

PREY OF PINNIPEDS AT SELECTED SITES IN OREGON
IDENTIFIED BY SCAT (FECAL) ANALYSIS, 1983 - 1996



Oregon Department of Fish and Wildlife
Wildlife Diversity Program

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ABSTRACT

Over the past 14 years the Oregon Department of Fish and Wildlife has been collecting pinniped scat (fecal) samples at both offshore and estuarine haulout locations in Oregon. Many of these collections were made opportunistically, during other research activities. Collections reported here include samples from Cascade Head, Rogue Reef, Orford Reef, and the Columbia, Rogue, Siletz, Umpqua, and Alsea rivers. These include scat samples collected from Pacific harbor seals (Phoca vitulina), California sea lions (Zalophus californianus) and Steller sea lions (Eumetopias jubatus). Prey identifications were made using fish bones, otoliths and cartilaginous parts recovered from scat samples. Pinnipeds are opportunistic feeders that consume a wide variety of prey species. From the 1,077 scat samples collected for all three species of pinnipeds, 44 species of fish and cephalopods were identified. An additional 19 prey items were identified to the genus, family or order level. These collections indicate that pinnipeds preyed heavily on schooling fishes, such as Pacific whiting and Pacific mackerel for sea lions, and on smelt and herring for harbor seals. Other species such as rockfish, lamprey, salmonids and flatfish were also commonly taken by pinnipeds. The variability in prey selection appeared to be related to the availability (seasonality), and abundance of prey species at a given location. Previous studies in Oregon have shown similar results with a large and diverse number of prey consumed by pinnipeds.

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INTRODUCTION

Populations of the three most common pinnipeds (seals and sea lions) in Oregon have increased since implementation of the Marine Mammal Protection Act in 1972. The Oregon Department of Fish and Wildlife (ODFW) has been monitoring pinniped distribution, abundance and population trends in Oregon since the mid-1970's. Over that period, harbor seal numbers have increased at about 7% per year to an estimated population of 9,000 - 12,000 (Huber et al. 1993). The U. S. population of California sea lions has increased at 6% per year (NMFS 1997) and peak counts in Oregon during fall and spring have increased from 1,000 - 2,000 in the mid-1970's to 4,000 - 8,000 in the mid-1990's (ODFW unpub. data). Steller sea lion numbers in Oregon have been slowly increasing over this same period and now total 2,500 - 3,500 adult and juvenile animals during the summer breeding season (Brown and Riemer, 1992). The potentially negative affect that increasing numbers of pinnipeds may have on declining stocks of salmonids and other fish species has generated renewed interest in the foraging behaviors of these predators.

While pinniped food habits have been examined at many locations from California to Alaska, relatively few studies have been conducted in Oregon. Beach et al. (1985), and Brown et al. (1995) reported on prey of pinnipeds in the Columbia River area. Food habits of pinnipeds in the Rogue River were examined by Roffe and Mate (1984) and by Riemer and Brown (1997); The only other sites in Oregon where pinniped prey have been reported are Netarts Bay (Brown, 1981; Brown and Mate, 1983) and in Coos Bay (Graybill 1981). These studies employed a variety of prey identification techniques, including surface feeding observations, stomach content analysis, and examination of fecal samples.

ODFW has been collecting scat (fecal) samples from pinnipeds at various sites along the Oregon coast for the past 14 years. In most cases, these collections were made while conducting other pinniped research activities and as a result, they were not intended to focus on the consumption of any single prey item (e. g. salmonids). However, analysis of these samples has identified many of the more

important and commonly taken prey species by pinnipeds, over a broad area and over many years. This report summarizes these collections to date, and presents the pinniped prey species identified at each collection site. No estimates of pinniped consumption rates of individual prey species or groups of species are presented here.

STUDY AREA AND METHODS

Information on food habits of pinnipeds in Oregon were obtained through examination of prey hardparts found in scat (fecal) samples. Scat collections were made at Cascade Head, Rogue Reef and Orford Reef, and in the Columbia, Rogue, Siletz, Umpqua, and Alsea rivers (Table 1). These collections include scat from Pacific harbor seals (*Phoca vitulina*), California sea lions (*Zalophus californianus*) and Steller sea lions (*Eumetopias jubatus*). All prey items in this report are reported as percent frequency of occurrence in the sample.

Pinnipeds use various "dry" substrates (e.g. mud/sand tidal flats, nearshore rocky islands) for resting or reproductive activities, and they often defecate while hauled-out of the water at these sites. By slowly approaching haul-out areas on foot or by boat, the animals were gradually moved into the water and the area was searched for scat samples. Using a hand trowel each sample was placed in an individual plastic bag which was then placed in a larger bag with other samples from the same collection. The larger bags were labeled with pinniped species, date and location of the collection and were stored in a freezer for processing at a later time. Scat samples were processed by thawing and partially dissolving the sample in water. The sample was then rinsed with running water through a series of nested sieves (2mm, 1mm, .71mm). All prey hard parts were recovered from the sieves with forceps and placed in small 20 ml scintillation vials with a 70% alcohol solution just covering the prey remains. After approximately one week the alcohol was poured off the samples and they were air-dried and labeled for storage prior to identification.

Prey species were determined by using all identifiable prey hard parts recovered from each sample (with the exception of scat collected at the East Mooring Basin, Columbia River). These hard parts consisted of numerous skeletal bones, otoliths, cartilaginous parts, lenses, teeth and cephalopod beaks. Samples were examined under a dissecting microscope and prey parts were separated for identification. The prey remains were identified by ODFW staff (SR) using a comparative collection of fish from the northeastern Pacific ocean and Oregon estuaries. Otoliths and diagnostic bones were identified, counted, and sided (left-right) to give minimum number of individuals. Diagnostic bones used to determine minimum number of individuals (MNI) varied depending on what structure was most numerous in the sample. Jaw bones, basioccipitals, angulars, otoliths, hypurals, vomers, branchials, and cephalopod beaks, were some of the diagnostic structures used to determine the MNI. Bone size was also considered when determining numbers of fish, for example if 2 different sized vertebrae of the same species were recovered in a sample they were recorded as two individual fish. Because of significant questions about the use of MNI for development of consumption estimates, neither MNI nor such estimates are presented in this report (see Discussion). Approximately 10% of these samples were sent to Pacific Identifications Inc., a biological consulting company, for verification.

