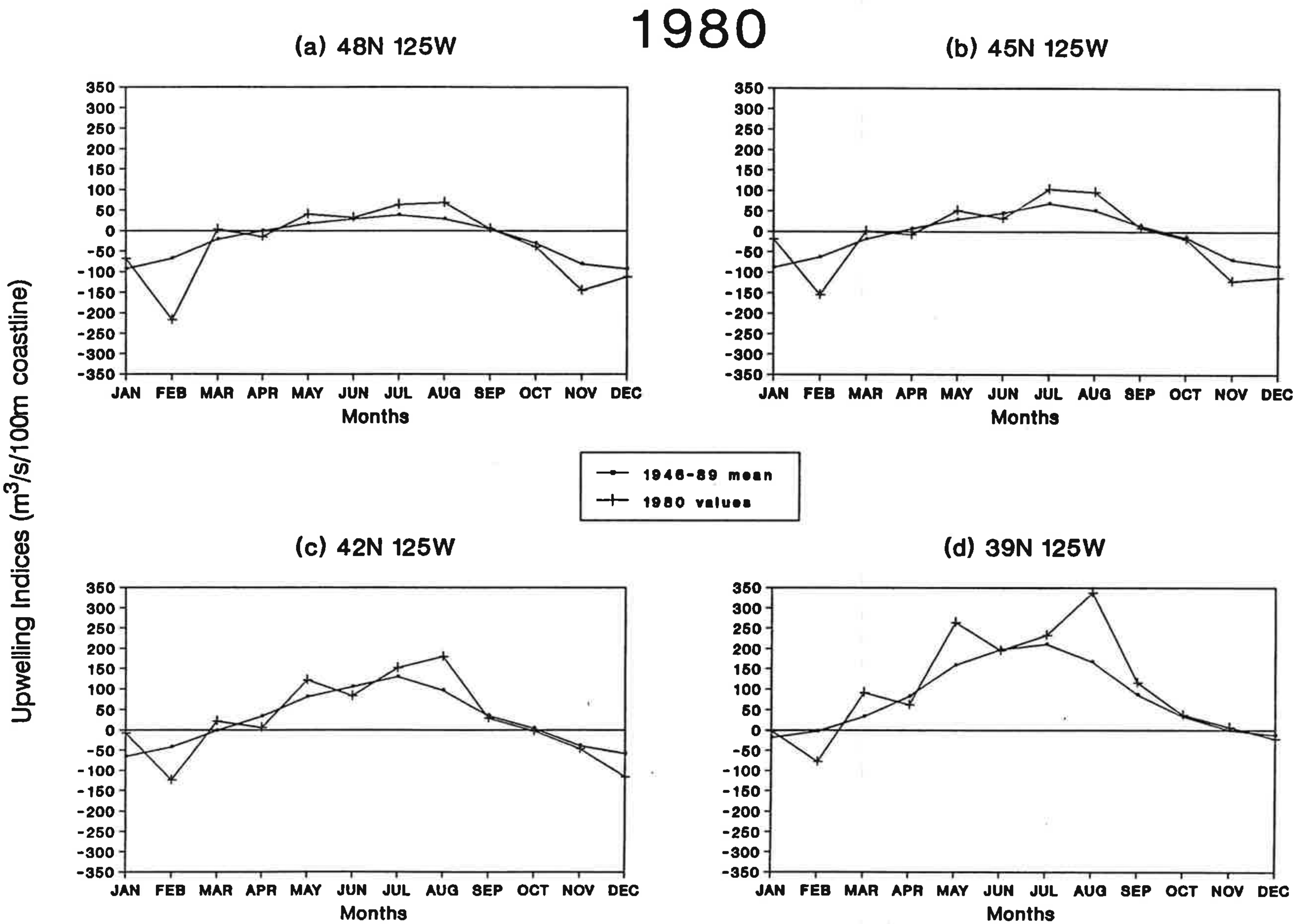

Figure 16. Monthly upwelling indices for 1980 at four locations along the west coast plotted with mean values for 1946 to 1989.

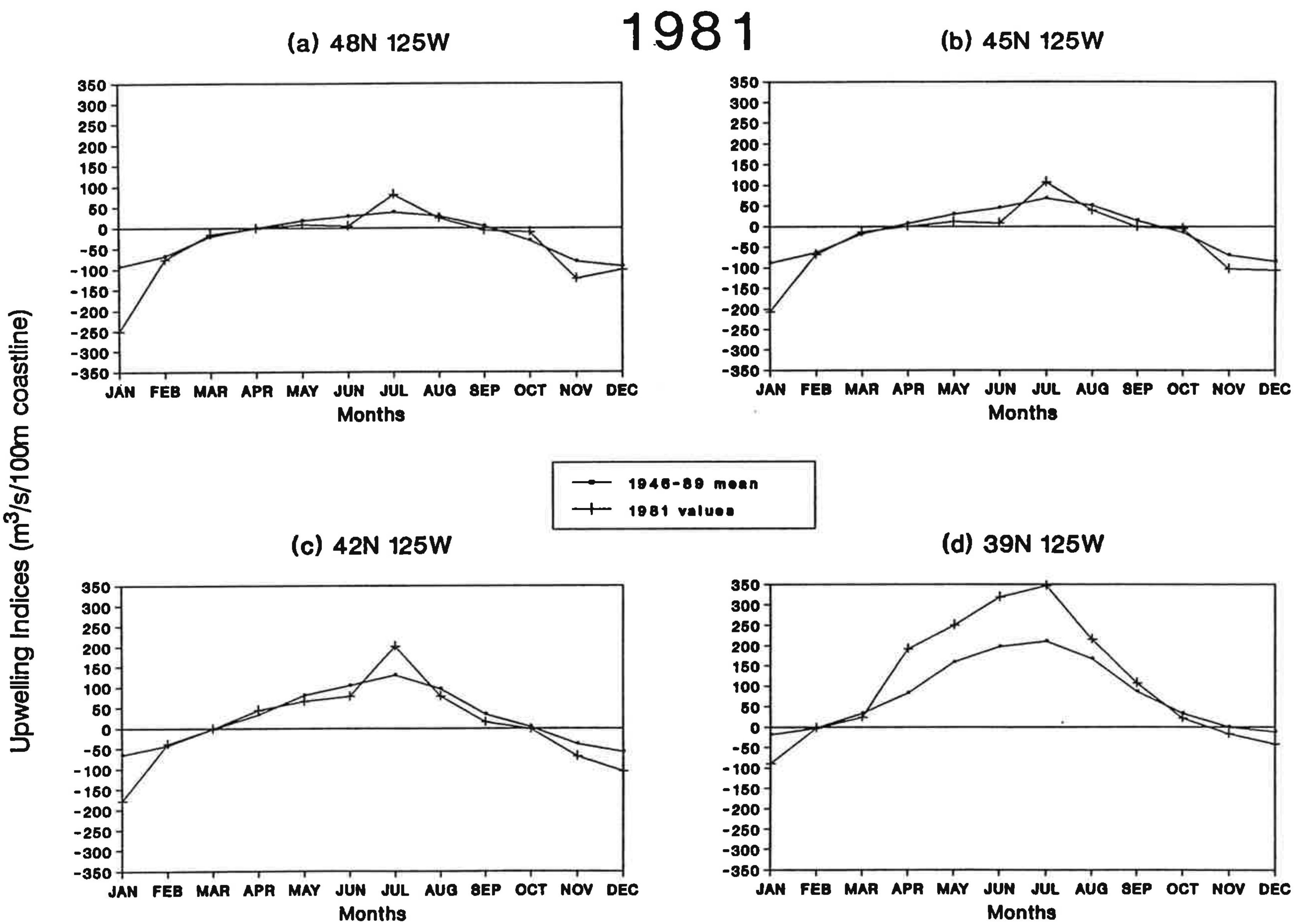

Figure 17. Monthly upwelling indices for 1981 at four locations along the west coast plotted with mean values for 1946 to 1989.

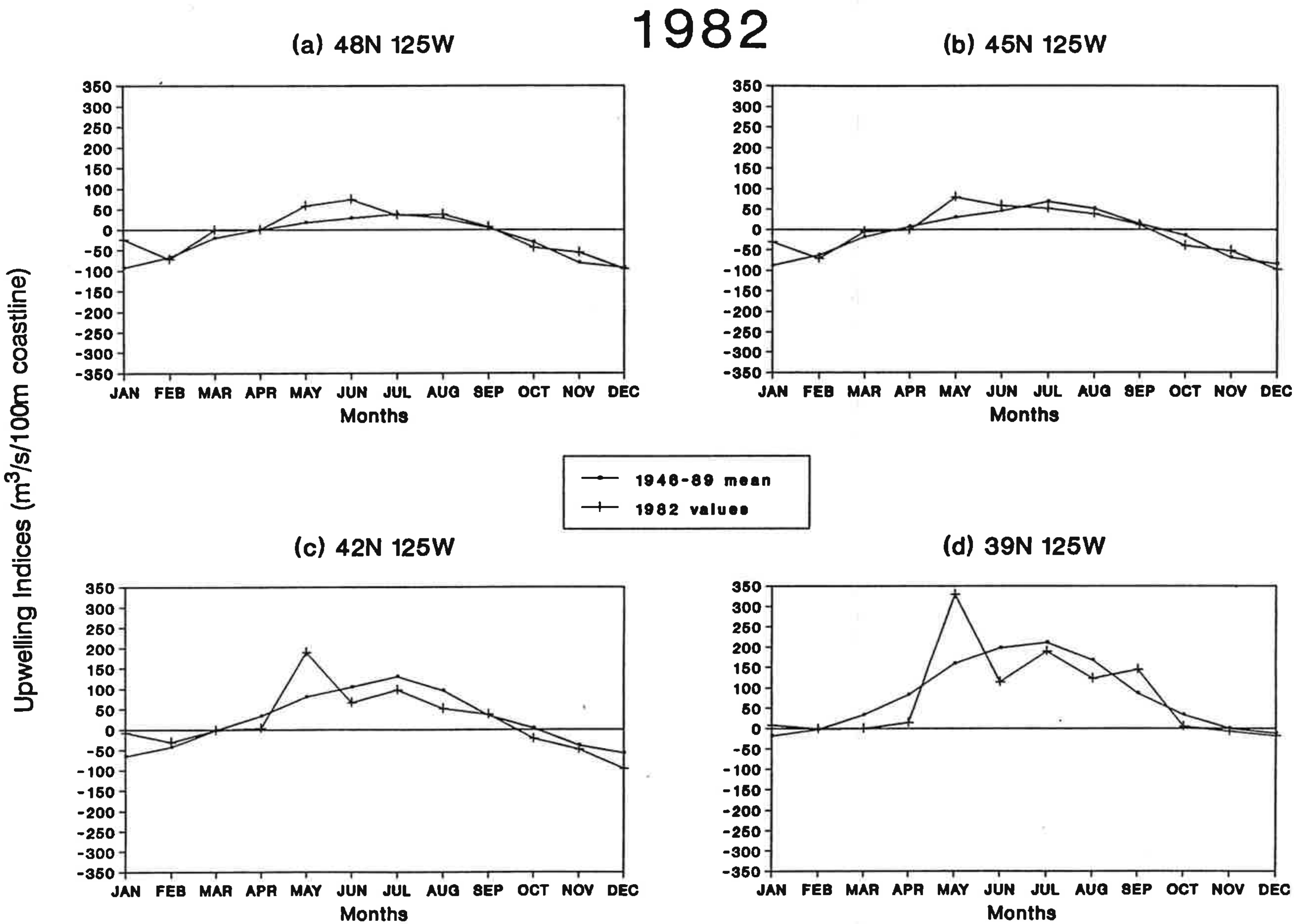

Figure 18. Monthly upwelling indices for 1982 at four locations along the west coast plotted with mean values for 1946 to 1989.

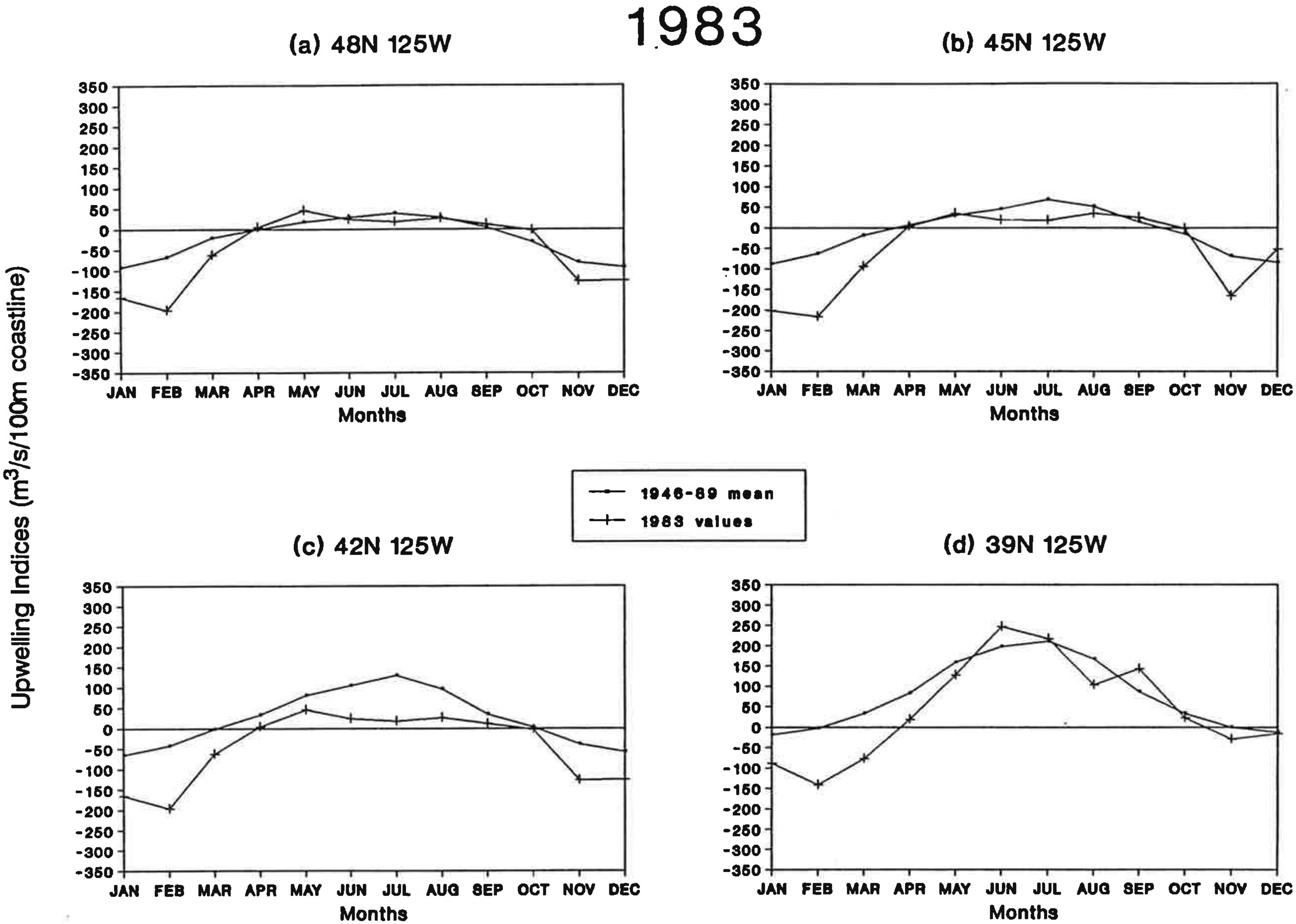

Figure 19. Monthly upwelling indices for 1983 at four locations along the west coast plotted with mean values for 1946 to 1989.

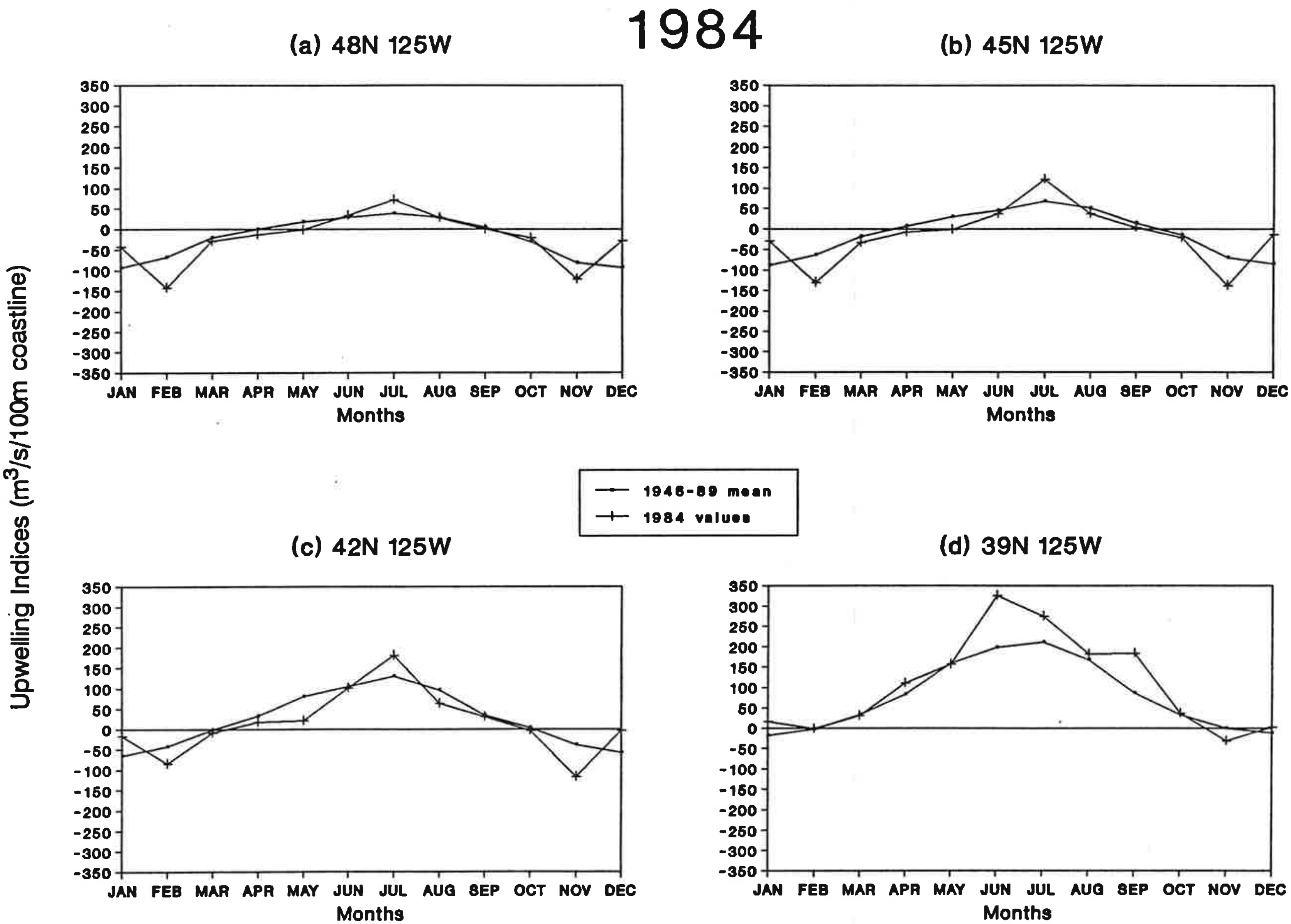

Figure 20. Monthly upwelling indices for 1984 at four locations along the west coast plotted with mean values for 1946 to 1989.

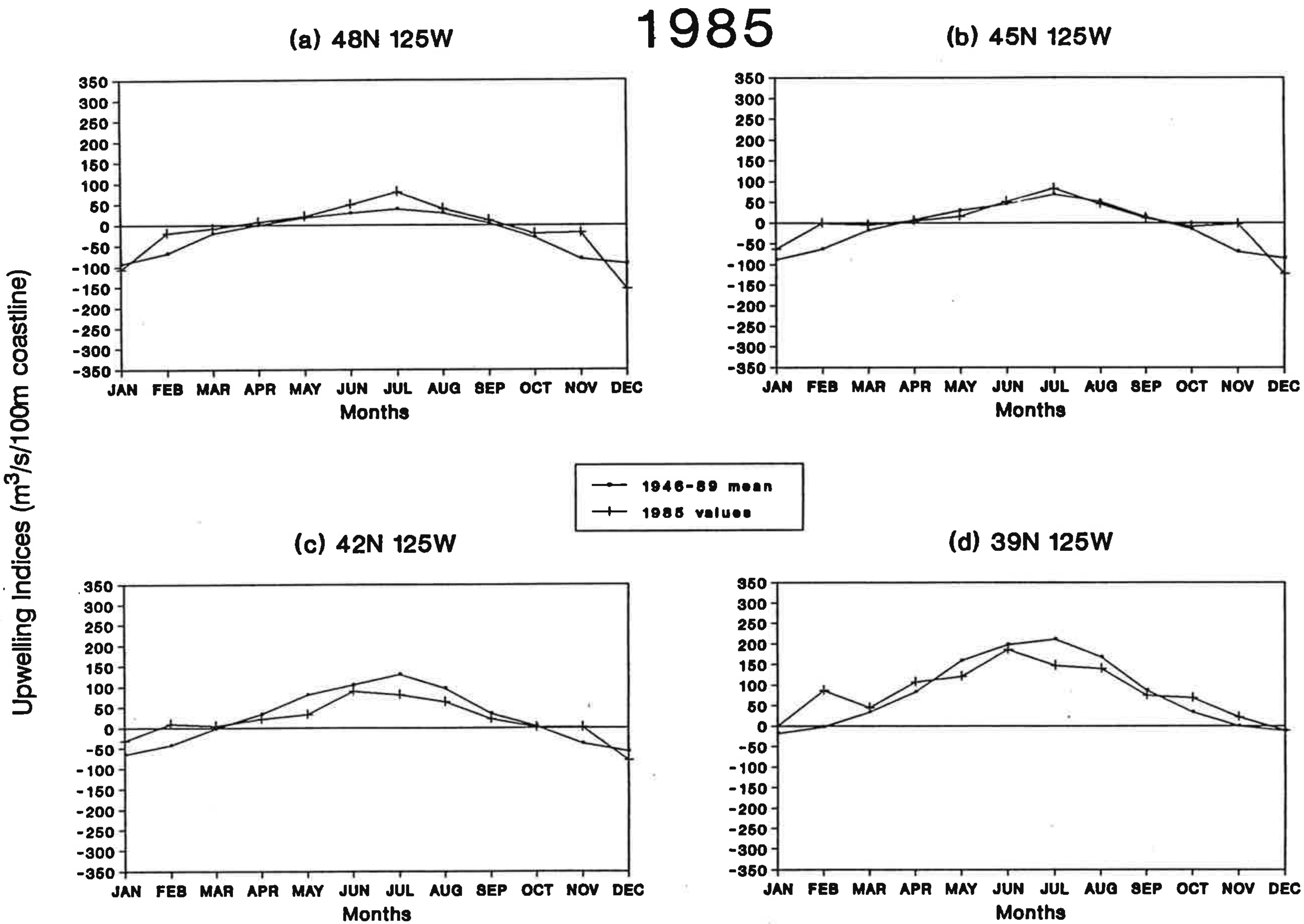

Figure 21. Monthly upwelling indices for 1985 at four locations along the west coast plotted with mean values for 1946 to 1989.

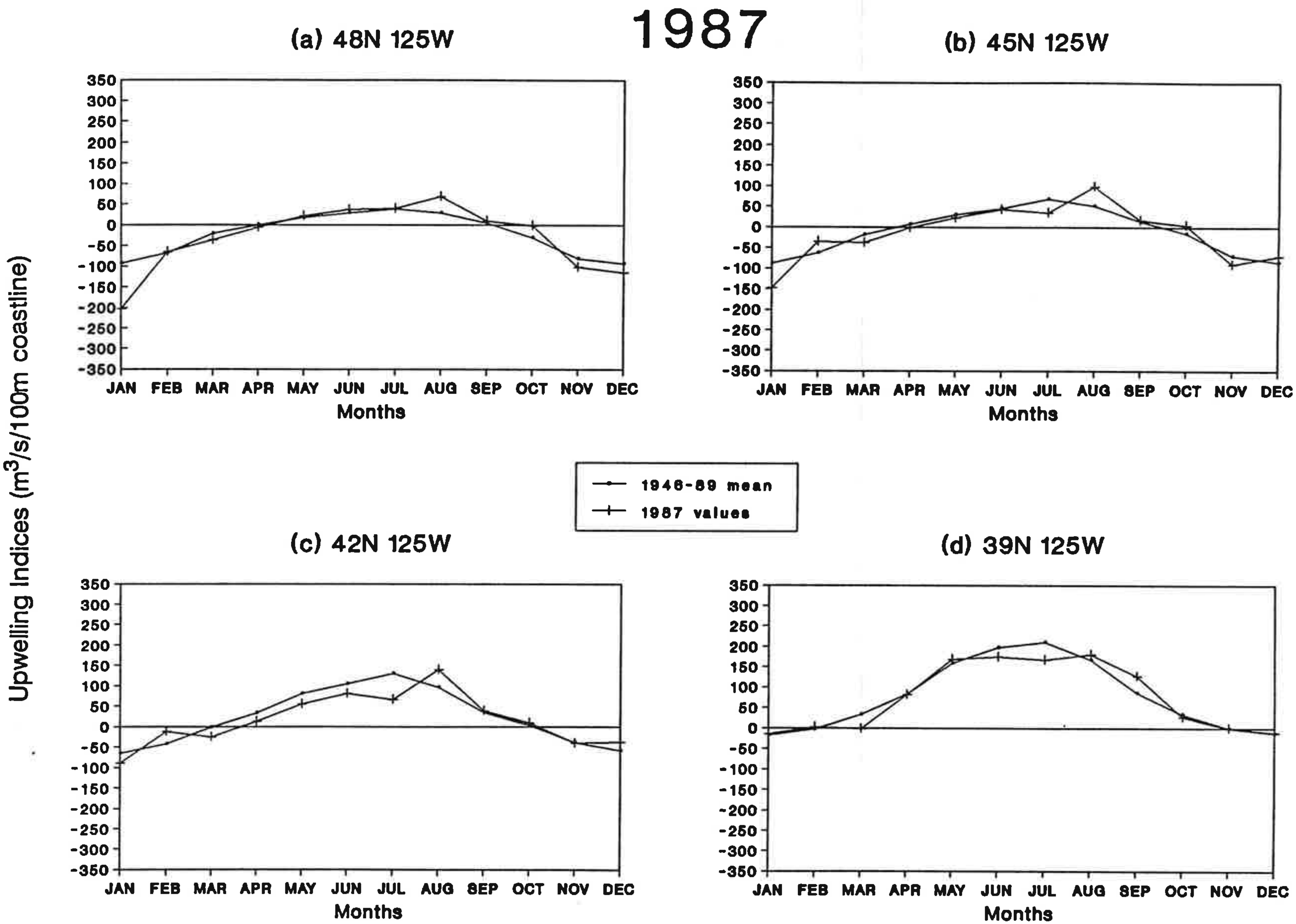

Figure 22. Monthly upwelling indices for 1987 at four locations along the west coast plotted with mean values for 1946 to 1989.

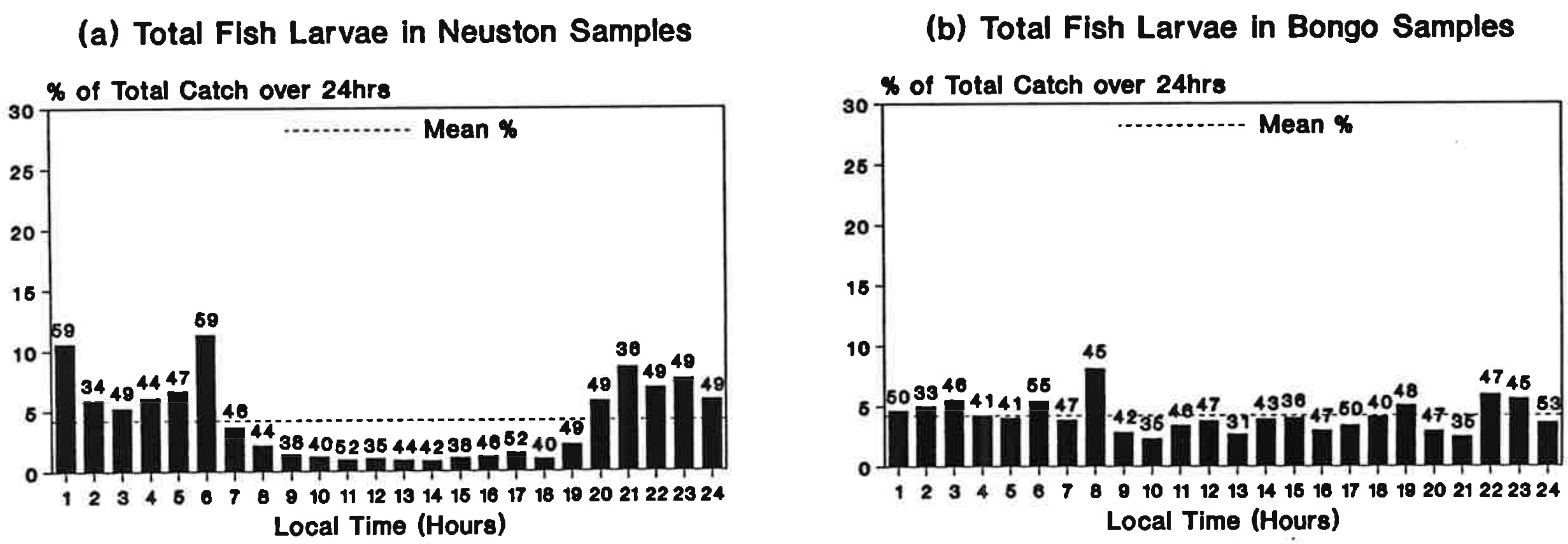

Figure 23. Diel variation in total catch of fish larvae in (a) neuston, and (b) bongo samples.
For each hourly interval, abundance was summed for all stations (10 cruises combined) where larvae were found.
The percentage of total catch accounted for by each hourly interval was then calculated.
Numbers above the bars are the total number of samples collected in which fish larvae were caught.

Table 3. Numbers of taxonomic categories identified for each life-history stage and sampling gear. Numbers in parentheses are the number of identifications to genus level only.

TAXONOMIC CATEGORIES	NEUSTON	BONGO
<u>EGGS</u>		
FAMILIES	17	19
GENERA	26(3)	28(3)
SPECIES	25	31
UNIDENTIFIED	5	7
<u>LARVAE</u>		
FAMILIES	23	38
GENERA	45(8)	85(17)
SPECIES	47	84
UNIDENTIFIED	0	0

Table 4. Percentage occurrence and mean abundance of all taxa of eggs in neuston samples collected during all cruises.

FAMILY	GENUS/SPECIES	% OCCURRENCE	MEAN No./1000m^3
Unidentified	Teleost Type A	1.89	1.67
	Teleost Type F	0.38	1.11
	Teleost Type G	0.09	0.02
	Teleost Type H	0.28	0.27
	Teleost Type P	0.19	0.03
Engraulidae	*Engraulis mordax*	2.74	32.28
Argentinidae	Unidentified	0.19	0.02
	Nansenia candida	0.28	0.04
	Nansenia crassa	0.38	0.07
Bathylagidae	Unidentified	1.51	0.60
	Bathylagus spp.	1.42	0.26
	Bathylagus ochotensis	0.28	0.04
Chauliodontidae	*Chauliodus macouni*	10.21	2.23
Melanostomidae	*Tactostoma macropus*	2.65	4.88
Myctophidae	Unidentified	0.09	0.02
Gadidae	*Merluccius productus*	0.09	0.01
	Theragra chalcogramma	0.19	0.07
Scomberesocidae	*Cololabis saira*	1.04	2.70
Trachipteridae	Unidentified	0.66	0.12
	Trachipterus altivelis	39.98	37.77
Scorpaenidae	*Sebastolobus* spp.	1.51	57.49
Carangidae	*Trachurus symmetricus*	0.19	0.08
Icosteidae	*Icosteus aenigmaticus*	10.21	5.54
Ammodytidae	*Ammodytes hexapterus*	0.09	0.02
Centrolophidae	*Icichthys lockingtoni*	30.15	43.48
Tetragonuridae	*Tetragonurus cuvieri*	0.47	0.13
Paralichthyidae	*Citharichthys* A	18.71	365.94
	Citharichthys B	8.32	23.43
Pleuronectidae	Unidentified	10.40	76.18
	Errex zachirus	8.88	13.05
	Hippoglossoides elassodon	0.57	0.13
	Pleuronectes isolepis	1.80	0.55
	Eopsetta exilis	5.86	4.13
	Microstomus pacificus	14.75	42.19
	Pleuronectes vetulus	3.50	3.13
	Platichthys stellatus	1.13	0.81
	Pleuronichthys coenosus	0.76	0.17
	Pleuronichthys decurrens	3.02	1.15
	Psettichthys melanostictus	4.44	3.43

Table 5. Percentage occurrence and mean abundance of all taxa of larvae in neuston samples collected during all cruises.

FAMILY	GENUS/SPECIES	% OCCURRENCE	MEAN No./1000m^3
Clupeidae	*Clupea harengus pallasi*	0.58	0.19
Engraulidae	*Engraulis mordax*	3.88	9.99
Osmeridae	Unidentified	1.23	1.07
Argentinidae	*Nansenia candida*	0.09	0.01
Bathylagidae	Unidentified	0.09	0.02
	Bathylagus spp.	0.09	0.02
	Bathylagus ochotensis	1.13	0.25
Myctophidae	Unidentified	0.19	0.02
	Ceratoscopelus townsendi	0.09	0.02
	Diaphus theta	0.28	0.04
	Lampanyctus regalis	0.09	0.02
	Protomyctophum crockeri	0.19	0.05
	Protomyctophum thompsoni	0.09	0.01
	Tarletonbeania crenularis	5.95	5.56
	Stenobrachius leucopsarus	1.42	0.65
	Symbolophorus californiense	0.19	0.03
Merluccidae	*Merluccius productus*	0.09	0.02
Gadidae	*Microgadus proximus*	0.09	0.01
	Theragra chalcogramma	0.09	0.01
Scomberesocidae	*Cololabis saira*	31.29	16.71
Scorpaenidae	Unidentified	0.09	0.19
	Sebastes spp.	18.05	19.86
	Sebastolobus spp.	0.09	0.05
Anoplopomatidae	*Anoplopoma fimbria*	22.02	26.46
Hexagrammidae	Unidentified	0.19	0.14
	Ophiodon elongatus	4.16	3.39
	Pleurogrammus monopterygius	0.19	0.04
	Hexagrammos spp.	0.19	0.06
	Hexagrammos decagrammus	19.01	15.16
	Hexagrammos lagocephalus	5.01	1.61
	Hexagrammos stelleri	0.09	0.04
Cottidae	Unidentified	0.28	0.04
	Artedius fenestralis	0.28	0.08
	Artedius harringtoni	0.28	0.08
	Cottus asper	0.09	0.01
	Hemilepidotus hemilepidotus	3.02	1.24
	Hemilepidotus spinosus	13.14	40.84
	Leptocottus armatus	0.76	0.21
	Radulinus spp.	0.09	0.16
	Radulinus asprellus	0.09	0.01
	Scorpaenichthys marmoratus	16.54	8.38

Table 5 continued.

FAMILY	GENUS/SPECIES	% OCCURRENCE	MEAN No./1000m^3
Agonidae	Unidentified	0.09	0.01
Cyclopteridae	Unidentified	0.94	0.16
Carangidae	*Trachurus symmetricus*	0.09	0.09
Bathymasteridae	*Bathymaster* spp.	0.19	0.03
	Ronquilus jordani	3.49	1.75
Stichaeidae	Unidentified	0.09	0.22
Cryptacanthodidae	*Delolepis gigantea*	0.09	0.01
	Cryptacanthodes aleutensis	1.42	1.83
Pholidae	*Pholis* spp.	0.09	0.02
Ammodytidae	*Ammodytes hexapterus*	4.06	7.11
Centrolophidae	*Icichthys lockingtoni*	0.39	0.07
Paralichthyidae	*Citharichthys* spp.	0.57	0.44
	Citharichthys sordidus	0.19	0.03
	Citharichthys stigmaeus	1.51	0.24
Pleuronectidae	*Eopsetta jordani*	0.28	0.09
	Errex zachirus	0.09	0.43
	Pleuronectes isolepis	0.28	0.22
	Microstomus pacificus	0.19	0.03
	Pleuronectes vetulus	1.42	0.44
	Platichthys stellatus	0.19	0.02
	Pleuronichthys decurrens	0.28	0.35
	Psettichthys sp. (2)	0.09	0.01
	Psettichthys melanostictus	0.28	0.06

Table 6. Percentage occurrence and mean abundance of all taxa of eggs in bongo samples collected during all cruises.

FAMILY	GENUS/SPECIES	% OCCURRENCE	MEAN No./10m^2
Unidentified	Teleost Type A	0.09	0.01
	Teleost Type C	0.28	0.03
	Teleost Type E	0.76	0.06
	Teleost Type G	6.14	1.21
	Teleost Type H	0.09	0.01
	Teleost Type M	0.85	0.11
	Teleost Type P	0.85	0.15
Engraulidae	*Engraulis mordax*	2.17	6.48
Argentinidae	Unidentified	1.51	0.13
	Nansenia candida	2.27	0.24
	Nansenia crassa	0.66	0.05
	Argentina sialis	0.09	0.01
	Microstoma microstoma	0.38	0.03
Bathylagidae	Unidentified	29.96	10.76
	Bathylagus spp.	18.71	3.49
	Bathylagus milleri	1.98	0.37
	Bathylagus ochotensis	7.56	1.21
	Bathylagus wesethi	0.09	0.01
Gonostomatidae	Unidentified	0.09	0.01
Chauliodontidae	*Chauliodus macouni*	20.69	2.45
Melanostomidae	*Tactostoma macropus*	2.17	0.63
Myctophidae	Unidentified	14.27	59.91
	Myctophidae B	0.19	0.09
Merluccidae	*Merluccius productus*	3.31	0.48
Gadidae	*Theragra chalcogramma*	0.85	0.07
Scomberesocidae	*Cololabis saira*	0.94	0.29
Trachipteridae	*Trachipterus altivelis*	32.61	4.29
Melamphaeidae	Unidentified	0.09	0.01
Scorpaenidae	*Sebastolobus* spp.	0.76	0.52
Carangidae	*Trachurus symmetricus*	0.09	0.08
Icosteidae	*Icosteus aenigmaticus*	13.04	2.06
Centrolophidae	*Icichthys lockingtoni*	20.71	3.48
Tetragonuridae	*Tetragonurus cuvieri*	0.95	0.13
Paralichthyidae	*Citharichthys* A	18.15	42.24
	Citharichthys B	7.85	2.61
Pleuronectidae	Unidentified	11.91	14.43
	Errex zachirus	15.12	3.76
	Hippoglossoides elassodon	0.19	0.02
	Pleuronectes isolepis	2.08	0.37
	Eopsetta exilis	21.83	14.03
	Microstomus pacificus	14.37	2.88
	Pleuronectes vetulus	3.59	0.95
	Platichthys stellatus	1.42	0.29
	Pleuronichthys coenosus	0.09	0.01
	Pleuronichthys decurrens	1.32	0.09
	Pleuronichthys verticalis	0.09	0.01
	Psettichthys melanostictus	4.82	0.58
	Hippoglossus stenolepis	0.76	0.01

Table 7. Percentage occurrence and mean abundance of all taxa of larvae in bongo samples collected during all cruises.

FAMILY	GENUS/SPECIES	% OCCURRENCE	MEAN No./10m²
Eurypharyngidae	*Eurypharynx* spp.	0.09	0.01
Clupeidae	*Clupea harengus pallasi*	0.19	0.02
Engraulidae	*Engraulis mordax*	5.67	13.16
Osmeridae	Unidentified	4.91	5.77
	Osmerus mordax	0.09	0.01
Argentinidae	*Nansenia candida*	5.86	0.82
	Argentina sialis	0.09	0.01
	Microstoma microstoma	0.19	0.01
Bathylagidae	Unidentified	2.08	0.44
	Bathylagus spp.	0.28	0.05
	Bathylagus milleri	1.79	0.11
	Bathylagus ochotensis	34.02	13.49
	Bathylagus pacificus	11.72	1.38
	Leuroglossus stilbius	0.19	0.04
Opisthoproctidae	*Macropinna microstoma*	0.19	0.01
Gonostomatidae	*Cyclothone* spp.	1.42	0.10
Sternoptychidae	*Argyropelecus* spp.	0.66	0.05
	Argyropelecus lychnus	0.28	0.18
	Argyropelecus sladeni	0.09	0.01
	Danaphos oculatus	0.85	0.06
Chauliodontidae	*Chauliodus macouni*	13.52	1.15
Melanostomidae	*Tactostoma macropus*	0.47	0.05
Scopelosauridae	*Scopelosaurus* spp.	0.09	0.01
Myctophidae	Unidentified	3.97	1.48
	Cerastoscopelus townsendii	0.19	0.01
	Diaphus theta	18.53	19.61
	Diogenichthys spp.	0.09	0.01
	Diogenichthys atlanticus	0.09	0.01
	Lampanyctus spp.	5.01	0.77
	Lampanyctus regalis	2.93	0.31
	Lampanyctus ritteri	6.90	0.91
	Protomyctophum crockeri	24.10	3.09
	Protomyctophum thompsoni	12.10	1.28
	Tarletonbeania crenularis	34.40	7.96
	Stenobrachius spp.	0.19	0.03
	Stenobrachius leucopsarus	56.33	71.65
	Symbolophorus californiense	0.47	0.04
	Loweina rara	0.09	0.01
Paralepididae	*Notolepis rissoi*	0.09	0.01
	Lestidiops ringens	9.64	0.96
Scopelarchidae	*Benthalbella dentata*	0.09	0.01

Table 7 continued.

FAMILY	GENUS/SPECIES	% OCCURRENCE	MEAN No./10m^2
Merluccidae	*Merluccius productus*	0.38	0.23
Gadidae	Unidentified	0.09	0.01
	Gadus macrocephalus	0.47	0.06
	Microgadus proximus	3.12	0.70
	Theragra chalcogramma	0.38	0.05
Macrouridae	Unidentified	0.09	0.01
Ophididae	Unidentified	0.76	0.08
Bythitidae	*Brosmophycis marginata*	0.28	0.02
Scomberesocidae	*Cololabis saira*	0.47	0.04
Trachipteridae	*Trachipterus altivelis*	2.08	0.15
Melamphaeidae	Unidentified	4.91	0.52
	Melamphaes spp.	0.94	0.08
	Melamphaes lugubris	0.57	0.05
Scorpaenidae	Unidentified	0.85	0.08
	Sebastes spp.	43.57	18.95
	Sebastes paucispinus	0.38	0.03
	Sebastolobus spp.	7.66	1.24
Anoplopomatidae	*Anoplopoma fimbria*	1.23	0.15
Hexagrammidae	*Ophiodon elongatus*	0.47	0.04
	Oxylebius pictus	0.09	0.01
	Hexagrammos decagrammus	0.66	0.04
	Hexagrammos stelleri	0.09	0.01
Cottidae	Unidentified	0.47	0.03
	Artedius spp.	0.19	0.07
	Artedius fenestralis	0.85	0.08
	Artedius harringtoni	3.31	0.33
	Artedius meanyi	0.85	0.11
	Cottus asper	0.19	0.09
	Hemilepidotus hemilepidotus	0.28	0.02
	Hemilepidotus spinosus	1.89	0.20
	Leptocottus armatus	0.57	0.37
	Paracelinus hopliticus	0.28	0.05
	Radulinus asprellus	1.32	0.09
	Radulinus boleoides	0.19	0.01
	Scorpaenichthys marmoratus	0.85	0.05
	Chitonotus pugetensis	0.09	0.01
	Icelus spp.	0.09	0.01
Agonidae	Unidentified	1.42	0.10
	Agonidae A	0.28	0.02
	Bathragonus swani	0.09	0.01
Cyclopteridae	Unidentified	10.11	0.92
	Liparus pulchellus	0.09	0.01

Table 7 continued.

FAMILY	GENUS/SPECIES	% OCCURRENCE	MEAN No./10m^2
Carangidae	*Trachurus symmetricus*	0.19	0.17
Bathymasteridae	*Bathymaster* spp.	0.09	0.01
	Ronquilus jordani	2.08	0.30
Stichaeidae	Unidentified	0.66	0.05
	Chirolophis spp.	0.28	0.02
	Plectobranchius evides	0.09	0.01
	Poroclinus rothrocki	0.19	0.02
	Stichaeus punctatus	0.09	0.01
Cryptacanthodidae	*Cryptacanthodes aleutensis*	0.19	0.01
Pholidae	*Pholis* spp.	0.19	0.02
Icosteidae	*Icosteus aenigmaticus*	1.04	0.09
Ammodytidae	*Ammodytes hexapterus*	1.80	0.24
Gobiidae	*Clevlandia ios*	0.09	0.01
	Lepidogobius lepidus	0.19	0.01
Centrolophidae	*Icichthys lockingtoni*	4.35	0.40
Tetragonuridae	*Tetragonurus cuvieri*	0.19	0.02
Paralichthyidae	*Citharichthys* spp.	4.16	1.92
	Citharichthys sordidus	6.71	0.73
	Citharichthys stigmaeus	6.61	0.58
Pleuronectidae	Unidentified	0.19	0.02
	Atheresthes stomias	0.66	0.06
	Embassichthys bathybius	0.19	0.02
	Eopsetta jordani	0.09	0.01
	Errex zachirus	6.24	0.78
	Hippoglossoides elassodon	0.47	0.03
	Pleuronectes isolepis	4.35	0.75
	Lepidopsetta bilineata	0.09	0.01
	Eopsetta exilis	16.07	3.17
	Microstomus pacificus	3.21	0.33
	Pleuronectes vetulus	5.20	2.05
	Platichthys stellatus	1.89	0.21
	Pleuronichthys coenosus	0.09	0.01
	Psettichthys melanostictus	4.06	0.52
	Rheinhardtius hippoglossoides	0.28	0.03

Table 8. List of dominant ichthyoplankton taxa and their association as eggs or larvae with the different sampling gears.

FAMILY	GENUS/SPECIES	NEUSTON		BONGO	
		EGGS	LARVAE	EGGS	LARVAE
ENGRAULIDAE	*Engraulis mordax*	X	X	X	X
OSMERIDAE	Unidentified				X
BATHYLAGIDAE	Unidentified			X	
	Bathylagus spp.			X	
	Bathylagus ochotensis			X	X
	Bathylagus pacificus				X
CHAULIODONTIDAE	*Chauliodus macouni*	X		X	X
MELANOSTOMIDAE	*Tactostoma macropus*	X			
MYCTOPHIDAE	Unidentified			X	X
	Diaphus theta				X
	Protomyctophum crockeri				X
	Protomyctophum thompsoni				X
	Tarletonbeania crenularis		X		X
	Stenobrachius leucopsarus				X
SCOMBERESOCIDAE	*Cololabis saira*		X		
TRACHIPTERIDAE	*Trachipterus altivelis*	X		X	
SCORPAENIDAE	*Sebastes* spp.		X		X
	Sebastolobus spp.				X
ANOPLOPOMATIDAE	*Anoplopoma fimbria*		X		
HEXAGRAMMIDAE	*Ophiodon elongatus*		X		
	Hexagrammos decagrammus		X		
	Hexagrammos lagocephalus		X		
COTTIDAE	*Hemilepidotus hemilepidotus*		X		
	Hemilepidotus spinosus		X		
	Scorpaenichthys marmoratus		X		
BATHYMASTERIDAE	*Ronquilus jordani*		X		
CRYPTACANTHODIDAE	*Cryptacanthodes aleutensis*		X		
ICOSTEIDAE	*Icosteus aenigmaticus*	X		X	
AMMODYTIDAE	*Ammodytes hexapterus*		X		
CENTROLOPHIDAE	*Icichthys lockingtoni*	X		X	
PARALICHTHYIDAE	*Citharichthys* spp.	X		X	
	Citharichthys sordidus				X
	Citharichthys stigmaeus				X
PLEURONECTIDAE	Unidentified	X		X	
	Errex zachirus	X		X	X
	Pleuronectes isolepis	X			X
	Eopsetta exilis	X		X	X
	Microstomus pacificus	X		X	
	Pleuronectes vetulus	X		X	X
	Psettichthys melanostictus	X		X	X

Table 9. Relative abundance of dominant taxa of fish eggs in neuston samples collected during all cruises.

FAMILY	GENUS/SPECIES	PERCENTAGE OF TOTAL ABUNDANCE
Engraulidae	*Engraulis mordax*	4.44
Chauliodontidae	*Chauliodus macouni*	0.30
Melanostomidae	*Tactostoma macropus*	0.69
Scomberesocidae	*Cololabis saira*	0.36
Trachipteridae	*Trachipterus altivelis*	5.19
Scorpaenidae	*Sebastolobus* spp.	7.93
Icosteidae	*Icosteus aenigmaticus*	0.76
Centrolophidae	*Icichthys lockingtoni*	5.99
Paralichthyidae	*Citharichthys* A	50.38
	Citharichthys B	5.90
Pleuronectidae	Unidentified	10.48
	Errex zachirus	1.79
	Eopsetta exilis	0.55
	Microstomus pacificus	5.80
	Pleuronectes vetulus	0.93
	Psettichthys melanostictus	0.42

Table 10. Relative abundance of dominant taxa of fish larvae in neuston samples collected during all cruises.

FAMILY	GENUS/SPECIES	PERCENTAGE OF TOTAL ABUNDANCE
Engraulidae	*Engraulis mordax*	5.96
Osmeridae	Unidentified	0.26
Myctophidae	*Tarletonbeania crenularis*	3.33
	Stenobrachius leucopsarus	0.26
Scomberesocidae	*Cololabis saira*	10.08
Scorpaenidae	*Sebastes* spp.	11.99
Anoplopomatidae	*Anoplopoma fimbria*	15.97
Hexagrammidae	*Ophiodon elongatus*	1.95
	Hexagrammos decagrammus	9.15
	Hexagrammos lagocephalus	0.91
Cottidae	*Hemilepidotus hemilepidotus*	0.74
	Hemilepidotus spinosus	24.65
	Scorpaenichthys marmoratus	5.06
Bathymasteridae	*Ronquilus jordani*	1.05
Cryptacanthodidae	*Cryptacanthodes aleutensis*	1.00
Ammodytidae	*Ammodytes hexapterus*	4.16

Table 11. Relative abundance of dominant taxa of fish eggs in bongo samples collected during all cruises.

FAMILY	GENUS/SPECIES	PERCENTAGE OF TOTAL ABUNDANCE
Engraulidae	*Engraulis mordax*	3.54
Bathylagidae	Unidentified	5.89
	Bathylagus spp.	1.91
	Bathylagus ochotensis	0.65
Chauliodontidae	*Chauliodus macouni*	1.34
Melanostomidae	*Tactostoma macropus*	0.35
Myctophidae	Unidentified	32.82
Trachipteridae	*Trachipterus altivelis*	2.35
Icosteidae	*Icosteus aenigmaticus*	1.13
Centrolophidae	*Icichthys lockingtoni*	1.91
Paralichthyidae	*Citharichthys* A	23.01
	Citharichthys B	1.39
Pleuronectidae	Unidentified	7.91
	Errex zachirus	2.05
	Eopsetta exilis	7.68
	Microstomus pacificus	1.57
	Pleuronectes vetulus	0.51

Table 12. Relative abundance of dominant taxa of fish larvae in bongo samples collected during all cruises.

FAMILY	GENUS/SPECIES	PERCENTAGE OF TOTAL ABUNDANCE
Engraulidae	*Engraulis mordax*	7.15
Osmeridae	Unidentified	3.04
Bathylagidae	*Bathylagus ochotensis*	7.31
	Bathylagus pacificus	0.84
Chauliodontidae	*Chauliodus macouni*	0.63
Myctophidae	Unidentified	0.96
	Diaphus theta	10.64
	Protomyctophum crockeri	1.68
	Protomyctophum thompsoni	0.69
	Tarletonbeania crenularis	4.32
	Stenobrachius leucopsarus	38.90
Scorpaenidae	*Sebastes* spp.	10.29
	Sebastolobus spp.	0.62
Paralichthyidae	*Citharichthys* spp.	1.00
	Citharichthys sordidus	0.35
	Citharichthys stigmaeus	0.27
Pleuronectidae	*Errex zachirus*	0.46
	Pleuronectes isolepis	0.35
	Eopsetta exilis	1.70
	Pleuronectes vetulus	1.10

Table 13a. Mean abundance (no./1000m³) of dominant taxa of eggs in neuston samples for each sampling period. Cruises arranged in order of timing of sampling. No eggs identified from neuston samples collected during cruise PO82. * = Taxon present but occurred in less than 5% of the samples. – = Taxon absent from samples.

	Early Spring	Spring	Spring	Spring	Late Spring	Late Summer	Late Autumn	Late Autumn	Winter
TAXA	PO84	BA85	TK80	EQ83	PO81	PO80	DA81	MF83	MF87
Teleost Type A	*	*	3.15	5.65	–	–	–	–	–
Teleost Type F	–	–	–	–	–	–	8.40	–	–
Engraulis mordax	–	–	86.65	156.23	1.14	46.51	–	*	–
Bathylagidae (unidentified)	*	–	–	–	–	*	–	*	5.65
Bathylagus spp.	0.79	–	–	–	–	–	–	*	1.83
Chauliodus macouni	1.84	–	1.75	*	1.17	1.38	4.54	3.88	6.33
Tactostoma macropus	–	–	–	–	–	56.78	–	–	–
Cololabis saira	–	–	*	–	*	30.01	*	–	–
Trachipterus altivelis	29.80	72.08	12.73	102.14	28.99	1.30	54.18	11.57	14.83
Sebastolobus spp.	1.23	–	–	15.38	477.75	–	–	–	–
Icosteus aenigmaticus	16.38	9.65	4.34	12.35	1.37	–	*	–	4.48
Icichthys lockingtoni	18.58	46.36	23.23	48.85	130.20	26.03	64.87	8.71	18.51
Citharichthys A	12.81	9.41	176.45	662.84	167.55	466.35	978.52	16.88	1065.62
Citharichthys B	3.57	*	6.62	7.92	*	100.67	46.01	10.77	72.76
Pleuronectidae (unidentified)	43.96	11.40	46.35	5.20	*	79.36	28.50	28.68	607.49
Errex zachirus	52.11	5.78	34.05	11.54	7.89	1.06	–	–	*
Pleuronectes isolepis	1.21	–	1.43	–	*	–	–	*	2.38
Eopsetta exilis	15.45	6.16	10.98	*	2.10	–	–	–	*
Microstomus pacificus	98.23	49.10	125.19	59.57	31.83	*	–	–	–
Pleuronectes vetulus	2.87	*	–	–	–	–	13.02	1.30	12.88
Platichthys stellatus	*	*	*	–	–	–	–	–	7.31
Psettichthys melanostictus	3.83	*	3.48	*	*	20.54	1.31	1.41	1.65
Pleuronichthys decurrens	3.46	*	*	*	*	–	2.30	2.97	1.83
Total Fish Eggs	311.30	218.67	541.53	1095.25	852.82	834.88	1204.89	87.72	1825.41

Table 13b. Relative abundance of dominant taxa of eggs in neuston samples (% of total egg abundance) for each sampling period. Cruises arranged in order of timing of sampling. No eggs identified from neuston samples collected during cruise PO82. * = Taxon present but occurred in less than 5% of the samples. – = Taxon absent from samples.

TAXA	Early Spring PO84	Spring BA85	Spring TK80	Spring EQ83	Late Spring PO81	Late Summer PO80	Late Autumn DA81	Late Autumn MF83	Winter MF87
Teleost Type A	*	*	0.58	0.52	–	–	–	–	–
Teleost Type F	–	–	–	–	–	–	0.70	–	–
Engraulis mordax	–	–	16.00	14.26	0.13	5.57	–	*	–
Bathylagidae (unidentified)	*	–	–	–	–	*	–	*	0.31
Bathylagus spp.	0.25	–	–	–	–	–	–	*	0.10
Chauliodus macouni	0.59	–	0.32	*	0.14	0.17	0.38	4.42	0.35
Tactostoma macropus	–	–	–	–	–	6.80	–	–	–
Cololabis saira	–	–	*	–	*	3.59	*	–	–
Trachipterus altivelis	9.57	32.96	2.35	9.33	3.40	0.16	4.50	13.19	0.81
Sebastolobus spp.	0.39	–	–	1.40	56.02	–	–	–	–
Icosteus aenigmaticus	5.26	4.41	0.80	1.13	0.16	–	*	–	0.25
Icichthys lockingtoni	5.97	21.20	4.29	4.46	15.27	3.12	5.38	9.93	1.01
Citharichthys A	4.11	4.30	32.58	60.52	19.65	55.86	81.21	19.25	58.38
Citharichthys B	1.15	*	1.22	0.72	*	12.06	3.82	12.28	3.99
Pleuronectidae (unidentified)	14.12	5.21	8.56	0.47	*	9.51	2.37	32.70	33.28
Errex zachirus	16.74	2.64	6.29	1.05	0.92	0.13	–	–	*
Pleuronectes isolepis	0.39	–	0.26	–	*	–	–	*	0.13
Eopsetta exilis	4.96	2.82	2.03	*	0.25	–	–	–	*
Microstomus pacificus	31.55	22.46	23.12	5.44	3.73	*	–	–	–
Pleuronectes vetulus	0.92	*	–	–	–	–	1.08	1.48	0.71
Platichthys stellatus	*	*	*	–	–	–	–	–	0.40
Psettichthys melanostictus	1.23	*	0.64	*	*	2.46	0.11	1.61	0.09
Pleuronichthys decurrens	1.11	*	*	*	*	–	0.19	3.39	0.10

Table 14a. Mean abundance (no./1000m^3) of dominant taxa of larvae in neuston samples for each sampling period. Cruises arranged in order of timing of sampling.
* = Taxon present but occurred in less than 5% of the samples. — = Taxon absent from samples.

TAXA	Early Spring PO84	Spring BA85	Spring TK80	Spring EQ83	Late Spring PO82	Late Spring PO81	Late Summer PO80	Late Autumn DA81	Late Autumn MF83	Winter MF87
Engraulis mordax	—	—	*	11.87	—	—	51.60	34.27	—	*
Osmeridae (unidentified)	*	—	—	—	*	*	4.97	—	*	*
Bathylagus ochotensis	*	*	*	*	0.53	*	—	—	—	—
Tarletonbeania crenularis	*	1.44	—	—	*	—	—	2.44	24.97	28.69
Stenobrachius leucopsarus	—	*	3.80	—	—	*	*	*	—	*
Cololabis saira	25.35	0.70	20.38	32.54	4.05	5.83	4.35	27.87	18.74	8.34
Sebastes spp.	5.05	15.85	49.27	52.13	11.58	4.73	39.74	1.52	0.42	1.94
Anoplopoma fimbria	29.90	54.98	94.09	40.08	7.01	2.73	—	—	—	—
Ophiodon elongatus	3.29	18.19	4.27	*	1.99	*	—	—	*	*
Hexagrammos decagrammus	24.05	28.28	6.72	6.54	2.86	—	—	5.82	0.83	76.74
Hexagrammos lagocephalus	0.83	*	*	—	—	*	—	3.96	1.21	9.83
Hemilepidotus hemilepidotus	1.34	4.19	2.57	*	—	—	—	—	—	3.46
Hemilepidotus spinosus	75.07	83.70	52.59	13.63	11.19	—	—	—	*	160.54
Scorpaenichthys marmoratus	7.47	3.28	16.54	14.98	2.01	6.69	7.60	4.68	5.83	7.81
Ronquilus jordani	—	*	1.73	4.88	4.12	2.12	2.80	—	—	—
Cryptacanthodes aleutensis	3.57	10.57	*	—	—	—	—	—	—	*
Ammodytes hexapterus	40.74	*	12.70	1.91	3.88	*	—	—	—	—
Total Fish Larvae	232.26	225.41	274.44	181.87	51.00	24.57	116.41	85.68	49.50	304.81

Table 14b. Relative abundance of dominant taxa of larvae in neuston samples (% of total larval abundance) for each sampling period. Cruises arranged in order of timing of sampling.
* = Taxon present but occurred in less than 5% of samples. — = Taxon absent from samples.

TAXA	Early Spring PO84	Spring BA85	Spring TK80	Spring EQ83	Late Spring PO82	Late Spring PO81	Late Summer PO80	Late Autumn DA81	Late Autumn MF83	Winter MF87
Engraulis mordax	—	—	*	6.52	—	—	44.33	39.99	—	*
Osmeridae (unidentified)	*	—	—	—	*	*	4.27	—	*	*
Bathylagus ochotensis	*	*	*	*	1.05	*	—	—	—	—
Tarletonbeania crenularis	*	0.64	—	—	*	—	—	2.85	50.43	9.41
Stenobrachius leucopsarus	—	*	1.38	—	—	*	*	*	—	*
Cololabis saira	10.92	0.31	7.43	17.89	7.94	23.74	3.74	32.53	37.86	2.74
Sebastes spp.	2.17	7.03	17.95	28.67	22.71	19.27	34.13	1.77	0.86	0.64
Anoplopoma fimbria	12.87	24.39	34.28	22.04	13.75	11.11	—	—	—	—
Ophiodon elongatus	1.42	8.07	1.56	*	3.90	*	—	—	*	*
Hexagrammos decagrammus	10.35	12.55	2.45	3.60	5.60	—	—	6.79	1.67	25.18
Hexagrammos lagocephalus	0.36	*	*	—	—	*	—	4.62	2.44	3.22
Hemilepidotus hemilepidotus	0.58	1.86	0.94	*	—	—	—	—	—	1.13
Hemilepidotus spinosus	32.32	37.13	19.16	7.49	21.93	—	—	—	*	52.67
Scorpaenichthys marmoratus	3.21	1.46	6.03	8.24	3.95	27.21	6.53	5.46	11.78	2.56
Ronquilus jordani	—	*	0.63	2.69	8.07	8.63	2.40	—	—	—
Cryptacanthodes aleutensis	1.54	4.69	*	—	—	—	—	—	—	*
Ammodytes hexapterus	17.54	*	4.63	1.05	7.62	*	—	—	—	—

Table 15a. Mean abundance (no./10m^2) of dominant taxa of eggs in bongo samples for each sampling period. Cruises arranged in order of timing of sampling.
* = Taxon present but occurred in less than 5% of the samples. – = Taxon absent from samples.

	Early Spring	Spring	Spring	Spring	Late Spring	Late Spring	Late Summer	Late Autumn	Late Autumn	Winter
TAXA	PO84	BA85	TK80	EQ83	PO82	PO81	PO80	DA81	MF83	MF87
Teleost Type G	–	–	–	–	–	*	–	5.83	3.41	1.44
Engraulis mordax	–	–	22.84	31.66	–	–	1.78	–	*	–
Argentinidae (unidentified)	*	–	*	–	–	*	0.60	*	–	–
Nansenia candida	0.87	–	–	–	*	0.56	–	–	–	0.82
Bathylagidae (unidentified)	29.99	4.33	3.87	4.55	2.26	4.56	0.35	10.27	6.60	38.26
Bathylagus spp.	13.05	1.26	–	2.62	2.01	1.44	–	3.37	4.46	4.43
Bathylagus milleri	–	–	–	–	–	–	–	–	–	4.48
Bathylagus ochotensis	2.73	–	5.60	0.62	–	*	–	0.70	0.69	*
Chauliodus macouni	2.16	2.33	1.68	1.56	1.69	2.23	1.62	4.12	1.42	5.23
Tactostoma macropus	–	–	–	–	–	–	7.38	–	–	–
Myctophidae (unidentified)	116.47	111.19	119.49	38.09	105.34	88.88	–	–	–	–
Merluccius productus	2.44	–	–	1.49	–	–	–	–	*	–
Trachipterus altivelis	3.48	8.68	3.10	4.68	3.44	2.06	*	4.84	6.12	4.00
Sebastolobus spp.	4.06	*	–	–	*	–	–	–	–	–
Icosteus aenigmaticus	6.08	2.79	2.80	2.08	1.21	0.75	–	*	–	3.74
Icichthys lockingtoni	1.81	3.06	3.32	1.70	8.41	1.63	3.71	5.18	1.33	8.21
Citharichthys A	2.04	*	32.16	45.40	67.64	35.19	16.58	168.83	3.16	46.43
Citharichthys B	0.82	–	*	2.33	2.43	1.89	6.67	5.84	1.68	4.67
Pleuronectidae (unidentified)	19.43	12.63	17.05	3.91	2.15	10.46	1.86	11.66	4.82	59.09
Errex zachirus	9.83	3.68	2.69	5.74	14.56	4.19	0.30	–	–	*
Pleuronectes isolepis	0.77	*	1.71	*	*	*	*	–	*	*
Eopsetta exilis	17.35	18.45	28.71	22.47	30.46	21.74	*	–	–	–
Microstomus pacificus	3.98	3.64	4.99	6.50	7.44	2.35	0.29	–	–	*
Pleuronectes vetulus	1.43	*	–	–	–	–	–	3.42	1.18	2.69
Psettichthys melanostictus	1.50	–	0.76	*	0.74	*	0.75	0.67	0.92	*
Total Fish Eggs	245.89	180.21	255.22	180.15	252.33	179.57	43.98	226.80	35.30	187.92

Table 15b. Relative abundance of dominant taxa of eggs in bongo samples (% of total egg abundance) for each sampling period. Cruises arranged in order of timing of sampling.
* = Taxon present but occurred in less than 5% of the samples. – = Taxon absent from samples.

	Early Spring	Spring	Spring	Spring	Late Spring	Late Spring	Late Summer	Late Autumn	Late Autumn	Winter
TAXA	PO84	BA85	TK80	EQ83	PO82	PO81	PO80	DA81	MF83	MF87
Teleost Type G	–	–	–	–	–	*	–	2.57	9.65	0.77
Engraulis mordax	–	–	8.95	17.58	–	–	4.05	–	*	–
Argentinidae (unidentified)	*	–	*	–	–	*	1.36	*	–	–
Nansenia candida	0.36	–	–	–	*	0.31	–	–	–	0.44
Bathylagidae (unidentified)	12.20	2.40	1.52	2.52	0.89	2.54	0.78	4.53	18.70	20.36
Bathylagus spp.	5.31	0.70	–	1.45	0.80	0.80	–	1.49	12.63	2.35
Bathylagus milleri	–	–	–	–	–	–	–	–	–	2.39
Bathylagus ochotensis	1.11	–	2.20	0.34	–	*	–	0.31	1.96	*
Chauliodus macouni	0.88	1.29	0.66	0.87	0.67	1.24	3.68	1.82	4.01	2.78
Tactostoma macropus	–	–	–	–	–	–	16.79	–	–	–
Myctophidae (unidentified)	47.36	61.70	46.82	21.15	41.75	49.50	–	–	–	–
Merluccius productus	0.99	–	–	0.83	–	–	–	–	*	–
Trachipterus altivelis	1.42	4.82	1.21	2.60	1.37	1.15	*	2.13	17.33	2.13
Sebastolobus spp.	1.65	*	–	–	*	–	–	–	–	–
Icosteus aenigmaticus	2.47	1.55	1.10	1.16	0.48	0.42	–	*	–	1.99
Icichthys lockingtoni	0.74	1.70	1.30	0.94	3.33	0.91	8.44	2.28	3.77	4.37
Citharichthys A	0.83	*	12.60	25.20	26.81	19.60	37.69	74.44	8.94	24.71
Citharichthys B	0.33	–	*	1.29	0.96	1.05	15.17	2.58	4.74	2.48
Pleuronectidae (unidentified)	7.90	7.01	6.68	2.17	0.85	5.82	4.23	5.14	13.66	31.44
Errex zachirus	4.00	2.04	1.05	3.19	5.77	2.33	0.69	–	–	*
Pleuronectes isolepis	0.31	*	0.67	*	*	*	*	–	*	*
Eopsetta exilis	7.06	2.02	11.25	12.48	12.07	12.11	*	–	–	–
Microstomus pacificus	1.62	3.64	1.96	3.61	2.95	1.31	0.66	–	–	*
Pleuronectes vetulus	0.58	*	–	–	–	–	–	1.51	3.34	1.43
Psettichthys melanostictus	0.61	–	0.30	*	0.29	*	1.69	0.29	2.59	*

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Table 16a. Mean abundance (no./10m²) of dominant taxa of larvae in bongo samples for each sampling period. Cruises arranged in order of timing of sampling.
* = Taxon present but occurred in less than 5% of the samples. – = Taxon absent from samples.

TAXA	Early Spring PO84	Spring BA85	Spring TK80	Spring EQ63	Late Spring PO82	Late Spring PO81	Late Summer PO80	Late Autumn DA81	Late Autumn MF83	Winter MF87
Engraulis mordax	–	–	–	9.61	–	–	138.97	0.52	–	–
Osmeridae (unidentified)	2.67	26.20	8.72	*	3.76	*	*	–	–	12.71
Nansenia candida	4.82	*	*	1.00	–	0.57	–	–	–	–
Bathylagidae (unidentified)	2.43	*	–	–	–	*	–	–	–	1.50
Bathylagus milleri	*	*	–	–	–	*	*	0.37	*	*
Bathylagus ochotensis	40.15	13.92	13.24	26.00	11.92	9.10	0.20	*	*	6.58
Bathylagus pacificus	4.27	2.16	1.57	1.46	2.89	1.08	–	–	–	*
Cyclothone spp.	*	–	*	–	–	–	–	*	0.33	–
Chauliodus macouni	0.96	0.51	1.56	1.64	1.05	0.95	1.65	0.82	1.03	1.23
Myctophidae (unidentified)	*	1.72	3.97	1.21	11.52	*	5.24	*	*	*
Diaphus theta	1.93	44.26	6.84	36.69	65.67	38.74	6.14	*	0.72	3.82
Protomyctophum crockeri	4.10	2.61	3.44	2.67	2.79	4.52	1.31	2.44	1.78	3.94
Protomyctophum thompsoni	1.01	2.50	1.24	1.24	0.56	0.51	1.39	0.41	0.63	3.10
Tarletonbeania crenularis	17.22	11.52	1.50	10.84	5.46	7.12	7.56	4.67	2.05	7.48
Stenobrachius leucopsarus	117.76	99.90	69.54	96.06	102.32	145.30	20.21	*	3.15	9.13
Lestidiops ringens	1.31	1.44	*	1.20	1.06	*	*	1.07	1.24	0.68
Microgadus proximus	1.49	*	2.02	0.61	*	*	–	*	–	–
Trachipterus altivelis	0.32	*	*	*	*	*	–	*	*	*
Melamphaeidae (unidentified)	1.71	*	0.60	0.69	*	*	–	0.41	*	0.37
Sebastes spp.	40.94	9.21	12.03	16.08	30.19	21.67	25.70	6.60	1.74	29.67
Sebastolobus spp.	3.84	1.28	*	3.67	*	0.58	0.50	*	–	–
Artedius harringtoni	*	0.62	*	*	0.65	0.51	0.30	*	–	*
Hemilepidotus spinosus	0.34	*	*	–	–	–	–	–	*	1.26
Cyclopteridae (unidentified)	0.68	1.39	*	1.17	2.62	2.03	0.19	0.40	–	0.84
Ronquilus jordani	*	*	*	*	1.32	*	*	*	–	–
Ammodytes hexapterus	1.53	*	*	*	*	*	–	–	–	–
Icichthys lockingtoni	*	*	*	0.78	0.58	*	0.45	0.65	*	*
Citharichthys spp.	–	–	*	2.41	–	*	*	13.15	*	*
Citharichthys sordidus	*	–	*	*	–	0.77	*	2.63	1.45	0.64
Citharichthys stigmaeus	*	–	*	*	*	–	–	1.72	1.91	1.00
Errex zachirus	0.71	–	0.72	3.70	1.93	0.60	0.95	*	–	–
Pleuronectes isolepis	0.48	*	0.92	1.20	3.58	0.58	1.22	*	–	–
Eopsetta exilis	0.29	*	6.19	6.90	7.19	6.37	0.61	–	–	–
Microstomus pacificus	–	*	*	1.19	*	0.95	*	–	–	*
Pleuronectes vetulus	10.13	*	0.52	0.62	0.47	–	–	*	*	7.37
Psettichthys melanostictus	0.70	*	1.54	1.35	0.62	0.48	*	*	–	–
Total Fish Larvae	273.60	230.96	169.14	246.33	287.98	263.46	211.55	41.94	18.42	94.52

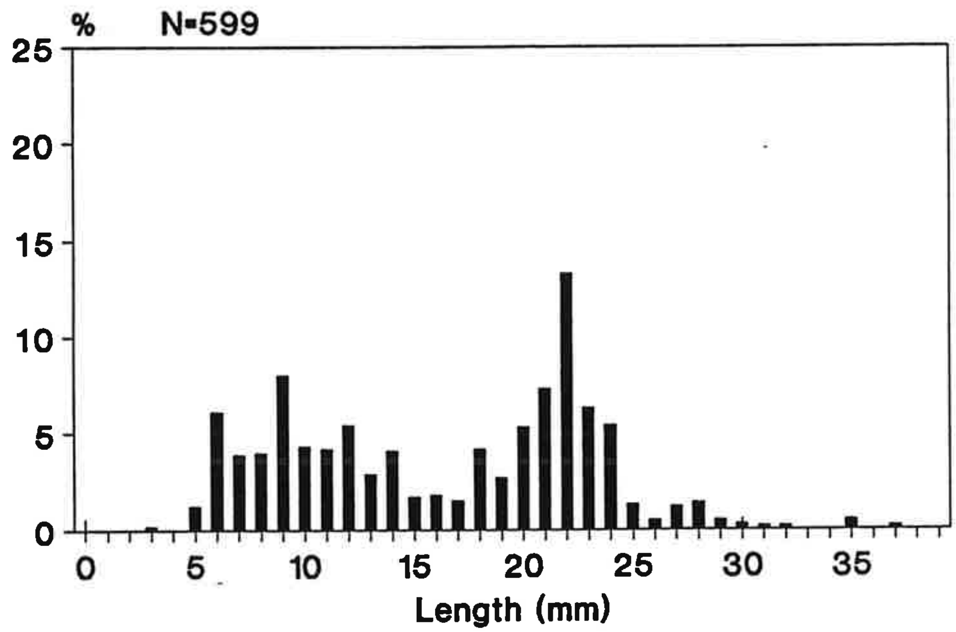
Table 16b. Relative abundance of dominant taxa of larvae in bongo samples (% of total larval fish abundance) for each sampling period. Cruises arranged in order of timing of sampling.
* = Taxon present but occurred in less than 5% of samples. – = Taxon absent from samples.

TAXA	Early Spring PO84	Spring BA85	Spring TK80	Spring EQ83	Late Spring PO82	Late Spring PO81	Late Summer PO80	Late Autumn DA81	Late Autumn MF83	Winter MF87
Engraulis mordax	–	–	–	3.98	–	–	65.69	1.25	–	–
Osmeridae (unidentified)	0.98	11.34	5.15	*	1.31	*	*	–	–	13.45
Nansenia candida	1.76	*	*	0.41	–	0.22	–	–	–	–
Bathylagidae (unidentified)	0.89	*	–	–	–	*	–	–	–	1.59
Bathylagus milleri	*	*	–	–	–	*	*	0.89	*	*
Bathylagus ochotensis	14.88	6.03	7.83	11.36	4.14	3.45	0.10	*	*	9.08
Bathylagus pacificus	1.56	0.94	0.93	0.60	1.00	0.41	–	–	–	*
Cyclothone spp.	*	–	*	–	–	–	–	*	1.78	–
Chauliodus macouni	0.35	0.22	0.92	0.67	0.36	0.36	0.78	1.97	5.58	1.30
Myctophidae (unidentified)	*	0.74	2.35	0.49	4.00	*	2.48	*	*	*
Diaphus theta	0.70	19.17	4.04	14.97	29.82	14.70	2.90	*	3.93	4.02
Protomyctophum crockeri	1.50	1.13	2.04	1.17	0.97	1.72	0.62	5.62	9.65	4.17
Protomyctophum thompsoni	0.37	1.06	0.73	0.50	0.20	0.19	0.66	0.96	3.41	3.26
Stenobrachius leucopsarus	43.04	43.25	52.94	39.61	35.53	55.15	9.55	*	17.13	9.65
Tarletonbeania crenularis	6.29	4.99	0.86	4.40	1.90	2.70	3.57	11.62	11.14	7.92
Lestidiops ringens	0.46	0.62	*	0.49	0.37	*	*	2.54	6.72	0.72
Microgadus proximus	0.55	*	1.19	0.25	*	*	–	*	–	–
Trachipterus altivelis	0.12	*	*	*	*	*	–	*	*	*
Melamphaeidae (unidentified)	0.62	*	0.60	0.28	*	*	–	0.96	*	0.40
Sebastes spp.	14.96	3.99	7.11	6.53	10.46	6.30	12.15	20.51	9.47	31.39
Sebastolobus spp.	1.41	0.56	*	1.49	*	0.22	0.24	*	–	–
Artedius harringtoni	*	0.27	*	*	0.23	0.19	0.14	*	–	*
Hemilepidotus spinosus	0.12	*	*	–	–	–	–	–	*	1.33
Cyclopteridae (unidentified)	0.25	0.60	*	0.48	0.91	0.77	0.09	0.95	–	0.89
Ronquilus jordani	*	*	*	*	0.46	*	*	*	–	–
Ammodytes hexapterus	0.56	*	*	*	*	*	–	*	–	–
Icichthys lockingtoni	*	*	*	0.32	0.20	*	0.21	2.03	*	*
Citharichthys spp.	–	–	*	0.98	–	*	*	31.36	*	*
Citharichthys sordidus	–	–	*	*	–	0.29	*	6.75	7.66	0.69
Citharichthys stigmaeus	*	–	*	*	*	–	–	4.10	10.36	1.06
Errex zachirus	0.26	–	0.42	1.50	0.67	0.23	0.45	*	–	–
Pleuronectes isolepis	0.16	*	0.55	0.49	1.24	0.22	0.56	*	–	–
Eopsetta exilis	0.10	*	4.84	2.80	2.50	3.18	0.29	–	–	–
Microstomus pacificus	–	*	*	0.48	*	0.36	*	–	–	*
Pleuronectes vetulus	3.70	*	0.31	0.33	0.16	–	–	*	*	7.60
Psettichthys melanostictus	0.26	*	0.91	0.55	0.22	0.16	*	*	–	–

Table 17.
Minimum, mean, and maximum lengths of <u>Engraulis mordax</u> larvae and number taken in neuston and bongo samples during each cruise.

			LENGTH (mm)		
CRUISE	SEASON	NUMBER	MIN.	MEAN	MAX.
NEUSTON:					
PO84	Early spring	-	-	-	-
BA85	Spring	-	-	-	-
TK80	Spring	7	28.0	33.4	37.0
EQ83	Spring	61	9.1	16.0	29.0
PO82	Spring	-	-	-	-
PO81	Spring	-	-	-	-
PO80	Late summer	250	3.9	10.2	29.0
DA81	Late autumn	280	15.0	21.8	30.5
MF83	Late autumn	-	-	-	-
MF87	Winter	1	19.0	19.0	19.0
BONGO:					
PO84	Early spring	-	-	-	-
BA85	Spring	-	-	-	-
TK80	Spring	-	-	-	-
EQ83	Spring	173	2.5	8.0	26.5
PO82	Spring	-	-	-	-
PO81	Spring	-	-	-	-
PO80	Late summer	3043	2.6	10.2	29.0
DA81	Late autumn	13	11.0	19.2	26.0
MF83	Late autumn	-	-	-	-
MF87	Winter	-	-	-	-

(a) *Engraulis mordax* Neuston Samples



(b) *Engraulis mordax* Bongo Samples

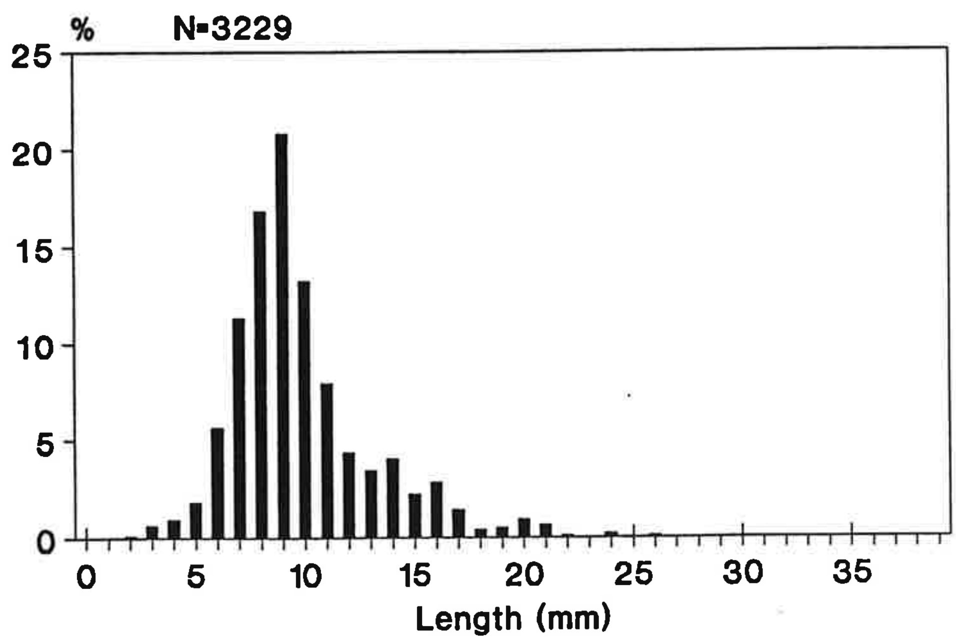
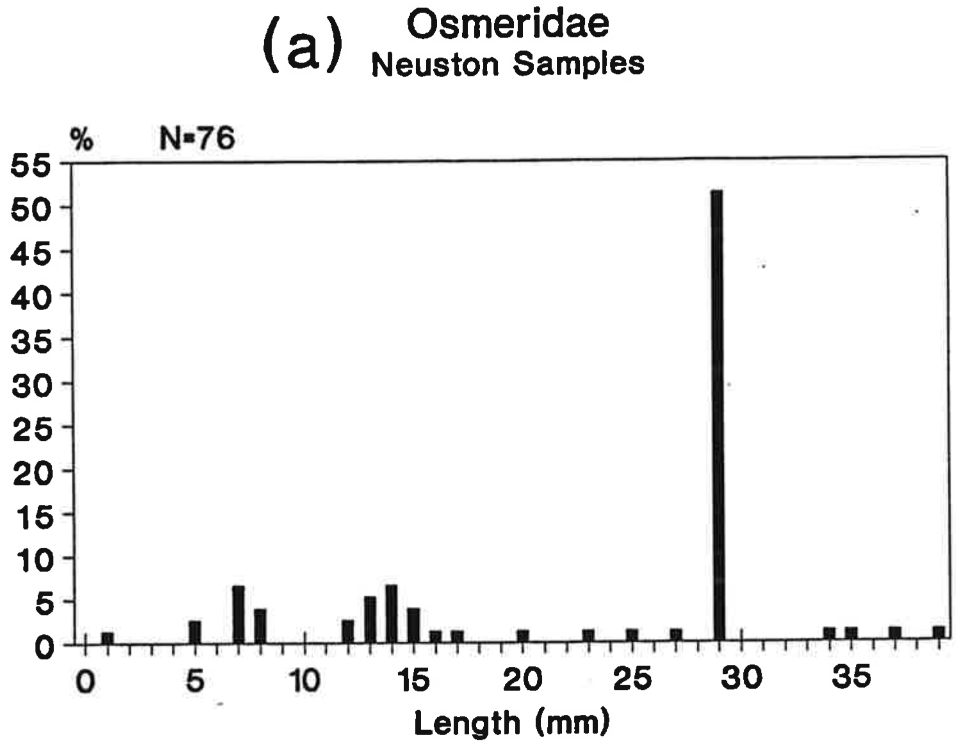


Figure 24. Length frequency distribution for Engraulis mordax larvae in (a) neuston samples, and (b) bongo samples from all cruises.

