Exxon Valdez Oil Spill
Restoration Project Annual Report

Alaska Predator Ecosystem Study:

Diet overlap, prey selection, diel feeding periodicity and potential food competition among forage fish species

Restoration Project 97163C
Annual Report

This annual report has been prepared for peer review as part of the *Exxon Valdez* Oil Spill Trustee Council restoration program for the purpose of assessing project progress. Peer review comments have not been addressed in this annual report.

Molly V. Sturdevant,
Leland B. Hulbert, and Audra L. J. Brase

National Marine Fisheries Service
Alaska Fisheries Science Center
Auke Bay Laboratory
11305 Glacier Highway
Juneau, Alaska 99801-8626

April, 1998

ABSTRACT

This component of the multi-year project Alaska Predator Ecosystem Experiment (APEX) investigates forage fish trophic interactions to complement other APEX studies on the abundance, distribution and composition of forage fish populations in Prince William Sound (PWS). Understanding variations in the feeding ecology of these prey of seabirds may help to explain the health of avian predator populations which were impacted during the *Exxon Valdez* Oil Spill. In FY98 the diet component focused on 1) processing samples from 1996 collections and preparing a preliminary analysis of the data for this annual report; and 2) completing analysis of all data (1994-1996) to submit as chapters in a final report and for publication.

We examined 467 stomachs from three species of forage fish collected near shore by beach and purse seine during July, 1996. We also analyzed 50 plankton samples collected concurrently in 20 m vertical hauls with a 0.5 m diameter ring net (243 μm mesh). Our report compares 1) the feeding of juvenile Pacific herring (*Clupea pallasi*), Pacific sandlance (*Ammodytes hexapterus*), and pink salmon (*Oncorhynchus gorbuscha*) collected from allopatric (single species) and sympatric (multi-species) aggregations; and 2) the diel feeding periodicity of sandlance collected in two regions of PWS.

Juvenile herring, sandlance and pink salmon occurred sympatrically in 21-41% of the hauls whereat least one of the species was present. Zooplankton numerical composition by species was similar for all aggregations (~80% small calanoids) and mean densities ranged from 1800-4200 organisms*m^{-3}. Juvenile herring and sandlance diets were similar (PSI > 60%) only when both were allopatric. Small calanoids predominated in the diets of both species, but herring also selected larvaceans. Sandlance consumed both prey taxa in proportion to their availability in the zooplankton. Pink salmon diets were not similar (PSI < 60%) to those of either herring or sandlance. Pink salmon selected larvaceans and avoided calanoids. Sandlance were the least selective of these planktivores.

Diet similarity and shifts were the first indications of potential competition among forage species. Diet composition of juvenile sandlance and herring shifted significantly ($P < 0.05$), but not dramatically, between fish in allopatric (n =14, 10 sets, respectively) and sympatric (n = 4 sets) aggregations, providing evidence for partitioning of prey. Sandlance also shifted diets when sympatric with pink salmon, but pink salmon and herring adhered to similar diets whether allopatric or sympatric. Diet composition of juvenile herring and pink salmon also shifted significantly ($P < 0.05$), but not dramatically, between fish in allopatric (n = 10, 3 sets, respectively) and sympatric (n = 6, 4 sets, respectively) aggregations.

Feeding declines were more dramatic than shifts in diet composition. Measures of food consumption and fullness declined significantly for all species in sympatric aggregations compared to those in allopatric aggregations, except for sandlance sympatric with pink salmon. Feeding declines did not appear to be related to time of day or fish size, but may have been related to decreased zooplankton densities in areas of sympatric aggregations. Our results suggest that competitive interactions limit the feeding of these sympatric forage species, which partially accommodate with shifts in overall diet. The health of forage populations could be affected by such competition if sympatry occurs regularly.

List of Tables

Table 1. Sample area, location, date, sampling time, times at low and high tide, and numbers of fish caught at stations with allopatric and sympatric aggregations of juvenile Pacific herring, Pacific sandlance, and pink salmon in PWS during July, 1996. Samples from stations C and F were collected by the pigeon guillemot (PIGU) project outside the APEX survey sites. Stations with the letter "D" were part of the diel sample series. BS = beach seine, PS = purse seine, Cast = cast net, Hand = hand dug.

Table 2. Species associations of juvenile Pacific herring, Pacific sandlance and pink salmon from 330 net hauls in PWS during July, 1996 as (a) total number of APEX stations catching forage fish, (b) percent frequency of occurrence of sympatric species, and © number of sets analyzed for diet study. Two species were classified as sympatric if any were present together; however, not all stations yielded sample sizes large enough to analyze stomachs of both species. Allopatric fish are indicated by shaded cells.

Table 3. Zooplankton density (numbers*m^{-3}) and biomass (mg*m^{-3} wet weight) available to juvenile Pacific herring, Pacific sandlance, and pink salmon at stations corresponding to allopatric and sympatric aggregations sampled in PWS during July, 1996. Values in parentheses are standard deviations of the means. Replicate zooplankton samples were collected in 20 m vertical hauls using a 0.5 m ring net with 243μm mesh.

Table 4. Number of fish examined, size class, mean preserved fork length (mm FL), mean numbers and weights of prey consumed, stomach fullness, number empty, and prey percent body weight of sets of allopatric and sympatric juvenile Pacific herring, Pacific sandlance, and pink salmon in PWS during July, 1996. Values in parentheses are standard deviations of the means.

Table 5. Range of mean sizes and overall median size (in parentheses, mm FL) of forage fish species from allopatric and sympatric aggregations in PWS during July, 1996. Allopatric fish are indicated by shaded cells.

Table 6. Diet similarity (PSI) by percent number and percent biomass of prey species within and between forage species in allopatric and sympatric aggregations in PWS during July, 1996. Significant diet similarity (> 60%) is indicated by shaded cells.

Table 7. Median stomach fullness, number and weight of prey consumed, and prey percent body weight of forage species in allopatric and sympatric aggregations in Prince William Sound during July, 1996. Fullness index values: 1 = empty, 2 = trace, 3 = 25%, 4 = 50%, 5 = 75%, 6 = 100%, 7 = distended. Results of Mann-Whitney Rank Sum Tests between fish in allopatric and sympatric aggregations are indicated with asterisks (n.s. = not significant, * P < 0.05, ** P < 0.01 and *** P < 0.001). See Table 2 for stations classified by type of fish aggregation.

List of Figures

Figure 1. Locations of APEX forage fish sampling stations for July, 1996 in Prince William Sound, Alaska.

Figure 2. Total density (number*m^{-3}) and relative contribution of major prey taxa of zooplankton available to juvenile Pacific herring, pink salmon, and Pacific sandlance in (a) allopatric and (b) sympatric aggregations collected in Prince William Sound during July, 1996.

Figure 3. Mean fork lengths (FL) of forage fish from sympatric and allopatric aggregations collected in Prince William Sound in July, 1996. The number of sets (10 fish in each set) are shown below the bars. Results of Mann-Whitney Rank Sum comparisons between allopatric and sympatric sizes are indicated: NS = not significant, * $p < 0.05$, *** $p < 0.001$.

Figure 4. Diet similarity (PSI) by percent number of prey for forage species in allopatric and sympatric aggregations collected from Prince William Sound during July, 1996. Line at 60% indicates threshold for significant overlap.

Figure 5. Diet composition as percent number of prey among allopatric and sympatric aggregations of juvenile: (a) Pacific herring, (b) pink salmon and © Pacific sandlance collected in Prince William Sound during July, 1996. Legend as in Figure 2.

Figure 6. Diet composition as percent biomass of prey among allopatric and sympatric aggregations of juvenile: (a) Pacific herring, (b) pink salmon and © Pacific sandlance collected in Prince William Sound during July, 1996. Legend as in Figure 2.

Figure 7. Feeding selectivity (Strauss' Linear Selection Index) for juvenile: (a) Pacific herring, (b) pink salmon, and © Pacific sandlance on major prey categories. Positive values indicate preference, negative values, avoidance. The order shown for the types of aggregations (shown in left-most panel) is repeated consistently among the remaining panels.

Figure 8. Shift in prey consumption (prey percent body weight) between allopatric and sympatric aggregations of forage species from Prince William Sound during July, 1996. Results of Mann-Whitney Rank Sum comparisons between groups are indicated: NS = not significant, * $p < 0.05$.

Figure 9. Diel feeding pattern (mean percent fullness index and standard deviations of 10 specimens per time) of juvenile sandlance collected at: (a) Knowles Head (section N0506, July 27-28) and (b) "Fuel Cache," Cabin Bay, Naked Island (Section C0704, July 21-22) in Prince William Sound in 1996. Codes adjacent to data points indicate station numbers. Arrows indicate time of tidal change (up = high tide, down = low tide).

Figure 10. Diel pattern of diet composition (percent biomass of major prey categories) for juvenile sandlance collected at Cabin Bay, Naked Island in Prince William Sound during July, 1996. See Figure 9 for diel pattern of stomach fullness.

List of Appendices

Appendix 1. Zooplankton as mean density (numbers*m^{-3}), percent density, biomass (mg*m^{-3} wet weight), and percent biomass by taxonomic group and total in three regions of PWS during July, 1996. Values in parentheses are standard deviations of the means. Replicate zooplankton samples were collected at the number of stations indicated, in 20 m vertical hauls using a 0.5 m ring net with 243 μm mesh.

Appendix 2a. Zooplankton available to juvenile Pacific herring as mean density (numbers*m^{-3}) and percent density by species in taxonomic groups at stations corresponding to allopatric (n = 8) and sympatric (n = 3 with pink salmon, n = 4 with sandlance) samples collected in PWS during July, 1996. Values in parentheses are standard deviations of the means. Replicate zooplankton samples were collected in 20 m vertical hauls using a 0.5 m ring net with 243μm mesh.

Appendix 2b. Zooplankton available to juvenile Pacific sandlance as mean density (numbers*m^{-3}) and percent density by species in taxonomic groups at stations corresponding to allopatric (n = 14) and sympatric (n = 4 with Pacific herring, n = 1 with pink salmon) samples collected in PWS during July, 1996. Values in parentheses are standard deviations of the means. Replicate zooplankton samples were collected in 20 m vertical hauls using a 0.5 m ring net with 243μm mesh.

Appendix 2c. Zooplankton available to juvenile pink salmon as mean density (numbers*m^{-3}) and percent density by species in taxonomic groups at stations corresponding to allopatric (n = 3) and sympatric (n = 3 with Pacific herring, n = 1 with Pacific sandlance) samples collected in PWS during July, 1996. Values in parentheses are standard deviations of the means. Replicate zooplankton samples were collected in 20 m vertical hauls using a 0.5 m ring net with 243μm mesh.

Appendix 3a. Mean percent frequency, percent number, and percent biomass of prey species consumed by allopatric and sympatric juvenile Pacific herring in PWS during July, 1996.

Appendix 3b. Mean percent frequency, percent number, and percent biomass of prey species consumed by allopatric and sympatric juvenile pink salmon in PWS during July, 1996.

Appendix 3c. Mean percent frequency, percent number, and percent biomass of prey species consumed by allopatric and sympatric juvenile Pacific sandlance in PWS during July, 1996.

INTRODUCTION

The high sea bird mortalities associated with the *Exxon Valdez* oil spill (EVOS) occurred during a period of decline in several sea bird populations (Piatt and Anderson 1996). Long-term shifts in the relative abundance of prominent forage fish species were noted in the 1970's and 1980's (Anderson et al. 1994), coincident with increasing numbers of juvenile salmonids being released into PWS by enhancement facilities. The environmental conditions, trophic interactions and other factors controlling growth and survival of forage fish, as well as sea birds, are not well understood. However, damage assessment studies since the spill have associated continuing sea bird declines with decreased availability of high quality forage fish prey. Reproductive failures were documented among black-legged kittiwakes from oiled areas (Irons 1996) and may be associated with feeding conditions. Greater declines of pigeon guillemots in oiled areas compared to non-oiled areas were associated with reduced deliveries of Pacific sandlance, a high energy prey, to their chicks (Oakley and Kuletz 1996). These forage fish population changes could be reflected in trophic interactions if food availability limits the carrying capacity of PWS (Cooney 1993; Heard 1998).

Information pertaining to the impact of interactions among forage fish species is essential to an understanding of their availability to apex predators. Knowledge of forage fish diets, prey availability and selection, shifts in food habits when fish distributions overlap (allopatry vs. sympatry), diel feeding chronology, and other aspects of feeding ecology, as well as geographic, seasonal and interannual comparisons of such trophic attributes, may provide insight into how the population dynamics of forage fish affect apex predators which utilize forage fish. Most of what is known about the associations of juvenile Pacific herring, Pacific sandlance and pink salmon relates to them as prey for piscivorous fish, sea birds or marine mammals (Cross et al. 1978; Rogers et al. 1979; Field 1988; Heard 1991; Gilman 1994; Schweigert 1997). Numerous diet reports have been published, yet details of the interactions among these species are poorly understood. Especially little is known about Pacific sandlance, principally due to its lack of importance as a commercial species in the eastern Pacific.

This diet study is a sub-project of the Alaska Predator Ecosystem Experiment (APEX 163A-Q), a multi-disciplinary study designed to understand the PWS food web and its effects on species injured in the *Exxon Valdez* oil spill. Understanding the interactions between forage fish species may help to explain changes in the food habits and reproductive biology of injured marine birds dependent on them, lending support to the APEX hypothesis that "planktivory is the factor determining abundance of the preferred forage species of seabirds."

Feeding overlap is one indication of competition. Herring, pink salmon and sandlance have high potential for feeding overlap due to their shared early life history requirement of nearshore residency (e.g., Simenstad et al. 1979). Competition among species can be inferred from an observed shift in resource use when two species co-occur, such as decreased presence in preferred habitat or decreased use of a preferred prey resource (Sogard 1994). The shift is then reflected in some measure of health, such as poorer condition, less energy reserves, or decreased growth. Ultimately, survival may be affected and populations reduced. For this study, samples collected by APEX 96163A were adapted to an *a posteriori* experimental design with nine types of species aggregations. We addressed the potential for competition between juvenile Pacific herring, Pacific sandlance and pink salmon by comparing feeding attributes of fish in allopatric aggregations to those in sympatric aggregations. We examined for a) diet shifts, by comparing prey composition, prey selection and total diet similarity, and for b) feeding declines, by comparing quantities of food consumed.

METHODS

The field and laboratory methodologies used to conduct this study are only briefly described herein. Extended summaries of the 1996 APEX field collections and gear specifications are described in the 97163A (Fish Population Sampling) annual report and laboratory methods are detailed in the FY97 Detailed Project Description (DPD 97163C "Protocol for Collecting and Processing Samples for APEX Forage Fish Diet Investigations").

Because of time and budget constraints, the diet study addressed only the first and second of the objectives listed in the FY98 proposal. We focused on our principal objective, an analysis of trophic interactions between allopatric and sympatric forage fish aggregations. Our second objective of determining diel feeding periods succeeded only for sandlance due to limited samples. We determined the principal time of feeding to provide information on whether temporal partitioning of prey occurs among different forage species feeding on the same resources. To our knowledge, this information is not currently available for any juvenile *Ammodytes* species. Although all objectives have not been met, all tasks scheduled in the FY98 proposal were completed. This annual report will be followed by a close-out Final Report in September, 1998, covering all findings of Project 163C.

Field Methods

Using several nets deployed from several small vessels, we sampled schools of forage fish in PWS during July, 1996. These samples were obtained while we assisted Project 96163A in conducting both offshore and nearshore fish surveys, the principal purpose being to assess the distribution and abundance of forage species. The offshore hydroacoustic surveys were conducted along established parallel transects in each APEX area of the sound (northeast, central, southwest). Nearshore hydroacoustic surveys were conducted concurrently along zig-zag transects in each area. Various nets were fished to verify acoustic targets, to determine species composition and to collect diet and other project samples which were routinely preserved or frozen. Schools detected hydroacoustically in offshore areas were sampled with purse seines and trawls. Schools detected hydroacoustically in deeper nearshore water or sighted at the surface were sampled primarily with purse seines, cast nets and dipnets. A nearshore beach seine survey was conducted systematically, but blindly (without sighting a hydroacoustic target) along shoreline segments defined in each region. Only alternate beach segments were seined due to time constraints (see Haldorson et al. 1997). We seined three randomly selected, but "fishable" sections out of the ten comprising each beach segment. The whole segment formed the base of the zig-zag that was hydroacoustically assessed. When fish were caught in beach seines, zooplankton samples (20 m vertical hauls, 0.5 m diameter ring net, 243μm mesh) and epibenthic samples (10 m horizontal hauls, 0.3 m diameter ring net, 243μm mesh) were also collected to assess the prey available to fish from pelagic and epibenthic production systems. Zooplankton samples were collected within approximately 100 m of the fish sampling site unless the site was too shallow. The epibenthic sled rested 11-cm above the substrate, thus collecting both epibenthic and planktonic organisms across the integrated micro habitats near the bottom. Replicates of either type of sample were preserved in 5% buffered formaldehyde solution in individual 500 ml sample bottles. Few additional plankton samples were collected offshore; therefore, prey samples collected to complement beach seined fish were used with purse seined fish samples from the same area in a few cases (see Table 1).

With the above survey priorities and limited time, it was not possible to conduct directed sampling on specific schools as proposed. Instead, we investigated feeding periodicity and compared diets between fish in allopatric and sympatric schools (97163C DPD) by adapting survey samples to a balanced, *a posteriori*, experimental design which could address competition. This design considered the factors: a) species, b) allopatric vs. sympatric, and c) species pairing for sympatric aggregations. With samples of herring, sandlance and pink salmon available, the factors comprised nine categories of aggregations.

We defined sympatric as any co-occurrence of two species in a sample set at a station. We re-examined the catch data (97163A) to determine the percent frequency of occurrence of sympatric Pacific herring, Pacific sandlance and pink salmon. Then we classified all sets catching one of the three species of interest as allopatric or sympatric (Tables 1 and 2). The criteria for classifying species aggregations were:

Allopatric	Sympatric
• mixed species per area in different hauls	• mixed species per area in same hauls
• 2 species with n < 9 for one of them	• 2 species with n ≥10 each
• 2 size classes for a species occurring alone (sandlance, 11-2B)	• 2 size classes of one species with a co-occurring second species
• additional species present in low numbers, but not of interest (e.g., tomcod)	

We analyzed all sympatric sets available, then selected sets from the more common allopatric aggregations to complement them and to represent intraspecific spatial variation in diet across the regions. We pooled sets across regions to make comparisons between allopatric and sympatric aggregations. Our experimental design was not spatially balanced because allopatric and sympatric samples of each species were not both captured in the northeast, central and southwestern regions of the sound, even though all three species were present throughout the sound.

For the second objective, diel samples were collected at four stations throughout 24 hours of beach seining in northeastern PWS at the end of the APEX surveys. Two beach segments (see above) were selected where fish of interest, particularly sandlance and herring, had been successfully seined earlier. We fished replicate stations on two beach segments, southwestern Bligh Island (sections N1503 and N1507) and Knowles Bay (sections N0505 and N0506). The four stations were fished during four, 6-hour diel intervals (I: 10:01-14:00, II: 14:01-20:00, III:

20:01-04:00, and IV: 04:01-10:00) except during time interval III. We successfully collected a 3-sample diel series of sandlance at Knowles Bay and obtained a 5-sample diel series from Cabin Bay on western Naked Island (Central PWS) by pre-arrangement with pigeon guillemot (PIGU) Project 96163F.

Laboratory methods

Once the experimental design was outlined, we followed established protocol for analyzing diet samples. We examined fish stomach contents to determine: a) if different forage species consumed the same prey types and b) if feeding shifts that could provide evidence of competition occurred between allopatric and sympatric aggregations of each species. Forage fish stomach samples and prey samples (zooplankton invertebrates) were analyzed at the NMFS Auke Bay Laboratory according to the protocol written in 1997. This process was greatly enhanced by having experienced NMFS employees on staff, compared to other years of the project.

Preserved fish were measured and weighed in the laboratory, stomachs were removed and weighed, and semiquantitative indices of stomach fullness and prey digestion were recorded from visual assessment. Relative fullness was recorded as: 1 = empty, 2 = trace, 3 = 25%, 4 = 50%, 5 = 75%, 6 = 100% full, and 7 = distended. The state of digestion was recorded as: 0 = fresh, 1 = partially digested, 2 = mostly digested, 3 = stomach empty. Stomach contents were teased apart and split according to standard subsampling techniques when stomachs were too full to count every prey item (Kask and Sibert 1976). We identified zooplankton to determine selection from pelagic prey fields by fish at each station. Because fish preyed very little on epibenthic prey taxa, we did not analyze the epibenthic tow samples. Zooplankton samples were split with a Folsom splitter. Organisms in stomachs and zooplankton samples were identified, enumerated under the microscope, and numbers were expanded. As much as possible, taxa were identified to allow examination of prey selection by species, sex and life history stage, and within size groups. Large copepods were identified as those > 2.5 mm total length (TL). Small copepods were identified as those ≤ 2.5. mm TL, and include the cyclopoid, *Oithona*. Taxa such as euphausiid or amphipod species were similarly defined by length ranges.

Data Summary and Statistical Methods

The numerical percentage composition and mean abundance of prey taxa in plankton samples were summarized to characterize the general resources available to planktivores at each station and in the three regions of PWS during July. Density of planktonic prey was standardized to 1 m^3 water volume using the number of animals per sample divided by the volume (V) of water sampled:

$$X=\frac{x_i(1/f)}{V}\ ,\quad V=\pi r^2 D$$

where x_i = number observed per taxon, f = the fraction of the sample analyzed, r = radius of the net (0.5 m) and D = depth of the tow. Depth of plankton samples were generally 20 m, filtering approximately 4 m^3 of water. Biomass was calculated by prey multiplying counts by the mean weight per taxon-size class from literature values and data-on-file.

Ten fish from each species-size group per station were analyzed from diet sample collections. Mean preserved fork lengths (FL) for each group was calculated to distinguish between intraspecific size/age groups. In general, herring and sandlance less than 100 mm were considered 0-age and fish greater than 100 mm were considered 1-age. All pink salmon were 0-age, but were classified in two similar size classes. Mean fullness index and stomach fullness as mean prey percent body weight (%BW) were also computed:

$$\% \ BW = \frac{\sum (x_i \ w_i)}{BW - (\sum x_i \ w_i)} 100$$

Where i = 1 to n prey taxa, x_i = total number of prey per taxon, w_i = the mean weight of each prey taxon in mg, and BW = the fish body weight in mg.

Overall food habits of forage fish species were summarized for the allopatric and sympatric groups of each species by pooling the specific prey taxa identified into major prey categories. These were presented as percent total biomass and percent total numbers. The Schoener Index of Overlap, also known as the Percent Similarity Index (PSI), was used as the principal measure of diet similarity (Wieser, 1960; Schoener 1974; Boesch, 1977; Hurlbert 1978; Krebs 1989). The PSI is computed by summing the minimum percentage of all prey taxa shared between two species of forage fish :

$$PSI_{jk} = \sum \ \min \ (p_{ij} \ , \ p_{ik}) \ = \ 1 - 0.5 \ (\sum |p_{ij} \ - \ p_{ik}|)$$

where p is the biomass proportion of the i^{th} prey taxon in n taxonomic categories consumed by fish species j and k. The PSI is a simple and conservative estimator of diet overlap based on the finest resolution identifications available. We used the measure to compare several groups of fish diets: interspecific-allopatric (both species allopatric), interspecific-sympatric (two co-occurring species), and intraspecific allopatric-sympatric (allopatric species compared to itself when sympatric). Values above 60% were considered significant.

Strauss Linear Selection Index was used as the principal measure of prey selection. This measure compares the percent numbers of prey taxa consumed by fish to the percent numbers available in prey resource sample (Ivlev 1961; Krebs 1989; Strauss 1979):

$$L_i = (p_i \ - \ e_i)100$$

where i = 1 to n prey taxa, p_i is the numerical proportion consumed and e_i is the numerical proportion in the prey resource sample. Selection values were calculated for fish whose stomach contents could be compared to zooplankton samples collected at the same station; in a few instances, nearby stations were substituted when exact station samples were not available. Selection values were calculated for all taxa observed in either the stomachs or the prey samples. Negative values indicate avoidance, positive values indicate selection, and values near zero indicate predation at a rate proportional to the availability of the taxon.

In statistical analyses, the set of fish at a station were the sampling unit, with stations as replicate observations of allopatric or sympatric occurrences. All data were tested for normality of distribution and homogeneity of variance. Transformations were unsuccessful; therefore, a nonparametric analysis was emphasized in tests for diet shifts and declines. We measured feeding shifts as changes in: a) overall diet similarity, b) prey percent composition, c) prey selection, d) numbers and biomass of prey consumed, and e) stomach fullness. We converted observations to ranks, then applied a two-way ANOVA on the ranked data (Conover 1980) with the allopatric-sympatric classification and species as factors. When the interaction term was significant ($P < 0.05$), multiple comparisons between allopatric and specific sympatric species combinations were performed (Mann-Whitney Rank Sum Test).

RESULTS

The locations fished for diet samples are shown in each of the three APEX geographic regions of PWS in Figure 1. More fish came from the northern region than the other two, but some stations in both the north and central regions were sampled more than once for the diel study. The allopatric-sympatric classification and characterics of stations in Figure 1 are shown in Table 1. All samples were collected in the second half of July during daylight hours (between 06:35 and 20:15), with the exception of set 87-1B-D4 (a diel station), which was fished at dawn (04:40).

The frequency of occurrence, abundance and distribution of forage species were summarized in the 1996 annual report; however, species associations were not presented (Haldorsen et al. 1997). We set the stage here by briefly repeating the findings. Forage fish were seldom encountered offshore in 1996, and differences between areas were noted for nearshore surveys. Of all gear types, fish were caught most frequently with beach seines onshore, where fishing effort was focused. Fish were not randomly distributed and were encountered in the north more often than in the other regions. Herring and sandlance were the most frequently occurring and abundant species caught in the north. Pink salmon and tomcod were the most frequently occurring species in the south and central areas, but herring (mostly adults) were the most abundant species in the south. Catches were generally low in the central area, and although we caught sandlance third most frequently there, other work suggests that our beach seine sites missed areas where they commonly occur. Sandlance schools were commonly sighted in the Naked Island complex during Sound Ecosystem Assessment (SEA) aerial surveys and the PIGU project (96163F) collected a number of samples for use in our diet study during its beach seining operations at Cabin Bay and other sites around Naked Island.

Sympatric forage fish aggregations were relatively common in July, 1996 (Table 2). Of the 330 sets that caught fish in the 1996 APEX surveys (excluding the samples provided by the PIGU project), juvenile Pacific herring, Pacific sandlance and pink salmon were caught in 39, 22 and 34 sets, respectively (Table 2a). We identified sympatric species pairs in 21-41% of the hauls catching at least one of the three species (Table 2b). All sympatric sets available were analyzed (four sets of herring-pink salmon, four sets of herring-sandlance, and one set of sandlance-pink salmon; Table 2c).

The total density and biomass of zooplankton available at allopatric and sympatric stations for each forage species are summarized in Table 3 for comparison of feeding environments to fish diets and feeding declines. We compared zooplankton densities and composition at allopatric stations to those at sympatric stations for each species. Mean zooplankton densities across the nine categories of aggregations ranged from approximately 1800 to $4200 * m^{-3}$; densities at stations within each type of aggregation generally varied by a factor of 2-3. For aggregations of herring, reduced zooplankton densities were evident where fish were sympatric with sandlance but not where they were sympatric with pink salmon. For aggregations of pink salmon, reduced zooplankton densities were evident where fish were sympatric with herring, but not with sandlance. For aggregations of sandlance, reduced zooplankton densities were evident where fish were sympatric with herring and higher zooplankton densities were observed where they were sympatric with pink salmon.

Although zooplankton densities differed between allopatric and sympatric aggregations, zooplankton composition was virtually identical (Figure 2). Zooplankton in the upper 20 m water column universally consisted of small organisms, with small copepods forming at least 72% by number. These were principally the calanoids, *Pseudocalanus*, *Acartia*, and *Centropages* and the cyclopoid, *Oithona*. Four taxa comprised the majority of the rest of the organisms present, but none comprised more than 10%: larvaceans (*Oikopleura dioica*), pteropod gastropods (*Limacina helicina*), cladocerans (*Evadne* and *Podon*), and "other" consisting mostly of bivalve larvae. Barnacle larvae and large calanoids (*Calanus pacificus)* were occasionally present also (< 3%). The species composition of zooplankton available to these forage fish aggregations is detailed in Appendix 2.

Differences in zooplankton total density at allopatric and sympatric stations did not appear to be due to regional differences. We pooled stations from different regions for the experimental design, but because more samples were collected in the north, processes there weighted the mean zooplankton density values. However, density values from the north included both the lowest and highest observed (Table 3; Appendix 1). Mean density of zooplankters by region was very similar to mean values among species aggregations, ranging from 2325 to $3490 * m^{-3}$ in the upper 20 m water column. Between-station variation in density was substantial within all regions and within all types of forage fish aggregations. Zooplankton composition was very similar between regions, with small calanoid copepods predominant and other taxa as described above for different fish aggregations (Appendix 1).

The mean sizes of forage species among stations classified as allopatric and sympatric suggested that most were 0-age or 1-age fish (Table 4). Within stations, fish FLs were fairly uniform, with typical coefficients of variation < 10%. Herring FL ranged from approximately 30 mm-191 mm, with a cluster of fish ≤ 55 mm, a cluster between 100-130 mm, and one set of 191 mm fish (Table 4). Sandlance clustered in groups of ≤ 89 mm and > 112 mm FL. Pink salmon ranged from 62-130 mm in FL. The interaction term in a two-way ANOVA testing lengths of the forage species classified as allopatric or sympatric was marginally significant ($P = 0.0538$). Further tests showed significant differences ($P < 0.001$) within species between median sizes of allopatric and sympatric forage fish (Figure 3). Herring sympatric with pink salmon (107 mm) were significantly larger than allopatric herring (47mm) and sandlance sympatric with pink salmon (63.5 mm) were significantly smaller than allopatric sandlance (79 mm). Conversely, herring sympatric with sandlance (46.5 mm) and sandlance sympatric with herring (76.5 mm) were each similar in size to allopatric individuals of the same species. Allopatric pink salmon (85 mm) were significantly smaller than pink salmon in both sympatric aggregations (98 mm). However, comparisons of species size with allopatric-sympatric classification revealed that virtually the full range of sizes of any of the three species were found sympatric with either of the other two species (Table 5).

Overall diet similarities (PSI) were used as the first indication of potential competitive interactions. We computed PSI between species occurring allopatrically, between species occurring sympatrically, and within species occurring allopatrically and sympatrically (Table 6; Figure 4). Few differences in the similarity of diets were noted when percent numbers or percent biomass of shared prey species was used for the comparisons. Interspecific diets were not similar (< 60%), except for allopatric herring and allopatric sandlance by percent number of prey species (73.1%). Interspecific diets were not similar for any pair of sympatric species. Intraspecific herring diets and intraspecific pink salmon diets were similar (61.0-72.7% overlap by both percent number and biomass) between allopatric aggregations and either sympatric aggregation. Intraspecific diets were similar (> 60.5% biomass) for allopatric sandlance and sandlance sympatric with herring.

The diet similarity analysis was followed by an examination for shifts in prey composition with sympatry. Diet compositions of forage species in allopatric and sympatric aggregations are presented as percent numbers (Figure 5) and percent biomass (Figure 6) of major prey groups to indicate principal prey and to examine for shifts between aggregations. Principal prey differed among forage species, and were: for herring, small calanoids and larvaceans; for pink salmon, larvaceans and fish; and for sandlance, small calanoids. Minor prey included large calanoids, decapod zoeae, barnacle larvae and molts, hyperiid amphipods, cladocera, gammarid amphipods and harpacticoid copepods. The frequency of occurrence, percent numerical contribution and percent gravimetric contribution of prey species consumed by forage species in each type of aggregation are presented in Appendix 3.

