AN ABSTRACT OF THE THESIS OF

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The Neptune site (35LA3), a small shell midden, is located approximately five kilometers south of Yachats on the central Oregon coast. Test excavations were conducted at the site during the summer of 1973 by Oregon State University under the direction of Dr. Richard E. Ross. A shell analysis was later proposed, and column samples were taken in the spring of 1977.

Although the information obtained from the shell analysis was limited, when combined with faunal data from the test excavation it indicated a spring or summer occupation during which the collection of sea mussel was emphasized. Additional data rounds out the picture of the site as a pre-contact temporary campsite occupied approximately 350 years ago.

Comparisons with the shellfish data from other coastal sites in Oregon, Washington, and California indicate that shellfish remains can contribute to the archaeological data base and refinement of seasonal activity models. Methods for the increased utilization of this data are suggested.

SHELL AND ARCHAEOLOGY: AN ANALYSIS OF SHELLFISH PROCUREMENT AND UTILIZATION ON THE CENTRAL OREGON COAST

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Chapter I

Introduction

In recent archaeological investigations, the delineation of subsistence patterns through the use of faunal studies has become a common theme. In most instances, earlier archaeological reports concerning the Oregon Coast have failed to utilize faunal metholo-logies in developing pictures of seasonal subsistence activities. The one study concentrating on faunal research, Snyder's 1978 study of sea mammal remains from the Seal Rock site (35LNC14), has shown that the Alsea were capable of killing large sea lions and were probably inhabiting the area from the spring to mid or late summer. The seasonal use of the area was established through the identification of infant and newborn sea lions which would have been present primarily during these seasons, and the concentrations of adult males which would have occurred only during the pupping and breeding season.

The remains of other food resources, such as shellfish, can also aid in determining the seasonal occupation of coastal sites. The relative frequency of shellfish remains in certain kinds of coastal sites is high when compared to the frequencies of other faunal remains, such as bird, mammal, and fish. If utilized properly, the abundant shellfish remains could either confirm the seasonality established using other faunal remains, or provide the sole indicator of seasonal use.

As seasonal indicators, shellfish have already proven useful in the analysis of sites in California (Wielde 1969) and British Columbia (Ham and Irvine 1975). These studies relied on the direct method of scrutinizing the growth rings that are readily apparent on some varieties of shellfish, much like the growth rings on trees. Dark, narrow bands are formed in the winter, and lighter, wider bands are formed in the spring and summer (Wilbur 1964).

Because shellfish, like other animals, have a specific set of environmental requirements that have to be met before they can thrive, their remains are susceptible to indirect methods of seasonal analysis. Tidal variation from winter to summer would, in some instances, cause the availability of deeper dwelling shellfish to dwindle to such a point that procurement of that resource would require an expenditure of energy disproportionate to the amount of food gained. Deep-dwelling varieties would thus most likely be available in sufficient quantities for profitable procurement only in spring or summer when extremely low tides and daylight hours coincide. Reasonably large quantities of these deep-dwelling varieties in an archaeological site would seem to indicate that the site was inhabited during a somewhat restricted period of time.

That shellfish can supply many of the dietary requirements for a normally active person has been pointed out by Greengo (1951). This is especially true of two of the primary requisites of the diet, protein and vitamins. A moderate number of shellfish (approximately 50 sea mussels, or its equivalent) can provide sufficient protein, and vitamins B_1, B_2, and C to fill the daily needs of an active man (Adams 1975). Even by modern standards, the aboriginal diet which combined plants, shellfish, and other animals would have been well-rounded.

The focus of this thesis will be to demonstrate the validity of shellfish analysis in determining the economic patterns associated with this resource at the Neptune site (35LA3) and its applicability as a general research tool for coastal archaeological investigations. The reasons for the presence or absence of certain shellfish species and the utility of these species as indicators of seasonal activity will by discussed. Shellfish will provide the basis for comparing Neptune with other sites in both similar and different environments. These comparisons will then serve as one criteria for testing Ross' (1979b) model of coastal habitation. Based on information accumulated during this investigation, recommendations for future sampling procedures will be outlined.

The report will be divided into two sections. The first section will be background material: previous archaeology from northern California to southern Washington; ethnographic use of shellfish; shellfish habitat requirements and behavior, and their implications for archaeological research; and shellfish from archaeological sites.

The next section will deal specifically with the Neptune site. In this section, physical setting, ethnography, descriptive archaeology, present-day shellfish environment, and shellfish samples from Neptune will be discussed. Included in the chapter on descriptive archaeology will be discussions of the choice of site, excavation process, artifact types, features, and faunal remains. This material helps to put the site into perspective and makes the information available to other researchers.

Chapter II

Previous Archaeology

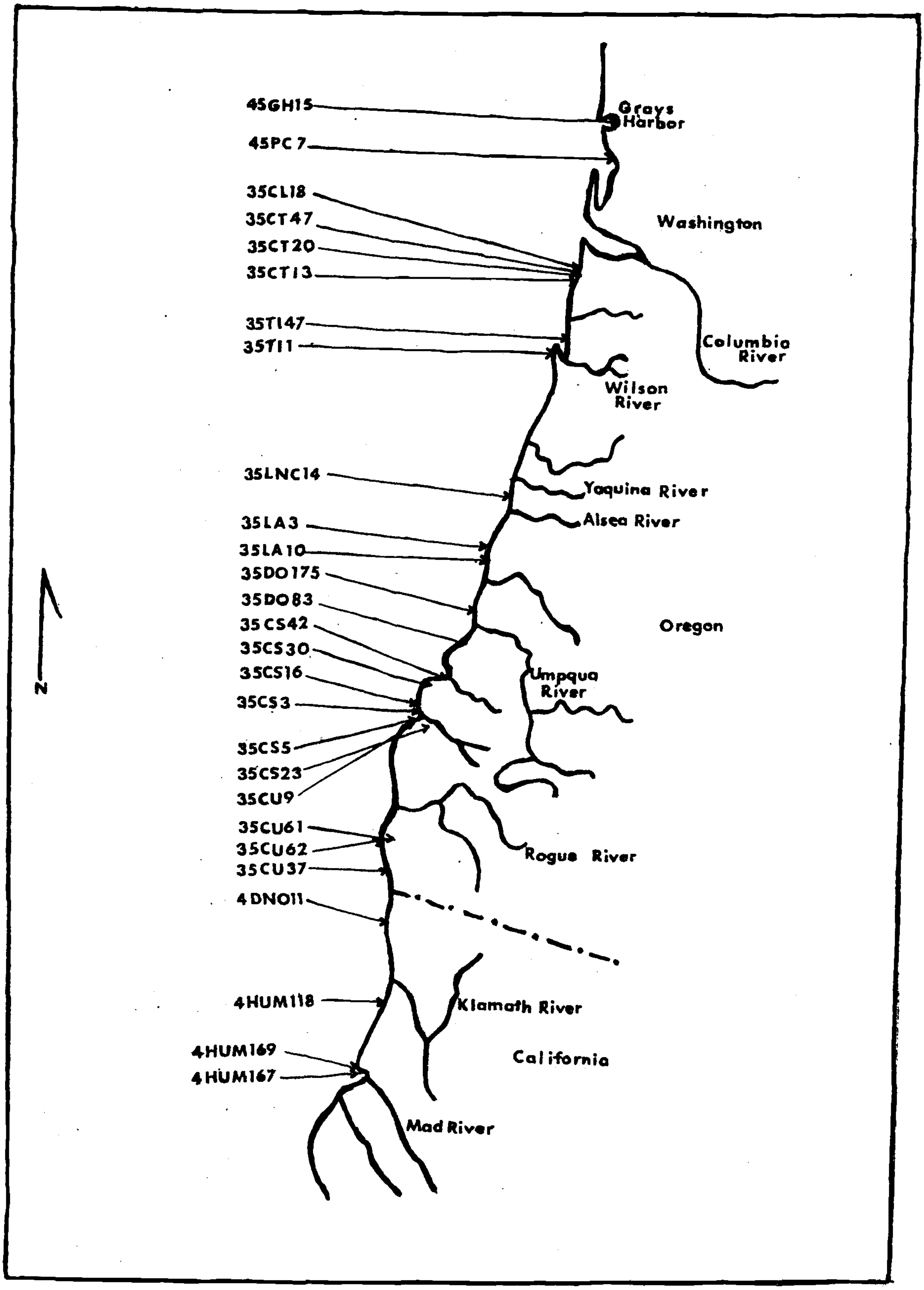
Oregon

Archaeology on the Oregon coast began with a brief flurry of activity in the latter part of the 1800's. Chase (1873), in what was probably the first professional article written on Oregon prehistory, described artifacts and discussed possible site locations in Curry County. He noted (1873:27) that wherever "we find a promininent knoll commanding a good view, with a sand beach near it, and outlying rocks, we find the remains of Indian occupancy." Schumacher (1874, 1877a,b), under the joint auspices of the Smithsonian Institution and the Indian Bureau, also visited Curry County and described the nature of its archaeological resources. His descriptions were relatively more explicit than Chase's and included maps of several villages. Perhaps Schumacher's greatest contribution to the archaeology of the Oregon Coast was the map he drew of a village site near the mouth of the Pistol River (1877b, plate 7), later used by Heflin to salvage portions of the site.

Coastal archaeology, as such, remained dormant for the next sixty years. The only information forthcoming during this period was settlement pattern data supplied by a pair of ethnographers. Dorsey (1890), while gathering ethnographic information at the Siletz Reservation, recorded the names and approximate locations of a number of village sites along the coast, and Waterman (1925), although concentrating on Tolowa village sites in northern California, collected the names and locations of a number of village sites in southwestern Oregon.

Although these early works provide some useful information, their value has been largely diminished by subsequent site destruction and the development of today's more systematic archaeology. Unfortunately, many of the sites located and described by the pioneering archaeologists and ethnographers have been destroyed by natural agents and construction projects. (See Figure 1 for the location of sites discussed in this report).

FIGURE 1. RELEVANT ARCHAEOLOGICAL SITES



The work of Berreman (1935) can probably be considered as the cornerstone of current archaeological research on the Oregon Coast. His survey of Curry County, Oregon, and Del Norte County, California, laid the foundation for much of what was to come in the following decades. Although his site evaluations are somewhat suspect by today's standards, based as they were on the availability of burials, he succeeded in demonstrating the abundance of coastal archaeological materials.

After examining 60 sites in the two counties, Berreman elected to return to an open coast site on Lone Ranch Creek, eight kilometers north of the Chetco River, in Curry County. Excavations at the Lone Ranch Creek site (35CU37) were conducted during the summers of 1936 and 1937. In his report, Berreman (1944) noted the presence of plank houses and numerous burials. He concluded that the site was probably inhabited by the ethnographic Chetco Indians for several hundred years, with occupation coming to an end sometime in the nineteenth century. Included in the report is an extensive list of shellfish species found during excavations.

Shortly after Berreman completed his work at Lone Ranch, Leatherman and Krieger (1940) began work on the Coquille River. Two sites were tested by them during the winter of 1938 and the spring of 1939. The "lower site", (35CS3), on the north bank of the river, near Bullards, yielded the remains of three structures and three burials. Although shellfish food resources are not mentioned, the artifact list contains a number of shell items that served as either decorations or receptacles. The "upper site", (35CS16), located eight kilometers upriver from (35CS3), was only briefly reported, with no mention of shellfish remains. The investigators concluded, on the basis of artifact typology, that the two sites were temporally distinct from each other, with (35CS16) being the older.

After a hiatus of a dozen years, activity on the coast picked up again when Collins began his survey, excluding Curry County which had already been covered by Berreman (Collins 1953). Although the survey relied more on informant testimony than on actual ground survey, it did add 133 site locations to the growing body of coastal data.

As a result of Collins' survey, three sites were excavated during 1952 and reported on by Cressman (1952, 1953) and Collins (1953). Housepit remains at 35CS5, on the Bandon sand spit near the mouth of the Coquille River, revealed faunal evidence suggesting a maritime/riverine adaption with supplementary utilization of land mammals. Reference to shellfish is minimal, although a pecten shell chopper is mentioned. 35CS23, twenty-nine kilometers upriver, near the town of Coquille, was dated at 300 and 450 BP±150 years (Newman 1959). Faunal evidence included elk and deer remains. Shellfish in the site, represented only by external chitinous layers, were not identified to species. The excavations at 35TI1, the Netarts Sand Spit site, consisted of testing several house pits. Data recovered from the site, located on the north coast, indicated a maritime subsistence pattern. Reference to shellfish is vague, although the presence of several general catagories is noted.

35TI1 was further investigated during the field seasons of 1956, 1957 and 1958 (Newman 1959). Three radiocarbon samples from this village site gave dates of 150±150BP, 280±150 BP, and 550±150 BP. Reference to shellfish is limited to four species, with their approximate precentages.

In conjunction with the excavations at the Netarts site, another house pit site overlooking Floras Lake on the southern coast was tested. This site, 35CU47, is separated from the ocean by sand dunes which form sandy beaches, both to the north and to the south (Newman 1959). Historic trade goods date the site at 1800 AD to 1850 AD. No mention is made of the shellfish species present in the site (Newman 1959).

The Meyers Creek site (35CU62), located at the mouth of Meyers Creek near the rocky outer coast, was excavated by Cole in 1961. A partially burned beam from the remains of a structure was dated at 3000±90 BP (Cole and Pettigrew 1976; Cressman 1977). No shellfish information is available from this site.

Heflin (1966) excavated portions of 35CU61 on the southern Oregon coast near the mouth of the Pistol River in 1962 and mapped in forty house pits, using Schumacher (1877b) as a guide. Despite the occurrence of historic artifacts, Heflin believed the site to be predominately of a late prehistoric date. Heflin (1966) lists the species and estimates the quantity of shellfish present. The site was destroyed by road construction in 1962.

Two large and seemingly important sites near Seaside, 35CT47 and 35CT20, have been part of an ongoing excavation since 1967. (Drucker 1978; Phebus and Drucker 1973). At the Palmrose site (35CT47) two housepits built into the subsoil were excavated. A sample taken from the lower levels of one of the housepits was carbon dated at 2600 BP (Phebus and Drucker 1973). Evidence indicates the presence of one or more later houses, which suggests a continued occupation (Drucker 1978). Shell adze blades are mentioned in the report. The dominant shellfish mentioned are rock and bay clam, but the varieties cannot be determined from the available information (Phebus and Drucker 1973).

No housepits were found at the Par-tee site (35CT20). It has been suggested by both Ross (1979a) and Drucker (1978) that a bay was present at the time of occupation, rather than the sandy beaches and riverine environment present today. A maximum time range of 1705 BP to 1035 BP is given (Phebus and Drucker 1973). Shell adze blades and a few shellfish species are mentioned in the report (Phebus and Drucker 1973).

In 1970 the Ave. "Q" site (35CT46) was tested by Phebus and Drucker (1973). A date range of AD 275 to AD620 was given for this site but there may have been a problem with contamination of the carbon sample. The same varieties of shellfish are mentioned for this site as those mentioned for the Palmrose site. (Phebus and Drucker 1973).

The Seal Rock site (35LNC14), on the central Oregon coast, was excavated by Ross in 1972 and 1974. The site, located on the shore adjacent to a number of rocks from which it takes its name, dates at 375$\pm$70 BP (Ross 1978). Snyder's (1978) study of sea mammal remains at Seal Rock indicates that the inhabitants of the site were capable of killing large adult sea lions. Analysis of the remains suggests that the animals were probably killed during spring and summer. Although a shell sample was taken from the site, an analysis of the material has not been completed.

The Indian Bay site (35CS30) on South Slough of the Coos Bay estuary, was excavated by Stubbs in 1973. Evidence suggests the inhabitants had a marine oriented economy and occupied the site year around. Amounts of shellfish present and an extensive list of species are given. Stubbs (1973) estimated that the site was probably abandoned before the mid-1800's.

Stenhouse (1974) tested 35DO83, the Umpqua-Eden site, at the mouth of the Umpqua River near Reedsport and located one house floor during 1974 (Ross 1978). Bay and open coastal environments are equally available near the site. Stenhouse lists and estimates the quantity of shellfish found at this site.

A survey by Ross (1976) of the coastal state parks fills in some of the gaps left by earlier surveys, although it did not include coastal areas that are not state lands. This survey is supplemented by smaller surveys along the coast (Cole and Rice 1965; Brauner 1976; Zontek et al. 1976).

The Gearhart site (35CL18) located near Gearhart, Oregon, on a sand dune, was excavated in 1976 under the direction of Hasle. Unfortunately, Hasle's information is unpublished. A preliminary faunal analysis by Oregon State University indicates the presence of both sea and land animals, with some mussel shell scrapers among the artifacts recovered. No other shellfish information is available.

Ross (1977) excavated a site, 35CU9, on the slopes of Port Orford Head in 1976. The Port Orford site has been described as a shallow shell midden, but no information is available on the shellfish remains, except that they represent the available intertidal resources of the area (Ross 1977).

At Bob Creek, south of the Seal Rock site, a burial was removed by Harrison in 1977. The extent of this bluff site, 35LA10, is unknown. No European trade materials were found in association with the burial (Harrison 1978). The report contains a relatively extensive list of shellfish species.

A shell midden, 35TI47, was tested by Zontek in 1977 at Oceanside Beach Wayside on the rocky outer coast. Zontek (1978) compared the artifact assemblages of 35TI47 and 35TI1 on the Netarts sand spit and tentatively proposed that the aboriginal inhabitants of the sites were contemporaries. Although a large amount of shellfish remains was recovered from the site, they have yet to be analyzed.

Excavations at the Unpqua-Eden site resumed in 1978 and continued in 1979 and 1980 under the direction of Ross. The site has been carbon-14 dated to 2960±44 years BP (Ross and Snyder 1979). Material from the site is currently under analysis.

Approximately eight kilometers from the mouth of the Umpqua River, the Tahkenitch Lake site (35DO175) was tested in 1978 by Hartmann (1978). This fairly deep midden on the west bank of the lake had been heavily disturbed by previous construction. Shellfish present at the site, and a possible environmental change, are discussed.

The Ross site (35CS42) located on Catching Slough at Coos Bay, was excavated by Barner and Draper in 1978. The site was probably a temporary fishing camp. Evidence of fish drying racks has been located. In addition to fishing, shellfish collecting took place. The shellfish have not been fully analyzed (Barner 1978).

The Philpott site (35CS1), located 2.4 kilometers up the Coquille River, was also excavated by Barner and Draper in 1978. Just south of the site fish weirs were found in the river, and a variety of stone tools were recovered from the site proper. Shellfish remains encountered were few. The periostracum of possible sea mussel was all that was recovered (Draper 1980).

Since the inception of coastal archaeology in the late 1800's, the southern coast has been investigated the most. The bulk of the previous archaeology conducted in Oregon has concentrated on recovery of artifacts and burials before impending destruction and has not focused on faunal materials. Salvage archaeology naturally has lacked the coherence necessary for understanding the various parts of the subsistence pattern on the coast. Systematic archaeological investigation on the Oregon coast is not extensive, but with information obtained from past surveys and excavations, Ross

(1979b) has suggested a model which delineates several types of habitation sites for recent aboriginal occupation. He proposes a river basin/coastal orientation that varies from past emphasis on open coastal shell middens and postulates that the aboriginal inhabitants maintained permanent winter villages with substantial houses on the estuaries and tidewater reaches of major streams. This type of settlement would afford protection from winter storms, yet allow the inhabitants easy access to shellfish beds and beaches where sea mammals might be washed ashore.

During the spring and summer, Ross feels that coastal inhabitants stayed on the coast proper, at shell midden sites, and probably constructed temporary structures. During low tides, shellfish and rockfish could be procured with maximum efficiency. Movement out to the coast proper would also place the inhabitants closer to sea mammal migration routes, rookeries, and hauling out places.

During the late summer and fall, the people would move back into the estuaries and up along the rivers to exploit the salmon runs. At the same time they might gather acorns, if available, and hunt land mammals. There, activities would be conducted from temporary upriver camps, although in some instances the winter villages would be used. This type of subsistence-settlement pattern is similar to that of the ethnographic Tolowa, described by Drucker (1940) and Gould (1975).

In contrast to shell midden sites, Ross discusses another type of site, the "bluff" site. Encountered during surveys, these enigmatic sites are located on bluffs along the outer coast and have a high lithic content, but no shell. The lithic technology represented at these sites is similar to the Levallois core technology of the southern Plateau's Cascade phase. Bluff sites are thought to represent a much older adaptation than the shell midden sites, possibly dating to 4,000 BP (Ross 1979b). However, bluff sites have yet to be systematically excavated. Most of the information we have from them comes from amateur surface collections.

Northern California

The northern California coastline is rugged and open, much like the Oregon coast. Several sites, inhabited by people with adaptations similar to those of the Oregon coastal peoples, have been excavated. The data on shellfish can be compared with that of the Oregon coastal sites. This section's description of the archaeological excavations proceeds geographically from north to south.

Point Saint George, 4DN011, was known ethnographically by the Tolowa to have been a village site for gathering shellfish and sea-weed, a camping place for sea lion hunting, and a flint knapping station (Gould 1966). The site, excavated by Gould in 1964, is located on the Point Saint George headland. A steep rocky coast-line with sandy beaches stretches to the north, with smaller sandy beaches to the south. The archaeological observations supported the oral traditions concerning the sites inhabitants and culture. The main shellfish foods are noted.

The Patrick's Point site, 4HUM118, is located to the south of Point Saint George on an unprotected rocky bluff directly on the ocean front. The site was excavated by Heizer in the summer of 1948. The site, probably a seasonal camp site, is located in ethnographic Coast Yurok territory. It is dated at 640$\pm$90 BP (Elasser and Heizer 1966). Information is available on the shell-fish found during excavation.

Tsurai, 4HUM169, is located on the north shore of Trinidad Bay. This permanent Yurok village site, excavated in 1949, is located on a sandy beach and was oriented towards an open coast economy (Heizer and Mills 1952). A list of shellfish remains found at the site is available.

The Gunther Island site, 4HUM67, on Gunther Island in Humbolt Bay, is dated at 1050$\pm$200 years BP. When the site was first excav-ated in 1913 twenty-two burials were recovered, and in 1918, 142 burials and associated cremation pits were exposed (Loud 1918;

Heizer and Elasser 1964). Elasser and Heizer (1966) considered Patrick's Point, 4HUM118, and Gunther Island to be contemporaneous. This was originally based on the similarity of artifacts, but the carbon-14 dates leave a possible gap of 120 years. The shellfish from the Gunther Island site are listed and those that were considered the main food species are noted.

Southern Washington

Like the northern California coast, the southern Washington coast is similar in environment and geography to the Oregon coast. Gray's Harbor is used here to delineate the southern and northern sections because the more northern cultures take on some of the elaborate Northwest Coast concepts that are not found on the Oregon coast.

The Minard site (45GH15) is located on the western shore of North Bay in Gary's Harbor and is reported to be an ethnographic Lower Chehalis village. Rocky and surf-swept sand beaches are found in the area. The site was first tested by Daughtery in 1969. In 1970 the excavations were continued by Roll (1974). The lower part of the shell midden was dated at 1080 BP. Shellfish represented at the site are listed by Roll (1974).

