



Crows Tears
Shirod Younker, linocut print, 8" × 10" 2007

Tectonic History and Cultural Memory

Catastrophe and Restoration on the Oregon Coast

by R. Scott Byram

ON A WINTER EVENING IN 1700, the village at the Nilestun shoreline on the Oregon Coast was wrenched in a massive earthquake. Deep cracks formed as the sand below liquefied with the earth movement and oozed to the surface. The land began to sink relative to sea level, and within a few moments a massive tsunami entered the Coquille River estuary, scouring the shoreline and pushing driftwood and dune sand well beyond the limits of tidewater. More tsunamis likely followed. When the large waves finally ceased, the village and the rest of the Nilestun shoreline remained underwater. One account from Coquille oral history describes how “the tidal wave tore up the land and changed the rivers.”¹

Many Coquille Indians may have lost their lives that winter night. Yet, the communities by the shore of the estuary recovered. In the long run, the economics of Coquille society were not greatly transformed. The tools and food remains left behind after the event are much like those that predated the event. In the 1850s, the fisheries in the Nilestun area were considered the largest and most economically important to the people of the Coquille River.

Landscape changes at the Nilestun shoreline demonstrate the impermanence of estuary shores on the Oregon coast, yet through all of these changes the Native communities were resilient and the biological productivity of the estuaries remained high.

Not many years ago, most residents of the Northwest held the view that earthquakes were a risk for people living in California, but they were not likely to occur in western Oregon and other parts of the region. Volcanic

eruptions were widely recognized as the greatest disaster threat, as memorialized at Crater Lake and demonstrated in 1980 at Mount St. Helens. In the late 1980s, however, geologists began to realize that massive earthquakes and related tsunamis had occurred every few centuries on the coast. Knowledge of these events has long been a part of Native peoples' oral tradition, and archaeological evidence and related landscape changes are evident at historic villages and other Native American sites along the coast.

Earthquakes and tsunamis are terrible realities for communities in many parts of the world. The largest and most devastating are those that occur along a subduction zone, where offshore and continental tectonic plates move against each other. The edges of the opposing tectonic plates may remain locked for centuries, accumulating strain and raising the land elevation along the shore. When the strain is too much for the friction between the plates to hold, they release suddenly, producing a massive earthquake and subsidence or uplift of the landmass at the continent's margin. As the plates unlock, the edge of the continent moves across the subducting ocean floor, displacing many cubic miles of water and resulting in a massive tsunami.

Most of us are familiar with the devastating effects of the Sumatran earthquake and tsunamis that swept across the Indian Ocean on December 26, 2004. On the shores closest to the source of the quake, entire towns were obliterated by a towering wave only minutes after the ground began to shake. Tsunamis traveled hundreds of miles in other directions and caused devastation as far away as Thailand and India. Though rare in any one region, such events happen often enough that their effects are well known. Forty-three years ago, a subduction zone along the coast of Alaska ruptured in a 9.2 magnitude earthquake, and the resulting tsunami destroyed several coastal villages and spread southward along the Pacific Coast, taking four lives in Oregon and eleven more in Crescent City, California. In 1960, an even larger subduction zone earthquake on the coast of Chile produced tsunamis twenty-five meters high, causing much damage in Hawaii, Japan, and the Philippines.

On the Cascadia Coast — which extends from northern Vancouver Island in British Columbia to Cape Mendocino in northern California — infrequent, catastrophic earthquakes are a reality. This region is west of the Cascade Mountain Range, a north-south trending range of actively volcanic and geologically young peaks. Oregon contains some 350 miles of the 750-mile shoreline.

Although geologists had long recognized that Cascadia was an area of tectonic subduction, until the mid-1980s there was consensus that the offshore Juan de Fuca Plate was moving under the edge of the opposing North American Plate in a steady but gradual manner, producing little perceptible

earth shaking. Seismologists Thomas Heaton and Hiroo Kanamori at the California Institute of Technology first pointed out the likelihood of subduction zone quakes in Cascadia in 1984. Three years later, U.S. Geological Survey geologist Brian Atwater found the first on-the-ground evidence for a subduction zone quake on the shores of Willapa Bay in southern Washington.² A small forest of cedar trees growing on a coastal plain had subsided rapidly into the intertidal zone, and the trees soon died in the new salt marsh conditions. The snags and stumps of these cedars were still standing, but radiocarbon dates placed the event at approximately three hundred years ago. Atwater also found buried soil layers, now exposed in the banks of the salt marsh channels, which had been well above the brackish tidewater prior to the subsidence.

After Atwater's findings were published in *Science* in 1987, other evidence of Cascadia Subduction Zone (CSZ) events began to come in.³ Researchers later pinpointed the date and time of the earthquake using archival tsunami records in Japan. Based on the recorded wave characteristics, they estimated the magnitude of the quake at 9.0 and determined that the date and time of the event was nine o'clock on the evening of January 26, 1700.⁴ Remaining geological research questions about CSZ events have largely to do with the extent and magnitude of each event, with some research suggesting that portions of the subduction zone shifted at different times, producing smaller earthquakes and tsunamis than events that occurred along the entire CSZ.

This special section of the *Oregon Historical Quarterly* focuses on the history of Cascadia earthquakes and tsunamis on the Oregon coast and the effects of these events and related landscape changes on the Native people who lived on this coast for millennia. Two of the contributors are Oregon coast Indians with considerable expertise in tribal history. Patricia Whereat Phillips and Jason Younker address the traditional narratives of tsunamis and subsiding shorelines with fresh perspectives, while continuing the long tradition of retelling these narratives for the benefit of current and future generations. Robert Losey and I bring perspectives from archaeology.