Significant ($P < 0.05$), but not dramatic, prey shifts occurred within species from allopatry to sympatry when the proportions of principal prey groups consumed by either number or weight were tested (Figures 5 and 6). Shifts occurred for sandlance sympatric with either herring or pink salmon and for herring sympatric with pink salmon. When with herring, sandlance shifted away from their principal prey, small calanoids, and consumed more larvaceans and alternative prey (harpacticoid copepods and barnacle larvae; Figures 5 and 6, Appendix 3). Conversely, when sympatric with pink salmon, sandlance shifted completely away from larvaceans, which constituted nearly 100% (numerically) of the pink salmon diet in these aggregations. When sympatric with pink salmon, herring consumed proportionately less small calanoids and proportionately more larvaceans ($P < 0.05$). When with sandlance, however, no significant shifts occurred in herring diet ($P > 0.05$). Pink salmon did not shift prey significantly when sympatric with either species (Figures 5 and 6).

Prey selection from the available zooplankton was computed for each species aggregation. We compared selection among forage species and we compared selection between allopatric and sympatric aggregations within each species (Figure 7). Prey selection did vary among species. Sandlance and herring selected small calanoids and larvaceans in fairly close proportion to their abundance in the environment. Pink salmon avoided small calanoids and strongly selected larvaceans. Few shifts in prey selection were noted between allopatric and sympatric fish, however. Herring had positive selection for large calanoids only when sympatric with pink salmon. Sandlance had a slightly positive selection value for larvaceans when allopatric, but had slightly negative values for larvaceans when sympatric with either herring or pink salmon. No other patterns of prey selection were observed (Figure 7).

Diet attributes used to examine for shifts between species in allopatric and sympatric aggregations included two measures of the amount of food consumed (total prey numbers and weight) and two measures of stomach fullness (fullness index and prey percent body weight; Table 7). The interaction terms in two-way ANOVAs testing each of these measures among forage species classified as allopatric and sympatric were highly significant ($P < 0.009$). Subsequent tests revealed that the amount of prey consumed by forage species in most sympatric aggregations was significantly less than the amount consumed in allopatric aggregations ($P < 0.05$). Declining trends of fish feeding in sympatric aggregations compared to fish feeding in allopatric aggregations are illustrated using prey percent body weight (Figure 8). The median value for prey percent body weight of allopatric herring was 1.5%, declining to 1.1% for herring sympatric with sandlance and 0.4% for herring sympatric with pink salmon. The median value for prey percent body weight of allopatric sandlance was 0.7%; the values for sympatric sandlance were not significantly different. The median value for prey percent body weight of allopatric pink salmon was 1.6%, declining to 0.8% for pink salmon sympatric with herring and 0.5% for herring sympatric with sandlance. Such downward shifts in feeding were observed for at least three of the four measures of prey utilization for each sympatric species combination except sandlance with pink salmon (Table 7).

We examined the diel feeding rhythm of sandlance from single locations to determine the time of peak feeding (Figure 9 and 10). On July 21-22, sandlance collected at the PIGU project "Fuel Cache" site in Cabin Bay (stations F1, F2) were seined from allopatric aggregations in five time periods. The fish caught at 08:00 and 12:00 had stomachs nearly 75% full, with mean prey percent body weight of 1.7% (Table 4). This occurred on the falling tide series. Fullness declined throughout the rest of the day as the tide rose. Stomachs were nearly empty on two successive nights at 20:00 (Figure 9). Food composition also changed over the diel period, differing at the three times when stomachs were at least 50% full (Figure 10). Early in the morning, larvaceans and decapod larvae predominated (46% and 33% biomass, respectively). In the middle of the day, the sandlance had eaten small calanoids (45%), barnacle larvae (31%) and other prey items, mainly harpacticoid copepods (16%). By late afternoon, the proportion of small calanoids present in the diet increased to nearly 90%.

The second set of diel samples were from Knowles Bay in the north and were collected approximately one week later than the central PWS diel samples, on July 27-28, during the opposite tidal cycle. These fish all had near empty stomachs and did not exhibit a feeding rhythm. Trace amounts of prey in a few stomachs consisted of small calanoids, harpacticoids and gammarid amphipods.

DISCUSSION

Species co-occurrence

During July of 1996, between 6.7% and 10.7% of 330 net hauls from APEX surveys in PWS caught juvenile Pacific herring, Pacific sandlance and pink salmon. In 21-41% of the hauls catching one of these species, a second species occurred sympatrically. These rates are likely to be even higher if sympatry is defined loosely, as the presence of two species in separate schools in a bay, for instance. We report on sympatric species feeding together in virtually single aggregations.

Few other reports exist that compare the food habits and co-occurrence of juvenile Pacific herring, Pacific Sandlance, and pink salmon, although each of these species is a common resident of nearshore habitats on the Pacific and Arctic coast in spring and summer (Craig 1984; Cross et al. 1978; Orsi and Landingham 1985; Robards and Piatt 1997; Rogers et al. 1986; Simenstad et al. 1979; Willette et al. In prep.). Their early life history strategies ensure that all three species overlap in spatial and temporal distributions during parts of this important feeding period. The interrelationships become complex when considering fish with such diverse life history patterns as are exhibited by herring, pink salmon and sandlance. Generally, in the spring, herring larvae hatch in the intertidal zone and spend the first two years of life nearshore (Norcross et al. 1995). Sandlance larvae are dispersed from intertidal areas where they hatch, moving onshore later in summer (McGurk and Warburton 1992; Blackburn and Anderson 1997). Pink salmon fry migrate from fresh water to nearshore estuaries before moving offshore in the summer of their first year of life (Heard 1991). These population pulses are especially pronounced in areas where millions of salmon are released by hatcheries (Heard 1997). However, spatial overlaps must decline by fall-winter, when pink salmon have left protected waters for the Gulf of Alaska (Heard 1991), sandlance become dormant in soft substrates (Ciannelli 1997), and older juvenile herring have migrated to different areas (Norcross et al. 1998).

Although investigators have rarely reported frequency of co-occurrence or species associations in samples, these three species are common and abundant (eg., Simenstad 1979; Robards and Piatt 1997). Their mutual presence in many areas suggests that habitat and prey utilization must be shared among them at least some of the time. However, ours is not the first study to report mixed schools (sympatry) of these species. Richards (1976) observed sympatric schools of herring and sandlance juveniles in the western Atlantic. Harris and Hartt (1977) reported frequent co-occurrence for these species near Kodiak and Haegele (1996) reported co-occurrence for juvenile herring and salmon. The potential for competition, however may vary seasonally, as indicated by monthly changes in the frequency of species associations observed in SEA juvenile salmon studies in PWS. SEA collected juvenile fish samples in the southwestern region of the sound from April to October, 1994 (Willette et al. In prep). The species associations, as well as frequencies of occurrence and abundance of juvenile herring, pink salmon and sandlance, varied widely over time. Generally, herring co-occurred with sandlance earlier than with pink salmon. Sandlance co-occurred with pink salmon at higher rates than with herring. Pink salmon co-occurred with sandlance at higher rates and earlier than with herring. This information, along with our high rates of co-occurrence for these forage species in July, and literature reports on their individual food habits, suggest that substantial diet overlap and competition for food are likely to occur for portions of the populations in summer.

Diet similarity

Juvenile Pacific herring, Pacific Sandlance, and pink salmon were grouped by Simenstad et al. (1979) into the same functional feeding group, pelagic planktivores, among neritic fish assemblages inhabiting northern Puget Sound and the Strait of Juan de Fuca, Washington. Sandlance and herring were defined as obligate, while pink salmon were considered facultative. The diets of all three species were usually dominated by calanoid copepods, although overlap was not reported (Simenstad et. al 1979). Calanoid copepods are commonly reported as the majority of prey weight found in the stomachs of Pacific herring (Willette et. al 1997), Pacific sandlance (e.g., Meyer et al 1979; Craig 1987; Field 1988), and pink salmon (e.g., Bailey et. al 1975; Sturdevant et. al 1996). This similarity of principal prey has been noted by other authors (Hobson 1986; Field 1988; McGurk and Warburton 1992; Willette et. al In Prep)). The diets of all three, however, may vary with season and habitat (eg., Simenstad 1979; Sturdevant et. al 1996; Willette et. al In prep; Craig 1987; Gordon 1984) and even time of day (this paper, diel sandlance). Thus, seasonal changes in the abundance and distribution of these species can affect both the potential for food and habitat competion among them and their availability to marine predators.

In our study, the similar composition of herring and sandlance diets was based principally on one shared resource, small calanoids. However, overall diet similarity was high only between allopatric aggregations of these species. Their diets diverged when they were sympatric. Because the composition of herring and sandlance diets was similar (Figures 5 and 6) and yet diet overlap was low in sympatric aggregations, we examined the prey size spectrum of these predators. Preliminary analysis of the data suggests that calanoid copepod prey are actually partitioned by size and species between sympatric herring and sandlance, decreasing the specific overlap. This aspect of feeding will be developed for the final report. Pink salmon and sandlance diets included no common prey.

Herring and pink salmon also shared principal prey resources, larvaceans. Both species, however, consumed large proportions of a second prey. For pink salmon, unlike herring, prey biomass was dominated by fish and virtually no copepods were consumed. While herring selected small calanoids in close proportion to their availability, pink salmon avoided them and were highly selective of larvaceans. However, small calanoids formed most of the density and biomass of PWS summer zooplankton, far exceeding the abundance of larvaceans. In contrast to spring (Cooney 1995; Cooney 1998), large copepods, including *Neocalanus* spp., were virtually absent from our 20 m zooplankton hauls. We did not observe large calanoids in many stomachs, but they are commonly preferred by pink salmon fry at some times in some areas (LeBrasseur and Parsons 1969; Bailey et al. 1975; Sturdevant et al. 1996; Willette et al 1997). In July, however, pink salmon have grown too large to be able to obtain a daily ration from this prey (LeBrasseur and Parsons 1969). Other investigators have suggested that larvaceans are targeted by juvenile salmon because they are highly visible (Bailey et. al 1975). When their mucous houses are intact, they are likely a similar size as large copepods, and unlike other gelatinous taxa, have a similar caloric density as copepods (Davis et al. 1997). Combined with a low escape response and high visibility, larvaceans may be a rich alternative prey for fish. In total, these findings suggest that pink salmon and herring had distinctive diets which they adhere to even when sympatric with another species. Sandlance generally had diets similar to herring but adhered less strongly to the preferred diet when sympatric.

Feeding declines and zooplankton

We observed declines in zooplankton density concurrent with feeding declines for four sympatric aggregations: herring with pink salmon, pink salmon with herring, pink salmon with sandlance, and sandlance with herring. Changes in prey density can greatly affect the success of fish feeding. For example, Campbell and Graham (1991) reported that the food supply available to larval herring during two periods (autumn, when feeding on copepodites and nauplii of small calanoids and cyclopoids; and winter, when feeding on adult small calanoids) was strongly related to their survival. In that study, for fish similar in size to the smaller herring we studied, a doubling of the density of zooplankton maximized larval survival, while halving the density decreased survival by 10-16%. We observed similar differences in zooplankton density between stations within aggregations and between types of aggregations. If the energy budget of these species requires a minimum density of appropriately-sized prey in order for calories consumed to balance calories expended, then the four sympatric aggregations with lower prey densities could have been food limited.

Both pink salmon sympatric aggregations occurred in areas of lower prey density than where allopatric pink salmon occurred. Densities could have been higher at areas with allopatric pink salmon no planktivores were present to crop the small calanoids. For pink salmon as large as ours, the small calanoids that predominated were not adequate prey for the long term. LeBrasseur and Parsons (1969) found that, although they would feed on small calanoids, 90 mm pink salmon could not obtain sufficient ration. In our study, pink salmon were highly selective of larvaceans, even though they contributed < 10% to prey composition, on the order of $0.5*\text{liter}^{-1}$. Larvaceans were not more prominent in aggregations where only one of these two predators occurred. Pink salmon diets also preyed on low numbers of larval fish at all aggregations. Larval fish were not quantitatively sampled by our zooplankton net; therefore, we have no estimate of their relative abundance.

For both herring and sandlance, zooplankton density was lowest for aggregations where these two species occurred sympatrically, and may have cropped down the resource. These densities are low compared to those during peak zooplankton blooms in the spring (Bailey et. al 1975; Cooney 1995; Cooney 1998), providing < 4 $\text{prey}*\text{liter}^{-1}$. Small calanoids occurred in densities of approximately $2\text{-}3*\text{liter}^{-1}$, up to $4*\text{liter}^{-1}$ at allopatric aggregations. These densities could make a difference to small fish. Herring larvae feeding on microzooplankton (copepod nauplii) did well at densities of about $4*\text{liter}^{-1}$ (Purcell and Grover 1990), but another study found that $5\text{-}12*\text{liter}^{-1}$ was adequate for good feeding, survival and growth (Kiorboe et al. 1985 in Purcell and Grover 1990). Although similar density relationships may hold for the juvenile fish in our study that fed on later copepod stages, size of prey was probably most important (Parsons and LeBrasseur 1969).

Mean zooplankton density was 40% lower at herring-pink salmon aggregations compared to densities at allopatric aggregations, but was not lower at herring-sandlance aggregations. Herring feeding also declined much more when they were sympatric with pink salmon than when they were sympatric with sandlance. This is surprising because, of the two predators, only herring fed on the predominant resource. For these herring, the feeding decline may reflect diminished prey availability. But for the pink salmon sympatric with herring, which did not feed on the predominant prey, the feeding decline was not driven by reduced zooplankton density, but by some other process. Both herring and pink salmon increased selection on larvaceans even though the relative density of this taxon was about equal to that at allopatric aggregations (Appendix 2). This type of shift suggests that perhaps fish minimize aggressive interactions while feeding sympatrically by targeting prey with a low escape response. The decreased energy expenditure to capture prey would also decrease the rate of encounters with a competitor. However, larvaceans predominated in pink salmon diets even when no competitor was present.

For pink salmon sympatric with sandlance, some measures did decline (%BW, fullness), but number of prey doubled. Feeding on small prey would make it difficult for fish their size to reach the daily ration (LeBrasseur and Parsons 1969). Bailey et al. (1975) concluded that a maximum of 544 copepod prey daily was sufficient for pink salmon up to 58 mm FL, approximately the number of prey observed in these pink salmon nearly twice that size. Since larvaceans numerically dominated (98%) the stomach contents of these pink salmon, the substantial prey biomass contributed by fish larvae having higher nutritional value is a vital dietary supplement. This may be a factor influencing the size of co-occurring herring-pink salmon and sandlance-pink salmon in late summer. The sandlance co-occurring with pink salmon were large enough to avoid predation, but the 0-age herring were probably not (Table 4).

The feeding of sandlance sympatric with herring declined and prey densities were lower than for allopatric sandlance by about 25%. Both of these species fed on the predominant prey, which may have been limiting. Sandlance feeding did not decline when sympatric with pink salmon, in aggregations where zooplankton density was 50% higher than at allopatric aggregations. Because these two species do not have similar diets, competition for available prey was not a limiting factor.

<u>Feeding declines, feeding periodicity, size</u>

In addition to patterns for zooplankton densities and feeding declines, we investigated for patterns by time of day. Downward shifts in prey consumption by fish in allopatric aggregations to that of fish in sympatric aggregations did not appear to be influenced by proximity of sample collections to peak feeding times. First, allopatric herring were collected approximately six hours earlier in the day than reported peak feeding times for juvenile herring (16:00; Willette et al. 1997). Therefore, they had probably not yet filled their guts. Both sympatric groups of herring were collected later in the day, near periods of peak feeding (approximately 14:00 and 16:00). They would therefore be expected to have fuller stomachs and higher prey percent body weight than the allopatric herring, but did not (Table 6). For pink salmon, peak fullness generally occurs at dusk (Godin 1981). The allopatric pink salmon we collected at ~11:30 had stomachs 75% full and the highest prey percent body weight we observed (Table 6). These values for allopatric pink salmon were significantly higher than those of sympatric pink salmon collected later in the day with herring (~15:30) or collected at approximately the same time of day with sandlance (~11:00). Finally, for sandlance, shifts in feeding depended on whom they were sympatric with. Our study of diel feeding patterns of juvenile sandlance indicated peak fullness occurs during mid-day (Figure 9). Measures of feeding were high for both allopatric sandlance collected ~14:30 and for sandlance sympatric with pink salmon collected ~11:00; however, stomach fullness of sandlance sympatric with herring was significantly lower than for allopatric sandlance, even hough they were taken at approximately the same time of day (~14:00). If literature values for time of peak feeding of herring and pink salmon hold for our study, then these results suggest that the feeding declines observed for sympatric fish were not artifacts of the time of day they were collected.

Few estimates of the diel feeding periodicity, gut evacuation rate or daily ration are available for either sandlance or herring. Larvae of the Japanese sand-eel (*A. personatus*) fed visually and actively all day beginning at dawn (Yamashita et al. 1985). Guts were fullest (60%) at 18:00. Age-0 and older juvenile herring off of Scotland had different feeding rhythms, each with two diel peaks in consumption; age-0 fish stomachs were fullest at 13:20 and 22:20, while 1+ fish were fullest earlier, at 10:20 and 18:20 (De Silva 1973). Age-0 herring in the Baltic Sea also had two feeding peaks daily (Arrhenius and Hansson 1994), in evening (about 18:00-20:00) and mid-morning (10:00). If different age classes have separate feeding rhythms, then the herring with pink salmon in our study could have a different peak feeding period than the herring with sandlance. If this is true, our conclusions about feeding declines and sampling times may not hold. For pink salmon peak fullness generally occurs at dusk after feeding throughout the day (Bailey et al. 1975), reportedly around 20:00 in spring (Godin 1981) and 16:00 in fall (Willette et al. 1997).

LeBrasseur et. al (1969) compared the diets of larval and juvenile sandlance, pink salmon and chum salmon in the spring plume of the Fraser River, British Columbia. These species became prominent in the nearshore at the same time (April-May) that the dominant copepods in zooplankton samples switched from small species of about 500 μm in length (*Microcalanus* sp., copepodites of *Calanus pacificus* and *Pseudocalanus minutus*) to a larger species of about 1500 μm in length (copepodites of *Neocalanus plumchrus*). In general, fish switched from consuming the small prey as larvae to the large prey as juveniles. Sandlance larvae feeding on *Microcalanus* had empty stomachs much more frequently than the juveniles feeding on *Neocalanus*. Ration experiments were not conducted for sandlance, but 85% of the zooplankton prey of juveniles > 40 mm were between 500 μm and 1000 μm in length, smaller than the salmonid's preferred prey. In controlled feeding experiments, salmonids could meet their daily ration when feeding on *Neocalanus* but not when feeding on *Microcalanus*, even when the latter's density or biomass were greater. Parsons and LeBrasseur (1970) noted that 90 mm juvenile pink salmon can obtain their ration of 683 mg of food per day by feeding on *Neocalanus plumchrus* continuously at prey biomass of 20 g*m^{-3}, but could not meet this food requirement when feeding on a *Pseudocalanus* crop even at prey densities of 90 g*m^{-3}. Maximum ration consumed by 90 mm pink salmon was 43 mg/hr *Neocalanus* at prey concentrations of 4,000*m^{-3}, but only 10 mg*hr^{-1} for *Pseudocalanus* at concentrations greater than 670,000*m^{-3}. These authors showed that the type and size of prey and the presence of highly dense patches were at least as important as overall prey biomass to juvenile salmon in obtaining adequate food efficiently.

The median prey percent body weight we observed in forage fish stomachs did not exceed 1.5% for herring, 0.7% for sandlance and 1.6% for pink salmon regardless of the type of aggregation. We did not compute daily ration, but compared amount of food in stomachs to roughly gauge feeding success. For pink salmon, we observed only one instance (58-2U; 13:30) close to a ration published for 90 mm pink salmon, 683 mg*day^{-1} (Parsons and LeBrasseur 1970). For sandlance, using Gilman's (1994) estimated ration at temperatures similar to summer in PWS (2.95% BW), we would expect total daily prey weights of 2.2-4.4 mg for our 63-79 mm sandlance. The observed values were 25.7 mg for allopatric sandlance, <1 mg for sandlance sympatric with herring, and 11.7 mg for sandlance sympatric with pink salmon, all taken during the peak feeding period we determined. For herring, using the 8.8% BW ration observed for 45-49 mm fish in summer (Arrhenius and Hansson 1994), and the 3.7% BW ration for 200 mm fish (Koster and Mollman 1997), we estimated daily prey requirements of 4.7 mg for allopatric herring (47 mm) and herring sympatric with sandlance (46.5 mm) and 36 mg for 107 mm herring sympatric with pink salmon. Our values for allopatric herring and for herring sympatric with sandlance were above these estimates, but our value for herring sympatric with pink salmon was far below the estimate. Daily rations of 0-age herring were higher in summer (up to 17% wet body weight for 30 mm fish) than fall (as low as 2.1% for 70-80 mm fish; Arrhenius and Hansson 1994). Daily rations of 0.4-3.7% body weight were estimated for herring approximately 200 mm in length feeding on copepods and ichthyoplankton (Koster and Mollmann 1997). Maximum percent body weight observed for *Ammodytes personatus* in spring ranged from 3.3-6.6% for fish up to 90 mm in length (Yamashita et al. 1985). Gilman (1994) reported a daily ration of 2.95% BW for *A. dubius* adults feeding on *Calanus finmarchius* in July at temperatures similar to those of the PWS in July Evacuation and therefore ration are more dependent on temperature and food quality than on other factors, including size (Arrhenius and Hansson 1994).

The caloric requirements of larval *Ammodytes americanus* appeared to be lower than for other species (Buckley et al. 1984) leading to speculation that sandlance were adapted to survival at low food concentrations. For Pacific sandlance, storage of fats for winter must depend on high levels of feeding throughout summer and fall because they burrow into soft substrates and become dormant during winter (Ciannelli 1997). Digestion time and food storage may be extended in Pacific sandlance to optimize uptake of nutrients from the gut during this period (Ciannelli 1997). Similarly, herring depend on stored energy to survive the winter (Paul 1998), when food abundances are low, but this characteristic may vary among species and regions A high frequency of low level winter feeding continued among 0-age herring (*C. harengus*), while older juveniles had a more seasonal rhythm (De Silva 1973). De Silva (1973) also noted that co-occurring herring and sprat partitioned prey seasonally by having different peak periods of feeding intensity. Paul and Willette (1997) concluded that growth of pink salmon may have been limited by intraspecific, density-dependent competition for food in western PWS, and noted a lack of data on the abundance of other competitors. Adequate growth is critical to pink salmon, which require sufficient energy storage and continued feeding to undergo their migration to the Gulf of Alaska (Perry et al. 1996). Some have speculated, in fact, that this characteristic migration is performed in response to reduced food levels (Healey 1980). For all of these species, the degree of food-limiting, negative interactions and competition experienced in spring and summer could have a profound effect on nutritional status and survival.

The lack of feeding of the sandlance collected in our Knowles Bay diel series is puzzling. Others have reported on regional differences in the oceanographic environment of PWS (Cooney 1995 Cooney and Coyle 1998). We observed that mean densities of plankton in the northeast region were lower than in the other two regions (Table 3). The densities of zooplankton at Cabin Bay station 47 and at Knowles Bay station 80, both collected near high tide at about the same time of day, were close to 3000 organisms$*m^{-3}$. Sandlance feeding was near its peak in Cabin Bay at that time but sandlance stomachs from Knowles Bay were empty. However, they were also empty at other times, when plankton densities were among the lowest observed (1360 and 775 organisms$*m^{-3}$, respectively) in the sound. We cannot explain this observation. If sandlance have a tidal feeding rhythm instead of an endogenous, strictly diel rhythm, then these two sample sets one week apart could exhibit opposite times for peak feeding. If sandlance emergence from substrates and their feeding are regulated by tidal rhythm, we could have missed a feeding period on the incoming tide between 18:00 and 06:00 at Knowles Bay. Winslade (1974) concluded that *A. marinus* activity was controlled both by a light-regulated endogenous diel pattern (emergence at dawn, burial at dusk), and the presence of food. Food was detected visually, not by olfaction, and buried sandlance did not respond to the presence of food. Therefore, low levels of partial emergence and swimming activity that occurred in darkness could lead to feeding at this time.

Declines in the amount of food consumed by sympatric fish compared to allopatric fish (Figure 7) were also unrelated to size (Table 6). Mean sizes of fish at each station were fairly uniform, with typical coefficients of variation < 10% (Table 5). The amount of food consumed by herring sympatric with pink salmon declined from the allopatric condition independently of size (Table 4). Feeding also declined for herring sympatric with sandlance and sandlance sympatric with herring, although they were not different in size than their allopatric counterparts. For pink salmon sympatric with sandlance, a significant increase in number of prey but significant declines in total prey weight, percent body weight, and fullness index occurred. The mean total weight of prey consumed by pink salmon was greater than 20 mg in all cases, roughly half the maximum observed in B.C. pink salmon of similar size (LeBrasseur et al. 1969). Compared to pink salmon 28-58 mm examined from mid-April to mid-June in Southeast Alaska (Bailey et al. 1975), however, the number of prey consumed by the larger pink salmon in our study was at the lower limit of daily consumption when they co-occurred with herring (136) but at the upper limit when they co-occurred with sandlance (544). Southeast prey densities were much higher than we observed, ranging from 9-51$*l^{-1}$ in April to 76-563$*l^{-1}$ in June (Bailey et al. 1975). Although interspecific sizes differed between allopatric and sympatric aggregations of forage fish, and the amount of food declined in all but one case (sandlance sympatric with pink salmon), species' size ranges were similar between categories of aggregations. In almost all cases, the range in measures of fullness varied similarly within and between size classes of fish species in both allopatric and sympatric aggregations. Therefore, declines in measures of food consumption within species in sympatric aggregations do not appear to be an artifact of size differences between allopatric and sympatric forage fish aggregations.

Part of the diel change in prey composition for sandlance could have been size-related and part due to sympatry. The sandlance at station 84 were sympatric with herring, while the other two sets (80 and 88) were allopatric. The fish hand dug from a coarse sand berm at the edge of the water at station 88 were larger than those collected at the other times. This occurred at dawn near low tide, after we failed to catch specimens from a school of smaller sandlance in shallow surface water. Although we sampled the same site, we did not always sample the same school of fish.

Sandlance were the most adaptable of these species when in sympatric aggregations. Sandlance prey utilization shifted when they were sympatric with either pink salmon or herring, but their total food consumption declined only when they were with herring. Sandlance with pink salmon was the only sympatric species combination in which feeding did not decline significantly from the amount consumed in allopatric aggregations. However, sandlance mean stomach fullness was already the lowest observed for these species, suggesting a factor other than competition contributed to the low incidence of feeding in these samples. Pacific sandlance are known to have a longer digestion time and food retention in the gut (Ciannelli 1997).

Juvenile Pacific herring, Pacific sandlance and pink salmon co-occur commonly during spring (Willette et al. In prep) and summer in PWS. Forage fish catches were extremely variable (Table 1) and we did not attempt to account for relative densities of these schooling species. Diets of herring and sandlance were sometimes similar, but pink salmon consumed different prey. All, however, exhibited reduced feeding when sympatric, independently of time of day and fish size. The declines may have been related to reduced prey densities in some cases. Forage species total diets were not greatly similar, but sandlance and herring were more similar than other species pairs. Contrary to other's findings of a specialized diet for sandlance (Simenstad et al. 1979) we found that sandlance were the more adaptive of these species because of their feeding flexibility.

Our findings concerning diet similarity indicate some important ideas about the trophic relationships of these species: 1) that herring and sandlance have similar prey requirements, but when co-occurring in the same prey environment, they tend to partition prey; 2) sandlance shifted prey most readily; and 3) pink salmon and herring adhere to similar diets whether allopatric or sympatric. Diet shifts were generally not disadvantageous in terms of nutritional value. The predominantly crustacean and larvacean prey are all relatively energy dense (Davis et. al 1996). However, total food consumption decreased for all three species when they were sympatric compared to when they were allopatric. This downward shift in feeding occurred even though declines in plankton densities were not consistent and composition did not differ between allopatric and sympatric stations, suggesting that competitive interactions do occur among nearshore forage species. The behavioral interactions which reduce feeding or cause prey shifts in these forage species have not been examined. Competition resulting in a less ideal diet, either in composition or quantity, could lead to lower survival or slower growth. Such effects of competitive interactions among forage fish remain to be tested, but if forage species occur sympatrically frequently enough to suggest that competition is a regulating factor, their interactions could lead to a decrease in the availability of high quality forage species to marine birds and mammals.

ACKNOWLEDGMENTS

This work would not have been possible without the cooperation of many individuals. We appreciate the assistance of APEX investigators, particularly Dr. Lewis Haldorson and Ms. Jennifer Boldt, as well as the vessel captains, biologists and technicians who helped to collect the fish samples used in this diet study. Thanks are also due to Mary Auburn-Cook for her assistance with microscopic analysis.

LITERATURE CITED

Anderson, P. J., J. E. Blackburn, W. R.Bechtol and J. F. Piatt. 1997. Synthesis and analysis of Gulf of Alaska Small-Mesh Trawl Data, 1953 to 1996, and Gulf of Alaska Forage Fish Ichthyoplankton Analysis, 1972 to 1996. *In*: D. C. Duffy (Compiler) APEX Project: Alaska Predator Ecosystem Experiment in Prince William Sound and the Gulf of Alaska. *Exxon Valdez* Oil Spill Restoration Project Annual Report (Restoration Project 96163 A-Q), Alaska Natural Heritage Program and Department of Biology, University of Alaska Anchorage, Alaska.

Anderson, P. J., S. A. Payne, and B. A. Johnson. 1994. Multi-species dynamics and changes in community structure in Pavlof Bay, Alaska, 1972-1992. Unpub. manus., National Marine Fisheries Service, Kodiak, Alaska. 26 pp.

Arrhenius, F. and S. Hansson. 1994. *In situ* food consumption by young-of-the-year Baltic Sea herring *Clupea harengus*: a test of predictions from a bioenergetics mode. Mar. Ecol. Prog. Ser. 110:145-149.

Bailey, J. E., W. L. Wing and C. R. Mattson. 1975. Zooplankton abundance and feeding habits of fry of pink salmon, *Onchorhynchus gorbuscha*, and chum salmon, *O. keta*, in Traitors Cove, Alaska, with speculations on the carrying capacity of the area. Fish Bull. 73(4):846-861.

Bechtol, W. R. 1997. Changes in forage fish populations in Kachemak Bay, Alaska, 1976-1995. Pgs. 441-454 *In*: Forage Fishes in Marine Ecosystems. Proceedings of the International Symposium on the Role of Forage Fishes in Marine Ecosystems. Alaska Sea Grant College Program Report No. 97-01. 816 pgs.

Blackburn, J. E. And P. J. Anderson. 1997. Pacific sand lance growth, seasonal availability, movements, catch variability, and food in the Kodiak-Cook Inlet area of Alaska. Pgs. 409-426 *In*: Proceedings of the International Symposium on the Role of Forage Fishes in Marine Ecosystems. Alaska Sea Grant College Program AK-SG-97-01. 816 pgs.

Boesch, D. F. 1977. Application of numerical classification in ecological investigations of water pollution. Special Scientific Rep. No. 77, Virginia Institute of Marine Science, EPA-600/3-77-033. 114 pp.

Boldt, J. L. 1997. Condition and distribution of forage fish in Prince William Sound, Alaska. Unpub. MS Thesis, University Of Alaska, Fairbanks. 155 pp.

Campbell, D. E. and J. J. Graham. 1991. Herring recruitment in Maine coastal waters: an ecological model. Can. J. Fish. Aquat. Sci. 48:448-471.

Ciannelli, L. 1997. Winter dormancy in the Pacific sand lance (*Ammodytes hexapterus*) in relation to gut evacuation time. Pgs. 95-104 *In*: Forage Fishes in Marine Ecosystems. Proceedings of the International Symposium on the Role of Forage Fishes in Marine Ecosystems. Alaska Sea Grant College Program Report No. 97-01. 816 pgs.

