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PUGET SOUND BASELINE PROGRAM:

NEARSHORE FISH SURVEY

by

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INTRODUCTION

Since July 1974, the Fisheries Research Institute's (FRI) Nearshore Fish Survey project has conducted an ecological survey of the nearshore* fishes of north Puget Sound. The primary objective of this project was to document the seasonal occurrence, abundance, and distribution of the marine and estuarine fishes frequenting the waters adjacent to the shoreline. The survey was supported by the Washington State Department of Ecology (DOE) under the auspices of its Baseline Study Program, a comprehensive scientific and management research program designed to evaluate the biological and economic risk of oil and other pollution in northern Puget Sound. Emphasis was placed upon biota of the nearshore (less than 20 m depth) environs because pollutant effects, especially those induced during oil spills, have been found to be most pronounced there. Reliable measures of the composition, distribution, and abundance of nearshore fishes permit both (1) evaluations of the economic and ecologic importance of these regions and their associated fish fauna, and (2) assembly of a data base (i.e., "pre-pollution") for future reference against similarly documented samples after a pollution incident.

Fish data were collected monthly in representative intertidal and shallow subtidal habitats using beach seines and SCUBA transect observations. Quarterly trammel net sampling also supplemented the SCUBA observations. In addition, periodic surface tow net sampling was conducted adjacent to the sampling sites about San Juan Island and sites established by Western Washington State College along the eastern margin of the north Sound.

This report discusses the characteristics of the type-habitats sampled, the sampling techniques utilized, and the results of the 1974-1975 collections and observations. Discussion of these results will include description of the characteristic fish assemblages found in each of the type-habitats, the variations inherent in the sampling and due to seasonal changes in the assemblages, and a preliminary examination of the trophic relationships between certain important members of these assemblages and the habitats they characterize.

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*"Nearshore" as used hereinafter refers to the littoral and inner sublittoral (bottom) and neritic (surface) waters inshore of the 20m depth level (see Hedgpeth, 1963).

METHODS AND MATERIALS

Study Habitats and Sites

In accordance with DOE Baseline Study guidelines, five representative habitat types were chosen as characteristic of the physically and biologically diverse shoreline environments in the region of concern, north Puget Sound from the U.S.-Canada border to the southern end of Rosario Strait. These included: (1) High gradient, exposed rocky shoreline with adjacent subtidal kelp (*Nereocystis*) beds; (2) high to moderate gradient, exposed beaches with substratum of large gravel to cobble; (3) moderate gradient, protected gravel beaches; (4) low gradient, protected sand beaches with eelgrass (*Zostera*) beds; and (5) low gradient, protected mud flats with accompanying eelgrass beds.

Study sites typifying each of these habitats were chosen within each of two "experimental regions" subject to existing chronic pollution or potentially subject to acute oil pollution on the eastern margin of the north Sound, and the "control region" on the west margin of the San Juan archipelago (Fig. 1).

The rocky/kelp bed habitat surveyed in this study was characterized by relatively steep contours, at times approaching vertical, with kelp growing at depths of 2.0 to 7.5 m. All areas were swept by strong tidal currents. The bottom was composed of scattered rock boulders or solid rock ledges with soft bottom sediments seldom occurring in any of the areas surveyed. The cobble habitat possessed high gradient beaches but typically sloped out into a low gradient slope subtidally. Because of the exposure to wave action at this habitat, the beach profile tended to change, especially at the extremely exposed South Beach, San Juan Island, site. During periods of inclement weather, this habitat was characterized by the greatest turbulence in the nearshore region. The gravel habitats selected were all moderate gradient beaches of gravel over or in a stable beach substratum. These sites were protected enough that the beach substrate did not usually change greatly with wave action. The beach profile often sloped gradually to a drop-off in the inner subtidal zone. Often the adjacent subtidal habitat was not composed of gravel and on occasion a gradation into sand occurred. Both sand/eelgrass and mud/eelgrass habitats were shallow beaches found in protected areas, the latter usually found in highly protected embayments; in these habitats, a large area of the intertidal is exposed during low tide periods because of the gradual-sloping beach. Eelgrass beds occurred from scattered bunches to a dense mat throughout the intertidal area.

Responsibilities of the Nearshore Fish Survey project included the sampling of nearshore fish at (1) all rocky/kelp bed study sites, (2) intertidal and shallow subtidal zones of the "control region" sites around San Juan Island, and (3) surface waters adjacent to all study sites (Table 1). Sampling frequency was maintained throughout the year except for a few instances in the winter months when one or two sites were bypassed because of inclement weather.

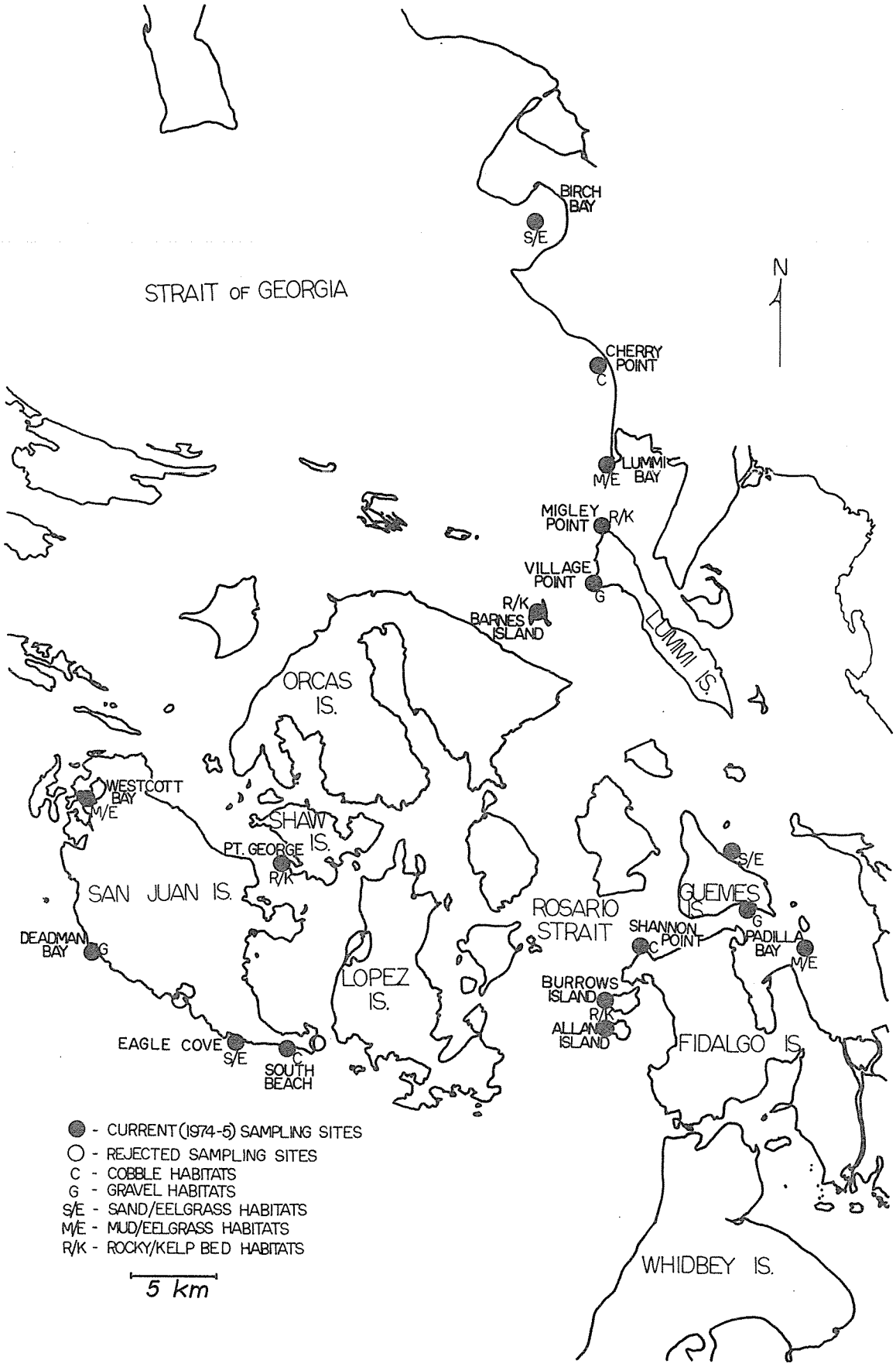

Fig. 1. North Puget Sound sampling sites during Nearshore Fish Survey, July 1974 - June 1975.

Table 1. Nearshore Fish Survey study sites, habitats, and sampling method and frequency.

Habitat	Study Site	Sampling Method	Frequency
Rocky with kelp bed, exposed	Pt. George, Shaw Island	SCUBA transect	Monthly
		Tow net	Monthly (spring & summer) Bimonthly (fall & winter)
	Collins Cove, San Juan Island	Trammel net	Quarterly
	Migley Point, Lummi Island	Tow net	Monthly (spring & summer) Bimonthly (fall & winter)
		Trammel net	Quarterly
	Barnes Island	SCUBA transect	Quarterly
	Burrows Island	Tow net	Monthly (spring & summer) Bimonthly (fall & winter)
	Allan Island	SCUBA transect	Monthly
Cobble, exposed	South Beach, San Juan Island	Beach seine	Monthly
		Tow net	Monthly (spring & summer) Bimonthly (fall & winter)
	Cherry Point	Tow net	Monthly (spring & summer) Bimonthly (fall & winter)
	Shannon Point, Fidalgo Island	Tow net	Monthly (spring & summer) Bimonthly (fall & winter)
Gravel, protected	Deadman Bay, San Juan Island	Beach seine	Monthly
		Tow net	Monthly (spring & summer) Bimonthly (fall & winter)
	Village Point, Lummi Island	Tow net	Monthly (spring & summer) Bimonthly (fall & winter)
	Guemes Island, south side	Tow net	Monthly (spring & summer) Bimonthly (fall & winter)
Sand with eelgrass, protected	Eagle Cove, San Juan Island	Beach seine	Monthly
		Tow net	Monthly (spring & summer) Bimonthly (fall & winter)
	Birch Bay	Tow net	Monthly (spring & summer) Bimonthly (fall & winter)

Table 1, cont'd

Habitat	Study Site	Sampling Method	Frequency
	Guemes Island, east side	Tow net	Monthly (spring & summer) Bimonthly (fall & winter)
Mud with eelgrass, protected	Westcott Bay, San Juan Island	Beach seine Tow net	Monthly (spring & summer) Bimonthly (fall & winter)
	Lummi Bay	Tow net	Monthly (spring & summer) Bimonthly (fall & winter)
	Padilla Bay	Tow net	Monthly (spring & summer) Bimonthly (fall & winter)

As one might expect, such generalized habitat designations are difficult to meet precisely when it comes to selecting sites which conform to our simple definitions and which also meet sampling design criteria at the same time. Accordingly, many sites did not precisely meet these requirements. For example, Deadman Bay has some sand with eelgrass in portions of the nearshore subtidal with rocky/kelp outcroppings closely adjacent; and the South Beach site does not have the larger cobble size characteristic of Cherry Point and other such cobble sites on the southeastern end of the Strait of Georgia characterizing Western Washington State College's study regions.

Sampling Techniques

Beach Seine. Two 37-m (120-ft) beach seine nets equipped with 18-m (59-ft) long, 3-mm (1-1/8-inch) mesh wings, and a 0.6-m x 2.4-m x 2.3-m bag of 6-mm (1/4-inch) mesh, were utilized to sample fishes in the nearshore waters of the cobble, gravel, sand/eelgrass, and mud/eelgrass type-habitat study sites on San Juan Island (Appendix 1a). One net was buoyant and swept the surface water layer over the nearshore region; the other, a sinking net, sampled the bottom area. The nets were set 30 m out from the beach from the stern of a rowed boat and retrieved to the beach at approximately 10 m/min. The lines attached to the poles at the end of each wing were initially hauled from positions 40 m apart until 20 m of line had been retrieved; the net was then closed down to a 12-m opening and the net retrieval completed. A conscious effort was made during the retrieval to keep the leadline portion of the wings in contact with the bottom at all times. Once the net was completely retrieved upon the beach, the collected fish were "worked" from the wings into the bunt or bag section of the net and the catch collected, labelled, and bagged for later processing.

In the sand/eelgrass and mud/eelgrass habitats, only the sinking net was utilized because in these shallow areas the cork line (top margin of net) did not sink below the water's surface. Both net samples were obtained in two replicate hauls during the lowest slack ebb tide period of each month. This involved nighttime samples from September to March. Typically, in the deeper water habitats, the first floating seine sample was made just before ebb slack, the two sinking seine replicates at the time of slack tide, and then the second replicate floating seine sample was obtained as the flood tide began. Usually, except in cases of low catches, at least 30 minutes elapsed between consecutive samples. At sites with sufficient beach area, the duplicate hauls were not fished over the same area but were staggered so that true replicate samples were obtained.

Tow Net. A tow net is a large net towed at relatively high speed along the surface of the water. In the Nearshore Fish Survey, a 3-m x 6-m (10x20-ft) tow net, with mesh sizes grading from 76 mm (3 inches) at the opening to 6 mm (1/4 inch) at the bag (Appendix 1b), was towed at

approximately 4 km/hr (2 knots) between the 12-m (38-ft) FRI vessel R.V. MALKA and a purse-seine skiff. Two ten-minute tows were made at each site. The first tow was made in one direction along the shoreline, the second tow along the same transect line in the opposite direction.

Sampling was conducted at night to minimize net avoidance by highly mobile pelagic species, and to optimize sampling of those species which undergo nocturnal migration into nearshore surface waters from deeper or offshore waters. An attempt was made to schedule tow net trips during periods of minimal tidal currents in order to avoid excessive current effects upon the net efficiency and resulting catch. The net was towed as close to the shoreline as depth permitted; the net dragged bottom in less than approximately 5 m (15 ft) of water. The towing system was quite manoeuvrable and the net was worked along the shoreline contours and kelp beds with relative ease.

Catches from each tow were bagged and labelled for later processing.

SCUBA Transect Observations. Quantitative observations were made in rocky/kelp bed habitats by SCUBA-equipped divers swimming along zigzag transects. Two divers swam across shoreline depth contours at approximately a 45-degree angle to a depth of 15 m (Fig. 2), turned 90 degrees, and swam back up to the shoreline, then repeated until about 250 m were surveyed. The width of the path was determined by the visibility which was measured with a standardized white board at 7.6 m depth at the initiation of each transect dive. The effective visibility is defined here as being one-half of the total visibility.

The Allan Island and Pt. George sites were surveyed monthly from June 1974 to March 1975 and seasonally thereafter. At both of these stations, two dives were made, each on a different section of shoreline, to measure variation within a site. The Barnes Island transect site was surveyed with one dive quarterly. It was necessary to make all dives on slack tides because of strong tidal currents in all study areas.

Two techniques were used for determining the exact distance of the transects (usually about 250 m)--permanent and temporary. Permanent transects were placed at Allan Island and Pt. George. Initially, these were 6-mm diameter yellow polypropylene lines anchored with rock-climbing pitons; these were later changed to stainless steel cable when it was found that currents pulled the buoyant polypropylene line loose. Before placing the permanent transects, and also for all dives at Barnes Island, temporary transects were used in which compass courses were followed. At the end of each transect leg an anchored marker was released for later surface measurement of the actual transect distance.

Trammel Net. A trammel net is a vertically-oriented set net with a loosely-hung small mesh net panel hung between two tightly-hung large mesh panels. Fish encountering the net along the bottom continue through the large mesh panel, forming a bag in the smaller mesh netting.

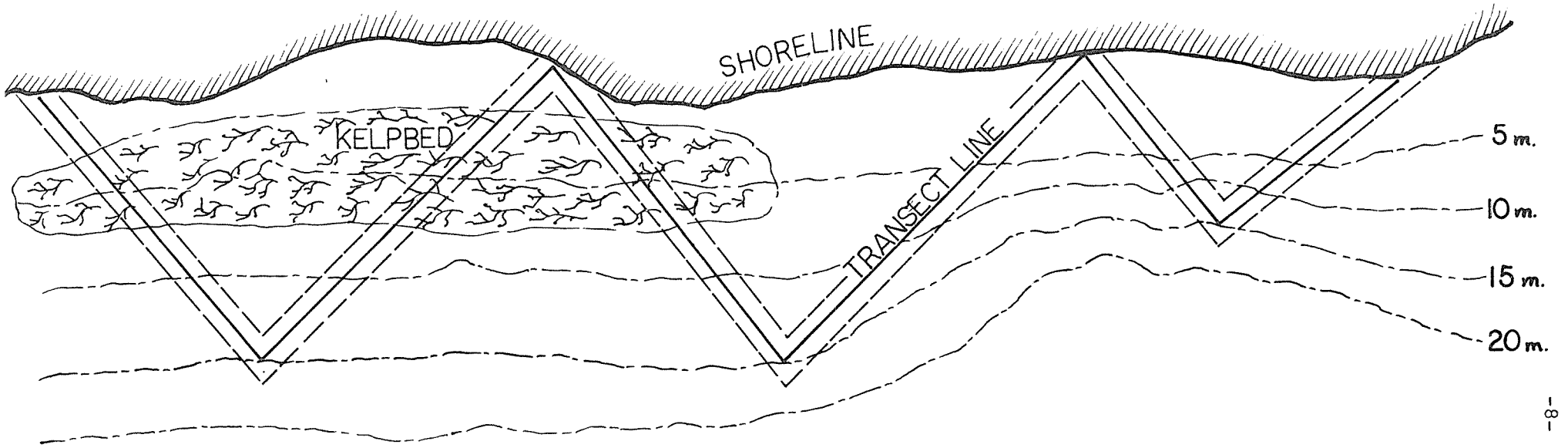

Fig. 2. Diagrammatic sketch of diving transects in rocky/kelp bed habitats. Width of transect determined by visibility of the water (not to scale).

The trammel net utilized during the Nearshore Fish Survey is a 45.7m x 1.8m (150x6-ft) net with two 51-cm (20-inch) large mesh panels and a 5-cm (2-inch) panel.

Two trammel nets are set parallel to each other and perpendicular to rocky/kelp bed habitats from dusk until daylight and the fish are removed for later processing.

Collection Information

For all modes of sampling, the location, date, time, tide, weather, and oceanographic and other pertinent environmental information are recorded at the time of sampling at each site, and the sampling area or volume is computed. Water depth was determined by direct measurement in the shallow areas and by echosounder in deeper areas. Sampling area for the beach seine is determined by the distance the net is set from shore multiplied by the length of the net. Tow net sampling volume is computed by the boat speed multiplied by the area of the net opening.

Water samples are obtained for salinity and dissolved oxygen determination by either (1) laboratory chemical analyses (potentiometric method and Winkler titration, respectively), or (2) in situ instrument readings (using a Beckman salinity-temperature probe and a YSI-dissolved oxygen meter).

All information is initially recorded on computer-format forms (Appendix 2a).*

The catch obtained from each sample is bagged and labelled in its entirety for later processing. If the catch is excessively large, it is subsampled and the numbers and total catch weight estimated from this subsample. This applies to an excessively large catch of one species as well as the total diverse catch. The bagged samples are refrigerated until processing can take place, usually from 1/2 hour to 8 hours later, depending upon the sampling method and the eventual use of the specimens--e.g., specimens for stomach analyses are processed as soon as practical.

Biological Information

Each procured fish sample is sorted according to species, enumerated, measured, and weighed. A count or estimate of the total number and biomass is made for each species as well as individual length (total length) and weight (to nearest 0.1 g) measurements, sex and age determinations, stomach contents and evidence of external disease, parasites, or other external abnormalities for selected subsamples of economically or ecologically important species (all those designated on DOE's list of economically important species). All catch and individual specimen data are recorded initially on computer-format forms for ease of analysis (Appendices 2b and 2c). The source utilized for identification of nearshore fishes was Hart (1973).

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*All coding forms and instructions used during this study are available from FRI upon request.

Subsampling

Our sampling methods are designed to avoid subsampling, but there were occasions when catches were too excessive to physically handle within the available time. In those cases the catch was mixed to a homogeneous state and successive scoops (using a scale or balance pan or similar container) were removed, every tenth scoop being retained to make a combined subsample of approximately ten per cent of the total. The total catch was then estimated from the subsample proportion of each species, each life history stage count, and weights. When an excessively large catch of one species is subsampled, a minimum of 50 (25 from each haul) of each life history stage is taken in a random manner. Any three data of (1) total count, (2) total weight, (3) subsample count, and (4) subsample weight allowed the estimation of the total number and biomass.

Stomach Analyses

Intact stomach samples were removed from selected samples of economically and ecologically important fishes obtained during the course of Nearshore Fish Survey sampling. These were preserved in 10% buffered Formalin and returned to FRI's Seattle laboratory for analysis.

A systematic, standardized procedure was developed for the examination and documentation of the stomach contents. The source of the stomach sample was identified by the collection number, date of collection, and specimen number designated at the time of stomach removal. Total contents weight (to nearest 0.1 g) was derived by subtraction of the empty stomach weight from the weight of the intact, full stomach. Subjective numerical evaluations of the stomach condition or degree of fullness (scaled from 1 to 7) and stage of digestion (scaled from 1 to 5) were made at this time. The contents of the stomach were then removed and sorted according to broad taxa and the sorted organisms counted and a total weight (to nearest 0.1 g unless less than 0.5 g and then to nearest 0.01 g) obtained. After final sorting, the organisms were counted. The groups were then further examined and sorted to the lowest identifiable taxa; at this stage, an attempt was made to identify organisms to species, genus, or family if at all possible. All data were initially recorded on computer-format forms (Appendices 2d and 2e) for statistical summarization using a computer program presently being assembled. Accordingly, all prey organisms and taxa possess an established numeric code allowing the digital storage, filing, retrieval, and analysis of prey organisms according to any phylogenetic level desired.

Sources of Sampling Error

The selection of any specific sampling techniques and/or design is accompanied by biases in the performance of the gear or the manner and pattern of its utilization which must be assumed to influence the collected data. This was especially true for certain aspects of the Nearshore Fish Survey program where a variety of sampling tools is intended to assemble similar, comparable information. Each possessed

a certain degree of selectivity for and against certain types of fish; and by our selected pattern of sampling we have often selected for and against dissimilar groups of fishes. Our interpretations of the collected data must be accompanied by these basic assumptions of selectivity.

Characteristics of the sampling gear which influenced its selectivity included shape, mesh size, type of net material, and fishing configuration. Fish characteristics included the organism's shape, size, swimming behavior, and ability to perceive and avoid the gear. Selectivity was also an inherent aspect of sampling time and duration, since tidal stage, diel period, and sun (or moon) light intensity are known to influence fish availability and catchability. And such variable environmental conditions as turbidity of water, bottom conditions, bioluminescence, and intensity and direction of current influenced effectiveness of the sampling techniques. Although these are discussed specifically further in the report, it is worth while to describe some of the important biases in our chosen methods.

The fine-mesh bag of the tow net and beach seines sampled larval and post-larval fish which passed through the larger mesh wings of these nets. Thus, the collection of these pre-juvenile or small juvenile fishes cannot be considered as quantitatively precise as with the larger fish.

The efficiency of the sinking beach seine decreased as the irregularities of the bottom increased; the net swept the sand habitat extremely efficiently as compared to over the more irregular cobble habitat. Dense beds of eelgrass could not be sampled with the beach seine owing to this net's tendency to roll up when set directly upon this vegetation. Thus, any fish exclusively associated with dense eelgrass vegetation were not well represented in our survey.

The speed of hauling the beach seines was not fast enough to capture rapidly swimming fishes if they encountered the outer margins of the net; nor could fish which rapidly surface upon contact with the net's wings be captured as effectively as those slower-moving demersal or benthic fishes. The tow net, however, as long as it did not encounter excessive current speeds, was moving fast enough to capture some rapid-swimming fishes as long as they did not encounter the wings of the net long before they progressed into the net mouth.

The set (trammel) net captured only active nocturnal fishes which were not too large to pass through the large-mesh panel and not too small to pass through the center small-mesh panel. Of these fish, the net also selected those which have spines and fins prone to being entangled in the webbing.

SCUBA transect surveys had the advantage of placing the sampling scientist directly in the fishes' environment. But the divers were more likely to see larger, especially schooling, species which were active within the field of observation. Small, sedentary, cryptic or

hidden fishes, on the other hand, had a greater possibility of not being observed. The diver himself, because of his breathing apparatus, may have been an element of attraction or repulsion to certain types of fishes.

Although detectable in the data, it should also be noted here that severe weather conditions in the nearshore waters could have influenced both the effectiveness of the sampling equipment and the occurrence and behavior of the fish assemblage being sampled. A more obvious effect of the sampling design was that all beach seining occurred during each month's maximum low tide series. During October through February, sampling took place at night. Thus, comparison with the diurnal samples the rest of the year must take into consideration the potential diel differences in fish distribution and occurrence as documented by this data series.

The stomach contents analyses and interpretation of those results also contained inherent biases. While most specimens were obtained from active sampling, the stomach contents of those originating from passive sampling methods such as trammel netting were prone to have differential stages of digestion because the fish were captured over an eight to ten hour period when the net was fishing. Certain sampling methods as well as certain species were also responsible for differing degrees of regurgitation. Specimens showing any obvious regurgitation, however, were not utilized for stomach analysis. In correlating the diet of fish with the habitat of origin, there were several basic assumptions which should also be considered: That the fish consumed the analyzed ration within that habitat, and that its prey were not imported into the habitat. These assumptions are probably valid for those sedentary, dominant species characterizing each habitat, but less valid for the more transitory, ubiquitous species. And one of the most important aspects of these analyses, the sample size, was certainly not sufficient (< 10) to represent valid interpretations of a fish's overall diet. Again, the species' characteristic feeding behavior is an important consideration in that an insufficient sample size from opportunistic feeders would be more likely to produce error than from specialized feeding fishes.

RESULTS

Environmental Conditions at Sampling Sites

Nearshore Intertidal Measurement. Surface water (0-1 m) temperatures measured in the San Juan Island vicinity sites varied over a maximum range of 10.5° C with a high of 14.8° C measured in July and a low of 4.3° C in January (Fig. 3a). The mud/eelgrass habitat exhibited the maximum range and temperature extremes, the sand/eelgrass habitat the second broadest range, and the remaining habitats generally a similar 6°C fluctuation. All type-habitat sites showed the same general trend, with a gradual decline in surface temperatures from mid-summer to January and then a rapid increase through April.

a. Temperature

b. Salinity

c. Dissolved oxygen

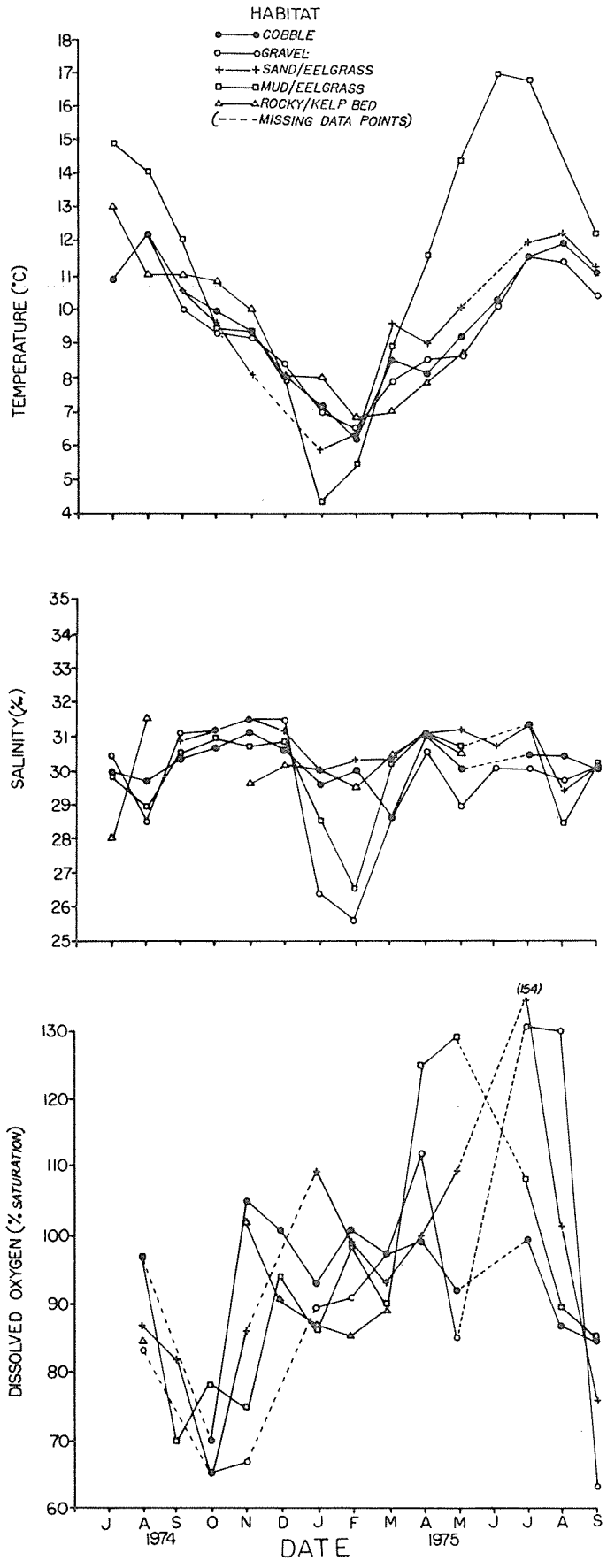


Fig. 3. Physiochemical characteristics of nearshore surface water at San Juan Island vicinity sampling sites.

Salinities fluctuated around an average of 29.9°/₀₀ with a high value of 31.5°/₀₀ recorded in November and December and a low in February of 25.6°/₀₀. All habitats showed similar trends, increasing from a fluctuating summer period to a less variable high salinity period in mid-winter, and declining from December with increasing fluctuations in the spring (Fig. 3b). There were no definitive differences detectable between the five habitats.

Dissolved oxygen values as measured at the San Juan Island vicinity sites indicated generally well saturated waters ranging from a peak of 129% saturation in May to a low value of 65% in October (Fig. 3c). While the variation in surface dissolved oxygen values among habitats was significant during some months, a definite trend was evident, indicating a fall depression and winter (January-February) optimum. The fall depression is apparently a function of upwelling of low-dissolved-oxygen coastal water via the Strait of Juan de Fuca (Collias and Barnes, 1966; Univ. Wn. Dept. Ocean, 1954). Such trends, however, should only be examined bearing in mind that gas solubility is inversely related to temperature and that the saturation level to which these values are compared is both temperature- and salinity-dependent.

Nearshore Surface Water Measurements. Temperature and salinity information obtained during tow net sampling, although not obtained monthly, allows us to examine physical differences among the 15 sites, five habitats, or three sampling areas. The dissolved oxygen measurements were not complete enough to formulate a seasonal continuum. These data are, however, included in the raw data tabulation in Appendix 3.

The San Juan Island sampling area represented a comparatively less variable surface water environment than the two areas on the eastern border of the north Sound (Figs. 4 and 5, Table 2). This area showed lower and less variable temperature and higher and less variable salinity values, presumably indicating the extent of mixing with oceanic water from the Strait of Juan de Fuca and proximity to coastal freshwater runoff. In fact, while the Cherry Point and Anacortes areas indicated an unusual decline in salinity in the December sampling, this was not evident in the San Juan Island area. Similar temperatures were, however, evident at this time throughout the north Sound sampling sites.

While trends do not appear to be significant, there were indications that the shallow, low gradient habitats undergo more severe physiochemical variation and fluctuation than the deeper, higher gradient habitats.

Subtidal Measurements. Water samples obtained at an average depth of 7.6 m in the course of the SCUBA transect observations provided a relative index of the temperature, salinity, and dissolved oxygen regimes characteristic of the nearshore subtidal waters along exposed rocky/kelp bed type-habitats in north Puget Sound. The rocky/kelp bed habitat exhibits a seasonal temperature regime similar to the surface waters with perhaps a slightly lower minimum (Fig. 6). Salinity and dissolved oxygen regimes showed trends generally similar to corresponding surface

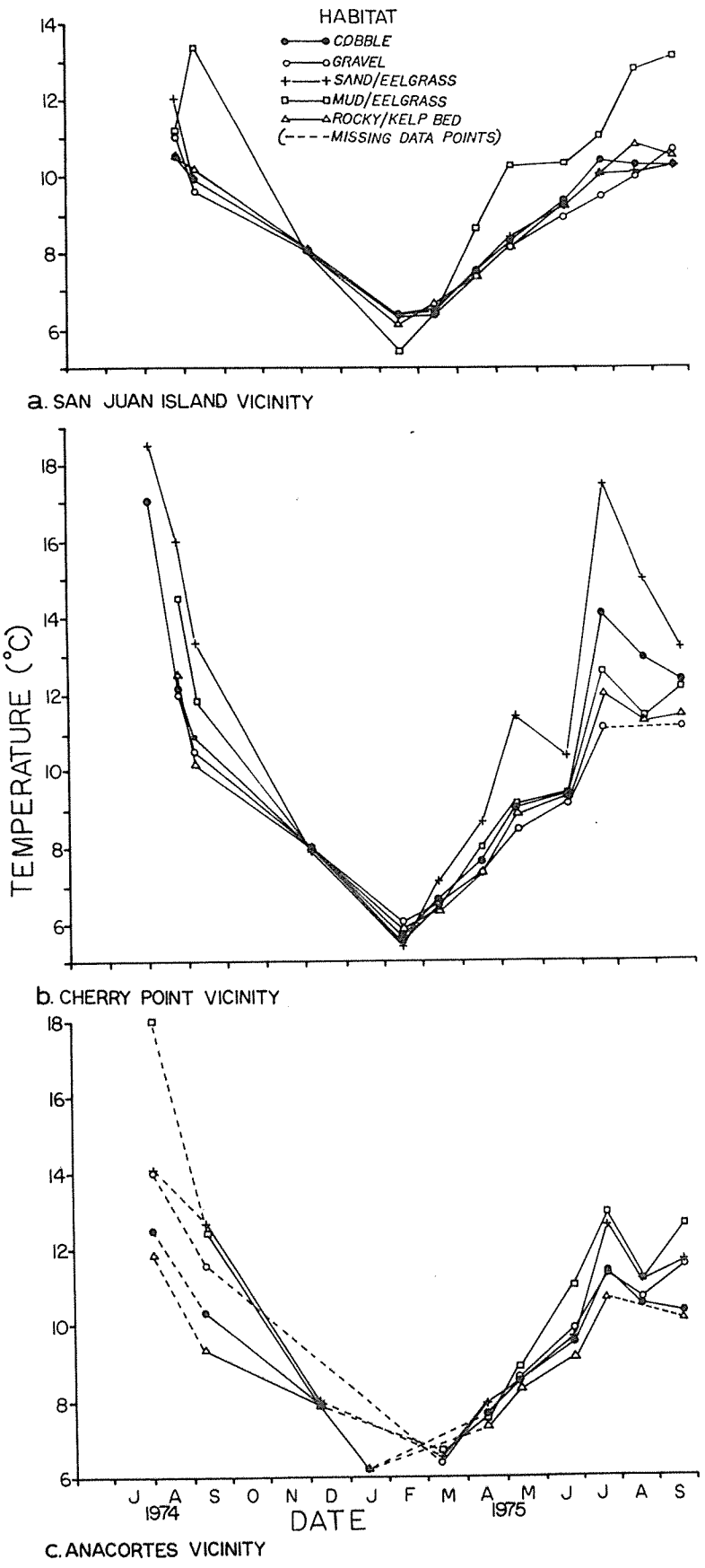


Fig. 4. Temperature of nearshore surface waters sampled during tow net surveys in north Puget Sound.

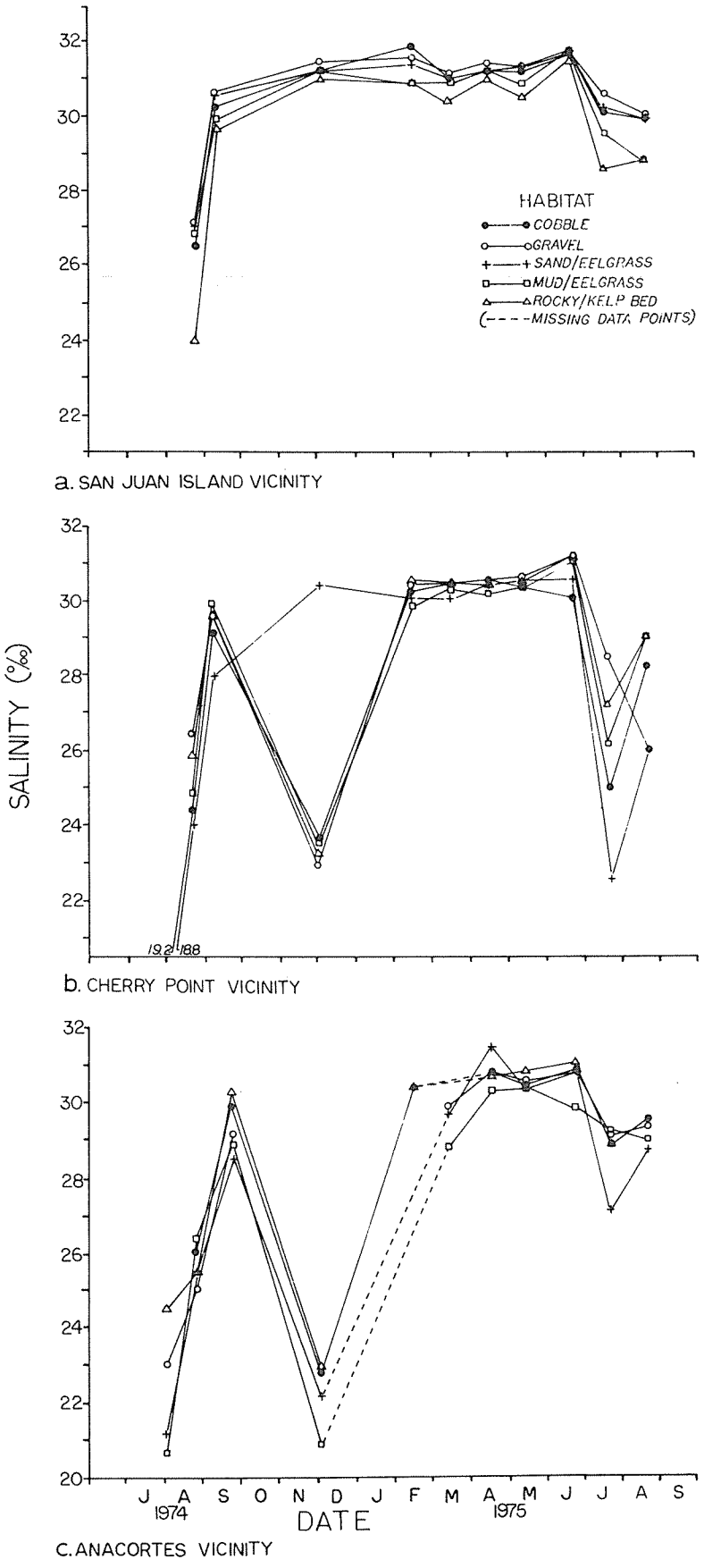


Fig. 5. Salinity of nearshore surface waters sampled during tow net surveys in north Puget Sound.

Table 2. Temperature and salinity means, standard deviations, extremes, and ranges among three sampling areas as measured during Nearshore Fish Survey.

		San Juan Island	Cherry Pt.	Anacortes
Temperature (°C):	$\bar{x}$	9.1	10.1	10.0
	s_x	2.0	3.4	2.5
	Min-max	5.4-13.4	5.4-18.5	6.2-18
	Range	8.0	13.1	11.8
Salinity (°/₀₀):	$\bar{x}$	29.2	27.8	28.1
	s_x	6.1	4.1	3.2
	Min-max	24.0-31.4	18.8-31.2	20.7-31.5
	Range	7.4	12.4	10.8

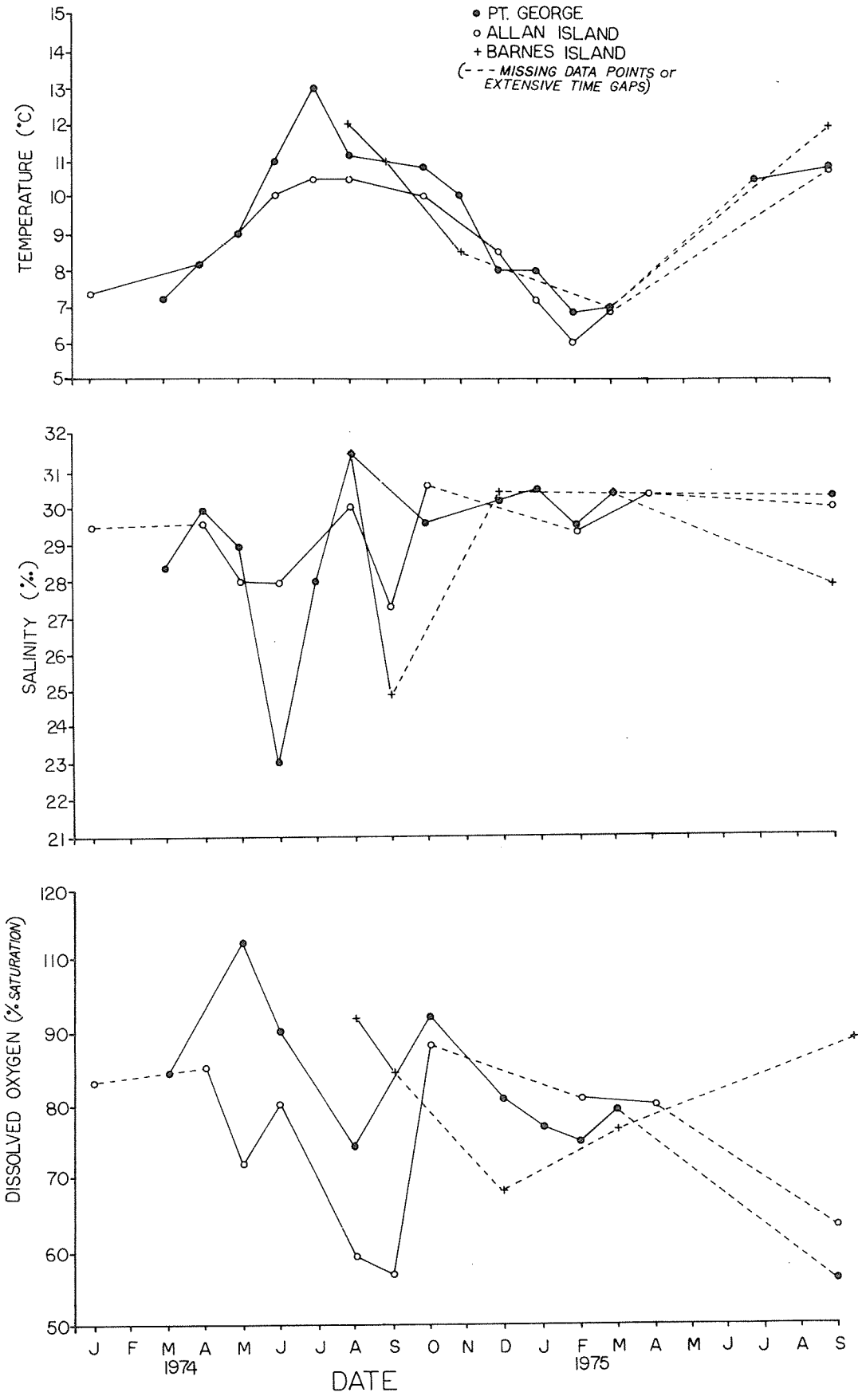


Fig. 6. Physiochemical characteristics of subtidal waters sampled during SCUBA transect observations in north Puget Sound.

water measurements, indicating a well-mixed water column in the habitat most prone to heavy current influences.

Nearshore Fish Assemblages

Specific raw catch data for each sampling site are appended (Appendix 4), providing the mean species richness, mean number of individuals, and mean biomass for each collection. Species richness is defined as the number of species; the number of individuals represents actual counts or subsample proportion estimates; and biomass is actual weights or subsample proportion estimates thereof. Means are of two sample replicates constituting each collection.

Seasonal occurrences of the documented nearshore fishes of north Puget Sound are diagrammed by habitat in Appendix 6, indicating peak abundance periods for those species or life history stages with fluctuating populations. Sampling frequency (see Methods and Materials) for the different sampling methods applied to each habitat should be kept in mind when interpreting these temporal distributions.

Species Distribution and Species Richness. Sampling for 15 months in north Puget Sound resulted in the capture of 96 positively identified species of marine and estuarine fishes. The relative occurrence and distribution of these species according to the different habitats sampled by the different techniques are appended (Appendix 5).

A coarse indication of the diversity of a community of organisms, species richness is illustrated for nearshore fish assemblages in Figs. 7 and 8. The gravel habitat site yielded the highest and the rocky/kelp bed the lowest number of species in demersal assemblages. The exposed, cobble habitat typically contained fewer species than the two protected embayment habitats. Maximum species richness generally occurred in the fall after a late summer decline; minimum species richness occurred in March and was most extreme in the more exposed habitats (cobble and gravel) during the winter storm period. The SCUBA observations, however, indicated a less variable abundance of species in the rocky/kelp bed habitat throughout the sampling year.

The pelagic component of the nearshore fish assemblages was most species-rich in the mud/eelgrass and cobble habitats, and the rocky/kelp bed habitat the least. Among the three study areas, the two eastern areas evidence slightly more species on the average than the San Juan Island area (Table 3).

Abundance. The mean abundance (number of individual fish) per collection, or the relative observed abundance in the case of SCUBA transect surveys, is included in the raw data tables (Appendix 5). These data, transformed into density values, are illustrated as a function of time for beach seine surveys (Fig. 9), tow net surveys (Fig. 10), and SCUBA transect surveys (Fig. 11).

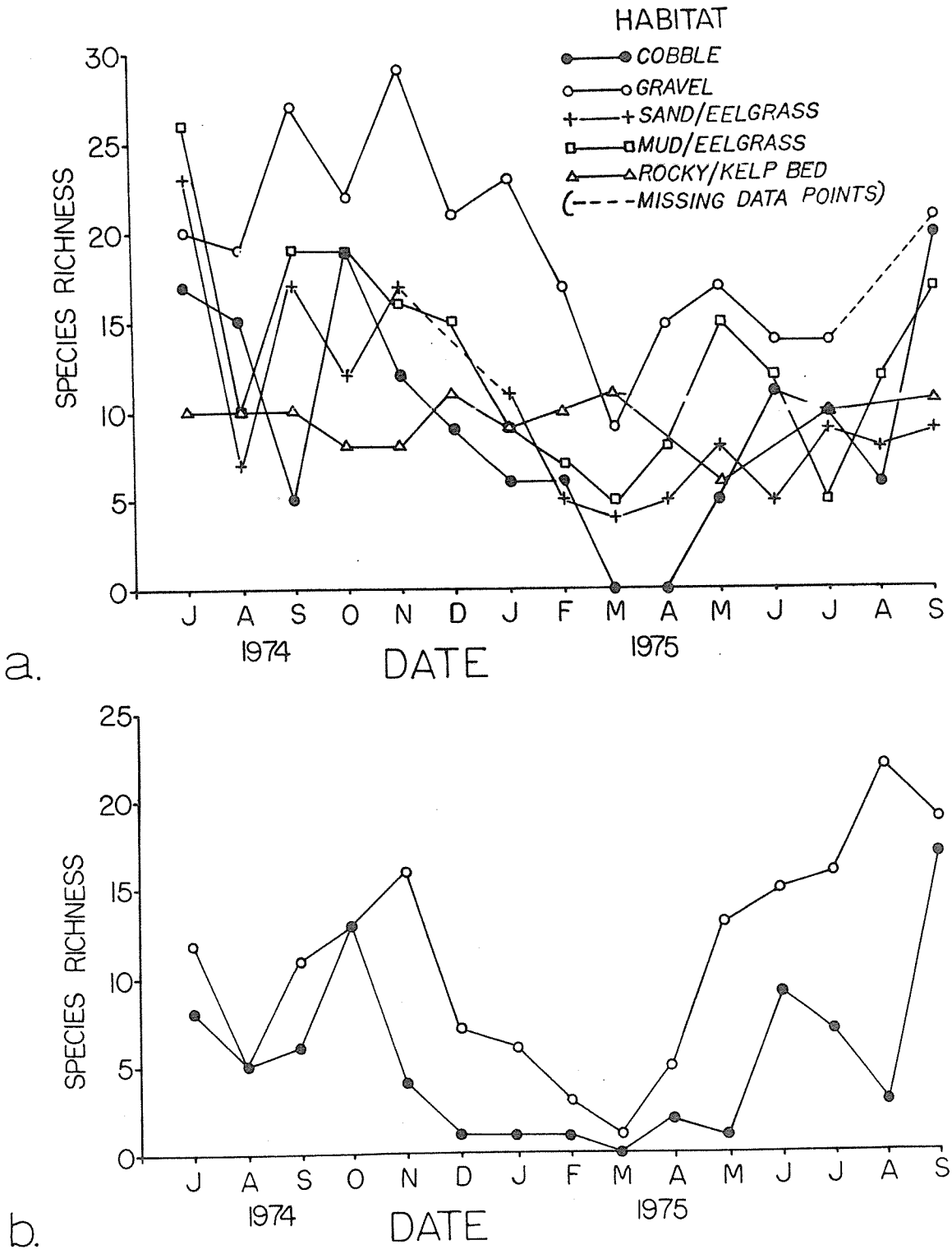


Fig. 7. Species richness, by habitat, of San Juan Island nearshore fish assemblages, as sampled by (a) sinking beach seine and SCUBA surveys and (b) floating beach seine surveys.