The Martin site (45PC7) was excavated by Greengo in 1959. It is located on North Beach Peninsula between the Pacific Ocean and Willapa Bay. Artifacts closely analogous with the artifacts from 35TI1 on the Oregon coast suggest a date sometime after 950 BP (Kidd 1967; Roll 1974). Kidd (1967) lists the shellfish remains.

Archaeological research in these coastal areas has been completed by many individuals with no one goal in mind. As such, no coherent picture of aboriginal coastal life has emerged. Varying methodologies and views towards shellfish have resulted in disparities in the information gained about the use of this resource.

Several reports include extensive lists of shellfish remains and relative frequencies of the various species (Berreman 1944; Heflin 1966; Stenhouse 1974; Stubbs 1973; Harrison 1978; Loud 1918). A few of the reports deal with the localities at which the main shellfish food resource might have been obtained and possible environmental changes that might have occurred (Hartmann 1978; Stubbs 1973). Although the information on shellfish from these reports is limited, an attempt will be made to compare the information obtained from them with the Neptune site.

Chapter III

Ethnographic Use of Shellfish

The Alsea Indians told a tale about the culture hero Sᵋū'ku who journeyed along the coast naming and finding uses for many things, including shellfish:

> "Then not long (afterward) he said: 'I am hungry. I wonder what shall I eat? Yes, I will go out to look at the ocean.' So when he arrived at the rock he saw something that was living on the rock. So he picked up one and said: 'I wonder what shall I call them? Yes, their name will be Mussels.' Then he spoke to them: 'Now you will stay only on this rock. Occasionally the low tide will (uncover) you; my children will gather you habitually and will eat you.' Then when he finished (with) them he picked up some, went back with them to shore, roasted them, and began to eat them" (Frachtenberg 1920:87).

In spite of its importance to aboriginal subsistence, shellfish collecting has generally been neglected in ethnographic studies of the Oregon coast. More glamorous pursuits such as hunting and fishing, requiring a more elaborate technology, were probably thought to be of greater importance, and received greater attention. This, even though shellfish supplied a large amount of the protein consumed by aboriginal coastal peoples. For instance, Barnett (1937), in his list of 1830 culture elements, mentions shellfish less than 20 times. Only four of the elements concern the preparation of shellfish and its use as food. The remaining elements deal with shellfish as a source of wealth or as decoration.

Although ethnographic information on the use of shellfish on the Oregon coast is scant, there is information available on the Tolowa of northwestern California. Shellfish were considered by Gould (1975) to be among the staple foods of the Tolowa; that is shellfish constituted at least 30% of the diet by weight at the time they were collected. One of the primary reasons for shellfish being a predominate food source along with anadromous fish, acorns, waterfowl, and surf fish was their almost year-round availability. The principal bivalve that was collected was the sea mussel (Mytilus californianus), which was favored for its abundance, the relatively large size, amount of edible muscle and other tissue, and good flavor (Gould 1975).

From mid-June to mid-September the Tolowa's principal activities involved the procurement of sea lions, cormorants, and smelt. In mid-August they moved from the large villages to camp along the beaches where the smelt were running. Later, they journeyed up the Smith River, away from the coast, to gather acorns and catch salmon from early September to November. In November they moved back to the coastal villages to emphasize shellfish utilization until the following spring salmon run (Gould 1975).

In comparison, Ross (1979b) postulates slightly different resources, but a similar seasonal round. During the spring and summer the aboriginal residents of the Oregon coast would have spent their time on the coast proper, utilizing sea mammals, rockfish, and shellfish. In the late summer and fall they might have gathered acorns, or procured both salmon and various land mammals while living up rivers and in estuaries. The permanent villages would have been located near estuaries and tidewater reaches where the inhabitants would have been protected from winter storms while still having easy access to open beaches. The open beaches would have allowed for the procurement of shellfish and beached sea mammals when necessary and possible.

The only limiting factors would have been occasional storms preventing access to the beaches, and shellfish poison, which might have occurred in the late summer or early fall. Shellfish poisoning occurs when plankton feeders ingest large quantities of the poison-laden dinoflagellate Gonyaulax catenella. When this marine plankton occurs in concentrations it causes the ocean to appear red by day and luminescent by night--commonly called the "red tide".

Cases of shellfish poisoning on the Northwest coast have been documented as far back as 1790 when Russians were in the area (Greengo 1952). Ethnographic evidence of how shellfish poisoning was dealt with is meager for the California groups, and almost non-existent for the Oregon peoples. Harrington (1943) mentions that Oregon peoples regarded the mussels on the top of sunlit rocks as not satisfactory. A similar belief was held by some California groups, such as the Tolowa (Greengo 1952). Eating woodpecker tongues was thought, by some, to cure the poisoned person. Drying the mussels was thought to eliminate the poison. The Coast Yuki and others thought that if a mussel was collected below the tide line it would be safe to eat. However, these various beliefs were ineffective in preventing poisoning. Watching for luminescence in mid-summer and early fall and avoiding mussels and other effected shellfish during this period was probably the most effective method for the prevention of shellfish poisoning. During the season when shellfish poisoning was most likely to occur, the native inhabitants were still concentrating on the procurement of sea mammals and waterfowl, and were beginning to turn their attention inland to the anadromous fish runs. This perhaps served to reduce the incidence of poisoning.

On the whole, shellfish were a reliable and easily obtainable resource, requiring only about one-half hour to obtain a daily portion for an adult (Gould 1975). The gathering of shellfish was regarded as women's work, though occasionally the men might help. Most groups used a specially made hardwood stick to dig clams or pry molluscs off the rocks. The Alsea used the same kind of curved, crutch-handled digging stick for both camas and shellfish procurement (Drucker 1943). Indeed, the only strenuous work involved in gathering shellfish was the carrying of the heavy-ladened baskets back to camp. Sometimes even this was not necessary. Coastal groups sometimes built fires on the top of rocks where barnacles were located, roasted them *in situ*, and consumed them on the spot (Harrington 1943). This practive is also reported for the California Pomo and the Kwakiutl of British Columbia (Greengo 1952).

Aboriginal inhabitants of the Northwest coast commonly followed the same pattern of preparing molluscs, sun-drying or smoking, soaking in fresh water, then cooking and eating (Greengo 1952). The

Alsea considered smoked clams on a hazel withe a delicacy (Drucker 1943). The Siuslaw and a few other Oregon coast groups were known to cook barnacles in ashes, which may have been a more common method than cooking them *in situ* (Harrington 1943; Greengo 1952; Barnett 1937). The Alsea and the Siuslaw, among many other coastal groups, used the same type of earth oven that was used for camas and fern roots to cook mussels (Barnett 1937).

Shellfish were important primarily as a food source, but they also provided useful materials for tools and utensils. Large mussel shells were ground sharp to form the women's knife common to most coastal Indian groups. Spoons were made of several types of clam shells. Utensils of the Siuslaw included mussel shell thumb guards for drawing fibers, clam shell oil containers, ladles, and spoons. The Alsea used knives of mussel or razor clam shell, and mussel shell spoons (Barnett 1937; Drucker 1943).

Besides utilitarian purposes, certain types of shellfish were used for decorations and wealth tokens. Dentalium was regarded as the most important of the wealth tokens by the Alsea and many other coastal peoples (Drucker 1943; Barnett 1937). The largest dentalium was used as money, while the smaller sizes were used for decorations on necklaces. The Alsea believed the shells were traded from the north where a fierce tribe guarded and hoarded the dentalium. Abalone and clam shell beads were also of value.

In summary, shellfish were an important and easily obtainable commodity for coastal Indian groups. Their importance is evident in the archaeological remains of coastal shell middens, and in their position in the seasonal round of such groups as the Tolowa. However, ethnographic data on shellfish, particularly on the Oregon coast, is rather scant and is lacking in technological detail. For this reason, an understanding of shellfish environments is especially important in order to interpret the archaeological record.

Chapter IV

Shellfish Habitat and Behavior

The knowledge of shellfish species present in an archaeological site, when considered with their habitat requirements, can provide information concerning habitat exploitation, environmental change, transportation of shellfish, and seasonality of site occupation. There are three primary variables in determining shellfish habitat (Ricketts and Calvin 1968). These are: 1) the degree of wave shock, 2) the nature of the substratum, and 3) the tide level. Habitats delineated by degree of wave shock are classified as being protected or open. Protected waters are those that receive little wave shock, such as bays, sloughs and estuaries. Protected waters on the outer coast would be found in areas shielded by islands or reefs. Protected beaches in this area are usually concave in outline. Open waters are found on the outer coast in areas not protected by headlands, spits or other geological formations, with beaches being convex in outline. Some species, such as horse and giant barnacle, can tolerate both open and protected waters, while others prefer a single habitat. Sea mussel, associated with the open coast, and bay mussel, in protected waters, are examples of the latter.

Habitats can be further delineated by the nature of the substratum, i.e. the attaching surface or burrowing matrix. This factor is extremely variable and exhibits gradations from solid rock to fine sands and muds. As in the case of open and protected waters, different species exhibit different tolerances for the variation in surface and matrix. For instance, while the cockle can be found in sand, mud or eelgrass flats, the razor clam is found almost exclusively on sandy beaches (Ricketts and Calvin 1968).

The tidal zone, or length of exposure between tides, is also a delineating factor in habitat preference for shellfish. Many species cannot withstand the temperature variations produced by cool winds or the heat of the sun during exposure at low tides. The gumboot chiton, for instance, cannot tolerate even the light from the sun and is usually seen only on foggy days at low tide. Other species have adapted to changing tide levels. An example of such an adaption is Littorina, which has developed an operculum, or horny door, that can close tight when exposed to the elements at low tides, thus retaining moisture and keeping fresh water and drying wind out. Acorn barnacles have adapted in much the same way with a set of plates that close very tightly.

The tides of the Pacific coast are semi-daily, a more or less even procession of high and low tides twice a day (Ricketts and Calvin 1968). However, because the daily tide cycles are of uneven amplitude, or mixed, extreme variations exist between the high and low tide, resulting in definite habitat zones. In the uppermost zone, at and above the line of high spring tides, live animals that are only wetted a few times each month by waves and spray. Other animals live below the line of low spring tides where they are uncovered only a few hours each month. Many of these animals adhere closely to a particular zone. Although overlapping does occur to some degree, tidal zones can be used to understand marine invertebrates and their procurement by man. The tidal movements have been broken into five zones (Flora and Fairbanks 1977:vi):

Zone I--above average spring high tide

Zone II--from average neap high tide level up to average spring high tide

Zone III--from the average neap low tide level to average neap high tide level

Zone IV-- from average spring low tide level up to average neap low tide

Zone V--below average spring low tide line

A neap or equatorial tide is defined as "that part of the lunar cycle with the least ranges of highs and lows, associated with the quarters of the moon." And the spring or tropic tide is defined as "the tide cycle of the greatest range, that is with the highest high and the lowest low, associated with the full and new moons or the period of maximum declination" (Ricketts and Calvin 1968: 571).

In areas of mixed tides, such as the Pacific Coast, zonal divisions are quite discrete. Zone V can only be examined or utilized a few hours each month. During spring and summer months the low water level of Zone V occurs in the daylight hours, whereas during the winter and fall it occurs during the night (Evans 1972). At the other extreme, Zones I and II are easily accessible except during very high tides.

Those species exclusively inhabiting Zone V and requiring a relatively large amount of time to gather, could only be utilized during the spring and summer months when the lowest tides occur in the daylight hours. Ham (1976) suggests that the collecting of large quantities of deep burrowing clams had to occur in the late spring to late summer because of the longer period of exposure during daylight hours. He further states that the high low tides of the winter months would not permit the collecting of large quantities of deep-dwelling species due to both the reduced intertidal period and the greater amount of time required to procure them. Thus, the tide would have affected both the quantity and the type of shellfish the aboriginal inhabitants of the coast could have procured during different seasons.

Another factor to be considered in the procurement of shellfish is the seasonal occurrence of shellfish poisoning, the "red tide" (Greengo 1952). Plankton feeders, such as the razor clam and sea mussel, consume marine plankton, one of which is a dinoflagellate, Gonyaulax catenella. This plankton contains two identified poisons-choline and trimethylamine. In mid-summer or early fall the organisms may occur in large concentrations, causing the sea to appear red by day and luminescent at night. The plankton feeders then ingest large amounts of the plankton. Although the toxin does not affect shellfish, it is stored in their livers and slowly excreted back into the water. If the shellfish is consumed by a warm-blooded animal before the poison is excreted, poisoning generally occurs. In mammals, in sufficient doses, the poison "paralyzes the motor and sensory nerve endings and in stronger dilutions abolishes all conductivity in the nerves" (Greengo 1952:86). A few milligrams are fatal to man. Today, it is rare that anyone is killed by this poison but we know little of its effects on aboriginal populations. Most protected water species do not ingest enough of the plankton to be harmful to man, unless the shellfish are taken near the bay entrance.

Other factors relevant to the use of a species as a food resource are size and whether it grows individually or in beds. For instance, sea mussel is large, reaching up to 24 centimeters in length and 10 centimeters in width, and grows in dense beds, making collecting relatively easy. A major aboriginal food species, sea mussel thrives on the open coast anchored to rocks by byssal hairs in Zone III.

Shellfish commonly associated with each other should also be noted. Sea mussel is usually found associated with goose barnacle, which thrives in Zones II-IV, and horse barnacle, which occurs in Zone IV. In some cases, these barnacle species would be gathered whether sought after or not when pulling sea mussel off the rocks. Although both of these barnacles are large enough to have formed part of the aboriginal diet, their occurrence in sites may be primarily the result of hitchhiking.

Razor clam grows individually rather than in beds. Like sea mussel, it is rather large and makes an excellent food source, but is more difficult to procure. Like sea mussel, razor clam is also found on the open coast, but on sandy beaches fully exposed to the surf in Zone IV. It is an extremely active burrower and can bury its length of approximately 10 centimeters in seven seconds. It leaves a slit-like opening in the sand when it withdraws its siphon, thus indicating its presence (Ricketts and Calvin 1968). Knowing that this clam is not as easy to gather as those growing in beds or those that are less active burrowers, we might expect it to have been used less frequently.

Bay mussel, as its name implies, is a protected water species. It, like sea mussel, attaches itself to rocks in Zone III with a byssal hair. Bay and sea mussel may occasionally overlap in their respective territories, but bay mussel has a much finer byssal hair and thus cannot withstand the pounding surf. Bay mussel is small, growing only to five centimeters, but it is also found in dense beds, making it easy and worthwhile to collect. Because bay mussel has greater flucuations in population size from year to year than sea mussel, it is a somewhat less reliable resource. However, it can re-establish its community completely in three to five years (Ricketts and Calvin 1968).

Several larger clams are found in sand or mud substratum. Cockle obtains a length of 11 centimeters and is found on the surface of sand, mud beaches, or eelgrass flats in Zone IV tidal areas. Although it may be found completely exposed at times, it is an extremely active digger when disturbed.

Bent-nose clam occurs in Zones II-V in heavy mud or mud-sand, 10 to 20 centimeters below the surface. It is large, reaching a length of 11 centimeters.

Native oyster inhabits Zone IV on the surface of mud flats near the mouths of rivers, in tide pools, bays and sloughs. It is smaller than the others, averaging five centimeters in length.

Butter clam is found in mud or sandy mud, 25 to 35 centimeters below the surface in Zones III and IV. It has a thick shell and reaches a length of 10 centimeters, making it desirable both as a food source and as a material for shell tools.

Horse and gaper clam are often confused, although their shape is slightly different. Their habitat is in Zone IV. Horse clam prefers a gravelly habitat while the gaper prefers sand or firm sandy mud. Both clams obtain a length of 20 centimeters unless they are found on the outer coast, where they are smaller and have rougher shells.

Littleneck clam occurs in coarse sandy mud five to seven and one-half centimeters below the surface of protected waters. It may also be found on the outer coast if there is a rocky point made up of small stones with a sand substratum. It grows up to five centimeters in length.

As noted in the previous discussion, shellfish habitat can be broken down into three main variables--1) degree of wave shock, 2) nature of substratum, and 3) tide level. Open and protected waters are the two main components in degree of wave shock. The substratum can vary from mud, to sand, to rock, or a combination of the three. The tidal zone can be classified from Zone 1, which is almost continuously exposed, to Zone 5, which is almost always covered. Tables 1, 2 and 3 provide habitat information for shellfish mentioned in this report (Abbott 1968; Cornwall 1975; Cox 1962; Fitch 1953; Flora and Fairbanks 1977; Griffith 1975; Guberlet 1936; Johnson and Snook 1927; Keen and Coan 1974; Keep 1935; Marriage 1958; Morris 1966; Quayle 1978; Ricketts and Calvin 1968; Roger 1908; Smith and Carlton 1954; Tinker 1958; Yakouleua 1965).

An example of how this information might be used to interpret shellfish remains is given in the Tahkenitch Lake site report (Hartmann 1978). The primary faunal remains from the site consist of shellfish, mostly salt-water bay species. Since the site is located on a fresh-water lake, approximately eight to ten kilometers from present-day bay resources, two interpretations present themselves - 1) the shellfish were gathered at a considerable distance from the site and transported, shell and all, to Tahkenitch Lake, or 2) the local environment has changed since the shellfish remains were deposited.

The first interpretation seems unlikely since numerous habitation sites are present close to the source of supply. If the shellfish were, in fact, transported eight to ten kilometers, it would seem that they would have been at least shelled to reduce the weight.

The second interpretation seems more likely, especially when considered in conjunction with Heusser's (1960) environmental work. He suggests that the sea level along the Oregon coast was somewhat higher 3,000-4,000 years ago. A rise in sea level of only a few meters could have altered the environment of the Tahkenitch Lake area, making it more of an estuarine environment, rather than a lacustrine one. This would have provided a local habitat for the shellfish found at the site, making transportation unnecessary.

Although the results from the Tahkenitch Lake test excavations are tentative, the use of shellfish habitat information has shown the possibilities for interpretation based on molluscan remains.

TABLE 1. SNAIL ENVIRONMENTAL REQUIREMENTS AND DESCRIPTIONS

Latin and Common Names	Zone	Habitat	Description	Range
Amphissa columbiana (Dall) wrinkled Amphissa	IV	rocky beaches, mud bottoms to 16 fathoms off California, gregarious	SIZE: up to 2.5 cm in length DESCRIPTION: close thread-like spiral sculpture, numerous fine longitudinal ridges from apex to ½ way down body whorl, 7 whorls, acute spire about same length as aperature, aperature rectangular, outer lip may be thickened, inner lip slightly reflected and covered with smooth enamal COLOR: pink or mauve to yellow, frequently mottled with brown	Alaska to California
Amphissa versicolor (Dall) *dove shell Joseph's coat Amphissa	IV	rocky beaches, uncommon	SIZE: 1.2 cm in length DESCRIPTION: 4 to 7 body whorls, surface roughened with vertical folds and lines paralleling whorls, virtually no spire, toothed inner surface of lip COLOR: variable yellow to brown	Oregon to Baja California
Antiplanes perversa (Gabb) common name not available	V	rocky, sand, or mud beaches to 25 fathoms	SIZE: up to 5 cm in length DESCRIPTION: 5 to 7 body whorls, vertical folds and lines paralleling whorls, virtually no spire, left hand whorl, no toothed surface of lip COLOR: yellow to brown	Alaska to California
Calliostoma ligatum (Gould) blue top shell	IV	on rocks and in crevices on rocky beaches	SIZE: up to 2.5 cm in diameter DESCRIPTION: about 7 evenly rounded whorls, columella widens into callus covering umbilicus, aperature round, interior pearly COLOR: more brown than blue, whitish spiral ribs	Alaska to San Pedro, California
Nassar sp. welks	IV-V	all but N. obstoetus prefer rocky intertidal areas, N. obsoletus prefers mud flats with brackish waters, carnivorous, eating clams or snails	SIZE: up to 5 cm in length DESCRIPTION: strong shell, ovoid pointed spire, short canal, columella usually with callus COLOR: varies	Alaska to Lower California

*indicates common name used in this report when two or more are given

TABLE 1. (cont'd) SNAIL ENVIRONMENTAL REQUIREMENTS AND DESCRIPTION

Latin and Common Names	Zone	Habitat	Description	Range
Nassarius fossatus (Gould) *giant western Nassa Nassa snail channeled dog welk	V	around or under rocks, sand, or mud intertidally, carnivorous	SIZE: up to 5 cm in length DESCRIPTION: shell plump, spire sharp and longer than aperature upper whorls marked by axil ribs and spiral ridges with granulated appearance, last whorl has spiral ridges only, deep groove around base, short canal, columella curved COLOR: interior-brown, edge of aperature yellow or orange exterior-gray-brown	Queen Charlotte Islands to Lower California
Nassarius perpinguis (Hinds) western fat Nassa snail	IV-V	rocky intertidal areas in moderately shallow water	SIZE: up to 2.5 cm in length DESCRIPTION: 7 whorls, plump, outer lip, thin whorls finely cris-crossed or beaded, ovoid, pointed spire, short canal COLOR: interior-white to brown exterior-2 to 3 spiral bands of orange or brown	Puget Sound to Mexico
Ocenebra lurida (Middendorff) lurid rock shell	III-V	rocky intertidal area	SIZE: up to 3 cm in length DESCRIPTION: spindle shaped shell, short, open or partially closed canals, about 6 rounded whorls, fine close spiral threads sculpture, low transverse ridges apex to body whorl, oval aperature, nearly straight colmella, 6 or 7 small lip teeth COLOR: interior-white exterior-pale yellow to dark brown or red	Alaska to California
Olivella biplicata (Sowerby) purple Olivella	IV-V	sandy beaches	SIZE: up to 2.5 cm in length DESCRIPTION: shiny globose shell, mostly body whorl, sharp, short spire, aperature very long, thin outer lip, smooth white inner lip, canal mere notch, two folds on columella COLOR: interior-white exterior-white, lavendar gray, dark purplish, or in between, brown markings	Sitka, Alaska to Lower California

*indicates common name used in this report when two or more are given

TABLE 1. (cont'd) SNAIL ENVIRONMENTAL REQUIREMENTS AND DESCRIPTIONS

Latin and Common Names	Zone	Habitat	Description	Range
Polinices lewisii (Gould) Lewis moonsnail	III-V	sandy, gravelly, or muddy protected beaches	SIZE: up to 5 cm in length DESCRIPTION: large, globose shell, about 6 whorls, body whorl comprises most of shell, low fairly sharp spire, faint spiral constriction on body whorl, wrinkling and flattening in front of suture, wide aperature, smooth outer lip and columella, umbilicus open COLOR: interior-polished brown and white or cream exterior-yellowish	Masset, British Columbia to Lower California
Tegula funebralis (Adams) *black turban snail black top snail	III-IV	rocky beaches, withstands strong surf	SIZE: up to 2.5 cm in diameter DESCRIPTION: low cone, rounded whorls, apex often eroded, fold next to suture of body whorl angled, base somewhat flattened, unbilicus completely closed, 2 teeth on lower columella COLOR: interior-pearly, black margins enterior-purplish black	British Columbia to Lower California
Thais sp purples	III-V	rocky beaches	SIZE: up to 7.5 cm in length DESCRIPTION: thick heavy shell, short spire, enlarged body whorl, wide aperture, short canal, variable COLOR: interior-white exterior-white to brown, sometimes bands	Arctic Ocean to Lower California
Thais canaliculata (Duclos) channeled purple	IV	rocky beaches	SIZE: up to 2.5 cm in length DESCRIPTION: extremely variable, 5 body whorls, sharp apex, spire nearly ½ length of shell, large body whorl, constricted suture, pronounced spiral cords, grooves deep in between cords, wide aperature, thin outer lip, flattened columella, short and slightly recurved canal, no umbilicus, similar to *T. lima* COLOR: interior-white exterior-white to brown, sometimes in bands	Aleutian Islands to California