Conover, W. J. 1980. Practical Nonparametric Statistics, 2nd ed. Wiley and Sons. 493 pgs.

Cooney, R. T. 1993. A theoretical evaluation of the carrying capacity of Prince William Sound, Alaska for juvenile Pacific salmon. Fish. Res. 18:1-17.

Cooney, R. T. and K. O. Coyle. 1996. The role of zooplankton in the Prince William Sound Ecosystem. Project 95320-H Annual Report. EVOS Trustee Council.

Cooney, R. T. 1998. SEA: The role of zooplankton in the Prince William Sound Ecosystem. Abstracts of 1997 Restoration Projects. *Exxon Valdez* Oil Spill Trustee Council 1998 Restoration Workshop, January 29-30, Anchorage, Alaska.

Coyle, K. O. and A. J. Paul. 1992. Interannual differences in prey taken by capelin, herring, and red salmon relative to zooplankton abundance during the spring bloom in a southeast Alaskan embayment. Fish. Oceanogr. 1(4):294-305.

Craig, P. C. 1984. Fish use of coastal waters of the Alaskan Beaufort Sea: A review. Trans. Amer. Fish. Soc. 113:265-282.

Craig, P. 1987. Forage fishes in the shallow waters of the North Aleutian Shelf. Pp. 49-54 *In*: Proceedings of the Conference on Forage Fishes of the Southeastern Bering Sea. Anchorage, Alaska, November 4-5, 1986. MMS Rep. 87-0017. 116 pgs.

Cross, J. N., K. L. Fresh, B. S. Miller, C. A. Simenstad, S. N. Steinfort, and J. C. Fegley. 1978. Nearshore fish and macro-invertebrate assemblages along the Strait of Juan de Fuca including food habits of common nearshore fish. Univ. Washington, Fis. Res. Inst. Ann. Rep. FRI-UW-7818. 188 pgs.

Davis, N. D., K. W. Myers, and Y. Ishida. 1997. Caloric value of high-seas salmon prey organisms and simulated salmon ocean growth and prey consumption. NPAFC Doc. Fisheries Research Institute, Univ. Of Washington, Box 357980, Seattle WA 981995-7980, USA. 19 pgs. + tables.

De Silva, S. S. 1973. Food and feeding habits of the herring *Clupea harengus* and the sprat *C. sprattus* in inshore waters of the west coast of Scotland. Mar. Biol. 20:282-290.

Digby, P. G. N. And R. A. Kempton. 1987. Multivariate Analysis of Ecological Communities. Chapman and Hall, London.

Dwyer, D. A., K. M. Bailey, and P. A. Livingston. 1987. Feeding habits and daily ration of walleye pollock (*Theragra chalcogramma*) in the eastern Bering Sea, with special reference to cannibalism. Can. J Fish. Aquat. Sci. 44: 1972-1984.

Field, L. J. 1988. Pacific sand lance, *Ammodytes hexapterus*, with notes on related *Ammodytes* species. p. 15-33 *In*: N. J. Wilimovsky, L. S. Incze and S. J. Westrheim, (eds.) Species Synopses: Life Histories of Selected Fish and Shellfish of the Northeast Pacific and Bering Sea. Washington Sea Grant Program and Fisheries Research Institute, Univ. Washington, Seattle. # pgs.

Gilman, S. L. 1994. An energy budget for northern sand lance, *Ammodytes dubius*, on Georges Bank, 1977-1986. Fish. Bull. 92:647-654.

Gordon, D. K. And C. D. Levings. 1984. Seasonal changes of inshore fish populations on Sturgeon and Roberts Bank, Fraser River Estuary British Columbia. Can. Tech. Rep. of Fish. and Aquatic Sci. No. 1240. 81 pgs.

Gotceitas, V., S. Fraser and J. A. Brown. 1995. Habitat use by juvenile Atlantic cod (*Gadus morhua*) in the presence of an actively foraging and non-foraging predator. Mar. Biol. 123:421-430.

Grover, J. J. 1991. Trophic relationship of age-0 and age-1 walleye pollock, *Theragra chalcogramma*, from the Gulf of Alaska in 1987. Fish Bull., U. S. 88:463-470.

Haegele, C. W. 1996. The occurrence, abundance, and food of juvenile herring and salmon in the Strait of Georgia, British Columbia in 1990 to 1994. Can. Manuscr. Rep. Fish. Aquat. Sci. 2064, 236 pp.

Haldorson, L. 1995. Fish net sampling. pgs. 55-83 *In*: Forage Fish Study in Prince William Sound, Alaska. *Exxon Valdez* Oil Spill Restoration Project 94163A Annual Report, University of Alaska Fairbanks, September, 1995. 208 p.

Haldorson, L. J., T. C. Shirley and K. C. Coyle. 1996. Biomass and distribution of forage species in Prince William Sound. *In*: D. C. Duffy (Compiler). APEX Project: Alaska Predator Ecosystem Experiment in Prince William Sound and the Gulf of Alaska. *Exxon Valdez* Oil Spill Restoration Project Annual Report (Restoration Project 95163 A-Q), Alaska Natural Heritage Program and Department of Biology, University of Alaska Anchorage, Alaska.

Haldorson, L., T. Shirley , K. Coyle and R. Thorne. 1997. Forage species studies in Prince William Sound. Project 96163A Annual Report *In*: D. C. Duffy (Compiler). APEX Project: Alaska Predator Ecosystem Experiment in Prince William Sound and the Gulf of Alaska. *Exxon Valdez* Oil Spill Restoration Project Annual Report (Restoration Project 96163 A-Q), Alaska Natural Heritage Program and Department of Biology, University of Alaska Anchorage, Alaska.

Hatch, S. A., G. V. Byrd, D. B. Irons, and G. L. Hunt. 1993. Status and ecology of kittiwakes in the North Pacific Ocean. Pages 140-153 *In*: K. Vermeer, K. T. Briggs, K. H. Morgan and D. Siegel-Causey, eds. The status, ecology, and conservation of marine birds of the North Pacific. Can. Wildl. Serv. Spec. Publ., Ottawa, Canada.

Hattori, H. 1989. Bimodal vertical distribution and diel migration of the copepods *Metridia pacifica, M. okhotensis* and *Pleuromamma scutullata* in the western North Pacific Ocean. Mar. Biol. 103:39-50.

Healey, M. C. 1980. The ecology of juvenile salmon in Georgia Strait, British Columbia. Pgs. 203-229 *In*: W. J. McNeil and D. C. Himsworth (eds). Salmonid Ecosystems of the North Pacific. Oregon State Univ. Press, Corvallis. 331 pgs.

Healey, M. C. 1991. Diets and feeding rates of juvenile pink, chum, and sockeye salmon in Hecate Strait, British Columbia. Trans. Am. Fish. Soc. 120:303-318.

Heard, W. R. 1991. Life history of pink salmon (*Oncorhynchus gorbuscha*). Pg. 119-230 *In*: C. Groot and L. Margolis (eds.). Pacific Salmon Life Histories. Univ. British Columbia Press, Vancouver. 564 pgs.

Heard, W. R. 1998. Do hatchery salmon affect the North Pacific Ocean ecosystem? N. Pac. Anadr. Fish Comm. Bull. No. 1: 405-411.

Hobson, E. S. 1986. Predation on the Pacific sand lance *Ammodytes hexapterus* (Pisces: Ammodytidae), during the transition between day and night in southeastern Alaska. Copeia 1:223-226.

Irons, D. B. 1996. Size and productivity of black-lgged kittiwake colonies in Prince William Sound, Alaska before and after the *Exxon Valdez* oil spill. Pgs. 738-747 *In*: S. D. Rice, R. B. Spies, D. A. Wolfe, and B. A. Wright (eds.), *Exxon Valdez* Oil Spill Symposium Proceedings. American Fisheries Society Symposium Number 18. American Fisheries Society, Bethesda, Maryland. 931 pgs.

Ivlev, V. S. 1961. Experimental Ecology of the Feeding of Fishes. Yale University Press, New Haven, CT. 302 pgs.

Johnson, M. W. 1934. The developmental stages of the copepod *Epilabidocera amphitrites* (= *E. longipedata*) McMurrich. Biol. Bull. 67(3):466-483.

Kask, B. And J. Sibert. 1976. A laboratory method for the analyses of fish stomach contents. Pp. 77-79 *In*: C. A. Simenstad and S. J. Lipovsky, eds. Fish Food Habits Studies. Proceedings of the First Pacific Northwest Technical workshop. Astoria, Oregon, October 13-15, 1976. Wash. Sea Grant Pub. 193 pp.

Koster, F. W. And C. Mollmann. 1997. Predation by sprat and herring on early life stages of cod and sprat in the central Baltic. Pgs. 41-68 *In*: Forage Fishes in Marine Ecosystems. Proceedings of the International Symposium on the Role of Forage Fishes in Marine Ecosystems. Alaska Sea Grant College Program Report No. 97-01. 816 pgs.

Krebs, C. J. 1989. Ecological Methodology. Harper and Row, New York. 654 pgs.

LeBrasseur, R. J., W. E. Barraclough, O. D. Kennedy and T. R. Parsons. 1969. Production studies in the Strait of Georgia. Part III. Observations on the food of larval and juvenile fish in the Fraser River plume, February to May, 1967. J. Exp. Mar. Biol Ecol 3:51-61.

Miller, B. C., C. A. Simenstad, J. N. Cross, K. L. Fresh, and S. N. Steinfort. 1980. Nearshore fish and macroinvertebrate assemblages along the Strait of Juan de Fuca including food habits of the common nearshore fish: Final report of three years sampling. U.S. Envir. Protection Agency, 600/7-80-027. 211 pgs.

McGurk, M. D. and Warburton. 1992. Fisheries Oceanography of the Southeast Bering Sea: Relationships of growth, dispersion and mortality of sand lance larvae to environmental conditions in the Port Moller Estuary. OCS Study MMS 92-0019, U. S. Dept. Interior.

Meyer, T. L., R. A. Cooper and R. W. Langton. 1979. Relative abundance, behavior, and food habits of the American sand lance, *Ammodytes americanus*, from the Gulf of Maine. Fish. Bull 77(1):243-253.

Mortensen, D.M. 1983. Laboratory studies on factors influencing the first feeding of newly emerged pink salmon (*Oncorhynchus gorbuscha*) fry. Unpub. M. S. Thesis, Univ. Alaska, Juneau. 108 pgs.

Norcross, B. L., K. D. E. Stokesbury, E. D. Brown and R. J. Foy. 1998. Juvenile Pacific herring growth and habitat. Abstracts of 1997 Restoration Projects. *Exxon Valdez* Oil Spill Trustee Council 1998 Restoration Workshop, January 29-30, Anchorage, Alaska.

Oakley, K. L. and K. J. and Kuletz. 1996. Population, reproduction and foraging of pigeon guillemots at Naked Island, Alaska, before and after the *Exxon Valdez* oil spill. Pgs. 759-770 *In*: S. D. Rice, R. B. Spies, D. A. Wolfe, and B. A. Wright (eds.), *Exxon Valdez* Oil Spill Symposium Proceedings. American Fisheries Society Symposium Number 18. American Fisheries Society, Bethesda, Maryland. 931 pgs.

Orsi, J. A. And J. H. Landingham. 1985. Numbers, species and maturity stages of fish captured with beach seines during spring 1981 and 1982 in some nearshore marine waters of southestern Alaska. NOAA Tech. Memo. NMFS F/NWC-86. 34 pgs.

Parsons, T. R. And R. J. LeBrasseur. 1973. The availability of food to different trophic levels in the marine food chain. Pgs. 325-343 *In*: J. H. Steel (ed.), Marine Food Chains. Univ. California Press, 552 pgs.

Paul, A. J. 1998. SEA: Fish Energetics. Abstracts of 1997 Restoration Projects. *Exxon Valdez* Oil Spill Trustee Council 1998 Restoration Workshop, January 29-30, Anchorage, Alaska.

Paul, A J. and M. Willette. 1997. Geographical variation in somatic energy content of migrating pink salmon fry from Prince William Sound: A tool to measure nutritional status. Pgs. 707-720 *In*: Forage Fishes in Marine Ecosystems. Proceedings of the International Symposium on the Role of Forage Fishes in Marine Ecosystems. Alaska Sea Grant

College Program Report No. 97-01. 816 pgs.

Piatt, J. F. and P. Anderson. 1996. Response of common murres to the *Exxon Valdez* oil spill and long-term changes in the Gulf of Alaska marine ecosystem. Pgs. 720-737 *In*: S. D. Rice, R. B. Spies, D. A. Wolfe, and B. A. Wright (eds.). Exxon Valdez Oil Spill Symposium Proceedings. American Fisheries Society Symposium Number 18. American Fisheries Society, Bethesda, Maryland. 931 pgs.

Purcell, J. E. and J. J. Grover. 1990. Predation and food limitation as causes of mortality in larval herring at a spawning ground in British Columbia. Mar. Ecol. Prog. Ser. 59:55-61.

Richards, S. W. 1976. Mixed species schooling of postlarvae of *Ammodytes hexapterus* and *Clupea harengus harengus*. J. Fish. Res. Board Can. 33: 843-844.

Robards, M. D. And J. F. Piatt. 1997. Temporal and geographic variation of fish populations in nearshore and shelf areas of lower Cook Inlet, Alaska. Project 96163M *In*: D. C. Duffy (Compiler). APEX Project: Alaska Predator Ecosystem Experiment in Prince William Sound and the Gulf of Alaska. *Exxon Valdez* Oil Spill Restoration Project Annual Report (Restoration Project 96163 A-Q), Alaska Natural Heritage Program and Department of Biology, University of Alaska Anchorage, Alaska.

Rogers, D. E., D. J. Rabin, B. J. Rogers, K. J. Garrison, and M. E. Wangerin. 1979. Seasonal composition and food web relationships of marine organisms in the nearshore zone of Kodiak Island including ichthyoplankton, meroplanktono (shellfish), zooplankton, and fish. Univ. Washington, Fish. Res. Inst. Final Rep. FRI-UW-7925. 291 p.

Rogers, D. E., B. J. Rogers, and R. J. Rosenthal. 1986. The nearshore fishes. Pgs. 399-415 *In*: D. W. Hood and S. T. Zimmerman (eds.). The Gulf of Alaska: Physical Environment and Biological Resources. OCS MMS 86-90095, U.S. Gov. Printing Office. 655 pgs.

Schweigert, J. F. 1997. Role of Pacific herring in the British Columbia marine ecosystem. Pgs. 655-681 *In*: Forage Fishes in Marine Ecosystems. Proceedings of the International Symposium on the Role of Forage Fishes in Marine Ecosystems. Alaska Sea Grant College Program Report No. 97-01. 816 pgs.

Scott, J. S. 1973. Food and inferred feeding behavior of northern sand lance (*Ammodytes dubius*). J. Fish. Res. Board Can. 30:451-454.

Sekiguchi, H., M. Nagoshi, K. Horiuchi and N. Nakanishi. 1976. Feeding, fat deposits and growth of sand-eels in Ise Bay, Central Japan. Bull. Jap. Soc. Sci. Fish. 42(8):831-835.

Simenstad, C. A., B. S. Miller, C. F. Nyblade, K. Thornburgh and L. J. Bledsoe. 1979. Food web relationships of northern Puget Sound and the Strait of Juan de Fuca: A synthesis of available knowledge. NOAA Interagency Energy/Environment R&D Program Report EPA-600/7-79-259. 334 pgs.

Smigielski, A. S., T. A. Halavik, L. J. Buckley, S. M. Drew and G. C. Laurence. 1984. Spawning, embryo development and growth of the American sand lance *Ammodytes americanus* in the laboratory. Mar. Ecol. Prog. Ser. 14:287-292.

Sogard, S. M. 1994. Use of suboptimal foraging habitats by fishes: consequences to growth and survival. p. 103-132 *In*: D. J. Stouder, K. L. Fresh, and R. J. Feller (eds.). Theory and application in fish feeding ecology. University of South Carolina Press, Columbia, South Carolina. 390 p.

Sturdevant, M. V., A. C. Wertheimer, and J. L. Lum. 1996. Diets of juvenile pink and chum salmon in oiled and non-oiled nearshore habitats in Prince William Sound, 1989 and 1990. Pgs. 564-592 *In*: S. D. Rice, R. B. Spies, D. A. Wolfe, and B. A. Wright (eds.). *Exxon Valdez* Oil Spill Symposium Proceedings. American Fisheries Society Symposium Number 18. American Fisheries Society, Bethesda, Maryland. 931 pgs.

Wieser, W. 1960. Benthic studies in Buzzards Bay: II. The meiofauna. Limnol. Oceanog. 5(2):121-137.

Willette, T. M. 1996. Impacts of the Exxon Valdez Oil Spill on the migration, growth, and survival of juvenile pink salmon in Prince William Sound. Pgs. 533-550 *In*: Rice, S. D., R. B. Spies, D. A. Wolfe, and B. A. Wright (eds.). *Exxon Valdez* Oil Spill Symposium Proceedings. American Fisheries Society Symposium Number 18. American Fisheries Society, Bethesda, Maryland. 931 pgs.

Willette, T. M., M. V. Sturdevant, S. Jewitt and E. Debevec. 1995. Forage fish influence on recovery of injured species: forage fish diet overlap. *Exxon Valdez* Oil Spill Restoration Project 94163 Annual Report, Alaska Dept. Fish Game. 105 p.

Willette, M., M. Sturdevant and S. Jewett. 1997. Prey resource partitioning among several species of forage fish in Prince William Sound, Alaska. Pgs. 11-29 *In*: Forage Fishes in Marine Ecosystems. Proceedings of the International Symposium on the Role of Forage Fishes in Marine Ecosystems. Alaska Sea Grant College Program Report No. 97-01. 816 pgs.

Willette, T. M., M. V. Sturdevant, and S. Jewitt. In prep. Seasonal changes in prey resource partitioning among several species of forage fish in Prince William Sound, Alaska.

Winslade, P. 1974. Behavioural studies on the lesser sandeel *Ammodytes marinus* (Raitt) I. The effect of food availability on activity and the role of olfaction in food detection. J. Fish Biol. 6:565-576.

Yamashita, Y., D. Kitagawa and T. Aoyama. 1985. Diel vertical migration and feeding rhythm of the larvae of the Japanese Sand-eel *Ammodytes personatus*. Bull. Jap. Soc. Sci. Fish. 51(1):1-5.

Table 1. Sample area, location, date, sampling time, times at low and high tide, and numbers of fish caught at stations with allopatric and sympatric aggregations of juvenile Pacific herring, Pacific sandlance, and pink salmon in PWS during July, 1996. Samples from stations C and F were collected by the PIGU project outside the APEX survey sites. Stations with the letter "D" were part of the diel sample series. Gear type: BS = beach seine , PS = purse seine, Cast=cast net, Hand=hand dug.

Fish station	Zoop. station	Gear type	Sample area	Location	Transect leg	Day-Month	Sample time	High tide	Low tide	Number caught
Pacific Herring										
				Allopatric						
14-1B	14-P	BS	South	W. of Pt. Countess	S1002	17-July	10:10	15:48	9:16	13
47-2S	60-P	Cast	North	NE Bligh Island	N1703A	23-July	17:30	7:26	12:45	414
47-5U	60-P	PS	North	NE Bligh Island	N1703A	23-July	16:15	7:26	12:45	176
54-1B	54-P	BS	North	Galena Bay W. of Narrows	N1904	23-July	11:10	7:26	12:45	17
61-1B	61-P	BS	North	W. Landlocked Bay Bidarka Pt.	N1302	24-July	11:45	8:15	13:39	95
68-1B	68-P	BS	North	E. Porcupine Pt.	N0704	25-July	10:40	9:40	14:48	10
68-5U	68-P	PS	North	Goose Island, off Porcupine Pt.	N0701B	26-July	19:00	11:00	16:09	234
79-1B-D1	79-P	BS	North	Knowles Bay	N0505	27-July	9:55	11:56	5:31	303
87-1B-D4	87-P	BS	North	Knowles Bay	N0505	28-July	4:40	12:52	6:24	88
C-?-15	48-P	BS	Central	NW Naked Is., E. Bob Day Bay	C0701	22-July	---	12:12	18:47	90
				Sympatric with pink salmon						
03-2U	10-P	PS	South	Prince of Wales Passage	S0604	16-July	15:48	15:18	8:43	650
10-1B	10-P	BS	South	Bainbridge Pt.	S0805	16-July	15:30	15:18	8:43	430
20-1B	20-P	BS	South	Paddy Bay	S1609	17-July	18:42	15:48	9:16	56
24-1B	24-P	BS	South	Italian Bay, SW Knight Is.	S2008	18-July	13:00	16:19	9:50	48
				Sympatric with sandlance						
18-2U	29-P	PS	Central	Bay of Isles, E. Knight Is.	C0105B	19-July	12:30	16:50	10:20	1300
60-1B	60-P	BS	North	West Bligh Is.	N1507	24-July	9:50	8:15	13:39	32000
72-1B	71-P	BS	North	Knowles Bay/Red Head	N0505	25-July	15:20	9:40	14:48	595
84-1B-D2	84-P	BS	North	Knowles Bay/Red Head	N0506	27-July	18:00	23:29	17:21	9
Pacific Sandlance										
				Allopatric						
11-2B	11-P	BS	South	inside Bainbridge Pt.	S0806	16-July	17:40	15:18	8:43	33
11-2B	11-P	BS	South	inside Bainbridge Pt.	S0806	16-July	17:40	15:18	8:43	33
47-1B	47-P	BS	Central	S. Cabin Bay	C0705	22-July	9:55	18:47	11:59	50
63-1B	63-P	BS	North	Boulder Bay (inside Bidarka Pt.)	N1306	24-July	13:35	8:15	13:39	52
64-2B	64-P	BS	North	Irish Cove, Port Fidalgo	N0905	24-July	15:20	8:15	13:39	579
66-1B	66-P	BS	North	Port Fidalgo	N0909	24-July	18:05	8:15	13:39	127
80-1B-D1	80-P	BS	North	Knowles Bay/Red Head	N0506	27-July	11:10	11:56	5:31	11000
82-1B-D2	82-P	BS	North	West Bligh Is.	N1507	27-July	15:00	11:56	17:21	11
88-1X-D4	88-P	Hand	North	Knowles Bay/Red Head	N0506	28-July	6:35	12:52	6:24	16
F-1-D8	47-P	BS	Central	Cabin Bay, Naked Is., "Fuel Cache"	C0704	21-July	19:55	18:02	11:33	12
F-1-D12	47-P	BS	Central	Cabin Bay, Naked Is., "Fuel Cache"	C0704	22-July	8:00	5:59	12:12	15
F-2-D13	47-P	BS	Central	Cabin Bay, Naked Is., "Fuel Cache"	C0704	22-July	12:10	5:59	12:12	17
F-1-D15	47-P	BS	Central	Cabin Bay, Naked Is., "Fuel Cache"	C0704	22-July	16:05	18:47	12:12	32
F-2-D16	47-P	BS	Central	Cabin Bay, Naked Is., "Fuel Cache"	C0704	22-July	20:15	18:47	0:07	15
				Sympatric with Herring						
18-2U	29-P	PS	Central	Bay of Isles, E. Knight Is.	C0105B	19-July	12:30	16:50	10:20	28
60-1B	60-P	BS	North	West Bligh Is.	N1507	24-July	9:50	8:15	13:39	600
71-1B	71-P	BS	North	Knowles Bay/Red Head	N0506	25-July	14:30	9:40	14:48	13500
84-1B-D2	84-P	BS	North	Knowles Bay/Red Head	N0506	27-July	18:00	23:29	17:21	17
				Sympatric with Pink Salmon						
48-1B	48-P	BS	Central	Pt. off N. arm of Cabin Bay	C0701	22-July	10:50	18:47	11:59	151
Pink Salmon										
				Allopatric						
49-1B	49-P	BS	Central	S. Storey Island	C0608	22-July	12:10	18:47	11:59	137
53-1B	53-P	BS	North	N. Galena Bay	N1908	23-July	9:00	7:26	12:45	67
58-2U	68-P	PS	North	Outer Port Fidalgo, Porcupine	N0901A	25-July	13:30	9:40	14:48	61
				Sympatric with Herring						
03-2U	10-P	PS	South	Prince of Wales Passage	S0604	16-July	15:48	15:18	8:43	78
03-2U	10-P	PS	South	Prince of Wales Passage	S0604	16-July	15:48	15:18	8:43	78
10-1B	10-P	BS	South	Bainbridge Pt.	S0805	16-July	15:30	15:18	8:43	199
10-1B	10-P	BS	South	Bainbridge Pt.	S0805	16-July	15:30	15:18	8:43	199
20-1B	20-P	BS	South	Paddy Bay	S1609	17-July	18:42	15:48	9:16	46
24-1B	24-P	BS	South	Italian Bay, SW Knight Is.	S2008	18-July	13:00	16:19	9:50	25
				Sympatric with Sandlance						
48-1B	48P	BS	Central	Pt. off N. arm Cabin Bay	C0701	22-July	10:50	18:47	11:59	64

Table 2. Species associations of juvenile Pacific herring, Pacific sandlance and pink salmon from PWS in July, 1996 as (a) total number of APEX stations catching forage fish, (b) percent frequency of occurrence of sympatric species, and (c) number of sets analyzed for diet study. Two species were classified as sympatric if any were present together, however, not all stations yielded samples sizes large enough to analyze both. Allopatric fish are indicated by shaded cells.

(a) Number of sets with species present

	Second species		
First species	Herring	Sandlance	Pink Salmon
Herring	39	8	13
Sandlance	8	22	9
Pink Salmon	13	9	34

(b) Percent frequency of sympatric sets

	Second species		
First species	Herring	Sandlance	Pink Salmon
Herring	--	20.5	33.3
Sandlance	36.4	--	40.9
Pink Salmon	38.2	26.5	--

(c) Number of sets analyzed

	Second species		
First species	Herring	Sandlance	Pink Salmon
Herring	10	4	4
Sandlance	4	14	1
Pink Salmon	6	1	3

Table 3. Zooplankton density (numbers*m^{-3}) and biomass (mg*m^{-3} wet weight) available to juvenile Pacific herring, Pacific sandlance and pink salmon at stations corresponding to allopatric and sympatric aggregations sampled in PWS during July, 1996. Values in parentheses are standard deviations of the means. Replicate zooplankton samples were collected in 20 m vertical hauls using a 0.5 m diameter ring net with 243 μm mesh.

Zooplankton Station	Total Density		Total Biomass		Gear Depth (m)	Date	Time
Pacific Herring							
			Allopatric				
14-P	3723.3	(577.8)	300.7	(62.7)	20	17-Jul-96	10:40
48-P	3642.0	(376.0)	223.1	(76.5)	20	22-Jul-96	11:05
54-P	1680.2	(63.7)	389.4	(322.3)	20	23-Jul-96	11:35
60-P	1989.2	(182.0)	168.9	(3.0)	20	24-Jul-96	10:10
61-P	2406.4	(321.6)	345.7	(48.6)	20	24-Jul-96	12:00
68-P	6641.5	(270.5)	526.0	(10.1)	8	25-Jul-96	10:55
79-P	3432.7	(229.8)	358.2	(35.0)	10	27-Jul-96	10:20
87-P	645.0	(27.7)	93.0	(2.0)	20	28-Jul-96	5:30
Grand mean	**3020.0**		**300.6**				
			Sympatric with pink salmon				
10-P	2501.0	(198.6)	239.5	(55.0)	20	16-Jul-96	16:20
20-P	3242.9	(1438.7)	166.1	(45.6)	20	17-Jul-96	18:55
24-P	3099.1	(817.1)	221.7	(67.8)	20	18-Jul-96	13:30
Grand mean	**2947.7**		**209.1**				
			Sympatric with sandlance				
29-P	2907.2	(467.3)	238.6	(1.1)	20	19-Jul-96	16:55
60-P	1989.2	(182.0)	168.9	(3.0)	20	24-Jul-96	10:10
71-P	950.9	(160.6)	94.9	(8.7)	20	25-Jul-96	15:35
84-P	1359.9	(132.0)	87.6	(2.2)	20	27-Jul-96	18:38
Grand mean	**1801.8**		**147.5**				
Pacific Sandlance							
			Allopatric				
11-P	2481.2	(283.2)	198.7	(53.0)	20	16-Jul-96	18:15
47-P	2798.2	(461.9)	229.0	(99.1)	20	22-Jul-96	10:10
63-P	3042.5	(472.5)	264.9	(3.2)	20	24-Jul-96	13:50
64-P	3046.9	(241.6)	412.5	(115.3)	20	24-Jul-96	15:30
66-P	2742.1	(254.6)	311.2	(46.8)	20	24-Jul-96	18:20
80-P	3163.1	(612.8)	226.3	(13.9)	20	27-Jul-96	11:55
82-P	1084.0	(306.1)	138.9	(71.2)	20	27-Jul-96	15:15
88-P	774.6	(112.7)	101.5	(45.1)	20	28-Jul-96	6:58
Grand mean	**2391.6**		**235.4**				
			Sympatric with Herring				
29-P	2907.2	(467.3)	238.6	(1.1)	20	19-Jul-96	16:55
60-P	1989.2	(182.0)	168.9	(3.0)	20	24-Jul-96	10:10
71-P	950.9	(160.6)	94.9	(8.7)	20	25-Jul-96	15:35
84-P	1359.9	(132.0)	87.6	(2.2)	20	27-Jul-96	18:38
Grand mean	**1801.8**		**147.5**				
			Sympatric with Pink Salmon				
48-P	3642.0	(376.0)	223.1	(76.5)	20	22-Jul-96	11:05
Pink Salmon							
			Allopatric				
49-P	4029.0	(852.4)	372.0	(236.7)	20	22-Jul-96	12:20
53-P	1918.0	(404.1)	189.0	(61.0)	20	23-Jul-96	10:30
68-P	6641.5	(270.5)	526.0	(10.1)	8	25-Jul-96	10:55
Grand mean	**4196.2**		**362.3**				
			Sympatric with Herring				
10-P	2501.0	(198.6)	239.5	(55.0)	20	16-Jul-96	16:20
20-P	3242.9	(1438.7)	166.1	(45.6)	20	17-Jul-96	18:55
24-P	3099.1	(817.1)	221.7	(67.8)	20	18-Jul-96	13:30
Grand mean	**2947.7**		**209.1**				
			Sympatric with Sandlance				
48-P	3642.0	(376.0)	223.1	(76.5)	20	22-Jul-96	11:05

Table 4. Number of fish examined, size class, mean preserved fork length (FL), mean numbers and weights of prey consumed, stomach fullness, number empty, and prey percent body weight of sets of allopatric and sympatric juvenile herring, sandlance and pink salmon at stations in PWS during July 1996. Values in parentheses are standard deviations of the means.

