

FISH FOOD HABITS AND THEIR INTERRELATIONSHIPS  
IN LOWER REDWOOD CREEK, HUMBOLDT COUNTY, CALIFORNIA

by

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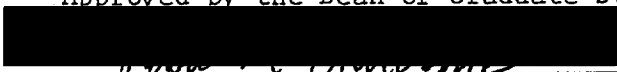
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## ABSTRACT

Eleven species of fishes within the lower Redwood Creek watershed were examined for food habits from February to December, 1980. Seasonal and spatial intraspecific patterns were analyzed, as well as interspecific diet overlaps. The fishes of lower Redwood Creek relied almost entirely on on autochthonous production for their food resources. The food habits of these fishes suggested that most of the species were benthic predators. The exception was juvenile chinook salmon, which appeared to rely more heavily on drift organisms. The limited contribution to the food habits by terrestrial prey items was, at least partially, a result of the lack of riparian habitat along the main channel of lower Redwood Creek. Such productive areas were eliminated during levee construction. The food habits of most fish suggested opportunistic feeding strategies, except for the more specialized Humboldt sucker. The fishes that were generally considered freshwater species fed most heavily on aquatic dipterans, specifically chironomids, at least while residing in the main channel portions of the study site. The most notable exception to this was the heavy utilization, by some fishes, of the abundant Corophium resource that was present in the embayment in the fall. The euryhaline fish species relied more on benthic crustaceans throughout the study. In the sloughs, all fish ate primarily crustaceans.

Most of the intraspecific food habit comparisons showed significant temporal and spatial variations, although there were a few cases of significant diet overlaps between sites and between seasons. This variability was attributed to the diversity of the food habits of most of the fishes. The most notable exception to this variation in food habits was for the Humboldt sucker that resided in the main channel of Redwood Creek. For this species, the almost sole reliance on chironomid larvae was responsible for the extreme similarity of diets.

All interspecific comparisons of diets were significantly different. Common utilization of certain food resources, mostly chironomid larvae or Corophium, by different species of fish resulted in some significant overlaps of food habits. Most of the overlaps were between nonsalmonid fish species. There were no cases of biologically significant diet overlaps between any of the salmonids. This might not have been the case if the berm had not been prematurely breached and the fish had been allowed to rear and compete in the embayment throughout the summer and fall. In any case, most of the biologically significant diet overlaps occurred during the summer when food was probably not a limiting factor. Fish predation on other fishes within lower Redwood Creek was insignificant for all species examined.

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## INTRODUCTION

Redwood Creek is a small coastal river that formerly produced many large chinook salmon (Oncorhynchus tshawytscha) and steelhead trout (Salmo gairdneri), as well as coho salmon (O. kisutch) and coastal cutthroat trout (S. clarki clarki) (Winzler and Kelly 1970; Ricks and Feranna 1981). Since 1981 the U.S. National Park Service has taken a management role in the Redwood Creek estuary (Hofstra 1983). Any successful fish management program should include the knowledge of food utilization. For this reason the food habits of fish and their interrelationships in lower Redwood Creek were studied. In 1980, this one year study was carried out in an attempt to characterize the diets of all resident and migratory fish species and identify any temporal or spatial patterns in their food habits. In addition, the interrelationships of the diets between the various fish species were investigated.

The U.S. Fish and Wildlife Service (1975) concluded that the anadromous fishery resources of Redwood Creek were far below those of the early 1900's. Records of anadromous fish returns to Humboldt County Prairie Creek Fish Hatchery show significant declines since the early 1960's--70-80 percent reduction for chinook salmon, 60 percent for coho salmon and 50 percent for the steelhead trout fishery (Hofstra 1983). Timber harvest practices within the watershed exacerbated by periodic flooding, as well as man-made alterations to the mouth of Redwood Creek are generally blamed for the reduction in salmonid productivity (Winzler

and Kelly 1970; Larson et al. 1982, 1983; Hofstra 1983; Ricks 1983, 1985). Some of the decline in fish returns may have been due to the loss of rearing habitat for juvenile salmonids. Pacific Coast estuaries play a beneficial role in the life history of juvenile anadromous salmonids. Coho salmon may use estuaries for less precise periods. Some downstream migrants remain only for brief periods for adaptation to ocean salinities, while others reside and feed within the estuary for extended periods (Healey 1979, 1982; Myers 1980; Durkin 1982; Myers and Horton 1982; Iwata and Komatsu 1984; Neilson et al. 1985). Chinook salmon, steelhead trout and coastal cutthroat trout depend heavily on estuaries as rearing areas for long term residence prior to ocean migration (Giger 1972; Amend et al. 1980; Healey 1980, 1982; Myers 1980; Kjelson et al. 1982; Myers and Horton 1982; Simenstad et al. 1982; Nicholas and Downey 1983). This role of the estuary as a nursery ground for juvenile salmonids has long been recognized. Rich (1920) noted that juvenile chinook salmon migration into the Columbia River estuary was accompanied by an increase in growth rate, as reflected in scale characteristics. Snyder (1931) studying downstream migrating fall chinook from the Klamath River, noted that the majority of growth in the first year for some of the fish occurred in the estuary. Needham (1940) suggested that the lagoons at the mouths of small Pacific Coast streams are important nursery and feeding grounds for young salmon and trout. He highlighted this importance by reporting that some steelhead return upstream as mature spawners without having entered the ocean.

More recent investigations document the role of estuaries as nursery areas of juvenile salmonids (Neilson et al. 1985; Neilson and

Geen 1986). Reimers (1973) stated that despite the fact that most juvenile fall chinook smolts migrated from an Oregon estuary in mid-summer, the majority of successfully returning adult spawners had resided (as juveniles) in the estuary for extended periods, migrating to sea in autumn.

Studies on lower Redwood Creek have shown that downstream migrant juvenile chinook salmon and steelhead trout utilize the estuary for extended periods throughout the summer (Larson et al. 1982, 1983; Larson 1987). Emigration into the estuary was shown to depend on discharge and water temperature regimes within the watershed (McKeon 1985). The survival and growth of these downstream migrants, as well as their length of residence depend on the carrying capacity of the estuary (Reimers 1973; Bottom et al. 1983; Neilson et al. 1985; Neilson and Geen 1986).

Survival, growth and length of residence within the estuary are partially a function of the food resources present at the time of salmonid residence (Reimers 1973; Simenstad et al. 1980; Simenstad and Salo 1982; Bottom et al. 1983; Neilson et al. 1985; Neilson and Geen 1986). Though many fish diets have been studied in other Pacific Coast estuaries, these studies generally have examined only the food habits of the juvenile salmonid species (Needham 1940; Gerke and Kaczynski 1972; Craddock et al. 1976; Healey 1980, 1982; Myers 1980; Durkin 1982; Kjelson et al. 1982; Pearce et al. 1982; Simenstad et al. 1982; Bottom et al. 1983; Nicholas and Lorz 1984; Larson 1987). However, the carrying capacity must be looked at in light of other fish species that may be using these same food resources. Hartley (1948) argued that interspecific competition for food is as important as intraspecific

competition in fish populations. Predation on juvenile salmonids by other fish species can also affect productivity. A few studies have included the diets of sympatric nonsalmonid species (Ganssle 1966; Engstrom-Heg 1968; Durkin 1982). In these studies, however, there was little interspecific analysis so that food habit interrelationships were purely speculative. McCabe et al. (1983) studied the interrelationships of diets of salmonid and nonsalmonid fish species in the Columbia River estuary.

## STUDY SITE

The Redwood Creek watershed is located in the Pacific Coast Range Mountains of Northern California. Situated between the Mad and the Klamath-Trinity River basins, the entire drainage of 730 km<sup>2</sup> lies within Humboldt County, California (Figure 1). From its headwaters on Boardcamp Mountain (elevation 1581 m), Redwood Creek flows 108 km on a north-northwesterly course, emptying into the Pacific Ocean 3.6 km west of the town of Orick. The drainage is unusually narrow and elongate in shape because the course of the creek is controlled by the Grogan Fault (Madej 1984). Iwatsubo et al. (1976) provided a more detailed description of the watershed.

The site of this study was the lower 3.6 km of Redwood Creek, from the U.S. Highway 101 bridge at Orick, west to the Pacific Ocean. Redwood Creek at this location is a sixth order stream (Iwatsubo et al. 1976). The area downstream of the bridge consisted of a main channel, an embayment and two sloughs (Figure 2).

The main channel consisted of the lower 3.5 km of Redwood Creek, which was constricted along its entirety by an earthen levee with rip-rap slope protection. This levee was constructed by the United States Army Corps of Engineers for flood control in 1968. The most obvious feature of this reach was the lack of any significant form of cover, either as a riparian zone, or as boulders or woody debris. The only vegetation within this reach were mats of the algae, Cladophora sp.,

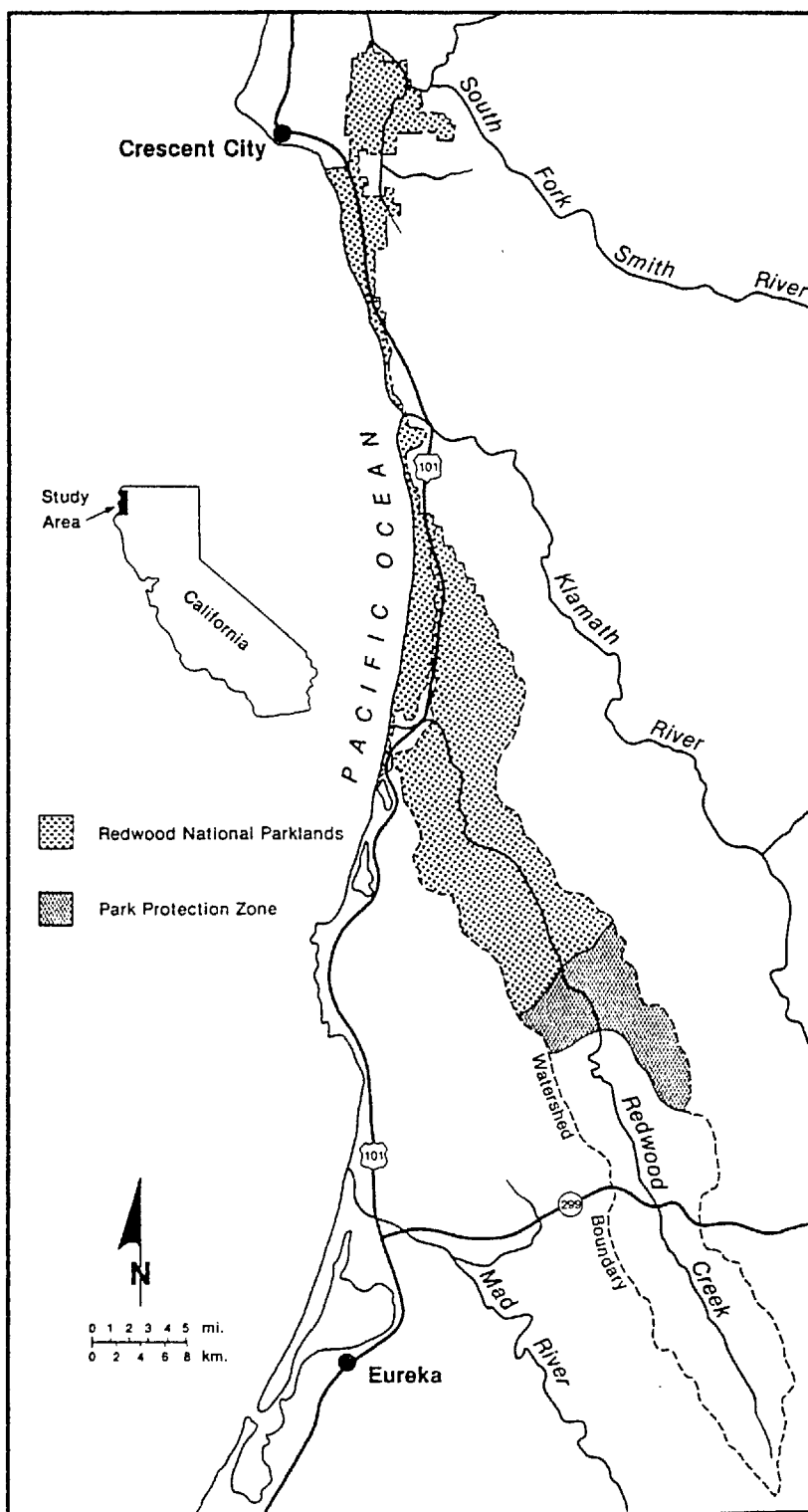


Figure 1. Northern California Location Map.

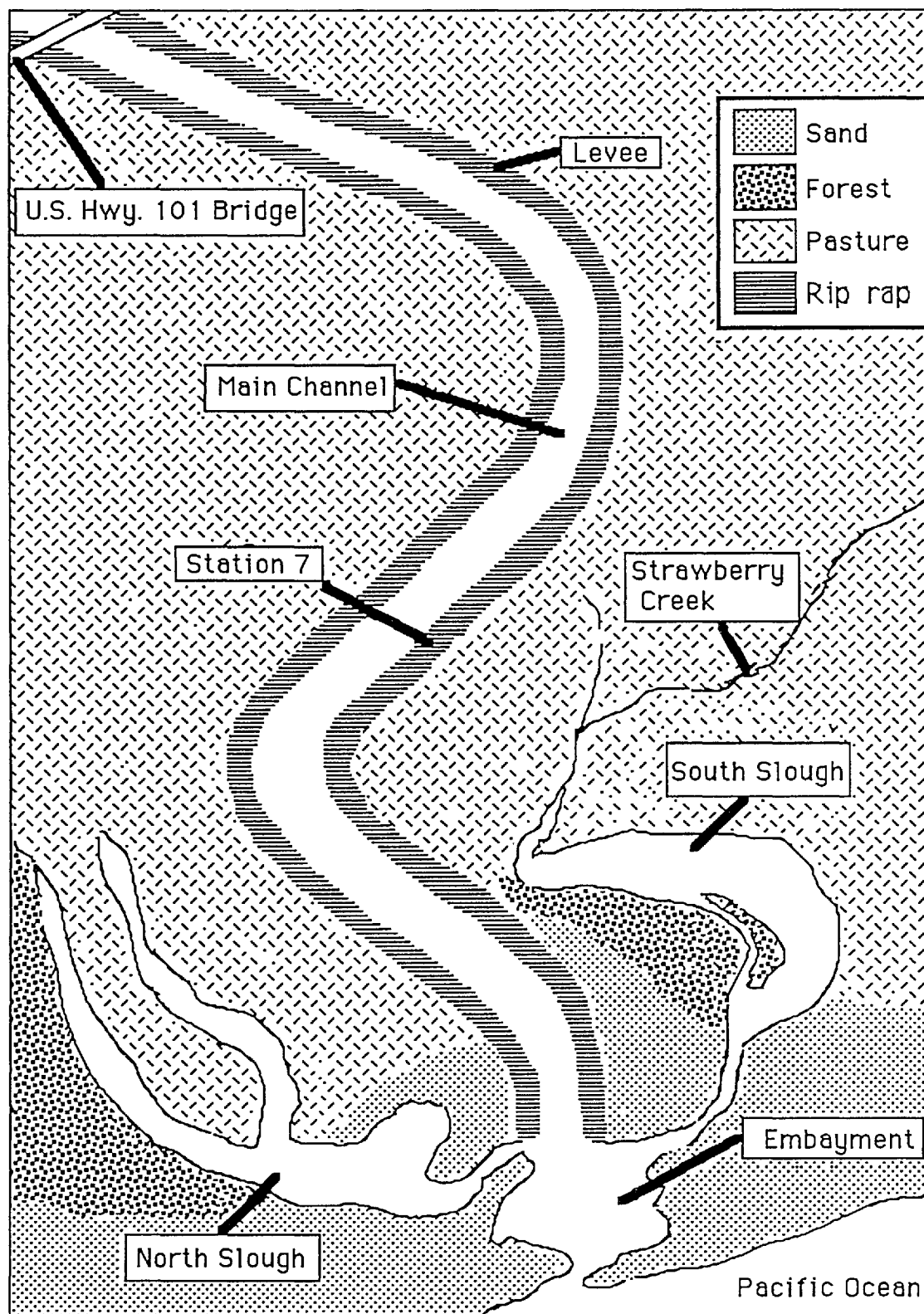


Figure 2. Lower Redwood Creek Study Area.

that were present in the summer and fall. Discharge within the main channel was highly seasonal. Less than 5 percent of the total discharge recorded during this study occurred between 1 June and 30 November. In 1980, the winter discharge averaged  $71 \text{ m}^3/\text{s}$ , while summer discharge averaged  $1.2 \text{ m}^3/\text{s}$  (United States Geological Survey 1980, 1981).

The embayment constituted the relatively deep broad part of the tidal inlet west of the levees and between the two sloughs (Figure 2). Prior to channelization the embayment was deeper and more extensive in area (Larson et al. 1982, 1983). Since the completion of the flood control project, altered circulation patterns at the mouth of the creek have resulted in the deposition of river transported sand (Ricks 1983, 1985). The shallowness of the embayment, coupled with the high discharges that were funneled between the levees and the relatively steep channel gradient (Ricks 1985), severely restricted the establishment of estuarine conditions in the winter and spring (Gregory 1982). True estuarine conditions in the early summer and fall were prevented by the formation of a sand berm at the mouth of the creek (Gregory 1982; Larson et al. 1982, 1983; Hofstra 1983; Ricks, 1983, 1985). It was the presence of this berm, however, that caused water levels in the embayment to rise, which resulted in a lagoon at the mouth of the creek suitable as a natural holding area for downstream migrant salmonids. A similar impoundment of water was noted for Waddell Creek, California (Needham 1940). Unfortunately, the Redwood Creek berm was artificially breached on 3 July 1980, with the loss of most of the rearing salmonids (Larson et al. 1982, 1983; Larson 1987).

Two other features within the study area were the South and North Sloughs (Figure 2). The South Slough formed from the last down-

stream meander of the creek that was by-passed during the channelization project. This relatively shallow body of water was bordered on the north by a riparian habitat of Sitka spruce (Picea sitchensis), red alder (Alnus rubra) and willow (Salix sp.), while pastures were to the south. Thick mats of the aquatic plant, Potamogeton pectinatis dominated the South Slough throughout the summer.

The North Slough may have formerly been a meander of the main channel. There was a riparian zone of spruce, alder and shore pine (Pinus contorta) on its north bank, with pasture bordering the south bank.

Both sloughs were fed by ephemeral streams, but sills at their mouths limited circulation with the main channel and embayment to periods of high water, which occurred only during extremes of discharge, spring tides or summer impoundment of water.

For this analysis, the lower Redwood Creek study area was divided into four study sites. The first of these was the upstream study site, which consisted of the creek from the U.S. Highway 101 bridge downstream to sampling station 7. Within this 2.0 km reach, lotic freshwater insects dominated the benthic fauna throughout the year (Salamunovich 1987). The second study site, referred to as the downstream study site, was the creek from station 7 to the west end of the levees, and the embayment. In this zone lotic freshwater insects dominated the benthic fauna in winter and spring, and estuarine crustaceans in the summer and fall (Salamunovich 1987). The last two study sites were the South and North Sloughs, where mixed populations of lentic freshwater and estuarine invertebrates made up the benthic fauna throughout the year (Salamunovich 1987).

## MATERIALS AND METHODS

The taxonomic keys used for the identification of invertebrates were those of Cummings (1933), Hungerford (1933), Lang (1948), Usinger (1956), Edmondson (1959), Allen and Edmunds (1962, 1963), Hartman (1968), Johannsen (1969), Schultz (1969), Brown (1972), Baumann (1975), Smith and Carlton (1975), Borror et al. (1976), Edmunds et al. (1976), Stark and Gaufin (1976), Smith (1977), Wiggins (1977), Pennak (1978), Lauck (1979), Williams and Lauck (1982), and Merritt and Cummins (1984). Sources for the identification fishes were Robins and Miller (1957), Kimsey and Fisk (1960), Miller and Lea (1972), Moyle (1976a), and Eddy and Underhill (1978). The reference for the identification of plants was Munz (1965).

Most of the fish examined for food habit analysis were captured in conjunction with a juvenile salmonid population study which described the materials and methods used in the capture of the fish in more detail (Larson 1987). In brief, fish were captured using either a 17m beach seine or a 67m purse seine modified for use as a beach seine, both with a 6.4mm mesh size. A few fish from the North Slough were captured in a minnow trap. Most of the juvenile threespine sticklebacks were captured in dredge or plankton net samples performed concurrent with this study.

Based upon direct observation of the fish species present in lower Redwood Creek there appeared to be little gear selectivity relative to the size of fish captured for stomach analysis. Except for

larval fish, the capture gear employed during the term of this study. primarily seines, caught all available sizes of fish. Also, except in the case of the threespine stickleback there did not appear to be any empirical evidence for a size-food habit relationship.

In preparation for examination, larger fish had their stomachs removed and then placed in a preservative of 70 percent isopropyl alcohol in the field, while smaller fish were placed directly in the preservative. Food items present in the esophagus and stomach of each fish were examined. Most of the fish species had the type of stomach with the posterior terminus delineated by a pyloric valve. For those species lacking this valve a more arbitrary limit was used. In such cases, a length of intestine equal to the length of the esophagus was examined.

Contents were separated, identified to the lowest taxonomic level possible and enumerated. If any parts of an organism were found in the gut contents, it was assumed the entire organism had been ingested. Although there is some evidence in the literature to support the argument of fish predators consuming only parts of their prey, the body parts in question are usually the necks of well anchored bivalves (Bryant 1916; Orcutt 1950; Porter 1964; Russo 1975; Cailliet 1977; Lane et al. 1979; de Vlas 1981). Prey species in this study were generally either epibenthic or shallow benthic in habit, so this assumption regarding the consumption of the whole organism is considered to be appropriate. The minimal number of organisms needed to provide those body parts that were observed, were used as the final count. That is to say, if 31 second antennae from the amphipod, Corophium salmonis, were found among the gut contents of a fish, it was recorded as having

consumed 16 of these amphipods. Thus:

$$\frac{31 \text{ second antennae}}{2 \text{ second antennae / amphipod}} = 15.5 \text{ amphipods,}$$

which was rounded up to 16 amphipods.

As a consequence of assuming the entire organism was consumed, a reconstructed weight was used in lieu of the actual weight of the stomach contents. This reconstructed weight was based upon the average dry weight of a number of individuals from a particular taxon. The representative individuals that were used as the standard for the reconstructed weight were selected from whole individuals of the taxon collected in dredge or plankton samples collected concurrent with this study. Representative samples of organisms were oven dried at 105° C for one hour and allowed to cool in a desiccator for one hour before being weighed to the nearest microgram on an analytical balance (Appendix A). Attempts were made to weigh organisms of the same species that were representative of the size of those found in the stomachs. In certain instances few or none of the species were available for reconstructed weight. In these cases estimates were made based upon the dry weight of closely related species that were similar in size and shape. Hyslop (1980) pointed out that calculations of dry weights may vary as a result of using representative organisms. This source of error was considered at the outset of this study, but any attempt to divide prey items and their reconstructed weights into specific size classes was beyond the scope of this study. Ranges of different sized individuals of a particular taxon were selected for use in the calculation of reconstructed weights. This reconstructed weight

methodology has been employed in other fish food habit studies (Elliot 1967; Efford and Tsumura 1973; Ellison 1980; Johnson and Johnson 1981; Wahl and Nielsen 1985).

Although this method of weighing did not yield the absolute weight of actual stomach contents, it did have several advantages. First, it avoided trying to obtain weights for stomach items that were beyond the capabilities of all but the most sensitive measuring devices. Second, it compensated for the problem of differential digestion rates among a variety of prey items or body parts that may occur in a single stomach sample (Hess and Rainwater 1939; Raney and Webster 1939; Gannon 1976; Berg 1979). Third, it provided for greater separation among prey items in terms of their importance in fish diets. By using reconstructed weights for the entire organisms a clearer picture of prey item importance may emerge.

Assessing the importance of particular prey items to the food habits of a fish has been done in the past using three different methods --frequency of occurrence, percentage composition by number, and gravimetric/volumetric analysis (Windell and Bowen 1978; Hyslop 1980). There are biases inherent in each of these approaches, and the use of any one of these methods alone can lead to errors (Wales 1946; Lagler 1956; Windell and Bowen 1978; Hyslop 1980). For many years these methods have been employed comparatively. Problems of assigning importance were encountered when an organism occurred in stomach samples with great frequency and in high numbers, but made up little in the way of volume or weight of the stomach contents (Thomas 1967; Greenfield 1968; Ebert and Summerfelt 1969; Frantz and Cordone 1970; Facey and La Bar 1981; Wallace 1981). Likewise, items that occurred infrequently,

and in small numbers, but made up a large percentage of total volume or weight of stomach contents can lead to errors when trying to assign importance to prey organisms (McConnell and Gerdes 1964).

Windell and Bowen (1978) stated that combined indices were more valuable than any single index, or group of indices employed in a separate but comparative fashion. An equation that relies on such a combination to yield an index of relative importance (IRI) for prey items was used in this investigation. The equation, first reported in Pinkas et al. (1971) has been adapted for the reconstructed weight method. It is:

$$IRI = (\%N + \%W)(\%F),$$

where

%N = the numerical percentage of a prey item,

%W = the reconstructed weight percentage of a prey item,

%F = the frequency of occurrence percentage of a prey item.

This method of analysis has been used to study the food habits of scombrids (Pinkas et al. 1971), rockfish (Prince 1975), sharks (Hulberg and Oliver 1979), salmonids (English 1983) and centrarchids (Okeyo and Hassler 1985). None of these studies addressed the question of sample size limitations for this method.

A Chi square ( $X^2$ ) test of independence based on a contingency model (Zar 1974) for diet homogeneity was employed to test the significance of diet variations. The test was based upon the numbers of food items in the five most important taxonomic orders of prey items as measured by IRI analysis. Food item life history habits were not combined, i.e. dipteran larvae, dipteran pupae and dipteran adults were all considered as separate categories. The one exception to this pooling was for the gammarid amphipods. Since the two species of Corophium, C. spinicorne and C. salmonis, are tube-dwelling organisms,

while Anisogammarus confervicolus are epibenthic in habit, these amphipods were always considered on a generic level.

An index of prey item importance is a useful tool when attempting to characterize the food habits of a population of fish; however, it is of little value for measuring diet similarity or overlap with other species (Wallace 1981). To make these comparisons, a diet overlap index ( $\alpha$ ) was calculated using Schoener's (1970) equation:

$$\alpha = 1 - 0.5 \left( \sum_{i=1}^n |p_{x,i} - p_{y,i}| \right).$$

where

- $n$  = the number of food categories,
- $p_{x,i}$  = the percentage of the  $i$ th food category in the diet of species  $x$ , by mean weight,
- $p_{y,i}$  = the percentage of the  $i$ th food category in the diet of species  $y$ , by mean weight.

The value of the overlap coefficient,  $\alpha$ , ranges from 0 when there are no food item categories in common, to 1.0 when when all food items are common to both species and occur in the same proportions. A value of 0.6 or greater was chosen to represent a biologically significant overlap on the basis of the judgements of prior authors (Zaret and Rand 1971; Mathur 1977; Johnson 1981a, 1981b; Johnson and Ringler 1980; Johnson and Johnson 1981; McCabe et al. 1983).

The overlap of food items were computed on the basis of the mean percentage of the restored weights. According to Wallace (1981), mean weight (or volume) percentages were the least objectionable measures of diet on which to base overlap indices. Weight (or volume) had some meaningful relationship to the caloric content of food items and the average value of a food item's contribution to the diet was a more

appropriate measure on which to base overlap than the percentage of the total weight (or volume) unless all prey items had similar weights (or volumes). The method of calculating mean weight percentage ( $\overline{\%W}$ ) was based on the equation used by Zaret and Rand (1971) and Mathur (1977):

$$\overline{\%W} = \frac{\sum_{x=1}^{n_j} W_{i,x}}{n_j}$$

where

$W_{i,x}$  = the percentage of the total restored weight made by food category  $i$  in the stomach of individual  $x$ ,  
 $n_j$  = the number of individuals of fish species  $j$ .

When calculating this number each individual fish was given equal weight independent of fish size or actual biomass of food items in its stomach.

Schoener's index of diet overlap was chosen as a descriptive measure of diet overlap because of its ease of calculation, its freedom from competitive process assumptions, its insensitivity to resource state manipulations and its facilitation in making intercommunity comparisons (Abrams 1980; Wallace 1981) and its adequacy as an overlap measure in the absence of resource availability data (Hurlbert 1978). Two Schoener indices were generated for each comparison. One overlap measure was calculated using all the prey categories identified to their lowest taxonomic levels. This was the diet overlap for all categories, or  $\alpha\alpha c$ . The second overlap measure was calculated after combining all food categories of similar habit to the ordinal level, i.e. dipteran larvae, or coleopteran adults. This measure was referred to as the diet overlap for combined categories, or  $\alpha c c$ . As was the case for the test for diet homogeneity, the two genera of amphipods were not combined.

The first measure may be considered more appropriate if one assumes that fish can distinguish between food items at a generic level. The second index may be more appropriate if one assumes fish distinguish prey items less critically. The diet overlap index for combined categories tended to be a less rigorous measure.

The variations in the importance of food items, tests of diet homogeneity, and diet overlap analysis, were analyzed not only as a function of fish species, but also as spatial and temporal functions. The diets were analyzed by location, as well as by season. As referred to in this study the seasons (and dates) were: winter (9 February-20 March), spring (27 March-1 June), summer (17 June-15 September), and fall (1 October-7 December). As a result of splitting the data into species/season/site categories, the loss of a stable fish population due to the 3 July berm breaching incident and the intention to avoid excessive harm to a fish population of unknown size within a U.S. National Park, sample sizes for any particular category tended to be small. All the information has been included for descriptive purposes since there is little available data on the food habits of these fishes in Redwood Creek; however, statistical tests were limited to comparisons having a minimum of five fish in each sample.

## RESULTS

A total of 582 fish, consisting of eleven species, was examined for food habits (Table 1). The species of fish encountered in lower Redwood Creek and examined for stomach contents included juvenile salmonids: steelhead trout, chinook salmon and coho salmon. Several sympatric species of nongame fishes were studied: prickly sculpin, Cottus asper; Humboldt sucker, Catostomus occidentalis humboldtianus; and threespine stickleback, Gasterosteus aculeatus. Also included in the analysis, were some euryhaline species with limited ranges within the lower portions of the study site: staghorn sculpin, Leptocottus armatus; starry flounder, Platichthys stellatus; surf smelt, Hypomesus pretiosus; tidewater goby, Eucyglobius newberryi; and shiner surfperch, Cymatogaster aggregata.

### Indices of Relative Importance

The food habits of each fish species are discussed according to location (upstream, downstream, South Slough, and North Slough) and by season within each location (winter, spring, summer, and fall). The examinations were based on the results of the IRI analyses. Even though some of the information is based on limited observations, the indices were calculated for all samples. Detailed results of these evaluations (i.e. taxonomic identification and life history stage of each food item, as well as its frequency of occurrence and its percentage by number and weight, etc.) may be found in Appendix B.

Table 1. Number and Size of Fish Examined for Food Habits from Lower Redwood Creek, February-December, 1980.

| Species              | Number |                                   |                                       | Length (millimeters) |                 |
|----------------------|--------|-----------------------------------|---------------------------------------|----------------------|-----------------|
|                      | Total  | Number with identified food items | Percentage with identified food items | Mean                 | Range           |
| Steelhead trout      | 79     | 76                                | 96.2%                                 | 115.3                | 28 - 221 (FL)1/ |
| Chinook salmon       | 78     | 78                                | 100.0%                                | 72.8                 | 36 - 111 (FL)   |
| Coho salmon          | 5      | 5                                 | 100.0%                                | 71.8                 | 33 - 157 (FL)   |
| Prickly sculpin      | 101    | 88                                | 87.1%                                 | 63.4                 | 30 - 140 (TL)2/ |
| Staghorn sculpin     | 25     | 23                                | 92.0%                                 | 89.0                 | 60 - 110 (TL)   |
| Starry flounder      | 43     | 35                                | 81.4%                                 | 25.3                 | 73 - 254 (TL)   |
| Humboldt sucker      | 41     | 35                                | 85.4%                                 | 93.5                 | 44 - 200 (FL)   |
| Juvenile stickleback | 48     | 45                                | 93.8%                                 | 14.0                 | 7 - 25 (TL)     |
| Adult stickleback    | 149    | 138                               | 92.6%                                 | 54.7                 | 28 - 77 (TL)    |
| Surf smelt           | 6      | 6                                 | 100.0%                                | 154.0                | 45 - 178 (FL)   |
| Tidewater goby       | 5      | 5                                 | 100.0%                                | 37.8                 | 31 - 41 (TL)    |
| Shiner surfperch     | 2      | 0                                 | 0.0%                                  | 39.5                 | 39 - 40 (FL)    |

1/ FL = Fork length

2/ TL = Total length

### Juvenile Steelhead

Seasonal diet analyses of juvenile steelhead at the upstream site were based upon the examination of 7 fish in the spring and 12 fish in the summer (Table 2). No fish were caught from this site in the winter or fall sampling periods. Dipteran larvae and pupae comprised approximately 70 percent of the diet in both spring and summer. The only notable change in diet was the switch from plecopteran nymphs which made up over 25 percent of the total IRI in the spring to ephemeropteran nymphs and trichopteran larvae each of which contributed over 10 percent to the summer diet.

The seasonal variations in diet of juvenile steelhead trout captured at the downstream study site were based on 6 fish in the spring, 36 fish in the summer, and 7 fish in the fall (Table 3). No fish were trapped at this location during the winter. As at the upstream site, dipteran larvae (mostly chironomids) were the most important food items in the spring and summer. However, considerable contributions were also made by estuarine and marine species during spring and summer. In the fall, the two species of Corophium, C. spinicorne and C. salmonis, predominated in the IRI.

The presence of large logs on the bottom of the South Slough, as well as the thick mats of pond weed, P. pectinatis, reduced the effectiveness of seining within this site. Consequently, only seven juvenile steelhead were captured for stomach content analysis from this site during this study. Seasonal diet analyses of juvenile steelhead trout from the South Slough were based on four fish captured in the summer (Table 4) and one fish from each of the other three seasons (Appendix B). In the winter isopods and amphipods dominated the diet,

Table 2. Percentage of the Total IRI Contributed by the Principal Prey Items Found in the Stomachs of Fish Captured at the Upstream Site of Redwood Creek, February-December, 1980\*.

WI = Winter; SP = Spring; SU = Summer; FA = Fall.

| Sample Size               | Juvenile Steelhead |          | Juvenile Chinook |         | Juvenile Coho |         | Prickly Sculpin |          |          |
|---------------------------|--------------------|----------|------------------|---------|---------------|---------|-----------------|----------|----------|
|                           | SP<br>7            | SU<br>12 | WI<br>2          | SP<br>5 | SU<br>3       | SP<br>4 | WI<br>3         | SP<br>10 | SU<br>15 |
| Acarl                     |                    |          |                  |         | 1.4           |         |                 |          |          |
| <u>Corophium</u> spp.     |                    |          |                  |         |               |         |                 |          |          |
| Ephemeroptera nymphs      | 1.1                | 11.6     | 5.0              | 1.8     | 6.5           |         | 3.3             |          | 56.2     |
| Plecoptera nymphs         | 25.8               |          |                  |         |               |         | 32.0            |          |          |
| Hemiptera nymphs & adults | 1.6                |          |                  |         |               | 1.2     |                 |          |          |
| Coleoptera larvae         | 2.0                |          | 0.8              |         |               |         |                 | 2.1      |          |
| Coleoptera adults         |                    |          |                  | 2.6     | 1.2           | 0.7     | 2.1             |          |          |
| Trichoptera larvae        |                    | 10.9     | 7.3              | 16.7    |               | 50.5    | 2.0             | 6.2      | 1.1      |
| Diptera larvae            | 42.5               | 46.1     | 82.7             | 34.6    | 29.1          | 33.7    | 57.3            | 55.1     | 42.2     |
| Diptera pupae             | 23.7               | 26.6     | 0.3              | 37.3    | 51.8          |         |                 |          |          |
| Fish                      |                    | 1.0      |                  |         |               |         |                 |          |          |
| Eggs                      |                    |          |                  |         |               |         |                 |          |          |
| Terrestrials              | 0.8                | 0.7      | 3.4              | 6.1     | 9.1           | 12.7    |                 | 35.2     |          |

Table 2. Percentage of the Total IRI Contributed by the Principal Prey Items Found in the Stomachs of Fish Captured at the Upstream Site of Redwood Creek, February-December, 1980.  
(continued)

| Sample Size               | Humboldt<br>Sucker |                |                | Juvenile<br>Threespine<br>Stickleback | Adult<br>Threespine<br>Stickleback |                 |                |
|---------------------------|--------------------|----------------|----------------|---------------------------------------|------------------------------------|-----------------|----------------|
|                           | <u>WI</u><br>4     | <u>SP</u><br>2 | <u>SU</u><br>5 | <u>SU</u><br>6                        | <u>SP</u><br>2                     | <u>SU</u><br>32 | <u>FA</u><br>4 |
| Acari                     |                    |                |                | 13.4                                  |                                    |                 |                |
| <u>Corophium</u> spp.     |                    |                |                |                                       |                                    |                 | 1.4            |
| Ephemeroptera nymphs      | 3.3                |                | 1.8            | 2.7                                   |                                    | 15.5            |                |
| Plecoptera nymphs         |                    |                |                |                                       |                                    |                 |                |
| Hemiptera nymphs & adults |                    |                |                |                                       |                                    |                 |                |
| Coleoptera larvae         | 0.8                |                |                |                                       |                                    | 2.9             |                |
| Coleoptera adults         | 2.9                |                |                |                                       |                                    |                 |                |
| Trichoptera larvae        |                    |                |                |                                       |                                    |                 |                |
| Diptera larvae            | 92.3               | 93.8           | 95.4           | 83.9                                  | 21.3                               | 70.0            | 64.6           |
| Diptera pupae             | 0.8                | 5.3            | 2.8            |                                       | 56.6                               | 10.3            | 34.0           |
| Fish                      |                    |                |                |                                       |                                    |                 |                |
| Eggs                      |                    | 0.8            |                |                                       |                                    |                 |                |
| Terrestrials              |                    |                |                |                                       | 15.4                               | 0.1             |                |

\* For a complete list of individual prey items, their frequency of occurrence, numbers, weights, and individual indices of importance, refer to Appendix B.

Table 3. Percentage of the Total IRI Contributed by the Principal Prey Items Found in the Stomachs of Fish Captured at the Downstream Site of Redwood Creek, February-December, 1980\*.  
 WI = Winter; SP = Spring; SU = Summer; FA = Fall.

| Sample Size                         | Juvenile Steelhead |                 |                | Juvenile Chinook |                 | Prickly Sculpin |                 |                |
|-------------------------------------|--------------------|-----------------|----------------|------------------|-----------------|-----------------|-----------------|----------------|
|                                     | <u>SP</u><br>6     | <u>SU</u><br>36 | <u>FA</u><br>7 | <u>SP</u><br>10  | <u>SU</u><br>53 | <u>SP</u><br>12 | <u>SU</u><br>23 | <u>FA</u><br>9 |
| <u>Neanthes succinea</u>            |                    |                 |                |                  |                 | 3.4             |                 |                |
| <u>Octopus rubescens</u>            |                    |                 |                |                  |                 |                 |                 |                |
| Acarl                               |                    |                 |                |                  | 0.6             |                 |                 |                |
| Copepods                            |                    |                 |                |                  |                 |                 |                 | 3.4            |
| <u>Neomysis mercedis</u>            |                    |                 | 0.5            |                  |                 |                 |                 |                |
| <u>Gnorimosphaeroma oregonensis</u> |                    |                 | 1.8            |                  |                 | 2.1             |                 |                |
| <u>Corophium</u> spp.               | 12.3               | 25.1            | 89.6           |                  |                 | 4.6             | 5.3             | 80.5           |
| <u>Anisogammarus confervicolus</u>  |                    |                 | 1.1            |                  |                 | 0.7             |                 |                |
| <u>Crangon franciscorum</u>         |                    |                 |                |                  |                 |                 |                 |                |
| <u>Emerita analoga</u>              | 22.5               |                 |                |                  |                 |                 |                 |                |
| Ephemeroptera nymphs                | 3.4                |                 |                |                  |                 |                 |                 |                |
| Plecoptera nymphs                   |                    |                 |                |                  |                 | 1.1             |                 |                |
| Coleoptera larvae                   |                    |                 |                |                  |                 | 2.1             |                 |                |
| Trichoptera larvae                  | 8.4                |                 |                | 2.2              |                 | 1.2             |                 |                |
| Diptera larvae                      | 39.3               | 49.3            | 1.1            | 20.6             | 40.0            | 84.1            | 85.6            | 5.5            |
| Diptera pupae                       | 8.7                | 19.3            | 1.4            | 56.9             | 57.6            |                 |                 |                |
| Fish                                |                    | 4.3             | 2.7            | 3.4              |                 |                 | 1.1             | 9.8            |
| Eggs                                |                    |                 |                |                  |                 |                 | 6.6             |                |
| Terrestrials                        | 1.8                | 0.4             | 1.6            | 15.2             | 1.4             | 0.2             |                 | 0.1            |

Table 3. Percentage of the Total IRI Contributed by the Principal Prey Items Found in the Stomachs of Fish Captured at the Downstream Site of Redwood Creek, February-December, 1980.  
(continued)

| Sample Size                         | Staghorn<br>Sculpin |                | Starry<br>Flounder |                |                 |                 | Humboldt<br>Sucker |                 |
|-------------------------------------|---------------------|----------------|--------------------|----------------|-----------------|-----------------|--------------------|-----------------|
|                                     | <u>SP</u><br>2      | <u>SU</u><br>9 | <u>WI</u><br>2     | <u>SP</u><br>5 | <u>SU</u><br>14 | <u>FA</u><br>12 | <u>SP</u><br>2     | <u>SU</u><br>14 |
| <u>Neanthes succinea</u>            | 100.0               |                |                    |                | 3.0             | 25.2            |                    |                 |
| <u>Octopus rubescens</u>            |                     | 18.2           |                    |                |                 |                 |                    |                 |
| Acari                               |                     |                |                    |                |                 |                 |                    |                 |
| Copepods                            |                     |                |                    |                |                 |                 | 35.9               |                 |
| <u>Neomysis mercedis</u>            |                     | 6.1            |                    | 8.2            |                 |                 |                    |                 |
| <u>Gnorimosphaeroma oregonensis</u> |                     | 1.0            | 0.9                | 10.8           | 4.2             |                 |                    |                 |
| <u>Corophium spp.</u>               |                     | 60.4           | 8.8                | 58.8           | 66.3            | 74.0            |                    |                 |
| <u>Anisogammarus confervicolus</u>  |                     | 1.9            | 82.4               | 4.5            |                 | 0.4             |                    |                 |
| <u>Crangon franciscorum</u>         |                     |                |                    |                | 6.7             |                 |                    |                 |
| <u>Emerita analoga</u>              |                     |                |                    |                |                 |                 |                    |                 |
| Ephemeroptera nymphs                |                     |                |                    |                |                 |                 |                    |                 |
| Plecoptera nymphs                   |                     |                | 8.0                |                |                 |                 |                    |                 |
| Coleoptera larvae                   |                     |                |                    |                |                 |                 |                    |                 |
| Trichoptera larvae                  |                     |                |                    |                |                 |                 |                    |                 |
| Diptera larvae                      |                     | 7.9            |                    | 14.1           | 19.4            |                 | 64.1               | 98.9            |
| Diptera pupae                       |                     | 1.0            |                    |                |                 |                 |                    | 0.8             |
| Fish                                |                     | 0.9            |                    |                |                 |                 |                    |                 |
| Eggs                                |                     |                |                    | 3.7            |                 |                 |                    |                 |
| Terrestrials                        |                     | 1.6            |                    |                |                 |                 |                    |                 |

Table 3. Percentage of the Total IRI Contributed by the Principal Prey Items Found in the Stomachs of Fish Captured at the Downstream Site of Redwood Creek, February-December, 1980.  
(continued)

| Sample Size                         | Juvenile<br>Threespine<br>Stickleback | Adult<br>Threespine<br>Stickleback |                 | Surfsmelt      |
|-------------------------------------|---------------------------------------|------------------------------------|-----------------|----------------|
|                                     | <u>SP</u><br>13                       | <u>SP</u><br>14                    | <u>SU</u><br>28 | <u>FA</u><br>6 |
| <u>Neanthes succinea</u>            | 1.7                                   |                                    |                 |                |
| <u>Octopus rubescens</u>            |                                       |                                    |                 |                |
| Acari                               | 1.1                                   | 1.2                                |                 |                |
| Copepods                            | 13.5                                  |                                    |                 | 61.6           |
| <u>Neomysis mercedis</u>            |                                       | 4.9                                |                 | 1.1            |
| <u>Gnorimosphaeroma oregonensis</u> |                                       | 1.1                                |                 |                |
| <u>Corophium</u> spp.               | 4.0                                   | 30.9                               |                 | 3.0            |
| <u>Anisogammarus confervicolus</u>  |                                       |                                    |                 | 32.6           |
| <u>Crangon franciscorum</u>         |                                       |                                    |                 |                |
| <u>Emerita analoga</u>              |                                       |                                    |                 |                |
| Ephemeroptera nymphs                |                                       |                                    |                 |                |
| Plecoptera nymphs                   |                                       |                                    |                 |                |
| Coleoptera larvae                   |                                       |                                    |                 |                |
| Trichoptera larvae                  |                                       |                                    |                 |                |
| Diptera larvae                      | 79.4                                  | 41.5                               | 98.7            |                |
| Diptera pupae                       |                                       | 20.0                               | 0.5             |                |
| Fish                                |                                       |                                    | 0.1             | 0.5            |
| Eggs                                |                                       |                                    |                 |                |
| Terrestrials                        |                                       |                                    | 0.1             | 0.1            |

\* For a complete list of individual prey items, their frequency of occurrence, numbers, weights, and individual indices of importance, refer to Appendix B.