Patricia Whereat Phillips is a Miluk Coos Indian who grew up by the slopes of Qalatl Mountain at Coos Bay. She comes from a family of tribal historians, and she honed her knowledge of Hanis and Miluk dialects as a graduate student in linguistics at the University of Oregon. In her contribution, Whereat Phillips retranslates traditional narratives depicting massive tsunamis and ground movement at Coos Bay in the not-so-distant past. She considers the mythical and historical context of the narratives, emphasizing "how deeply the image of great waves rolling across the land is embedded in Hanis Coos culture."

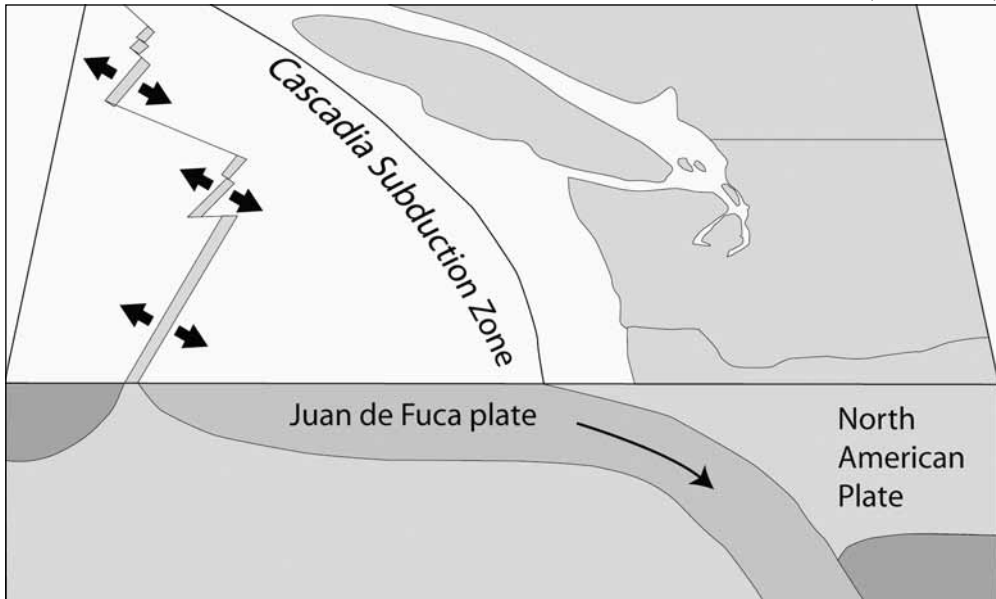
Jason Younker is an active member of the Coquille Indian Tribe and an assistant professor of anthropology at the Rochester Institute of Technology. Younker, who grew up on the shores of South Slough, shares his appreciation for a landscape that is a key anchor point for indigenous oral tradition. His essay presents a personal perspective on the calamitous events that affected his ancestral community at Coos Bay. He considers the instructive value of the tsunami narratives in Coos Indian oral tradition, observing that accounts clearly relate how people avoided disaster through respectful behavior toward the natural world and strategies of survival and recovery.

Robert Losey is recognized as the foremost researcher on the historical effects of Cascadia earthquakes and tsunamis on Native communities. A professor of anthropology at the University of Alberta, Losey uses an interdisciplinary approach, integrating archaeological research with a thorough consideration of Native oral tradition, geology, and paleoecology. He focuses on two villages sites on the northern Oregon coast, where people lived before, after, and probably during the 1700 earthquake and tsunami. Considering both the short- and long-term effects of these events on those communities, Losey points out that subduction earthquakes and tsunamis “are not of themselves disasters or catastrophes” but are better viewed as hazards. People have a role in determining the scope of a hazard through the choices they make. He argues that the residents of the Oregon coast had the means to survive past CSZ events and resume village life relatively quickly, probably more than we would today.

Collaborations among tribal heritage specialists, geologists, and archaeologists have led to some remarkable findings. Although most of these projects have not focused specifically on earthquakes and tsunamis, research at several coastal archaeological sites in recent years has revealed some of the effects of CSZ events and related sea-level changes. This special section is my first opportunity to bring together these findings as a dimension of Cascadia earthquake and tsunami history.

AS LONG AS PEOPLE HAVE LIVED on the Oregon coast, the landscape has been altered greatly by Cascadia earthquakes and long-term climate-related changes in sea-level.⁵ For countless generations, subduction-zone earthquakes and tsunamis represented a terrific threat to coastal communities, yet they may have also brought about ecological restoration. Cascadia Subduction Zone earthquakes caused landslides and triggered devastating tsunamis, but they often replenished the intertidal portions of estuaries, enhancing the most productive setting for traditional coastal fishing practices.

Native American place-names reflect some of the legacy of those changes. For example, the Athapaskan name Enashet, for Crook Point in

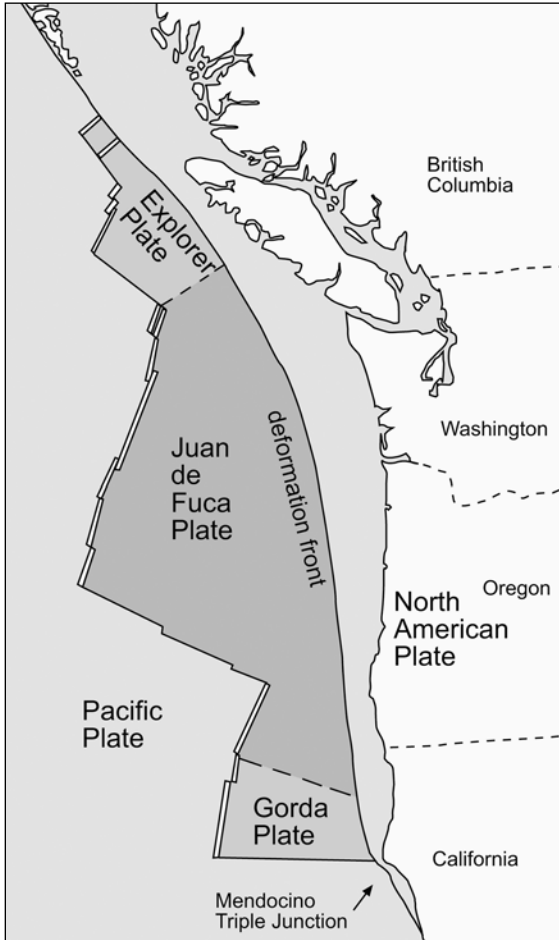


This east-west cross section, running roughly through Seaside and Portland, shows the Juan de Fuca Plate descending as it moves toward the heavier North American Plate.