The ability to identify prey items to the species level varies depending on the type of bone(s) recovered, the state of digestion, the amount of bone erosion, and the group of fish identified. For example, rockfish species (Sebastes) are difficult to identify to the species level using bones, so they are reported only to genus. Since very few salmonid otoliths are recovered from scat and current techniques do not allow individual salmonid species (Onchorhynchus) to be identified using skeletal bones alone, they are identified in this report as salmonid, (except where identification was made to species using otoliths). Salmonid remains were categorized either as adult or as smolt/small salmonid, by the size of hard parts recovered. Included in the smolt/small salmonid category are all species of salmonid smolts, and small trout species. The adult salmonid group includes all species of salmonids spawning in Oregon rivers and tributaries,

including jacks and steelhead half-pounders. Both classifications include both hatchery and wild fish.

RESULTS

Twenty scat collections were made at 9 different locations in Oregon with a total of 1,077 scat samples collected from Pacific harbor seals (n=591), California sea lions (n=230) and Steller sea lions (n=256) (Table 1). In these collections a total of 44 prey items were identified to species level and 19 other prey types were identified to the genus, family or order level (Appendix A).

Steller Sea Lions

Rogue Reef and Orford Reef

Rogue Reef and Orford Reef are located on the southern Oregon coast near Gold Beach and Port Orford, respectively. Both areas are important breeding sites for approximately 3,000 threatened Steller sea lions (Brown and Riemer, 1992). Scat collections were made at Pyramid Rock, Rogue Reef and Long Brown Rock, Orford Reef in conjunction with other sea lion research activities during late May through early July of 1986 - 1988, 1990, 1993 and 1996 (Table 1). Pacific whiting and Pacific lamprey were the two most frequently identified prey species in all sample sets for each year of collection. Whiting was found in 62% - 100% and lamprey occurred in 2% - 83% of the samples collected within each year (Tables 2 - 8). Other commonly taken prey items included Pacific herring and various species of rockfish, flatfish and cephalopods. Salmonids were identified as sea lion prey in each year's samples with frequencies of occurrence ranging from 5% - 33%. One sample collected in May, 1996 contained two otoliths from an adult chinook salmon, all other salmonids were identified using bones or otoliths too eroded to identify to species. A total of 25 different prey items were identified to the species level. An additional 15 prey types were identified to the order, family or genus level.

California Sea Lions

Cascade Head

Cascade Head, located on the central Oregon Coast north of Lincoln City, is one of the largest haulout areas for California sea lions in Oregon. This rocky headland is used by 500 to 2,000 California sea lions in the fall, winter and spring (Brown, 1988; ODFW unpublished data). Collections were made at this site in 1994 during February and October (Table 1). In the February collection, Pacific mackerel (found in 52.4% of the 82 samples) was the most commonly occurring prey item, followed by Pacific sardine in 29.3%, and salmonids and cephalopods in 26.8% (Table 9). Of the samples which contained salmonids, 18 (21.9%) contained adult salmonid remains and 14 (17.1%) contained smolt/small salmonid remains. Five other scat samples (6.1%) contained salmonid otoliths identified as chinook smolt/small salmonid. Pacific whiting was identified in 73.7% of the 38 scat samples collected in October, with Pacific mackerel (65.8%), jackmackerel (36.8%) and Pacific herring (31.6%) found as the next most frequently identified prey items (Table 10). Adult salmonids occurred in 5.3% of the samples collected in October. One other scat sample contained a salmonid otolith identified as an adult chinook. A total of 21 fish species were identified in these collections along with 8 additional prey items identified to the genus, family or order level.

Columbia River, East Mooring Basin

The East Mooring Basin haulout at Astoria is used by approximately 100 - 200 California sea lions throughout the fall, winter and spring. A commercial fish processing plant is located near the basin within 1,000 feet of the haulout. Other fish processing plants are found along the Astoria waterfront within a few miles of the haulout site. Scat samples were collected at this location in March of 1992 and 1993. Information from ODFW staff at Astoria suggested that fish carcasses and sometimes whole fish were occasionally discarded by fish plant staff during the time that these scat collections were made. This information was substantiated by the initial identification of prey parts in scat samples, and a comparison with commercial fish landing data from the lower Columbia River during the same time period. One species commonly identified in these scat samples was dover

sole, which was the most frequently landed commercial species during the time of the collections. Salmon landings during the time of the scat collections however, were low, and it was believed that salmon (whole fish or carcasses) were not discarded by the plants. Because it was unlikely any salmonids had been discarded from the plant, only salmonid remains recovered in these samples were identified and included in this report. Because scat samples were only examined for salmonids, these two March (1992 and 1993) collections were combined (Table 1). Salmonid remains were recovered in 21 (19.1%) of the 110 samples examined. Nineteen samples (17.2%) contained adult salmonid remains, and four (3.6%) contained smolt/small salmonid remains. Because of the eroded condition of the otoliths, no salmonid otoliths recovered in these samples could be identified to species.

Pacific Harbor Seals

Columbia River, Desdemona Sands

Desdemona Sands is the most commonly used harbor seal haulout area in the lower Columbia River. Counts of harbor seals at this site range from 500 - 1,200 seals year-round, with peak numbers occurring during mid-winter (Beach et al. 1985; Brown, 1988). The three groupings of prey presented in this report came from 8 different collection trips made during: 1) February 1992 and March 1993; 2) September and October of 1994; and 3) April 1995. These collections were summarized as spring (February/March, 1992-93), fall, (September/October, 1994) and April 1995 (Table 1). Because eulachon (Columbia River smelt), an important prey species, is abundant in the Columbia River during February and March, these two months were combined. April 1995 was presented separately because eulachon is not as abundant during that month. The most frequently occurring prey item identified in the spring collection was eulachon (found in 84.3% of 51 samples), followed by Pacific lamprey (19.6%) and starry flounder (11.8%) (Table 11). Eulachon spawn in Columbia River tributaries from January through March, and are taken in large numbers by harbor seals during this time. Northern anchovy (found in 50% of 36 samples) was the main prey item in the scat collected during the fall, followed by Pacific herring (44.4%), salmonids (38.9%), unidentified

smelt species (25%), and Pacific staghorn sculpin (19.4%) (Table 12). Of the 14 fall samples which contained salmonids, 12 (33.3%) contained remains from adult fish and 4 (11.1%) contained remains from smolt/small salmonids. The main prey items identified in the April 1995 scat samples were Pacific staghorn sculpin (found in 49.3% of the 67 samples), starry flounder (35.8%), Pacific herring (28.4%), and salmonids (19.4%). Of the 13 samples collected during April, 1995 which contained salmonids, 6 (9%) had remains from adult fish and 8 (11.9%) had remains from smolt/small salmonids (Table 13). Because of the eroded condition of the otoliths in these collections, no salmonid otoliths recovered in these samples could be identified to species. Twenty-two different prey items were identified to the species level, with an additional 10 prey types identified to the order, family or genus level.