Table 4. Percentage of the Total IRI Contributed by the Principal Prey Items Found in the Stomachs of Fish Captured at the South Slough Site of Redwood Creek, February-December, 1980\*.

WI = Winter; SP = Spring; SU = Summer; FA = Fall.

|                                     | Juvenile<br>Steelhead | Juvenile<br>Chinook | Prickly<br>Sculpin |           | Staghorn<br>Sculpin |           |           | Starry<br>Flounder |
|-------------------------------------|-----------------------|---------------------|--------------------|-----------|---------------------|-----------|-----------|--------------------|
|                                     | <u>SU</u>             | <u>SU</u>           | <u>WI</u>          | <u>SU</u> | <u>WI</u>           | <u>SP</u> | <u>SU</u> | <u>WI</u>          |
| Sample Size                         | 4                     | 5                   | 8                  | 6         | 5                   | 2         | 3         | 2                  |
| Acarl                               |                       |                     |                    |           |                     |           |           |                    |
| Cladocerans                         |                       | 0.5                 |                    |           |                     |           |           |                    |
| Ostracods                           |                       |                     | 2.6                |           |                     |           |           |                    |
| Copepods                            |                       |                     |                    | 2.2       |                     |           |           |                    |
| <u>Neomysis mercedis</u>            | 0.6                   | 8.9                 |                    | 7.2       | 26.6                | 84.0      | 75.7      |                    |
| <u>Gnorimosphaeroma oregonensis</u> | 1.4                   | 4.0                 | 46.2               | 82.1      | 44.3                |           | 1.0       | 63.6               |
| <u>Corophium</u> spp.               | 18.0                  | 53.5                | 18.0               | 0.9       | 15.8                | 10.5      | 23.0      |                    |
| <u>Anisogammarus confervicolus</u>  |                       |                     | 29.3               |           | 10.7                |           |           | 33.7               |
| <u>Ischnura cervula</u> naiads      |                       | 5.5                 |                    |           |                     |           |           |                    |
| Plecoptera nymphs                   |                       | 0.9                 |                    |           |                     |           |           |                    |
| Corixid nymphs & adults             | 54.1                  |                     |                    |           |                     |           |           |                    |
| <u>Notonecta shooteri</u> nymphs    | 2.7                   |                     |                    |           |                     |           |           |                    |
| <u>Glyphopsyche</u> sp. larvae      | 1.6                   | 0.7                 |                    |           |                     |           |           |                    |
| Diptera larvae                      |                       | 1.5                 | 4.0                | 6.8       | 2.6                 | 5.5       |           | 2.7                |
| Diptera pupae                       | 5.1                   | 12.3                |                    |           |                     |           | 0.3       |                    |
| Fish                                |                       | 4.1                 |                    |           |                     |           |           |                    |
| Eggs                                |                       |                     |                    |           |                     |           |           |                    |
| Terrestrials                        | 13.6                  | 4.9                 |                    |           |                     |           |           |                    |

Table 4. Percentage of the Total IRI Contributed by the Principal Prey Items Found in the Stomachs of Fish Captured at the South Slough Site of Redwood Creek, February-December, 1980.  
(continued)

| Sample Size                         | Humboldt<br>Sucker | Juvenile<br>Threespine<br>Stickleback |                |                | Adult<br>Threespine<br>Stickleback |                 |                 |                |
|-------------------------------------|--------------------|---------------------------------------|----------------|----------------|------------------------------------|-----------------|-----------------|----------------|
|                                     | <u>SU</u><br>8     | <u>SP</u><br>6                        | <u>SU</u><br>5 | <u>FA</u><br>3 | <u>WI</u><br>12                    | <u>SP</u><br>10 | <u>SU</u><br>13 | <u>FA</u><br>7 |
| Acari                               |                    | 1.4                                   | 5.6            |                |                                    |                 |                 |                |
| Cladocerans                         |                    | 20.6                                  | 25.1           | 6.2            |                                    |                 |                 |                |
| Ostracods                           |                    | 14.2                                  | 26.6           | 1.3            |                                    |                 |                 |                |
| Copepods                            |                    | 30.4                                  |                |                |                                    |                 | 4.9             |                |
| <u>Neomysis mercedis</u>            |                    |                                       |                | 57.5           | 46.3                               | 31.4            | 13.4            | 96.3           |
| <u>Gnorimosphaeroma oregonensis</u> | 65.3               |                                       |                |                | 2.4                                | 10.1            | 15.6            | 0.7            |
| <u>Corophium</u> spp.               | 19.9               |                                       |                |                | 26.1                               | 5.7             | 48.7            | 0.8            |
| <u>Anisogammarus confervicolus</u>  |                    |                                       |                |                | 7.1                                |                 |                 |                |
| <u>Ischnura cervula</u> naiads      | 1.0                |                                       |                |                |                                    |                 | 1.3             |                |
| Plecoptera nymphs                   |                    |                                       |                |                |                                    |                 |                 |                |
| Corixid nymphs & adults             |                    |                                       |                |                |                                    |                 | 0.9             |                |
| <u>Notonecta shooteri</u> nymphs    | 3.0                |                                       |                |                |                                    |                 |                 |                |
| <u>Glyphopsyche</u> sp. larvae      | 2.1                |                                       |                |                |                                    |                 |                 |                |
| Diptera larvae                      | 7.8                | 27.1                                  | 8.6            | 13.3           | 4.2                                | 37.7            | 6.5             |                |
| Diptera pupae                       |                    | 6.3                                   |                | 21.8           | 13.9                               | 14.5            | 4.9             | 1.6            |
| Fish                                |                    |                                       |                |                |                                    |                 | 0.6             |                |
| Eggs                                |                    |                                       | 34.1           |                |                                    |                 | 2.7             |                |
| Terrestrials                        |                    |                                       |                |                |                                    |                 |                 |                |

\* For a complete list of individual prey items, their frequency of occurrence, numbers, weights, and individual indices of importance, refer to Appendix B.

while terrestrial input in the form of zygopteran adults (Enallagma) contributed most heavily to the spring and fall diet. In the summer the fish examined revealed a diet dependent on hymenopteran adults and nymphs.

Only one juvenile steelhead was analyzed from the North Slough. This fish, captured in early May, had the anisopteran naiad, Aeshna sp., as its most important food item (Appendix B). Threespine stickleback juveniles and chironomid larvae also made up a large portion of the diet.

#### Juvenile Chinook

Seasonal variations in the diets of juvenile chinook salmon for upstream Redwood Creek were based upon the examination of two fish in the winter, five fish in the spring, and three fish in the summer (Table 2). In the winter, dipteran larvae (mostly chironomids) accounted for most of the total IRI. In the spring, chironomid larvae and pupae appeared to be equally important as the primary food items in the diet. Terrestrial input to the diet during the spring was greater than in the winter.

By summer most of the juvenile chinook salmon had migrated through the upstream site (Larson 1987). Three fish captured on 17 June (the first day of the summer sampling period) were the only fish examined for summer food habits. Chironomid pupae were the main food item, though dipteran larvae still remained a major component of the diet. The input from terrestrial sources increased from the spring contribution.

Variations in the diets of juvenile chinook salmon examined from the downstream site of Redwood Creek were based on 10 fish in spring and 53 fish from summer (Table 3). No fish were captured in the winter or fall. In spring and summer, dipteran pupae (mostly chironomid) dominated the IRI. For both seasons, dipteran larvae (mostly chironomid) was the second most important item.

The breaching of the berm at the mouth of Redwood Creek on 3 July 1980 greatly reduced the size of the summer rearing habitat for juvenile chinook and steelhead and apparently forced most of the estimated population of 20,000 salmonid smolts residing in the embayment to sea (Larson et al. 1981, 1982; Larson 1987). After this date, few chinook were trapped, and none were examined for food habits.

The only chinook stomachs examined from the South Slough were from fish captured in the summer (Table 4). The diet appears to rely on a greater diversity of important food items than those of salmon from either the upstream or downstream site for the corresponding season. The amphipod, Corophium, made up the greatest portion of the diet.

#### Juvenile Coho

Juvenile coho salmon spend little, if any, time rearing in lower Redwood Creek during their migration downstream (Larson, personal communication). By mid-spring all the fish had apparently entered the ocean. Only four fish captured during the spring at the upstream site were examined for food habits (Table 2). Trichopteran larvae, mostly Dicosmoecus sp. and Rhyacophila sp., made up approximately half of the total IRI. Chironomid larvae accounted for most of the remainder.

No coho were captured from either the downstream or South Slough sites. One fin clipped juvenile coho, captured on 12 April, was examined for food habits from the North Slough (Appendix B). This fish was the only fish of known hatchery origin in this study and had been reared at the Prairie Creek facility and released earlier in the year. Chironomid pupae dominated the diet index.

### Prickly Sculpin

Prickly sculpin were relatively abundant residents of lower Redwood Creek and were commonly found throughout the study site. Seasonal variations in the diets of prickly sculpin from the upstream site were based upon the examination of 3 fish in winter, 10 fish in spring, and 15 in summer (Table 2). Dipteran larvae (mostly chironomid) accounted for most of the total IRI in the winter and spring. In winter, the plecopteran nymph, Calineuria californica, was an important component of the overall diet, while in spring, prey of terrestrial origin, namely oligochaetes, were important. Prickly sculpin captured at the downstream site in the summer show little diversity in the types of food items consumed. Ephemeropteran nymphs (several species) were the primary prey items. No prickly sculpin were captured at this site in the fall.

Seasonal variations in the food habits of prickly sculpin from the downstream site were based upon the examination of 12 fish in the spring, 23 fish in summer, and 9 fish in fall (Table 3). No prickly sculpin from this site were examined for winter food habits. Dipteran larvae (mostly chironomid) dominated the diet index in the spring and summer. In the fall, dipteran larvae ceased to dominate the diet, as

the two species of Corophium combined to become the most important item in the diet of prickly sculpin.

Seasonal variations in the food habits of prickly sculpin from the South Slough were based on eight fish in spring, six fish in summer, (Table 4), and one fish each in spring and fall (Appendix B). In the winter, summer, and fall diets, the isopod, Gnorimosphaeroma oregonensis, was the major contributor to the diet. The amphipod, C. spinicorne, dominated the IRI of the single fish examined in spring.

#### Staghorn Sculpin

Staghorn sculpin were common, but not abundant, residents of lower Redwood Creek. Their distribution appeared to be limited to the embayment, the South slough, and the lower 0.5 km of the main channel of Redwood Creek. Seasonal diet analyses of staghorn sculpin from the downstream site were based on the examination of two fish in spring, nine fish in summer (Table 3), and one fish each from winter and fall (Appendix B). The one fish examined for winter food habits had been feeding exclusively on the amphipod, A. confervicolus. In the spring, the polychaete, Neanthes succinea, was the only food item found in the stomachs. The diet of fish captured during the summer revealed greater diversity, with the amphipods, C. salmonis and C. spinicorne, making up most of the total IRI. The amphipod, Anisogammarus confervicolus, was the most important food item of the single staghorn sculpin examined in the fall.

Seasonal variations in the diet for staghorn sculpin captured at the South Slough site were based on the examination of five fish in winter, two fish in spring, and three fish in summer (Table 4). The

winter diet appeared more diverse in character with the isopod, G. oregonensis, being the primary food item. In spring and summer, the diets showed less diversity and were dominated by Neomysis mercedis.

#### Starry Flounder

Similar in distribution and abundance to the staghorn sculpin, starry flounder were seldom caught far from the mouth of Redwood Creek. Seasonal variations in the diets for starry flounder from the downstream site were based on the examination of 2 fish in winter, 5 fish in spring, 14 fish in summer, and 12 fish in fall (Table 3). Amphipods dominated the diets for all seasons. In winter, A. confervicolus was the most important food item. In spring, summer, and fall, Corophium dominated the total IRI.

Only two flounder were examined for food habits from the South Slough (Table 4). Both these fish captured in the winter, revealed a diet that depended heavily on isopods and amphipods.

#### Humboldt Sucker

Though plant and detrital material were found among the stomach contents of the Humboldt sucker, only invertebrate food items were considered in this analysis. The seasonal variations in the diet of the Humboldt sucker from the upstream site were based on the examination of four fish in winter, two fish in spring, and five fish in summer (Table 2). There appeared to be little seasonal variation in the diet with dipteran larvae (mostly chironomid) dominating the diet to the exclusion of almost all other prey items. In the winter, spring, and summer food habits, this food item accounted for 92 percent, 94 percent and 95 percent, respectively, of the total IRI.

Downstream diets were based on the examination of 2 fish in spring, and 14 fish in summer (Table 3). Though chironomid larvae were the most important food item in spring, a major contribution was made by the epibenthic copepod, Huntemannia sp. The summer diet, showed less diversity as dipteran larvae dominated the stomach contents of the sucker and contributed 99.0 percent of the total diet index. No fish from this site were caught for examination either in winter or fall.

Humboldt suckers were seined in the South Slough only in the summer. The diet analyses was based on the examination of eight fish (Table 4). The diet of the suckers from this site in summer showed much more diversity than from the other sites for the same season. Dipteran larvae contributed little to the total IRI. The main prey item was the isopod, G. oregonensis.

#### Juvenile Threespine Stickleback

The threespine stickleback were subdivided into two categories for this analysis. Individuals less than 26 millimeters in total length were labelled "juveniles". Fish greater than 26 millimeters in total length were referred to as "adults". These categories were chosen, on the basis that fish shorter than 26 millimeters in total length tended to consume small benthic and planktonic food items with more regularity; the categories were not meant to infer stages of sexual maturity.

Six of these smaller sticklebacks from the upstream site were analyzed for summer food habits (Table 2). Dipteran larvae were the primary item of importance in the overall IRI. Only one juvenile was captured in the fall (Appendix B). The majority of its diet was

chironomid larvae and pupae, which were of near equal importance, contributing 49 percent and 42 percent, respectively, to the total IRI.

Juvenile sticklebacks were captured from downstream sites only on 1 June. The characterization of the diet, based on the examination of 13 fish (Table 3), revealed dipteran larvae (mostly chironomid) were the primary food items in the diet.

Seasonal variations in the diets for juvenile threespine sticklebacks from the South Slough site were based on 6 fish in spring, 5 fish in summer, and 3 fish in fall (Table 4). No fish were trapped for stomach analysis in the winter. In the spring, no one item dominated the diet, but rather the cyclopoid copepod, Eucyclops sp., chironomid larvae and cladocerans each contributed between 20 percent and 30 percent of the total IRI. Ostracods were also an important component of the spring diet and accounted for 14 percent of the total index.

The summer diet, like the spring, had no one item that dominated. Again there was a diversity of important prey items in the diet, as Eucyclops, cladocerans and eggs (probably cladoceran), each contributed between 25 percent and 35 percent of the total IRI. In the fall, the mysid, N. mercedis, dominated the dietary index.

Seasonal variations in the diets of juvenile threespine stickleback from the North Slough were based on the examination of nine fish in spring, and two fish in summer (Table 5). No fish were trapped at this site in the winter or fall. Fish captured in the spring relied almost exclusively on eggs (probably cladoceran) for their diet. The summer diet, based on a sample of two fish, had zooplankters, namely, cladocerans and Eucyclops, dominating the diet.

Table 5. Percentage of the Total IRI Contributed by the Principal Prey Items Found in the Stomachs of Fish Captured at the North Slough Site of Redwood Creek, February-December, 1980\*.  
 WI = Winter; SP = Spring; SU = Summer; FA = Fall.

| Sample Size                        | Juvenile<br>Threespine<br>Stickleback |         | Adult<br>Threespine<br>Stickleback | Tidewater<br>Goby |
|------------------------------------|---------------------------------------|---------|------------------------------------|-------------------|
|                                    | SP<br>9                               | SU<br>2 | SP<br>14                           | SU<br>5           |
| Acari                              |                                       | 7.3     |                                    |                   |
| Cladocerans                        |                                       | 48.0    | 29.4                               | 2.3               |
| Ostracods                          |                                       |         | 20.2                               |                   |
| Copepods                           |                                       | 33.7    | 3.7                                | 22.9              |
| <u>Neomysis mercedis</u>           |                                       |         | 1.1                                |                   |
| <u>Gnoriomphaeroma oregonensis</u> |                                       |         | 3.6                                | 4.2               |
| <u>Corophium</u> spp.              |                                       |         | 1.0                                | 3.8               |
| Diptera larvae                     |                                       | 11.1    | 34.8                               | 66.6              |
| Diptera pupae                      |                                       |         | 4.1                                |                   |
| Eggs                               | 99.6                                  |         |                                    |                   |

\* For a complete list of individual prey items, their frequency of occurrence, numbers, weights, and individual indices of importance, refer to Appendix B.

### Adult Threespine Stickleback

The label "adult" refers to fish that were greater than 26 millimeters in total length. Seasonal variations in the diet of adult threespine stickleback from the upstream site of Redwood Creek were based upon the examination of 2 fish in spring, 32 fish in summer, and 4 fish in fall (Table 2). No fish were captured in the winter. Chironomid pupae were the most important prey item in the spring diet. In the summer and fall, dipteran larvae (mostly chironomid) accounted for most of the overall index.

Seasonal variations in the diet for adult threespine sticklebacks from the downstream site of Redwood Creek were based on the examination of 14 fish in spring and 28 fish in summer (Table 3). No fish were trapped in the winter. Of the 14 fish examined for spring diet, 13 were gravid females. This group had a diet that was diverse. The most important food item was chironomid larvae, but Corophium and dipteran pupae accounted for a large part of the diet. The summer food habits were virtually dependent on one food item --chironomid larvae. Only one fish was examined for fall food habits (Appendix B). It contained four specimens of the mysid, N. mercedis.

Seasonal variations in the diets of adult threespine stickleback from the South Slough site were based on the examination of 12 fish in winter, 10 fish in spring, 13 fish in summer, and 7 fish in fall (Table 4). The winter diet revealed a diverse diet, that was dominated by N. mercedis. The spring diet was also diverse in character, with the major prey item, chironomid larvae, followed closely by N. mercedis. The summer diet continued to be diverse. Corophium (mostly C. spinicorne) was the major component of the diet. The fall diet, unlike those of the

other seasons, was not diverse. The mysid, N. mercedis, dominated all stomach contents.

Adult threespine stickleback were captured from the North Slough only in the spring. The diet analysis was based on the examination of 14 fish (Table 5). Almost equal proportions of the total index were contributed by dipteran larvae (mostly chironomid) and cladocerans.

### Surf Smelt

Surf smelt were not commonly encountered during seining operations and were apparently only seasonal visitors to the lower Redwood Creek. These fish were only trapped on one date--1 November. At this time they were present in large numbers in the embayment and lower 0.5 km of the river.

The surf smelt diet is based upon the examination of six fish (Table 3). The calanoid copepod, Eurytemora sp., dominated the the diet numerically, and as a percentage of the total IRI. The amphipod, A. confervicolus, also contributed substantially to the overall diet.

### Tidewater Goby

Another uncommon species in lower Redwood Creek was the tidewater goby. Its distribution in the creek seemed to be limited, as it was only trapped from the North Slough in the mid-summer. It did not appear to be present in any great numbers, and only 5 individuals were captured and examined for food habits (Table 5). The summer food habits of this goby in the North Slough of Redwood Creek were dominated by chironomid larvae. The copepod, Eucyclops sp., was also an important food item.

### Shiner Surfperch

The shiner surfperch, like the two previous species was not common in Redwood Creek. Its presence, based on seining and direct observation while snorkeling, appears to be limited to a small number of juveniles at the mouth of Redwood Creek. The two juvenile shiner surfperch examined had no identifiable invertebrate material among the stomach contents and appeared to have consumed only algae.

### Diet Comparisons

#### Temporal Diet Comparisons by Species

Comparisons of diet within species from the same site during different seasons were computed using the Chi square test of diet homogeneity (Table 6). Some comparisons were not appropriate because of insufficient data. The hypothesis that the diets were homogenous was rejected in all but one case. The exception was for Humboldt suckers from the upstream site when the winter and spring diets were pooled and compared to the summer diet.

Diet overlap values were computed for within location and between season intraspecific comparisons (Table 7). The comparison that displayed homogeneity of diet in the Chi square analysis also showed biologically significant diet overlaps. In fact, all the sucker comparisons had biologically significant diet overlap values.

Juvenile chinook salmon displayed biologically significant diet overlap only for the comparison of spring and summer diets from the upstream site. When the winter and spring diets from the upstream site were combined and compared to the corresponding summer diet the overlap

Table 6. Chi Square ( $X^2$ ) Values for Within Location Intraspecific Comparisons of Diets for Fish from Lower Redwood Creek, February-December, 1980. The Chi Square Values Were Computed Using Numbers of Food Items That Constituted the Top Five IRI Values. n1/n2 = Ratio of Sample Size of Group 1 to Group 2; d.f. = Degrees of Freedom; U = Upstream; D = Downstream; SS = South Slough; NS = North Slough.

| SEASON                  |                | LOCATION | n1/n2 | d.f. | $X^2$     |
|-------------------------|----------------|----------|-------|------|-----------|
| <b>STEELHEAD</b>        |                |          |       |      |           |
| spring                  | vs summer      | (U)      | 7/12  | 7    | 80.155*   |
| spring                  | vs summer      | (D)      | 6/36  | 7    | 86.087*   |
| spring                  | vs fall        | (D)      | 6/ 7  | 8    | 1696.916* |
| summer                  | vs fall        | (D)      | 36/ 7 | 7    | 4095.019* |
| 24-25 June              | vs 7 July      | (D)      | 13/ 9 | 6    | 627.152*  |
| <b>CHINOOK</b>          |                |          |       |      |           |
| winter/spring           | vs summer      | (U)      | 7/ 3  |      | #         |
| winter                  | vs spring      | (U)      | 2/ 5  |      | #         |
| winter                  | vs summer      | (U)      | 2/ 3  |      | #         |
| spring                  | vs summer      | (U)      | 5/ 3  |      | #         |
| spring                  | vs summer      | (D)      | 10/53 | 6    | 120.793*  |
| <b>PRICKLY SCULPIN</b>  |                |          |       |      |           |
| winter/spring           | vs summer      | (U)      | 13/15 | 7    | 86.562*   |
| winter/spring           | vs summer/fall | (SS)     | 9/ 7  | 5    | 33.517*   |
| winter                  | vs spring      | (U)      | 3/10  |      | #         |
| winter                  | vs summer      | (U)      | 3/15  |      | #         |
| winter                  | vs summer      | (SS)     | 8/ 6  | 6    | 26.131*   |
| spring                  | vs summer      | (U)      | 10/15 | 5    | 78.478*   |
| spring                  | vs summer      | (D)      | 12/23 | 7    | 96.358*   |
| spring                  | vs fall        | (D)      | 12/ 9 | 7    | 203.379*  |
| summer                  | vs fall        | (D)      | 23/ 9 | 7    | 621.499*  |
| 24-25 June              | vs 7 July      | (D)      | 19/ 2 |      | #         |
| <b>STAGHORN SCULPIN</b> |                |          |       |      |           |
| winter/spring           | vs summer/fall | (D)      | 3/10  |      | #         |
| winter/spring           | vs summer      | (SS)     | 7/ 3  |      | #         |
| winter                  | vs spring      | (SS)     | 5/ 2  |      | #         |
| winter                  | vs summer      | (SS)     | 5/ 3  |      | #         |
| spring                  | vs summer      | (D)      | 2/ 9  |      | #         |
| spring                  | vs summer      | (SS)     | 2/ 3  |      | #         |

Table 6. Chi Square ( $X^2$ ) Values for Within Location Intraspecific Comparisons of Diets for Fish from Lower Redwood Creek, February-December, 1980. (continued)

| SEASON                            | LOCATION | n1/n2 | d.f. | $X^2$    |
|-----------------------------------|----------|-------|------|----------|
| STARRY FLOUNDER                   |          |       |      |          |
| winter/spring vs summer           | (D)      | 7/14  | 6    | 605.315* |
| winter/spring vs fall             | (D)      | 7/12  | 5    | 498.764* |
| winter vs spring                  | (D)      | 2/ 5  |      | #        |
| winter vs fall                    | (D)      | 2/12  |      | #        |
| spring vs summer                  | (D)      | 5/14  | 6    | 97.270*  |
| spring vs fall                    | (D)      | 5/12  | 5    | 152.373* |
| summer vs fall                    | (D)      | 14/12 | 5    | 260.724* |
| 24-25 June vs 7 July              | (D)      | 4/ 6  |      | #        |
| preberm summer vs postberm summer | (D)      | 4/10  |      | #        |
| HUMBOLDT SUCKER                   |          |       |      |          |
| winter/spring vs summer           | (U)      | 6/ 5  | 4    | 5.560    |
| winter vs spring                  | (U)      | 4/ 2  |      | #        |
| winter vs summer                  | (U)      | 4/ 5  |      | #        |
| spring vs summer                  | (U)      | 2/ 5  |      | #        |
| spring vs summer                  | (D)      | 2/14  |      | #        |
| JUVENILE THREESPIKE STICKLEBACK   |          |       |      |          |
| spring vs summer                  | (SS)     | 6/ 5  | 6    | 39.956*  |
| spring vs summer                  | (NS)     | 9/ 2  |      | #        |
| spring vs fall                    | (SS)     | 6/ 3  |      | #        |
| summer vs fall                    | (SS)     | 5/ 3  |      | #        |
| ADULT THREESPIKE STICKLEBACK      |          |       |      |          |
| winter vs spring                  | (SS)     | 12/10 | 5    | 30.174*  |
| winter vs summer                  | (SS)     | 12/13 | 6    | 89.708*  |
| winter vs fall                    | (SS)     | 12/ 7 | 5    | 15.934*  |
| spring vs summer                  | (U)      | 2/ 3  |      | #        |
| spring vs summer                  | (D)      | 14/28 | 5    | 994.369* |
| spring vs summer                  | (SS)     | 10/13 | 5    | 202.201* |
| spring vs fall                    | (U)      | 2/ 4  |      | #        |
| spring vs fall                    | (SS)     | 10/ 7 | 4    | 39.298*  |
| summer vs fall                    | (U)      | 32/ 4 |      | #        |
| summer vs fall                    | (SS)     | 13/ 7 | 5    | 154.455* |

\* denotes values that are significant at the  $P \leq 0.05$  level.

# denotes that sample sizes are too small to justify statistical analysis.

Table 7. Diet Overlap Values for Within Location Intraspecific Comparisons of Diets for Fish from Lower Redwood Creek, February-December, 1980. n1/n2 = Ratio of Sample Size of Group 1 to Group 2;  $\alpha_{ac}$  = Diet Overlap Values Computed Using All Food Item Categories;  $\alpha_{cc}$  = Diet Overlap Values Computed Using Food Item Categories Combined to Ordinal Taxonomic Level; U = Upstream; D = Downstream; SS = South Slough; NS = North Slough.

| SEASON                  |                | LOCATION | n1/n2 | $\alpha_{ac}$ | $\alpha_{cc}$ |
|-------------------------|----------------|----------|-------|---------------|---------------|
| <b>STEELHEAD</b>        |                |          |       |               |               |
| spring                  | vs summer      | (U)      | 7/12  | 0.3732        | 0.5170        |
| spring                  | vs summer      | (D)      | 6/36  | 0.2565        | 0.3441        |
| spring                  | vs fall        | (D)      | 6/ 7  | 0.2287        | 0.2978        |
| summer                  | vs fall        | (D)      | 36/ 7 | 0.4146        | 0.4943        |
| 24-25 June              | vs 7 July      | (D)      | 13/ 9 | 0.3609        | 0.3802        |
| <b>CHINOOK</b>          |                |          |       |               |               |
| winter/spring           | vs summer      | (U)      | 7/ 3  | 0.5498        | 0.6074*       |
| winter                  | vs spring      | (U)      | 2/ 5  | 0.2613        | 0.4254        |
| winter                  | vs summer      | (U)      | 2/ 3  | 0.1922        | 0.2661        |
| spring                  | vs summer      | (U)      | 5/ 3  | 0.6630*       | 0.7139*       |
| spring                  | vs summer      | (D)      | 10/53 | 0.4570        | 0.5210        |
| <b>PRICKLY SCULPIN</b>  |                |          |       |               |               |
| winter/spring           | vs summer      | (U)      | 13/15 | 0.2755        | 0.2944        |
| winter/spring           | vs summer/fall | (SS)     | 9/ 7  | 0.4260        | 0.4260        |
| winter                  | vs spring      | (U)      | 3/10  | 0.2444        | 0.3137        |
| winter                  | vs summer      | (U)      | 3/15  | 0.2544        | 0.3269        |
| winter                  | vs summer      | (SS)     | 8/ 6  | 0.3988        | 0.3988        |
| spring                  | vs summer      | (U)      | 10/15 | 0.2550        | 0.2799        |
| spring                  | vs summer      | (D)      | 12/23 | 0.6898*       | 0.7521*       |
| spring                  | vs fall        | (D)      | 12/ 9 | 0.1949        | 0.2801        |
| summer                  | vs fall        | (D)      | 23/ 9 | 0.1896        | 0.3042        |
| 24-25 June              | vs 7 July      | (D)      | 19/ 2 | 0.3097        | 0.3762        |
| <b>STAGHORN SCULPIN</b> |                |          |       |               |               |
| winter/spring           | vs summer/fall | (D)      | 3/10  | 0.2104        | 0.2104        |
| winter/spring           | vs summer      | (SS)     | 7/ 3  | 0.5587        | 0.5587        |
| winter                  | vs spring      | (SS)     | 5/ 2  | 0.2945        | 0.3142        |
| winter                  | vs summer      | (SS)     | 5/ 3  | 0.3627        | 0.3627        |
| spring                  | vs summer      | (D)      | 2/ 9  | 0.0000        | 0.0000        |
| spring                  | vs summer      | (SS)     | 2/ 3  | 0.8906*       | 0.9110*       |

Table 7. Diet Overlap Values for Within Location Intraspecific Comparisons of Diets for Fish from Lower Redwood Creek, February-December, 1980. (continued)

| SEASON                            | LOCATION | n1/n2 | $\alpha_{ac}$ | $\alpha_{cc}$ |
|-----------------------------------|----------|-------|---------------|---------------|
| STARRY FLOUNDER                   |          |       |               |               |
| winter/spring vs summer           | (D)      | 9/14  | 0.3736        | 0.3736        |
| winter/spring vs fall             | (D)      | 9/12  | 0.2252        | 0.2252        |
| winter vs spring                  | (D)      | 2/ 5  | 0.4474        | 0.4474        |
| winter vs fall                    | (D)      | 2/12  | 0.0346        | 0.0346        |
| spring vs summer                  | (D)      | 5/14  | 0.5668        | 0.5719        |
| spring vs fall                    | (D)      | 5/12  | 0.3162        | 0.3162        |
| summer vs fall                    | (D)      | 14/12 | 0.6241*       | 0.6241*       |
| 24-25 June vs 7 July              | (D)      | 4/ 6  | 0.5072        | 0.5657        |
| preberm summer vs postberm summer | (D)      | 4/10  | 0.4251        | 0.4821        |
| HUMBOLDT SUCKER                   |          |       |               |               |
| winter/spring vs summer           | (U)      | 6/ 5  | 0.8351*       | 0.8728*       |
| winter vs spring                  | (U)      | 4/ 2  | 0.7538*       | 0.7612*       |
| winter vs summer                  | (U)      | 4/ 5  | 0.7539*       | 0.8105*       |
| spring vs summer                  | (U)      | 2/ 5  | 0.8925*       | 0.8925*       |
| spring vs summer                  | (D)      | 2/14  | 0.7790*       | 0.8837*       |
| JUVENILE THREESPINE STICKLEBACK   |          |       |               |               |
| spring vs summer                  | (SS)     | 6/ 5  | 0.4527        | 0.4534        |
| spring vs summer                  | (NS)     | 9/ 2  | 0.1134        | 0.2249        |
| spring vs fall                    | (SS)     | 6/ 3  | 0.2951        | 0.2951        |
| summer vs fall                    | (SS)     | 5/ 3  | 0.2657        | 0.2657        |
| ADULT THREESPINE STICKLEBACK      |          |       |               |               |
| winter vs spring                  | (SS)     | 12/10 | 0.5146        | 0.5169        |
| winter vs summer                  | (SS)     | 12/13 | 0.5684        | 0.5747        |
| winter vs fall                    | (SS)     | 12/ 7 | 0.2714        | 0.2768        |
| spring vs summer                  | (U)      | 2/32  | 0.2206        | 0.3873        |
| spring vs summer                  | (D)      | 14/28 | 0.4744        | 0.4933        |
| spring vs summer                  | (SS)     | 10/13 | 0.6810*       | 0.6810*       |
| spring vs fall                    | (U)      | 2/ 4  | 0.3654        | 0.3654        |
| spring vs fall                    | (SS)     | 10/ 7 | 0.4122        | 0.4153        |
| summer vs fall                    | (U)      | 32/ 4 | 0.4834        | 0.5343        |
| summer vs fall                    | (SS)     | 13/ 7 | 0.3656        | 0.3656        |

\* denotes values that are considered biologically (not necessarily statistically) significant.

was biologically significant only when the food categories had been combined to the ordinal level.

For prickly sculpin, the spring and summer downstream diets had a biologically significant overlap, as did the summer and fall downstream diets of starry flounder. The comparisons of the diets of the adult threespine stickleback also yielded only one case of biologically significant diet overlap, that of spring and summer fish captured at the South Slough site.

#### Spatial Diet Comparisons by Species

Intraspecific comparisons were also made of fish captured during the same season but at different sites. All of the comparisons tested yielded significant Chi square values, indicating that all the within species, within seasons, between sites diet comparisons were significantly different (Table 8).

The majority of the food habit overlap values computed for these same comparisons were not biologically significant (Table 9). The few exceptions included the spring diets and the summer diets of juvenile chinook salmon from the upstream vs the downstream site (though the former of these two was biologically significant only when all the food categories had been combined to the ordinal taxonomic level). The sucker diets from the upstream and the downstream sites had biologically significant overlaps for the seasons compared. Juvenile threespine stickleback from the North and South Sloughs during the summer showed a biologically significant diet overlap. Finally, the spring diets of adult sticklebacks from the downstream site compared to those from the South Slough site yielded a biologically significant diet overlap.

Table 8. Chi Square ( $X^2$ ) Values for Within Season Intraspecific Comparisons of Diets for Fish from Lower Redwood Creek, February-December 1980. The Chi Square Values Were Computed Using Numbers of Food Items That Constituted the Top Five IRI Values. n1/n2 = Ratio of Sample Size of Group 1 to Group 2; d.f. = Degrees of Freedom; W = Winter; SP = Spring; SU = Summer; F = Fall; J = 24-25 June; T = Total.

| LOCATION                |                 | SEASON | n1/n2 | d.f. | $X^2$     |
|-------------------------|-----------------|--------|-------|------|-----------|
| <b>STEELHEAD</b>        |                 |        |       |      |           |
| upstream                | vs downstream   | (SP)   | 7/ 6  | 7    | 49.637*   |
| upstream                | vs downstream   | (SU)   | 12/36 | 7    | 759.581*  |
| upstream                | vs South Slough | (SU)   | 12/ 4 |      | #         |
| downstream              | vs South Slough | (SU)   | 36/ 4 |      | #         |
| <b>CHINOOK</b>          |                 |        |       |      |           |
| upstream                | vs downstream   | (SP)   | 5/10  | 5    | 30.138*   |
| upstream                | vs downstream   | (SU)   | 3/53  |      | #         |
| upstream                | vs South Slough | (SU)   | 3/ 5  |      | #         |
| downstream              | vs South Slough | (SU)   | 53/ 5 | 7    | 3697.587* |
| <b>PRICKLY SCULPIN</b>  |                 |        |       |      |           |
| upstream                | vs downstream   | (W/SP) | 13/13 | 7    | 32.325*   |
| upstream                | vs South Slough | (W/SP) | 13/ 9 | 8    | 128.282*  |
| downstream              | vs South Slough | (W/SP) | 13/ 9 | 6    | 85.904*   |
| upstream                | vs South Slough | (W)    | 3/ 8  |      | #         |
| upstream                | vs downstream   | (SP)   | 10/12 | 7    | 25.912*   |
| upstream                | vs downstream   | (SU)   | 15/23 | 8    | 600.008*  |
| upstream                | vs South Slough | (SU)   | 15/ 6 | 8    | 122.156*  |
| downstream              | vs South Slough | (SU)   | 23/ 6 | 7    | 612.300*  |
| <b>STAGHORN SCULPIN</b> |                 |        |       |      |           |
| downstream              | vs South Slough | (W/SP) | 3/ 7  |      | #         |
| downstream              | vs South Slough | (SP)   | 2/ 2  |      | #         |
| downstream              | vs South Slough | (SU)   | 9/ 3  |      | #         |
| downstream              | vs South Slough | (J)    | 8/ 3  |      | #         |
| downstream              | vs South Slough | (T)    | 13/10 | 5    | 78.626*   |
| <b>STARRY FLOUNDER</b>  |                 |        |       |      |           |
| downstream              | vs South Slough | (W)    | 2/ 2  |      | #         |
| <b>HUMBOLDT SUCKER</b>  |                 |        |       |      |           |
| upstream                | vs downstream   | (W/SP) | 9/ 2  |      | #         |
| upstream                | vs downstream   | (SP)   | 2/ 2  |      | #         |
| upstream                | vs downstream   | (SU)   | 5/14  | 5    | 29.059*   |
| upstream                | vs downstream   | (T)    | 11/16 | 6    | 67.240*   |
| upstream                | vs South Slough | (SU)   | 5/ 8  | 6    | 135.172*  |
| downstream              | vs South Slough | (SU)   | 14/ 8 | 5    | 666.295*  |

Table 8. Chi Square ( $X^2$ ) Values for Within Season Intraspecific Comparisons of Diets for Fish from Lower Redwood Creek, February-December 1980. (continued)

| LOCATION                        |                 | SEASON | n1/n2 | d.f. | $X^2$     |
|---------------------------------|-----------------|--------|-------|------|-----------|
| JUVENILE THREESPINE STICKLEBACK |                 |        |       |      |           |
| downstream                      | vs South Slough | (SP)   | 13/ 6 | 7    | 156.865*  |
| downstream                      | vs South Slough | (SP)   | 13/ 9 | 7    | 1784.686* |
| South Slough                    | vs North Slough | (SP)   | 6/ 9  | 5    | 1232.059* |
| upstream                        | vs South Slough | (SU)   | 6/ 5  | 5    | 55.135*   |
| upstream                        | vs North Slough | (SU)   | 6/ 2  |      | #         |
| South Slough                    | vs North Slough | (SU)   | 5/ 2  |      | #         |
| upstream                        | vs South Slough | (SU/F) | 7/ 8  | 7    | 63.332*   |
| upstream                        | vs South Slough | (T)    | 7/14  | 7    | 56.048*   |
| upstream                        | vs North Slough | (T)    | 7/11  | 7    | 1155.536* |
| South Slough                    | vs North Slough | (T)    | 14/11 | 6    | 891.820*  |
| ADULT THREESPINE STICKLEBACK    |                 |        |       |      |           |
| upstream                        | vs downstream   | (SP)   | 2/13  |      | #         |
| upstream                        | vs South Slough | (SP)   | 2/10  |      | #         |
| upstream                        | vs North Slough | (SP)   | 2/14  |      | #         |
| downstream                      | vs South Slough | (SP)   | 14/10 | 5    | 69.709*   |
| downstream                      | vs North Slough | (SP)   | 14/14 | 7    | 803.437*  |
| South Slough                    | vs North Slough | (SP)   | 10/14 | 7    | 663.008*  |
| upstream                        | vs downstream   | (SU)   | 32/28 | 7    | 923.856*  |
| upstream                        | vs South Slough | (SU)   | 32/13 | 8    | 1138.564* |
| downstream                      | vs South Slough | (SU)   | 28/13 | 6    | 1997.749* |
| upstream                        | vs downstream   | (SU/F) | 36/29 | 7    | 921.366*  |
| upstream                        | vs South Slough | (F)    | 4/ 7  |      | #         |
| upstream                        | vs downstream   | (T)    | 38/43 | 7    | 881.262*  |
| upstream                        | vs South Slough | (T)    | 38/42 | 7    | 981.040*  |
| downstream                      | vs South Slough | (T)    | 43/42 | 5    | 1468.944* |

\* denotes values that are significant at the  $P \leq 0.05$  level.

