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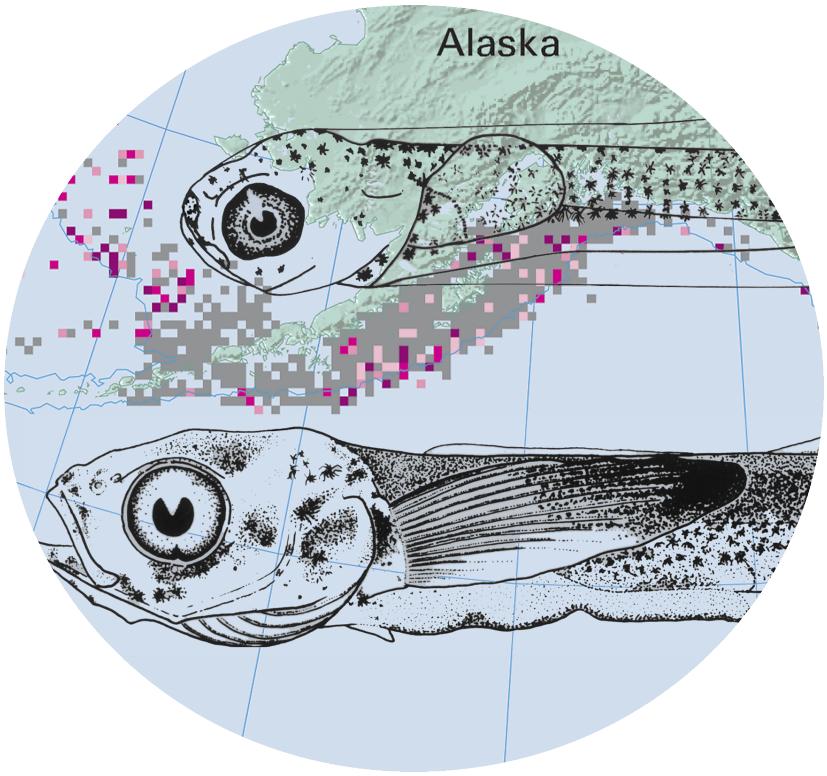
A Taxonomic Guide and Atlas for the Early Life History Stages of Northeast Pacific Fishes

Ann C. Matarese, Deborah M. Blood, Kimberly Bahl,
Lisa De Forest, and Małgorzata Konieczna



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Acknowledgements

Several years ago, it became apparent that our taxonomic guide to the early life history stages of Northeast Pacific and Bering Sea fishes published in 1989 was in need of updating. At the same time, we were completing our companion atlas on the distribution and abundance of the early life history stages of fishes collected from the same geographic area. Faced with the daunting task of yet another large volume years in the making, we met and discussed alternative options. The results of our brainstorming are the Ichthyoplankton Information System (IIS): timely, searchable, printable and easily updated.

We thank those involved in getting this project off the ground for financial support, but more importantly for their vision and willingness to embrace change and creativity: Jeff Napp (Recruitment Processes (RP) Program Manager), Gary Stauffer (former Resource Assessment Conservation Engineering (RACE) Division Director) and Russ Nelson (current RACE Division Director). Art Kendall (retired) and Lisa Rugen (formerly Alaska Fisheries Science Center (AFSC)) developed a rockfish database several years ago that served as a model for concept and design. This project could never have been accomplished without the labor-intensive work done by students Erin MacDonald, Margarita Reimer, and Pamela Woods, under the direction of Ted Pietsch, through several contracts with the University of Washington Fish Collection (UWFC). Erin was part of the initial project team and Pamela completed the final version; both tasks involved juggling information from many sources. We thank them for their patience and flexibility as we made one change after another. Morgan Busby assisted in data verification and worked with us to code pigmentation characters. Rachael Cartwright organized and scanned many illustrations and extensively reviewed pigmentation characters. Susan Calderon and Gary Shaw and his staff offered technical assistance. We thank the following who were asked to review a beta version of the IIS: Morgan Busby, Rachael Cartwright, Ned Laman, and Janet Duffy-Anderson (AFSC); Michael Fahay and Jon Hare (Northeast Fisheries Science Center), Joanne Lyczkowski-Shultz and William Richards (Southeast Fisheries Science Center), William Watson (Southwest Fisheries Science Center) and the staff at the Plankton Sorting and Identification Laboratory, Szczecin, Poland (ZSIOP).

After our creative webmaster, William Rugen, retired in September 2007, Kimberly Bahl took on the responsibility of webmaster. Kimberly also produces the dynamic PDF, succeeding Jessica Tingg (formerly of the Office of Fisheries Information Systems). We also thank the many RP scientists and students who continue to assist us in updating this website, but particularly Jan Benson, Morgan Busby, Lisa De Forest, Ashlee Overdick, and Tiffany Vance. We thank Angie Grieg for creating the 2015 edition of static maps and the addition of interactive distribution maps.

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ANN C. MATARESE
DEBORAH M. BLOOD
WILLIAM C. RUGEN

Alaska Fisheries Science Center
National Marine Fisheries Service, NOAA
7600 Sand Point Way N.E.
Seattle, Washington 98115

Introduction

The Recruitment Processes Program at NOAA's Alaska Fisheries Science Center (AFSC) has been collecting ichthyoplankton in the Northeast Pacific and Bering Sea since the early 1970s, yielding an invaluable collection of specimens and a comprehensive dataset of locality, distribution, and abundance information for the early-life-history (ELH) stages of fishes in the area. This work led to the publication of a taxonomic guide to the identification of the eggs and larvae of >200 species of fishes (Matarese et al., 1989) and an atlas that presents data on spatial and temporal trends in the dominant fish eggs and larvae (Matarese et al., 2003). The consolidation of data (updated from the taxonomic guide, atlas, and associated metadata) from these sources form the backbone of the Ichthyoplankton Information System (IIS). The IIS is an online, interactive, searchable information system that is routinely updated to include the most current publications. The IIS consolidates almost 40 years of fish ELH data representing almost 300 taxa into a single website that is accessible to everyone. The IIS is an invaluable tool providing the most up-to-date information on the ELH of fishes in the Northeast Pacific and Bering Sea, including some of the most diverse and commercially valuable ecosystems in the world.

Recruitment Processes Program Ichthyoplankton Sampling Studies

(for a complete discussion see Matarese et al., 2003).

The Recruitment Processes Program has been collecting and analyzing ichthyoplankton for almost 40 years (Fig. 1, Appendix A). Beginning in 1965, AFSC, then known as the Bureau of Commercial Fisheries (BCF) Seattle Biological Laboratory, started an ichthyoplankton program off the Northeast Pacific coast to determine the northernmost extent of *Merluccius productus* ((Pacific hake) spawning. Only data on Pacific hake were kept and analyzed. The Marine Resources Monitoring, Assessment, and Prediction Program (MARMAP) began in 1971, sampling in the eastern Bering Sea, off Kodiak Island, Alaska, and off Vancouver Island, British Columbia. Samples were collected using MARMAP standard protocol (Jossi and Marak, 1983) and all taxa were sorted, counted, and identified by larval taxonomists at the Seattle laboratory, at that time known as the Northwest Fisheries Center (NWFC). The Outer Continental Shelf Environmental Assessment Program (OCSEAP) supported five cruises conducted 1977-1979 in the shelf waters east of Kodiak Island in the Gulf of Alaska. These studies were developed to assess the spatial and temporal distribution of plankton that might be affected by oil exploration and development. In 1980, the Plankton Sorting and Identification Laboratory in Szczecin, Poland, began processing ichthyoplankton samples collected by our center, which had been renamed the Northwest and Alaska Fisheries Center (NWAFC) in 1974. For most of the early 1980s, sampling was conducted along the Washington, Oregon, and northern California coasts in cooperation with the Soviet Union (USSR/USA cruises, 1980-87). As the first large-scale ichthyoplankton surveys to be done in this region, this work sought to document patterns in occurrence, distribution, and abundance of ichthyoplankton in coastal waters of the Northeast Pacific. The Fisheries Oceanography Coordinated Investigations (FOCI) Program began in 1985 and was initially centered on physical and biological factors affecting survival of ELH stages of walleye pollock (*Gadus chalcogrammus*) in the Gulf of Alaska. Bering Sea FOCI was established in 1991 (after the NWAFC was split into two centers, the Northwest Fisheries Science Center (NWFSC) and the AFSC) under the auspices of NOAA's Coastal Ocean Program (COP) to address similar research in the eastern Bering Sea shelf region. Bering Sea FOCI ended in 1996, but was immediately followed in 1997 by the Southeast Bering Sea Carrying Capacity Program (SEBSCC), also sponsored by COP. This program sought to document the role of juvenile walleye pollock in the eastern Bering Sea ecosystem, to examine the factors affecting their survival, and to develop and test annual indices of prerecruitment abundance (Dagg and Royer, 2002). The Northeast Pacific Global Ocean Ecosystems Dynamics Program (GLOBEC) was added to the Recruitment Processes Program in 1998. The GLOBEC research, in addition to compiling a comprehensive atlas that presents data on spatial and temporal trends in the dominant fish eggs and larvae (Matarese et al., 2003), includes studies comparing multi-species ichthyoplankton assemblages from the Gulf of Alaska, Bering Sea, and U.S. west coast (Doyle et al., 2002a; Doyle et al., 2009) and larval flatfish transport studies, concentrating on the influence of El Niño in the Gulf of Alaska (Bailey and Picquelle, 2002). These investigations provided insight into the spawning strategies of the fish populations in these regions and how they relate to oceanographic conditions. Steller sea lion research was undertaken in 2002 to provide a retrospective analysis of ichthyoplankton data from the Gulf of Alaska and Bering Sea. This analysis contributed to understanding ecosystem dynamics in relation to Steller sea lion decline.

Ongoing Investigations

Over the years, the Recruitment Processes program has broadened its focus from single species studies to a more holistic ecosystem approach. FOCI, one of our original projects, became so broad that this acronym was being used as the "umbrella" for many different projects. To reflect this broadening of our investigations, in 2005 the group agreed to put all existing and future projects under the Eco-FOCI acronym (Ecosystem & Fishery-Oceanography Coordinated Investigations). This evolution occurred as NOAA Fisheries was also broadening its focus and adopting an ecosystem approach to management. One of our newer projects that is a perfect fit for Eco-FOCI is the North Pacific Climate Regimes and Ecosystem Productivity project (NPCREP), which seeks to observe and understand how climate determines the structure and function of marine ecosystems (Bering Sea and Gulf of Alaska). This new project, in collaboration with NOAA's Pacific Marine Environmental Laboratory, will also apply our new knowledge of climate-ecosystem linkages to the management of living marine resources, as does our original FOCI program.

Our original FOCI studies on walleye pollock and their ecosystem continue in the Gulf of Alaska and the eastern Bering Sea. For the Gulf of Alaska, FOCI conducts process studies and annual larval surveys and incorporates these data into recruitment estimates for walleye pollock (Megrey et al., 1996; Bailey, 2002). Correlation modeling methods have been developed to analyze hydroacoustic survey results of spawning aggregations, ichthyoplankton surveys of larvae, estimates of spawning biomass and recruitment from annual stock assessment, measurements of ocean temperature, winds, rainfall, sea-level pressure gradient, and other biological and physical factors (Megrey et al., 1995). Studies in the Bering Sea continue to document the role of walleye pollock in the eastern Bering Sea ecosystem, including their interaction with seabirds and marine mammals.

GLOBEC-supported investigations have identified dominant taxa and multispecies assemblages in the ichthyoplankton, described their horizontal distribution patterns, and related these patterns to the oceanographic variables (Doyle et al., 2002a). Temporal variation in the composition, distribution, and abundance of these assemblages is being further investigated. In addition, we are examining temporal variability in the occurrence, abundance, and distribution of many ichthyoplankton species that are numerically dominant (e.g., *Hippoglossoides elassodon* , flathead sole, Porter, 2005; *Lepidopsetta polyxystra*, northern rock sole, Lanksbury et al., 2007; *Atheresthes stomias*, arrowtooth flounder, Blood et al., 2007) and ecologically important (e.g., *Mallotus villosus*, capelin, Doyle et al., 2002b). Seasonal ichthyoplankton assemblages are being identified and described (e.g., summer ichthyoplankton in the Bering Sea, Duffy-Anderson, 2006; fall ichthyoplankton in the Gulf of Alaska, Lanksbury et al., 2005). Other studies are also investigating advective processes associated with onshore transport of ichthyoplankton, developing cross-shelf exchange tracers composed of offshore ichthyoplankton assemblages, and identifying key species that may be indicators of changes in oceanographic conditions or cross-shelf flow.

Geographic and Temporal Coverage (Fig. 2, Appendix A)

Most data for the initial BCF Pacific hake and MARMAP studies in the mid-1960s and early 1970s were not entered into a permanent database. Our database became more consistent in 1977 with OCSEAP, the first broad-scale program offering NWAFC scientists the opportunity to study seasonal occurrences of eggs and larvae in the Northeast Pacific Ocean. During the 1970s, sampling intensity was highest in the Gulf of Alaska east of Kodiak Island (Map 1, Appendix B). The OCSEAP Program offered broad monthly coverage (February-November), but, overall, only 13 cruises were conducted between 1972 and 1979 (no cruises from 1973 to 1976). The graphs adjacent to each map show that the sampling effort over the months of the year varied by decade and by region. In the 1970s, comparatively few cruises were conducted, but most (81%) were conducted in the Gulf of Alaska with the remainder in the Bering Sea.

By the mid-1980s, there was a dramatic increase in the number of surveys due to the addition of U.S. west coast cruises (USSR/USA, 1980-1987) and the initiation of the FOCI Program (Map 2). Sampling was greatest in the Gulf of Alaska in Shelikof Strait and southwest of Kodiak Island. The number of cruises increased from 13 during the 1970s to 44 during the 1980s. January was included in the monthly coverage, but 88% of cruises occurred from March to May, which is the peak period of walleye pollock spawning in Shelikof Strait. Only three cruises were conducted in the Bering Sea, but coverage was expanded with ten cruises conducted along the U.S. west coast. Sampling distribution along the west coast was highest along the continental shelf region from Washington to northern California, while sampling was limited nearshore and in the deeper offshore waters.

Coverage in the 1990s was expanded to include more sampling in the Bering Sea with the onset of the Bering Sea FOCI and SEBSCC Programs (Map 3). More cruises were conducted than in the 1980s (58 versus 46) and a much higher percentage of Bering Sea cruises were conducted than ever before (46%). Summer coverage (27%) was also more extensive. Sampling gear other than bongo and neuston nets and Tucker trawls was used (e.g., MOCNESS nets to assess fine-scale vertical distribution) and cruises using Methot nets were designed to collect early juveniles; however, these special purpose gears were not included in the abundance and distribution data presented here.

For the years 2000-2009, most cruises were conducted in the Bering Sea (63%). Sampling was extended to the most northern areas of the Bering Sea (Map 4, Appendix B), while also adding some areas in the Gulf of Alaska beyond the shelf break off Southeast Alaska and British Columbia. In 2004, the first cruise of a cooperative long term census of the Arctic between Russian and United States scientists took place in the northern Bering and Chukchi seas. In 2008, ichthyoplankton samples were collected in the Beaufort Sea as part of an initial assessment of the distribution and abundance of fish and invertebrates in this Arctic area.

Overview of the Physical Oceanographic Environment

The abundance patterns of ichthyoplankton are summarized for three major ecosystems: the eastern Bering Sea (EBS), western Gulf of Alaska (GOA), and the U.S. west coast. An overall description of the physical and oceanographic characteristics of these three ecosystems is summarized below (Doyle et al., 2002a; Matarese et al., 2003). The eastern Bering Sea is characterized by an exceptionally broad (>500 km) shelf region with a narrow continental slope adjoining an extensive Aleutian Basin (Map 5, Appendix B).The EBS shelf is one of the most productive regions in the world and sustains a high biomass of higher trophic level organisms (Loughlin et al., 1999). Circulation in the basin is generally cyclonic and is fed by inflow from the Alaskan Stream through the Aleutian Islands (Schumacher and Stabeno, 1998) (Map 6, Appendix B). Flow is greatest in the Bering Slope Current, which transports nutrients onto the outer shelf. Flow over the shelf itself is generally weak and large eddies are a common feature. Ice covers a substantial portion of the EBS each winter and spring, although there is considerable interannual variation in the duration and extent of ice coverage. There are three recognized biophysical domains on the shelf, separated by frontal boundaries at roughly the 50 m, 100 m, and 200 m isobaths, which differ hydrographically depending on the degree of stratification and mixing. Productivity appears to be highest at the shelf-break front and phytoplankton blooms there can begin in May and last throughout the summer (Springer et al., 1996). Zooplankton production is estimated to be highest along the shelf edge and outer shelf where the mesozooplankton consists primarily of large oceanic copepod spe

Numerous troughs and shallow banks characterize the topography of the western Gulf of Alaska. The Aleutian shelf area, as defined by the 200 m isobath, is narrower than the EBS shelf (65-175 km) and drops abruptly to depths of 5000-6000 m in the Aleutian Trench, which parallels the shelf edge (Map 5, Appendix B). The Alaskan Stream, which flows southwesterly and roughly parallel to the shelf break at 50-100 cm/sec, dominates offshore, near-surface circulation (Map 6, Appendix B). Nearshore, the Alaska Coastal Current (ACC) is the dominant feature (Reed and Schumacher, 1986). The upper layer flows in a southwesterly direction. With surface speeds of 25-100 cm/sec, the ACC in the vicinity of Shelikof Strait is one of the most vigorous and dynamic coastal currents in the world (Stabeno et al., 1995). Temperatures follow a clear seasonal pattern, with the coldest values occurring in March and the warmest values in August (Reed and Schumacher, 1986). Freshwater discharge into coastal waters peaks in the fall and strongly affects the circulation (Royer, 1998). This region has been referred to as the Coastal Downwelling Domain and is characterized by mainly onshore flow at the surface (Ware and McFarlane, 1989). A seasonal peak in phytoplankton production occurs first in the ACC, and then in the adjacent shelf area, during the first week in May (Napp et al., 1996). Production of copepod nauplii and other zooplankton usually accelerates significantly at this time, but, because of low temperatures and low concentrations of gravid adults, does not reach a maximum until mid-summer (Cooney, 1987).

In contrast to the EBS and the western GOA, the continental shelf is narrow off the U.S. west coast (Map 7, Appendix B). 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 about 10 km off Cape Mendocino. A series of submarine canyons transect the shelf and slope off Washington and California.

These canyons are absent off Oregon where rocky submarine banks are found along the shelf. The U.S. west coast is part of

an extensive Coastal Upwelling Domain extending from Baja California to southern British Columbia (Ware and McFarlane, 1989). The oceanography of this region is characterized by the California Current system, a typical eastern boundary current regime (Hickey, 1989; 1998) (Map 6, Appendix B). The main California Current proceeds southwards along the U.S. west coast and is slow, meandering, broad, and indistinct. Prevailing winds cause downwelling close to the coast in winter and upwelling of cold, nutrient-laden, oceanic water close to the coast in summer. The intensity of Ekman transport and associated upwelling is variable along the coast and tends to increase from north to south with a local maximum at Cape Mendocino off northern California (Parrish et al., 1981). Annual sea-surface temperature minimums and salinity maximums generally occur in summer after sustained upwelling-favorable winds. Phytoplankton blooms occur during relaxed upwelling conditions between peak upwelling periods during spring and fall (Small and Menzies, 1981). A zone of high zooplankton standing stock is generally observed 10-30 km offshore in summer and the community is dominated by copepods (Landry and Lorenzen, 1989).

Sampling Protocol

The taxonomic data used in this website were obtained from eggs and larvae collected during ichthyoplankton surveys conducted from 1972 to 2009 by the Recruitment Processes Program (Table 1). Data on distribution and abundance of eggs and larvae were based on surveys from 1972-2009, excluding 1973-1976. Collection data for cruises conducted up to 1988 can be found in Dunn and Rugen (1989), and in the AFSC ichthyoplankton cruise database (Rugen, 2008) for those cruises conducted from 1989 to 2009. The majority of the data are from samples collected using a MARMAP type bongo sampler (Posgay and Marak, 1980) with an inside diameter of 60 cm and a 0.333 or 0.505-mm mesh net. Before 1985, standard MARMAP oblique tows were made to 200 m following MARMAP sampling procedures (Smith and Richardson 1977). In 1985, sampling depth in the Gulf of Alaska was changed to near bottom in order to accurately determine the abundance of walleye pollock eggs and early larvae. Beginning in the early 1990s, annual larval surveys in the Gulf of Alaska began to sample to 100 m in late May because that is where the larvae are most abundant. Flowmeters suspended in the mouths of the nets of all ichthyoplankton gear were used to determine the volume of water filtered by each net. Data from 1-m Tucker trawls were used only for cruises in which Tucker trawls were the primary gear (14 cruises, 1035 tows; Table 1, Appendix C).

A Sameoto neuston sampler (Sameoto and Jaroszyinski, 1969), with a mouth opening 0.3 m high x 0.5 m wide and a 0.505-mm mesh net, was used sporadically throughout the time series to collect eggs and larvae that reside in the upper surface waters. A partial summary and analysis of our spring neuston collections from the Gulf of Alaska (1981-1986) are presented by Doyle et al. (1995). A summary and analysis of our neuston collections off the U.S. west coast are presented by Doyle (1992). In comparison to bongo collections presented here (Table 1, Appendix C), Table 2 (Appendix C) presents an overall summary, based on the standard data set for 1972–1996 (Matarese et al., 2003), of the 20 most common taxa collected with neuston gear and arranged by percent frequency of occurrence. Data from the neuston tows were selected to generate maps and graphs for 12 taxa for which the best geographic distribution pattern was described using surface gear (Table 3, Appendix C).

The sampled population is defined as fish in the size range that is effectively caught by the sampling gear, and may include both larvae and juveniles because the transformation point between these two stages is unknown for many species, and because fish were staged inconsistently over the years. The number of individuals caught in each of the three sampling gears (i.e., bongo net, neuston net, and Tucker trawl) was standardized to number caught per 10 m^2 of surface area. Catches from bongo and Tucker gear were standardized based on net mouth area and tow depth and length (Smith and Richardson, 1977). Some of the Tucker tows were depth stratified; that is, two nets sampled two contiguous depth intervals. In these cases, the catches per 10 m^2 from both nets were summed to integrate over the depths sampled by both nets. Since both gears were fished at similar depth ranges, we assumed that bongo and Tucker gear sample essentially the same population, and thus allowed data from these two gears to be combined. This assumption is supported by Shima and Bailey (1994), who concluded that the fish-length-specific sampling effectiveness of these two gears is not significantly different. It was also assumed that no individuals occurred below the depth sampled by the gear, thus the number caught per 10 m^2 of surface area represents the total number of individuals in the water column below a surface area of 10 m^2. Samples collected by neuston gear were standardized to number caught per 10 m^2 of surface area based on net mouth width and tow length. Neuston data are usually represented as number per 1000 m^3, but we chose to scale the data to surface area because that describes the number of animals in a specified area of the neuston layer. In comparing neuston catches and bongo catches per unit area, the neuston catches are much smaller because the volume of water filtered is much smaller. The neuston net effectively samples the top 15 cm of the surface layer; hence animals occurring below this depth are not sampled. It was assumed that most individuals of neustonic species occur in the top 15 cm, although many species migrate vertically in and out of the neuston.

Plankton samples were preserved in the field using a 5% formalin-seawater solution buffered with calcium carbonate chips or sodium borate; after 1983, fish larvae were transferred to 70% ethanol after formalin fixation. All fish eggs, larvae, and juveniles have been removed and identified to the lowest possible taxon since 1980 at the Plankton Sorting and Identification Center in Szczecin, Poland (Fig. 1, Appendix A). Identifications are verified by the taxonomic team at AFSC using information found in Matarese et al. (1989) and supplemented by a number of more recent publications including those by Moser (1996), Busby (1998), and Orr and Matarese (2000), and Blood and Matarese (2011).

Geographic Coverage

The study area extends from the Bering Sea, into the Gulf of Alaska, and along the U.S. west coast (Map 8, Appendix B). Most of the sampling throughout the time series occurred in Shelikof Strait and west toward the sea valley and along the Alaskan Peninsula (Map 9, Appendix B). Repeated sampling was more extensive with bongo/Tucker gear than with neuston gear (Map 10 and Map 11, Appendix B). Coverage is most complete in the Gulf of Alaska (except for 1980 when no sampling occurred there; Fig. 2, Appendix A) and less extensive in the Bering Sea and off the U.S. west coast. Coverage is also more complete along shelf regions and less extensive in deeper ocean waters where mesopelagic and deepwater flatfishes spawn. No ichthyoplankton sampling occurred in the North Pacific in Canadian waters. Most of the 625 km^2 grid cells were sampled 1–10 times.

Most of the data used in this study were obtained from bongo tows taken during April and May. Combined bongo tows and Tucker trawls during these two months account for 52–79% of the yearly total, depending on geographic region (Fig. 3, Appendix A). Data from neuston tows were more evenly distributed throughout the year, with tows made during April and May accounting for 0–54% of the yearly total in each region (Fig. 3, Appendix A). The distribution of combined bongo tows/Tucker trawls and neuston tows by year and geographic region further illustrates our extensive coverage of the Gulf of Alaska during the 11-yr period (1977–1987) of routine sampling with neuston gear (Fig.4, Appendix A).

Taxonomic Coverage (Matarese et al., 1989; Matarese et al., 2003)

The increase in our taxonomic knowledge over almost 40 years has allowed our basic knowledge of the early life history of species to be expanded and fine-tuned. Of the 646 known fish species that occur in the Northeast Pacific Ocean and Bering Sea, we can currently identify a portion of the early life history stages for about 320 (personal commun., Busby unpubl.). Phylogenetic order of higher taxa generally follows Nelson (1994); genera and species are listed alphabetically within families.

Larvae -- Most of the larvae included in the IIS can be found in our laboratory guide (Matarese et al., 1989), atlas (Matarese et al., 2003), or CalCOFI Atlas 33 (Moser, 1996). Any taxa that spawn in our study area and have been described with accompanying illustrations can be found within this guide. Taxa that do not produce planktonic early-life-history stages are generally excluded (e.g., Embiotocidae) as are strictly freshwater and estuarine species or spawners. Sources useful in identifying early-life-history stages of freshwater and estuarine species found adjacent to our study area include Wang (1981, 1986) and Auer (1982). Updated and new ELH data and figures will be added as information is published.

The complete list of larval fish taxa collected from Recruitment Processes Program cruises 1972 through 1996 used for initial consideration in the atlas (Matarese et al., 2003) is presented in Table 4 (Appendix C). This list was reduced to 102 taxa within 34 families (Table 5, Appendix C). All individual species covered in Matarese et al. (2003) are found in this website; taxa covered only at the genus or family level are not included. Additional maps are added as distributional data are published. Currently, distribution maps are available for 113 taxa.

Eggs -- Similar to the larvae as described above, most of the fish egg taxa included in the IIS can be found in our laboratory guide (Matarese et al., 1989), atlas (Matarese et al., 2003), or CalCOFI Atlas 33 (Moser, 1996). Of larval taxa in the IIS, any of their respective eggs that have been described can be found within this website; most/many have accompanying illustrations.

The complete list of fish egg taxa collected from Recruitment Processes Program cruises 1972 through 1996 used for initial consideration in the atlas is presented in Table 6 (Appendix C). Data were restricted to pelagic fish eggs due to sampling strategies and gear limitations. The selection process resulted in a total of 30 taxa included in 14 families (Table 7, Appendix C). For each of the 28 individual species in the final list, distributional maps depicting presence/absence are presented in the IIS. As with larvae, additional egg distribution maps are added as data are published. Currently, distribution maps are available for 29 taxa.

General life history -- Life history data are provided as ancillary information, which may aid in identification of eggs and larvae. These data were extracted from the current general literature as well as original unpublished material. Geographic ranges are from three types of sources: RACEBASE, an oracle database developed by the Resource Assessment and Conservation Engineering Division (RACE) which contains information collected by fishery scientists on research survey cruises; ICHBASE, a database developed by AFSC which contains information on larval fish and eggs collected from research cruises; and from current literature. Mecklenburg et al., 2002 provided a significant amount of new information. Range information is restricted to the study area. Thus, the limits of the southern distribution beyond the California-Mexican border (SSC = South of southern California, below 32° 30’ N), the northern range beyond the Arctic to the north and east, and the western range beyond the Bering Sea are not specified.

Statistical Overview for Map Generation (for complete details, see Matarese et al., 2003)

The data described in the Information and Data Sources Section were combined to produce an average spatial distribution as presented in the maps on individual taxon pages. Abundance from each station was measured as catch per 10 m^2 surface area. The statistical method, which we adopted, was to stratify the data into equal-sized time intervals (e.g., years), which partially controls the bias due to uneven sampling effort in time. This does not completely correct the bias because some time interval strata have no data at all, and stratification does not help in these cases. Bias for the strata that do have data is corrected by giving each stratum equal weight regardless of the number of stations. For the maps, the data within each 625 km^2 grid cell were stratified by year. This removes bias due to uneven sampling between years within each cell, but only for those years for which each cell was sampled; this does not correct for uneven sampling for those years where the cell was not sampled at all.

Data Layers

The maps were produced with a geographic information system using ArcGIS software (ArcMap 10.2.1), a product of Environmental Systems Research Institute (ESRI). The ESRI Ocean Basemap is a composite of data from the following sources: ESRI, General Bathymetric Chart of the Oceans digital aatlas (GEBCO), NOAA, CHS, CSUMB, National Geographic, DeLorme, and NAVTEQ..