*indicates common name used in this report when two or more are given

TABLE 1. (cont'd)   SNAIL ENVIRONMENTAL REQUIREMENTS AND DESCRIPTIONS

Latin and Common Names	Zone	Habitat	Description	Range
Thais emarginata (Deshayes) *rock dwelling Thais short spired purple	IV	prefers open rocky beaches, not in protected waters	SIZE: up to 2.5 cm in length DESCRIPTION: variable shell-usually short and plump, low spire, 3 whorls, or can be obtuse or acute, enlarged body whorl, spiral rib sculpture with small and large rib alternating, ribs may have coarse nodules, operature wide, thin lip, arched and flattened columella, very short and slightly recurved canal, shell may be thick, elongated, and nearly smooth COLOR: interior-white exterior-dirty gray to black, brown or yellow white bands on ribs	Bering Sea to Mexico
Thais lamellosa (Gmelin) wrinkled purple	VII-IV	protected and open waters on rocky beaches	SIZE: up to 7.5 cm in length DESCRIPTION: variable shell-exposed locations: thick, smooth, short spire. sheltered locations-up to 12 transverse frills, spire as long as aperature and canal. enlarged body whorl, spiral ridges sometimes angular at shoulder mark whorls, wide aperature, more or less pronounced teeth inside outer lip, straight columella, short canal, no unbilicus COLOR: interior-whitist with some color exterior-white, yellow, orange, purple, or brown with plain or contrasting bands	Alaska to Santa Cruz, California

*indicates common name used in this report when two or more are given

TABLE 2. BIVALVE ENVIRONMENTAL REQUIREMENTS AND DESCRIPTIONS

Latin and Common Names	Zone	Habitat	Description	Range
Clinocardium nuttallii (Conrad) *cockle basket cockle heart cockle	IV	protected water, substrate of sand or mud or mixture of the two, low intertidal to deep water, eelgrass flats, active diggers--but not too great depth	SIZE: up to 11 cm in length DESCRIPTION: heavy shells heart shaped in cross-section, triangular to round in shape, external surface has 37-38 prominent radiating ribs, thin periostracum, edge strongly scalloped, muscle scar evident, no pallial sinus, external ligament COLOR: interior-chalky inside pallial line, nacreous outside pallial line exterior-young are light brown, mottled darker with age	Bering Sea to San Diego, California
Donax gouldii (Dall) bean clam	III-V	surface of open coastal sand beaches, subject to resurgent populations	SIZE: slightly over 2.5 cm in length DESCRIPTION: heavy shells, deeply arched, marked by indistinct radiating grooves, older shells have widely spaced external growth rings, interlocking margin teeth, thin periostracum COLOR: extremely variable-chiefly white, yellow, orange or bluish purple	Pismo Beach, California to San Lucas, Baja California
Donax californica (Conrad) wedge clam	III-V	protected waters, sand or mud substratum, not an active burrower, at or near surface, subject to resurgent populations but never as numerous as bean clam	SIZE: up to 2.5 cm in length DESCRIPTION: thin shell, wedge-shaped, faint radiating external grooves, margin finely crenulate, heavy varnish-like periostracum COLOR: interior-white buff exterior-yellow periostracum, buff shell without periostracum	Santa Barbara, California to Baja California
Hinnites Multirugosus (Gale) *purple hinged pecten rock oyster purple hinged rock scallop	V	open coast, attached to rocks or in rocky crevices, low tide to 2.5 fathoms, right valve adheres to rock substrate and conforms to it	SIZE: up to 25 cm in diameter DESCRIPTION: circular but may be irregular, upper valve external surface has strong unequal radiating ribs with short fluted spines, internal shell smooth, umbones central COLOR: interior-glossy white exterior-brown or green	Aleutian Islands to California

*indicates common name used in this report when two or more are given

TABLE 2. (cont'd) BIVALVE ENVIRONMENTAL REQUIREMENTS AND DESCRIPTIONS

Latin and Common Names	Zone	Habitat	Description	Range
Kellia laperousii (Deshayes) kelly shell	III-V	protected water along outer coast, intertidal to 35 fathoms in crevices or empty shells of other species, among mussels and oysters, abundant on matter continually suspended above bottom	SIZE: up to 2.5 cm in length DESCRIPTION: thin shells, circular to oval, concentric sculpture on external surface, hinge ligament internal, hinge area between lateral teeth lacking, umbones small and central COLOR: interior-dull white exterior-olive yellow periostracum, may have eroded umbonal area	Bering Sea to California
Macoma nasuta (Conrad) bent-nose clam	III-IV	protected waters, heavy mud or muddy sand substratum, 10 to 20 cm below surface, can stand stale water, often found in lagoons with occassional communication with the sea, few surface indications of presence	SIZE: up to 5 cm in length DESCRIPTION: valves thin, oval, smooth external surface, anterior end round, posterior rather pointed, relatively long external hinge ligament, umbones central with a fold close to posterior edge COLOR: interior-white exterior-gray brown periostracum, particularly in ventral and posterior regions	Alaska to Lower California
Macoma secta (Conrad) *sand clam cleft clam	III-V	protected water, clean sand or sandy mud, 3-9 m of water along the protected outer coast, small clams usually within several cm's of surface, large clams up to 45 cm below surface	SIZE: up to 11 cm in length DESCRIPTION: solid shell, sharp angled posterior, diagonal ridge from umbone to posterior ventral margin, posterior slope steep, ligament thick, prominent and short, inserted on rib-like callus COLOR: interior-smooth glossy white exterior-white	British Columbia to Baja California
Mytilus californianus (Conrad) *sea mussel california mussel big mussel rock mussel	III	surf-swept open coast-line, attached to rocks by byssal thread, communal	SIZE: up to 25 cm in length DESCRIPTION: elongated, anterior end pointed, posterior rounded, umbone terminal, 12 prominent ribs emanate from just above umbone and extend to end of shell, hinge ligament both internal and external COLOR: interior-iridescent blue to gray exterior-heavy black periostracum, older shells may have eroded blue ribs	Aleutian Islands to Socorro Island, Mexico

*indicates common name used in this report when two or more are given

TABLE 2. (cont'd) BIVALVE ENVIRONMENTAL REQUIREMENTS AND DESCRIPTIONS

Latin and Common Names	Zone	Habitat	Description	Range
<u>Mytilus edulis</u> <u>(Linnaeus)</u> *bay mussel edible mussel blue mussel	III	protected waters, attached to rocks by byssal threads, dense beds	SIZE: up to 5 cm in length DESCRIPTION: elongated, anterior end pointed, posterior rounded, umbones terminal, external surface smooth with fine concentric sculpture, hinge ligament both internal and external COLOR: interior-dull blue exterior-black, blue, or brown periostracum, usually blue where periostracum is eroded	Arctic Ocean to Baja California
<u>Mya arenaria</u> <u>(Linnaeus)</u> soft-shelled clam	III-V	heavy, black mud, protected waters where there is some mixing of fresh water, 25 cm below surface with slit like siphon holes (accidently introduced from the east, first detected in California in 1874.)	SIZE: up to 13 cm in length DESCRIPTION: oval in outline, shell light and brittle, umbone central, occassional external concentric growth lines, spoon-like projecting tooth or cartilige pit near umbone on inside left valve COLOR: interior-dull white exterior-dull white	British Columbia to Elkhorn Slough, California
<u>Ostrea lurida</u> <u>(Carpenter)</u> *native oyster Olympia oyster	IV	beds on surface of mud flats and gravel bars near mouth of rivers, tide pools, under rocks	SIZE: up to 5 cm in diameter DESCRIPTION: valves thin, irregular shaped, circular or elongate, sometimes scalloped edges, dorsal and ventral margin near hinge crenulate, umbones terminal COLOR: interior-nacreous, often iridescent olive green exterior-gray	Sitka, Alaska to Baja California
<u>Penitella penita</u> <u>(Conrad)</u> *piddock tipped piddock common piddock	III-V	protected outer coast, bores into clay, shale, sandstone, or other soft rock up to 12 cm in depth, small round holes in rock indicate presence, sharp blow to rock will cause clam to squirt water	SIZE: up to 7 cm in length DESCRIPTION: smoothly bulbous, rounded posterior, interior and exterior surfaces both divided into 3 areas, hinge covered with triangular plate, umbones not prominent COLOR: interior-smooth white exterior-gray brown	Aleutian Islands to Baja California

*indicates common name used in this report when two or more are given

TABLE 2. (cont'd) BIVALVE ENVIRONMENTAL REQUIREMENTS AND DESCRIPTIONS

Latin and Common Names	Zone	Habitat	Description	Range
Pododesmus cepio (Gray) (formerly Pododesmus macroschisma) jingle shell	IV-V	protected waters, outer coast, attached to solid objects, low tide to 35 fathoms	SIZE: up to 13 cm in diameter DESCRIPTION: circular, may be irregular according to form of object attached to, lower valve smaller and thinner than upper and perforated by a pear shaped byssal aperature, umbone near edge, prominent hinge with no teeth, pallial line continuous COLOR: interior-polished iridescent green enterior-yellowish white, usually obscured by plant and animal growth	British Columbia to Mexico
Protothaca staminea (Conrad) (formerly Paphia staminea (Conrad)) *littleneck clam rock cockle rock venus	III-IV	protected waters-gravel/mud, coarse sandy mud, not more than 7 cm below surface open coast-rocky point associated with small cobbles and coarse sand substratum	SIZE: up to 13 cm in diameter DESCRIPTION: oval to round, radiating ribs, less prominent, shell solid, muscle scars smooth, pallial line sinuated, hinge has 3 diverging cardinal teeth in each valve, umbone promenent near anterior, crenulate interior margin COLOR: interior-white exterior-angular pattern brown and white or white only	Aleutian Islands to Baja California
Protothaca tenerrima (Carpenter) *thinshelled littleneck little neck clam	III-V	protected water, firm sandy mud, burrows 25-40 cm deep, often found with Washington clam, not common	SIZE: up to 13 cm in length DESCRIPTION: elongate, oval, valves thin, exterior concentric ridges prominant, radiating ribs faint, pallial sinus deep-reaching 2/3rds of distance to anterior muscle scar, ventral margin smooth COLOR: interior-white-grayish enterior-grayish brown	British Columbia to Baja California
Saxidomus giganteus (Deshayes) *butterclam hard-shelled clam money clam smooth Washington clam giant Saxidome	III-IV	protected waters, mud or sandy mud, burrows 25-35 cm, slit mark indicates presence	SIZE: up to 12 cm in length DESCRIPTION: square to oval, heavy valves, slight posterior gape, prominent external concentric striations, deep winter checks, strong prominent external hinge ligament, pronouces umbones COLOR: interior-white, smooth, not glossy exterior-yellow when young changing to graywhite with age, affected by soil type	Aleutian Islands to San Francisco, California

*indicates common name used in this report when two or more are given

TABLE 2. (cont'd) BIVALVE ENVIRONMENTAL REQUIREMENTS AND DESCRIPTIONS

Latin and Common Names	Zone	Habitat	Description	Range
Saxidomus nuttallii (Conrad) Washington clam	III-IV	protected waters, mud, sandy mud, or sand, burrows 30-45 cm, slit mark indicates presence	SIZE: up to 18 cm in length DESCRIPTION: thick shell, oval, roughened exterior, numerous concentric ridges, gapes slightly at siphon end COLOR: interior-shiny white, dark purple posterior enterior-gray-white	Humboldt Bay, California to Baja California
Siliqua patula (Dixon) razor clam	IV	open coast, sandy beaches, particularly broad and flat sand beaches, active burrower, slit-like opening indicates presence	SIZE: up to 28 cm in length DESCRIPTION: elongate, thin, brittle, flat, smooth exterior, umbones nearer anterior than posterior, heavy glossy periostracum, prominent rib extending from umbone to margin COLOR: interior-white exterior-glossy brownish yellow	Alaska to Pismo Beach, California
Tresus capax (Gould) horse clam	IV	protected waters, gravelly sand or gravelly sand mud, burrows 35-40 cm deep	SIZE: up to 20 cm in length DESCRIPTION: nearly equilateral, posterior portion extends slightly, shell varies from thin and brittle to thick and heavy, rougher exterior than T. nuttallii, umbone anterior ligament small, internal resilium large and strong COLOR: interior-chalky to nacreous white-yellow exterior-white-yellow, heavy brown to black periostratcum	Alaska to California
Tresus nuttallii (Conrad) *gaper clam summer clam horse clam otter shell	IV	protected waters, fine sand or firm sandy mud, occasionally found on protected outer coast but is smaller with rougher shell, burrows 35-40 cm deep	SIZE: up to 20 cm in length, up to 2 kg in weight DESCRIPTION: valves unequal, upswept posterior which gapes, umbones displaced to anterior, smooth concentric enternal structure, ligament small but internal, resilium large and strong COLOR: interior-chalky to nacreous white to yellow exterior-white or yellow, heavy brown to black periostratcum that peels readily	Puget Sound to Baja California

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TABLE 2. (cont'd) BIVALVE ENVIRONMENTAL REQUIREMENTS AND DESCRIPTIONS

Latin and Common Names	Zone	Habitat	Description	Range
Volsella rectus (Gould) *horse mussel big mussel	IV	protected waters, protected outer coast, sand, gravel, mud, solitary, buried vertically with posterior protruding	SIZE: up to 20 cm in length DESCRIPTION: wedge shape, oblong with concave ventral margin, rounded at both ends, umbone nearer anterior, light concentric enternal structure, hinge ligament largely internal, anterior end narrower COLOR: interior-shiny blue-white exterior-shiny brown periostratcum, hairy posterior	Vancouver Island to California
Zirphaea pilsbryi (Lowe) rough piddock	III-V	protected waters, bores into heavy mud, clay, or soft rocks up to 35 cm, sometimes found in soft rock on outer coast, round siphon holes 1 cm in diameter indicates presence	SIZE: up to 15 cm in length DESCRIPTION: shell solid, elongate, gaping at both ends, anterior ventral area cut away, external surface divided into 2 main areas by oblique groove, coarse concentric markings, anterior ventral edge with spines and teeth, myophore rounded end, dorsal articulating area COLOR: interior-chalky white exterior-shell whitish, dark periostracum	Alaska to Baja California

*indicates common name used in this report when two or more are given

TABLE 3. OTHER SHELLFISH ENVIRONMENTAL REQUIREMENTS AND DESCRIPTIONS

Latin and Common Names	Zone	Habitat	Description	Range
Balanus cariosus (Pallas) horse barnacle	IV	rocky coasts at quarter-tide level, gregarious	SIZE: up to 3 cm in diameter up to 6.5 cm in height DESCRIPTION: steep-walled cone with numerous downward pointing spines, thatched appearance, when crowded takes on a tubular form and may lack spines, base membranous COLOR: white	Pacific Coast of North America and Japan
Balanus nubilus (Darwin) giant barnacle	V	below low tide level usually 3-7 meters, occassionally to 30 fathoms of water, gregarious, frequently found on hold-fast kelp	SIZE: up to 7 cm in diameter up to 27 cm in height DESCRIPTION: large opercular opening with jagged edge, beak of tergum projects above opening, prominent ribs present in young specimens, ribs obscured by erosion in older specimens, base calcareous and porous crowded specimens gain room by deepening base COLOR: interior-cinnamon buff cover plates, purple patch usually near beak of tergum exterior-dirty white	S. Alaska to Monterey Bay, California
Balanus glandulus (Darwin) acorn barnacle	II-IV	extremely variable, abundant on rocks, occassionally in brachish water and on ships bottoms, gregarious	SIZE: up to 10-18 mm in diameter 5-9 mm in height DESCRIPTION: cone-shaped, cylindrical or club shaped when crowded, variation from small regular pores with cross-septa to no pores, pores filled with white powder COLOR: interior-jet black cover plates, remainder dirty white exterior-dirty white or gray	Aleutian Islands to Lower California
Mitella polymerus (Sowerby) goose barnacle	II-IV	littoral zone, especially Zone III, strong wave action	SIZE: capitulum up to 45 mm in length, peduncle up to 25 cm in length DESCRIPTION: capitulum enclosed by 2 large plates on each side, one plate (carina) on back edge, several rows of plates below these, up to one hundred or more depending on age COLOR: plates-creamy white peduncle-dark brown	world-wide

TABLE 3. (cont'd) OTHER SHELLFISH ENVIRONMENTAL REQUIREMENTS AND DESCRIPTIONS

Latin and Common Names	Zone	Habitat	Description	Range
Cancer magister (Stimpson) Dungeness crab	V	low tide to 100 fathoms, rarely seen exposed at low tide, mates in summer months in shallow water, sand, and eelgrass flats, burrows in sand or hides under rocks at lowest tides, common in Oregon in shallow water in summer when it comes in to molt	SIZE: up to 22 cm across carapace 13 cm in length DESCRIPTION: carapace with fine granulations, ten teeth on the margin in back of the eye, white tipped fingers of the chiliped COLOR: reddish brown carapace, yellow underneath	Aleutians to S. California
Cancer productus (Randall) red rock crab	V	rocky shores, half buried in the sandy substratum, under rocks, restricted to rocky bottoms	SIZE: maximum width across carapace 25 cm DESCRIPTION: carapace wider than long, 9-12 teeth front portion, between the eyes 5 nearly equal teeth, tips of claws dark COLOR: adults-brick red	Alaska to Baja California
Dendraster excentricus (Eschscholtz) sand dollar	IV	sand flats, buried, lowest or subtidal zones of sandy beaches, bays, and estuaries, free of surf	SIZE: 4.5-7 cm in width DESCRIPTION: flat, nearly circular, radial symetry of 5 parts evinced by star shape on aboral surface COLOR: alive-dark purple-brown dead-dull white	Alaska to California
Strongylocentrotus franciscanus (Agassiz) giant red urchin	IV-V	rocky surf swept shores, subtidal, gregarious	SIZE: up to 25 cm in diameter spines up to 7 cm in length DESCRIPTION: hemispherical in shape, calcareous plate made up of 500-600 pieces, divided into 10 divisions, covered with a great number of spherical knobs that spines fit over COLOR: alive-red purple dead-gray	Alaska to Lower California

TABLE 3. (cont'd) OTHER SHELLFISH ENVIRONMENTAL REQUIREMENTS AND DESCRIPTIONS

Latin and Common Names	Zone	Habitat	Description	Range
Strongylocentrotus purpuratus (Stimpson) purple urchin	IV-V	low tide or subtidal surf swept shores, may burrow into rock where wave action is great	SIZE: up to 6 cm in diameter spines up to 2.5 cm in length DESCRIPTION: hemispherical shape, calcareous plates made up of 500-600 pieces fitted together, divided into 10 divisions COLOR: alive-purple dead-dull gray	Alaska to Lower California
Cryptochiton stelleri (Middendorff) gumboot chiton	IV-V	prefers protected outer coast at depths of 0-600 m, on a variety of bottoms preferring stone or pebbles, observed to migrate into intertidal zone during some periods of life cycle	SIZE: up to 32 cm in length DESCRIPTION: 8 valves, anterior valve with 4-7 incisions, interior mediate or posterior valves with a single incision on either side, apex and carina poorly developed, apex of all but anterior valves have a small depression COLOR: alive-reddish brown dead-white or ivory, with touch of pink	Alaska to California
Katherina tunicata (Wood) black katy chiton	IV	sublitoral form, found on stony bottoms to a depth of 40 m, prefers surf swept beaches	SIZE: up to 15 cm in length DESCRIPTION: 8 valves, anterior valve fan-shaped with 7 or 8 incisions, posterior valve which with 8-10 superficial incisions, central areas of intermediate valves convex with slightly ribbed surface, lateral areas elevated COLOR: alive-black dead-white with black spot	Alaska to California
Molopalia muscova (Gould) Hairy chiton	III-IV	outer coast, rocky intertidal areas	SIZE: up to 6 cm in length DESCRIPTION: 8 flattened broadly ovate valves, central areas of plates have close, longintudinal ribs or markings COLOR: alive-blackish green dead-bluish green	Alaska to Lower California
Acmaea mitra (Eschoscholtz) whitecap limpet	IV	rock beaches at low tide to 10 fathoms	SIZE: up to 3.5 cm in diameter DESCRIPTION: thick, cone-shaped with a high apex, aperature cone-shaped, interior muscle scar horseshoe-shaped COLOR: interior-smooth white enterior-white	Alaska to California

TABLE 3. (cont'd) OTHER SHELLFISH ENVIRONMENTAL REQUIREMENTS AND DESCRIPTIONS

Latin and Common Names	Zone	Habitat	Description	Range
Acmaea pelta (Eschscholtz) shield limpet	II	lowest low tide to highest high tide, more common above mid-tide area on rocks and occassionally on seaweed	SIZE: up to 3 cm in diameter DESCRIPTION: conical shell with straight side, apex slightly forward of middle, exterior rough-ribbed COLOR: interior-bluish, margin dark or with light and dark alternating marks exterior-white and dark stripped	Alaska to Mexico
Acmaea persona (Eschscholtz) mask limpet	II	prefers shady area near fresh water seep high on rocks	SIZE: up to 3.5 cm in diameter, up to 2 cm high OESCRIPTION: apex of shell forward of center, sides slope, convex in profile COLOR: interior-bluish white with dark border and dark stain behind apex enterior-mottled gray with brown or black	Alaska to California
Acmaea testudinalis (Eschscholtz) plate limpet	III-IV	prefers rocky surf-swept beaches, usually camoufl-aged by algae	SIZE: up to 5 cm in diameter OESCRIPTION: low, flattened cone-shape, central apex with fine radiating lines, oval aperature COLOR: interior-shiny, bluish with dark marks around aperature exterior-greenish gray with brownish center	Alaska to California
Oiodora aspera (Eschscholtz) keyhole limpet	V	rocky beaches at low tide to 8 or more fathoms	SIZE: up to 6 cm in diameter OESCRIPTION: low conical shell, long oval base, apex well forward of center, top opening nearly round, sides slope, nearly arched, exterior of shell has radiating ridges crossed by concentric rings, edge crenulated COLOR: interior-white exterior-gray and drab, sometimes white with brown rays	Alaska to Lower Cal-ifornia
Notoacmaea (formerly A. fenestrata (Reeve)) owl's eye limpet	III-IV	smooth boulders along open coast	SIZE: up to 3.5 cm in length DESCRIPTION: apex slightly forward of center, nearly circular, moderately arched COLOR: interior-dark blue blending to brown at apex exterior-brown, slightly eroded top resembles owl's eye	Alaska to Mexico

TABLE 3. (cont'd) OTHER SHELLFISH ENVIRONMENTAL REQUIREMENTS AND DESCRIPTIONS

Latin and Common Names	Zone	Habitat	Description	Range
Haliotis rufescens (Swainson) red abalone	IV	rocky shores, outer coast, rocky headlands, and promontories, near high tide to approximately 170 m, maximum concentration 7-18 m, northern part of range nearer shore	SIZE: over 28 cm in diameter DESCRIPTION: oval, flattened, sculpture has rounded spiral ribs and radiating waves, outer lip extends over inner nacreous surface typically forming narrow red rim, tubular and oval holes slightly raised, usually 3-4 holes open, but varies, distinctive prominent interior muscle scar COLOR: interior-iridescent, highly polished, dark green markings on muscle scar exterior-dull brick red	Sunset Bay, Oregon to Baja California
Dentalium pretiosum (Sowerby) dentalium	V	mud or sand, below the low tideline to several hundred fathoms	SIZE: up to 3 cm in length DESCRIPTION: elephant tusk-like in shape in miniature, open at both ends, slightly curved, tapers gradually from small upper end to larger bottom end COLOR: opaque white with dirty buff colored growth rings	Alaska to Mexico

Chapter V

Shellfish from Archaeological Sites on the Southern Washington, Oregon, and Northern California Coasts

A brief account of the archaeological sites pertinent to this report was given in Chapter I. Although most of the site reports mention a list of shellfish found in the site, only the main species are generally indicated. A few of the reports (Hartmann 1978; Stubbs 1973) attempt to utilize the type of information outlined in Chapter IV. Utilizing reported shellfish species lists in conjunction with the information outlined in Tables 1, 2 and 3, habitat exploitation, environmental change, and seasonality will be examined in this chapter. The sites will be discussed in order from north to south along the coasts.

