AN ABSTRACT OF THE THESIS OF

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Title: Aboriginal Fishing at Seal Rock (35-LC-14) and Neptune (35-LA-3): Late-Prehistoric Archaeological Sites on the Central Oregon Coast

Abstract approved:  

Richard E. Ross

A sample of fish remains from two late-prehistoric archaeological sites on the central coast of Oregon were analyzed to partially evaluate two models of aboriginal subsistence-settlement systems. One model is based upon ethnographic data, primarily Drucker's (1939), for Yakonen speakers collected in the late 19th and early 20th centuries. The second model, that of Ross and Snyder 1979, uses ethnographic and archaeological data from the entire Oregon coast to reconstruct a subsistence-settlement system during the last 3000 years. The study also examines the samples to determine their research potential and to recommend refinements in data collection methods for fish faunal remains.
The fish species represented at the sites were determined by comparing the remains with a skeletal collection of common nearshore marine fishes of the region. The results were then interpreted within the framework of a descriptive model of marine habitats of the central Oregon coast.

The results favor the composite model (Ross and Snyder 1979) and indicates that the ethnographic data may overstate the importance of river fishing of salmon and underestimate the economic contribution of purely marine resources during the late-prehistoric period. The ethnographic model, however, may be representative of the historic period. The study concludes with recommendations for research on changes in subsistence-settlement systems during the past several hundred years in the study area.
Aboriginal Fishing at Seal Rock (35-LC-14) and Neptune (35-LA-3): Late-Prehistoric Archaeological Sites on the Central Oregon Coast

by

Terry Zontek

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CHAPTER I

Introduction

This research analyzes the fish remains from two late-prehistoric archaeological sites -- Seal Rock (35-LC-14) and Neptune (35-LA-3) -- located on the central coast of Oregon (Figure 1). The role of fishing in the subsistence economy in general and the role of salmon fishing in particular are the general topics of study. Accordingly, the problems of the analysis of the fish remains are to (1) determine the species represented in the archaeological collections from the sites, and (2) determine the aquatic habitats from which fish were caught. These results are then used to evaluate published ethnographic and archaeologically derived assertions regarding fishing in the late-prehistoric to early-historic Native American societies of the region. The study also discusses some methodological requirements for sampling fish remains from archaeological sites, and suggests a general strategy for archaeological research on the
Figure 1. Location of Seal Rock and Neptune, and Ethnographic Distribution of Yakonen Speakers
central Oregon coast in relationship to faunal material.

The two sites provide well controlled comparisons, because they share many similarities. They also differ in some important regards. First the similarities. Seal Rock and Neptune are contemporaries; radiocarbon dates and the absence of Euro-American trade goods indicate initial occupation 300 to 400 years ago and abandonment around A.D. 1800. Both are complex, stratified shell middens containing an abundance of extremely well preserved faunal remains. They probably were occupied by the same Yakonen speaking groups identified as inhabiting the area at contact. Seal Rock is well within Alsea territory while Neptune is on the boundary between the Alsea and the Siuslaw. Precise determination of ethnic affiliation is insignificant, however, since the Alsea and Siuslaw apparently shared nearly identical cultures with the exception of minor linguistic differences. The general environmental contexts of the sites are also very similar. Both are situated on rocky, open coastlines several kilometers from the nearest salmon streams. Ethnographic information on the use of the coastline is very sparse, but indicates that the area had few permanent settlements and was not a major supplier of subsistence needs. Archaeological evidence indicates
that both sites were probably occupied during the late spring and early summer. Finally, identical methods of excavation were used at both sites.

The differences are fewer and may largely be related to slight environmental variations between the sites. Neptune is situated on a completely exposed reach of shoreline adjacent to sandy ocean floor that extends several miles coastwise and out to sea. Seal Rock is located on a semi-protected shoreline and has a rocky reef lying less than one-half mile offshore. The aquatic habitats at Seal Rock are, therefore, more diverse and productive because of the greater protection from wave shock (Ricketts and Calvin 1968). Until at least the 1870's Seal Rock was also the site of a Northern sea lion rookery, whereas the nearest such concentration to Neptune was 17 kilometers to the south near Heceta Head. These differences in resource potential probably explain certain differences in the faunal assemblages of the sites, and may help explain why Seal Rock is ten times the size of Neptune.

The Problem

The major ethnographic work, and the only one providing the semblance of a comprehensive portrayal of a central coast group, describes the Alsea as
highly specialized, riverine-based salmon fisherman:

"The Alsea were fisher folk. Their choice of dwelling sites, their seasonal migrations up and down their little valleys, and their technological interests reflect the importance of this pursuit in their lives. In their economy, salmon ranked first of the several kinds of fish taken. Dried, it was the mainstay which permitted a life of leisure unknown to any people lacking a plentiful and easily preserved food source. Other fish and game served only to supplement the diet" (Drucker 1939:82)..."The Alsea did not fish offshore" (Drucker 1939:82).

Although Drucker later presents evidence indicating that camas was also an important food in the winter, the pre-eminence of salmon and the strong riverine orientation is not otherwise qualified. Most notable is the denial of offshore fishing and the absence of reference to food-getting activities along the coastline. Despite this, Drucker and other ethnographic sources place at least three villages on the coast. One of these villages was located in the Seal Rock area, but 35-LC-14 cannot be positively identified as that village.

Recently, Ross and Snyder (1979) offered an alternative model of late-prehistoric subsistence and settlement that explains the presence of coastal sites such as Neptune and Seal Rock. Their model, based on a synthesis of the available archaeological and ethno-
graphic data for the entire coast (including information from Seal Rock and Neptune) retains a strong riverine orientation, but includes the regular use of coastal resources since 1000 B.C.:

"Our general and tentative model suggests some movement among coastal peoples from season to season in order to maximize their resource utilization. The primary and main occupation sites were probably along the main rivers and estuaries up as far as tidewater. According to this model, these primary occupation areas were used by most of the people during the fall and winter months. They were located principally in those areas where salmon fishing was convenient, an activity which occurred mainly in the fall. These sites would also be located in areas protected somewhat from the fierce winter storms that frequently lash the coast. Spring and early summer would have been times of movement away from the streams and estuaries to the coast proper to exploit the marine resources.

Other resource systems would be exploited during this time such as the upland areas where land mammals and plants (including camas, wapato, and a variety of berries) were available. When the fall and winter storms descended on the coast and the large salmon runs began, there seems to have been a return movement to the rivers, estuaries, and larger streams where fishing could be accomplished (Ross and Snyder 1979:1-2)."

The analysis of the fish remains will serve as a partial check of their ideas as well as of Drucker's (1939) ethnographic reconstruction. It will provide data on the role of fishing in the subsistence economies
represented at the sites. This study also evaluates
the applicability of the model or Ross and Snyder to
a specific region of the Oregon coast.
CHAPTER II

Environmental Setting

The Seal Rock site (35-LC-14) and the Neptune site (35-LA-3) are in the Coast Range physiographic province as defined by Franklin and Dyrness (1973). In Oregon, ninety percent of the province is heavily forested slopes of the Coast Range mountains. These mountains are steep and rugged, but relatively low in elevation. Main ridges typically rise 450 to 750 meters above sea level and the highest point, Marys Peak, is just 1249 meters high. The only non-mountainous areas are the small and narrow river valleys and the uplifted marine terraces 7.5 to 15 meters high along most of the coastline.

The shoreline is mainly straight, sandy beaches interrupted every few miles by basaltic flows extending westward from the main body of the coast mountains. These flows form dramatic, rocky headlands which often rise almost vertically over 200 meters above the beach. The beaches occur as distinct units varying in size from small pocket beaches tucked in the sheltered areas of large headlands to vast strands up to 48 kilometers long (Dicken et al. 1961:19).
Extensive sand dunes have developed in places where the marine terraces widen or are absent (Dicken et al. 1961:5; Franklin and Dyrness 1973:13). A large dune area is found between Coos Bay and Heceta Head, and smaller dune fields occur at many river mouths. Most dunes are stabilized by vegetation, but active dunes continually invade forested areas, and alter coastal drainages. Numerous coastal lakes were formed when dunes blocked the outlets of small streams.

Except for the Umpqua River, coastal streams and rivers originate within the Coast Range Province less than 60 kilometers from the ocean. The upper portions of the main river valleys are narrow and flanked by steep, forested slopes. Post-Pleistocene sea level rises drowned the mouths of the rivers producing large estuaries in the lower reaches of many valleys. Within the study area the Yaquina, Alsea, and Siuslaw Rivers have large estuaries (State of Oregon, 1973). Small estuaries occur at the Yachats River, Ten Mile Creek, and Beaver Creek.

Vegetation

Two coniferous vegetational zones (based on the probable climax species) dominate the Oregon coastal strip (Franklin and Dyrness 1973:52-109). The Picea
sitchensis (Sitka Spruce) zone lies in a narrow strip a few kilometers wide along the entire coastline. The Tsuga heterophylla (Western Hemlock) zone occurs away from the coastal strip at elevations of 150 to 1000 meters. Numerous special zone types and communities are distributed within the dominant forests to produce a complex vegetational structure.

Ethnographically the minor vegetation zones had the greatest economic importance. Camas from wet meadows in the upper valleys; skunkcabbage from the swamps most commonly found in the Picea sitchensis zone, and the several species of berries found in disturbed habitats were particularly important plant foods. The forests produced economically important trees, ferns, shrubs, and herbs used for medicine, manufacturing, and food, but were exploited less intensely than the more open areas along the rivers and the sea shore.

Table 1. Climatic Data for the "Mid-Coast Basin" at the Newport Weather Station\(^a\)

<table>
<thead>
<tr>
<th>Mean Jan. Temp.</th>
<th>Mean July Temp.</th>
<th>Diurnal Temp. Var.(^b)</th>
<th>Mean Annual Precip.</th>
<th>Frost Free Season at 0°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.5°C</td>
<td>14.2°C</td>
<td>6-10°C</td>
<td>1670 mm</td>
<td>284 days</td>
</tr>
</tbody>
</table>

\(^a\)Thomas and Simonson (1979:3)
\(^b\)Franklin and Dyrness (1973:42)
Climate

A strong maritime influence gives the Oregon coast a mild climate with moderate temperatures and high annual precipitation (Table 1). Temperatures have narrow diurnal and seasonal limits, but precipitation shows a pronounced fall/winter maxima--75% to 85% occurs between October 1 and March 31 (Franklin and Dyrness 1973:38-42). Rains taper off in the spring, and long summertime stretches of fair, dry weather are common. Large fog banks temper the summer heat and often extend several miles up coastal valleys (Thomas and Simonson 1979:2). Snow and freezing are rare.

The cyclonic storm systems that produce the annual rainfall pattern bring strong prevailing winds throughout the year. Winds strike the coast from the north-northwest from May through September as a high pressure center in the Gulf of Alaska moves storm tracks to the north. Between November and March the storms shift to the south and winds arrive from the south-southwest. Wind velocity is less during this period, but the highest intermittent velocities (up to 183 kmh) occur as a succession of storms assault the coast. April and October are transitional months when winds switch back and forth between the summer and winter
patterns (Dicken et al 1961:10-12; Stander and Holton 1978).

Local maritime and elevational effects produce marked variations in temperature, relative humidity, and precipitation between coastline and mountain crest. The frequent summer fogs near the shore give the coast higher relative humidity, and 1.8°C to 3.3°C cooler temperatures compared to inland locales in the Coast Range. The winter pattern is reversed; the higher inland elevations experience temperatures averaging 1.1°C to 2.2°C less than along the shore and precipitation is much greater (Thomas and Simonson 1969:2).

Marine Habitats and Associated Fish Species

For the purpose of this study, six ocean habitats are defined for the central Oregon coast (Figure 2):

(1) sandy beaches, (2) rocky shores, (3) near-shore rocky reefs, (4) inner continental shelf, (5) outer continental shelf, and (6) pelagic waters.

The descriptions and distributions of these habitats are presented below. Included with the habitat discussions are lists of associated fish species that would most likely be found in each habitat. These
Descriptions and lists represent a beginning effort to understand prehistoric human interactions with the marine environment of the central Oregon coast. The lists were compiled from a variety of sources in an attempt to control for the wide distribution of some species and possible biases in commercial catch statistics, the most common source of data.