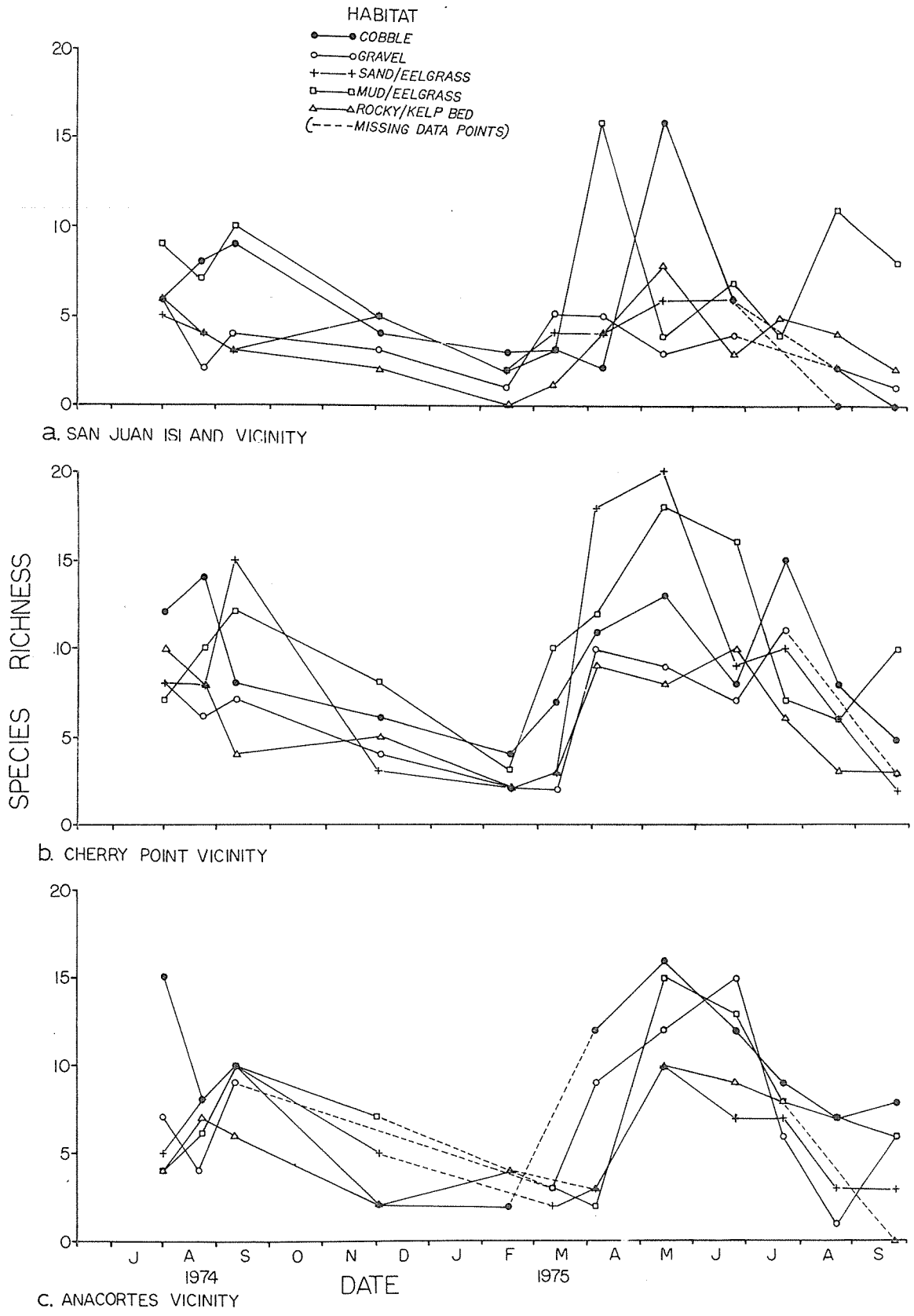


Fig. 8. Species richness, by habitat, of San Juan Island, Cherry Point, and Anacortes vicinity nearshore surface fish assemblages, as sampled by tow net.

Table 3. Mean species richness, over all habitats, of nearshore surface fish communities sampled by tow net in three north Puget Sound areas, July 1974 through June 1975.

	Date								
Area	July/Aug.	Aug.	Sept.	Dec.	Feb.	Mar.	Apr.	May	June
San Juan Island	6.4	5.0	5.8	3.8	1.6	7.0			
Cherry Point	9.0	9.2	9.2	5.2	2.6	6.0		7.0	
Anacortes	7.0	6.6	9.0	4.0	4.5	3.0			

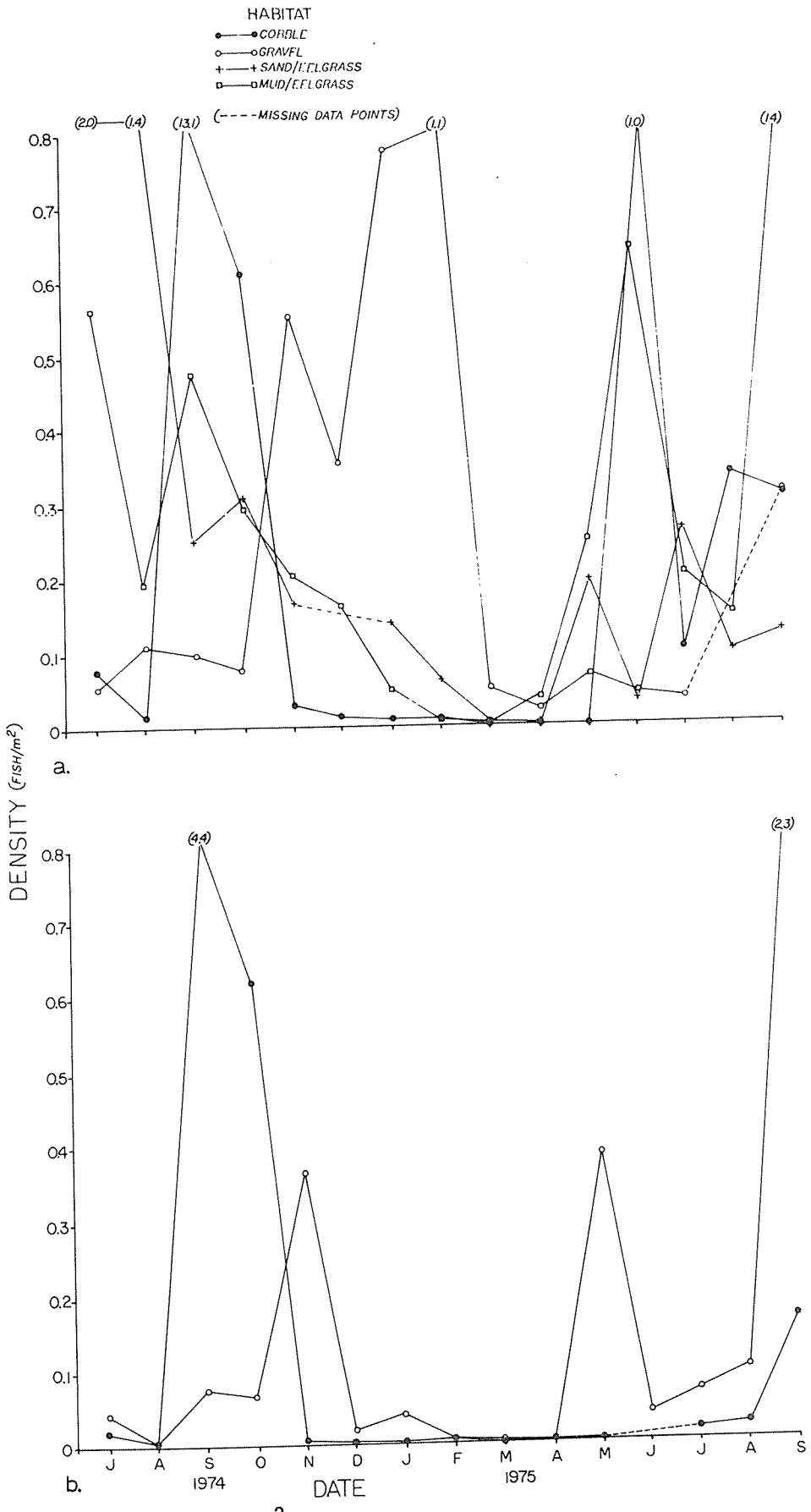


Fig. 9. Mean density (fish/m^2) per collection by habitat of San Juan Island nearshore fish assemblages, as sampled by (a) sinking and (b) floating beach seines.

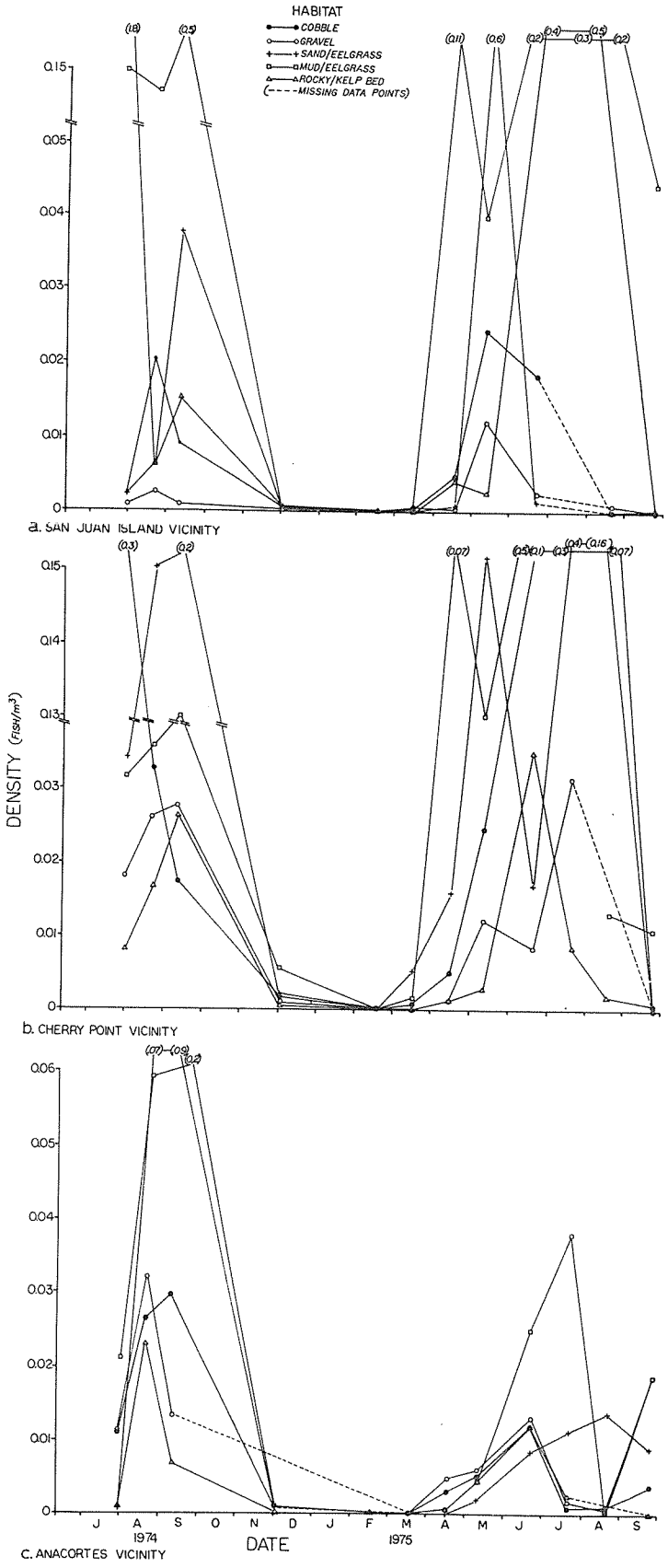


Fig. 10. Mean density (fish/m^3) of fish per collection by habitat, of north Puget Sound nearshore surface fish assemblages as sampled by tow net.

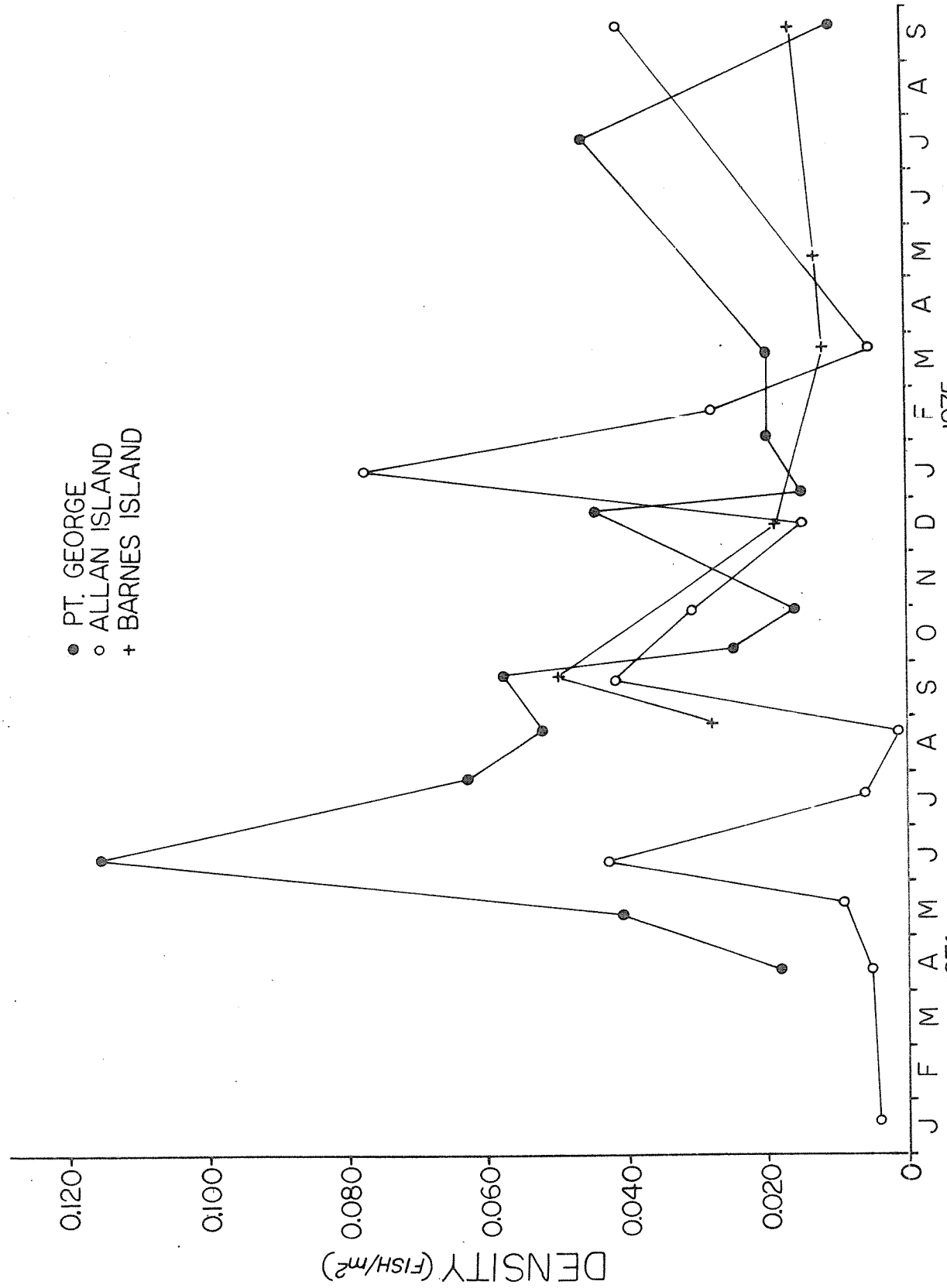


Fig. 11. Mean density (fish/m^2) of nearshore subtidal rocky/kelp bed habitat as sampled by SCUBA transect observations, January 1974 to March 1975.

Fluctuation is evident in the total density of nearshore fish during these surveys. An important source of this variance is the occurrence of schooling species in the collections. This is especially evident in the case of the rocky/kelp bed SCUBA observations (Fig. 11) where schooling rockfish and other species contribute to this variability. Exclusion of these species (*Sebastes emphaeus, S. flavidus, S. melanops, Embiotoca lateralis,* and *Clupea harengus pallasi*) from the data in Table 4 significantly reduces the variance estimates.

Densities of nearshore surface fish assemblages over cobble and gravel habitats (Fig. 10) followed patterns similar to the bottom-associated assemblages, illustrating similar fall increases and periodic fluctuations caused by the influx of abundant schooling species. In the case of these surface assemblages, however, the winter densities declined to basically zero without the fluctuations seen in the corresponding bottom communities.

Comparison of the respective fish densities found in the nearshore surface waters sampled in the three north Sound sampling areas (Fig. 10) illustrated a relatively consistent pattern. From a moderate level (higher in the Cherry Pt. and Anacortes areas than about San Juan Island) in early August, there was a rapid increase in late August and September, caused primarily by the influx of juvenile Pacific herring into nearshore waters. These densities, as high as 1.8 fish/m^3, declined to less than 0.004 fish/m^3 by December and into mid-February. Not until mid-March did the catches begin to increase, due not so much to the appearance of adult fishes as to the influx of pelagic larvae into these surface waters. The subsequent spring increases are basically due to the appearance of larvae, juvenile salmonids, and schools of threespine stickleback. The inshore movement of Pacific herring in the fall and the appearance of herring, Pacific sandlance, and smelt larvae and post-larvae in the late winter resulted in the highest fish densities in the two shallow embayment environments--the sand/eelgrass and mud/eelgrass habitats.

Standing Crop. The standing crop of nearshore fish assemblages, expressed as the mean wet weight (kilograms) per unit area, is illustrated for the San Juan Island assemblages sampled with beach seines (Fig. 12) and as mean wet weight (kilograms) per unit volume sampled by tow net, for collections in the San Juan Island, Cherry Point, and Anacortes regions of north Puget Sound (Fig. 13). The estimated standing crop of rocky/kelp bed habitat fish assemblages from SCUBA transect observations is also illustrated (Fig. 14).

Table 4. Seasonal densities of fish observed in rocky/kelp bed habitat (number of fish/1000 m^2); values in parentheses indicate densities excluding schooling species. Variance value is one standard deviation.

	Spring	Summer	Fall	Winter	Summer
Allan Is.	21.7 ± 28.8 (10.4 ± 4.9)	48.4 ± 51.2 (14.0 ± 5.0)	23.4 ± 33.2 (4.5 ± 1.3)	44.4 ± 58.2 (7.7 ± 3.0)	37.4 ± 32.8 (21.4 ± 10.2)
Pt. George	57.1 ± 60.2 (18.4 ± 13.7)	57.8 ± 30.1 (22.1 ± 8.2)	32.7 ± 28.1 (11.2 ± 3.2)	19.1 ± 10.3 (10.7 ± 3.3)	37.4 ± 32.8 (21.4 ± 10.2)
Barnes Is.	16.7 (16.7)	45.5 ± 13.6 (45.5 ± 13.6)	23.0 (23.0)	20.9 (20.9)	14.3 (14.3)

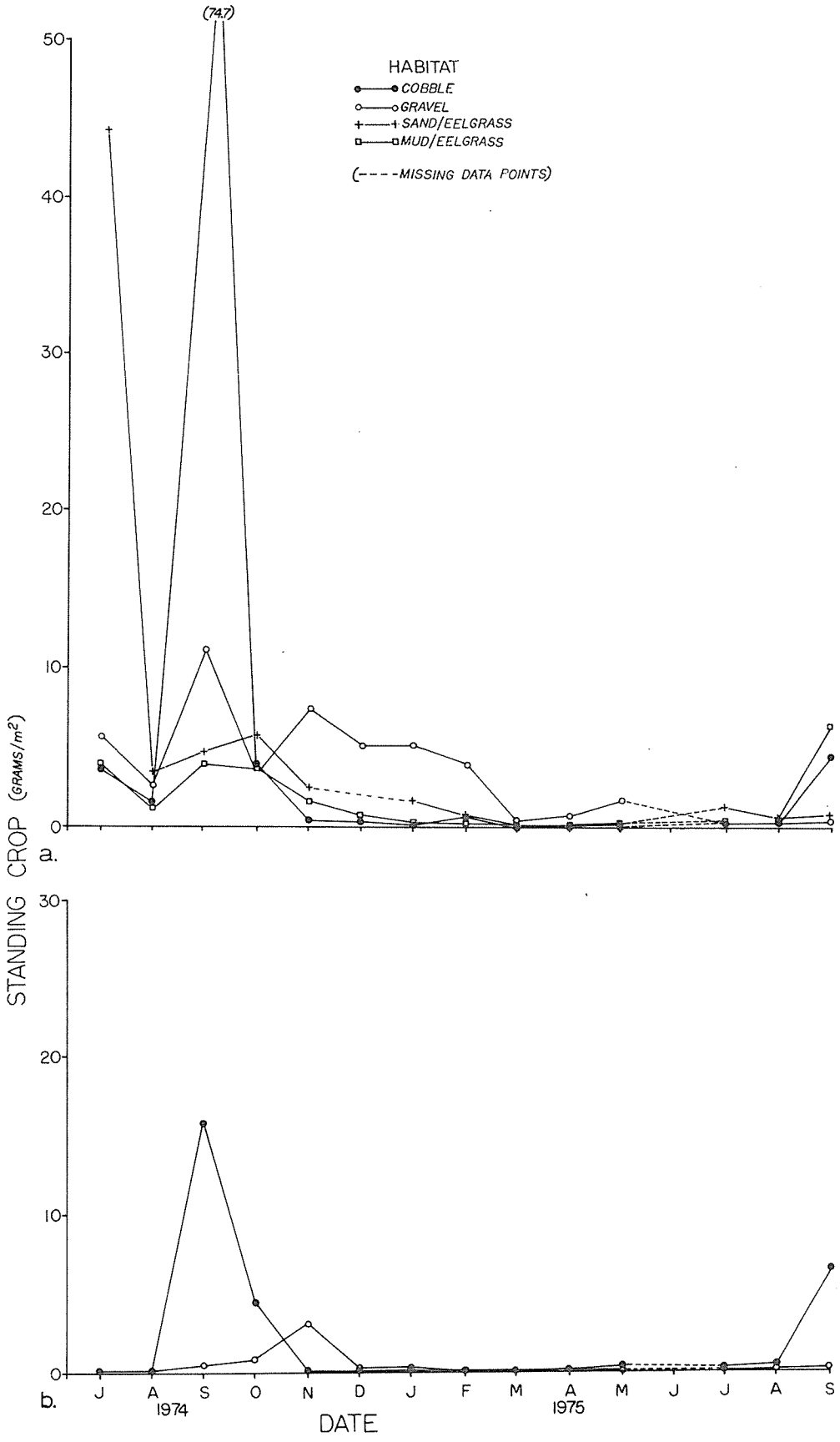


Fig. 12. Standing crop, in mean wet weight (kilograms) per m^2, for collections (two samples) in San Juan Island vicinity fish assemblages as sampled by (a) sinking and (b) floating beach seines.

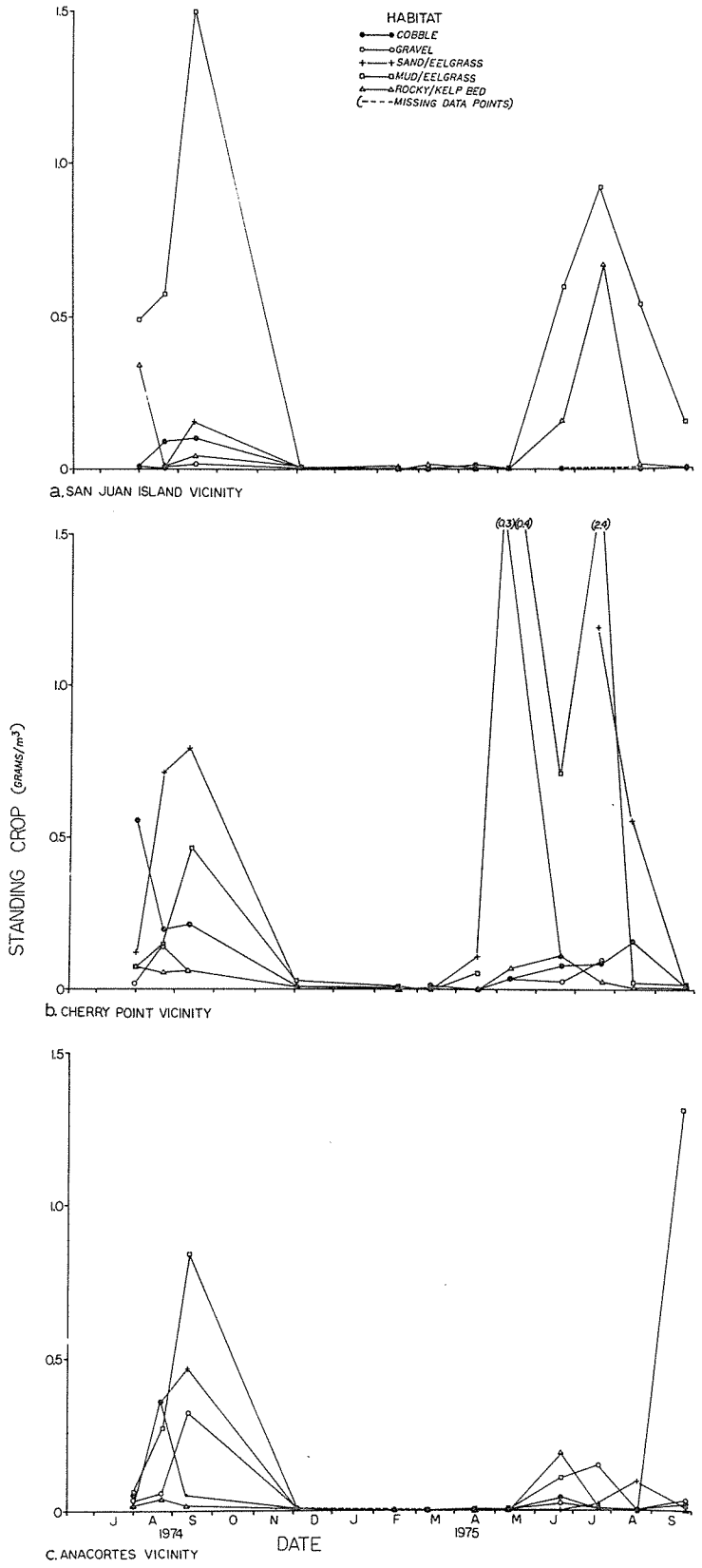


Fig. 13. Standing crop, in mean wet weight (kilograms) per m^3, by habitat, for nearshore surface fish assemblages sampled during tow net surveys in north Puget Sound.

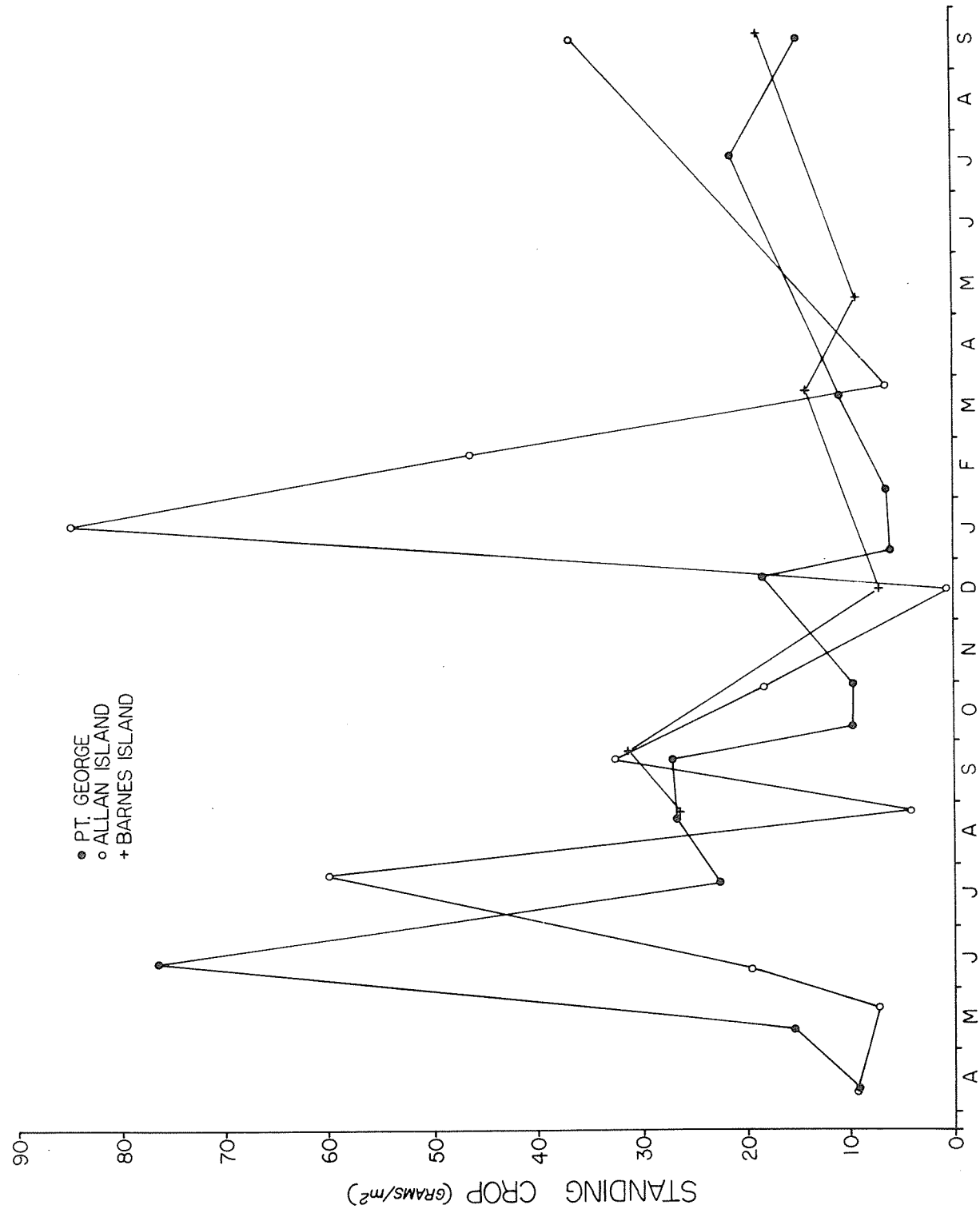


Fig. 14. Estimated standing crop, in mean wet weight (kilograms) per m^2, for nearshore rocky/kelp bed habitat fish assemblages observed during SCUBA transect dives in north Puget Sound.

Standing crop generally corresponded to the trends observed in the numbers of fish captured. There were, however, obvious differences. In the beach seine samples and SCUBA transect observations from the San Juan Island vicinity (Figs. 12 and 14), the ranking of several habitats had reversed when mean abundance was compared to mean standing crop. While the mud/eelgrass habitat typically indicated the greatest fish abundances and densities, the standing crop in this habitat was typically the lowest of the five habitats. Similarly, the standing crop of the fish communities in the sand/eelgrass habitat generally did not correspond to the densities of the fish assemblages observed there. The high winter densities observed in the gravel habitat were not accompanied by an equivalent increase in standing crop. Deletion from the data of those species which occur infrequently but as large dense schools (e.g., Pacific herring) produced a standing crop measure of these fish assemblages that was not so highly variable, averaging about 3 to 4 grams/m^2 in the summer and fall and dropping gradually to less than one gram/m^2 during the winter.

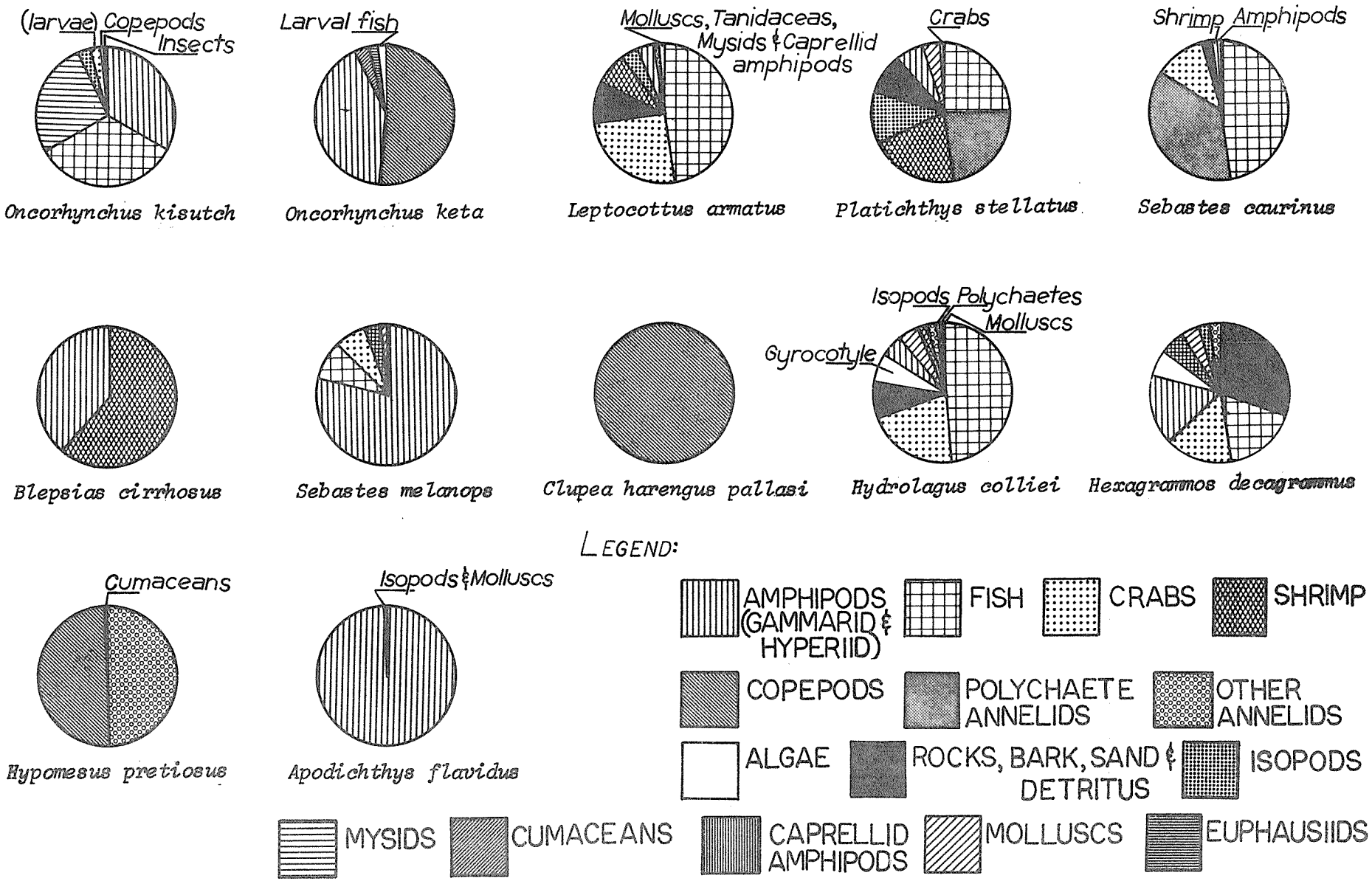
The situation of standing crop ranking according to habitat was dramatically reversed in the case of the surface components of the nearshore fish assemblages. The protected, shallow, eelgrass-associated habitats characteristically had the highest standing crop values, and the surface waters adjacent to rocky/kelp bed habitats typically possessed the lowest. While the seasonal trends in standing crop were similar among the three north Sound sampling areas, the fall increase was of a generally greater magnitude in the eastern north Sound than in the habitats in the San Juan Island vicinity.

Fish Stomach Analyses

The stomachs of 205 specimens retained for analyses have been examined for the composition and numeric and gravimetric contributions of prey organisms found (Appendix 8). These analyses encompass the diet breakdown for 30 species representing all habitats sampled on San Juan Island, location of the western "control" sampling area.

The composition of the investigated fish diets was itemized, both in mean biomass consumed for each prey organism taxon and in percentage composition by occurrence and biomass (Appendix 9). The overall contribution to the diet of 12 species, in percentage of the biomass of all food organisms and identifiable material contained in the stomachs, was illustrated (Fig. 15). Sample sizes for the remaining 18 species were inadequate to represent their general utilization of nearshore prey resources and provide little more than a suggestion of their trophic relationships with their San Juan Island habitats. Intercollection variances and differences between habitats were examined.

Fig. 15. Contribution, in percentage of total biomass, of food organisms and identifiable material to diet of 12 species of fish sampled in Nearshore Fish Survey, July 1974 through June 1975.



A preliminary listing of the identifiable prey organisms and their relative occurrence in the stomachs of the fish analyzed was compiled (Table 5). The occurrence of specific prey in the diet of some fishes is further delineated in Table 6. Taxonomic verification of several species (noted as sp. or unidentified) is presently being obtained from experts in those taxa.

Malacostracan crustaceans and fish provided most of the biomass contributing to the diets of the nearshore fishes investigated. The most commonly represented taxon was the Amphipoda, itself an ecologically and taxonomically diverse group. Natantian decapods (shrimps) were also significant nearshore food organisms. Other than fish, the remaining prey taxa were fairly restricted to specific fish predators.

Variability of Nearshore Fish Data

Potential sources of variability within the sampling design of the Nearshore Fish Survey were discussed earlier. These and the natural fluctuations of the organism populations in response to the environment are combined within the observed variability of the survey data. Statistical expression of this variability represented by the coefficient of variation* (Table 7), indicates the relative constancy or predictability of an organism's (or assemblage of organisms) occurrence, abundance, or standing crop.

There are indications in the beach seine data that the exposed, cobble habitat is characterized by the most variable nearshore fish assemblage, followed by the sand/eelgrass, mud/eelgrass, and the least variable, the gravel habitat. The surface-dwelling fishes, dominated by pelagic schooling species, exhibit a greater variability than the demersal component of these nearshore assemblages, as indicated by the high variability associated with the floating beach seine catches compared to the sinking seine catches.

The tow net catch data also illustrate the higher variability associated with surface fish fauna. In these data, the sand/eelgrass habitat catches were generally the most variable, followed by the cobble and gravel habitats, with the mud/eelgrass and rocky/kelp bed habitats characterizing the lower coefficients of variation.

Another general indication from the tow net catch data is that the surface fish fauna from the San Juan Island vicinity is characterized by greater variation than that of the two eastern study areas.

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*Coefficient of variation $= \left(\frac{\text{Standard deviation}}{\text{Mean}}\right) 100$

Table 5. Prey organisms and their relative occurrence for fish analyzed for stomach contents composition during Nearshore Fish Survey, 1974-1975.

Prey organism	Occurrence
Phylum Mollusca	
Class Gastropoda	
Transenella tantilla (?)	rare
Class Bivalvia	
(Small white clam)	rare
Phylum Annelida	
Class Polychaeta	rare
Phylum Arthropoda	
Subphylum Mandibulata	
Class Crustacea	
Subclass Copepoda	
Order Calanoida	
Epilabidocera amphitrites	common
Order Harpacticoida	common
Subclass Malacostraca	
Order Leptostraca	
Nebalia pugettensis (?)	rare
Order Mysidacea	
Holmesiella anomala	abundant
Neomysis awatschensis	rare
Order Cumacea	rare
Order Tanaidacea	
Leptochelia dubia (?)	rare
Order Isopoda	
Suborder Flabellifera	
(> 3 types)	common
Suborder Valvifera	
(> 3 types)	common
Order Amphipoda	
Allorchestes sp 1	common
Allorchestes sp 2	rare
Amphithoe lacertoss } same?	rare
Amphithoe sp. } same?	rare
Aorides sp.	rare

Table 5, cont'd

Prey organism	Occurrence
Atylus sp.	common
Calliopius laeviusculus	rare
Eohaustorius sp.	common
Eusirid sp.	rare
Eysiroides sp. (?)	abundant
Gammaridae sp. unindentified	rare
Hyale sp.	rare
Hyperridae	common
Ischyrocerus sp.	rare
Lyssianasidae sp. unidentified	rare
Paraphoxus spinosa (?)	common
Paraphoxus (Trichophoxus) sp 1	common
Photis californica } same?	common
Photis sp. } same?	common
Pontogeneia sp. 1	rare
Pontogeneia sp. 2	common
Synchelidium sp.	rare
Talitroidea sp. unidentified	rare
Order Decapoda	
Suborder Natantia	
Section Caridea	
Heptacarpus stimpsoni	common
Heptacarpus tridens	rare
Hippolyte clarki	rare
Crangon sp.	common
Suborder Reptantia	
Section Anomura	
Paguridae sp.	rare
Section Brachyura	
Cancer magister	common
Cancer oregonensis	common
Oregonia gracilis	rare
Pugettia gracilis	common
Pugettia richii (?)	rare
Telmessus cheiragonus	rare
Class Insecta	
Order Diptera	rare
Phylum Chordata	
Class Pisces	
Clupea harengus pallasi (?)	rare

Table 6. Specific prey organisms identified from nearshore fish; frequency of occurrence is listed for those fish species examined with sample sizes ≥5.

Fish species	Prey organism	% Frequency of occurrence
Hydrolagus colliei	(Crabs)	
	Cancer magister	55
	C. oregonsis	55
	Pugettia gracilis	9
	Pugettia sp.	18
	Oxyrhyncha sp. (juvenile)	18
	Telmessus cheiragonus	18
	(Shrimp)	
	Heptacarpus stimpsoni	9
	Hippolyte clarki	9
	(Unident.)	18
	Crangon sp.	9
	(Amphipods)	
	Eusiroides sp.	64
	Pontogeneia sp.	9
	(Unident.)	55
	Lyssianasidae sp.	27
	Photis californica	18
	Photis sp.	9
	Paraphoxus spinosa	91
	Aorides sp.	27
	Atylus	18
	Synchelidium sp.	18
	Idotea sp.	9
	Synidotea sp. (2 types)	64
	Flabellifera spp. (2 types)	64
	(Molluscs)	
	Transenella sp.?	
	Lacuna carinata?	73
	Caprellidea spp.	18
	(Cumaceans)	
	Unident. sp.	9
	(Anomuran crabs)	
	Paguridae sp.	18

Table 6, cont'd

Fish species	Prey organism	% Frequency of occurrence
Oncorhynchus kisutch	(Amphipods)	
	Eusiroides sp.	66
	Atylus sp.	38
	Allorchestes spp.	34
	Eohaustorius sp.	31
	Calliopius laeviusculus	3
	Hyperiidea	21
	Talitroidea sp.	3
	Eusirides sp.	3
	Hyale sp.	3
	Paraphoxus spinosa	3
	Paraphoxus sp.	24
	Pontogeneia sp.	7
	(Unident. spp.)	28
	(Shrimp)	
	Heptacarpus stimpsoni	3
	Crangonidae	3
	(Mysids)	
	Holmesiella anomala	48
	(Isopods)	
	Gnorimosphaeroma oregonense	3
	Exosphaeroma sp.	3
	Flabelifferan unident. sp.	41
	(Copepods)	
	Epilabidocera amphitrites	17
	Calanoida unident. sp.	3
	(Insects)	
	Unident. sp.	34
Sebastes melanops	(Amphipods)	
	Pontogeneia sp. #1	58
	Pontogeneia sp. #2	83
	Pontogeneia unident. sp.	8
	Eusiroides sp.	100
	Ischyrocerus	33

Table 6, cont'd

Fish species	Prey organism	% Frequency of occurrence
	Hyale sp.	50
	Atylus	75
	Paraphoxus spinosa	8
	Photis californica	25
	Photis sp.	17
	Amphithoe lacertosa	8
	Amphithoe sp.	25
	Unident. Gammaridae	8
	Unident. spp.	67
	Caprellidea	8
	(Shrimp)	
	Heptacarpus stimpsoni	58
	H. tridens	17
	Crangon sp.	33
	Hippolyte clarki	17
	Unident. sp.	8
	(Leptostracan)	
	Nebalia sp.	17
	(Polychaete)	
	Unident. Errantiate sp.	17
	(Fish)	
	Unident. sp.	33
	(Crab)	
	Cancer oregonensis	25
	C. magister	8
	Pugettia gracilis	17
	Oxyrhyncha sp.	8
	Telmessus cheiragonus	8
	Unident. Megalops	8
	Unident. sp.	17
	(Molluscs)	
	Lacuna carinata?	8
	(Insects)	
	Unident. sp.	8
	(Isopods)	
	Flabellifera sp.	8

Table 6, cont'd

Fish species	Prey organism	% Frequency of occurrence
Leptocottus armatus	(Amphipods)	
	Allorchestes sp.	36
	Eohaustorius sp.	9
	Atylus sp.	9
	Paraphoxus spinosa	9
	Talitroidea sp.	9
	Hyperiidea sp.	9
	Unident. spp.	
	(Shrimp)	
	Crangon sp.	45
	(Cumacean)	
	Unident. sp.	9
	(Mysid)	
	Holmesiella anomala	27
	(Isopods)	
	Flabellifera sp.	18
	Valifera sp.	36
	Unident. sp.	18
	(Crabs)	
	Cancer magister	28
	Oregonia gracilis	9
	(Fish)	
	Unident. sp.	9
	(Insect)	
	Unident. sp.	9

Table 6, cont'd

Fish species	Prey organism
Theragra chalcogramma juv.	(Shrimp) *Heptacarpus tridens* *Crangon* sp. (Amphipods) *Atylus* sp.
Sebastes flavidus	(Amphipods) *Pontogeneia* sp. #1 *Pontogeneia* sp. #2 *Eusiroides* sp. *Lyssianasidae* sp. *Ischyrocerus* sp. *Atylus* sp. *Photis californicus* Hyperiidea (Shrimp) *Crangon* spp. (Mysid) *Neomysis awatschensis* (Leptostracan) *Nebalia* sp.
Sebastes maliger	(Shrimp) *Heptacarpus stimpsoni* *H. tridens* *Hippolyte clarki* Unident. sp. (Amphipods) *Eusiroides* sp. *Atylus* (Isopods) *Idotea* sp. *Synidotea* sp. Flabellifera spp. (Mysid) Unident. sp. (Leptostracan) *Nebalia* sp.

Table 6, cont'd

Fish species	Prey organism
Hexagrammos decagrammus	(Crabs) *Oxyhryncha* sp. *Telmessus cheiragonus* *Cancer magister* *Pugettia gracilis* *Oregonia gracilis* (Isopods) *Idothea* sp. Flabellifera sp. (Shrimp) *Crangon* sp. *Heptacarpus stimpsoni* *H. tridens* Unident. sp. (Amphipods) *Eusiroides* sp. *Amphithoides* sp. (Molluscs) *Lacuna carinata?*
Hexagrammos stelleri	(Amphipods) *Eusiroides* sp. Gammaridae unident. sp. *Amphithoe* sp. Unident. sp. (Crabs) *Cancer oregonensis* *Pugettia gracilis* *Oxyhryncha* sp. (Shrimp) *Heptacarpus stimpsoni*
Blepsias cirrhosus	(Shrimp) *Heptacarpus stimpsoni* (Amphipods) *Amphithoe* sp. Unident. sp.
Enophrys bison	(Algae) *Ulva?*

Table 6, cont'd

Fish species	Prey organisms
Hemilepidotus hemilepidotus	(Crabs) *Cancer magister* *C. oregonensis*
Scorpaenichthys marmoratus	(Shrimp) *Heptacarpus stimpsoni* (Amphipods) *Eusiroides* sp. *Atylus* *Allorchestes* sp. Unident. spp. (Crabs) *Cancer oregonensis*
Platichthys stellatus	(Mysid) *Holmsiella anomala* (Isopod) Flabellifera sp. (Amphipods) *Atylus* Unident. sp. (Polychaete) Unident. Errantiate sp. (Insects) Unident. spp.

Table 7. Coefficient of variation values for species richness (top), abundance (middle), and biomass (bottom), for (a) beach seine and (b) tow net catches, and (c) SCUBA observations. Values for fish abundance without data for schooling species appear in parentheses.