Fish station	Number examined	Size class	FL (mm)		Body weight (g)		Number of Prey		Prey Weight (mg)		Fullness Index		Number empty	Prey % Body Weight	
Pacific Herring															
							Allopatric								
14-1B	10	1	99.7	(10.7)	6.6	(2.2)	59.6	(62.8)	3.9	(4.7)	2.7	(0.8)	1	0.8	(0.6)
47-2S	10	0	55.1	(2.1)	0.9	(0.1)	2507.9	(701.5)	193.7	(86.0)	6.8	(0.4)	0	6.4	(1.8)
47-5U	10	1	115.3	(5.5)	13.3	(2.0)	5249.5	(2995.4)	234.0	(107.4)	5.8	(0.8)	0	2.2	(0.8)
54-1B	10	0	30.4	(2.0)	0.1	(0.0)	28.1	(44.5)	0.7	(1.1)	2.9	(2.0)	2	0.0	(0.0)
61-1B	10	0	40.5	(2.9)	0.4	(0.1)	372.8	(154.5)	12.3	(8.4)	4.9	(1.6)	0	1.4	(0.6)
68-1B	10	0	49.3	(3.2)	0.5	(0.1)	532.4	(278.9)	39.2	(20.4)	4.7	(1.1)	0	2.1	(0.8)
68-5U	10	1	130.1	(8.1)	19.5	(3.9)	680.0	(687.0)	339.0	(162.0)	3.5	(0.7)	0	0.8	(0.2)
79-1B-D1	10	0	44.8	(2.7)	0.5	(0.1)	608.4	(361.6)	102.3	(118.0)	5.9	(0.9)	0	2.3	(1.2)
87-1B-D4	10	0	42.1	(2.3)	0.4	(0.1)	179.8	(62.0)	10.6	(6.6)	5.0	(0.9)	0	1.3	(0.4)
C-?-15	10	0	37.8	(2.3)	0.2	(0.1)	492.6	(225.0)	13.1	(5.7)	5.4	(1.1)	0	1.3	(0.6)
							Sympatric with pink salmon								
03-2U	10	2	191.3	(10.0)	68.6	(15.3)	598.8	(364.1)	667.3	(519.8)	4.8	(0.9)	0	0.9	(0.4)
10-1B	10	0	38.2	(4.4)	0.2	(0.1)	22.0	(27.3)	1.0	(1.9)	2.8	(1.5)	1	0.1	(0.2)
20-1B	10	1	113.5	(11.6)	12.3	(4.3)	117.3	(255.9)	4.5	(8.9)	2.7	(1.8)	4	1.4	(2.1)
24-1B	10	0	105.9	(7.3)	9.0	(2.1)	31.9	(63.9)	6.5	(9.3)	1.7	(0.5)	3	0.2	(0.2)
							Sympatric with sandlance								
18-2U	9	1	125.6	(12.7)	17.0	(6.3)	402.2	(328.2)	42.4	(27.8)	2.8	(0.7)	1	0.2	(0.1)
60-1B	10	0	47.6	(4.3)	0.5	(0.2)	343.3	(194.6)	11.8	(6.7)	5.2	(1.0)	0	2.9	(1.2)
72-1B	10	0	46.3	(3.9)	0.5	(0.1)	679.7	(580.4)	22.6	(12.8)	4.8	(1.0)	0	1.8	(0.6)
84-1B-D2	9	0	33.2	(1.2)	0.1	(0.0)	44.2	(42.7)	1.6	(1.3)	3.1	(1.2)	1	0.5	(0.4)
Pacific Sandlance															
							Allopatric								
11-2B	10	0	72.3	(8.1)	1.3	(0.4)	971.4	(220.6)	51.2	(14.0)	4.8	(0.4)	0	2.2	(0.6)
11-2B	10	1	134.6	(7.2)	11.4	(4.3)	3244.8	(1496.5)	355.8	(254.9)	5.1	(0.3)	0	2.2	(1.2)
47-1B	10	0	86.5	(5.8)	1.8	(0.5)	76.0	(166.0)	5.3	(12.3)	2.1	(1.4)	4	0.3	(0.5)
63-1B	9	0	88.9	(10.3)	2.2	(0.8)	423.9	(536.6)	31.6	(41.5)	3.4	(2.2)	1	0.5	(0.5)
64-2B	10	0	65.8	(3.4)	0.7	(0.1)	1118.2	(802.0)	68.2	(60.0)	4.5	(1.1)	0	1.5	(0.6)
66-1B	10	0	95.9	(6.2)	2.8	(0.5)	2182.9	(1600.3)	179.0	(178.0)	5.6	(1.4)	0	1.6	(0.9)
80-1B-D1	10	0	75.5	(8.7)	1.2	(0.4)	31.1	(43.1)	0.9	(1.2)	2.5	(0.7)	0	0.3	(0.2)
82-1B-D2	10	0	78.4	(7.8)	1.3	(0.4)	690.6	(542.6)	35.5	(27.9)	4.9	(1.3)	0	1.1	(0.6)
88-1X-D4	10	1	109.6	(10.1)	4.0	(1.7)	0.8	(1.2)	0.4	(0.7)	1.4	(0.5)	6	0.2	(0.2)
F-1-D8	10	0	68.9	(6.8)	0.9	(0.2)	313.4	(617.0)	15.6	(34.5)	2.6	(2.0)	4	0.6	(1.3)
F-1-D12	10	1	114.1	(15.2)	5.4	(2.0)	975.3	(673.5)	63.3	(43.6)	5.5	(1.4)	0	1.1	(0.5)
F-2-D13	10	0	61.1	(6.6)	0.7	(0.2)	616.2	(547.9)	30.0	(16.0)	5.3	(1.3)	0	1.2	(0.9)
F-1-D15	10	0	73.5	(6.0)	1.1	(0.3)	849.9	(644.1)	37.7	(34.4)	4.6	(1.3)	0	0.5	(0.3)
F-2-D16	10	0	72.4	(7.3)	1.1	(0.5)	78.1	(186.4)	3.3	(7.9)	2.3	(1.3)	1	0.2	(0.1)
							Sympatric with Herring								
18-2U	10	1	111.8	(6.2)	5.5	(1.0)	2120.0	(510.5)	145.9	(35.9)	4.7	(0.5)	0	2.1	(0.6)
60-1B	10	0	71.6	(5.7)	0.9	(0.3)	71.3	(103.9)	5.5	(9.2)	2.8	(1.5)	1	0.7	(0.6)
71-1B	10	0	76.1	(4.1)	1.2	(0.2)	111.5	(223.5)	4.8	(10.0)	2.2	(1.4)	4	0.4	(0.6)
84-1B-D2	10	0	75.5	(8.5)	1.1	(0.4)	0.1	(0.3)	0.0	(0.0)	1.1	(0.3)	9	0.1	(0.1)
							Sympatric with Pink Salmon								
48-1B	10	0	64.3	(2.5)	0.8	(0.1)	221.6	(203.4)	12.0	(6.9)	3.9	(1.1)	0.00	0.9	(0.5)
Pink Salmon															
							Allopatric								
49-1B	10	0	83.3	(5.1)	4.7	(0.9)	443.4	(168.6)	19.7	(8.0)	4.2	(0.8)	0	1.3	(0.4)
53-1B	10	0	74.2	(9.9)	3.7	(1.7)	356.8	(264.4)	40.3	(67.1)	4.3	(1.2)	0	1.3	(0.7)
58-2U	10	0	98.1	(6.2)	7.1	(1.3)	47.1	(22.1)	848.9	(389.3)	5.6	(0.8)	0	2.8	(1.3)
							Sympatric with Herring								
03-2U	10	0	102.8	(5.6)	8.7	(1.6)	178.0	(247.4)	78.2	(66.0)	3.5	(0.8)	0	0.6	(0.2)
03-2U	10	0	130.0	(5.1)	17.7	(1.6)	56.9	(82.5)	290.6	(531.7)	4.1	(1.7)	0	1.0	(0.8)
10-1B	10	0	64.1	(5.5)	2.3	(0.6)	380.6	(204.5)	59.3	(48.2)	5.0	(0.8)	0	1.7	(1.3)
10-1B	10	0	102.4	(9.7)	9.6	(3.0)	180.0	(269.0)	13.9	(18.2)	3.6	(1.4)	0	1.1	(0.7)
20-1B	10	0	90.3	(9.4)	6.6	(1.9)	822.0	(944.5)	24.9	(31.6)	4.2	(1.7)	0	1.4	(0.9)
24-1B	10	0	96.8	(6.0)	8.1	(1.8)	91.9	(67.4)	11.2	(17.7)	3.0	(0.9)	0	0.8	(0.4)
							Sympatric with Sandlance								
48-1B	10	0	97.9	(3.6)	7.4	(1.4)	588.7	(453.8)	29.5	(20.6)	3.6	(0.8)	0	0.6	(0.3)

Table 5. Range of mean sizes and overall median size (in parentheses; mm FL) of forage species from allopatric and sympatric aggregations in PWS during July, 1996. Allopatric fish are shown in shaded cells.

	Second species		
First species	Herring	Sandlance	Pink Salmon
Herring	30.4 - 130.1 (47.0)	33.2 - 125.6 (46.5)	38.2 - 191.3 (107.0)
Sandlance	71.6 - 111.8 (76.5)	61.1 - 134.6 (79.0)	(63.5)
Pink Salmon	64.1 - 130.0 (98.0)	(97.9)	74.2 - 98.1 (85.0)

Table 6. Diet similarity (PSI) by percent number and percent biomass of prey species within and between forage species in allopatric and sympatric aggregations in PWS during July, 1996. Significant diet similarity (> 60%) is indicated by shaded cells.

(a) Diet similarity between species in allopatric aggregations.

allopatric aggregation	allopatric aggregation	% Number	% Biomass
pink salmon	sandlance	15.3	11.0
pink salmon	herring	25.6	17.1
sandlance	herring	73.1	51.3

(b) Diet similarity between species in sympatric aggregations.

sympatric aggregation	sympatric aggregation	% Number	% Biomass
pink salmon w/ sandlance	sandlance w/ pink salmon	0.5	3.2
pink salmon w/ herring	herring w/ pink salmon	36.2	37.8
herring w/ sandlance	sandlance w/ herring	46.1	53.5

(c) Diet similarity within species between allopatric and sympatric aggregations.

allopatric aggregation	sympatric aggregation	% Number	% Biomass
pink salmon	pink salmon w/ sandlance	66.5	56.1
pink salmon	pink salmon w/ herring	69.1	61.0
sandlance	sandlance w/ pink salmon	42.8	54.9
sandlance	sandlance w/ herring	55.6	60.5
herring	herring w/ pink salmon	62.9	38.2
herring	herring w/ sandlance	72.7	70.2

Table 7. Median stomach fullness, number and weight of prey consumed, and prey percent body weight of forage species in allopatric and sympatric aggregations in Prince William Sound during July, 1996. Fullness index values: 1 = empty, 2 = trace, 3 = 25%, 4 = 50%, 5 = 75%, 6 = 100%, 7 = distended. Results of Mann-Whitney Rank Sum Tests between fish in allopatric and sympatric aggregations are indicated with asterisks (n.s. = not significant, * P < 0.05, ** P < 0.01 and *** P < 0.001). See Table 2 for stations classified by type of fish aggregation.

	Number of Fish	Sample Time (mean)	Length	Fullness Index	Number of Prey	Weight of Prey	Percent Body Weight
Pacific herring							
Allopatric	100	11:07	47.0	5	384	20.0	1.5
Sympatric with Sandlance	38	13:54	46.5	4	270	11.9	1.1
			n.s.	**	*	*	n.s.
Sympatric with Pink Salmon	40	15:45	107.0	2.5	24	1.7	0.4
			***	***	**	**	***
Pacific sandlance							
Allopatric	139	14:24	79.0	4	454	25.7	0.7
Sympatric with Herring	40	13:42	76.5	2	14.5	0.7	0.4
			n.s.	***	*	*	n.s.
Sympatric with Pink Salmon	10	10:50	63.5	4	176	11.7	0.8
			***	n.s.	n.s.	n.s	n.s.
Pink salmon							
Allopatric	30	11:36	85.0	5	288.5	24.8	1.6
Sympatric with Herring	60	15:24	98.0	4	123	25.1	0.8
			***	*	n.s.	*	***
Sympatric with Sandlance	30	10:50	98.0	3	588.7	22.8	0.5
			*	**	*	n.s.	***

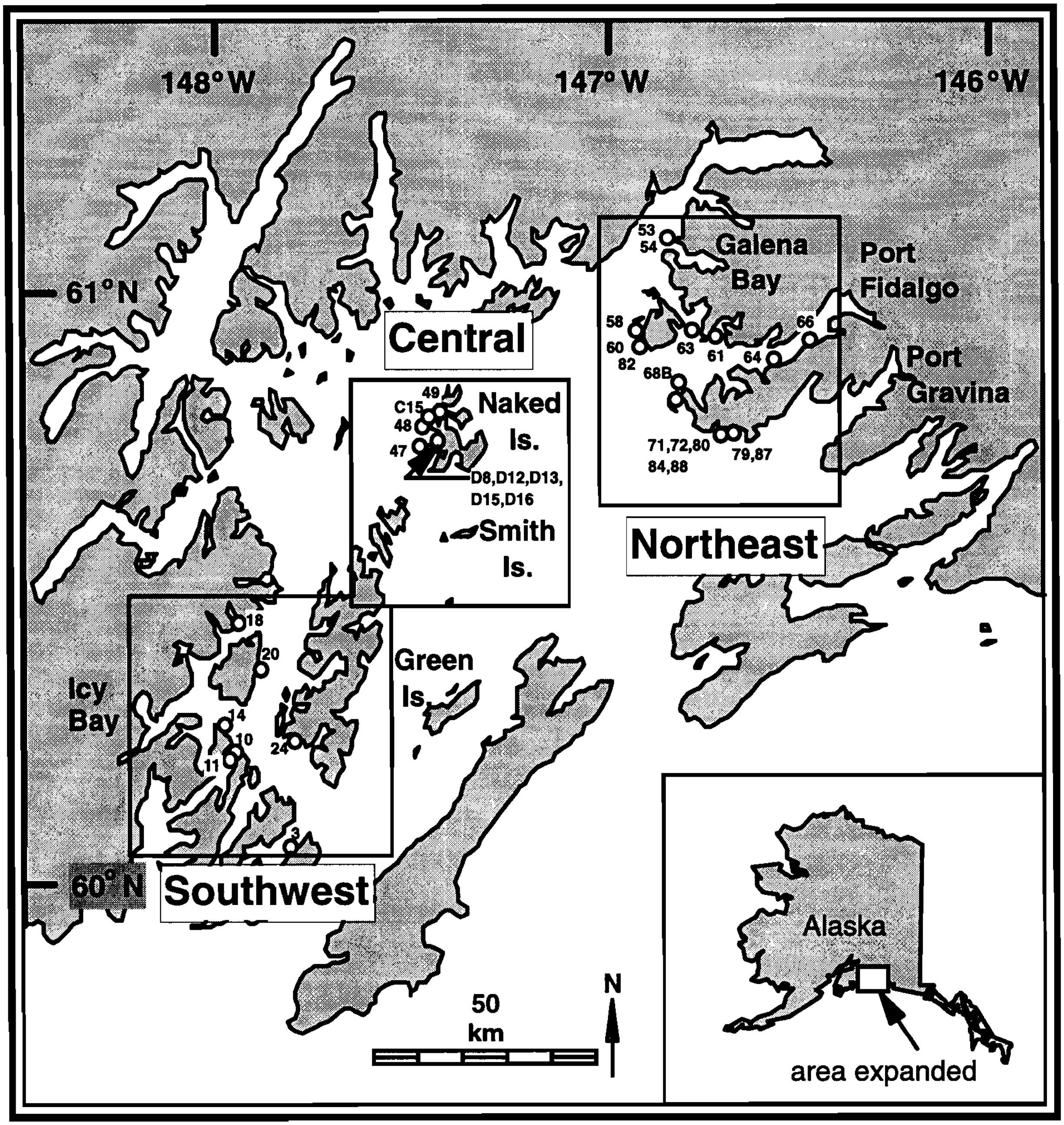

Figure 1. Locations of APEX forage fish sampling stations for July, 1996 in Prince William Sound, Alaska.

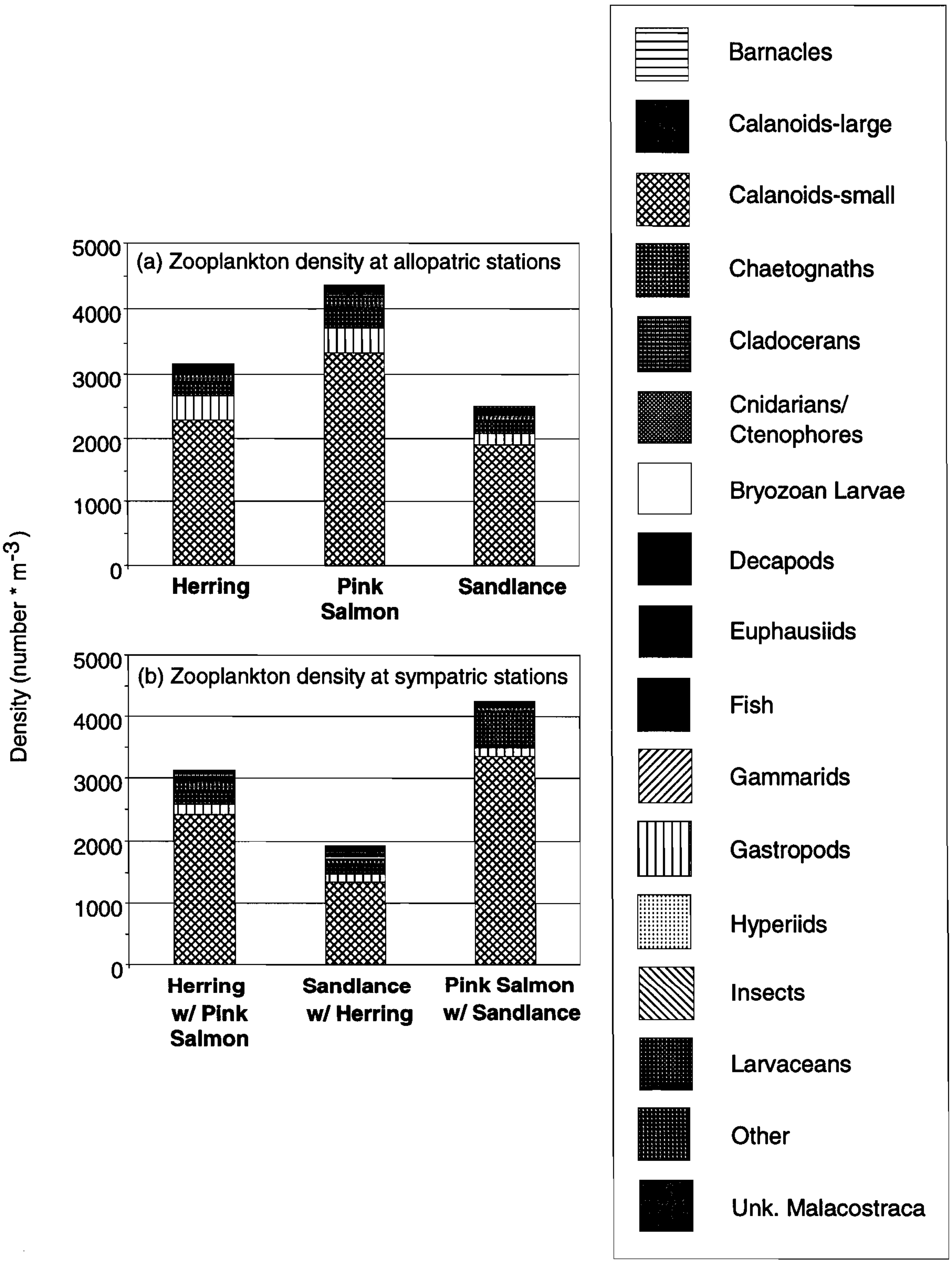

Figure 2. Total density (number*m^{-3}) and relative contribution of major prey taxa of zooplankton available to juvenile Pacific herring, pink salmon, and Pacific sandlance in (a) allopatric and (b) sympatric aggregations collected in Prince William Sound during July, 1996.

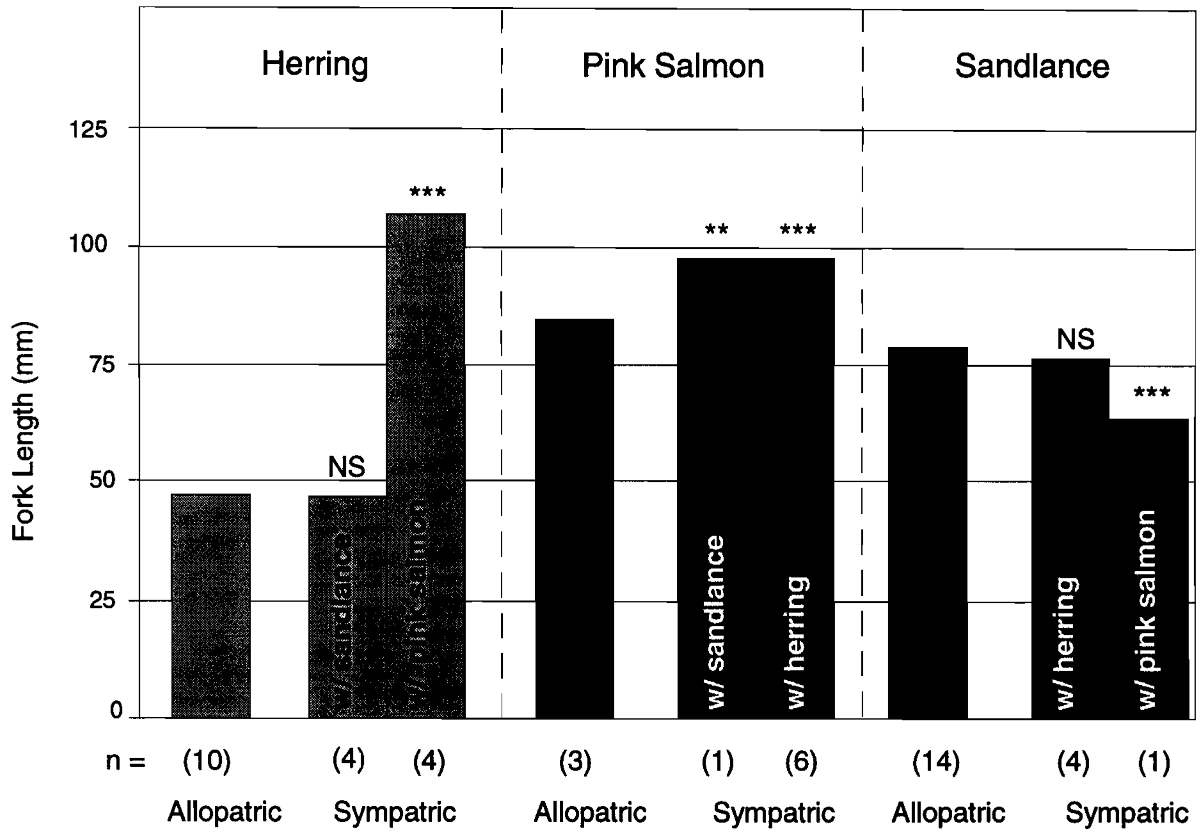

Figure 3. Mean fork lengths (FL) of forage fish from sympatric and allopatric aggregations collected in Prince William Sound in July, 1996. The number of sets (with 10 fish in each set) are shown below the bars. Results of Mann-Whitney Rank Sum comparisons between allopatric and sympatric sizes are indicated: NS = not significant, * $p < 0.05$, *** $p < 0.001$.

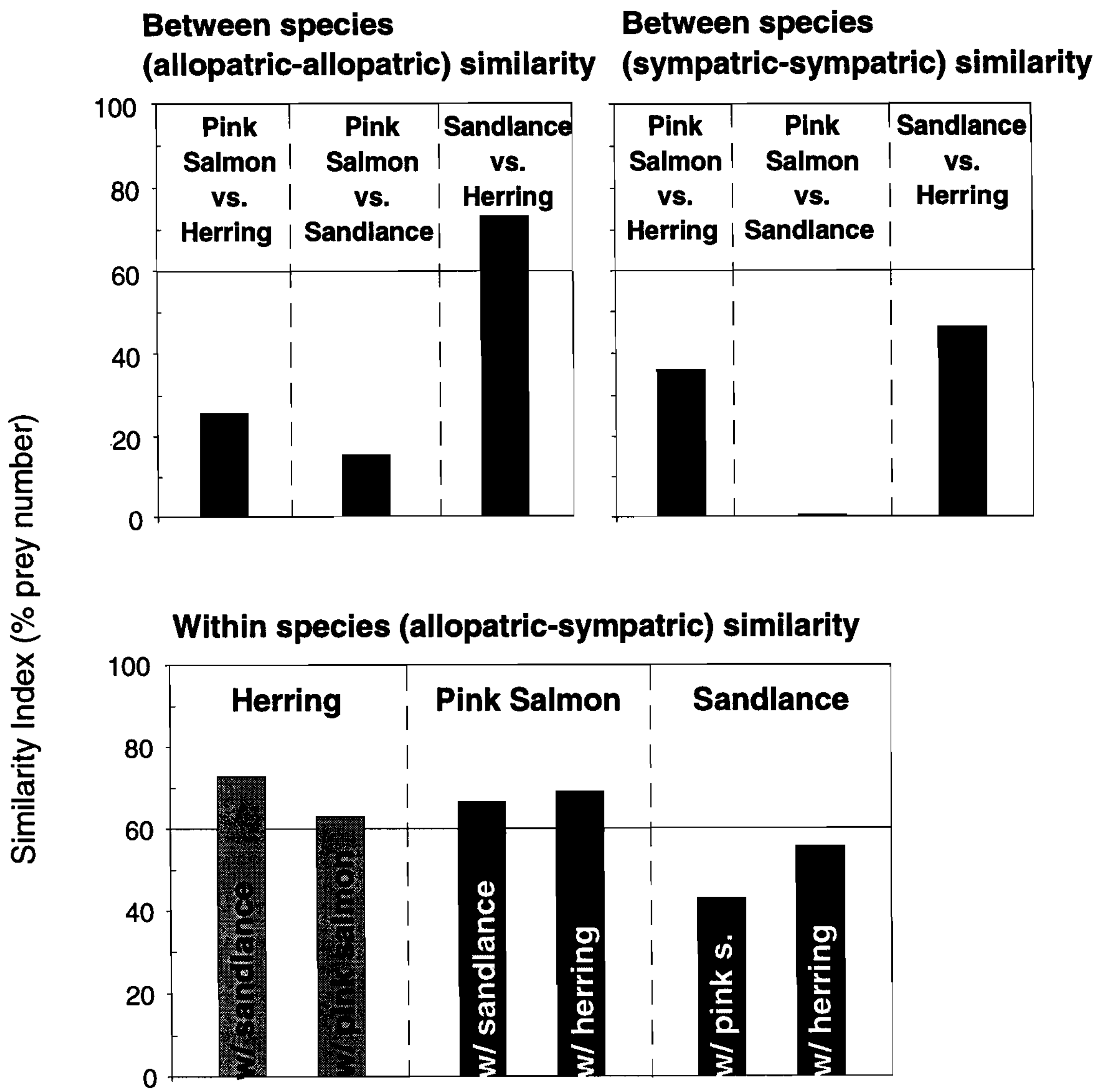

Figure 4. Diet similarity (PSI) by percent number of prey for forage species in allopatric and sympatric aggregations collected from Prince William Sound during July, 1996. Line at 60% indicates threshold for significant overlap.

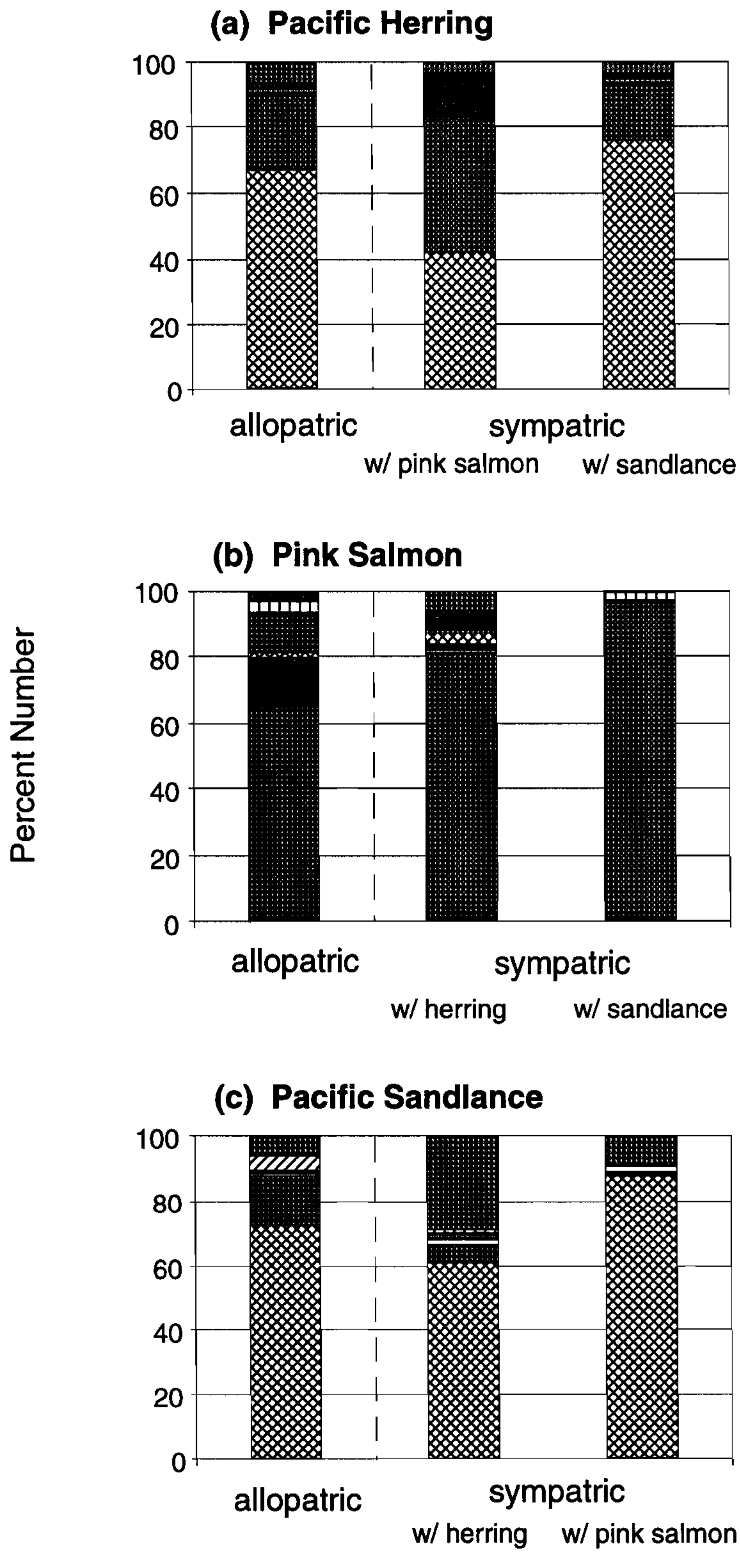

Figure 5. Diet composition as percent number of prey among allopatric and sympatric aggregations of juvenile: (a) Pacific herring, (b) pink salmon and (c) Pacific sandlance collected in Prince William Sound in July, 1996. Legend as in Figure 2.