Southern Washington Coast

Minard (45GH15)

The shellfish from the Minard site on North Bay in Gray's Harbor are listed in descending order of relative abundance (Roll 1974). They are the "abundant" bent-nose clam, basket cockle, razor clam, and bay mussel. Gaper, butter, and littleneck clams are listed as "present". Welks, purples, barnacles, and limpets are "rare" and crab are "very rare". All of these are found near the site. Bent-nose clam, basket cockle, razor clam, gaper clam, and littleneck clam all inhabit Zone IV, from near the surface for basket cockle, to 35-40 centimeters below the surface for gaper clam. Razor clam and basket cockle are very active diggers. The time to procure these shellfish in quantity could be in the spring or summer months when the lowest tides coincide with daylight hours (Ham 1976), indicating at least a spring or summer occupation for the site.

Martin (45PC7)

Most of the shellfish food resources from the Martin site can be found in the Willapa Bay area near the site. Listed in decreasing order are native oyster, cockle, razor clam, horse clam, bent-nose clam, butter or Washington clam, and littleneck clam. Also present is bay mussel, Thais sp., barnacles, crabs, sand dollar, and one specimen of sea mussel (Kidd 1967). The sea mussel shell had been made into a scraper or ground knife. Native oyster, cockle, horse clam, bent-nose clam, butter or Washington clam, and littleneck clam would be easier to gather in quantity in the spring or summer months, although some of these could also be procured during other seasons (Ham 1976). Razor clam can be found on the outer coast not far from the site.

Oregon Coast

Par-tee (35CT20)

Phebus and Drucker (1973) list mussel, razor clam, sea snails, barnacles, and Olivella shell beads as being present at the Par-tee site. Today, the site is located on the east bank of the Necanicum River, which empties into the ocean approximately three to five kilometers from the site. Razor clam can be found on the surf-swept beaches near the mouth of the river. Although there is no indication of what type of mussel is present, it may be bay mussel, as both Drucker (1978) and Ross (1979a) suggest that a bay environment was present near the site at the time of occupation. If this is so, Olivella, and various sea snails and barnacles would also be found in this environment. More information is needed before firm conclusions can be drawn about possible environmental changes at the site subsequent to occupation.

Netarts Sand Spit (35TI1)

The shellfish component of the Netarts Sand Spit site accounted for 60-70% of the total midden volume, with 50% of this being made up of cockle. The remaining 50% was almost entirely gaper clam. Butter clam and bent-nosed clam are almost negligible (Newman 1959). The site is located between Netarts Bay and the ocean. All of these shellfish can be found in the vicinity of the former. Cockle, an active digger, is found in Zone IV at no great depth, due to its short siphon, while gaper clam, also of Zone IV, is found from 35 to 40 centimeters below the surface. Butter clam is found in Zone III-IV from 10 to 20 centimeters below the surface. Following Ham's (1976) suggestion that deep burrowing clams, gathered in quantities, indicate a spring or summer occupation because of the longer intertidal periods, the presence of gaper clam and possibly cockle would suggest occupation during this period. This is not to say the site was not inhabited during other seasons as well.

Bob Creek (35LA16)

The next site report that gives any detailed information on shellfish is the report of the burial salvage from Bob Creek on the central Oregon coast (Harrison 1978). Black katy chiton, rough keyhole limpet, sea mussel, piddock clam, acorn and giant barnacle, and both terrestrial and littoral snails are reported, although in limited quantities. All of those listed can be found in the general vicinity, at nearby rock outcroppings and stretches of sandy beach. However, the limited nature of the excavation makes it all but impossible to attempt a statement of seasonality.

Tahkenitch Lake (35DO175)

Field observations at Tahkenitch Lake indicated that both sea and bay mussel were present, with the later considered the most prevalent. A few lenses of gaper clam, littleneck clam, and cockle were present in the lower parts of the midden. Small fragments of razor clam were found throughout the midden. All of the shellfish present can be found in the Umpqúa River tidal flats and rocky shores eight to ten kilometers to the south. Razor clam can also be found on the sandy beaches between the site and the Umpqua estuary. Other than shellfish, food remains at the site were few, indicating that shellfish were the main food species. As noted previously, transporting whole shellfish eight to ten kilometers seems inefficient and would lead one to believe that lowering sea levels and subsequent dune formation have greatly altered the local environment at Tahkenitch Lake (Hartmann 1978; Heusser 1960; Wiedemann, Dennis, and Smith 1974).

Umpqua-Eden (35DO83)

Shellfish remains accounted for 75% of the food residue at the Umpqua-Eden site (Stenhouse 1974). Although testing of the site is not yet complete, Stenhouse concludes that shellfish were a secondary resource, with fish being the primary resource.

Clams and mussels of the "bay type" were found in the largest quantities. Stenhouse states that the "bay type" was more prevalent. It is unclear whether bay mussel is more prevalent, or if this category includes the other bay species present, such as bent-nose clam, butter clam, soft-shelled clam, cockle, and horse mussel.

Razor clam, moon snail, and sand dollar were also found. Moon snail and sand dollar can be found on protected sand beaches, while razor clam prefers surf-swept sand beaches. Both of these habitats are relatively close to the site. Horse, giant, and acorn barnacles, which inhabit rocky areas in bays or on the outer coast, were all found during excavation. Habitats suitable for them are also relatively close to the site. Owl's eye limpet and sea mussel were also present. Both of these molluscs prefer the surf-swept, rocky open coast, which does not occur in the general vicinity of the site.

Although soft-shelled clam is listed as present in the site, it is not native to the Pacific Northwest. Evidence indicates that it was transplanted to the San Francisco area, where it was first detected in 1874 (Fitch 1953; Quayle 1978). There is no indication of how much of, or at what depth this species was found. It could have been misidentified, or have been found in the most recent occupational levels.

In the Umpqua-Eden site, most of the species present could have been gathered with little difficulty and very little travel. The exceptions, sea mussel and owl's eye limpet, may have been found in small quantities near the mouth of the river. Since there are no quantities given for these two species, it is impossible to make any quantitative statements concerning travel and shellfish transportation associated with the site.

Indian Bay (35CS30)

At the Indian Bay site, 75-90% of the shell in the midden is made up of sea and bay mussel. Although sea mussel is cited as the most common, relative quantities were not determined (Stubbs 1973).

Cockle and gaper clam each comprised 5-10% of the midden. Gaper clam was found in the lower levels of the midden in sizeable deposits of uncompacted shells. In keeping with Ham's (1976) suggestion, these two molluscs could be gathered in quantity during the spring or summer months with greater ease than during other periods.

Butter clams were found in small deposits in the bottom of the midden. Stubbs does not believe this clam was systematically collected, because they were generally scarce in the midden.

Littleneck, bent-nose, and sand calms were rare in the site and were not numerous enough to have been eaten on a regular basis. Gumboot chiton and black katy chiton were also rare but were found in small patches. Channeled purple was present in enough numbers to occasionally be part of the diet. With the exception of the clams, all of these molluscs inhabit the same type of area as sea mussel. Littleneck clam can be found on the open coast, but it would more likely be found with bent-nose clam and sand clam in the bay near the site. Rock dwelling Thais and numerous small limpets were found. These were generally thought to be hitchhikers brought in on larger food sources.

Several types of barnacles were found. Giant and goose barnacle are large enough to be eaten and were present in some numbers.

Sea urchin, Dungeness crab and red rock crab were found also.

The urchins could be gathered off the rocks on the outer coast while crab could be found in both the bay and the outer coast habitat.

This site contained more shell artifacts than noted in many sites. Two valves of native oyster were found, one of which had holes drilled in it. One unidentified limpet that was found during excavation had had the top filed off. Although purple Olivella was rare, when it was found it had generally been made into beads. One cockle shell scraper was noted.

Sea mussel and other open coast species occur within three kilometers of the site. Protected water species occur in the adjacent estuary. Stubbs suggests that because of the presence of salmon remains, the site was occupied during the late summer and fall. He tentatively suggests that occupation was year-round. The presence of lenses of cockle and gaper clam suggests spring and summer occupation. The presence of a wide variety of both open and protected water species, some of which required transportation over at least three kilometers, would tend to support Stubb's contention of year-round occupation.

Bullards Beach (35CS3)

The literature from Bullards Beach lists only those species that were used as ornaments or tools (Leatherman and Krieger 1940). Rough keyhole limpet, white cap limpet, and jingle shell were listed as ornaments. Jingle shell is cited as Anomia sp., but the distribution of Anomia on the Pacific Coast does not range above San Diego today. It is unlikely that the range has changed since occupation of the site. The shell in question is probably Pacific jingle, Podoesma machroshisma, which is very similar. Purple hinged pecten, otter shell, and cockle were used as cups. However, otter shell (Lutrania maxima) does not occur in the Pacific, so this is probably gaper clam which is very similar in appearance to otter shell (Roger 1908; Abbott 1968). The limpets, pecten, and jingle are usually found on rocks on the outer coast. This type of habitat is located approximately four kilometers from the site. Gaper clam and cockle can be found in the mud and sand of the protected waters near the site. The data available does not allow for a statement of seasonal use.

Pistol River (35CU61)

Heflin (1966) estimates that 70-80% of the shell in the Pistol River site was either bay or sea mussel. In addition, black katy chiton, channeled purple, gumboot chiton, purple hinged pecten, black turban snail and sea urchin were found. These species inhabit the same surf-swept shores that sea mussel inhabits, and are large enough to be considered food resources. Rock dwelling Thais, dove shell, rough keyhole limpet, white cap limpet, shield limpet, giant western and western fat Nassa snail, all open water species, were also present. They are small in size and were probably hitchhikers to the site, rather than exploited food resources.

Cockle, gaper clam, littleneck clam and thin shelled littleneck clam were found in the site. These species prefer the same clam waters that bay mussel inhabits.

Cancer crab is also listed as being present in the site. It can be found in both types of environment. Active surf species such as sea mussel can be collected from rocks to the north of the site. Bay mussel and the calmer water species can be collected from the rocks or dug from the mud and sand of the tidal flats near the mouth of Pistol River.

The presence of a wide variety of both active and calm water species, all locally available, adds little to the acknowledged fact that the Pistol River site was a village site, occupied year-round.

Lone Ranch Creek Site (35CU37)

At the Lone Ranch Creek site, Berreman (1944) estimated over 90% of the shellfish remains to be sea mussel, locally available in the rocky intertidal area near the site. Gaper clam, giant barnacle, black turban snail and purple hinged pecten were also found in sufficient quantities to represent a food resource, according to

Berreman. Of these, gaper clam is the only one that does not inhabit the surf-swept rocky shores near the site. The closest readily identifiable area suitable for gaper clam habitat appears to be the mouth of the Chetco River, approximately eight kilometers to the south.

Littleneck clam, rock dwelling Thais, channeled purple, rough keyhole limpet, mask limpet, white cap limpet, kelly shell, black katy chiton, Antiplanes perversa, wrinkled Amphissa, and gumboot chiton were also found at the site, and are all locally available. Berreman evidently felt that the quantities were not sufficient to represent a food resource. However, gumboot chiton, littleneck clam, black katy chiton, rough keyhole limpet, and channeled purple are all large enough to have been exploited for food. The remaining species were probably hitchhikers to the site.

Purple Olivella, dentalium, and red abalone shell were present. The dentalium was found in association with burials. It was most likely obtained in trade from the Puget Sound area (Keep 1935). The Olivella was used for beads. Red abalone was used as an ornament. It can be obtained from rocky crevices on the shores of the outer coast. Although it occurs in the area, fragments being found in the local beach gravels, it is more common further to the south.

The land snails found at the site, Haptothrema sportella semedecussatum and Monodema fidella, probably occurred naturally. Many of the shells were found whole, and considering their fragile nature, Berreman concluded that they were not eaten.

All of the shellfish food resources, with the exception of gaper clam, could have been obtained near the site. Giant barnacle, purple hinged pecten, and gaper clam may have been gathered in the spring or summer months when low tides occur more often in the daylight hours. The amounts of these species may have been minimal, so that no concise statement on seasonality can be made. Assuming that no protected areas occur on the outer coast nearer than the Chetco River, the presence of gaper clam would seem to indicate that they were transported to the site from a considerable distance. However, this suggestion is very tentative, and should be documented by a visual inspection of the site area.

Northern California Coast

Point Saint George (4DNO11)

Further down the coast, at Point Saint George, ethnographic and archaeological evidence indicates that shellfish were processed at both the habitation area and the workshop knolls (Gould 1966).

Molluscs present in the site that could have been gathered from the rocky areas to the west and south of the site include limpets, gumboot chiton, purple hinged pecten, barnacles, sea urchin (probably purple), sea mussel, black turban snail, welks and blue top shell. Littleneck clam, sand dollar, Olivella, *Saxidomus* sp., horse clam and cockle were also found in the site. These species might be found near the site if the headland and offshore rocks provide a protected water habitat. A more likely area would be at Crescent Bay, eight kilometers to the south. Razor clam, another food resource at the site, can be gathered from the surf-swept beaches to the north.

Razor clam, *Saxidomus* sp., horse clam and cockle can be gathered with greater ease and in larger quantity during the spring or summer months rather than in the fall or winter months. No quantities were given for the various species, so it would be difficult to postulate seasonality based on shellfish. However, Gould's (1975) ethnographic data indicates that the occupants were probably never absent from the main village for any length of time except from August to November.

Patrick's Point (4HUM118)

The molluscan remains from Patrick's Point were the dominant faunal material (Elasser and Heizer 1966). *Saxidomus* sp., *Macoma* sp., purple hinged pecten, bean clam, sea mussel and native oyster were the main food species. The present range of bean clam extends northward only to Pismo Beach, approximately seven hundred kilometers south of Patrick's Point. Unless the range of bean clam has changed dramatically since the site was occupied, the species was probably misidentified. Although the remains of chitons, barnacles, sea urchin, and small gastropods were found, they were not identified further, thus providing little information. Abalone and Olivella were present in the site, although rare.

The rocky, outer coast intertidal area adjacent to Patrick's Point provides suitable habitat for purple hinged pecten, sea mussel, chitons, barnacles, sea urchins and abalone. Saxidomus sp., Macoma sp., and oyster are found in protected waters such as Trinidad Bay, 11 kilometers south of the site. Since no quantities are given for the various species, a seasonality statement is unwarranted. However, if Saxidomus sp., Macoma sp., and purple hinged pecten occurred in large quantities, it would be indicative of a spring or summer occupation.

Tsurai (4HUM169)

The north shore of Trinidad Bay, where the village of Tsurai is located, is bordered by a rocky shore with some stretches of sandy beaches. A reconstruction of the economy places an emphasis on sea mussel, cockle, butter clam, razor clam and purple hinged pecten as shellfish food resources. Purple sea urchin, red abalone, moon snail and barnacles, were also utilized (Heizer and Mills (1952). Olivella and abalone ornaments were also present (Elasser and Heizer 1966). All of these resources can be found either on the bay or the adjacent outer coast. As noted previously, butter clam, razor clam and cockle are deep-dwellers and their procurement in quantity would seem to indicate a spring or summer habitation.

Gunther Island (4MUN67)

Molluscs listed for Gunther Island include littleneck clam, gaper clam, bent-nose clam, Washington clam, bay mussel, moon snail, red abalone, purple Olivella, dentalium, purple hinged pecten and rough piddock (Loud 1918). The first six comprise the food species and are found in the bay near the site. Bay mussel and sea snails remains were not numerous. Abalone and Olivella were limited to ornaments. The dentalium was probably obtained in trade. Gaper clam was probably procured in quantity primarily in the spring or summer months if it comprised one of the main food species.

Conclusion

The purpose of this chapter was to ascertain if the shellfish remains from archaeological sites along the southern Washington, Oregon and northern California coasts could answer questions concerning environmental change, habitat exploitation and seasonality.

Only two sites, Tahkenitch Lake and Par-tee, offered shellfish evidence for environmental change.

Half of the sites examined indicated the possibility that shellfish were transported from three to eleven kilometers if the environments have not changed. None of the transported shellfish were major food resources, as in the case of Tahkenitch Lake.

Ham (1976) proposes that shellfish inhabiting the lower intertidal zones were collected in quantity in the late spring to late summer, when low tides coincide with daylight hours. Other seasons would provide insufficient time to gather deep-dwelling molluscs in quantity. Suggested methods for procuring these molluscs in the winter months include the use of the full moon to see by, diving, wading, and gaffing with a hook and pole (Ham 1976). All of these methods seem impractical for gathering large quantities of deep-dwelling molluscs.

Two species discussed by Ham are represented in this report. These are *Saxidomus* sp. and *Tresus* sp. These clams dwell up to 40 cm below the surface in Zones III-IV. Although not included by Ham as deep-dwellers, this report includes cockle and razor clam which inhabit Zone IV and are extremely active diggers. Also included are giant barnacle and purple hinged pecten. These two species adhere to rocks in Zone V and would take considerable time to gather.

Species estimates are available for 15 sites on the southern Washington, Oregon and northern California coasts. Realizing estimates are very subjective, this report tentatively suggests late spring to late summer habitations for six of these sites - Minard, Martin, Netarts Sand Spit, Indian Bay, Tsurai, and Gunther Island, all village sites located on or near bays. The village sites of

Lone Ranch Creek, Pistol River, Point Saint George and Patrick's Point, located on the outer coast, also had quantities of the deep-dwelling species. However, the amounts were not noted and may have been minimal, so that occupations during spring and summer may be invalid.

Ross's (1979b) model suggests that the aboriginal inhabitants spent the spring and summer months on the outer coast before moving up river for the salmon runs and acorn harvests in the fall. The winter months were spent in the large permanent villages on bays. Six of the fifteen sites discussed suggest more time was spent at the permanent village near esturine bodies than postlated by Ross. However, they do not conflict with Gould's (1975) model for the Tolowa, who spent nine to ten months every year at the main village and were only absent from mid-August to early November when they were on the outer coast and up river.

This is hardly conclusive evidence for occupation of the bay or esturine sites during the spring and summer months exclusively, since outer coastal sites show evidence for occupation during this period also (Snyder 1978). However, it does suggest more time was spent at estuary sites than postulated by Ross. Three tentative models for spring and summer activities can be suggested from this information: 1) a number of individuals remained at the village during this period to harvest deep-dwelling shellfish; 2) only short excursions were made to the outer coast during this period; and 3) early spring to mid-summer was spent on the outer coast utilizing shellfish and sea mammals before returning to the estuaries to harvest deep-dwelling shellfish from mid to late summer.

The third model is enhanced when it is noted that by following this procedure the coastal inhabitants would have avoided the shellfish poisoning likely to occur on the outer coast during the late summer and fall.

Chapter VI

The Neptune Site 35LA3

The selection of the Neptune site, on the central Oregon coast, was part of a regional research design proposed by Dr. Richard E. Ross to expand our understanding of aboriginal subsistence strategies. The site was chosen for comparison with the data from the Seal Rock site, excavated in 1972 and 1974. Both sites were believed to be located in ethnographic Alsea territory.

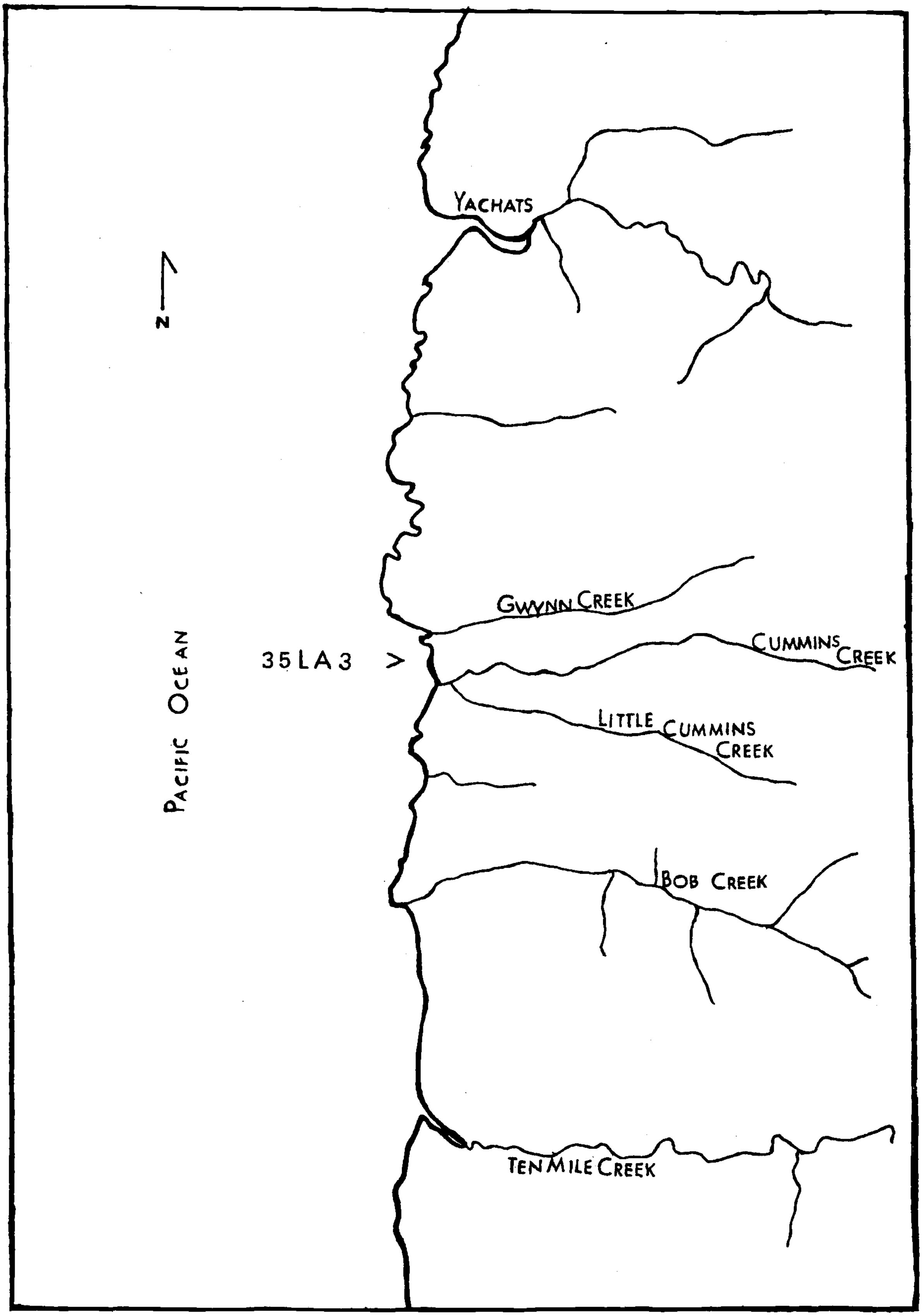
The Neptune site is located between Gwynn and Cummins Creeks, 4.8 kilometers south of Yachats, inside Neptune State Park (Figure 2). Eleven shell middens, excluding Neptune, have been located in the vicinity of the park. Most of these appear to be small and shallow--not over one meter in depth. Neptune was chosen for excavation because it appeared larger and deeper than other sites in the area, was apparently less disturbed, and contained depressions that seemed to be housepits. Excavation proved the latter contention to be untrue.