Curry County, has been translated as ‘moving-ground place.’⁶ Comparisons of modern and historic survey maps show the extent of land loss on this headland, and there is visible evidence of ongoing landslides there. Another south coast headland has the Athapaskan name Qa’-i-na’-na-i-tc’-tunne, which has been translated as ‘where the trail is no longer used’ or ‘people all departed’. It designates a small headland and cove where a coastal village was abandoned after the houses and many inhabitants were buried by a massive landslide. Archaeologists working with Siletz Tribe heritage specialist Robert Kentta have pieced together the history of this locality. The layers of earth at Qa’-i-na’-na-i-tc’-tunne show clear signs of a landslide covering the shell debris and stone tools of a village. These layers have been radiocarbon dated, establishing that the landslide occurred sometime after 1500 AD.⁷ Although Qa’-i-na’-na-i-tc’-tunne is an excellent place for a coastal village, located at a protected cove with a fast-flowing stream of freshwater, the site was not reoccupied after the landslide, apparently for generations. The locations of villages destroyed by tsunamis may have been treated the same way, avoided for many years and memorialized in place-names and oral tradition.

There are many other places on the Oregon coast where oral history depicts catastrophic events and even more locations where researchers

Courtesy of Robert Losey



The area of subduction, which is east of the deformation front, is ten to one hundred miles offshore, but the effects of Cascadia earthquakes extend many miles inland.

have found archaeological and geological evidence of large-scale landscape changes. In the span of a single generation, Oregon coast physiography and ecology may appear to be relatively static aspects of the environments people live in; but viewed over the long term, this is hardly so. Bays become valley floors, and river channels migrate, shifting canoe routes and fisheries over wide areas. Dunes form and sweep across forests and prairies, and massive fires reduce forestlands and load stream channels with sediments that settle downstream in estuary marshes.

Landscape changes occur at different temporal and geographic scales. Locally, the frequency and magnitude of storms, seasonal wind, and rainfall patterns bring incremental changes over long periods, while landslides, fires, and floods bring more rapid changes. Regionally, Cascadia earthquakes and tsunamis transform tidewater shores every five centuries on average,

with gradual uplift occurring at many locations in the intervening periods. The Cascadia Coast is also affected by changes on a global scale. Sea-level changes over centuries, caused by climatic variation and related glaciation, produce vast changes to ocean shorelines.

The choices people make are also a major factor in the way environmental change affects a society. People live at particular locations based partly on their perceived exposure to risk, and societies may pass on knowledge of environmental conditions so that even infrequent hazardous natural events may be considered by those who establish new villages or campsites. There

are also direct cultural influences on the environment, such as controlled burning of forests and prairies, which encourages the growth of favored plants and promotes habitat for game.⁸

The most recent landscape changes are often the most evident. On the Cascadia Coast, inland watersheds were deforested after the 1840s, leading to sedimentation in river valleys and tidal wetlands. The Tillamook Burn, a series of large forest fires that swept through Oregon's northern Coast Range mountains from 1933 to 1951, altered Tillamook Bay to such an extent that its effects are still prominent today. Along the coast, diking and draining of tidal wetlands, dredging and removal of woody debris, channel realignment, and jetty construction also have had major effects.

Climate-related global sea-level changes and tectonic shifts are much more dramatic. Fifteen thousand years ago, the shoreline of the Oregon coast was from two to ten miles west of its current location and over 300 feet lower in elevation. Between 12,000 and 7,000 years ago, glaciers retreated around the globe and sea level began to approach its current level. We know little about what the Oregon coast looked like then, but a team of Oregon State University archaeologists, led by Loren Davis, is examining sites from this period to determine which settings people would have lived in during the late Pleistocene and early Holocene. By identifying buried soil layers that date to this period, they know where to look for evidence of cultural activity.⁹

Indian Sands, in Curry County, is one of the few Oregon coast archaeological sites with a soil that dates to the Pleistocene-Holocene transition. The coastal headland would have been a promontory at the western edge of a ridge overlooking a coastal plain. Davis's team has identified stone tools in a 10,500-year-old soil at this site, though the precise age of the artifacts is not known. Previous fieldwork and radiocarbon dating by University of Oregon archaeologists Madonna Moss and Jon Erlandson identified a scatter of 8,000-year-old mussel shell, establishing this as one of the oldest sites on the Oregon coast. During the early Holocene, people camped on a surface of wind-borne sediments that had been lifted from the exposed shoreline as the ocean retreated in response to increased glaciation.¹⁰

Through the early Holocene, rising seas eroded much of the early coastline and produced dune sheets that have continued to grow during the last 7,000 years. Beginning in the 1990s, Moss and Erlandson dated hundreds of Oregon coast archaeological sites, and nearly all of them date within the last 3,500 years or so.¹¹ Most earlier sites and landscapes have been worn away by erosional processes. Many documented coastal villages occur in stabilized dune soils, which are well drained and well suited to building houses. But even vegetated dunes may not be stable surfaces over many generations.¹²

At the Tseriadun site in Port Orford, cycles of repeated dune stabilization and reactivation set the stage for villages and then repeatedly buried the remains over thousands of years. Recently, the Coquille Tribe, the Siletz Tribe, and the Oregon Parks and Recreation Department worked with the city to preserve the site as a state park, while documenting erosion of the archaeological resources.¹³ In one episode five thousand years ago, dunes swept across this coastal village, sealing in what appears to be the floor of a house as well as a nearby shell midden. In addition to stone tool fragments and charcoal, this time capsule holds mussel shell, urchin spines, and — attesting to the longstanding proficiency of coastal hunters — numerous sea lion bones. Repeated dune movement across the site eventually stabilized, and for centuries the people of this community built several more plank houses with smooth clay floors. Tectonic uplift appears to have been a factor in stabilizing the site.