Siletz Bay

The Siletz Bay haulout area is located at the mouth of the Siletz river and is used by approximately 200 - 400 harbor seals year-round (Brown, 1988; ODFW unpub. data). Six scat collection trips were made to the Siletz Bay haulout during all seasons from 1983 to 1985 (Table 1). Since the total number of scat collected was fairly low, all scat collections were combined for this summary. Dover sole, found in 66.7% of the 18 samples, was the main prey item identified in these collections, followed by rex sole in 27.8% (Table 14). Adult salmonids occurred in 2 (11.1%) samples. Seven prey items were identified to species with four other prey types identified to genus, family or order level.

Alsea Bay

One scat collection trip was made to Alsea Bay in September 1986. Alsea Bay has a number of haulout areas throughout the lower estuary which are used by approximately 300 - 600 harbor seals (Brown, 1988; ODFW unpub. data). The five prey species identified in the 6 scat samples were rex sole (83.3%), Pacific whiting (33.3%), dover sole (33.3%), smelt (16.7%) and adult salmonid (16.7%).

Umpqua River

Approximately 600 - 800 harbor seals use haulout areas in the lower Umpqua River on the southern Oregon coast near Reedsport (Brown, 1988; ODFW unpub. data). Four scat collection trips were made to the Umpqua River between 1988 and 1993; half of the collections were made in the summer and the other half in the winter. Because of the small number of samples (n=25) these collections were combined. The main prey item identified in these samples was Pacific lamprey (found in 52% of 25 scat samples), followed by unidentified fish (44%) and surfperch species (20%) (Table 15). The unidentified fish in this collection were in most cases eye lenses from bony fishes that were recovered in samples that contained Pacific lamprey remains, and could not be identified further. A total of 7 prey items were identified to species level with 5 other prey types identified to the genus, family or order level.

Rogue River

The Rogue River harbor seal haulout is a sand spit located inside the Gold Beach marina adjacent to the south jetty. The number of harbor seals using this in-river haulout varies depending on the season, with highest numbers (200 - 300) occurring in March and April. ODFW began scat collections in the Rogue River in April 1995 and continued through April 1997. Reported here are 388 scat samples from collections made during all seasons from 1995 - 1996. A total of 32 different prey items were identified to species with an additional 11 prey types identified to order, family or genus. In the spring (March through May) of 1995 - 1996, Pacific tomcod (in 27.4% of 244 samples), Pacific lamprey (25.0%), rex sole (21.3%), and rockfish species (21.3%) were the four most frequently identified prey items (Table 16). During the summer (June through August) of 1995, Pacific lamprey was found in 54.9% of the 51 scat samples, followed by flatfish species in 23.5% and rex sole in 19.6% (Table 17). The most commonly observed prey item in scat collected in the fall (September through November) of 1995 were salmonids, found in 35.6% of the 45 scat samples collected, followed by rex sole in 31.1% (Table 18). Of the 16 fall samples which contained salmonids, 12 (26.7%) were from adult fish, and 5 (11.1%) were from smolt/small salmonids. Another 2 scat samples (4.4%) contained

remains from smolt/small chinook salmon. Rockfish species (found in 37.5% of 48 scat samples), rex sole (29.2%) and Pacific lamprey (20.8%) were the most frequently identified prey items in the winter (December through February) of 1995 - 1996 scat collection (Table 19).

DISCUSSION

This report provides a summary of recent information on pinniped food habits collected in Oregon since the early 1980's. Pinniped food habit analyses can provide information on seasonal prey selection, feeding location and prey availability. Variation in the results of food habits studies is often related to differences in the species of predator, feeding location (estuarine, nearshore ocean, freshwater), and prey availability (seasonality). Because pinniped diets change with location and season, prey selection information from one site can not be applied to large geographic areas or over long periods of time.

When individual scat samples were analysed in this study, a minimum number of individuals (MNI) was recorded for each species or type of prey identified in the sample. This information was not reported here however, because of uncertainties regarding the accuracy of minimum number determinations and the value of such information in describing pinniped diets. For example, a scat sample may represent only what was eaten during the last 5 to 6 hours of foraging and so may not give a complete picture of the diet. However, the pinniped food habit information presented in this report can provide an overall picture of the prey species consumed and can give some indication of the seasonal importance of some types of prey. The food habit data reported here indicate that these pinnipeds preyed heavily on schooling fishes, such as Pacific whiting and Pacific mackerel for sea lions, and smelt and herring for harbor seals. Other prey types which occurred in pinniped diets during most seasons were cephalopods, rockfish, salmonids, skates, Pacific tomcod, sculpins, flatfish, Pacific hagfish and Pacific lamprey. A total of 44 species of fish and cephalopods were identified in the 1,077 scat samples reported here. Also an additional 19 prey items

were identified to the genus, family or order level. This type of diversity indicates that pinnipeds in Oregon feed on a wide variety of prey species. This report is not intended to imply that these are the only prey species consumed by pinnipeds in Oregon, and it does not attempt to attribute relative levels of importance to any individual prey item in the overall diet.

With the growing concern about declining salmonid stocks in the Pacific Northwest, more interest has been focused on the predators of these fishes. There is little doubt that pinnipeds have been feeding on salmonids for as long as they have co-existed. Determining the impact that pinnipeds may have on depressed salmonid populations is difficult. The anadromous life history of salmonids makes them available as prey during a number of seasons. Salmonids are not present in estuaries at all times of the year, but can be abundant during the peak of their up and down stream migrations. Because pinnipeds are opportunistic feeders and are successful in changing prey species depending on the availability of fish, these predators will utilize fish, such as salmon, when they are abundant. Currently available information suggests that the majority of the pinniped predation on salmonids occurs when adult fish are returning to coastal streams to spawn and to a lesser degree when smolt outmigration occurs. It is possible that new studies may demonstrate more predation on salmonid smolts than has been previously documented. Of all the pinnipeds, harbor seals may be the most likely predator of smolts because of their smaller size and higher abundance in coastal estuaries.

Pinnipeds are thought to be more effective predators on salmonids in the restrictive waters of coastal rivers and streams. Artificial structures such as fish ladders, at dams and hatcheries, which channel fish through narrow areas, can slow fish passage, concentrate the prey, and may increase predation on these fishes. Pinnipeds can adapt to utilize this type of available food source, as has been observed in many areas, most notably at the locks at Ballard, Washington and more recently at Willamette Falls, Oregon. The removal of woody debris in estuaries and rivers may also allow for more effective predation on salmonids by

removing the hiding places needed by fish to elude predators.

