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Brush Fences and Basket Traps: The Archaeology and Ethnohistory of Tidewater Weir Fishing on the Oregon Coast

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BRUSH FENCES AND BASKET TRAPS: THE ARCHAEOLOGY
AND ETHNOHISTORY OF TIDEWATER WEIR FISHING
ON THE OREGON COAST

by

ROBERT SCOTT BYRAM

A DISSERTATION

Presented to the Department of Anthropology
and the Graduate School of the University of Oregon
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“Brush Fences and Basket Traps: The Archaeology and Ethnohistory of Tidewater Weir Fishing on the Oregon Coast,” a dissertation prepared by Robert Scott Byram in partial fulfillment of the requirements for the Doctor of Philosophy degree in the Department of Anthropology. This dissertation has been approved and accepted by:

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Title: BRUSH FENCES AND BASKET TRAPS: THE ARCHAEOLOGY AND
ETHNOHISTORY OF TIDEWATER WEIR FISHING ON THE OREGON
COAST

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Anthropologists recognize the economic importance of fishing weirs in the harvest of marine resources by Northwest Coast peoples. Yet very little research has focused on the range of variability in weir technology and its cultural and environmental context. I examine intertidal fishing technologies on the Oregon Coast, a southerly portion of the Northwest Coast. On the Oregon Coast, the estuary ecotone held a great abundance and diversity of fishes. The largest and most numerous Native residential centers were located along the shores of estuaries, and tidewater fishing appears to have been central to the region's economy.

I examine extensive unpublished archival accounts of Native oral history relating to Tidewater weir technology. I also present the results of archaeological survey, radiocarbon dating, feature characterization, and ecological and taphonomic studies. This archaeological research fills a large gap; 10 years ago only 6 of the 72 archaeological weir sites reported here had been recorded and none of the 81 radiocarbon (^{14}C) dates from weir stakes and lattice had been acquired. Over 80 percent of the ^{14}C dates from wood stakes date to the last millennium, with earlier dates distributed evenly over the period between about 3400 and 1000 years ago.

Using of the new data on tidewater weir fishing, I address some of the economic aspects of theories that relate weir use to the development of social ranking and wealth differentiation on the Northwest Coast. I find that several prevailing assumptions about weir technology and its cultural context are unfounded. In many ways tidal weir fishing has been portrayed as involving large group organization, annual rebuilding, short-term intensive harvest, and processing for long-term storage, characteristics thought to be related to the development of hierarchical social organization. Yet fishing structures used in Oregon Coast estuaries were very different from the large fish dams used in rivers above tidewater. Where riverine weirs were often built and used only for seasonal use, tidal weirs were used throughout the year to harvest a diversity of marine fishes such as herring, sardine, smelt, and salmon, fishes that collectively entered estuaries in large numbers during all seasons.

I argue that researchers investigating tidal weir use should consider the full range of subsistence activities possible with these structures. Furthermore, models relating social developments to weir fishing should be revised in light of new data on the temporal, geographic, and residential context of weir fishing.

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CHAPTER 1

INTRODUCTION

In this dissertation, I examine the intertidal fishing weir of the Northwest Coast of North America, a technology that was used to harvest marine resources. Historically, weir fishing was of primary economic importance to many coastal societies. Weir fishing was particularly important to many Pacific Northwest tribes, although variation in historic and archaeological weir technologies has not been adequately examined. My study explores the variability in archaeological weirs in Oregon Coast estuaries, along with ethnohistoric information about weir fishing in the region, addressing the role this technology played in traditional coastal economies. Further, the study of archaeological fishing weirs and their cultural context can address key questions in the anthropology of coastal societies. Throughout the world, maritime hunting, fishing and gathering peoples developed forms of social and economic organization not seen in societies in non-maritime environments. Many anthropologists (e.g. Thomas and Koyama 1979; Yesner 1987; Erlandson 2001) hold that the general productivity of marine environments accounts for much of this difference, as they often provided higher levels of resource abundance and diversity than were available to non-agricultural societies in other environments.

I have chosen to explore variability in archaeological and ethnographic representations of fishing weir technology in the southern portion of the Northwest Coast cultural area. The Northwest Coast has been chosen as the focal area because pre-colonial indigenous societies in this region have long been recognized as exceptional in terms of their social and economic organization. Yet whether or not Northwest Coast groups were truly exceptional socio-economically in anthropological terms, the role weir fishing played in their economies remains a topic worthy of investigation. It is clear from ethnographic data that during the period of

recorded history, marine resources provided much of the surplus that made possible some of the social and economic hallmarks of the Northwest Coast culture area, including dense populations, multi-seasonal residential site occupation, nonegalitarian social organization, an elaboration of material culture including considerable wealth accumulation, and systematic long distance trade (Matson and Coupland 1995). Historically, weirs and related traps were widely used to intensively harvest some of the most productive marine resources in the region, including anadromous fishes such as salmon and some species of smelt.

Because weir technology played an important role in the mass harvest of storable marine resources such as salmon, researchers have attempted to relate the development of this technology to the development of social and economic phenomena that may have depended on this technology. To examine these developments, however, a thorough understanding of the range of variability in weir technology and its archaeological contexts is warranted. Much ethnographic literature details the use of weirs to harvest anadromous fish in freshwater during runs (e.g., Hewes 1947; Rostlund 1952; Stewart 1977), but there are also references to weirs used in tidewater settings to harvest other species (Drucker 1951:19; Barnett 1955:80-81; Elmendorf 1992:76), or even a broad spectrum of resources including several species of fishes as well as crabs (Hewes cited in Kroeber and Barrett 1960:29). These diversified, multi-season harvests are less often cited in studies examining the role of weirs in socioeconomic developments, yet the relative importance of this form of weir technology is clearly relevant to this problem.

The areal scope of my study is the estuaries of the Oregon Coast, a subregion of the southern Northwest Coast cultural area. I chose this area not just because of proximity and convenience but also because it contains numerous estuaries of a range of sizes, and archaeological weirs were known to be visible as surface sites here (e.g., Draper 1982). As is the case for other parts of the Northwest Coast, published references to weirs used in rivers on the

Oregon Coast are much more common than references to weirs used in estuaries (e.g., see Stewart 1977). Yet at the outset of this study, I found considerable archaeological evidence and numerous unpublished ethnographic accounts indicating that weirs were heavily used in the estuaries of this region. In addition, archaeological and ethnographic evidence for much of the Northwest Coast indicates intensive occupation occurred along the margins of estuaries, where use of fishing weirs may have provided a major portion of peoples' subsistence.

In addition to exploring questions of tidewater weir use on the Oregon Coast, I help to fill gaps in the archaeology and ethnohistory of this coastal region. Although the estuary is often portrayed as central to subsistence and settlement on the southern Northwest Coast (Minor and Toepel 1983; Draper 1988; Ross 1990; Lyman 1991), relatively little archaeological investigation of estuarine resource procurement technologies has taken place to date, particularly on the Oregon Coast. Sites where resources are procured are much more common on dry land than in the estuary. This is partly because several types of resource procurement activities occurred over water, leaving many sites unidentifiable through pedestrian survey. The fishing weir is a widespread estuarine site type that is an exception to this rule. These sites occur in mudflats, salt marshes, and erosional channel banks of estuary intertidal zones. From the 1950s to the 1980s, six sites containing archaeological weirs were recorded on the Oregon Coast (Chapter 4), but only very limited information was available about the features at these sites beyond their interpretation as fishing weirs. Surveys have since shown that wood stake weir sites are prevalent over much of the Northwest Coast, and that through survey and ^{14}C dating of wood elements, the distribution and chronology of these sites can be investigated (Moss et al. 1990; Byram 1998; Erlandson et al. 1998; Moss and Erlandson 1998; Tveskov 2000). Ethnohistorical and environmental analyses also hold considerable potential for examining the function of these sites.

My research combines site characterization and chronology with ethnohistoric and environmental research. I examine ethnographic and archaeological evidence of intertidal weir fishing through literature survey, archaeological reconnaissance of estuarine intertidal zones, and weir site analysis involving mapping, environmental characterization, artifact sampling, and excavation. Additional archaeological, geomorphological, and ethnohistoric information provides a broader cultural and environmental context for my fieldwork at weir sites, including residential and subsistence-related data. My interpretations of weir function are based on a combination of ethnographic analogy, technological analysis, and environmental analysis.

The scope and methods I chose for this study suit the current state of research on the topic. There was a need for thorough inventory of the range of intertidal fishing sites (Figure 1) present on the Oregon Coast, and a need for the development and implementation of techniques that document variability in surface characteristics at these sites. There was also a need for chronological information from weir sites, best addressed through ^{14}C dating, stratigraphic and artifact analysis, and historic documentation. Information on landscape change and site taphonomy is crucial to interpreting the relative intensity of site use over time and fundamental in reconstructing the technology represented in site remains. Most importantly, there was a need for a close examination of published and unpublished historical information pertaining to the use of tidewater fishing technologies represented archaeologically on the Oregon Coast.

While these issues are the subject of my research, not all aspects of Native peoples' fishing practices are addressed in this study. Ceremony was a key aspect of fishing tradition for Native communities of the Oregon Coast and research on this topic may one day contribute to tribal cultural heritage studies in the region. I do not emphasize ceremonial traditions relating to fishing. Instead, I focus on the more technological aspects of fishing practices



Figure 1: Wood Stake Fishing Weir on Coos Bay Tideflats (35-CS-128)

explicated in numerous ethnographic and historic accounts, and the archaeological manifestations of such practices. It is my hope that the research presented here may assist tribal cultural heritage researchers in addressing other dimensions of the diversified history of fishing practices on the Oregon Coast.

The Study of Archaeological Fishing Structures

Sites holding features interpreted as fishing weirs occur throughout much of the world, in both freshwater and tidewater settings. Fishing technologies are diverse, but archaeological evidence indicates one of the most common harvesting techniques involved the use of wood or stone structures built to limit fish movement without greatly impeding water flow. Such features are often called weirs on the Northwest Coast, and elsewhere they are referred to as fish traps, tidal traps, kraals, guides, leads, pounds, impoundments, fish fences, fish ponds, and other terms. (These different terms often derive more from local vernacular than structural variation.) Weir features are the remains of composite structures with elements that may be temporary or permanent, portable or fixed. They vary in the degree of effort required in their construction as well as the use they are put to. Thus, they vary in the economic and cultural roles they play.

The weirs I describe in this study are alignments of vertical wooden stakes occurring in intertidal mud flat and channel settings, sometimes associated with woven lattice panels, brush, and other artifacts. The stakes are typically spaced at narrow intervals to provide a physical barrier to swimming fish while allowing relatively unrestricted flow of tidal currents. I interpret these features as fishing weirs based on ethnographic accounts of their construction and use (Chapter 3) and their configuration and setting (Chapter 4). Although some may also have been

used to trap sediments and shift channel configuration, as proposed in Chapter 5, this was likely a secondary use.

Tidal weirs were used historically throughout the world. They were a fundamental part of the fishing systems of many coastal societies prior to the spread of commercial-industrial fishing practices. Tidal weirs were used until the 1950s in parts of the British Isles, where they were often termed “head weirs” or “ebb weirs” (Went 1984; see also Davis 1923). In the early 20th century they were used in the estuaries of India, Indonesia, the Philippines, and parts of Oceania (Hornell 1950:136-157). On the east coast of Canada tidal weirs are still used today (Wilbur and Wentworth 1986), as they are in South Africa (Felgate 1982:67), Australia (Flood 1999:115) and in other regions.

In North America, weir use by indigenous peoples declined with the onset of colonial occupation and subsequent industrial development. Despite extensive ethnographic accounts of weir use, archaeologists showed little interest in archaeological weir sites before the advent of ¹⁴C dating, and after that only marginal interest until the last two decades. This general lack of attention to archaeological wet sites is typical of archaeological research throughout the world (Coles 1984:1). It results in part from the special methods required to investigate wet sites and the extensive conservation efforts needed to preserve excavated organic materials (Cronyn 1990). Other reasons for a lack of interest among archaeologists in fishing weir sites include the assumption that such sites are of very recent antiquity, and an apparent acceptance of ethnographic representations of weir technology available in several cursory overviews and a few more detailed studies.

Archaeological Weir Research on the Northwest Coast

Archaeologist Harlan Smith recognized the great potential of tidal wetland archaeological sites as early as 1898 (see Bernick 2001:218). His 1922 documentation of archaeological weirs in the Northern Bentick Arm of the Bella Coola River is the earliest I have identified for the Northwest Coast. While doing ethnographic work for the Geological Survey of Canada under Edward Sapir, Smith photographed an archaeological weir and recorded a description based on the testimony of the Nuxalk individuals he interviewed.

The trap was called kiltes. It was used to take kilkil, a small fish which lays its eggs on the beach. There are many such traps on the south arms of the mouth of the Bella Coola. The line of piles in this trap run diagonally from the bank. The trap also caught coho, humpback, and dog salmon not sockeye, spring or steelhead. This trap was made before the slough had cut away the earth at this place. It was semi-circular and the fish got in at high tide. When the tide went down they were unable to get out. Small cross sticks of hemlock or any convenient wood placed horizontally were used in making this trap. Many dog salmon were taken. The trap is very old. The frames or racks, similar to those on which berries were dried by the Bella Coola Indians, were tied with cedar limbs to the piles to make this trap (Tepper 1991:70).

Other early descriptions of weirs related to ethnographic accounts exist in the unpublished ethnographic records from the Northwest Coast (e.g., see Chapter 3).

Since the late 1970s, weir site research has grown to become an important dimension of Northwest Coast archaeological studies. As outlined by Moss and Erlandson (1998), more work was initially done on the coasts of southeast Alaska and in British Columbia, but the Oregon Coast has become one of the best-documented regions.

The first published paper on archaeological weirs in the region was written by Pomeroy (1976), who examined intertidal stone structures in the Bella Bella region of the British Columbia Coast. He documented weir layout in part using aerial photography. Based on their inferred association with ¹⁴C dated shell middens, Pomeroy suggested the intertidal stone traps could be as

much as 3000 years old. A focus on stone weirs or traps continued as Ackerman and Shaw (1981) reported on sites near Ketchikan in southeast Alaska. Their interpretation of fishing structure use was based in part on Tlingit oral tradition relating to the sites, which suggested these structures were used for fishing until the 1920s. Also during the early 1980s, Langdon began a sustained effort to survey and document fishing weirs or traps in southeast Alaska. Like Pomeroy, Langdon et al. (1986) used aerial photography to document sites. Later, Langdon and his associates also examined formal variation in wood stake structures at Little Salt Lake near Klawock, Alaska (Langdon et al. 1995).

Despite longstanding evidence from the east coast of North America that wood stake tidal weirs could be as much as 4-5000 years old (Decima and Dincauze 1998:157), radiocarbon dating of stakes from these features was not conducted on the west coast until 1985, when Moss pursued this as part of her dissertation research (Moss 1989). She described two fishing weirs on Admiralty Island in southeast Alaska. Moss et al. (1990) compiled unpublished dates from 10 fishing weir sites in southeast Alaska, showing that the chronology of these widespread and accessible features could be determined through surface sampling, and that these structures could remain preserved for as much as 3000 years in tideflat settings. This was 1500 years earlier than Fladmark (1975; 1986:105) had proposed for weir sites, based on their association with near modern day sea-levels.

Beginning in the late 1980s, a number of research papers were presented with more ^{14}C dates and descriptions of the surface characteristics of weir features (see Moss and Erlandson 1998). Ream and Saleeby (1987) reported ^{14}C dates from extensive weir features at the Exchange Cove estuary of northern Prince of Wales Island. Monks (1987) explored the faunal remains and historic accounts relating to a site at Deep Bay, on Vancouver Island, along the Strait of Georgia. Based on the analysis of ethnographic accounts and associated midden constituents, Monks

proposed that fishers drew herring into this structure as bait for predatory sea mammals that were also harvested. Eldridge and Acheson (1992) reported dates ranging from 4500 to 3900 RYBP from probable weir stakes at the Glenrose Cannery site near the mouth of the Fraser River in British Columbia, pushing back evidence of this technology well into the middle Holocene.

Weir sites in southeast Alaska and British Columbia continue to be documented with the techniques established by Pomeroy, Langdon, Moss, and others. Reimer (2000) used his community's oral history in his analysis of the Chi-yak site (DhRs233) in Burrard Inlet north of the Fraser River. The Squamish name for the site's tideflat setting is *Steets e mah*, which translates roughly as "a good place to catch fishes such as crab, flat fishes, salmon, and trout." Most recently, Mobley and McCallum (2001) documented wood stake and stone weirs with well-preserved enclosures at the Sandy Beach site in southeast Alaska, illustrating a rare aspect of weir (or "tidal trap") features in the region.

Of the numerous stone fish weirs or traps in southeast Alaska and British Columbia, none have yet been dated, though research has focused on the possible role of these features as sediment traps (Putnam and Greiser 1993), and their association with productive salmon streams (e.g., Langdon et al. 1986). Based on the environmental setting of features, Pomeroy (1976:166, 173) suggested that some of the stone fish traps in the Bella Bella region may have been used for intensive salmon harvests, whereas others were used for the harvest of diverse marine fishes. Although chronological information is lacking for the stone features, it appears that some of the same questions can be addressed in the study of both wood and stone fishing structures.

Compared with the southeast Alaskan and the British Columbian coasts, the study of archaeological weirs proceeded more slowly on the Oregon and Washington coasts prior to the 1990s. I am aware of reports or articles for only two archaeological weir sites on the Washington Coast (Munsell 1976; Schalk and Burtchard 2001). There is also a weir site near Olympia that is

still being investigated (Croes 2002), one at Willapa Bay that was ^{14}C dated by Brian Atwater to ca. 380 RYBP (see Moss and Erlandson 1998:183), and there is also a weir site in a non-tidal lake in the floodplain of the Columbia Estuary (Wessen 1983).

The unusually well preserved Wapato Creek weir site was the first to be reported on the Washington Coast (Munsell 1976). It is located in a tidal inlet near Tacoma. Munsell described an undated feature of vertical stakes and wattles with associated net fragments. Some of this netting was attached to the wattles of the weir. The mesh of the net is relatively large, averaging 2 cm by 4.5 cm, suggesting it may have been used for larger fish such as salmon (see Chapter 7). A much more extensive assemblage was recently reported from the intertidal margin of Gray's Harbor. The Newskah Creek Fish Trap Complex holds indications of many episodes of rebuilding (Schalk and Burtchard 2001). The site appears to contain the remains of multiple episodes of V-shaped tidal weirs that were oriented southeasterly, open toward the direction of the ebb tide. Some may have been built across the shifting mouth of Newskah Creek or another subsidiary tidal channel, and older weirs are positioned lower in the intertidal zone than later weirs. Four redcedar stakes were radiocarbon dated, two at approximately 1000 and two at approximately 600 RYBP. Given the excellent preservation of these features, the site appears to hold great potential for the study of weir use in a relatively stable intertidal setting.

In Oregon, archaeologists had long been aware that wood stake fishing weirs were preserved in mudflats, though in most cases they chose not to record these as archaeological sites. However, Lloyd Collins (1953) of the University of Oregon noted the presence of weir features when he recorded sites 35-CS-1 and 35-CS-17 on the Coquille River in early 1950s, and in the 1980s former Bureau of Land Management archaeologist Reg Pullen (1985) recorded four other Coquille River weir sites, 35-CS-97, 108, 109, and 118. Woodward identified a possible weir and lattice feature at site 35-TI-4 on the shore of Nehalem Bay (Linick 1984), but it is not included in

my analysis due to insufficient reporting. Although six or seven sites with weirs had been recorded prior to 1993, very little analysis of these had been done, and only one piece of wood, from 35-TI-4, had been ^{14}C dated.

There was promising research on the Oregon Coast during the 1980s and 1990s on other archaeological topics closely related to the study of fishing weirs. Research on estuary landscape change relating to cultural history (McDowell 1986; Connolly 1988; Woodward et al. 1990) helped set the stage for the examination of landscape change at intertidal weir sites. The implementation of fine-grained analysis of midden constituents led to the identification of diverse marine fish species thought to have been harvested with fishing weirs or other mass harvest devices (Greenspan 1986, 1996; Byram et al. 1997; Losey 1996; Tveskov 2000). Because numerous fishing techniques were used by residents of the Oregon Coast, and because the archaeological faunal assemblages are not directly associated with the weirs, fish remains from occupation sites do not necessarily represent fish caught with weirs. However, these assemblages do represent fish that were harvested and they provide useful contextual evidence for interpreting weir use. Studies show that many of the fishes common in occupation sites near Oregon estuaries include salmonids, herring, flounder, perch, smelt, sculpin, and others.

In terms of archaeological research on the Oregon Coast, all weir sites recorded or revisited between 1993 and 2001 are discussed in this dissertation. Other relevant reports and articles are cited throughout, but most noteworthy are those by Erlandson and Moss (1993), Moss and Erlandson (1994, 1995a, and 1998), Byram (1995), Byram and Witter (1999), the Coquille Indian Tribe Cultural Resource Program, or CITCRP (1999), Erlandson et al. (1999), and Tveskov and Erlandson (2002). Collectively, the Oregon Coast research demonstrates that wood stake weirs were a widespread technology in the region, and they appear to have been a fundamental aspect of Native economies on the Oregon Coast prior to colonial settlement.

Current Issues in Site Distribution, Taphonomy, and Comparative Chronologies for the Northwest Coast

Radiocarbon dating has been a fundamental aspect of the study of intertidal wood stake fishing weir sites in Northwest Coast archaeology, primarily because chronological distributions provide indications of the development of this technology and its cultural context. For example, patterns in frequencies of ^{14}C dates have been related to models of cultural change and subsistence practices (see Fladmark 1975, 1986). As Moss and Erlandson (1998:183) note, the “antiquity of weir/trap fishing is ... consistent with Fladmark’s (1975) model that mid-Holocene sea-level stabilization allowed for the establishment of abundant salmon populations, which in turn made possible the evolution of the ethnographic Northwest Coast cultures.” However, it has become clear that inferring the frequency of weir use based on patterns in ^{14}C dates is problematic without attention to the factors that condition the sample of sites and features available for dating. In particular, changes in sea-level and estuary shorelines may seriously affect the preservation and visibility of fishing weirs in tidewater settings. Throughout this dissertation, ^{14}C dates presented in years BP refer to cal yr BP (calendar years before present). The abbreviation RYBP will be used to refer to ^{14}C years BP, or uncalibrated ^{14}C dates.

In their 1998 article, Madonna Moss and Jon Erlandson examined the differential antiquity of weir sites along the Northwest Coast. They suggested a pattern of earlier ^{14}C dates for weir sites on the coasts of Alaska and British Columbia (northern and central Northwest Coast), in contrast to younger dates from sites on the southern Northwest Coast, may be due to differing coastal processes relating to regional environmental histories (Moss and Erlandson 1998).

Moss and Erlandson presented extensive ^{14}C data from southeast Alaska and the Oregon Coast. They noted that a much lower frequency of weir site investigations accounts for the paucity of dates from the British Columbia and Washington coasts. Yet the data were sufficient

for a comparison of these patterns between the southern and northern portions of the Northwest Coast. For southeast Alaska, they presented 71 ^{14}C dates from 42 fishing weir sites. These ranged from 3770 RYBP to modern, with six sites dating to 3000 years or more (Moss and Erlandson 1998:184). Although fewer dates were available from the British Columbia Coast, these included some of the oldest dates from reported fishing weir features at the Glenrose Cannery site, dating between 4400 and 5300 RYBP. The British Columbia dates are also increasing through more recent investigations (see Reimer 2000). On the whole, the dates from the northern and central Northwest Coast show a wide time range, with the highest frequencies in the last three millennia, and a peak in the second millennium BP.

Moss and Erlandson suggested that different processes may be at work on the southern Northwest Coast. In this region, weirs date much later on average, and the earliest dates from the southern Northwest Coast are several centuries to millennia younger than those in the north. Only four intertidal weir features have been dated on the Washington Coast, all at the Newskah Creek site, and distributed between 1000 and 500 years BP (Schalk and Burtchard 2001). Far more dates are available from the Oregon Coast. At the time Moss and Erlandson's (1998) article was written, the 31 available dates ranged from 2400 BP to modern, but the vast majority of dates from this region were for the last millennium, including 65 percent from the last 500 years. More recent dating efforts (Chapter 4) have brought the total to 81 dates from 72 sites (including two dates from lattice panels associated with weirs), extending the southern Northwest Coast time range for weir sites to ca. 3400 BP. Although the new dates span over 3400 years, 85 percent of the dates for Oregon Coast weirs fall within the last 1000 years, and post-1850 milled wood is present in at least four sites.

Continued ^{14}C dating of wood stake fishing weirs has extended the time depth of this site type in both the northern and southern portions of the Northwest Coast, yet the basic

chronological patterns first presented and discussed by Moss and Erlandson still hold for the region. The earliest sites are still found in southeast Alaska and British Columbia, at approximately 5000 years ago in contrast with 3400 years ago in Oregon, and the majority of sites in the south are much more recent than those in the northern sample. Although the new ^{14}C data do not change this relative chronology, in conjunction with recent geological findings, weir site data are shedding new light on the processes that affect site preservation and visibility along intertidal estuary shorelines in Oregon.

Processes Affecting Estuary Shoreline Landscapes

The geomorphology of the Oregon Coast “is shaped by tectonic uplift and warping, the effects of eustatic sea level changes, wave and wind action, and fluvial and tidal processes in estuaries” (McDowell 1987:544). Recent geological research on the Northwest Coast has begun to elucidate the landform history relevant to weir site preservation in the region’s estuaries. In southeast Alaska as well as Oregon, coastal geological research has undergone fundamental changes during the past decade. Although the complexities of environmental change are still being sorted out in both regions, several factors that affect estuary shorelines are now clear. The most significant of these is that global sea-level rise during the late Pleistocene and the Holocene, and associated coastal erosion, far outweighs any other factor in the preservation and visibility of ancient intertidal shoreline deposits. Global sea-level rise stems from long-term global warming and subsequent deglaciation. For Earth as a whole, sea-levels have risen over 120 meters since the last glacial maximum at 23,000 years ago. Globally, it appears that much of this rise occurred prior to the middle Holocene, with sea-levels approaching a few meters of their modern levels by 3-4000 years ago. One result of global sea-level rise is that intertidal weir sites older than 7000 to

10,000 years are unlikely to be found within or above the intertidal zone in Northwest Coast estuaries (see Chapter 5; Putnam and Fifield 1995:21).

While global sea-level change has the greatest effect in shaping coastlines, regional geological processes such as tectonic shifts and isostatic rebound can also move a shoreline vertically in relation to sea-level. Because of these processes, it is important to distinguish between local relative sea-level change and global sea-level change. In terms of a site and its nearby setting, a relative sea-level record can be established based on sedimentary sequences that indicate subtidal, intertidal, and subaerial depositional exposure of buried facies. For example, geologist Robert Witter (1999) examined several sediment cores from sites around the margins of the Coquille Estuary, finding evidence for a diminishing rate of sea-level rise over the past 7000 years. This evidence consisted of ^{14}C dated stratigraphic sequences of layers containing fossil flora and fauna indicative of earlier sea-levels below those of today.

On a regional scale, the most significant geological force affecting relative sea-level on the southern Northwest Coast is tectonic movement, with isostasy more significant in the north. For many years, geologists viewed the Oregon Coast as tectonically stable. Fifteen years ago Brian Atwater (1987) and subsequently other geologists (e.g., Nelson et al. 1995) showed the region to be tectonically active, with massive earthquakes occurring at intervals of several hundred years. Tectonic uplift is produced in the region as the Juan de Fuca Plate under the Pacific Ocean moves toward the North American Plate. The edge of the latter accumulates strain and buckles, gradually rising along much of the coastline. After a few centuries of accumulation, this strain is released and the plate edge rapidly subsides, causing a massive earthquake and associated tsunami. Evidence of these massive subsidence events has been documented in several estuaries on the Oregon and Washington coasts, often seen in alternating buried marsh and bay mud layers (Nelson et al. 1995; Witter 1999). Although the changes caused by subsidence and

uplift are massive, these tectonic shifts may have a limited effect on the long-term intertidal position of many weir features. This is because interseismic uplift and seismic subsidence generally cancel each other out over time.

In some cases other shifts result in net upward or downward movement of a shoreline. In particular, settings where large glaciers have retreated are likely to experience rebound, or uplift beyond the rate expected based on strain accumulation. This process, known as isostatic rebound, is thought to account for increased rates of Holocene uplift from Puget Sound northward, where large glaciers retreated in the late Pleistocene (Putnam and Fifield 1995). Such rebound may be a key factor in the visibility of earlier weir sites on the northern Northwest Coast (Moss and Erlandson 1998).

Landform responses to tectonic shifts can vary within a region and even within a single estuary. For example, the southern edge of the Coquille Estuary is geologically distinct from the northern portion and it appears to have experienced less relative sea-level rise in recent millennia than the northern portion (Witter 1999). This may explain the presence of weirs over 3000 years old in a southern tributary of the Coquille just below the mean lower low water level, while weirs at sites across the valley to the north are 2000 years younger though at comparable elevation.

Within the immediate setting of a site, processes such as estuary infilling, sediment shifting and erosion may bury, expose, and destroy weir features. Estuary infilling is best documented along emerging riverbanks in the Coquille Estuary (see Chapter 5). Here riverbank levee accretion appears to be building parallel to the main channel in a downstream direction. The riverbank is estimated to have developed at a rate of over 200 meters per century between 1100 and 400 BP based on ^{14}C dates from weir features (Chapter 5). Although infilling does not affect relative sea-level change, it seriously affects site visibility, as features become buried under accumulated mudflat, riverbank, and marsh sediments. Once a site becomes subaerial (due to

uplift or receding global sea-level), soil shrinkage and swelling due to drying and flooding can affect its vertical position relative to local sea-level (Proctor et al. 1980:3-39). Additionally, erosional processes vary within and between estuaries. In settings such as the Coquille Estuary these changes can be drastic. Here sediments appear to have accumulated on the main channel floor in recent decades (possibly due to jetty construction), and stronger currents are pushed to channel margins, severely eroding the riverbank. Diking and draining also have a major effect on site preservation and visibility. The trapping of floodwaters behind a dike during an outgoing tide can lead to massive difference in volume, forcing a washout, as occurred in the winter of 1996-97 at the Philpott site (see Chapter 5). The lowest portion of the estuary may also be affected by horizontal shifts in river mouths brought about by flooding, storm surges, and other factors (Erlandson et al. 2000; Tveskov 2000:221-230).

To summarize, the preservation and visibility of weir sites on the Northwest Coast are affected by relative sea-level history and other processes. Global sea-level change is the largest factor in relative sea-level change, followed by more local effects of tectonic uplift and subsidence. Sedimentation (infilling) and erosion are also major factors determining the presence and visibility of sites along estuary shores. To understand the development of weir technologies in any given drainage, estuary, or region, the effects of such geological and human-induced landscape changes on the preservation or visibility of weir sites must also be understood.

Because of technological factors, a feature's relative age may not be easy to estimate based solely on its elevation within the intertidal zone. Diurnal tidal range varies cyclically throughout the Northwest Coast. Therefore, to function effectively in the harvest of fish over the course of the year, or even a season, a tidewater weir must be effective in a range of water depths. It may be expected that a weir would cover a vertical range from the lower intertidal to the middle or upper intertidal zone. Since weirs were frequently built across subsidiary tidal channels, they

often followed the contour of the channel from its mid-channel floor to upper mudflat margins. For the depth of the feature base (the portion best preserved archaeologically), this means a vertical range sometimes more than a meter for a single feature. This is seen in Oregon Coast weirs at 35-CS-1 and 35-LA-1103 (Chapters 4, 5). Data from these sites show that a substantial portion of the vertical range of weir feature basal elements is due to feature construction and variation in bottom conformation, and is not the result of sediment accumulation and sea-level change over time. In most archaeological contexts only the upper, lower, or middle segments of the weir feature are likely to be exposed. Thus, even in settings where relative sea-level has risen and sediments have accumulated, portions of older weirs may be higher in the intertidal zone than younger weirs. Except in cases where features are stratigraphically positioned above or below other features (e.g., the Ahnkuti site, Chapter 6) and substantial amounts of sediment have accumulated (due to processes such as subsidence, flooding subsequent to massive forest fires, and large landslides), for sites dating to the Late Holocene, relative weir elevation is only a very coarse indicator of relative age.

Modeling Social Developments and Weir Use on the Northwest Coast

As noted, the relative antiquity of weirs in various regions of the Northwest Coast may relate more to site formation processes than to cultural factors such as social organization. Yet the study of archaeological weirs has been proposed as a direction for research on the development of nonegalitarian societies on the Northwest Coast (e.g., Matson and Coupland 1995:195). To the extent that the frequency and distribution of weirs may reflect the actual frequency and distribution of weir fishing over time, several aspects of the use and productivity of fishing weirs as harvesting systems must yet be considered before an association can be made between the

presence of weirs and the development of nonegalitarian social organization. This includes both the potential returns of specific weir systems in their settings, and the social and economic context of their use.

First is the productivity of the fishing structures, involving the abundance and period of availability of the species of fishes that may have been harvested at a given weir. There has been a widespread assumption that many weirs were used for salmon nearly to the exclusion of other fish. This appears to be based in part on ethnographic overviews (e.g., Hewes 1947; Stewart 1977:99-100), which emphasize the importance of salmon harvesting in weir fishing. From this stems the contention that archaeological weirs are indicators of salmon harvesting, processing, and storage. Several researchers have asserted this relationship in some way. Referring to the Favorite Bay weir documented by Moss (1989), Matson (1992:386) noted that it is “difficult to visualize a feature such as this weir as anything but part of the technology for obtaining large numbers of salmon for processing and storage.” He also observed that the “dating of weirs, then, in conjunction with a careful examination of their setting, appears to be a very fruitful approach to examining this question of the initiation of large-scale salmon processing and storage” (Matson 1992:420).

Moss et al. (1990) based their interpretation of Favorite Bay and other southeast Alaskan weir sites as salmon fishing stations on their association with highly productive salmon streams. This view was echoed by Eldridge and Acheson (1992:114), who argued that the “presence of fish weirs 4,000 to 4,500 years ago at the mouth of the Fraser River would contradict present interpretations concerning the origin of fish traps, and by inference large-scale harvesting and storage, and the attendant development of complex societies on the Northwest Coast.”

Although salmon were vastly important to local economies throughout the Northwest Coast, there is also clear ethnographic evidence that numerous weirs were used for harvesting

other fishes. Some archaeological weir site researchers have allowed for this possibility (e.g., Pomeroy 1976; Monks 1987; Tepper 1991:70). In my own research, I consider the harvest potential of various weir features through archaeological site characterization, ethnohistoric accounts of weir use, and environmental reconstruction focusing on the estuary.

The second issue involves the social and economic factors in weir ownership, construction and use that are proposed to be related to the development of ranking and differential wealth in Northwest Coast societies. Several researchers hold that fishing strategies involving weirs have played a key role in these social developments, and that fishing (especially for salmon) was the foundation for the development of nonegalitarian societies, with pronounced wealth differentiation and social ranking or class divisions. They cite different factors as bringing about these developments, centering on the particularities of fish harvesting with devices such as weirs, and related fish processing and storage. The models that rest specifically on weir fishing can be grouped into two general categories, group management models and resource control models. Some researchers have based their arguments on both of these models.

Proponents of group management models hold that nonegalitarian societies developed through a need for organization of the work effort involved in activities such as building weirs, harvesting massive amounts of salmon, processing these fish, and maintaining long-term storage (Johnson and Earle 2000:137, 211; see also Swezey and Heizer 1993:324). Group management of harvest, processing and storage is seen as particularly important in settings where resource abundance varies seasonally. According to Schalk (1977), efficiency in processing and storage was particularly necessary in the northern Northwest Coast and in interior valleys, where the duration of salmon runs was shortest. Johnson and Earle (2000:211) argued that regulation of weir fishing by leaders prevented impacts to salmon populations or excessive delays in the runs, providing the “critical management function that overrides the tragedy of the commons.”

The foundation of resource control models is that ranking and wealth differential developed when a group controlled access to an abundant, localized, and reliable resource, such as salmon harvested at large riverine weirs. Control of the resource is maintained by establishing a residence at or near the weir fishing station (Matson 1992:373), defending or acquiring access to a station through violence (Coupland 1985:223), or by the group expending effort to build and maintain key harvesting structures such as salmon weirs (Hayden 1995). Hayden argued that on the Northwest Coast,

cooperative labor involving several families was important for the effective procurement or processing of basic subsistence resources, including the building of structures to dry and store surplus foods, the construction of weirs, and the labor required to take and process the maximum number of salmon at peak migration times Under these conditions, individuals or families that supplied capital and labor to enhance (intensify) the productivity of specific resource locations could claim not only exclusive control of that produce, but also privileged use of the resource locations (e.g., weir sites) that they had developed or enhanced (Hayden 1995:37).

Similarly, Coupland (1998:48) noted that

Productive riverine and saltwater fishing locations tend to be discrete and localized, which may have placed a premium on ownership of salmon fishing locations to ensure dependable access. Ownership of resource locations, coupled with the labor demands of large-scale procurement and processing may have led to the formation of corporate multi-family households....

These passages illustrate the importance of weir fishing for salmon in models of the development of nonegalitarian societies on the Northwest Coast. In resource control models, the group controlling the resource achieves higher status by allowing others access to the resource or by amassing a surplus for exchange with other groups.

Collectively, these researchers argue that the geographic and chronological distribution of archaeological fishing weirs, tidal or non-tidal, relates to the extent of nonegalitarian societies on the Northwest Coast. Yet relatively few researchers concerned with these social developments

have allowed for much variability in weir use beyond the intensive, seasonal harvest of salmon. Stevenson (1998:227) provided an early critique of the assumption that salmon were the exclusive target of tidal weir fishing systems used in the Fraser Estuary. I presented a similar view based on my study of the Oregon Coast data (Byram 1998), and in their synthesis of Northwest Coast weir chronology, Moss and Erlandson (1998:193) noted that weirs were often used to harvest diverse fishes and other species. There have also been numerous studies focusing on faunal remains (e.g., Hanson 1995; Bowers and Moss 2001) and non-weir fishing technologies (e.g., Stevenson 1998; Croes 1995) that echo these views.

My dissertation does not provide a new model for the development of social ranking on the Northwest Coast, and in fact I present only limited information on the social organization in this region. Instead, I address the fishing technology criteria laid out in these models with data available from the Oregon Coast, while examining the scope and range of variability in weir fishing data from this region.

The Native Peoples of the Oregon Coast

The Native peoples of the Oregon Coast suffered devastating assaults on their homelands during the 19th century, as European and American explorers and settlers moved into the area. They also experienced great losses from newly introduced diseases (Boyd 1999a). Oral tradition and documentary sources indicate that prior to these losses, populations were dense throughout the coast and in some nearby inland areas. The village was the political unit and groups were designated by village names. However, broader names were applied to communities based on the river valley they resided in (e.g., Siuslaw, Coos) or based on the language they spoke (e.g., Tillamook).

Distinct social class divisions were recognized among these communities, as they were in other parts of the Northwest Coast (Barnett 1934[1]:1; E. Jacobs 1934a[106-7]; M. Jacobs 1934[96]; Zenk 1990:576; Moss and Erlandson 1995b; Tveskov 2000:71-78). According to Barnett (1937:185) social ranking was related to wealth differentiation in all Oregon Coast groups. While the scale of social ranking and wealth differential in this region may have been different from that seen in other parts of the Northwest Coast and in Northwest California, it is clear that a nonegalitarian social structure prevailed through the region at the time of Euro-American incursion. The economic foundation for these social developments has not been a topic of extensive anthropological research.

Based on the historic and ethnographic sources detailed in Chapters 2 and 3, the following summary of traditional Oregon Coast economies is possible. The distribution of Native communities and their resource use between the Nehalem and Coquille rivers on the Oregon Coast formed a complex web across the landscape, covering a narrow stretch along the shore the length of the region, and extending inland at larger streams and river valleys. At estuaries, where tidewater reached 5 to 70 kilometers inland, Native use of the landscape involved enhanced plant and animal habitats, fishing stations, elk pits, woodworking areas, and a host of other activity areas. The communities located along the shores of the tidal rivers were composed of small and large houses often built of split wood planks and timber frames, work sheds and work yard areas, sweat lodges, large dance houses where winter gatherings were held, gaming fields where festivals took place in warm weather, canoe haulouts, extensive outdoor food drying racks, and tobacco gardens in sheltered areas near the villages. Less is known about communities along the rocky shores of the outer coast, or lakeshore settlements inland from the dunes, but diverse activities were probably represented in the layout of these communities as well.

Activities changed through the course of the year in Native communities. Along the estuaries and on the outer coast, many food resources such as marine fish and shellfish were probably harvested throughout the year, but some of the most valued foods had to be harvested in quantities, processed, and stored when they were available. These included salmon, drift whales, other sea mammals, starchy plants such as camas and fern roots, and elk, typically hunted in summer or fall only. Summer travel often took village residents to inland valleys or north and south along the coast for trade, gaming, and socializing. When adequate stores were acquired at the village, people again had time to travel and visit relatives or attend large gatherings at other communities on the coast. In fall, many people left the estuarine villages to go above tidewater to fish for salmon. Winter was a period of less outdoor work activity, when most village residents remained at home and relied largely on stored foods. Stories were told, dances were held, and tools, clothing, basketry, and other crafts and art were produced and maintained. In spring, various plants and marine fish became abundant, and the tides were low on the shore for shellfish harvests. In late spring and summer the anadromous eels and Chinook salmon would become available above tidewater, and groups would move to upriver camps to begin their harvests, and to gather and process plant foods such as camas.

Like coastal peoples in many parts of the world, the Native people of the Oregon Coast lived in comparatively large residential groups or villages, and they oriented their transportation and subsistence to diverse resources available within village catchments. It is the complex relationship between food-getting strategies and social relationships that forms the anthropological focus of my analysis. I examine aspects of the relationship of Oregon Coast peoples to their environment, addressing theories of the development of wealth differentiation and social ranking in a setting of abundant and diversified resources.

CHAPTER 2

ENVIRONMENTAL AND CULTURAL CONTEXT

In this chapter I address the cultural and environmental settings of archaeological weir sites on the Oregon Coast. Researchers of Oregon Coast history and archaeology sometimes assume certain patterns in the relationship between Native residence and environmental settings in the region, both historically and archaeologically (Minor and Toepel 1983; Lyman 1991:82-83; Erlandson et al. 1998), yet many of the most detailed and reliable sources of this information are unpublished and relatively inaccessible. The first part of this chapter systematically relates broader variability in Oregon Coast environments to historic Native residential patterns. In the second part, I present a more detailed characterization of the region's estuaries, resource abundance in these settings, and variability relating to tidewater fishing practices and the archeological visibility of weir sites.

Ecological Zones and Ecotones

The Oregon Coast extends from the mouth of the Columbia River southward to the state's border with California, near the Winchuck River. This is a region of heavy annual precipitation (200-300 cm annually), much of it falling between November and May (Proctor et al. 1980:2-32-44). Very little precipitation occurs in June, July, and August. Snowfall is limited at lower elevations due to moderate year-round temperatures influenced by the Pacific Ocean. Due to the prevailing onshore flow of moist marine air, cloud cover ranges from approximately two weeks per month in summer to less than one week per month in winter. These conditions strongly influence local ecology, producing dense forests, perennial springs, strong seasonal river

flow, and seasonal variability in estuarine habitats (Proctor et al. 1980:2-32-44). Estuaries are small or nonexistent in the streams of the extreme southern portion of the Oregon Coast. Therefore, the study area I have chosen for this project lies between the Nehalem River in the north and the Coquille River in the south (Figure 2).

The Oregon Coast is highly dynamic in terms of its geology, hydrology and biology. Few portions of the coast today retain features of late Pleistocene to middle Holocene shorelines, and processes of change are so rapid that archaeological sites can become exposed and erode completely within a few years (Komar 1997; Erlandson and Moss 1999). Onshore, the region is bracketed in the east by the mountains of the Coast Range, which extend westward to the coast in places, forming headlands (Baldwin 1981). Between these headlands there are dune sheets, marine terraces, and expansive coastal alluvial plains. Some of these low gradient valleys extend several miles inland, as in the Tillamook and Coquille valleys, and lands suitable for residential use are adjacent to nearly all coastal rivers.

Ecologically, the landward portion of the study area lies within the southern portion of the Coast Range ecoregion (Boyd 1999b:6). Onshore vegetation is dominated by conifers, including Sitka spruce (*Picea sitchensis*), western hemlock (*Tsuga heterophylla*), Douglas fir (*Pseudotsuga menziesii*), and western redcedar (*Thuja plicata*). Vegetation is more dominated by conifers in the northern part of the region, with prairies occurring in inland valleys, on headlands, and occasional upland prairies. To the south, mixed woodland and upland prairie openings are more common, particularly on the forks of the Coquille River and southward. These prairies may be largely anthropogenic, and they provided the greatest abundance of flora for human use, including various ferns and grasses, root and bulb plants, and berries. Openings in forests appear to have been more common in the past (Benner 1991; Alabak and Pojar 1997; Boyd 1999b:25; Byram and Ivy 2001). West of the Coast Range, oak (*Quercus* spp.) and possibly hazel (*Cornata*)

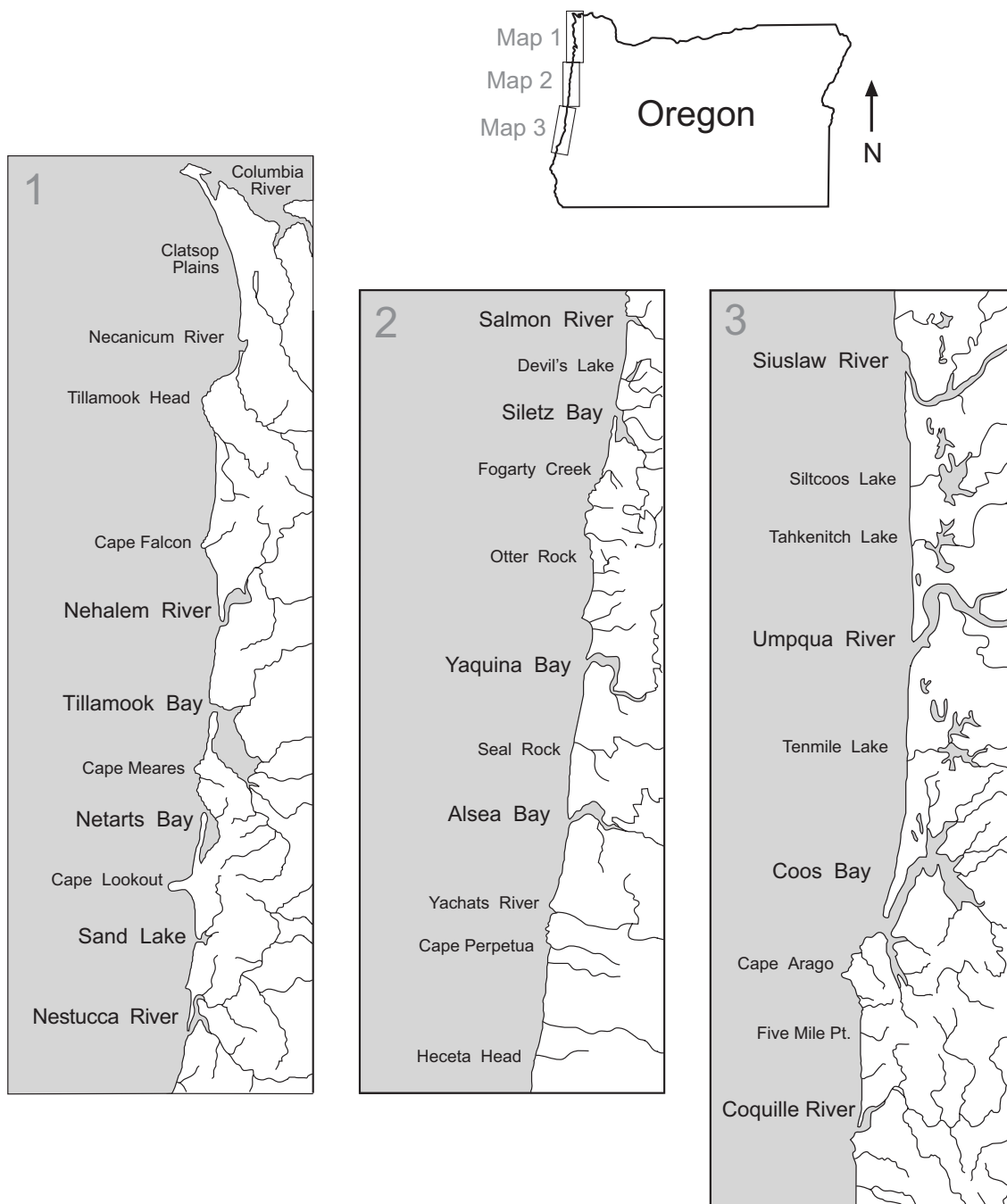


Figure 2: Map of the Oregon Coast Study Area (The names of surveyed estuaries appear in larger, italicized fonts; other labeled locations are mentioned in the text).

trees are much more common in the south, and it appears that in the past camas (*Camassia* sp.), wild oats (*Madia* spp.), and other seed, bulb, and root plants were also most prevalent in the southern part of the region. This gradient also occurs moving inland from the northern Oregon Coast, as the Willamette Valley and other interior valleys were more diversified in flora historically. Rainfall, sunlight, and geology appear to be key factors in these biotic gradients (Alabak and Pojar 1997).

The Oregon Coast shoreline, and immediate onshore settings, can be subdivided into nine biomes, or “ecological zones.” These environmental subdivisions are based largely on biomes recognized by biological researchers (Proctor et al. 1980:1-6, 3-8, 3-9; Alabak and Pojar 1997; Simenstad et al. 1997). In outlining these divisions, I also integrate distinctions made in the region’s historic and ethnographic records. This classification serves as a framework for considering the relative importance of different ecological settings for Native peoples’ residential and subsistence practices. The term catchment is used to mean a radius of localities accessible from a residence on a daily basis.

Of the nine ecological zones outlined for this study, *upland forests* are the most pervasive, occurring in a discontinuous swath across the entire study area. *Upland prairie* is far less prevalent, but it also occurs in many parts of the region, often as small patches within other ecological zones. The other seven zones include two in the mountain-shore ecotone (*rocky shores* and *coastal stream corridors*), two in the coastal river valley ecotone (*estuaries* and *valley bottomlands*), and three in the dune sheet ecotone (*beaches*, *dunes*, and *freshwater lakes*). The general character of each of the nine ecological zones is outlined below, emphasizing the importance of each for traditional Native economies.

Upland Forests

Forests of the coastal region are predominantly coniferous, and historically they were dominated by Sitka spruce, western hemlock, Douglas fir, shore pine (*Pinus contorta*), and western redcedar trees. Some of the most common forest undergrowth includes sword fern (*Polystichum munitum*), salmon berry (*Rubus spectabilis*) and several other berries, salal (*Gaultheria shallon*), and devil's club (*Oplopanax horridum*). In riparian zones and openings in the conifer forests, hardwood trees and various shrubs are abundant, including big leaf maple (*Acer macrophyllum*), alder (*Alnus* spp.), vine maple (*Acer circinatum*), and willow (*Salix* spp.). The upland forest ecological zone occurs through much of the study area, including the hills that surround water courses and lowlands (Proctor et al. 1980:3-4). Riparian forests in particular are recognized as “the ‘keystone’ ecosystem or the central hot spot of diversity in coastal ecosystems” (Alabak and Pojar 1997:73-74). Numerous resources used traditionally by Oregon Coast peoples are available in the coastal forest ecological zone, including a variety of game, food plants, and raw materials for various technologies. In general, biodiversity and biomass are very high in this zone, although these resources were not used intensively prior to industrial development in the region. Because of its wide extent within the region, access to the coastal forests was likely within the catchment of all Native communities.

Upland Prairies

Upland prairies are habitats where grasses, shrubs, and ferns grew in abundance, including numerous food plants such as berries, camas, wild oats, and in oak savannah settings, acorns. Upland prairie settings ranged in size from small clearings in a forest to vast, open terraces in river valleys and treeless outer coast headlands. As elsewhere in western Oregon, this ecological zone would likely have been rare on the Oregon Coast if not for controlled burning by

Native peoples (Cotton 1915:73; E. Jacobs 1934[106]:22, 1934a[107]:25; Harrington 1942[23]:236, 377; Johannesson et al. 1961; Boyd 1999b). Ecologists Paul Alabak and Jim Pojar (1997:76) argue that Native burning determined the forest makeup in much of the region historically. The great fires that burned across western Oregon between the mid 1800s and the early 1900s may have resulted from a build up of fuel following curtailment of traditional burning. Although many prairies have been replaced by forests or destroyed by construction over the past century, prairies with few or no trees were common on the Oregon Coast in the mid 19th century (Talbot 1851; Davidson 1889:394-443; Benner 1971). Some remain preserved today (Davidson 1967; Byram and Ivy 2001:14).

Detailed data for these historic plant communities are not available, though plants mentioned in many accounts include grasses, ferns, salal, numerous berries, and several edible roots. In addition to providing food plants for humans, these open settings provided important browse for deer and elk. Ethnohistoric data suggest that prairies were within catchment radii of most Native residences. However, because there is a strong possibility that Native people created or enhanced these conditions near their villages or camps, it may be more appropriate to view this setting as a product of human activity, rather than an ecological zone that attracted Native communities.

The Mountain and Shore Ecotone

Rocky shores occur where mountains or rocky marine terraces meet the ocean shore. In these outer coast settings sediments are scoured away by wave action and erosion, leaving exposed rock headlands, outcrops, and intertidal shelves, often interspersed with small, narrow beaches. A variety of resources used by Oregon Coast peoples is available here, including rich

littoral resources such as shellfish, small vertebrates, and sea plants, as well as sea mammals, sea birds, and various terrestrial resources. Rocky shores and associated reefs also support large fish populations, particularly where kelp beds were present (Jackson et al. 2001; Hatch 2002). Several sea mammal habitats are also located at or near rocky shores (Lyman 1991:99). Additionally, canoe launching for offshore fishing, marine mammal hunting, and travel is facilitated by conditions in coves leeward of prevailing winds or in areas between rocky headlands. These characteristics may have encouraged Native people to reside at or near rocky shores.

Due to high rainfall along the Oregon Coast, *coastal stream corridors* are numerous in the region. There are several small to mid-sized streams in the more mountainous portions of the Oregon Coast. Most are relatively steep, with narrow valleys and canyons, and lack intertidal estuaries at their mouths. Although the margins of these streams are densely forested, many have open prairies along their lower-gradient inland segments. These streams support abundant game, and seasonally abundant fishes including salmonids and lamprey. Riparian corridors hold many traditionally important plants used for food and technologies. Canoe travel is generally quite limited in these streams because of their steep gradients. This ecological zone is not used as a separate category in analyzing settlement. Instead I group it with the rocky shore setting. Nonetheless, there may be important variation in residence distribution as it relates to stream size, fish runs, and other characteristics of freshwater streams on the Oregon Coast.

Coastal River Valley Ecotone

Estuaries are the tidally influenced portions of coastal basins where freshwater and saltwater mix (Pritchard 1967). In other settings, estuaries range from large bays such as Puget Sound to smaller freshwater river mouths with minimal tidal influence, such as the rivers and

streams of the southern Oregon Coast. Thirteen estuaries occur within my study area, ranging in size from Sand Lake at 2.1 km², to Coos Bay at 50.1 km² (Proctor et al. 1980:2-49). Most Oregon Coast estuaries are the lower portions of rivers that drain the Coast Range (Proctor et al. 1980:2-49; McDowell 1987:554). Estuaries are the most diverse ecotone on the Oregon Coast; numerous marine and anadromous fishes are abundant (Monaco et al. 1990-91), and sea mammals, waterfowl, and tidewater plants are also available in this setting. Tidewater is often ideal for canoe travel. Additionally, terrestrial animals such as deer and elk, aquatic furbearers, and waterfowl frequent the margins of estuaries, and these settings are bracketed by biologically diverse riparian corridors and upland forests. Portions of estuaries may also be located near beaches, freshwater lakes and rocky shores. Thus, estuaries were attractive to Native peoples for many reasons. The abundance and diversity of resources in this setting, particularly marine and anadromous fishes, appears to have provided subsistence for many Native communities.

Valley bottomlands are represented by the low gradient portions of the larger river valleys, beginning at the upper reaches of tidewater and extending inland from the coast. They include those valleys where extensive swamps, brush stands, and mixed hardwood forests were present. This setting has been greatly altered historically, and many of these bottomlands are now open agricultural lands (Benner 1971). Of the coastal rivers within my study area, only the Umpqua drains extensive land east of the Coast Range. Expansive interior valleys occur at or near the heads of most of the coastal rivers in the study area. Most of these valleys could be reached in less than two days canoe travel by people from residences at or near the outer coast (Talbot 1851:112; Scholfield 1855; Williams 1878; Harrington 1942[24]:160). The forest and grassland resources of some valley bottomlands are highly diverse, including species of the coastal forest as well as dry interior species (Alabak and Pojar 1997:76). These include roots, nuts, and other food

plants, anadromous fish, and game including elk and deer. Trade with groups from east of the Coast Range could also be conducted at interior valley residences.

The Dune Sheet Ecotone

Occurring on the outer coast, *beaches* are intertidal shores where sandy sediments accumulate through wave and wind action (see McDowell 1987:544-548; Komar 1997:32-33). The beaches extending southward from the Siuslaw River to Coos Bay occur along the largest dune sheet on the coast of the United States. Other smaller dune sheets occur throughout the study area, separated by rocky shores. The resources available in the sandy beach zone include fauna such as shellfish, drift whales, marine fish, shore birds, and surf smelt. Beaches were important travel routes through much of the region. Although ready access to a beach was probably important for many groups, the pervasive winds in this exposed setting would have made residence difficult at this land-sea ecotone during much of the year.

Dunes include hills and terraces of beach sand that back beaches along the outer coast. Some dune areas are forested, and over time soil development may transform dunes into vegetated coastal plains or upland forests, as seen near the mouth of the Siuslaw. Numerous freshwater lakes occur among dunes, but in the dunes themselves, resources used by Oregon Coast peoples are not abundant. Except where dunes converged with other ecological zones, Native communities do not appear to have used this setting extensively.

Most *freshwater lakes* on the Oregon Coast were formed as dunes built up on the outer coast, sealing off estuaries or forming large, deflated basins (McDowell 1986). Lakes with dunes along their western margins are most common on the central coast, where the largest stretches of dunes occur. Each of the lakes discussed in this study has an outlet stream that flows into the

ocean. Oregon Coast peoples used multiple resources at this ecotone, including anadromous fish, freshwater fish, various terrestrial food plants and game, and other forest resources. The use of canoes allowed efficient movement between points on the shore, or upstream and downstream from the lake. Although not as diverse as the estuary or rocky shore ecotones, freshwater lakes did support Native communities, and lakeshore residences grew in size during late spring and early summer when lamprey and salmon were fished.

Each of these nine Oregon Coast ecological zones was important to the subsistence of Native peoples, yet some were more suited to permanent, large scale residence for Oregon Coast peoples historically. To examine these relationships, I now consider the extensive published and unpublished ethnohistoric information about the geography of Native residential sites throughout the study area.

Residential Patterns

The two main sources of primary data on residential geography for this study are ethnographic field notes and historic documents. The former consist primarily of oral histories from Native elders, recorded in the early decades of the 20th century by anthropologists and linguists. The historic document sources consulted include maritime ship logs, fur trade journals and correspondence, U.S. Military reports, missionary observations, U.S. Coast Survey records, General Land Office survey reports, Indian Agency documents, journals and letters of settlers, early published historical works, journalist observations, and early western nonfiction publications. These sources vary considerably in quality and scope. In most cases the Native accounts and observations from other sources came from people who observed the communities

they described. The earliest sources date to the late 19th century, but records become more detailed in the 20th century.

The 19th century was a time of devastating change for Native people on the Oregon Coast. Diseases reduced populations by as much as 90 percent in some areas (Boyd 1999a), and some peoples, such as the Siletz Tillamook and the Yachats Alsea, were almost completely wiped out before the 1850s (E. Jacobs 1934[120]:11; Harrington 1942[26]:75). Most of the people who survived epidemics were forced to leave their homes and many were killed in massacres or died due to conditions at the Coast Reservation camps in the 1850s and 1860s when Euroamericans began to rapidly settle the Oregon Coast (Palmer 1854:10-12; Tveskov 2000; Wasson 2001). American settlement on the coast in the 1850s displaced thousands of people, and many of the Native elders who provided accounts cited here lived in these displaced communities.

Although devastating, these impacts did not wipe out Native culture and oral tradition. Elders who survived the ravaging years imparted cultural history to the younger people in their communities and sometimes to scholars with notebooks. The largely unpublished ethnographic notes of Philip Drucker, Leo Frachtenburg, Elizabeth and Melville Jacobs, John Harrington, and others contain much information on traditional residence patterns.

These Native oral history data, combined with written accounts from early Euroamerican observers in the region, are sufficient to assess broad patterns in Native land residence types, their distribution, and their relationship to local ecology along the Oregon Coast during the first half of the 19th century.

Definition of General Residence Types

Two basic residence types were distinguished for this study: camps and villages. Camps are defined as short-term residences, occupied for a period between a few nights and one season, and villages are defined as long-term residences occupied for multiple seasons or the entire year. Most of the sites or localities identified as residences were described as specific communities, camps, or villages, and names were given for many of these residential localities.

The data overwhelmingly indicate that the predominant residence strategy for Native groups on the central and northern Oregon Coast involved a permanent residential community (village) and temporary residential sites (camps) usually located outside village catchment areas. In many cases people lived in a village throughout the year, but it was also common for groups of village residents to visit other communities and to establish short term camps at locations to carry out various activities, such as fishing or plant harvesting. Thus, the population of most residential localities fluctuated considerably. During the peak of a salmon or lamprey run, scores of people might camp at a good fishing station, and at these times the villages may have held fewer occupants than such fishing camps (Chapter 3). Therefore, population size alone does not indicate a residence is a village or a camp. Similarly, during a shinny (team sport) tournament the residents of several villages would converge at one village for a period of days or weeks.

In most Native accounts, the distinction between camps and villages is evident in the description of a residence, such as “my mother’s village” or “the place where the Indians used to camp when hunting sea lions.” Similarly, observer documentary records usually distinguish between villages and more temporary sites. When possible, I have tried to confirm these observations by comparing accounts of the same locality and by considering seasonality information. If a residence was occupied during different seasons when observers passed through

the area, I classified it as a village. I also interpret the presence of plankhouses or excavated pithouses as indicating a village.

When villages or camps cannot be distinguished from the available data I use the term “residential locality” to refer to these generally. In a few cases, residences are indicated but specific sites are not mentioned. For example, the statement “X was the name for the people living on the coast between the Y and Z rivers,” indicates residences were present in this location, but lacks specifics on these communities. Areas such as this are categorized as “villages or camps.”

Comparing the Size and Frequency of Residential Localities

Due to limitations in the data, I compare residence size and frequency only at a very general level. Many Native communities were spread out over a large area, and boundaries between villages and camps are not always clear. The use of canoes for daily activities necessitated that many houses were distributed in a linear arrangement along river banks or the ocean shore. Therefore, in distinguishing single residences from multiple residences located close together, I rely on distinctions made by the Native elders or outside observers. When accounts of residence boundaries are ambiguous, I lump communities rather than split them. Comparisons of population size are made only at the most general level.

Although these are not the focus of my study, nonresidential activity areas are also represented in the ethnohistoric data. Villages and camps were frequently used as bases from which other parts of the landscape could be visited for various purposes. For example, a village or camp might have access to several mussel gathering and processing stations within its catchment, as well as plant gathering areas, elk hunting grounds, fishing stations, etc. – all potentially non-

residential activity areas. Descriptions of activities at nonresidential localities provide important information regarding the relationship of villages and camps to local ecology.

Archaeological evidence of residential patterns has not been incorporated here because it is often difficult to differentiate residential sites from non-residential work stations, and except in limited instances it is even more difficult to distinguish short-term residences from long-term ones archaeologically. Most archaeologically identified villages (i.e., sites with house remains) are also known ethnohistorically and archaeological sampling is very sporadic through the study area (Moss and Erlandson 1995a,b).

Frequency of Residence Types at Oregon Coast Ecological Zones

Although I discussed nine ecological zones as representing the context of Native residences of the Oregon Coast, only five are represented in Table 1. These five zones are the settings of most permanent and temporary residential localities in the study area historically. The upland prairie and forest settings are grouped together, as many accounts do not specify the ecological landscape of inland residences.

For the 18 geographic areas where residences occur, camps and villages are roughly comparable in number, although several are unspecified. This patterning would be expected if people had access to an abundant and diverse resource base from permanent villages. However, it may also be due in part to an inherent sample bias in historic accounts. Long-term residences are more likely to have been occupied and recorded than short-term residences when observers traveled through a study area. Native oral history is a better source of information about camps, but some of these accounts may emphasize more familiar camps to the exclusion of others. As a result, it is likely that camps (i.e., residential localities used for a single season or less) were more

Table 1. Ecological Settings of Villages and Camps in the Oregon Coast Study Area. (Major sources are listed in the last column, except for the John P. Harrington [1942] notes, covering most areas.)

Area	Rocky Shore	Coastal Lake	Estuary Shore	Valley Bottoms	Prairies & Forests	Sources
Nehalem River	--	--	large villages	village & camps	camps	Vaughn n.d.; Suphan 1974; E. Jacobs 1934a
Tillamook Bay	camp	n/a	large villages	--	--	Vaughn n.d.; Moulton 1983; E. Jacobs 1934a
Netarts Bay	--	n/a	villages	n/a	--	E. Jacobs 1934a
Nestucca/Neskowin	camp	n/a	large villages	--	camps	Byram and Kentta 1998 Pipes 1934
Salmon River-Devil's Lake	--	village camp	large village	camp	camps	Barnett 1934; Byram and Kentta 1998
Siletz Bay	n/a	n/a	villages	villages	camps	Byram and Kentta 1998; Talbot 1849
Fogarty Creek-Cape Foulweather	villages & camps	--	n/a	--	--	Byram and Kentta 1998
Yaquina Bay	village or camp	n/a	large villages	villages	camps	Dorsey 1890; Drucker 1939
Seal Rock/Beaver Creek	large village	n/a	n/a	--	--	Byram in prep.; Drucker 1939
Alsea River	--	n/a	large villages	village	camps	Dorsey 1890; Drucker 1939
Yachats River	large village	n/a	n/a	camps	--	Drucker 1939; Byram and Kentta 1998
Cape Perpetua-Heceta Head	villages & camps	n/a	n/a	--	camps	Scholfied 1855; Byram and Kentta 1998
Siuslaw River	n/a	villages	large villages	villages	camps	Severy 1960; Byram and Kentta 1998
Siltcoos Lake-Tahkenitch Lake	n/a	villages &/or camps	n/a	--	--	McLeod 1826; M. Jacobs 1934; Sullivan 1934
Umpqua River	n/a	village	villages	villages	camps	Hines 1851; Sullivan 1934
Tenmile and Eel Lakes	n/a	villages and camps	n/a	--	camps	U.S. Court of Claims 1931; Tveskov 2000
Coos Bay and Cape Arago	villages	n/a	large villages	--	villages, camps	M. Jacobs 1934; Tveskov 2000
Coquille River & Fivemile Point	camp	n/a	large villages	large villages	villages, camps	E. Jacobs 1934; Tveskov 2000

widely distributed than indicated in Table 1. Nonetheless, most Native people on the Oregon Coast appear to have spent the better part of the year in villages that were their primary place of residence.

This tabulation is a very general representation of complex residential activities. The catchment of most communities reached across multiple ecological zones. At the richest and most diverse ecotones, the resource use tied to a single residence formed a mosaic across the landscape. Nonetheless, some zones were clearly more important as residences than others. None were reported at beaches or in dunes, except for forested sand hills at estuary or lake margins and villages or camps at estuary sand spits. Dune and beach settings were likely used for incidental travel camps, or for temporary staging areas for drift whale processing. Similarly, upland forest camps were rarely reported except for travel camps and those upland settings where prairie openings were maintained for game habitat and edible plants.

My analysis of residence location suggests that villages occurred most often on estuary shores. Accounts indicate that multiple larger villages were present at 8 of the 13 estuaries in the study area, and numerous large villages were located in only one other setting, the interior valleys of the Coquille River. Estuaries that were the locus of population centers on the Oregon Coast include the Nehalem, Tillamook, Netarts, Nestucca, Salmon (or Nechesne), Siletz, Yaquina, Alsea, Siuslaw, Umpqua, Coos, and Coquille. Of the estuaries in the study area, only Sand Lake is not recorded as the locus of residences, this being the smallest and perhaps the least biologically productive of the 13 estuaries. The size and permanence of these settings is also indicated by the relationship of tribe names to villages at these estuaries. In most cases the recorded name of the estuary corresponds to the name of the tribe on a particular portion of the coast. This is not the case for outer coast communities such as the Baldiyaca of the Cape Arago

rocky shore (Tveskov 2000), or the small tribe dwelling between Cape Foulweather and Whale Cove (Harrington 1942[20]:612).

General ethnographic accounts also support the prominence of estuary shores as residential centers. For example, Drucker (1939:81) observed that in the homelands of the Yaquina and Alsea peoples, “[m]ost of the villages, or at least the more important ones, were situated between the mouths of rivers and the head of tidewater.” Based on an interview with Clara Pearson, Elizabeth Jacobs (1934a[81-74]:103) observed that for the Tillamook, permanent dwellings were in clusters around the estuaries and bays above tide flats. Similarly, Melville Jacobs (1934[99]:17) observed that among Coos and Coquille peoples,

houseclusters or villages, of only a few houses each, were found not on sandy beaches proper, but on the alluvial banks above, always in fairly sheltered spots along tidewater inlets or streams: mainly about the lower few miles of the Coquille River, and around the shores and sloughs of Coos Bay some twenty odd miles to the north. The intervening area was unoccupied, save for a few villages in some slightly sheltered beach coves and at Coos Bay lighthouse.

There appear to be many reasons why Native people chose to reside along estuary shores. The estuary ecotone is of unmatched richness in the region, and for many, residence in this setting provided daily access to beach, forest, and often rocky shore settings. Moreover, both marine and anadromous fish were frequently caught in this part of the estuary. Estuaries also tend to be centrally located between outer coast, marine, riparian, and various upland habitats. Thus, at estuaries, Native people resided where ecological diversity was greatest. In fact, the data indicate that at most estuaries, residences were most numerous and populations highest at the lower and middle portions of the estuary, where marine-influenced ecological diversity was greatest. The abundance of marine and anadromous fishes available in this part of the estuary may have been a key factor.

Ethnohistoric data also indicate that villages were located in non-estuary environments. Of the 12 clearly specified village localities outside estuaries, five were on rocky shores, five were at freshwater lakes with outlets to the ocean, and two were in upriver areas. Notably, of the five rocky shore villages outside estuaries, four were located in rocky shore areas near locations where sea mammal haulouts existed historically (Lyman 1991:99). These rocky shore areas include (from north to south) the coastline between Tillamook Head and Arch Cape at Seal Rock, from Yachats to Heceta Head, and from Coos Head to Whiskey Run. None of these outer coast residential localities appears to have been comparable in population size to the larger communities at estuary shores.

The data indicate that multi-season villages were located at a minimum of three freshwater lakes, Devil's, Tahkenitch, and Tenmile, and probably Siltcoos and Sutton lakes. These and other lakes on the central Oregon Coast were important sites during seasonal fish runs, and the inhabitants of these communities likely relied heavily on processed and stored salmon and lamprey, particularly during winter months.

Finally, there appears to have been one exception to the estuary/interior residential pattern in the coastal river valley ecotone. Numerous large communities resided year round on the forks of the Coquille River, above or near the head of tidewater, and often at prime fishing stations (M. Jacobs 1934[99]:17; Tveskov 2000). The village residential pattern in the upper portion of the Coquille Valley may relate to ecological factors. The Coquille River is the southernmost coastal river in the study area, and at this latitude, the coniferous forests of the Coast Range are interspersed with mixed woodland forests and open, grassy valleys (Benner 1991; Alabak and Pojar 1997; Byram and Ivy 2001). The abundant wild oats, camas, hazel, oak, and other plant resources of this interior region appear to have been key in the establishment of more permanent Native communities here (Tveskov 2000:109-114). On the Oregon Coast south

of the Coquille, a continuum of residence on coastal streams, from mouths to headwaters, characterizes the rivers and larger streams (Abbott 1858; Drucker 1939; Draper 1988; Tveskov 2000).

Camps, or shorter-term residences, were common in several settings on the central and northern Oregon Coast. These include fishing stations at the head of tidewater and in upriver areas (e.g., the first rapids on the upper Siuslaw and Nehalem rivers), hunting areas in the uplands (e.g., Clover Ridge north of Florence), interior valleys where inland plants were available (e.g., the Alsea and Siletz river valleys), sea mammal hunting areas near rocky shores (e.g., Cape Creek near Sea Lion Point), and localities where freshwater streams meet the ocean (such as Neskowin Creek and Yachats River). There are also several accounts of people visiting relatives or camping at estuary shore settings for fishing. Sometimes small villages doubled as large camp sites, especially during fish runs or camas gathering events.

Catchment Radius and Residence Patterns

Multiple ecological zones would have been within the catchment areas of residences in each geographic area. Figure 3 depicts idealized residential patterns and catchments on the Oregon Coast. Villages near an estuary mouth may be located near forest, beach and rocky shore settings, in addition to the estuary. It might be estimated that residents of a village or camp would travel up to two hours to and from a resource gathering area on a given day (cf. Bernick 1983). Thus, residents of the large village of Tsisniwutch at Salmon River had access to the rocky shore at Cascade Head, but the Siuslaw village of Quat-Quat-Clee (Severy 1960) was located too far away for daily access to the rocky shore at Heceta Head.

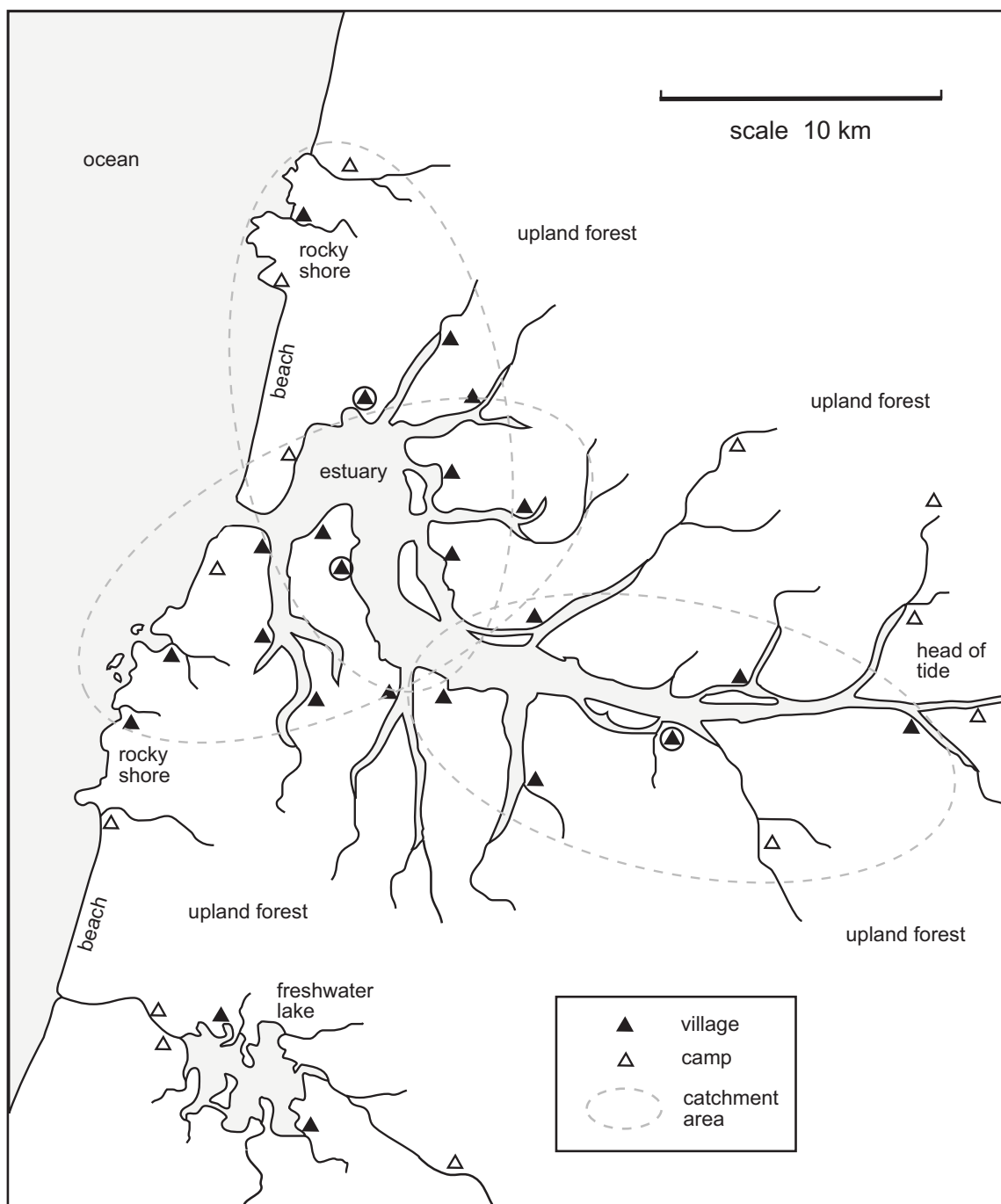


Figure 3: Idealized Distribution of Villages, Camps, and Catchment Areas on the Oregon Coast. (The three catchment areas correspond to the three circled villages.)