INSIGHT INTO PAST ENVIRONMENTS often comes from those who live and work closest to the land. Rancher Rick McKenzie knows the landscape of the southern Oregon coast as well as anyone. When researchers from the Coquille Tribe began studying landscape changes in the New River Lowlands, McKenzie took them to a place on his ranch by the shore of New Lake. Scattered across the site, on a broad knoll just a few feet above the floodplain, were fragments of shell and debris from stone tool-making. Most interesting were the shells themselves. They were not razor clams from the nearby beach or mussels from offshore rocks, but bay clams such as cockles, gapers, and butter clams. Today, the nearest saltwater bay where such species are common is the estuary of the Coquille River, fifteen miles to the north. Archaeological investigations of the midden and soil layers at the New Lake site revealed an extensive buried shell layer with stone and bone tools, the remains of sea lions, and other marine mammals and fish such as salmon and flounder.¹⁴

Oral tradition indicates that the Athapaskan-speaking people who once lived on the shores of this former bay were known as Kwatami, ‘people by the inside water’. Their descendants are among the Siletz and Coquille Indians. At the time the Vikings were settling in Iceland, the Kwatami people were hunting and fishing on the shores the Kwatami estuary, which is now an expansive alluvial plain and a small lake. Over time, the estuary, which may have been miles across during the middle Holocene, reduced in size as Floras Creek and its other feeder streams brought sediments from uplands that settled out in the tidal currents. The wetlands of the Kwatami estuary may have oscillated between tidewater and freshwater, depending on the extent of vertical movement produced by Cascadia subduction. The demise of the Kwatami estuary meant a major subsistence shift for the residents of this



These sea lion and waterfowl bones and fire-cracked rock and cockle shells were exposed during archaeological excavation at the New Lake Midden site on the McKenzie Ranch.

portion of the Oregon coast. The change may have been abrupt, involving earthquake-related uplift, or gradual, as stream deposited silt accumulated on salt marshes and they emerged to form alluvial terraces.

Archaeological sites that occur in the intertidal zones of today's estuaries can serve as a record of past sea-level changes. These sites hold evidence that can tell us how people responded to tsunamis and tectonic subsidence. One common site in Oregon is the wood-stake fishing weir, which consists of lines of vertically positioned wooden stakes arranged to guide fish into traps. University of Oregon archaeologists and heritage specialists Donald Ivy of the Coquille Tribe and Robert Kentta of the Siletz Tribe have identified over eighty of these sites in Oregon estuaries.¹⁵ The buried portions of the weir stakes can remain preserved for many centuries, and several weir sites hold a record of tectonic subsidence history that compares with nearby buried marsh sequences studied by geologists.

The Ahnkuti site in Yaquina Bay has the longest dated sequence of repeated fishing-weir building on the Oregon coast. From 2,100 years ago

to the nineteenth century, people built and used fishing weirs here at the mouth of a tributary tidal slough channel. The weirs were used to catch fish that entered the slough with the high tide. Today, at the Ahnkuti site, the 2,100-year-old weirs are never above water, even during very low tides; and they are found below 1,100-year-old weirs, which are in turn overlapped by those dating to 350 years ago.¹⁶

Burial and preservation of the Ahnkuti fishing weirs may have been caused by rapid subsidence during CSZ events. At a nearby Yaquina Bay marsh, Portland State University geologist Curt Peterson revealed a sequence of buried marsh surfaces capped by tsunami sands, dating to 300 years ago, 800 years ago, and 1,100 years ago, with older undated layers present at deeper levels.¹⁷ The comparable age, depth, and stratigraphic sequence at the Ahnkuti site shows that the Yaquina Bay Indians maintained tidewater fishing traditions through several earthquake and tsunami events and over many generations.

RESEARCH ON THE ESTUARY portion of the Coquille River has greatly advanced our understanding of the effects of Cascadia subduction events on the heavily populated tidewater shores of the Oregon coast. Four thousand years ago, the tidally influenced portion of the Coquille River was more of an open bay than the tidal river channel is today. This transformation involved sea-level changes, local landform processes, and Cascadia earthquakes.

In 1992, the Coquille River estuary became one of several locations on the Oregon coast to reveal evidence of the last CSZ event. Alan Nelson of the U.S. Geological Survey dated organic material from a buried soil layer on the bank of the river that once was a high and dry shoreline. This soil, is now submerged during high tides due to earthquake-associated sinking of the coast in January 1700. Part of this soil exposure occurs along the Nilestun shoreline, a U.S. Fish and Wildlife Service refuge.

In 1994, researchers with the Coquille Indian Tribe and the University of Oregon began investigating the history of archaeological sites on the Nilestun shoreline and in nearby tidewater settings. Previous studies had shown that the remains of villages or fishing camps were present in the 300-year-old soil layer, but those studies predated Atwater's discovery of periodic CSZ events.¹⁸ Lines of wooden stakes, the remains of fishing weirs, were known to occur along the intertidal Nilestun shoreline, and researchers assumed that the stone tools in the upper portion of the site were left by people who had fished in the adjacent intertidal riverbank at low tide.