# denotes that sample sizes are too small to justify statistical analysis.

Table 9. Diet Overlap Values for Within Season Intraspecific Comparisons of Diets for Fish from Lower Redwood Creek, February-December 1980.  $n1/n2$  = Ratio of Sample Size of Group 1 to Group 2;  $\alpha_{ac}$  = Diet Overlap Values Computed Using All Food Item Categories;  $\alpha_{cc}$  = Diet Overlap Values Computed Using Food Item Categories Combined to Ordinal Level; W = Winter; SP = Spring; S = Summer; F = Fall; J = 24-25 June; T = Total.

| LOCATION                |                 | SEASON | $n1/n2$ | $\alpha_{ac}$ | $\alpha_{cc}$ |
|-------------------------|-----------------|--------|---------|---------------|---------------|
| <b>STEELHEAD</b>        |                 |        |         |               |               |
| upstream                | vs downstream   | (SP)   | 7/ 6    | 0.1147        | 0.2164        |
| upstream                | vs downstream   | (SU)   | 12/36   | 0.3787        | 0.4386        |
| upstream                | vs South Slough | (SU)   | 12/ 4   | 0.0189        | 0.0705        |
| downstream              | vs South Slough | (SU)   | 36/ 4   | 0.0608        | 0.0659        |
| <b>CHINOOK</b>          |                 |        |         |               |               |
| upstream                | vs downstream   | (SP)   | 5/10    | 0.5768        | 0.6956*       |
| upstream                | vs downstream   | (SU)   | 3/53    | 0.6372*       | 0.6767*       |
| upstream                | vs South Slough | (SU)   | 3/ 5    | 0.1230        | 0.1390        |
| downstream              | vs South Slough | (SU)   | 53/ 5   | 0.1804        | 0.2146        |
| <b>PRICKLY SCULPIN</b>  |                 |        |         |               |               |
| upstream                | vs downstream   | (W/SP) | 13/13   | 0.3506        | 0.4982        |
| upstream                | vs South Slough | (W/SP) | 13/ 9   | 0.1851        | 0.1851        |
| downstream              | vs South Slough | (W/SP) | 13/ 9   | 0.2895        | 0.3992        |
| upstream                | vs South Slough | (W)    | 3/ 8    | 0.1383        | 0.1383        |
| upstream                | vs downstream   | (SP)   | 10/12   | 0.3244        | 0.4297        |
| upstream                | vs downstream   | (SU)   | 15/23   | 0.2673        | 0.2681        |
| upstream                | vs South Slough | (SU)   | 15/ 6   | 0.0498        | 0.0498        |
| downstream              | vs South Slough | (SU)   | 23/ 6   | 0.1289        | 0.1289        |
| <b>STAGHORN SCULPIN</b> |                 |        |         |               |               |
| downstream              | vs South Slough | (W/SP) | 3/ 7    | 0.0918        | 0.0918        |
| downstream              | vs South Slough | (SP)   | 2/ 2    | 0.0000        | 0.0000        |
| downstream              | vs South Slough | (SU)   | 9/ 3    | 0.1847        | 0.2236        |
| downstream              | vs South Slough | (J)    | 8/ 3    | 0.1788        | 0.2268        |
| downstream              | vs South Slough | (T)    | 13/10   | 0.2417        | 0.3550        |
| <b>STARRY FLOUNDER</b>  |                 |        |         |               |               |
| downstream              | vs South Slough | (W)    | 2/ 2    | 0.3113        | 0.3113        |
| <b>HUMBOLDT SUCKER</b>  |                 |        |         |               |               |
| upstream                | vs downstream   | (W/SP) | 9/ 2    | 0.7592*       | 0.8187*       |
| upstream                | vs downstream   | (SP)   | 2/ 2    | 0.7592*       | 0.8836*       |
| upstream                | vs downstream   | (SU)   | 5/14    | 0.8518*       | 0.8518*       |
| upstream                | vs downstream   | (T)    | 11/16   | 0.8355*       | 0.8408*       |
| upstream                | vs South Slough | (SU)   | 5/ 8    | 0.1056        | 0.1056        |
| downstream              | vs South Slough | (SU)   | 14/ 8   | 0.0909        | 0.1016        |

Table 9. Diet Overlap Values for Within Season Intraspecific Comparisons of Diets for Fish from Lower Redwood Creek, February-December 1980. (continued)

| LOCATION                        |                 | SEASON | n1/n2 | $\alpha_{ac}$ | $\alpha_{cc}$ |
|---------------------------------|-----------------|--------|-------|---------------|---------------|
| JUVENILE THREESPIKE STICKLEBACK |                 |        |       |               |               |
| downstream                      | vs South Slough | (SP)   | 13/ 6 | 0.2622        | 0.2639        |
| downstream                      | vs South Slough | (SP)   | 13/ 9 | 0.1158        | 0.1158        |
| South Slough                    | vs North Slough | (SP)   | 6/ 9  | 0.1177        | 0.2285        |
| upstream                        | vs South Slough | (SU)   | 6/ 5  | 0.1642        | 0.1642        |
| upstream                        | vs North Slough | (SU)   | 6/ 2  | 0.3419        | 0.3419        |
| South Slough                    | vs North Slough | (SU)   | 5/ 2  | 0.8204*       | 0.8204*       |
| upstream                        | vs South Slough | (SU/F) | 7/ 8  | 0.2571        | 0.2571        |
| upstream                        | vs South Slough | (T)    | 7/14  | 0.2947        | 0.2947        |
| upstream                        | vs North Slough | (T)    | 7/11  | 0.1641        | 0.1641        |
| South Slough                    | vs North Slough | (T)    | 14/11 | 0.3271        | 0.4180        |
| ADULT THREESPIKE STICKLEBACK    |                 |        |       |               |               |
| upstream                        | vs downstream   | (SP)   | 2/13  | 0.2645        | 0.2648        |
| upstream                        | vs South Slough | (SP)   | 2/10  | 0.2512        | 0.2512        |
| upstream                        | vs North Slough | (SP)   | 2/14  | 0.1929        | 0.1929        |
| downstream                      | vs South Slough | (SP)   | 14/10 | 0.6692*       | 0.6692*       |
| downstream                      | vs North Slough | (SP)   | 14/14 | 0.5481        | 0.5612        |
| South Slough                    | vs North Slough | (SP)   | 10/14 | 0.5447        | 0.5469        |
| upstream                        | vs downstream   | (SU)   | 32/28 | 0.4230        | 0.4725        |
| upstream                        | vs South Slough | (SU)   | 32/13 | 0.2457        | 0.2653        |
| downstream                      | vs South Slough | (SU)   | 28/13 | 0.3038        | 0.3240        |
| upstream                        | vs downstream   | (SU/F) | 36/29 | 0.4615        | 0.5055        |
| upstream                        | vs South Slough | (F)    | 4/ 7  | 0.0527        | 0.0581        |
| upstream                        | vs downstream   | (T)    | 38/43 | 0.5036        | 0.5455        |
| upstream                        | vs South Slough | (T)    | 38/42 | 0.2866        | 0.2927        |
| downstream                      | vs South Slough | (T)    | 43/42 | 0.4853        | 0.4875        |

\* denotes values that are considered biologically (not necessarily statistically) significant.

### Interspecific Diet Comparisons

The interspecific comparisons of fish from within sample site and within season were made using the Chi square test of diet homogeneity (Table 10). All but one of the diets being compared were significantly different at the  $P \leq 0.05$  level. The case where the diet appeared to be homogenous was the comparison of the winter food habits of staghorn sculpin and adult stickleback from the South Slough.

The diet overlap values for these same comparisons between species, surprisingly, indicated that the one case of positive diet homogeneity had a corresponding diet overlap value that was not biologically significant (Table 11). Juvenile steelhead diets had biologically significant overlaps with the diets of other species only when the food items were combined to the ordinal taxonomic level. These biologically significant overlaps occurred on 24 and 25 June during an intense seining operation carried out at the downstream site on lower Redwood Creek in conjunction with a juvenile salmonid population estimate. The representations of the diets, based on IRI analysis, for fish caught during this sampling session are presented in Figures 3a-g. At this time and site, juvenile steelhead diets had a biologically significant overlap with those of prickly sculpin, starry flounder, Humboldt sucker, and adult threespine stickleback. Other significant alpha values occurred for the comparisons of juvenile steelhead diet from upstream summer with those of prickly sculpin and adult threespine stickleback.

Analysis of juvenile chinook salmon diets revealed biologically significant diet overlap with only one other species, Humboldt suckers from the upstream site during the winter.

Table 10. Chi Square ( $X^2$ ) Values for Within Location and Within Season Interspecific Comparisons of Diets for Fish from Lower Redwood Creek, February-December, 1980. The Chi Square Values Were Computed Using Numbers of Food Items That Constituted the Top Five IRI Values.  $n1/n2$  = Ratio of Sample Size of Group 1 to Group 2; d.f. = Degrees of Freedom.

| LOCATION and SEASON                | $n1/n2$ | d.f. | $X^2$     |
|------------------------------------|---------|------|-----------|
| STEELHEAD vs CHINOOK               |         |      |           |
| upstream spring                    | 7/ 5    | 6    | 20.301*   |
| downstream spring                  | 6/10    | 7    | 219.890*  |
| upstream 17 June                   | 3/ 3    |      | #         |
| downstream 24-25 June              | 13/47   | 5    | 819.195*  |
| downstream summer                  | 36/53   | 6    | 1675.774* |
| South Slough summer                | 4/ 5    |      | #         |
| STEELHEAD vs COHO                  |         |      |           |
| upstream spring                    | 7/ 4    |      | #         |
| STEELHEAD vs PRICKLY SCULPIN       |         |      |           |
| upstream spring                    | 7/10    | 6    | 65.484*   |
| downstream spring                  | 6/12    | 7    | 48.365*   |
| downstream 24-25 June              | 13/19   | 7    | 772.592*  |
| downstream 7 July                  | 9/ 2    |      | #         |
| upstream summer                    | 12/15   | 5    | 148.768*  |
| downstream summer                  | 36/23   | 6    | 1311.071* |
| South Slough summer                | 4/ 6    |      | #         |
| downstream fall                    | 7/ 9    | 6    | 830.072*  |
| South Slough total                 | 7/16    | 7    | 60.086*   |
| STEELHEAD vs STAGHORN SCULPIN      |         |      |           |
| downstream spring vs               |         |      |           |
| downstream/South Slough spring     | 6/ 4    |      | #         |
| downstream 24-25 June vs           |         |      |           |
| downstream/South Slough 24-25 June | 13/11   | 8    | 1079.849* |
| downstream 24-25 June              | 13/ 8   | 8    | 895.127*  |
| downstream summer vs               |         |      |           |
| downstream/South Slough summer     | 36/12   | 7    | 662.077*  |
| downstream summer                  | 36/ 9   | 7    | 429.706*  |
| South Slough summer                | 4/ 3    |      | #         |
| South Slough total                 | 7/10    | 4    | 61.044*   |

Table 10. Chi Square ( $\chi^2$ ) Values for Within Location and Within Season Interspecific Comparisons of Diets for Fish from Lower Redwood Creek, February-December, 1980. (continued)

| LOCATION and SEASON                                 | n1/n2 | d.f. | $\chi^2$   |
|-----------------------------------------------------|-------|------|------------|
| <b>STEELHEAD vs STARRY FLOUNDER</b>                 |       |      |            |
| downstream spring                                   | 6/ 5  | 7    | 26.278*    |
| downstream 24-25 June                               | 13/ 4 |      | #          |
| downstream 7 July                                   | 9/ 6  | 6    | 729.347*   |
| downstream postberm summer                          | 21/10 | 7    | 452.482*   |
| downstream summer                                   | 36/14 | 7    | 815.521*   |
| downstream fall                                     | 7/12  | 7    | 284.111*   |
| <b>STEELHEAD vs HUMBOLDT SUCKER</b>                 |       |      |            |
| upstream spring                                     | 7/ 9  | 5    | 39.519*    |
| upstream summer                                     | 12/ 5 | 4    | 52.489*    |
| upstream postberm summer                            | 9/ 5  | 4    | 61.239*    |
| downstream 24-25 June                               | 13/14 | 7    | 84.450*    |
| South Slough summer                                 | 4/ 8  |      | #          |
| <b>STEELHEAD vs JUVENILE THREESPINE STICKLEBACK</b> |       |      |            |
| downstream spring                                   | 6/13  | 7    | 121.145*   |
| upstream postberm summer                            | 9/ 6  | 5    | 107.398*   |
| upstream summer                                     | 12/ 6 | 5    | 121.813*   |
| South Slough summer                                 | 4/ 5  |      | #          |
| South Slough total                                  | 7/14  | 8    | 159.230*   |
| <b>STEELHEAD vs ADULT THREESPINE STICKLEBACK</b>    |       |      |            |
| upstream spring                                     | 7/ 2  |      | #          |
| downstream spring                                   | 6/14  | 7    | 56.476*    |
| downstream 24-25 June                               | 13/23 | 7    | 293.103*   |
| upstream summer                                     | 12/32 | 6    | 324.768*   |
| downstream summer                                   | 36/28 | 6    | 1483.291*  |
| South Slough summer                                 | 4/13  |      | #          |
| South Slough total                                  | 7/42  | 6    | 222.725*   |
| <b>STEELHEAD vs SURFSMELT</b>                       |       |      |            |
| downstream fall                                     | 7/ 6  | 8    | 12896.968* |
| <b>CHINOOK vs COHO</b>                              |       |      |            |
| upstream spring                                     | 5/ 4  |      | #          |

TABLE 10. Chi Square ( $X^2$ ) Values for Within Location and Within Season Interspecific Comparisons of Diets for Fish from Lower Redwood Creek, February-December, 1980. (continued)

| LOCATION and SEASON                        | n1/n2 | d.f. | $X^2$     |
|--------------------------------------------|-------|------|-----------|
| CHINOOK vs PRICKLY SCULPIN                 |       |      |           |
| upstream winter/spring                     | 7/13  | 7    | 41.587*   |
| upstream winter                            | 2/ 3  |      | #         |
| upstream spring                            | 5/10  | 6    | 77.740*   |
| downstream spring                          | 10/12 | 8    | 229.369*  |
| downstream 24-25 June                      | 47/19 | 8    | 2489.059* |
| upstream summer                            | 3/15  |      | #         |
| downstream summer                          | 53/23 | 8    | 2774.242* |
| South Slough summer                        | 5/ 6  | 7    | 237.398*  |
| CHINOOK vs STAGHORN SCULPIN                |       |      |           |
| downstream spring vs                       |       |      |           |
| downstream/South Slough spring             | 10/ 4 |      | #         |
| downstream 24-25 June vs                   |       |      |           |
| downstream/South Slough 24-25 June         | 47/11 | 8    | 3062.167* |
| downstream 24-25 June                      | 47/ 8 | 8    | 2600.445* |
| downstream summer vs                       |       |      |           |
| downstream/South Slough summer             | 53/12 | 8    | 3537.004* |
| downstream summer                          | 53/ 9 | 8    | 3159.869* |
| South Slough summer                        | 5/ 3  |      | #         |
| CHINOOK vs STARRY FLOUNDER                 |       |      |           |
| downstream spring                          | 10/ 5 | 8    | 311.452*  |
| downstream 24-25 June                      | 47/ 4 |      | #         |
| downstream summer                          | 53/14 | 8    | 3981.454* |
| CHINOOK vs HUMBOLDT SUCKER                 |       |      |           |
| upstream winter/spring                     | 7/ 6  | 6    | 25.456*   |
| upstream winter                            | 2/ 4  |      | #         |
| upstream spring                            | 5/ 2  |      | #         |
| downstream spring                          | 10/ 2 |      | #         |
| downstream 24-25 June                      | 47/14 | 7    | 858.208*  |
| upstream summer                            | 3/ 5  |      | #         |
| South Slough summer                        | 5/ 8  | 8    | 264.982*  |
| CHINOOK vs JUVENILE THREESPINE STICKLEBACK |       |      |           |
| downstream spring                          | 10/13 | 8    | 439.899*  |
| upstream summer                            | 3/ 6  |      | #         |
| South Slough summer                        | 5/ 5  | 9    | 419.314*  |

Table 10. Chi Square ( $X^2$ ) Values for Within Location and Within Season Interspecific Comparisons of Diets for Fish from Lower Redwood Creek, February-December, 1980. (continued)

| LOCATION and SEASON                     | n1/n2 | d.f. | $X^2$     |
|-----------------------------------------|-------|------|-----------|
| CHINOOK vs ADULT THREESPINE STICKLEBACK |       |      |           |
| upstream spring                         | 5/ 2  |      | #         |
| downstream spring                       | 10/14 | 7    | 284.821*  |
| downstream 24-25 June                   | 47/23 | 7    | 2220.370* |
| upstream summer                         | 3/32  |      | #         |
| downstream summer                       | 53/28 | 7    | 2260.951* |
| South Slough summer                     | 5/13  | 7    | 143.829*  |
| COHO vs PRICKLY SCULPIN                 |       |      |           |
| upstream spring                         | 4/10  |      | #         |
| COHO vs HUMBOLDT SUCKER                 |       |      |           |
| upstream spring                         | 4/ 2  |      | #         |
| COHO vs ADULT THREESPINE STICKLEBACK    |       |      |           |
| upstream spring                         | 4/ 2  |      | #         |
| PRICKLY SCULPIN vs STAGHORN SCULPIN     |       |      |           |
| downstream winter/spring                | 13/ 3 |      | #         |
| South Slough winter/spring              | 9/ 7  | 4    | 11.462*   |
| South Slough winter                     | 8/ 5  | 5    | 14.368*   |
| downstream spring vs                    |       |      |           |
| downstream/South Slough spring          | 12/ 4 |      | #         |
| downstream 24-25 June                   | 19/ 8 | 7    | 545.218*  |
| downstream summer                       | 23/ 9 | 7    | 582.777*  |
| South Slough summer                     | 6/ 3  |      | #         |
| South Slough total                      | 16/10 | 4    | 42.767*   |
| PRICKLY SCULPIN VS STARRY FLOUNDER      |       |      |           |
| downstream winter/spring vs             |       |      |           |
| downstream/South Slough winter/sping    | 13/ 9 | 6    | 165.424*  |
| South Slough winter                     | 8/ 2  |      | #         |
| downstream spring                       | 12/ 5 | 6    | 62.895*   |
| downstream 24-25 June                   | 19/ 4 |      | #         |
| downstream 7 July                       | 9/ 2  |      | #         |
| downstream summer                       | 23/14 | 6    | 1007.781* |
| downstream postberm summer              | 4/10  |      | #         |
| downstream fall                         | 9/12  | 6    | 172.376*  |

Table 10. Chi Square ( $X^2$ ) Values for Within Location and Within Season Interspecific Comparisons of Diets for Fish from Lower Redwood Creek, February-December, 1980. (continued)

| LOCATION and SEASON                                | n1/n2 | d.f. | $X^2$     |
|----------------------------------------------------|-------|------|-----------|
| PRICKLY SCULPIN vs HUMBOLDT SUCKER                 |       |      |           |
| upstream winter/spring                             | 13/ 9 | 7    | 17.462*   |
| upstream winter                                    | 3/ 4  |      | #         |
| upstream spring                                    | 10/ 2 |      | #         |
| downstream spring                                  | 12/ 2 |      | #         |
| downstream 24-25 June                              | 19/14 | 6    | 477.559*  |
| upstream summer                                    | 15/ 5 | 4    | 59.732*   |
| South Slough summer                                | 6/ 8  | 6    | 49.331*   |
| PRICKLY SCULPIN vs JUVENILE THREESPINE STICKLEBACK |       |      |           |
| downstream spring                                  | 12/13 | 6    | 63.788*   |
| upstream summer                                    | 15/ 6 | 5    | 43.729*   |
| South Slough summer                                | 6/ 5  | 7    | 64.467*   |
| South Slough total                                 | 16/14 | 7    | 111.002*  |
| PRICKLY SCULPIN vs ADULT THREESPINE STICKLEBACK    |       |      |           |
| South Slough winter/spring                         | 9/22  | 5    | 59.534*   |
| South Slough winter                                | 8/12  | 6    | 25.161*   |
| upstream spring                                    | 10/ 2 |      | #         |
| downstream spring                                  | 12/14 | 7    | 113.878*  |
| downstream 24-25 June                              | 19/23 | 6    | 1682.685* |
| upstream summer                                    | 15/32 | 5    | 112.647*  |
| downstream summer                                  | 23/28 | 6    | 1104.905* |
| South Slough summer                                | 6/13  | 5    | 80.584*   |
| South Slough total                                 | 16/42 | 5    | 63.672*   |
| PRICKLY SCULPIN vs SURFSMELT                       |       |      |           |
| downstream fall                                    | 9/ 6  | 7    | 2700.960* |
| STAGHORN SCULPIN vs STARRY FLOUNDER                |       |      |           |
| downstream/South Slough winter                     | 6/ 4  |      | #         |
| South Slough winter                                | 5/ 2  |      | #         |
| downstream/South Slough spring vs                  |       |      |           |
| downstream spring                                  | 4/ 5  |      | #         |
| downstream spring                                  | 2/ 5  |      | #         |
| downstream 24-25 June                              | 8/ 4  |      | #         |
| downstream summer                                  | 9/14  | 7    | 161.226*  |

Table 10. Chi Square ( $X^2$ ) Values for Within Location and Within Season Interspecific Comparisons of Diets for Fish from Lower Redwood Creek, February-December, 1980. (continued)

| LOCATION and SEASON                                 | n1/n2 | d.f. | $X^2$     |
|-----------------------------------------------------|-------|------|-----------|
| STAGHORN SCULPIN vs HUMBOLDT SUCKER                 |       |      |           |
| downstream/South Slough spring vs downstream spring | 4/ 2  |      | #         |
| downstream spring                                   | 2/ 2  |      | #         |
| downstream 24-25 June                               | 8/14  | 7    | 653.994*  |
| South Slough summer                                 | 3/ 8  |      | #         |
| STAGHORN SCULPIN vs JUVENILE THREESPINE STICKLEBACK |       |      |           |
| downstream/South Slough spring vs downstream spring | 4/13  |      | #         |
| downstream spring                                   | 2/13  |      | #         |
| South Slough spring                                 | 2/ 6  |      | #         |
| South Slough summer                                 | 3/ 5  |      | #         |
| South Slough total                                  | 10/14 | 7    | 147.112*  |
| STAGHORN SCULPIN vs ADULT THREESPINE STICKLEBACK    |       |      |           |
| South Slough winter/spring                          | 7/22  | 5    | 24.758*   |
| South Slough winter                                 | 5/12  | 5    | 10.139    |
| downstream/South Slough spring vs downstream spring | 4/14  |      | #         |
| downstream spring                                   | 2/14  |      | #         |
| South Slough spring                                 | 2/10  |      | #         |
| downstream 24-25 June                               | 8/23  | 6    | 1969.944* |
| downstream summer                                   | 9/28  | 6    | 1654.399* |
| South Slough summer                                 | 3/13  |      | #         |
| South Slough total                                  | 10/42 | 5    | 41.664*   |
| STARRY FLOUNDER vs HUMBOLDT SUCKER                  |       |      |           |
| downstream spring                                   | 5/ 2  |      | #         |
| downstream 24-25 June                               | 4/14  |      | #         |
| STARRY FLOUNDER vs JUVENILE THREESPINE STICKLEBACK  |       |      |           |
| downstream spring                                   | 5/13  | 7    | 151.546*  |
| STARRY FLOUNDER vs ADULT THREESPINE STICKLEBACK     |       |      |           |
| downstream spring                                   | 5/14  | 6    | 29.922*   |
| downstream 24-25 June                               | 4/23  |      | #         |
| downstream summer                                   | 14/28 | 7    | 2179.026* |
| STARRY FLOUNDER vs SURFSMELT                        |       |      |           |
| downstream fall                                     | 12/ 6 | 7    | 6746.333* |

Table 10. Chi Square ( $X^2$ ) Values for Within Location and Within Season Interspecific Comparisons of Diets for Fish from Lower Redwood Creek, February-December, 1980. (continued)

| LOCATION and SEASON                                | n1/n2 | d.f. | $X^2$     |
|----------------------------------------------------|-------|------|-----------|
| HUMBOLDT SUCKER vs JUVENILE THREESPINE STICKLEBACK |       |      |           |
| downstream spring                                  | 2/13  |      | #         |
| upstream summer                                    | 5/ 6  | 3    | 17.797*   |
| South Slough summer                                | 8/ 5  | 8    | 156.964*  |
| HUMBOLDT SUCKER vs ADULT THREESPINE STICKLEBACK    |       |      |           |
| downstream spring                                  | 2/14  |      | #         |
| downstream 24-25 June                              | 14/23 | 6    | 27.592*   |
| upstream summer                                    | 5/32  | 4    | 23.798*   |
| downstream summer                                  | 14/28 | 6    | 31.192*   |
| South Slough summer                                | 8/13  | 6    | 140.810*  |
| JUVENILE vs ADULT THREESPINE STICKLEBACK           |       |      |           |
| downstream spring                                  | 13/14 | 7    | 215.265*  |
| South Slough spring                                | 6/10  | 7    | 158.162*  |
| North Slough spring                                | 9/14  | 5    | 2463.696* |
| upstream summer                                    | 6/32  | 4    | 55.250*   |
| South Slough summer                                | 5/13  | 7    | 166.923*  |
| South Slough fall                                  | 3/ 7  |      | #         |
| JUVENILE THREESPINE STICKLEBACK vs TIDEWATER GOBY  |       |      |           |
| North Slough summer                                | 2/ 5  |      | #         |
| ADULT THREESPINE STICKLEBACK vs TIDEWATER GOBY     |       |      |           |
| North Slough spring vs North Slough summer         | 14/ 5 | 6    | 184.141*  |

\* denotes values that are significant at the  $P \leq 0.05$  level.

# denotes that sample sizes are too small to justify statistical analysis.

Table 11. Diet Overlap Values for Within Location and Within Season Interspecific Comparisons of Diets for Fish from Lower Redwood Creek, February-December, 1980.  $n1/n2$  = Ratio of Sample Size of Group 1 to Group 2;  $\alpha_{ac}$  = Diet Overlap Values Computed Using All Food Item Categories;  $\alpha_{cc}$  = Diet Overlap Values Computed Using Food Item Categories Combined to Ordinal Level.

| LOCATION and SEASON                                                             | $n1/n2$ | $\alpha_{ac}$ | $\alpha_{cc}$ |
|---------------------------------------------------------------------------------|---------|---------------|---------------|
| STEELHEAD vs CHINOOK                                                            |         |               |               |
| upstream spring                                                                 | 7/ 5    | 0.3715        | 0.4205        |
| downstream spring                                                               | 6/10    | 0.1376        | 0.2682        |
| upstream 17 June                                                                | 3/ 3    | 0.3168        | 0.5298        |
| downstream 24-25 June                                                           | 13/47   | 0.4741        | 0.5196        |
| downstream summer                                                               | 36/53   | 0.4712        | 0.5359        |
| South Slough summer                                                             | 4/ 5    | 0.1931        | 0.2158        |
| STEELHEAD vs COHO                                                               |         |               |               |
| upstream spring                                                                 | 7/ 4    | 0.2233        | 0.2674        |
| STEELHEAD vs PRICKLY SCULPIN                                                    |         |               |               |
| upstream spring                                                                 | 7/10    | 0.2577        | 0.3270        |
| downstream spring                                                               | 6/12    | 0.2178        | 0.4019        |
| downstream 24-25 June                                                           | 13/19   | 0.5717        | 0.6761*       |
| downstream 7 July                                                               | 9/ 2    | 0.3261        | 0.3471        |
| upstream summer                                                                 | 12/15   | 0.5626        | 0.6424*       |
| downstream summer                                                               | 36/23   | 0.4700        | 0.5750        |
| South Slough summer                                                             | 4/ 6    | 0.0366        | 0.0366        |
| downstream fall                                                                 | 7/ 9    | 0.5334        | 0.5756        |
| South Slough total                                                              | 7/16    | 0.2086        | 0.2134        |
| STEELHEAD vs STAGHORN SCULPIN                                                   |         |               |               |
| downstream spring vs<br>downstream/South Slough spring                          | 6/ 4    | 0.0406        | 0.0510        |
| downstream 24-25 June vs<br>downstream/South Slough 24-25 June                  | 13/11   | 0.0686        | 0.1554        |
| downstream 24-25 June<br>downstream summer vs<br>downstream South Slough summer | 13/ 8   | 0.0766        | 0.1673        |
|                                                                                 | 36/12   | 0.3018        | 0.3488        |
| downstream summer                                                               | 36/ 9   | 0.3633        | 0.4030        |
| South Slough summer                                                             | 4/ 3    | 0.0477        | 0.0738        |
| South Slough total                                                              | 7/10    | 0.2106        | 0.2112        |

Table 11. Diet Overlap Values for Within Location and Within Season Interspecific Comparisons of Diets for Fish from Lower Redwood Creek, February-December, 1980. (continued)

| LOCATION and SEASON                                 | n1/n2 | $\alpha_{ac}$ | $\alpha_{cc}$ |
|-----------------------------------------------------|-------|---------------|---------------|
| <b>STEELHEAD vs STARRY FLOUNDER</b>                 |       |               |               |
| downstream spring                                   | 6/ 5  | 0.2301        | 0.2829        |
| downstream 24-25 June                               | 13/ 4 | 0.5574        | 0.6175*       |
| downstream 7 July                                   | 9/ 6  | 0.2332        | 0.2505        |
| downstream postberm summer                          | 21/10 | 0.5635        | 0.5802        |
| downstream summer                                   | 36/14 | 0.5690        | 0.5915        |
| downstream fall                                     | 7/12  | 0.4453        | 0.4453        |
| <b>STEELHEAD vs HUMBOLDT SUCKER</b>                 |       |               |               |
| upstream spring                                     | 7/ 9  | 0.2845        | 0.3222        |
| upstream summer                                     | 12/ 5 | 0.3276        | 0.3483        |
| upstream postberm summer                            | 9/ 5  | 0.3564        | 0.3810        |
| downstream 24-25 June                               | 13/14 | 0.5586        | 0.6335*       |
| South Slough summer                                 | 4/ 8  | 0.1475        | 0.1475        |
| <b>STEELHEAD vs JUVENILE THREESPINE STICKLEBACK</b> |       |               |               |
| downstream spring                                   | 6/13  | 0.0645        | 0.1286        |
| upstream postberm summer                            | 9/ 6  | 0.3653        | 0.3899        |
| upstream summer                                     | 12/ 6 | 0.3364        | 0.3571        |
| South Slough summer                                 | 4/ 5  | 0.0019        | 0.0055        |
| South Slough total                                  | 7/14  | 0.0263        | 0.0264        |
| <b>STEELHEAD vs ADULT THREESPINE STICKLEBACK</b>    |       |               |               |
| upstream spring                                     | 7/ 2  | 0.3247        | 0.3468        |
| downstream spring                                   | 6/14  | 0.2282        | 0.2815        |
| downstream 24-25 June                               | 13/23 | 0.5799        | 0.6678*       |
| upstream summer                                     | 12/32 | 0.5019        | 0.6851*       |
| downstream summer                                   | 36/28 | 0.3661        | 0.4047        |
| South Slough summer                                 | 4/13  | 0.1131        | 0.1131        |
| South Slough total                                  | 7/42  | 0.2251        | 0.2532        |
| <b>STEELHEAD vs SURFSMELT</b>                       |       |               |               |
| downstream fall                                     | 7/ 6  | 0.1884        | 0.2584        |
| <b>CHINOOK vs COHO</b>                              |       |               |               |
| upstream spring                                     | 5/ 4  | 0.4750        | 0.5275        |

Table 11. Diet Overlap Values for Within Location and Within Season Interspecific Comparisons of Diets for Fish From Lower Redwood Creek, February-December, 1980. (continued)

| LOCATION and SEASON                       | n1/n2 | $\alpha_{ac}$ | $\alpha_{cc}$ |
|-------------------------------------------|-------|---------------|---------------|
| CHINOOK vs PRICKLY SCULPIN                |       |               |               |
| upstream winter/spring                    | 7/13  | 0.2851        | 0.5272        |
| upstream winter                           | 2/ 3  | 0.3984        | 0.4905        |
| upstream spring                           | 5/10  | 0.2485        | 0.5016        |
| downstream spring                         | 10/12 | 0.1039        | 0.2002        |
| downstream 24-25 June                     | 47/19 | 0.3099        | 0.3245        |
| upstream summer                           | 3/15  | 0.2321        | 0.2786        |
| downstream summer                         | 53/23 | 0.3357        | 0.3595        |
| South Slough summer                       | 5/ 6  | 0.1740        | 0.1746        |
| CHINOOK vs STAGHORN SCULPIN               |       |               |               |
| downstream spring vs                      |       |               |               |
| downstream/South Slough spring            | 10/ 4 | 0.0208        | 0.0208        |
| downstream 24-25 June vs                  |       |               |               |
| downstream/South Slough 24-25 June        | 47/11 | 0.0565        | 0.0674        |
| downstream 24-25 June                     | 47/ 8 | 0.0645        | 0.0805        |
| downstream summer vs                      |       |               |               |
| downstream /South Slough summer           | 53/12 | 0.0628        | 0.0696        |
| downstream summer                         | 53/ 9 | 0.0725        | 0.0816        |
| South Slough summer                       | 5/ 3  | 0.2019        | 0.2019        |
| CHINOOK vs STARRY FLOUNDER                |       |               |               |
| downstream spring                         | 10/ 5 | 0.0894        | 0.0973        |
| downstream 24-25 June                     | 47/ 4 | 0.2923        | 0.3057        |
| downstream summer                         | 53/14 | 0.2594        | 0.2897        |
| CHINOOK vs HUMBOLDT SUCKER                |       |               |               |
| upstream winter/spring                    | 7/ 6  | 0.4220        | 0.4717        |
| upstream winter                           | 2/ 4  | 0.7412*       | 0.8000*       |
| upstream spring                           | 5/ 2  | 0.3097        | 0.3131        |
| downstream spring                         | 10/ 2 | 0.0824        | 0.0884        |
| downstream 24-25 June                     | 47/14 | 0.3155        | 0.3253        |
| upstream summer                           | 3/ 5  | 0.2358        | 0.3257        |
| South Slough summer                       | 5/ 8  | 0.3427        | 0.4390        |
| CHINOOK vs JUVENILE THREESPIN STICKLEBACK |       |               |               |
| downstream spring                         | 10/13 | 0.1027        | 0.1150        |
| upstream summer                           | 3/ 6  | 0.2335        | 0.3234        |
| South Slough summer                       | 5/ 5  | 0.0121        | 0.0127        |

Table 11. Diet Overlap Values for Within Location and Within Season Interspecific Comparisons of Diets for Fish from Lower Redwood Creek, February-December, 1980. (continued)

| LOCATION and SEASON                     | n1/n2 | $\alpha_{ac}$ | $\alpha_{cc}$ |
|-----------------------------------------|-------|---------------|---------------|
| CHINOOK vs ADULT THREESPINE STICKLEBACK |       |               |               |
| upstream spring                         | 5/ 2  | 0.4315        | 0.4771        |
| downstream spring                       | 10/14 | 0.2584        | 0.2664        |
| downstream 24-25 June                   | 47/23 | 0.3423        | 0.3558        |
| upstream summer                         | 3/32  | 0.3902        | 0.4078        |
| downstream summer                       | 53/28 | 0.3557        | 0.3910        |
| South Slough summer                     | 5/13  | 0.5074        | 0.5822        |
| COHO vs PRICKLY SCULPIN                 |       |               |               |
| upstream spring                         | 4/10  | 0.2329        | 0.5342        |
| COHO vs HUMBOLDT SUCKER                 |       |               |               |
| upstream spring                         | 4/ 2  | 0.2229        | 0.2229        |
| COHO vs ADULT THREESPINE STICKLEBACK    |       |               |               |
| upstream spring                         | 4/ 2  | 0.1128        | 0.1440        |
| PRICKLY SCULPIN vs STAGHORN SCULPIN     |       |               |               |
| downstream winter/spring                | 13/ 3 | 0.1217        | 0.1217        |
| South Slough winter/spring              | 9/ 7  | 0.5450        | 0.6105*       |
| South Slough winter                     | 8/ 5  | 0.6345*       | 0.7066*       |
| downstream spring vs                    |       |               |               |
| downstream/South Slough spring          | 12/ 4 | 0.0978        | 0.1082        |
| downstream 24-25 June                   | 19/ 8 | 0.1864        | 0.2244        |
| downstream summer                       | 23/ 9 | 0.2933        | 0.3081        |
| South Slough summer                     | 6/ 3  | 0.2153        | 0.2153        |
| South Slough total                      | 16/10 | 0.4395        | 0.4863        |
| PRICKLY SCULPIN VS STARRY FLOUNDER      |       |               |               |
| downstream winter/spring vs             |       |               |               |
| downstream/South Slough winter/spring   | 13/ 9 | 0.3307        | 0.4018        |
| South Slough winter                     | 8/ 2  | 0.6523*       | 0.6523*       |
| downstream spring                       | 12/ 5 | 0.4698        | 0.4698        |
| downstream 24-25 June                   | 19/ 4 | 0.6404*       | 0.6952*       |
| downstream 7 July                       | 9/ 2  | 0.3023        | 0.3043        |
| downstream summer                       | 23/14 | 0.4700        | 0.5003        |
| downstream postberm summer              | 4/10  | 0.5579        | 0.5665        |
| downstream fall                         | 9/12  | 0.6084*       | 0.6666*       |

Table 11. Diet Overlap Values for Within Location and Within Season  
Interspecific Comparisons of Diets for Fish from lower  
Redwood Creek, February-December, 1980. (continued)

| LOCATION and SEASON                                    | n1/n2 | $\alpha_{ac}$ | $\alpha_{cc}$ |
|--------------------------------------------------------|-------|---------------|---------------|
| PRICKLY SCULPIN vs HUMBOLDT SUCKER                     |       |               |               |
| upstream winter/spring                                 | 13/ 9 | 0.3022        | 0.3527        |
| upstream winter                                        | 3/ 4  | 0.5167        | 0.5659        |
| upstream spring                                        | 10/ 2 | 0.2486        | 0.2716        |
| downstream spring                                      | 12/ 2 | 0.5193        | 0.5193        |
| downstream 24-25 June                                  | 19/14 | 0.6068*       | 0.6163*       |
| upstream summer                                        | 15/ 5 | 0.3207        | 0.3207        |
| South Slough summer                                    | 6/ 8  | 0.5077        | 0.5077        |
| PRICKLY SCULPIN vs JUVENILE THREESPINE STICKLEBACK     |       |               |               |
| downstream spring                                      | 12/13 | 0.5950        | 0.6078*       |
| upstream summer                                        | 15/ 6 | 0.3768        | 0.3768        |
| South Slough summer                                    | 6/ 5  | 0.0658        | 0.0658        |
| South Slough total                                     | 16/14 | 0.1589        | 0.1589        |
| PRICKLY SCULPIN vs ADULT THREESPINE STICKLEBACK        |       |               |               |
| South Slough winter/spring                             | 9/22  | 0.3906        | 0.4708        |
| South Slough winter                                    | 8/12  | 0.3432        | 0.4543        |
| upstream spring                                        | 10/ 2 | 0.1462        | 0.1924        |
| downstream spring                                      | 12/14 | 0.5174        | 0.5236        |
| downstream 24-25 June                                  | 19/23 | 0.6344*       | 0.6580*       |
| upstream summer                                        | 15/32 | 0.5678        | 0.6060*       |
| downstream summer                                      | 23/28 | 0.6329*       | 0.6510*       |
| South Slough summer                                    | 6/13  | 0.3955        | 0.4137        |
| South Slough total                                     | 16/42 | 0.3744        | 0.4405        |
| PRICKLY SCULPIN vs SURFSMELT                           |       |               |               |
| downstream fall                                        | 9/ 6  | 0.1528        | 0.1891        |
| STAGHORN SCULPIN vs STARRY FLOUNDER                    |       |               |               |
| downstream/south slough winter                         | 6/ 4  | 0.5866        | 0.5866        |
| South Slough winter                                    | 5/ 2  | 0.4964        | 0.4987        |
| downstream/South Slough spring vs<br>downstream spring | 4/ 5  | 0.1388        | 0.1388        |
| downstream spring                                      | 2/ 5  | 0.0000        | 0.0000        |
| downstream 24-25 June                                  | 8/ 4  | 0.2366        | 0.2491        |
| downstream summer                                      | 9/14  | 0.4096        | 0.4199        |

Table 11. Diet Overlap Values for Within Location and Within Season  
Interspecific Comparisons of Diets for Fish from Lower  
Redwood Creek, February-December, 1980. (continued)

| LOCATION and SEASON                                    | n1/n2 | $\alpha_{ac}$ | $\alpha_{cc}$ |
|--------------------------------------------------------|-------|---------------|---------------|
| STAGHORN SCULPIN vs HUMBOLDT SUCKER                    |       |               |               |
| downstream/South Slough spring vs<br>downstream spring | 4/ 2  | 0.0145        | 0.0145        |
| downstream spring                                      | 2/ 2  | 0.0000        | 0.0000        |
| downstream 24-25 June                                  | 8/14  | 0.0520        | 0.0621        |
| South Slough summer                                    | 3/ 8  | 0.0777        | 0.1479        |
| STAGHORN SCULPIN vs JUVENILE THREESPINE STICKLEBACK    |       |               |               |
| downstream/South Slough spring vs<br>downstream spring | 4/13  | 0.0947        | 0.0971        |
| downstream spring                                      | 2/13  | 0.0698        | 0.0698        |
| South Slough spring                                    | 2/ 6  | 0.0290        | 0.0290        |
| South Slough summer                                    | 3/ 5  | 0.0000        | 0.0000        |
| South Slough total                                     | 10/14 | 0.0821        | 0.0997        |
| STAGHORN SCULPIN vs ADULT THREESPINE STICKLEBACK       |       |               |               |
| South Slough winter/spring                             | 7/22  | 0.4052        | 0.5695        |
| South Slough winter                                    | 5/12  | 0.3566        | 0.5956        |
| downstream/South Slough spring vs<br>downstream spring | 4/14  | 0.1318        | 0.1348        |
| downstream spring                                      | 2/14  | 0.0000        | 0.0000        |
| South Slough spring                                    | 2/10  | 0.2954        | 0.3138        |
| downstream 24-25 June                                  | 8/23  | 0.1251        | 0.1367        |
| downstream summer                                      | 9/28  | 0.1603        | 0.1765        |
| South Slough summer                                    | 3/13  | 0.2357        | 0.3240        |
| South Slough total                                     | 10/42 | 0.4916        | 0.6287*       |
| STARRY FLOUNDER vs HUMBOLDT SUCKER                     |       |               |               |
| downstream spring                                      | 5/ 2  | 0.2623        | 0.2623        |
| downstream 24-25 June                                  | 4/14  | 0.5397        | 0.6459*       |
| STARRY FLOUNDER vs JUVENILE THREESPINE STICKLEBACK     |       |               |               |
| downstream spring                                      | 5/13  | 0.2602        | 0.2602        |
| STARRY FLOUNDER vs ADULT THREESPINE STICKLEBACK        |       |               |               |
| downstream spring                                      | 5/14  | 0.5825        | 0.6200*       |
| downstream 24-25 June                                  | 4/23  | 0.5438        | 0.6494*       |
| downstream summer                                      | 14/28 | 0.3056        | 0.3354        |
| STARRY FLOUNDER vs SURFSMELT                           |       |               |               |
| downstream fall                                        | 12/ 6 | 0.1126        | 0.1126        |

Table 11. Diet Overlap Values for Within Location and Within Season Interspecific Comparisons of Diets for Fish from Lower Redwood Creek, February-December, 1980. (continued)

| LOCATION and SEASON                                | n1/n2 | $\alpha_{ac}$ | $\alpha_{cc}$ |
|----------------------------------------------------|-------|---------------|---------------|
| HUMBOLDT SUCKER vs JUVENILE THREESPINE STICKLEBACK |       |               |               |
| downstream spring                                  | 2/13  | 0.7890*       | 0.8708*       |
| upstream summer                                    | 5/ 6  | 0.7340*       | 0.8375*       |
| South Slough summer                                | 8/ 5  | 0.0624        | 0.0624        |
| HUMBOLDT SUCKER vs ADULT THREESPINE STICKLEBACK    |       |               |               |
| downstream spring                                  | 2/14  | 0.3525        | 0.3525        |
| downstream 24-25 June                              | 14/23 | 0.8273*       | 0.8279*       |
| upstream summer                                    | 5/32  | 0.5057        | 0.5824        |
| downstream summer                                  | 14/28 | 0.7690*       | 0.7695*       |
| South Slough summer                                | 8/13  | 0.4954        | 0.4954        |
| JUVENILE vs ADULT THREESPINE STICKLEBACK           |       |               |               |
| downstream spring                                  | 13/14 | 0.3863        | 0.3917        |
| South Slough spring                                | 6/10  | 0.2814        | 0.2814        |
| North Slough spring                                | 9/14  | 0.1178        | 0.1645        |
| upstream summer                                    | 6/32  | 0.5602        | 0.6148*       |
| South Slough summer                                | 5/13  | 0.1311        | 0.1512        |
| South Slough fall                                  | 3/ 7  | 0.3483        | 0.3483        |
| JUVENILE THREESPINE STICKLEBACK vs TIDEWATER GOBY  |       |               |               |
| North Slough summer                                | 2/ 5  | 0.3370        | 0.3385        |
| ADULT THREESPINE STICKLEBACK vs TIDEWATER GOBY     |       |               |               |
| North Slough spring vs North Slough summer         | 14/ 5 | 0.4737        | 0.4867        |

\* denotes values that are considered biologically (not necessarily statistiacally) significant.