While these habitats are geographically discrete and relatively stable, some of the associated fish species have wide environmental tolerances and occur in more than one habitat. For example, the staghorn sculpin is a species distributed from the upper estuaries, in an almost freshwater context, to the fully marine waters of rocky shores. Such cosmopolitan behavior makes it impossible to rely on a single species as a positive environmental indicator. Similarly, anomalous environmental events can temporarily introduce exotic species into an area. In 1958-1959 and 1963 a change in current patterns made southern warm water species extremely abundant in Oregon coastal waters (Pearce 1972). No exotic species were identified in the Seal Rock and Neptune samples, but the overlapping distribution of resident species is a problem of which to be aware. For these reasons the entire species composition of each habitat is emphasized as the significant analytic unit rather than one species.
Another problem in defining the species compositions of the various habitats is cultural bias represented in the commercial and sport catch statistics. These sources are less desirable than ecologically oriented research data, but they usually represent the only available distributional data. Gear selection and market conditions mean that the fish caught and reported probably represent a restricted range of species and sizes present in any habitat.

Experimental fisheries data for central Oregon coast neritic reefs illustrate the problem of using catch statistics. Each of the five gears used on the reefs produced a distinctive faunal composition comprised of different species in varying proportions (Barker 1974:28). The two jigs and trolling yielded similar results, catching mainly rockfish and lingcod. The setline hooked large numbers of the Big skate, a large edible cartilagenous fish of low sport and commercial value. Ratfish, a small and edible cartilagenous fish of almost no current value, dominated the diving gillnet catch statistics. The latter two species, although common, are not the object of commercial fisheries and do not appear in the catch statistics for neritic reefs (Stander and Holton, 1978:36-63). Modern standards of taste and utility do not correspond to those of the prehistoric cultures of the area,
Thus catch statistics may not precisely reflect the species caught by prehistoric populations.

Despite this shortcoming, the lists provide valuable information on the distribution and abundance of certain species. They show that although there is some overlap in species distribution between marine habitats, there are definite differences and with careful use one can determine, from archaeological fish remains, the marine habitats that were most commonly used. The following habitats occur along the central coast of Oregon within the range of modern, small day-fishing boats (10 mile (16 kilometer) radius).

Sandy Beaches

On sandy beaches from early spring to fall several species of smelt either spawn in the surf-zone, or pass through the breakers at river mouths for upstream spawning (Beardsley and Bond 1973:9-10; Fry 1973:83-90; Baxter and Duffy 1974:21-22; Carl 1963). The surf smelt occur in large numbers on many beaches with pea-size gravel, fresh water seepage, some afternoon shade, and is seemingly adjusted to running during spring tides. The night smelt spawns at night on coarser gravel beaches, runs more erratically, and apparently is not adjusted to the tide. The eulachon
is usually caught in the estuaries and rivers during early spring, but they are also taken in the breakers at river mouths. These are all small fishes, less than 20 cm in total length, but large amounts can be quickly taken using a scoop net. Catches over 11 kg per scoop are common, and hauls over 22 kg have been recorded (Baxter and Duffy 1974:22).

Several species of surfperches share the surf zone with the smelts (Wares 1968; Beardsley 1969; De Martini 1969; Bare and Bare 1971; Bennett 1971; McCauley 1973). The red tail surfperch is the most abundant species on Oregon beaches. Other important species are the striped seaperch, white seaperch, pile seaperch, and shiner perch. These fishes usually weigh less than a kilogram, though a large pile perch may exceed 2 kilograms. Surfperches often form large schools, and are most available from spring through early fall.

Rocky Shores

In the study area, rocky shores occur where igneous rocks form the shoreline. Although less extensive than sandy beaches, rocky intertidal areas are biologically richer because of increased tidal influence and more stable substrate (Hedgepeth 1956b; McCauley
Great variation in the productivity of rocky shores can exist depending on exposure to waves, the shore's steepness, local salinity, exposure to sun, and the many other variables interacting at each intertidal locale (Ricketts and Calvin 1968).

The rocky, intertidal zone is utilized by two distinct assemblages of fish species. The first is composed of the many, small, tidepool species belonging to several families (Baxter and Duffy 1974:65-70). These are small, solitary creatures which remain on the exposed shore at low tide hiding in tidepools, in crevices, beneath rocks, and under vegetation.

The second assemblage is comprised of the larger fish which invade the intertidal zone, feeding at high tide then retreating to subtidal habitat at low tide. On the Oregon coast, the prominent species in this category are the surfperches, the greenlings, the rockfishes, and the sculpins. Within the first three groups the striped seaperch, the kelp greenling, and the black rockfish are probably the most numerous. Of the sculpins, Pacific staghorn sculpin and buffalo sculpin are most plentiful. Other large fishes, particularly lingcod and cabezon, inhabit the intertidal zone. The lingcod is more abundant in the winter months when a portion of offshore populations move inshore to spawn (Miller and Geibel 1973:75-77).
Nearshore Reefs

On the central Oregon coast, an almost continuous series of reefs and offshore rocks in depths less than 25 fathoms (45 meters) occur from Seal Rock to Siletz Bay. Large resident and migratory fish populations (Barker 1974; Miller and Geibel 1973:77), shallow depths, and closeness to shore make this a potentially important microenvironment in prehistoric fisheries.

Table 2 shows the composition of the bottom and near bottom dwelling species found on the reefs from Seal Rock to Yaquina Head. The list is probably the most representative of the range of species diversity in all offshore microenvironments, because the data was collected using a variety of fishing gear.

Two commercially important fishes, Rockfishes and Lingcod, make up over one-half of the catch.

Table 2. Species Composition of the Catch (1%) and Total Number of Fish Caught on Nearshore Reefs from Seal Rock to Yaquina Head, Oregon Using a Variety of Bottom Gear Types

<table>
<thead>
<tr>
<th>Species</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratfish</td>
<td>24.30</td>
</tr>
<tr>
<td>Black rockfish</td>
<td>20.87</td>
</tr>
<tr>
<td>Lingcod</td>
<td>16.47</td>
</tr>
<tr>
<td>Rockfishes (6 + species)</td>
<td>9.22</td>
</tr>
<tr>
<td>Big skate</td>
<td>7.22</td>
</tr>
</tbody>
</table>

(cont'd next page)
(Table 2 cont'd)

<table>
<thead>
<tr>
<th>Species</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue rockfish</td>
<td>7.12</td>
</tr>
<tr>
<td>Hake</td>
<td>3.62</td>
</tr>
<tr>
<td>Sand sole</td>
<td>2.82</td>
</tr>
<tr>
<td>Cabezon</td>
<td>2.14</td>
</tr>
<tr>
<td>Kelp greenling</td>
<td>1.97</td>
</tr>
<tr>
<td>Spiny dogfish</td>
<td>1.72</td>
</tr>
<tr>
<td>English sole</td>
<td>0.49</td>
</tr>
<tr>
<td>Wolf-eel</td>
<td>0.42</td>
</tr>
<tr>
<td>Longnose skate</td>
<td>0.32</td>
</tr>
<tr>
<td>Coho salmon</td>
<td>0.29</td>
</tr>
<tr>
<td>Starry flounder</td>
<td>0.26</td>
</tr>
<tr>
<td>Chinook salmon</td>
<td>0.19</td>
</tr>
<tr>
<td>White sturgeon</td>
<td>0.09</td>
</tr>
<tr>
<td><strong>Total percent</strong>*</td>
<td>99.53</td>
</tr>
<tr>
<td><strong>Total fish</strong></td>
<td>3,090</td>
</tr>
</tbody>
</table>

*error due to rounding

Over one-third of the catch contains two species of cartilagenous fishes with almost no commercial value. The ratfish and the big skate are highly edible and abundant.

**Inner Continental Shelf**

The continental shelf can be divided into an inner zone and an outer zone to conform to the differential distribution of bottom dwelling species according to depth (Alverson et al. 1964:161-176). In the study area, the inner continental shelf extends from 0 - 50
fathoms (0 - 92 meters) deep over sandy bottom except for rocky portions of Stonewall Bank. According to commercial logbook summaries and experimental trawls the following species occur in commercial concentrations within a 16 kilometer radius of Seal Rock and Neptune on the inner continental shelf: petrale sole, rex sole, English sole, sand sole, starry flounder, sanddab, and lingcod. Rockfishes are also caught in commercial quantities in the Seal Rock area (Stander and Holton 1978:40-61).

Outer Continental Shelf

The outer continental slope is in water 50-100 fathoms (92-183 meters) deep, and occurs at least 25 kilometers from the shoreline. The five most commonly caught commercial species off the Oregon and Washington coast are: hake, arrowtooth flounder, dover sole, rex sole, and sablefish (Alverson et al. 1964:153). Other species caught in commercial quantities in waters opposite Seal Rock and Neptune are lingcod, English sole, petrale sole, and rockfishes (Stander and Holton 1978:40-61). Of the rockfishes Pacific ocean perch and other deep water forms are more common on the outer continental slope. Although located beyond the small
boat range, this habitat is included for comparative purposes.

Pelagic Waters

The last marine habitat is the pelagic zone or the entire water column overlying the continental shelf. This is the open ocean habitat where many small, schooling species and their predators live (Carl 1971:10). The main forage fishes in this zone are the smelts, the northern anchovy and the pacific herring. Their predators include the spiny dogfish, salmons, Pacific cod, and hake.
Figure 2. Marine Habitats of the Central Oregon Coast (after Stander and Holton 1978).
CHAPTER III

The Sites

This chapter describes the environmental setting at Seal Rock and Neptune, and summarizes what is known about the archaeology of each site. Sandra Snyder (1978) analyzed the sea mammal remains from Seal Rock. She concluded that the offshore rocks were the location of a previously unknown northern sea lion rookery that was intensively hunted by the inhabitants of the site. No other material, except for a few artifacts that are probably related to sea mammal hunting, have been studied. Debra Barner (1981) analyzed samples of shellfish remains from Neptune, and described artifacts and part of the site's stratification. The work of Snyder and Barner represent important contributions to Oregon coastal archaeology; however, they emphasized a narrow range of data recovered from the sites. The basic descriptions and classifications of all the excavated material as well as the more advanced analyses, such as those needed to determine the stratigraphy of the sites, are incomplete. Until these studies are done, integrated, compared with previous archaeology on the coast, and published, the full significance of Seal Rock and Neptune will be unknown.
Seal Rock (35-LC-14)

The Seal Rock site is a large shell midden located at the only rocky shore between the mouths of the Yaquina and Alsea Rivers. Topographically, a low, uplifted marine terrace dominates this reach of coastline. The mountains are set back 1 to 3 kilometers in most places, and the flanking shoreline is gently sloping sandy beach. This gentle and regular topography probably made Seal Rock easily accessible by land and sea in aboriginal times.

The top of the site lies about 10 meters above the beach on a consolidated Quaternary sand dune (Ross 1979:PC) which caps a wave-cut platform of Tertiary sedimentary strata (Putman 1971:265). Exposure of the dune to waves and wind is causing the rapid seaward erosion of the western edge of the site. Remnants of an Oligocene basaltic sill (State of Oregon 1961) forms two linear series of offshore rocks paralleling the coastline. The outer series lies about 1 kilometer offshore and forms an extensive complex of Neritic reefs and exposed rocks. The inner series outcrops at places on the mainland shore, and also creates a discontinuous line of offshore rocks paralleling the coastline for approximately 2 kilometers. At low or
minus tides some of these rocks are easily accessible from the shore (Snyder 1978).

The rocky shoreline makes the Seal Rock locality a biologically rich and diverse zone in the midst of greater than 24 kilometers of less productive sandy beach. Large populations of mussels, sea urchins, and barnacles live in the rocky intertidal zone. The well protected lee sides of the inner series of rocks create especially favorable habitat for these marine invertebrates and the many species of fish which feed there at high tide.

The outer series of rocks is the southern end of a nearly continuous 55 kilometer long series of nearshore reefs (Stander and Holton 1978:88). The Seal Rock area produced the greatest yields in a recent fisheries investigation of nearshore reefs between Yaquina Head and Seal Rock (Barker 1974). The area between the rocky zones is flat, sand covered inner continental shelf.