The 1994–1995 University of Oregon/Coquille Indian Tribe project was the first to focus on the wood-stake fishing weirs in this estuary. A suite of radiocarbon dates established that weirs were used for over three thousand



Native people used wooden stake weirs, such as this one on the tidal flats of Coos Bay, to guide fish into basketry traps or to corral them for spearing. Tidal weirs were critical to the livelihood of Oregon coast communities for millennia, providing year-round harvests of marine and anadromous fish.



Expansive salt marsh channels flow through the lowlands north and south of the Coquille River in Coos County, Oregon.

years along the changing shoreline of the Coquille estuary. Archaeological sites were mapped and sampled, and findings were related to geological research being performed at the same time by Robert Witter of the University of Oregon. Examining soil core samples, Witter was able to show that at least twelve subsidence events had occurred in the Coquille estuary during the last 7,000 years, and during these events the land surface dropped one meter or more. Gradual uplift may have occurred during intervening centuries, but older surfaces remained buried beneath later ones in the marshes along the estuary margins.¹⁹

In the winter of 1996–1997, massive erosion caused by an El Niño–related storm occurred at the Nilestun shoreline, exposing extensive archaeological materials. Extremely high flood waters had overtopped the artificial levee that bordered the adjacent lowlands; and as the storm surge receded, the waters drained from the flooded agricultural field through a gap in the levee that soon expanded into a washout over fifty feet in diameter. Donald Ivy



During low tide, archaeologist Robert Losey measures a hearth in an eroding bank at the Nilestun fishing village, which was submerged during the 1700 CSZ earthquake and tsunami.

and Sharon Parrish of the Coquille Indian Tribe immediately assembled a team to document the eroding portion of the site.²⁰

The team found a stratigraphic sequence that was unlike any they had seen before. The lowest levels were sand and mud, dating to the period when the Coquille estuary was an expansive bay. Fishing weirs found in the mud dated to approximately 800 years ago, demonstrating that the bay had filled or uplifted enough for intertidal fishing to take place by then. People had built the fishing weirs across a tidal channel that drained the once-expansive tidal flats north and inland from the site, a productive setting for fishing throughout the year.

Gradually, the bay continued to fill, beginning with an intertidal “levee” of sand that built along the north bank of the tidal river channel. As more sand accumulated on the levee, it was used more and more as a work station for fishers and eventually became a seasonal camp. The diverse tools recovered from the site attest to the many activities pursued by the Coquille Indians

who lived there between 600 and 300 years ago. The weirs in the channel acted as sediment traps, and gradually the tidal channel filled and closed. The outlet to the adjacent tidal flats apparently shifted two hundred meters to the west, where more recent fishing weirs have been identified. Among the tools left behind is an antler wedge for splitting wood, possibly for fish traps and lattice panels used in new channels that opened nearby.

CASCADIA SUBDUCTION ZONE earthquakes, tsunamis, sea-level rise, and related landscape changes have greatly altered the landscape of the Oregon coast as long as people have lived there. Some of these changes were catastrophic events that destroyed villages, such as the subsidence at Nilestun and the landslide at Qa'-i-na'-na-i-tc'-tunne. Other changes were extensive but more gradual, such as the dune shifts at Tseriadun and the infilling of the Kwatami estuary. In estuaries along much of the Oregon coast, CSZ events appear to have expanded tidewater fishing grounds and channels for canoeing, as at the Ahnkuti site in Yaquina Bay and the marshes of the Coquille estuary.

Along with the Native oral tradition portraying great earthquakes and tsunamis on the Oregon coast, the archaeological evidence of the effects of those events on coastal communities is a history that continues to unfold through collaborations among tribal historians, archaeologists, and geologists. As the articles in this special section show, this history does not comprise simple accounts of disaster, response, and recovery. Coastal communities benefited from an intergenerational perspective on CSZ events through the practice of oral tradition, and their knowledge enabled many who lived in vulnerable areas to survive and recover.

Though little known for many years, this history is compelling for what it tells us about the resilience of cultural traditions through periodic upheaval and the sustained ties across generations that continue to shape Native society. This knowledge is also critical in efforts to prepare for CSZ events that will undoubtedly happen in the future. It is unfortunate that Native oral tradition was not better integrated into the region's collective history decades ago. Informed by this knowledge, scientists might have found physical evidence of these catastrophic events much earlier, which may have influenced the design of bridges and buildings and the identification of tsunami hazard zones.

The geological discoveries that eventually revealed the tumultuous legacy of this changing coastal landscape have helped open the way to viewing history through multiple lenses, giving us a perspective that promises to expand and invigorate our understanding and appreciation of Oregon history.

Tsunamis and Floods in Coos Bay Mythology

by Patricia Whereat Phillips

The principal evidence for major prehistoric earthquakes associated with subduction comes from investigations of estuarine marsh sediments buried by sand layers. These deposits suggest that portions of the coast subsided abruptly and were then overwashed by extreme tsunamis, or “tidal waves,” that swept over the area and deposited the sand. . . . The number of these layers . . . indicate that catastrophic earthquakes have occurred along the Northwest coast at least six times in the past 7,000 years, at intervals ranging from 300 to 600 years, with the last having occurred about 300 years ago.

— Paul Komar¹



TSUNAMIS ARE TERRIFYING and destructive events but relatively infrequent from the standpoint of a human lifetime. It is no wonder, then, that tsunamis appear in the mythology of coastal peoples. To my knowledge, no one has looked in depth at a particular Oregon coastal people’s language and their mythology to assess the scope and effect of these events from the point of view of Native people. I will focus on the mythology of the Coos Bay Indians and on the Hanis language (along with Milluk, it was one of the two languages that was spoken on Coos Bay), as it is the one I am the most familiar with.