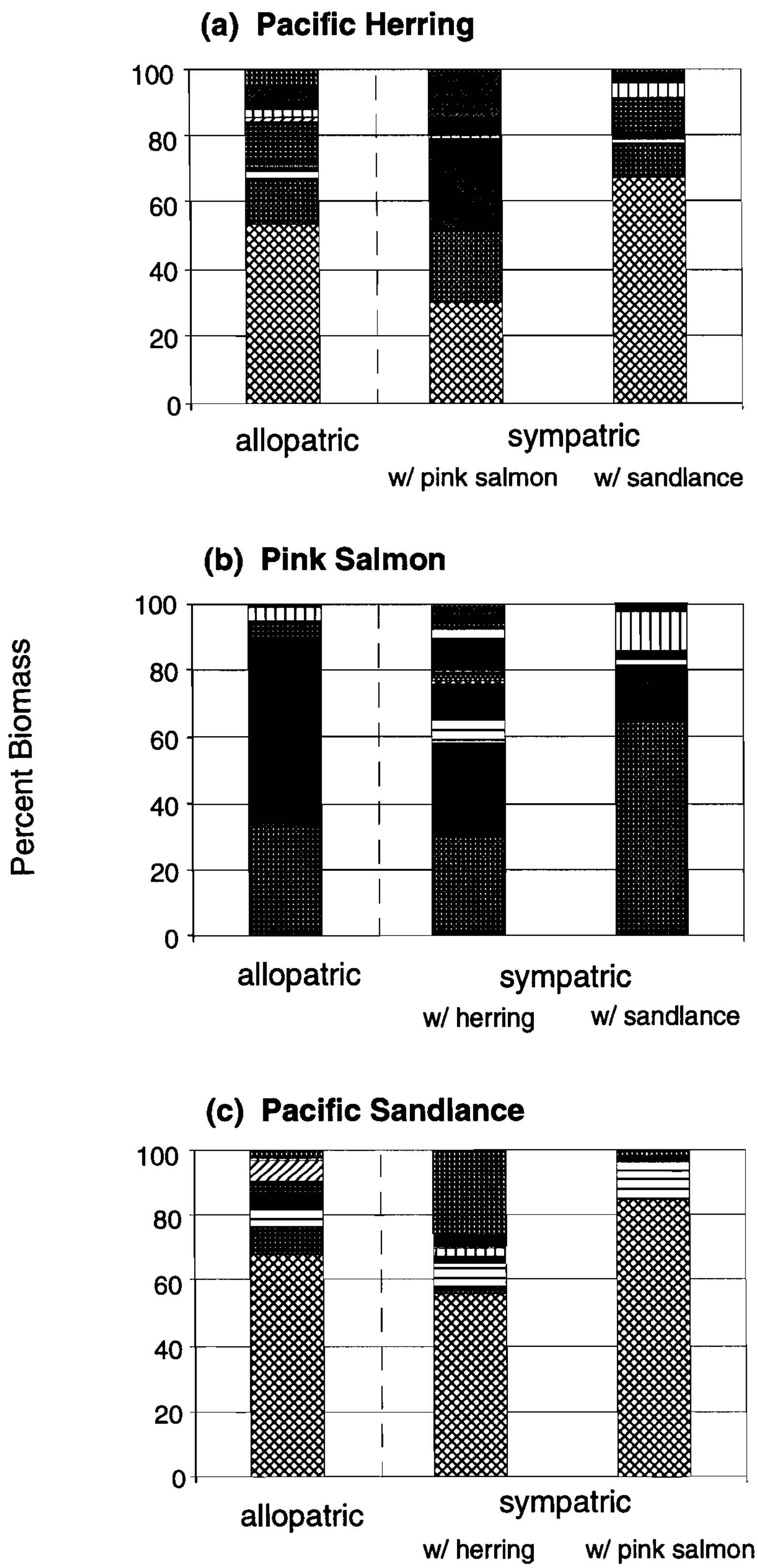

Figure 6. Diet composition as percent biomass of prey among allopatric and sympatric aggregations of juvenile: (a) Pacific herring, (b) pink salmon and (c) Pacific sandlance collected in Prince William Sound in July, 1996. Legend as in Figure 2.

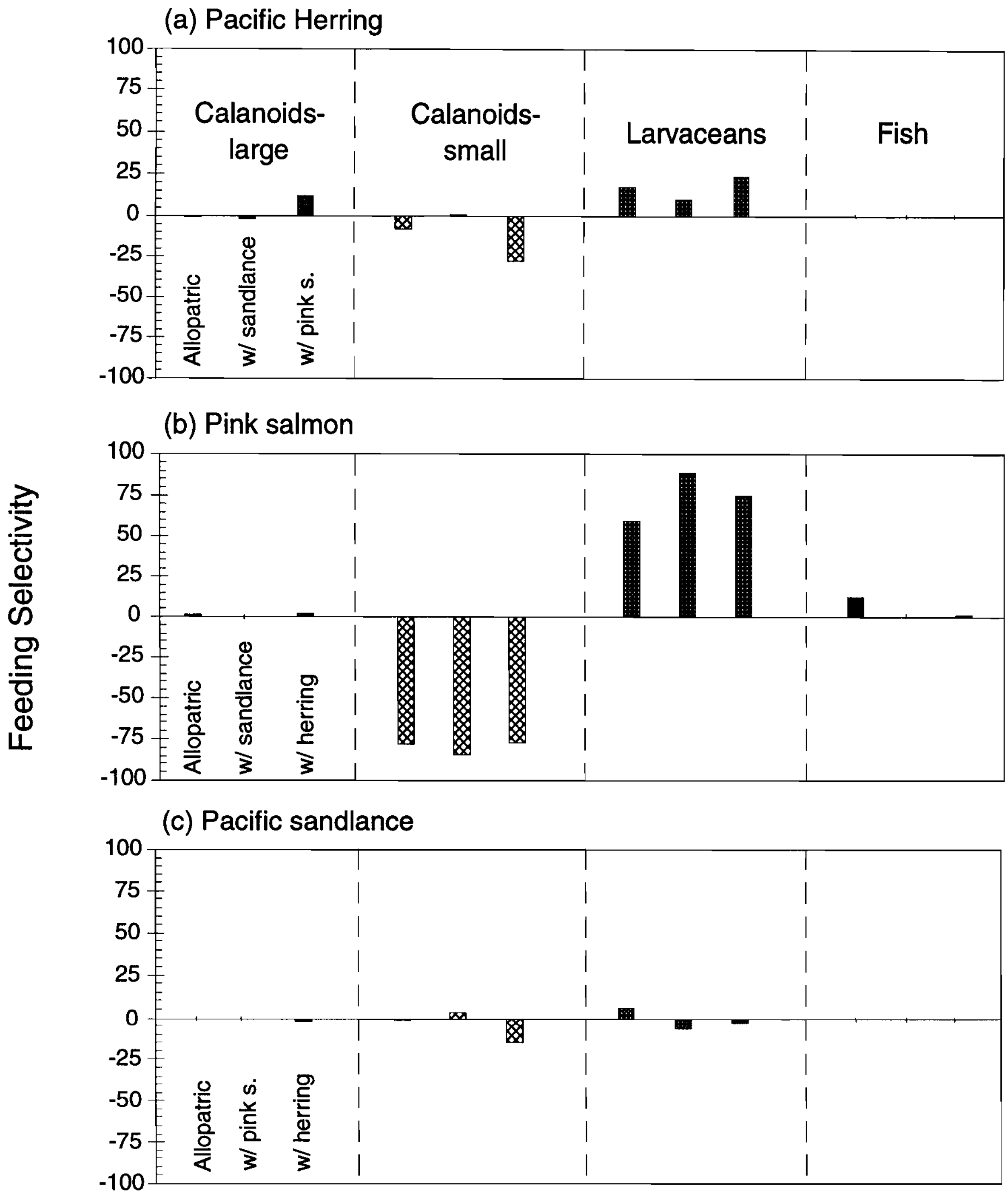

Figure 7. Feeding selectivity (Strauss' Linear Selection Index) for juvenile: (a) Pacific herring, (b) pink salmon, and (c) Pacific sandlance on major prey categories. Positive values indicate preference, negative values, avoidance. The order shown for the types of aggregations (shown in the left-most panel) is repeated consistently among the remaining panels.

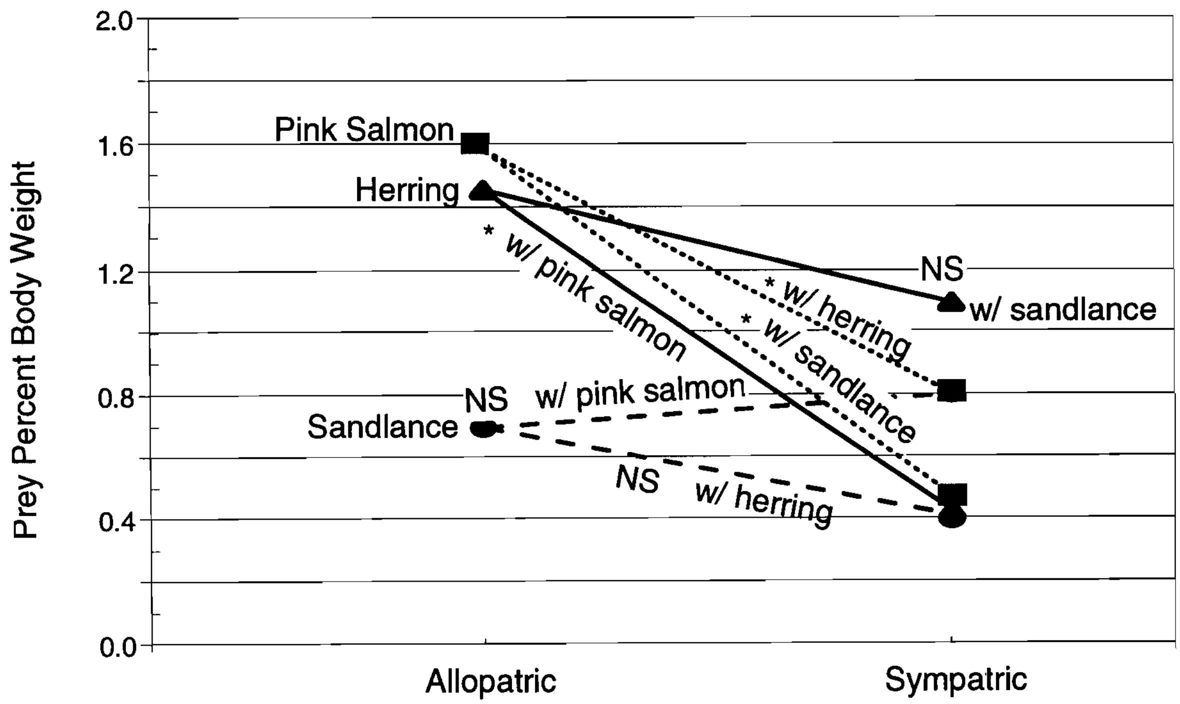

Figure 8. Shift in prey consumption (prey percent body weight) between allopatric and sympatric aggregations of forage species from Prince William Sound during July, 1996. Results of Mann-Whitney Rank Sum comparisons between groups are indicated: NS = not significant, * $p < 0.05$.

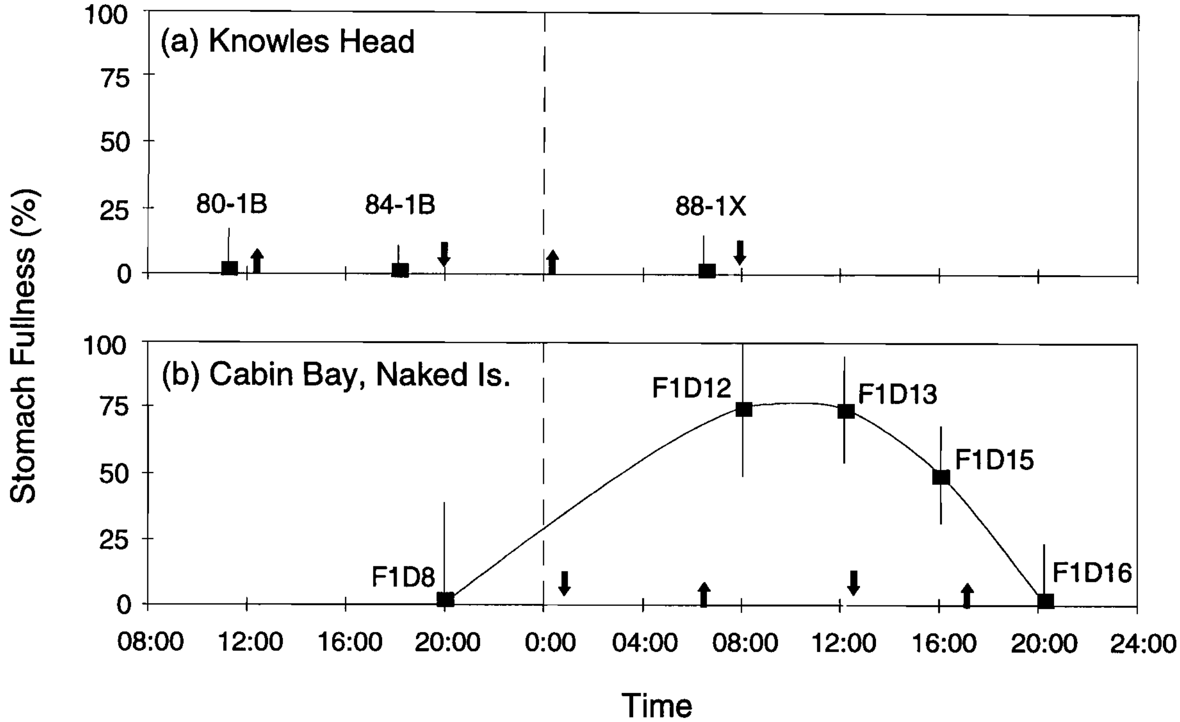

Figure 9. Diel feeding pattern (mean percent fullness index and standard deviations of 10 specimens per station) of juvenile sandlance collected at: (a) Knowles Head (section N0506, July 27-28) and (b) "Fuel Cache" Cabin Bay, Naked Island (Section C0704, July 21-22) in Prince William Sound, 1996. Codes adjacent to data points indicate station numbers. Arrows indicate time of tidal change (up = high tide, down = low tide).

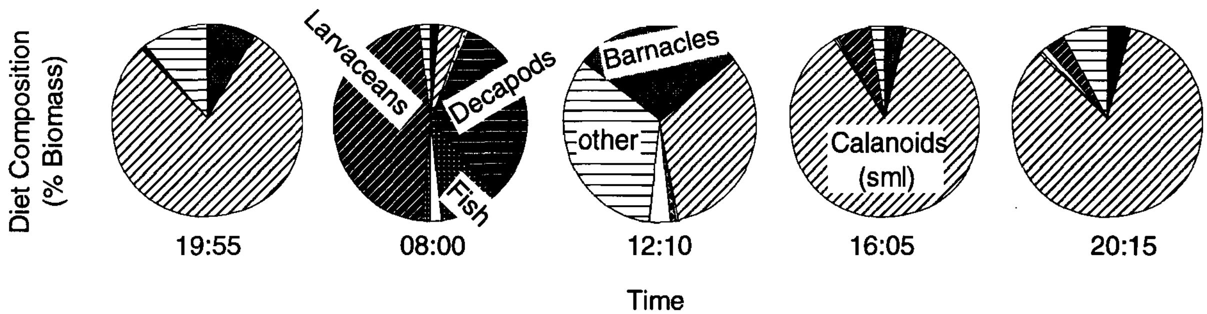

Figure 10. Diel pattern of diet composition (percent biomass of major prey categories) for juvenile sandlance collected at Cabin Bay, Naked Island in Prince William Sound during July, 1996. See Figure 9 for diel pattern of stomach fullness.

Appendix 1. Zooplankton as mean density (number*m^{-3}), percent density, biomass (mg*m^{-3} wet weight), and percent biomass by taxonomic group and total in three regions of PWS during July, 1996. Values in parentheses are standard deviations of the means. Replicate zooplankton samples were collected at the number of stations indicated, in 20 m vertical hauls using a 0.5 m diameter ring net with 243 μm mesh .

Northeast Region

Taxonomic Group	Density		% Density		Biomass		% Biomass	
Barnacles	7.1	(10.6)	0.3	(0.6)	1.57	(2.2)	0.68	(0.9)
Large Calanoids	29.2	(47.9)	1.4	(1.8)	9.88	(10.3)	5.38	(5.7)
Small calanoids	1745.9	(1213.6)	72.8	(12.5)	123.20	(98.6)	49.17	(21.0)
Chaetognaths	0.6	(1.3)	0.0	(0.1)	0.26	(0.6)	0.19	(0.6)
Cladocerans	26.0	(24.5)	1.4	(1.6)	1.02	(1.0)	0.48	(0.4)
Cyphonautes	6.0	(15.4)	0.2	(0.3)	0.12	(0.3)	0.04	(0.1)
Decapods	12.8	(8.8)	0.7	(0.5)	40.04	(37.8)	18.14	(14.7)
Euphausiids	18.7	(28.3)	0.8	(0.9)	2.85	(3.3)	1.36	(1.3)
Fish	0.7	(2.2)	0.0	(0.1)	11.72	(29.3)	3.22	(7.4)
Gammarid Amphipods	0.1	(0.5)	0.0	(0.1)	0.08	(0.3)	0.09	(0.3)
Gastropods	228.9	(254.8)	10.6	(9.7)	41.61	(70.2)	13.72	(15.0)
Hyperiid Amphipods	1.0	(0.8)	0.1	(0.1)	2.58	(2.8)	1.62	(2.5)
Insects	0.2	(0.6)	0.0	(0.1)	0.05	(0.2)	0.04	(0.1)
Cnidarians/ Ctenophores	14.7	(20.0)	1.0	(1.3)	3.00	(2.6)	1.98	(2.1)
Larvaceans	156.5	(110.2)	7.3	(3.8)	5.21	(3.7)	2.40	(1.2)
Other	76.6	(65.0)	3.3	(3.2)	3.99	(7.8)	1.49	(2.2)

Total Density 2325.1 (1513.2) Total Biomass 247.2 (45.3)

n = 15 stations

Central Region

Taxonomic Group	Density		% Density		Biomass		% Biomass	
Barnacles	10.9	(8.5)	0.4	(0.3)	2.2	(1.8)	1.1	(0.8)
Large Calanoids	17.2	(18.1)	0.4	(0.4)	9.3	(12.0)	2.7	(2.5)
Small calanoids	2768.7	(726.1)	78.6	(7.9)	158.3	(64.6)	60.5	(21.1)
Chaetognaths	0.3	(0.2)	0.0	(0.0)	0.1	(0.1)	0.1	(0.1)
Cladocerans	86.9	(59.4)	2.7	(2.4)	3.4	(2.3)	1.5	(1.4)
Cyphonautes	0.7	(1.2)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)
Decapods	15.0	(6.2)	0.4	(0.2)	60.4	(43.5)	17.0	(12.3)
Euphausiids	9.5	(13.1)	0.2	(0.3)	1.8	(2.5)	0.4	(0.4)
Fish	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)
Gammarid Amphipods	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)
Gastropods	172.6	(51.8)	5.2	(2.4)	22.0	(7.2)	9.0	(3.5)
Hyperiid Amphipods	0.2	(0.3)	0.0	(0.0)	1.3	(1.5)	0.8	(1.0)
Insects	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)
Cnidarians/ Ctenophores	13.3	(12.0)	0.4	(0.4)	4.6	(3.6)	2.4	(2.4)
Larvaceans	319.2	(60.1)	9.2	(0.9)	10.6	(2.0)	4.3	(0.3)
Other	75.4	(40.6)	2.4	(1.7)	0.5	(0.2)	0.3	(0.1)

Total Density 3489.7 (629.4) Total Biomass 274.7 (84.3)

n = 3 stations

Southwest Region

Taxonomic Group	Density		% Density		Biomass		% Biomass	
Barnacles	35.7	(59.7)	1.2	(2.0)	11.6	(14.1)	4.6	(5.4)
Large Calanoids	14.3	(6.8)	0.5	(0.2)	8.3	(4.8)	3.5	(1.9)
Small calanoids	2328.9	(586.0)	77.5	(12.0)	152.0	(57.7)	66.7	(19.1)
Chaetognaths	2.5	(4.0)	0.1	(0.1)	1.1	(1.7)	0.5	(0.6)
Cladocerans	97.4	(89.4)	3.3	(3.0)	3.8	(3.5)	1.7	(1.4)
Cyphonautes	5.6	(4.9)	0.2	(0.2)	0.1	(0.1)	0.1	(0.1)
Decapods	4.4	(6.8)	0.1	(0.2)	11.5	(17.9)	5.2	(8.4)
Euphausiids	1.4	(2.1)	0.0	(0.1)	0.1	(0.3)	0.1	(0.1)
Fish	0.1	(0.1)	0.0	(0.0)	4.2	(3.3)	2.2	(1.9)
Gammarid Amphipods	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)
Gastropods	131.8	(93.4)	4.3	(3.1)	16.6	(11.9)	7.5	(5.5)
Hyperiid Amphipods	1.0	(1.7)	0.0	(0.1)	4.3	(7.5)	1.9	(3.1)
Insects	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)
Cnidarians/ Ctenophores	18.0	(9.4)	0.6	(0.2)	4.0	(1.9)	1.7	(0.7)
Larvaceans	218.0	(81.1)	7.6	(2.9)	7.3	(2.7)	3.4	(1.4)
Other	133.5	(122.8)	4.5	(3.9)	2.7	(4.3)	0.9	(1.2)

Total Density 2992.5 (473.0) Total Biomass 227.6 (45.3)

n = 7 stations

Appendix 2a. Zooplankton available to juvenile Pacific herring as mean density (number*m^{-3}) and percent density by species in taxonomic groups at stations corresponding to allopatric (n = 8) and sympatric (n = 3 with pink salmon, n = 4 with sandlance) samples collected in PWS during July, 1996. Values in parentheses are standard deviations of the means. Replicate samples were collected at each station in 20 m vertical hauls using a 0.5 m diameter ring net with 243 mm mesh.

Pacific Herring

		Allopatric Stations				Sympatric Stations							
						with Pink Salmon				with Sandlance			
Species	Code	Density		%Density		Density		%Density		Density		%Density	
Barnacles													
Barnacle, cyprid	BMC	3.6	(7.4)	0.0	(0.1)	5.4	(9.4)	0.1	(0.1)	4.6	(4.2)	0.1	0.1
Barnacle, adult molt (cirri & moutharea)	BMM	0.0	(0.0)	0.0	(0.0)	5.4	(9.4)	0.1	(0.2)	0.1	(0.1)	0.0	0.0
Barnacle, nauplius	BMP	11.8	(13.2)	0.2	(0.2)	9.5	(10.3)	0.3	(0.3)	40.7	(74.8)	1.4	2.5
Large Calanoids													
Calanoid, *Calanus spp.* female	CCF	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, large, *Neocalanus/Calanus*	CLN	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.7	(1.4)	0.0	0.1
Calanoid, *Calanus marshallae* general	CM	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *C. marshallae* copepodite CV	CMC	1.3	(1.9)	0.1	(0.1)	0.1	(0.1)	0.0	(0.0)	3.6	(3.2)	0.2	0.1
Calanoid, *C. marshallae* female	CMF	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.1	(0.1)	0.0	0.0
Calanoid, *C. marshallae* male	CMM	0.1	(0.2)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.1	(0.3)	0.0	0.0
Calanoid, *Calanus pacificus* adult	CPA	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Calanus pacificus*, general	CPC	0.0	(0.1)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)	0.2	(0.1)	0.0	0.0
copepodids	CPD	19.6	(48.2)	0.6	(1.4)	10.9	(4.7)	0.2	(0.0)	33.6	(27.1)	1.8	2.0
Calanoid, *Calanus pacificus* female	CPF	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.1	(0.1)	0.0	0.0
Calanoid, *Calanus spp.* general	CPG	0.2	(0.5)	0.0	(0.0)	1.1	(1.7)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Calanus pacificus* male	CPM	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.1	(0.1)	0.0	0.0
Calanoid, *C. pacificus* copepodite CV	CPV	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Eucalanus bungii*, copepodite	EBC	0.0	(0.0)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *E.longipedata*, copepodite	EPC	0.1	(0.2)	0.0	(0.0)	0.3	(0.4)	0.0	(0.0)	0.6	(1.0)	0.0	0.1
Calanoid, *E.longipedata*, female	EPF	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.1	(0.1)	0.0	0.0
Calanoid, *E.longipedata*, male	EPM	0.1	(0.2)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)	0.1	(0.1)	0.0	0.0
Calanoid, *Eucalanus bungii*, general	EUB	0.0	(0.1)	0.0	(0.0)	0.2	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Metridia spp.* copepodids I-IV	MCP	4.3	(11.4)	0.1	(0.2)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Metridia pacifica* copepodite	MCS	0.3	(0.7)	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Metridia pacifica*, general	MEP	0.5	(1.4)	0.0	(0.0)	1.4	(2.4)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Metridia ochotensis* female	MOF	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *M.pacifica* CV copepodite	MPC	0.0	(0.1)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Metridia pacifica*, female	MPF	0.3	(0.8)	0.0	(0.0)	0.7	(1.2)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Neocalanus spp.* copepodite	NCP	5.7	(9.4)	0.1	(0.2)	9.5	(13.1)	0.1	(0.2)	10.0	(7.9)	0.4	0.4
Calanoid, *Neocalanus plumchrus* female	NPF	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Small Calanoids													
Calanoid, *Acartia spp.*	AC	12.7	(32.8)	1.0	(2.6)	0.0	(0.0)	0.0	(0.0)	1.0	(2.0)	0.0	0.0
Calanoid, *Acartia spp.* copepodids	ACP	57.3	(139.7)	2.0	(4.2)	0.0	(0.0)	0.0	(0.0)	58.1	(68.0)	2.4	3.6
Calanoid, *Acartia longiremus* copepodite	ALC	90.4	(73.9)	3.1	(2.6)	155.5	(81.1)	4.9	(2.0)	45.6	(65.7)	2.5	3.3
Calanoid, *Acartia longiremis* female	ALF	95.5	(108.5)	2.7	(2.6)	62.5	(38.5)	1.1	(0.4)	48.9	(62.1)	2.2	3.3
Calanoid, *Acartia longiremus* male	ALM	53.5	(81.6)	1.3	(1.5)	27.2	(33.9)	0.4	(0.4)	19.9	(30.7)	0.9	1.6
Calanoid, *C.abdominalis*, copepodite	CAC	141.5	(194.2)	5.3	(5.6)	98.5	(65.6)	3.5	(2.5)	117.1	(95.0)	6.4	3.9
abdominalis ,female	CAF	25.0	(29.9)	0.7	(0.6)	12.9	(4.2)	0.3	(0.2)	5.7	(6.6)	0.5	0.4
Calanoid, *Centropages abdominalis* ,male	CAM	42.8	(57.9)	1.1	(1.2)	32.6	(43.1)	0.6	(0.9)	9.2	(10.7)	0.5	0.6
Calanoid, general nauplius	CAN	13.9	(26.6)	0.3	(0.8)	4.1	(4.1)	0.1	(0.1)	6.9	(5.5)	0.4	0.4
Calanoid, general small (x<2.5 mm)	CAS	4.1	(8.7)	0.1	(0.1)	2.7	(4.7)	0.1	(0.1)	24.4	(43.6)	0.6	0.7
Calanoid, Copepodite small, general	COS	7.3	(18.6)	0.2	(0.5)	0.0	(0.0)	0.0	(0.0)	4.1	(8.1)	0.3	0.6
Calanoid, *E.pacifica*, copepodite	EYC	11.2	(18.3)	0.5	(1.1)	0.0	(0.0)	0.0	(0.0)	2.0	(4.1)	0.1	0.1
Calanoid, *Eurytemora pacifica* female	EYF	8.7	(14.2)	0.2	(0.2)	0.0	(0.0)	0.0	(0.0)	6.1	(7.8)	0.2	0.2
Calanoid, *Eurytemora pacifica*, gravid	EYG	4.6	(8.6)	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Eurytemora pacifica* male	EYM	3.1	(5.7)	0.1	(0.2)	2.7	(4.7)	0.1	(0.1)	2.5	(3.1)	0.2	0.2
Cyclopoid, *Corycaeus spp.*	GOG	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	2.0	(4.1)	0.0	0.1
Cyclopoid, *Oithona spp.*, general	OIT	86.6	(95.5)	2.2	(1.8)	112.0	(55.8)	3.7	(1.4)	41.0	(27.9)	2.7	2.7
Cyclopoid, *Oithona similis*, general	OS	11.8	(27.2)	0.6	(1.1)	0.0	(0.0)	0.0	(0.0)	15.3	(30.6)	1.1	2.2
Cyclopoid, *Oithona spp.* copepodite	OSC	3.6	(10.1)	0.1	(0.3)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cyclopoid, *Oithona similis* AF	OSF	13.0	(28.0)	0.2	(0.4)	1.4	(2.4)	0.0	(0.0)	6.1	(7.8)	0.3	0.4
Cyclopoid, *Oithona similis* AM	OSM	1.0	(2.9)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.5	(1.0)	0.0	0.1
Cyclopoid, *Oithona spinirostris*, female	OTF	10.2	(14.3)	0.2	(0.2)	8.1	(8.1)	0.2	(0.2)	5.1	(7.7)	0.1	0.2
Cyclopoid, *Oithona spinirostris*, male	OTM	2.5	(7.2)	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cyclopoid, *Oithona spinirostris*	OTS	0.0	(0.0)	0.0	(0.0)	5.4	(9.4)	0.1	(0.2)	1.0	(2.0)	0.0	0.0
Calanoid, *Pseudocalanus* copepodids I-IV	PCP	1150.8	(821.2)	36.6	(12.6)	1432.8	(291.0)	48.2	(3.5)	681.7	(284.7)	38.6	5.1
Calanoid, *Pseudocalanus spp.*, general	PSA	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Pseudocalanus spp.* female	PSF	416.2	(330.7)	12.9	(4.6)	431.9	(168.6)	15.5	(8.2)	232.7	(89.6)	14.7	5.9
female	PSG	2.0	(5.8)	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0