In addition to abundant fish and shellfish resources archaeological evidence indicates that the Seal Rock area probably was the location of a northern sea lion rookery when the site was occupied (Snyder 1978). Currently the area is only used as a hauling out spot for seals and sea lions resting between feedings.
In contrast to the rich marine environment, the streams in the Seal Rock area have low resource potential. Salmon and Steelhead runs would be small or non-existent because most streams are small, originating within 3 - 4 kilometers of the coastline (USGS, Waldport, Oregon 15' quadrangle; USGS, Yaquina, Oregon 15' quadrangle) and discharge directly into the ocean via shallow braided channels across the beaches. The latter condition prevents or greatly impedes the upstream passage of migrating fish. Small drainage basins produce small and highly variable sized salmon runs because of instable stream flows and the paucity of suitable spawning beds (Schalk 1977). The only stream likely to have good runs of anadromous fish is Beaver Creek located about 4 kilometers north of Seal Rock. Beaver Creek has a small estuary and drains most of the area between Alsea and Yaquina Rivers.

Before being bisected by the U.S. Highway 101, 35-LC-14 probably measured about 100 meters by 60 meters. At one time the site was undoubtably much larger since the seaward side suffers continually from natural erosion. The upper 40 centimeters of deposit was heavily disturbed by Euroamerican activities beginning in about 1850 (Snyder 1978:4-5), and in the 1970's the northern edge was, for several years, mined for sea lion canines used in scrimshaw. Despite these
problems the remaining deposit contains up to three meters of well preserved faunal remains from late-prehistoric times.

C-14 dates taken at two levels within the midden place the initial occupation around 400 years ago (WSU 1643:375 ± 70 years B.P.), and abandonment at about A.D. 1800 (WSU 1642:160 ± 80 years B.P.). The absence of Euroamerican trade goods further supports a terminal occupation date before A.D. 1830.

The Oregon State University archaeological field school, under the direction of Dr. Richard E. Ross, worked at Seal Rock during the summers of 1972 and 1974. Excavations were confined to the western section of the shell midden in an area slightly west of the long axis, about equi-distant from the northern and southern boundaries of the site. Twenty-two 2 X 2 meter pits and four 1 X 2 m pits were excavated in undisturbed cultural deposits; all but three of the larger pits and one of the smaller were dug in a contiguous block. Excavation units were located within a standard cartesian grid with a north/south axis. A datum arbitrarily set at 100 m was used to insure vertical and horizontal control.

The pits were excavated by the following procedures: (1) the top layer of vegetation and loose soil was removed to expose the top of the midden;
(2) the squares were then leveled to the nearest even 10 cm elevation below datum, e.g., 98.50 m, 97.30 m; (3) the midden was then removed in 20 cm increments (levels) unless major stratigraphic changes were encountered. The contents of the different strata within the levels were then excavated and bagged separately; (4) trowels were the usual excavation tool. Shovels were used when rocks, bones, and artifacts were scarce. The only exception to the above procedure was the excavation of an early historic period Euro-American house along structural lines rather than arbitrary units. Normally, excavation in a pit was stopped when sterile deposit was reached.

All excavated material was passed through \( \frac{1}{4} '' \) (6.35 mm) hardware cloth. Most cultural material was field sorted into general categories, then placed in separate bags according to their 20 cm level or smaller provenience unit. Shell and fire cracked rock, the major constituents of the midden, were not collected or recorded except for the retention of a column sample.

The recovered cultural materials consist mainly of the remains of fish, sea mammals, and marine molluscs discarded by the inhabitants of the site. Land mammal remains occur in small amounts. All artifact classes other than fire cracked rock occur in extremely low
frequencies. Field notes indicate that concentrations of fire cracked rock are the major cultural features encountered below the recently disturbed surface layer. This evidence, plus the occasional discovery of aboriginal burials in the trailer court immediately to the west (Ross 1976:PC), may indicate that the shell midden is a specialized activity loci of a larger site. Ethnographic sources indicate that an Alsea village was located in the Seal Rock vicinity, but 35-LC-14 cannot be identified as this village (Dorsey 1890; Berreman 1937).

Excavation of 131.6 cubic meters of cultural matrix yielded very few formed artifacts (Snyder 1978:5-6). The most common were the chert projectile points and bone barbs which together formed the harpoon heads used in pinniped hunting. One probable fragment of a one-piece, acute angle, bone fish hook is the only fishing gear recovered (Field Notes 1972). There were no net sinkers, mesh spacers, composite fish hook parts, or bi-pointed bone gorges commonly found in Oregon coastal sites.

The sea mammal remains indicate that 35-LC-14 was a spring to mid or late summer settlement where pinniped hunting, especially for adult male northern sea lions, played an important economic role (Snyder 1978). Without comparable data on all the faunal remains,
however, we cannot estimate the relative importance of pinniped resources. Nevertheless, their unusually great abundance here compared to other coastal sites is clear indication that seals and sea lions were a strong attraction to the inhabitants of Seal Rock.

The presence of fetal or newborn individuals and the predominance of adult male northern sea lions is strong evidence that a rookery existed in the Seal Rock vicinity during the time of aboriginal occupation (Snyder 1978). Currently the area is only used as a hauling out spot for sea lions, and the nearest rookery is nearly 45 kilometers to the south at Seal Lion Caves.

Sea lions form rookeries in the spring for purposes of pupping and mating. The defensive, territorial behavior of adult males at this time makes them more susceptible to human predation which may account for the 4.8:1 sex ratio favoring adult males over adult females. However, cultural selection must be considered since the Alsea are reported to have ceremonially hunted adult males in the Seal Rock vicinity in the 1870's (Caday 1978, cited in Snyder 1978, 27-28).

Incidently, Caday's information may mean that a northern sea lion rookery still existed at that late date. If so, the hypothesised pre-1830 abandonment of 35-LC-14 cannot be laid to the disappearance of a
major economic resource. Disease-caused depopulation, associated with early contact with Euroamericans, probably accounts for the demise of the site as a major settlement.

Neptune (35-LA-3)

The Neptune site is a small shell midden located 25 kilometers south of Seal Rock between the mouths of the Alsea and the Siuslaw rivers. The site lies on a narrow consolidated Quaternary dune surface (Barner 1981) lying between the beach and Eocene basalt flows (State of Oregon, 1961). The basalt flows are extremely steep and rugged and form a 12 kilometer long rocky shoreline between Yachats and Gwynn Knoll. Neptune is situated above the only sandy beach on this reach of shoreline. Although small, less than 1 kilometer long, and fully exposed to wind and waves, the beach may have been important for boat access to the site since the rugged topography makes land approaches extremely difficult. The combination of the beach and the flat consolidated dune makes the Neptune locality one of the best places for human habitation between Yachats and Gwynn Knoll.

The rocky shoreline with its abundant mussels and barnacles must have been a strong attraction to the
area. However, the shoreline at Neptune is more exposed than that at Seal Rock and appears to be poorer in shellfish resources and offers less protection and forage for intertidal fish species. The offshore topography is also different as there are no offshore reefs or rocks to provide habitat for reef-fish, seals, and sea lions. The nearest pinniped rookery is 17 kilometers to the south at Sea Lion Caves, and the nearest reefs are found at Seal Rock. In general, the intertidal and marine environment around the Neptune site is less diverse and potentially less productive than around the Seal Rock site.

Like Seal Rock, Neptune is located several kilometers from potential salmon streams. Gwynn Creek and Cummins Creek are located only a few hundred meters away, but have small drainage basins and shallow, braided distributary channels. The nearest salmon runs probably occurred on the Yachats River 4.5 kilometers to the north and on Ten Mile Creek 5.3 kilometers to the south. Both streams have relatively large drainages and small tidal estuaries (State of Oregon, 1973).

The Neptune site covers about 550 square meters, or about one-tenth the area of Seal Rock (Barner 1981). Like Seal Rock, an unknown portion of Neptune has been lost to seaward erosion and vandalism. Several pits
originally thought to represent house depressions proved to be the work of amateur collectors. Undisturbed portions of the site contained cultural deposits almost two meters deep.

Neptune is contemporary with the Seal Rock site. A radiocarbon date taken from near the base of the midden places the initial occupation at 320 B.P. ± 45 (DIC-1399). One artifact of non-Indian origin, an iron wedge, occurred in undisturbed deposits 70 centimeters below the surface. The cultural affiliation is unknown, but is probably from driftwood from a Japanese shipwreck which predated European contact (Barner 1981:64-68). The absence of European-derived trade goods indicates that Neptune was probably abandoned by the early 1800’s (Barner 1981:64-68).

Ethnographically, the Neptune site lies near the boundary of the Alsea and Siuslaw, but the exact demarcation between these groups is unknown (Drucker 1939; Barner 1981:55). The southernmost Alsea village at the mouth of the Yachats river (Drucker 1939) was abandoned by 1856 when the government settled a mixed group of Coos and Yakonen speakers at that location (Beckham 1977). A listing of Siuslaw sites includes no coastal sites whatsoever (Berreman 1937).

The Oregon State University archaeological field school worked there for eight weeks under the direction
of Dr. Richard E. Ross beginning in June of 1973. Efforts were concentrated in undisturbed deposits along the western edge of the site. They excavated five 2 X 2 meter pits, and two 1 X 2 meter pits, but three of the larger pits were the only ones taken to sterile deposits. Those are the three pits analyzed in this study. Excavation procedures were the same as those used at 35-LC-14.

Debra Barner (1981) collected two column samples from the site in 1977 which were then analyzed along with the material recovered by the field school. Composition of the Neptune midden appears to be very similar to that at Seal Rock, although comparison must be tentative since only the sea mammal remains from the latter site have been analyzed. Shell is the major faunal constituent of both sites, but Neptune has a vastly lower relative amount of pinniped remains. Nevertheless, seals and sea lions are the most common mammal remains. Other mammals represented include whale (a few bone fragments), elk, black-tail deer, beaver, sea otter, river otter, rabbit, and raccoon. A few artifacts of bone, antler, and stone were found along with the aforementioned iron wedge. These artifacts appear to be similar in type and style to those from Seal Rock.
Barner's analysis states that the Neptune site was a temporary spring or summer camp where the locally abundant sea mussels were the prime focus of subsistence. The presence of an infant or juvenile black-tailed deer and infant northern sea lion remains indicate a spring or summer occupation. Barner felt that the site may have been abandoned in the late summer to avoid the shellfish poisoning that sometimes occurs in marine waters during the late summer or fall, and to take advantage of very low late-summer tides to exploit deep water shell fish in the estuaries. A review of faunal materials from estuary sites on the northern California, Oregon, and southern Washington coast supported her hypothesis (Barner 1981:88-92).
CHAPTER IV

Ethnographic Background

Important sociocultural and demographic changes took place between the late prehistoric period and the postcontact period. These changes represent the significant "environmental" differences between the two periods since the biophysical environment probably remained essentially unchanged until the late 19th century or later. The available ethnographic data is primarily based on oral tradition accounts collected from a handful of informants in the 1930's. It is very likely that the informants were recalling profoundly altered lifeways reflecting adaptation to a multitude of new and adverse conditions arising from Euroamerican contact. Although physiographically isolated from intensive early direct contact with whites, the aboriginal peoples of the central Oregon coast suffered severely from epidemic diseases transmitted through native intermediaries in the fur trade, and experienced the repercussions of Euroamerican conflicts with more accessible native groups.

Early Spanish and English explorers undoubtedly contacted local aboriginal groups before 1775, but left no record of ever having done so (Taylor, 1953:3).
The American explorer and trader William Gray made the first known direct contact with central Oregon coast peoples in 1778 while anchored between the Alsea River and Cape Perpetua. Two Indian men in an "Ex-tremely (SIC) well built/canoe/...sharp at the head and stern" (Taylor, 1953:5) paddled out to invite Gray to their village for trading. Gray declined, possibly because just two days before while cruising in the same area, a long boat from his ship rowed close to shore and saw a "vast number" of well armed and hostile warriors lined up along the beach.

Wherever Gray met native groups on the Oregon coast he found that they already had a good familiarity with standard fur trading practices and goods, possessed smallpox scars, blue eyes, and other evidence of Euroamerican landfall on the Oregon coast (Taylor, 1953:6-7; Beckham 1977:101). For example, the "Nechesne" Indians at the mouth of the Salmon River possessed metal and ceramic trade items, and their faces bore smallpox scars. These traits either came directly from earlier contact with white traders, or derived from the vast Indian trade network centered with the Chinook of the lower Columbia (Ruby and Brown 1975).