Table 18.
Minimum, mean, and maximum lengths of Osmeridae larvae and number taken in neuston and bongo samples during each cruise.

CRUISE	SEASON	NUMBER	LENGTH (mm) MIN.	MEAN	MAX.
NEUSTON:					
PO84	Early spring	39	7.2	14.5	29.5
BA85	Spring	-	-	-	-
TK80	Spring	-	-	-	-
EQ83	Spring	-	-	-	-
PO82	Spring	2	35.0	36.0	37.0
PO81	Spring	4	5.6	19.4	39.0
PO80	Late summer	22	8.0	15.6	34.5
DA81	Late autumn	-	-	-	-
MF83	Late autumn	1	-	25.5	-
MF87	Winter	9	1.0	6.2	8.5
BONGO:					
PO84	Early spring	50	4.5	11.0	24.3
BA85	Spring	477	5.0	9.7	33.5
TK80	Spring	219	4.0	7.2	15.2
EQ83	Spring	17	5.5	13.5	18.0
PO82	Spring	35	6.1	9.4	13.0
PO81	Spring	-	-	-	-
PO80	Late summer	-	-	-	-
DA81	Late autumn	-	-	-	-
MF83	Late autumn	-	-	-	-
MF87	Winter	230	5.0	7.7	19.0



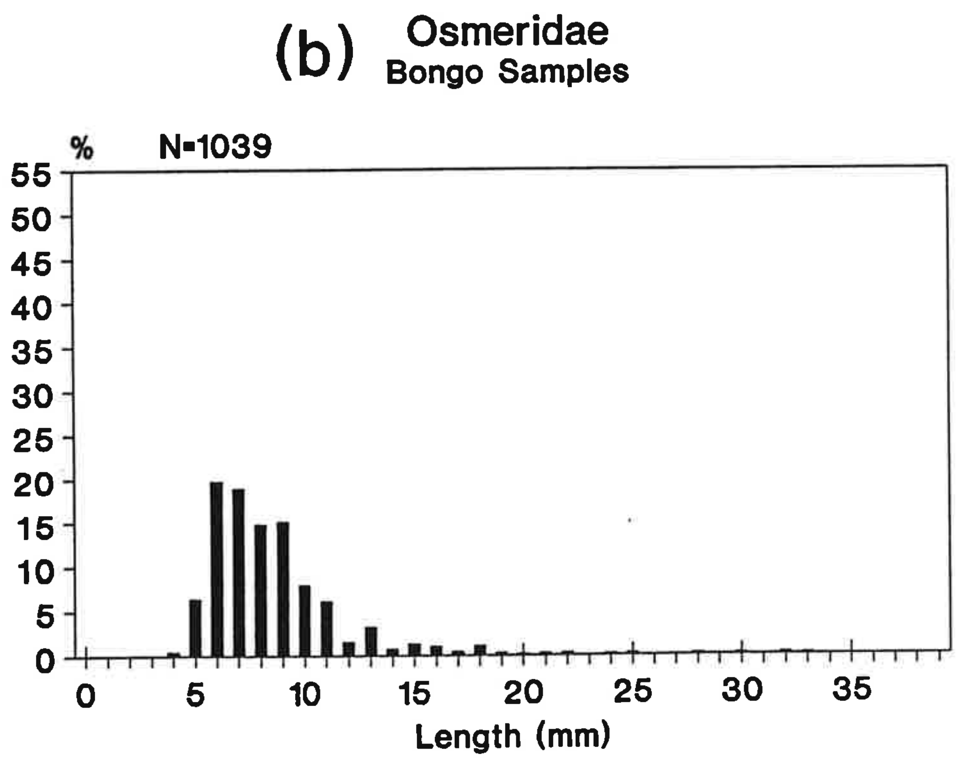


Figure 25. Length frequency distribution for Osmeridae larvae in (a) neuston samples, and (b) bongo samples from all cruises.

Table 19.
Minimum, mean, and maximum lengths of Bathylagus ochotensis larvae taken in bongo samples during each cruise.

			LENGTH (mm)		
CRUISE	SEASON	NUMBER	MIN.	MEAN	MAX.
PO84	Early spring	758	3.8	7.6	23.0
BA85	Spring	210	4.5	8.9	22.0
TK80	Spring	203	4.6	9.9	26.7
EQ83	Spring	438	1.5	9.9	35.0
PO82	Spring	84	4.0	9.9	21.5
PO81	Spring	155	5.0	9.6	25.2
PO80	Late summer	4	5.2	13.5	27.0
DA81	Late autumn	3	5.0	7.0	10.0
MF83	Late autumn	4	6.5	8.0	10.0
MF87	Winter	94	3.2	6.7	12.4

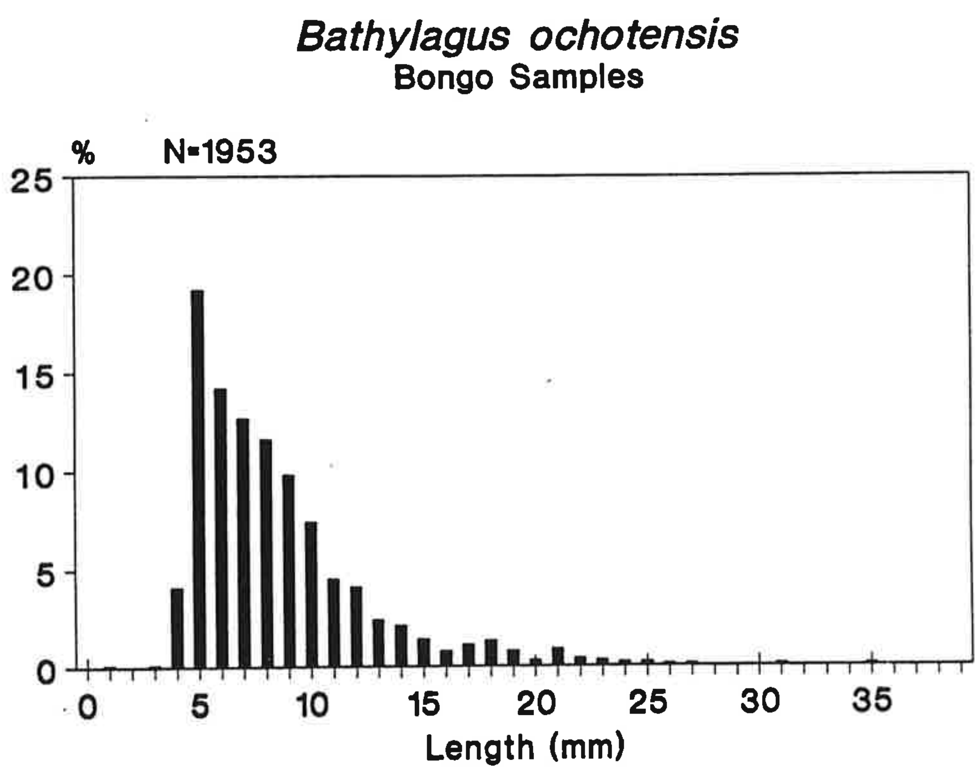


Figure 26. Length frequency distribution for Bathylagus ochotensis larvae in bongo samples.

Table 20.
Minimum, mean, and maximum lengths of Bathylagus pacificus larvae taken in bongo samples during each cruise.

			LENGTH (mm)		
CRUISE	SEASON	NUMBER	MIN.	MEAN	MAX.
PO84	Early spring	81	5.5	7.5	15.5
BA85	Spring	33	6.0	8.6	13.0
TK80	Spring	24	7.1	12.9	24.5
EQ83	Spring	23	7.0	11.1	17.1
PO82	Spring	20	6.5	11.2	18.0
PO81	Spring	18	7.2	10.5	15.0
PO80	Late summer	-	-	-	-
DA81	Late autumn	-	-	-	-
MF83	Late autumn	-	-	-	-
MF87	Winter	2	7.0	7.0	7.0

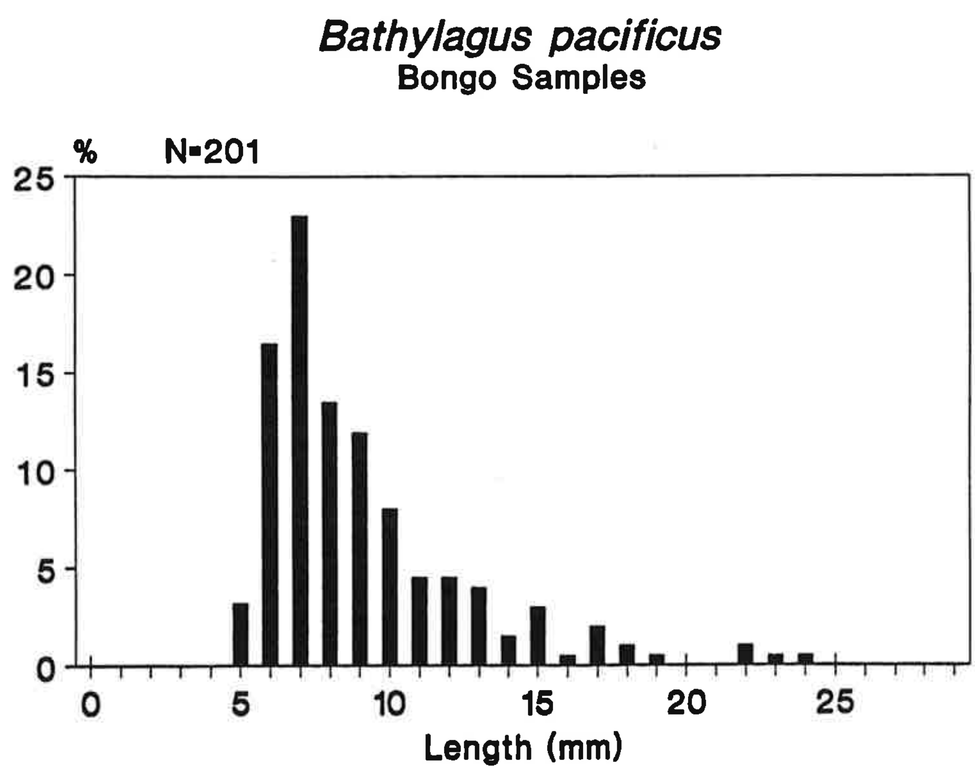


Figure 27. Length frequency distribution for Bathylagus pacificus larvae in bongo samples.

Table 21.
Minimum, mean, and maximum lengths of Chauliodus macouni larvae, and number taken in bongo samples during all cruises.

			LENGTH (mm)		
CRUISE	SEASON	NUMBER	MIN.	MEAN	MAX.
PO84	Early spring	18	8.0	23.3	48.3
BA85	Spring	8	8.7	26.1	50.4
TK80	Spring	24	8.5	27.9	54.0
EQ83	Spring	26	7.0	34.1	54.0
PO82	Spring	7	10.3	27.2	48.7
PO81	Spring	16	10.0	27.1	52.0
PO80	Late summer	28	10.0	30.7	49.0
DA81	Late autumn	17	10.5	29.4	47.0
MF83	Late autumn	22	10.0	29.2	45.5
MF87	Winter	13	10.0	28.7	49.3

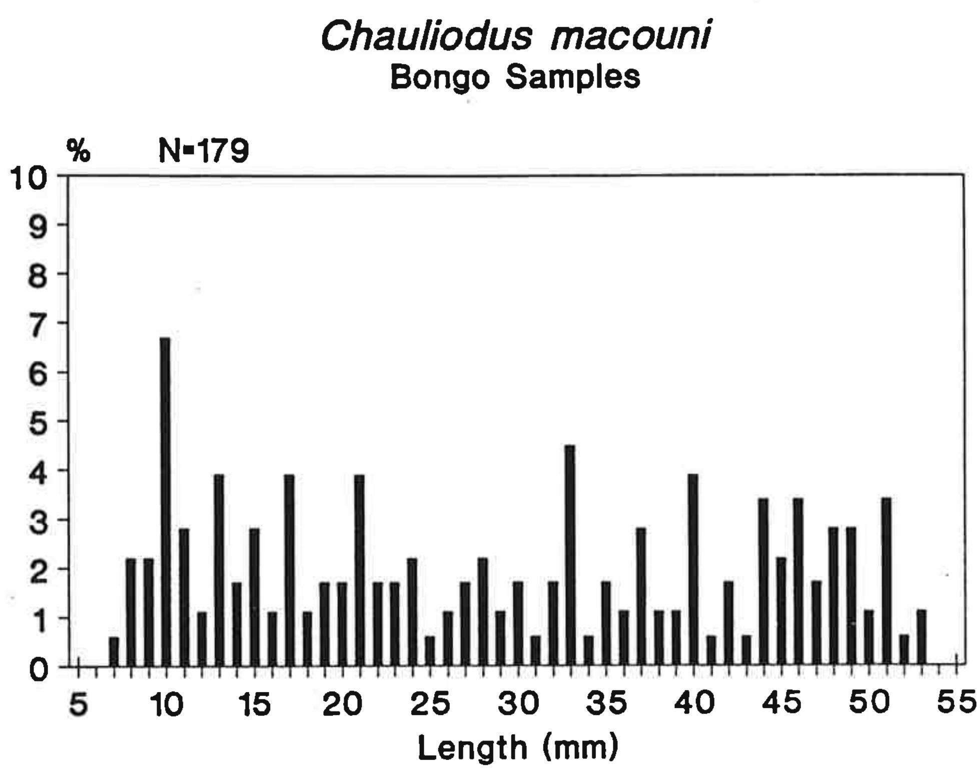


Figure 28. Length frequency distribution for Chauliodus macouni larvae in bongo samples.

Table 22.
Minimum, mean, and maximum lengths of Diaphus theta larvae, and number taken in bongo samples during all cruises.

			LENGTH (mm)		
CRUISE	SEASON	NUMBER	MIN.	MEAN	MAX.
PO84	Early spring	37	2.2	3.5	4.7
BA85	Spring	657	2.5	4.2	42.0
TK80	Spring	100	2.6	3.4	5.8
EQ83	Spring	571	2.5	4.9	8.0
PO82	Spring	690	2.8	3.3	7.5
PO81	Spring	649	2.5	5.0	9.0
PO80	Late summer	90	3.1	7.3	16.5
DA81	Late autumn	2	9.3	10.7	12.0
MF83	Late autumn	15	9.0	27.3	65.0
MF87	Winter	45	20.5	30.0	54.0

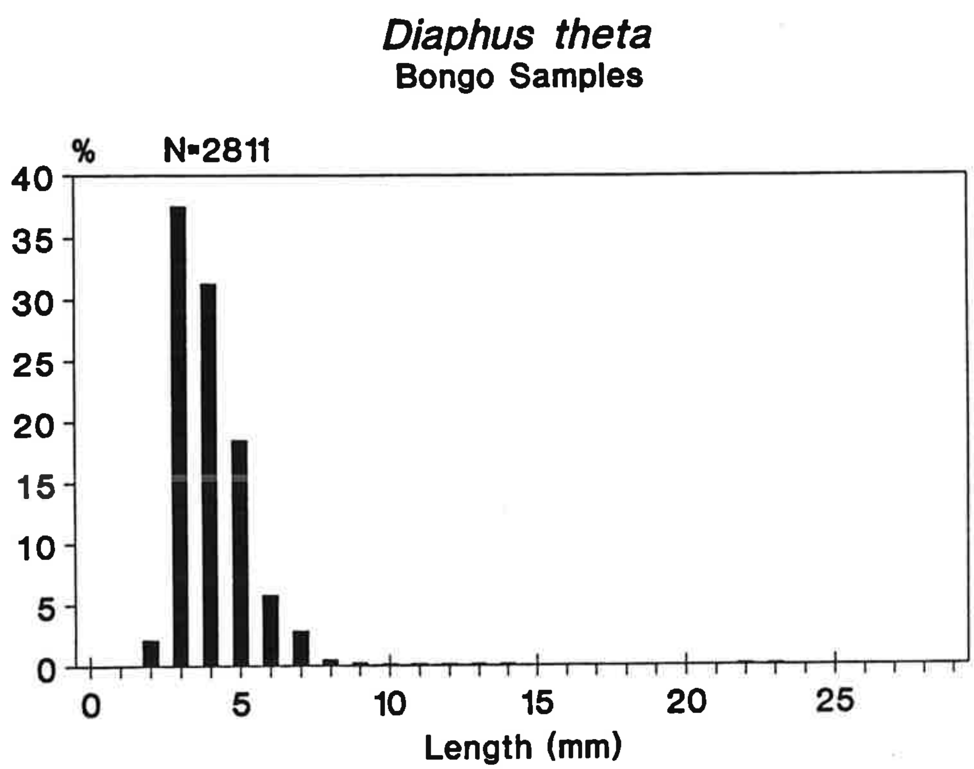


Figure 29. Length frequency distribution for Diaphus theta larvae in bongo samples.

Table 23.
Minimum, mean, and maximum lengths of Protomyctophum crockeri larvae, and number taken in bongo samples during all cruises.

CRUISE	SEASON	NUMBER	LENGTH (mm) MIN.	MEAN	MAX.
PO84	Early spring	78	3.7	8.2	16.0
BA85	Spring	39	3.2	9.8	17.5
TK80	Spring	51	2.0	8.0	18.0
EQ83	Spring	45	4.1	10.2	18.5
PO82	Spring	20	3.5	9.5	15.0
PO81	Spring	80	3.0	8.5	19.0
PO80	Late summer	23	3.7	9.7	18.0
DA81	Late autumn	53	3.7	9.4	16.7
MF83	Late autumn	37	3.8	10.1	15.0
MF87	Winter	42	3.6	7.5	13.1

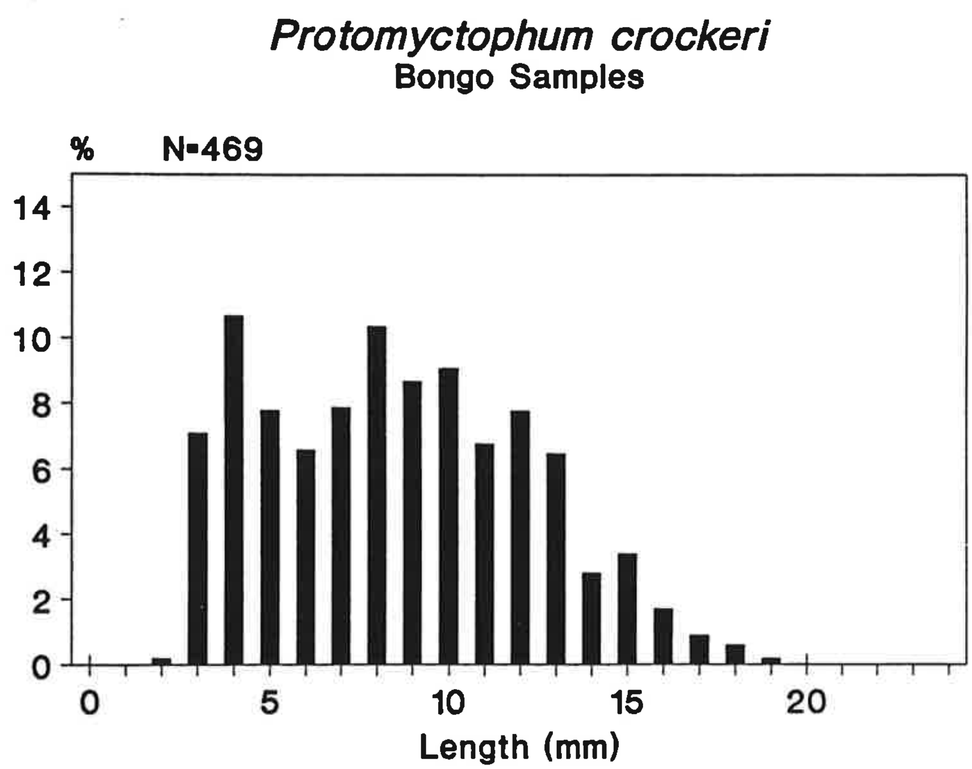


Figure 30. Length frequency distribution for Protomyctophum crockeri larvae in bongo samples.

Table 24.
Minimum, mean, and maximum lengths of Protomyctophum thompsoni larvae, and number taken in bongo samples during all cruises.

			LENGTH (mm)		
CRUISE	SEASON	NUMBER	MIN.	MEAN	MAX.
PO84	Early spring	19	5.7	8.5	11.1
BA85	Spring	38	5.2	10.8	19.1
TK80	Spring	19	3.2	9.7	16.0
EQ83	Spring	19	4.7	10.3	16.0
PO82	Spring	4	9.0	10.5	11.8
PO81	Spring	9	4.0	12.3	18.0
PO80	Late summer	24	5.2	10.5	17.0
DA81	Late autumn	9	6.0	10.2	17.0
MF83	Late autumn	13	6.0	8.5	14.0
MF87	Winter	36	4.2	8.7	16.2

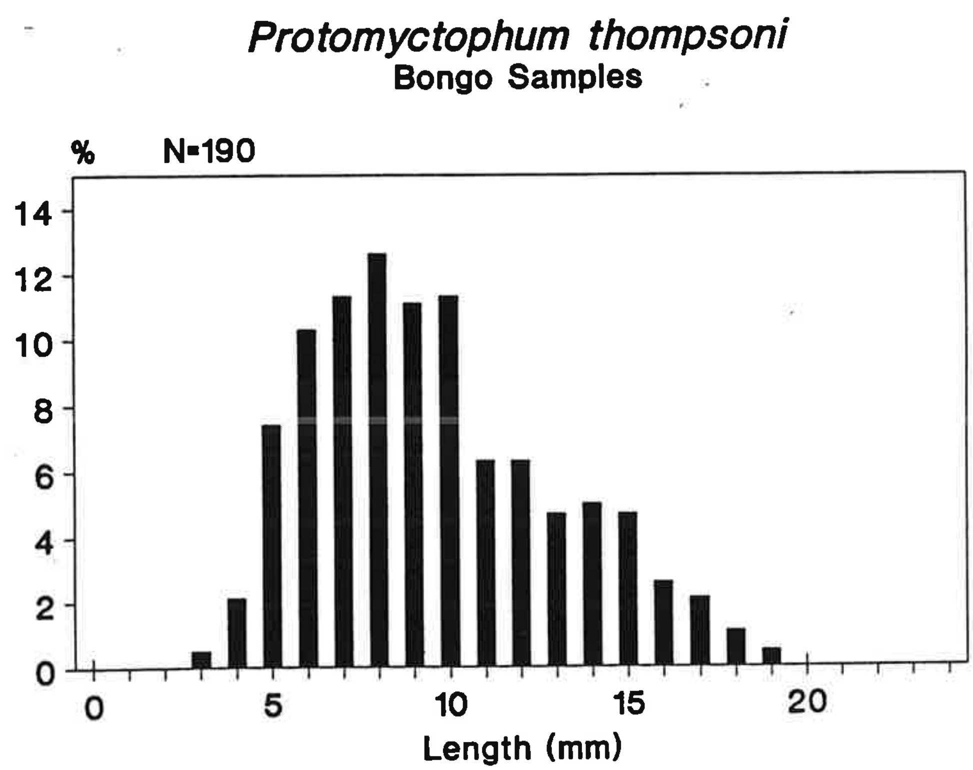
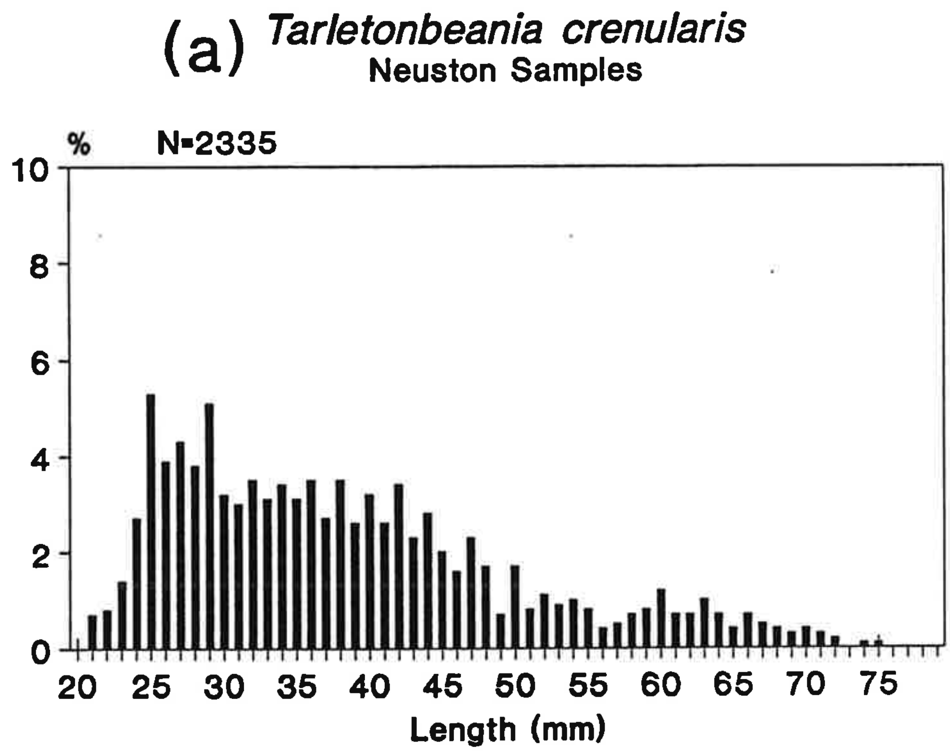


Figure 31. Length frequency distribution for Protomyctophum thompsoni larvae in bongo samples.

Table 25.
Minimum, mean, and maximum lengths of <u>Tarletonbeania crenularis</u> larvae and juveniles, and number taken in neuston and bongo samples during all cruises.

			LENGTH (mm)		
CRUISE	SEASON	NUMBER	MIN.	MEAN	MAX.
NEUSTON:					
PO84	Early spring	321	21.4	38.4	72.0
BA85	Spring	144	21.5	34.1	57.0
TK80	Spring	254	21.0	35.7	73.0
EQ83	Spring	75	25.5	38.0	72.0
PO82	Spring	188	21.5	39.2	77.0
PO81	Spring	171	23.0	43.3	70.0
PO80	Late summer	313	26.0	53.8	75.0
DA81	Late autumn	115	23.0	31.4	54.0
MF83	Late autumn	217	21.9	33.4	73.2
MF87	Winter	537	21.0	31.6	67.0
BONGO:					
PO84	Early spring	331	2.0	5.4	16.0
BA85	Spring	174	3.4	7.1	18.0
TK80	Spring	23	2.9	6.5	16.5
EQ83	Spring	168	2.7	6.3	18.5
PO82	Spring	38	3.5	6.4	13.0
PO81	Spring	123	3.0	6.1	15.7
PO80	Late summer	147	2.7	8.2	18.8
DA81	Late autumn	106	2.1	6.3	19.0
MF83	Late autumn	40	3.0	15.4	38.0
MF87	Winter	85	3.6	7.5	13.1



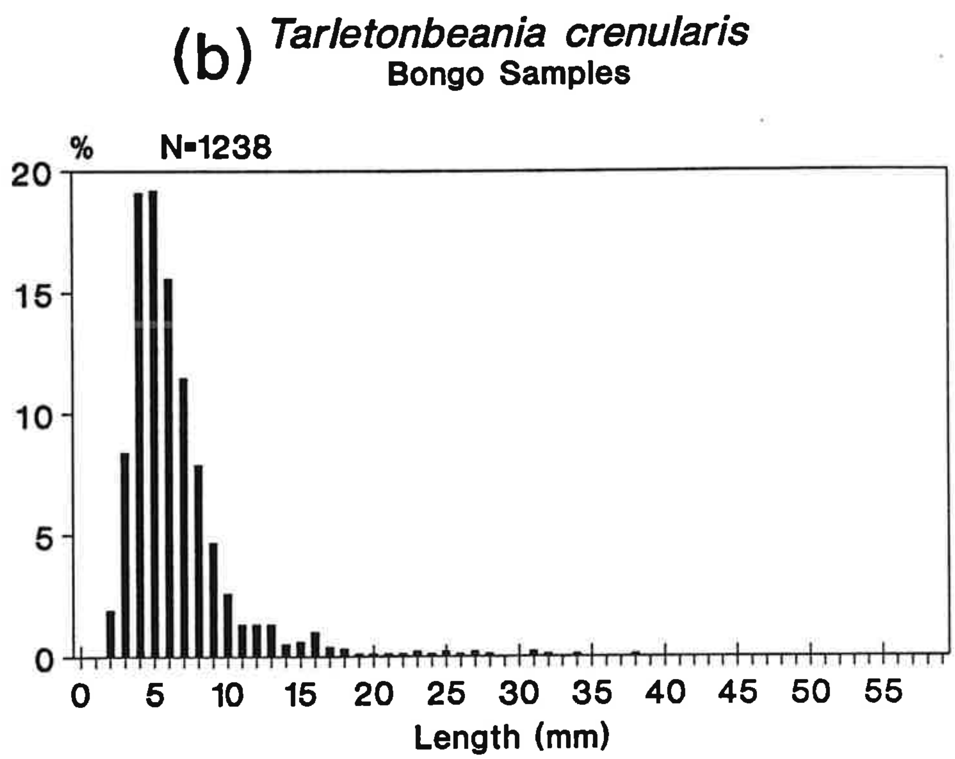


Figure 32. Length frequency distribution for Tarletonbeania crenularis larvae in (a) neuston samples, and (b) bongo samples from all cruises.

Table 26.
Minimum, mean, and maximum lengths of Stenobrachius leucopsarus larvae, and number taken in bongo samples during all cruises.

			LENGTH (mm)		
CRUISE	SEASON	NUMBER	MIN.	MEAN	MAX.
PO84	Early spring	2246	2.0	5.1	27.0
BA85	Spring	1529	2.5	5.9	27.0
TK80	Spring	1362	2.5	5.8	52.0
EQ83	Spring	1533	2.5	6.2	36.4
PO82	Spring	737	3.0	6.0	10.1
PO81	Spring	2525	2.7	5.8	50.0
PO80	Late summer	423	3.7	8.0	17.0
DA81	Late autumn	4	2.9	7.9	14.5
MF83	Late autumn	61	3.5	29.7	79.0
MF87	Winter	102	2.5	3.9	5.2

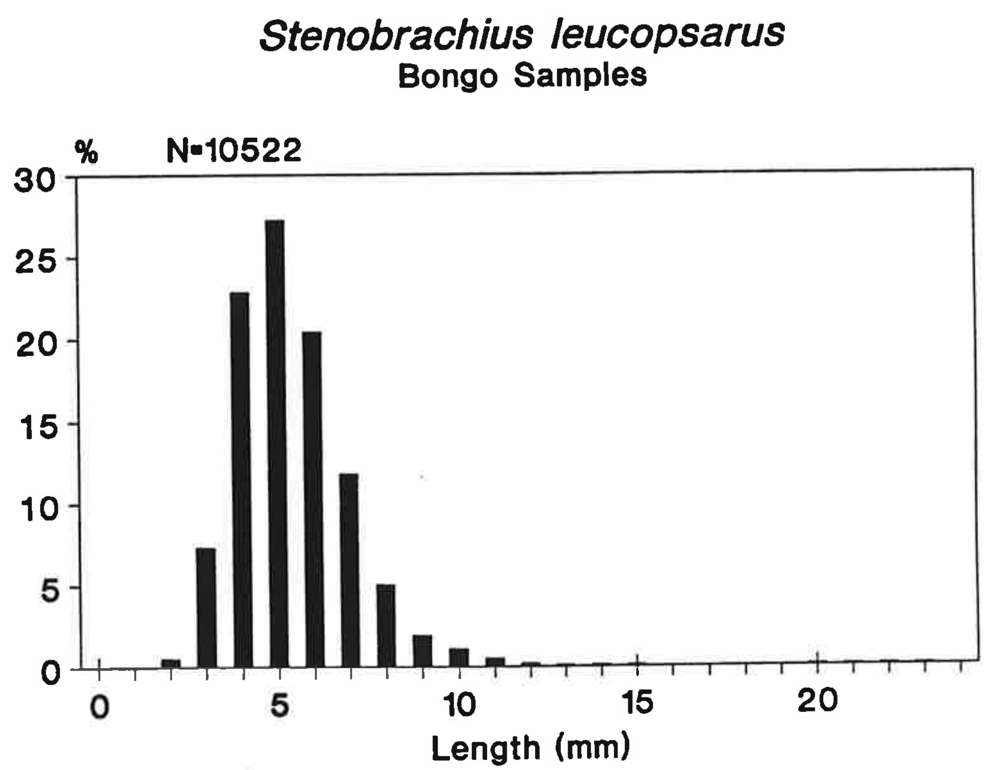


Figure 33. Length frequency distribution for Stenobrachius leucopsarus larvae in bongo samples.

Table 27.
Minimum, mean, and maximum lengths of Cololabis saira larvae and juveniles, and number taken in neuston samples during all cruises.

CRUISE	SEASON	NUMBER	LENGTH (mm) MIN.	MEAN	MAX.
PO84	Early spring	274	5.5	18.4	59.0
BA85	Spring	6	6.8	9.2	11.0
TK80	Spring	135	5.5	11.7	56.0
EQ83	Spring	217	3.3	26.6	70.0
PO82	Spring	39	* 7.0	7.0	7.0
PO81	Spring	54	6.0	16.9	33.5
PO80	Late summer	23	5.1	17.5	30.0
DA81	Late autumn	284	5.7	19.3	57.0
MF83	Late autumn	173	15.2	48.4	93.9
MF87	Winter	42	7.3	24.6	57.0

* Only two larvae measured.

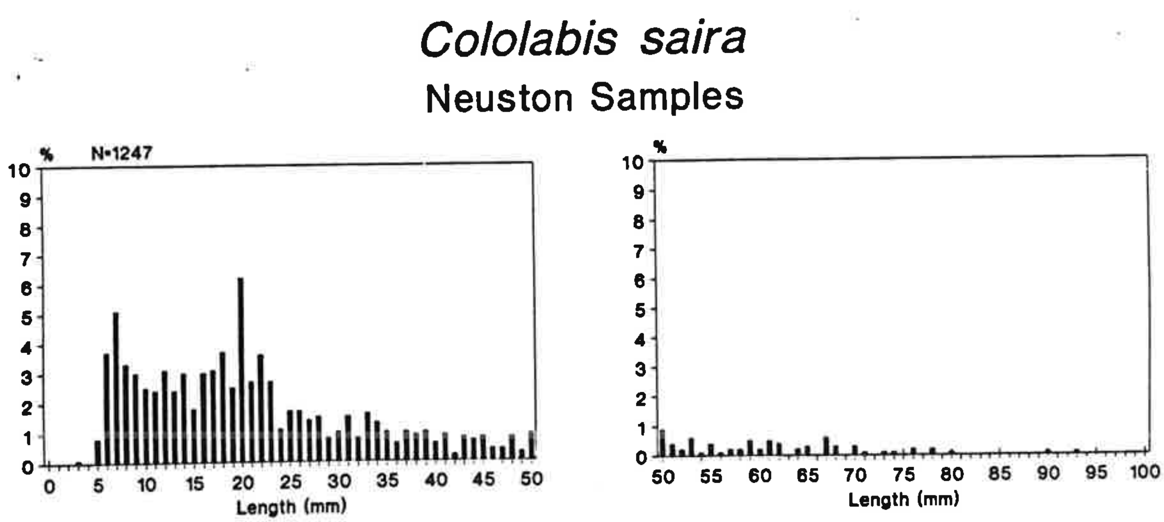
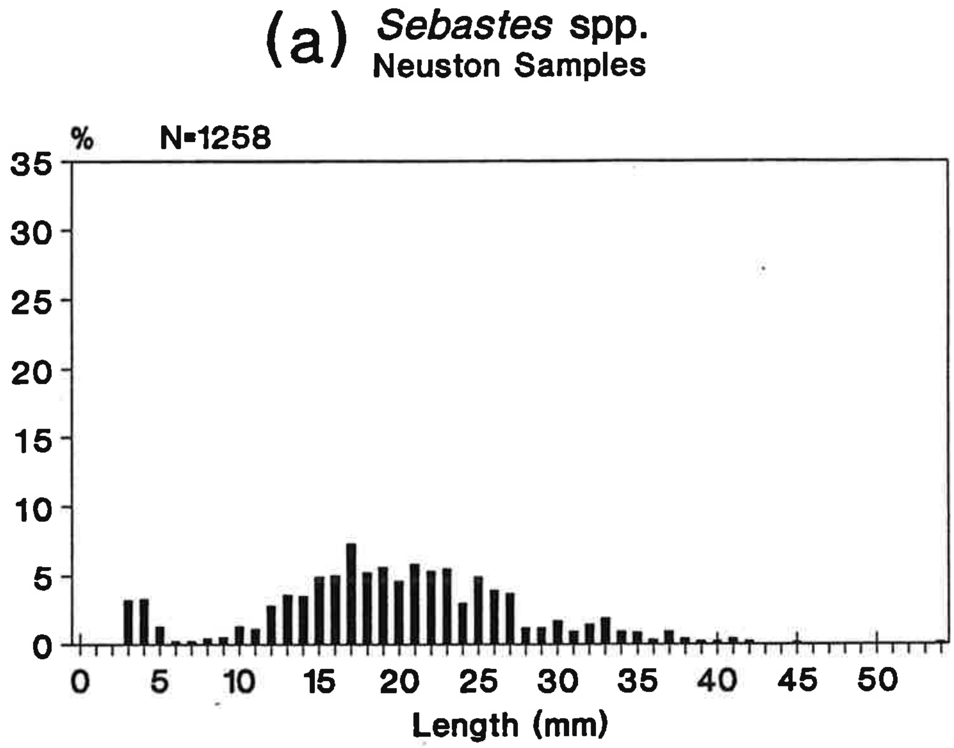


Figure 34. Length frequency distribution for Cololabis saira larvae in bongo samples.

Table 28.
Minimum, mean, and maximum lengths of _Sebastes_ spp. larvae and juveniles, and numbers taken in neuston and bongo samples during each cruise.

CRUISE	SEASON	NUMBER	LENGTH (mm) MIN.	MEAN	MAX.
NEUSTON:					
PO84	Early spring	55	3.0	16.6	28.0
BA85	Spring	129	4.8	29.3	54.3
TK80	Spring	338	3.2	20.9	41.0
EQ83	Spring	370	5.3	22.6	30.0
PO82	Spring	121	3.0	13.1	29.0
PO81	Spring	44	3.3	10.1	34.1
PO80	Late summer	172	3.2	14.5	33.4
DA81	Late autumn	15	4.0	15.6	28.0
MF83	Late autumn	4	12.9	14.3	15.7
MF87	Winter	10	4.0	6.0	15.9
BONGO:					
PO84	Early spring	764	2.0	4.5	18.9
BA85	Spring	143	3.0	5.0	16.0
TK80	Spring	185	3.2	5.9	33.0
EQ83	Spring	272	2.0	9.2	28.0
PO82	Spring	218	3.2	4.7	11.0
PO81	Spring	388	2.8	4.9	13.7
PO80	Late summer	567	2.6	5.2	28.5
DA81	Late autumn	188	2.4	4.3	17.5
MF83	Late autumn	43	3.0	4.5	11.0
MF87	Winter	377	2.3	3.8	11.0



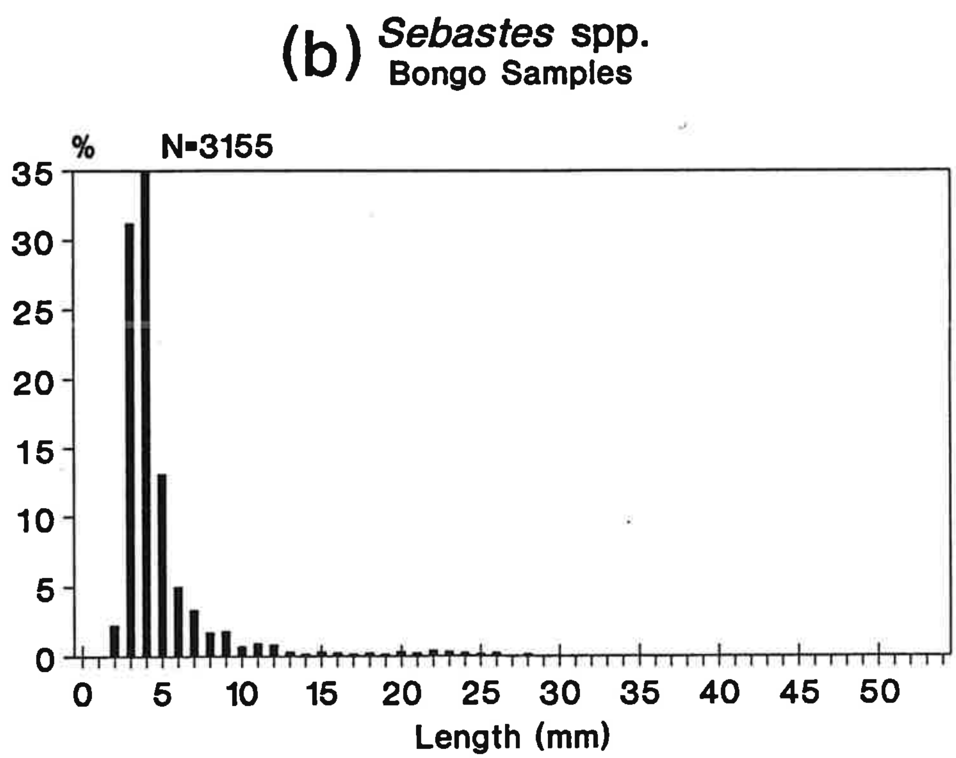


Figure 35. Length frequency distribution for Sebastes spp. larvae in (a) neuston samples, and (b) bongo samples from all cruises.

Table 29.
Minimum, mean, and maximum lengths of Anoplopoma fimbria larvae and juveniles, and numbers taken in neuston samples during each cruise.

			LENGTH (mm)		
CRUISE	SEASON	NUMBER	MIN.	MEAN	MAX.
PO84	Early spring	270	7.1	11.2	28.5
BA85	Spring	460	9.5	17.6	34.7
TK80	Spring	621	6.3	14.2	37.0
EQ83	Spring	259	7.2	16.0	38.0
PO82	Spring	74	10.7	17.3	41.2
PO81	Spring	23	10.5	23.4	36.5
PO80	Late summer	-	-	-	-
DA81	Late autumn	-	-	-	-
MF83	Late autumn	-	-	-	-
MF87	Winter	-	-	-	-

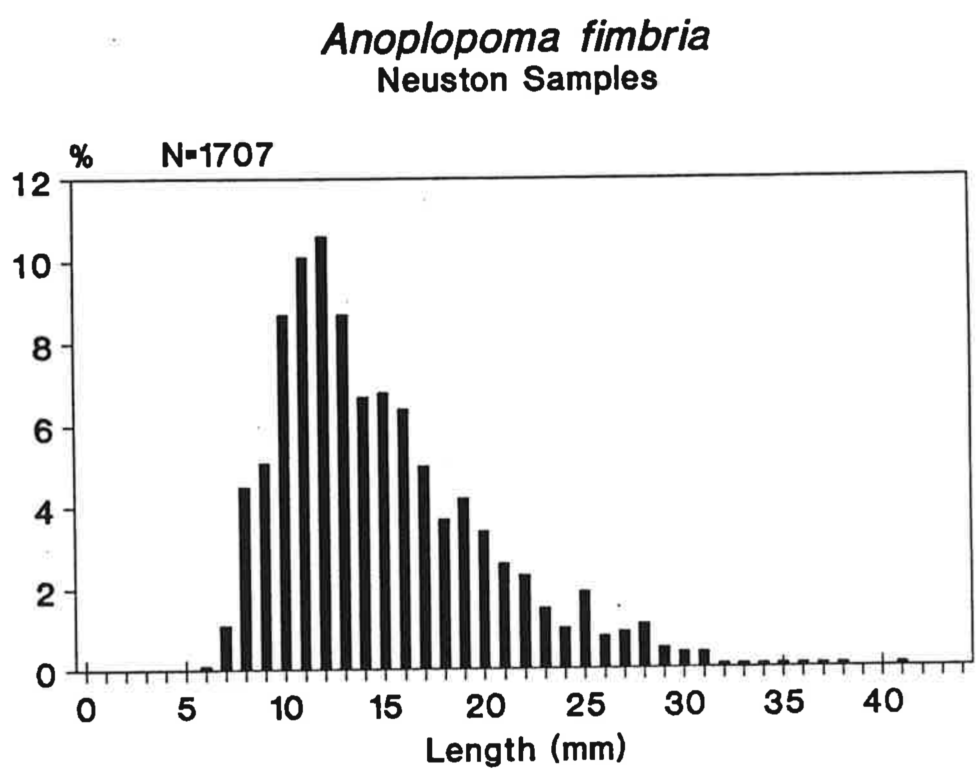


Figure 36. Length frequency distribution for Anoplopoma fimbria larvae in neuston samples.

Table 30.
Minimum, mean, and maximum lengths of Ophiodon elongatus larvae, and numbers taken in neuston nets during all cruises.

			LENGTH (mm)		
CRUISE	SEASON	NUMBER	MIN.	MEAN	MAX.
PO84	Early spring	34	8.4	15.6	25.0
BA85	Spring	154	11.0	15.5	45.0
TK80	Spring	32	18.3	27.4	42.0
EQ83	Spring	5	10.0	14.6	22.0
PO82	Spring	19	11.0	21.3	36.5
PO81	Spring	1	10.0	10.0	10.0
PO80	Late summer	-	-	-	-
DA81	Late autumn	-	-	-	-
MF83	Late autumn	1	10.2	10.2	10.2
MF87	Winter	4	8.5	10.5	14.4

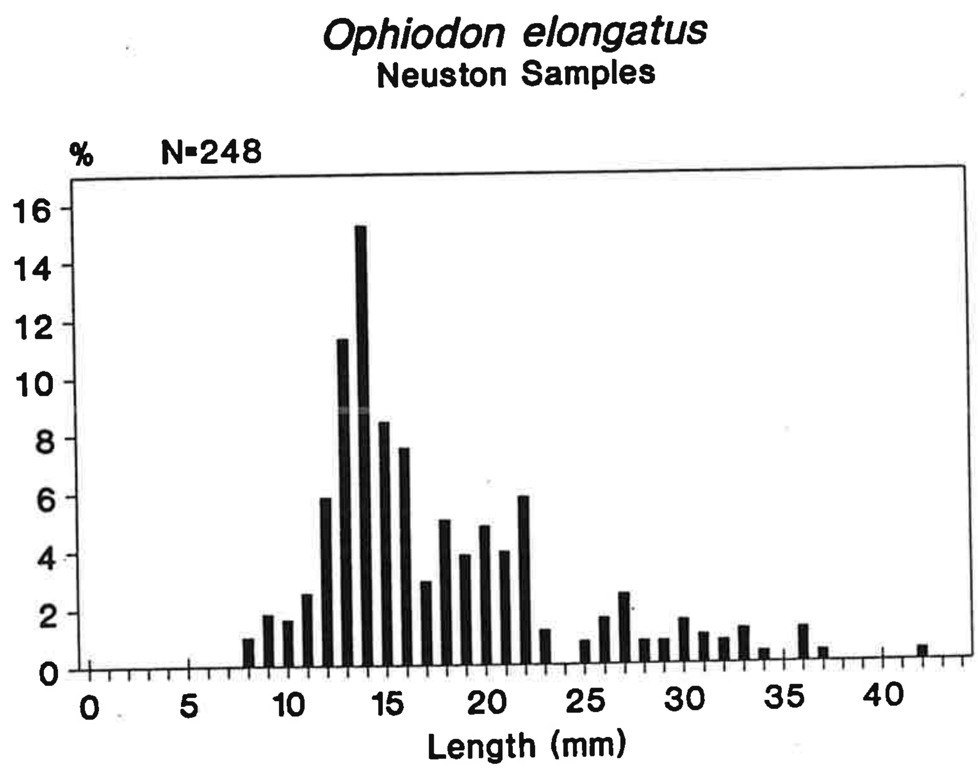


Figure 37. Length frequency distribution for Ophiodon elongatus larvae in neuston samples.

Table 31.
Minimum, mean, and maximum lengths of Hexagrammos decagrammus larvae and juveniles, and numbers taken in neuston nets during all cruises.

			LENGTH (mm)		
CRUISE	SEASON	NUMBER	MIN.	MEAN	MAX.
PO84	Early spring	244	8.0	19.0	40.0
BA85	Spring	234	9.8	23.9	55.0
TK80	Spring	47	16.5	34.7	56.6
EQ83	Spring	46	12.2	28.5	57.0
PO82	Spring	29	16.0	30.8	47.0
PO81	Spring	5	22.6	34.0	48.0
PO80	Late summer	-	-	-	-
DA81	Late autumn	60	6.0	7.6	9.4
MF83	Late autumn	8	7.8	10.3	14.5
MF87	Winter	386	6.2	12.0	18.0

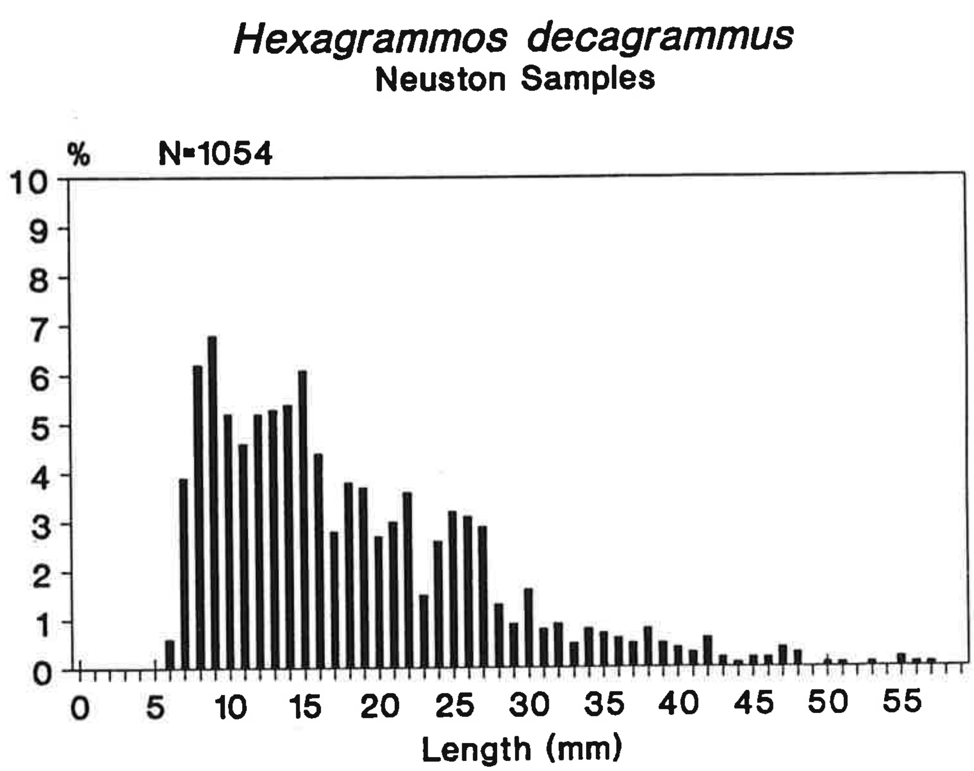


Figure 38. Length frequency distribution for Hexagrammos decagrammus larvae in neuston samples.

Table 32.
Minimum, mean, and maximum lengths of Hexagrammos lagocephalus larvae, and numbers taken in neuston nets during all cruises.

CRUISE	SEASON	NUMBER	LENGTH (mm) MIN.	MEAN	MAX.
PO84	Early spring	7	18.0	23.8	31.3
BA85	Spring	4	15.4	20.7	32.0
TK80	Spring	3	28.5	33.3	38.0
EQ83	Spring	-	-	-	-
PO82	Spring	-	-	-	-
PO81	Spring	2	39.0	40.5	42.0
PO80	Late summer	-	-	-	-
DA81	Late autumn	34	6.6	8.8	14.0
MF83	Late autumn	11	7.4	6.3	9.8
MF87	Winter	49	6.1	15.3	28.5

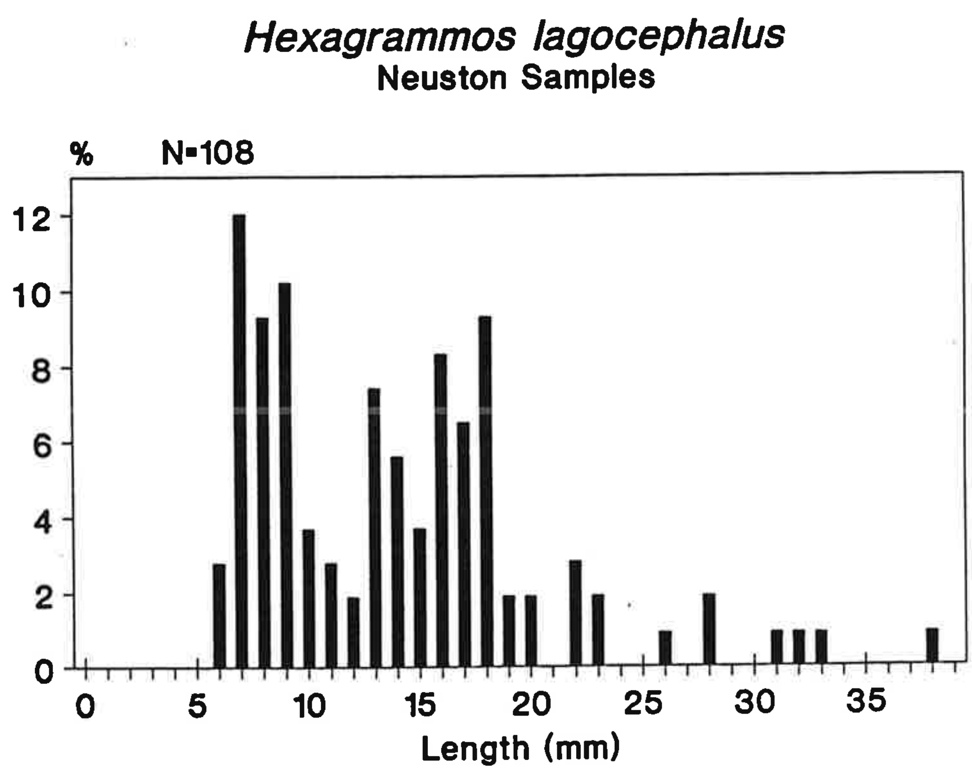


Figure 39. Length frequency distribution for Hexagrammos lagocephalus larvae in neuston samples.

Table 33.
Minimum, mean, and maximum lengths of Hemilepidotus hemilepidotus larvae, and numbers taken in neuston samples during all cruises.

			LENGTH (mm)		
CRUISE	SEASON	NUMBER	MIN.	MEAN	MAX.
PO84	Early spring	13	10.0	13.4	17.5
BA85	Spring	34	14.0	20.1	25.0
TK80	Spring	17	14.0	19.5	23.0
EQ83	Spring	1	20.0	20.0	20.0
PO82	Spring	-	-	-	-
PO81	Spring	-	-	-	-
PO80	Late summer	-	-	-	-
DA81	Late autumn	-	-	-	-
MF83	Late autumn	-	-	-	-
MF87	Winter	16	6.0	7.9	10.9

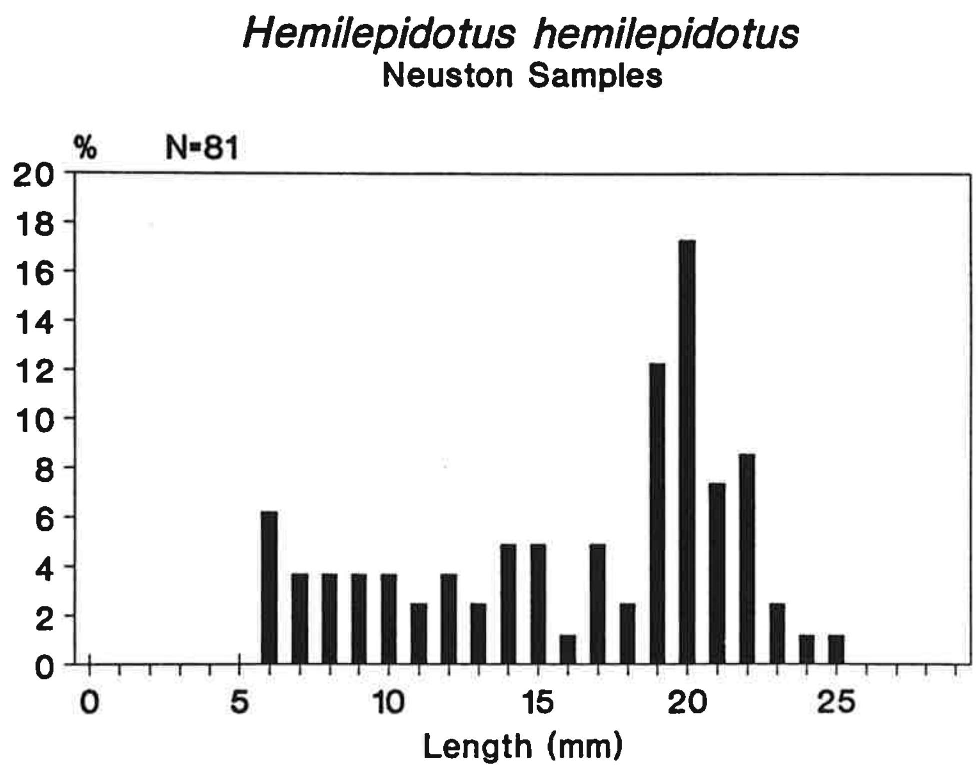


Figure 40. Length frequency distribution for Hemilepidotus hemilepidotus larvae in neuston samples.

Table 34.
Minimum, mean, and maximum lengths of Hemilepidotus spinosus larvae, and numbers taken in neuston samples during all cruises.

			LENGTH (mm)		
CRUISE	SEASON	NUMBER	MIN.	MEAN	MAX.
PO84	Early spring	749	4.5	9.3	22.5
BA85	Spring	638	12.0	17.0	25.0
TK80	Spring	357	3.1	15.8	30.6
EQ83	Spring	99	10.0	16.0	26.0
PO82	Spring	109	11.0	15.8	37.0
PO81	Spring	-	-	-	-
PO80	Late summer	-	-	-	-
DA81	Late autumn	-	-	-	-
MF83	Late autumn	2	5.6	5.9	6.1
MF87	Winter	802	3.9	5.7	10.5

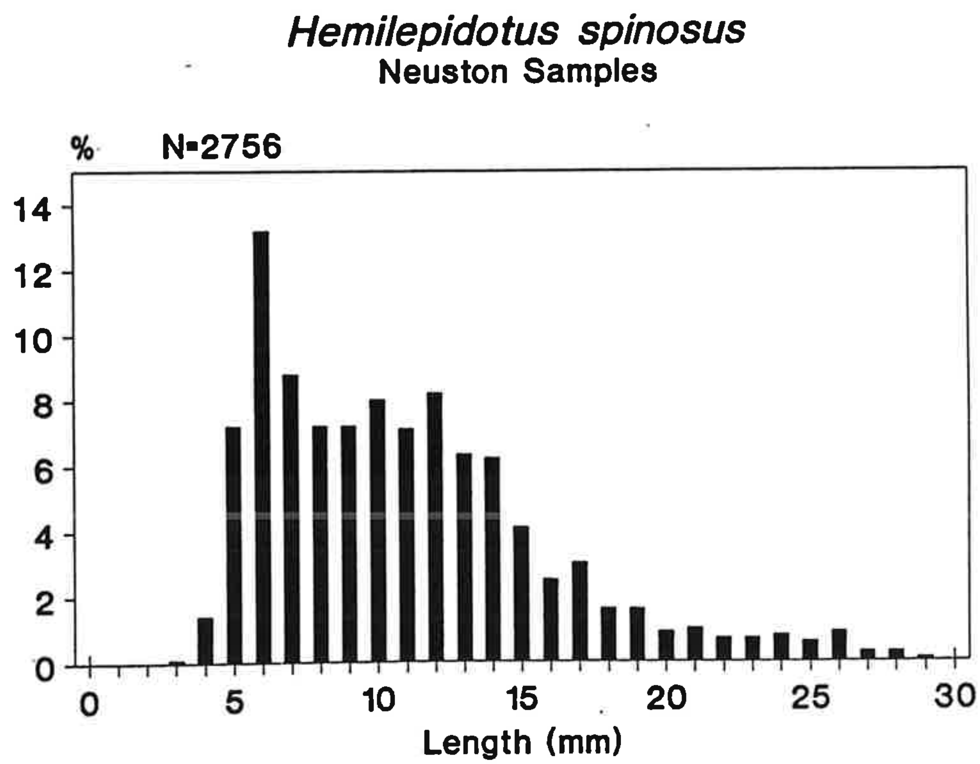


Figure 41. Length frequency distribution for Hemilepidotus spinosus larvae in neuston samples.

Table 35.
Minimum, mean, and maximum lengths of Scorpaenichthys marmoratus larvae, and numbers taken in neuston samples during all cruises.

CRUISE	SEASON	NUMBER	LENGTH (mm) MIN.	MEAN	MAX.
PO84	Early spring	77	4.3	5.8	11.4
BA85	Spring	28	5.0	11.0	31.0
TK80	Spring	114	4.1	8.7	35.0
EQ83	Spring	93	4.0	9.3	33.0
PO82	Spring	20	5.7	9.9	20.0
PO81	Spring	65	4.9	5.4	12.0
PO80	Late summer	37	4.8	7.9	31.4
DA81	Late autumn	47	4.0	7.5	14.0
MF83	Late autumn	55	3.7	5.7	8.2
MF87	Winter	39	5.0	7.5	22.4

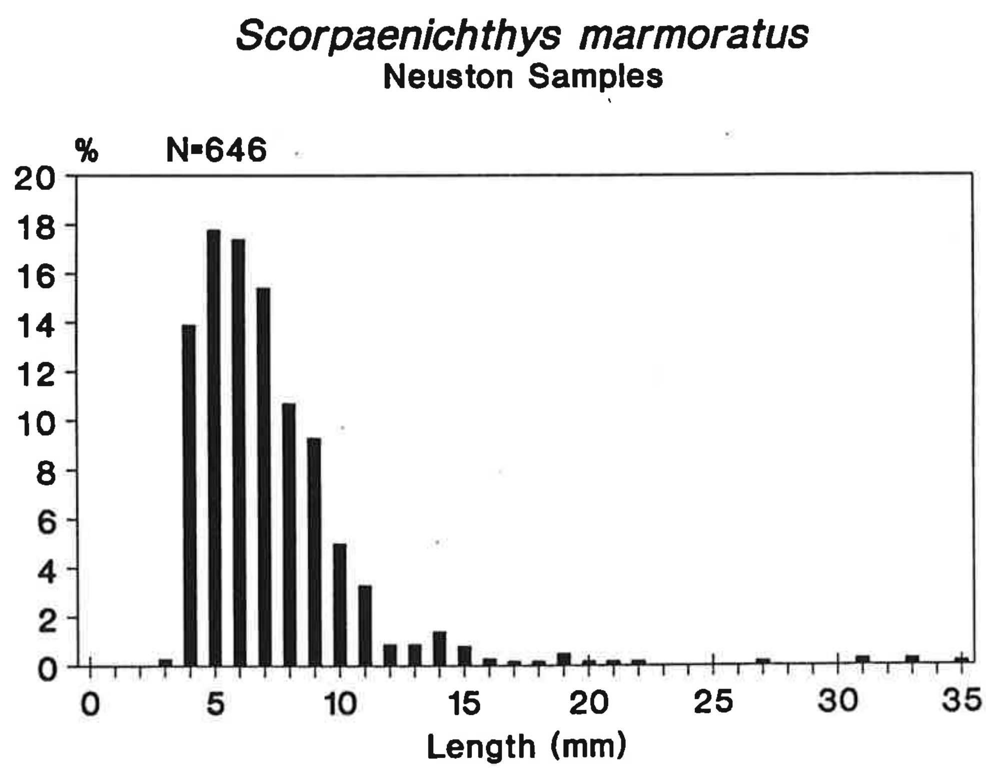


Figure 42. Length frequency distribution for Scorpaenichthys marmoratus larvae in neuston samples.

Table 36.
Minimum, mean, and maximum lengths of Ronquilus jordani larvae, and numbers taken in neuston samples during all cruises.

			LENGTH (mm)		
CRUISE	SEASON	NUMBER	MIN.	MEAN	MAX.
PO84	Early spring	-	-	-	-
BA85	Spring	1	19.4	19.4	19.4
TK80	Spring	12	5.5	15.3	24.6
EQ83	Spring	35	6.3	16.4	24.0
PO82	Spring	38	8.5	16.4	25.5
PO81	Spring	1	7.6	7.6	7.6
PO80	Late summer	15	22.0	28.8	33.5
DA81	Late autumn	-	-	-	-
MF83	Late autumn	-	-	-	-
MF87	Winter	-	-	-	-

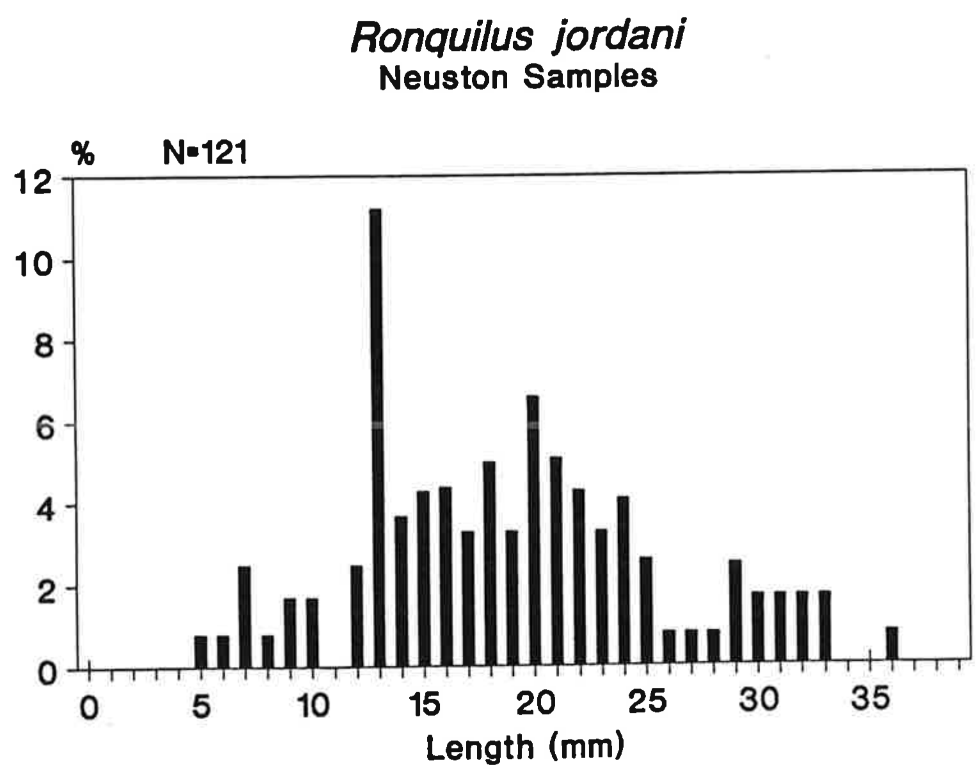


Figure 43. Length frequency distribution for Ronquilus jordani larvae in neuston samples.

Table 37.
Minimum, mean, and maximum lengths of Cryptacanthodes aleutensis larvae, and numbers taken in neuston samples during all cruises.

CRUISE	SEASON	NUMBER	LENGTH (mm) MIN.	MEAN	MAX.
PO84	Early spring	37	12.0	16.3	28.0
BA85	Spring	90	10.0	17.9	29.0
TK80	Spring	5	26.2	28.5	32.0
EQ83	Spring	-	-	-	-
PO82	Spring	-	-	-	-
PO81	Spring	-	-	-	-
PO80	Late summer	-	-	-	-
DA81	Late autumn	-	-	-	-
MF83	Late autumn	-	-	-	-
MF87	Winter	6	12.9	13.3	14.2

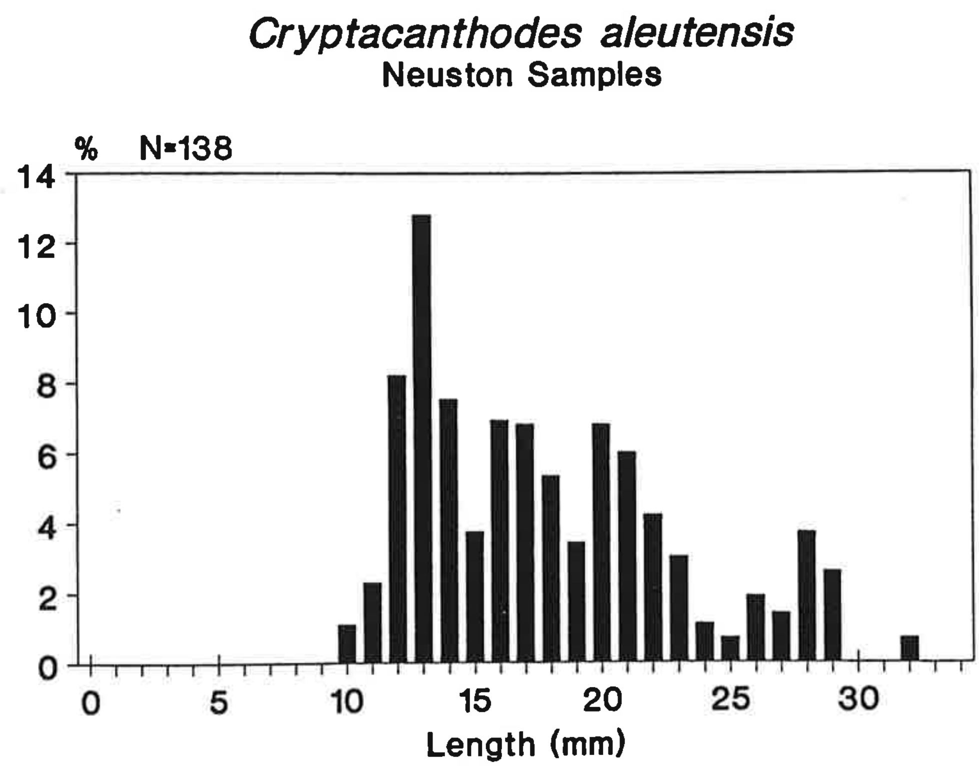


Figure 44. Length frequency distribution for Cryptacanthodes aleutensis larvae in neuston samples.

Table 38.
Minimum, mean, and maximum lengths of Ammodytes hexapterus larvae and juveniles, and numbers taken in neuston and bongo samples during all cruises.

CRUISE	SEASON	NUMBER	LENGTH (mm) MIN.	MEAN	MAX.
NEUSTON:					
PO84	Early spring	380	11.8	16.9	34.0
BA85	Spring	1	-	-	-
TK80	Spring	93	21.5	38.2	58.0
EQ83	Spring	17	15.0	34.3	49.0
PO82	Spring	40	28.0	44.8	55.5
PO81	Spring	4	16.5	30.8	43.0
PO80	Late summer	-	-	-	-
DA81	Late autumn	-	-	-	-
MF83	Late autumn	-	-	-	-
MF87	Winter	-	-	-	-
BONGO:					
PO84	Early spring	32	4.0	12.9	20.4
BA85	Spring	1	-	8.2	-
TK80	Spring	1	-	9.3	-
EQ83	Spring	2	6.7	13.6	30.5
PO82	Spring	1	-	17.0	-
PO81	Spring	1	-	8.0	-
PO80	Late summer	-	-	-	-
DA81	Late autumn	-	-	-	-
MF83	Late autumn	-	-	-	-
MF87	Winter	-	-	-	-

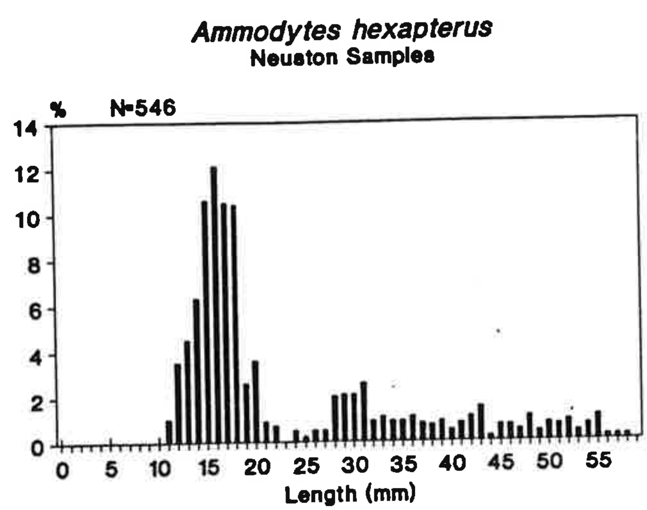


Figure 45. Length frequency distribution for Ammodytes hexapterus larvae in neuston samples.

Table 39.
Minimum, mean, and maximum lengths of Citharichthys spp. larvae, and numbers taken in neuston and bongo samples during each cruise.

CRUISE	SEASON	NUMBER	LENGTH (mm) MIN.	MEAN	MAX.
NEUSTON:					
PO84	Early spring	-	-	-	-
BA85	Spring	-	-	-	-
TK80	Spring	-	-	-	-
EQ83	Spring	-	-	-	-
PO82	Spring	-	-	-	-
PO81	Spring	-	-	-	-
PO80	Late summer	-	-	-	-
DA81	Late autumn	14	2.8	5.7	25.0
MF83	Late autumn	-	-	-	-
MF87	Winter	14	3.0	3.1	3.5
BONGO:					
PO84	Early spring	-	-	-	-
BA85	Spring	-	-	-	-
TK80	Spring	2	4.2	-	4.3
EQ83	Spring	40	3.1	4.9	7.5
PO82	Spring	-	-	-	-
PO81	Spring	1	-	6.1	-
PO80	Late summer	1	-	5.2	-
DA81	Late autumn	257	2.4	4.3	6.8
MF83	Late autumn	4	3.5	4.1	5.0
MF87	Winter	7	3.0	3.5	4.5

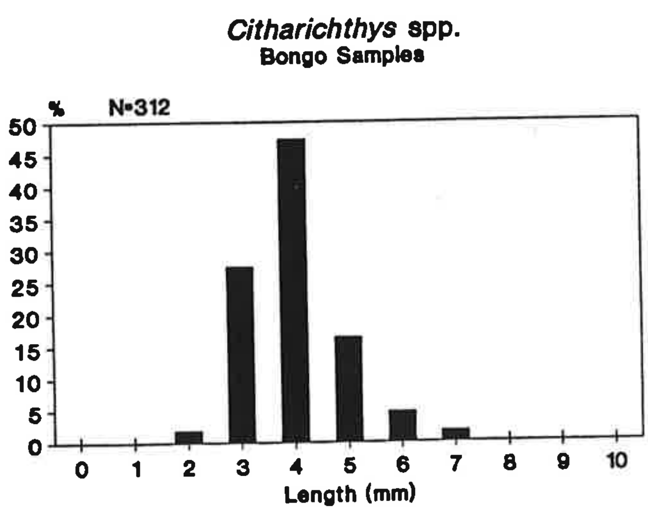


Figure 46. Length frequency distribution for Citharichthys spp. larvae in bongo samples.

Table 40.
Minimum, mean, and maximum lengths of Citharichthys sordidus larvae, and numbers taken in neuston and bongo samples during each cruise.

CRUISE	SEASON	NUMBER	LENGTH (mm) MIN.	MEAN	MAX.
NEUSTON:					
PO84	Early spring	-	-	-	-
BA85	Spring	-	-	-	-
TK80	Spring	1	-	28.0	-
EQ83	Spring	-	-	-	-
PO82	Spring	-	-	-	-
PO81	Spring	-	-	-	-
PO80	Late summer	-	-	-	-
DA81	Late autumn	-	-	-	-
MF83	Late autumn	-	-	-	-
MF87	Winter	1	-	24.8	-
BONGO:					
PO84	Early spring	1	-	29.0	-
BA85	Spring	-	-	-	-
TK80	Spring	1	-	42.0	-
EQ83	Spring	10	2.5	6.1	12.5
PO82	Spring	-	-	-	-
PO81	Spring	13	12.0	18.7	45.0
PO80	Late summer	1	-	20.0	-
DA81	Late autumn	60	5.2	10.8	34.0
MF83	Late autumn	31	8.0	11.9	24.0
MF87	Winter	7	10.0	16.1	26.2

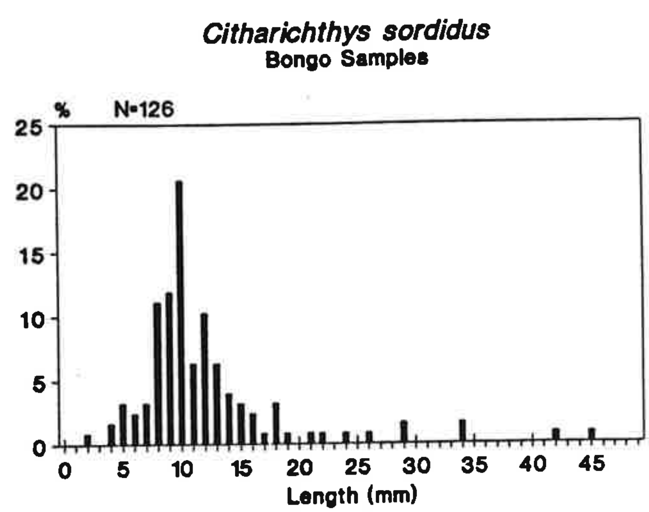


Figure 47. Length frequency distribution for Citharichthys sordidus larvae in bongo samples.

Table 41.
Minimum, mean, and maximum lengths of <u>Citharichthys stigmaeus</u> larvae, and numbers taken in neuston and bongo samples during each cruise.

			LENGTH (mm)		
CRUISE	SEASON	NUMBER	MIN.	MEAN	MAX.
NEUSTON:					
PO84	Early spring	6	19.4	26.8	35.5
BA85	Spring	-	-	-	-
TK80	Spring	5	24.0	30.3	35.0
EQ83	Spring	-	-	-	-
PO82	Spring	3	33.5	35.7	39.5
PO81	Spring	1	-	39.0	-
PO80	Late summer	-	-	-	-
DA81	Late autumn	1	-	-	-
MF83	Late autumn	3	23.3	23.7	24.1
MF87	Winter	1	-	30.8	-
BONGO:					
PO84	Early spring	5	7.6	22.7	32.0
BA85	Spring	-	-	-	-
TK80	Spring	6	4.0	23.4	37.0
EQ83	Spring	2	6.7	18.6	30.5
PO82	Spring	1	-	36.3	-
PO81	Spring	-	-	-	-
PO80	Late summer	-	-	-	-
DA81	Late autumn	37	4.6	10.9	28.9
MF83	Late autumn	25	7.3	12.0	20.0
MF87	Winter	11	14.0	19.9	28.4

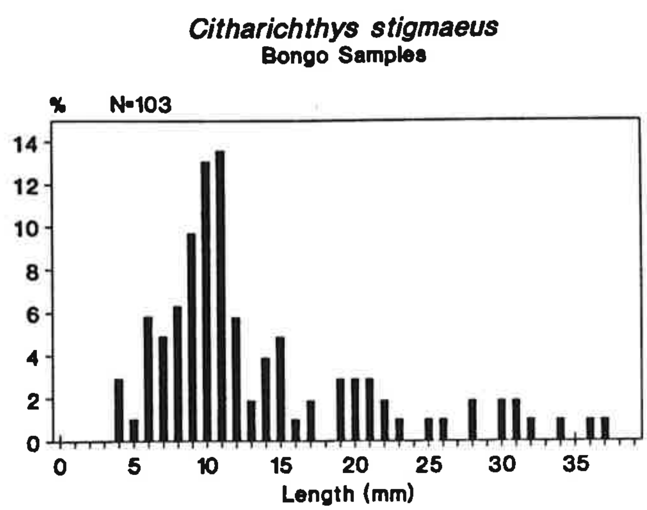


Figure 48. Length frequency distribution for <u>Citharichthys stigmaeus</u> larvae in bongo samples.

Table 42.
Minimum, mean, and maximum lengths of Errex zachirus larvae, and numbers taken in bongo samples during all cruises.

CRUISE	SEASON	NUMBER	LENGTH (mm) MIN.	MEAN	MAX.
PO84	Early spring	14	5.7	7.9	17.9
BA85	Spring	-	-	-	-
TK80	Spring	12	7.7	13.3	22.0
EQ83	Spring	60	5.0	15.7	48.0
PO82	Spring	14	5.0	12.2	25.0
PO81	Spring	12	7.0	17.3	37.0
PO80	Late summer	4	5.8	25.8	43.6
DA81	Late autumn	1	-	67.5	-
MF83	Late autumn	-	-	-	-
MF87	Winter	-	-	-	-

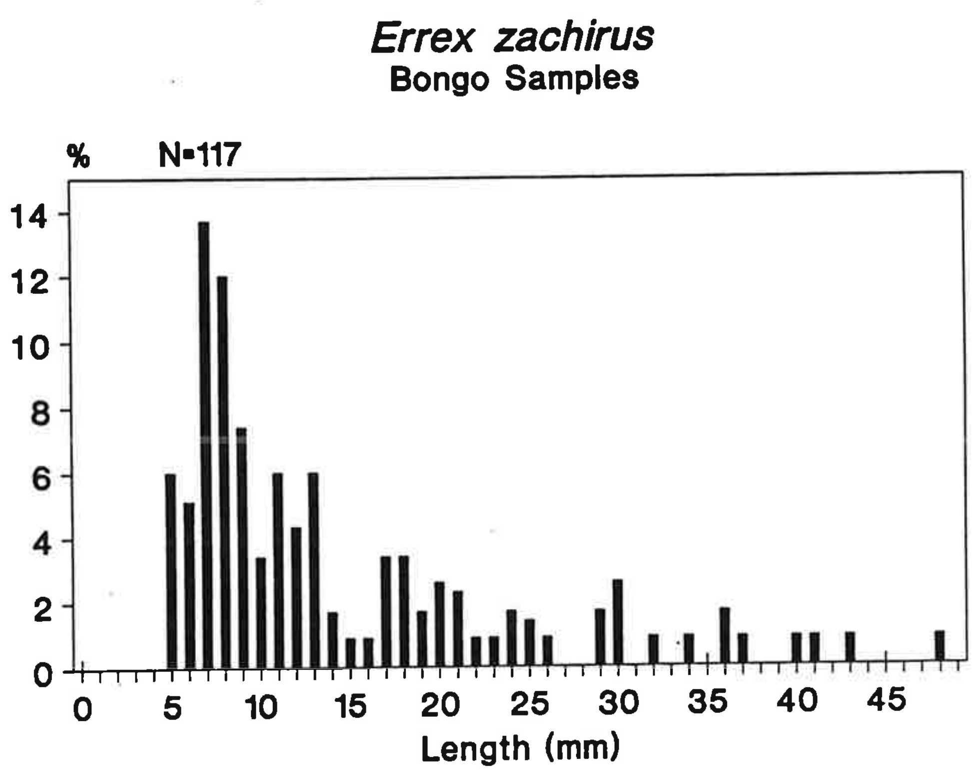


Figure 49. Length frequency distribution for Errex zachirus larvae in bongo samples.