Occurrence Map Generation

Larval Occurrence Map

The fish density data layer shows all the sample locations referenced geographically. However, samples were often taken at the same location resulting in points plotting on top of each other. Because we wanted to show the quantity and distribution of the samples, a different symbology was needed. Fish density is continuous in space even though the density may be zero at some locations. So, point locations were aggregated into a surface by overlaying the points onto a regular grid and assigning a mean value to each grid cell. The cell size of the grid is 25 km x 25 km (625 km^2), or roughly 15.5 miles x 15.5 miles. The mean value at each grid cell was derived in two stages. First, the mean catch per 10 m^2 was calculated per cell per year, and then the mean catch per 10 m^2 was calculated per cell averaged over the years. This equalized the contribution of any single year since some years may have had a greater number of samples. The resulting data layer was a polygon showing all cells where samples were taken and their associated abundance based on catch per 10 m^2.

A chloropleth map design was chosen to depict abundance. The purpose of the map is to show the general spatial extent of the data and the general trend of average larval abundance over space. Chloropleth maps shade statistical units with intensity proportional to the data values. All cells that were sampled, but contained no individuals of the taxon, are symbolized as gray, indicating absence. The remaining data were classified using quantiles: data were ranked, ordered, and divided into four categories, each containing an equal number of observations. The legend shows the range for each class and the colors are hierarchical in that lighter colors connote lower levels of abundance and darker colors connote higher levels.

Adult Occurrence Map

The occurrences of adults were derived for the most part from AFSC data residing in RACEBASE, an Oracle database. RACEBASE was developed by the Resource Assessment and Conservation Engineering Division (RACE) and comprises data from assessment, hydroacoustic, and foreign surveys conducted by federal fishery scientists from 1948 to the present. The geographic extent of RACEBASE data covers the continental shelf and slope of western North America and northeastern Asia from the Arctic Ocean (72° 14’ N, 167° 52’ W) south through the eastern half of the Chukchi Sea, throughout the Bering Sea (including the continental shelf of northeast Siberia), the Aleutian Basin and eastward along the Aleutian Islands, and along the U.S. Pacific coast from the Gulf of Alaska to the southern border of California (32° 28’ N, 119° 18’ W). Adult occurrence data points for taxa where standard RACEBASE data were insufficient were obtained from literature and unpublished sources. Maps generated with alternative data show presence only because the geographic extent of individual surveys was unknown (no gray area appears). Some maps that have a combination of both RACEBASE and alternative data will include the extent of known Race surveys.

Egg Occurrence Map

The data for the egg occurrence map was processed similarly to the adult occurrence map. A data layer was overlaid with a polygon grid having a 25 km x 25 km cell size to produce the final data layer showing presence or absence of eggs of the taxon. The result was a layout design consistent with the larval abundance map, which overcame the issue of stacked data points. Gray circles denote where samples were taken, but no eggs were found. Orange circles show the presence of the taxon.

The organization of this guide is to allow the user to browse through the 296 taxa (Table 8) currently included in the IIS and to aid in identification of ELH fish specimens. For each taxon, when available, there is information pertaining to distribution, meristics, life history and ecology, early life history descriptions, illustrations, and relevant literature. Phylogenetic order generally follows Nelson (1994) and Nelson et al. (2004) and scientific names follow Robins et al. (1991) and Nelson et al. (2004).

ELH Characters

As fish larvae do not often look like their adult counterparts, the following characters are useful when trying to identify an unknown egg or larval fish specimen from the Northeast Pacific or Bering Sea. The first step is to determine the developmental stage of the specimen because the size of the larvae at certain stages can sometimes be an identifying trait.

Developmental Stage Definitions (Fig. 5, Appendix A)

EGG/EMBRYO STAGE (spawning to hatching): There are two general categories of diagnostic characters pertaining to fish eggs. The first category pertains to the egg itself and contains characters such as: egg diameter and shape; envelope sculpturing and color; yolk diameter, pigmentation, and character (homogeneous or segmented); number, size, and position of oil globules; and width of perivitelline space. The second category pertains to the embryo developing within the egg and contains characters such as: pigmentation, timing of development, body shape, number of myomeres, and presence or absence of elongate fin rays.

One of the first characters used to identify eggs is diameter. Tables with the diameters of all of the eggs that have been collected within the study area are provided and list those taxa whose eggs are 0.5–1.0 mm (Table 9, Appendix C), 1.0–2.0 mm (Table 10, Appendix C), 2.0–3.0 mm (Table 11, Appendix C), and 3.0–4.0 mm (Table 12, Appendix C) in diameter. As egg diameters are described as a range, a species name may appear in Tables 9–12 more than one time. In addition, a table lists the diameters of all eggs that contain oil (Table 13, Appendix C); numbers of oil globules and their diameters are also shown. A table of distinguishing characters of eggs is arranged in order of egg diameter and, in addition to including information about the chorion, oil, yolk, and pigment, characters are listed that are useful to differentiate similar taxa (Table 14, Appendix C). Finally, a table of the frequency of occurrence of eggs collected in the Gulf of Alaska and Bering Sea and off the U.S. west coast will further guide the reader as to the likelihood of collecting a particular taxon (Table 15, Appendix C).

YOLK-SAC STAGE (hatching to complete absorption of yolk sac): Larvae hatch from the egg at various stages of development. For larvae hatched from pelagic marine eggs, hatching generally occurs before the yolk sac has been completely absorbed. However, larvae of species with demersal eggs hatch as preflexion larvae having absorbed their yolk while still in the egg. In species that do have a yolk-sac stage, larvae usually hatch without a functional mouth, eye pigment, or differentiated fins.

Diagnostic characters for yolk-sac larvae include body size and shape, gut shape and length, pigment patterns, number of myomeres, size and shape of yolk sac, oil globule size and position within the yolk, and presence or absence of specialized larval characters such as elongate fin rays, enlarged finfolds, and stalked eyes.

PREFLEXION STAGE (complete yolk-sac absorption to start of notochord flexion): The preflexion stage begins once both hatching and complete absorption of the yolk sac have occurred and ends with the start of notochord flexion. Diagnostic characters for preflexion larvae are similar to those for other larval stages: meristics (myomeres, fin rays), body size and shape, fin development sequence, gut shape and length, pigmentation pattern, presence or absence of head spines, and presence or absence of specialized larval characters such as fin-ray ornamentation, stalked eyes, and a trailing gut.

FLEXION STAGE (start of notochord flexion to completion of notochord flexion): The flexion stage is defined as beginning with the dorsal bending of the notochord tip concurrent with development of the caudal-fin rays and supporting skeletal elements. Diagnostic characters for this stage are similar to those for other larval stages: meristics (myomeres, fin rays), body size and shape, fin development sequence, gut shape and length, pigmentation pattern, presence or absence of head spines, and presence or absence of specialized larval characters such as fin-ray ornamentation, stalked eyes, and a trailing gut. Additionally, osteological characters, such as the sequence and timing of ossification, become useful during this stage. The flexion stage ends when the notochord tip has reached its final position at approximately 45 degrees from the notochord axis and the principal caudal-fin rays and supporting skeletal elements are in the adult longitudinal position. The supporting skeletal elements may or may not be completely developed.

POSTFLEXION STAGE (completion of notochord flexion to start of metamorphosis): The postflexion stage begins after the completion of notochord flexion and ends at the onset of metamorphosis (transformation). Diagnostic characters for this stage are similar to those for other larval stages: meristics (myomeres, fin rays), body size and shape, fin development sequence, gut shape and length, pigmentation pattern, presence or absence of head spines, presence or absence of specialized larval characters such as fin-ray ornamentation and stalked eyes, and osteological characters such as timing and sequence of bone and cartilage development.

TRANSFORMATION STAGE (start of metamorphosis to completion of fin-ray development and beginning of scale formation; can be considered late postflexion): The loss of larval characters and the attainment of juvenile/adult characters distinguish the transformation stage. Changes in body shape and pigment pattern can be dramatic. Additional changes that may occur include fin migration, photophore formation, loss of specialized larval characters, eye migration, and scale formation. The transformation stage is generally defined as ending

with the completion of fin-ray development and the onset of scales. The duration of this stage differs among taxa.

JUVENILE STAGE (completion of fin-ray development and start of scale formation to attainment of sexual maturity): Individuals that have reached the juvenile stage of development generally resemble small adults. Although the juvenile stage is characterized by the attainment of different developmental landmarks in different families, scale formation and complete ossification of the skeleton occurs during this period. The stage ends with the attainment of sexual maturity.

OTHER STAGE For several taxonomic groups, exceptions were made to the generalized life stage classification used above, e.g., rockfishes (extrusion larvae are categorized as yolk sac), leptocephalus larvae (pigment only filled out for "postflexion" stage), macrourids ("Preanal-fin formation" stage larvae are categorized as "preflexion," and laterstage "Anal-fin formation" specimens are categorized as "postflexion" [Ambrose 1996]), and gadids ("preflexion" have no caudal-fin elements yet developed, "flexion" exhibit some caudal-fin element development, "postflexion" exhibit near-completion of caudal-fin element development, "juvenile" indicate that caudal-fin elements are complete).

Meristic Definitions

For identification of fish larvae, meristic characters are essential and should be determined. The following meristic characters are listed for each taxa, when available.

BONY PARTS-
- Vertebrae
  - Total
  - Precaudal
  - Caudal
- Gill Rakers
  - Upper Gill Rakers
  - Lower Gill Rakers
- Branchiostegal Rays

FIN COUNTS (Spines and Rays)
- Pelvic
- Dorsal
- Pectoral
- Anal
- Caudal
  - Upper Secondary
  - Upper Principal
  - Lower Principal
  - Lower Secondary

Larval Pigment Region Definitions

Pigmentation available as taxonomic characters on larvae is limited to melanophores, since other pigment cells (e.g., xanthophores) do not retain their color in currentlyused fixatives and preservatives. Melanophore patterns are very useful for identifying larval fishes. Their relative size, position, and sometimes the number of melanophores in series should be noted. In some cases, pigmentation consists of a group of melanophores in a specific area; in others the pigmentation consists of an individual melanophore. Pigmentation generally changes as larvae develop. Movement of individual melanophores is rather limited, but addition or loss of melanophores is common. Usually preflexion larvae are less pigmented than later larvae, and late in the larval period, as transformation occurs, the larval pigment pattern is overgrown by the largely superficial pattern of the juvenile. Between the preflexion and transformation stages in most fish there is a definite larval pigment pattern which is relatively stable, and unique to a species in many cases. In this guide, pigment present in each developmental stage previously described is listed for the following regions (Fig. 6, Appendix A).

PREANAL -
Mouth - pigment anterior to a vertical line drawn from anteriormost edge of eye. Usually includes posteriormost end of maxilla, (upper and lower jaw, lateral or ventral surface), snout, or anterior area of the forebrain.

Crown - pigment on dorsal surface of head, from anterior margin of eye to posterior edge of head defined by a line vertically from hindbrain to opercular margin, and then laterally to a horizontal line drawn at mid-orbit (although no eye pigment is included in this or any other category).

Nape - pigment in dorsal region of body beginning at posterior edge of crown and extending to a line drawn vertically from posterior edge of pectoral fin base. Extending more laterally, and includes spots in cleithral area dorsal to pectoral fin insertion.

Cheek - pigment on opercle that lies ventral to a horizontal line through mid-orbit, and posterior to a vertical line drawn at the end of maxilla. Including spots along ventral or posterior edge of opercle, on branchiostegals, and on mandibular articulation (jaw angle), even if these are only visible ventrally. "Mouth" uses the vertical line at the anteriormost edge of the eye, which means that in fish with long maxillas (myctophids and a few others), there will be a small undefined space between these lines.

Isthmus - pigment in ventral region of head connecting gular and cleithral regions; includes pigment on or anterior to cleithrum, but ventral to edge of pectoral fin base.

Dorsal gut - pigment outlining dorsal surface of gut cavity from just behind pectoral fin to anus, and may round only slightly onto lateral edges of gut. Pigment is on gut surface, on dorsal wall of gut cavity, on gas bladder, or on skin covering junction between hypaxial musculature and gut cavity. Includes "hind-gut", which is posteriorly instead of dorsally placed when the gut curves ventrally near the anus.

Lateral gut - includes any pigment between rounding edges of dorsal and ventral gut regions and is posterior to cleithrum. May include pigment ventral to pectoral fin base or pigment lining the anterior edge of gut cavity.

Ventral gut - includes pigment on ventral surface of gut cavity, rounding only slightly onto lateral edges of gut. Includes pigment on cleithrum that extends posteriorly

(although no pigment that is solely on cleithrum), pigment that encircles anus, pigment on or around pelvic fins in most cases, and pigment lining anterior edge of the gut cavity that extends onto ventral surface.

POSTANAL -
Dorsal finfold - includes pigment that is found on or that extends onto rays or membranes of dorsal finfold or dorsal fins. Does not include pterygiophores.

Anal finfold - includes pigment that is found on or that extends onto rays or membranes of anal finfold or anal fins. Includes post-ventral melanophores (PVMs) that extend onto anal finfold, but excludes pterygiophores.

Caudal finfold - pigment that is found on or that extends onto rays or membranes of caudal finfold or fin. Does not include pigment that outlines notochord tip or urostyle, or thickened areas in preflexion and flexion larvae that will later develop into elements of the caudal fin (see "Caudal" for these areas).

Pectoral fin - includes pigment on either blade or base of pectoral fin, as well as in area of cleithrum directly anterior to pectoral fin base, sometimes partially covered by the opercle.

Dorsal - pigment dorsal to, but not including, a dorsolateral line formed by the fulcra of V's in epaxial musculature; begins behind nape and extends to the end of the last vertebra, includes dorsal midline melanophores. In preflexion or flexion larva in which these fulcra have not yet formed, the dorsal edge of the notochord will replace this line.

Ventral - pigment ventral to, but not including, a ventrolateral line formed by the fulcrum of V's in hypaxial musculature; begins along the dorsal gut and extends to the end of vertebra, includes any post-ventral melanophores (PVMs). In preflexion or flexion larva in which these fulcra have not yet formed, the ventral edge of the notochord will replace this line.

Mediolateral - pigment on and medial to mediolateral lines of pigment that define ventral boundary of "Dorsal" and the dorsal boundary of "Ventral". Begins at nape or pectoral fin base, extends partially along dorsal gut, and continues along the "Ventral" and "Dorsal" boundaries until the last vertebra. Does not include notochord pigment.

Caudal - pigment on or outlining urostyle or notochord tip and hypural elements. May extend into the peduncle region, but pigment on the caudal peduncle and not on caudal elements is not included. May include last few PVMs, and pigment above thickened areas where hypural elements are developing in flexion larvae. If these elements have not yet begun developing in preflexion larvae but pigment is still found in this region, it is placed in the "caudal finfold" category.

Although photophores are found in various regions of the body, pigment associated with photophores during or after formation is considered distinct from the melanistic pigment described above, and is not included in any of the previous pigment definitions. Instead, photophore illustrations (Appendices A) of myctophids (Fig. 7), gonostomatids (Fig. 8), sternoptychids (Fig. 9), and stomioids (Fig. 10) (with accompanying photophore key, Table 16, Appendix C) are available as identification tools. Additionally, ecological information, such as depth of capture, geographic area of capture, and date of collection can aid in identification.

Taxon Page

For each taxon, the information is organized into six categories: distribution, meristics, life history, ELH descriptions, illustrations, and footnotes (general references).

Distribution - This page is composed of three maps for each taxon: a larval distribution and abundance map, an egg occurrence map, and an adult occurrence map (Matarese et al., 2003, in part). Gray squares show where samples occurred, but no individuals of a taxon were found. The sampling distribution is different among the three maps. The square grid cell is the same size on all three maps, but appears smaller on the egg and adult occurrence maps due to scale changes.

Heading - The upper left corner of the page includes the common name of the taxon (see Nelson et al., 2004). A blank indicates that no common name is available for that taxon. The upper right corner includes the name of the family in which the taxon occurs.

Larval Distribution and Abundance Map - This map shows the quantity of larvae from combined bongo and Tucker trawl data (or neuston data for those taxa whose distribution is best described using surface gear; Table 3) in the mapped areas. The data are classified such that sampling location information and abundance are provided. Sampling location is represented by the small squares on the map. Gray squares show where sampling occurred, but no individuals of a taxon were found; colored squares show the average abundance of larvae found in the sampled area. The quantity is color coded with lighter color depicting less and darker color depicting more. The color codes function to show general trends in the quantity of the larvae. The map is designed to show the overall abundance of the larvae, rather than the specific values of individual samples. The individual range values in the legend include the lowest value, but not the highest; the highest number marks the end of the range and is not inclusive. The user should also keep in mind that the number of samples varies greatly among the squares.

Egg Occurrence Map - Egg identification or abundance data is available for less than 17% of those fish species for which larvae are identified in the Northeast Pacific Ocean and Bering Sea (Kendall and Matarese, 1994). Gear that is used for collecting fish eggs is biased toward planktonic individuals; demersal eggs are severely underrepresented or entirely absent from our database. Egg occurrence in this map is displayed as presence only as determined

using bongo, Tucker, and neuston gears; black squares show where eggs were present when sampled. For those taxa whose eggs are demersal or unknown, the legend within the map states that eggs are not collected.

Adult Occurrence Map - RACEBASE is a database based on adult groundfish assessment, hydroacoustic, and foreign surveys conducted by federal fishery scientists. Standard adult occurrence maps were generated with RACEBASE data that were limited to the years 1975-2005. Blue squares show where adults were found when sampled. Gray squares denote where samples were taken, but no individuals of that taxon were found. Adult occurrence maps generated with alternative data are identified with an asterisk in the legend on individual taxon pages (Matarese et al., 2003). Adult occurrence maps generated with alternative data other than RACEBASE show presence only because the geographic extent of individual surveys was unknown (no gray area appears on the map).

Meristics - For each taxon, if available, minimum, modal, and maximum counts are given for the following meristic characters: vertebrae (total, precaudal, and< caudal), upper gill rakers, lower gill rakers, branchiostegal rays, caudal-fin rays (upper secondary, upper principal, lower principal and lower secondary), pelvic fin (spines and rays), pectoral-fin rays, dorsal fin (spines and rays) and anal fin (spines and rays). Unknown meristic counts are denoted with an 'X'. Data are from Matarese et al. (1989), updated from recent taxonomic works.

Life History - For each taxon, if available, data for the following life history features are presented: General (geographic range, ecology, ELH pattern, and longevity) and Spawning (area, season, mode, fecundity, age at maturity, and migration). Sections are blank if data are unknown. Data are from Matarese et al. (1989), Moser (1996) and Matarese et al. (2003), and from recent taxonomic works.

ELH Descriptions - For each taxon, a description of the eggs and larvae is provided along with pigment and/or morphological diagnostic characters for distinguishing them from similar-looking species. If available, data for the following ELH features are presented: Egg (diameter, number and size of oil globules, yolk, chorion, and pigment on yolk and embryo) and Larvae (hatch size, preanal length, flexion length, length at transformation, sequence of fin development, and larval pigment pattern). Sections are blank if data are unknown. Descriptions are from Matarese et al. (1989), and Moser (1996), and from recent taxonomic works.

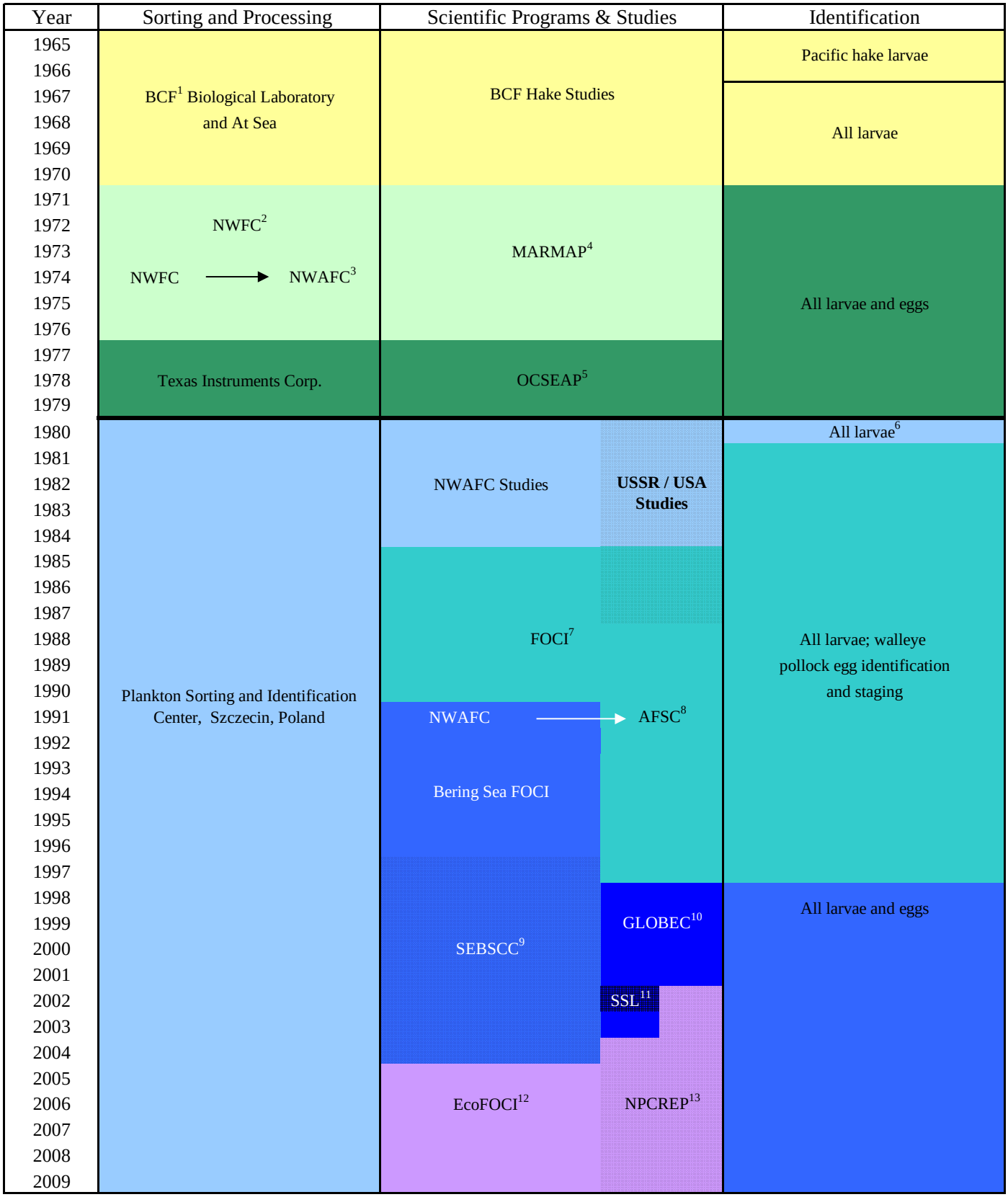
Illustrations - For each taxon, if available, illustrations of the following life history stages are presented: egg, yolk sac, preflexion, flexion, postflexion, and either a transforming or early juvenile. Sources for these illustrations include those previously published and originals drawn from specimens in our collections); collection data are provided for original illustrations (Table 17, Appendix C). Original measurements of larvae are in millimeters and given in standard length (SL) unless otherwise noted. Some measurements taken from the literature are expressed as head length (HL) (Macrouridae), body length (BL), notochord length (NL), or total length (TL). The majority of illustrations are from Matarese et al. (1989), but new and revised figures have been added throughout to reflect the more recent taxonomic literature.

Footnotes - A list of literature referenced specifically for each taxon is provided. General references are listed first, followed by footnotes, and sources for figures.

Citations

A complete list of literature referenced for all 296 taxa found in the IIS. The citations include references cited in the text, footnotes, and sources of figures.

Figure 1. Ichthyoplankton protocols and level of identification for sampling programs conducted by the Recruitment Processes Program, 1965-2009.



[1]Bureau of Commercial Fisheries.

[2]Northwest Fisheries Center.
[3]Northwest and Alaska Fisheries Center.
[4]Marine Resources Monitoring, Assessment, and Prediction.
[5]Outer Continental Shelf Environmental Assessment Program.
[6]Eggs identified and larvae verified by Recruitment Processes Program.
[7]Fisheries-Oceanography Coordinated Investigations.
[8]Alaska Fisheries Science Center.
[9]Southeast Bering Sea Carrying Capacity.
[10]Global Ocean Ecosystems Dynamics (1998-2003).
[11]Steller Sea Lion research (2002).
[12]Ecosystems & Fisheries-Oceanography Coordinated Investigations.
[13]North Pacific Climate Regimes and Ecosystems Productivity (2002-present).

Figure 2. Geographic and temporal coverage of Recruitment Processes Program ichthyoplankton survey data 1972-2009 available in larval fish database (EcoDAAT).

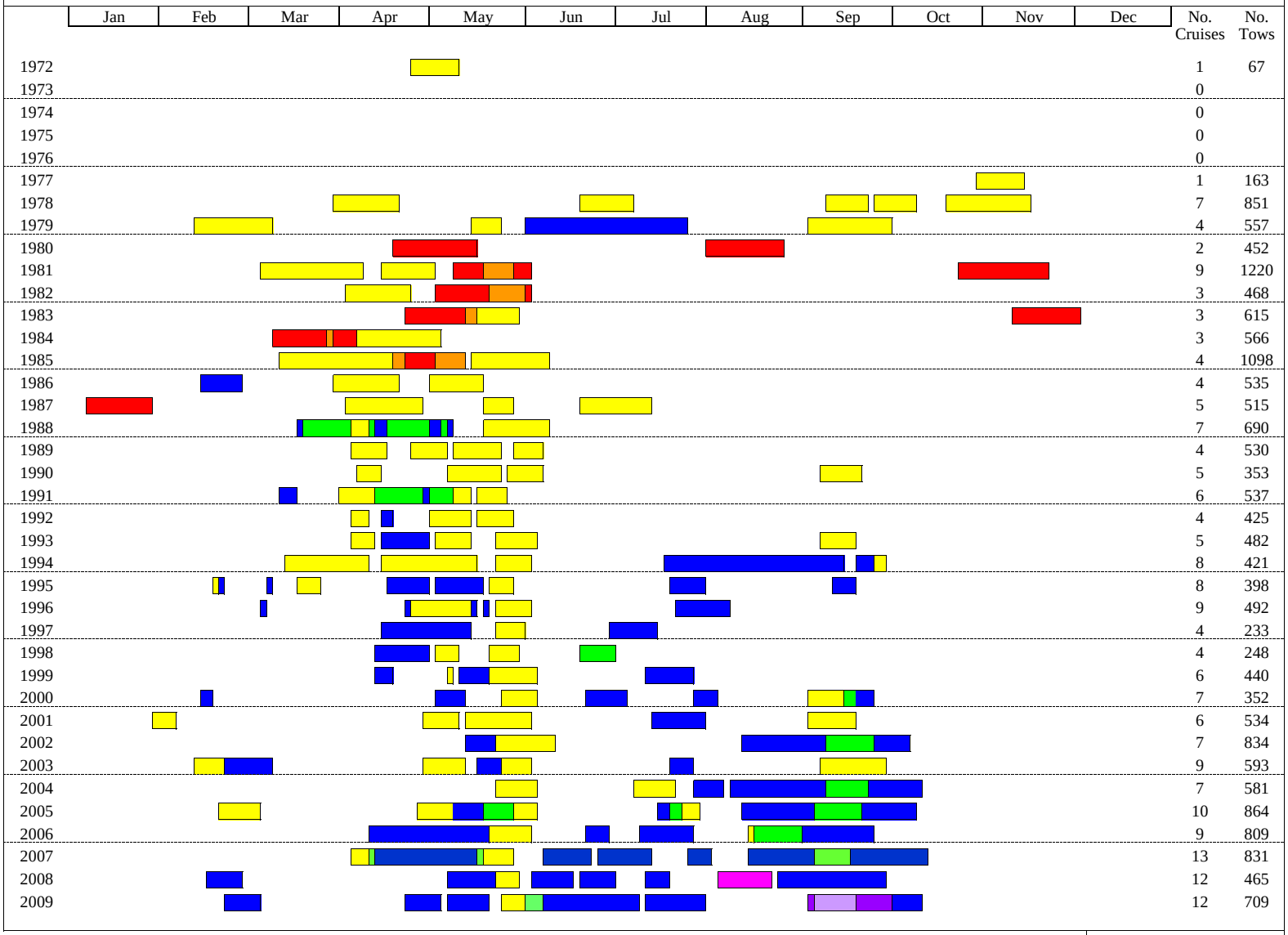
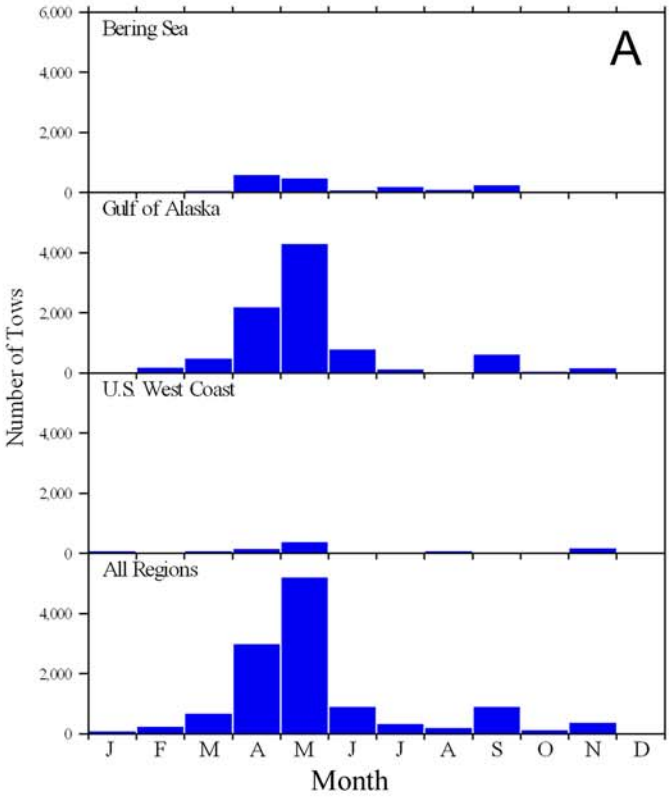


Figure 3. Monthly distribution and number of (A) combined bongo and Tucker tows (number of tows scaled to 6,000) and (B) neuston tows (number of tows scaled to 1,000) by region.