The linguistic data on this subject are unfortunately quite limited. The sole phrase recorded in the Hanis language for earthquake is *tł'ta lishtats*. It translates literally as 'earth shaking', from *tł'ta* (or *tł'da*) for 'earth, land, ground' and the verb root *lish-* 'to shake, to move'.² Although there are a handful of Coos texts that mention tsunamis, there are none explicitly about earthquakes. In various interviews with ethnologists and linguists, however, some mention of earthquakes has been recorded. In a 1942 interview with linguist John P. Harrington, Hanis Coos informant John Waters said, "My [grandmother] told when years ago there was a big earthquake that caused cracks in the ground."³ In 1881, when George Bissell was working on a vocabulary list with an unidentified Lower Umpqua woman, he listed *só hwass* as a word for earthquake and noted next to it on his schedule that "*yúohy* for a caving in."⁴ The woman volunteering 'caving in' along with 'earthquake' hints that she had heard accounts of earthquakes.

Several words and phrases describe high and low tides, which is to be expected in the vocabulary of a coastal people. I was able to find only one word in Hanis Coos that can be translated as 'flood', *ma'atl*, but there was no further definition of the semantic domain for the word. The word was recorded only once, as the title of a tsunami story told by James Buchanan, from the Hanis village Wu'allach (near Empire). *Ma'atl* probably refers to flooding in general and not specifically tsunamis. More often in the Hanis language, phrases are used to describe tsunamis, as 'when the flood time came there was no ebb tide', 'now the water rushed in', and 'the water ran ashore far across the land'. I will consider these descriptions within the context of the narratives in which they appear.

Although dozens of Coos myths (both in Hanis and Milluk) and other narratives have been recorded, they represent only a small portion of the narratives that have existed. Most of the narratives that have come down to us are primarily from two Hanis-speaking informants — Jim Buchanan, who worked principally with Henry Hull St. Clair and Leo Frachtenberg in the first decade of the twentieth century, and Annie Minor Peterson, who worked with Melville Jacobs in 1933 and 1934. Annie Peterson, who was born on Coos Bay near Wu'länch (Cooston) but raised at the Yachats reservation, also spoke Milluk, the language spoken at Cape Arago and South Slough on Coos Bay.

The traditional narratives can be divided loosely between myths and historical narratives. Throughout the Northwest, Indians recognized this division of their stories. As Melville Jacobs noted,

Long ago, [Franz] Boas and others pointed to the larger Pacific Northwest's natives own contrast of myths versus tales. Boas wrote correctly that this larger region's myths



Coos elder Annie Miner Peterson displays her traditional regalia and baskets in Empire, Oregon, in 1914.

comprised recitals of happenings dated in an early era when things were rather different from what they were in the more recent era that was described in tales. . . . It was the natives' own laconic way of commenting about the two recital forms which they recognized.⁵

This was a division that the Coos Indians also recognized, dividing tales into *lægauwiyat'as*, which were about 'happenings, customs, events, true history', and *hæchit'*, which were defined as 'story, myth, prehuman world'.⁶

If we include Jim Buchanan's version of the creation story, which describes great waves washing across the newly created earth, then there are essentially three narratives that can be interpreted as describing tsunami events. In traditional storytelling, rarely are detailed descriptions of characters or events expressed, so at times it is not clear if flooding or a tsunami is being described. The narratives tend to be spare, because their audiences probably already understood them well from a cultural context and because they had heard them throughout their lives. Also, there are no clear references to earthquakes in Buchanan's narrative, except for one brief mention of "sinking land."

The other two narratives are highly symbolic rather than historical narratives, although one of the stories combines history and myth with a possible reference to the most recent tsunami event in January 1700. It may be

a stretch to include a creation story here, which is an entirely mythological rather than a historical event and, since it happened in prehuman times, was also understood by Natives to be a *hæchit*, ‘myth’. But I believe this narrative illustrates how deeply the image of great waves roaring across the land is embedded in Hanis Coos culture. At the beginning of the story, the world is covered with water. Two young men from the sky world drop five disks of blue clay down into the water, but it is not stable. The story continues as follows, which I retranslated from Frachtenberg:

The land stuck out.
They watched the heavy waves.
The water continually went back and forth.
They watched it from above.
“How is your heart? Shall we try it again?”
“What shall we try?”

And the water was going back and forth.
“Let’s split this mat in two.”
“We shall try it.”
They did indeed try it.
From above they laid it down.

Joined together there they put it down.
They were afraid.
There they went down.
Still the land was not solid, when they laid down the matting.
The waves were rolling over the matting.

Now one said “that basket we should split in two.”
Surely they put it down.
Joined together there they put it down.
Now on the ocean beach they put it down.
Beach sand was on the land.

There they put it down.
The basket was split.
Now it held back the waves.
Now indeed that is the way it got, when it held back the waves.
The water ran down (through the basket).

Now there they went down.
It was held back.
Again the water went through (the basket). . . .⁷

Another heavily mythologized image of a tsunami appears in a narrative told by Annie Peterson, “Salmon Did Ill to Boys.” In this myth, a tsunami is caused by some young men acting disrespectfully while fishing by pretending that a salmon is one man’s wife. In traditional Coos culture, behaving disrespectfully toward animals that are hunted for food was considered dangerous.⁸

Another year, and then the salmon came up river (again). Now they heard something (jingling), everybody went outside and watched it. “Ho! quantities of salmon are coming.” But out in front a baby was being held aloft (on the salmon), and its decorations were what was jingling. “You should not watch a thing like that!” So some of them indeed did not go outside (to look). Now water (a tidal wave) rushed in, and thus all of those people (who had gone outside to look at the salmon baby) drifted away (with the flood). Pretty nearly all the people were gone.

That is how it is not a good thing when the children do all sorts of tricky things. You are not to do such things. You should not belittle food, because the people die (from that). You should not perpetrate all sorts of tricks!⁹

The original line describing the tidal wave was in Milluk Coos:

hei-má'tsi-há'p'-he'gwen, wen-gu•s-kwi•-ge'-tkxi-tke-k'a
PAR PAR water rush.in, thus all PAR ? drift ART people
Now water rushed in, and thus those people drifted away.