Table 43.
Minimum, mean, and maximum lengths of <u>Eopsetta</u> <u>exilis</u> larvae, and numbers taken in bongo samples during all cruises.

			LENGTH (mm)		
CRUISE	SEASON	NUMBER	MIN.	MEAN	MAX.
PO84	Early spring	7	4.5	5.8	8.0
BA85	Spring	5	5.2	6.3	7.1
TK80	Spring	133	2.8	7.0	16.0
EQ83	Spring	114	3.0	8.6	17.5
PO82	Spring	54	3.0	7.5	13.5
PO81	Spring	145	4.4	9.3	22.2
PO80	Late summer	9	8.0	15.1	24.0
DA81	Late autumn	-	-	-	-
MF83	Late autumn	-	-	-	-
MF87	Winter	-	-	-	-

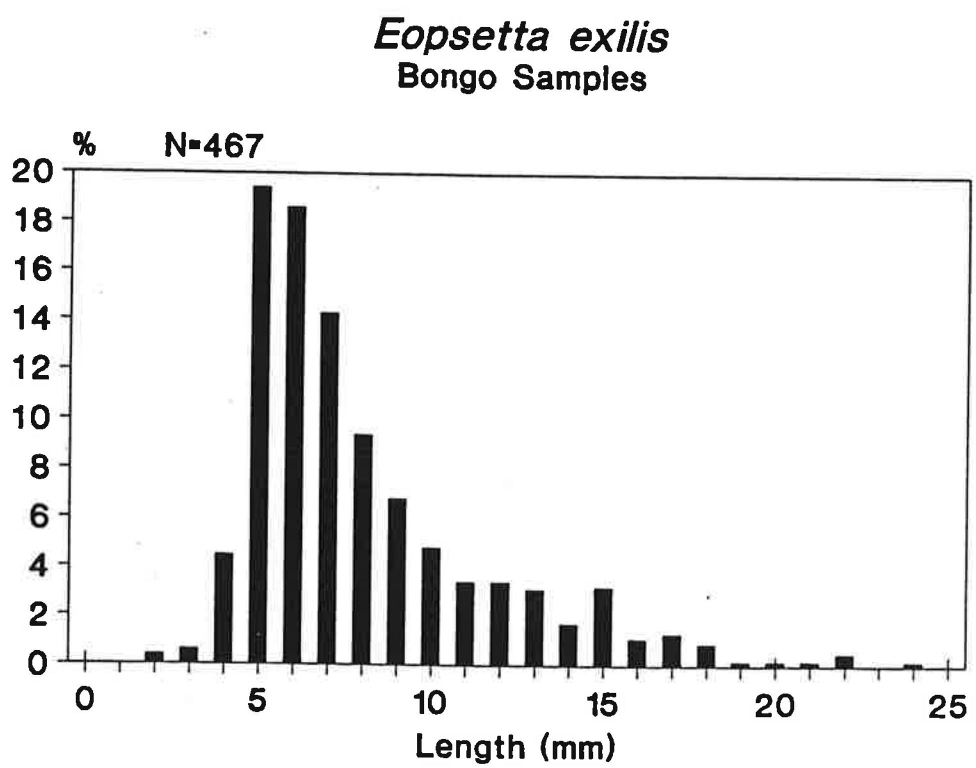


Figure 50. Length frequency distribution for <u>Eopsetta</u> <u>exilis</u> larvae in bongo samples.

Table 44.
Minimum, mean, and maximum lengths of Microstomus pacificus larvae, and numbers taken in bongo samples during all cruises.

CRUISE	SEASON	NUMBER	LENGTH (mm) MIN.	MEAN	MAX.
PO84	Early spring	-	-	-	-
BA85	Spring	3	5.0	6.1	6.3
TK80	Spring	4	7.0	8.3	9.1
EQ83	Spring	19	5.8	8.8	13.0
PO82	Spring	2	5.5	5.8	6.0
PO81	Spring	16	6.5	11.2	22.0
PO80	Late summer	1	22.5	22.5	22.5
DA81	Late autumn	-	-	-	-
MF83	Late autumn	-	-	-	-
MF87	Winter	1	16.0	16.0	16.0

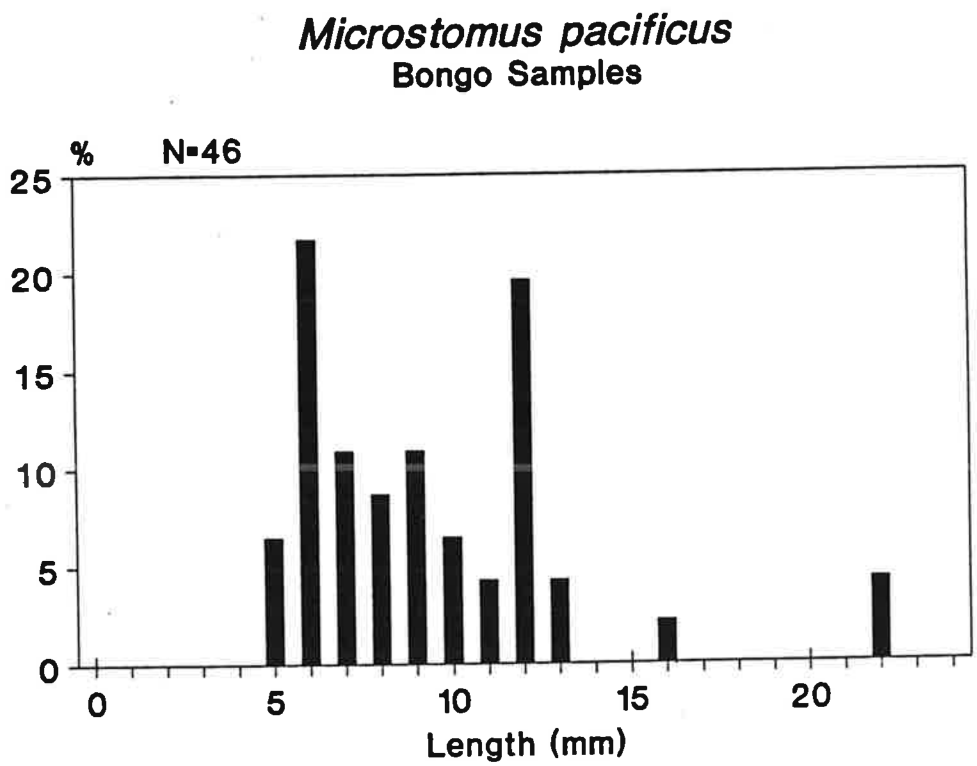


Figure 51. Length frequency distribution for Microstomus pacificus larvae in bongo samples.

Table 45.
Minimum, mean, and maximum lengths of Pleuronectes vetulus larvae, and numbers taken in bongo samples during all cruises.

			LENGTH (mm)		
CRUISE	SEASON	NUMBER	MIN.	MEAN	MAX.
PO84	Early spring	200	2.6	7.6	17.8
BA85	Spring	2	16.0	16.7	17.5
TK80	Spring	9	3.2	16.3	22.3
EQ83	Spring	14	3.0	12.0	21.0
PO82	Spring	5	16.0	18.5	21.0
PO81	Spring	-	-	-	-
PO80	Late summer	-	-	-	-
DA81	Late autumn	8	3.5	4.5	7.0
MF83	Late autumn	4	3.3	3.8	4.2
MF87	Winter	122	2.5	3.7	9.3

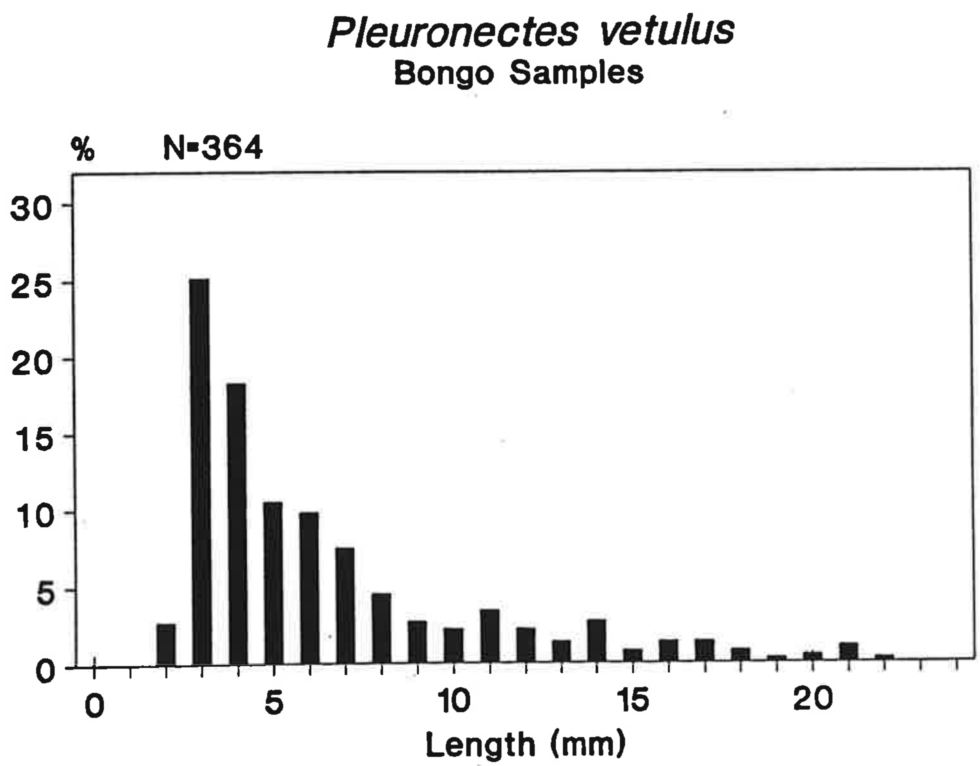


Figure 52. Length frequency distribution for Pleuronectes vetulus larvae in bongo samples.

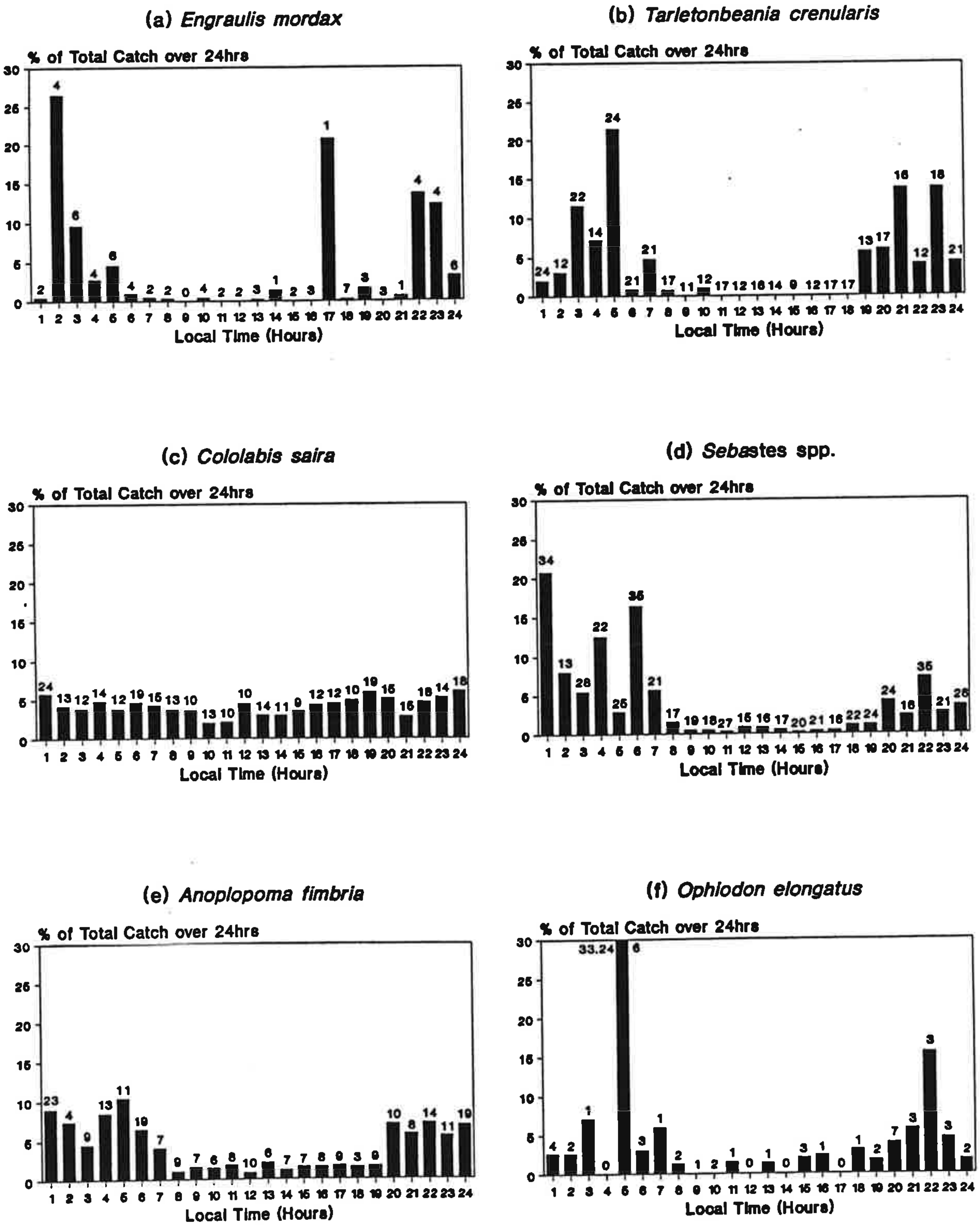


Figure 53. Diel variation in catches of dominant taxa of fish larvae in neuston. Numbers above the bars are the total number of samples collected in which larvae of the particular species were caught.

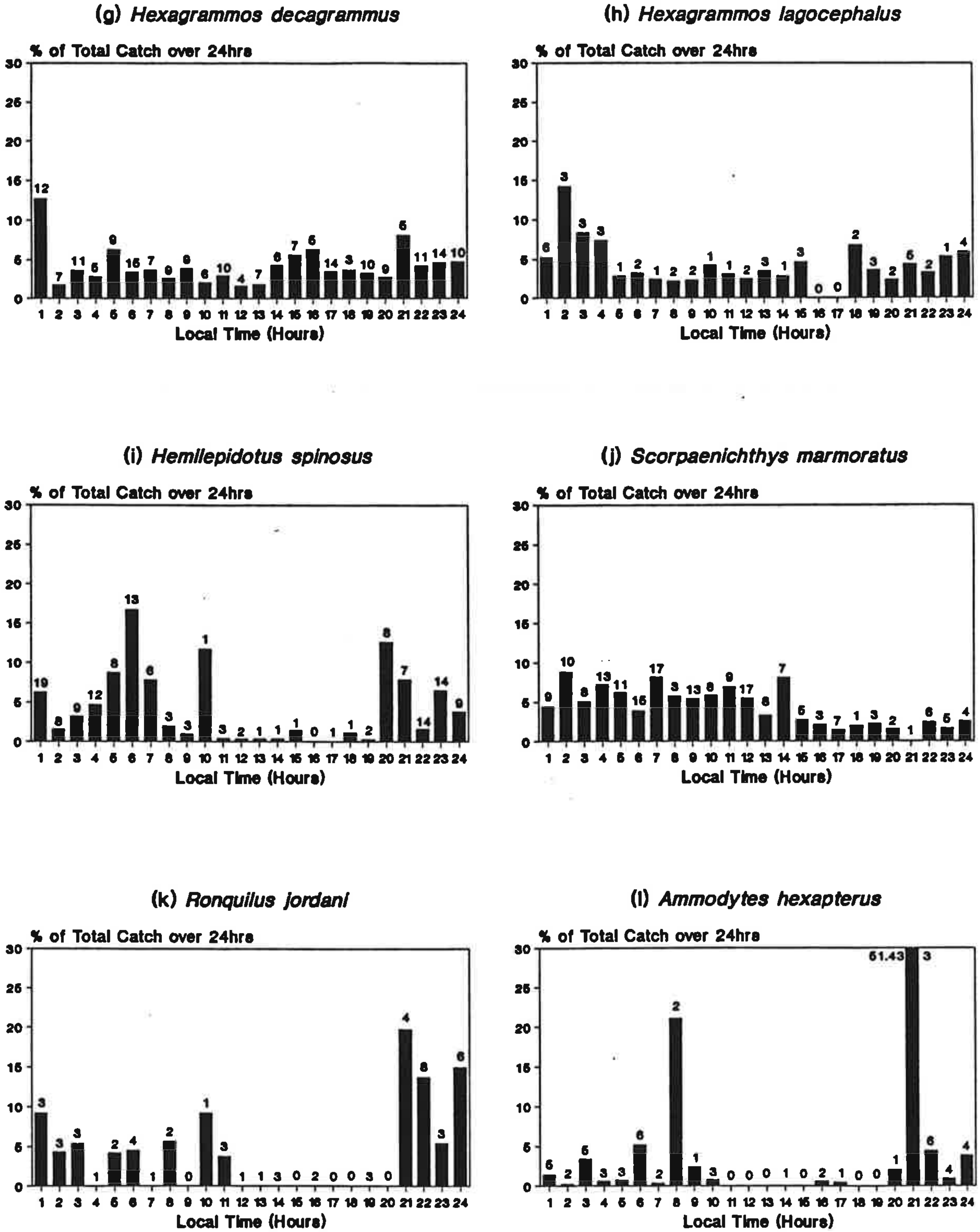
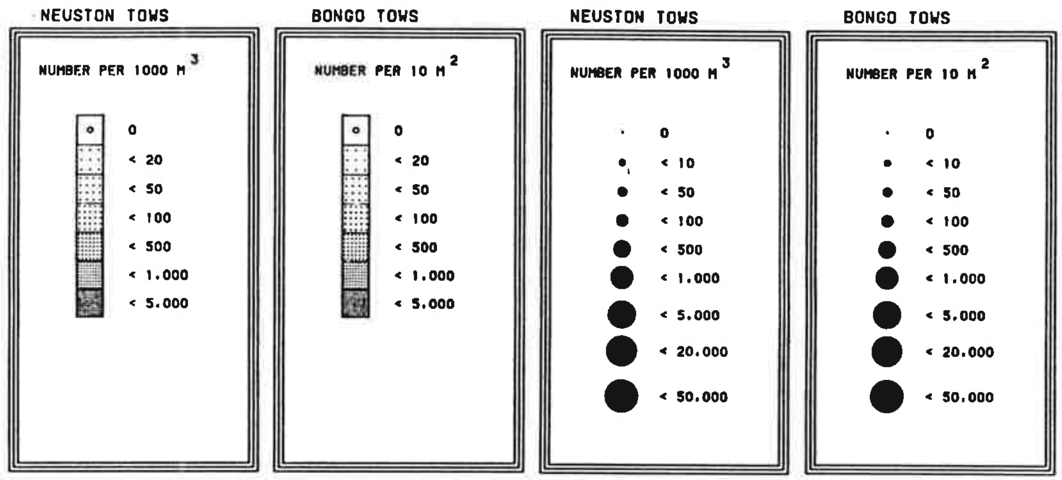


Figure 53. continued



Legends for distribution maps: Figures 54 to 116.

Engraulis mordax
Neuston: Eggs
(a) Mean distribution

(b) Cruise TK80

(c) Cruise PO80

(d) Cruise EQ83

Figure 54. Distribution patterns for Engraulis mordax eggs in the neuston.

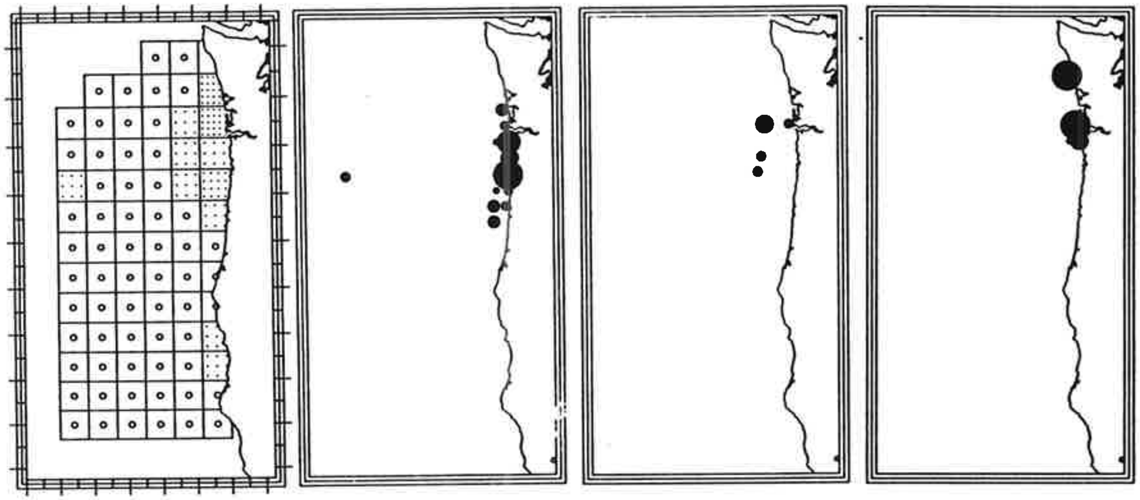
Engraulis mordax
Neuston: Larvae
(a) Mean distribution

(b) Cruise PO80

(c) Cruise DA81

(d) Cruise EQ83

Figure 55. Distribution patterns for Engraulis mordax larvae in the neuston.



Engraulis mordax
Bongo: Eggs
(a) Mean distribution

(b) Cruise TK80

(c) Cruise PO80

(d) Cruise EQ83

Figure 56. Distribution patterns for Engraulis mordax eggs from the bongo samples.

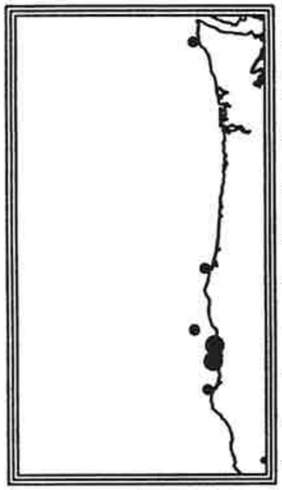
Engraulis mordax
Bongo: Larvae
(a) Mean distribution

(b) Cruise PO80

(c) Cruise DA81

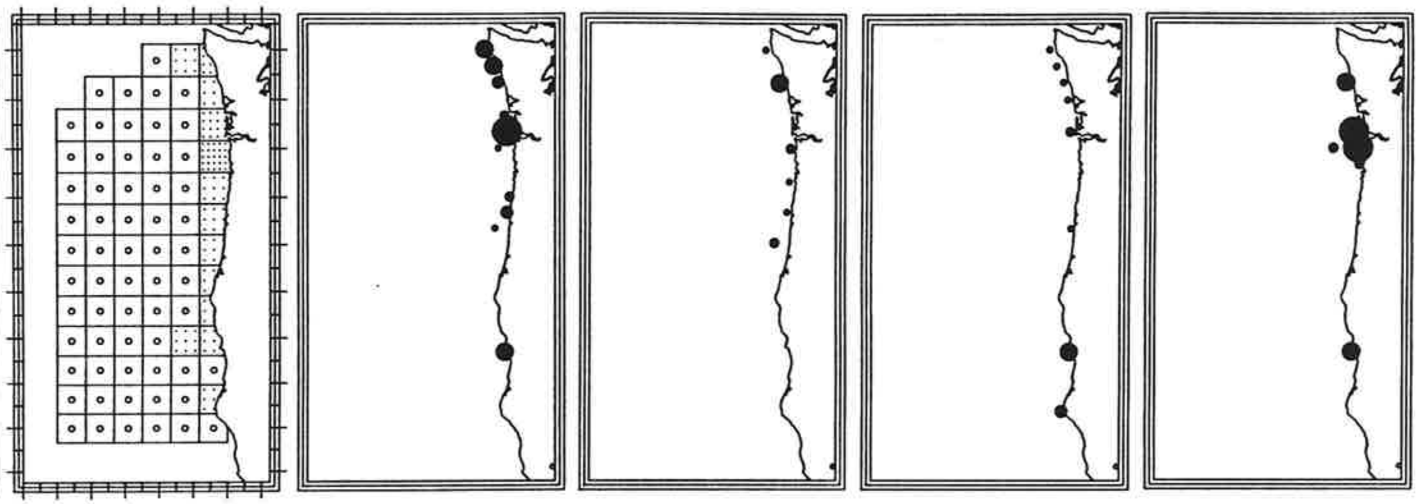
(d) Cruise EQ83

Figure 57. Distribution patterns for Engraulis mordax larvae from the bongo samples.



Osmeridae
Neuston: Larvae
Cruise PO82

Figure 58.



Osmeridae
Bongo: Larvae
(a) Mean distribution

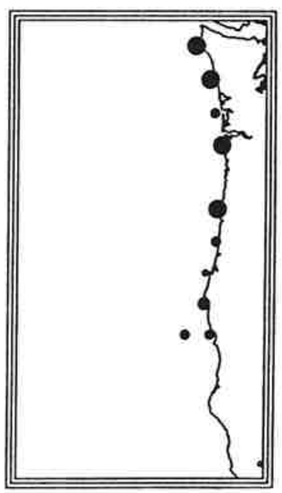
(b) Cruise TK80

(c) Cruise PO82

(d) Cruise PO84

(e) Cruise BA85

Figure 59. Distribution patterns for osmerid larvae from the bongo samples.



(f) Cruise MF87

Figure 58. Distribution of osmerid larvae in the neuston.

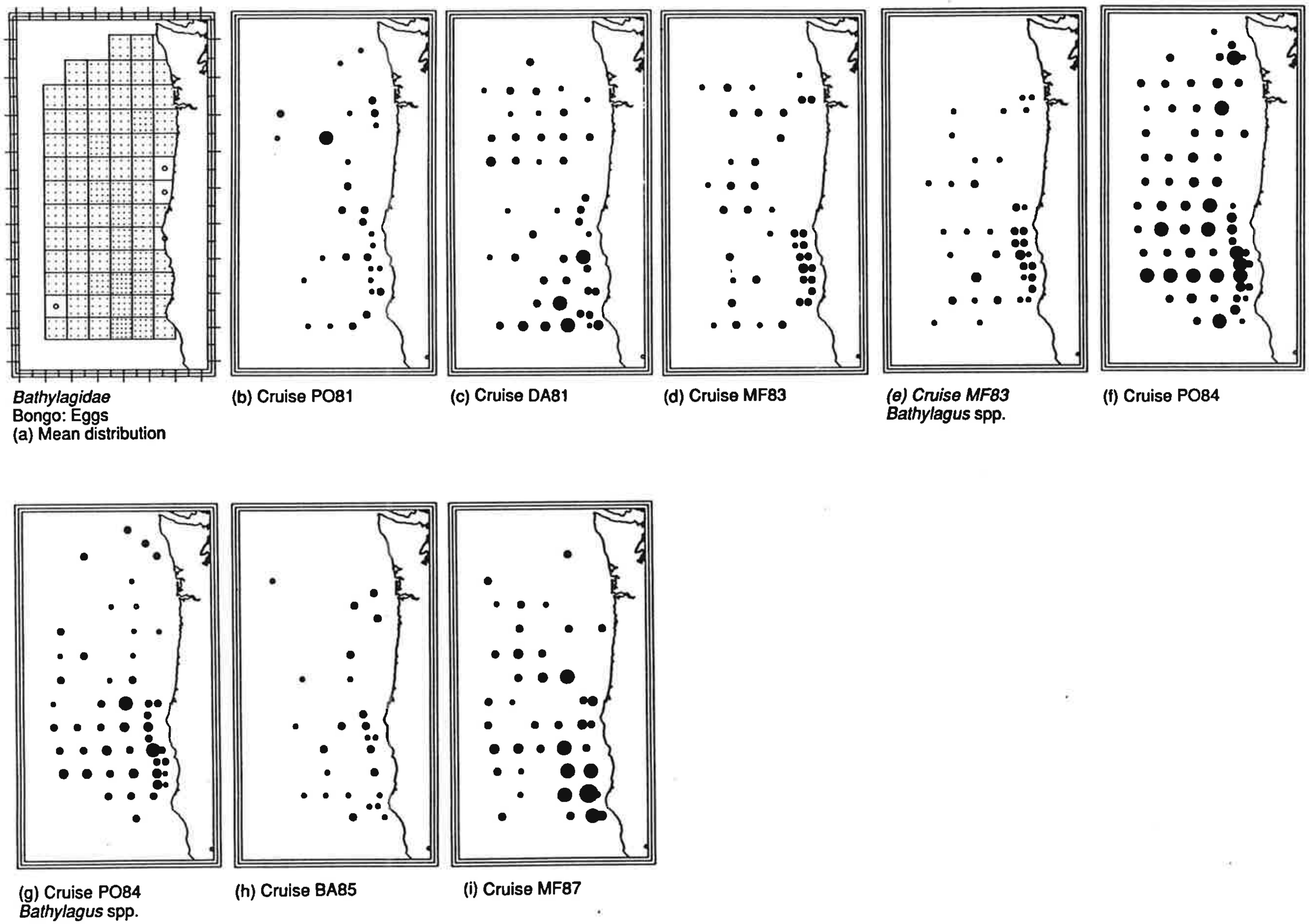


Figure 60. Distribution patterns for bathylagid eggs from the bongo samples.

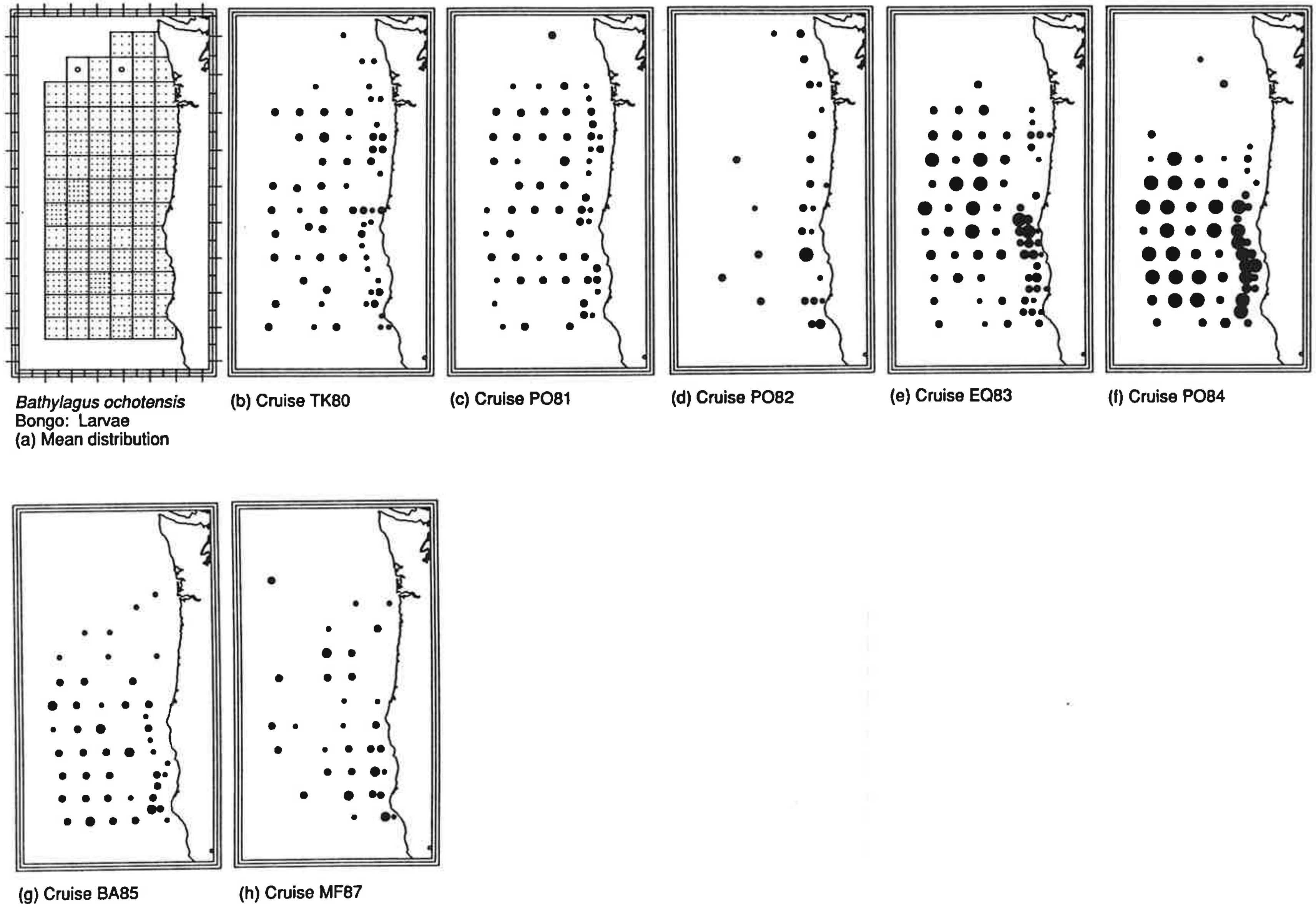


Figure 61. Distribution patterns for Bathylagus ochotensis larvae from the bongo samples.

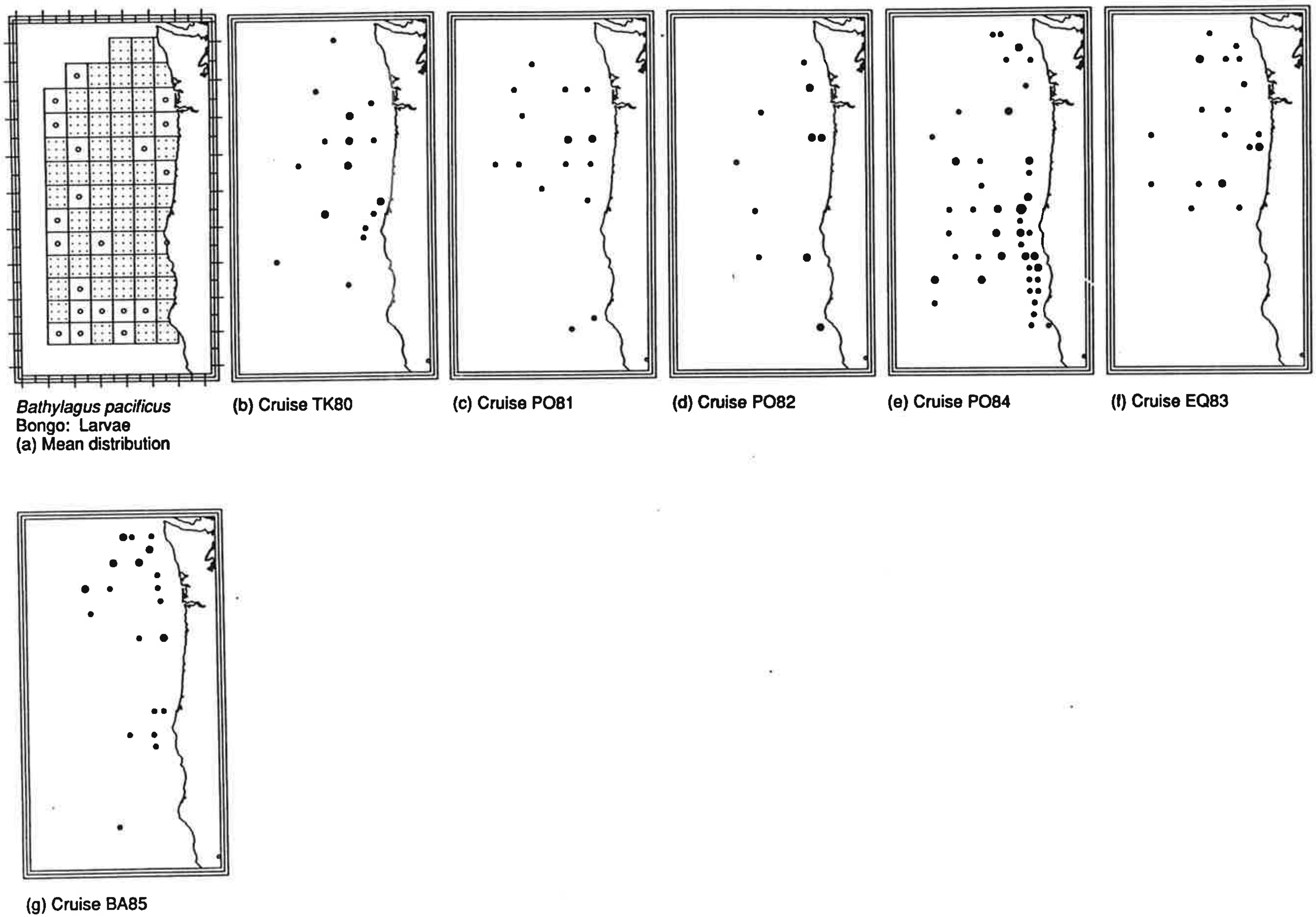
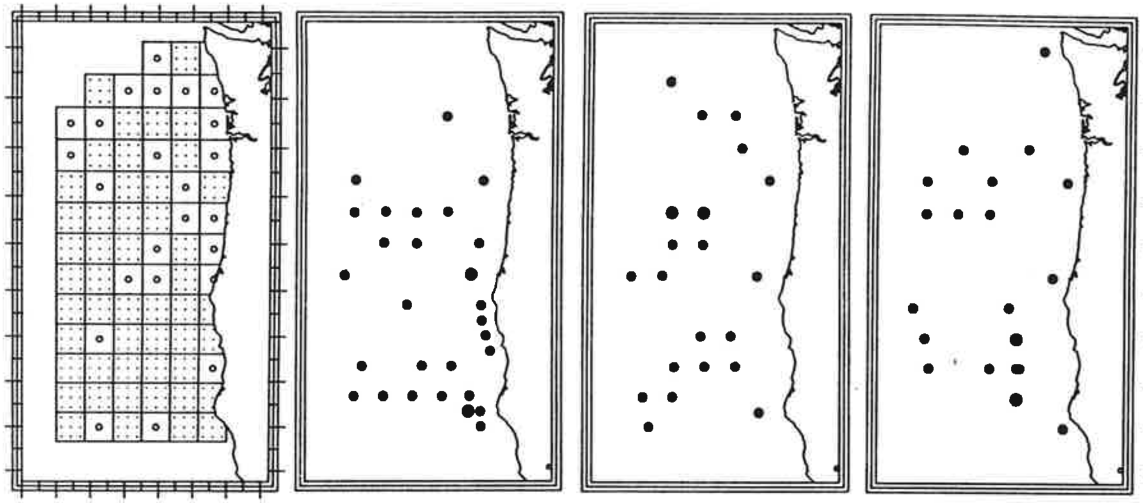


Figure 62. Distribution patterns for Bathylagus pacificus larvae from the bongo samples.



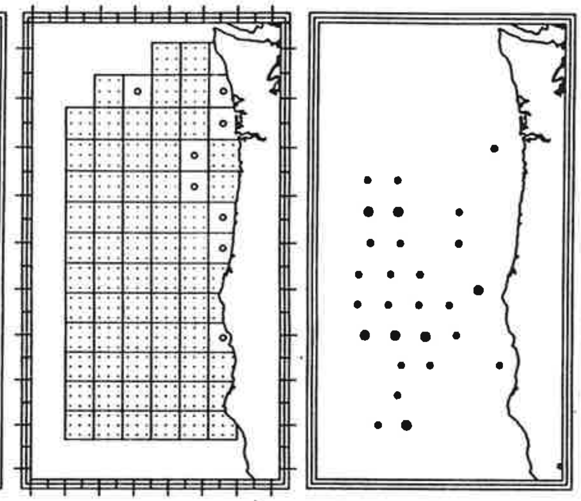
Chauliodus macouni
Neuston: Eggs
(a) Mean distribution

(b) Cruise DA81

(c) Cruise MF83

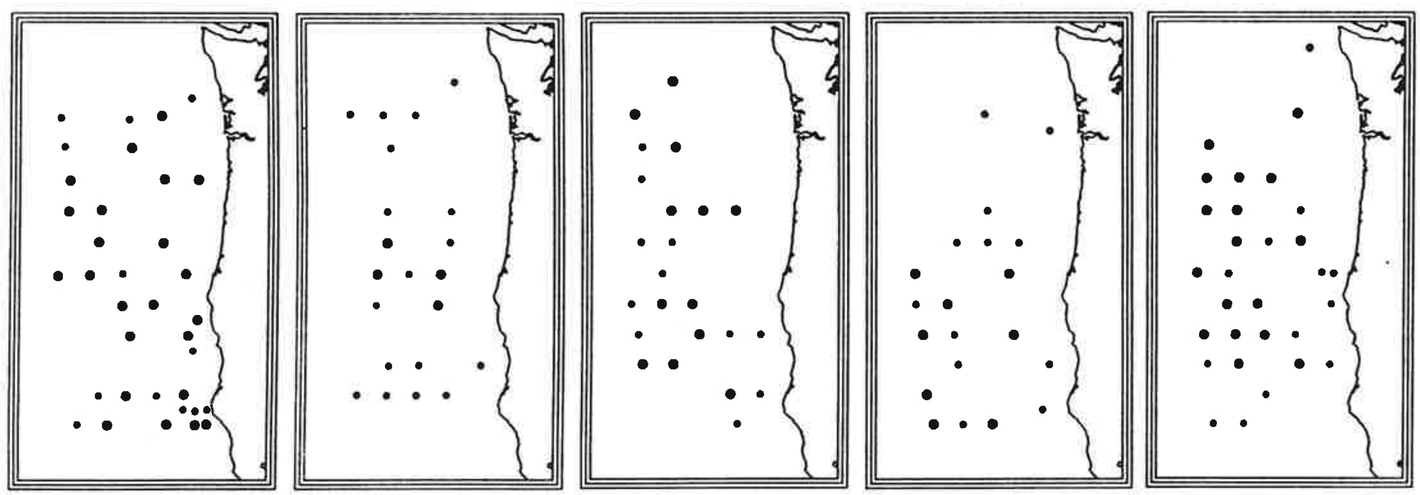
(d) Cruise MF87

Figure 63. Distribution patterns for Chauliodus macouni eggs in the neuston.



Chauliodus macouni
Bongo: Eggs
(a) Mean distribution

(b) Cruise PO81



(c) Cruise DA81

(d) Cruise MF83

(e) Cruise PO84

(f) Cruise BA85

(g) Cruise MF87

Figure 64. Distribution patterns for Chauliodus macouni eggs from the bongo samples.

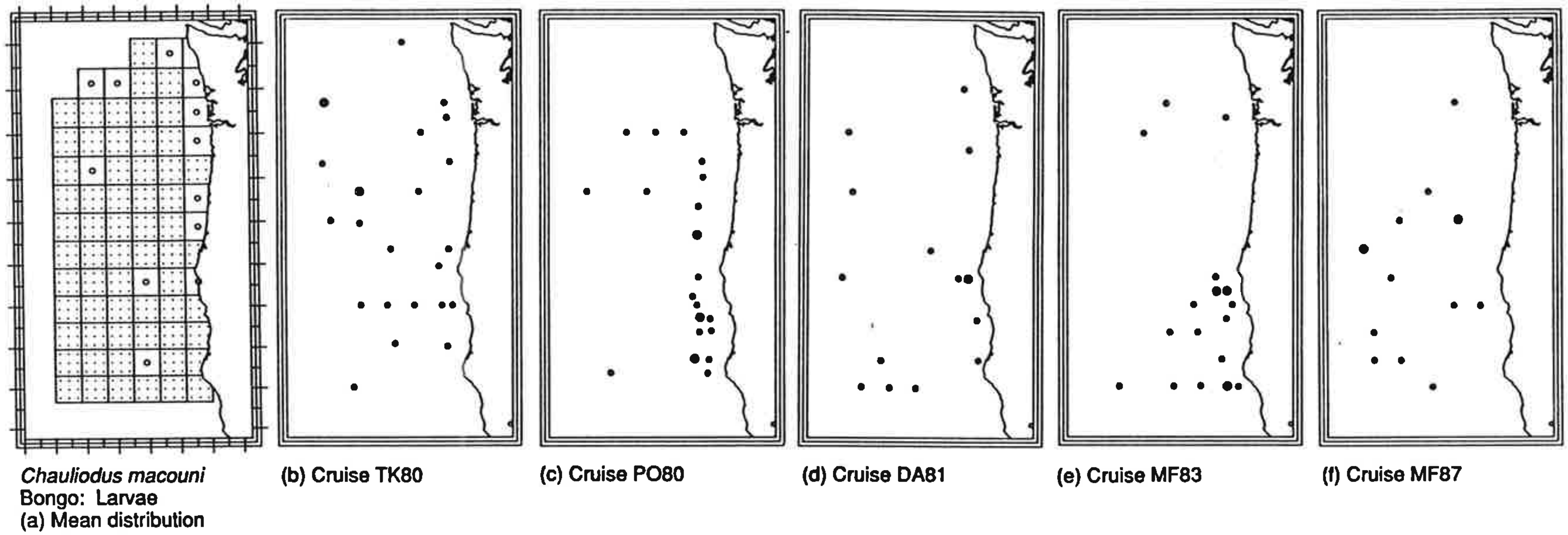
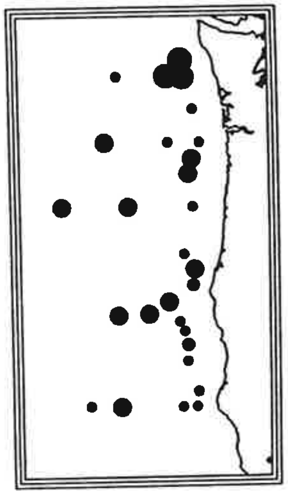
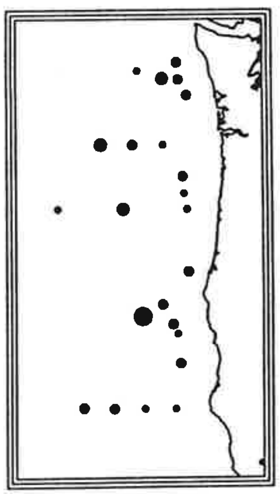


Figure 65. Distribution patterns for Chauliodus macouni larvae from the bongo samples.



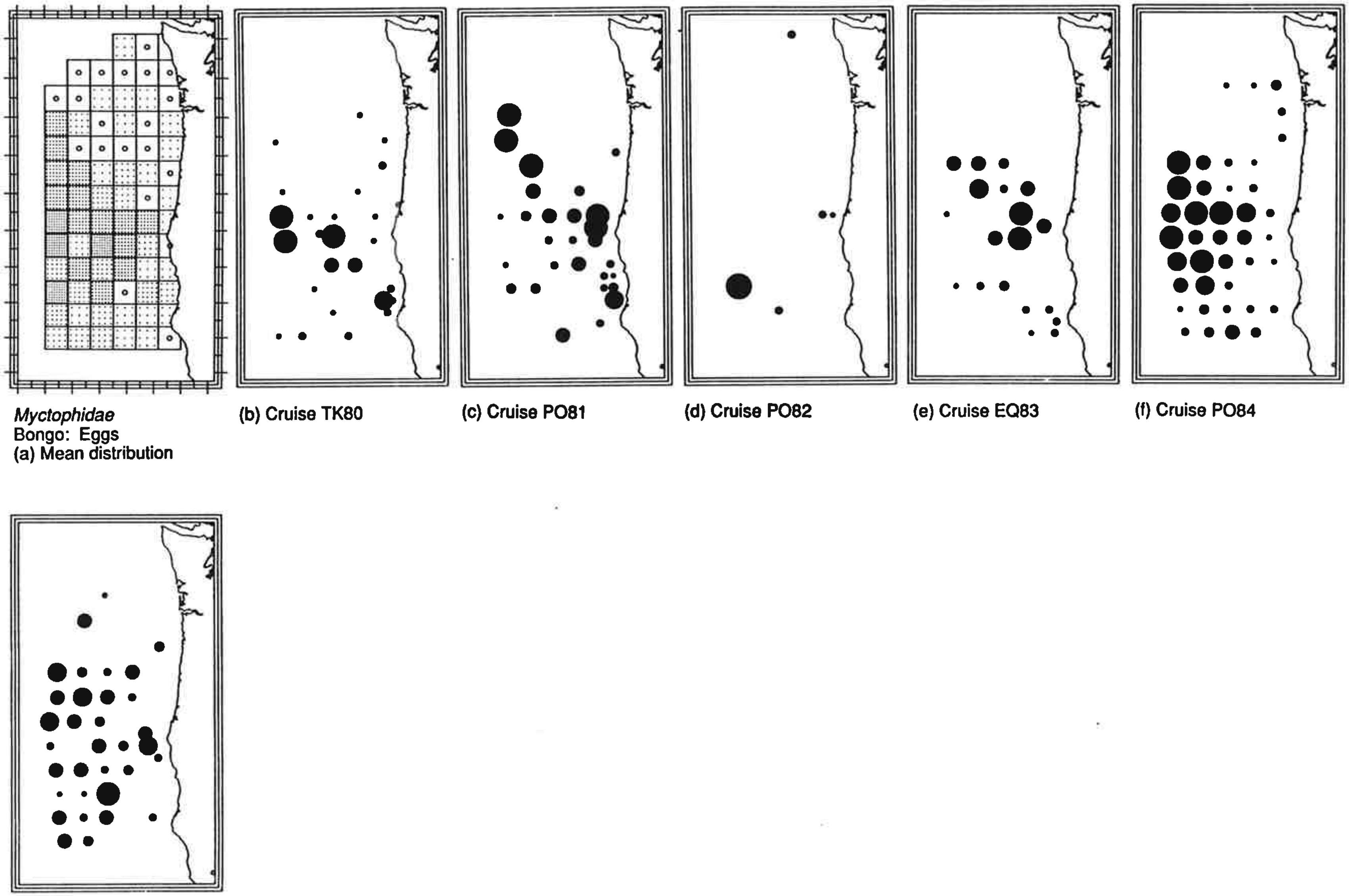
Tactostoma macropus
Neuston: Eggs
Cruise PO80

Figure 66. Distribution of <u>Tactostoma</u> <u>macropus</u> eggs in the neuston.



Tactostoma macropus
Bongo: Eggs
Cruise PO80

Figure 67. Distribution of <u>Tactostoma</u> <u>macropus</u> eggs from the bongo samples.



Myctophidae
Bongo: Eggs
(a) Mean distribution

(b) Cruise TK80

(c) Cruise PO81

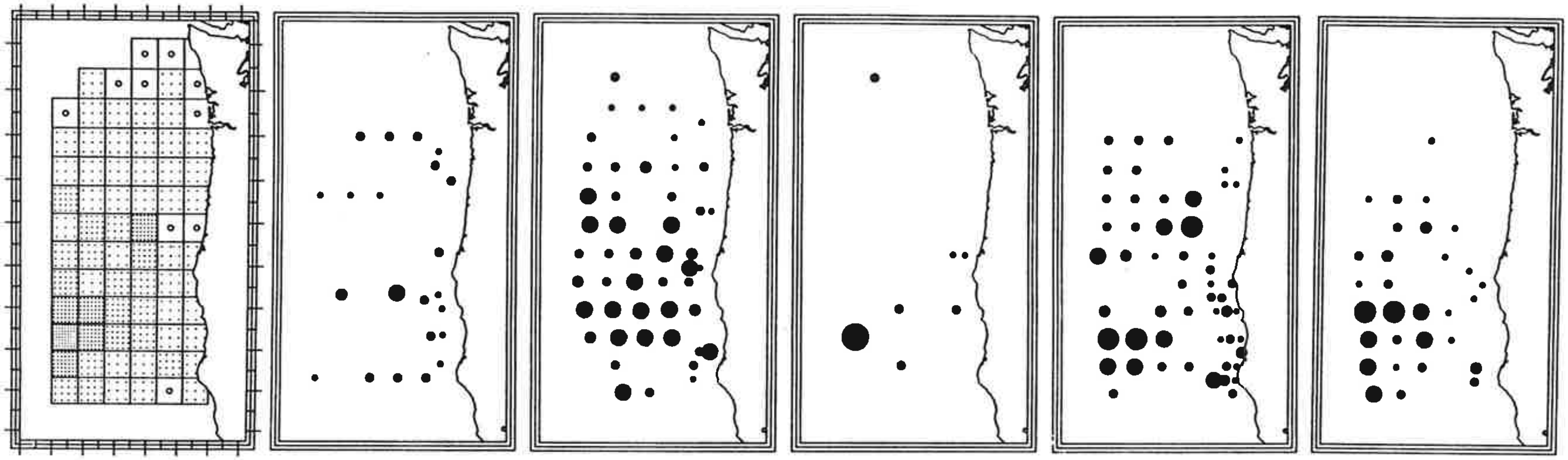
(d) Cruise PO82

(e) Cruise EQ83

(f) Cruise PO84

(g) Cruise BA85

Figure 68. Distribution patterns for myctophid eggs from the bongo samples.



Diaphus theta
Bongo: Larvae
(a) Mean distribution

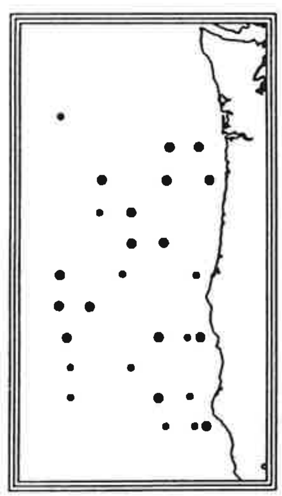
(b) Cruise PO80

(c) Cruise PO81

(d) Cruise PO82

(e) Cruise EQ83

(f) Cruise BA85



(g) Cruise MF87

Figure 69. Distribution patterns for Diaphus theta larvae from the bongo samples.

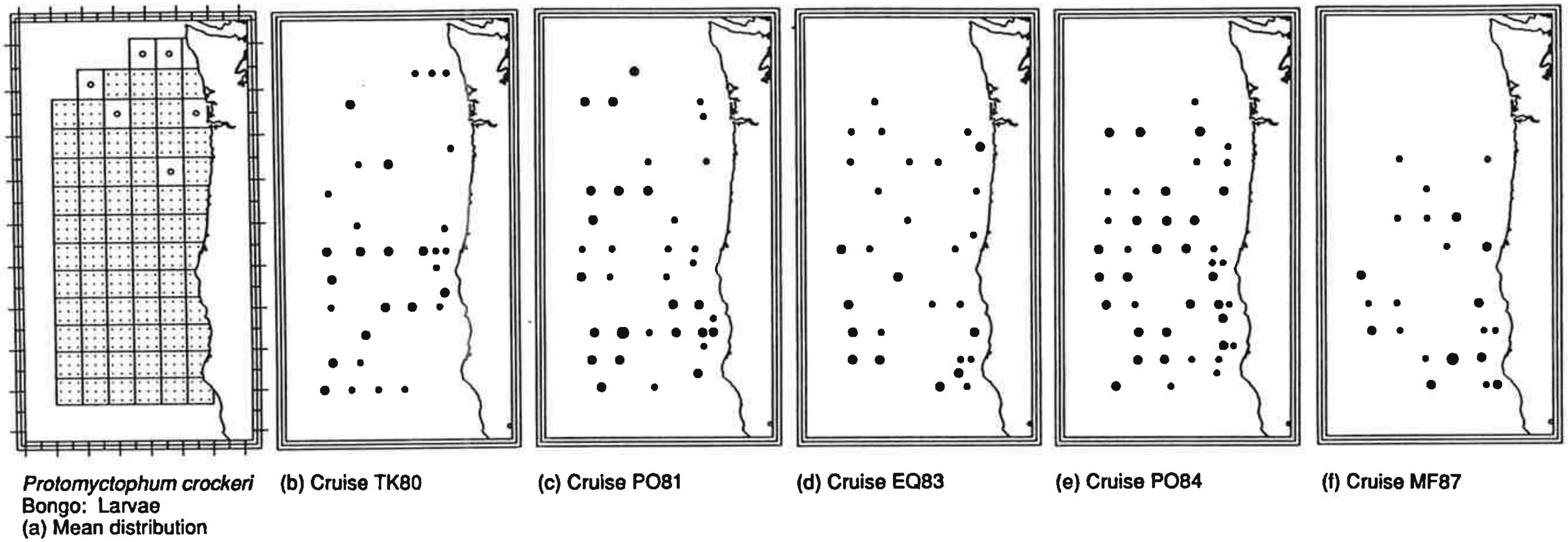


Figure 70. Distribution patterns for Protomyctophum crockeri larvae from the bongo samples.

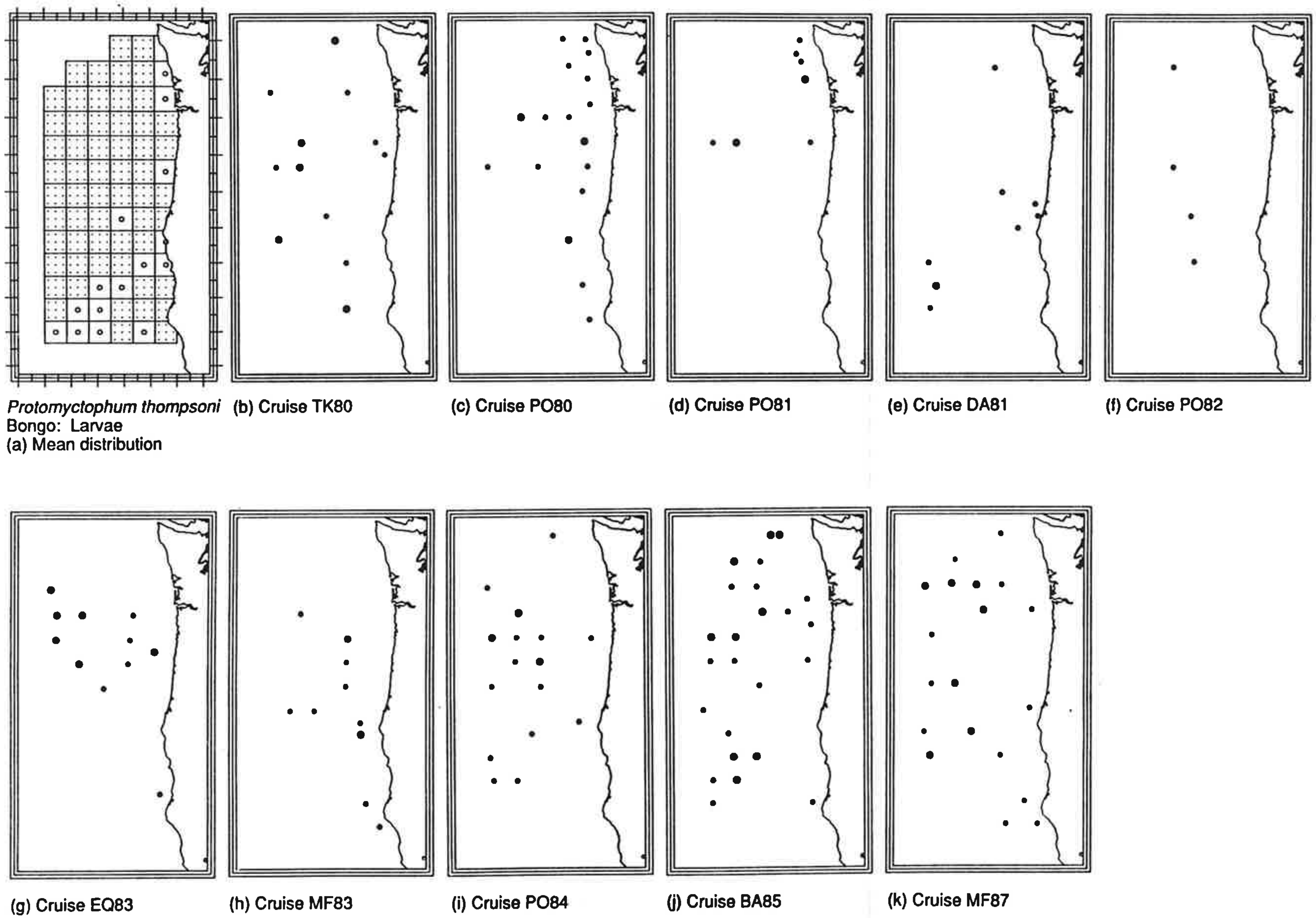


Figure 71. Distribution patterns for Protomyctophum thompsoni larvae from the bongo samples.

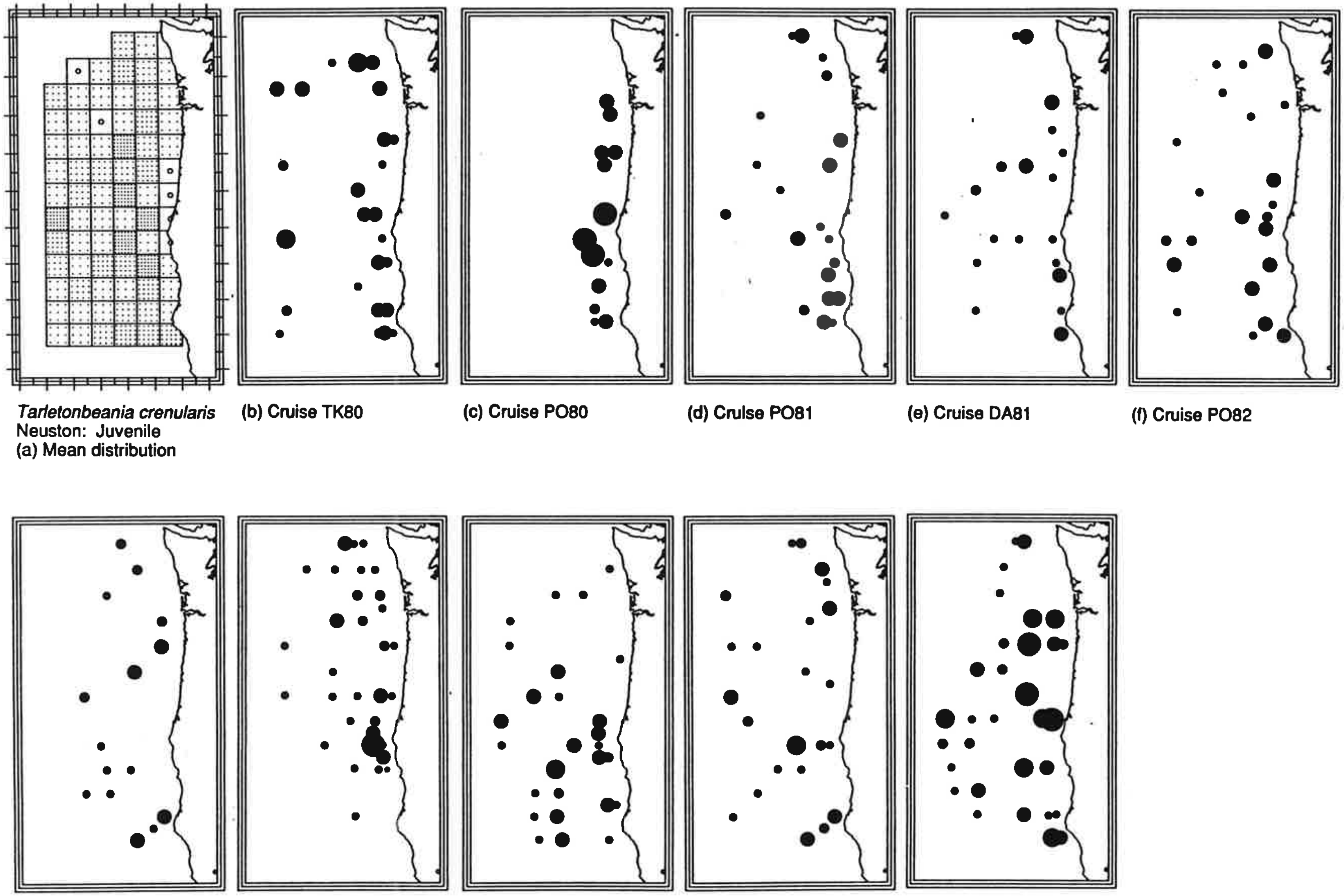


Figure 72. Distribution patterns for Tarletonbeania crenularis juveniles in the neuston.

Tarletonbeania crenularis
Bongo: Larvae
(a) Mean distribution

(b) Cruise TK80

(c) Cruise PO80

(d) Cruise PO81

(e) Cruise DA81

(f) Cruise PO82

(g) Cruise EQ83

(h) Cruise MF83

(i) Cruise PO84

(j) Cruise BA85

(k) Cruise MF87

Figure 73. Distribution patterns for Tarletonbeania crenularis larvae from the bongo samples.

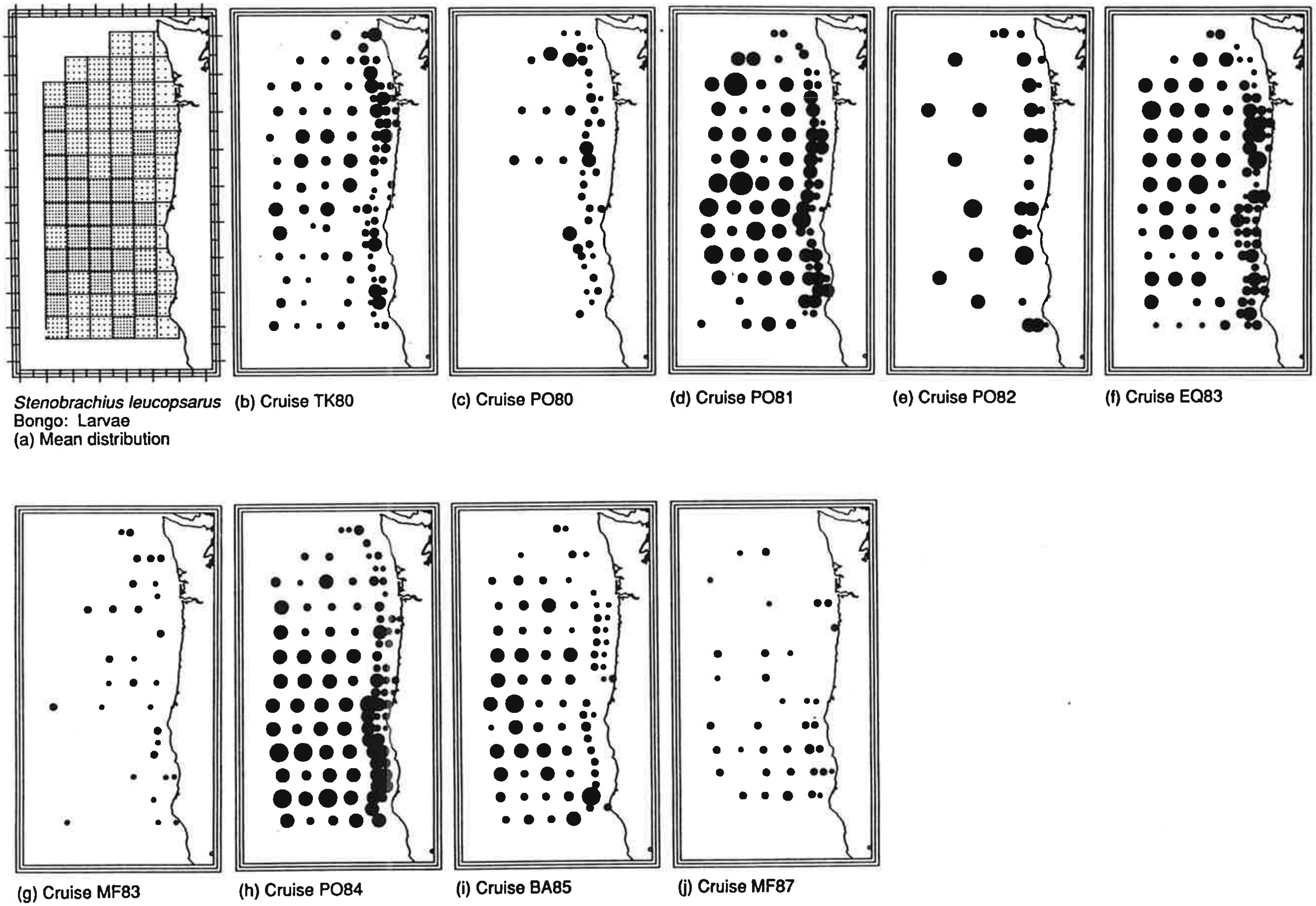
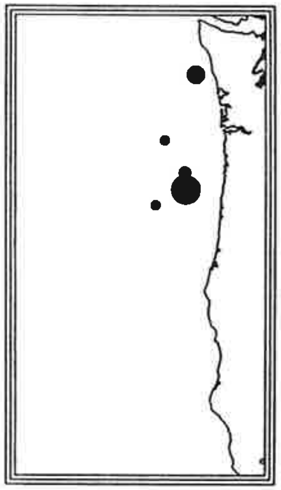
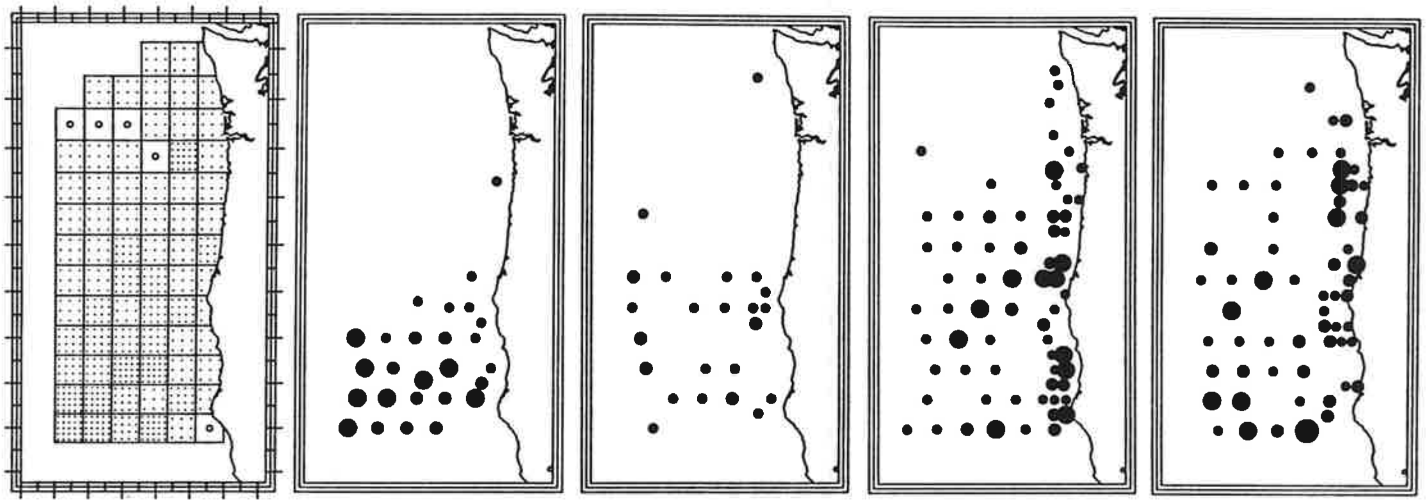


Figure 74. Distribution patterns for <u>Stenobrahcius</u> <u>leucopsarus</u> larvae from the bongo samples.



Cololabis saira
Neuston: Eggs
Cruise PO80

Figure 75.



Cololabis saira
Neuston: Larvae
(a) Mean distribution

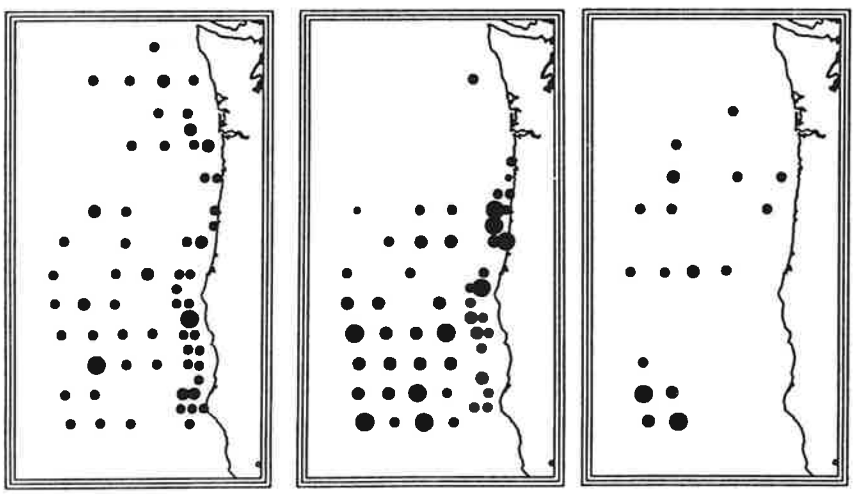
(b) Cruise TK80

(c) Cruise PO81

(d) Cruise DA81

(e) Cruise EQ83

Figure 76. Distribution patterns for Cololabis saira larvae in the neuston.

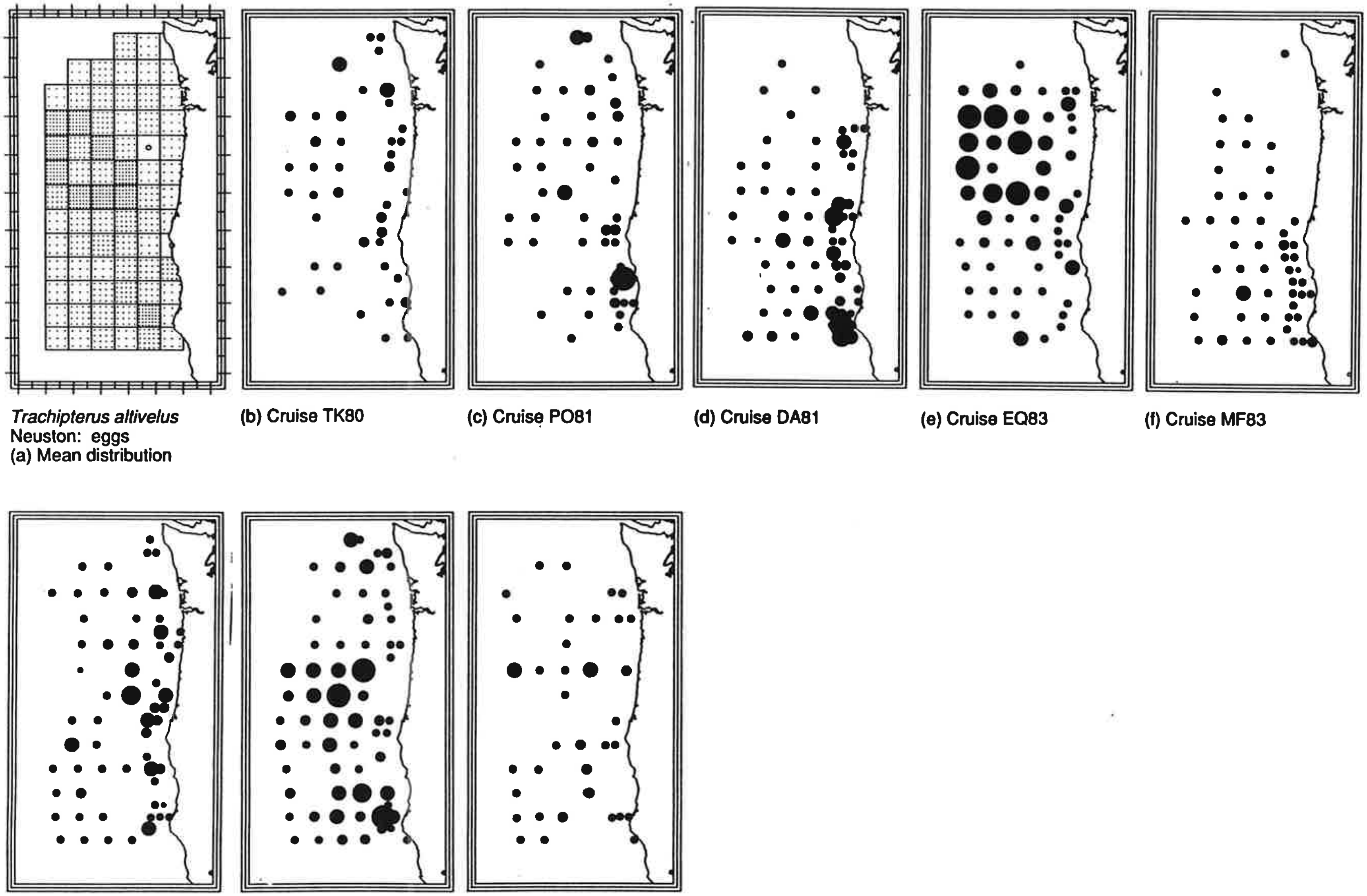


(f) Cruise MF83

(g) Cruise PO84

(h) Cruise MF87

Figure 75. Distribution of Cololabis saira eggs in the neuston



Trachipterus altivelus
Neuston: eggs
(a) Mean distribution

(b) Cruise TK80

(c) Cruise PO81

(d) Cruise DA81

(e) Cruise EQ83

(f) Cruise MF83

(g) Cruise PO84

(h) Cruise BA85

(i) Cruise MF87

Figure 77. Distribution patterns for Trachipterus altivelis eggs in the neuston.

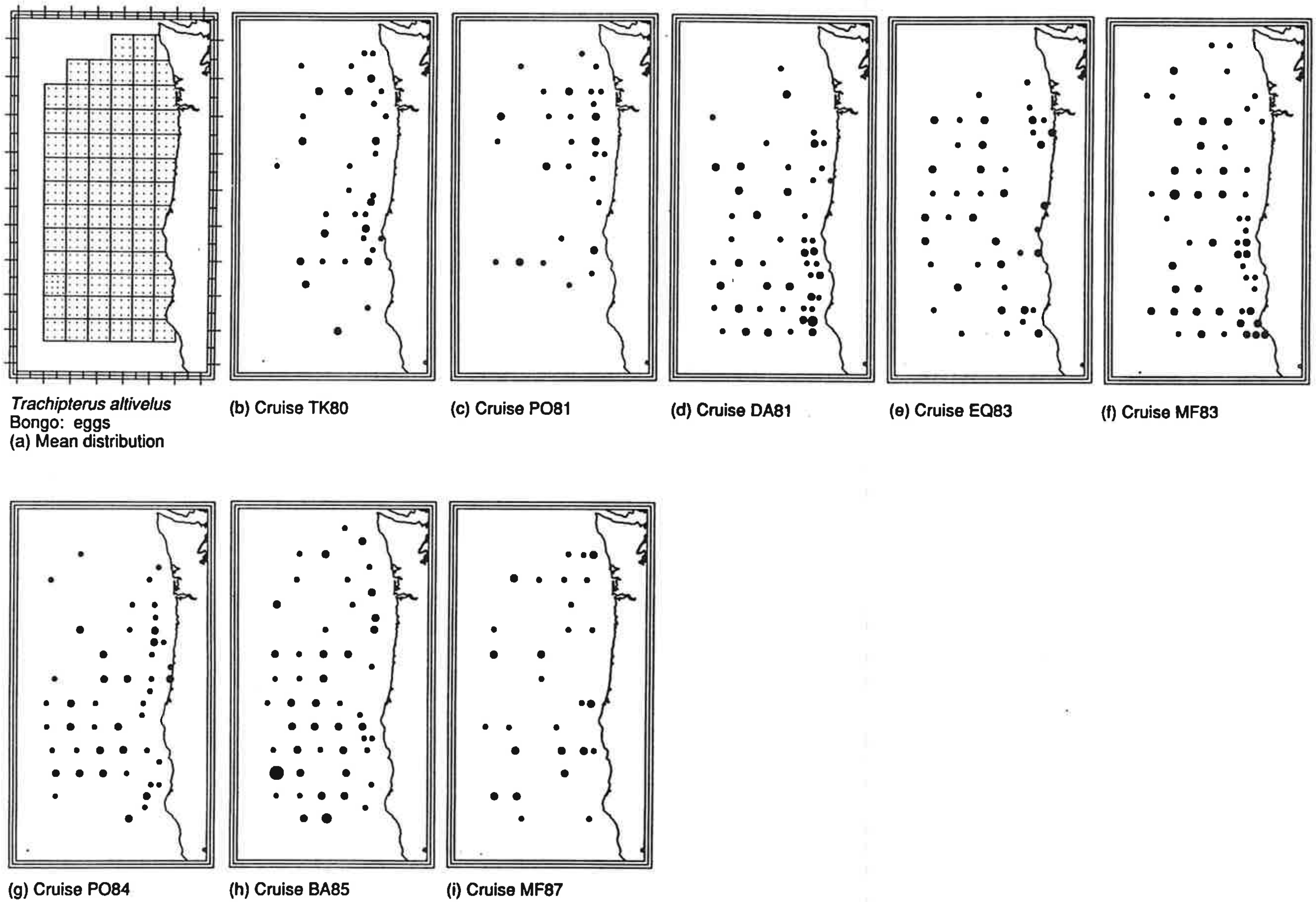


Figure 78. Distribution patterns for Trachipterus altivelis eggs from the bongo samples.

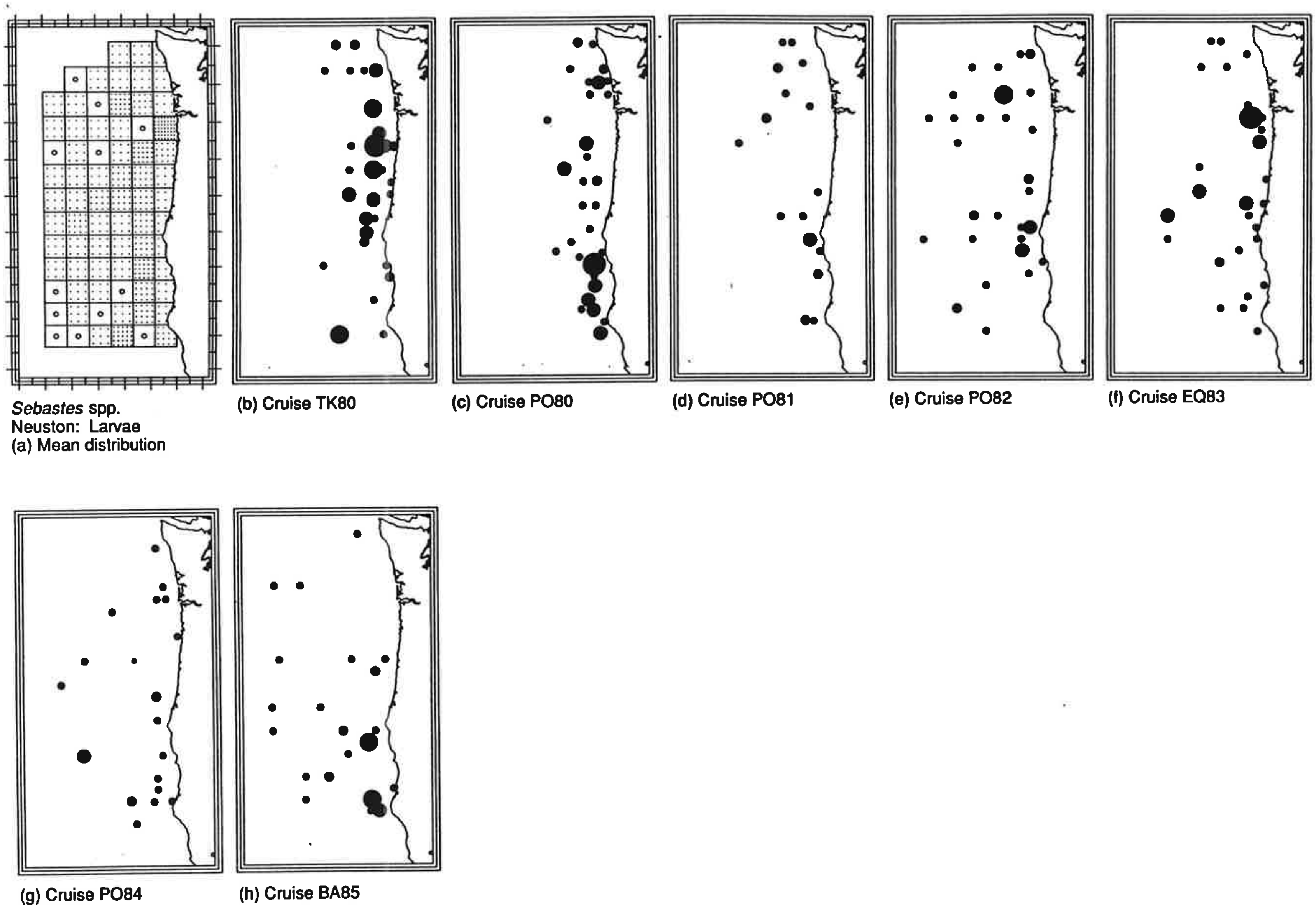


Figure 79. Distribution patterns for Sebastes spp. larvae in the neuston.