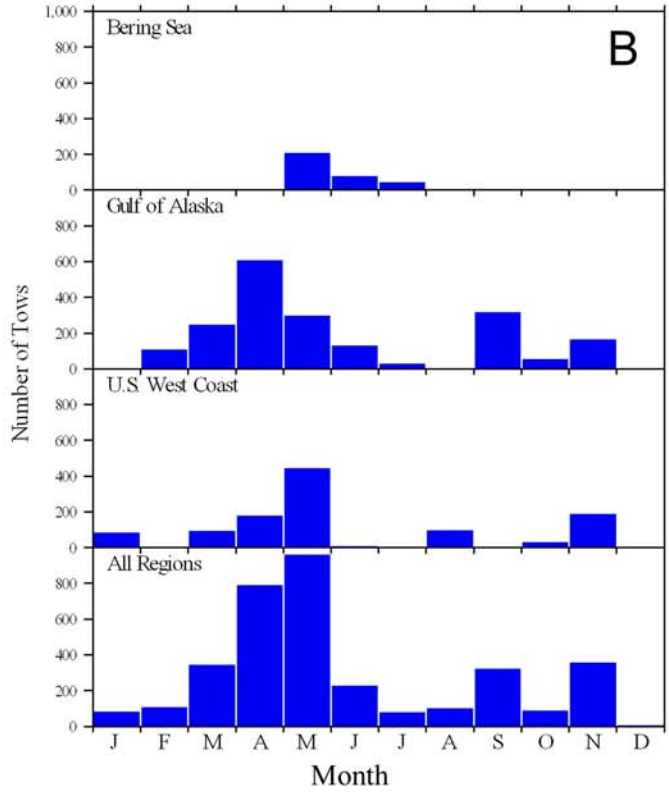
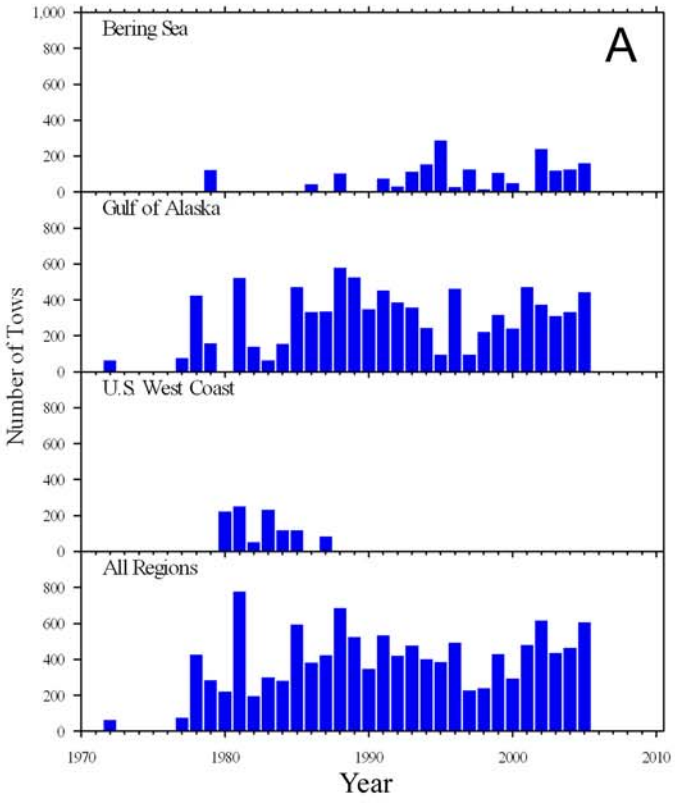


Figure 4. Yearly distribution and number of (A) combined bongo and Tucker tows (number of tows scaled to 1,000) and (B) neuston tows (number of tows scaled to 500) by region.



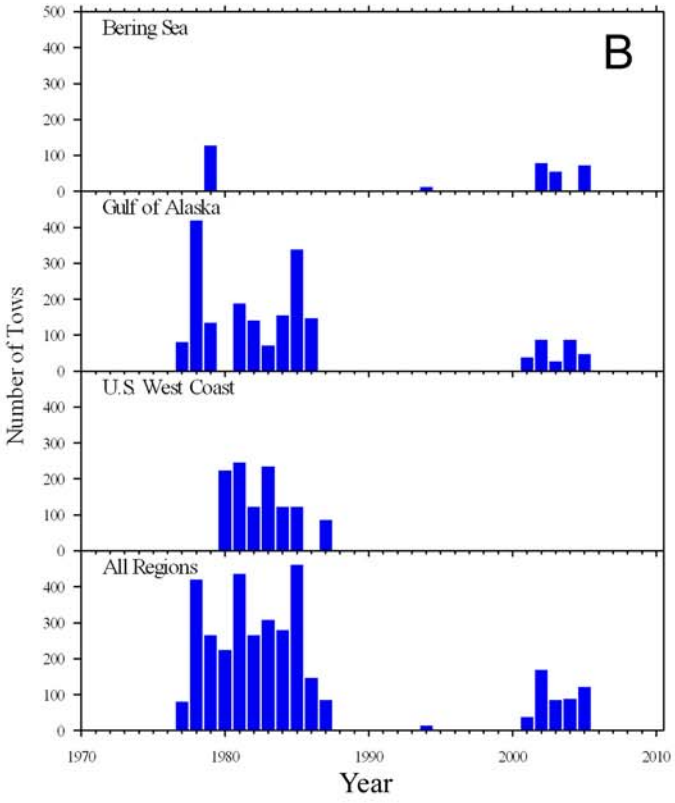


Figure 5. Illustration of developmental stages.

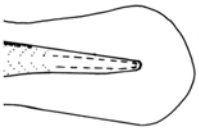
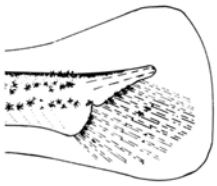
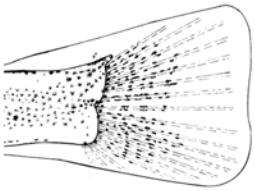
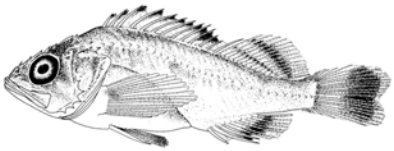
Egg/embryo: spawning to hatching 	Yolk-sac Larvae: hatching to complete absorption of yolksac 	Preflexion Larvae: complete yolksac absoption to start of notochord flexion 
Flexion Larvae: start of notochord flexion to completion of notochord flexion 	Post-flexion Larvae: completion of notochord flexion to start of metamorphosis 	Juvenile: completion of fin-ray development and start of squamation to attainment of sexual maturity 

Figure 6. Pigmentation area defintions.

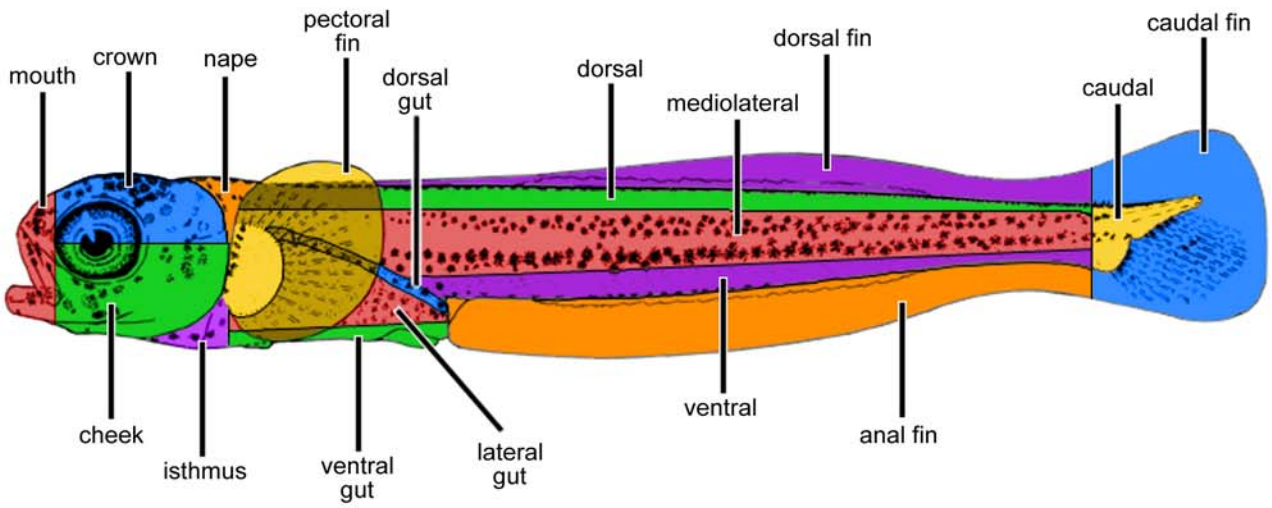


Figure 7. Generalized Myctophidae photophore pattern and terminology for Myctophidae (from Fujii 1984c). Ant—antorbital organ; AO—anal organs; AOa—anterior anal organs; AOp—posterior anal organs; Br—branchiostegal organs; Bu—buccal organ; Cp—cheek organ; Dn—dorsonasal organ; INGL—infracaudal luminous gland; Op—opercular organs; PLO—suprapectoral organ; PO—thoracic organs or pectoral organs; Pol—posterolateral organ; Prc—precaudal organs; PVO—subpectoral organs; SAO—supraanal organs; So—suborbital organ; SUGL—supracaudal luminous gland; Suo—supraorbital organ; VLO—supraventral organ; Vn—ventronasal organ; VO—ventral organs.

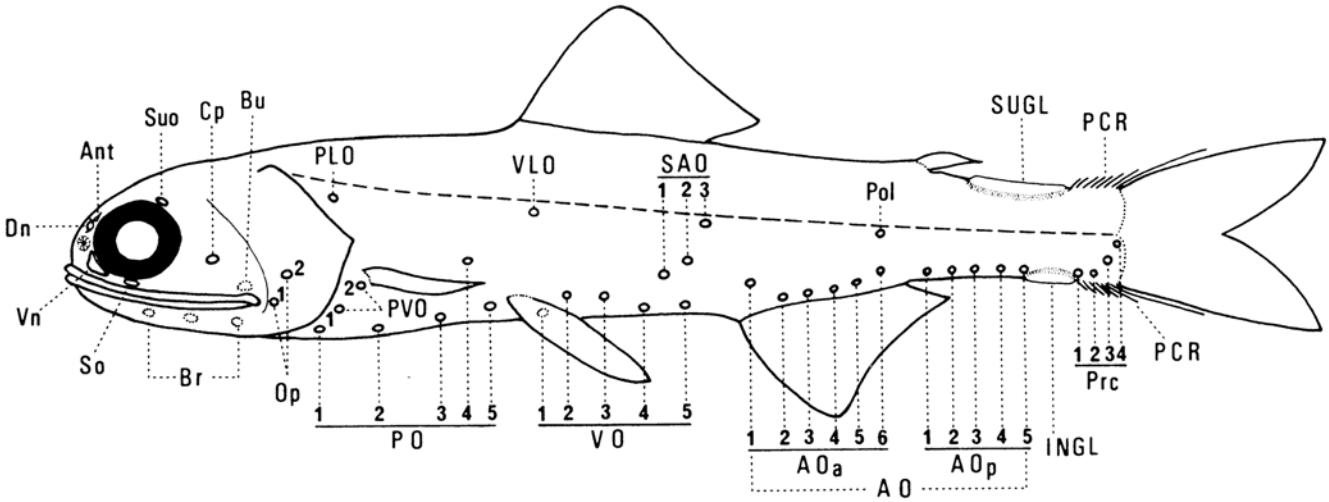


Figure 8. Generalized photophore patterns for gonostomatids (Fahay, 1983). For photophore definitions, see Table 9.

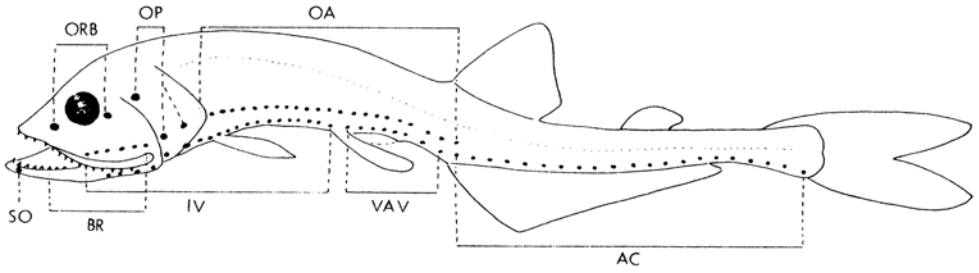


Figure 9. Generalized photophore patterns for sternoptychids (Moser and Watson, 1996; modified). For photophore definitions, see Table 9.

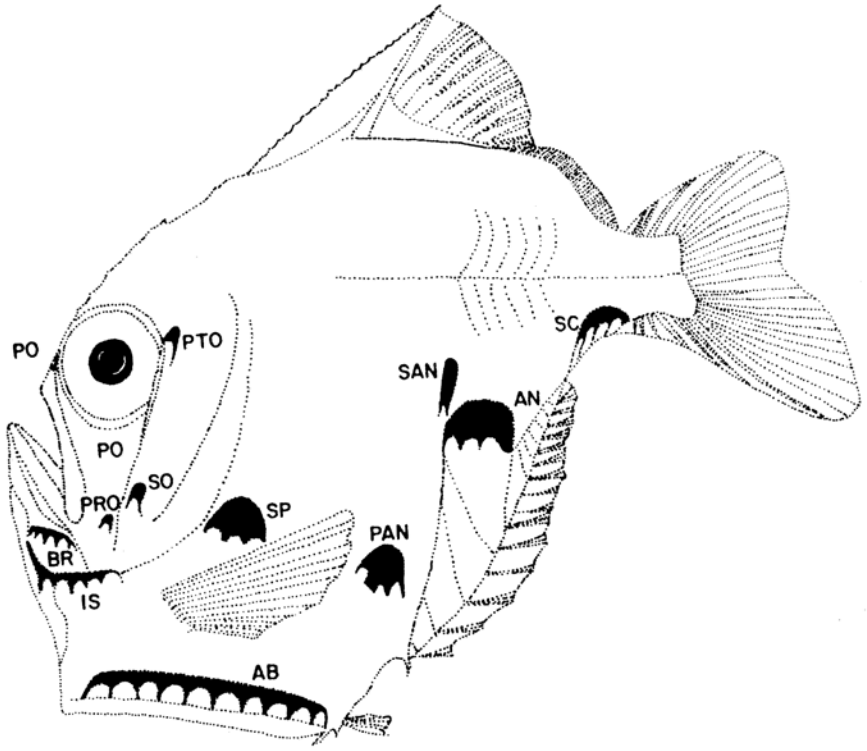
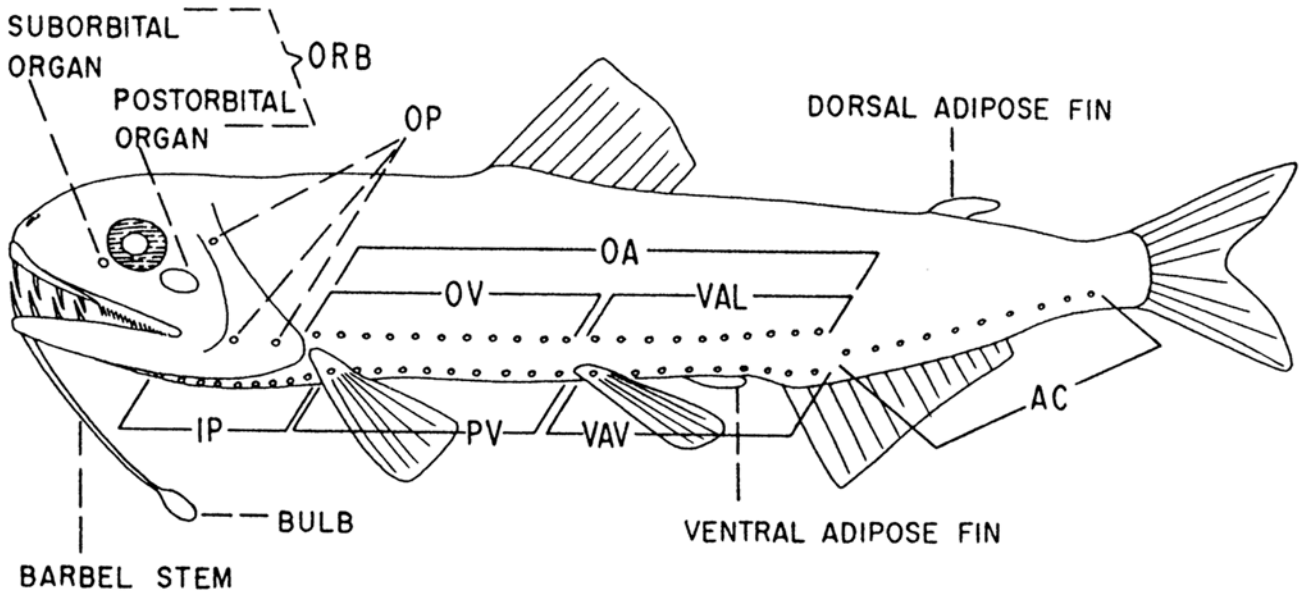
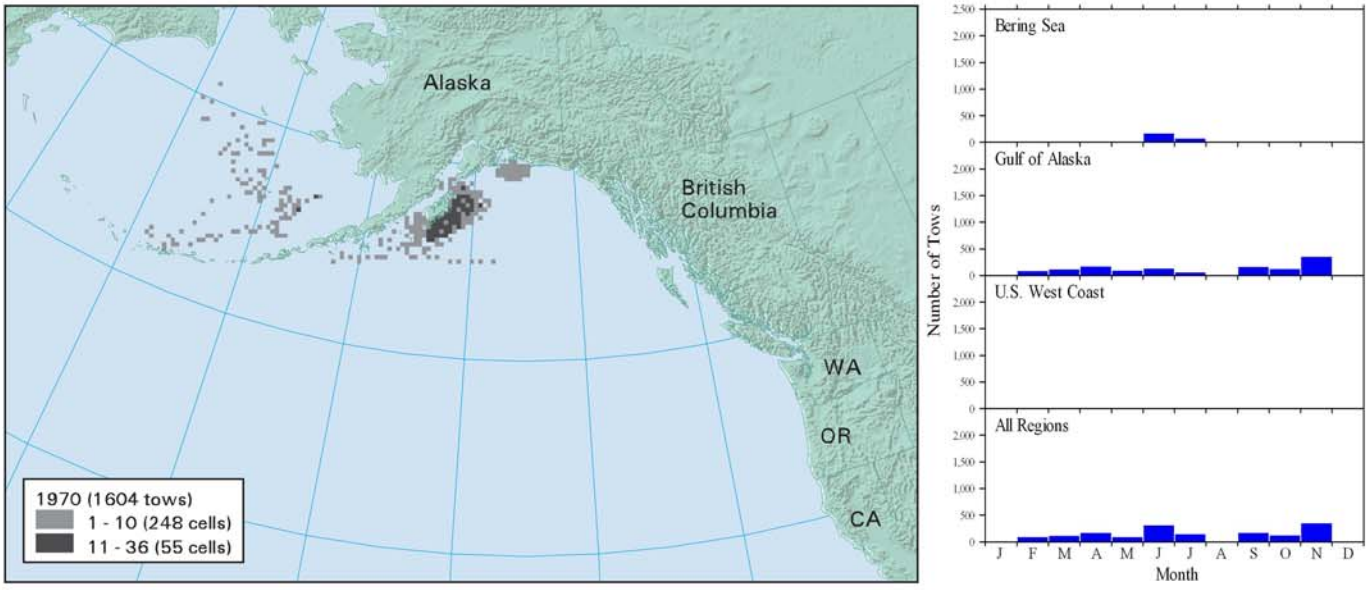


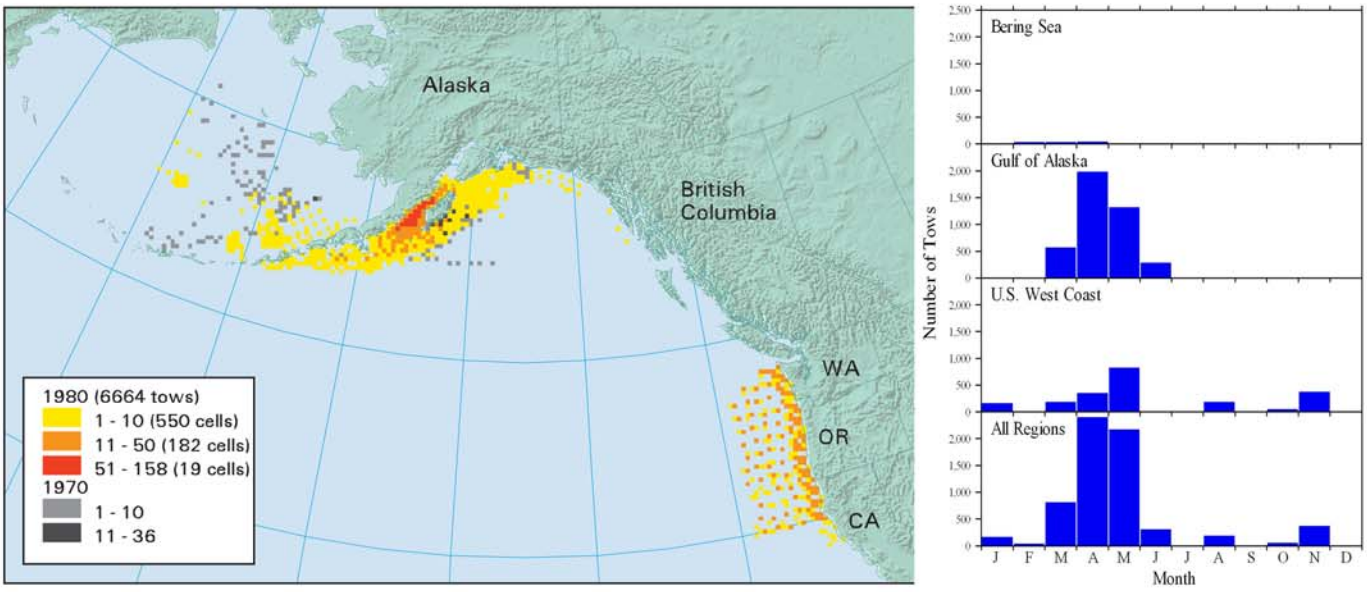
Figure 10. Generalized photophore patterns for stomioids (Morrow, 1964). For photophore definitions, see Table 9.



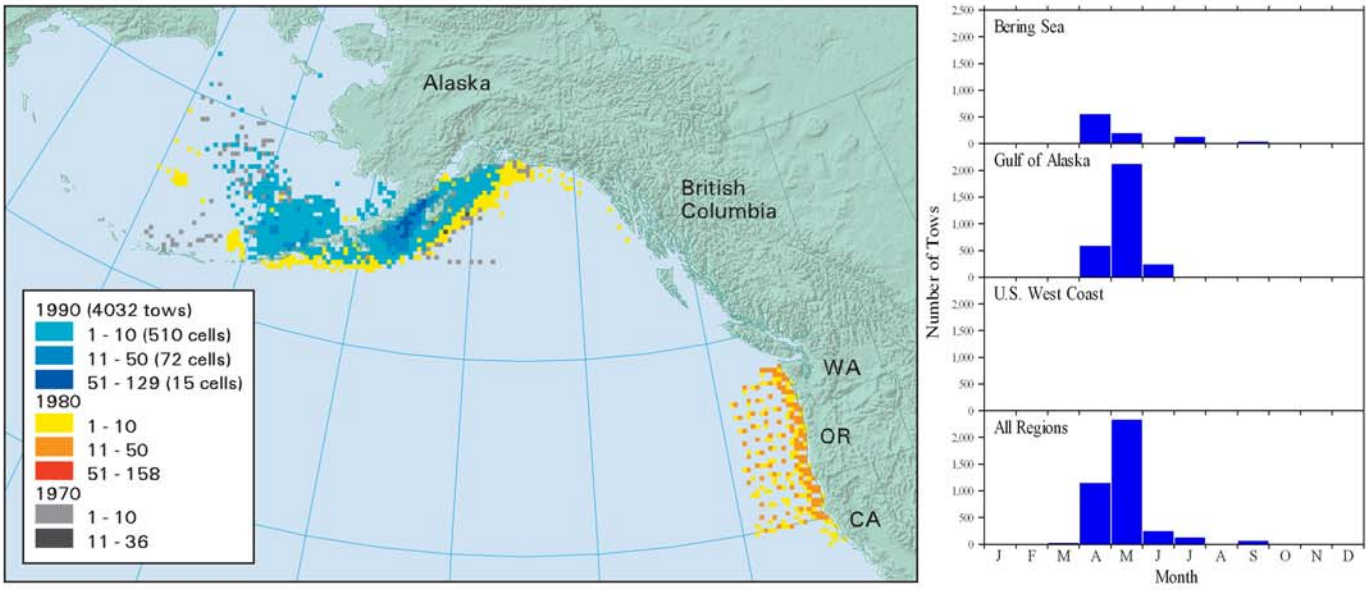
Map 1. Geographic distribution and sampling frequency of cruises conducted by the Recruitment Processes Program 1972-1979. Area sampled is divided into 625 km^2 cells. Gray cells were sampled 1-10 times; black cells were sampled 11-36 times. Graph at right shows monthly distribution and number of tows in the Bering Sea, Gulf of Alaska, and the two regions combined for the 1970s.



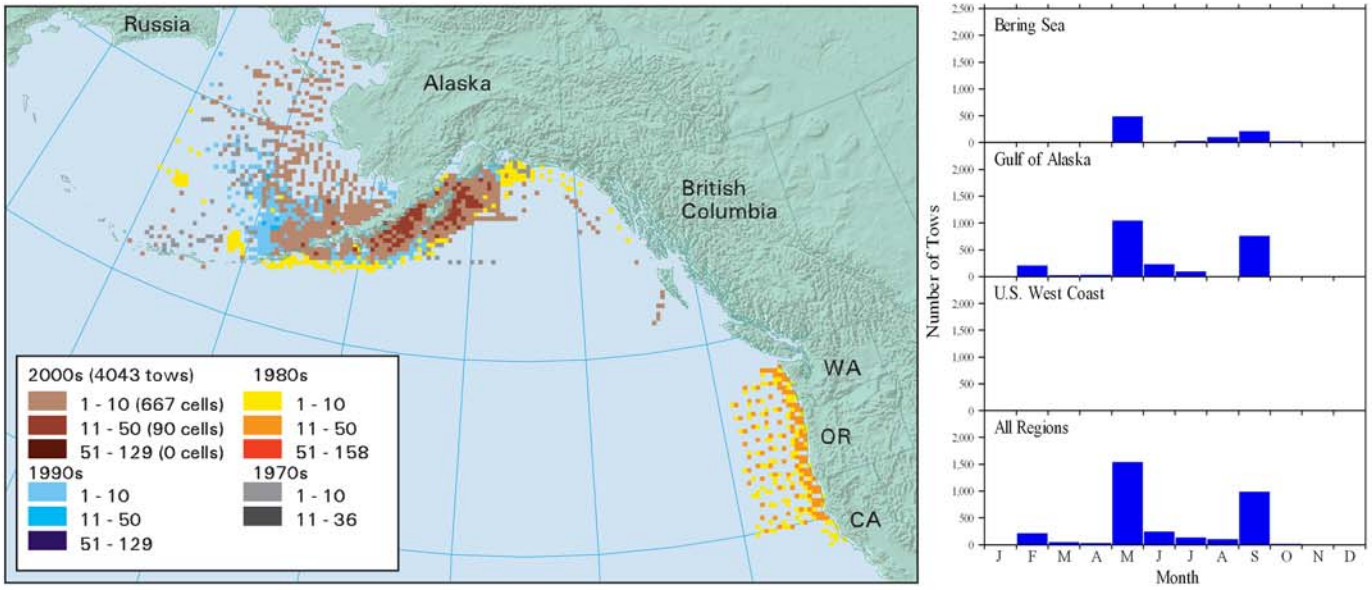
Map 2. Geographic distribution and sampling frequency of cruises conducted by Recruitment Processes Program 1972-1979 and 1980-1989. Area sampled is divided into 625 km^2 cells; 1970s data overlaid by 1980s data. For 1980s data, yellow cells were each sampled 1-10 times, orange cells were each sampled 11-50 times, and red cells were each sampled 51-158 times. Graph at right shows monthly distribution and number of tows in the Bering Sea, Gulf of Alaska, and off the U.S. west coast, and the three regions combined for the 1980s.