The third narrative, which recounts a flood from the sea washing people away, has been told in different versions by three different storytellers — Jim Buchanan, Annie Peterson, and Annie’s niece, Lottie Evanoff. The oldest recorded version was told by Jim Buchanan to Leo Frachtenberg. Buchanan called the story *ma'atl*, which Frachtenberg translated simply as ‘flood’. Buchanan himself said this story was true history rather than *hæchit*, a myth from prehuman times. He told Melville Jacobs:

It’s “history” that there was a flood that made the people get on qa’latl mountain in Coos Bay, the only one that stayed above water. . . . They say that lots of people who went inland never came west again, but settled “east.”¹⁰

The flood in Buchanan’s story was caused by a *tʔuni* ‘flood tide’ that did not ebb. This is also the only story that has a line that might describe an earthquake. Buchanan said, “The earth sunk into the water,” using the verb *tɔk'wil*, which means to sink or to dive.

In this story, people get into canoes to save themselves. Some anchor onto trees, other canoes ride out the currents. Eventually, the water recedes, and people become scattered around the world. My retranslation of the entire story is included later in this article, but here are some of the relevant lines.

The story opens:

î la^u L_ 'n_ hats _n tEwí'tsu
when DEM flood.tide CONJ NEG ebb.tide
When the flood tide came there was no ebb tide.

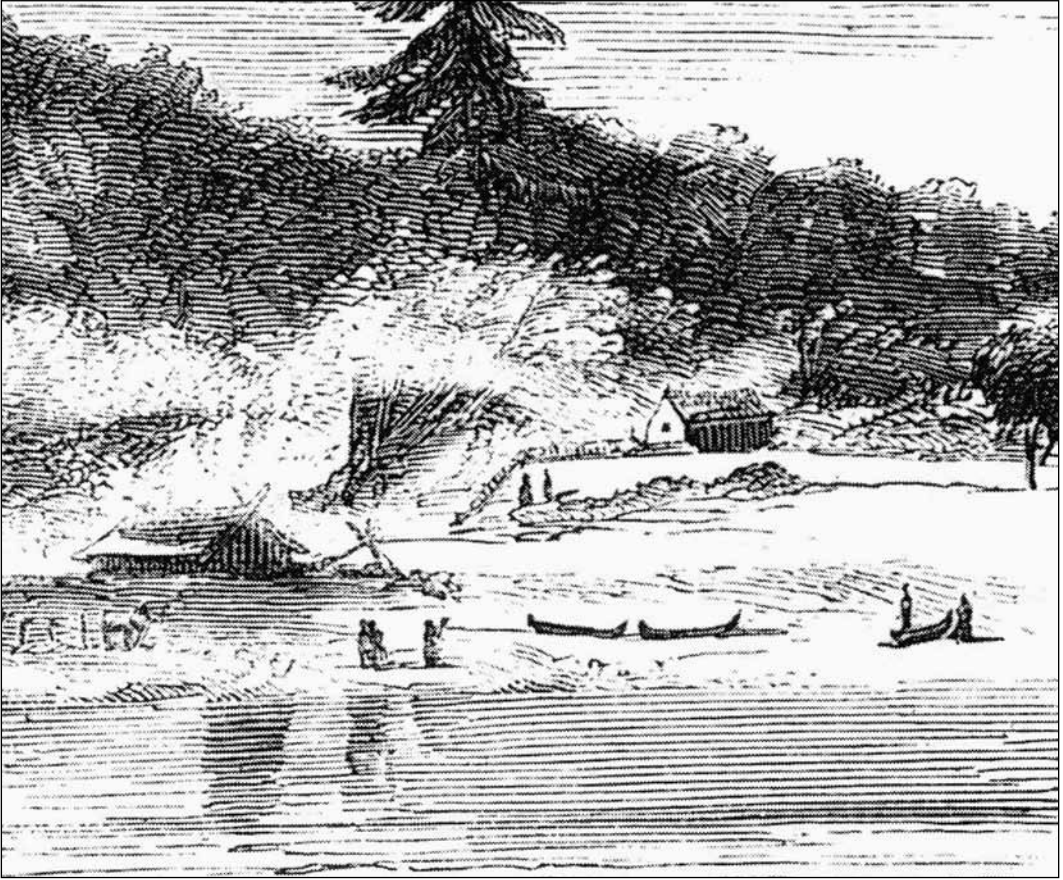
People run and get into their canoes. A few more lines down, there is a mention of the earth sinking into the water, which could be a reference to the subsidence of earth that often accompanied coastal seismic events.

TEk_wí'l IE x_patc IE L_ta
to.dive/sink ART water.LOC ART earth
The earth sank into the water.
Qantc he tsä'yux^u en_ 'k'exEm la^u tc_ hE ik ka
where ART small stick.out.PROG DEM there ART 3PL go
Wherever a small bit of land stuck out, that's where they went.¹¹

Annie Peterson recounted what appears to be a shorter version of this story, which she titled in Milluk *tł̥-há•p'-he•wi*. Melville Jacobs translated this as 'the water got high', but a more literal translation is 'the water grew'. Although I do not have translations for all of the Milluk words, here is the gist of the opening lines based on Jacobs's transcription:

tł̥ he•niye gu•s-min ile•q
ART long.time all time rain
Long ago it rained all the time.
Án-wá• ílges, e•t'cili-ilges
NEG ? Rain, small rain
It was not a heavy rain, small raindrops
he•niye ileq'
long.time rain
A long time it rained.
Hei-má•tsi báldi•mes phwi•lat'
PAR PAR ocean raised
Then the ocean raised
wenkwi hewi tł̥ ha•p
PAR grew ART water.LOC
Then the waters grew¹²

Perhaps the most interesting part is at the end of her narrative, where Annie says that, as a child, her maternal grandfather, Minkws (Quiet), saw a survivor from this flood:



This detail from “Scenes and Incidents of Oregon Territory,” published in the April 24, 1858, edition of Frank Leslie’s Illustrated Magazine, shows village residents near their canoes and plank houses on the shore of the Umpqua River estuary near Winchester Bay. Most tidewater villages on the Oregon coast were similarly situated.