For about the next sixty years direct contact with Euroamericans was probably relatively infrequent or limited to meetings with isolated trappers or small
parties. Beginning in 1825, the Hudson's Bay Company conducted an annual overland trading expedition down the Umpqua River from the Willamette Valley then southward along the coast. The trading route was located well south of the study area. Early American settlement was concentrated north of the study area, around Tillamook Bay, or south, in the Coos Bay area.

The relative isolation of the central Oregon coast ended in 1855 when the United States Government established the Coast (later Siletz) Indian Reservation (Kent 1973). To satisfy the wants of American settlers in other parts of the State a vast tract of land centering on Yaquina Bay was set aside to contain most of the Indians of western Oregon. A diverse assemblage of native populations representing seven language families, varying physical types, and often radically different lifestyles found themselves suddenly thrust together (Kent 1973:1-8).

This new population struggled to survive under extremely difficult conditions of government neglect, ill-conceived acculturation programs, pressure from an encroaching White population, and a devastating death rate. At first they practiced a mixed economy of aboriginal style food collection supplemented by agriculture and Government allotments. In 1865 the United States yielded to business interests and opened
up the resource rich Yaquina Bay to white settlement (Kent 1973:18-20). As the native population dwindled the reservation was steadily reduced in size until it was eventually confined to the Siletz River Valley. A few Alsea and Siuslaw, the groups originally inhabiting the areas of Seal Rock and Neptune, were able to hold on to part of their territory along the coast under the protection of the Alsea Subagency. They received 160 acre homestead grants when the Alsea Subagency was abolished in 1876 (Kent 1973:38). Some of these Alsea and Siuslaw, attracted by added Government inducements, moved to the Siletz Agency. By 1884, those Indians living at Siletz had adopted American-style clothing, houses, and made their living by agriculture (Dorsey 1889:55). This latter group is the one that provided the early ethnographic information we rely on for this study.

In pre-reservation times, European epidemic diseases probably altered native populations more that did direct contact with Euroamericans. Many groups in other parts of western Oregon were devasted by epidemics and there is no reason to suggest that coastal groups escaped a similar fate. The greatest blows to aboriginal populations came during the 1830 and 1833 epidemics which completely obliterated some western Oregon groups (Cook 1955). After the establishment of the reservation

Population reductions beginning at contact closely match Cook's (1954) estimates for other areas of the northwest. Kroeber (1939:136) estimates the combined population of the Alsea, Siuslaw and Yaquina to have been 6,000 in 1780. In the 1865 census report for the Siletz Reservation the number had fallen to 420 people (Kent 1974:47), or a 93% reduction. From 1865 to 1913 the Alsea population dropped another 97% from 150 to 5 (Kent 1973:47; Frachtenberg 1917). Even greater losses are recorded for the Siletz and the Yaquina (Dorsey 1890; Frachtenberg 1917).

Ethnographic observation on the Oregon coast began rather late and was very superficial compared to the coverage given the more intact groups to the north. The bulk of the information is biased toward the non-material aspects of culture thus providing little archaeologically useful data (Dorsey 1889, 1890; Farrand 1901; Frachtenberg 1914, 1917; Barnett 1937; Drucker 1939). The ethnographers neither observed the functioning subsistence and settlement systems they described, nor is it clear whether any of the information represents oral testimony from people who actually participated in the behavior they describe. In addition,
significant inconsistencies and contradictions occur within and between the ethnographies.

The only comprehensive ethnographic descriptions for the Alsea are survey data collected in 1933 from two informants whose knowledge of the old life "was little more than a memory at the time of their youth" (Drucker 1939:81). Oral tradition accounts may be extremely accurate indicators of events and conditions several hundred years in past, or they may be extremely inaccurate (Gould 1966:1-8). Without a wide range of ethnohistoric and ethnographic data, the reliability of such a small body of literature collected under such stressful conditions must be seriously questioned (C.F. Jones 1978:241-243).

In summary, ethnographic information for the central Oregon coast is extremely sparse and may not accurately represent the late-prehistoric or the historic periods. It is primarily oral tradition collected from a small body of informants at least two hundred years after the initial Euroamerican contact. During that time, conditions changed as follows:

1. Drastic depopulation from introduced European diseases.

2. The introduction of new technologies and new systems of subsistence, i.e., agriculture, government allotments, wage labor.
3. A changed socio-cultural environment brought about by the introduction of fur trade, white settlement, and the influx of exotic aboriginal groups on the Siletz Indian Reservation.

The following is a generalized description of Yakonen environmental adaptations. Most of the information is for the Alsea, but as the main ethnographic sources (Farrand 1901; Barnett 1937; Drucker 1939) recognize the close similarity of the Yakonen groups, the model is provisionally assumed to apply to the entire study area. The purpose is to provide a framework for deriving archaeological expectations regarding the subsistence-settlement system that can be evaluated with the fish bone data from Seal Rock and Neptune.

Native Populations

At contact the Yaquina, Alsea, Siuslaw and Lower Umpqua occupied the river basins of the same names and the interconnecting coastline (Berreman 1937:36-37) (Figure 1). These groups were linguistic divisions of the Yakonen family, a small Penutian division entirely distributed in the above areas (Voegelin and Voegelin 1966; Powell 1890; Dorsey 1891). The Alsea and Yaquina shared a language differentiated by a few provincialisms. The Siuslaw and the Lower Umpqua spoke dialects of
another Yakonen language. The linguistic differences between the two Yakonen languages were slight and posed no barrier to close and friendly contact between their respective speakers (Farrand 1901). Other slight cultural differences and a weak sense of group identity further defined the named Yakonen groups (Berreman 1937: 10).

Cultural similarities, however, seemed to overwhelm minor ethnic differences. Drucker (1939) combines the Alsea and Yaquina into one group, the Alsea, and Farrand (1901) notes the close intervillage ties between the Siuslaw and the Alsea. Trait lists (Barnett 1937) also indicate that Yakonen groups had very similar social, political, and subsistence structures.

Each Yakonen division was composed of politically and economically independent villages. Most villages were populated by a single consanguineous kinship group of related families under the leadership of a commonly recognized headman (Drucker 1939:92). Large villages might have two or three headmen, although it is not clear whether this means they contained multiple kin-groups since "assistant headmen" sometimes existed (Barnett 1937).

Drucker (1939:86) states, "The sole intervillage ties were individual ones of blood and marriage;" however, this is not entirely accurate since kinship
and marriage always included familial, and sometimes, extra-familial obligations (Drucker 1955). Important economic and social considerations accompanied these ties. Brideprice based on, and consisting of, the wealth of the families, competitive gift giving between families during a marriage, and serious economic sanctions for divorce and death of a spouse would have created strong economic linkages between villages (Drucker 1939:93-94; Farrand 1901:242-243). Also, the practice of brideprice loans by the village headman (Barnett 1937:185) would have increased the scope of obligation within and between villages. The strong tendency for village exogamy (Farrand 1901:242) probably resulted in a complex kinship network which linked most villages with one another to a greater or lesser extent.

The close personal ties uniting the village populations with one another and the emphasis on local autonomy does not mean that all villages or kinship groups were equal. The "more important" villages were located around the estuaries (Drucker 1939:82). "More important" probably meant "larger" since the relative independence of a local group depended on its size and strength (Farrand 1901:243-244). Furthermore, since the larger villages may have contained multiple kinship groups
we should expect more complex socio-political organization in those villages.

Inequality between individuals also marked Yakonен society. Individuals were ranked on the basis of wealth into nobility, commoner, and slave classes. Drucker (1939) and Farrand (1901) maintained that anyone with ambition could raise his status by accumulating wealth. However, the competitive nature of wealth exchange in marriage and the high brideprice for women of nobility (Drucker 1939:93-94) certainly restricted upward mobility. Slaves were said to have never been able to improve their position since they "were constantly changing hands and constantly deprived of a favorable opportunity for demonstrating their value" (Farrand 1901:242).

Subsistence

The Alsea collected natural resources in season as they ripened, or became more abundant and easier to take (Drucker 1939:82-85). Men began salmon fishing in the midsummer when chinook salmon ascended the rivers on their annual spawning migrations. Coho and dog salmon arrived in the early fall and steelhead in the late fall and winter. Herring, smelt, lamprey, sea perch, trout, and flounder were the other types of fish
taken. The various species of salmon, smelt, herring, and lamprey were preserved for the winter by smoking (salmon and lamprey) or by sun drying whole (smelt and herring). The butchering and preserving techniques of the Alsea-Taquina would have resulted in all of the salmon bones being transported back to the villages; few, if any, bones would have been discarded at the fishing camps (Drucker 1939:85).

Hunting was also a male activity, but was only a minor pursuit. Deer were shot in the summer, and elk in the fall when they were fattest and easiest to approach. Pitfalls were occasionally used to trap elk. Quail, grouse, waterfowl, beaver, and an occasional seal or sea lion rounded out the list of game. Elk meat was the only game animal valued enough to be dried for winter consumption (Drucker 1939).

Women gathered the plant foods and shellfish, and did all the preparation and storage of all foods. They collected camas, ferns, skunk cabbage, berries, greens, and acorns in season. Camas seems to have been particularly important since "the women dug great quantities" which they stored for winter (Drucker 1939:84). Many people went to the upper Alsea Valley in the summer to gather camas and other wild plants (Drucker 1939:82). Shellfish were gathered like plants with a digging stick and basket. Smoked clams were
considered a great delicacy. The Alsea also eagerly scavenged beached whales. Such an occurrence signaled a windfall of valuable products, including the especially prized oil rendered from the blubber.

The fisheries were strongly oriented to anadromous salmonid species taken by mass capture methods. Weirs used in conjunction with traps, conical dipnets, and harpoons were the most important methods for catching salmon (Drucker 1939:82-83; Barnett 1937; Hewes 1947). Salmon were also taken from the shore with thrusting harpoons, and occasionally in gill nets drifted downstream between two canoes. They used A-shaped dipnets, herring rakes, gaffs, and eel pots for the other anadromous, schooling species.

Resident and non-schooling species were taken by a few, miscellaneous methods. Sharp angled hooks and bone gorges attached to a line were used for trout in the rivers (Drucker, 1939:83). Flounders were speared with a sharp stick after being pinned to the bottom of mudflats by the fisherman's feet (Drucker 1939:82). Nash (1882, cited in Hewes 1947:91) notes that in Yaquina Bay flounders were speared from canoes at night by the light of fires built on planks laid crosswise.

The most striking environmental characteristic of Yakonen fisheries is their complete river and estuary orientation. Fishing from the shore along
the coast is never discussed, and offshore fishing is categorically and emphatically denied: "The Alsea did not fish offshore" (Drucker 1939:83). No technological barriers prevented the Alsea from fishing offshore since they had sea-going canoes and types of gear commonly used for ocean fishing by native Northwest coast peoples (Drucker 1939; H. Stewart 1977; Hewes 1948).

Settlements

The Alsea and Siuslaw probably practiced a semi-sedentary lifeway featuring major seasonal population moves between their villages and seasonal camps. They spent winters in the villages living on foods collected earlier in the year, and probably supplemented the preserved foods with fresh caught coho, steelhead, and herring. The estuary fringes served as the setting for the vast majority of Alsea and Siuslaw villages. Drucker (1939) states that most of the dozen or less Alsea villages, including the "more important" ones were located between tidewater and river mouth. An unknown number were above tidewater. He is most likely referring to the Alsea river and the Yaquina river, the major drainages.

Three Alsea villages occurred along the coast (Drucker 1939; Dorsey 1890). One at the mouth of the
Yachats river, and another on Beaver creek are actually partially riverine as both streams have small estuaries and salmon runs. The only fully coastal Alsea village, i.e., the only one not situated on a salmon stream was at Seal Rock (Dorsey 1890: Berreman 1937). Ethnographic information collected in 1978 at the Siletz Reservation indicates that Seal Rock was used ceremonially in the 1870's but was not a village at that time (Caday 1978).

Siuslaw villages show the same strong tendency for estuarine locations (Berreman 1937:37; Dorsey 1890: 232). According to Berreman, all Siuslaw villages were along the Siuslaw River as far upstream as Mapleton. This would match the lower river emphasis of the Alsea since Mapleton is located in the upper estuary (State of Oregon 1973).