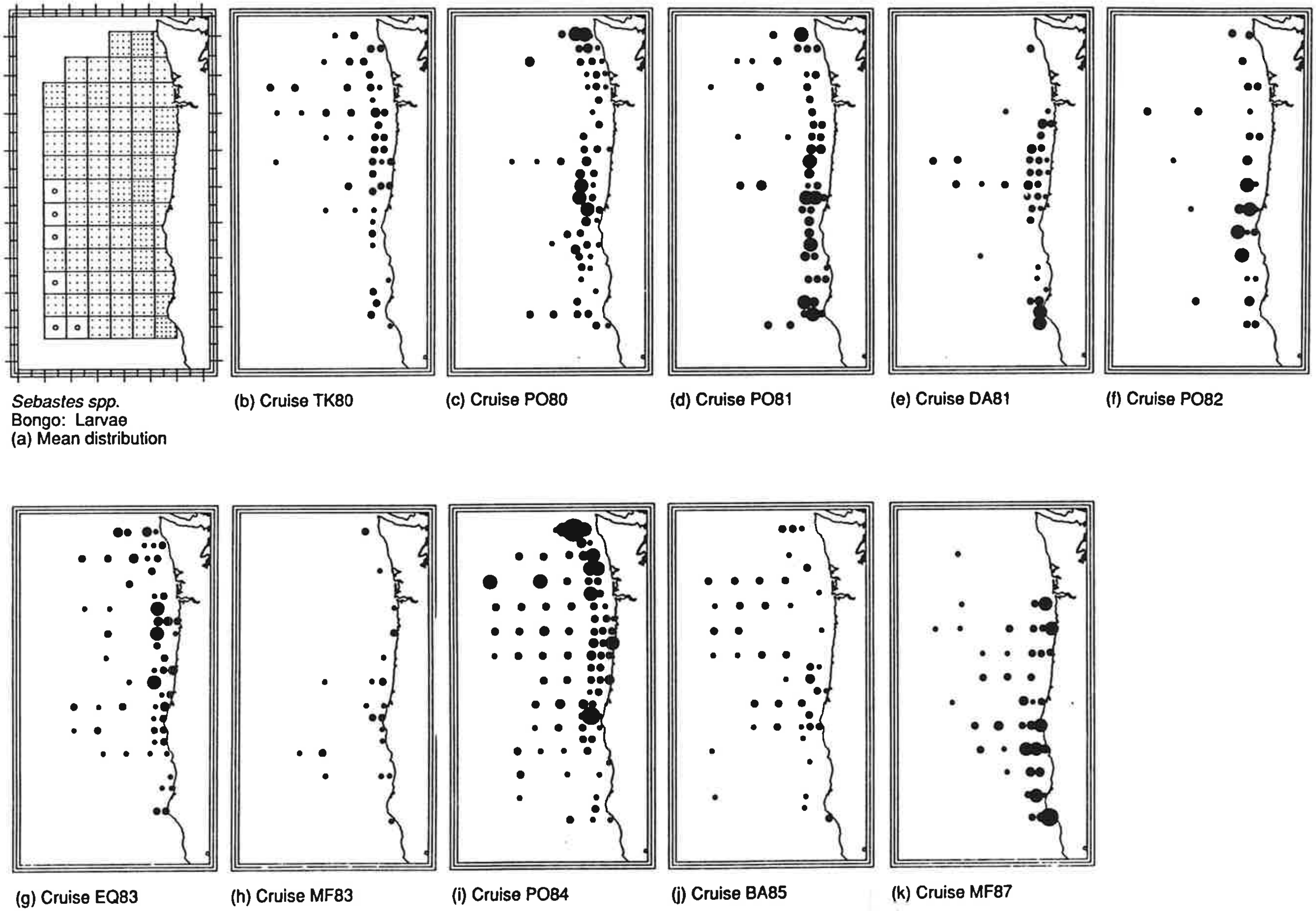
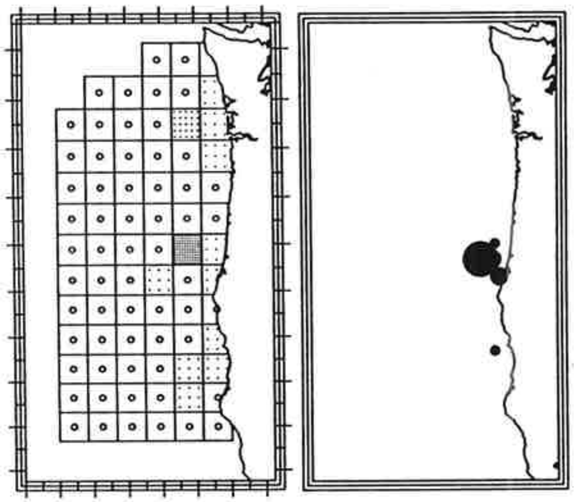
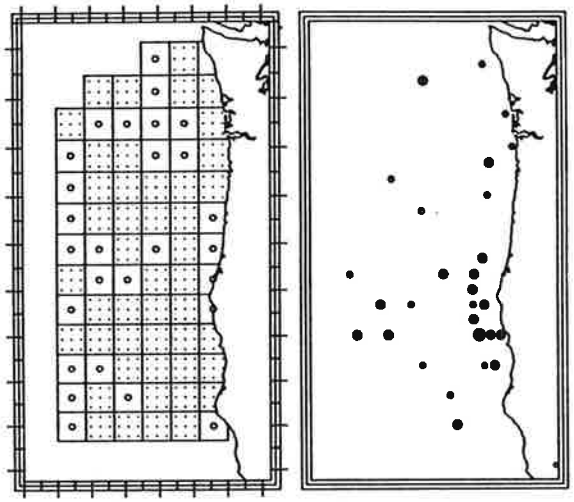


Figure 80. Distribution patterns for Sebastes spp. larvae from the bongo samples.



Sebastolobus spp.
Neuston: Eggs
(a) Mean distribution

(b) Cruise PO81

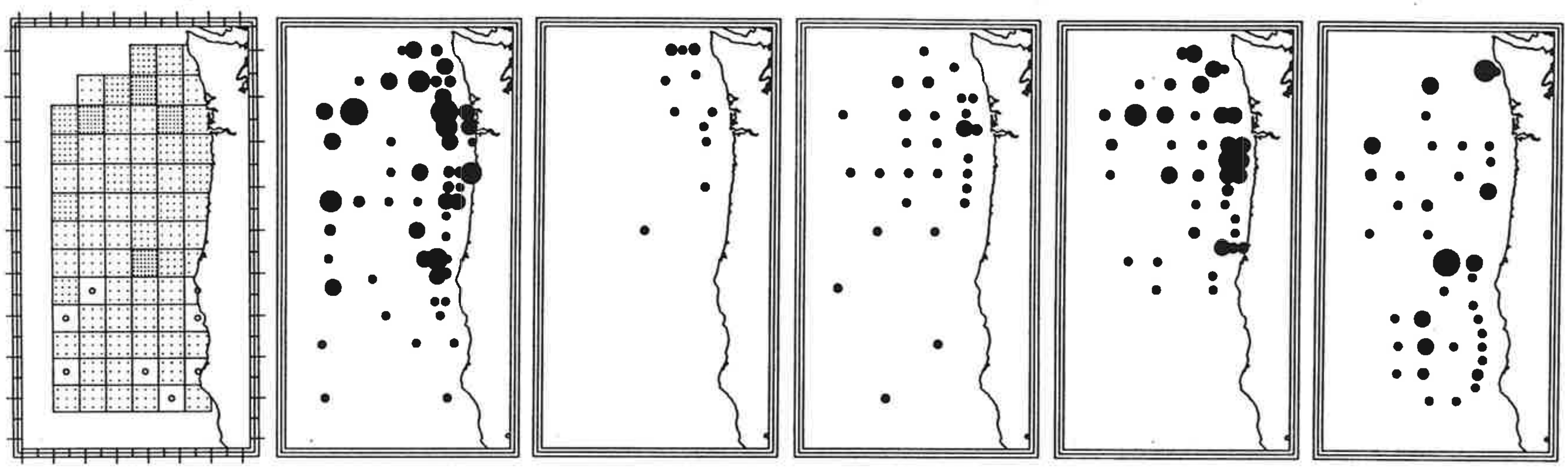


Sebastolobus spp.
Bongo: Larvae
(a) Mean distribution

(b) Cruise EQ83

Figure 81. Distribution patterns for Sebastolobus spp. eggs in the neuston.

Figure 82. Distribution patterns for Sebastolobus spp. larvae from the bongo samples.



Anoplopoma fimbria
Neuston: Larvae
(a) Mean distribution

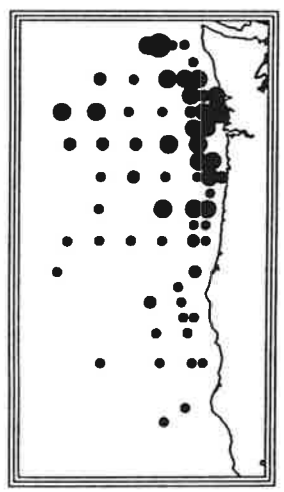
(b) Cruise TK80

(c) Cruise PO81

(d) Cruise PO82

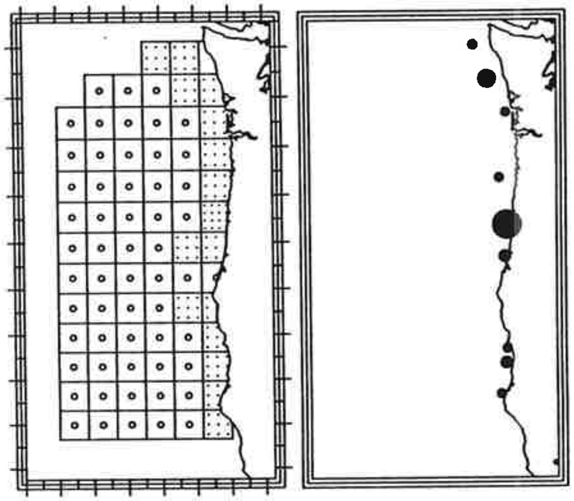
(e)Cruise EQ83

(f) Cruise PO84



(g) Cruise BA85

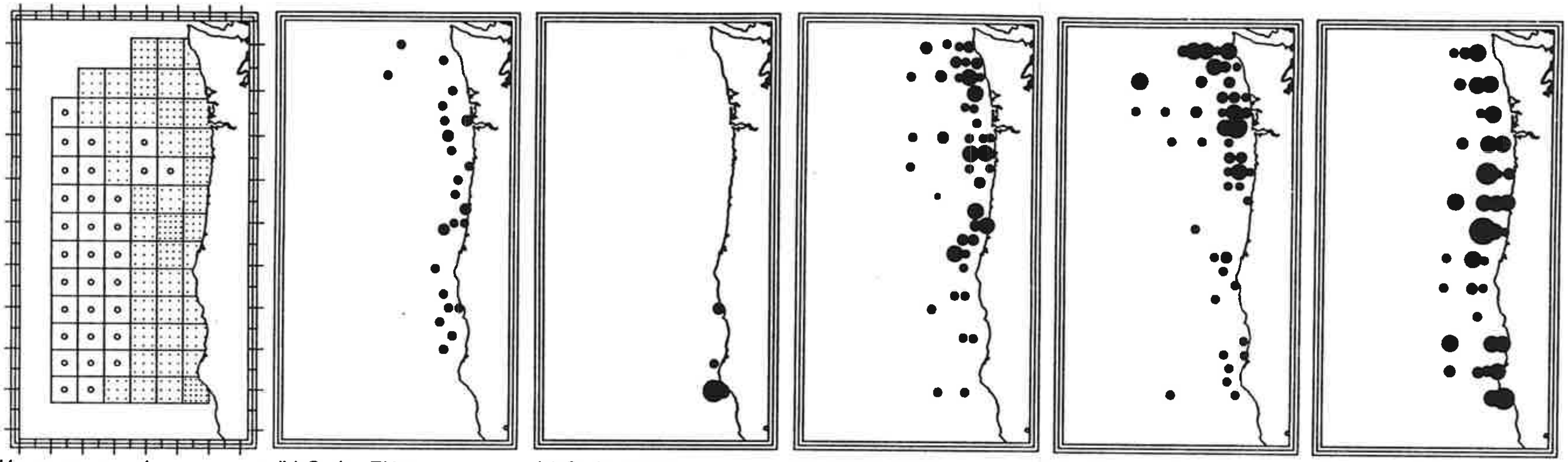
Figure 83. Distribution patterns for Anoplopoma fimbria larvae in the neuston.



Ophiodon elongatus
Neuston: Larvae
(a) Mean distribution

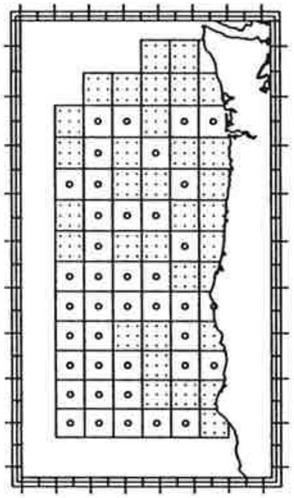
(b) Cruise BA85

Figure 84. Distribution patterns for Ophiodon elongatus larvae in the neuston.



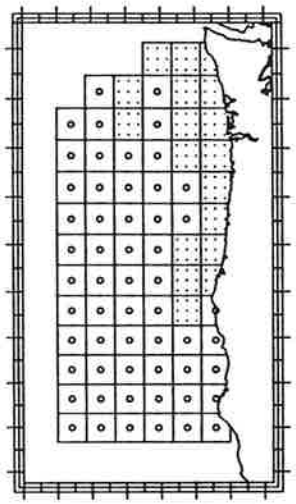
Hexagrammos decagrammus (b) Cruise TK80 (c) Cruise DA81 (d) Cruise PO84 (e) Cruise BA85 (f) Cruise MF87
Neuston: Larvae
(a) Mean distribution

Figure 85. Distribution patterns for Hexagrammos decagrammus larvae in the neuston.



Hexagrammos lagocephalus
Neuston: Larvae
(a) Mean distribution

Figure 86. Distribution pattern for <u>Hexagrammos</u> <u>lagocephalus</u> larvae in the neuston.



Hemilepidotus hemilepidotus
Neuston: Larvae
(a) Mean distribution

Figure 87. Distribution pattern for Hemilepidotus hemilepidotus larvae in the neuston.

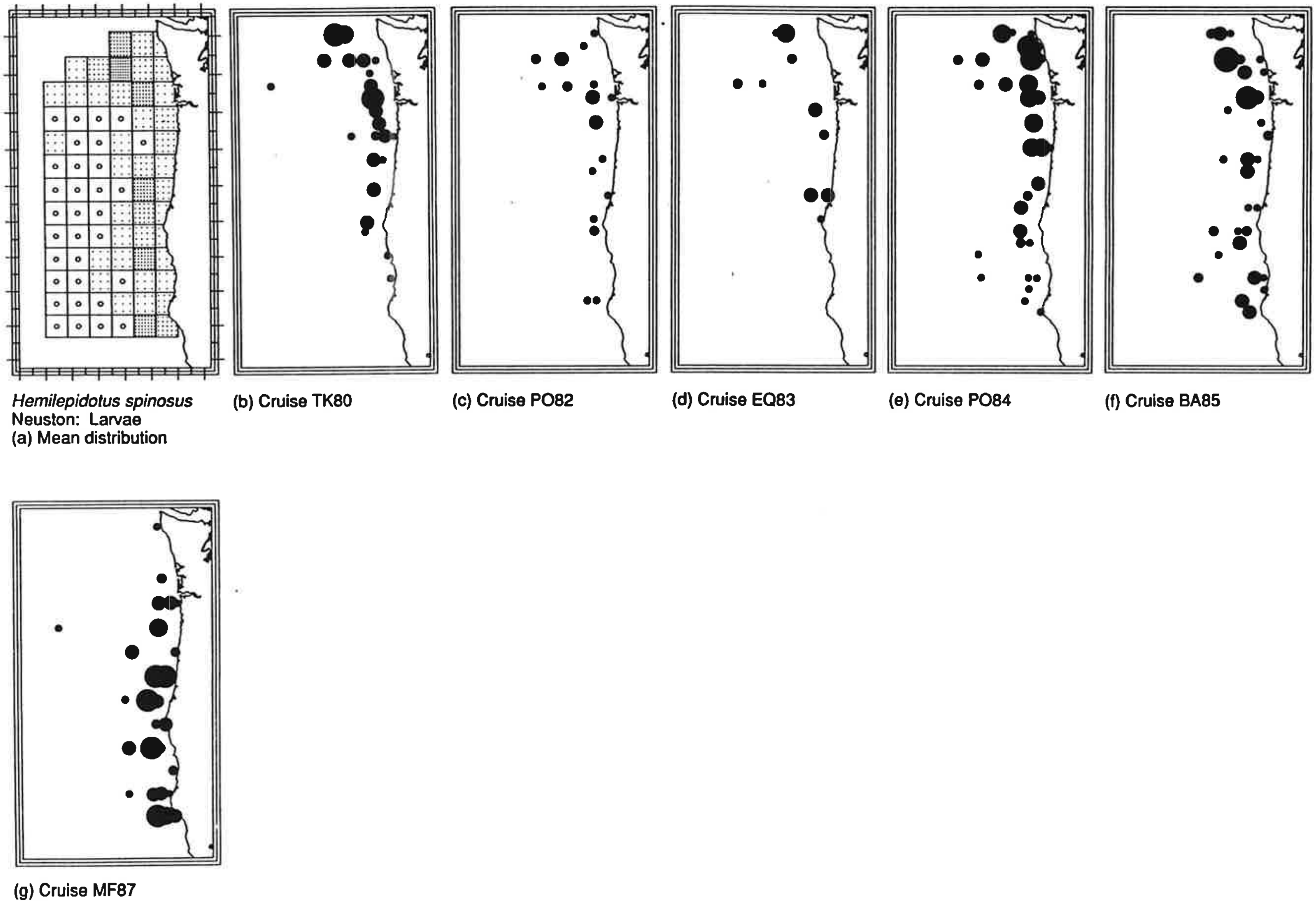


Figure 88. Distribution patterns for Hemilepidotus spinosus larvae in the neuston.

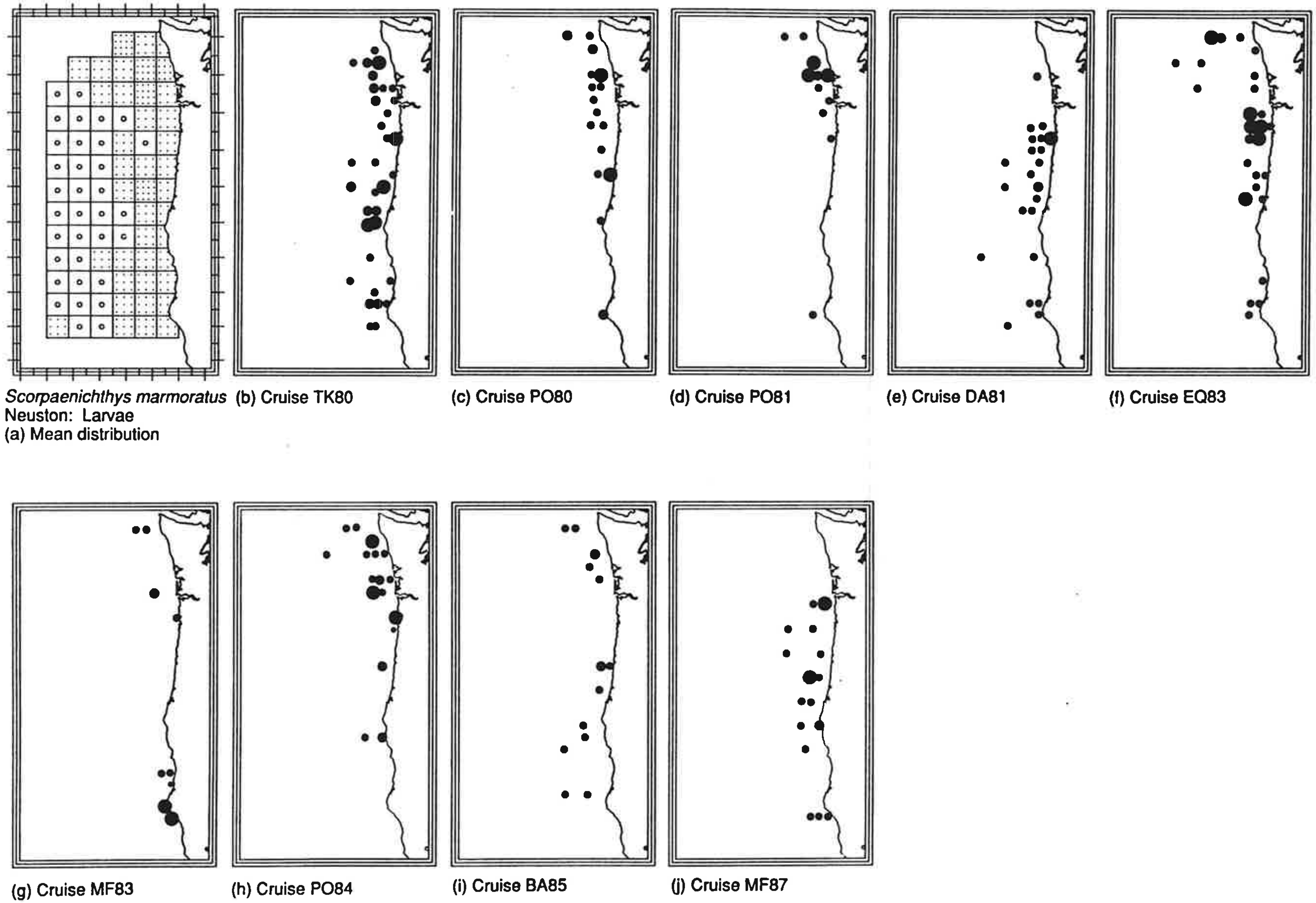
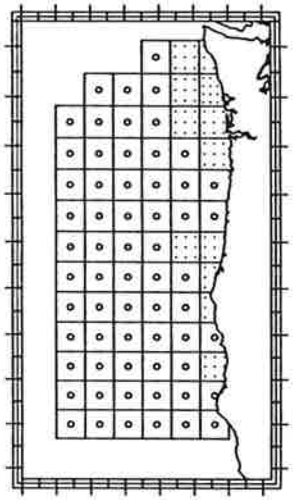
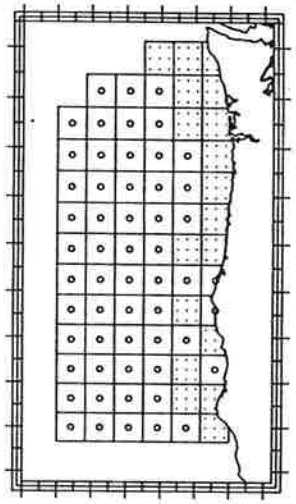


Figure 89. Distribution patterns for Scorpaenichthys marmoratus larvae in the neuston.



Cryptacanthodes aleutensis
Neuston: Larvae
Mean distribution

Figure 90. Distribution pattern for Ronquilus jordani larvae in the neuston.



Ronquilus jordani
Neuston: Larvae
Mean distribution

Figure 91. Distribution pattern for Cryptacanthodes aleutensis larvae in the neuston.

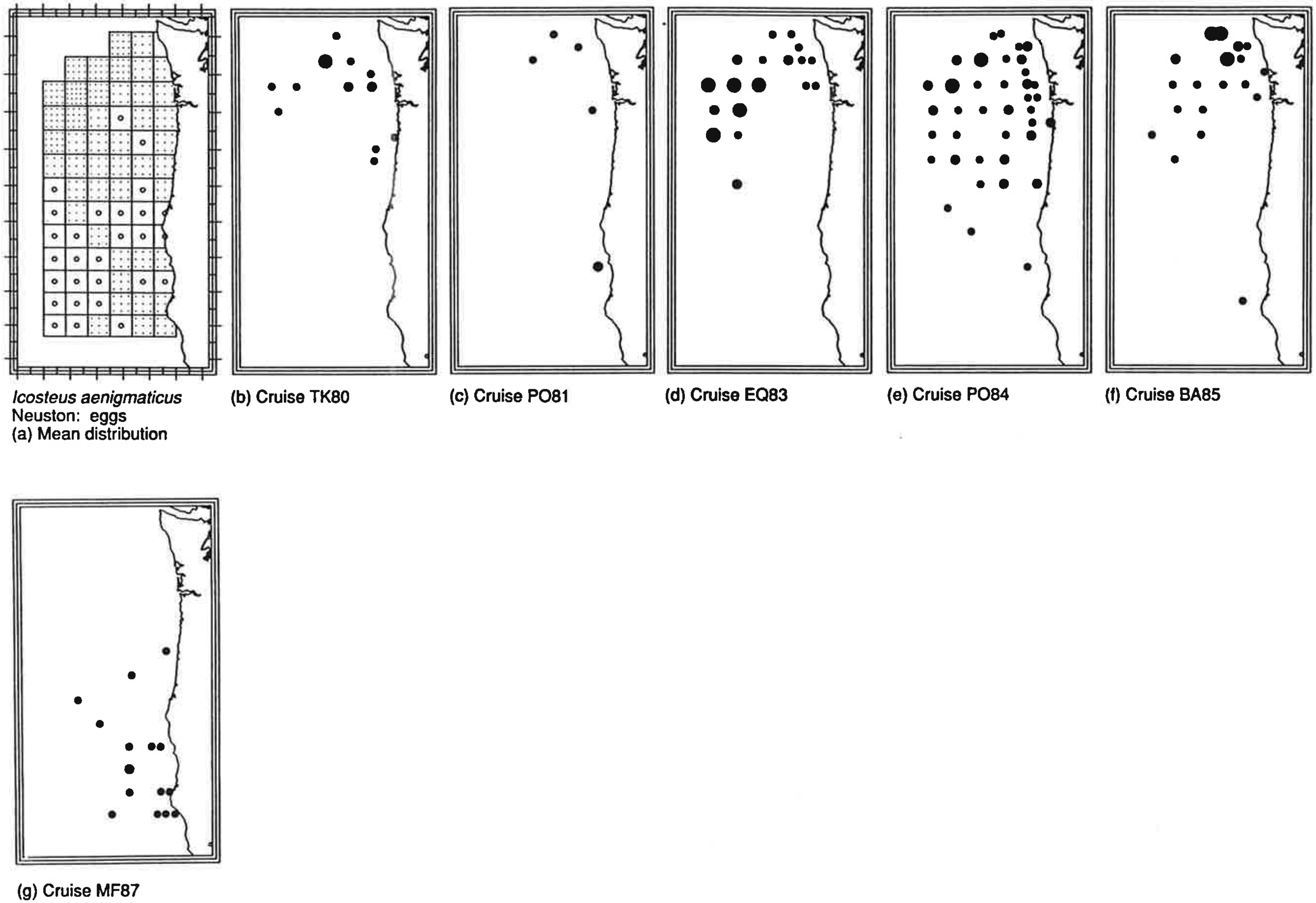
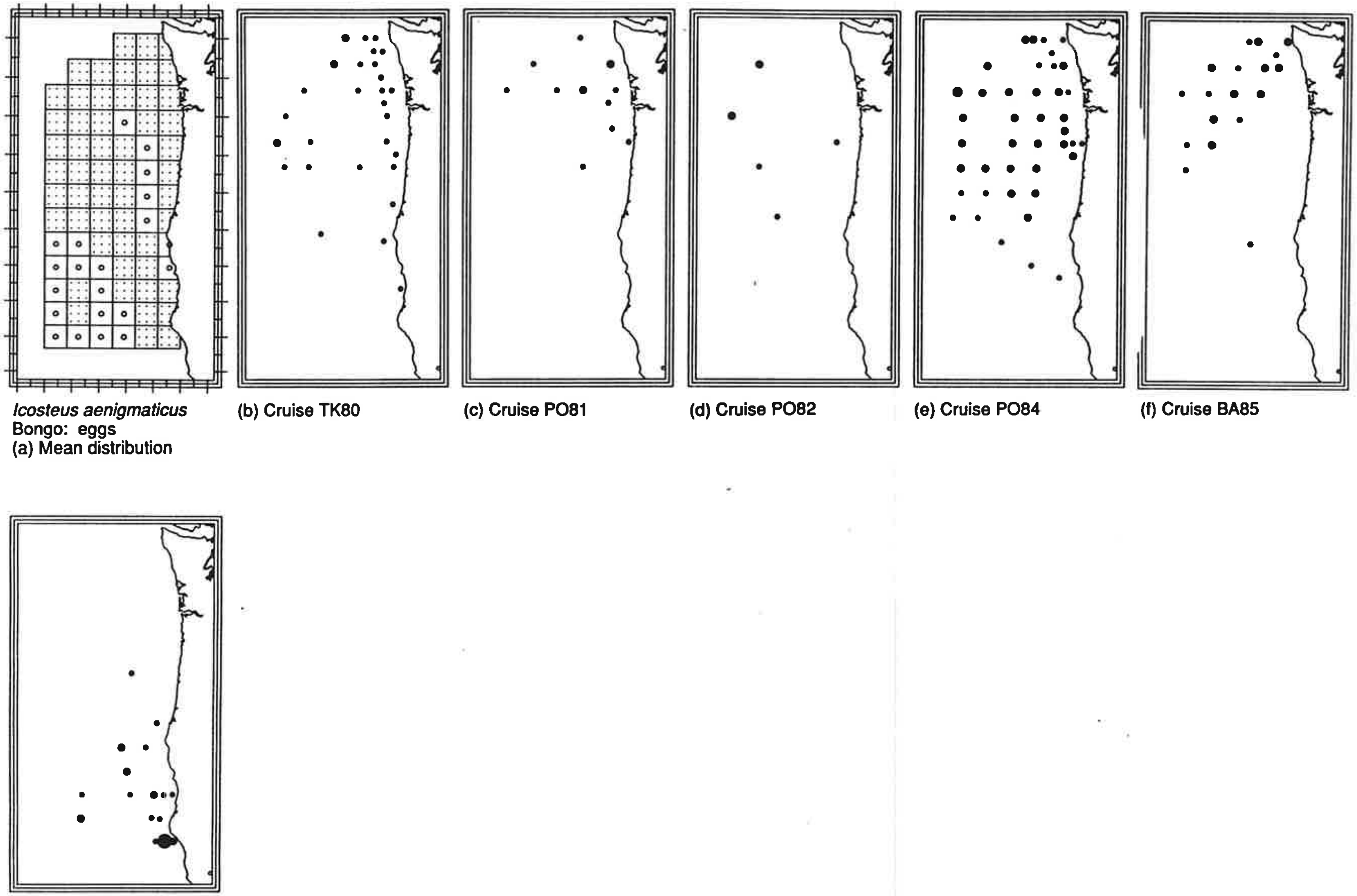


Figure 92. Distribution patterns for *Icosteus aenigmaticus* eggs in the neuston.



Icosteus aenigmaticus
Bongo: eggs
(a) Mean distribution

(b) Cruise TK80

(c) Cruise PO81

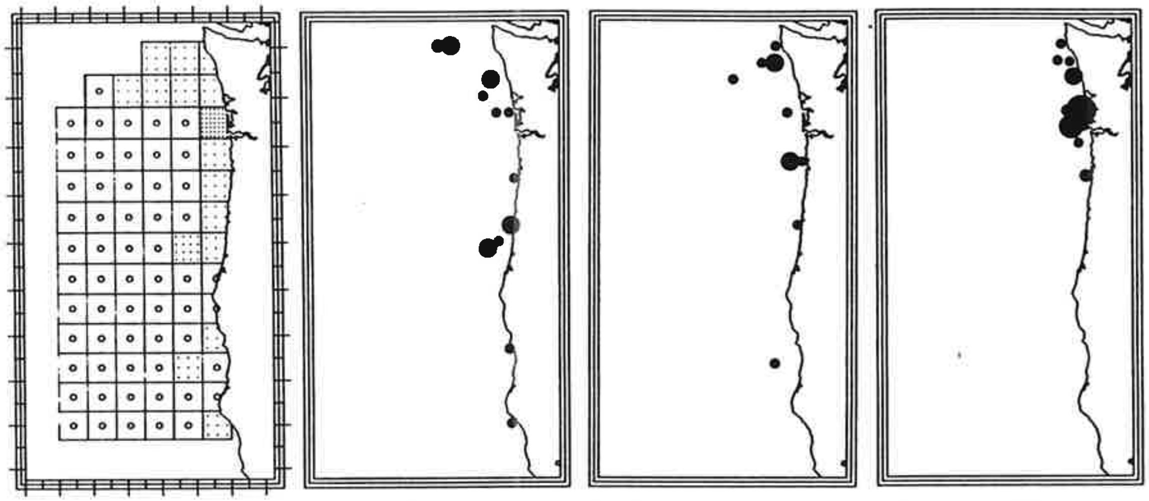
(d) Cruise PO82

(e) Cruise PO84

(f) Cruise BA85

(g) Cruise MF87

Figure 93. Distribution patterns for Icosteus aenigmaticus eggs from the bongo samples.



Ammodytes hexapterus
Neuston: Larvae
(a) Mean distribution

(b) Cruise TK80

(c) Cruise PO82

(d) Cruise PO84

Figure 94. Distribution patterns for Ammodytes hexapterus larvae in the neuston.

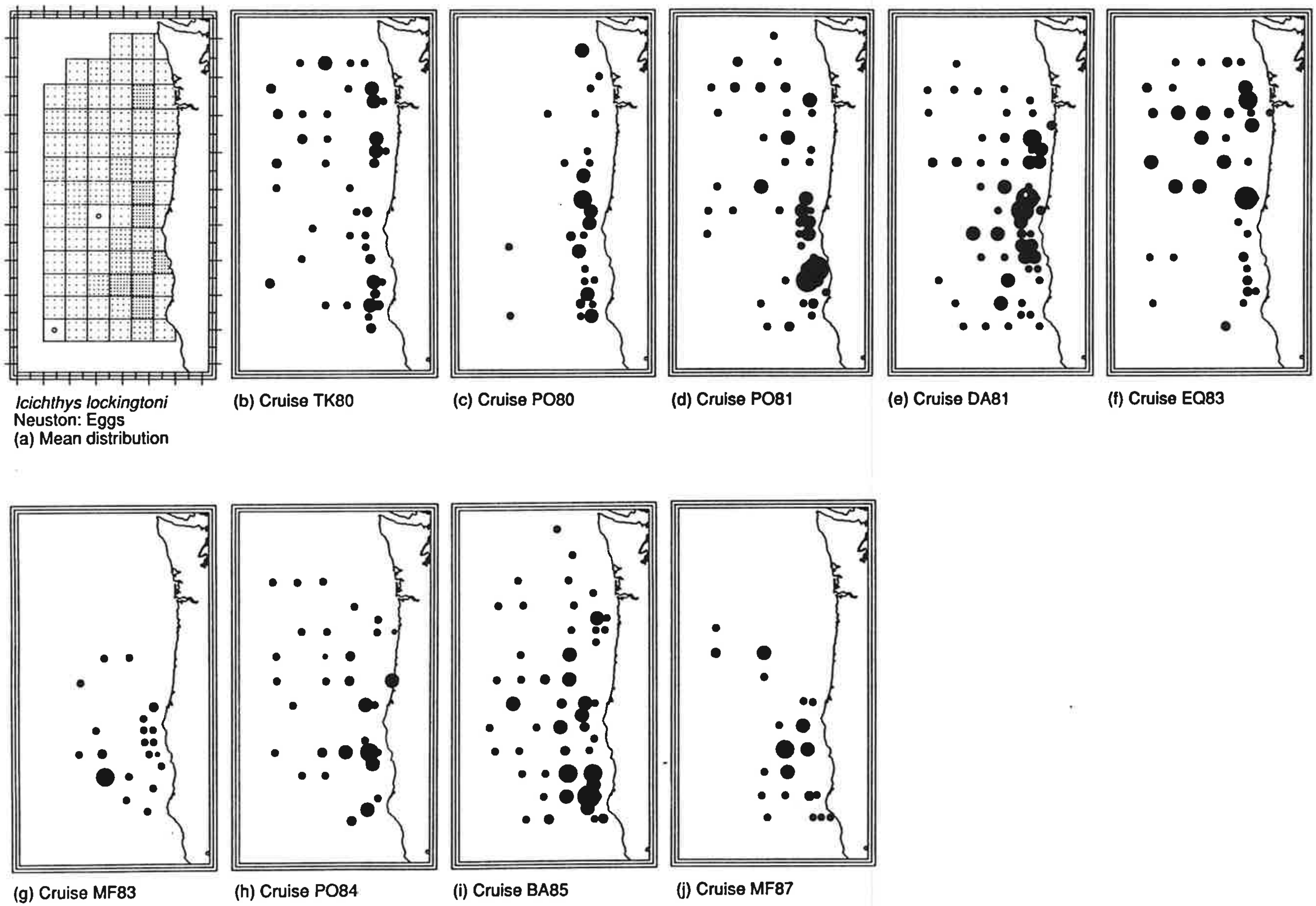
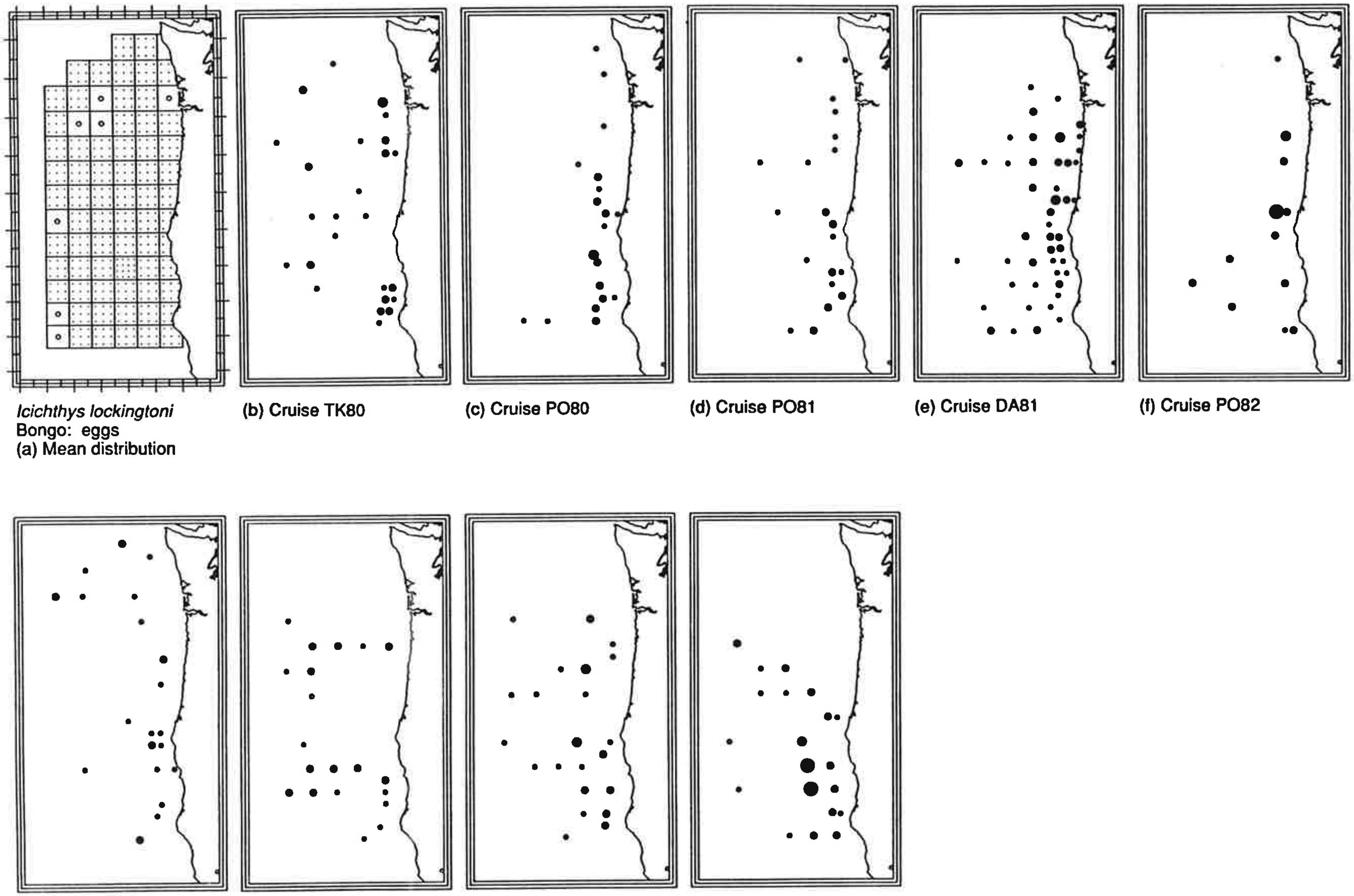


Figure 95. Distribution patterns for Icichthys lockingtoni eggs in the neuston.



Icichthys lockingtoni
Bongo: eggs
(a) Mean distribution

(b) Cruise TK80

(c) Cruise PO80

(d) Cruise PO81

(e) Cruise DA81

(f) Cruise PO82

(g) Cruise EQ83

(h) Cruise PO84

(i) Cruise BA85

(j) Cruise MF87

Figure 96. Distribution patterns for Icichthys lockingtoni eggs from the bongo samples.

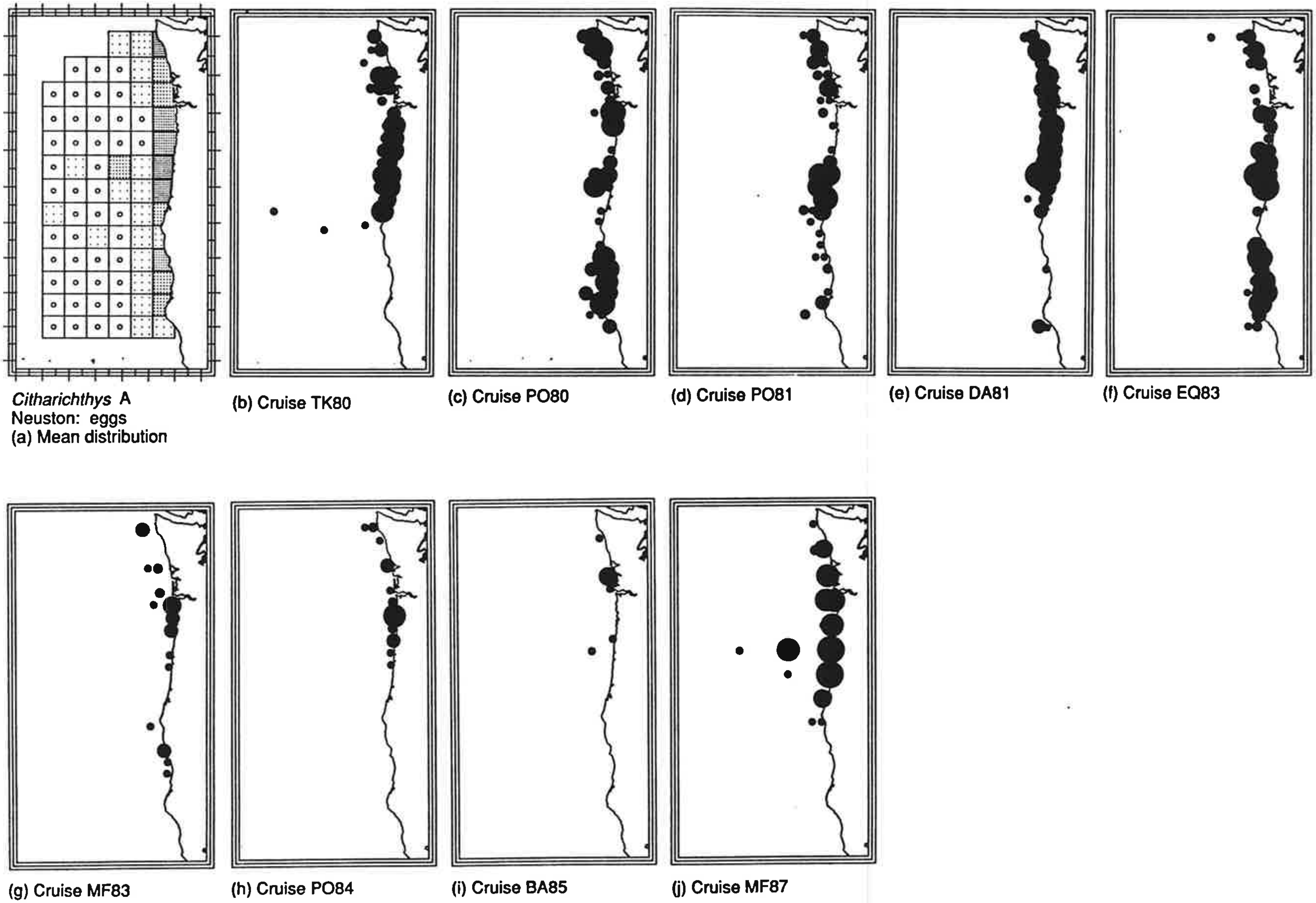


Figure 97. Distribution patterns for <u>Citharichthys</u> A eggs in the neuston.

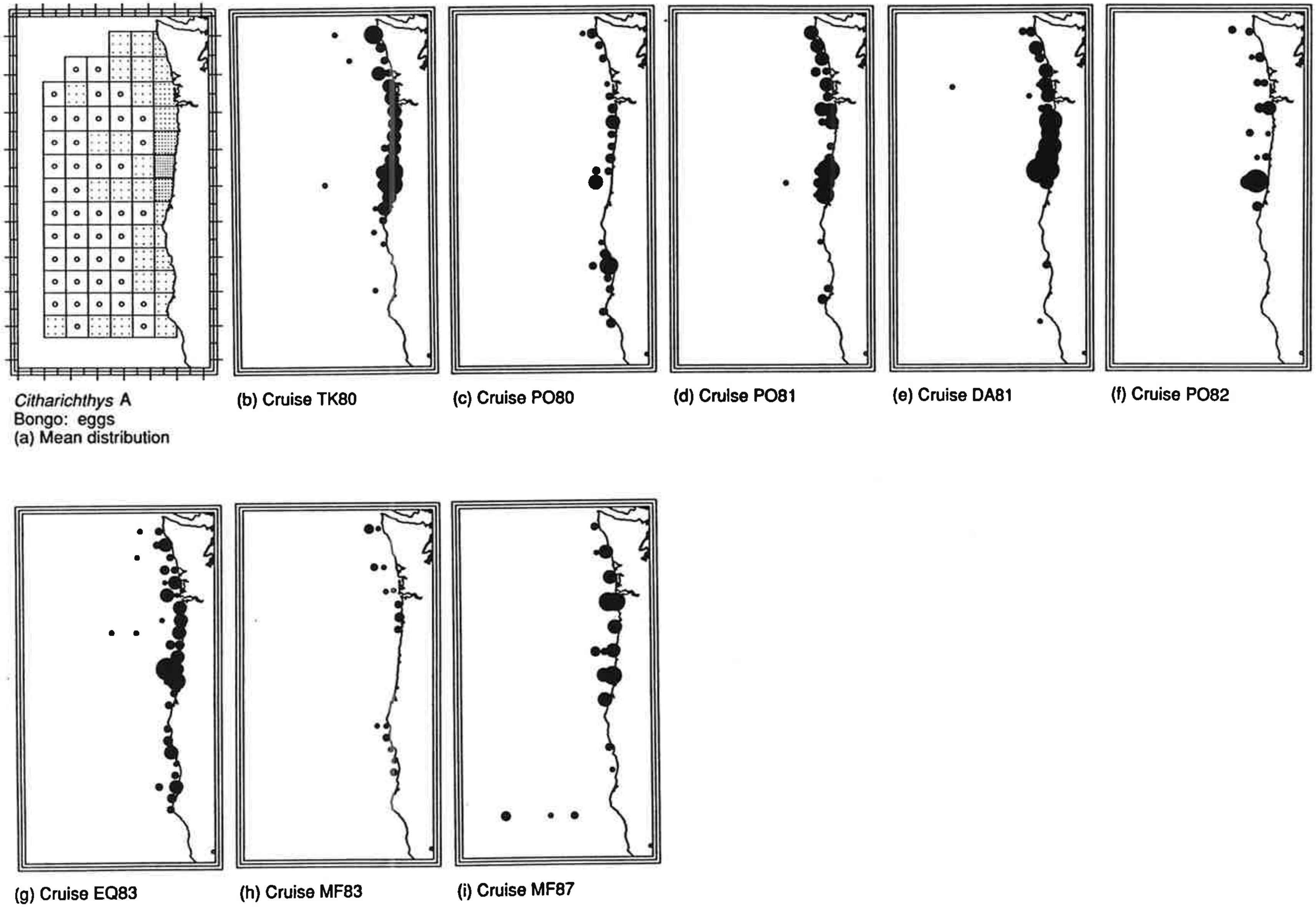


Figure 98. Distribution patterns for Citharichthys A eggs from the bongo samples.

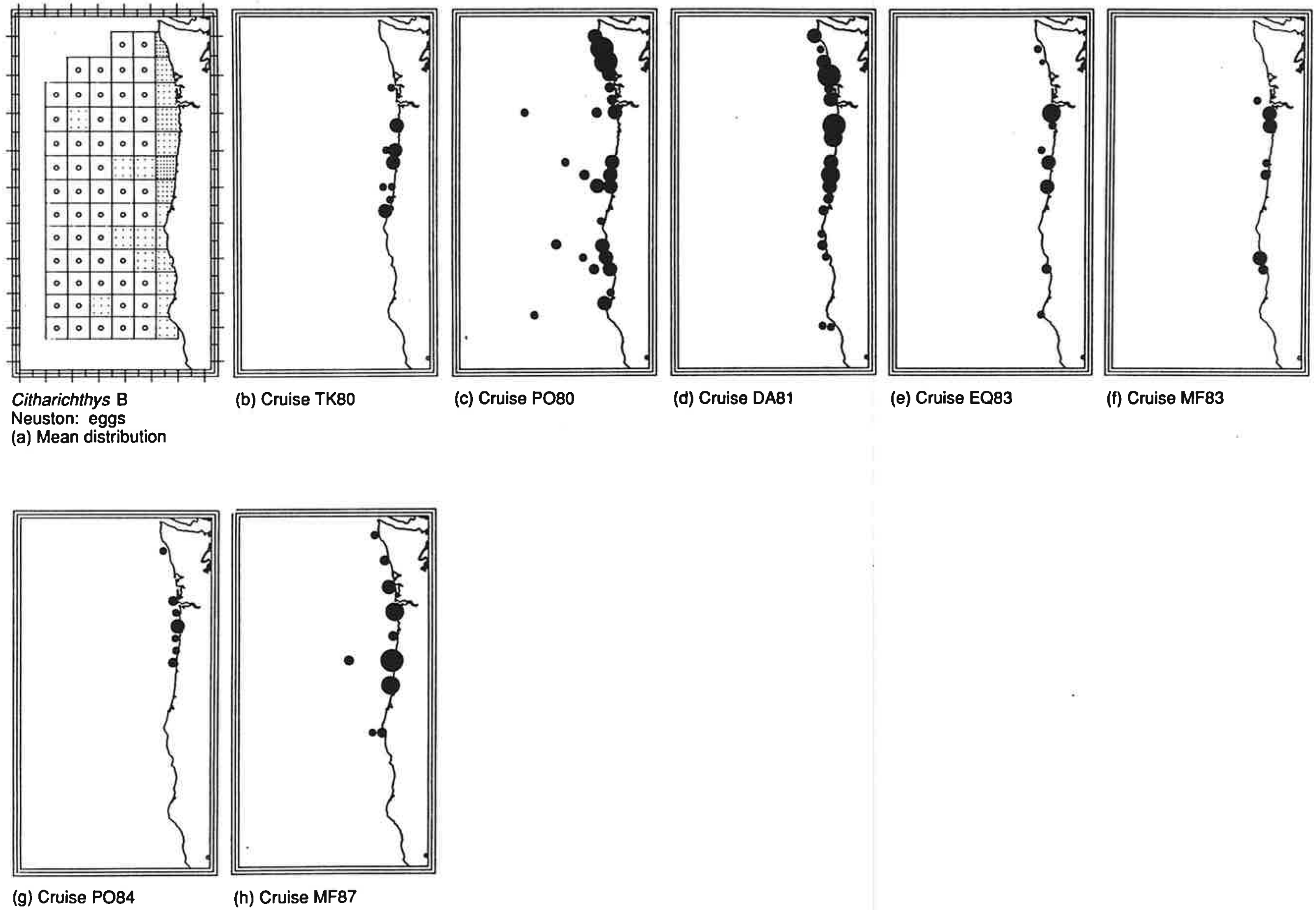
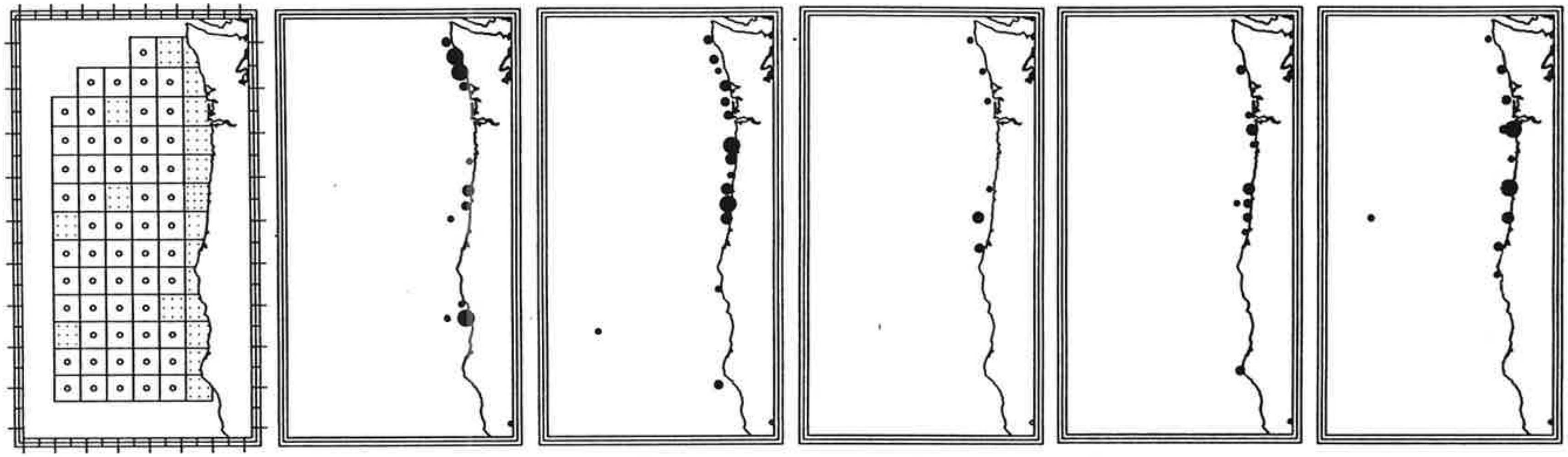


Figure 99. Distribution patterns for Citharichthys B eggs in the neuston.



Citharichthys B
Bongo: eggs
(a) Mean distribution

(b) Cruise PO80

(c) Cruise DA81

(d) Cruise PO82

(e) Cruise EQ83

(f) Cruise MF87

Figure 100. Distribution patterns for Citharichthys B eggs from the bongo samples.

Citharichthys spp. (total)
Bongo: Larvae
(a) Mean distribution

Citharichthys spp.
(unidentified)
(b) Cruise DA81

(c) Cruise EQ83

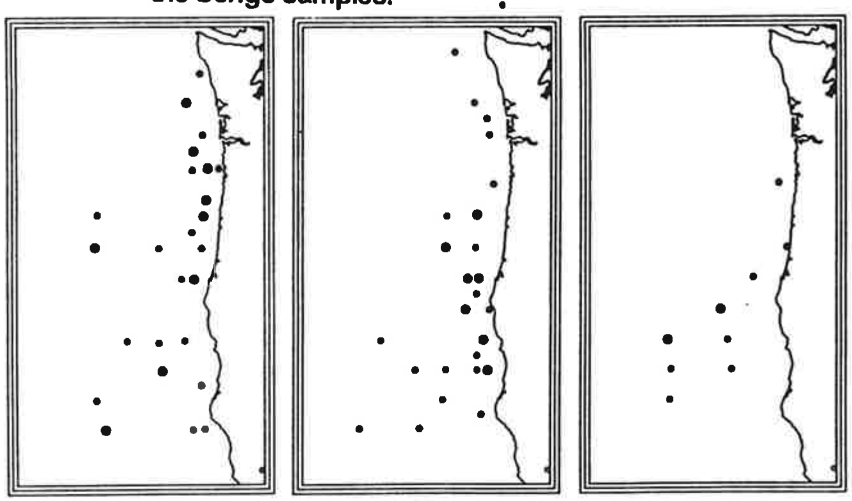
Figure 101. Distribution patterns for Citharichthys spp. larvae from the bongo samples.

Citharichthys sordidus
Bongo: larvae
(a) Cruise DA81

(b) Cruise MF83

(d) Cruise MF87

Figure 102. Distribution patterns for Citharichthys sordidus larvae from the bongo samples.



Citharichthys stigmaeus
Bongo: Larvae
(a) Cruise DA81

(b) Cruise MF83

(c) Cruise MF87

Figure 103. Distribution patterns for Citharichthys stigmaeus larvae from the bongo samples.

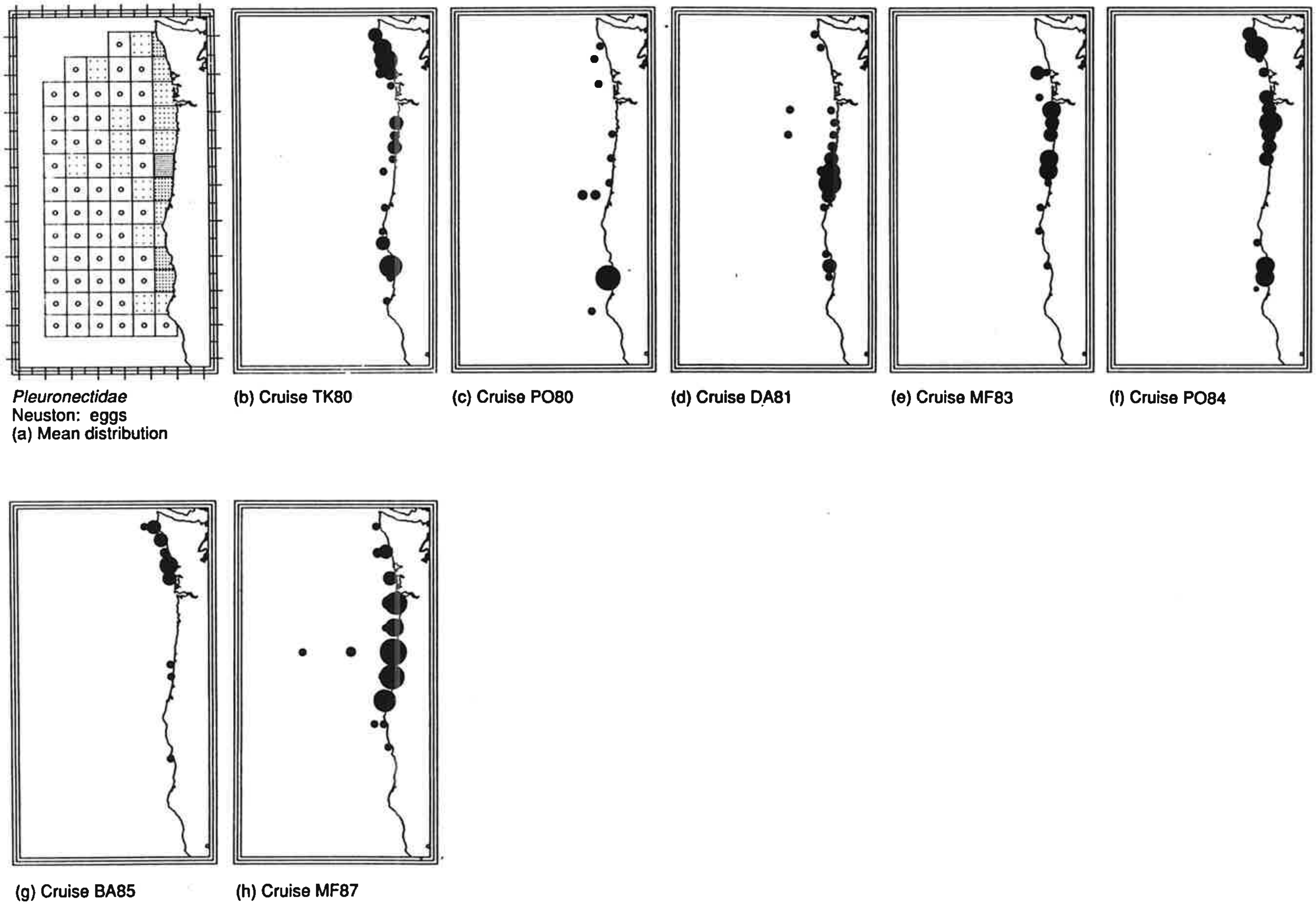


Figure 104. Distribution patterns for pleuronectid eggs in the neuston.

Pleuronectidae
Bongo: eggs
(a) Mean distribution

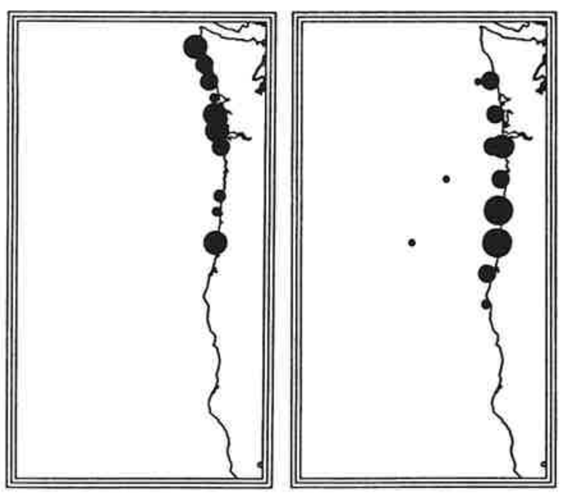
(b) Cruise TK80

(c) Cruise PO81

(d) Cruise DA81

(e) Cruise MF83

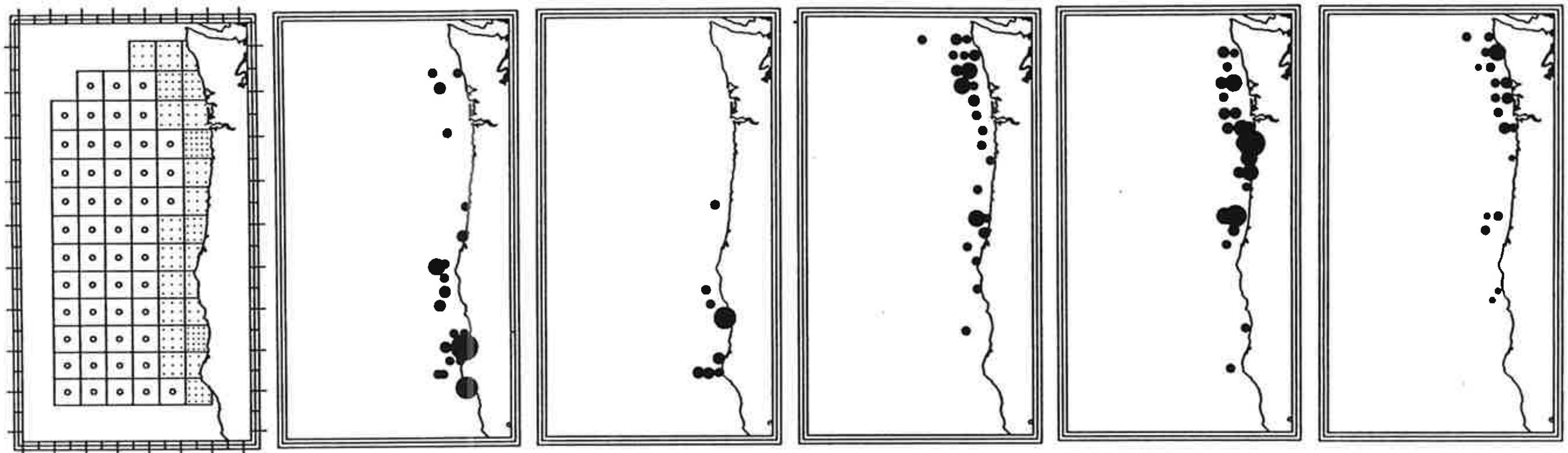
(f) Cruise PO84



(g) Cruise BA85

(h) Cruise MF87

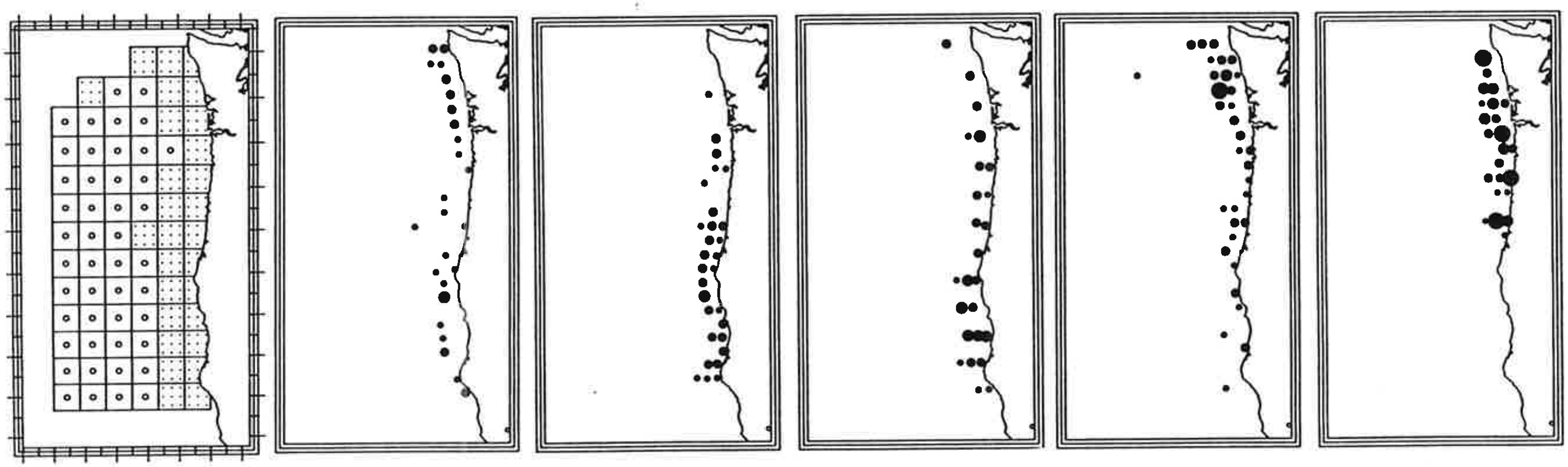
Figure 105. Distribution pattems for pleuronectid eggs from the bongo samples.



Errex zachirus
Neuston: Eggs
(a) Mean distribution

(b) Cruise TK80 (c) Cruise PO81 (d) Cruise EQ83 (e) Cruise PO84 (f) Cruise BA85

Figure 106. Distribution patterns for <u>Errex</u> <u>zachirus</u> eggs in the neuston.



Errex zachirus
Bongo: Eggs
(a) Mean distribution

(b) Cruise TK80 (c) Cruise PO81 (d) Cruise PO82 (e) Cruise EQ83 (f) Cruise PO84

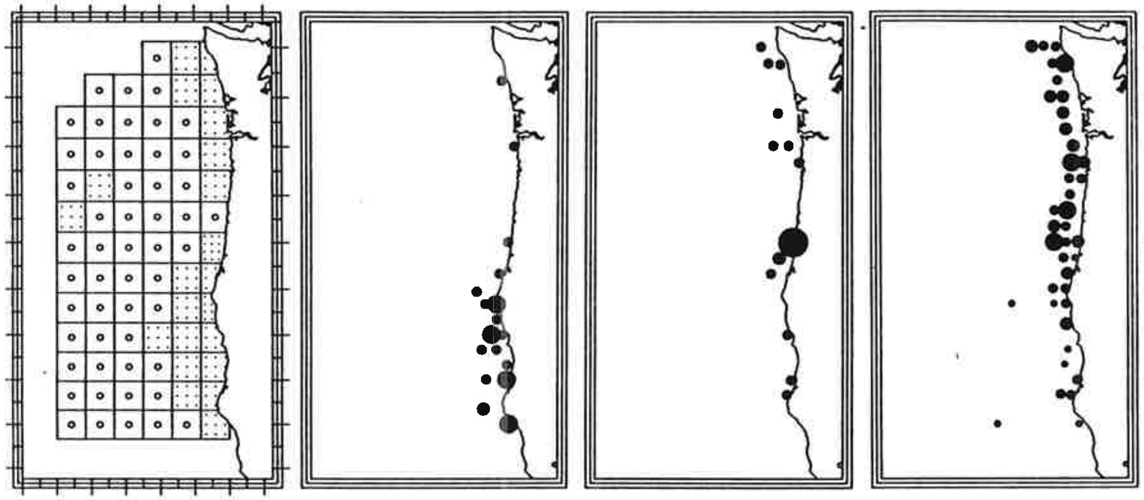
Figure 107. Distribution patterns for <u>Errex</u> <u>zachirus</u> eggs from the bongo samples.

Errex zachirus
Bongo: Larvae
(a) Mean distribution

(b) Cruise PO82

(c) Cruise EQ83

Figure 108. Distribution patterns for Errex zachirus larvae from the bongo samples.



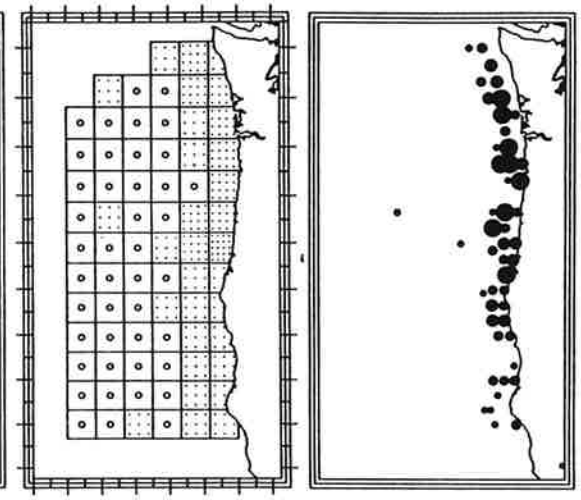
Eopsetta exilis
Neuston: Eggs
(a) Mean distribution

(b) Cruise TK80

(c) Cruise PO84

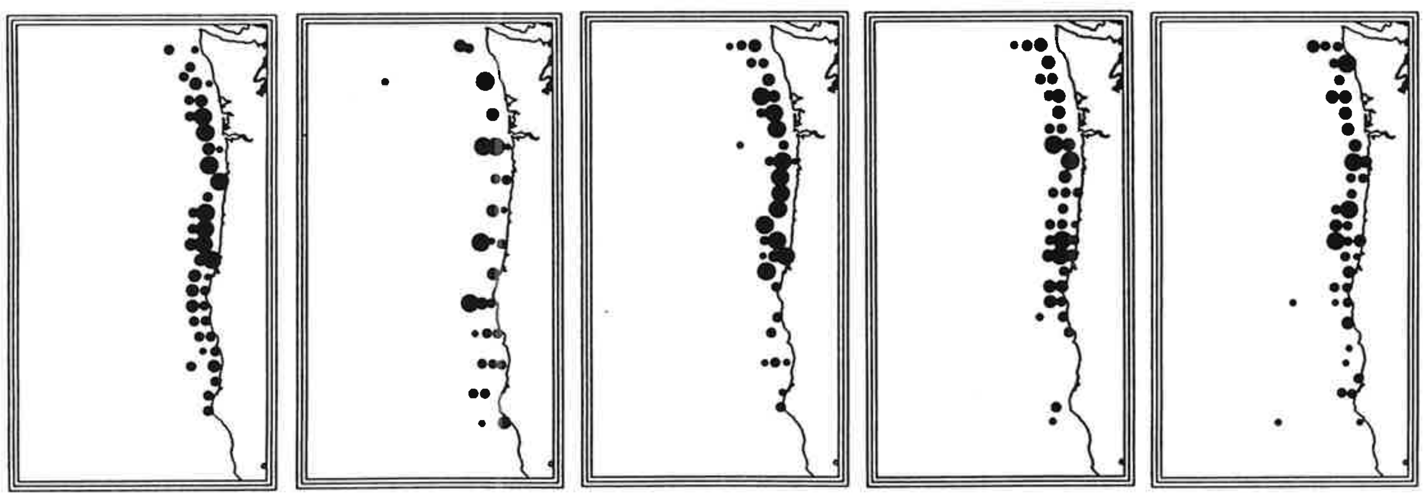
(d) Cruise BA85

Figure 109. Distribution patterns for Eopsetta exilis eggs in the neuston.



Eopsetta exilis
Bongo: Eggs
(a) Mean distribution

(b) Cruise TK80



(c) Cruise PO81

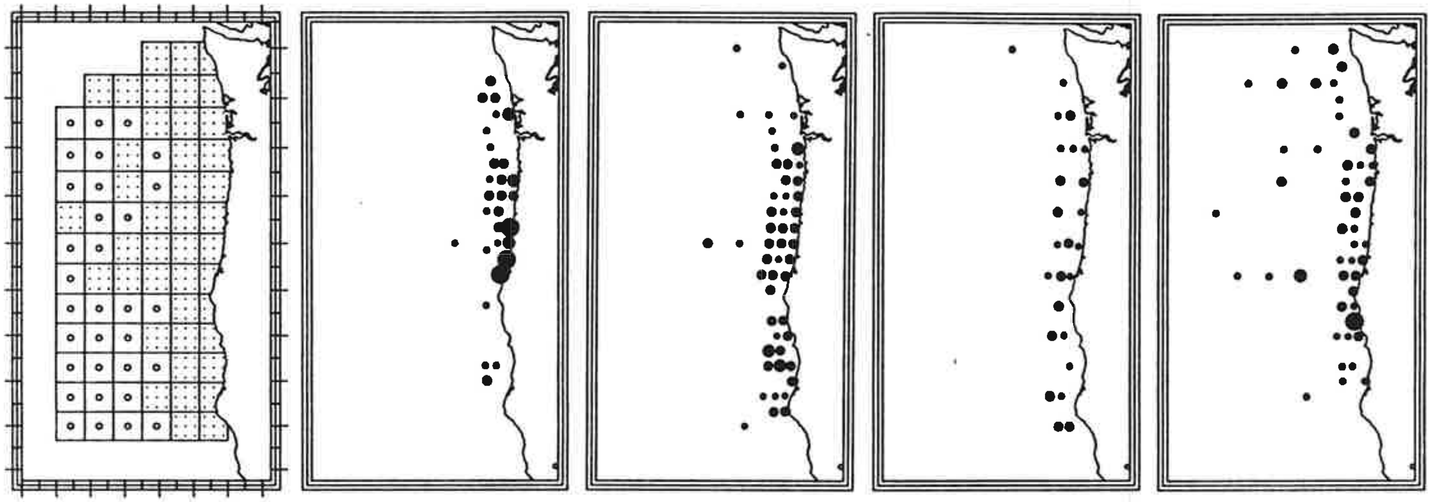
(d) Cruise PO82

(e) Cruise EQ83

(f) Cruise PO84

(g) Cruise BA85

Figure 110. Distribution patterns for Eopsetta exilis eggs from the bongo samples.



Eopsetta exilis
Bongo: Larvae
(a) Mean distribution

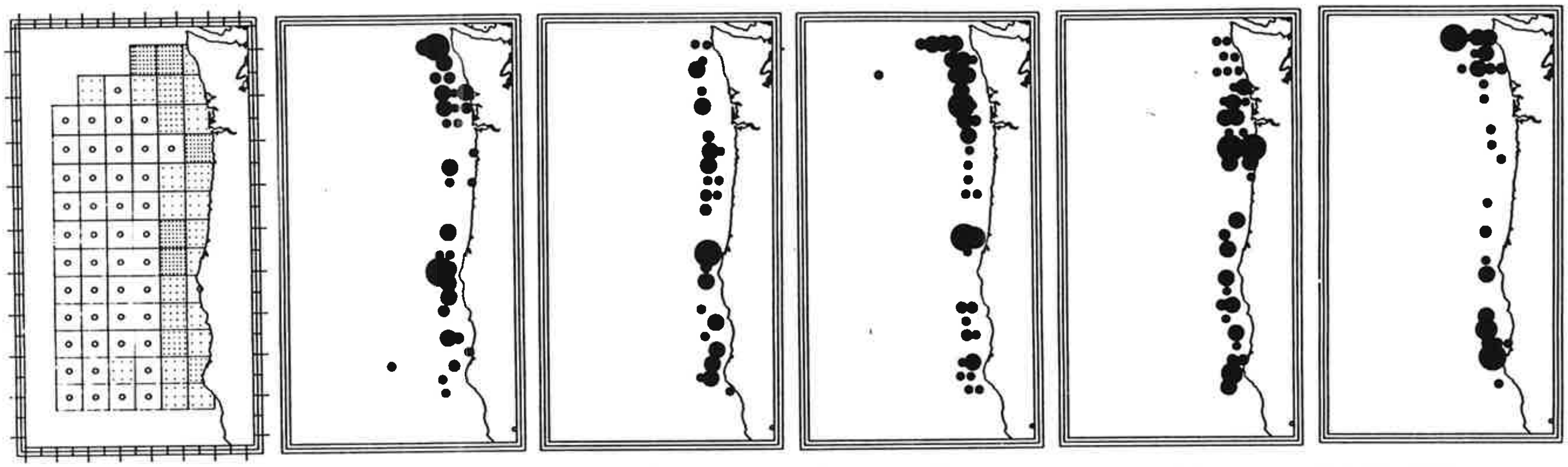
(b) Cruise TK80

(c) Cruise PO81

(d) Cruise PO82

(e) Cruise EQ83

Figure 111. Distribution patterns for Eopsetta exilis larvae from the bongo samples.



Microstomus pacificus
Neuston: Eggs
(a) Mean distribution

(b) Cruise TK80

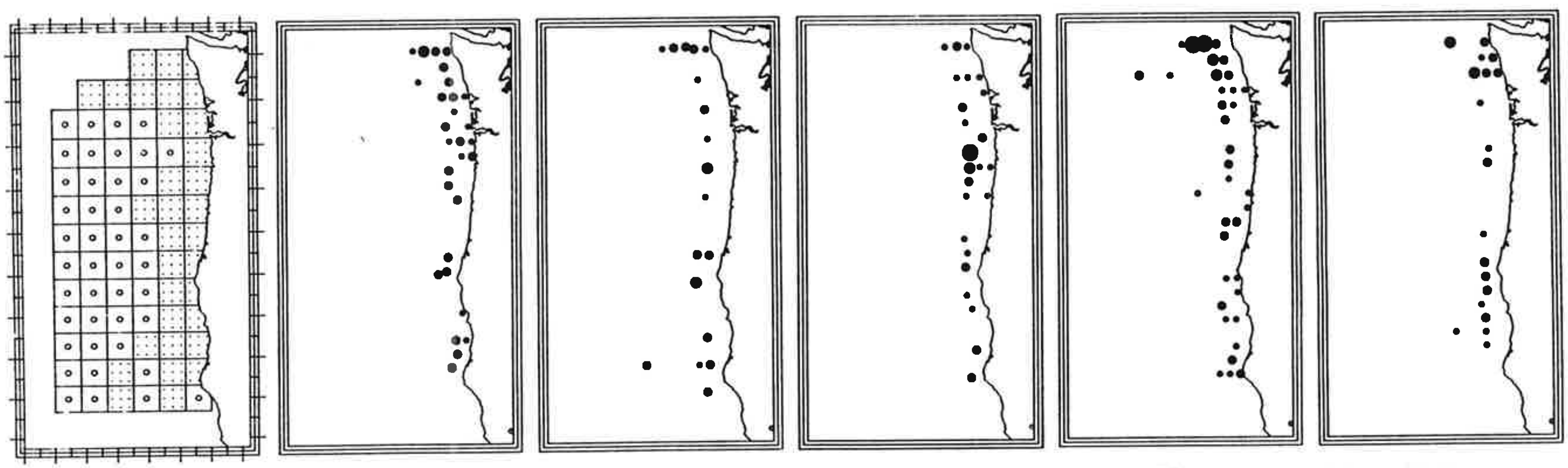
(c) Cruise PO81

(d) Cruise EQ83

(e) Cruise PO84

(f) Cruise BA85

Figure 112. Distribution patterns for Microstomus pacificus eggs in the neuston.



Microstomus pacificuus
Bongo: Eggs
(a) Mean distribution

(b) Cruise TK80

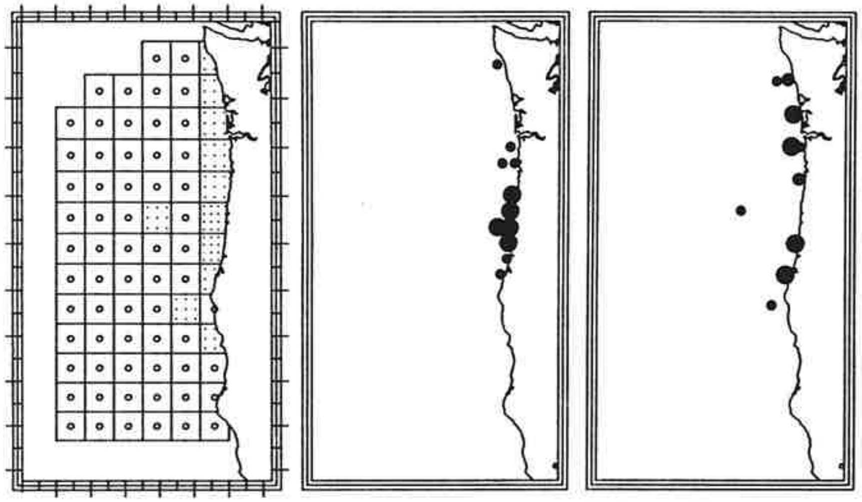
(c) Cruise PO82

(d) Cruise PO84

(e) Cruise EQ83

(f) Cruise BA85

Figure 113. Distribution patterns for Microstomus pacificus eggs from the bongo samples.