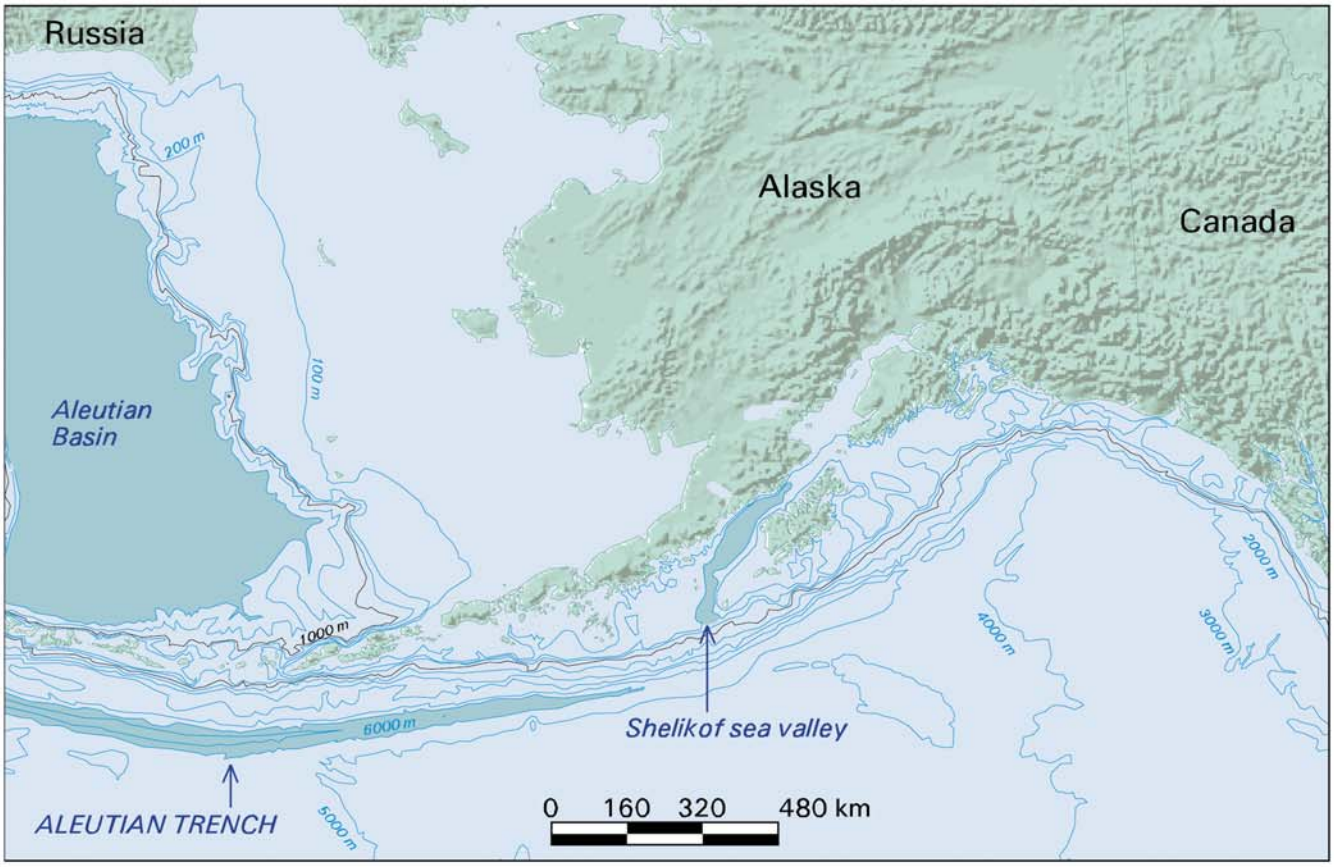
Map 3. Geographic distribution and sampling frequency of cruises conducted by Recruitment Processes Program 1972-1979, 1980-1989, and 1990-1999. Area sampled is divided into 625 km^2 cells; 1970s and 1980s data overlaid by 1990s data. For 1990s data, light blue cells were each sampled 1-10 times, medium blue cells were each sampled 11-50 times, and dark blue cells were each sampled 51-129 times. Graph at right shows monthly distribution and number of tows in the Bering Sea, Gulf of Alaska, and the two regions combined for the 1990s.



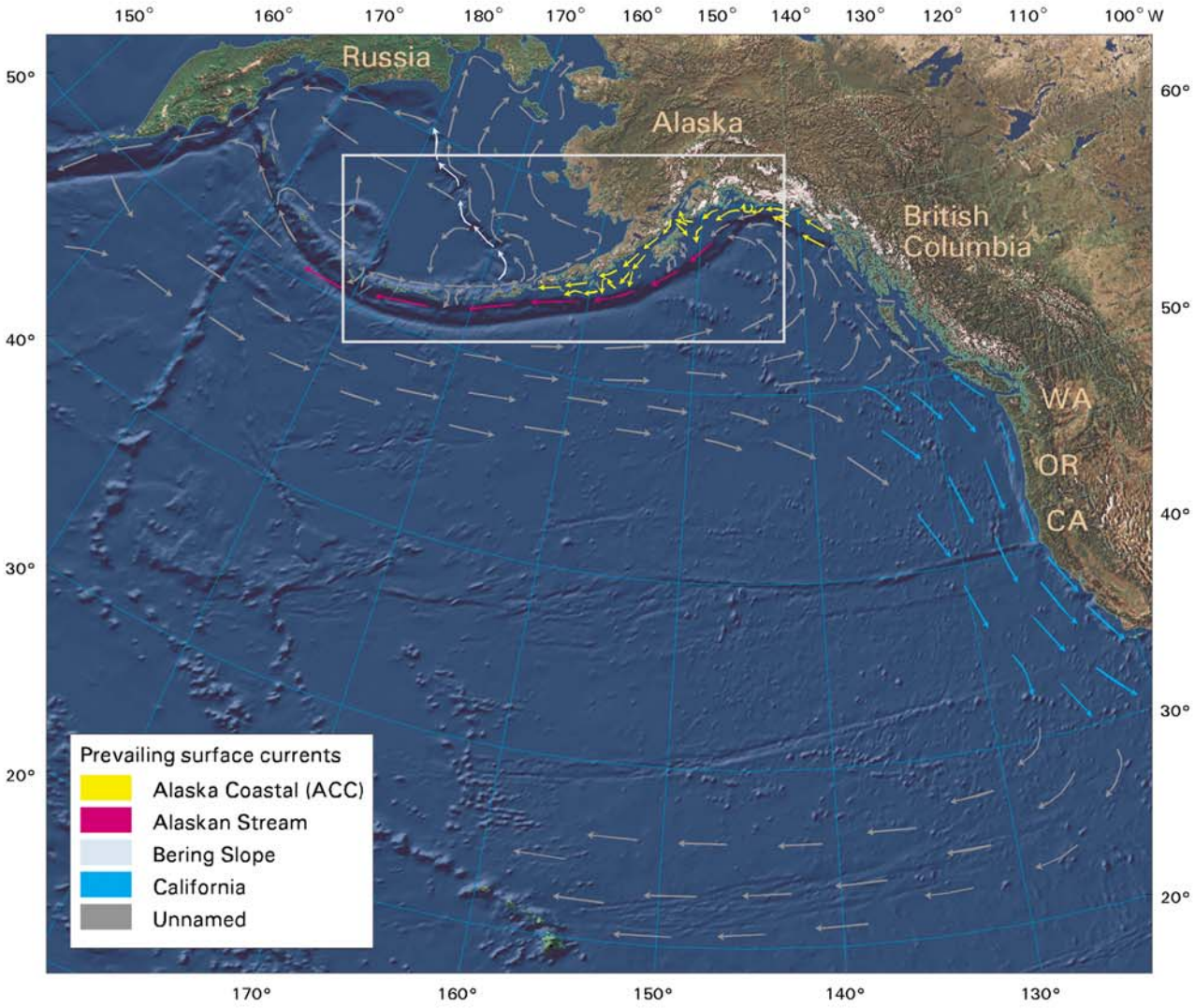
Map 4. Geographic distribution and sampling frequency of cruises conducted by Recruitment Processes Program 1972-1979, 1980-1989, 1990-1999, and 2000-2005. Area sampled is divided into 625 km^2 cells; 1970s, 1980s, and 1990s data overlaid by 2000s data. For 2000s data, light brown cells were each sampled 1-10 times, medium brown cells were each sampled 11-50 times, and dark brown cells were each sampled 51-129 times. Graph at right shows monthly distribution and number of tows in the Bering Sea and Gulf of Alaska, and the two regions combined for the 2000s.

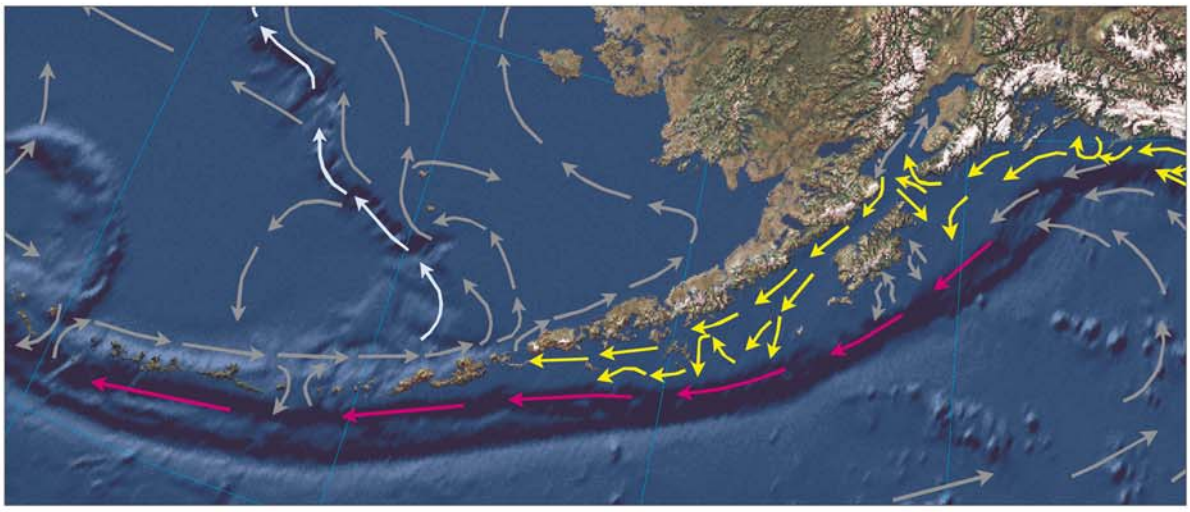


Map 5. Bathymetry of the eastern Bering Sea and Gulf of Alaska. Aleutian Basin, Aleutian Trench and Shelikof sea valley are shaded; 1000 m bathymetry contour line is black.

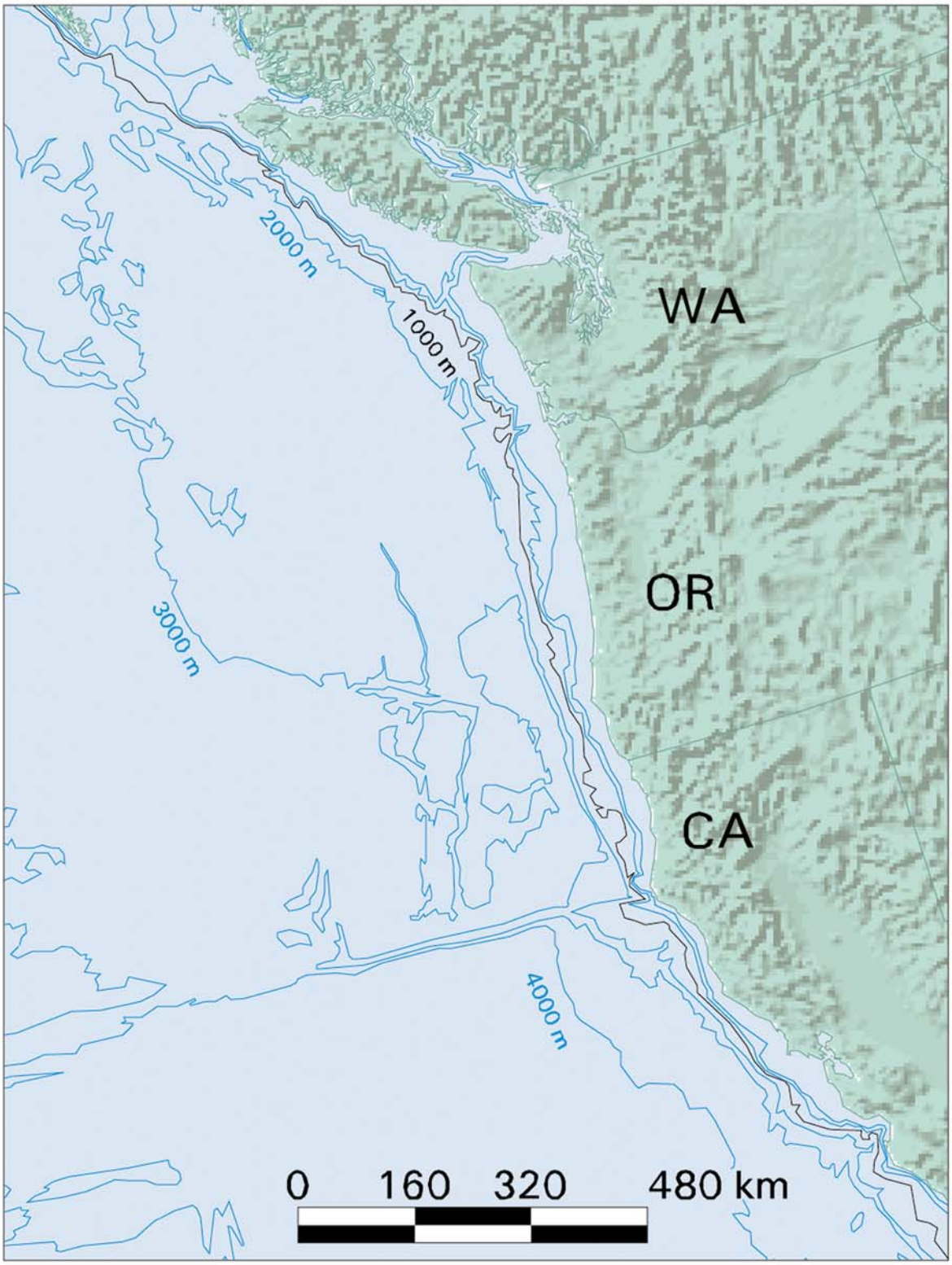


Map 6. Prevailing surface currents in the Bering Sea, Gulf of Alaska, and eastern North Pacific Ocean. Inset shows enlargement of surface currents in Alaskan waters.



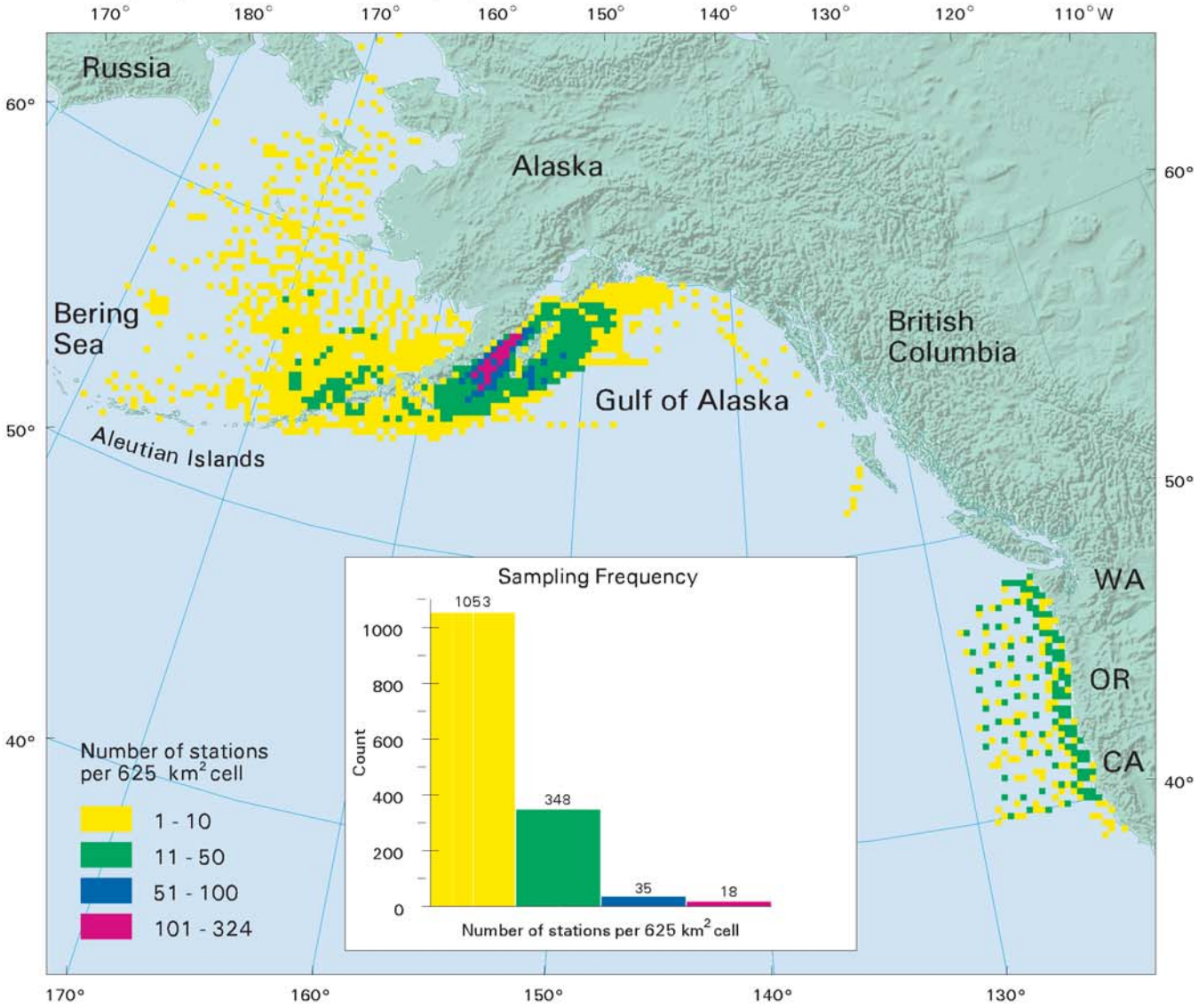


Map 7. Bathymetry of the North Pacific Ocean off the U.S. west coast.

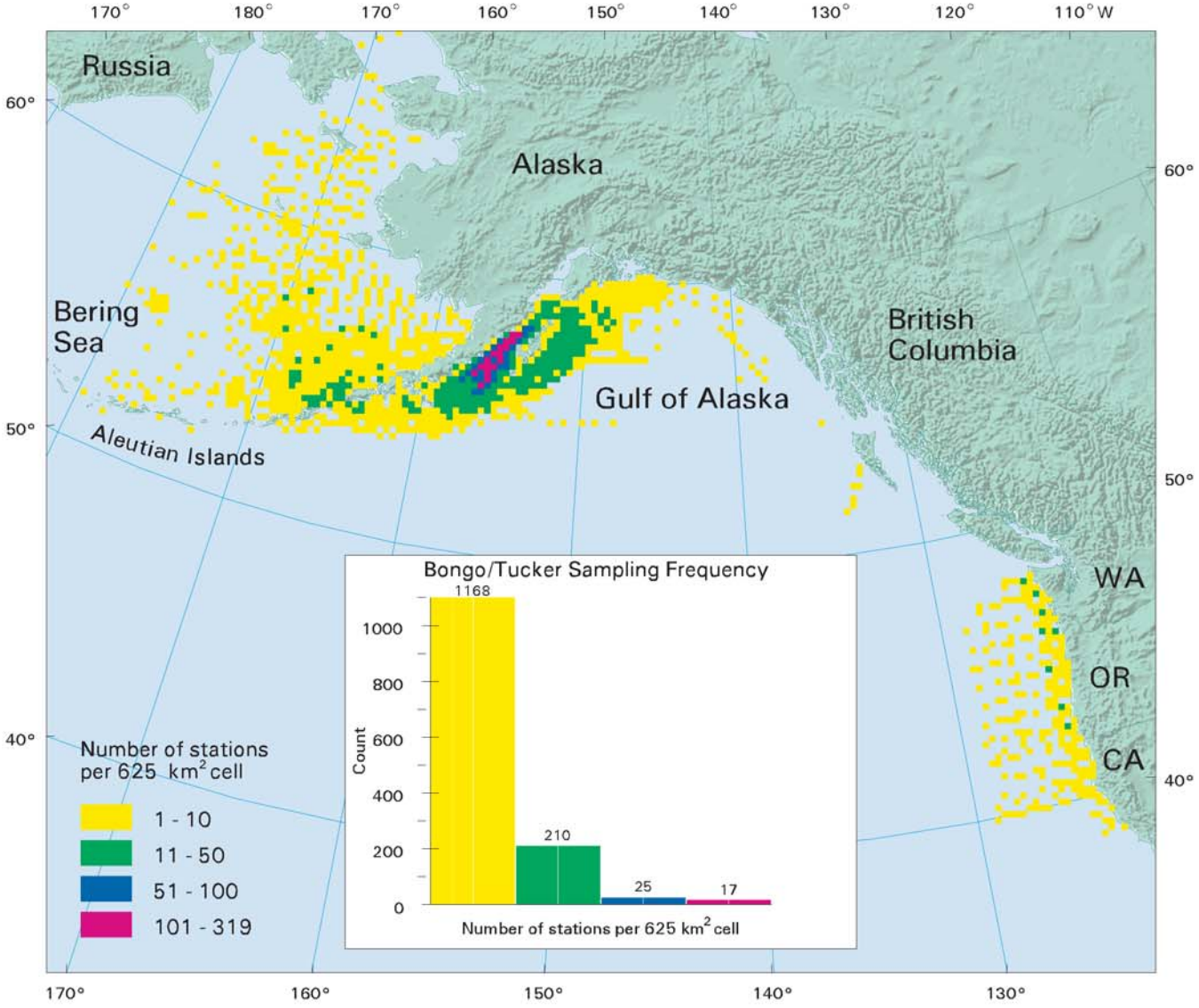


Map 8. Study area showing geographic features for Alaska (top map) and U.S. west coast (bottom map).

Map 9. Geographic distribution and frequency of sampling during Recruitment Processes Program ichthyoplankton surveys for 1972-2005. Area sampled is divided into 625 km^2 cells. Numbers over bars in histogram equal number of cells that contain 1-10 stations (yellow), 11-50 stations (green), 51-100 stations (blue), and 101-324 stations (red).



Map 10. Geographic distribution and frequency of sampling with bongo/Tucker gear during Recruitment Processes Program ichthyoplankton surveys for 1972-2005. Area sampled is divided into 625 km^2 cells. Numbers over bar in histogram equal number of cells that contain 1-10 stations (yellow), 11-50 stations (green), 51-100 stations (blue), and 101-319 stations (red).



Map 11. Geographic distribution and frequency of sampling with neuston gear during Recruitment Processes Program ichthyoplankton surveys for 1972-2005. Area sampled is divided into 625 km^2 cells. Numbers over bars in histogram equal number of cells that contain 1-10 stations (yellow) and 11-50 stations (green).

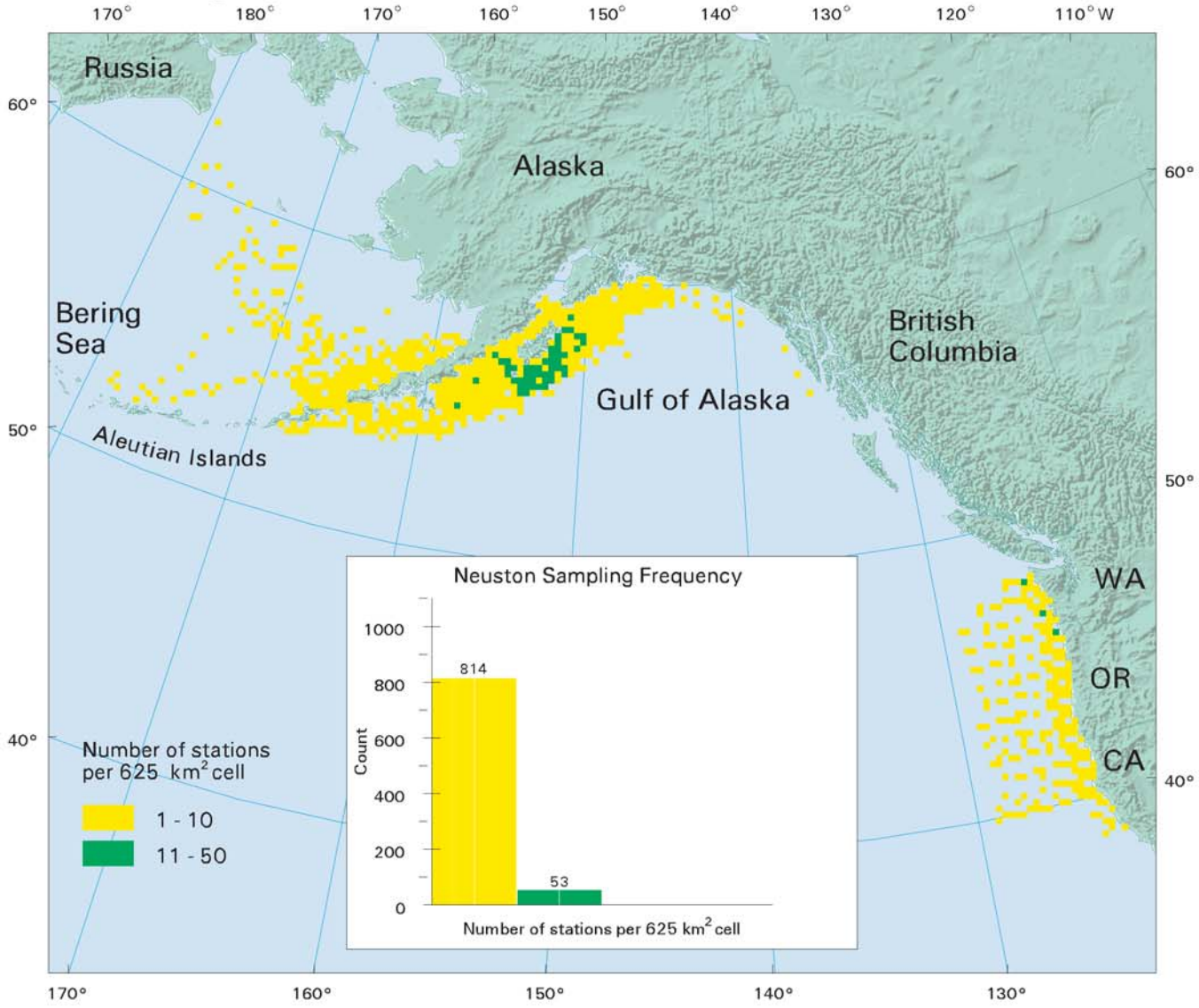


Table 1

Summary of Recruitment Processes Task ichthyoplankton surveys (1972-2009) with positive tows for larvae used in this study. BS = Bering Sea, GOA = Gulf of Alaska, NSB = North of Bering Sea, WC = U. S. west coast. Bongo = bongo net, neuston = neuston net, Tucker = Tucker trawl. EcoDAAT data not available for years 1973-1976.