Information on the number and distribution of seasonal camps is scarce and very vague. For the Alsea-Yaquina Drucker (1939) estimates there were about twice as many fishing and plant-food gathering camps as villages, i.e., about two dozen camps. Fishing camps would probably be located adjacent to weirs on the main rivers and side streams. One area, the upper Alsea Valley "back in the coast ranges, was a place where many people went in the summer to harvest camas and other wild crops" (Drucker 1939:82). Information for the Siuslaw suggests that a very similar pattern existed
(Dorsey 1890; Berreman 1937:37). For both groups the coastal area appears to have been little used although claimed as part of the tribal geographic area.

Structures in the villages and seasonal camps differed in terms of their durability and effort expended in construction. Quickly built temporary shelters characterized the seasonal camps that were occupied during the dry months. Fishing camps contained thatch roof, pole-framed, above ground, rectangular houses usually built for one season (Drucker 1939:86). In contrast, the villages contained a number of large, semi-subterranean plankhouses that sheltered three to four families each. The only internal division was a sleeping platform around the perimeter at a height of two to three feet above the floor. The poor often lived in a less elaborate mat-lined hole-in-the-ground covered with a movable gabled roof (Drucker 1939:86-86).

Discussion

The following points are relevant to the occurrence of fish remains at late-prehistoric sites in the region:

1. Villages were the main occupation sites during the fall and winter. The remains of semi-subterranean houses would be evident. Other than the differences
in house type, because of differences in individual wealth, no information is available on the layout of Yakonen villages. Also, it is not known if the villages were abandoned part of the year or were continually occupied. However, the practice of preservation and storage of seasonally available foods for winter consumption should have produced distinctive trash deposits. Village middens should contain abundant salmon remains, and evidence of resources representing a wide seasonal and geographic range.

2. Temporary camps were established in the summer in the upper valleys where camas and other wild crops were gathered. In the fall, transient fishing camps were set up along the streams near important fishing places where temporary, above-ground structures were built each year. Salmon were caught in weirs and by other methods. The butchering and preservation techniques would have resulted in virtually all salmon bones being transported to the winter villages. In contrast with the villages, middens at temporary camps probably reflect a more restricted temporal and geographic scope of food remains.
CHAPTER V

Faunal Analysis

The initial goal of this research was to apply a wide range of analyses to the fish remains from the two sites. But, as the published literature was consulted, it became apparent that the sampling methods and excavation strategy used at Seal Rock and Neptune produced data amenable to only a few types of manipulation. Also, there is a great lack in the biological and ecological information on the major species recovered; this limits the range of possible studies. For instance, dating the season of death of the fish to help reconstruct seasonal activity patterns at the sites was impractical because the growth patterns of the relevant species are poorly known. These difficulties have, however, focused attention on the data requirements for faunal analysis and resulted in the identification of areas for improvement in archaeological research of the region.

This section presents the results of the faunal analysis as they pertain to several methodological concerns identified in a review of literature on sampling methods and faunal analysis. Natural and cultural agencies of site formation, and the archaeo-
logical excavation methods are evaluated to identify probable biases in the samples. The major purpose is to present the rationale for addressing the types of anthropological questions of this study. In addition, it contains observations on the distribution of fish remains which appear to indicate significant temporal variation in subsistence orientation at the Neptune site.

In the last 50 years faunal studies in archaeology have changed from a paleontological orientation emphasizing the evolution of domestic species from wild forms and the definition of temporally diagnostic faunal change to a paleoecological/paleoeconomic orientation (Payne 1972). Archaeology now emphasizes the species' interactions with human populations, and the economic relationships within and between human populations. Analytic methods have shifted from the morphological study of single specimens to the statistical treatment of whole samples and analysis of the patterned distribution of faunal remain on living floors. The new methods require greater control over collection techniques and sampling methods and better understanding of the processes which structure the archaeological record.

The research design is the best place to begin considering the requirements for faunal studies.
Study objectives are defined and methodology integrated into an efficient problem solving sequence (Pelto 1970:331-337; Payne 1972:80; Watson 1976:85-86). A multistage research design is the optimum approach because the results of the earlier stages are used to refine the goals and methods, sampling fraction, and analytic operations. Determining these variables before fieldwork increases the chances for obtaining the data relevant to the questions asked.

Like this study, however, faunal remains normally receive serious consideration only after being excavated. The faunal specialist is called in and asked to produce a report usable to the archaeologist preparing a monograph for the site.

In these cases the faunal specialist must ask a number of questions about the sample before beginning his analysis. The research design process must, in a sense, be done in reverse to ascertain the quality of the data which in turn controls the types of analyses which are appropriate. This step is necessary to avoid irrelevant quantification and misleading inference.

The archaeological record is a contemporary, statis phenomenon resulting from the operation of an unobservable, extinct behavioral system (Schiffer 1972; Binford 1977; Thomas 1979). As long as the archaeological site is the direct result of cultural depositional
processes, the archaeologist is in a relatively good position to interpret the situation. But this rarely occurs since past depositional processes have usually altered the original structure of the archaeological site. Although a static record, the archaeological site is the result of dynamic mechanisms such as erosion, vandalism, differential preservation, and later reuse which may be operating up to the moment of excavation.

Cultural deposition processes produce two kinds of archaeological contexts for faunal remains: primary refuse representing remains discarded precisely where they were butchered or eaten, and; secondary refuse representing remains discarded away from the original place of use (Schiffer 1972). A third type of deposit results when primary and secondary deposits become mixed. Each of these types of deposits present varying potentials for faunal studies. Archaeologists commonly map primary refuse in place to reconstruct specific economic activities and social behavior. For example, Lyman (1976) used ethnographic information and detailed living floor maps to reconstruct prehistoric butchering techniques and interfamily sharing patterns in the houses at the Alpowa locality in southeastern Washington. However, studies such as that can only be done when one is dealing with obvious features such as hearths and living floors.
Secondary refuse presents greater interpretive problems because materials from numerous unrelated primary associations often become hopelessly combined into a homogenous deposit. Secondary refuse is usually recovered by screening the archaeological matrix through standard size screens and saving the retained reside. Analyses of secondary refuse are usually statistically oriented and concerned with more generalized economic behavior than are studies of primary refuse.

The first step in a faunal analysis is to distinguish nonutilized remains from utilized remains, then separate food remains from nonfood remains in the utilized category (Lyman 1976:16). Utilized remains are those fragments of non-human tooth, osseous material, shell, and other faunal remains deposited as the direct result of human activity (Thomas 1971:366). Non-utilized remains are deposited as a result of other agencies including the indirect consequences of human activity. Archaeologists usually study utilized remains, although in certain situations non-utilized remains are studied for the environmental information they yield. To differentiate utilized remains from non-utilized remains may require consideration of: (1) archaeological context; (2) defined butchery patterns, skinning marks, and technology marks; (3) relative degrees of weathering and mineralization, and (4) ethnographic analogy (Lyman 1976:16).
The following sections address the above concern.

Processes of Accumulation

Fish remains can become an integral part of a midden in several ways:

"(1) they can come from fishes the Indians catch for food and carry home with
them; (2) they can come from the stomachs of fish-eating birds, mammals, and fish
that the Indians eviscerated at their camp site after killing the animal for feathers,
fur or food; (3) they can be brought to the site in the digestive tract of some
scavenging bird, coyote, or bear and left there in excrement as the scavenger either
feeds or roosts on the village garbage dump; or (4) they can be carried to the
site by Indians who bartered for their fish at distant villages (Fitch 1972:101)."

The cultural processes of accumulation, numbers 1 and 4, are the subjects of archaeological study. The natural processes represent interferences which must be identified before cultural studies can be confidently undertaken.

The stomach contents of prey species is a special concern because the two sites studies here contain numerous seal and sea lion remains. The remains of nine individuals from three pinniped species were found at Neptune (Barner 1981:68), and Snyder (1978)
identified 68 individuals representing four species. In numbers, and in total live weight, the northern sea lion dominates the faunal assemblage from Seal Rock. The harbor seal is an important minor species. These two species are completely carnivorous, ingesting from 2 percent to 11 percent of their body weight (up to 900 kg total body weight for northern sea lions) daily in marine fish and invertebrates (Ingles 1965:397; Spalding 1964). Based on stomach content analysis, harbor seals and sea lions eat many of the same fish species in a seasonal pattern of exploitation similar to ethnographic northwest groups (Smith 1902; Scheffer 1928; Bonnot 1930; Scheffer and Sperry 1931; Scheffer and Slip 1944; Fisher 1947, 1952; Imber and Sarber 1952; Mathisen 1959; Mathisen et al. 1962; Spalding 1964; Fiscus and Baines 1966).

Given the excellent preservation of the fish remains at the sites it is safe to assume that the samples have not been biased by the addition of pinniped stomach contents. The thorough digestion by pinnipeds would leave unmistakable signs in the form of erosion and pitting of all bone surfaces (Mate 1979:PC). Furthermore, the extremely rapid digestion rate of seals and sea lions would probably leave otoliths (earstones) as the only fish remains in the stomach (Leatherwood 1979:PC).
The stomach contents of fish the Indians caught for food are another possible source of fish remains. A few vertabrae from smelts and herring, two forage fish which are potentially important in the prehistoric economy, were recovered from Seal Rock. These species are insignificant in terms of numbers in the sample and for the moment the cultural significance of these remains is unknown.

Because the fish bones are not eroded and almost all remains are from marine species we can assume that the feces of terrestrial scavenger and carnivores did not significantly add to the deposit. Dogs, bears and other animals attracted to a midden would probably remove remains from a site, but this would be impossible to identify.

The disposal of the remains of cooked meals or butchered fresh carcasses seem to be the best explanation for the presence of the fish bones. The total lack of artifacts made from fish remains and the absence of evidence for "natural" sources of deposition indicate that the sample is composed of food remains.

Process of Attrition

The problem of bone survival in archaeological deposits is the next area of concern. Bones can
disappear from a site in two general ways: (1) differential destruction through chemical, physical and biological attrition, and (2) the wholesale destruction of parts of the site by erosion or man-caused disturbances (vandalism and construction).

Differential destruction is a complex problem dependent on numerous physical characteristics of a site, the bones, and cultural practices of the human population discarding the debris (Brain 1967; Lyon 1970; Casteel 1971; Crader 1974; Binford and Bertram 1977). Because of the lack of information about the attrition of fish remains, and the partial recovery methods used in excavation, assessment of differential destruction will be limited to qualitative remarks.

There is little evidence suggesting that bone attrition is a problem in the samples from Seal Rock and Neptune. The entire fish bone assemblage, not just the portion identified for this study appear to be comprised mainly of complete or nearly complete bones, indicating that physical agencies are not important. There is no sign of chemical erosion from digestive or soil acids. All the bones examined, from the smallest and most delicate to the stoutest are morphologically indistinguishable from their counterparts in modern comparative collections. Based on the absence of gnawing by scavengers and rodents on
the Seal Rock pinniped remains (Snyder 1979), biological alteration of the fish remains is also assumed to be negligible.

The wholesale loss of fish bone through erosion and road construction has affected the sites more than differential destruction. Seaward erosion of the middens has claimed an unknown portion of both sites; the amount could be substantial given the rapid erosion rates of Oregon marine terraces (Kulm 1978:15). At Seal Rock construction of U.S. Highway 101 apparently has destroyed about 40% of the surviving shell midden, and an historic house disturbed the upper layers in a small area. None of the pits analyzed were in these affected areas, therefore, samples are unaffected by these disturbances.

Archaeologically it would be impossible to determine if fish remains were discarded in non-preservation environments like the beach. We can probably expect that very small fish species were eaten whole resulting in the off-site deposition of at least some of the remains in human feces (Limp and Reidhead 1979:75). Should the feces have been deposited on the sites, mechanical and chemical attrition from digestion would cause differential destruction of the fish bones and render many unidentifiable.
Archaeological Sampling

So far as we have considered possible errors in the archaeological data resulting from the formation and attritional processes of the archeofaunal record. Now we will examine the second major source of errors, archaeological and analysis procedures (Read 1975:48).