Pinnipeds effectively utilize locally abundant prey species. Some very abundant fishes found in Oregon coastal marine waters, such as Pacific whiting, are common prey items for sea lions during the summer and fall. Pacific whiting appears to be an important prey item for breeding Steller sea lions in Oregon. Preliminary results from satellite tagging studies indicate that female Steller sea lions may stay on a rookery for several days while caring for their pup and then leave for 12 - 14 hours to forage before returning (ODFW unpub. data). The high frequency of occurrence of Pacific whiting in the scat collected during this period (May - July) suggests this prey item is an important element in the Steller sea lions diet during the breeding season (Tables 2 - 8). It is possible that these sea lions concentrate their feeding activities on these large schools of pelagic fish to maximize their foraging efficiency.

As previously stated, the summaries in this report indicate that schooling fishes such as smelts, herring, Pacific whiting, and Pacific mackerel are all frequently taken prey species for Oregon pinnipeds (Table 20). The schooling behavior and regional abundance of some of these fishes may be the reason they are frequently consumed by pinnipeds. Utilizing these fishes as prey may provide an energy savings for the animals by allowing them an opportunity to feed on large numbers of fish during a single foraging period. Eulachon occur in the Columbia River from January to April, and in this report were identified as a preferred prey item by harbor seals during February and March (Table 11). Frequent consumption of this oily fish may help these animals build the fat reserves necessary prior to the pupping season (Beach et al. 1985). Pacific mackerel, another schooling fish, was identified as a common prey item of California sea lions at Cascade Head in October and February (Tables 9 and 10).

Pacific lamprey has been identified in many pinniped food habit studies as a frequently consumed prey item. Pacific lamprey occur in most estuaries in Oregon and in recent years concern over declining lamprey populations has been an issue.

Pacific lamprey has been listed as a vulnerable species on the Oregon State Sensitive Species List. Much of this predation on lamprey may be occurring when these anadromous fishes return to spawn in coastal rivers and streams.

The prey items presented in this report are similar to those presented in previous pinniped food habit studies. Brown and Mate (1983) found Pacific sand lance to be the most frequently identified prey item in the 95 harbor seal scat samples collected in Netarts Bay. Along with sand lance, five species of flatfish and Pacific staghorn sculpin were the seven most common prey items reported in this study. Graybill (1981) identified 45 prey species in 296 harbor seal scat samples collected in Coos Bay. The main prey items identified in this collection were Pacific staghorn sculpin, followed by English sole, shiner surfperch, Pacific herring and cephalopods. In the 1,088 scat samples collected in the Columbia River, Grays and Willapa Bays, from 1980 to 1982, fifty-two species of bony fish were identified as harbor seal prey (Beach et al. 1985). The five most frequently occurring otoliths from scats in this collection were from Pacific herring, northern anchovy, whitebait smelt, longfin smelt, and Pacific tomcod. Pacific lamprey was the most frequently occurring prey item in the 107 harbor seal scats collected in the Rogue River by Roffe and Mate (1984).

RECOMMENDATIONS FOR FUTURE STUDY

ODFW has continued to collect scat samples at numerous sites on the Oregon Coast and the Columbia River during this reporting period. Processing and identification of these scats continues to be a priority.

- * Develop techniques to: 1) identify salmonid species using prey bones (other than otoliths); 2) determine sizes and ages (smolt, juvenile, jack, adult) of salmonids.

- * Identify river systems of special concern where depressed salmonid stocks may be impacted by high local pinniped abundance. Focus scat collections and other food habits analysis techniques on periods when these salmonid species return for spawning and during smolt outmigration. Assess ability to determine impact of pinniped predation on salmonid stocks of concern.

- * All Steller sea lion scat collections in Oregon to date have been made from May - July. Steller sea lion scat samples should be collected from rookeries and haul out areas during other times of the year in order to describe year-round food habits of these animals.

- * Scat collection at Cascade Head should be continued and the frequency of collections should be increased. Samples collected here give a picture of California sea lion food habits in the nearshore ocean in the absence of a major river system nearby. Collections should be made during all seasons when California sea lions are present.

- * Other sea lion haulout areas should be evaluated as potential sites for scat collections and food habits analysis (Cape Arago, South Jetty Columbia River).

- * Continue processing and identifying the harbor seal scat samples collected in the Rogue River to complete a 2 year picture of food habits for seals in this area.

- * Collect, process and identify harbor seal scat from the Alsea River during the smolt outmigration period to evaluate impact to coho salmon.

- * Collect, process and identify harbor seal scat from the Umpqua River to evaluate impact to searun cutthroat trout.

- * Scat collected by Beach et al. (1985) should be re-examined for all prey species. A partial re-examination of all bones in scat collected in the Columbia River in July 1981 identified Pacific whiting in over 41% of the samples, while Beach et al. (1985) reported whiting at 3.3% using otoliths alone. Re-identifying the 1980-82 collections with techniques used in the recent Columbia River study (Brown et al. 1995) would allow comparison of these two collections and would more accurately describe pinniped food habits in the Columbia River area over a 15 year period.

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Table 1. Oregon pinniped scat collections examined for this report including, date, species, sample size (n) and location; Pv - Pacific harbor seal, Zc - California sea lion, Ej - Steller sea lion.

<u>Date</u>	<u>Species</u>	<u>n</u>	<u>Collection Location</u>
June 1986	Ej	18	Rogue Reef, Pyramid Rock
June 1987	Ej	37	Rogue Reef, Pyramid Rock
June 1988	Ej	18	Rogue Reef, Pyramid Rock
July 1990	Ej	46	Rogue Reef, Pyramid Rock
June 1993	Ej	36	Rogue Reef, Pyramid Rock
May 1996	Ej	60	Rogue Reef, Pyramid Rock
July 1990	Ej	41	Orford Reef, Long Brown Rock
February 1994	Zc	82	Cascade Head
October 1994	Zc	38	Cascade Head
March 1992-93*	Zc	110	Columbia River, East Mooring Basin
Feb/March 1992-93	Pv	51	Columbia River, Desdemona Sands
Sept/Oct 1994	Pv	36	Columbia River, Desdemona Sands
April 1995	Pv	67	Columbia River, Desdemona Sands
Year-round 1983-85	Pv	18	Siletz River
September 1986	Pv	6	Alsea River

* - These samples were only identified for salmonid remains.