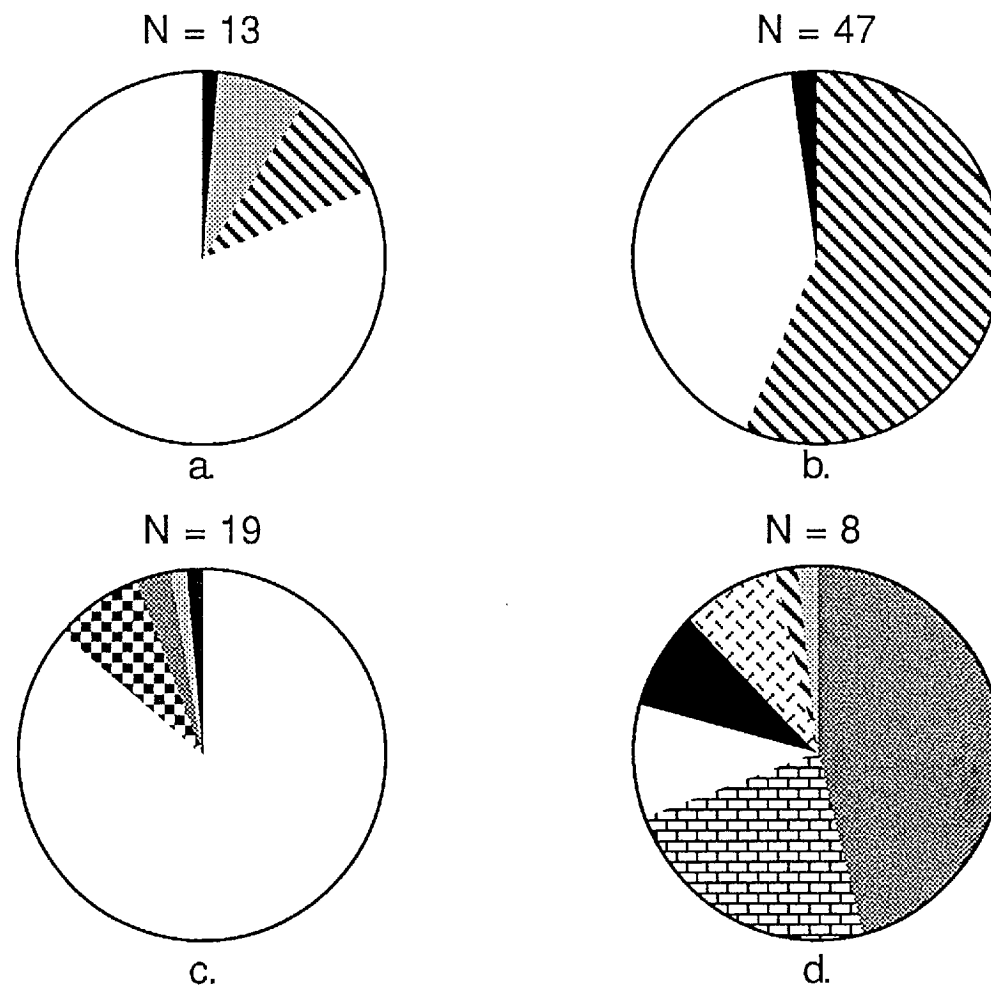
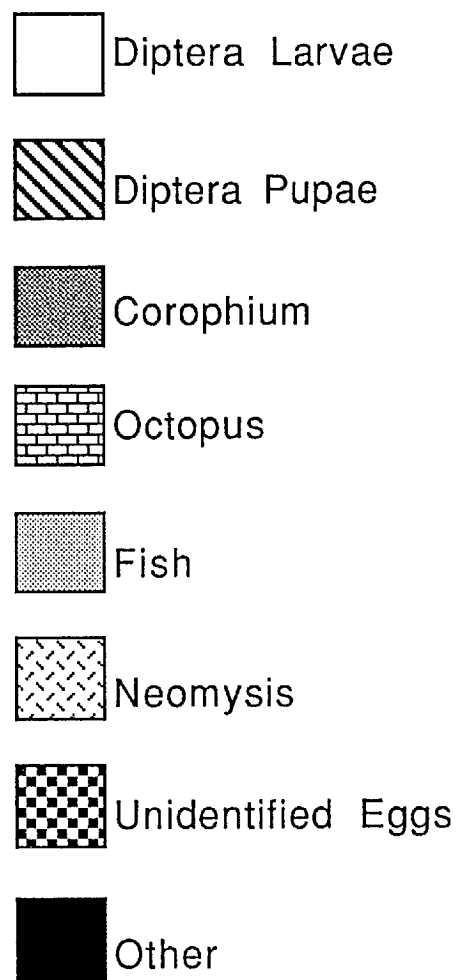


Figure 3. Percentage of the Total IRI Contributed by Certain Prey Items Found in the Stomachs of Fish Captured in the Downstream Site of Redwood Creek on 24-25 June, 1980: a. Juvenile Steelhead Trout; b. Juvenile Chinook Salmon; c. Prickly Sculpin; d. Staghorn Sculpin.

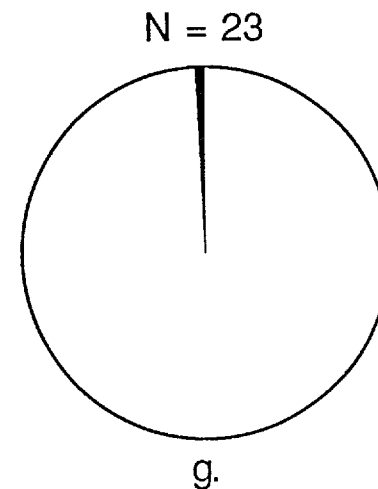
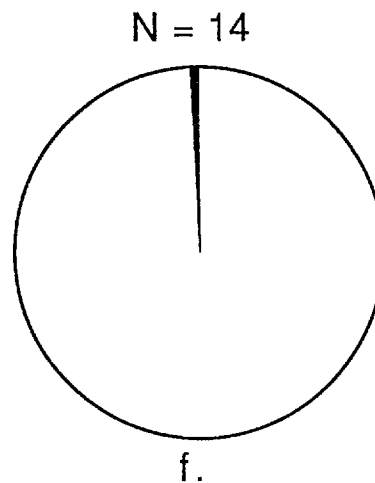
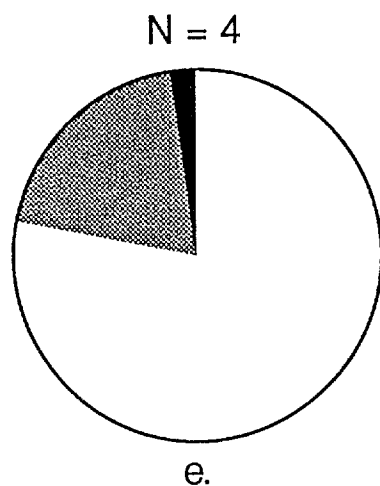
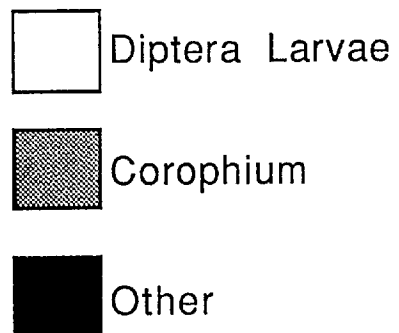


Figure 3. Percentage of the Total IRI Contributed by Certain Prey Items Found in the Stomachs of Fish Captured in the Downstream Site of Redwood Creek on 24-25 June, 1980: e. Starry Flounder; f. Humboldt Sucker; g. Adult Threespine Stickleback. (continued)

Prickly sculpin diets had more cases of biologically significant overlap with the diets of other species than any other fish during this study. Prickly sculpin diets displayed a biologically significant overlap with juvenile steelhead diets on two occasions (see above). This cottid's diet also showed biologically significant overlaps with its euryhaline relative, the staghorn sculpin, from the South Slough in winter, and the same location when winter and spring fish were combined. Prickly sculpin and starry flounder diet overlap comparisons yielded significant alpha values for South Slough winter, downstream 24-25 June (for IRI's for this period see Figures 3c and 3e), and downstream fall diets. Prickly sculpin diet had a biologically significant overlap with Humboldt sucker diet during the downstream 24-25 June sampling period (for IRI's for this period see Figures 3c and 3f). Prickly sculpin and juvenile threespine stickleback diets showed a biologically significant overlap only at the downstream site during spring, and then only when the food item categories had been combined. Prickly sculpin and adult stickleback diet comparisons yielded significant alpha values for downstream summer, as well as the during the downstream 24-25 June period (for IRI's for this period see Figures 3c and 3g). The upstream summer diets of these two species showed biologically significant overlap when food items were combined to the ordinal taxonomic level.

Besides the staghorn sculpin diet overlaps with prickly sculpin described above, this euryhaline cottid's diet also had biologically significant overlap with that of the adult threespine stickleback when all the fish of the two species from the South Slough were compared, but only when the food items were combined to the ordinal level.

Starry flounder diets that showed biologically significant overlap with the diets of other species and have not yet been discussed above, occurred only when the prey items were combined to the ordinal taxonomic level. These instances of significant alpha values occurred for the comparisons with Humboldt suckers for the downstream 24-25 June period (for IRI's for this period see Figures 3e and 3f), and with adult sticklebacks for the downstream spring and the downstream 24-25 June period (for IRI's for this period see Figures 3e and 3g).

Biologically significant diet overlap values not already identified for the comparisons of the Humboldt sucker with other fish species of lower Redwood Creek occurred when its downstream spring and its upstream summer diets were compared to those of the juvenile stickleback. Significant alpha values were also seen when sucker diets were compared to those of adult stickleback for downstream summer, as well as the 24-25 June period (for IRI's for this period see Figures 3f and 3g). The final overlap of biological significance occurred between juvenile and adult threespine stickleback from the upstream site during the summer. It was biologically significant only when the food items were combined to the ordinal taxonomic level.

## DISCUSSION

No records of any previous fish survey of lower Redwood Creek within the present study site were available. Prior reports on the fish of lower Redwood Creek considered the watershed upstream of this study and did not address food habits (Briggs 1953; Iwatsubo et al. 1976).

### Indices of Relative Importance

#### Juvenile Steelhead

The food habits of juvenile steelhead trout in lower Redwood Creek were variable between sites and seasons. Other investigators have found the food habits of rainbow trout to vary depending on the watershed under investigation and usually to be a function of prey availability (Shepherd 1928; Needham 1934, 1938; Chapman and Quistorff 1938; Idyll 1942; Shapovalov and Taft 1954; Ball 1961; Coche 1967; Jenkins et al. 1970; Waters 1972; Tippetts and Moyle 1978; McCabe et al. 1983).

Juvenile steelhead trout in lower Redwood Creek fed almost entirely on benthic invertebrates, including primarily chironomids, ephemeropterans and amphipods. In the lentic environment of the South Slough where more terrestrial forms such as zygopteran adults were available, more surface feeding was observed; however, benthic invertebrates still dominated the food habits. These observations were

consistent with other investigations of the food habits of steelhead smolts in the lower portions of small coastal streams (Needham 1940; Engstrom-Heg 1968).

Juvenile steelhead from the upstream study site of Redwood Creek showed little variation in the utilization of aquatic chironomids between spring and summer. During both seasons chironomid larvae were the most important food. Exceptions to this stability of diet between seasons were the importance of plecopteran nymphs to the spring diet and their virtual disappearance from the summer diet, while ephemeropteran nymphs and trichopteran larvae displayed the opposite trend. These phenomena were attributable to the relative availability of these benthic invertebrates (Salamunovich 1987). In the late spring, as flows decreased and temperatures increased, plecopteran nymphs disappeared from the substrate samples while large populations of ephemeropteran nymphs--particularly, Serratella levis, Siphonurus sp. and Tricorythodes sp.-- and the trichopteran nymph, Ochrotrichia sp., became established throughout the study site.

The scarcity of terrestrial forms in the diets was probably caused by the largely benthic nature of the diet as well as the general lack of any riparian habitat which could have contributed terrestrial insects to streams (Meehan et al. 1977; Reiser and Bjornn 1979; Gray et al. 1984; Mahoney and Erman 1984; Platts 1985). There is little information about the seasonal and spatial variability in the food habits of juvenile steelhead trout from a particular watershed. Johnson and Ringler (1980) did find that benthic insects dominated the diet of age-0 steelhead throughout the summer but there were more terrestrial forms in the diet in the mid and late summer.

Seasonal trends at the downstream site were similar to those at the upstream site. In the spring and summer chironomid larvae were the most important food item. McCabe et al. (1983) reported that the benthic amphipods, Corophium spinicorne and C. salmonis, were the most important food items in the spring diets of steelhead smolts in both the upper and lower portions of the Columbia River estuary. As was indicated in the results, the apparent importance of the sand crab, Emerita analoga, to the spring diet of juvenile steelhead trout in Redwood Creek was an anomaly and did not reflect its true value in the overall diet.

The diversity of the summer diet (Appendix B) suggested an opportunistic feeding behavior for the juvenile steelhead. However, the lack of diversity with respect to the principal food items would suggest a benthic feeding strategy that cues on the most abundant prey. This tendency to feed on the most abundant prey was also apparent in the late summer and fall at the downstream site. During this time, there was a progressive increase in the importance of the benthic amphipods, C. spinicorne and C. salmonis, in the diets. These amphipods began building substantial populations in the late spring (Salamunovich 1987). Though disturbed by the breaching of the berm, these invertebrates were numerically dominant in the benthic samples by late summer and early fall. The biomasses of these amphipods in the benthos were estimated to be 1.4-13.4, 1.4-12.7, and 0.8-4.8 g dry wt/m<sup>2</sup>, for the dates 22 August, 22 September and 1 November, respectively (Larson et al. 1982, 1983). Thus, the increase in the Corophium population was directly reflected in the diet of the juvenile steelhead. Whether there was a random selection of available prey or food resource selection as has been

purported to occur in trout (Bryan and Larkin 1972) was not discernible. Needham (1940) found little use of a similarly large Corophium resource in Waddell Creek lagoon by steelhead smolts. However, these fish were held in enclosures which may have limited their access to the Corophium.

Diet indices for juvenile steelhead captured in the South Slough during the summer showed a greater utilization of swimming invertebrates, such as corixids and notonectids, and terrestrial stages of aquatic invertebrates, namely Enallagma sp., than did fish from the main channel. Though only three fish were captured in the South Slough during the other sampling periods, they exhibited similar dietary trends. The predominance of hemipterans is not inconsistent with, nor does it preclude a benthic feeding strategy. The corixids, though capable of sustained swimming activity, spend much of the time resting and foraging on the substrate (Lauck 1979). Notonectids and the coleopteran, Deronectes sp., also exhibit this behavior. The importance of Enallagma adults to the diets of the fish examined seems to suggest opportunistic feeding. The juvenile steelhead appeared to utilize this food resource as it became available. Coenagrionid adults are susceptible to predation by fish during emergence, flight and rest over or near the water, and oviposition (Smith and Pritchard 1956). The availability of this food resource was greater in the lentic water habitat of the South Slough than in the lotic habitats of lower Redwood Creek (Salamunovich 1987).

All evidence indicated that juvenile steelhead trout in lower Redwood Creek were benthic foragers that fed opportunistically and relied on aquatic invertebrates for the bulk of their diet.

### Juvenile Chinook

The food habits of chinook smolts in Redwood Creek suggest opportunistic, as well as selective feeding. In Redwood Creek, as in other watersheds that have been studied, juvenile chinook salmon displayed a plasticity of feeding strategies that allowed for the use of a variety of prey resources (Craddock et al. 1976; Healey 1980; Pearce et al. 1982; McCabe et al. 1983; Jacobs et al. 1984; Nicholas and Lorz 1984). Aquatic chironomids and amphipods were the dominant food items in lower Redwood Creek. Elsewhere, juvenile chinook salmon have demonstrated the ability to use benthic organisms (Chapman and Quistorff 1938; Breuser 1961; Loftus and Lenon 1977), drift organisms (Rutter 1902; Ganssle 1966; Sasaki 1966; Becker 1973; Johnson 1981b), planktonic organisms (Kjelson et al. 1982), and pelagic organisms (Myers 1980).

When discussing the diet analyses from Redwood Creek it should be noted that the sample sizes from the upstream site were extremely small. Despite this, a trend was evident in the seasonal variation of diet in this zone. A gradual shift was observed from reliance on chironomid larvae as the main winter food item, to a spring diet that had both chironomid larvae and pupae of near equal importance, followed by a summer diet where chironomid pupae were the most important. This shift in diet can be partially explained by the expected seasonal availability of the different life history stages of chironomids in Redwood Creek. One would expect the relative abundance of pupae to increase in the spring, and to further increase in the summer. However, the larvae were certainly still available in the spring and summer, and in fact were the primary prey items utilized by the juvenile steelhead at this site during these seasons. On the other hand, it appears that

the juvenile chinook were selecting chironomid pupae, even though larvae were available as indicated by the diet of juvenile steelhead. This may have been resource partitioning (Schoener 1974) accomplished by the employment of different feeding strategies. The steelhead, based on their diet, appeared to rely more on a benthic feeding mode. The diets of downstream migrant chinook reflected more of a drift and surface feeding strategy, at least in the spring and early summer. Similar observations for sympatric species of salmon and trout have been made in other investigations (Engstrom-Heg 1968; Johnson and Ringler 1980; Johnson 1981b; Johnson and Johnson 1981). Corroborative evidence for this conclusion was seen in the season to season increase in importance of terrestrial insects to the juvenile chinook diet.

At the downstream study site, spring and early summer variations in diet indicated a reliance on drift organisms during spring. In the spring, chironomid pupae clearly dominated the diet index. The importance of the terrestrial input, as well as fish, was higher in the spring than in the summer. These observations lead to the conclusion that drift feeding was more important to the juvenile chinook at the downstream site in the spring. During the early summer, the diet was diverse in the types of food items consumed, but not in the dominant food items. Prey items that are typically considered drift were still the most important. However, from spring to summer, there was an increase in the importance of chironomid larvae, which indicated a greater dependence on benthic organisms in the early summer compared to the spring. It seems significant that this trend was accompanied by a decrease in the importance of terrestrial items, but drift organisms were still the most important items in the summer diet.

The observed decrease in the use of drift organisms at the downstream site in the early summer by juvenile chinooks may have been affected by the number of salmonids that were concentrated in the embayment by early summer. Larson et al. (1982) estimated that the combined chinook salmon - steelhead trout population for 25 June was 20,000 individuals, about 10,000 smolts of each species. This large concentration of juvenile salmonids in this small area may have produced a situation where the prey items available in the drift and at the surface were in insufficient numbers to support the large numbers of chinook smolts. These fish may have then been forced to rely to a greater degree (than in the spring) on benthic foraging. More complete resource partitioning may have been overridden by the paucity of appropriate prey items. Plankton tows from this area in early June showed a lack of available organisms in the water column (Salamunovich 1987).

The analyses of the late summer and fall food habits were limited due to the premature breaching of the berm and release of salmonids into the ocean on 3 July. The results of this diet analysis may have been altered if these fish had remained in the embayment throughout the summer and fall.

In the South Slough, chinook smolts consumed more benthic amphipods than any other food item. While feeding from the water column did appear to occur, most of the diet was comprised of organisms typically classified as benthic. Juvenile chinook salmon in the South Slough seemed to rely on a benthic mode of feeding during the summer, while their counterparts in the main channel of the creek depended more heavily on drift feeding. It is tempting to postulate that this

difference in feeding strategies was due to the overall lack of use of the South Slough by salmonid smolts. Seining caught few fish, but the inefficiency of the nets within this site may have been largely responsible. Therefore more reliable data from the sloughs of lower Redwood Creek are necessary before any salmonid-invertebrate/predator-prey dynamics can be understood.

#### Juvenile Coho

Descriptions by other investigators of the food habits of juvenile coho salmon are varied enough to suggest opportunistic feeding on those prey most available (Pearce et al. 1982; Nicholas and Lorz 1984). The results of the food habits of the few coho salmon examined in lower Redwood Creek support this conclusion.

Analysis of the food habits of juvenile coho from the upstream site of lower Redwood Creek, revealed, at least in the spring, a benthic feeding strategy. Other investigators have found juvenile coho to be benthic predators (Breuser 1961; Peck 1974; Durkin 1982; McCabe et al. 1983). This was indicated by their reliance on large trichopteran larvae (mostly Dicosmoecus sp. and Rhyacophila sp.) and chironomid larvae. These fish did not seem to be selecting for these food items since these organisms were readily available from the benthos in the early spring when the fish were sampled (Salamunovich 1987). Further evidence of the opportunistic nature of their feeding behavior was indicated by the importance of terrestrial food items in the diet.

The single hatchery coho seined from the North Slough apparently relied on drift feeding, as chironomid pupae were the dominant prey item and benthic organisms were secondary. Drift feeding has been observed

in juvenile coho by other investigators (Demory 1961; Johnson and Ringler 1980; Myers 1980; Johnson and Johnson 1981; Durkin 1982). Drift feeding in Redwood Creek may have been less a function of feeding strategy than of prey availability in this lentic habitat. It may also have been a result of the configuration and water quality of the North Slough. Oxygen profiles from this site showed that anoxic conditions prevailed near the bottom (Gregory 1982) which may have limited benthic production and prevented use of this area by fish.

### Prickly Sculpin

Prickly sculpin in the lower Redwood Creek were clearly benthic predators. This was not surprising considering their bottom dwelling habit, their distinctive body shape, their lack of a swim bladder, and their cryptic coloration (Moyle 1976a; McGinnis 1984). The food habits exhibited by prickly sculpin in lower Redwood Creek were consistent with the diets reported in the literature (Clemens et al. 1939; Northcote 1954; Engstrom-Heg 1968; Millikan 1968; Broadway and Moyle 1978).

Prickly sculpin from the upstream site relied on dipteran larvae for the majority of their winter and spring diets, with plecopteran nymphs also important in the winter. The opportunistic nature of this sculpins' feeding was indicated by the importance of terrestrial oligochaetes in the spring diet. Presumably these prey items washed in from the bank upstream during a period of high runoff.

Benthic food items also dominated the summer diet with ephemeropteran nymphs and chironomid larvae providing the bulk of the prey. The importance of the former was a reflection of its increased abundance from the middle part of the summer through the fall at the

upstream site (Salamunovich 1987). Two species of ephemeropteran nymph, Serratella levis and Tricorythodes sp., dominated the invertebrate standing crop in the substrate, as well as in the stomachs of prickly sculpins.

The diet of prickly sculpin at the downstream site was also dominated by benthic prey items. Chironomid larvae made up the bulk of the spring and summer diets. As was the case for the juvenile steelhead from this site, there was a strong shift in the fall diet toward the tube-dwelling amphipod, Corophium.

Benthic crustaceans were the most important food items in the diets of prickly sculpin from the South Slough. Broadway and Moyle (1978) observed that prickly sculpin from Clear Lake, California, fed mostly on the amphipod, Hyallela, and chironomid larvae.

### Staghorn Sculpin

The euryhaline staghorn sculpin was never seined far upstream from the mouth of Redwood Creek, corroborating previous observations that this fish is only found in the lower portions of coastal rivers and streams (Jones 1962; Porter 1964; Moyle 1976a; McGinnis 1984).

The diet analyses of staghorn sculpin from the downstream site indicated a diet largely dependent on benthic prey organisms, mostly amphipods and polychaetes. Benthic crustaceans and polychaetes have been reported as the dominant food resource of staghorn sculpin in other estuaries (Jones 1962; Porter 1964; Ganssle 1966; Smith 1980; McCabe et al. 1983).

One staghorn sculpin examined in the summer had the beak of an Octopus rubescens in its stomach. The original assumption that any

parts of an organism in the stomach implied ingestion of the entire organism probably gave it more importance than it should have had. Further, this octopus is a marine species, not likely to be found in the study site (Hochberg and Fields 1980). So, O. rubescens was an incidental food item and its calculated IRI value was probably an overestimate.

The food habits of staghorn sculpin from the South Slough also indicate benthic feeding behavior. The diets of the fish from all the seasons sampled were dominated by benthic crustaceans. The isopod, Gnorimosphaeroma oregonensis, was the most important food item in the winter diet, while the mysid, Neomysis mercedis, made up the bulk of the spring and summer diets. Though this mysid is capable of a planktonic existence, it is considered benthic due to its habit of remaining close to the substrate (Green 1968; Cannon 1982).

### Starry Flounder

Starry flounder had the highest percentage of empty stomachs (19.6 percent) of any species examined during this study. Porter (1964) reported that starry flounder digestion rates were 2.2 times faster in salt water than in fresh water. Moyle (1976a) observed that it was not unusual to find emaciated specimens in fresh water and suggested that initial feedings in fresh water may cause osmotic stress. Orcutt (1950) reported that 16.7 to 19.2 percent of the starry flounders that he examined from Monterey Bay, California, had empty stomachs. When Porter (1964) examined the food habits of starry flounders from several Humboldt County, California, sites he noted that 24 percent of the fish from Big Lagoon, 34 percent of the fish from the Mad and Little Rivers,

and 27 percent of the fish from Humboldt Bay had empty stomachs. This condition may not be species specific, as Kilner and Akroyd (1978) found very high percentages of empty stomachs for several species of flounders from a New Zealand estuary.

The results from Redwood Creek agree with other studies that found starry flounders feed mainly on benthic food items (Orcutt 1950; Porter 1964; Ganssle 1966; Cailliet 1977; McCabe et al. 1983). Starry flounders from the downstream site fed almost exclusively on benthic invertebrates--mainly crustaceans. Of the two fish seined in winter, Anisogammarus confervicolus was the main food, with the remainder of the diet made up of C. spinicorne and a plecopteran nymph. In the spring, C. spinicorne and C. salmonis accounted for the bulk of the diet. Other benthic prey items, such as chironomid larvae, isopods and mysids were also consumed. This shift in diet was probably due in part to changes in seasonal patterns of prey availability, as few A. confervicolus were found in substrate samples taken during this time. However, some kind of selection may have taken place because at this same time and location the most important food item in the prickly sculpin diet was chironomid larvae, while staghorn sculpin used benthic polychaetes. These observations may be explained by the fact that the starry flounder and staghorn sculpin were captured over sandy substrate in the embayment where amphipods and polychaetes were more prevalent. Prickly sculpin were captured a little further upstream where chironomid larvae dominated the fauna (Salamunovich 1987).

The summer diet of starry flounder from the downstream site remains virtually unchanged from the spring diet except for the increased utilization of chironomid larvae. This is no doubt due to the

importance of this dipteran in the early summer diet (Figure 3e). Over the course of the sampling period both species of Corophium still dominated the diet of the starry flounder, as it did the staghorn sculpin. Benthic food items continued to dominate the starry flounder diet in the fall as the two species of Corophium as well as Neanthes succinea accounted for virtually all of the stomach contents. The importance of Corophium to the late summer and fall food habits suggested an opportunistic feeding behavior on the part of the starry flounder as this prey item was the most plentiful benthic organism during this period in the embayment and lower creek (Larson et al. 1982, 1983).

The two flounder examined from the South Slough support the characterization of this species as an opportunistic benthic predator. These fish contained only benthic prey items present in numbers that reflected their abundance in the winter benthos (Salamunovich 1987).

#### Humboldt Sucker

This study did not address the utilization of detrital or vegetable resources by the Humboldt sucker. Suffice it to note that algal and detrital matter were found in some sucker stomachs. However, because this material was not consumed by any other of the commonly occurring fish species in lower Redwood Creek, and because of the inability to enumerate "algae" or "detritus" for IRI analysis, it was not treated in the results or discussion. Moyle (1976a) stated that Sacramento suckers, C. occidentalis, consume algae and detritus. Brauer (1971) estimated that 40 percent of the stomach contents of Sacramento suckers was vegetable material, mostly diatoms. Villa (1985)

investigating this same species found that algae and detritus made up 45 percent of the stomach contents by weight. Sand contributed another 43 percent. Dauble (1980) that found periphyton was the dominant food for the bridgelip sucker, C. columbianus, in the Columbia River.

Results from the stomach analysis of Humboldt suckers from lower Redwood Creek show a diet largely dependent on benthic prey items. At the upstream site chironomid larvae dominated the diet for all the seasons sampled. This prey item accounted for 92 percent, 95 percent and 95 percent of the total diet index for winter, spring and summer, respectively. For suckers examined from the downstream site the results were similar except for a large contribution to the spring diet by the benthic copepod, Huntemannia sp. Villa (1985) found aquatic insects contributed less than 10 percent to Sacramento sucker diets and concluded they were incidental food items. Brauer (1971), however, found them to rely primarily on benthic invertebrates for their food resource, with chironomid larvae being the most numerous prey item. He further noted a greater diversity of prey items for smaller fish which consumed acari, cladocerans, ephemeropteran nymphs, as well as trichopteran, simuliid and chironomid larvae.

Humboldt suckers captured in the South Slough consumed different types of benthic invertebrates. Due to different prey availabilities in this lentic environment, benthic crustaceans made up most of the sucker diet. Isopods and amphipods were the important food items, while chironomid larvae made only a modest contribution to the diet. Investigators studying other species of suckers from lentic habitats also have found benthic crustaceans to be important components of the diet (Carl 1936; Engstrom-Heg 1968; Marrin et al. 1984).

### Juvenile Threespine Stickleback

"Juvenile" threespine stickleback were distinguished from the larger "adults" and were treated separately in the analysis. This distinction was made because of apparent differences of diet between small and large sticklebacks.

Analysis of juvenile sticklebacks from lower Redwood Creek revealed a diet influenced heavily by food availability as well as mouth size. At the upstream site juvenile sticklebacks were captured only during the summer. Results showed a benthic diet with chironomid larvae dominating the diet index. Bottom dwelling acari were also an important, though secondary, part of the diet.

At the downstream site, juveniles were captured only in the spring; again chironomid larvae dominated the diet index. The only other food item of importance was also benthic, the harpacticoid, Huntemannia sp. Other benthic organisms such as amphipods, polychaetes and acari made only minor contributions to the diet. The importance of mouth size on the diet of these fish was implied by the fact that all of the amphipods consumed by these juvenile sticklebacks were small, immature Corophium. Presumably, these small fish were not able to ingest the larger Corophium and thus had to utilize the smaller amphipods instead. The importance of prey availability to the food habits of these fish was seen when comparing the diets of small sticklebacks reported in the literature to those observed in the main channel and embayment of lower Redwood Creek. This study found benthic prey items to predominate in the diets of juvenile threespine stickleback. Previous investigations have stressed the importance of zooplankton in the diets (Blegvad 1917; Hynes 1950; Rogers 1968; Manzer

1976; Peterson and Martin-Robichaud 1982). A possible explanation for this is that zooplankton were not abundant at these sites; plankton tows at these sites demonstrated a paucity of zooplankton (Salamunovich 1987). The lack of abundant zooplankton precluded their use by juvenile sticklebacks and benthic prey items were consumed instead. Saunders (1914) did report that small sticklebacks fed on insect larvae, as well as small crustaceans.

Results of the diet analysis of juvenile stickleback from the South Slough showed a different picture of feeding strategy. At this site zooplankton were more abundant and were utilized to a greater degree than at other locations. If cladocerans, cyclopoid copepods and chironomid pupae were categorized as plankters, 57 percent of the spring IRI and 52 percent of the summer IRI were accounted for by zooplankton. During the summer, 34 percent of the overall diet was contributed by eggs. Though not positively identified, these seemed to be invertebrate eggs. This high percentage of eggs in the summer diet, the diversity of important food items and the utilization of both planktonic and benthic prey items suggested that these fish were opportunistic predators capable of consuming a variety of food items as they become available.

The fall diet of juvenile sticklebacks from the South Slough showed a heavy reliance on benthic prey items. Mysids and chironomid larvae accounted for almost 75 percent of the diet index. Again this seasonal shift in food habits seemed due to changes in the availability of food items rather than selection of specific food items. Results of the analysis of the food habits of these juvenile fish from the North Slough supported the characterization of this fish as an opportunistic predator. In the spring, eggs dominated the diet index. Of the nine

fish examined, one was captured on 5 April and eight were taken on 1 June. The lone juvenile stickleback from the early spring depended on chironomid larvae for the bulk of its diet with a minor contribution from Huntemannia sp. The fish from late spring consumed eggs, a highly seasonal prey item, to the virtual exclusion of all other prey items.

This difference in the diets suggested the ability of small sticklebacks to prey on a variety of benthic organisms as they become available. This conclusion was supported by the analysis of the summer food habits of the two fish from the North Slough. Cladocerans and cyclopoid copepods, both plankters, accounted for over 82 percent of the total IRI. This seasonal shift in food habit from benthos to zooplankton demonstrated the facility of these fish to adapt their mode of feeding to available food.

The opportunistic feeding behavior of juvenile threespine sticklebacks and their ability to utilize both planktonic and benthic prey would be advantageous to growth and survival. While they are small these fish can eat only small prey. Employing a opportunistic feeding behavior increases the variety of prey and ensures greater food consumption and growth. Opportunistic feeders benefit further by having to spend less time foraging for specific food items. This limits their exposure to predation, an important consideration for small fish such as juvenile threespine sticklebacks.

#### Adult Threespine Stickleback

Variations in the diet of adult threespine sticklebacks from lower Redwood Creek revealed were explained by prey abundance and availability. The spring diet of these fish from the upstream site

appeared heavily reliant on drift insects. Caution should be exercised since only two fish made up this sample. A larger sample size may have yielded different results. In any event, the differential use of benthic and drift organisms, and the importance of terrestrial food items--in this case cicadellids--suggested opportunistic feeding. These findings agree with other diet studies (Hartley 1948; Hynes 1950; Hagen 1967; Rogers 1968; McCabe et al. 1983; Snyder 1984; Wootton 1984).

The summer diet from the upstream site showed greater dependence on benthic insects. Chironomid larvae, along with a variety of ephemeropteran nymphs, and coleopteran larvae contributed over 89 percent of the total IRI. The importance of benthic invertebrates to the food habits of sticklebacks has been demonstrated elsewhere (Blegvad 1917; Hartley 1948; Hynes 1950; Hagen 1967; Peterson and Martin-Robichaud 1982; Snyder 1984).

The fall diet was still largely benthic, though to a lesser degree than in the summer. During the fall there was little diversity in the prey items consumed as aquatic chironomids made up virtually all of the diet.

The diet of adult sticklebacks from the downstream site was mostly benthic. The spring diet, based primarily on the analysis of gravid females, showed a diversity in the items that were consumed. It is interesting to note that Worgan and FitzGerald (1981) observed a wider feeding niche for female threespine sticklebacks than for males. For this sample period, chironomid larvae were the most important food item, followed closely by C. spinicorne. Though there were a variety of food items consumed, benthic organisms accounted for 80 percent of the diet.

The summer diet of sticklebacks from the downstream site suggested a dependence on benthic insects. Though a variety of food items were consumed only chironomid larvae were of any importance.

The one fish examined in fall had consumed only mysids, which were considered to be benthic food items. Thus, adult sticklebacks from the main channel and embayment of Redwood Creek were largely benthic insect predators capable of utilizing drift organisms when they were available.

The diets of adult sticklebacks from the South Slough site also suggested a benthic feeding strategy. Mysids were the most important food items in the winter and the fall, and chironomid larvae and mysids were about equally important in the spring. During summer, benthic amphipods were the most important prey items. The diversity of the winter, spring and summer diets suggested opportunistic feeding. Despite this opportunistic feeding behavior, benthic organisms were the most important food items. They accounted for 86 percent, 85 percent, 88 percent and 98 percent of the total IRI for winter, spring, summer and fall, respectively. Except during the spring, when aquatic chironomids were important, most of the benthic prey organisms were crustaceans.

Some studies have stressed the importance of microcrustaceans (copepods, cladocerans and ostracods) to the diets of threespine stickleback (Hartley 1948; Hynes 1950; Rogers 1968; Manzer 1976; Worgan and FitzGerald 1981; McCabe et al. 1983). Though these items were available in the South Slough (these items were important food items in the spring and summer food habits of juvenile threespine sticklebacks) they were little used by the adult sticklebacks. In the spring, adult

threespine sticklebacks from the North Slough fed predominantly on benthic prey items, though they did use more zooplankton than at any other site. It may be that these microcrustaceans were more abundant and therefore more available at this site. Perhaps the lack of benthic organisms at this site along with the vast amounts of large woody debris which covered the benthos limited the efficiency of benthic feeding.

Some investigators have reported that vascular plants, algae and diatoms were important food of sticklebacks (Saunders 1914; Hartley 1948). Others have found algae present in the diet but unimportant (Hynes 1950; Hagen 1967; Rogers 1968). The present study found no algae, diatoms or vascular plant material in any stomachs, though this it was readily available in lower Redwood Creek in the summer and fall.

### Surf Smelt

Stomach analysis of surf smelt from the downstream site of Redwood Creek revealed a heavy dependence on planktonic feeding. The calanoid copepod, Eurytemora sp., accounted for 62 percent of the total IRI. Benthic prey items, mostly the gammarid amphipod, A. confervicolus, made up the remainder of the diet. These results are consistent with those of McCabe, et al., (1983), who reported that the diet of surf smelt in the Columbia River estuary consisted mostly of calanoid copepods, as well as cladocerans and the amphipod, C. spinicorne.

Unlike delta smelt, Hypomesus transpacificus, eulachon, Thaleichthys pacificus, and longfin smelt, Spirinchus thaleichthys, which spawn in fresh or brackish water, surf smelt require exposed beaches for reproduction (Miller and Lea 1972; McGinnis 1984). This,

plus a lack of gonadal development, indicates that these fish did not enter Redwood Creek to spawn. It was more likely these fish entered the estuary with a high tide.

No Eurytemora were ever found in any abundance in the embayment, but they were found in the North Slough in late summer and early fall (Salamunovich 1987). Perhaps the copepods entered the estuary from the sloughs during the ebbing tides. Despite the source, the surf smelt fed primarily on zooplankton and displayed the capacity to use benthic prey as well.

#### Tidewater Goby

The tidewater gobies examined from the shallow portions of the North Slough seemed to be primarily benthic predators. Most of the diet was comprised of chironomid larvae. Wang (1984) found amphipods and mysids dominated the diet of adult tidewater gobies in a lagoon in the Golden Gate National Recreation Area. He found juveniles fed primarily on small amphipods. In lower Redwood Creek tidewater gobies also fed on plankton as copepods and cladocerans made up 25 percent of the overall diet index. Berg (1979) reported that the goby, Gobiusculus flavescens, from the North Sea off Germany was a carnivorous plankton feeder.

The siting and capture of tidewater gobies is the first report of this species from Redwood Creek. This a slight range extension from its previously reported northern limit in Stone Lagoon, 4.0 km south of Redwood Creek (Miller and Lea 1972).

#### Shiner Surfperch

Unlike the estuary of the Sixes River, Oregon, where Reimers (1973), found shiner surfperch to be abundant throughout the summer,

these fish were infrequently captured in Redwood Creek. The two fish examined were captured at the mouth of the creek and neither contained any recognizable remains of invertebrate food items. The stomach contents were composed solely of filamentous green algae, probably Cladophora sp., which was abundant in the lower creek. McCabe et al. (1983) examining the food habits of fish in the Columbia River estuary, observed that shiner surfperch from the pelagic zone of the lower estuary had nothing identifiable in their stomachs in the spring. In the summer copepods were the most important prey.

### Diet Comparisons

#### Temporal Diet Comparisons by Species

Attempts to detect temporal variations in the diet of a fish species and seasonal overlaps in food habits at a specific location were carried out using the Chi square test for diet homogeneity and the Schoener index of diet overlap. The first was a test to determine statistical significance ( $P \leq 0.05$ ) of diet homogeneity, the second was a comparison to determine biological significance of diet overlap. It should be stressed that the Schoener index did not measure any potential for intraspecific competition since that would require the resource users be sympatric, which was not the case for the seasonal comparisons. This index was used here to measure seasonal overlaps in the diet of a species. In the interest of avoiding confusion, a statistically significant Chi square test indicated that the diets were different, while a biologically significant alpha (Schoener overlap) value indicated diets were similar.

Analyses of the juvenile steelhead trout diets showed seasonal variations at specific locations. For all the cases tested, the diets were significantly different. This was corroborated by the Schoener indices for the same comparisons, none of which were biologically significant. Seasonal variations have been found in the diets of juvenile steelhead from other watersheds (Coche 1967; Johnson and Ringler 1980).

The Chi square analyses for all juvenile chinook salmon comparisons suggested that the diets varied significantly between seasons and within locations. Many investigators have observed seasonal variations in the diets of juvenile chinook salmon (Breuser 1961; Engstrom-Heg 1968; Becker 1973; Craddock et al. 1976; Healey 1980; Myers 1980; Pearce et al. 1982; McCabe et al. 1983; Jacobs et al. 1984). The Schoener indices showed two instances of significant overlap for these same comparisons. The first instance occurred when the winter and spring diets of juvenile chinook from the upstream site were combined and compared to the summer diet at this site. In this case the significant overlap was artificially produced by the combining of the winter and spring diets. A comparison of the winter diet alone to the summer diet was not significant, while the comparison of the spring to the summer diet yielded overlaps that were significant for all prey categories, as well as the combined categories. This last comparison was considered the only valid occurrence of significant overlap since the influence of the spring diet outweighed that of the winter diet when the two were combined and compared to the summer diet of chinook smolts. The significant overlaps between the spring and summer diets at the upstream site were due to the stability in the utilization of chironomid

pupae and chironomid larvae from spring to summer as well as the common use of terrestrial organisms, namely arachnids.

Prickly sculpin diets were deemed to vary seasonally. The Chi square tests for diet homogeneity revealed that all the between season comparisons of diets were significant. Millikan (1968) found little evidence to indicate a distinct seasonal trend in food habits of prickly sculpin from a small Washington stream. He did note that chironomid larvae were more important in the summer than in any other season. The predominance of chironomid larvae in the spring and summer diets of prickly sculpin from the downstream site of Redwood Creek, as well as the common utilization of Corophium and the polychaete, N. succinea, resulted in a significant diet overlap. These diets were still sufficiently diverse to be judged significantly different by the Chi square test.

Chi square analyses of staghorn sculpin food habits revealed that all between season comparisons yielded significant values, and thus these diets were considered to be significantly different. Seasonal variations in the food habits of staghorn sculpin have been reported by other investigators (Jones 1962; Smith 1980; McCabe et al. 1983).

The food habits of starry flounder in lower Redwood Creek, when compared and tested by Chi square analyses, showed significant seasonal variations in all cases. Seasonal variations in the food habits of starry flounder from the Columbia River estuary have been reported (McCabe et al. 1983). When these comparisons were tested for diet overlaps only diets at the downstream site in the summer compared to the fall yielded a significant value. The flounder from these two samples

fed on both species of Corophium, as well as isopods and polychaetes to such a degree their diets were deemed to overlap significantly.

The Humboldt sucker showed one case of apparent diet homogeneity. Dauble (1980) observed little seasonal variation in the diet (mostly periphyton) of the bridgelip sucker from the central Columbia River. Villa (1985) reported that the diet of the Sacramento sucker from Thomas Creek in California's Central Valley, varied little seasonally and consisted mostly of algae, detritus and sand. In Redwood Creek, when the winter and the spring food habits were combined and compared to the summer, the diets were not significantly different. The common and heavy use of chironomid larvae was responsible for the determination that the diets were similar. Regardless of the significant differences in the diets, the Schoener indices of diet overlap were significant for all seasonal comparisons. Again, this was due to the predominance of chironomid larvae in the diet for all seasons.

The food habits of juvenile threespine sticklebacks from the slough sites displayed significant seasonal variations between spring and summer. Further, none of the diet overlaps were biologically significant.

The diets of the adult threespine sticklebacks were seasonally different as is reported in the literature (Hynes 1950; Manzer 1976; McCabe et al. 1983; Snyder 1984). Chi square analyses of between season comparisons revealed that all were significantly different with little significant overlap. An exception was when the spring and summer food habits for sticklebacks from the South Slough were compared. Even though the relative importances of the different prey items was very

different between these two seasons, there was enough common use of a variety of items to provide for a significant overlap.

The temporal variations in the food habits among species of fish in lower Redwood Creek were probably caused by the changes in the abundance and availability of prey organisms throughout the year, which were a function of the life history of these prey items, as well as the discharge and flow dynamics within altered stream channels (Moyle 1976b; Griswold et al. 1978; Schmal and Sanders 1978). Shifts in the utilization of various prey items may be great or small as was indicated by the Schoener indices.

#### Spatial Diet Comparisons by Species

Between site and among season comparisons were carried out using the same homogeneity test and overlap indices to detect spatial variations in the food habits and between site diet overlaps for a specific sample period.

Juvenile steelhead diets showed spatial variation. Both Chi square tests for between site comparisons of food habits yielded significant values. There was also enough diversity of prey consumed at these sites that no diet overlap values for these comparisons were significant. This was inconsistent with the results of McCabe et al. (1983) who found little variability in the spring food habits of steelhead smolts from different areas of the Columbia River estuary.

The food habits of juvenile chinook salmon also showed spatial variations within lower Redwood Creek. Both between site comparisons of diet were significantly different. Other investigators have reported similar spatial variations in the food habits of juvenile chinook from

different locations within a watershed (Rutter 1902; Becker 1973; Healey 1980; Myers 1980; Kjelson et al. 1982; Pearce et al. 1982; McCabe et al. 1983; Jacobs et al. 1984). The diet overlap values for the comparisons of the upstream sites to the downstream sites were significant. In the spring, the diet overlap was significant only when prey items were combined. The common use of arachnids, ephemeropteran nymphs, trichopteran larvae, and chironomid larvae and pupae between these sites was responsible for the critical overlap. In the summer, the mutual consumption of arachnids and chironomids caused the significant overlap.