Catchment radii vary depending on mode of travel. Although there were numerous trails in the study area historically, a canoe travel catchment is likely to have been larger than a pedestrian catchment. Similarly, round-trip canoe travel on smooth water in estuaries and lakes is likely to be greater than canoe travel on non-tidal rivers and the ocean, particularly when travel is synchronized with tidal currents. Thus, the catchment area is largest in estuaries and coastal lakes. However, more ecological zones are accessible within the Coastal River Valley ecotone than in the Dune Sheet ecotone, and thus estuaries are the best settings for access to diverse resources over a wide area.

On the Oregon Coast and adjacent inland settings, the most numerous and most populous residential settings were the shores of estuaries in the area that were protected while being heavily influenced by ocean waters. Biotic richness was a key factor in making this the best setting for work and residence. Estuaries are among the most biologically productive settings on the planet, “supporting more plant and animal growth per unit of area than even the best agricultural lands” (McConnaughey and McConnaughey 1986:76; see also Proctor et al. 1980:3-77). In addition to being highly productive, estuary resources could be harvested en masse with techniques such as weir fishing. The diverse, abundant resources available in and near the region’s estuaries, along with the combination of canoe and pedestrian travel, set the stage for a kind of “commuter economy” in these settings. Archaeological harvesting or processing station sites within the catchment of estuary villages are likely to occur in diverse settings, reflecting numerous work activities. Diverse activities are also likely to be represented at the residential sites themselves, which are likely to be most common in estuary shore settings suitable for permanent architecture and village layout.

The Estuary Setting of Fishing Sites

Ecologist Charles Simenstad (1983:4) identified four types of estuaries in the Pacific Northwest: drowned river valleys produced by rising sea-levels; fjords formed by glacial action and sea-level rise; bar-built estuaries formed by sediment accumulation across a river mouth; and estuaries created by faulting and other tectonic processes. The estuaries in my study area include drowned river valleys and bar-built estuaries. While all Oregon estuaries are river valleys drowned by rising sea-levels (Proctor et al. 1980:2-49), those classified as bar-built have bays largely configured by dune sheet dynamics. All the region's estuaries occur in coastal plain settings surrounded by ridges, plateaus, and mountains.

Further classification of Oregon estuaries may be possible based on marine and riverine influence, and topography relating to hydrology (Duxbury 1987). Yet, as Proctor et al. (1980:2-50) noted, "Classification of (Northwest) estuaries by salinity intrusion and mixing is simply not documented well enough yet, and within any estuary may change drastically in time and space."

Comparative characteristics of Oregon estuaries are presented in Table 2. The tidewater area of most Oregon estuaries is small compared with San Francisco Bay to the south, and with most of the estuaries farther north on the Pacific Coast of the United States. Intertidal area ranges from 1 to 50 km². Daily tidal range in these estuaries averages over 2 meters and tidal currents range from 1-2.5 knots (0.5-1.4 m/sec) (Proctor et al. 1980:2-50). The shallower estuaries such as Netarts and Siletz bays possess substantial intertidal zones, representing up to 70 percent of estuary surface area. Others, such as the Yaquina and the Umpqua, have deeper bays and narrower intertidal margins (Proctor et al. 1980:2-56).

Estuaries of the Oregon Coast are short-lived geologically, no more than 10,000 to 15,000 years old (Maser and Sedell 1994:57; Komar 1997:30-23). Created by rising sea-levels,

Table 2: Characteristics of Estuaries in the Study Area (after Proctor et al. 1980:2-49; Simenstad 1984:26-29).

Estuary Name	Total Area (km ²)	Intertidal Area (km ²)	Mean Ann. Drainage (hm ³ yr ⁻¹)	Estuary Type	Channel Morphology
Nehalem	9	4	77	bar-built	fixed, dendritic, braided
Tillamook	34	17	1080	bar-built	fixed, dendritic, braided
Netarts	9	6		bar-built	fixed, dendritic
Sand Lake	2	2		bar-built	fixed, dendritic
Nestucca	4	2		bar-built	fixed, dendritic
Salmon	1	1		drowned river valley	fixed
Siletz	5	3	1404	bar-built	fixed, dendritic
Yaquina	16	6	219	drowned river valley	fixed, dendritic
Alsea	9	4	1362	bar-built	fixed, dendritic
Siuslaw	9	3	259	bar-built	fixed, dendritic, meandering
Umpqua	28	6	6604	bar-built	fixed, dendritic, braided
Coos	50	25		bar-built	fixed, dendritic, meandering
Coquille	3	1	960	drowned river valley	fixed, dendritic

riverine sedimentation, and wind and wave action, these estuaries undergo continuous changes. As much as 72,000 tons of sediment can flow downstream into an estuary in a single year (Schultz 1990:167). As river-borne sediments reach tidewater, they slow and a portion of the sediment is deposited on the floor of the estuary, gradually filling the flooded river valley (Komar 1997). In the early Holocene, rising sea-levels outpaced sedimentation, and estuaries became deeper. But during the late Holocene sea-level rise has slowed, and estuaries have become more shallow (McDowell 1987:544, 546). On the Oregon Coast, the estuaries that are filling the most rapidly are the Nehalem, Tillamook, Alsea, Umpqua, Coos, and Coquille (Schultz 1990:167). At the mouths of estuaries, wind and wave action shift sands and gravels which typically form a barrier bar between the ocean and the estuary. More stable estuarine bars may become hilly and forested, as at Netarts Bay or the Umpqua River mouth, but in other cases estuarine bars are more transitory, as at Tillamook Bay and the Coquille River (Komar 1997:30).

There is considerable variation in the productivity levels of Northwest estuaries (Thom 1987:30). The foundation of productivity in estuary environments involves the combination of river-borne detritus mixed with marine upwelling nutrients brought in by tidal currents (Schultz 1990:30), resulting in an exceptionally high biomass. Upwelling is the key source of marine nutrients transported to the estuary. This process occurs in summer, as northerly winds push upper waters away from shore, drawing deeper waters (100-200 m) upward along the shore. The deeper ocean water is nutrient rich, resulting in an increased biomass in surface nearshore waters in summer. As Proctor et al. (1980:2-64) observed, “[t]he success and timing of the fisheries of the Pacific Northwest is closely correlated with the timing and location of the upwelling zones.” The shelf along the Oregon Coast is a region of major upwelling, particularly south of Cape Blanco (Proctor et al. 1980:2-84). In addition to the estuary, other settings of high productivity in the region include offshore reefs and kelp beds.

Much of the primary production in Oregon estuaries occurs in salt marshes along estuary margins. Due in part to a long growing season, moderate temperatures, and a lack of scouring from ice, “salt marsh primary production in the region is ... twice that of the upwelling regions of the ocean shelf” (Proctor et al. 1980:3-43). Eelgrass (*Zostera* sp.) beds are also an important estuary habitat. Although they are not as productive as salt marshes or phytoplankton masses in upwelling areas, eelgrass beds provide important habitat for numerous flora and fauna, including several species of fishes. Herring, smelt, and flounder are particularly reliant on this habitat (Proctor et al. 1980:3-77-86). There is also variability in biological productivity within tidal channels, with the greatest biomass present in the lower portions of these channels (Simenstad 1983:52).

Although the estuary biomass is highest in summer, fish and other fauna are sustained year round by the estuary's reservoir of nutrients. For example, eelgrass represents a large portion of the biomass in estuaries such as Yaquina Bay, but only becomes an important source of food for estuary fauna after it dies in the fall and winter (Proctor et al. 1980:3-82).

Physiographic Variability within the Estuary

Estuarine landforms include mainstem channels, subsidiary and blind channels, tideflats, salt marshes, and levees (Figure 4). As defined by Simenstad (1983:4), mainstem channels that contain the principal transport of water into and out of the estuary. Subsidiary channels are tidal streams within the estuary that transport minor amounts of water, often consisting of the tidal portions of tributary streams and surrounding tidal wetlands. Blind channels are those that drain tideflats, and these are grouped with subsidiary channels in this discussion. Tideflats are littoral flats located below salt marsh and above the subtidal zone. Levees (not depicted in Figure 4 but

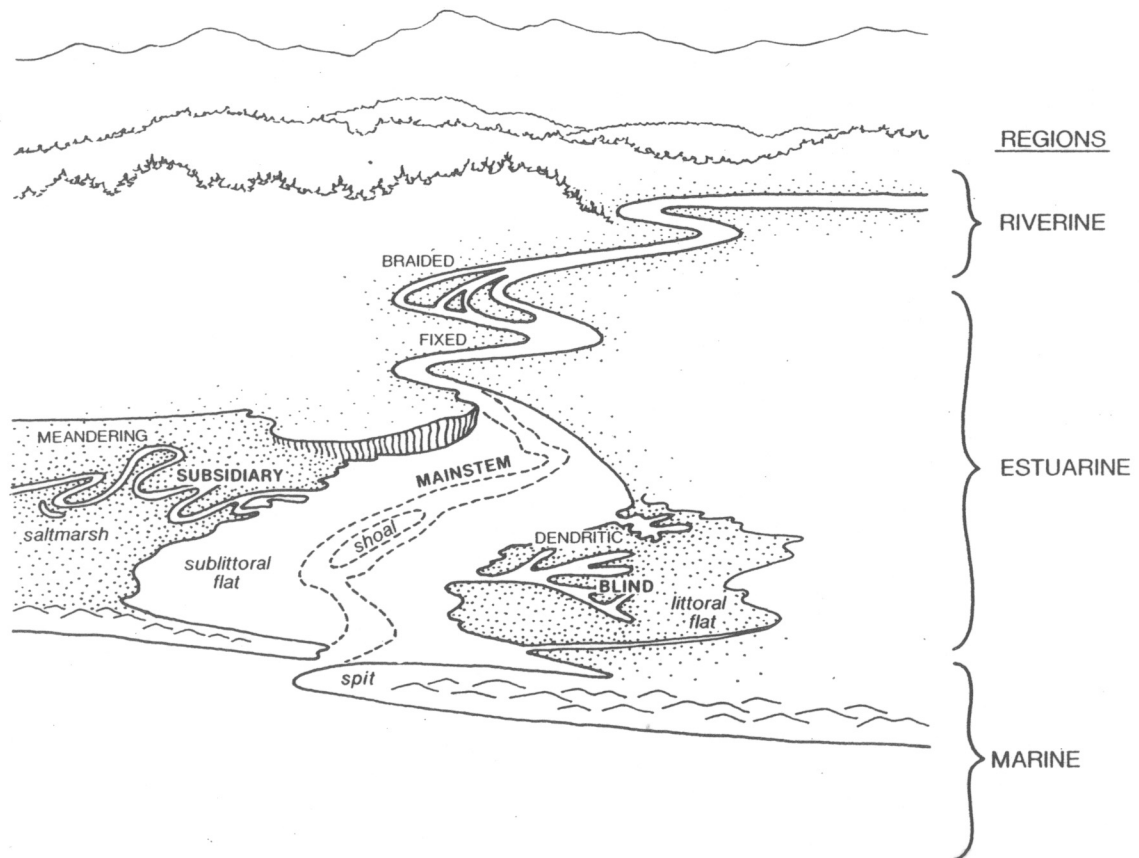


Figure 4: Physiographic Variability within the Estuary Environment (after Simenstad 1983:5).

see Chapter 5) occur along mainstem channel banks where riverine sediments have spilled over the bank and settled to a strip of higher ground parallel to the mainstem channel.

Channel configuration in drowned river valleys usually reflects the original configuration of the river, while channels in the lowest portions of bar built estuaries are less permanent (Simenstad 1983:7; see also Maser and Sedell 1994:57). In most Oregon estuaries, tidal river channels in less marine-influenced areas are generally stable over the long term, though sedimentation and levee accretion alters tideflat and subsidiary channel configuration (Chapter 5).

General estuary habitat zones distinguished by biologists include marsh, littoral, and sub-littoral settings (Simenstad 1983). The littoral zone is the intertidal shore area. Within an estuary, both channels and flats may occur in littoral as well as sub-littoral zones, and larger channels and flats may extend across more than one biological zone.

The circulation of water and sediments in the estuary involves an interplay of tidal and freshwater movement, salinity, and temperature mixing processes. In the Pacific Northwest, tides are diurnally mixed (Simenstad 1983:10). There are two high tides and two low tides per day in Oregon estuaries. On most days the two highs include a greater and a lesser tide, as do the two lows. The timing and magnitude of these tides are produced by the spin of the earth and gravitational forces involving the moon, earth, and sun. The sun's pull on the tides is roughly half that of the moon. During full moon and new moon the sun's pull is in line with that of the moon's, producing higher high tides (also called spring tides) and lower low tides. Other factors that affect the tides are global, regional, and local, involving the continental gyre and ocean currents, and landform characteristics. Tidal range varies throughout the world's oceans, from a few centimeters to as much as 10 meters (Rafaelli and Hawkins 1996:4-8). On the Oregon Coast, mean diurnal tidal variation (the distance from mean higher high water to mean lower low water) ranges from 2 meters at neap tides to nearly 4 meters at spring tides.

Tidewater extends inland as much as 70 kilometers on the Coquille, but fewer than 10 kilometers at Netarts Bay and the Salmon River. The intertidal area of estuaries in the study area ranges from 1.2 km² for the Coquille to 25.1 km² for Coos Bay (Proctor et al. 1980: 2-49-53). The highest high tides and the lowest low tides occur June to July and December to January.

Within individual estuaries, tides and channel characteristics combine to produce a hydraulic effect. As Maser and Sedell (1994:59) noted, the "tide affects the water level much farther upstream than the greatest inland penetration of even the most dilute sea water at the

highest tide.” Little or no saltwater penetrates to the upper reaches of the estuary (and during episodes of heavy runoff, freshwater may predominate through most of the estuary). It is only in the middle and lower portion of an estuary that flood tide reverses surface flow. Relating to the hydraulic effect, salinity produces vertical stratification of estuary waters and currents, wherein “the less dense, low-salinity surface layer of mixed fresh water and sea water flows downstream toward the sea, and the denser, more saline sea water ... flows upstream near the bottom” (Maser and Sedell 1994:60). There is a gradient of river-flow dominated waters to tidal current-dominated waters, though this changes with rainfall and runoff levels through the course of the year. Salinity in marine waters may be over 30 parts per thousand (ppt), whereas the upper estuary may contain waters under 5 ppt salinity, which is considered the threshold of freshwater (Schultz 1990:30, 219).

Sediments deposited in the estuary are riverine as well as marine in origin. There is a point at “mid-estuary” where the water flow on the bottom is not appreciable in either up or downstream directions, known as the *null point*. Sedimentation is more rapid and turbidity is higher above the null point, and freshwater runoff conditions distribute sediments according to currents and grain size. Below the null point there is more input of marine sediments, and suspended sediments are generally coarser. Higher salinity levels in the lower estuary cause clay particles to flocculate, producing larger mean grain size. However, over time the null point shifts in the estuary, as sedimentation, erosion, and relative sea-level change alter hydrological conditions. Sediments from different depositional regimes may be transposed, particularly in tectonically shifting settings (Proctor et al. 1980; Simenstad 1983:21; Maser and Sedell 1994:60, 67; Witter 1999).

Unlike channels in freshwater settings, channels in salt marshes and tideflats above the lower estuary are remarkably stable (Proctor et al. 1980:3-39). This is due in part to

comparatively slow currents in tidewater, the low frequency of coarse sediment layers (i.e., gravel and larger sands) prone to undercutting in banks, and abundant plant cover. Sediments in the more marine-influenced portion of the lower estuary are more prone to shifting, as they are coarser, subject to intensive wave and wind action along the dune sheet, and often less protected by vegetation.

Biological zonation within the estuary refers to differences in biological habitats relating to the salinity gradient. Species considered truly estuarine are those that occupy the central portions of estuaries, where salinity levels range from 5 ppt to 18 ppt. However, many estuarine species, including a large number of fishes, are marine organisms that tolerate reduced salinity levels. In contrast, few freshwater species can tolerate the salinity of the estuarine environment. Due in part to the dynamic nature of salinity levels in the estuary, such as the salt wedge phenomenon, “distinct boundaries between zones of individual species are usually not possible to locate along the length of the estuary” (Raffaelli and Hawkins 1996:66-69). Vertical mixing of salinity levels varies through the year and through the course of a lunar month.

While much of the variation in an estuary is characterized along the length of the mainstem channel, there is also important variation along estuary margins. Maser and Sedell (1994:82) observed that “Pacific Northwest estuaries typically have more tidelands [intertidal areas] than subtidal areas” and that salt marshes “have high annual rates of vegetative production of plants, a significant portion of which is exported to the estuary as detritus.” Along the estuary margin, estuary succession transforms the landscape from bay to shore. In general, succession proceeds from subtidal mud or sand, to eelgrass beds, to intertidal flats, to salt marsh, to shrub wetland, and finally to forested wetland (Proctor et al. 1980:3-130). Accumulations of woody debris play a role in succession, forming the structure for sedimentation and the expansion of channel banks, marsh, and eventually upland plant communities. Woody debris also provides

important habitat for a number of estuarine fauna, and this debris was much more extensive in Oregon estuaries in the past than it is today (Maser and Sedell 1994:83, 84; Simenstad et al. 1997:160). Eelgrass beds of the littoral and sub-littoral zones represent important habitat for several estuarine species (Proctor et al. 1980:3-84-86).

Some botanical resources of the estuary were harvested by Native people. For example, several elders recalled the gathering of the roots of a plant known in Tillamook as *yetska*. It was apparently abundant in the tidal marshes of the Nehalem and Salmon rivers (Harrington 1942[20]:416; Pearson 1990). Although I have found no botanical identification of this plant in published accounts, one ethnographic account indicates the *yetska* blossom resembles that of the tiger lily (E. Jacobs 1934a[84-107]:78).

Although comprehensive studies have not been undertaken to characterize habitat variability within and between Oregon estuaries, in the 1970s the Oregon Department of Fish and Wildlife (ODFW) developed a preliminary habitat classificatory scheme for this region (Starr 1979). Based on the distinctive qualities of Oregon estuaries, this scheme recognized marine, bay, slough, and riverine settings as the four estuary subsystems. Within each of these subsystems there are subtidal and tidal regimes with classes and subclasses involving variation in estuary floor characteristics and plant communities. The bay and slough systems are the settings most likely to have been the scene of intertidal weir fishing activities that are represented archaeologically.

In the ODFW classification, the bay system is largely intertidal, the setting of expansive tideflats. Because it is the interface of marine and freshwater settings, coarse marine sands are mixed with river-borne silts and clays. Salinity may be high in summer, but varies significantly with tidal stage and runoff. Habitat diversity is high in bay systems, including tideflats, eelgrass beds, algal beds and salt marshes. In the ODFW classification the slough system is a

sheltered environment, which is usually a narrow, isolated arm of the estuary. Freshwater drainage into the slough system is either low or dispersed ... so that the current flowing through the slough channel is slow. The salinity is influenced by the proximity of the slough to the estuary mouth. Sloughs usually have fine organic sediments and high percentages of intertidal land, consisting of extensive flats, eelgrass beds, and marshes (Starr 1979:31).

The other two subsystems bracket the bay and slough settings. Marine systems represent the extreme lower estuary and the river mouth. This high-energy setting is influenced by strong currents, and therefore it is not a setting likely to have been used for construction of tidewater fishing structures. The riverine system is more likely to have been used for this purpose, although currents are seasonally stronger in this setting, particularly during seasonal episodes of high runoff, and therefore fishing structures are less likely to have been used year-round. Conditions for wood preservation may also be poor, as sediment grain size varies considerably in this setting, ranging from clay to cobble. Riverine tidal marshes have largely been diked and drained through most of the study area, but they were once extensive (Benner 1991; Maser and Sedell 1994). Lower salinity levels also reduce marine species presence in the riverine system, and this setting also holds the least intertidal area of the four estuary environments (Starr 1979:32).

Fishes in Oregon Estuaries

Biological variation is the basis of the fish harvest potential of a given estuary location. Fisheries data for Oregon Coast estuaries show that numerous species inhabit the intertidal zone through the course of the year (Monaco et al. 1990-91). These species vary in number, though the estuary maintains a high biomass for the entire year (Proctor et al. 1980:3-35, 3-82). Fish species inhabit different portions of the intertidal zone at different times. As noted by Simenstad et al. (1997:166),

The principal “fuel” for most organisms in estuarine and freshwater tidal habitats is detritus - dead and decaying matter - made up primarily of plant material (leaves, needles, even trees) either exported from the watershed, generated within the estuary itself (macroalgae, eelgrass), or washed in from the open ocean.

The process of detritus decomposition is most intense in tidal sloughs and in marshes. Prey for fish is high at the interface of saltwater and freshwater, which shifts spatially through the course of the year within a given estuary.

The fish taxa present in Oregon estuaries (Figure 5), based on available research (Simenstad 1983:69-76; Monaco et al. 1990-91), are shown in Table 3. The study conducted by the National Ocean Service and National Marine Fisheries Service (Monaco et al. 1990-91) summarizes information from biological studies in 9 of the 13 estuaries covered by my research. The criteria of selection for species in the NOS/NMFS study emphasized commercial, recreational, and ecological value, as well as the relative potential of species as indicators of environmental stress (Monaco et al. 1990:3). Thus, some fishes that were historically abundant but have since declined, were not studied.

There is little statistical information available about the relative abundance of different fish species in Oregon estuaries historically. “Except for a few species (e.g., salmonids), very little research has focused on species’ habitat preferences and environmental tolerances” (Monaco et al. 1990:6). Also, because sampling techniques varied considerably between estuaries, data are not reliable for any but the most general comparisons of species abundance between estuaries. Nonetheless, general trends in diversity and abundance of fish species are evident. Fisheries biologists distinguish pelagic from demersal fishes in estuaries. Pelagic species inhabit the water column, whereas demersal fishes inhabit the floor of the estuary. Fishes in both categories may inhabit mainstem channels, subsidiary channels, and shallow estuary margins. The most extensive studies of pelagic fish populations have been conducted in Tillamook Bay, Coos

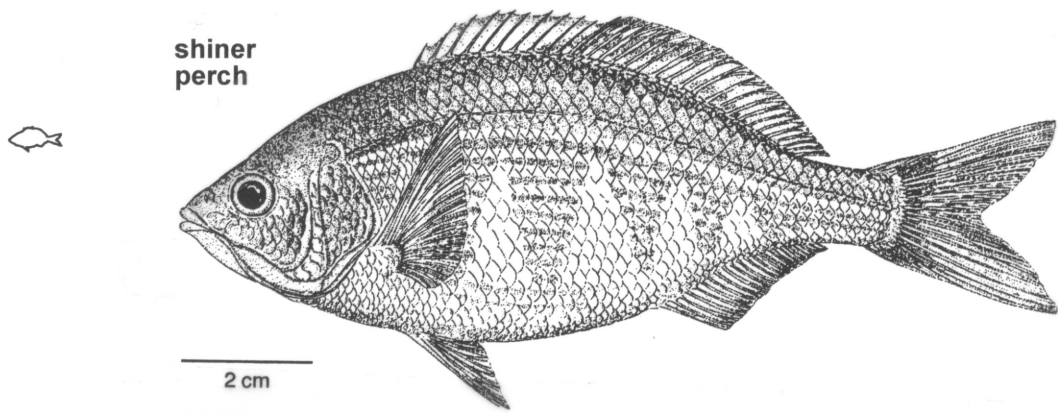
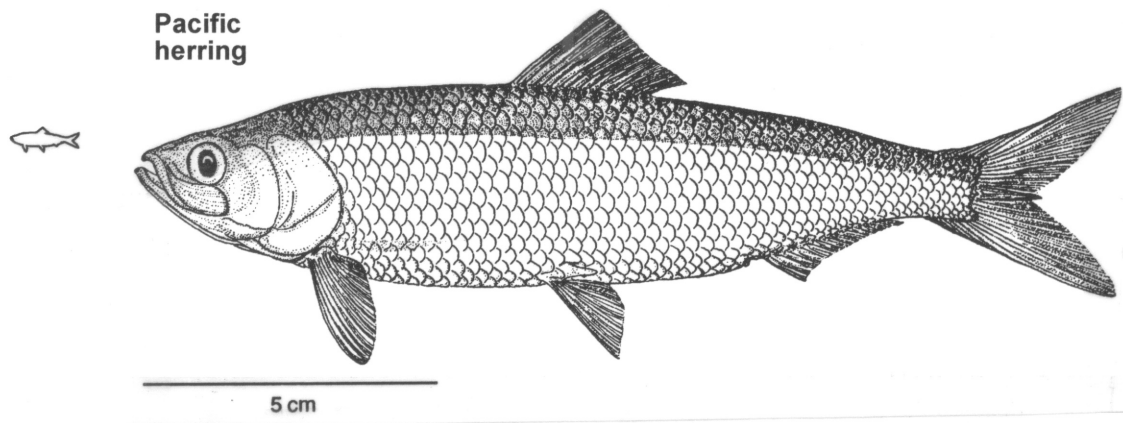
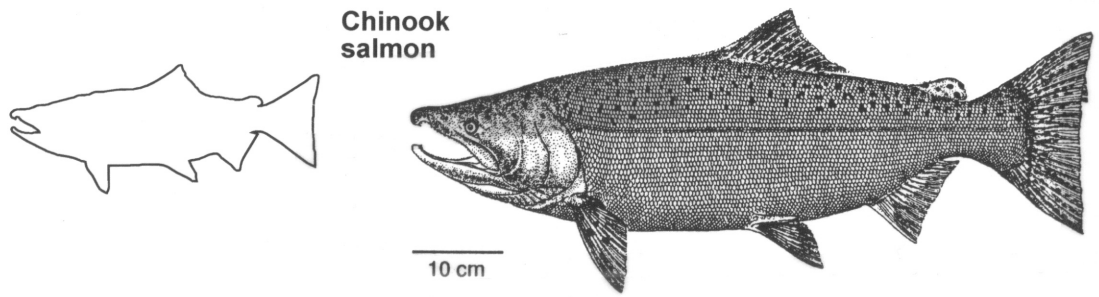


Figure 5: Selected Fish Species in Oregon Estuaries (adapted from Monaco et al. 1990-91; relative size shown at left).

Table 3: Fish Taxa in Oregon Estuaries (from biological and historic sources cited in Chapters 2 and 3; abundance, seasonality and habitat information from NOS/NMFS survey [Monaco et al. 1990-91]).

Family, Genus, Species & Common Name	Estuary Setting ¹	Salinity Zone ²	Abundance in Nine Surveyed Estuaries ³	Seasons Present ⁴
Acipenseridae				
<i>Acipenser medirostris</i> green sturgeon	main, edge subsid., flat	T M S	common in 3 estuaries*	W, Sp, Su, F
<i>Acipenser transmontanus</i> white sturgeon	main, edge subsid., flat	T M S	common in 5 estuaries*	W, Sp, Su, F
Atherinidae				
<i>Atherinops affinis</i> topsmelt	main, edge subsid., flat	M S	common to abundant 7 estuaries*	Sp, Su, F
<i>Atherinops californiensis</i> jacksmelt	main, edge subsid., flat	M S	common in Coos & possibly Coquille	Sp, Su
Catastomidae				
<i>Catostomus macrocheilus</i> largescale sucker	main, subsidiary	n/a	not in NOS/NMFS survey*	n/a
Clupeidae				
<i>Clupea pallasii</i> Pacific herring	main, edge subsid.	M S	common to highly abundant, 8 estuaries*	W, Sp, Su, F
<i>Sardinops sagax</i> Pacific sardine	n/a	n/a	not in NOS/NMFS survey*	n/a
<i>Alosa sapidissima</i> American shad	main, edge subsidiary	T M S	abundant in 5 estuaries	Su
Cottidae				
<i>Leptocottus armatus</i> staghorn sculpin	main, edge subsid., flat	T M S	abundant to highly abundant, 9 estuaries	W, Sp, Su, F
<i>Enophrys bison</i> buffalo sculpin	main, edge subsid., flat	n/a	not in NOS/NMFS survey	n/a
Embiotocidae				
<i>Cymatogaster aggregata</i> shiner perch	main, edge subsid., flat	T M S	abundant to highly abundant, 10 estuaries*	Sp, Su, F
<i>Amphisitichus rhodotus</i> redtail surfperch	main, subsidiary	n/a	not in NOS/NMFS survey	n/a
<i>Hyperprosopon ellipticum</i> silver surfperch	main	n/a	not in NOS/NMFS survey	n/a
Engraulidae				
<i>Engraulis mordax</i> northern anchovy	main, edge subsidiary	M S	common to abun- dant in 7 estuaries	Su, F
Gadidae				
<i>Microgadus proximus</i> Pacific tomcod	main, edge subsidiary	M S	common to abun- dant in 8 estuaries	Sp, Su, F
Hexagrammidae				
<i>Hexagrammos</i> spp. greenling	main, subsidiary	n/a	not in NOS/NMFS survey	n/a

Family, Genus, Species & Common Name	Estuary Habitats ¹	Salinity Zone ²	Abundance in Nine Surveyed Estuaries ³	Seasons Present ⁴
Osmeridae				
<i>Thaleichthys pacificus</i> ooligan	main, edge subsid., flat	T M S	rare to common in 3 estuaries*	W
<i>Hypomesus pretiosus</i> surf smelt	main, edge subsid., flat	M S	common to highly abundant, 8 estuaries	W, Sp, Su, F
<i>Spirinchus thaleichtys</i> long fin smelt	main, edge subsidiary	T M S	rare to common 6 estuaries	W, Sp, Su, F
Percichthyidae				
<i>Morone saxatilis</i> striped bass	main, edge subsidiary	T M S	rare to common in 6 estuaries	W, Sp, Su, F
Percidae				
<i>Perca flavescens</i> yellow perch	main, subsidiary	n/a	not in NOS/NMFS survey	n/a
Petromyzonidae				
<i>Lampetra tridentata</i> Pacific lamprey ('eel')	main, subsidiary	n/a	not in NOS/NMFS survey*	n/a
Pleuronectidae				
<i>Platichthys stellatus</i> starry flounder	main, subsidiary	T M S	common in 8 estuaries*	W, Sp, Su, F
<i>Parophrys vetulus</i> English sole	main, subsidiary	M S	abundant to highly abundant, 9 estuaries	W, Sp, Su, F only
Rajidae				
<i>Raja binoculata</i> big skate	main	n/a	not in NOS/NMFS survey	n/a
Salmonidae				
<i>Oncorhynchus kisutch</i> coho salmon	main, edge subsid., flat	T M S	abundant in 8 estuaries, common in 1 estuary*	F
<i>Oncorhynchus tshawytscha</i> chinook salmon	main, subsidiary	T M S	fall: abundant 8 estuaries spring: common in 6*	W, Sp, Su, F
<i>Oncorhynchus keta</i> chum salmon	main, edge subsid., flat	T M S	common to abundant in 8 estuaries*	F, W
<i>Oncorhynchus gairdneri</i> steelhead	main, edge subsid., flat	T M S	winter stage common to abundant 8 estuaries	W, Sp, Su
<i>Oncorhynchus clarki</i> cutthroat trout	main, edge subsid., flat	T M S	common to abundant, all estuaries*	Sp, Su, F
Scorpaenidae				
<i>Sebastes</i> spp. rockfish	main	n/a	not in NOS/NMFS survey	n/a

1. Intertidal settings: mainstem channel, channel edge, subsidiary channel, and tideflat.
2. Salinity zone. T: tidal freshwater, M: mixing zone, S: seawater zone; n/a: not in NOS/NMFS study; italics indicate variable zone preferences between estuaries where the species is present.
3. Relative abundance in the nine Oregon estuaries covered by the NOS/NMFS study; declines from historically abundant levels indicated by *.
4. W: Winter, Sp: Spring, Su: Summer and F: Fall

Bay, and the Umpqua River (Simenstad 1983:73). There are 36 pelagic fish taxa in Pacific Northwest estuaries, including 13 anadromous species, 16 appearing as larvae or juveniles, and 8 that maintain extended residence in tidal channels. The greatest diversity of pelagic fishes occurs in the central portion of estuaries. Seasonal diversity of pelagic species is highest from April through September, with a peak in late May and June. Almost the opposite pattern holds for demersal fishes. There are 43 demersal species present in Northwest estuaries, and nine of these are common in most estuaries. For these species, diversity is highest in the lower portion of the estuary, and more taxa are present from September to March than in late spring and summer.

The relative seasonal abundance of key species in three estuaries is depicted in Figure 6. The fish population data from Coos Bay on the Oregon Coast is compared with Humboldt Bay on the northern California Coast and Willapa Bay of the Washington Coast. These data show that the seasonal abundance of Coos Bay fish populations is comparable to estuaries in adjacent regions to the north and south on the Pacific Coast.

Estuaries are especially important to marine fauna as refugia from predators and as settings for spawning and early life stages (Monaco et al. 1990-91). These two roles account in large part for the presence of several marine fishes in estuary habitats. Settings and seasonality of spawning relate to temperature, salinity, and channel floor habitats. Some estuarine species are fully marine, and enter only the lower estuary where salinity is high and temperature levels are close to those of neritic marine waters (Simenstad 1983:68). Others, such as salmon, sturgeon, ooligan, and long fin smelt, move to freshwater settings at or above the upper estuary for spawning. Salinity and temperature vary through the year, such that conditions for herring spawning occur in early spring, while conditions for sardine spawning are best in late summer. Coquille elder Coquel Thompson's observation (Harrington 1942[25]:503), that nearly every fish

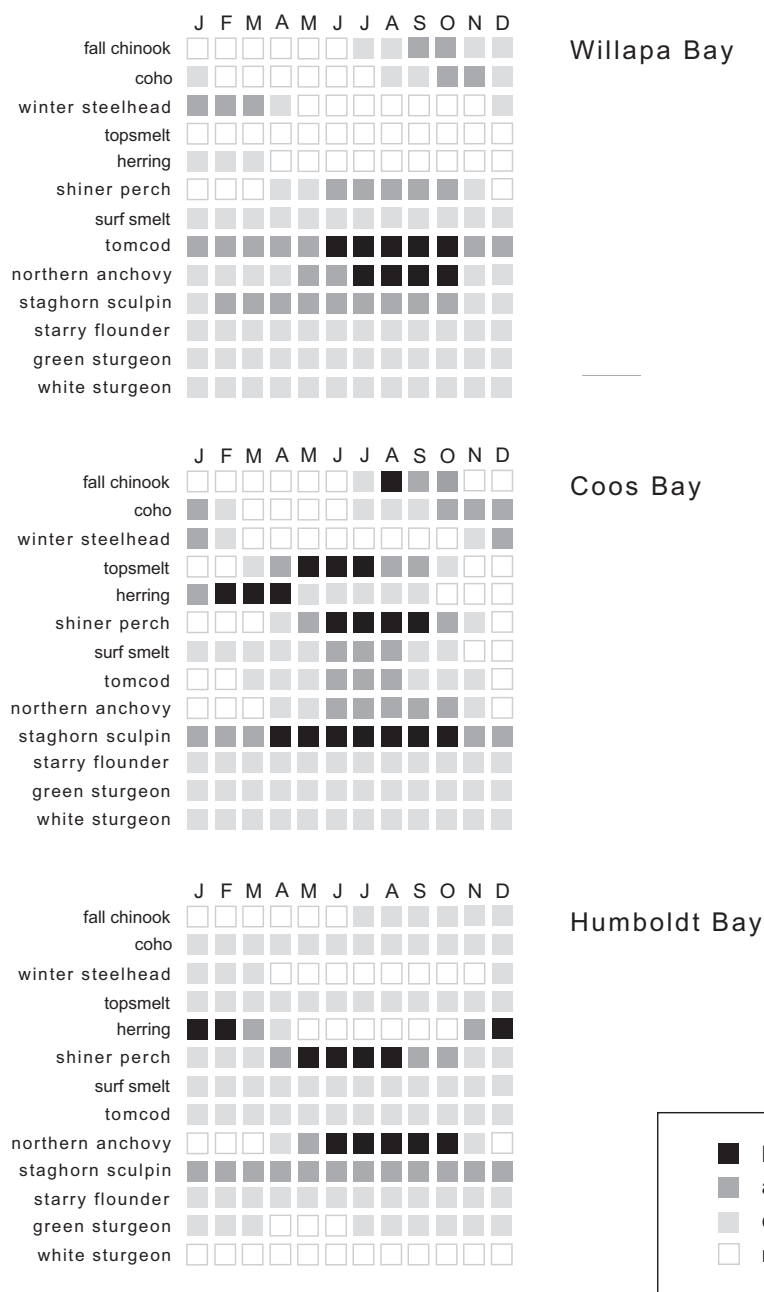


Figure 6: Relative Seasonal Abundance of Selected Fishes Inhabiting Three Pacific Coast Estuaries (adult fish only: from Monaco et al. 1990-91).

but spring salmon comes into the coastal rivers in September, appears to be consistent with 20th century ecological research.

Forage Fishes

Several of the fishes in Oregon estuaries are grouped as *forage fish*, referring to their importance in marine and estuarine ecosystems as prey for larger fish, birds and mammals. Forage fish include herring (clupeids), anchovies (engraulids), smelts (osmerids), silversides (atherinids), and sand lances (ammodytids) (Simenstad et al. 1997:172). Herring are among the most abundant fishes in the region, although their estuary habitat has been severely reduced in recent decades. As Simenstad (1983:76-77) observed,

Herring spawning appears to be highly correlated with the occurrence of substrates suitable for egg deposition, such as eelgrass and macroalgae, and with moderately high water flushing rates. This may explain why herring spawning tends to be more pronounced in such coastal estuaries as Yaquina Bay and Coos Bay than in more freshwater-dominated estuaries such as the Columbia River estuary, which has no extensive eelgrass or kelp bed habitats.

Topsmelt spawn in Coos Bay and the Umpqua River in early summer and reside in estuaries during all seasons (Simenstad 1983:78). Sardines appear to be returning to some parts of the Oregon Coast (S. Hall 1998). Longfin smelt and ooligan are anadromous osmerids that spawn in more freshwater-dominated settings such as the Columbia River during winter months. Like other anadromous species, these smelt prefer less saline or freshwater conditions for spawning (Simenstad 1983:85).

Demersal Fishes

Demersal (bottom-dwelling) fishes in Oregon estuaries include flounder, sculpin, and several species that occur as juveniles, the most prominent of these being greenling, halibut

(*Hippoglossus stenolepis*), and English sole (Simenstad 1983:68). Flounder appear to be far less abundant in Oregon estuaries than they were a century ago. Sculpins are abundant throughout the region. Many of the demersal fishes remain in the estuary for much of the year, in contrast to anadromous and forage fishes that congregate seasonally during spawning runs. Because demersal fish in estuaries are less important commercially, there has been much less research on these populations than on the large schooling pelagic species.

Salmonids

Over half of the anadromous fish species occupying estuary channels are salmonids (Simenstad 1983:79). Their importance as a resource stems from their abundance, size, and presence throughout the year. According to Simenstad (1983:84), the entry “of adult salmon into estuarine channels prior to their migration upriver occurs essentially year-round, although the maximum migration period is between July and September.” Within the estuary, salmonids often group in “staging areas” before beginning their upriver movement for spawning. Residence time for most adult salmon in estuary channels is estimated at 1-6 weeks. This is the time when predation in the estuary setting by humans is most intense. Notably, anadromous cutthroat and steelhead do not use the estuary as often as Chinook, coho, and chum salmon (Simenstad 1983:84).

Pacific Lamprey

Widely referred to in ethnographic and historic accounts as “eel,” the anadromous Pacific lamprey passes through the estuary setting on its way from the ocean to freshwater settings for spawning (Rostlund 1952:8; Downey et al. 1996). Based on historic accounts (Chapter 3), it was one of the key fishes in traditional Oregon Coast economies. Its abundance in spring appears to

have been comparable to or greater than spring Chinook in many Oregon Coast rivers. There is also a smaller lamprey that is a year-round resident of freshwater streams (Rostlund 1952:7). Of the anadromous lamprey, two varieties are distinguished in historic accounts, a day running fish and a night running one. Kroeber and Barrett (1960:72) indicate this distinction corresponds to males vs. females, while (Sondena 1996:8) suggests this is a taxonomic distinction.

Non-Native Fishes

American shad and striped bass are anadromous fishes introduced to the region in the late 1800s (Coos Bay News 1895; Kroeber and Barrett 1960:4). Striped bass are most common in the Umpqua River and Coos Bay (Simenstad 1983:84-86). These have little relevance for understanding traditional fishing prior to European contact, but they may have altered the ecology and abundance of native fish in Oregon estuaries, as discussed below.

Historic Abundance and Diversity of Fishes

Historic accounts have not been thoroughly represented in biological studies of changing fish populations on the Oregon Coast. Therefore, I have drawn from numerous sources, published and unpublished, to address the relative abundance of various estuarine fishes historically. My emphasis is on accounts from Native people who fished.

The earliest written descriptions of Oregon Coast fisheries emphasize the abundance and the diversity of these resources, as well as their importance to Native communities. In 1841, the United States Exploring Expedition visited the Oregon Coast. Expedition leader Charles Wilkes (1911:287) described the region's fisheries

In the rivers and sounds are found several kinds of salmon, salmon trout, sturgeon, cod, carp, sole, flounders, ray, perch, herring, lamprey eels, and a kind of smelt called sprow in great abundance; also are large quantities of shellfish ... which are all used by the natives and constitute the greater proportion of their food.

Wilkes term sprow is probably from shrow, another name for the smelt known as ooligan (Gibson 1992:9)

A few years later Superintendent of Indian Affairs Joel Palmer (1854:12) described the resources important to Native people of the central and northern Oregon Coast, the location he proposed as the Coast Reservation for Western Oregon tribes: “The rocks along the coast contain an inexhaustible supply of muscles (sic), the beach a variety of clams, and salmon, herring, sardines, and a variety of other fish are found in perpetual succession in the streams.”

Anthropologists recorded several interviews with Native elders during the early and middle decades of the 20th century. These describe the presence, use, and relative abundance of various fishes in Oregon estuaries. These unpublished sources have largely been unavailable to researchers, and such documents greatly augment the historical research performed by fisheries biologists (e.g., Nehlsen et al. 1991). Along with a small number of settlers’ descriptions of fisheries, the Native accounts are surveyed geographically, from north to south along the Oregon Coast. Some accounts mention species not represented in well known historic sources or modern studies.

Accounts from Native elders from the northern Oregon Coast, such as Louis Fuller (Salmon River Tillamook) and Clara Pearson (Nehalem Tillamook), describe several fishes. Among salmon, they depict Chinook, coho, and chum as the most prevalent. As elsewhere, the Chinook in late summer (August-September) and early fall, the coho ran during mid to late fall (late September and October), and the chum throughout fall (October through December). Steelhead were also mentioned as running in winter (November to March or April), but runs of

sockeye and humpback salmon were not present (E. Jacobs 1934a[81-74]:146; Harrington 1942[20]:211, 215). Oral tradition indicates none of the rivers within the study area had a large spring run of Chinook salmon, but the Rogue to the south and the Columbia to the north did (Harrington 1942[20]:208).

Louis Fuller also helped clarify terms widely used colloquially for certain fishes. For example, *dog fish* sometimes refers to chum salmon, not the small shark common in estuaries, while *dog tooth* salmon refers to old Chinook salmon. The term *salmon trout* usually refers to juvenile salmon of various species, primarily coho, but it is sometimes used to refer to cutthroat trout (Harrington 1942[20]:216, 228-30;[21]:797).

Other fishes mentioned by Native elders for the northern Oregon Coast in general include flounder, halibut, and a small fish called “pogie,” possibly a perch (Harrington 1942[20]:218, 230; Donald Ivy, 2002, personal communication; George Wasson [2002, personal communication] identifies this as a surf perch). According to Pearson, Pacific lamprey runs occurred in June and July, though there were resident eels of a smaller variety that could be caught and eaten at any time (E. Jacobs 1934[106-5]:24). Notably, in his survey of Native American freshwater fishing, Rostlund (1952:7) could report no instances where this smaller eel was caught and consumed.

Native accounts also mention fishes in specific rivers and bays of the north coast, including flounder and sturgeon in Nehalem Bay, and there were sturgeon in Tillamook Bay (Harrington 1942[20]:697, 714; Pearson 1990:130). Clara Pearson recalled that in the early 1940s, sturgeon were gone from places where they were once abundant (Harrington 1942[20]:714). Chum salmon were particularly abundant in Tillamook Bay historically, as they are today (Harrington 1942[21]:792), but coho salmon formerly ran in streams they no longer spawn in (Harrington 1942[20]:727). Accounts of surf smelt harvests on beaches are rare, but in

one narrative they were gathered in abundance from the beach at Neskowin, north of the Salmon River (Pearson 1990:123). Accounts also suggest that salmon were unusually abundant in the Salmon River, but herring did not run there (Frachtenburg 1920:185-187; Harrington 1942[20]:226).

Because the Coast Reservation was rapidly downsized by Congress, leaving Native lands confined to the Siletz Valley after the 1880s, there are more accounts of fishing in Siletz Bay and River than most other parts of the coast. Although salmon and eel runs were strong in this system (Downey et al. 1996), the Siletz estuary does not appear to have been as biologically productive as some of the larger estuaries in the study area. The Native accounts depict four runs of salmon in the Siletz. Chinook salmon “come into the Siletz River in June, are seen coming up among the eels ...” (Harrington 1942[24]:653). Chum salmon were also present, as well as fall Chinook and coho. Cutthroat were once abundant in the Siletz. Louis Fuller described a 10 inch sea run trout with a blueish back that appeared in the Siletz River around July 1. He recalled for this fish “one of these trout makes a good meal for one person. They won't take a hook when they first come, but along about November you can catch them with a hook then” (Harrington 1942[20]:208, 228). Lamprey were an important resource, and there appears to have been some variation in this species. Several accounts distinguish brown eels from blue eels, corresponding to a day-running variety and a night-running variety (e.g., Harrington 1942[20]:225). The “night eels” appear to be *Lampetra tridentata*, a species that was greatly preferred as a food over day run eel. The “day eels” may be the females of the same species (Kroeber and Barrett 1960:72), or another *Lampetra* taxon (Sondena 1996:8).

Other fishes observed by Native people in the Siletz include green sturgeon, which were caught in the lower estuary but not the river; mudcat (taxon unknown, possibly *Cottidae*), of which there were two varieties, grey and black, both 8 inches long; and flounder, herring, and

bullhead (*Cottidae*). Coquel Thompson explained that the bullhead and mudcat are similar, but the former occurs in the ocean and the latter in rivers (Harrington 1942[25]:501). The mudcat may be a catfish (Harrington 1942[25]:507). Louis Fuller recalled that no sardines were caught in Siletz River, although Thompson indicated that this was a local resource, possibly harvested in the bay. Nor were there halibut in Siletz River (Harrington 1942[20]:200-231, 488;[24]:695;[25]:506).

Yaquina Bay seems to have been highly productive, with a diversity of fishes, as indicated in this description from George Boone, a colonist who settled there in the 1860s.

In August the bay is alive with sardines; in March and April alive with herring; in August, September, October, and November, the air is full of salmon leaping, jumping right out of the water. Scow loads of salmon are taken right in front of our house. Thousands of cases are canned close by. We can our own salmon. Norwegian herring (pilchards) are caught by the bushel, so fat they break in two like a stick. Bears come down and eat small fish and windrows of spawn that lie along the shore. Crabs we take with and without nets (Dye 1941:220-231).

Another early written account mentions an abundance of hake (*Merluccius productus*), a predator to the numerous small fishes that ran in the bay. A segment in the Aug. 21, 1872 edition of Salem's *Oregon Statesman*, reads "South and North Beaches are covered with hake, a fine variety of fish. They seem to get beached while in pursuit of smaller fish, as both kinds come in together."

Native accounts of fish in Yaquina Bay also emphasize diversity. Herring are frequently mentioned. Halibut were caught here and sturgeon went as far up the bay as Elk City, at the head of tidewater. Flounder fishing is widely depicted for this bay, and at nearby rocky shores, rock cod (i.e., rockfish) were frequently caught (Nash 1877:151; Harrington 1942[20]:200, 225-231;[25]:502).

South of Yaquina Bay, the Seal Rock area was an offshore fishery historically. As George Davidson (1889:412) noted, "these rocks were formerly the resort of seals and sea-lions.

The Indians are reported to sometimes catch large numbers of codfish off these rocks, and in 1868 a (commercial) fishery was established here.” The specific rockfish that was the focus of this fishery is not clear from this account.

Salmon are the fish most often described in Alsea Bay, and Chinook, coho and chum are among the species mentioned by Native elders (Frachtenburg 1920:83, 107). One narrative indicates herring were abundant through much of the year (Frachtenburg 1920:239), and a visitor in September, 1849 observed a fish resembling the sardine in great abundance in Alsea Bay (Talbot 1851:112). Sturgeon also populated this estuary (Harrington 1942[20]:231). In his published ethnography of the Alsea people, Drucker (1939:82) mentioned that salmon were fished, as well as “smelt, herring, flounders, perch, lampreys, and salmon trout.”

The outer coast Native community of Yachats was devastated by disease in the 1850s, but in the early 1860s Native people from farther south were forcibly relocated here by the U.S. military. They tried to survive by fishing for surf smelt during runs on the beach (one of the few accounts of this activity I have found for my study area), caught salmon in Yachats River, and kelp fish on the ocean and from the rocky shores (Harrington 1942[24]:797; [24]:95).

Several Native elders made observations that apply to much of the central Oregon Coast. Siuslaw fisherman Clay Barrett noted that in this area, there appear to have been two runs of Chinook salmon, a run of smaller individuals in June and a run of larger ones in fall. He also observed that coho salmon was caught on the Oregon Coast, but no sockeye or humpback salmon were caught in this region south of Columbia (Harrington 1942[21]:809, 811). “Shiners” are mentioned in some accounts, but it is not clear if this term refers to surf smelt or shiner perch (Harrington 1942[24]:652–657). Lower Umpqua fisher Spencer Scott identified three kinds of perch: silver, striped (green) perch, and red tailed perch. He noted that red tails were caught in rivers, not the ocean. “The olden Indians used to catch these along with flounders. White meat, a

foot long” (Harrington 1942[25]:489. In the same passage Scott described a bigger, blackish colored perch “full of tiny fish” which was probably black surfperch. Clay Barrett noted that “the beach is often full of hakes that get stranded and can’t get away” (Harrington 1942[21]:820). The lakes of the central coast were also mentioned in the ethnographers’ notes. Sturgeon made their way into Siltcoos Lake, and lamprey were abundant in Tenmile and Eel lakes. Chubs (*Hybopsis* sp.) were also found in all of the central Oregon coast lakes (Harrington 1942[21]:786; see also Chapter 3).

Several of the Native fishers interviewed by ethnographers resided on the Siuslaw River, including Frank Drew, Clay Barrett, Jim Buchanon, and Spencer Scott. Scott and Barrett observed that chum salmon were caught in the Siuslaw, as were fall Chinook and coho. Drew remembered that some spring Chinook were caught in the upper Siuslaw in May (Harrington 1942[21]:792;[24]:653). These individuals also reported catching sturgeon, flounder, and several small types of fish. Sardines of various sizes came into the Siuslaw, as did a smaller number of anchovies (Harrington 1942[21]:778-80, 815-820). Another taxon of fish mentioned frequently in Siuslaw ethnographic accounts is the sucker (*Catostomus* sp.), which was one of the few freshwater fishes that was often caught on tide flats (see Chapter 3).

Herring are included in an account of two small anadromous fishes that spawned in the Siuslaw in great numbers. Frank Drew observed that

The bloaters ... come up the river from the ocean in August and September and the river gets white with dead ones This bloater slightly resembles herring, but herring come into the Siuslaw River from the ocean in March. It used to be that one could get all you wanted in just a little while, but now herrings come up the Siuslaw River only as far as (the North Fork confluence) (Harrington 1942[24]:758).

I have not been able to identify the species referred to as the “bloater,” but there appear to have been multiple runs of herring as well as sardine in central Oregon Coast estuaries, and it may

have been one of these. Clay Barrett observed that “the bloater comes into the Siuslaw River from the Ocean in July, shaped like a herring but wider and a foot long, these are the fish (canned) sold as ‘Booth’s sardines,’ they are fat, they fry in their own grease...delicious” (Harrington 1942[21]:807).

Herring were also abundant in the Umpqua Estuary. In early May, 1864, Corporal Bensell (1959:148) noted that herring “can be caught here by the thousands when the tide ebbs. Bushels of these excellent (sic) fish can be had for picking them up.” Nathan Scholfield was an immigrant who settled near the mouth of the Umpqua River in 1851. Four years later he described the estuary fisheries in a letter to a regional newspaper: “[t]he Umpqua River abounds with a great variety of the choicest fish, such as sturgeon, salmon, salmon trout, greyling, lamper eel, flounders, herring, etc.” (Scholfield 1855). In 1914 Lower Umpqua elder Louisa Smith recalled that before the reservation years, people from villages down the bay would bring boatloads of flounders to her childhood home on Smith River (Frachtenburg 1914:101). Sturgeon and salmon were also abundant in the Umpqua River (Harrington 1942[21]:778-80). Coquille and Coos Indians who fish recall dipping for smelt (probably ooligan and/or longfin smelt) near the head of tidewater on the Umpqua in the 1960s, though these runs have since declined (Donald Ivy and David Brainard, 2002, personal communication).

Accounts from Native elders who fished at Coos Bay depict a greater diversity of fish species than for any other part of the study area. Some of this difference may be due to more intensive ethnographic research here, including interviews that focused on fishing, particularly in the work of Melville and Elizabeth Jacobs (see Chapter 3). But the fisheries here may have been somewhat more diverse than in areas to the north because this was the northern limit of some fishes, such as certain *Atherinops* species. It may also reflect the larger size of Coos Bay relative to the other estuaries, and its presence at the northern edge of the range of certain species.

Collectively, the fishes caught by the Indians at Coos Bay, as noted in the ethnographic summaries of M. Jacobs (1934:96-22), Frachtenburg (1909:17-20); and Drucker (1934), include over 30 taxa (Table 4).

Specific accounts provide further information about Coos Bay fishes. Coos elders observed that some Chinook salmon came into lower Coos Bay in spring, but most of this species runs in September and October (Harrington 1942[24]:411, 650). Several accounts mention flounders in the bay, and there are references to abundant shiner perch, perch of several other species, and abundant tomcod (Harrington 1942[21]:807, [22]:892-893, [24]:695). The 'he'i-'k' run mentioned by Melville Jacobs (1934:96-22) may be hake, though this fish is no longer abundant in the region's estuaries. A substantial early spring herring fishery continued in Coos Bay into the 1890s (Coos Bay News 1890). Salmon, lamprey, perch and flounder are mentioned in the Coos Bay fishing technologies described in Chapter 3.

Table 4 Coos Bay Fish Taxa Noted in Ethnographers' Accounts of Native Fishing.

Chinook salmon*	green sturgeon	surf smelt*
coho salmon*	perch, taxon 1	long fin smelt*
chum salmon*	perch, taxon 2	sardine, taxon 1*
steelhead*	perch, taxon 3	sardine, taxon 2*
trout	silver perch	bloater (sardine?)*
sucker	herring, smaller taxon*	flounder
halibut	herring, larger taxon*	chub
crab, taxon 1 (larger)	tomcod	blue eels (lamprey)*
crab, taxon 2 (smaller)	candle fish (ooligan)*	brown eels (lamprey)*
white sturgeon	topsmelt*	hake*

Note: The varieties of herring, perch, and sardine may represent different species or genera, or some may be a single species with populations that visit Coos Bay in different seasons. The numbered taxon designations are added for differentiation in the list. Historic indications of a seasonal presence for a fish in the bay or its tributaries are indicated by an asterisk.

Ethnographic sources also indicate that several species of fishes were once abundant in the Coquille Estuary. For example, Drucker (1934[2]:12] made this entry in his field notes during an interview with Coquel Thompson, steelhead “come downriver about June – go up in highwater-midwinter. No spring salmon. Chinook run about Sept. Silverside about same. Lamprey eels-run in early summer –No smelt on beach; perch and flounders down at mouth.” A more general statement is offered by Coquille elder Beverly Ward (1986:26), “[t]he (Coquille) streams and the bay afforded some kind of fish all the year around.” She also noted that runs of smelt came into the river to spawn. Coquel Thompson mentioned other fishes as well, including suckers, two kinds of mudcats, and night eels (again preferred over day eels) (Harrington 1942[25]:489-500).

Changes in Fisheries at Oregon Estuaries

There are numerous indications that the populations of many Oregon estuary fish species have declined since American settlement ensued in the 1850s. As Simenstad (1983:xiii) noted, “... Pacific Northwest coast estuaries have been utilized extensively for log and lumber transport, storage and processing; harvest, culture, and processing of finfish and shellfish; dredging, filling, and diking; and industrial and urban waste disposal” For the most part, these practices have been conducted with economic goals in mind, and sustainable resource use has not been a priority. Resulting declines in fisheries appear to be comparable to those in many other estuaries, part of a worldwide trend that currently shows no signs of improving (Jackson et al. 2001).

Although declines in several fish species are mentioned in the fisheries biology literature, the greatest attention has been paid to salmonids. According to Nehlsen et al. (1991:4),

The decline in native salmon, steelhead, and sea-run cutthroat populations has resulted from habitat loss and damage, and inadequate passage and flows caused by hydropower, agriculture, logging, and other developments, overfishing, primarily of weaker stocks in mixed-stock fisheries; and negative interactions with other fishes, including nonnative hatchery salmon and steelhead.

Pacific salmon are now extinct or at risk of extinction in over half of their historic range (Nelson and Lichatowich 1997:221). Significant declines have been documented for salmonids inhabiting Oregon estuaries. According to Nehlsen et al. (1991:8-10), spring/summer Chinook are at risk of extinction in the Nehalem, Siletz, Alsea, Umpqua, and the Coquille rivers; fall Chinook in the Yaquina and Coos rivers; coho in the Nehalem, Tillamook, Nestucca, Salmon, Siletz, Alsea, Umpqua, Coos and Coquille rivers; chum in the Tillamook, Netarts, Nestucca, Siletz, Yaquina, Alsea, Umpqua, and Coos rivers; and steelhead in the Tillamook, Nestucca, Salmon, Siletz, Yaquina, Alsea, and Siuslaw rivers. Notably, the spring/summer run of salmon in the Siuslaw River, recounted in Native oral history (Harrington 1942[21]:809-11;[24]:653), now appears to be extinct, although it is not included in lists maintained by fisheries biologists (Monaco et al. 1990-91:181; Nehlsen et al. 1991:17).

Declines in fish populations appear to be due to the convergence of several factors. While the most obvious impacts involve habitat loss, overfishing, the removal of keystone species such as sea otter, the introduction of non-native species, and intentional fish eradication efforts have also played major roles in changing fish populations in the region.

Habitat Losses

The process of estuary infilling that began roughly 6,000 years ago was rapidly increased by agricultural and industrial development in Oregon's estuaries (Schultz 1990:317). Once expansive tidal marsh systems were largely diked and drained for agricultural use, and filled for

residential and industrial use. The diking and draining of tidal wetlands appears to account for much of the salmonid habitat loss (Simenstad 1983:121). Even the construction of a relatively narrow roadway along the margin of an estuary may cut off a large portion of the tidal slough habitat in that estuary. Roadways are common along the shorelines of most Oregon estuaries, such as the north shore of Yaquina Bay and the south shore of Alsea Bay. Although these landscape changes are not thoroughly documented for the Oregon Coast, salt marsh losses in Coos Bay may be as high as 90 percent, and other Oregon estuaries have undergone comparable impacts from diking, draining, and filling (Proctor et al. 1980; Benner 1991).

Historically, sawdust from mills was dumped directly into estuaries, filling expansive tidal wetlands and burying demersal habitats. Thick layers of buried, saturated sawdust can still be seen in the eroding salt marsh banks of southeastern Coos Bay. More recently toxic industrial pollutants, particularly heavy metals, have been dumped into estuaries, placing further stress on fish populations. Organic pollution brought to estuaries from agricultural fields, mill waste, and sewage can increase the biotic activity in the estuary (Schultz 1990:320-23), but this increased activity can deplete the estuary of oxygen and limit fish habitat.

Several channel alteration activities modify drainage patterns and change fish habitats (Schultz 1990:320; Simenstad et al. 1997:176-77). The construction of jetties at river mouths slows the outgoing rate of larger sediments, causing these to settle on channel floors. As the channel floor rises currents are increased along channel banks, producing severe erosion, as seen along the banks of the Coquille River (Chapter 5). Channel dredging is conducted regularly in many estuaries to obviate this problem and to maintain lanes for shipping. This dredging alters mainstem and larger subsidiary channels, and dredge spoils are often deposited on tidal wetlands.

One of the most extensive alterations to fish habitat has been the removal of drift logs and other woody debris from channel margins and tideflats. U.S. Coast Survey records from the

1850s and 1860s show that many of the region's tidal channels were filled with drift logs and woody debris (Benner 1991; Maser and Sedell 1994). Tributary rivers and streams such as the North Fork Siuslaw were navigable only by the smallest canoe (McLeod 1826; Harrington 1942[24]:762). Removal of woody debris began at the onset of American settlement, and increased through the early decades of the 20th century with the efforts of the U.S. Army Corps of Engineers and several port authorities. The aim was to clear channels for navigation and log drives. In the late 1800s and early 1900s, the U.S. Army Corps of Engineers removed thousands of drifted trees from Oregon estuaries in an effort to improve channel conditions for navigation in tidewater. They kept detailed records for at least three estuaries. Nearly 10,000 drift trees were removed from the Tillamook and Coos estuaries, and 6,400 trees were removed from the Coquille. From 1890 to 1917 an average of 336 drift trees per river mile was removed from each of these three estuaries (Maser and Sedell 1994:123). This removal probably did not include drift trees in less navigable slough and high marsh settings, but most of these areas were diked and drained and converted to agricultural land during this same period (Benner 1991; Maser and Sedell 1994). Buried driftwood in former marsh sediments has been identified in archaeological excavations in drained marshlands along the Coquille River (CITCRP 1999:14-20)

While the full effect of this habitat alteration on estuary fishes is not known, the value of woody debris as habitat for estuary fishes is well established (Maser and Sedell 1994:79). The significance of this as fish habitat was recognized by many Native people on the Oregon Coast. For example, Coquel Thompson observed that "herrings spawn on hemlock and more rarely spruce boughs that hang into the water. The Indians get lots of eggs thus Anywhere the hemlock or spruce dips into the water ..." (Harrington 1942[25]:510-11). Other elders bemoaned the erosion that resulted after settlers removed woody debris from tidal wetlands. As Frank Drew recalled for the Siuslaw, "now all the drift of the main river has been removed and the removal of

this miles and miles of drift which broke the current has resulted in the washing away of marshlands (Frank Drew in Harrington 1942[23]:464).

Some logging practices can move large sediment loads into estuaries over time, although streamside logging was curtailed in much of the region in the 1990s. As Siletz fisherman Elmer Reed (U.S. Court of Claims 1945:136) observed, there “used to be a split run (of spring salmon) that started in April and May. There has been so much logging on the upper (Siletz) streams that more or less got into the spawning grounds, and that (run) does not seem to come anymore.” Perhaps the greatest impact from forestry practices relates to the suspension of traditional burning in forest management. Massive fires burned throughout the Coast Range from the 1850s through the 1940s (Morris 1934). When Indian populations were higher and communities were more widespread in the region, traditional burning practices may have kept the fuel load to a minimum along forest margins and in open parklands (Harrington 1942[24]:740; Boyd 1999b). When this practice ended in the middle 1800s, the scale and intensity of fires was huge. Runoff in areas deforested by these fires brought massive sediment loads into estuaries, far more than reaches the rivers in normal years (McDowell 1987:539-542). It is estimated that marsh expansion in the Nehalem and Tillamook estuaries reduced the intertidal area by 50 percent as a result (Johanneson 1964; Schultz 1990:167).

Commercial Fishing and Hunting

The removal of higher trophic level species has been a major factor in the reduction of fish populations throughout the world (Jackson et al. 2001). Keystone species in the northeast Pacific include fishes, sea mammals, and other fauna. On the Oregon Coast, unregulated fishing during the early years of American settlement undoubtedly affected some fish populations. Fisheries regulations were developed in the late 1800s, but the implementation of conservation

measures in fisheries management has rarely succeeded (Jackson et al. 2001). However, techniques for measuring the full extent of the impacts of commercial fishing in Oregon estuaries are not evident. As Schultz (1990:318) observed, the “success of the Northwest fishing industry has undoubtedly taken a heavy toll on estuaries, but we may never know its exact effects simply because we have little idea what estuaries were like before the industry.”

One of the largest Oregon estuary fish populations to be impacted by overfishing is that of the Pacific sardine. Once abundant in Oregon estuaries and nearshore waters, the sardine was almost completely wiped out in the 1930s and remains low even today (Proctor et al. 1980). Soon after the sardine was over-harvested, northern anchovy populations actually increased, indicating niche sharing between these species (Monaco et al. 1990-91). Reductions in other species, such as starry flounder, may be due in part to differences in fishing techniques and poor conservation practices. As Coquel Thompson observed, the “Indians always took only enough clams or game, but whites caused extinction. Now there are no flounders at Taft (Siletz Bay). Indians caught flounders only in July and August” (Harrington 1942[26]:122).

Commercial gill net fishing was intense in Oregon estuaries beginning with the establishment of canneries in the 1870s and 1880s in many estuaries (Cobb 1931). This industry had a measurable impact on salmon, and it was outlawed in most estuaries by the 1950s, after salmon populations had declined substantially. Traditionally, such impacts to salmon and other fishes may have been more limited. Native resource management practices are widely mentioned in the accounts of fishing practices on the Oregon Coast. For example, the spacing of basket trap warps was often determined based on the size of the fish targeted. In some cases the gauge was sufficiently large to allow the escape of juvenile fishes (Chapter 3). These practices may have been especially important in riverine weir fisheries above tidewater, where large structures could completely stop salmon and lamprey runs. While there may have been impacts in the past, Native

conservation practices were a fundamental part of weir fishing, as reflected in the limitations on harvest during the first days or weeks of the spring salmon runs, and in the short period of use for large salmon weirs (Barnett 1937:193; Kroeber and Barrett 1960; Swezey and Heizer 1993).

The effects of the loss of the sea otter in coastal ecosystems have recently been explored by researchers from the Elakha Alliance, a consortium of individuals from Oregon tribes, universities, government agencies, and non-governmental organizations (Hatch 2002). Known as elakha in Chinook Jargon, the sea otter was a keystone species on the Oregon Coast, but its populations declined during the fur trade years, and the species was completely wiped out in the region by the late 19th century. The decline of the sea otter coincided with the massive loss of kelp beds along the Oregon coast, as this species was the key predator of sea urchins, which feed on kelp. Like estuaries, kelp beds hold some of the highest biomass on the Northwest Coast, and their large scale loss in the region was likely a significant, though unmeasured, factor in the reduction of many estuarine fish populations (Jackson et al. 2001). The Elakha Alliance is currently developing plans to reestablish sea otter populations on the Oregon Coast.

Predation by Non-Native Fishes

The introduction of non-native fishes has taken a major toll on fish populations in Oregon estuaries (Monaco et al. 1991-92; Simenstad et al. 1997). Some of this predation involves juvenile anadromous fishes above tidewater, such as the predation on salmon smolts by small mouth bass in the Umpqua River. Striped bass were introduced to the Oregon Coast in the late 1800s, and they may be very destructive for native fishes in estuaries. This species is present in the Siletz, Yaquina, Siuslaw, Umpqua, and Coos estuaries, and its prey includes various smelts, flounder, northern anchovy, and juvenile Chinook salmon. Coos Bay Indians had recognized the impacts of this fish by the early 1940s, attributing the loss of flounder and other fishes to the non-

native bass (Harrington 1942[24]:696). As Lottie Jackson Evanoff recalled, “every slough used to be full of shiners, when you were pulling around Coos Bay they used to jump in the boat. Bass have eaten them all...” (Harrington 1942[22]:892-893). Shad were introduced into Oregon rivers by the state fish commission in 1876 as game fish (Coos Bay News 1895). This species’s impact on salmon and other fishes may be less due to predation and more related to habitat occupancy.

Lamprey Eradication Efforts

One of the most important fishes for Oregon Coast Native communities, the Pacific lamprey, drastically declined in numbers on the Oregon Coast during the 20th century (Downey et al. 1996). It may have been the target of eradication efforts by the State Department of Fish and Game in the middle decades of the 20th century. According to several Siletz elders interviewed by Downey et al. (1996), at the same time Native people were harvesting this resource in the Siletz, lamprey were being poisoned. The reported motivation for these efforts was that the lamprey were considered an impact to salmon populations. The severe decline in this fishery may also be related to biocides used in forest management (Downey et al. 1996:41). I have not found documentation for this in fisheries records, and I have not interviewed the staff at the Oregon Department of Fish and Wildlife regarding these statements. The Confederated Tribes of Siletz have attempted to reestablish once abundant lamprey populations in coastal rivers and streams, but they have had limited success at this point (Robert Kentta, 2002, personal communication).

Collectively, these changes appear to account for the substantial reductions in fish populations, and the possible reduction in species diversity, that are indicated by comparisons between modern fish populations and those depicted in historic accounts. They clearly show, moreover, that the productivity of Native fishing cannot be judged from recent survey or

historical data, where several key species are now “ecological ghosts” of their past abundance or range.

Summary

On the Oregon Coast, a combination of high rainfall and rich soils in terrestrial settings and seasonal upwelling in marine settings produces an exceptionally high biomass. This biomass is present in diverse ecotones that were the homelands for Native communities for thousands of years. Among the mountain-shore, dune sheet, and coastal river valley ecotones, the estuary is the setting that historically held the greatest abundance of resources accessible to Native peoples. Twentieth century industrial impacts have severely reduced estuary fish populations, but diverse fish species were once the foundation of coastal economies. These included large runs of salmon and forage fish during all seasons, and other pelagic and demersal fishes that were resident throughout the year. The largest, most numerous, and most permanent Native communities were located on estuary shores, and seasonal residence at upstream salmon and lamprey fishing stations was common for many people.

CHAPTER 3 ETHNOHISTORIC ACCOUNTS OF FISHING

“When the Indians have a hard time, no grub, they say well, mouth is just like a kawaymi [estuary], maybe pretty soon some fish will come in.”

Lottie Jackson Evanoff, as told to John Harrington (1942[24]:698).

In Salmon Season they Cought great numbers of that fish in the Small Creeks, when the Salmon was Scerce they found Sturgeon and a variety of other fish thrown up by the waves and left by the tide which was very fine....”

William Clark, based on the testimony of a Tillamook man in 1805 (Moulton 1983:184).

In this chapter, I survey the literature on traditional Native American fishing practices in and around Oregon estuaries. Ethnographic analogy is key to understanding the use of weir technology in the region, yet previously published summaries of Oregon Coast fishing technology were very generalized and often biased toward a limited set of fishing strategies. The range of variation in this technology has not been adequately documented for this region, nor for the broader Northwest Coast, though overviews of fishing practices have been presented for areas north of Oregon (Hewes 1947; Stewart 1977) and the northern California Coast (Kroeber and Barrett 1960). Fortunately, I was able to identify extensive ethnographic and ethnohistoric accounts that shed much light on fishing technology and its context in the study area.

My approach has been to draw from as wide a range of sources as possible, looking at primary notes when these are available. General descriptions of fishing by ethnographers are considered in terms of the collective accounts. Although ethnographic and historic accounts are better for some parts of the study area than for others, I synthesize information about fishing traditions from the Tillamook peoples in the north to the Coquille peoples in the south. The sources I have drawn from most heavily are notes from interviews conducted by John Harrington (1942), Melville Jacobs (1934), Elizabeth Jacobs (1934), Philip Drucker (1934), Homer Barnett

who assisted Drucker (see Kroeber 1937), and Leo Frachtenburg (1909). These anthropologists interviewed several Native elders from Oregon Coast tribes between the turn of the 19th century and the 1940s. Fortunately, they recorded extensive accounts of fishing and most of this material consists of nearly direct transcripts of interviews. The people who provided the most thorough descriptions of fishing and related activities were Coquel Thompson, Agnes Johnson, Ida Mecum, Annie Miner Peterson, Jim Buchanon, Lottie Jackson Evanoff, and Frank Drew for the Coos-Coquille; Spencer Scott for the Lower Umpqua; John Albert for the Alsea; and Louis Fuller and Clara Pearson for the Tillamook.

Of these individuals, only Clara Pearson, Louis Fuller, and John Albert remained near or within their tribal homelands throughout their lives. All of the others were forced to leave their homelands by the U.S. government during the early reservation years or were born at the Coast Reservation after their parents had been relocated. Some of these people returned to their homelands after closure of the Alsea Agency in 1876, and in some cases they resumed or continued their traditional fishing practices until these were made illegal by fish and game laws, or made impractical because of private property ownership and new economic conditions.

Accounts drawn from the extensive interview notes provide direct descriptions of fishing activities with much detail. However, the activities described were not always seen by the people describing them and were sometimes told to these individuals by their elders as part of their cultural education. In some cases the interviewees appear to have discussed activities that changed due to American settlement and forced removal to reservation camps such as Yachats. There are few accounts of scoop net fishing for surf smelt between the Coquille and the Columbia, for example, but accounts indicate this was an important activity during the reservation years at Yachats. Because the people here relied on marine fish but were denied

access to highly productive estuary fisheries, they turned to a technique that may not have been as important in this region at earlier times.

Published ethnographic material includes Franz Boas (1898, 1909, 1923), Frachtenburg (1917), M. Jacobs (1940), Drucker (1939), and Barnett (1937). Except for Boas, these articles and books are largely based on the interview notes I consulted, and thus they are treated as secondary sources of information, except in cases where specific individuals are cited for an account. One important source of information I consulted was narrative text. Researchers (e.g., Simmons 1988; Ridington 1990; Newton and Moss 1994) have shown that oral tradition can be an important source of ethnographic information relating to subsistence and other activities. The Clara Pearson (1990) narratives recorded by Elizabeth Jacobs shed light on Tillamook fishing practices. Additionally, I have cited the book *White Moccasins* by Beverly Ward (1983). Ward's grandparents lived in the Coquille Valley before American settlers arrived, and late in life she recorded her family's traditions and those of other Coquille elders in this volume.