		← 1974					1975 →								
		J	A	S	O	N	D	J	F	M	A	M	J	J	A	S
a. Beach Seine catches																
Cobble	(sinking)	10	12.5	-	8.3	25	21.8	20	33.3	0	0	-	40.0	15.6	28.3	0
		4.3	11.8	-	3.3	11.8	18.5	21.3	35	0	0	-	146.8	76.4	128.9	20.4
		0.7	2.6	-	1.1	3.4	3.5	7.4	3.7	0	0	-	-	70.1	130.5	66.1
	(floating)	29	48	-	0	0	140	140	0	0	46.7	46.7	-	60.0	0	21.8
		3.8	42.5	-	0.9	28.3	-	-	34.5	0	46.7	28.3	-	15.6	130.7	61.5
		6.4	16	-	0.3	12.1	-	-	100	0	150	20.0	-	137.8	6.8	85.0
Gravel	(sinking)	10	4.5	6.7	4.8	10.5	9.7	9.7	14.2	12.7	10.0	15.6	42	47.6	41.6	0
		5.7	3.2	5.5	5.2	2.8	2.3	2.3	1.1	13.2	4.5	46.4	23.3	70.2	9.4	24.2
		1.1	1.1	7	1.6	6.4	1.0	1.0	0.9	5.9	2.5	30.5	-	86.8	82.2	6.2
	(floating)	0	34.3	17.5	7.4	18.1	26.7	35.0	0	100	34.3	52.5	36.8	75.3	-	8.8
		10	33.3	3.2	9.8	3.3	7.4	11.7	33.3	-	8.7	138.3	17.1	109.4	-	78.1
		4.9	64.7	1.2	1.9	1.3	6.8	4.8	16.6	-	10.9	135.1	-	103.8	-	63.4
Sand/Eelgrass		-	30	0	7.4	10.0	-	21.3	25	33.3	33.3	10.8	15.6	28.0	2.9	7.4
	(sinking)	-	1.9	3.7	4.0	5.0	-	7.2	9.8	34	24.3	40.8	87.8	89.1	28.9	2.6
		-	0.8	0.8	1.0	1.6	-	2.0	3.3	10.1	12.6	11.6	-	99.3	56.6	57.7
Mud/Eelgrass		9.3	14.1	8.8	14.3	10.8	20	9.3	15.6	20	16.7	5.6	36.8	35.4	21.2	4.6
	(sinking)	2.7	3	1.9	3.8	4.4	4.2	9.1	12.6	28	8.9	59.0	2.6	2.3	28.3	2.6
		0.8	1.1	0.7	1.1	1.5	2.4	5.4	7.6	10.4	4.5	7.0	-	18.9	61.2	2.4
b. Tow Net catches																
Cobble (South Beach)		70.0	28.0	12.7			140.0		70.0	140.0	0	14.0	-	-	0	-
		10.0	86.7	118.3			107.7		70.0	140.0	69.6	40.8	-	-	0	-
		20.3	97.0	112.8			69.4		47.5	128.6	63.9	43.2	-	-	0	-

Table 7, cont'd

	← 1974						1975 →								
	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S
(Cherry Pt.)	28.0	14.0	9.3			28.0		46.7	77.8	47.2	22.1	60.6	57.0	0	60.0
	30.8	30.1	26.6			23.9		60.0	106.3	84.8	23.1	135.2	120.9	45.0	103.7
	38.6	46.5	38.2			66.3		71.4	141.0	119.5	24.6	119.3	121.5	60.6	92.8
(Shannon Pt.)	46.7	28.0	17.5			46.7		46.7	-	28.3	22.1	53.0	9.3	56.6	0
	3.4		19.2			109.6		77.8	-	52.5	14.9	135.1	53.8	81.9	38.6
	29.7		2.0			119.2		11.8	-	105.2	73.0	62.5	66.5	114.4	1.7
Gravel (Deadman Bay)	15.6	46.7	53.8			70.0		140.0	15.6	60.6	15.6	101.1	-	47.3	140.0
	51.8	47.0	141.1			93.3		140.0	87.6	23.5	87.6	68.0	-	106.9	140.0
	54.4	72.8	139.6			85.3		140.0	28.2	16.3	28.2	48.7	-	107.9	141.4
(Village Pt.)	12.7	28.0	28.0			84.0		0	28.0	8.4	28.0	0	0	-	0
	57.8	75.8	114.8			110.0		70.0	10.8	47.1	10.8	52.0	1.0	-	72.9
	58.9	72.3	68.4			98.6		140.7	61.0	60.3	61.0	135.1	14.8	-	95.8
(Guemes Is., S.)	46.7	0	17.5			-		-	70.0	28.3	70.0	12.8	70.0	0	12.9
	133.3	32.3	5.4			-		-	70.0	51.4	70.0	71.2	54.4	68.5	84.6
	77.8	0.5	90.2			-		-	121.3	17.5	121.3	125.4	16.5	16.5	64.8
Sand/Eelgrass (Eagle Cove)	35.0	190.0	28.0			190.0		140.0	20.0	27.4	20.0	101.1	-	141.0	-
	0	97.4	43.8			123.8		140.0	56.0	58.2	56.0	54.9	-	141.5	-
	35.1	107.3	37.2			102.2		141.4	54.1	9.8	54.1	107.0	-	140.3	-
(Birch Bay)	20.0	10.8	38.2			140.0		46.7	0	7.5	0	15.8	17.5	12.9	140.0
	19.7	86.6	96.1			135.7		38.2	30.7	131.4	30.7	123.7	77.9	37.9	141.4
	68.9	80.6	32.7			140.7		84.6	25.4	73.8	25.4	87.9	74.5	5.2	141.1
(Guemes Is., E.)	46.7	10.8	17.5			0		-	0	70.5	0	84.8	23.3	70.5	28.3
	25.5	23.2	102.2			82.1		-	0	47.0	0	110.8	103.1	119.9	45.5
	112.3	61.7	102.2			113.0		-	114.3	87.1	114.3	9.1	57.7	2.6	16.5
Mud/Eelgrass (Westcott Bay)	63.6	10.8	24.7			0		0	28.0	55.3	28.0	84.0	20.0	66.0	141.4
	90.9	93.9	73.5			35.0		0	0	81.2	0	124.7	72.0	20.1	47.3
	91.7	96.2	2.5			25.0		46.7	90.0	9.4	90.0	136.2	66.9	30.6	47.1

Table 7, cont'd

	J	A	S	O	N	← 1974 D	1975 → J	F	M	A	M	J	J	A	S
(Lummi Bay)	46.7	17.5	20.0			32.3		140.0	15.6	0	15.6	10.8	35.0	47.1	90.0
	10.0	23.4	45.4			32.6		140.0	21.1	64.3	21.1	36.6	123.1	63.3	138.2
	32.4	58.8	32.5			27.4		141.4	114.9	130.9	114.9	91.1	123.9	65.8	139.5
(Padilla Bay)	20.0	46.7	9.3			60.0		-	70.0	0	70.0	0	38.2	38.5	12.9
	37.6	30.1	19.3			10.8		-	7.0	43.0	70.0	6.1	27.2	56.1	3.5
	23.2	73.5	15.9			87.6		-	100.0	117.6	100.0	13.5	97.6	7.8	12.6
Rocky/Kelp Bed	70.0	0	28.0			0		0	0	20.3	0	28.4	20.0	47.0	140
(Pt. George)	83.4	77.7	79.4			122.7		0	0	118.3	105.0	114.2	61.7	74.8	141.5
	31.3	81.0	30.6			140.0		0	14.3	123.0	66.2	116.4	51.3	136.7	141.1
(Migley Pt.)	9.3	38.2	20.0			20.0		140.0	28.0	28.2	23.3	22.3	15.6	28.4	0
	6.0	41.9	40.5			28.0		140.0	28.0	99.5	93.4	34.5	55.2	9.8	38.5
	71.9	49.1	15.8			90.0		150.0	111.4	112.0	130.7	12.8	67.7	68.8	22.3
(Burrows Is.)	20.0	12.7	15.6			46.7		70.0	-	-	23.3	32.6	12.7	-	0
	50.3	32.4	10.6			20.0		108.9	-	-	5.6	18.9	75.9	-	0
	2.8	46.3	64.9			2.7		129.4	-	-	9.0	136.7	65.5	-	0
c. SCUBA Observations															
(Pt. George)	17.5	8.2	8.2	20.0		8.2	38.2	9.3	0						
	109.3	4.9	47.1	40.7		74.1	84.7	2.5	79.1						
	(12.2)	(32.3)	(9.7)	(35.5)		(34.6)	(46.7)	(8.0)	(9.0)						
	22.6	33.5	58.1	53.2		79.2	94.9	9.8	44.3						
(Allan Is.)	10.8		9.3	38.2				28							
	123.5		91.4	126.8				106.9							
	(47.4)		(24.0)	(28.0)				(10.8)							

SCUBA transect data (Table 7c) indicate that these characteristics of the subtidal fish assemblages in the rocky/kelp bed habitat are more variable than those documented using beach seine and tow net methods. Removal of data for schooling species, however, reduces this variation considerably.

Seasonal variation in these data illustrates that, associated with the winter declines in these assemblages, the winter - early spring period is generally the most variable for nearshore fish fauna.

In all these data, the variability usually increases among the three indices, species richness, abundance, and biomass.

Both the beach seine and tow net data were examined for indications of variability resulting from our sampling techniques or design. There was suggestion of a slight bias toward the first beach seine sample of the two sample collections. In a number of instances schooling species were captured in greater abundance in the initial sample than in the second, especially in those habitats with restricted sampling area. This evidence, however, is not definitive and does not appear to present a significant error. The tow net data were similarly free of any discernible biases.

DISCUSSION

Habitat-Associated Fish Communities

Animal and plant associations called "communities" are established and maintained through a set of synergistic interrelationships among organisms, i.e., predation, competition, and trophic interactions, and between organisms and their physical environment. Ultimately, these communities should be defined on the basis of the complex system of biotic and biotic-abiotic relationships. However, on the initial level of investigation of the Nearshore Fish Survey, we can discuss the nearshore fish fauna only in terms of assemblages which occupy definable nearshore habitats. It is anticipated that the associated stomach analyses of the important members of these communities, examined in the light of the invertebrate studies in the same habitat-sites, will begin to establish a second important criterion, the trophic character of these relationships. A statistical approach to defining communities through the quantified associations between species occurring together will also be applied to our existing (and expanding) data base in the next stage of the survey. In accordance with the goals of DOE's Baseline Study program, the eventual objective of this approach will be to define specific fish communities which can be predictably identified with certain habitats, seasons, and measurable environmental or biotic conditions. The validity of this method will depend upon the resulting variance associated with the sampling method and that inherent in the fish communities as they are sampled over several years. As of this writing we have only two or three months of data with which to document annual variation so it

is too early to make any conclusions about the predictability of community composition, abundance or standing crop during any month or season. There are indications, at least for the three summer, late fall months with two years of data, that between-habitat trends hold and that the coefficient of variation may not be unrealistically high, depending upon the incidence of abundant, schooling species.

Rocky/Kelp Bed. Of the 23 fish species documented in the SCUBA transect study of the rocky/kelp bed habitat, 7 could be considered community dominants by their occurrence in more than 40 per cent of the dives. As mentioned, the survey technique was better suited to detecting large species, so small species may be under-represented or even missed altogether (e.g., gunnels, pricklebacks, and small sculpins). The kelp greenling was the most frequently encountered fish (96 per cent of the dives), and was third in total abundance, behind two schooling rockfish species (black and yellowtail); it was the only fish which showed relatively constant abundance in the study areas throughout all seasons.

The densities of fish in the rocky region varied with season. Densities were highest in the summer, dropped in the fall and winter, and rose again in the spring. These seasonal fluctuations, however, were not as severe as observed in the shallower fish assemblages sampled by beach seine and tow net. Both the kelp bed influence and the deeper waters may account for a more benign winter environment than in the shallower beach habitats. The control area (Pt. George) indicated consistently higher densities than the main study area (Allan Island). Barnes Island, surveyed by one dive quarterly, showed the highest density with comparable seasonal fluctuations.

Four rockfish species--copper, quillback, black, and yellowtail--were found consistently in the Pt. George and Allan Island study areas. The first two species are solitary bottom dwellers, the second two are schooling pelagic species. Because of the schooling behavior of the latter two species, they were the dominant species in terms of number of fish seen. Both species occurred very seasonally, being absent from the areas in winter and spring, and consistently present during only the summer and fall; the two species probably moved to deeper water during the winter months. Neither of the schooling species was seen at Barnes Island. Of the two bottom-dwelling species, the copper rockfish was more abundant overall and seen more frequently.

The longfin sculpin (third in frequency of occurrence and fourth in overall abundance) rarely exceeded 100 mm and is probably much more common than the data indicate. The lingcod, a large predator, was sighted on half the dives. The total number and densities of lingcod were not high, although this is not surprising as top predators, such as this species, require larger territories than species at lower trophic levels. Egg masses guarded by males were found in the February-to-April period in depths of 3 to 12 m (10 to 40 ft).

Dogfish and ratfish are two species which did not appear during the daylight SCUBA observations but which apparently made diurnal migrations into the habitat at night, as indicated by the trammel net catches (Appendix 5d). The striped seaperch also appeared dominant at night, although this may have been a site-associated occurrence rather than a diel change characteristic of the SCUBA transect sites. The other dominant species in the nocturnal composition of the community, kelp greenling, buffalo sculpins, and black rockfish, were also commonly observed during SCUBA dives.

An interesting indication from the data is that none of the fish observed seemed to be uniquely associated with the kelp (Nereocystis); fish were seen in apparently equal densities in areas with and without kelp beds. A major reason for this is probably the shallow depth range of the kelp in the northern Puget Sound region. Water depth may be a more important criterion than kelp coverage in determining fish distribution.

The surface component of the rocky/kelp bed fish assemblage was typically the least species-rich when compared to the other habitats, dominated by large schools of juvenile Pacific herring, threespine sticklebacks, and juvenile salmonids. It must be kept in mind, however, that the tow net was not capable of sampling through the kelp bed canopy, only adjacent to it on its outer deeper margins. Therefore, those species using the kelp canopy for refuge and food will not have been effectively sampled. Thus, the surface component of this habitat's fish assemblage should be considered generally underestimated in these data.

Cobble. Of the five habitats investigated, the exposed, cobble habitat proved to possess the most variable fish fauna. The associated nearshore fish community was characteristically the poorest in species, and usually low in abundance and biomass. Only in cases of intermittently abundant pelagic schooling species (i.e., juvenile Pacific herring, chum and coho salmon) was this community comparable to the others.

More than in any other habitat, the exposed, cobble community was greatly influenced by the physical aspects of the habitat. While the habitat's physiochemical environment was probably the most stable of the five examined, perhaps due to a high degree of mixing of the water column in this habitat, the high degree of exposure made this habitat the most physically stressed to fishes inhabiting the nearshore environs. During fall and spring, wave forces tended to keep the beach substrate unstable, also affecting the presence of demersal fishes associated with the shallow nearshore. The occurrence of these species, which depend upon the substrate for food and protection, varied with the degree of

turbulence in the beach region. At such times of nearshore disturbance, it was primarily the pelagic species which composed the better part of the fish assemblage.

Dominant* demersal fishes of the assemblage consisted of juvenile Pacific tomcod, padded sculpins, sharpnose sculpins, buffalo sculpins, shiner perch, ratfish, juvenile walleye pollock, and ringtail snailfish. Species characteristic of the habitat's nearshore surface waters as sampled by the floating beach seine were juvenile Pacific herring, and on a less frequent basis, surf smelt, juvenile coho salmon, and juvenile chum salmon. Those associated with the surface waters in the nearshore vicinity of the cobble habitat as sampled by tow net are dominantly pelagic schooling species--Pacific herring, juvenile coho, chum, and chinook salmon, threespine stickleback, Pacific sandlance, surf smelt, and longfin smelt. The staghorn sculpin, a demersal fish, was also frequently captured in the nearshore surface waters during nighttime sampling, especially in the two eastern north Sound sampling areas. Other than these, the some thirty other species are generally not abundant or are transients from outside the community which occurred on an infrequent basis. Fishes such as juvenile English sole, rock sole, and starry flounder are examples of species from the more offshore sand and mud habitats which are often adjacent to the nearshore cobble habitat areas in north Puget Sound.

The composition of the assemblage maintained at a relatively constant level of 15 to 19 species through October, thereafter declining with the initiation of the fall storm period and declining water temperatures. The community is apparently dispersed in the winter and essentially nonexistent in the intertidal and nearshore surface waters except for the pelagic larvae of surf smelt, Pacific herring, and Pacific sandlance which begin occurring in February. Pelagic schools of threespine stickleback and chum salmon are also periodically found in the nearshore surface waters of this habitat in late winter and spring.

There is no pronounced difference in the composition of the nearshore surface component of the assemblages in the three study areas. The Cherry Point and Anacortes areas were more prone to having chinook salmon, staghorn sculpins, surf smelt, and longfin smelt than the more oceanic-influenced San Juan Island area. And, as documented earlier in the report, species richness, abundance, and standing crop of the community in the two eastern north Sound areas were typically greater than in the western area. This reflects, we feel, both the additional estuarine influence and reduced exposure characterizing the eastern study areas.

Gravel. The most complex assemblage sampled was that associated with the gravel habitat, especially as reflected in the nearshore fish fauna documented at Deadman Bay, San Juan Island. As mentioned earlier, this reflects the complex habitat at this site which may be anomalous

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*Dominant members of a community here are defined as species occurring in 50 per cent or more of the collections in that habitat.

when compared to the characteristic gravel habitats about Puget Sound proper; the gravel beaches characteristic of the San Juan Island archipelago are typically like that at Deadman Bay--narrow, usually moderately exposed, and confined by kelp beds on adjoining rocky promontories. Thus, at least for the San Juan Island "control" sampling area, the composition and nature of the associated fish assemblage could be considered representative.

Of the some fifty-eight species captured from the area using the two beach seines, some twenty-one species could be considered dominants in the intertidal component of the habitat's fish assemblage. These include copper rockfish, kelp greenling, silverspotted sculpins, tubesnouts, juvenile Pacific tomcod, buffalo sculpins, white-spotted greenling, padded sculpins, staghorn sculpins, Pacific herring, English sole, tidepool sculpins, crescent gunnels, great sculpins, smoothhead sculpins, spiny lumpsuckers, threespine sticklebacks, and bay pipefish, approximately in that order. Of these, shiner perch, tubesnouts, and Pacific herring, by their occurrence in the surface beach seine collections, appeared to occupy the surface waters more than the other fishes. The tidepool sculpin appeared dominantly in the surface seine samples, but because of its observed behavior, it was assumed that the first seine, usually a surface set, captured most of these bottom-associated cottids as it swept the bottom close to the beach.

In addition to the common adult members of the assemblage, the early life history stages of several species, including larvae and/or juveniles of copper rockfish, Pacific sandfish, surf smelt, and chum salmon, commonly utilize the nearshore portion of this habitat for food and protection during brief periods (two to three months) of the year. Rockfish juveniles were found throughout the late summer and fall.

Though the intertidal fauna underwent various shifts in composition, this element of the assemblage sustained a significant abundance and standing crop throughout the sampling period. Copper rockfish, Pacific tomcod, and tidepool sculpins had generally migrated out of the community by December. Pacific herring had departed by February. Dominant species such as great and smoothhead sculpins, spiny lumpsuckers, threespine sticklebacks, and bay pipefish were present only in late fall and early winter, not appearing until September-October, and many had left the community by February. Several species, however, maintained relatively stable populations through the winter, i.e., kelp greenling, buffalo and padded sculpins, and English sole, and several species--notably, shiner perch and tubesnouts--increased significantly during the winter. The movement of the latter two species was probably correlated with behavior oriented to their March-April spawning periods.

The pelagic fish fauna captured in the surface waters adjacent to the gravel habitat were characterized by juvenile Pacific herring, juvenile chum and chinook salmon, threespine stickleback, and Pacific sand lance. The San Juan Island site typically possessed the poorest fauna, the salmon juveniles essentially disappearing after late July - early August, with just the dominant juvenile Pacific herring population

persisting through December. On the other hand, both eastern north Sound gravel habitats had populations of most of these species into December, and a greater diversity of incidental species accompanied these dominants than was found at San Juan Island. The difference between the nearshore pelagic fish in eastern and western north Sound study areas may be either a factor of distance in the case of the juvenile salmonids, since these may be differentially introduced into marine waters from river systems both in northwestern Washington and British Columbia, or of exposure which allowed the fish protection or food in the less exposed sites of the eastern areas.

Both demersal and pelagic components of the gravel habitat's fish assemblage were typically highest in species richness and fish densities. If the data for transient, schooling species are removed from the beach seine catch results, however, the demersal fauna densities fall below that of the mud/eelgrass habitat.

Sand/Eelgrass. The assemblage of fishes found associated with sandy beaches and eelgrass beds, while generally the least species-rich of the five habitats under study, maintained a relatively high abundance and standing crop compared to the other assemblages. This generalization also appeared to hold into the second year's data, although there are only three comparable months and such conclusions cannot be made until two full years of data have been accumulated. The results for the first two months of beach seine sampling were not strictly comparable because the first two areas sampled, False Bay and Cattle Point, were found to be atypical of the habitat. False Bay especially was of such a configuration that at low tide the majority of the bay's nearshore fish were intensely concentrated in the only location available for beach seine sampling. Eagle Cove was finally established as the site for this habitat and the data for that assemblage were continuous from September.

Except for during early winter periods of storm action and wave turbulence in the nearshore region (preventing any sampling in December), the composition of the assemblage remained relatively constant through January (minimum surface water temperatures were encountered). Part of the reason for this phenomenon is that the incidence and abundance of surf smelt increased significantly during their January-February spawning period. Once this period had passed, the overall assemblage diminished until June when, with the occurrence of abundant juvenile chum salmon, it began to re-establish itself.

Dominants of the nearshore demersal fauna include surf smelt, staghorn sculpins, starry flounders, juvenile English sole, and sand sole, with the latter three species maintaining some representation in the community throughout the year. Owing to the early sampling irregularity, several other species may not be represented in the July-August data equivalent to their actual role in the assemblage. Hence, Pacific sand lance, juvenile walleye pollock and Pacific tomcod, and shiner perch should also be considered as potentially important, although more intermittent, members of the assemblage. As mentioned, juvenile chum salmon are very abundant in the habitat in May and June, while coho salmon juveniles are commonly encountered from July through October.

That portion of the assemblage in the nearshore surface waters adjacent to the sand/eelgrass habitat is analogous to the demersal fauna in many respects. Pacific sand lance, starry flounders, surf smelt, shiner perch, and staghorn sculpins are well represented in the nighttime tow net catches; typically pelagic species captured include Pacific herring, threespine sticklebacks, and occasional spiny dogfish. Juvenile chum salmon began appearing in abundance in May, especially in the eastern north Sound study areas. The Cherry Point and Anacortes study sites additionally proved to be more species-rich and productive in terms of the abundance and biomass of nearshore pelagic fish fauna as compared to the San Juan Island study site. This may, however, be a consequence of the sizable sand/eelgrass habitat at the Birch Bay and Guemes Island East sites relative to the confined sand/eelgrass area at Eagle Cove on San Juan Island. This is further manifested in our ability to tow net over the sand/eelgrass habitat at the two eastern sites while we can only sample adjacent to the habitat on San Juan Island. Additionally, Eagle Cove is distinctly more exposed than either Birch Bay or Guemes Island East suggesting another influence upon the composition and dimension of the pelagic portion of this habitat's nearshore fish fauna during the seasons of inclement weather.

An important phenomenon observed in the tow net data from the protected embayment habitats--the sand/eelgrass and mud/eelgrass-- is that while fish abundances and standing crops of the more exposed habitat assemblages declined in the fall, they increased significantly during the fall sampling period in the protected habitats (Fig. 16). While it cannot be verified within the scope of the Nearshore Fish Survey sampling design, the implication is that nearshore pelagic fish fauna congregate in the protected embayments at this time of the year. The cause of this potential migration has yet to be determined. This phenomenon was essentially repeated in the spring when the pelagic larvae of several dominant members of the nearshore surface assemblages were captured in abundance in these embayments, suggesting that if they are not optimum habitats for food and protection for the adult populations in the fall, they apparently offer an advantageous environment for spawning fish or aggregations of their early life stages.

Mud/Eelgrass. In this general examination, it was apparent that the demersal component of the nearshore fish assemblage characterizing mud flats with abundant eelgrass beds, such as sampled at Westcott Bay, San Juan Island, was second only to the gravel habitat assemblage in species richness, fish abundance, and standing crop. Considering the unusually heterogeneous character of the gravel habitat sampled at Deadman Bay, the mud/eelgrass assemblage may indeed be comparable or superior to that associated with less diverse gravel habitats.

Dominants in the demersal component of this assemblage included juvenile English sole and starry flounders, threespine sticklebacks, staghorn sculpins, tidepool sculpins, spiny lumpsuckers, snake pricklebacks, shiner perch, sharpnose sculpins, saddleback gunnels, and surf smelt.

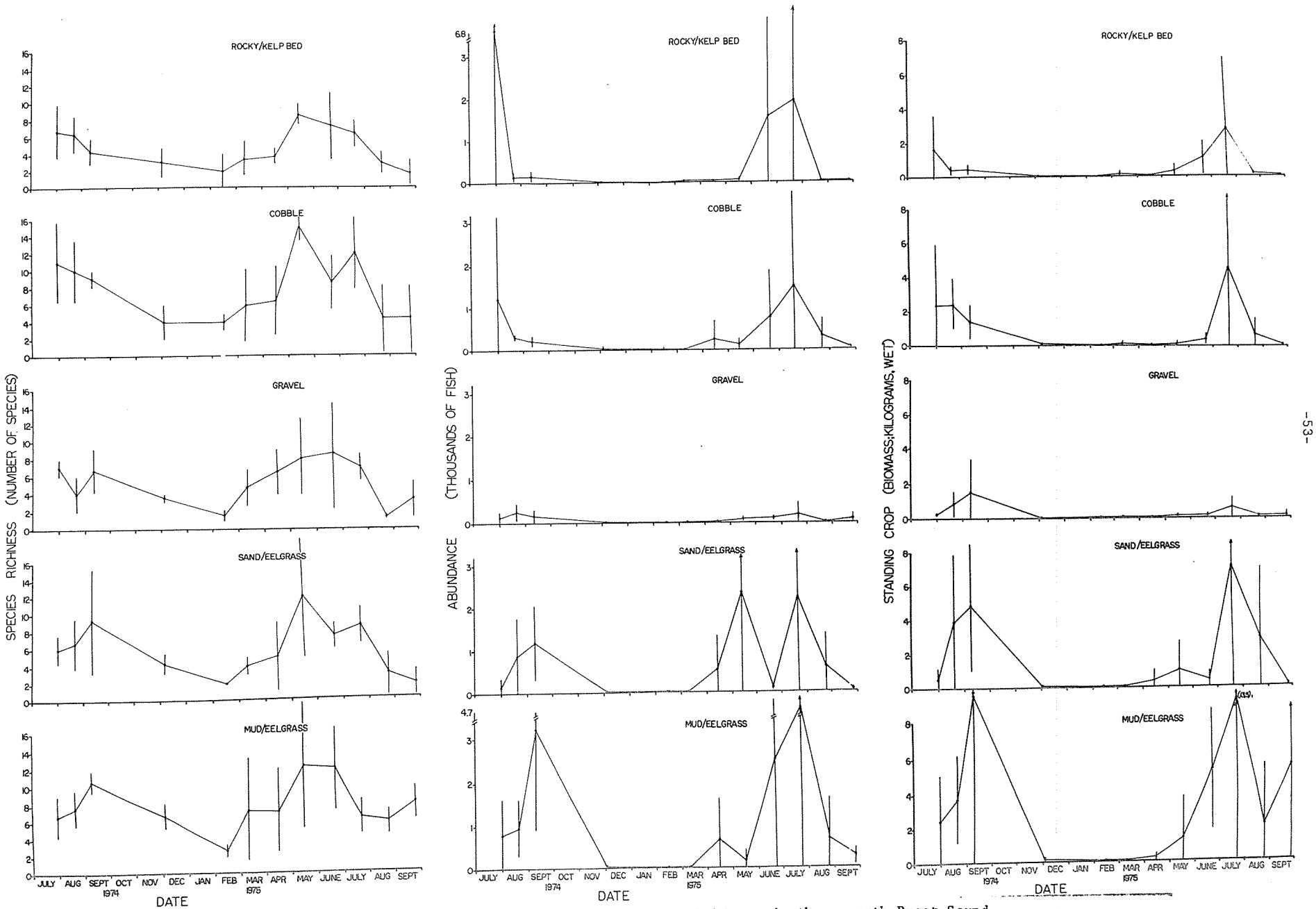


Fig. 16. Combined mean tow net catches over five habitats in three north Puget Sound sampling areas: (a) Species richness, (b) abundance (number of fish), and (c) standing crop (kilograms). One standard deviation shown by line on either side of mean.

The nearshore demersal fish fauna was maintained at a remarkably stable number of species, abundance, and standing crop biomass from a July peak through December. Coincident with a sharp decline in nearshore surface water temperatures to below 5.5°C in January, the assemblage diminished to a minimum in March and April. In April, the larvae and juveniles of Pacific herring, surf smelt, Pacific sand lance, and kelp greenling began appearing in the nearshore regions; by May, juvenile staghorn sculpins were also abundant and several of the dominant species were again recurring.

When comparing the nearshore surface fish fauna from the mud/eelgrass habitat with that of the other communities, it is apparent that this habitat generally supported the richest, most abundant pelagic fish fauna of those sampled. Dominant species included Pacific herring, threespine stickleback, surf smelt, and staghorn sculpins with less frequent abundances of shiner perch and chinook salmon. The other 16 or 18 species infrequently captured in pelagic waters were usually immigrants from adjacent habitats or from the demersal component of that assemblage. Peak catches occurred in this habitat in September with the suspected inshore movement of pelagic fish into the protected embayments. As with all habitats, the pelagic component of the assemblage was sparse during December through February, and began increasing in April with the appearance of larval Pacific herring and Pacific sand lance and schools of threespine sticklebacks.

Consistent differences in composition of the assemblage were not apparent among the three areas wherein the pelagic fauna in the mud/eelgrass habitat was sampled. Abundance and standing crop, however, are extremely variable with the San Juan Island site typically being the most productive.

Summarizing the composition of the nearshore fish assemblages in the five north Puget Sound shoreline habitats (Table 8), it is apparent that the habitats possessed distinctive fish faunas. Most of those species specifically associated with one habitat were demersal forms which are distinctively adapted to the habitat's characteristic substrate and associated benthic flora and fauna.

Few pelagic species were confined to any specific habitat. Instead, Pacific herring, threespine stickleback, surf smelt, Pacific sand lance, and juvenile salmonids ranged the nearshore surface waters common to the north Sound shoreline environment, though their populations seasonally congregated in preferred habitats. Their early life history stages were also characteristically found in these same habitats. Widely distributed demersal species were rare, including the shiner perch and staghorn sculpin.

In addition to those fishes which maintained resident populations in the nearshore waters, the juvenile forms of several common offshore species utilized the nearshore environs. Pacific tomcod, walleye pollock, and juvenile English sole were all dominant members of the shallow-water communities characterizing the five habitats. Juvenile English sole, however, was the only one species that was widely distributed among the five.

Table 8. Community dominants documented for five nearshore habitats in north Puget Sound during Nearshore Fish Survey, 1974-75. C = common to both demersal and pelagic sampling; P = pelagic only; and D = demersal only.

Species	HABITAT				
	Rocky/ kelp bed	Cobble	Gravel	Sand/ eelgrass	Mud/ eelgrass
Kelp greenling	D		D		
Copper rockfish	D		D (juveniles)		
Longfin sculpin	D				
Quillback rockfish	D				
Black rockfish	P				
Lingcod	D				
Yellowtail rockfish	D				
Pacific tomcod (juveniles)		D	D		
Pacific herring (juveniles)	P	C	C	P	P
Padded sculpin		D	D		
Sharpnose sculpin		D			
Buffalo sculpin		D	D		
Shiner perch		D	D	P	D
Ratfish		D			
Walleye pollock (juveniles)		D			
Ringtail snailfish		D			
Silverspotted sculpin			D		
Tubesnouts			D		
Whitespotted greenling			D		
Staghorn sculpin	P*	P*	D	C	C
English sole (juveniles)			D	D	D
Tubenose poacher			D		
Tidepool sculpin			D		D
Crescent gunnel			D		
Starry flounder				C	D
Surf smelt		P		C	C
Sand sole				D	
Snake prickleback					D
Threespine stickleback	P	P	P	P	C
Saddleback gunnel					D
Spiny lumpsucker					D
Longfin smelt	P	P			
Chinook salmon (juveniles)	P	P	P		
Pacific sand lance		P	P	P	
Chum salmon (juveniles)			P		
Spiny dogfish				P	

*Refer to text for discussion of pelagic occurrence of staghorn sculpin.

Juveniles of Pacific herring and the prevalent Pacific salmon utilized the north Sound nearshore during their first year in marine waters before migrating out of Puget Sound into oceanic areas to feed until returning as adults years later. While they have not been captured in Nearshore Fish Survey sampling, spawning populations of adult Pacific herring have been documented throughout the north Sound region including sampling sites at Westcott Bay, Birch Bay, Cherry Point, Lummi Bay, and Pt. Migley (Millikan, et al., 1974). To a great extent, Pacific salmon spawning habitat is limited in the Puget Sound archipelago (small chum and pink salmon runs occur in scattered streams, including several artificial runs). The waters of the north Sound are, however, along the principal migration routes of both outmigrating juveniles and returning adults from northwestern Washington and British Columbia spawning grounds. Although juvenile sockeye salmon are present in great abundance during the spring outmigration, they typically occupy the offshore pelagic waters and are not as common to the nearshore environs as the other species of Pacific salmon. And while the juvenile chum and pink salmon schools appear to pass quickly through the inshore waters of the Sound, chinook and coho juveniles are common in nearshore waters through the summer of their migration into late fall. Pink salmon, it should be noted, were not captured in any abundance through the first year of the survey which occurred during an off-peak year (even-numbered year) in pink salmon spawning in Puget Sound. Peak spawning should occur during the following year and the relative occurrence and abundance of pink juveniles should be determined during the next sampling year.

Food Web Associations

With some knowledge of the ecology of the specific prey organisms occurring in the diets of north Puget Sound nearshore fish, the feeding behavior and trophic relationships between the fish and the habitat's available prey resources may be illustrated. While bearing in mind the insufficient sample size for the number of stomachs examined and the very preliminary nature of these results, the following qualitative species-specific discussions of diet composition provide some beginning indications of the role of the analyzed fish in the nearshore food web about north Puget Sound.

Juvenile Coho Salmon. Juvenile coho salmon apparently were feeding in the pelagic surface waters immediately adjacent to the shoreline, their diet emphasizing pelagic and epibenthic crustaceans and small fishes. The dominant food organisms were epibenthic amphipods, *Eusiroides* sp., *Allorchestes* spp., and *Atylus* sp., which comprised the majority of the amphipods in the diet. The swarming, epibenthic mysid, *Holmesiella anomala*, was the second most important single food item. Fish, which contributed heavily to the total diet composition, were rarely found in an identifiable state, although small, juvenile herring were included in that category. The copepods and isopods were pelagic forms.

Juvenile Chum Salmon. In their early months (April-May) in nearshore marine waters, juvenile chum fed dominantly on epibenthic harpacticoid

copepods. Later into their summer residence in nearshore waters, their diet began to include a higher proportion of larger epibenthic or pelagic crustaceans, i.e., amphipods, mysids, cumaceans, and euphausiids, and larval fish.

Staghorn Sculpin. In accordance with being the species most universally distributed among the nearshore habitats studied, the staghorn sculpin also appears to be the universal omnivore. Its principal food organisms are diverse benthic crustaceans and fish, the latter contributing the greatest proportion of the biomass consumed. The fish consumed were primarily shiner perch, crabs were *Cancer magister*, shrimp were dominantly *Crangon* sp., and amphipods typically *Atylus* sp.

Starry Flounder. The diet of this large flatfish indicates that it is an omnivorous benthic predator, consuming fish, polychaete annelids, and benthic crustaceans and molluscs.

Copper Rockfish. Copper rockfish (mostly from the gravel habitat site at Deadman Bay) also fed dominantly on benthic organisms--demersal fish, polychaete annelids, and crustaceans.

Silverspotted Sculpin. As sampled from Deadman Bay, this small cottid was found to have a highly specialized diet emphasizing shrimp (*Heptacarpus stimpsoni* (?)) and gammarid amphipods (*Amphithoe* sp.).

Black Rockfish. A pelagic schooling species, black rockfish contained both benthic pelagic crustaceans and fish in its diet. A significant proportion of the decapod crustaceans consumed in late summer was in the form of megalops stages of both shrimp and crabs. The most prevalent amphipod by far was the epibenthic species, *Eusiroides* sp. and *Atylus* sp., the shrimp, *Heptacarpus stimpsoni*, and the crab, *Cancer oregonensis*.

Juvenile Pacific Herring. All Pacific herring examined had consumed the pelagic calanoid copepod, *Epilabidocera amphitrites*.

Ratfish. Because of the unique spiral valve structure of the ratfish digestive organ, stomach contents examinations were more difficult for this species and the results most preliminary. Indications are that this nocturnal predator in nearshore waters emphasizes its feeding upon fish--primarily Pacific herring--crabs (*Cancer magister, C. oregonensis,* and *Telmessus cheiragonus*), and a diverse assortment of amphipods, specializing on *Paraphoxus spinosa* (?), molluscs, polychaetes, and both valviferan and flabelliferan isopods.

Kelp Greenling. The large contribution of detritus to the total stomach contents biomass suggests that this species feeds along the bottom; the diverse composition of its diet suggests that it is typically omnivorous. The fish were not identifiable. Crabs were usually *Oxyrhyncha* sp., *Telmessus cheiragonus*, or *Cancer magister*, the epipelagic amphipods *Eusiroides* sp. and *Amphithoides* sp., and the shrimp *Heptacarpus stimpsoni* (?).

Surf Smelt. The pelagic, schooling surf smelt appeared to concentrate on an unidentified annelid species and both harpacticoid and calanoid copepods.

Tubesnout. Other than a small contribution from benthic isopods and molluscs, tubesnouts fed upon epibenthic amphipods.

Snake Prickleback. Apparently focusing their feeding on the benthic epifauna, the diet of this species emphasized annelids, bivalve molluscs (siphon tips), annelids, and tanidaceans.

Whitespotted Greenling. Like the kelp greenling, whitespotted greenling diet is primarily composed of benthic or epibenthic crustaceans. Decapods included three crab species--*Pugettia gracilis, Cancer oregonensis,* and *Oxyrhyncha* sp.--and dominantly one shrimp, *Heptacarpus stimpsoni* (?). The prevalent amphipod was again the epibenthic form *Eusiroides* sp. Fish found in the whitespotted greenling stomachs were not positively identifiable but resembled juvenile rockfish, *Sebastes* sp.

Shiner Perch. Shiner perch stomachs contained approximately equal biomass proportions of polychaete annelids, cumaceans, and caprellid amphipods, and to a lesser extent, gammarid amphipods, indicating feeding on bottom-associated fauna. Considering the habitats involved and the ecological characteristics of these prey organisms, it is likely that this species is feeding upon organisms attached or associated with eelgrass or algal vegetation.

Rock Sole. As a benthic feeder, rock sole appear to consume dominantly benthic amphipod forms, annelids and cumaceans.

Threespine Stickleback. This pelagic schooling species was the only fish found to prey selectively or to any significant degree on the pelagic euphausiid populations. Cumaceans, typically benthic or epibenthic organisms, contributed a small percentage of the overall consumed biomass.

Striped Seaperch. The stomachs of the few specimens examined all contained a diverse assemblage of epibenthic amphipods.

Pacific Sand Lance. The Pacific sand lance, like the herring a pelagic schooling species, fed exclusively upon the dominant calanoid copepod, *Epilabidocera amphitrites.*

C-O Sole. A demersal flatfish, the C-O sole stomachs contained predominantly annelids and a scattering of gammarid amphipods, shrimp, molluscs, and mysids, all benthic or epipelagic organisms.

Juvenile English Sole. Juvenile English sole stomachs contained only an unidentified polychaete annelid.

Buffalo Sculpin. Two buffalo sculpin stomachs were almost completely filled with an ulvoid type of alga. It is doubtful that this species is

herbivorous and it is more likely that the algae were consumed in conjunction with the predation upon organisms attached to or hiding within the algae. Many more stomachs will have to be analyzed before any conclusive evidence of this species' diet can be verified.

Yellowtail Rockfish. The bulk of this rockfish's diet was amphipods, principally *Pontogeneia* sp. (type 2) and *Eusiroides*, both epibenthic forms, and a number of less abundant species. The mysid, *Neomysis awatschensis*, also contributed a small proportion to the diet.

Red Irish Lord. *Cancer oregonensis* was the prevalent prey organism for this demersal sculpin; benthic amphipods accounted for the remaining prey biomass.

Saddleback Gunnel. This benthic, almost sedentary, intertidal species appeared to feed upon benthic amphipods, both gammarid and caprellid, and valviferan isopods. The presence of detritus in the form of sand grains and annelid tubes also suggests that this gunnel preys upon tube-building annelids.

Cabezon. This large predaceous sculpin preyed upon *Heptacarpus stimpsoni*, the epibenthic amphipod *Eusiroides* sp., and a crab, *Cancer oregonensis*.

Smoothhead Sculpin. Stomach contents from one sculpin examined contained one mysid, one amphipod, and one shrimp, all specifically unidentifiable.

Great Sculpin. One great sculpin examined had been feeding upon an unidentifiable shrimp, possibly *Heptacarpus*.

Quillback Rockfish. One examined quillback rockfish had consumed a variety of shrimp (*Heptacarpus stimpsoni* (?), *H. tridens* (?), and *Hippolyte clarki* (?)), amphipods, *Eusiroides* sp. and *Atylus* sp., and both flabelliferan and valviferan (*Idotea* sp., *Synidotea* sp.) isopods.

Juvenile Walleye Pollock. Prey from the stomach of one juvenile walleye pollock included the shrimps *Heptacarpus tridens* and *Crangon* sp. and an amphipod, *Atylus* sp.

Examining the distribution of prey organisms occurring in fish from the different nearshore habitats, several distinctions were evident. In the rocky/kelp bed community, fish were important as prey in rockfish, hexagrammid (greenling), and ratfish diets. The cobble habitat provided mysids important in the diets of feeding juvenile coho salmon and fish for both juvenile coho salmon and ratfish. Amphipods and shrimp were dominant prey organisms for many fish appearing in the gravel habitat. Decapod crabs and shrimp also occurred in the diets of demersal feeders common to that habitat. Juvenile chum salmon utilized the gravel habitat to exploit the harpacticoid copepod populations there; later in their early marine residence they include larger epibenthic crustaceans,

amphipods, and cumaceans in their diet. In the sand/eelgrass habitat, annelids, especially polychaetes, become somewhat more important in the diet of community dominants. The mud/eelgrass habitat contributes an abundance of annelids to fishes from this community as well as crustaceans associated with the eelgrass. Calanoid copepods and larval fish were the only significant prey organisms common to pelagic fishes except for one species, the threespine stickleback, which exploited the planktonic euphausiid populations.

SUMMARY

1. The marine environment at five nearshore habitats--rocky/kelp bed, cobble, gravel, sand/eelgrass, and mud/eelgrass--under study in north Puget Sound exhibited particular physical and chemical characteristics over an annual period. Nearshore water temperatures declined gradually from mid-summer (10.5°C max.) to January (4.3°C min.) and increased sharply through the spring. Salinities fluctuated during the late summer (average 29.9°/oo), sustained high stable values in mid-winter (31.5°/oo), and declined from December with increasing spring fluctuations. Dissolved oxygen values indicated well saturated waters, with a fall depression (65%) and optimums in January-February (129%). The shallow, low gradient habitats illustrated more extreme physiochemical variation and fluctuation than the deeper, higher gradient habitats.

2. Nearshore intertidal fish assemblages associated with these habitats indicated distinct compositions and seasonal trends; pelagic fish fauna of the nearshore, however, were not characteristically associated with particular habitats. The survey documented 92 species from the nearshore environs with the number of species (species richness) reaching a maximum during the fall and declining to a minimum in March. Maximum demersal species richness typically occurred in the gravel habitats; surface assemblages were richest in the mud/eelgrass habitats; in both cases the rocky/kelp bed habitat typically possessed the least fish fauna.

3. The existence of schooling fishes complicated comparisons of fish abundance between habitats and areas. The protected, shallow habitats--mud/eelgrass and sand/eelgrass--supported the highest fish densities, peaking in the fall with an influx of juvenile Pacific herring into those nearshore waters, reaching densities close to 1.8 fish/m^3, and again in the spring when the larval and early juvenile forms of Pacific herring, Pacific sand lance, and surf smelt congregated in the protected embayments.

4. Standing crop (biomass) values for nearshore intertidal assemblages ranged from 3 to 4 grams/m^2 in the summer and fall, dropping to less than one gram/m^2 in the winter, with the highest values exhibited in the rocky/kelp bed assemblage and the lowest in the shallow habitats. Surface fish fauna, however, illustrated the reverse ranking in standing crop.

5. Stomach analyses of 30 species of important nearshore fishes indicated the importance of malacostracan crustaceans and fish as prey for nearshore fish communities. Epibenthic amphipods and copepods and shrimps were the most significant food organisms.

LITERATURE CITED

Collias, E.E., and C.A. Barnes. 1966. Physical and chemical data for Puget Sound and approaches, January 1966 - December 1966. Univ. Wn. Dept. Ocean. Tech. Rept. 161.

Hart, J.L. 1973. Pacific fishes of Canada. Fish. Res. Bd Canada Bull. 180, 740 pp.

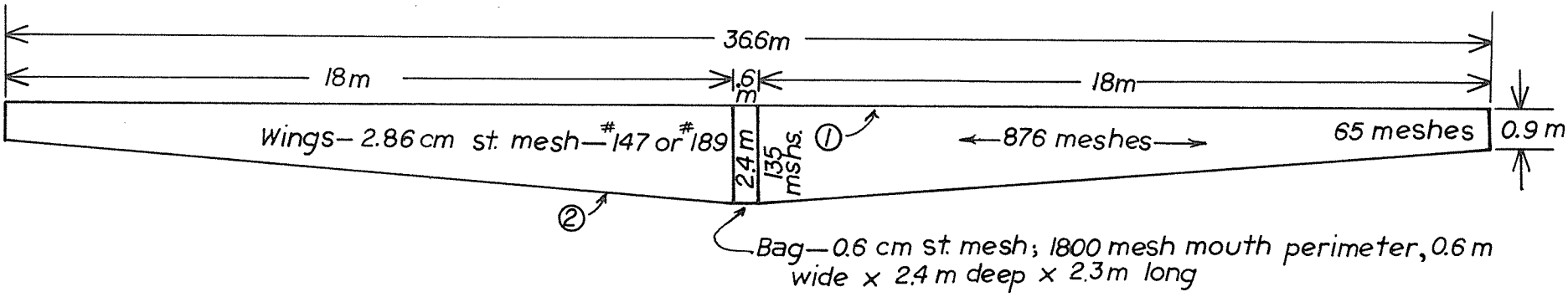
Hedgpeth, Joel W. (ed.). 1963. Treatise on marine ecology and paleoecology. Vol. 1. The Geological Society of America, Memoir 67, p. 18.

Millikan, A., D. Penttila, and D. Day. 1974. Puget Sound baitfish study. July 1, 1973 - June 30, 1974. Wash. Dept. Fish., Mar. Fish. Invest. Prog. Rept., 31 pp.

University of Washington, Department of Oceanography. 1954. Puget Sound and approaches: A literature survey. 3 vols.

APPENDIX 1

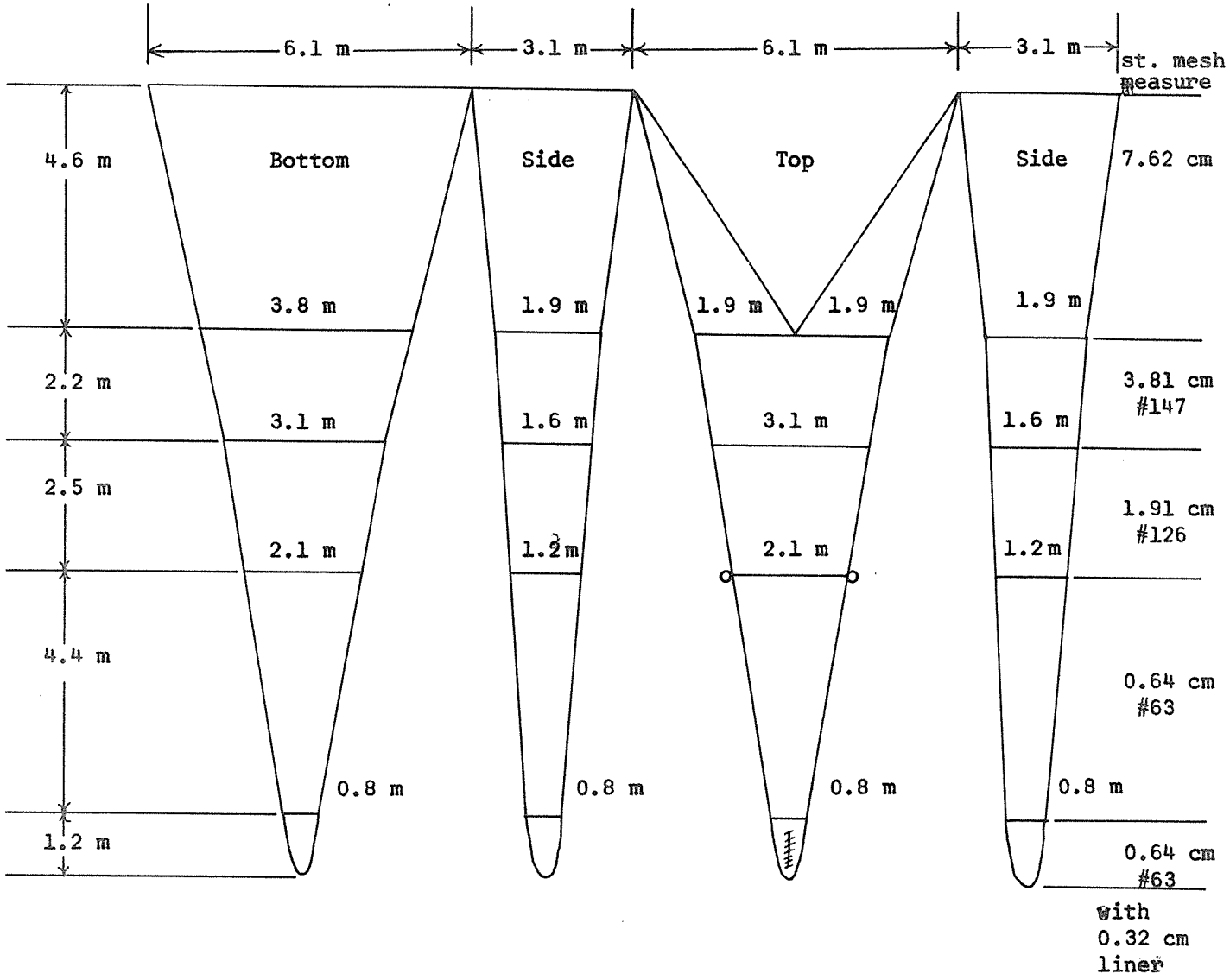
Nets utilized during the 1974-1975 Nearshore Fish Survey



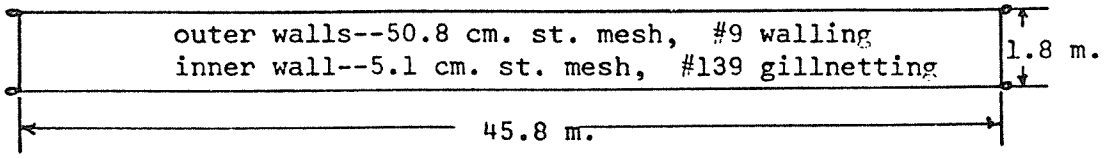
Appendix 1a. Convertible beach seine utilized during Nearshore Fish Survey, July 1974 - June 1975.