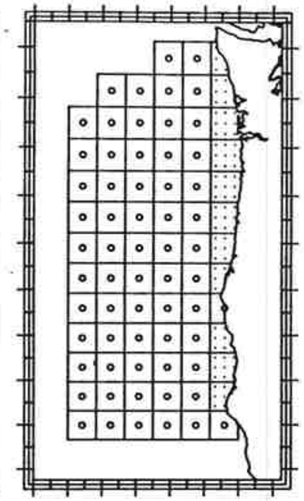


Pleuronectes vetulus
Neuston: Eggs
(a) Mean distribution

(b) Cruise DA81

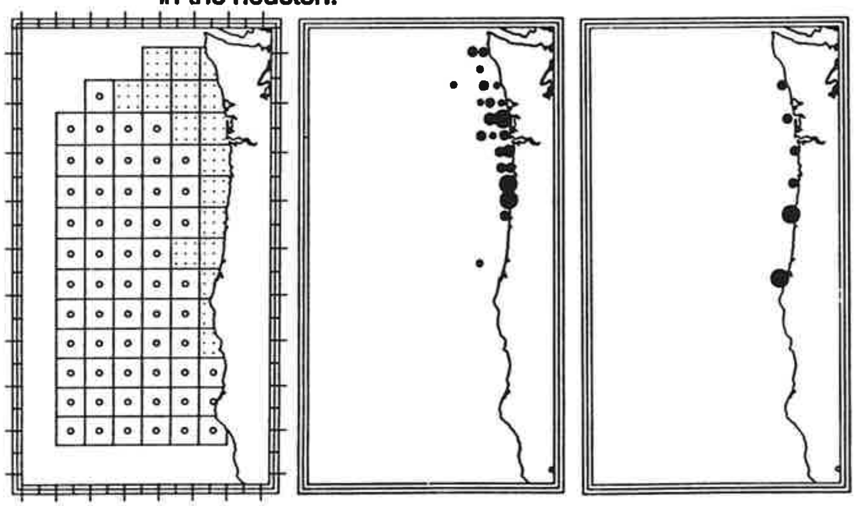
(c) Cruise MF87

Figure 114. Distribution patterns for Pleuronectes vetulus eggs in the neuston.



Pleuronectes vetulus
Bongo: Eggs
Mean distribution

Figure 115. Distribution pattern for Pleuronectes vetulus eggs from the bongo samples.



Pleuronectes vetulus
Bongo: Larvae
(a) Mean distribution

(b) Cruise PO84

(c) Cruise MF87

Figure 116. Distribution patterns for Pleuronectes vetulus larvae from the bongo samples.

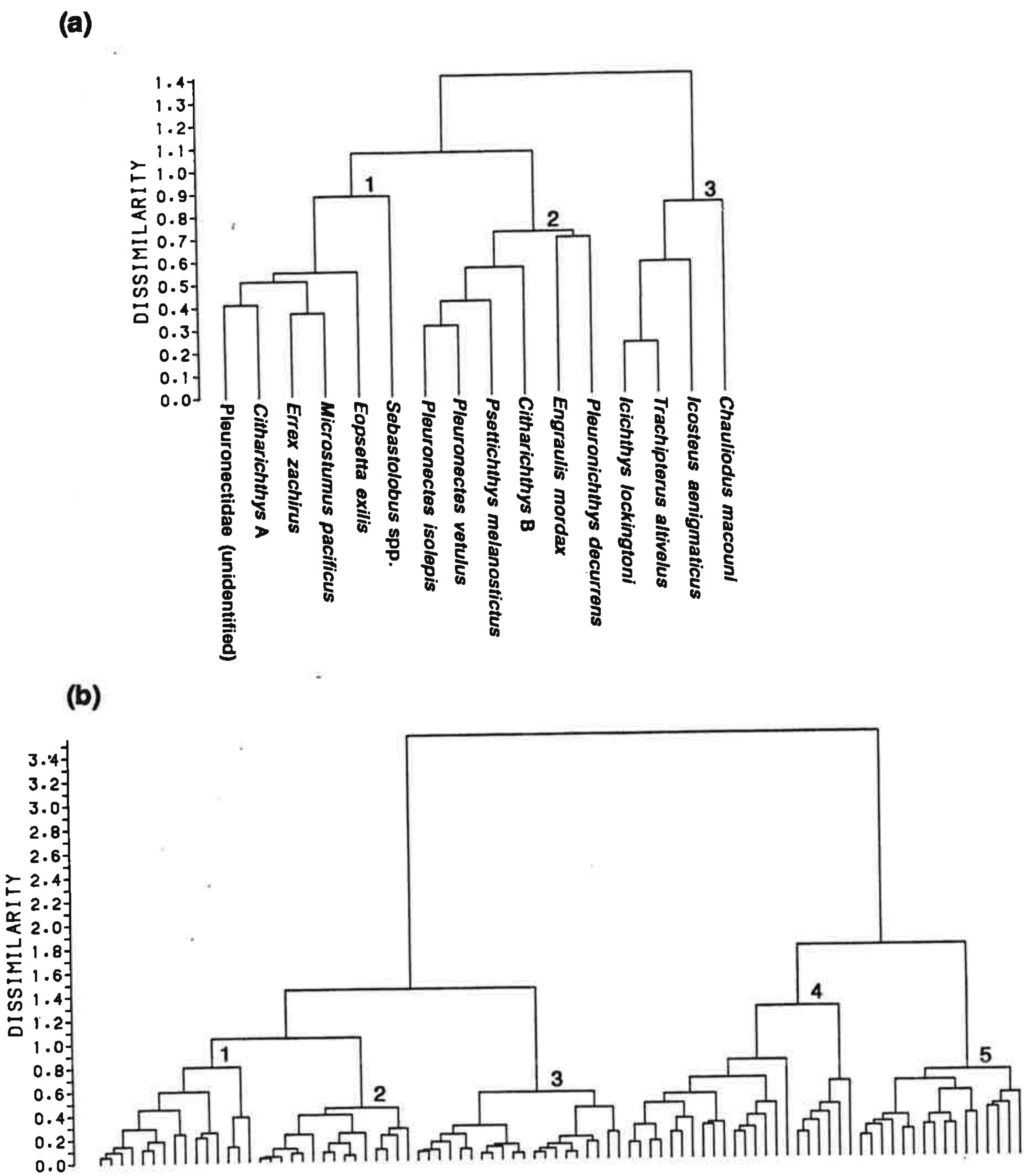


Figure 117. Dendrograms showing (a) species groups and (b) station groups for dominant taxa of eggs in neuston, spring cruises.

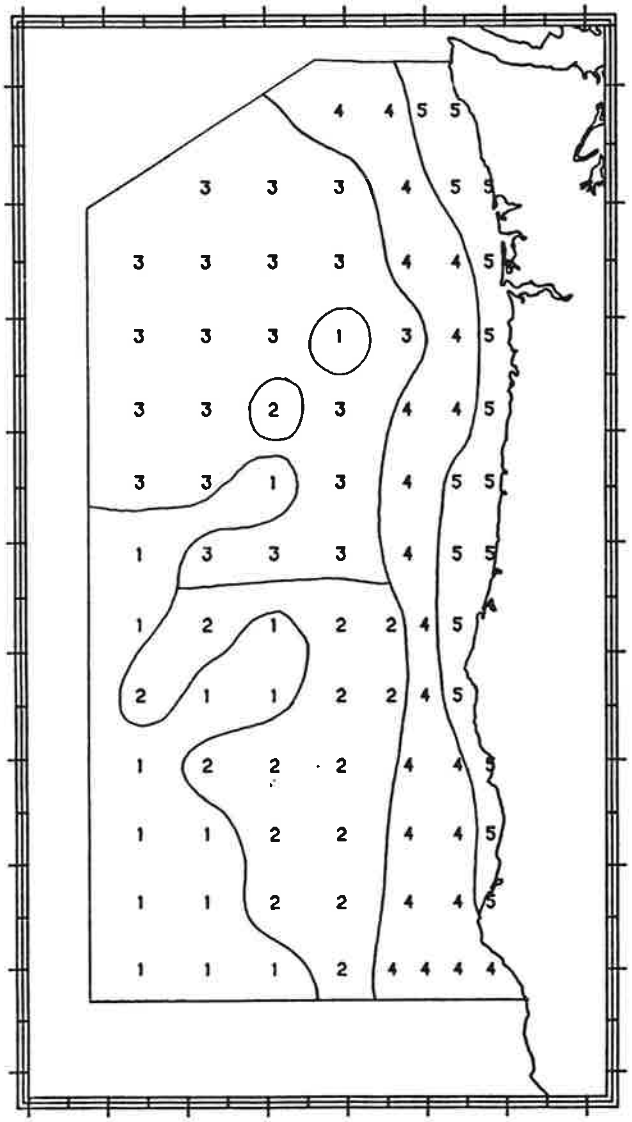


Table 46.

Two–way coincidence table resulting from numerical classification of egg abundance data from neuston collections taken during spring cruises (data from six cruises combined). Mean abundance in station groups expressed as numbers/1000m^3.

SPECIES GROUPS		STATION GROUPS 1	2	3	4	5
1	Pleuronectidae (unidentified)	0.0	0.0	0.1	0.4	76.7
	Citharichthys A	0.5	0.0	0.0	58.3	604.1
	Errex zachirus	0.0	0.0	0.0	12.6	48.2
	Microstomus pacificus	0.0	0.2	0.4	101.5	43.2
	Eopsetta exilis	0.0	0.2	0.0	5.0	16.6
	Sebastolobus spp.	0.0	0.2	0.0	227.8	3.2
2	*Pleuronectes isolepis*	0.0	0.0	0.0	0.0	1.8
	Pleuronectes vetulus	0.0	0.0	0.0	0.0	2.0
	Psettichthys melanostictus	0.0	0.0	0.0	0.0	5.3
	Ciatharichthys B	0.0	0.0	0.0	0.2	9.4
	Engraulis mordax	0.0	0.3	0.0	1.6	118.5
	Pleuronichthys decurrens	0.0	0.0	0.0	0.6	2.3
3	*Icichthys lockingtoni*	5.2	31.4	32.3	90.0	1.8
	Trachipterus altivelis	30.0	47.2	128.9	25.5	3.3
	Icosteus aenigmaticus	0.3	0.3	29.6	5.8	1.7
	Chauliodus macouni	2.6	0.0	2.3	0.6	0.0
	TOTAL FISH EGGS (dominant taxa)	38.6	79.8	193.6	529.5	938.1

Figure 118. Distribution of station groups for dominant taxa of eggs in neuston, spring cruises.

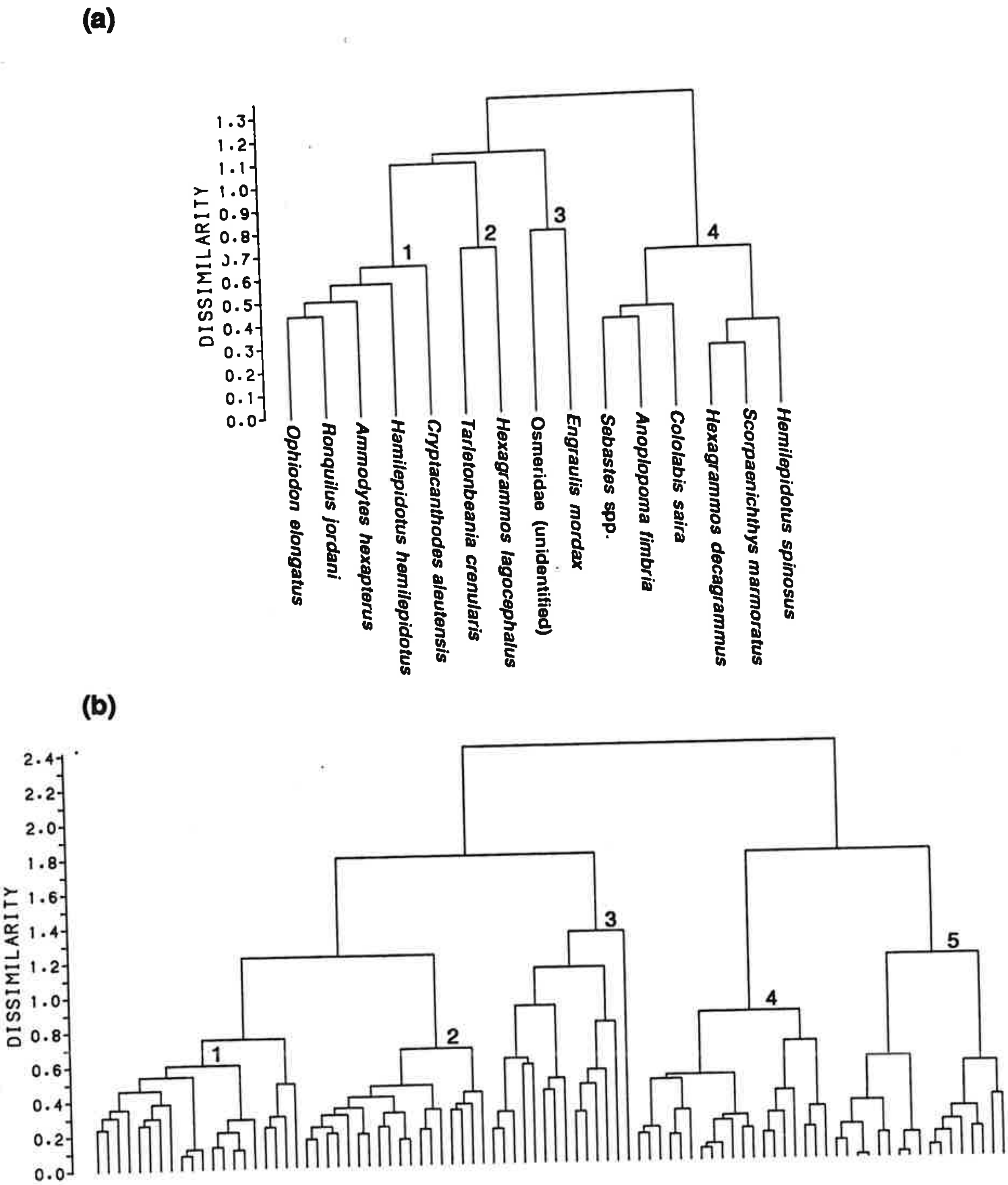


Figure 119. Dendrograms showing (a) species groups and (b) station groups for dominant taxa of larvae in neuston, spring cruises.

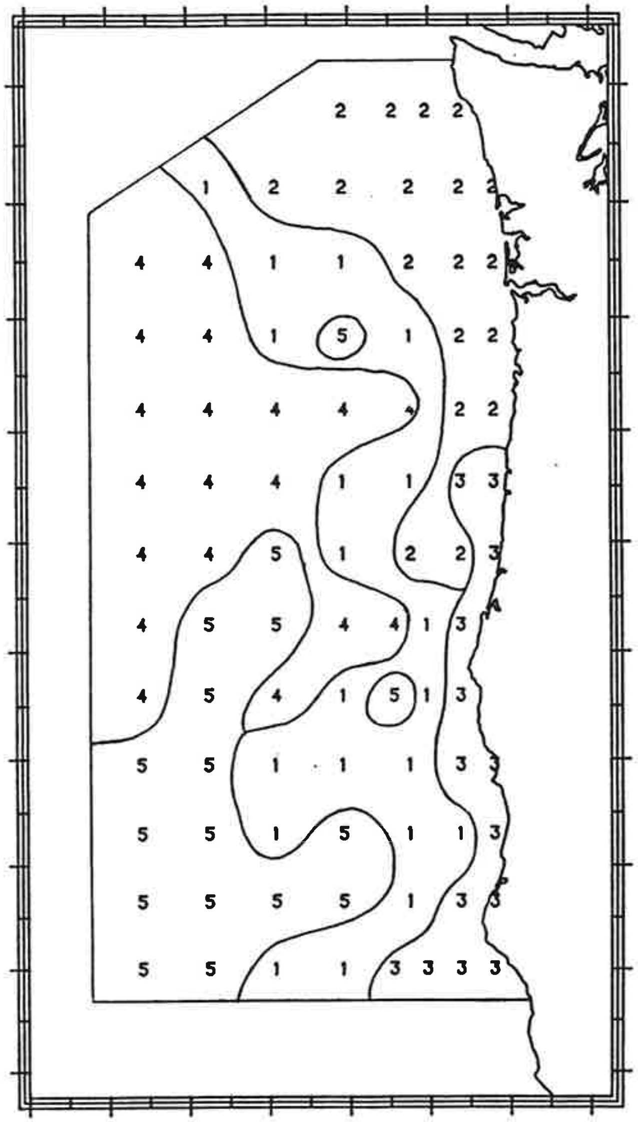


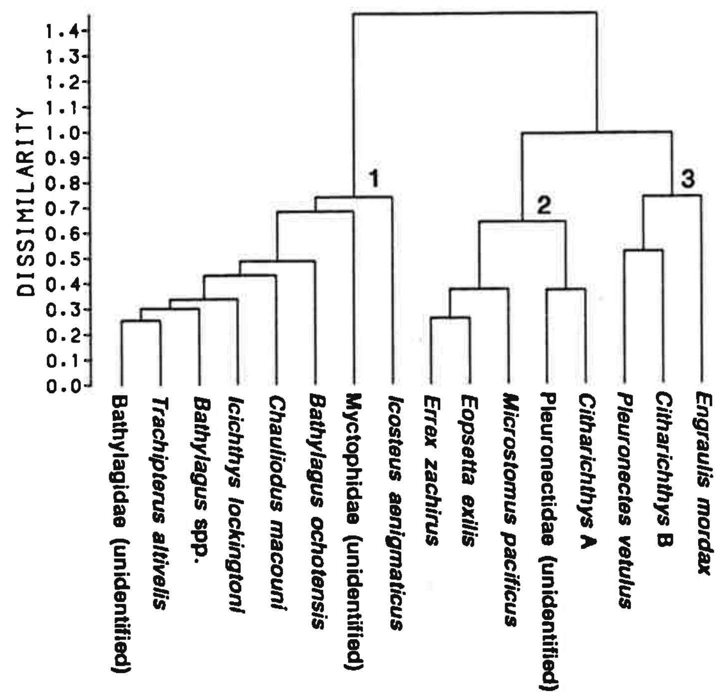
Table 47.

Two–way coincidence table resulting from numerical classification of larval abundance data from neuston collections taken during spring cruises (data from six cruises combined). Mean abundance in station groups expressed as numbers/1000m³.

	STATION GROUPS				
SPECIES GROUPS	1	2	3	4	5
1 *Ophiodon elongatus*	0.1	4.7	13.1	0.0	0.0
Ronquilus jordani	0.2	4.9	1.5	0.0	0.0
Ammodytes hexapterus	0.1	32.6	1.9	0.0	0.0
Hemilepidotus hemilepidotus	0.1	4.2	0.6	0.0	0.0
Cryptacanthodes aleutensis	0.0	6.1	0.9	0.0	0.0
2 *Tarletonbeania crenularis*	0.2	0.6	0.0	0.0	0.0
Hexagrammos lagocephalus	0.2	0.5	0.0	0.8	0.0
3 Osmeridae (unidentified)	0.1	0.2	2.6	0.0	0.0
Engraulis mordax	0.0	0.1	11.0	0.0	0.2
4 *Sebastes* spp.	28.2	33.9	4.0	3.3	9.6
Anoplopoma fimbria	22.8	72.3	3.1	73.8	4.5
Cololabis saira	24.4	3.5	8.2	5.4	44.4
Hexagrammos decagrammus	7.4	25.7	6.2	0.3	0.0
Scorpaenichthys marmoratus	3.4	18.8	4.6	0.0	0.8
Hemilepidotus spinosus	13.6	73.3	4.8	1.0	0.0
TOTAL FISH LARVAE (dominant taxa)	100.8	281.4	62.5	83.8	59.3

Figure 120. Distribution of station groups for dominant taxa of larvae in neuston, spring cruises.

(a)



(b)

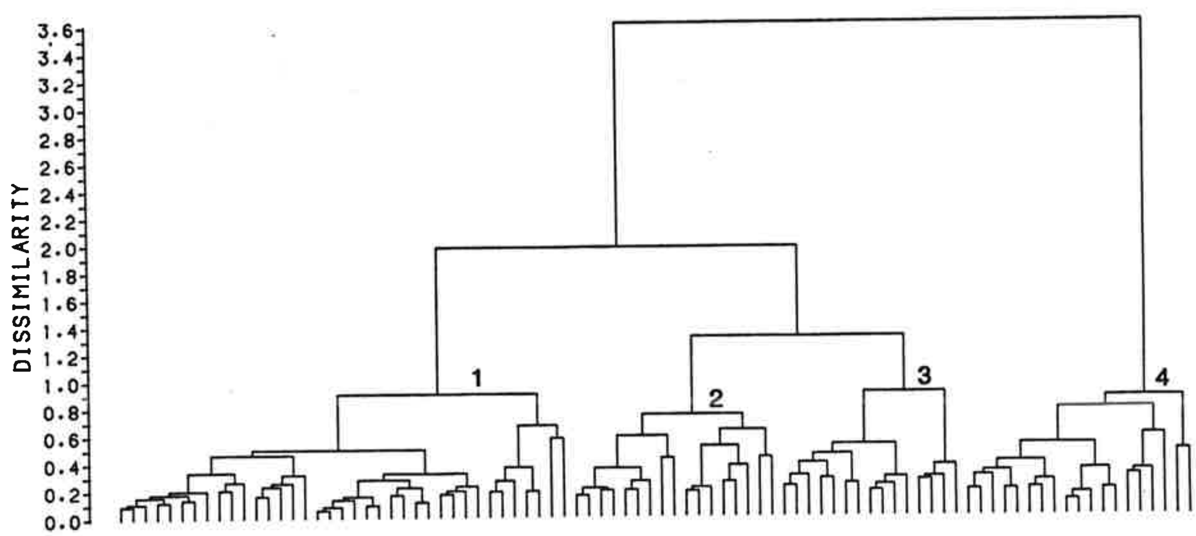


Figure 121. Dendrograms showing (a) species groups and (b) station groups for dominant taxa of eggs in bongo samples, spring cruises.

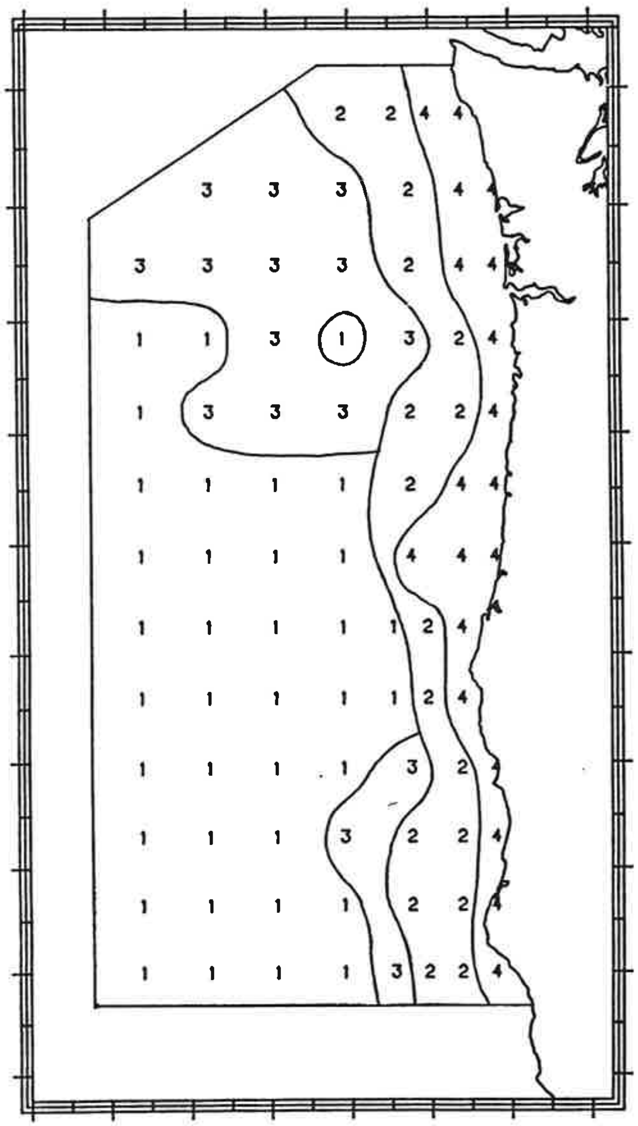


Table 48.

Two–way coincidence table resulting from numerical classification of egg abundance data from bongo samples taken during spring cruises (data from six cruises combined). Mean abundance in station groups expressed as numbers/10m^2.

	STATION GROUPS			
SPECIES GROUPS	1	2	3	4
1 Bathylagidae (unidentified)	16.1	7.3	19.2	0.1
Trachipterus altivelis	8.6	2.9	5.0	0.9
Bathylagus spp.	6.3	3.2	6.5	0.1
Icichthys lockingtoni	3.1	4.4	3.9	0.2
Chauliodus macouni	5.3	0.7	2.0	0.0
Bathylagus ochotensis	2.7	2.4	0.8	0.0
Myctophidae (unidentified)	228.7	34.5	0.5	0.1
Icosteus aenigmaticus	2.6	1.9	9.9	0.7
2 *Errex zachirus*	0.0	5.6	0.5	10.9
Eopsetta exilis	0.2	21.9	0.3	41.4
Microstomus pacificus	0.1	9.7	0.9	2.6
Pleuronectidae (unidentified)	0.0	0.1	0.1	33.0
Citharichthys A	0.1	3.8	0.6	79.0
3 *Pleuronectes vetulus*	0.0	0.0	0.0	0.9
Citharichthys B	0.0	0.2	0.1	4.3
Engraulis mordax	0.1	0.1	0.0	28.9
TOTAL FISH EGGS (dominant taxa)	273.9	97.7	50.3	203.1

Figure 122. Distribution of station groups for dominant taxa of eggs in bongo samples, spring cruises.

(a)

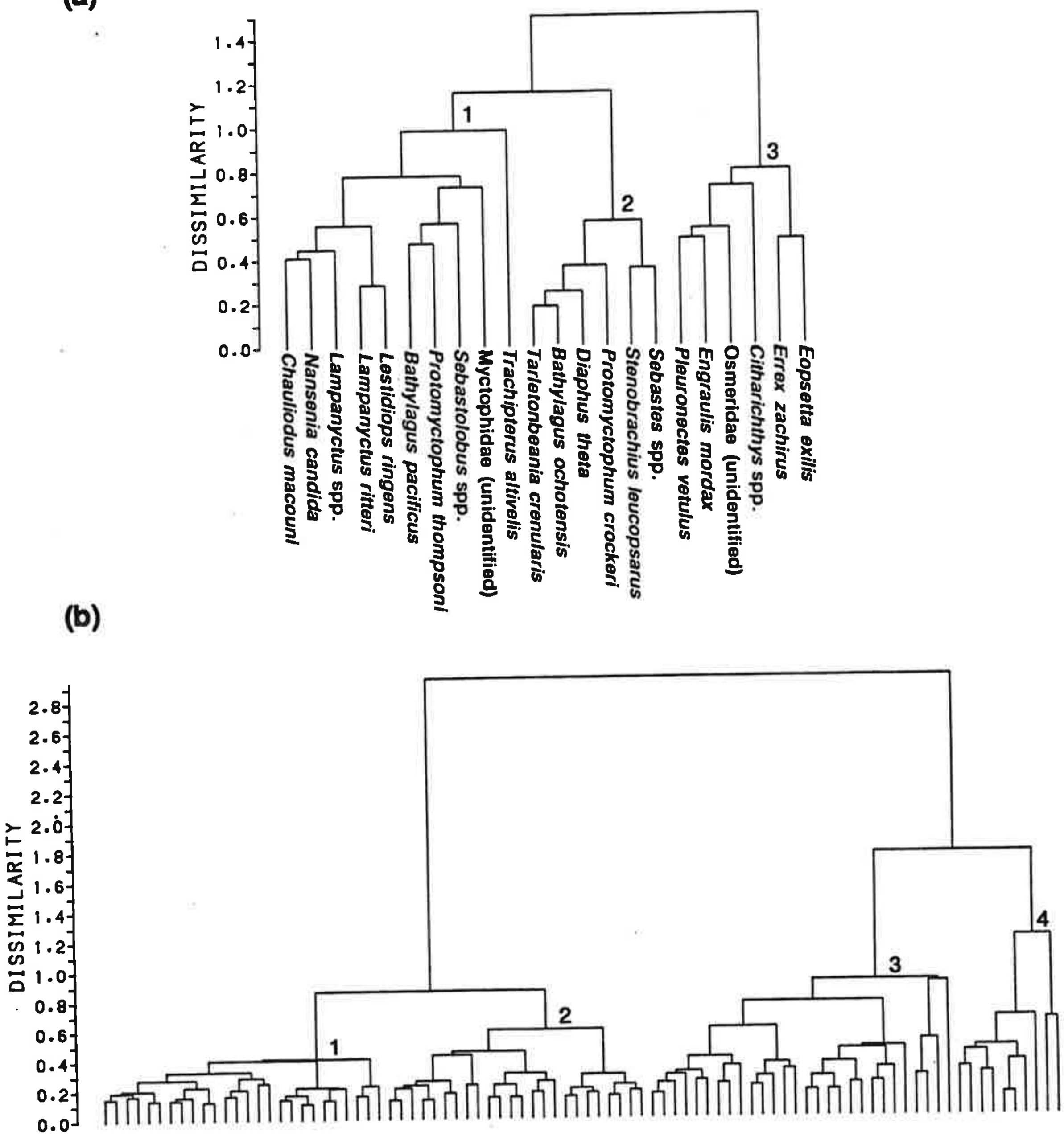


Figure 123. Dendrograms showing (a) species groups and (b) station groups for dominant taxa of larvae in bongo samples, spring cruises.

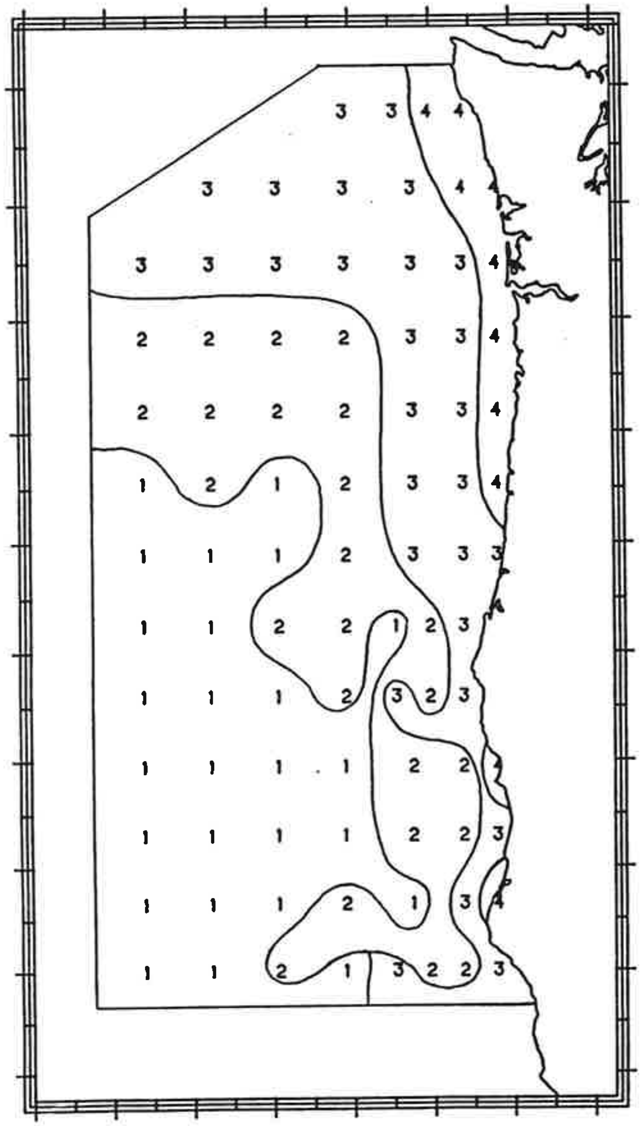


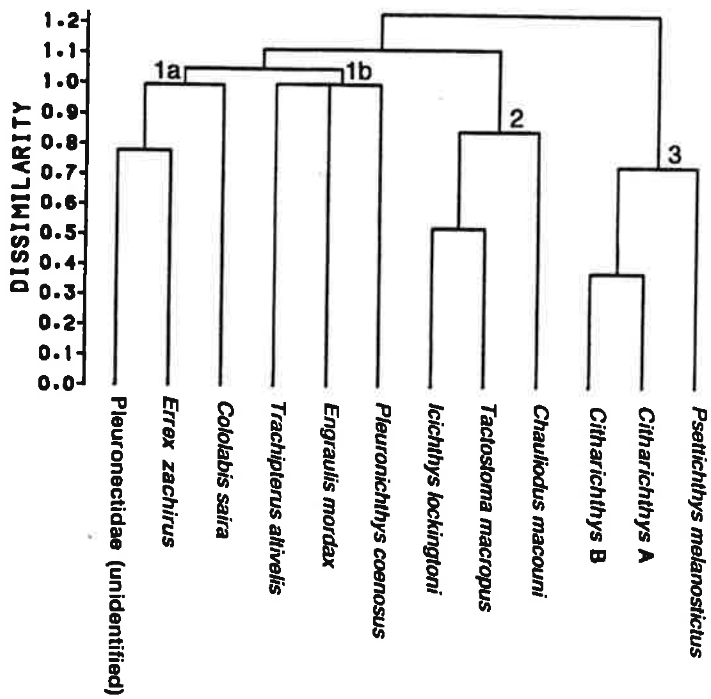
Table 49.

Two–way coincidence table resulting from numerical classification of larval abundance data from bongo samples taken during spring cruises (data from six cruises combined). Mean abundance in station groups expressed as numbers/10m².

SPECIES GROUPS	STATION GROUPS 1	2	3	4
1 *Chauliodus macouni*	2.8	1.7	0.4	0.0
Nansenia candida	4.4	1.5	0.2	0.0
Lampanyctus spp.	3.8	1.2	0.2	0.0
Lampanyctus ritteri	4.8	1.0	0.2	0.0
Lestidiops ringens	4.2	0.3	0.1	0.0
Bathylagus pacificus	1.3	3.8	2.7	0.1
Protomyctophum thompsoni	1.7	2.4	1.2	0.1
Sebastolobus spp.	2.5	2.8	1.0	0.4
Myctophidae (unidentified)	7.2	1.4	0.9	0.3
Trachipterus altivelis	0.6	0.1	0.0	0.0
2 *Tarletonbeania crenularis*	22.8	11.9	3.6	0.1
Bathylagus ochotensis	51.0	28.8	4.2	0.2
Diaphus theta	118.8	20.0	1.9	0.3
Protomyctophum crockeri	10.0	4.0	1.1	0.1
Stenobrachius leucopsarus	214.2	144.9	87.6	6.4
Sebastes spp.	4.8	15.8	31.4	9.6
3 *Pleuronectes vetulus*	0.0	0.0	0.7	11.8
Engraulis mordax	0.0	0.2	1.1	6.2
Osmeridae (unidentified)	0.0	0.0	0.3	35.4
Citharichthys spp.	0.0	0.1	0.6	0.9
Errex zachirus	0.4	0.4	1.8	1.5
Eopsetta exilis	0.5	3.6	6.0	5.2
TOTAL FISH LARVAE (dominant taxa)	455.8	245.9	147.2	78.6

Figure 124. Distribution of station groups for dominant taxa of larvae in bongo samples, spring cruises.

(a)



(b)

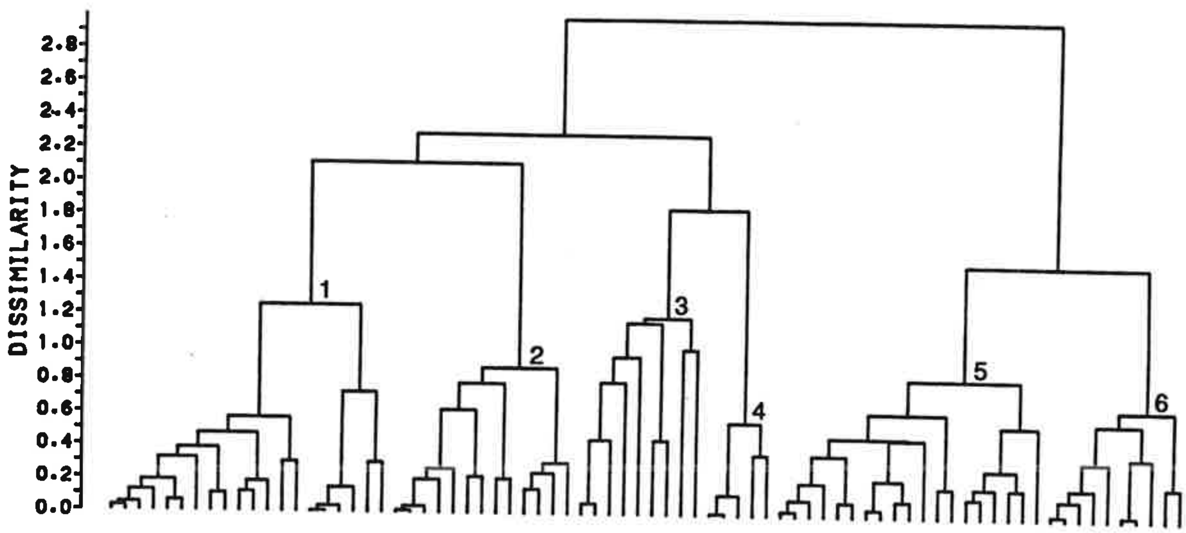


Figure 125. Dendrograms showing (a) species groups and (b) station groups for dominant taxa of eggs in neuston, cruise PO80.

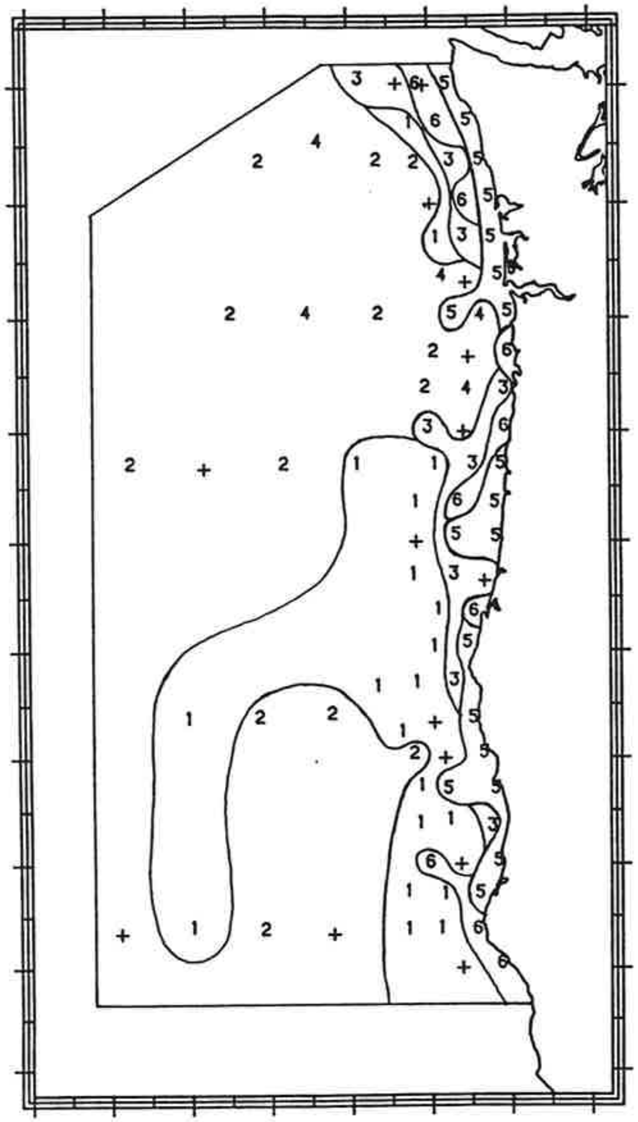


Figure 126. Distribution of station groups for dominant taxa of eggs in neuston, cruise PO80.
+ = stations where eggs were absent from samples.

Table 50.

Two–way coincidence table resulting from numerical classification of egg abundance data from neuston collections taken during cruise PO80, August 1980. Mean abundance in station groups expressed as numbers/1000m^3.

		STATION GROUPS					
SPECIES GROUPS		1	2	3	4	5	6
1a	Pleuronectidae (unidentified)	3.7	0.0	784.3	0.0	4.7	0.0
	Errex zachirus	0.0	0.0	6.5	0.0	0.9	2.1
	Cololabis saira	2.0	9.3	285.4	0.0	0.0	0.0
1b	*Trachipterus altivelis*	0.8	1.8	6.9	0.0	0.0	1.7
	Engraulis mordax	0.0	233.2	0.0	144.7	25.1	0.0
	Pleuronichthys coenosus	0.0	0.0	2.0	0.0	4.1	0.0
2	*Icichthys lockingtoni*	102.2	0.0	1.9	3.5	0.9	27.3
	Tactostoma macropus	84.8	265.7	0.0	0.0	0.9	0.0
	Chauliodus macouni	3.8	3.8	0.0	0.0	0.0	0.0
3	*Citharichthys* B	3.8	10.9	0.0	0.0	470.7	0.0
	Citharichthys A	0.8	0.0	219.7	0.0	1976.2	289.6
	Psettichthys melanostictus	0.0	0.0	0.0	0.0	98.4	0.0
	TOTAL FISH EGGS	210.6	536.2	1309.8	148.2	2581.8	320.8

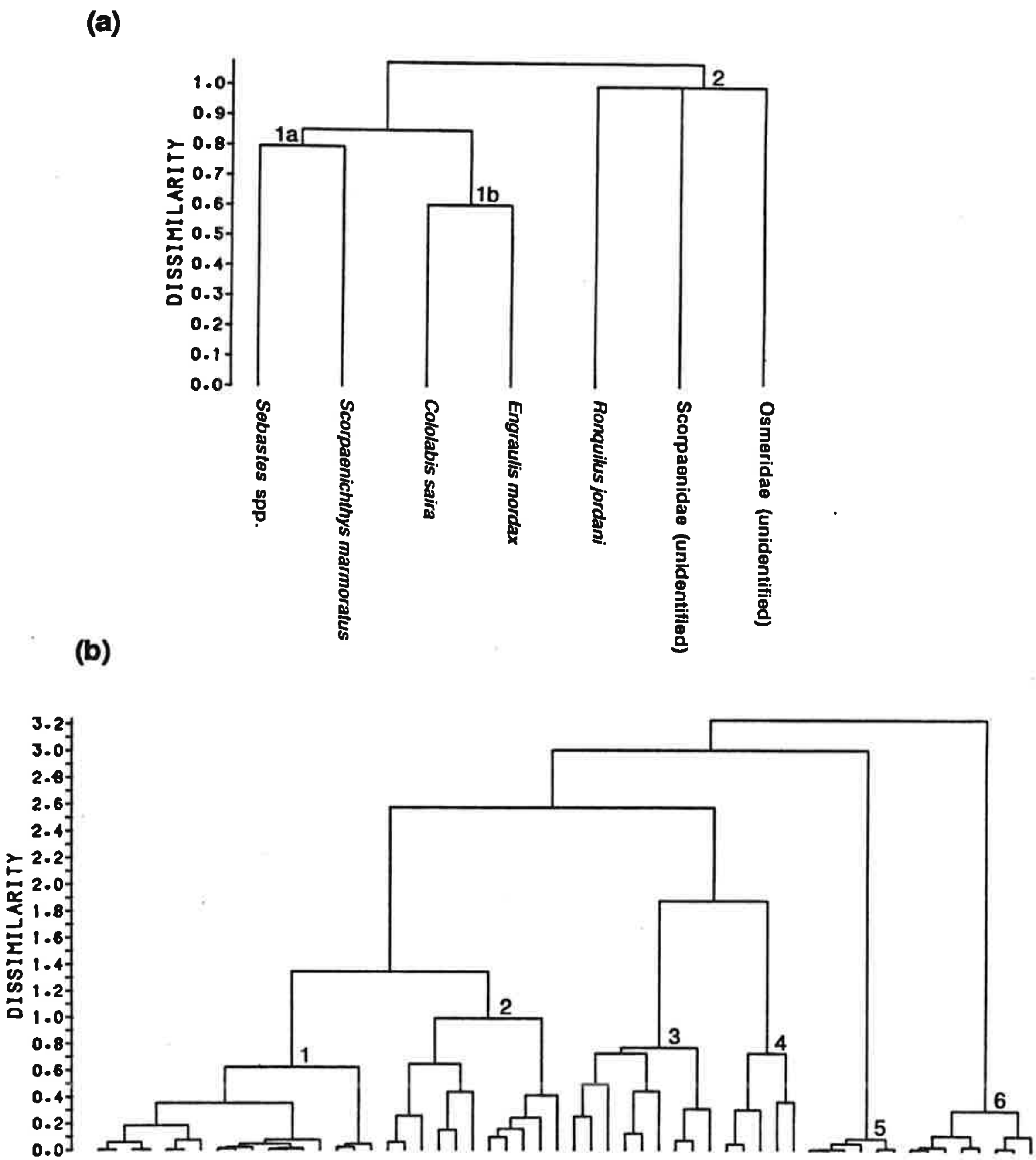


Figure 127. Dendrograms showing (a) species groups and (b) station groups for dominant taxa of larvae in neuston, cruise PO80.

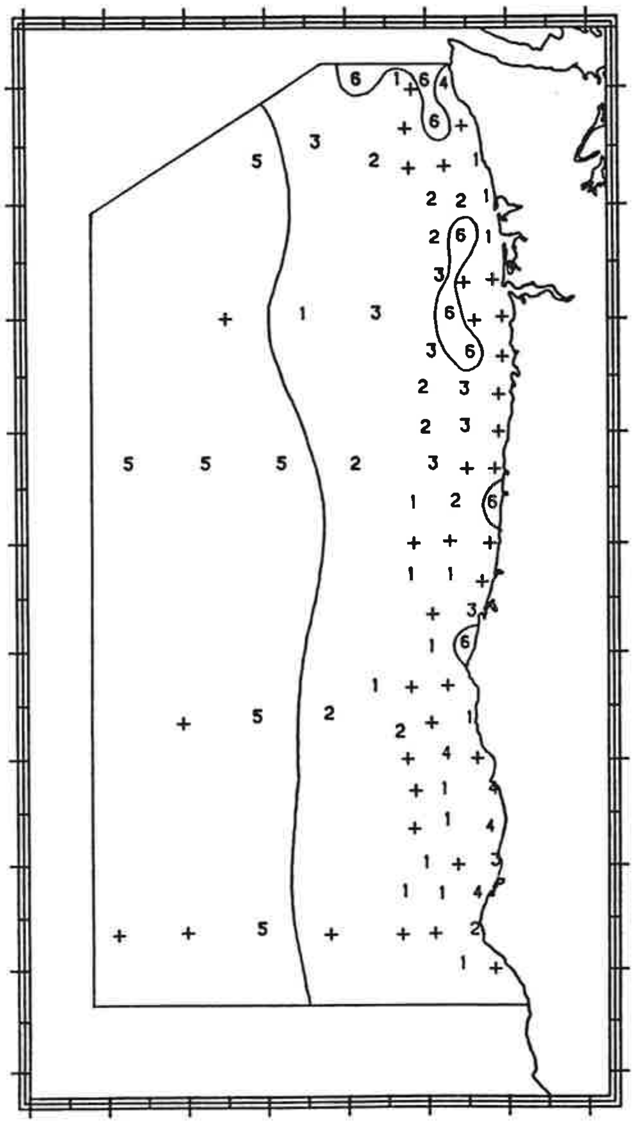
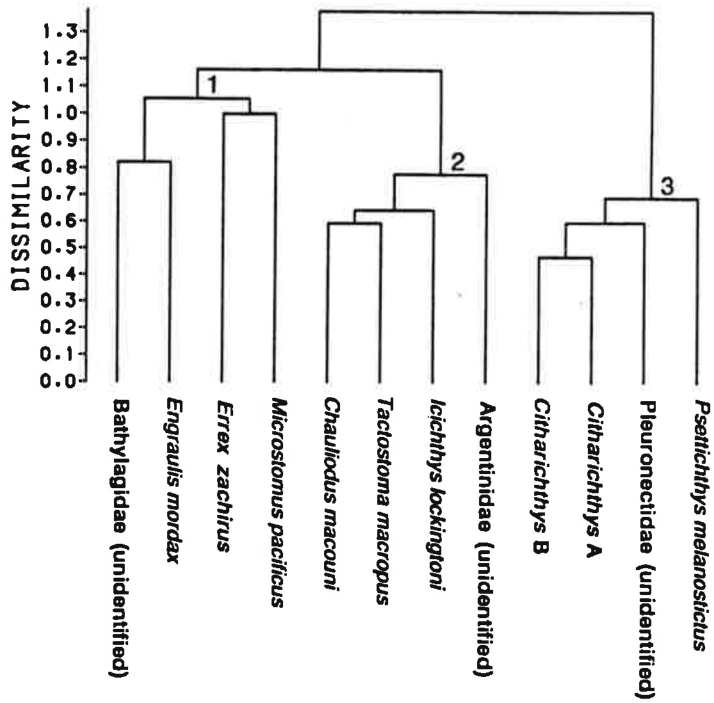


Figure 128. Distribution of station groups for dominant taxa of larvae in neuston, cruise PO80.
+ = stations where larvae were absent from samples.

Table 51.
Two–way coincidence table resulting from numerical classification of larval abundance data from neuston collections taken during cruise PO80, August 1980. Mean abundance in station groups expressed as numbers/1000m^3.

SPECIES GROUPS		STATION GROUPS 1	2	3	4	5	6
1a	*Sebastes* spp.	99.4	82.2	0.0	204.4	0.0	0.0
	Scorpaenichthys marmoratus	0.0	23.0	8.2	0.0	0.0	45.6
1b	*Cololabis saira*	0.0	11.5	16.8	0.0	19.7	0.0
	Engraulis mordax	0.0	156.0	328.8	4.2	0.0	0.0
2	*Ronquilus jordani*	0.0	23.2	0.0	0.0	0.0	0.0
	Scorpaenidae (unidentified)	0.0	0.0	22.0	0.0	0.0	0.0
	Osmeridae (unidentified)	0.0	0.0	1.9	87.0	0.0	0.0
	TOTAL FISH LARVAE	104.8	310.4	377.6	302.9	19.7	45.6

(a)



(b)

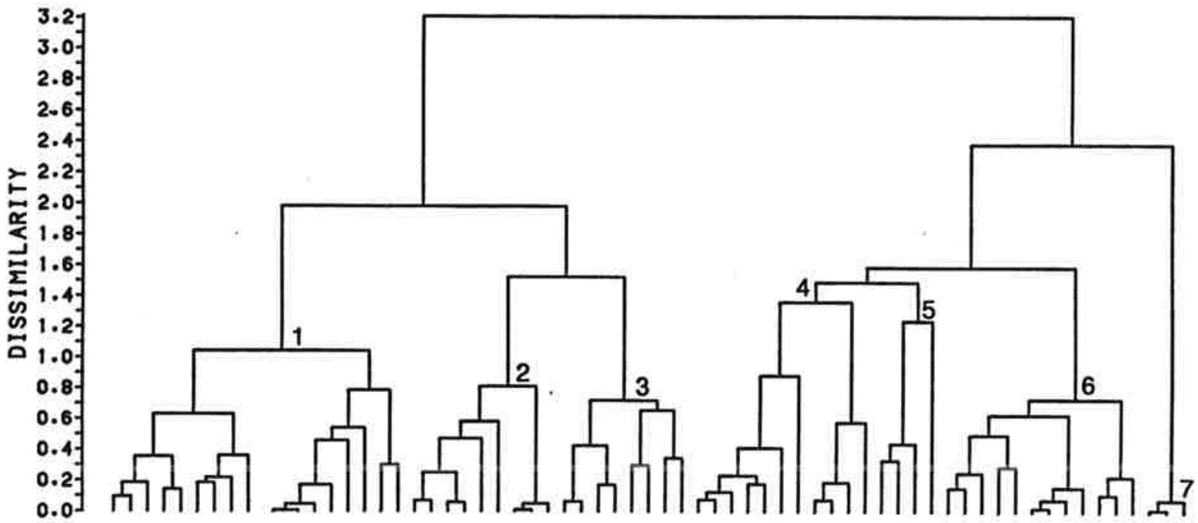


Figure 129. Dendrograms showing (a) species groups and (b) station groups for dominant taxa of eggs in bongo samples, cruise PO80.

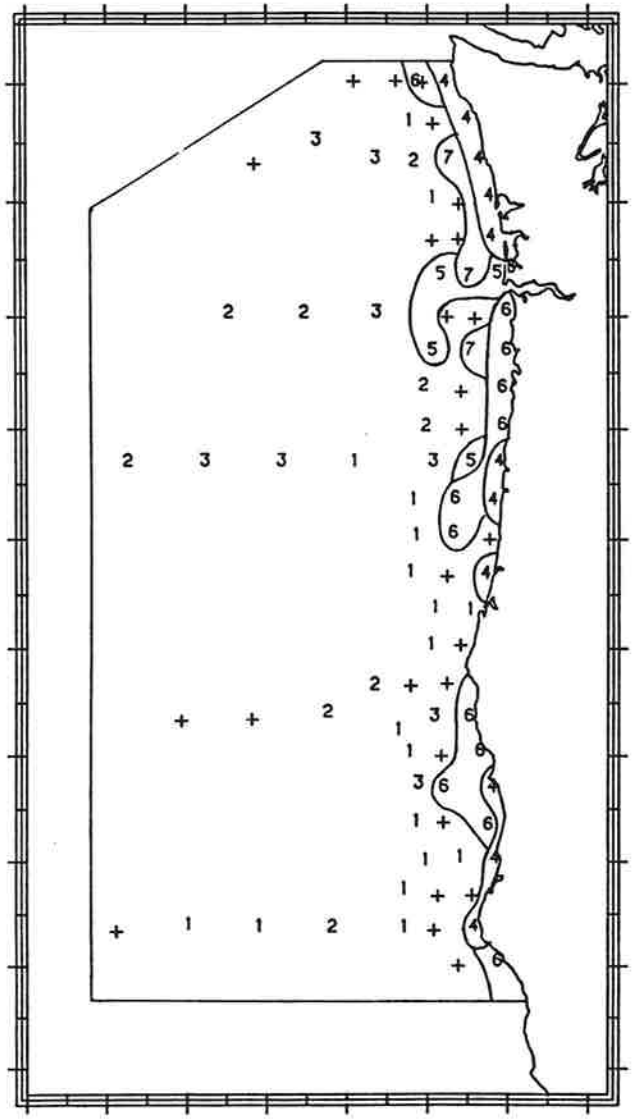


Table 52.

Two–way coincidence table resulting from numerical classification of egg abundance data from bongo collections taken during cruise PO80, August 1980. Mean abundance in station groups expressed as numbers/10m^2.

	STATION GROUPS						
SPECIES GROUPS	1	2	3	4	5	6	7
1 Bathylagidae (unidentified)	1.0	0.7	0.9	0.0	0.0	0.0	0.0
Engraulis mordax	0.0	1.3	0.0	0.0	37.5	0.0	0.0
Errex zachirus	0.4	0.0	0.0	0.0	1.4	1.3	0.0
Microstomus pacificus	0.1	0.4	0.0	0.0	0.0	0.0	7.2
2 *Chauliodus macouni*	3.6	0.0	9.6	0.0	0.0	0.5	0.0
Tactostoma macropus	12.0	33.2	19.7	0.0	0.0	0.0	0.0
Icichthys lockingtoni	18.5	0.0	0.0	0.0	1.2	0.0	0.0
Argentinidae (unidentified)	2.0	0.0	2.3	0.0	0.0	0.0	0.0
3 *Citharichthys* B	0.0	0.0	0.0	53.2	0.0	1.9	0.0
Citharichthys A	0.0	0.0	0.0	72.5	3.3	58.1	0.0
Pleuronectidae (unidentified)	0.4	0.4	0.0	14.5	0.0	0.0	0.0
Psettichthys melanostictus	0.0	0.0	0.0	6.2	0.0	0.0	0.0
TOTAL FISH EGGS	40.6	47.7	33.2	148.0	43.4	62.8	7.2

Figure 130. Distribution of station groups for dominant taxa of eggs in bongo samples, cruise PO80. + = stations where eggs were absent from samples.

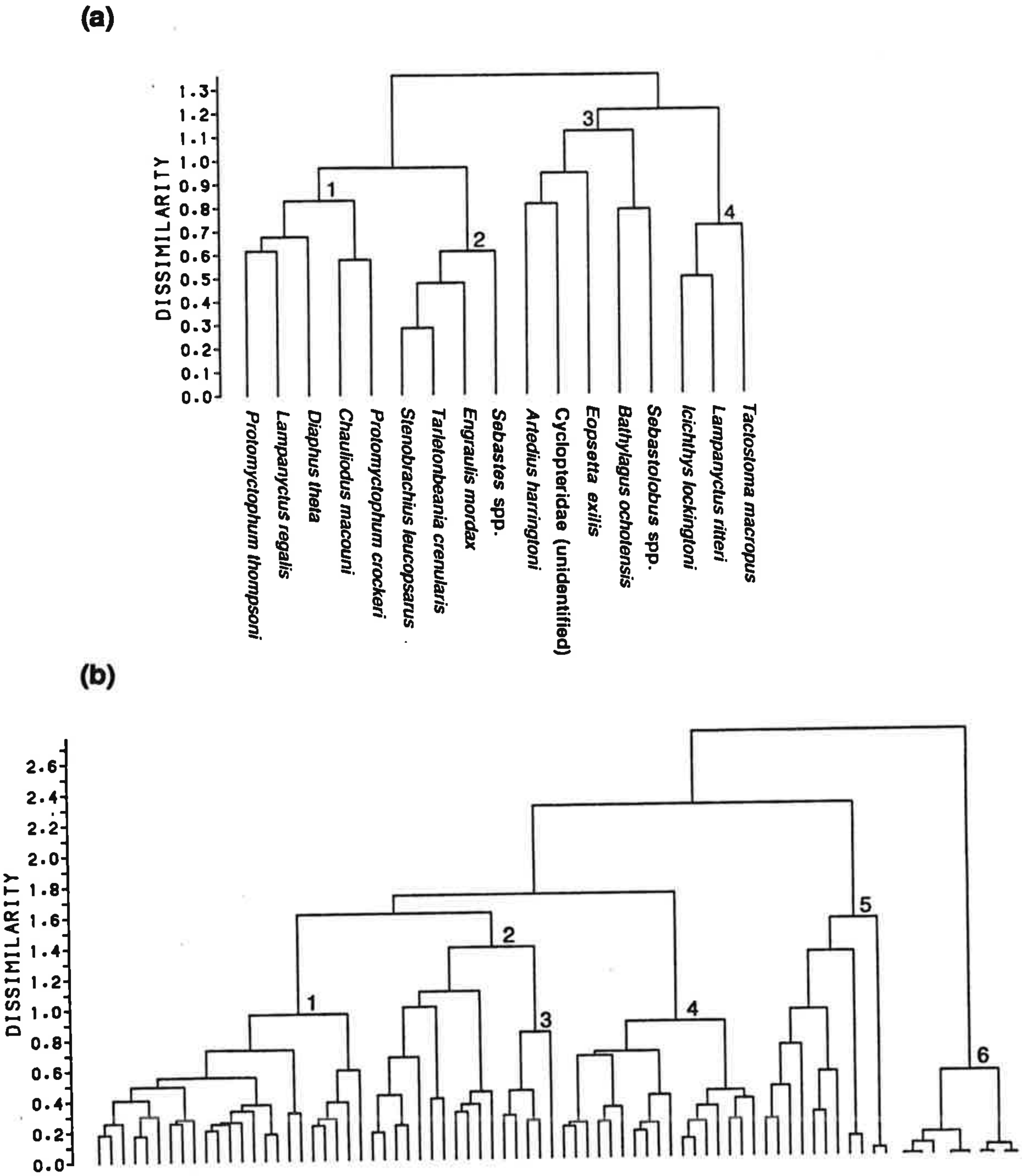


Figure 131. Dendrograms showing (a) species groups and (b) station groups for dominant taxa of larvae in bongo samples, cruise PO80.

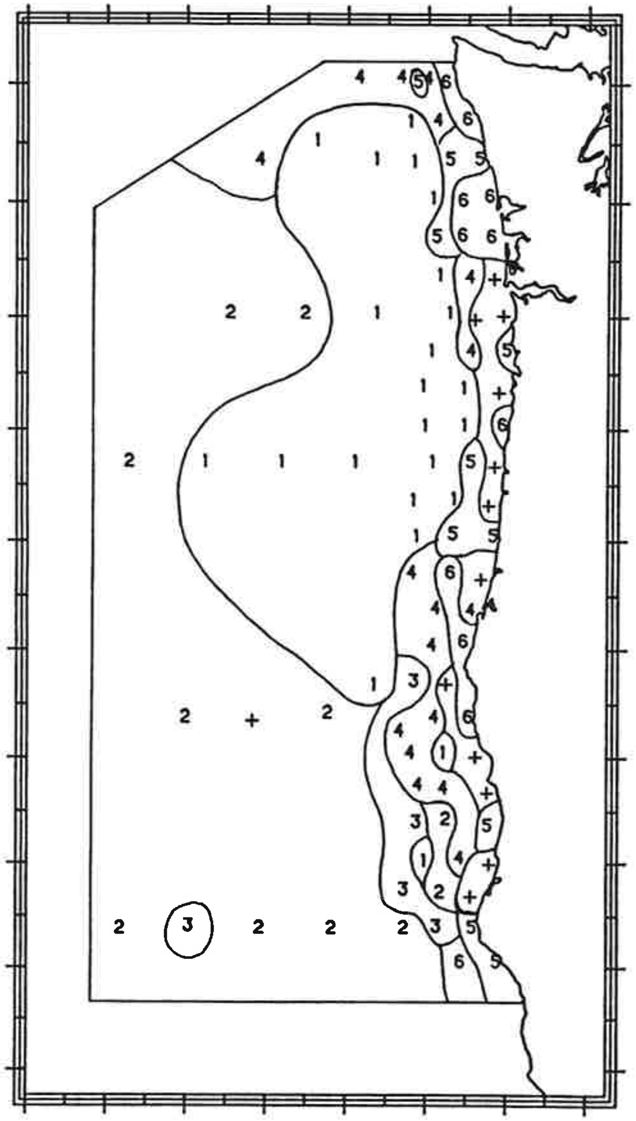


Table 53.

Two-way coincidence table resulting from numerical classification of larval abundance data from bongo collections taken during cruise PO80, August 1980. Mean abundance in station groups expressed as numbers/10m^2.

		STATION GROUPS					
SPECIES GROUPS		1	2	3	4	5	6
1	*Protomyctophum thompsoni*	3.5	2.4	2.2	0.4	0.0	0.0
	Lampanyctus regalis	3.3	5.7	0.0	0.8	0.0	0.0
	Diaphus theta	3.7	36.3	2.6	3.6	0.0	0.0
	Chauliodus macouni	1.0	2.9	9.7	2.7	0.0	0.0
	Protomyctophum crockeri	2.6	1.5	8.4	0.0	0.0	0.0
2	*Stenobrachius leucopsarus*	62.2	7.0	0.0	19.2	0.4	0.0
	Tarletonbeania crenularis	19.6	10.2	2.0	6.7	0.0	0.0
	Engraulis mordax	548.0	1.9	0.0	0.0	1.9	0.0
	Sebastes spp.	26.3	7.7	18.4	80.1	8.5	9.2
3	*Artedius harringtoni*	0.0	0.0	0.0	0.0	2.5	0.0
	Cyclopteridae (unidentified)	0.1	0.0	0.0	0.1	1.1	0.0
	Eopsetta exilis	0.0	0.3	0.0	2.0	1.7	0.0
	Bathylagus ochotensis	0.5	0.0	0.0	0.2	0.4	0.0
	Sebastolobus spp.	0.6	0.5	2.9	0.7	0.0	0.0
4	*Icichthys lockingtoni*	0.2	3.3	0.0	0.0	0.0	0.0
	Lampanyctus ritteri	0.0	2.3	0.0	0.5	0.0	0.0
	Tactostoma macropus	0.4	3.4	0.0	0.0	0.0	0.0
	TOTAL FISH LARVAE	674.7	103.7	49.7	118.2	16.4	14.0

Figure 132. Distribution of station groups for dominant taxa of larvae in bongo samples, cruise PO80.
+ = stations where larvae were absent from samples.

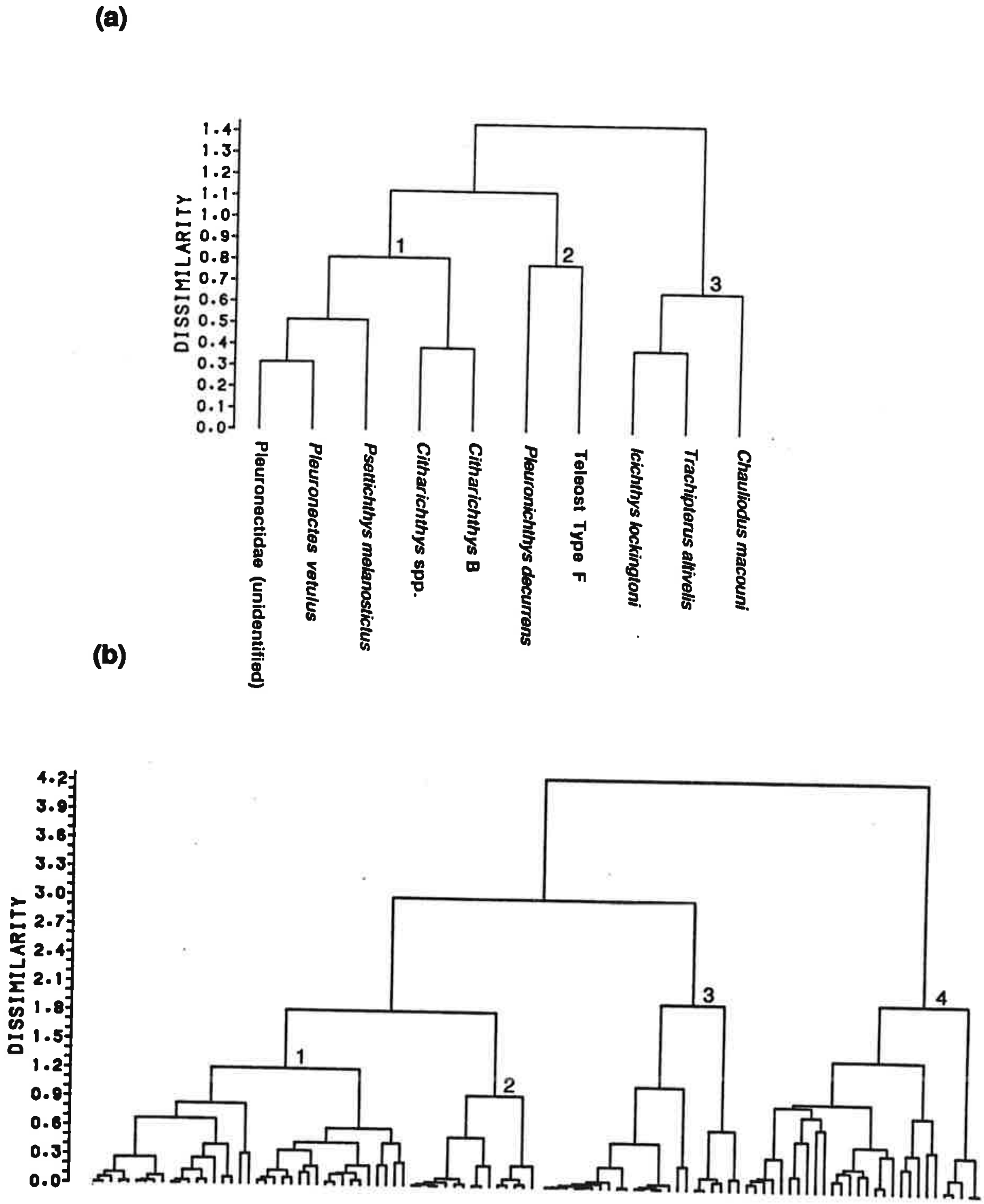


Figure 133. Dendrograms showing (a) species groups and (b) station groups for dominant taxa of eggs in neuston, cruise DA81.

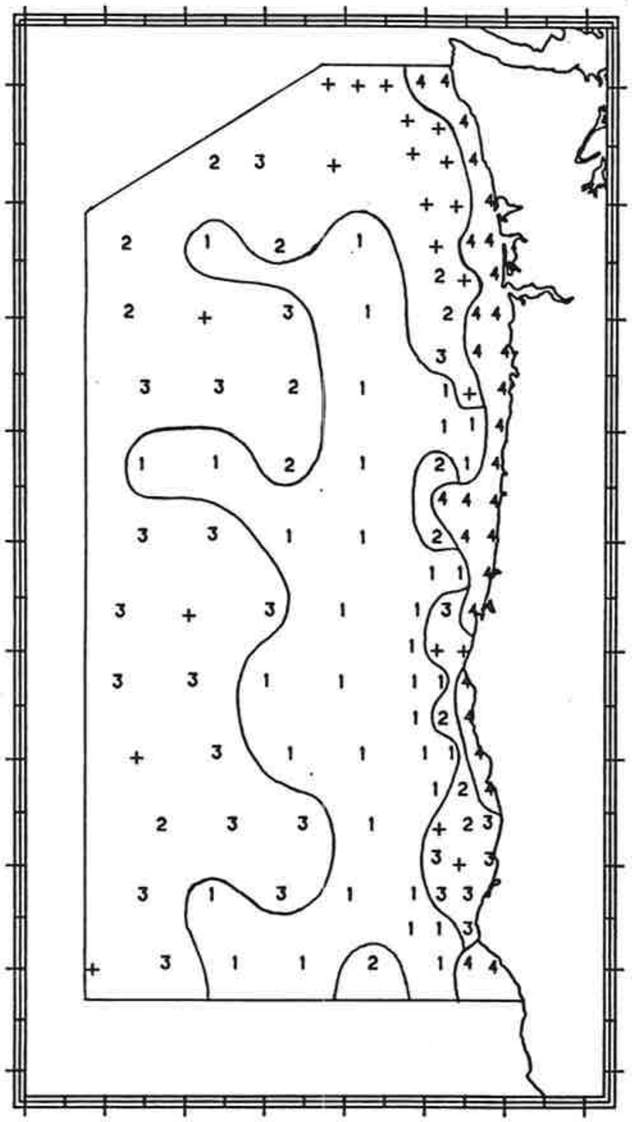


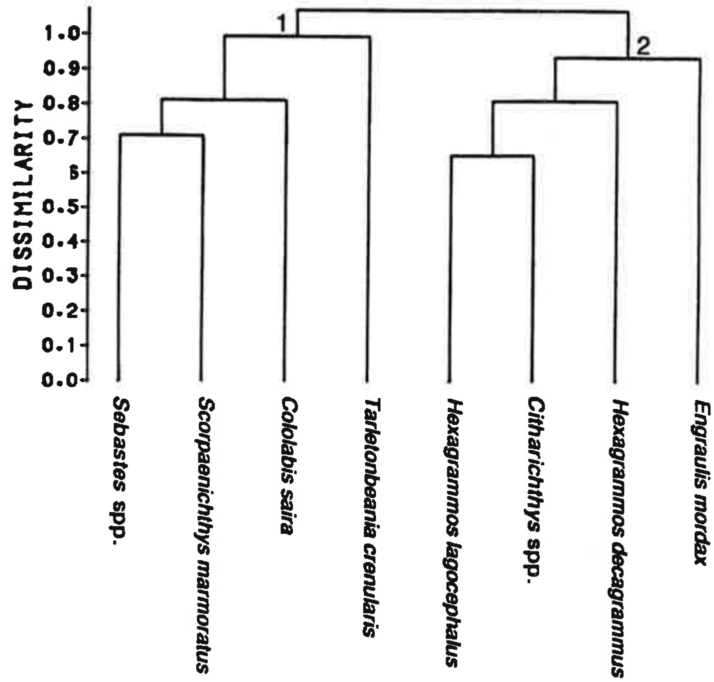
Table 54.

Two–way coincidence table resulting from numerical classification of egg abundance data from neuston collections taken during cruise DA81, October/November 1981. Mean abundance in station groups expressed as numbers/1000m^3.

		STATION GROUPS			
SPECIES GROUPS		1	2	3	4
1	Pleuronectidae (unidentified)	0.7	0.0	0.6	125.8
	Pleuronectes vetulus	0.0	0.0	0.0	58.1
	Psettichthys melanostictus	0.0	0.0	0.0	10.2
	Citharichthys B	0.0	0.0	0.0	205.4
	Citharichthys A	1.4	0.0	0.0	4366.5
2	*Pleuronichthys decurrens*	0.0	0.0	1.6	4.5
	Teleost Type F	0.3	0.0	0.0	37.1
3	*Icichthys lockingtoni*	198.6	37.0	0.0	7.4
	Trachipterus altivelis	161.9	0.0	24.6	6.9
	Chauliodus macouni	10.1	4.2	5.4	0.0
	TOTAL FISH EGGS	380.5	41.2	33.9	4825.0

Figure 134. Distribution of station groups for dominant taxa of eggs in neuston, cruise DA81. + = stations where eggs were absent from samples.

(a)



(b)

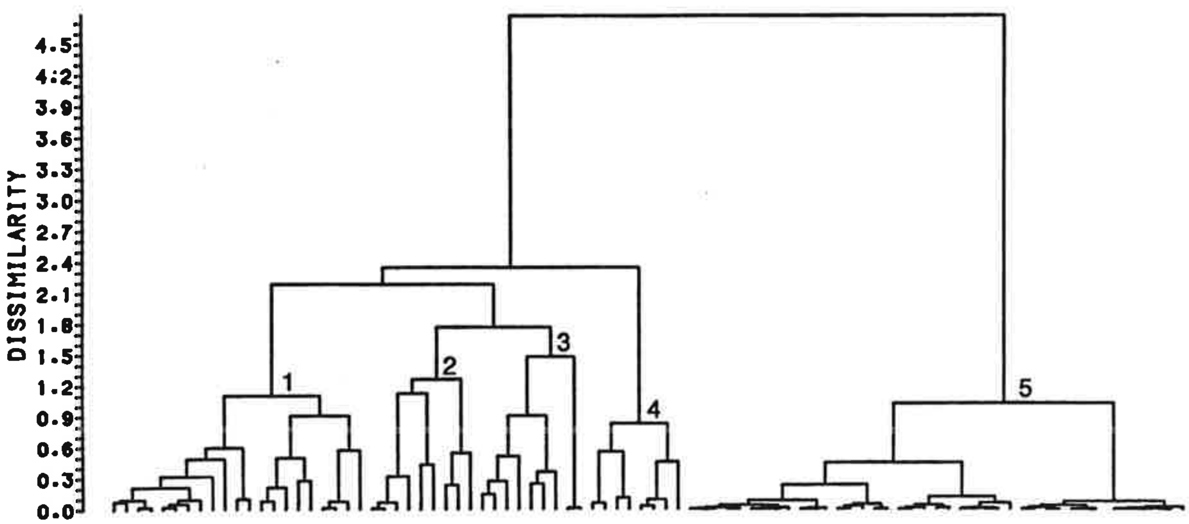


Figure 135. Dendrograms showing (a) species groups and (b) station groups for dominant taxa of larvae in neuston, cruise DA81.

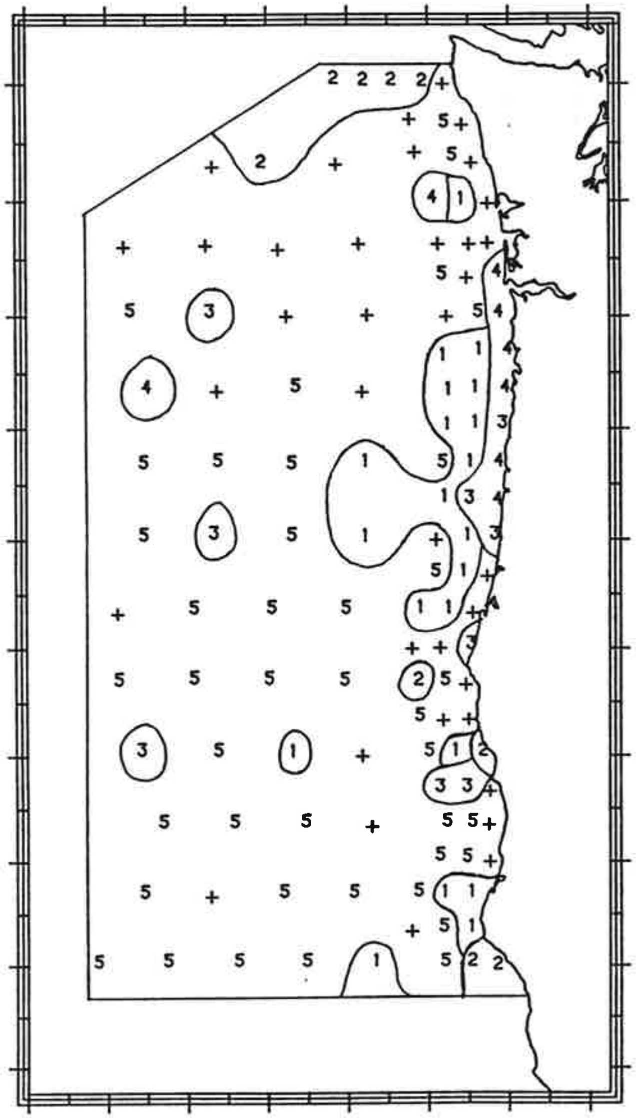


Figure 136. Distribution of station groups for dominant taxa of larvae in neuston, cruise DA81.
+ = stations where larvae were absent from samples.

Table 55.

Two–way coincidence table resulting from numerical classification of larval abundance data from neuston collections taken during cruise DA81, October/November 1981. Mean abundance in station groups expressed as numbers/1000m^3.

	STATION GROUPS				
SPECIES GROUPS	1	2	3	4	5
1 *Sebastes* spp.	4.7	0.0	10.1	0.0	0.0
Scorpaenichthys marmoratus	18.6	0.0	0.0	24.3	0.0
Cololabis saira	56.6	0.0	38.2	4.8	46.6
Tarletonbeania crenularis	11.5	7.1	0.0	0.0	0.0
2 *Hexagrammos lagocephalus*	1.6	39.3	11.8	0.0	0.0
Citharichthys B	0.0	5.4	16.7	0.0	0.0
Hexagrammos decagrammus	0.6	79.5	0.0	0.0	0.0
Engraulis mordax	0.7	0.0	333.9	158.1	0.0
TOTAL FISH LARVAE	101.8	140.9	414.0	189.0	48.4

(a)

(b)

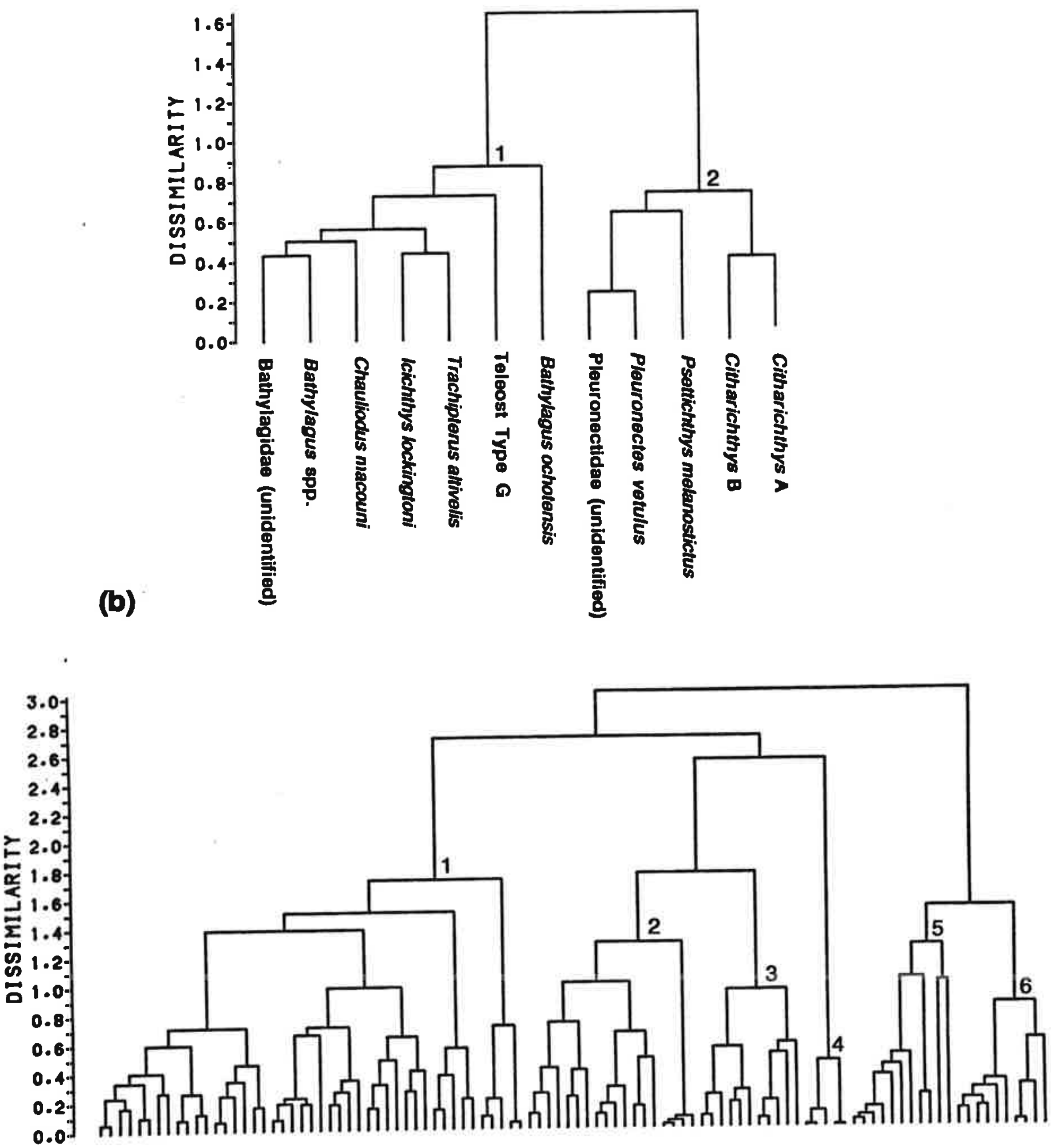


Figure 137. Dendrograms showing (a) species groups and (b) station groups for dominant taxa of eggs in bongo samples, cruise DA81.

Table 56.
Two-way coincidence table resulting from numerical classification of egg abundance data from bongo collections taken during cruise DA81, October/November 1981. Mean abundance in station groups expressed as numbers/10m^2.