Prickly sculpin food habits varied by location in the study area. All between site comparisons showed that the diets were significantly different. Millikan (1968) found little spatial variation in the food habits of prickly sculpin in lower Conner Creek, Washington. However, Broadway and Moyle (1978) reported spatial variations in the food habits of prickly sculpin in Clear Lake, California. All the between site-within season comparisons failed to yield any significant diet overlaps.

The diets of staghorn sculpin in lower Redwood Creek varied between the downstream and South Slough sites. These between site comparisons proved to be significantly different. No biologically significant overlaps in food habits were noted for any of the comparisons.

Not enough starry flounder were examined to test for statistical differences in diet. Starry flounders from other West Coast estuaries have displayed spatial variations in food habits (Cailliet 1977; McCabe

et al. 1983). The overlap in the food habits of starry flounder from the downstream site and the South Slough was not significant.

Those Humboldt sucker food habits from the different sample sites that were tested were all statistically different from one another. Brauer (1971) reported that the food habits of the Sacramento sucker varied between two locations in Hat Creek. However, his samples were taken from two different years, which may have been more responsible for the variation than the different locations. Marrin et al. (1984) observed that the food habits of the Tahoe sucker, C. tahoensis, from two impoundments were different. Despite the significant differences in the comparisons of between site food habits in Redwood Creek, the heavy use of the chironomid larvae resource by fish from the upstream and downstream sites resulted in these overlaps being significant. The dramatic difference in the types of prey items consumed by suckers in the South Slough precluded any meaningful superimposition of food habits with suckers from any other site.

The diets of juvenile sticklebacks varied spatially as all the between site comparisons tested were significantly different. All but one of the comparisons tested yielded insignificant food habit overlaps. The exception was the summer diet of juvenile sticklebacks from the South and North Sloughs. The significant overlap was due primarily to the consumption of crustacean zooplankers--cyclopoid copepods and cladocerans-- as well as acari and chironomid larvae by the fish at both sites.

The food habits of adult sticklebacks varied spatially. The Chi square test for diet homogeneity yielded significant values for all of the between site comparisons. Other investigators have found evidence

of spatial variations in the food habits of the threespine stickleback (Hagen 1967; Obrebski and Sibert 1977; McCabe et al. 1983). All but one of the between site comparisons had insignificant diet overlaps. The case of significant overlap resulted from the common utilization of chironomid larvae and pupae, as well as mysids, isopods and amphipods in the spring food habits of sticklebacks from the downstream and South Slough sites.

The spatial variations in the diets within species of fish in lower Redwood Creek was probably best explained by differences in the invertebrate faunas and their abundances at the different sites. The downstream site, upon the seasonal reduction in streamflow and the subsequent appearance of the berm at the mouth of the creek, provided conditions for the establishment of a stable substrate as a lagoon formed. The formation of the lagoon, or embayment, allowed for a different fauna to dominate in mid-summer at the downstream site than was found at the upstream site, and this no doubt had an effect on diet variations between the two locations. The Chi square values for the downstream versus upstream comparisons were lower in the winter and spring when stream conditions were most uniform at the two sites. They tended to be higher in the summer and fall when conditions at these two locations became more heterogeneous.

#### Interspecific Diet Comparisons

Most interspecific comparisons for food habit homogeneity were judged significantly different. In one case, however, the food habits were not significantly different. In this instance the diet overlaps were not biologically significant. This was due to the different

criteria used in these analyses as well as the small sample sizes. The Chi square test was based on the comparisons of numbers of food items in the five most important ordinal categories. The Schoener index was based on the mean weight percentage of food items for individual and ordinal categories. Any large discrepancies between numbers of food items and the weight of those items could have been responsible for the situation where diets were judged not to be significantly different and yet their overlaps were judged to be significantly different. However, if all prey items were of equal weight, this bias would not occur. In addition, the small sample sizes limited the data on which judgements were made. Small sample sizes tend to overemphasize the value of heavier items that may occur infrequently and thus influence the results of the Schoener index. Small sample sizes also tended to limit the number of food items used in the Chi square analyses which may have affected the outcomes. This was a source of error especially if the numbers of food items were unequal. Such an inequality occurred in the comparison of the spring diet of two staghorn sculpin from the South Slough with that of ten adult threespine stickleback. The Chi square analysis was based on seven total food items from the staghorn sculpin and 164 from the sticklebacks. In this case, the diet overlaps were not remotely significant.

Thus, the cases where the diets were not found to be significantly different were probably a function of the small sample sizes. Larger sample sizes would have reduced the effect of small numbers of food items being compared and reduced any overemphasis on heavier food items.

Addressing the situations where significant overlaps were measured leads to the caveat that the level of biological significance was arbitrarily chosen and, even more importantly, meaningful overlaps do not necessarily equate to competition. For competition to occur, the food resource which is being simultaneously sought by two or more sympatric species must be limiting. Competition exists only when the food resource cannot sustain the populations of the two competitors without at least one of the species suffering reduced production due to the presence of the competing species (Gause 1934; Park 1954; Odum, H.T. 1983; Hanson and Leggett 1985). Thus, competition involves a negative interaction due to a shortage of resources used by at least two species (Odum, E.P. 1983; Krebs 1985).

The importance of interspecific competition by fish for food has been often studied (Hartley 1948; Nilsson 1963, 1967; Maitland 1965; Straskraba et al. 1966; Munro 1967; Andreasson 1971; Fagade 1971; Zaret and Rand 1971; Mason and Machidori 1956; Obrebski and Sibert 1977; Werner and Hall 1977; Deselle et al. 1978; Fraser 1978; Myers 1980; Minkley 1982; McCabe et al. 1983; Hanson and Leggett 1985). Resource partitioning (Schoener 1974) or interactive segregation (Brian 1956) has been used to describe the separation of sympatric species into different niches (e.g. food habits or habitat selection) due to their competitive interactions. Without this divergence, one species would theoretically be eliminated due to the principle of competitive exclusion (Hutchinson, 1965). Examples of resource partitioning between competing species have been inferred in the literature (Nilsson 1963, 1967; Andreasson 1971; Werner and Hall 1977; Deselle et al. 1978; Mathur 1977; Johnson 1981b; Myers and Horton 1982). This partitioning may not always lead to a

reduction in competition. If, in a hypothetical stream, benthic invertebrates were limiting, the production of two benthic predators could cause one species to alter its feeding strategy and feed instead on drift organisms. The second species may still continue to obtain the bulk of its prey foraging directly from the substrate. Brocksen et al.(1968) presented evidence to suggest that by harvesting benthic invertebrates in an artificial stream, sculpin reduced the number of invertebrates available to the drift and thus adversely affected the productivity of a trout population which depended on the drift for nutrition. Engstrom-Heg (1968) studying the food habits of fish from a estuarine impoundment in Oregon, found that juvenile steelhead relied primarily on chironomid larvae for their food, while juvenile chinook utilized the pupae of this dipteran. Although one may not consider them in direct competition over two different aquatic forms of the insect, the harvesting of the larval stage would necessarily reduce the number maturing to the pupal stage. Thus, the juvenile steelhead, although feeding on a different life history stage of the chironomid from the benthos, could affect the nutrition of the chinook salmon feeding from the drift.

In this study it was not known when, or if, food resources were limiting. Also, no measures of the growth and survival of the fish were made. Therefore, the diet overlaps generated in the analysis can only be used to point to the temporal and spatial potentials for competition. These measures, when significant, only indicate the presence of the first criterion needed for competition, which is the common utilization of a food resource by sympatric species. This also provides the reason

why the intraspecific overlaps discussed earlier were not competitive indices. The fish compared were not co-occurring in space and time.

Rapid changes in the food habits of sympatric species can occur over short periods of time and space (Obrebski and Sibert, 1977; Myers, 1980). These diets may change due to the competitive interactions described above, changes in food availability (Bryan and Larkin, 1972), or mutually altered feeding efficiencies. Obrebski and Sibert (1977) speculated that it was possible for sympatric species to facilitate their joint feeding efficiencies. Dense sympatric populations of fish might make more benthic prey items available by disturbing the substrate more than would lower densities of one fish species.

Significant diet overlaps between juvenile steelhead and other fish species were noted only when prey item categories had been pooled. On 24-25 June at the downstream site, the diet of the steelhead showed significant overlap with the diets of prickly sculpin, starry flounder, Humboldt suckers and adult threespine sticklebacks. For all these cases the overlaps were primarily, if not entirely, due to the common use of chironomid larvae (Figure 3a, c, e, f and g). The summer food habits of juvenile steelhead from the upstream site showed significant overlaps with the diets of prickly sculpin and threespine stickleback. The overlap with prickly sculpin was caused by the common use of ephemeropteran nymphs and dipteran larvae. These same items along with dipteran pupae were responsible for the significant overlap of steelhead and sticklebacks.

The heavy use of the chironomid pupae resource by juvenile chinook salmon at the upstream and downstream sites and its lack of utilization by other fish species is responsible for the generally low

Schoener indices for these comparisons. The one exception was the significant overlap that occurred in the winter food habits of chinook smolts and suckers at the upstream site. The predominance of chironomid larvae in the diets of both species was responsible for the significant values. It is tempting to speculate that the predominance of chironomid pupae in the diet of chinook salmon smolts during the summer at the upstream site and in the spring and summer at the downstream site represents interactive segregation by juvenile chinook salmon in response to competition with other fish species, especially the abundant juvenile steelhead. However, the high degree of overlaps between juvenile steelhead and other benthic predators suggested that chironomid larvae were not limiting. If this was so, why didn't the salmon smolts also utilize the chironomid larvae resource to a greater degree? Perhaps it is a behavioral trait of the species to concentrate feeding effort on the pupae as they become available in the drift. This is not supported by the predominance of chironomid larvae in the winter diet of chinook from the upstream site nor its heavy secondary importance to the spring and summer food habits at the upstream and downstream sites. Few chironomid larvae would be expected in the drift at the downstream site due to the lentic habitat of the embayment. Because large numbers of both steelhead and chinook smolts were present in the lower creek during the spring and early summer, they represented the possible competing species. Interactive segregation did occur between these two abundant juvenile salmonids. The nonsalmonid species were not as abundant nor in such dense concentrations and thus may not be in the same degree of competition with these salmonids.

Juvenile coho salmon displayed no critical overlaps with the diets of any other fish species from the upstream site in spring. Even though only four fish were used in the analysis it is believed that the potential for competition with other species is small. The downstream migration of juvenile coho in Redwood Creek peaks earlier and occurs over a shorter span (Larson, personal communication) than the migration of either chinook salmon or steelhead trout (Larson et al. 1982, 1983). They also posed little threat as a competitor to nonsalmonids as they tended to move immediately out of the creek and into the ocean with little or no estuarine residence. Similar observations have been made for coho juveniles from other watersheds (Peck 1974; Myers 1980; Myers and Horton 1982).

As was stated in the results section, prickly sculpin exhibited a higher number of significant interspecific overlaps than any other fish species. At the upstream site prickly sculpin and adult sticklebacks had a significant overlap in their summer food habits when the prey items were pooled. The common use of ephemeropteran nymphs and chironomid larvae was largely responsible. At the downstream site, a number of significant overlaps were observed. The first instance was in the comparison of the spring food habits of prickly sculpin and juvenile sticklebacks when prey items had been pooled. The overlap resulted from, in large part, the common use of the chironomid larvae resource. The utilization of polychaetes, Corophium and chironomid pupae also helped the index attain the level of significance. The summer food habits of prickly sculpin and adult threespine sticklebacks from the downstream site also overlapped to a critical degree. The use of chironomid larvae, Corophium and eggs were responsible for the diet

overlap. On 24-25 June, prickly sculpin diet had significant overlaps with starry flounder, Humboldt sucker and adult threespine stickleback diets. In all three cases, chironomid larvae were the major contributor to the overlaps (Figure 3c, e, f and g). In the first and last cases the use of Corophium and eggs, respectively, added to the overlap. The last instance of significant diet overlap at the downstream site occurred in the diets of prickly sculpin and starry flounder in the fall because of the common use of the isopod, Gnorimosphaeroma oregonensis, and both species of Corophium.

Starry flounder and staghorn sculpin winter food habits significantly overlapped that of the prickly sculpin from the South Slough. In the case of the former species, the isopod, G. oregonensis, and the amphipod, A. confervicolus, were responsible for the overlap of with the prickly sculpin. These same items along with Corophium and dipteran larvae accounted for the overlap of prickly and staghorn sculpin diets. The overlap of the prickly and staghorn sculpin food habits from the South Slough when the winter and spring diets had been combined is a result of the greater influence of the winter diet on the pooled data. As was discussed in the previous case of significant overlap, the winter diets of these fish displayed significant overlaps, while the spring food habits did not (Table 7). Thus, this pooled season overlap was artificially induced and merits little more consideration.

Though no significant overlaps were noted for any between season comparison of staghorn sculpin and adult threespine sticklebacks food habits from the South Slough, when the fish of each species from all the seasons were totaled and compared, a significant overlap was generated.

This overlap was attributable to the common utilization of mysids, amphipods, isopods and diptera larvae. This particular case of significance points out the possibility of generating implied overlaps when data collected over long periods of time are pooled. For example, if fish species A utilizes prey organism X during spring and summer and prey organism Y during fall and winter, while fish species B consumes primarily prey organism Y in the spring and summer and prey organism X in the fall and winter. Seasonal analysis of the data would reveal no significant overlap of diet; however, if the data had been pooled over an entire year, significant overlaps could be interpreted and the investigator might be misled. The same problem exists for spatial considerations. For these indices to be truly meaningful, they should be generated from comparisons of the food habits of fish collected from the same dates and locations and should involve as little pooling as possible.

Chironomid larvae and the crustaceans, Corophium, G. oregonensis and N. mercedis, were all utilized to a degree that resulted in the significant overlap of the spring food habits of starry flounder and adult sticklebacks at the downstream site. Other cases of significant overlaps for pooled prey items involving starry flounder occurred when their 24-25 June food habits were compared to that of Humboldt suckers and adult threespine sticklebacks. In both of these comparisons the predominance of dipteran larvae in the food habits of these fish led to the critical overlap (Figure 3e, f and g).

The Humboldt suckers and juvenile threespine sticklebacks had two occurrences of meaningful diet overlap. The first was in spring at the downstream site. The mutual use of chironomid and ceratopogonid

larvae was responsible for this overlap. The second critical overlap was at the upstream site during the summer. It was again caused primarily by the use of chironomid larvae, along with the ephemeroptera nymph, Serratella levis.

Chironomid larvae were the sole prey item responsible for the significant overlaps of Humboldt sucker and threespine stickleback diets. These overlaps occurred for the 24-25 June downstream comparison (Figure 3f and g) and for the summer downstream comparison.

The last overlap of significance was the only one that occurred between juvenile and adult threespine sticklebacks (and so was actually a case of intraspecific diet overlap). The summer food habits of these fish from the upstream site showed a meaningful overlap when prey items were combined. The mutual use of chironomid larvae, ephemeropteran nymphs and acari were responsible for the critical value.

Andreasson (1971) pointed out that identity in food habits does not mean severe competition exists. The greatest overlaps in diets between sympatric species are usually noted during periods when there is a superabundance of food (Nilsson 1967; Zaret and Rand 1971; Mathur 1977; Myers 1980; McCabe et al. 1983). If a food resource that is being utilized in common among two or more species does become limiting, overlaps point to the possibility of competition, but resource partitioning may occur to reduce the competition. In Redwood Creek, the vast majority of the cases of significant overlap occurred during the summer when food resources were probably not limiting. Thus, the higher number of overlaps at this time suggested that there was an adequate supply of prey available to support all the fish species.

### Piscivory

In lower Redwood Creek salmonid predation upon other salmonids was observed when a larger two year old steelhead smolt had three chinook salmon smolts in its stomach. The only other instance of predation by a salmonid was that of an adult coastal cutthroat trout, Salmo clarki clarki, that was captured with the caudal fin of a juvenile salmonid protruding from its mouth (Larson et al. 1983). Though predation on salmonids by other salmonids was documented, it appeared to be an infrequent occurrence and insignificant part of the diet. As a result, this form of predation should not be a major concern when considering the management of mixed salmonid resources within lower Redwood Creek. Chapman and Quistorff (1938) investigated the diets of fishes in the central Columbia River drainage and found no cases of predation on salmonids by juvenile steelhead or chinook. Of the 1713 fish stomachs examined only four Dolly Varden, Salvelinus malma, stomachs contained any salmonid remains. They concluded that predation upon salmonids by salmonids was not a serious threat. Both McCabe et al. (1983) studying the diets of a variety of fish species, and Durkin (1982) investigating juvenile coho diets in particular, from the Columbia River estuary found predation upon juvenile salmonids by other salmonids or nonsalmonids was uncommon and not a significant part of any of the diets. Sibert and Kask (1977) studying chinook and coho diets from several British Columbian estuaries noted that chum salmon fry was an occasional but relatively unimportant food item. Pearce et al. (1982) and Engstrom-Heg (1968) studying the food habits of juvenile salmonids from estuaries in Washington, Myers (1980) and Nicholas and

Lorz (1984) investigating juvenile salmonid diets in Oregon estuaries found no evidence of any predation on salmonids by juvenile chinook or coho salmon.

Predation on nonsalmonids by juvenile salmon in Pacific Coast estuaries is well documented in the literature (Sibert and Kask 1977; Pearce et al. 1982; McCabe et al. 1983; Nicholas and Lorz 1984). Most of the prey were the larvae and juveniles of marine fishes, such as, the herring, Clupea harengus, the northern anchovy, Engraulis mordax, the sand lance, Ammodytes hexapterus, and various osmerids. Their importance to the diets of juvenile salmonids varied from being extremely important (Healey 1980; Myers 1980), to being insignificant (Ganssle 1966; Sasaki 1966; Engstrom-Heg 1968; Durkin 1982; Kjelson et al. 1982). In Redwood Creek, where the berm at the mouth of the creek limited oceanic influences (Gregory 1982), the larvae and juveniles of marine fish species were never encountered except in the food habits of the surf smelt in the fall after the berm had just been breached. Salmonid predation upon nonsalmonids was confined to the larvae and juveniles of the threespine stickleback and juvenile prickly sculpin. It was not believed that these fish provided a significant portion of the diet of the juvenile salmonids that were rearing in the lower creek. These nonsalmonids occurred in only 10 of the 162 juvenile salmonid stomachs examined (6 percent) and accounted for no more than 4 percent of the total IRI for any seasonal sample.

Predation on these same nonsalmonid species, as well as on stickleback eggs, by prickly sculpin, staghorn sculpin and threespine stickleback was also observed. Reports of the use of these and other nonsalmonid species has been documented for prickly sculpin (Munro and

Clemens 1937; Clemens et al. 1939; Northcote 1954; Millikan 1968), staghorn sculpin (Jones 1962; Porter 1964), and threespine stickleback (Hynes 1950; Rogers 1968; Semler 1971; Manzer 1976; Kynard 1978; Rowher 1978; Worgan and FitzGerald 1981; Snyder 1984). Nonsalmonid fish and eggs played an insignificant role in the food habits of the sculpins and sticklebacks in lower Redwood Creek, occurring in 14 of the 275 prickly sculpin, staghorn sculpin and adult threespine stickleback stomachs examined (5 percent). These food items rarely contributed significantly to the overall diet. Fish was a significant portion of the summer diet of prickly sculpin at the downstream site. One prickly sculpin (117mm TL) had consumed a clutch of stickleback (or prickly sculpin) eggs. The ova made up almost 8 percent of the total IRI (Figure 3c). The other exception was a prickly sculpin (102mm TL) that had consumed a 35mm TL prickly sculpin in the fall at the downstream site, but it still contributed less than 10 percent of the total diet index.

The last example of predation was on osmerid eggs and larvae. The former item occurred in the stomach contents of a staghorn sculpin during the summer, the latter items were consumed by surf smelt in the fall. In neither of the cases were the items of any significance to the food habits of the predator fish.

In summary, predation upon fishes by other fish in lower Redwood Creek was observed to occur, but was rarely a significant, and never more than a minor, component of the diet of any fish species.

## SUMMARY

1. Eleven species of fishes within the lower Redwood Creek watershed were examined for food habits from February to December, 1980. Seasonal and spatial intraspecific patterns were analyzed, as well as interspecific diet overlaps.
2. The importance of particular prey items to a fish diet was calculated by using an index of relative importance (IRI). A Chi square ( $X^2$ ) test of independence for diet homogeneity was used to test for the significance of diet variations. Comparisons of diet similarity, or overlap, were based upon the Schoener index ( $\alpha$ ).
3. The fishes of lower Redwood Creek relied almost entirely on autochthonous aquatic production for their food resources. The limited contribution to the food habits by terrestrial prey items was, at least partially, a result of the lack of riparian habitat along the main channel of lower Redwood Creek. Such productive areas were eliminated by levee construction.
4. The food habits of the fishes suggested that most of the species were benthic predators. The exception was juvenile chinook salmon, which appeared to rely more heavily on drift organisms.
5. The food habits of most fishes suggested opportunistic feeding strategies, except for the more specialized Humboldt sucker.
6. The freshwater species of fish captured at the upstream and downstream study areas fed most heavily on aquatic dipterans. The most

notable exception to this was the heavy utilization by steelhead trout and prickly sculpin of the abundant Corophium resource that was present in the embayment in the fall.

7. The euryhaline fish species relied more on benthic crustaceans throughout the study.

8. In the sloughs, all fish examined ate primarily crustaceans.

9. Most of the intraspecific food habit comparisons showed significant temporal and spatial variations, although there were a few cases of biologically significant diet overlaps between sites and between seasons. This variability was attributed to the diversity of the food habits of most of the fishes. The most notable exception to this variation in food habits was for the Humboldt sucker captured in the main channel of Redwood Creek. For this species, the almost sole reliance on chironomid larvae was responsible for the extreme similarity of diets.

10. Interspecific comparisons of diets of fishes captured at the same time and location were all judged to be statistically different.

Common utilization of certain food resources, mostly chironomid larvae or Corophium, by different species of fish resulted in some biologically significant overlaps of food habits. Most of the overlaps were between nonsalmonid fish species. There were no cases of biologically significant diet overlaps between any of the salmonids. This might not have been the case if the berm between the embayment and ocean had not been prematurely breached and the fish had been allowed to rear and compete in the embayment throughout the summer and fall.

11. Most of the biologically significant diet overlaps occurred during the summer when food was probably not a limiting factor.

12. Fish predation on other fishes within lower Redwood Creek was insignificant for all species examined.

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APPENDIX A. Taxonomic List of Prey Items and Their Dry Weights for Food Habit Study of Fishes of Lower Redwood Creek, February-December, 1980. Weights Were Determined from Actual Weights of Items, or Representatives from Benthos and Plankton Samples, Except Where Indicated Otherwise. (ew = Estimated Weight from a Prey Item of Similar Size and Shape; mw = Mean Weight from Other Organisms Within the Same Taxon; C = Weight Taken from Culver et al. 1985).

| TAXA                      | DRY WEIGHT (grams) |
|---------------------------|--------------------|
| Phylum Annelida           |                    |
| Class Polychaeta          |                    |
| Subclass Errantia         |                    |
| Family Nereidae           |                    |
| <u>Neanthes succinea</u>  | 1.77 x10-2         |
| Class Oligochaeta         | 1.65 x10-1         |
| Phylum Mollusca           |                    |
| Class Gastropoda*         |                    |
| Subclass Pulmonata        |                    |
| Order Bassomatophora      |                    |
| Family Lymnaeidae         |                    |
| <u>Lymnaea sp.</u>        | 1.14 x10-4         |
| Subclass Prosobranchia    |                    |
| Order Mesogastropoda      |                    |
| Family Bulimidae          |                    |
| <u>Amnicola sp.</u>       | 1.14 x10-4(ew)     |
| Class Pelecypoda          |                    |
| Order Anisomyaria         |                    |
| Family Mytilidae          |                    |
| <u>Musculus senhousia</u> | 3.92 x10-5(ew)     |
| Class Cephalopoda         |                    |
| Subclass Coleoidea        |                    |
| Order Octopoda            |                    |
| Family Octopodidae        |                    |
| <u>Octopus rubescens</u>  | 39.97 (ew)         |
| Phylum Arthropoda         |                    |
| Subphylum Chelicerata     |                    |
| Class Arachnida           |                    |
| Order Araneae             | 9.21 x10-3         |
| Order Acari               | 1.03 x10-4         |

APPENDIX A. Taxonomic List of Prey Items and Their Dry Weights for Food  
Habit Study of Fishes of Lower Redwood Creek, February-  
December, 1980. (continued)

| TAXA                               | DRY WEIGHT (grams) |
|------------------------------------|--------------------|
| Order Amphipoda                    |                    |
| Suborder Gammaridea                |                    |
| Family Corophiidae                 |                    |
| <u>Corophium salmonis</u>          |                    |
| adult                              | 1.19 x10-4         |
| juvenile                           | 8.0 x10-6          |
| <u>Corophium spinicorne</u>        |                    |
| adult                              | 1.63 x10-4         |
| Family Talitridae                  |                    |
| <u>Hyalella azteca</u>             | 1.14 x10-4         |
| Family Gammaridae                  |                    |
| <u>Anisogammarus confervicolus</u> | 9.26 x10-4         |
| Order Decapoda                     |                    |
| Decapod zoea                       | 8.9 x10-6(C)       |
| Suborder Natantia                  |                    |
| Family Crangonidae                 |                    |
| <u>Crangon franciscorum</u>        | 3.24 x10-1         |
| Suborder Reptantia                 |                    |
| Family Hippidae                    |                    |
| <u>Emerita analoga</u>             | 1.91               |
| Class Diplopoda                    |                    |
| Order Julida                       | 3.4 x10-3          |
| Class Insecta                      |                    |
| unidentified insect                | 4.31 x10-3(mw)     |
| Subclass Apterygota                |                    |
| Order Collembola                   | 8.9 x10-6(ew)      |
| Subclass Pterygota                 |                    |
| Order Ephemeroptera                |                    |
| unidentified nymph                 | 5.01 x10-4(mw)     |
| unidentified subimago              | 1.2 x10-3          |
| Family Siphonuridae                |                    |
| <u>Ameletus sp.</u>                |                    |
| nymph                              | 9.84 x10-4         |
| <u>Siphonurus sp.</u>              |                    |
| nymph                              | 9.84 x10-4(ew)     |

APPENDIX A. Taxonomic List of Prey Items and Their Dry Weights for Food  
Habit Study of Fishes of Lower Redwood Creek, February-  
December, 1980. (continued)

| TAXA                       | DRY WEIGHT (grams) |
|----------------------------|--------------------|
| Family Baetidae            |                    |
| <u>Baetis sp.</u>          |                    |
| nymph                      | 2.55 x10-4         |
| <u>Callibaetis sp.</u>     |                    |
| nymph                      | 1.84 x10-3         |
| Family Oligoneuriidae      |                    |
| <u>Isonychia sp.</u>       |                    |
| nymph                      | 1.84 x10-3(ew)     |
| Family Heptageniidae       |                    |
| <u>Heptagenia sp.</u>      |                    |
| nymph                      | 1.43 x10-4         |
| Family Ephemerellidae      |                    |
| <u>Ephemerella sp.</u>     |                    |
| nymph                      | 6.75 x10-4(ew)     |
| <u>Drunella flavilinea</u> |                    |
| nymph                      | 6.75 x10-4(ew)     |
| <u>Serratella levis</u>    |                    |
| nymph                      | 6.75 x10-4         |
| Family Tricorythidae       |                    |
| <u>Tricorythodes sp.</u>   |                    |
| nymph                      | 4.5 x10-4          |
| Order Odonata              |                    |
| Suborder Anisoptera        |                    |
| Family Aeshnidae           |                    |
| <u>Aeshna sp.</u>          |                    |
| naiad                      | 6.28 x10-2         |
| Suborder Zygoptera         |                    |
| Family Coenagrionidae      |                    |
| <u>Ischnura cervula</u>    |                    |
| naiad                      | 5.48 x10-3         |
| adult                      | 6.98 x10-3         |
| <u>Enallagma spp.</u>      |                    |
| naiad                      | 5.48 x10-3         |
| <u>Enallagma civile</u>    |                    |
| adult                      | 6.98 x10-3         |
| <u>Enallagma perparva</u>  |                    |
| adult                      | 6.98 x10-3         |

APPENDIX A. Taxonomic List of Prey Items and Their Dry Weights for Food  
Habit Study of Fishes of Lower Redwood Creek, February-  
December, 1980. (continued)

| TAXA                          | DRY WEIGHT (grams) |
|-------------------------------|--------------------|
| Order Plecoptera              |                    |
| unidentified nymph            | 8.09 x10-3(mw)     |
| Family Capniidae              |                    |
| <u>Capnia sp.</u>             |                    |
| nymph                         | 1.43 x10-4         |
| Family Perlidae               |                    |
| <u>Calineuria californica</u> |                    |
| nymph                         | 2.24 x10-2         |
| adult                         | 2.09 x10-2         |
| Family Perlodidae             |                    |
| <u>Isoperla sp.</u>           |                    |
| nymph                         | 1.47 x10-3         |
| Family Chloroperlidae         |                    |
| <u>Alloperla sp.</u>          |                    |
| nymph                         | 3.58 x10-4         |
| adult                         | 1.0 x10-3          |
| Order Psocoptera              |                    |
| adult                         | 1.99 x10-5(ew)     |
| Order Thysanoptera            |                    |
| adult                         | 1.99 x10-5(ew)     |
| Order Hemiptera               |                    |
| Suborder Hydrocorizae         |                    |
| Family Corixidae              |                    |
| unidentified adult            | 2.63 x10-3(mw)     |
| <u>Cenocorixa blaisdelli</u>  |                    |
| adult                         | 4.04 x10-3         |
| <u>Sigara mckinstryi</u>      |                    |
| nymph                         | 3.46 x10-4         |
| adult                         | 1.23 x10-3         |
| <u>Sigara vandykei</u>        |                    |
| nymph                         | 3.46 x10-4         |
| adult                         | 1.23 x10-3         |
| Family Notonectidae           |                    |
| <u>Notonecta shooteri</u>     |                    |
| nymph                         | 4.85 x10-3         |

APPENDIX A. Taxonomic List of Prey Items and Their Dry Weights for Food  
Habit Study of Fishes of Lower Redwood Creek, February-  
December, 1980. (continued)

| TAXA                     | DRY WEIGHT (grams) |
|--------------------------|--------------------|
| Suborder Amphibicorizae  |                    |
| Family Gerridae          |                    |
| <u>Gerris remigis</u>    |                    |
| nymph                    | 7.03 x10-3         |
| Family Saldidae          |                    |
| adult                    | 4.16 x10-4(ew)     |
| Suborder Geocorizae      |                    |
| Family Pentatomidae      |                    |
| adult                    | 8.2 x10-3(ew)      |
| Order Homoptera          |                    |
| unidentified adult       | 3.32 x10-4(mw)     |
| Suborder Auchenorrhyncha |                    |
| Family Membracidae       |                    |
| adult                    | 8.2 x10-3          |
| Family Cicadellidae      |                    |
| adult                    | 4.16 x10-4         |
| Suborder Stenorrhyncha   |                    |
| Family Psyllidae         |                    |
| adult                    | 4.16 x10-4(ew)     |
| Family Aphididae         |                    |
| adult                    | 8.07 x10-5         |
| Order Coleoptera         |                    |
| unidentified adult       | 4.5 x10-3(mw)      |
| Suborder Adephaga        |                    |
| Family Gyrinidae         |                    |
| <u>Gyrinus sp.</u>       |                    |
| larva                    | 3.0 x10-4(ew)      |
| Family Haliplidae        |                    |
| <u>Brychius sp.</u>      |                    |
| larva                    | 3.35 x10-4         |
| <u>Haliphus sp.</u>      |                    |
| larva                    | 3.35 x10-4         |

APPENDIX A. Taxonomic List of Prey Items and Their Dry Weights for Food  
Habit Study of Fishes of Lower Redwood Creek, February-  
December, 1980. (continued)

| TAXA                        | DRY WEIGHT (grams) |
|-----------------------------|--------------------|
| Family Dytiscidae           |                    |
| <u>Agabus sp.</u>           |                    |
| larva                       | 4.92 x10-4         |
| <u>Bidessus sp.</u>         |                    |
| adult                       | 1.13 x10-4(ew)     |
| <u>Deronectes sp.</u>       |                    |
| larva                       | 3.28 x10-4         |
| adult                       | 1.58 x10-3         |
| <u>Hydroporus sp.</u>       |                    |
| larva                       | 3.28 x10-4(ew)     |
| <u>Ilybius sp.</u>          |                    |
| larva                       | 4.92 x10-4         |
| Suborder Polyphaga          |                    |
| Family Hydrophilidae        |                    |
| unidentified larva          | 3.0 x10-4(ew)      |
| <u>Crenitis sp.</u>         |                    |
| adult                       | 1.13 x10-4(ew)     |
| <u>Enochrus sp.</u>         |                    |
| larva                       | 3.0 x10-3          |
| Family Staphylinidae        |                    |
| larva                       | 1.43 x10-4(ew)     |
| adult                       | 1.0 x10-4          |
| Family Elmidae              |                    |
| <u>Narpus sp.</u>           |                    |
| adult                       | 1.13 x10-4(ew)     |
| <u>Optioservus seriatus</u> |                    |
| larva                       | 1.43 x10-4         |
| adult                       | 1.13 x10-4         |
| <u>Zaitzevia sp.</u>        |                    |
| larva                       | 1.43 x10-4(ew)     |
| adult                       | 1.13 x10-4(ew)     |
| Family Elateridae           |                    |
| adult                       | 1.94 x10-2         |
| Family Anthicidae           |                    |
| adult                       | 8.23 x10-5         |
| Family Curculionidae        |                    |
| adult                       | 5.7 x10-3          |

APPENDIX A. Taxonomic List of Prey Items and Their Dry Weights for Food  
Habit Study of Fishes of Lower Redwood Creek, February-  
December, 1980. (continued)

| TAXA                            | DRY WEIGHT (grams) |
|---------------------------------|--------------------|
| Order Trichoptera**             |                    |
| unidentified larva              | 5.91 x10-3(mw)     |
| unidentified adult              | 8.4 x10-3(ew)      |
| Family Rhyacophilidae           |                    |
| <u>Rhyacophila sp.</u>          |                    |
| larva                           | 8.5 x10-3          |
| Family Glossosomatidae          |                    |
| <u>Protophila sp.</u>           |                    |
| larva                           | 3.83 x10-5(ew)     |
| Family Hydropsychidae           |                    |
| <u>Cheumatopsyche sp.</u>       |                    |
| larva                           | 2.07 x10-3(ew)     |
| <u>Hydropsyche sp.</u>          |                    |
| larva                           | 2.07 x10-3         |
| pupa                            | 3.0 x10-3          |
| Family Hydroptilidae            |                    |
| <u>Ochrotrichia sp.</u>         |                    |
| larva                           | 3.83 x10-5         |
| <u>Oxyethira sp.</u>            |                    |
| larva                           | 3.83 x10-5(ew)     |
| Family Limnephilidae            |                    |
| unidentified early instar larva | 4.07 x10-4(ew)     |
| unidentified pupa               | 2.06 x10-2         |
| unidentified adult              | 8.4 x10-3          |
| <u>Dicosmoecus sp.</u>          |                    |
| larva                           | 3.54 x10-2         |
| <u>Glyphopsyche sp.</u>         |                    |
| larva                           | 5.94 x10-3         |
| <u>Limnephilus sp.</u>          |                    |
| larva                           | 1.42 x10-2         |
| <u>Onocosmoecus sp.</u>         |                    |
| larva                           | 3.54 x10-2         |
| Family Odontocercidae           |                    |
| <u>Parthina sp.</u>             |                    |
| larva                           | 4.07 x10-4(ew)     |

APPENDIX A. Taxonomic List of Prey Items and Their Dry Weights for Food  
Habit Study of Fishes in Lower Redwood Creek, February-  
December, 1980. (continued)

| TAXA                     | DRY WEIGHT (grams) |
|--------------------------|--------------------|
| Family Lepidostomatidae  |                    |
| <u>Lepidostoma sp.</u>   |                    |
| larva                    | 4.07 x10-4         |
| pupa                     | 5.89 x10-4         |
| Family Brachycentridae   |                    |
| <u>Amiocentrus sp.</u>   |                    |
| larva                    | 4.07 x10-4(ew)     |
| <u>Brachycentrus sp.</u> |                    |
| larva                    | 4.07 x10-4(ew)     |
| Family Sericostomatidae  |                    |
| <u>Gumaga sp.</u>        |                    |
| larva                    | 4.07 x10-4(ew)     |
| Order Lepidoptera        |                    |
| early instar larva       | 3.83 x10-5(ew)     |
| adult                    | 8.4 x10-3          |
| Order Diptera            |                    |
| Suborder Nematocerca     |                    |
| Superfamily Tipuloidea   |                    |
| Family Tipulidae         |                    |
| larva                    | 2.42 x10-3         |
| pupa                     | 3.59 x10-2         |
| Superfamily Psychodoidea |                    |
| Family Psychodidae       |                    |
| larva                    | 1.67 x10-4(ew)     |
| adult                    | 6.12 x10-5(ew)     |
| Superfamily Culicoidea   |                    |
| Family Dixidae           |                    |
| <u>Dixa sp.</u>          |                    |
| larva                    | 4.28 x10-5         |
| Family Ceratopogonidae   |                    |
| larva                    | 8.01 x10-5         |
| pupa                     | 5.62 x10-5         |
| adult                    | 6.12 x10-5(ew)     |

APPENDIX A. Taxonomic List of Prey Items and Their Dry Weights for Food  
Habit Study of Fishes of Lower Redwood Creek, February-  
December, 1980. (continued)

| TAXA                        | DRY WEIGHT (grams) |
|-----------------------------|--------------------|
| Family Chironomidae         |                    |
| larva                       | 1.67 x10-4         |
| pupa                        | 1.28 x10-4         |
| adult                       | 6.12 x10-5         |
| Family Simuliidae           |                    |
| <u>Simulium sp.</u>         |                    |
| larva                       | 4.25 x10-4         |
| adult                       | 9.39 x10-5(ew)     |
| Superfamily Mycetophiloidea |                    |
| Family Cecidomyiidae        |                    |
| adult                       | 1.42 x10-5         |
| Family Sciaridae            |                    |
| adult                       | 1.42 x10-5         |
| Suborder Brachycerca        |                    |
| Superfamily Tabanoidea      |                    |
| Family Stratiomyiidae       |                    |
| <u>Euparyphus sp.</u>       |                    |
| larva                       | 9.33 x10-5         |
| Family Tabanidae            |                    |
| larva                       | 2.42 x10-3(ew)     |
| Superfamily Empidoidea      |                    |
| Family Empididae            |                    |
| larva                       | 1.5 x10-4          |
| adult                       | 9.39 x10-5(ew)     |
| Family Dolichopodidae       |                    |
| adult                       | 9.39 x10-5(ew)     |
| Suborder Cyclorrhapha       |                    |
| Superfamily Phoroidea       |                    |
| Family Phoridae             |                    |
| adult                       | 1.42 x10-5(ew)     |
| Superfamily Milichioidea    |                    |
| Family Sphaerocercidae      |                    |
| adult                       | 9.39 x10-5         |

APPENDIX A. Taxonomic List of Prey Items and Their Dry Weights for Food  
Habit Study of Fishes of Lower Redwood Creek, February-  
December, 1980. (continued)

| TAXA                        | DRY WEIGHT (grams) |
|-----------------------------|--------------------|
| Superfamily Drosophiloidea  |                    |
| Family Ephydriidae          |                    |
| larva                       | 1.5 x10-4(ew)      |
| pupa                        | 1.2 x10-4          |
| adult                       | 9.39 x10-5         |
| Family Drosophilidae        |                    |
| adult                       | 9.39 x10-5(ew)     |
| Superfamily Muscoidea       |                    |
| Family Muscidae             |                    |
| larva                       | 1.08 x10-3         |
| adult                       | 1.53 x10-4         |
| Order Hymenoptera           |                    |
| Suborder Apocrita           |                    |
| Superfamily Ichneumonoidea  |                    |
| Family Braconidae           |                    |
| adult                       | 2.85 x10-5         |
| Family Ichneumonidae        |                    |
| adult                       | 2.85 x10-5         |
| Superfamily Chalcidoidea    |                    |
| unidentified adult          | 2.85 x10-5(ew)     |
| Family Eurytomidae          |                    |
| adult                       | 2.85 x10-5         |
| Family Mymaridae            |                    |
| adult                       | 1.0 x10-5(ew)      |
| Family Pteromalidae         |                    |
| adult                       | 2.85 x10-5         |
| Superfamily Cynipoidea      |                    |
| Family Cynipidae            |                    |
| adult                       | 2.85 x10-5         |
| Superfamily Proctotrupoidea |                    |
| Family Cephronidae          |                    |
| adult                       | 2.85 x10-5         |

APPENDIX A. Taxonomic List of Prey Items and Their Dry Weights for Food  
Habit Study of Fishes of Lower Redwood Creek, February-  
December, 1980. (continued)

| TAXA                            | DRY WEIGHT (grams) |
|---------------------------------|--------------------|
| Superfamily Scolioidea          |                    |
| Family Formicidae               |                    |
| adult                           | 2.46 x10-3         |
| Superfamily Apoidea             |                    |
| unidentified adult              | 2.46 x10-3(ew)     |
| Phylum Chordata                 |                    |
| Subphylum Vertebrata            |                    |
| Class Osteichthys               |                    |
| Superorder Protacanthopterygii  |                    |
| Order Salmoniformes             |                    |
| Suborder Salmonoidei            |                    |
| Superfamily Salmonoidae         |                    |
| Family Salmonidae               |                    |
| <u>Oncorhynchus tshawytscha</u> |                    |
| smolt 77 mm FL                  | 2.93               |
| smolt 85 mm FL                  | 4.30               |
| smolt 95 mm FL                  | 6.77               |
| Superfamily Osmeroidae          |                    |
| Family Osmeridae                |                    |
| larva 10 mm TL                  | 5.6 x10-4(ew)      |
| Superorder Acanthopterygii      |                    |
| Order Gasterosteiformes         |                    |
| Family Gasterosteidae           |                    |
| <u>Gasterosteus aculeatus</u>   |                    |
| larva 11 mm TL                  | 5.6 x10-4          |
| juvenile 25 mm TL               | 2.42 x10-2         |
| adult 50 mm TL                  | 2.6 x10-1          |
| Order Scorpaeniformes           |                    |
| Suborder Cottoidei              |                    |
| Family Cottidae                 |                    |
| <u>Cottus asper</u>             |                    |
| juvenile 40 mm TL               | 1.08 x10-1         |
| Miscellaneous: Eggs             |                    |
| 0.5 mm diameter                 | 1.84 x10-5         |
| 1.0 mm diameter                 | 1.48 x10-4         |

\* weight includes shell

\*\* weight does not include case

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. n = sample size;  $\Sigma N$  = Total Number of Items in Stomach Contents;  $\Sigma W$  = Total Weight of Stomach Contents; %F = Percentage Frequency Prey Item Occurred in Stomachs; %N = Percentage of Total Number of Prey Item; — %W = Percentage of Total Weight of Prey Item; %W = Percentage of Mean Weight Per Stomach of Prey Item; IRI = Index of Relative Importance of Prey Item.