Recovery Methods

To obtain a representative sample, the field collection methods must be geared to the size of the faunal remains, their physical condition, cultural contexts, and frequency in an archaeological site (Hester and Conover 1970; Chaplin 1971:24-29). Inappropriate methods can lead to the destruction and loss of remains, thus obscuring the evidence for interpopulation ecological relationships, and cultural behavior regarding the use of fisheries resources. At Seal Rock and Neptune two collection methods were used: (1) most midden material was sifted through \( \frac{1}{4} \) inch (6.35 mm) mesh shaker screens. The excavators then separated the fish remains from the other archaeological material retained in the screen; and (2) bone concentrations and individual skeletal elements were recorded in situ and totally collected. Several
characteristics of the samples indicate that the main faunal recovery method, screening, caused the under-representation of small fish remains.

Pacific herring and smelts were represented by a few vertebrae from the Neptune site. A number of factors could account for the low frequency of these taxa, but, since all but one herring vertebra were collected in situ, the screen samples appear to be biased against small remains. Unless small faunal remains are in recognizable concentrations, excavators are likely to miss those small pieces scattered throughout a midden (Struever 1968:353). The absence of smelts at Seal Rock is particularly significant in the light of the extensive sandy beaches in the area, and the ethnographic importance of these fishes to other northwest groups situated directly on the open coast (Kroeber and Barrett 1960; Gould 1966). Of course it is possible that most small fish remains were deposited offsite or in another part of the site.

The absence of Elasmobranch (sharks, rays, skates) remains is vexing because this taxon is common in the shallow inshore waters of the northeast Pacific (Follett 1965:40; Miller and Lea 1972:34-51; Beardsley and Bond 1973), and was ethnographically used for food and by-products north of the Oregon coast (Fladmark 1974:44; F. L. Stewart 1975; Friedman 1976:144; H. Stewart 1977).
Among native groups of the northwest California coast, fishing for shark is specifically denied (Kroeber and Barrett 1960:90). Archaeologically, however, Follett (1966:85-86) identified large soupfin sharks from the Point St. George site in Del Norte County. North of Oregon the spiny dogfish has been recorded at least once, but in no place are they numerous (F. L. Stewart 1975; Friedman 1976:145; Casteel 1976; Huelsbeck 1980). No elasmobranch remains have been identified in any archaeological site in Oregon, nor has the use of sharks been recorded ethnographically.

The relative scarcity of elasmobranch remains from archaeological sites in the northwest may be related to the relatively large meshes routinely used. Except for an occasional ossified vertebra, and dogfish spines, elasmobranch parts likely to survive are the extremely small dermal denticles and teeth of most species. Recovery of these remains requires fine screening (Follett 1965:40). Identification to the species level is usually possible because of the distinct shapes of these parts (Norman and Greenwood 1975: 59, 115).

The frequency distributions of Teleostean skeletal elements are skewed in a manner indicating recovery bias caused by screening. The most obvious feature is a total lack of otoliths and the abundance of other
cranial elements; other skeletal elements show similar incongruous distributions. Table I illustrates the problem in one species recovered from Neptune and two from Seal Rock. These three species were chosen because their relatively great abundance reduces the chance of sampling error causing the observed pattern.

Table 3. Frequency distribution of identified skeletal elements for selected species at Seal Rock and Neptune.

<table>
<thead>
<tr>
<th></th>
<th>P. Stellatus</th>
<th>A. rhodoterus</th>
<th>H. deagrammus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Left</td>
<td>Right</td>
<td>Left</td>
</tr>
<tr>
<td>Ceratohyal</td>
<td>0</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>Premaxillary</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Maxillary</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Dentary</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Quadrable</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Articular</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Operculum</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Preoperculum</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Hyomandibulum</td>
<td>3</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Cleithrum</td>
<td>4</td>
<td>6</td>
<td>0</td>
</tr>
</tbody>
</table>

Unpaired elements

<table>
<thead>
<tr>
<th></th>
<th>35-LC-14</th>
<th>35-LA-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vomer</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>Parasphenoid</td>
<td>2</td>
<td>23</td>
</tr>
<tr>
<td>Basioccipital</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>1st Vertebra</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Penultimate Vert.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ultimate Vert.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1st Anat Pt.</td>
<td>20</td>
<td>NA</td>
</tr>
<tr>
<td>Pharyngeal</td>
<td>NA</td>
<td>80</td>
</tr>
</tbody>
</table>
In the Seal Rock data the most common skeletal element from the starry flounder is the first anal pterigiophore, and from the rectail surfperch, the fused pharyngeals. Both bones are exceptionally large and dense compared to other skeletal elements in those species. If it were not for these bones the observed frequency of these fishes would be much lower. For the kelp greenling, a species containing no exceptionally large or stout bones, the differences in the relative frequencies between parts are also very substantial. The low frequency of vertabrae in all species could be due to butchery practices, but the erratic occurrence of cranial elements argues for recovery methods as the probable cause of bias.

Several workers have found that small mesh size is needed to efficiently recover fish remains. Thomas (1969) compared $\frac{1}{4}$ inch (6.35 mm), 1/8 inch (3.18 mm), and 1/16 inch (1.59 mm) meshes to find the size classes of animals most efficiently collected by each mesh. In the Great Basin cave sites he investigated 3.18 mm is sufficiently fine to recover the remains of animals weighing more than 5 kg. Smaller animals required 1.59 mm mesh to collect a representative sample. No fish remains were recovered in mesh larger than 1.59 mm.

In a similar study at a medieval townsite in the Netherlands, practically no fish remains were found
in 10 mm mesh, the largest size used (Clason and Prummel 1977). An "explosive" increase in fish remains occurs in the 4 mm screens, and another dramatic rise in frequency happens at 1 mm (Table 2). At this site fish remains are the main contents in the smaller meshes. Analysis of the 1 mm residue is not complete, but the authors feel that it will contain additional species, and smaller bones of the species found in the 4 mm mesh.

Table 4. The total number of fish remains collected at the early medieval site of Dorestad, Netherlands according to the mesh size in a series of superimposed screens (Clason and Prummel 1977:173).

<table>
<thead>
<tr>
<th>Screen Size</th>
<th>Fish Remains (number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>first screen (10 mm mesh)</td>
<td>601</td>
</tr>
<tr>
<td>second screen (4 mm mesh)</td>
<td>19,334</td>
</tr>
<tr>
<td>third screen (1 mm mesh)</td>
<td>31,579</td>
</tr>
</tbody>
</table>

At coastal shell middens, fine screening with mesh as fine as 0.5 mm may be needed to recover small ichthyofaunal remains (Follett 1965:40-41); (Fitch 1969:59, 1972:102, 1975:437). At 4-VEN-3, a prehistoric Chumash village in southern California, small teleost species and elasmobranchs were not well repre-
sented in the 6.35 mm and 8.18 mm screen samples. When a small portion of the residue that passed through 3.18 mm mesh was put through a series of screens with mesh as fine as 0.50 mm, the species count at the site increased from 10 to 45. Each successively finer mesh turned up a greater number of species represented by small remains. Ten to fifteen more species probably would have been identified if a larger volume had been processed through the 0.50 mm screen (Fitch 1969:58-60).

Other studies confirm that traditional archaeological recovery techniques introduce substantial bias favoring large fish remains (Struever 1968; Fitch 1972, 1975; Casteel 1972, 1976a:90-92, 1976b; Lord 1977; Garson 1980). Samples biased toward the larger end of the size range under-represent the small species, small members of a fish population, and the smaller body parts of a species in the deposits. Differences in the size of fishes further complicates the problem by producing continuous variation in the degree of the effects, thus making comparison between fish of different sizes impossible unless one knows the relative ratios of recovery. One could not, for instance, assume that ratios of recovered skeletal elements of a 10 kg fish is comparable to the ratios of recovered parts of a 1 kg fish of the same species.
Lateral Sampling Plan

Another potential explanation for the lack of small fish remains is a biased sampling of the lateral variation in the two sites. Unless one has prior information that the data needed to answer a question are probably contained within a certain restricted area of a site, excavation of that area cannot be assumed to provide a representative sample of the necessary data (Reid et al., 1975:219-220; Payne 1972:65-66). At neither Seal Rock nor Neptune do we have the requisite negative evidence from outlying areas indicating the the sites are totally comprised of a shell midden. At Seal Rock, in particular, there is strong evidence that the site may have associated cultural deposits. Further excavation and analysis is the only way to resolve this important point, but the following information is offered to illustrate the potential effects of village layout on deposits of fish remains.

Ethnographic information for the northwest coast indicates that patterns of trash discard are complex and highly variable. On the northern northwest coast many villages had a centralized pattern of geographically contiguous activity areas arranged parallel to a river bank or sea shore (Hester and Conover 1970:138; Oberg 1973:58). With that type of village pattern shell middens are stratigraphically complex deposits often with progressively older strata situated farther away
from the waterline. They functioned as refuse heaps, contained fish smoking houses, and often were later used as living house sites.

At the other end of the scale is the de-centralized village pattern of the Tolowa on California's north coast (Gould 1966). Tolowa villages consisted of three distinct localities—workshop area, habitation area, and cemetery—separated by several hundred meters of culturally sterile deposit.

The Tolowa example is especially relevant to this study because many of their villages were located on rocky shores on the open coast with abundant sandy beaches nearby. Surf smelt caught in dipnets on these beaches were the most important single fish species in the economy. Salmon taken on inland rivers, and marine fish caught from boats in adjacent ocean waters were also important. Smelt were sun dried whole then transported directly to the habitation area for storage. Salmon were butchered and smoked at the river fishing camp before being taken to the village; the ethno-graphic Tolowa butchering pattern described by Drucker (1940:234-235) would have left all the bones in the split and smoked salmon carcasses. Marine fish were treated very differently. They were butchered fresh in the workshop and the bones discarded there.
Because of the different processing methods we can probably expect two types of trash deposits at Tolowa sites containing fish remains: (1) primary refuse deposits in the workshop area with marine species, and (2) secondary refuse deposits in the habitation area mainly containing smelt and salmon remains. The archaeology at the Point St. George site (4-DNO-11), an ethnographically known Tolowa village, partly bears this out. Most of the fish remains were recovered from the workshop area in trash pits. The majority of these fish were strictly marine species.

Unfortunately, the midden was not screened and very few bones were recovered from the habitation area midden (Gould 1966). Smelts were completely missing, but this is expected in light of the recovery method. The point still holds, however, that lateral variation produced different assemblages of fish remains in different activity areas. Without archaeological excavation in both areas, we would have a distorted idea of the lateral distribution of fish remains.

Vertical Distribution of the Fish Remains

The vertical distributions of E, the number of identified elements per taxon, are now examined to determine if frequency variations are culturally
significant or the result of random errors. This shall be a cursory analysis since the stratigraphy and other contextual data is not yet completely analyzed. Variations in element frequency will be compared to field notes and stratigraphic profiles. Statistical tests to help decide which changes are significant are not justified because E does not provide statistically independent observations (Grayson 1977:1), the sample variates were not randomly selected, and the effects of biased recovery techniques are unknown. In this case, analysis of E is preferable to an analysis of Minimum Numbers of Individuals per species (MNI) because sample size for E is larger and thus less subject to random fluctuations. Furthermore, statistical tests on MNI would be just as invalid as tests on E because of the bias which probably effects these samples.

In the six excavation units analyzed, 2 or 3 taxa tended to dominate the sample: 8 to 12 other taxa are represented by frequencies ranging from 40 to 191 skeletal elements. To reduce the effects of random error, because of the small sample sizes for most types of fish, the samples from each excavation unit were pooled. Figures 3 and 4 present the frequencies of the number of identified skeletal elements per taxon, E, per level per excavation unit for the two sites.
Figure 3. Bar Graph of Identified Skeletal Elements (E) Per 20 cm. Level From Each Excavation at Neptune.
The vertical distribution of E exhibits significant variation at each site. The occurrence of fish remains at Neptune is strikingly similar in each excavation unit. The pit to pit variation is greater at Seal Rock, but the pattern is generally the same. The less consistent pattern at Seal Rock is probably caused by random variation in the small samples from units 45/30 and 48/30.

Fish remains from the Neptune site, particularly in pits 56/20 and 44/16, have strongly bimodal distributions (Figure 3). Examination of the field copies of the stratigraphic profiles and the field notes give ambiguous explanations for the phenomenon. The profiles indicate the decline in frequency occurs in a different stratigraphic context in each pit. Because of the unique descriptors used to label the strata in each profile, it could not be determined if the contents were really different, or were the products of the different student-drawing-teams.