Appendix 1b. Surface tow net utilized during Nearshore Fish Survey, July 1974 - June 1975.

Surface Trawl - 2.1 m x 3.1 m mouth
15 m long



All seams of 3.81 cm and smaller mesh reinforced with heavy 2.54 cm nylon tape including center lines of bottom and top panels. Rib-lines of 0.95 cm diameter polypro on four corner seams full length. Mouth of net double twine and hung on 0.35 cm polypro single braid with mimbles at each corner. A 0.9 m nylon coil zipper shall be sewn into cod-end and liner in the top panel. Six 4-oz. leads shall be spaced evenly along the foot line. 5.08 cm rings shall be sewn on top panel at 1.91 cm - 0.64 cm seam.



floatline: 1.3 cm. polycore with one B-2 float every 7th hanging
leadline: 34 kg. leadcore

Appendix 1c. Trammel net used in Nearshore Fish Survey.

APPENDIX 2

Data forms utilized during 1974-1975
Nearshore Fish Survey

ECOLOGY AND DISTRIBUTION OF PUGET SOUND FISHES
COLLEGE OF FISHERIES / FISHERIES RESEARCH INSTITUTE
UNIVERSITY OF WASHINGTON

COLLECTION NUMBER [ ][ ][ ][ ][ ] (5) HAUL NUMBER [ ][ ] (7) DATE DAY [ ][ ] (9) MONTH [ ][ ] (11) YEAR [ ][ ] (13)

LOCATION _____ CODE SUBAREA [ ][ ] (15) SITE [ ][ ][ ] (18)

LATITUDE _____ LONGITUDE _____

HABITAT TYPE _____ CODE [ ][ ] (20)

BOTTOM TYPE _____ CODE [ ] (21) EXPOSURE _____

BOTTOM DEPTH [ ][ ][ ][ ] (25) *meters* COLLECTION DEPTH [ ][ ][ ][ ] (29) *meters*

GEAR TYPE _____ CODE [ ][ ][ ] (32)

LINE OUT _____ *m.* WIRE ANGLE _____ ° SPEED _____ *km/hr*

DISTANCE FISHED [ ][ ][ ][ ] (36) *meters* TIME: START [ ][ ][ ][ ] (40) *hours* DURATION [ ][ ][ ][ ] (44) *minutes*

AREA FISHED [ ][ ][ ][ ] (48) $meters^2$ VOLUME STRAINED [ ][ ][ ][ ][ ] (54) $meters^3$

WEATHER: WIND SPEED _____ *km/hr* DIRECTION _____ VISIBILITY _____ *kilometers*

% CLOUD COVER _____ PRECIPITATION _____

AIR TEMPERATURE _____ °C

SEA: SURFACE TEMPERATURE [ ][.][ ] (57) °C TIDE: STAGE _____ [ ] (58) HEIGHT [ ][.][ ] (61) *meters*

VISIBILITY (SECCHI) @ _____ *m.* DEPTH [ ][.][ ] (64) *meters* SEA STATE _____

COLOR _____ CURRENT: DIRECTION _____ VELOCITY _____ *km/hr*

WATER SAMPLES: DEPTH _____ *m.* TEMPERATURE [ ][.][ ] (67) °C

DEPTH _____ *m.* SALINITY [ ][.][ ] (70) °/oo BOTTLE NUMBER _____

DEPTH _____ *m.* O_2 [ ][ ][ ] (73) % *sat.* BOTTLE NUMBER _____

PERSONNEL _____

HANDLING OF FISH CATCH _____ CODE [ ] (74)

REMARKS _____

FORM TYPE [0] (77)

Appendix 2b.

REVISED S240.1
CATCH SUMMARY FORM

ECOLOGY AND DISTRIBUTION OF PUGET SOUND FISHES
COLLEGE OF FISHERIES / FISHERIES RESEARCH INSTITUTE
UNIVERSITY OF WASHINGTON

COLLECTION		DATE		
Number	Hl	Day	Mo.	Yr.
5	7	9	11	13

	SPECIES	SPECIES CODE	TOTAL NUMBER	TOTAL WEIGHT *grams*	DATA	REMARKS	SPECIES	SPECIES CODE	TOTAL NUMBER	TOTAL WEIGHT *grams*	DATA	REMARKS	FORM TYPE
		17	22	27	28			32	37	42	43		77
1													1
2													1
3													1
4													1
5													1
6													1
7													1
8													1
9													1
10													1
11													1
12													1
13													1
14													1
15													1
16													1
17													1
18													1
19													1
20													1
21													1
22													1
23													1
24													1

REMARKS _____

Appendix 2c. ~~11/04/74~~ REVISED FISH EXAMINATION FORM S240.2

11/14/74

ECOLOGY AND DISTRIBUTION OF PUGET SOUND FISHES
COLLEGE OF FISHERIES / FISHERIES RESEARCH INSTITUTE
UNIVERSITY OF WASHINGTON

COLLECTION NUMBER	COLLECTION HL.	DATE DAY	DATE MO.	DATE YR.		SPECIES	NORMAL/ ABNORMAL	PRES. METHOD	LENGTH TYPE	LENGTH mm	ROUND WEIGHT grams	SEX	MATURITY	AGE METHOD	AGE	L.H. STAGE	FIN ROT dsl.	FIN ROT anal	FIN ROT cdl.	FIN ROT E.pt.	FIN ROT B.pt.	FIN ROT E.vtl	FIN ROT B.vtl	TOTAL AEN TUMORS	AEN eyed side	AEN blind side	TOTAL EP TUMORS	EP eyed side	EP blind side	EXT. NEMATODES	(individual remarks)	SPECIMEN NUMBER	FORM TYPE		DATA SOURCE
5	7	9	11	13		16	18	19	20	24	30	31	32	33	35	36	37	38	39	40	41	42	43	45	47	49	51	53	55	56		76	77		80
					1																												2		
					2																												2		
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					24																												2		
					25																												2		

Species

REMARKS ______________________________

Ecology and Distribution of Puget Sound Fishes
College of Fisheries
University of Washington

Appendix 2d.

Form S240.3
Stomach Examination

Collection		Date			Specimen Number	Species			Condition Fac.	Digestion Fac.	Total Contents	1			2			3			Form Type		Continuation
Number	Haul	Day	Month	Year		Code	L.H. Stg				Weight grams	Food Organism Code	No.	Weight grams	Food Organism Code	No.	Weight grams	Food Organism Code	No.	Weight grams			
5	7	9	11	13	15	18	19		22	23	28	37	40	44	53	56	60	69	72	76	77		80
1																							
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25																							

Remarks: _____

ECOLOGY AND DISTRIBUTION OF PUGET SOUND FISHES
College of Fisheries/Fisheries Research Institute
University of Washington

Appendix 2e.

Form S240.4
Stomach exam.-prey freq.

Collection		Date		
Number	Haul	Day	Month	Year
5	7	9	11	13

Species _____

Specimen Number	Species Code	L.H.stage
15	18	19

Prey organism taxa (initial sorting) _____

Organism code				L.H.stage
Phylum Class	Order Family	Genus	Species	
21	23	25	27	28

Prey species
(final determination)

Organism code				L.H.stage	Number	
Phylum Class	Order Family	Genus	Species			
					40 52 64 76	80 Continuation
				4	77	
					40 52 64 76	80
				4	77	
					40 52 64 76	80
				4	77	
					40 52 64 76	80
				4	77	
					40 52 64 76	80
				4	77	

Appendix 3. Temperature, salinity, and dissolved oxygen values from fifteen tow net sites in north Puget Sound

	31-7-74 → 3-8-74	20-8-74 → 23-8-74	10-9-74 → 13-9-74	4-12-74 → 6-12-74	14-2-75 → 19-2-75	10-3-75 → 12-3-75	14-4-75 → 17-4-75
Pt. George		10.5 24.0	10.2 29.7	8.1 31.0	6.1 30.9 89	6.6 30.4 88	7.4 31.0 86
South Beach		10.5 26.5	9.9 30.2	8.1 31.2	6.2 31.9 91	6.5 31.0 89	7.5 31.2 90
Eagle Cove (Cattle Pt.)		12.0 27.0	9.8 30.5	8.1 31.2 83	6.4 31.4 91	6.4 31.0 89	7.5 31.2 90
Deadman Bay		11.0 27.2	9.6 30.6	8.1 31.5	6.3 31.7 91	6.3 31.2 85	7.4 31.5 83
Westcott Bay		11.2 26.8	13.4 29.9	8.0 31.2	5.4 30.9 88	6.4 30.9 99	8.7 31.2 97
Birch Bay	18.5 18.8	16.0 24.0	13.3 28.0	7.9 30.4	5.4 30.0 97	7.1 30.0 101	8.7 30.3 115
Cherry Pt.	17.0 19.2	12.1 24.4	10.8 29.1	8.0 23.6	5.6 30.2 94	6.6 30.4 105	7.6 30.5 97
Lummi Bay		14.5 24.8	11.8 29.9	8.0 23.5	5.5 29.8 96	6.4 30.3 96	8.0 30.1 96
Pt. Migley		12.5 25.8	10.2 29.6	8.0 23.2 77	5.8 30.5 92	6.3 30.4 90	7.3 30.3 91
Village Pt.		12.0 26.4	10.5 29.6	8.0 22.8	6.0 30.4 92	6.5 30.4 91	7.3 30.5 92
Guemes Is. E.	14.2 21.2	 25.5	12.7 28.5	8.0 22.2	Inclement weather	6.5 29.7 95	7.9 31.5 104

Appendix 3. Temperature, salinity, and dissolved oxygen values from fifteen tow net sites in north Puget Sound - continued

	12-5-75 →14-5-75	24-6-75 →26-6-75	22-7-75 →25-7-75	19-8-75 →22-8-75	22-9-75 →25-9-75
Pt. George	8.2 30.5 89	9.3 31.5 78	10.1 28.6 84	10.9 28.8 89	10.6 21.9 66
South Beach	8.3 31.2 85	9.4 31.7 77	10.5 30.1 86	10.3 30.0 77	10.3 22.2 73
Eagle Cove (Cattle Pt.)	8.4 31.3 84	9.3 31.7 74	10.1 30.2 90	10.2 30.0 82	10.3 22.9 67
Deadman Bay	8.2 31.3 82	9.0 31.8 74	9.5 30.6 78	10.0 30.1 76	10.6 21.6 72
Westcott Bay	10.3 30.9 105	10.4 31.8 72	11.1 29.6 116	12.9 28.8 158	13.2 20.3 118
Birch Bay	11.4 30.5 174	10.3 30.5 97	17.5 22.5 141	15.0 25.8 144	13.2 20.5 121
Cherry Pt.	9.1 30.3 107	10.3 30.0 105	14.1 24.8 133	12.8 28.2 119	12.3 20.8 109
Lummi Bay	9.2 30.3 97	9.4 31.0 86	12.5 26.1 116	11.4 29.0 86	12.1 21.9 81
Pt. Migley	8.8 30.3 94	9.3 31.1 84	11.9 27.2 92	11.3 29.0 91	11.3 21.5 54
Village Pt.	8.4 30.6 90	9.2 31.2 80	11.1 28.4 87	Inclement Weather	11.1 20.3 75
Guemes Is. E.	8.5 30.3 89	9.7 30.8 96	12.6 27.2 101	11.2 28.8 89	11.7 20.7 89

Appendix 3. Temperature, salinity, and dissolved oxygen values from fifteen tow net sites in north Puget Sound - continued

	31-7-74 → 3-8-74	20-8-74 → 23-8-74	10-9-74 → 13-9-74	4-12-74 → 6-12-74	14-2-75 → 19-2-75	10-3-75 → 12-3-75	14-4-75 → 17-4-75
Padilla Bay	18.0 20.7	 26.3	12.4 28.9	7.9 20.9	Inclement weather	6.7 28.8 101	7.5 30.3 99
Guemes Is. S.	14.0 23.0	 25.0	11.6 29.1	Inclement weather	Inclement weather	6.4 29.9 92	7.9 30.8 93
Shannon Pt.	12.5	 26.0	10.3 29.9	7.9 22.8	6.2 30.4 91	Gear breakdown & inclement weather ↓	7.6 30.8 90
Burrows Is.	11.8 24.5	 25.5	9.4 30.3	7.9 23.0 83	6.2 30.4 89		7.3 30.7 87

LEGEND

Temp ° C.

Salinity °/oo D.O. % Sat.

Appendix 3. Temperature, salinity, and dissolved oxygen values from fifteen tow net sites in north Puget Sound - continued

	12-5-75 →14-5-75	24-6-75 →26-6-75	22-7-75 →25-7-75	19-8-75 →22-8-75	22-9-75 →25-9-75
Padilla Bay	8.8 30.4 90	11.0 30.8 96	12.9 29.3 96	11.2 29.0 77	12.6 20.0 96
Guemes Is. S.	8.6 30.6 89	9.9 30.8 80	11.3 29.2 82	10.7 29.4 73	11.6 20.9 75
Shannon Pt.	8.5 30.5 87	9.6 30.9 79	11.4 28.9 83	10.5 29.6 83	10.3 21.3 69
Burrows Is.	8.3 30.9 85	9.2 31.1 80	10.7 28.9 79	Inclement weather	10.1 22.8 72

APPENDIX 4

Relative occurrence, according to habitat, of species captured during beach seine, tow net, trammel net, and SCUBA surveys. X signifies common occurrence, abundant (relative to that species) in more than 50% of the samples; 0, uncommon occurrence, not abundant (relative to that species) in more than 50% of the samples; and #, uncommon occurrence but in abundance when encountered

Appendix 4. Relative occurrence, according to habitat, of species captured during beach seine, tow net, trammel net, and SCUBA surveys. X signifies common occurrence, abundant (relative to that species) in more than 50% of the samples; 0, uncommon occurrence, not abundant (relative to that species) in more than 50% of the samples; and #, uncommon occurrence but in abundance when encountered

Sampling method	Beach Seine				Tow Net					Trammel Net	SCUBA Transect
Habitat	Mud / eelgrass	Sand / eelgrass	gravel	cobble	Mud / eelgrass	Sand / eelgrass	gravel	cobble	Rocky/ kelp bed	Rocky/ kelp bed	Rocky/ kelp bed
Species											
Phylum Chordata											
Class Agnatha											
Family Petromyzontidae											
Entosphenus tridentatus Pacific lamprey							0		0		
Lampetra ayresi, river lamprey					0	0		0			
Class Chrondrichthyes											
Family Squalidae											
Squalus acanthias, spiny dogfish				0	X	X	X		0	X	0
Family Rajidae											
Raja binoculata, big skate	0										
Family Chimaeridae											
Hydrolagus colliei, ratfish		0	0	X		0				X	
Class Osteichthyes											
Family Clupeidae											
Clupea harengus pallasi, Pacific herring	X	X	X	#	X	X	X	X	X	X	#
Family Engraulidae											
Engraulis mordax, northern anchovy					X	0	0	0	0		
Family Salmonidae											
Salmo clarki, cutthroat trout			0								
Oncorhynchus gorbuscha, pink salmon			0	0	0	0	0	0	0		

Appendix 4. Relative occurrence, according to habitat, of species captured during beach seine, tow net, trammel net, and SCUBA surveys, X signifies common occurrence, abundant (relative to that species) in more than 50% of the samples; 0 uncommon occurrence, not abundant (relative to that species) in more than 50% of the samples; and #, uncommon occurrence but in abundance when encountered - continued

Sampling method	Beach Seine				Tow Net					Trammel Net	SCUBA Transect
Habitat	Mud / eelgrass	Sand / eelgrass	gravel	cobble	Mud / eelgrass	Sand / eelgrass	gravel	cobble	Rocky/ kelp bed	Rocky/ kelp bed	Rocky/ kelp bed
Species											
Oncorhynchus keta, chum salmon		0	#	#	X	X	X	X	X		
Oncorhynchus kisutch, coho salmon		X	0	X	X	X	0	X	X		
Oncorhynchus tshawytscha, chinook salmon					X	X	X	X	X		
Salmo clarki, cutthroat trout			0								
Family Osmeridae											
Hypomesus pretiosus, surf smelt	X	X	0	X	X	X	0	X	X		
Spirinchus thaleichthys, longfin smelt					X	0	X	0	X		
Family Batrachoidae											
Porichthys notatus, plainfin midshipman					0			0			
Family Gobiesocidae											
Gobiesox meandricus, northern clingfish		0	0	0							
Family Gadidae											
Gadus macrocephalus, Pacific cod		0									
Microgadus proximus, Pacific tomcod	X	X	X	X	0	X		X	0		
Theragra chalcogramma, walleye pollock	0	X	0	X	0			0			
Family Zoarcidae											
Lycodes palearis, wattled eelpout	X										
Lycodes sp. (unidentified eelpout)						X					

Appendix 4. Relative occurrence, according to habitat, of species captured during beach seine, tow net, trammel net, and SCUBA surveys. X signifies common occurrence, abundant (relative to that species) in more than 50% of the samples; O, uncommon occurrence, not abundant (relative to that species) in more than 50% of the samples; and #, uncommon occurrence but in abundance when encountered - continued

Sampling method	Beach Seine				Tow Net					Trammel Net	SCUBA Transect
Habitat	Mud / eelgrass	Sand / eelgrass	gravel	cobble	Mud / eelgrass	Sand / eelgrass	gravel	cobble	Rocky/ kelp bed	Rocky/ kelp bed	Rocky/ kelp bed
Species											
Oncorhynchus keta, chum salmon		O	#	#	X	X	X	X	X		
Oncorhynchus kisutch, coho salmon		X	O	X	X	X	O	X	X		
Oncorhynchus nerka, sockeye salmon					O		O				
Oncorhynchus tshawytscha, chinook salmon					X	X	X	X	X		
Salmo clarki, cutthroat trout			O								
Family Osmeridae											
Hypomesus pretiosus, surf smelt	X	X	O	X	X	X	O	X	X		
Spirinchus thaleichthys, longfin smelt					X	O	X	O	X		
Family Mytophidae											
Stenobrachius leucopsarus northern lampfish					O						
Family Batrachoidae											
Porichthys notatus, plainfin midshipman					O			O			
Family Gobiesocidae											
Gobiesox meandricus, northern clingfish		O	O	O							
Family Gadidae											
Gadus macrocephalus, Pacific cod		O									
Microgadus proximus, Pacific tomcod	X	X	X	X	O	X		X	X		
Theragra chalcogramma, walleye pollock	O	X	O	X	O			O			
Family Zoarcidae,											
Lycodes palearis, wattled eelpout	X										
Lycodes, sp. (unidentified eelpout)						X					

Appendix 4. Relative occurrence, according to habitat, of species captured during beach seine, tow net, trammel net, and SCUBA surveys. X signifies common occurrence, abundant (relative to that species) in more than 50% of the samples; 0, uncommon occurrence, not abundant (relative to that species) in more than 50% of the samples; and #, uncommon occurrence but in abundance when encountered - continued

Sampling method	Beach Seine				Tow Net					Trammel Net	SCUBA Transect
Habitat	Mud / eelgrass	Sand / eelgrass	gravel	cobble	Mud / eelgrass	Sand / eelgrass	gravel	cobble	Rocky/ kelp bed	Rocky/ kelp bed	Rocky/ kelp bed
Species											
Lycodopsis pacifica larvae, blackbelly eelpout			0	0	0		0	0			
Family Gasterosteidae											
Aulorhynchus flavidus, tubesnout	0	X	X	#	X	0		0			
Gasterosteus aculeatus, threespine stickleback	X	X	X	0	X	X	X	X	X		
Family Syngnathidae											
Syngnathus griseolineatus, bay pipefish	0		X		X	0					
Family Embiotocidae											
Brachyistius frenatus, kelp perch			0								
Cymatogaster aggregata, shiner perch	X	X	X	X	X	X		0		0	
Embiotoca lateralis, striped seaperch			0		0					0	X
Rhacochilus vacca, pile perch	0		X			0					0
Family Trichodontidae											
Trichodon trichodon, Pacific sandfish				0		0	0	0			
Family Stichaeidae											
Anoplarchus purpurescens, high cockscomb	0		0				0				
Lumpenus sagitta, snake prickleback	X	0	0		0	0	0	0	0		
Phytichthys chirus, ribbon prickleback			0								

Appendix 4. Relative occurrence, according to habitat, of species captured during beach seine, tow net, trammel net, and SCUBA surveys. X signifies common occurrence, abundant (relative to that species) in more than 50% of the samples; 0, uncommon occurrence, not abundant (relative to that species) in more than 50% of the samples; and #, uncommon occurrence but in abundance when encountered - continued

Sampling method	Beach Seine				Tow Net					Trammel Net	SCUBA Transect
Habitat	Mud / eelgrass	Sand / eelgrass	gravel	cobble	Mud / eelgrass	Sand / eelgrass	gravel	cobble	Rocky/ kelp bed	Rocky/ kelp bed	Rocky/ kelp bed
Species											
Family Pholidae											
Apodichthys flavidus, penpoint gunnel	X	0	X		0						
Pholis laeta, crescent gunnel		0	X		0	0	0	0	0		
Pholis ornata, saddleback gunnel	X	0	X	0	X	X	0	0	0		
Family Anarhichadidae											
Anarrhichthys ocellatus, wolf-eel											0
Family Cryptacanthodidae											
Lyconectes aleutensis, dwarf wrymouth							0				
Family Ammodytidae											
Ammodytes hexapterus, Pacific sandlance		X	#	0	X	X	X	X	X		
Family Gobiidae											
Clevelandia ios, arrow goby	0										
Coryphopterus nicholsi, blackeye goby											X
Lepidogobius lepidus, bay goby	0										
Family Scorpaenidae											
Sebastes auriculatus, brown rockfish			0								
Sebastes caurinus, copper rockfish			X								X
Sebastes emphaeus, Puget Sound rockfish											X
Sebastes flavidus, yellow-tail rockfish			X								X
Sebastes maliger, quillback rockfish			0								X

Appendix 4. Relative occurrence, according to habitat, of species captured during beach seine, tow net, trammel net, and SCUBA surveys. X signifies common occurrence, abundant (relative to that species) in more than 50% of the samples; 0, uncommon occurrence, not abundant (relative to that species) in more than 50% of the samples; and #, uncommon occurrence but in abundance when encountered - continued

Sampling method	Beach Seine				Tow Net					Trammel Net	SCUBA Transect
Habitat	Mud / eelgrass	Sand / eelgrass	gravel	cobble	Mud / eelgrass	Sand / eelgrass	gravel	cobble	Rocky/ kelp bed	Rocky/ kelp bed	Rocky/ kelp bed
Species											
Sebastes melanops, black rockfish			X							0	X
Sebastes nigrocinctus, tiger rockfish											0
Sebastes larvae/juveniles		0	X		0	0	0	X	0		
Family Hexagrammidae											
Hexagrammos decagrammus, kelp greenling	0		X		0			0	0	X	X
Hexagrammos stelleri, whitespotted greenling			X								
Ophiodon elongatus, lingcod					X						X
Oxylebius pictus, painted greenling											0
Family Cottidae											
Artedius fenestralis, padded sculpin	X	0	X	X							
Artedius harringtoni, scaly-head sculpin			0								X
Artedius lateralis, smooth-head sculpin			X	0				0			
Ascelichthys rhodorus, rosylip sculpin		0		X							
Blepsias cirrhosus, silver-spotted sculpin	0	0	X	0	0	0		0			
Clinocottus acuticeps, sharpnose sculpin	X	0	X	X							0
Enophrys bison, buffalo sculpin	X	X	X	X						0	
Gilbertidia sigalutes, soft sculpin					0	X	0	0	0		

Appendix 4. Relative occurrence, according to habitat, of species captured during beach seine, tow net, trammel net, and SCUBA surveys. X signifies common occurrence, abundant (relative to that species) in more than 50% of the samples; 0, uncommon occurrence, not abundant (relative to that species) in more than 50% of the samples; and #, uncommon occurrence but in abundance when encountered - continued

Sampling method	Beach Seine				Tow Net					Trammel Net	SCUBA Transect
Habitat	Mud / eelgrass	Sand / eelgrass	gravel	cobble	Mud / eelgrass	Sand / eelgrass	gravel	cobble	Rocky/ kelp bed	Rocky/ kelp bed	Rocky/ kelp bed
Species											
Hemilepidotus hemilepidotus red Irish lord			X								X
Jordania zonope, longfin sculpin											X
Leptocottus armatus, Pacific staghorn sculpin	X	X	X	X	X	X	X	X	X		
Myoxocephalus polyacanthacephalus, great sculpin		0	X	0						0	
Nautichthys oculofasciatus, sailfin sculpin			0		0		0			0	
Oligocottus maculosus, tidepool sculpin	X	0	X	0							
Psychrolutes paradoxus, tadpole sculpin			X	0	X	X	0	X	0		
Rhamphocottus richardsoni, grunt sculpin					0		0	0	0	0	
Scorpaenichthys marmoratus, cabezon	0	0	0	0				0		0	
Synchirus gilli, manacled sculpin			X								
Cottid larvae/juveniles unidentified			0		0	0	0		0		
Family Agonidae											
Agonus acipenserinus, sturgeon poacher	X	X	0	0	0	0	0	0	0		
Anaplogonus inermis, smooth alligatorfish							0				
Pallasina barbata, tubenose poacher	0	X	X		0	0					
Xeneretmus latifrons, blacktip poacher					0						

Appendix 4. Relative occurrence, according to habitat, of species captured during beach seine, tow net, trammel net, and SCUBA surveys. X signifies common occurrence, abundant (relative to that species) in more than 50% of the samples; 0, uncommon occurrence, not abundant (relative to that species) in more than 50% of the samples; and #, uncommon occurrence but in abundance when encountered - continued

Sampling method	Beach Seine				Tow Net					Trammel Net	SCUBA Transect
Habitat	Mud / eelgrass	Sand / eelgrass	gravel	cobble	Mud / eelgrass	Sand / eelgrass	gravel	cobble	Rocky/ kelp bed	Rocky/ kelp bed	Rocky/ kelp bed
Species											
Family Cyclopteridae											
Eumicrotremus orbis, spiny lumpsucker	X	0	X	0	0				0		
Liparis callyodon, spotted snailfish	0		0	0	0						
Liparis cyclopus, ribbon snailfish	0										
Liparis florae, tidepool snailfish	X	0	0								
Liparis fucensis (?) slipskin snailfish						0					
L. mucosus											
Liparis pulchellus, tadpole snailfish		0		0							
Liparis rutteri, ringtail snailfish		0	0	X				0			
Liparis sp. (unidentified snailfish)	0		0								
Family Bothidae											
Citharichthys stigmaeus, speckled sanddab			0								
Family Pleuronectidae											
Isopsetta isolepis, butter sole		0									
Lepidopsetta bilineata, rock sole		0	0	0							
Parophrys vetulus, English sole	X	X	X	X	0			X	0		
Platichthys stellatus, starry flounder	X	X	0	0	0	X	0	0			
Pleuronichthys coensus, C-O sole			0	X							

Appendix 4. Relative occurrence, according to habitat, of species captured during beach seine, tow net, trammel net, and SCUBA surveys. X signifies common occurrence, abundant (relative to that species) in more than 50% of the samples; 0, uncommon occurrence, not abundant (relative to that species) in more than 50% of the samples; and #, uncommon occurrence but in abundance when encountered - continued

Sampling method	Beach Seine				Tow Net					Trammel Net	SCUBA Transect
Habitat	Mud / eelgrass	Sand / eelgrass	gravel	cobble	Mud / eelgrass	Sand / eelgrass	gravel	cobble	Rocky/ kelp bed	Rocky/ kelp bed	Rocky/ kelp bed
Species											
Psettichthys melanostictus, sand sole	0	X	0								
Species richness (not including larvae/juveniles of species or genera already recorded from habitat)	31	38	53	37	42	32	29	31	25	7	23

APPENDIX 5

Fish catches, 1974-1975
Nearshore Fish Survey

South Beach, San Juan Island Cobble exposed	July No.	 Wt.
Species:		
Microgadus proximus juveniles	5.0	5.0
Clupea harengus pallasi juveniles	1.0 *0.5*	0.5 *0.1*
Artedius fenestralis	22.0 *9.6*	8.5 *4.0*
Parophrys vetulus juveniles	2.0	1.0
Lepidopsetta bilineata	1.0	238.0
Oncorhynchus keta juveniles	19.0 *2.0*	143.5 *16.0*
O. kisutch juveniles	3.0	150.5
Agonus acipenserinus	3.0 *1.0*	1.0 *0.6*
Clinocottus acuticeps	3.5 *1.0*	1.0 *0.4*
Ascelichthys rhodorus	1.0	0.6
Platichthys stellatus	3.0	2645.5
Enophrys bison	7.5 *1.6*	4.0 *2.0*
Leptocottus armatus	2.0 *1.0*	1.0 *0.3*
Liparis callyodon	0.5	0.3
Pleuronichthys coenosus	0.5	36.0
Myoxocephalus polyacanthocephalus	0.5	0.5
Ammodytes hexapterus	0.5 *2.0*	0.5 *11.0*
Oncorhynchus gorbuscha juveniles	1.0	4.0
Scorpaenichthys marmoratus		
Oligocottus maculosus		

August		September		October		November		December		January		February		March		April		May		June		July		August		September	
No.	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
5.0	3.5	11.0	51.0	44.0	245.1	18.5	167.9	2.0	22.2	3.0	42.5									0.5						153.5	485
		12.5	*67.5*	*22.5*	*135.9*			*0.5*	*3.5*											+						*108*	*347.5*
0.5	0.3	12000	45360	275.5	1950.6	1.5	4.2	0.5	1.3											1		5.5	0.7			9	26.9
		4000	*11325*	*510.5*	*3750.0*	*3.0*	*16.2*													+		*0.5*	*0.4*			*3*	*8.7*
1.5	2.0			35.5	139.4	1.0	3.9	0.5	13.3	0.5	0.8									0.5						3.5	7.8
		0.5	*4.5*	*9.0*	*32.6*																					*0.5*	*1.6*
						1.0	33.4	6.1	0.5											0.5		3.5	0.3			1.5	2.7
																				+							
												0.5	5.5							0.5		0.5	130.7				
																				+							
0.5	5.0																			0.5							
2.0	*22.5*																					*5*	*48.7*				
1.5	23.5																										
0.5	*1.0*	*5.5*	*265.5*	*1.0*	*74.9*																			*0.5*	*45.5*		
																						1	11.2				
																				+							
1.5	0.5			1.0	0.6							0.5	0.5									2.5	0.3	0.5	0.1		
				0.5	*0.5*	*0.5*	*0.5*																	*0.5*	*0.1*	*0.5*	*0.2*
						0.5	7.5													3.5		48.5	16.2	14	9.4	11.5	13.9
				1.0	*1.7*															+						*4*	*4.5*
1.0	1197.5																			0.5				0.5	219.8	0.5	885
0.5	0.5			12.0	62.4	3.0	49.4			1.0	2.2	1.5	5.3							1.5		0.5	11	5.5	10	7.5	60.2
				7.0	*21.6*															+						*1.5*	*2.5*
0.5	26.5			1.0	40.3																					1	24.1
				0.5	*0.4*																	*0.5*	*0.1*				
				8.0	7.7																						
				2.5	*4.2*																						
1.0	32.0			0.5	22.7																						
				2.0	42.0													0.5	14.7			3	3.6			2.5	17.5
																										1.5	*9.9*
																				889.5	9784.5*					24	67.8
																				+						*1.5*	*4.2*
0.5	1.5			3.0	38.8																						
1.0	0.5																										
				1.0	*0.7*																						
0.5	0.3			0.5	0.5																						
0.5	*0.3*																										
1.0	0.5			1.5	12.9			7.0	60.1	2.0	14.9															1.5	36.3
				3.5	*29.9*																					*0.5*	*12.3*
		13.0	5345.0	1.0	742.5			0.5	207.7			0.5	697.5													3.5	2200
																										0.5	*220*
		1.0	5.0	2.0	135.2	1.0	5.0	0.5	9.7																	49	197.5
		1.5	*5.0*																							*23.5*	*90*
		3.0	18000																								
		0.5	*2925.0*																								
				170.5	242.0			1.0	2.8																	1.5	1
				12.5	*17.9*																					*2.5*	*1.3*
				0.5	0.1																						

ine catches.

Appendix 5a, cont'd

Deadman Bay, San Juan Island Gravel, protected	July No.	July Wt.	
Species:			
Sebastes caurinus	15.0 *1.0*	813.5 *64.0*	4
Hexagrammos decagrammus	3.5	3134.5	2
Cymatogaster aggregata	0.5	25.0	1
Blepsias cirrhosus	7.0 *0.6*	11.5 *0.5*	7
Aulorhynchus flavidus	4.0	1.0	14 *1.*
Microgadus proximus juveniles	3.5 *0.6*	2.0 *0.6*	8
Enophrys bison	1.0 *1.5*	1.0 *1.0*	3.
Hexagrammos stelleri	0.5	3.5	0.
Sebastes juveniles	*0.5*	*0.1*	9. *0.*
Artedius fenestralis			6. *0.*
Apodichthys flavidus	5.0	304.0	4.
Hemilepidotus hemilepidotus	0.5	432.5	0.
Oncorhynchus keta juveniles	1.5	12.0	0.
Leptocottus armatus	2.0	1.5	
Lumpenus sagitta	0.5	0.5	
Lepidopsetta bilineata	0.5	83.0	
Pleuronichthys coenosus	0.5	109.0	
Ammodytes hexapterus	1.0 *1.0*	0.5 *3.0*	22.
Clupea harengus pallasi juveniles	3.0 *26.5*	0.5 *33.0*	2. *1.*
Platichthys stellatus	- -		1.5

Blepsi...
Hypomesus p...
Trichodon tricho...
Psychrolutes paradoxu...
Liparis rutteri
Eumicrotremus orbis

ust Wt.	September No.	Wt.	October No.	Wt.	November No.	Wt.	December No.	Wt.	January No.	Wt.	February No.	Wt.	March No.	Wt.	April No.	Wt.	May No.	Wt.	June No.	Wt.	July No.	Wt.	August[1] No.	Wt.	September No.	Wt.
578.5	10.0	1698.5	4.5	849.5	2.5	558.4													0.5							
	1.5	*34.6*			*0.5*	*103.0*													*0.5*							
1534.5	2.5	851.0	0.5	457.5	0.5	138.0							0.5	0.8	0.5	428.2	1.5	1334.9	3.5	2040						
			0.5	*487.0*																			*0.5*	*580*			
26.0	4.0	81.0	11.5	93.3	394.5	4626.5	270.0	3722.0	182.0	2192.3	694.0	1097.5					0.5	5.3	0.5						0.5	15.8
	0.5	*2.5*	*26.5*	*260.1*	*86.5*	*1072.6*	*14.0*	*143.7*			*1.0*	*7.2*											*1*	*12.4*	*0.5*	*2.5*
17.5	4.0	44.0	7.0	560.5	37.0	306.0	5.5	37.1	2.0	23.0	0.5	3.6					3.0	41.2	11.5		2	3			9	15.5
					1.0	*14.7*											*1.5*	*6.9*	*9.5*		*7*	*13.6*	*18.5*	*33.7*	*2*	*10.2*
5.0	11.5	5.0	8.5	11.7	5.0	4.2	4.5	6.9	465.0	1907.5	282.5	1202.5	4.0	12.1	8.0	21.7	1.0	2.8							25.5	15.7
0.4	*1.5*	*4.0*	*2.5*	*6.0*	*0.5*	*0.4*	*0.5*	*2.4*	*7.5*	*31.2*													*15.5*	*3.6*	*15*	*9.3*
10.5	1.5	2.5	1.5	6.1	0.5	3.3																			30	67.4
			0.5	*3.5*																			*6.5*	*3.7*	*20*	*88.8*
53.8	2.5	2.0	12.0	176.8	1.0	14.6	5.0	19.4	2.5	84.5	9.0	38.1			0.5	1.9									1	2.1
	3.5	*5.0*	*7.5*	*9.0*	*17.5*	*47.2*															*3.5*	*0.8*	*2.5*	*2.3*	*3.5*	*5.1*
85.0	1.0	150.5	1.5	288.0	1.5	278.2			0.5	45.8							1.0	211.1								
																	1.0	*47.4*								
3.8	6.0	5.5	5.0	10.2	22.0	72.8	6.0	28.8											0.5		1.5	16			25.5	13.5
0.3			*1.0*	*2.5*	*1.5*	*6.6*															*0.5*	*0.1*	*8.5*	*0.9*	*7*	*12.9*
55.8	4.5	4.5	12.0	36.2	10.0	32.4	10.5	47.5	2.5	7.7	1.0	3.5									1.5	0.7			0.5	0.9
0.3	*2.0*	*3.0*	*7.5*	*18.7*	*7.5*	*37.4*					*0.5*	*11.8*			1.5	2.4	*0.5*	*2.3*			*0.5*	*0.2*	*8*	*5.4*	*8.5*	*11.7*
170.5					1.5	35.3											5.0	117.8	6		5	54				
																	4.0	*114.3*	*7*		*5*	*49.5*	*6*	*107.4*		
370.0	1.0	290.0															1	426.4								
85.0															1.0	0.4	1.5	2.3	0.5							
																	335.5	*395.3*								
	0.5	27.5	0.5	18.8	1.0	204.5			3.5	153.6	1.5	67.3														
					0.5	*45.2*																				
					1.0	5.8																				
											0.5	239.1			0.5	173									0.5	38.2
27.0																	20.5	114.7								
																	0.5	*0.4*								
1.5	4.0	15.5			1.0	7.1	0.5	2.5																	150.5	507.5
0.1	*60.0*	*337.5*	*8.5*	*85.2*	*215.0*	*1412.5*	*2.5*	*14.0*	*4.0*	*31.9*													*0.5*	*2*	*1948*	*5272.5*
370.0																					*0.5*	*56.7*				
					1.0	1.0	1.0	1.3							0.5	3.6										
																			0.5				*0.5*	*5.8*		
	2.0	1.5											0.5	0.7					1.5		2.5	0.4				
	1.5	*1.0*	*1.5*	*1.3*															*6*		*4.5*	*1.2*	*1*	*0.3*	*1*	*0.4*
20.3	0.5	0.5	2.5	19.7	0.5	1.0			1.0	2.0	1.5	0.6	0.5	0.4	2.0	2.9	0.5	8.2								
	1.0	*1.0*	*1.5*	*11.7*	*0.5*	*2.6*											*3.0*	*1.7*			*1.5*	*0.8*	*3.5*	*4.3*		
																					3.5	0.4			7	5.9
1.8	1.0	1.0	0.5	0.4	1.5	2.1	0.5	0.9	2.0	3.7									5.5		22	2.3	6	3.3	1.5	1.3
																					2	0.2			2	0.7
2.8	1.5	0.5									0.5	2.2									12	2.1	0.5	0.1	2	0.8
0.6	*2.5*	*1.0*	*1.0*	*0.1*	*0.5*	*0.2*																				
12.5			0.5	0.7	6.5	27.8	1.5	4.2	1.0	10.1							4.0	19.0	2.5		1.5	4.5				
					0.5	*0.7*	*0.5*	*0.5*									*2.0*	*3.9*	*0.5*		2	*16.3*	*3*	*27.4*		
	6.5	3170.0																								
	1.5	113.5			0.5	60.5																			29	63.8
	0.5	*1.0*																					*2*	*1.5*	*50*	*186.7*
	20.5	2758.5	2.5	243.5	0.5	84.5															0.5	58.6			0.5	42.5
																			0.5							
	1.0	738.5			0.5	246.5			0.5	138.0									0.5							
																			2							
	1.0	1.0																							0.5	1.6
	0.5	0.5	0.5	0.7	1.0	1.7	0.5	0.6																		

Synchirus gilli
Myoxocephalus polyacanthocephalus
Sebastes flavidus
Artedius lateralis
Sebastes maliger
Liparis callyodon
Eumicrotremus orbi[illegible]
Gasterosteus
Syngnath[illegible]
Hy[illegible]

	1.0	1.0					2.5	3.0	3.0	2.5														
		309.0			0.5	103.5	0.5	19.9	0.5	20.3	0.5	44.4					2.0	92.9						
			0.5	*8.6*	*0.5*	*167.5*											*6.5*	*3.3*						
		0																						
			0.5	8.7	10.0	44.4	1.0	5.1	2.0	16.9					0.5	2.6	1	6.0						
																					0.5	*4.5*		
				169.0																				
				0.3			5.0	10.7							0.5	0.1								
							0.5	*0.9*																
					0.5	1.2	1.5	3.4	1.5	6.8	1.0	4.2												
					0	3.0	1.0	0.8	9.5	10.4	3.0	3.8	5.5	8.5	1.5	2.7	1.0	3.0					5	2.2
						0.6	*0.5*	*0.7*	*2.0*	*22.0*							*1.0*	*2.5*			*0.5*	*1*	*3.5*	*2*
						0.2	4.0	1.4	4.5	5.8	1.0	0.7	2.5	1.7	1.0	0.4	2.5	1.7	2				1	0.2
																			1	*0.5*	*0.2*		*1.5*	*2.8*
									4.0	52.5							*0.6*	*0.1*				*1.5*	*8.5*	*1.5*	*12.7*
									11.5	*142.8*														
									0.5	3.9														
									0.6	*1.3*														
									2.5	122.5														
Totals:									0.5	17.5														
Key: sinking seine / *floating seine*								*1.4*																
								15.0												0.5	14.7			
								3.6									0.5	2.3						
								4.0																
									21.5	8.3	11.0	3.9	31.5	8.4										
									12.5	*4.5*	*1.5*	*0.9*												
									0.6	*29.4*							*0.5*	*5.4*						
									1.0	24.2													1	8.2
																							1	*8*
Myoxocephalus polyacanthocephalus juveniles									0.5	1.6					0.5	0.5			0.5					
											0.5	0.2												
Gadus macrocephalus juveniles											0.5	22.1												
Cottid unidentified											0.5	18.5												
Phytichthys chirus													0.5	190.0										
Ascelichthys rhodorus													0.5	0.1										
Ammodytes hexapterus juveniles															3.0	0.4								
															2.5	*0.2*								
Sebastes caurinus juveniles															0.5	0.2								
H. stelleri juveniles															0.5	0.9								
Hexagrammos decagrammus juveniles															0.5	0.1								
Blepsias juveniles															1.5	0.1			*0.6*					
Ophiodon elongatus																	5.5	55.0						
Sebastes auriculatus																	0.5	469.8						
Clupea harengus pallasi larvae																							0.5	4.5
																							0.5	17.5

								1.5 0.1		0.5			
									5.5 55.0				
									0.5 469.8				
									1.5 0.3				
									2.0 9.4				0.5 4.5
										0.5	1 1.5		
									0.5 1.3	0.5	0.5 1.5		0.5 17.5
										7 116.7a	7.5 117.2		
									0.5 0.2	1	4 128.2	3 62.9	
													0.5 1.5
										0.5	1 1.2		7 20.9
										1.5			
										0.5			
												0.5 0.1	
										2			
											2.5 2		
											2 1.1		0.5 3.8
	27	22	29	21	23	17	9	15	18	14	13		21
5	93.5	77	508	324	714	1009	46	22	64	30.5	31		289.5
3	10,350	2955.3	6881.3	4868.1	4861.4	2752.2	5.5	641.1	3252.1	--	273.2		825.2
	11	13	16	7	6	3	1	5	12	16	10	22	19
	75	60	335.5	19	38.5	3	5.5	124.5	357	37.5	67.5	90	2074
7	301	884.1	2938.4	163.6	263.1	19.9	1.0	83.3	685.9	--	276.8	904.1	5652.4

malfunction.