Natural Setting

The site is situated on the top of a bluff formed by a consolidated sand dune, approximately 15 meters above the present beach level. It is 15 meters west of Highway 101 in T. 15 S., R. 12 W., Section 10, SE¼. The site is highly visible and easily accessible from the beach below. This, combined with the site's location on the outer coast, has led to considerable destruction from both vandalism and natural erosion processes.

Present day vegetation surrounding the site consists of lodgepole pine, Sitka spruce, salal, and thimbleberry. The site itself is covered by grasses, ferns and forbs. The vegetation of the area is typical of that which inhabits the Bandon soil series found around the site. (U. S. Soil Conservation Service, Soil Survey Staff 1975). The vegetation of the area has not changed substan-

FIGURE 2. AREA OF THE NEPTUNE SITE (35LA3)



tially since post-Pliestocene times (Hansen 1941).

The dense vegetation surrounding the site and the rugged terrain of the Coast range to the east of the site provide cover for deer, elk, and various small animals (Franklin and Dryness 1973). Rock outcroppings on the beach immediately below and to the north of the site are the favorite habitats of molluscs and other intertidal organisms. The sand beaches stretching between the rock outcroppings provide cover for various species of clam.

The climate of the coast is relatively mild. Prevailing winds are from the northwest during the summer, changing to the south and southwest during the winter. The mean minimum temperature in January is between 2.5 and 0° C., and in July the mean maximum temperature is between 20.0 and 17.5° C. (Franklin and Dryness 1973). Cape Perpetua, to the north of the site, provides a buffer from the winds during the summer months and makes the site a favorable area for habitation.

Ethnography and History

Neptune lies near the boundary of the ethnographic Alsea and Siuslaw, although the exact boundaries of these two Penutian-speaking peoples of Yakonan stock has not been clearly delineated (Schaeffer 1959; Swanton 1952). Berreman (1937) places the Alsea border approximately at the Yachats River, north of Neptune, while Harrington (1943) places it south of Neptune at Ten Mile Creek. Thus, it is difficult to determine with absolute certainty which ethnographic group did, in fact, occupy the Neptune area.

The ethnographic information for both of these groups is rather sparce. For the Siuslaw, we must depend on Barnett's (1937) culture element list. The Alsea are somewhat better known, with contributions from both Barnett (1937) and Drucker (1943). According to the correlation coefficients derived by Barnett and Kroeber (Barnett 1937), the Siuslaw and Alsea are fairly closely related, at least in terms of those culture elements discussed by Barnett. Ethnographic detail pertinent to this report, that is shellfish information, has been previously discussed in Chapter III, and will not be repeated.

The Alsea and Siuslaw, like many other coastal groups, suffered both a decline in population and a shattering of their culture after contact with Europeans. The precontact (1780) population of the Alsea, Siuslaw, and Yaquina, estimated at 6,000 individuals, was reduces to 55 by 1930, and further reduced to 9 in 1930 (Mooney 1928; U. S. Department of Commerce, Bureau of the Census 1937). The decimation was mainly attributed to the introduction of European diseases. In 1788 Gray mentions that the Indians of Oregon already showed signs of small pox. The reservation years, 1853-1887, forced the coastal groups into close proximity, effectively destroying the traditional culture of the individual groups (Beckham 1977).

The rugged nature of the environment surrounding the Neptune site led early explorers to bypass the area thus limiting the information we have. The first mention of the central Oregon coast comes from Gray who, in 1788, described the Indians of the Alsea River area as being hostile (Bancroft 1884). Thirty-eight years later, in the summer of 1826, McLeod mentions "two Indian camps thinly inhabited" near Cape Perpetua (Davies 1961:163). These may have been remnants of the Alsea people after disease swept through.

Chapter VII

Descriptive Archaeology

The excavation of the Neptune site was accomplished by a crew of 11 students from the Oregon State University field school, under the direction of Dr. Richard E. Ross. The project began in June of 1973, and lasted eight weeks.

A horizontal grid system with a north-south orientation was superimposed over the site. Vertical measurements were in reference to a datum established arbitrarily at one hundred meters, and were tied into the grid system for spatial distribution. Where district strata were not observed in the shell midden, excavations were conducted in vertical units of five or ten centimeters.

The basic units of excavation were two-meter squares tied into the grid system. Units were chosen for excavation according to depth, stratigraphy, surface features, and overall view of the site. The stratigraphy and depth of the midden could be viewed on the west face of the bluff where the midden was eroding out. The west side of the midden was estimated to be the deepest, so several units were excavated in this area. Placement of these units was such that erosion of the bluff would not be intensified.

The several surface depressions, initially thought to be house pits, proved to be the work of amateur collectors and were avoided. Excavation units and surface features are shown in Figure 3.

Most of the excavation was done by hand, with trowels, although skim-shoveling was sometimes employed. The fill was hand screened through quarter-inch mesh. Tools and faunal remains found _in situ_ were kept separate, with individual proveniences. Other artifacts and faunal remains were bagged by level.

The stratigraphy of the Neptune site is complex (Figure 4). The intermingling of the various lenses, composed of ash, clay, sand, and shell, made it difficult to discern the stratigraphic sequences. Shell lenses varied in the degree of breakage and compaction. Gradual changes in the shell caused the profilers problems in delineating the different layers. Ash lenses were usually very thin, but often extended for considerable distances. Ash and sand were

FIGURE 3. SITE MAP OF NEPTUNE

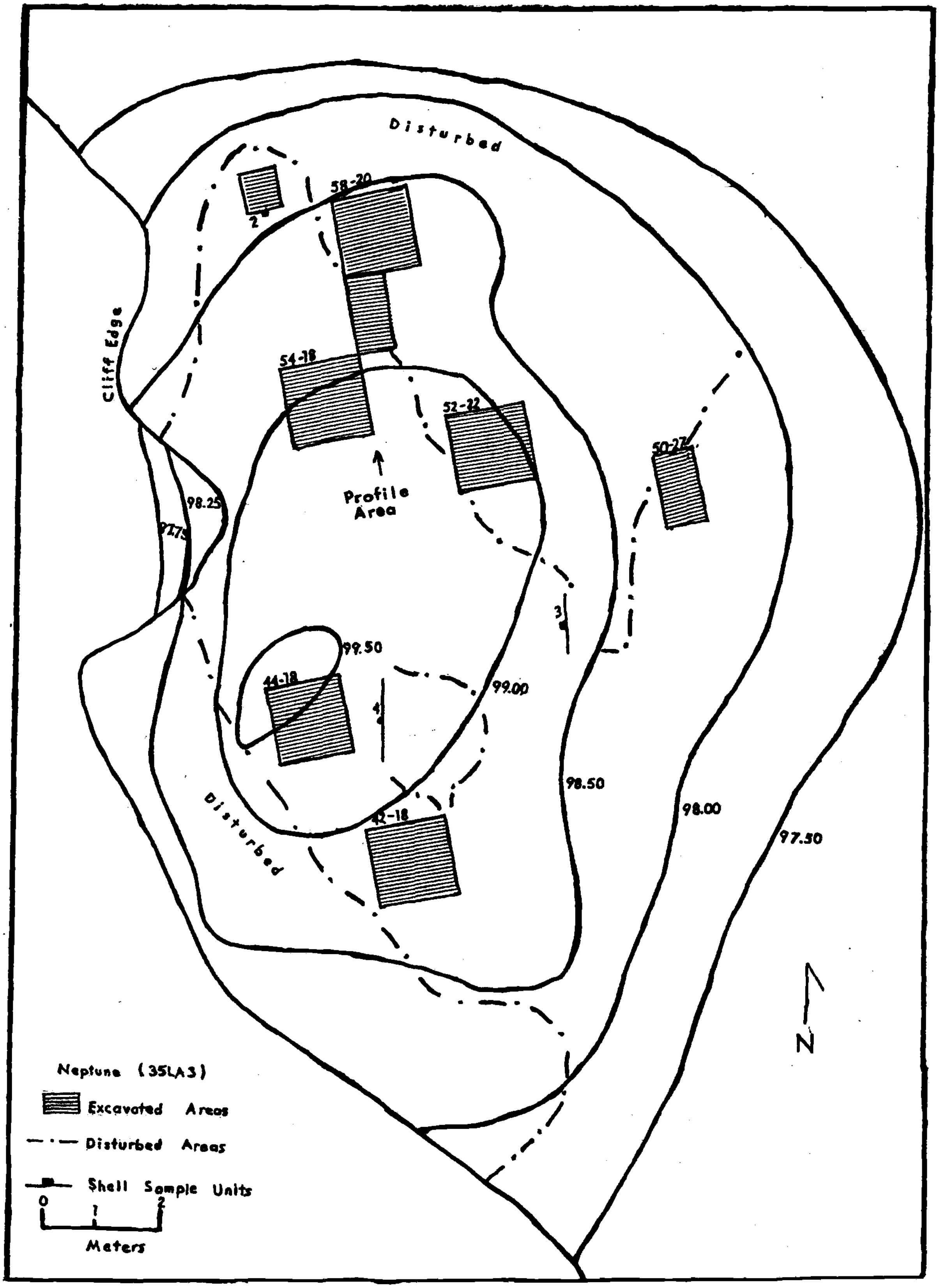
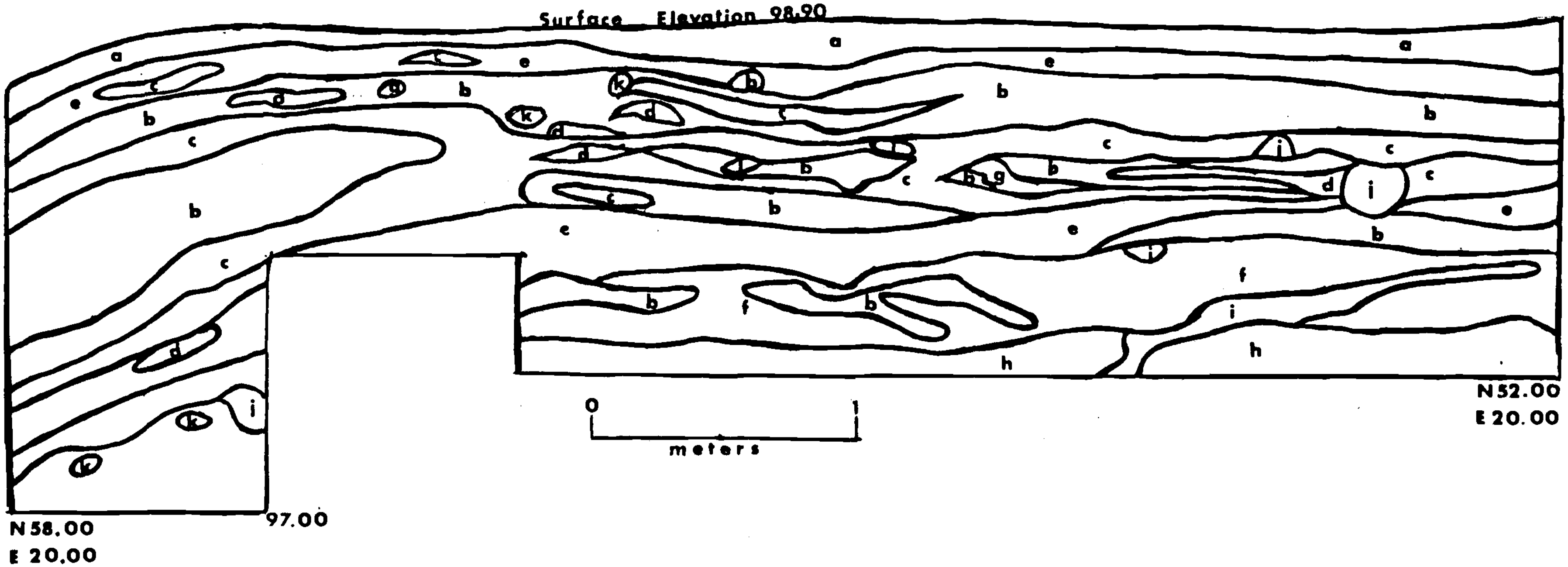


FIGURE 4. STRATIGRAPHY OF THE NEPTUNE SITE



a - sod

b - concentrated shell

c - sandy soil with medium amount of shell

d - ash & charcoal

e - sparse shell

f - dark brown soil

g - yellow clay

h - reddish sandstone

i - sterile soil, possibly disturbed

j - rodent disturbance

k - rock

l - bone

generally mixed. Clay lenses were small and found infrequently. Rodent burrows often confused and complicated the profiles. No identifiable living floors or breaks in occupation were noted during excavation. Several areas thought to be living floors were traced until it became apparent that they represented only depositional features. The profile presented here, the longest continuous profile from the site, is thought to be representative of much of the site. The original descriptions have been retained.

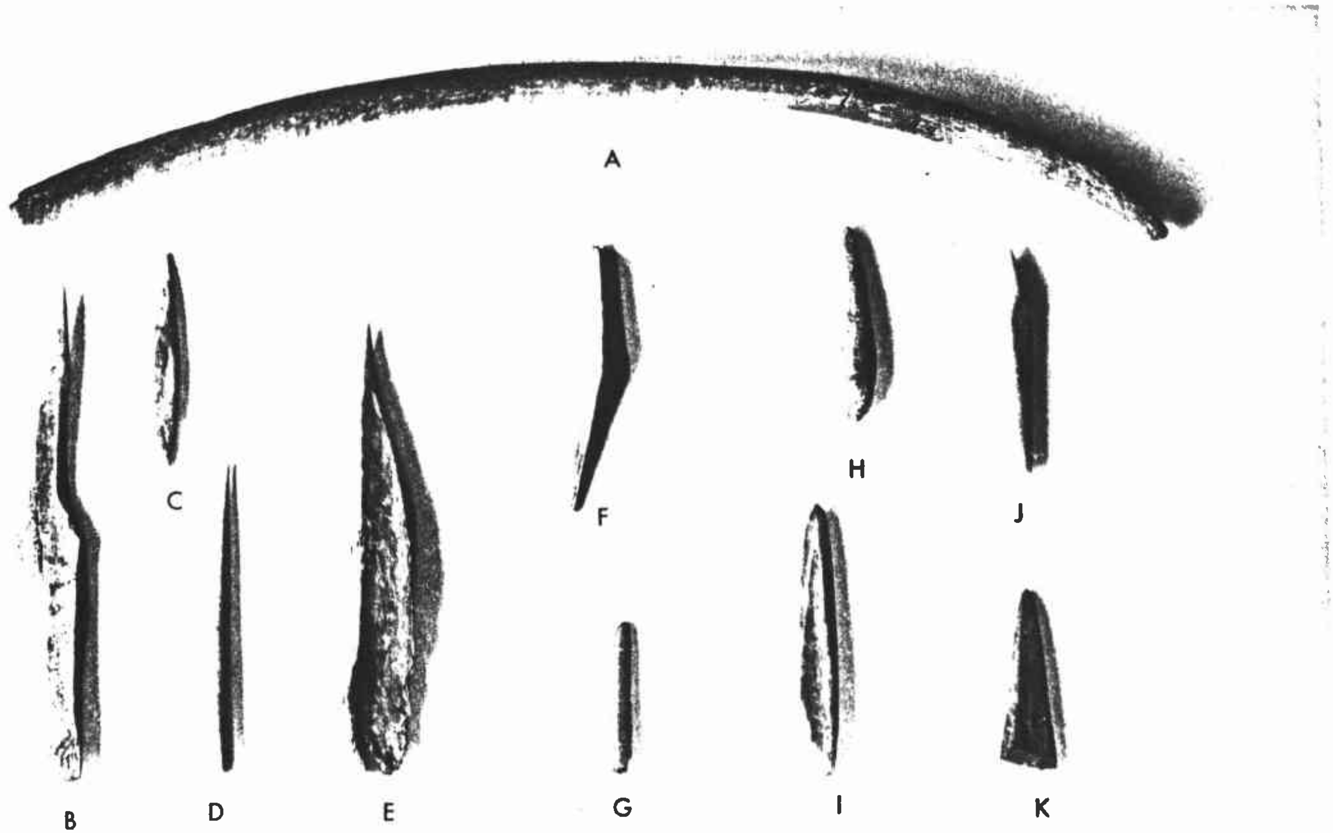
The artifacts recovered from the site can be classified by type of material and use (Appendix A). Antler, bone, and stone were the most commonly used materials for recovered artifacts. Although ethnographic records indicate that both wood and shell were used (Drucker 1943; Barnett 1937), wood was not preserved in the site, and no shell artifacts were found. Considering the quantity of shell excavated and the little modification required for most shell artifacts, it may be that shell tools went unnoticed.

The uses of the artifacts can be broken into three catagories: 1) artifacts directly involved in procurement activities; 2) artifacts utilized to modify the results of the procurement activity; and 3) artifacts that were used to manufacture procurement implements or facilities (Roll 1974).

Several varieties of bone and antler artifacts were recovered. Those that would have been directly involved in subsistence activities include three unbarbed points, one flat triangular point, and one composite harpoon valve (Figure 5). Several types of artifacts were found that would have been used either for modifying the results of the procurement activities, or manufacturing implements and facilities. Included in this catagory are two elk antler wedges, one deer antler wedge, several modified tines, three small bone awls, one bone flesher, and several unidentified bone artifacts (Figures 5, 6 and 7). Several fragments of elk antler show evidence of girdling and other modification.

The few stone artifacts recovered can be classified both by material and use, as were bone artifacts. Stone artifacts that would have been directly involved in subsistence activities include one small basal-notched projectile point and one fragment of a stemmed

FIGURE 5. BONE TOOLS



A Flesher
B-E Awls

F Harpoon valve
G Decorated bone

H-K Bone points

FIGURE 6. WEDGES AND WHALE BONE CYLINDER

A-C Antler wedges D Whale bone cylinder

FIGURE 7. MODIFIED ANTLER TINES

projectile point (Figure 8). Both of these were manufactured from cryptocrystalline material. Several scrapers, knives, and worked or utilized flakes were present, and were probably used to modify the results of the procurement activity (Figures 8 and 9). Most of the debitage was cryptocrystalline material. Obsidian was represented by only two flakes, one of which was utilized.

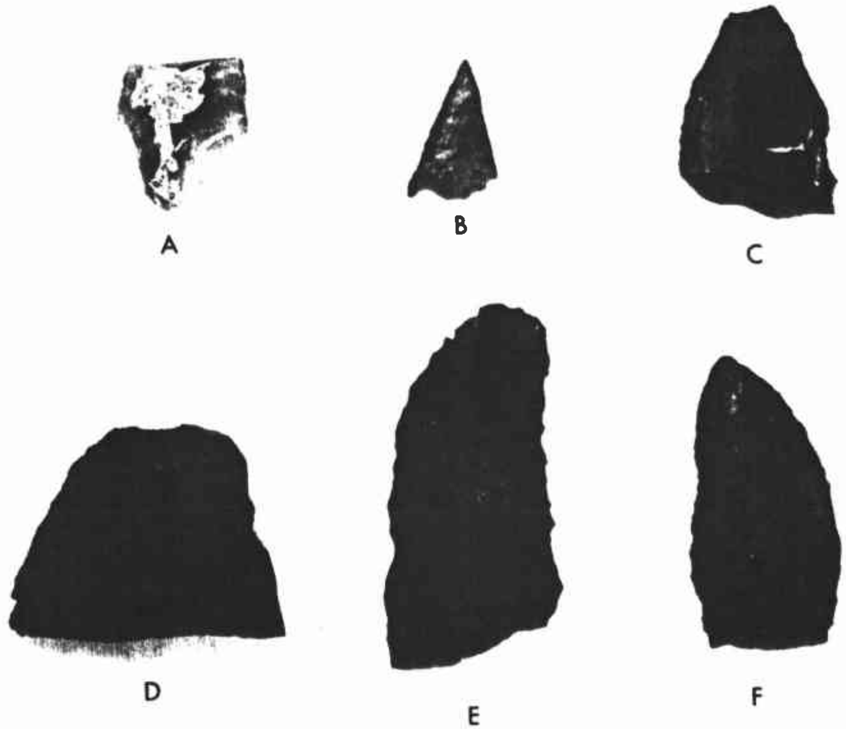
Some very recent historic artifacts, including .22 caliber and .25-20 caliber shell casings, were found in the sod layer within the first ten centimeters. However, what appears to be an iron wedge was found some seventy centimeters below the surface (Figure 10). From the stratigraphy it appears that the wedge was cached in a ten centimeter deep hole below the shell midden. No other historic artifacts were found in the intervening layers between the sod and the iron artifact.

The use of iron by the aboriginal inhabitants of the west coast has been noted as early as 1775 at Trinidad Head in northern California (Rickard 1939). Captain Cook (1784) observed that iron implements were common at both Nootka Sound and Prince William Sound in 1778. Since iron smelting technologies were unknown in aboriginal North America, several possibilities have been suggested to explain its early presence on the Northwest Coast. Drucker (1955, 1965) has suggested that it was obtained in trade from Siberian sources, while others (Laguna 1956; Laguna et. al. 1964; Rickard 1939) postulate that the source was the driftwood of wrecked vessels.

Although Russian hunters and traders were dealing in iron as early as 1649, when they founded the Siberian fortress Anadyrsk (Jochelson 1928), their iron was probably restricted to the Bering Sea area and the Aleutian Islands. This assumption is based on Jochelson's (1928) statement that iron was still rare in the Aleutian Islands as late as the mid 1800s.