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Steelhead Trout Captured at Upstream Site During Spring; n= 7;  
 $\Sigma N$  = 88;  $\Sigma W$  = 0.0703565 grams

| Prey Item                           | %F    | %N    | %W    | —<br>%W | IRI     |
|-------------------------------------|-------|-------|-------|---------|---------|
| Unidentified Insect                 | 14.29 | 1.14  | 6.13  | 9.40    | 103.89  |
| <u>Ameletus</u> sp. nymph           | 14.29 | 1.14  | 1.40  | 0.60    | 36.30   |
| <u>Baetis</u> sp. nymph             | 14.29 | 1.14  | 0.36  | 1.61    | 21.44   |
| <u>Drunella flavilinea</u> nymph    | 14.29 | 3.41  | 2.88  | 11.34   | 89.88   |
| <u>Calineuria californica</u> nymph | 28.57 | 2.27  | 63.76 | 27.89   | 1886.48 |
| <u>Alloperla</u> sp. nymph          | 28.57 | 3.41  | 1.53  | 3.57    | 141.14  |
| <u>Sigara vandykei</u> adult        | 14.29 | 3.41  | 5.24  | 2.68    | 123.61  |
| <u>Crenitis</u> sp. adult           | 14.29 | 1.14  | 0.16  | 0.22    | 18.58   |
| <u>Optioservus seriatus</u> larva   | 28.57 | 4.55  | 0.81  | 0.91    | 153.14  |
| <u>Zaitzevia</u> sp. adult          | 14.29 | 1.14  | 0.16  | 0.27    | 18.58   |
| Chironomidae larva                  | 71.43 | 38.64 | 8.07  | 25.87   | 3336.50 |
| Chironomidae pupa                   | 42.86 | 37.50 | 6.00  | 10.96   | 1864.41 |
| Formicidae adult                    | 14.29 | 1.14  | 3.50  | 4.70    | 66.31   |

Steelhead Trout Captured at Upstream Site During Summer; n=12;  
 $\Sigma N$  = 691;  $\Sigma W$  = 0.2151742 grams

| Prey Item                        | %F    | %N   | %W    | —<br>%W | IRI    |
|----------------------------------|-------|------|-------|---------|--------|
| Acari                            | 16.67 | 0.29 | 0.10  | 0.06    | 6.50   |
| Unidentified Insect              | 8.33  | 0.14 | 2.00  | 0.38    | 17.83  |
| Unidentified Ephemeroptera nymph | 33.33 | 2.03 | 3.26  | 2.17    | 176.32 |
| <u>Ameletus</u> sp. nymph        | 8.33  | 0.58 | 1.83  | 0.34    | 20.08  |
| <u>Siphonurus</u> sp. nymph      | 25.00 | 2.17 | 6.86  | 4.97    | 225.75 |
| <u>Baetis</u> sp. nymph          | 25.00 | 0.58 | 0.47  | 0.50    | 26.25  |
| <u>Isonychia</u> sp. nymph       | 8.33  | 0.14 | 0.85  | 0.97    | 8.25   |
| <u>Heptagenia</u> sp. nymph      | 8.33  | 0.14 | 0.07  | 0.04    | 1.75   |
| <u>Drunella flavilinea</u> nymph | 16.67 | 0.43 | 0.94  | 0.86    | 22.84  |
| <u>Serratella levis</u> nymph    | 50.00 | 4.78 | 10.35 | 32.25   | 756.50 |
| <u>Tricorythodes</u> sp. nymph   | 25.00 | 0.72 | 1.05  | 1.97    | 44.25  |
| <u>Alloperla</u> sp. nymph       | 25.00 | 0.58 | 0.67  | 2.30    | 31.25  |
| <u>Sigara vandykei</u> adult     | 8.33  | 0.14 | 0.57  | 0.31    | 5.91   |
| Saldidae adult                   | 8.33  | 0.14 | 0.19  | 0.16    | 2.75   |
| <u>Deronectes</u> sp. adult      | 8.33  | 0.14 | 0.74  | 0.83    | 7.33   |
| <u>Deronectes</u> sp. larva      | 8.33  | 0.14 | 0.15  | 0.03    | 2.42   |
| Staphylinidae adult              | 8.33  | 0.14 | 0.05  | 0.04    | 1.58   |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Steelhead Trout Captured at Upstream Site During Summer (continued)

| Prey Item                              | %F    | %N    | %W    | %W    | IRI     |
|----------------------------------------|-------|-------|-------|-------|---------|
| <u>Optioservus seriatus</u> adult      | 8.33  | 0.14  | 0.05  | 0.06  | 1.58    |
| <u>Zaitzevia</u> sp. adult             | 8.33  | 0.14  | 0.05  | 0.06  | 1.58    |
| <u>Hydropsyche</u> sp. pupa            | 16.67 | 0.29  | 2.79  | 3.55  | 51.34   |
| <u>Ochrotrichia</u> sp. larva          | 50.00 | 19.39 | 2.39  | 4.48  | 1089.00 |
| <u>Oxyethira</u> sp. larva             | 8.33  | 0.43  | 0.05  | 0.06  | 4.00    |
| <u>Lepidostoma</u> sp. larva           | 8.33  | 0.14  | 0.19  | 0.21  | 2.75    |
| <u>Lepidostoma</u> sp. pupa            | 8.33  | 0.14  | 0.27  | 0.65  | 3.42    |
| <u>Amiocentrus</u> sp. larva           | 8.33  | 0.14  | 0.19  | 0.04  | 2.75    |
| Tipulidae larva                        | 8.33  | 0.14  | 1.12  | 0.21  | 10.50   |
| Tipulidae pupa                         | 8.33  | 0.14  | 16.68 | 3.13  | 140.11  |
| Psychodidae larva                      | 8.33  | 0.14  | 0.08  | 0.09  | 1.83    |
| Ceratopogonidae larva                  | 33.33 | 2.03  | 0.52  | 0.36  | 84.99   |
| Ceratopogonidae pupa                   | 8.33  | 0.14  | 0.03  | 0.04  | 1.42    |
| Chironomidae larva                     | 75.00 | 39.22 | 21.03 | 16.92 | 4518.75 |
| Chironomidae pupa                      | 83.33 | 21.42 | 8.80  | 13.05 | 2518.23 |
| Chironomidae adult                     | 16.67 | 0.43  | 0.09  | 0.19  | 8.67    |
| Empididae larva                        | 8.33  | 0.14  | 0.07  | 0.01  | 1.75    |
| Ephydriidae adult                      | 8.33  | 0.87  | 0.26  | 0.05  | 9.41    |
| Muscidae larva                         | 16.67 | 0.43  | 1.51  | 1.40  | 32.34   |
| Muscidae adult                         | 16.67 | 0.29  | 0.14  | 0.28  | 7.17    |
| Formicidae adult                       | 16.67 | 0.29  | 2.29  | 4.88  | 43.01   |
| <u>Gasterosteus aculeatus</u> juvenile | 8.33  | 0.14  | 11.25 | 2.11  | 94.88   |

Steelhead Trout Captured at Upstream Site on 17 June; n = 3;  
 EN = 190;  $\Sigma W = 0.1100167$  grams

| Prey Item                        | %F    | %N   | %W    | %W    | IRI     |
|----------------------------------|-------|------|-------|-------|---------|
| Acari                            | 33.33 | 0.53 | 0.09  | 0.04  | 20.66   |
| Unidentified insect              | 33.33 | 0.53 | 3.92  | 1.50  | 148.32  |
| Unidentified Ephemeroptera nymph | 66.67 | 2.11 | 1.86  | 3.10  | 264.68  |
| <u>Ameletus</u> sp. nymph        | 33.33 | 2.11 | 3.58  | 1.37  | 189.65  |
| <u>Baetis</u> sp. nymph          | 66.67 | 1.05 | 0.46  | 1.20  | 100.67  |
| <u>Drunella flavilinea</u> nymph | 66.67 | 1.58 | 1.84  | 3.43  | 228.01  |
| <u>Serratella levis</u> nymph    | 33.33 | 0.53 | 0.61  | 2.96  | 38.00   |
| <u>Alloperla</u> sp. nymph       | 33.33 | 0.53 | 0.33  | 2.25  | 28.66   |
| <u>Deronectes</u> sp. larva      | 33.33 | 0.53 | 0.30  | 0.11  | 27.66   |
| <u>Hydropsyche</u> sp. pupa      | 66.67 | 1.05 | 5.45  | 14.19 | 433.36  |
| <u>Ochrotrichia</u> sp. larva    | 33.33 | 2.63 | 0.17  | 0.07  | 93.32   |
| <u>Lepidostoma</u> sp. pupa      | 33.33 | 0.53 | 0.54  | 2.58  | 35.66   |
| <u>Brachycentrus</u> sp. larva   | 33.33 | 0.53 | 0.37  | 0.14  | 30.00   |
| Tipulidae larva                  | 33.33 | 0.53 | 2.20  | 0.84  | 90.99   |
| Tipulidae pupa                   | 33.33 | 0.53 | 32.63 | 12.50 | 1105.22 |
| Ceratopogonidae larva            | 33.33 | 0.53 | 0.07  | 0.03  | 20.00   |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Steelhead Trout Captured at Upstream Site on 17 June (continued)

| Prey Item                           | %F     | %N    | %W    | %W    | IRI     |
|-------------------------------------|--------|-------|-------|-------|---------|
| Chironomidae larva                  | 100.00 | 48.42 | 13.97 | 8.28  | 6239.00 |
| Chironomidae pupa                   | 100.00 | 29.47 | 6.52  | 20.95 | 3599.00 |
| Chironomidae adult                  | 33.33  | 1.05  | 0.11  | 0.54  | 38.66   |
| Empididae larva                     | 33.33  | 0.53  | 0.14  | 0.05  | 22.33   |
| Ephydriidae adult                   | 33.33  | 3.16  | 0.51  | 0.20  | 122.32  |
| Muscidae adult                      | 33.33  | 0.53  | 0.14  | 0.89  | 22.33   |
| Formicidae adult                    | 33.33  | 0.53  | 2.24  | 14.36 | 92.32   |
| <u>Gasterosteus aculeatus</u> adult | 33.33  | 0.53  | 22.00 | 8.43  | 750.92  |

Steelhead Trout Captured at Upstream Site During Summer After the Berm Had Been Breached; n= 9;  $\Sigma N = 502$ ;  $\Sigma W = 0.1056586$  grams

| Prey Item                         | %F    | %N    | %W    | %W    | IRI     |
|-----------------------------------|-------|-------|-------|-------|---------|
| Acari                             | 11.11 | 0.20  | 0.10  | 0.07  | 3.33    |
| Unidentified Ephemeroptera nymph  | 22.22 | 2.19  | 5.22  | 2.63  | 164.65  |
| <u>Siphonurus</u> sp. nymph       | 33.33 | 2.99  | 13.96 | 6.62  | 564.94  |
| <u>Baetis</u> sp. nymph           | 11.11 | 0.40  | 0.48  | 0.27  | 9.78    |
| <u>Isonychia</u> sp. nymph        | 11.11 | 0.20  | 1.74  | 1.29  | 21.55   |
| <u>Heptagenia</u> sp. nymph       | 11.11 | 0.20  | 0.13  | 0.05  | 3.67    |
| <u>Serratella levis</u> nymph     | 55.56 | 6.37  | 20.44 | 42.01 | 1489.56 |
| <u>Tricorythodes</u> sp. nymph    | 33.33 | 1.00  | 2.13  | 2.63  | 104.32  |
| <u>Alloperla</u> sp. nymph        | 22.22 | 0.60  | 1.02  | 2.32  | 36.00   |
| <u>Sigara vandykei</u> adult      | 11.11 | 0.20  | 1.16  | 0.41  | 15.11   |
| Saldidae adult                    | 11.11 | 0.20  | 0.39  | 0.22  | 6.55    |
| <u>Deronectes</u> sp. adult       | 11.11 | 0.20  | 1.50  | 1.11  | 18.99   |
| Staphylinidae adult               | 11.11 | 0.20  | 0.09  | 0.05  | 3.22    |
| <u>Optioservus seriatus</u> adult | 11.11 | 0.20  | 0.11  | 0.08  | 3.44    |
| <u>Zaitzevia</u> sp. adult        | 11.11 | 0.20  | 0.11  | 0.08  | 3.44    |
| <u>Ochrotrichia</u> sp. larva     | 55.56 | 25.70 | 4.68  | 5.95  | 1687.91 |
| <u>Oxyethira</u> sp. larva        | 11.11 | 0.06  | 0.11  | 0.08  | 7.89    |
| <u>Lepidostoma</u> sp. larva      | 11.11 | 0.20  | 0.38  | 0.29  | 6.44    |
| Psychodidae larva                 | 11.11 | 0.20  | 0.16  | 0.12  | 4.00    |
| Ceratopogonidae larva             | 33.33 | 2.59  | 0.99  | 0.47  | 119.32  |
| Ceratopogonidae pupa              | 11.11 | 0.20  | 0.05  | 0.06  | 2.78    |
| Chironomidae larva                | 66.67 | 35.66 | 28.29 | 19.80 | 4263.55 |
| Chironomidae pupa                 | 77.78 | 18.33 | 11.15 | 10.41 | 2292.95 |
| Chironomidae adult                | 11.11 | 0.20  | 0.06  | 0.08  | 2.89    |
| Muscidae larva                    | 22.22 | 0.60  | 3.08  | 1.87  | 81.77   |
| Muscidae adult                    | 11.11 | 0.20  | 0.14  | 0.08  | 7.55    |
| Formicidae adult                  | 11.11 | 0.20  | 2.33  | 1.73  | 28.11   |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Steelhead Trout Captured at Downstream Site During Spring; n= 6;  
 EN = 178; ΣW = 2.1936807 grams

| Prey Item                           | %F    | %N    | %W     | %W    | IRI     |
|-------------------------------------|-------|-------|--------|-------|---------|
| Araneae                             | 16.67 | 0.56  | 0.420  | 0.08  | 16.34   |
| <u>Neomysis mercedis</u>            | 33.33 | 1.12  | 0.074  | 1.20  | 39.80   |
| <u>Gnorimosphaeroma oregonensis</u> | 16.67 | 0.56  | 0.067  | 2.16  | 10.45   |
| <u>Corophium spinicorne</u>         | 33.33 | 23.60 | 0.312  | 13.06 | 769.99  |
| <u>Anisogammarus confervicolus</u>  | 33.33 | 1.12  | 0.084  | 1.37  | 40.13   |
| <u>Emerita analoga</u>              | 16.67 | 0.56  | 86.936 | 16.33 | 1458.56 |
| Julida adult                        | 33.33 | 1.12  | 0.310  | 5.04  | 47.66   |
| <u>Siphonurus</u> sp. nymph         | 33.33 | 4.49  | 0.359  | 2.74  | 161.62  |
| <u>Baetis</u> sp. nymph             | 16.67 | 1.12  | 0.023  | 0.06  | 19.05   |
| <u>Serratella levis</u> nymph       | 33.33 | 1.69  | 0.092  | 1.61  | 59.39   |
| <u>Calineuria californica</u> nymph | 16.67 | 0.56  | 1.022  | 5.03  | 26.37   |
| <u>Isoperla</u> sp. nymph           | 16.67 | 1.69  | 0.201  | 0.04  | 31.52   |
| <u>Alloperla</u> sp. nymph          | 16.67 | 1.12  | 0.033  | 0.11  | 19.22   |
| Cicadellidae adult                  | 16.67 | 0.56  | 0.019  | 0.003 | 9.65    |
| Unidentified Coleoptera adult       | 16.67 | 0.56  | 0.205  | 1.01  | 12.75   |
| <u>Optioservus seriatus</u> larva   | 16.67 | 0.56  | 0.007  | 0.002 | 9.45    |
| Elateridae adult                    | 16.67 | 0.56  | 0.885  | 0.17  | 24.09   |
| <u>Cheumatopsyche</u> sp. larva     | 16.67 | 0.56  | 0.094  | 0.78  | 10.90   |
| <u>Dicosmoecus</u> sp. larva        | 50.00 | 2.81  | 8.074  | 37.62 | 544.20  |
| Tipulidae larva                     | 16.67 | 0.56  | 0.110  | 3.57  | 11.17   |
| Ceratopogonidae larva               | 33.33 | 1.69  | 0.011  | 0.16  | 56.69   |
| Ceratopogonidae pupa                | 16.67 | 0.56  | 0.003  | 0.01  | 9.39    |
| Chironomidae larva                  | 66.67 | 35.96 | 0.487  | 5.23  | 2429.92 |
| Chironomidae pupa                   | 50.00 | 11.24 | 0.117  | 1.07  | 567.85  |
| Chironomidae adult                  | 16.67 | 1.12  | 0.006  | 0.03  | 18.77   |
| Empididae larva                     | 16.67 | 3.93  | 0.048  | 1.55  | 66.31   |

Steelhead Trout Captured at Downstream Site During Summer; n=36;  
 EN = 2521; ΣW = 14.6635427 grams

| Prey Item                           | %F    | %N    | %W    | %W    | IRI     |
|-------------------------------------|-------|-------|-------|-------|---------|
| Araneae                             | 5.56  | 0.16  | 0.251 | 3.11  | 2.29    |
| Acari                               | 13.89 | 0.28  | 0.005 | 0.09  | 3.96    |
| <u>Neomysis mercedis</u>            | 11.11 | 0.75  | 0.105 | 3.74  | 9.50    |
| <u>Corophium salmonis</u>           | 30.56 | 4.20  | 0.086 | 5.52  | 130.98  |
| <u>Corophium spinicorne</u>         | 61.11 | 22.57 | 0.633 | 24.88 | 1417.94 |
| <u>Anisogammarus confervicolus</u>  | 5.56  | 0.08  | 0.013 | 0.38  | 0.52    |
| Unidentified Ephemeroptera nymph    | 5.56  | 0.28  | 0.024 | 0.35  | 1.69    |
| <u>Siphonurus</u> sp. nymph         | 2.78  | 0.08  | 0.013 | 0.21  | 0.26    |
| <u>Serratella levis</u> nymph       | 13.89 | 0.79  | 0.092 | 5.50  | 12.25   |
| <u>Aeshna</u> sp. nymph             | 2.78  | 0.04  | 0.428 | 2.03  | 1.30    |
| <u>Calineuria californica</u> nymph | 2.78  | 0.04  | 0.153 | 0.72  | 0.54    |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Steelhead Trout Captured at Downstream Site During Summer (continued)

| Prey Item                             | %F    | %N    | %W     | %W    | IRI     |
|---------------------------------------|-------|-------|--------|-------|---------|
| <u>Alloperla</u> sp. nymph            | 5.56  | 0.12  | 0.007  | 0.22  | 0.71    |
| Thysanoptera adult                    | 2.78  | 0.04  | 0.001  | 0.003 | 0.11    |
| Cicadellidae adult                    | 2.78  | 0.04  | 0.003  | 0.15  | 0.12    |
| Unidentified Coleoptera adult         | 5.56  | 0.08  | 0.061  | 2.65  | 0.78    |
| <u>Brychius</u> sp. larva             | 2.78  | 0.04  | 0.002  | 0.11  | 0.12    |
| <u>Bidessus</u> sp. larva             | 2.78  | 0.04  | 0.001  | 0.06  | 0.11    |
| <u>Deronectes</u> sp. larva           | 2.78  | 0.04  | 0.002  | 0.01  | 0.12    |
| <u>Deronectes</u> sp. adult           | 2.78  | 0.04  | 0.011  | 0.23  | 0.14    |
| Staphylinidae larva                   | 2.78  | 0.04  | 0.001  | 0.02  | 0.11    |
| Staphylinidae adult                   | 2.78  | 0.04  | 0.001  | 0.02  | 0.11    |
| <u>Narpus</u> sp. adult               | 2.78  | 0.04  | 0.001  | 0.09  | 0.11    |
| <u>Optioservus seriatus</u> larva     | 5.56  | 0.79  | 0.020  | 0.90  | 4.50    |
| <u>Optioservus seriatus</u> adult     | 13.89 | 0.36  | 0.007  | 0.35  | 5.10    |
| Anthicidae adult                      | 2.78  | 0.08  | 0.001  | 0.04  | 0.23    |
| <u>Ochrotrichia</u> sp. larva         | 5.56  | 0.28  | 0.002  | 0.03  | 1.57    |
| <u>Oxyethira</u> sp. larva            | 11.11 | 0.24  | 0.002  | 0.05  | 2.69    |
| <u>Gumaga</u> sp. larva               | 2.78  | 0.04  | 0.003  | 0.07  | 0.12    |
| Lepidoptera adult                     | 5.56  | 0.08  | 0.115  | 2.79  | 1.08    |
| Tipulidae larva                       | 2.78  | 0.12  | 0.050  | 0.78  | 0.47    |
| Psychodidae larva                     | 8.33  | 0.12  | 0.003  | 0.12  | 1.02    |
| Ceratopogonidae larva                 | 44.44 | 5.63  | 0.078  | 2.41  | 253.66  |
| Ceratopogonidae pupa                  | 13.89 | 3.17  | 0.031  | 0.73  | 44.46   |
| Ceratopogonidae adult                 | 8.33  | 0.12  | 0.001  | 0.03  | 1.01    |
| Chironomidae larva                    | 69.44 | 38.99 | 1.120  | 24.93 | 2785.24 |
| Chironomidae pupa                     | 63.89 | 18.25 | 0.402  | 12.87 | 1191.68 |
| Chironomidae adult                    | 13.89 | 0.99  | 0.010  | 0.21  | 13.89   |
| <u>Simulium</u> sp. larva             | 2.78  | 0.12  | 0.009  | 0.14  | 0.36    |
| <u>Euparyphus</u> sp. larva           | 5.56  | 0.12  | 0.002  | 0.04  | 0.68    |
| Phoridae adult                        | 2.78  | 0.04  | 0.001  | 0.002 | 0.11    |
| Ephydriidae larva                     | 2.78  | 0.04  | 0.001  | 0.08  | 0.11    |
| Ephydriidae adult                     | 8.33  | 0.28  | 0.004  | 0.13  | 2.37    |
| Braconidae adult                      | 5.56  | 0.08  | 0.001  | 0.01  | 0.45    |
| Formicidae adult                      | 2.78  | 0.04  | 0.017  | 0.40  | 0.16    |
| <u>Oncorhynchus tshawytscha</u> smolt | 2.78  | 0.12  | 95.493 | 2.76  | 265.80  |
| <u>Cottus asper</u> juvenile          | 2.78  | 0.04  | 0.738  | 0.02  | 2.16    |
| Unidentified egg (0.5mm)              | 2.78  | 0.04  | 0.001  | 0.005 | 0.11    |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Steelhead Trout Captured at Downstream Site During Fall; n= 7;

ΣN = 5747; ΣW = 1.4011516 grams

| Prey Item                           | %F     | %N    | %W    | %W    | IRI      |
|-------------------------------------|--------|-------|-------|-------|----------|
| <u>Neanthes succinea</u>            | 14.29  | 0.02  | 1.26  | 0.79  | 18.29    |
| Acari                               | 28.57  | 0.03  | 0.01  | 0.08  | 1.14     |
| <u>Eurytemora</u> sp.               | 14.29  | 0.02  | 0.01  | 0.001 | 0.43     |
| <u>Neomysis mercedis</u>            | 42.86  | 0.44  | 1.44  | 12.81 | 80.58    |
| <u>Gnorimosphaeroma oregonensis</u> | 57.14  | 0.75  | 4.49  | 4.24  | 299.41   |
| <u>Corophium salmonis</u>           | 71.43  | 1.84  | 0.90  | 1.66  | 195.72   |
| <u>Corophium spinicorne</u>         | 100.00 | 87.99 | 58.83 | 36.41 | 14682.00 |
| <u>Anisogammarus confervicolus</u>  | 57.14  | 0.68  | 2.58  | 5.86  | 186.28   |
| Crab zoea                           | 14.29  | 0.02  | 0.01  | 0.003 | 0.43     |
| <u>Alloperla</u> sp. adult          | 14.29  | 2.77  | 11.35 | 13.24 | 201.77   |
| Psocoptera adult                    | 14.29  | 0.02  | 0.01  | 0.001 | 0.43     |
| <u>Sigara vandykei</u> adult        | 14.29  | 0.02  | 0.09  | 2.88  | 1.57     |
| Cicadellidae adult                  | 28.57  | 0.03  | 0.06  | 0.04  | 2.57     |
| Aphididae adult                     | 14.29  | 0.02  | 0.01  | 0.001 | 0.43     |
| <u>Brychius</u> sp. larva           | 14.29  | 0.14  | 0.19  | 0.07  | 4.72     |
| <u>Deronectes</u> sp. larva         | 14.29  | 0.02  | 0.02  | 0.77  | 0.57     |
| <u>Narpus</u> sp. adult             | 14.29  | 0.03  | 0.02  | 0.06  | 0.71     |
| <u>Optioservus seriatus</u> larva   | 42.86  | 0.07  | 0.04  | 0.21  | 4.71     |
| <u>Optioservus seriatus</u> adult   | 14.29  | 0.02  | 0.01  | 0.01  | 0.43     |
| <u>Oxyethira</u> sp. larva          | 42.86  | 0.33  | 0.05  | 1.54  | 16.29    |
| Ceratopogonidae larva               | 57.14  | 1.27  | 0.42  | 0.39  | 96.57    |
| Ceratopogonidae pupa                | 14.29  | 0.02  | 0.01  | 0.13  | 0.43     |
| Chironomidae larva                  | 85.71  | 0.56  | 0.38  | 3.50  | 80.57    |
| Chironomidae pupa                   | 71.43  | 2.07  | 1.09  | 5.69  | 225.72   |
| Empididae larva                     | 14.29  | 0.02  | 0.01  | 0.35  | 0.43     |
| Sciaridae adult                     | 14.29  | 0.02  | 0.01  | 0.001 | 0.43     |
| Ephydriidae adult                   | 14.29  | 0.61  | 0.23  | 0.27  | 12.00    |
| Drosophilidae adult                 | 14.29  | 0.02  | 0.01  | 0.001 | 0.43     |
| Braconidae adult                    | 14.29  | 0.02  | 0.01  | 0.001 | 0.43     |
| Cynipidae adult                     | 14.29  | 0.02  | 0.01  | 0.003 | 0.43     |
| Formicidae adult                    | 42.86  | 0.10  | 1.05  | 2.05  | 49.29    |
| <u>Cottus asper</u> juvenile        | 28.57  | 0.03  | 15.44 | 6.93  | 441.98   |

Steelhead Trout Captured at Downstream Site on 24-25 June (=Preberm Summer); n=13; ΣN = 1211; ΣW = 14.3238987

| Prey Item                        | %F    | %N   | %W    | %W   | IRI   |
|----------------------------------|-------|------|-------|------|-------|
| Acari                            | 15.38 | 0.25 | 0.002 | 0.09 | 3.88  |
| <u>Neomysis mercedis</u>         | 15.38 | 0.17 | 0.011 | 2.40 | 2.78  |
| <u>Corophium spinicorne</u>      | 30.77 | 0.41 | 0.006 | 0.80 | 12.80 |
| Unidentified Ephemeroptera nymph | 15.38 | 0.58 | 0.024 | 0.98 | 9.29  |
| <u>Siphonurus</u> sp. nymph      | 7.69  | 0.17 | 0.014 | 0.59 | 1.41  |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Steelhead Trout Captured at Downstream Site on 24-25 June (=Preberm Summer); (continued)

| Prey Item                             | %F    | %N    | %W     | %W    | IRI     |
|---------------------------------------|-------|-------|--------|-------|---------|
| unidentified Coleoptera adult         | 15.38 | 0.17  | 0.063  | 7.33  | 3.58    |
| <u>Bidessus</u> sp. adult             | 7.69  | 0.08  | 0.001  | 0.17  | 0.62    |
| <u>Deronectes</u> sp. adult           | 7.69  | 0.08  | 0.011  | 0.65  | 0.70    |
| <u>Optioservus seriatus</u> larva     | 7.69  | 0.41  | 0.005  | 1.09  | 3.19    |
| <u>Optioservus seriatus</u> adult     | 23.08 | 0.50  | 0.005  | 0.48  | 11.66   |
| Anthicidae adult                      | 7.69  | 0.17  | 0.001  | 0.11  | 1.31    |
| <u>Ochrotrichia</u> sp. larva         | 15.38 | 0.58  | 0.002  | 0.08  | 8.95    |
| <u>Oxyethira</u> sp. larva            | 23.08 | 0.41  | 0.001  | 0.13  | 9.49    |
| Lepidoptera adult                     | 7.69  | 0.08  | 0.059  | 2.25  | 1.07    |
| Tipulidae larva                       | 7.69  | 0.25  | 0.051  | 2.17  | 2.31    |
| Psychodidae larva                     | 15.38 | 0.17  | 0.002  | 0.30  | 2.65    |
| Ceratopogonidae larva                 | 69.23 | 8.67  | 0.059  | 5.10  | 604.31  |
| Ceratopogonidae adult                 | 7.69  | 0.08  | 0.001  | 0.02  | 0.62    |
| Chironomidae larva                    | 92.31 | 72.75 | 1.027  | 52.78 | 6810.35 |
| Chironomidae pupa                     | 76.92 | 11.15 | 0.121  | 13.50 | 866.97  |
| Chironomidae adult                    | 15.38 | 1.57  | 0.008  | 0.34  | 24.27   |
| <u>Simulium</u> sp. larva             | 7.69  | 0.25  | 0.009  | 0.38  | 1.99    |
| Phoridae adult                        | 7.69  | 0.08  | 0.001  | 0.01  | 0.62    |
| Ephydriidae larva                     | 7.69  | 0.08  | 0.001  | 0.23  | 0.62    |
| Ephydriidae adult                     | 15.38 | 0.50  | 0.004  | 0.34  | 7.75    |
| Braconidae adult                      | 7.69  | 0.08  | 0.001  | 0.01  | 0.62    |
| <u>Oncorhynchus tshawytscha</u> smolt | 7.69  | 0.25  | 97.758 | 7.63  | 753.68  |
| <u>Cottus asper</u> juvenile          | 7.69  | 0.08  | 0.755  | 0.06  | 6.42    |

Steelhead Trout Captured at Downstream Site on 7 July; n= 9;  $\Sigma N$  = 582;  $\Sigma W$  = 0.1325823 grams

| Prey Item                          | %F    | %N   | %W    | %W    | IRI    |
|------------------------------------|-------|------|-------|-------|--------|
| Araneae                            | 22.22 | 0.69 | 27.79 | 12.44 | 632.83 |
| Acari                              | 33.33 | 0.69 | 0.31  | 0.22  | 33.33  |
| <u>Neomysis mercedis</u>           | 22.22 | 2.92 | 10.35 | 11.48 | 294.86 |
| <u>Corophium salmonis</u>          | 22.22 | 0.34 | 0.18  | 0.17  | 11.55  |
| <u>Corophium spinicorne</u>        | 66.67 | 3.44 | 2.46  | 3.01  | 393.35 |
| <u>Anisogammarus confervicolus</u> | 11.11 | 0.17 | 0.70  | 0.32  | 9.67   |
| <u>Serratella levis</u> nymph      | 44.44 | 3.09 | 9.16  | 17.49 | 544.39 |
| <u>Alloperla</u> sp. nymph         | 22.22 | 0.52 | 0.81  | 0.89  | 29.55  |
| Thysanoptera adult                 | 11.11 | 0.17 | 0.02  | 0.01  | 2.11   |
| Cicadellidae adult                 | 11.11 | 0.17 | 0.31  | 0.59  | 5.33   |
| Staphylinidae larva                | 11.11 | 0.17 | 0.11  | 0.09  | 3.11   |
| <u>Oxyethira</u> sp. adult         | 11.11 | 0.17 | 0.03  | 0.02  | 2.22   |
| <u>Gumaga</u> sp. adult            | 11.11 | 0.17 | 0.31  | 0.27  | 5.33   |
| Psychodidae larva                  | 11.11 | 0.17 | 0.13  | 0.05  | 3.33   |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Steelhead Trout Captured at Downstream Site on 7 July; (continued)

| Prey Item                   | %F     | %N    | %W    | %W    | IRI     |
|-----------------------------|--------|-------|-------|-------|---------|
| Ceratopogonidae larva       | 66.67  | 5.33  | 1.87  | 1.82  | 480.02  |
| Ceratopogonidae pupa        | 22.22  | 13.23 | 3.26  | 2.79  | 366.41  |
| Ceratopogonidae adult       | 11.11  | 0.17  | 0.05  | 0.04  | 2.44    |
| Chironomidae larva          | 100.00 | 13.75 | 10.08 | 17.23 | 2383.00 |
| Chironomidae pupa           | 100.00 | 53.09 | 29.83 | 29.20 | 8292.00 |
| Chironomidae adult          | 11.11  | 0.52  | 0.14  | 0.12  | 7.33    |
| <u>Euparyphus</u> sp. larva | 11.11  | 0.34  | 0.14  | 0.06  | 5.33    |
| Ephydriidae adult           | 11.11  | 0.17  | 0.07  | 0.03  | 2.67    |
| Braconidae adult            | 11.11  | 0.17  | 0.02  | 0.02  | 2.11    |
| Formicidae adult            | 11.11  | 0.17  | 1.86  | 1.61  | 22.55   |
| Unidentified egg (0.5mm)    | 11.11  | 0.17  | 0.01  | 0.02  | 2.00    |

Steelhead Trout Captured at Downstream Site During Summer After the Berm Had Been Breached; n=21;  $\Sigma N = 1275$ ;  $\Sigma W = 0.241829$  grams

| Prey Item                          | %F    | %N    | %W    | %W    | IRI     |
|------------------------------------|-------|-------|-------|-------|---------|
| Araneae                            | 9.52  | 0.31  | 15.24 | 5.33  | 148.04  |
| Acari                              | 14.29 | 0.31  | 0.17  | 0.09  | 6.86    |
| <u>Neomysis mercedis</u>           | 9.52  | 1.33  | 5.68  | 4.92  | 66.74   |
| <u>Corophium salmonis</u>          | 52.38 | 8.31  | 5.22  | 9.47  | 708.70  |
| <u>Corophium spinicorne</u>        | 85.71 | 44.24 | 38.02 | 42.16 | 7050.50 |
| <u>Anisogammarus confervicolus</u> | 9.52  | 0.16  | 0.77  | 0.64  | 8.85    |
| <u>Serratella levis</u> nymph      | 23.81 | 1.57  | 5.58  | 9.43  | 170.24  |
| <u>Alloperla</u> sp. nymph         | 9.52  | 0.24  | 0.44  | 0.38  | 6.47    |
| Thysanoptera adult                 | 4.76  | 0.08  | 0.01  | 0.01  | 0.43    |
| Cicadellidae adult                 | 4.76  | 0.08  | 0.17  | 0.25  | 1.19    |
| <u>Brychius</u> sp. larva          | 4.76  | 0.08  | 0.14  | 0.18  | 1.05    |
| Staphylinidae larva                | 4.76  | 0.08  | 0.06  | 0.04  | 0.67    |
| <u>Narpus</u> sp. adult            | 4.76  | 0.08  | 0.05  | 0.16  | 0.62    |
| <u>Optioservus seriatus</u> adult  | 4.76  | 0.08  | 0.05  | 0.22  | 0.62    |
| <u>Oxyethira</u> sp. adult         | 4.76  | 0.08  | 0.02  | 0.01  | 0.48    |
| <u>Gumaga</u> sp. adult            | 4.76  | 0.08  | 0.17  | 0.11  | 1.19    |
| Psychodidae larva                  | 4.76  | 0.08  | 0.07  | 0.02  | 0.71    |
| Ceratopogonidae larva              | 28.57 | 2.43  | 1.03  | 0.78  | 98.85   |
| Ceratopogonidae pupa               | 19.05 | 6.20  | 1.84  | 1.25  | 153.16  |
| Ceratopogonidae adult              | 9.52  | 0.16  | 0.05  | 0.05  | 2.00    |
| Chironomidae larva                 | 57.14 | 7.84  | 6.91  | 10.04 | 842.82  |
| Chironomidae pupa                  | 57.14 | 25.25 | 17.04 | 13.56 | 2416.45 |
| Chironomidae adult                 | 14.29 | 0.47  | 0.15  | 0.14  | 8.86    |
| <u>Euparyphus</u> sp. larva        | 4.76  | 0.16  | 0.08  | 0.03  | 1.14    |
| Ephydriidae adult                  | 4.76  | 0.08  | 0.04  | 0.01  | 0.57    |
| Braconidae adult                   | 4.76  | 0.08  | 0.01  | 0.01  | 0.43    |
| Formicidae adult                   | 4.76  | 0.08  | 0.01  | 0.01  | 0.43    |
| Unidentified egg (0.5mm)           | 4.76  | 0.08  | 0.01  | 0.01  | 0.43    |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Steelhead Trout Captured at South Slough Site During Winter; n = 1;  
 EN = 27; EW = 0.0283271 grams

| Prey Item                           | %F     | %N    | %W    | %W    | IRI     |
|-------------------------------------|--------|-------|-------|-------|---------|
| <u>Neomysis mercedis</u>            | 100.00 | 7.41  | 5.70  | ----- | 1311.00 |
| <u>Gnorimosphaeroma oregonensis</u> | 100.00 | 40.74 | 56.85 | ----- | 9759.00 |
| <u>Corophium spinicorne</u>         | 100.00 | 3.70  | 0.58  | ----- | 428.00  |
| <u>Anisogammarus confervicolus</u>  | 100.00 | 40.74 | 35.97 | ----- | 7671.00 |
| Chironomidae pupa                   | 100.00 | 7.41  | 0.90  | ----- | 831.00  |

Steelhead Trout Captured at South Slough Site During Spring; n = 1;  
 EN = 4; EW = 0.008735 grams

| Prey Item                           | %F     | %N    | %W    | %W    | IRI      |
|-------------------------------------|--------|-------|-------|-------|----------|
| <u>Gnorimosphaeroma oregonensis</u> | 100.00 | 25.00 | 16.76 | ----- | 4176.00  |
| <u>Corophium spinicorne</u>         | 100.00 | 25.00 | 1.87  | ----- | 2687.00  |
| <u>Enallagma</u> sp. adult          | 100.00 | 25.00 | 79.91 | ----- | 10491.00 |
| Chironomidae pupa                   | 100.00 | 25.00 | 1.47  | ----- | 2647.00  |

Steelhead Trout Captured at South Slough Site During Summer; n = 4;  
 EN = 67; EW = 0.1331388 grams

| Prey Item                           | %F    | %N    | %W    | %W    | IRI     |
|-------------------------------------|-------|-------|-------|-------|---------|
| <u>Neomysis mercedis</u>            | 25.00 | 1.49  | 0.61  | 0.92  | 52.50   |
| <u>Gnorimosphaeroma oregonensis</u> | 25.00 | 2.99  | 2.20  | 1.49  | 129.75  |
| <u>Corophium salmonis</u>           | 25.00 | 5.97  | 0.36  | 0.54  | 158.25  |
| <u>Corophium spinicorne</u>         | 50.00 | 28.36 | 2.33  | 3.41  | 1534.50 |
| Unidentified insect                 | 25.00 | 2.99  | 6.47  | 9.78  | 236.50  |
| <u>Enallagma carnuculatum</u> adult | 25.00 | 8.96  | 31.46 | 20.19 | 1010.50 |
| Corixidae adult                     | 75.00 | 29.85 | 37.83 | 26.14 | 5076.00 |
| <u>Notonecta shooteri</u> nymph     | 25.00 | 2.99  | 7.29  | 10.77 | 257.00  |
| Membracidae adult                   | 25.00 | 1.49  | 6.16  | 9.31  | 191.25  |
| <u>Glyphopsyche</u> sp. larva       | 25.00 | 1.49  | 4.46  | 16.04 | 148.75  |
| Chironomidae larva                  | 25.00 | 1.49  | 0.13  | 0.19  | 40.50   |
| Chironomidae pupa                   | 50.00 | 8.96  | 0.58  | 1.01  | 477.00  |
| Drosophilidae adult                 | 25.00 | 2.99  | 0.14  | 0.21  | 78.25   |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Steelhead Trout Captured at South Slough Site During Fall; n= 1;  
 $\Sigma N = 50$ ;  $\Sigma W = 0.1648155$  grams

| Prey Item                           | %F     | %N    | %W    | %W    | IRI     |
|-------------------------------------|--------|-------|-------|-------|---------|
| <u>Neomysis mercedis</u>            | 100.00 | 6.00  | 1.47  | ----- | 747.00  |
| <u>Enallagma carunculatum</u> adult | 100.00 | 32.00 | 67.68 | ----- | 9968.00 |
| Pentatomidae adult                  | 100.00 | 2.00  | 4.97  | ----- | 697.00  |
| Aphididae adult                     | 100.00 | 14.00 | 0.34  | ----- | 1434.00 |
| <u>Deronectes</u> sp. adult         | 100.00 | 26.00 | 12.46 | ----- | 384.60  |
| Limnephilidae pupa                  | 100.00 | 2.00  | 12.51 | ----- | 1451.00 |
| Chironomidae pupa                   | 100.00 | 12.00 | 0.47  | ----- | 1247.00 |
| Ephydriidae pupa                    | 100.00 | 2.00  | 0.07  | ----- | 207.00  |
| Braconidae adult                    | 100.00 | 2.00  | 0.02  | ----- | 202.00  |
| Pteromalidae adult                  | 100.00 | 2.00  | 0.02  | ----- | 202.00  |

Steelhead Trout Captured at North Slough Site During Spring; n= 1;  
 $\Sigma N = 7$ ;  $\Sigma W = 0.88222$  grams

| Prey Item                                           | %F     | %N    | %W    | %W    | IRI     |
|-----------------------------------------------------|--------|-------|-------|-------|---------|
| <u>Aeschna</u> sp. naiad                            | 100.00 | 14.29 | 71.22 | ----- | 8551.00 |
| Chironomidae larva                                  | 100.00 | 42.86 | 0.57  | ----- | 4343.00 |
| Chironomidae pupa                                   | 100.00 | 14.29 | 0.15  | ----- | 1444.00 |
| <u>Gasterosteus aculeatus</u> larva<br>and juvenile | 100.00 | 28.57 | 28.07 | ----- | 5664.00 |

Chinook Salmon Captured at Upstream Site During Winter; n= 2;  $\Sigma N = 164$ ;  
 $\Sigma W = 0.0297868$  grams

| Prey Item                         | %F     | %N    | %W    | %W    | IRI      |
|-----------------------------------|--------|-------|-------|-------|----------|
| <u>Baetis</u> sp. nymph           | 100.00 | 3.66  | 5.13  | 5.20  | 879.00   |
| Aphididae adult                   | 50.00  | 4.88  | 2.17  | 6.71  | 352.50   |
| <u>Optioservus seriatus</u> larva | 50.00  | 0.61  | 0.48  | 0.29  | 54.50    |
| Unidentified Hydrophilidae larva  | 50.00  | 0.61  | 1.01  | 0.60  | 81.00    |
| <u>Brachycentrus</u> sp. larva    | 50.00  | 7.93  | 17.75 | 10.59 | 1284.00  |
| Ceratopogonidae larva             | 50.00  | 0.61  | 0.27  | 0.16  | 44.00    |
| Ceratopogonidae pupa              | 50.00  | 0.61  | 0.19  | 0.59  | 40.00    |
| Ceratopogonidae adult             | 50.00  | 1.21  | 0.41  | 1.27  | 81.50    |
| Chironomidae larva                | 100.00 | 78.05 | 71.76 | 73.60 | 14481.00 |
| Chironomidae pupa                 | 50.00  | 0.61  | 0.43  | 0.26  | 52.00    |
| Chironomidae adult                | 100.00 | 1.22  | 0.41  | 0.76  | 163.00   |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Chinook Salmon Captured at Upstream Site During Spring; n= 5;  $\Sigma N = 111$ ; EW = 0.1573355 grams

| Prey Item                     | %F    | %N    | %W    | %W    | IRI     |
|-------------------------------|-------|-------|-------|-------|---------|
| Araneae                       | 40.00 | 1.80  | 11.71 | 15.27 | 540.40  |
| <u>Ameletus</u> sp. nymph     | 20.00 | 0.90  | 0.63  | 0.15  | 30.60   |
| <u>Serratella levis</u> nymph | 40.00 | 2.70  | 1.29  | 4.74  | 159.60  |
| <u>Sigara vandykei</u> adult  | 20.00 | 0.90  | 0.78  | 0.19  | 33.60   |
| Unidentified Coleoptera adult | 20.00 | 2.70  | 8.59  | 2.06  | 225.80  |
| <u>Dicosmoecus</u> sp. larva  | 20.00 | 2.70  | 67.55 | 16.22 | 1405.00 |
| <u>Parthina</u> sp. larva     | 20.00 | 2.70  | 0.78  | 1.84  | 69.60   |
| Chironomidae larva            | 80.00 | 34.23 | 4.03  | 25.90 | 3060.80 |
| Chironomidae pupa             | 60.00 | 50.45 | 4.56  | 32.99 | 3300.60 |
| Empididae larva               | 20.00 | 0.90  | 0.10  | 0.67  | 20.00   |