Appendix 5a, cont'd

Eagle Cove, San Juan Island (False Bay, Cattle Pt.) Sand with eelgrass

Species	October No.	October Wt.	November No.	November Wt.	December No.	December Wt.	January No.	January Wt.	February No.	February Wt.	March No.	March Wt.	April No.	April Wt.	May No.	May Wt.	June No.	June Wt.	July No.	July Wt.	August No.	August Wt.	September No.	September Wt.
Leptocottus armatus	6.5	970.4	11.5	537.5	(inclement weather prevented sampling)		9.5	227.4	2.0	36.6					3.5	194.9	1	--	0.5	36.1	6	566.2	10	454.4
Platichthys stellatus	[illegible]	1690.7	1.0	235.8			3.0	89.7	2.5	107.1	0.5	1.8	0.5	4.7					0.5	287.5			0.5	44
Parophrys vetulus juven[illegible]	[illegible]	491.0	56.5	287.5			1.5	7.9	0.5	0.1	2.5	11.2	4.5	39.1	21.5	57.2	17.5	--	36	202.6	72.5	905	53.5	821
Oncorhynchus kisutch	[illegible]	[illegible].1																						
Microgadus proxim[illegible]			24.0	214.0																	2	1.4	44.5	138.4
Hypomesus pret[illegible]			21.5	207.5			100.0	1042.8	53.5	576.2	1	0.7											1	26.2
Agonus acip[illegible]			[illegible].5	1.3																	0.5	0.2	0.5	0.8
Psettich[illegible]			[illegible]	71.5			7.5	43.0	2.0	9.7	1	5.3	1	1.9	3.0	37.2	0.5	--	0.5	0.1	2.5	46.8	4.5	200.3
Cymat[illegible]			[illegible]	45.5			3.0	82.6											0.5	20.3				
B[illegible]															0.5	0.3								
							0.5	1.0																
							0.5	4.6																
															91.5	233.6								
																			1	0.3	0.5	0.2		
															57.5	188.7	16	--	192.5	1647.5			0.5	2
																	1.5	--	0.5	0.2				
							0.5	11.3																
							0.5	1.8																
							0.5	7.2																
									1.0	0.5			0.5	0.2	1.0	0.5								
													0.5	0.1										
															1.5	0.2								
																	0.5	--	1	0.3				
																					0.5	0.1		
																							0.5	28.7
																			2	6.1	0.5	0.2	2.5	2.3
																			2.5	0.9				
							11		5		4		5		8		5		9		8		9	
							127		59.5		5		7		180				237.5		85		118	
							[illegible]		[illegible]		19		46.9		1424.6				2201.9		1520.1		1718.1	

Appendix 5a, cont'd

Wescott Bay, San Juan Island
Mud with eelgrass protected

Species:	July No.	July Wt.	Augu[st] No.
Leptocottus armatus	137.0	1852.0	73.0
Cymatogaster aggregata	35.5	745.0	3.5
Lumpenus sagitta	69.0	220.0	0.5
Platichthys stellatus juveniles	2.0	3.0	10.5
Parophrys vetulus juveniles	31.5	143.0	23.0
Gasterosteus aculeatus	1.0	0.3	0.5
Oligocottus maculosus	70.0	64.0	66.0
Blepsias cirrhosus	0.5	0.3	
Apodichthys flavidus	1.0	2.5	0.5
Aulorhynchus flavidus	2.5	1.0	
Enophrys bison	0.5	0.1	
Pholis ornata	0.5	0.3	1.5
Clinocottus acuticeps	0.5	0.3	
Lallasina barbata aix	2.5	2.0	
Artedius fenestralis	0.5	0.3	
Anoplarchus purpurescens	0.5	0.3	
Liparis callyodon	0.5	5.0	
Psettichthys melanostictus juv.	1.5	2.0	
Eumicrotremus orbis	0.5	0.3	
Scorpaenichthys marmoratus	0.5	0.1	
Liparis florae	1.0	0.3	0.5
Hypomesus pretiosus	0.5	2.0	
Raja binoculata	0.5	2.5	
Rhamphocottus vacca	0.5	1.0	
Clupea harengus pallasi juveniles	158.0	575.0	
Microgadus proximus	1.0	4.0	
Agonus acipenserinus			
Theragra chalcogramma juveniles			
Lycodes palearis			
Liparis cyclopus			
Clevelandia ios			
Lepidogobius lepidus			
Hypomesus larvae			

	September		October		November		December		January		February		March		April		May		June		July		August		September	
	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
.0	105.5	1745.5	143.5	2577.5	63.0	992.5	30.0	543.1	9.0	114.7	4.5	97.3			3.0	0.4	153.5	92.0	282	2020	146.5	694.4	81	703.9	116	1315
.0	122.0	875.0	13.5	117.4	0.5	3.8													185	4095			0.5	8.4	372	1982.5
.5	71.5	238.5			0.5	9.2	3.0	13.8	2.0	24.8							68.5	34.9	2				0.5	3.8	275	730
.5	3.0	9.0	19.5	175.1	9.0	78.2	4.5	23.2	3.5	13.2	0.5	2.4	1.5	30.5	2.5	30.4			2	101.3*	0.5	0.6	1.5	3.1	5	26.1
.0	16.5	122.5	18.5	212.3	2.5	19.9	0.5	1.0			0.5	2.9	1.5	2.8	11	25.4	9.5	27.9	32	212	9	61.7	8	51.7	11	84.5
	0.5	0.5	0.5	0.4	4.0	5.5	3.0	2.6	2.5	3.1	0.5	0.8	1.0	1.7	6.5	12.6	3.5	12.4	0.5				3	0.5	1.5	1.7
.5	10.5	10.0	56.5	93.7	58.5	88.6	82.5	135.5	22.5	31.5	2.5	2.9					3.5	1.5			30.5	23.7	28.5	29	10	15.7
	0.5	1.0															2.5	0.5	0.5				0.5	0.6		
.5	1.0	6.5																					5	15.2	4	18.1
	4.5	5.0															0.5	4.0							4.5	4.5
			0.5	4.4	0.5	4.5			0.5	1.0																
.5	2.0	4.5	0.5	3.2	0.5	0.5																	2.5	10.4	5	15.4
			1.0	0.9	18.5	21.3	15.5	20.9	14.0	17.9											0.5	0.4			0.5	0.5
																	2	0.2								
	3.0	21.0	2.0	19.5	1.0	12.5																			5	32.6
							1.5	12.1																		
	0.5	4.0																								
	0.5	0.5	4.0	19.4	10.5	69.8	2.5	22.2	0.5	0.7			0.5	2.3												
.0					2.0	15.6											0.5	0.1								
	22.5	246.5	1.5	45.5	13.5	193.3	0.5	9.7	0.5	9.8							10.5	1.8							23	177.6
			0.5	78.9															0.5							
	3.5	40.5																								
	67.5	410.0	0.5	5.0																					449	1495
	0.5	2.5	0.5	2.7																						
	0.5	5.0	2.0	13.8	1.0	10.8	2.5	6.9									1.0	4.2	4							
			2.0	21.8																					3	16.1
			1.5	21.1	1.0	16.0	1.5	21.6			0.5	10.1														
			0.5	9.0			0.5	5.3																	0.5	5.4
							0.5	0.2																		
							0.5	5.7																		
											0.5	0.3														
													0.5	3.0									0.5	0.1		
															0.5	0.9										
															0.5	0.1										
															11	43.5			86	57.5						
															1	0.1										
																	2.0	0.9								
																	1.5	0.1								
																	0.5	0.7	0.5							
																	0.5	1.1	1							
																							5.5	20.1		
																							0.5	0.4		
																									1.5	17.8
	19		19		16		15		9		7		5		8		14		12		5		12		17	
	436.5		269		186.5		149		55		9.5		5		38		229.0		596		187		137.5		1286.5	
	3748		3421.6		1542		823.8		216.7		116.7		40.3		119.4		182.0				700.8		847.2		5938.5	

APPENDIX 5b

Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site

Pt. George, Shaw Island Rocky w/Kelp, exposed	July/Aug 31-7-74 to 2-8-74		August 20-8-74 to 22-8-74		September 10-9-74 to 12-9-74		December 4-12-74 to 5-12-74	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juveniles	20269	3711.5	68	86	176	448		
Oncorhynchus kisutch juveniles	1	11.5			1.5	59		
Oncorhynchus keta juveniles	10.5	148.5						
Oncorhynchus tshawytscha juveniles	1.5	23	0.5	6.5				
Oncorhynchus gorbuscha juveniles	1	11.5						
Microgadus proximus juveniles	3	6						
Ammodytes hexapterus			2	3.5				
Pholis ornata			0.5	2				
Psychrolutes paradoxus					0.5	1		
Unidentified larvae, possibly Cottid							0.5	0.003
Gilbertidia sigalutes							7	2.5
Lepidopsetta bilineata								
Hexagrammos sp. juveniles								
Squalus acanthias								
Gasterosteus								
Clupea harengus pallasi larvae								
Psychrolutes paradoxus juv.								
Ammodytes hexapterus juv.								
Unknown sp. (3) larvae								
Parophrys vetulus larvae								
Totals:								
Species richness (number of species)	6		4		3		2	
Mean number of individuals	20,286		71		178		7.5	
Mean wet weight (*grams*)	3,912		98		508		2.5+	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Pt. George, Shaw Island (cont'd.)	February 14-2-75, 19-2-75		March 10-3-75 to 12-3-75		April 14-4-75 to 17-4-75		May	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juveniles					Inclement weather prevented sampling			
Oncorhynchus kisutch juveniles							0.5	0.4
Oncorhynchus keta juveniles								
Oncorhynchus tshawytscha juveniles								
Oncorhynchus gorbuscha juveniles								
Microgadus proximus juveniles			0.5	1				
Ammodytes hexapterus								
Pholis ornata								
Psychrolutes paradoxus								
Unidentified larvae, possibly Cottid								
Gilbertidia sigalutes								
Lepidopsetta bilineata			0.5	252.5				
Hexagrammos sp. juveniles								
Squalus acanthias								
Gasterosteus								
Clupea harengus pallasi larvae							4.6	0.8
Psychrolutes paradoxus juv.							17.5	3.8
Ammodytes hexapterus juv.							9.5	1.4
Unknown sp. (3) larvae							16.5	0.5
Parophrys vetulus larvae							0.5	0.1
Totals:								
Species richness (number of species)	0		2				8	
Mean number of individuals	0		1				85.5	
Mean wet weight (*grams*)	0		253.5				6.8	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Pt. George, Shaw Island (cont'd.)	June 24-6-75 to 26-6-75		July 23-7-75 to 25-7-/5		August 19-8-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juveniles	17.0	7.3	242.0	330.0	5	11.5
Oncorhynchus kisutch juveniles						
Oncorhynchus keta juveniles					1	12.2
Oncorhynchus tshawytscha juveniles						
Oncorhynchus gorbuscha juveniles			0.5	2.5		
Microgadus proximus juveniles			0.5	1.0		
Ammodytes hexapterus	4183.0	2117.5	5517.0	7134.5	2	4.5
Pholis ornata						
Psychrolutes paradoxus						
Unidentified larvae, possibly Cottid						
Gilbertidia sigalutes						
Lepidopsetta bilineata						
Hexagrammos sp. juveniles	0.5	2.0				
Squalus acanthias			0.5	400.0		
Gasterosteus					0.5	0.3
Clupea harengus pallasi larvae						
Psychrolutes paradoxus juv.						
Ammodytes hexapterus juv.						
Unknown sp. (3) larvae						
Parophrys vetulus larvae						
Totals:						
Species richness (number of species)	3		5		4	
Mean number of individuals	4200.0		5760.5		8.5	
Mean wet weight (*grams*)	2126.7		7868.0		28.5	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Birch Bay Sand/Eelgrass, Protected	July/Aug. 31-7-74 to 2-8-74		August 20-8-74 to 22-8-74		September 10-9-74 to 12-9-74	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juveniles	276	937.5	1650	6651.5	1626.5	5548
Gasterosteus aculeatus	105.5	47.5	30	37	219	74
Oncorhynchus kisutch juveniles	1.5	12			0.5	12
O. tshawytscha juveniles	3	41	2.5	32	13	433.5
Platichthys stellatus	0.5	175	0.5	475	0.5	305
Cymatogaster aggregata	0.5	17.5	19.5	146	165	1686
Hypomesus pretiosus	5.5	87	72.5	596.5	75.5	692.5
Leptocottus armatus	1.5	17.5	3.5	78	3	64
Pholis ornata			0.5	2.5		
Aulorhynchus flavidus					20	37
Synamathus griseolineatus					3.5	2.5
Rhacochilus vacca					8	144.5
Lycodes sp.					0.5	--
Cottid sp.					0.5	--
Blepsias cirrhosus					0.5	1.5
Pleuronectid sp.					0.5	--
Clupea harengus pallasi larvae						
Hexagrammos decagrammus						
Hypomesus pretiosus larvae						
Ammodytes hexapterus						
Ammodytes larvae						
Hexagrammid juveniles						
Unident. Agonid juv.						
Sebastes sp. larvae						
Psychrolutes paradoxus juv.						
Unidentified larvae						
Parophrys larvae						
Clupea larvae						
Lepidogobius						
Unident. Cottid larvae						
Pleuronectidae larvae						
Gasterosteus aculeatus juveniles						
Hypomesus pretiosus juveniles						
Spirinchus thaleichthys						
Lumpenus sagitta juveniles						
Ammodytes hexapterus juveniles						
Lamptera ayresi juveniles						
Engraulis mordax						
Cymatogaster aggregata juveniles						
Oncorhynchus kisutch						
Lepidogobius lepidus (?) larvae						
Lumpenus sagitta larvae						
Pleuronectidae sp. larvae						
Psychrolutes paradoxus juveniles						
Unknown sp. (3) larvae						
Squalus acanthias						
Pallasina barbata						
Oncorhynchus keta juveniles						
Hexagrammos sp. juveniles						
Agonidae sp. juveniles						
Stichaeidae sp. larvae						
Totals						
Species richness (No. of species)	8		8		15	
Mean number of individuals	394		1779		2136.5	
Mean wet weight (grams)	1335		8018.5		9000.5	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Birch Bay (cont'd.)	December 4-12-74 to 5-12-74		February 14-2-75, 19-2-75		March 10-3-75 to 12-3-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juveniles						
Gasterosteus aculeatus	3.5	3			1	0.4
Oncorhynchus kisutch juveniles						
O. tshawytscha juveniles						
Platichthys stellatus	0.5	207.5				
Cymatogaster aggregata						
Hypomesus pretiosus						
Leptocottus armatus						
Pholis ornata						
Aulorhynchus flavidus						
Syngnathus griseolineatus						
Rhacochilus vacca						
Lycodes sp.						
Cottid sp.						
Blepsias cirrhosus						
Pleuronectid sp.						
Clupea harengus pallasi larvae	21.5	3				
Hexagrammos decagrammus			1	0.5	27.5	11.6
Hypomesus pretiosus larvae			4.5	1	40.5	5.4
Ammodytes hexapterus						
Ammodytes larvae						
Hexagrammid juveniles						
Unident. Agonid juv.						
Sebastes sp. larvae						
Psychrolutes paradoxus juv.						
Unidentified larvae						
Parophrys larvae						
Clupea larvae						
Lepidogobius						
Unident. Cottid larvae						
Pleuronectidae larvae						
Gasterosteus aculeatus juveniles						
Hypomesus pretiosus juveniles						
Spirinchus thaleichthys						
Lumpenus sagitta juveniles						
Ammodytes hexapterus juveniles						
Lamptera ayresi juveniles						
Engraulis mordax						
Cymatogaster aggregata juveniles						
Oncorhynchus kisutch						
Lepidogobius lepidus (?) larvae						
Lumpenus sagitta larvae						
Pleuronectidae sp. larvae						
Psychrolutes paradoxus juveniles						
Unknown sp. (3) larvae						
Squalus acanthias						
Pallasina barbata						
Oncorhynchus keta juveniles						
Hexagrammos sp. juveniles						
Agonidae sp. juveniles						
Stichaeidae sp. larvae						
Totals						
Species richness (No. of species)	3		2		3	
Mean number of individuals	25.5		5.5		69	
Mean wet weight (grams)	213.5		1.5		17.4	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Birch Bay (cont'd.)	April 14-4-75 to 17-4-75		May 12-5-75 to 15-5-75		June 24-6-75 to 26-6-75	
Species	No.	Wt.	No.	Wt.	No.	Wt.
Clupea harengus pallasi juveniles					182.5	178.3
Gasterosteus aculeatus	2	5.3	25.0	82.5	1.0	0.3
Oncorhynchus kisutch juveniles						
O. tshawytscha juveniles						
Platichthys stellatus	1.5	1140	1.5	1400	2.5	903.6
Cymatogaster aggregata			1.5	37.5		
Hypomesus pretiosus			1	26.0		
Leptocottus armatus						
Pholis ornata						
Aulorhynchus flavidus						
Syngnathus griseolineatus	0.5	0.1				
Rhacochilus vacca						
Lycodes sp.						
Cottid sp.						
Blepsias cirrhosus						
Pleuronectid sp.						
Clupea harengus pallasi larvae			6819.0	285.6		
Hexagrammos decagrammus						
Hypomesus pretiosus larvae						
Ammodytes hexapterus	0.5	2.2				
Ammodytes larvae	36.5	1	170.5	17.5		
Hexagrammid juveniles	0.5	0.4				
Unident. Agonid juv.	0.5	0.1				
Sebastes sp. larvae	0.5	0.1				
Psychrolutes paradoxus juv.	50.5	3.6			0.5	0.4
Unidentified larvae	4	0.1				
Parophrys larvae	0.5	0.1				
Clupea larvae	85.5	0.9			6.5	8.4
Lepidogobius	0.5	0.2				
Unident. Cottid larvae	0.5	0.1				
Pleuronectidae larvae					0.5	0.1
Gasterosteus aculeatus juveniles					0.5	0.1
Hypomesus pretiosus juveniles					2.5	0.1
Spirinchus thaleichthys			9.0	30.5	1.0	5.6
Lumpenus sagitta juveniles					0.5	0.1
Ammodytes hexapterus juveniles					1.0	0.1
Lamptera ayresi juveniles						
Engraulis mordax						
Cymatogaster aggregata juveniles						
Oncorhynchus kisutch						
Lepidogobius lepidus (?) larvae			6.5	7.6		
Lumpenus sagitta larvae			0.5	0.1		
Pleuronectidae sp. larvae			0.5	0.1		
Psychrolutes paradoxus juveniles			2	0.4		
Unknown sp. (3) larvae			6	0.5		
Squalus acanthias			0.5	1125		
Pallasina barbata			0.5	3.5		
Oncorhynchus keta juveniles			0.5	2.0		
Hexagrammos sp. juveniles			2.0	1.0		
Agonidae sp. juveniles			2.0	1.0		
Stichaeidae sp. larvae			0.5	0.1		
Totals						
Species richness (No. of species)	18		20		9	
Mean number of individuals	184		7049.0		199.0	
Mean wet weight (grams)	1154.2		3019.8		1097.1	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Birch Bay (cont'd.)	July 23-7-75 to 25-7-75		August 21-8-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juveniles	4360.0	11447.0	1325.5	4394.5
Gasterosteus aculeatus	8.0	17.0	2	0.6
Oncorhynchus kisutch juveniles	3.5	45.0		
O. tshawytscha juveniles	3.5	71.0		
Platichthys stellatus	3.0	2010.0		
Cymatogaster aggregata				
Hypomesus pretiosus	1.0	6.0	177	2856
Leptocottus armatus	4.0	253.0	2	81.9
Pholis ornata				
Aulorhynchus flavidus				
Syngnathus griseolineatus				
Rhacochilus vacca				
Lycodes sp.				
Cottid sp.				
Blepsias cirrhosus				
Pleuronectid sp.				
Clupea harengus pallasi larvae				
Hexagrammos decagrammus				
Hypomesus pretiosus larvae				
Ammodytes hexapterus			0.5	1.4
Ammodytes larvae				
Hexagrammid juveniles				
Unident. Agonid juv.				
Sebastes sp. larvae				
Psychrolutes paradoxus juv.				
Unidentified larvae				
Parophrys larvae				
Clupea larvae				
Lepidogobius				
Unident. Cottid larvae				
Pleuronectidae larvae				
Gasterosteus aculeatus juveniles				
Hypomesus pretiosus juveniles			0.5	0.1
Spirinchus thaleichthys				
Lumpenus sagitta juveniles				
Ammodytes hexapterus juveniles	7.0	9.0		
Lamptera ayresi juveniles	0.5	10.0		
Engraulis mordax	4.5	52.2		
Cymatogaster aggregata juveniles			9.5	85.1
Oncorhynchus kisutch			3	94.7
Lepidogobius lepidus (?) larvae				
Lumpenus sagitta larvae				
Pleuronectidae sp. larvae				
Psychrolutes paradoxus juveniles				
Unknown sp. (3) larvae				
Squalus acanthias				
Pallasina barbata				
Oncorhynchus keta juveniles				
Hexagrammos sp. juveniles				
Agonidae sp. juveniles				
Stichaeidae sp. larvae				
Totals				
Species richness (No. of species)	10		7	
Mean number of individuals	4395.0		1520	
Mean wet weight (grams)	13920.2		7514.3	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Burrows Island Rocky w/Kelp, Exposed	July/Aug. 31-7-74 to 2-8-74		August 20-8-74 to 22-8-74		September 10-9-74 to 12-9-74	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Gasterosteus aculeatus	7	25	33	10	71.5	57.5
Oncorhynchus keta juveniles	6.5	124			0.5	27.5
O. tshawytscha juveniles	1.5	22.5	4	62.5	2	66.5
O. gorbuscha juveniles	0.5	5				
Clupea harengus pallasi juv.			233	369.5	5	35
Leptocottus armatus			1	15		
Ammodytes hexapterus			0.5	1.5	0.5	1.5
Psychrolutes paradoxus			0.5	1		
Pholis ornata			0.5	3.5		
Spirinchus thaleichthys					0.5	0.5
Eumicrotremus orbis						
Hypomesus pretiosus larvae						
Gilbertidia sigalutes						
Psychrolutes larvae						
Rhamphocottus juveniles						
Ammodytes larvae						
Unidentified species						
Oncorhynchus kisutch juveniles						
Hypomesus pretiosus						
Clupea harengus pallasi larvae						
Ammodytes hexapterus juveniles						
Cottidae larvae						
Pleuronectidae larvae						
Lumpenus sagitta						
Psychrolutes paradoxus juveniles						
Unknown spp. (3) larvae						
Totals:						
Species richness (No. of species)	4		7		6	
Mean number of individuals	15.5		272.5		80	
Mean wet weight (grams)	176.5		463		188.5	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Burrows Island (cont'd)	December 4-12-74 to 5-12-74		February 14-2-75, 19-2-75		March 10-3-75 to 12-3-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Gasterosteus aculeatus			0.5	0.5	(Inclement weather prevented sampling)	
Oncorhynchus keta juveniles						
O. tshawytscha juveniles						
O. gorbuscha juveniles						
Clupea harengus pallasi juv.	3	24	0.5	4.5		
Leptocottus armatus						
Ammodytes hexapterus						
Psychrolutes paradoxus						
Pholis ornata						
Spirinchus thaleichthys						
Eumicrotremus orbis	0.5	1.5				
Hypomesus pretiosus larvae			0.5	0.3		
Gilbertidia sigalutes			3	1.5		
Psychrolutes larvae						
Rhamphocottus juveniles						
Ammodytes larvae						
Unidentified species						
Oncorhynchus kisutch juveniles						
Hypomesus pretiosus						
Clupea harengus pallasi larvae						
Ammodytes hexapterus juveniles						
Cottidae larvae						
Pleuronectidae larvae						
Lumpenus sagitta						
Psychrolutes paradoxus juveniles						
Unknown spp. (3) larvae						

Totals:

Species richness (No. of species)	2	4
Mean number of individuals	3.5	4.5
Mean wet weight (grams)	25.5	6.8

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Burrows Island (cont'd.)	April 14-4-75 to 17-4-75		May 12-5-75 to 15-5-75		June 24-6-75 to 26-6-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Gasterosteus aculeatus			0.5	1.5	1.0	3.1
Oncorhynchus keta juveniles					7.5	76.5
O. tshawytscha juveniles						
O. gorbuscha juveniles						
Clupea harengus pallasi juv.			1	1.5	43.3	8.4
Leptocottus armatus					0.5	68.5
Ammodytes hexapterus						
Psychrolutes paradoxus						
Pholis ornata						
Spirinchus thaleichthys						
Eumicrotremus orbis						
Hypomesus pretiosus larvae			1.5	3.0		
Gilbertidia sigalutes	8.5	0.9				
Psychrolutes larvae	1	0.1				
Rhamphocottus juveniles	1.5	0.1	2	0.1		
Ammodytes larvae	3	0.1				
Unidentified species					4.0	78.7
Oncorhynchus kisutch juveniles					0.5	3.0
Hypomesus pretiosus			27.5	3.8	69.0	2.7
Clupea harengus pallasi larvae					6.5	2.7
Ammodytes hexapterus juveniles			0.5	0.1	1.5	0.1
Cottidae larvae			1.0	0.1	1.0	0.1
Pleuronectidae larvae						
Lumpenus sagitta			12.0	2.1		
Psychrolutes paradoxus juveniles			4	0.2		
Unknown spp. (3) larvae						
Totals:						
Species richness (No. of species)	5		10		9	
Mean number of individuals	14		50.0		135	
Mean wet weight (grams)	1.2		12.2		243.6	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Burrows Island (cont'd.)	July 23-7-75 to 25-7-75	
Species	*No.*	*Wt.*
Gasterosteus aculeatus	17	54.5
Oncorhynchus keta juveniles		
O. tshawytscha juveniles	4.5	80.1
O. gorbuscha juveniles	3	51.5
Clupea harengus pallasi juv.	2.5	6.2
Leptocottus armatus		
Ammodytes hexapterus		
Psychrolutes paradoxus		
Pholis ornata	0.5	4.0
Spirinchus thaleichthys		
Eumicrotremus orbis		
Hypomesus pretiosus larvae		
Gilbertidia sigalutes		
Psychrolutes larvae		
Rhamphocottus juveniles		
Ammodytes larvae		
Unidentified species		
Oncorhynchus kisutch juveniles		
Hypomesus pretiosus	1.0	2.8
Clupea harengus pallasi larvae		
Ammodytes hexapterus juveniles	3	5.9
Cottidae larvae		
Pleuronectidae larvae		
Lumpenus sagitta	1	2.0
Psychrolutes paradoxus juveniles		
Unknown spp. (3) larvae		

Totals:

Species richness (No. of species)	8
Mean number of individuals	34.5
Mean wet weight (grams)	206.8

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Cherry Point Cobble, Exposed	July/Aug. 31-7-74 to 2-8-74		August 20-8-74 to 22-8-74		September 10-9-74 to 12-9-74	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juv.	2475	3510	171	1005.5	160	1686
Oncorhynchus tshawytscha juv.	11.5	131	18	304	5	178
Oncorhynchus kisutch juv.	1.5	30	0.5	11		
Gasterosteus aculeatus	752	258.5	125	25.9	9	67.5
Platichthys stellatus	0.5	267.5	3	16		
Leptocottus armatus	19.5	724.5	16.5	751	8	324
Cymatogaster aggregata	107.5	868.5	0.5	2.5		
Lampetra ayresi	0.5	3				
Lumpenus sagitta	0.5	20				
Pallasina barbata aix	0.5	<0.5				
Hypomesus pretiosus	47	252.5	17	46	2	16
Spirinchus thaleichthys	33.5	268	24	51	6	64.5
Oncorhynchus keta juv.			0.5	11		
Ammodytes hexapterus			0.5	1.5		
Aulorhynchus flavidus			0.5	0.5		
Microgadus proximus juv.			1	1	9	114
Pholis ornata			1	7	0.5	5
Pholis laeta						
Clupea harengus pallasi larvae						
Hypomesus pretiosus larvae						
Hexagrammos decagrammus juveniles						
Gilbertidia sigalutes						
Unidentified larvae						
Clevelandia ios						
Syngnathus griseolineatus						
Agonis acipenserinus						
Hypomesus juvenile						
Ammodytes larvae						
Hexagrammid juveniles						
Parophrys larvae						
Psychrolutes larvae						
Unidentified larvae						
Hexagrammos sp. juvenile						
Spirinchus thaleichthys juv.						
Lumpenus sagitta larvae						
Unknown spp. (2) larvae						
Psychrolutes paradoxus juv.						
Leptocottus armatus						
Agonidae sp. larvae						
Engraulis mordax						
Gasterosteus aculeatus juv.						
Hypomesus pretiosus juv.						
Pleuronectidae larvae						
Ammodytes hexapterus juveniles						
Lamptera ayresi juveniles						
Oncorhynchus keta juv.						
O. gorbuscha juv.						
Gasterosteus aculeatus juveniles						
Theragra chalcogramma juv.						
Totals						
Species richness (No. of species)	12		14		8	
Mean number of individuals	3449.5		379		199.5	
Mean wet weight (grams)	6335		2233.9		2455	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Cherry Point, cont'd	December 4-12-74 to 5-12-74		February 14-2-75, 19-2-75		March 10-3-75 to 12-3-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt*
Clupea harengus pallasi juv.	10	39.5			2	13
Oncorhynchus tshawytscha juv.						
Oncorhynchus kisutch juv.						
Gasterosteus aculeatus	4.5	3.5			1	0.3
Platichthys stellatus						
Leptocottus armatus	0.5	54			2.5	137.5
Cymatogaster aggregata						
Lampetra ayresi						
Lumpenus sagitta						
Pallasina barbata aix						
Hypomesus pretiosus	0.5	1			5.5	107.5
Spirinchus thaleichthys	3	3.5				
Oncorhynchus keta juv.						
Ammodytes hexapterus						
Aulorhynchus flavidus						
Microgadus proximus juv.						
Pholis ornata					0.5	0.5
Pholis laeta	0.5	2				
Clupea harengus pallasi larvae	1	0.1				
Hypomesus pretiosus larvae			1	0.3	0.5	0.1
Hexagrammos decagrammus juveniles			0.5	0.3	2	1.5
Gilbertidia sigalutes			0.5	0.1		
Unidentified larvae			1.5	0.1		
Clevelandia ios					0.5	0.3
Syngnathus griseolineatus					0.5	0.5
Agonis acipenserinus						
Hypomesus juvenile						
Ammodytes larvae						
Hexagrammid juveniles						
Parophrys larvae						
Psychrolutes larvae						
Unidentified larvae						
Hexagrammos sp. juvenile						
Spirinchus thaleichthys juv.						
Lumpenus sagitta larvae						
Unknown spp. (2) larvae						
Psychrolutes paradoxus juv.						
Leptocottus armatus						
Agonidae sp. larvae						
Engraulis mordax						
Gasterosteus aculeatus juv.						
Hypomesus pretiosus juv.						
Pleuronectidae larvae						
Ammodytes hexapterus juveniles						
Lamptera ayresi juveniles						
Oncorhynchus keta juv.						
O. gorbuscha juv.						
Gasterosteus aculeatus juveniles						
Theragra chalcogramma juv.						
Totals						
Species richness (No. of species)	6		4		9	
Mean number of individuals	20		3.5		15	
Mean wet weight (grams)	103.6		0.8		261.2	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Cherry Point, cont'd	April 14-4-75 to 17-4-75		May 12-5-75 to 15-5-75		June 24-6-75 to 26-6-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juv.			1.0	17.0	1954.0	649.5
Oncorhynchus tshawytscha juv.						
Oncorhynchus kisutch juv.						
Gasterosteus aculeatus	2.5	5.4	106.0	338.0	4.5	16.0
Platichthys stellatus					0.5	132
Leptocottus armatus						
Cymatogaster aggregata			0.5	8.5		
Lampetra ayresi						
Lumpenus sagitta						
Pallasina barbata aix						
Hypomesus pretiosus						
Spirinchus thaleichthys					12.0	64.0
Oncorhynchus keta juv.						
Ammodytes hexapterus					7.5	7.9
Aulorhynchus flavidus						
Microgadus proximus juv.						
Pholis ornata						
Pholis laeta						
Clupea harengus pallasi larvae			127.5	2.4	8.5	0.4
Hypomesus pretiosus larvae						
Hexagrammos decagrammus juveniles						
Gilbertidia sigalutes						
Unidentified larvae	14.5	0.2				
Clevelandia ios						
Syngnathus griseolineatus						
Agonis acipenserinus	0.5	26.3				
Hypomesus juvenile	1.5	1.1				
Ammodytes larvae	35.5	0.9	10.0	0.7		
Hexagrammid juveniles	1.5	0.5				
Parophrys larvae	1	0.1	0.5	0.1		
Psychrolutes larvae	5.5	0.4				
Unidentified larvae						
Hexagrammos sp. juvenile			0.5	0.4		
Spirinchus thaleichthys juv.			4.0	13.5		
Lumpenus sagitta larvae			10.5	1.4		
Unknown spp. (2) larvae			4	0.4		
Psychrolutes paradoxus juv.			7.0	1.3		
Leptocottus armatus			0.5	22.0		
Agonidae sp. larvae			0.5	0.1		
Engraulis mordax					2.0	10.7
Gasterosteus aculeatus juv.					0.5	0.5
Hypomesus pretiosus juv.					8.0	0.5
Pleuronectidae larvae					0.5	0.1
Ammodytes hexapterus juveniles						
Lamptera ayresi juveniles						
Oncorhynchus keta juv.						
O. gorbuscha juv.						
Gasterosteus aculeatus juveniles						
Theragra chalcogramma juv.						
Totals						
Species richness (No. of species)	11		13		8	
Mean number of individuals	62.5		272.5		1998.0	
Mean wet weight (grams)	34.9		405.6		846.4	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Cherry Point, cont'd	July 23-7-75 to 25-7-75		August 21-8-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juv.	2905.5	8222.1	242.5	766.1
Oncorhynchus tshawytscha juv.	1.5	73.5		
Oncorhynchus kisutch juv.				
Gasterosteus aculeatus	4.5	14.5	28.5	74.2
Platichthys stellatus				
Leptocottus armatus			6	378.7
Cymatogaster aggregata				
Lampetra ayresi				
Lumpenus sagitta	2.5	25.0		
Pallasina barbata aix				
Hypomesus pretiosus	18.0	151.0	2	25
Spirinchus thaleichthys	5.0	43.0	4.5	39.8
Oncorhynchus keta juv.				
Ammodytes hexapterus			0.5	1.2
Aulorhynchus flavidus	0.5	1.0		
Microgadus proximus juv.				
Pholis ornata				
Pholis laeta				
Clupea harengus pallasi larvae				
Hypomesus pretiosus larvae				
Hexagrammos decagrammus juveniles				
Gilbertidia sigalutes				
Unidentified larvae				
Clevelandia ios				
Syngnathus griseolineatus				
Agonis acipenserinus				
Hypomesus juvenile			2	25.4
Ammodytes larvae				
Hexagrammid juveniles				
Parophrys larvae				
Psychrolutes larvae				
Unidentified larvae				
Hexagrammos sp. juvenile				
Spirinchus thaleichthys juv.			446	272.7
Lumpenus sagitta larvae	0.5	10.0		
Unknown spp. (2) larvae				
Psychrolutes paradoxus juv.				
Leptocottus armatus	9.0	710.5		
Agonidae sp. larvae				
Engraulis mordax	2.0	26.0		
Gasterosteus aculeatus juv.	0.5	0.2		
Hypomesus pretiosus juv.				
Pleuronectidae larvae				
Ammodytes hexapterus juveniles	9.5	12.0		
Lamptera ayresi juveniles				
Oncorhynchus keta juv.	0.5	1.0	1	7.5
O. gorbuscha juv.	1.0	50.0		
Gasterosteus aculeatus juveniles			31	10.3
Theragra chalcogramma juv.			2.5	4.6
Totals				
Species richness (No. of species)	13		9	
Mean number of individuals	2961		773	
Mean wet weight (grams)	9422.5		1831.3	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Deadman Bay, San Juan Is. Gravel, Protected	July/Aug. 31-7-74 to 2-8-74		August 20-8-74 to 22-8-74		September 10-9-74 to 12-9-74	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juv.	2.5	11	30.5	8.15	5	23.5
Oncorhynchus kisutch juv.	2.5	53.5				
O. keta juv.	3.5	67.5				
O. gorbuscha juv.	1	15				
O. tshawytscha juv.	1	27.5			2	204
Leptocottus armatus	0.5	7.5				
Gasterosteus aculeatus			1	< 1		
Ammodytes hexapterus					2.5	2
Pholis ornata					0.5	10
Sebastes sp. larvae						
Sebastes sp. juv.						
Hypomesus pretiosus larvae						
Hexagrammos sp. juvenile						
Cottid larvae						
Pallasina barbata						
Gilbertidia sigalutes						
Psychrolutes paradoxus juv.						
Gobiidae sp. larvae						
Clupea harengus pallasi larvae						
Ammodytes hexapterus juv.						
Pleuronectidae larvae						
Clupea harengus pallasi						
Totals:						
Species richness (No. of species)	6		2		4	
Mean number of individuals	11		31.5		8	
Mean wet weight (grams)	182		81.5		239.5	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Deadman Bay (cont'd.)	December 4-12-74 to 4-12-74		February 14-2-75, 19-2-75		March 10-3-75 to 12-3-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juv.	1	4			0.5	4.5
Oncorhynchus kisutch juv.						
O. keta juv.						
O. gorbuscha juv.						
O. tshawytscha juv.						
Leptocottus armatus						
Gasterosteus aculeatus	1.5	2.5			1	1
Ammodytes hexapterus					0.5	2
Pholis ornata						
Sebastes sp. larvae	0.5	1				
Sebastes sp. juv.			0.5	0.5		
Hypomesus pretiosus larvae					0.5	1.6
Hexagrammos sp. juvenile					0.5	0.3
Cottid larvae					0.5	0.2
Pallasina barbata					0.5	1.5
Gilbertidia sigalutes						
Psychrolutes paradoxus juv.						
Gobiidae sp. larvae						
Clupea harengus pallasi larvae						
Ammodytes hexapterus juv.						
Pleuronectidae larvae						
Clupea harengus pallasi						
Totals:						
Species richness (No. of species)	3		1		7	
Mean number of individuals	3		0.5		10.5	
Mean wet weight (grams)	7.5		0.5		11.1	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Deadman Bay (cont'd.)	May 12-5-75 to 15-5-75		June 24-6-75 to 26-6-75		August 20-8-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juv.			9.0	25.2		
Oncorhynchus kisutch juv.						
O. keta juv.						
O. gorbuscha juv.						
O. tshawytscha juv.						
Leptocottus armatus						
Gasterosteus aculeatus						
Ammodytes hexapterus					1	3
Pholis ornata						
Sebastes sp. larvae						
Sebastes sp. juv.						
Hypomesus pretiosus larvae						
Hexagrammos sp. juvenile						
Cottid larvae			2.5	0.1		
Pallasina barbata						
Gilbertidia sigalutes	2.0	6.5				
Psychrolutes paradoxus juv.	1.0	0.3				
Gobiidae sp. larvae	0.5	0.1				
Clupea harengus pallasi larvae			7.0	0.8		
Ammodytes hexapterus juv.			1.0	0.2		
Pleuronectidae larvae			1.0	0.1		
Clupea harengus pallasi					19.5	73

Totals:

Species richness (No. of species)	3	4	2
Mean number of individuals	4.0	25.0	20.5
Mean wet weight (grams)	6.9	26.9	76

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Eagle Cove Sand w/Eelgrass, Protected	July/Aug.* 31-7-74 to 2-8-74		August** 20-8-74 to 22-8-74		September** 10-9-74 to 12-9-74	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juv.	24	67.5	73.5	93	430.5	1813
Oncorhynchus keta juv.	1.5	67.5			0.5	17.5
Gasterosteus aculeatus juv.	1.5	< 0.8				
Microgadus proximus juv.	0.5	< 0.5				
Ammodytes hexapterus	0.5	< 0.5	2	5	3.5	7
Pholis ornata			0.5	--		
Pholis laeta			0.5	--		
Engraulis mordax						
Psychrolutes paradoxus						
Trichodon trichodon						
Aulorhynchus flavidus						
Hypomesus pretiosus larvae						
Hexagrammos sp. juvenile						
Unidentified larvae						
Clupea harengus pallasi larvae						
Hydrolagus colliei juv.						
Cottidae larvae						
Agonus acipenserinus juv.						
Ammodytes hexapterus juv.						
Pleuronectidae larvae						
Psychrolutes paradoxus juv.						
Rhamphocottus richardsoni juv.						
Hexagrammos sp. larvae						
Ammodytes hexapterus larvae						
Totals:						
Species richness (No. of species)	5		4		3	
Mean number of individuals	28		76.5		434.5	
Mean wet weight (grams)	136.8		98		1837.5	

*False Bay
**Cattle Pt.

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Eagle Cove (cont'd.)	December 4-12-74 to 5-12-74		February 14-2-75, 19-2-75		March 10-3-75 to 12-3-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juv.	2	8.5				
Oncorhynchus keta juv.						
Gasterosteus aculeatus juv.	4	2.5				
Microgadus proximus juv.						
Ammodytes hexapterus	1	4	1	11.5		
Pholis ornata						
Pholis laeta					0.5	2
Engraulis mordax	1	2				
Psychrolutes paradoxus	0.5	2				
Trichodon trichodon			0.5	115.5		
Aulorhynchus flavidus					0.5	4.5
Hypomesus pretiosus larvae					2.5	0.6
Hexagrammos sp. juvenile					0.5	0.2
Unidentified larvae					1	0.1
Clupea harengus pallasi larvae						
Hydrolagus colliei juv.						
Cottidae larvae						
Agonus acipenserinus juv.						
Ammodytes hexapterus juv.						
Pleuronectidae larvae						
Psychrolutes paradoxus juv.						
Rhamphocottus richardsoni juv.						
Hexagrammos sp. larvae						
Ammodytes hexapterus larvae						
Totals:						
Species richness (No. of species)	5		2		5	
Mean number of individuals	8.5		1.5		5	
Mean wet weight (grams)	19		127		7.4	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Eagle Cove (cont'd.)	May 12-5-75 to 15-5-75		June 24-6-75 to 26-6-75		August 20-8-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juv.			4.0	1.4		
Oncorhynchus keta juv.						
Gasterosteus aculeatus juv.						
Microgadus proximus juv.						
Ammodytes hexapterus						
Pholis ornata						
Pholis laeta						
Engraulis mordax						
Psychrolutes paradoxus						
Trichodon trichodon						
Aulorhynchus flavidus						
Hypomesus pretiosus larvae						
Hexagrammos sp. juvenile						
Unidentified larvae	1.5	0.1				
Clupea harengus pallasi larvae	4.5	0.1	9.5	0.5		
Hydrolagus colliei juv.			0.5	2.8		
Cottidae larvae			2.5	0.1		
Agonus acipenserinus juv.			0.5	0.1		
Ammodytes hexapterus juv.			0.5	0.1		
Pleuronectidae larvae			0.5	0.1		
Psychrolutes paradoxus juv.	9	1.9				
Rhamphocottus richardsoni juv.	0.5	0.1				
Hexagrammos sp. larvae	0.5	0.1				
Ammodytes hexapterus larvae	0.5	0.1				
Gasterosteus					0.5	0.3
Clupea					1.5	6
Totals:						
Species richness (No. of species)	6		6		2	
Mean number of individuals	16.5		9.5		2	
Mean wet weight (grams)	2.2		4.6		6.3	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Guemes Island, E. Sand/Eelgrass, Protected	July/Aug. 31-7-/4 to 2-8-/4		August 20-8-74 to 22-8-/4		September 10-9-74 to 12-9-74	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juv.	7.5	28.5	704.5	3090	975.5	4845
Gasterosteus aculeatus	2.5	10	75	26	5	15
Psychrolutes paradoxus	0.5	1			0.5	0.5
Squalus acanthias	0.5	140	1	390	0.5	240
Oncorhynchus tshawytscha juv.	0.5	18.5			1	34.5
O. kisutch juveniles			1	25		
O. keta juveniles			0.5	7.5		
Leptocottus armatus			1	11	4.5	150.5
Spirinchus thaleichthys			1	5.5	2	2
Pholis ornata			0.5	3	1	12
Microgadus proximus juveniles					1	1
Ammodytes hexapterus					0.5	1
Pholis laeta						
Gilbertidia sigalutes						
Hypomesus pretiosus larvae						
Sebastes sp. juveniles						
Unidentified larvae						
Gilbertidia juveniles						
Anoplagonus inermis						
Liparis fucensis						
Clupea harengus pallasi larvae						
Ammodytes hexapterus larvae						
Unknown spp. (3) larvae						
Pleuronectidae sp. larvae						
Engraulis mordax						
Cottidae larvae						
Astrotheca sp. larvae						
Oncorhynchus gorbuscha juv.						
Ammodytes hexapterus juveniles						
Microgadus proximus						
Totals						
Species richness (No. of species)	5		8		10	
Mean number of individuals	11.5		784.5		991.5	
Mean wet weight (grams)	198		3558		5301.5	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Guemes Island E. (cont'd.)	December 4-12-74 to 5-12-74		February 14-2-75, 19-2-75		March 10-3-75 to 13-3-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juv.	6.5	55	(Inclement			
Gasterosteus aculeatus	2	2	weather			
Psychrolutes paradoxus			prevented			
Squalus acanthias			sampling)			
Oncorhynchus tshawytscha juv.						
O. kisutch juveniles						
O. keta juveniles						
Leptocottus armatus	0.5	24				
Spirinchus thaleichthys						
Pholis ornata						
Microgadus proximus juveniles						
Ammodytes hexapterus					0.5	1
Pholis laeta	1	3				
Gilbertidia sigalutes	0.5	0.5				
Hypomesus pretiosus larvae					0.5	0.1
Sebastes sp. juveniles					0.5	0.3
Unidentified larvae					0.5	0.1
Gilbertidia juveniles						
Anoplagonus inermis						
Liparis fucensis						
Clupea harengus pallasi larvae						
Ammodytes hexapterus larvae						
Unknown spp. (3) larvae						
Pleuronectidae sp. larvae						
Engraulis mordax						
Cottidae larvae						
Astrotheca sp. larvae						
Oncorhynchus gorbuscha juv.						
Ammodytes hexapterus juveniles						
Microgadus proximus						
Totals						
Species richness (No. of species)	5				4	
Mean number of individuals	10.5				2	
Mean wet weight (grams)	84.5				1.5	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Guemes Island E. (cont'd.)	April 14-4-75 to 17-4-75		May 12-5-75 to 15-5-75		June 24-6-75 to 26-6-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juv.					0.5	4.7
Gasterosteus aculeatus			15.5	48.0	3.5	16.5
Psychrolutes paradoxus						
Squalus acanthias						
Oncorhynchus tshawytscha juv.						
O. kisutch juveniles						
O. keta juveniles						
Leptocottus armatus						
Spirinchus thaleichthys					0.5	2.6
Pholis ornata						
Microgadus proximus juveniles						
Ammodytes hexapterus						
Pholis laeta						
Gilbertidia sigalutes						
Hypomesus pretiosus larvae	0.5	0.1			21.5	1.3
Sebastes sp. juveniles						
Unidentified larvae						
Gilbertidia juveniles	2	0.6	1.5	0.2		
Anoplagonus inermis	0.5	1				
Liparis fucensis			0.5	0.4		
Clupea harengus pallasi larvae			1	0.1	64.5	1.3
Ammodytes hexapterus larvae			1	0.1		
Unknown spp. (3) larvae			4.5	0.3		
Pleuronectidae sp. larvae			0.5	0.1	5.5	0.2
Engraulis mordax			0.5	3.0		
Cottidae larvae					0.5	0.1
Astrotheca sp. larvae					0.5	0.1
Oncorhynchus gorbuscha juv.						
Ammodytes hexapterus juveniles						
Microgadus proximus						

Totals

Species richness (No. of species)	3	10	7
Mean number of individuals	3	25.0	97.0
Mean wet weight (grams)	1.7	52.1	26.5