Year	Cruise	Area	Dates	Tows	Gear
1972	2KE72	GOA	4/26 - 5/9	67	bongo
1973					
1974					
1975					
1976					
1977	4MF77	GOA	10/30 - 11/14	80	Tucker
				83	neuston
1978	4DI78	GOA	3/29 - 4/20	85	bongo
				113	neuston
	2MF78	GOA	6/20 - 7/5	102	Tucker
				112	neuston
	3MF78	GOA	9/9 - 9/21	26	bongo
				28	neuston
	4MF78	GOA	9/26 - 10/7	66	bongo
				45	neuston
	5MF78	GOA	10/19 - 11/1	19	bongo
				11	neuston
	1WE78	GOA	10/27 - 11/13	88	bongo
				92	neuston
	6MF78	GOA	11/8 - 11/16	43	bongo
				21	neuston
1979	1MF79	GOA	2/14 - 3/8	88	bongo
				89	neuston
	5TK79	GOA	5/16 - 5/24	58	bongo
	3MF79	BS	6/1 - 7/23	126	bongo
				130	neuston
	1PO79	GOA	9/3 - 9/29	18	bongo
				48	neuston

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Year	Cruise	Area	Dates	Tows	Gear
1980	1TK80	WC	4/20 - 5/15	125	bongo
				125	neuston
	1PO80	WC	8/1 - 8/25	101	bongo
				101	neuston
1981	1SH81	GOA	3/5 - 3/30	131	bongo
			3/5 - 3/27	130	neuston
	1MF81	GOA	3/12 - 3/20	31	bongo
	2MF81	GOA	3/30 - 4/8	89	bongo
	2SH81	GOA	4/16 - 4/24	60	bongo
				60	neuston
	3MF81	GOA	4/26 - 5/2	79	bongo
	1PO81	WC	5/9 - 6/2	131	bongo
				123	neuston
	4MF81	GOA	5/20 - 5/24	80	bongo
	3SH81	GOA	5/20 - 5/28	56	bongo
	1DA81	WC	10/24 - 11/21	125	bongo
				125	neuston
1982	1DA82	GOA	4/4 - 4/23	83	bongo
				82	neuston
	1PO82	WC	5/3 - 6/1	56	bongo
				124	neuston
	2DA82	GOA	5/21 - 5/31	62	bongo
				61	neuston
1983	1EQ83	WC	4/23 - 5/15	124	bongo
				124	neuston
	1CH83	GOA	5/14 - 5/30	68	bongo
			5/14 - 5/28	73	neuston
	1MF83	WC	11/12 - 12/2	113	bongo
				113	neuston
1984	1PO84	WC	3/11 - 4/5	124	bongo

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Year	Cruise	Area	Dates	Tows	Gear
				124	neuston
1984	3CH84	GOA	3/28	4	bongo
	1SH84	GOA	4/7 - 5/4	157	bongo
				157	neuston
1985	1DI85	GOA	3/11 - 3/28	69	bongo
	1PO85	GOA	3/29 - 4/21	154	bongo
				151	neuston
	1MF85	GOA	4/9	36	bongo
	1BA85	WC	4/19 - 5/11	124	bongo
				124	neuston
1985	2MF85	GOA	5/3 - 5/11	62	bongo
	2PO85	GOA	5/16 - 6/8	189	bongo
				189	neuston
1986	MF862	BS	2/16 - 2/28	48	bongo
	1GI86	GOA	3/30 - 4/20	149	bongo
				149	neuston
	1MF86	GOA	4/4 - 4/12	81	bongo
	2MF86	GOA	5/2 - 5/18	108	bongo
1987	1MF87	WC	1/7 - 1/28	88	bongo
				88	neuston
	2MF87	GOA	4/4 - 4/16	143	bongo
	1BB87	GOA	4/9 - 4/27	117	bongo
	3MF87	GOA	5/19 - 5/27	60	bongo
	4MF87	GOA	6/20 - 7/11	19	bongo
1988	1OC88	BS	3/17 - 4/4	61	bongo
	1DN88	GOA	3/19 - 4/11	157	bongo
	1MF88	GOA	4/1 - 4/12	173	bongo
	1DN88	BS	4/11 - 5/8	46	bongo
	2MF88	GOA	4/17 - 4/30	64	bongo
	3MF88	GOA	5/6	13	bongo
	4MF88	GOA	5/20 - 6/7	176	Tucker

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Year	Cruise	Area	Dates	Tows	Gear
1989	1MF89	GOA	4/6 - 4/15	128	bongo
	2MF89	GOA	4/26 - 5/5	92	bongo
	3MF89	GOA	5/9 - 5/24	211	bongo
	4MF89	GOA	5/29 - 6/5	99	Tucker
1990	1MF90	GOA	4/8 - 4/13	107	bongo
	2MF90	GOA	5/7 - 5/15	90	bongo
	3MF90	GOA	5/18 - 5/24	17	bongo
	4MF90	GOA	5/28 - 6/5	133	bongo
	5MF90	GOA	9/8 - 9/20	6	bongo
1991	0MF91	BS	3/11 - 3/15	20	bongo
	1MF91	GOA	4/2 - 4/13	90	bongo
	1MP91	BS	4/14 - 5/8	61	bongo
	2MF91	GOA	4/16 - 4/27	150	bongo
	3MF91	GOA	5/1 - 5/13	119	bongo
	4MF91	GOA	5/17 - 5/25	97	bongo
1992	1MF92	GOA	4/5 - 4/10	94	bongo
	2MF92	BS	4/16 - 4/18	36	bongo
	3MF92	GOA	5/2 - 5/14	158	bongo
	4MF92	GOA	5/18 - 5/28	137	bongo
1993	2MF93	GOA	4/6 - 4/11	96	bongo
	3MF93	BS	4/15 - 4/30	119	bongo
	4MF93	GOA	5/3 - 5/13	141	bongo
	5MF93	GOA	5/23 - 6/3	114	bongo
	6MF93	GOA	9/7 - 9/17	12	Tucker
1994	3MF94	GOA	3/14 - 4/9	19	bongo
	4MF94	GOA	4/15 - 4/30	128	bongo
	5MF94	GOA	5/2 - 5/15	89	bongo
	6MF94	GOA	5/24 - 6/1	139	bongo
	7MF94	BS	7/17 - 9/6	10	neuston

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Year	Cruise	Area	Dates	Tows	Gear
1994	1SU94	BS	9/4 - 9/13	30	bongo
			9/12	2	neuston
	8MF94	BS	9/21 - 9/24	2	neuston
	8MF94	GOA	9/25 - 9/28	2	neuston
1995	1MF95	BS	2/19	1	bongo
	1MF95	BS	2/22	2	bongo
	2MF95	BS	3/8	1	bongo
	4MF95	GOA	3/17 - 3/24	5	bongo
	6MF95	BS	4/17 - 4/30	137	bongo
	7MF95	BS	5/4 - 5/18	134	bongo
	8MF95	GOA	5/21 - 5/28	99	bongo
	2SU95	BS	9/11 - 9/18	16	Tucker
	1OM95	BS	7/19 - 7/31	3	Tucker
1996	2MF96	BS	3/6	1	bongo
	5MF96	BS	4/23 - 4/24	4	Tucker
	1DI96	GOA	4/26 - 5/6	154	bongo
	6MF96	GOA	5/2 - 5/14	177	bongo
	6MF96	BS	5/15	5	bongo
	7MF96	BS	5/19 - 5/20	5	Tucker
	8MF96	GOA	5/24 - 6/1	130	bongo
	9MF96	BS	7/21 - 8/7	16	bongo
1997	5MF97	BS	4/15 - 5/1	34	bongo
	6MF97	BS	5/3 - 5/13	32	bongo
	8MF97	GOA	5/23 - 5/31	100	bongo
	4WE97	BS	6/29 - 7/14	67	bongo
1998	2MF98	BS	4/14 - 4/29	20	bongo
	4MF98	GOA	5/1 - 5/10	72	bongo
	5MF98	GOA	5/21 - 5/30	130	bongo
	3WE98	GOA	6/17 - 6/30	26	bongo
1999	1MF99	BS	4/10 - 4/19	37	bongo

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Year	Cruise	Area	Dates	Tows	Gear
	1WE99	GOA	5/7 - 5/9	6	bongo
1999	4MF99	BS	5/12 - 5/20	21	bongo
	5MF99	GOA	5/12 - 6/2	114	bongo
	2WE99	GOA	5/21 - 6/5	202	bongo
	1GP99	BS	7/12 - 7/26	60	bongo
2000	2MF00	BS	2/15 - 2/16	2	bongo
	5MF00	BS	5/1 - 5/12	67	bongo
	6MF00	GOA	5/25 - 6/4	142	bongo
	7MF00	BS	6/21 - 7/3	14	bongo
	1OM00	BS	7/21 - 8/3	8	bongo
	8MF00	GOA	9/2 - 9/20	103	Tucker
	1RB00	BS	9/16 - 9/23	16	bongo
2001	1MF01	GOA	6/21 - 2/5	18	bongo
	2MF01	GOA	4/28 - 5/8	148	bongo
	1RB01	GOA	5/13 - 5/23	81	bongo
	3MF01	GOA	5/24 - 6/2	148	bongo
	1OM01	BS	7/14 - 7/29	9	bongo
	4MF01	GOA	9/2 - 9/19	90	Tucker
				40	neuston
2002	3MF02	BS	5/12 - 5/21	80	bongo
				80	neuston
	1EW02	GOA	5/22 - 6/10	124	bongo
	4MF02	GOA	5/23 - 6/1	137	bongo
	1MA02	BS	8/14 - 8/28	5	bongo
	1SS02	BS	8/20 - 10/6	108	bongo
	5MF02	GOA	9/8 - 9/23	122	bongo
				136	neuston
	1NW02	BS	9/8 - 10/6	42	bongo
2003	1MF03	GOA	2/13 - 2/22	66	bongo
				26	neuston

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Year	Cruise	Area	Dates	Tows	Gear
	2MF03	BS	2/24 - 3/7	15	bongo
	2KM03	GOA	4/29 - 5/11	67	bongo
	4MF03	BS	5/17 - 5/24	120	bongo
2003				58	neuston
	5MF03	GOA	5/25 - 6/2	115	bongo
				4	neuston
	1OM03	BS	7/19 - 7/26	5	bongo
	7MF03	GOA	9/7 - 9/21	67	Tucker
	1SS03	GOA	9/9 - 9/27	45	bongo
	3KM03	GOA	9/20 - 9/26	5	bongo
2004	5MF04	GOA	5/23 - 6/3	190	bongo
	2HX04	GOA	7/8 - 7/19	60	bongo
	1OM04	BS	7/28 - 8/5	6	bongo
	1KR04	BS	8/10 - 8/22	36	bongo
	1SS04	BS	8/14 - 9/28	97	bongo
	7MF04	GOA	9/9 - 9/22	91	bongo
				90	neuston
	8MF04	BS	9/24 - 10/4	11	bongo
2005	2MF05	GOA	2/21 - 3/4	118	bongo
				51	neuston
	1TT05	GOA	4/28 - 5/7	23	bongo
	5MF05	BS	5/9 - 5/20	94	bongo
				74	neuston
	3TT05	BS	5/16 - 5/27	42	bongo
	6MF05	GOA	5/21 - 6/3	193	bongo
	1OM05	BS	7/15 - 7/21	9	bongo
	1FA05	GOA	7/19 - 7/28	47	bongo
	1SS05	BS	8/14 - 10/7	118	bongo
	7MF05	GOA	9/5 - 9/19	79	Tucker
	8MF05	BS	9/21 - 10/4	16	bongo
2006	1TT06	BS	4/12 - 5/10	92	bongo
	3MF06	BS	5/8 - 5/19	90	bongo

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Year	Cruise	Area	Dates	Tows	Gear
				90	neuston
	4MF06	GOA	5/21 - 6/1	175	bongo
	1OM06	BS	6/21 - 6/28	21	bongo
	1AR06	BS	7/10 - 7/25	15	bongo
	5MF06	GOA	8/16 - 8/31	19	bongo
	1SS06	BS	8/18 - 9/20	99	bongo
	1NW06	BS	8/23 - 9/5	36	bongo
	6MF06	BS	9/8 - 9/23	86	bongo
				86	neuston
2007	2MF07	GOA	4/6 - 4/12	75	bongo
	1HE07	BS	4/10 - 5/12	64	bongo
	3MF07	BS	4/18 - 4/28	6	bongo
	4MF07	BS	5/7 - 5/18	101	bongo
				84	neuston
	5MF07	GOA	5/19 - 5/28	134	bongo
	1AR07	BS	6/8 - 6/22	12	bongo
	2AR07	BS	6/25 - 7/11	16	bongo
	1OM07	BS	7/25 - 8/1	12	bongo
	1SS07	BS	8/15 - 10/8	126	bongo
	6MF07	GOA	9/5 - 9/15	65	Tucker
	2DY07	BS	9/5 - 9/25	47	bongo
	1TT07	BS	9/27 - 10/11	75	bongo
	8MF07	BS	10/3 - 10/11	14	bongo
2008	1MF08	BS	2/18 - 2/26	44	bongo
	1DY08	BS	2/19 - 2/28	9	bongo
	2DY08	BS	5/7 - 5/10	11	bongo
	3DY08	BS	5/12 - 5/21	65	bongo
	4DY08	GOA	5/24 - 5/30	95	bongo
	1AR08	BS	6/3 - 6/16	14	bongo
	2AR08	BS	6/20 - 6/29	8	bongo
	3AR08	BS	7/11 - 7/18	7	bongo
	1OE08	NBS	8/6 - 8/22	38	bongo

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Year	Cruise	Area	Dates	Tows	Gear
	1ME08	BS	8/26 - 9/11	93	bongo
	6DY08	BS	9/11 - 9/27	32	bongo
	3MF08	BS	9/11 - 9/20	49	bongo
2009	1DY09	BS	2/25 - 3/4	28	bongo
	2DY09	BS	4/24 - 5/4	12	bongo
	3DY09	BS	5/7 - 5/20	87	bongo
				78	neuston
	4DY09	GOA	5/26 - 6/6	152	bongo
	1AR09	BS	6/2 - 6/17	9	bongo
	2AR09	BS	6/18 - 7/7	11	bongo
	3AR09	BS	7/12 - 7/30	10	bongo
	1EE09	BS	9/1 - 9/14	41	bongo
	5DY09	BS	9/3 - 9/27	53	bongo
	1KR09	NBS	9/4 - 9/29	24	bongo
	1MF09	GOA	9/6 - 9/19	137	Tucker
	2MF09	BS	9/24 - 10/10	67	bongo
Totals				18,928	

Table 2

Ranked frequency of occurrence (FO) of the 20 most common larval fish taxa collected in neuston nets from Recruitment Processes Program survey cruises 1972-1996. Average catch (no./10m^2) at positive hauls is included. Total number of Sameoto neuston tows = 3011 (Matarese et al., 2003).

Taxon	No. Positive Hauls	% FO	Sum of Catch/10m^2	Avg. Catch/10m^2
Hexagrammos decagrammus	1385	46.00	637.652	0.212
Hexagrammos stelleri	384	12.75	75.230	0.025
Anoplopoma fimbria	382	12.69	74.945	0.025
Cryptacanthodes aleutensis	341	11.33	142.190	0.047
Hemilepidotus spp.	341	11.33	267.906	0.089
Cololabis saira	325	10.79	24.615	0.008
Hemilepidotus hemilepidotus	322	10.69	99.288	0.033
Bathymaster spp.	306	10.16	830.176	0.276
Hexagrammos lagocephalus	266	8.83	152.912	0.051
Sebastes spp.	263	8.73	42.836	0.014
Ammodytes hexapterus	257	8.54	236.692	0.079
Hexagrammos octogrammus	238	7.90	56.265	0.019
Pleurogrammus monopterygius	212	7.04	109.330	0.036
Hemilepidotus spinosus	211	7.01	73.237	0.024
Scorpaenichthys marmoratus	177	5.88	13.273	0.004
Mallotus villosus	160	5.31	30.691	0.010
Hemilepidotus jordani	103	3.42	8.203	0.003
Hexagrammos spp.	102	3.39	15.344	0.005
Theragra chalcogramma	100	3.32	24.469	0.008
Stichaeidae	90	2.99	4.870	0.002

Table 3

Taxa abundance and distribution generated by neuston data.

Family	Taxon
Scomberesocidae	*Cololabis saira*
Anoplopomatidae	*Anoplopoma fimbria*
Hexagrammidae	*Hexagrammos decagrammus* *Hexagrammos lagocephalus* *Hexagrammos octogrammus* *Hexagrammos stelleri* *Ophiodon elongatus*
Cottidae	*Hemilepidotus jordani* *Hemilepidotus spinosus* *Scorpaenichthys marmoratus*
Stichaeidae	*Bryozoichthys lysimus* *Bryozoichthys marjorius* *Chirolophis decoratus*
Cryptacanthodidae	*Cryptacanthodes aleutensis* *Cryptacanthodes gigantea*

Table 4

Ranked frequency of occurrence (FO) of larval fish taxa collected in bongo nets from Recruitment Processes Task survey cruises 1972-1996. Average catch (number per $10m^2$) at positive hauls is included. Total number of 60 cm bongo tows = 8368 (includes 312 Tucker trawls). Bolded taxa are covered in Matarese et al. (2003). Gray taxa are combined at a higher taxonomic level.

Taxon	No. Positive Hauls	% FO	Sum of Catch/$10m^2$	Avg. Catch/$10m^2$
Gadus chalcogrammus	4773	57.04	4984654.103	595.680
Ammodytes hexapterus	4542	54.28	358528.691	42.845
Stenobrachius leucopsarus	2581	30.84	111925.502	13.375
Lepidopsetta polyxystra	2093	25.01	72725.350	8.691
Hippoglossoides elassodon	1867	22.31	108951.468	13.020
Gadus macrocephalus	1823	21.79	98380.316	11.757
***Bathymaster* spp.**	1457	17.41	151675.355	18.126
***Sebastes* spp.**[1]	1309	15.64	59128.424	7.066
Hexagrammos decagrammus	1063	12.70	16103.647	1.924
Gadidae	1043	12.46	174694.365	20.876
Atheresthes stomias	932	11.14	40228.857	4.807
***Icelinus* spp.**	774	9.25	13974.818	1.670
Cyclopteridae	718	8.58	8550.829	1.022
Leuroglossus schmidti	690	8.25	7606.181	0.909
Hippoglossus stenolepis	643	7.68	7203.780	0.861
Bathyagonus alascanus	583	6.97	4888.797	0.584
Bathylagus pacificus	523	6.25	5284.756	0.632
Lumpenus maculatus	481	5.75	4597.007	0.549
Disintegrated	475	5.68	7990.944	0.955
Mallotus villosus	475	5.68	11348.954	1.356
Cryptacanthodes aleutensis	453	5.41	3823.550	0.457
Platichthys stellatus	448	5.35	8004.080	0.957
Protomyctophum thompsoni	446	5.33	3850.982	0.460
Hemilepidotus hemilepidotus	433	5.17	4625.840	0.553
Cottidae	417	4.98	5315.520	0.635
Tarletonbeania crenularis	389	4.65	8875.654	1.061
Lepidopsetta bilineata	385	4.60	4424.407	0.529
Atheresthes spp.	382	4.57	9245.819	1.105
***Lumpenus* spp.**	376	4.49	3302.633	0.395
Bathylagus ochotensis	373	4.46	14590.430	1.744
***Anoplarchus* spp.**	330	3.94	6140.290	0.734
Hemilepidotus spp.	311	3.72	14138.913	1.690
Glyptocephalus zachirus	288	3.44	3328.929	0.398
Protomyctophum crockeri	274	3.27	3467.119	0.414

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Taxon	No. Positive Hauls	% FO	Sum of Catch/$10m^2$	Avg. Catch/$10m^2$
Poroclinus rothrocki	264	3.15	3224.067	0.385
Diaphus theta	256	3.06	21918.638	2.619
Unidentified	220	2.63	3384.227	0.404
Artedius harringtoni	210	2.51	1619.195	0.193
Zaprora silenus	196	2.34	1411.285	0.169
Reinhardtius hippoglossoides	192	2.29	2372.440	0.284
Lyopsetta exilis	184	2.20	3475.021	0.415
Pleuronectes quadrituberculatus	179	2.14	1408.827	0.168
Anoplopoma fimbria	176	2.10	1777.740	0.212
Radulinus asprellus	175	2.09	1269.537	0.152
Osmeridae[2]	173	2.07	44895.193	5.365
Lumpenus sagitta	164	1.96	1321.844	0.158
Chauliodus macouni	162	1.94	1365.560	0.163
Agonidae	125	1.49	987.317	0.118
Microstomus pacificus	125	1.49	1163.814	0.139
Stichaeidae	123	1.47	1197.698	0.143
Lumpenella longirostris	120	1.43	1660.305	0.198
Isopsetta isolepis	112	1.34	1774.415	0.212
Ruscarius meanyi	107	1.28	756.404	0.090
Liparidae	103	1.23	1169.191	0.140
Lestidiops ringens	102	1.22	1015.174	0.121
Pleurogrammus monopterygius	96	1.15	1109.763	0.133
Parophrys vetulus	88	1.05	2481.143	0.297
***Sebastolobus* spp.**	88	1.05	1351.225	0.161
Nannobrachium ritteri	86	1.03	1049.816	0.125
***Pholis* spp.**	83	0.99	1020.082	0.122
Myoxocephalus B[3]	82	0.98	1172.842	0.140
Bathylagidae	80	0.96	1008.448	0.121
Bathyagonus infraspinatus	78	0.93	419.048	0.050
Hexagrammos lagocephalus	78	0.93	2435.621	0.291
Myoxocephalus spp.[3]	78	0.93	588.522	0.070
Macrouridae[4]	74	0.88	462.768	0.055
Citharichthys stigmaeus	73	0.87	638.370	0.076
Citharichthys sordidus	72	0.86	778.503	0.093

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Taxon	No. Positive Hauls	% FO	Sum of Catch/$10m^2$	Avg. Catch/$10m^2$
Nansenia candida	67	0.80	905.344	0.108
***Liparis* spp**[5]	66	0.79	903.933	0.108
Myoxocephalus G[3]	63	0.75	529.201	0.063
Engraulis mordax	61	0.73	13876.181	1.658
Hexagrammos stelleri	59	0.71	524.865	0.063
Myctophidae	59	0.71	1800.924	0.215
Psettichthys melanostictus	59	0.71	728.765	0.087
Gymnocanthus A	58	0.69	416.647	0.050
Hemilepidotus spinosus	57	0.68	493.171	0.059
Nannobrachium spp.	57	0.68	841.834	0.101
Melamphaeidae[6]	53	0.63	526.923	0.063
Ophiodon elongatus	53	0.63	316.392	0.038
Ronquilus jordani	53	0.63	546.780	0.065
Stenobrachius spp.	52	0.62	877.596	0.105
Bryozoichthys lysimus	51	0.61	325.180	0.039
Podothecus acipenserinus	51	0.61	394.838	0.047
Pleuronectidae	49	0.59	493.858	0.059
Malacocottus zonurus 1	48	0.57	314.704	0.038
Icichthys lockingtoni	47	0.56	423.619	0.051
Citharichthys spp.	45	0.54	2026.624	0.242
Chirolophis spp.	44	0.53	361.609	0.043
Hemilepidotus jordani	41	0.49	224.907	0.027
Dasycottus setiger	40	0.48	274.199	0.033
Bathylagus milleri	39	0.47	293.025	0.035
Hexagrammos octogrammus	37	0.44	714.789	0.085
Malacocottus zonurus	37	0.44	265.162	0.032
Cryptacanthodes gigantea	36	0.43	276.190	0.033
Microgadus proximus	35	0.42	722.255	0.086
Stichaeus punctatus	35	0.42	224.049	0.027
Nannobrachium regalis	33	0.39	337.580	0.040
Tactostoma macropus	28	0.33	220.875	0.026
Clupea pallasi	26	0.31	604.672	0.072
Gymnocanthus spp.	26	0.31	254.121	0.030
Nectoliparis pelagicus	25	0.30	155.864	0.019

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Taxon	No. Positive Hauls	% FO	Sum of Catch/$10m^2$	Avg. Catch/$10m^2$
Cyclothone spp.	23	0.27	173.651	0.021
Triglops forficata	23	0.27	146.538	0.018
Triglops macellus	23	0.27	127.087	0.015
Ptilichthys goodei	22	0.26	127.541	0.015
Trachipterus altivelis	22	0.26	159.338	0.019
Leptagonus frenatus	21	0.25	143.917	0.017
Artedius fenestralis	18	0.22	147.778	0.018
Bryozoichthys marjorius	18	0.22	104.854	0.013
Hemilepidotus zapus	17	0.20	233.058	0.028
Icelinus borealis	17	0.20	146.731	0.018
Bathyagonus spp.	16	0.19	146.158	0.017
Anoplagonus inermis	14	0.17	88.207	0.011
Leptocottus armatus	14	0.17	87.974	0.011
Bathyagonus nigripinnis	13	0.16	83.579	0.010
Chirolophis decoratus	13	0.16	89.825	0.011
Hemitripterus bolini	13	0.16	73.340	0.009
Hexagrammidae	12	0.14	67.882	0.008
Limanda aspera	12	0.14	82.503	0.010
Melamphaes spp.	12	0.14	94.387	0.011
Icosteus aenigmaticus	11	0.13	97.372	0.012
Paraliparis spp.	11	0.13	108.125	0.013
Psychrolutes paradoxus	11	0.13	55.906	0.007
Scorpaenichthys marmoratus	11	0.13	60.297	0.007
Scorpaenidae	11	0.13	99.762	0.012
Zoarcidae[7]	11	0.13	189.707	0.023
Chirolophis nugator	10	0.12	72.875	0.009
Psychrolutes sigalutes	10	0.12	75.648	0.009
Artedius spp.	9	0.11	112.285	0.013
Aptocyclus ventricosus	8	0.10	29.985	0.004
Aspidophoroides monopterygius	8	0.10	42.123	0.005
Danaphos oculatus	8	0.10	52.603	0.006
Ophidiidae	8	0.10	80.564	0.010
Argyropelecus lychnus	7	0.08	44.087	0.005
Argyropelecus spp.	7	0.08	56.018	0.007

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Taxon	No. Positive Hauls	% FO	Sum of Catch/$10m^2$	Avg. Catch/$10m^2$
Bathyagonus pentacanthus	7	0.08	32.764	0.004
Bathylagus spp.	7	0.08	97.328	0.012
Bryozoichthys spp.	7	0.08	66.791	0.008
Embassichthys bathybius	7	0.08	41.140	0.005
Hexagrammos spp.	7	0.08	426.851	0.051
Stenobrachius nannochir	7	0.08	79.892	0.010
Triglops pingeli	7	0.08	32.262	0.004
Triglops spp.	7	0.08	45.628	0.005
Cololabis saira	6	0.07	44.147	0.005
Hypsagonus quadricornis	6	0.07	34.101	0.004
Melamphaes lugubris	6	0.07	54.892	0.007
Radulinus spp.	6	0.07	36.126	0.004
Symbolophorus californiensis	6	0.07	44.149	0.005
Anoplarchus insignis	5	0.06	73.497	0.009
Blepsias bilobus	5	0.06	41.478	0.005
Merluccius productus	5	0.06	278.533	0.033
Argyropelecus affinis	4	0.05	8.297	0.001
Hypsagonus mozinoi	4	0.05	26.157	0.003
Sebastes paucispinis	4	0.05	32.029	0.004
Xeneretmus latifrons	4	0.05	34.464	0.004
Brosmophycis marginata	3	0.04	21.210	0.003
Ceratoscopelus townsendi	3	0.04	20.486	0.002
Leuroglossus stilbius	3	0.04	48.511	0.006
Myctophidae B	3	0.04	20.000	0.002
Nautichthys oculofasciatus	3	0.04	16.737	0.002
Paricelinus hopliticus	3	0.04	55.382	0.007
Pholidae	3	0.04	19.138	0.002
Bathymaster 2	2	0.02	20.344	0.002
Bathymaster signatus	2	0.02	8.707	0.001
Bathymasteridae	2	0.02	7.718	0.001
Bothragonus swani	2	0.02	24.587	0.003
Clinocottus spp.	2	0.02	13.229	0.002
Cottoid type A	2	0.02	4.460	0.001
Cottus asper	2	0.02	13.562	0.002

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Taxon	No. Positive Hauls	% FO	Sum of Catch/$10m^2$	Avg. Catch/$10m^2$
Gasterosteus aculeatus	2	0.02	8.222	0.001
Icelus spp.	2	0.02	18.800	0.002
Lepidogobius lepidus	2	0.02	12.833	0.002
Liparis florae	2	0.02	10.477	0.001
Macropinna microstoma	2	0.02	12.351	0.001
Malacocottus zonurus 2	2	0.02	14.415	0.002
Microstoma sp.	2	0.02	14.318	0.002
Nautichthys robustus	2	0.02	10.006	0.001
Radulinus boleoides	2	0.02	15.379	0.002
Rhinoliparis barbulifer	2	0.02	16.629	0.002
Scopelosaurus spp.	2	0.02	14.583	0.002
Stellerina xyosterna	2	0.02	11.333	0.001
Tetragonurus cuvieri	2	0.02	20.072	0.002
Trachurus symmetricus	2	0.02	179.402	0.021
Triglops scepticus	2	0.02	12.652	0.002
Allosmerus elongatus	1	0.01	5.579	0.001
Anarhichas orientalis	1	0.01	9.051	0.001
Anoplarchus purpurescens	1	0.01	16.782	0.002
Argentina sialis	1	0.01	8.213	0.001
Argyropelecus sladeni	1	0.01	8.735	0.001
Aristostomias scintillans	1	0.01	5.744	0.001
Benthalbella dentata	1	0.01	7.041	0.001
Blepsias cirrhosus	1	0.01	13.313	0.002
Careproctus spp.	1	0.01	9.635	0.001
Chitonotus pugetensis	1	0.01	6.848	0.001
Clevelandia ios	1	0.01	3.996	0.000
Clinocottus acuticeps	1	0.01	39.428	0.005
Clupeiformes	1	0.01	7.759	0.001
Diogenichthys atlanticus	1	0.01	8.483	0.001
Diogenichthys spp.	1	0.01	5.303	0.001
Enophrys spp.	1	0.01	6.584	0.001
Eopsetta jordani	1	0.01	8.536	0.001
Eurypharynx spp.	1	0.01	6.539	0.001
Idiacanthus spp.	1	0.01	6.272	0.001

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Taxon	No. Positive Hauls	% FO	Sum of Catch/$10m^2$	Avg. Catch/$10m^2$
Leptagonus leptorhynchus	1	0.01	2.018	0.000
Liparis pulchellus	1	0.01	6.368	0.001
Loweina rara	1	0.01	15.761	0.002
Lycodapus spp.	1	0.01	7.059	0.001
Lycodes brevipes	1	0.01	7.626	0.001
Lycodes diapterus	1	0.01	8.758	0.001
Myoxocephalus polyacanthocephalus	1	0.01	8.047	0.001
Notolepis rissoi	1	0.01	8.415	0.001
Osmerus mordax	1	0.01	6.500	0.001
Oxylebius pictus	1	0.01	5.060	0.001
Pallisina barbata	1	0.01	6.571	0.001
Paraliparis holomelas	1	0.01	8.874	0.001
Parvilux ingens	1	0.01	8.347	0.001
Pholis laeta	1	0.01	4.129	0.000
Plectobranchus evides	1	0.01	6.232	0.001
Pleuronichthys coenosus	1	0.01	6.580	0.001
Rhamphocottus richardsoni	1	0.01	2.764	0.000
Thaleichthys pacificus	1	0.01	8.689	0.001
Trachipteridae	1	0.01	7.894	0.001
Trichodon trichodon	1	0.01	3.457	0.000
Xiphister spp.	1	0.01	5.505	0.001

[1]Species in the study area are *Sebastes aleutianus, S.alutus, S. auriculatus, S. aurora, S. babcocki, S. borealis, S. brevispinis, S. caurinus, S. chlorostictus, S. ciliatus, S. crameri, S. diploproa, S. elongatus, S. emphaeus,S. entomelas, S. flavidus, S. glaucus, S.goodei, S. helvomaculatus, S. jordani, S. maliger, S. melanops, S. melanostictus, S. miniatus, S. mystinus, S. nebulosus, S. nigrocinctus, S. paucispinis, S. pinniger, S. polyspinis, S. proriger, S. rastrelliger, S. reedi, S. ruberrimus, S. rufus, S. saxicola, S. variegatus, S. wilsoni,* and *S. zacentrus.*

[2]Species in the study area are *Allosmerus elongatus, Hypomesus pretiosus, Mallotus villosus, Osmerus mordax, Spirinchus starksi, S. thaleichthys,* and *Thaleichthys pacificus.*

[3]Species in the study area are *Myoxocephalus axillaris, M. brandti, M. jaok, M. niger, M. polyacanthocephalus, M. quadricornis, M. scorpius, M. stelleri,* and *M. verrucosus.*

[4]Species in the study area are *Albatrossia pectoralis, Coryphaenoides acrolepis, C. armatus, C. cinereus, C. filifer, C. leptolepis, C. liocephalus, C. longifilis, C. yaquinae,* and *Nezumia*

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Taxon	No. Positive Hauls	% FO	Sum of Catch/$10m^2$	Avg. Catch/$10m^2$

stelgidolepis.