I have also assembled several ethnohistoric accounts from diverse sources. These were acquired at regional and national manuscript archives such as the Southwest Oregon Research Project (SWORP) collection, assembled by researchers from the University of Oregon and the Coquille Indian Tribe. The National Anthropological Archives at the Smithsonian and the National Archives hold many of the original documents I consulted. Other sources provide incidental accounts which are often quite relevant. These include early newspaper accounts and magazine articles. Military records provide much detail on encounters with Oregon tribes, in some cases describing tragic events. For example, in 1851, Colonel Silas Casey led an assault on the people of the Coquille River during the height of the fall fishing season (see Tveskov 2000:412-418), and his report describes the destruction of numerous houses filled with smoked salmon, as well as the fisheries that were still in use. In contrast, Lieutenant Theodore Talbot's

(1851) report of his September, 1849, expedition to the Alsea River in search of coal yielded a very detailed description of a weir being used to harvest large quantities of smelt.

Overview of Fishing Technologies

Definitions of Terms

As fishing was the mainstay of Oregon Coast economies traditionally, it was highly diversified in apparatus, strategy, geographic setting, and social context. I define technology as both the material objects (tools, etc.) and the strategic knowledge used in fishing (see Ridington 1990:86). This discussion focuses on the material aspects of fishing technology, involving the apparatus in relation to the setting of the fishing activity, along with the actual returns of the harvest. For traditional Oregon Coast Indian communities, the most frequently identified fishing apparatuses include: 1) structures (e.g., weirs, traps, and platforms); 2) piercing implements (e.g., spears and hooks); and 3) nets. There are also ancillary tools such as clubs, scoops, baskets, rope lines, and anchors.

Fishing Structures

Structures may be small and moveable and or large and stationary, but during use they are freestanding objects designed to impound fish or support people during harvesting. Structures used for fishing include weirs and woven traps that are fixed or portable devices of rigid material which limit fish movement while allowing water flow. Hilary Stewart (1977:98-123) documented a range of variants in weir and trap technology used by several tribes and First Nations on the central and northern Northwest Coast. As typically referred to on the Oregon Coast, weirs consist

of a wood (and rarely stone) fence constructed in moving water. Woven traps (or basket traps) are impounding structures that may be cylindrically-shaped, open-work units similar to baskets, enclosures of lattice panels, or simply open trays of woven sticks. Woven traps act much as weirs do, but they are generally smaller. When used with a weir, the woven trap is usually the

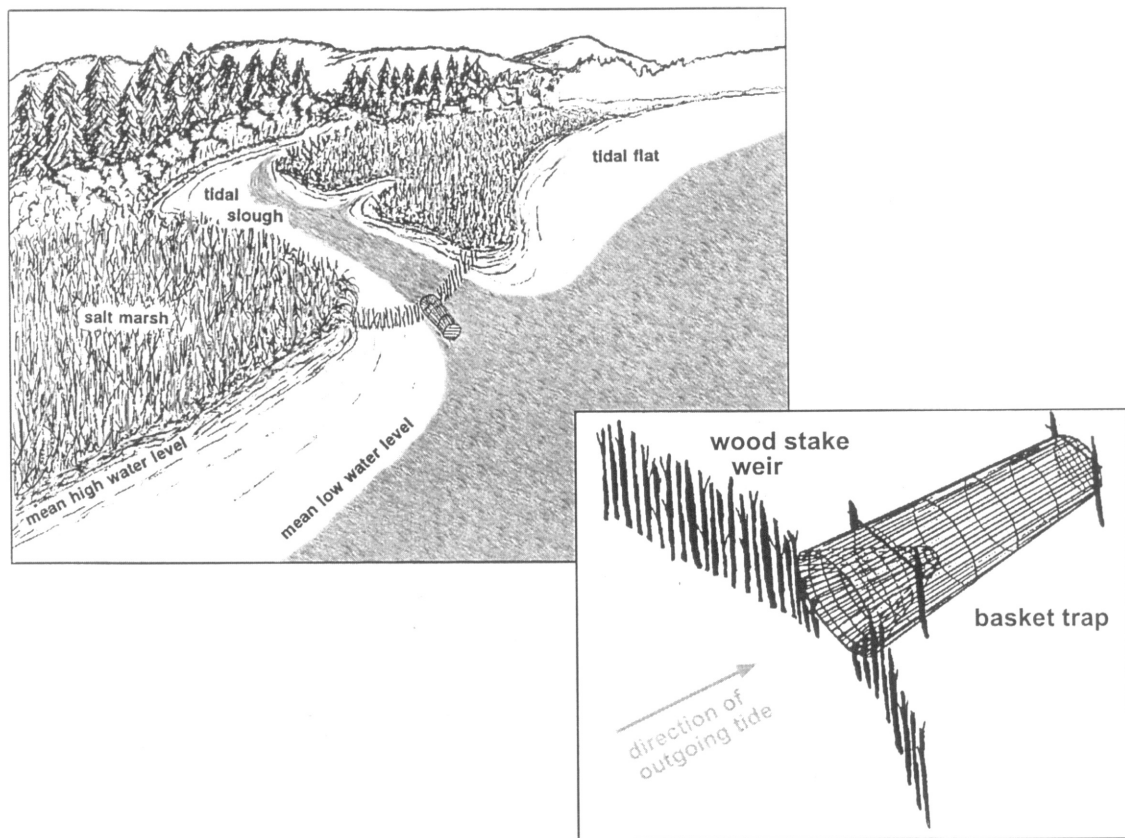


Figure 7: Wood Stake Weir with Basket Trap in Tidewater (a semi-permanent structure built across a non-mainstem tidal channel).

impounding device for fish. There are important but often overlooked distinctions between weirs used in tidewater (Figure 7) and weirs used in freshwater, riverine settings (Figure 8).

Other structures include platforms that support the fisher, such as scaffolds and canoes. Various freestanding platforms were used with or without weirs as surfaces to stand on above the water. Some were covered with shades so a fisher would not be noticed by the fish. Canoes could be tied to a weir or the shore and used as a fixed platform. They were also used as moveable platforms or barges for transporting fish back to residential areas for processing.

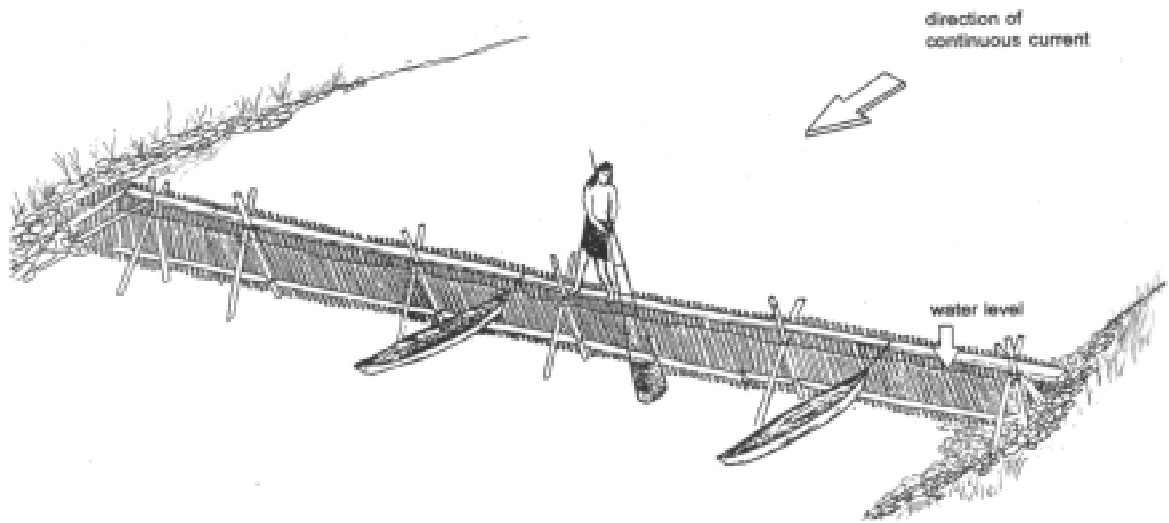


Figure 8: Large Riverine Weir or "Fish Dam" (dip nets and basket traps were typically used at weir openings).

Piercing Implements

These include devices used to pierce and retrieve fish from the water or the channel floor (e.g., see Drucker 1955:27-31; Stewart 1977:65-73). According to some Oregon Coast accounts, the salmon harpoon was the most common fishing tool used in the region. In several ethnographic accounts, the term spear is used in reference to the harpoon. This was a composite device consisting of a wooden shaft as the handle (pole) with a detachable point, and a strong, thin line of a meter or more connecting the point to the shaft. It appears that the toggle harpoon point of bone was most common on the Oregon Coast. The only non-harpoon spear widely reported was one designed for harvesting flounder in shallow water on tidal flats. Gaff hooks had a shaft and fixed point like a spear, but the point projected rearward toward the wielder.

A common fishing strategy, at least in southern Oregon Coast estuaries, used a buoyant float with a line of baited hooks attached. Trolling with single hooks, or fishing poles with lines and hooks are not mentioned in Oregon Coast accounts.

There are limited references to the use of a rake, a long paddle-like pole with sharpened “teeth” along one or more edges (see Stewart 1977:76). Fishers would “rake” the water to pierce or snag herring and other small, shoaling fish during dense spawning aggregations.

Nets

Nets are flexible devices woven of fiber that allow water passage while impeding fish movement for harvest (see Stewart 1977:79-98). Two general categories of nets were used historically by Native peoples of the Oregon Coast. These include two forms of gill nets: set nets and drift nets. These were generally large (10 cm or more) mesh nets that allowed salmon to move partially through the mesh, becoming stuck when the net reached the fish’s gill openings. Set nets were fixed to the shore or the floor of the river, while drift nets moved with the current.

Both were most often used in tidewater. Dip nets were generally smaller than gill nets and were normally operated by one person. The most common had a single pocket with a wooden hoop rim and a long pole handle affixed to the hoop. A similar single pouch dip net consisted of two long poles, converging at the end which was held, with the pouch at the opposite end and one or more cross pieces between the pouch and the point of convergence. When used in conjunction with weirs, in pools below falls or in tidewater amid shoals of spawning fish, these dip nets were very effective mass harvest devices. This net type should not be confused with smaller dipping containers, sometimes termed “dippers,” of basketry or carved wood. These ancillary fishing tools were used to remove fish from woven traps or canoes.

Other tools widely used in fishing include clubs used to dispatch fish caught with other devices; various lines or ropes used to anchor nets, affix traps to weirs, and anchor canoes; baskets used to haul catches; and floats used to mark submerged traps.

Together, fishing structures, nets, and piercing implements and ancillary tools were part of a suite techniques that Native people used to harvest immense numbers of fish through the course of the year in Oregon estuaries and upriver settings. They were so effective that, in many cases, they were preferred over industrial equipment brought to the region by colonial settlers.

Ethnographic Accounts of Fishing Practices

There are comparatively few published ethnographies for the Oregon Coast and fewer still depict fishing practices in detail. Given this dearth, as well as the richness of the accounts I was able to find in manuscript collections and other sources, I chose not to rely on most of the generalizations made by ethnographers. A comparison of two ethnographic sources illustrates the limitations of the more cursory approach compared with more in-depth research. This comparison

also points to more widespread limitations in ethnographic research on fishing techniques beyond the study area.

The two sources I compare are Drucker's (1939) *Alsea Ethnography* and Melville Jacobs' (1934[96-22]) unpublished Coos-Coquille ethnography. Both are based on research conducted in the mid 1930s on the Oregon Coast. Drucker admitted his study was cursory, conducted incidental to more thorough research on the Oregon Dené culture. This lack of depth may explain his view that Alsea culture was peripheral to Northwest Coast society (Drucker 1939:81). In terms of its representation of fishing, Drucker seems not to have recognized the importance of estuarine fishing in Alsea subsistence. Based on interviews with Alsea elders, Leona Ludson and John Albert, Drucker (1939:82) wrote,

The Alsea were fisher folk. Their choice of dwelling sites, their seasonal migrations up and down their little valleys, and their technological interests reflect the importance of this pursuit in their lives. In their economy, salmon ranked first of the several kinds of fish taken ... other fish and game served only to supplement the diet.

Of these other fish he mentioned smelt, herring, lampreys, flounders, perch, and salmon trout. The two fishing devices considered most effective by the Alsea were woven traps (with weirs) and harpoons. "Traps were used in conjunction with weirs, either in the main river or in side streams" (Drucker 1939:82). Drucker discussed John Albert's description of a large weir structure built across the river but did not specify the location of this weir. His notes from this interview, which I happened to find in the first pages of his Nootka notebooks at the National Anthropological Archives (Drucker 1933-1954), reveal that this large weir was built at the first riffle above tidewater, and that different types of traps were used with the weir.

After claiming that the Alsea relied most heavily on salmon, and that these fish were harvested with traps at weirs, Drucker does not explain why most Alsea villages were located along estuary shores. The upriver setting of John Albert's large weir is left out of the published

account (Drucker 1939). Given what is now known about the importance of fishing in estuaries, it appears that Drucker's cursory ethnography of the Alsea helped perpetuate an inaccurate generalization about fishing practices that may be widespread on the Northwest Coast.

Melville Jacobs did much more lengthy ethnographic interviews with Coquille and Coos people on the central and southern Oregon Coast. Yet he had nearly finished his months of ethnographic fieldwork before he realized, during an interview with Annie Miner Peterson, that he had not recognized the most fundamental subsistence pursuit for the people who resided at the Coos and Coquille estuaries. Compared with Drucker, Jacobs provided a broader perspective on estuary-oriented subsistence.

The most important sources of food were almost too obvious for mention. I obtained no end of what to me were petty details about how individuals conducted minor aspects of hunting and fishing before I discovered that the principal supply of foods was shared by all in a most un-individualistic manner. The minor details and the rarer foods interested the survivors much more than the general ways in which the larger staples were obtained. As for the latter, I finally learned that the men made such prodigious hauls when one or another run of fish came into the Lower Coquille and Coos Bay that everybody went and got all he or she needed, in the 'go-help-yourself' free for all that was actually the largest single source for the Coos larder. This 'go-help-yourself' was so commonplace and so completely uninteresting to most of the informants that they never volunteered mention of it at all. Annie remarked upon it lightly in the last days of my work with her, and she was rather amused that I should be interested in anything so prosaic and obvious, or that I had not taken some such thing for granted in the first place. Perhaps I should have; but not being a native of the Oregon Coast and having had no live conception of the wealth of fish that enter the coastal rivers and bays, the notion of wholesale hauls, enough for everybody, did not quite enter my head. And after all, my own white culture had not gone about these tremendous fish runs in quite the communal spirit of enough-for-everybody and everybody-have-some in which the Indians proceeded.

This attitude turns out to be central to an understanding of the Coos economic and social life. When a Coos suffered it was never from crude want of food or clothes There was no thought of putting monetary evaluation on the wholesale fish hauls, nor on any other types of food, since everybody could have all they wanted; if none were wanted, there were more of the same school or run of fish out in the river or bay; the swarming waters were limitless in their bounty; more boatloads could be gotten with little effort.... The only real limitation on the fish production lay in the productive ability of the women to clean and smoke the fish that were brought in....

The monetary evaluation was on the products of the leisure period, after food and elementary clothing and shelter needs had been taken care of (M. Jacobs 1934[96-22]:11-13).

With a transition from typed to handwritten text, Jacobs continued,

Whenever a fisherman noted a run of one of these fish, he spread the news, and soon all the well-to-do men [i.e. middle and upper class] who had canoes and were fishermen on occasion, went out, to return with load after load, dumped on the beaches; the women, rich and poor, came down barefoot on the sands carrying their large, openwork baskets and transported back all the fish they wanted.

... All bay fishing was village-communal; (the fisherman) obtained an excess that would take care of every other household in his village. The village wives of all classes helped themselves to what they wanted of his haul.

Among the techniques used by bay fishermen for the large 'go-help-yourself' hauls, were the following. Small fish, such as herrings, sardines and bay smelts could be dipped up from canoes, by hand, using handled sieve-like 'dippers' that were made either of woven hazels or spruce limbs; or by using solid wooden dippers that also could serve as canoe 'bailers' when needed.

The 'go-help-yourself' public hauls were only of fish that entered the rivers and bay in limitless numbers. These were two kinds of 'herring', a smaller and larger type; several kinds of 'salmon', one called (?) ... another Chinook salmon, a third Silverside salmon, two kinds of sardine; two kinds of 'smelts', one 'surf smelts', the other so-called 'Coos Bay smelts', and a run of so-called 'he'i-'k' fish. There may have been others. Not all of these wholesale hauls were gotten out in deep bay or ocean waters; some were taken in shallower places near sloughs or creeks (M. Jacobs 1934[96-22]:13-16).

Analysis of Drucker and Jacobs

Based on detailed accounts presented below, Jacobs' representation of estuary fishing is more accurate than Drucker's. Yet neither ethnographer thoroughly characterized fishing practices that seem to have been common on the Oregon Coast. Drucker emphasized the importance of seasonal salmon fishing, while Jacobs emphasized the harvest of diverse fishes in the estuary setting. As we shall see, however, the residents of tidewater villages relied on estuarine fishing most of the year, but also traveled to upstream locations for salmon and Pacific lamprey ("eel") fishing during part of the year. Although generally overlooked by ethnographers, lamprey fishing may have been as important as salmon fishing during spring or summer for many groups, and after processing this fish could be stored for over a year. Like salmon, lamprey were most often caught above tidewater, in shallow water where their movement was limited by obstacles. The fish Jacobs recorded as 'he'i-'k' may be the hake, given the historic accounts of its

former abundance in Oregon estuaries seasonally (Chapter 2). It may have been caught in weirs along with herring or other forage fish it feeds on in the estuary (see Hanson 1995:37-38), and evidence of its use would appear to reflect much more abundant forage fish populations than exist today in Oregon estuaries.

Generalizations such as those made by Drucker (1939) appear to have been passed down in the literature, resulting in continued modeling of subsistence practices along the lines of a winter village-seasonal round scheme (e.g., Lyman 1991:82). Salmon fishing at upstream settings could occur into mid-winter on some parts of the coast, and while estuary fishing may have been most successful in spring and summer, it could be done throughout the year. There are no indications that all residents of tidewater villages moved to upriver settings during the salmon and lamprey seasons. Instead, there is evidence that some people went inland to fish, while others went hunting or to the coast for shellfish, and still others stayed in the villages. Models involving semi-sedentary residential patterns, with seasonal dispersal of subgroups and diversified subsistence appear to better account for Oregon Coast economies in the pre-Reservation era.

Accounts of Oregon Coast Fishing

Weir and Basket Trap Fishing

Ethnographers' depictions and historic accounts of fishing technologies are often inconsistent with regard to terminology. For example, a weir may be called a fence, lead, dam, enclosure, or even a fish trap. Basket traps can be termed pots, pens, *verveau*, fish baskets, or fish traps. Fortunately, most of the accounts presented here are clear in their referent. In discussing the various devices, I follow the most common usage in the Oregon Coast ethnographic accounts, generally using the terms weir and basket trap, and eschewing ambiguous terms such as fish trap.

Weirs were large or small, made of wood and/or stone, and used variously with basket traps, dip nets, gaff hooks, canoes, and other fishing-related implements and structures. Riverine weirs built in freshwater, and occasionally in tidewater, were most often used to harvest Pacific lamprey and various salmon species, usually during spawning runs when these fish were most numerous and their movements predictable. Tidal weirs worked in conjunction with tidal action, and were designed to harvest herring, flounder, smelt, sardine, salmon, and numerous other fishes, during spawning gatherings and at other times as well.

Devices identified as basketry fish traps, or simply *basket traps*, appear to have been quite common on the Oregon Coast. They ranged considerably in size and shape, in their settings of use, and in the fishes they were used to harvest. Many were used with weirs or “leads,” while others were used at falls, and some alone. Many were cylindrical or cone-shaped, while others were open or folded panels. Basket traps were often made from lattice panels, which have been identified archaeologically (Chapter 7). Lattice panels were also used to form enclosures, or as weir panels supported by stakes, though these two uses are not widely reported in the region’s ethnographic accounts.

There has been no systematic overview of the available ethnographic accounts involving weir and trap use on the Oregon Coast, although Barnett (1937:163-164) reported that all groups in the study area used the fish dam, as well as a fishing scaffold sometimes in conjunction with the weir. He also reported that all groups used basketry fish traps of willow or fir; all used the eel pot with in-folded opening; and all but the Coos recalled using a salmon trap with a triangular base, apparently woven of split wood. These comparisons are of limited value for my study because Barnett did not distinguish between tidewater and freshwater fishing.

In this section, I present accounts of non-tidal salmon weirs and basket traps first, followed by lamprey fishing accounts, and then more generalized tidewater weir and basket trap

fishing. The large number of accounts of these fishing structures is indicative of their importance to Oregon Coast economies.

Riverine Salmon Weirs

Oregon Coast ethnographic and ethnohistoric accounts describe different types of weirs built across rivers and used to harvest salmon. Some were built at riffles or falls above tidewater, and others were built in tidewater. Yet whatever their setting, these weirs were used to harvest salmon without use of tidal action.

Upriver Weirs at Riffles

The most frequently mentioned salmon weir is the kind built in shallow water at localities well suited to weir building and salmon harvesting. Sometimes termed “salmon dams” or “fish dams,” these were built above tidewater or in the upper part of a tidal river. They were designed to temporarily stop or redirect salmon moving upstream during spawning runs. Many were large structures that took substantial group effort and coordination to build, and returned massive harvests of fish sufficient for long term use.

Perhaps the most widely cited example of a riverine salmon weir is from northwestern California. The Kepel Fish Dam was described by Waterman and Kroeber (1943:49-80). This immense weir was rebuilt annually in a shallow portion of the Klamath River by people from several Yurok villages. Although its construction required a massive effort, the weir was only used for 10 days before it was dismantled, though related ceremonies lasted several days before and afterwards. Considered one of the great engineering efforts of Native Californians, the “structure absolutely checked the run of salmon” which, by all accounts, was immense in the Klamath River during the time of the dam’s construction (Waterman and Kroeber 1943:50;

Swezey and Heiser 1993). Several other well-known Northwest ethnographies depict large weirs in river channels being used to harvest salmon (Smith 1940; Barnett 1955:80; Ballard 1957; Stewart 1977).

Although riverine weirs such as the Kepel Dam were impressive structures worthy of note in the discussion of Northwest fishing technologies, the construction of these weirs and their use appear to have differed greatly from that of many other weirs built in northwest California and on the Oregon Coast. Many non-tidal salmon weirs were smaller, apparently involving fewer supervisors, fishers, and fish processors.

Relatively large non-tidal salmon weirs were built in most (if not all) Oregon Coast rivers. Tillamook elder Clara Pearson described such weirs used in north coast rivers,

in the spring, cross-stream weirs of sticks were built with basket traps for fishing the large runs of salmon and trout. Such weirs were built across a riffle by filling up the shallow bed with more rocks and sticks. The mouth of one or more large spruce-root baskets formed the only opening in this cross-stream barrier. The Natives could turn the baskets around with the mouth either up or downriver and catch the salmon fighting their way upstream, or reverse it for those returning to the sea (E. Jacobs 1934[106]:5-12).

A similar weir was built on the Alsea River. John Albert (Alsea) told Drucker of a weir built at the first rapids above tidewater (Drucker 1933-54). This structure incorporated basket traps, and it had a catwalk that people could walk across (Drucker 1939:82).

One of the largest non-tidal salmon weirs used on the Oregon Coast was built annually in the Umpqua River, at the first rapids above tidewater (near Scottsburg). This structure may have been used with dipnets. Settler Albert Lyman (1851) sketched and described this

... Indian fish dam During the season in which the salmon run the Indians remove to the vicinity of the rapids on the river where they construct a dam and traps for catching salmon which they smoke and dry for future use.

His sketch clearly shows a structure reaching across the entire river channel. In late August, 1840, fishers at this dam appear to have supplied four smoke houses, with at least 100 people present at the fishery (Hines 1851:101). Accounts of this as a major fishery date back as early as 1834, when Hudson's Bay Company staff referred to the Scottsburg area as "the Verveau," or fish trap place (Work 1923:253-255).

Non-tidal salmon weirs were also described for the Coquille River. According to Coquel Thompson, when the "first Chinook come in they have big fence, [on the upper Coquille] and lower mouth of Coquille people come up ... no fish down below so they come up ... when they get enough to eat they go back, pack fresh fish" (E. Jacobs 1934[103]:105). Ida Mecum, a Lower Coquille Miluk-speaker, mentioned that her tribal elders had used such a weir with basket traps (Drucker 1934[1]:45).

Other Coquille River weirs may have been used more exclusively by upriver peoples. These last three above-tidewater weirs were used by upriver Coquille people. In a conversation with Drucker, Coquel Thompson described a large weir "built by communal labor – sections woven by men, under the direction of two, three old men – put in – speared fish when coming up – when they coming back put in basket traps" Drucker's notes include a sketch of a basket trap with the mouth facing upstream under water, and the opposite end out of the water; a note to the sketch reads, "fish get in above water, can't get back," indicating that the current forces the fish up and out of the water where they can be removed from the trap by hand or hook. The account continues, "Old people know when its time to build this ... doesn't give orders etc. for it. Built in early summer when water beginning to get low" (Drucker 1934[1]:124).

The Coquille communal weir was likely used for salmon, as eels (the other fish targeted with upriver weirs) reportedly were not caught in traps this way. The weir may have had multiple components: a cross-channel fish dam as well as one or more downstream leads ending at basket

traps. In a separate conversation with Harrington, Thompson described the construction of a cross-channel weir for salmon fishing: “[o]ne Indian holds the sticks while the other does the pounding. It takes one day to drive the stakes in a row crossing the stream” (Harrington 1942[25]:804). In another account, Thompson mentioned the setting of these weirs in spring, when they “caught first fish (salmon), those people know when it’s time, because people fix that fence up at riffles” (E. Jacobs 1934[120]:48). As elsewhere, the best settings for building weirs above tidewater appear to have been shallow sections of river with gravel bottoms suitable for driving sharpened wood stakes.

There are indications that some of the largest upriver villages on the Coquille River were located near places in a river well suited to salmon weir construction and use (Harrington 1942[26]:202-17; Tveskov 2000). This residential pattern may not have prevailed in other parts of the Oregon Coast. Of the rivers in the study area, the Coquille and the Umpqua are the only two where different tribal communities inhabited interior valleys and lower estuary shores.

Non-Tidal Salmon Weirs in Tidewater

In the Siuslaw and Coos estuaries large weirs were used in the upper portion of tidewater to block fish passage during high tide as well as low tide. These do not appear to have been built across deeper portions of the river channels, but they must have been large structures to have functioned in a region where tidal fluctuation is often over two vertical meters. According to Alec Evanoff, an Aleut fisherman who moved to Coos Bay and married Lottie Jackson Evanoff,

At Graveyard Point ca. 2 mi. up Coos River from the mouth of the Coos River ... they put a ... salmon fence clear across Coos River with only a gap large enough for a canoe to go through, and when they had caught as many salmon as they wanted then they would remove the fence. They had a string attached to a fish basket and pulled string when fish basket was full (Harrington 1942[24]:484).

The account was reiterated in less detail elsewhere by Lottie Jackson,

My father (Chief Jackson) used always to say that Graveyard Point was (his father's) home and (his) father went up to that place every summer, and since he was a chief would merely look on as his men were catching salmons there (Harrington 1942[24]:102).

In this second account it is clear that the weir was built under the supervision of Lottie Jackson Evanoff's grandfather, a Hanis Coos chief, and his men, in a side channel parallel to the main Coos River channel, known locally as the "Cutoff." The topography of this channel is clarified in General Land Office maps dating to 1875 and 1883. As the "Cutoff" side channel was a branch of the river channel and not a tidal slough channel, the weir built here appears to have been a river-crossing weir.

Frank Drew described a non-tidal salmon weir in the upper tidewater portion of the Siuslaw River:

In September, about when the fish are getting plentiful, both streams are tightly dammed with sticks (because of deep water) each just above a fork. Young fir are put down in the mud bottom. Up on top of the stakes a pole is put across to fasten them, tied with roots When the tide is a couple of hours before low water ... they go in canoe in the dark and gaff hook Chinook salmon, only sometimes use dip net. Lots of fish (M. Jacobs 1934[91]:21-22).

Although positioned in tidewater, these two weirs appear to have functioned in much the same way as their upriver counterparts. Their position in upper tidewater may have been dictated not so much by ease of construction (as is indicated for upriver weirs located at shallow riffles) as ease of access for residents of downstream villages. It is important to note that neither of these weirs was built in the lower main channel portions of the estuary, where waters are now too deep for practical weir construction. They may have been shallower in the past, but no ethnographic accounts support weir use across tidal river channels in middle or lower portions of estuaries.

Jump-Over Dam with Trough-Shaped Basket Trap

While fishers often took advantage of natural channel features to spear or trap fish, in some places they built fences that had the same effect as a rapids or falls. Frank Drew recalled,

Only silver salmon was speared, the others are caught in fall's baskets. Chinooks come in the first run in spring, about in May. The men who fish watch for them. The men go up to where the tidewater goes. They make a dam of rocks, boulders, at a falls. The salmon jumps into a basket ... 4 ft. deep by 8 ft. wide. The fish are picked out by hand next morning. When the fish came up plentifully they had enough by that time, and the remaining chinooks were allowed to go on upstream (M. Jacobs 1934[91]:21).

The same trap may be described in this later account from Mr. Drew, "Indians in the Siuslaw River had a box built of twigs above Mapleton and spring salmon coming up would jump into that box" (Harrington 1942[23]:555, 839). Similarly, Coquel Thompson described how to "Make (a) salmon fence. Salmon jump through stakes into basket down below waiting for them ..." (E. Jacobs 1934[104]:99). Kroeber and Barrett (1960:68-69) described similar basket traps used in Northwest California, which they term *trough-shaped traps*. A similar trap for salmon is described for the Alsea (Harrington 1942[23]:196).

A salmon trap described in an Alsea creation story may be of the "jump over" type.

After going up the Yachach River he stopped at a certain place and said, "I'll make a fish trap here so as to enable the people to catch salmon." So he laid some rocks down at the riffles and said, "I'll lay here a tree across the river." Then he went up a hill to cut a tree. But when he arrived at the top of the hill he heard the ocean roar and said, "No, I'll not build a salmon trap here; it is too close to the ocean" (Frachtenburg 1920:233).

These "jump over" structures as well as the weir-like use of rocky sections in streams may have been more common than suggested in the four preceding accounts. Among the basket trap accounts presented below are several traps that may have been used with this technology.

Indeterminate Fish Traps or Weirs

Other accounts of salmon fishing structures are less clearly described, and some may refer to basket traps rather than weirs. A Tillamook narrative describes an old man who lived far up Nestucca River who had a fish trap ... which was full every morning with both small and large fish (Boas 1898:34-35). In a Nehalem Tillamook story, an old man says “I have a (fish) trap. I catch fish in this trap.” The trap catches a steelhead (Pearson 1990:56). An Alsea narrative depicts a salmon trap used every night, downstream from a residence (Frachtenburg 1920:240). A settler observed an Indian fish trap near the head of tide on Coos River, but gave no further description (Joe Maloney 1934[98]).

Each of the three riverine salmon weir types - freshwater and tidewater fish dams, and jump-over weirs - depended on the upstream movement of salmon during spawning runs. Each was used for a period of days or weeks. Each type also required the use of an ancillary structure or fishing implement such as a basket trap, gaff hook, dip net, or canoe. Many of the salmon weirs may have yielded massive amounts of fish representing a substantial portion of the annual diet for those who used these devices.

Basket Traps for Salmon in Non-Tidal Settings

The accounts in this section describe traps used for harvesting salmon above tidewater. Some traps were clearly used with large weirs or fish dams built across rivers, as depicted above. Many other basket traps were used in smaller streams well above tidewater.

Spencer Scott described a trap used in the Fall Creek tributary of the Alsea River, “[l]ots of steelhead there; Alsea Indians had basket there into which the salmon would jump and from which they were hooked ashore with a wooden hook” (Harrington 1942[23]:196). An Alsea narrative includes an account of “a fish-basket for salmon” (Frachtenburg 1917:69). While living

on the Siuslaw River, Frank Drew observed that large “salmon trout ... are gotten in fish baskets. They are eaten at once - are too small- and are not put away for the winter's supply” (M. Jacobs 1934[92]:97). Lottie Jackson Evanoff “saw lots of basketry fish traps” at head of South Slough [Coos Bay], near “the old Wasson place” (Harrington 1942[23]:1108). Susan Adulsa Wasson was known to make basket traps (Maloney 1934[100]:3).

Many basket traps were used at a falls in rivers and streams. Some appear to have been trough-shaped traps, such as one described above by Frank Drew (Harrington 1942[23]:839). Elsewhere, perhaps describing the same structure, “a few spring Chinook used to come into the Siuslaw in May ... Old Man Mishel used to catch some above Mapleton in May. They used to jump right into the ‘baskets’ he built” (Harrington 1942[24]:653). Coquel Thompson described a large basket trap used at a falls in the Coquille River. A large opening was made for the basket mouth. The trap was:

Five feet square down to foot high. Tie way up on falls, tie with soft hazel branches. Tie both ends. Tie way over there. Fish jump way up, fall in basket. Water runs down in basket. Pulls fish right down. Steelhead and silver side when going up river got that way. One man owned it. When he get full, they untie pull ashore. He give everybody fish. Men made that kind of basket. Vine maple and hazelnut. Stout open work, open all around. About inch size network or weave, baby fish go through (E. Jacobs 1934[121]:17).

Annie Miner Peterson told Drucker of a “box-like affair set under falls, just over water, so salmon fall back into it” (Drucker 1934[1]:55-56).

Jim Buchanon noted, after describing larger tidewater traps, “in falls small fish traps were used” (Frachtenburg 1909:17). He also recorded that among the Alsea,

In shallow water fish was caught with [two kinds of] fishbaskets. [1] was an oblong basket made of sticks of dried fir-tree put up horizontally and diagonally and fastened together with spruce roots ... a fence was made of hardwood and the basket ... between it. The fence and basket were usually placed under a waterfall. In small creeks these baskets were covered, because the coon and wildcat used to get the fish (Frachtenburg 1910:10).

Some of the smaller basket traps in settings above tidewater were probably used for other fishes such as trout (e.g., E. Jacobs 1934a[81-74]:66).

None of these accounts indicate that basket traps for salmon were used without weirs or some kind of a natural feature in the river such as a falls. Therefore, these accounts can be seen as further depiction of the weir and trap fishing for salmon on the rivers of the Oregon Coast.

Lamprey Weirs and Basket Traps

Widely referred to in Northwest ethnographic and historic accounts as “eel,” the Pacific lamprey was a key fish in traditional Oregon Coast economies. Although there are more accounts of eel fishing for the central and south coast, this practice appears to have been important on the north coast as well. Even more so than salmon, eel fishing took place above tidewater, as noted by Coquel Thompson, “Eels were nowhere caught by the Indians close to the ocean. It was there deep water, and the water was too deep. One has to go well up the rivers to get eels” (Harrington 1942[25]:511). The ethnographic and historic accounts presented below begin with weir and trap descriptions, followed by depictions of basket traps.

Among the central Oregon Coast ethnographic accounts of fishing practices is one by Frank Drew that provides much detail on eel fishing and its context. The account may refer to fishing on the Siuslaw. Among other things this account shows that, for lamprey, weirs had to be built no higher than the water’s depth.

Eels...were gone for by men. A 5-8 inch deep place was managed by a dam of large rocks or boulders, and a lead of that depth led to the trap basket glubet of young hazels. This basket is about half the size of a ha-'k fish basket. The latter is 4 feet, the glubet is about 2 ft. in diameter. But glubet is built on the same principle. The reason is that eel baskets have to be transported upriver so far (into the jungle) that a large basket would be too bulky in a canoe. The eels were taken out of the door of the basket. May and June were the eel months. The eels are taken ashore when caught. At the campsite there they see that they have a sandy graveled place available, with a hot sun. They dig a round hole

in the sand, the eels are dumped in, in order that the coarse sand would take off the slime ... (M. Jacobs 1934[91]:16).

A recent report on eel fishing by the Confederated Tribes of Siletz (Downey et al. 1996) shows how important traditional eel fishing was for this Indian community in the 20th century. Gaff hooks were widely used for eel fishing in the 20th century, yet it appears basket traps had also been widely used at Siletz. An article in the Siletz section of the Toledo, Oregon *Lincoln County Leader* dated July 18, 1919 reads,

Eel Catching – Lots of it going on now – The reason they use the hook on stick is because they used to use eel baskets but as the baskets caught so many trout, it is ruled out by law. The Indians are drying and putting away large quantities of dried eels for winter use.”

The trout referred to may have been juvenile salmon (Donald Ivy, 2001, personal communication). In a related account, Coquel Thompson appears to have referred to this shift in the years prior to his 1934 interview by Drucker, “Lamprey eels-run in early summer – set eel pots all across river. Baskets with small hole on one side. Didn’t use to gaff them at night” (Drucker 1934[2]:12). John Albert told Drucker (1933-54:2) that the Alsea did not use eel hooks, but caught them in basket traps at a weir.

In another account, Coquel Thompson described the eel trap in greater detail. This may have been the kind of trap he used while living in the upper Coquille Valley, and this technology may have been brought to Siletz by Coquille Indians,

men made ... [eel trap] of ... small vine maple. Not quite as wide a mesh. Eels go through anywhere. About three inch diameter wide front. Water pushes eels in. Takes whole basket full. Empty eels in boat. Then put basket top pole to dry (E. Jacobs 1934[121]:16-17).

The use of this type of basket trap is described by Frank Drew (for unspecified central coast tribes) – “w’aep – eel basketry trap, set out in river at night and the eels are taken out in the

morning” (Harrington 1942[22]:277). George B. Wasson Sr. described this activity as part of his testimony at a U.S. Court of Claims (1931:155) hearing on tribal lands. He said that for the Coos-Coquille homeland, when “the salmon berries began to sprout and their blossoms showed up on the bushes, it indicated ... the eels would be running in the small streams near tidewater. They would trap them in baskets and dry them”

Eel fishing was clearly important on the Siuslaw River, as related by Frank Drew and Jim Buchanan. Siuslaw resident Andrew Charles recalled that Tom Johnson, a Lower Umpqua/Siuslaw fisher, caught eels in Lake Creek on the upper Siuslaw. “Right this very day you can see the fence built across the river ... where he used to catch his fish and eels” (Harrington 1942[23]:550,553). At the 1931 U.S. hearing he testified that

The way that Mr. Johnson catches fish he builds a fence or weir across the river and leaves an opening of three and a half to four feet across where the eels, fish, or trout go through. Then in some places where the water goes swift that makes the fish go slow and they spear or hook them (U.S. Court of Claims 1931:108).

At Coos Bay and the streams feeding Eel Lake and Tenmile Lake to the north, eel fishing was an annual event that continued after the Alsea Agency closed in 1876 and people returned to their homelands. Daisy Coddling recalled that her mother “Susan Adulsa caught and dried an abundance of eels at Tenmile Creek” (Harrington 1942[24]:77). She also told Joe Maloney (1934[100]:3) that Susan Adulsa, “made eel baskets and traps.” Elsewhere Coddling mentioned that “the Indians dammed Eel Creek, used eel basket. Fished in dark – no moonlight” (Harrington 1942[24]:79). Similarly, Lottie Jackson Evanoff remembered that “They dammed Eel Creek. Cut up mud ... and put in eel basket ...” (Harrington 1942[24]:79). Harrington also interviewed Mrs. William Waters, who noted the Indians “caught eels in both forks of Coos River and at Tenmile” (Harrington 1942[24]:78).

Agnes Johnson told Drucker (1934[I]:20) that the “eel dam” was small. This weir was “put in (the) bottom of (the) river to catch all the eels.” Some eel weirs were apparently larger and more like salmon dams. For example, an eel dam described in a traditional Coos narrative (M. Jacobs 1934[91]:106-107) was large enough to be used as a footbridge across a river. Large eel weirs such as this have been described in more detail in northwestern California (Hewes 1940).

Eel fishing weirs and basket traps were also used on the Coquille River and its various forks. Coquel Thompson mentioned a plank dam for eels on North Fork Coquille River in Fairview Valley (Harrington 1942[24]:392). He also described the building of an eel weir and placement of traps,

Regular high water when riffles high and swift. Fence goes straight across for eel. In our country, my father had three, another man had three holes [for baskets]. Three or four mine. [One] basket each hole ... (E. Jacobs 1934[121]:16-17).

These accounts show that lamprey fishing with weirs and traps almost always took place above tidewater in riffles or at falls. Weirs were sometimes large, like salmon weirs, and sometimes they were built low in the water. Weirs were sometimes made of piled rock, sometimes wooden stakes or planks. In most cases lamprey weirs were used with basket traps, but sometimes the traps or “pots” were used in rivers without weirs.

Tidal Weir Fishing

Compared with non-tidal weir use, there are fewer accounts of tidal weirs being used to harvest salmon, and none that indicate lamprey were targeted. Instead, most tidal weirs and associated basket traps were apparently used to harvest diverse estuary fishes in all seasons. Some

may have specifically targeted herring, flounder, or salmon, but the accounts indicate that most tidal weirs were used for more generalized fishing.

Accounts of Tidal Weirs Used for Multiple Fish Species

The most common accounts of tidal weirs are those indicating these devices were used to harvest a variety of fishes through different seasons, often in conjunction with basket traps (figures 9 and 10). One large trap was called the ha:'k, hayak, or hay'k-i in Coos. According to Annie Miner Peterson, this large cylindrical trap with a cone shaped mouth was "just used when going to have big doings" (Drucker 1934[1]:55-56). Coos elder Jim Buchanon also described a cylindrical trap with a cone mouth (Figure 9), apparently referring to the hayak. This cylindrical trap was often quite large (8 to 14 feet long, 3 to 4 feet in diameter), and it appears to have been used for diverse fish harvests in tidal slough settings throughout the year. In his 1909 account Buchanon also described a weir used with a basket trap to harvest diverse fishes in tidewater. He noted that a stake spacing of 2-3 inches is sufficient for guiding small fish into traps.

Fish were also caught in fish traps, pieces of fir wood, 8 or 10 feet long, 2-4 inches wide were split, one end was sharpened and ... driven into the mud. These pieces were put up in ... rows, like a fence leaving a space about 2-3 inches between each piece.

Sometimes they put fish baskets (ha'k-i) at the end of these fish traps. The basket was made of fir wood between 2 and 8 ft. long, 3 ft. wide. They had holes at the end, a few inches wide. These fish baskets were fastened to bottom with 4 sticks, one each corner. Fish traps were set up in the bay or river. In falls small fish traps were used. Also mostly flounder ... small fish caught in fish traps. For salmon and bigger fish they used dip nets (Frachtenburg 1909:17).

In a separate account, Buchanon described a smaller basket trap also used for mass harvest of small fishes. An accompanying sketch shows that this was used in a tidal marsh channel, with a wood stake weir as the lead,

Split, whittled firs were used to make a fish basket (glubet) for suckers, smaller in size, but the same as the ones for herring and flounders and quantity fishing. It was 5 to 6 ft.

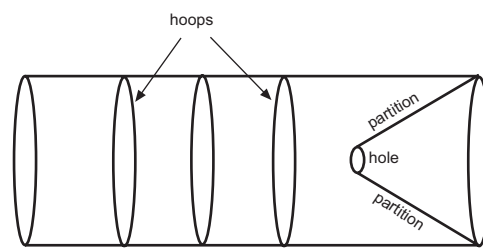


Figure 9: Diagram of Cylindrical Hayek Basket Trap
(after Frachtenburg 1909:21)

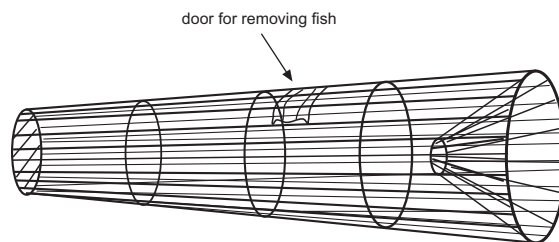


Figure 10: Sketch of Conical Hayek Basket Trap
(after Jacobs 1934[92]:111)

long, about 3 ft. in diameter. Vine maple hoops were used. The outside as well as the doorway part are made flat, first it is tied with spruce roots, at 5 or 6 places for the large basket part, and at three or 4 places for the doorway part. Then it is made into the curved circular shape. This is the best and fastest way to build it. Even flounders get caught in it.

[The glubet was] set out in the evening at the edge of a mudflat, on the mud, with a lead (fence) of closely placed young round fir poles which will force the suckers at low tide to go towards the basket trap. Next morning canoeman goes out and takes the fish out of the basket and lets the (basket) stay there. The basket is held in place by 4 posts driven in the mud, with crosspieces above which hold the basket down under. At high tide the basket is deep in water, of course (M. Jacobs 1934[92]:111).

The term “quantity fishing” is not clearly explained in this account, but it may refer to the kinds of mass harvests depicted by Melville Jacobs in his unpublished overview of Coos and Coquille fishing. According to Jacobs, these mass harvests of various estuarine fishes were fundamental to subsistence for the Coos and Coquille people. These harvests may have been fundamental in other parts of the Oregon Coast as well.

Several other accounts indicate tidal weirs were used widely in central and southern Oregon Coast estuaries:

Herring ... are gotten in fish baskets, treated like smelts pretty much. A fence ... of any kind of sticks is driven into rivers, and a fish basket blocks the river. Women, boys, and even men go barefooted with sharpened stakes ... around above the fence, and step on flounders, and stab them and bring up the flounders ... (M. Jacobs 1934[91]:14).

Numerous accounts depict fishing at a well-known tidal weir fishing station near the mouth of the North Fork in the Siuslaw estuary. Several archaeological weirs have been recorded at this locality, including the Half Moon Weir site (see Chapter 4). Frank Drew recalled that:

In 1878 I saw the trap at the lower end of the middle land The Indians cut young fir trees, or cedar sprouts in wings of a V erecting them in the mudflats so as to guide the fish into the basket...” (Harrington 1942[24]:727).

Harrington (1942[23]:437) noted that Spencer Scott and Frank Drew had mentioned:

the lower end of the island (a little upstream from Florence) ... Spencer says they have been driving young fir stakes there In 1876 autumn Old Pete took Frank on his arrival here at Florence this fishtrap place.

Drew explained that

There is a mudflat island in the Main River which starts at mouth of North Fork and extends ½ m[ile] downstream towards Florence, and the place is at the lowest end of this island, at which spot they used to catch fish and fish-traps – they had several fishtraps there ... (Harrington 1942[23]:444).
That was where they got the fish in the early days ... the fish-trap at the lowest (most downriver) end of that middleland” (Harrington 1942[23]:480).

Another account depicts the “lower end of the long middleland ...” at the mouth of the North Fork Siuslaw, identified as “where the Indians used to have lots of fishtraps” (Harrington 1942[23]:479). According to Siuslaw fisherman Clay Barrett,

The place at the lower end of the island where the tide comes in, there is a kind of little slough there which opens for fish to come in. One quarter mile upriver of Florence Used to be stakes and fishtraps driven, and would take pants off and step on flounders” (Harrington 1942[23]:480).

One reason this weir fishing station on the Siuslaw has been referred to so often is that it was located adjacent to the largest 19th century Siuslaw Indian community. The weir and basket trap fishing that took place here appear to have gone a long way toward supplying the needs of this community before and during the Coast Reservation years (Byram 2001).

Accounts of Tidal Weirs Used for Taxa Identified by Name

Several accounts tell of tidal weirs and basket traps being used to harvest individual fish species. It is not clear if any of these weirs were used exclusively for the fish taxa mentioned in the specific accounts. These may simply represent instances of weir use through the course of the year, particularly as various fishes came into the estuary for spawning runs.

The fish most widely associated with tidal weirs is herring. These were caught in weirs built in tidal slough channels and on tidal flats. In his overview of Coos and Coquille fishing, Melville Jacobs (1934[99]:41) mentioned a weir used to harvest “herring – dipnetted from canoes in shallow water V-shaped fences.” The habitat of herring during spawning runs may help explain the usefulness of tidal weirs in the harvest of this fish. According to Coquel Thompson, in tidal sloughs, “Indians would sometimes pick up half a basketful of stranded herrings when the tide went out” (Harrington, 1942[25]:506). Annie Miner Peterson recalled that herring “are gotten in dip nets from canoes, with fir limb fences to guide the fish; or they put 4 or 5 baskets at a fence entrance” (M. Jacobs 1934[97]:44). A related account from Lottie Jackson Evanoff indicates that these weirs were often made of western hemlock (Harrington 1942[22]:1036).

Coquille elder Ida Mecum described a “herring trap of hazel or fir” (Drucker 1934[1]:45). A drawing on the same page of Drucker’s notebook shows a trap with a cone mouth, tapered in profile the length of the trap, “up to 10, 12 ft. long, 4 ft. high”. A version of this trap was also used for catching eel, and it appears to have been constructed like the hayek described by Jim Buchanon. Daisy Coddington noted that a Miluk fisherman, Tarheel, fished in Coos Bay quite often, and “he brought herring ... by the canoe load.” She also related that the Coos Bay Indians caught “all kinds of fish especially herring” (U.S. Court of Claims 1931:84-87).

Two accounts from traditional narratives describe herring fishing with weirs. In one narrative a man feeds his community by "usually supplying the village with herring." Later in the account, “he found his trap full of herring. So he took them out with the dipnet, filled his canoe, and went home; whereupon the whole village had as much food as it wanted” (Frachtenburg 1920:240).

Salmon were also targeted with tidal weirs and traps. One account from Lottie Jackson Evanoff indicates tidal weirs were used for catching salmon. She explained that at Coos Bay,

“[e]very slough had a salmon trap” (Harrington 1942[24]:484). Frachtenburg (1910:11) wrote of an Alsea trap that involved a:

big long basket almost 20 ft. long in the shape of a gramophone ... speaking tube with a long tube. It was made of maple sticks with hazel tied by means of spruce, marked Salmon usually caught in it. Rocks are placed on each side and while going down at low tide the salmon are caught in it. Salmon speared at moonlight also could have been caught in the fence.

An east shore Coos Bay settler who occupied land with intact weirs in the nearby tidelands reported catching salmon with the “extensive salmon or fish traps built before the recollection of whites” (Maloney 1934[98]). The weirs were finally destroyed by log rafting. Jim Buchanan told Leo Frachtenburg (1909:19) of a “large tidewater salmon basket” and “salmon caught in fence” in tidewater.

There is one account of a tidewater weir used to catch a fish normally thought of as a freshwater fish, the sucker.

Suckers were caught in winter and spring ... with baskets in mudflats. When tide goes out a fence of stakes in the river guides the suckers to the trap. They are not preserved, but eaten at once, not being thought of as a very good fish, but eaten for a change (M. Jacobs 1934:91:42).

The account also explains that suckers were often caught 25-30 miles upstream. Coquel Thompson confirmed that suckers were eaten by people of the Oregon Coast (E. Jacobs 1934[120]:70). In his summary of Coos-Coquille fishing strategies, Melville Jacobs (1934[99-15]:41) noted that perch were caught by “hook and line in bay or river or in fish baskets.”

While there are numerous historic accounts of people stepping on and spearing flounder on tideflats at Coos Bay, Yaquina Bay, and the Siuslaw River (see below), certain accounts describe weirs made to corral flounder for spearing. Lottie Jackson Evanoff recalled that her father “made a fish trap by that (place) where we live and the Indians used to come to his trap and

tramp for flounders with their feet” (Harrington 1942[24]:223). Two of the generalized fishing accounts presented above mention weirs used in the harvest of flounders and other smaller estuarine fishes. Coos elder Andrew Charles (U.S. Court of Claims 1931:108) described use of a flounder weir built in a tidal slough channel. The weir was built “from some bank on the mud flat across the slough and when the tide goes out that leaves the fish behind shut up so they cannot get out and then they go and pick out what fish they want and let the rest go.”

Smaller sturgeon were also caught with basket traps. It is likely that a wood stake weir or rock weir was used with this trap described by Wolverton Orton,

My father was telling that the Indians would put lots of rocks in canoe to throw at sturgeons in the deep pool above the fishbasket. They threw rocks in the pool and thus all the little fellows ran down to the fishbasket, all the smaller ones (Harrington 1942[25]:487).

Accounts of Tidal Weirs Used for Unspecified Fishes

Some of the most detailed accounts of tidal weir and basket trap fishing in Oregon estuaries do not specify the fish taxa harvested with the devices described. This may be because many different fishes could be harvested with tidal weirs and basket traps through the course of the year.

Frank Drew described a permanent, multiseason tidewater basket trap, identified as a Ha-
'k fish trap (redrawn in Figure 10):

A kind of fish basket trap 12-14 feet long used in rivers for catching fish. Men make this kind of basket. These were made of fir split and whittled to pencil size thickness on the average. Vine maple was taken for the hoop. The door is on top middle. Baskets of this type were permanent, even barnacles grew on them. (M. Jacobs 1934[91]:110).

As depicted in Figure 11, a sketch based on M. Jacobs' (1934:92:111), basket traps were often placed at the end of a line of stakes, near the mouths of tidal channels. Some tidal weirs had

flexible lattice enclosures instead of cylindrical basket traps. Coos elder Agnes Johnson described the “kl’um, fish dam,” to Philip Drucker (1934[1]:20). An accompanying sketch in Drucker’s notebook (see Figure 12) shows a V-shaped weir with the apex pointing in the direction of the outgoing tide. At the apex is a gap in the weir with a round enclosure, and near this a note reads “basket across mouth; put across sloughs; when tide goes out fish left in it” (Drucker 1934[1]:20). The enclosure was most likely a flexible lattice panel enclosure, as it does not resemble a basket trap or a set of flat lattice panels.

Enclosures used for harvesting crab, though poorly documented, are worth noting because of their similarity to tidal weirs and basket traps used to harvest finfish. There is one Oregon Coast reference to a structure built in tidewater to fence in crabs. Clara Pearson (1990:87) related this as part of the Rabbit narrative: “[t]hen she told him about old man Shyashyakook who killed people and made a fence of them in the water. He corralled all the good crabs in that fence.” Later Pearson (1990:88) referred to the structure as a “crab fence.” This weir-like structure may have been used to corral live crabs so that they were available when needed for meals or bait. Annie Miner Peterson described a “crab trap, large fish basket. Flat on bottom, round side, hole in top. Baited with smashed up crab. Left with floats. Men’s work. But women get them, basketfuls, walking on the tideflats. For a feast, (men) get them quickly in a trap” (M. Jacobs 1934 [101]:16).

Interregional Comparisons

Most published ethnographies from coastal regions to the north and south of the study area present far more detail on riverine weirs than tidal weirs, but there are references to a tidal weir used in the Columbia River estuary (Curtis 1907-11[8]:120-121). Two accounts describe this type of weir used at Willapa Bay, just north of the Columbia River on the Washington Coast: “[a]

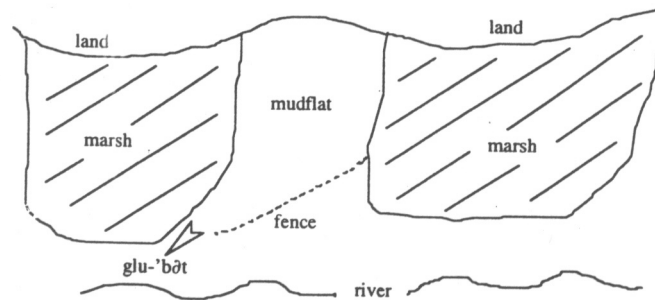


Figure 11: Sketch of Weir and basket Trap in Tidal Slough Setting (after Jacobs 1934[92]:111).

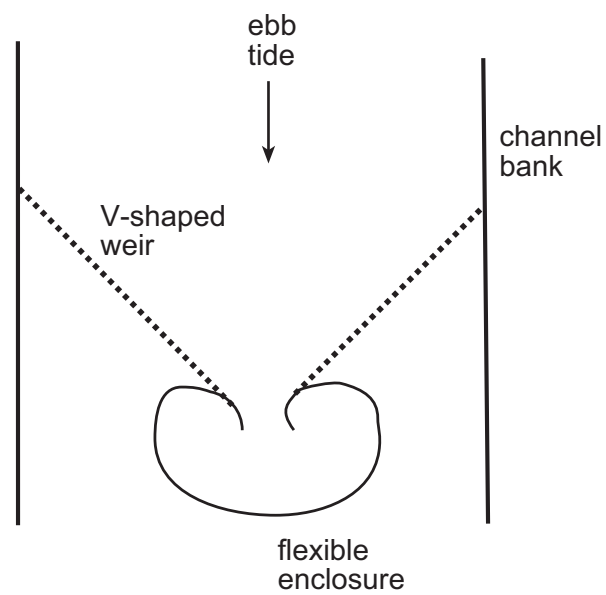


Figure 12: Sketch of Kl'um, Cross-Channel Tidal Weir with Lattice Enclosure (after Drucker 1934[1]:14).

salt-water trap was made by arranging on the tideflats two long, converging lines of upright poles, which led the fish into a *cul de sac*, where they remained as the tide receded” (Curtis 1907-11[9]:50). Another account from Willapa Bay depicts V-shaped structures built to catch herring and other fishes (Swan 1857:27). Similar weirs were used by the Twana of Hood Canal, south of Puget Sound. This detailed account is from an unpublished traditional narrative and brings to mind Melville Jacob’s description of Coos-Coquille tidewater fishing.

Now he says to the people ‘ma hayat now, make a fish trap, so the fish and herring will go in there.’ And the people began to cut brush and tied the butt ends of the brush together in bunches and put them out and anchored them by sticking them down in the flats at low tide Now you take your canoes and go out to the brush traps (ha’yat) and dip up the herring and eat ... and they went out to the brush traps and there were multitudes of herring and skate and salmon in the brush traps – and they hauled them in, had all they could eat (Elmendorf 1940[7]:6-7).

It is noteworthy that the Twana word for this brush weir is hayat, which is close to the Oregon Coast Penutian word for the large tidewater basket trap described above, the hayak or ha-‘k.

Diverse tidal weir harvests also took place south of my study area, in Humboldt Bay of northwest California. An account recorded by Gordon Hewes (1940:22; see also Kroeber and Barrett 1960:29) includes a description of a cross-channel tidal weir of lattice, used by the Wiyot. This weir may have resembled the kl’um enclosure used at Coos Bay. The flexible panels of this lattice weir were placed across the mouth of a tidal slough during high tide, and fish were left in 5-10 cm of water when the tide receded. The weir was used to catch shiner perch, flounders, sculpin, herring, and crabs.

Except for the Wiyot weir, the structures described in these accounts from nearby regions resemble tidal weirs used on the Oregon Coast. These appear to have been highly effective fishing systems suited to tideflats and tidal sloughs. They are discussed by Stewart (1977:105, 107) based on descriptions in several ethnographies, but as noted in Chapter 1, they are not as

widely represented as non-tidal riverine weirs in general discussions of Northwest Coast fishing technologies.

An Ethnographic Typology of Fishing Weirs

For interpreting archaeological tidal weir and lattice technologies, there appear to be three general types of fishing weirs represented in the Oregon Coast ethnographic literature (cf. Byram 1998). Riverine and estuarine *fish dams* (or cross-channel non-tidal weirs) include the large structures built across rivers to temporarily stop the upstream migration of salmon and lamprey. These were often used with basket traps or dip nets. Estuarine *cross-channel tidal weirs* were built across relatively shallow, non-mainstem tidal channels and designed to allow fish passage at high tide, while impounding fish as the tide receded. The weirs often led to openings where basket traps were placed. Nets may have been used at times in place of basket traps. Cross-channel tidal weirs were used to harvest herring, salmon, and a variety of other fishes (pelagic and demersal) present along estuary margins. Estuarine *tideflat weirs* were built across expansive tideflats, and are not clearly associated with basket traps or other impounding devices. The accounts indicate that tideflat weirs were most often used to corral demersal fishes such as flounder for spearing. Both types of tidal weirs were relatively permanent in comparison with the fish dams, which were used for periods as short as a few weeks, reflecting their settings, the seasonality of fish harvests above and below tidewater, and the need to allow fish to spawn or reach upriver peoples.

Spears, Harpoons, and Gaff Hooks

Probably the most widely mentioned tool for harvesting salmon and other large fishes was the spear, or more specifically the harpoon (Figure 13). Barnett (1937:163-164) identified the fish harpoon with toggle head as ubiquitous among Oregon Coast tribes (see Stewart 1977:65, 71). Often referred to as the “salmon spear,” this was used in both tidewater and upstream settings. The harpoon was most effective where conditions restricted the movement of salmon, as at falls, riffles, and weirs built in upstream settings, and in shallow bay margins and shoals in tidewater. Barnett (1937:164) also recorded the double-foreshafted spear as common on the Oregon Coast, that may have been a leister (see Stewart 1977:74). Specific accounts of this device are not common among the Oregon Coast ethnohistoric sources I have examined.

Although most of the accounts presented here mention the use of fishing spears, it is clear that most of the devices called spears were actually harpoons. Accounts clearly describe these tools as composite devices with a shaft or “pole,” and a smaller, sharply pointed and barbed element that detached from the pole during use, but remained tethered to the shaft by a line. Coquel Thompson described the making of a harpoon in some detail to Harrington (1942[25] 806), who observed that this was the only kind of “spear” Thompson knew of. The harpoons described by Thompson and others were used primarily for catching larger fish such as salmon and sturgeon. If leisters were used on the Oregon Coast, they were likely used for salmon. Actual spears, having a fixed point, barbed or unbarbed, were used for catching smaller fish such as starry flounder. A third, related tool is the gaff hook, which is fixed like a spear but has a prong angled back toward the wielder.

The advantage of the harpoon over the spear for larger fish is described by Hilary Stewart (1977:65),

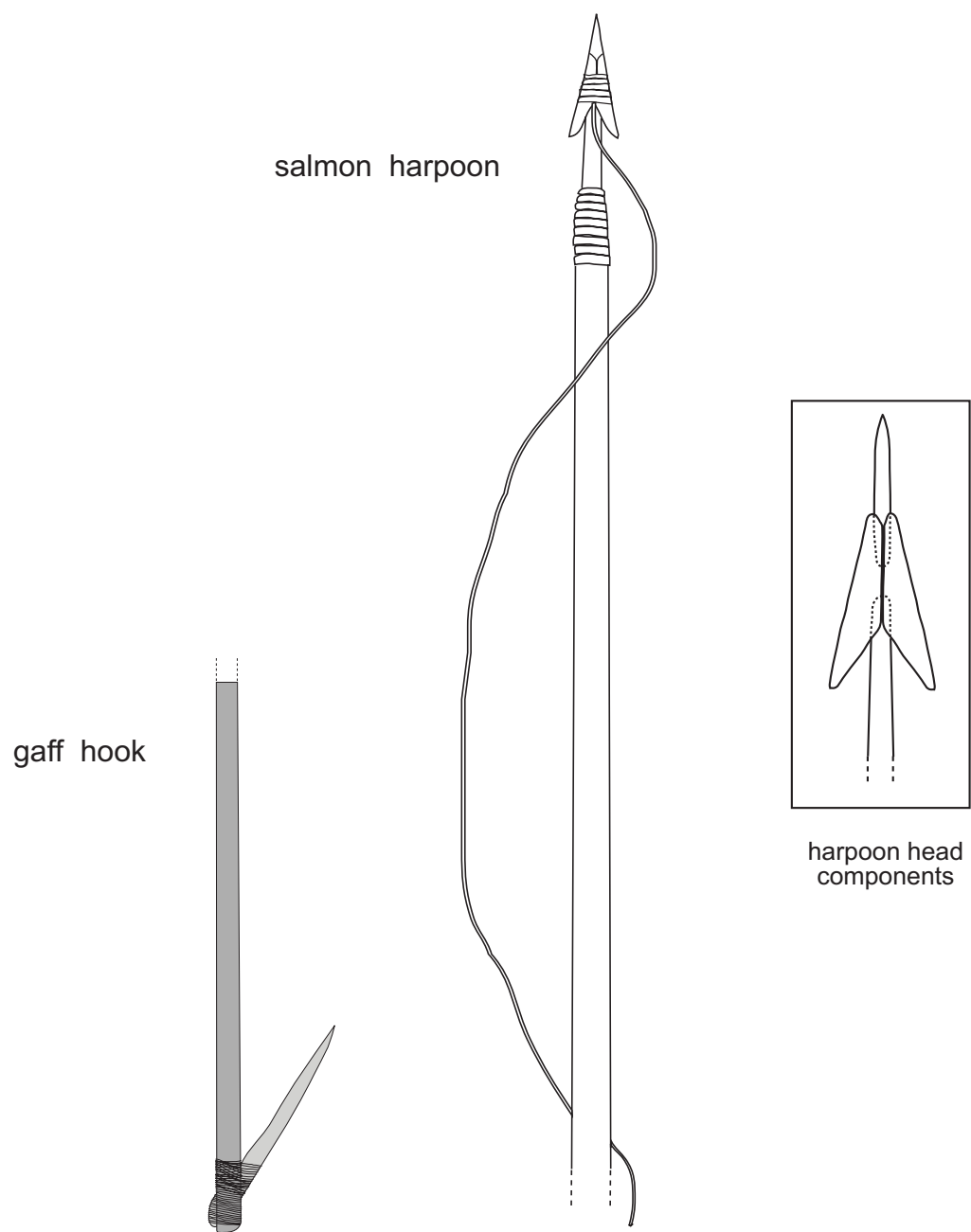


Figure 13: Diagrams of Gaff Hook and Salmon Harpoon
(adapted from Stewart [1977:72-75]).

While a large, struggling fish impaled on a fixed spear point could break the shaft or point, or free itself by thrashing about, the detachable harpoon head allowed the fish to move in the water without putting direct strain on the gear, while its struggles imbedded the barbs well into the flesh.

The toggle head is not clearly described in most accounts, though Barnett (1937:164) indicated it was used by all Oregon Coast tribes. This type of harpoon head turns sideways after entering the fish and detaching from the shaft, which prevents it from pulling free while the fish is pulled in. Kroeber and Barrett (1960:74) also found that toggle harpoons were used far more often than fixed spears on the northern California Coast.

The act of fishing with a harpoon appears to have been conflated with angling in many Oregon Coast ethnographies. It is frequently depicted as “pole and line fishing,” with the harpoon shaft identified as the “fishing pole.” Angling with a pole, line, and baited hook seems to have been quite rare on the Oregon Coast traditionally, although baited hooks were used with lines attached to floats in a multi-implement strategy described in several accounts (see below).

Several other accounts describe harpoon or “pole and line” fishing,

For creek fishing (steelhead and old salmon) only a 3-4 foot buckskin string is enough, and a smaller (spear), of maybe only 8 ft, and the salmon (steelhead in winter ... caught this way in small streams) is hauled in with the shorter pole (M. Jacobs 1934[92]:109).

In a Tillamook narrative, a man goes far up small streams to spear steelhead in winter, and there is reference in the story to the shaft as a “fish pole” (Pearson 1990:167). In another narrative, the spear is the harpoon head and the harpoon shaft is termed the pole, “if you want fresh fish you must spear it yourself. I have a spear and pole That man would go and spear a fish for himself” (Pearson 1990:155). The use of “pole and line” for harpoon fishing may have been an effort to label a traditional technology with an American colloquialism. Alternatively, it may reflect the Native fishers’ need to disguise a more effective traditional fishing technique that they continued to use as fish and game laws increasingly restricted these practices.

Harpoons and spears were sometimes used with weirs on the Oregon Coast, but accounts indicate that for salmon, their most frequently cited target, these were more often used outside the periods of weir use. For example, salmon could be speared along estuary margins as they schooled in river mouths in advance of the spawning runs. Furthermore, salmon move into a river system several weeks before they actually spawn, and during this time they can be speared, though they might not be suitably congregated for effective weir and basket trap use. This probably widened the period of the availability of fresh salmon, and at times it may also have allowed upstream residents to harvest fish richer in oil than those available during the periods when weir fishing took place.

Manufacture of Spears and Harpoons

Several accounts describe the manufacture of harpoons (Frachtenburg 1909:18; M. Jacobs 1934[92]:117, 135). For example, Harrington (1942[25]:806) wrote of Coquel and Martha Thompson's descriptions of

the ordinary fish spear at Siletz has a double prong at the end and that point sticks in the salmon, and the cord is maybe 2 feet long. One keeps hold of the handle. The handle he calls the pole, which is fir and 10 feet long, maybe even 20 ft. The point was anciently of bone. The point becomes detached from the pole but tied on the string. The pole is kept outdoors. Also shorter pole was used when it was low water, one wading into the river. Thompson knows only this one kind of spear (which was used for salmon).

A diagram and description of a salmon harpoon, based on an ethnographic interview by M. Jacobs, is shown in Figure 14. I have encountered no accounts describing the manufacture of spears that lacked harpoon heads, such as those used for spearing flounder.

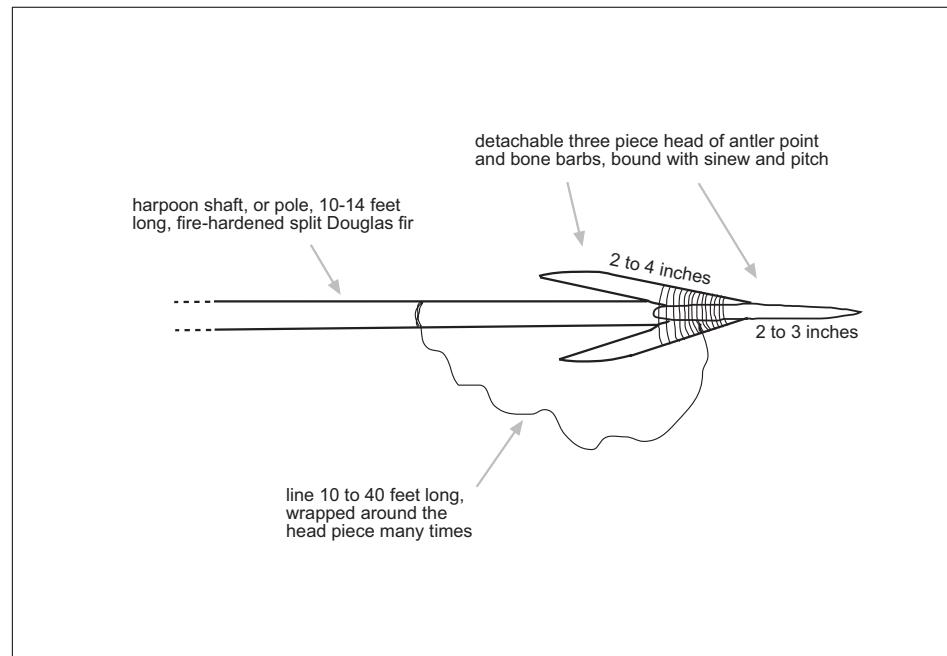


Figure 14: Salmon Harpoon Used on the Oregon Coast (based on M. Jacobs' [1934(92):117] sketch and notes made from Frank Drew's testimony; sinew binding the head components may have been conflated with the tethering line.)

Salmon Spearing in Unspecified Settings

Accounts mentioning the use of spears are found in records from much of the Oregon Coast. For example, Clara Pearson noted that the Tillamook speared and clubbed salmon (E. Jacobs 1934[106-5]:12), and a Coos elder mentioned that on the central coast, "only silver salmon was speared, the others are caught in fall's baskets" (M. Jacobs 1934[91]:21). In a Tillamook narrative recorded by Boas (1898:23), there is a reference to "spearing salmon in (Neskowin) Creek" with a "salmon spear." Most other accounts specify settings as tidewater or upstream.

Salmon Spearing in Rivers Above Tidewater

Salmon spearing in upriver settings is depicted in several accounts by Coquel Thompson, describing. He recalled that “in the olden times, few nets were used, salmons were largely speared” (Harrington 1942[25]:807). Elsewhere Thompson noted that “Chinook salmon ... will take your spear way sometimes” (Harrington 1942[25]:480). However, he also noted that during the September-October fishing season, people “speared fish from boats ... they fished for about two months,” first Chinooks with spears, then silversides with salmon nets (E. Jacobs 1934[116]:94). Chum salmon were also commonly speared (Frachtenburg 1920:107).

Coquel Thompson described a blind hut over the river in which a man sat and speared salmon (Harrington 1942[25]:808). Andrew Charles described a similar structure used by the Siuslaw to facilitate the spearing of salmon (U.S. Court of Claims 1931:120). The shade of the hut hid the silhouette of the fisher. Fishing structures such as this were known in other parts of the Northwest (Kroeber and Barrett 1960:80).

Some Oregon Coast accounts indicate salmon spearing far upstream from tidewater. In a narrative recorded by Frachtenburg (1920:185-187), people speared salmon in a small river or creek. The two subjects traveled far upstream, to the fishes’ spawning grounds.

In some cases, salmon were speared at night by torchlight, as in this account from Coquel Thompson,

on riffles ... men stand on banks. One boy holds light. They stand on gravel bar. No special place to spear fish. Just so they got them. Club on head, remove spear, sling on side. Each man had his own pile. When issue out, each man gave away his own.... They save eggs, but just let milt go. Don’t use that kind.

When catch all night, men have to sleep during daytime. Boys tend trap. They get to take it home themselves. Usually some boy in man’s own household anyhow (E. Jacobs 1934[120]:72).

Salmon were often speared at falls, as in this early account from the South Fork Coquille River,

... reached another village greater and more populous than the last. Here the river assumes a different aspect, it becomes rocky (sic), with many cataracts, some perpendicular falls, that afford a means of spearing the salmon trout” (McLeod 1826:196).

Steelhead were among the fishes speared in the rivers of the Oregon Coast, as described in two narratives told by Clara Pearson (1990:162, 167) where these fish are speared in the upper reaches of streams during winter.

Together, these accounts indicate that salmon spearing frequently occurred above tidewater, and took place both during and outside seasons of large fish runs. In some cases, spearing may have been a strategy for augmenting dried stores during seasons when weir or net fishing was not practical in certain settings.

Spearing Salmon in Tidewater

Several accounts depict the spearing of salmon at night by torchlight in tidewater. This activity likely took place prior to the times of year when salmon runs began, as salmon typically school in estuaries waiting for conditions suitable for movement upriver.

Accounts from the Coquille River indicate that in tidewater, salmon were typically speared from canoes. According to Coquel Thompson (E. Jacobs 1934[120]:72), at the “mouth of river, near tide, one man sat in boat holding torch, up near shore, one man spears. They follow tide mile or mile and half up river.” Similarly, Ida Mecum recalled that salmon were “speared from canoes, by torchlight” (Drucker 1934[1]:45). In 1855 William Wells visited the Oregon Coast and described his trip in an issue of *Harper’s Magazine*, including an account of salmon spearing by torchlight (1856:607). The fishing was done from canoes in the lower portion of Coos Bay, approximately one mile south of Empire. Frachtenburg (1909:17) also recorded that the

Coos speared fish “in shallow water by torch light.” Spencer Scott attested to the effectiveness of salmon spearing in moonlight on Alsea Bay by Alsea Indians (Harrington 1942[23]:196).

On the central Oregon Coast, people sometimes speared salmon from shore in estuary settings. One such fishing station was located at the mouth of the North Fork Siuslaw River. According to Frank Drew, “this marsh formerly stuck way out as a point projecting on the main river, and Indians would stand on that point and spear fish as they came out of the water and almost never miss the fish” (Harrington 1942[23]:464-65).