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Guemes Island E. (cont'd.)	July 23-7-75 to 25-7-75		August 22-8-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juv.	107.5	219.9	162.5	114.8
Gasterosteus aculeatus	1.5	3.1	1.5	2.7
Psychrolutes paradoxus				
Squalus acanthias				
Oncorhynchus tshawytscha juv.	3.0	60.0		
O. kisutch juveniles				
O. keta juveniles	0.5	1.0		
Leptocottus armatus				
Spirinchus thaleichthys				
Pholis ornata				
Microgadus proximus juveniles				
Ammodytes hexapterus				
Pholis laeta				
Gilbertidia sigalutes				
Hypomesus pretiosus larvae				
Sebastes sp. juveniles				
Unidentified larvae				
Gilbertidia juveniles				
Anoplagonus inermis				
Liparis fucensis				
Clupea harengus pallasi larvae				
Ammodytes hexapterus larvae	2.5	5.0		
Unknown spp. (3) larvae				
Pleuronectidae sp. larvae				
Engraulis mordax				
Cottidae larvae				
Astrotheca sp. larvae				
Oncorhynchus gorbuscha juv.	4.0	50.0		
Ammodytes hexapterus juveniles				
Microgadus proximus	0.5	1.5		
Oncorhynchus kisutch			0.5	14.5
Totals				
Species richness (No. of species)	7		3	
Mean number of individuals	119.5		164.5	
Mean wet weight (grams)	340.5		132	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Guemes Is., S. Gravel, Protected	July/Aug. 31-7-74 to 2-8-74		August 20-8-74 to 22-8-74		September 10-9-74 to 12-9-74	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juv.	34.5	27.75	92	367	107	705
Oncorhynchus tshawytscha juv.	2.5	56.25	0.5	13.5	2	44.5
O. keta juveniles	1.5	8.5			0.5	29
Spirinchus thaleichthys	1	10			1	1
Leptocottus armatus	2	81.5			0.5	9
Pholis laeta	0.5	4.5				
Gasterosteus aculeatus	87.5	111	284	98.5	41	29
Squalus acanthias			0.5	275	1	2820
Hypomesus pretiosus					1	12.5
Ammodytes hexapterus					2	4
Hexagrammos decagrammus juv.						
Unidentified larvae						
Nautichthys oculeofasciatus						
Hypomesus larvae						
Lycodopsis (?) larvae						
Lyconodes (?) larvae						
Anoplarchus larvae						
Psychrolutes larvae						
Sebastes sp. larvae						
Rhamphocottus juveniles						
Ammodytes larvae						
Gilbertidia sigalutes juv.						
Clupea harengus pallasi larv.						
Trichodon trichodon larvae						
Psychrolutes paradoxus juv.						
Platichthys stellatus juv.						
Oncorhynchus kisutch juv.						
Ammodytes hexapterus juv.						
Lumpenus sagitta juveniles						
Xeneretmus sp. juveniles						
Cottidae larvae						
Oncorhynchus nerka juveniles						
Pleuronectidae larvae						
Oncorhynchus gorbuscha						
Astrotheca						
Gasterosteus aculeatus juv.						
Totals						
Species richness (No. of species)	7		4		9	
Mean number of individuals	129.5		377		156	
Mean wet weight (grams)	299.5		754		3654	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Guemes Island S. (cont'd.)	December 4-12-74 to 5-12-74		February 14-2-75, 19-2-75		March 10-3-75 to 12-3-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juv.					0.5	6.5
Oncorhynchus tshawytscha juv.	(Inclement weather prevented sampling)		(Inclement weather prevented sampling)			
O. keta juveniles						
Spirinchus thaleichthys						
Leptocottus armatus						
Pholis laeta						
Gasterosteus aculeatus					0.5	0.5
Squalus acanthias						
Hypomesus pretiosus						
Ammodytes hexapterus						
Hexagrammos decagrammus juv.					0.5	0.4
Unidentified larvae					0.5	0.1
Nautichthys oculofasciatus						
Hypomesus larvae						
Lycodopsis (?) larvae						
Lyconodes (?) larvae						
Anoplarchus larvae						
Psychrolutes larvae						
Sebastes sp. larvae						
Rhamphocottus juveniles						
Ammodytes larvae						
Gilbertidia sigalutes juv.						
Clupea harengus pallasi larv.						
Trichodon trichodon larvae						
Psychrolutes paradoxus juv.						
Platichthys stellatus juv.						
Oncorhynchus kisutch juv.						
Ammodytes hexapterus juv.						
Lumpenus sagitta juveniles						
Xeneretmus sp. juveniles						
Cottidae larvae						
Oncorhynchus nerka juveniles						
Pleuronectidae larvae						
Oncorhynchus gorbuscha						
Astrotheca						
Gasterosteus aculeatus juv.						
Totals						
Species richness (No. of species)					4	
Mean number of individuals					2	
Mean wet weight (grams)					7.5	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Guemes Island S. (Cont'd.)	April 14-4-75 to 17-4-75		May 12-5-75 to 15-5-75		June 24-6-75 to 26-6-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juv.			5.5	10.8	25.1	4.8
Oncorhynchus tshawytscha juv.			3.5	4.1		
O. keta juveniles						
Spirinchus thaleichthys			0.5	18.5	0.5	68.5
Leptocottus armatus						
Pholis laeta			3.5	11.8	14.5	48.1
Gasterosteus aculeatus						
Squalus acanthias						
Hypomesus pretiosus						
Ammodytes hexapterus						
Hexagrammos decagrammus juv.						
Unidentified larvae	34	0.4	7	0.7		
Nautichthys oculeofasciatus	0.5	0.1				
Hypomesus larvae	9	0.2	24.5	0.5		
Lycodopsis (?) larvae	9.5	0.7				
Lyconodes (?) larvae	7	0.4				
Anoplarchus larvae	3	0.1				
Psychrolutes larvae	1.5	0.3				
Sebastes sp. larvae	0.5	0.1				
Rhamphocottus juveniles	0.5	0.1	0.5	0.1		
Ammodytes larvae	13.5	0.3	1	0.5		
Gilbertidia sigalutes juv.			2.5	0.4		
Clupea harengus pallasi larv.			8	0.3	54.5	1.0
Trichodon trichodon larvae			2.0	0.9		
Psychrolutes paradoxus juv.			0.5	0.1	1.0	0.4
Platichthys stellatus juv.			0.5	0.1		
Oncorhynchus kisutch juv.					7.0	220.5
Ammodytes hexapterus juv.			7.5	12.9	16.0	10.4
Lumpenus sagitta juveniles					0.5	0.1
Xeneretmus sp. juveniles					0.5	0.1
Cottidae larvae					7.5	0.1
Oncorhynchus nerka juveniles					4.6	72.0
Pleuronectidae larvae					7.5	0.1
Oncorhynchus gorbuscha						
Astrotheca						
Gasterosteus aculeatus juv.						
Totals						
Species richness (No. of species)	14		12		11	
Mean number of individuals	79		67.0		164.1	
Mean wet weight (grams)	2.7		60.9		436.8	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Guemes Island S. (cont'd.)	July 23-7-75 to 25-7-75		August	
Species	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juv.	2	3.1		
Oncorhynchus tshawytscha juv.				
O. keta juveniles				
Spirinchus thaleichthys				
Leptocottus armatus				
Pholis laeta				
Gasterosteus aculeatus	15	42.5	4	10.6
Squalus acanthias				
Hypomesus pretiosus				
Ammodytes hexapterus				
Hexagrammos decagrammus juv.				
Unidentified larvae				
Nautichthys oculeofasciatus				
Hypomesus larvae				
Lycodopsis (?) larvae				
Lyconodes (?) larvae				
Anoplarchus larvae				
Psychrolutes larvae				
Sebastes sp. larvae				
Rhamphocottus juveniles				
Ammodytes larvae				
Gilbertidia sigalutes juv.				
Clupea harengus pallasi larv.				
Trichodon trichodon larvae				
Psychrolutes paradoxus juv.				
Platichthys stellatus juv.				
Oncorhynchus kisutch juv.				
Ammodytes hexapterus juv.	0.5	0.8		
Lumpenus sagitta juveniles				
Xeneretmus sp. juveniles				
Cottidae larvae				
Oncorhynchus nerka juveniles				
Pleuronectidae larvae				
Oncorhynchus gorbuscha	1.0	11.1		
Astrotheca	0.5	2.6		
Gasterosteus aculeatus juv.	0.5	0.1	11.5	2.8
Totals				
Species richness (No. of species)	5		1	
Mean number of individuals	19.5		15.5	
Mean wet weight (grams)	62.5		13.4	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Lummi Bay Mud/Eelgrass, Protected	July/Aug. 31-7-74 to 2-8-74		August 20-8-74 to 22-8-74		September 10-9-74 to 12-9-74	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juveniles	138.5	642.5	247.5	1160.5	1053.5	4866
Gasterosteus aculeatus	207	57.5	126.5	39.5	400.5	168
Hypomesus pretiosus	6.5	31.5	20	182.5	1	5.5
Aulorhynchus flavidus	1	0.5			0.5	1.5
Lumpenus sagitta	0.5	13.5				
Leptocottus armatus	6	125.5	7	187	6	159
Oncorhynchus spp. juveniles	2.5	--				
Cymatogaster aggregata			0.5	2	1.5	1.5
Porichthys notatus			0.5	6.5		
Ammodytes hexapterus			1.5	3.5	0.5	1
Oncorhynchus tshawytscha juv.			6	68.5	5.5	144.5
Spirinchus thaleichthys			1	12.5	2	20.5
Pallasina barbata aix			0.5	1		
Microgadus proximus juveniles					5	13.5
Cottid juveniles (*Triglops* sp?)						
Syngnathus griseolineatus					2	4.5
Parophrys larvae						
Parophrys vetulus					0.5	0.5
Hypomesus larvae						
Psychrolutes paradoxus						
Gilbertidia sigalutes (?) larvae						
Pholis laeta						
Xeneretmus latifrons						
Odontopyxis trispinosa (?)						
Hexagrammos decagrammus juveniles						
Unidentified larvae						
Platichthys stellatus						
Armodytes larvae						
Psychrolutes larvae						
Unident. Pleuronectid larvae						
Unident. Cottid larvae						
Lycodopsis (?) larvae						
Lepidogobius (?) larvae						
Unident. Osmerid larvae						
Unident. *Sebastes* sp. larvae						
Unident. Bathymasteridae (?) larv.						
Clupea harengus pallasi larvae						
Agonus acipenserinus						
Xeneretmus sp. juveniles						
Oncorhynchus kisutch juveniles						
O. gorbuscha						
Enaraulis mordax						
Hypomesus pretiosus juveniles						
Ophiodon elongatus juveniles						
Cottid larvae						
Ammodytes hexapterus juveniles						
Squalus acanthias						
Lumpenus sagitta juveniles						
Pleuronectidae larvae						
Lampetra ayresi juveniles						
Oncorhynchus kisutch						
O. tshawytscha						
Clupea harengus pallasi						
Gasterosteus juveniles						
Theragra chalcogramma						
Spirinchus thaleichthys juv.						
Psychrolutes paradoxus juv.						
Oncorhynchus keta juv.						
Hexagrammos sp. juv.						
Rhamphocottus richardsoni larvae						
Unknown spp. (3) larvae						
Lumpenus sagitta larvae						
Leptocottus armatus						
Pholis ornata						
Agonidae larvae						
Totals						
Species richness (No. of species)	7		10		12	
Mean number of individuals	362		411		1478.5	
Mean wet weight (grams)	871		1663.5		5386	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Lummi Bay (cont'd.)	December 4-12-74 to 5-12-74		February 14-2-75, 19-2-75		March 10-3-75 to 12-3-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juveniles	47	275	0.5	1.5	0.5	2.2
Gasterosteus aculeatus	3	3.5			1	0.7
Hypomesus pretiosus						
Aulorhynchus flavidus						
Lumpenus sagitta						
Leptocottus armatus					0.5	22.4
Oncorhynchus spp. juveniles						
Cymatogaster aggregata						
Porichthys notatus						
Ammodytes hexapterus	2	14.5				
Oncorhynchus tshawytscha juv.						
Spirinchus thaleichthys	9.5	77.5			1	1.5
Pallasina barbata aix						
Microgadus proximus juveniles						
Cottid juveniles (*Triglops* sp?)					0.5	0.1
Syngnathus griseolineatus	0.5	0.5			2.5	1.8
Parophrys larvae					3.5	0.3
Parophrys vetulus			1	138.1		
Hypomesus larvae					0.5	0.1
Psychrolutes paradoxus	2	6				
Gilbertidia sigalutes (?) larvae					13	1.1
Pholis laeta	0.5	2				
Xeneretmus latifrons	0.5	0.5				
Odontopyxis trispinosa (?)					0.5	0.1
Hexagrammos decagrammus juveniles			0.5	0.3	1.5	0.8
Unidentified larvae			0.5	0.1	2	0.2
Platichthys stellatus						
Ammodytes larvae						
Psychrolutes larvae						
Unident. Pleuronectid larvae						
Unident. Cottid larvae						
Lycodopsis (?) larvae						
Lepidogobius (?) larvae						
Unident. Osmerid larvae						
Unident. *Sebastes* sp. larvae						
Unident. Bathymasteridae (?)larv.						
Clupea harengus pallasi larvae						
Agonus acipenserinus						
Xeneretmus sp. juveniles						
Oncorhynchus kisutch juveniles						
O. gorbuscha						
Engraulis mordax						
Hypomesus pretiosus juveniles						
Ophiodon elongatus juveniles						
Cottid larvae						
Ammodytes hexapterus juveniles						
Squalus acanthias						
Lumpenus sagitta juveniles						
Pleuronectidae larvae						
Lampetra ayresi juveniles						
Oncorhynchus kisutch						
O. tshawytscha						
Clupea harengus pallasi						
Gasterosteus juveniles						
Theragra chalcogramma						
Spirinchus thaleichthys juv.						
Psychrolutes paradoxus juv.						
Oncorhynchus keta juv.						
Hexagrammos sp. juv.						
Rhamphocottus richardsoni larvae						
Unknown spp. (3) larvae						
Lumpenus sagitta larvae						
Leptocottus armatus						
Pholis ornata						
Agonidae larvae						
Totals						
Species richness (No. of species)	8		3		14	
Mean number of individuals	65		2		27	
Mean wet weight (grams)	379.5		138.5		31.3	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Lummi Bay (cont'd.)	April 14-4-75 to 17-4-75		May 12-5-75 to 15-5-75		June 24-6-75 to 26-6-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juveniles			1.5	90.0	5074.5	7460.0
Gasterosteus aculeatus	5.5	13.5	243.0	771.0	22.0	85.5
Hypomesus pretiosus						
Aulorhynchus flavidus						
Lumpenus sagitta			0.5	1.5		
Leptocottus armatus						
Oncorhynchus spp. juveniles						
Cymatogaster aggregata			2.5	28.0		
Porichthys notatus						
Ammodytes hexapterus						
Oncorhynchus tshawytscha juv.						
Spirinchus thaleichthys	1	0.1			1.5	8.5
Pallasina barbata aix						
Microgadus proximus juveniles						
Cottid juveniles (*Triglops* sp?)						
Syngnathus griseolineatus						
Parophrys larvae			1.5	0.1		
Parophrys vetulus						
Hypomesus larvae						
Psychrolutes paradoxus						
Gilbertidia sigalutes (?) larvae						
Pholis laeta						
Xeneretmus latifrons						
Odontopyxis trispinosa (?)						
Hexagrammos decagrammus juveniles			1.0	1.0		
Unidentified larvae						
Platichthys stellatus	1	454				
Ammodytes larvae	135	3.2	6.5	1.0		
Psychrolutes larvae	697	47.9				
Unident. Pleuronectid larvae	3	0.1				
Unident. Cottid larvae	1	0.1				
Lycodopsis (?) larvae	0.5	0.1				
Lepidogobius (?) larvae	0.5	0.4				
Unident. Osmerid larvae	1.5	1.9				
Unident. *Sebastes* sp. larvae	1	0.3				
Unident. Bathymasteridae (?) larv.	0.5	0.2				
Clupea harengus pallasi larvae			84.5	2.0	21.5	1.0
Agonus acipenserinus					1.0	21.0
Xeneretmus sp. juveniles					0.5	0.1
Oncorhynchus kisutch juveniles			0.5	14.0	4.0	66.0
O. gorbuscha					1.0	12.5
Engraulis mordax					1.0	5.5
Hypomesus pretiosus juveniles					18.0	2.6
Ophiodon elongatus juveniles					0.5	1.7
Cottid larvae					1.0	0.1
Ammodytes hexapterus juveniles					2.0	3.5
Squalus acanthias					0.5	242.5
Lumpenus sagitta juveniles					0.5	0.2
Pleuronectidae larvae			0.5	0.1	2.0	0.1
Lampetra ayresi juveniles					0.5	1.5
Oncorhynchus kisutch						
O. tshawytscha						
Clupea harengus pallasi						
Gasterosteus juveniles						
Theragra chalcogramma						
Spirinchus thaleighthys juv.			5.5	11.0		
Psychrolutes paradoxus juv.			74.0	11.4		
Oncorhynchus keta juv.			2.5	6.6		
Hexagrammos sp. juv.			1	1.0		
Rhamphocottus richardsoni larvae			1.0	0.1		
Unknown spp. (3) larvae			7.0	0.3		
Lumpenus sagitta larvae			29	4.3		
Leptocottus armatus			1.5	151.5		
Pholis ornata			0.5	2.5		
Agonidae larvae			1.5	0.1		
Totals						
Species richness (No. of species)	12		18		16	
Mean number of individuals	847.5		465.0		5157	
Mean wet weight (grams)	521.8		4177.2		7912.0	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Lummi Bay (cont'd.)	July 23-7-75 to 25-7-75		August 21-8-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juveniles	10127	27766.5	55	191
Gasterosteus aculeatus			5.5	16.2
Hypomesus pretiosus				
Aulorhynchus flavidus				
Lumpenus sagitta				
Leptocottus armatus	0.5	23.0		
Oncorhynchus spp. juveniles				
Cymatogaster aggregata				
Porichthys notatus				
Ammodytes hexapterus	1.0	2.5		
Oncorhynchus tshawytscha juv.				
Spirinchus thaleichthys	1.5	9.0		
Pallasina barbata aix				
Microgadus proximus juveniles				
Cottid juveniles (*Triglops* sp?)				
Syngnathus griseolineatus				
Parophrys larvae				
Parophrys vetulus				
Hypomesus larvae				
Psychrolutes paradoxus				
Gilbertidia sigalutes (?) larvae				
Pholis laeta				
Xeneretmus latifrons				
Odontopyxis trispinosa (?)				
Hexagrammos decagrammus juveniles				
Unidentified larvae				
Platichthys stellatus				
Ammodytes larvae				
Psychrolutes larvae				
Unident. Pleuronectid larvae				
Unident. Cottid larvae				
Lycodopsis (?) larvae				
Lepidogobius (?) larvae				
Unident. Osmerid larvae				
Unident. *Sebastes* sp. larvae				
Unident. Bathymasteridae (?) larv.				
Clupea harengus pallasi larvae				
Agonus acipenserinus				
Xeneretmus sp. juveniles				
Oncorhynchus kisutch juveniles				
O. gorbuscha				
Engraulis mordax	1.0	7.5	0.5	3.6
Hypomesus pretiosus juveniles				
Ophiodon elongatus juveniles				
Cottid larvae				
Ammodytes hexapterus juveniles				
Squalus acanthias				
Lumpenus sagitta juveniles				
Pleuronectidae larvae				
Lampetra ayresi juveniles				
Oncorhynchus kisutch	0.5	6.0	1	16.7
O. tshawytscha	1.0	63.5		
Clupea harengus pallasi				
Gasterosteus juveniles			85	28.3
Theragra chalcogramma			0.5	0.4
Spirinchus thaleichthys juv.			10	3.4
Psychrolutes paradoxus juv.				
Oncorhynchus keta juv.				
Hexagrammos sp. juv.				
Rhamphocottus richardsoni larvae				
Unknown spp. (3) larvae				
Lumpenus sagitta larvae				
Leptocottus armatus				
Pholis ornata				
Agonidae larvae				
Totals				
Species richness (No. of species)	7		6	
Mean number of individuals	10132.5		157.5	
Mean wet weight (grams)	27883.5		259.6	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Migley Pt., Lummi Is. Rocky w/Kelp, Exposed	July/Aug 31-7-74 to 2-8-74		August 20-8-74 to 22-8-74		September 10-9-74 to 12-9-74	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juveniles	131.5	494	119.5	412	134.5	612.5
Gasterosteus aculeatus	48	63	68.5	114	169.5	101.5
Oncorhynchus tshawytscha juv.	3.5	66	1.5	60		
Squalus acanthias	0.5	130				
Leptocottus armatus	1.5	6	1.5	45	0.5	10
Microgadus proximus juveniles	0.5	0.5				
Hypomesus pretiosus	3.5	21	0.5	12.5		
Spirinchus thaleichthys	0.5	5	4	1.5		
Entosphenus tridentatus	1.5	12.5				
Hexagrammos decagrammus	0.5	90				
Agonus acipenserinus			0.5	1		
Oncorhynchus kisutch juveniles			1	11		
Ammodytes hexapterus					1	2
Pholis ornata						
P. laeta						
Unidentified larvae						
Hypomesus larvae						
Gilbertidia sigalutes (?) larvae						
Clupea harengus pallasi						
Psychrolutes larvae						
Ammodytes larvae						
Unidentified *Sebastes* larv.						
Oncorhynchus gorbuscha juveniles						
Engraulis mordax						
Cottidae larvae						
Pleuronectidae larvae						
Clupea harengus pallasi larvae						
Lumpenus sagitta						
Ammodytes hexapterus juveniles						
Hypomesus pretiosus juveniles						
Oncorhynchus tshawytscha						
Gasterosteus juveniles						
Oncorhynchus kisutch						
Psychrolutes paradoxus juv.						
Lumpenus sagitta larvae						
Unknown spp. (2) larvae						
Platichthys stellatus						
Totals:						
Species richness (No. of species)	10		8		4	
Mean number of individuals	95.75		197		305.5	
Mean wet weight (grams)	888		657		726	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Migley Pt. (cont'd.)	December 4-12-74 to 5-12-74		February 14-2-75, 19-2-75		March 10-3-75 to 12-3-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juveniles	2.5	19			0.5	4.5
Gasterosteus aculeatus	1	1.5				
Oncorhynchus tshawytscha juv.						
Squalus acanthias						
Leptocottus armatus					0.5	40
Microgadus proximus juveniles						
Hypomesus pretiosus						
Spirinchus thaleichthys	3	4.5				
Entosphenus tridentatus						
Hexagrammos decagrammus			0.5	0.1		
Agonus acipenserinus						
Oncorhynchus kisutch juveniles						
Ammodytes hexapterus						
Pholis ornata	0.5	3				
P. laeta	0.5	5				
Unidentified larvae			0.5	0.1	0.5	0.1
Hypomesus larvae					0.5	0.3
Gilbertidia sigalutes (?) larvae					0.5	0.1
Clupea harengus pallasi						
Psychrolutes larvae						
Ammodytes larvae						
Unidentified *Sebastes* larv.						
Oncorhynchus gorbuscha juveniles						
Engraulis mordax						
Cottidae larvae						
Pleuronectidae larvae						
Clupea harengus pallasi larvae						
Lumpenus sagitta						
Ammodytes hexapterus juveniles						
Hypomesus pretiosus juveniles						
Oncorhynchus tshawytscha						
Gasterosteus juveniles						
Oncorhynchus kisutch						
Psychrolutes paradoxus juv.						
Lumpenus sagitta larvae						
Unknown spp. (2) larvae						
Platichthys stellatus						
Totals:						
Species richness (No. of species)	5		2		5	
Mean number of individuals	7.5		1		2.5	
Mean wet weight (grams)	33		0.2		45	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Migley Pt. (cont'd)	April 14-4-75 to 17-4-75		May 12-5-75 to 15-5-75		June 24-6-75 to 26-6-75	
Species	No.	Wt.	No.	Wt.	No.	Wt.
Clupea harengus pallasi juveniles					147.0	219.6
Gasterosteus aculeatus	0.5	1.4	13	34	202.5	857.5
Oncorhynchus tshawytscha juv.						
Squalus acanthias						
Leptocottus armatus						
Microgadus proximus juveniles						
Hypomesus pretiosus						
Spirinchus thaleichthys	0.5	0.9			1.5	0.7
Entosphenus tridentatus						
Hexagrammos decagrammus						
Agonus acipenserinus						
Oncorhynchus kisutch juveniles						
Ammodytes hexapterus						
Pholis ornata						
P. laeta			0.5	2.0		
Unidentified larvae	10	14.6				
Hypomesus larvae	11.5	8.7			4.5	0.3
Gilbertidia sigalutes (?) larvae						
Clupea harengus pallasi	0.5	2.4				
Psychrolutes larvae	1	0.1				
Ammodytes larvae	2.5	0.1	1.5	0.2		
Unidentified *Sebastes* larv.	0.5	0.1				
Oncorhynchus gorbuscha juveniles					2.0	20.5
Engraulis mordax					1.0	7.4
Cottidae larvae					0.5	0.4
Pleuronectidae larvae					3.5	0.7
Clupea harengus pallasi larvae			1	0.1	53.5	4.2
Lumpenus sagitta					0.5	0.2
Ammodytes hexapterus juveniles					1.5	1.0
Hypomesus pretiosus juveniles					0.5	3.2
Oncorhynchus tshawytscha						
Gasterosteus juveniles						
Oncorhynchus kisutch						
Psychrolutes paradoxus juv.			13.5	1.9		
Lumpenus sagitta larvae			1	0.1		
Unknown spp. (2) larvae			1.5	0.1		
Platichthys stellatus			0.5	775.0		
Totals:						
Species richness (No. of species)	9		8		10	
Mean number of individuals	27		32.5		418.5	
Mean wet weight (grams)	21.4		813.0		1120.1	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Migley Pt. (cont'd.)	July 23-7-75 to 25-7-75		August 21-8-75	
Species	No.	Wt.	No.	Wt.
Clupea harengus pallasi juveniles	77.0	200.0		
Gasterosteus aculeatus	1.0	3.5	0.5	1.3
Oncorhynchus tshawytscha juv.				
Squalus acanthias				
Leptocottus armatus				
Microgadus proximus juveniles				
Hypomesus pretiosus				
Spirinchus thaleichthys	0.5	2.0		
Entosphenus tridentatus				
Hexagrammos decagrammus				
Agonus acipenserinus				
Oncorhynchus kisutch juveniles				
Ammodytes hexapterus				
Pholis ornata				
P. laeta				
Unidentified larvae				
Hypomesus larvae				
Gilbertidia sigalutes (?) larvae				
Clupea harengus pallasi			19.5	63.1
Psychrolutes larvae				
Ammodytes larvae				
Unidentified *Sebastes* larv.				
Oncorhynchus gorbuscha juveniles				
Engraulis mordax	1.0	9.5		
Cottidae larvae				
Pleuronectidae larvae				
Clupea harengus pallasi larvae				
Lumpenus sagitta				
Ammodytes hexapterus juveniles	2.0	4.0		
Hypomesus pretiosus juveniles				
Oncorhynchus tshawytscha	0.5	11.0		
Gasterosteus juveniles			8.5	2.6
Oncorhynchus kisutch			0.5	35
Psychrolutes paradoxus juv.				
Lumpenus sagitta larvae				
Unknown spp. (2) larvae				
Platichthys stellatus				
Totals:				
Species richness (No. of species)	6		3	
Mean number of individuals	82.0		29	
Mean wet weight (grams)	230.0		102	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Padilla Bay Mud/Eelgrass, Protected	July/Aug. 31-7-74 to 2-8-74		August 20-8-74 to 22-8-74		September 10-9-74 to 12-9-74	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juv.	170	664	158	659	2030.5	8671.5
Hypomesus pretiosus	4	32.5				
Gasterosteus aculeatus	68	55.5	511	205.5	186.5	98
Oncorhynchus tshawytscha juv.	0.5	9	2	86	0.5	16
Leptocottus armatus			2	41	7	113.5
Psychrolutes paradoxus			1	1		
Squalus acanthias			8	1935	0.5	315
Cymatogaster aggregata					62	312.5
Lumpenus sagitta					1	9
Pholis ornata					0.5	5
Pallasina barbata aix					0.5	0.5
Ammodytes hexapterus					0.5	1
Pholis laeta						
Spirinchus thaleichthys						
Apodichthys flavidus						
Syngnathus griseolineatus						
Hypomesus larvae						
Unidentified larvae						
Gilbertidia juveniles						
Gilbertidia adults						
Liparis callyodon						
Rhamphocottus richardsoni juv.						
Oncorhynchus keta juveniles						
Psychrolutes paradoxus juv.						
Unknown spp. (3) larvae						
Ammodytes hexapterus larvae						
Clupea harengus pallasi larv.						
Nautichthys oculeofasciatus larv.						
Pleuronectidae sp. larvae						
Engraulis mordax						
Oncorhynchus kisutch juv.						
Ammodytes hexapterus juv.						
Lumpenus sagitta larvae						
Cottidae larvae						
Stenobrachius leucopsarus (?) juv.						
Oncorhynchus nerka juv.						
Gasterosteus aculeatus juveniles						
Oncorhynchus kisutch						
O. keta						
Totals						
Species richness (No. of species)	4		6		10	
Mean number of individuals	242.5		682		2289.5	
Mean wet weight (grams)	761		2927.5		9542	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site - continued

Padilla Bay (cont'd.)	December 4-12-/4 to 5-12-74*		February 14-2-75, 19-2-75		March 10-3-75 to 13-3-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi **juv.**			(Inclement weather prevented sampling)			
Hypomesus pretiosus						
Gasterosteus aculeatus	1	2			0.5	0.8
Oncorhynchus tshawytscha **juv.**						
Leptocottus armatus	1	68				
Psychrolutes paradoxus						
Squalus acanthias						
Cymatogaster aggregata						
Lumpenus sagitta						
Pholis ornata	1	5				
Pallasina barbata aix						
Ammodytes hexapterus						
Pholis laeta	6	13				
Spirinchus thaleichthys	2	5				
Apodichthys flavidus	1	6				
Syngnathus griseolineatus	1	1				
Hypomesus larvae					1	0.3
Unidentified larvae					0.5	0.1
Gilbertidia juveniles						
Gilbertidia adults						
Liparis callyodon						
Rhamphocottus richardsoni juv.						
Oncorhynchus keta juveniles						
Psychrolutes paradoxus juv.						
Unknown spp. (3) larvae						
Ammodytes hexapterus larvae						
Clupea harengus pallasi larv.						
Nautichthys oculeofasciatus larv.						
Pleuronectidae sp. larvae						
Engraulis mordax						
Oncorhynchus kisutch juv.						
Ammodytes hexapterus juv.						
Lumpenus sagitta larvae						
Cottidae larvae						
Stenobrachius leucopsarus (?) juv.						
Oncorhynchus nerka juv.						
Gasterosteus aculeatus juveniles						
Oncorhynchus kisutch						
O. keta						
Totals						
Species richness (No. of species)	7				3	
Mean number of individuals	13				2	
Mean wet weight (grams)	100				1.2	

*Extrapolated from two 5-minute tows.

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site continued

Padilla Bay (cont'd.)	April 14-4-/5 to 17-4-75		May 12-5-75 to 15-5-75		June 24-6-75 to 26-6-75	
Species	No.	Wt.	No.	Wt.	No.	Wt.
Clupea harengus pallasi juv.	1.5	16.5			46.0	1.2
Hypomesus pretiosus						
Gasterosteus aculeatus	0.5	1.5	16	54.0	180.5	488.0
Oncorhynchus tshawytscha juv.					2.5	17.7
Leptocottus armatus						
Psychrolutes paradoxus						
Squalus acanthias					0.5	585.0
Cymatogaster aggregata						
Lumpenus sagitta						
Pholis ornata						
Pallasina barbata aix						
Ammodytes hexapterus						
Pholis laeta			0.5	8.0		
Spirinchus thaleichthys						
Apodichthys flavidus						
Syngnathus griseolineatus						
Hypomesus larvae			5.0	0.1	12.0	0.6
Unidentified larvae						
Gilbertidia juveniles	3.5	1.6	1	0.2		
Gilbertidia adults	1	2.5	0.5	1.5		
Liparis callyodon			1.5	10.5		
Rhamphocottus richardsoni juv.			2.5	0.2		
Oncorhynchus keta juveniles			0.5	0.5		
Psychrolutes paradoxus juv.			4.5	0.7		
Unknown spp. (3) larvae			7	0.5		
Ammodytes hexapterus larvae			1.5	0.1		
Clupea harengus pallasi larv.			4.5	0.1	23.0	69.4
Nautichthys oculeofasciatus larv.			0.5	0.1		
Pleuronectidae sp. larvae			0.5	0.1	5.5	0.1
Engraulis mordax					8.0	39.4
Oncorhynchus kisutch juv.					5.0	72.2
Ammodytes hexapterus juv.					5.5	0.7
Lumpenus sagitta larvae					0.5	0.1
Cottidae larvae					3.0	0.1
Stenobrachius leucopsarus (?) juv.					0.5	0.2
Oncorhynchus nerka juv.					0.5	16.5
Gasterosteus aculeatus juveniles						
Oncorhynchus kisutch						
O. keta						
Totals						
Species richness (No. of species)	3		15		13	
Mean number of individuals	6.5		46.0		293.0	
Mean wet weight (grams)	22.1		76.4		1291.0	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site continued

Padilla Bay (cont'd.)	July 23-7-75 to 25-7-75		August 22-8-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juv.	15.1	90.2	10	32
Hypomesus pretiosus			3	29.8
Gasterosteus aculeatus	192.0	524.7	5	15
Oncorhynchus tshawytscha juv.	29.0	276.2		
Leptocottus armatus	0.5	8.2		
Psychrolutes paradoxus				
Squalus acanthias	1.0	1000		
Cymatogaster aggregata				
Lumpenus sagitta				
Pholis ornata			0.5	11.5
Pallasina barbata aix				
Ammodytes hexapterus				
Pholis laeta				
Spirinchus thaleichthys				
Apodichthys flavidus				
Syngnathus griseolineatus				
Hypomesus larvae				
Unidentified larvae				
Gilbertidia juveniles				
Gilbertidia adults				
Liparis callyodon				
Rhamphocottus richardsoni juv.				
Oncorhynchus keta juveniles				
Psychrolutes paradoxus juv.				
Unknown spp. (3) larvae				
Ammodytes hexapterus larvae				
Clupea harengus pallasi larv.				
Nautichthys oculeofasciatus larv.				
Pleuronectidae sp. larvae				
Engraulis mordax				
Oncorhynchus kisutch juv.	0.5	2.9		
Ammodytes hexapterus juv.	1.0	1.6	0.5	1.7
Lumpenus sagitta larvae				
Cottidae larvae				
Stenobrachius leucopsarus (?) juv.				
Oncorhynchus nerka juv.				
Gasterosteus aculeatus juveniles	195.0	55.5	37.5	10
Oncorhynchus kisutch			1	17.1
O. keta			1	9.5
Totals				
Species richness (No. of species)	7		7	
Mean number of individuals	434.1		58.5	
Mean wet weight (grams)	1959.3		126.6	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site continued

Shannon Pt., Fidalgo Is. Cobble, Exposed	July/Aug. 31-7-74 to 2-8-74		August 20-8-74 to 22-8-74		September 10-9-74 to 12-9-74	
Species	No.	Wt.	No.	Wt.	No.	Wt.
Clupea harengus pallasi juv.	6	2.1	273.5	4016.5	35.5	221
Oncorhynchus keta juv.	7.5	112.5				
O. tshawytscha juv.	6.5	78.8	0.5	12.5	5	86.5
O. gorbuscha juv.	0.5	2.9				
O. kisutch juv.	2.5	18.1				
Gasterosteus aculeatus	91	250.6	29.5	11.5	281	205
Leptocottus armatus	1.5	64.5	0.5	12	3.5	90
Psychrolutes paradoxus	2.5	2.5			5.5	6.5
Ammodytes hexapterus	0.5	0.5	0.5	2.5	1	2
Lampetra ayresi	0.5	4				
Lumpenus sagitta	0.5	5.5			0.5	1.5
Scorpaenichthys marmoratus	0.5	<0.5				
Agonus acipenserinus	0.5	<0.5				
Pholis laeta	0.5	<0.5				
Gilbertidia sigalutes	3	6				
Pholis ornata			0.5	0.5		
Microgadus proximus juv.			0.5	2		
Spirinchus thaleichthys			0.5	<0.5		
Hypomesus pretiosus					0.5	6
Porichthys notatus					0.5	12
Pallasina barbata aix					0.5	0.5
Cymatogaster aggregata						
Hexagrammos decagrammus						
Liparis rutteri						
Oncorhynchus kisutch						
Parophrys larvae						
Ammodytes larvae						
Psychrolutes larvae						
Hypomesus larvae						
Lycodopsis (?) larvae						
Sebastes sp. larvae						
Spirinchus juveniles						
Unidentified Pleuronectid larvae						
Unidentified larvae						
Ammodytes hexapterus juveniles						
Psychrolutes paradoxus juv.						
Clupea harengus pallasi larv.						
Unknown spp. (4) larvae						
Rhamphocottus richardsoni juv.						
Agonidae sp. juvenile						
Cottidae sp. larvae						
Lumpenus sagitta juveniles						
Gasterosteus juveniles						
Theragra chalcogramma						
Oncorhynchus keta						
Totals						
Species richness (No. of species)	15		8		10	
Mean number of individuals	124		306		343.5	
Mean wet weight (grams)	549.6		4058		631	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site continued

Shannon Pt. (cont'd.)	December 4-12-74 to 5-12-74		February 14-2-75, 19-2-75		April 14-4-75 to 17-4-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juv.	13	92	0.5	2.5	1.5	9.3
Oncorhynchus keta juv.						
O. tshawytscha juv.						
O. gorbuscha juv.						
O. kisutch juv.						
Gasterosteus aculeatus						
Leptocottus armatus						
Psychrolutes paradoxus						
Ammodytes hexapterus			1	3.5		
Lampetra ayresi						
Lumpenus sagitta						
Scorpaenichthys marmoratus						
Agonus acipenserinus						
Pholis laeta					0.5	5
Gilbertidia sigalutes			2	1.5		
Pholis ornata						
Microgadus proximus juv.						
Spirinchus thaleichthys						
Hypomesus pretiosus						
Porichthys notatus						
Pallasina barbata aix						
Cymatogaster aggregata	0.5	10				
Hexagrammos decagrammus			0.5	0.3		
Liparis rutteri			0.5	1.5		
Oncorhynchus kisutch					1	35.8
Parophrys larvae					0.5	0.9
Ammodytes larvae					4.5	0.2
Psychrolutes larvae					19	2.2
Hypomesus larvae					1	0.1
Lycodopsis (?) larvae					1	0.1
Sebastes sp. larvae					1	0.1
Spirinchus juveniles					0.5	1
Unidentified Pleuronectid larvae					0.5	0.1
Unidentified larvae					13	0.6
Ammodytes hexapterus juveniles						
Psychrolutes paradoxus juv.						
Clupea harengus pallasi larv.						
Unknown spp. (4) larvae						
Rhamphocottus richardsoni juv.						
Agonidae sp. juvenile						
Cottidae sp. larvae						
Lumpenus sagitta juveniles						
Gasterosteus juveniles						
Theragra chalcogramma						
Oncorhynchus keta						
Totals						
Species richness (No. of species)	2		5		16	
Mean number of individuals	13.5		4.5		44	
Mean wet weight (grams)	102		9.3		55.4	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site continued

Shannon Pt. (cont'd.)	May 12-5-75 to 15-5-75		July 23-7-75 to 25-7-75		August	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juv.	0.5	0.7	1.5	6.8	0.5	2.1
Oncorhynchus keta juv.	1.5	2.3				
O. tshawytscha juv.			4.0	29.7		
O. gorbuscha juv.			2.0	18.3		
O. kisutch juv.	0.5	15.5	0.5	4.6		
Gasterosteus aculeatus	2	5.5	7.0	25.0	5	13.3
Leptocottus armatus			0.5	28.9		
Psychrolutes paradoxus					0.5	0.9
Ammodytes hexapterus						
Lampetra ayresi						
Lumpenus sagitta	0.5	0.7				
Scorpaenichthys marmoratus						
Agonus acipenserinus						
Pholis laeta	2.5	3.7				
Gilbertidia sigalutes						
Pholis ornata						
Microgadus proximus juv.						
Spirinchus thaleichthys						
Hypomesus pretiosus			0.5	2.3		
Porichthys notatus						
Pallasina barbata aix						
Cymatogaster aggregata						
Hexagrammos decagrammus						
Liparis rutteri						
Oncorhynchus kisutch					5.5	88.8
Parophrys larvae						
Ammodytes larvae						
Psychrolutes larvae						
Hypomesus larvae						
Lycodopsis (?) larvae						
Sebastes sp. larvae	0.5	0.1				
Spirinchus juveniles						
Unidentified Pleuronectid larvae						
Unidentified larvae						
Ammodytes hexapterus juveniles	9.5	1.3	0.5	0.5	2	4.4
Psychrolutes paradoxus juv.	10.0	2.3				
Clupea harengus pallasi larv.	2.0	0.9				
Unknown spp. (4) larvae	7.5	0.4				
Rhamphocottus richardsoni juv.	0.5	0.1				
Agonidae sp. juvenile	0.5	0.1				
Cottidae sp. larvae	1.0	0.1				
Lumpenus sagitta juveniles			0.5	0.6		
Gasterosteus juveniles					4.5	1.5
Theragra chalcogramma					0.5	1.1
Oncorhynchus keta					0.5	7.2
Totals						
Species richness (No. of species)	16		9		7	
Mean number of individuals	57.0		14.5		19	
Mean wet weight (grams)	33.3		113.1		119.3	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site continued

South Beach, San Juan Island Cobble, exposed	July/Aug. 31-7-74 to 2-8-74		August 20-8-74 to 22-8-74		September 10-9-74 to 12-9-74	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juveniles	20.5	65	107	240	98.5	864
Oncorhynchus gorbuscha juveniles	3.5	51.5				
Oncorhynchus keta juveniles	2.5	32.5	0.5	6	1	12.5
Oncorhynchus kisutch juveniles	0.5	12.5			0.5	27.5
Oncorhynchus tshawytscha juveniles	0.5	5			1	85
Gasterosteus aculeatus	0.5	<0.5	0.5	1	0.5	0.5
Microgadus proximus juveniles			122.5	666.5	1	6.5
Ammodytes hexapterus			3	4.5	1	2.5
Parophrys vetulus			0.5	89		
Trichodon trichodon			0.5	35		
Hypomesus pretiosus			0.5	3		
Leptocottus armatus					0.5	7.5
Pholis ornata					0.5	2.5
Sebastes sp. larvae						
Artedius lateralis						
Hypomesus larvae						
Parophrys larvae						
Cottid larvae						
Psychrolutes paradoxus juv.						
Pholis laeta						
Agonidae sp. juvenile						
Clupea harengus pallasi larvae						
Ammodytes hexapterus larvae						
Unknown spp. (3) larvae						
Ammodytes hexapterus juv.						
Pleuronectidae sp. larvae						
Blepsias cirrhosus juveniles						
Totals:						
Species richness (No. of species)	6		8		9	
Mean number of individuals	28		235		104.5	
Mean wet weight (grams)	167		1045		1108.5	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site continued

South Beach, San Juan Island (cont'd.)	December 4-12-74 to 5-12-74		February 14-2-75, 19-2-75		March 10-3-75 to 12-3-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juveniles	3.5	17.5	1	8		
Oncorhynchus gorbuscha juveniles						
Oncorhynchus keta juveniles						
Oncorhynchus kisutch juveniles						
Oncorhynchus tshawytscha juveniles						
Gasterosteus aculeatus	2	2				
Microgadus proximus juveniles						
Ammodytes hexapterus	0.5	4	0.5	1.5		
Parophrys vetulus						
Trichodon trichodon						
Hypomesus pretiosus						
Leptocottus armatus						
Pholis ornata						
Sebastes sp. larvae	0.5	0.1				
Artedius lateralis			0.5	2.5		
Hypomesus larvae					1.5	0.5
Parophrys larvae					0.5	0.1
Cottid larvae					0.5	0.1
Psychrolutes paradoxus juv.						
Pholis laeta						
Agonidae sp. juvenile						
Clupea harengus pallasi larvae						
Ammodytes hexapterus larvae						
Unknown spp. (3) larvae						
Ammodytes hexapterus juv.						
Pleuronectidae sp. larvae						
Blepsias cirrhosus juveniles						
Totals:						
Species richness (No. of species)	4		3		3	
Mean number of individuals	6.5		2		2.5	
Mean wet weight (grams)	23.6		12		0.7	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site continued

South Beach, San Juan Island (cont'd.)	May 12-5-75 to 15-5-75		August 21-8-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juveniles	1	9.0		
Oncorhynchus gorbuscha juveniles				
Oncorhynchus keta juveniles	0.5	0.8		
Oncorhynchus kisutch juveniles				
Oncorhynchus tshawytscha juveniles				
Gasterosteus aculeatus	2.5	5.3		
Microgadus proximus juveniles				
Ammodytes hexapterus				
Parophrys vetulus				
Trichodon trichodon	0.5	22.0		
Hypomesus pretiosus				
Leptocottus armatus				
Pholis ornata				
Sebastes sp. larvae	0.5	0.1		
Artedius lateralis				
Hypomesus larvae				
Parophrys larvae	1	0.1		
Cottid larvae				
Psychrolutes paradoxus juv.	2.0	4.5		
Pholis laeta	0.5	1.2		
Agonidae sp. juvenile	1	0.1		
Clupea harengus pallasi larvae	11.5	0.4		
Ammodytes hexapterus larvae	3	0.1		
Unknown spp. (3) larvae	3.5	0.2		
Ammodytes hexapterus juv.	5	13.2		
Pleuronectidae sp. larvae	1	0.1		
Blepsias cirrhosus juveniles	1	0.1		
Totals:				
Species richness (No. of species)	16		0	
Mean number of individuals	52.0		0	
Mean wet weight (grams)	61.3		0	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site continued

Village Pt., Lummi Is. Gravel, Protected	July/Aug. 31-7-74 to 2-8-74		August 20-8-74 to 22-8-74		September 10-9-74 to 12-9-74	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juv.	60.5	42.5	258	1459.5	70.5	612.5
Oncorhynchus gorbuscha juv.	1	10				
O. tshawytscha juvenile	2.5	42.5	2	16	1	14.5
O. keta juvenile	5.5	49	2	44.5	0.5	10
Gasterosteus aculeatus	138	117.5	37.5	38	245.5	107.5
Ammodytes hexapterus	0.5	2.5	0.5	25.5	0.5	0.5
Leptocottus armatus	1.5	15				
Entosphemus tridentatus	0.5	5				
Spirinchus thaleichthys			1.5	7.5		
Hypomesus pretiosus					0.5	2.5
Pholis ornata					0.5	< 1
Squalus acanthias						
Hypomesus pretiosus larvae						
Ammodytes hexapterus larvae						
Gilbertidia						
Gilbertidia juvenile						
Psychrolutes larvae						
Unidentified Hexagrammid						
Unidentified *Sebastes* larvae						
" Pleuronectid larvae						
" larvae						
Psychrolutes paradoxus juv.						
Clupea harengus pallasi larv.						
Lumpenus sagitta larvae						
Agonidae larvae						
Unknown spp. (2) larvae						
Ammodytes hexapterus juveniles						
Cottidae larvae						
Pleuronectidae larvae						
Oncorhynchus gorbuscha						
Engraulis mordax						
Liparis sp.						
Lumpenus sagitta						
Gasterosteus aculeatus juv.						
Totals						
Species richness (No. of species)	8		6		7	
Mean number of individuals	210		301.5		319	
Mean wet weight (grams)	284		1591		747.5	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site continued

Village Pt. (cont'd.)	December 4-12-74 to 5-12-74		February 14-2-75, 19-2-75		March 10-3-75 to 12-3-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juv.	7.5	30.5			1	21
Oncorhynchus gorbuscha juv.						
O. tshawytscha juvenile						
O. keta juvenile						
Gasterosteus aculeatus	0.5	0.5			5	3
Ammodytes hexapterus						
Leptocottus armatus	0.5	17.5			0.5	37.5
Entosphemus tridentatus						
Spirinchus thaleichthys	0.5	1				
Hypomesus pretiosus						
Pholis ornata						
Squalus acanthias			0.5	101		
Hypomesus pretiosus larvae			1.5	0.3		
Ammodytes hexapterus larvae						
Gilbertidia						
Gilbertidia juvenile						
Psychrolutes larvae						
Unidentified Hexagrammid						
Unidentified *Sebastes* larvae						
" Pleuronectid larvae						
" larvae						
Psychrolutes paradoxus juv.						
Clupea harengus pallasi larv.						
Lumpenus sagitta larvae						
Agonidae larvae						
Unknown spp. (2) larvae						
Ammodytes hexapterus juveniles						
Cottidae larvae						
Pleuronectidae larvae						
Oncorhynchus gorbuscha						
Engraulis mordax						
Liparis sp.						
Lumpenus sagitta						
Gasterosteus aculeatus juv.						
Totals						
Species richness (No. of species)	4		2		3	
Mean number of individuals	9		2		6.5	
Mean wet weight (grams)	49.5		101.3		61.5	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site continued

Village Pt. (cont'd.)	April 14-4-75 to 17-4-75		May 12-5-75 to 15-5-75		June 24-6-75 to 26-6-75	
Species	No.	Wt.	No.	Wt.	No.	Wt.
Clupea harengus pallasi juv.	3	33.5			29.0	13.7
Oncorhynchus gorbuscha juv.						
O. tshawytscha juvenile						
O. keta juvenile	0.5	0.3	0.5	0.8	12.0	85.7
Gasterosteus aculeatus	2.5	5.8	102	333.5	5.5	16.2
Ammodytes hexapterus			0.5	2.5		
Leptocottus armatus						
Entosphemus tridentatus						
Spirinchus thaleichthys						
Hypomesus pretiosus						
Pholis ornata						
Squalus acanthias						
Hypomesus pretiosus larvae	2	7.5				
Ammodytes hexapterus larvae	13.5	0.5	3	0.6	3.0	0.2
Gilbertidia	0.5	1.8				
Gilbertidia juvenile	0.5	0.2				
Psychrolutes larvae	0.5	0.2				
Unidentified Hexagrammid	0.5	0.2				
Unidentified *Sebastes* larvae	0.5	0.1				
" Pleuronectid larvae	0.5	0.1				
" larvae	2	0.1				
Psychrolutes paradoxus juv.			29.5	4.1	0.5	0.1
Clupea harengus pallasi larv.			2.5	0.1	32.0	1.1
Lumpenus sagitta larvae			1.5	0.2		
Agonidae larvae			1.0	0.1		
Unknown spp. (2) larvae			2.0	0.1		
Ammodytes hexapterus juveniles					1.5	0.2
Cottidae larvae					0.5	0.1
Pleuronectidae larvae					12.5	0.6
Oncorhynchus gorbuscha						
Engraulis mordax						
Liparis sp.						
Lumpenus sagitta						
Gasterosteus aculeatus juv.						
Totals						
Species richness (No. of species)	10		9		7	
Mean number of individuals	26.5		142.5		96.5	
Mean wet weight (grams)	50.3		341.8		117.6	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site continued

Village Pt. (cont'd.)	July 23-7-75 to 25-7-75	
Species	*No.*	*Wt.*
Clupea harengus pallasi juv.	276.5	759.5
Oncorhynchus gorbuscha juv.		
O. tshawytscha juvenile	0.5	7.5
O. keta juvenile	0.5	3.0
Gasterosteus aculeatus	23.5	74.5
Ammodytes hexapterus		
Leptocottus armatus		
Entosphemus tridentatus		
Spirinchus thaleichthys	0.5	1.0
Hypomesus pretiosus		
Pholis ornata		
Squalus acanthias		
Hypomesus pretiosus larvae		
Ammodytes hexapterus larvae		
Gilbertidia		
Gilbertidia juvenile		
Psychrolutes larvae		
Unidentified Hexagrammid		
Unidentified *Sebastes* larvae		
" Pleuronectid larvae		
" larvae		
Psychrolutes paradoxus juv.		
Clupea harengus pallasi larv.		
Lumpenus sagitta larvae		
Agonidae larvae		
Unknown spp. (2) larvae		
Ammodytes hexapterus juveniles	46.0	82.5
Cottidae larvae		
Pleuronectidae larvae		
Oncorhynchus gorbuscha	3.5	45.0
Engraulis mordax	0.5	2.5
Liparis sp.	0.5	1.0
Lumpenus sagitta	1.0	2.0
Gasterosteus aculeatus juv.	8.5	2.4

Totals

Species richness (No. of species)	7
Mean number of individuals	361.5
Mean wet weight (grams)	980.7

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site continued

Westcott Bay, San Juan Island Mud/Eelgrass, Protected	July/Aug. 31-7-74 to 2-8-74		August 20-8-74 to 22-8-74		September 10-9-74 to 12-9-74	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juveniles	1717	5478.5	1601.5	5899.5	5815.5	16866
Leptocottus armatus	1.5	54	13	240.5	1	8.5
Oncorhynchus kisutch juveniles	0.5	12.5				
Oncorhynchus gorbuscha juveniles	0.5	5				
Blepsias cirrhosus	0.5	1				
Hypomesus pretiosus	3	5	3	16	2.5	15
Syngnathus griseolineatus	0.5	0.3				
Gasterosteus aculeatus	1.5	0.5	1	0.8	28	128
Pholis ornata	0.5	0.5				
Oncorhynchus tshawytscha juv.			0.5	35	1.5	60.5
Microgadus proximus			2	10		
Cymatogaster aggregata			70.5	346.5	6	45.5
Aulorhynchus flavidus					5	10.5
Embiotoca lateralis					0.5	5
Ammodytes hexapterus					0.5	--
Sebastes sp. larvae					0.5	0.5
Eumicrotremus orbis						
Pholis laeta						
Parophrys vetulus larvae						
Unidentified larvae						
Clupea harengus pallasi larvae						
Squalus acanthias						
Ammodytes hexapterus juveniles						
Unident. sp.						
Clupea harengus pallasi						
Theragra chalcogramma						
Lumpenus sagitta						
Pallasina barbata						
Oncorhynchus keta						
Gilbertidia sigalutes						
Unknown sp. larvae						
Totals						
Species richness (No. of species)	9		7		10	
Mean number of individuals	1725.5		1691.5		5861	
Mean wet weight (grams)	5557.3		6548.3		17139.5	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site continued

Westcott Bay (cont'd.)	December 4-12-74 to 5-12-74		February 14-2-75, 19-2-75		March 10-3-75 to 12-3-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juveniles	2.5	24.5				
Leptocottus armatus	0.5	13.5				
Oncorhynchus kisutch juveniles						
Oncorhynchus gorbuscha juveniles						
Blepsias cirrhosus						
Hypomesus pretiosus	0.5	5.5				
Syngnathus griseolineatus					0.5	0.3
Gasterosteus aculeatus	3.5	4.5	0.5	0.5		
Pholis ornata						
Oncorhynchus tshawytscha juv.						
Microgadus proximus						
Cymatogaster aggregata						
Aulorhynchus flavidus					0.5	1.5
Embiotoca lateralis						
Ammodytes hexapterus						
Sebastes sp. larvae						
Eumicrotremus orbis	1	5.5				
Pholis laeta			0.5	1		
Parophrys vetulus larvae					0.5	0.1
Unidentified larvae					1.5	0.2
Clupea harengus pallasi larvae						
Squalus acanthias						
Ammodytes hexapterus juveniles						
Unident. sp.						
Clupea harengus pallasi						
Theragra chalcogramma						
Lumpenus sagitta						
Pallasina barbata						
Oncorhynchus keta						
Gilbertidia sigalutes						
Unknown sp. larvae						
Totals						
Species richness (No. of species)	5		2		5	
Mean number of individuals	8		1		3	
Mean wet weight (grams)	53.5		1.5		2.1	