[5]Species found in the study area are *Liparis bristolensis, L. callyodon, L. catharus, L. cyclopus, L. dennyi, L. florae, L. fucensis, L. gibbus, L. grebnitzki, L. marmoratus, L. mednius, L. megacephalus, L. micraspidophorus, L. mucosus, L. ochotensis, L. pulchellus, L. rutteri,* and *L.tunicatus.*

[6]Species found in the study area are *Melamphaes lugubris, Poromitra crassiceps,* and *Scopeloberyx robustus.*

[7]Species in the study area are *Bothocara brunneum, B. hollandi, B. molle, B. pusillum, B. remigerum, Derepodichthys alepidotus, Gymnelis hemifasciatus, G. popovi, G. viridis, Krusensterniella pavlovskii, Lycenchelys altus, L. camchaticus, L. crotalinus, L. hippopotamus, L. jordani, L. longirostris, L. microporus, L. pliciferus, L. rassi, L. ratmanovi, L. roseus, L. volki, Lycodapus derjugini, L. dermatinus, L. endemoscotus, L. fierasfer, L. leptus, L. mandibularis, L. pachysoma, L. parviceps, L. poecilis, L. psarosomatus, Lycodes brevipes, L.concolor, L. cortezianus, L. diapterus, L. mucosus, L. pacifica, L. palearis, L. raridens, L. turneri, Lyconema barbatum, Melanostigma pammelas, Nalbantichtys elongatus, Opaeophacus acrogeneius, Pachycara bulbiceps, Puzanovia rubra,* and *Taranetzella lycoderma.*

Table 5

Larval taxa covered in Matarese et al. (2003).

Family	Taxon	Common Name
Engraulidae	*Engraulis mordax*	Northern anchovy
Clupeidae	*Clupea pallasi*	Pacific herring
Microstomatidae	*Nansenia candida*	Bluethroat argentine
Bathylagidae	*Bathylagus milleri*	Robust blacksmelt
	Bathylagus ochotensis	Popeye blacksmelt
	Bathylagus pacificus	Pacific blacksmelt
	Leuroglossus schmidti	Northern smoothtongue
Osmeridae	Osmeridae	Smelts
	Mallotus villosus	Capelin
Stomiidae	*Chauliodus macouni*	Pacific viperfish
	Tactostoma macropus	Longfin dragonfish
Paralepididae	*Lestidiops ringens*	Slender barracudina
Myctophidae	*Diaphus theta*	California headlightfish
	Nannobrachium regalis	Pinpoint lampfish
	Nannobrachium ritteri	Broadfin lampfish
	Protomyctophum crockeri	California flashlightfish
	Protomyctophum thompsoni	Northern flashlightfish
	Stenobrachius leucopsarus	Northern lampfish
	Tarletonbeania crenularis	Blue lanternfish
Trachipteridae	*Trachipterus altivelis*	King-of-the-salmon
Macrouridae	Macrouridae	Grenadiers
Merlucciidae	*Merluccius productus*	Pacific hake
Gadidae	*Gadus chalcogrammus*	Walleye pollock
	Gadus macrocephalus	Pacific cod
	Microgadus proximus	Pacific tomcod
Scomberesocidae	*Cololabis saira*	Pacific saury
Melamphaidae	Melamphaidae	Bigscales
Scorpaenidae	*Sebastes* spp.	Rockfishes
	Sebastolobus spp.	Thornyheads
Anoplopomatidae	*Anoplopoma fimbria*	Sablefish
Hexagrammidae	*Hexagrammos decagrammus*	Kelp greenling
	Hexagrammos lagocephalus	Rock greenling
	Hexagrammos octogrammus	Masked greenling
	Hexagrammos stelleri	Whitespotted greenling
	Ophiodon elongatus	Lingcod
	Pleurogrammus monopterygius	Atka mackerel
Cottidae	*Artedius fenestralis*	Padded sculpin
	Artedius harringtoni	Scalyhead sculpin

Table 5

Larval taxa covered in Matarese et al. (2003).

Family	Taxon	Common Name
Cottidae	*Gymnocanthus* spp.	
	Hemilepidotus hemilepidotus	Red Irish lord
	Hemilepidotus jordani	Yellow Irish lord
	Hemilepidotus spinosus	Brown Irish lord
	Hemilepidotus zapus	Longfin Irish lord
	Icelinus spp.	
	Leptocottus armatus	Pacific staghorn sculpin
	Myoxocephalus spp.	
	Radulinus asprellus	Slim sculpin
	Ruscarius meanyi	Puget Sound sculpin
	Scorpaenichthys marmoratus	Cabezon
Agonidae	*Anoplagonus inermis*	Smooth alligatorfish
	Aspidophoroides monopterygius	Alligatorfish
	Bathyagonus alascanus	Gray starsnout
	Bathyagonus infraspinatus	Spinycheek starsnout
	Bathyagonus nigripinnis	Blackfin poacher
	Bathyagonus pentacanthus	Bigeye poacher
	Hypsagonus mozinoi	Kelp poacher
	Hypsagonus quadricornis	Fourhorn poacher
	Leptagonus frenatus	Sawback poacher
	Podothecus acipenserinus	Sturgeon poacher
	Xeneretmus latifrons	Blacktip poacher
Psychrolutidae	*Dasycottus setiger*	Spinyhead sculpin
	Psychrolutes paradoxus	Tadpole sculpin
	Psychrolutes sigalutes	Soft sculpin
Cyclopteridae	*Aptocyclus ventricosus*	Smooth lumpsucker
Liparidae	*Liparis* spp.	Snailfishes
	Nectoliparis pelagicus	Tadpole snailfish
Bathymasteridae	*Bathymaster* spp.	
	Ronquilus jordani	Northern ronquil
Zoarcidae	Zoarcidae	Eelpouts
Stichaeidae	*Anoplarchus* spp.	Cockscombs
	Chirolophis spp.	Warbonnets
	Lumpenella longirostris	Longsnout prickleback
	Lumpenus spp.	
	Lumpenus sagitta	Snake prickleback
	Poroclinus rothrocki	Whitebarred prickleback
	Stichaeus punctatus	Arctic shanny

Table 5

Larval taxa covered in Matarese et al. (2003).

Family	Taxon	Common Name
Cryptacanthodidae	*Cryptacanthodes aleutensis*	Dwarf wrymouth
	Cryptacanthodes giganteus	Giant wrymouth
Pholidae	*Pholis* spp.	Gunnels
Ptilichthyidae	*Ptilichthys goodei*	Quillfish
Zaproridae	*Zaprora silenus*	Prowfish
Ammodytidae	*Ammodytes hexapterus*	Pacific sand lance
Icosteidae	*Icosteus aenigmaticus*	Ragfish
Centrolophidae	*Icichthys lockingtoni*	Medusafish
Paralichthyidae	*Citharichthys sordidus*	Pacific sanddab
	Citharichthys stigmaeus	Speckled sanddab
Pleuronectidae	*Atheresthes stomias*	Arrowtooth flounder
	Embassichthys bathybius	Deepsea sole
	Glyptocephalus zachirus	Rex sole
	Hippoglossoides elassodon	Flathead sole
	Hippoglossus stenolepis	Pacific halibut
	Isopsetta isolepis	Butter sole
	Lepidopsetta bilineata	Southern rock sole
	Lepidopsetta polyxystra	Northern rock sole
	Limanda aspera	Yellowfin sole
	Lyopsetta exilis	Slender sole
	Microstomus pacificus	Dover sole
	Parophrys vetulus	English sole
	Platichthys stellatus	Starry flounder
	Pleuronectes quadrituberculatus	Alaska plaice
	Psettichthys melanostictus	Sand sole
	Reinhardtius hippoglossoides	Greenland halibut

Table 6

Ranked frequency of occurrence (FO) of pelagic fish egg taxa collected in bongo nets from AFSC survey cruises 1972-1996. Average catch (no./10m^2) at positive hauls is included. Total number of 60-cm bongo tows = 8368 (includes 312 Tucker trawls). Bolded taxa are covered in Matarese et al. (2003).

Taxon	No. Positive Hauls	% FO	Sum of Catch/10m^2	Avg. Catch/10m^2
Gadus chalcogrammus	4550	54.37	35278888.20	7753.60
Hippoglossoides elassodon	2864	34.23	475785.28	166.13
Glyptocephalus zachirus	1063	12.70	45043.70	42.37
Microstomus pacificus	870	10.40	65049.14	74.77
Pleuronectidae	682	8.15	44669.33	65.50
Pleuronectes quadrituberculatus	622	7.43	9336.05	15.01
Trachipterus altivelis	353	4.22	4604.84	13.04
Bathylagidae	328	3.92	11428.22	34.84
Lyopsetta exilis	245	2.93	15135.02	61.78
Unidentified	234	2.80	8267.54	35.33
Icichthys lockingtoni	231	2.76	3791.03	16.41
Chauliodus macouni	222	2.65	2603.39	11.73
Bathylagus spp.	202	2.41	3720.66	18.42
Paralichthyidae	197	2.35	44053.13	223.62
Platichthys stellatus	176	2.10	3369.03	19.14
Myctophidae	167	2.00	66279.60	396.88
Macrouridae	158	1.89	5852.28	37.04
Icosteus aenigmaticus	145	1.73	2202.99	15.19
Leuroglossus schmidti	119	1.42	4840.86	40.68
Embassichthys bathybius	115	1.37	1017.19	8.85
Disintegrated	94	1.12	4393.12	46.74
Citharichthys spp.	84	1.00	3065.76	36.50
Parophrys vetulus	82	0.98	1876.34	22.88
Bathylagus ochotensis	80	0.96	1279.03	15.99
Isopsetta isolepis	75	0.90	1386.28	18.48
Teleost type G*	65	0.78	1263.05	19.43
Psettichthys melanostictus	55	0.66	641.14	11.66
Limanda aspera	46	0.55	1820.18	39.57
Merluccius productus	35	0.42	508.12	14.52
Nansenia candida	25	0.30	276.76	11.07
***Sebastolobus* spp.**	24	0.29	674.45	28.10
Tactostoma macropus	23	0.27	668.86	29.08
Engraulis mordax	23	0.27	6792.14	295.31
Bathylagus milleri	21	0.25	392.56	18.69
Reinhardtius hippoglossoides	20	0.24	255.59	12.78
Hippoglossoides spp.	20	0.24	2075.27	103.76
Anoplopoma fimbria	19	0.23	162.16	8.53

Table 6

Ranked frequency of occurrence (FO) of pelagic fish egg taxa collected in bongo nets from AFSC survey cruises 1972-1996. Average catch (no./10m^2) at positive hauls is included. Total number of 60-cm bongo tows = 8368 (includes 312 Tucker trawls). Bolded taxa are covered in Matarese et al. (2003).

Taxon	No. Positive Hauls	% FO	Sum of Catch/10m^2	Avg. Catch/10m^2
Gadus chalcogrammus	4550	54.37	35278888.20	7753.60
Argentinidae	17	0.20	143.56	8.44
Pleuronichthys decurrens	15	0.18	100.99	6.73
Teleost type E*	13	0.16	112.18	8.63
Tetragonurus cuvieri	11	0.13	152.81	13.89
Cololabis saira	10	0.12	313.08	31.31
Teleost type P*	9	0.11	160.21	17.80
Hippoglossus stenolepis	8	0.10	56.96	7.12
Nansenia crassa	7	0.08	56.41	8.06
Gadus macrocephalus	6	0.07	65.49	10.91
Microstoma sp.	4	0.05	29.56	7.39
Teleost type C*	3	0.04	28.20	9.40
Pleuronichthys coenosus	2	0.02	21.18	10.59
Pleuronichthys verticalis	1	0.01	7.72	7.72
Teleost type Q*	1	0.01	7.37	7.37
Bathylagus wesethi	1	0.01	5.79	5.79
Argentina sialis	1	0.01	6.93	6.93
Trachurus symmetricus	1	0.01	79.83	79.83
Hippoglossoides robustus	1	0.01	10.84	10.84
Teleost type H*	1	0.01	6.29	6.29
Gonostomatidae	1	0.01	6.82	6.82
Pleuronectes spp.	1	0.01	3.05	3.05

*Teleost egg types are recognizable by character but remain unidentified.

Table 7

Pelagic fish egg occurrences covered in Matarese et al. (2003)

Family	Taxon
Engraulidae	*Engraulis mordax*
Microstomatidae	*Nansenia candida*
Bathylagidae	*Bathylagus milleri*
	Bathylagus ochotensis
	Leuroglossus schmidti
Stomiidae	*Chauliodus macouni*
	Tactostoma macropus
Trachipteridae	*Trachipterus altivelis*
Macrouridae	*Macrouridae*
Merlucciidae	*Merluccius productus*
Gadidae	*Gadus macrocephalus*
	Theragra chalcogramma
Scomberesocidae	*Cololabis saira*
Scorpaenidae	*Sebastolobus* spp.
Anoplopomatidae	*Anoplopoma fimbria*
Icosteidae	*Icosteus aenigmaticus*
Stromateidae	*Icichthys lockingtoni*
Pleuronectidae	*Embassichthys bathybius*
	Glyptocephalus zachirus
	Hippoglossoides elassodon
	Hippoglossus stenolepis
	Isopsetta isolepis
	Limanda aspera
	Lyopsetta exilis
	Microstomus pacificus
	Parophrys vetulus
	Platichthys stellatus
	Pleuronectes quadrituberculatus
	Psettichthys melanostictus
	Reinhardtius hippoglossoides

Table 8.

Taxonomic dictionary and information of the complete list of taxa included on the IIS website.

Scientific Name	Common Name	Order	Family (Common)
Agonopsis vulsa	Northern Spearnose Poacher	Scorpaeniformes	Agonidae (Poachers and Alligatorfishes)
Albatrossia pectoralis	Giant Grenadier	Gadiformes	Macrouridae (Grenadiers)
Alepisaurus ferox	Longnose Lancetfish	Aulopiformes	Alepisauridae (Lancetfishes)
Ammodytes hexapterus	Pacific Sand Lance	Perciformes	Ammodytidae (Sand Lances)
Anarhichas orientalis	Bering Wolffish	Perciformes	Anarhichadidae (Wolffishes)
Anarrhichthys ocellatus	Wolf-Eel	Perciformes	Anarhichadidae (Wolffishes)
Anoplagonus inermis	Smooth Alligatorfish	Scorpaeniformes	Agonidae (Poachers and Alligatorfishes)
Anoplarchus insignis	Slender Cockscomb	Perciformes	Stichaeidae (Pricklebacks)
Anoplarchus purpurescens	High Cockscomb	Perciformes	Stichaeidae (Pricklebacks)
Anoplogaster cornuta	Fangtooth	Beryciformes	Anoplogastridae (Fangtooths)
Anoplopoma fimbria	Sablefish	Scorpaeniformes	Anoplopomatidae (Sablefishes)
Anotopterus pharao	Daggertooth	Aulopiformes	Anotopteridae (Daggertooths)
Apodichthys flavidus	Penpoint Gunnel	Perciformes	Pholididae (Gunnels)
Aptocyclus ventricosus	Smooth Lumpsucker	Scorpaeniformes	Cyclopteridae (Lumpfishes and Snailfishes)
Arctozenus risso	White Barracudina	Aulopiformes	Paralepididae (Barracudinas)
Argentina sialis	Pacific Argentine	Osmeriformes	Argentinidae (Argentines)
Argyropelecus affinis	Slender Hatchetfish	Stomiiformes	Sternoptychidae (Hatchetfishes)
Argyropelecus hemigymnus	Spurred Hatchetfish	Stomiiformes	Sternoptychidae (Hatchetfishes)
Argyropelecus lychnus	Tropical Hatchetfish	Stomiiformes	Sternoptychidae (Hatchetfishes)
Argyropelecus sladeni	Lowcrest Hatchetfish	Stomiiformes	Sternoptychidae (Hatchetfishes)
Aristostomias scintillans	Shiny Loosejaw	Stomiiformes	Stomiidae (Loosejaws)
Artedius fenestralis	Padded Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Artedius harringtoni	Scalyhead Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Artedius lateralis	Smoothhead Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Ascelichthys rhodorus	Rosylip Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Asemichthys taylori	Spinynose Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Aspidophoroides monopterygius	Alligatorfish	Scorpaeniformes	Agonidae (Poachers and Alligatorfishes)
Atheresthes evermanni	Kamchatka Flounder	Pleuronectiformes	Pleuronectidae (Righteye Flounders)
Atheresthes stomias	Arrowtooth Flounder	Pleuronectiformes	Pleuronectidae (Righteye Flounders)
Atherinops affinis	Topsmelt	Atheriniformes	Atherinidae (Silversides)
Atherinopsis californiensis	Jacksmelt	Atheriniformes	Atherinidae (Silversides)

Table 8.

Taxonomic dictionary and information of the complete list of taxa included on the IIS website.

Scientific Name	Common Name	Order	Family (Common)
Aulorhynchus flavidus	Tube-Snout	Gasterosteiformes	Gasterosteidae (Sticklebacks)
Avocettina infans	Blackline Snipe Eel	Anguilliformes	Nemichthyidae (Snipe Eels)
Bathlagus wesethi	Snubnose Blacksmelt	Stomiiformes	Stomiidae (Scaleless Black Dragonfishes)
Bathophilus flemingi	Highfin Dragonfish	Scorpaeniformes	Agonidae (Poachers and Alligatorfishes)
Bathyagonus alascanus	Gray Starsnout	Scorpaeniformes	Agonidae (Poachers and Alligatorfishes)
Bathyagonus infraspinatus	Spinycheek Starsnout	Scorpaeniformes	Agonidae (Poachers and Alligatorfishes)
Bathyagonus nigripinnis	Blackfin Poacher	Scorpaeniformes	Agonidae (Poachers and Alligatorfishes)
Bathyagonus pentacanthus	Bigeye Poacher	Osmeriformes	Bathylagidae (Blacksmelts)
Bathylagus milleri	Robust Blacksmelt	Osmeriformes	Bathylagidae (Blacksmelts)
Bathylagus ochotensis	Popeye Blacksmelt	Osmeriformes	Bathylagidae (Blacksmelts)
Bathylagus pacificus	Pacific Blacksmelt	Osmeriformes	Bathylagidae (Blacksmelts)
Bathylychnops exilis	Javelin Spookfish	Osmeriformes	Opisthoproctidae (Spookfishes)
Bathymaster signatus	Searcher	Perciformes	Bathymasteridae (Ronquils)
Bathysaurus mollis	Highfin Lizardfish	Aulopiformes	Synodontidae (Lizardfishes)
Benthalbella dentata	Northern Pearleye	Aulopiformes	Scopelarchidae (Pearleyes)
Benthalbella linguidens	Longfin Pearleye	Aulopiformes	Scopelarchidae (Pearleyes)
Blepsias bilobus	Crested Sculpin	Scorpaeniformes	Hemitripteridae (Sculpins)
Blepsias cirrhosus	Silverspotted Sculpin	Scorpaeniformes	Hemitripteridae (Sculpins)
Boreogadus saida	Arctic Cod	Gadiformes	Gadidae (Codfishes)
Bothragonus swani	Rockhead	Scorpaeniformes	Agonidae (Poachers and Alligatorfishes)
Bothrocara hollandi	Bigfin Eelpout	Perciformes	Zoarcidae (Eelpouts)
Brama japonica	Pacific Pomfret	Perciformes	Bramidae (Pomfrets)
Brosmophycis marginata	Red Brotula	Ophidiiformes	Bythitidae (Viviparous brotulas)
Bryozoichthys lysimus	Nutcracker Prickleback	Perciformes	Stichaeidae (Pricklebacks)
Bryozoichthys marjorius	Pearly Prickleback	Perciformes	Stichaeidae (Pricklebacks)
Caristius macropus	Bigmouth Manefish	Perciformes	Caristiidae (Veilfins)
Ceratoscopelus townsendi	Dogtooth Lampfish	Myctophiformes	Myctophidae (Lanternfishes)
Chaenophryne longiceps	Smoothhead Dreamer	Lophiiformes	Oneirodidae (Dreamers)
Chauliodus macouni	Pacific Viperfish	Stomiiformes	Stomiidae (Viperfishes)
Chesnonia verrucosa	Warty Poacher	Scorpaeniformes	Agonidae (Poachers and Alligatorfishes)
Chilara taylori	Spotted Cusk-Eel	Ophidiiformes	Ophidiidae (Cusk-Eels)

Table 8.

Taxonomic dictionary and information of the complete list of taxa included on the IIS website.

Scientific Name	Common Name	Order	Family (Common)
Chirolophis decoratus	Decorated Warbonnet	Perciformes	Stichaeidae (Pricklebacks)
Chirolophis nugator	Mosshead Warbonnet	Perciformes	Stichaeidae (Pricklebacks)
Chirolophis snyderi	Bearded Warbonnet	Perciformes	Stichaeidae (Pricklebacks)
Chitonotus pugetensis	Roughback Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Citharichthys sordidus	Pacific Sanddab	Pleuronectiformes	Paralichthyidae (Lefteye Flounders)
Citharichthys stigmaeus	Speckled Sanddab	Pleuronectiformes	Paralichthyidae (Lefteye Flounders)
Clevelandia ios	Arrow Goby	Perciformes	Gobiidae (Gobies)
Clinocottus acuticeps	Sharpnose Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Clinocottus embryum	Calico Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Clinocottus globiceps	Mosshead Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Clinocottus recalvus	Bald Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Clupea pallasi	Pacific Herring	Clupeiformes	Clupeidae (Herrings)
Cololabis saira	Pacific Saury	Beloniformes	Scomberesocidae (Sauries)
Coryphaenoides acrolepis	Pacific Grenadier	Gadiformes	Macrouridae (Grenadiers)
Coryphaenoides cinereus	Popeye Grenadier	Gadiformes	Macrouridae (Grenadiers)
Coryphaenoides filifer	Threadfin Grenadier	Gadiformes	Macrouridae (Grenadiers)
Coryphaenoides leptolepis	Ghostly Grenadier	Gadiformes	Macrouridae (Grenadiers)
Cottus asper	Prickly Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Cryptacanthodes aleutensis	Dwarf Wrymouth	Perciformes	Cryptacanthodidae (Wrymouths)
Cryptacanthodes giganteus	Giant Wrymouth	Perciformes	Cryptacanthodidae (Wrymouths)
Cyclothone acclinidens	Benttooth Bristlemouth	Stomiiformes	Gonostomatidae (Bristlemouths)
Cyclothone atraria	Black Bristlemouth	Stomiiformes	Gonostomatidae (Bristlemouths)
Cyclothone pallida	Tan Bristlemouth	Stomiiformes	Gonostomatidae (Bristlemouths)
Cyclothone pseudopallida	Slender Bristlemouth	Stomiiformes	Gonostomatidae (Bristlemouths)
Cyclothone signata	Showy Bristlemouth	Stomiiformes	Gonostomatidae (Bristlemouths)
Cyema atrum	Bobtail Snipe-Eel	Saccopharyngiformes	Cyematidae (Bobtail Snipe Eels)
Danaphos oculatus	Bottlelight	Stomiiformes	Sternoptychidae (Hatchetfishes)
Dasycottus setiger	Spinyhead Sculpin	Scorpaeniformes	Psychrolutidae (Sculpins)
Diaphus theta	California Headlightfish	Myctophiformes	Myctophidae (Lanternfishes)
Dolichopteryx longipes	Brownsnout Spookfish	Osmeriformes	Opisthoproctidae (Spookfishes)
Electrona risso	Chubby Flashlightfish	Myctophiformes	Myctophidae (Lanternfishes)

Table 8.

Taxonomic dictionary and information of the complete list of taxa included on the IIS website.

Scientific Name	Common Name	Order	Family (Common)
Eleginus gracilis	Saffron Cod	Gadiformes	Gadidae (Codfishes)
Embassichthys bathybius	Deepsea Sole	Pleuronectiformes	Pleuronectidae (Righteye Flounders)
Engraulis mordax	Northern Anchovy	Clupeiformes	Engraulidae (Anchovies)
Enophrys bison	Buffalo Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Enophrys diceraus	Antlered Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Eopsetta jordani	Petrale Sole	Pleuronectiformes	Pleuronectidae (Righteye Flounders)
Eumicrotremus orbis	Pacific Spiny Lumpsucker	Scorpaeniformes	Cyclopteridae (Lumpfishes and Snailfishes)
Gadus chalcogrammus	Walleye Pollock	Gadiformes	Gadidae (Codfishes)
Gadus macrocephalus	Pacific Cod	Gadiformes	Gadidae (Codfishes)
Genyonemus lineatus	White Croaker	Perciformes	Sciaenidae (Croakers)
Glyptocephalus stelleri	Long Flounder	Pleuronectiformes	Pleuronectidae (Righteye Flounders)
Glyptocephalus zachirus	Rex Sole	Pleuronectiformes	Pleuronectidae (Righteye Flounders)
Gobiesox maeandricus	Northern Clingfish	Perciformes	Gobiesocidae (Clingfishes)
Gonostoma atlanticum	Atlantic Fangjaw	Stomiiformes	Gonostomatidae (Bristlemouths)
Gonostoma gracile	Slender Fangjaw	Stomiiformes	Gonostomatidae (Bristlemouths)
Gymnelus viridis	Fish Doctor	Perciformes	Zoarcidae (Eelpouts)
Gymnocanthus tricuspis	Arctic Staghorn Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Gymnoclinus cristulatus	Trident Prickleback	Perciformes	Stichaeidae (Pricklebacks)
Hemilepidotus gilberti	Banded Irish Lord	Scorpaeniformes	Cottidae (Sculpins)
Hemilepidotus hemilepidotus	Red Irish Lord	Scorpaeniformes	Cottidae (Sculpins)
Hemilepidotus jordani	Yellow Irish Lord	Scorpaeniformes	Cottidae (Sculpins)
Hemilepidotus spinosus	Brown Irish Lord	Scorpaeniformes	Cottidae (Sculpins)
Hemilepidotus zapus	Longfin Irish Lord	Scorpaeniformes	Cottidae (Sculpins)
Hemitripterus bolini	Bigmouth Sculpin	Scorpaeniformes	Hemitripteridae (Sculpins)
Heterostichus rostratus	Giant Kelpfish	Perciformes	Clinidae (Kelpfishes)
Hexagrammos decagrammus	Kelp Greenling	Scorpaeniformes	Hexagrammidae (Greenlings)
Hexagrammos lagocephalus	Rock Greenling	Scorpaeniformes	Hexagrammidae (Greenlings)
Hexagrammos octogrammus	Masked Greenling	Scorpaeniformes	Hexagrammidae (Greenlings)
Hexagrammos stelleri	Whitespotted Greenling	Scorpaeniformes	Hexagrammidae (Greenlings)
Hippoglossoides elassodon	Flathead Sole	Pleuronectiformes	Pleuronectidae (Righteye Flounders)
Hippoglossoides robustus	Bering Flounder	Pleuronectiformes	Pleuronectidae (Righteye Flounders)

Table 8.

Taxonomic dictionary and information of the complete list of taxa included on the IIS website.