The field notes for 44/16 mention the decline in fish remains and a correlated rise in sea mammal remains and barnacles in level 4. Declines in the frequency of fish remains also occur at about the same depth in units 52/18 and 56/20. In all the pits, bone counts increase to higher frequencies in the next lower level. Thereafter the frequencies steadily de-
Figure 4. Bar Graph of Identified Skeletal Elements (E) per 20 cm. Level from Each Excavation Unit at Seal Rock.
cline in successively lower levels except for a minor increase in level 9 in 44/16.

Stratigraphic changes also appear to be significant factors in some of the observed frequency changes in fish bone counts at Seal Rock (Figure 4). Based on field notes and stratigraphic profiles the absence of fish remains at level 5 in 46/30, and at level 11 in 56/32 corresponds to stratigraphic changes. As in level 4 of 44/16 at Neptune, barnacles or another "white shell" predominates in those levels. In level 12 of 56/32 "white shell" diminishes and fish bones occur in the greatest numbers of any single level at the site.

This extremely brief examination of the vertical distribution of fish remains indicates that cultural activities are responsible for many of the observed fluctuations. At Neptune a drastic reduction in fish bones occurs at about 40-50 centimeters below the surface in the three excavation units. The correlated increase of sea mammal bones and barnacles during this decline in fish suggests that economic changes temporarily occurred. Similar frequency reductions of fish remains at Seal Rock are associated with an increase in shellfish. Causes for such a shift are unknown, but the similar effect on major and minor taxa clearly indicates that random fluctuations are probably not
responsible. Perhaps when the stratigraphic profiles have been correlated and the archaeological contents determined it will be possible to explain the changes.

Summary and Conclusions

The fish bone samples from Seal Rock and Neptune appear to be discarded food remains. Natural agencies of accumulation probably have not added significant amounts of fish bones to the sites. Small forage fish may have entered the deposits via the stomachs of predator fish used for food by the site's inhabitants but the small numbers observed in the samples are not significant. One potentially important source of noncultural fish bones, sea mammal stomach contents, seems to have played no role in the depositional history of the sites. The physiology of pinniped digestion and aboriginal butchering practices probably accounts for the absence of sea mammal stomach contents.

On the other hand agencies of attrition have caused the wholesale loss of large portions of the deposits. An unknown percentage has been lost to seaward erosion. Recent highway construction may have claimed at least 40% of the remaining portion of Seal Rock. Other natural agencies of attrition may have been relatively insignificant. The top several
centimeters of the deposit and part of the northern edge of Seal Rock have been disturbed by cultural activities in the past 120 years. The vandalism on the north slope is considerable, but this area was not sampled.

Recovery methods may have produced a biased sample of the fish remains. The large mesh screens most probably led to the underrecovery of small species, the small members of a population, and the smaller skeletal parts of large fish. The main effects could be the loss of evidence indicating the use of pelagic waters and sandy beaches inhabited by small forage fish such as smelt and herring, and underestimation of the importance of small species in the economy.

Variability in the vertical distribution of the samples appears to be culturally based. Much more supporting archaeological data is needed to support this observation and determine the causes for changes in the frequency of the fish remains. The scanty contextual data prevents the confident partitioning of the Neptune sample based on the possible stratigraphic break about one-half meter below the surface. By separating the bone sample from the upper and lower portions of the site independent MNI calculations
could be made for intrasite comparisons. The observed vertical variations indicate the sites may record prehistoric changes in aboriginal subsistence-settlement systems.

The numerous questions about the quality of the samples limit the types of inferences and analyses which can confidently be done. Because of the generalized contextual data and possible statistical biases the fish remains are considered to represent the average of the economic activities carried out over the entire span of accumulation of the deposit. No attempt will be made to further interpret lateral and vertical variation in the deposit. By keeping in mind the probable bias toward large fishes some inferences concerning the relative importance of the different species can be made. Statistical tests, however, are not defensible for this study. The most important use of the samples is as a source for constructing tentative species lists for each site.

Methods of Identification and Materials

The identified fish bone sample consisted of 1,182 skeletal elements from the Neptune site and
601 from the Seal Rock site. These remains were retrieved from ¼ inch mesh screens from three 2m X 2m excavation units at each site. Excavation of additional pits recovered several thousand of additional bones, but these pits were not analyzed because of the sampling problems discussed earlier.

Eleven paired and nine unpaired elements were chosen for identification (Table 5). One element, otolith, did not occur in the sample. The suite of identified skeletal elements represent the head and tail region of the fish and are especially diagnostic for taxonomic determinations (Casteel 1976a). Whole and fragmented elements were identified to taxon, body part, portion, and segment as defined by Gifford and Crader (1977). The bones were examined for burning, human modification, rodent gnawing, and weathering, but these conditions were rarely observed. Only one burned bone occurred, and except for mechanical breakage and discoloration caused by burial in a dark soil the remainder were in excellent condition.

Table 5. Identified Skeletal Elements

<table>
<thead>
<tr>
<th>Paired Elements</th>
<th>Unpaired Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>preoperculum</td>
<td>basioccipital</td>
</tr>
<tr>
<td>cleithrum</td>
<td>first vertebra</td>
</tr>
<tr>
<td>articular</td>
<td>second vertebra</td>
</tr>
<tr>
<td>operculum</td>
<td>penultimate vertebra</td>
</tr>
<tr>
<td>hyomandibulum</td>
<td>ultimate vertebra</td>
</tr>
<tr>
<td></td>
<td>(cont'd next page)</td>
</tr>
</tbody>
</table>
Paired Elements | Unpaired Elements
---|---
dentary | parasphenoid
quadrate | first anal pterigiophore*
preamaxillary | vomer
maxillary | fused pharyngeal**
ceratohyal | otolith
otolith | |

* only in Flatfish
** only in Surfperches

To help insure accurate taxonomic identification a comparative skeleton collection of common nearshore marine and adadronmous fishes was assembled, and osteological literature consulted. The collection consisted of 87 specimens representing 44 species. Fishes were collected from fish processing plants in Newport, Oregon State fish hatcheries, and by angling. Bones not assignable to the species level on the first attempt at identification were examined a second or third time on different days before assigning them to a higher taxonomic level. The first excavation unit examined, 44/16 from Neptune was partially re-examined to check the accuracy of the taxonomic determinations. To provide a degree of observational independence, the second examination took place seven months later. 98.7%, or 229 of 232, determinations agreed.

Table 6 presents the frequency and percentage distributions of $E$ for the four taxonomic levels
determined in this study. The data show a high degree of intrasite consistency. Intersite differences probably stem from the differences in species composition at the sites. Seal Rock contains a greater number of rockfish and flatfish, taxa with several morphologically similar species. In contrast, the kelp greenling, an easily identified species, dominated the Neptune collection.

Table 6. Distribution of Identified Skeletal Elements (E) Per Taxonomic Level at Seal Rock and Neptune.

<table>
<thead>
<tr>
<th>Excavation Unit</th>
<th>Seal Rock</th>
<th>Neptune</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>56/32</td>
<td>48/30</td>
</tr>
<tr>
<td>Total E</td>
<td>405</td>
<td>102</td>
</tr>
<tr>
<td>E to species</td>
<td>319</td>
<td>87</td>
</tr>
<tr>
<td>% E to species</td>
<td>78.8</td>
<td>85.3</td>
</tr>
<tr>
<td>E to genus</td>
<td>41</td>
<td>9</td>
</tr>
<tr>
<td>% E to genus</td>
<td>10.1</td>
<td>9.92</td>
</tr>
<tr>
<td>E to family</td>
<td>32</td>
<td>5</td>
</tr>
<tr>
<td>% E to family</td>
<td>7.9</td>
<td>4.9</td>
</tr>
<tr>
<td>E to superorder</td>
<td>13</td>
<td>1</td>
</tr>
<tr>
<td>% E to superorder</td>
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<td>1.0</td>
</tr>
</tbody>
</table>

The small number of bones at the superorder level means that interpretation of the sample will not be hampered by a large group of essentially unidentified bones. Based on general morphology and size most of these bones are sculpin-like and may represent a small nearshore sculpin, red Irish lord, not in the comparative collection.
The major problem with the sample is the probable strong bias favoring larger species and the smaller bones of large fish. One-quarter inch mesh screen is too coarse for the representative recovery of fish bones at Seal Rock and Neptune. This problem and other characteristics of the sample are discussed in the following section.

Results

The same major groups of fishes occur at Seal Rock and Neptune, but in different proportions (Table 7). The assemblage from Neptune is dominated by the greenlings while that from Seal Rock has several well-represented groups. At Neptune, greenlings constitute 67% of the MNI and 85.4% of the E. No other type of fish exceeds 10% of the MNI or 6.5% of the E at the site. The most abundant group at Seal Rock is the surfperches with 30.3% of the E and 45.4% of the MNI. Greenlings comprise 26% of the E, but only 12.6% of the MNI. Flatfish, rockfish, and sculpins occur in moderate numbers in the Seal Rock inventory. Salmon are scarce at both sites: 5.4% of the MNI and 0.8% of the E at Neptune; 1.7% of the MNI and 1.0% of the E at Seal Rock.
Table 7. Distribution of identified skeletal elements (E) and Minimum Numbers of Individuals (MNI) per major higher taxonomic units at Seal Rock and Neptune.

<table>
<thead>
<tr>
<th></th>
<th>Neptune</th>
<th>Seal Rock</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% of MNI Total</td>
<td>% of E Total</td>
</tr>
<tr>
<td>Surfperches</td>
<td>6 5.4 79 45.4</td>
<td>8 0.7 30.3 182 12.6</td>
</tr>
<tr>
<td>Greenlings</td>
<td>75 67.0 22 19.0</td>
<td>1009 85.4 33 95 26.1</td>
</tr>
<tr>
<td>Flatfishes</td>
<td>3 2.7 33 11 12.1</td>
<td>5 0.3 65 10.8</td>
</tr>
<tr>
<td>Rockfishes</td>
<td>3 2.7 11 6.3</td>
<td>7 0.4 54 9.0</td>
</tr>
<tr>
<td>Sculpins</td>
<td>8 7.1 21 12.1</td>
<td>28 2.4 11 5 1.0</td>
</tr>
<tr>
<td>Salmon</td>
<td>6 5.4 3 1.7</td>
<td>10 0.8 6 1.0</td>
</tr>
<tr>
<td>Cabezon</td>
<td>11 9.8 5 2.9</td>
<td>77 6.5 25 4.2</td>
</tr>
<tr>
<td>Unidentified</td>
<td>NA NA 42 3.6</td>
<td>NA NA 18 2.9</td>
</tr>
<tr>
<td>Roundfish</td>
<td></td>
<td>TOTALS 112 100.1 174 100.0</td>
</tr>
</tbody>
</table>

Twelve species were identified at Seal Rock and ten at Neptune. The differences involve a total of 12 identified skeletal elements from eight individuals (Tables 8-11). The species occurring only at Seal Rock include: striped seaperch, pile perch, petrale sole, and black rockfish. An individual sand sole, represented by one bone in unit 44/16, was the only species unique to Neptune. Tables 9 and 11 also show the cabezon was the only fish, other than kelp greenling, regularly occurring in the Neptune site.

Of the greenlings from Neptune, the kelp greenling contributes 1,007 of 1,009 bones identified for that family. The lingcod is represented by one bone each
Table 8. Distribution of Identified Skeletal Elements (E) Per Taxon at Seal Rock

<table>
<thead>
<tr>
<th>Taxon</th>
<th>56/32 E</th>
<th>56/32 % of Total</th>
<th>48/30 E</th>
<th>48/30 % of Total</th>
<th>46/30 E</th>
<th>46/30 % of Total</th>
</tr>
</thead>
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<td>1.0</td>
<td>0</td>
<td>0</td>
</tr>
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<td>Striped seaperch</td>
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<td>1.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Redtail surfperch</td>
<td>138</td>
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<td>2.1</td>
</tr>
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<td>2.0</td>
<td>3</td>
<td>3.2</td>
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<td>42</td>
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<td>17</td>
<td>16.7</td>
<td>19</td>
<td>20.2</td>
</tr>
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<td>0.2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sand sole</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
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<td>0</td>
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<td>2.1</td>
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<td>4.3</td>
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<td>0</td>
</tr>
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<td>9.7</td>
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<td>0</td>
</tr>
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Table 9. Distribution of Identified Skeletal Elements (E) Per Taxon at Neptune

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<tr>
<th>Taxon</th>
<th>52/18 E</th>
<th>% of Total</th>
<th>44/16 E</th>
<th>% of Total</th>
<th>56/20 E</th>
<th>% of Total</th>
</tr>
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<tbody>
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<td>0</td>
<td>0</td>
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<td>0</td>
</tr>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>0.6%</td>
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<td>0.4%</td>
</tr>
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<td>1</td>
<td>0.4%</td>
</tr>
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<td>0.7%</td>
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<td>0.4%</td>
</tr>
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<td>0</td>
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<td>723</td>
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</table>
Table 10. Distribution of Minimum Numbers of Individuals (MNI) Per Taxon at Seal Rock.