Pacific Herring

Species	Code	Allopatric Stations				Sympatric Stations with Pink Salmon				Sympatric Stations with Sandlance			
		Density		%Density		Density		%Density		Density		%Density	
Calanoid, *Pseudocalanus spp.* male	PSM	11.1	(27.0)	0.2	(0.3)	16.3	(14.1)	0.2	(0.2)	4.1	(4.7)	0.2	0.3
Chaetognaths													
Chaetognath, species unknown	CHT	0.8	(1.4)	0.0	(0.0)	1.5	(1.3)	0.1	(0.1)	1.1	(2.3)	0.1	0.2
Chaetognath, *Sagitta elegans*	SGE	0.1	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.3	(0.5)	0.0	0.0
Cladocerans													
Cladocera, General	CLA	0.1	(0.4)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cladoceran, *Evadne spp.*	EVD	20.9	(20.6)	0.7	(0.8)	41.4	(14.5)	1.4	(0.4)	40.5	(68.1)	1.5	2.3
Cladoceran, *Podon spp.*	PON	39.5	(28.4)	1.7	(1.8)	44.8	(21.6)	1.5	(0.6)	41.8	(53.9)	1.4	1.8
Cyphonautes													
Bryozoa, cyphonautes larva	CFN	11.7	(20.3)	0.3	(0.3)	10.4	(2.2)	0.4	(0.2)	1.9	(2.2)	0.1	0.2
Decapods													
Decapod, megalops, unknown crab	DCM	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Decapod, zoea, *Brachyura*, general	DGB	4.1	(5.1)	0.2	(0.2)	3.8	(6.3)	0.2	(0.3)	4.3	(8.0)	0.1	0.1
Decapod, zoea, unknown general	DUG	2.2	(5.7)	0.0	(0.1)	0.3	(0.3)	0.0	(0.0)	0.1	(0.3)	0.0	0.0
Decapod zoea, crab, *Brachyrhyncha*	DZB	2.2	(3.7)	0.1	(0.1)	0.0	(0.0)	0.0	(0.0)	2.0	(4.1)	0.1	0.1
Decapod zoea, Shrimp, *Crangonidae*	DZC	2.0	(4.1)	0.1	(0.2)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Decapod zoea, crab, general unknown	DZG	0.8	(1.5)	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Decapod zoea, Shrimp, *Hippolytidae*	HIE	0.1	(0.4)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)	0.4	(0.4)	0.0	0.0
Decapod zoea, Anomuran, *Lithodidae*	LIZ	0.1	(0.2)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Decapod zoea, crab, *Oregoninae*	ORG	0.6	(1.4)	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.2	(0.4)	0.0	0.0
Decapod zoea, hermit crab, *Paguridae*	PGZ	0.1	(0.2)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)	0.2	(0.2)	0.0	0.0
Decapod zoea, general shrimp	SHR	4.7	(4.0)	0.2	(0.3)	0.4	(0.7)	0.0	(0.0)	0.3	(0.4)	0.0	0.0
Euphausiids													
Euphausiid egg	EU1	7.6	(21.6)	0.1	(0.2)	0.0	(0.0)	0.0	(0.0)	6.6	(13.2)	0.4	0.8
Euphausiid nauplii	EU2	5.0	(10.7)	0.1	(0.2)	2.7	(4.7)	0.1	(0.1)	1.5	(3.1)	0.1	0.2
Euphausiid calyptopis	EU3	7.3	(10.5)	0.3	(0.4)	2.7	(4.7)	0.0	(0.1)	2.8	(3.8)	0.1	0.2
Euphausiid furcilia	EU4	1.6	(3.0)	0.1	(0.1)	0.1	(0.1)	0.0	(0.0)	0.4	(0.5)	0.1	0.1
Euphausiid juvenile, general	EUJ	0.1	(0.3)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.2	(0.4)	0.0	0.0
Euphausiid, *Thysannoessa spp.* juvenile	THJ	0.1	(0.2)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Euphausiid, *Thysanoessa spinifera*	TS	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Fish													
Fish, robust larva	FIS	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Fish egg (~1.0 mm)	FSE	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Fish, small juvenile/larva, general	FSL	0.5	(1.4)	0.0	(0.0)	0.2	(0.1)	0.0	(0.0)	0.1	(0.1)	0.0	0.0
Fish, *Scorpaenidae*, gen. rockfish spp.	FSR	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Gammarid Amphipods													
Amphipod, Gammarid, unknown, small	GA1	0.2	(0.5)	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Gastropods													
Gastropod, juv. snail w/ black pigment	GSB	243.8	(321.1)	7.6	(11.4)	129.0	(85.9)	1.9	(0.7)	103.9	(127.0)	3.7	4.2
Gastropoda, general juvenile (SNAIL)	GST	66.2	(148.0)	1.8	(4.3)	0.0	(0.0)	0.0	(0.0)	10.2	(20.4)	0.3	0.5
Gastropod, Pteropod, *Limacina helicina* A	LMA	51.4	(145.5)	1.6	(4.4)	0.0	(0.0)	0.0	(0.0)	4.1	(8.1)	0.1	0.2
Gastropod, Pteropod, *Limacina helicina* J	LMJ	31.6	(60.1)	1.8	(4.6)	54.3	(26.5)	1.5	(0.7)	10.2	(15.4)	0.5	0.9
Gastropod, general veliger	VEL	0.5	(1.4)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Hyperiid Amphipods													
Amphipod, Hyperiid, *Hyperia spp.*	HP	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.3	(0.6)	0.0	0.0
Amphipod, Hyperiid, *Hyperia spp.* juvenile	HPJ	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Amphipod, Hyperiid, unknown SMALL	HYB	0.0	(0.1)	0.0	(0.0)	2.8	(4.6)	0.1	(0.1)	0.3	(0.4)	0.0	0.0
Amphipod, Hyperiid, unknown MEDIUM	HYP	0.5	(0.8)	0.0	(0.1)	0.5	(0.4)	0.0	(0.0)	0.2	(0.4)	0.0	0.0
Amphipod, Hyperiid/*P. pacifica* juvenile	PA1	0.3	(0.7)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Amphipod, Hyperiid/*P. pacifica* juvenile	PA2	0.5	(0.6)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.4	(0.7)	0.0	0.0
Amphipod, Hyperiid, *P.libellula*	PL1	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.2	(0.4)	0.0	0.0
Amphipod, Hyperiid, *P. libellula*	PL2	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.1	(0.1)	0.0	0.0
Insects													
Insect, Collembola, globular, purple	CGR	0.3	(0.7)	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Insect, larva, unknown	ILU	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cnidarians/ Ctenophores													
Cnidaria, Anthozoa, anemone	CAA	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cnidaria, Hydrozoan medusae, general	CHM	4.7	(5.0)	0.2	(0.3)	0.0	(0.0)	0.0	(0.0)	3.2	(4.7)	0.2	0.3
Cnidaria, general jellyfish (x>2mm)	CNI	0.9	(1.4)	0.0	(0.0)	12.9	(11.7)	0.3	(0.2)	1.3	(2.2)	0.1	0.2
Cnidaria, general jellyfish (x<2mm)	CNS	17.7	(27.1)	0.8	(1.3)	6.7	(8.6)	0.2	(0.4)	22.9	(17.4)	0.9	0.9
Cnidaria, *Eperetmus typus*	EPT	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cnidaria, *Halitholus spp.*	HTS	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cnidaria, *Melicertum spp.*	MEL	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cnidaria, *Proboscidactyla flavicirrata*	PFL	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cnidaria, *Phialidium gregarium*	PHG	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cnidaria, Hydrozoa, Siphonophore "larva"	SIP	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0

Pacific Herring

Species	Code	Allopatric Stations				Sympatric Stations with Pink Salmon				Sympatric Stations with Sandlance			
		Density		%Density		Density		%Density		Density		%Density	
Cnidaria, *Trachymedusae spp.*	TRC	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Larvaceans													
Larvacea, *Oikopleura* < 2mm	OI1	6.2	(12.1)	0.1	(0.2)	0.0	(0.0)	0.0	(0.0)	1.0	(2.0)	0.0	0.1
Larvacea, *Oikopleura dioica*	OKI	43.8	(123.9)	0.6	(1.6)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Larvacea, Oikopleura spp.	OKP	174.7	(138.5)	5.4	(2.0)	220.7	(47.8)	7.6	(0.8)	152.5	(128.8)	7.7	3.0
Other													
Bivalve, general juvenile	BVJ	0.3	(0.7)	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Bivalve, larvae	BVL	87.1	(99.3)	3.0	(3.6)	149.4	(183.1)	4.9	(5.7)	56.5	(68.2)	2.4	2.1
Ostracod, *Conchoecia spp.*, small	CNC	2.0	(5.8)	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Echinodermata, Brittlestar pluteus	EBP	1.0	(2.9)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
(<0.2mm)	EGG	0.5	(1.4)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
(>0.2mm)	EGL	2.4	(4.2)	0.1	(0.1)	2.7	(4.7)	0.1	(0.1)	13.8	(7.7)	0.6	0.5
Gastropod, egg case (Littorina)	GEC	0.2	(0.4)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)	2.0	(4.1)	0.0	0.1
Harpacticoid, general, unknown stage	HR	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	2.0	(4.1)	0.0	0.1
Harpacticoid, general copepodite	HRC	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Harpacticoid, *Harpacticus*, unknown stage	HSU	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Harpacticoid, *Zaus spp.* copepodite	HZC	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.5	(1.0)	0.0	0.1
Harpacticoid, *Zaus spp.* general	HZZ	1.5	(3.0)	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Isopod, general	ISP	2.5	(7.2)	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Copepod, *Monstrilla spp.*	MX	0.3	(0.7)	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Polychaeta, general, juvenile	PLL	1.0	(2.9)	0.0	(0.1)	0.1	(0.1)	0.0	(0.0)	3.1	(3.9)	0.1	0.1

Appendix 2b. Zooplankton available to juvenile sandlance as mean density (number*m^{-3}) and percent density by species in taxonomic groups at stations corresponding to allopatric (n = 14) and sympatric (n = 4 with herring, n = 1 with pink salmon) samples collected in PWS during July, 1996. Values in parentheses are standard deviations of the means. Replicate samples were collected at each station in 20 m vertical hauls using a 0.5 m diameter ring net with 243 mm mesh.

Pacific Sandlance

Species	Code	Allopatric Stations				Sympatric Stations with Herring				Sympatric Stations with Pink Salmon	
		Density		%Density		Density		%Density		Density	%Density
Barnacles											
Barnacle, cyprid	BMC	1.0	(2.9)	0.0	(0.0)	4.6	(4.2)	0.1	(0.1)	0.0	0.0
Barnacle, adult molt (cirri & moutharea)	BMM	0.0	(0.0)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)	0.0	0.0
Barnacle, nauplius	BMP	9.9	(12.4)	0.5	(0.8)	40.7	(74.8)	1.4	(2.5)	8.1	0.1
Large Calanoids											
Calanoid, *Calanus spp.* female	CCF	1.0	(2.9)	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, large, *Neocalanus/Calanus*	CLN	0.0	(0.0)	0.0	(0.0)	0.7	(1.4)	0.0	(0.1)	0.0	0.0
Calanoid, *Calanus marshallae* general	CM	0.1	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *C. marshallae* copepodite CV	CMC	5.0	(11.3)	0.1	(0.2)	3.6	(3.2)	0.2	(0.1)	0.0	0.0
Calanoid, *C. marshallae* female	CMF	0.0	(0.0)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)	0.0	0.0
Calanoid, *C. marshallae* male	CMM	0.0	(0.1)	0.0	(0.0)	0.1	(0.3)	0.0	(0.0)	0.0	0.0
Calanoid, *Calanus pacificus* adult	CPA	0.1	(0.2)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Calanus pacificus*, general	CPC	1.2	(2.8)	0.0	(0.1)	0.2	(0.1)	0.0	(0.0)	0.0	0.0
copepodids	CPD	17.6	(36.2)	0.6	(1.2)	33.6	(27.1)	1.8	(2.0)	4.1	0.1
Calanoid, *Calanus pacificus* female	CPF	0.0	(0.0)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)	0.0	0.0
Calanoid, *Calanus spp*. general	CPG	1.2	(2.9)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Calanus pacificus* male	CPM	0.0	(0.0)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)	0.0	0.0
Calanoid, *C. pacificus* copepodite CV	CPV	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Eucalanus bungii*, copepodite	EBC	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *E.longipedata*, copepodite	EPC	1.0	(2.9)	0.0	(0.1)	0.6	(1.0)	0.0	(0.1)	0.0	0.0
Calanoid, *E.longipedata*, female	EPF	0.1	(0.2)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)	0.0	0.0
Calanoid, *E.longipedata*, male	EPM	0.0	(0.1)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)	0.0	0.0
Calanoid, *Eucalanus bungii*, general	EUB	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Metridia spp*. copepodids I-IV	MCP	0.3	(0.7)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Metridia pacifica* copepodite	MCS	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Metridia pacifica*, general	MEP	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Metridia ochotensis* female	MOF	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *M.pacifica* CV copepodite	MPC	0.5	(1.4)	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Metridia pacifica*, female	MPF	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Neocalanus spp*. copepodite	NCP	1.3	(2.9)	0.0	(0.1)	10.0	(7.9)	0.4	(0.4)	0.0	0.0
Calanoid, *Neocalanus plumchrus* female	NPF	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Small Calanoids											
Calanoid, *Acartia spp*.	AC	16.8	(44.3)	1.2	(3.2)	1.0	(2.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Acartia spp*. copepodids	ACP	66.7	(141.3)	2.5	(4.8)	58.1	(68.0)	2.4	(3.6)	0.0	0.0
Calanoid, *Acartia longiremus* copepodite	ALC	62.9	(62.6)	2.9	(3.6)	45.6	(65.7)	2.5	(3.3)	99.8	2.8
Calanoid, *Acartia longiremis* female	ALF	43.5	(46.2)	1.6	(1.6)	48.9	(62.1)	2.2	(3.3)	38.7	1.0
Calanoid, *Acartia longiremus* male	ALM	32.1	(55.8)	1.1	(1.8)	19.9	(30.7)	0.9	(1.6)	8.1	0.1
Calanoid, *C.abdominalis*, copepodite	CAC	129.5	(154.9)	5.7	(5.3)	117.1	(95.0)	6.4	(3.9)	136.5	3.9
abdominalis,female	CAF	14.2	(8.1)	0.5	(0.3)	5.7	(6.6)	0.5	(0.4)	12.2	0.2
Calanoid, *Centropages abdominalis*,male	CAM	18.8	(39.0)	0.8	(1.3)	9.2	(10.7)	0.5	(0.6)	36.7	0.5
Calanoid, general nauplius	CAN	13.5	(22.0)	0.5	(0.8)	6.9	(5.5)	0.4	(0.4)	8.1	0.1
Calanoid, general small (x<2.5 mm)	CAS	5.1	(9.7)	0.1	(0.2)	24.4	(43.6)	0.6	(0.7)	24.4	0.4
Calanoid, Copepodite small, general	COS	7.1	(17.1)	0.3	(0.6)	4.1	(8.1)	0.3	(0.6)	0.0	0.0
Calanoid, *E.pacifica*, copepodite	EYC	7.1	(11.1)	0.2	(0.3)	2.0	(4.1)	0.1	(0.1)	0.0	0.0
Calanoid, *Eurytemora pacifica* female	EYF	2.3	(3.7)	0.1	(0.1)	6.1	(7.8)	0.2	(0.2)	4.1	0.1
Calanoid, *Eurytemora pacifica*, gravid	EYG	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	16.3	0.2
Calanoid, *Eurytemora pacifica* male	EYM	3.3	(6.0)	0.1	(0.1)	2.5	(3.1)	0.2	(0.2)	0.0	0.0
Cyclopoid, *Corycaeus spp*.	GOG	0.0	(0.0)	0.0	(0.0)	2.0	(4.1)	0.0	(0.1)	0.0	0.0
Cyclopoid, *Oithona spp*., general	OIT	50.9	(66.9)	1.8	(2.4)	41.0	(27.9)	2.7	(2.7)	260.8	3.9
Cyclopoid, *Oithona similis*, general	OS	32.2	(59.0)	1.8	(2.6)	15.3	(30.6)	1.1	(2.2)	0.0	0.0
Cyclopoid, *Oithona spp*. copepodite	OSC	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	28.5	0.7
Cyclopoid, *Oithona similis* AF	OSF	3.6	(10.1)	0.3	(0.9)	6.1	(7.8)	0.3	(0.4)	81.5	1.0
Cyclopoid, *Oithona similis* AM	OSM	0.0	(0.0)	0.0	(0.0)	0.5	(1.0)	0.0	(0.1)	8.1	0.1
Cyclopoid, *Oithona spinirostris*, female	OTF	3.6	(6.7)	0.1	(0.2)	5.1	(7.7)	0.1	(0.2)	0.0	0.0
Cyclopoid, *Oithona spinirostris*, male	OTM	3.1	(8.6)	0.1	(0.2)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cyclopoid, *Oithona spinirostris*	OTS	4.1	(11.5)	0.1	(0.2)	1.0	(2.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Pseudocalanus* copepodids I-IV	PCP	887.2	(455.8)	34.2	(11.2)	681.7	(284.7)	38.6	(5.1)	1939.4	53.4
Calanoid, *Pseudocalanus spp*., general	PSA	10.7	(30.3)	1.0	(2.9)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Pseudocalanus spp*. female	PSF	463.6	(376.0)	17.4	(12.5)	232.7	(89.6)	14.7	(5.9)	554.1	15.0
female	PSG	5.1	(6.1)	0.1	(0.1)	0.0	(0.0)	0.0	(0.0)	16.3	0.2

Pacific Sandlance

Species	Code	Allopatric Stations				Sympatric Stations					
						with Herring				with Pink Salmon	
		Density		%Density		Density		%Density		Density	%Density
Calanoid, *Pseudocalanus spp.* male	PSM	8.7	(15.5)	0.2	(0.3)	4.1	(4.7)	0.2	(0.3)	77.4	1.0
Chaetognaths											
Chaetognath, species unknown	CHT	0.2	(0.3)	0.0	(0.0)	1.1	(2.3)	0.1	(0.2)	0.8	0.0
Chaetognath, *Sagitta elegans*	SGE	0.1	(0.2)	0.0	(0.0)	0.3	(0.5)	0.0	(0.0)	0.3	0.0
Cladocerans											
Cladocera, General	CLA	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cladoceran, *Evadne spp.*	EVD	15.7	(23.6)	0.6	(0.8)	40.5	(68.1)	1.5	(2.3)	12.2	0.3
Cladoceran, *Podon spp.*	PON	25.0	(27.8)	0.8	(1.0)	41.8	(53.9)	1.4	(1.8)	32.6	0.9
Cyphonautes											
Bryozoa, cyphonautes larva	CFN	2.3	(3.7)	0.1	(0.1)	1.9	(2.2)	0.1	(0.2)	4.1	0.1
Decapods											
Decapod, megalops, unknown crab	DCM	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Decapod, zoea, *Brachyura*, general	DGB	3.1	(5.7)	0.1	(0.2)	4.3	(8.0)	0.1	(0.1)	0.0	0.0
Decapod, zoea, unknown general	DUG	0.1	(0.3)	0.0	(0.0)	0.1	(0.3)	0.0	(0.0)	0.0	0.0
Decapod zoea, crab, *Brachyrhyncha*	DZB	1.4	(2.9)	0.1	(0.1)	2.0	(4.1)	0.1	(0.1)	0.0	0.0
Decapod zoea, Shrimp, *Crangonidae*	DZC	3.7	(5.9)	0.2	(0.2)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Decapod zoea, crab, general unknown	DZG	3.1	(6.0)	0.1	(0.1)	0.0	(0.0)	0.0	(0.0)	4.1	0.1
Decapod zoea, Shrimp, *Hippolytidae*	HIE	0.3	(0.6)	0.0	(0.0)	0.4	(0.4)	0.0	(0.0)	0.0	0.0
Decapod zoea, Anomuran, *Lithodidae*	LIZ	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Decapod zoea, crab, *Oregoninae*	ORG	0.4	(0.6)	0.0	(0.0)	0.2	(0.4)	0.0	(0.0)	0.0	0.0
Decapod zoea, hermit crab, *Paguridae*	PGZ	1.2	(2.8)	0.0	(0.0)	0.2	(0.2)	0.0	(0.0)	0.0	0.0
Decapod zoea, general shrimp	SHR	3.2	(4.6)	0.1	(0.2)	0.3	(0.4)	0.0	(0.0)	6.2	0.2
Euphausiids											
Euphausiid egg	EU1	2.3	(5.7)	0.1	(0.2)	6.6	(13.2)	0.4	(0.8)	0.0	0.0
Euphausiid nauplii	EU2	6.6	(11.9)	0.2	(0.3)	1.5	(3.1)	0.1	(0.2)	0.0	0.0
Euphausiid calyptopis	EU3	10.1	(19.9)	0.4	(0.6)	2.8	(3.8)	0.1	(0.2)	8.1	0.1
Euphausiid furcilia	EU4	0.9	(1.9)	0.1	(0.1)	0.4	(0.5)	0.1	(0.1)	0.0	0.0
Euphausiid juvenile, general	EUJ	0.0	(0.0)	0.0	(0.0)	0.2	(0.4)	0.0	(0.0)	0.0	0.0
Euphausiid, *Thysannoessa spp.* juvenile	THJ	0.1	(0.2)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Euphausiid, *Thysanoessa spinifera*	TS	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Fish											
Fish, robust larva	FIS	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Fish egg (~1.0 mm)	FSE	2.0	(5.8)	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Fish, small juvenile/larva, general	FSL	0.1	(0.1)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)	0.0	0.0
Fish, *Scorpaenidae, gen. rockfish spp.*	FSR	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Gammarid Amphipods											
Amphipod, Gammarid, unknown, small	GA1	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Gastropods											
Gastropod, juv. snail w/ black pigment	GSB	108.7	(86.7)	4.7	(3.7)	103.9	(127.0)	3.7	(4.2)	140.6	3.9
Gastropoda, general juvenile (SNAIL)	GST	13.8	(35.7)	0.4	(1.2)	10.2	(20.4)	0.3	(0.5)	0.0	0.0
Gastropod, Pteropod, *Limacina helicina* A	LMA	0.0	(0.1)	0.0	(0.0)	4.1	(8.1)	0.1	(0.2)	0.0	0.0
Gastropod, Pteropod, *Limacina helicina* J	LMJ	63.9	(103.7)	2.7	(4.7)	10.2	(15.4)	0.5	(0.9)	0.0	0.0
Gastropod, general veliger	VEL	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	4.1	0.1
Hyperiid Amphipods											
Amphipod, Hyperiid, *Hyperia spp.*	HP	0.0	(0.0)	0.0	(0.0)	0.3	(0.6)	0.0	(0.0)	0.0	0.0
Amphipod, Hyperiid, *Hyperia spp.* juvenile	HPJ	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Amphipod, Hyperiid, unknown SMALL	HYB	0.1	(0.2)	0.0	(0.0)	0.3	(0.4)	0.0	(0.0)	0.0	0.0
Amphipod, Hyperiid, unknown MEDIUM	HYP	0.2	(0.3)	0.0	(0.0)	0.2	(0.4)	0.0	(0.0)	0.0	0.0
Amphipod, Hyperiid/*P. pacifica* juvenile	PA1	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Amphipod, Hyperiid/*P. pacifica* juvenile	PA2	0.5	(0.9)	0.0	(0.0)	0.4	(0.7)	0.0	(0.0)	0.0	0.0
Amphipod, Hyperiid, *P.libellula*	PL1	0.0	(0.0)	0.0	(0.0)	0.2	(0.4)	0.0	(0.0)	0.0	0.0
Amphipod, Hyperiid, *P. libellula*	PL2	0.0	(0.0)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)	0.0	0.0
Insects											
Insect, Collembola, globular, purple	CGR	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Insect, larva, unknown	ILU	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cnidarians/ Ctenophores											
Cnidaria, Anthozoa, anemone	CAA	0.1	(0.2)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cnidaria, Hydrozoan medusae, general	CHM	2.6	(5.0)	0.2	(0.4)	3.2	(4.7)	0.2	(0.3)	12.2	0.2
Cnidaria, general jellyfish (x>2mm)	CNI	2.1	(4.1)	0.1	(0.2)	1.3	(2.2)	0.1	(0.2)	1.8	0.0
Cnidaria, general jellyfish (x<2mm)	CNS	9.6	(11.9)	0.3	(0.4)	22.9	(17.4)	0.9	(0.9)	8.1	0.1
Cnidaria, *Eperetmus typus*	EPT	0.1	(0.2)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cnidaria, *Halitholus spp.*	HTS	0.1	(0.2)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cnidaria, *Melicertum spp.*	MEL	0.1	(0.3)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cnidaria, *Proboscidactyla flavicirrata*	PFL	0.1	(0.3)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cnidaria, *Phialidium gregarium*	PHG	0.4	(1.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cnidaria, Hydrozoa, Siphonophore "larva"	SIP	0.8	(2.3)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0

Pacific Sandlance

Species	Code	Allopatric Stations				Sympatric Stations with Herring				Sympatric Stations with Pink Salmon	
		Density		%Density		Density		%Density		Density	%Density
Cnidaria, *Trachymedusae spp.*	TRC	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Larvaceans											
Larvacea, *Oikopleura* < 2mm (IMS)	OI1	12.5	(30.5)	1.1	(3.0)	1.0	(2.0)	0.0	(0.1)	32.6	0.5
Larvacea, *Oikopleura dioica*	OKI	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	350.4	4.5
Larvacea, Oikopleura spp.	OKP	195.4	(64.7)	8.7	(2.6)	152.5	(128.8)	7.7	(3.0)	211.9	3.1
Other											
Bivalve, general juvenile	BVJ	0.5	(1.4)	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Bivalve, larvae	BVL	61.9	(51.9)	2.5	(2.0)	56.5	(68.2)	2.4	(2.1)	44.8	1.2
Ostracod, *Conchoecia spp.*, small	CNC	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Echinodermata, Brittlestar pluteus	EBP	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
(<0.2mm)	EGG	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	4.1	0.1
(>0.2mm)	EGL	8.1	(20.0)	0.3	(0.8)	13.8	(7.7)	0.6	(0.5)	0.0	0.0
Gastropod, egg case (Littorina)	GEC	0.0	(0.0)	0.0	(0.0)	2.0	(4.1)	0.0	(0.1)	0.0	0.0
Harpacticoid, general, unknown stage	HR	0.0	(0.0)	0.0	(0.0)	2.0	(4.1)	0.0	(0.1)	0.0	0.0
Harpacticoid, general copepodite	HRC	0.1	(0.2)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Harpacticoid, *Harpacticus*, unknown stage	HSU	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Harpacticoid, *Zaus spp.* copepodite	HZC	0.0	(0.0)	0.0	(0.0)	0.5	(1.0)	0.0	(0.1)	0.0	0.0
Harpacticoid, *Zaus spp.* general	HZZ	1.0	(2.9)	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	8.1	0.1
Isopod, general	ISP	1.3	(2.9)	0.1	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Copepod, *Monstrilla spp.*	MX	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Polychaeta, general, juvenile	PLL	1.1	(2.9)	0.0	(0.1)	3.1	(3.9)	0.1	(0.1)	0.0	0.0

Apendix 2c. Zooplankton available to juvenile pink salmon as density (number*m^{-3}) and percent density by species in taxonomic groups at stations corresponding to allopatric (n = 3) and sympatric (n = 3 with herring, n = 1 with sandlance) samples collected in PWS during July, 1996. Values in parentheses are standard deviations of the means. Replicate samples were collected at each station in 20 m vertical hauls using a 0.5 m diameter ring net with 243 μm mesh.

Pink Salmon

		Allopatric Stations				Sympatric Stations					
						with Herring				with Sandlance	
Species	Code	Density		%Density		Density		%Density		Density	%Density
Barnacles											
Barnacle, cyprid	BMC	11.5	(10.5)	0.3	(0.4)	5.4	(9.4)	0.1	(0.1)	0.0	0.0
Barnacle, adult molt (cirri & moutharea)	BMM	0.0	(0.0)	0.0	(0.0)	5.4	(9.4)	0.1	(0.2)	0.0	0.0
Barnacle, nauplius	BMP	19.0	(20.5)	0.2	(0.2)	9.5	(10.3)	0.3	(0.3)	8.1	0.1
Large Calanoids											
Calanoid, *Calanus spp.* female	CCF	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, large, *Neocalanus/Calanus*	CLN	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Calanus marshallae* general	CM	0.3	(0.6)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *C. marshallae* copepodite CV	CMC	0.6	(0.6)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)	0.0	0.0
Calanoid, *C. marshallae* female	CMF	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *C. marshallae* male	CMM	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Calanus pacificus* adult	CPA	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Calanus pacificus*, general	CPC	0.0	(0.0)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)	0.0	0.0
copepodids	CPD	8.1	(14.1)	0.1	(0.2)	10.9	(4.7)	0.2	(0.0)	4.1	0.1
Calanoid, *Calanus pacificus* female	CPF	0.1	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Calanus spp*. general	CPG	0.0	(0.0)	0.0	(0.0)	1.1	(1.7)	0.0	(0.0)	0.0	0.0
Calanoid, *Calanus pacificus* male	CPM	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *C. pacificus* copepodite CV	CPV	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Eucalanus bungii*, copepodite	EBC	0.0	(0.0)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)	0.0	0.0
Calanoid, *E.longipedata*, copepodite	EPC	0.0	(0.0)	0.0	(0.0)	0.3	(0.4)	0.0	(0.0)	0.0	0.0
Calanoid, *E.longipedata*, female	EPF	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *E.longipedata*, male	EPM	0.1	(0.1)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)	0.0	0.0
Calanoid, *Eucalanus bungii*, general	EUB	0.0	(0.0)	0.0	(0.0)	0.2	(0.1)	0.0	(0.0)	0.0	0.0
Calanoid, *Metridia spp*. copepodids I-IV	MCP	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Metridia pacifica* copepodite	MCS	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Metridia pacifica*, general	MEP	0.0	(0.0)	0.0	(0.0)	1.4	(2.4)	0.0	(0.0)	0.0	0.0
Calanoid, *Metridia ochotensis* female	MOF	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *M.pacifica* CV copepodite	MPC	0.0	(0.0)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)	0.0	0.0
Calanoid, *Metridia pacifica*, female	MPF	0.0	(0.0)	0.0	(0.0)	0.7	(1.2)	0.0	(0.0)	0.0	0.0
Calanoid, *Neocalanus spp*. copepodite	NCP	16.3	(28.2)	0.2	(0.3)	9.5	(13.1)	0.1	(0.2)	0.0	0.0
Calanoid, *Neocalanus plumchrus* female	NPF	0.1	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Small Calanoids											
Calanoid, *Acartia spp*.	AC	2.7	(4.7)	0.1	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Acartia spp*. copepodids	ACP	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Acartia longiremus* copepodite	ALC	157.5	(98.3)	5.7	(6.3)	155.5	(81.1)	4.9	(2.0)	99.8	2.8
Calanoid, *Acartia longiremis* female	ALF	209.8	(114.1)	5.2	(4.1)	62.5	(38.5)	1.1	(0.4)	38.7	1.0
Calanoid, *Acartia longiremus* male	ALM	114.1	(114.1)	2.0	(1.5)	27.2	(33.9)	0.4	(0.4)	8.1	0.1
Calanoid, *C.abdominalis*, copepodite	CAC	73.3	(49.6)	2.2	(1.4)	98.5	(65.6)	3.5	(2.5)	136.5	3.9
abdominalis,female	CAF	47.5	(38.9)	0.9	(0.5)	12.9	(4.2)	0.3	(0.2)	12.2	0.2
Calanoid, *Centropages abdominalis*,male	CAM	72.0	(90.2)	1.6	(1.4)	32.6	(43.1)	0.6	(0.9)	36.7	0.5
Calanoid, general nauplius	CAN	6.8	(11.8)	0.1	(0.1)	4.1	(4.1)	0.1	(0.1)	8.1	0.1
Calanoid, general small (x<2.5 mm)	CAS	0.0	(0.0)	0.0	(0.0)	2.7	(4.7)	0.1	(0.1)	24.4	0.4
Calanoid, Copepodite small, general	COS	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *E.pacifica*, copepodite	EYC	9.5	(10.3)	0.1	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Eurytemora pacifica* female	EYF	13.6	(23.5)	0.1	(0.2)	0.0	(0.0)	0.0	(0.0)	4.1	0.1
Calanoid, *Eurytemora pacifica*, gravid	EYG	6.8	(11.8)	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	16.3	0.2
Calanoid, *Eurytemora pacifica* male	EYM	0.0	(0.0)	0.0	(0.0)	2.7	(4.7)	0.1	(0.1)	0.0	0.0
Cyclopoid, *Corycaeus spp*.	GOG	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cyclopoid, *Oithona spp*., general	OIT	108.0	(30.4)	3.3	(1.8)	112.0	(55.8)	3.7	(1.4)	260.8	3.9
Cyclopoid, *Oithona similis*, general	OS	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cyclopoid, *Oithona spp*. copepodite	OSC	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	28.5	0.7
Cyclopoid, *Oithona similis* AF	OSF	0.0	(0.0)	0.0	(0.0)	1.4	(2.4)	0.0	(0.0)	81.5	1.0
Cyclopoid, *Oithona similis* AM	OSM	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	8.1	0.1
Cyclopoid, *Oithona spinirostris*, female	OTF	13.6	(23.5)	0.2	(0.4)	8.1	(8.1)	0.2	(0.2)	0.0	0.0
Cyclopoid, *Oithona spinirostris*, male	OTM	6.8	(11.8)	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cyclopoid, *Oithona spinirostris*	OTS	5.4	(9.4)	0.1	(0.1)	5.4	(9.4)	0.1	(0.2)	0.0	0.0
Calanoid, *Pseudocalanus* copepodids I-IV	PCP	1781.9	(1032.7)	41.7	(12.6)	1432.8	(291.0)	48.2	(3.5)	1939.4	53.4
Calanoid, *Pseudocalanus spp*., general	PSA	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Calanoid, *Pseudocalanus spp*. female	PSF	700.8	(438.5)	16.0	(1.4)	431.9	(168.6)	15.5	(8.2)	554.1	15.0
female	PSG	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	16.3	0.2