Scientific Name	Common Name	Order	Family (Common)
Hippoglossus stenolepis	Pacific Halibut	Pleuronectiformes	Pleuronectidae (Righteye Flounders)
Hygophum reinhardtii	Slender Lanternfish	Myctophiformes	Myctophidae (Lanternfishes)
Hypomesus pretiosus	Surf Smelt	Osmeriformes	Osmeridae (Smelts)
Hypsagonus mozinoi	Kelp Poacher	Scorpaeniformes	Agonidae (Poachers and Alligatorfishes)
Hypsagonus quadricornis	Fourhorn Poacher	Scorpaeniformes	Agonidae (Poachers and Alligatorfishes)
Icelinus borealis	Northern Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Icichthys lockingtoni	Medusafish	Perciformes	Centrolophidae (Medusafishes)
Icosteus aenigmaticus	Ragfish	Perciformes	Icosteidae (Ragfishes)
Idiacanthus antrostomus	Pacific Blackdragon	Stomiiformes	Stomiidae (Black dragonsfishes)
Idiacanthus fasciola	Ribbon Sawtail Fish	Stomiiformes	Stomiidae (Black dragonsfishes)
Isopsetta iSolepis	Butter Sole	Pleuronectiformes	Pleuronectidae (Righteye Flounders)
Katsuwonus pelamis	Skipjack Tuna	Perciformes	Scombridae (Mackerels)
Lampadena urophaos	Sunbeam Lampfish	Myctophiformes	Myctophidae (Lanternfishes)
Lampanyctus ritteri	Broadfin Lampfish	Myctophiformes	Myctophidae (Lanternfishes)
Lampris guttatus	Opah	Lampriformes	Lampridae (Opahs)
Lepidogobius lepidus	Bay Goby	Perciformes	Gobiidae (Gobies)
Lepidopsetta bilineata	Southern Rock Sole	Pleuronectiformes	Pleuronectidae (Righteye Flounders)
Lepidopsetta polyxystra	Northern Rock Sole	Pleuronectiformes	Pleuronectidae (Righteye Flounders)
Leptagonus decagonus	Atlantic Poacher	Scorpaeniformes	Agonidae (Poachers and Alligatorfishes)
Leptagonus frenatus	Sawback Poacher	Scorpaeniformes	Agonidae (Poachers and Alligatorfishes)
Leptagonus leptorhynchus	Longnose Poacher	Scorpaeniformes	Agonidae (Poachers and Alligatorfishes)
Leptocottus armatus	Pacific Staghorn Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Lestidiops ringens	Slender Barracudina	Aulopiformes	Paralepididae (Barracudinas)
Leuroglossus schmidti	Northern Smoothtongue	Osmeriformes	Bathylagidae (Blacksmelts)
Leuroglossus stilbius	California Smoothtongue	Osmeriformes	Bathylagidae (Blacksmelts)
Limanda aspera	Yellowfin Sole	Pleuronectiformes	Pleuronectidae (Righteye Flounders)
Limanda proboscidea	Longhead Dab	Pleuronectiformes	Pleuronectidae (Righteye Flounders)
Liopsetta glacialis	Arctic Flounder	Pleuronectiformes	Pleuronectidae (Righteye Flounders)
Liparis callyodon	Spotted Snailfish	Scorpaeniformes	Liparidae (Lumpfishes and Snailfishes)
Liparis florae	Tidepool Snailfish	Scorpaeniformes	Liparidae (Lumpfishes and Snailfishes)
Liparis fucensis	Slipskin Snailfish	Scorpaeniformes	Liparidae (Lumpfishes and Snailfishes)

Table 8.

Taxonomic dictionary and information of the complete list of taxa included on the IIS website.

Scientific Name	Common Name	Order	Family (Common)
Liparis gibbus	Variegated Snailfish	Scorpaeniformes	Liparidae (Lumpfishes and Snailfishes)
Liparis mucosus	Slimy Snailfish	Scorpaeniformes	Liparidae (Snailfishes)
Liparis pulchellus	Showy Snailfish	Scorpaeniformes	Liparidae (Lumpfishes and Snailfishes)
Loweina rara	Dwarf Lanternfish	Myctophiformes	Myctophidae (Lanternfishes)
Lumpenella longirostris	Longsnout Prickleback	Perciformes	Stichaeidae (Pricklebacks)
Lumpenus fabricii	Slender Eelblenny	Perciformes	Stichaeidae (Pricklebacks)
Lumpenus maculatus	Daubed Shanny	Perciformes	Stichaeidae (Pricklebacks)
Lumpenus medius	Stout Eelblenny	Perciformes	Stichaeidae (Pricklebacks)
Lumpenus sagitta	Snake Prickleback	Perciformes	Stichaeidae (Pricklebacks)
Luvarus imperialis	Louvar	Perciformes	Luvaridae (Louvars)
Lyopsetta exilis	Slender Sole	Pleuronectiformes	Pleuronectidae (Righteye Flounders)
Macropinna microstoma	Barreleye	Osmeriformes	Opisthoproctidae (Spookfishes)
Magnisudis atlantica	Duckbill Barracudina	Aulopiformes	Paralepididae (Barracudinas)
Malacocottus zonurus	Darkfin Sculpin	Scorpaeniformes	Psychrolutidae (Sculpins)
Mallotus villosus	Capelin	Osmeriformes	Osmeridae (Smelts)
Melamphaes lugubris	Highsnout Bigscale	Stephanoberyciformes	Melamphaidae (Bigscales)
Melanolagus bericoides	Bigscale Deepsea Smelt	Osmeriformes	Bathylagidae (Blacksmelts)
Merluccius productus	Pacific Hake	Gadiformes	Merlucciidae (Hakes)
Microgadus proximus	Pacific Tomcod	Gadiformes	Gadidae (Codfishes)
Microstomus pacificus	Dover Sole	Pleuronectiformes	Pleuronectidae (Righteye Flounders)
Mola mola	Ocean Sunfish	Tetraodontiformes	Molidae (Molas)
Myoxocephalus polyacanthocephalus	Great Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Nannobrachium regale	Pinpoint Lampfish	Myctophiformes	Myctophidae (Lanternfishes)
Nansenia candida	Bluethroat Argentine	Osmeriformes	Microstomatidae (Pencilsmelts)
Naucrates ductor	Pilotfish	Perciformes	Carangidae (Jacks)
Nautichthys oculofasciatus	Sailfin Sculpin	Scorpaeniformes	Hemitripteridae (Sculpins)
Nautichthys pribilovius	Eyeshade Sculpin	Scorpaeniformes	Hemitripteridae (Sculpins)
Nautichthys robustus	Shortmast Sculpin	Scorpaeniformes	Hemitripteridae (Sculpins)
Nectoliparis pelagicus	Tadpole Snailfish	Scorpaeniformes	Liparidae (Lumpfishes and Snailfishes)
Nemichthys scolopaceus	Slender Snipe Eel	Anguilliformes	Nemichthyidae (Snipe Eels)
Nezumia stelgidolepis	California Grenadier	Gadiformes	Macrouridae (Grenadiers)

Table 8.

Taxonomic dictionary and information of the complete list of taxa included on the IIS website.

Scientific Name	Common Name	Order	Family (Common)
Occella dodecaedron	Bering Poacher	Scorpaeniformes	Agonidae (Poachers and Alligatorfishes)
Odontopyxix trispinsosa	Pygmy Poacher	Scorpaeniformes	Agonidae (Poachers and Alligatorfishes)
Oligocottus maculosus	Tidepool Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Oligocottus snyderi	Fluffy Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Oneirodes bulbosus	Bulbous Dreamer	Lophiiformes	Oneirodidae (Dreamers)
Ophiodon elongatus	Lingcod	Scorpaeniformes	Hexagrammidae (Greenlings)
Opisthocentrus ocellatus	Ocellated Blenny	Perciformes	Stichaeidae (Pricklebacks)
Opostomias mitsuii	Pitgum Dragonfish	Stomiiformes	Stomiidae (Scaleless Black Dragonfishes)
Oxylebius pictus	Painted Greenling	Scorpaeniformes	Hexagrammidae (Greenlings)
Pallasina barbata	Tubenose Poacher	Scorpaeniformes	Agonidae (Poachers and Alligatorfishes)
Paraliparis holomelas	Ebony Snailfish	Scorpaeniformes	Liparidae (Lumpfishes and Snailfishes)
Paricelinus hopliticus	Thornback Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Parophrys vetulus	English Sole	Pleuronectiformes	Pleuronectidae (Righteye Flounders)
Parvilux ingens	Giant Lampfish	Myctophiformes	Myctophidae (Lanternfishes)
Peprilus simillimus	Pacific Pompano	Perciformes	Stromateidae (Butterfishes)
Percis japonica	Dragon Poacher	Scorpaeniformes	Agonidae (Poachers and Alligatorfishes)
Pholis laeta	Crescent Gunnel	Perciformes	Pholididae (Gunnels)
Phytichthys chirus	Ribbon Prickleback	Perciformes	Stichaeidae (Pricklebacks)
Platichthys stellatus	Starry Flounder	Pleuronectiformes	Pleuronectidae (Righteye Flounders)
Plectobranchus evides	Bluebarred Prickleback	Perciformes	Stichaeidae (Pricklebacks)
Pleurogrammus monopterygius	Atka Mackerel	Scorpaeniformes	Hexagrammidae (Greenlings)
Pleuronectes quadrituberculatus	Alaska Plaice	Pleuronectiformes	Pleuronectidae (Righteye Flounders)
Pleuronichthys coenosus	C-O Sole	Pleuronectiformes	Pleuronectidae (Righteye Flounders)
Pleuronichthys decurrens	Curlfin Sole	Pleuronectiformes	Pleuronectidae (Righteye Flounders)
Podothecus acipenserinus	Sturgeon Poacher	Scorpaeniformes	Agonidae (Poachers and Alligatorfishes)
Poroclinus rothrocki	Whitebarred Prickleback	Perciformes	Stichaeidae (Pricklebacks)
Poromitra crassiceps	Crested Bigscale	Stephanoberyciformes	Melamphaidae (Bigscales)
Protomyctophum crockeri	California Flashlightfish	Myctophiformes	Myctophidae (Lanternfishes)
Protomyctophum thompsoni	Northern Flashlightfish	Myctophiformes	Myctophidae (Lanternfishes)
Psettichthys melanostictus	Sand Sole	Pleuronectiformes	Pleuronectidae (Righteye Flounders)
Psychrolutes paradoxus	Tadpole Sculpin	Scorpaeniformes	Psychrolutidae (Sculpins)

Table 8.

Taxonomic dictionary and information of the complete list of taxa included on the IIS website.

Scientific Name	Common Name	Order	Family (Common)
Psychrolutes phrictus	Blob Sculpin	Scorpaeniformes	Psychrolutidae (Sculpins)
Psychrolutes sigalutes	Soft Sculpin	Scorpaeniformes	Psychrolutidae (Sculpins)
Ptilichthys goodei	Quillfish	Perciformes	Ptilichthyidae (Quillfishes)
Radulinus asprellus	Slim Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Radulinus boleoides	Darter Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Reinhardtius hippoglossoides	Greenland Halibut	Pleuronectiformes	Pleuronectidae (Righteye Flounders)
Rhamphocottus richardsoni	Grunt Sculpin	Scorpaeniformes	Rhamphocottidae (Sculpins)
Rhinogobiops nicholsii	Blackeye Goby	Perciformes	Gobiidae (Gobies)
Rhinoliparis barbulifer	Longnose Snailfish	Scorpaeniformes	Liparidae (Lumpfishes and Snailfishes)
Rimicola muscarum	Kelp Clingfish	Perciformes	Gobiesocidae (Clingfishes)
Ronquilus jordani	Northern Ronquil	Perciformes	Bathymasteridae (Ronquils)
Ruscarius meanyi	Puget Sound Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Sardinops sagax	Pacific Sardine	Clupeiformes	Clupeidae (Herrings)
Scomber japonicus	Chub Mackerel	Perciformes	Scombridae (Mackerels)
Scopeloberyx robustus	Longjaw Bigscale	Stephanoberyciformes	Melamphaidae (Bigscales)
Scopelosaurus harryi	Scaly Paperbone	Aulopiformes	Notosudidae (Waryfishes)
Scorpaenichthys marmoratus	Cabezon	Scorpaeniformes	Cottidae (Sculpins)
Sebastes aleutianus	Rougheye Rockfish	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastes auriculatus	Brown Rockfish	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastes aurora	Aurora Rockfish	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastes babcocki	Redbanded Rockfish	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastes caurinus	Copper Rockfish	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastes crameri	Darkblotched Rockfish	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastes diploproa	Splitnose Rockfish	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastes elongatus	Greenstriped Rockfish	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastes emphaeus	Puget Sound Rockfish	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastes entomelas	Widow Rockfish	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastes flavidus	Yellowtail Rockfish	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastes goodei	Chilipepper	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastes helvomaculatus	Rosethorn Rockfish	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastes jordani	Shortbelly Rockfish	Scorpaeniformes	Scorpaenidae (Rockfishes)

Table 8.

Taxonomic dictionary and information of the complete list of taxa included on the IIS website.

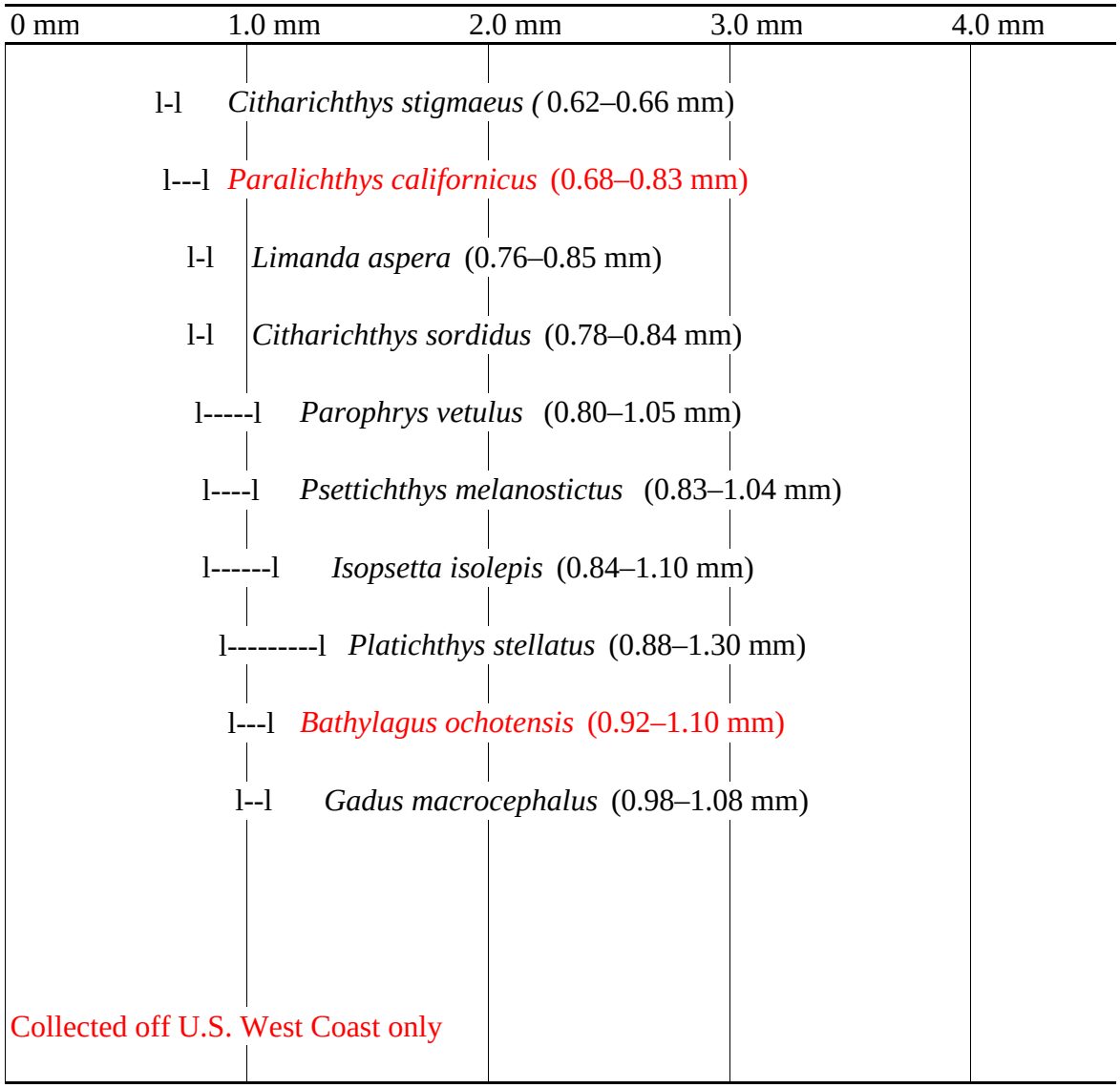
Scientific Name	Common Name	Order	Family (Common)
Sebastes melanops	Black Rockfish	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastes melanostomus	Blackgill Rockfish	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastes miniatus	Vermilion Rockfish	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastes mystinus	Blue Rockfish	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastes paucispinis	Bocaccio	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastes pinniger	Canary Rockfish	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastes polyspinis	Northern Rockfish	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastes proriger	Redstripe Rockfish	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastes rastrelliger	Grass Rockfish	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastes reedi	Yellowmouth Rockfish	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastes rufus	Bank Rockfish	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastes saxicola	Stripetail Rockfish	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastes zacentrus	Sharpchin Rockfish	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastolobus alascanus	Shortspine Thornyhead	Scorpaeniformes	Scorpaenidae (Rockfishes)
Sebastolobus altivelis	Longspine Thornyhead	Scorpaeniformes	Scorpaenidae (Rockfishes)
Serrivomer jesperseni	Crossthroat Sawpalate	Anguilliformes	Serrivomeridae (Sawtooth Eels)
Stellerina xyostema	Pricklebreast Poacher	Scorpaeniformes	Agonidae (Poachers and Alligatorfishes)
Stenobrachius leucopsarus	Northern Lampfish	Myctophiformes	Myctophidae (Lanternfishes)
Sternoptyx diaphana	Longspine Hatchetfish	Stomiiformes	Sternoptychidae (Hatchetfishes)
Sternoptyx pseudobscura	Highlight Hatchetfish	Stomiiformes	Sternoptychidae (Hatchetfishes)
Stichaeus punctatus	Arctic Shanny	Perciformes	Stichaeidae (Pricklebacks)
Symbolophorus californiensis	California Lanternfish	Myctophiformes	Myctophidae (Lanternfishes)
Symphurus atricaudus	California Tonguefish	Pleuronectiformes	Cynoglossidae (TongueSoles)
Synchirus gilli	Manacled Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Syngnathus leptorhynchus	Bay Pipefish	Syngnathiformes	Syngnathidae (Pipefishes and Seahorses)
Synodus lucioceps	California Lizardfish	Aulopiformes	Synodontidae (Lizardfishes)
Tactostoma macropus	Longfin Dragonfish	Stomiiformes	Stomiidae (Scaleless Black Dragonfishes)
Tarletonbeania crenularis	Blue Lanternfish	Myctophiformes	Myctophidae (Lanternfishes)
Tetragonurus cuvieri	Smalleye Squaretail	Perciformes	Tetragonuridae (Squaretails)
Thalassenchelys coheni	Transparent Eel	Anguilliformes	Chlopsidae (False Morays)
Thaleichthys pacificus	Eulachon	Osmeriformes	Osmeridae (Smelts)

Table 8.

Taxonomic dictionary and information of the complete list of taxa included on the IIS website.

Scientific Name	Common Name	Order	Family (Common)
Trachipterus altivelis	King-of-the-Salmon	Lampriformes	Trachipteridae (Ribbonfishes)
Trachurus symmetricus	Jack Mackerel	Perciformes	Carangidae (Jacks)
Trichodon trichodon	Pacific Sandfish	Perciformes	Trichodontidae (Sandfishes)
Triglops forficata	Scissortail Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Triglops macellus	Roughspine Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Triglops pingeli	Ribbed Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Triglops scepticus	Spectacled Sculpin	Scorpaeniformes	Cottidae (Sculpins)
Ulcina olriki	Arctic Alligatorfish	Scorpaeniformes	Agonidae (Poachers and Alligatorfishes)
Xeneretmus latifrons	Blacktip Poacher	Scorpaeniformes	Agonidae (Poachers and Alligatorfishes)
Xeneretmus leiops	Smootheye Poacher	Scorpaeniformes	Agonidae (Poachers and Alligatorfishes)
Xiphister atropurpureus	Black Prickleback	Perciformes	Stichaeidae (Pricklebacks)
Xiphister mucosus	Rock Prickleback	Perciformes	Stichaeidae (Pricklebacks)
Zaniolepis frenata	Shortspine Combfish	Scorpaeniformes	Hexagrammidae (Greenlings)
Zaniolepis latipinnis	Longspine Combfish	Scorpaeniformes	Hexagrammidae (Greenlings)
Zaprora silenus	Prowfish	Perciformes	Zaproridae (Prowfishes)
Zesticelus profundorum	Flabby Sculpin	Scorpaeniformes	Cottidae (Sculpins)

Ocean and Bering Sea.



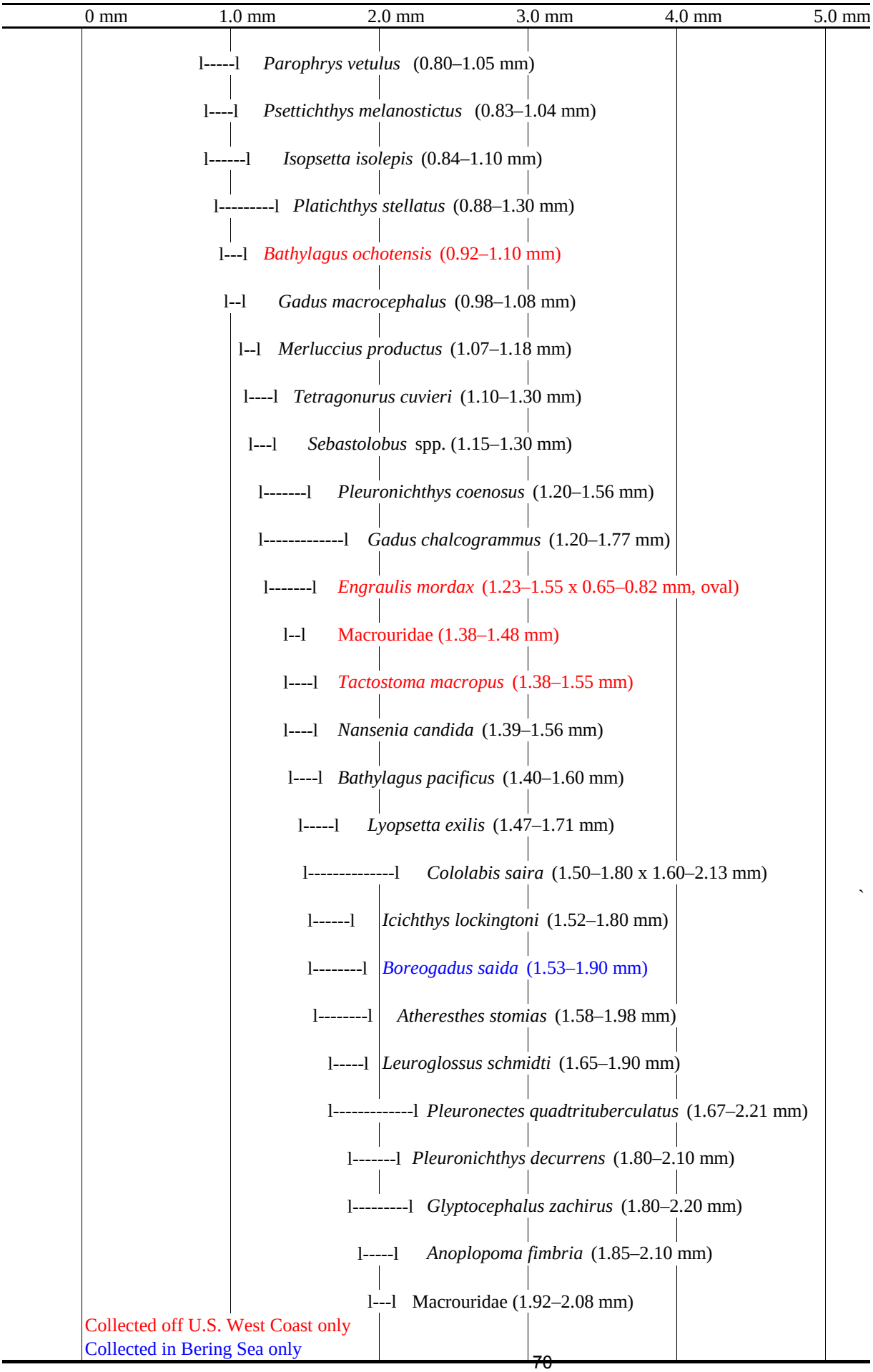

0 mm
1.0 mm
2.0 mm
3.0 mm
4.0 mm
5.0 mm
Parophrys vetulus (0.80–1.05 mm)
Psettichthys melanostictus (0.83–1.04 mm)
Isopsetta isolepis (0.84–1.10 mm)
Platichthys stellatus (0.88–1.30 mm)
Bathylagus ochotensis (0.92–1.10 mm)
Gadus macrocephalus (0.98–1.08 mm)
Merluccius productus (1.07–1.18 mm)
Tetragonurus cuvieri (1.10–1.30 mm)
Sebastolobus spp. (1.15–1.30 mm)
Pleuronichthys coenosus (1.20–1.56 mm)
Gadus chalcogrammus (1.20–1.77 mm)
Engraulis mordax (1.23–1.55 x 0.65–0.82 mm, oval)
Macrouridae (1.38–1.48 mm)
Tactostoma macropus (1.38–1.55 mm)
Nansenia candida (1.39–1.56 mm)
Bathylagus pacificus (1.40–1.60 mm)
Lyopsetta exilis (1.47–1.71 mm)
Cololabis saira (1.50–1.80 x 1.60–2.13 mm)
Icichthys lockingtoni (1.52–1.80 mm)
Boreogadus saida (1.53–1.90 mm)
Atheresthes stomias (1.58–1.98 mm)
Leuroglossus schmidti (1.65–1.90 mm)
Pleuronectes quadrituberculatus (1.67–2.21 mm)
Pleuronichthys decurrens (1.80–2.10 mm)
Glyptocephalus zachirus (1.80–2.20 mm)
Anoplopoma fimbria (1.85–2.10 mm)
Macrouridae (1.92–2.08 mm)
Collected off U.S. West Coast only
Collected in Bering Sea only

Table 11

Pelagic fish eggs 2.00–3.00 mm diameter collected in plankton tows in the Northeast Pacific Ocean and Bering Sea.

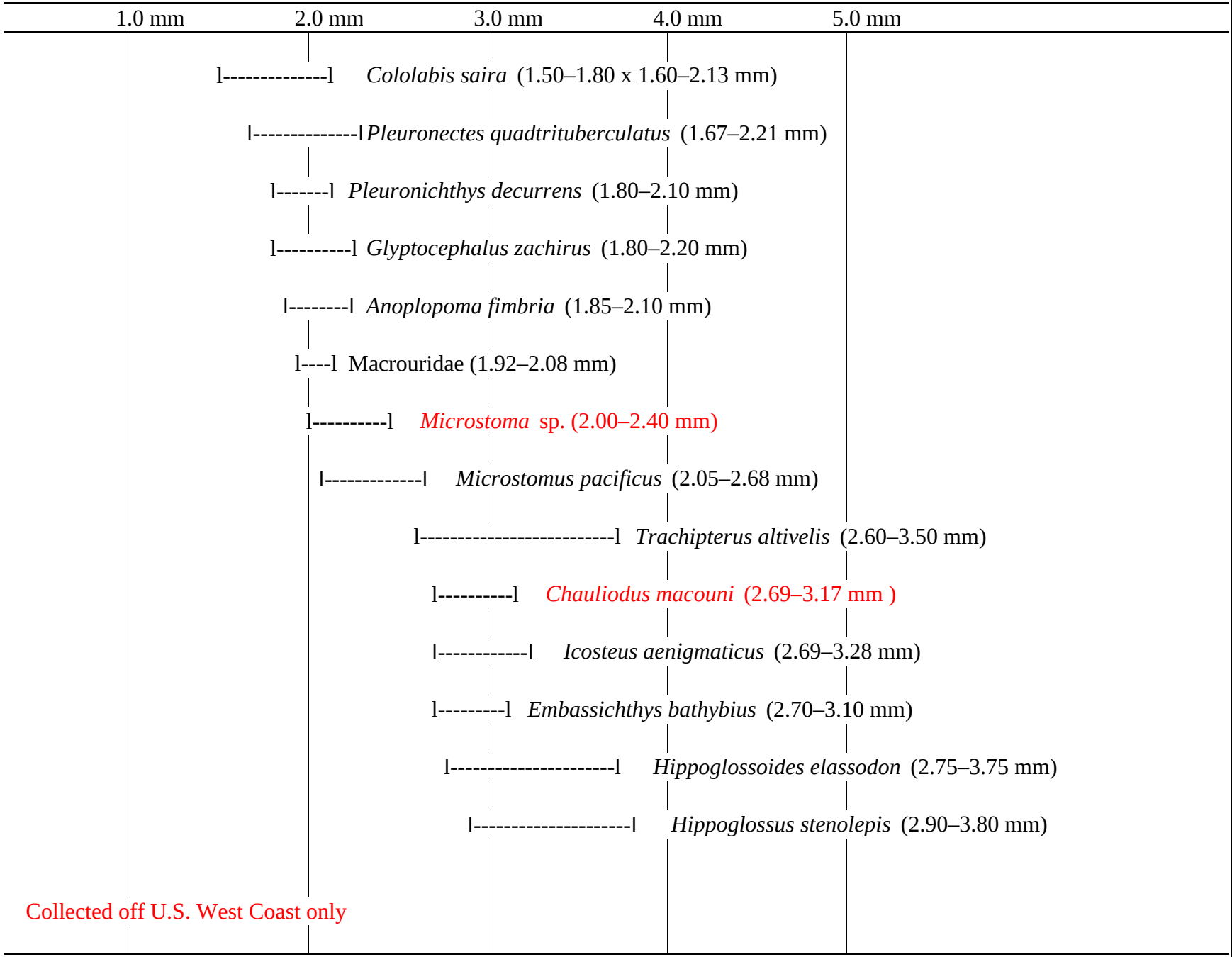


Table 12

Pelagic fish eggs 3.00–4.50 mm diameter collected in plankton tows in the Northeast Pacific Ocean and Bering Sea.