Table 1. cont. Oregon pinniped scat collections examined for this report including, date, species, sample size (n) and location; Pv - Pacific harbor seal, Zc - California sea lion, Ej - Steller sea lion.

<u>Date</u>	<u>Species</u>	<u>n</u>	<u>Collection Location</u>
Summer/winter 1988-93	Pv	25	Umpqua River
March - May 1995-96	Pv	244	Rogue River
June - August 1995	Pv	51	Rogue River
September - November 1995	Pv	45	Rogue River
December - February 1995-96	Pv	48	Rogue River

Table 2. Prey species identified from Steller sea lion scat (fecal) samples (n=18) collected in June 1986 at Pyramid Rock, Rogue Reef, Oregon.

<u>Prey Species</u>	<u>Percent Frequency of Occurrence</u>
Pacific Lamprey	83.3
Pacific Whiting	66.7
Fish unid.	16.7
Flatfish	16.7
Rockfish	11.1
Squid	11.1
Northern Anchovy	5.6
Northern Clingfish	5.6
Rex Sole	5.6
Salmonid adult	5.6
Sculpin	5.6

Table 3. Prey species identified from Steller sea lion scat (fecal) samples (n=37) collected in June 1987 at Pyramid Rock, Rogue Reef, Oregon.

<u>Prey Species</u>	<u>Percent Frequency of Occurrence</u>
Pacific Lamprey	67.7
Pacific Whiting	62.2
Salmonid adult	24.3
Squid	18.9
Fish unid.	16.2
Octopus	8.1
Wolf-eel	8.1
Flatfish	2.7
Greenling/lingcod	2.7
Pacific Herring	2.7
Pacific Tomcod	2.7
Rockfish	2.7
Sculpin	2.7
Smelt	2.7

Table 4. Prey species identified from Steller sea lion scat (fecal) samples (n=18) collected in June 1988 at Pyramid Rock, Rogue Reef, Oregon.

<u>Prey Species</u>	<u>Percent Frequency of Occurrence</u>
Pacific Whiting	77.8
Pacific Lamprey	55.6
Rockfish	22.2
Fish unid.	11.1
Salmonid adult	11.1
Skate	11.1
Squid	11.1
Pacific Herring	5.6
Pacific Tomcod	5.6

Table 5. Prey species identified from Steller sea lion scat (fecal) samples (n=46) collected in July 1990 at Pyramid Rock, Rogue Reef, Oregon.

<u>Prey Species</u>	<u>Percent Frequency of Occurrence</u>
Pacific Whiting	95.7
Pacific Lamprey	26.1
Pacific Herring	19.6
Salmonid adult	17.4
Jackmackerel	6.5
Pacific Mackerel	6.5
Rockfish	6.5
Flatfish	2.2
Spiny Dogfish	2.2
Pacific Hagfish	2.2
Pacific Staghorn Sculpin	2.2
Surfperch	2.2
Squid	2.2

Table 6. Prey species identified from Steller sea lion scat (fecal) samples (n=36) collected in June 1993 at Pyramid Rock, Rogue Reef, Oregon.

<u>Prey Species</u>	<u>Percent Frequency of Occurrence</u>
Pacific Whiting	100.0
Pacific Herring	52.8
Pacific Lamprey	41.7
Skate	41.7
Salmonid*	30.6
Sculpin	27.8
Smelt	25.0
Threespine Stickleback	25.0
Flatfish	19.4
Pacific Mackerel	19.4
Squid/octopus	19.4
Fish unid.	13.9
Red Irish Lord	13.9
Rockfish	13.9
Pacific Hagfish	11.1
Prickleback	8.3
Squid	8.3
Clingfish	5.6
Spiny Dogfish	5.6
Cod	2.7
Greenling/lingcod	2.7
Gunnel	2.7
Jackmackerel	2.7
Lingcod	2.7
Northern Anchovy	2.7
Pacific Sandfish	2.7
Pacific Sardine	2.7
Pacific Staghorn Sculpin	2.7
Shark	2.7
Whitebait Smelt	2.7

* Of the 11 samples (30.6%) which contained salmonids, 9 (25.0%) contained adult salmonid remains and 3 (8.3%) contained smolt/small salmonid remains.

Table 7. Prey species identified from Steller sea lion scat (fecal) samples (n=60) collected in May 1996 at Pyramid Rock, Rogue Reef, Oregon.

<u>Prey Species</u>	<u>% Frequency of Occurrence</u>
Pacific Whiting	73.3
Skate	38.3
Pacific Lamprey	36.6
Pacific Herring	33.3
Salmonid adult	33.3
Smelt	26.6
Octopus	18.3
Sculpin	18.3
Rockfish	16.7
Flatfish	10.0
Herring/shad	8.3
Pacific Tomcod	8.3
Squid/octopus	8.3
Fish unid.	6.6
Pacific Hagfish	6.6
Squid	6.6
Lingcod	5.0
Dover Sole	3.3
Jackmackerel	3.3
Pacific Mackerel	3.3
Pacific Sanddab	3.3
Pacific Sand Lance	3.3
Rex Sole	3.3
Chinook Salmon adult	1.6
Northern Anchovy	1.6
Pacific Cod	1.6
Petrale Sole	1.6
Prickly Sculpin	1.6
Spiny Dogfish	1.6

Table 8. Prey species identified from Steller sea lion scat (fecal) samples (n=41) collected in July 1990 at Long Brown Rock, Orford Reef, Oregon.

<u>Prey Species</u>	<u>Percent Frequency of Occurrence</u>
Pacific Whiting	100.0
Salmonid adult	19.5
Pacific Herring	2.4
Pacific Lamprey	2.4
Skate	2.4
Squid	2.4

Table 9. Prey species identified from California sea lion scat (fecal) samples (n=82) collected in February 1994 at Cascade Head, Oregon.

<u>Prey Species</u>	<u>% Frequency of Occurrence</u>
Pacific Mackerel	52.4
Pacific Sardine	29.3
Salmonid*	26.8
Squid/octopus	26.8
Pacific Herring	24.4
Smelt	24.4
Pacific Lamprey	22.0
Spiny Dogfish	22.0
Rockfish	20.7
Skate	15.9
Pacific Whiting	14.6
Northern Anchovy	13.4
Pacific Sand Lance	13.4
Flatfish	9.8
Whitebait Smelt	9.8
Fish unid.	8.5
Pacific Staghorn Sculpin	8.5
Chinook smolt/small salmonid	6.1
Pacific Hagfish	3.6
Sturgeon Poacher	3.6
Jackmackerel	2.4
Lingcod	2.4
Pacific Tomcod	2.4
Rex Sole	2.4
Cod	1.2
Pacific Cod	1.2
Peamouth	1.2
Poacher	1.2
Starry Flounder	1.2

* Of the 22 samples (26.8%) which contained salmonids, 18 (21.9%) contained adult salmonid remains and 14 (17.1%) contained smolt/small salmonid remains.