There are several accounts of fishing with spears in northern Oregon estuaries. Coquel Thompson recalled that on the Siletz Estuary, “[o]ne old man lived way down by Kusydan. Whole lot of [Yaquina] there. They all went mouth Siletz for fish. No net. Go on gravel, spear fish that are left by tide. That old man went early in A.M.” (E. Jacobs 1934[121]:23). The Yaquina also speared and clubbed salmon at the short stream that enters the ocean from Devil’s Lake to the north of Siletz Bay. In an account of a tragic conflict with Rogue River tribes relocated to this area by the U.S. military, Ione Baker explained that the Yaquina recognized rights to this fishing station in the late 1850s (Portland *Oregonian* June 11, 1933:4 col. 2-3).

Farther north at the Nestucca Estuary, Louis Fuller described a stream near Pacific City where “they spear fish...they couldn’t set a net for no place was deep enough, so in the fall of the year they speared them” (Harrington 1942[20]:572). A similar setting is described for a stream near Idaville along Tillamook Bay, where there was a fishery. It was “not deep enough for a net. They just speared them” (Harrington 1942[20]:727). In December, 1852, a settler at Tillamook Bay observed that the Native people of Kilchis Point “were expert at catching fish with spears of their own manufacture” (Vaughn n.d.:9, 12).

Spearing Other Fishes in Tidewater

Several accounts mention flounder spearing in shallow water on tideflats. Clara Pearson mentioned that this was a common Tillamook practice (E. Jacobs 1934a[84-111]). Drucker (1939:83) recorded that the Alsea Indians used a flounder spear. He also interviewed Coos elder Agnes Johnson, and noted that “flounders – (speared) come in with tide ... (people) go out with pitch light at night and spear them” (Drucker 1934[1]:14). Martha and Coquel Thompson described flounder fishing barefoot at the mouth of Yaquina Bay. People stepped on the fish and threw them in a pack basket. They said that flounder like eelgrass areas, and that the water was about 2 ft. deep at low tide when they went flounder fishing (Harrington 1942[25]:504). In the 1870s, Wallis Nash (1877:151) observed Indian people at Yaquina Bay spearing flounders from canoe by torchlight.

There are no indications that the flounder spear was actually a harpoon, as seems to have been the case for salmon. Yet I have encountered no descriptions of the actual spear used in this activity. It may have been a two- or three-pronged tool as depicted by Hilary Stewart (1977:66).

Sturgeon were commonly harpooned on the Oregon Coast. Some fishers remarked that a speared sturgeon often pulled the canoe quite a distance through the water (M. Jacobs 1934[91]:15; Harrington 1942[22]:870).

Gaff Hook

Large gaff hooks were used to catch salmon and other large fishes in the water column, particularly in pools below weirs or falls, where the salmon were numerous during runs. Smaller gaffs were used to hook lamprey from rocks, and to pull salmon from trough-shaped traps and other open impounding devices. There were many types of gaff hooks used on the Northwest

Coast (Kroeber and Barrett 1960:81; Stewart 1977:75), and it appears that a diversity was also used on the Oregon Coast.

According to Barnett (1937:163-164) the “eel gaff” was widely used on the Oregon Coast to harvest lamprey. Coquel Thompson described a tool for hooking eels from a canoe tied to a large stone anchor above a riffle, with fifty feet of willowbark rope (Harrington 1942[25]:812). This activity took place at night, and a fire was built in the canoe (Harrington 1942 [25]:812). An account from Beverly Ward (1986:24) probably indicates a gaff hook rather than a spear “men speared the eels off the rocks” Native people continued to use the eel gaff through the late 1900s at Siletz (Downey et al. 1996).

The gaff hook was also to harvest salmon at night from canoes in the river (Harrington 1942[23]:117). During an interview with Coquel Thompson, Harrington (1942[25]:806) noted that the “salmon gaffhook (was) a big hook tied on the end of a stick, the Indians both hit and snag salmons with this same instrument. Only 1 1/2 ft. long.” This was apparently the shorter shafted gaff used for removing salmon from trough-shaped traps. The larger gaff hook was used differently:

... at pitch dark night, they go out in the canoe, land below the dam. They run the pole and bone [gaff] down in the water. The flat pole end surface indicates the direction in which the hook ... is pointing down below. They feel around with the fish hooking pole, and when they feel a fish they give a quick tug up and perhaps catch one below the belly and pull him up into the canoe. Three or four hours of work bring out lots of fish. Sometimes a simpler pole without a bone socket is used, but it is likelier to break the pole.... Sometimes a Chinook salmon may be caught in a dipnet, but mostly with a pull [gaff] hook as above (M. Jacobs 1934[91]:22).

Frank Drew noted that the “Alsea caught salmon with gaff hook from canoe at night – below upper tidewater weir,” and Drew himself fished this way at Mapleton (Harrington 1942[24]:736). Elizabeth Jacobs (1934a[84-107]:66) learned that at least one Tillamook man often used a large gaff hook to catch sturgeon.

Hook, Line, and Float Fishing

Fishing with hooks tied to lines fixed to floats is a widespread technique on the Northwest Coast (Kroeber and Barrett 1960: Stewart 1977:25-55). A fishing technique widely used on two southern Oregon Coast estuaries involved a float of bundled tule reed or other buoyant material, and a line with several baited hooks. Coquel Thompson told Drucker (1934[2]:12) that people at the mouth of the Coquille River caught salmon with hooks and floats, when the fish were jumping. When Drucker (1934[1]:45) interviewed Coquille elder Ida Mecum she described a similar technique, termed trolling, “hook of bone tied to line wrapped around tule float. Bunch of these put out when fish bit, unrolled line, lit out, fisherman chased, caught, pulled in.” Beverly Ward (1983:26) reported that the Indians of the Coquille Estuary “fastened hooks on long lines and set them out in the water.” According to Coos elder Nellie Lane, small fish, “something like the sardine” were often used as a bait fish (Drucker 1934[2]:133).

In 1855 Wells described the Coos Indians using the float, line and hook fishing technique from canoes on the bay. In this activity, the surface of the water “is speedily covered with dozens of little reels, on each of which are wound about ten yards of line. There are generally about half a dozen hooks attached to the end, which are allowed to hang from ten to twelve feet below the surface ...” (Wells 1856:607). Coquille fisherman Donald Ivy suggests that a line with this many hooks was probably not used for salmon. Indeed, an account by Annie Miner Peterson (M. Jacobs 1934[96]:112) indicates other fish were caught with this method. She recalled that “Perch were caught with a hook and line in the bay. Flounders were caught with a hook and line ... halibut and salmon were caught in the ocean that way. For bay fishing with hook and line they made a float” The larger fish such as salmon were probably caught on a line with fewer hooks. The float in this system was attached to a ten foot line for the hook, and was used mostly in June and July for

Chinook salmon. Peterson also noted that “small fish like shiners, herring, sardines etc. (were) used for bait. Each person can identify his own float.” Drawings of the float and composite hook appear in one of Drucker’s (1934[1]:54) notebooks, based on this account.

Other accounts also describe this fishing technique at Coos Bay (e.g., Frachtenburg 1909:18). Daisy Coddling (M. Jacobs 1934 [100]:3) recalled that at South Slough people used a spool for trolling made of tule. The technique was also used on the ocean by residents of outer coast villages south of Coos Bay. Agnes Johnson remembered that “South Slough and lighthouse people went outside [on the ocean] to fish. Fished with hooks – used larger buoys with long sticks colored red with alder bark, so they could see” (Drucker 1934[1]:13-14). Offshore fishing at locations such as Seal Rock near Alsea Bay (Davidson 1889:412) may have involved similar devices.

There is little evidence that angling with a single line and baited hook was a common practice on the Oregon Coast, and it is even described as an entirely new technique in some accounts (e.g. Harrington 1942[21]:817). Although the sharp-angled fish hook was widespread on the Oregon Coast, according to Barnett (1937:163-164), it is not clear if the float, line, and hook technique was used in estuaries other than the Coos and Coquille. As it is described in the foregoing accounts, it was not always a mass harvest technique, but in comparison with modern day angling, it had the potential to bring in several times the number of fish for the time expended. This made the technique well suited to conditions where salmon or other schooling fish were present in large numbers for short durations in deep water. As with spearing or harpooning salmon, it may have been a means of catching fish outside the seasons of major spawning runs and at the very beginning of these runs.

Fishing Nets

A wide variety of nets were used in Native North America traditionally, and many nets were used on the Northwest Coast. Unfortunately, as net making traditions declined in the 19th and early 20th century, much of the richness of this technology was lost. Although there are few net makers in the Northwest, Native net fishing continues with commercial equipment in the interior and coastal Northwest. Historically, nets were used in riverine and tidewater settings, and on the outer coast of southern Oregon.

According to Rostlund (1952:86),

The distribution of (Native peoples') fish nets on the Pacific slope was irregularly spotty both in the types of nets employed and the prevalence of their use. Certain highly specialized forms of the dip-net family characterized the fishery in some localities but not in others; large towed nets, hauled seines, and set gill nets are reported, but they were far from universally used.

This seems to fit the patterns indicated in the Oregon Coast accounts I collected during my archival research. There are general trends across the Oregon Coast, but there are also differences in net use.

There are some apparent contradictions in ethnographic accounts of net use on the Oregon Coast. Some individuals indicate in one interview that certain nets, or nets in general, were not used traditionally. Yet these same individuals provide conflicting accounts in other interviews. It is possible that some of this confusion involves differing terms used by the interviewer and interviewee. Accounts from the Coquille River are particularly confusing. For example, Coquel Thompson related to Harrington (1942[25]:816) that “there were very few Indians that had nets, and their nets were weighted with stones every few feet, most of the Indians speared fish.” Yet elsewhere Thompson described several different types of nets used on the Coquille River. Beverly Ward (1983:26) offers a contrasting Lower Coquille account, “The

Indians ... made nets and fastened them down with rocks They used big dip-nets and spears to get the fish, and left the little ones in the river to grow.” It is possible that the Lower Coquille people used nets more than the Upper Coquille, however the fiber used in net construction was apparently harvested and exported by residents of the Coquille River and areas to the south (Harrington 1942[21]:1023), and Coquel Thompson mentioned that people living at the head of the Coquille River made their own string for nets (Harrington 1942[25]:728).

Dip Nets

A variety of dip nets (Figure 15) were apparently used on the Northwest Coast and on the northern California Coast (Stewart 1977:90-91; Kroeber and Barrett 1960:42-48). Similar devices were used on the Oregon Coast. As I have shown, dip nets were often used with weirs. They were sometimes used at weirs in place of basket traps (e.g., see Figure 7), but they were also used in

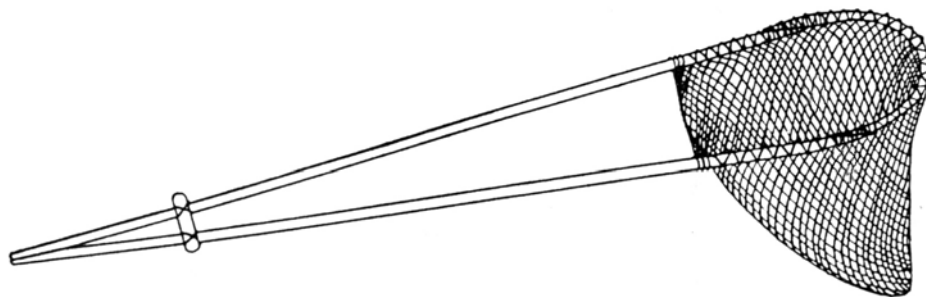


Figure 15: A-Frame Dip Net (adapted from Kroeber and Barrett 1960:42)

pools below falls, and in bays at times when small fish such as herring, ooligan, and sardine were present in large numbers. Handling small fish at mass harvest stations and throughout tidewater was a frequent activity for Oregon Coast peoples.

Barnett (1937:163-164) determined that an oval-shaped lifting net with a handle was widespread on the Oregon Coast. Drucker (1939:83) provides some detail on this type of net. Yet there are accounts that also describe long A-frame nets. For example, Frank Drew observed that the “Coos Indians made dipnets only, 2 sticks with net hanging between....” Lottie Jackson Evanoff added that the blue flower iris used for the twine in these nets was “ imported in bunches from Rogue River region” (Harrington 1942[22]:980). Annie Miner Peterson told Drucker (1934[1]:55-56) of an A-frame salmon dipnet that was “used from canoe, frame about the same as for smelt-net, but doesn’t have big ‘pocket’ ... used on river” This suggests the salmon dip net, used in upriver settings, was sometimes an A-frame net, similar to the scoop net of northwestern California (Kroeber and Barrett 1960:45), but lacking the large pouch-shape for the net (see below).

Jim Buchanon contrasted Coos dip nets used for salmon with smaller scoop nets used for smaller fishes,

For salmon and bigger fish they used dip nets. The dipnets were placed just like the basket [with a lead or weir]. A line was fastened to it and then held in the hand of the fisher-man he could feel ... when a fish was caught ... made of a ... grass ... that never broke. This grass was of a brown color. They used scoop nets for small fish, mostly sardines (Frachtenburg 1909:17).

Coquel Thompson described a dip net used from canoes for catching salmon (apparently steelhead) on their way back to the ocean in April (Harrington 1942[25]:813). He mentioned that a dip net was also used at weirs for salmon (Drucker 1934[5]:35). An account of fishing implements used below a fish dam in upper tidewater reads:

Sometimes a Chinook salmon may be caught in a dip net, but mostly with a pull [or gaff] hook Steelhead: Dip nets are used, as well as other devices. Where dip nets are used and there is a dam across stream, the people are in a canoe above the dam. They hold the dip net under the water 3 or 4 feet until a fish comes against it or in it. Mostly salmon are pursued and obtained, when dip-netting (M. Jacobs 1934[91]:22).

A sketch of an A-frame dip net accompanies the foregoing account, and the device is described as being 9-12 feet long.

Only one account indicates dip nets were used for catching Pacific lamprey. Beverly Ward (1983:24) noted that on the Coquille River, Native people “used canoes in places, and dipped up the eels with long handled dip nets.”

Surf fishing for smelt with dip nets was a widespread seasonal practice on the coast of southern Oregon and northern California. However there are comparatively few accounts of this technique being used on the Oregon Coast north of the Coquille River mouth in pre-Reservation years (see Barnett 1937:164). This may be because people had access to surf smelt and many other fishes in the region’s estuaries, where they could be harvested en masse without the risks of surf fishing. It is also possible that surf fishing was a traditional subsistence activity in the study area but is under-reported. During the years of the Coast Reservation, surf fishing may have become more important, especially at Yachats (Harrington 1942[23]:60), where people were forced to live without regular access to estuarine resources.

There are conflicting accounts of surf fishing at the mouth of the Coquille River. Beverly Ward (1983:26) wrote that Coquille “Indians dipped the smelt up and dried them,” while Drucker (1934[2]:12) recorded Coquel Thompson’s statement that there were no smelt caught on the beach in this area. What is clear is that the numerous accounts of dip net use describe devices used in riverine and tidewater settings far more than outer coast settings. Coquel and Martha Thompson described a dip net that was used to catch smelts in the surf (Harrington 1942[25]:501, 814), but they did not mention the localities where it may have been used. As a youth, David

Brainard (2002, personal communication) fished with his family and other Indian people at Smelt Beach on the coast south of Coos Bay. They used an A frame net with a deep pouch that stored the catch, possibly like the one described above by Annie Miner Peterson (Drucker 1934[1]:55-56). Coos and Coquille people continue to surf fish with dip nets at this location (Donald Ivy, 2001, personal communication). Andrew Charles described this practice at an unspecified location on the central Oregon Coast. He explained that the Indians made “dip nets so big that you could not reach the top with your head and the net is woven fine so that the smelts could not get through. Then they held it right in the surf and dip out the smelts” (U.S. Court of Claims 1931:119).

In estuaries, numerous small fishes were caught with dip nets used with and without weirs. Melville Jacobs (1934[99]:41), in his unpublished overview of Coos-Coquille fishing strategies, noted “herring – dipnetted from canoes in shallow water V fences.” A narrative by Clara Pearson (1990:147-148) recounts “[t]hose men at Newport (Yaquina Bay) had dip baskets for dipping small fish, like herring.” Elizabeth Jacobs (1934a[84-106]:55) recorded that the Tillamook used dip nets for harvesting small fish such as herring.

There may have been quite a bit of variation between different types of Oregon Coast dip nets, as characterized by Kroeber and Barrett (1960) for northwest California and Hilary Stewart (1977:90-91) for the central and northern Northwest Coast. However, aside from the distinction between large dip nets used for salmon and smaller nets for small fish, the only other clear distinction is between nets used for harvesting small fish and those used for removing the fish from a canoe, basket trap, or small weir enclosure (see Stewart 1977:88). Annie Miner Peterson described a wood or basketry dipper,

used for dipping small fish into a basket, when they do not want to use their hands because that would be too slow a way. Those made solid would of course not sieve

through the water like the openwork woven kind. It is left in canoes and used only there (M. Jacobs 1934[93]:100).

Jacobs also noted that the solid dippers could also be used as canoe bailers. This account suggests that many small fish were being harvested, perhaps too many for the effective use of hands. If the openwork basketry dippers were left in canoes, this would indicate ongoing harvests, rather than short-term efforts (wooden dippers could have been retained in canoes for bailing purposes).

Larger Nets

Several sources describe gill nets (Figure 16) in use on the Oregon Coast, both fixed or “set” nets and mobile, or “drift” nets. There are few indications that the seine was used on the Oregon Coast south of the Columbia River (Frachtenburg 1909:19; Drucker 1934[1]:55-56; Barnett 1937:163-164). May Edel (1934[3-1]:140) observed that the Nehalem Tillamook fished at low water with a seine made of spruce root, with weights of stone and floats. Some residents of Tillamook and Nehalem communities also traveled to the Columbia to fish with seines (E. Jacobs 1934[106]:148; Harrington 1942[20]:795; Pearson 1990:130, 140). One reason for these trips may have been that salmon were more abundant during more of the year in the Columbia River.

Gill nets were primarily designed to catch salmon in bays or rivers. They had a mesh sufficient to allow a fish’s head to pass through, but restrictive enough to constrict the fish at the gill openings, thus trapping the fish. Coquille fisherman Donald Ivy (2001, personal communication) suggested to me that the various large nets could have often been used for small marine fish, and not exclusively for salmon. Nets were made from iris (*Iris* sp.) fiber, Indian hemp (*Apocynum* sp.), or from several other fibers available at or near the Oregon Coast. According to Coquel Thompson (Drucker 1934[5]:35), grooved rocks were used for the lead line

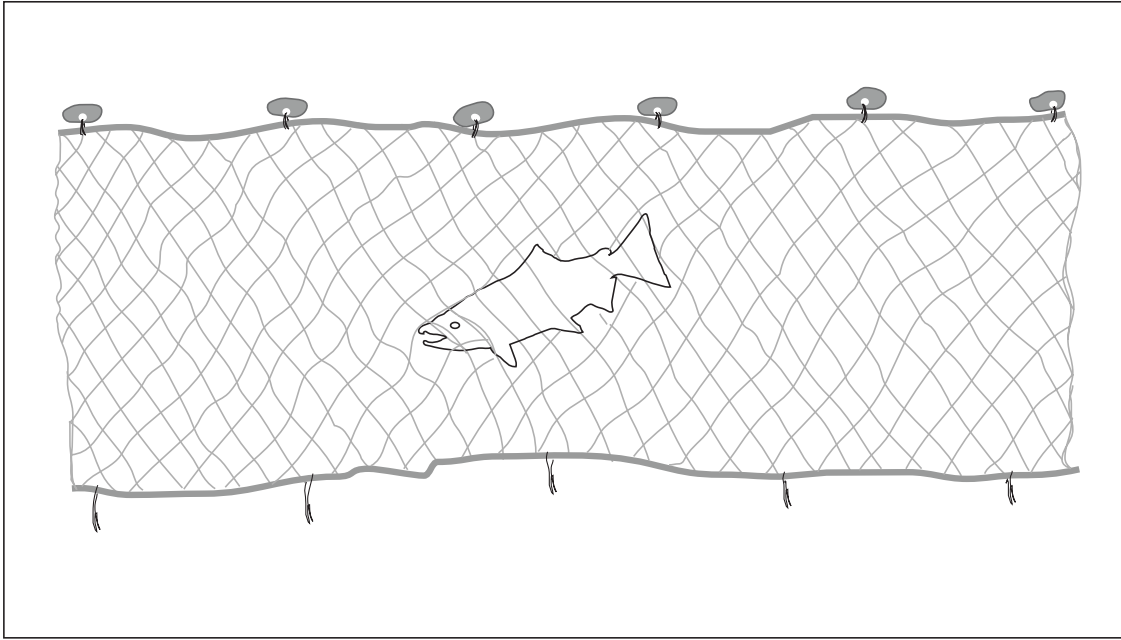


Figure 16: Gill Net for Salmon Fishing

(lower edge of net), and triangular pieces of cedar were used on the cork line (net edge at water surface).

Barnett (1937:163-164) found no indications that the was used between the Coquille and Alsea estuaries, but he did record its use by the Tillamook. However, I encountered several references to both set and drift gill net fishing in the estuaries of the southern, central, and northern Oregon Coast. Barnett did not have access to many of the accounts I was able to review, but part of this discrepancy may also be due to confusion over terminology. For example,

Harrington (1942[25]:817) wrote that Coquel Thompson didn't know if the Indians had gill nets, yet Thompson described set nets in several accounts recorded by Harrington and others.

According to Kroeber and Barrett (1960:53), drift nets were typically used in the day and set nets were used at night. This probably relates to the movement of fish and the ability of fish to see the net in the water in daylight. However, the available accounts from the Oregon Coast do not indicate drift net fishing was exclusively a daytime activity, nor the alternative for set nets, although net fishing in general seems to have been most effective at night. On the Oregon Coast, these nets were often dyed to cloak their presence when used during the day. Coquel Thompson related that set nets were used with "small rocks tied on for sinkers ... shaped stick for float. Set nets in eddies" (Drucker 1934:66). Elsewhere he noted that they "didn't spear silversides, used big salmon net for them. They set it [the net for coho] – one man helped by wife set net. They worked all night" (E. Jacobs 1934[116]:94-95). As indicated, this fishing was normally done at night (E. Jacobs 1934[120]:71).

In an interview with Harrington (1942[25]:813-814), Thompson mentioned three types of larger nets used by the Upper Coquille. One was for steelhead, a second was a "fish net runs half way across a river," and a third was "a seine with stone weights on it, whenever a fish was caught the net would get much tangled up." The second was probably a set net, and the first, for steelhead, is not clearly described.

Several sources described the use of drift nets in Oregon estuaries. A Coos elder described a drift net used with a canoe at both ends (Harrington 1942[21]:1023). A more detailed account from Alsea fisherman John Albert specified a drift net used in Alsea Bay. This "was 2-3 fathoms long by one deep, held on two poles and drifted downstream between two canoes" (Drucker 1939:83).

Drift nets were apparently quite commonly used in northern Oregon estuaries. Clara Pearson related that for the Tillamook a “year round method of fishing was the employment of a ‘common drift net’ attached to a canoe” (E. Jacobs 1934[106-5]:12). Drift net fishing is also mentioned in traditional Tillamook narratives. In Pearson’s narrative “The Man Who was Husband to a Seal,” a man at Nehalem is asked by his brothers, ““Do you want to come along? We will drift with our nets.’ Finally he went with them. They drifted. Soon that net was caught on a snag ...” (Pearson 1990:174).

Some Native elders apparently recalled little or no traditional use of large nets. For example, Harrington (1942[21]:816) recorded Clay Barrett as saying that the “local [Siuslaw] Indians had only dipnets, weirs, fishbaskets (with approaching lead), but no seines, no gillnets.” Yet Frank Drew noted that his Siuslaw wife used to fish for salmon with gill nets in the North Fork (Harrington 1942[22]:411). Annie Miner Peterson told Drucker (1934[1]:55-56) that the Indians of Coos Bay did not make or use gill nets or seines.

Two accounts indicate large nets were used but do not specify the type of net. During his November, 1851, assault on Coquille communities, Col. Casey described a Coquille fishery, approximately two miles upriver from the mouth, where he found “nets extending across the river ...” (Casey 1851:12). In a narrative told by Clara Pearson (1990:182), a fish net big enough for two boys to hide under is mentioned. It was left in a large house at the point on the North Fork Nehalem.

A single account depicts a tubular net held open with hoops, with a funnel-shaped opening. “The men set funnel shaped nets in the stream” for eels (Ward 1983:24).

The Geography of Fishing Practices

The historic and ethnographic accounts presented in this section mention fishing in specific Oregon Coast settings, but do not specify the fishing technologies used. Instead, they broaden the geographic dimension of my discussion of fishing practices, relating fishing sites to residential settings. The accounts are presented by their location, from north to south.

Nehalem

The name Nehalem means a place where “salt water and fresh water mixed together” (Clara Pearson in Harrington 1942[20]:519). The Nehalem people appear to have fished in both salt and freshwater. A fall move to upriver fishing villages is supported in a Pearson (1990:162) narrative, where a man and his wives lived “far up Nehalem River. He was living there that winter. Other people moved back near the ocean after the fishing season. But this man and his two wives were going to remain there all winter.” She also recalled (Harrington 1942[20]:555-56) that the Nehalem people used to go “way up the Nehalem River” to a “place ... where the Indians used to go to dry fish There used to be a waterfall (there), but when the white people put the railroad through there they blasted those falls away.” Suphan (1974:232) explained that “as for fishing, both Louis Fuller and Ellen Center suggested that the falls of the Nehalem would be about the limit to which these villagers would have gone upstream.” Fuller also explained that the Nehalem people went regularly to Seaside to fish (Suphan 1974:234). In December, 1852, Vaughn (n.d.:9) noted that the “Indians at this time of year had journeyed up the Nehalem River to fish and dry salmon for their winter's use.”

Clara Pearson related a narrative that took place on the Nehalem River, in the place known as God's Valley. “People fished in the North Fork of the Nehalem River near there. Many

people used to live in that valley in the wintertime....” and in later times the “... men would go up there in the wintertime and fish steelhead in the river” (Jacobs 1990:176-177). Ellen Center and Clara Pearson explained that fishing would draw people away from their homes for as much as a year; people from Nehalem might go to fish at Nestucca or vice versa (E. Jacobs 1934a[84-106]:1). In one account from Nehalem Bay a seasonal fish camp (Fishery Point) was used seasonally by residents of a permanent village on the same estuary (E. Jacobs 1934a[106-8]).

Tillamook

Suphan (1974:236) noted that as “explorer William Clark was told, salmon were plentiful in the streams flowing into Tillamook Bay; these could be taken at their mouths or at no great distance upstream according to informants.” This was apparently confirmed by the Native elders Suphan interviewed, Abe Hudson, Louis Fuller, and Ellen Center. Clara Pearson related that villages were usually located at the good fishing sites (E. Jacobs 1934a[81-74]:103).

In addition to frequent trips to the Columbia and the Necanicum for fishing and trading, Suphan (1974:236) reported that the Tillamook fished and hunted at the Salmon River. Boas, interviewing Louis Fuller, recorded that the Tillamook also visited Neskowin Creek for fishing (Boas 1898:23). Clark’s account of Tillamook fishing indicates salmon were harvested above tidewater during runs, and other marine fishes were harvested in tidewater during other seasons (Moulton 1983:184). Tillamook fishing stations may have been accessible to most people traditionally, as nearly everyone had a canoe (E. Jacobs 1934a[84-106]:15).

Nestucca

There appear to have been permanent houses along the lower portion of the Nestucca estuary, near modern day Pacific City. Missionary John Frost (Pipes 1934:254) passed through in

late August 1841, and observed a man catching a salmon in a canoe near the ocean. Louis Fuller told Harrington (1942[20]:563, 572) of a fish spearing site at a little creek that may be at the junction of the little or mainstem Nestucca, 3 kilometers from the ocean. Boas (1923:13) included a narrative of a man going up the Nestucca to catch salmon in a small brook. There are two references to people fishing and drying fish, most likely salmon, in nearby Neskowin Creek (Boas 1898:23; Harrington 1942[20]:563).

Salmon River

Louis Fuller told Homer Barnett (1934[1]:29) that his father's people, the Salmon River Tillamook, lived at Tsisniwutch (the main village) at the estuary, and they would go upriver to Long Prairie for hunting and fishing. I have not identified the upriver location, and it may have been on the Siletz River, the next large drainage to the south. According to Suphan (1974:236) there is evidence that the Salmon River, like the Neskowin, was fished and hunted by Tillamook people from farther north.

Siletz

Wolverton Orton was told by Dr. Johnson (Siletz Tillamook) that the pre-reservation Siletz Indians used to go up to Rock Creek falls to catch fish, presumably salmon or lamprey (Harrington 1942[26]:75). Coquel Thompson recalled that lots of fish were caught at the riffle where Spencer's Creek comes from the north into the Siletz River (Harrington 1942[25]:800). Several accounts describe fishing by Indian people from other parts of the Oregon Coast who were moved here by the U.S. military in the 1850s and afterward. These accounts have been included in other portions of this chapter, as they relate to specific aspects of fishing practices.

Yaquina

Several accounts describe flounder fishing in Yaquina Bay, possibly because this was done on a large flat visible from Newport (Harrington 1942[25]:504). After a visit to Yaquina Bay in June, 1852, Cyrus Olney wrote to the *Oregon Statesman* (Salem, June 22, 1852) at “this season the (Yaquina) Indians live principally on flounders” After his visit in September, 1849, Theodore Talbot (1851:111) wrote that “the Yaconas subsist principally on fish, crabs, clams, and roots, occasionally hunting elk in the neighboring mountains.”

Coquel Thompson described a salmon fishing village on the upper part of the bay,

I can remember (an) Indian town at the site of present day Toledo, Oregon, a Yaquina village, where Indians fished for Chinook salmons. But the government silently took this away from the Indians and then gave it to the white people. It is a good place for a saw mill (Harrington 1942[26]:107).

Alsea

According to Alsea fisherman John Albert, there was also a place at tidelands on the south side of the Alsea River “where the Indians used to live, getting fall salmon, a salmon-drying camp” (Harrington 1942[23]:158). He also mentioned that a creek 3 kilometers from the ocean on Alsea Bay had a name that translates “coho salmon go up to spawn when they get old in the winterime” (Harrington 1942[23]:143). The Alsea also fished for salmon in other creeks tributary to the bay (Drucker 1939:83). Albert explained that the “Indians used to go over there and fish. The Waldport Indians never went as far as Seal Rock or Beaver Creek (on the coast north of Alsea) and vicinity to fish” (Harrington 1942[23]:140-150). However, Spencer Scott noted that the Alsea Indians went to Beaver Creek, in early fall to catch coho salmon (Harrington 1942[23]:146). There are also references to Alsea fishing for spring Chinook and fall coho near Yachats (Harrington 1942[23]:46).

Siuslaw

A detailed summary of the seasonal changes in residence and food harvesting on the Siuslaw was provided by Lower Umpqua elder, William Smith, (Frachtenburg 1914:81-83),

During the salmon season they lived up the river. All people lived (then) up-stream, catching salmon.... They used to dry salmon right there where they lived, up-stream. When the salmon was gone (ready), they then went (back) to the mouth of the river. Some of their people hunted habitually, having gone far up the river. They killed elk, and dried their (killed game) When their food (accumulated) greatly, they went back Then they assembled at the mouth of the river. Many people lived there When the summer was about to commence, then the people used to eat herring. Thus they lived long ago.

Frank Drew recalled, “[o]nce I went in the summer from Yachach, and stayed here with Siuslaw-John. And from here a whole bunch of Siuslaws went up to Mapleton and got lots of eels” (Harrington 1942[23]:482). He also noted that “Swishhome ... was the summer home or eel camping place of Siuslaw Dick and many others every season” (Harrington 1942[23]:493) and that Siuslaw people used to go to Triangle Lake “to hunt, fish and trap in early times” (Harrington 1942[23]:553). He also mentioned that the Siuslaw went to the east side of the Coast Range to trade dried fish for camas (M. Jacobs 1934[91]:154).

Drew also remarked that Siuslaw John, the Chief of this tribe during the reservation years, had a “place on North Fork where (he) went up in the autumn, a fishing ground ... 400 acres of marshland” (Harrington 1942:527). Apparently Chief John had three residences, one at Florence, one near a “little Prairie near Drew's present place” and one that was three or four miles up the North Fork, the latter being his fall home when getting fish. Melville Jacobs (1934[91]:124) remarked that,

Drew gives the impression that even long ago there was lots of moving around for the yearly cycle of activities, they stayed a month or two at a summer fishing home; they had a temporary place further up, where eels (and incidentally other things such as deer and elk) were gotten for a time of three weeks perhaps. One's whole family would go along on these excursions. The heaviest eel run is in the better part of May.

Umpqua

Traditional fishing practices are comparatively few for the people of the lower Umpqua River. This may be due in part to the early economic influence of the Hudson's Bay Company. When Gustavus Hines (1851:101) traveled down the river in August, 1841, he found people fishing at the head of tide near Scottsburg, but it is not clear that these were coastal peoples; they may have been upper Umpqua Athabaskan speakers. Coos linguist and historian Patty Whereat (2001 personal communication) explained that Lower Umpqua territory extended to this fishery, and that it may have been used seasonally by the people from villages along the estuary. This weir fishing stations was also in use in fall of 1851 (Lyman 1851). Lodges were present near this fishery during both of these visits, and there are indications that Native people continued to build weirs near Scottsburg seasonally during the Coast Reservation years (Kent 1973:29).

In a recent interview with Elizabeth Morrissey of Smith River, Patty Whereat (2000) recorded a brief account of the Smith River Falls lamprey fishery. Morrissey's father "recalled Indians went to Smith River falls for eels. Canoe up. Nice people." Whereat also referenced a manuscript in her possession entitled *Smith River Memories*, which, on page 78, includes this passage: "The Indians used to come up and camp near (Smith River) falls in the summer, catch eels and smoke them for winter."

Coos

Melville Jacobs (1934[97]:24) described the seasonal changes in residence tied to fishing practices at Coos Bay,

The Coos had autumn fishing villages for temporary living, with knife grass or brush houses there; some had lumber houses. These were temporary seasonal quarters; these were near the falls and shallow water. The salmon were when they first came in caught

from the lower bay permanent houses. Then as the salmon went up the people went up to their upriver houses, and stayed there for eels and salmon until New Years or thereabouts.

The foregoing account may refer to two separate episodes of upriver fishing, one in late spring (for eels) and one in fall (for salmon).

A specific account of seasonal fishing trips upriver is provided by Frachtenburg (1909:20), “the Coos went up the forks of the river in the fall about this time (October) of year to catch fish (salmon). They stayed there until about Christmas.” Coquille elder Laura Metcalf recalled that the Indians, when she was a child, used to go “when the fishing season comes, up to Coos River and Ten Mile (Creek) to get their fish” (U.S. Court of Claims 1931:76).

There are also accounts of fish being traded with interior peoples. For example, Jim Buchanan recalled that “lots of Coos married (Upper Umpqua) women. The (Umpqua people) came to the coast for dried fish sometimes, and then the Coos met them. Similarly the Tututnis intermarried with the Coos” (M. Jacobs 1934[93]:3). George Bundy Wasson explained that interior tribes such as the Kalapuya came to Coos Bay to trade plant foods for dried fish from the coast (U.S. Court of Claims 1931:155-156).

Coquille

According to Coquel Thompson, “[e]veryplace they caught salmon they would have a village” (Harrington 1942[26]:221). Lamprey were also caught in upstream settings. Nellie Freeman recalled that they “got their eels from the streams in (Tenmile Creek), and toward Fairview” (on the North Fork Coquille) (Harrington 1942[24]:392). Beverly Ward (1983:23) provided further detail on fishing in the North Fork: eels “were important food. Other Indians came down on the Coquille when the eels were running. Some of the lower Coquille left their

canoes where the town of Coquille is now, then they walked through the hills to gather eels at a big fall on the North Fork.”

Fishing Strategies and Their Settings

Although variation clearly existed between the river settings of the Oregon Coast, some generalizations are possible based on the ethnographic and historic accounts presented in this chapter. In general, weirs, woven traps, and large nets seem to have been the most effective devices for harvesting large numbers of fish. Harpoons, dip nets, and other smaller fishing tools were often used, but they were typically used in association with conditions or other devices that consolidated fish or limited their movement, such as torchlight, falls, and weirs. Only when schools were very dense could tools such as the dip net or the hook, line and float be effective in the deeper waters of the bay. Canoes (Figure 17) were key to the successful use of many of these fishing systems, allowing people to harvest and transport large numbers of fish, and extending the catchment area of a given residential locality across a wide range of estuary settings (see Chapter 2).

The most intensive salmon fishing with weirs and often with basket traps took place in the larger rivers and their tributaries, both in the upper portion of tidewater and above tidewater. In the lower portions of the estuaries, harpoons, hook lines with floats, and tidal weirs were used to harvest salmon before runs, and harpoons were commonly used in rivers, especially at times when weirs were not in use. This salmon fishing strategy was also used during fish runs in outer coast streams and main river tributaries. Nets were used for salmon in riverine and estuarine settings, but the types used varied. Dip nets were used at falls and riverine weirs. Set nets and drift nets were used in upper tidewater and riverine settings. Like harpoons, these nets could be

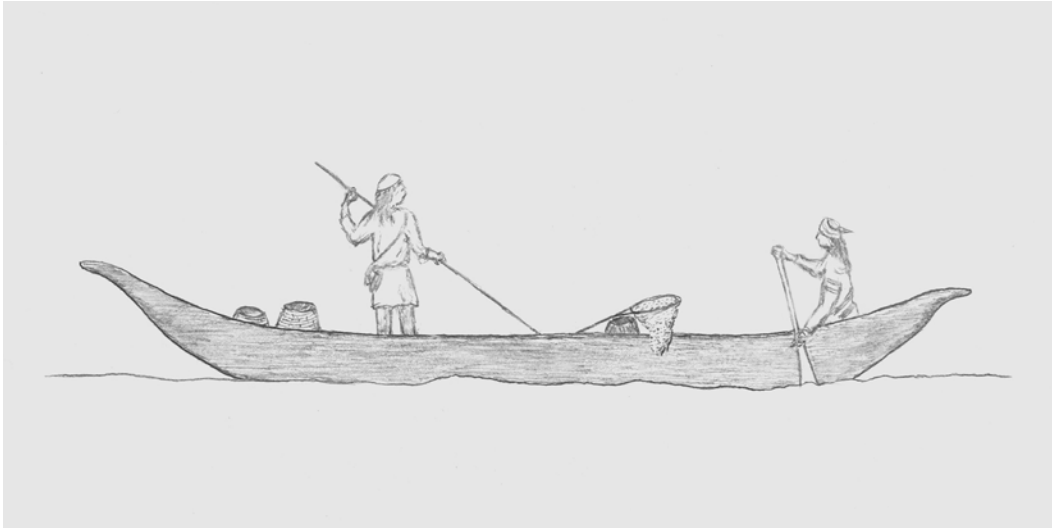


Figure 17: Men Poling and Paddling an Oregon Coast Canoe (drawing based on historic accounts and depictions from the 1850s).

used at times when riverine weirs were not as effective (i.e. when anadromous fish were not moving upriver), and in settings not suited to either tidal or riverine weir use.

Pacific lamprey harvests were much like those of salmon, although there are no indications that lamprey were harvested in tidewater or in deeper riverine waters. Lamprey fishing stations were sometimes farther upstream than salmon fishing stations, in part because this species could move above some of the steeper falls that limited salmon passage. There are indications that lamprey fishing was sometimes tied to interaction with inland tribes.

The geographic setting of fish processing was similar for both of these anadromous taxa. Both salmon and lamprey were processed at upriver fishing camps or villages near the major upriver fisheries. Salmon caught in tidewater were processed at villages along estuary shores and

some salmon caught near the head of tide were also brought back to the permanent villages for processing.

In estuary settings diverse fish species were harvested with tidal weirs and woven traps, apparently during all seasons. Other tools, such as dip nets, were often used for harvesting these fishes, which were often much smaller but more numerous than salmon. Most of the fish caught in the estuary appear to have been harvested during spawning runs. Yet tidal weirs, basket traps and spears could be used to harvest estuary fish year round, particularly in intertidal flats and slough channels.

Surprisingly, accounts do not refer to scheduling conflicts resulting from overlapping runs of fish. There seem to have been runs of herring, smelt, and other small fishes in winter and early spring, followed by lamprey and in some cases salmon runs in the spring and early summer. There were runs of smelt, sardine, and possibly other small fish again during the summer, followed by Chinook salmon, then coho salmon in the fall. In the northern estuaries chum salmon was abundant well into January. Steelhead were often caught through the winter, although this fish seems to have been most important to people living well above tidewater. Estuary fishes that seem to have been harvested at any time of year include sturgeon, flounder, and various perch. It is likely that various smelt, herring, and other species were available throughout the year as well, though not in the numbers seen during spawning runs.

Some accounts indicate a summer or fall residential move to upriver fishing stations for whole families, possibly entire communities, yet other accounts indicate people from the same community went different places for fishing, hunting or other activities depending on their chosen subsistence specialization. Still other accounts indicate that tidewater villages remained occupied by some residents throughout the year. It does appear that overall subsistence practices were diversified for Oregon Coast groups, yet the importance of estuary fishing seems to have made

the shores of the estuary the center of settlement for all Oregon Coast tribes in the study area, with the exception of the Upper Coquille, who apparently did not rely on fish caught in the lower reaches of the estuary for a substantial portion of their diet. The Upper Coquille, as well as residents of the upper portions of valleys such as the Siuslaw, Alsea, and Siletz, apparently relied more on plant foods, game, and seasonal anadromous fisheries. It is also clear that many inland groups traded plant foods to coastal peoples in return for dried fish.

Regional Variation in Tidal Fishing Practices

Tidal weirs and woven traps are clearly identified in ethnographic accounts of the central and southern estuaries in the study area, from Yaquina Bay to the Coquille River except for the Umpqua River. In these estuaries, diverse harvests of herring, flounder, salmon, smelt, suckers – the “quantity fishing” of Jim Buchanon and the “go-help-yourself” hauls of Melville Jacobs – seem to have been the foundation of the local economy. Yet there are no clear accounts of these fishing structures being used in the estuaries of the northern Oregon Coast. This might be expected for Sand Lake and Salmon River estuaries because these are small, with relatively limited intertidal zones most of the year. But the Nehalem, Tillamook, Netarts, Nestucca, and Siletz estuaries are moderate to large, with expansive intertidal zones, much like the southern estuaries. As noted, there are also accounts of tidal weirs in the Columbia estuary, Willapa Bay, and Puget Sound.

Is there something about the environment on the northern Oregon Coast that limited the potential of tidal weirs there? Sediments suitable for weir building are present, and archaeological weirs have been observed in Netarts Bay (Chapter 4). The explanation may partly relate to the relative abundance of fishes that could be harvested with tidal weirs in these estuaries, stemming

from differences in upwelling (see Proctor et al. 1980: 2-84). The answer may also involve differing technological preferences. Drift nets appear to have been widely used on the north coast. Yet these would only account for salmon harvests, as they do not appear to have been used for smaller fishes such as herring. Smaller mesh nets could have been used much as weirs were in tidal sloughs and on tidal flats, yet the available accounts do not mention this practice.

If different technologies are comparably suited to people's fish harvesting needs, there may have been a cultural preference for tidal weirs and traps in the south and harpoons and nets in the north. Another explanation for this variation in fishing technologies may be that there is a gap in the ethnographic documentation of tidal weir technology in north coast estuaries. Further research may yet uncover accounts of this activity. But if archaeological evidence is any indication (Chapter 4), these fishing structures were much less common on the northern Oregon Coast. Environmental or cultural factors could be more at play here than ethnographic limitations. Further archaeological survey may help to answer these questions.

Fish Processing

Ethnographic and historic accounts of fish processing provide a more complete view of the residential context of mass harvest fishing on the Oregon Coast. The accounts presented in this section were transcribed during research on fish harvesting technologies, and no attempt has been made to glean all documentary accounts of fish processing. Yet the accounts presented here show a diversified technology oriented to both year-round and seasonal harvests. Small estuarine fishes are discussed first, followed by salmon and then lamprey. Brief accounts indicate that both white and green sturgeon also were dried (M. Jacobs 1934[91]:15; Harrington 1942[21]:783).

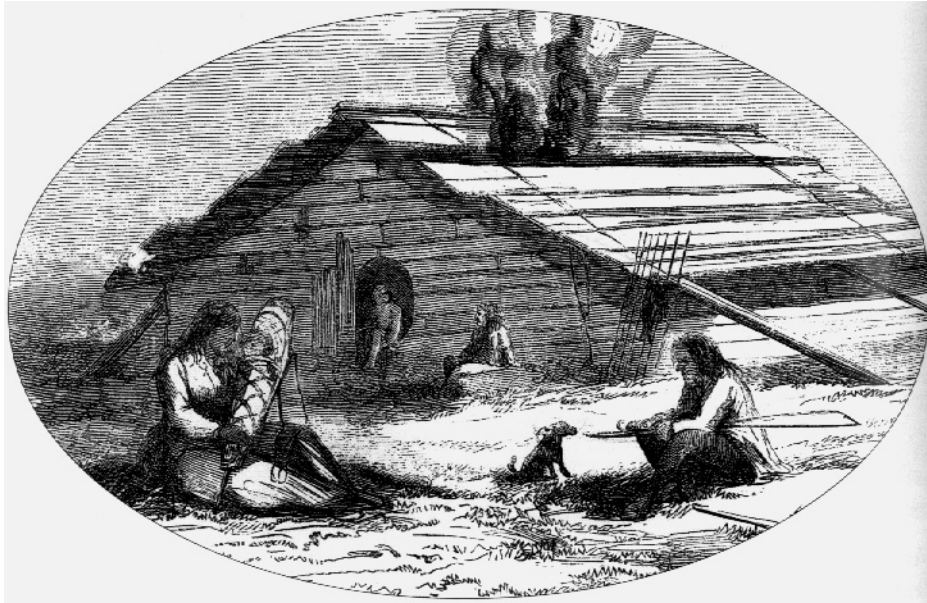


Figure 18: An Oregon Coast Plank House (Courtesy of Oregon Historical Society, negative OrHi 76450, from image in *Frank Leslie's Illustrated Newspaper*, 1858).

Small Estuarine Fishes

The harvest of small fishes in Oregon estuaries typically occurred in settings accessible to village residents on a daily basis. The processing of these fishes typically involved cleaning, stringing or racking, and smoke-drying. Just as cooked small fish are consumed whole throughout the world today, there was little need for butchering. As Lottie Jackson Evanoff noted for herrings, when “properly fried they eat them bones and all” (Harrington 1942[24]:435). She also observed that shiner perch “are good when fried” and remembered a “big perch” noting that the Indians “used to dry (these), but sometimes ate them fresh” (Harrington 1942[24]:480). A key component I the processing technologies used on the Oregon Coast was the split wood plank

house (Figure 18). This residential structure also served as a facility for smoke-drying and preserving fish throughout the year.

Coquel and Martha Thompson recalled eating “dried surf smelt all winter” (Harrington 1942[25]:501). Even the oil of these small fish was valued. There are numerous Northwest Coast accounts of the value of fish oil (Byram and Lewis 2001), and accounts from the Oregon Coast indicate small fish provided oil. As a Coos elder recalled, “perch fat was set in a clam shell by the fire and cooked in there, and eaten with berries or meat was dipped in it” (M. Jacobs 1934[96]:112).

Some small fishes were harvested and eaten year round. Clara Pearson remembered that in north coast estuaries “flounder was plentiful, and liked well enough, but people never dried it since it could be obtained fresh the year round” (E. Jacobs 1934[106-5]:14). (Both small and large flounder were harvested in Oregon estuaries.) Annie Miner Peterson recalled that the central coast peoples did not dry flounders either (M. Jacobs 1934[97]:44).

The most detailed descriptions of small fish processing are in the testimony of Annie Miner Peterson, as recorded by Melville Jacobs (1934[91]:14):

Another way of curing smelts is by putting them high overhead in the house on netted together whittled fir sticks held together with root strings. The fish are laid atop (smelt, herring or any kind), over a smoke fire. Another way of curing smelt or herring is to take round sticks, 5-6 feet long, several of them, then run these through the gills of a string of fishes, and this fish poles are laid over a smoky fire. Another way of fish curing is by splitting 3-4 foot fir sticks lengthwise and putting the fish in between the stick splinters, and these are placed leaning against the fire - this method is for quick smoking - curing, or rather everyday roasting - for quick luncheon.

Annie Miner Peterson also recalled that after the fish are caught in weirs,

the herring are cleaned on the beach, and dried in quantity.... They are cleaned or wiped by running the hand which holds the moss – to take off the scales. They never use water to wash things before smoking. They do not butcher the herring. They string them as they are, merely wiped, thru the head on a thin split and whittled fir stick. Every other herring is thrown over an adjacent stick, though the heads are strung on one stick, each other

herring is placed over the adjacent stick, so that the fish shouldn't touch each other (M. Jacobs 1934[97]:44).

Peterson's accounts were a major source for Jacobs' (1934[96]:22) depiction of Coos-Coquille "go-help-yourself" fish hauls, in which the only limits on harvests involved processing time.

Frank Drew mentioned herring and smelt curing techniques much like those described by Peterson. He noted that smelt were dumped in a hole in the sand and dried in the rafters of a house, or smoked above a fire (M. Jacobs 1934[91]:13-14). Some accounts mention small fish processing incidentally, as in this statement describing berry drying mats "made of very fine fir sticks sewn at the ends Herring or smelt or small pieces of elk or deer meat could be put on such mats ... 4 by 6 or 8 ft" (M. Jacobs 1934[91]:35). The Tillamook also dried herring (E. Jacobs 1934a[84-111]).

Midsummer may have been the only time of year when fish were dried in the sun on the Oregon Coast. Some accounts relate that smelt caught in August were dried this way. For example, on August 13, 1878 Robert Summers observed Indians drying smelt on scaffolds, and on the roofs of their houses at Siletz Bay. He also observed that some of the small fish were being smoked on poles above a fire. This situation may have resembled the Yurok fish camp shown in Figure 19. Frank Drew also mentioned that smelt were sometimes sun-dried (M. Jacobs 1934[91]:13-14).

Salmon

Although small estuarine fishes were clearly fundamental to Oregon Coast economies, accounts of salmon storage and processing also describe enormous harvests, during fall in particular. Salmon were processed at upstream fishing stations as well as in villages along estuary shores.



Figure 19: Sun-Drying Smelt at Redwood Creek, Northern California Coast (courtesy of the Phoebe Apperson Hearst Museum of Anthropology and the Regents of the University of California, photographed by T.T. Waterman, 1928, no. 15-11470).

After visiting Nehalem Bay in December, 1852, Vaughn (n.d.: 9) observed the Nehalem method of drying chum salmon: “[w]hen nearly dry, the rack would be raised, a fresh one put in its place and so on until the house is about full. We have seen tons of fish dried in their houses at a time.” Elsewhere Vaughn (n.d.:12) wrote that the Nehalem people “had all been up the river to their old fishing ground drying salmon for winter use and that they were still living there.” Later describing a community at Kilchis Point on Tillamook Bay, he observed “... the Indian's winter quarters where they dried their salmon. We found

drying salmon indoors in ethnographic interviews. Frachtenburg (1910:11) wrote that the Alsea smoke-dried salmon in their houses. It is clear from these accounts that the salmon were smoke-dried, not air-dried. Smoking seems to have been common on the Oregon Coast, likely due to weather conditions and high humidity.

A narrative told by Clara Pearson (1990:164) explains how a camp was moved after an attack by Wild Man, and may represent the activities described by Vaughn, "people were drying fish up the Nehalem River" then, after Wild Man attacked their camp, "[o]ne side of that large house where they had dried fish was smashed to pieces They put all their belongings and their fish in canoes and left that place for good After that no one would camp on that side of the river."

For some communities, salmon fisheries at the head of tidewater could be reached in less than a day's travel. Fish would be caught and brought back to tidewater villages the same day for processing. Frank Drew describes this for an upper tidewater fish dam on the Siuslaw, where men harvest the salmon and "women do the fish dressing and butchering after the fish are brought back down to the village" (M. Jacobs 1934[91]:22).

There are accounts of specialized smokehouses in villages at tidewater on the Siuslaw (Siuslaw Pioneer 1954:11), and near upriver fisheries (Harrington 1942[24]:830). As with the north coast, some central and south coast accounts suggest that houses used as residences were also used to smoke fish. After his soldiers had destroyed several Coquille houses, Col. Silas Casey (1851:9) wrote "... we found two large lodges, covered with boards and matting ... In one of them Salmon was cooking They contained large quantities of the different articles used by the Indians, fishing nets etc., together with three or four tons of dried Salmon." Casey's (1851:12) summary of his devastating assault indicates the scope of fish storage on the tidewater portion of

the Coquille River, “[d]uring the operations on the (Coquille) river, we took and destroyed 20 large lodges, and destroyed about 13 tons of dried salmon....”

Rostlund (1952:301) placed the Oregon Coast within the region where salmon meal was widely prepared and traded, possibly based on Barnett’s (1937) cultural element list. Yet I have found no indication that this product was made with fish caught on the Oregon Coast. There is some indication that salmon caught by Tillamook people visiting the Columbia River were sun dried (not smoked) and pounded into a meal (E. Jacobs 1934a[84-107]:74). This exception seems to have held for “Columbia River fish” only, probably spring or summer Chinook. The entry on Barnett’s (1937:166) list simply indicates that dried salmon were pulverized, a process that often occurred during meal preparation. According to Coquel Thompson, “Klamath River and also the Warm Springs Indians made salmon meal, but our people did not...” (Harrington 1942[25]:512). Large scale salmon meal preparation for storage and trade may require sunnier and/or drier conditions than those prevailing on the Oregon Coast. In the dry Columbia Plateau, sun dried salmon could be stored two to three years (Gibson 1997:49). Based on interviews with Ellen Center and Clara Pearson, Elizabeth Jacobs (1934a[81-74]:135) wrote that dried salmon could last up to one year on the Oregon Coast.

On the Oregon Coast, salmon was normally stored in the rafters of the plank houses people lived in. Sometimes storage and drying were accomplished at the same time. For example, one Coquille account describes the use of discarded cradles, or baby baskets, being reused to dry salmon heads in the rafters of houses (Harrington 1942[25]:749). Salmon heads as well as backbones were valued and stored, and dried salmon were often dipped in various oils when they had lost their flavor (M. Jacobs 1934[91]:15;[92]: 97). Dried salmon heads were also burned in hearths when extra light was needed (E. Jacobs 1934a[81-74]:152). Salmon eggs were also dried

(Vaughn n.d.:12; E. Jacobs 1934a[81-74]:170). Dried salmon was also traded with interior peoples (Frachtenburg 1917:72; U.S. Court of Claims 1931:155-156; Summers 1994:100).

Lamprey

Pacific lamprey were treated similar to salmon as a resource, and they may have been nearly as abundant in many rivers during spring and early summer. It appears people often went far upriver to harvest eels, however, so most lamprey processing was done away from the large estuarine villages. A detailed account of one Siuslaw man's lamprey harvests and trading was related by Andrew Charles (U.S. Court of Claims 1931:107),

Thomas Johnson he goes up there to catch eels, way up the Coast Range thirty or forty miles above tidewater If he catches enough for a winter's supply and whatever he can spare he goes up to Triangle Lake and he goes over to do some trading with the Valley Indians.

Other accounts indicate lamprey caught in late spring were dried for use in winter. In May, 1853, near the confluence of the Middle and South Forks of the Coquille River, a settler observed "at least 100 Indians camped at what is now known as the Hoffman Place ... fishing for eels, (of which they) dried large quantities for winter use" (Dodge 1898:127). Frank Drew provided detailed descriptions of lamprey processing, and the communal sharing of this and other harvests.

After the lamprey are caught,

they are tied in square bundles to be taken ... to the winter homes by canoe, they are divided up among the families on arrival in the winter village The house at such a place would be like the fish-drying house ... if they had a house at all. And the next season they would use the same shelter, repairing what was necessary to make it habitable (M. Jacobs 1934[91]:124-125).

Since there are enormous piles of smoked eel, it is potlatched about, everybody gets some. Those out catching salmon reciprocate by potlatching what they have gotten. So everybody has a variety of food, though each must specialize (M. Jacobs 1934[91]:20).

According to Clara Pearson or Ellen Center, Tillamook people split eels with a knife, and because they were so oily they were smoke-dried outdoors over an open fire (E. Jacobs 1934a[81-74]:163).

Discussion of Fish Processing

Combined with accounts of fishing practices, these accounts of fish processing indicate that for many Oregon Coast communities a kind of “commuter economy” prevailed, where people harvested estuary resources within a daily catchment radius of permanent villages, and occasionally took trips to upriver fishing stations for large scale but short term fishing. Other places visited were interior prairies, upland hunting sites, and outer coast gathering camps. In tidewater settings the canoe seems to have been key to this commuter economy, both as a means of personal transportation and as a vehicle for hauling fish and other goods from harvesting stations to residential localities. Structures suitable for smoke-drying and storing fish were also key in processing, and the widespread architectural tradition of semi-subterranean split cedar plank houses was appropriate for fish smoking and storage.

The Social Context of Fishing

Three categories of ethnographic accounts pertain to the social context of fishing. These are accounts of ceremony relating to fishing, descriptions of the ownership of fishing stations and structures, and indications of the age and sex of the people who conducted specific fishing activities. This information about the social context of fishing is an important aspect of understanding the overall social and economic role of fishing in Oregon Coast societies.

Fishing Technology and Ceremony

It is important to recognize that although fishing was a daily activity for much of the year on the Oregon Coast, fishing activities were often conducted in a context of ceremony and ritual. Group activities included the First Salmon ceremony, celebrated throughout the region (Barnett 1937:193; E. Jacobs 1934[120]:48) and ceremonies associated with the building of some weirs (Boas 1923:10). Individual practices included strong taboos relating to fishing, fish processing, and eating fish (Barnett 1937:166-167), the practice of returning salmon bones to the river after removal of flesh and oil (Barnett 1934[1]:3), and restrictions on tool use. As Coos elder Lottie Jackson Evanoff explained that if “you cut eels with a knife, they are poisonous to you and won’t come upriver anymore either. You have to cut the eels with a freshwater mussel shell. There are middens of freshwater mussel shells up the Coos River” (Harrington 1942[22]:883; see also E. Jacobs 1934[120]:48; M. Jacobs 1934[100],[91]:16, 173).

Ownership of Fishing Stations

In the three models relating weir fishing to social organization I outlined in Chapter 1, the ownership of fishing stations is a key issue. In this section I survey the Oregon Coast ethnographic literature for accounts of fishing site ownership, and review ethnographers’ statements about site ownership in the region.

In Barnett’s (1937:186) cultural elements list entry *property*, it appears that fishing involved special ownership not seen in other aspects of culture. Fish dams were owned by builders from the Tolowa north to the Tillamook, with no entry for the Alsea. The list also indicates that for most groups, weir owners allowed the renting of dams, nets, traps, etc. “on

share.” Hook and bait fishing was generally open to all. Fishing places were individually owned for all but the Coos, with no information from the Alsea. Riffle claims reportedly were acknowledged by all but the Coos, with no information from the Alsea. For those groups that recognized ownership (with no data for the Coos or Alsea), inheritance was recognized. In contrast, for all groups on the Oregon Coast land was open to anyone for hunting and for building a house in the village (Barnett 1937:186).

The most general ethnographic assessment of the ownership of Oregon Coast fishing stations was offered by Suphan (1974:173) who made the following blanket statement based on Barnett’s (1937:186) survey, his own research, and the other published ethnographies, from the “Tolowa on the south to the Tillamook on the north there is impressive agreement in the basic aspects of culture.” He specifies these commonalities as social ranking by wealth, the village as the political unit, groups designated by village name [or stream], fish dams owned by their builder, fishing stations individually owned and inherited, and hunting land free to all.

There are always exceptions to ethnographic generalizations. Given the accounts of fishing practices outlined earlier in this chapter, this statement may be founded on an incomplete assessment of the scope of fishing practices in the region. Like most ethnographers, Suphan did not distinguish between riverine weirs and tidal weirs in generalizing as to weir ownership and access. The differences in these technologies may be important. For example, tidal weirs were often more permanent than the riverine structures, and they were also dispersed along estuary margins, not arranged in a linear sequence where use of one weir depended on the opening of another. The ambiguity of ownership is seen in this statement by Drucker (1937:59, quoted by Suphan 1974:191), assessing Tolowa weir use:

Although it was said by the natives that individuals owned and inherited fishing stations, the local community exerted a claim to them in that permission to use them, perhaps

contingent upon payment of rent, could not be denied any fellow villager. In effect, the village was the owner, the individual the steward, of the fishing station.

Suphan provided a complicated version of resource ownership and use on the Oregon Coast. He seems to have argued that fishing stations were the most significant resource areas, and so were often owned by individuals, while other settings were not. Yet Suphan and Barnett (1937:186) before him may have had preconceptions about the nature of property ownership in this region. It may be that a form of ownership follows from the investment of energy in harvesting activities at a particular locality. The following accounts shed further light on access to and ownership of fishing stations on the Oregon Coast.

For the northern Oregon Coast, it is noteworthy that Suphan's (1974:230) own interviews with Louis Fuller yielded a different perspective from the one he arrived at. Suphan (1974:231) wrote that although "each (Tillamook) group did have its own name of geographical reference for itself, hunting and fishing territory was open to all Tillamook-speakers." Yet Fuller had earlier told that for the Salmon River Tillamook, "[l]and back from river open to all hunters – no ownership of fishing spots. Chief usually only one able to own seaworthy boat to go out to sea lion rocks" (Barnett 1934[1]:29). The second part of this account may reflect on the ownership question; it may be that ownership of the technology was more key in site ownership than ownership of land by individuals.

Boas interviewed the Tillamook elder Hyas John (probably John Baxter), who provided further support for Fuller's statements. He recalled that the "people living at the headwaters of a river had the right to go down to its mouth and hunt there. There was no law forbidding the people on one river to catch fish in another river" (Boas 1923:5). Clara Pearson (E. Jacobs 1934[106]:5) explained that:

fishing privileges were automatically extended to all Tillamook peoples on the various Tillamook rivers. There were no privately owned ocean or river sites for fishing.

Nehalem Tillamooks might spend a season fishing at Nestucca, during which time they lived with friends or relatives or erected temporary dwellings.

Clara Pearson told Elizabeth Jacobs (1934[106]:5) “[f]ishing privileges were automatically extended to all Tillamook peoples on the various Tillamook rivers. There were no privately owned ocean or river sites for fishing.” She also explained that people from Nestucca and Nehalem might visit each other and fish together for a season. Together, accounts from the northern Oregon Coast suggest that there was no geographic ownership of fishing stations by individuals. Perhaps Barnett’s survey reflected individual ownership of specific fishing apparatus, rather than the locality in which they were used.

On the central Oregon Coast, there is one account of a conflict over a fishing station at the short stream flowing from Devil’s Lake to the ocean, north of Siletz Bay (*Oregonian* June 11, 1933:4 col. 2-3). This occurred during the early years of the Coast Reservation, yet it is clear that the Yaquina people claimed rights to fish here when people from Rogue River tribes attempted to use the station. Notably, this appears to have been an instance of the Yaquina recognizing tribal ownership of a fishing station, similar to that described for the Tillamook.

A brief account from Alsea Bay also suggests site ownership. In a description of the First Salmon ceremony, Drucker (1939:97) wrote that “John Albert said that after a weir was built, the owner of the place cooked and ate the first salmon trout caught.” Here again the device and the land may be conflated.

According to Frank Drew, apparently referring to the Siuslaw homeland, “[t]here was no private root or fern places, or in fishing or berries or hunting. The only crime on public property was exterminating too much game in the mountains/ He might not be permitted to hunt in that territory again, by the Chief’s orders and attitudes” (M. Jacobs 1934[91]:35).

There are several accounts relating to fishing station ownership in the Coos-Coquille homelands. Melville Jacobs’ (1934[96]:22) wrote of the “go-help-yourself” communal fishing

hauls, noting that the principal food supply was shared collectively, and that “[a]ll bay fishing was village-communal; (the fishermen) obtained an excess that would take care of every other household in his village.” Although he stated that “all bay fishing was communal,” it is not clear whether or not fishing stations were owned. Much of the bay fishing took place over open water, but another large portion was done at tidal weirs that may have been owned. Other accounts provide more information about this.

In Lottie Jackson Evanoff’s account of the large weir near the mouth of Coos River, she indicated her grandfather owned the weir and that those under his leadership constructed it (Harrington 1942[24]:102). At their home on the lower portion of the estuary near Empire, Evanoff recalled that her father made a tideflat weir near their home at Empire, which was used by other Indians (Harrington 1942[24]:223). In these two accounts fishing weirs were built and apparently owned by a chief who recognized the nearby land as his home. It is not clear if the actual site of the fishing station was owned as well.

Coquel Thompson offered several accounts pertaining to fishing site ownership on the Coquille River. Drucker (1934:123) wrote during his interview with Thompson, “[s]mall creeks where steelhead ran were owned by ‘all the people’ outsiders had to get permission to use. Apparently not much trespass ... some were owned by individuals – esp. for winter fishing. But other members of same town could go there and fish.” Apparently the situation was different in tidewater. He told Elizabeth Jacobs (1934[104]:98-99) that “people could fish anywhere. No one owned spots at mouth. But just above tidewater, I own place, put up fence around it up above me another fellow would make fence.” Other fishing sites above tidewater were apparently owned, “[m]ake salmon fence. Salmon jump through stakes into basket down below waiting for them ... Only fence part is owned. People never steal fish because they can ask for it. You have more fish than you want” (E. Jacobs 1934[104]:98-99).

Apparently the ownership of fishing sites on the upper Coquille River sometimes extended to more than fishing weirs. Thompson mentioned that set nets were used “in eddies. Holes, riffles owned. Same way hunting grounds” (Drucker 1934:66). Elsewhere, in an account about a basket trap used at falls for steelhead and coho salmon, he recalled that “One man owned it. When get full, they untie pull ashore. He give everybody fish” (E. Jacobs 1934[121]:16).

During his work with Drucker on the Oregon Coast, Barnett recorded two accounts that pertain to weir use on the south coast. One perspective on weir ownership was offered by Billy Metcalf, of Chetco and Joshua Tututni descent, “[m]en who built dams owned them – exclusive rights on these as other fishing places. Son inherited if he wanted to use it” (Barnett 1934[1]:74). Similarly, Oscar Brown, whose parents were Sixes River and Lower Coquille told Barnett (1934[1]:113) that “[f]ish dams definitely owned by individual.” Since tidal weirs were not practical in much of southwest Oregon, it can be assumed that Metcalf’s account depicts riverine weirs, but Brown may be referring to these or to tidal weirs or both.

Age and Sex of Fishers

By considering the age and sex of the individuals who fished with various techniques and of those who processed the fish, further questions of the social and economic context of fishing can be addressed. In most of the ethnographic accounts of fishing and related activities presented in this chapter, the participants in the activities are not clearly identified by age, sex, or social role. However, several accounts provide direct or incidental indications of social identity. These accounts show that men, women, and children were involved in fishing-related activities, though certain activities are described as the role of men or women specifically. Children generally assisted adults in various activities, sometimes according to gender.

Two of the most comprehensive accounts on gender and fishing were given by Clara Pearson. The first is the statement that among the Tillamook, “[w]omen did all of the meat drying after the men brought it in. Men just did the fishing and hunting, not the drying” (E. Jacobs 1934[106]:5). The second is found in a narrative Pearson (1990:178) told about a Garibaldi Tillamook woman named Neshukulayloo, who did work that men normally do, “[s]he could do anything with her great strength She did a man's work. She made dams in the river, she made and tended basket traps. No ordinary woman could do that.” A geographic description in the account indicates these were upriver dams and traps, not tidewater structures. The other accounts in this portion of the chapter are grouped by the activities they represent.

Making Nets and Other Fishing Implements

Melville Jacobs summarized the division of labor in Coos-Coquille manufacturing, including fishing implements. During winter, “women made baskets, mats, clothes; men made weapons, canoe poles, paddles, fish trap baskets, fish fences, ropes, fishhooks, shinny clubs, and so on” (M. Jacobs 1934[99]:17).

Nets were typically made by men, and in some cases even the fiber used to make the nets was harvested and processed by men. In discussing Tututni fish net making, Cora Dubois (1934:8) described this process, “net twine made of iris fibers. Iris – temeale. Fiber extracted by splitting leaf with teeth Gathering iris, spinning and net making were all men’s work” Women and children were barred from seeing nets being made “because that would frighten away the salmon.” Kroeber and Barrett (1960:58) attest to the ubiquity of men making nets in northwest California. Similar accounts are available for the Oregon Coast. According to Barnett (1937:164), fishing nets were made by men among the Alsea and Tillamook, but no information was available for the central and southern Oregon estuaries. There are accounts indicating that

Coos and Coquille men made fishing nets (E. Jacobs 1934[4]:127), and in some cases they did this “out in the woods,” because it was “ill luck” for women to see the net being made (Harrington 1942[24]:711). However, Nellie Wasson Freeman (M. Jacobs 1934[100-3]) recalled that her mother not only made basket traps, “she made nets too, but from string that papa got her. I don’t know what she used in the old days.”

Fish traps were often, but not exclusively made by men. According to Barnett (1937:164), men made basket traps in nearly every Oregon Coast tribe, with no reporting for the Coos. There are accounts of women making traps as well, as in Daisy Coddington’s recollection of her mother, Susan Adulsa, making eel traps (Maloney 1934[100]:3). Several accounts depict men making traps, including an Alsea narrative “... he made a fish-basket – a fish-basket for salmon” (Frachtenburg 1917:69). Although they are termed basket traps, these devices were constructed very differently from most of the baskets women typically made, with rigid warp and semi-rigid weft (Chapter 7). Those made for salmon were especially robust, unlike the intricately woven baskets the region is known for (E. Jacobs 1934[121]:17).

There are indications that men typically made harpoons and other specialized fishing equipment. A full discussion of these restrictions is beyond the scope of this study. Yet it is clear that there were gender roles and discrete boundaries in some aspects of fishing tool manufacture and use, but these did not hold under all circumstances.

Making Weirs

As with specific fishing tools, the larger structures used in fishing were apparently built by men in most cases, but women were also involved in some weir construction. Frank Drew, describing the large tidal weir at the mouth of the North Fork Siuslaw, noted that it “was

community work to build weirs – women and men all chipping in to build a weir” (Harrington 1942[24]:727).

There was clearly a range in scale for riverine weirs. One Coquel Thompson account (Harrington 1942[25]:804) of building an upriver salmon weir indicates it takes only two people a day to assemble the structure. Yet in an account he gave Drucker (1934[1]:124) he observed that weirs were “built by communal labor – sections woven by men, under the direction of 2, 3 old men – put in – speared fish when coming up – when they coming back put in basket traps Old people know when it’s time to build this ... doesn’t give orders etc. for it.”

Several of the accounts presented in the first part of this chapter incidentally depict men making weirs. Yet there are no indications that weir building was commonly a gender-specific activity. As with the actual fishing done at these structures (see below), the construction of these larger weirs may have been supervised by community leaders.

Fishing

According to Clara Pearson (E. Jacobs 1934a[106]:5), Tillamook “men did both ocean and river fishing...” and “men did the fishing and hunting, cut firewood, built houses, made canoes and paddles” (E. Jacobs 1934a[106]:148).

Fishing at the larger Oregon Coast weirs was directed by leaders. Frank Drew recalled that “[t]hose who built and ran those weirs (at the North Fork Siuslaw) were old man Pidil and old Dan (Harrington 1942[24]:727). A Hanis Coos Chief supervised the fishing at a Coos Bay weir (Harrington 1942[24]:102). In some cases a shaman was in charge of fishing, particularly during the First Salmon Ceremony (Boas 1923:10). Although some Coquille chiefs did not have to catch their own fish, even shamans had to fish for a living (E. Jacobs 1934[130]).

Other accounts of weir fishing do not specify leadership, but indicate men used weirs. For example, Coquel Thompson noted that “Chinooks (salmon) come in the first run in spring, about in May. The men who fish watch for them. The men go up to where the tidewater goes. They make a dam of rocks, boulders, at a falls” (M. Jacobs 1934[91]:21).

In other cases women and children participated in weir and basket trap fishing. Coquel Thompson recalled that when men have caught fish all night, boys take over the traps during the day (E. Jacobs 1934[120]:72). Jim Buchanon described the diverse makeup of fishers at a tidal weir on the central coast, a “fence ... of any kind of sticks is driven into rivers, and a fish basket blocks the river. Women, boys, and even men go barefooted with sharpened stakes around above the fence, and step on flounders, and stab them and bring up the flounders” (M. Jacobs 1934[91]:14).

Some fishing activities were performed by teams of one man and one woman. Coquel Thompson described coho fishing on the Coquille River, “one man helped by wife set net. They worked all night” (E. Jacobs 1934[116]:94-95). In an 1856 account in *Harpers Magazine*, William Wells (1856:607) described women paddling the canoes and pulling fish from the men’s spears in the torchlight fishing on the lower portion of Coos Bay. Women may have participated in the hook, line and float fishing Wells also described for Coos Bay. Annie Miner Peterson recalled that her mother used to fish this way on Coos Bay, but she was not certain that women fished this way before the settlers arrived (M. Jacobs 1934[96]:112). Frank Drew recalled that men and women both fished with spears at the Siuslaw River (Harrington 1942[23]:464).

Fish Processing

Most accounts indicate women did most of the fish processing on the Oregon Coast. For example, Coquel Thompson explained that “[w]omen cut and smoked fish, that’s their job” (E.

Jacobs 1934[IV]:87). Beverly Ward (1983:27) wrote that on the lower Coquille River “[w]omen tended to the fish” describing the processing of salmon, with children tending the smoking fire. She also explained that women and children processed lamprey (Ward 1983:24). Frank Drew observed that “[w]omen do the (salmon) dressing and butchering after the fish are brought back down to the village” (M. Jacobs 1934[91]:22).

Although slave-holding seems to have been rare on the Oregon Coast, Louis Fuller recounted that among the Salmon River Tillamook, slaves worked for the chief “cutting and drying fish, getting wood, making canoes etc. Chief’s wife did little except make baskets” (Barnett 1934[1]:29).

Chapter Summary

Tidal weir and basket trap fishing was central to Native peoples’ subsistence on much of the Oregon Coast. Other technologies such as nets, harpoons, and hooks were also fundamental, but many of these were most effective when used with weirs. A wide diversity of fishes was harvested with tidal weirs, including species that ran in large numbers during every season. Within the study area, there is far more information on tidal weir fishing for the central and southern Oregon Coast estuaries, from Yaquina Bay to the Coquille River. Tidal weirs may have been more common in these places. But it is also possible that the settings suitable for tidal weir and basket trap fishing were not as common in the northern estuaries. Other technologies may have been more feasible in these tidewater settings.

Upriver weir and basket trap fishing is recounted for nearly the entire study area. These weirs were most often built of wood stakes, with or without lattice, and sometimes they were built of rocks. These weirs were often used with basket traps or other harvesting devices such as gaff

hooks and dip nets. Some basket traps were used without weirs, but usually in settings where river conditions resembled weirs, such as river falls. There may be a gradient of priority for salmon in the north and eel in the south, though this may simply reflect differing knowledge or perspectives of the elders interviewed. In general though, seasonal harvests of anadromous fish at upriver fishing stations apparently provided substantial returns which residents of estuary shores could take home for long term storage.

The processing of fish was done upriver in some cases, but more often at permanent villages within the context of a “commuter economy” in which village catchment included numerous tidal weir stations. Smaller marine fishes accessible in the estuary may also have been more efficiently processed and stored than salmon.

Despite the claims of some ethnographers, Native accounts from the Oregon Coast do not provide a clear picture of fishing site ownership. In many cases it seems to have been the fishing apparatus that was owned, rather than the site itself, which was considered communal property of the village or larger social group. There are few indications that individuals or families recognized rights akin to site ownership. For the northern Oregon Coast, there are no indications that any fishing stations were owned by individuals. Some weirs may have been owned and some not, accounting for the ambiguity in these accounts.