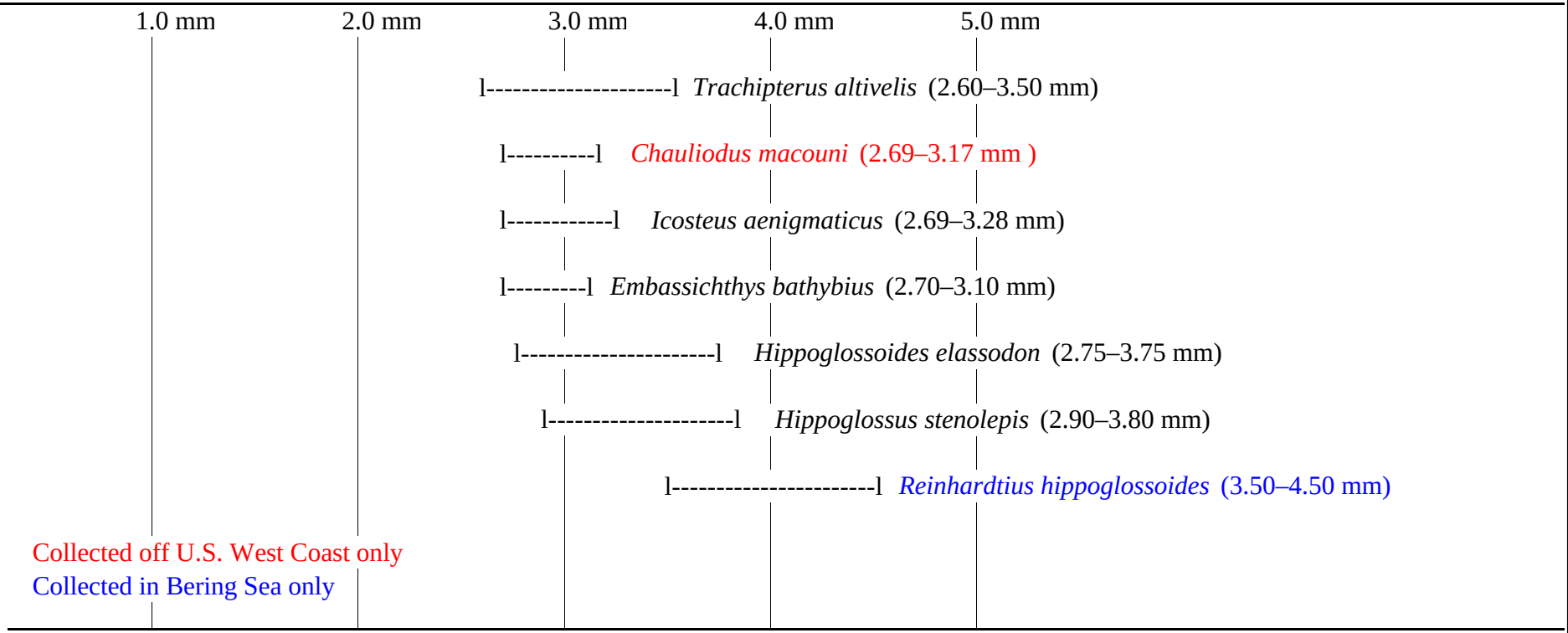


Table 13

Pelagic fish eggs with oil globules collected in plankton tows in the Northeast Pacific Ocean and Bering Sea.

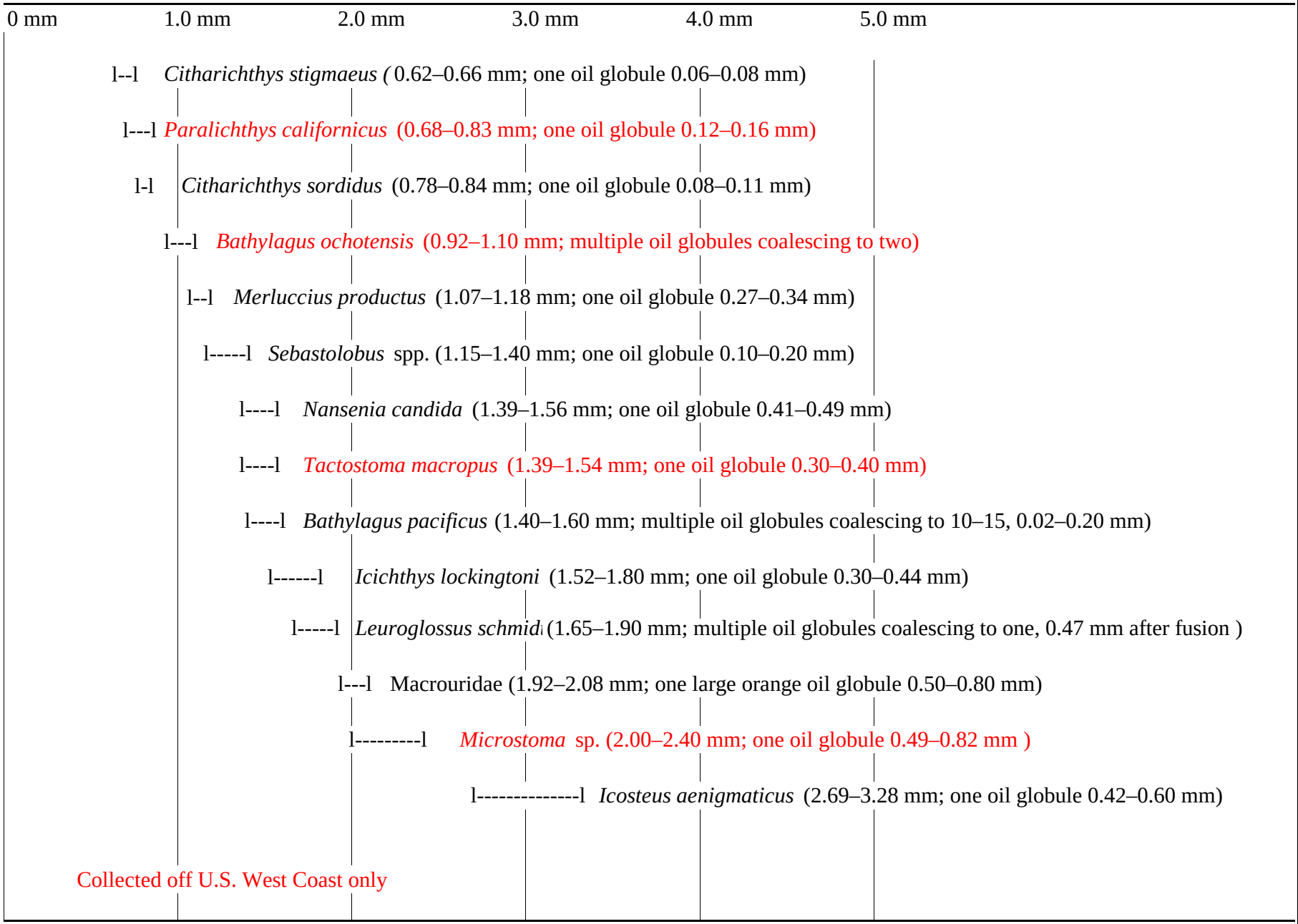


Table 14

Distinguishing characters of fish eggs occurring in the Northeast Pacific Ocean and Bering Sea arranged by size.

Citharichthys stigmaeus (0.62–0.66 mm)	Smooth chorion, small size; one oil globule, 0.06–0.08 mm.
Paralichthys californicus (0.68–0.83 mm)	Smooth chorion, small size; one oil globule, 0.12–0.16 mm.
Limanda aspera (0.76–0.85 mm)	Smooth chorion, small size; no oil globule.
Citharichthys sordidus (0.78–0.84 mm)	Smooth chorion, small size; one oil globule, 0.08–0.11 mm.
Parophrys vetulus (0.80–1.05 mm)	Distinguish from *Isopsetta*, *Platichthys*, and *Psettichthys* by two rows of pigment between the eyes and moderate amount of ventral pigment.
Psettichthys melanostictus (0.83–1.04 mm)	Distinguish from *Isopsetta* and *Parophrys* by pigment scattered uniformly over head and body, and pigment on yolk. Distinguish from *Platichthys* by pigment on yolk other than area of pectoral fins and slender-bodied embryo.
Isopsetta isolepis (0.84–1.10 mm)	Distinguish from *Parophrys*, *Platichthys*, and *Psettichthys* by near-absence of head pigment, "saddle" of pigment behind head, and near-absence of pigment along the ventral midline to tail.
Platichthys stellatus (0.88–1.30 mm)	Distinguish from *Isopsetta* and *Parophrys* by pigment scattered uniformly over head and body, almost continuous line of pigment around tail, and finfold pigment. Distinguish from *Psettichthys* by large size of embryo and lack of yolk pigment except in area of pectoral fins.
Bathylagus ochotensis (0.92–1.10 mm)	Pustules on inner surface of chorion; segmented yolk; >10 oil globules coalesce to 2 at equatorial poles; no pigment.
Gadus macrocephalus (0.98–1.08 mm)	Thick chorion with golden color; size of egg.
Merluccius productus (1.07–1.18 mm)	Chorion thin, smooth; one oil globule, 0.27–0.34 mm; pigment on late-stage embryo in four dorsal patches and one ventral patch opposite posterior dorsal patch; eyes of late-stage embryo unpigmented.
Tetragonurus cuvieri (1.10–1.30 mm)	Chorion golden with pink tint; one oil globule, 0.25–0.30 mm; double row of dorsal pigment splits at nape to outline brain and extending onto snout, ventral pigment over gut extending along ventral margin of tail, on oil globule.

Sebastolobus spp. (1.15–1.30 mm)	Chorion thin, appears to have pale blue color in transmitted light, egg shape out-of-round; one yellow oil globule, 0.10–0.20 mm; early to middle-stage embryo unpigmented; late-stage embryo with large dorsal finfold extending onto head; pigment blotch on posterior gut and opposing dorsal and ventral blotches at about 75% body length.
Pleuronichthys coenosus (1.20–1.56 mm)	Hexagonal sculpturing on chorion; pigment lightly scattered on yolk, heavy uniform pigment on body; no pigment on tail except at tip.
Gadus chalcogrammus (1.20–1.77 mm)	Thin chorion; late-stage embryo has two postanal bars and lacks pigment at end of tail; no pigment on yolk.
Engraulis mordax (1.23–1.55 x 0.65–0.82 mm)	Ellipsoidal shape; segmented yolk.
Macrouridae (1.38–1.48 mm)	One large orange oil globule, chorion usually ornamented with raised patterns (hexagons). North Pacific coast (similar to Macrouridae 1.92–2.08 mm in Gulf of Alaska; pattern may not be as raised)
Tactostoma macropus (1.38–1.55 mm)	Smooth chorion; segmented yolk; large perivitelline space; one oil globule, 0.30–0.40 mm; long gut length, 80% NL.
Nansenia candida (1.39–1.56 mm)	Pustules on inner surface of chorion; segmented yolk; one oil globule, 0.41–0.49 mm; pigment on yolk and along gut; long gut length, 70% NL.
Bathylagus pacificus (1.40–1.60 mm)	Chorion covered with small contiguous bumps (looks like snakeskin); segmented yolk ; numerous oil globules of varied size (0.02–0.20 mm) at vegetal pole, coalescing and forming 2 polar groups in late-stage eggs.
Lyopsetta exilis (1.47–1.71 mm)	Pigment on late-stage embryo covers entire body with heavy concentration on caudal finfold; pigment on ventral surface of yolk.
Cololabis saira (1.50–1.80 x 1.60–2.13 mm)	Chorion oval with 12–20 adhesive filaments at pole and 1 thicker lateral filament; pigment on yolk and completely covering late-stage embryo.
Icichthys lockingtoni (1.52–1.80 mm)	One oil globule, 0.30–0.44 mm; uninterrupted row of pigment along dorsal surface of gut and ventral surface of tail to around notochord tip, on finfold around notochord tip, and on ventral surface of oil globule.

Boreogadus saida (1.53–1.90 mm)	Thin chorion; late-stage embryo has two postanal bars and lacks pigment at end of tail; no pigment on yolk. Distinguish from late-stage *Gadus chalcogrammus* by larger head, heavier pigment on head, size, geographic location (northern Bering Sea).
Atheresthes stomias (1.58–1.98 mm)	Smooth chorion, medium thickness; embryo and yolk unpigmented. Size, timing (winter), and occurrence in deep water overlaps *Anoplopoma fimbria.* Late–stage embryo has preanal length of 40%; myomeres 47–50.
Leuroglossus schmidti (1.65–1.90 mm)	Segmented yolk; one oil globule, 0.35–0.40 mm, positioned in yolk next to midpoint of gut; late-stage embryo pigmented on tip of notochord, caudal finfold, and on ventral surface of gut directly over oil globule.
Pleuronectes quadrituberculatus (1.67–2.21 mm)	Thick, "wavy" chorion with coppery color, pigment on posterior half of ventral surface of yolk, late-stage embryo has double row of postanal ventral pigment.
Pleuronichthys decurrens (1.80–2.10 mm)	Hexagonal sculpturing on chorion; pigment lightly scattered on yolk, heavy uniform pigment on body; no pigment on tail except at tip.
Glyptocephalus zachirus (1.80–2.20 mm)	Thick chorion with pebbled surface, pigment on ventral surface of yolk, late–stage embryo has 4 bands and is curled 2½ times around top of yolk.
Anoplopoma fimbria (1.85–2.20 mm; usually ≥ 2.00)	Smooth chorion, medium thickness; embryo and yolk unpigmented. Size, timing (winter), and occurrence in deep water overlaps *Atheresthes* spp. Late–stage embryo has preanal length of 50–60%; myomeres 61–66.
Macrouridae (1.92–2.08 mm)	One large orange oil globule, 0.50–0.80 mm; chorion usually ornamented with raised patterns (hexagons).
Microstoma sp. (2.00–2.40 mm)	Pustules on inner surface of chorion; segmented yolk; one large oil globule, 0.49–0.82 mm; pigment on yolk and along ventral surface of trunk above gut, extending onto head and tail region.
Microstomus pacificus (2.05–2.68 mm)	Smooth chorion; pigment on ventral surface of yolk in later stages, late–stage embryo has moderately large pigment spots in a row laterally on tail and pigment on caudal finfold.
*Trachipterus altiv*elis (2.60–3.50 mm)	Chorion smooth and thick, appears pink or red; precocious development of elongate anterior dorsal and pelvic-fin rays with terminal pigmented swellings

Chauliodus macouni (2.69–3.17 mm)	Smooth chorion; segmented yolk; large perivitelline space; long gut length, 87% NL.
Icosteus aenigmaticus (2.69–3.28 mm)	Chorion sometimes rose-tinted; one oil globule, 0.42–0.60 mm, decreasing in size with development; pigment on head, dorsal body, caudal finfold, and oil globule; opposing patches of pigment on dorsal and anal finfolds.
Embassichthys bathybius (2.70–3.10 mm)	Early to early-late-stage egg is similar to *Microstomus*, but is larger and pigment on embryo is finer; late-stage embryo has 3 postanal bands and pigment on caudal finfold.
Hippoglossoides elassodon (2.75–3.75 mm)	Very thin chorion (easily broken); large perivitelline space; embryo covered with small closely-spaced melanophores that later migrate to four postanal bands; pigment on the dorsal, anal, and caudal finfolds.
Hippoglossus stenolepis (2.90–3.80 mm)	Large size; embryo and yolk unpigmented. Late-stage embryo has 49–51 myomeres.
Reinhardtius hippoglossoides (3.50–4.50 mm)	Large size; chorion may be tinted red; embryo and yolk unpigmented. Late-stage embryo has 60–65 myomeres.

Table 15

Frequency of occurrence (FO) of eggs collected by bongo and neuston gear in the Gulf of Alaska and Bering Sea and off the U.S. west coast. Bolded taxa listed under the west coast heading are not collected farther north.

Gulf of Alaska and Bering Sea		West Coast (WA, OR, CA)	
Taxon	% FO	Taxon	% FO
Gadus chalcogrammus	46.08	*Trachipterus altivelis*	34.18
Hippoglossoides elassodon	34.93	*Icichthys lockingtoni*	24.10
Glyptocephalus zachirus	13.13	Paralichthyidae	17.44
Microstomus pacificus	11.00	Bathylagidae	14.72
Pleuronectes quadrituberculatus	6.98	*Chauliodus macouni*	14.55
Limanda spp.	3.35	*Microstomus pacificus*	13.80
Platichthys stellatus	2.34	*Lyopsetta exilis*	13.15
Hippoglossoides spp.	2.26	*Glyptocephalus zachirus*	11.35
Leuroglossus schmidti	2.08	*Icosteus aenigmaticus*	10.87
Macrouridae	1.86	Pleuronectidae	10.65
Embassichthys bathybius	1.69	*Bathylagus* spp.	9.47
Parophrys vetulus	0.86	*Citharichthys* spp.	7.49
Boreogadus saida	0.83	*Psettichthys melanostictus*	4.29
Limanda aspera	0.80	***Bathylagus ochotensis***	**3.64**
Isopsetta isolepis	0.70	*Parophrys vetulus*	3.29
Atheresthes stomias	0.40	***Engraulis mordax***	**2.28**
Hippoglossus stenolepis	0.37	*Tactostoma macropus*	2.23
Icosteus aenigmaticus	0.32	*Pleuronichthys decurrens*	2.02
Sebastolobus spp.	0.27	*Isopsetta isolepis*	1.80
Anoplopoma fimbria	0.25	*Merluccius productus*	1.58
Gadus macrocephalus	0.18	*Nansenia candida*	1.23
Psettichthys melanostictus	0.17	*Platichthys stellatus*	1.18
Reinhardtius hippoglossoides	0.16	*Sebastolobus* spp.	1.10
Hippoglossoides robustus	0.12	*Embassichthys bathybius*	0.92
Lyopsetta exilis	0.12	*Cololabis saira*	0.92
Bathylagus pacificus	0.10	Argentinidae	0.79
Bathylagidae	0.08	***Tetragonurus cuvieri***	**0.74**
Trachipterus altivelis	0.05	*Gadus chalcogrammus*	0.48
Chauliodus macouni	0.03	***Nansenia crassa***	**0.48**
Icichthys lockingtoni	0.03	Macrouridae	0.39
Clupea pallasi	0.03	*Pleuronichthys coenosus*	0.39
Nansenia candida	0.01	*Hippoglossus stenolepis*	0.35
Tactostoma macropus	0.01	*Hippoglossoides elassodon*	0.35
Cololabis saira	0.01	*Bathylagus pacificus*	0.35
Merluccius productus	0.01	Trachipteridae	0.31
Trachipteridae	0.01	*Anoplopoma fimbria*	0.18
Clupeidae	0.01	***Microstoma* sp.**	**0.18**
Scomberesocidae	0.01	***Trachurus symmetricus***	**0.13**
Bathylagus spp.	0.01	***Pleuronichthys verticalis***	**0.04**
Citharichthys spp.	0.01	***Argentina sialis***	**0.04**
Pleuronichthys decurrens	0.01	**Gonostomatidae**	**0.04**
Pleuronichthys coenosus	0.01	***Bathylagus wesethi***	**0.04**

Table 16

Definitions of symbols used for designating photophore groups in stomiiform fishes (Moser, 1996).

Deep-bodied sternoptychids		Other stomiiforms	
Code	Definition	Code	Definition
SO	Subopercle photophore which is equivalent to posteriormost photophore in opercular series of gonostomatids.	SO	Symphyseal photophores (organs) located at tip of lower jaw.
PO	Photophore located anterior (pre) to orbit.	Orb	Photophores associated with the eye located anterior and posterior of orbit.
PTO	Photophore located posterior to orbit, may be equivalent to upper photophore of opercular series of gonostomatids.	Op	Photophores of opercle series, generally three coded as follows: 1/(1+1).
PRO	Preopercular photophore.	Br(BRP)	Photophores located on the branchiostegal membranes.
Br	Same as gonostomatid definition.	Is (I)	Photophores located on the isthmus.
Is	Same as gonostomatid definition.	IP	Photophores of the ventral series found from the isthmus to the base of the pectoral fin.
AB	Photophores of ventral series located abdominally between pectoral fin base and pelvic fin base and equivalent to PV in gonostomatids, plus a few posterior photophores of the IP series.	PV	Photophores of the ventral series found from the pectoral fin base to the pelvic (ventral) fin base.
PAN	Photophores found anterior (pre) to anal fin may be equivalent to VAV or VA in gonostomatids.	VAV	Photophores of the ventral series found from the pelvic (ventral) fin base to the anal fin base.
AN	Photophores found above anal fin.	AC	Photophores of the ventral series found from the anal fin base to caudal fin base.

Table 16

Definitions of symbols used for designating photophore groups in stomiiform fishes (Moser, 1996).

Deep-bodied sternoptychids		Other stomiiforms	
Code	Definition	Code	Definition
SC	Photophores found on lower (sub) caudal peduncle. Together with AN group may be equivalent to AC in gonostomatids.	IC	Summary of photophores of the ventral series from isthmus to caudal fin base (IP+PV+VAV+AC).
SAB	Photophores located above (supra) to the abdominal series and may be equivalent to VAL in gonostomatids (SAB lacking in Sternoptyx).	IV	Summary of photophores of the ventral series from isthmus to pelvic (ventral) fin base (IP+PV).
SP	Photophores located above (supra) the pectoral fin and may be equivalent to OV in gonostomatids.	OV	Photophores of the lateral series from the opercle to pelvic (ventral) fin base.
		VAL (VALA)	Photophores of the lateral series from the pelvic (ventral) fin base to the anal fin base.
		OA (OAA, OAB)	Summary of lateral photophores from the opercle to anal fin base (OV+VA).
		OAC (OC)	Entire lateral series on body just dorsal to ventral series and extending from opercular border, or just medial to it, over anal fin to caudal fin base.
		ODM	Photophores (organs) found dorsal to the lateral midline (found only in Gonostoma gracile).

Table 17

Collection data for original illustrations by Recuitment Processes Program at Alaska Fisheries Science Center.

Taxon	SL (mm)	Cruise	Station number[1]	Gear[2]	Date	Location or N°	W°
Clupea pallasi	28.0			Dip net	8-May-93	47.56	123.00
Clupea pallasi	35.0			Beach Seine	22-Jun-93	47.57	122.55
Clupea pallasi	egg	1TT11	94	Neuston	13-May-11	59.39	140.83
Bathylagus pacificus	egg	1MF08	45 H2 N2	MOCNESS	25-Feb-08	54.52	167.22
Tactostoma macropus	13.2/14.0 composite	IP080	G011A	6B5	3-Aug-80	47.31	125.22
Tarletonbeania crenularis	4.6/4.9 composite	1MF01	6	6B5	30-Jan-01	57.14	151.08
Gadus macrocephalus	22.0	5MF91	C0012A	Methot	24-Jul-91	55.30	160.20
Theragra chalcogramma	egg	1AK10	7	60Bon	13-Jun-10	55.98	162.88
Sebastolobus spp.	egg	1NW11	113	Neuston	11-Jul-11	57.20	136.60
Dasycottus setiger	17.0	3MF79	57	6B5	1-Jun-79	56.18	170.50
Hemilepidotus jordani	15.5	2MF92	G013A	6B3	17-Apr-92	53.98	168.65
Nautichthys pribilovius	23.0	ODO710	OD44	Bottom Trawl	14-Sep-07	64.81	167.44
Bathyagonus nigripinnis	21.0	1OM01	23	MBT	24-Jul-01	56.01	169.04
Nectoliparis pelagicus	10.4	3MF89	G044A	6B3	12-May-89	57.11	155.56
Nectoliparis pelagicus	12.5	2MF86	G071A	6B3	7-May-86	56.86	155.94
Icosteus aenigmaticus	7.5	2NW10	62 N2	60Bon	20-Jul-20	56.63	135.98
Limanda aspera	16.2	3MF08	12	60Bon	13-Sep-08	58.16	160.57
Parophrys vetulus	17.7	SF7702	ST B-2			48.25	123.42
Parophrys vetulus	egg	4MF06	111	60Bon	28-May-06	56.78	155.01
Platichthys stellatus	egg	3MF06	90 H2	60Bon	18-May-06	56.60	160.00
Pleuronectes quadrituberculatus	egg	1TT10	35 N3	MOCNESS	25-Jun-10	57.44	169.82
Pleuronectes quadrituberculatus	4.6	1AR07	6	60Bon	15-Jun-07	58.19	162.13
Pleuronectes quadrituberculatus	5.7	1AR07	7	60Bon	16-Jun-07	56.70	162.21
Pleuronectes quadrituberculatus	9.9	4MF88	G152A	1T5	6-Jun-88	55.87	156.55
Pleuronectes quadrituberculatus	10.1	10M07	17	MBT	29-Jul-07	59.00	166.01
Psettichthys melanostictus	egg	3DY10	70	60Bon	26-May-10	56.89	156.08

[1]Station number: H = haul, N = net

[2] Gear: 6B5 = 60-cm bongo net, 0.505-mm mesh; 6B3 = 60-cm bongo net, 0.333-mm mesh; MBT = Methot Beam Trawl; 1T5 = 1-m Tucker trawl, 0.505-mm mesh.

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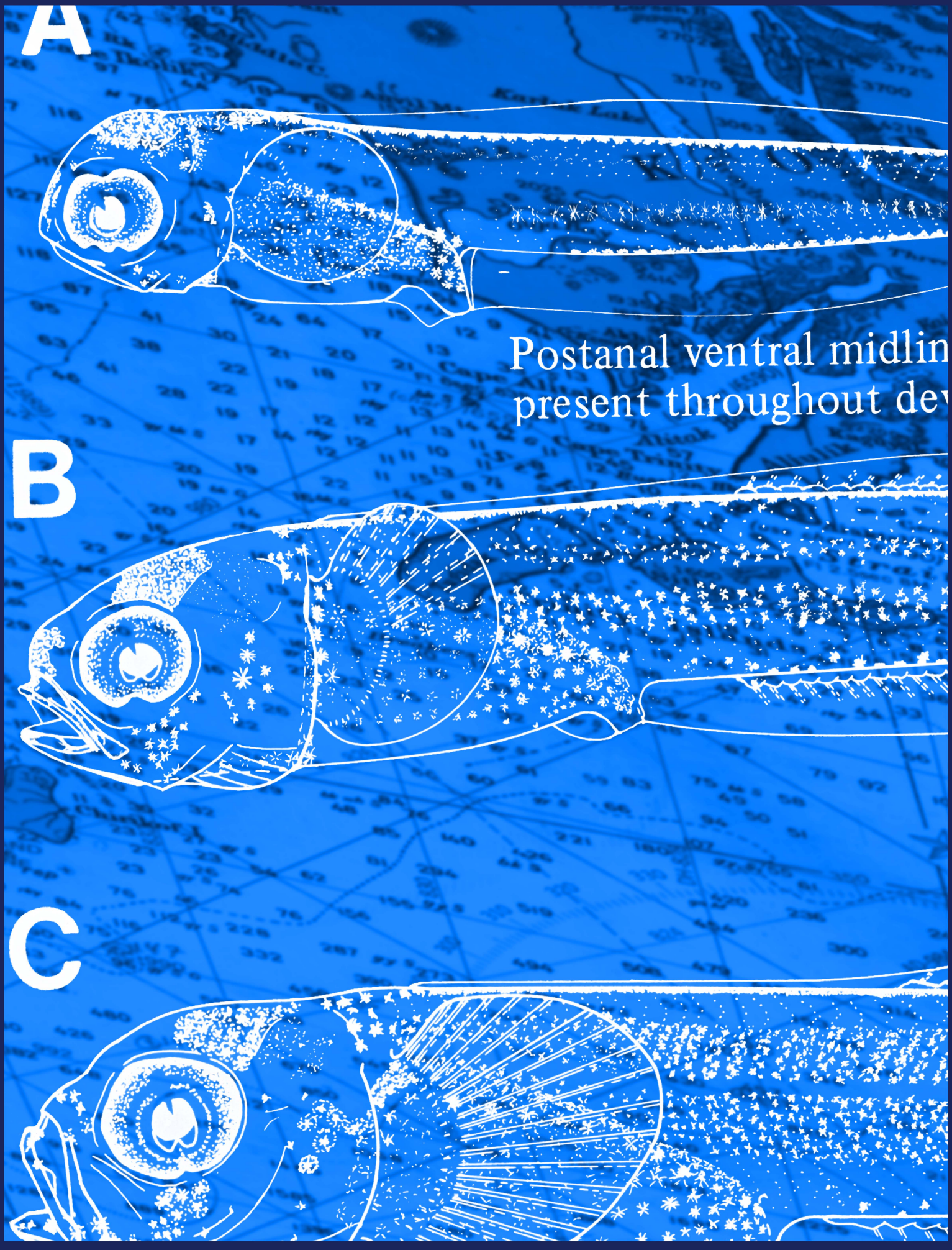
A
Postanal ventral midlin
present throughout dev
B
C

Citations

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