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site continued

Westcott Bay (cont'd.)	May 12-5-75 to 15-5-75	
Species	*No.*	*Wt.*
Clupea harengus pallasi juveniles		
Leptocottus armatus		
Oncorhynchus kisutch juveniles		
Oncorhynchus gorbuscha juveniles		
Blepsias cirrhosus		
Hypomesus pretiosus		
Syngnathus griseolineatus		
Gasterosteus aculeatus	4.5	13.5
Pholis ornata		
Oncorhynchus tshawytscha juv.		
Microgadus proximus		
Cymatogaster aggregata		
Aulorhynchus flavidus		
Embiotoca lateralis		
Ammodytes hexapterus		
Sebastes sp. larvae		
Eumicrotremus orbis		
Pholis laeta		
Parophrys vetulus larvae		
Unidentified larvae		
Clupea harengus pallasi larvae		
Squalus acanthias		
Ammodytes hexapterus juveniles		
Unident. sp.		
Clupea harengus pallasi	3.0	67.5
Theragra chalcogramma		
Lumpenus sagitta		
Pallasina barbata		
Oncorhynchus keta		
Gilbertidia sigalutes	0.5	2.0
Unknown sp. larvae	0.5	0.1

Totals

Species richness (No. of species)	4
Mean number of individuals	8.5
Mean wet weight (grams)	83.1

Appendix 5b. Tow net catches (species, numbers, and weight), July 1974 through February 1975. Values given for numbers and weight are the average of two tows per month per sample site continued

Westcott Bay (cont'd.)	June 24-6-75 to 26-6-75		July 23-7-75 to 25-7-75		August 20-8-75	
Species	*No.*	*Wt.*	*No.*	*Wt.*	*No.*	*Wt.*
Clupea harengus pallasi juveniles	2050.0	7065.5	3633.5	10577.5		
Leptocottus armatus			1.0	2.8	0.5	7
Oncorhynchus kisutch juveniles	0.5	10.6				
Oncorhynchus gorbuscha juveniles	0.5	5.5				
Blepsias cirrhosus					2.5	14.5
Hypomesus pretiosus						
Syngnathus griseolineatus			0.5	1.5	0.5	0.2
Gasterosteus aculeatus						
Pholis ornata						
Oncorhynchus tshawytscha juv.						
Microgadus proximus					13.5	64.5
Cymatogaster aggregata					0.5	0.4
Aulorhynchus flavidus	1.0	0.3				
Embiotoca lateralis					1	6.5
Ammodytes hexapterus						
Sebastes sp. larvae						
Eumicrotremus orbis						
Pholis laeta						
Parophrys vetulus larvae						
Unidentified larvae						
Clupea harengus pallasi larvae	11.5	0.4				
Squalus acanthias	0.5	650.0				
Ammodytes hexapterus juveniles	7.5	1.7	6.5	41.0		
Unident. sp.	0.5	1.2				
Clupea harengus pallasi					1753.5	6147
Theragra chalcogramma					1.5	6
Lumpenus sagitta					5	11.5
Pallasina barbata					0.5	1.5
Oncorhynchus keta					1	24.1
Gilbertidia sigalutes						
Unknown sp. larvae						
Totals						
Species richness (No. of species)	7		4		11	
Mean number of individuals	2072		3641.5		1780	
Mean wet weight (grams)	7735.1		10648.0		6283.2	

Appendix 5c. Fish sighted at Allan Island during SCUBA transect study

Species	6 Feb 74	9 Apr	20 May	11 Jun	25 Jul	23 Aug	23 Sep	29 Oct	17 Dec	14 Jan	21 Feb 75	24 Mar
Pacific herring					+							
Blackeye goby							1	6				
Copper rockfish			1	2	1	2	2	3	2	4	8	1	1			1		2	
Yellowtail rockfish					~50	1	1	~50	1	7	~81		~65			~33	1	5	
Quillback rockfish		1		1	2	1		1			6		1			1			
Black rockfish			1	1			1	~65			~39	1	~37			~25	1	~31	
Kelp greenling	3		2	5	2	4	5	2	7	5	10	11	3	5		2	3	3	2
Lingcod		1	1		1				1			2						1	1
Scalyhead sculpin			1							2	2		1	1	2			1	
Red Irish lord					1					1	1	2			1				
Longfin sculpin		1		1		2	4	2	6	5	4	3		1		1			1
Grunt sculpin							1												
Cabezon								1									1		
Rockfish (juv.)				1	1		1				~5								
Cottid														1					
Number of fish	3	3	5	8	9	~59	15	9	~133	16	~34	~158	6	~111	4	63	6	43	4
Number of species	1	3	4	4	7	5	7	6	7	6	8	7	4	7	3	6	4	6	3

No data

No data

No data

Appendix 5c. Fish sighted at Pt. George during SCUBA transect study - continued

Species	13 Mar		10,12 Apr		8,9 May		13 Jun		24 Jul		24 Aug		24 Sep	8 Oct	30 Oct		23 Dec	4 Jan		5,6 Feb		22 Mar	
Pacific herring									+		+	+	+										
Striped seaperch	1												2	8	6	8	~100	~20	~10	1		26	
Pile perch																		1					
Wolf eel			1																				
Blackeye goby							1	1	2		1	1		4								3	
Copper rockfish		4	3	4	4	2	7	3	9		9	11	4	11	5	2	4	2	1	2		3		4	1
Puget Sound rockfish				25	5	10	5	2										2		1		10	11		
Yellowtail rockfish					~40		~50	4	~50	11	~53	~56	~52	5		1		2						12	
Quillback rockfish			3	1	3	1		1	5	4	2	3	2		1	5	2	1		3	2	1			1
Black rockfish				11	10		~40	~15	3	6	7	~13	9	7		4	2	3		2					1
Kelp greenling	4	4	6	3	7	8	5	7	3	2	6	10	5	6	7	9	11	8	2	4	5	5	6		5
Lingcod				2	1			2			2	3			2	4		2		2	1	2	1		3
Painted greenling							1																		
Scalyhead sculpin						1		1		1	1	1	2	5			1			2		2			
Buffalo sculpin								1		1				1							1				3
Red Irish lord																									1
Longfin sculpin				3	7	5	8	8	7	15	17	6	7	10	3	3	5	1	1	1	4	5	1		
Great sculpin								1														1			
Rockfish (juv.)	1																								
Number of fish	6	8	12	49	~76	27	~116	~46	~79	50	~103	~96	~94	47	21	38	~125	~39	6	~24	28	27	53		15
Number of species	3	3	5	7	9	7	8	12	7+	9+	9+	8+	9+	8	6	8	8	9	4	7	8	7	7		7

Appendix 5c. Fish sighted at Barnes Island during SCUBA transect study - continued

Species	26 Aug	25 Sep	17 Dec	23 Mar	6 May
Spiny dogfish		1			
Striped seaperch					6
Blackeye goby	1	1			
Copper rockfish	10	12	3	5	9
Quillback rockfish	10	30	4	3	
Tiger rockfish					1
Kelp greenling	4	17	12	6	8
Lingcod		3	2	1	1
Painted greenling		2			
Scalyhead sculpin	1		2		
Longfin sculpin	9	6	1	3	1
Sailfin sculpin			1		
Cabezon	3			2	2
Number of fish	38	72	25	20	28
Number of species	7	8	7	6	7

Appendix 5d. Densities of seven most abundant species by month in rocky habitat as determined by SCUBA transects (number of fish per 1000 m^2). Hyphen (-) indicates no dives were made

	Spring		Summer			Fall			Winter					
	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	July	Sep.
Allan Island														
Sebastes caurinus		1.5	1.6	2.1	1.4	2.6	0.5	-	-	3.2	1.1	0	-	2.6
S. maliger	0.7	0.5	1.6	0.4	0	1.4	0.2	-	-	1.6	0	0	-	1.6
S. flavidus	0	0	28.4	21.3	0.7	19.8	16.0	-	-	52.8	3.4	0	-	26.0
S. melanops	0.7	0.5	0	27.5	0	9.0	9.3	-	-	40.0	18.3	0	-	5.7
Hexagrammos decagrammus	1.3	3.6	5.0	3.4	3.5	4.3	2.0	-	-	3.2	3.4	2.5	-	3.1
Ophiodon elongatus	1.3	0.5	0	0.4	0	0.5	0	-	-	0	0.6	1.2	-	1.0
Jordania zonope	0.65	0.5	3.3	3.4	3.5	1.4	0.2	-	-	1.6	0	1.2	-	0.6
Pt. George														
Sebastes caurinus	1.9	1.7	6.7	8.1	4.2	4.8	1.6	-	0.8	0.8	1.1	1.5	10.1	3.4
S. maliger	1.2	1.2	0.65	6.0	1.3	0.6	1.6	-	0.8	1.2	1.1	0.3	1.3	0.6
S. flavidus	0	11.6	36.0	34.9	28.9	17.4	0.3	-	0.6	0	0	3.6	10.7	1.1
S. melanops	2.7	2.9	36.7	3.5	5.2	4.6	1.1	-	1.4	0.8	0	0.3	9.5	0
Hexagrammos decagrammus	2.0	3.3	8.0	2.4	4.2	3.2	4.2	-	5.2	2.4	4.0	3.3	2.5	2.8
Ophiodon elongatus	0.5	0.3	1.4	0	1.3	0	1.6	-	0.6	0.8	1.1	1.2	0.6	0.6
Jordania zonope	0.75	3.5	10.7	8.4	6.5	4.8	1.6	-	1.7	0.8	3.3	0.3	5.7	0
Barnes Island														
Sebastes caurinus	-	4.6	-	-	7.7	8.4	-	-	2.3	-	-	4.3	-	2.9
S. maliger	-	0	-	-	7.7	21.0	-	-	3.0	-	-	2.6	-	6.7
S. flavidus	-	0	-	-	0	0	-	-	0	-	-	0	-	1.9
S. melanops	-	0	-	-	0	0	-	-	0	-	-	0	-	0
Hexagrammos decagrammus	-	4.1	-	-	3.1	11.9	-	-	9.1	-	-	5.2	-	2.9
Ophiodon elongatus	-	0.5	-	-	0	2.1	-	-	1.5	-	-	0.9	-	0
Jordania zonope	-	0.5	-	-	6.9	4.2	-	-	0.8	-	-	2.6	-	0.7

Appendix 5e. Trammel net catches

Collins Cove, San Juan Island

	30-10-74		30-3-75	
	no.	*wt.*	*no.*	*wt.*
Hexagrammos decagrammus	6.0	8748.0	3.0	1581.0
Sebastes melanops	1.0	157.5		
Embiotoca lateralis	1.0	364.5	1.0	113.5
Hydrolagus colliei	1.0	638.0		
Squalus acanthias	0.5	2000.0	0.5	4000.0
Hexagrammos stelleri			0.5	113.3
Sebastes melanops			0.5	81.0
Sebastes flavidus			0.5	43.0
Myoxocephalus polyacanthocephalus			1.0	509.5
Nautichthys oculofasciatus			0.5	14.0
Species richness (no. of species)	5		8	
Mean number of individuals	9.5		7.5	
Mean wet weight *grams*	8951.5		6455.3	

Migley Pt., Lummi Island

	5-12-74		11-3-75	
	no.	*wt.*	*no.*	*wt.*
Hexagrammos decagrammus	2.0	930.0	2.0	1435.0
Hydrolagus colliei	2.5	2345.0	0.5	318.5
Squalus acanthias	7.5	3862.5	0.5	112.8
Cymatogaster aggregata	1.0	60.0		
Enophrys bison	0.5	35.0	0.5	31.7
Scorpaenichthys marmoratus			1.0	957.5
Species richness (no. of species)	5		5	
Mean number of individuals	10.5		41.5	
Mean wet weight *grams*	7202.5		2855.5	

Appendix 5f. Frequency of sightings and percentage of total number of fish observed (2,241) during 52 SCUBA transect dives

Species	Percent occurrence	Percent of total number observed
Hexagrammos decagrammus	96	12.4
Sebastes caurinus	83	8.7
Jordania zonope	77	8.0
Sebastes maliger	65.8	5.2
**Sebastes melanops*	52	16.1
Ophiodon elongatus	52	2.0
**Sebastes flavidus*	52	31.3
Artedius harringtoni	42	1.5
**Embiotoca lateralis*	27	8.4
**Sebastes emphaeus*	18	3.2
Coryphopterus nicholsi	18	1.0
Hemilepidotus hemilepidotus	12	0.3
**Clupea harengus pallasi*	13	+
Enophrys bison	9	0.3
Scorpaenichthys marmoratus	9	0.4
Oxylebius pictus	6	0.1
Anarrhichthus ocellatus	4	0.09
Squalus acanthias	2	0.04
Rhocochilus vacca	2	0.04
Sebastes nigrocinctus	2	0.04
Nautichthys oculofasciatus	2	0.04
Rhamphocottus richardsoni	2	0.04
Gadidae larvae	2	0.3

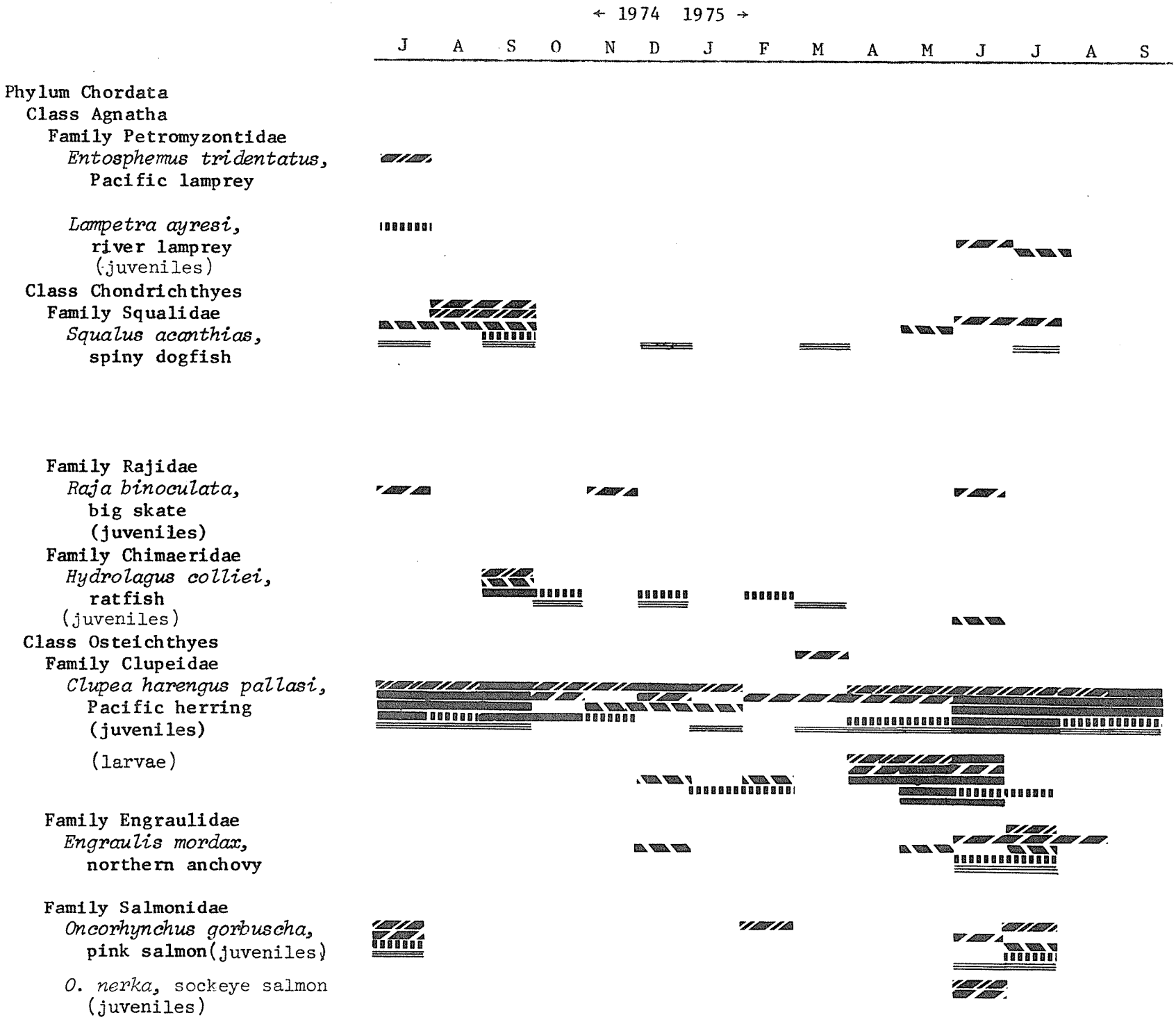
*Schooling species.

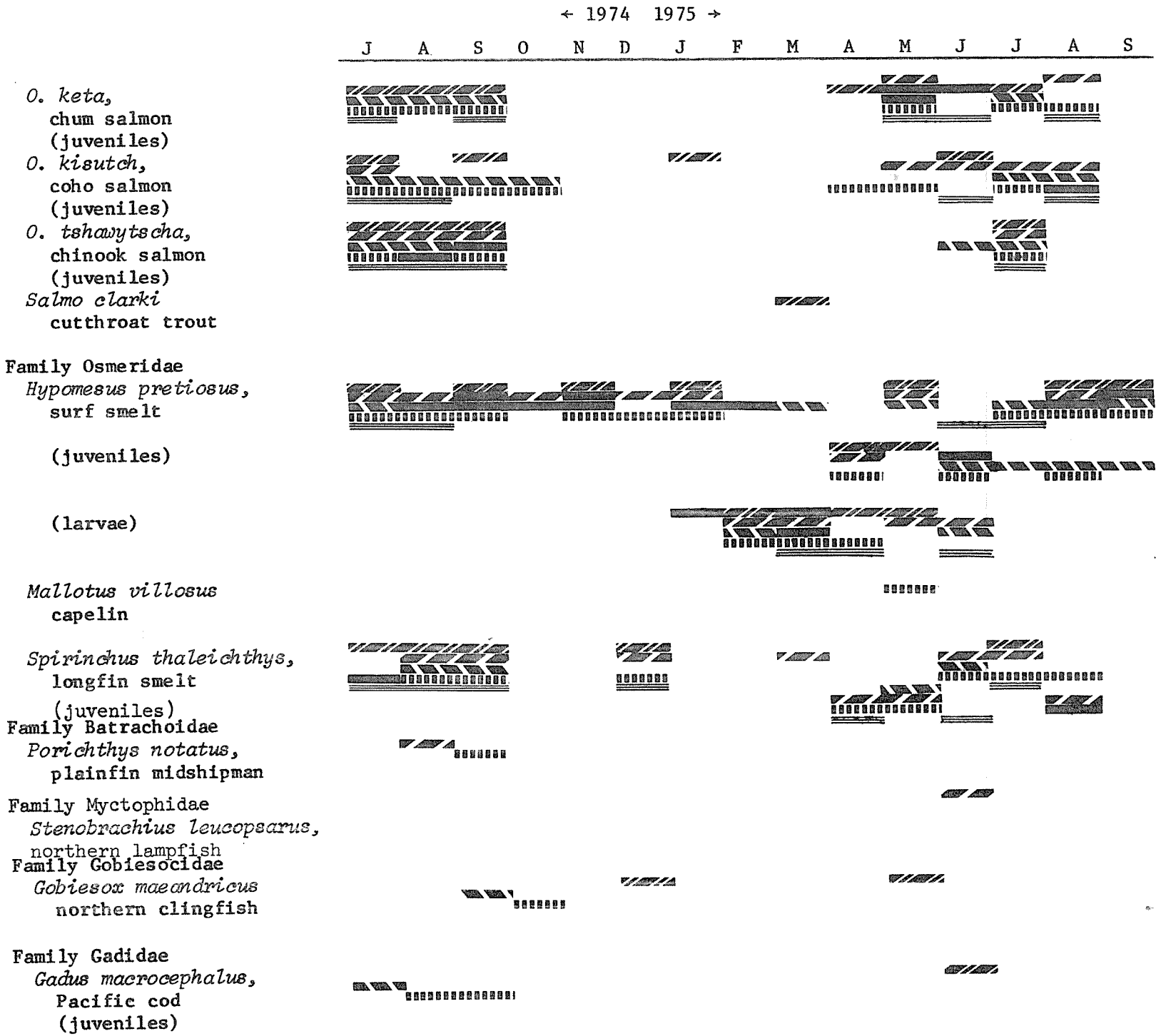
APPENDIX 6

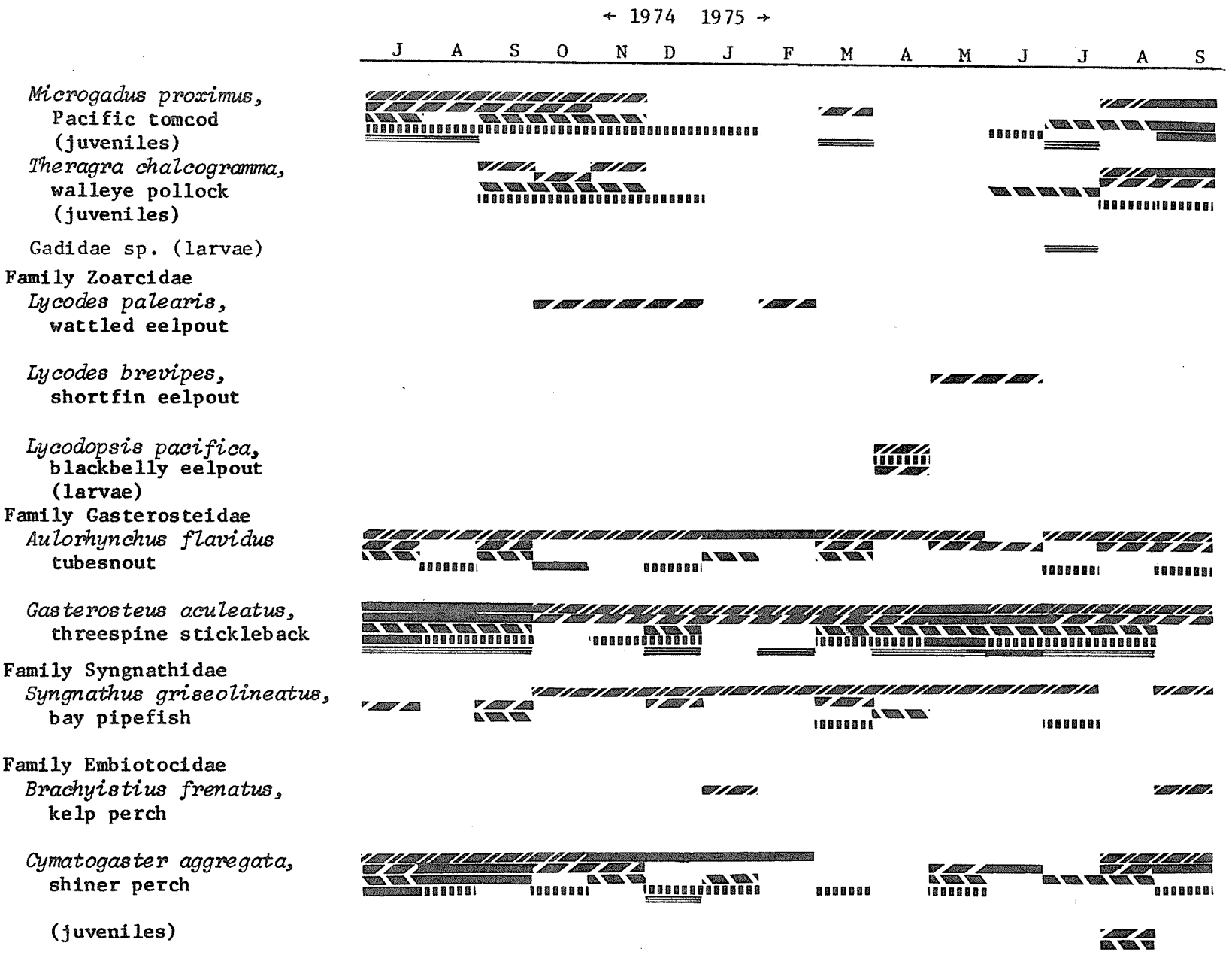
Temporal occurrence, by habitat, of nearshore fish species captured over 15-month period, July 1974 - September 1975. Periods of peak abundance are denoted by solid black lines

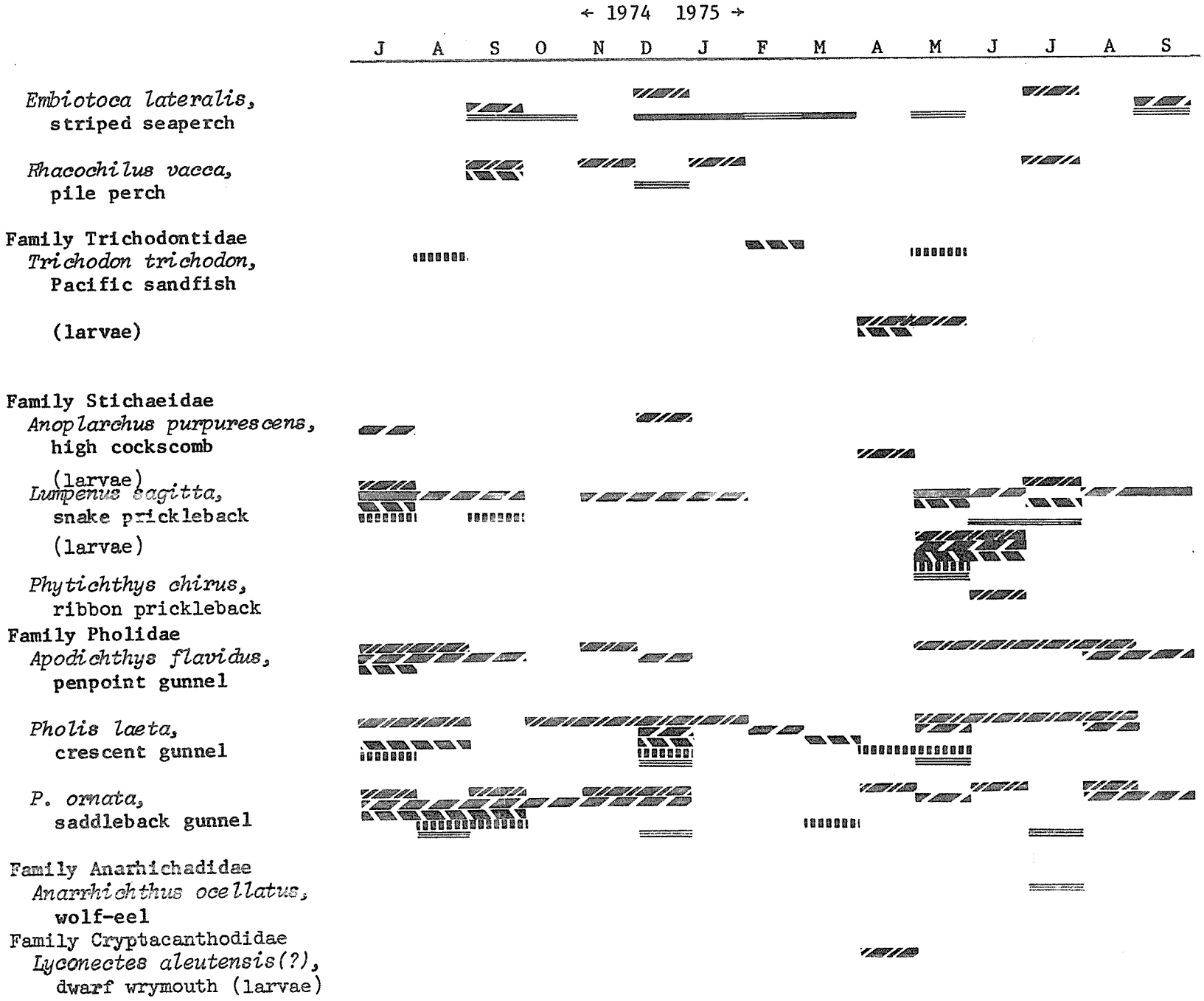
Habitat legend:

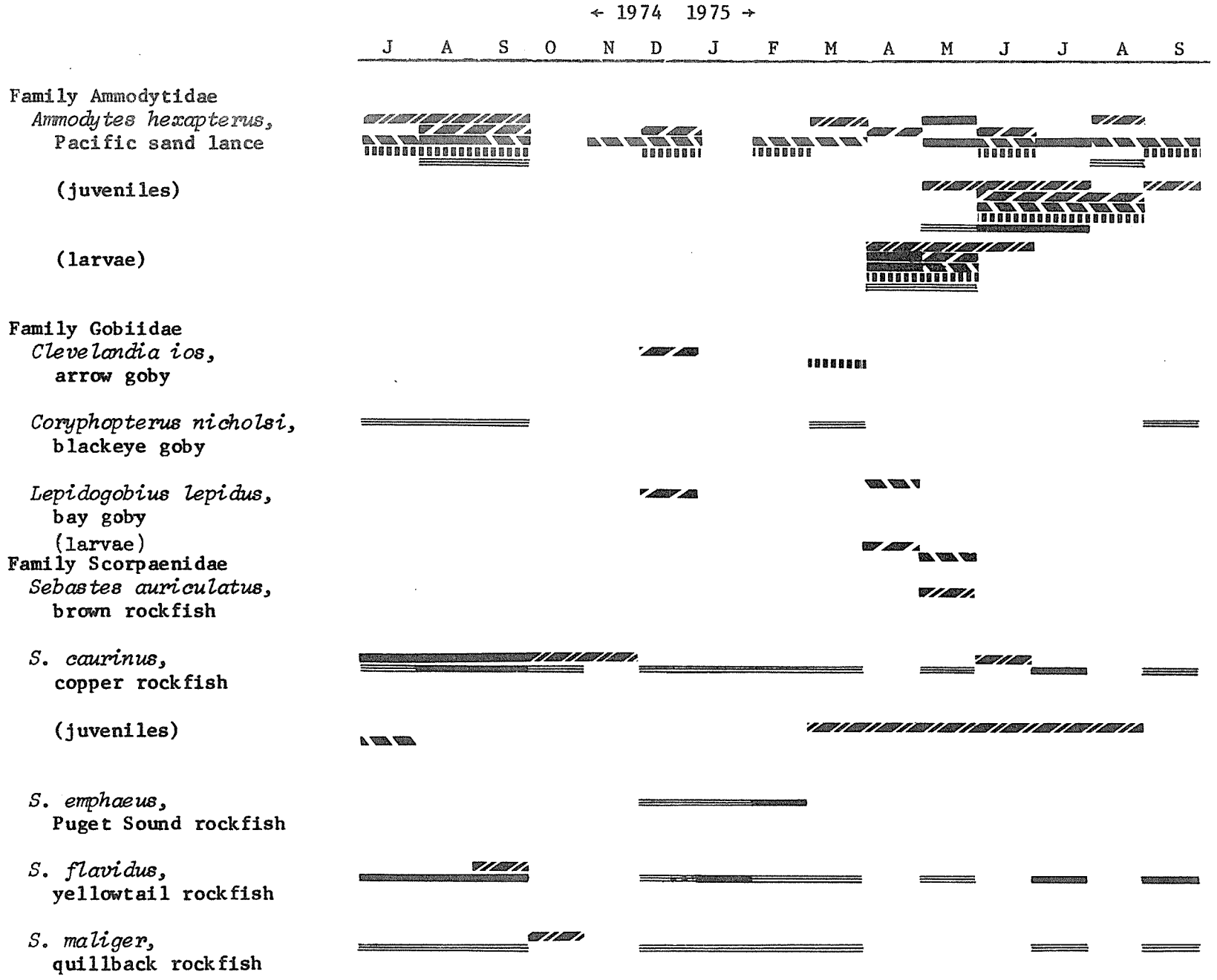
Gravel
Mud/eelgrass
Sand/eelgrass
Cobble
Rocky/kelp bed

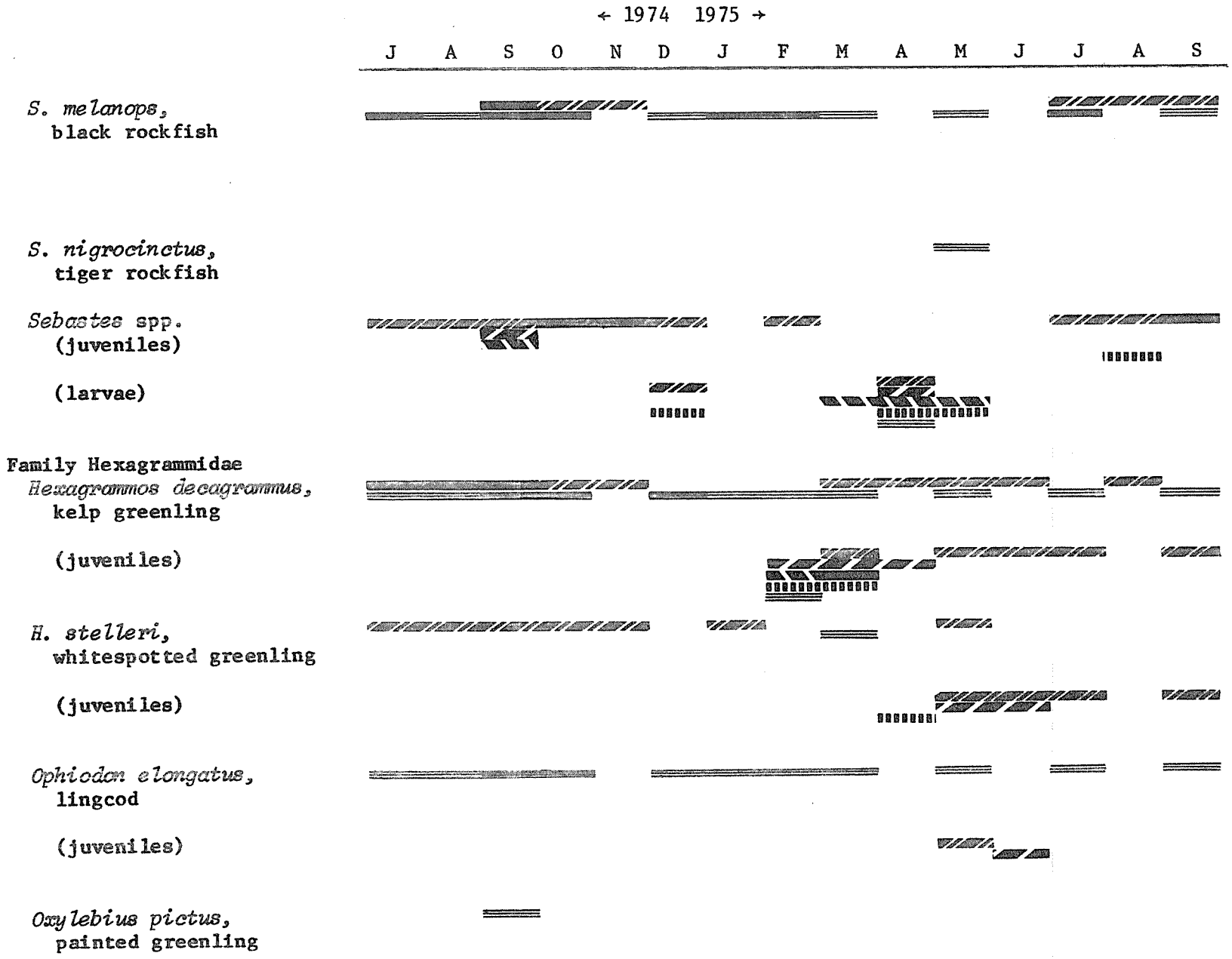

← 1974 1975 →
J A S O N D J F M A M J J A S
Phylum Chordata
Class Agnatha
Family Petromyzontidae
Entosphemus tridentatus, Pacific lamprey
Lampetra ayresi, river lamprey (juveniles)
Class Chondrichthyes
Family Squalidae
Squalus acanthias, spiny dogfish
Family Rajidae
Raja binoculata, big skate (juveniles)
Family Chimaeridae
Hydrolagus colliei, ratfish (juveniles)
Class Osteichthyes
Family Clupeidae
Clupea harengus pallasi, Pacific herring (juveniles)
(larvae)
Family Engraulidae
Engraulis mordax, northern anchovy
Family Salmonidae
Oncorhynchus gorbuscha, pink salmon (juveniles)
O. nerka, sockeye salmon (juveniles)

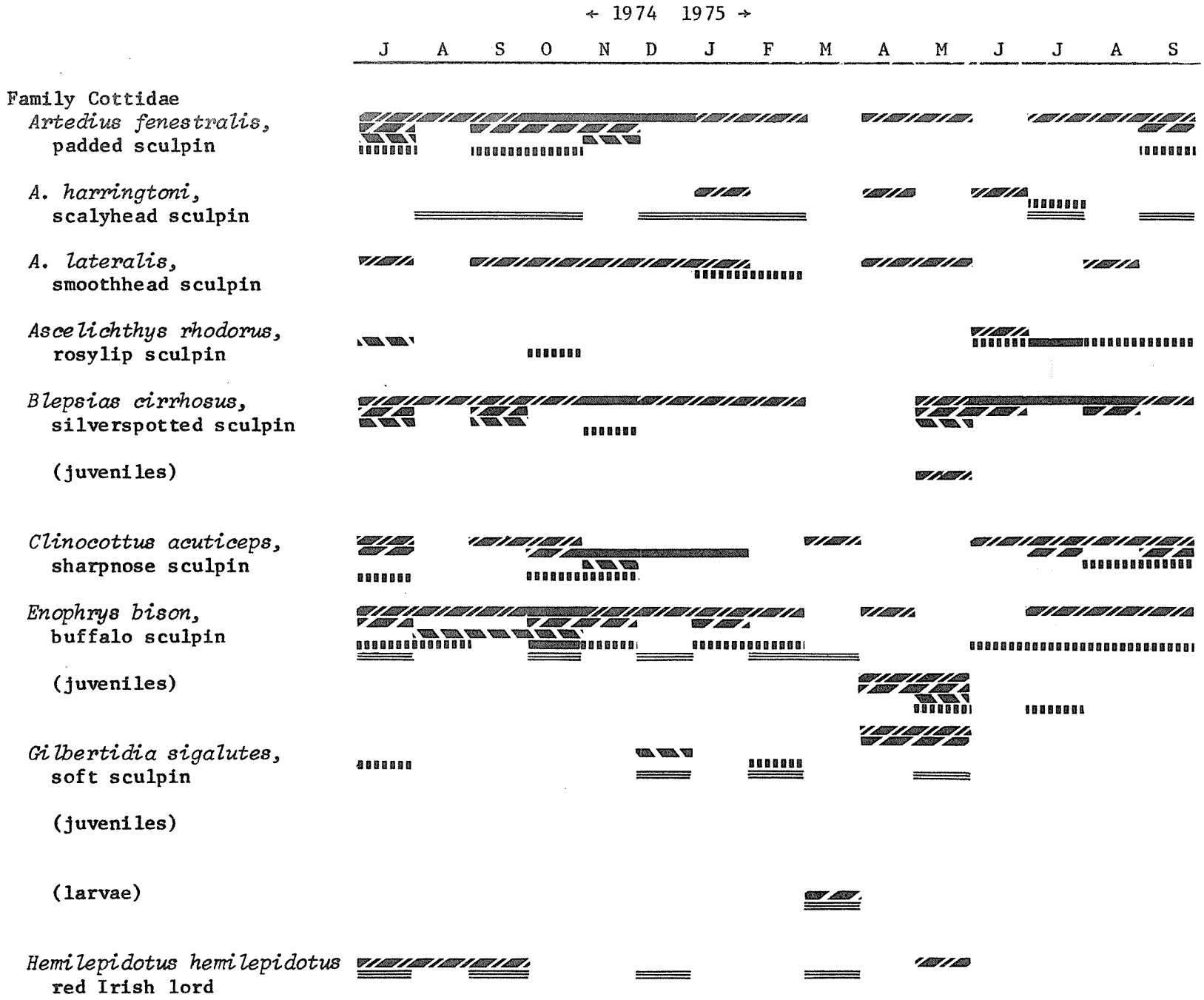

← 1974 1975 →
J A S O N D J F M A M J J A S
O. keta,
chum salmon
(juveniles)
O. kisutch,
coho salmon
(juveniles)
O. tshawytscha,
chinook salmon
(juveniles)
Salmo clarki
cutthroat trout
Family Osmeridae
Hypomesus pretiosus,
surf smelt
(juveniles)
(larvae)
Mallotus villosus
capelin
Spirinchus thaleichthys,
longfin smelt
(juveniles)
Family Batrachoidae
Porichthys notatus,
plainfin midshipman
Family Myctophidae
Stenobrachius leucopsarus,
northern lampfish
Family Gobiesocidae
Gobiesox maeandricus
northern clingfish
Family Gadidae
Gadus macrocephalus,
Pacific cod
(juveniles)

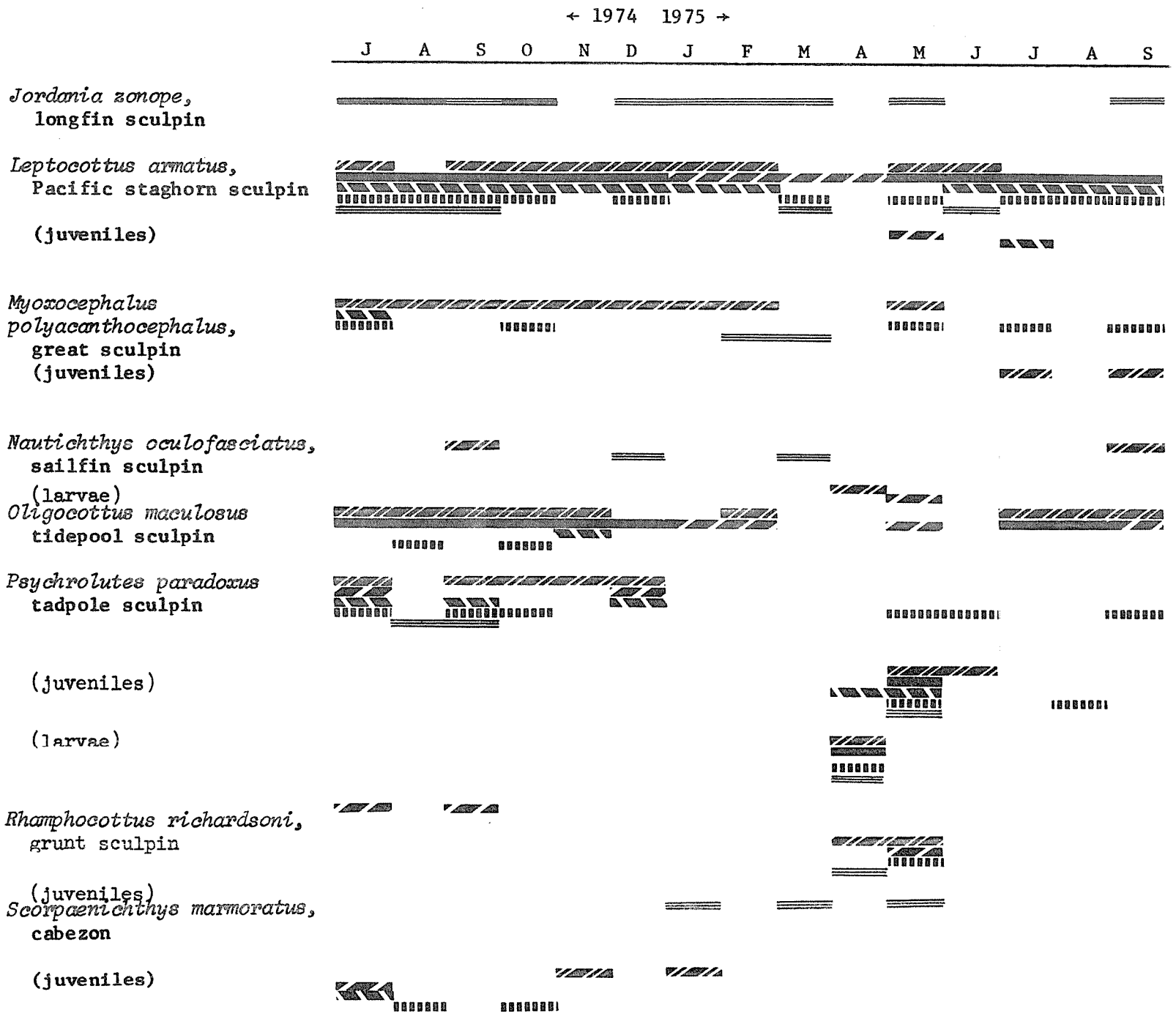

← 1974 1975 →
J A S O N D J F M A M J J A S
Microgadus proximus, Pacific tomcod (juveniles)
Theragra chalcogramma, walleye pollock (juveniles)
Gadidae sp. (larvae)
Family Zoarcidae
Lycodes palearis, wattled eelpout
Lycodes brevipes, shortfin eelpout
Lycodopsis pacifica, blackbelly eelpout (larvae)
Family Gasterosteidae
Aulorhynchus flavidus tubesnout
Gasterosteus aculeatus, threespine stickleback
Family Syngnathidae
Syngnathus griseolineatus, bay pipefish
Family Embiotocidae
Brachyistius frenatus, kelp perch
Cymatogaster aggregata, shiner perch
(juveniles)

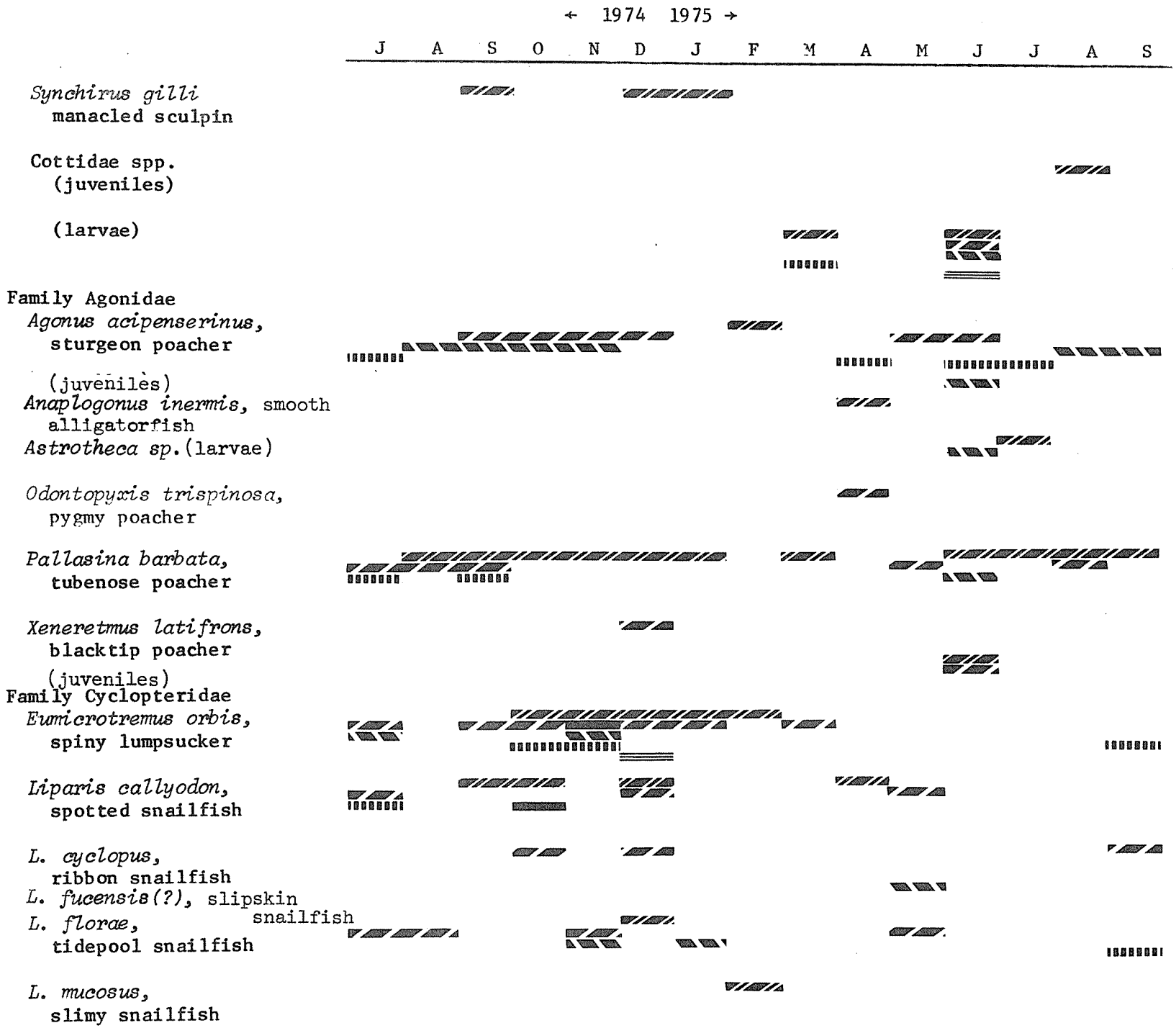

← 1974 1975 →
J A S O N D J F M A M J J A S
Embiotoca lateralis,
striped seaperch
Rhacochilus vacca,
pile perch
Family Trichodontidae
Trichodon trichodon,
Pacific sandfish
(larvae)
Family Stichaeidae
Anoplarchus purpurescens,
high cockscomb
(larvae)
Lumpenus sagitta,
snake prickleback
(larvae)
Phytichthys chirus,
ribbon prickleback
Family Pholidae
Apodichthys flavidus,
penpoint gunnel
Pholis laeta,
crescent gunnel
P. ornata,
saddleback gunnel
Family Anarhichadidae
Anarrhichthus ocellatus,
wolf-eel
Family Cryptacanthodidae
Lyconectes aleutensis(?),
dwarf wrymouth (larvae)