	STATION GROUPS					
SPECIES GROUPS	1	2	3	4	5	6
1 Bathylagidae (unidentified)	27.8	1.8	0.0	0.0	0.0	0.0
Bathylagus spp.	7.6	4.0	0.5	0.0	0.0	0.0
Chauliodus macouni	8.9	3.7	4.4	0.0	0.0	0.0
Icichthys lockingtoni	8.8	3.5	14.4	0.0	1.1	1.5
Trachipterus altivelis	8.7	8.0	5.7	0.0	0.0	0.5
Teleost Type G	9.0	11.9	0.0	21.7	0.0	0.0
Bathylagus ochotensis	0.7	2.6	0.5	0.0	0.5	0.0
2 Pleuronectidae (unidentified)	0.0	0.0	0.4	0.0	0.0	145.3
Pleuronectes vetulus	0.0	0.0	0.0	0.0	2.0	40.6
Psettichthys melanostictus	0.0	0.0	0.0	0.0	1.4	6.8
Citharichthys B	0.4	0.3	0.0	0.0	31.8	35.5
Citharichthys A	0.4	0.0	0.0	0.0	268.7	1813.1
TOTAL FISH EGGS	75.6	38.2	26.9	22.7	308.4	2045.8

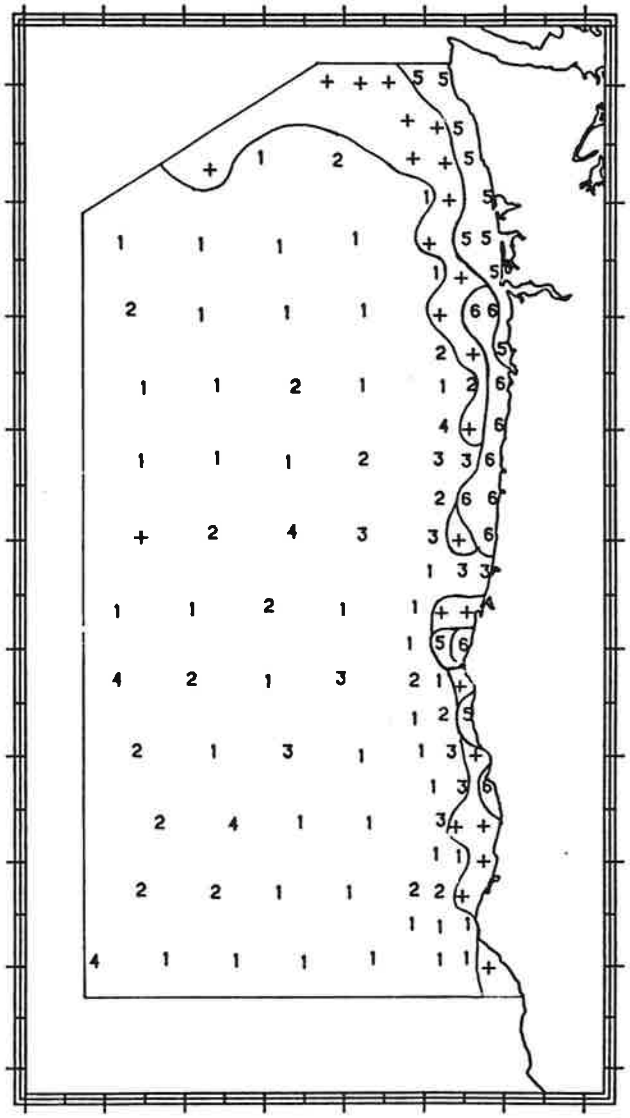


Figure 138. Distribution of station groups for dominant taxa of eggs in bongo samples, cruise DA81.
+ = stations where eggs were absent from samples.

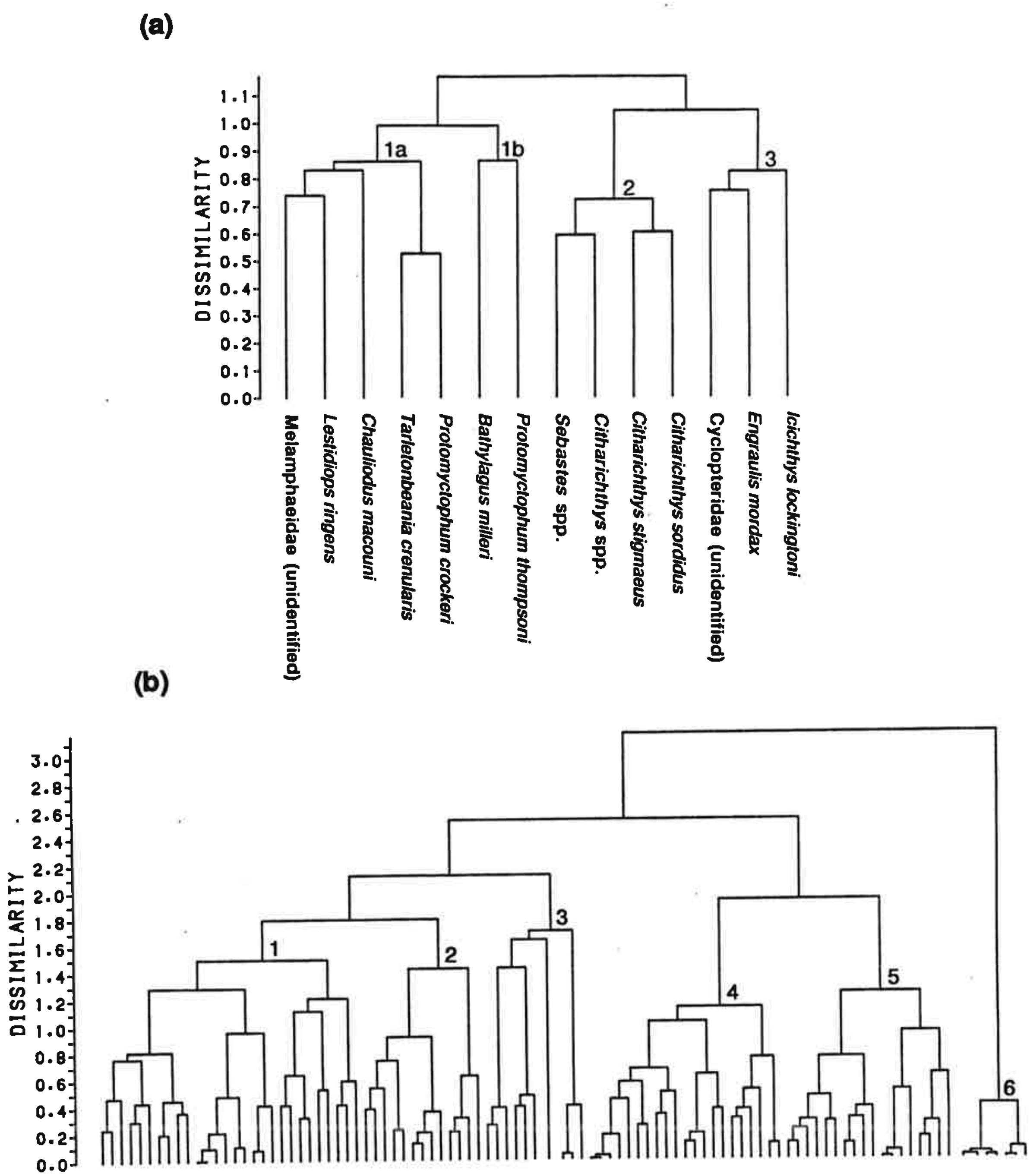


Figure 139. Dendrograms showing (a) species groups and (b) station groups for dominant taxa of larvae in bongo samples, cruise DA81.

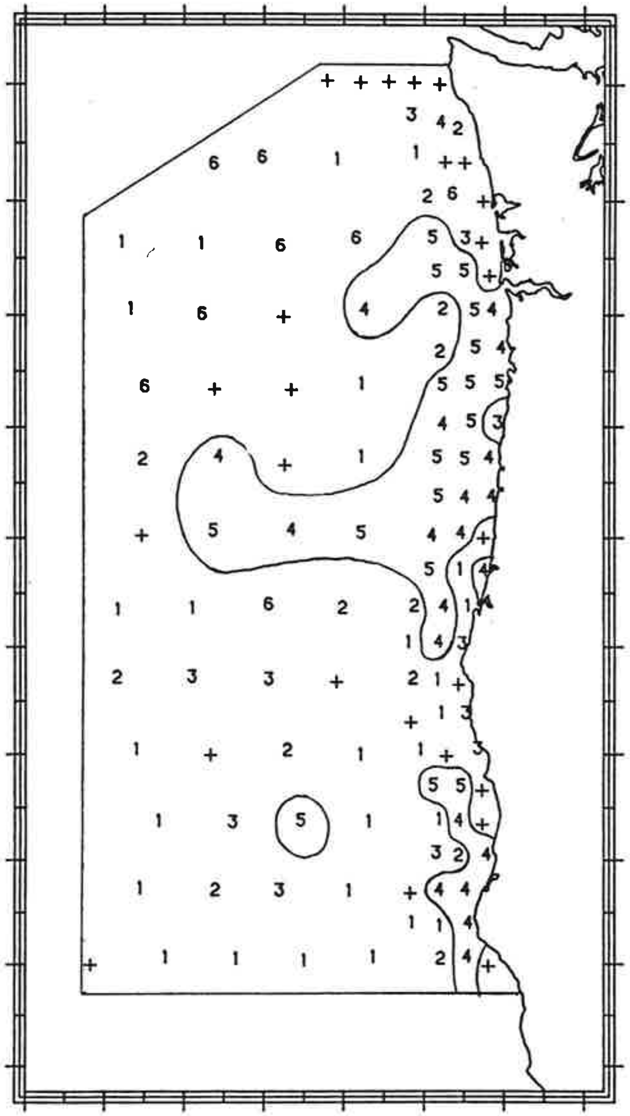


Figure 140. Distribution of station groups for dominant taxa of larvae in bongo samples, cruise DA81.
+ = stations where larvae were absent from samples.

Table 57.

Two–way coincidence table resulting from numerical classification of larval abundance data from bongo collections taken during cruise DA81, October/November 1981. Mean abundance in station groups expressed as numbers/10m^2.

SPECIES GROUPS		STATION GROUPS 1	2	3	4	5	6
1a	Melamphaeidae (unidentified)	1.7	0.0	0.5	0.0	0.0	0.0
	Lestidiops ringens	3.3	1.2	2.4	0.0	0.0	0.0
	Chauliodus macouni	1.7	3.5	0.0	0.3	0.3	0.0
	Tarletonbeania crenularis	11.7	6.1	0.0	3.5	2.6	10.3
	Protomyctophum crockeri	7.9	1.2	0.0	3.0	0.3	0.0
1b	*Protomyctophum thompsoni*	1.6	0.0	0.0	0.0	0.3	0.0
	Bathylagus milleri	1.3	0.0	0.0	0.5	0.0	0.0
2	*Sebastes* spp.	0.5	1.6	0.0	37.9	13.6	0.0
	Citharichthys spp.	0.2	0.0	1.0	50.4	31.6	0.0
	Citharichthys stigmaeus	1.3	5.5	0.0	1.6	4.0	0.0
	Citharichthys sordidus	1.5	4.3	0.6	0.0	13.8	0.0
3	Cyclopteridae (unidentified)	0.0	0.0	1.0	1.8	0.0	0.0
	Engraulis mordax	0.0	0.4	3.6	0.7	0.3	0.0
	Icichthys lockingtoni	1.8	0.0	2.3	1.2	0.3	0.0
	TOTAL FISH LARVAE	37.9	26.0	15.3	108.9	71.4	12.7

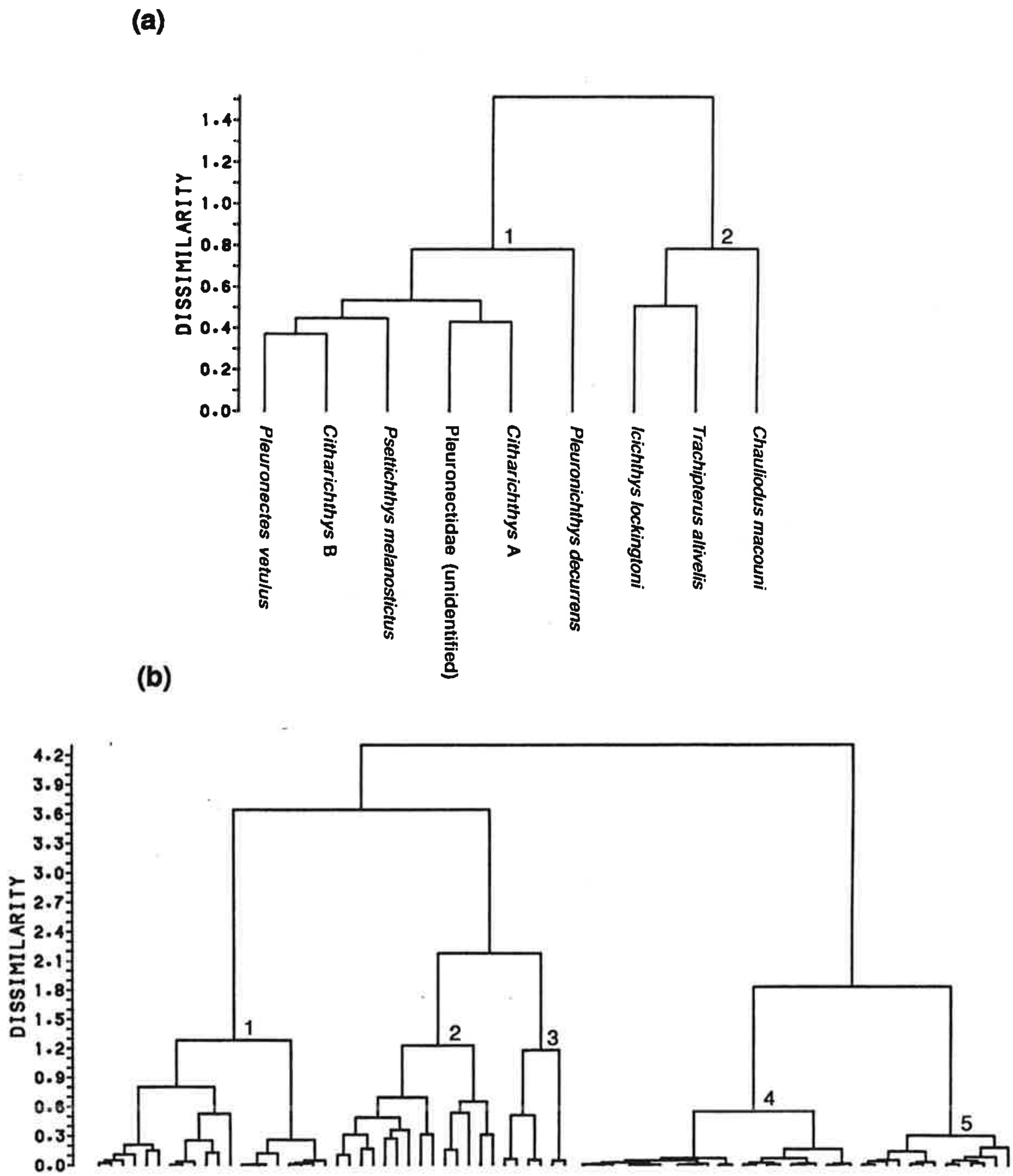


Figure 141. Dendrograms showing (a) species groups and (b) station groups for dominant taxa of eggs in neuston, cruise MF83.

Table 58.

Two–way coincidence table resulting from numerical classification of egg abundance data from neuston collections taken during cruise MF83, November 1983. Mean abundance in station groups expressed as numbers/1000m^3.

SPECIES GROUPS	STATION GROUPS 1	2	3	4	5
1 *Pleuronectes vetulus*	0.0	10.5	0.0	0.0	0.0
Citharichthys B	0.0	87.0	0.0	0.0	0.0
Psettichthys melanostictus	0.0	24.0	0.0	0.0	0.0
Pleuronectidae (unidentified)	0.0	224.3	16.7	0.0	0.0
Citharichthys A	0.0	136.3	0.0	0.0	0.0
Pleuronichthys decurrens	0.0	7.9	8.1	0.0	0.0
2 *Icichthys lockingtoni*	33.0	2.6	0.0	0.0	22.2
Trachipterus altivelis	21.2	1.8	0.0	23.1	23.3
Chauliodus macouni	21.9	0.0	0.0	0.0	0.0
TOTAL FISH EGGS	78.6	497.6	24.8	26.4	45.4

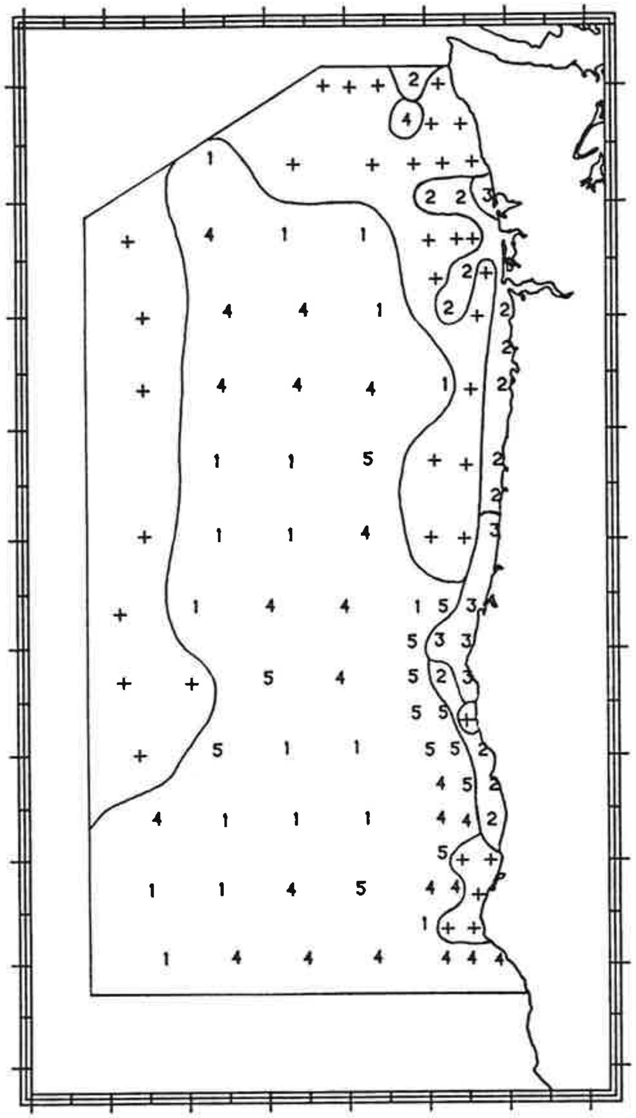


Figure 142. Distribution of station groups for dominant taxa of eggs in neuston, cruise MF83.
+ = stations where eggs were absent from samples.

(a)

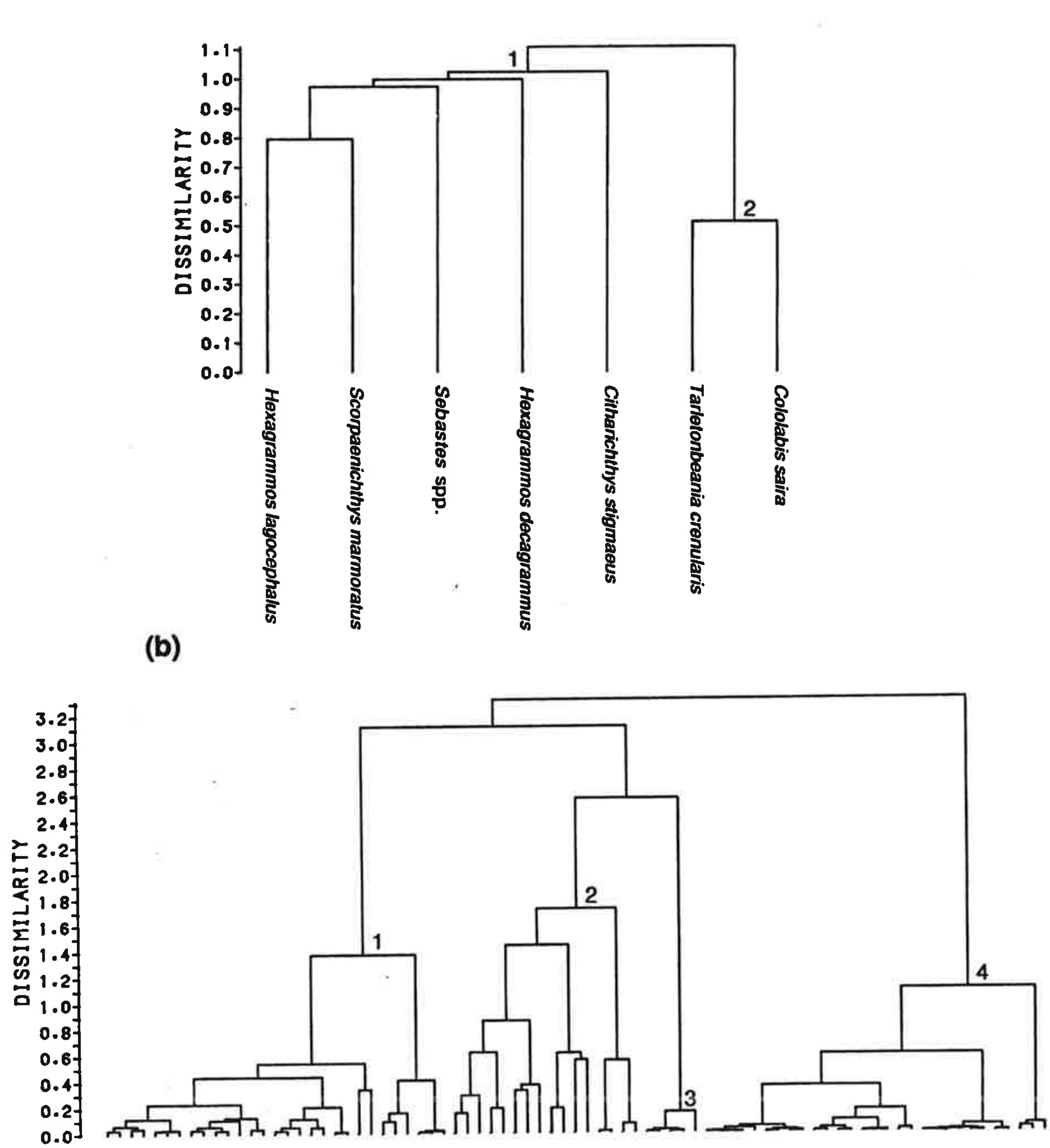


Figure 143. Dendrograms showing (a) species groups and (b) station groups for dominant taxa of larvae in neuston, cruise MF83.

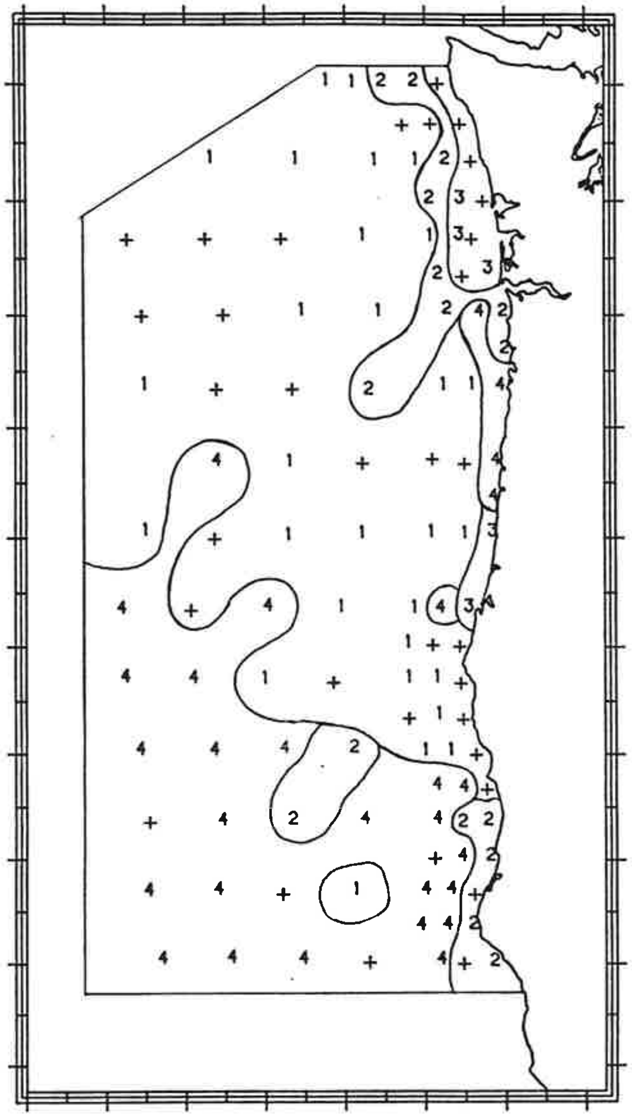


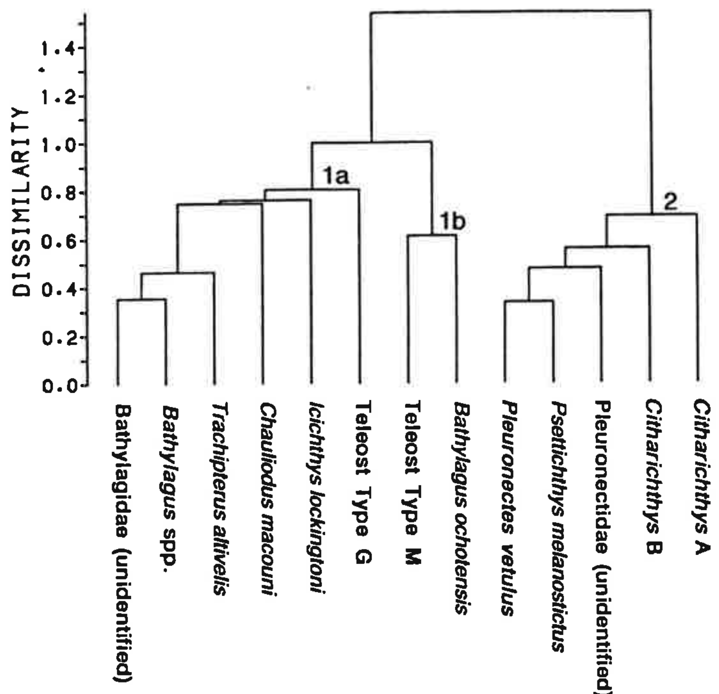
Figure 144. Distribution of station groups for dominant taxa of larvae in neuston, cruise MF83.
+ = stations where larvae were absent from samples.

Table 59.

Two–way coincidence table resulting from numerical classification of larval abundance data from neuston collections taken during cruise MF83, November 1983. Mean abundance in station groups expressed as numbers/1000m^3.

	STATION GROUPS			
SPECIES GROUPS	1	2	3	4
1 *Hexagrammos lagocephalus*	0.0	8.5	0.0	0.0
Scorpaenichthys marmoratus	0.0	41.2	0.0	0.0
Sebastes spp.	0.0	3.0	0.0	0.0
Hexagrammos decagrammus	0.4	0.7	14.0	0.0
Citharichthys stigmaeus	0.0	0.0	0.0	1.3
2 *Tarletonbeania crenularis*	95.6	3.1	0.0	0.0
Cololabis saira	31.7	15.4	0.0	32.9
TOTAL FISH LARVAE	128.1	52.9	14.0	35.0

(a)



(b)

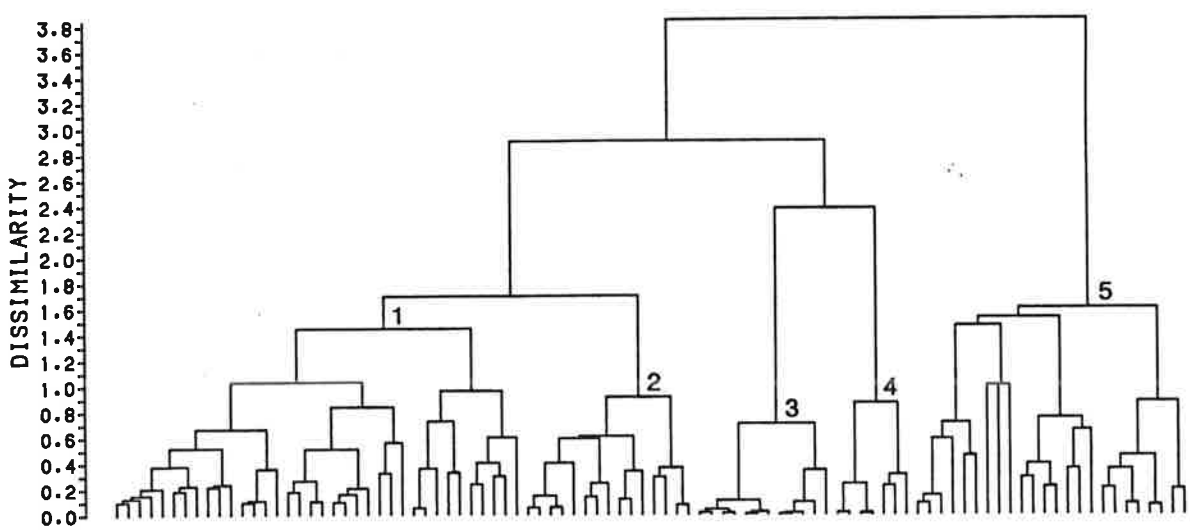


Figure 145. Dendrograms showing (a) species groups and (b) station groups for dominant taxa of eggs in bongo samples, cruise MF83.

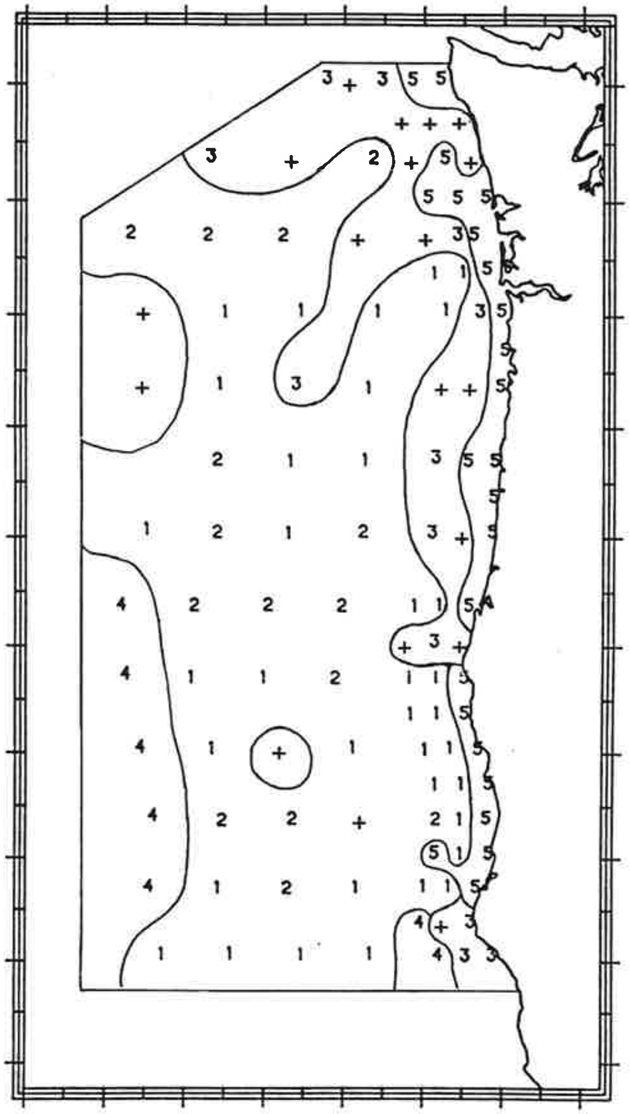


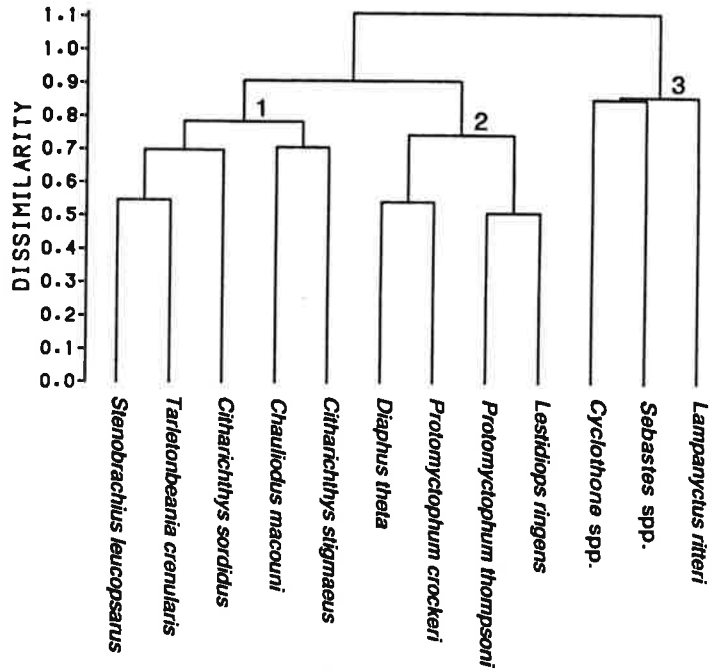
Figure 146. Distribution of station groups for dominant taxa of eggs in bongo samples, cruise MF83.
+ = stations where eggs were absent from samples.

Table 60.

Two–way coincidence table resulting from numerical classification of egg abundance data from bongo collections taken during cruise MF83, November 1983. Mean abundance in station groups expressed as numbers/10m^2.

SPECIES GROUPS		STATION GROUPS				
		1	2	3	4	5
1a	Bathylagidae (unidentified)	16.0	11.0	0.0	0.0	0.3
	Bathylagus spp.	11.9	5.0	0.0	0.0	0.0
	Trachipterus altivelis	8.4	14.1	9.5	9.3	0.0
	Chauliodus macouni	0.8	8.5	0.0	0.8	0.0
	Icichthys lockingtoni	3.4	1.2	0.3	0.8	0.0
	Teleost Type G	5.5	0.4	0.0	25.6	0.2
1b	Teleost Type M	2.9	0.4	0.0	0.0	0.3
	Bathylagus ochotensis	2.0	0.0	0.0	0.0	0.3
2	*Pleuronectes vetulus*	0.1	0.0	0.0	0.0	5.4
	Psettichthys melanostictus	0.1	0.0	0.0	0.0	4.1
	Pleuronectidae (unidentified)	0.0	0.0	0.0	0.0	22.7
	Citharichthys B	0.0	0.0	0.0	0.0	7.9
	Citharichthys A	0.3	0.0	0.0	0.0	14.5
	TOTAL FISH EGGS	52.5	41.3	10.2	36.5	50.2

(a)



(b)

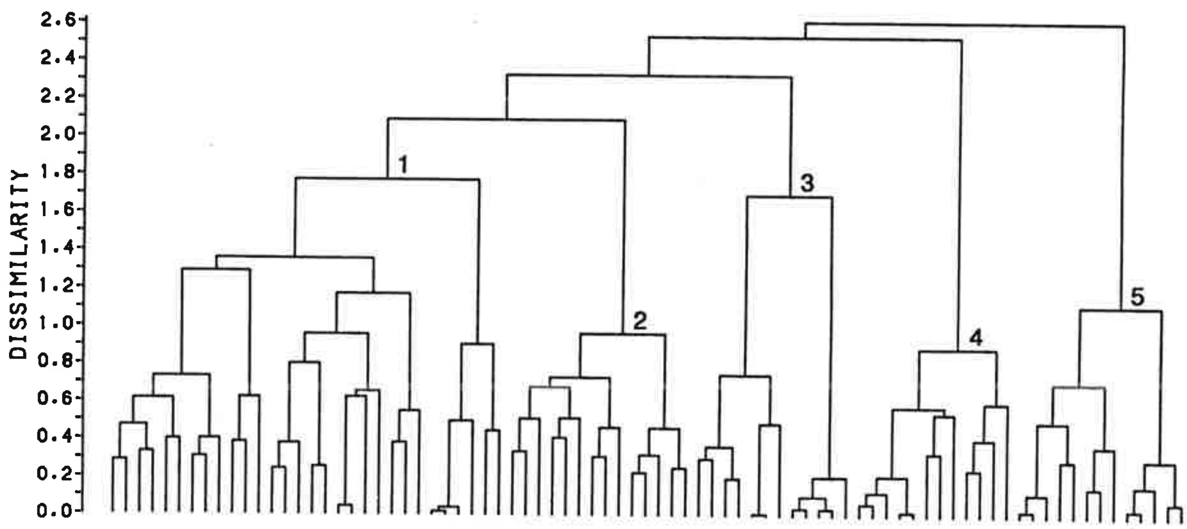


Figure 147. Dendrograms showing (a) species groups and (b) station groups for dominant taxa of larvae in bongo samples, cruise MF83.

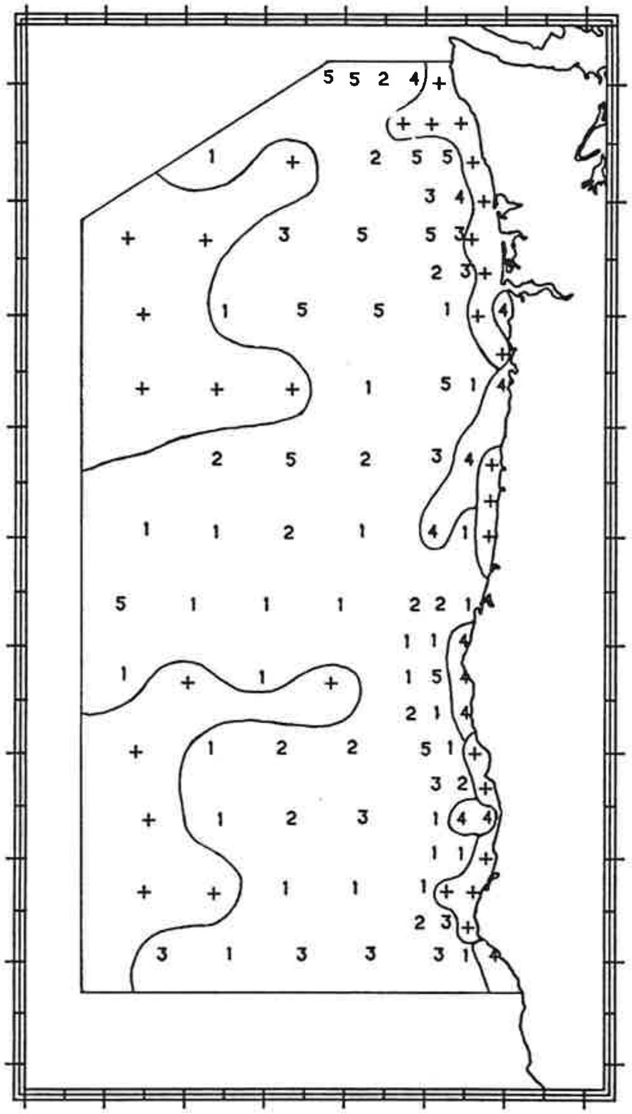


Table 61.

Two–way coincidence table resulting from numerical classification of larval abundance data from bongo collections taken during cruise MF83, November 1983. Mean abundance in station groups expressed as numbers/10m^2.

SPECIES GROUPS		STATION GROUPS 1	2	3	4	5
1	*Stenobrachius leucopsarus*	1.6	2.7	1.1	1.6	18.4
	Tarletonbeania crenularis	3.5	4.5	0.0	0.0	4.9
	Citharichthys spp.	1.3	8.6	0.0	0.0	0.4
	Chauliodus macouni	1.4	1.9	3.9	0.0	0.0
	Citharichthys stigmaeus	2.6	4.0	5.0	1.8	0.0
2	*Diaphus theta*	1.9	0.0	0.0	0.0	1.9
	Protomyctophum crockeri	5.0	0.8	0.0	0.0	2.9
	Protomyctophum thompsoni	2.2	0.4	0.0	0.0	0.0
	Lestidiops ringens	3.6	0.9	0.8	0.0	0.8
3	*Cyclothone* spp.	0.9	0.0	0.0	0.9	0.0
	Sebastes spp.	2.3	2.4	0.0	7.7	0.0
	Lampanyctus ritteri	0.5	0.5	0.0	0.4	0.4
	TOTAL FISH LARVAE	32.4	29.6	12.5	16.0	29.7

Figure 148. Distribution of station groups for dominant taxa of larvae in bongo samples, cruise MF83. + = stations where larvae were absent from samples.

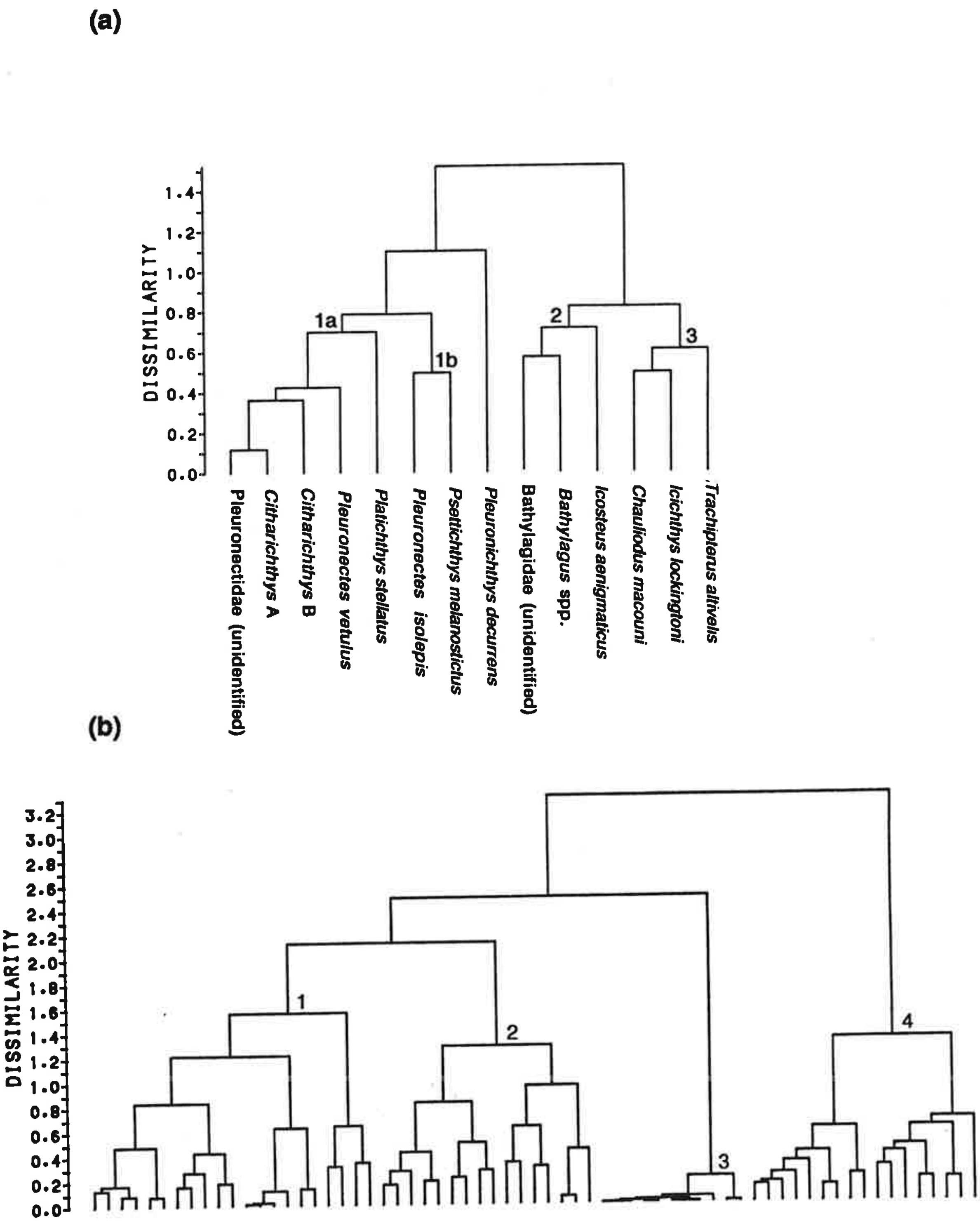


Figure 149. Dendrograms showing (a) species groups and (b) station groups for dominant taxa of eggs in neuston, cruise MF87.

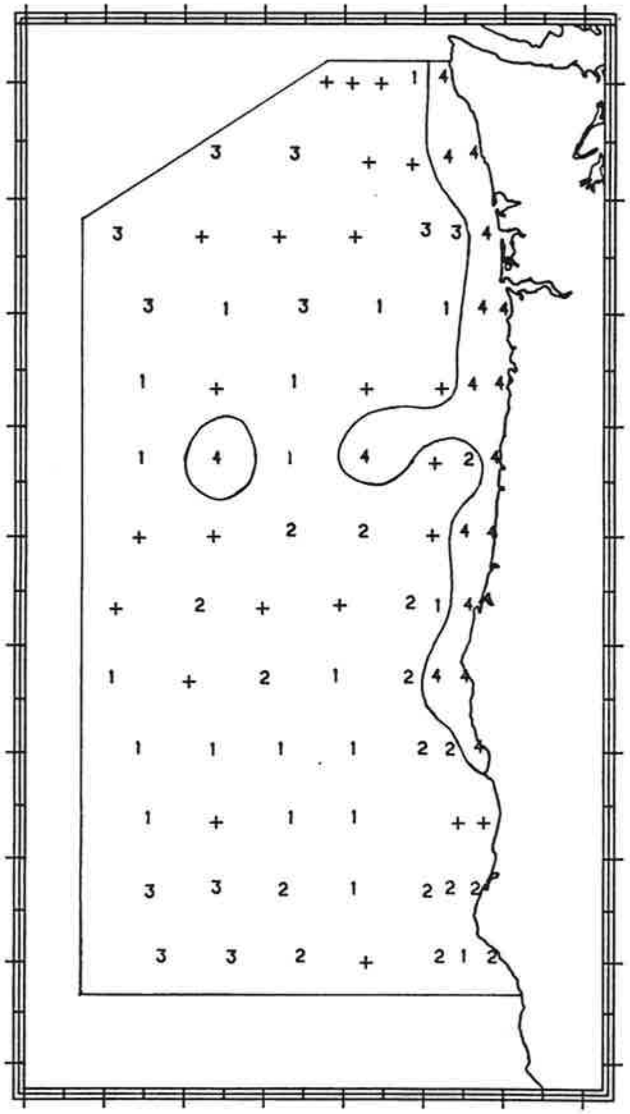


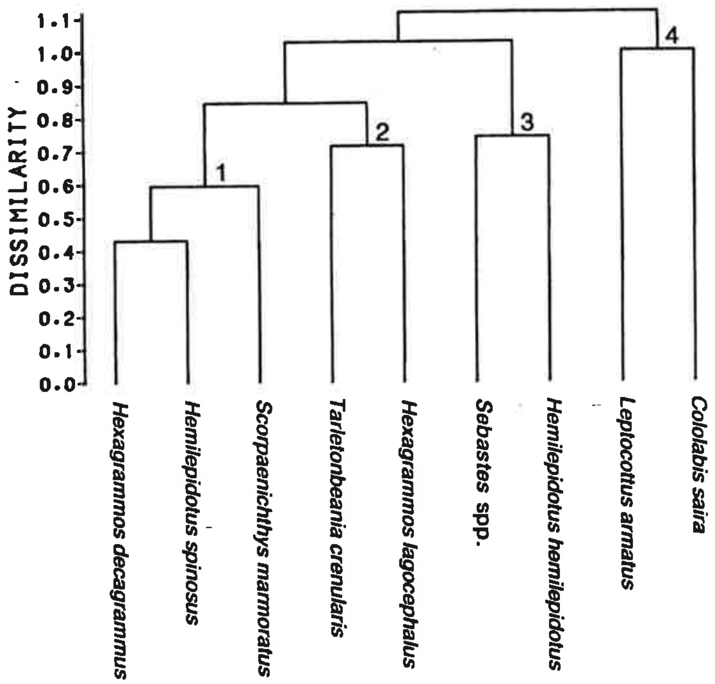
Figure 150. Distribution of station groups for dominant taxa of eggs in neuston, cruise MF87.
+ = stations where eggs were absent from samples.

Table 62.

Two–way coincidence table resulting from numerical classification of egg abundance data from neuston collections taken during cruise MF87, January 1987. Mean abundance in station groups expressed as numbers/1000m^3.

SPECIES GROUPS		STATION GROUPS 1	2	3	4
1a	Pleuronectidae (unidentified)	0.0	0.0	0.0	3144.7
	Citharichthys A	0.0	1.1	0.0	5515.1
	Citharichthys B	0.0	0.0	0.0	376.7
	Pleuronectes vetulus	0.0	0.0	0.0	66.6
	Platichthys stellatus	0.0	0.0	0.0	37.8
1b	*Pleuronectes isolepis*	0.0	0.0	0.0	12.3
	Psettichthys melanostictus	0.0	0.0	0.0	9.5
	Pleuronichthys decurrens	0.0	3.3	0.0	5.4
2	Bathylagidae (unidentified)	12.5	14.6	0.0	0.0
	Bathylagus spp.	7.7	0.0	0.0	0.0
	Icosteus aenigmaticus	6.6	16.0	0.0	0.0
3	*Chauliodus macouni*	24.9	0.0	0.0	2.0
	Icichthys lockingtoni	54.9	29.8	0.0	0.0
	Trachipterus altivelis	29.4	18.9	20.8	9.3
	TOTAL FISH EGGS	139.3	87.4	22.2	9180.5

(a)



(b)

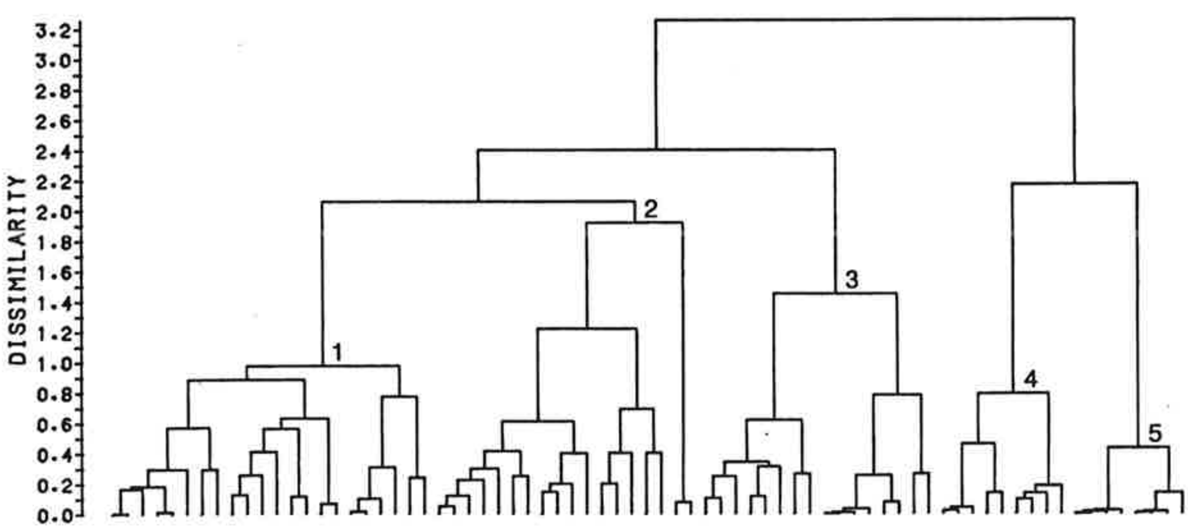


Figure 151. Dendrograms showing (a) species groups and (b) station groups for dominant taxa of larvae in neuston, cruise MF87.

Table 63.

Two–way coincidence table resulting from numerical classification of larval abundance data from neuston collections taken during cruise MF87, January 1987. Mean abundance in station groups expressed as numbers/1000m^3.

SPECIES GROUPS	STATION GROUPS 1	2	3	4	5
1 *Hexagrammos decagrammus*	132.6	156.9	63.3	0.0	0.0
Hemilepidotus spinosus	10.5	681.4	102.0	0.0	0.0
Scorpaenichthys marmoratus	1.6	33.4	3.2	0.0	0.0
2 *Tarletonbeania crenularis*	0.0	20.9	80.8	95.1	0.0
Hexagrammos lagocephalus	8.3	6.0	36.0	0.0	0.0
3 *Sebastes* spp.	2.3	6.6	0.0	0.0	0.0
Hemilepidotus hemilepidotus	2.5	13.8	0.0	0.0	0.0
4 *Leptocottus armatus*	5.7	0.9	0.0	0.0	0.0
Cololabis saira	2.5	0.0	3.3	28.2	46.5
TOTAL FISH LARVAE	166.8	946.5	289.7	123.3	46.5

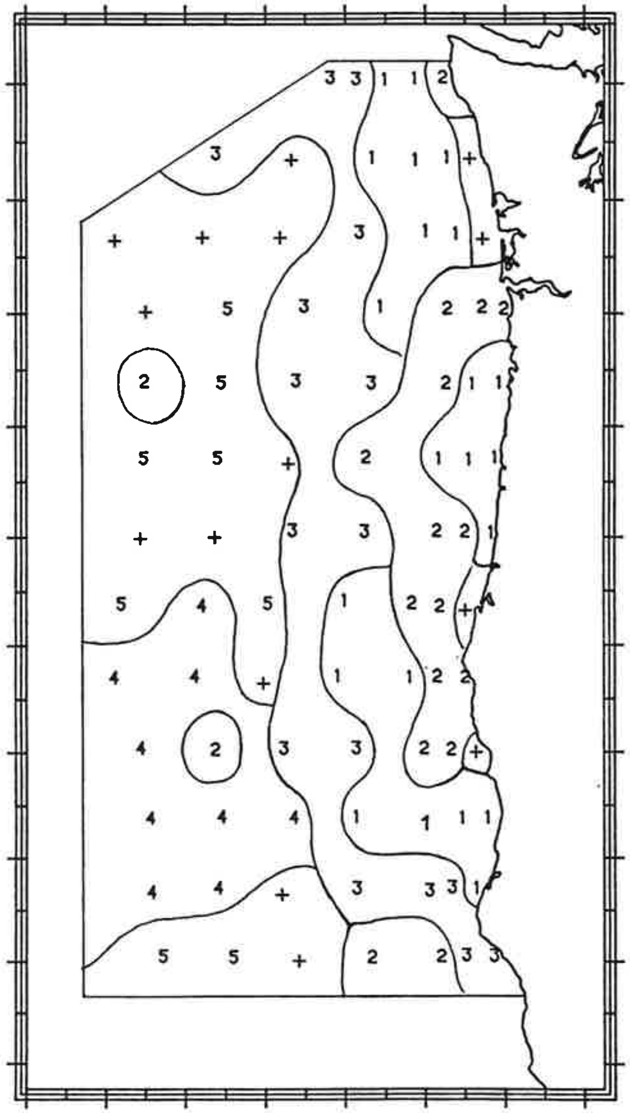


Figure 152. Distribution of station groups for dominant taxa of larvae in neuston, cruise MF87.
+ = stations where larvae were absent from samples.

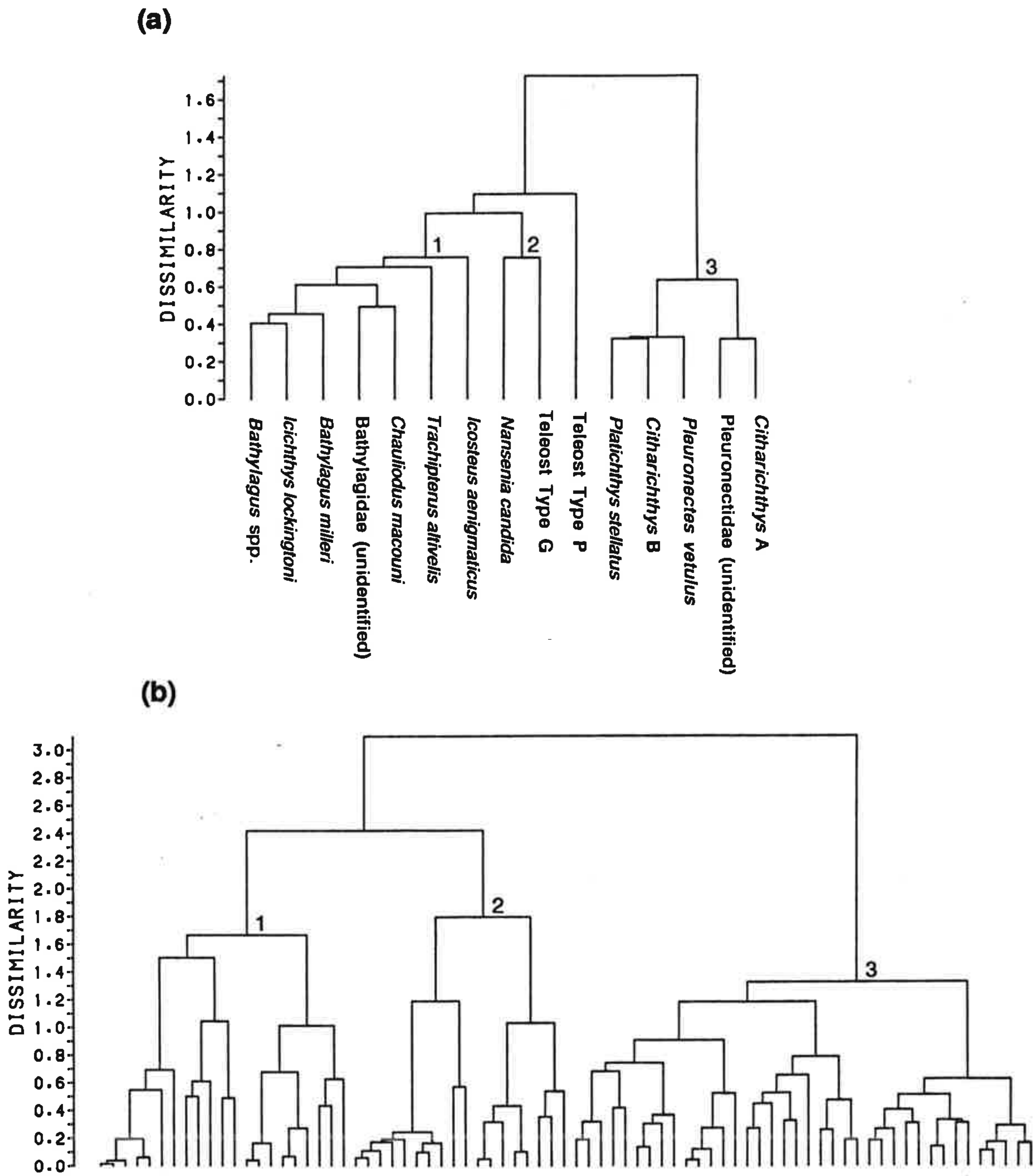


Figure 153. Dendrograms showing (a) species groups and (b) station groups for dominant taxa of eggs in bongo samples, cruise MF87.

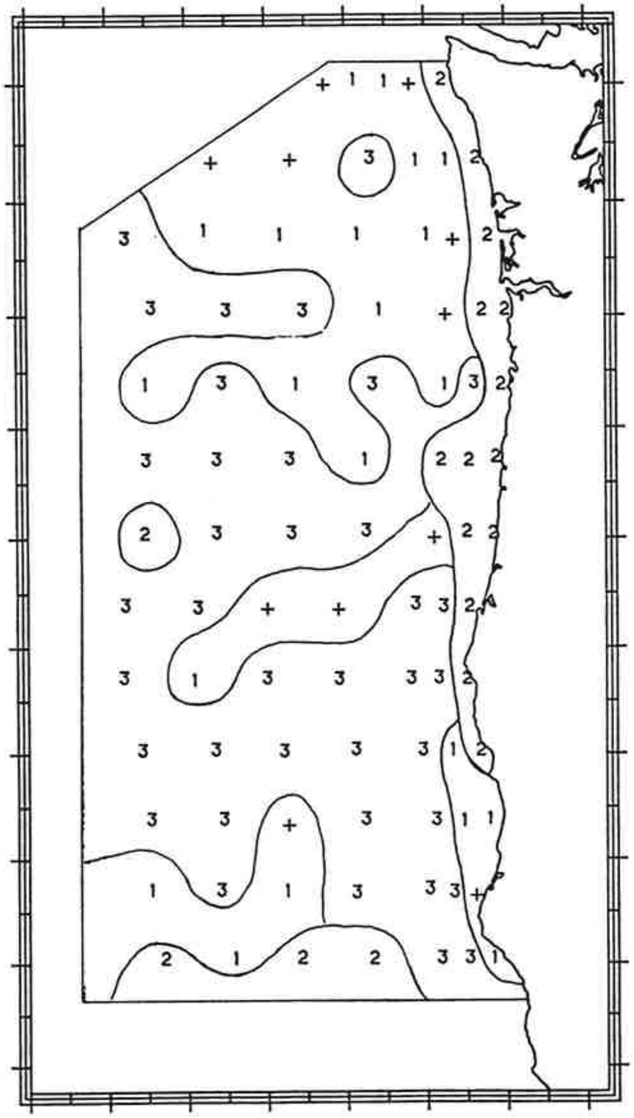


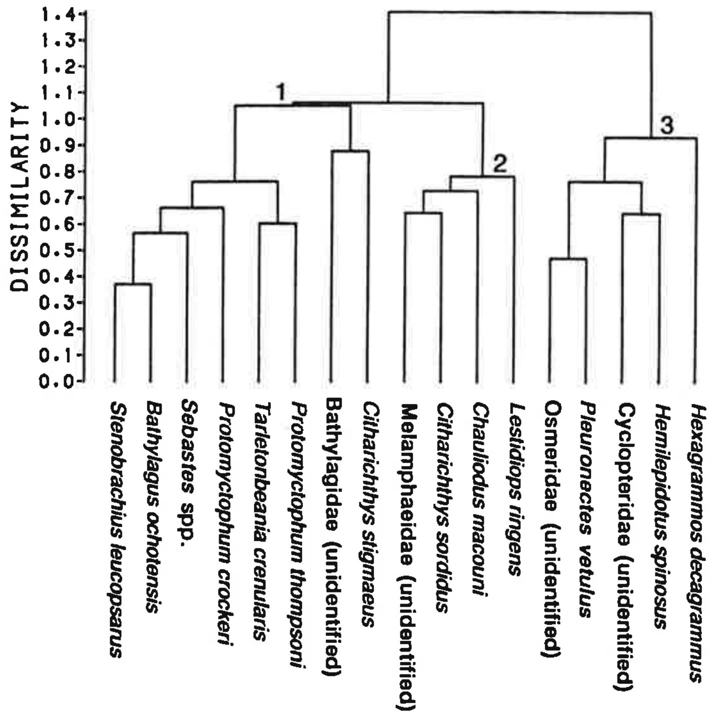
Table 64.

Two–way coincidence table resulting from numerical classification of egg abundance data from bongo collections taken during cruise MF87, January 1987. Mean abundance in station groups expressed as numbers/10m^2.

	STATION GROUPS		
SPECIES GROUPS	1	2	3
1 *Bathylagus* spp.	1.6	0.0	9.4
Icichthys lockingtoni	0.6	1.4	18.0
Bathylagus milleri	0.7	0.5	9.8
Bathylagidae (unidentified)	0.0	3.6	86.9
Chauliodus macouni	5.0	0.5	9.1
Trachipterus altivelis	5.9	0.0	6.0
Icosteus aenigmaticus	1.5	0.0	7.8
2 *Nansenia candida*	0.0	0.5	1.7
Teleost Type G	0.3	0.0	3.2
Teleost Type P	2.6	0.0	0.5
3 *Platichthys stellatus*	0.0	9.0	0.0
Citharichthys B	0.0	22.8	0.0
Pleuronectes vetulus	0.0	13.2	0.0
Pleuronectidae (unidentified)	0.3	287.7	0.4
Citharichthys A	0.7	226.1	0.0
TOTAL FISH EGGS	19.4	571.1	154.0

Figure 154. Distribution of station groups for dominant taxa of eggs in bongo samples, cruise MF87.
+ = stations where eggs were absent from samples.

(a)



(b)

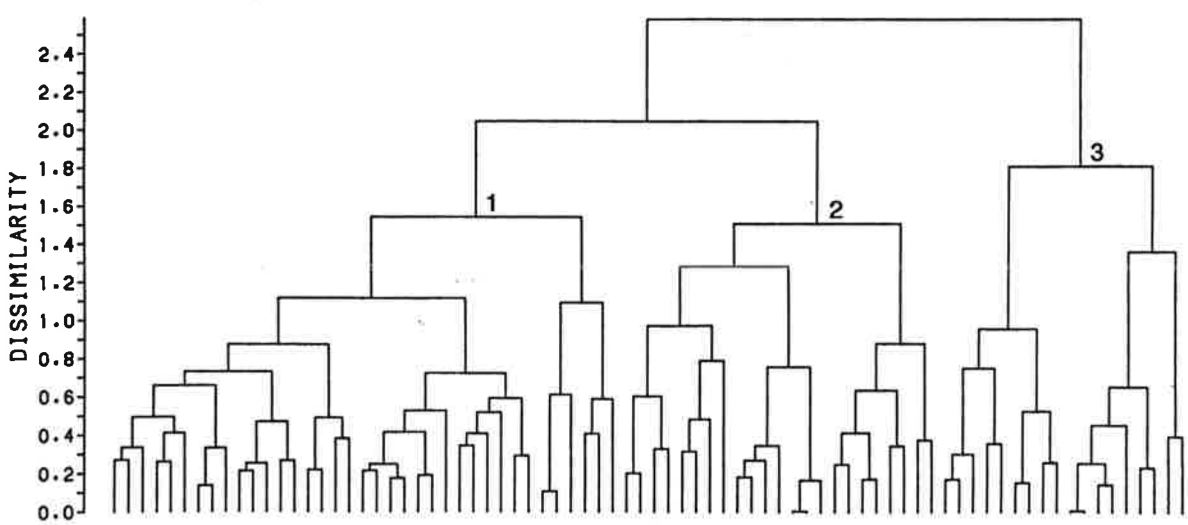


Figure 155. Dendrograms showing (a) species groups and (b) station groups for dominant taxa of larvae in bongo samples, cruise MF87.

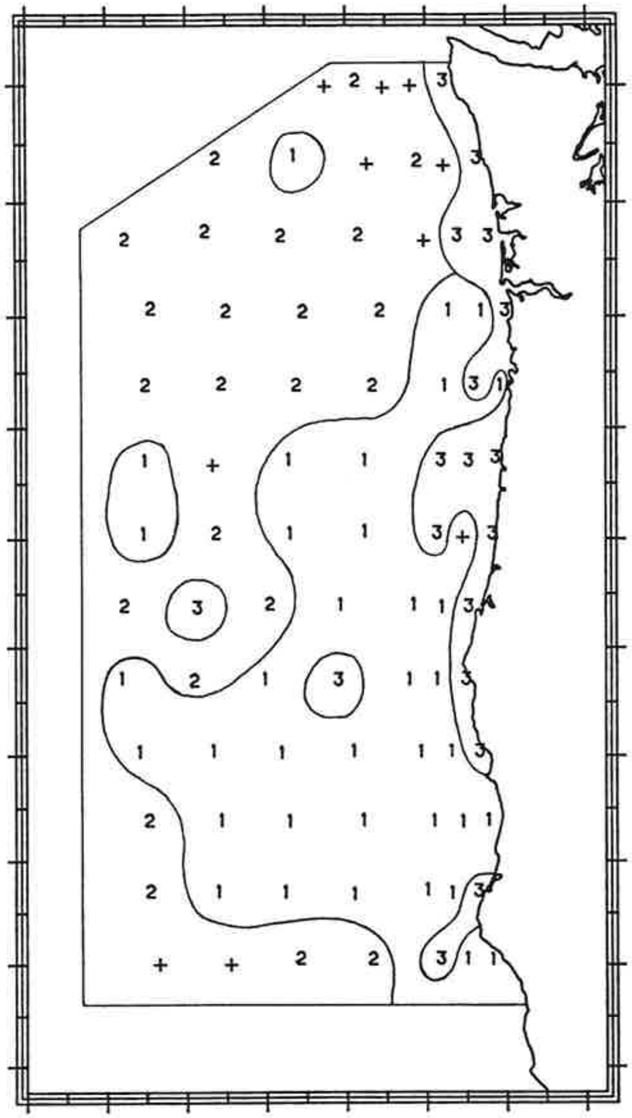


Figure 156. Distribution of station groups for dominant taxa of larvae in bongo samples, cruise MF87.
+ = stations where larvae were absent from samples.

Table 65.
Two–way coincidence table resulting from numerical classification of larval abundance data from bongo collections taken during cruise MF87, January 1987. Mean abundance in station groups expressed as numbers/10m^2.

SPECIES GROUPS	STATION GROUPS 1	2	3
1 *Stenobrachius leucopsarus*	19.8	3.1	0.0
Bathylagus ochotensis	18.6	2.6	0.5
Sebastes spp.	55.9	2.5	26.9
Protomyctophum crockeri	7.2	3.1	0.5
Tarletonbeania crenularis	7.7	16.3	0.0
Protomyctophum thompsoni	2.9	7.2	0.0
2 Bathylagidae (unidentified)	2.8	1.2	0.0
Citharichthys stigmaeus	1.5	0.0	1.8
Melamphaeidae (unidentified)	0.2	1.1	0.0
Citharichthys sordidus	1.3	1.2	0.0
Chauliodus macouni	1.3	2.5	0.0
Lestidiops ringens	1.2	0.6	0.0
3 Osmeridae (unidentified)	0.4	0.0	61.2
Pleuronectes vetulus	0.4	0.0	35.3
Cyclopteridae (unidentified)	0.8	0.0	2.4
Hemilepidotus spinosus	1.6	0.0	3.0
Hexagrammos decagrammus	0.2	0.0	1.8
TOTAL FISH LARVAE	128.8	43.4	141.9

Table 66. West coast ichthyoplankton assemblages.
Based on eggs and larvae taken in subsurface samples and eggs taken in neuston samples.

	ASSEMBLAGES			
SEASON	COASTAL	SLOPE/TRANSITIONAL	COLUMBIA RIVER PLUME	OCEANIC
SPRING	* Engraulis mordax * Osmeridae Sebastes spp. * Citharichthys spp. (eggs) * Citharichthys sordidus * Citharichthys stigmaeus * Pleuronectidae (unidentified) Errex zachirus * Pleuronectes isolepis Eopsetta exilis Microstomus pacificus * Pleuronectes vetulus * Pleuronichthys decurrens * Psettichthys melanostictus	Engraulis mordax Bathylagus ochotensis Bathylagus pacificus Myctophidae (unidentified) Stenobrachius leucopsarus Tarletonbeania crenularis Trachipterus altivelis * Sebastes spp. * Sebastolobus spp. Icichthys lockingtoni Citharichthys spp. (eggs) * Errex zachirus * Eopsetta exilis * Microstomus pacificus		Bathylagidae (unidentified) N Bathylagus pacificus N Protomyctophum thompsoni N Trachipterus altivelis N Sebastes spp. N Icosteus aenigmaticus N Eopsetta exilis S Nansenia candida S Bathylagus ochotensis S Chauliodus macouni S Myctophidae (unidentified) S Diaphus theta S Lampanyctus spp. S Protomyctophum crockeri S Stenobrachius leucopsarus S Tarletonbeania crenularis Icichthys lockingtoni
SUMMER	Engraulis mordax Sebastes spp. * Artedius harringtoni Cyclopteridae * Citharichthys spp. (eggs) * Pleuronectidae (unidentified) Eopsetta exilis * Psettichthys melanostictus	Chauliodus macouni Diaphus theta Stenobrachius leucopsarus Tarletonbeania crenularis * Cololabis saira * Sebastes spp. Citharichthys spp. (eggs) * Pleuronectidae (unidentified) * Eopsetta exilis * Microstomus pacificus	* Engraulis mordax * Stenobrachius leucopsarus * Tarletonbeania crenularis Sebastes spp.	Argentinidae (unidentified) Bathylagidae (unidentified) Tactostoma macropus Chauliodus macouni Diaphus theta Lampanyctus spp. Protomyctophum thompsoni Stenobrachius leucopsarus Tarletonbeania crenularis Sebastes spp. Icichthys lockingtoni
AUTUMN	* Sebastes spp. * Citharichthys spp. (eggs) * Citharichthys sordidus * Citharichthys stigmaeus * Pleuronectidae (unidentified) * Pleuronectes vetulus * Pleuronichthys decurrens * Psettichthys melanostictus			Engraulis mordax Bathylagidae (unidentified) Bathylagus ochotensis Chauliodus macouni Protomyctophum crockeri Protomyctophum thompsoni Tarletonbeania crenularis Trachipterus altivelis Lestidiops ringens Icichthys lockingtoni Citharichthys sordidus Citharichthys stigmaeus
WINTER	* Osmeridae Sebastes spp. * Cyclopteridae * Hemilepidotus spinosus * Hexagrammos decagrammus * Citharichthys spp. (eggs) * Pleuronectidae (unidentified) * Pleuronectes isolepis * Pleuronectes vetulus * Platichthys stellatus * Pleuronichthys decurrens * Psettichthys melanostictus			Chauliodus macouni N Protomyctophum thompsoni N Tarletonbeania crenularis S Bathylagidae (unidentified) S Bathylagus ochotensis S Protomyctophum crockeri S Stenobrachius leucopsarus S Lestidiops ringens Trachipterus altivelis S Sebastes spp. S Icosteus aenigmaticus S Icichthys lockingtoni Citharichthys sordidus S Citharichthys stigmaeus

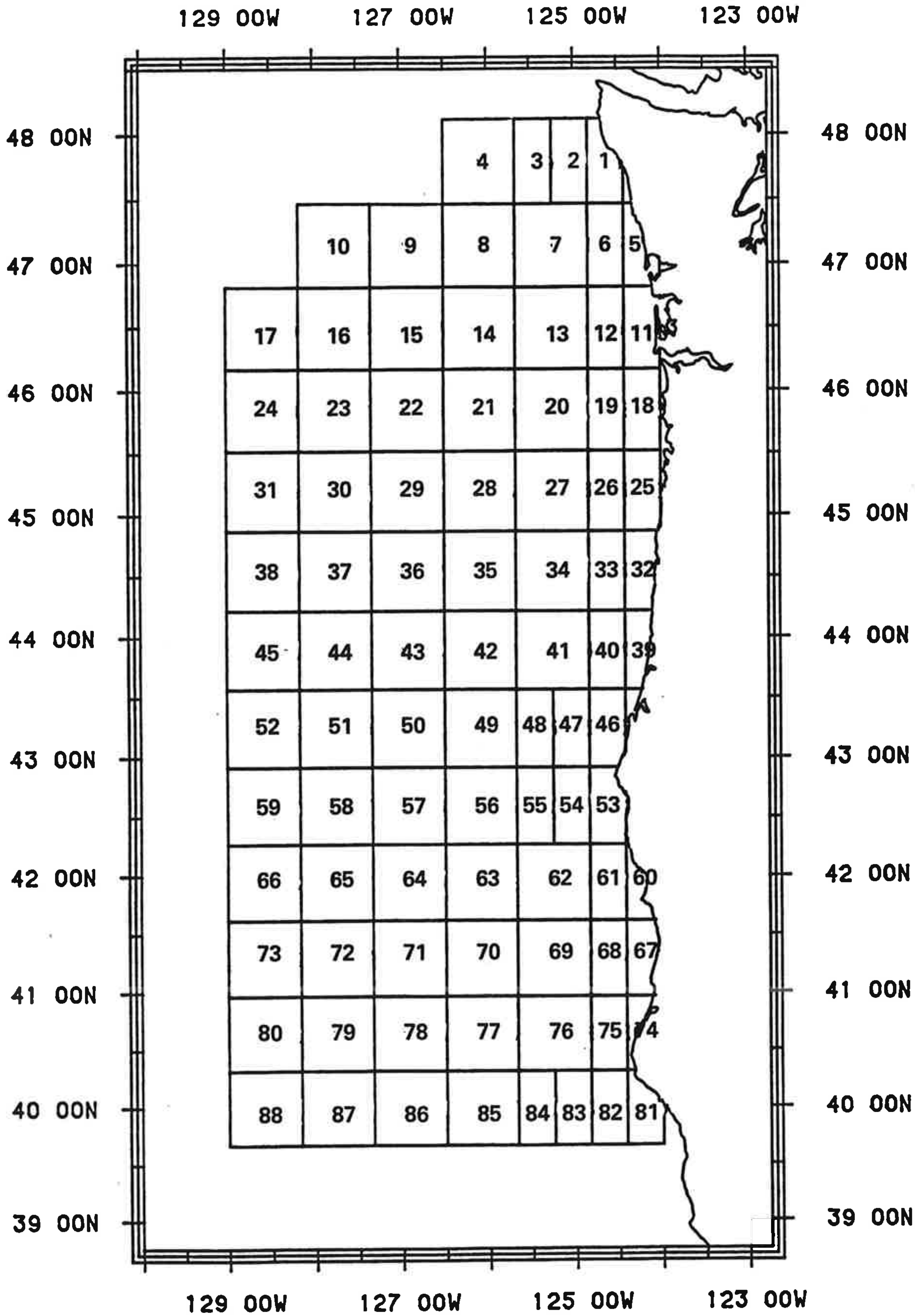
* = definitive taxa for coastal, slope and plume assemblages.

N = most abundant in northern sector of oceanic zone.
S = most abundant in southern sector of oceanic zone.

APPENDIX

Interpretation of species codes in Appendix Tables 1-20.

CODE	TAXA/SPECIES
148	Osmeridae (unidentified)
150	Bathylagidae (unidentified)
151	*Bathylagus* spp.
152	*Bathylagus milleri*
153	*Bathylagus pacificus*
156	*Chauliodus macouni*
157	Myctophidae (unidentified)
158	*Diaphus theta*
160	*Stenobrachius leucopsarus*
162	*Tarletonbeania crenularis*
163	*Protomyctophum crockeri*
164	*Protomyctophum thompsoni*
171	*Sebastes* spp.
177	*Hexagrammos decagrammus*
178	*Hexagrammos lagocephalus*
181	*Ophiodon elongatus*
183	*Anoplopoma fimbria*
186	*Artedius harringtoni*
194	*Hemilepidotus hemilepidotus*
199	*Leptocottus armatus*
213	Cyclopteridae (unidentified)
220	*Ronquilus jordani*
229	*Cryptacanthodes aleutensis*
233	*Ammodytes hexapterus*
234	*Citharichthys stigmaeus*
235	Pleuronectidae (unidentified)
237	*Errex zachirus*
239	*Pleuronectes isolepis*
242	*Eopsetta exilis*
243	*Microstomus pacificus*
244	*Pleuronectes vetulus*
245	*Platichthys stellatus*
247	*Psettichthys melanostictus*
261	Teleost Type M
263	*Citharichthys* B (eggs)
	Citharichthys spp. (larvae)
270	Scorpaenidae (unidentified)
271	*Bathylagus ochotensis*
272	Melamphaeidae (unidentified)
273	*Scorpaenichthys marmoratus*
274	*Icichthys lockingtoni*
275	*Lampanyctus ritteri*
276	*Nansenia candida*
277	*Lampanyctus* spp.
278	*Tactostoma macropus*
279	*Citharichthys sordidus*
281	*Hemilepidotus spinosus*
282	*Sebastolobus* spp.
283	*Icosteus aenigmaticus*
285	*Trachipterus altivelis*
287	*Cololabis saira*
288	*Lestidiops ringens*
290	*Engraulis mordax*
292	*Cyclothone* spp.
293	*Citharichthys* A (eggs)
	Citharichthys spp. (larvae)
298	*Pleuronichthys coenosus*
299	*Pleuronichthys decurrens*
300	Argentinidae (unidentified)
305	*Lampanyctus regalis*
322	Teleost Type G
325	Teleost Type F
339	Teleost Type P



Appendix Figure 1.
Grid of squares and rectangles for which mean abundance of dominant ichthyoplankton taxa in each division were calculated, based on data combined from the six spring cruises.

Appendix Table 1.

Two-way coincidence table of species abundance (no./1000m³) among station groups for eggs in neuston samples, six spring cruises combined. Numbers in species groups are species codes. See list accompanying this table for interpretation.