The most likely source of the numerous, large pieces of iron noted by Cook would seem to be the driftwood of wrecked ships. Rickard's (1939) study of numerous historical records indicates that drift iron would have been relatively plentiful after 1639. In that year, the shogun Iyemitsu issued an edict commanding all Japanese

FIGURE 8. PROJECTILE POINTS AND BLADES



A-B Projectile points   C-F Blades

FIGURE 9. SCRAPERS

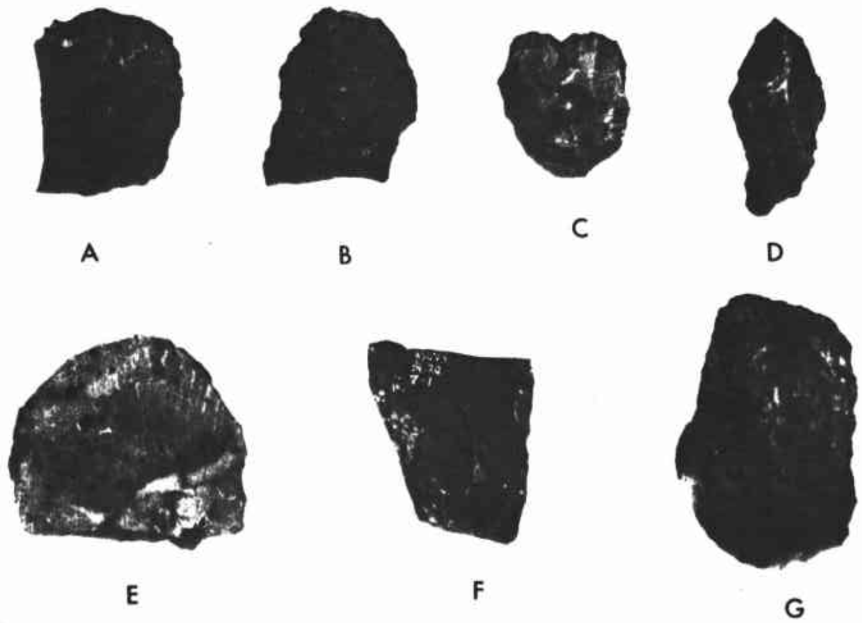
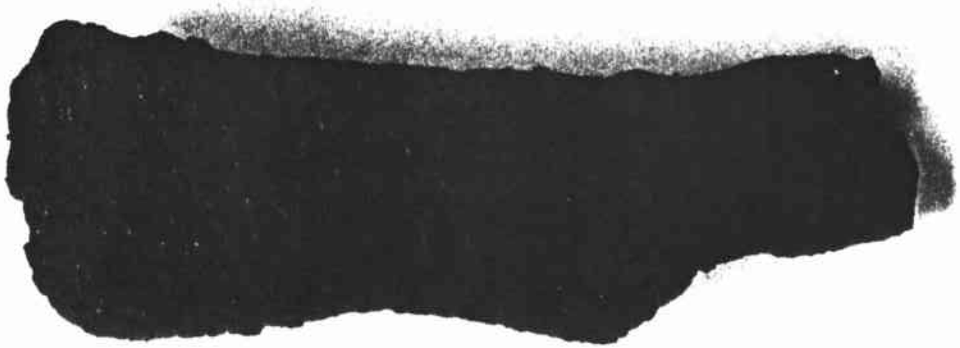


FIGURE 10. IRON WEDGE



A

ships to be built with open sterns and large, square rudders. The intention was to keep Japan isolated by making her ships unfit for voyages in the open ocean. But if the vessels were forced from the coast by bad weather, they were soon disabled and swept into the Japanese Current. In this manner, hundreds of vessels were lost, providing an ample supply of drift iron.

The radiocarbon date of A.D. 1630 (320 BP±45 DIC-1399) that was obtained from the site roughly coincides with the data on drift iron. The date was derived from a sample of bone material just below the heavy shell strata, at approximately 1.2-1.4 meters below the surface. The absence of historic artifacts, aside from the iron wedge, makes it reasonable to assume that the site was abandoned prior to European contact in the early 1800s.

A considerable amount of identifiable bone material was recovered from the site (Appendix B). Only a small portion was fragmented to the degree that it could not be identified to species. The comparative faunal collection at Oregon State University was used to identify the bone elements to species, age, and sex. If possible, the bone elements were further identified to right or left side. These categories were used to establish a minimum number of individuals per species. All of the mammals were identified in this manner. However, because of a lack of comparative avifaunal material, bird bone was not identified. Fish bone as identified by Terry Zontek (1980).

Sea mammal remains comprised the single largest group of bone material. The remains of a minimum number of two infant, one juvenile, one adult female, and one adult male Stellar sea lion were identified. Other sea mammals included a minimum number of one infant and one adult harbor seal (sex unknown), a fur seal (probably an adult), and a juvenile sea otter. A few whale vertebra were also recovered. Unfortunately, these could not be identified to species. However, in all probability, they were from a small adult whale. The remains of the male and infant Stellar sea lions indicate a spring or early summer occupation (Snyder 1978).

The large land mammals that were identified consisted of a minimum number of one adult and one juvenile elk, and two adult and one infant or juvenile black-tailed deer. The remains of the infant or juvenile deer verify the spring or summer occupation suggested by the infant Stellar sea lion remains. Small land mammals consisted of a minimum number of one adult rabbit, one adult raccoon, and one beaver--probably an adult. There was a minimal amount of small mammal bone that was not represented in the comparative collection and could not be identified. Much of this was rodent size and may have been intrusive in the site.

Fish bone was identified from three units of the site (Zontek 1980). A minimum number of 111 fish were present. Of these, rock fish were the most common. A minimum number of 73 kelp greenling, 11 cabazon, four redtail surf perch, three buffalo sculpin, two ling cod, two staghorn sculpin, one starry flounder, and one sand sole were identified to species. Families identified included a minimum number of three of the sculpin family, three of the rockfish family, two of the surf perch family and one of the flounder family. A minimum number of three coho salmon and two salmon family were also identified. Zontek's work on the fish remains from both Seal Rock and Neptune, when published, will provide a more detailed analysis of his findings.

The absence of house pits and living floors, coupled with the limited extent of the site, leads to the conclusion that Neptune was occupied only temporarily. The orientation of the economy towards marine resources is shown by the heavy reliance on shellfish, sea mammals, and fish, as opposed to land mammals. The presence of infant Stellar sea lion and deer indicate that the site was occupied in the spring or early summer. However, this does not exclude other seasons as well. The artifacts are of a limited quantity and were used in the procurement and processing of locally available resources. The presence of drift iron is somewhat enigmatic, although it tends to support the late prehistoric date derived from the radiocarbon sample. From the information thus far derived, it can be assumed that Neptune was a pre-contact temporary, seasonal campsite, occupied in the spring or summer approximately 350 years ago.

Chapter VIII

Common Contemporary Shell Fish of the Neptune Area

The intertideal rocky areas in the vicinity of Neptune today teem with life. The Mytilus-Pollicipes-Pisaster (sea mussel-goose barnacle-starfish) community is common to this rugged stretch of coast. They have been described as "horizon markers" because they "are almost certain to be associated wherever there is a stretch of rocky cliff exposed to the open Pacific" (Ricketts and Calvin 1968: 188). Once these surf-loving animals are established, they not only alter the physical environment and the substrate upon which they settle, but they also alter the surrounding water by extracting tremendous amounts of plankton. By changing the surrounding environment, they offer protection from the pounding surf for other marine creatures that otherwise could not inhabit the area (Ricketts and Calvin 1968). With the establishment of this type of community, a variety of limpets, sea urchins, sea anemones, chitons, and snails can then inhabit the area.

At first glance it appears that the intertidal zone in front of and to the north of Neptune is inhabited by sea mussel, goose barnacle, and a few starfish, with few exceptions. Although sea mussel and goose barnacle are the dominant species, careful observation can add at least a dozen more reasonably important edible species. Several different types of barnacles can be found, ranging from the smallest barnacle--acorn barnacle, to the largest--giant barnacle. A variety of limpets (shield, whitecap, and plate limpets) and snails (rock dwelling Thais, channeled purple) can be found scattered among the dominant species. The green sea anemone can be observed clinging to the rocks. The keen observer can spot hairy and black katy chiton, although they blend into their surroundings remarkably well. Notably absent from these rocky shores are sea urchins, purple hinged pecten, gumboot chiton, and black turban snail, all common to rocky shores elsewhere on the Oregon coast. Table 4 lists common invertebrates identified at Neptune during a summer observation period.

TABLE 4. COMMON INTERTIDAL INVERTEBRATES OF THE NEPTUNE AREA

	Barnacles	Bivalves	Others
Zone I			
Zone II	goose barnacle acorn barnacle		shield limpet
Zone III	goose barnacle acorn barnacle	sea mussel	plate limpet hairy chiton channeled purple
Zone IV	acorn barnacle horse barnacle	razor clam	plate limpet whitecap limpet hairy chiton black katy chiton wrinkled purple rock dwelling Thais purple starfish green anemone
Zone V	giant barnacle		green anemone

The surf-swept sandy beaches found between the rocky areas in front of and to the south of the site apparently provide a habitat for razor clam. When a razor clam is disturbed, it withdraws its siphon, leaving a characteristic slit-like opening indicating its presence. Although these slit-like openings were not seen on the beach during the period of observation, razor clam shell fragments were noted, suggesting that they are present but not abundant.

Assuming the environment has changed very little since occupation of the Neptune site, many of these species could have been gathered with relative ease. Sea mussel and goose barnacle would be two of the easiest species to gather because they inhabit Zone III. These two species would also provide a good quantity of meat. Horse barnacle and black katy chiton, inhabiting Zone IV, would require a lower tide for access to gather them. Razor clam, occupying Zone IV, would require more effort to gather because it is buried and is an active digger. The snails, limpets, and hairy chiton are relatively small and probably would not have been a major focus of procurement. Giant barnacle is usually found only during the lowest spring tides, which occur only a few hours each month. This species was probably gathered during the late spring to late summer when the low tides coincide with daylight hours.

Chapter IX

Neptune Shell Samples

In reviewing the faunal material from the Neptune site it was decided that a study of the shell might provide data on the seasons of occupation. Although a shell sample (Sample 1) was taken in 1973 during the excavation of the site, part of it was destroyed in a flotation study. Because the remaining sample was inadequate, permission to do further sampling was requested from the Oregon State Parks Department. The request was granted, due in large part to Ted Long, then archaeologist for the State Historic Preservation Office.

Upon arriving at the site on April 23, 1977, it became obvious that vandals had been at work. They had burrowed into the cliff face, causing the topsoil to cave in and furthering natural erosion. Several large man-made holes were also found in the deeper portion of the midden. The original plan had been to place two units in the deeper portion of the midden and one in the cliff face. However, the combination of potholes and previously excavated units left little of the site intact. No sampling could be done on the cliff face without furthering erosion.

It was finally decided that using the edges of the potholes would permit column samples to be taken with the least amount of damage to what little remained of the site. The edges of two potholes were squared off and cleaned out so that samples could be taken from their vertical faces. Very little fill material had to be excavated from these units to extend their depths to the lower limits of the shell deposit. In addition, a 50 X 50 centimeter test unit was excavated on the northern perimeter of the site for placement of the third sample. A transit was used to tie the samples into the grid system used during the 1973 excavation. Coordinates for the columns are: Sample 2 - N57.80/58.00, E17.65/17.85; Sample 3 - N44.80/45.00, E18.70/18.90; Sample 4 - N46.25/46.45, E24.00/24.20. For simplicity, the column samples will be referred to by numbers. The shell was taken from the columns in five-centimeter levels. After the sampling was complete, profiles were drawn (Figure 11).

Two columns were selected for study, Sample 4 from the central portion of the midden and Sample 2 from the shallower northern edge of the midden. Sample 3 was saved for study at a later date.

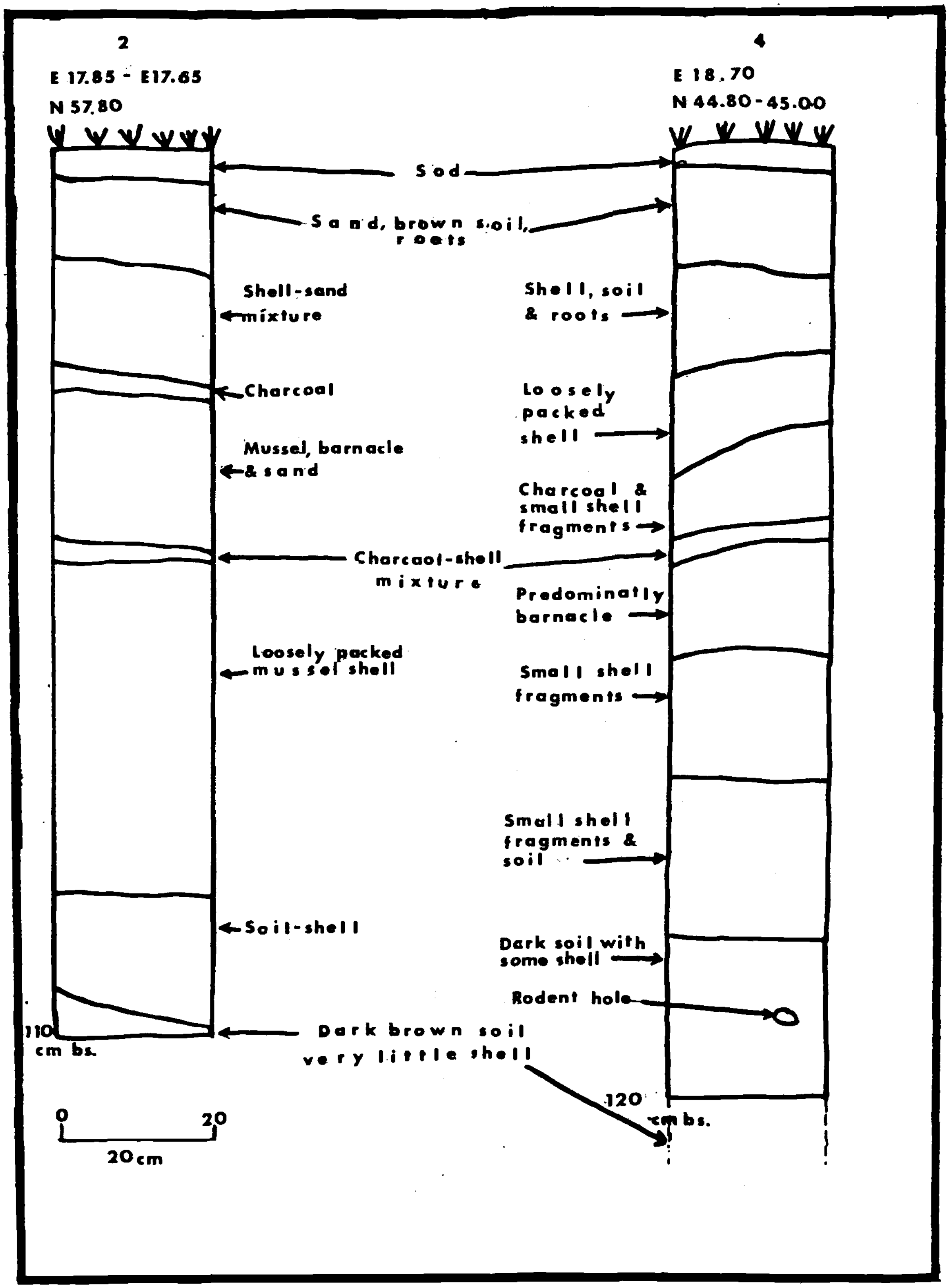
The samples were dried at room temperature, and after several weeks each five-centimeter level was weighed with electronic scales. Numerous levels were chosen at random and heated to 350° F. for three hours. They were then re-weighed to determine moisture loss. Less than one percent of the sample weight was lost through baking. Since this loss might be accounted for by minute particles clinging to the baking container, or from dust being lost during the re-weighing process, the effect was deemed insignificant and the baking process was discontinued.

After drying, each level was screened through 6.35 millimeter mesh. This size of mesh was chosen to facilitate identification of the shellfish species and other faunal remains. Smaller screen sizes were tried, but, as in other studies, the time spent in the lab sorting the shell increased exponentially with the decrease in screen size (Koloseike 1968). The particles that were small enough to fall through the sieve were retained but not analyzed.

The next step was to establish categories for sorting the material. The various shellfish species were the most important of these categories. Smith and Carlton (1954) and Keen and Coan (1974) were the two main keys that were used for the identification of the shell material. Other keys were used but these two were found to be the most valuable. A small comparative collection was established to facilitate the identification process.

The various bivalves, univalves, and crustaceans were set up as categories after it was established that they were present in the samples. Other categories included bone, organic material, rock, and residue. Fish and mammal bone were weighed separately. No bird bone was found. Organic material included charcoal and roots. Fire-cracked rock and beach pebbles were weighed together

FIGURE 11. SHELL SAMPLE PROFILES



in the rock category. Residue was made up of all the material that passed through the screen. Cultural material, i. e. flakes, was weighed separately when found.

From the beginning, it was obvious that sea mussel would be the largest category represented in the samples. It is distinctive in color, texture, and hinge structure from other bivalves. The only shellfish it might be mistaken for is bay mussel. However, bay mussel has a much thinner shell, a wider hinge angle, and a smoother surface texture.

Most of the barnacle fragments were small, eroded, and did not have enough distinctive characteristics to allow them to be separate-ed. A few horse barnacles were identified by the presence of their scutum and tergum, calcareous plates found in pairs on both sides of the barnacle's center opening. These plates are distinctive and enable the species to be identified. A limited number of acorn and giant barnacles were also identified. This was accomplished by distinguishing between their porous calcareous bases, a feature lacking in horse barnacle. Acorn and giant barnacle are different-iated by the size of their bases. Although some of the larger fragments could be distinguished, it was felt that too many could not be identified properly, so the categories were combined.

Goose barnacle is an exception, so it was sorted in a category separate from the other barnacles. The goose barnacle's capitulum, or head, is enclosed by three relatively large plates. Below these there may be 100 or more smaller plates, depending on the age. Because these plates are very distinctive and easily identified, it was felt that the majority of goose barnacle remains were properly categorized.

Razor clam shell fragments were easy to discern. The fragments were usually a dull whitish color with no periostrocum. They were usually represented by thin strips broken along the growth rings, or by hinge fragments. The razor clam shell is also flatter and thinner than other shells found in the vicinity.

On the opposite end of the scale, gaper clam has a very thick white shell with a prominent hinge and concentric growth rings. Like razor clam, the periostracum is usually absent. The thickness of the shell and the prominent hinge make it easy to distinguish.

Two species of chiton were represented in the samples--black katy chiton and hairy chiton. A chiton has eight articulated plates instead of the single shell of a snail or the double shell of the bivalve. The plates of the black katy chiton are wing-shaped and have a black or discolored patch on the center of the white plate. The plates of the hairy chiton are smaller, thinner, and are greenish in color. The identification of these two chitons was made easier by the fact that most of their plates were whole.

The shells of most of the snails were also whole. Channeled purple and rock dwelling Thais were commonly found. Land snails were also present. The identification of the snails was relatively easy because of the lack of fragmentation.

Whitecap, shield, and owl's eye limpets were represented in the samples. Because they retained some of their color and were generally found in good condition, they were relatively easy to identify.

A few crab claws were found and were tentatively identified using the claws from the comparative collection. No fragments of carapice were found. Most of the claws present in the samples were small and fragile.

All bone material was separated out of the samples and weighed. The bone material was placed in categories according to whether it was fish or mammal. Mammal bone was identified to species using the comparative collection housed at Oregon State University. The fish bone was not identified.

The only cultural materials recovered from the samples were lithic flakes. These were weighed and placed in a separate category.

A category was developed for unidentifiable shell fragments. Some fragments could not be identified even by using the comparative collection. The manuals describe the ideal specimen. However, shell midden specimens are usually fragmented, discolored, and eroded.

A magnifying glass aided in distinguishing some of the fragments, but others were too badly eroded to identify.

Approximately 250 hours were spent identifying and weighing the shell samples. This process was speeded up when the comparative collection was established and the investigator became more practiced.

The results of the shell anaylsis should not be surprising to anyone who has visited the outer Oregon coast. On this stretch of coast sea mussel is the predominant species of shellfish. As it turned out, sea mussel was also the predominant species in the column samples, representing by weight 46.56 percent of Sample 2 (Table 5) and 53.23 percent of Sample 4 (Table 6). Of the total shellfish weight, sea mussel represented 89.67 percent of Sample 2 and 87.82 percent of Sample 4. Sea mussel then represents the main shellfish food resource at Neptune. Sea mussel inhabits Zone III and could be collected throughout the year at low tides. The byssal threads of sea mussel intertwine, so that collecting them in clumps is relatively easy. When collecting sea mussel this way, smaller species may be collected accidently. Some of these, such as the larger barnacle species, may also be big enough to eat.

Barnacle, the second most prevalent species, represented 4.97 percent of Sample 2 and 7.08 percent of Sample 4. It represented 9.57 percent of the total shell weight in Sample 2, and 11.68 percent of the total shell in Sample 4. These figures include goose barnacle, which, for comparative purposes, is separate in the tables.

Horse barnacle seemed to be the most common barnacle present in the samples. This barnacle prefers to inhabit Zone IV, but is commonly found in association with sea mussel. It doesn't have a base, and would therefore be difficult to collect off the rocks without damaging the meat. If it was collected with sea mussel, as a hitchhiker, however, it could have been procured without damaging the meat.