Pink Salmon

Species	Code	Allopatric Stations				Sympatric Stations					
						with Herring				with Sandlance	
		Density		%Density		Density		%Density		Density	%Density
Calanoid, *Pseudocalanus spp*. male	PSM	5.4	(9.4)	0.1	(0.1)	16.3	(14.1)	0.2	(0.2)	77.4	1.0
Chaetognaths											
Chaetognath, species unknown	CHT	0.4	(0.7)	0.0	(0.0)	1.5	(1.3)	0.1	(0.1)	0.8	0.0
Chaetognath, *Sagitta elegans*	SGE	0.1	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.3	0.0
Cladocerans											
Cladocera, General	CLA	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cladoceran, *Evadne spp.*	EVD	28.5	(29.4)	0.6	(0.7)	41.4	(14.5)	1.4	(0.4)	12.2	0.3
Cladoceran, *Podon spp.*	PON	12.2	(10.8)	0.4	(0.5)	44.8	(21.6)	1.5	(0.6)	32.6	0.9
Cyphonautes											
Bryozoa, cyphonautes larva	CFN	23.1	(33.2)	0.4	(0.5)	10.4	(2.2)	0.4	(0.2)	4.1	0.1
Decapods											
Decapod, megalops, unknown crab	DCM	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Decapod, zoea, *Brachyura*, general	DGB	2.7	(4.7)	0.0	(0.1)	3.8	(6.3)	0.2	(0.3)	0.0	0.0
Decapod, zoea, unknown general	DUG	0.2	(0.4)	0.0	(0.0)	0.3	(0.3)	0.0	(0.0)	0.0	0.0
Decapod zoea, crab, *Brachyrhyncha*	DZB	5.9	(9.1)	0.3	(0.5)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Decapod zoea, Shrimp, *Crangonidae*	DZC	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Decapod zoea, crab, general unknown	DZG	11.1	(18.6)	0.1	(0.2)	0.0	(0.0)	0.0	(0.0)	4.1	0.1
Decapod zoea, Shrimp, *Hippolytidae*	HIE	0.0	(0.0)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)	0.0	0.0
Decapod zoea, Anomuran, *Lithodidae*	LIZ	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Decapod zoea, crab, *Oregoninae*	ORG	0.1	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Decapod zoea, hermit crab, *Paguridae*	PGZ	0.1	(0.1)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)	0.0	0.0
Decapod zoea, general shrimp	SHR	5.8	(5.1)	0.1	(0.1)	0.4	(0.7)	0.0	(0.0)	6.2	0.2
Euphausiids											
Euphausiid egg	EU1	20.4	(35.3)	0.1	(0.3)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Euphausiid nauplii	EU2	15.6	(15.3)	0.2	(0.2)	2.7	(4.7)	0.1	(0.1)	0.0	0.0
Euphausiid calyptopis	EU3	15.6	(15.3)	0.2	(0.2)	2.7	(4.7)	0.0	(0.1)	8.1	0.1
Euphausiid furcilia	EU4	5.4	(9.4)	0.1	(0.1)	0.1	(0.1)	0.0	(0.0)	0.0	0.0
Euphausiid juvenile, general	EUJ	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Euphausiid, *Thysannoessa spp.* juvenile	THJ	0.2	(0.4)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Euphausiid, *Thysanoessa spinifera*	TS	0.1	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Fish											
Fish, robust larva	FIS	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Fish egg (~1.0 mm)	FSE	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Fish, small juvenile/larva, general	FSL	0.0	(0.0)	0.0	(0.0)	0.2	(0.1)	0.0	(0.0)	0.0	0.0
Fish, *Scorpaenidae,* gen. rockfish spp.	FSR	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Gammarid Amphipods											
Amphipod, Gammarid, unknown, small	GA1	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Gastropods											
Gastropod, juv. snail w/ black pigment	GSB	306.9	(325.8)	5.8	(4.2)	129.0	(85.9)	1.9	(0.7)	140.6	3.9
Gastropoda, general juvenile (SNAIL)	GST	20.4	(35.3)	0.3	(0.5)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Gastropod, Pteropod, *Limacina helicina* A	LMA	2.8	(4.9)	0.1	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Gastropod, Pteropod, *Limacina helicina* J	LMJ	43.5	(75.3)	0.5	(0.8)	54.3	(26.5)	1.5	(0.7)	0.0	0.0
Gastropod, general veliger	VEL	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	4.1	0.1
Hyperiid Amphipods											
Amphipod, Hyperiid, *Hyperia spp*.	HP	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Amphipod, Hyperiid, *Hyperia spp*. juvenile	HPJ	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Amphipod, Hyperiid, unknown SMALL	HYB	0.0	(0.0)	0.0	(0.0)	2.8	(4.6)	0.1	(0.1)	0.0	0.0
Amphipod, Hyperiid, unknown MEDIUM	HYP	0.1	(0.1)	0.0	(0.0)	0.5	(0.4)	0.0	(0.0)	0.0	0.0
Amphipod, Hyperiid/*P. pacifica* juvenile	PA1	0.6	(1.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Amphipod, Hyperiid/*P. pacifica* juvenile	PA2	1.0	(1.1)	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Amphipod, Hyperiid, *P.libellula*	PL1	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Amphipod, Hyperiid, *P. libellula*	PL2	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Insects											
Insect, Collembola, globular, purple	CGR	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Insect, larva, unknown	ILU	1.4	(2.4)	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cnidarians/ Ctenophores											
Cnidaria, Anthozoa, anemone	CAA	0.1	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cnidaria, Hydrozoan medusae, general	CHM	2.1	(1.2)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	12.2	0.2
Cnidaria, general jellyfish (x>2mm)	CNI	0.5	(0.9)	0.0	(0.0)	12.9	(11.7)	0.3	(0.2)	1.8	0.0
Cnidaria, general jellyfish (x<2mm)	CNS	0.0	(0.0)	0.0	(0.0)	6.7	(8.6)	0.2	(0.4)	8.1	0.1
Cnidaria, *Eperetmus typus*	EPT	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cnidaria, *Halitholus spp.*	HTS	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cnidaria, *Melicertum spp.*	MEL	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cnidaria, *Proboscidactyla flavicirrata*	PFL	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cnidaria, *Phialidium gregarium*	PHG	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Cnidaria, Hydrozoa, Siphonophore "larva"	SIP	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0

Pink Salmon

Species	Code	Allopatric Stations				Sympatric Stations					
						with Herring				with Sandlance	
		Density		%Density		Density		%Density		Density	%Density
Cnidaria, *Trachymedusae spp.*	TRC	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Larvaceans											
Larvacea, *Oikopleura* < 2mm (IMS)	OI1	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	32.6	0.5
Larvacea, *Oikopleura dioica*	OKI	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	350.4	4.5
Larvacea, Oikopleura spp.	OKP	300.1	(224.8)	6.3	(3.7)	220.7	(47.8)	7.6	(0.8)	211.9	3.1
Other											
Bivalve, general juvenile	BVJ	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Bivalve, larvae	BVL	139.9	(80.9)	4.2	(3.5)	149.4	(183.1)	4.9	(5.7)	44.8	1.2
Ostracod, *Conchoecia spp.*, small	CNC	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Echinodermata, Brittlestar pluteus	EBP	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
(<0.2mm)	EGG	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	4.1	0.1
(>0.2mm)	EGL	0.0	(0.0)	0.0	(0.0)	2.7	(4.7)	0.1	(0.1)	0.0	0.0
Gastropod, egg case (Littorina)	GEC	0.0	(0.0)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)	0.0	0.0
Harpacticoid, general, unknown stage	HR	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Harpacticoid, general copepodite	HRC	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Harpacticoid, *Harpacticus*, unknown stage	HSU	2.7	(4.7)	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Harpacticoid, *Zaus spp.* copepodite	HZC	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Harpacticoid, *Zaus spp.* general	HZZ	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	8.1	0.1
Isopod, general	ISP	6.8	(11.8)	0.0	(0.1)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Copepod, *Monstrilla spp.*	MX	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	0.0
Polychaeta, general, juvenile	PLL	0.0	(0.0)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)	0.0	0.0

Appendix 3a. Mean percent frequency, percent number, and percent weight of prey species consumed by allopatric and sympatric juvenile herring in PWS during July, 1996.

Preyname	Species Code	Allopatric Herring (n = 10 sets)			Herring Sympatric with Pink Salmon (n = 4 sets)			Herring Sympatric with Sandlance (n = 4 sets)		
		Percent Freq.	Percent Number	Percent Weight	Percent Freq.	Percent Number	Percent Weight	Percent Freq.	Percent Number	Percent Weight
Barnacles										
Barnacle, cyprid	BMC	13.0	0.4	1.6	0.0	0.0	0.0	38.3	0.3	1.7
Barnacle, adult molt (cirri & moutharea)	BMM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Barnacle, nauplius	BMP	12.0	0.0	0.2	0.0	0.0	0.0	36.9	0.4	1.4
Large Calanoids										
Calanoid, general large (x>2.5 mm)	CAL	4.0	0.0	0.1	17.5	5.8	12.9	0.0	0.0	0.0
Calanoid, *Calanus spp.* copepodite	CCP	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Neocalanus cristatus*, adult	CCR	0.0	0.0	0.0	5.0	0.0	0.2	0.0	0.0	0.0
Calanoid, *Neocalanus cristatus* stage V	CCV	0.0	0.0	0.0	2.5	0.0	0.1	0.0	0.0	0.0
Calanoid, large, *Neocalanus/Calanus*	CLN	0.0	0.0	0.0	15.0	1.2	2.4	0.0	0.0	0.0
Calanoid, *Calanus marshallae* general	CM	0.0	0.0	0.0	7.5	0.0	0.8	0.0	0.0	0.0
Calanoid, *C. marshallae* copepodite CV	CMC	4.0	0.0	0.0	2.5	0.0	0.0	10.0	0.1	2.1
Calanoid, *C. marshallae* female	CMF	1.0	0.0	0.3	7.5	0.0	0.0	0.0	0.0	0.0
Calanoid, *C marshallae* male	CMM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Calanus pacificus* adult	CPA	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Calanus pacificus*, general	CPC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Calanus/Neocalanus* copepodids	CPD	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0
Calanoid, *Calanus pacificus* female	CPF	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Calanus spp.* general	CPG	2.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0
Calanoid, *C. pacificus* copepodite CV	CPV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Eucalanus bungii*, female	EBF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Eucalanus bungi*, male	EBM	1.0	0.0	0.3	2.5	0.0	0.0	0.0	0.0	0.0
Calanoid, *E longipedata*, copepodite	EPC	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *E.longipedata*, female	EPF	5.0	0.0	0.1	2.5	0.0	0.0	0.0	0.0	0.0
Calanoid, *E longipedata*, general	EPI	0.0	0.0	0.0	5.0	0.0	0.1	0.0	0.0	0.0
Calanoid, *E.longipedata*, male	EPM	6.0	0.1	0.2	2.5	0.0	0.0	0.0	0.0	0.0
Calanoid, *Euchirella rostrata* female	ERF	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Eucalanus bungii*, general	EUB	0.0	0.0	0.0	25.0	0.4	1.4	0.0	0.0	0.0
Calanoid, *Metridia pacifica* copepodite	MCS	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0
Calanoid, *Metridia pacifica*, general	MEP	0.0	0.0	0.0	7.5	0.3	0.1	0.0	0.0	0.0
Calanoid, *Metridia spp* female	MGF	0.0	0.0	0.0	2.5	0.1	3.4	0.0	0.0	0.0
Calanoid, *Metridia ocholensis* female	MOF	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0
Calanoid, *Metridia ocholensis*, general	MOP	0.0	0.0	0.0	12.5	1.8	2.4	0.0	0.0	0.0
Calanoid, *M pacifica* CV copepodite	MPC	2.0	0.0	0.0	10.0	0.2	0.0	0.0	0.0	0.0
Calanoid, *Metridia pacifica*, female	MPF	0.0	0.0	0.0	17.5	2.1	1.5	0.0	0.0	0.0
Calanoid, *Metridia pacifica*, male	MPM	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0
Calanoid, *M ocholensis* CV male	MVM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Neocalanus spp.* copepodite	NCP	0.0	0.0	0.0	10.0	0.6	0.5	0.0	0.0	0.0
Calanoid, *Neocalanus spp.* adult	NEO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Neocalanus plumchrus* female	NPF	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0
Small Calanoids										
Calanoid, *Acartia spp.*	AC	27.0	1.0	0.4	2.5	0.0	0.0	27.5	1.9	1.6
Calanoid, *Acartia clausi* male	ACM	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Acartia sp.* copepodids	ACP	15.0	1.0	0.1	10.0	0.1	0.0	5.6	0.0	0.0
Calanoid, *Acartia longiremus* adult	AL	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0
Calanoid, *Acartia longiremus* copepodite	ALC	7.0	0.1	0.0	2.5	0.0	0.0	13.9	0.3	0.1
Calanoid, *Acartia longiremis* female	ALF	17.0	0.2	0.1	5.0	0.1	0.0	5.0	0.0	0.0
Calanoid, *Acartia longiremis*, general	ALG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Acartia longiremus* male	ALM	4.0	0.0	0.0	0.0	0.0	0.0	2.8	0.0	0.0

Preyname	Species Code	Allopatric Herring (n = 10 sets)			Herring Sympatric with Pink Salmon (n = 4 sets)			Herring Sympatric with Sandlance (n = 4 sets)		
		Percent Freq.	Percent Number	Percent Weight	Percent Freq.	Percent Number	Percent Weight	Percent Freq.	Percent Number	Percent Weight
Calanoid, *C. abdominalis*, general	CA	2.0	0.0	0.0	5.0	0.1	0.1	5.6	0.1	0.1
Calanoid, *C. abdominalis*, copepodite	CAC	36.0	0.4	0.1	5.0	0.1	0.1	52.2	0.7	0.5
Calanoid, Centropages abdominalis,female	CAF	20.0	0.5	0.2	2.5	0.0	0.0	33.3	0.2	0.9
Calanoid, *Centropages abdominalis*,male	CAM	4.0	0.1	0.0	2.5	0.0	0.0	2.8	0.0	0.0
Calanoid, general nauplius	CAN	47.0	7.2	2.3	5.0	0.5	0.1	70.3	7.0	2.0
Calanoid, general small (x<2.5 mm)	CAS	68.0	28.4	28.0	50.0	37.2	25.1	81.9	24.1	37.5
Calanoid, *Centropages*, general	CAU	4.0	0.9	0.2	0.0	0.0	0.0	2.5	0.0	0.0
Calanoid, Copepodite small, general	COS	30.0	11.1	7.8	2.5	0.6	0.0	84.2	41.9	28.7
Calanoid, *E. pacifica*, copepodite	EYC	11.0	0.1	0.2	0.0	0.0	0.0	5.0	0.0	0.1
Calanoid, *Eurytemora pacifica* female	EYF	2.0	0.0	0.0	0.0	0.0	0.0	5.6	0.0	0.0
Calanoid, *Eurytemora pacifica* male	EYM	1.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0
Calanoid, *Eurytemora pacifica*, general	EYT	4.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0
Cyclopoid, *Oithona spp.*, general	OIT	49.0	5.6	2.0	20.0	11.9	3.2	60.8	8.3	3.0
Cyclopoid, *Oithona similis*, general	OS	3.0	0.0	0.0	0.0	0.0	0.0	30.0	6.2	2.0
Cyclopoid, *Oithona spp.* copepodite	OSC	11.0	3.4	1.5	0.0	0.0	0.0	7.5	0.8	0.3
Cyclopoid, *Oithona similis* AF	OSF	7.0	0.1	0.0	0.0	0.0	0.0	10.3	0.1	0.0
Cyclopoid, *Oithona similis* gravid female	OSG	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclopoid, *Oithona similis* AM	OSM	2.0	0.0	0.0	0.0	0.0	0.0	2.8	0.0	0.0
Cyclopoid, *Oithona spinirostris*, female	OTF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclopoid, *Oithona spinirostris*	OTS	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0
Calanoid, *Pseudocalanus copepodids* I-IV	PCP	23.0	1.2	0.8	12.5	0.5	0.1	16.7	1.3	0.8
Calanoid, *Pseudocalanus spp*, general	PSA	40.0	3.7	7.2	10.0	0.4	0.4	41.1	1.4	5.1
Calanoid, *Pseudocalanus spp.* female	PSF	31.0	1.0	1.7	17.5	0.3	0.6	36.7	0.2	0.9
Calanoid, *Pseudocalanus spp*. gravid female	PSG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Pseudocalanus spp*. male	PSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chaetognaths										
Chaetognath, species unknown	CHT	0.0	0.0	0.0	25.0	0.1	0.0	0.0	0.0	0.0
Chaetognath, *Sagitta elegans*	SGE	0.0	0.0	0.0	5.0	0.1	0.2	0.0	0.0	0.0
Cladocerans										
Cladocera, General	CLA	5.0	0.2	0.1	5.0	0.3	0.3	20.6	0.1	0.1
Cladoceran, *Evadne spp.*	EVD	26.0	0.3	0.2	2.5	0.0	0.0	36.1	0.2	0.2
Cladoceran, *Podon spp.*	PON	48.0	1.4	1.8	22.5	0.8	0.7	87.5	1.2	1.0
Cyphonautes										
Bryozoa, *Cyphonautes* larva	CFN	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapods										
Decapod, megalops, Cancridae	CAJ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod zoea, crab, Cancridae	CNZ	4.0	0.1	0.3	2.5	0.0	0.0	0.0	0.0	0.0
Decapod, megalops, unknown crab	DCM	0.0	0.0	0.0	2.5	0.0	0.1	0.0	0.0	0.0
Decapod, zoea, Brachyura, general	DGB	8.0	0.1	0.8	10.0	0.0	0.1	11.1	0.0	1.0
Decapod, megalops, Brachyura	DMG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod, megalops, *Majidae*	DMM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod, megalops, *Paguridae*	DMP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod, zoea, unknown general	DUG	18.0	0.5	5.3	2.5	0.0	0.0	8.3	0.1	2.5
Decapod zoea, crab, *Brachyrhyncha*	DZB	9.0	0.1	0.6	0.0	0.0	0.0	5.6	0.0	1.3
Decapod zoea, Shrimp, *Crangonidae*	DZC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod zoea, crab, general unknown	DZG	16.0	0.3	5.6	0.0	0.0	0.0	8.3	0.1	4.6
Decapod zoea, Shrimp, *Hippolytidae*	HIE	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod zoea, Anomuran, *Lithodidae*	LIZ	1.0	0.0	0.0	2.5	0.0	0.1	0.0	0.0	0.0
Decapod zoea, crab, *Oregoninae*	ORG	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod zoea, Shrimp, *Pandalidae*	PDZ	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod zoea, hermit crab, Paguridae	PGZ	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Preyname	Species Code	Allopatric Herring (n = 10 sets)			Herring Sympatric with Pink Salmon (n = 4 sets)			Herring Sympatric with Sandlance (n = 4 sets)		
		Percent Freq.	Percent Number	Percent Weight	Percent Freq.	Percent Number	Percent Weight	Percent Freq.	Percent Number	Percent Weight
Decapod,Shrimp, gen. unknown juv./adult	SHP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod zoea, general shrimp	SHR	10.0	0.0	0.0	0.0	0.0	0.0	2.8	0.0	0.0
Euphausiids										
Euphausiid nauplii	EU2	1.0	0.0	0.0	0.0	0.0	0.0	2.8	0.0	0.0
Euphausiid calyptopis	EU3	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Euphausiid furcilia	EU4	3.0	0.0	0.0	5.0	0.0	0.0	5.0	0.0	0.3
Euphausiid juvenile, general	EUJ	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0
Euphausiid, general unknown	EUP	0.0	0.0	0.0	10.0	0.0	0.3	0.0	0.0	0.0
Euphausiid, *Thysanoessa spp.*, gen. adult	TH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fish										
Fish, *Ammodytes hexapterus* (sandlance)	AMM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fish, flatfish larvae (Pleuronectiform)	FFL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fish, herring juvenile (41-60mm)	FH1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fish, elongate larva	FIL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fish, robust larva	FIS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fish egg (~1.0 mm)	FSE	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.0	0.9
Fish, juvenile, general	FSJ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fish, small juvenile/larva, general	FSL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fish, walleye pollock, (41-60mm)	FW2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gammarid Amphipods										
Amphipod, Gammarid, unknown, small	GA1	3.0	0.1	0.7	0.0	0.0	0.0	2.5	0.0	0.1
Amphipod, Gammarid, unknown, medium	GA2	1.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Gammarid, unknown, large	GA3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Gammarid, *Jassa spp*	GAJ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Gammarid, *Hippomedon spp*	HPP	1.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Gammarid, *Phoxocephalidae*	PHX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gastropods										
Gastropod, juv. snail w/ black pigment	GSB	22.0	0.2	0.2	5.0	0.0	0.0	21.7	0.3	0.6
Gastropoda, general juvenile (SNAIL)	GST	12.0	0.2	0.5	5.0	0.1	0.6	20.0	0.5	2.5
Gastropod, Pteropod, *Limacina helicina* Ad.	LMA	2.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0
Gastropod, Pteropod, *Limacina helicina* Juv	LMJ	16.0	0.1	0.4	12.5	0.1	0.0	33.1	0.7	3.5
Gastropod, general veliger	VEL	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hyperiid Amphipods										
Amphipod, Hyperiid, *Hyperoche med.* GF	HMG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Hyperiid, *Hyperia spp.*	HP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Hyperiid, *Hyperia spp.* juvenile	HPJ	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.1	0.9
Amphipod, Hyperiid, *Hyperoche medusarum*	HPM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Hyperiid, unknown LARGE	HYA	1.0	0.0	0.0	7.5	0.2	2.5	0.0	0.0	0.0
Amphipod, Hyperiid, unknown SMALL	HYB	0.0	0.0	0.0	2.5	0.0	0.0	7.8	0.0	0.2
Amphipod, Hyperiid, unknown MEDIUM	HYP	6.0	0.0	2.4	17.5	0.1	3.3	2.8	0.0	2.1
Amphipod, Hyperiid, *P. pacifica* juvenile	PA1	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0
Amphipod, Hyperiid, *P. pacifica* juvenile	PA2	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Hyperiid, *P. libellula*	PL2	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0
Amphipod, Hyperiid, *P. macropa*	PR2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Hyperiid, *Parathemisto spp.*	PS1	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Hyperiid, *Parathemisto spp.*	PS2	0.0	0.0	0.0	5.0	0.0	0.1	0.0	0.0	0.0
Amphipod, Hyperiid, *Parathemisto spp*	PS3	0.0	0.0	0.0	2.5	0.0	0.1	0.0	0.0	0.0
Insects										
Insect, Collembola, elongate, purple	CEP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insect, Collembola, globular, pink	CGP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insect, Collembola, globular, purple	CGR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Preyname	Species Code	Allopatric Herring (n = 10 sets)			Herring Sympatric with Pink Salmon (n = 4 sets)			Herring Sympatric with Sandlance (n = 4 sets)		
		Percent Freq.	Percent Number	Percent Weight	Percent Freq.	Percent Number	Percent Weight	Percent Freq.	Percent Number	Percent Weight
Insect, Chironomidae, larva (naiad)	CHL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insect, Chironomidae, pupa	CHP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insect, Dipteran adult	DIP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insect, Dipteran larvae	DPL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insect, Dipteran pupae	DPP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insect, general	INS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insect, pupa, unknown	IPU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insect, unknown, large	IUL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cnidarians / Ctenophores										
Cnidaria, general jellyfish (x>2mm)	CNI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cnidaria, general jellyfish (x<2mm)	CNS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ctenophore, only ctenes present	CTM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
White granular matter	WGM	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0
Larvaceans										
Larvacea, *Oikopleura spp.* < 2mm (IMS)	OI1	5.0	0.2	0.3	2.5	0.0	0.0	16.7	1.3	1.2
Larvacea, *Oikopleura dioica*	OKI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larvacea, Oikopleura spp.	OKP	73.0	22.8	13.6	50.0	30.7	21.1	95.3	20.0	11.5
Malocostracans										
Amphipod, unknown gammarid/hyperiid	AMP	1.0	0.0	0.0	0.0	0.0	0.0	2.8	0.0	0.1
Malacostraca, eyes only	MAE	1.0	0.0	0.0	10.0	0.1	0.0	0.0	0.0	0.0
Malacostraca	MAL	2.0	0.1	4.2	12.5	0.2	14.0	0.0	0.0	0.0
Other										
Arthropod, Arachnid, Araneae spp	ARS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Barnacle cirri (setose legs)	BAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bivalve, larvae	BVL	46.0	1.7	0.1	17.5	0.4	0.0	89.7	4.2	0.5
Amphipod, Caprellidae	CAP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ostracod, *Conchoecia spp.*, small	CNC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cumacea	CUM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Echinodermata, Brittlestar pluteus	EBP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unknown invertebrate egg, small (<0.2mm)	EGG	19.0	1.3	0.4	12.5	1.5	0.3	15.3	0.1	0.0
Unknown invertebrate egg, large (>0.2mm)	EGL	3.0	0.0	0.0	2.5	0.1	0.0	0.0	0.0	0.0
Gastropod, egg case (Littorina)	GEC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Harpacticus uniremis*	HAU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, general clasping pair	HCP	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0
Harpacticoid, *Dactylopodia spp.* gravid female	HDG	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Dactylopodia spp.* general	HDP	7.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Ectinosomatid spp.*	HEC	6.0	0.0	0.0	0.0	0.0	0.0	22.5	0.1	0.0
Harpacticoid, *Ectinosomatid spp.*, gravid	HEG	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, general eggsac	HEM	8.0	0.2	0.5	5.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, general, unknown stage	HR	17.0	1.4	2.0	5.0	0.1	0.1	27.8	0.1	0.4
Harpacticoid, general copepodite	HRC	11.0	0.9	0.8	0.0	0.0	0.0	20.0	0.1	0.1
Harpacticoid, general gravid (eggs)	HRE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Harpacticus spp.* female adult	HRF	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Harpacticus spp.* gravid female	HRG	1.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Harpacticus spp.* copepodite	HRJ	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Harpacticus spp.* male adult	HRM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, general nauplius	HRN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, general adult	HRP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Harpacticus spp.* general ad	HRS	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Harpacticus spp.*, unknown stage	HSU	4.0	0.3	0.3	0.0	0.0	0.0	2.8	0.0	0.0
Harpacticoid, *Zaus spp* copepodite	HZC	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Preyname	Species Code	Allopatric Herring (n = 10 sets)			Herring Sympatric with Pink Salmon (n = 4 sets)			Herring Sympatric with Sandlance (n = 4 sets)		
		Percent Freq.	Percent Number	Percent Weight	Percent Freq.	Percent Number	Percent Weight	Percent Freq.	Percent Number	Percent Weight
Harpacticoid, *Zaus spp.* gravid female	HZG	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Zaus spp.* general	HZZ	4.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Isopod, *Gnorimosphaeroma spp.*	IGN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Isopod, general	ISP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Laophontidae spp* , copepodite	LAC	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Laophontidae spp.*, adult	LAO	1.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0
Arthropod, Arachnid, Halacarid mite	MIT	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.2
Copepod, *Monstrillid spp.*	MNX	2.0	0.0	0.0	2.5	0.0	0.0	7.5	0.0	0.0
Bivalve, mussel juvenile	MUJ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mytiloida, *Musculus spp.*	MUS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nematode	NEM	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0
Polychaeta, *Nereidae spp.*	NER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Copepod, *Oithona spp.* egg cases	OIE	9.0	0.1	0.3	2.5	0.1	0.2	17.5	0.1	0.2
Ostracod, general unknown	OST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Copepod, *Caligidae spp.*, parasitic copepod	PCO	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Polychaeta, adult	PLA	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0
Polychaeta, general, juvenile	PLL	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Tisbe spp* , adult	TSB	2.0	0.0	0.0	2.5	0.1	0.0	0.0	0.0	0.0
Harpacticoid, *Tisbe spp* , gravid female	TSG	1.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0
Harpacticoid, *Tisbe spp* , stage unknown	TSU	13.0	0.4	0.3	0.0	0.0	0.0	20.0	0.1	0.1
Unknown egg mass	UEM	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unidentified item	UNI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unknown nauplius	UNP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unknown "worm" shaped – trematode	UNW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Appendix 3b. Mean percent frequency, percent number, and percent weight of prey species consumed by allopatric and sympatric juvenile pink salmon in PWS during July, 1996

Preyname	Species Code	Allopatric Pink Salmon (n = 3 sets) Percent Freq.	Percent Number	Percent Weight	Pink Salmon Sympatric with Herring (n = 6 sets) Percent Freq.	Percent Number	Percent Weight	Pink Salmon Sympatric with Sandlance (n = 1 set) Percent Freq.	Percent Number	Percent Weight
Barnacles										
Barnacle, cyprid	BMC	0.0	0.0	0.0	10.0	0.2	0.5	10.0	0.1	0.8
Barnacle, adult molt (cirri & moutharea)	BMM	0.0	0.0	0.0	6.7	0.2	6.8	10.0	0.0	1.2
Barnacle, nauplius	BMP	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Large Calanoids										
Calanoid, general large (x>2.5 mm)	CAL	16.7	0.4	1.2	18.3	0.1	1.4	0.0	0.0	0.0
Calanoid, *Calanus spp.* copepodite	CCP	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Calanoid, *Neocalanus cristatus*, adult	CCR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Neocalanus cristatus* stage V	CCV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, large, *Neocalanus/Calanus*	CLN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Calanus marshallae* general	CM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *C. marshallae* copepodite CV	CMC	6.7	0.2	0.0	10.0	0.1	0.5	0.0	0.0	0.0
Calanoid, *C. marshallae* female	CMF	10.0	0.2	0.0	8.3	0.1	0.4	0.0	0.0	0.0
Calanoid, *C. marshallae* male	CMM	3.3	0.1	0.0	3.3	0.0	0.1	0.0	0.0	0.0
Calanoid, *Calanus pacificus* adult	CPA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Calanus pacificus*, general	CPC	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Calanoid, *Calanus/Neocalanus* copepodids	CPD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Calanus pacificus* female	CPF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Calanus spp.* general	CPG	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Calanoid, *C. pacificus* copepodite CV	CPV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Eucalanus bungii*, female	EBF	0.0	0.0	0.0	1.7	0.0	0.1	0.0	0.0	0.0
Calanoid, *Eucalanus bungii*, male	EBM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *E.longipedata*, copepodite	EPC	0.0	0.0	0.0	3.3	0.0	0.2	0.0	0.0	0.0
Calanoid, *E.longipedata*, female	EPF	13.3	0.8	0.1	8.3	0.1	0.4	0.0	0.0	0.0
Calanoid, *E.longipedata*, general	EPI	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Calanoid, *E.longipedata*, male	EPM	20.0	0.7	0.1	11.7	0.2	1.0	0.0	0.0	0.0
Calanoid, *Euchirella rostrata* female	ERF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Eucalanus bungii*, general	EUB	0.0	0.0	0.0	8.3	0.2	4.3	0.0	0.0	0.0
Calanoid, *Metridia pacifica* copepodite	MCS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Metridia pacifica*, general	MEP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Metridia spp.* female	MGF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Metridia ocholensis* female	MOF	0.0	0.0	0.0	5.0	0.2	0.1	0.0	0.0	0.0
Calanoid, *Metridia ocholensis*, general	MOP	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Calanoid, *M pacifica* CV copepodite	MPC	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Calanoid, *Metridia pacifica*, female	MPF	0.0	0.0	0.0	8.3	0.8	1.3	0.0	0.0	0.0
Calanoid, *Metridia pacifica*, male	MPM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *M. ocholensis* CV male	MVM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Neocalanus spp.* copepodite	NCP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Neocalanus spp.* adult	NEO	0.0	0.0	0.0	5.0	0.1	0.4	0.0	0.0	0.0
Calanoid, *Neocalanus plumchrus* female	NPF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Small Calanoids										
Calanoid, *Acartia spp*	AC	0.0	0.0	0.0	6.7	0.9	0.2	0.0	0.0	0.0
Calanoid, *Acartia clausi* male	ACM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Acartia sp.* copepodids	ACP	0.0	0.0	0.0	3.3	0.1	0.0	0.0	0.0	0.0
Calanoid, *Acartia longiremus* adult	AL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Acartia longiremus* copepodite	ALC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Acartia longiremis* female	ALF	6.7	0.0	0.0	3.3	0.1	0.0	10.0	0.0	0.0
Calanoid, *Acartia longiremis*, general	ALG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Acartia longiremus* male	ALM	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0