STATION GROUPS	(grid squares)	SPECIES GROUPS 1: 235	293	237	243	242	282	2: 239	244	247	263	290	299	3: 274	285	283	156
1	66	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.8	13.8	0.0	3.7
	72	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.6	17.4	0.0	3.6
	73	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1	20.2	0.0	1.4
	86	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.6	42.9	0.0	6.2
	36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.7	64.0	3.3	1.6
	45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.2	74.5	0.0	1.8
	57	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.1	49.8	1.5	2.4
	52	0.0	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	10.9	0.0	2.6
	80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	6.9	0.0	4.3
	50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.4	0.0	0.0
	79	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.6	0.0	1.7
	58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	64.9	0.0	9.4
	21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	3.6	0.0	0.0
	87	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	6.4	0.0	0.0
	88	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.4	0.0	0.0
2	56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.1	42.1	0.0	0.0
	85	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.3	36.2	0.0	0.0
	48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.0	27.1	0.0	0.0
	55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.7	12.2	0.0	0.0
	77	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.1	19.6	0.0	0.0
	63	0.0	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.2	9.0	0.0	0.0
	59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	26.5	0.0	0.0
	71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.3	35.1	0.0	0.0
	64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.6	15.0	0.0	0.0
	65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.6	13.0	0.0	0.0
	78	0.0	0.0	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	44.9	0.0	0.0
	29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.7	191.9	2.3	0.0
	51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.4	51.2	1.7	0.0
	49	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	22.5	92.9	0.0	0.0
	70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	120.7	92.0	0.0	0.0
3	15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.5	31.7	35.0	0.0
	17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.7	11.8	38.0	0.0
	16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.6	25.2	101.2	0.0
	9	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.6	43.2	60.9	0.0
	8	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.3	25.3	45.1	0.0
	10	0.0	0.0	0.0	4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.2	10.8	33.4	0.0
	14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.6	37.6	17.2	0.0
	20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.0	42.1	21.7	0.0
	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1	80.9	15.9	0.0
	24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.1	183.3	32.0	0.0
	42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.9	147.3	12.2	0.0
	35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	73.3	237.6	12.2	10.8
	44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.7	200.4	14.6	3.7
	38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.8	209.9	7.3	2.2
	22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.4	79.7	9.8	2.9
	28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.2	58.7	4.2	4.2
	23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.3	511.2	71.6	8.8
	43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	58.5	432.7	1.8	4.8
	31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	162.0	42.5	6.0
	37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	47.2	15.5	1.6
4	19	0.0	3.7	7.0	256.6	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.8	28.6	2.8	0.0
	47	0.0	6.0	11.8	658.6	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	58.5	44.5	0.0	0.0
	54	0.0	0.0	6.8	62.3	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.8	16.2	8.0	0.0	0.9
	62	0.0	0.0	5.6	57.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.7	20.1	1.0	1.0
	12	0.0	22.9	15.9	33.3	4.8	0.0	0.0	0.0	0.0	0.0	26.4	0.0	3.0	4.0	6.2	0.0
	26	0.0	35.8	3.6	35.4	0.6	0.0	0.0	0.0	0.0	2.5	9.6	0.8	23.0	12.4	5.4	0.0
	75	0.6	42.8	14.3	111.4	2.9	0.0	0.0	0.0	1.0	2.0	0.0	10.1	11.7	10.5	0.0	0.7
	4	0.0	2.2	1.1	185.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	34.2	55.2	0.0
	7	0.0	1.5	35.8	140.4	12.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	4.2	12.8	0.0
	3	1.2	0.0	6.5	107.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.1	14.0	1.3
	13	0.0	7.8	10.5	140.8	0.0	148.6	0.0	0.0	0.0	0.0	0.0	0.0	177.8	54.2	19.6	1.1
	69	0.0	1.7	8.4	75.3	2.7	7.6	0.0	0.0	0.0	0.0	0.0	0.0	225.8	29.5	0.0	1.7
	76	0.0	6.5	9.5	6.7	6.9	1.6	0.0	0.0	0.0	0.0	0.0	0.0	153.5	112.5	2.3	0.0
	61	2.8	1133.6	1.9	21.5	16.7	4.5	0.0	0.0	0.0	0.0	0.0	1.1	838.8	150.2	6.6	5.8
	41	2.6	0.0	28.1	214.5	0.0	4849.9	0.0	0.0	0.0	0.0	0.0	0.0	221.7	16.5	0.0	0.0
	81	0.0	0.0	107.8	2.0	54.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.1	0.0	0.0
	68	0.8	4.5	3.7	50.2	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	1.9	0.0	0.0
	83	0.0	3.2	0.0	30.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.6	3.7	0.0	0.0
	27	0.0	0.0	0.0	22.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.7	0.0	0.0	0.0
	34	0.0	0.0	0.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.2	11.1	1.5	0.0
	82	0.0	11.1	0.0	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.5	0.0	0.0	0.0
	84	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.5	0.0	0.0	0.0
5	18	97.2	338.5	200.2	236.1	2.1	1.4	4.5	9.9	9.8	51.1	232.2	16.4	1.7	2.7	4.0	0.0
	25	43.0	251.5	37.2	22.5	1.2	0.0	2.4	2.7	5.2	19.8	609.1	0.8	0.8	1.6	1.4	0.0
	5	174.6	121.9	26.8	74.2	0.0	2.3	5.6	5.4	12.5	0.0	27.3	6.9	0.0	0.0	8.0	0.0
	6	75.9	79.8	43.1	23.6	12.0	0.0	0.0	0.0	5.9	0.5	858.5	0.0	0.0	0.8	0.7	0.0
	1	314.3	315.5	19.3	7.6	1.8	0.0	4.2	5.5	14.1	3.8	3.1	0.0	0.0	0.0	0.0	0.0
	11	42.6	147.0	1.2	7.6	0.0	1.1	6.2	1.2	6.4	6.4	29.9	0.0	0.0	0.0	0.0	0.0
	2	24.4	40.0	19.2	204.2	12.3	0.0	0.7	2.9	0.0	0.0	0.0	0.0	0.0	8.5	6.0	0.0
	40	9.3	205.6	107.8	82.5	7.8	27.2	0.0	0.0	0.0	1.4	0.0	0.0	4.1	23.0	6.6	0.0
	67	51.3	928.6	226.8	2.9	18.6	2.6	0.0	0.0	2.9	0.0	0.0	1.3	1.0	7.4	0.0	0.0
	74	10.4	968.4	5.2	23.7	11.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0
	53	22.8	48.4	2.6	0.0	36.6	0.0	5.7	0.0	2.9	2.2	0.0	0.0	0.0	0.0	0.0	0.0
	60	315.1	16.7	61.4	0.0	22.6	0.0	0.0	1.0	19.0	5.7	0.0	0.0	2.1	3.1	0.0	0.0
	32	38.8	1053.3	4.0	0.0	0.0	0.0	0.0	2.7	6.6	25.9	0.0	1.8	0.0	0.0	0.0	0.0
	46	2.4	157.3	1.1	3.5	1.2	15.4	0.0	0.0	0.0	15.0	0.0	1.2	0.0	0.0	0.0	0.0
	39	2.3	3458.4	12.5	0.0	136.7	1.7	0.0	0.0	0.0	17.8	0.0	0.0	19.2	1.3	0.0	0.0
	33	3.3	1533.9	2.3	2.5	0.0	0.0	0.0	0.0	0.0	0.0	135.4	7.6	0.0	0.0	0.0	0.0

Appendix Table 2.

Two-way coincidence table of species abundance (no./1000m^3) for larvae in neuston samples, six spring cruises combined. Numbers in species groups are species codes. See list accompanying Appendix Table 1 for interpretation.

STATION GROUPS	(grid squares)	SPECIES GROUPS 1					2		3		4					
		181	220	233	194	229	162	178	148	290	171	183	287	177	273	281
1	35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.6	29.4	4.6	1.5	2.6	5.0
	42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.5	42.9	12.2	2.7	9.4	0.0
	22	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0	25.0	29.2	3.0	11.7	0.0	0.0
	85	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	154.0	16.0	156.2	2.6	0.0	0.0
	63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.3	2.4	43.3	3.8	2.4	2.4
	86	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	1.7	51.9	2.5	0.0	0.0
	62	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	2.6	5.8	14.1	1.4	1.4	0.0
	69	0.0	1.7	1.3	0.0	0.0	0.0	0.0	2.5	0.0	7.7	7.0	11.0	6.5	1.7	3.4
	56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.4	16.1	20.1	0.0	0.0	11.2
	64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	28.4	24.5	0.0	0.0	6.9
	71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.9	18.0	61.9	0.0	0.0	11.9
	34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.1	49.5	15.9	3.5	4.8	51.6
	47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.1	47.1	12.9	29.8	27.3	31.6
	54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.4	6.6	18.0	2.9	3.6	34.7
	76	0.0	1.1	0.0	0.0	0.0	2.5	0.0	0.0	0.0	44.9	7.1	20.5	2.1	9.5	15.8
	14	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57.9	23.7	0.0	17.0	1.8	33.7
	10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.8	0.0	23.8	2.2	12.6
	15	0.0	0.0	0.0	0.0	0.0	0.0	2.1	0.0	0.0	0.0	54.2	0.0	7.4	2.5	25.2
	20	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	54.8	12.0	27.2	0.0	9.9
	68	1.3	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	2.7	5.3	2.4	0.0	15.2
2	2	4.6	2.9	17.7	3.8	1.4	0.0	0.0	0.0	0.0	8.0	68.4	0.0	32.5	15.0	110.0
	6	30.0	3.3	34.2	7.1	69.2	0.0	0.0	0.0	0.0	6.8	19.9	0.0	21.6	33.6	87.4
	12	7.2	8.2	95.1	1.2	2.4	0.0	0.0	0.0	0.0	3.5	51.5	4.4	80.7	14.1	20.8
	41	14.1	2.6	39.7	0.0	6.4	0.0	0.0	0.0	0.0	61.4	14.5	4.4	13.6	41.8	25.2
	7	5.8	9.5	1.4	19.2	3.4	5.6	4.5	0.0	0.0	2.8	60.0	2.6	16.3	48.3	49.0
	4	1.6	1.1	27.2	13.7	0.0	2.5	2.3	0.0	0.0	10.8	113.1	0.0	50.9	35.6	329.5
	9	0.0	0.0	11.7	13.1	0.0	0.0	0.0	0.0	2.0	7.4	93.5	0.0	15.3	8.1	138.2
	8	0.0	0.0	2.0	0.0	0.0	0.0	2.3	0.0	0.0	20.7	216.9	2.1	30.8	2.7	0.3
	13	0.0	3.8	0.0	1.4	1.4	3.3	0.0	0.0	0.0	61.4	277.8	2.0	33.2	27.4	348.4
	19	3.9	23.1	9.2	1.9	0.0	0.0	0.0	0.0	0.0	309.9	83.0	15.9	47.2	28.8	98.1
	26	1.8	3.8	0.0	0.8	0.0	0.0	0.0	0.0	0.0	92.0	66.0	16.4	17.3	9.4	77.6
	18	1.9	12.0	3.7	1.1	0.0	0.0	0.0	0.0	0.0	1.8	32.2	1.6	20.0	17.8	1.5
	25	2.2	3.6	7.6	1.4	0.0	0.0	0.0	0.0	0.0	8.7	81.0	5.1	4.2	11.9	8.2
	3	1.3	4.6	0.0	6.5	0.0	0.0	0.0	0.0	0.0	13.6	16.7	0.0	33.4	2.7	2.7
	5	0.0	2.2	11.9	0.0	2.7	0.0	0.0	0.0	0.0	0.0	24.1	0.0	2.7	17.5	2.7
	40	0.0	0.0	2.9	0.0	6.6	0.0	0.0	0.0	0.0	1.1	12.4	8.7	17.3	14.8	13.2
	1	0.0	5.9	9.5	2.4	9.2	0.0	0.0	0.0	0.0	0.0	1.8	0.0	13.7	2.0	7.4
	11	10.8	1.0	312.2	1.2	7.5	0.0	0.0	3.9	0.0	0.0	65.0	0.0	12.1	6.5	1.0
	33	0.0	9.7	0.0	4.6	0.0	0.0	0.0	0.0	50.2	2.5	32.0	37.8	32.9	14.0	3.6
	39	6.9	6.5	0.0	1.1	0.0	0.0	0.0	0.0	19.6	4.6	6.5	41.8	26.3	3.2	23.7
	46	0.0	0.0	0.0	2.8	0.8	0.0	0.0	0.0	26.3	3.4	2.3	10.5	4.0	5.8	6.1
	32	148.3	0.0	20.8	0.0	0.0	0.0	0.0	35.8	16.3	2.8	0.0	7.7	7.4	8.6	0.0
	74	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.4	4.0	0.0	0.0	0.0	11.0	0.0
	82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.8	2.8	0.0	2.4	2.8	0.0
	83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	3.7	0.0
	53	0.0	0.0	0.0	0.0	10.3	0.0	0.0	0.0	0.0	2.5	0.0	1.3	5.0	4.7	0.0
	67	12.2	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	3.0	0.0	7.9	2.4	4.6	7.6
	75	6.7	2.1	0.0	0.0	0.0	0.7	0.0	0.0	1.0	13.4	0.0	1.9	1.4	6.5	22.7
	60	5.7	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	9.4	0.0	0.0	1.0	0.0	4.0
	61	1.2	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	5.9	2.3	0.0	0.0
	81	2.0	2.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	84	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.0	4.0	0.0	0.0	0.0
	48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	128.9	7.2	0.0	0.0	0.0
	29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.0	5.3	3.7	0.0	0.0
	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	11.5	2.6	0.0	0.0	0.0
	57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	5.4	8.2	0.0	0.0	0.0
	44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.8	3.6	0.0	0.0	0.0
	36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1	17.9	11.5	0.0	0.0	0.0
	52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.9	14.8	17.1	0.0	0.0	0.0
	59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.9	36.0	16.2	0.0	0.0	0.0
	45	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	1.8	23.9	11.8	0.0	0.0	0.0
	38	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.0	7.0	95.3	3.7	0.0	0.0	0.0
	49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	211.7	10.8	0.0	0.0	0.0
	17	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	2.7	82.7	0.0	0.0	0.0	3.0
	28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	36.0	0.0	0.0	0.0	2.9
	24	0.0	0.0	0.0	0.0	0.0	0.0	5.7	0.0	0.0	2.1	131.1	0.0	0.0	0.0	0.0
	16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.2	474.2	0.0	2.6	0.0	12.8
	23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	9.4	0.0	0.0	0.0	0.0
	37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	26.0	0.0	0.0	0.0	0.0
	27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.3	0.0	0.0	0.0	0.0
5	72	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	9.3	34.5	0.0	0.0	0.0
	78	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	33.2	0.0	0.0	0.0
	73	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	53.5	0.0	0.0	0.0
	87	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	56.9	0.0	0.0	0.0
	70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.4	80.1	0.0	6.5	0.0
	88	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	86.0	0.0	2.6	0.0	0.0
	66	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.9	0.0	0.0	0.0
	80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	67.4	0.0	0.0	0.0
	55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.4	0.0	0.0	0.0
	50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.2	2.5	26.9	0.0	0.0	0.0
	65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.9	1.9	21.7	0.0	0.0	0.0
	43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.1	15.6	23.5	0.0	0.0	0.0
	79	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.0	1.7	120.8	0.0	0.0	0.0
	58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0	31.4	0.0	0.0	0.0
	77	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.2	0.0	30.6	0.0	2.4	0.0
	21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.5	3.9	0.0	0.0	0.0	0.0
	51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	34.9	3.5	9.8	0.0	0.0	0.0

Appendix Table 3.

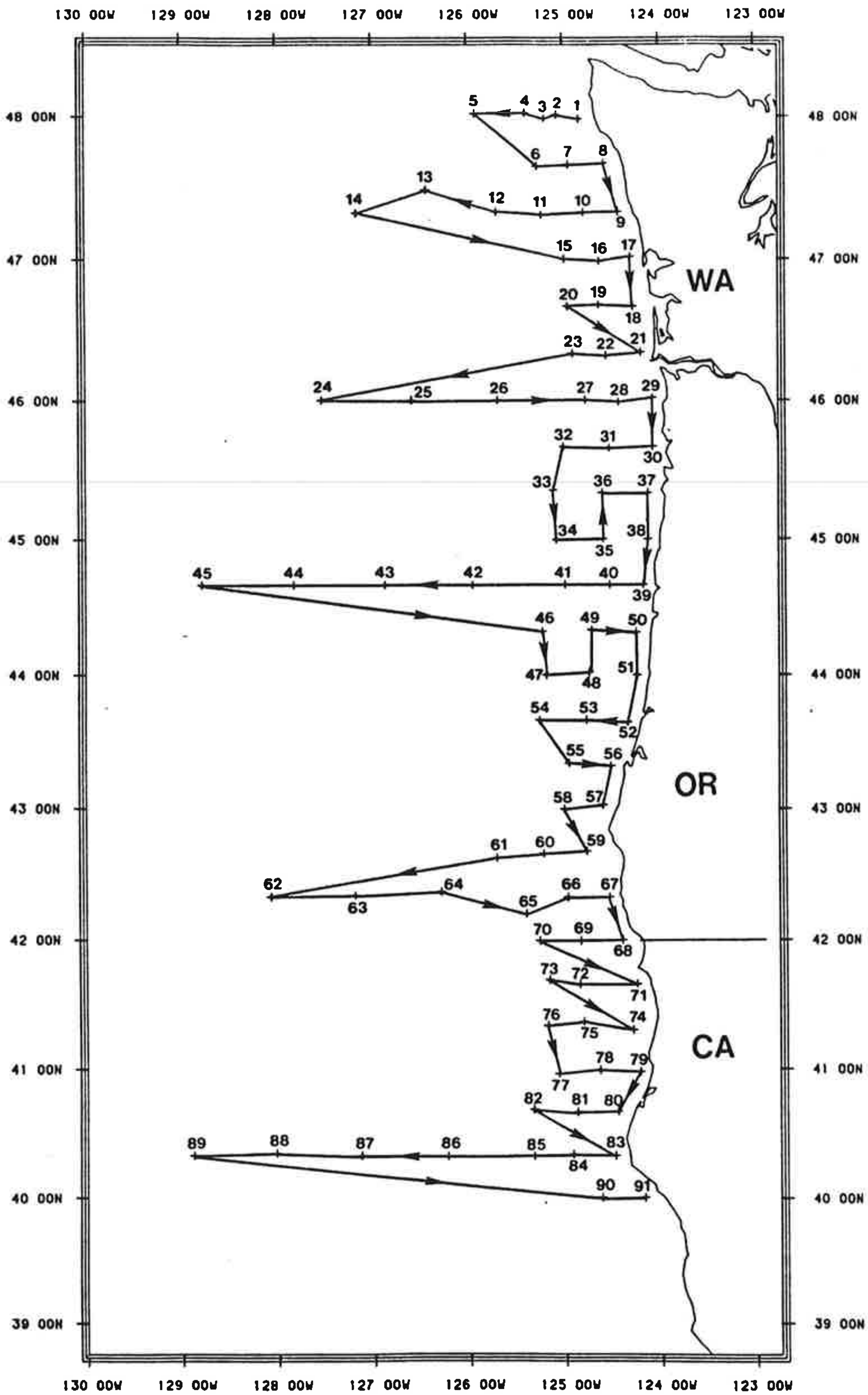
Two-way coincidence table of species abundance (no./10m^2) among station groups for eggs in bongo samples, six spring cruises combined. Numbers in species groups are species codes. See list accompanying Appendix Table 1 for interpretation.

STATION GROUPS	(grid squares)	SPECIES GROUPS 1: 150	285	151	274	156	271	157	283	2: 237	242	243	235	293	3: 244	263	290
1	45	8.4	4.3	4.1	1.4	4.4	0.0	365.4	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	50	17.7	14.3	3.3	2.5	3.6	0.0	278.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	51	12.6	8.8	0.0	1.6	2.8	0.0	374.7	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	52	9.5	5.8	1.2	0.0	4.7	0.0	0.6	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	57	14.9	6.8	5.0	1.2	3.5	1.3	0.5	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	38	5.3	9.5	1.2	1.2	7.6	0.0	521.7	9.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	59	3.6	6.0	2.4	1.6	7.3	0.0	860.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	44	8.3	3.1	0.0	2.7	5.9	3.3	482.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	24	3.3	10.5	1.6	2.7	1.1	0.0	186.7	12.1	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0
	43	14.5	7.1	1.3	0.0	1.4	0.0	137.5	7.0	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0
	31	10.7	1.4	2.4	1.6	4.3	1.2	244.7	13.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8
	35	21.1	10.1	2.5	12.1	5.4	5.1	82.9	12.1	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0
	78	18.6	7.7	2.2	5.7	3.6	1.1	46.3	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0
	86	4.0	11.6	1.4	3.3	5.8	0.0	72.5	0.0	0.0	1.9	1.4	0.0	0.0	0.0	0.0	0.0
	77	5.7	8.3	4.0	1.8	4.1	1.2	13.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	36	11.9	13.8	0.0	1.6	7.6	10.0	17.7	2.6	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0
	64	23.0	10.2	8.5	6.2	9.4	3.3	91.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	72	26.6	13.2	15.1	4.3	7.2	2.9	150.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	63	20.6	13.1	8.5	9.0	7.6	5.3	202.8	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	85	48.5	10.3	11.8	5.2	5.3	6.7	27.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	58	33.0	7.2	8.2	1.6	11.0	8.2	84.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	66	7.9	6.2	9.2	1.5	19.1	5.3	156.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	48	39.3	5.8	7.0	4.0	0.0	1.8	191.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	71	22.2	2.7	5.6	1.4	1.5	0.0	469.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	65	9.5	12.0	8.3	10.2	4.6	1.4	515.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	73	17.4	58.0	12.0	4.2	8.0	1.1	950.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	37	8.0	6.5	7.4	5.6	5.2	1.9	298.1	11.3	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0
	56	45.4	17.0	21.7	16.1	1.5	4.4	334.5	3.2	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0
	42	23.6	7.6	13.6	3.1	4.7	9.3	60.3	4.2	1.5	1.5	0.0	0.0	1.5	0.0	0.0	0.0
	49	82.0	2.0	52.0	2.0	9.8	4.9	633.1	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	80	0.0	4.4	0.0	0.0	4.7	0.0	103.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	88	0.0	0.0	0.0	7.9	0.0	60.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	87	1.4	4.8	0.0	0.0	4.5	5.0	52.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	23	7.2	2.9	0.0	0.0	5.5	0.0	44.4	6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	79	7.3	1.6	1.6	0.0	5.8	0.0	27.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	21	3.5	3.5	3.5	0.0	0.0	15.1	7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	55	0.0	0.0	6.7	0.0	0.0	0.0	316.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	47	6.7	2.1	4.7	8.6	1.6	0.0	270.8	0.0	3.1	28.6	7.8	0.0	0.0	0.0	0.0	0.0
	54	14.2	3.5	6.2	3.4	1.4	1.2	57.3	0.3	9.4	29.0	7.6	0.7	0.3	0.0	0.0	0.0
	68	5.6	0.5	2.7	5.7	0.6	6.7	83.2	0.0	6.9	5.9	6.0	0.5	0.0	0.0	0.0	0.0
	69	28.7	1.3	13.8	9.0	0.8	2.3	137.4	0.0	10.3	9.3	4.1	0.0	2.9	0.0	0.0	0.0
	13	15.0	4.4	2.6	7.5	1.3	10.9	6.8	6.0	9.3	7.4	9.3	0.0	0.0	0.0	0.0	0.0
	26	5.3	6.1	3.4	6.9	0.0	8.1	7.3	2.9	3.8	38.0	13.7	0.0	6.2	0.0	0.0	0.7
	76	12.7	5.1	2.4	10.9	2.6	4.8	9.4	0.0	1.2	3.7	1.8	0.0	0.0	0.0	0.0	0.0
	82	2.4	2.4	1.2	6.0	1.1	1.2	0.0	0.0	1.2	1.1	0.0	0.0	0.0	0.0	0.0	0.0
	83	6.4	0.0	1.7	1.7	1.6	0.0	3.1	0.0	1.6	3.0	3.4	0.0	0.0	0.0	0.0	0.0
	3	5.8	3.7	5.0	0.6	0.0	0.0	0.0	4.6	6.6	22.3	26.5	0.0	2.5	0.0	0.0	0.0
	7	9.5	3.2	1.0	0.5	0.5	0.0	0.0	3.9	15.7	57.1	16.3	0.7	0.0	0.0	0.0	0.0
	19	3.6	4.7	0.8	0.9	0.5	0.5	1.2	3.6	7.7	71.2	19.1	0.4	16.1	0.0	0.4	0.5
	61	5.4	0.5	5.0	1.0	0.0	2.0	1.7	0.0	4.5	20.3	2.3	0.0	26.2	0.0	0.0	0.0
	75	1.3	0.5	1.7	1.4	0.0	3.3	4.6	0.0	6.0	9.1	10.3	0.0	6.7	0.4	2.5	0.0
	34	0.6	2.0	0.0	4.7	0.0	2.0	2.0	0.0	2.0	64.1	1.2	0.0	2.1	0.0	0.0	0.0
	4	0.6	0.7	1.9	2.2	0.0	0.0	1.0	10.2	2.6	1.2	18.7	0.0	1.2	0.0	0.0	0.0
	27	0.0	8.4	0.0	4.2	0.0	0.0	0.0	0.0	4.2	0.0	16.8	0.0	0.0	0.0	0.0	0.0
3	14	13.4	7.3	2.6	1.5	0.0	0.0	1.1	19.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	15	7.7	6.5	3.2	0.0	3.3	0.0	3.0	13.9	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0
	10	6.3	5.1	6.2	1.3	3.6	0.0	0.0	20.0	1.3	1.2	2.6	0.0	0.0	0.0	0.0	0.0
	8	7.8	1.8	6.0	1.3	0.0	0.0	0.0	13.0	0.0	0.0	1.8	1.8	5.0	0.0	0.0	0.0
	28	9.9	3.2	1.3	2.8	0.0	0.0	0.0	6.4	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0
	9	1.6	5.2	0.0	1.6	0.0	0.0	0.0	14.4	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0
	16	3.1	1.7	0.0	5.2	0.0	0.0	0.0	11.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	22	7.1	8.5	2.2	0.0	4.1	1.0	0.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	30	3.5	7.1	1.3	2.5	6.3	1.8	0.0	11.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	29	41.8	6.7	1.7	2.5	5.1	1.3	0.0	2.5	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0
	17	12.3	1.6	0.0	3.0	6.2	1.6	0.0	24.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	62	40.0	4.2	21.4	4.4	0.6	3.6	3.2	0.8	6.8	0.7	5.6	0.0	0.0	0.0	0.0	0.0
	70	32.1	11.9	12.0	4.6	1.5	1.3	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0
	20	53.9	4.8	25.6	7.8	0.0	2.2	0.0	6.5	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0
	84	47.7	0.0	13.6	20.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	53	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	7.5	23.9	1.4	14.3	11.1	0.0	0.6	0.0
	67	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.7	13.6	15.7	1.3	15.2	29.5	0.6	0.0	0.0
	12	0.0	1.4	0.0	0.0	0.0	0.0	0.0	2.5	24.7	104.9	1.4	0.7	15.7	0.0	0.0	0.0
	41	0.6	3.1	0.0	0.0	0.0	0.0	0.0	0.0	3.8	36.0	4.1	1.1	18.8	0.0	0.0	0.0
	46	0.0	2.4	0.0	3.2	0.7	0.0	0.7	0.0	5.0	33.1	4.9	1.6	22.6	0.0	3.7	0.0
	33	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.7	4.1	124.8	1.3	3.5	225.0	0.0	0.8	12.7
	40	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.7	26.3	113.9	2.6	1.3	247.6	0.0	7.5	0.0
	39	0.0	2.5	0.0	0.0	0.0	0.0	0.7	0.0	15.2	49.0	0.0	21.1	329.5	0.0	2.4	0.0
	18	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.9	20.5	73.2	2.3	29.0	67.5	1.3	5.7	34.0
	25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	22.0	33.7	0.6	41.0	65.7	1.8	3.5	186.1
	6	0.9	0.8	1.0	0.3	0.0	0.0	0.0	3.2	17.5	54.5	7.8	38.4	24.7	1.2	1.6	108.6
	2	0.0	0.9	0.0	0.0	0.0	0.0	0.0	2.0	18.6	38.6	13.5	41.1	15.2	1.2	0.7	0.0
	11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.8	0.4	155.2	77.1	5.0	4.6	179.0
	32	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	1.4	1.7	1.5	26.9	235.0	4.3	18.3	0.6
	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	0.0	3.8	144.4	19.6	0.0	27.4	0.0
	74	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	9.0	17.9	0.0	0.0	0.0
	60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	8.4	0.8	51.0	0.4	0.7	0.0	0.0
	81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	32.2	0.0	0.0	0.0	0.0	0.0	0.0
	33	3.3	1533.9	2.3	2.5	0.0	0.0	0.0	0.0	0.0	0.0	135.4	7.6	0.0	0.0	0.0	0.0

Appendix Table 4.

Two-way coincidence table of species abundance (no./10m²) among station groups for larvae in bongo samples, six spring cruises combined. Numbers in species groups are species codes. See list accompanying Appendix Table 1 for interpretation.

STATION GROUPS	(grid squares)	SPECIES GROUPS 1: 156	276	277	275	288	153	164	282	157	285	2: 162	271	158	163	160	171	3: 244	290	148	263	237	242
1	44	6.8	5.2	6.3	1.3	2.6	0.0	0.0	0.0	0.0	3.0	24.4	84.3	96.0	5.6	440.0	6.3	0.0	0.0	0.0	0.0	0.0	0.0
	71	5.8	8.5	6.3	1.7	4.3	4.1	0.0	3.2	1.7	1.4	40.2	81.7	152.0	7.6	185.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	45	4.2	33.0	2.8	1.5	2.8	1.5	1.4	0.0	0.0	0.0	22.7	38.2	30.8	6.0	321.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	51	1.3	15.7	16.9	3.1	4.1	1.3	0.0	0.0	0.0	0.0	23.9	51.8	62.4	9.1	433.8	3.1	0.0	0.0	0.0	0.0	3.1	1.6
	52	1.6	6.5	3.1	3.1	5.9	0.0	1.6	1.5	0.0	0.0	28.4	100.7	78.1	16.4	400.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	66	1.5	4.0	4.6	4.4	8.6	1.5	1.3	7.5	0.0	0.0	4.5	66.3	406.6	13.0	420.3	1.8	0.0	0.0	0.0	0.0	0.0	0.0
	38	4.7	2.7	3.0	1.5	1.5	1.5	3.1	0.0	0.0	0.0	15.2	31.6	82.5	8.8	201.9	4.4	0.0	0.0	0.0	0.0	0.0	1.6
	84	6.9	2.4	4.1	5.6	0.0	6.0	1.6	1.2	0.0	0.0	87.6	61.2	54.9	10.8	203.3	2.7	0.0	0.0	0.0	0.0	0.0	1.2
	64	1.4	1.1	7.0	5.5	1.3	2.4	5.5	3.3	0.0	0.0	24.6	45.3	102.2	12.5	187.1	2.5	0.0	0.0	0.0	0.0	2.8	0.0
	70	4.1	1.5	8.2	5.5	0.0	1.5	0.0	2.9	0.0	0.0	16.9	16.1	35.6	7.0	92.6	1.3	0.0	0.0	0.0	0.0	0.0	0.0
	87	4.5	0.0	7.0	4.3	1.3	0.0	0.0	1.4	0.0	0.0	19.2	30.6	50.2	8.2	57.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	79	0.0	0.0	1.5	5.1	8.0	0.0	0.0	1.5	0.0	1.4	7.5	46.9	36.0	14.5	70.3	1.4	0.0	0.0	0.0	0.0	0.0	0.0
	88	1.3	0.0	8.6	17.2	15.6	0.0	0.0	0.0	1.3	9.3	9.3	23.1	79.9	22.8	89.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	72	3.0	1.4	0.0	12.0	6.1	0.0	5.9	0.0	0.0	1.5	29.7	54.9	188.1	18.1	103.3	2.7	0.0	0.0	0.0	0.0	0.0	0.0
	78	1.1	1.1	2.5	3.3	1.1	0.0	0.0	0.0	1.3	2.5	3.4	45.9	24.5	9.1	152.1	3.4	0.0	0.0	0.0	0.0	3.4	0.0
	85	1.7	1.7	6.4	1.7	3.9	0.0	0.0	16.7	0.0	1.7	47.2	44.5	1.8	11.3	270.1	3.3	0.0	0.0	0.0	0.0	0.0	0.0
	43	4.3	2.6	0.0	4.5	2.7	4.5	4.4	3.0	0.0	0.0	27.1	50.8	55.6	5.7	245.3	14.8	0.0	0.0	0.0	0.0	0.0	6.1
	76	1.9	1.2	0.0	3.0	4.0	0.0	0.0	2.9	0.6	0.7	20.2	43.1	44.9	5.6	205.7	28.3	0.0	0.0	0.0	0.0	0.0	1.8
	57	2.5	1.2	0.0	3.5	3.7	0.0	1.1	1.2	6.0	0.0	20.0	69.1	41.6	5.3	201.8	8.0	0.0	0.0	0.0	0.0	0.0	0.0
	65	1.5	4.1	0.0	4.4	3.2	1.4	3.2	5.7	7.9	0.0	27.2	67.9	249.6	4.5	173.0	8.2	0.0	0.0	0.0	0.0	0.0	0.0
	36	2.8	4.0	1.5	0.0	1.3	1.3	2.6	3.0	0.0	0.0	19.4	42.5	6.7	7.1	147.7	15.7	0.0	0.0	0.0	0.0	0.0	0.0
	49	3.6	3.5	0.0	3.7	0.0	1.8	1.8	5.6	8.1	0.0	19.9	52.7	7.8	8.0	155.9	14.4	0.0	0.0	0.0	0.0	0.0	0.0
	58	0.0	3.3	2.0	5.4	3.9	1.6	2.0	3.7	3.9	1.9	9.4	64.8	15.4	5.1	264.6	1.9	0.0	0.0	0.0	0.0	0.0	0.0
	73	3.9	0.0	2.0	4.8	8.9	2.2	2.6	0.0	96.6	0.0	22.4	38.9	907.9	10.8	212.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	80	0.0	1.6	4.7	14.9	10.7	1.3	1.6	0.0	6.3	0.0	18.6	51.4	182.5	11.5	206.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0
	90	0.0	8.1	0.0	4.0	4.9	0.0	5.1	0.0	54.1	0.0	3.6	21.6	94.1	14.3	126.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	23	3.0	0.0	0.0	0.0	0.0	4.5	5.7	1.4	0.0	0.0	8.9	17.7	6.0	4.2	101.5	15.2	0.0	0.0	0.0	0.0	0.0	0.0
	28	1.9	0.0	0.0	0.0	0.0	13.7	1.6	1.7	0.0	1.9	16.4	15.8	1.9	2.9	105.6	11.1	0.0	0.0	0.0	0.0	0.0	0.0
	24	1.0	1.1	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	15.1	10.4	4.9	6.1	252.1	11.3	0.0	0.0	0.0	0.0	0.0	0.0
	31	4.4	0.0	0.0	0.0	1.5	2.9	15.0	0.0	0.0	0.0	28.3	20.6	9.3	1.7	191.6	9.7	0.0	0.0	0.0	0.0	0.0	0.0
	37	3.4	0.9	0.0	0.0	1.5	5.3	10.0	0.0	0.0	0.0	7.0	28.5	14.8	11.6	271.1	4.2	0.0	0.0	0.0	0.0	0.0	0.0
	30	0.0	1.8	1.8	0.0	0.0	0.0	10.0	3.0	0.0	0.0	7.0	33.9	11.0	3.1	146.6	16.1	0.0	0.0	0.0	0.0	0.0	0.0
	56	0.0	1.4	0.0	0.0	0.0	4.4	0.0	1.6	0.0	0.0	10.5	34.6	13.6	1.5	112.2	10.5	0.0	0.0	0.0	0.0	0.0	0.0
	77	0.0	0.0	0.0	5.6	1.2	0.0	3.3	1.5	0.0	0.0	7.0	18.5	9.2	3.0	93.1	0.0	0.0	0.0	0.0	0.0	0.0	1.5
	86	0.0	0.0	0.0	11.7	1.3	1.9	0.0	5.8	0.0	0.0	9.8	15.3	2.7	4.2	49.3	2.7	0.0	0.0	0.0	0.0	0.0	0.0
	22	1.4	3.7	0.0	1.2	0.0	2.3	2.9	2.1	0.0	0.0	3.4	21.2	6.7	2.0	108.4	21.6	0.0	0.0	0.0	0.0	1.3	1.3
	54	0.7	1.4	0.0	1.1	0.0	2.6	0.0	3.2	0.0	0.0	15.1	37.0	4.0	2.5	86.3	31.4	0.0	0.0	0.0	0.0	0.6	3.0
	68	1.6	1.2	0.6	0.0	0.0	1.0	0.8	1.4	0.0	0.0	8.0	21.8	12.3	4.1	99.1	3.9	0.0	0.0	0.0	0.0	1.4	7.5
	69	1.5	0.0	0.0	0.0	0.0	1.2	0.0	1.5	0.7	0.0	19.4	32.0	3.5	4.4	154.3	8.0	0.0	0.0	0.0	0.7	2.2	7.3
	61	1.2	1.5	0.0	0.0	0.0	3.4	0.0	3.0	0.0	0.0	13.8	23.6	7.8	1.0	47.1	3.9	0.0	1.5	0.0	0.7	0.0	5.8
	62	0.0	1.2	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	3.6	14.4	3.6	1.2	40.6	2.4	0.0	0.0	0.0	0.0	0.0	6.0
	63	3.0	1.6	0.0	0.0	0.0	1.3	0.0	1.3	0.0	0.0	3.0	6.1	0.0	1.6	71.8	4.7	0.0	0.0	0.0	0.0	0.0	3.4
	21	3.8	3.6	3.6	0.0	0.0	7.5	0.0	0.0	3.8	0.0	10.7	37.1	3.5	0.0	148.9	15.1	0.0	0.0	0.0	0.0	0.0	0.0
	35	3.4	1.7	3.3	0.0	0.0	4.8	1.7	0.0	1.8	0.0	21.2	38.9	26.1	0.0	203.1	9.8	0.0	0.0	0.0	0.0	0.0	3.6
	42	1.5	1.4	4.5	0.0	1.4	6.6	0.0	0.0	9.4	0.0	9.3	40.9	185.7	4.3	199.6	24.5	0.0	0.0	0.0	0.0	1.6	4.6
	50	2.4	1.1	1.2	0.0	0.0	7.4	2.4	0.0	5.7	0.0	5.0	40.0	15.1	8.5	310.2	16.2	0.0	0.0	0.0	0.0	0.0	1.3
	29	3.2	0.0	6.1	1.7	0.0	1.5	1.2	1.2	8.3	0.0	14.5	39.1	16.5	7.8	142.6	27.1	0.0	1.7	0.0	0.0	0.0	6.8
	47	1.7	0.8	3.2	0.8	0.8	5.8	0.0	1.7	0.0	0.0	13.9	27.5	17.8	2.9	146.5	48.7	0.0	1.4	0.0	0.0	0.5	6.8
	48	0.0	9.9	4.0	0.0	0.0	3.3	0.0	9.9	1.6	0.0	13.2	46.2	94.3	9.2	269.8	43.4	0.0	0.0	0.0	0.0	0.0	18.1
	82	2.1	2.3	1.2	2.1	0.0	6.1	0.0	27.9	2.0	1.3	22.5	69.2	10.2	7.8	125.6	36.7	0.0	0.0	0.0	0.0	2.0	8.7
3	34	0.0	0.6	1.3	0.0	0.0	2.4	0.7	1.8	0.0	0.0	4.4	10.0	3.4	1.8	94.2	50.7	0.0	0.0	0.0	0.0	0.0	6.5
	41	0.0	0.5	0.7	0.4	0.0	1.4	0.0	2.8	0.0	0.0	4.6	4.8	0.0	0.6	61.6	60.7	0.5	0.0	0.0	0.0	1.2	6.5
	19	0.0	0.0	0.0	0.0	0.4	0.0	0.5	1.6	0.0	0.5	6.3	4.8	0.0	1.4	101.6	51.6	0.0	1.1	2.0	1.0	0.5	7.2
	27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.2	0.0	0.0	37.7	8.4	0.0	0.0	268.2	79.6	0.0	0.0	0.0	0.0	12.6	8.4
	14	0.0	1.3	0.0	0.0	0.0	1.3	1.7	0.0	0.0	0.0	6.4	5.7	1.3	1.1	64.7	19.4	0.0	0.0	0.0	0.0	5.0	1.3
	26	0.4	0.0	1.4	0.0	0.0	5.8	2.1	0.7	0.4	0.0	10.7	13.7	2.5	0.9	129.0	35.6	0.4	1.9	0.0	1.3	5.7	12.1
	40	0.0	0.0	0.6	0.0	0.0	2.1	0.0	0.0	0.0	0.0	0.7	3.8	0.0	0.8	26.9	27.3	0.0	0.0	2.5	0.0	0.0	9.8
	84	0.0	0.0	0.0	0.0	0.0	6.8	0.0	0.0	0.0	0.0	0.0	20.4	0.0	0.0	54.5	40.9	0.0	0.0	0.0	0.0	0.0	6.8
	75	0.0	0.4	1.7	1.9	1.8	1.1	0.5	0.4	0.0	0.0	2.4	9.0	6.7	1.0	37.9	23.9	0.0	0.0	3.3	0.0	0.8	3.9
	39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.5	0.0	0.0	24.4	16.1	0.7	2.2	0.0	1.1	4.6	27.7
	53	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	2.7	0.0	19.8	11.0	0.7	0.0	0.0	2.1	3.5	14.5
	46	1.2	0.0	0.0	0.6	0.0	0.6	0.0	0.0	0.0	0.0	3.8	2.4	0.6	0.6	27.3	17.3	0.0	3.1	0.0	0.0	2.9	18.3
	12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	40.4	9.9	6.5	0.0	0.8	0.0	0.5	6.4
	33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	1.2	0.6	0.7	61.8	13.5	2.0	21.7	0.5	10.5	0.5	12.5
	7	0.0	0.7	0.0	0.0	0.0	1.6	1.8	0.7	0.0	0.0	0.5	2.7	0.0	0.7	72.2	39.5	1.2	0.0	0.0	0.0	1.4	4.1
	9	0.0	0.0	0.0	0.0	0.0	8.1	1.7	3.2	0.0	0.0	0.0	1.5	0.0	4.3	88.3	18.8	1.6	0.0	0.0	0.0	1.6	3.2
	8	1.8	0.0	0.0	0.0	0.0	9.6	0.0	0.0	0.0	0.0	3.1	0.0	0.0	1.8	73.0	35.2	1.5	0.0	0.0	0.0	3.1	6.1
	13	1.3	0.0	0.0	0.0	0.0	5.6	0.6	0.0	0.6	0.0	7.3	5.5	0.6	1.3	113.4	22.2	2.1	0.0	0.0	0.0	2.0	3.2
	4	0.6	0.0	0.0	0.0	0.0	4.6	6.1	0.0	3.6	0.0	0.7	3.0	0.0	0.0	42.6	50.0	0.7	0.0	0.0	0.7	0.7	1.8
	20	0.0	0.0	0.0	0.0	0.0	9.1	5.2	0.0	5.2	0.0	0.0	2.6	0.0	4.3	65.2	9.1	0.0	0.0	0.0	0.0	0.0	2.6
	15	1.3	0.0	0.0	0.0	0.0	3.4	1.7	0.0	1.6	0.0	2.9	11.0	1.6	0.0	119.8	43.5	0.0	0.0	0.0	0.0	0.0	0.0
	16	1.6	0.0	0.0	0.0	0.0	4.7	1.7	0.0	0.0	0.0	1.6	1.3	1.3	7.9	562.2	15.8	0.0	0.0	0.0	0.0	0.0	0.0
	17	3.1	0.0	0.0	0.0	0.0	0.0	6.1	1.5	0.0	0.0	1.5	0.0	0.0	2.7	105.0	57.5	0.0	0.0	0.0	0.0	0.0	0.0
	3	0.0	0.0	0.0	0.0	0.0	6.6	0.7	9.7	13.8	0.0	2.0	0.0	0.0	0.0	24.4	111.2	0.6	0.0	0.0	0.0	0.0	0.5
	10	0.0	0.0	0.0	1.1	0.0	0.0	3.8	2.5	0.0	0.0	1.1	0.0	5.7	0.0	61.0	8.7	0.0	0.0	0.0	0.0	1.3	1.3
	67	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.6	1.8	0.7	5.9	0.0	25.4	3.2	0.0	0.6	0.0	0.0	1.9	4.3
	55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.2	0.0	87.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	81	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	1.4	8.4	0.0	0.0	0.0	0.0	0.0	0.0
4	11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	12.6	7.6	109.0	0.0	1.2	3.3
	18	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.4	2.6	0.0	0.4	0.0	0.4	0.9	41.9	5.7	8.6	23.4	145.7	0.8	3.3	9.0
	25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.7	0.0	0.0	5.1	12.4	69.5	10.3	1.1	5.1	5.0	12.9
	32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	7.5	5.5	8.3	5.8	1.9	1.0	14.0
	2	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.0	0.0	0.0	0.7	0.0	0.0	3.6	32.1	4.3	1.3	4.6	0.4	1.8	2.0
	6	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.3	0.0	0.0	0.3	0.4	0.0	0.4	5.4	27.2	3.5	1.5	18.1	0.0	1.4	3.4
	60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.8	0.0	33.3	0.0	0.0	2.3
	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	1.3	1.3	0.0	0.0	0.0
	74	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0



Appendix Figure 2.
Sampling stations, positions, and cruise track for cruise PO80 (August 1980).

Appendix Table 5.

Two-way coincidence table of species abundance (no./1000m³) among station groups for eggs in neuston samples, cruise PO80, August 1980. Numbers in species groups are species codes. See list accompanying Appendix Table 1 for interpretation.

STATION GROUPS		SPECIES GROUPS 1a 235	237	287	1b 285	290	298	2 274	278	156	3 263	293	247	TOTAL
1a	6	0.0	0.0	0.0	0.0	0.0	0.0	119.8	838.4	0.0	0.0	0.0	0.0	978.1
	66	0.0	0.0	0.0	0.0	0.0	0.0	110.0	22.0	0.0	0.0	0.0	0.0	220.0
	55	0.0	0.0	0.0	0.0	0.0	0.0	219.0	151.6	0.0	0.0	0.0	0.0	370.6
	58	0.0	0.0	0.0	0.0	0.0	0.0	266.1	62.6	15.7	0.0	0.0	0.0	344.4
	61	0.0	0.0	0.0	0.0	0.0	0.0	87.2	305.2	21.8	0.0	0.0	0.0	414.2
	85	0.0	0.0	0.0	0.0	0.0	0.0	24.4	24.4	24.4	0.0	0.0	0.0	73.1
	54	57.1	0.0	0.0	0.0	0.0	0.0	613.6	28.5	14.3	0.0	0.0	0.0	727.7
	84	16.3	0.0	0.0	0.0	0.0	0.0	113.9	16.3	0.0	0.0	16.3	0.0	178.9
	41	0.0	0.0	0.0	0.0	0.0	0.0	24.8	49.6	0.0	0.0	0.0	0.0	74.4
	73	0.0	0.0	0.0	0.0	0.0	0.0	24.7	74.1	0.0	0.0	0.0	0.0	98.8
	88	0.0	0.0	0.0	0.0	0.0	0.0	16.2	48.6	0.0	0.0	0.0	0.0	81.1
	20	0.0	0.0	0.0	0.0	0.0	0.0	18.1	18.1	0.0	0.0	0.0	0.0	36.2
	81	0.0	0.0	0.0	0.0	0.0	0.0	46.5	23.3	0.0	0.0	0.0	0.0	69.8
	76	0.0	0.0	0.0	16.4	0.0	0.0	32.9	32.9	0.0	0.0	0.0	0.0	82.2
1b	60	0.0	0.0	0.0	0.0	0.0	0.0	26.8	0.0	0.0	0.0	0.0	0.0	26.8
	75	0.0	0.0	0.0	0.0	0.0	0.0	27.7	0.0	0.0	0.0	0.0	0.0	27.7
	82	0.0	0.0	0.0	0.0	0.0	0.0	33.2	0.0	0.0	0.0	0.0	0.0	33.2
	62	0.0	0.0	0.0	0.0	0.0	0.0	70.5	0.0	0.0	0.0	0.0	0.0	70.5
	42	0.0	0.0	40.9	0.0	0.0	0.0	40.9	0.0	0.0	20.5	0.0	0.0	122.8
	46	0.0	0.0	0.0	0.0	0.0	0.0	127.1	0.0	0.0	54.5	0.0	0.0	181.5
2	43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	128.4	0.0	0.0	0.0	0.0	128.4
	45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	143.1	0.0	0.0	0.0	0.0	143.1
	63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	186.6	0.0	0.0	0.0	0.0	248.8
	12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	916.2	0.0	0.0	0.0	0.0	916.2
	14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39.8	0.0	0.0	0.0	0.0	39.8
	26	0.0	0.0	23.0	0.0	0.0	0.0	0.0	23.0	0.0	0.0	0.0	0.0	46.1
	33	0.0	0.0	98.2	0.0	0.0	0.0	0.0	196.4	0.0	0.0	0.0	0.0	294.6
	11	0.0	0.0	0.0	0.0	2927.0	0.0	0.0	991.9	0.0	0.0	0.0	0.0	3919.0
	32	0.0	0.0	0.0	0.0	104.2	0.0	0.0	173.7	0.0	0.0	0.0	0.0	278.0
	64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	206.9	0.0	62.1	0.0	0.0	331.1
	70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.7	0.0	23.9	0.0	0.0	95.5
	24	0.0	0.0	0.0	23.4	0.0	0.0	0.0	187.0	0.0	23.4	0.0	0.0	233.7
	87	0.0	0.0	0.0	0.0	0.0	0.0	0.0	213.8	49.3	32.9	0.0	0.0	296.0
3	37	45.4	22.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.1
	53	94.4	18.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	113.2
	19	27.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	54.8
	74	6870.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1977.0	0.0	8847.0
	40	0.0	16.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.9
	10	21.6	0.0	194.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	216.1
	34	0.0	0.0	2374.0	0.0	0.0	0.0	17.5	0.0	0.0	0.0	0.0	0.0	2392.0
	5	0.0	0.0	0.0	62.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.0
	59	0.0	0.0	0.0	0.0	0.0	17.9	0.0	0.0	0.0	0.0	0.0	0.0	17.9
4	23	0.0	0.0	0.0	0.0	309.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	309.8
	28	0.0	0.0	0.0	0.0	276.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	276.8
	36	0.0	0.0	0.0	0.0	105.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	105.2
	13	0.0	0.0	0.0	0.0	14.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.1
	25	0.0	0.0	0.0	0.0	17.6	0.0	17.6	0.0	0.0	0.0	0.0	0.0	35.3
5a	18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	64.7	145.6	0.0	210.3
	72	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	98.6	164.3	0.0	262.8
	67	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	117.2	50.2	0.0	167.4
	17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	261.9	14.5	0.0	276.4
	39	35.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	323.3	251.5	0.0	610.7
	51	34.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	119.8	68.3	0.0	222.0
	1	0.0	0.0	0.0	0.0	0.0	40.4	0.0	0.0	0.0	323.5	829.0	0.0	1193.0
	48	0.0	0.0	0.0	0.0	0.0	20.2	0.0	0.0	0.0	283.4	1539.0	0.0	1842.0
	68	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	143.8	1246.0	0.0	1390.0
	80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	347.2	6662.0	0.0	7009.0
	57	0.0	0.0	0.0	0.0	0.0	17.0	0.0	0.0	0.0	34.0	17.0	0.0	67.9
	21	0.0	0.0	0.0	0.0	237.5	0.0	0.0	0.0	0.0	54.8	91.3	0.0	383.6
	29	0.0	0.0	0.0	0.0	239.8	0.0	0.0	0.0	0.0	167.8	12732.0	0.0	13139.0
5b	50	0.0	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	466.5	933.0	133.3	1550.0
	71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	218.2	1600.0	181.8	2000.0
	79	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.4	685.1	64.2	770.7
	8	19.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3641.0	10265.0	437.7	14363.0
	9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2173.0	237.7	1019.0	3430.0
	27	0.0	0.0	0.0	0.0	0.0	0.0	16.7	16.7	0.0	83.5	16.7	33.4	167.1
6	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	304.6	0.0	304.6
	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	404.3	0.0	404.3
	91	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	125.1	0.0	125.1
	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1514.1	0.0	1514.1
	49	0.0	21.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	274.3	0.0	295.4
	38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.9	0.0	44.9
	83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.4	0.0	37.4
	56	0.0	0.0	0.0	16.8	0.0	0.0	0.0	0.0	0.0	0.0	33.7	0.0	50.6
	16	0.0	0.0	0.0	0.0	0.0	0.0	17.0	0.0	0.0	0.0	50.9	0.0	67.9
	77	0.0	0.0	0.0	0.0	0.0	0.0	256.4	0.0	0.0	0.0	106.8	0.0	363.3

Appendix Table 6.

Two-way coincidence table of species abundance (no./1000m^3) among station groups for larvae in neuston samples, cruise PO80, August 1980. Numbers in species groups are species codes. See list accompanying Appendix Table 1 for interpretation.

STATION GROUPS		SPECIES GROUPS 1a 171	273	1b 287	290	2 220	270	148	TOTAL
1a	18	32.3	0.0	0.0	0.0	0.0	0.0	0.0	32.3
	72	32.9	0.0	0.0	0.0	0.0	0.0	0.0	32.9
	54	42.8	0.0	0.0	0.0	0.0	0.0	0.0	42.8
	61	43.6	0.0	0.0	0.0	0.0	0.0	0.0	65.4
	4	68.0	0.0	0.0	0.0	0.0	0.0	0.0	68.0
	9	67.9	0.0	0.0	0.0	0.0	0.0	0.0	67.9
	81	116.3	0.0	0.0	0.0	0.0	0.0	0.0	116.3
1b	58	15.7	0.0	0.0	0.0	0.0	0.0	0.0	15.7
	67	16.7	0.0	0.0	0.0	0.0	0.0	0.0	16.7
	17	14.5	0.0	0.0	0.0	0.0	0.0	0.0	14.5
	25	17.6	0.0	0.0	0.0	0.0	0.0	0.0	17.6
	46	18.2	0.0	0.0	0.0	0.0	0.0	0.0	18.2
	53	18.9	0.0	0.0	0.0	0.0	0.0	0.0	18.9
	82	23.5	0.0	0.0	0.0	0.0	0.0	0.0	94.0
1c	77	384.6	0.0	0.0	0.0	0.0	0.0	0.0	384.6
	80	498.8	0.0	0.0	0.0	0.0	0.0	0.0	498.8
	75	277.1	0.0	0.0	0.0	0.0	0.0	0.0	277.1
2a	15	36.6	36.6	0.0	18.3	0.0	0.0	0.0	91.5
	49	63.3	21.1	0.0	21.1	0.0	0.0	0.0	105.5
	65	44.0	0.0	0.0	22.0	0.0	0.0	0.0	66.0
	20	18.1	18.1	0.0	0.0	0.0	0.0	0.0	36.2
	83	37.4	74.9	0.0	0.0	0.0	0.0	0.0	112.3
	16	169.8	101.9	0.0	0.0	254.7	0.0	0.0	526.3
2b	34	34.9	0.0	17.5	87.3	0.0	0.0	0.0	139.7
	42	286.6	0.0	20.5	81.9	0.0	0.0	0.0	389.0
	33	176.8	0.0	19.6	1453.0	0.0	0.0	0.0	1670.0
	12	16.1	0.0	48.2	32.1	0.0	0.0	0.0	112.5
	64	20.7	0.0	20.7	0.0	0.0	0.0	0.0	165.6
3	13	0.0	0.0	99.0	1118.0	0.0	0.0	0.0	1217.0
	26	0.0	0.0	0.0	1290.0	0.0	0.0	0.0	1290.0
	41	0.0	0.0	0.0	248.0	0.0	198.4	0.0	446.4
	38	0.0	0.0	0.0	52.6	0.0	0.0	0.0	52.6
	79	0.0	0.0	0.0	21.4	0.0	0.0	0.0	21.4
	86	0.0	0.0	0.0	16.9	0.0	0.0	16.9	33.7
	23	0.0	17.2	17.2	120.5	0.0	0.0	0.0	154.9
	32	0.0	17.4	34.7	52.1	0.0	0.0	0.0	104.2
	36	0.0	39.3	0.0	39.3	0.0	0.0	0.0	78.6
4	71	0.0	0.0	0.0	0.0	0.0	0.0	145.5	181.8
	74	0.0	0.0	0.0	0.0	0.0	0.0	226.8	226.8
	80	0.0	0.0	0.0	0.0	0.0	0.0	21.7	21.7
	1	20.2	0.0	0.0	0.0	0.0	0.0	20.2	40.4
	69	1002.0	0.0	0.0	20.9	0.0	0.0	20.9	1044.0
5	45	0.0	0.0	20.4	0.0	0.0	0.0	0.0	20.4
	63	0.0	0.0	20.7	0.0	0.0	0.0	0.0	20.7
	14	0.0	0.0	19.9	0.0	0.0	0.0	0.0	19.9
	43	0.0	0.0	25.7	0.0	0.0	0.0	0.0	25.7
	44	0.0	0.0	15.3	0.0	0.0	0.0	0.0	15.3
	87	0.0	0.0	16.4	0.0	0.0	0.0	0.0	16.4
6	2	0.0	17.8	0.0	0.0	0.0	0.0	0.0	17.8
	57	0.0	17.0	0.0	0.0	0.0	0.0	0.0	17.0
	31	0.0	20.0	0.0	0.0	0.0	0.0	0.0	20.0
	19	0.0	27.4	0.0	0.0	0.0	0.0	0.0	27.4
	27	0.0	33.4	0.0	0.0	0.0	0.0	0.0	33.4
	5	0.0	62.0	0.0	0.0	0.0	0.0	0.0	62.0
	7	0.0	53.9	0.0	0.0	0.0	0.0	0.0	53.9
	50	0.0	133.3	0.0	0.0	0.0	0.0	0.0	133.3

Appendix Table 7.

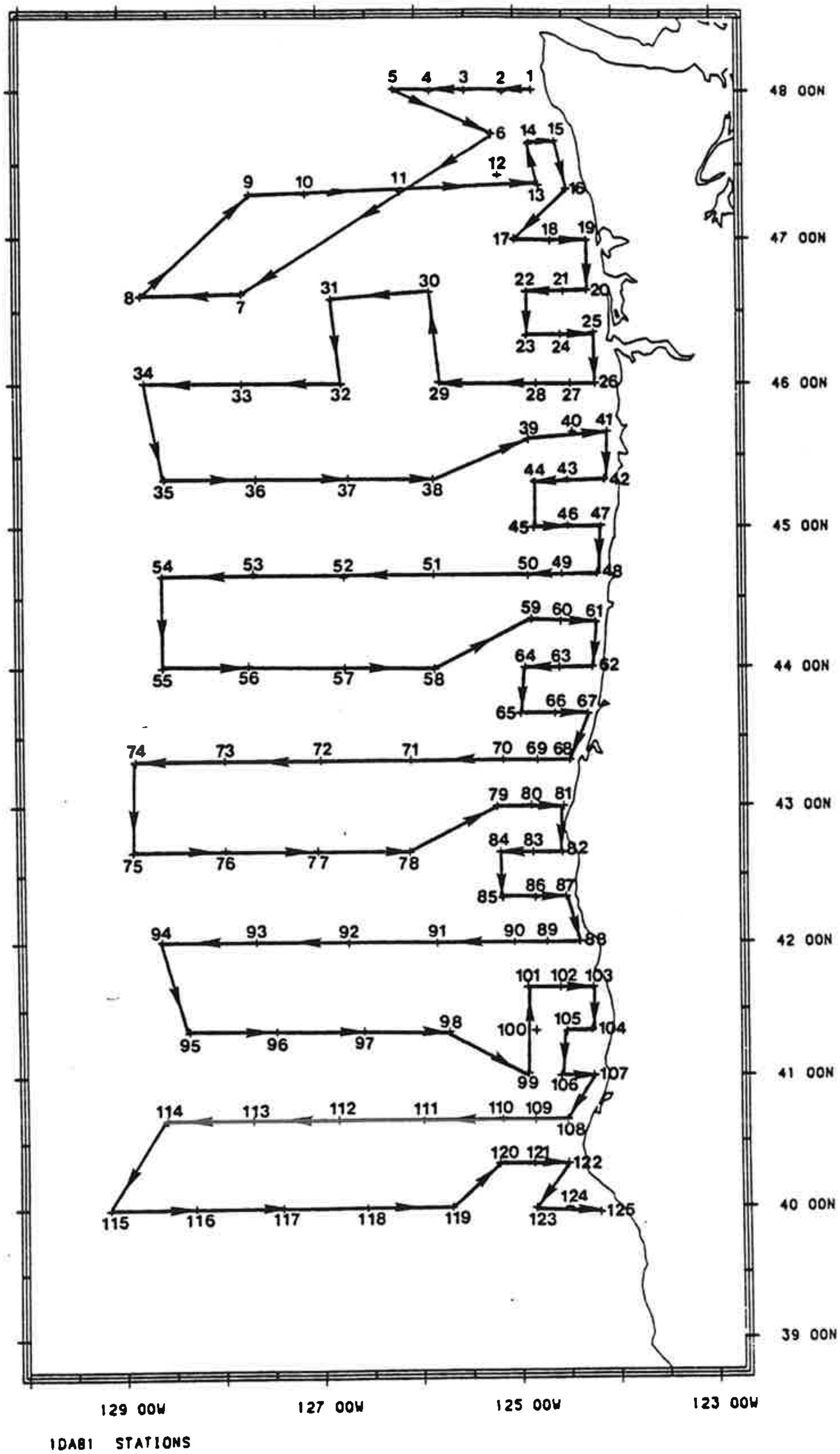
Two-way coincidence table of species abundance (no./10m²) among station groups for eggs in bongo samples, cruise PO80, August 1980. Numbers in species groups are species codes. See list accompanying Appendix Table 1 for interpretation.

STATION GROUPS		SPECIES GROUPS 1 150	290	237	243	2 156	278	274	300	3 263	293	235	247	TOTAL
1a	15	0.0	0.0	0.0	0.0	4.7	23.7	4.7	0.0	0.0	0.0	0.0	0.0	33.1
	87	0.0	0.0	0.0	0.0	12.8	32.0	6.4	0.0	0.0	0.0	0.0	0.0	64.1
	76	0.0	0.0	0.0	0.0	6.4	19.2	44.8	0.0	0.0	0.0	0.0	0.0	70.5
	65	0.0	0.0	0.0	0.0	15.0	45.0	52.5	22.5	0.0	0.0	0.0	0.0	134.9
	70	0.0	0.0	0.0	0.0	14.2	7.1	28.4	7.1	0.0	0.0	0.0	0.0	56.7
	6	0.0	0.0	0.0	1.7	0.0	27.3	8.5	0.0	0.0	0.0	0.0	0.0	39.2
	55	0.0	0.0	0.0	0.0	0.0	39.3	31.5	0.0	0.0	0.0	0.0	0.0	70.8
	85	0.0	0.0	0.0	0.0	0.0	7.7	11.5	0.0	0.0	0.0	0.0	0.0	19.2
	88	14.7	0.0	0.0	0.0	0.0	14.7	7.3	0.0	0.0	0.0	0.0	0.0	44.0
1b	42	0.0	0.0	0.0	0.0	0.0	0.0	6.5	0.0	0.0	0.0	0.0	0.0	26.0
	56	0.0	0.0	0.0	0.0	0.0	0.0	6.5	0.0	0.0	0.0	0.0	0.0	13.0
	78	0.0	0.0	0.0	0.0	0.0	0.0	6.3	0.0	0.0	0.0	0.0	0.0	6.3
	47	0.0	0.0	0.0	0.0	0.0	0.0	7.6	0.0	0.0	0.0	0.0	0.0	7.6
	46	0.0	0.0	0.0	0.0	0.0	0.0	13.1	0.0	0.0	0.0	0.0	0.0	13.1
	82	3.3	0.0	0.0	0.0	0.0	0.0	19.9	0.0	0.0	0.0	0.0	0.0	23.2
	58	0.0	0.0	0.0	0.0	0.0	0.0	6.3	6.3	0.0	0.0	0.0	0.0	12.6
	54	0.0	0.0	7.0	0.0	7.0	0.0	34.9	0.0	0.0	0.0	7.0	0.0	55.8
	77	0.0	0.0	0.0	0.0	4.5	0.0	36.3	0.0	0.0	0.0	0.0	0.0	40.9
2	24	0.0	0.0	0.0	0.0	0.0	59.6	0.0	0.0	0.0	0.0	0.0	0.0	59.6
	64	0.0	0.0	0.0	0.0	0.0	110.9	0.0	0.0	0.0	0.0	0.0	0.0	203.4
	25	0.0	0.0	0.0	0.0	0.0	16.3	0.0	0.0	0.0	0.0	0.0	0.0	16.3
	61	0.0	0.0	0.0	0.0	0.0	23.8	0.0	0.0	0.0	0.0	0.0	0.0	31.8
	11	0.0	0.0	0.0	3.3	0.0	33.0	0.0	0.0	0.0	0.0	3.3	0.0	39.6
	33	6.0	12.1	0.0	0.0	0.0	36.2	0.0	0.0	0.0	0.0	0.0	0.0	54.2
	34	0.0	0.0	0.0	0.0	0.0	6.8	0.0	0.0	0.0	0.0	0.0	0.0	6.8
	45	0.0	0.0	0.0	0.0	0.0	6.5	0.0	0.0	0.0	0.0	0.0	0.0	6.5
	86	0.0	0.0	0.0	0.0	0.0	5.5	0.0	0.0	0.0	0.0	0.0	0.0	11.0
3	12	0.0	0.0	0.0	0.0	6.1	64.5	0.0	0.0	0.0	0.0	0.0	0.0	70.6
	43	0.0	0.0	0.0	0.0	12.8	77.0	0.0	0.0	0.0	0.0	0.0	0.0	89.8
	13	0.0	0.0	0.0	0.0	3.5	3.5	0.0	0.0	0.0	0.0	0.0	0.0	7.0
	26	0.0	0.0	0.0	0.0	10.4	5.2	0.0	0.0	0.0	0.0	0.0	0.0	15.6
	41	0.0	0.0	0.0	0.0	7.1	7.1	0.0	7.1	0.0	0.0	0.0	0.0	21.4
	73	0.0	0.0	0.0	0.0	22.5	0.0	0.0	11.3	0.0	0.0	0.0	0.0	39.4
	44	7.4	0.0	0.0	0.0	7.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.8
	66	0.0	0.0	0.0	0.0	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.8
4	8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	110.2	44.1	26.4	17.6	216.0
	39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	98.8	53.2	15.2	3.8	171.0
	50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.6	29.6	7.4	11.1	88.7
	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39.1	86.9	13.0	0.0	139.0
	9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	129.4	22.1	72.6	0.0	224.1
	71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	150.0	502.8	0.0	35.3	688.1
	17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.9	0.0	0.0	0.0	16.9
	18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	5.6	0.0	11.2
	83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.8	5.4	0.0	16.2
	79	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.8	5.4	0.0	48.2
	62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.1	0.0	8.1
5	23	0.0	106.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	106.8
	32	0.0	23.5	0.0	0.0	0.0	0.0	4.7	0.0	0.0	0.0	0.0	0.0	28.2
	21	0.0	19.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.2	0.0	0.0	33.0
	40	0.0	0.0	5.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4
6	37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.6	19.7	0.0	0.0	26.3
	68	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	55.3	0.0	0.0	58.4
	72	0.0	0.0	0.0	0.0	6.1	0.0	0.0	0.0	6.1	18.4	0.0	0.0	30.7
	48	0.0	0.0	6.4	0.0	0.0	0.0	0.0	0.0	6.4	108.9	0.0	0.0	121.7
	49	0.0	0.0	8.8	0.0	0.0	0.0	0.0	0.0	0.0	17.7	0.0	0.0	26.5
	74	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.5	0.0	0.0	48.5
	81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	58.8	0.0	0.0	71.8
	29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	95.4	0.0	0.0	95.4
	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	244.8	0.0	0.0	244.8
	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.9	0.0	0.0	8.9
	38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.5	0.0	0.0	16.5
	67	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	0.0	0.0	4.4
7	10	0.0	0.0	0.0	7.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.6
	31	0.0	0.0	0.0	8.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.2
	22	0.0	0.0	0.0	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.8

Appendix Table 8.

Two-way coincidence table of species abundance (no./10m²) among station groups for larvae in bongo samples, cruise PO80, August 1980. Numbers in species groups are species codes. See list accompanying Appendix Table 1 for interpretation.

STATION GROUPS		SPECIES GROUPS 1					2				3					4			
		164	305	158	156	163	180	162	290	171	186	213	242	271	282	274	275	278	TOTAL
1	6	0.0	10.2	0.0	0.0	0.0	81.8	34.1	117.6	40.9	0.0	3.4	0.0	0.0	0.0	0.0	0.0	0.0	287.9
	11	0.0	0.0	0.0	0.0	0.0	69.3	46.2	141.8	26.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.6	290.3
	34	0.0	0.0	0.0	3.4	0.0	178.9	16.9	847.1	47.3	0.0	0.0	0.0	3.4	0.0	0.0	0.0	0.0	1100.0
	27	0.0	0.0	0.0	0.0	0.0	33.7	6.7	40.5	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	87.7
	49	0.0	0.0	0.0	0.0	0.0	26.5	0.0	35.4	26.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	88.5
	44	0.0	0.0	7.4	0.0	0.0	51.8	14.8	29.6	7.4	0.0	0.0	0.0	0.0	7.4	0.0	0.0	0.0	118.5
	41	7.1	14.3	0.0	0.0	0.0	192.4	49.9	78.4	71.3	0.0	0.0	0.0	7.1	7.1	0.0	0.0	0.0	427.5
	61	15.9	7.9	0.0	0.0	15.9	119.1	31.8	7.9	31.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	230.2
	23	9.3	4.6	0.0	0.0	0.0	60.4	55.7	37.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	167.2
	12	9.2	0.0	0.0	0.0	0.0	184.3	39.9	2411.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	2650.0
	13	0.0	10.5	0.0	0.0	0.0	171.8	10.5	2072.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2275.0
	32	0.0	0.0	4.7	0.0	0.0	37.6	14.1	840.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	897.0
	26	5.2	5.2	10.4	5.2	5.2	77.8	15.6	2225.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2354.0
	15	4.7	23.7	0.0	0.0	0.0	33.1	4.7	1117.0	4.7	0.0	0.0	0.0	0.0	0.0	4.7	0.0	0.0	1193.0
	33	18.1	0.0	18.1	6.0	0.0	48.2	12.1	1507.0	12.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1627.0
	43	4.3	0.0	8.6	4.3	0.0	12.8	4.3	124.0	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	171.1
	35	0.0	0.0	32.6	0.0	0.0	0.0	8.2	375.2	24.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	448.7
	36	0.0	0.0	0.0	0.0	0.0	0.0	6.5	496.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	503.2
	42	0.0	0.0	0.0	0.0	13.0	19.5	39.0	52.0	45.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	175.5
	47	7.6	0.0	0.0	0.0	0.0	15.1	22.7	22.7	174.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	242.1
	46	0.0	0.0	0.0	4.4	4.4	4.4	4.4	21.8	69.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	117.8
	69	0.0	0.0	4.2	0.0	4.2	8.3	4.2	4.2	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.3
	77	0.0	0.0	0.0	0.0	18.2	4.5	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.8
2a	24	11.9	0.0	29.8	6.0	0.0	23.8	17.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	101.2
	25	8.2	8.2	16.3	8.2	0.0	24.5	16.3	8.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	89.7
	75	0.0	0.0	5.6	5.6	16.7	11.1	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.7
	81	0.0	0.0	5.9	5.9	0.0	5.9	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.6
	45	6.5	0.0	6.5	6.5	0.0	0.0	0.0	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.5	32.4
	62	0.0	0.0	65.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	91.8
	89	0.0	0.0	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.6
2b	86	0.0	5.5	33.1	0.0	0.0	0.0	0.0	0.0	27.6	0.0	0.0	0.0	0.0	5.5	5.5	5.5	0.0	82.7
	87	0.0	12.8	12.8	0.0	0.0	0.0	19.2	0.0	32.0	0.0	0.0	0.0	0.0	0.0	6.4	0.0	0.0	83.3
	85	0.0	11.5	19.2	0.0	0.0	11.5	11.5	0.0	19.2	0.0	0.0	3.8	0.0	0.0	0.0	7.7	0.0	88.3
	64	0.0	24.7	178.7	0.0	0.0	0.0	24.7	6.2	6.2	0.0	0.0	0.0	0.0	0.0	24.7	12.3	30.8	480.7
3	80	0.0	0.0	0.0	7.1	14.1	0.0	0.0	0.0	21.2	0.0	0.0	0.0	0.0	7.1	0.0	0.0	0.0	49.4
	82	0.0	0.0	0.0	23.2	16.6	0.0	9.9	0.0	36.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	89.4
	76	6.4	0.0	12.8	6.4	6.4	0.0	0.0	0.0	6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.4
	84	4.7	0.0	0.0	4.7	4.7	0.0	0.0	0.0	27.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.9
	88	0.0	0.0	0.0	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3	0.0	0.0	0.0	29.4
4	55	0.0	0.0	39.3	0.0	0.0	39.3	23.6	0.0	110.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	212.5
	65	0.0	7.5	15.0	7.5	0.0	97.4	37.5	0.0	60.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	232.4
	14	0.0	3.2	0.0	0.0	0.0	44.9	16.0	0.0	60.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	125.0
	70	0.0	0.0	0.0	7.1	0.0	14.2	7.1	0.0	35.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	63.8
	73	0.0	0.0	0.0	11.3	0.0	5.6	11.3	0.0	11.3	0.0	0.0	0.0	0.0	11.3	0.0	0.0	0.0	50.6
	72	0.0	0.0	0.0	6.1	0.0	0.0	6.1	0.0	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.6
	68	0.0	0.0	6.8	0.0	0.0	13.5	6.8	0.0	20.3	0.0	0.0	6.8	0.0	0.0	0.0	0.0	0.0	54.1
	78	0.0	0.0	0.0	0.0	0.0	18.9	6.3	0.0	6.3	0.0	0.0	6.3	0.0	0.0	0.0	0.0	0.0	37.9
	56	0.0	0.0	0.0	0.0	0.0	13.0	0.0	0.0	13.0	0.0	0.0	6.5	0.0	0.0	0.0	0.0	0.0	32.6
	54	0.0	0.0	0.0	13.9	0.0	13.9	0.0	0.0	174.4	0.0	0.0	13.9	0.0	0.0	0.0	0.0	0.0	216.2
	22	0.0	0.0	0.0	0.0	0.0	5.8	0.0	0.0	34.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.5
	58	0.0	0.0	0.0	0.0	0.0	12.6	0.0	0.0	75.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	88.2
	4	0.0	0.0	0.0	0.0	0.0	3.4	0.0	0.0	399.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	403.0
	31	0.0	0.0	0.0	0.0	0.0	24.7	0.0	0.0	49.4	0.0	0.0	0.0	0.0	0.0	0.0	8.2	0.0	82.3
	5	3.1	0.0	0.0	0.0	0.0	9.3	0.0	0.0	43.3	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0	61.9
	7	2.4	2.4	0.0	0.0	0.0	9.6	0.0	0.0	81.8	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	101.1
	2	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	179.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	183.2
5a	10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	45.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.1
	48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.4	6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.8
	20	0.0	0.0	0.0	0.0	0.0	4.9	0.0	4.9	4.9	0.0	0.0	0.0	4.9	0.0	0.0	0.0	0.0	19.6
	40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4	0.0	0.0	5.4	0.0	0.0	0.0	0.0	0.0	0.0	10.7
	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.8	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	26.8
	9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.3	3.2	3.2	0.0	0.0	0.0	0.0	0.0	0.0	12.6
	91	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.5	6.5	0.0	6.5	0.0	0.0	0.0	0.0	0.0	19.6
5b	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4
	74	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.1
5c	51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.6	0.0	0.0	0.0	0.0	0.0	6.6
	83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4	0.0	0.0	0.0	0.0	0.0	5.4
6	17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6
	18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6
	38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5
	57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.1
	8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.6
	67	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.7
	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3
	16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.1
	19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.6
	53	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.9
	90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.2



Appendix Figure 3.
Sampling stations, positions, and cruise track for cruise DA81 (October/November 1981).

Appendix Table 9.

Two-way coincidence table of species abundance (no./1000m²) among station groups for eggs in neuston samples, cruise DA81, October/November 1981. Numbers in species groups are species codes. See list accompanying Appendix Table 1 for interpretation.

STATION GROUPS		SPECIES GROUPS 1					2		3			
		336	944	247	583	293	299	325	274	365	156	TOTAL
1a	65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.5	82.2	0.0	105.7
	101	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.9	87.0	0.0	111.9
	117	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.3	58.8	0.0	94.1
	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.1	31.1	0.0	62.2
	91	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.5	27.5	0.0	55.0
	92	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.3	22.5	0.0	33.8
	116	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.3	24.5	0.0	36.8
	71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.4	20.7	0.0	31.1
	45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.7	13.7	0.0	27.3
	76	0.0	0.0	0.0	0.0	0.0	0.0	0.0	178.9	84.2	0.0	263.1
	89	0.0	0.0	0.0	0.0	0.0	0.0	0.0	180.6	83.4	0.0	264.0
	86	0.0	0.0	0.0	0.0	0.0	0.0	0.0	232.5	103.3	0.0	335.8
	88	0.0	0.0	0.0	0.0	0.0	0.0	0.0	135.3	36.9	0.0	172.2
	84	0.0	0.0	0.0	0.0	0.0	0.0	0.0	76.9	38.4	0.0	115.3
	79	0.0	0.0	0.0	0.0	0.0	0.0	11.3	384.5	45.2	0.0	441.1
	48	0.0	0.0	0.0	0.0	15.1	0.0	0.0	165.6	15.1	0.0	195.7
	49	0.0	0.0	0.0	0.0	25.4	0.0	0.0	266.8	25.4	0.0	317.6
	29	13.4	0.0	0.0	0.0	0.0	0.0	0.0	13.4	0.0	0.0	26.7
	38	13.1	0.0	0.0	0.0	0.0	0.0	0.0	65.3	26.1	0.0	104.6
1b	89	0.0	0.0	0.0	0.0	0.0	0.0	0.0	223.0	59.5	14.9	297.3
	88	0.0	0.0	0.0	0.0	0.0	0.0	0.0	151.2	41.2	13.7	206.2
	63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.9	35.1	11.7	128.8
	44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	503.1	179.7	12.0	694.7
	77	0.0	0.0	0.0	0.0	0.0	0.0	0.0	140.9	184.3	21.7	390.2
	110	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.3	198.8	37.3	298.2
	111	0.0	0.0	0.0	0.0	0.0	0.0	0.0	165.5	295.8	23.6	567.5
	54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	95.9	13.7	13.7	164.5
	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.1	13.7	13.7	68.6
	83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.3	15.2	15.2	60.7
	113	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.4	46.9	11.7	93.8
	51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4	11.4	11.4	34.1
	57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.8	23.7	11.8	47.3
	120	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.1	48.4	72.5	133.0
	65	0.0	0.0	0.0	0.0	12.1	0.0	0.0	1904.0	412.3	0.0	2328.0
	70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1985.0	534.4	63.6	2583.0
	121	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.1	2537.0	13.4	2618.0
	123	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	511.6	11.9	571.1
2	8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.6	0.0	0.0	11.6
	119	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4	0.0	0.0	11.4
	28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.3	0.0	0.0	12.3
	34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.2	0.0	0.0	12.2
	37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.2	0.0	0.0	10.2
	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.8	0.0	0.0	13.8
	105	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.8	0.0	0.0	15.8
	33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.0	0.0	0.0	37.0
	31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39.2	0.0	0.0	39.2
	50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	161.7	0.0	0.0	161.7
	52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.6	0.0	14.6	29.1
	66	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.1	0.0	13.1	26.3
	64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.7	0.0	10.8	32.5
	102	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	0.0	12.5	37.5
	56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	135.4	0.0	12.3	147.7
3a	75	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.9	0.0	11.9
	98	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.9	0.0	23.9
	106	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.8	0.0	11.8
	60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.5	0.0	11.5
	10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.3	0.0	12.3
	55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.5	0.0	12.5
	53	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.2	0.0	13.2
	35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.5	0.0	14.5
	78	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.9	0.0	9.9
	32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.9	0.0	24.9
	39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.3	0.0	23.3
	72	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	78.5	0.0	78.5
	108	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	74.3	0.0	98.6
	69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.0	0.0	68.0
	122	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.9	0.0	68.9
	118	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.7	0.0	52.7
	104	14.3	0.0	0.0	0.0	0.0	14.3	0.0	0.0	14.3	0.0	42.9
	107	0.0	0.0	0.0	0.0	0.0	24.9	0.0	0.0	12.4	0.0	37.3
3b	86	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.3	14.3	28.6
	74	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.7	13.7	27.4
	97	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.2	26.2	52.5
	112	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.7	35.0	46.6
	36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.3	13.3
	114	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.1	42.1
4a	19	0.0	0.0	0.0	1045.0	1216.0	0.0	0.0	0.0	0.0	0.0	2261.0
	26	0.0	0.0	0.0	470.8	4016.0	0.0	0.0	0.0	0.0	0.0	4487.0
	20	0.0	0.0	0.0	75.5	3822.0	0.0	0.0	0.0	0.0	0.0	3898.0
	18	0.0	0.0	0.0	228.1	384.2	0.0	0.0	0.0	0.0	0.0	612.3
	42	25.9	0.0	0.0	931.0	3310.0	0.0	0.0	0.0	0.0	0.0	4306.0
	41	12.4	24.7	0.0	1290.0	16737.0	0.0	0.0	86.6	12.4	0.0	18172.0
	65	11.7	35.2	0.0	70.3	175.8	0.0	0.0	70.3	11.7	0.0	375.0
	124	0.0	0.0	0.0	24.4	158.8	36.7	1039.0	48.9	146.6	0.0	1454.0
	40	0.0	11.2	0.0	0.0	44.7	0.0	0.0	0.0	22.3	0.0	89.3
	103	306.3	0.0	0.0	0.0	47.1	0.0	0.0	0.0	0.0	0.0	353.4
4b	46	262.6	395.7	26.3	127.2	18025.0	0.0	0.0	0.0	0.0	0.0	18859.0
	61	598.5	254.7	0.0	547.8	9347.0	0.0	0.0	0.0	0.0	0.0	10748.0
	62	1775.0	347.6	173.8	484.1	868.9	24.8	0.0	0.0	0.0	0.0	3674.0
	15	28.9	43.3	14.4	43.3	3190.0	14.4	0.0	0.0	0.0	0.0	3334.0
	67	299.0	22.1	11.1	77.5	498.4	0.0	0.0	0.0	0.0	0.0	908.1
	47	64.5	161.2	48.4	0.0	19780.0	0.0	0.0	0.0	0.0	0.0	20054.0
	80	54.5	305.3	10.9	0.0	42059.0	0.0	0.0	0.0	0.0	0.0	42440.0
	28	13.3	26.7	0.0	0.0	320.2	0.0	0.0	0.0	0.0	0.0	360.2
4c	1	13.4	0.0	0.0	200.5	173.7	13.4	0.0	0.0	0.0	0.0	414.3
	126	0.0	0.0	0.0	23.5	35.2	11.7	0.0	0.0	0.0	0.0	70.4
	88	35.9	0.0	0.0	23.9	0.0	23.9	0.0	0.0	0.0	0.0	83.8
	93	0.0	0.0	0.0	14.1	0.0	0.0	0.0	0.0	0.0	0.0	28.3
	37	0.0	0.0	0.0	65.5	0.0	0.0	0.0	0.0	0.0	0.0	65.5
4d	2	0.0	0.0	0.0	0.0	87.9	0.0	0.0	0.0	0.0	0.0	87.9
	21	0.0	0.0	0.0	0.0	109.5	0.0	0.0	0.0	0.0	0.0	109.5
	63	0.0	0.0	0.0	0.0	33.8	0.0	0.0	0.0	0.0	0.0	33.8
	27	0.0	0.0	0.0	0.0	11.0	0.0	0.0	0.0	0.0	0.0	11.0
	99	0.0	0.0	0.0	0.0	10.9	0.0	0.0	0.0	0.0	0.0	10.9

Appendix Table 10.

Two-way coincidence table of species abundance (no./1000m^3) among station groups for larvae in neuston samples, Cruise DA81, October/November 1981. Numbers in species groups are species codes. See list accompanying Appendix Table 1 for interpretation.