For other parts of the Oregon Coast, there are indications that chiefs owned large non-tidal weir stations in some sense. It may have been that a chief was the only one with enough clout to organize the group effort to build and use the weir. Maintenance of the weir annually in the same location may have led to effective site ownership, but this may have stemmed from ownership of the weir, wealth, and leadership, rather than ownership of the land. In estuary settings above tidewater it appears that ownership of fishing sites was less common. As most tidal weirs were more permanent than non-tidal weirs, ownership of technologies would have

conferred long term access to the site. Yet there are no clear indications that individuals controlled access to tidal weirs.

The accounts that depict gender roles in fishing and related activities are not numerous, and particularly with the social and economic influences of American settlement, generalizations should be made cautiously. Yet it appears that for the Native American peoples of the Oregon Coast, fish harvesting and processing was an activity all members of the community participated in, reflecting the importance of fish in the regional diet. Fishing as an occupation was largely restricted to men, but women often paddled canoes for them, and women, children and the elderly spear-fished for flounder and tended weirs and basket traps in some cases. Men did much of the fishing tool preparation, though women made baskets for gathering and sometimes nets and basket traps. Overall, tidal weir use appears to have been open to able-bodied people, whereas larger riverine weirs were often owned and more heavily controlled.

CHAPTER 4

SITE DISTRIBUTION, CHRONOLOGY, AND FEATURE CHARACTERIZATION

“When I was young you’d still see stakes sticking out of the water at various sloughs remaining from the Indian weirs. Now you can see these stakes no more.”

Coos elder Lottie Jackson Evanoff, as told to John P. Harrington (1942[24]:483).

Intertidal Surveys

During the past decade, the discussion of archaeological fishing weir sites in Oregon estuaries has grown from incidental notation (for the most part) to a key aspect of Oregon Coast archaeology. Between 1993 and 1999 over 70 sites with wood stake weir features were recorded in the region, increasing the number of such sites by over 1000 percent. Some of these sites hold diverse perishable assemblages, with abundant evidence of fishing strategies, and sedimentary profiles that illustrate estuary landscape change. One or more features at most of the sites have now been radiocarbon dated, sedimentary context has been documented in many cases, several stakes have been characterized, and all known features have been examined for evidence of specific weir fishing strategies. Analysis of these widely distributed sites illustrates the central role of the estuary in traditional Native economies through several centuries.

Archaeological weirs in Oregon estuaries have been recognized by Native and non-Native people for generations. Lottie Jackson Evanoff and her husband Alec told Harrington (1942[22]:1036) of the numerous fish fences and salmon traps preserved in the sloughs of Coos Bay and American settlers observed wood stake alignments, describing these as “fish traps” (J. Maloney 1934[98]4; Stafford 1975; Byram 1995b). Yet archaeological investigations of intertidal weir sites were sorely lacking. Of the six recorded sites that clearly contained wood stake weir

features, only one had been mapped (Draper 1982). At the time University of Oregon intertidal surveys began in the 1993, no Oregon Coast weir stakes had been ^{14}C dated, and because they consisted of wooden elements, most were thought to be relatively recent in origin.

I was encouraged to begin a survey of Oregon estuaries by Jon Erlandson and Madonna Moss, who had previously documented weir sites in southeast Alaska with surprising time depth (Moss 1989; Moss et al. 1990). An initial goal of my archaeological research was to determine both the spatial and temporal distribution of weir sites in the study area. In pursuing this goal, I conducted and supervised field surveys in several Oregon Coast estuaries. I also coordinated these surveys with those of Jon Erlandson and Mark Tveskov at Coos Bay, performed in part as research for Tveskov's dissertation on Coos-Coquille history (Tveskov 2000; see also Tveskov and Erlandson 2002).

I chose the tidewater portion of the Siuslaw River as the first location to survey, and scheduled a canoe survey for a minus tide in May 1993. Archaeologists Mark Tveskov, David Powell, and Scott Dano participated in this initial survey, and two sites were identified. The extensive assemblage apparent at one of these, the Half Moon Weir site (35-LA-1104), demonstrated that these sites held important information about fishing practices, woodworking, and related technologies.

The intertidal surveys developed into an aspect of a survey of state lands on the Oregon Coast headed by Moss and Erlandson (1995a, 1996). Over the next three years, I conducted and supervised minus tide surveys in 13 Oregon estuaries, identifying 47 weir sites containing nearly 200 features and thousands of stakes. At some sites woven lattice panels, basketry fragments, stone, wood, and antler tools, and residential debris were identified (Byram 1994, 1995). Funding for these surveys, and subsequent ^{14}C dating, was provided by grants from the State Historic Preservation Office (Erlandson and Moss 1993; Moss and Erlandson 1994, 1995a, 1996;

Erlandson et al. 1999). I also oversaw in-depth site characterization and salvage excavation efforts at the Osprey and Philpott sites on the Coquille Estuary, supported by the Coquille Indian Tribe and the SHPO grants, and at the Ahnkuti site at Yaquina Bay, supported in part by the Confederated Tribes of Siletz (Byram and Erlandson 1996; Byram et al. 1997; Byram 2001; Chapters 5 and 6).

During the late 1990s I conducted weir site surveys as part of a fourth state lands project (Erlandson et al. 1999), with the Confederated Tribes of Siletz, and with the Coquille Indian Tribe Cultural Resources Program. These projects added several weir sites to the inventory, successfully nominated several weir sites to the National Register of Historic Places, and provided key information about weir technology, chronology, and site taphonomy. The Coquille Tribe's 1998-99 project was a particularly extensive, multidisciplinary survey focused on the analysis of eroding riverbank sites and Holocene landscape change in the Coquille Estuary (CITCRP 1999; Byram and Witter 2000; Ivy and Byram 2001; Chapter 5). To date, the Coquille Estuary research represents the most extensive investigation of landscape change and cultural history at an Oregon estuary.

The surveys conducted at Coos Bay by Mark Tveskov and Jon Erlandson of the University of Oregon (Erlandson et al. 1999; Tveskov 2000; Tveskov and Erlandson 2002), added 21 weir sites to the Oregon Coast inventory. Along with the six sites I recorded in this estuary with members of the Coquille Indian Tribe, and the Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw, this makes Coos Bay the estuary with the largest number of recorded weir sites in the region.

Altogether, there are now 72 archaeological weir sites documented in intertidal settings in Oregon estuaries south of the Columbia River. These hold over 250 wood stake alignment features, over 20,000 individual stakes (Figure 20), 29 lattice panels and several scattered

fragments, numerous pieces of worked wood, brush features, fragments of basketry, and associated stone tools and residential debris.

Intertidal surveys were conducted during spring and summer minus tides, when water levels dropped between 0.3 and 0.75 m (1.0 and 2.5 ft.) below mean lower low water, the 0.0 ft. tide level designated by the National Ocean Service (1988). Traditional dry land archaeological survey techniques involving closely spaced transects were generally not used during this survey. Mudflat surfaces are often difficult to traverse, with deep, loose mud and quicksand common in many areas. Fortunately, many weir features are visible from 30 to over 100 meters distance in most intertidal settings, especially with binoculars. With few exceptions (e.g., 35-CS-108), weirs that do not protrude vertically from the mudflat surface are unlikely to be seen by closer observation during surface survey. Therefore, the survey methods employed for this study involved visually scanning mudflats and channel margins from vantage points on shore, pedestrian survey of mudflat surfaces or channel banks, and visual scanning from canoes, kayaks, or motor boats on the water. In most estuaries, a single transect along each shoreline was sufficient to determine whether weirs are exposed along that shore segment. Opportunistic surveys were also conducted in locations where weirs had been observed by individuals such as Donald Ivy, Donald Whereat, Reg Pullen, and Jerry Running Foxe. Because estuaries are sediment traps and continually infilling (despite localized erosion), numerous unrecorded weir features undoubtedly remain buried in the region's tidal wetland sediments.

In this and subsequent chapters, I have decided not to include maps of site locations and specific surveyed areas, with few exceptions. This is because of the particularly fragile condition of exposed perishable artifacts and features at numerous intertidal sites, and the threat posed by recreational visits to these sites. Kayaking and other boating is increasing in Oregon estuaries. The rate of site destruction would greatly increase if site location maps were to be made public



Figure 20: Wooden Weir Stake from Site 35-LA-1104 (showing cut marks and western hemlock bark).

and subsequently published in guide books. Efforts are currently under consideration by the Coquille Tribe and the U.S. Fish and Wildlife Service to provide wetland site interpretation and possibly guided access to specific weir sites in the Coquille Estuary. But without education and supervision, visitors will inadvertently trod on delicate wooden materials exposed at low tide on intertidal surfaces. In cases where site visits are appropriate, weir and lattice features should be viewed from adjacent upland areas or the water (taking care to avoid submerged stakes).

Maps of all surveyed areas and site locations are available to researchers at the State Historic Preservation Office in Salem and the State Museum of Anthropology at the University of Oregon. The numerous reports and articles cited in this chapter and Chapters 5, 6, and 7 provide further information about site locations and survey findings.

Oregon Coast intertidal survey emphasized the portions of estuaries where intertidal areas were most expansive, yet protected from the direct influence of ocean waves. These are generally the middle and lower portions of estuaries characterized by stable, fine-grained mudflat settings. Areas of marine sedimentation were often surveyed, but sites were generally found in areas of predominantly riverine or mixed sedimentation (see Kulm and Byrne 1966). These oxygen-reduced settings are most likely to contain the buried remains of fishing weir features and related assemblages. Exposures such as channel cuts were also given particular attention, as these frequently hold signs of buried intertidal surface sediments (Erlandson and Moss 1999). In most of the estuaries surveyed, access was limited along portions of the shoreline due to conditions such as loose mud or quicksand, and private property and industrial usage restrictions. In many estuaries within the study area, land fill, construction, and dredging have severely modified portions of the intertidal zone. Only cursory survey was conducted in areas that had obviously been heavily impacted.

In some cases the size of an estuary or the expanse of its intertidal flats prevented complete survey. For example, the expansive flats of loose mud in the southern portion of Tillamook Bay were only examined from a distance with binoculars, as pedestrian survey appeared to be impossible in the loose muds of this setting. In each of the northern Oregon Coast estuaries, shorelines were examined from land, and boat surveys were conducted in all but Tillamook Bay and Sand Lake.

Because superficial intertidal sediments are prone to shifting, weir features may be visible during one season and not visible the next. Sites also become visible for a limited period as they are eroded by channel changes. Fortunately for my study, most survey work was conducted during the last two summers of a drought that occurred 1990-1994. By 1995, weir features, lattice, and other associated cultural material had become more difficult to identify on some mudflat surfaces in Oregon estuaries, particularly in the Coquille River. This was largely due to the accumulation on intertidal surfaces of loose, organic-rich sediment deposited during periods of high runoff.

Numerous weir features have been damaged and a number of sites likely lost due to the effects of log rafting and storage, dredging, the snagging of nets during commercial fishing, clam digging, and oyster farming. Waves caused by wind and by boat wakes also destroy features. Most of these impacts have been monitored at various sites, but few instances of ongoing management of sites have shown much success (CITCRP 1999; Byram 2001). There is also a growing threat to weir sites from recreational use of Oregon estuaries. The more people become aware of these sites, the greater these impacts will be, as even foot traffic on a weir site can do damage to features and erode wetland sediments. I hope that the dissemination of this document will help educate land managers and the concerned public about the value of these sites, so local communities and agencies can have a greater role in site protection.

Site Settings, Feature and Artifact Characterization

The 72 recorded Oregon Coast weir sites are located in three of the four estuary settings distinguished in Oregon estuary fish habitat studies (Monaco et al. 1991:312-316). These are subsidiary channels (or tidal slough channels), the edges of mainstem channels, and expansive

tideflats along estuary margins. Archaeological weir features have not (yet) been found extending across the fourth estuary setting, mainstem channels, and although they are observed along main channel margins, many of the structures in this setting are thought to be associated with subsidiary channels.

Most of the features at Oregon Coast weir sites are discrete alignments of stakes (see Figure 1), though in portions of some sites the identification of alignments has been limited by the presence of what appear to be overlapping structures. Lattice fragments (Figure 21), observed at eight weir sites with extensive erosional exposures are interpreted as the remains of either weir panels or basket traps. At some sites, other types of artifacts have been observed on the mudflats near weir features, including residential debris.

In addition to documentation and analysis of surface-collected artifacts, detailed maps have been made at several sites. Eighty-one weir stakes and two lattice elements from Oregon Coast sites have been sampled for ^{14}C dating, documenting at least 3400 years of weir fishing. Several stakes and lattice fragments have also been examined microscopically for botanical identification.

Wood Stake Types

The approximately 250 weir features at Oregon estuary sites contain anywhere from four to several thousand wooden stakes. The buried portion of these stakes is generally well-preserved, as indicated by over 100 stakes collected for ^{14}C dating or other analyses, and many have well-preserved cut marks at their distal ends (Figure 20). Because the upper portion of the stakes has usually been lost to organic decomposition and/or damage from logs or other debris, the original

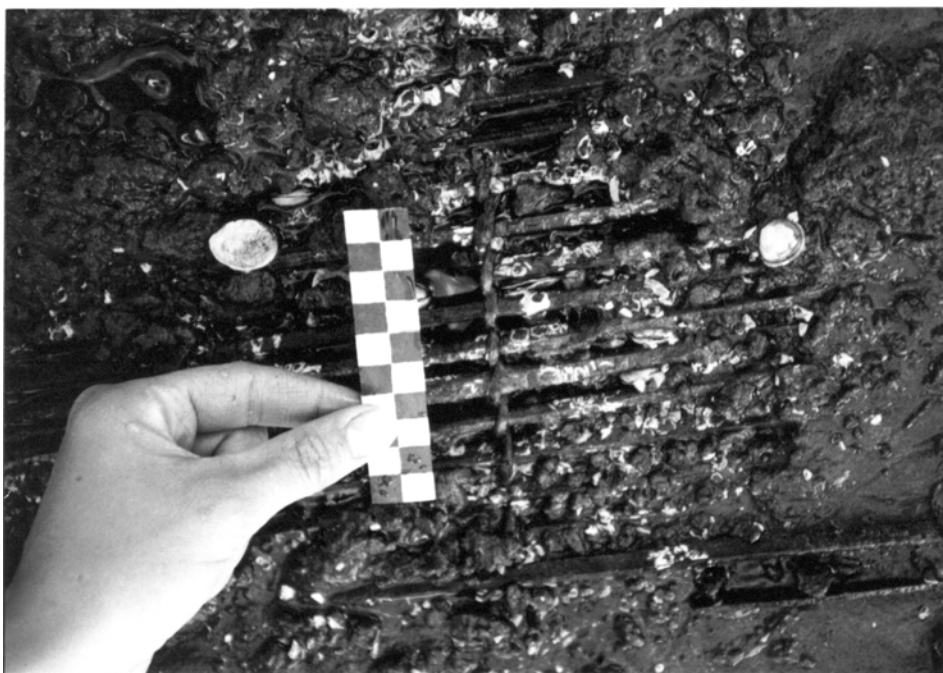


Figure 21: Split Wood Woven Lattice Exposed at Site 35-CS-130 (Feature 6).

height and other characteristics of these proximal ends are uncertain. The thousands of weir stakes preserved in Oregon estuary sites hold evidence of woodworking techniques, showing that plank-making technology and the use of stone tools suitable for intensive chopping have been present for over 3000 years.

Stem Stakes

Stem stakes are whole sections of stems, i.e., branch or trunk sections. They are round in cross section and their exteriors generally retain the outermost growth rings. Many retain well-

preserved bark on buried portions, and in many instances this is recognizable as the bark of western hemlock. Stem stakes observed in weir features range from 1.5 cm to 12 cm in diameter, with most in the 2-4 cm diameter range. The largest are found outside wood stake alignments, and may have served as anchor poles for nets or piling for tying canoes. Branches, or secondary stems, are usually retained on these stakes. The bases of these stakes show signs of having separated from parent stems by bending or by chopping and bending. The distal ends of several stem stakes were carefully sharpened to a point. Proximal ends are generally not preserved, but in one exception (35-CS-1, Feature 3) a proximal stake end showed frayed, battered wood indicating it had been pounded into the mud with a mallet or pile driver. Because stem stakes are less likely to have been “old wood” (see Schiffer 1986) at the time they were incorporated into the feature, stem stakes make up the bulk of wood sampled for ^{14}C dating in the study area.

A variant of stem stakes, brush stakes, are generally small in diameter (< 2 cm) and retain numerous branches, some that may protrude from the mud around the stake. Some have no obvious central stem, appearing as clusters of branches protruding from the surface. Brush stakes that have been sampled show signs of being harvested and shaped with the same techniques used in stem stake production. When placed in the mudflats, these produce more of a brushy barrier rather than a “picket fence”-like structure. In some features, stem stakes may be the lower portions of brush stakes that have become exposed and weathered. Brush stakes are recorded as stem stakes in most site descriptions, as the distinction between these and stem stakes is often arbitrary, and often a consequence of differential preservation.

Although most brush stakes are positioned vertically, in some cases brush stakes are incorporated into weirs horizontally among stem or split wood stakes. Similar tidal weirs from Kwakwaka'wakw territory are described and illustrated by Stewart (1977:107). This may have been more common than represented archaeologically in Oregon estuary sites, as surficial feature

elements do not preserve as well as those more deeply buried at the time of feature construction. In at least one v-shaped weir feature (east area, 35-CS-130), brush stakes became increasingly common moving away from the apex of the V. Many of the brush elements in Oregon Coast weirs retain western hemlock bark. As Coos elder Lottie Jackson Evanoff recalled, “hemlock sinks, and Indian fish fences were made of hemlock brush” (Harrington 1942[22]:1036). Elsewhere she observed that “[h]emlock brush was tied together when made into a weir (Harrington 1942[24]:700). Because they are more difficult to sample for conventional ^{14}C dating than stem stakes, fewer brush stakes have been collected.

Split Wood Stakes

These stakes are split from larger pieces of wood such as planks or logs, and more rarely from small to mid-sized branch and trunk stem sections. These are usually rectilinear in cross section, though not often rectangular, which facilitates distinguishing these from milled wood stakes. They range in diameter from 2 cm x 2 cm to 8 cm x 15 cm, and they are typically placed so the broadest dimension is perpendicular to the direction of the weir line. Split wood stakes average 2 cm x 4 cm in many sites, and they are often found interspersed with stem stakes. Outer wood is rarely found on these, and none are known to retain bark. Because these stakes are more likely to have been split from the interior wood of large trees or drift logs, they are subject to the “old wood” problem, and few have been ^{14}C dated. As few have been sampled, patterns of distal end modification are not as well known for this stake type. However, those examined show signs of being segmented through chopping, chopping and bending, and splitting to a thin taper. I have not observed any with preserved proximal ends.

Milled Wood Stakes

Sawmills were established in portions of the study area between the 1850s and 1890s. Prior to this development, milled wood was available only as an import product, as driftwood, and as salvage from shipwrecks, probably not in quantities sufficient for regular use in weirs. Weir features at two sites (35-LA-1103 and 35-LA-1108) clearly hold stakes of milled lumber, often split and chopped. One site (35-CS-133) appears to have milled shakes among its split wood stakes. At 35-LA-1108 the wood is preserved well enough to show arced saw marks from a small diameter circular saw blade. Features with milled wood appear to have been built much like earlier weirs, although 35-LA-1103, the Picket Fence site, has a rectangular box of stakes at the apex of the V. This site may have been used for commercial salmon fishing associated with canneries at the Siuslaw Estuary during the late 1800s. Distinctive patterns of cut marks have been identified at several Siuslaw sites (see Siuslaw survey results, this chapter) containing milled wood stakes and other types of stakes, indicating changes in woodworking techniques related to the incorporation of western industrial technology in this locality.

Archaeological Weir Feature Types

A flexible typology that accounts for variation in archaeological weirs is applied to Oregon Coast survey and site characterization data. My typology is based on the Oregon Coast archaeological weirs and their settings, as well as ethnographic and ethnohistoric accounts of weirs in this region and elsewhere on the Northwest Coast and in northwest California. To be useful for archaeological research, this typology is based on characteristics observable under conditions of variable preservation. The foundation of the weir—whether wood, stone, or other material—most often survives in the archaeological record. Therefore, variability in the

configuration of an alignment of weir stakes in relation to the local environment is an attribute that will likely be present at nearly all weir sites.

Based on the variation in ethnographic weirs, there are two contextual factors that may determine archaeological weir classification (Figure 22). The first is tidal hydrology; weirs are either tidal or non-tidal, functioning with or without tidal action. Most extant archaeological weirs are preserved in intertidal settings, and unless they appear to have been very large structures that blocked fish passage during both high and low tide, these archaeological weirs may be designated tidal weirs. The second factor is the configuration of the weir in relation to site topography, including drainage basin and landform characteristics. *Cross-channel tidal weirs* are the most widely reported ethnographic type, and these can be identified archaeologically by the presence of wood stake alignments oriented at angles oblique or perpendicular to tidal channels. Extensive stake alignments on tideflats are classified as *tideflat weirs*, which are also identified ethnographically. Those weir features occurring on flats near channels may be designated tidal weirs of indeterminate type. Weirs occurring along the banks of large, deep river channels may be classified as *channel edge weirs*, a type that may or may not have been used in the region historically. Because in-filling is an ongoing process in estuaries, stratigraphic analysis may be necessary to distinguish between cross-channel tidal weirs and channel edge weirs in riverbank levee settings (see Chapter 5).

Elsewhere weirs have been classified according to their shape or outline in plan view. Examples include “V-shaped weirs” (Byram and Tveskov 1994) “chevron weirs” (Langdon et al. 1995), and double leads with heart-shaped enclosures (Mobley and McCallum 2001). My analysis indicates that weir shape is a useful attribute for classification, but primarily when it is related to weir setting. Weirs are not always built in a particular shape for the same reason. For example, Kroeber and Barrett (1960:13) suggested that the Kepele weir was V-shaped to give it strength in

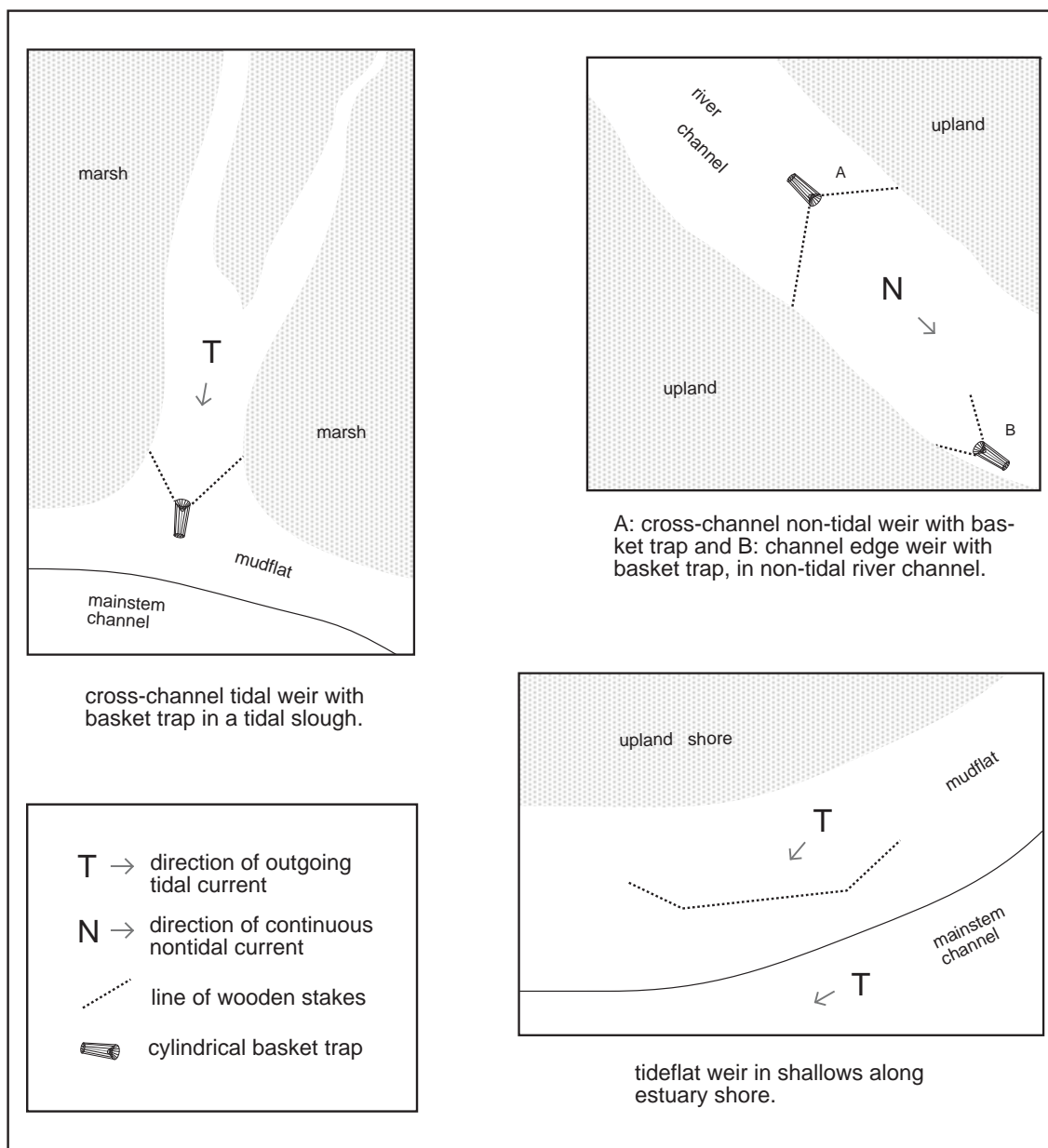


Figure 22: Estuary Weir Types Discussed in Chapter 4. (Panel enclosures, dip nets, and other devices were likely used in place of basket traps in many cases.)

the heavy current of the Klamath River, whereas Hewes (1947: Figures 1, 5, 13) illustrated weirs that were V-shaped to guide fish toward a trap or a net at the apex of the V, as is often indicated in Oregon Coast ethnographic accounts. There are considerable differences in fish habitat and fish populations between estuarine and riverine, and tidal and non-tidal settings, and much variation within these settings. Thus, whether a weir is linear or curvilinear, or of single or multiple lines of stakes, its configuration in relation to surrounding topography, hydrology, and ecology most conditions its use. Because biological populations have drastically changed historically (Chapter 2), only the first two of these contextual factors is used here for classification.

The configuration and setting typology I use is far less varied than the ethnographic weir types documented (Chapter 3), but it characterizes the general patterns in weir use indicated in historic accounts. Further examination of weir construction and associated artifacts and sediments will likely reveal more specific types among the archaeological features I have documented.

Documentation of weir feature characteristics has varied according to the degree of feature preservation and exposure in sediments and within the intertidal zone, the extent of opportunities for sedimentary analysis (such as eroding channel banks), the number and timing of site visits, and the techniques used during the survey. Surveys identified tidal weirs in subsidiary tidal channels, on tideflats, along the banks of tidal rivers, and in deltaic or braided tidal channels. In most cases the structures are thought to be only partially exposed or preserved. Only minimal subsurface probing has been done at most sites to determine whether other feature elements remain buried.

Field documentation techniques included the use of line tapes for feature measurement, scale photography and video for measurement checks in the lab, use of calipers to measure stake thickness, and transit, GPS, and EDM mapping. Sampling of stakes was done through excavation

by hand, as mudflat sediments are normally quite loose. Very few features were excavated with traditional techniques, although erosional exposures were sometimes documented as profile units. Excavated perishables were sealed in polyethylene containers and kept wet until they could be sampled for analysis or prepared for conservation.

Associated Artifacts and Features

Worked wood is abundant in Oregon Coast weir sites. Many stakes show evidence of modification through chopping, and occasional wood chips are identified at sites, though none have been shown to be contemporary with the weirs. Woodworking tools have also been identified at or near weir sites (Chapters 5 and 6, CITCRP 1999). Split wood woven lattice fragments and panels are relatively common at certain sites where erosion is ongoing (Chapter 7). Lattice was documented with scale photography, and measured and described in the field as well as the lab. Several pieces were collected, analyzed in the lab, and conserved. Other botanical materials at sites include channel floor litter such as bark, leaves, and conifer needles eroding at or near weir feature exposures. These organic debris hold enormous potential for paleoecological studies, and at some sites it may be possible to trace changes in channel floor configuration by examining these debris layers.

Stone tools and residential debris were also documented at or near weir sites. These range from isolated bifaces and flake tools to dense layers of eroded stone tools, burned rock, and flakes. Fish bone is common at these residential sites near weir fishing stations (Tveskov 2000). Although botanical remains are abundant at weir sites, remaining well-preserved in the acidic, oxygen-reduced sediments, faunal remains are relatively rare. There are no known instances of targeted fish remains found preserved among weir or lattice features. However, barnacles are

preserved on many features and stake segments, and strata of benthic fauna, including various bay mussels, clams, and crabs, are often abundant in site sediments. While many of these appear to be natural in origin, several sites contain faunal remains that may be contemporary with or older than nearby weir features.

Survey Results

Characteristics of each of the 72 recorded Oregon Coast weir sites are summarized in Table 5. Site settings include subsidiary channels, mainstem channel edges, deltaic marsh channels, and tideflats. These divisions are based on the classifications made by biological researchers for fish habitat (see Chapter 2). The estimated position of features within the intertidal zone, for the purposes of this study, is defined as below -2 ft. for sub-tidal range; -2 to -1 ft. for extreme lower low water; -1 to +1 ft for mean lower low water; and 1.5 ft. for mean water level. This delineation corresponds roughly to tidal datum reporting established by the National Ocean Service (1988) for Oregon estuaries. For example, tidal datum elevations for the Coquille Estuary at Bandon, Oregon show Mean Higher High Water (MHHW) at 7.04 feet, Mean High Water (MHW) at 6.39 feet, Mean Tide Level (MTL) at 3.77 feet, the National Geodetic Vertical Datum – 1929 (NGVD) at 3.69 feet, Mean Low Water (MLW) at 1.15 feet, and Mean Lower Low Water (MLLW) at 0.00 feet.

The estimated period of site use is based on ^{14}C dates, historical accounts of site use, and the presence of milled wood. Weir feature description emphasizes configuration, size, feature composition, and relationship to channels present. Inferred weir types are based on configuration in relation to setting, along with ethnographic comparisons. For the feature tabulation the site is the unit of analysis in most cases. Because weir types relate closely to setting, they are generally

Table 5: Characteristics of 72 Oregon Coast Weir Sites.

Site #	Modern Setting ¹	Intertidal Position ²	Age (cal BP)	Weir Feature Length and Configuration ³	Inferred Weir Types ⁴	Stake Types, Diameter, Density ⁵	Associated Artifacts, & Features; Comments ⁶
NEHALEM							
TI-71	channel edge	≤MLW	post-1850	1 line perpendicular to main channel, 9m	XC non-tidal or channel edge	58 split stakes (8-15 cm) spaced 16/m, axe cut	several historic structures nearby
NETARTS							
TI-64	tideflat	MLW	post - 250 BP	1 widely arced line, open to shore, 30m	tideflat	18 large (3-12 cm) split stakes	
TI-68	subsidiary channel	>MLW	500-250 BP	1 line in small channel, <2m	insufficient data	4 split stakes	burned cobble feature; this may be an upland feature (non-weir).
TI-69	"	MLW	unknown	1 line, arc-shaped, open to shore, 2 lines of rocks	XC tidal	37 stem and split stakes (5-15+ cm)	rocks may be weirs, or related to nearby road construction.
TI-70	channel edge	MLW	unknown	1 L-shaped line open to shore, ~7 m	holding pen or crab fence?	~50 split stakes (~5 cm) spaced 15-25 cm apart	partly buried by road; possible holding pen or crab fence.
YAQUINA							
LNC-76	subsidiary channel	ST-≤MLLW	2100-350 BP	>25 lines oblique & perpendicular to channel, 1-25 m	XC tidal	100s of stem, split, brush stakes (2+ cm)	lattice, stone tools, post-1870 midden; 3 vertical weir strata
LNC-77	" channel	≤MLLW	2100-1900 BP	2 lines, 2 m and 3 m oblique to channel	XC tidal	16-20 stem stakes (2-3 cm)	heavy siltation may cloak more features. Lines may form V feature
LNC-78	subsidiary channel	≤MLLW	2350-2100 BP	2 converging lines <2m oblique to channel	XC tidal	18 stem stakes (2-3 cm)	oldest weir in study area outside Coquille. Lines likely transposed.
LNC-81	"	ST	1900-1750 BP	1 line perpendicular to channel, 2 m+	XC tidal	6+ stem stakes (2-4 cm)	channel seems to have changed configuration since use.
LNC-82	channel edge	ELLW-MLLW	900-750 BP	1 line oblique to channel at edge	XC tidal or channel edge	10+ stem stakes (4-6 cm) spaced 15-30 cm	

Site #	Modern Setting ¹	Intertidal Position ²	Age (cal BP)	Weir Feature Length and Configuration ³	Inferred Weir Types ⁴	Stake Types, Diameter, Density ⁵	Associated Artifacts, & Features; Comments ⁶
LNC-83	subsidiary channel	MLLW-MLW	<250 BP	0.8 m diffuse line 3.5 m oblique to channel	XC tidal	~10 branching stems (1.5-3.5 cm)	split wood lattice warp among stakes, and bundled split root.
LNC-84	subsidiary channel	≤MLLW	<250 BP	1 line of 2 m, perpendicular to channel	XC tidal	10 branching stems, (2-5 cm)	
LNC-85	subsidiary channels	MLW	1200-950 BP	3 loci of features oblique to small channel mouths	XC tidal or channel edge	stem and split stakes (2-10 cm)	extensive lattice fragments, few clear alignments; basket trap stations?
Rac-2	subsidiary channel	ELLW-MLLW	unknown	1 line of brush oblique to channel	XC tidal	<10 branching stem stakes	lattice in feature
Rac-3	"	ELLW-MLLW	unknown	several stakes in bank no obvious alignments	XC tidal	stemstakes (2-3 cm) split stakes (3-6 cm)	stratigraphically beneath forested bank
Rac-4	"	ELLW-MLW	unknown	1 line >3 m perpendicular to channel	XC tidal	split stakes (4-7 cm) spacing (5-10 cm)	
Rac-5	"	≤MLLW	unknown	2 parallel lines perpendicular to channel	XC tidal	one line stems (2-3 cm) one line split stakes	exposed at opposite edges of marsh bank in bend of slough
Rac-W	"	≤MLLW	unknown	1 line, 2 m perpendicular to channel	XC tidal	stem stakes (3-8 cm) spaced (3-4 cm)	
SIUSLAW							
LA-1101	"	MLLW-MLW	<400 BP	5 parallel lines, 2-10m, oblique to channel	XC tidal	stem and split stakes (2-5 cm)	may be arms of 5 V-shaped weirs; located below 1 st side channel
LA-1102	"	MLLW-MLW	unknown	3 parallel lines perpendicular to channel, 5-11m	XC tidal	stem and split stakes, (2-5 cm)	channel has been deepened by dredging, was more shallow.
LA-1103	"	ELLW-MLLW	post-1876	single V- weir of two 40m converging arms and box	XC tidal	>200 split boards and stems (3-10 cm)	well preserved; highest vertical stake length (0.4 to 1m)
LA-1104	"	ST-MLLW	<250 BP; ~1880s	numerous transposed lines up to 30m, V shape	XC tidal	>1500 stems & split split stakes (1.5-5 cm)	stake density higher below surface; some cut marks like LA-1103 stks
LA-1105	channel edge	ST-MLLW	900-750 BP	70m arced line open to shore, in 3 segments	XC tidal or channel edge	> 25 stem stakes (2-3 cm)	only known Siuslaw weir over 300 years old
LA-1106	subsidiary channel	≤MLLW	unknown	1 line perpendicular to main channel	XC tidal or channel edge	15 stem stakes (2-3 cm) spaced 2-3/m	cut marks like LA-1103 stakes
LA-1107	channel edge	≤MLLW	unknown	nonlinear concentration	uncertain	stems and possible split stakes	

Site #	Modern Setting ¹	Intertidal Position ²	Age (cal BP)	Weir Feature Length and Configuration ³	Inferred Weir Types ⁴	Stake Types, Diameter, Density ⁵	Associated Artifacts, & Features; Comments ⁶
LA-1108	open marsh channel	≤MLLW	post-1876	1 line, relationship to channel uncertain	uncertain	split boards (3-4 cm)	crosses marsh channel, but channel may be recent; saw marks on stakes
LA-1224	subsidiary channel	≤MLLW	post-1876	4 parallel lines, perpendicular to channel, 5-15m	XC tidal	split, boards, and stem stakes (3-5 cm)	channel shift tied to weir setting; cut marks like LA-1103 stakes
LA-1225	"	≤MLLW	through 1880s	2 converging lines, 5-20m	XC tidal	13+ stem stakes, (5-7 cm)	extensive sediment accumulation; historic accounts of use in 1870s
COOS BAY							
CS-122	"	ST-MLW	<250 BP	2 parallel lines oblique to channel, 60 & 90 m	channel edge or XC tidal	>200 stems and split stakes (1.5-10cm)	scattered burned rock
CS-123	"	MLLW-MLW	<250 BP	2 parallel lines perpendicular to channel, 15-20m	XC tidal	>300 densely packed stem and split stakes	
CS-124	tideflat & channel	≤MLLW	<250 BP	2 parallel lines oblique to channel, 140 m	XC tidal or tideflat	stem and split stakes, 2-10 stakes/m	buried horizontal elements appear to be brush and stakes
CS-125	tideflat	MLLW-MLW	400-250 BP	2 groups of 6 & 4 lines, parallel and oblique	tideflat	>300 stem and split stakes	buried between 1993-97
CS-126	"	≤MLLW	400-250 BP	1 line parallel to channel approx. 100m	tideflat	~100 split stakes	two nearby clusters of stakes indicate other buried features
CS-127	"	≤MLLW	unknown	3 oblique, 1 parallel lines to 100 m	tideflat	stem stakes (2-4 cm)	
CS-128	"	≤MLLW	<250 BP	5+ main lines parallel & oblique to channel, 45-90m	tideflat	stem and split stakes (2-10 cm)	"wing" lines may be stations for portable traps
CS-132	subsidiary channel	≤MLLW	<300 BP	2 converging lines oblique to channel, 15-20m long	XC tidal or channel edge	stems and split stakes (8-10/m)	at confluence with small side channel
CS-133	"	ST-MLLW	post-1860	2 converging lines to 80m form V across channel	XC tidal	stems and split stakes, shake	at confluence with small side channel
CS-134	"	MLLW-MLW	<250 BP	2 converging lines 15m long, forming V	XC tidal or channel edge	stems and split stakes, spaced 12/m	at confluence with small side channel
CS-143	"	≤MLLW	<250 BP	3 parallel lines, oblique to channel	XC tidal	split stakes (2-3 cm)	

Site #	Modern Setting ¹	Intertidal Position ²	Age (cal BP)	Weir Feature Length and Configuration ³	Inferred Weir Types ⁴	Stake Types, Diameter, Density ⁵	Associated Artifacts, & Features; Comments ⁶
CS-144	subsidiary channel	≤MLLW	<250 BP	2 parallel lines oblique to channel, 8 m	XC tidal	split stakes with few stems (2-3 cm)	
CS-145	"	≤MLLW	unknown	1 ephemeral line of 10 m, oblique to channel	XC tidal	stem stakes	
CS-149	channel edge	≤MLLW-MLW	unknown	1 line perpendicular to main inlet channel, 2 m	channel edge	7-8 stem stakes (2-4 cm) spaced 15-20 cm	large portion may be buried.
CS-150	"	≤MLLW	950- <250 BP	3 parallel lines oblique to channel, 40-50 m	channel edge	>300 stems and split spaced 5 to 20/m	three temporal components in single location
CS-151	subsidiary channel	≤MLLW	unknown	3 m line or cluster, oblique to channel	XC tidal	12 stem stakes and brush	
CS-152	"	ST to MLLW	650-550 BP	2 lines of 1.5 & 1 m, oblique to channel	XC tidal	~35 stems and 12 split staves, spaced 2-15 cm	two components in single location
CS-153	tideflat	≤MLLW	<250 BP	1 line of 160m parallel to channel, on flat	tideflat	mostly stem, some split, spaced 5-30 cm	brush may be woven among stakes in places
CS-154	subsidiary channel	≤MLLW	unknown	1 line 60m, parallel; 2 lines 10 m perpendicular to channel	uncertain	>50 stems (2-4 cm) spaced 5-30 cm	
CS-155	tideflat	≤MLLW	unknown	2 parallel lines, 25 m and 150 m	tideflat	1000s of mostly stem stakes, spaced 5-20 cm	
CS-156	subsidiary channel	≤MLLW	unknown	parallel lines	XC tidal	>20 stem stakes spaced 15-20 cm	
CS-157	"	ELLW	unknown	1 cluster at channel edge	XC tidal or tideflat	10 stem stakes spaced 5-20 cm	
CS-162	deltaic chan. edge	MLLW-MLW	400 to <250 BP	9 lines oblique to channel 1-20 m	XC tidal & possible chan. edge	stem stakes (2-4 cm)	on mudflat and in marsh channels
CS-163	deltaic channel	ELLW-MLLW	500 to 250 BP	3 lines oblique to channel 2 m	XC tidal & possible chan. edge	<20 stem stakes (2-4 cm)	
CS-164	channel edge	ELLW-MLLW	900-700 BP	5 crossing lines at various angles, 3-7 m	XC tidal or channel edge	> 100 stem and split, (1.5-3 cm)	

Site #	Modern Setting ¹	Intertidal Position ²	Age (cal BP)	Weir Feature Length and Configuration ³	Inferred Weir Types ⁴	Stake Types, Diameter, Density ⁵	Associated Artifacts, & Features; Comments ⁶
CS-165	subsidiary channel	MLLW	unknown	3 parallel lines oblique to channel 4-6 m	XC tidal	> 100 stem and split (2-3 cm) spaced <20/m	
CS-166	delta marsh channel	ELLW	<250 BP	1 line oblique to channel	XC tidal	~ 10 stem stakes, (2-3 cm)	
COQUILLE							
CS-1	channel	ELLW-MLLW	900-700 BP	3 lines perpendicular to channel 3-(20) m	XC tidal & possible chan. edge	< 80 stem and split, (1.5-4 cm) spaced <20/m	stratified beneath upland sedim. and midden.
CS-17	"	MLLW	800-650 BP	1 line perpendicular to channel 2 m	XC tidal or channel edge	<20 stems (2-3 cm) spaced 12/m	lattice at same strat. level, midden above this level
CS-97	"	ST - MLLW	1250-650 BP	28 oblique and perpendicular to channel, to 32 m	XC tidal or channel edge	>500 mostly stems, (2-6 cm) spaced 3-15/m	stratified beneath upland sedim. and midden.
CS-108	"	MLLW	900-650 BP	3 parallel lines oblique to channel, 2-5 m	XC tidal or channel edge	~40 stems (2-4 cm)	stratified beneath upland strata and midden.
CS-109	"	ELLW-MLLW	n/a	2 clusters of stakes, not mapped	unknown	unknown	weirs not described in site record
CS-116	subsidiary channel	MLLW	750-550 BP	one line oblique to channel 1 m	XC tidal	6 stems (2-4 cm) spaced 6/m	
CS-118	tideflat	MLLW-MLW	unknown	5 lines in meander channel on tideflat, 2-10 m	XC tidal or tideflat	> 60 stem stakes (3-5 cm)	
CS-130	channel edge	ST-MLLW	900-<250 BP	40 lines, V shaped oblique & perpendicular to channel 1-18 m	XC tidal & channel edge?	>2000 stems & split (2-12cm) spaced 3-20/m.	14 lattice panel fragments and basketry
CS-146	"	MLLW	unknown	2 perpendicular lines, large 1 parallel to mainstem 4-15 m	unknown	stems (3-6 cm) spaced 2-3/m	may be a non-weir structure
CS-147	subsidiary channel	ELLW-MLLW	unknown	3 lines oblique to channel 3-12 m	XC tidal or tideflat	mostly stems (2-6 cm) spaced 2-10/m	
CS-148	subsidiary channel	MLLW	unknown	1 line perpendicular to channel <1 m	small trap or holding pen?	5 split stakes (1 cm)	split root woven between stakes loosely resembles lattice.
CS-159	channel edge	ELLW-MLLW	950-750 BP	9 lines oblique to channel 2-10 m	XC tidal or channel edge	stem and split stakes (2-6 cm), spaced 2-10/m	mostly small exposures in steep bank

Site #	Modern Setting ¹	Intertidal Position ²	Age (cal BP)	Weir Feature Length and Configuration ³	Inferred Weir Types ⁴	Stake Types, Diameter, Density ⁵	Associated Artifacts, & Features; Comments ⁶
CS-160	"	ST-MLLW	1100-800 BP	10 lines oblique to channel 1-5 m	XC tidal or channel edge	mostly stem stakes (2-5 cm), spaced 5-10/m	small exposures in steep bank
CS-167	subsidiary channel	ST-ELLW	3450-3250 BP	2 perpendicular lines in narrow channel, 1 m, 4 m	XC tidal	split and stem stakes (2-10 cm), spaced 7-15/m	
CS-168	channel edge	ELLW-MLLW	900-750 BP	2 parallel lines oblique to channel, 3 m, 4 m	XC tidal or channel edge	stem stakes (3-4 cm) spaced up to 8/m	
CS-170	subsidiary channel	ST-ELLW	3400-3250 BP	1 line oblique to narrow tidal channel, 5 m	XC tidal	stem and split stakes (3-8 cm), spaced 4-6/m	
CS-176	channel edge	ST-ELLW	950-800 BP	5 parallel lines, oblique to channel, 2-10 m	XC tidal or channel edge	stem stakes (3-7 cm) spaced 2-8/m	

Notes to Table 5

1. intertidal setting; subsidiary channel, tideflat, channel edge, deltaic marsh channel

2. refers to vertical position of the exposed elements within the intertidal zone (estimated based on water levels during minus tide surveys).

ST = subtidal; ELLW = extreme lower low water; MLLW = mean lower low water; MLW = mean low water; MW = mean water

3. length varies year to year based on erosion and sedimentation, and has not been recorded for all sites and features.

4. weir features types: cross-channel tidal (or XC tidal), tideflat, channel edge (or chan. edge).

5. stake types = stem, brush, split wood, milled wood (boards); stake diameter in parentheses

6. associated artifacts: lattice, stone tools, residential midden stratum, etc.

interpreted to be the same throughout a site, with few exceptions. In some cases both cross-channel tidal weirs and channel edge weirs may be present at the same site, but sites with tideflat weirs are exclusive of these because the other two types of features are only present in tidal channels. Characteristics and numbers of weir stakes have not been recorded in the same way at each site, and are often limited by surface conditions and access, but this information includes stake types, and their size and quantity. Lastly, associations include lattice, other artifacts such as stone tools, non-weir features such as middens, and other relevant information about the site.

Summary of Survey Findings for Each Estuary

Nehalem Bay

Nehalem Bay is the northernmost estuary on the outer coast where weir site survey took place. Woodward (1986:221) had previously established that perishable botanical artifacts were preserved in the saturated portions of 35-TI-4. Approximately 10.5 river kilometers were surveyed in the Nehalem Estuary during two separate visits in 1994 and 1995. In the lower estuary, a canoe survey covered the shorelines from the Wheeler Boat Ramp to a point 1 km south of the Nehalem State Park Boat Ramp. Here the bay shore consists of salt marshes and expansive tideflats along the north shore, and a narrow strip of tideflat and cut bank on the south shore. One tideflat at river mile 3 on the north bank, adjacent to the state park, is so extensive that it was surveyed from the southern edge with binoculars.

A shoreline pedestrian survey was performed at accessible points in 1995, covering about 3 km of the eastern bay shore and on both east and west shores above Wheeler. A single possible weir site (35-TI-71) was identified south of the U.S. Highway 101 bridge near the town of Manzanita. This feature was mapped and a stake was collected for ^{14}C dating (dated to <300 BP).

There may be numerous weir features buried under sediments deposited in the Nehalem Estuary since the 1930s and 1940s, when large forest fires in the area brought massive amounts of sediment into the tidal wetlands (Schultz 1990:167-168). As noted in Chapter 3, however, there are few ethnographic accounts of tidal weir use on the northern Oregon Coast.

In general, the upper estuary environment, above Wheeler, is quite different from the lower bay, and only a narrow strip of mudflat exists along the edge of the tidewater riverbank. Agricultural and residential development is extensive in this upper portion of the estuary, and associated cutting and filling may have impacted sites in the intertidal zone.

Tillamook Bay

Although Tillamook Bay is the second largest estuary in the study area, a substantial portion (50%) of its intertidal area consists of vast mudflats exposed during mean low water. The bay's intertidal area was apparently much larger in the past, but sediments have been swept into the estuary by upland erosion stemming from the massive Tillamook forest fires of the 1930s and 1940s (Schultz 1990:167).

An opportunistic roadway survey was conducted along the east shore from Bay City to Garibaldi, and a pedestrian survey was conducted from Bay City to Kilchis Point. Over this entire portion of the bay, extensive tideflats extend from the shore towards the center of the bay at low tide. Much of this area is mudflat, though a wide strip along the bay shore consists of rock or firm rocky soil from local erosion. No cultural features were observed along the east shore of the bay.

Binocular survey was performed along the south shore of the estuary at accessible points along Bayocean Road. The southwestern margin of the bay consists of extensive mudflats cut by meandering channels. Here large shoals of mud are deeply incised, indicating sediments had accumulated, most likely residual from flood deposits subsequent to the forest fires of the 1930s

and 1940s. Local residents reported weirs in the bay, but these were not located. Unsurveyed areas remaining that could contain visible weir features include the tidewater portions of the Wilson, Trask, and Tillamook rivers. A large portion of the estuary remains to be surveyed, but much may remain inaccessible until techniques allow traversing expanses of loose mud during low tide.

Netarts Bay

Netarts Bay is smaller than Tillamook, and though it has a similarly expansive intertidal zone (65% exposed at mean low water), it is fed by an unusually small drainage basin and lacks large tributary streams. Because of the large size of the Netarts tideflats, a 1994 canoe survey during lower low water was limited to the northern third of the bay. The bay was also surveyed with two other techniques. The east shore was visually scanned with binoculars from vantage points along Whiskey Creek Road. With this technique two weir sites were identified (35-CS-69 and 35-TI-70). Repeated pedestrian surveys also took place along the inside of Netarts Spit, where Erlandson recorded site 35-TI-64 (Moss and Erlandson 1995) and I identified site 35-TI-68. Two of the four recorded sites appear to be recent, and the two others have been ^{14}C dated to less than 400 BP.

Sand Lake

This small, ephemeral estuary is almost entirely intertidal, and drains a small basin. Only a small set of narrow tidal channels remain submerged at low tide. Because of the high elevation of its floor relative to mean tide level, perishable artifacts such as wooden weir stakes would not likely remain preserved for long in this setting. Furthermore, the sediments in this estuary seems to consist primarily of coarse sand, of a grain size comparable to outer coast dune or beach sand.

This sediment is less conducive to the development of anaerobic conditions at shallow depths than fine, riverine sediments deposited by gentle tidal currents.

A brief survey of the central portion of Sand Lake was conducted in 1994 to assess its condition. Surveying the perimeter of Whalen Island on foot, with the use of binoculars, I found no weirs, and no settings likely to contain such features at or near the surface. However, more fine-grained wetland sediments may exist beneath these marine sediments.

Nestucca Bay

Nestucca Bay is comparable in size to Sand Lake, but not as shallow. I surveyed the bay in May of 1994 by canoe, along road margins, and on foot. Scans of the entire lower bay shore were achieved, between Pacific City, the estuary mouth, and the U.S. Highway 101 bridge. This included 5.5 kilometers along each bank of the estuary. As observed at Sand Lake, the sediments here are quite sandy, and they appear to shift frequently due to the actions of waves and current. This may also be a poor environment for weir stake preservation. However, there are other areas upstream from the surveyed portions of this estuary that may contain weir features. Shifts in sands could also reveal buried sediments in the middle and lower estuary that are more fine grained, holding intertidal weir features.

Salmon River

The Salmon River reaches the Pacific Ocean at the southern edge of the large landform known as Cascade Head. It forms a small estuary 4-5 km long. In 1994 a crew of University of Oregon students surveyed this estuary, paying special attention to two locations of possible weir features identified on a USGS map provided by Le Gilsen, SHPO archaeologist. The surveyors identified no weir sites.

Siletz Bay

Siletz Bay lies at the mouth of Siletz River. A narrow sand spit separates Siletz Bay from the Pacific Ocean. Survey of this estuary in 1995 found indications that the spit had been breached by the ocean at times in the past (see McDowell 1987:546; Komar 1997:104). Large drift timbers, root wads, and beach gravels and cobbles up to fist size were present along the east shore of the bay. Canoe survey took place in one portion of the bay containing salt marsh and less rocky mud flats, from the mouth of Siletz River north to Anderson Creek. The tidal portions of Siletz River and Schooner Creek were not surveyed, but kayak survey did take place in Kernville Slough, south of Siletz River. Although no weirs were identified, a line of branching *Tsuga* stakes was found in the upper portion of an agricultural dike, along with some larger split timbers bearing saw marks. One of the stakes in this line was removed and examined, and found to have cut marks resembling many weir stakes. It is possible that this feature represents a transfer of technology from fishing to agricultural purposes, possibly during or after the years this was part of the Coast Reservation.

Yaquina Bay

Extensive surveys of the intertidal margins of Yaquina Bay were conducted on three separate occasions, and 13 weir sites containing over 40 features were recorded. In January, 1994, the Ahnkuti site (35-LNC-76) was identified during a road survey, involving the use of binoculars at points of visibility from the roadway. This survey also encompassed the entire north shore of the estuary from Toledo westward to Newport. No weir sites were identified on the north shore, but cultural material was recorded at Coquille Point, east of Newport. Several tidal sloughs were observed on the north shore, and identified as suitable settings for weir use. However,

construction of a railway and road along this shoreline, as well as diking and draining, appeared to have silted in most of the lower intertidal portion of these sloughs. Survey along the south shore was conducted from Toledo west to Oysterville. Only the Ahnkuti site was identified. Due to its rapid erosion, it was revisited several times and extensively documented (see Chapter 6). It is among the Oregon Coast weir sites now listed on the National Register of Historic Places (Erlandson et al. 1999). Chapter 6 presents a detailed analysis of the Ahnkuti site.

Surveys were conducted on foot along portions of the south shore in 1995, yielding evidence of two more sites. Site 35-LNC-77 was identified by Robert Kentta in a slough, or subsidiary channel, west of the Ahnkuti site, and I recorded 35-LNC-78 in a slough farther upriver. Site 35-LNC-78 was ^{14}C dated to about ~2300 BP, the oldest known fishing weir on the Oregon Coast at the time. The inference that the features at 35-CS-78 are cross-channel tidal weirs is due to the orientation and setting of these features at the mouth of the creek.

35-LNC-78 has also been nominated to and listed on the National Register of Historic Places (Erlandson et al. 1999). The physical features at this site are not outstanding in comparison with other weir sites of the Oregon Coast, yet research involving these two Yaquina Bay sites established that weir fishing technology of nearly 2500 years ago was comparable in form to that of more recent centuries.

In 1996, surveys were conducted in the tidal channels west of Oysterville, and five additional weir sites were recorded. Sites 35-LNC-83 and 35-LNC-84 are located in the lower, northern portion of a long tidal channel that drains a large basin south of the bay. Each consists of one feature. Although one is in the upper intertidal and the other exposed only at extreme lower low water, the two sites are comparable in age, dating to the past 300 years.

Farther west, an extensive site of numerous weir and lattice features was recorded in a marsh along the south bank of Yaquina Bay. One feature at site 35-LNC-85 was dated to

approximately 1000 years BP. In a slough west of this marsh two sites, each with a single feature, date to 1700 BP (35-LNC-81) and 900 BP (35-LNC-82). Ongoing erosion is exposing the sites along the south shore of Yaquina Bay, and it is likely that further survey will reveal other weir and lattice features in these sediments.

Five weir sites were recorded in a subsidiary channel I designated Raccoon Slough, and one occurs in a smaller channel nearby. These sites contain predominantly stem stakes, brush, and in one case a fragment of lattice. All the sites in Raccoon Slough are interpreted as cross-channel tidal weirs because of their settings. Most are single alignments of wooden stakes, but in Raccoon Slough #3 (a.k.a. Rac 3) numerous features are stratified beneath forested upland sediments, and exposed in a sloping channel bank rather than the channel floor. No survey has yet been conducted in King Slough.

In terms of its tidal wetland archaeological sites, Yaquina Bay has much in common with the Coquille River. Long term continuity in weir fishing is evident in more than one setting, and there are numerous fragments of split wood lattice at Yaquina Bay sites. Settings along the south shore appear to be best preserved, but they are threatened by recreational use, and potentially by continued logging, road building, and residential development.

Alsea Bay

A motorboat survey was conducted over much of Alsea Bay in 1995. Although much of the intertidal area was examined from the water, no sites were identified. A later survey was conducted at vantage points along Oregon Highway 34, and on foot in Lint Slough, southeast of Waldport. No weir sites were identified. It appears that slough channels in Alsea Bay have been greatly altered by infilling, road construction, diking and draining, and the flooding of a large

slough for a lake. Given the numerous historic accounts of weir fishing in this estuary (Chapter 3), historic landscape alterations may best explain the lack of exposed sites.

Siuslaw River

Survey was conducted in the Siuslaw Estuary by canoe and kayak. These surveys took place in May and June of 1993 on the lower North Fork, on the lower mainstem between Cushman and Florence, and the South Slough and South Inlet tributaries of the mainstem. Three other sites were recorded during later surveys by Tveskov and Connolly, and I again surveyed the estuary in 1997, recording sites 35-LA-1224 and 35-LA-1225. Altogether, the 10 recorded weir sites occur in a variety of settings, and hold over 25 features. Some clearly show evidence of



Figure 23: Well-Preserved Weir Feature at Site 35-LA-1103

many episodes of weir construction superimposed in a single location. Others consist of single linear features, apparently representing only one episode of use. Unlike most Oregon Coast weir sites, there is specific oral tradition relating to the use of at least one Siuslaw weir site. Two and possibly more of these weir features contain milled wood, indicating they were built and used sometime after 1876. In the site chronology section below I discuss the evidence for use of the Siuslaw weir sites during the Coast Reservation and early American settlement years.

Radiocarbon dates from Siuslaw weir sites are generally very recent. One exception, site 35-LA-1105, is a fishing weir approximately 800 years old. This weir occurs subtidally and at extreme low water, much lower than most of the other Siuslaw weirs. Of the 5 remaining ^{14}C dates, only one (from 35-LA-1101) predates the period of multiple calibration intercepts of the last 300 years. The well preserved Picket Fence site (Figures 23 and 24) (35-LA-1103) and the extensive Half Moon Weir site (35-LA-1104) have been listed on the National Register of Historic Places (Erlandson et al. 1999).

Umpqua River

I surveyed a large portion of the Umpqua River estuary by boat in 1995 with Jon Erlandson, emphasizing the portion of tidewater between Gardiner and Dean Creek, lower Smith River to Otter Slough, and the shore in the vicinity of Scholfield Slough. No sites were identified. Many of the wetlands in this area appear to have been diked and drained, except for the wetlands of Butler Creek Slough which were not surveyed. One local resident reported a weir in the “cutoff” channel near the south bank in the large bend in the river below Gardiner. This area has not been surveyed. Farther downstream, pedestrian survey was conducted in Jordan and Macy Coves, in the vicinity of the Umpqua Eden archaeological site (35-DO-83), and along the north

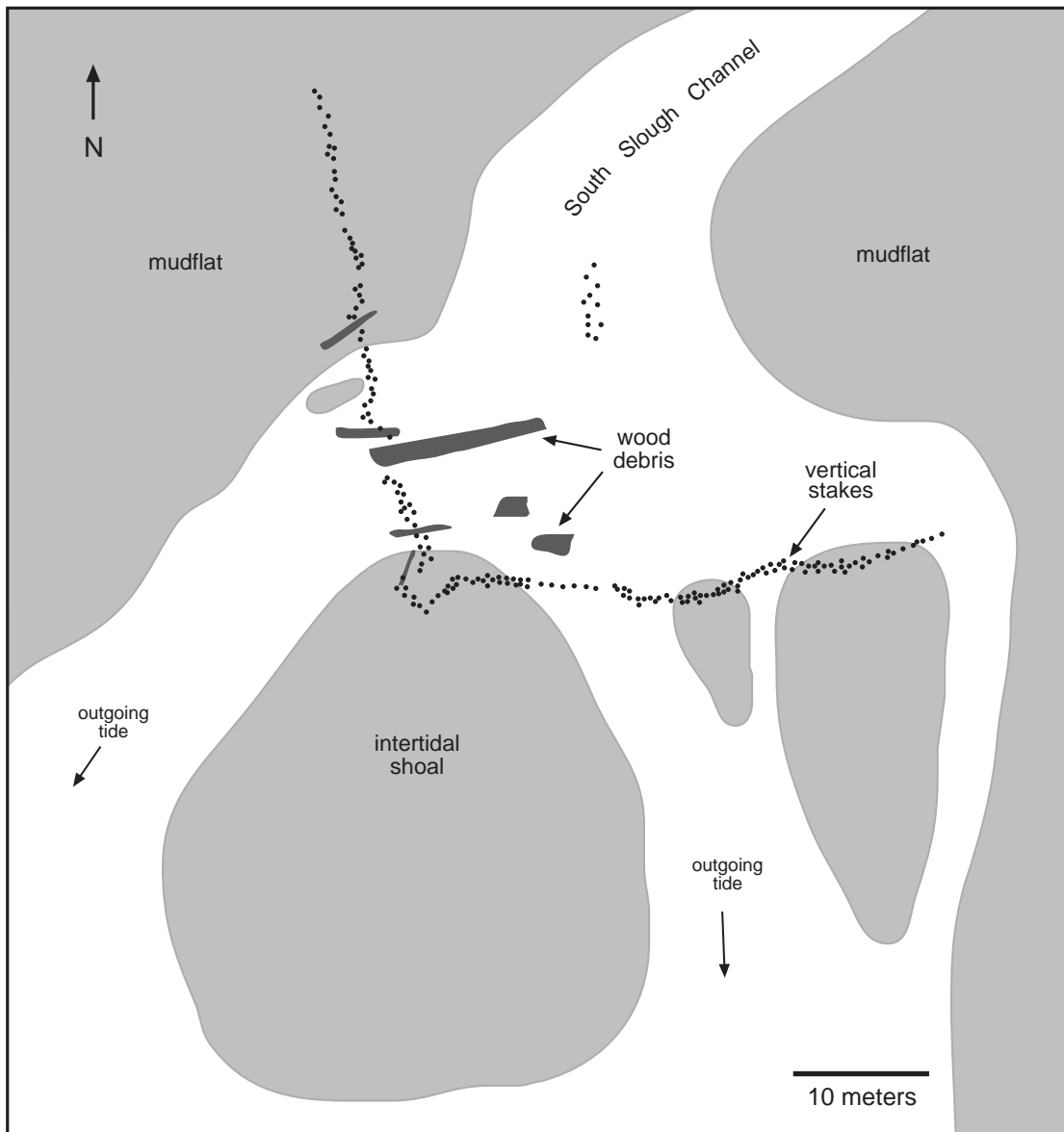


Figure 24: Map of Weir Feature at 35-LA-1103, Siuslaw Estuary.
(Feature and intertidal topography are shown at lowest tide level.)

bank between Gardiner and Barrett's Landing. Cultural material was recorded, but perishables were not identified in the intertidal zone.

Numerous net weights have been identified at sites along the lower Umpqua River. This artifact class does not appear to be as common in other estuary shore sites on the Oregon Coast. It may reflect the use of seines for spring Chinook salmon fishing in deep water, and the larger size of the salmon populations in the Umpqua watershed in comparison with other Oregon Coast rivers. Because of these conditions, the salmon in the tidewater portion of the Umpqua may often have been harvested with different techniques from the tidal weirs so prevalent in other estuaries. Notably, net weights are also numerous in assemblages from the Columbia, Rogue, and Pistol rivers. Still, weir features may yet be recorded in future surveys of the Umpqua intertidal flats and channels.

Coos Bay

The largest estuary in the study area, Coos Bay also has the largest number of recorded weir sites (n=28) and recorded features (over 77). This is due in large part to the efforts of Mark Tveskov and Jon Erlandson (Erlandson and Moss 1995; Tveskov and Erlandson 2002). Donald Ivy, Jason Younker, and I also recorded a small set of sites Ivy had seen while fishing the bay, and Tveskov and I recorded sites in South Slough and the east shore of Coos Bay. Patty Whereat of the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw recorded GPS points for the features Ivy identified. Weirs in the Haynes Inlet portion of Coos Bay are discussed by Tveskov (2000:193-204) and Tveskov and Erlandson (2002).

Approximately one millennium of weir fishing is represented at Coos Bay intertidal sites, with sites from the last 500 years being most common. More of the Coos Bay weirs occur on wide tideflats than in tidal channels, but it was observed during survey that most of the smaller

subsidiary tidal slough channels had been diked and drained for agricultural use. Because weirs occur in the portions of these channels that are not diked, there may be more sites that have been buried behind dikes. Weir sites occur in at least five tributary arms or inlets to Coos Bay.

Four weirs recorded by Erlandson and Tveskov in North Slough are visible from U.S. Highway 101 during low tide. The configuration of features in the two more northerly sites in this slough indicates cross-channel tidal weirs, while the configuration of features in the two more southerly sites is less clear. This may be because a railroad was constructed immediately west of the slough where these other weirs are located. It is possible that the two southern weirs were oriented across the main channel, and were partly buried as the channel shifted due to railroad construction. Alternatively, these weirs may have been built to block side channels that ran to the west/northwest. Notably, most of the weirs in this slough are located near the confluence of small streams that enter North Slough from the west. These may have been subsidiary channels large enough for cross channel tidal weir use at their confluences.

Both cross-channel tidal weirs and tideflat weirs are present in Coos Bay. These include some of the most dense and extensive weir structures on the Oregon Coast, with as many as 8000 stakes estimated for one site, 35-CS-155 (Tveskov and Erlandson 2002). In some cases, tideflat weirs may have been used in conjunction with cross-channel or channel edge weirs, directing fish across flats into impoundments in the deeper water of the channels. Some of the features in Haynes Inlet sites (such as 35-CS-125) have “wings” that may have been stations for multiple basket traps or other enclosures, used simultaneously at various points along the weir. Weirs from the two sites on the east shore of Coos Bay resemble those of Haynes Inlet, with tideflat weirs being predominant here as well. These tideflat weirs also have elements that may have served as enclosures, consisting of splits in the main weir line that are rejoined after 2-5

meters of bifurcation (Figure 25). These may have supported flexible lattice panel traps, hemlock brush, or other structures used for harvesting fish.

In the southeast part of Coos Bay, weirs have been identified in several settings, including a braided or “deltaic” marsh channel near the former mouth of the Coos River. These features appear to be cross-channel tidal weirs, but they are built in channels open at two or more points. In some cases two weirs may have been used together to impound fish. There are also indications that portions of a large weir feature, or multiple features, along with lattice, eroded from the banks of the bay near Graveyard Point. Stephen Dow Beckham (1977:2) reported from a



Figure 25: Diverging Lines in a Tideflat Weir (35-CS-128).

1964 interview with Herman Larson, then a 96 year old Coos Bay resident, "...when dredging at Graveyard point when he built the dike road along Coos River that he discovered a maze of poles and mesh work of a jungle of Indian fish traps or weirs that ran all across the river at this point." This account suggests that the non-tidal weir was built across the width of the Coos River channel. However, Harrington's (1942[24]:103) notes from his interviews with Alec Evanoff and Lottie Jackson Evanoff suggests that the weir built by Mrs. Evanoff's grandfather in this location was a non-tidal fishing weir built annually across a "cutoff" channel that formerly existed in this part of the bay. Non-tidal weirs are extremely rare in tidewater settings (Chapter 3), apparently because of the depth of tidal rivers, but General Land Office surveyor's records from 1875 and 1883 indicate that before it was filled, this smaller channel ran parallel to the main channel and was narrower and shallower. This parallel channel would appear to have been more suited to weir construction and use than the main channel of Coos River.

South Slough is much closer to the mouth of Coos Bay than the other inlets, and correspondingly more influenced by marine currents. Most of the smaller tidal sloughs along the perimeter of South Slough were diked and drained in the past, and most still hold sediments that accumulated during decades of agricultural use. One exception is a small channel entering the western arm of the Slough from the southeast, near Long Island Point. Possibly because historic alterations were less extensive in this location, several weir features remain preserved near the mouth of this slough. The features in sites 35-CS-143, 35-CS-144, and 35-CS-145 may represent multiple episodes of cross-channel tidal weir construction at this location.

No lattice was identified at Coos Bay sites during surveys in the 1990s, although former Oregon State Museum of Anthropology archaeologist David Cole (2000, personal communication) reported excavating a split wood woven lattice fish trap from subtidal sediments

near North Bend in 1961. The trap does not appear to have survived in the museum, no photographs or notes of the structure have been found, and no ^{14}C dates are available.

Coquille River

The lower 14 kilometers of the Coquille River is the most heavily researched estuary on the Oregon Coast. Over several years, archaeologists from the University of Oregon, Oregon State University, and the Coquille Indian Tribe Cultural Resources Program have documented 19 weir sites and over 100 features. There are more discrete weir features recorded in this estuary than in any other on the Oregon Coast, and ^{14}C dates from weir features represent the longest time range for weir technology (~3400 years). Few tideflat settings remain in this estuary, which is largely in-filled in comparison with Coos Bay or Yaquina Bay. Except for two subsidiary channels and one expansive tideflat, most of the weirs occur along the margins of the main channel. Because of infilling and succession, many weir sites are stratigraphically positioned underneath marsh and upland sediments, in some cases underlying strata with dense residential debris (Chapter 5).

I conducted surveys in conjunction with UO/SHPO projects and CITCRP projects from 1994 to 2001. These projects were funded by the Coquille Indian Tribe, National Park Service Historic Preservation funds, and the State Historic Preservation Office. Numerous individuals participated in these surveys, including several students and tribal members. Key participants include Donald Ivy (CIT), Mark Tveskov (UO), Denise Hockema (CIT/UO), Jon Erlandson and Madonna Moss (UO), and Kathryn Bernick.

One of the first features identified during these surveys may also be the most rare. In January, 1994, a set of three stem wood hoops was observed, tied to a single thick piece of stem wood with split root or bark bindings. The feature was first identified by former BLM

archaeologist Reg Pullen, who notified Mark Tveskov and me of its location. The hoop feature may fit the description of a basket trap structure that would have supported an external cylinder of lattice. The wooden structure was not collected and has since been lost to erosion. It was photographed (Figure 26) and measured, and the diameter of the hoops is estimated to have been 70 centimeters. Another hoop feature may be associated with lattice panel 4 at 35-CS-97 (Chapter 7).

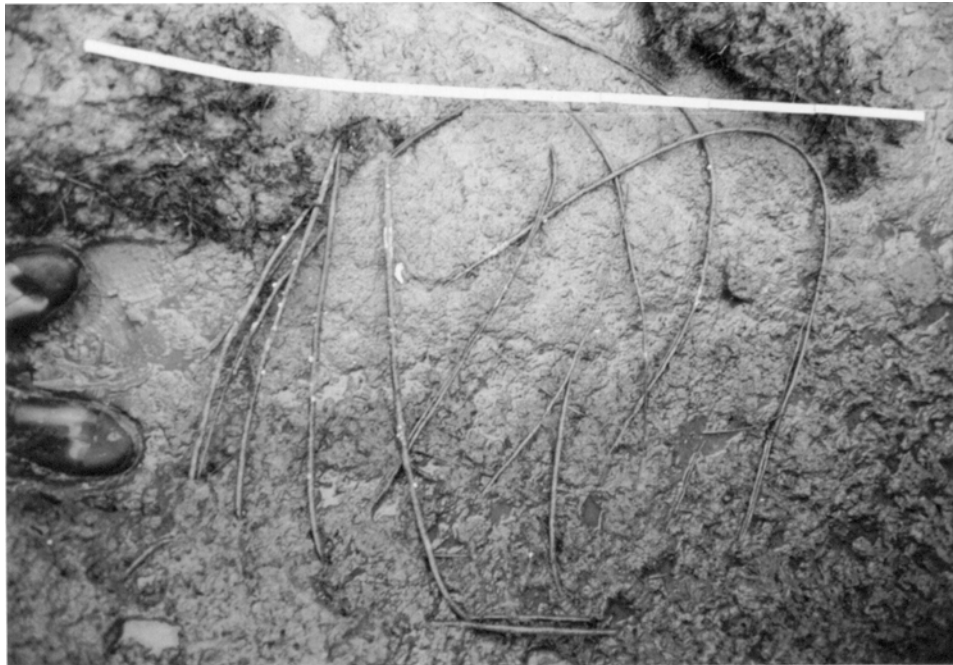


Figure 26: Lashed Withe Hoop Feature, 35-CS-17
(possibly the inner structure of a basket trap).

Documentation of the Osprey and Philpott sites (35-CS-130 and 35-CS-1) took place during field seasons from 1994-1997, including mapping and excavation. Three other weir sites were recorded during this period. Ongoing monitoring of the Osprey and Philpott sites showed that erosion was rapidly destroying features, indicating that the conditions that had preserved these sites for centuries had drastically changed.

In 1998 and 1999, the Coquille Indian Tribe led an effort to document all sites along the shoreline of the estuary and map and ^{14}C date features exposed by erosion. I served as project archaeologist for this effort. Archaeological survey was conducted along the entire length of the Coquille Estuary. This included survey of the entire estuary by boat (Bandon to Myrtle Point), pedestrian survey of the lower 10 miles of the estuary, and revisitation of previously recorded sites. Although the project was intended to assess the extent of sites along the entire estuary shore, land access for pedestrian survey was feasible only along the lower nine river miles of the estuary, where an intertidal mudflat of varying width parallels the riverbank on both sides of the river. Site visibility was much higher in this part of the estuary than in the upper 30 miles and site density proved to be quite high along the lower nine river miles.

All previously recorded weir sites were revisited, and their boundaries expanded to encompass newly identified features. Six new weir sites were recorded. Features were mapped for all Coquille intertidal sites, and 14 ^{14}C dates were obtained from fishing weirs, as well as two from lattice (CITCRP 1999). These sites range in age from 3400 BP to less than 300 BP.

Upriver from the Osprey site the mudflats narrow, and a dark, buried soil is visible in the upper intertidal portion of the cutbank. This soil extends several hundred meters to the east, appearing sporadically on both sides of the river between Prosper and Randolph. In places this buried soil contains residential debris, including lithic artifacts, charcoal, shell, bone, burned rock, burned soil features, and pit features. The soil is up to 80 cm thick and it is thought to have been

buried following a massive subsidence earthquake 300 years ago (Nelson 1992). Beneath this soil is a thick layer of blue-gray wetland sediments containing weir features and other perishables, similar to those occurring at Osprey and other intertidal sites. The 300 year old soil is hidden by riprap in places but clearly exposed in portions of the Philpott (35-CS-1), Riprap (35-CS-159), Driftwood (35-CS-160), and Culvert (35-CS-108) sites along the north bank. Other sites containing the buried soil with cultural deposits include the Randolph Island site (35-CS-17) and the South Bank site (35-CS-97).

Summary of Intertidal Survey Findings

Weir sites have been identified in 6 of the 13 estuaries surveyed. They are most abundant in the Yaquina, Siuslaw, Coos, and Coquille estuaries. There are comparatively few weirs in estuaries of the northern Oregon Coast, though a few were recorded in Netarts and Nehalem bays. All of the Oregon estuary weir sites are located in the middle and lower portions of estuaries, generally above the zone of large scale marine sediment deposition.