Table 10. Prey species identified from California sea lion scat (fecal) samples (n=38) collected in October 1994 at Cascade Head, Oregon.

<u>Prey Species</u>	<u>% Frequency of Occurrence</u>
Pacific Whiting	73.7
Pacific Mackerel	65.8
Jackmackerel	36.8
Pacific Herring	31.6
Squid/octopus	10.5
Salmonid adult	5.3
Chinook salmon adult	2.6
Flatfish	2.6
Pacific Sand Lance	2.6
Pacific Staghorn Sculpin	2.6
Petrale Sole	2.6
Smelt	2.6
Spiny Dogfish	2.6

Table 11. Prey species identified from Pacific harbor seal scat (fecal) samples (n=51) collected in spring (February/March) 1992 - 1993 at the Columbia River, (Desdemona Sands) Oregon.

<u>Prey Species</u>	<u>% Frequency of Occurrence</u>
Eulachon	84.3
Pacific Lamprey	19.6
Starry Flounder	11.8
Fish unid.	7.8
Pacific Staghorn Sculpin	7.8
Pacific Herring	5.9
Smelt	5.9
Whitebait Smelt	3.9
Longfin Smelt	2.0
Pacific Sand Lance	2.0
Pacific Tomcod	2.0
Pacific Whiting	2.0

Table 12. Prey species identified from Pacific harbor seal scat (fecal) samples (n=36) collected in fall (September/October) 1994 in the lower Columbia River, (Desdemona Sands) Oregon.

<u>Prey Species</u>	<u>% Frequency of Occurrence</u>
Northern Anchovy	50.0
Pacific Herring	44.4
Salmonid*	38.9
Smelt	25.0
Pacific Staghorn Sculpin	19.4
Fish unid.	16.7
Flatfish	11.1
Pacific Whiting	8.3
Rex Sole	8.3
Whitebait Smelt	8.3
Dover Sole	5.6
Pacific Sand Lance	5.6
Starry Flounder	5.6
Surfperch	5.6
Pacific Lamprey	2.8
Pacific Mackerel	2.8
Pacific Tomcod	2.8
Peamouth	2.8
Shiner Surfperch	2.8

* Of the 14 samples (38.9%) which contained salmonids, 12 (33.3%) contained adult salmonid remains and 4 (11.1%) contained smolt/small salmonid remains.

Table 13. Prey species identified from Pacific harbor seal scat (fecal) samples (n=67) collected in April 1995 in the lower Columbia river, (Desdemona Sands) Oregon.

<u>Prey Species</u>	<u>% Frequency of Occurrence</u>
Pacific Staghorn Sculpin	49.3
Starry Flounder	35.8
Pacific Herring	28.4
Salmonid*	19.4
Smelt	17.9
Pacific Lamprey	16.4
Prickleback	14.9
Fish unid.	9.0
Flatfish	7.5
Pacific Sand Lance	7.5
Shiner Surfperch	7.5
Pacific Tomcod	6.0
Northern Anchovy	4.5
River Lamprey	4.5
American Shad	3.0
Peamouth	3.0
Rockfish	3.0
Surfperch	3.0
Threespine Stickleback	3.0
Whitebait Smelt	3.0
Herring/shad	1.5
Pacific Hagfish	1.5
Pacific Sandfish	1.5
Pacific Whiting	1.5
Pile Surfperch	1.5
Sculpin	1.5
Shrimp	1.5
Snailfish	1.5

* Of the 13 samples (19.4%) which contained salmonids, 6 (9.0%) contained adult salmonid remains and 8 (11.9%) contained smolt or small adult salmonid remains.

Table 14. Prey species identified from Pacific harbor seal scat (fecal) samples (n=18) collected year around from 1983 - 1985 at the Siletz river, Oregon.

<u>Prey Species</u>	<u>% Frequency of Occurrence</u>
Dover Sole	66.7
Rex Sole	27.8
Fish unid.	11.1
Pacific Whiting	11.1
Salmonid adult	11.1
Flatfish	5.6
Pacific Lamprey	5.6
Pacific Staghorn Sculpin	5.6
Rockfish	5.6
Shiner Surfperch	5.6
Starry Flounder	5.6
Surfperch	5.6

Table 15. Prey species identified from Pacific harbor seal scat (fecal) samples (n=25) collected in winter and summer, 1988 - 1993 at the Umpqua River, Oregon.

<u>Prey Species</u>	<u>% Frequency of Occurrence</u>
Pacific Lamprey	52.0
Fish unid.	44.0
Surfperch	20.0
Pacific Staghorn Sculpin	12.0
Smelt	12.0
Squid/octopus	12.0
Pacific Tomcod	8.0
Rex Sole	8.0
Dover Sole	4.0
Flatfish	4.0
River Lamprey	4.0
Sculpin	4.0
Threadfin Sculpin	4.0

Table 16. Prey species identified from Pacific harbor seal scat (fecal) samples (n = 244) collected in the spring (March - May) of 1995 and 1996 at the Rogue River, Oregon.

<u>Prey Species</u>	<u>% Frequency of Occurrence</u>
Pacific Tomcod	27.4
Pacific Lamprey	25.0
Rex Sole	21.3
Rockfish	21.3
Octopus	18.0
Pacific Herring	17.6
Fish unid.	14.8
Flatfish	13.5
Salmonid*	11.9
Slender Sole	11.9
Squid/octopus	11.1
Pacific Whiting	7.8
Pacific Sanddab	7.0
Smelt	6.6
Squid	5.7
Dover Sole	4.5
Surf Smelt	4.1
Pacific Hagfish	2.9
Sculpin	2.9
English Sole	2.4
Herring/shad	2.4
Skate	2.4
Lingcod	1.6
Pacific Mackerel	1.6
Eelpout	1.2
Northern Clingfish	1.2
Buffalo Sculpin	0.8
Pacific Staghorn Sculpin	0.8
Threespine Stickleback	0.8
Cabezon	0.4
Chinook Salmon adult	0.4
Gunnel	0.4
Jackmackerel	0.4
Largescale Sucker	0.4
Northern Anchovy	0.4
Northern Ronquil	0.4
Pacific Sand Lance	0.4
Prickly Sculpin	0.4
Shiner Surfperch	0.4
Starry Flounder	0.4
Steelhead Trout juvenile	0.4

* Of the 29 samples (11.9%) which contained salmonids, 25 (10.2%) contained adult salmonid remains and 4 (1.6%) contained smolt/small salmonid remains.