STATION GROUPS		SPECIES GROUPS 1				2				
		171	273	287	162	178	263	177	290	TOTAL
1	39	0.0	11.6	279.5	0.0	0.0	0.0	0.0	0.0	291.1
	70	0.0	25.4	165.4	0.0	0.0	0.0	0.0	0.0	190.9
	58	0.0	12.3	86.1	0.0	0.0	0.0	0.0	0.0	98.4
	122	0.0	13.4	107.0	0.0	0.0	0.0	0.0	0.0	120.4
	51	0.0	11.4	45.5	0.0	0.0	0.0	0.0	0.0	56.9
	119	0.0	11.4	34.2	0.0	0.0	0.0	0.0	0.0	68.5
	92	0.0	11.3	22.5	0.0	0.0	0.0	0.0	0.0	45.0
	44	0.0	24.0	35.9	0.0	0.0	0.0	0.0	0.0	59.9
	66	0.0	11.7	129.2	0.0	11.7	0.0	0.0	0.0	164.4
	108	0.0	11.8	11.8	0.0	0.0	0.0	11.8	0.0	35.4
	69	0.0	23.0	114.9	80.5	0.0	0.0	0.0	0.0	218.4
	109	0.0	12.4	37.1	180.9	0.0	0.0	0.0	0.0	247.5
	46	15.1	30.1	15.1	0.0	0.0	0.0	0.0	0.0	75.3
	49	12.7	25.4	50.8	0.0	0.0	0.0	0.0	0.0	88.9
	59	32.7	21.8	54.5	0.0	10.9	0.0	0.0	0.0	119.9
	40	11.2	22.3	0.0	0.0	0.0	0.0	0.0	0.0	33.5
	45	27.3	13.7	0.0	0.0	0.0	0.0	0.0	13.7	54.7
	18	0.0	16.1	0.0	0.0	0.0	0.0	0.0	0.0	16.1
	89	0.0	14.9	0.0	0.0	0.0	0.0	0.0	0.0	29.7
	43	0.0	10.9	0.0	0.0	0.0	0.0	0.0	0.0	10.9
	63	0.0	55.9	0.0	0.0	11.2	0.0	0.0	0.0	111.8
2	2	0.0	0.0	0.0	0.0	29.3	0.0	0.0	0.0	29.3
	4	0.0	0.0	0.0	0.0	31.2	0.0	0.0	0.0	31.2
	3	0.0	0.0	0.0	0.0	20.8	0.0	0.0	0.0	83.1
	5	0.0	0.0	0.0	0.0	211.7	0.0	0.0	0.0	211.7
	10	0.0	0.0	0.0	12.3	12.3	0.0	0.0	0.0	24.5
	84	0.0	0.0	0.0	51.2	0.0	0.0	0.0	0.0	51.2
	88	0.0	0.0	0.0	0.0	12.0	0.0	95.7	0.0	107.7
	125	0.0	0.0	0.0	0.0	0.0	0.0	82.2	0.0	82.2
	124	0.0	0.0	0.0	0.0	36.7	48.9	537.6	0.0	647.6
3	94	12.1	0.0	12.1	0.0	0.0	0.0	0.0	0.0	24.2
	101	24.9	0.0	37.3	0.0	0.0	0.0	0.0	0.0	62.2
	56	28.6	0.0	42.8	0.0	0.0	14.3	0.0	0.0	85.7
	102	0.0	0.0	175.1	0.0	0.0	12.5	0.0	0.0	187.7
	60	0.0	0.0	32.7	0.0	10.9	10.9	0.0	10.9	65.4
	81	0.0	0.0	11.8	0.0	47.3	0.0	0.0	11.8	71.0
	47	0.0	0.0	32.2	0.0	48.4	112.8	0.0	2982.0	3192.0
	33	13.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.1
	62	12.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.8
4	17	0.0	0.0	14.0	0.0	0.0	0.0	0.0	14.0	28.0
	41	0.0	0.0	24.7	0.0	0.0	0.0	0.0	12.4	37.1
	26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.7	26.7
	35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.3	13.3
	25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	308.9	323.8
	48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	452.2	452.2
	61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	152.8	152.8
	42	0.0	194.0	0.0	0.0	0.0	0.0	0.0	284.5	478.4
5a	52	0.0	0.0	58.3	0.0	0.0	0.0	0.0	0.0	58.3
	117	0.0	0.0	58.8	0.0	0.0	0.0	0.0	0.0	58.8
	99	0.0	0.0	56.8	0.0	0.0	0.0	0.0	0.0	124.6
	50	0.0	0.0	51.9	0.0	0.0	0.0	0.0	0.0	51.9
	121	0.0	0.0	53.4	0.0	0.0	0.0	0.0	0.0	53.4
	76	0.0	0.0	49.3	0.0	0.0	0.0	0.0	0.0	49.3
	110	0.0	0.0	49.7	0.0	0.0	0.0	0.0	0.0	49.7
	96	0.0	0.0	47.7	0.0	0.0	0.0	0.0	0.0	83.5
	72	0.0	0.0	44.9	0.0	0.0	0.0	0.0	0.0	44.9
	23	0.0	0.0	37.0	0.0	0.0	0.0	0.0	0.0	37.0
	55	0.0	0.0	37.5	0.0	0.0	0.0	0.0	0.0	37.5
	97	0.0	0.0	39.4	0.0	0.0	0.0	0.0	0.0	39.4
	57	0.0	0.0	23.7	0.0	0.0	0.0	0.0	0.0	23.7
	100	0.0	0.0	24.0	0.0	0.0	0.0	0.0	0.0	36.0
	37	0.0	0.0	20.4	0.0	0.0	0.0	0.0	0.0	20.4
	54	0.0	0.0	27.4	0.0	0.0	0.0	0.0	0.0	27.4
	90	0.0	0.0	27.8	0.0	0.0	0.0	0.0	0.0	27.8
	65	0.0	0.0	72.8	0.0	0.0	0.0	0.0	0.0	72.8
	123	0.0	0.0	71.4	0.0	0.0	0.0	0.0	0.0	71.4
	85	0.0	0.0	64.8	0.0	0.0	0.0	0.0	0.0	64.6
	78	0.0	0.0	94.7	0.0	0.0	0.0	0.0	0.0	94.7
	106	0.0	0.0	82.8	0.0	0.0	0.0	0.0	0.0	82.8
	71	0.0	0.0	114.0	0.0	0.0	0.0	0.0	0.0	114.0
	77	0.0	0.0	108.4	0.0	0.0	0.0	0.0	0.0	108.4
	93	0.0	0.0	119.1	0.0	0.0	0.0	0.0	0.0	119.1
	118	0.0	0.0	122.6	0.0	0.0	0.0	0.0	0.0	134.9
	105	0.0	0.0	173.7	0.0	0.0	0.0	0.0	0.0	173.7
5b	13	0.0	0.0	14.2	0.0	0.0	0.0	0.0	0.0	14.2
	114	0.0	0.0	14.0	0.0	0.0	0.0	0.0	0.0	14.0
	14	0.0	0.0	15.1	0.0	0.0	0.0	0.0	0.0	15.1
	83	0.0	0.0	15.2	0.0	0.0	0.0	0.0	0.0	15.2
	95	0.0	0.0	13.1	0.0	0.0	0.0	0.0	0.0	26.3
	116	0.0	0.0	13.2	0.0	0.0	0.0	0.0	0.0	13.2
	115	0.0	0.0	12.8	0.0	0.0	0.0	0.0	0.0	25.7
	53	0.0	0.0	11.7	0.0	0.0	0.0	0.0	0.0	11.7
	112	0.0	0.0	11.7	0.0	0.0	0.0	0.0	0.0	11.7
	75	0.0	0.0	11.9	0.0	0.0	0.0	0.0	0.0	11.9
	111	0.0	0.0	11.8	0.0	0.0	0.0	0.0	0.0	11.8
	34	0.0	0.0	12.2	0.0	0.0	0.0	0.0	0.0	12.2
	73	0.0	0.0	12.1	0.0	0.0	0.0	0.0	0.0	12.1
	27	0.0	0.0	11.0	0.0	0.0	0.0	0.0	0.0	11.0

Appendix Table 11.

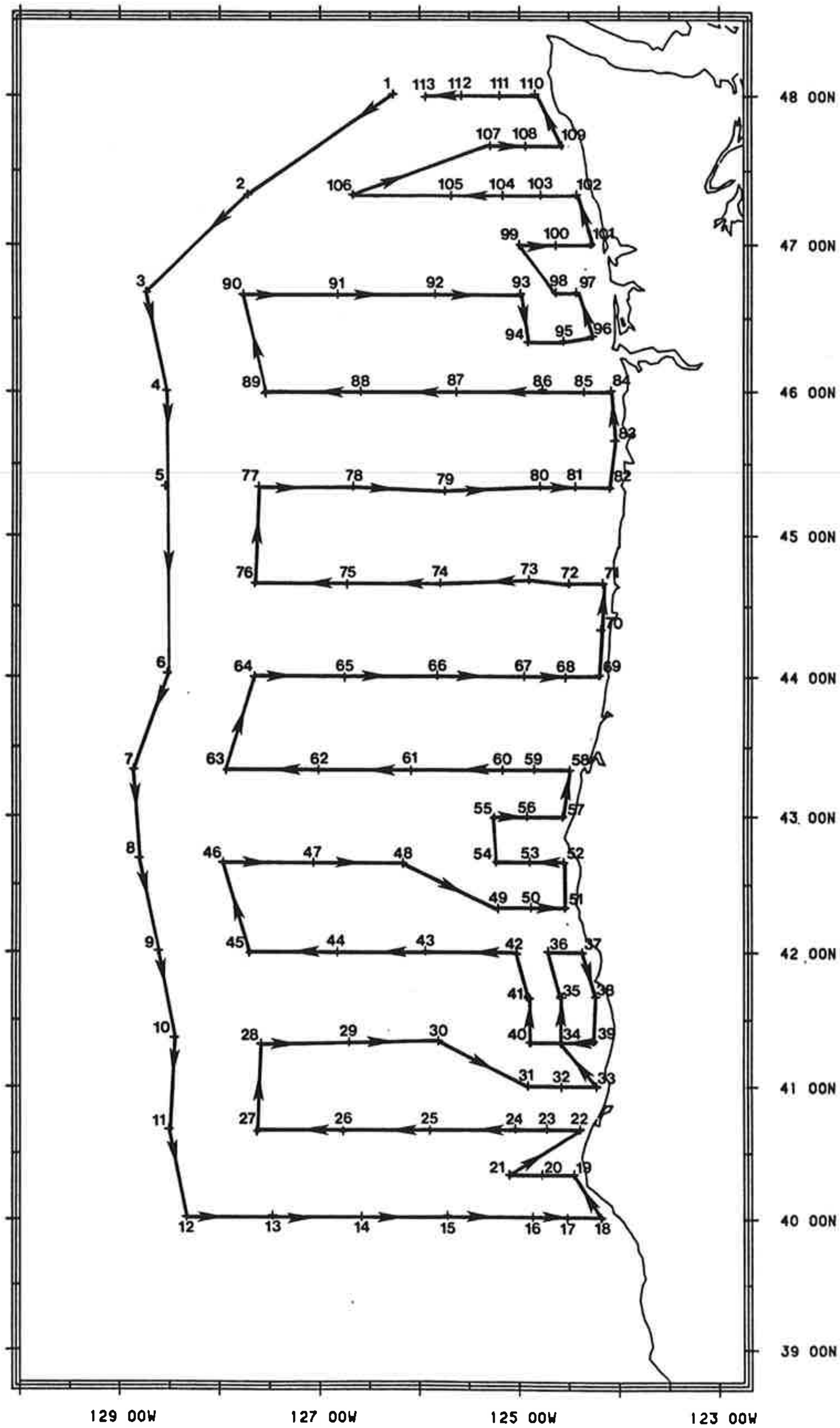
Two-way coincidence table of species abundance (no./10m^2) among station groups for eggs in bongo samples, cruise DA81, October/November/1981. Numbers in species groups are species codes. See list accompanying Appendix Table 1 for interpretation.

STATION GROUPS		SPECIES GROUPS 1: 150	151	156	274	285	322	271	2: 235	244	247	263	293	TOTAL
1a	98	26.9	20.1	0.0	6.7	13.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	67.1
	99	13.1	32.8	0.0	6.6	13.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	65.6
	111	126.0	24.5	7.0	3.5	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	168.1
	121	17.3	23.0	5.8	5.8	57.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	115.2
	44	25.9	6.5	19.4	71.2	19.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	142.4
	70	39.8	17.1	22.7	45.5	5.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	130.7
	83	5.8	5.8	0.0	17.3	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.6
	85	0.0	24.5	0.0	12.2	18.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.1
	93	11.6	5.8	0.0	0.0	17.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.8
	106	12.7	6.4	0.0	0.0	6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.2
	116	17.7	11.8	5.9	0.0	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.1
	120	14.6	4.9	9.7	0.0	14.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.9
	30	6.6	0.0	13.3	6.6	13.3	6.6	0.0	0.0	0.0	0.0	0.0	0.0	46.4
	53	10.7	0.0	10.7	5.4	10.7	10.7	0.0	0.0	0.0	0.0	0.0	0.0	48.2
	101	10.7	0.0	5.3	5.3	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.1
	123	6.5	0.0	13.0	0.0	39.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	65.0
	97	13.7	0.0	0.0	6.9	13.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.4
	118	77.5	0.0	0.0	6.5	45.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	135.7
1b	90	129.4	14.9	14.9	5.0	5.0	5.0	5.0	0.0	0.0	0.0	0.0	0.0	179.1
	119	115.4	19.2	38.5	12.8	6.4	6.4	6.4	0.0	0.0	0.0	0.0	0.0	211.6
	38	48.2	6.9	13.8	27.6	0.0	6.9	6.9	0.0	0.0	0.0	0.0	0.0	110.2
	54	54.3	6.8	20.4	27.1	27.1	20.4	0.0	0.0	0.0	0.0	0.0	0.0	162.9
	117	73.9	0.0	13.4	13.4	26.9	6.7	6.7	0.0	0.0	0.0	0.0	0.0	141.1
	124	97.8	13.0	19.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.6	6.5	156.5
	65	34.0	11.3	0.0	68.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	119.1
	79	40.2	28.7	0.0	5.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	74.7
	91	10.8	10.8	0.0	16.2	0.0	0.0	5.4	0.0	0.0	0.0	0.0	0.0	48.5
	29	16.6	16.6	0.0	11.1	0.0	61.0	0.0	0.0	0.0	0.0	0.0	0.0	105.4
	32	6.5	6.5	19.5	0.0	0.0	19.5	0.0	0.0	0.0	0.0	0.0	0.0	52.1
	73	6.4	6.4	19.3	0.0	6.4	6.4	0.0	0.0	0.0	0.0	0.0	0.0	45.0
	71	6.7	6.7	0.0	0.0	0.0	6.7	0.0	0.0	0.0	0.0	0.0	0.0	20.0
	36	22.8	0.0	0.0	0.0	0.0	22.8	0.0	0.0	0.0	0.0	0.0	0.0	45.7
	35	46.6	11.6	34.9	0.0	0.0	93.2	0.0	0.0	0.0	0.0	0.0	0.0	192.1
	112	17.3	0.0	25.9	0.0	8.6	51.8	0.0	0.0	0.0	0.0	0.0	0.0	146.8
	74	0.0	0.0	29.6	0.0	0.0	82.8	0.0	0.0	0.0	0.0	0.0	0.0	112.4
1c	10	13.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.4
	33	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7
	7	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	20.1
	23	5.7	0.0	0.0	5.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	17.0
	52	6.0	0.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.9
1d	31	21.6	0.0	5.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.8
	77	19.6	0.0	13.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.6
	8	4.9	0.0	9.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.7
	17	0.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6
	122	0.0	0.0	4.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.3
2	86	0.0	5.1	15.3	10.2	10.2	0.0	10.2	0.0	0.0	0.0	0.0	0.0	50.9
	110	0.0	18.5	18.5	6.2	6.2	0.0	12.3	0.0	0.0	0.0	0.0	0.0	73.9
	113	0.0	30.3	7.6	7.6	15.1	22.7	15.1	0.0	0.0	0.0	0.0	0.0	105.9
	109	0.0	8.7	0.0	0.0	8.7	8.7	8.7	0.0	0.0	0.0	0.0	0.0	52.4
	56	0.0	10.0	10.0	0.0	10.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0
	72	0.0	0.0	6.2	0.0	12.3	6.2	0.0	0.0	0.0	0.0	0.0	0.0	24.7
	34	0.0	0.0	8.5	0.0	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.8
	37	13.3	0.0	0.0	6.6	6.6	26.6	0.0	0.0	0.0	0.0	0.0	0.0	53.2
	94	6.2	0.0	0.0	6.2	6.2	81.1	0.0	0.0	0.0	0.0	0.0	0.0	99.8
	51	12.4	0.0	0.0	12.4	6.2	6.2	0.0	0.0	0.0	0.0	0.0	0.0	37.1
	84	0.0	0.0	0.0	13.3	6.6	6.6	0.0	0.0	0.0	0.0	0.0	0.0	26.6
	39	0.0	0.0	0.0	0.0	4.7	4.7	0.0	0.0	0.0	0.0	0.0	0.0	9.4
	76	0.0	0.0	0.0	0.0	5.3	16.0	0.0	0.0	0.0	0.0	0.0	0.0	21.3
	95	0.0	0.0	0.0	0.0	12.3	24.5	0.0	0.0	0.0	0.0	6.1	0.0	49.1
	11	0.0	0.0	0.0	0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0
	43	0.0	0.0	0.0	0.0	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.7
	114	0.0	0.0	0.0	0.0	8.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.9
	59	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0
3	89	0.0	0.0	0.0	5.7	5.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4
	102	0.0	0.0	0.0	5.3	10.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.9
	49	0.0	0.0	0.0	26.3	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8
	78	0.0	5.9	11.9	11.9	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.6
	92	0.0	0.0	13.1	6.6	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.3
	58	0.0	0.0	23.1	34.7	28.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	92.5
	68	0.0	0.0	0.0	10.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6
	100	0.0	0.0	0.0	14.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.5
	64	0.0	0.0	0.0	5.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7
	67	0.0	0.0	0.0	4.6	0.0	0.0	0.0	4.6	0.0	0.0	0.0	0.0	9.2
	50	0.0	0.0	0.0	32.5	0.0	0.0	5.4	0.0	0.0	0.0	0.0	0.0	37.9
4	45	0.0	0.0	0.0	0.0	0.0	9.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0
	115	0.0	0.0	0.0	0.0	0.0	9.3	0.0	0.0	0.0	0.0	0.0	0.0	13.9
	57	0.0	0.0	0.0	0.0	0.0	6.1	0.0	0.0	0.0	0.0	0.0	0.0	6.1
	75	0.0	0.0	0.0	0.0	0.0	41.4	0.0	0.0	0.0	0.0	0.0	0.0	41.4
	96	0.0	0.0	0.0	0.0	0.0	42.9	0.0	0.0	0.0	0.0	0.0	0.0	42.9
5	20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.6	387.5	420.1
	25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.1	209.5	247.6
	19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	92.0	237.6	329.6
	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.7	67.9	99.5
	15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.8	0.0	13.1	479.8	514.7
	16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	5.0	94.7	114.7
	41	0.0	0.0	0.0	12.5	0.0	0.0	0.0	0.0	0.0	0.0	131.7	1455.0	1611.0
	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.9	17.9
	21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	5.7
	80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.8
	87	0.0	0.0	0.0	0.0	0.0	0.0	5.7	0.0	0.0	0.0	5.7	0.0	11.3
6	42	0.0	0.0	0.0	5.9	0.0	0.0	0.0	41.4	17.7	5.9	59.1	887.0	1017.0
	48	0.0	0.0	0.0	4.7	0.0	0.0	0.0	131.8	141.2	4.7	61.2	4943.0	5282.0
	61	0.0	0.0	0.0	0.0	4.8	0.0	0.0	217.9	67.8	14.5	159.8	1245.0	1710.0
	62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	591.6	46.6	4.7	69.9	335.4	1062.0
	47	0.0	0.0	0.0	4.8	0.0	0.0	0.0	48.0	72.0	38.4	4.8	4462.0	4634.0
	60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	242.1	31.9	0.0	0.0	6123.0	6398.0
	26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.2	11.3	0.0	0.0	62.1	101.6
	27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.9	12.0	0.0	0.0	41.9	89.8
	103	0.0	0.0	0.0	0.0	0.0	0.0	0.0	104.9	0.0	0.0	0.0	31.5	136.4
	81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.6	5.8	0.0	0.0	0.0	17.4

Appendix Table 12.

Two-way coincidence table of species abundance (no./10m^2) among station groups for larvae in bongo samples, cruise DA81, October/November 1981. Numbers in species groups are species codes. See list accompanying Appendix Table 1 for interpretation.

STATION GROUPS		SPECIES GROUPS 1a					1b		2				3			
		272	288	156	162	163	164	152	171	263	234	279	213	290	274	TOTAL
1	34	4.3	8.5	4.3	25.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.7
	116	5.9	11.8	5.9	5.9	11.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.3
	7	0.0	5.0	0.0	45.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.3
	98	0.0	6.7	0.0	6.7	20.1	0.0	6.7	0.0	0.0	13.4	6.7	0.0	0.0	13.4	87.3
	119	0.0	12.8	0.0	19.2	6.4	0.0	0.0	0.0	0.0	0.0	12.8	0.0	0.0	6.4	57.7
	117	0.0	0.0	6.7	20.2	6.7	0.0	0.0	0.0	0.0	13.4	0.0	0.0	0.0	26.9	80.6
	66	0.0	5.3	0.0	10.6	5.3	5.3	0.0	10.6	0.0	0.0	5.3	0.0	0.0	0.0	42.5
	68	0.0	0.0	0.0	4.6	9.2	4.6	0.0	4.6	0.0	0.0	9.2	0.0	0.0	0.0	32.2
	79	0.0	23.0	0.0	114.9	11.5	5.7	0.0	0.0	5.7	0.0	5.7	0.0	0.0	0.0	183.9
	94	0.0	18.7	0.0	6.2	6.2	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.9
	8	0.0	0.0	0.0	9.8	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.5
	120	0.0	0.0	0.0	9.7	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.6
	73	0.0	0.0	0.0	6.4	6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.3
	121	0.0	0.0	0.0	11.5	23.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.6
	83	0.0	0.0	23.0	5.8	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.3
	118	0.0	0.0	6.5	6.5	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.4
	90	0.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	14.9
	91	0.0	0.0	0.0	0.0	5.4	0.0	0.0	0.0	0.0	5.4	0.0	0.0	0.0	0.0	16.2
	100	0.0	0.0	0.0	0.0	7.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.2
	11	0.0	0.0	0.0	0.0	0.0	7.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.9
	12	0.0	0.0	0.0	0.0	0.0	0.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6
	51	0.0	0.0	0.0	6.2	0.0	0.0	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.6
	86	0.0	0.0	0.0	5.1	20.4	0.0	5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.5
	95	0.0	0.0	0.0	0.0	18.4	12.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.9
	114	0.0	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5
	74	11.8	0.0	0.0	0.0	17.7	0.0	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.5
	111	10.5	0.0	0.0	7.0	14.0	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	3.5	38.5
	38	13.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.8
2	17	0.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	0.0	11.2	16.8	0.0	5.6	0.0	39.2
	39	0.0	0.0	4.7	0.0	0.0	0.0	0.0	0.0	0.0	9.4	0.0	0.0	0.0	0.0	14.1
	113	0.0	15.1	7.6	0.0	15.1	0.0	0.0	0.0	0.0	7.6	0.0	0.0	0.0	0.0	45.4
	15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	0.0	0.0	0.0	0.0	4.4
	28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.4	0.0	0.0	0.0	0.0	13.4
	70	0.0	0.0	0.0	5.7	0.0	0.0	0.0	0.0	0.0	5.7	5.7	0.0	0.0	0.0	28.4
	123	0.0	0.0	0.0	13.0	0.0	0.0	0.0	0.0	0.0	6.5	13.0	0.0	0.0	0.0	32.5
	92	0.0	0.0	0.0	6.6	0.0	0.0	0.0	6.6	0.0	6.6	13.1	0.0	0.0	0.0	46.0
	106	0.0	0.0	0.0	6.4	0.0	0.0	0.0	0.0	0.0	6.4	0.0	0.0	0.0	0.0	12.7
	71	0.0	0.0	6.7	13.3	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0	0.0	0.0	26.6
	75	0.0	0.0	6.9	20.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.6
	54	0.0	0.0	6.8	13.6	0.0	0.0	0.0	13.6	0.0	0.0	0.0	0.0	0.0	0.0	40.7
	84	0.0	0.0	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.6
3	21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	0.0	5.7
	47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.0	0.0	24.0
	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.0	0.0	0.0	9.7	0.0	14.5
	77	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.5	0.0	0.0	6.5	13.1
	99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.1	13.1
	81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.8	0.0	0.0	0.0	0.0	5.8	11.6
	87	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	0.0	0.0	5.7
	88	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	0.0	0.0	11.4
	96	0.0	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.3
	112	0.0	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.3
	76	5.3	10.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.3
4	57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.1	0.0	0.0	0.0	0.0	0.0	0.0	18.2
	105	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0
	29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	0.0	0.0	0.0	0.0	0.0	0.0	5.5
	14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.2	0.0	0.0	0.0	0.0	0.0	0.0	11.2
	107	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.3	0.0	0.0	0.0	0.0	0.0	0.0	18.5
	60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.2	0.0	0.0	0.0	0.0	0.0	0.0	44.6
	108	0.0	0.0	6.5	0.0	0.0	0.0	0.0	58.9	0.0	0.0	0.0	0.0	0.0	0.0	78.5
	53	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7	0.0	5.4	0.0	0.0	0.0	0.0	16.1
	63	0.0	0.0	0.0	5.1	0.0	0.0	0.0	20.3	5.1	5.1	0.0	0.0	0.0	0.0	35.6
	26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	5.6	0.0	0.0	0.0	0.0	0.0	11.3
	64	0.0	0.0	0.0	17.1	11.4	0.0	0.0	85.3	0.0	0.0	0.0	0.0	0.0	0.0	113.8
	109	0.0	0.0	0.0	26.2	17.5	0.0	0.0	17.5	0.0	0.0	0.0	0.0	0.0	0.0	104.8
	69	0.0	0.0	0.0	16.5	16.5	0.0	0.0	22.0	0.0	11.0	0.0	0.0	0.0	0.0	66.0
	67	0.0	0.0	0.0	0.0	4.6	0.0	0.0	9.2	0.0	0.0	0.0	0.0	0.0	4.6	18.3
	80	0.0	0.0	0.0	0.0	6.6	0.0	0.0	19.8	0.0	0.0	0.0	6.6	0.0	0.0	32.9
	41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.1	319.8	6.3	0.0	0.0	0.0	6.3	420.1
	45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	63.2	279.7	0.0	0.0	0.0	0.0	0.0	342.9
	124	0.0	0.0	0.0	0.0	6.5	0.0	6.5	143.4	391.2	6.5	0.0	13.0	0.0	0.0	567.2
	122	0.0	0.0	0.0	9.3	0.0	0.0	4.7	219.5	9.3	0.0	0.0	0.0	0.0	0.0	256.8
	48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.4	18.8	0.0	0.0	14.1	4.7	4.7	56.5
	61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.7	29.1	0.0	0.0	4.8	9.7	9.7	63.0
5	46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.5	28.7	11.5	34.4	0.0	0.0	0.0	86.0
	59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.1	6.0	6.0	30.1	0.0	0.0	0.0	60.2
	40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	70.1	11.7	17.5	5.8	0.0	0.0	0.0	116.9
	56	0.0	0.0	0.0	35.0	0.0	0.0	0.0	20.0	55.0	15.0	10.0	0.0	0.0	0.0	135.0
	49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.3	0.0	10.5	5.3	0.0	0.0	5.3	73.6
	58	0.0	0.0	0.0	0.0	0.0	5.8	0.0	28.9	0.0	5.8	11.6	0.0	0.0	0.0	52.0
	43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.3	0.0	0.0	30.6	0.0	0.0	0.0	45.9
	65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.3	0.0	0.0	11.3	0.0	0.0	0.0	28.3
	50	0.0	0.0	0.0	5.4	0.0	0.0	0.0	16.3	0.0	0.0	5.4	0.0	0.0	0.0	32.5
	102	0.0	0.0	5.3	0.0	0.0	0.0	0.0	5.3	0.0	0.0	10.6	0.0	0.0	0.0	42.3
	22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	0.0	0.0	0.0	5.5
	23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	0.0	0.0	0.0	5.7
	97	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.9	0.0	0.0	0.0	6.9
	101	0.0	0.0	0.0	0.0	5.3	0.0	0.0	0.0	0.0	0.0	10.7	0.0	0.0	0.0	26.7
	24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4	5.7	28.6	0.0	0.0	0.0	45.8
	27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.0	0.0	23.9	0.0	0.0	0.0	41.9
	44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.5	0.0	6.5	0.0	0.0	0.0	12.9
	42	0.0	0.0	0.0	5.9	0.0	0.0	0.0	0.0	437.6	0.0	5.9	0.0	5.9	0.0	467.1
6	18	0.0	0.0	0.0	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.8
	35	0.0	0.0	0.0	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.6
	31	0.0	0.0	0.0	5.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4
	10	0.0	0.0	0.0	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7
	72	0.0	0.0	0.0	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.2
	9	0.0	0.0	0.0	19.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.0
	33	0.0	0.0	0.0	20.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.6
	30	0.0	0.0	0.0	13.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.3



Appendix Figure 4.
Sampling stations, positions, and cruise track for cruise MF83 (November/December 1983).

Appendix Table 13

Two-way coincidence table of species abundance (no./1000m^3) among station groups for eggs in neuston samples, cruise MF83, November/December 1983. Numbers in species groups are species codes. See list accompanying Appendix Table 1 for interpretation.

STATION GROUPS		SPECIES GROUPS 1						2			
		244	263	247	235	293	299	274	285	156	TOTAL
1a	12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.8	12.6	50.3
	65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.4	14.5	57.9
	63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.4	12.7	38.1
	43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.5	35.5	71.1
	11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1	11.1	22.1
	76	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7	64.3	75.0
	21	0.0	0.0	0.0	0.0	0.0	0.0	13.4	26.7	13.4	53.5
	30	0.0	0.0	0.0	0.0	0.0	0.0	13.6	27.2	13.6	68.1
	64	0.0	0.0	0.0	0.0	0.0	0.0	12.5	37.6	12.5	62.7
	29	0.0	0.0	0.0	0.0	0.0	0.0	516.1	132.0	12.0	684.2
	44	0.0	0.0	0.0	0.0	0.0	0.0	87.3	37.4	12.5	149.7
	75	0.0	0.0	0.0	0.0	0.0	0.0	16.8	0.0	50.4	67.2
1b	28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	25.0
	91	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.3	25.3
	87	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.6	24.6
	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.0	46.0
	80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0	13.0
	92	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.4	12.4
	27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.5	11.5
	60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	15.0
2a	70	26.1	52.2	78.3	822.1	13.0	26.1	0.0	0.0	0.0	1017.8
	71	53.0	39.8	119.3	808.4	13.3	0.0	0.0	0.0	0.0	1033.7
	83	20.7	371.9	0.0	155.0	196.3	72.3	0.0	0.0	0.0	816.1
	84	24.2	434.9	36.2	712.7	906.0	12.1	0.0	0.0	0.0	2150.3
	82	11.8	0.0	0.0	260.1	106.4	0.0	0.0	0.0	0.0	378.3
	100	0.0	0.0	67.0	346.2	78.2	0.0	0.0	0.0	0.0	491.4
	95	10.9	10.9	21.9	10.9	54.7	0.0	0.0	0.0	0.0	120.4
	37	0.0	256.9	0.0	0.0	145.2	0.0	0.0	0.0	0.0	413.3
	38	0.0	50.9	0.0	25.4	25.4	0.0	0.0	0.0	0.0	101.7
2b	86	0.0	0.0	0.0	0.0	12.6	0.0	0.0	0.0	0.0	12.6
	99	0.0	0.0	0.0	0.0	34.1	0.0	0.0	0.0	0.0	34.1
	111	0.0	0.0	13.0	0.0	273.8	0.0	0.0	0.0	0.0	286.8
	39	0.0	0.0	0.0	0.0	12.5	0.0	0.0	12.5	0.0	24.9
	53	0.0	0.0	0.0	0.0	36.5	0.0	36.5	12.2	0.0	85.3
3	52	0.0	0.0	0.0	13.0	0.0	13.0	0.0	0.0	0.0	25.9
	68	0.0	0.0	0.0	25.2	0.0	12.6	0.0	0.0	0.0	37.7
	58	0.0	0.0	0.0	36.5	0.0	0.0	0.0	0.0	0.0	36.5
	101	0.0	0.0	0.0	25.3	0.0	0.0	0.0	0.0	0.0	25.3
	56	0.0	0.0	0.0	0.0	0.0	10.2	0.0	0.0	0.0	10.2
	57	0.0	0.0	0.0	0.0	0.0	12.9	0.0	0.0	0.0	12.9
4	10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.7	0.0	11.7
	107	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.7	0.0	11.7
	79	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.5	0.0	34.4
	90	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.1	0.0	24.1
	34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.8	0.0	12.8
	41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.8	0.0	12.8
	89	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.9	0.0	12.9
	26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.6	0.0	12.6
	14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.2	0.0	11.2
	88	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.2	0.0	11.2
	15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.0	0.0	11.0
	77	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	0.0	42.5
	40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.3	0.0	14.3
	48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	0.0	14.0
	13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	54.4	0.0	54.4
	18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.8	0.0	51.8
	17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.9	0.0	44.9
	62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.5	0.0	59.3
	61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.3	0.0	36.3
	66	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.9	0.0	34.9
	16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.9	0.0	38.9
	23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.8	0.0	25.8
	78	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.0	0.0	26.0
	24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.0	0.0	24.0
5	45	0.0	0.0	0.0	0.0	0.0	0.0	24.9	12.4	0.0	37.3
	55	0.0	0.0	0.0	0.0	0.0	0.0	25.7	12.8	0.0	38.5
	35	0.0	0.0	0.0	0.0	0.0	0.0	34.5	11.5	0.0	46.0
	49	0.0	0.0	0.0	0.0	0.0	0.0	20.5	10.2	0.0	30.7
	31	0.0	0.0	0.0	0.0	0.0	0.0	10.6	10.6	0.0	21.2
	36	0.0	0.0	0.0	0.0	0.0	0.0	9.9	9.9	0.0	19.7
	50	0.0	0.0	0.0	0.0	0.0	0.0	11.9	11.9	0.0	23.8
	42	0.0	0.0	0.0	0.0	0.0	0.0	11.5	34.5	0.0	46.0
	47	0.0	0.0	0.0	0.0	0.0	0.0	10.6	31.8	0.0	42.4
	54	0.0	0.0	0.0	0.0	0.0	0.0	13.5	53.9	0.0	67.3
	74	0.0	0.0	0.0	0.0	0.0	0.0	13.0	39.0	0.0	51.9
	25	0.0	0.0	0.0	0.0	0.0	0.0	26.2	39.3	0.0	65.5
	59	0.0	0.0	0.0	0.0	0.0	0.0	75.4	25.1	0.0	100.5

Appendix Table 14.

Two-way coincidence table of species abundance (no./1000m^3) among station groups for larvae in neuston samples, cruise MF83, November/December 1983. Numbers in species groups are species codes. See list accompanying Appendix Table 1 for interpretation.

		SPECIES GROUPS							
STATION		1					2		
GROUPS		178	273	171	177	234	162	287	TOTAL
1a	2	0.0	0.0	0.0	0.0	0.0	46.0	15.3	61.3
	75	0.0	0.0	0.0	0.0	0.0	33.6	16.8	50.4
	53	0.0	0.0	0.0	0.0	0.0	36.5	24.4	60.9
	106	0.0	0.0	0.0	0.0	0.0	22.3	22.3	44.5
	65	0.0	0.0	0.0	0.0	0.0	29.0	43.4	72.4
	81	0.0	0.0	0.0	0.0	0.0	36.4	36.4	72.9
	105	0.0	0.0	0.0	0.0	0.0	39.3	52.5	91.8
	60	0.0	0.0	0.0	0.0	0.0	90.1	30.0	120.1
	88	0.0	0.0	0.0	0.0	0.0	100.9	44.9	145.8
	92	0.0	0.0	0.0	0.0	0.0	61.8	24.7	86.5
	93	0.0	0.0	0.0	0.0	0.0	61.2	36.7	97.9
	55	0.0	0.0	0.0	0.0	0.0	231.2	25.7	256.9
	67	0.0	0.0	0.0	0.0	0.0	115.8	12.9	128.7
	87	0.0	0.0	0.0	0.0	0.0	73.9	12.3	86.2
	36	0.0	0.0	0.0	0.0	0.0	9.9	39.4	49.3
	47	0.0	0.0	0.0	0.0	0.0	10.6	31.8	42.4
	42	0.0	0.0	0.0	0.0	0.0	11.5	23.0	34.5
	6	0.0	0.0	0.0	0.0	0.0	16.5	16.5	33.1
	113	0.0	0.0	0.0	0.0	0.0	12.5	12.5	25.0
	61	0.0	0.0	0.0	0.0	0.0	12.1	84.6	96.7
	68	0.0	0.0	0.0	0.0	0.0	12.2	97.3	109.4
	50	0.0	0.0	0.0	11.9	0.0	119.0	202.3	333.2
	54	0.0	0.0	0.0	0.0	0.0	1252.1	13.5	1279.1
1b	5	0.0	0.0	0.0	0.0	0.0	186.7	0.0	186.7
	80	0.0	0.0	0.0	0.0	0.0	78.1	0.0	78.1
	66	0.0	0.0	0.0	0.0	0.0	34.9	0.0	34.9
	25	0.0	0.0	0.0	0.0	0.0	13.1	0.0	13.1
	104	0.0	0.0	0.0	0.0	0.0	12.5	0.0	12.5
	5	0.0	0.0	0.0	0.0	0.0	11.7	0.0	11.7
2	33	0.0	9.9	0.0	0.0	0.0	0.0	0.0	9.9
	39	0.0	24.9	0.0	0.0	0.0	0.0	0.0	24.9
	18	0.0	116.5	0.0	0.0	0.0	0.0	0.0	116.5
	83	10.3	20.7	0.0	0.0	0.0	0.0	0.0	31.0
	111	78.2	13.0	0.0	0.0	0.0	0.0	0.0	104.3
	19	0.0	360.2	0.0	11.6	0.0	0.0	23.2	
	34	0.0	25.5	0.0	0.0	0.0	0.0	12.8	38.3
	94	0.0	50.7	0.0	0.0	0.0	25.4	88.8	164.8
	29	0.0	0.0	12.0	0.0	0.0	0.0	48.0	60.0
	43	0.0	0.0	11.8	0.0	0.0	11.8	35.5	59.2
	79	0.0	0.0	11.5	0.0	0.0	0.0	0.0	11.5
	112	0.0	37.7	12.6	0.0	0.0	12.6	0.0	62.8
	84	12.1	0.0	0.0	0.0	0.0	0.0	0.0	36.2
	99	11.4	0.0	0.0	0.0	0.0	0.0	0.0	11.4
	86	12.6	0.0	0.0	0.0	0.0	0.0	25.2	37.8
	103	12.1	0.0	0.0	0.0	0.0	0.0	12.1	24.2
3	58	0.0	0.0	0.0	12.2	0.0	0.0	0.0	12.2
	69	0.0	0.0	0.0	12.6	0.0	0.0	0.0	12.6
	96	0.0	0.0	0.0	11.2	0.0	0.0	0.0	11.2
	98	0.0	0.0	0.0	11.7	0.0	0.0	0.0	11.7
	100	0.0	0.0	0.0	22.3	0.0	0.0	0.0	22.3
4a	7	0.0	0.0	0.0	0.0	0.0	0.0	23.3	23.3
	27	0.0	0.0	0.0	0.0	0.0	0.0	23.0	23.0
	62	0.0	0.0	0.0	0.0	0.0	0.0	23.7	23.7
	82	0.0	0.0	0.0	0.0	0.0	0.0	23.6	35.5
	9	0.0	0.0	0.0	0.0	0.0	0.0	20.7	20.7
	12	0.0	0.0	0.0	0.0	0.0	0.0	25.2	25.2
	59	0.0	0.0	0.0	0.0	0.0	0.0	25.1	25.1
	20	0.0	0.0	0.0	0.0	0.0	0.0	26.5	26.5
	30	0.0	0.0	0.0	0.0	0.0	0.0	27.2	27.2
	8	0.0	0.0	0.0	0.0	0.0	0.0	34.8	34.8
	11	0.0	0.0	0.0	0.0	0.0	0.0	33.2	33.2
	16	0.0	0.0	0.0	0.0	0.0	0.0	38.9	38.9
	71	0.0	0.0	0.0	0.0	0.0	0.0	39.8	39.8
	23	0.0	0.0	0.0	0.0	0.0	0.0	51.7	51.7
	46	0.0	0.0	0.0	0.0	0.0	0.0	50.7	50.7
	76	0.0	0.0	0.0	0.0	0.0	0.0	53.6	53.6
	24	0.0	0.0	0.0	0.0	0.0	0.0	84.0	84.0
	28	0.0	0.0	0.0	0.0	0.0	0.0	100.1	100.1
	32	0.0	0.0	0.0	0.0	0.0	0.0	12.9	12.9
	70	0.0	0.0	0.0	0.0	0.0	0.0	13.0	13.0
	41	0.0	0.0	0.0	0.0	0.0	0.0	12.8	12.8
	21	0.0	0.0	0.0	0.0	0.0	0.0	13.4	13.4
	44	0.0	0.0	0.0	0.0	0.0	0.0	12.5	25.0
	45	0.0	0.0	0.0	0.0	0.0	0.0	12.4	12.4
	13	0.0	0.0	0.0	0.0	0.0	0.0	10.9	10.9
	14	0.0	0.0	0.0	0.0	0.0	0.0	11.2	11.2
4b	45	0.0	0.0	0.0	0.0	11.5	0.0	34.5	46.0
	40	0.0	0.0	0.0	0.0	14.3	0.0	43.0	57.3
	85	0.0	0.0	0.0	0.0	11.9	0.0	71.3	83.2

Appendix Table 15.

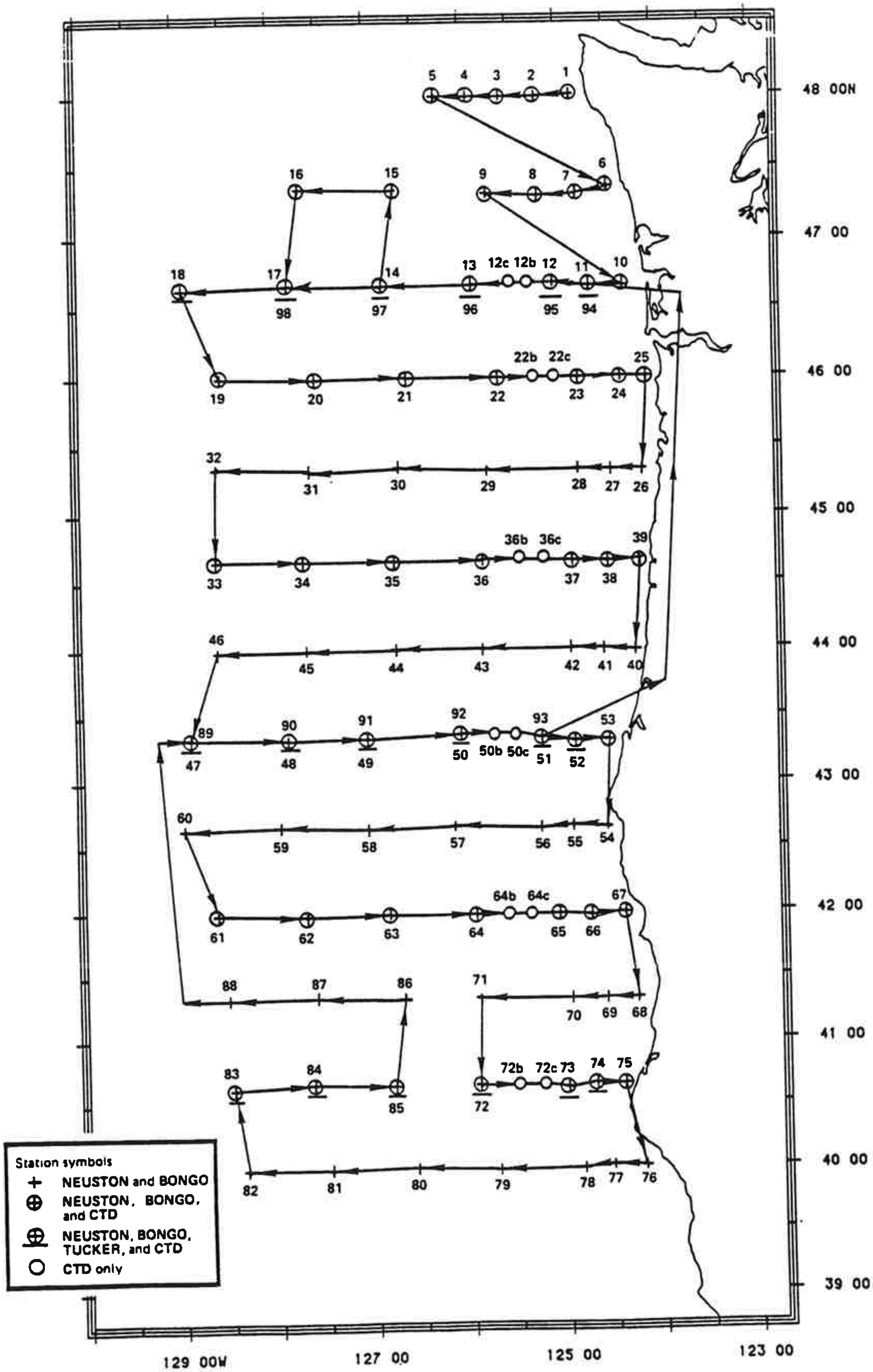
Two-way coincidence table of species abundance (no./10m^2) among station groups for eggs in bongo samples, cruise MF83, November/December 1983. Numbers in species groups are species codes. See list accompanying Appendix Table 1 for interpretation.

STATION GROUPS		SPECIES GROUPS 1a 150	151	285	156	274	322	1b 261	271	2 244	247	235	263	293	TOTAL
1a	24	19.4	6.5	6.5	0.0	0.0	12.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.2
	65	35.9	17.9	12.0	0.0	0.0	12.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	77.7
	75	40.0	5.0	5.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.0
	6	8.6	4.3	4.3	0.0	0.0	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.1
	14	6.5	6.5	12.9	0.0	0.0	38.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	64.7
	45	19.5	4.9	29.2	0.0	0.0	9.7	0.0	4.9	0.0	0.0	0.0	0.0	0.0	68.2
	89	18.9	6.3	31.5	6.3	0.0	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	75.6
	27	46.1	35.9	10.2	5.1	0.0	5.1	0.0	5.1	0.0	0.0	0.0	0.0	0.0	107.6
	13	13.7	0.0	6.9	0.0	6.9	20.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.1
	88	17.6	0.0	23.5	0.0	0.0	11.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.8
	15	12.0	0.0	6.0	0.0	0.0	24.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.1
	34	21.0	14.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.0
	94	12.5	6.2	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0
	87	31.5	6.3	12.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.4
	79	10.3	0.0	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.5
	23	11.5	5.7	11.5	0.0	5.7	0.0	0.0	5.7	0.0	0.0	0.0	0.0	0.0	40.2
	35	12.3	36.8	6.1	0.0	42.9	0.0	0.0	6.1	0.0	0.0	0.0	0.0	0.0	104.2
	49	5.5	16.4	11.0	0.0	5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.4
	54	14.4	14.4	4.8	0.0	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.4
	42	32.2	51.5	6.4	0.0	0.0	0.0	6.4	6.4	0.0	0.0	0.0	0.0	0.0	103.1
	50	27.5	32.1	13.7	0.0	0.0	0.0	13.7	13.7	0.0	0.0	0.0	0.0	0.0	100.8
	53	20.7	15.5	10.3	0.0	0.0	0.0	10.3	10.3	0.0	0.0	0.0	0.0	5.2	72.4
	41	70.0	25.0	10.0	0.0	10.0	0.0	10.0	5.0	0.0	0.0	0.0	0.0	0.0	130.0
	32	34.7	17.4	0.0	0.0	0.0	0.0	40.5	0.0	0.0	0.0	0.0	0.0	0.0	92.7
	36	11.0	5.5	0.0	0.0	0.0	0.0	5.5	0.0	0.0	0.0	0.0	0.0	0.0	27.5
	95	18.4	9.2	0.0	0.0	0.0	0.0	0.0	0.0	4.6	4.6	0.0	0.0	4.6	46.0
1b	77	0.0	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.5
	86	0.0	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.4
	12	3.4	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.1
	59	0.0	6.0	6.0	0.0	0.0	0.0	18.1	0.0	0.0	0.0	0.0	0.0	0.0	30.2
	60	0.0	13.2	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.8
	25	0.0	12.1	12.1	6.0	12.1	0.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0	48.3
	74	0.0	5.2	20.8	5.2	15.6	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.1
	46	0.0	4.6	0.0	4.6	4.6	32.4	0.0	4.6	0.0	0.0	0.0	0.0	0.0	50.8
	47	0.0	4.1	4.1	0.0	4.1	4.1	0.0	4.1	0.0	0.0	0.0	0.0	0.0	20.6
	43	0.0	21.7	0.0	0.0	10.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.6
2	3	5.3	0.0	5.3	5.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.0
	90	10.4	0.0	5.2	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.8
	28	5.4	0.0	21.5	5.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.7
	76	6.3	0.0	12.7	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.3
	63	18.2	0.0	6.1	24.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	54.6
	66	0.0	0.0	23.1	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.9
	105	0.0	0.0	7.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.9
	26	0.0	4.3	12.9	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.8
	29	38.8	54.3	38.8	7.8	11.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	151.3
	64	30.8	6.2	55.5	12.3	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	111.1
	48	5.7	5.7	22.8	11.4	0.0	0.0	5.7	0.0	0.0	0.0	0.0	0.0	0.0	51.2
	40	15.6	5.2	0.0	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.9
	62	16.7	0.0	0.0	5.6	0.0	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.8
	61	5.7	0.0	0.0	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.1
	91	5.8	0.0	0.0	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.6
3	1	0.0	0.0	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5
	67	0.0	0.0	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8
	56	0.0	0.0	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.2
	98	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0
	73	0.0	0.0	5.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4
	85	0.0	0.0	5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.0
	112	0.0	0.0	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9
	17	0.0	0.0	16.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.8
	18	0.0	0.0	17.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.2
	78	0.0	0.0	18.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.2
	2	0.0	0.0	11.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.6
	19	0.0	0.0	15.3	0.0	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.2
4	7	0.0	0.0	0.0	0.0	0.0	15.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.5
	9	0.0	0.0	0.0	0.0	0.0	17.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.0
	8	0.0	0.0	0.0	0.0	0.0	51.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.0
	10	0.0	0.0	0.0	0.0	0.0	46.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.8
	16	0.0	0.0	34.1	0.0	5.7	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.2
	21	0.0	0.0	20.2	0.0	0.0	27.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.2
	11	0.0	0.0	10.7	5.4	0.0	10.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.8
5	51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.4	42.4
	111	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	87.9	87.9
	39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.8	21.8
	52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	2.9
	99	6.5	0.0	0.0	0.0	0.0	0.0	0.0	6.5	0.0	0.0	6.5	0.0	19.4	51.7
	110	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.0	9.7	14.5
	31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.6
	72	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.2	0.0	0.0	0.0	15.2
	103	0.0	0.0	0.0	0.0	0.0	0.0	6.6	0.0	0.0	0.0	0.0	0.0	0.0	13.3
	38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	5.6	1.9	31.8
	96	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	2.3	2.3	4.6	11.4
	58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.7	3.7	0.0	7.5
	101	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	3.4	3.4	0.0	10.3
	22	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	8.0
	33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9	0.0	9.9
	37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	70.7	4.4	75.1
	82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	0.0	63.6	0.0	26.5	106.0
	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.2	12.4	83.8	0.0	9.3	111.7
	83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	14.0	46.5	27.9	79.1	
	84	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	21.1	37.0	47.6	37.0	
	70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.8	12.2	126.3	4.1	0.0	195.6
	71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.8	15.2	94.5	15.2	0.0	185.9
	69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	40.2	0.0	0.0	43.3
	97	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.7	0.0	0.0	30.7

Appendix Table 16.

Two-way coincidence table of species abundance (no./10m²) among station groups for larvae in bongo samples, cruise MF83, November/December 1983. Numbers in species groups are species codes. See list accompanying Appendix Table 1 for interpretation.

STATION GROUPS		SPECIES GROUPS 1					2				3			
		160	162	279	156	234	158	163	164	288	292	171	275	TOTAL
1	24	6.5	0.0	0.0	6.5	0.0	6.5	6.5	6.5	6.5	0.0	0.0	0.0	45.2
	50	4.6	4.6	4.6	13.7	0.0	4.6	9.2	0.0	4.6	0.0	0.0	0.0	45.8
	66	17.3	5.8	0.0	0.0	11.6	5.8	0.0	5.8	5.8	0.0	0.0	0.0	52.0
	69	12.6	25.2	0.0	6.3	0.0	0.0	0.0	6.3	6.3	0.0	0.0	0.0	56.7
	36	0.0	5.5	0.0	5.5	11.0	5.5	22.0	0.0	0.0	0.0	0.0	0.0	54.9
	54	0.0	14.4	28.8	4.8	24.0	9.6	14.4	14.4	4.8	0.0	0.0	4.8	134.6
	55	0.0	5.2	0.0	0.0	0.0	5.2	10.4	5.2	5.2	0.0	0.0	0.0	36.3
	63	0.0	0.0	0.0	0.0	0.0	0.0	24.3	6.1	12.1	0.0	0.0	0.0	48.5
	79	0.0	5.2	0.0	0.0	0.0	0.0	0.0	10.3	5.2	0.0	0.0	0.0	20.6
	2	0.0	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.2
	58	0.0	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.7	0.0	7.5
	40	0.0	5.2	0.0	0.0	5.2	0.0	0.0	0.0	0.0	5.2	0.0	0.0	36.3
	25	0.0	0.0	0.0	0.0	6.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0	24.2
	45	0.0	0.0	0.0	0.0	9.7	0.0	4.9	0.0	0.0	0.0	4.9	0.0	19.5
	81	0.0	18.8	0.0	0.0	6.3	0.0	6.3	0.0	0.0	0.0	0.0	0.0	50.0
	56	0.0	0.0	0.0	0.0	4.2	4.2	4.2	0.0	4.2	0.0	41.9	0.0	58.6
	68	0.0	0.0	0.0	0.0	0.0	0.0	4.9	0.0	4.9	0.0	19.6	0.0	29.4
	8	0.0	0.0	0.0	0.0	0.0	0.0	5.7	0.0	0.0	0.0	0.0	0.0	5.7
	13	0.0	0.0	0.0	0.0	0.0	0.0	6.9	0.0	0.0	0.0	0.0	0.0	6.9
	17	0.0	0.0	0.0	5.6	0.0	0.0	5.6	5.6	0.0	0.0	0.0	0.0	16.8
	31	0.0	0.0	5.3	0.0	0.0	0.0	5.3	0.0	0.0	5.3	0.0	0.0	26.6
	6	0.0	0.0	0.0	0.0	0.0	4.3	8.6	0.0	0.0	0.0	0.0	0.0	12.9
	61	0.0	5.7	0.0	0.0	0.0	5.7	5.7	0.0	0.0	0.0	0.0	5.7	28.4
	28	0.0	0.0	0.0	0.0	0.0	5.4	0.0	0.0	0.0	0.0	0.0	0.0	5.4
	32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.8	0.0	0.0	0.0	11.6
	64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.2	0.0	0.0	0.0	
	86	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	0.0	0.0	0.0	5.2
	26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	0.0	0.0	0.0	8.6
	47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.5	4.1	0.0	4.1	28.9
	62	5.6	0.0	0.0	0.0	0.0	0.0	0.0	5.6	11.1	11.1	0.0	0.0	39.0
2	35	0.0	0.0	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.1
	112	0.0	0.0	5.9	0.0	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.7
	74	5.2	0.0	5.2	0.0	5.2	0.0	0.0	5.2	0.0	0.0	0.0	0.0	26.1
	59	0.0	6.0	12.1	0.0	24.2	0.0	0.0	0.0	6.0	0.0	0.0	0.0	48.3
	60	6.6	6.6	6.6	0.0	13.2	0.0	0.0	0.0	0.0	0.0	6.6	6.6	59.5
	65	6.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0	6.0	0.0	29.9
	29	0.0	0.0	15.5	3.9	7.8	0.0	0.0	0.0	0.0	0.0	7.8	0.0	34.9
	44	0.0	0.0	13.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.8	0.0	32.3
	43	0.0	0.0	10.9	5.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.2
	21	0.0	13.5	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.2
	105	13.9	13.9	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.8
	94	6.2	6.2	6.2	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0
	49	0.0	11.0	5.5	11.0	0.0	0.0	5.5	0.0	0.0	0.0	0.0	0.0	32.9
	76	0.0	6.3	12.7	0.0	0.0	0.0	6.3	0.0	0.0	0.0	0.0	0.0	25.3
3	12	3.4	0.0	0.0	3.4	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.1
	14	0.0	0.0	0.0	6.5	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.4
	30	4.2	0.0	0.0	4.2	8.4	0.0	0.0	0.0	4.2	0.0	0.0	0.0	29.5
	41	0.0	0.0	0.0	10.0	10.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	25.0
	15	0.0	0.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0
	91	0.0	0.0	0.0	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.6
	16	5.7	0.0	0.0	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.1
	20	0.0	0.0	0.0	0.0	5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5
	99	0.0	0.0	0.0	0.0	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.5
	95	0.0	0.0	0.0	0.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6
	98	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0
	73	0.0	0.0	0.0	0.0	10.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7
4	51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.7	0.0	7.7
	82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	0.0	15.9
	84	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	0.0	26.4
	57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.7	0.0	14.7
	111	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.5	0.0	16.5
	39	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	6.2
	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	0.0	6.2
	72	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.1	5.1	15.2
	34	7.0	0.0	0.0	0.0	14.0	0.0	0.0	0.0	0.0	7.0	7.0	0.0	35.0
	67	4.8	0.0	0.0	0.0	4.8	0.0	0.0	0.0	0.0	0.0	9.6	0.0	19.2
	52	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.0	5.8	0.0	11.5
	18	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	4.3	0.0	17.2
5	80	28.3	5.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.0
	113	33.3	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	39.9
	88	11.7	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.6
	92	13.5	6.8	0.0	0.0	0.0	13.5	0.0	0.0	0.0	0.0	0.0	0.0	33.8
	104	43.7	0.0	0.0	0.0	0.0	6.2	0.0	0.0	0.0	0.0	0.0	0.0	49.9
	42	12.9	12.9	0.0	0.0	0.0	0.0	12.9	0.0	0.0	0.0	0.0	0.0	38.7
	53	20.7	10.3	0.0	0.0	0.0	5.2	10.3	0.0	0.0	0.0	0.0	0.0	46.6
	75	15.0	15.0	5.0	0.0	0.0	0.0	15.0	0.0	10.0	0.0	0.0	5.0	64.9
	7	10.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.3
	87	12.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.6
	103	26.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.6
	1	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5
	93	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.3



Appendix Figure 5.
Sampling stations, positions, and cruise track for cruise MF87 (January 1987).

Appendix Table 17.

Two-way coincidence table of species abundance (no./1000m^3) among station groups for eggs in neuston samples, cruise MF87, January 1987. Numbers in species groups are species codes. See list accompanying Appendix Table 1 for Interpretaion.

STATION		SPECIES GROUPS 1a					1b			2			3			
GROUP		235	293	263	244	245	239	247	299	150	151	283	156	274	285	TOTAL
1a	33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.6	66.2	182.0	314.4
	35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.3	121.3	34.7	173.3
	52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.5	18.5	18.5	55.6
	57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.8	17.8	88.9	124.5
	32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.5	48.8	0.0	81.3
	86	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.5	20.7	0.0	82.9
	64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.0	17.0	34.0	51.0	645.7	85.0	849.6
	71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.1	18.0	0.0	36.1	126.3	54.1	270.7
	70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	102.4	0.0	68.3	34.1	51.2	17.1	273.2
	72	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	54.4	18.1	18.1	54.4	18.1	0.0	163.1
	77	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.6	17.6	17.6	17.6	0.0	70.3
1b	22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.3	0.0	17.3	34.6
	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.5	0.0	18.5	36.9
	88	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.9	0.0	15.9	47.8
	61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.8	0.0	30.8	61.5
	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.4	0.0	0.0	37.4
	20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.2	0.0	0.0	15.2
1c	23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.4	35.6	0.0	0.0	0.0	17.8	124.7
	62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.9	0.0	0.0	0.0	35.8	53.8
	60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.2	0.0	17.2	0.0	0.0	34.4
	63	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.6	0.0	0.0	0.0	0.0	19.6
2a	38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.4	0.0	0.0	87.1	104.5
	75	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.3	0.0	0.0	17.6	52.9
	76	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.3	0.0	16.4	32.8	98.5
	58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.1	0.0	17.1	0.0	0.0	17.1	51.4
	74	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.7	0.0	15.2	0.0	15.2	15.2	91.5
	44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.0	16.3	65.3
	56	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.5	0.0	0.0	0.0	0.0	105.3	17.5	140.3
	73	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	158.6	0.0	0.0	0.0	79.3	47.6	285.4
	85	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.9	0.0	0.0	0.0	12.9	51.5	115.9
2b	43	0.0	17.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.9	0.0	0.0	0.0	35.8
	48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.8	0.0	0.0	0.0	35.6
	65	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.3	0.0	0.0	18.3	0.0	146.8	0.0	183.5
	66	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.7	0.0	0.0	17.7	0.0	0.0	0.0	35.5
	78	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.6	0.0	17.6	0.0	35.1
	80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.9	0.0	16.5	0.0	49.4
	51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.1	0.0	18.1
3	15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.3	18.3
	18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.2	18.2
	21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.6	18.6
	16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.5	19.5
	19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.3	19.3
	11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.5	17.5
	81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.7	17.7
	82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.2	17.2
	12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.3	15.3
	83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.5	34.5
	84	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.3	48.4
4a	10	376.8	1561.2	215.3	125.6	0.0	0.0	17.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2296.9
	25	1378.0	1278.4	514.7	33.2	0.0	33.2	33.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3270.7
	26	562.8	1801.0	56.3	75.0	0.0	18.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2513.9
	6	187.0	673.2	74.8	93.5	18.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1065.9
	36	53.1	3470.3	88.5	17.7	17.7	0.0	53.1	0.0	0.0	0.0	0.0	0.0	0.0	106.2	3806.8
	24	167.2	1374.5	0.0	148.6	0.0	18.6	37.1	0.0	0.0	0.0	0.0	0.0	0.0	18.6	1764.5
	53	1055.7	918.8	0.0	195.5	0.0	39.1	19.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2228.6
	39	41988.8	51281.0	4691.9	0.0	73.3	18.3	0.0	91.6	0.0	0.0	0.0	0.0	0.0	0.0	98145.0
	40	7347.8	31175.3	632.6	389.3	486.6	81.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40112.7
4b	7	96.1	57.7	0.0	38.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	192.2
	41	52.8	17.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	70.4
	55	32.3	16.2	16.2	16.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.2	97.0
	1	23.6	47.1	47.1	0.0	47.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	165.0
	54	49.3	49.3	65.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	164.2
	27	36.5	18.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.3	0.0	0.0	73.1
	34	16.4	16.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.4	0.0	16.4	65.6
	67	35.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.2

Appendix Table 18.

Two-way coincidence table of species abundance (no./1000m^3) among station groups for larvae in neuston samples, cruise MF87, January 1987. Numbers in species groups are species codes. See list accompanying Appendix Table 1 for interpretation.

STATION GROUPS		SPECIES GROUPS 1			2		3		4		
		177	281	273	162	178	171	194	199	287	TOTAL
1a	3	56.1	0.0	0.0	0.0	37.4	0.0	0.0	0.0	0.0	93.6
	9	57.3	0.0	0.0	0.0	38.2	0.0	0.0	0.0	0.0	95.5
	71	18.0	0.0	0.0	0.0	18.0	0.0	0.0	0.0	0.0	36.1
	2	149.5	0.0	0.0	0.0	18.7	0.0	0.0	0.0	0.0	168.2
	70	170.7	0.0	0.0	0.0	17.1	0.0	0.0	0.0	0.0	187.8
	37	176.2	0.0	0.0	0.0	17.6	0.0	0.0	0.0	17.6	211.4
	7	211.4	0.0	0.0	0.0	0.0	0.0	38.4	0.0	0.0	249.9
	22	51.9	0.0	0.0	0.0	34.6	0.0	17.3	0.0	0.0	103.9
1b	12	15.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.3
	57	35.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.6
	8	160.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	160.1
	40	48.7	0.0	0.0	0.0	0.0	0.0	0.0	16.2	0.0	64.9
	38	313.6	0.0	17.4	0.0	0.0	0.0	0.0	0.0	0.0	331.0
	56	52.6	0.0	17.5	0.0	0.0	0.0	0.0	0.0	0.0	70.2
	26	93.8	0.0	0.0	0.0	0.0	18.8	0.0	0.0	0.0	112.6
	69	161.5	0.0	0.0	0.0	0.0	32.3	0.0	0.0	0.0	193.8
1c	11	384.9	52.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	437.4
	68	397.1	69.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	466.1
	75	141.1	35.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	176.4
	39	184.9	55.0	0.0	0.0	0.0	0.0	0.0	110.0	0.0	348.2
	27	18.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.3	36.5
	50	37.5	18.8	0.0	0.0	0.0	0.0	0.0	0.0	18.8	75.0
2a	28	578.0	508.0	35.0	0.0	0.0	0.0	0.0	0.0	0.0	1121.0
	41	281.8	1250.3	35.2	0.0	0.0	0.0	0.0	0.0	0.0	1567.3
	36	194.8	141.6	17.7	0.0	0.0	0.0	0.0	0.0	0.0	354.1
	24	130.0	352.9	130.0	0.0	0.0	18.6	0.0	0.0	0.0	743.0
	42	1156.4	3123.9	155.3	0.0	0.0	0.0	51.8	0.0	0.0	4504.7
	23	267.1	160.3	35.6	0.0	71.2	0.0	17.8	0.0	0.0	569.9
	52	37.0	407.4	18.5	0.0	37.0	37.0	74.1	0.0	0.0	611.2
	51	126.8	1738.7	36.2	181.1	0.0	0.0	18.1	0.0	0.0	2100.9
	65	36.7	2678.4	36.7	36.7	0.0	0.0	0.0	0.0	0.0	2788.5
	78	0.0	1316.3	35.1	158.0	0.0	0.0	0.0	0.0	0.0	1509.4
	54	0.0	377.7	65.7	0.0	0.0	0.0	0.0	0.0	0.0	492.6
2b	32	0.0	16.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.3
	66	0.0	71.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	71.0
	25	0.0	33.2	0.0	0.0	0.0	0.0	0.0	16.6	0.0	166.0
	1	0.0	23.6	0.0	0.0	0.0	0.0	70.7	0.0	0.0	212.1
	55	16.2	64.7	0.0	0.0	0.0	16.2	16.2	0.0	0.0	161.7
2c	62	0.0	0.0	0.0	0.0	0.0	17.9	0.0	0.0	0.0	17.9
	79	0.0	0.0	0.0	0.0	0.0	29.6	0.0	0.0	0.0	29.6
3a	72	90.6	18.1	0.0	108.7	18.1	0.0	0.0	0.0	0.0	235.6
	73	63.4	126.9	0.0	63.4	31.7	0.0	0.0	0.0	0.0	285.4
	64	0.0	135.9	0.0	51.0	34.0	0.0	0.0	0.0	0.0	237.9
	76	558.4	295.6	16.4	32.8	16.4	0.0	0.0	0.0	0.0	919.8
	77	193.3	720.3	17.6	421.6	35.1	0.0	0.0	0.0	0.0	1387.9
	74	76.2	335.5	0.0	0.0	30.5	0.0	0.0	0.0	0.0	442.2
	4	30.2	0.0	0.0	543.8	45.3	0.0	0.0	0.0	0.0	619.3
	43	0.0	0.0	0.0	71.7	35.8	0.0	0.0	0.0	0.0	107.5
3b	5	0.0	0.0	0.0	0.0	18.7	0.0	0.0	0.0	0.0	18.7
	21	0.0	0.0	0.0	0.0	18.6	0.0	0.0	0.0	0.0	18.6
	16	0.0	0.0	0.0	0.0	19.5	0.0	0.0	0.0	0.0	19.5
	44	0.0	0.0	0.0	0.0	16.3	0.0	0.0	0.0	0.0	16.3
	30	0.0	0.0	0.0	0.0	73.9	0.0	0.0	0.0	0.0	73.9
	63	0.0	0.0	0.0	0.0	39.3	0.0	0.0	0.0	0.0	39.3
	13	0.0	0.0	0.0	0.0	35.1	0.0	0.0	0.0	17.6	52.7
	29	0.0	0.0	17.8	0.0	106.9	0.0	0.0	0.0	35.6	160.3
4	86	0.0	0.0	0.0	20.7	0.0	0.0	0.0	0.0	0.0	20.7
	87	0.0	0.0	0.0	18.1	0.0	0.0	0.0	0.0	0.0	18.1
	61	0.0	0.0	0.0	15.4	0.0	0.0	0.0	0.0	0.0	15.4
	59	0.0	0.0	0.0	466.2	0.0	0.0	0.0	0.0	0.0	466.2
	60	0.0	0.0	0.0	103.1	0.0	0.0	0.0	0.0	0.0	103.1
	48	0.0	0.0	0.0	35.6	0.0	0.0	0.0	0.0	35.6	71.1
	84	0.0	0.0	0.0	16.1	0.0	0.0	0.0	0.0	64.6	80.7
	83	0.0	0.0	0.0	69.0	0.0	0.0	0.0	0.0	137.9	206.9
	88	0.0	0.0	0.0	111.6	0.0	0.0	0.0	0.0	15.9	127.5
5	33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.5	16.5
	34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.4	16.4
	47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.7	17.7
	20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.2	15.2
	49	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	54.4	54.4
	82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.5	51.5
	31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	59.2	59.2
	81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	141.2	141.2

Appendix Table 19.

Two-way coincidence table of species abundance (no./10m^2) among station groups for eggs in bongo samples, cruise MF87, January 1987. Numbers in species groups are species codes. See list accompanying Appendix Table 1 for interpretation.

STATION GROUPS		SPECIES GROUPS 1: 151	274	152	150	156	285	283	2: 276	322	339	3: 245	263	244	235	293	TOTAL
1a	8	0.0	0.0	0.0	0.0	0.0	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0
	14	0.0	0.0	0.0	0.0	0.0	7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5
	22	0.0	0.0	0.0	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.1
	17	0.0	0.0	0.0	0.0	0.0	20.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.2
	83	0.0	0.0	0.0	0.0	0.0	14.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.1
	66	0.0	0.0	8.0	0.0	0.0	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.0
	7	0.0	0.0	0.0	0.0	0.0	12.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.4	6.4	25.8
1b	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.4	0.0	0.0	0.0	0.0	0.0	6.4
	28	0.0	0.0	0.0	0.0	0.0	8.3	0.0	0.0	0.0	41.7	0.0	0.0	0.0	0.0	0.0	50.1
	69	0.0	0.0	6.9	0.0	0.0	0.0	6.9	0.0	0.0	6.9	0.0	0.0	0.0	0.0	0.0	20.6
	68	0.0	0.0	0.0	0.0	0.0	0.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.2	13.8
	76	0.0	0.0	0.0	0.0	0.0	0.0	13.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.5
1c	3	0.0	0.0	0.0	0.0	7.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.4
	85	0.0	0.0	0.0	0.0	8.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.9
	30	0.0	0.0	0.0	0.0	17.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.3
	13	0.0	0.0	0.0	0.0	15.4	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.1
	81	0.0	0.0	0.0	0.0	9.5	9.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.0
	59	0.0	0.0	0.0	0.0	20.3	6.8	0.0	0.0	6.8	0.0	0.0	0.0	0.0	0.0	0.0	33.8
	12	5.7	0.0	0.0	0.0	0.0	5.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4
	32	6.3	12.7	0.0	0.0	19.0	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.4
	36	21.6	0.0	0.0	0.0	7.2	0.0	7.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.1
2a	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.3	11.2	26.1	128.6	223.4	413.2
	24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.9	14.3	28.6	107.3	722.6	915.7
	26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.4	6.7	6.7	187.9	355.6	570.4
	53	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.8	24.7	0.0	355.3	266.4	666.1
	10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.0	27.0	238.7	211.7	500.0
	25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	131.1	6.2	855.2	630.5	1641.7
	39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.4	127.3	6.7	2164.4	375.3	2693.8
	40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.1	55.4	135.5	1121.1	856.2	2229.9
2b	46	0.0	0.0	0.0 -	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	0.0	0.0	0.0	8.0
	54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.9	8.6	0.0	21.4	0.0	42.8
2c	38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.5	27.3
	67	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.2	15.2
	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	0.0	0.0	16.6	22.1
	37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	76.9	76.9
	41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	206.3	213.7
	79	0.0	16.2	8.1	48.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.2	105.1
	80	0.0	9.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.3	27.8
	82	0.0	0.0	0.0	17.0	8.5	0.0	0.0	8.5	0.0	0.0	0.0	0.0	0.0	0.0	67.9	110.3
3a	31	6.4	0.0	0.0	19.1	12.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.2
	45	7.7	7.7	0.0	30.7	30.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	76.7
	20	7.2	0.0	0.0	21.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.9
	21	0.0	0.0	0.0	7.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.8
	27	0.0	0.0	0.0	18.4	0.0	0.0	0.0	0.0	0.0	9.2	0.0	0.0	0.0	0.0	0.0	27.6
	19	0.0	0.0	0.0	8.3	24.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.3
	58	0.0	0.0	0.0	41.5	20.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.2
	87	0.0	0.0	0.0	6.5	13.1	0.0	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.1
	48	0.0	0.0	0.0	8.3	8.3	0.0	0.0	0.0	8.3	0.0	0.0	0.0	0.0	0.0	0.0	24.9
	47	0.0	0.0	10.1	20.2	20.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.4
	63	0.0	0.0	16.2	24.4	24.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	65.0
	55	0.0	0.0	7.5	29.8	7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.7
	61	0.0	0.0	17.9	71.5	35.7	0.0	0.0	0.0	8.9	0.0	0.0	0.0	0.0	0.0	0.0	134.0
	72	0.0	0.0	41.7	267.1	0.0	0.0	0.0	0.0	8.3	0.0	0.0	0.0	0.0	0.0	0.0	325.5
3b	18	0.0	0.0	0.0	44.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.2
	56	0.0	0.0	0.0	83.3	0.0	0.0	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	91.6
	77	17.6	0.0	0.0	61.5	0.0	0.0	123.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	202.0
	57	0.0	51.3	0.0	42.7	0.0	8.5	25.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	128.2
	74	0.0	7.9	0.0	31.6	0.0	0.0	7.9	0.0	0.0	7.9	0.0	0.0	0.0	0.0	0.0	79.0
	84	0.0	0.0	0.0	7.9	0.0	23.8	15.9	39.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	87.3
	9	0.0	0.0	0.0	14.0	0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.0
	29	0.0	0.0	0.0	40.1	0.0	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	0.0	56.1
	44	0.0	7.6	0.0	68.0	7.6	7.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.6	0.0	98.3
	51	0.0	26.5	0.0	26.5	8.8	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	70.7
3c	34	17.4	8.7	8.7	52.1	26.0	0.0	0.0	0.0	8.7	0.0	0.0	0.0	0.0	0.0	0.0	121.5
	43	8.4	41.8	8.4	167.0	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	242.2
	88	9.9	9.9	29.6	29.6	9.9	0.0	0.0	9.9	39.5	0.0	0.0	0.0	0.0	0.0	0.0	138.1
	33	10.1	0.0	10.1	30.4	10.1	10.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	71.0
	62	7.3	0.0	0.0	51.1	14.6	14.6	0.0	7.3	21.9	0.0	0.0	0.0	0.0	0.0	0.0	116.9
	35	17.5	26.3	17.5	35.1	0.0	26.3	0.0	0.0	8.8	0.0	0.0	0.0	0.0	0.0	0.0	131.6
	65	8.3	16.6	24.9	49.8	0.0	16.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	116.3
	52	0.0	8.9	26.6	53.3	8.9	26.6	8.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	133.2
	60	0.0	6.9	13.7	34.3	0.0	6.9	0.0	6.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.6
	64	24.5	220.5	16.3	155.2	8.2	24.5	32.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	481.8
	71	68.8	127.8	9.8	491.6	29.5	29.5	9.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	767.0
	78	19.0	47.6	19.0	295.2	0.0	9.5	9.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	399.9
	70	41.8	33.4	16.7	183.8	8.4	0.0	41.8	0.0	8.4	0.0	0.0	0.0	0.0	0.0	0.0	334.2
	73	83.9	34.9	76.9	678.0	0.0	0.0	7.0	0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	887.6

Appendix Table 20.

Two-way coincidence table of species abundance (no./10m²) among station groups for larvae in bongo samples, cruise MF87, January 1987. Numbers in species groups are species codes. See list accompanying Appendix Table 1 for interpretation.

STATION GROUPS		SPECIES GROUPS 1						2						3					
		160	271	171	163	162	164	150	234	272	279	156	288	148	244	213	281	177	TOTAL
1a	28	0.0	33.4	16.7	8.3	8.3	0.0	0.0	0.0	0.0	0.0	0.0	8.3	0.0	0.0	0.0	0.0	0.0	75.1
	44	22.7	22.7	37.8	7.6	15.1	0.0	0.0	0.0	7.6	7.6	0.0	7.6	0.0	0.0	0.0	0.0	0.0	136.0
	43	0.0	25.1	33.4	16.7	25.1	0.0	0.0	0.0	0.0	16.7	16.7	0.0	0.0	0.0	0.0	0.0	0.0	142.0
	35	26.3	61.4	8.8	8.8	17.5	0.0	0.0	0.0	0.0	0.0	8.8	0.0	0.0	0.0	8.8	0.0	0.0	140.4
	64	24.5	32.7	8.2	0.0	16.3	8.2	0.0	8.2	0.0	0.0	8.2	0.0	0.0	0.0	0.0	0.0	0.0	130.7
	65	66.4	33.2	132.9	16.6	16.6	0.0	33.2	0.0	0.0	0.0	8.3	0.0	16.6	0.0	0.0	24.9	0.0	357.1
	52	8.9	8.9	8.9	17.8	0.0	8.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	62.2
	73	21.0	41.9	28.0	21.0	0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	118.8
	77	0.0	52.7	52.7	26.4	0.0	8.8	43.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	184.5
	50	7.7	7.7	0.0	7.7	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.4
	60	34.3	13.7	0.0	13.7	6.9	6.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	75.4
	72	50.1	50.1	0.0	75.1	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	192.0
	46	8.0	15.9	0.0	0.0	8.0	8.0	0.0	0.0	0.0	0.0	0.0	8.0	0.0	0.0	0.0	0.0	0.0	63.7
	61	17.9	35.7	0.0	8.9	0.0	17.9	0.0	0.0	0.0	0.0	0.0	8.9	0.0	0.0	0.0	0.0	0.0	89.3
	36	7.2	36.1	7.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57.7
	86	18.7	31.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0
	71	29.5	19.7	9.8	0.0	0.0	0.0	19.7	9.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	118.0
	84	31.8	15.9	0.0	0.0	0.0	0.0	0.0	7.9	0.0	0.0	7.9	0.0	0.0	0.0	0.0	0.0	0.0	63.5
1b	24	21.5	7.2	114.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	171.7
	63	48.7	8.1	24.4	0.0	8.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	89.4
	69	13.7	6.9	68.6	6.9	6.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	109.8
	70	25.1	50.1	66.8	8.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	150.4
	55	14.9	14.9	59.6	0.0	0.0	0.0	0.0	0.0	0.0	7.5	0.0	0.0	0.0	0.0	14.9	0.0	0.0	119.3
	74	7.9	39.5	150.1	0.0	0.0	0.0	0.0	0.0	0.0	7.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	205.4
	76	0.0	6.7	693.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7	0.0	0.0	706.7
	56	41.6	0.0	33.3	0.0	0.0	0.0	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	83.3
	58	48.4	0.0	13.8	0.0	0.0	34.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	96.7
	23	27.5	0.0	34.3	0.0	48.1	6.9	0.0	0.0	0.0	0.0	0.0	6.9	0.0	0.0	0.0	0.0	0.0	123.6
	26	26.8	0.0	268.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.4	0.0	0.0	6.7	335.5
	51	8.8	0.0	53.0	0.0	8.8	0.0	0.0	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.8	0.0	88.4
	66	16.0	16.0	144.1	0.0	40.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.0	0.0	240.1
1c	15	15.3	0.0	0.0	0.0	22.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.2
	33	10.1	0.0	0.0	0.0	10.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.3
	68	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.2
	62	7.3	0.0	0.0	7.3	0.0	0.0	0.0	14.6	0.0	7.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.5
	85	17.7	0.0	0.0	8.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.6
	87	0.0	0.0	0.0	6.5	0.0	0.0	0.0	6.5	0.0	0.0	0.0	6.5	0.0	0.0	0.0	0.0	0.0	19.6
2a	22	0.0	9.1	0.0	0.0	18.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.4
	30	0.0	8.6	0.0	0.0	25.9	0.0	0.0	0.0	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.2
	59	0.0	6.8	0.0	0.0	13.5	0.0	0.0	0.0	6.8	0.0	6.8	6.8	0.0	0.0	0.0	0.0	0.0	40.6
	83	0.0	0.0	0.0	0.0	21.2	0.0	0.0	0.0	0.0	7.1	7.1	7.1	0.0	0.0	0.0	0.0	0.0	49.5
	45	0.0	0.0	0.0	7.7	38.4	23.0	0.0	0.0	0.0	0.0	7.7	0.0	0.0	0.0	0.0	0.0	0.0	76.7
	80	0.0	0.0	0.0	37.1	9.3	0.0	0.0	0.0	0.0	0.0	9.3	0.0	0.0	0.0	0.0	0.0	0.0	55.6
	88	49.3	0.0	0.0	19.7	19.7	0.0	0.0	0.0	9.9	19.7	9.9	0.0	0.0	0.0	0.0	0.0	0.0	128.2
	47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.1	0.0	0.0	0.0	0.0	0.0	0.0	10.1
2b	20	0.0	0.0	7.2	0.0	21.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.9
	31	0.0	0.0	6.4	6.4	19.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.2
	32	0.0	0.0	6.3	0.0	31.7	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.4
	29	0.0	0.0	32.0	0.0	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.1
	8	0.0	0.0	0.0	0.0	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.0
	49	0.0	0.0	0.0	0.0	7.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.8
	19	0.0	0.0	0.0	0.0	16.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.5
2c	13	0.0	0.0	0.0	0.0	7.7	7.7	0.0	0.0	0.0	0.0	7.7	0.0	0.0	0.0	0.0	0.0	0.0	30.8
	17	0.0	0.0	0.0	0.0	6.7	13.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.2
	14	0.0	0.0	0.0	0.0	30.2	30.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60.3
	21	7.8	0.0	0.0	0.0	39.2	47.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	102.0
	16	6.1	0.0	6.1	0.0	6.1	6.1	18.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.4
	18	8.9	26.6	0.0	0.0	26.6	17.7	8.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	88.7
	4	0.0	0.0	0.0	0.0	0.0	6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.4
	79	0.0	8.1	0.0	0.0	0.0	8.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.2
3a	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	383.5	22.3	0.0	0.0	3.7	417.0
	25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	112.4	37.5	0.0	0.0	0.0	181.0
	10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.5	13.5	0.0	0.0	0.0	27.0
	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	237.7	0.0	5.5	0.0	0.0	254.3
	40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.2	0.0	0.0	0.0	0.0	12.3	0.0	6.2	0.0	0.0	30.8
	39	0.0	0.0	20.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	241.2	167.5	13.4	6.7	0.0	489.2
	53	0.0	0.0	19.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9	394.7	9.9	9.9	0.0	449.0
	54	0.0	0.0	145.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.4	0.0	8.6	21.4	8.6	274.1
	67	0.0	0.0	86.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.2	0.0	0.0	15.2	0.0	146.7
3b	37	0.0	0.0	42.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.3
	38	0.0	0.0	41.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.0
	42	0.0	0.0	18.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.5
	48	0.0	0.0	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.3
	78	0.0	0.0	19.0	9.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.6
	27	0.0	0.0	27.6	0.0	0.0	0.0	0.0	9.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8
	57	0.0	8.5	51.3	0.0	0.0	0.0	0.0	17.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	76.9
	11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	5.7
	75	0.0	0.0	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.6	18.1