Chinook Salmon Captured at Upstream Site During Summer; n= 3;  $\Sigma N = 336$ ; EW = 0.0821307 grams

| Prey Item                      | %F     | %N    | %W    | %W    | IRI     |
|--------------------------------|--------|-------|-------|-------|---------|
| Araneae                        | 33.33  | 0.60  | 22.43 | 12.78 | 767.59  |
| Acari                          | 33.33  | 4.76  | 2.00  | 5.02  | 225.31  |
| <u>Ameletus</u> sp. nymph      | 100.00 | 2.08  | 8.38  | 7.84  | 1046.00 |
| <u>Baetis</u> sp. nymph        | 33.33  | 0.60  | 0.62  | 0.35  | 40.66   |
| <u>Heptagenia</u> sp. nymph    | 33.33  | 0.30  | 0.17  | 0.20  | 15.67   |
| <u>Alloperla</u> sp. nymph     | 33.33  | 0.30  | 0.45  | 0.25  | 25.00   |
| Unidentified Coleoptera adult  | 33.33  | 0.30  | 5.48  | 3.12  | 192.65  |
| Unidentified Trichoptera adult | 33.33  | 0.30  | 10.23 | 12.07 | 350.96  |
| <u>Ochrotrichia</u> sp. larva  | 66.67  | 0.60  | 0.09  | 0.08  | 46.00   |
| Ceratopogonidae larva          | 66.67  | 1.19  | 0.39  | 0.60  | 105.34  |
| Chironomidae larva             | 100.00 | 27.08 | 18.50 | 18.32 | 4558.00 |
| Chironomidae pupa              | 100.00 | 54.46 | 28.52 | 37.79 | 8298.00 |
| Chironomidae adult             | 33.33  | 0.89  | 0.22  | 0.13  | 37.00   |
| Ephydriidae adult              | 33.33  | 6.55  | 2.52  | 1.43  | 302.30  |

Chinook Salmon Captured at Downstream Site During Spring; n= 10;  $\Sigma N = 513$ ; EW = 0.3232654 grams

| Prey Item                           | %F    | %N   | %W    | %W    | IRI    |
|-------------------------------------|-------|------|-------|-------|--------|
| Araneae                             | 50.00 | 0.97 | 14.25 | 26.26 | 761.00 |
| Acari                               | 30.00 | 0.58 | 0.10  | 0.42  | 20.40  |
| <u>Gnorimosphaeroma oregonensis</u> | 10.00 | 0.19 | 0.45  | 0.12  | 6.40   |
| <u>Asellus</u> sp.                  | 10.00 | 0.19 | 0.21  | 0.13  | 4.00   |
| <u>Corophium spinicorne</u>         | 20.00 | 0.78 | 0.20  | 0.63  | 19.60  |
| Unidentified Ephemeroptera nymph    | 10.00 | 0.78 | 0.62  | 1.55  | 14.00  |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Chinook Salmon Captured at Downstream Site During Spring; (continued)

| Prey Item                         | %F    | %N    | %W    | %W    | IRI     |
|-----------------------------------|-------|-------|-------|-------|---------|
| <u>Baetis</u> sp. nymph           | 10.00 | 0.97  | 0.39  | 0.25  | 13.60   |
| <u>Heptagenia</u> sp. nymph       | 10.00 | 0.19  | 0.04  | 0.02  | 2.30    |
| <u>Alloperla</u> sp. nymph        | 20.00 | 0.39  | 0.22  | 0.35  | 12.20   |
| <u>Capnia</u> sp. nymph           | 10.00 | 0.19  | 0.04  | 0.02  | 2.30    |
| Cicadellidae adult                | 10.00 | 0.19  | 0.13  | 0.37  | 3.20    |
| Aphididae adult                   | 60.00 | 2.92  | 0.37  | 0.71  | 197.40  |
| <u>Deronectes</u> sp. larva       | 10.00 | 0.19  | 0.10  | 0.03  | 2.90    |
| <u>Deronectes</u> sp. adult       | 10.00 | 0.39  | 0.98  | 0.26  | 13.70   |
| Staphylinidae adult               | 20.00 | 1.17  | 0.19  | 0.52  | 27.20   |
| <u>Optioservus seriatus</u> larva | 10.00 | 0.19  | 0.04  | 0.01  | 2.30    |
| <u>Ochrotrichia</u> sp. larva     | 10.00 | 0.19  | 0.01  | 0.03  | 2.00    |
| Limnephilidae adult               | 10.00 | 0.39  | 5.20  | 2.47  | 55.90   |
| <u>Dicosmoecus</u> sp. larva      | 10.00 | 0.19  | 10.96 | 5.21  | 111.50  |
| <u>Onocosmoecus</u> sp. larva     | 10.00 | 0.19  | 10.96 | 6.85  | 111.50  |
| <u>Brachycentrus</u> sp. larva    | 20.00 | 0.39  | 0.25  | 0.86  | 12.80   |
| <u>Dixa</u> sp. larva             | 10.00 | 0.19  | 0.01  | 0.03  | 2.00    |
| Ceratopogonidae larva             | 10.00 | 0.39  | 0.05  | 0.06  | 4.40    |
| Ceratopogonidae pupa              | 30.00 | 3.51  | 0.31  | 1.26  | 114.60  |
| Ceratopogonidae adult             | 20.00 | 0.78  | 0.08  | 0.06  | 17.20   |
| Chironomidae larva                | 80.00 | 20.27 | 5.37  | 8.19  | 2051.20 |
| Chironomidae pupa                 | 90.00 | 51.27 | 10.41 | 28.94 | 5551.20 |
| Chironomidae adult                | 20.00 | 1.75  | 0.17  | 0.15  | 38.40   |
| Cecidiomyiidae adult              | 10.00 | 0.19  | 0.01  | 0.05  | 2.00    |
| Empididae larva                   | 20.00 | 0.39  | 0.09  | 0.57  | 9.60    |
| Ephydriidae pupa                  | 10.00 | 0.39  | 0.07  | 0.04  | 4.60    |
| Ephydriidae adult                 | 30.00 | 7.80  | 1.16  | 2.81  | 268.80  |
| Hymenoptera adult                 | 40.00 | 1.17  | 3.06  | 2.02  | 169.20  |
| <u>Cottus asper</u> juvenile      | 10.00 | 0.19  | 33.47 | 8.77  | 336.60  |

Chinook Salmon Captured at Downstream Site During Summer; n= 53;  
 ΣN = 4651; ΣW = 0.7310654 grams

| Prey Item                           | %F    | %N   | %W   | %W     | IRI   |
|-------------------------------------|-------|------|------|--------|-------|
| Araneae                             | 9.43  | 0.13 | 7.56 | 4.47   | 72.52 |
| Acari                               | 32.08 | 1.57 | 1.02 | 0.76   | 83.09 |
| <u>Huntemannia</u> sp.              | 1.89  | 0.09 | 0.01 | 0.0002 | 0.19  |
| <u>Neomysis mercedis</u>            | 3.77  | 0.32 | 1.66 | 1.58   | 7.46  |
| <u>Gnorimosphaeroma oregonensis</u> | 1.89  | 0.02 | 0.20 | 0.30   | 0.42  |
| <u>Corophium salmonis</u>           | 1.89  | 0.28 | 0.21 | 0.27   | 0.93  |
| <u>Corophium spinicorne</u>         | 3.77  | 0.04 | 0.04 | 0.04   | 0.30  |
| Unidentified Insect                 | 5.66  | 0.06 | 1.68 | 2.17   | 9.85  |
| Collembola                          | 1.89  | 0.02 | 0.01 | 0.001  | 0.06  |
| <u>Baetis</u> sp. nymph             | 5.66  | 0.06 | 0.10 | 0.10   | 0.91  |
| <u>Drunella flavilinea</u> nymph    | 7.55  | 0.13 | 0.55 | 0.76   | 5.13  |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Chinook Salmon Captured at Downstream Site During Summer; (continued)

| Prey Item                         | %F    | %N    | %W    | %W    | IRI     |
|-----------------------------------|-------|-------|-------|-------|---------|
| <u>Alloperla</u> sp. nymph        | 3.77  | 0.06  | 0.15  | 0.10  | 0.79    |
| Psocoptera adult                  | 5.66  | 0.34  | 0.04  | 0.03  | 2.15    |
| Thysanoptera adult                | 3.77  | 0.04  | 0.01  | 0.01  | 0.19    |
| Cicadellidae adult                | 7.55  | 0.09  | 0.23  | 0.46  | 2.42    |
| Psyllidae adult                   | 5.66  | 0.06  | 0.17  | 0.16  | 1.30    |
| Aphididae adult                   | 24.53 | 0.39  | 0.20  | 0.44  | 14.47   |
| <u>Haliphus</u> sp. larva         | 1.89  | 0.02  | 0.05  | 0.07  | 0.13    |
| <u>Deronectes</u> sp. larva       | 1.89  | 0.06  | 0.13  | 0.40  | 0.36    |
| <u>Deronectes</u> sp. adult       | 7.55  | 0.11  | 1.08  | 2.04  | 8.98    |
| <u>Hydroporus</u> sp. larva       | 1.89  | 0.02  | 0.04  | 0.22  | 0.11    |
| Staphylinidae larva               | 1.89  | 0.02  | 0.02  | 0.03  | 0.08    |
| Staphylinidae adult               | 1.89  | 0.02  | 0.01  | 0.02  | 0.06    |
| <u>Narpus</u> sp. adult           | 1.89  | 0.02  | 0.02  | 0.01  | 0.08    |
| <u>Optioservus seriatus</u> larva | 13.21 | 0.15  | 0.14  | 0.15  | 3.83    |
| <u>Optioservus seriatus</u> adult | 15.09 | 0.24  | 0.17  | 0.15  | 6.19    |
| <u>Zaitzevia</u> sp. larva        | 1.89  | 0.02  | 0.02  | 0.04  | 0.08    |
| <u>Zaitzevia</u> sp. adult        | 1.89  | 0.02  | 0.02  | 0.01  | 0.08    |
| Anthicidae adult                  | 11.32 | 0.17  | 0.09  | 0.09  | 2.94    |
| Curculionidae adult               | 3.77  | 0.04  | 1.56  | 2.06  | 6.03    |
| Unidentified Trichoptera larva    | 1.89  | 0.02  | 0.81  | 0.40  | 1.57    |
| <u>Ochrotrichia</u> sp. larva     | 1.89  | 0.02  | 0.01  | 0.002 | 0.06    |
| <u>Oxyethira</u> sp. larva        | 7.55  | 0.13  | 0.03  | 0.04  | 1.21    |
| Psychodidae larva                 | 3.77  | 0.06  | 0.07  | 0.09  | 0.49    |
| Psychodidae adult                 | 1.89  | 0.02  | 0.01  | 0.003 | 0.06    |
| Ceratopogonidae larva             | 35.85 | 5.81  | 2.96  | 1.52  | 314.40  |
| Ceratopogonidae pupa              | 26.42 | 2.43  | 0.87  | 1.18  | 87.19   |
| Ceratopogonidae adult             | 1.89  | 0.13  | 0.05  | 0.08  | 0.34    |
| Chironomidae larva                | 88.68 | 31.61 | 33.58 | 27.69 | 5781.05 |
| Chironomidae pupa                 | 94.34 | 50.76 | 41.34 | 46.93 | 8688.71 |
| Chironomidae adult                | 22.64 | 3.01  | 1.17  | 0.99  | 94.64   |
| <u>Simulium</u> sp. larva         | 5.66  | 0.24  | 0.64  | 0.60  | 4.98    |
| <u>Simulium</u> sp. adult         | 1.89  | 0.02  | 0.01  | 0.01  | 0.06    |
| Sciaridae adult                   | 3.77  | 0.11  | 0.01  | 0.01  | 0.45    |
| <u>Euparyphus</u> sp. larva       | 13.21 | 0.15  | 0.09  | 0.10  | 3.17    |
| Empididae adult                   | 3.77  | 0.04  | 0.03  | 0.02  | 0.26    |
| Sphaeroceridae adult              | 3.77  | 0.04  | 0.03  | 0.02  | 0.26    |
| Ephydriidae adult                 | 20.75 | 0.41  | 0.24  | 2.09  | 13.49   |
| Drosophilidae adult               | 3.77  | 0.04  | 0.03  | 0.02  | 0.26    |
| Muscidae adult                    | 5.66  | 0.06  | 0.06  | 0.04  | 0.68    |
| Formicidae adult                  | 3.77  | 0.04  | 0.67  | 1.18  | 2.68    |
| Braconidae adult                  | 7.55  | 0.11  | 0.02  | 0.01  | 0.98    |
| Chalcidoidea adult                | 1.89  | 0.02  | 0.01  | 0.01  | 0.06    |
| Cynipidae adult                   | 1.89  | 0.02  | 0.01  | 0.01  | 0.06    |
| Eurytomidae adult                 | 1.89  | 0.02  | 0.01  | 0.003 | 0.06    |
| Pteromalidae adult                | 1.89  | 0.02  | 0.01  | 0.003 | 0.06    |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Chinook Salmon Captured at Downstream Site During Summer Before the Berm Had Been Breached; n= 47;  $\Sigma N$  = 3981;  $\Sigma W$  = 0.6295849 grams

| Prey Item                           | %F    | %N    | %W    | %W     | IRI     |
|-------------------------------------|-------|-------|-------|--------|---------|
| Araneae                             | 6.38  | 0.10  | 5.85  | 2.38   | 37.96   |
| Acari                               | 34.04 | 1.63  | 1.06  | 0.83   | 91.57   |
| <u>Huntemannia</u> sp.              | 2.13  | 0.10  | 0.01  | 0.0002 | 0.23    |
| <u>Neomysis mercedis</u>            | 2.13  | 0.35  | 1.80  | 1.75   | 4.58    |
| <u>Gnorimosphaeroma oregonensis</u> | 2.13  | 0.03  | 0.23  | 0.34   | 0.55    |
| <u>Corophium spinicorne</u>         | 2.13  | 0.03  | 0.03  | 0.01   | 0.13    |
| Unidentified Insect                 | 6.38  | 0.08  | 2.05  | 2.45   | 13.59   |
| Collembola                          | 2.13  | 0.03  | 0.01  | 0.001  | 0.09    |
| <u>Baetis</u> sp. nymph             | 6.38  | 0.08  | 0.12  | 0.11   | 1.28    |
| <u>Drunella flavilinea</u> nymph    | 6.38  | 0.08  | 0.32  | 0.41   | 2.55    |
| <u>Alloperla</u> sp. nymph          | 2.13  | 0.05  | 0.11  | 0.04   | 0.34    |
| Psocoptera adult                    | 6.38  | 0.40  | 0.05  | 0.03   | 2.87    |
| Thysanoptera adult                  | 4.26  | 0.05  | 0.01  | 0.01   | 0.26    |
| Cicadellidae adult                  | 8.51  | 0.10  | 0.26  | 0.52   | 3.06    |
| Psyllidae adult                     | 6.38  | 0.08  | 0.20  | 0.18   | 1.79    |
| Aphididae adult                     | 25.53 | 0.43  | 0.22  | 0.49   | 16.59   |
| <u>Halipius</u> sp. larva           | 2.13  | 0.03  | 0.05  | 0.08   | 0.17    |
| <u>Deronectes</u> sp. adult         | 4.26  | 0.08  | 0.75  | 1.43   | 3.54    |
| <u>Hydroporus</u> sp. larva         | 2.13  | 0.03  | 0.05  | 0.25   | 0.17    |
| Staphylinidae larva                 | 2.13  | 0.03  | 0.02  | 0.03   | 0.11    |
| Staphylinidae adult                 | 2.13  | 0.03  | 0.02  | 0.02   | 0.11    |
| <u>Narpus</u> sp. adult             | 2.13  | 0.03  | 0.02  | 0.02   | 0.11    |
| <u>Optioservus seriatus</u> larva   | 12.77 | 0.15  | 0.14  | 0.15   | 3.70    |
| <u>Optioservus seriatus</u> adult   | 14.89 | 0.23  | 0.16  | 0.15   | 5.81    |
| <u>Zaitzevia</u> sp. larva          | 2.13  | 0.03  | 0.02  | 0.05   | 0.11    |
| <u>Zaitzevia</u> sp. adult          | 2.13  | 0.03  | 0.02  | 0.01   | 0.11    |
| Anthicidae adult                    | 12.77 | 0.20  | 0.10  | 0.10   | 3.83    |
| Curculionidae adult                 | 4.26  | 0.05  | 1.81  | 2.32   | 7.92    |
| Unidentified Trichoptera larva      | 2.13  | 0.03  | 0.94  | 0.46   | 2.07    |
| <u>Ochrotrichia</u> sp. larva       | 2.13  | 0.03  | 0.01  | 0.002  | 0.09    |
| <u>Oxyethira</u> sp. larva          | 6.38  | 0.13  | 0.03  | 0.02   | 1.02    |
| Psychodidae larva                   | 4.26  | 0.08  | 0.08  | 0.10   | 0.68    |
| Psychodidae adult                   | 2.13  | 0.03  | 0.01  | 0.003  | 0.09    |
| Ceratopogonidae larva               | 34.04 | 1.23  | 0.62  | 0.91   | 62.97   |
| Ceratopogonidae pupa                | 23.40 | 2.46  | 0.87  | 1.26   | 77.92   |
| Ceratopogonidae adult               | 2.13  | 0.15  | 0.06  | 0.09   | 0.45    |
| Chironomidae larva                  | 91.49 | 35.40 | 37.38 | 29.24  | 6658.64 |
| Chironomidae pupa                   | 97.87 | 51.23 | 41.46 | 50.63  | 9071.57 |
| Chironomidae adult                  | 23.40 | 3.49  | 1.35  | 1.11   | 113.26  |
| <u>Simulium</u> sp. larva           | 4.26  | 0.15  | 0.41  | 0.21   | 2.39    |
| <u>Simulium</u> sp. adult           | 2.13  | 0.03  | 0.01  | 0.01   | 0.09    |
| Sciaridae adult                     | 4.26  | 0.13  | 0.01  | 0.01   | 0.60    |
| <u>Euparyphus</u> sp. larva         | 14.89 | 0.18  | 0.10  | 0.12   | 4.17    |
| Empididae adult                     | 4.26  | 0.05  | 0.03  | 0.03   | 0.34    |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Chinook Salmon Captured at Downstream Site During Summer Before the Berm Had Been Breached; (continued)

| Prey Item             | %F    | %N   | %W   | %W    | IRI  |
|-----------------------|-------|------|------|-------|------|
| Sphaerocercidae adult | 4.26  | 0.05 | 0.03 | 0.03  | 0.34 |
| Ephydriidae adult     | 19.15 | 0.33 | 0.19 | 0.19  | 9.96 |
| Drosophilidae adult   | 4.26  | 0.05 | 0.03 | 0.02  | 0.34 |
| Muscidae adult        | 6.38  | 0.08 | 0.07 | 0.05  | 0.96 |
| Formicidae adult      | 4.26  | 0.05 | 0.78 | 1.33  | 3.54 |
| Braconidae adult      | 8.51  | 0.13 | 0.02 | 0.02  | 1.28 |
| Chalcidoidea adult    | 2.13  | 0.03 | 0.01 | 0.01  | 0.09 |
| Cynipidae adult       | 2.13  | 0.03 | 0.01 | 0.01  | 0.09 |
| Eurytomidae adult     | 2.13  | 0.03 | 0.01 | 0.004 | 0.09 |
| Pteromalidae adult    | 1.89  | 0.03 | 0.01 | 0.004 | 0.09 |

Chinook Salmon Captured at South Slough Site During Summer; n = 5;  
 EN = 589; EW = 0.1822182 grams

| Prey Item                           | %F    | %N    | %W    | %W    | IRI     |
|-------------------------------------|-------|-------|-------|-------|---------|
| Cladocera                           | 20.00 | 2.04  | 0.04  | 0.01  | 41.60   |
| Harpacticoid Copepods               | 20.00 | 2.38  | 0.15  | 0.06  | 50.60   |
| <u>Neomysis mercedis</u>            | 60.00 | 4.24  | 11.08 | 6.37  | 919.20  |
| <u>Gnорimosphaeroma oregonensis</u> | 60.00 | 1.19  | 5.62  | 8.79  | 408.60  |
| <u>Corophium salmonis</u>           | 60.00 | 43.29 | 16.65 | 12.01 | 3596.40 |
| <u>Corophium spinicorne</u>         | 60.00 | 21.22 | 11.18 | 8.98  | 1944.00 |
| Unidentified Insect                 | 20.00 | 0.34  | 4.73  | 4.40  | 101.40  |
| <u>Callibaetis</u> sp. nymph        | 20.00 | 0.17  | 1.01  | 0.85  | 23.60   |
| <u>Ischnura cervula</u> naiad       | 20.00 | 1.53  | 27.04 | 9.75  | 571.40  |
| Unidentified Plecoptera nymph       | 20.00 | 0.17  | 4.44  | 3.72  | 92.20   |
| <u>Cenocorixa blaisdelli</u> adult  | 20.00 | 0.17  | 2.22  | 0.80  | 47.80   |
| <u>Sigara mckinstryi</u> adult      | 20.00 | 0.17  | 0.67  | 3.81  | 16.80   |
| Corixidae Egg                       | 20.00 | 0.17  | 0.01  | 0.01  | 3.60    |
| Psyllidae adult                     | 20.00 | 0.17  | 0.23  | 1.29  | 8.00    |
| Aphididae adult                     | 80.00 | 1.02  | 0.27  | 0.77  | 103.20  |
| <u>Deronectes</u> sp. larva         | 20.00 | 0.17  | 0.18  | 0.06  | 7.00    |
| <u>Glyphopsyche</u> sp. larva       | 20.00 | 0.17  | 3.26  | 2.73  | 68.60   |
| Lepidoptera larva                   | 20.00 | 0.17  | 0.02  | 0.12  | 3.80    |
| Chironomidae larva                  | 60.00 | 1.70  | 0.92  | 1.18  | 157.20  |
| Chironomidae pupa                   | 80.00 | 11.21 | 4.64  | 9.59  | 1268.00 |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Chinook Salmon Captured at South Slough Site During Summer; (continued)

| Prey Item                           | %F     | %N   | %W   | %W    | IRI    |
|-------------------------------------|--------|------|------|-------|--------|
| Chironomidae adult                  | 20.00  | 0.17 | 0.03 | 0.08  | 4.00   |
| Empididae adult                     | 20.00  | 0.34 | 0.10 | 0.58  | 8.80   |
| Ephydriidae pupa                    | 20.00  | 0.17 | 0.07 | 0.37  | 4.80   |
| Ephydriidae adult                   | 100.00 | 3.06 | 0.93 | 2.86  | 399.00 |
| Muscidae adult                      | 20.00  | 2.21 | 1.09 | 6.16  | 66.00  |
| Braconidae adult                    | 40.00  | 0.34 | 0.03 | 0.12  | 14.80  |
| Ichneumonidae adult                 | 20.00  | 0.17 | 0.02 | 0.04  | 3.80   |
| <u>Gasterosteus aculeatus</u> larva | 80.00  | 1.87 | 3.38 | 14.48 | 420.00 |

Coho Salmon Captured at Upstream Site During Spring; n= 4;  $\Sigma N = 88$ ;  
EW = 0.2247324 grams

| Prey Item                    | %F    | %N    | %W    | %W    | IRI     |
|------------------------------|-------|-------|-------|-------|---------|
| Araneae                      | 25.00 | 3.41  | 12.30 | 9.00  | 392.75  |
| Acari                        | 25.00 | 1.14  | 0.05  | 0.02  | 29.75   |
| <u>Siphonurus</u> sp. nymph  | 25.00 | 1.14  | 0.44  | 2.84  | 39.50   |
| <u>Gerris remigis</u> nymph  | 25.00 | 1.14  | 3.13  | 1.55  | 106.75  |
| Unidentified Homoptera adult | 25.00 | 1.14  | 0.15  | 0.11  | 32.25   |
| Cicadellidae adult           | 25.00 | 9.09  | 1.48  | 1.08  | 264.25  |
| Psyllidae adult              | 25.00 | 1.14  | 0.19  | 0.14  | 33.25   |
| Aphididae adult              | 25.00 | 1.14  | 0.04  | 0.03  | 29.50   |
| <u>Crenitis</u> sp. adult    | 25.00 | 2.27  | 0.10  | 0.05  | 59.25   |
| <u>Rhyacophila</u> sp. larva | 50.00 | 4.55  | 15.13 | 27.77 | 984.00  |
| <u>Dicosmoecus</u> sp. larva | 50.00 | 4.55  | 63.05 | 34.88 | 3380.00 |
| Ceratopogonidae adult        | 25.00 | 6.82  | 0.16  | 0.12  | 174.50  |
| Chironomidae larva           | 50.00 | 54.55 | 3.57  | 22.27 | 2906.00 |
| Chironomidae pupa            | 25.00 | 1.14  | 0.06  | 0.03  | 30.00   |
| Chironomidae adult           | 25.00 | 1.14  | 0.03  | 0.02  | 28.50   |
| Sphaeroceridae adult         | 25.00 | 3.41  | 0.13  | 0.09  | 88.50   |
| Braconidae adult             | 25.00 | 1.14  | 0.01  | 0.01  | 28.75   |
| Mymaridae adult              | 25.00 | 1.14  | 0.01  | 0.01  | 28.75   |

Coho Salmon Captured at North Slough Site During Spring; n= 1;  $\Sigma N = 114$ ;  
EW = 0.016386 grams

| Prey Item                   | %F     | %N    | %W    | %W    | IRI      |
|-----------------------------|--------|-------|-------|-------|----------|
| <u>Corophium spinicorne</u> | 100.00 | 6.14  | 6.96  | ----- | 1310.00  |
| Psyllidae adult             | 100.00 | 0.88  | 2.54  | ----- | 342.00   |
| <u>Agabus</u> sp. larva     | 100.00 | 0.88  | 3.00  | ----- | 388.00   |
| Chironomidae larva          | 100.00 | 20.18 | 23.44 | ----- | 4362.00  |
| Chironomidae pupa           | 100.00 | 71.93 | 64.05 | ----- | 13598.00 |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Prickly Sculpin Captured at Upstream Site During Winter; n= 3;  $\Sigma N$  = 18;  $\Sigma W$  = 0.0266622 grams

| Prey Item                          | %F    | %N    | %W    | %W    | IRI     |
|------------------------------------|-------|-------|-------|-------|---------|
| <u>Anisogammarus confervicolus</u> | 33.33 | 5.56  | 3.47  | 1.32  | 300.97  |
| <u>Ameletus</u> sp. nymph          | 33.33 | 5.56  | 3.69  | 10.97 | 308.30  |
| <u>Calineuria</u> sp. nymph        | 33.33 | 5.56  | 84.13 | 32.01 | 2989.37 |
| <u>Optioservus seriatus</u> adult  | 33.33 | 5.56  | 0.42  | 11.83 | 199.31  |
| <u>Ochrotrichia</u> sp. larva      | 33.33 | 5.56  | 0.14  | 4.01  | 189.98  |
| Chironomidae larva                 | 66.67 | 72.22 | 8.14  | 39.85 | 5357.60 |

Prickly Sculpin Captured at Upstream Site During Spring; n=10;  $\Sigma N$  = 105;  $\Sigma W$  = 0.5132322 grams

| Prey Item                         | %F    | %N    | %W    | %W    | IRI     |
|-----------------------------------|-------|-------|-------|-------|---------|
| Oligochaete                       | 20.00 | 2.86  | 96.70 | 19.98 | 1991.20 |
| <u>Corophium spinicorne</u>       | 10.00 | 0.95  | 0.03  | 8.10  | 9.80    |
| <u>Siphonurus</u> sp. nymph       | 10.00 | 0.95  | 0.19  | 4.62  | 11.40   |
| <u>Capnia</u> sp. nymph           | 10.00 | 0.95  | 0.03  | 0.01  | 9.80    |
| <u>Optioservus seriatus</u> larva | 30.00 | 3.81  | 0.10  | 11.84 | 117.30  |
| <u>Ochrotrichia</u> sp. larva     | 30.00 | 6.67  | 0.05  | 6.52  | 201.60  |
| Early Instar Limnephilidae larva  | 20.00 | 2.86  | 0.24  | 9.68  | 62.00   |
| <u>Protoptila</u> sp. larva       | 30.00 | 2.86  | 0.02  | 12.08 | 86.40   |
| <u>Dixa</u> sp. larva             | 10.00 | 0.95  | 0.01  | 2.30  | 9.60    |
| Chironomidae larva                | 40.00 | 75.24 | 2.57  | 20.42 | 3112.40 |
| Chironomidae pupa                 | 20.00 | 1.90  | 0.05  | 4.44  | 39.00   |

Prickly Sculpin Captured at Upstream Site During Summer; n=15;  $\Sigma N$  = 124;  $\Sigma W$  = 0.0523146 grams

| Prey Item                      | %F    | %N    | %W    | %W    | IRI     |
|--------------------------------|-------|-------|-------|-------|---------|
| <u>Ameletus</u> sp. nymph      | 6.67  | 0.81  | 1.88  | 4.42  | 17.94   |
| <u>Siphonurus</u> sp. nymph    | 20.00 | 4.03  | 9.40  | 9.60  | 268.60  |
| <u>Ephemerella</u> sp. nymph   | 6.67  | 3.23  | 5.16  | 4.88  | 55.96   |
| <u>Serratella levis</u> nymph  | 40.00 | 31.45 | 50.32 | 31.52 | 3270.80 |
| <u>Tricorythodes</u> sp. nymph | 46.67 | 14.52 | 15.48 | 26.22 | 1400.10 |
| <u>Deronectes</u> sp. larva    | 6.67  | 1.61  | 1.26  | 1.19  | 19.14   |
| <u>Oxyethira</u> sp. larva     | 26.67 | 3.23  | 0.29  | 0.70  | 93.88   |
| Chironomidae larva             | 66.67 | 40.32 | 15.96 | 21.02 | 3752.19 |
| Chironomidae pupa              | 6.67  | 0.81  | 0.24  | 0.46  | 7.00    |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Prickly Sculpin Captured at Downstream Site During Winter; n= 1;  $\Sigma N$  = 7;  $\Sigma W$  = 0.001141 grams

| Prey Item                   | %F     | %N     | %W     | %W     | IRI      |
|-----------------------------|--------|--------|--------|--------|----------|
| <u>Corophium spinicorne</u> | 100.00 | 100.00 | 100.00 | 100.00 | 20000.00 |

Prickly Sculpin Captured at Downstream Site During Spring; n=12;  $\Sigma N$  = 139;  $\Sigma W$  = 0.0530763 grams

| Prey Item                           | %F    | %N    | %W    | %W    | IRI     |
|-------------------------------------|-------|-------|-------|-------|---------|
| <u>Neanthes succinea</u>            | 8.33  | 0.72  | 33.35 | 6.90  | 283.80  |
| <u>Gnorimosphaeroma oregonensis</u> | 16.67 | 2.16  | 8.27  | 3.56  | 173.87  |
| <u>Corophium spinicorne</u>         | 41.67 | 6.47  | 2.76  | 12.10 | 384.61  |
| <u>Anisogammarus confervicolus</u>  | 8.33  | 2.16  | 5.24  | 6.29  | 61.64   |
| <u>Alloperla</u> sp. nymph          | 16.67 | 2.88  | 2.70  | 5.85  | 93.02   |
| Cicadellidae adult                  | 8.33  | 0.72  | 0.78  | 0.94  | 12.50   |
| <u>Optioservus seriatus</u> larva   | 25.00 | 5.04  | 1.89  | 3.25  | 173.25  |
| Unidentified Trichoptera larva      | 8.33  | 0.72  | 11.14 | 8.22  | 98.79   |
| Ceratopogonidae larva               | 25.00 | 2.16  | 0.45  | 0.59  | 65.25   |
| Chironomidae larva                  | 66.67 | 72.66 | 31.78 | 51.34 | 6963.01 |
| Chironomidae pupa                   | 8.33  | 0.72  | 0.24  | 0.66  | 8.00    |
| Unidentified Egg                    | 8.33  | 3.60  | 1.39  | 0.29  | 41.57   |

Prickly Sculpin Captured at Downstream Site on 24-25 June (=Preberm Summer); n=19;  $\Sigma N$  = 953;  $\Sigma W$  = 0.2192143 grams

| Prey Item                                                                | %F    | %N    | %W    | %W    | IRI     |
|--------------------------------------------------------------------------|-------|-------|-------|-------|---------|
| <u>Neanthes succinea</u>                                                 | 5.26  | 0.10  | 8.07  | 4.26  | 42.97   |
| <u>Gnorimosphaeroma oregonensis</u>                                      | 10.53 | 0.21  | 1.34  | 2.67  | 16.32   |
| <u>Corophium salmonis</u>                                                | 26.32 | 5.04  | 2.61  | 7.45  | 201.35  |
| <u>Corophium spinicorne</u>                                              | 42.11 | 1.15  | 0.82  | 2.88  | 82.96   |
| <u>Siphonurus</u> sp. nymph                                              | 10.53 | 0.21  | 0.90  | 4.91  | 11.69   |
| <u>Deronectes</u> sp. larva                                              | 15.79 | 0.52  | 0.75  | 3.04  | 20.05   |
| <u>Optioservus seriatus</u> larva                                        | 10.53 | 0.21  | 0.13  | 5.39  | 3.58    |
| <u>Optioservus seriatus</u> adult                                        | 5.26  | 0.10  | 0.05  | 0.07  | 0.79    |
| <u>Ochrotrichia</u> sp. larva                                            | 5.26  | 0.10  | 0.02  | 0.10  | 0.63    |
| Ceratopogonidae larva                                                    | 42.11 | 1.26  | 0.44  | 1.48  | 71.59   |
| Chironomidae larva                                                       | 94.74 | 48.48 | 35.20 | 56.77 | 7927.84 |
| Chironomidae pupa                                                        | 15.79 | 0.42  | 0.23  | 0.30  | 10.26   |
| Muscidae larva                                                           | 5.26  | 0.10  | 0.49  | 0.95  | 3.10    |
| <u>Gasterosteus aculeatus</u> juvenile                                   | 5.26  | 0.21  | 22.08 | 4.50  | 117.25  |
| Unidentified eggs (probably stickleback or prickly sculpin eggs) (0.5mm) | 10.53 | 41.87 | 26.88 | 5.25  | 723.94  |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Prickly Sculpin Captured at Downstream Site on 7 July; n= 2;  $\Sigma N$  = 6;  $\Sigma W$  = 0.0018297 grams

| Prey Item                   | %F     | %N    | %W    | %W    | IRI     |
|-----------------------------|--------|-------|-------|-------|---------|
| <u>Neomysis mercedis</u>    | 50.00  | 16.67 | 44.13 | 41.43 | 3040.00 |
| <u>Corophium spinicorne</u> | 50.00  | 16.67 | 19.58 | 20.95 | 1812.50 |
| <u>Alloperla</u> sp. nymph  | 50.00  | 16.67 | 8.91  | 9.53  | 1279.00 |
| Chironomidae larva          | 100.00 | 50.00 | 27.38 | 28.10 | 7738.00 |

Prickly Sculpin Captured at Downstream Site During Summer After the Berm Had Been Breached; n= 4;  $\Sigma N$  = 37;  $\Sigma W$  = 0.0080477 grams

| Prey Item                           | %F    | %N    | %W    | %W    | IRI     |
|-------------------------------------|-------|-------|-------|-------|---------|
| <u>Neomysis mercedis</u>            | 25.00 | 2.70  | 10.03 | 20.72 | 318.25  |
| <u>Gnorimosphaeroma oregonensis</u> | 25.00 | 2.70  | 18.19 | 7.30  | 522.25  |
| <u>Corophium spinicorne</u>         | 75.00 | 70.27 | 52.66 | 35.38 | 9219.75 |
| <u>Alloperla</u> sp. nymph          | 25.00 | 2.70  | 4.45  | 10.47 | 178.75  |
| Chironomidae larva                  | 75.00 | 10.81 | 8.30  | 17.52 | 1433.25 |
| Chironomidae pupa                   | 50.00 | 10.81 | 6.36  | 8.62  | 858.50  |

Prickly Sculpin Captured at Downstream Site During Fall; n= 9;  $\Sigma N$  = 125;  $\Sigma W$  = 0.1396021 grams

| Prey Item                           | %F     | %N    | %W    | %W    | IRI     |
|-------------------------------------|--------|-------|-------|-------|---------|
| <u>Eurytemora</u> sp.               | 22.22  | 13.60 | 0.11  | 0.65  | 304.64  |
| Cypris larva                        | 11.11  | 0.80  | 0.03  | 0.17  | 9.22    |
| <u>Gnorimosphaeroma oregonensis</u> | 11.11  | 0.80  | 1.05  | 6.52  | 20.55   |
| <u>Corophium salmonis</u>           | 55.56  | 17.60 | 1.88  | 10.44 | 1082.31 |
| <u>Corophium spinicorne</u>         | 100.00 | 52.80 | 7.71  | 57.05 | 6051.00 |
| <u>Anisogammarus confervicolus</u>  | 11.11  | 0.80  | 0.66  | 3.80  | 16.22   |
| Chironomidae larva                  | 11.11  | 0.80  | 0.12  | 0.02  | 10.22   |
| Ephydriidae adult                   | 11.11  | 0.80  | 0.07  | 2.48  | 9.67    |
| Muscidae larva                      | 22.22  | 11.20 | 10.88 | 8.52  | 490.62  |
| <u>Cottus asper</u> juvenile        | 11.11  | 0.80  | 77.51 | 10.35 | 870.02  |

Prickly Sculpin Captured at South Slough Site During Winter; n= 8;  $\Sigma N$  = 26;  $\Sigma W$  = 0.0133176 grams

| Prey Item                           | %F    | %N    | %W    | %W    | IRI     |
|-------------------------------------|-------|-------|-------|-------|---------|
| Ostracoda                           | 25.00 | 7.69  | 0.59  | 0.56  | 207.00  |
| <u>Gnorimosphaeroma oregonensis</u> | 50.00 | 19.23 | 54.96 | 34.29 | 3709.50 |
| <u>Corophium salmonis</u>           | 12.50 | 7.69  | 1.79  | 12.50 | 118.50  |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Prickly Sculpin Captured at South Slough Site During Winter; (continued)

| Prey Item                          | %F    | %N    | %W    | %W    | IRI     |
|------------------------------------|-------|-------|-------|-------|---------|
| <u>Corophium spinicorne</u>        | 37.50 | 26.92 | 8.57  | 6.56  | 1330.88 |
| <u>Anisogammarus confervicolus</u> | 50.00 | 19.23 | 27.82 | 33.59 | 2352.50 |
| Chironomidae larva                 | 12.50 | 19.23 | 6.27  | 12.50 | 318.75  |

Prickly Sculpin Captured at South Slough Site During Spring; n= 1;  
 EN = 26; EW = 0.0105492 grams

| Prey Item                           | %F     | %N    | %W    | %W    | IRI     |
|-------------------------------------|--------|-------|-------|-------|---------|
| <u>Neomysis mercedis</u>            | 100.00 | 19.23 | 38.27 | ----- | 5750.00 |
| <u>Gnorimosphaeroma oregonensis</u> | 100.00 | 7.69  | 27.76 | ----- | 3545.00 |
| <u>Corophium spinicorne</u>         | 100.00 | 65.38 | 26.27 | ----- | 9165.00 |
| Early Instar Limnephilidae larva    | 100.00 | 7.69  | 7.71  | ----- | 154.00  |

Prickly Sculpin Captured at South Slough Site During Summer; n= 6;  
 EN = 39; EW = 0.0294894 grams

| Prey Item                           | %F    | %N    | %W    | %W    | IRI      |
|-------------------------------------|-------|-------|-------|-------|----------|
| Cyclopoid Copepod                   | 16.67 | 15.38 | 0.40  | 1.82  | 263.05   |
| <u>Neomysis mercedis</u>            | 33.33 | 12.82 | 13.69 | 18.07 | 883.58   |
| <u>Gnorimosphaeroma oregonensis</u> | 83.33 | 41.03 | 79.43 | 74.30 | 10037.93 |
| <u>Corophium salmonis</u>           | 16.67 | 2.56  | 0.40  | 0.40  | 49.34    |
| <u>Corophium spinicorne</u>         | 16.67 | 5.13  | 1.11  | 0.62  | 104.02   |
| Chironomidae larva                  | 33.33 | 20.51 | 4.53  | 4.76  | 834.58   |
| Chironomidae pupa                   | 16.67 | 2.56  | 0.43  | 0.23  | 49.84    |

Prickly Sculpin Captured at South Slough Site During Fall; n= 1;  
 EN = 1; EW = 0.001464 grams

| Prey Item                           | %F     | %N     | %W     | %W    | IRI      |
|-------------------------------------|--------|--------|--------|-------|----------|
| <u>Gnorimosphaeroma oregonensis</u> | 100.00 | 100.00 | 100.00 | ----- | 20000.00 |

Staghorn Sculpin Captured at Downstream Site During Winter; n= 1;  
 EN = 19; EW = 0.0175997 grams

| Prey Item                          | %F     | %N     | %W     | %W    | IRI      |
|------------------------------------|--------|--------|--------|-------|----------|
| <u>Anisogammarus confervicolus</u> | 100.00 | 100.00 | 100.00 | ----- | 20000.00 |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Staghorn Sculpin Captured at Downstream Site During Spring; n = 2;  
 $\Sigma N = 2$ ;  $\Sigma W = 0.0354$  grams

| Prey Item                | %F     | %N     | %W     | %W    | IRI      |
|--------------------------|--------|--------|--------|-------|----------|
| <u>Neanthes succinea</u> | 100.00 | 100.00 | 100.00 | ----- | 20000.00 |

Staghorn Sculpin Captured at Downstream Site During Summer; n = 9;  
 $\Sigma N = 219$ ;  $\Sigma W = 40.4313936$  grams

| Prey Item                              | %F    | %N    | %W     | %W    | IRI     |
|----------------------------------------|-------|-------|--------|-------|---------|
| <u>Octopus rubescens</u>               | 11.11 | 0.46  | 98.869 | 11.02 | 1103.55 |
| <u>Neomysis mercedis</u>               | 44.44 | 8.23  | 0.036  | 9.17  | 367.34  |
| <u>Gnorimosphaeroma oregonensis</u>    | 22.22 | 2.74  | 0.022  | 5.12  | 61.37   |
| <u>Corophium salmonis</u>              | 55.56 | 26.03 | 0.017  | 5.56  | 1447.17 |
| <u>Corophium spinicorne</u>            | 66.67 | 33.33 | 0.029  | 22.20 | 2224.04 |
| <u>Anisogammarus confervicolus</u>     | 22.22 | 5.02  | 0.025  | 12.99 | 112.10  |
| <u>Crangon franciscorum</u>            | 11.11 | 0.46  | 0.802  | 0.09  | 14.02   |
| Ceratopogonidae larva                  | 22.22 | 1.83  | 0.001  | 0.21  | 40.68   |
| Chironomidae larva                     | 55.56 | 8.68  | 0.008  | 3.60  | 482.71  |
| Chironomidae pupa                      | 33.33 | 1.83  | 0.001  | 0.54  | 61.03   |
| Tabanidae larva                        | 11.11 | 0.46  | 0.006  | 0.90  | 5.18    |
| Ephydriidae adult                      | 11.11 | 8.23  | 0.004  | 0.67  | 91.48   |
| Muscidae adult                         | 11.11 | 0.46  | 0.0004 | 0.06  | 5.12    |
| <u>Gasterosteus aculeatus</u> juvenile | 33.33 | 1.37  | 0.180  | 27.78 | 51.66   |
| Unidentified Egg                       | 11.11 | 0.91  | 0.0001 | 0.10  | 10.11   |