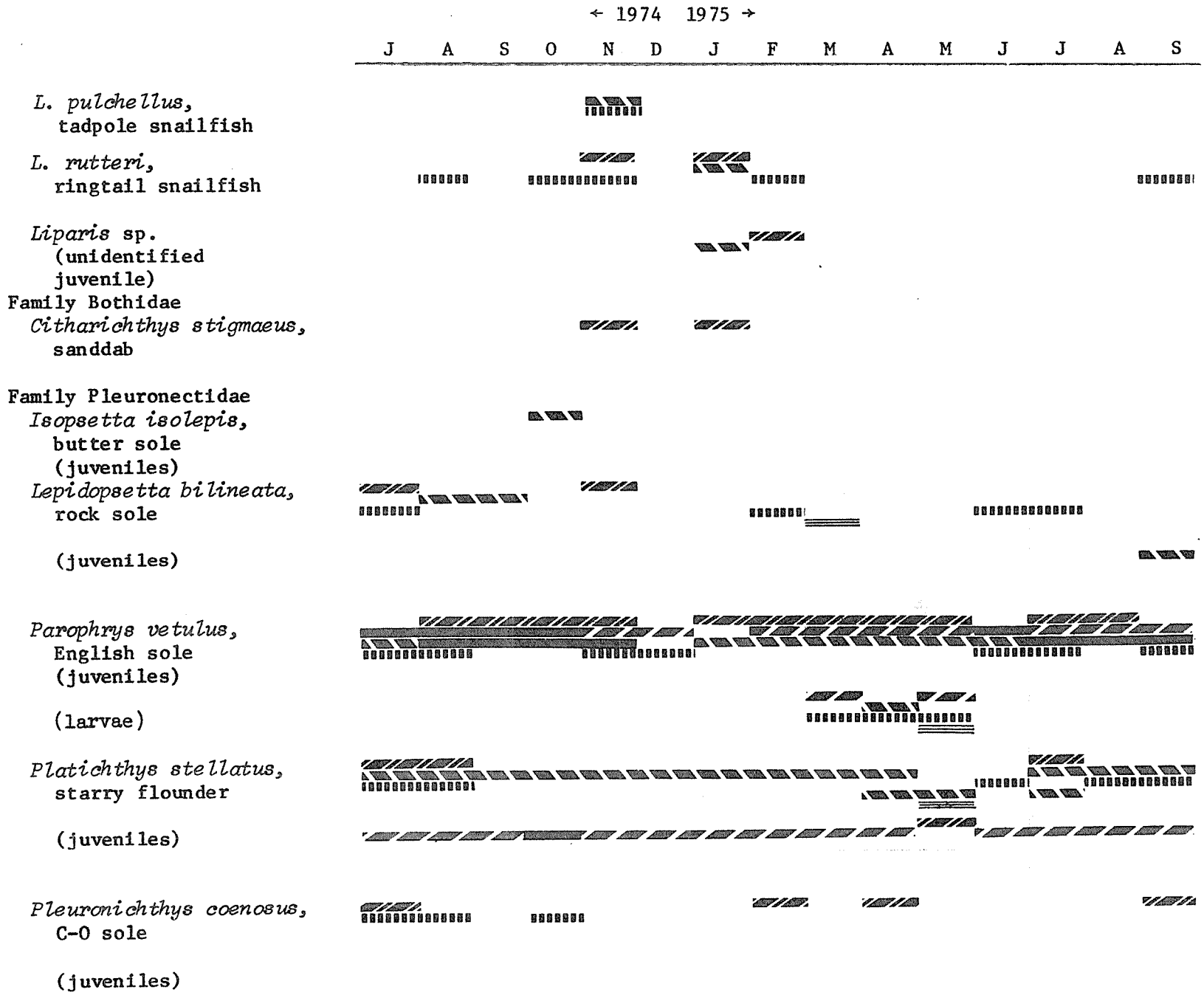

← 1974 1975 →
J A S O N D J F M A M J J A S
Family Ammodytidae
Ammodytes hexapterus,
Pacific sand lance
(juveniles)
(larvae)
Family Gobiidae
Clevelandia ios,
arrow goby
Coryphopterus nicholsi,
blackeye goby
Lepidogobius lepidus,
bay goby
(larvae)
Family Scorpaenidae
Sebastes auriculatus,
brown rockfish
S. caurinus,
copper rockfish
(juveniles)
S. emphaeus,
Puget Sound rockfish
S. flavidus,
yellowtail rockfish
S. maliger,
quillback rockfish

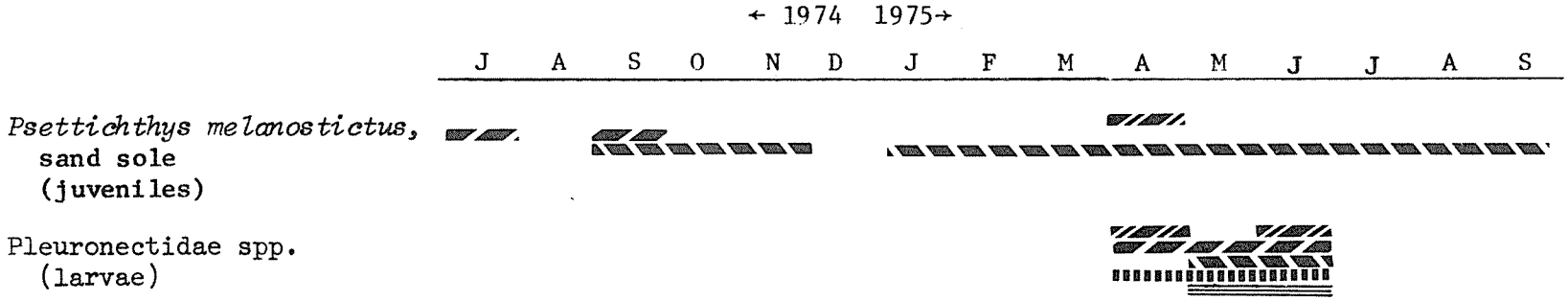

← 1974 1975 →
J A S O N D J F M A M J J A S
S. melanops, black rockfish
S. nigrocinctus, tiger rockfish
Sebastes spp. (juveniles)
(larvae)
Family Hexagrammidae
Hexagrammos decagrammus, kelp greenling
(juveniles)
H. stelleri, whitespotted greenling
(juveniles)
Ophiodon elongatus, lingcod
(juveniles)
Oxylebius pictus, painted greenling


← 1974 1975 →
J A S O N D J F M A M J J A S
Family Cottidae
Artedius fenestralis, padded sculpin
A. harringtoni, scalyhead sculpin
A. lateralis, smoothhead sculpin
Ascelichthys rhodorus, rosylip sculpin
Blepsias cirrhosus, silverspotted sculpin
(juveniles)
Clinocottus acuticeps, sharpnose sculpin
Enophrys bison, buffalo sculpin
(juveniles)
Gilbertidia sigalutes, soft sculpin
(juveniles)
(larvae)
Hemilepidotus hemilepidotus red Irish lord


← 1974 1975 →
J A S O N D J F M A M J J A S
Jordania zonope,
longfin sculpin
Leptocottus armatus,
Pacific staghorn sculpin
(juveniles)
Myoxocephalus
polyacanthocephalus,
great sculpin
(juveniles)
Nautichthys oculofasciatus,
sailfin sculpin
(larvae)
Oligocottus maculosus
tidepool sculpin
Psychrolutes paradoxus
tadpole sculpin
(juveniles)
(larvae)
Rhamphocottus richardsoni,
grunt sculpin
(juveniles)
Scorpaenichthys marmoratus,
cabezon
(juveniles)


← 1974 1975 →
J A S O N D J F M A M J J A S
Synchirus gilli
manacled sculpin
Cottidae spp.
(juveniles)
(larvae)
Family Agonidae
Agonus acipenserinus,
sturgeon poacher
(juveniles)
Anaplogonus inermis, smooth
alligatorfish
Astrotheca sp. (larvae)
Odontopyxis trispinosa,
pygmy poacher
Pallasina barbata,
tubenose poacher
Xeneretmus latifrons,
blacktip poacher
(juveniles)
Family Cyclopteridae
Eumicrotremus orbis,
spiny lumpsucker
Liparis callyodon,
spotted snailfish
L. cyclopus,
ribbon snailfish
L. fucensis(?), slipskin
L. florae, snailfish
tidepool snailfish
L. mucosus,
slimy snailfish


← 1974 1975 →
J A S O N D J F M A M J J A S
L. pulchellus, tadpole snailfish
L. rutteri, ringtail snailfish
Liparis sp. (unidentified juvenile)
Family Bothidae
Citharichthys stigmaeus, sanddab
Family Pleuronectidae
Isopsetta isolepis, butter sole (juveniles)
Lepidopsetta bilineata, rock sole
(juveniles)
Parophrys vetulus, English sole (juveniles)
(larvae)
Platichthys stellatus, starry flounder
(juveniles)
Pleuronichthys coenosus, C-O sole
(juveniles)


← 1974 1975→
J A S O N D J F M A M J J A S
Psettichthys melanostictus, sand sole (juveniles)
Pleuronectidae spp. (larvae)

Appendix 7. Composition and origin of Nearshore Fish Survey fish specimens whose whole stomach contents have been analyzed, July 1974 through June 1975

Species	Sample size	Collection period	Collection locations, San Juan Island
Oncorhynchus kisutch, coho salmon (juveniles)	35	July 1974	False Bay
			South Beach
		September 1974	Eagle Cove
		October 1974	South Beach
			Eagle Cove
Oncorhynchus keta, chum salmon (juveniles)	24	July 1974	Deadman Bay
			False Bay
			South Beach
		April 1975	Deadman Bay
Leptocottus armatus, staghorn sculpin	16	July 1974	False Bay
			Westcott Bay
		October 1974	Eable Cove
		November 1974	Deadman Bay
Platichthys stellatus, starry flounder	16	July 1974	Deadman Bay
			South Beach
		September 1974	Eagle Cove
		October 1974	Eagle Cove
		November 1974	Eagle Cove
Sebastes caurinus, copper rockfish	13	July 1974	Deadman Bay
Blepsias cirrhosus, silverspotted sculpin	12	July 1974	Deadman Bay
		October 1974	Deadman Bay
Sebastes melanops black rockfish	10	September 1974	Deadman Bay
Clupea harengus pallasi, Pacific herring (juveniles)	9	July 1974	Deadman Bay
		November 1974	Eagle Cove

Appendix 7. Composition and origin of Nearshore Fish Survey fish specinens whose whole stomach contents have been analyzed, July 1974 through June 1975 - continued

Species	Sample size	Collection period	Collection location San Juan Island
Hydrolagus colliei, ratfish	9	September 1974 October 1974 February 1975	South Beach South Beach South Beach
Hexagrammos decagrammus, kelp greenling	9	July 1974 September 1974 October 1974	Deadman Bay Deadman Bay Deadman Bay
Hypomesus pretiosus, surf smelt	5	July 1974	Deadman Bay
Apodichthys flavidus, tubesnout	5	July 1974	Deadman Bay
Lumpenus sagitta, snake prickleback	4	July 1974	Westcott Bay
Hexagrammos stelleri, whitespotted greenling	4	July 1974 October 1974	Deadman Bay Deadman Bay
Cymatogaster aggregata, shiner perch	4	July 1974	Deadman Bay False Bay Westcott Bay
Lepidopsetta bilineata, rock sole	3	July 1974 September 1974	South Beach Eagle Cove
Gasterosteus aculeatus, threespine stickleback	3	July 1974	South Beach
Embiotoca lateralis, striped seaperch	3	December 1974	Deadman Bay
Ammodytes hexapterus, Pacific sand lance	3	July 1974	Deadman Bay South Beach

Appendix 7. Composition and origin of Nearshore Fish Survey fish specimens whose whole stomach contents have been analyzed, July 1974 through June 1975 - continued

Species	Sample size	Collection period	Collection location San Juan Island
Pleuronichthys coenosus, C-O sole	2	July 1974	Deadman Bay South Beach
Parophrys vetulus, English sole	2	July 1974	Westcott Bay
Enophrys bison, buffalo sculpin	2	October 1974	South Beach Deadman Bay
Sebastes flavidus, yellowtail rockfish	2	September 1974	Deadman Bay
Hemilepidotus hemilepidotus, red Irish lord	2	July 1974 September 1974	Deadman Bay Deadman Bay
Pholis ornata, saddleback gunnel	2	July 1974	Deadman Bay
Scorpaenichthys marmoratus, cabezon	2	October 1974	South Beach
Artedius lateralis, smoothhead sculpin	1	July 1974	Deadman Bay
Myoxocephalus polyacanthocephalus, great sculpin	1	November 1974	Deadman Bay
Sebastes maliger, quillback rockfish	1	October 1974	Deadman Bay
Theragra chalcogramma, walleye pollock (juveniles)	1	October 1974	South Beach

APPENDIX 8

Stomach Analyses Data of the
1974-75 Nearshore Fish Survey

Appendix 8a. Mean biomass, in grams wet, of total stomach contents, prey organism, detritus, and unidentified material categories for 30 species of fish captured during Nearshore Fish Survey

Collection number	Sample size, n	Total contents Wt. $\bar{x}$(g)	Fish $\bar{x}$ No.	Fish $\bar{x}$ Wt.	Amphipods $\bar{x}$ No.	Amphipods $\bar{x}$ Wt.	Crab larvae $\bar{x}$ No.	Crab larvae $\bar{x}$ Wt.	Copepods $\bar{x}$ No.	Copepods $\bar{x}$ Wt.	Shrimp $\bar{x}$ No.	Shrimp $\bar{x}$ Wt.	Isopods $\bar{x}$ No.	Isopods $\bar{x}$ Wt.	Polychaetes $\bar{x}$ No.	Polychaetes $\bar{x}$ Wt.	Insects $\bar{x}$ No.	Insects $\bar{x}$ Wt.	Mysids $\bar{x}$ No.	Mysids $\bar{x}$ Wt.
O. kisutch																				
74203-1	10	1.24	3.1	0.91	0.2	0.01	2.3	0.09												
74206-2	1	0.41							120	0.34	2	0.01								
74206-3	5	1.71			107.4	1.12	2.2	0.13	0.6	0.01			1	0.01	1	0.02				
74206 (pooled)	6	1.49			89.5	0.93	1.8	0.02	20.5	0.06	0.3	*	0.17	*	0.17	*				
74217-1	1	1.26			23	0.12							74	0.48			6	0.04	38	0.53
74217-2	6	1.24	0.50	0.22	20.5	0.15					0.17	*	12.0	0.04			2.17	0.02	43.67	0.61
74217 (pooled)	7	1.25	0.43	0.19	20.86	0.15					0.14	*	15.71	0.10			2.71	0.02	42.86	0.60
74219-1	2	2.83	1.5	0.86	150	1.41											0.5	*		
74221-1	6	1.41			12.67	0.16					0.17	*	4.33	0.02			2	0.02	76.5	0.57
74221-2	4	2.33	0.5	0.19	305.3	0.60					0.5	0.01	8.5	0.04			7.25	0.07	67.5	0.69
74221 (pooled)	10	1.78	0.2	0.8	129.7	0.34					0.3	*	6.0	0.03			4.10	0.04	7.29	0.62
Overall	35	1.53	1.11	0.37	65.17	0.37	0.97	0.03	3.51	0.01	0.17	*	4.89	0.03	0.03	*	1.74	0.02	29.4	0.30
			Copepods		Amphipods		Natantia larvae		Mysids		Cumacea		Gastropod remains		Annelid fragments		Insects		Larval fish	
O. keta																				
75221-1	10	0.02	104.7	0.01	*	*	*	*												
74206-2	7	0.28	104.7	0.21	15.9	0.02	*	*	*	*	*	*	*	*	*	*				
74201-2	1	0.30			45	0.29	1	*			4	*					1	*		
74201-1	1	0.21	4	*	15	0.10											1	*		
74205-1	3	0.19	*	*	23	0.11	*	*			5	0.03			*	*				
74206-3	1	0.37	70	0.10	15	0.01													1	0.02
74203-1	1	0.44			45	0.43														

Appendix 8a. Mean biomass, in grams wet, of total stomach contents, prey organism, detritus, and unidentified material categories for 30 species of fish captured during Nearshore Fish Survey - continued

Detritus $\bar{x}$		Unident. $\bar{x}$		$\bar{x}$		$\bar{x}$		$\bar{x}$	
No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
			0.24						
			0.06						
			0.56						
			0.47						
			0.09						
			0.21						
			0.19						
			0.64						
			0.74						
			0.68						
			0.41						
Euphausiids		Crab		Trematodes		Unident.			
						0.01			
		*	*	*	*	0.05			
						0.01			
						0.11			
1	0.01			*	*	0.04			
2	0.02			*	*	0.22			
						0.01			

Appendix 8a. Mean biomass, in grams wet, of total stomach contents, prey organism, detritus, and unidentified material categories for 30 speices of fish captured during Nearshore Fish Survey - continued

Collection number	Sample size, n	Total contents Wt. $\bar{x}$(g)	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.
			Copepods		Amphipods		Natantia larvae		Mysids		Cumacea		Gastropod remains		Annelid fragments		Insects		Larval fish	
74201 (pooled)	2	0.26	2	*	30	0.20	*	*			2	*					1	*		
74206 (pooled)	8	0.29	100.4	0.19	15.8	0.02	*	*	*	*	*	*	*	*	*	*			*	*
Overall	24	0.17	77.3	0.07	12.6	0.05	*	*	*	*	*	*	*	*	*	*	*	*	*	*
			Annelida		Caprellids		Isopods		Crab		Mysids		Shrimp		Tanidacea		Amphipods		Cumacea	
Leptocottus armatus																				
74203-1	3	0.97	1.3	0.06											5	*	107.7	0.31	1.3	*
74204-2	2	1.12	2	0.26	2.5	0.02	0.5	0.01	0.5	0.01	1.5	0.02	[illegible]	0.14	5	*	11.5	0.16		
74221-1	5	1.58					1	0.15	--	0.14	0.6	0.01	[illegible].8	0.50			5.2	0.10		
74221-2	5	4.86					1.4	0.30	1.2	2.5			1.2	0.14			3	0.07		
74221 (pooled)	10	3.22					1.2	0.22	0.6	1.3	0.3	*	1.5	0.30			4.1	0.09		
74229-2	1	30.4											1	0.21						
Overall	16	4.23	0.5	0.04	0.3	*	0.8	0.14	0.4	0.81	0.4	*	1.1	0.23	1	*	24.2	0.13	0.25	*
			Bivalves		Gastropods		Decapods		Amphipods		Trematodes		Rocks		Cumacea		Algae		Polychaetes	
Platichthys stellatus																				
74201-2	1	5.72																	1	4.70
74206-2	5	3.04	0.2	0.03	2.6	0.09	0.3	*	62.2	0.29	0.8	*					--	0.02		
74206-3	2	6.15	1.5	0.22	1	0.01			1.5	0.01	3	0.01	--	1.06					0.5	0.35
74206 (pooled)	7	3.93	0.6	0.08	2.1	0.06	0.1	*	44.9	0.21	1.4	*	--	0.3			--	0.01	0.14	0.10

Appendix 8a. Mean biomass, in grams wet, of total stomach contents, prey organism, detritus, and unidentified material categories for 30 species of fish captured during Nearshore Fish Survey - continued

$\bar{x}$ No.	Wt.	$\bar{x}$ No.	Wt.	$\bar{x}$ No.	Wt.	$\bar{x}$ No.	Wt.	$\bar{x}$ No.	Wt.
Euphausiids		Crab		Trematodes		Unident.			
						0.06			
*	*					0.08			
*	*	*	*	*	*	0.05			
Larval Decapod		Fish		Bivalve Siphons		Insects		Bark & Sand Grains	
0.3	*	0.3	0.3						
				7.5	0.04				
0.2	*							--	0.02
		0.4	0.2			0.2	0.01		
0.1	*	0.2	0.1			0.1	0.01	--	0.01
		3	23.05						
0.13	*	0.4	1.6	0.9	0.01	0.6	*	--	0.01
Shrimp		Pisces		Isopods		Crab		Unident.	
1	*								1.02
		0.4	0.71	3	0.3				1.61
		1.5	1.2	3.5	0.46				2.86
									1.97
		0.71	0.85	3.1	0.34				0.53

Rocks		Unident.
		0.26
		0.48
		0.66
--	0.07	1.57
--	0.04	1.15
	4.45	2.69
--	0.3	0.99

Appendix 8a. Mean biomass, in grams wet, of total stomach contents, prey organism, detritus, and unidentified material categories for 30 sepcies of fish captured during Nearshore Fish Survey - continued

Collection number	Sample size, n	Total contents Wt. $\bar{x}$(g)	Bivalves $\bar{x}$ No.	Bivalves $\bar{x}$ Wt.	Gastropods $\bar{x}$ No.	Gastropods $\bar{x}$ Wt.	Decapods $\bar{x}$ No.	Decapods $\bar{x}$ Wt.	Amphipods $\bar{x}$ No.	Amphipods $\bar{x}$ Wt.	Trematodes $\bar{x}$ No.	Trematodes $\bar{x}$ Wt.	Rocks $\bar{x}$ No.	Rocks $\bar{x}$ Wt.	Cumacea $\bar{x}$ No.	Cumacea $\bar{x}$ Wt.	Algae $\bar{x}$ No.	Algae $\bar{x}$ Wt.	Polychaetes $\bar{x}$ No.	Polychaetes $\bar{x}$ Wt.
			Bivalves		Gastropods		Decapods		Amphipods		Trematodes		Rocks		Cumacea		Algae		Polychaetes	
74217-1	3	0.53									4.7	*								
74217-2	1	0.08																		
74217 (pooled)	4	0.42									3.5	*								
74221-1	3	0.21																		
74230-1	1	5.8							2	*					1	*				
Overall	16	2.58	0.25	0.04	0.93	0.03	0.06	*	19.8	0.09	1.5	*	--	0.13	0.06	*	--	0.01	0.13	0.34
			Shrimp		Fish		Amphipods		Isopods		Polychaetes		Crab		Rocks		Nematodes		Annelid	
Sebastes caurinus																				
74201-1	9	7.21	1.2	0.01	1.3	2.29	2.4	0.01	0.11	0.01	0.11	1.7	0.11	0.5	--	0.17	0.22	*		
74201-2	4	0.18	1.3	0.04			7.3	0.03	3	0.03							0.25	*	0.25	*
Overall	13	5.1	1.2	0.02	0.93	1.58	3.9	0.02	1	0.01	0.08	1.2	0.08	0.36	--	0.12	0.23	*	0.08	*
			Amphipods		Shrimp		Unident.													
Blepsias cirrhosus																				
74201-1	2	0.04	7	0.02	1	0.01		0.01												
74201-2	9	0.06	6.3	0.03	0.11	*		0.03												
74201 (pooled)	11	0.06	6.5	0.03	0.27	*		0.03												
74223-1	1	1.8	--	0.4	9	1.1		0.3												
Overall	12	0.20	6	0.06	1	0.09		0.05												

Appendix 8a. Mean biomass, in grams wet, of total stomach contents, prey organism, detritus, and unidentified material categories for 30 species of fish captured during Nearshore Fish Survey - continued

$\bar{x}$ No.	Wt.	$\bar{x}$ No.	Wt.	$\bar{x}$ No.	Wt.	$\bar{x}$ No.	Wt.	$\bar{x}$ No.	Wt.
Shrimp		Pisces		Isopods		Crab		Unident.	
									0.08
									0.42
									0.21
35	4.7			2	0.29	3	0.18		0.63
2.3	0.29	0.31	0.37	1.5	0.17	0.19	0.01		1.10
Unident.									
	2.51								
	0.07								
	1.7								

Appendix 8a. Mean biomass, in grams wet, of total stomach contents, prey organism, detritus, and unidentified material categories for 30 species of fish captured during Nearshore Fish Survey - continued

Collection number	Sample size, n	Total contents Wt. $\bar{x}$(g)	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.
			Amphipods		Crab Megalops		Crabs		Natantia		Flabellifera		Decapods		Pisces		Insects		Molluscs	
Sebastes melanops																				
74216-1 (Overall)	10	2.54	318	1.8	0.3	*	1.6	0.16	1.8	0.07	0.30	0.01	0.7	0.01	0.4	0.18	0.7	*	0.6	0.03
			Copepods		Unident.															
Clupea pallasi																				
74202-2	7	0.01	18.7	*	0.01															
75730	2	0.14	56.5	0.11	0.03															
Overall	9	0.04	27	0.03	0.01															
			Amphipods		Crabs		Gastropods		Gyrocotyle		Worm tubes		Bivalve Shell		Caprellids		Shrimp		Isopods	
Hydrolagus colliei																				
74220-1	1	27.5	13	0.10	2	0.13	3	0.03	2	0.46	7	0.28	--	1.28						
74220-2	1	7.57	41	0.20					2	0.07	14	0.27	--	0.03	6	0.04			4	0.02
74220 (pooled)	2	17.5	27	0.15	1	0.07	1.5	0.02	2	0.27	10.5	0.28	--	0.66	3	0.02			2	0.01
74214-1	6	17.0	43.8	0.19	5.3	0.71	4.2	0.06	1.3	0.17							0.67	0.10	5.7	0.06
75208-2	1	31	4	0.02	--	2.24			2	0.34										
Overall	9	18.6	35.7	0.16	3.8	0.74	3	0.04	1.3	0.21	2.3	0.06	--	0.15	0.67	*	0.44	0.07	4.2	0.04
			Fish		Flabellifera		Isopods		Amphipods		Crabs		Natantia		Decapods		Caprellids		Annelids	
Hexagrammos decagrammus																				
74201-1	5	21.9	2.4	2.8	33.6	0.24	15	0.10	213.6	2.2	0.4	0.7	2.6	0.24	1	0.01			2.8	0.39
74201-2	1	24.4							65	0.5	2	4.65	2	0.01						
74201 (pooled)	6	22.3	2	2.3	28	0.20	12.5	0.08	188.8	1.9	0.67	1.36	2.5	0.20	0.83	*			2.3	0.32

Appendix 8a. Mean biomass, in grams wet, of total stomach contents, prey organism, detritus, and unidentified material categories for 30 species of fish captured during Nearshore Fish Survey - continued

$\bar{x}$ No.	Wt.	$\bar{x}$ No.	Wt.	$\bar{x}$ No.	Wt.	$\bar{x}$ No.	Wt.	$\bar{x}$ No.	Wt.
Nematodes		Bark		Unident.					
--	*	--	*		0.28				
Algae		Polychaetes		Fish		Rocks		Unident.	
--	0.09							25.2	
								6.9	
		--	0.05	0.83	2.6	--	0.42	16.0	
								12.6	
								28.4	
--	0.01	--	0.04	0.56	1.74	--	0.28	14.0	
Stones & bk		Algae		Gastropods		Unident.			
	2.7		0.8	7.4	0.61		11.1		
	2.17		1.12	4	0.13		15.8		
	2.60		0.86	6.8	0.53		11.95		

Appendix 8a. Mean biomass, in grams wet, of total stomach contents, prey organism, detritus, and unidentified material categories for 30 species of fish captured during Nearshore Fish Survey - continued

Collection number	Sample size, n	Total contents Wt. $\bar{x}$(g)	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.
			Fish		Flabellifera		Isopods		Amphipods		Crabs		Natantia		Decapods		Caprellids		Annelids	
74216-2	1	1.8					1	0.01	35	0.12	8	0.15			5	0.21	1	0.01		
74222-2	1	4.9							0.21	0.80	1	0.40	3	0.40						
74223-1	1	16.7	1	0.2	1				2	0.10	8	3.5	31	2.7						1.0
Overall	9	17.5	1.4	1.6	18.8	0.13	8.4	0.06	143.4	1.4	2.3	1.35	5.4	0.48	1.1	0.03	0.1	*	1.6	0.21
			Copepods		Decapod larvae		Cumacea		Annelid		Unident.									
Hypomesus pretiosus																				
74203-1	3	0.06	28.3	*	2	*	0.3	*	4	0.01		0.05								
74202-2	2	0.06	83.5	0.01								0.05								
Overall	5	0.06	50.4	*	1.2	*	0.2	*	2.4	*		0.05								
			Amphipods		Isopods		Gastropods		Tanidaceans		Unident.									
Apodichthys flavidus																				
74201-1 (overall)	5	1.05	348.2	0.72	0.8	*	1	*	0.4	*	--	0.32								
			Annelida		Tanidacea		Bivalve Siphon Tips		Amphipods		Cumacea		Caprellids		Bivalve		Nematodes		Unident.	
Lumpenus sagitta																				
74204-2 (overall)	4	0.12	4.8	0.05	17.3	0.01	10.3	0.02	2.8	*	3.5	*	0.25	*	0.25	*	--	*		0.4
			Crabs		Natantia		Amphipods		Pisces		Gastropods		Mysids		Algae		Unident.			
Hexagrammos stelleri																				
74223-1	3	2.4	2	0.13	11.3	0.7	2.3	0.5			--	0.10	0.3	*			1.0			
74201-2	1	13.2	2	6.34	1	0.34	5	0.01	1	2.01					--	1.2	3.3			
Overall	4	5.1	2	1.68	8.8	0.61	3	0.38	0.25	0.50	--	0.08	0.25	*	--	0.30	1.6			

Appendix 8a. Mean biomass, in grams wet, of total stomach contents, prey organism, detritus, and unidentified material categories for 30 species of fish captured during Nearshore Fish Survey - continued

$\bar{x}$ No.	Wt.	$\bar{x}$ No.	Wt.	$\bar{x}$ No.	Wt.	$\bar{x}$ No.	Wt.	$\bar{x}$ No.	Wt.
Stones & bk		Algae		Gastropods		Unident.			
0.80						1.3			
6.1						2.5			
						4.1			
2.5		0.57		4.6	0.35	8.82			

Appendix 8a. Mean biomass, in grams wet, of total stomach contents, prey organism, detritus, and unidentified material categories for 30 species of fish captured during Nearshore Fish Survey - continued

Collection number	Sample size, n	Total contents Wt. $\bar{x}$(g)	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.
			Caprellids		Amphipods		Polychaetes		Cumacea		Copepods		Unident.			
Cymatogaster aggregata																
74201-1	1	0.00														
74203-1	1	0.42			88	0.04			407	0.16	1	*	0.22			
74204-2	2	0.24	18	0.08	9.5	0.01	2.5	0.1					0.05			
Overall	4	0.23	9	0.04	26.8	0.02	1.3	0.05	101.7	0.04	0.25	*	0.08			
			Amphipods		Cumaceans		Polychaetes		Annelids		Nematodes		Unident.			
Lepidopsetta bilineata																
74206-2 (overall)	2	1.88	66	0.38	18	0.06	2.5	0.05	--	0.20	--	*	1.19			
			Euphausiids		Cumacea		Amphipods		Trematodes		Unident.					
Gasterosteus aculeatus																
74205-1 (overall)	3	0.16	2.7	0.06	0.33	*	0.33	*	--	*	0.10					
			Amphipods		Unident.											
Embiotoca lateralis																
74234-2 (overall)	3	0.41	8.3	0.07	0.34											
			Copepods		Unident.											
Ammodytes hexapterus																
74205-2	2	0.03	71	0.005	0.025											
74201-1	1	0.00														
Overall	3	0.02	71	*	0.016											

Appendix 8a. Mean biomass, in grams wet, of total stomach contents, prey organism, detritus, and unidentified material categories for 30 species of fish captured during Nearshore Fish Survey - continued

Collection number	Sample size, n	Total contents Wt. $\bar{x}$(g)	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.	$\bar{x}$ No.	$\bar{x}$ Wt.
			Polychaetes		Amphipods		Cumacea		Natantia		Trematodes		Nematodes		Crab		Gastropods		Unident.	
Pleuronichthys coenosus																				
74201-2	1	1.76	4	0.42	8	0.04	1	*	1	0.02	4	0.01	2	*						1.27
74206-3	1	1.11	--	0.49	13	0.02			1	0.04					1	0.01	1	0.01		0.54
Overall	2	1.44	2	0.46	10.5	0.03	0.05	*	1	0.08	2	0.01	1	*	0.05	0.01	0.05	0.01		0.88
			Copepods		Cumacea		Annelida		Bivalve siph		Tanidacea		Nematodes		Ophiuroid		Unident.			
Parophrys vetulus																				
74204-2 (overall)	2	0.06	2.5	*	0.5	*	2	0.04	0.5	*	2	*	--	*	0.5	*		0.02		
			Algae		Pisces		Nematodes		Unident.											
Enophrys bison																				
74220-1	1	1.33	--	0.38	1	0.22	1	*		0.73										
74223-1	1	15.3	--	15.3						0.0										
Overall	2	8.31	--	7.84	0.5	0.11	0.5	*		0.37										
			Amphipods		Mysids		Cladoceran		Unident.											
Sebastes flavidus																				
74216-1 (overall)	2	0.42	41	0.32	1	0.01	0.5	*		0.09										
			Crabs		Amphipods		Unident.													
Hemilepidotus hemilepidotus																				
74201-1	1	0.24			53	0.14		0.10												
74216-2	1	5.88	16	2.1	76	0.51		3.27												
Overall	2	3.06	8	1.05	64.5	0.33		1.69												

Appendix 8a. Mean biomass, in grams wet, of total stomach contents, prey organism, detritus, and unidentified material categories for 30 species of fish captured during Nearshore Fish Survey - continued

Collection number	Sample size, n	Total contents Wt. $\bar{x}$(g)	$\bar{x}$ No.	Wt.	$\bar{x}$ No.	Wt.	$\bar{x}$ No.	Wt.	$\bar{x}$ No.	Wt.	$\bar{x}$ No.	Wt.	$\bar{x}$ No.	Wt.	$\bar{x}$ No.	Wt.	$\bar{x}$ No.	Wt.
			Valvifera		Amphipods		Caprellids		Unident.									
Pholis ornata																		
74201-2 (overall)	2	0.31	1.5	0.01	11	0.05	1.5	0.01	0.25									
			Natantia		Amphipods		Crab		Unident.									
Scorpaenichthys marmoratus																		
74220-1 (overall)	2	0.53	3	0.30	19	0.11	0.5	0.05	0.08									
			Mysids		Amphipods		Natantia		Unident.									
Artedius lateralis																		
74202-2 (overall)	1	0.06	1	0.03	1	0.005	1	0.02	0.001									
			Natantia		Unident.													
Myxocephalus polyacantho-cephalus																		
74228-1 (overall)	1	1.24	2	0.65	0.59													
			Shrimp		Isopods		Amphipods		Nebalia		Unident.							
Sebastes maliger																		
74223-1 (overall)	1	2.2	8	1.0	4	0.10	9	0.20	2	*	0.9							
			Natantia		Amphipods		Unident.											
Theragra chalcogramma																		
74220-1 (overall)	1	1.9	6	1.25	2	0.14	0.51											

Appendix 8b. Percentage occurrence, composition (numeric), composition (gravimetric), and composition (gravimetric minus unidentified) of prey organism, detritus, and unidentified material categories for 30 species of fish captured during Nearshore Fish Survey, July 1974 through June 1975. Percentage occurrence is also indicated for nematode and trematode parasites.

	Total sample size, n	Fish	Amphipods	Crab larvae	Copepods	Shrimp	Isopods	Polychaetes	Insects	Mysids	Detritus	Unident.
Oncorhynchus kisutch	35											
% occurrence		43	66	11	9	14	37	3	37	43	9	
% composition (numeric)		1	61	1	3	*	5	*	2	27		
% composition (gravimetric)		24	24	2	1	*	2	*	1	19		27
% composition (gravimetric) minus unidentified		33	33	3	1	*	3	*	1	26		
		Copepods	Amphipods	Natantia larvae	Mysids	Cumacea	Gastropod remains	Annelid fragments	Insects	Larval fish	Euphausiids	Crab
Oncorhynchus keta	24											
% occurrence		83	63	17	4	25	4	8	8	8	8	4
% composition (numeric)		83	15	*	*	1	*	*	*	*	*	*
% composition (gravimetric)		40	32	*	*	3	*	*	*	1	1	*
% composition (gravimetric) minus unidentified		52	41	*	*	3	*	*	*	1	2	*
		Annelida	Caprellids	Isopods	Crab	Mysids	Shrimp	Tanidacea	Amphipods	Cumacea	Larval Decapod	Fish
Leptocottus armatus	16											
% occurrence		31	13	44	31	25	56	13	75	19	13	25
% composition (numeric)		2	1	3	1	1	4	3	79	1	*	1
% composition (gravimetric)		1	*	3	19	*	5	*	3	*	*	37
% composition (gravimetric) minus unidentified		1	*	4	25	*	7	*	4	*	*	48

Appendix 8b. Percentage occurrence, composition (numeric), composition (gravimetric), and composition (gravimetric minus unidentified) of prey organism, detritus, and unidentified material categories for 30 species of fish captured during Nearshore Fish Survey, July 1974 through June 1975. Percentage occurrence is also indicated for nematode and trematode parasites - continued

Trematodes	Nematodes				
6	9				
Trematodes	Unident.				
8 * * *	22				
Bivalve siphons	Insects	Bark & Sand Grains	Rocks	Unident.	
6 3 * *	6 * * *	25 -- * *	13 -- 7 9	23	

Appendix 8b. Percentage occurrence, composition (numeric), composition (gravimetric), and composition (gravimetric minus unidentified) of prey organism, detritus, and unidentified material categories for 30 species of fish captured during Nearshore Fish Survey, July 1974 through June 1975. Percentage occurrence is also indicated for nematode and trematode parasites - continued

	Total sample size, n	Bivalves	Gastro-pods	Decapods	Amphipods	Trema-todes	Rocks	Cumacea	Algae	Poly-chaetes	Shrimp	Pisces
Platichthys stellatus	16											
% occurrence		13	25	19	38	25	6	6	19	13	13	13
% composition (numeric)		1	3	1	73	6	--	*	--	*	8	1
% composition (gravimetric)		1	1	*	4	*	5	*	*	13	11	14
% composition (gravimetric) minus unidentified		2	2	*	6	*	9	*	*	23	20	25

	Total sample size, n	Shrimp	Fish	Amphipods	Isopods	Poly-chaete	Crab	Rocks	Nematode	Annelid	Unident.	
Sebastes caurinus	13											
% occurrence		62	31	62	15	8	8	23	23	8	34	
% composition (numeric)		16	11	52	3	1	1	--	3	1		
% composition (gravimetric)		*	31	*	*	24	7	2	*	*		
% composition (gravimetric) minus unidentified		1	48	1	*	36	11	4	*	*		

	Total sample size, n	Amphipods	Shrimp	Unident.
Blepsias cirrhosus	12			
% occurrence		92	25	26
% composition (numeric)		86	14	
% composition (gravimetric)		28	46	
% composition (gravimetric) minus unidentified		38	62	

	Total sample size, n	Amphipods	Crab Megalops	Crab	Natantia	Flabelli-fera	Decapods	Pisces	Insects	Molluscs	Nematodes	Bark
Sebastes melanops	10											
% occurrence		100	20	10	60	10	20	40	10	10	10	10
% composition (numeric)		98	*	*	1	*	*	*	*	*	--	--
% composition (gravimetric)		71	*	6	3	*	*	7	*	1	*	*
% composition (gravimetric) minus unidentified		79	*	7	3	*	*	8	*	1	*	*

Appendix 8b. Percentage occurrence, composition (numeric), composition (gravimetric), and composition (gravimetric minus unidentified) of prey organism, detritus, and unidentified material categories for 30 species of fish captured during Nearshore Fish Survey, July 1974 through June 1975. Percentage occurrence is also indicated for nematode and trematode parasites - continued

Isopods	Crab	Unident.		
19 6 7 11	6 1 * 1	43		
Unident.				
11				

Appendix 8b. Percentage occurrence, composition (numeric), composition (gravimetric), and composition (gravimetric minus unidentified) of prey organism, detritus, and unidentified material categories for 30 species of fish captured during Nearshore Fish Survey, July 1974 through June 1975. Percentage occurrence is also indicated for nematode and trematode parasites - continued

	Total Sample size, n	Copepods	Unident.									
Clupea pallasi	9											
% occurrence		67	35									
% composition (numeric)		100										
% composition (gravimetric)		65										
% composition (gravimetric) minus unidentified		100										
		Amphipods	Crabs	Gastropods	Gyrocotyle	Worm tubes	Bivalve shells	Caprellids	Shrimp	Isopods	Algae	Polychaetes
Hydrolagus colliei	9											
% occurrence		89	78	67	67	22	22	11	33	67	11	11
% composition (numeric)		69	7	6	3	4	--	1	1	8	--	--
% composition (gravimetric)		1	4	*	1	*	1	*	*	*	*	*
% composition (gravimetric) minus unidentified		5	21	1	6	2	4	*	2	1	*	--
		Fish	Flabellifera	Isopods	Amphipods	Crabs	Natantia	Decapods	Caprellids	Annelids	Gastropods	Stones & Bark
Hexagrammos decagrammus	9											
% occurrence		33	33	33	100	67	67	22	11	33	33	67
% composition (numeric)		1	10	5	77	1	3	1	*	1	2	--
% composition (gravimetric)		9	1	*	8	8	3	*	*	1	2	14
% composition (gravimetric) minus unidentified		18	2	1	16	16	6	*	*	2	4	29
		Copepods	Decapod larvae	Cumacea	Annelids	Unident.						
Hypomesus pretiosus	5											
% occurrence		60	20	20	40							
% composition (numeric)		93	2	*	4							
% composition (gravimetric)		7	*	*	7	86						
% composition (gravimetric) minus unidentified		50	*	*	50							

Appendix 8b. Percentage occurrence, composition (numeric), composition (gravimetric), and composition (gravimetric minus unidentified) of prey organism, detritus, and unidentified material categories for 30 species of fish captured during Nearshore Fish Survey, July 1974 through June 1975. Percentage occurrence is also indicated for nematode and trematode parasites - continued

Fish	Rocks	Unident.			
22	22				
1	--				
9	1	81			
49	8				
Algae	Unident.				
33					
--					
3	51				
6					

Appendix 8b. Percentage occurence, composition (numeric), composition (gravimetric), and composition (gravimetric minus unidentified) of prey organism, detritus, and unidentified material categories for 30 species of fish captured during Nearshore Fish Survey, July 1974 through June 1975. Percentage occurrence is also indicated for nematode and trematode parasites - continued

	Total Sample size, n											
Apodichthys flavidus	5	Amphipods	Isopods	Gastro-pods	Tanida-ceans	Unident.						
% occurrence		60	40	40	20							
% composition (numeric)		99	*	*	*							
% composition (gravimetric)		68	1	1	*	31						
% composition (gravimetric) minus unidentified		99	*	*	*							
Lumpenus sagitta	4	Annelida	Tanidacea	Bivalve siphon tips	Amphipods	Cumacea	Caprel-lids	Bivalvia	Nematodes	Unident.		
% occurrence		100	100	100	25	50	25	25	100			
% composition (numeric)		12	44	26	7	9	1	1	--			
% composition (gravimetric)		41	4	18	2	*	*	*	--	35		
% composition (gravimetric) minus unidentified		63	6	28	3	*	*	*	--			
Hexagrammos stelleri	4	Crabs	Natantia	Algae	Amphipods	Pisces	Gastropods	Mysid	Unident.			
% occurrence		75	100	25	75	25	25	25				
% composition (numeric)		14	61	--	21	2	--	2				
% composition (gravimetric)		33	12	6	7	10	1	*	31			
% composition (gravimetric) minus unidentified		47	17	8	11	14	2	*				
Cymatogaster aggregata	4	Caprel-lids	Amphipods	Poly-chaetes	Cumacea	Copepods	Unident.					
% occurrence		25	50	25	25	25						
% composition (numeric)		6	19	1	73	*						
% composition (gravimetric)		17	7	20	18	*	38					
% composition (gravimetric) minus unidentified		27	11	33	29	*						

Appendix 8b. Percentage occurrence, composition (numeric), composition (gravimetric), and composition (gravimetric minus unidentified) of prey organism, detritus, and unidentified material categories for 30 species of fish captured during Nearshore Fish Survey, July 1974 through June 1975. Percentage occurrence is also indicated for nematode and trematode parasites - continued

	Total sample size, n	Amphipods	Cumaceans	Poly-chaetes	Annelids	Nematodes	Unident.					
Lepidopsetta bilineata	2											
% occurrence		100	50	50	50	50						
% composition (numeric)		76	21	3	--	--						
% composition (gravimetric)		20	3	2	11	--	63					
% composition (gravimetric) minus unidentified		55	9	7	29	--						
		Euphau-siids	Cumacea	Amphipods	Trema-todes	Unident.						
Gasterosteus aculeatus	3											
% occurrence		67	33	33	67							
% composition (numeric)		80	10	10	--							
% composition (gravimetric)		39	*	2	*	59						
% composition (gravimetric) minus unidentified		95	*	5	*							
		Amphipods	Unident.									
Embiotoca lateralis	3											
% occurrence		33										
% composition (numeric)		100										
% composition (gravimetric)		16	84									
% composition (gravimetric) minus unidentified		100										
		Copepods	Unident.									
Ammodytes hexapterus	3											
% occurrence		67										
% composition (numeric)		100										
% composition (gravimetric)		17	83									
% composition (gravimetric) minus unidentified		100										

Appendix 8b. Percentage occurrence, composition (numeric), composition (gravimetric), and composition (gravimetric minus unidentified) of prey organism, detritus, and unidentified material categories for 30 species of fish captured during Nearshore Fish Survey, July 1974 through June 1975. Percentage occurrence is also indicated for nematode and trematode parasites - continued

	Total sample size, n	Poly-chaetes	Amphipods	Cumacea	Natantia	Trema-todes	Nematodes	Crab	Gastro-pods	Seaweed & Stones	Unident.	
Pleuronichthys coenosus	2											
% occurrence		100	100	50	100	50	50	50	50	50		
% composition (numeric)		11	58	3	6	11	6	3	3	--		
% composition (gravimetric)		32	2	*	2	*	*	*	*	--	63	
% composition (gravimetric) minus unidentified		86	6	*	6	1	*	1	1	--		

	Total sample size, n	Copepods	Cumacea	Annelida	Bivalve Siphon	Tanidacea	Nematodes	Ophiuroid	Unident.			
Parophrys vetulus	2											
% occurrence		50	50	50	50	50	50	50				
% composition (numeric)		31	6	25	6	25	--	6				
% composition (gravimetric)		*	*	67	*	*	*	*	33			
% composition (gravimetric) minus unidentified		*	*	100	*	*	*	*				

	Total sample size, n	Algae	Pisces	Nematodes	Unident.							
Enophrys bison	2											
% occurrence		100	50	50								
% composition (numeric)		--	50	50								
% composition (gravimetric)		94	1	*	4							
% composition (gravimetric) minus unidentified		99	1	*								

	Total sample size, n	Amphipods	Mysid	Clado-ceran	Unident.							
Sebastes flavidus	2											
% occurrence		100	100	50								
% composition (numeric)		96	2	1								
% composition (gravimetric)		76	2	1	20							
% composition (gravimetric) minus unidentified		96	3	1								

Appendix 8b. Percentage occurrence, composition (numeric), composition (gravimetric), and composition (gravimetric minus unidentified) of prey organism, detritus, and unidentified material categories for 30 species of fish captured during Nearshore Fish Survey, July 1974 through June 1975. Percentage occurrence is also indicated for nematode and trematode parasites - continued

	Total sample size, n											
Hemilepidotus hemilepidotus	2	Crabs	Amphipods	Unident.								
% occurrence		50	100									
% composition (numeric)		11	89									
% composition (gravimetric)		34	11	55								
% composition (gravimetric) minus unidentified		76	24									
		Valvifera	Amphipods	Caprellids	Sandgrains Tubes	Unident.						
Pholis ornata	2											
% occurrence		50	100	50	100							
% composition (numeric)		11	78	11								
% composition (gravimetric)		2	15	2		81						
% composition (gravimetric) minus unidentified		9	82	9								
		Natantia	Amphipods	Crab	Unident.							
Scorpaenichthys marmoratus	2											
% occurrence		100	100	50								
% composition (numeric)		13	84	2								
% composition (gravimetric)		57	20	9	14							
% composition (gravimetric) minus unidentified		66	23	11								
		Mysid	Amphipods	Natantia	Unident.							
Artedius lateralis	1											
% occurrence		100	100	100								
% composition (numeric)		33	33	33								
% composition (gravimetric)		50	8	33	8							
% composition (gravimetric) minus unidentified		55	9	36								

Appendix 8b. Percentage occurrence, composition (numeric), composition (gravimetric), and composition (gravimetric minus unidentified) of prey organism, detritus, and unidentfied material categories for 30 species of fish captured during Nearshore Fish Survey, July 1974 through June 1975. Percentage occurrence is also indicated for nematode and trematode parasites - continued

	Total sample size, n	Natantia	Unident.										
Myxocephalus polyacanthocephalus	1												
% occurrence		100											
% composition (numeric)		100											
% composition (gravimetric)		52	48										
% composition (gravimetric) minus unidentified		100											
		Shrimp	Isopods	Amphipods	Nebalia	Unident.							
Sebastes maliger	1												
% occurrence		100	100	100	100								
% composition (numeric)		35	17	39	9								
% composition (gravimetric)		45	5	9	*	41							
% composition (gravimetric) minus unidentified		77	8	15	*								
		Natantia	Amphipod	Unident.									
Theragra chalcogramma	1												
% occurrence		100	100										
% composition (numeric)		75	25										
% composition (gravimetric)		66	7	27									
% composition (gravimetric) minus unidentified		90	10										