Weir Feature Characterization

In the estuaries of the study area, the remains of intertidal fishing structures are most common in subsidiary tidal channels, and several occur in settings where these channels once fed into mainstem channels. Many of the sites in these settings contain features that appear to be incomplete components of larger weirs, such as lines running across part of a channel or a small segment of a line exposed in a bank with both ends buried. Weir sites also occur on tideflats and in deltaic marsh channels, and some may have been built along the edges of mainstem channels.

Of the 72 recorded weir sites on the Oregon Coast, including over 250 features, the most common type is the cross-channel tidal weir, represented at 34 sites, or 81 percent of the 42 weir sites with clearly identifiable types. Four of the sites with cross-channel tidal weirs also hold features that may be channel edge weirs. Tideflat weirs have been designated at six sites (14%), and two sites (5%) hold features identified as channel edge weirs. Among the remaining 30 sites, 16 hold features that are either cross-channel or channel edge weirs, 5 hold either tideflat or cross-channel weirs, 2 consist of possible pens for storing crabs or bait, and 7 hold indeterminate weir types. As expected, large cross-channel non-tidal weirs are not clearly represented in the sample.

Except for channel edge weirs, these patterns appear to match the relative frequency of tidewater weir types represented in ethnohistoric accounts (see Chapter 3). The relatively high incidence of features not clearly identifiable as to type may reflect limitations of the typology stemming from landscape change and differential exposure. For example, most of the sites with possible channel edge weirs are located on the banks of the Coquille River. Yet in this setting channel banks are actively eroding, exposing weirs that may once have been built across the mouths of subsidiary tidal channels that entered the main channel in the vicinity of the eroding riverbank (Chapter 5). Despite extensive archaeological investigation of Coquille weir sites, no structures have been shown to be the remains of channel edge weirs, yet several may represent cross-channel tidal weirs.

In most other cases the archaeological weir types correspond to their current settings. Tideflat weirs are most common on the expansive tideflats of Coos Bay, while cross-channel tidal weirs occur in the subsidiary sloughs of nearly every estuary where weirs have been recorded. These are most common near the mouths of the tributary channels, but several larger subsidiary channels contain multiple weir sites.

Wood Stake Characterization

The four types of stakes present in Oregon estuaries are not equally abundant. Stem stakes are predominant at most sites, with those in the 2-4 cm diameter size range being the most common weir element. Many of these retain branching. Split wood stakes are common at many sites, and in nearly every instance they are interspersed with stem stakes. Milled wood has been identified in features at only three sites, but it may be present at several other sites.

Stake density varies between features and sites and within individual features. Some of this variability is due to visibility, erosion, and differential exposure. In some cases stakes may have been removed from one location to be repositioned elsewhere. Portions of weirs may become exposed and weather away while others remain buried.

Post-depositional processes aside, variability in stake density between weir features may relate to: 1) intensity of rebuilding reflecting regularity of use over time; and 2) the frequency and extent of damage to weirs during the period of weir use relating to factors such as current rates and exposure to waves. Sites exhibiting characteristics of intensive rebuilding include 35-CS-155 and others at Haynes Inlet in Coos Bay. In some of these features stake alignments are as much as 15 stakes deep, suggesting numerous episodes of rebuilding. Factors such as sedimentation rates, frequency and intensity of use, and frequency and intensity of impacts to weirs probably affect the density of stakes in individual weir features. For example, the unusually dense stake alignments at such sites may reflect intensive weir fishing in settings where debris frequently damages the upper portions of vertical stakes, necessitating the frequent addition of weir stakes to maintain an alignment adequate for blocking fish passage.

Sedimentation rates appear to be a key factor in stake density as well. At four sites on the north bank of the Coquille River, weir building shifted westward over several centuries,

apparently in conjunction with estuary landform changes (Chapter 5). In this setting of rapid sedimentation, episodes of weir rebuilding appear to be reflected in an increased number of weirs and their position relative to their age, though the strategy of cross-channel tidal weir use seems to have persisted through this period.

Variation in stake density within single features likely reflects different phenomena, including: 1) rebuilding, as at Haynes Inlet sites; 2) proximity to the harvesting device, as seen in increases in stake density near the apex of the V at Osprey (also the area where lattice is most often found); 3) the placement of stake supports for nets (e.g., Osprey site central zone feature) and weir panels or basket traps (e.g., 35-CS-97 lattice 3; 35-LNC-85 lattice 1); 4) design suited to the behavior of certain fishes under site conditions; and 5) preservation.

Stake length is not well documented, partly because the lower (distal) portion of the weir stake is normally buried and the upper portion of the stake is usually weathered or broken, and is thought to have been longer when it was used. In feature 3 at the Philpott site (35-CS-1), a 2 cm diameter stem stake with a battered and frayed proximal end was documented. The 10 stem stakes collected at the Osprey site ranged from 40 to over 70 cm long, and one stem stake 140 cm long was recovered from 35-CS-118. There are few features that retain stakes that appear to have proximal ends preserved. At the Ahnkuti site (35-LNC-76), several large sharpened stakes are preserved horizontally among the weir features in Zone 3. These have not been directly dated, but their distal ends resemble those of stakes preserved in features at the site. The horizontal stakes at the Ahnkuti site are from approximately one to two meters long, which is close to the size of largest stakes identified by Moss et al. (1990:147) in southeast Alaskan weir sites.

One final source of information about stake height is the testimony of Coos elder Jim Buchanon, who resided near and may have built the Picket Fence site weir (35-LA-1103). Buchanon reported that the stakes used in tidal weir construction were 8-10 feet long split planks.

Several of the stakes at the Picket Fence site remain over one meter long, though they are clearly over 50 years old. One large, sharpened stake at the Half Moon site (35-LA-1104) is nearly 3 meters long and 12 cm wide, but it is thought to have been part of a scaffold or other structure that extended above the water surface during weir use.

Horizontal elements are not visible in most weirs, but they have been identified in some sites. Brush, some clearly western hemlock, is the most common element. Lattice is sometimes recorded in association with a weir feature, though no pieces have been found tied to or superimposed upon a row of weir stakes. In the eastern portion of the Osprey site, two 12 cm wide planks were found positioned horizontally as fence boards near the apex of a V-shaped weir.

In addition to woven lattice and spilt wood stakes, split wood technology represented at weir sites includes lattice frames and possibly a platform (at 35-LNC-76, Zone 1, F2) positioned next to a weir on loose mud, which may have been used for standing.

Species has been identified for 13 wooden stakes from archaeological weirs (Table 6). The analysis of these stakes was performed by paleoethnobotanist Ann Trieu (1999) using high powered thin section microscopy. Ten of 11 stem stakes are western hemlock, and one is a hardwood, possibly salal or manzanita. One split wood stake in the sample is western redcedar, and one milled wood stake is Douglas fir. Notably, young growth hemlock bark is visually distinctive (Figure 27), and the frequency of other stakes showing hemlock bark is quite high among those sampled for ^{14}C dating. No other bark types have been documented on stakes at weir sites. Hemlock is highly abundant along the Oregon Coast. Because it is shade tolerant, small trees and branches are found in mature forests as well as younger forests. It is also relatively brittle when green; a stem section will snap after a partial cut has been made in the wood. As Lottie Jackson Evanoff noted, however, the most outstanding characteristic of hemlock as a raw material for tidal weir building is the propensity of the wood to sink after only a short time in



Figure 27: Bark and Brush of a Young Western Hemlock
(The predominant raw material for stem stake manufacture)

water. Unlike Sitka spruce, western redcedar, and other abundant woods, western hemlock loses its buoyancy in a matter of hours after submersion. This may have been particularly important given the loose, fine-grained sediments the Oregon Coast weirs have been identified in. Western hemlock has also been reported ethnographically (Gunther 1973:18) and identified in weir features elsewhere on the Northwest Coast (e.g., Putnam and Greiser 1993; Tepper 1991; Mobley and McCallum 2001). Its widespread use relates to its distribution and abundance as well as the properties of its wood.

Table 6: Wood Stake Species Identification of Oregon Coast Weir Stakes.

Site	Provenience	Stake Type	Species	Age of Sample
CS-1	feature 1	stem	western hemlock	900-700 BP (^{14}C)
CS-1	washout feature	stem	western hemlock	900-700 BP (^{14}C)
CS-130	eastern area	stem	western hemlock	700-600 BP (^{14}C)
CS-130	eastern area	stem	western hemlock	700-600 BP (^{14}C)
CS-130	western area	stem	western hemlock	900-750 BP (^{14}C)
CS-122	south line	stem	western hemlock	<300 BP (^{14}C)
CS-125	feature 2	stem	western hemlock	400-300 BP (^{14}C)
CS-126	feature	stem	western hemlock	400-300 BP (^{14}C)
CS-128	feature 2	split	western redcedar	<300 BP (^{14}C)
CS-132	south wing	stem	western hemlock	<300 BP (^{14}C)
LA-1103	feature 1	milled	Douglas fir	post-1876
LA-1105	west edge	stem	western hemlock	900-750 BP (^{14}C)
LA-1101	weir 6	stem	<i>Ericaceae</i> (salal, manzanita)	<400 BP (^{14}C)

Seasonality of Stake Harvest

A sample of 36 stem stakes was examined for growth ring analysis. My goal was to determine the season of stake harvest, as this may relate to season of weir construction, maintenance, and use. For the conifer species in the study area, growth rings vary through the growing season, with early growth represented in cross section by larger tracheid cells and late growth represented by smaller, more compressed tracheid cells (Hoadley 1990). In most cases the stake sectioning was done on specimens sampled for ^{14}C dating. Four of the stem sections could not be classified as having early or late wood in the outer growth ring. Yet 26 of the 32 remaining stakes clearly had late wood in the outer rings, indicating they were harvested outside the growing season or near the end of the growing season. Outer wood growth stage estimates were not possible for the remaining 6 stakes due to deterioration.

Unfortunately, data on intra-annual growth ring patterns of tree species in western Oregon are very limited (Barbara Gartner, 1995, personal communication). I sampled western hemlock branches over two years at a stand of trees near the Umpqua River mouth. I examined the outer ring wood from these samples in cross section under 10x and 30x magnification, and determined that, for 1995 and 1996 on the central Oregon Coast, the presence of recognizable early wood in the outer growth ring of western hemlock begins in April and extends to midsummer, when late wood begins to appear. This small sample suggests that the harvest of weir stakes may have occurred most often between midsummer and early spring. However, since early wood outer rings represent only about 3.5 months (30%) of the year, and this growth stage is represented on 20 percent of the sample, the sample could represent stake harvest throughout the year.

Clearly, more work on the seasonality of western hemlock growth patterns and weir stake cutting is required before any definitive patterns can be identified. However, seasonality studies

give no indication that weir construction occurred annually with the onset of the arrival of salmon in Oregon estuaries. Both the spring-summer and fall Chinook runs arrive in estuaries during the early wood growth season for western hemlock. There are also no ethnographic indications that tidal weirs were built and rebuilt at the same time every year. Instead, it appears that many weirs were maintained throughout the year and rebuilt only as sediments shifted or perhaps after damage from debris swept in by floods or storm surges. Marine mammals or large fish may also have fouled weirs when they became trapped, or when they pursued fish caught in tidal impoundments. Given the high degree of preservation in many of the features today, it appears that tidal weirs were much more permanent than their non-tidal freshwater counterparts. Madonna Moss (2002 personal communication) suggests the weirs would have been rebuilt and maintained most often during daylight spring tides, when the structures are best exposed. Such tides occur in the spring and summer months.

Chronology and Taphonomy of Oregon Coast Weir Features

Radiocarbon dating has been the primary source of information on the chronology of weir use on the Northwest Coast. Information about weir chronology can also be elucidated through stratigraphic relationships, as seen in the numerous weir features of the Coquille River occurring stratigraphically beneath soils dated between 900 and 300 years BP (Chapter 5). Other sources of information about weir chronology include the presence of milled wood in features and historic accounts, some associated with specific sites.

Radiocarbon Dating

The extensive sample now available from the Oregon Coast provides a foundation for addressing issues of site formation and landscape change, and potentially the relative intensity of weir fishing through space and time.

A total of 79 wood stakes and two pieces of wood associated with lattice features have been ^{14}C dated (Table 7). Several more weir features occur in sediments lying beneath stratigraphic layers that have been ^{14}C dated, particularly on the banks of the Coquille River. The procedures followed for sample recovery and treatment are those outlined in three reports of the Oregon Coast State Parks surveys (Erlandson and Moss 1993:11-2, 82-96; Moss and Erlandson 1994:90-93; 1995a:92-93, 113-116). These reports also outline the methods I have followed in interpreting the results of the ^{14}C dating, including issues involving calibration, multiple intercepts, range of error, the distinction between marine and terrestrial carbon, lab selection, contamination, and the “old wood” problem.

Geographically, the sample of ^{14}C dated weir stakes reflects the relative frequency of intertidal weir sites in Oregon estuaries (Figure 28). Few dates are available from north of Yaquina Bay and Lincoln County because fewer sites have been identified in the more northerly estuaries. Sampling also reflects the intensity of research; the Coquille Indian Tribe has conducted intensive investigations of weir sites in the Coquille Estuary, including extensive ^{14}C sampling.

Almost 90 percent of the ^{14}C dates from weirs and lattice date to the last 1200 years. Of the 9 earlier dates, there are clusters centered at about 3300 BP and 2100 BP. Each of these early clusters is represented at two sites in close proximity; the earlier set in the Coquille Estuary and the later set in the Yaquina Estuary.

Table 7: ^{14}C Dates from 81 Weir and Lattice Samples from Oregon Coast Intertidal Sites. (Calibrations performed using the CALIB 4.1 program, based on the data provided by Stuiver and Reimer 1993.)

Site No.	Lab # (Beta-)	Uncor. ^{14}C Date	Estimated Age Range (cal BP)	Provenience	Publication or Report
TI-64	85391	190 ± 60	290 (170) 0*		Moss and Erlandson 1996
TI-68	85392	320 ± 70	470 (400) 290*		Moss and Erlandson 1996
TI-71	85393	80 ± 70	260 (50) 20*		Moss and Erlandson 1996
LNC-76	83324	320 ± 40	440 (390) 300*	zone 3	Moss and Erlandson 1995
LNC-76	83323	350 ± 70	500 (360) 300*	zone 2: cut bank	Moss and Erlandson 1995
LNC-76	83322	560 ± 70	640 (540) 420	zone 2: feature 4	Moss and Erlandson 1995
LNC-76	77988	1160 ± 40	1080 (1060) 990	zone 1	Moss and Erlandson 1995
LNC-76	83326	1330 ± 80	1300 (1060) 990	zone 5: feature 1	Moss and Erlandson 1995
LNC-76	83321	1400 ± 60	1330 (1300) 1280	zone 1: SE line	Moss and Erlandson 1995
LNC-76	83325	2120 ± 70	2150 (2090) 1990*	zone 4: feature 1	Moss and Erlandson 1995
LNC-77	83327	1920 ± 80	1960 (2030) 2170	locus 1: So. weir line	Moss and Erlandson 1995
LNC-78	83328	2220 ± 80	2340 (2250) 2120*	feature 1	Moss and Erlandson 1995
LNC-78	83329	2410 ± 80	2710 (2360) 2340	feature 2	Moss and Erlandson 1995
LNC-81	94116	1900 ± 60	1880 (1840) 1740		Byram 1998
LNC-82	94117	920 ± 60	920 (870) 740*		Byram 1998
LNC-83	94118	100 ± 60	270 (60) 0*		Byram 1998
LNC-84	94119	150 ± 60	280 (140) 0*		Byram 1998
LNC-85	94120	1150 ± 70	1170 (1020) 960*		Byram 1998
LA-1101	74866	130 ± 60	280 (140) 0*	south edge of site	Moss and Erlandson 1995
LA-1101	83330	280 ± 50	420 (300) 290	feature 1: N. site area	Moss and Erlandson 1995
LA-1104	63842	"modern"	250 (0) 0	south wing	Erlandson and Moss 1993
LA-1104	63844	90 ± 60	270 (30) 0*	north line	Erlandson and Moss 1993
LA-1104	63843	160 ± 60	290 (130) 0*	southern arc	Erlandson and Moss 1993
LA-1105	74745	910 ± 50	920 (790) 740*	western weir feature	Moss and Erlandson 1995
CS-1	106992	860 ± 60	880 (740) 700	feature RB 2	Byram et al. 1997
CS-1	106993	870 ± 70	900 (750) 700	feature WO 1	Byram et al. 1997
CS-17	134322	810 ± 60	780 (720) 670*	weir feature 1	CITCRP 1999; Byram and Witter 2000
CS-97	132213	610 ± 60	750 (600) 540*	feature 25	Erlandson et al. 1999
CS-97	132214	970 ± 60	940 (920) 790	feature 12	Erlandson et al. 1999
CS-97	134323	1260 ± 60	1270 (1210) 1090*	feature 10	CITCRP 1999; Byram and Witter 2000
CS-97	134317	740 ± 60	690 (670) 650	feature 18	CITCRP 1999; Byram and Witter 2000

<u>Site No.</u>	<u>Lab # (Beta-)</u>	<u>Uncor. ¹⁴C Date</u>	<u>Estimated Age Range (cal BP)</u>	<u>Provenience</u>	<u>Publication or Report</u>
CS-97	134324	970 ± 60	950 (920) 790	feature 30	CITCRP 1999; Byram and Witter 2000
CS-97	134319	990 ± 70	960 (930) 790	branch rope, lattice panel 2	CITCRP 1999; Byram and Witter 2000
CS-108	132215	860 ± 60	890 (700) 650	feature 1	Erlandson et al. 1999
CS-116	134325	690 ± 60	740 (660) 560	weir feature 1	CITCRP 1999; Byram and Witter 2000
CS-122	67581	180 ± 50	290 (150) 0*	southern line	Moss and Erlandson 1994
CS-123	67582	240 ± 70	310 (290) 0*		Moss and Erlandson 1994
CS-124	74738	30 ± 50	260 (0) 0*		Moss and Erlandson 1995
CS-125	74740	230 ± 70	310 (290) 0*	weir feature 3	Moss and Erlandson 1995
CS-125	74739	290 ± 50	430 (300) 290*	weir feature 2	Moss and Erlandson 1995
CS-126	74741	290 ± 60	430 (300) 290*		Moss and Erlandson 1995
CS-128	74742	140 ± 50	280 (140) 0	southeast weir line	Moss and Erlandson 1995
CS-128	67583	210 ± 50	300 (150) 0*	feature 2	Moss and Erlandson 1995
CS-130	88465	400 ± 60	510 (480) 320	Jerry's weir feature	Byram and Erlandson 1996
CS-130	88466	600 ± 70	650 (550) 530	feature 7	Byram and Erlandson 1996
CS-130	72791	660 ± 50	660 (650) 560	baseline E: 16.2E/1.3S	Byram and Erlandson 1996
CS-130	72790	670 ± 50	670 (650) 560	1 m E. of Feature B3	Byram and Erlandson 1996
CS-130	86017	790 ± 60	690 (650) 600	below lattice feature 8	Byram and Erlandson 1996
CS-130	74746	940 ± 50	930 (830) 760*	west site area	Byram and Erlandson 1996
CS-130	111760	180 ± 50	290 (150) 0*	lattice panel 8-C	CITCRP 1999; Byram and Witter 2000
CS-132	74868	20 ± 60	260 (0) 0*		Byram and Erlandson 1996
CS-134	74869	180 ± 60	290 (150) 0*		Byram and Erlandson 1996
CS-143	77990	100 ± 60	270 (40) 0*	east side of tidal channel	Moss and Erlandson 1995
CS-144	77991	70 ± 60	250 (0) 0*	linear line of weir stakes	Moss and Erlandson 1995
CS-150	111953	670 ± 60	670 (650) 560	sample B1	Tveskov and Erlandson 2002
CS-150	111954	140 ± 70	280 (140) 0	sample B2	Tveskov and Erlandson 2002
CS-150	111955	970 ± 60	950 (920) 790	sample B3	Tveskov and Erlandson 2002
CS-152	111957	640 ± 60	660 (580) 550	sample D1	Tveskov and Erlandson 2002
CS-153	111959	160 ± 50	285 (200) 0	sample E1	Tveskov and Erlandson 2002
CS-153	111960	210 ± 60	300 (230) 10	sample E2	Tveskov and Erlandson 2002
CS-154	133477	460 ± 60	530 (480) 490	feature 1	Erlandson et al. 1999
CS-155	133479	"Modern"	0 (0) 0	feature 1	Erlandson et al. 1999
CS-155	133478	240 ± 60	310 (290) 0*	feature 1	Erlandson et al. 1999
CS-156	133481	290 ± 50	430 (310) 290*		Erlandson et al. 1999
CS-156	133480	440 ± 60	490 (500) 470		Erlandson et al. 1999
CS-157	133482	220 ± 60	300 (290) 0*		Erlandson et al. 1999

<u>Site No.</u>	<u>Lab # (Beta-)</u>	<u>Uncor. ¹⁴C Date</u>	<u>Estimated Age Range (cal BP)</u>	<u>Provenience</u>	<u>Publication or Report</u>
CS-159	124339	990 ± 60	950 (920) 800	feature 8	CITCRP 1999; Byram and Witter 2000
CS-159	124340	960 ± 50	930 (910) 780	feature 3	CITCRP 1999; Byram and Witter 2000
CS-160	124338	1120 ± 50	1060 (990) 960	feature 10	CITCRP 1999; Byram and Witter 2000
CS-160	124337	960 ± 50	930 (910) 780	feature 3	CITCRP 1999; Byram and Witter 2000
CS-162	132208	200 ± 60	300 (280) 0	feature 1	Erlandson et al. 1999
CS-162	132209	300 ± 60	450 (310) 300	feature	Erlandson et al. 1999
CS-163	132207	340 ± 60	490 (360) 300*	feature C7	Erlandson et al. 1999
CS-164	132212	1110 ± 60	890 (750) 700	feature 1	Erlandson et al. 1999
CS-165	132211	140 ± 60	290 (140) 0*	feature 1	Erlandson et al. 1999
CS-166	132210	190 ± 60	300 (280) 0*	feature 1	Erlandson et al. 1999
CS-167	134321	3180 ± 70	3470 (3390) 3350	feature 1	CITCRP 1999; Byram and Witter 2000
CS-167	151031	3120 ± 60	3390 (3360) 3270	feature 2	CRAMP or CIT records
CS-168	134320	910 ± 50	920 (820) 740*	feature 2	Erlandson et al. 1999
CS-170	151032	3100 ± 70	3390 (3360) 3270	feature 1	CRAMP or CIT records
CS-176	134318	1010 ± 60	970 (930) 800	feature 1	CITCRP 1999; Byram and Witter 2000

Comparing frequencies of dates between estuaries, the Coquille has the earliest dates, but between 3300 BP and 1200 BP there is a large gap. Only 1 of the 23 Coquille weirs sampled postdates 400 BP. In contrast, most Coos Bay, Siuslaw, Netarts, and Nehalem weirs date to the last 400 years. Yaquina Bay is the only estuary for which weir stake ^{14}C dates are distributed relatively evenly across the represented range, from 2400 BP to the last 300 years.

These patterns in ^{14}C dates between estuaries likely stem from site formation processes conditioning the sample of exposed weir features. As perishable structures, wood stake features are not likely to remain well preserved in exposed settings for long periods of time. Thus, the stakes currently exposed during low tide have become so through recent erosion or shifts in sediments due to current changes. For example, the banks of the Coquille River are undergoing tremendous erosion due to sediment accumulation in the main channel (Chapter 5). Comparatively stable tidal channels in most parts of Yaquina Bay do not appear to be undergoing such changes, and this may help explain the more even distribution of Yaquina ^{14}C dates. The exception to channel bank stability at Yaquina Bay is seen in the Ahnkuti site (35-LNC-76), where a deep erosional pool has exposed three strata of weirs representing nearly 2000 years of traditional fishing (Chapter 6).

The relatively late weir dates in Coos Bay and the Siuslaw River likely reflect weir construction in a setting of continual in-filling that has not undergone the down-cutting seen in the Coquille Estuary and the Ahnkuti site. Additionally, extensive portions of Coos Bay tidal wetlands have been diked and drained, so many identified weirs occur on tideflats, not in channels where lower strata may be examined.

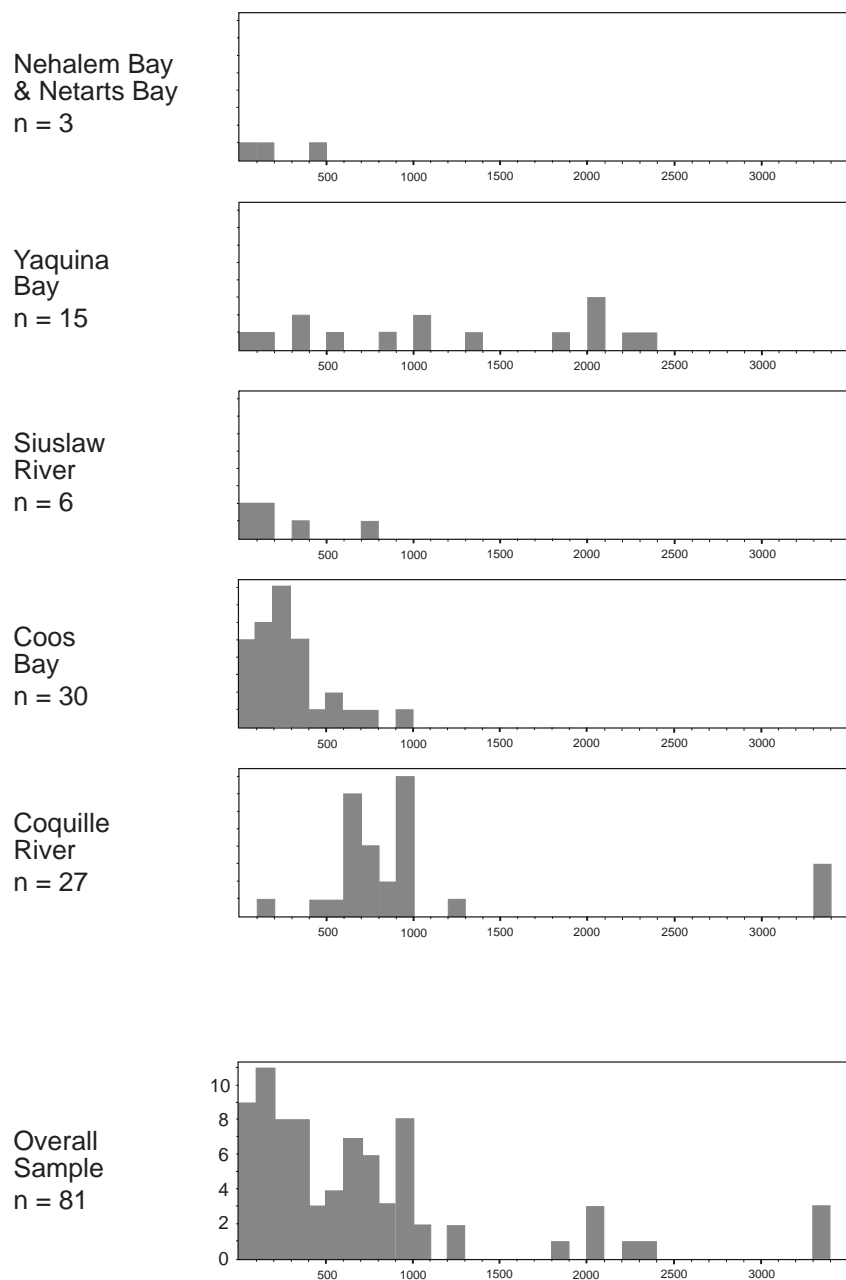


Figure 28: Comparative Graph of ^{14}C dates (mean calibrated years BP) for Oregon Coast Weir and Lattice Features.

Weir Use During and After Colonization

Several weir sites appear to hold milled wood elements. Others are in locations specifically described as fishing stations used by Native communities during and after the Coast Reservation years (AD 1855 to 1875 for the Alsea Agency). A number of ^{14}C dates also fall into the post-300 BP period of multiple calibration intercepts, and some of these weirs probably date to the late 19th century. Archaeological weir sites on the Siuslaw Estuary are particularly informative for this period.

After the Alsea Subagency of the Coast Reservation was opened to American settlement by Congress in March, 1875 (Schwartz 1991:253-54), several Native people from the Reservation moved to the Siuslaw River, and many homesteaded here along with Native Siuslaw residents. There were an estimated 200 Coos, Lower Umpqua, and Siuslaw people living in the area at that time, with very few Euro-Americans until the 1880s. The first commercial cannery and sawmill were established on the Siuslaw in 1877. Native people worked at the cannery and did most of the fishing. They also fished for their own subsistence.

Several archaeological weirs in the Siuslaw Estuary may reflect this cannery era, which extended through the end of the 19th century. The presence of milled wood in at least two Siuslaw weirs dates these structures to the commercial fishing era, and their use in harvesting salmon for canneries is supported by historic accounts (Harrington 1942[23]:437-480; Stafford 1975). While the Native use of weirs on the Siuslaw declined with the increasing availability of nets, sites such as the Picket Fence site (35-LA-1103) may have been used for subsistence fishing into the early decades of the 20th century. This site and others with distinctive stake types are adjacent to lands owned by Native people, such as Jim Buchanon, Frank Drew, and Andrew Charles. These individuals described weir fishing during and after the reservation years (Chapter 3). For

example, Buchanon described a weir much like the Picket Fence structure during an interview with Leo Frachtenburg (1909:17),

Fish were also caught in fish traps [i.e. weirs], pieces of fir wood, 8 or 10 feet long, 2-4 inches wide were split, one end was sharpened and ... driven into the mud. These pieces were put up in ... rows, like a fence leaving a space about 2-3 inches between each piece.

The use of split fir wood, rather than branching hemlock stem stakes, may reflect the use of these weirs for intensive salmon harvests during this commercial fishing era, and the preference of Douglas fir (over wood such as hemlock) for commercial lumber production. It is not clear if these individuals were still using these structures to fish when they were interviewed by ethnographers in the first decades of the 20th century. Weir use likely became increasingly difficult as log rafting increased in the Siuslaw River during this period, and fish and game laws outlawed many traditional fishing practices.

As noted in Chapter 3, Native people in other parts of the Oregon Coast continued fishing with weirs and basket traps during and after the Coast Reservation years. Laura Metcalf (U.S. Court of Claims 1931:76) described weir and trap fishing on Coos River and Tenmile Creek, and there are other accounts of her mother, Susan Adulsa Wasson, and other Indians fishing at Tenmile Creek (Daisy Coddington in Harrington 1942[24]:77). A South Slough Coos Bay Native named Tarheel made seasonal trips to Coos River, where he fished for salmon. There are also several accounts of traditional fishing continuing at Siletz, Yaquina Bay, and the Smith River tributary to the Umpqua River (Chapter 3). None of these has been correlated with archaeological fishing structures as at the Siuslaw River, although milled wood may yet be identified in other sites dating to the post-300 BP period.

Site Taphonomy

Sixty years ago, after learning from Lottie Jackson Evanoff and Alec Evanoff that Native people's fishing weirs were largely made of western hemlock wood, Harrington (1942[22]:1036) wrote, "Alec says he could show me the remains of Indian fish fences, the deep-in-the-water hemlock brush not having rotted while the hemlock above (near water surface) has rotted." Today, the brush of even the most recent weirs has largely deteriorated, and the only indications of brush at most sites are in the bases of twig-sized stems that protrude from the mud around stem stakes. This process illustrates the first stage of taphonomic change at an archaeological weir site. Smaller elements exposed in the water column deteriorate due to exposure to air and sunlight, barnacle encrustation, shipworm and gribble burrowing, and impacts from rafted logs or driftwood. Only in areas of active erosion, such as the Ahnkuti site at Yaquina Bay (Chapter 6), are the smaller brush and lattice elements exposed on eroding site surfaces. These features deteriorate rapidly after exposure.

Nearly all the wood stake weir sites occur in finer estuarine sediments, more of riverine than marine origin. Some are layered between coarser sediments, as at the Osprey and Philpott sites on the Coquille River. Some of these coarser sediments may be marine in origin, such as tsunami deposits (Hodges 1996). In localities where riverbank erosion is high due to heavy currents, as seen in the Coquille Estuary, layers of coarse sediments in a bank are more prone to erosion and may undercut, causing slumping and increased erosion along riverbanks (CITCRP 1999).

Site topography or estuary basin setting is a key factor in taphonomy, with riverbank settings undergoing the highest rates of burial and erosion, and tidal slough settings being the most stable. Stake features in tideflat settings are exposed to erosion from debris and wave action,

and large scale sediment shifts, as observed at Coos Bay. All basin settings where sites occur are subject to ongoing sediment accumulation from the normal estuary infilling process (Chapters 2 and 5).

The influence of marine waters conditions the microorganisms present in the water column and sediments surrounding stakes. Marine influence may vary considerably through the course of the year and over long time periods, with sea level change and infilling. Most tidal weirs have been identified in areas of at least seasonal saline water, though salinity decreases severely during seasons of high rainfall and runoff, especially in the middle and upper portions of the estuary.

In terms of intertidal range, weir sites are most common in the lowest portion of the intertidal zone. In some cases these features consist of the bases of stakes that may have extended to near or above the upper intertidal zone. However, for weirs to be effective in tidal settings, they must generally allow passage of fish during high tide, and therefore it is expected that stake height for tidal weirs was not more than one meter above the floor of the estuary. Research on the original vertical height of weir features will require subsurface investigation and the reconstruction of the intertidal paleosols that the individual weir features were associated with. My research did not involve substantial subsurface investigations. Except for the few instances where erosion had exposed apparent paleosols (e.g., 35-LNC-76, 35-CS-130), I did not document these relationships during this study.

Agents of Biological Deterioration

Ecologists Chris Maser and Jim Sedell's detailed study of driftwood in Northwest coastal wetlands provides much information relevant to the study of wooden artifact taphonomy in Oregon estuaries. They note that

Marine fungi and bacteria use lignin and cellulose [respectively] as sources of energy.... Marine fungi, such as Fungi Imperfecti and Ascomycetes, help to decompose cellulose, but their ability to break it down rapidly or extensively in large pieces of driftwood appears to be much less pronounced than that of their terrestrial counterparts. Most of the fungi, which break down lignin, attack only the surface layers of the wood, and then no deeper than about one sixteenth of an inch.

The role of marine cellulose digesting bacteria is largely obscure, but many species, which can actively break down cellulose, have been identified. Aerobic bacteria, which can decompose cellulose, are abundant in sea water and marine sediments (Maser and Sedell 1994:63).

Notably, the limited microscopic analysis that has been conducted with wooden weir stakes from Oregon estuary sites indicates that both cellulose and lignin remain preserved in these specimens, though there is more deterioration of cellulose (Trieu 1999). One possible reason for this high degree of preservation is that the weirs preserved archaeologically may have been built upstream from the more saline portions of estuaries. In the finer sediments of middle and upper estuary settings (at or above the null point), anaerobic conditions prevail and only cellulose-digesting fungi are present as agents of decomposition (Maser and Sedell 1994:76). In the lower portion of the estuary, higher salinity causes clay particles to bond, forming coarser sediments that allow more oxygenation of ground water, sustaining microorganisms that consume wood. More saline waters also sustain marine fungi as well as organisms such as gribbles and ship worms that produce wood deterioration on a massive scale (Maser and Sedell 1994:76-77).

There are several environmental processes that alter intertidal fishing sites over time. The goal of my research has been to document these processes sufficiently to allow the study of site chronology and the general classification of feature types relating to fishing techniques depicted ethnographically. In the future, more detailed study of site taphonomy will be key to further reconstruction of weir technology and evaluation of the condition of Oregon estuary weirs.

CHAPTER 5

FISHING SITES AND LANDSCAPE CHANGE IN THE COQUILLE ESTUARY

The earth is flat and floating on water which is underneath and on all sides. Every so often the earth rocks up and down and tips a little, and this is the cause of the tides. When the Creator made the earth the water came all over the earth at every high tide. In order to make the land appear the Creator obtained 'blue earth' and laid down a layer of it. But it was not enough because the water still covered it over. [So he laid down two more layers.] But still at each tipping the water ran too far inland. So then people placed strips of basketry along the whole length of the ocean shore. The water ran through the basketry and back out, and it came no further inland than where the basketry was placed; the basketry is now the sands along the beaches. The blue earth can still be seen under the ocean water.

-from The Ocean Went Far Into the Land, a Coos-Coquille creation narrative
(M. Jacobs 1940:240)

Extensive archaeological research has been conducted in the Coquille Estuary (Figure 29) during the past decade. Much of this has been performed by the Coquille Indian Tribe in conjunction with archaeologists from the University of Oregon and Oregon State University (R. Hall 1995; Byram and Erlandson 1996; Moss and Erlandson 1996; Byram et al. 1997; CITCRP 1999; Byram and Witter 2000; Ivy and Byram 2001). This research has shed light on several aspects of the cultural and environmental history of the estuary, including considerable information about fishing sites. Initial archaeological investigations in the 1990s were aimed at determining the age and geographic extent of Coquille fishing weirs, and at exploring the role fishing structures once played in the local economy. As research progressed, the processes of landscape change became key in understanding the history of Coquille fishing traditions. Because weir use was closely linked to changes in the estuary, many of these changes are revealed in the spatial and chronological patterning of archaeological weir remains.

In this chapter, I present the results of survey and surface characterization at 17 archaeological weir sites, and more intensive analysis of the Osprey (35-CS-130) and Philpott (35-CS-1) sites. Most of the investigated sites are located along the narrow intertidal margin of

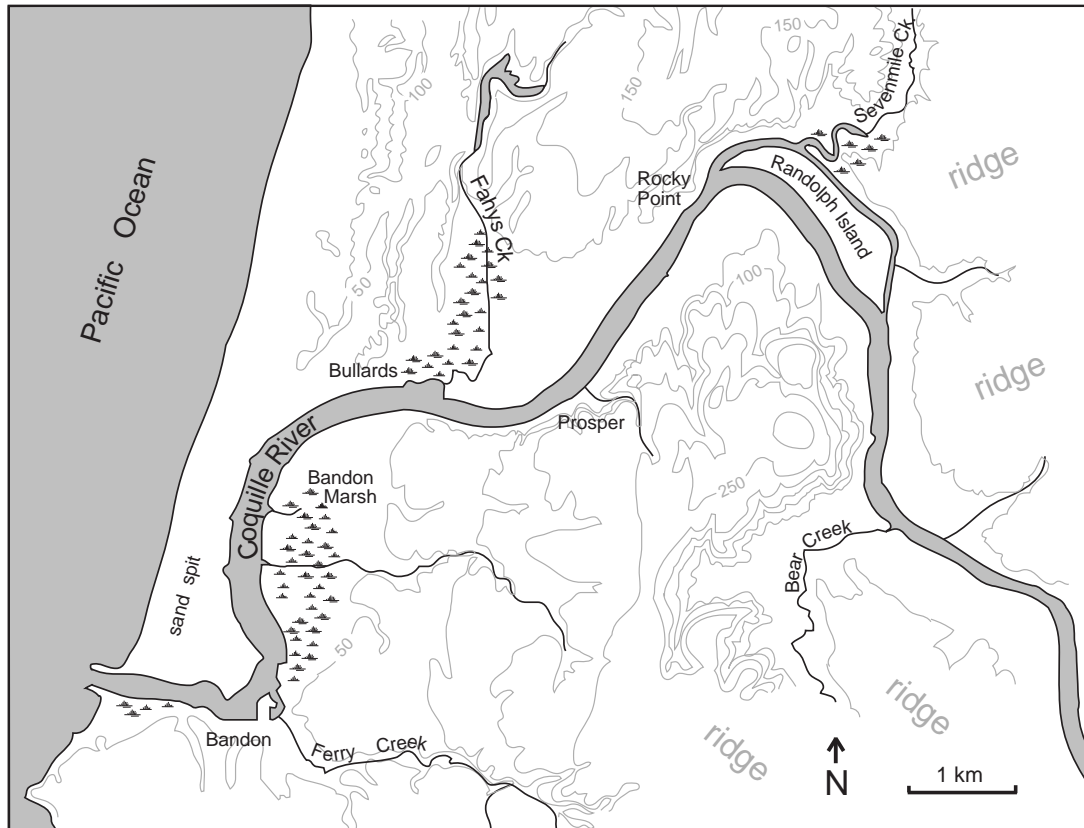


Figure 29: Map of the Lower Coquille Estuary (showing some of the locations mentioned in the text).

the lower Coquille River. These sites have eroded severely in recent years as tidal and freshwater currents have changed due to extensive diking of wetlands and jetty construction at the river's mouth. Much of the research stems from ongoing monitoring of eroding river bank sites with cut bank exposures of stratified cultural material, including wetland layers holding weirs and fossil woody debris, and upland layers holding diverse residential debris. In several instances, weir features are positioned stratigraphically beneath upland strata in the same sequence. Based on ^{14}C dates, at least 3400 years of cultural activity is represented at these sites. This includes the most extensive fishing-related artifact assemblages on the Oregon Coast.

Environmental Setting

Geology and Geomorphology

In the valley of the Coquille River, geological and hydrological processes have created a narrow river-dominated estuary bordered by an extensive alluvial plain. The river mouth is bordered by a sand spit, dune fields, and rocky outer coast settings. Among the estuaries of the Oregon Coast, the Coquille has one of the most extensive tidewater lengths, extending inland some 40 miles (65 km). However, in surface area the estuary is comparatively small, primarily consisting of a narrow river channel surrounded by alluvial lowlands. In the lower estuary (below river mile 10) the intertidal zone ranges in size from a narrow strip of mudflat between the main channel and the steep river bank, to an expansive tidal flat and salt marsh near the mouth of the river. The outflow of the Coquille is comparable to that of the Nehalem and Alsea rivers, and varies seasonally, being as much as 10 times higher in winter than in summer (Proctor et al. 1980:2-41, 42).

On summer days the lower Coquille River Valley appears as a wide lowland surrounded by forested hills. The river flows through this lowland in a tidal channel that gradually widens as it nears the ocean. In winter this scene is often quite different in much of the valley. Frequent rains and coastal storm surges conspire to raise water levels in the estuary, at times submerging thousands of acres of lowlands.

Because most of the precipitation in the region occurs between late fall and early spring, freshwater levels in the Coquille fluctuate considerably, being highest December through March and lowest June through September. Water levels in the lower estuary are determined primarily by tidal action. Mean tidal range in the lower Coquille is 1.6 meters overall, and 2.1 meters diurnally (Proctor et al. 1980:2-52). During spring tides, the range may be over 3 meters.

The intertidal portion of the Coquille Estuary has been reduced by wetland drainage and marsh accumulation in historic times (Proctor et al. 1980:2-41, 2-49). Constructed dikes border many of the fields, and tidegates have been built across tributary channels that were once tidally influenced. Before the mid- to late 1800s, when American settlement brought intensive farming to the Coquille Valley, many of these fields were marshes, and tidal channels formed an extensive network through the lowlands (Benner 1991).

The lower portion of the Coquille River channel opens into the broader Bandon Marsh area on the south shore. An 1862 description of the area suggests that this part of the estuary was more expansive in the past than it is today.

The widest part of the mouth is less than 200 yards, after which the river spreads out into a large sheet of shallow water, about two miles long by three quarters of a mile broad, and bounded by low ground. Into the northeast part of this lagoon enters the river, which has been followed [by the survey team] a distance of 30 miles in a northeasterly direction, and having a depth throughout of not less than 15 feet, and an average width of 40 yards. It drains a very fertile region, densely covered with many varieties of wood (U.S. Coast Survey 1862:349).

According to this report, much of the lower two miles of the estuary was three-fourths of a mile wide when surveyed in 1860, with large marsh or mudflat areas covered with driftwood (see D. Hall 1995:72). Today the estuary is no more than one-fourth of a mile wide. What was once described as a bay is now a tidal river channel, bordered by emergent marsh on inland stretches and on portions of the sand spit. Some of the difference in width between then and now may be due to the accumulation of silts and windblown sands, or tectonic uplift (D. Hall 1995). But geological research (Witter 1999) and my archaeological research (this chapter; Byram and Witter 2000) indicate that relative sea-level rise and stabilization, along with continual input of river-borne sediments, also account for much of this change.

Accounts of Weir Fishing on the Coquille

Historic accounts of weirs in the lower Coquille River date to 1851. These derive from the initial military presence in the area, when members of the T'Vault expedition first explored the entire tidewater portion of the Coquille River. T'Vault's party reached the river from the interior after being lost and short on food for several days. On September 14, 1851, the party traveled the length of tidewater to the coast by canoe. A member of the expedition whose journal has survived, Loren L. Williams (n.d.), observed many large fish weirs which he said were still being constructed, as they were “nearly complete.” Williams may have meant the weirs did not extend all the way across the river as others he had seen upriver probably had. The “nearly complete” weirs indicated to Williams that the salmon season was at hand.

Williams' account of weirs in the tidewater portion of the Coquille is important but somewhat problematic. He implies that these structures, when completed, would have extended all the way across the river. This is unlikely for two reasons. First, as noted above (U.S. Coast

Survey 1862:349), channel soundings taken the same year show the entire tidewater segment of the river was at least 15 feet deep, and based on soundings shown on the 1861 Coast Survey map, this was apparently the high tide depth. In a river this deep, a weir would have to be nearly five meters tall in the deepest part of the channel to block fish during high tide. Even if such a structure was used to block fish only during low tide, it would have to be 2.5 to 3.5 meters high to be effective. No other accounts of weirs in the region describe structures built in water this deep, and the size of most weir stakes is not consistent with such lengths. Even the largest weirs on the Klamath River were built in less than 2 meters of water, well above the estuarine portion of the river (Kroeber and Barrett 1960:13; Swezey and Heizer 1993).

Large fish dams for salmon were built and used by large groups of people in the upper, non-tidal portion of the Coquille River (Chapter 3). These weirs probably extended across portions of the upper Coquille River that were very shallow compared with the lower estuary near the Osprey site. Historic accounts make it clear that extensive fishing structures were built in or near the lower estuary. One such account is recorded by Col. Silas Casey, who led a devastating U.S. military attack on Coquille villages in November of 1851. After traveling the tidewater length of the river Casey (1851:12) observed,

I am well satisfied...that [the Indians'] villages are all on the river. I am also satisfied that their principal means of subsistence is the salmon obtained from the river, and that their principal fisheries are at the mouth, and within a short distance of the mouth.

Casey referred to the fishing structures as “fisheries,” a term widely used in historic accounts to describe weirs, nets, and basket traps. Casey’s account is in accord with Williams’ (n.d.) observation of “hundreds” of Indians constructing weirs two to three miles from the river mouth. Given the presence of numerous archaeological weirs along the banks and side channels of the lower Coquille River, the most likely interpretation of both Casey’s and Williams’ accounts is

that they describe tidal weirs built at the mouths of subsidiary channels along the intertidal margins of the lower tidewater portion of the Coquille, probably including the area now known as the Osprey site. Set nets or seines may also have been used there.

It is also possible that the "nearly complete" weirs Williams observed were channel edge weirs, never intended to be built across the entire channel. These weirs may have been built in shallower portions of the river, perhaps to guide fish toward a trap, net, or spearing area, rather than blocking fish passage entirely. Based on other accounts (such as Harrington 1942[26]:217), September 14 seems very late for the onset of weir construction, which also suggest these were complete functional weirs at the time of Williams' visit.

Another possibility is that some of the fishing devices Williams described as weirs were actually nets, or a combination of weirs and nets, which stretched all the way across the river. Substantial nets stretching across the tidewater portion of the river are noted in Casey's (1851:5) account from later that same year. When interviewed by John Harrington (1942[25]:813, 815), Coquel Thompson mentioned a type of Native fish net which ran half the way across the river. Numerous net weights have been found by archaeologists and collectors along the tidewater Coquille (CITCRP 1999). Some of these weigh several pounds and could have anchored large gill nets.

The 1994-95 Osprey Site Archaeological Project

The first joint University of Oregon/Coquille Indian Tribe archaeological project on the Coquille Estuary was conducted at the Osprey site (35-CS-130) in the summers of 1994 and 1995. The Osprey site is located in the lower portion of the estuary on the north bank (Figure 30). It was investigated because of its large size (750 meters of river bank) and high degree of

preservation, and because the site was threatened by ongoing erosion (CITCRP 1999). The project was partly funded by the State's Historic Preservation Office. In addition to providing cultural resources training for members of the Coquille Tribe, the goals of the project were to map and characterize exposed weir features and lattice fragments, and to recover a sample of stakes for ^{14}C dating and pieces of lattice for conservation.

The Osprey project led to a better understanding of fishing weir technology in tidewater settings. Initial efforts focused on mapping, photographing, and ^{14}C dating the extensive wood stake weir features exposed at the site during minus tides. These features consist of lines or clusters of vertical wooden stakes (Figure 31). They are interpreted as the remains of fishing structures based on ethnographic accounts of tidewater weirs and their settings, feature orientation in relation to tidal channels, and their location on intertidal mudflats and channels edges (Moss and Erlandson 1994; Byram and Erlandson 1996; Chapter 4).

Figure 30: Map of the Osprey and Philpott Sites, Coquille River



Figure 31: Wood Stakes Exposed by Erosion at the Osprey Site, 1997.
(feature L3 area; stakes have since been lost to erosion).

Historic Documentation of Changes at the Osprey Site

Like the Coquille Estuary as a whole, the Osprey site environment has changed between the time the weirs were in use and today. This is evident from historic accounts, early maps and aerial photos, and site stratigraphy in relation to weir configuration. Evidence suggests that the intertidal area north and east of the Osprey site was larger prior to Euroamerican settlement and the onset of agricultural activity along the Coquille River. Prior to this, the site occurred along the southern margin of a larger intertidal area that extended northeast of the site.

Williams (1878) noted numerous sloughs, or subsidiary tidal channels present in the surrounding area. He described a village on the north bank of the river, approximately two miles from the mouth, as being the largest village on the river. Approaching the village, the party observed many Indians and 20 or more canoes coming out of “little sloughs and bayous on each side” (of either the river or the village). It is likely the village he described is 35-CS-2/3, which is adjacent to the Osprey site (Tveskov 2000; Erlandson et al. 2001). The area with sloughs and bayous that Williams mentioned probably would have included the area surrounding the Osprey site. According to Williams, some of these sloughs were large enough to be navigable by canoes.

Aerial photos depicting the Osprey site area have been taken periodically since 1939. These show how the site environment has changed from an expansive intertidal area to a narrow intertidal channel bank, as reconstructed in Figure 32. Historic topographic maps also show the changes in the environment surrounding the Osprey site. The shrinkage of intertidal areas northeast of the site apparently stemmed from the diking of the Coquille’s north bank and the tidal channel that extended northeast of the Osprey site. The 1895 map of the lower Coquille area shows a small cove or tidal delta where the Osprey site is located. This indentation does not appear on the most recent U.S.G.S. topographic map of the area. The 1895 map also shows that the channel of the slough that had crossed the Osprey site was diverted southward prior to this time. Benner’s (1991:3.2-44) reconstruction of the topography in the Coquille River bottomlands, based on land survey notes, shows a marsh encompassing the bottomlands northeast of the site and following the edge of the bluffs which skirt the river valley. Currently this bottomland is fed by a large creek and a few spring drainages, but it was most likely a tidal wetland in the past. Thus, it is likely that the Osprey site was used during a period when intertidal channels and mudflats were considerably more extensive than today.

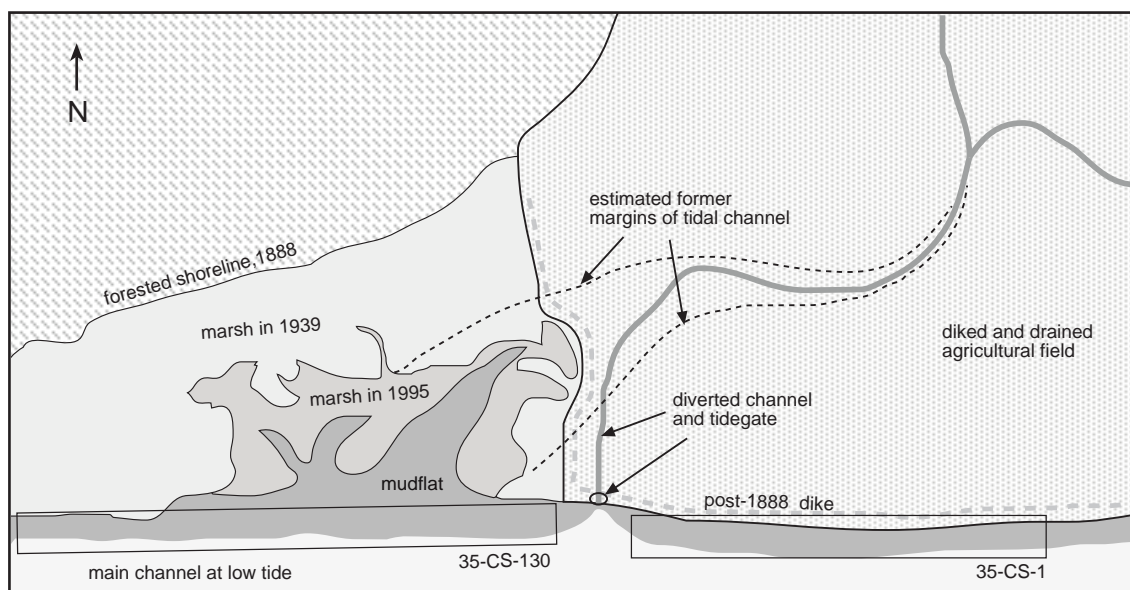


Figure 32: Marsh Accretion at the Osprey Site (reconstruction based on 1888 U.S. Coast Survey map and aerial photos from 1939 and 1995; intertidal sites marked by rectangular boxes).

Archaeological Field Investigations

Investigations in 1994 focused on mapping the extensive weir features at the Osprey site. Our goals were to thoroughly document the exposed weir and lattice features at the site with photographs, illustrations, video, and detailed mapping of individual artifacts and environmental features. While over 1,500 stakes were mapped, the Osprey site is so extensive that a large part of the site remained unmapped after the 1994 field season.

The second phase of the project occurred in May of 1995, which I planned along with Jon Erlandson of the University of Oregon, Sharon Parrish and Jerry Running Foxe of the Coquille Tribe, and Kathryn Bernick, a wet site specialist based in British Columbia. The goal of this

phase was to complete mapping of exposed features, and to recover eroding lattice fragments for analysis and conservation. Geomorphology was conducted by Charles Hodges and Mark Tveskov oversaw the weir feature mapping.

When Jerry Running Foxe and I visited the site in late June of 1995 to assess conditions, we intended to relocate lattice fragments observed during the 1994 mapping project. However, an accumulation of 4-6 cm of loose organic-rich silt blanketed much of the site, obscuring most lattice and many weir stakes seen the previous year. This organic-rich “muck” accumulates in the intertidal zone of the Coquille Estuary during summer (CITCRP 1999). Large floods in the winter of 1994-1995, the first in several years, may have contributed to this sedimentation. Even in the lower intertidal portion of the site, where the loose organic material was not present, river-deposited silts had accumulated since 1994, obscuring cultural materials. Nonetheless, the 1995 project proceeded as scheduled.

Mapping

All exposed weir features not mapped in 1994 were mapped during the 1995 project, though visibility was comparatively poor. Additionally, overall site topography, geomorphology sample units, and excavation units were mapped along with three lattice features not observed in 1994. Because the site is linear and quite large, it was necessary to designate arbitrary areas for the purpose of organization. The western area lies west of the U.S. Highway 101 bridge, the central area extends eastward from the bridge to a point between the two broad tidal channels that drain the marsh north of the site, and the eastern area extends from this point eastward to the current tidegate of the diverted tidal slough.

During both phases of fieldwork, two site mapping techniques were used. First, in areas where weir features were numerous, baseline metric tapes were placed along weir concentrations,

and individual stakes were mapped in relation to points on the baseline. Individual weir features, most consisting of discrete lines of stakes, were mapped (Figure 33). Exposures of lattice fragments were numbered as features (panel 1, panel 2, etc). Second, a transit was set up at three datum locations, allowing the mapping of baseline endpoints, excavation units, and overall site topography. The western, central, and eastern zones of the site were thoroughly mapped during the project.

Additional documentation of features exposed on the site surface included videotaping and photography, with Coquille tribal member George Wasson as lead photographer. Descriptive notes, including stake types and size were taken on several features. These records are on file along with the photographs at the Coquille Indian Tribe Administrative Offices in North Bend.

Geomorphology

Geomorphological analyses were conducted by Charles Hodges, Jon Erlandson, and me. These were aimed at documenting site stratigraphy as well as the soil and sediment formation processes related to landform changes in the site vicinity, with an emphasis on the central and eastern site areas where exposed weir stakes were most numerous (Hodges 1996). The units used to investigate site geomorphology included 30 ¾-inch cutaway auger probes, five 1 m x 0.5 m test units, and five profile scrapes along the channel cutbank running through the site. Additionally, sediments in the lattice feature 8 excavation area were examined. These units were sufficient to identify four general stratigraphic layers (strata), though more subtle variation, particularly within the lower strata at the site, was discernible with the sampling techniques used. It was determined that to more thoroughly study these sediments, future investigations at the site will need to employ coring devices which extract undisturbed core samples.

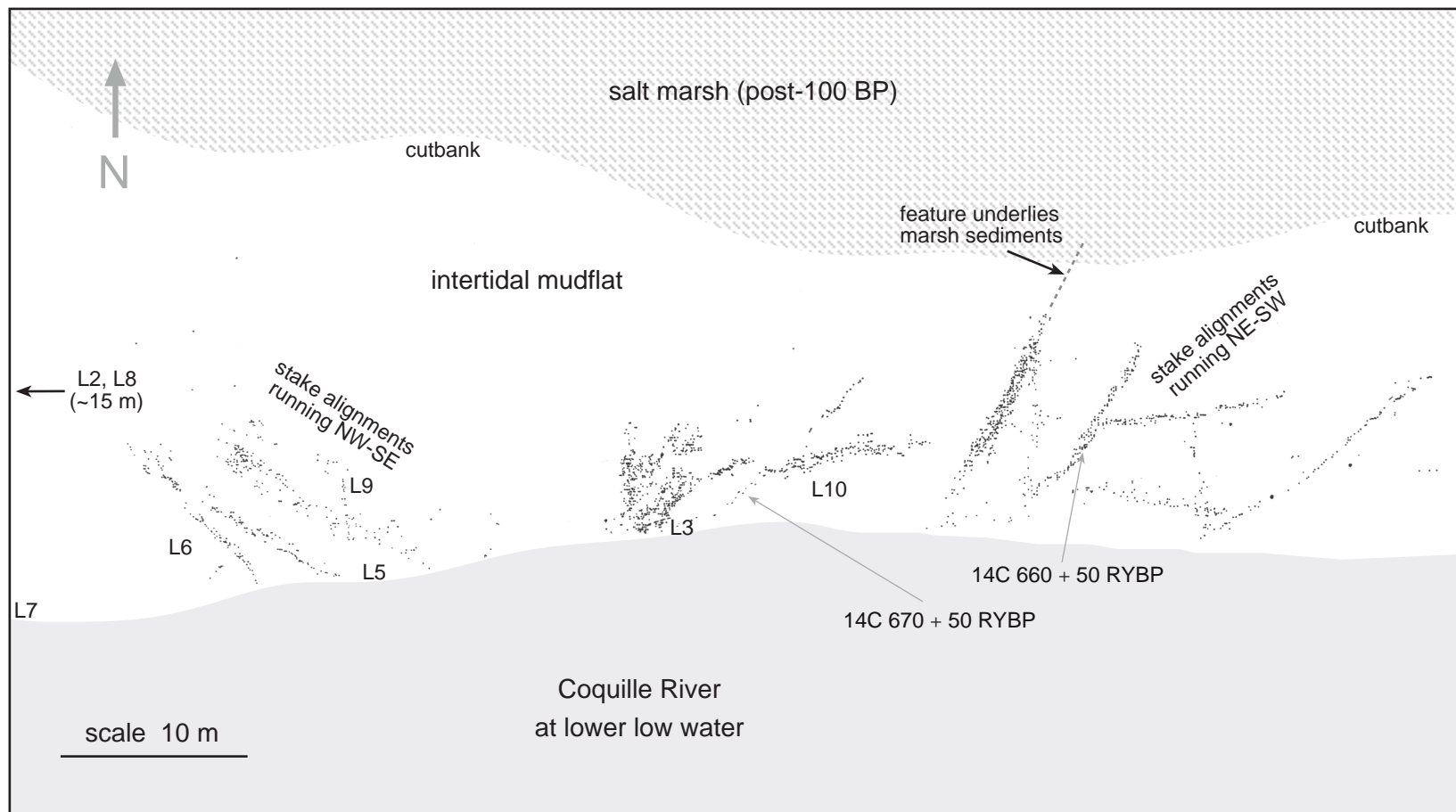


Figure 33: Map of Multiple V-Shaped Weirs in Eastern Area, Osprey Site (35-CS-130). (Dots represent individual stakes; lattice features are designated L2, L3 etc.; stake locations plotted by Mark Tveskov in 1995, and many have since been lost to riverbank erosion.)

Feature Excavation

A major focus of the 1995 fieldwork was the excavation of woven lattice artifacts. Kathryn Bernick and I led the excavations. Donald Ivy of the CIT provided equipment support. As portions of the Osprey site continue to erode relatively rapidly, these excavations targeted areas where lattice was clearly threatened. Lattice panel 2 was initially chosen for excavation because it was relatively high in the intertidal zone and more likely to deteriorate from exposure. However, soon after work began lattice feature 8 was exposed in the drainage trench created for water runoff from the lattice feature 2 excavation. Because of its high degree of preservation, we decided to excavate lattice feature 8, which consisted of four overlapping lattice panels (Figure 34). Later, lattice panel 7 was identified near the surface of the site along the river's edge at low tide. This small lattice fragment was excavated as well, making a total of six excavated lattice fragments.

The excavation of perishable artifacts made from wood and plant fiber presents special problems. Although perishable artifacts may preserve in wet sites for centuries, they are often very fragile and when exposed to the air they may deteriorate rapidly. This is because anaerobic bacteria present in buried sediments eat away cellulose and much of the lignin in wood cells, and only the surface tension of water keeps these saturated wood cells from collapsing. Therefore artifacts such as lattice fragments must be kept wet throughout excavation, transportation, analysis, and treatment. The long-term conservation of degraded wet site wood often involves treatment with a stable material that replaces the water in the wood cells (Barbour and Leney 1981; Bernick 1983; Hamilton 1996).

The excavation of perishable artifacts at the Osprey site involved a very different strategy from most dry land excavation, comparable to excavation at the sites Ozette (Samuels 1991), Hoko River (Croes 1995), and Axeti (Hobler 1976). Instead of shovels and trowels, water was



Figure 34: Overlapping Lattice Panels in Feature 8, Osprey Site (scale in cm; photo by George B. Wasson).

used to excavate site sediments. Water pressure was supplied by four garden hoses attached to a gasoline-powered pump placed on the deck of a supply boat in the river near the excavation. The water washed away the saturated sandy mud, exposing the artifacts. Plastic and aluminum tools such as spatulas, trays, and sieves were used instead of trowels and shovels.

Each of the excavated lattice artifacts was exposed with water pressure, then pedestaled by sluicing a trench around the artifact. When it was determined that a lattice fragment could be freed from the mud with little or no damage, the artifact was more thoroughly exposed with water pressure, then carefully lifted and placed on a sheet of rigid acrylic. This technique worked for

lattice panels 2, 7, and 8-B, but the other feature 8 lattice fragments were too large to be removed in this manner without being damaged. To safely remove the larger panels, an acrylic sheet was slid through the mud below each lattice fragment, and the entire pedestal was lifted and placed on a sheet of one inch thick plywood. Following removal, each artifact in its pedestal was covered in wet muslin fabric. Then the artifact, sediment matrix, and supporting sheet was wrapped in plastic to prevent evaporation during transport to the lab, where the final stages of excavation took place.

Sediments in the excavation area were sampled and screened. Samples of mud were collected from the stratum bearing the artifacts and from each 10 cm level in the sediments below the artifacts. Some of these samples were water-screened over 1/8-inch hardware cloth, and others remain either in wet storage (refrigerated in polyethylene bags) or in dry storage. Few artifacts were found in the screened material, consisting solely of loose lattice warps. These and other loose fragments of lattice in the excavation area were also collected and stored in polyethylene bags.

Lab Methods

The excavation of the feature 8 matrix blocks took place in the laboratory at the University of Oregon's State Museum of Anthropology in Eugene. I conducted this phase along with Kathryn Bernick and Denise Hockema. The initial step was to establish a drain station with low-pressure water sources, achieved with tap water and spray bottles. Saturation of exposed lattice was maintained through frequent mist spraying. Areas not being worked on were covered with wet muslin fabric.

Because of the large size and fragile nature of the lattice elements, techniques used in most basketry excavations were not possible. The lattice panels would not stay intact if lifted from the mud by hand, to be floated and cleaned in water tanks. Instead, to remove the lattice

from the mud, an adjustable wooden frame clamp was constructed and positioned around the lattice and its mud matrix. The top of the frame was removed, and several rigid wires were carefully pushed through the mud underneath the lattice, forming a supporting mesh.

Once the wire formed a complete mesh under the lattice, the top of the frame was replaced, anchoring the ends of the wires in the frame (Figure 35). The lattice was then gently lifted from the mud. With the lattice resting on the wire supports it was cleaned, while being frequently sprayed with mist. Brushes and bamboo sticks were used to clean the lattice, and the attributes of each piece were recorded at this time. Once cleaned, the lattice, wire mesh, and frame were

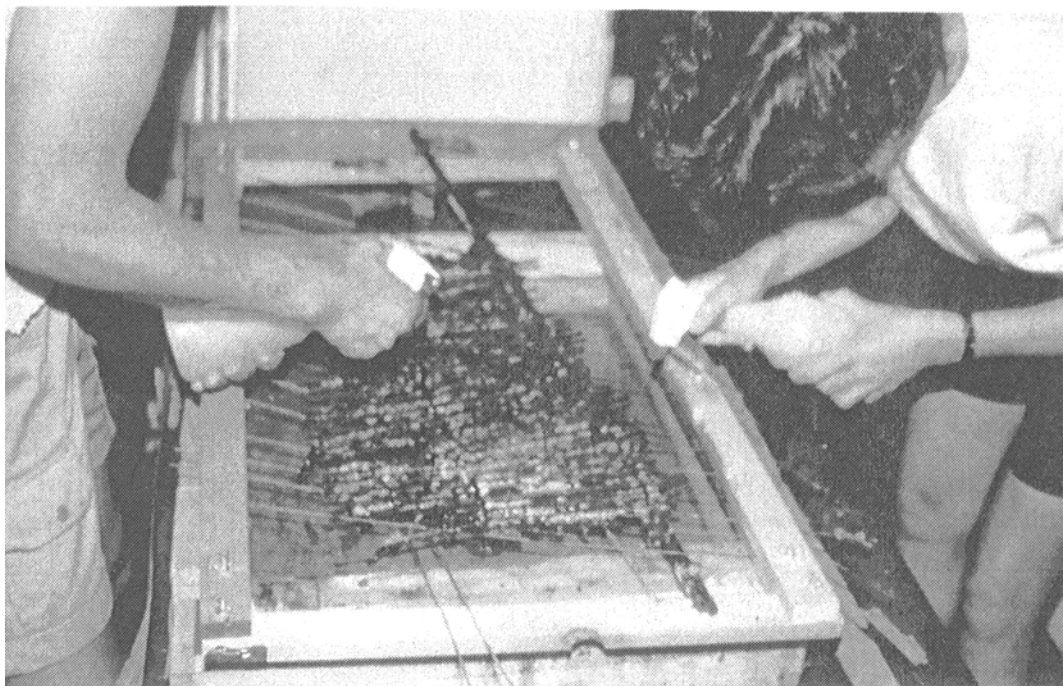


Figure 35: In-Lab Excavation of Lattice (photo by Madonna Moss).

placed on a layer of nylon mesh (window screen) on an acrylic sheet supported by blocks the same thickness as the frame. Next the frame clamps were released, and the wires removed one by one from beneath the lattice. With the mesh and frame removed, the lattice rested directly on the nylon screen and acrylic sheet. A nylon screen cover was placed over the lattice and sewn to the layer underneath the lattice. It was then placed in a shallow tank of tap water for temporary storage.

The wire mesh and frame technique proved highly successful, and even the more delicate portions of the lattice remained intact through this process. However, nearly all of the lattice changed color within a few hours after exposure to air. Most of the newly exposed wood was medium brown in color, resembling non-deteriorated wet conifer wood, but the wood became dark brown and black in color, probably due to the interaction of the wood with minerals in surrounding sediments, which form iron tannates and sulphides (Croon 1990:250).

This wire mesh frame technique was used again during the conservation treatment of Osprey site lattice with silicone oils. This technique, referred to as passivation polymer conservation, was chosen because it imparts long term stability to artifacts of wood. It has proven effective through several experiments conducted at Texas A&M University (TAMU) Archaeological Preservation Laboratories (Hamilton 1996). I conducted the treatment of the Osprey lattice along with Denise Hockema, under the supervision of Wayne Smith and Helen Dewolf of TAMU.

Like other conservation techniques involving polyethylene glycol and other bulking agents (see Barbour and Leney 1981), the goal of the passivation polymer technique is to replace the water in deteriorated wood cells with a bulking agent that is stable, thereby preventing cell wall collapse and resulting shrinkage and splitting of the artifact (Smith 1996). The technique

involves dehydration through several stages of immersion in baths of water/alcohol, alcohol/acetone, and acetone solutions. Once dehydrated, the wooden artifact is moved from the acetone bath to a hydroxyl-ended silicone polymer in solution with a crosslinker, methyltrimethoxysilane (MTMS). The polymer solution replaces the acetone in the wood with no noticeable loss of bulking in the wood cells. The treated wood is then sealed in a container and exposed to a vapor catalyst that activates the crosslinker, transforming the silicone oil into a stable solid that bonds with the cell wall. The half life of silicone polymer is estimated to be over 200 years (Smith 1996). In general, the results were good for Osprey lattice specimens, although we determined that gradual dehydration, over a period of several weeks is necessary to prevent warping of wood in the conservation process. The artifacts are now curated and displayed at the administrative offices of the Coquille Indian Tribe in North Bend, Oregon.

Interpreting the Osprey Site

Site Structure and Chronology

The Osprey Weir site extends for over 600 m along the north bank of the Coquille River. By the end of the 1995 project, over 2,000 individual wooden stakes had been mapped at the site. Most of these are found in linear features, more than 40 of which have been identified. Additionally, 11 lattice fragments have been identified. Unfortunately, since 1995, erosion of the Coquille River's north bank has been severe and large portions of the Osprey site have been lost, along with hundreds of weir stakes and several lattice fragments (CITCRP 1999).

Understanding changes in the site environment was a central goal of the Osprey project. Research on this topic involves site chronology and stratigraphy. There are currently seven ¹⁴C dates available from the Osprey site, two from weir features in the eastern area, two from the

central area, one from a weir in the western area, and one from lattice panel 8-C. All seven dates are based on the analysis of well-preserved segments of wooden stem stakes (branch or trunk segments) and one lattice panel element. When calibrated to calendar years, these dates range from approximately 850 BP to after 250 BP, with four in the 650-550 BP range. Three weir stakes from the eastern site area date to approximately 650 BP, two from separate weirs in the largest concentration of weirs at the site and one from below lattice feature 8. The two most recent weir stake dates are from weirs in the central area, and the oldest date comes from a stake in a western area weir.

Hodges (1996) summarized our 1995 geoarchaeological investigations at the Osprey site, documenting four distinct strata at the site (Figure 36). The lowest stratum is Stratum IV, a dark, blueish gray fine loamy sand that underlies portions of the site in which weirs and other cultural material occur. Many of the weirs in the eastern site area are embedded in this stratum, which may represent intertidal sediments that accumulated prior to or during site occupation. Above Stratum IV, exposed in cutbank profiles along the northern edge of the intertidal zone, Stratum III is a relatively homogeneous fine sandy loam. Unlike Stratum IV, Stratum III shows little evidence of soil formation, suggesting it was deposited rapidly. Hodges suggested three possible events that may account for this stratum: 1) a large storm surge coupled with an extreme high tide; 2) a tsunami, possibly occurring with an earthquake and subsidence episode; and 3) a large flood on the Coquille River.

Stratum II overlies Stratum III and represents the marsh soil present in many areas north of the site. In places, this soil exhibits signs of being a very recent development, as is seen in many other salt marshes in the region (Witter 1999). Stratum II is subdivided into three sub-strata that vary in color from brown to blueish gray and in texture from fine sandy loam to silt/clay loam. Extensive organic materials (including living roots) are present in this stratum and milled

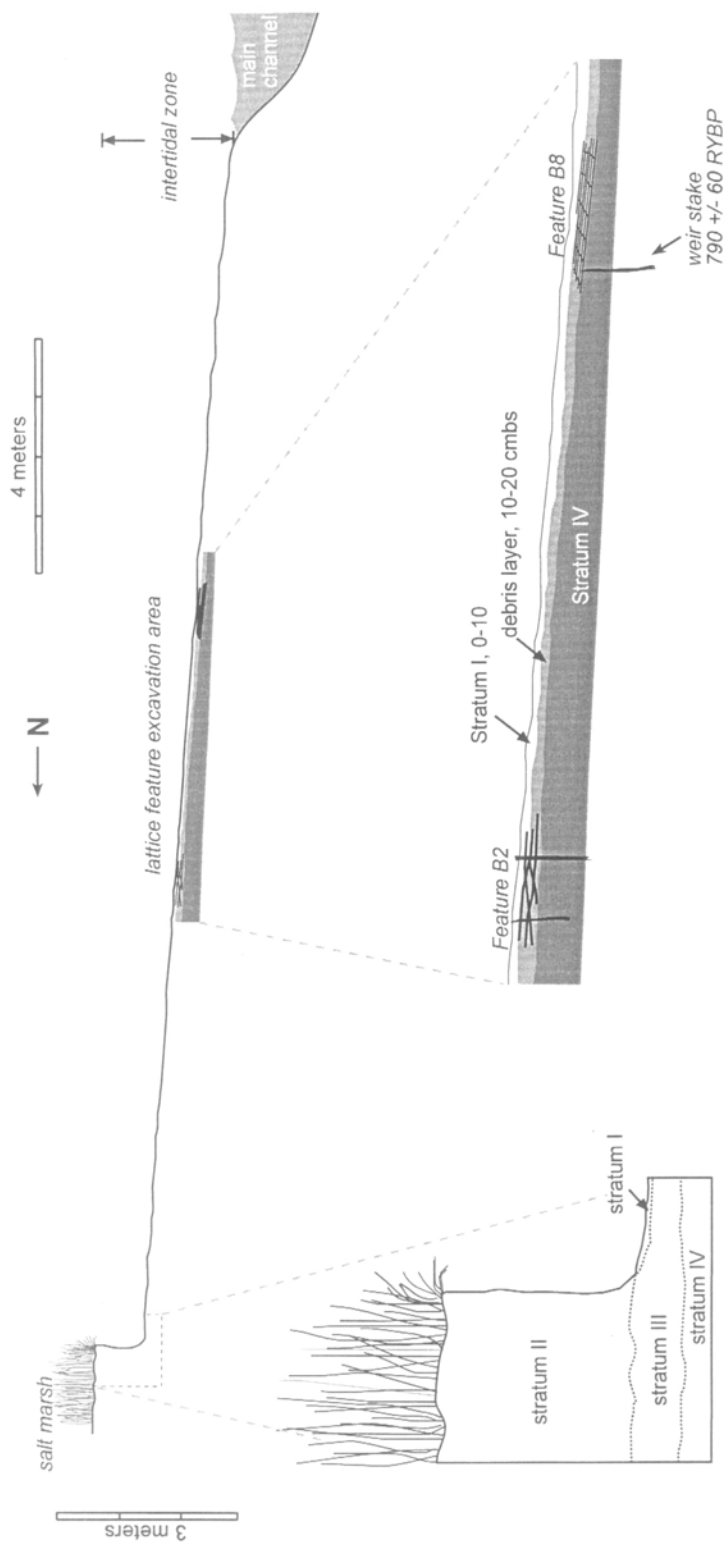


Figure 36: Stratigraphy of the Osprey Site (running north-south through lattice features 2 and 8 excavation).

wood has been observed in this stratum approximately 50 cm below the salt marsh surface.