<table>
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<tr>
<th>Taxon</th>
<th>56/32 MNI</th>
<th>% of Total</th>
<th>48/30 MNI</th>
<th>% of Total</th>
<th>46/30 MNI</th>
<th>% of Total</th>
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<td>Pile seaperch</td>
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</tr>
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<td>6.3</td>
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<td>% of Total</td>
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<td>% of Total</td>
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<td>------</td>
<td>------------</td>
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<td>1.6</td>
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<td>7.9</td>
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<td>1.6</td>
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<td>3.7</td>
</tr>
<tr>
<td>Coho salmon</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>3.2</td>
<td>1</td>
<td>3.7</td>
</tr>
<tr>
<td>Salmon Family</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1.6</td>
<td>2</td>
<td>7.4</td>
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<tr>
<td><strong>TOTALS</strong></td>
<td><strong>22</strong></td>
<td><strong>99.7</strong></td>
<td><strong>63</strong></td>
<td><strong>100.1</strong></td>
<td><strong>27</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>
from units 44/16 and 52/18. Similarly, the most abundant family at Seal Rock, the surfperches, are dominated by a single species, the redtail surfperch.

One qualitative observation of importance is the absence of a hook or "kype" at the tip of the salmon jawbones in the sample. The presence of this feature would have been a definite indication that the fish were caught during or at the approach of spawning time. The absence of the feature does not, however, necessarily indicate that the fish were caught during a non-spawning period since this feature only occurs in males and the jaws cannot otherwise be sexed (Norman 1975:243).
CHAPTER VI

Discussion, Conclusions, and Recommendations

The results of the identification of fish remains from Seal Rock and Neptune serve as a basis for reconstructing at least part of the economic round. Chapter II described six major marine habitats, and their associated assemblages of fish species that occur along the central Oregon coast. Comparison of the bone assemblages from the sites will enable one to infer from which habitats the fish were caught. Evaluation of the fish bone data in conjunction with other archaeological information from Seal Rock and Neptune will also permit some limited inferences regarding fishing methods and the season of occupation. Because of the sampling problems discussed in chapter V the conclusions of this study will be somewhat tentative. The major problems effecting the samples are: (1) a probable bias in the recovery methods favoring the collection of larger fish remains, and (2) questions regarding the dispersion of the excavation units over the site. Further research at Seal Rock and Neptune will be needed to test these tentative conclusions.

The two assemblages of fish remains reflect highly localized fisheries emphasizing the rocky
intertidal zone and, possibly at Seal Rock, nearshore rocky reefs. Nearby salmon streams, sandy bottom marine habitat and sandy shorelines apparently were not regularly fished. The few flatfish and salmon in the collections probably represent incidental catches since these fish occur in small numbers in rocky habitats. The inhabitants of both sites apparently exploited selected fisheries resources within a few minutes walk or canoe ride. The species composition at Seal Rock indicates that reef fishing may have been practiced at that site. The diversity is very similar to that observed by Barker (1974) in his experimental jig and trolling fisheries at the Seal Rock reef and others occurring along the central coast. However, two variables interfere with the clear definition of offshore fishing at Seal Rock: (1) the protected intertidal habitat can be expected to produce a similarly wide diversity of species because it duplicates many of the microhabitats of the reefs, and; (2) the close proximity of the reefs may effect the intertidal species composition because of the movement of fish between the two habitats (Miller and Geibel 1973). In contrast, the absence of offshore reefs and the dominance of kelp greenlings, the most common intertidal species, is very strong evidence for a rocky shore fishery only at Neptune.
All but one of the species represented in the collections from Seal Rock and Neptune are year around residents in offshore water. Summer occupation at Seal Rock is indicated by a single bone from a petrale sole since they winter in waters deeper than 100 Fathoms (Hart 1973, cited in Huelsbeck 1980). The scarcity of salmon would be expected if the site was only occupied in the summer since ethnographically salmon were preserved for winter consumption. The absence of hooked or "kyped" salmon jaws also support a spring to summer occupancy. Thus the information from the fish bones suggest that both sites could have been occupied year around, but probably were not occupied during the winter. None of this contradicts separate lines of evidence indicating spring/summer or summer usage of the sites (Barner 1981; Snyder 1978). In addition, all of the major categories of faunal remains identified so far are from species that would have been locally available; ethnographic evidence (chapter IV) indicates that village middens should contain major species representing a region-wide geographic range.

The faunal remains represent a generalized exploitation of littoral marine resources at Neptune with minor use of land mammals and birds. Much the same situation exists at Seal Rock with the exception of a definite
emphasis, or seasonal specialization, on northern sea lions. Fish appear to be a regular component of the diet. An important contribution of fish, out of proportion to the amount of flesh it provided, may have been as a source of high quality protein since mollusc (Parmalee and Klippel 1974) and pinniped (Brauner 1978:PC) flesh may be relatively poor nutritionally. A generalized diet may also have been consciously sought to provide a wide sensory experience, especially after a winter dominated by a few preserved foods.

Direct evidence of fishing methods is limited to a fragment of an acute-angle, bone fishhook from Seal Rock. Two indirect lines of evidence support, however, the inference that a hook-and-line fishery probably prevailed. First, the archaeological species assemblages closely resemble the results obtained by Barker (1974) with jigs and trolling in his experimental fisheries at the Seal Rock reef. Second, the absence of notched or grooved stones at the sites indicates that seines and gillnets (gear that needs net sinkers) were not practiced at the sites.

The data from Seal Rock and Neptune tend to support the contention of Ross and Snyder (1979) that coastal resources were important during the spring and early summer. The neglect of coastal resources apparent
in the ethnographic record for the area is not evident in the archaeology. Drucker's (1939) model of Alsea subsistence, dominated by river caught salmon, also does not apply at Seal Rock and Neptune. The negligible numbers of salmon at the two sites probably represent incidental catches made while fishing for other species along rocky shores, and possibly, over offshore reefs. However, the data from Seal Rock and Neptune may not be valid for the ethnographic period. Both sites were occupied during the late-prehistoric, and possibly during part of the protohistoric period, when aboriginal populations were greater and had not undergone some of the other effects of Euroamerican contact discussed in chapter IV.

The Yakonen peoples suffered from most of the same post-contact problems that beset other native groups in the Northwest Coast. Although the particular Yakonen adaptations to these stresses are unknown, the general areas of change were probably very similar. For example, the Kwakiutl, drastically changed long-standing ecological and socio-cultural relationships within a few years of contact (Harris 1968:302-318).

With regard to subsistence-settlement systems of the Yakonen, the most important affects may have been caused by introduced epidemic diseases. The remnant populations of the several autonomous villages in each
Yakonen subdivision may have converged and coalesced into new village units around the estuaries, and reduced their use of coastline and marine resources. Concentration around the lower reaches of the main rivers would have been especially attractive because of the rich diversity of abundant resources, particularly salmon, and the possible need for minimum village population sizes to efficiently process salmon for the winter (C. F. Schalk 1977). If so, site components from the late-prehistoric and protohistoric periods should be relatively poorly represented along the coastline.

The data to evaluate whether or not significant subsistence and settlement changes occurred during the ethnographic period is not currently available. One of the major needs is a sample of sites that represents all major aspects of the seasonal round during the past several hundred years. Ross and Snyder (1979) recognize the need for up river sites to test their model. This is certainly the case, particularly in the Yakonen area where all sites excavated so far have been along the coast or near river mouths (Barner 1981:4-12).

The geographic scope of future studies should be at the regional scale rather than encompassing the entire Oregon coast. The model of Ross and Snyder
is important because it provides numerous testable hypotheses and is the first comprehensive synthesis of an entire seasonal round using the available archaeological evidence on the Oregon coast. But, subsistence-settlement systems operate on a regional scale (Thomas 1979:237-316), or the area that is:

"... roughly equivalent to the space that might be occupied by a social unit larger than a community, a unit to which we may with extreme trepidation apply the term tribe or society. This rough equation is based on what we know of American tribal distributions in early historic times and must be accorded the same flexibility that we see in the size of those distributions (Wiley and Phillips 1958:19-20)."

In the central Oregon coast this is generally one or two small river systems and the connecting coastline, i.e., the areas occupied by the four Yakonen linguistic subdivisions.

Methodological changes in intra-site sampling and recovery methods will also have to be implemented. Too little is known about the structure of aboriginal sites on the coast to assume that shell middens will provide representative samples. In areas such as at Seal Rock, where there is ample room on the wide marine terrace, activities may have been arrayed around the midden in functionally and spatially discrete sub-areas.
A variety of improved recovery methods should be used to recover small faunal and floral remains from the different types of archaeological contexts that may be present in Northwest Coast sites (Hester and Conover 1970). An accurate assessment of all fish remains is extremely important, because, as the Tolowa (Gould 1966) example illustrates, small species with easily overlooked remains, are potentially more important than salmon.

Three things should be done, however, before new sites are excavated to solve the above problems. First, sites in the region must be protected from destruction and damage by human and natural agencies. Seal Rock, Neptune, and the numerous other coastal sites that are being damaged by erosion and vandalism need immediate active protection. If they are neglected, the data base of archaeology will be gone forever. Second, the many sites, such as Seal Rock and Neptune, that have been excavated during the past decade should be thoroughly analyzed and the results published. Until this data is available, further work on new sites should be sharply curtailed. Finally, all future work should be guided by a comprehensive research design that identifies hypotheses to be tested, methods of analysis, and sampling requirements.
The major contributions of this study are: (1) Pointing out the need, and suggesting some ways to improve the fish fauna data base. Understanding the role of fisheries resources is critical in any archaeological study on the Pacific coast in general and the Oregon coast in particular.

(2) Providing basic data on the fisheries at Seal Rock and Neptune. This information was used to evaluate two subsistence-settlement models applicable to the study area.

(3) Categorizing the marine habitats of the central Oregon coast, and compiling lists of associated species. This aspect can be greatly improved as better fisheries data becomes available. This study, however, shows that the faunal assemblages from each site sensitively reflect the different local marine environments. These results provide important information on foraging radius around each site and indicate the potential of this type of environmental modeling for predictive studies of subsistence behavior.

(4) Identifies substantive problems for future research and suggests a general research orientation for addressing these problems.
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Wares, P. G.

Watson, P. J.

Willey, G. R., and P. Phillips
APPENDIX

I. **Cartilagenous Fishes**

Skates
- Big skate
- Longnose skate

Requiem Sharks
- Soupfin shark

Dogfishes
- Spiny dogfish

Ratfish
- Ratfish

Sturgeons
- White sturgeon

II. **Bony Fishes**

Herrings
- Pacific herring

Anchovies
- Northern anchovy

Trouts and Salmon
- Rainbow trout and
- Steelhead
- Chinook
- Coho

Smelts
- Surf smelt
- Night smelt
- Eulachon

Cod
- Pacific cod
- Pacific hake

Rajidae
- *Raja binoculata*
- *Raja rhina*

Carcharhinidae
- *Galeorhinus zyopterus*

Squalidae
- *Squalus acantbias*

Chimaeridae
- *Hydrolagus colliei*

Acipenseridae
- *Acipenser transmontanus*

Clupeidae
- *Clupea harengus pallasi*

Engraulidae
- *Eugraulis mordax*

Salmonidae
- *Salmo gairdneri*
- *Oncorhynchus tshawytscha*
- *Oncorhynchus kisutch*

Osmeridae
- *Hypomesus pretiosus*
- *Spirinchus starksi*
- *Thaleichthys pacificus*

Gadidae
- *Gadus macrocephalus*
- *Merluccius productus*
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