Giant barnacle was estimated to occur next in frequency to horse barnacle. In some of the sample levels, and in the site ex-

TABLE 5. SAMPLE 2 SHELL WEIGHTS IN GRAMS

Category	Level	1	2	3	4	5	6	7	8	9	10
sea mussel		73.1	133.4	539.4	797.5	1068.8	764.3	634.5	948.2	802.7	1408.6
barnacle		1.8	5.9	63.3	78.3	157.3	83.2	117.7	91.9	151.4	82.1
goose barnacle		.8	.7	7.1	4.8	8.0	14.6	5.0	.7	13.6	14.6
razor clam				.5	1.7	.2		9.6	2.2		.9
channeled purple			.5	1.5			1.8	.8	2.0	2.8	.5
rock dwelling Thais				.4	.7	2.0	1.0	1.0	1.0	.4	.3
limpets					.6	.5	.5	.9	.8		.4
black katy chiton				2.3	1.2					.1	
littleneck clam						.2					.1
bent-nose clam										.1	.1
Dungeness crab									.3		
fish bone			.5	.4		.5	.6	.8	1.0	.2	.3
mammal bone					.5		.3				
cultural detritus						3.2					
rock		5.0	27.3	4.7	8.8	10.1	20.0	18.9	3.7	5.5	130.0
organic material		1.0	.6	.4		2.7	2.6	2.5	3.3	.6	3.0
sand dollar						.3	.5				
land snail											
residue		1282.1	945.7	1208.3	678.3	748.5	535.0	494.5	528.0	513.0	697.6
total		1363.8	1114.6	1828.3	1572.4	2002.3	1424.4	1286.2	1583.1	1490.4	2338.5

TABLE 5. SAMPLE 2 SHELL WEIGHTS IN GRAMS (cont'd)

Category	Level	11	12	13	14	15	16	17	18	TOTAL
sea mussel		948.8	856.4	844.2	786.3	993.9	1581.3	364.8	254.8	13801.0
barnacle		84.0	69.0	22.3	29.0	32.0	168.7	71.0	54.8	1363.7
goose barnacle			3.8	10.5	12.8	5.0	5.5	1.4	.8	109.7
razor clam		.5					1.0	.8	55.0	72.4
channeled purple				.1						10.0
rock dwelling Thais		.3	.3	.7	.6		1.5			10.2
limpets		.6	.2		.1		.2			4.8
black katy chiton				1.7	4.4		6.1	2.3		18.1
littleneck clam										.3
bent-nose clam										.2
Dungeness crab				.2						.5
fish bone		2.0	.6	.1		.1		.2	.8	8.1
mammal bone		43.7								44.5
cultural detritus										3.2
rock		6.0	2.6				11.0	16.7	886.0	1156.3
organic material		7.8	.8	.1	.6		2.0	4.0		32.0
sand dollar										.8
land snail							1.0			1.0
residue		729.4	557.3	419.4	360.5	429.5	1241.0	695.0	943.0	13006.1
total		1823.1	1491.0	1299.3	1194.3	1460.5	3019.3	1156.2	2195.2	29642.9

Percent of Total Weight

sea mussel	46.56
barnacle	4.97
residue	43.88
shellfish	51.92

Percent of Shellfish Weight

sea mussel	89.67
barnacle	9.57

TABLE 6. SAMPLE 4 SHELL WEIGHTS IN GRAMS

Category	Level 1	2	3	4	5	6	7	8	9	10	11	12
sea mussel	140.0	905.8	1194.5	1557.4	1326.0	1299.2	923.9	1373.3	1569.3	1158.7	1408.3	1252.0
barnacle	13.5	96.0	164.6	154.3	85.4	90.8	174.2	85.5	60.0	39.3	60.7	186.5
goose barnacle	.8	5.9	1.6	3.2	23.4	14.2	43.5	30.1	7.9	9.4	28.8	4.6
razor clam		.6	4.0							1.9	.3	
channeled purple			1.5	1.5			1.5	.6		1.6		.2
rock dwelling Thais			1.6	1.4		1.9	.6	1.2		.9	.2	
limpets			1.4	.4	.2	.6	.8	.5	1.2	1.3	.4	.6
black katy chiton												
hairy chiton									.6			
gaper clam												
littleneck clam			.8									
Dungeness crab				.1		.4			3.7	2.1		
fish bone	.5	.4	.7	6.0	1.7	.3	.5	2.6	1.1	.6		.3
mammal bone												
cultural detritus	.2											
rock	6.7		33.6		6.9	3.0	3.0		60.5	8.0	1.0	3.9
organic material	2.3	.8	9.9		1.0	3.0	4.5	4.5	1.8	3.2	.4	5.6
sand dollar						1.6	.4					
land snail												
unidentified shell						.4			.5			
residue	1800.3	1252.6	850.8	810.4	561.0	593.9	475.4	482.8	639.8	557.3	617.5	534.2
total	1964.3	2262.1	2265.0	2534.7	2005.6	2009.3	1628.3	1981.1	2346.4	1784.3	2117.6	1987.9

TABLE 6. SAMPLE 4 SHELL WEIGHTS IN GRAMS (cont'd)

Category Level	13	14	15	16	17	18	19	20	21	22	23	TOTAL
sea mussel	946.1	1569.8	1303.9	852.1	893.0	1408.0	906.4	1016.5	792.8	645.6	530.8	24973.4
barnacle	415.5	258.3	193.4	300.9	208.3	189.9	128.2	38.0	66.0	29.4	28.4	3067.1
goose barnacle	3.7	8.2	5.8	2.4	14.4	15.5	16.2		2.7	7.4	3.1	252.8
razor clam	.2	.7	1.4		4.7	.5						14.3
channeled purple	1.0		2.2	3.6		2.3	2.8	2.0	.4	.9	.3	22.4
rock dwelling Thais		1.0		.2	.5	1.6	1.0	3.7				15.8
limpets	.4	.7	.6	.3	.4	1.6	.4		.2	.2		12.2
black katy chiton	25.9	20.0	6.1			.2	1.7					53.9
hairy chiton												.6
gaper clam			6.5					1.5			.8	8.8
littleneck clam												.8
Dungeness crab			.2	.3								6.8
fish bone	1.3	4.4	2.5	3.3	.2	1.2	.9	5.0	1.8	.5	.2	36.0
mammal bone		.2				3.1		.4	.2	52.4		56.3
cultural detritus											.4	.6
rock	17.0	2.0	10.3		1.5	2.7	18.2	376.4	44.1	10.7	69.3	678.8
organic material	3.5	6.8	4.0	2.2	1.3	6.5	2.2	2.2	1.1	.7	.4	67.9
sand dollar		.6						1.7				4.3
land snail			.1									.1
unidentified shall							.5	.4	.9			2.7
residue	461.7	894.4	724.5	577.7	655.6	963.9	940.2	1034.3	759.4	572.6	877.8	17638.1
total	1876.3	2767.1	2261.5	1743.0	1779.9	2597.0	2018.7	2482.1	1669.6	1320.4	1511.5	46913.7

Percent of Total Weight

sea mussel	53.23
barnacle	7.08
residue	37.60
shellfish	60.61

Percent of Shellfish Weight

sea mussel	87.82
barnacle	11.68

cavation, large, unbroken or nearly whole, giant barnacle shells were found with the base intact. Some of the specimens found during excavation were still attached to rock that had been broken off the basalt outcroppings adjacent to the site. This implies that at least some of the specimens were collected from the rock outcroppings and not from the beach where they might have been washed up attached to seaweed. Lenses of giant barnacle are described in the field notes from the excavation. Giant barnacle occurs only in Zone V, accessible only during the lowest tides. Collecting any sizeable quantity of the barnacle would require a reasonable amount of time to pry them off the rocks. The high low tides of winter would not expose Zone V for any great length of time. Hence, giant barnacle was probably collected during the late spring or summer months.

The smallest barnacle present in the column samples was acorn barnacle. This tiny crustacean represented only a very small part of the sample weight.

Goose barnacle does not occur in the samples in any great quantity. The ethnographic literature notes that fires were sometimes built on the rocks over barnacles to roast them <u>in situ</u> (Harrington 1943). If this were the case, then they may have also been cleaned on the rocks, or at the shore, resulting in only the meat being transported back to the site. If this method of preparation was used often, it could result in an under estimation of the importance of not only goose barnacle, but also horse barnacle.

A variety of clams are found on the Oregon coast. However, most of them inhabit the calm waters of bays and inlets and are not found in the vicinity of the Neptune site. Because clams are not commonly found in the area of Neptune, their low frequencies in the samples are to be expected.

Razor clam occurred only sparsely in the samples. It might have been identified in somewhat higher quantities if a finer screen had been used, since the shell is fragile and breaks easily. During the excavation of the site, razor clam was noted in lenses, as if it had been gathered for an occasional meal, but not used on a regular basis. As noted in the previous chapter, razor clam occurs adjacent to the site, but is not abundant.

Littleneck clam was represented in the samples by one small valve and a few fragments. This clam is generally found in bays and estuaries, but can also inhabit the outer coast near rocky points if a cobble substratum underlain by sand is present. Bay and estuary environments are located to the north of Neptune at the Yachats River and Alsea Bay areas. The rocky point type of environment might have been present in the Neptune area in the past, but is apparently lacking today. Littleneck clam was evidently not utilized to any great extent by the inhabitants of the Neptune site.

Several small fragments of bent-nose clam were found in the samples. This clam inhabits the mud or sand of protected waters and might be present in the Yachats River area, but would more likely occur in Alsea Bay. Like littleneck clam, it was little used at Neptune.

Very little gaper clam was found in the samples, although two valves were found during excavation of the site. This clam prefers the calm waters of bays and estuaries, or very sheltered waters on the outer coast. These types of environments are not found in the vicinity of the surf-swept shores of Neptune today. As in the case of both littleneck and bent-nose clam, the closest area that provides a suitable environment is approximately four kilometers north, at the Yachats River. A more likely area would be Alsea Bay, fourteen kilometers to the north.

Two species of chiton common to the Oregon coast were represented in the column samples--hairy chiton and black katy chiton. Both hairy and black katy chiton occur in reasonably equal quantities on the rocks adjacent to Neptune. However, black katy chiton was found to be more prevalent in the samples than hairy chiton, though neither occurred in large quantities.

A variety of snails and limpets were found in the samples, with rock dwelling Thais and channeled purple snails being the most common. Although these snails can obtain a greater length, those in the sample were no longer than three centimeters. Limpets in the sample include plate, whitecap, and owl's eye. The largest limpet was two centimeters in diameter. Because these univalves are small and did not occur in any great quantity, they probably hitchhiked to the site clinging to barnacles and sea mussels.

Land snails were also represented in the samples, although only marginally. They were whole when found, and as Berreman (1944) postulated, probably occurred naturally due to the fragile nature of the shell. It is unlikely that they would survive intact if they were processed as a food source.

The charred tips of crab claws were present in the samples. Although not many were found in the samples, they were routinely found during excavation. The carapace was also found occasionally during excavation. The claws from the samples have been tentatively identified as Dungeness crab (Cancer magister). They were compared with those in the comparative collection and found to be reasonably similar.

The extremely small number of sand dollar fragments found in the samples were wave-washed, but identifiable to species. Sand dollar was noted in the field notes from the excavation but was not common. The fragments may have been transported to the site attached to other organisms, intertwined with the byssal threads of sea mussel, or caught up in sea weed.

Many of the rocks in the samples were water-worn pebbles. Fire-cracked rock, not differentiated from pebbles in the tables, occurred only in a few of the heavier sample levels. The water-worn pebbles were probably also transported to the site intertwined in the byssal threads of sea mussel.

Fish bone was found quite regularly in the samples. Although it was not analyzed, there is no reason to expect the species present to differ in any great respect from the largely rockfish species recovered during the test excavations. The intertidal zone at Neptune today does not offer enough protection for rockfish to be abundant. Zontek (1980) points out that fish were probably not the primary reason for the occupation at Neptune.

Very little mammal bone was found in the samples. The identifiable bone included an adult elk vertebra in level 2 of Sample 2, and an adult raccoon skull fragment in level 18 of Sample 4. The identifiable bone fragments were included in the minimum number calculations for the site (Appendix 3).

Cultural debris in the shell samples consisted of only three flakes.

Organic material was found to some extent throughout the samples. In the upper levels it consisted primarily of roots, while in the deeper levels it consisted primarily of charcoal.

The analysis of the Neptune shell samples, by itself, did not contribute very much to the reconstruction of the aboriginal way of life. Perhaps the greatest benefits from the analysis were the quantification of the major species present, sea mussel and barnacle, and the positive identification of the minor species.

The fact that several species associated with spring and summer procurement were identified, sheds a glimmer of light on the season of occupation and tends to support the conclusion drawn from other faunal remains. One of these species, razor clam, was identified in the excavation notes. The other, giant barnacle, was described, but not identified, in the field notes. Therefore, positive identification in the column samples substantiates the information from the field notes. However, because only two column samples were analyzed, an accurate estimate of their abundance is not possible. The field notes indicate that the two species occurred in large lenses, but these lenses were not encountered in columns.

The identification of several species of clam not found in the immediate vicinity of Neptune gives an indication that shellfish were at least occasionally transported to the site from a considerable distance. The only evidence we have for these species, bentnose, littleneck, and gaper clams, comes from the column samples. They were not reported in the field notes. Like giant barnacles and razor clam, however, an accurate estimate of their abundance is impossible due to the limited extent of the column sampling procedure.

The limited sampling also resulted in rarer species not being represented. Olivella, for example, was reported during the excavation but was not encountered in the columns. Like the protected water clam species, Olivella was probably transported from some distance away.

In addition to the identification and quantification of shellfish species, the analysis also resulted in the realization that perhaps additional methods should be adopted for dealing with the excavation of shell middens. These methods will be discussed in the concluding chapter.

Chapter X

Conclusion

The identification of shellfish species in the Neptune column samples allows comparisons to be made between Neptune and other coastal sites. The shellfish content at five sites was found to be comparable to that at Neptune. The Indian Bay, Pistol River, Lone Ranch Creek, Point Saint George, and Patrick's Point sites are all located on or very near the outer coast. The vicinities of these sites are characterized by rocky intertidal zones and stretches of sand beach, much like Neptune. Sea mussel is common in all the sites. Purple hinged pecten, black turban snail, purple sea urchin, gumboot chiton, giant barnacle, rock dwelling Thais, gaper clam, whitecap limpet, Olivella, little-neck clam, black katy chiton, and Saxidomus sp. were noted in three or more of the sites (Tables 7, 8 and 9). However, the first four were not found at Neptune. These four species are not present in the intertidal zones of Neptune today, and their absence in the archaeological record at Neptune indicates that they did not inhabit the area in the recent past.

A general survey of the physiography near the six sites indicates that calm-water species may have been transported over a considerable distance to four of them, Indian Bay and Pistol River being the exceptions. The presumed distance of transport varies between eight and fourteen kilometers. The species involved are cockle, Olivella, Tresus sp., Saxidomus sp., and Macoma sp. Most of these species have either utilitarian or decorative uses, in addition to being food resources, which may account for their presence.

Although Neptune compares favorable with the five sites in terms of shellfish content and transportation, it varies considerably in terms of the seasonal activities involved. The five sites compared with Neptune were all relatively large villages, or at least the scene of year-round activity. This indicates that models

TABLE 7. SNAILS IN ARCHAEOLOGICAL SITES

Latin name	Common name	Minard	Martin	Par-tee	Netarts	Neptune	Bob Creek	Tahkenitch	Umpqua-Eden	Indian Bay	Bullards Beach	Pistol River	Lone Ranch Creek	Point Saint George	Patrick's Point	Tsurai	Gunther Island
<u>Amphissa</u> <u>columbiana</u>	wrinkled Amphissa												X				
<u>Amphissa</u> <u>versicolor</u>	dove shell											X					
<u>Antiplanes</u> <u>perversa</u>	unknown												X				
<u>Calliostoma</u> <u>ligatum</u>	blue top shell													X			
<u>Haliotis</u> <u>rufescens</u>	red abalone												X		X	X	X
<u>Nassar</u> sp.	welks	X												X			
<u>Nassarius</u> <u>fossatus</u>	western Nassa											X					
<u>Nassarius</u> <u>perpinguis</u>	western fat Nassa											X					
<u>Ocenebra</u> <u>lurida</u>	lurid rock shell											X					
<u>Olivella</u> <u>biplicata</u>	purple Olivella			X		X				X			X	X	X	X	X
<u>Polinices</u> <u>lewisii</u>	moon snail								X							X	X
<u>Tegula</u> <u>funebralis</u>	black turban snail											X	X	X			
<u>Thais</u> sp.	purples	X	X														
<u>Thais</u> <u>canaliculata</u>	channeled purple					X				X			X				
<u>Thais</u> <u>emarginata</u>	rock dwelling Thais					X				X		X	X				
<u>Thais</u> <u>lamellosa</u>	wrinkled purple											X	X				

TABLE 8. BIVALVES IN ARCHAEOLOGICAL SITES

Latin name	Common name	Minard	Martin	Par-tee	Netarts	Neptune	Bob Creek	Tahkenitch	Umpqua-Eden	Indian Bay	Bullards Beach	Pistol River	Lone Ranch Creek	Point Saint George	Patrick's Point	Tsurai	Gunther Island
Clinocardium nuttalli	cockle	X	X		X			X	X	X	X	X				X	
Donax gouldi	bean clam														X		
Donax californica	wedge clam														X		
Hinnites multirugosus	purple hinged pecten										X	X	X	X	X	X	X
Kellia laperousii	kelly shell												X				
Macoma nasuta	bent-nose clam	X	X		X	X			X	X							X
Macoma secta	sand clam									X					X		
Mytilus californianus	sea mussel		X			X	X	X	X	X		X	X	X	X		
Mytilus edulis	bay mussel	X		X				X	X	X		X					X
Mya arenaria	soft-shelled clam								X								
Ostrea lurida	native oyster		X							X					X		
Penitella penita	piddock						X										
Pododesmus cepio	jingle shell										X						
Protothaca staminea	littleneck clam	X	X			X		X		X		X	X	X			X
Protothaca tenerrima	thin-shelled littleneck											X					
Saxidomus giganteus	butter clam	X	X		X				X	X				X	X		
Saxidomus nuttallii	Washington clam		X											X	X	X	X
Siliqua patula	razor clam	X	X	X		X		X	X					X		X	
Tresus capax	horse clam		X											X			
Tresus nuttallii	gaper clam	X			X	X		X		X	X	X	X				X
Volsella rectus	horse mussel								X								
Zirfaea pilsbryi	rough piddock																X

TABLE 9. OTHER SHELLFISH IN ARCHAEOLOGICAL SITES

Latin name	Common name	Minard	Martin	Par-tee	Netarts	Neptune	Bob Creek	Tahkenitch	Umpqua-Eden	Indian Bay	Bullards Beach	Pistol River	Lone Ranch Creek	Point Saint George	Patrick's Point	Tsurai	Gunther Island
Balanus cariosus	horse barnacle					X			X								
Balanus glandulus	acorn barnacle					X	X		X								
Balanus nubilus	giant barnacle					X	X		X	X				X			
Mitella polymerus	goose barnacle					X				X							
Cryptochiton stelleri	gumboot chiton									X		X	X	X			
Katherina tunicata	black katy chiton					X	X			X		X	X				
Molopalia muscova	hairy chiton					X											
Dentalium pretiosum	dentalium												X				X
Dendraster excentricus	sand dollar					X			X					X			
Stronglycentrotus franciscanus	red sea urchin											X					
Stronglycentrotus purpuratus	purple sea urchin									X		X	X	X		X	
Cancer sp.	crabs											X					
Cancer magister	Dungeness crab					X				X							
Cancer productus	red rock crab									X							
Acmaea mitra	whitecap limpet										X	X	X				
Acmaea pelta	shield limpet											X					
Acmaea persona	mask limpet												X				
Acmaea testudinalis	plate limpet					X											
Diodora aspera	keyhole limpet						X				X	X	X				
Notoacmaea	owl's eye limpet					X			X								

of seasonal activity and procurement that postulate only short-term occupation on the outer coast may need refinement. However, since the compared sites are all located towards the southern end of the study area, perhaps the refinement need be only geographical in nature.

Shellfish analysis should have been an integral part of the excavation strategy. If this had been done, the results would have undoubtedly been more informative. Subsequent analysis did provide glimpses of the potential for using shellfish as a source of archaeological data and served as a starting point for a critical look at the methods used in dealing with shellfish remains.

The use of satisfactory methods for dealing with shellfish must begin with the person in charge of the excavation. He/she should be well-versed in the molluscan species likely to occur in the local environment, and pass this information on to the field hands.

Since it is impossible to save every shell in a midden, the field hands should be instructed, at a minimum, to retain all of the rarer types and selected whole shells, together with their proveniences.

A comparative collection should be established to aid field hands with the identification of unmodified shells. Keys and manuals can also help with identification. Familiarity with the appearance of unmodified shells would also assist in the identification of shell artifacts often overlooked in the field.

Column or bulk samples should be taken from each unit excavated as the field season progresses. Treganza and Cook (1948) suggest a 10 centimeter by 10 centimeter square taken on either arbitrary or stratigraphic levels. However, a column this small is physically difficult to extract due to the general instability of midden walls. A somewhat larger column, perhaps 20 centimeters square, is easier to deal with and provides additional data. Bulk samples from each level could be of a comparable size.

In addition to the column or bulk samples, samples should be taken from obvious lenses. For instance, this could have been done with the razor clam and giant barnacle lenses mentioned in the

Neptune field notes.

After collection, the shell samples should be placed in firm cardboard boxes with plastic bag linings. This should keep shell breakage caused by handling, transportation, and storage to a minimum.

Before starting the laboratory sorting process, the samples should be dried and weighed. Appropriate drying periods suitable for local conditions can be formulated by baking, re-weighing, and calculating moisture loss.

Once the samples are dry, the sorting process can begin. Established catagories, such as shellfish species, bird, fish, and mammal bone, charcoal, rock, and residue are used to order the data. Each catagory is weighed, recorded, and labeled separately. Sorting is generally done by screening. Discretion should be used in selecting the screen size. The largest size for a reasonably accurate estimate of site content is around six millimeters. A smaller size of between three and four millimeters is more accurate because it allows less material to fall into the residue category. However, the smaller screen greatly increases the time required for the sorting process.

After the initial identification of species and calculations of percentages, other tests can be conducted. One of the more common tests involves an attempt to establish shell/meat ratios (Cook and Treganza 1947; 1950; Cook 1950; Cook and Heizer et. al. 1951; Ascher 1959; Meighan 1959; Shawcross 1967; Ham 1976). The shell/meat ratios are generally established to compare the relative reliance on the various faunal remains found in a site. They have also been used to assign aboriginal population estimates on the basis of total protein available in the midden (Cook 1946; Ascher 1959). This technique, however, relies on numerous subjective assumptions and does not seem to be reliable.

Various problems arise when attempting to calculate the amount of meat associated with either bone or shell. One of the most obvious is trying to calculate the average weight of mammal, bird, and fish species. This problem also occurs with shellfish species.

According to Koloseike (1968:380):

> "of some importance is the hazard involved in equating grams of shell with a given weight of shellfish meat. The problem hinges on consideration of allometric exponential growth in molluscs, that is, differential growth of shell versus meat. Shell/meat ratios can only be established for particular empirical mollusc populations, each such population being unique. A shell/meat ratio derived from a current mollusc sample population may not apply very accurately to the molluscs harvested by aborigines in the past."

Because of the problems associated with shell/meat ratios, perhaps a more substantial research tool is the utilization of shellfish remains as seasonality indicators. In the past, archaeologists have relied heavily on avian or mammalian remains to infer the season of occupation. In these cases, as with shellfish, the season of death is considered the season of occupation. The use of avian faunal remains depends on the presence of known migratory birds in the faunal record. The presence of infant mammal remains usually indicates a spring or early summer occupation. Experiments with growth rings have proved that molluscs can also be used successfully as seasonal indicators (Weilde 1969; Coutts and Higham 1971; Coutts and Jones 1974; Ham 1976).

A variety of shellfish have been used as indicators of seasonality. The Pismo clam was used by Weilde (1969) to demonstrate a spring or summer collection period for a California shell midden. Choine stutchbury (Bray) and Protothaca crassicasta (Deshayes) were used for seasonality dates in New Zealand shell middens (Coutts and Higham 1971). Also in New Zealand, sea urchin (Euchinus chloroticus Val) was studied and found to have potential as a seasonality indicator (Coutts and Jones 1974). Bay mussel, butter clam, littleneck clam, gaper clam, and superlative rock venus (Venerupis tenerrira Carpenter) were used in conjunction with other faunal remains to obtain seasonal dates for the various components of the Glenrose Cannery site in British Columbia (Ham 1976).