Stratum I occurs on the surface of the intertidal zone adjacent to the salt marsh cutbank. This sediment includes the silty organic-rich muck deposited over the winter, as well as the eroded remnants of slump blocks of Stratum II and III material that have collapsed along the river bank.

During the excavation of lattice features 2 and 8, an extensive layer of peaty organic debris was identified on the surface of Stratum IV. This organic layer, which included the lattice features, was about 5 to 10 cm thick and composed of bark, twigs, leaves, and more fragmented and less identifiable organics. This organic material is probably the remnants of organic flotsam periodically deposited in the middle to upper intertidal zone of many mudflats of Oregon Coast estuaries.

Hodges concluded that much of the salt marsh adjacent to the recorded portion of the site postdates weir construction. During 1995 fieldwork, Jon Erlandson excavated a test unit at the northern edge of a weir exposure in the eastern site area and found that this weir was positioned stratigraphically below Strata II and III. Given the slope of the weir features in profile, and the slope of the Stratum IV surface identified in probes across the site, it appears that the intertidal mudflat surface on which the weirs were constructed was much more flat than the site surface is today. This seems to fit with interpretations based on aerial photos and historic maps that the intertidal area in which the eastern weirs were built and used may have been much more extensive than it is now. The eastern site area may have had a gradient similar to that of the central and western portions of the Osprey site.

Weir and Lattice Features

The many lines of wooden stakes at the Osprey site are all interpreted as the remains of fishing weirs. Some non-linear features (e.g., clusters of large posts resembling pilings) may be

sets of stakes used to anchor basket traps, or “dolphins” used to tie canoes. These smaller features are unlikely to be confused with more extensive weir features, however, since only lines of stakes are considered in this discussion of weir features.

Among the wood stake weirs mapped at the Osprey site, there appear to be two feature types. These configurations may represent different types of weirs, or different degrees of preservation and visibility. In the eastern area the densest concentration of weir lines appears to consist of the arms of broad V-shaped weirs positioned across what may have once been the mouth of a large tidal slough channel (near lattice Feature 3 in Figure 33). The weir lines in the eastern part of this cluster run predominantly in a northeasterly direction, while those in the western half run mostly in a northwesterly direction. These may be the remnants of several V-shaped cross-channel weirs repeatedly built across the former tidal channel of the tidal slough that extended northwest of the site.

In the central and western areas, no clusters of weir lines indicative of rebuilding have been recognized. In these portions of the site, some weir lines are oblique to the current river channel, some are nearly perpendicular to the river bank, and a few are almost parallel to the current channel edge. The oblique alignments may be partial remains or limited exposures of V-shaped cross-channel weirs, as are found in the eastern area. These weirs may also have been single lines running across a channel or a small flat, perhaps guiding fish with the receding tide toward a basket trap. Those weir lines in the central and western areas that are nearly perpendicular to the main channel of the Coquille River may be the remains of channel margin weirs, rather than cross channel tidal weirs. Because of their position perpendicular to the main channel, these may have been built to impede fish passage in the river rather than in tidal channels draining from the north. It is also possible that small side-channels or sloughs

meandered as they met the main channel, and that the weirs in the central and western site areas were built across such channels.

Overall variation between the east area weirs and those in the central area can also be seen in stake types used, though there has been no systematic sampling of weir stakes from every feature. Three stake types referred to in Chapter 4 are present: stem stakes, brush stakes, and split wood stakes.

Of the three stake types, brush stakes appear to be the least common at the Osprey site. Most of the un-split stakes are stem stakes, round in cross section but lacking the numerous small branches of brush stakes. Stem stakes observed at the site range from 1.5 to 12 cm in diameter, with most in the 2-4 cm diameter range. Of 10 stakes collected, length ranges from 40 cm to over 70 cm. The distal ends of these stakes show signs of having been broken by bending or by chopping and bending. Bark is often retained on the buried portions of the stem stakes, and branches are usually retained but sometimes appear to have been removed. Split wood stakes range in size from 2 cm x 2 cm to 5 cm x 10 cm in cross section, probably averaging about 3 cm x 5 cm, but none were collected from the site. Larger split wood planks over 10 cm wide are visible in parts of the eastern area. In one cut bank exposure in the lattice feature 3 area, two such planks were integrated into a buried weir, placed on their sides in line with the weir, possibly to provide added fencing near the apex of the weir.

In all areas of the Osprey site, stem stakes 2-4 cm diameter appear to be most common, as they are at many other sites (Chapter 4). But differences can be seen in the distribution and frequencies of large stem stakes, split wood stakes, and brush stakes. Weirs incorporating large stem stakes and split wood stakes of various sizes are most common in the eastern site area, where they typically form closely spaced, narrow lines. Some of the stakes in these eastern weirs are very well preserved, with portions of stakes protruding as much as 40 cm above the mudflats.

Brush stakes are most common in the central area, where several weirs consist of diffuse lines of numerous small stem stakes and narrow branches, creating what appears to be a nearly impenetrable but low (25 cm) wall of brush. Fewer data are available about stake variability in the western area, but average-sized stem stakes appear to be most common there as well.

Stake spacing varies across the site, sometimes considerably within a single feature. This is probably due in part to differential preservation resulting from channel cutting, selective removal of stakes for recycling, and other disturbance, as well as maintenance and re-use (removal of stakes for use elsewhere). To compare stake spacing in the eastern and central areas, maps of individual weirs were examined for areas where stake spacing appeared most regular. The mean number of stakes per meter in weirs from the eastern area is 9, with highs of 20 and a low of 3. The mean number of stakes per meter in weirs from the central area is 12, with a high of 30 and a low of 4. The lower mean density of stakes in the eastern weirs, however, may be offset by the larger size of the stakes in this area.

It appears stakes were spaced relatively densely at the Osprey site, which seems to be typical of weir sites in tidal channels (Chapter 4). The Osprey site is also one of the few recorded sites on the Oregon Coast with weirs that may be of the channel margin type. However, ethnographic data suggest that with some exceptions, stake spacing may have varied little between tidal weirs used in different tidewater settings for different purposes. Configuration and setting or other weir characteristics may be much better indicators of weir function.

Lattice Descriptions

Ten features of split wood lattice have been identified at the Osprey site. Most of these were in the eastern area, where six lattice panels from three features were excavated in 1995. The term feature is used to describe an *in situ* concentration of lattice panels, while fragment, panel,

and artifact are terms used to refer to individual lattice specimens. The detailed attributes of Osprey site lattice are discussed in Chapter 7.

Except for Feature 8, the Osprey lattice features consist of a single section of intact lattice, or closely positioned fragments that appear to be from a single panel. Each includes woven weft and warp elements laying horizontally on the surface of the site, primarily in the lower intertidal zone. Lattice features 1 through 6 were photographed during 1994, when samples were taken from loose warps and wefts in some features for possible species identification or ^{14}C dating. Lattice feature 4 was recorded among these, but it was later determined that this feature was within the boundaries of the Philpott site (35-CS-1). Feature 4 appears to consist of multiple panels, also positioned horizontally, but exposed in the cutbank of the main channel. Lattice features 2 and 4 are the only features recorded in 1994 that were examined again during the 1995 project. Both had deteriorated severely during the intervening period. Lattice features 7, 8, and 9 were first observed in 1995, when features 2, 7, and 8 were excavated that year.

Most of the lattice panels documented at the Osprey site are finely made artifacts, with semi-rigid warps 3 to 7 mm in diameter and smaller and more flexible weft elements (see Chapter 7). In the larger, better preserved lattice panels, such as panels 1 and 8-C, split wood warps are a meter or more long, varying little in thickness over their entire length.

Lattice feature 8 was the primary focus of the 1995 excavation efforts. The feature consists of four lattice panels (8-A, B, C, and D), in an exposure nearly 3 m east to west by 1.5 m north to south (Figure 37). Particularly unusual in this feature is the presence of thick, rigid pieces of split wood, attached to the lattice in panels A and C. This suggests that these panels were incorporated into a rigid, flat structure, rather than rolled into cylinders. Therefore, the feature 8 panels are interpreted as the remains of weir panels rather than elements of basket traps. Three of the feature 8 panels are nearly identical in lattice construction. This, along with their relative

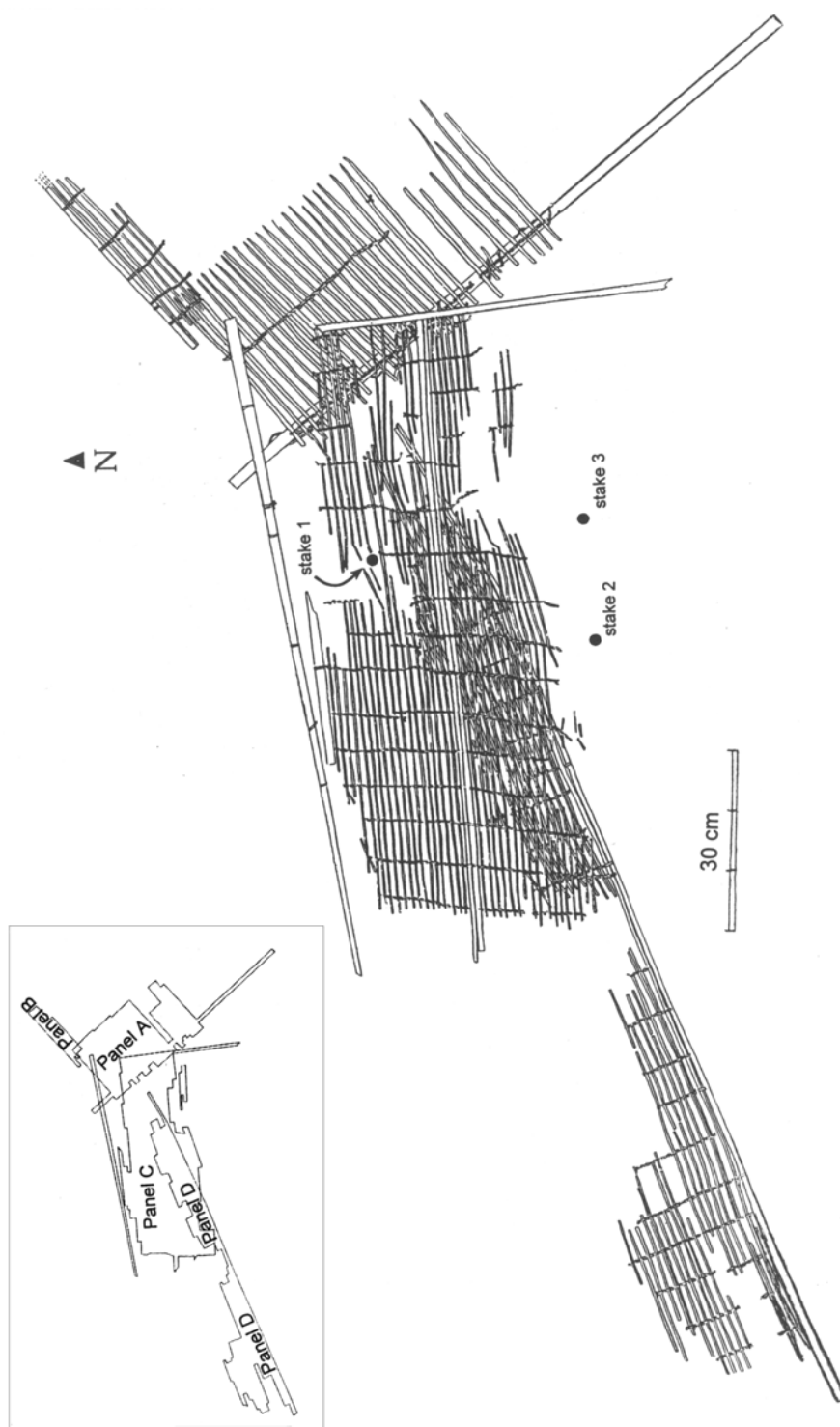


Figure 37: Plan View of Lattice Feature 8, Osprey Site Excavation

positions and certain other characteristics, suggests the feature may be the remains of a collapsed lattice weir.

Panels 8-B, C, and D share many characteristics. They are identical in warp diameter and weft spacing, with nearly the same gauge (8-9 mm). Each is twined with a full-turn twining technique, although panel B is twined with an S twist, while panels A, C, and D are twined with a Z twist. One other unusual characteristic seen in 8-B, C, and D is the incorporation of occasional warps of larger split wood or even stem wood. These larger warps are often 4-5 times the diameter of the split warps which make up most of each panel. The larger warps typically extend beyond the edge of the normal warps in the better-preserved panels, as though they were intended to anchor the panel to a rigid structure. Therefore they are referred to as support warps.

On Panels A and C, thicker boards have been attached, apparently to maintain flatness and rigidity in the panel, and possibly to support the panel vertically. These boards range from 2-3 cm in diameter, and one on Panel C is attached by selvage at weft rows 5, 6, 11, 14, and 15 (from west to east). A second board lay along the east edge of Panel C but did not appear to be attached to the panel with weft or lashings, though it may have been loosely attached at one time. The board along the west edge of Panel A is attached with a spiral lashing along one of the two widely-spaced weft rows in this panel (see Figure 37). Panel A has many unusual characteristics that suggest it served a special function requiring greater flexibility.

Two sets of weir lines were uncovered during the feature 8 excavations. One line, immediately south of Panels C and D, consisted of stakes that appear to have been broken by compression when the wood was in good condition. (Breaks in ancient wood show little evidence of longitudinal fibrous structure at the time of the break; they break more like a carrot than a wooden stick). Stakes with snapped tops such as these have been observed in other Oregon Coast weir sites. The lack of weathering on the upper portions of these stakes suggests they were broken

at or below the mudflat surface and buried soon afterward. If the feature 8 panels were part of a weir that collapsed in this location, these snapped stakes may have been support stakes for one or more panel, and they may have broken during the same event that collapsed the panels. The second weir was found beneath the northern edge of Panel C. The top of one stake from this weir, ^{14}C dated to 790 ± 60 RYBP, was buried beneath the lattice, and weathered to a splintered point, typical of stakes exposed above the mud in the intertidal zone. Coupled with good wood preservation below its weathered top, this suggested that the feature 8 lattice was no more than 650 years old, and that a stable intertidal surface existed for a time about 10 cm below the top of the stake, before the deposition of Panel C.

In 1999, a ^{14}C sample from lattice panel 8-C was submitted for analysis at Beta Analytic. The sample was dated to 180 ± 50 RYBP, putting it in the post 250 BP period. This is currently the youngest ^{14}C date from a Coquille intertidal site. As the lattice in this feature is more complete than other fragments at the site, it is possible this feature represents the remains of a collapsed structure, such as a section of weir or a lattice enclosure or trap. The snapped stakes nearby may have supported the panels and broken during the same event that toppled and buried the panels. Two known events that fall within the time range of the 8-C ^{14}C date are the earthquake and tsunami of AD 1700 (Nelson et al. 1995; Byram and Witter 2000), and the destruction of Native peoples' fisheries during attacks by the U.S. Military in 1851 (Casey 1851).

Additional characteristics suggest that lattice feature 8 may have been a relatively permanent tidewater structure while it was used. Each of the four panels had considerable barnacle growth on their surfaces. During the final stages of excavation in the lab, it was determined that these barnacles were as dense on the downward face of each panel as they were on the upward face. As barnacles depend on exposure to moving water for growth, it would have been impossible for these shellfish to have grown on the downward faces of these panels after

they had fallen onto the mud. And on most other objects exposed in estuary muds, barnacles occur on upper, exposed surfaces only. According to one Native elder's account, some basket traps were permanent, and barnacles grew on them (M. Jacobs 1934[91]:110; see Chapter 3). The presence of comparable barnacle growth on both upward and downward faces of the Osprey feature 8 panels may suggest that barnacles grew on the panels while they stood upright before they collapsed.

If the feature 8 lattice panels were part of a single composite structure that stood in place in a tidal channel setting, they may have formed part of a lattice panel weir with one or more gates. These gates could have been opened with ebb tides and closed with flood tides, and they may have been positioned as shown in Figure 38. If it was positioned in a relatively protected setting, such as a narrow tidal slough, this type of weir may have been well suited to multi-season harvests of herring, perch, salmon and other fishes that move into these settings through the course of the year. The gates could have been left open when the weir was not in use, allowing fish passage.

Summary of Fishing Technology at the Osprey Site

At the Osprey site, most of the weir features in the eastern site area appear to be the remains of V-shaped cross-channel tidal weirs built repeatedly across the mouth of tidal slough channel that once drained an extensive tidal wetland northeast of the Osprey site. Weirs in the central portion of the site are less clearly configured, but they may have been built across the tidal channel that crosses the site today. Those in the western portion of the site were likely associated with another tidal channel that drained a smaller area to the north.

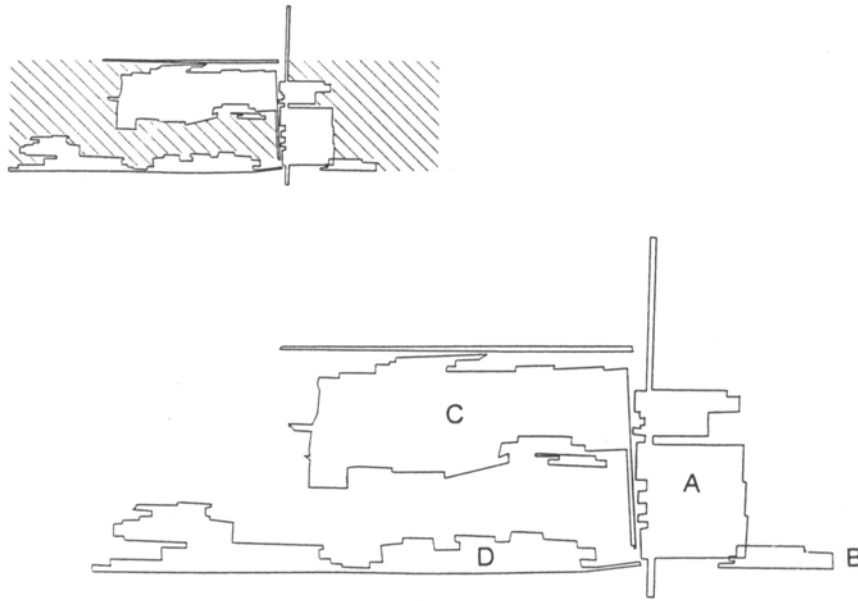


Figure 38: Reconstruction of Lattice Feature 8 Panels (as they may have appeared in vertical position; panel A hypothesized as a moveable gate, with warp ends fixed to panel B).

Some of the weir stake alignments at the Osprey site may be the remains of channel edge weirs. However, channel edge weirs are rarely if ever described in the ethnographic and historic material from the Oregon Coast (Chapter 3). Because of the extensive landform changes evident at the site, it is not clear that any of the Osprey weir features are actually of this type. Few examples are currently available for interpreting the possible use of channel edge weirs along the Coquille River. These may have been used during salmon runs for spearing or trapping, or they may have been used in conjunction with set nets for salmon, as they were at Smith River in northwest California (Drucker 1937:232; see also Stevenson 1998). Or they may have been used

with basket traps, similar to the ooligan weirs described by Boas (1966:24) at Knight Inlet, on the British Columbia Coast.

As for the extensive split wood woven lattice technology represented at the site, it is clear that at least some pieces represent the remains of weir panels or other semi-rigid structures. Other fragments may be from cylindrical basket traps, which are widely described ethnographically. The close association of panels 9 and 11 with linear weir features suggests these two panels were used in conjunction with closely spaced wood stake weirs. However, panels 8A, B, C, and D may have been part of a structure composed largely of lattice panels, with loosely spaced wood stake supports. The more open weaving of robust elements seen in panel 2 may represent yet another technique, the portable lattice weir. Variation in archaeological lattice is discussed more fully in Chapter 7.

There is likely a diversity of fishing technology represented in the four or more centuries of archaeological deposits at the Osprey site. Wood stake weirs are the most visible remains of fishing activities, but lattice features show considerable technological variation. Yet the spatial variation at the site appears to reflect more than technology. Analysis of Osprey site structure has benefited from subsequent work on weirs and landscape change across the lower Coquille Estuary.

Weirs and Landscape Change: Developing a Hypothesis

With only six of over 50 weir features at the site dated, interpretations of site structure involving chronology are possible at only a general level. At the close of the 1994-95 Osprey site project, I proposed a model of landscape change that was modified as new data were gathered from other Coquille weir sites. The initial version of this model focused on horizontal variation in

the age of weir features relating to hypothesized changes in topography stemming from tectonic subsidence and uplift.

The cluster of three stake alignments in the eastern area dated to about 650 BP, and the presence of older and younger weir features in the other site areas suggested the possibility that the position of the weirs shifted laterally through time. This hypothesized shift may have occurred in response to changes in the conformation of tidal slough channels over time (Byram 1997). I proposed that because the nearby wetlands were slightly higher in elevation moving eastward, as uplift raised the floor of the estuary the inlets to tidal channels would have shifted westward. Following subsidence episodes, the channels would shift eastward as the estuary became deeper. I suggested that the widespread Cascadia subsidence events at 800 BP and 250 BP Nelson et al. (1995) bracketed the east and west ends of the site. The single earlier date of 830 BP from a weir stake in the western site area was suggested to represent an earlier, pre-subsidence shift westward in weir placement.

An opportunity to test the proposed landscape changes arose in 1997, when an unfortunate erosional episode exposed previously buried fishing weirs at the Philpott site (35-CS-1), immediately east of the Osprey site.

Weirs and Evolving Wetland Landscapes

1997 Philpott Site Project

The spatial and chronological patterning first observed at the Osprey site became clearer during later investigations at the Philpott site (35-CS-1). In summer, 1997, research was conducted here in response to a major episode of erosion that had occurred at the site during the previous winter (Figure 30). The Philpott site had previously been investigated in 1978 by a team

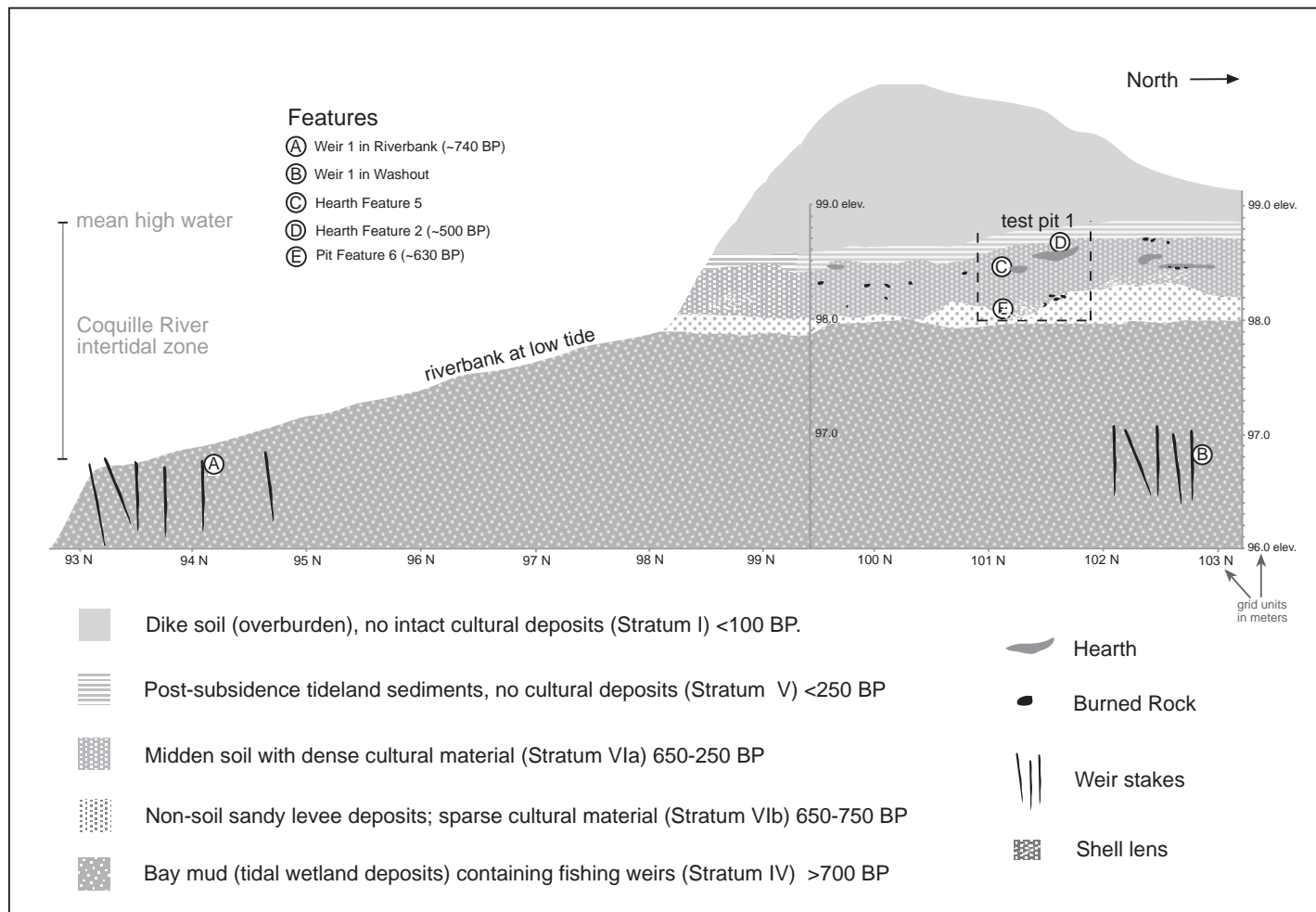


Figure 39: Composite Profile of the Philpott Site (35-CS-1) Riverbank (at West edge of 1997 Washout Area).

from Oregon State University, and subsequently listed on the National Register of Historic Places (Draper 1982). During this earlier project weirs had been noted in the narrow mudflat along the edge of the site, but excavations focused on the upper river bank soil which contained dense cultural material consisting of flaked stone tools and debitage, bone and antler tools, burned rock, and faunal remains. This “midden” soil occurs in a natural levee which is slightly higher than the lowlands stretching northward from the site (Figure 39).

Several decades ago a dike was constructed along the portion of the river bank that includes the Philpott site. This dike was built to keep floodwaters out of the drained wetlands north of the site, but it is only effective in seasons when rainfall is moderate or low. Unfortunately, the levee at the Philpott site is continually eroding, and some areas where dikes have been built are being undermined. In the winter of 1996-97, after a period of heavy rains and storm surges, a break occurred in the dike near the center of the Philpott site, and much of the water from the flooded field behind the dike drained out through this opening. This flooding and draining continued through several tidal cycles, and eventually washed out an estimated 300 cubic meters of midden. Recognizing the significance of the loss, the Coquille Indian Tribe Cultural Resource Program and University of Oregon archaeologists conducted investigations to assess the extent of the damage and learn more about the site from the exposed washout cutbanks (Byram et al. 1997). The project was also aimed at further investigating landscape changes relating to weir use.

The most significant finding during this project was the presence of a single wood stake weir feature on the floor of the washout area, in a wetland layer stratigraphically beneath the river bank midden. The weir was partially excavated and found to be in line with another weir segment exposed on the mudflat south of the river bank (indicated as B and A in Figure 39). Prior to this

erosion, it was not evident that the weirs exposed in the narrow mudflat were from a stratigraphic layer that predated the levee and midden, but this was now clearly demonstrated. The chronology of the site partly supported my initial hypothesis of wetland landscape change. Two ^{14}C dates were obtained from the midden layer, 860 ± 60 RYBP and 870 ± 70 RYBP. Another date was obtained from the upper portion of the midden in the west bank of the washout, and combined with two from Draper's earlier excavation, these indicated that the natural levee had become subaerial (i.e., a river bank soil, Stratum VIa, above the intertidal zone) by 600 BP, and was occupied until the site was abandoned after the massive Cascadia subsidence episode of AD 1700. The two ^{14}C dates for weir stakes, including the feature that extends into the washout area, indicate the site was a tidal wetland fishing station some 800 years ago (Stratum IV), before the levee had developed.

These data necessitated an adjustment to the model of landscape change I had developed for this portion of the Coquille Estuary. Instead of a pulsating sequence of eastward and westward shifts corresponding to subsidence and uplift, there appeared to be a general shift westward (downstream) in weir dates over time. The single 830 BP date from the western portion of the Osprey site was thought to be associated with tidal channels farther to the west, or possibly channel margin settings. Without this date, the distribution of the other 6 dates from weir features showed a shift from east to west, from about 800 BP to about 500 BP.

The Philpott project also entailed fine-grained analysis of the midden and core sampling for sediment data in the surrounding area (Byram et al. 1997; Hodges 1997; Tveskov 2000). The midden was found to contain extensive faunal remains, with several thousand bones of herring, salmon, and other species in a 0.4 cubic meter excavation unit, a diversity of lithic and bone tools, and a number of small hearth and pit features.

Sediments examined along the nearby river bank and in probes extending northward show that the buried river bank soil gradually transitions into a buried marsh soil. Apparently the Philpott site was located on the highest dry ground on the levee, and areas to the north, east, and west were too marshy for residential use or dry land work activities. Beneath the buried midden soil is a sandy levee layer which contains artifacts, but in much lower frequency. This is the sand which appears to have buried the weirs as the levee encroached westward, and although it remained in the intertidal zone, people may have used it as a work area during periods of low water.

1998-99 Coquille River Archaeological Mapping Project

Beginning in June, 1998, the CITCRP conducted an 18 month project to survey, map, and characterize several known and reported intertidal sites in the Coquille Estuary. The Coquille River Archaeological Mapping Project was funded by the Coquille Indian Tribe and the National Park Service Historic Preservation Fund and led by Donald Ivy and Scott Byram (CITCRP 1999). Prior to the project, several sites had been reported along the banks of the lower estuary, but few had been studied in detail. Erosion of the banks of the river has been severe in recent years through much of the area, and one goal of the project was to document sites that were eroding and to monitor this erosion through careful mapping, photography, and videotaping. Archaeological investigations of eroding exposures have become a central dimension in Oregon Coast archaeology, and the Coquille project utilized a suite of techniques that have proven effective over the last decade (Erlandson and Moss 1999).

The 1998-99 project brought the total number of inventoried Coquille river bank sites to 28. These included lithic scatters, sites with fishing weir components only, sites with weir and

midden components (i.e., components with dense organic debris and stained soil), and sites with middens only. Examination of cutbank exposures and intertidal mudflats revealed that the general stratigraphic sequence identified at the Philpott site appears to be repeated at six other weir and midden sites. At the close of the 1999 fieldwork, 18 new ^{14}C dates had been obtained, including three submitted as part of a collaborative University of Oregon project funded by the State Historic Preservation Office (Erlandson et al. 1999). Complete transit and GPS maps and feature profiles were made for all weir sites and several midden exposures, and individual stakes have been mapped in over 95 percent of the known Coquille River weir features.

Research at these sites began to provide a more complete picture of Native peoples' activities including weir fishing and other subsistence and residential practices. Archaeological lattice and lithic artifacts were collected (from state tidelands and in some cases adjacent private lands under permit) for conservation and interpretation at Coquille Tribal facilities. Altogether, the sites appear to represent a wide range of cultural activities, weir fishing and settlement along the river are best represented.

Age and Settings of Archaeological Fishing Weirs

As noted above, ^{14}C dating of wooden weir stakes has been undertaken through the last decade of archaeological investigations on the Coquille River. These dates are shown in their relative geographic position in Table 8. Although sampling for ^{14}C dating was initially aimed at exploring chronological variation in weir technology and its development on the Oregon Coast, patterns in ^{14}C -dated features also provide insight into long term landscape changes in the estuary. These changes form the context for understanding weir construction, maintenance, and abandonment over many generations. Of the 25 ^{14}C dates obtained from weir features, 88 percent

Table 8: ^{14}C Dates from 1995-1999 Coquille Estuary Research.

<u>Site</u>	<u>Weir Feature</u>	<u>Uncalibrated Age (RYBP)*</u>	<u>Calibrated Age BP</u>	<u>Lab No. (Beta)</u>
<u>North Shore</u>				
CS-176	1	1010 \pm 60	970 (930) 800	134318
CS-17	1	810 \pm 60	780 (720) 670	134322
CS-108	1	860 \pm 60	890 (700) 650	132215
<i>(contiguous sites)</i>				
CS-160	10	1120 \pm 50	1060 (990) 960	124338
	3	960 \pm 50	930 (910) 780	124337
CS-159	8	990 \pm 60	950 (920) 800	124339
	3	960 \pm 50	930 (910) 780	124340
CS-1	WO-1	870 \pm 70	900 (750) 700	106993
	RB-2	860 \pm 60	780 (220) 670	106992
CS-130	(East) E1	660 \pm 50	660 (650) 560	72791
	(East) E1	670 \pm 50	670 (650) 560	72790
	(East) E2	790 \pm 60	690 (650) 600	86017
	(Central) C1	600 \pm 70	650 (550) 530	88466
	(Central) C2	400 \pm 60	510 (480) 320	88465
	(West) W1	940 \pm 50	930 (830) 760	74746
<u>South Shore</u>				
CS-170	1	3100 \pm 70	3390 (3360) 3270	151032
CS-168	2	910 \pm 50	920 (790) 740	134320
CS-167	1	3180 \pm 70	3450 (3370) 3280	134321
	2	3120 \pm 60	3390 (3360) 3270	151031
CS-97	10	1260 \pm 60	1260 (1180) 1080	134323
	12	970 \pm 60	950 (810) 790	132214
	18	740 \pm 60	690 (670) 660	134317
	30	970 \pm 60	950 (810) 790	134324
	25	610 \pm 60	660 (600) 540	132213
CS-116	1	690 \pm 60	670 (660) 560	134325
<u>Lattice Samples</u>				
CS-97	lattice rope	990 \pm 70	960 (930) 800	134319
CS-130	lattice warp	180 \pm 50	290 (150) 0	111760

Notes: Calibrated ages (rounded to the nearest decade) are derived from Stuiver and Reimer (1993); dating performed by Beta Analytic and shown at 1σ . Weir dates are arranged upstream to downstream for each bank.

fall between about 1200 BP and 500 BP. Three dates of approximately 3400 BP were obtained from weirs in an unusual setting, a tributary channel upriver from most other known sites. These two sites are 1000 years older than any others yet recorded on the Oregon Coast and 35-CS-167 currently holds the oldest known weir feature on the Pacific Coast south of Canada. So far, only one Coquille weir-related feature has been dated to the last 300 years, lattice panel 8-C at the Osprey site.

Changes in the location of weirs appear to be related to landform changes over time. Within the Coquille Estuary there is a general tendency for weirs to be older to the east (upstream) and younger in the west (downstream) (Table 8). This pattern is especially evident within certain segments of the river bank. These areas are the margins of marshy alluvial lowlands that have been drained for agriculture but are still inundated by winter floods. At four contiguous sites along the shore of one expansive north bank lowland, weirs date to 480 and 550 years BP at the downstream edge of this lowland, the central zone in the Osprey site. A concentration of 650 BP weirs lies 200 meters upstream from these at the same site, followed by two weirs from upstream that date to 750 BP (site 35-CS-1). Upstream from these are several more weirs, three of which have been dated to approximately 900 BP. These weirs are distributed over more than one kilometer of the river bank (sites 35-CS-159 & 160). Finally, a weir upstream from these has been dated to approximately 1000 BP (upriver edge of 35-CS-160).

A similar situation occurs on the south bank, at site 35-CS-97, which also has an upper intertidal midden component exposed in the eroding river bank. Five dates have been obtained from stakes in this extensive weir site. The oldest is 1200 BP and this is also the most upstream of the dated weir features. The youngest, 600 BP, is the most downstream of the dated weirs at this site. Dates between these two features range from 800 to 650 years BP, in the expected sequence.

Downstream from both the Philpott site and 35-CS-97, weirs occur in similar wetland strata but do not underlie a buried river bank soil, though some are capped by marsh. These downstream weirs are, for the most part, younger than the upstream weirs that underlie the buried soil in the river bank upstream. The most likely explanation for the apparent shift in weir building over time is that it corresponded to shifts in tidal channel networks. These shifts likely occurred in response to large scale changes in the estuary involving ongoing infilling and levee accumulation. The sediment trapping of weir features and other debris may have also played a role in this process.

Earthquake Hazard Research

Coquille Estuary archaeological research has benefited considerably from geological research on earthquake history. Investigations by geologists in the 1990s (Nelson 1992; Witter 1999) focused on assessing earthquake hazards in the Coquille Estuary. In documenting this earthquake history, geologists uncovered a stratigraphic record of over 6000 years of landform and sea-level change. Archaeological data have subsequently contributed to this reconstruction of landform change.

In the early 1990s, Alan Nelson (1992) of the U.S. Geological Survey examined river bank exposures of the buried soil visible in portions of the lower estuary above Bandon Marsh. This is the soil that contains cultural material at Philpott and several other sites in this area. Nelson obtained ^{14}C dates from buried sedge leaves and a buried tree stump in the river bank, and based on these, he concluded that the soil these plants grew in had been above the intertidal zone until it was subsided during a massive event which occurred along the Cascadia Subduction Zone ca. AD 1700 (Nelson 1992; Nelson et al. 1995:373). During this event the surface of the Coquille

levee dropped between one and two meters in elevation, which explains why the river bank soil/midden is now within the intertidal zone. This research helped explain the stratigraphic sequence seen at many Coquille River sites (Figure 40).

For his doctoral research in geology at the University of Oregon, Robert Witter (1999) investigated a longer record of earthquake history in the Coquille River Valley. He first examined river bank sediments between Randolph Island and Bandon Marsh for buried soils predating the one that Nelson reported to have subsided 300 years ago (i.e. 250 BP). Finding no older soils, he concluded that the levee soil along much of this shoreline was the first to form in the portion of the shoreline represented by today's river bank. Prior to this levee forming, this part of the estuary was either open bay or tideflat. To find a longer record of earthquake events, Witter examined marshes that held sediments from estuary shores dating back 5000 to 7000 years. Twelve core samples from Fahys Creek swamp and eight from Sevenmile Creek yielded long stratigraphic records. Stratigraphy in these marshes shows a sequence of layers alternating between marsh and bay mud, with some layers of marine sand that may have been deposited by tsunamis.

The Sevenmile Creek core samples provided the longest sequence of subsidence and uplift, and evidence for long-term sea-level change in the estuary. This sequence records the burial of 11 salt marsh soils over the last 6600 years, although the 300-year-old buried soil evident in cutbank exposures along the river was not identified here. A typical burial sequence includes several centimeters of intertidal mud with broken shells of mudflat clams and fossil diatoms indicating tideflat environments. The mud grades upward into a marsh soil containing diatoms from high marsh and upland environments. The soil is in turn abruptly buried by deposits of sand or mud, in some cases multiple sand beds that fine upwards and contain sparse fragments of diatoms from sand flat environments. The sparse presence of the diatom fragments suggests the deposit was transported from lower portions of the estuary (Witter 1999:86).

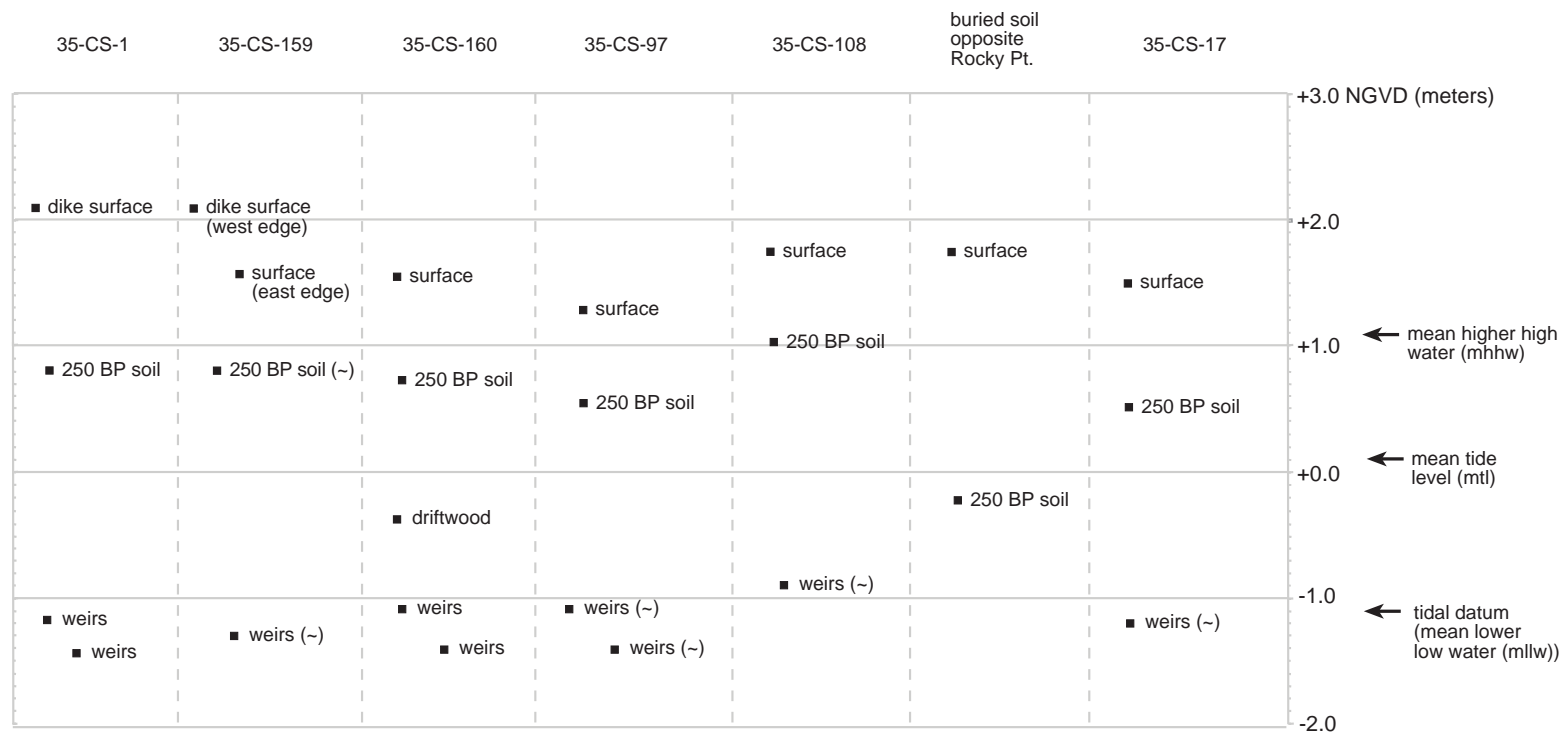


Figure 40: Relative Profiles of Seven Locations along the Coquille River (showing elevations of the modern surface, the top of the 250 BP buried soil, and driftwood and wood stake weir features in wetland sediments. Ordered from downstream to upstream, approximately 4 km.)

These repeated sequences of buried marsh soils appear to represent instances of rapid relative sea-level rise that abruptly submerged the marsh, followed by periods of gradual emergence of the marsh as sediment filled the estuary and marsh plants re-colonized the shores (Witter 1999:85-90). Instances of sudden relative sea-level rise reflect regional subsidence during great Cascadia earthquakes. In some cases, tsunamis generated by these earthquakes deposited beds of sand in the distal reaches of the estuary. Some sand layers contained as many as 8 sand layers with graded (fining upward) bedding, suggesting that several tsunami waves entered the estuary during the event. Between earthquakes the marsh emerged as riverine sediment moved into the estuary and interseismic uplift gradually reduced relative sea-level.

The alternating marsh to bay mud core sequence documented at Sevenmile and Fahys creeks provides evidence for 12 subsidence earthquakes at an average rate of one every 580 years. The elevation drop during these events is estimated to have been 0.5 meter or more. Many of the dated events overlap with the ages estimated for events documented in other estuaries of the Cascadia Coast, suggesting that several prehistoric earthquakes may have ruptured the entire Cascadia Subduction Zone. Yet, not all parts of the coast have been affected in the same way. Some areas appear to undergo more subsidence than others. Even within the Coquille Estuary there appears to be variation in subsidence and uplift rates. The southern edge of the estuary may have subsided less during earthquakes than the northern part of the lower estuary. This may relate to the presence of the Coquille fault, which extends offshore from the Coquille River mouth northwest along the floor of the Pacific, or to shifts in an upper plate fold which underlies the region (McInelly and Kelsey 1990; Witter 1999:93-96, 105-109).

Long-Term Changes in the Coquille Estuary

Sea-level rise, subsidence, and uplift have produced major changes in the Coquille Estuary. Geological studies (Nelson 1992; Witter 2000) from the Coquille River area, coupled with archaeological data from weir sites, allow the modeling of long term landscape change within the estuary. During the early Holocene (11,000-8000 years ago) global sea-levels rose from more than 50 meters to less than 20 meters below today's level, and the area that is now the estuary would have been a non-tidal, freshwater river (Witter 1999:95-96). Core samples from Sevenmile Creek indicate that the valley was under tidal influence by 7000 years ago, when sea-level was approximately seven meters below its current level in the estuary.

Based on the valley's topography and the stratigraphic record at localities such as Sevenmile and Fahys creeks, the estuary may have appeared as depicted in Figure 41, 4000 years ago. The change from open bay to a narrower river channel with numerous tidal sloughs forms the context for the construction and use of weirs over three millennia. Twelve centuries of this activity are represented in archaeological weir features exposed along the modern river bank, while the first millennium of this period appears to be represented by weir features in tidal channels over one kilometer inland from the modern river bank.

The decrease in the size of the estuary since 3500 years ago is due to reduced sea-level rise and continued sedimentation in the estuary. Infilling occurs as runoff from precipitation washes sediments from slopes into streams or their floodplains, and eventually the main river. Sediments are transported downstream to the estuary, where lower gradients, water speed, and tidal influence cause sediments carried downriver to settle (Simenstad 1983:18-21; Komar 1997:31). Tons of new sediment wash into the estuary every year. Much of the coarser material settles-out near the bank, forming a natural levee along both banks of the river. Finer materials

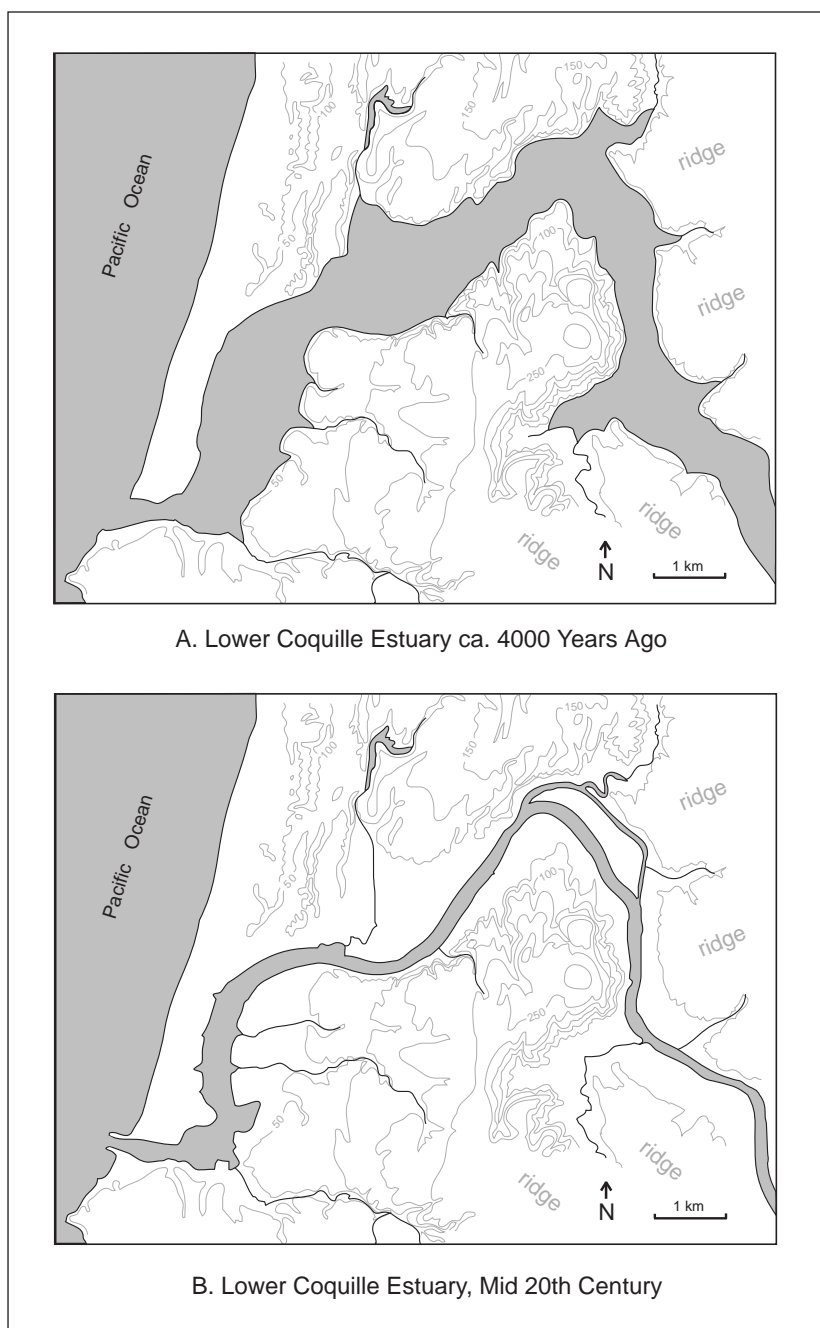


Figure 41: Changing Coquille Estuary Landscape, 4000 Years Ago and Today (sandspit configuration on earlier map is entirely hypothetical).

remain suspended longer, and these settle throughout the intertidal zone and flooded lowlands of the river valley. Infilling may also occur as sediments are moved into the lower estuary from the ocean shore by tsunamis, storm surges, and dune building. Gradual uplift in the time between earthquakes may also reduce the size of the estuary, but this effect is offset by episodic subsidence during the earthquakes.

Currently there is a lack of ^{14}C dated cultural material from the 7000-3500 BP period, yet during this period weirs may have been built along the shores of the emerging Coquille Estuary. The oldest dated weir (3360 years BP) is from the time when the rate of sea-level rise slowed, and prior to this time the intertidal zone would have been lower in relative elevation. Thus, the earliest weir features in estuary sediments are likely to be found inland from the modern river bank, in the upstream portions of alluvial lowlands. Residential sites from the 4000-3000 BP period also appear to be more common inland from the modern estuary shore. The two earliest ^{14}C dates from residential sites in the vicinity of the Coquille Estuary are of comparable age, 3170 BP from the Bussmann site (CITCRP 1999) and 3550 RYBP from Nah-so-mah village at Bandon (Hall and Radosevich 1995; R. Hall 2000).

Today, most of the intertidal area exposed at low tide in the Coquille Estuary occurs within 15 kilometers of the coast. Here the estuary consists of a small bay, expansive tidal flats, and tidal marsh and alluvial lowlands bordered by the levee. These down-river settings form a gradation which reflects the history of a larger Coquille Estuary in the past. Once a larger bay, infilling began outpacing sea-level rise about 3500 years ago, and tidal flats and salt marshes emerged along the margins of the lower estuary. In the upper estuary marsh surfaces were buried, forming marshy alluvial lowlands, and the levee grew in height and length, encroaching toward the river mouth (cf., Kelsey et al. 1998).

Radiocarbon dates from weirs and midden soils along a portion of the Coquille Estuary's north bank document the processes of marsh emergence, alluvial lowland development, and levee formation over five centuries, from 1100 to 600 years ago. Figure 42 is a model of these changes based on modern topography, wetland core sampling, and archaeological features and ^{14}C dates from weir and midden sites. It appears that on this part of the river bank, Coquille fishing stations were rarely maintained in a single location for more than a few generations. Notably, Witter documented no subsidence events between 1000 BP and 250 BP. It appears that estuary infilling rather than earthquake-induced subsidence accounts for much of the estuary landscape change. Networks of tidal channels shifted downstream as sediments accumulated and the estuary gradually emerged in the direction of the river mouth. This model projects river bank development at a rate of over 200 meters per century, which is comparable to modern rates of marsh progradation documented in the Nehalem Estuary (Johannessen 1964).

Shifts in tidal channels are unlike shifts in non-tidal stream channels. Typical stream channels have banks of coarse sand and gravel which undermine and collapse, allowing the channel to migrate laterally. In contrast, tidal channels form in cohesive, fine muddy sediments more resistant to lateral erosion (Simenstad 1984:18). Lacking a source of new sediment, tidal channels can last for centuries in the same location. Yet the mouths of tributary channels in the Coquille Estuary coincide with a developing levee, and overbank sedimentation may have caused these channels to fill within decades of their initial formation. The construction of weirs, which slowed water flow and trapped sediments, may have contributed to this rapid sedimentary infilling (this same process has been outlined by Putnam and Greiser 1993. As one outlet filled, another outlet farther downstream was formed or expanded; as weirs became buried in the old channel people built new weirs in the new outlet to the wetland.

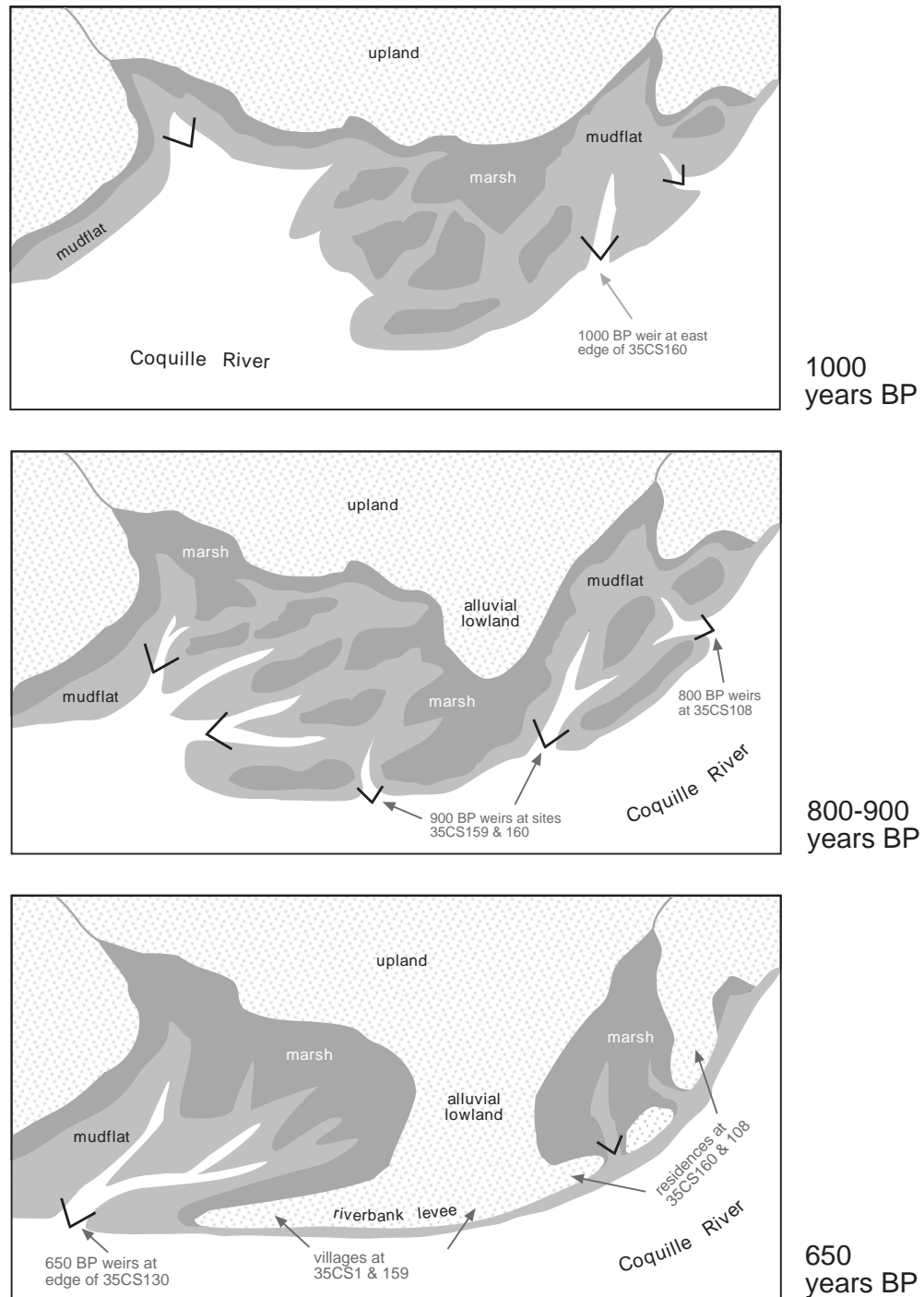


Figure 42: Marsh Emergence and Levee Development on the Lower Coquille Estuary (based on stratigraphic profiles and ^{14}C dates from archaeological sites; arrows mark recorded weir and midden features).

Summary of Wetland Emergence and Shifting Land Use

Although less devastating than tsunamis and subsidence, sea-level change and infilling brought sustained, long term changes to the Coquille Estuary over centuries and millennia. During the early and middle Holocene, emergent marshes and high river banks common in the estuary today would have been more ephemeral, as sea-level rise outpaced infilling. Shoreline settings suitable for residential use may have been present in what is now the upper estuary, closer to the head of tide, but they may have been rare along the shore of the lower estuary. From 7000 to 3500 years ago the lower portion of the Coquille Valley was a deep bay surrounded by bluffs and upland terraces. Villages and camps near the estuary may have been located in these upland areas adjacent to the estuary shore, or in more dynamic dune settings near the mouth of the estuary.

Although many questions remain about the effects of subsidence and sea-level change on village sites, the relationship between these environmental changes and Coquille fishing systems is becoming clearer. In some parts of the estuary earthquake-induced subsidence may have actually improved some conditions for the Coquille economy by rejuvenating the estuary and re-establishing channels in silted-in tidelands, thereby expanding fish habitat and deepening boat transportation corridors. Archaeological evidence shows that people took advantage of changes in the Coquille wetlands, maintaining weirs for generations then rebuilding them in new locations as conditions changed.

It is possible that some Coquille Estuary changes were partly the result of people using weir structures to alter the wetland landscape, improving fishing habitat and making weir fishing systems more efficient. Resource management involving conservation and enhancement is a longstanding tradition among Native communities in the Northwest, and this approach was used

in several subsistence activities. Most well known is the use of fire to manage the botanical landscape (Boyd 1999b). Considering the rate of river bank change indicated by ^{14}C dated weirs, it seems the people who used these weirs would have been well aware of their effects as sediment traps in tidal channels. The rapid rate of river bank accretion and shifting weir locations in a downstream direction may result from planned sediment trapping intended to expand the extent of wetlands in this part of the estuary and improve fish habitat and resource productivity. The intentional trapping of sediments may have been most intense about 800 years ago, when weir building dates indicate tidal channels shifted one kilometer in just a few generations. I know of no oral history that documents such activity, however the Coos-Coquel creation story (M. Jacobs 1940:240) quoted at the beginning of this chapter holds intriguing similarities. Alternatively, this narrative may simply reflect peoples' observations of eroding lattice in blue shoreline sediments. The possible use of weirs in wetland enhancement could be explored through further research at Coquille wetland sites.

Today, Native people continue to manage the tidal wetland fishing places in the Coquille Estuary, though in different ways. The Osprey site and other sites along the Coquille Estuary are recognized by the Coquille Indian Tribe as a significant aspect of their cultural heritage in this portion of their tribal homelands (Ivy and Byram 2001). Many of the research questions outlined in this chapter will continue to be addressed through research conducted by the Coquille Indian Tribe cultural resource program. In addition, the Tribe undertakes efforts to preserve wetland archaeological sites, in part by collaborating with organizations and agencies such as the U.S. Fish and Wildlife Service, Coos County Planning Department, the University of Oregon Department of Anthropology, and the Archaeological Conservancy. These efforts have reaffirmed the Tribe's stewardship of the Coquille wetlands, and shed light on a rich and diverse legacy of fishing traditions and changing landscapes represented by a truly unique archaeological record.

CHAPTER 6

CONTINUITY IN WEIR TECHNOLOGY OVER TWO MILLENNIA AT THE AHNKUTI SITE

The Ahnkuti site (35-LNC-76) has one of the longest ^{14}C documented records of human use on the Oregon Coast. Some 2000 years of subsistence activity are represented at the site, from 2100 BP to the 19th century. As a ‘wet site,’ it holds perishable materials such as wood and basketry. The site’s long record led Robert Kentta of the Confederated Tribes of Siletz to choose Ahnkuti as the site’s name, meaning very old or a long time in Chinook Jargon. Located in the intertidal zone of a tributary tidal slough channel in Yaquina Bay, several features at the site are interpreted as wood stake fishing structures or weirs.

This chapter addresses the long term persistence of weir fishing at the Ahnkuti site. The site is vertically stratified, with older weirs underlying younger features. This sequence appears to be related to sea-level change, estuary infilling, and tectonic subsidence and uplift, changes through which weir use was adapted and maintained. Analysis of the site demonstrates continuity in the fundamental characteristics of weir fishing over the last two millennia. This continuity provides archaeological support for the interpretation that weir fishing has been central to Northwest Coast economies for millennia (Moss and Erlandson 1998). In addition to features interpreted as the remnants of fishing weirs, fragments of woven split wood lattice panels have been observed at the Ahnkuti site, as well as stone artifacts, wood and bone tools, and historic material such as metal, ceramics, leather, glass, and wooden dock footings.

Site Setting

Yaquina Bay is located on the central Oregon Coast between the Siletz and Alsea rivers (Figure 43). The tidewater area of the bay is 15 square kilometers, and its intertidal area consists of 35 percent of this area (Proctor et al. 1980:2-49). Like most Oregon estuaries, the Yaquina is river-dominated, although its comparatively small drainage basin and low gradient leaves it more heavily influenced by the ocean than systems with larger basins, such as the Siuslaw, Nehalem, and Coquille. This marine influence, along with the relatively limited effects of flood waters in the bay portion of the estuary, make Yaquina Bay suitable habitat for a number of marine species traditionally harvested by Native people.

The Ahnkuti site is located near the mouth of a tidal slough on the south shore of Yaquina Bay between Newport and Toledo. Today, this slough is tidally influenced for 700 meters above the site, and drains a narrow valley extending 2.5 kilometers to the southeast. In the lower (downstream) portion of the slough, the broad levee of a road crosses the site in an east-west direction.

Historically, the Yaquina people were the northernmost of the central Oregon Coast Penutian speakers. They interacted closely with the Siletz Tillamook to the north and the Alsea to the south, and shared much of their language with the latter group. Because Yaquina Bay was chosen as the center of the Coast Reservation resettlement program enforced by the U. S. military during the 1850s, and subsequently opened to non-Indian settlement in 1865, Yaquina communities were severely impacted by mid-19th century social and economic changes. Many were the victims of violence and disease, and by the mid 1860s they were largely displaced from their homelands (Byram, in preparation). Only limited ethnographic and historic accounts of

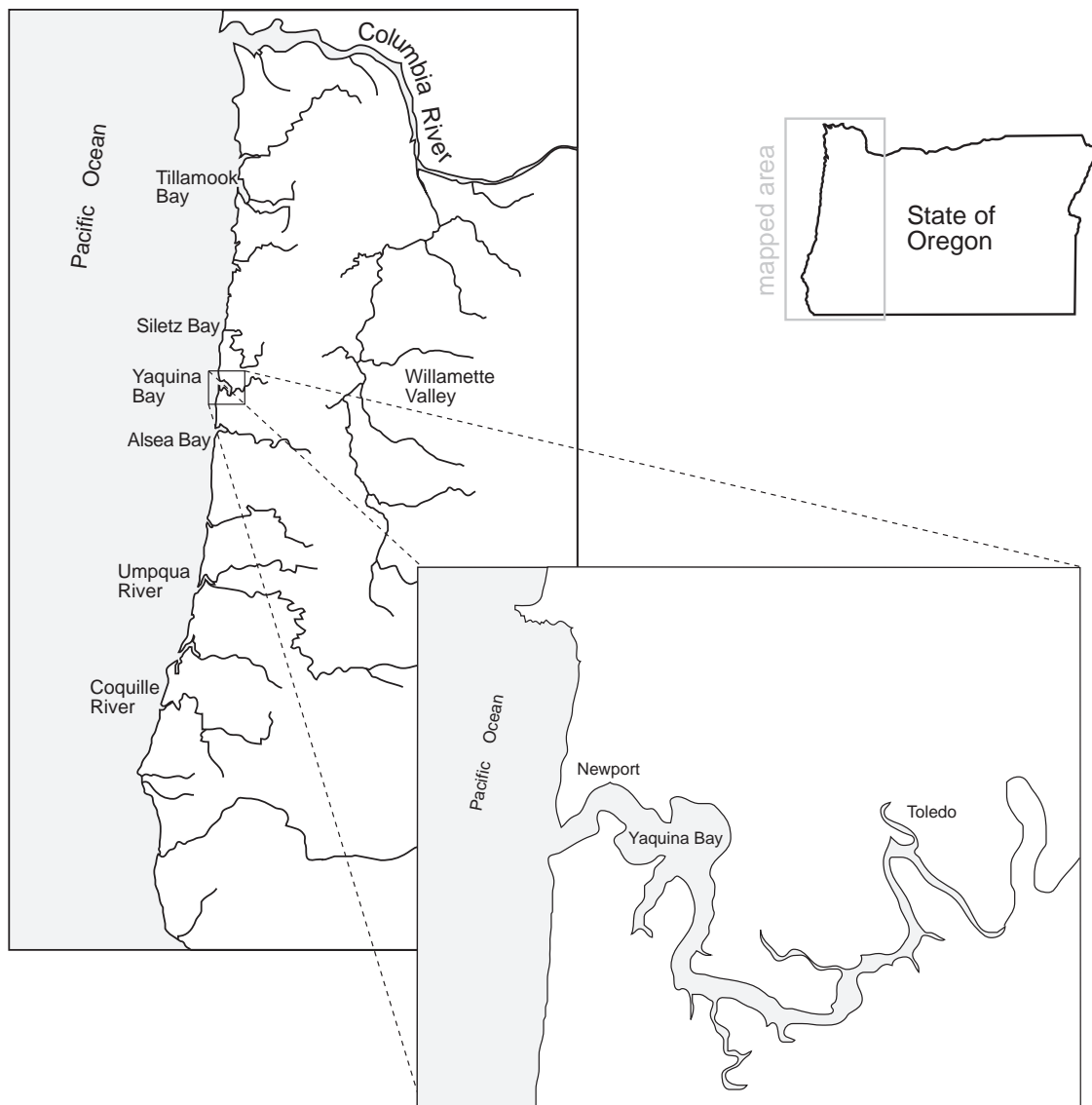


Figure 43: Map showing the location of Yaquina Bay.

Yaquina communities are preserved, yet these show that Yaquina villages were predominantly located along the shores of the estuary, from the mouth to above the head of tide (Drucker 1939). In the 1880s a Native elder named Yaquina John supplied the linguist J. Owen Dorsey with the names of several Yaquina villages, located on the north and south shores of the estuary. Many of these were probably uninhabited by the 1850s, when only about 80 Yaquina people remained in their homeland. During the Coast Reservation years, Yaquina Bay was also the home of many Coquille and Rogue River peoples (Talbot 1849; Kent 1973; Byram, in preparation).

The importance of tidewater weir fishing at Yaquina Bay is indicated in the accounts of Indian agents reporting to the Oregon Superintendency of Indian Affairs from the earliest years of the Coast Reservation. These reports indicate that for the Yaquina, as well as Indians who came from other coastal localities, the fisheries of Yaquina Bay were central to their survival (Kent 1973). The diversity and seasonal variation in these fisheries is not well documented, although specific accounts do describe some of the fishing Indians did on the bay.

There is some indication that in the 1830s the Yaquina people from the largest Yaquina village, now called Old Town Newport, moved in spring to the Oysterville area near the Ahnkuti site to fish in nearby tidewater. This appears to have coincided with Pacific herring spawns (Harrington 1942[26]:95; Byram, in preparation). This may have been a time when people used the Ahnkuti site intensively. Other Yaquina villages were well known fishing localities. Coquel Thompson, a Coquille tribal elder and long term resident of Siletz, recalled a Yaquina Indian town near Toledo, where Indians fished for Chinook salmon (Harrington 1942[26]:107).

Such accounts (see Chapter 3) demonstrate that during the 19th and early 20th centuries a variety of fishes was available in Yaquina Bay and that traditionally, Native people harvested these throughout the year using techniques that included tidal weir and basket trap fishing. The technology represented in Ahnkuti site features appears to reflect longstanding use of these

historically documented fish harvesting techniques.

Ahnkuti Slough History

Yaquina Bay was part of the Coast Reservation from 1856 to 1864, when it was opened to non-Indian settlement. According to observers, in the land rush that followed, many Indians were forcibly removed from their homes, which were then occupied by squatters from the Willamette Valley and elsewhere (Kent 1973:19). Subsequent changes to Yaquina Bay and its watershed were extensive. A railroad was completed in 1885, and this was constructed across the mouths of numerous tidal sloughs along the north shore of the estuary (Castle et al. 1979:30), settings similar to the Ahnkuti site, where weirs may also have been built in the past.

In the immediate vicinity of the Ahnkuti site, a causeway for South Bay Drive was constructed across the slough and the site in the 1950s. This causeway blocked most of the tidal drainage of the large slough until a new culvert was placed under the road prism in 1992 as part of a wetland habitat mitigation project performed by Lincoln County Roads Department (Division of State Lands Permit 6386, dated 10-29-1991). The placement of this larger culvert, which funnels large volumes of water into a restricted area appears to be the cause of the extensive erosion documented at the site from 1994 to 1999.

Archaeological Research

The “fish traps” of the Ahnkuti site have been known to local residents for decades, but the site was first identified by archaeologists in 1994 during a survey of state tidelands (Byram

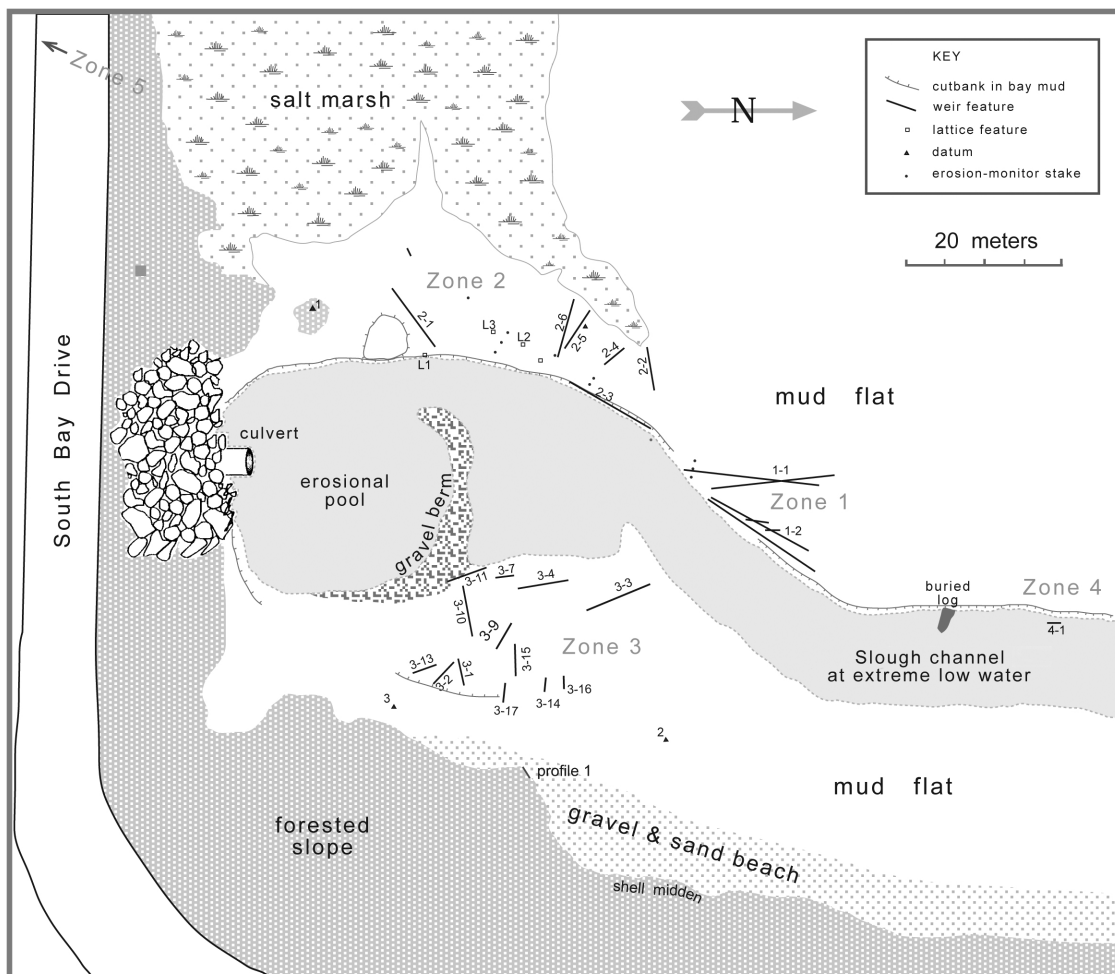


Figure 44: Map of the Ahnkuti Site (35-LNC-76), Zones 1-4 (based on surveys in 1995, 1996, and 1998).



Figure 45: Wood Stake Weir Features in Zone 1, Ahnkuti Site (35-LNC-76)

1995a, b). During the second visit to the site, Byram and Erlandson observed extensive perishable cultural material eroding from the banks of a pool immediately north of the raised road prism (Figure 44). This pool is located at the mouth of the culvert that drains the slough south of the road levee on receding tides. The cultural material observed included several wood stake fishing weir features (Figure 45) and a split wood lattice panel one meter long on the west bank of the pool, and other weirs along with sparse lithic artifacts and historic debris on the east bank of the pool. A wood stake ^{14}C sample dated to between about 1300 and 1000 BP (Beta-77988), which made this the oldest known weir site on the Oregon Coast at that time.

During further visits to the site in 1994 and 1995 by Jon Erlandson, Robert Kentta, and myself, it became clear that the site was rapidly eroding. The erosion was apparently caused by alterations to the slough's drainage through the road levee, which took place in 1992. As part of a wetlands mitigation project for unavoidable fill at three bridge sites elsewhere, Lincoln County Roads Department (LCRD) replaced a collapsed 3 to 4 feet diameter culvert with an 8 feet diameter oval culvert underlying the roadway, to restore tidal wetlands in the slough south of the road.

As outlined in the Division of State Lands (DSL) permit application for this project “a layer of fine gravel up to existing streambed elevation (was) recommended by the Oregon Division of Fish and Wildlife to provide a natural bottom for fish traveling through the culvert.” The culvert design plan included with the permit application shows a “granular base” fill in the culvert, and riprap underlying the culvert and extending northward below the floor of the channel. Examination of the setting today shows that the gravel was apparently placed in and adjacent to the culvert as part of the culvert replacement project. Unfortunately, the faster current and greater volume of water exiting the slough during low tide have apparently flushed the gravel away from the floor and northern edge of the culvert. This gravel has accumulated in an arc-shaped berm at the center of the erosional pool north of the culvert. The gravel berm has been present in this location since 1994. Rapid, outgoing currents flowing from the culvert are redirected east and west by the berm, where they are steadily eroding soft bay mud and marsh sediments. The erosion appears to reach greatest intensity during lower low tides, when the difference in elevation of water north and south of the culvert is greatest.