Staghorn Sculpin Captured at Downstream Site on 24-25 June (=Preberm Summer; n = 8;  $\Sigma N = 148$ ;  $\Sigma W = 40.4199369$  grams

| Prey Item                              | %F    | %N    | %W     | %W    | IRI     |
|----------------------------------------|-------|-------|--------|-------|---------|
| <u>Octopus rubescens</u>               | 12.50 | 0.68  | 98.897 | 12.40 | 1244.71 |
| <u>Neomysis mercedis</u>               | 37.50 | 11.49 | 0.034  | 9.42  | 432.15  |
| <u>Gnorimosphaeroma oregonensis</u>    | 25.00 | 4.05  | 0.022  | 5.76  | 101.80  |
| <u>Corophium salmonis</u>              | 50.00 | 30.41 | 0.013  | 4.66  | 1521.15 |
| <u>Corophium spinicorne</u>            | 62.50 | 14.86 | 0.009  | 15.71 | 929.31  |
| <u>Anisogammarus confervicolus</u>     | 25.00 | 7.43  | 0.025  | 14.62 | 186.38  |
| <u>Crangon franciscorum</u>            | 12.50 | 0.68  | 0.802  | 0.10  | 18.53   |
| Ceratopogonidae larva                  | 12.50 | 0.68  | 0.0002 | 0.24  | 8.50    |
| Chironomidae larva                     | 50.00 | 10.14 | 0.006  | 3.30  | 507.30  |
| Chironomidae pupa                      | 37.50 | 2.70  | 0.001  | 0.60  | 101.29  |
| Tabanidae larva                        | 12.50 | 0.68  | 0.006  | 1.01  | 8.59    |
| Ephydriidae adult                      | 12.50 | 12.16 | 0.004  | 0.76  | 152.05  |
| Muscidae adult                         | 12.50 | 0.68  | 0.0004 | 0.07  | 8.51    |
| <u>Gasterosteus aculeatus</u> juvenile | 37.50 | 2.03  | 0.180  | 31.26 | 82.88   |
| Unidentified Egg                       | 12.50 | 1.35  | 0.0001 | 0.11  | 16.88   |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Staghorn Sculpin Captured at Downstream Site During Fall; n= 9;  $\Sigma N = 26$ ;  $\Sigma W = 0.0367592$  grams

| Prey Item                          | %F     | %N    | %W     | %W    | IRI      |
|------------------------------------|--------|-------|--------|-------|----------|
| <u>Neanthes succinea</u>           | 100.00 | 3.85  | 48.15  | ----- | 5200.00  |
| <u>Neomysis mercedis</u>           | 100.00 | 7.69  | 4.39   | ----- | 1208.00  |
| <u>Corophium salmonis</u>          | 100.00 | 15.38 | 1.77   | ----- | 1715.00  |
| <u>Corophium spinicorne</u>        | 100.00 | 3.85  | 0.32   | ----- | 417.00   |
| <u>Anisogammarus confervicolus</u> | 100.00 | 69.23 | 45.365 | ----- | 11459.00 |

Staghorn Sculpin Captured at South Slough Site During Winter; n= 5;  $\Sigma N = 35$ ;  $\Sigma W = 0.0255443$  grams

| Prey Item                           | %F    | %N    | %W    | %W    | IRI     |
|-------------------------------------|-------|-------|-------|-------|---------|
| <u>Neomysis mercedis</u>            | 40.00 | 34.29 | 37.93 | 23.60 | 2888.80 |
| <u>Gnorimosphaeroma oregonensis</u> | 80.00 | 20.00 | 40.12 | 35.84 | 4809.60 |
| <u>Corophium salmonis</u>           | 40.00 | 14.29 | 2.33  | 20.39 | 664.80  |
| <u>Corophium spinicorne</u>         | 60.00 | 14.29 | 3.19  | 2.86  | 1048.80 |
| <u>Anisogammarus confervicolus</u>  | 60.00 | 8.57  | 10.88 | 12.86 | 1167.00 |
| Chironomidae larva                  | 20.00 | 5.71  | 1.31  | 0.94  | 140.40  |
| Muscidae larva                      | 20.00 | 2.86  | 4.25  | 3.51  | 142.20  |

Staghorn Sculpin Captured at South Slough Site During Spring; n= 2;  $\Sigma N = 7$ ;  $\Sigma W = 0.0036786$  grams

| Prey Item                   | %F     | %N    | %W    | %W    | IRI      |
|-----------------------------|--------|-------|-------|-------|----------|
| <u>Neomysis mercedis</u>    | 100.00 | 57.14 | 87.79 | 92.18 | 14493.00 |
| <u>Corophium salmonis</u>   | 50.00  | 14.29 | 3.23  | 2.07  | 876.00   |
| <u>Corophium spinicorne</u> | 50.00  | 14.29 | 4.43  | 2.84  | 936.00   |
| Chironomidae larva          | 50.00  | 14.29 | 4.54  | 2.91  | 941.50   |

Staghorn Sculpin Captured at South Slough Site During Summer (=24-25 June); n= 3;  $\Sigma N = 77$ ;  $\Sigma W = 0.0361198$  grams

| Prey Item                           | %F     | %N    | %W    | %W    | IRI      |
|-------------------------------------|--------|-------|-------|-------|----------|
| <u>Neomysis mercedis</u>            | 100.00 | 48.05 | 82.71 | 86.18 | 13076.00 |
| <u>Gnorimosphaeroma oregonensis</u> | 33.33  | 1.30  | 4.05  | 2.40  | 178.32   |
| <u>Corophium salmonis</u>           | 66.67  | 45.45 | 11.53 | 9.46  | 3798.86  |
| <u>Corophium spinicorne</u>         | 33.33  | 3.90  | 1.35  | 0.80  | 174.98   |
| Chironomidae pupa                   | 33.33  | 1.30  | 0.35  | 1.15  | 54.99    |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Starry Flounder Captured at Downstream Site During Winter; n = 2;  
EN = 71; EW = 0.0801757 grams

| Prey Item                           | %F     | %N    | %W    | %W    | IRI      |
|-------------------------------------|--------|-------|-------|-------|----------|
| <u>Gnorimosphaeroma oregonensis</u> | 50.00  | 1.41  | 1.83  | 1.36  | 162.00   |
| <u>Corophium spinicorne</u>         | 100.00 | 14.08 | 2.03  | 1.67  | 1611.00  |
| <u>Anisogammarus confervicolus</u>  | 100.00 | 83.10 | 68.16 | 76.24 | 15126.00 |
| <u>Calineuria</u> sp. nymph         | 50.00  | 1.41  | 27.98 | 20.74 | 1469.50  |

Starry Flounder Captured at Downstream Site During Spring; n = 5;  
EN = 26; EW = 0.0082983 grams

| Prey Item                           | %F    | %N    | %W    | %W    | IRI     |
|-------------------------------------|-------|-------|-------|-------|---------|
| <u>Neomysis mercedis</u>            | 20.00 | 7.69  | 19.46 | 9.96  | 543.00  |
| <u>Gnorimosphaeroma oregonensis</u> | 40.00 | 7.69  | 35.28 | 29.03 | 718.80  |
| <u>Corophium salmonis</u>           | 20.00 | 15.38 | 5.74  | 4.49  | 422.40  |
| <u>Corophium spinicorne</u>         | 60.00 | 38.46 | 19.64 | 26.81 | 3486.00 |
| <u>Anisogammarus confervicolus</u>  | 20.00 | 3.85  | 11.16 | 14.29 | 300.20  |
| Chironomidae larva                  | 40.00 | 15.38 | 8.05  | 24.73 | 937.20  |
| Unidentified Egg (0.5mm)            | 20.00 | 11.54 | 0.67  | 0.68  | 244.20  |

Starry Flounder Captured at Downstream Site on 24-25 June (=Preberm Summer); n = 4; EN = 108; EW = 0.019304 grams

| Prey Item                   | %F     | %N    | %W    | %W    | IRI      |
|-----------------------------|--------|-------|-------|-------|----------|
| <u>Corophium salmonis</u>   | 50.00  | 17.59 | 11.71 | 16.01 | 1465.00  |
| <u>Corophium spinicorne</u> | 75.00  | 12.96 | 11.82 | 19.66 | 1858.50  |
| Tipulidae larva             | 25.00  | 0.93  | 12.54 | 5.99  | 336.75   |
| Chironomidae larva          | 100.00 | 67.59 | 63.15 | 53.72 | 13074.00 |
| Empididae larva             | 25.00  | 0.93  | 0.78  | 4.63  | 42.75    |

Starry Flounder Captured at Downstream Site During Summer After the Berm Had Been Breached; n = 10; EN = 862; EW = 1.7117317 grams

| Prey Item                           | %F    | %N    | %W    | %W    | IRI     |
|-------------------------------------|-------|-------|-------|-------|---------|
| <u>Neanthes succinea</u>            | 30.00 | 1.16  | 10.34 | 15.70 | 345.00  |
| <u>Gnorimosphaeroma oregonensis</u> | 30.00 | 9.74  | 7.18  | 10.35 | 507.60  |
| <u>Corophium salmonis</u>           | 60.00 | 26.10 | 1.56  | 10.43 | 1659.60 |
| <u>Corophium spinicorne</u>         | 90.00 | 44.43 | 3.65  | 34.64 | 4327.20 |
| <u>Anisogammarus confervicolus</u>  | 10.00 | 0.12  | 0.05  | 5.26  | 1.70    |
| <u>Crangon franciscorum</u>         | 10.00 | 0.46  | 75.74 | 9.65  | 762.00  |
| Ceratopogonidae larva               | 30.00 | 0.46  | 0.02  | 0.12  | 14.40   |
| Chironomidae larva                  | 50.00 | 16.59 | 1.40  | 12.42 | 899.50  |
| Chironomidae pupa                   | 50.00 | 0.93  | 0.06  | 1.43  | 49.50   |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Starry Flounder Captured at Downstream Site on 7 July; n= 6;  $\Sigma N$  = 558;  $\Sigma W$  = 0.1050157 grams

| Prey Item                           | %F    | %N    | %W    | %W    | IRI     |
|-------------------------------------|-------|-------|-------|-------|---------|
| <u>Neanthes succinea</u>            | 16.67 | 0.18  | 16.85 | 9.08  | 283.89  |
| <u>Gnorimosphaeroma oregonensis</u> | 16.67 | 0.18  | 1.39  | 0.53  | 26.17   |
| <u>Corophium salmonis</u>           | 83.33 | 22.40 | 14.16 | 10.36 | 3046.54 |
| <u>Corophium spinicorne</u>         | 83.33 | 49.28 | 42.68 | 47.98 | 7663.03 |
| <u>Anisogammarus confervicolus</u>  | 16.67 | 0.18  | 0.88  | 8.77  | 17.67   |
| Ceratopogonidae larva               | 50.00 | 0.72  | 0.31  | 0.20  | 51.50   |
| Chironomidae larva                  | 83.33 | 25.63 | 22.74 | 20.71 | 4030.67 |
| Chironomidae pupa                   | 83.33 | 1.43  | 0.98  | 2.39  | 200.83  |

Starry Flounder Captured at Downstream Site During Fall; n= 12;  $\Sigma N$  = 676;  $\Sigma W$  = 0.6363951 grams

| Prey Item                           | %F    | %N    | %W    | %W     | IRI     |
|-------------------------------------|-------|-------|-------|--------|---------|
| <u>Neanthes succinea</u>            | 33.33 | 4.44  | 83.44 | 30.98  | 2929.04 |
| <u>Huntemannia sp.</u>              | 8.33  | 0.15  | 0.01  | 0.0008 | 1.33    |
| <u>Gnorimosphaeroma oregonensis</u> | 25.00 | 0.59  | 0.92  | 8.89   | 37.75   |
| <u>Corophium salmonis</u>           | 58.33 | 34.62 | 4.38  | 15.28  | 2274.87 |
| <u>Corophium spinicorne</u>         | 91.67 | 58.88 | 10.19 | 43.43  | 6331.65 |
| <u>Anisogammarus confervicolus</u>  | 25.00 | 1.04  | 1.02  | 0.44   | 51.50   |
| Chironomidae larva                  | 16.67 | 0.30  | 0.05  | 0.99   | 5.83    |

Starry Flounder Captured at South Slough Site During Winter; n= 2;  $\Sigma N$  = 22;  $\Sigma W$  = 0.0253124 grams

| Prey Item                           | %F     | %N    | %W    | %W    | IRI      |
|-------------------------------------|--------|-------|-------|-------|----------|
| <u>Gnorimosphaeroma oregonensis</u> | 100.00 | 54.55 | 69.40 | 69.06 | 12395.00 |
| <u>Anisogammarus confervicolus</u>  | 100.00 | 36.36 | 29.28 | 29.77 | 6564.00  |
| Chironomidae larva                  | 50.00  | 9.09  | 1.32  | 1.17  | 520.50   |

Humboldt Sucker Captured at Upstream Site During Winter n= 4;  $\Sigma N$  = 36;  $\Sigma W$  = 0.0063845 grams

| Prey Item                         | %F     | %N    | %W    | %W    | IRI      |
|-----------------------------------|--------|-------|-------|-------|----------|
| Unidentified Ephemeroptera nymph  | 25.00  | 5.56  | 15.70 | 4.92  | 531.50   |
| <u>Optioservus seriatus</u> larva | 25.00  | 2.78  | 2.24  | 0.71  | 125.50   |
| <u>Optioservus seriatus</u> adult | 25.00  | 11.11 | 7.08  | 18.26 | 454.75   |
| Chironomidae larva                | 100.00 | 75.00 | 70.62 | 74.76 | 14562.00 |
| Chironomidae pupa                 | 25.00  | 2.78  | 2.00  | 0.64  | 119.50   |
| Empididae larva                   | 25.00  | 2.78  | 2.35  | 0.74  | 128.25   |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Humboldt Sucker Captured at Upstream Site During Spring; n= 2;  $\Sigma N = 34$ ;  $\Sigma W = 0.0054514$  grams

| Prey Item                | %F     | %N    | %W    | %W    | IRI      |
|--------------------------|--------|-------|-------|-------|----------|
| Chironomidae larva       | 100.00 | 91.18 | 94.97 | 94.65 | 18615.00 |
| Chironomidae pupa        | 100.00 | 5.88  | 4.70  | 5.09  | 1058.00  |
| Unidentified Egg (0.5mm) | 50.00  | 2.94  | 0.34  | 0.27  | 164.00   |

Humboldt Sucker Captured at Upstream Site During Summer; n= 5;  $\Sigma N = 68$ ;  $\Sigma W = 0.0124856$  grams

| Prey Item                     | %F     | %N    | %W    | %W    | IRI      |
|-------------------------------|--------|-------|-------|-------|----------|
| <u>Siphonurus</u> sp. nymph   | 20.00  | 1.47  | 7.88  | 4.42  | 187.00   |
| <u>Serratella levis</u> nymph | 20.00  | 1.47  | 5.41  | 6.17  | 137.60   |
| Chironomidae larva            | 100.00 | 89.71 | 81.59 | 84.16 | 17130.00 |
| Chironomidae pupa             | 40.00  | 7.35  | 5.13  | 5.25  | 499.20   |

Humboldt Sucker Captured at Downstream Site During Spring; n= 2;  $\Sigma N = 80$ ;  $\Sigma W = 0.0008231$  grams

| Prey Item              | %F     | %N    | %W    | %W    | IRI     |
|------------------------|--------|-------|-------|-------|---------|
| <u>Huntemannia</u> sp. | 50.00  | 93.75 | 9.11  | 11.64 | 5143.00 |
| Ceratopogonidae larva  | 50.00  | 1.25  | 9.73  | 12.44 | 549.00  |
| Chironomidae larva     | 100.00 | 5.00  | 81.16 | 75.93 | 8616.00 |

Humboldt Sucker Captured at Downstream Site on 24-25 June (= Summer); n=14;  $\Sigma N = 716$ ;  $\Sigma W = 0.1201381$  grams

| Prey Item                           | %F     | %N    | %W     | %W    | IRI      |
|-------------------------------------|--------|-------|--------|-------|----------|
| Acari                               | 7.14   | 0.14  | 0.09   | 0.05  | 1.64     |
| <u>Huntemannia</u> sp.              | 7.14   | 0.14  | 0.0008 | 0.006 | 1.01     |
| <u>Gnorimosphaeroma oregonensis</u> | 7.14   | 0.14  | 1.22   | 0.81  | 9.71     |
| <u>Corophium salmonis</u>           | 7.14   | 0.14  | 0.10   | 0.21  | 1.71     |
| <u>Corophium spinicorne</u>         | 7.14   | 0.14  | 0.14   | 0.05  | 2.00     |
| <u>Deronectes</u> sp. larva         | 14.28  | 0.42  | 0.82   | 1.07  | 17.71    |
| Ceratopogonidae larva               | 21.43  | 0.56  | 0.27   | 1.97  | 17.79    |
| Chironomidae larva                  | 100.00 | 96.23 | 95.78  | 94.82 | 19201.00 |
| Chironomidae pupa                   | 42.86  | 2.09  | 1.60   | 1.02  | 158.15   |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Humboldt Sucker Captured at South Slough Site During Summer; n= 8;  
EN = 126; EW = 0.0896928 grams

| Prey Item                            | %F    | %N    | %W    | %W    | IRI     |
|--------------------------------------|-------|-------|-------|-------|---------|
| Ostracod                             | 12.50 | 0.79  | 0.04  | 0.33  | 10.83   |
| <u>Neomysis mercedis</u>             | 12.50 | 0.79  | 0.90  | 0.98  | 21.13   |
| <u>Gnoringosphaeroma oregonensis</u> | 62.50 | 30.16 | 62.03 | 43.98 | 5761.88 |
| <u>Corophium salmonis</u>            | 12.50 | 13.49 | 2.26  | 2.44  | 196.88  |
| <u>Corophium spinicorne</u>          | 50.00 | 25.40 | 5.82  | 22.72 | 1561.00 |
| <u>Ischnura cervula</u> naiad        | 12.50 | 0.79  | 6.10  | 5.62  | 86.13   |
| <u>Haliphus</u> sp. larva            | 12.50 | 14.29 | 6.73  | 6.19  | 262.75  |
| <u>Glyphopsyche</u> sp. larva        | 12.50 | 1.59  | 13.24 | 7.19  | 185.38  |
| Chironomidae larva                   | 50.00 | 11.11 | 2.61  | 7.01  | 686.00  |
| Chironomidae pupa                    | 25.00 | 1.59  | 0.29  | 3.55  | 47.00   |

Juvenile Threespine Stickleback Captured at Upstream Site During Summer;  
n= 6; EN = 22; EW = 0.0041175 grams

| Prey Item                     | %F    | %N    | %W    | %W    | IRI      |
|-------------------------------|-------|-------|-------|-------|----------|
| Acari                         | 50.00 | 22.73 | 12.45 | 10.18 | 1759.00  |
| <u>Serratella levis</u> nymph | 16.67 | 4.55  | 16.39 | 16.67 | 349.07   |
| Chironomidae larva            | 83.33 | 68.18 | 60.84 | 67.23 | 10751.24 |
| <u>Simulium</u> sp. larva     | 16.67 | 4.55  | 10.32 | 5.93  | 247.88   |

Juvenile Threespine Stickleback Captured at Upstream Site During Fall;  
n= 1; EN = 7; EW = 0.0009242 grams

| Prey Item          | %F     | %N    | %W    | %W    | IRI     |
|--------------------|--------|-------|-------|-------|---------|
| Ostracod           | 100.00 | 14.29 | 4.24  | ----- | 1853.00 |
| Chironomidae larva | 100.00 | 42.86 | 54.21 | ----- | 9707.00 |
| Chironomidae pupa  | 100.00 | 42.86 | 41.55 | ----- | 8441.00 |

Juvenile Threespine Stickleback Captured at Downstream Site During Spring; n= 13; EN = 307; EW = 0.0512257 grams

| Prey Item                | %F    | %N    | %W    | %W    | IRI     |
|--------------------------|-------|-------|-------|-------|---------|
| <u>Neanthes succinea</u> | 7.69  | 0.33  | 34.55 | 6.97  | 268.23  |
| Acari                    | 38.46 | 2.61  | 1.60  | 2.71  | 161.92  |
| <u>Eurytemora</u> sp.    | 7.69  | 0.33  | 0.02  | 0.004 | 2.69    |
| <u>Huntemannia</u> sp.   | 84.62 | 24.43 | 0.15  | 0.24  | 2079.96 |
| Cypris larva             | 7.69  | 0.65  | 0.15  | 0.35  | 6.15    |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Juvenile Threespine Stickleback Captured at Downstream Site During Spring; (continued)

| Prey Item                                           | %F     | %N    | %W    | %W    | IRI      |
|-----------------------------------------------------|--------|-------|-------|-------|----------|
| <u>Corophium salmonis</u> (4 adult and 17 juvenile) | 76.92  | 6.84  | 1.26  | 1.28  | 622.89   |
| Ceratopogonidae larva                               | 53.85  | 4.56  | 2.19  | 2.73  | 363.49   |
| Chironomidae larva                                  | 100.00 | 59.28 | 59.33 | 84.10 | 11861.00 |
| Chironomidae pupa                                   | 23.08  | 0.98  | 0.75  | 1.60  | 39.93    |

Juvenile Threespine Stickleback Captured at South Slough Site During Spring; n = 6;  $\Sigma N = 50$ ;  $\Sigma W = 0.0024259$  grams

| Prey Item              | %F    | %N    | %W    | %W    | IRI     |
|------------------------|-------|-------|-------|-------|---------|
| Acari                  | 16.67 | 2.00  | 4.23  | 3.55  | 103.85  |
| Cladoceran             | 50.00 | 28.00 | 3.58  | 3.33  | 1579.00 |
| Ostracod               | 50.00 | 12.00 | 9.70  | 32.76 | 1085.00 |
| <u>Huntemannia</u> sp. | 16.67 | 4.00  | 0.08  | 0.07  | 68.01   |
| <u>Eucyclops</u> sp.   | 50.00 | 32.00 | 13.13 | 32.16 | 2256.50 |
| Chironomidae larva     | 33.33 | 14.00 | 48.19 | 21.84 | 2072.79 |
| Chironomidae pupa      | 16.67 | 8.00  | 21.11 | 6.31  | 485.26  |

Juvenile Threespine Stickleback Captured at South Slough Site During Summer; n = 5;  $\Sigma N = 41$ ;  $\Sigma W = 0.000751$  grams

| Prey Item            | %F    | %N    | %W    | %W    | IRI     |
|----------------------|-------|-------|-------|-------|---------|
| Acari                | 20.00 | 2.44  | 13.65 | 16.48 | 321.80  |
| Cladoceran juvenile  | 40.00 | 34.15 | 1.86  | 20.32 | 1440.40 |
| <u>Eucyclops</u> sp. | 60.00 | 12.20 | 13.25 | 43.20 | 1527.00 |
| Chironomidae larva   | 20.00 | 2.44  | 22.24 | 6.24  | 493.60  |
| Unidentified Egg     | 20.00 | 48.78 | 49.00 | 13.76 | 1955.60 |

Juvenile Threespine Stickleback Captured at South Slough Site During Fall; n = 3;  $\Sigma N = 34$ ;  $\Sigma W = 0.01536$  grams

| Prey Item                | %F    | %N    | %W    | %W    | IRI     |
|--------------------------|-------|-------|-------|-------|---------|
| Cladoceran               | 33.33 | 14.71 | 0.20  | 33.33 | 496.95  |
| Ostracod                 | 33.33 | 2.94  | 0.26  | 1.41  | 106.66  |
| <u>Neomysis mercedis</u> | 33.33 | 50.00 | 89.36 | 31.76 | 4644.87 |
| Chironomidae larva       | 66.67 | 11.76 | 4.35  | 18.46 | 1074.05 |
| Chironomidae pupa        | 66.67 | 20.59 | 5.83  | 15.03 | 1761.42 |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Juvenile Threespine Stickleback Captured at North Slough Site During Spring; n = 9;  $\Sigma N = 1566$ ;  $\Sigma W = 0.029718$  grams

| Prey Item                | %F    | %N    | %W    | %W    | IRI      |
|--------------------------|-------|-------|-------|-------|----------|
| Cladoceran               | 33.33 | 0.26  | 0.08  | 0.26  | 11.33    |
| Ostracod                 | 11.11 | 0.06  | 0.13  | 0.12  | 2.11     |
| <u>Huntemannia</u> sp.   | 22.22 | 0.26  | 0.01  | 11.15 | 6.00     |
| Chironomidae larva       | 11.11 | 0.38  | 3.37  | 11.08 | 41.66    |
| Chironomidae pupa        | 11.11 | 0.06  | 0.43  | 0.25  | 5.44     |
| Unidentified Egg (0.5mm) | 77.78 | 98.98 | 95.97 | 77.14 | 15163.21 |

Juvenile Threespine Stickleback Captured at North Slough Site During Summer; n = 2;  $\Sigma N = 48$ ;  $\Sigma W = 0.0010036$  grams

| Prey Item            | %F     | %N    | %W    | %W    | IRI     |
|----------------------|--------|-------|-------|-------|---------|
| Acari                | 50.00  | 4.17  | 20.43 | 14.74 | 1230.00 |
| Cladoceran           | 100.00 | 62.50 | 18.53 | 17.86 | 8103.00 |
| <u>Eucyclops</u> sp. | 100.00 | 29.17 | 27.76 | 43.39 | 5693.00 |
| Chironomidae larva   | 50.00  | 4.17  | 33.28 | 24.02 | 1872.50 |

Adult Threespine Stickleback Captured at Upstream Site During Spring; n = 2;  $\Sigma N = 37$ ;  $\Sigma W = 0.0063509$  grams

| Prey Item                        | %F    | %N    | %W    | %W    | IRI     |
|----------------------------------|-------|-------|-------|-------|---------|
| <u>Drunella flavilinea</u> nymph | 50.00 | 2.70  | 10.63 | 17.37 | 666.50  |
| Psocoptera adult                 | 50.00 | 2.70  | 0.31  | 0.51  | 150.50  |
| Cicadellidae adult               | 50.00 | 8.11  | 19.65 | 32.12 | 1388.00 |
| Chironomidae larva               | 50.00 | 21.62 | 21.04 | 10.18 | 2133.00 |
| Chironomidae pupa                | 50.00 | 64.86 | 48.37 | 39.83 | 5661.50 |

Adult Threespine Stickleback Captured at Upstream Site During Summer; n = 32;  $\Sigma N = 1048$ ;  $\Sigma W = 0.2831953$  grams

| Prey Item                        | %F    | %N   | %W   | %W   | IRI    |
|----------------------------------|-------|------|------|------|--------|
| Acari                            | 12.50 | 1.53 | 0.58 | 2.42 | 26.38  |
| Unidentified Ephemeroptera nymph | 3.13  | 0.19 | 0.35 | 0.15 | 1.69   |
| Unidentified Ephemeroptera adult | 3.13  | 0.19 | 0.85 | 0.95 | 3.26   |
| <u>Ameletus</u> sp. nymph        | 25.00 | 1.81 | 6.60 | 6.82 | 210.25 |
| <u>Siphonurus</u> sp. nymph      | 6.25  | 1.24 | 4.52 | 1.84 | 36.00  |
| <u>Baetis</u> sp. nymph          | 3.13  | 0.19 | 0.18 | 0.07 | 1.16   |
| <u>Heptagenia</u> sp. nymph      | 18.75 | 0.86 | 0.45 | 0.35 | 24.56  |
| <u>Drunella flavilinea</u> nymph | 3.13  | 0.38 | 0.95 | 0.85 | 4.16   |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Adult Threespine Stickleback Captured at Upstream Site During Summer;  
(continued)

| Prey Item                      | %F    | %N    | %W    | %W    | IRI     |
|--------------------------------|-------|-------|-------|-------|---------|
| <u>Serratella levis</u> nymph  | 43.75 | 4.58  | 11.44 | 15.92 | 700.88  |
| <u>Tricorythodes</u> sp. nymph | 28.13 | 10.88 | 18.16 | 11.94 | 816.90  |
| <u>Sigara vandykei</u> nymph   | 3.13  | 0.10  | 0.12  | 0.37  | 0.69    |
| Membracidae adult              | 3.13  | 0.10  | 2.90  | 0.15  | 9.39    |
| <u>Deronectes</u> sp. larva    | 28.13 | 5.15  | 6.26  | 4.74  | 320.96  |
| Tipulidae larva                | 6.25  | 0.27  | 2.56  | 4.26  | 17.69   |
| Ceratopogonidae larva          | 12.50 | 0.57  | 0.17  | 0.14  | 9.25    |
| Chironomidae larva             | 81.25 | 59.35 | 36.68 | 37.31 | 7802.44 |
| Chironomidae pupa              | 65.63 | 11.83 | 5.60  | 11.04 | 1143.93 |
| <u>Simulium</u> sp. larva      | 6.25  | 0.57  | 0.90  | 0.38  | 9.19    |
| Muscidae larva                 | 3.13  | 0.19  | 0.77  | 0.31  | 3.00    |

Adult Threespine Stickleback Captured at Upstream Site During Fall;  
n = 4; EN = 66; EW = 0.009918 grams

| Prey Item                   | %F     | %N    | %W    | %W    | IRI      |
|-----------------------------|--------|-------|-------|-------|----------|
| <u>Corophium spinicorne</u> | 25.00  | 4.55  | 4.93  | 18.64 | 237.00   |
| Chironomidae larva          | 100.00 | 53.03 | 58.93 | 55.0  | 11196.00 |
| Chironomidae pupa           | 75.00  | 42.42 | 36.14 | 26.37 | 5892.00  |

Adult Threespine Stickleback Captured at Downstream Site During Spring;  
n = 14; EN = 252; EW = 0.0560269 grams

| Prey Item                           | %F    | %N    | %W    | %W    | IRI     |
|-------------------------------------|-------|-------|-------|-------|---------|
| Acari                               | 14.29 | 7.14  | 3.29  | 1.03  | 149.04  |
| <u>Neomysis mercedis</u>            | 21.43 | 5.95  | 21.62 | 9.56  | 590.83  |
| <u>Gnorimosphaeroma oregonensis</u> | 7.14  | 2.38  | 15.68 | 6.40  | 128.95  |
| <u>Corophium salmonis</u>           | 14.29 | 1.19  | 0.64  | 0.74  | 26.15   |
| <u>Corophium spinicorne</u>         | 78.57 | 27.38 | 20.07 | 29.94 | 3728.15 |
| <u>Alloperla</u> sp. nymph          | 7.14  | 0.40  | 0.64  | 0.16  | 7.43    |
| <u>Deronectes</u> sp. larva         | 7.14  | 0.40  | 0.59  | 0.62  | 7.07    |
| Ceratopogonidae pupa                | 7.14  | 0.40  | 0.10  | 0.03  | 3.57    |
| Chironomidae larva                  | 85.71 | 33.33 | 25.04 | 35.25 | 5002.89 |
| Chironomidae pupa                   | 71.43 | 21.43 | 12.34 | 16.27 | 2412.19 |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Adult Threespine Stickleback Captured at Downstream Site on 24-25 June (=Preberm Summer); n= 23; EN = 2327; EW = 0.3928996 grams

| Prey Item                           | %F    | %N    | %W    | %W    | IRI      |
|-------------------------------------|-------|-------|-------|-------|----------|
| Acari                               | 4.35  | 0.99  | 0.60  | 1.02  | 6.92     |
| <u>Neomysis mercedis</u>            | 8.70  | 0.52  | 2.47  | 7.49  | 26.01    |
| <u>Corophium salmonis</u>           | 13.04 | 0.26  | 0.25  | 0.32  | 6.65     |
| <u>Corophium spinicorne</u>         | 17.39 | 0.26  | 0.18  | 0.28  | 7.65     |
| <u>Baetis</u> sp. nymph             | 4.35  | 0.04  | 0.06  | 0.03  | 0.44     |
| <u>Deronectes</u> sp. larva         | 8.70  | 0.09  | 0.17  | 0.09  | 2.26     |
| <u>Ochrotrichia</u> sp. larva       | 4.35  | 0.04  | 0.01  | 0.02  | 0.22     |
| Ceratopogonidae larva               | 8.70  | 0.21  | 0.10  | 0.10  | 2.70     |
| Chironomidae larva                  | 95.65 | 94.71 | 93.68 | 81.21 | 18019.50 |
| Chironomidae pupa                   | 39.13 | 1.07  | 0.81  | 2.27  | 73.56    |
| Chironomidae adult                  | 4.35  | 0.04  | 0.02  | 0.01  | 0.26     |
| Empididae larva                     | 4.35  | 0.04  | 0.04  | 0.06  | 0.35     |
| <u>Gasterosteus aculeatus</u> larva | 4.35  | 0.04  | 0.14  | 0.31  | 0.78     |
| Unidentified Egg                    | 13.04 | 1.68  | 1.47  | 6.78  | 41.08    |

Adult Threespine Stickleback Captured at Downstream Site During Summer; n= 28; EN = 2386; EW = 0.4033584 grams

| Prey Item                           | %F    | %N    | %W    | %W    | IRI      |
|-------------------------------------|-------|-------|-------|-------|----------|
| Acari                               | 3.57  | 0.96  | 0.58  | 0.84  | 5.50     |
| <u>Neomysis mercedis</u>            | 7.14  | 0.50  | 2.40  | 6.15  | 20.71    |
| <u>Corophium salmonis</u>           | 17.86 | 0.34  | 0.24  | 2.63  | 10.36    |
| <u>Corophium spinicorne</u>         | 17.86 | 0.88  | 0.85  | 0.46  | 30.90    |
| <u>Anisogammarus confervicolus</u>  | 3.57  | 0.08  | 0.46  | 2.08  | 1.93     |
| <u>Baetis</u> sp. nymph             | 3.57  | 0.04  | 0.06  | 0.02  | 0.36     |
| <u>Deronectes</u> sp. larva         | 7.14  | 0.08  | 0.16  | 0.08  | 1.71     |
| <u>Ochrotrichia</u> sp. larva       | 3.57  | 0.04  | 0.01  | 0.01  | 0.18     |
| Ceratopogonidae larva               | 10.71 | 0.29  | 0.14  | 0.22  | 4.61     |
| Chironomidae larva                  | 89.29 | 93.67 | 92.53 | 75.27 | 16625.80 |
| Chironomidae pupa                   | 42.86 | 1.17  | 0.89  | 3.91  | 88.29    |
| Chironomidae adult                  | 10.71 | 0.17  | 0.06  | 2.42  | 2.46     |
| Empididae larva                     | 3.57  | 0.04  | 0.04  | 0.05  | 0.29     |
| <u>Gasterosteus aculeatus</u> larva | 3.57  | 0.04  | 0.14  | 0.26  | 0.64     |
| Unidentified Egg                    | 14.29 | 1.68  | 1.44  | 5.59  | 44.58    |

Adult Threespine Stickleback Captured at Downstream Site During Fall; n= 1; EN = 4; EW = 0.0032296 grams

| Prey Item                | %F     | %N     | %W     | %W    | IRI      |
|--------------------------|--------|--------|--------|-------|----------|
| <u>Neomysis mercedis</u> | 100.00 | 100.00 | 100.00 | ----- | 20000.00 |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Adult Threespine Stickleback Captured at South Slough Site During Winter; n = 12;  $\Sigma N = 49$ ;  $\Sigma W = 0.0256608$  grams

| Prey Item                           | %F    | %N    | %W    | %W    | IRI     |
|-------------------------------------|-------|-------|-------|-------|---------|
| <u>Neomysis mercedis</u>            | 25.00 | 38.78 | 59.78 | 19.25 | 2464.00 |
| <u>Gnorimosphaeroma oregonensis</u> | 8.33  | 4.08  | 11.41 | 2.62  | 129.03  |
| <u>Corophium spinicorne</u>         | 41.67 | 24.49 | 7.62  | 25.81 | 1388.02 |
| <u>Anisogammarus confervicolus</u>  | 16.67 | 8.16  | 14.44 | 9.99  | 376.74  |
| Chironomidae larva                  | 16.67 | 10.20 | 3.25  | 8.71  | 224.21  |
| Chironomidae pupa                   | 41.67 | 14.29 | 3.49  | 33.62 | 740.89  |

Adult Threespine Stickleback Captured at South Slough Site During Spring; n = 10;  $\Sigma N = 165$ ;  $\Sigma W = 0.0753268$  grams

| Prey Item                           | %F    | %N    | %W    | %W    | IRI     |
|-------------------------------------|-------|-------|-------|-------|---------|
| <u>Neomysis mercedis</u>            | 40.00 | 27.88 | 49.31 | 23.56 | 3087.60 |
| <u>Gnorimosphaeroma oregonensis</u> | 30.00 | 7.88  | 25.27 | 17.52 | 994.50  |
| <u>Corophium salmonis</u>           | 10.00 | 0.61  | 0.16  | 0.23  | 7.70    |
| <u>Corophium spinicorne</u>         | 40.00 | 10.30 | 3.68  | 5.94  | 559.20  |
| Unidentified Corixidae adult        | 10.00 | 0.61  | 3.49  | 7.96  | 41.00   |
| Chironomidae larva                  | 70.00 | 38.79 | 14.19 | 29.85 | 3708.60 |
| Chironomidae pupa                   | 80.00 | 13.94 | 3.91  | 14.94 | 1428.00 |

Adult Threespine Stickleback Captured at South Slough Site During Summer; n = 13;  $\Sigma N = 369$ ;  $\Sigma W = 0.0985322$  grams

| Prey Item                           | %F    | %N    | %W    | %W    | IRI     |
|-------------------------------------|-------|-------|-------|-------|---------|
| Acari                               | 7.69  | 0.27  | 0.10  | 0.26  | 2.85    |
| Cladoceran adult                    | 15.38 | 0.81  | 0.02  | 0.02  | 12.77   |
| Harpacticoid Copepod                | 15.38 | 20.60 | 1.53  | 2.01  | 340.36  |
| <u>Neomysis mercedis</u>            | 38.46 | 5.96  | 18.03 | 18.58 | 922.66  |
| <u>Gnorimosphaeroma oregonensis</u> | 38.46 | 4.34  | 23.77 | 15.66 | 1081.11 |
| <u>Corophium salmonis</u>           | 23.08 | 2.44  | 1.09  | 0.63  | 81.47   |
| <u>Corophium spinicorne</u>         | 46.15 | 44.17 | 26.96 | 16.09 | 3282.65 |
| <u>Callibaetis</u> sp. nymph        | 7.69  | 0.27  | 1.86  | 1.96  | 16.38   |
| <u>Ischnura cervula</u> naiad       | 7.69  | 0.54  | 11.11 | 6.79  | 89.59   |
| Unidentified Corixidae adult and    |       |       |       |       |         |
| <u>Sigara mckinstrii</u> nymph      | 15.38 | 0.81  | 3.37  | 3.74  | 64.29   |
| Chironomidae larva                  | 53.85 | 5.15  | 3.22  | 13.11 | 450.72  |
| Chironomidae pupa                   | 38.46 | 5.96  | 2.86  | 10.83 | 339.22  |
| Gasterosteus aculeatus larva        | 15.38 | 0.81  | 1.71  | 3.73  | 38.76   |
| Unidentified Egg                    | 15.38 | 7.86  | 4.36  | 6.58  | 187.94  |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Adult Threespine Stickleback Captured at South Slough Site During Fall; n= 7;  $\Sigma N = 42$ ;  $\Sigma W = 0.0292672$  grams

| Prey Item                           | %F    | %N    | %W    | %W    | IRI      |
|-------------------------------------|-------|-------|-------|-------|----------|
| <u>Neomysis mercedis</u>            | 85.71 | 78.57 | 91.04 | 82.03 | 14537.27 |
| <u>Gnorimosphaeroma oregonensis</u> | 14.29 | 2.38  | 5.00  | 12.16 | 105.46   |
| <u>Corophium salmonis</u>           | 14.29 | 2.38  | 0.41  | 0.54  | 39.87    |
| <u>Corophium spinicorne</u>         | 14.29 | 7.14  | 1.67  | 2.21  | 125.89   |
| Chironomidae larva                  | 14.29 | 2.38  | 0.57  | 0.36  | 42.16    |
| Chironomidae pupa                   | 28.57 | 7.14  | 1.31  | 2.70  | 241.42   |

Adult Threespine Stickleback Captured at North Slough Site During Spring; n= 14;  $\Sigma N = 1019$ ;  $\Sigma W = 0.0549193$  grams

| Prey Item                           | %F    | %N    | %W    | %W    | IRI     |
|-------------------------------------|-------|-------|-------|-------|---------|
| <u>Amnicola</u> sp.                 | 14.29 | 0.29  | 0.62  | 0.71  | 13.00   |
| <u>Lymnaea</u> sp.                  | 7.14  | 0.98  | 2.07  | 2.92  | 21.78   |
| <u>Musculus senhousia</u>           | 7.14  | 0.10  | 0.07  | 0.02  | 1.21    |
| Acari                               | 14.29 | 0.20  | 0.37  | 0.53  | 8.15    |
| Cladoceran                          | 64.29 | 36.41 | 4.12  | 11.15 | 2605.67 |
| Ostracod                            | 35.71 | 28.95 | 21.06 | 16.20 | 1785.86 |
| <u>Huntemannia</u> sp.              | 14.29 | 1.86  | 0.03  | 0.07  | 27.01   |
| Harpacticoid Copepod                | 21.43 | 0.88  | 0.33  | 0.69  | 25.93   |
| <u>Eucyclops</u> sp.                | 14.29 | 16.78 | 6.20  | 3.98  | 328.38  |
| <u>Neomysis mercedis</u>            | 21.43 | 0.29  | 4.41  | 3.40  | 100.72  |
| <u>Gnorimosphaeroma oregonensis</u> | 14.29 | 0.79  | 21.33 | 7.52  | 316.09  |
| <u>Corophium salmonis</u>           | 7.14  | 0.10  | 0.22  | 0.45  | 2.28    |
| <u>Corophium spinicorne</u>         | 28.57 | 0.79  | 2.37  | 3.15  | 90.28   |
| <u>Sigara mckinstryi</u> nymph      | 14.29 | 0.20  | 1.26  | 1.20  | 20.86   |
| <u>Gyrinus</u> sp. larva            | 14.29 | 0.20  | 1.09  | 1.47  | 18.43   |
| <u>Agabus</u> sp. larva             | 14.29 | 0.20  | 1.79  | 1.87  | 28.44   |
| <u>Ilybius</u> sp. larva            | 7.14  | 0.10  | 0.90  | 1.27  | 7.14    |
| <u>Enochrus</u> sp. larva           | 7.14  | 0.10  | 0.55  | 0.53  | 4.64    |
| Ceratopogonidae larva               | 21.43 | 1.08  | 1.60  | 0.69  | 57.43   |
| Chironomidae larva                  | 92.86 | 7.95  | 24.63 | 31.76 | 3025.38 |
| Chironomidae pupa                   | 64.29 | 1.67  | 3.96  | 9.12  | 361.95  |
| <u>Gasterosteus aculeatus</u> larva | 7.14  | 0.10  | 1.02  | 1.31  | 8.00    |

APPENDIX B. Stomach Content Data for Fishes Captured in Lower Redwood Creek, February-December, 1980. (continued)

Surf Smelt Captured at Downstream Site During Fall; n= 6; EN = 8364; EW = 0.3795899 grams

| Prey Item                           | %F     | %N    | %W    | %W    | IRI      |
|-------------------------------------|--------|-------|-------|-------|----------|
| Acari                               | 33.33  | 0.04  | 0.08  | 0.24  | 4.00     |
| <u>Eurytemora</u> sp.               | 100.00 | 92.54 | 18.15 | 35.28 | 11069.00 |
| Cypris larva                        | 66.67  | 1.35  | 1.17  | 3.60  | 168.01   |
| <u>Neomysis mercedis</u>            | 50.00  | 0.22  | 3.83  | 5.46  | 202.50   |
| <u>Gnorimosphaeroma oregonensis</u> | 16.67  | 0.06  | 1.93  | 2.41  | 33.17    |
| <u>Corophium salmonis</u>           | 50.00  | 1.87  | 4.89  | 5.19  | 338.00   |
| <u>Corophium spinicorne</u>         | 100.00 | 0.42  | 1.50  | 3.04  | 192.00   |
| <u>Anisogammarus confervicolus</u>  | 83.33  | 3.28  | 66.86 | 40.99 | 5844.77  |
| Aphididae adult                     | 16.67  | 0.02  | 0.04  | 0.01  | 1.00     |
| Chironomidae larva                  | 50.00  | 0.04  | 0.13  | 0.19  | 8.50     |
| Chironomidae pupa                   | 33.33  | 0.08  | 0.24  | 0.14  | 10.67    |
| Osmeridae larva                     | 66.67  | 0.10  | 1.18  | 3.46  | 85.34    |

Tidewater Goby Captured at North Slough Site During Summer; n= 5; EN = 77; EW = 0.0110495 grams

| Prey Item                           | %F     | %N    | %W    | %W    | IRI     |
|-------------------------------------|--------|-------|-------|-------|---------|
| Cladoceran                          | 60.00  | 5.19  | 0.18  | 0.22  | 322.20  |
| Ostracod                            | 20.00  | 1.30  | 0.35  | 0.15  | 33.00   |
| Harpacticoid Copepod                | 20.00  | 2.60  | 0.36  | 0.15  | 59.20   |
| <u>Eucyclops</u> sp.                | 100.00 | 27.27 | 3.78  | 9.47  | 3105.00 |
| <u>Gnorimosphaeroma oregonensis</u> | 20.00  | 2.60  | 26.50 | 10.85 | 582.00  |
| <u>Corophium salmonis</u>           | 40.00  | 6.49  | 5.38  | 2.71  | 474.80  |
| <u>Corophium spinicorne</u>         | 20.00  | 1.30  | 1.48  | 12.42 | 55.60   |
| Chironomidae larva                  | 80.00  | 53.25 | 61.97 | 64.04 | 9217.60 |