The basis for the growth ring technique lies in the fact that different rings are formed in different seasons. A growth layer, or ring, is defined as two surfaces that vary in color from the previous growth layer as a result of a change in the deposition rate of calcium carbonate (Wilbur 1964; Ham and Irvine 1975). The deposition rate of calcium carbonate is influenced by the physical or chemical changes in the environment. The growth rings found in marine molluscs are explained as the result of a food increase in the spring and summer which, in turn, increases shell growth. A decline in shell growth occurs in the fall and winter with the decrease in food supply and temperature (Ham and Irvine 1975). In bivalves, shell growth occurs on the ventral edge of the shell when the valves are open collecting food. A dark thin ring is formed in the winter when growth rate declines, and a light wide ring occurs when shell growth is the greatest during the spring and summer. By checking the growth rings on the surface of a clam or mussel valve, using the most recent winter check ring and subsequent growth, the approximate season of death can be obtained (Ham and Irvine 1975).

Ham and Irvine (1975) discuss four techniques for studying growth rings, two of which proved to be very reliable. The first technique involves sawing a valve in half lenghwise and polishing the transection. The brownish check lines, or winter growth lines, are visible to the naked eye. A microscope can be used to help distinguish the winter check rings from other rings. The second technique utilized prepared sections which are mounted on glass slides. The translucent winter check rings are readily visible to the naked eye and low-power magnification. This technique is the most expensive but provides the clearest indication of seasonality. Unfortunately, these techniques are apparently only applicable to certain bay species.

Recently, a new technique has been published for determining the seasonality of sea mussel and several other species (Killingley 1981). The technique is very useful for species that do not exhibit regular growth rings such as those commonly present in open coastal sites. The technique involves the measurement of the oxygen isotopic ratio of shell carbonate. The ratio is a function of the water temperature from which the carbonate precipitated. A measurement of the ratio taken at the shell's terminal edge provides an indication of the water temperature at the time of death. This can then be correlated with seasonal temperature variations. Two of the species analyzed by Killingley, sea mussel and rock dwelling Thais common to Oregon coastal sites, were found to be highly accurate in determining seasonal changes. A drawback of this method is that it requires the use of a mass spectrometer.

In recent years, archaeologists working on the coast have begun to explore the possibility of using faunal resources to reconstruct the aboriginal seasonal round. Shellfish, as a faunal resource, has yet to be utilized in this manner to its fullest potential. Hopefully, in the future some of the methods noted above will become standard practice, enabling shellfish remains to become an integral part of the data base.

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Appendix A

Artifact Descriptions

Artifact Descriptions

Few artifacts were recovered during the excavation of the Neptune site. The following pages give descriptions and measurements for the artifacts mentioned in Chapter VII. This appendix is divided into three general catagories based on material used in manufacturing the tool--bone or antler, stone, and iron.

Bone or antler provides the widest inventory, with 12 different artifact types. Many of the tool types described are commonly found on the Oregon coast. Antler flakers and wedges, bone projectile points, awl-perforators, and a composite harpoon valve are among these. The decorated bone cylinder, possible flesher, and unidentified modified bone may be somewhat unusual.

Stone artifacts included four different types. Two of these are different varieties of projectile points. The remaining two types are blades or knives, and scrapers. Most of the material used in the manufacture of these tools was cryptocrystalline Utilized flakes and debitage were analyzed but not included in this report. This analysis showed that much of the material used was from water-worn cobbles. The information is on file at the Department of Anthropology, Oregon State University.

The iron catagory is made up of one tool--the iron wedge or blade.

Bone and Antler

Antler Flakers (Figure 7)

These specimens are generally considered to be flaking tools for stone artifacts. They are antler tines with blunted and frequently battered distal ends. The proximal ends are generally cut and broken.

Unit	52-18	52-18	40-18	48-27	40-18	52-18
Length	8.3 cm	13.5 cm	8.6 cm	15.5 cm	3.9 cm	6.1 cm
Diameter at butt	2.2 cm	1.7 cm	1.6 cm	2.2 cm	1.4 cm	1.9 cm
Level	1	5	2	2	3	7
Material	antler					

Whale Bone Cylinder (Figure 6)

This specimen is considered to be a flaking tool. The distal end is rounded but shows no evidence of wear. The proximal end is broken and jagged. The bone is very porous and deteriorated.

Unit	52-18
Length	13 cm
Width	3.1 cm
Level	6
Material	bone

Modified Rib (Figure 5)

This large mammal rib, probably elk, has been smoothed along the lateral edges and distal tip. The tip is blunted. It is thought to be a flesher but could have been used as a flaker.

Unit	44-16
Length	21.5 cm
Width	1.6 cm
Thickness	.4 cm
Level	2
Material	bone

Wedges (Figure 6)

These specimens are generally considered to be wood working tools. Unlike the elk antler speciemns which are straight, the deer antler wedge (52-18) is slightly curved. On all the specimens the proximal end is battered and the distal end is beveled.

Unit	40-18	56-20	52-18
Length	13 cm	13 cm	13 cm
Diameter	2.8 cm	2.5 cm	3 cm
Bevel Length	4.8 cm	3.6 cm	3.2 cm
Level	2	6	1
Material	antler		

Bone Projectile Points (Figure 5)

These specimens are made from heavy mammal bone. They are oval in cross-section with the widest point towards one end. One speciment is bi-pointed while the others are pointed at the large end, with the small end being blunted or broken. These specimens were probably used in a composite harpoon.

Unit	50-22	44-16	40-18
Length	3.6 cm	4.2 cm	5.1 cm
Width	.7 cm	.7 cm	.7 cm
Level	4	7	3
Material	bone		

Composite Harboon Valve (Figure 5)

This valve appears to have been manufactured from a heavy bird long bone. It is concave in outline, with divergent tips. It has been grooved to accept a point.

Unit	44-16
Length	4.8 cm
Width	.6 cm
Level	5
Material	bone

Triangular Bone Point (Figure 5)

A mammal long bone fragment has been ground smooth and flat to form a triangular shaped point. The base of this specimen has been broken.

Unit	44-16
Length	3.3 cm
Width	1 cm
Thickness	.5 cm
Level	8
Material	bone

Awls-Perforators (Figure 5)

Long bone fragments have been modified to form perforators. The specimens are polished and smoothed, with the tip sharpened. The proximal end is blunted on one specimen, while the others are unmodified or broken.

Unit	54-20	52-18	44-16	57-20
Length	5.6 cm	8.2 cm	8.9 cm	3.9 cm
Width	.4 cm	1.2 cm	1.2 cm	.5 cm
Level	5	4	unknown	4 cm
Material	bone			

Decorated Bone Cylinder (Figure 5)

A smooth cylinder of bone has been decorated with three parallel lines running part way across the shaft. One end is smooth while the other has been broken.

Unit	50-22
Length	2.8 cm
Width	.4 cm
Level	4
Material	bone

Unidentifiable Modified Scapula Fragments

What appears to be a large acapula has been smoothed on both sides, forming a sharp double bevel edge. They seem to be fragments of a much larger artifact.

Unit	56-20	44-16
Length	9.2 cm	14 cm
Width	2.2 cm	5.5 cm
Thickness	1.2 cm	1.8 cm
Level	3	3
Material	bone	

Unidentifiable Modified Fragments

A large mammal bone has been smoothed along one lateral edge forming a sharp beveled edge.

Unit	54-20	44-16
Length	5.4 cm	3.5 cm
Width	2.5 cm	2 cm
Thickness	.9 cm	.4 cm
Level	3	7
Material	bone	

Stone

Projectile Point (Figure 8)

This specimen is basally notched and triangular in shape. One barb is broken.

Unit	40-18
Length	2.5 cm
Width	1.6 cm
Thickness	.3 cm
Stem Width	.4 cm
Level	4
Material	cryptocrystalline

Projectile Point base (Figure 8)

This specimen consists of the base of a large stemmed projectile point. The stem tapers to a blunt proximal end.

Unit	50-22
Length	2.6 cm
Width	2.4 cm
Thickness	.6 cm
Stem Width	1.5 cm
Level	5
Material	cryptocrystalline

Blades or Knives (Figure 8)

These specimens are assymetrical in outline, tapering to blunt points. The proximal ends are broken or unmodified. The blunt points are bifacially worked.

Unit	50-22	57-20	44-16	52-18
Length	5.1 cm	4.7 cm	3.7 cm	6.3 cm
Width	2.6 cm	3.7 cm	2.9 cm	3.1 cm
Thickness	1.1 cm	1.3 cm	1 cm	1.6 cm
Level	5	4	7	7
Material	cryptocrystalline			

Scrapers (Figure 9)

Generally considered hide preparation tools, these scrapers exhibit a variety of shapes and sizes. Many of them are almost square in shape with discontinuous bifacial flaking.

Unit	52-18	44-16	52-18	52-18
Length	3.2 cm	2.6 cm	4.6 cm	4 cm
Width	2.8 cm	2.3 cm	3.1 cm	3.3 cm
Thickness	1 cm	.7 cm	1.4 cm	1.1 cm
Shape	quadrilateral	heart-shaped	rectangular	half oval
Flaking	unifacial/ discontinuous	bifacial/ discontinuous	bifacial/ discontinuous	bifacial/ discontinuous
Level	7	3	7	unknown
Material	cryptocrystalline			

Unit	50-22	52-18	40-18
Length	3.5 cm	3.1 cm	3.5 cm
Width	2.5 cm	2.4 cm	1.6 cm
Thickness	1.1 cm	1.6 cm	1 cm
Shape	square	quadrilateral	rectangular
Flaking	unifacial/ continuous	bifacial/ discontinuous	unifacial/ discontinuous
Level	5	6	1
Material	cryptocrystalline		

Iron

Iron Blade (Figure 10)

A rectangular bar of iron has been shaped in the general configuration on an axe head. The sides are incurvate. Both ends could have once been double beveled but considerable oxidization has taken place so it is difficult to determine. One corner of the rectangle appears to have been broken.

Unit	50-20
Length	15.5 cm
Width	4.5 cm
Thickness	2.9 cm
Level	7
Material	iron

Appendix B

Faunal Data

Faunal Data

The bone material from Neptune was identified using the comparitive collection at Oregon State University. After identification to species, age, and sex, a minimum number was established. The presence of duplicated bone elements, i.e. two left radii, was used to determine a minimum number of more than one individual. For many species no duplication of elements existed. It was assumed that the bone material from these species represented a minimum number of one individual.

A small portion of the bone material was either too fragmentary to be identified or not present in the comparative collection. Included in the second category is a small amount of bird and rodent bone. The bird bone was large in size and could have been from some type of large gull. The rodent bone was probably from a mole or gopher and intrusive into the site. A total of 543.3 grams of bone could not be identified to species because of its fragmentary condition or not being represented in the collection.

The following pages contain information on the identifiable bone. The species, age class, and sex determine each catagory. The unit, level, right or left if applicable, and element description is listed. Pertinent information on minimum number, sex, and age determination is given below the element list.

Harbor Seal (*Phoca vitulina*)

Age class: infant or newborn

Sex: unknown

Unit	Level	Right/Left	Description
50-22	5	unknown	humerus fragment, no epiphysis

A minimum number of one individual is represented. Size and epiphysis formation were used to determine age.

Age class: adult

Sex: unknown

Unit	Level	Right/Left	Description
56-20	3	unknown	phalanx
56-20	3	unknown	phalanx
48-27	3	unknown	patella

A minimum number of one individual is represented. Size and epiphysis formation were used to distinguish adult from infant. Sex could not be determined from the material present.

Fur Seal (*Callorhinus ursinus*)

Age class: adult

Sex: female

Unit	Level	Right/Left	Description
56-20	3	unknown	proximal pelvis fragment
56-20	3	not applicable	sternum
54-20	6	not applicable	sternum

A minimum number of one individual is represented. The pelvis fragment was used to identify the sex.

Sea Otter (*Ennydra lutris*)

Age class: juvenile

Sex: unknown

Unit	Level	Right/Left	Description
54-20	6	right	mandible fragment

A minimum number of one individual is represented. The age was determined by using the teeth. In this case the eruption of the permanent teeth was incomplete.

Whale (<u>Cetacea</u> sp.)

Age class: juvenile/adult

Sex: unknown

Unit	Level	Right/Left	Description
44-16	2	not applicable	vertebra cap fragment
44-16	3	not applicable	vertebra cap fragment
54-20	4	not applicable	unidentifiable bone fragment
56-20	6	not applicable	vertebra cap fragment
44-16	6	not applicable	unidentifiable bone fragment
54-20	6	not applicable	axis vertebra body (adult ?)
P-1	unknown	not applicable	vertebra body (juvenile ?)

The type of whale could not be identified due to lack of comparative material. The use of vertebrae to age an individual is questionable. In this case the epiphysis are not formed on the juvenile vertebra.

Stellar Sea Lion (<u>Eumetopias</u> <u>jubata</u>)

Age class: infant or newborn

Sex: unknown

Unit	Level	Right/Left	Description
48-27	2	left	proximal scapula epiphysis
40-18	2	unknown	maxilla fragment, 7 teeth
56-22	3	left	humerus
56-20	3	left	humerus fragment
54-20	4	right	humerus epiphysis
48-27	6	left	humerus fragment, very decayed

A minimum number of two individuals are represented by the two left humeri. Size, epiphysis formation, and bone structure were used to differentiate newborn or infant from older individuals. The size of this class is decidedly smaller than the next age class.

Age class: juvenile

Sex: unknown

Unit	Level	Right/Left	Description
40-18	1	right	ulna epiphysis fragment
40-18	2	unknown	mandible fragment, two teeth
56-20	2	unknown	phalanx
54-20	2	unknown	distal end of phalanx
56-30	3	unknown	rib fragment
40-18	3	right	canine fragment
56-20	3	right	pelvis fragment
56-20	3	unknown	phalanx
40-18	3	unknown	canine

Stellar Sea Lion (<u>Eumetopias jubata</u>) (cont'd)

Unit	Level	Right/Left	Description
54-20	3	unknown	phalanx
56-20	3	unknown	phalanx
50-22	4	right	radius epiphysis fragment
56-20	6	left	proximal tibia fragment
44-16	7	unknown	skull fragments with maxilla and teeth

A minimum number of one individual is represented. The epiphysis of the phalanges are not well formed, making it difficult to determine right or left, and therefore, individuals. Most of the material represented here is extremely fragmentary.

Age class: adult

Sex: female

Unit	Level	Right/Left	Description
48-27	2	left	D5 metatarsal
48-27	2	right	D2 metatarsal
54-20	2	left	D2 phalanx 2
58-20	2	right	D2 phalanx 2
56-20	3	right	D5 phalanx 2
48-27	3	left	D4 metatarsal
48-27	3	right	D4 phalanx 1
58-20	3	left	D2 metacarpal
48-27	3	right	D5 metatarsal
56-20	3	left	D2 phalanx 2
50-22	3	unknown	carpal
56-20	3	unknown	carpal
54-20	3	not applicable	sternum
56-20	3	not applicable	sternum
54-20	3	left	pelvis fragment
50-22	4	unknown	D4 phalanx 2
50-22	4	unknown	rib fragment
44-16	4	left	humerus
40-18	6	unknown	rib fragment
44-16	7	unknown	rib fragment
54-20	?	left	D2 phalanx 1
58-20	3	unknown	carpal

A minimum number of one female adult Stellar sea lion is represented. This age class is judged by size, texture, and fused epiphysis. Differentiating sex of male and female Stellar sea lions is based on the size. The male is much larger than the female (Snyder 1978).

Stellar Sea Lion (<u>Eumetopias jubata</u>) cont'd)

Age class: adult

Sex: male

Unit	Level	Right/Left	Description
44-16	2	unknown	navicular
54-20	3	right	mandible fragment
56-20	3	left	D1 metarsal fragment
54-20	3	unknown	rib
54-20	3	unknown	rib
58-20	3	unknown	metatarsal fragment
56-20	3	right	distal pelvis fragment
54-20	3	right	carpal
50-22	3	left	carpal
56-24	3	not applicable	sternum
50-22	4	unknown	rib fragment
54-20	4	unknown	hyoid aperatus fragment
54-20	4	unknown	phalanx fragment
40-18	5	unknown	hyoid aperatus fragment
56-20	5	right	pelvis fragment
56-20	5	unknown	rib
56-20	6	unknown	proximal rib fragment
56-20	6	unknown	proximal rib fragment
56-20	6	left	D5 metatarsal
44-16	6	right	D5 metatarsal
44-16	7	right	ulna epiphysis fragment
TP 2	3	unknown	rib fragment

A minimum number of one adult male Stellar sea lion is represented.

Rabbit (<u>Lepus</u> sp)

Age class: adult

Sex: unknown

Unit	Level	Right/Left	Description
50-22	3	left	distal humerus fragment

A minimum number of one individual is represented. Epiphysis were used to determine age.

Raccoon (Protor lotor)

Age class: adult

Sex: unknown

Unit	Level	Right/Left	Description
56-20	6	right	mandible fragment (old juvenile or young adult)
56-20	7	right	femur
P 10		not applicable	axis vertebra

A minimum number of one individual is represented. The mandible fragment tooth eruption is not complete, but was such that it could be a young adult. A comparison between the mandible vertebra, and femur was deemed inadequate to assume a minimum number of two.

Beaver (Castor canadensis)

Age class: unknown

Sex: unknown

Unit	Level	Right/Left	Description
50-22	2	unknown	beaver incisor fragment

A minimum number of one individual is represented.

Black-tail deer (Odocoileus hemionus)

Age class: juvenile

Sex: male

Unit	Level	Right/Left	Description
TP 1	1	left	3rd phalanx
TP 1	1	right	pelvis fragment
56-20	3	left	lunate
44-16	3	unknown	proximal rib fragment, epiphysis not formed
56-20	3	right	1st phalanx
56-20	3	right	2nd phalanx
50-24	4	not applicable	lumbar vertebra
56-20	5	not applicable	vertebra body
56-20	6	unknown	lumbar vertebra
40-18	6	unknown	parietal fragment
54-20	6	left	naviculo-cuboid
44-16	7	left	mandible frament
44-16	7	left	ulna fragment, distal end missing

A minimum number of one individual is represented. The age of the bone material was based on size, epiphysis formation, and texture. The sex is based on the presence of an antler base on the parietal.

Black-tail deer (<u>Odocoileus hemionus</u>) (cont'd)
fragment of a skull.

Age class: adult

Sex: unknown

Unit	Level	Right/Left	Description
44-16	1	unknown	rib fragment
44-16	1	not applicable	thoracic vertebra body
54-20	1	not applicable	thoracic vertebra
TP 2A	1	left	proximal scapula fragment
48-27	1	unknown	long bone fragment
44-16	2	right	proximal epiphysis, 1st phalanx
40-18	2	unknown	rib fragment
40-18	2	unknown	rib fragment
40-18	2	not applicable	thoracic vertebra
56-20	2	left	pelvis fragment with illial fossa
50-22	2	unknown	rib fragment
54-20	3	left	distal radius fragment
44-16	3	unknown	proximal rib fragment
56-20	3	unknown	proximal rib fragment
56-20	3	left	lunate
56-20	3	left	cuniform
50-22	3	left	cuniform
50-22	3	left	lunate
50-22	3	right	pelvis fragment
44-16	4	left	triquetrum cuniform
40-18	4	unknown	rib fragment
54-20	4	left	2nd phalanx
54-20	4	left	radius fragment
56-20	4	unknown	rib fragment
56-20	4	unknown	rib fragment
56-20	4	left	proximal radius fragment
48-27	4	unknown	rib fragment
48-27	4	left	scapula fragment
50-22	4	not applicable	lumbar vertebra
44-16	5	unknown	rib fragment
40-18	5	left	calcaneous
40-18	5	right	triquetrum cuniform
56-20	5	left	naviculo-cuboid
56-22	5	left	mandibular process fragment
48-27	5	unknown	rib fragment
48-27	5	unknown	rib fragment
48-27	5	unknown	metatarsal fragment with vascular groove
56-20	6	left	metatarsal fragment
48-27	6	unknown	rib fragment
44-16	7	left	3rd phalanx
44-16	7	unknown	rib fragment
56-20	7	unknown	rib fragment
44-16	9	unknown	rib fragment
44-16	10	left	incisor

Black-tail deer (Odocoileus hemionus) (cont'd)

Unit	Level	Right/Left	Description
P 8	unknown	not applicable	vertebra body

A minimum number of two individuals is indicated by the two left radii fragments, cuniforms, and lunates. Although the radii are from the proximal and distal ends the overlap is such to make it impossible for them to be from the same animal. The left cuniform and lunate from level 3, unit 56-20, are probably from the same animal, as is the left cuniform and lunate from level 3, unit 50-22. The pairs fit together remarkably well. The age was determined by fused epiphysis, size and texture.

Roosevelt Elk (Cervus canadensis nelsoni)

Age class: juvenile

Sex: unknown

Unit	Level	Right/Left	Description
40-18	5	left	pre-maxilla fragment
40-18	6	left	proximal 1st or 2nd phalanx

A minimum number of one individual is indicated. The age was determined by size and epiphysis formation.

Age class: adult

Sex: unknown

Unit	Level	Right/Left	Description
TP 2	1	right	cipitate
44-16	2	unknown	distal metatarsal fragment
44-16	2	unknown	rib fragment
40-18	2	left	3rd phalanx
44-16	3	right	distal 2nd phalanx
52-18	3	unknown	metatarsal fragment
50-22	4	unknown	frontal skull fragment
50-22	4	unknown	rib fragment
50-22	4	unknown	rib fragment
50-22	4	unknown	frontal skull fragment
50-22	4	unknown	rib fragment
50-22	4	unknown	femur fragment
50-22	4	unknown	metatarsal fragment
56-20	4	left	distal phalanx fragment
56-20	4	unknown	metatarsal fragment
40-18	5	left	distal metatarsal fragment
40-18	5	left	distal tibia fragment
40-18	5	unknown	radius fragment
40-18	5	unknown	distal 1st phalanx fragment
40-18	5	unknown	tibia fragment
40-18	5	unknown	metatarsal fragment

Roosevelt Elk (Cervus canadensis nelsoni) (cont'd)

Unit	Level	Right/Left	Description
40-18	5	unknown	skull fragment
40-18	5	right	pelvis fragment
54-20	5	unknown	rib fragment
54-20	5	left	rib fragment
50-22	5	unknown	distal metatarsal fragment
40-18	6	left	humerus fragment
40-18	6	left	humerus fragment
40-18	6	right	proximal tibia fragment
40-18	6	unknown	radius fragment
40-18	6	unknown	long bone fragment
40-18	6	unknown	rib fragment
40-18	6	unknown	long bone fragment
40-18	6	unknown	rib fragment
40-18	6	right	radius fragment
40-18	6	right	3rd phalanx
40-18	6	left	1st phalanx
40-18	6	right	distal phalanx fragment
40-18	6	left	distal humerus fragment
40-18	6	right	distal radius fragment
40-18	6	unknown	metatarsal fragment
40-18	6	unknown	radius fragment
40-18	6	not applicable	lumbar vertebra
50-22	6	right	naviculo-cuboid
44-16	7	unknown	1st phalanx fragment
44-16	7	unknown	frontal skull fragments
56-20	7	unknown	rib fragment
44-16	9	unknown	long bone fragment
TP 2	11 (5)	not applicable	thoracic vertebra
TP 2	16 (8)	right	distal 1st phalanx epiphysis
44-16	unknown	left	2nd phalanx
44-16	unknown	left	3rd phalanx

A minimum number of one individual is represented. Age was determined by epiphysis formation, size, and texture. Sex was not determined. Antler fragments were found but are included in the artifact analysis because they show modification.