In 1995 and 1996, erosion monitoring stakes were placed in wetland sediments throughout the site. These white plastic stakes were 40 to 50 cm long, and their position was mapped along with weir features and topography. Between 1995 and 1998, 80 percent of these

stakes were lost to erosion. The volume of sediment lost from the site between 1992 and 1999 has not been measured, but it is clearly massive. There are no indications that a pool of any size existed in the channel prior to 1992, and by 1996 the pool was about 30 meters wide in the subtidal range, and 60 meters wide in the upper intertidal portion. The pool extended approximately 55 meters north of the culvert opening. Depending on the size of the pool that may have been here before culvert placement, as much as 1100 cubic meters of site deposits may have been lost.

The extensive, ongoing erosion at the Ahnkuti site has reversed the sedimentation process that normally preserves archaeological sites in tidal wetlands. High velocity currents produced by culvert drainage account for the large number of weir features and other artifacts exposed at the site since it was first recorded. As of 1999, many of these weirs had been heavily eroded or completely washed away.

During frequent monitoring visits to the site by University of Oregon archaeologists and Siletz tribal staff between 1994 and 1998, over 30 distinct fishing weir features were recorded, along with four lattice panel fragments and several tools of stone, bone, and wood. A small portion of this material was collected, conserved, and ^{14}C dated, and is now curated at the University of Oregon. During two field projects in 1995 and 1996 (Byram et al. 1996) detailed maps were made of most weir features, lattice panels were characterized *in situ* and one was recovered, systematic surface artifact collection was conducted, and five more ^{14}C samples were submitted from wooden weir stakes, pushing the site's earliest occupation back to over 2000 years. Evidence for a late 19th century occupation was also identified along the eastern shoreline of the site's intertidal zone. These site mapping and surface characterization projects established that older weirs were positioned stratigraphically beneath more recent ones.

On the site map and in descriptive records the weir features are designated by zone and

feature number. Thus, Feature 3-8 is the eighth weir recorded in Zone 3. Six have been recorded in Zone 2, 17 in Zone 3, one in Zone 4, and two in Zone 5. Zone 1 contains multiple overlapping lines of stakes, probably representing ten or more separate features, but these are designated in two groupings, Features 1-1 and 1-2.

Stratigraphy and Chronology

Zones, Cultural Strata, and Chronology

Based on the seven ^{14}C dates (Table 9) as well as vertical and horizontal stratification, the site has been divided into five zones (Byram et al. 1996:3). These include intertidal and subtidal settings, and all contain ^{14}C dated wood stake weir features.

Zone 4, at the north end of the site, contains a single subtidal line of stakes dated to ~ 2100 BP (Beta-83325). This line of weir stakes occurs subtidally, in the deepest portion of the slough channel, less than one meter from the western channel bank. The single confirmed Zone 4 feature (feature 4-1) is the oldest yet dated at the site. It has likely been exposed due to recent down-cutting of the slough channel. In the cutbank, and approximately one meter above the level of the Zone 4 weir, a set of horizontal sticks are exposed. These appear to be weir stakes moved into horizontal position through sediment shifting. However, these upper wood elements have not been excavated, and they may be unmodified wood. They may be stratigraphically associated with the features in Zone 1, to the south, at a comparable elevation.

Table 9: ^{14}C Dates from the Ahnkuti Site.

Lab No. (Beta-)	Uncorrected ¹⁴ C Date BP	Calibrated Years BP	Provenience
83324	320 ± 40	440 (390) 300	Zone 3: central area
83323	350 ± 70	500 (360) 300	Zone 2: cut bank
83322	560 ± 70	640 (540) 420	Zone 2: Feature 4
77988	1160 ± 40	1080 (1060) 990	Zone 1: Feature 1, SW
83326	1330 ± 80	1300 (1060) 990	Zone 5: Feature 1
83321	1400 ± 60	1330 (1300) 1280	Zone 1: Feature 2, SE
83325	2120 ± 70	2150 (2090) 1990	Zone 4: Feature 1

Notes: All samples are stem wood from small, branching stakes; dry weight ranged from 8 to 20 grams; calibrated age ranges at 1 sigma, derived from Stuiver and Reimer (1993).

Zone 1 lies 20 meters south of Zone 4, though the two zones are separated by a high bar of sand which covers any cultural features that may lie in the intermediate area. Two stakes from Zone 1 were dated to 1160 ± 40 RYBP (Beta-77988), calibrated to approximately 1100 BP, and 1400 ± 60 RYBP (Beta-83321) calibrated to about 1300 BP. The weirs in Zone 1 are the densest features in the site, with over 350 stakes exposed in an area less than 20 meters in diameter. Zone 1 weirs also appear to extend southward, appearing sparsely in the channel bank beneath the Zone 2 surface.

Zone 2 lies southwest of Zone 1, approximately 50-75 cm higher in the intertidal zone. Its western margin is defined by a high marsh cutbank. In Zone 2 five small brush-stake weirs are exposed along with four lattice panel fragments, occasional cobbles, and extensive organic litter indicating this was once a stable surface. Two ¹⁴C dates have been obtained from Zone 2 weirs, 350 ± 70 and 560 ± 70 RYBP (Beta-83323 and 83322), calibrated to about 350 BP and 550 BP. A single blue glass trade bead was also found on an eroding marsh pedestal in Zone 2, suggesting

Native people used this part of the site in the late 18th or early 19th century.

Zone 3 is defined as the portion of the site east of the slough channel and north of the roadway. A date of 320 " 40 RYBP (Beta-83324) has been obtained for a weir stake in Zone 3, calibrated to about 400 BP. Weirs in the eastern part of the site do not appear to be vertically stratified, and the surface of Zone 3 is at roughly the same level as Zone 1. It is hypothesized that for much of the time the site was used, Zone 3 was in a deeper portion of the slough channel, where sediments were scoured to a level below the intertidal zone. Thus, the numerous weir features in Zone 3 may represent a wide time range. This could be assessed through further ¹⁴C dating.

The western part of the slough south of the road has been designated Zone 5 (see Erlandson et al. 1999; Byram 2001). Two weir features have been recorded in Zone 5, and a stake from one of these was dated to 1330 " 80 RYBP (Beta-83326), calibrated to 1100 BP. Based on their position in the western part of the slough, they are likely associated with the western channel that formerly drained this area, depicted on a 1946 USGS topographic map. Following road construction across the slough in the 1950s, this area appears to have undergone sedimentation, and only vestiges of this previous channel remain. The weir features from Zone 1 are roughly contemporary with those in Zone 5, suggesting that weirs may have been built in both the eastern and western slough channels at the same time.

Sediments

The sediments of Yaquina Bay have been classified by oceanographers Kulm and Byrne (1966), based on core samples taken at stations throughout the estuary. They designated the sediments in the portion of the bay above Oneatta Point, including the Ahnkuti site, as belonging

to the fluvial realm. Yaquina fluvial sediments originated in tertiary mudstones, siltstones, sandstones, and intrusive igneous rocks of the Coast Range physiographic province (Kulm and Byrne 1966:236). These are angular to subangular sands and silts of riverine origin, contrasting with the rounded sediments of marine origin occurring in the lower bay. The fluvial sedimentary setting is typical of archaeological weirs on the Oregon Coast. This may reflect better preservation conditions in more fine-grained riverine sediments in tidewater than in coarser marine sediments, or more frequent use of tidal weirs above areas of marine sediment deposition.

Although fluvial estuarine sediments comprise the bay muds surrounding the site, these are accompanied by two other sediment types in the intertidal portion of the Ahnkuti site. These are erosive beach sand and gravel (tan, brown, and red) of local origin, and gravel, cobbles, and boulders deposited during road construction and maintenance activities. In the eastern part of the site the sand, gravel and bay muds are underlain by a sedimentary bedrock, also exposed in the upland slope east of the site. This bedrock appears to be the parent material for the beach sand and gravels in Zone 3. Bay mud sediments form the substrate for the salt marsh, which is most extensive in Zone 2 and westward. Recent exposures of these fine, silty sands are blue-gray in color. These muds have been deposited over several centuries, based on the presence of dated, stratified weir features.

A stratigraphic profile was examined in one portion of the eroding intertidal cutbank at the east edge of Zone 3 (Figure 46). In this profile, two interbedded strata have been tentatively

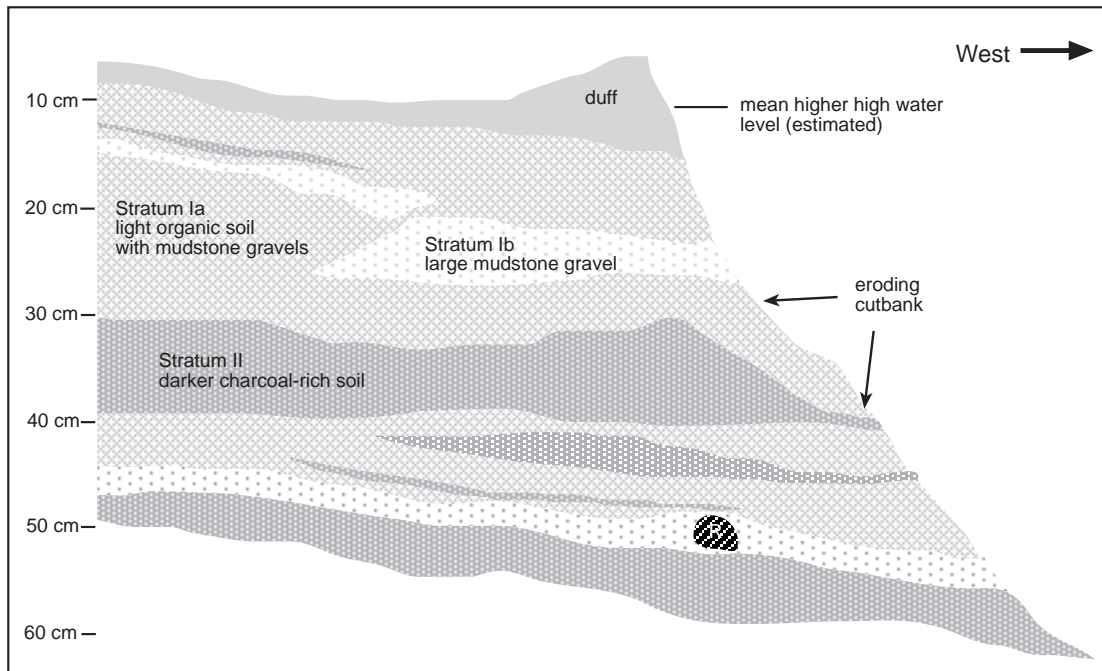


Figure 46: Provisional Stratigraphic Profile in Zone 3 Erosional Cutbank.
 (Diagram of profile 1 displays interbedded beach sediment layers [Stratum group I] and soil layers [Stratum group II].)

identified. Stratum I is a sterile sand and gravel of mudstone origin; the parent rock appears to be the upslope mudstone bedrock. This stratum is similar to the coarse beach sand and gravel on the surface of Zone 3 along the cutbank. Stratum II is a darker, organic-rich version of this same sediment, but it is finer grained. Stratum II contains cultural material including a concentration of burned rock that may be a hearth feature, scattered charcoal, a piece of burned bone, and a chert flake. It is possible that Stratum II represents a former aerial or subaerial exposure, whereas

Stratum I is thought to have been an intertidal beach. Given the subsidence and uplift history of Yaquina Bay (Peterson 1995), these interbedded sediments may reflect gradual uplift (subaerial to emergent Stratum II) and subsidence (intertidal Stratum I), a process known to produce alternating intertidal and subaerial deposits in a single stratigraphic sequence (Nelson 1992; Witter 1999).

Weir Building and Relative Sea-Level Change

The infilling of the Yaquina Estuary along with relative sea-level rise appear to be represented in the stratigraphic sequence along the western margin of the slough channel, between Zones 4, 1, and 2 at the Ahnkuti site. Zone 4, with the oldest weirs, is overlapped by Zone 1, with weirs of moderate age. Zone 1 is in turn overlapped by Zone 2, with the youngest weirs in the sequence. This sequence probably derives from sediment accumulation in the estuary associated with sea-level rise during the past two millennia. Burial and preservation of weir features may have been enhanced by rapid subsidence during tectonic shifts, although subsidence is eventually offset by gradual uplift occurring between earthquake events (Nelson et al. 1995), as has been demonstrated for the Coquille Estuary (Chapter 5). In Table 10, the relative depth (below the salt marsh surface) of dated weir features is compared to the relative depth of dated peat deposits buried by tsunami sands, presumably during Cascadia earthquake events. The peat sequence established by Peterson (1995) demonstrates the rate of sea-level rise in the estuary. The sequence at the Ahnkuti site suggests that weir fishing traditions were maintained through several episodes of major environmental change.

Table 10. Comparison of Ahnkuti Stratigraphic Sequence with Subsidence-related Marsh Peat Sequence YB 11 (after Peterson 1995:37).

Ahnkuti Site Strata			YB 11 Marsh Core Strata		
<u>Zone/feature</u>	<u>Dates</u>	<u>Depth</u>	<u>Peat Layer</u>	<u>Dates</u>	<u>Depth</u>
salt marsh	modern	0.00 m	salt marsh	modern	0.00 m
Zone 2	350-500 BP	1.55 m	burial event	300 BP	0.50 m
			burial event	800 BP	0.75 m
Zone 1	1100 BP	2.25 m	burial event	1100 BP	1.00 m
			burial event	unknown	1.35 m
			burial event	unknown	1.65 m
Zone 4	2100 BP	3.45 m			

Notes: Weirs were typically used at a level lower than the marsh surface (Chapter 4); subtracting one meter from each of the weir-bearing stratum depths at the Ahnkuti site yields a sequence comparable to that seen in YB 11 tsunami sand/peat layers at the Parker locality.

Cultural Features and Artifacts

During fieldwork in 1995 and 1996, each of the linear wood stake alignments at the site was mapped as an individual feature, with stakes characterized on a separate feature form. This information has not been tabulated but remains curated, along with photographs, video and collected artifacts, at the University of Oregon. Most of the alignments of wooden stakes are interpreted as fishing weirs due to feature components and configuration. A small number of features in Zone 3 may be the remains of historic structures related to docks or cut bank stabilization.

Ahnkuti weir features consist of alignments of vertically placed split and stem stakes. Many of the latter have small branches, and were probably brushy in appearance when in use. Horizontal elements are present in a few features. These consist of conifer brush placed among branching vertical stakes, as in Zone 2 features. Features in other zones may have contained brush that has since been washed away.

Given their configuration and setting, all of the weirs recorded at the Ahnkuti site are likely cross-channel tidal weirs. The weirs at the Ahnkuti site were likely built across the slough channel and used to harvest fishes during an outgoing tide. In this configuration, fish are able to swim upstream past the weir during high tide, either above the weir in the water column or through gaps where portions of the weir (such as lattice panels or basket traps) have been temporarily removed. As the tide recedes the fish are trapped behind the weir, either on the mud, in a small pool where they can be dipped, or in some form of a trap, such as cylindrical basket or an impoundment of lattice panels or brush. Given the range of stake and lattice types, weir feature densities and orientation, there is likely considerable variation within this class represented at the site, and future investigations may determine whether there are important differences in

construction among the weir and trap components.

There is variation between weir features across the site in terms of configuration, weir density, superimposition, and construction elements. Weir density is highest in Zone 1, where multiple, tightly spaced split wood stake features overlap. Zone 2 primarily contains loosely spaced, small round brushy stakes. Zone 3 contains the greatest range of features. As in Zone 1, many of these are tightly placed and consist of relatively robust split wood and stem stakes. Zone 3 lies along the eastern bedrock and gravel shoreline of the slough, and this may have been the deepest portion of the channel prior to recent erosion. It is possible that Zone 5 weirs were built across a western slough channel that may not have been as deep as the channel that passes between Zones 2 and 3. Historic topographic maps show that a second channel drained the western part of this slough (Byram 2001).

The stakes in Zones 1, 4, and 3 are larger in diameter than those in Zones 2 and 5, yet this may be due in part to the relative position of the weirs in the intertidal zone. Features in Zones 2 and 5 are exposed above mean low water, while features in the other three zones are at or below mean lower low water. Larger, taller stakes may have been needed in the deepest portion of the tidal channel for effective weir use. An alternative explanation is that small, branching stakes were used for weir building in certain periods, while larger stakes were used at other times. Changes in weir construction over time likely relate to hydrological changes stemming from subsidence, uplift, and wetland sedimentation.

Archaeological Lattice

Basket traps or lattice enclosures appear to have been used with the weirs during at least part of the time the Ahnkuti site served as a fishing station. All four woven lattice fragments were observed in Zone 2. Concentrations of possible disintegrated lattice warp have also been seen in

upper Zone 4 and in Zone 3. Because these two concentrations of split wood lacked any visible weft, they were not included in the site's inventory of woven lattice. The split wood lattice at Ahnkuti is similar to specimens identified elsewhere at Yaquina Bay and at wet sites in the Coquille estuary on the southern Oregon Coast (Chapters 5 and 7; Connolly and Byram 1997). Small in gauge and warp diameter, this lattice may have been designed to harvest smaller fishes, or possibly diverse fish populations (Chapter 7).

Other Cultural Materials

In addition to weir stakes and lattice samples, artifacts recovered from the site include a collared wooden wedge (Figure 47), a bone chisel, several expedient lithic tools, a glass trade bead, and several late 19th century artifacts. Most of these items were collected or observed in Zone 3, and some appear to be eroding from the shoreline cutbank in this portion of the site.

Some of the precontact tools indicate woodworking, likely relating to weir construction and maintenance. Yet the diversity of these tools suggests that residences or work stations may have been located along the east bank of the slough. No investigations have taken place beyond the intertidal portion of the site. However, as noted above, eroding cutbank stratigraphy at the base of the slope has revealed paleosols containing flakes, charcoal, and burned rock at an elevation now within the intertidal zone due to relative sea level rise. A late 19th century shell deposit, dated by the presence of non-native *Mya arenaria* shell fragments (Jon Erlandson, 1996, personal communication), suggests that the upland portion of the site may have also been a residential locality for people in the years following American settlement at Yaquina Bay.



Figure 47: Collared Wooden Wedge from Zone 3, Ahnkuti Site (35-LNC-76)
(80% scale; proximal end frayed from battering during use).

The glass, ceramic, metal, leather, and brick materials observed in the eastern portion of the site (Zone 3) have not been fully characterized. However, archaeologists Gary Bowyer and Lou Ann Speulda from the U.S. Fish and Wildlife Service examined a sample of the collection, and it is their impression that the assemblage represents the residential debris of a relatively affluent household. The property was owned by a prominent doctor in the 1890s and early 1900s, and these materials are thought to derive from this period. The remains of a wooden dock structure may date to this period or later.

The blue glass bead from Zone 2 clearly suggests the presence of Native people at the site during the 19th century. Although it has not yet been established that the site was used as an Indian fishing station into the late 19th century, this is a distinct possibility. During the first decade of the Coast Reservation, Indian fishing was intensive in Yaquina Bay (Kent 1973). Given the configuration of the slough, it would likely have been a popular weir fishing station until the bay was opened to non-Indian settlement in 1865. After that time Indian fishing continued at Yaquina Bay, but Native peoples' access to locations such as the Ahnkuti site may have been limited by property ownership. The nearby residence of Siletz tribal member Anna Ditalo and her family from the late 1800s through the 1930s appears to be the last regular use of the Ahnkuti site slough area by Native people.

Summary

Although heavily damaged by erosion, the Ahnkuti site holds the longest stratified sequence of Native American fishing weir use known for a single location on the Oregon Coast, from over 2000 years ago to the past 500 years. One of the older and more complex weir sites in

the region, 35-LNC-76 provides evidence of continuity and change in weir building over many generations of Native peoples' presence at Yaquina Bay. In recognition of its uniqueness and diversity of cultural heritage information, the site was listed on the National Register of Historic Places in 2001 (Erlandson et al. 1999).

The Ahnkuti site has provided key information for research on wood stake weir fishing (Byram 1998; Moss and Erlandson 1998), variation in archaeological lattice (Connolly and Byram 1997; Chapter 7), the history of Yaquina Bay Indian communities (Byram in preparation), and the effects of tectonics and relative sea-level change on weir use and site taphonomy (cf. Byram and Witter 2000). The site is also recognized by the Confederated Tribes of Siletz as a significant cultural heritage locality, and several tribal members have participated in research and preservation efforts at the site. If efforts to preserve the site are successful, further research here promises to shed more light on these subjects along with many others, such as Native woodworking technology and variation in weir building over time.

CHAPTER 7

ANALYSIS OF ARCHAEOLOGICAL LATTICE

Archaeological lattice appears to represent the remains of enclosures and traps used in conjunction with weirs, and therefore it may hold important information on the fishes targeted and the harvesting strategies used at the intertidal fishing sites where this technology occurs. This chapter presents the results of my analysis of lattice fragments from tidal wetland strata in Oregon estuary archaeological sites such as the Ahnkuti and Osprey sites. My discussion covers ethnographic representations of lattice, the spatial and temporal distribution of archaeological lattice, and detailed characteristics of lattice features and individual specimens. A preliminary typology for archaeological lattice is also presented as a heuristic device for examining variation in relation to hypothesized fishing strategies.

Archaeological evidence suggests that split wood woven lattice technology was used for over a millennium in the region, and it occurs over a relatively wide geographic area. Coupled with the prominence of this technology in ethnographic accounts, this indicates that lattice was an important aspect of the fish harvesting systems used by Native people at Oregon estuaries. In the eight archaeological sites where lattice fragments have been found on the Oregon Coast, some fragments occur separate from wood stake weirs, and others have been found in close association with weir features. Lattice has most often been found near main channel edges, at the mouths of former subsidiary tidal sloughs. It is often found in settings that would have been the location of V-shaped cross-channel weirs when these were used, and several fragments occur at or near the convergence of apparently related weir lines.

In this discussion, I use the term feature to describe an *in situ* concentration of lattice panels, while lattice fragment, panel, and artifact refer to individual lattice specimens. I use

basketry terminology to characterize lattice elements. This contrasts with barrel element terminology (hoop, stave and lashing) used at the Montana Creek site in Alaska for larger basket trap elements (Betts 1998:245), but it is similar to the basketry terminology Bernick (1983) used to describe lattice at the Little Qualicum site. Unlike basketry fragments, however, there is usually no clear rim or base in a lattice panel. Therefore warp is designated as the more rigid of the two woven elements, and weft is the semi-rigid to flexible twining element.

In all, 29 distinct lattice panel fragments have been observed and described in eight intertidal sites. Four of these sites are found in Yaquina Bay and four in the Coquille River. Most of these pieces have been found lying flat on eroding mudflat surfaces (Figure 48), and they range



Figure 48: Lattice Fragments Eroding from Bay Mud at the Osprey Site (scale in cm).

in size from 5 cm x 5 cm to 230 cm x 55 cm. Archaeological lattice in Oregon Coast sites consists of split wood rigid warps twined at a fixed gauge with a semi-rigid weft twining (Figure 49). In some pieces associated elements include larger support warps of split wood or stem sections, split wood framing, and cordage or twisted branch “rope.” As of this writing, no complete lattice structures appear to be present among the pieces identified, and most pieces are so fragmentary that their original structure, or their role in a larger composite device, is not readily evident.

The goal of my analysis is to determine the most likely structural associations for the lattice fragments based on attributes apparent in small fragments. This in turn provides information about possible fishing strategies that employed lattice fragments. I also examine the construction elements for indications of the size of the fishes that could have been harvested with a particular lattice panel.



Figure 49: Lattice Panel 8-D from Site 35-CS-130, with Labeled Attributes.

Ethnographic Lattice Manufacture

The archaeological lattice in Oregon Coast weir sites is most likely the remains of weir panels or basket traps, but in most cases it is unclear if a particular lattice fragment was used as part of a trap or a weir panel. This information would be useful to know, in part because it helps to elucidate the fishing strategies that took place at a site. In addition to the archaeological data, there are several ethnographic accounts depicting the use of lattice for intertidal fishing that help to illustrate lattice variation.

Ethnographic accounts typically describe lattice used in cylindrical basket traps, often in conjunction with wood stake weirs. Coquille elder Daisy Coddington told Joe Maloney (1934:100-3) that her mother, Susan Adulsa Wasson, “made eel baskets and traps. She took fir roots - they don't have any odor like cedar, and made the main body of the trap, then wove in spruce roots. She put spruce roots in hot ashes and then peeled them and split them and wove them in.” George Wasson (1996, personal communication), Adulsa's grandson, suggests that fir branches were more likely used for the main body (warps) instead of fir roots.

Some of the accounts presented in Chapter 3 depict the construction of basket traps used with wood stake weirs in tidewater. They indicate that these were often cylindrical, made from one or more flexible panels that were rolled around a hoop structure. The traps were often 8 to 10 feet long (2.5 to 3.0 m), with a cone-shaped mouth, and they were often placed at the downstream end of the weir. In the case of V-shaped cross-channel tidal weirs, this would be the apex of the V.

Traditional fishing tools from the Oregon Coast are not abundant in museum collections, and large objects such as basket traps and canoes are especially rare. The one complete Oregon Coast basket trap I have examined is shown in Figure 50. This well-preserved trap, collected by at

Siletz in 1916 by Leo Frachtenburg is housed at the National Museum of the American Indian (NMAI cat. no. 047528). It is described as Siletz-Tututni, and Siletz basket maker Robert Kentta (personal communication, 1996) suggests that it may be a small model, rather than a full-size trap. Nonetheless it is similar in some ways to the traps described ethnographically and the lattice in archaeological sites on the Oregon Coast.

The Siletz trap appears to be made of split and whittled wood warps, up to 71.5 cm long, with the cone 36 cm long. Its maximum diameter is 26.5 cm at the mouth, 18 cm at the opposite end. The trap is woven with what appears to be split root S twist twining that is wrapped in some places and full turn in others, maintaining an average warp spacing of 7 mm. Hoops provide the inside structure of the trap. The trap is a partially collapsed cylinder, fully cylindrical at the opening, where a cone-shaped mouth had been installed (and has since come loose), and flattened at the opposite end. This shape gives the trap a conical outline viewed from above, while allowing the main body of the trap to be made from a single rectangular lattice panel with few or no added warps. The trap has carrying handles. There does not appear to be an opening for removing fish, which supports Kentta's suggestion that it is a model. Yet the construction of the trap does illustrate Drew's observation that rectangular panels were in some cases rolled into a cylindrical shape around hoops to form such traps.

Elsewhere (M. Jacobs 1934[91]:50) Frank Drew observed that Native people made "small whittled sticks for fish traps, tied together into sections with fine spruce roots, 4-5-6 ft. long. Wrapped together and placed not on the ground but endwise against the shed wall." When I visited Drew's daughter, Marge Severy, in 1996, she told me to look in the shed beside their house for a fish trap her father had made as a young man, soon after arriving at the Siuslaw River from Yachats. I found it in a dry place, in relatively good condition after so many years (Figure 51). The trap consists of a rolled rectangular lattice panel in three pieces, of approximately 38

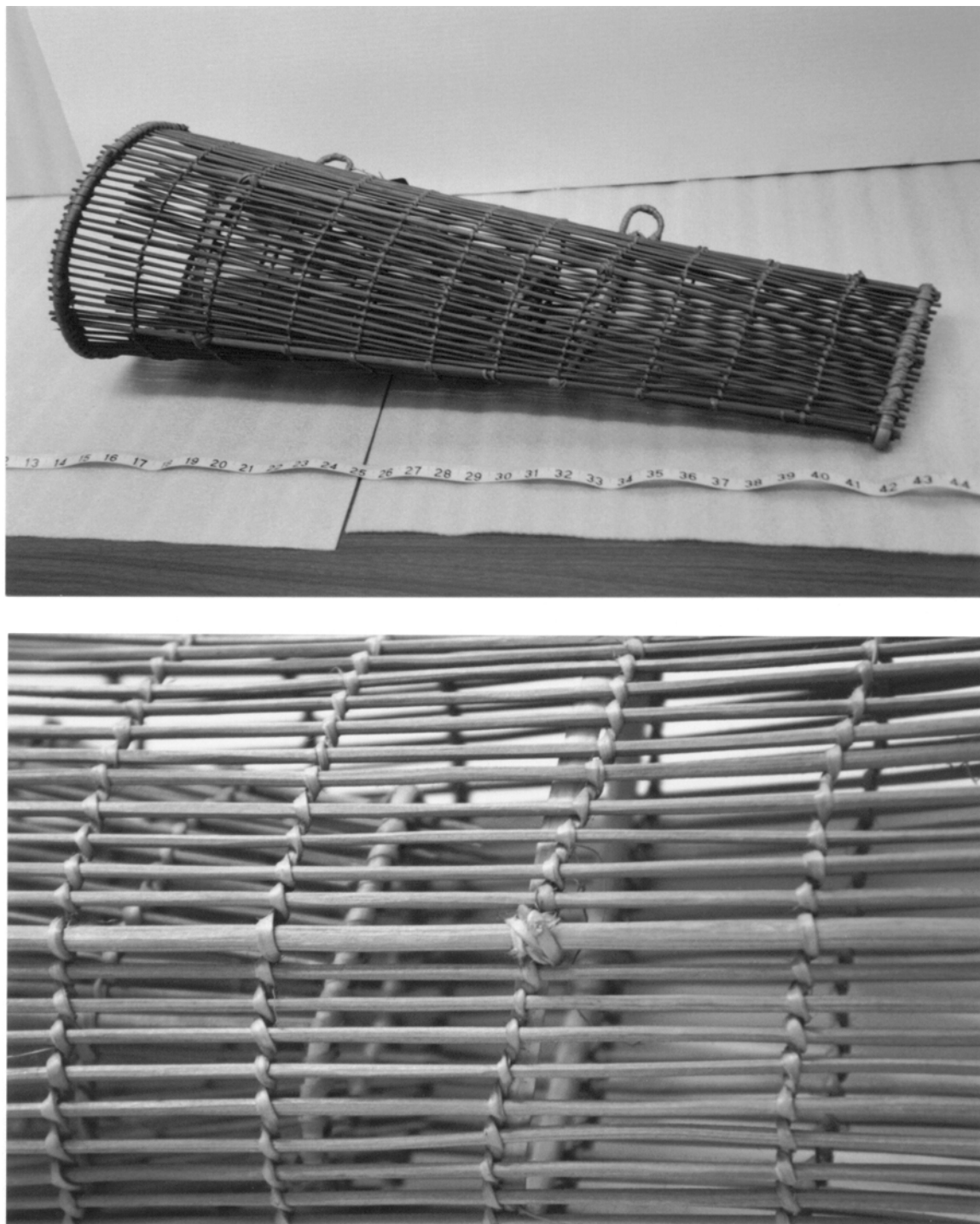


Figure 50: Basket Trap Collected at Siletz in 1916 (upper photo scale in inches).

split, whittled warps and 13 split root weft rows. The warps are spaced from an average of 9 mm, and the weft is S-twist full turn twined, spaced at 12-16 cm. Several of the warps are sharpened, and there are large diameter sections at the ends of some of the larger warps that may have served to tie the trap to anchoring stakes or for tying rope handles. I did not learn what species of fish the trap may have been used for. Marge Severy later donated the lattice panel to the Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw (David Brainard, 2001 personal communication).

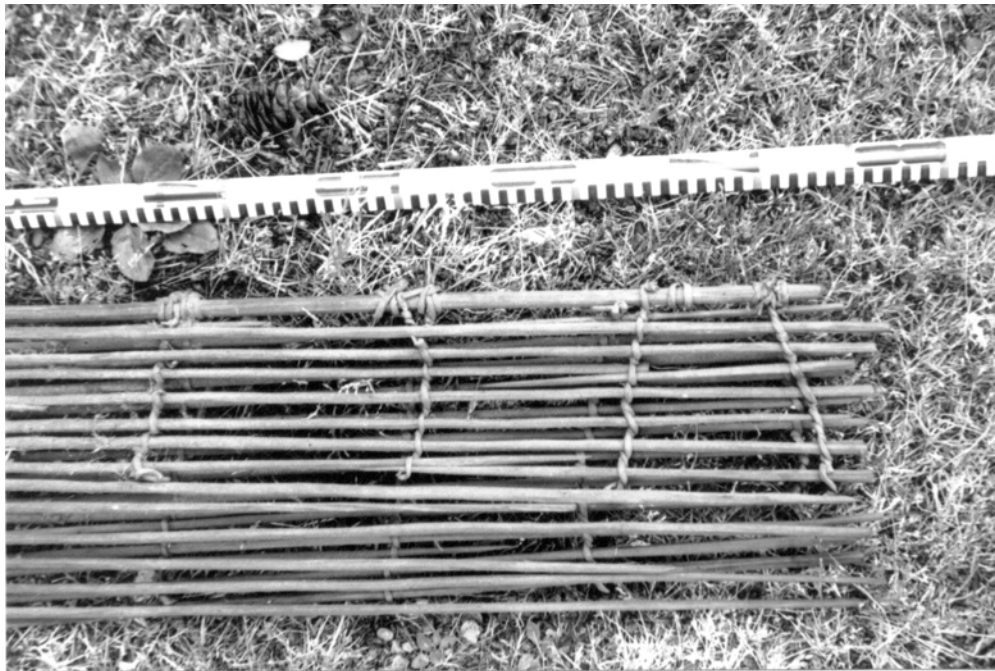


Figure 51: Detail of Lattice Panel Made By Frank Drew (Coos) in 1880s (scale in cm).

A photograph of a lattice fish trap, possibly Siuslaw in origin, appears in an article by amateur historian Margie Knowles (1952:8). According to the description accompanying the photo, the “fish trap of cedar sticks is a little over five feet high, 9 inches at the smaller end and 14 at the wider end with bindings 4 to 5 inches apart. At times these traps were set so close together in the North Fork that a boat could not get through....” Although the trap is somewhat tapered, there are no obvious lost warps in the photograph; the difference in diameter appears to have been produced by a gradual reduction of warp spacing over the length of the trap. Elsewhere in the article, Knowles (1952:13), who had interviewed several Siuslaw people, wrote that the Siuslaw “[f]ish traps were made from willow withes woven together with some kind of fiber string to make a tube shaped basket five or six feet long, open at each end, and about 16 to 20 inches across at one end, smaller at the other. Sometimes those traps were made or whittled out of cedar sticks about as big around as a lead pencil and fastened with fiber strings every five or six inches.”

Norman Dick (n.d.) recorded oral tradition from Coos elder Andrew Charles. He wrote that “[t]he vertical grain of the old growth cedar splits very easily and was rived out into small slats. These were later woven into fish traps with the aid of rings of green roots woven in at intervals to give them strength and to hold their shape.” He further noted that the “sapwood of cedar (near bark) is less brittle than the rest ... better for most technologies.” Frachtenburg (1910:10) noted that the Alsea made a “fishbasket” which was an “oblong basket made of sticks of dried fir-tree put up horizontally and diagonally fastened together with spruce roots” used in shallow tidewater.

Based on ethnographic accounts, the single photograph and the two preserved traps from the Oregon Coast, it appears that the use of a rectangular panel to make a cylindrical trap was a common technique. Occasional references to “conical” basket traps may actually refer to

cylindrical traps with conical mouth inserts, or slightly tapered traps such as the one depicted in the Knowles photograph. If this is the case, then the added warps necessary to weave a basket trap with a conical body should not be as common as parallel warp lattice. This would also mean that basket trap lattice should be similar to weir panel lattice in its warp configuration, i.e., both should have parallel warps and no added warps other than splicing. Thus, the lack of added warps in Oregon Coast lattice does not necessarily mean these fragments were parts of lattice panels. If fragments of conical trap mouths are preserved in sites such as Osprey, these will be more likely to show added warps in an expanding configuration (see Connolly and Byram 1997). Some of the traps made more recently are whittled, possibly reflecting the use of metal knives. But these traps appear similar to those depicted in oral history in other ways, including construction materials.

Ethnographic accounts also indicate that lattice panels were made for uses other than fishing. Some were used for drying meat, berries, and other foods. A Coos elder described a mat for seal meat, a “drying mat of small fir sticks held together by roots” (M. Jacobs 1934[92]:109). Robust lattice panels were also used as platforms between canoes for barge transport (M. Jacobs 1934 [97]:24). These were made of “split fir sticks” woven together with spruce roots. This large “mat” could be rolled up for transport or storage in the rafters of a house. Despite these other uses, the close association of archaeological lattice with wood stake features interpreted as weirs supports the inference that these panels are the remains of basket traps, weir panels, or other enclosures used in conjunction with weir fishing.

Archaeological Lattice Characteristics

The characteristics of archaeological lattice are presented in Table 11. Comparison of these weaving techniques and others in the region is discussed by Connolly and Byram (1997). Twining techniques represented in Oregon Coast lattice include simple twining and full-turn twining. In terms of fishing strategies, the use of different twining techniques may reflect the need to maintain measured spacing between warps. Full turn twining involves an additional half turn between warps than is used in simple twining, and given comparable weft thickness and rigidity, it maintains greater space between warps than does simple twining. Other tabulated lattice attributes include overall length and width of the exposed elements, warp diameter, weft spacing when multiple weft rows are present, the taxon of identified wood elements, and the presence or absence of support warps and frame pieces in the panel.

Several instances of probable warp fragment scatters have not been tabulated, since only pieces with woven structure have been classified as lattice (Table 11). There are two exceptions: Osprey panel 10 appears to retain even spacing and other characteristics of a twined panel, though no twining was evident on the exposed portion. Since its warp characteristics and gauge are evident, it is included in the tabulation. Panel 1 at 35-LNC-83 lacks weft twining and regular warp spacing, but is included in Table 11 due to the large number of contiguous well-preserved warp elements in this feature.

Lattice Distribution

All lattice fragments were identified in weir sites, none as isolates, and most are closely associated with weir feature concentrations. Only lattice feature 1 at 35-LNC-85 in Yaquina Bay

Table 11: Characteristics of 29 Lattice Specimens from Oregon Coast Intertidal Sites.

Tier 1 Type, Site No., Lattice No.	Max. Leng. ¹ cm	Max. Wid. ² cm	Mean Lattice Gauge ³ mm	Mean Warp Diam. mm	Mean Weft Spac. cm	Weft Twining ⁴	Weft Twist	Weft Taxon I.D.	Warp Taxon I.D.	Mean Warp Diam/ Gauge	(Tier 2) Structural Type	Comments
<u>Type A</u>												
LNC-76: 1	100	16	5.5	4.5		full turn	Z	<i>Tsuga</i>	<i>Tsuga</i> , <i>Pseudotsuga</i>	0.8		
LNC-76: 4	23	20	7.0	8.0	9.0	simple	Z			1.1	rolled	
LNC-85: 1	30	40	8.0	5.5		full turn	Z			0.8		
Rac-2: 1	30	25	8.0	5.0	9.0	full turn	Z	<i>Larix</i>	<i>Pseudotsuga</i>	0.8		
CS-130: 1	236	55	3.0	3.5	12.0	simple	Z	<i>Thuja</i>		1.2		support warps
CS-130: 3	15	16	5.0	6.0		simple	Z			1.2		
CS-130: 5	102	43	5.0	5.0	16.0	simple	Z			1.0		
CS-130: 6	>30	24	8.0	7.0		simple	Z	<i>Thuja</i>		1.0		
CS-130: 7	23	20	5.0	6.0	11.0	simple	Z		<i>Pseudotsuga</i>	1.2		
CS-130: 11	60	24	4.0	4.0	9.0	simple	Z			1.0		support warps
CS-1: 2	12	8	6.0	4.5		simple	Z			0.8		
<u>Type B</u>												
CS-1: 4	30	40	6.5	8.0	11.0	simple	S			1.3		
CS-130: 10	20	120	8.5	8.0						0.9	vertical	warp only
<u>Type C</u>												
LNC-76: 2	5	8	8.0	4.0		full turn	Z			0.5		
LNC-76: 3	5	5	10.0	5.5		wrapped	Z			0.6		
CS-17: 1	25	40	19.0	5.0	5.5	full turn	Z		<i>Thuja</i>	0.3		
CS-17: 2	18	54	9.0	3.0	6.0	simple	Z			0.3		
CS-97: 1	10	5	8.0	3.5		simple	S			0.4		
CS-97: 2	18	18	9.5	4.5		simple	Z			0.5		
CS-97: 3	25	25	8.0	3.5		simple	S			0.4		
CS-97: 4A	18	4	10.0	4.0	8.5	simple	Z			0.4		support warp

Tier 1 Type, Site No., Lattice No.	Max. Leng. ¹ cm	Max. Wid. ² cm	Mean Lattice Gauge ³ mm	Mean Warp Diam. mm	Mean Weft Spac. cm	Weft Twining ⁴	Weft Twist	Weft Taxon I.D.	Warp Taxon I.D.	Mean Warp Diam/ Gauge	(Tier 2) Structural Type	Comments
<u>Type C (continued)</u>												
CS-97: 4B	12	10	7.5	4.0		simple	Z			0.5		with hoop (?)
CS-130: 8A	35	54/119	10.0	4.5	15.0	full turn	Z			0.5	flat panel	(possible gate)
CS-130: 8B	>36	9	8.0	3.5	6.5	full turn	S			0.4	flat panel	support warps
CS-130: 8C	99/111	48/53	8.0	3.5	6.5	full turn	Z			0.4	flat panel	support warps
CS-130: 8D	179	23	9.0	3.5	6.5	full turn	Z			0.4	flat panel	support warps
CS-130: 9	63	13	9.0	3.0	9.0	full turn	Z			0.3	horizontal	support warps
<u>Type D</u>												
CS-130: 2	140	40	30.0	9.0	20.0	full turn	Z	<i>Tsuga</i>	<i>Tsuga</i>	0.3	rolled	
<u>Insufficient Data</u>												
LNC-83: 1	34			5.0					<i>Pseudotsuga</i>			warp only

Notes to Table 11:

¹ Length: maximum distance (cm) between ends of warps. When larger board is attached to lattice (Osprey 8-C only) board length Y follows lattice length X, as X/Y.

² Width: maximum dimension (cm) of lattice in line with weft rows, running perpendicular to warps. Board length follows lattice width when these are different lengths (Osprey 8 A and C).

³ Lattice Gauge: average distance (mm) between warp rows, usually the smallest dimension of the two lattice mesh dimensions.

⁴ Weft Twining: open simple twining, open wrapped twining, and open full-turn techniques are used in Oregon Coast lattice. Only Osprey lattice panel 8-A incorporates both, apparently for the purpose of maintaining warp spacing as weft material thickness varies. Puseman (1994), Bernick (1995, personal communication), and Trieu (1999) identified botanical taxa.

is located in a part of a site where no weir features have been identified. Notably this is one of the larger lattice fragments, and it may have been used alone, without stake supports. All of the archaeological lattice has been identified in the Coquille and Yaquina estuaries, though lattice has been reported from two localities in Coos Bay (Chapter 4). No lattice has been reported from estuaries north of Yaquina Bay, possibly because survey was less intense in this part of the study area and fewer weir sites were identified. The lack of lattice in the Siuslaw is surprising given the numerous historic descriptions of basket trap use in this estuary. However, many of the Siuslaw weirs recorded at this time may date to the commercial fishing era (post Reservation), and though wood stake weirs clearly remained effective compared with other techniques, lattice may have been replaced by nets by this time. Other sites with lattice likely remain buried in the sediments of the Siuslaw and Coos estuaries, as they are in the Coquille and Yaquina estuaries.

At this time, three sites (35-CS-130, 35-CS-97, and 35-LNC-76) account for 22 of the 29 lattice fragments recorded on the Oregon Coast. Each of these sites underwent intensive erosion during the period they were monitored. Therefore, taphonomic processes may be a major factor in the differential frequency of this artifact type in the known sites. Lattice appears to be most commonly observed in sites where erosion is most persistent and most extensive. Eroding banks may not be as common in portions of the Siuslaw and Coos Bay where weir sites are present but lattice has not been identified.

Cultural factors likely account for some of the distribution of archaeological lattice as well. Lattice use may have been limited spatially and temporally in comparison with wood stake weir use. For example, no lattice has been found associated with weirs occurring in tideflat settings. If tideflat weirs were used for corralling demersal fishes such as flounder for spearing, lattice panels and basket traps may not have been needed (cf. Elmendorf 1992:76).

Archaeological lattice is most common in settings thought to represent cross-channel tidal weir

use, at or near the mouths of subsidiary tidal channels. In these settings, the lattice was likely used in conjunction with wood stake weirs to impound fish as tides receded.

Analysis of Osprey Lattice Feature 8

Panels 8-B, C, and D at the Osprey Site (35-CS-130) share many characteristics. They are identical in warp diameter and weft spacing, with nearly the same gauge (8-9 mm). Each is twined with a full-turn twining technique, although panel B is twined with an S-twist, while panels A, C, and D are twined with a Z-twist. One other unusual characteristic seen in panels 8-B, C and D is the incorporation of occasional warps of larger split wood or even stem wood. These support warps are as much as 4-5 times the diameter of the split wood warps that make up most of each of the lattice panels. Support warps are seen on four other lattice panels with narrow warps.

On panels A and C, thicker boards have been attached at margins, apparently to maintain flatness and rigidity in the panel, and possibly to support the panel vertically (Figures 37 and 38). These boards range from 2-3 cm in diameter, and one on panel C is attached by selvage at weft rows 5, 6, 11, 14, and 15 (from west to east). A second board lay along the east edge of panel C but did not appear to be attached to the panel with weft or lashings, though it may have been loosely attached at one time. The board along the west edge of panel A is attached with a spiral lashing along one of the two widely-spaced weft rows in this panel. Panel A has many unusual characteristics that suggest it served a special function requiring greater flexibility. In particular, is the only panel with tapered warps along one margin. As noted, two of these warp ends were spliced into the adjacent panel B, which led to the hypothesis that panel A served as a gate.

Lattice Types

It appears that much of the variation in lattice construction relates to fishing strategies. Framed lattice panels are constructed differently from cylindrical basket traps, and environmental setting and types of fish targeted may factor in the choice of lattice used for a particular device. This variability may be reflected in formal groupings of lattice or lattice types.

Three lattice types were distinguished at the outset of investigations of archaeological lattice (Byram and Erlandson 1996). These types were initially based on a sample of 15 lattice fragments, primarily from two sites, including four from Osprey feature 8 that are likely related to each other. As the sample has nearly doubled in recent years, and lattice has been recorded at several more sites, I am proposing a new typology with two tiers.

Because warp is generally better preserved than weft on most lattice fragments, warp spacing (or gauge) and warp diameter form the basis for the first tier, construction elements. Additionally, warp diameter divided by lattice gauge seems to provide a useful criterion for distinguishing the two small and medium gauge types. One final difference is in the presence or absence of “support warps,” i.e., warp elements over three times the diameter of the average warp in a panel and woven into the lattice at wide intervals.

Element Types (Tier 1):

Lattice Type A, small gauge/narrow warp: This panel type is represented by 11 archaeological lattice fragments. It is the most common, and it may have been used in basket trap construction, flexible enclosures, and in weir panels. Warp thickness is large relative to lattice gauge, the ratio ranging from 0.8 to 1.3.

Lattice Type B, small gauge/robust warp: This type is represented in panel 4 at the Philpott site, and panel 10 at the Osprey site. It may have been used much like type 2a, but its

heavier construction would have made it more suitable for use as a flexible, freestanding enclosure, or as a self-supporting weir panel. In either case it is more likely to have been used with warps oriented vertically, as is indicated by the positioning of Osprey panel 10 in relation to an adjacent line of weir stakes. The ratio of warp diameter to lattice gauge for this type is 0.9 to 1.3.

Lattice Type C, medium gauge/narrow warp: This type is represented by Osprey lattice panels 8a, 8b, 8c, 8d, and 9, lattice panels 1 and 2 at 35-CS-17, all lattice panels at 35-CS-97, and panels 2 and 3 at 35-LNC-76. Because warp diameter is small relative to lattice gauge, ranging from 0.3 to 0.6, lattice of this type may have been too gracile to have been used as a freestanding panel with warps positioned vertically. It was most likely used in weir panels with warps horizontal (Osprey 9), and in framed panels (Osprey lattice feature 8). Support warps are commonly integrated into this type of panel. Type C lattice panels 4A and 4B at 35-CS-97 may be associated with a hoop structure from a basket trap.

Lattice Type D, large gauge/robust warp: Only one lattice panel has been placed in this class, Osprey lattice panel 2. It is larger in all attributes, and contains more stem wood elements than the more common split wood lattice. Based on this one panel, the type appears to have been a portable panel used with warps oriented vertically. The ends of the warps in this fragment have cut marks indicating they are complete, and some appear to have been sharpened, possibly for driving into bay mud. The ratio of warp diameter to lattice gauge for this panel is 0.3.

The second tier of the typology involves structural types, i.e., use of the lattice in basket traps and flat panels, and the overall position of the panel relative to weir features. There are four structural lattice variants among the assemblages of the Oregon Coast. The first two involve lattice occurring in direct association with weirs, indicating they served as weir panels (or fencing). These are lattice fragments 9 and 10 at the Osprey site. The more gracile panel 9 was

positioned horizontally, parallel to the stakes of a weir, while the more robust panel 10 was identified perpendicular to a weir, indicating it had stood vertically against the weir. These distinctions suggest that panels with more robust warp may be self supporting with warps vertical, while more gracile lattice would have been hung from stakes much like netting.

A third form is the framed panel with support warps, as seen in lattice feature 8 at the Osprey site. These panels may have served as enclosure walls for a trap, or as weir panels (see Chapter 5). Osprey lattice panel 8A may represent a subclass of the framed panel. With its tapered warps and single frame, it appears to have been an extension of another panel, and it may have functioned as a gate. The third tier 2 type is simply the rolled lattice panel, as seen in lattice fragment 4 at the Ahnkuti site and lattice fragment 2 at the Osprey site. These panels show evidence of having been rolled during or after use, distinguishing them from frame panels which are flat. Rolled lattice fragments could have been part of basket traps, weir panels, or freestanding enclosures. A fourth type includes those fragments lacking information about overall structure.

In summary, given the widespread representation of cylindrical basket traps in ethnographic accounts from the region, it might be expected that lattice occurring at intertidal fishing sites would show characteristics of basket trap construction, yet no clearly cylindrical structures have been identified. Although none of the archaeological lattice fragments is clearly part of a cylindrical basket trap, several may have been used in this type of device, and two lattice fragments at 35-CS-97 are associated with a hoop structure that may be from a basket trap. Also, a feature of multiple hoops bound to a cross piece identified at 35-CS-17 (Chapter 4) may have been the frame of a basket trap, but no lattice was identified with this feature.

Other structural types have been more clearly identified. Frame panels that clearly were not cylindrical are present in Osprey feature 8. Osprey features 2, 9, and 10 are closely associated with weir stakes. Two of these (2 and 10) were likely flexible panels in freestanding enclosures,

possibly resembling the lattice enclosure in the kl'um weir described by Agnes Johnson (Chapter 3), and one (lattice 9) may have been a weir panel supported by stakes. The remaining 21 lattice fragments could be the remains of basket trap lattice, framed panels, lattice tied horizontally to weirs, and freestanding enclosures. It is possible that tier 1 types A, B, C, and D correlate closely to the tier 2 structural types, but until more lattice is found in association with weir features and other structures, the relationships between construction elements and fishing apparatus will remain largely hypothetical.

Lattice Gauge and Fish Size

Nearly all of the Oregon Coast lattice fragments are of sufficiently fine gauge to prevent the passage of small fish such as herring, smelt, and shiner perch (Figure 52). Twenty-six of the 28 fragments with regular warp spacing have gauge measurements of 1 cm or less. Only one panel (Osprey 2) has a gauge large enough to allow the passage of adult herring, smelt, or shiner perch, but not adult salmonids.

In historically documented weirs that targeted large fish such as salmon, lattice panels were generally coarse, averaging 40 mm or more (Barnett 1955:80; Stewart 1977:102; Stewart 1987:107). This gauge measurement is over four times the average size of the Oregon Coast archaeological specimens.

Why was fine gauge lattice used so often on the Oregon Coast? Assuming raw materials were not in short supply, I suggest that fine gauge lattice was likely used when small fish were targeted, or when generalized harvests of both small and large fish were intended. When large

shiner perch
Cymatogaster aggregata

adult chinook salmon
Oncorhynchus tshawytscha

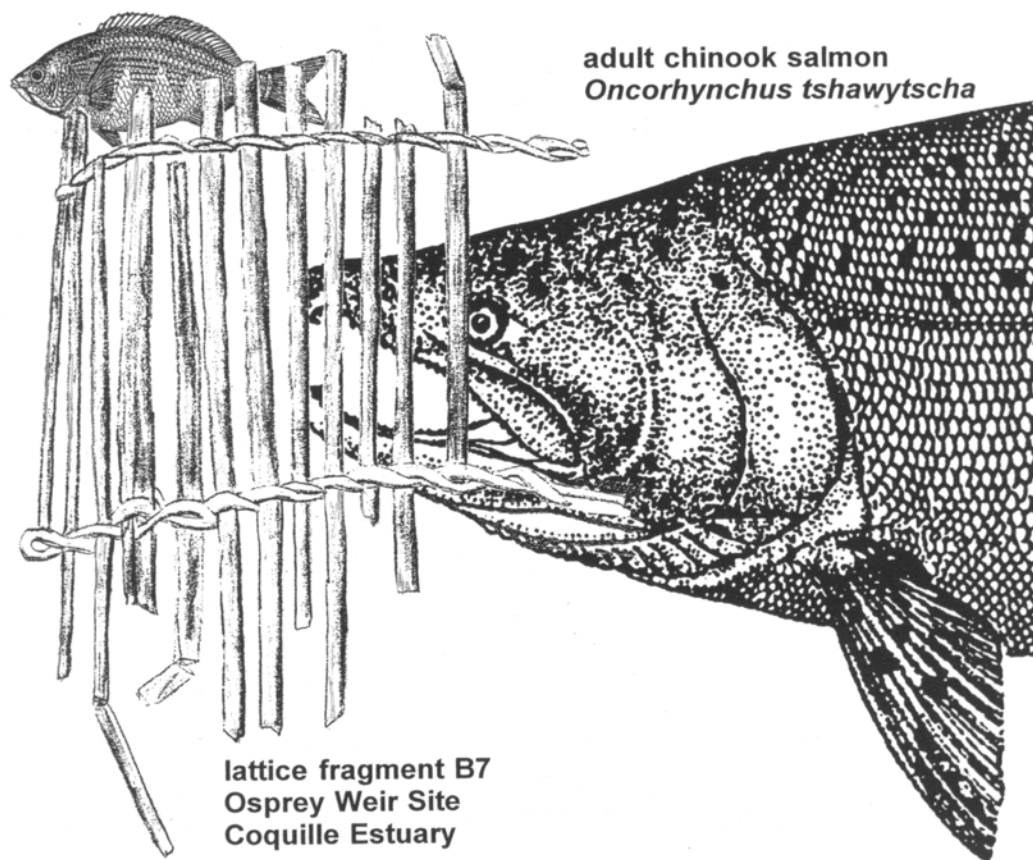


Figure 52: Typical Lattice Panel and Small and Large Fishes Present in Oregon Estuaries (to scale representation).

fish such as salmon were exclusively targeted, coarse gauge lattice (perhaps ≥ 50 mm) would most likely have been used, being more efficient to produce and probably more durable. In some cases, there is support for these generalized harvests in archaeological faunal remains. For example, the diverse fish species represented at residential archaeological sites 35-CS-2/3 and 35-CS-1 adjacent to and contemporary with the Osprey site indicate herring and other small fishes were harvested at least as often as salmon (Losey 1996; Byram et al. 1997; Tveskov 2000; Erlandson et al. 2001). However, manufacturing efficiency and fish size may not be the only factors conditioning the dimensions of lattice. Other possible factors include resistance to tidal current, durability, and aesthetic preferences.

Whatever the impetus for producing fine-gauge lattice, its use would have allowed the harvest of the numerous forage fish and other smaller sized fishes that inhabited estuary settings in vast numbers seasonally. This supports data from ethnohistoric accounts and fishing-related archaeological village or camp sites, which strongly suggest that tidal weirs were used by Oregon Coast Native peoples to catch a variety of fish, including small fish traditionally underemphasized in anthropological accounts of Northwest Coast societies.

CHAPTER 8

SUMMARY AND CONCLUSIONS

Prior to the mid 1990s, the history and archaeology of intertidal fishing weirs on the southern Northwest Coast were nearly unknown. My archival research has brought to light a wealth of data on fishing technologies along the Oregon Coast, documenting a considerable range of variability in this technology, particularly as depicted in oral history. Along the Oregon Coast, archaeological research has led to the identification of 72 intertidal weir sites, containing over 250 wood stake features ranging from a handful of stakes to over 8000 in a single feature. Twenty-nine lattice panels have been recorded, ranging from small fragments to large framed panels buried in mudflat paleosols. There are now 81 ^{14}C dates for estuarine weirs, representing at least 3400 years of wood stake weir building. So effective was this technology that it persisted into the 20th century in some parts of the Oregon Coast. In the last decade, University of Oregon archaeologists have literally transformed the Oregon Coast landscape from “terra incognita” regarding archaeological knowledge of fish weirs, to one of the best documented regions (along with southeast Alaska) for this key Northwest Coast technology.

The rich ethnohistoric accounts that are the foundation for my analysis of archaeological weir technology are undoubtedly more thorough because people continued to use weirs and traps during and after the Coast Reservation years. Conversely, there are relatively few accounts of stone tool manufacture and use, as this technology was largely abandoned with the introduction of forged metal tools and the disruption of long distance trade networks. Other traditional technologies or arts that persisted through the settlement era include basket making, hide working, house building and woodworking. Although some of these practices changed during and after the Reservation years with new economic conditions and limits on trade networks, the

techniques of weir use, basket making, and other traditions were well known to the Native elders interviewed by anthropologists in the early to middle 20th century.

Ultimately, the decline of Oregon Coast weir fishing technology was caused by the displacement of Native communities by American settlers and the incorporation of Oregon Coast fisheries into the global web of commercial fishing and overexploitation. Although a few settlers may have adopted tidal weir fishing to some extent, its persistence through the first decades of American settlement was largely limited to places where Native people continued to reside along estuary shores. Weirs and/or basket traps were still used in the late 19th century along the Siletz River, Alsea Bay, the Siuslaw and Umpqua rivers, and South Slough on Coos Bay. While newly introduced fishing technologies may have led some Indian people to abandon the use of weirs, traditional fishing systems remained some of the most effective techniques available. It may not have been changes in fishing technologies that ended weir use in the region, but the implementation of government regulations designed to halt dramatic declines in coastal fisheries caused by commercial overfishing by canneries and other interests bent on export. Over time, log rafting and private property ownership also increasingly limited the use of these structures, though eventually the diminished returns caused by degradation of estuary habitats by industry would have curtailed weir and trap fishing. If not for these impacts, weirs and traps might still be used today by some Native communities of the Oregon Coast. Given the emphasis on fishing and cultural heritage in today's Native communities (Ivy and Byram 2001; Brainard 2002) the day may come when these traditional fishing practices put food on the table once again.

Re-Modeling Oregon Coast Archaeology

My archaeological and ethnohistoric analysis of tidal weir fishing and other estuary resource use on the Oregon Coast portrays a different subsistence focus for Native peoples than has often been portrayed for the region. Archaeologists often model land use and residential patterns in terms of resource use during different seasons. While the value of such generalizations is debatable, the ethnohistoric and archaeological data I have assembled warrant revision of widely cited models of Oregon Coast peoples' annual residential patterns and land use.

Several researchers have proposed land use models for portions of the Oregon Coast, particularly the portion from Coos Bay southward (Minor and Toepel 1983; Draper 1988; Tveskov 2000). Yet the most widely cited model encompassing my study area is one developed by Lyman (1991; see also Lyman and Ross 1988). As presented by Lyman (1991:82-83), this model of Native land use applies to the Oregon Coast during the "late prehistoric" period. Although he rejected the value of ethnohistoric data, Lyman's model is clearly based more on published ethnographies than archaeological data. In Lyman's scheme, villages along estuary shores were occupied by large residential groups, primarily during winter when people relied on stored food. In spring, when stores were depleted, most people left the villages along the estuary shores to go to shellfish gathering camps and sea mammal hunting camps on the outer coast, or to upriver camps. These dispersed camps were used through mid to late summer, after which people nucleated at the lowest reaches of the rivers and on the shores of estuaries, establishing fishing camps or re-occupying winter villages. Fish were caught, dried, and stored for winter use. This fishing continued as the main focus until the end of the fall runs of salmon, at which point people returned to the winter villages. According to Lyman, when population pressure became a problem along estuaries and non-tidal river mouths, villages were established on the outer coast.

Although Lyman's model recognized that estuary shores were often the settings for winter and fall residential locations and fall fishing sites, ethnohistoric and archaeological data now available show that the estuary was much more central to local economies. Ethnohistoric accounts indicate that many villages were occupied year round by at least a portion of the residential group, and these settings appear to have been the locus of food harvesting and processing activities as well as storage and consumption. Estuarine resources were available throughout the year and large fish runs occurred during all seasons. This abundance appears to have been a major reason why the largest communities were located along estuary shores. In very general terms, villages were located at points of greatest access to a reliable and diversified year-round resource base.

In terms of a "seasonal round," combined ethnohistoric and archaeological data justify a new general model. In spring, the largest coastal communities were at estuary shores, where people fished for smelt, herring, and other fishes and harvested plants and game from nearby areas. In late spring and early summer many people left estuary villages to visit upriver villages or camps for lamprey and salmon fishing at upriver weirs and falls. These fish runs lasted only a few weeks, but plant foods such as camas and wild oats were also available in many of these upstream settings at this time of year. Trade and social interaction with interior communities was also pursued during these visits. Fish were smoke-dried or sun-dried outdoors or in shelters, and along with camas they were brought back to tidewater villages for distribution among families and storage. This return may have coincided with the onset of summer runs of herring, sardine, and other fishes. Ongoing harvests of flounder and other fishes were pursued by people who had not made the trip upstream. In late summer, trips to dispersed elk hunting and berry gathering places could be taken. Many of these places could also be visited within the daily catchment radius of the village.

There are no indications that villages near estuary shores were regularly abandoned in spring or summer, and several accounts indicate people relied on estuary fishing at this time of year. Summer was also a time of visiting, and people traveled to other parts of the coast and interior to see friends and relatives, to participate in gaming and athletic contests, and to trade. In September, those who had been away returned to estuary shores, as estuary fishing was intense during this month. By mid fall, many people left the villages to go to camps and villages near the head of tide and on freshwater streams, where Chinook, coho, and chum salmon could be caught in abundance. Productive fishing also continued in the middle and lower estuary. At this time of year most of the fish were smoke-dried in plank houses near the estuary shore, often being brought back to these villages on a daily basis. Salmon fishing continued well into winter, overlapping in timing with smelt runs in the estuary. Though an indoor lifestyle may have prevailed during this season due to the weather, people still fished in estuary and upriver settings during winter. Settings such as the Coquille River Valley may have been somewhat different than the other coastal river valleys. On the Coquille, the rich resources of interior valleys sustained large residential communities year round well above tidewater, but the general model may apply for the people of the lower Coquille Estuary (cf. Tveskov 2000). Throughout the year smaller residential communities in non-estuary settings may have visited the estuary for fishing, but they probably relied more on locally available resources such as trout, salmon, and sturgeon (freshwater lakes), sea mammals and ocean fish (outer coast), and game and plant foods (interior valleys).

Residential Sites vs. Work Stations: The Case for a Commuter Economy

Compared to most previous models of Native land use along the Oregon Coast, I see estuarine villages as the center of a relatively sedentary lifestyle, in which diverse and productive estuarine resources support large populations. One reason the mosaic of village catchment along estuary shores appears to go unrecognized by many archaeologists is the widespread assumption that most archaeological sites represent residential use, rather than work stations within the catchment of residential sites (e.g., Ross 1984; Minor 1985:10-11; Lyman 1991). Having reviewed extensive ethnographic sources and surveyed large portions of the region's estuary shores, I contend that a larger portion of the archaeological sites identified on the Oregon Coast are work stations, rather than residential sites. The assumption of hyper-mobility is a longstanding tradition in "hunter-gatherer" archaeology, stemming in part from colonial narratives that facilitated the disenfranchisement of Native peoples. There is no indication that Oregon Coast people lacked permanent, year round villages. Far from roving campers who left small shell middens, lithic scatters, or fishing structures at or near each camp they visited, Native people of the Oregon Coast more often visited various localities through the course of a week, month, or season. Their use of large, fast moving canoes transformed tidal channels into the arteries of a commuter economy in Oregon estuaries, and to a lesser extent on the outer coast and in upriver settings. As Donald Ivy (2001, personal communication) has remarked, "it takes four Coquille Indians approximately 20 minutes to paddle a Chinook style canoe two to three miles across Coos Bay." Thus, the residents of a single village at the estuary may have had daily access to numerous harvesting or processing stations, including fishing weirs, elk pits, shellfish gathering and processing sites, tobacco gardens, quarries, and many others.

On the outer coast, nonresidential “stations” may include coastal bluff sites where tool stone was heat treated and tools were made (Minor and Toepel 1983; Tveskov et al. 1996), as well as numerous shell middens located within the catchment of larger occupation sites (Moss and Erlandson 1995). Initial processing of resources at these sites would likely be aimed at reducing weight prior to transport (reducing tool stone mass, roasting or drying shellfish meat, etc.). For example, among the Tillamook it was common to dry shellfish meat with a fire on the beach before bringing the harvest back to the village (E. Jacobs 1934a[84-106]:24). To the extent that processing was done on the beach, shellfish consumed by village residents is not likely to be represented archaeologically. Similarly elk were often butchered and dried at hunting stations, with only the dried meat brought back to peoples’ homes (e.g., Harrington 1942[20]:566), and therefore elk bone in site deposits may reflect tool making more than food processing.

Archaeological and Ethnographic Biases in Subsistence Portrayals

Despite evidence to the contrary, published ethnographies clearly portray salmon as being more important than other fishes for Oregon Coast economies. There may be several reasons for this ethnographic misrepresentation. Researchers may have paid less attention to tidewater fishing because large groups did not generally make a residential move to do this. As they often did fieldwork during summer months, ethnographers may have observed riverine weir fishing for salmon more often than estuarine fishing in tidal slough settings. Melville Jacobs noted that tidewater fishing was considered so basic or fundamental by the people he interviewed that it was not brought up in the interviews; people preferred to tell him of their annual salmon fishing trips and elk hunts. A similar disparity between the food getting practices described in ethnographic interviews and the actual foods consumed has been noted by Moss (1993) for shellfish gathering

among the Tlingit of southeast Alaska. Assumptions on the part of ethnographers involving gender roles may also have been a factor. Whether the source of this misrepresentation on the Oregon Coast is due to methodology or historical circumstances, there are now abundant data that warrant a new perspective on traditional fishing and land use in this region.

The apparent lack of attention to key subsistence practices also seen in numerous archaeological studies may stem from archaeological methods in addition to ethnographic analogy. For example, Lyman's (1991) volume has been criticized for its lack of emphasis on the full range of faunal remains recovered with fine-grained techniques from residential sites (Moss 1994; Erlandson et al. 1998). The absence of many fish bone analyses is particularly telling. Lyman's focus on salmon, to the virtual exclusion of any other fish, demonstrates a lack of attention to the full faunal record (see Greenspan 1996; Losey 1996; Tveskov 2000), possibly resulting from relatively coarse sampling of faunal remains. Our work at the Philpott site (35-CS-1) illustrates this disparity; extensive excavations by Ross et al. (Draper 1982) recovered only one fish bone, whereas limited sampling using fine mesh screens recovered over 7000 fish bones, most from small species such as herring (Byram et al. 1997; Tveskov 2000:208).

Additionally, a large portion of the anadromous fish harvests in the region is not well-represented in published ethnographies nor in archaeological reports. Ethnohistoric research indicates Pacific lamprey (eel) was an extremely important resource for many Native people. Its value in late spring and early summer appears to have exceeded spring Chinook salmon in many rivers in the study area. Lamprey is also oilier than salmon, and if smoked it may store for over a year. As the lamprey is cartilaginous, only its teeth are likely to be represented archaeologically (Virginia Butler, 1996, personal communication), and this part of the fish may or may not have been deposited near sites where dried stores were prepared and consumed.

Salmon and lamprey together were clearly valued by many communities, but the use of salmon may have required much more labor than the processing of the smaller marine fishes such as herring, sardine, and smelt. Nearly every variety of fish could be smoked, dried, and stored through the year, but larger fishes such as salmon must first be butchered. Furthermore, salmon and lamprey harvests often required a residential move away from permanent villages during part of the year. When upriver fishing was combined with family visiting, trading, plant harvesting and hunting, the seasonal residential move away from the estuary may have been worthwhile, though estuary resources remained productive during seasons of upriver salmon and lamprey availability.

Along the Oregon Coast, there are no indications – ethnohistoric or archaeological – that estuarine weirs were specifically designed to harvest salmonids during runs. Instead, there are numerous indications that a diversity of fishes was harvested with each tidal weir type. Small gauge lattice is far more common than the large gauge lattice more likely to be associated with the exclusive fishing of salmon or other large fishes. Salmon were certainly among the fish caught in these tidal weirs, but several other fishes appear to have been as well.

Fishing and the Development of Nonegalitarian Societies

Recent research on the Oregon Coast has direct relevance for models that posit fishing strategies as the foundation for the development of nonegalitarian societies on the Northwest Coast. As outlined in Chapter 1, several researchers see weirs as an indicator of intensive salmon fishing and associated socio-economic developments that led to ranking and wealth differentials. Both group management models and resource control models account for the proposed role of weir fishing in these developments. My research on the southern Northwest Coast suggests that

wealth and social ranking may have developed with a reliance on much more diversified harvest of a variety of fish and other resources. Tidal weirs served a critical role in Oregon Coast Native economies, and riverine weirs were important in this region as well.

Group management models (Johnson and Earle 2000:137, 211) where wealth and ranking facilitate management of activities such as intensive weir harvests and fish processing, are perhaps more applicable to riverine groups that did not rely on estuarine weir use. In contrast to riverine weir use, the operation of one tidal weir did not preclude the use of another, and multiple weirs could have been used simultaneously even by one individual. No tidal weirs identified on the Oregon Coast to date appear to have required large-scale annual rebuilding, and many likely remained standing not only through multiple seasons, but through multiple years. Furthermore, diverse estuarine fishes were important subsistence resources, spawning runs occurred during all seasons, and day-to-day harvests outside times of spawning runs may have also provided a substantial portion of annual weir harvests. Therefore intensive processing for long-term storage may not have been necessary to sustain relatively large and sedentary populations in Oregon Coast settings. As Melville Jacobs (1934[96-22]:11-16) observed, the key subsistence pursuit in at least some Oregon estuaries was largely communal, and the abundance of marine fish was so great that there were more limitations involving processing than in harvesting.

Resource control models (Coupland 1985:223; 1998:48; Matson 1992:373; Hayden 1995:37) are not supported by the Oregon Coast data either. Because tidal weirs were numerous and widely dispersed, control of access to weirs through nearby residence was likely impractical in many localities. Due to the ubiquitous use of the canoe in tidewater areas, people may have harvested at weirs located kilometers from their homes (though people often did live near productive fisheries). In addition, the widespread occupation of plank houses in estuary villages meant that the community's processing facilities were readily available and unlikely to have been

controlled by a few individuals. Thus, although the resource abundance and economic structure necessary to sustain social ranking and wealth appears to have been present in estuary-oriented communities on the Oregon Coast, the social mechanisms which led to nonegalitarian society remain in question.

Neither managerial efficiency nor control of localized resources appear to explain the development of complexity among groups residing near Oregon Coast estuaries, where fish resources were apparently diverse, abundant, and widely available both spatially and temporally. The apparent conflation of ethnographically well-documented riverine weir use with less understood estuarine fishing strategies seems to account for this discrepancy. Although I have only addressed this problem for the Oregon Coast, it seems likely that diversified estuarine fishing may be under-emphasized in other parts of the region as well.

Other researchers have reached similar conclusions. For example, Stevenson (1998:227) argues that tidal traps should not be seen as indicators of large group effort comparable to that seen in large riverine weir building. Wet site archaeologist Kathryn Bernick has summarized the relationship of archaeological fishing materials to theorizing based on this evidence,

Wet-site archaeology on the Northwest Coast today is dominated by fishing sites and the interpretation of fishing-related features and artefacts. The central role of fishing on the Northwest Coast means that direct evidence of fishing technologies merits attention. Yet, archaeologists have been in the habit of reconstructing methods of fishing to fit their theories. Those who work with wet-site data are calling for reassessment. Three-thousand-year-old netting consistent with salmon gill-nets challenges assumptions that gill netting is a modern technique introduced by Europeans; relatively simple tidal weirs question the notion that all weirs document ... mass harvesting of salmon (Bernick 2001:222).

Moss and Erlandson (1998:193-4) suggest that while some tidal weir/trap sites required more massive construction efforts, "there is a variety of types of weirs and traps across the Northwest Coast; some of these may have been the products of small task groups."

On the Oregon Coast, the densest communities were those on estuary shores, who relied heavily on the abundance of the estuary harvested with tidal weirs and other techniques. While the abundance necessary to sustain nonegalitarian social organization appears to have been present in the estuary environment, the factors that brought about these developments remain in question. Thus, it appears that general models relating social developments to fishing practices on the Northwest Coast are in need of major refinements that take into account regional variation. These models may be applicable in some contexts but certainly not all.

Future Research Directions

My study shows that the variability in the weir fishing strategies used by Native peoples of the southern Northwest Coast can be effectively studied through a combination of archaeological and archival research. Although the oral histories of Oregon Coast tribes have sometimes been characterized as either limited or severely biased, in archival sources I have found a rich source of data on the history relevant to the archaeology of the Oregon Coast. Continued investigation of variability in fishing sites on the Oregon Coast and elsewhere will ultimately lead to a better understanding of the importance of estuarine fishing technologies in the development of maritime societies of the Northwest Coast, the Pacific Coast of the Americas, and around the world.

Some of the more compelling avenues for future research involve the search for earlier intertidal fishing sites, including underwater survey of subtidal channel banks, more dating of known features and comparative analysis of regional chronologies, and further investigation of the geological processes and cultural factors relating to the spatial and temporal distribution of weir sites. In particular, investigation of areas where sites are few or yet unknown holds promise,

such as the northern Oregon Coast. Numerous weirs reportedly exist in Willapa Bay, and study of these sites will shed more light on this fundamental subsistence technology on the southern Northwest Coast. Similarly, large gaps remain in survey coverage in British Columbia and northern California (Moss and Erlandson 1998).

Future research involving weir sites on the Oregon Coast and elsewhere on the Northwest Coast may lead in many new directions. Particularly promising are studies focusing on the paleoecology and topography of buried intertidal surfaces. Analysis of these paleo-surfaces, as well as subsurface characterization of weir features, will provide a clearer picture of the configuration of weirs relative to the settings in which they were used.

Several aspects of technology may be explored through the study of intertidal weir site assemblages. Differences in lattice technology may be furthered explored, focusing on temporal and geographic variation. This research could focus on the specific taxa harvested with various weir and trap types, the seasonality of weir building and the relative permanence or frequency of maintenance. Weir stake manufacture may also vary over time and geographically. Replication and experimentation could also be conducted to elucidate many aspects of weir and trap use. A focus on woodworking technology and the study of “wood scatters” across estuary paleosurfaces could be developed along the lines of lithic scatter and potsherd surface site studies.

The immense research potential of intertidal weir site studies reflects the prominent role of tidal weir fishing in traditional Native economies on the Oregon Coast. Although largely overlooked until now in ethnographic and archaeological research, tidal weirs and related traps were key fishing systems in the commuter economy that sustained the region’s largest populations throughout the year. Aspects of these fishing practices that are only now clear are the great diversity of fish species harvested, the abundance of these fishes during all seasons, and the high efficiency and accessibility of harvests through the use of weirs, traps, and related

techniques. Because of these findings, research on Native cultural history on the Oregon Coast must now hold as a premise that the mass harvest of fishes in estuaries was at the core of the region's economy historically, and may have been so for thousands of years.

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