Preyname	Species Code	Allopatric Pink Salmon (n = 3 sets)			Pink Salmon Sympatric with Herring (n = 6 sets)			Pink Salmon Sympatric with Sandlance (n = 1 set)		
		Percent Freq.	Percent Number	Percent Weight	Percent Freq.	Percent Number	Percent Weight	Percent Freq.	Percent Number	Percent Weight
Calanoid, *C. abdominalis*, general	CA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *C. abdominalis*, copepodite	CAC	6.7	0.1	0.0	6.7	0.1	0.0	0.0	0.0	0.0
Calanoid, Centropages abdominalis,female	CAF	6.7	0.2	0.0	3.3	0.0	0.0	0.0	0.0	0.0
Calanoid, *Centropages abdominalis*,male	CAM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, general nauplius	CAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, general small (x<2.5 mm)	CAS	13.3	0.2	0.2	46.7	1.6	0.6	20.0	0.1	0.1
Calanoid, *Centropages*, general	CAU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, Copepodite small, general	COS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *E. pacifica*, copepodite	EYC	3.3	0.2	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Calanoid, *Eurytemora pacifica* female	EYF	3.3	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Eurytemora pacifica* male	EYM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Eurytemora pacifica*, general	EYT	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0
Cyclopoid, *Oithona spp.*, general	OIT	0.0	0.0	0.0	6.7	0.1	0.0	20.0	0.3	0.1
Cyclopoid, *Oithona similis*, general	OS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclopoid, *Oithona spp.* copepodite	OSC	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclopoid, *Oithona similis* AF	OSF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclopoid, *Oithona similis* gravid female	OSG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclopoid, *Oithona similis* AM	OSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclopoid, *Oithona spinirostris*, female	OTF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclopoid, *Oithona spinirostris*	OTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Pseudocalanus* copepodids I-IV	PCP	6.7	0.0	0.0	5.0	0.0	0.0	10.0	0.0	0.0
Calanoid, *Pseudocalanus spp.*, general	PSA	0.0	0.0	0.0	13.3	0.2	0.2	10.0	0.0	0.0
Calanoid, *Pseudocalanus spp* female	PSF	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Pseudocalanus spp.* gravid female	PSG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Pseudocalanus spp.* male	PSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chaetognaths										
Chaetognath, species unknown	CHT	6.7	0.0	0.1	11.7	0.1	0.3	20.0	0.1	0.4
Chaetognath, *Sagitta elegans*	SGE	3.3	0.0	0.1	18.3	1.0	0.5	0.0	0.0	0.0
Cladocerans										
Cladocera, General	CLA	3.3	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0
Cladoceran, *Evadne spp.*	EVD	0.0	0.0	0.0	6.7	0.0	0.0	0.0	0.0	0.0
Cladoceran, *Podon spp.*	PON	16.7	0.1	0.0	20.0	0.3	0.1	0.0	0.0	0.0
Cyphonautes										
Bryozoa, *Cyphonautes* larva	CFN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapods										
Decapod, megalops, Cancridae	CAJ	3.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Decapod zoea, crab, Cancridae	CNZ	10.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod, megalops, unknown crab	DCM	6.7	0.5	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Decapod, zoea, Brachyura, general	DGB	3.3	0.2	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Decapod, megalops, Brachyura	DMG	10.0	0.1	1.2	1.7	0.1	0.1	0.0	0.0	0.0
Decapod, megalops, *Majidae*	DMM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod, megalops, *Paguridae*	DMP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod, zoea, unknown general	DUG	20.0	2.6	1.9	1.7	0.0	0.1	10.0	0.0	1.6
Decapod zoea, crab, *Brachyrhyncha*	DZB	10.0	0.3	0.7	1.7	0.0	0.5	0.0	0.0	0.0
Decapod zoea, Shrimp, *Crangonidae*	DZC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod zoea, crab, general unknown	DZG	20.0	2.7	0.7	1.7	0.1	0.1	0.0	0.0	0.0
Decapod zoea, Shrimp, *Hippolytidae*	HIE	0.0	0.0	0.0	1.7	0.0	0.1	0.0	0.0	0.0
Decapod zoea, Anomuran, *Lithodidae*	LIZ	3.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod zoea, crab, *Oregoninae*	ORG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod zoea, Shrimp, *Pandalidae*	PDZ	3.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod zoea, hermit crab, Paguridae	PGZ	3.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Preyname	Species Code	Allopatric Pink Salmon (n = 3 sets) Percent Freq.	Percent Number	Percent Weight	Pink Salmon Sympatric with Herring (n = 6 sets) Percent Freq.	Percent Number	Percent Weight	Pink Salmon Sympatric with Sandlance (n = 1 set) Percent Freq.	Percent Number	Percent Weight
Decapod,Shrimp, gen. unknown juv /adult	SHP	3.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod zoea, general shrimp	SHR	33.3	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Euphausiids										
Euphausiid nauplii	EU2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Euphausiid calyptopis	EU3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Euphausiid furcilia	EU4	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Euphausiid juvenile, general	EUJ	3.3	0.2	0.0	10.0	0.1	0.4	0.0	0.0	0.0
Euphausiid, general unknown	EUP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Euphausiid, *Thysannoessa spp.*, gen. adult	TH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fish										
Fish, *Ammodytes hexapterus* (sandlance)	AMM	16.7	1.8	7.4	1.7	0.6	8.3	0.0	0.0	0.0
Fish, flatfish larvae (Pleuronectiform)	FFL	10.0	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0
Fish, herring juvenile (41-60mm)	FH1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fish, elongate larva	FIL	23.3	3.1	25.3	11.7	0.9	8.4	0.0	0.0	0.0
Fish, robust larva	FIS	16.7	2.6	0.7	0.0	0.0	0.0	0.0	0.0	0.0
Fish egg (~1.0 mm)	FSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fish, juvenile, general	FSJ	3.3	0.1	4.0	0.0	0.0	0.0	0.0	0.0	0.0
Fish, small juvenile/larva, general	FSL	20.0	4.3	15.9	8.3	0.1	11.6	10.0	0.0	17.0
Fish, walleye pollock, (41-60mm)	FW2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gammarid Amphipods										
Amphipod, Gammarid, unknown, small	GA1	0.0	0.0	0.0	3.3	0.0	0.1	0.0	0.0	0.0
Amphipod, Gammarid, unknown, medium	GA2	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Amphipod, Gammarid, unknown, large	GA3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Gammarid, *Jassa spp.*	GAJ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Gammarid, *Hippomedon spp.*	HPP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Gammarid, *Phoxocephalidae*	PHX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gastropods										
Gastropod, juv. snail w/ black pigment	GSB	36.7	0.4	0.3	10.0	0.1	0.2	30.0	0.4	0.7
Gastropoda, general juvenile (SNAIL)	GST	3.3	2.3	0.0	0.0	0.0	0.0	10.0	0.0	0.1
Gastropod, Pteropod, *Limacina helicina* Ad.	LMA	16.7	0.1	2.8	6.7	0.0	0.1	30.0	0.2	5.2
Gastropod, Pteropod, *Limacina helicina* Juv.	LMJ	23.3	0.3	1.2	20.0	0.2	0.2	60.0	1.6	5.7
Gastropod, general veliger	VEL	0.0	0.0	0.0	3.3	0.1	0.0	0.0	0.0	0.0
Hyperiid Amphipods										
Amphipod, Hyperiid, *Hyperoche med.* GF	HMG	0.0	0.0	0.0	1.7	0.0	0.2	0.0	0.0	0.0
Amphipod, Hyperiid, *Hyperia spp.*	HP	0.0	0.0	0.0	1.7	0.0	1.3	0.0	0.0	0.0
Amphipod, Hyperiid, *Hyperia spp.* juvenile	HPJ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Hyperiid, *Hyperoche medusarum*	HPM	0.0	0.0	0.0	3.3	0.1	1.4	0.0	0.0	0.0
Amphipod, Hyperiid, unknown LARGE	HYA	0.0	0.0	0.0	8.3	0.2	1.7	0.0	0.0	0.0
Amphipod, Hyperiid, unknown SMALL	HYB	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Amphipod, Hyperiid, unknown MEDIUM	HYP	0.0	0.0	0.0	18.3	0.3	4.2	10.0	0.0	2.7
Amphipod, Hyperiid, *P. pacifica* juvenile	PA1	0.0	0.0	0.0	13.3	0.3	0.3	0.0	0.0	0.0
Amphipod, Hyperiid, *P. pacifica* juvenile	PA2	0.0	0.0	0.0	6.7	0.1	0.3	0.0	0.0	0.0
Amphipod, Hyperiid, *P. libellula*	PL2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Hyperiid, *P. macropa*	PR2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Hyperiid, *Parathemisto spp*	PS1	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Amphipod, Hyperiid, *Parathemisto spp.*	PS2	0.0	0.0	0.0	3.3	0.1	0.1	0.0	0.0	0.0
Amphipod, Hyperiid, *Parathemisto spp*	PS3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insects										
Insect, Collembola, elongate, purple	CEP	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insect, Collembola, globular, pink	CGP	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Insect, Collembola, globular, purple	CGR	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0

Preyname	Species Code	Allopatric Pink Salmon (n = 3 sets) Percent Freq.	Allopatric Pink Salmon (n = 3 sets) Percent Number	Allopatric Pink Salmon (n = 3 sets) Percent Weight	Pink Salmon Sympatric with Herring (n = 6 sets) Percent Freq.	Pink Salmon Sympatric with Herring (n = 6 sets) Percent Number	Pink Salmon Sympatric with Herring (n = 6 sets) Percent Weight	Pink Salmon Sympatric with Sandlance (n = 1 set) Percent Freq.	Pink Salmon Sympatric with Sandlance (n = 1 set) Percent Number	Pink Salmon Sympatric with Sandlance (n = 1 set) Percent Weight
Insect, Chironomidae, larva (naiad)	CHL	0.0	0.0	0.0	3.3	0.0	0.1	0.0	0.0	0.0
Insect, Chironomidae, pupa	CHP	0.0	0.0	0.0	5.0	0.1	0.1	0.0	0.0	0.0
Insect, Dipteran adult	DIP	3.3	0.1	0.0	15.0	0.3	0.5	0.0	0.0	0.0
Insect, Dipteran larvae	DPL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insect, Dipteran pupae	DPP	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0
Insect, general	INS	10.0	0.1	0.3	20.0	0.4	2.6	0.0	0.0	0.0
Insect, pupa, unknown	IPU	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Insect, unknown, large	IUL	0.0	0.0	0.0	3.3	0.1	0.1	0.0	0.0	0.0
Cnidarians / Ctenophores										
Cnidaria, general jellyfish (x>2mm)	CNI	0.0	0.0	0.0	3.3	0.4	1.2	0.0	0.0	0.0
Cnidaria, general jellyfish (x<2mm)	CNS	0.0	0.0	0.0	5.0	0.1	0.1	0.0	0.0	0.0
Ctenophore, only ctenes present	CTM	0.0	0.0	0.0	5.0	0.1	0.0	0.0	0.0	0.0
White granular matter	WGM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larvaceans										
Larvacea, *Oikopleura spp.* < 2mm (IMS)	OI1	3.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larvacea, *Oikopleura dioica*	OKI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larvacea, *Oikopleura spp*	OKP	60.0	65.4	34.0	91.7	81.8	30.1	100.0	96.8	64.3
Malocostracans										
Amphipod, unknown gammarid/hyperiid	AMP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Malacostraca, eyes only	MAE	6.7	2.6	0.1	5.0	0.1	0.0	0.0	0.0	0.0
Malacostraca	MAL	0.0	0.0	0.0	11.7	0.1	5.1	0.0	0.0	0.0
Other										
Arthropod, Arachnid, *Araneae spp*	ARS	3.3	0.0	0.2	3.3	0.0	0.1	0.0	0.0	0.0
Barnacle cirri (setose legs)	BAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bivalve, larvae	BVL	40.0	0.2	0.0	23.3	4.4	0.4	70.0	0.3	0.0
Amphipod, Caprellidae	CAP	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Ostracod, *Conchoecia spp.*, small	CNC	3.3	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Cumacea	CUM	6.7	0.1	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Echinodermata, Brittlestar pluteus	EBP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unknown invertebrate egg, small (<0.2mm)	EGG	0.0	0.0	0.0	1.7	0.1	0.0	0.0	0.0	0.0
Unknown invertebrate egg, large (>0.2mm)	EGL	0.0	0.0	0.0	3.3	0.1	0.0	0.0	0.0	0.0
Gastropod, egg case (Littorina)	GEC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Harpacticus uniremis*	HAU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, general clasping pair	HCP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Dactylopodia spp.* gravid female	HDG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Dactylopodia spp.* general	HDP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Ectinosomatid spp.*	HEC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Ectinosomatid spp.*, gravid	HEG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, general eggsac	HEM	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Harpacticoid, general, unknown stage	HR	0.0	0.0	0.0	3.3	0.1	0.0	0.0	0.0	0.0
Harpacticoid, general copepodite	HRC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, general gravid (eggs)	HRE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Harpacticus spp.* female adult	HRF	0.0	0.0	0.0	1.7	0.1	0.0	0.0	0.0	0.0
Harpacticoid, *Harpacticus spp.* gravid female	HRG	0.0	0.0	0.0	5.0	0.1	0.0	0.0	0.0	0.0
Harpacticoid, *Harpacticus spp.* copepodite	HRJ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Harpacticus spp.* male adult	HRM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, general nauplius	HRN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, general adult	HRP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Harpacticus spp.* general ad	HRS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Harpacticus spp.*, unknown stage	HSU	0.0	0.0	0.0	3.3	0.1	0.0	0.0	0.0	0.0
Harpacticoid, *Zaus spp.* copepodite	HZC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Preyname	Species Code	Allopatric Pink Salmon (n = 3 sets)			Pink Salmon Sympatric with Herring (n = 6 sets)			Pink Salmon Sympatric with Sandlance (n = 1 set)		
		Percent Freq.	Percent Number	Percent Weight	Percent Freq.	Percent Number	Percent Weight	Percent Freq.	Percent Number	Percent Weight
Harpacticoid, *Zaus spp.* gravid female	HZG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Zaus spp.* general	HZZ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Isopod, *Gnorimosphaeroma spp.*	IGN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Isopod, general	ISP	0.0	0.0	0.0	1.7	0.0	0.1	0.0	0.0	0.0
Harpacticoid, *Laophontidae spp.*, copepodite	LAC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Laophontidae spp.*, adult	LAO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arthropod, Arachnid, Halacarid mite	MIT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Copepod, *Monstrillid spp.*	MNX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bivalve, mussel juvenile	MUJ	0.0	0.0	0.0	6.7	0.0	0.0	0.0	0.0	0.0
Mytiloida, *Musculus spp.*	MUS	0.0	0.0	0.0	1.7	0.0	0.3	0.0	0.0	0.0
Nematode	NEM	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0
Polychaeta, *Nereidae spp.*	NER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Copepod, *Oithona spp.* egg cases	OIE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ostracod, general unknown	OST	3.3	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Copepod, *Caligidae spp.*, parasitic copepod	PCO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Polychaeta, adult	PLA	0.0	0.0	0.0	6.7	0.1	0.0	0.0	0.0	0.0
Polychaeta, general, juvenile	PLL	0.0	0.0	0.0	3.3	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Tisbe spp.*, adult	TSB	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Tisbe spp.*, gravid female	TSG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Tisbe spp.*, stage unknown	TSU	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Unknown egg mass	UEM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unidentified item	UNI	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0
Unknown nauplius	UNP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unknown "worm" shaped ~ trematode	UNW	0.0	0.0	0.0	11.7	0.8	0.0	0.0	0.0	0.0

Appendix 3c. Mean percent frequency, percent number, and percent weight of prey species consumed by allopatric and sympatric juvenile sandlance during July, 1996

Preyname	Species Code	Allopatric Sandlance (n = 14 sets)			Sandlance Sympatric with Herring (n = 4 sets)			Sandlance Sympatric with Pink Salmon (n = 1 set)		
		Percent Freq.	Percent Number	Percent Weight	Percent Freq.	Percent Number	Percent Weight	Percent Freq.	Percent Number	Percent Weight
Barnacles										
Barnacle, cyprid	BMC	44.5	0.9	4.8	42.5	0.9	4.5	80.0	1.6	8.4
Barnacle, adult molt (cirri & moutharea)	BMM	0.8	0.0	0.4	0.0	0.0	0.0	10.0	0.0	3.0
Barnacle, nauplius	BMP	18.7	0.2	0.6	30.0	1.2	3.4	40.0	0.4	1.4
Large Calanoids										
Calanoid, general large (x>2.5 mm)	CAL	6.4	0.1	1.5	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Calanus spp.* copepodite	CCP	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Neocalanus cristatus*, adult	CCR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Neocalanus cristatus* stage V	CCV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, large, *Neocalanus/Calanus*	CLN	0.0	0.0	0.0	2.5	0.0	1.0	0.0	0.0	0.0
Calanoid, *Calanus marshallae* general	CM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *C. marshallae* copepodite CV	CMC	2.9	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *C. marshallae* female	CMF	1.4	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *C. marshallae* male	CMM	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0
Calanoid, *Calanus pacificus* adult	CPA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Calanus pacificus*, general	CPC	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Calanus/Neocalanus* copepodids	CPD	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Calanus pacificus* female	CPF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Calanus spp* general	CPG	1.4	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *C. pacificus* copepodite CV	CPV	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Eucalanus bungi*, female	EBF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Eucalanus bungii*, male	EBM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *E.longipedata*, copepodite	EPC	5.2	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *E.longipedata*, female	EPF	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *E.longipedata*, general	EPI	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *E.longipedata*, male	EPM	7.2	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Euchirella rostrata* female	ERF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Eucalanus bungii*, general	EUB	4.3	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Metridia pacifica* copepodite	MCS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Metridia pacifica*, general	MEP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Metridia spp.* female	MGF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Metridia ochotensis* female	MOF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Metridia ochotensis*, general	MOP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *M pacifica* CV copepodite	MPC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Metridia pacifica*, female	MPF	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Metridia pacifica*, male	MPM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *M. ochotensis* CV male	MVM	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Neocalanus spp.* copepodite	NCP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Neocalanus spp.* adult	NEO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Neocalanus plumchrus* female	NPF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Small Calanoids										
Calanoid, *Acartia spp.*	AC	17.2	0.2	0.1	20.0	2.7	1.1	0.0	0.0	0.0
Calanoid, *Acartia clausi* male	ACM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Acartia sp.* copepodids	ACP	11.7	0.6	0.1	12.5	0.7	0.1	30.0	0.1	0.0
Calanoid, *Acartia longiremus* adult	AL	1.4	0.0	0.0	7.5	0.1	0.1	10.0	0.1	0.1
Calanoid, *Acartia longiremus* copepodite	ALC	16.4	0.3	0.1	5.0	0.2	0.0	0.0	0.0	0.0
Calanoid, *Acartia longiremis* female	ALF	24.3	0.6	0.7	15.0	0.1	0.1	0.0	0.0	0.0
Calanoid, *Acartia longiremis*, general	ALG	6.4	0.2	0.2	2.5	0.0	0.0	0.0	0.0	0.0
Calanoid, *Acartia longiremus* male	ALM	10.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Preyname	Species Code	Allopatric Sandlance (n = 14 sets)			Sandlance Sympatric with Herring (n = 4 sets)			Sandlance Sympatric with Pink Salmon (n = 1 set)		
		Percent Freq.	Percent Number	Percent Weight	Percent Freq.	Percent Number	Percent Weight	Percent Freq.	Percent Number	Percent Weight
Calanoid, *C. abdominalis*, general	CA	2.1	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0
Calanoid, *C. abdominalis*, copepodite	CAC	33.2	1.2	0.5	15.0	0.4	0.2	0.0	0.0	0.0
Calanoid, Centropages abdominalis,female	CAF	16.4	0.3	0.6	2.5	0.0	0.0	0.0	0.0	0.0
Calanoid, *Centropages abdominalis*,male	CAM	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, general nauplius	CAN	42.2	7.7	2.2	7.5	0.1	0.0	10.0	0.2	0.0
Calanoid, general small (x<2.5 mm)	CAS	70.3	35.1	46.2	45.0	35.8	44.2	100.0	55.4	76.4
Calanoid, *Centropages*, general	CAU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, Copepodite small, general	COS	30.1	5.8	3.0	7.5	1.6	0.5	0.0	0.0	0.0
Calanoid, *E pacifica*, copepodite	EYC	7.1	0.1	0.1	5.0	0.1	0.1	0.0	0.0	0.0
Calanoid, *Eurytemora pacifica* female	EYF	2.9	0.0	0.0	10.0	0.0	0.1	0.0	0.0	0.0
Calanoid, *Eurytemora pacifica* male	EYM	0.7	0.0	0.0	10.0	0.1	0.1	0.0	0.0	0.0
Calanoid, *Eurytemora pacifica*, general	EYT	4.4	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Cyclopoid, *Oithona spp*, general	OIT	31.1	5.8	1.3	42.5	15.6	4.1	80.0	31.5	7.0
Cyclopoid, *Oithona similis*, general	OS	31.4	7.4	2.1	0.0	0.0	0.0	0.0	0.0	0.0
Cyclopoid, *Oithona spp.* copepodite	OSC	5.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclopoid, *Oithona similis* AF	OSF	12.9	0.2	0.1	7.5	0.1	0.0	10.0	0.2	0.1
Cyclopoid, *Oithona similis* gravid female	OSG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclopoid, *Oithona similis* AM	OSM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclopoid, *Oithona spinirostris*, female	OTF	1.4	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0
Cyclopoid, *Oithona spinirostris*	OTS	5.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0
Calanoid, *Pseudocalanus copepodids* I-IV	PCP	34.4	2.2	1.1	7.5	0.4	0.1	0.0	0.0	0.0
Calanoid, *Pseudocalanus spp.*, general	PSA	25.8	1.8	3.2	20.0	1.5	2.8	0.0	0.0	0.0
Calanoid, *Pseudocalanus spp.* female	PSF	36.6	2.1	6.0	15.0	0.4	1.0	0.0	0.0	0.0
Calanoid, *Pseudocalanus spp.* gravid female	PSG	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Calanoid, *Pseudocalanus spp.* male	PSM	7.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chaetognaths										
Chaetognath, species unknown	CHT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chaetognath, *Sagitta elegans*	SGE	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cladocerans										
Cladocera, General	CLA	10.0	0.0	0.0	5.0	0.3	0.2	10.0	0.1	0.1
Cladoceran, *Evadne spp*	EVD	21.6	0.2	0.2	20.0	0.2	0.1	0.0	0.0	0.0
Cladoceran, *Podon spp*	PON	39.7	0.4	0.2	37.5	1.4	0.7	0.0	0.0	0.0
Cyphonautes										
Bryozoa, *Cyphonautes* larva	CFN	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapods										
Decapod, megalops, Cancridae	CAJ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod zoea, crab, Cancridae	CNZ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod, megalops, unknown crab	DCM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod, zoea, Brachyura, general	DGB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod, megalops, Brachyura	DMG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod, megalops, *Majidae*	DMM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod, megalops, *Pagurdae*	DMP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod, zoea, unknown general	DUG	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod zoea, crab, *Brachyrhyncha*	DZB	4.3	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0
Decapod zoea, Shrimp, *Crangonidae*	DZC	2.1	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0
Decapod zoea, crab, general unknown	DZG	2.1	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0
Decapod zoea, Shrimp, *Hippolytidae*	HIE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod zoea, Anomuran, *Lithodidae*	LIZ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod zoea, crab, *Oregoninae*	ORG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod zoea, Shrimp, *Pandalidae*	PDZ	2.1	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0
Decapod zoea, hermit crab, Paguridae	PGZ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Preyname	Species Code	Allopatric Sandlance (n = 14 sets)			Sandlance Sympatric with Herring (n = 4 sets)			Sandlance Sympatric with Pink Salmon (n = 1 set)		
		Percent Freq.	Percent Number	Percent Weight	Percent Freq.	Percent Number	Percent Weight	Percent Freq.	Percent Number	Percent Weight
Decapod,Shrimp, gen. unknown juv./adult	SHP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Decapod zoea, general shrimp	SHR	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Euphausiids										
Euphausiid nauplii	EU2	5.1	0.0	0.0	10.0	0.3	0.1	0.0	0.0	0.0
Euphausiid calyptopis	EU3	1.4	0.0	0.0	2.5	0.0	0.1	0.0	0.0	0.0
Euphausiid furcilia	EU4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Euphausiid juvenile, general	EUJ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Euphausiid, general unknown	EUP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Euphausiid, *Thysannoessa spp.*, gen. adult	TH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fish										
Fish, *Ammodytes hexapterus* (sandlance)	AMM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fish, flatfish larvae (Pleuronectiform)	FFL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fish, herring juvenile (41-60mm)	FH1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fish, elongate larva	FIL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fish, robust larva	FIS	0.7	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Fish egg (~1 0 mm)	FSE	2.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Fish, juvenile, general	FSJ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fish, small juvenile/larva, general	FSL	0.7	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0
Fish, walleye pollock, (41-60mm)	FW2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gammarid Amphipods										
Amphipod, Gammarid, unknown, small	GA1	3.6	3.6	4.6	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Gammarid, unknown, medium	GA2	0.7	0.9	2.3	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Gammarid, unknown, large	GA3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Gammarid, *Jassa spp.*	GAJ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Gammarid, *Hippomedon spp*	HPP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Gammarid, *Phoxocephalidae*	PHX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gastropods										
Gastropod, juv snail w/ black pigment	GSB	26.7	0.2	0.4	22.5	0.3	0.6	40.0	0.2	0.4
Gastropoda, general juvenile (SNAIL)	GST	10.0	0.1	0.4	10.0	0.3	0.6	0.0	0.0	0.0
Gastropod, Pteropod, *Limacina helicina* Ad.	LMA	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gastropod, Pteropod, *Limacina helicina* Juv	LMJ	5.1	0.0	0.1	10.0	0.5	1.4	0.0	0.0	0.0
Gastropod, general veliger	VEL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hyperiid Amphipods										
Amphipod, Hyperiid, *Hyperoche med* GF	HMG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Hyperiid, *Hyperia spp.*	HP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Hyperiid, *Hyperia spp* juvenile	HPJ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Hyperiid, *Hyperoche medusarum*	HPM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Hyperiid, unknown LARGE	HYA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Hyperiid, unknown SMALL	HYB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Hyperiid, unknown MEDIUM	HYP	0.7	0.0	0.1	2.5	0.0	3.6	0.0	0.0	0.0
Amphipod, Hyperiid, *P. pacifica* juvenile	PA1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Hyperiid, *P pacifica* juvenile	PA2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Hyperiid, *P libellula*	PL2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Hyperiid, *P. macropa*	PR2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Hyperiid, *Parathemisto spp.*	PS1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Hyperiid, *Parathemisto spp*	PS2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amphipod, Hyperiid, *Parathemisto spp*	PS3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insects										
Insect, Collembola, elongate, purple	CEP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insect, Collembola, globular, pink	CGP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insect, Collembola, globular, purple	CGR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Preyname	Species Code	Allopatric Sandlance (n = 14 sets)			Sandlance Sympatric with Herring (n = 4 sets)			Sandlance Sympatric with Pink Salmon (n = 1 set)		
		Percent Freq.	Percent Number	Percent Weight	Percent Freq.	Percent Number	Percent Weight	Percent Freq.	Percent Number	Percent Weight
Insect, Chironomidae, larva (naiad)	CHL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insect, Chironomidae, pupa	CHP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insect, Dipteran adult	DIP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insect, Dipteran larvae	DPL	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insect, Dipteran pupae	DPP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insect, general	INS	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insect, pupa, unknown	IPU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insect, unknown, large	IUL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cnidarians / Ctenophores										
Cnidaria, general jellyfish (x>2mm)	CNI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cnidaria, general jellyfish (x<2mm)	CNS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ctenophore, only ctenes present	CTM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
White granular matter	WGM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larvaceans										
Larvacea, *Oikopleura* spp.< 2mm (IMS)	OI1	20.1	1.8	1.2	10.0	0.5	0.2	0.0	0.0	0.0
Larvacea, *Oikopleura dioica*	OKI	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Larvacea, *Oikopleura spp*	OKP	47.5	13.7	6.8	22.5	4.5	2.0	20.0	1.0	0.6
Malocostracans										
Amphipod, unknown gammarid/hyperiid	AMP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Malacostraca, eyes only	MAE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Malacostraca	MAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other										
Arthropod, Arachnid, *Araneae spp.*	ARS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Barnacle cirri (setose legs)	BAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bivalve, larvae	BVL	53.8	1.0	0.1	42.5	4.0	0.3	80.0	7.9	0.7
Amphipod, Caprellidae	CAP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ostracod, *Conchoecia spp.*, small	CNC	2.9	0.0	0.2	10.0	0.1	1.0	0.0	0.0	0.0
Cumacea	CUM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Echinodermata, Brittlestar pluteus	EBP	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unknown invertebrate egg, small (<0.2mm)	EGG	20.0	1.4	0.1	12.5	0.1	0.0	10.0	0.0	0.0
Unknown invertebrate egg, large (>0.2mm)	EGL	6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gastropod, egg case (Littorina)	GEC	0.7	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Harpacticus uniremis*	HAU	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, general clasping pair	HCP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Dactylopodia spp* gravid female	HDG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Dactylopodia spp.* general	HDP	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Ectinosomatid spp*	HEC	5.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Ectinosomatid spp.*, gravid	HEG	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, general eggsac	HEM	4.3	0.1	0.3	2.5	0.0	0.0	0.0	0.0	0.0
Harpacticoid, general, unknown stage	HR	15.1	1.8	0.4	2.5	0.0	0.0	70.0	1.0	1.7
Harpacticoid, general copepodite	HRC	15.0	0.6	0.7	10.0	25.1	25.1	0.0	0.0	0.0
Harpacticoid, general gravid (eggs)	HRE	1.4	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Harpacticus spp.* female adult	HRF	1.4	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Harpacticus spp.* gravid female	HRG	0.7	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Harpacticus spp* copepodite	HRJ	4.3	0.1	0.0	2.5	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Harpacticus spp.* male adult	HRM	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, general nauplius	HRN	0.7	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0
Harpacticoid, general adult	HRP	5.0	0.1	0.1	5.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Harpacticus spp* general ad	HRS	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Harpacticus spp.*, unknown stage	HSU	5.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Zaus spp.* copepodite	HZC	2.1	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0

Preyname	Species Code	Allopatric Sandlance (n = 14 sets)			Sandlance Sympatric with Herring (n = 4 sets)			Sandlance Sympatric with Pink Salmon (n = 1 set)		
		Percent Freq.	Percent Number	Percent Weight	Percent Freq.	Percent Number	Percent Weight	Percent Freq.	Percent Number	Percent Weight
Harpacticoid, *Zaus spp.* gravid female	HZG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Zaus spp.* general	HZZ	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Isopod, *Gnorimosphaeroma spp.*	IGN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Isopod, general	ISP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Laophontidae spp.*, copepodite	LAC	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Laophontidae spp.*, adult	LAO	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arthropod, Arachnid, Halacarid mite	MIT	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Copepod, *Monstrillid spp.*	MNX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bivalve, mussel juvenile	MUJ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mytiloida, *Musculus spp.*	MUS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nematode	NEM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Polychaeta, *Nereidae spp.*	NER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Copepod, *Oithona spp.* egg cases	OIE	5.7	0.1	0.1	2.5	0.0	0.0	0.0	0.0	0.0
Ostracod, general unknown	OST	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Copepod, *Caligidae spp.*, parasitic copepod	PCO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Polychaeta, adult	PLA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Polychaeta, general, juvenile	PLL	8.6	0.0	0.1	2.5	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Tisbe spp.*, adult	TSB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Tisbe spp.*, gravid female	TSG	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harpacticoid, *Tisbe spp.*, stage unknown	TSU	6.5	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Unknown egg mass	UEM	1.4	0.0	0.0	2.5	0.1	0.0	0.0	0.0	0.0
Unidentified item	UNI	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unknown nauplius	UNP	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unknown "worm" shaped ~ trematode	UNW	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0