Table 17. Prey species identified from Pacific harbor seal scat (fecal) samples (n=51) collected in the summer (June - August) of 1995 at the Rogue River, Oregon.

<u>Prey Species</u>	<u>% Frequency of Occurrence</u>
Pacific Lamprey	54.9
Flatfish	23.5
Rex Sole	19.6
Rockfish	17.6
Fish unid.	15.7
Eelpout	11.8
Slender Sole	11.8
Octopus	9.8
Pacific Hagfish	9.8
Pacific Herring	9.8
Salmonid adult	9.8
Squid	9.8
Squid/octopus	7.8
Pacific Sanddab	5.9
Surf Smelt	5.9
Chinook Salmon adult	3.9
Pacific Mackerel	3.9
Pacific Whiting	3.9
Sculpin	3.9
Dover Sole	2.0
Herring/shad	2.0
Pacific Cod	2.0
Pacific Tomcod	2.0
Smelt	2.0
Threespine Stickleback	2.0

Table 18. Prey species identified from Pacific harbor seal scat (fecal) samples (n=45) collected in the fall (September - November) of 1995 at the Rogue River, Oregon.

<u>Prey Species</u>	<u>% Frequency of Occurrence</u>
Salmonid*	35.6
Rex Sole	31.1
Flatfish	24.4
Fish unid.	13.3
Octopus	13.3
Pacific Whiting	13.3
Rockfish	13.3
Slender Sole	13.3
Pacific Hagfish	11.1
Pacific Tomcod	11.1
Prickly Sculpin	11.1
Smelt	11.1
Dover Sole	8.9
English Sole	8.9
Pacific Herring	8.9
Pacific Lamprey	8.9
Pacific Sanddab	6.7
Chinook smolt/small salmonid	4.4
Squid/octopus	4.4
Starry Flounder	4.4
Cabezon	2.2
Cod	2.2
Eelpout	2.2
Herring/shad	2.2
Northern Anchovy	2.2
Pacific Staghorn Sculpin	2.2
Peamouth	2.2
Sculpin	2.2
Skate	2.2
Threespine Stickleback	2.2

* Of the 16 samples (35.6%) which contained salmonids, 12 (26.7%) contained adult salmonid remains and 5 (11.1%) contained smolt/small salmonid remains.

Table 19. Prey species identified from Pacific harbor seal scat (fecal) samples (n=48) collected in the winter (December - February) of 1995 and 1996 at the Rogue River, Oregon.

<u>Prey Species</u>	<u>% Frequency of Occurrence</u>
Rockfish	37.5
Rex Sole	29.2
Fish unid.	20.8
Pacific Lamprey	20.8
Octopus	18.7
Sculpin	12.5
Eelpout	10.4
Pacific Hagfish	10.4
Pacific Staghorn Sculpin	10.4
Slender Sole	10.4
Flatfish	8.3
Pacific Tomcod	8.3
Squid/octopus	8.3
Skate	6.3
Jackmackerel	4.2
Northern Clingfish	4.2
Pacific Whiting	4.2
Buffalo Sculpin	2.1
Dover Sole	2.1
Northern Anchovy	2.1
Pacific Herring	2.1
Pacific Mackerel	2.1
Squid	2.1
Whitebait Smelt	2.1

Table 20. Prey of California sea lions, Pacific harbor seals, and Steller sea lions, identified in 10% or more of scat (fecal) samples collected from 1983 - 1996 at 9 locations in Oregon. (n=number of fecal samples examined).

California sea lions (n=120)

<u>Species</u>	<u>% frequency of occurrence</u>
Pacific Mackerel	56.7
Pacific Whiting	33.3
Pacific Herring	26.7
Squid/octopus	21.7
Pacific Sardine	20.0
Salmonid	20.0
Smelt	17.5
Spiny Dogfish	15.8
Pacific Lamprey	15.0
Rockfish	14.2
Jackmackerel	13.3
Skate	10.8
Pacific Sand Lance	10.0

Steller sea lions (n=256)

<u>Species</u>	<u>% frequency of occurrence</u>
Pacific Whiting	83.6
Pacific Lamprey	39.1
Salmonid	23.0
Pacific Herring	19.9
Squid/octopus	18.0
Skate	16.0
Smelt	10.2

Pacific harbor seals (n=591)

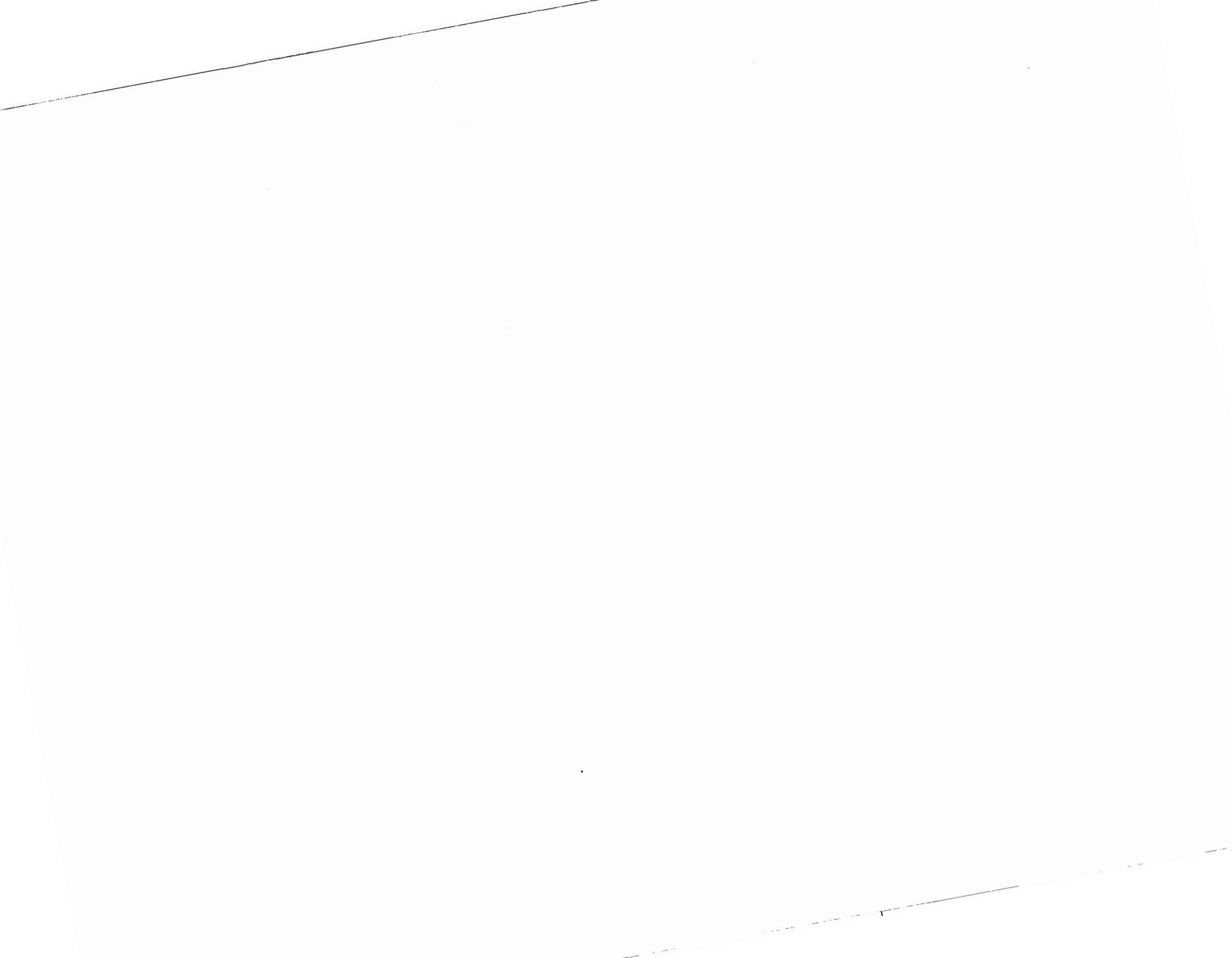
<u>Species</u>	<u>% frequency of occurrence</u>
Pacific Lamprey	23.5
Squid/octopus	21.0
Rex Sole	16.9
Pacific Herring	15.4
Rockfish	14.9
Pacific Tomcod	14.4
Salmonid	13.4

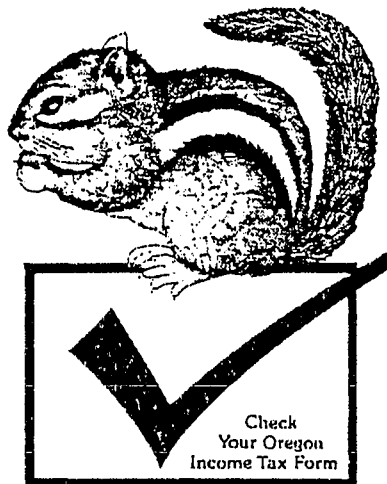
Appendix A. Scientific and common names of prey identified in pinniped scat collected in Oregon.

<u>Common Name</u>	<u>Scientific Name</u>
American Shad	<u>Alosa sapidissima</u>
Buffalo Sculpin	<u>Enophrys bison</u>
Cabezon	<u>Scorpaenichthys marmoratus</u>
Chinook Salmon	<u>Oncorhynchus tshawytscha</u>
Clingfish	Gobiesocidae
Cod	Gadidae
Dover Sole	<u>Microstomus pacificus</u>
Eelpout	Zoarcidae
English Sole	<u>Parophrys vetulus</u>
Eulachon	<u>Thaleichthys pacificus</u>
Flatfish	Pleuronectiformes
Greenling/lingcod	Hexagrammidae
Gunnel	Pholididae
Herring/shad	Clupeidae
Jackmackerel	<u>Trachurus symmetricus</u>
Largescale Sucker	<u>Catostomus macrocheilus</u>
Lingcod	<u>Ophiodon elongatus</u>
Longfin Smelt	<u>Spirinchus thaleichthys</u>
Northern Anchovy	<u>Engraulis mordax</u>
Northern Clingfish	<u>Gobiesox maendricus</u>
Northern Ronquil	<u>Ronquilus jordani</u>
Pacific Cod	<u>Gadus macrocephalus</u>
Pacific Hagfish	<u>Eptatretus stoutii</u>
Pacific Herring	<u>Clupea pallasii</u>
Pacific Lamprey	<u>Lampetra tridentata</u>
Pacific Mackerel	<u>Scomber japonicus</u>
Pacific Sanddab	<u>Citharichthys sordidus</u>
Pacific Sandfish	<u>Trichodon trichodon</u>
Pacific Sand Lance	<u>Ammodytes hexapterus</u>
Pacific Sardine	<u>Sardinops sagax</u>
Pacific Staghorn Sculpin	<u>Leptocottus armatus</u>
Pacific Tomcod	<u>Microgadus proximus</u>
Pacific Whiting	<u>Merluccius productus</u>
Peamouth	<u>Mylocheilus caurinus</u>
Petrale Sole	<u>Eopsetta jordani</u>
Pile Surfperch	<u>Damalichthys vacca</u>
Poacher	Agonidae
Prickleback	Stichaeidae
Prickly Sculpin	<u>Cottus asper</u>
Red Irish Lord	<u>Hemilepidotus hemilepidotus</u>
Rex Sole	<u>Glyptocephalus zachirus</u>
River Lamprey	<u>Lampetra ayresii</u>

Appendix A. cont. Scientific and common names of prey identified in pinniped scat collected in Oregon.

<u>Common Name</u>	<u>Scientific Name</u>
Rockfish	<u>Sebastes</u> sp.
Salmonid	<u>Oncorhynchus</u> sp.
Sculpin	Cottidae
Shark	Hexanchiformes
Shiner Surfperch	<u>Cymatogaster aggregata</u>
Shrimp	Crustacean
Skate	Rajidae
Slender Sole	<u>Lyopsetta exilis</u>
Smelt	Osmeridae
Snailfish	Liparididae
Spiny Dogfish	<u>Squalus acanthias</u>
Squid/Octopus	Cephalopod
Starry Flounder	<u>Platichthys stellatus</u>
Steelhead Trout	<u>Oncorhynchus mykiss</u>
Sturgeon Poacher	<u>Agonus acipenserinus</u>
Surfperch	Embiotocidae
Surf Smelt	<u>Hypomesus pretiosus</u>
Threadfin Sculpin	<u>Icelinus filamentosus</u>
Threespine Stickleback	<u>Gasterosteus aculeatus</u>
Whitebait Smelt	<u>Allosmerus elongatus</u>
Wolf-eel	<u>Anarrhichthys ocellatus</u>





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