My grandfather (Minkws) saw one of the old women (survivors) who had been left alive. She had been hung up on a tree, and the limbs of that tree were too high up. So she took her pack line and tied it to a limb, and then when she wanted to go down by means of that, she fell, she was just a girl when she fell from it. Her back was broken from it (she had a humpback thereafter). That is what she told about the raised water.¹³

Could Minkws have met a survivor from the 1700 tsunami event? It is possible, but I am far from certain. Annie Peterson was born in 1860. It is not known when Minkws was born, but it is not unreasonable to assume somewhere around the year 1800, give or take a decade. If he was acquainted

with a survivor from the 1700 event, she was very elderly indeed by the time of Minkws's youth. I think it is more likely that Minkws heard the story of this survivor from his parents or grandparents and passed it on to his granddaughter.

Annie Peterson's niece, Lottie Evanoff, told the same story, but she placed the cause of the flood on a boy who killed crows when he was told not to. This echoes the belief that a tsunami is punishment for a transgression, as in the "Salmon Did Ill to Boys" myth. Lottie also recalled the family lore that Minkws had met one of the survivors of the flood. Her narrative was recorded, primarily in English, for J.P. Harrington as follows (normalized for grammar and spelling):

A boy was told, don't you ever kill crows, and he killed them, several, only one crow was saved, one crow flew away. That killing was what started the flood, thereupon it rained fine rain for five days.

It was this flood, that the canoe landed on top of Blue Ridge. . . .

The Indians that had no canoes, drowned.

They call fine rain crow's tears, when fine rain always call it thus, for the surviving crow wept, má•Katl' ts'xwá•las.

My mother's grandfather told the flood story. The water was just rising slowly when the flood came but when the flood subsided, then it went fast & that was when lots of Indians got drowned. A woman grabbed a standing spruce tree as the log she was clinging to butted against that standing spruce, and the woman fell loose but grabbed the spruce and as the water subsided found herself high above the ground in that spruce. She decided to jump to the ground and as she did so, she broke her back.

My mother's grandfather saw that woman who had a broken back, she was already old, her back was broken near the shoulders, at Yachats, she was a heavy-set woman, awful white.¹⁴

Although Lottie's placement of the tsunami in time is about a century off — the Yachats reservation period lasted from 1860 to 1875 — her narrative, like her aunt's, describes what may have been an actual survivor of a tsunami.

One can also get a sense of how narratives of devastating historical events become interwoven into mythological narrative. A tsunami was perhaps the most destructive single event that could befall a coastal community. Few riverine floods could rival it for the amount of destruction and loss of life. The human mind tries to impose patterns and predictability onto chaotic and not always predictable nature. Myths try to put the inexplicable into a comprehensible context. One hundred and fifty years after the most recent tsunami event, the story of the survivor with the broken back was interwoven into flood myths.

The ocean was regarded as a setting of powerful forces worthy of respect. When traveling by canoe, correct behavior had to be observed, and people were expected to behave in a serious manner and not to point at floating logs or other objects. The image of the powerful currents of the sea and tides ran deep in Coos cosmology. In the creation story, the ocean existed before the land, and after the land was formed the waves ran across it until beaches were created. The ocean was responsible for scattering the people so that the entire world was populated.

The “Salmon Did Ill to Boys” and Lottie’s flood story have a different connection to the power of the sea in Coos cosmology. Crows had the power to understand human speech and see the immediate future, and they were supposed to be close friends of the Thunderbirds, who had power over the ocean and all of its creatures. Salmon were the most beloved of the sea’s children in the eyes of the Thunderbirds.¹⁵

Although not explicitly stated in either narrative, the Coos may have understood the Thunderbirds sending tsunamis as punishment for maltreatment of what they held dear.

The power of the tsunamis and the myths reminded the people to treat the nonhuman world with respect. As Annie Peterson noted, when taboos are broken or people behave foolishly and recklessly, “the people die (from that). You should not perpetrate all sorts of tricks!”¹⁶



OHS neg, CN 001300

Transcripts of Coos elder Lottie (Jackson) Evanoff's conversations with John P. Harrington and others portray many aspects of Native history on the central and southern Oregon coast.

MA'ATŁ, THE FLOOD

In 1909, linguist Leo Frachtenberg worked with Jim Buchanan on Coos myths and cultural traditions. One of the stories that was recorded was “The Flood” (see Frachtenberg, Coos Texts, pages 44–49). I have retranslated the story from the Hanis and arranged the translation into lines of verse. In this way, I hope to illustrate Buchanan’s use of repetition of imagery and rhythm in his narration.

When the flood tide came there was no ebb tide.
All was full of water.
It was wholly filled.

The world was full of people.
There were too many people.
They looked, when that water reached its fullness.

Some people had large canoes.
And some had small canoes.
All kinds of people crowded in when they settled down on the earth.

Some people were ready with braided ropes they’d stored away.
So they quickly went into the canoes.
all people became scared.

The earth sank into the water.
Wherever a small bit of land stuck out,
that’s where they went.

A small bit of land was sticking out
Here the people assembled.

All the animals came there in twos.
All small birds came there in twos.
All kinds of things came there in that manner.

They were mixed together there with the people.
It’s as though they did not know one another,
when they were mixed together with the people.

Wherever the top of a fir tree was sticking out, there they fastened the
canoes.

And some people were without braided ropes.
Some people drifted far away.

Many people had braided ropes.
They no longer knew one another.

The small piece of land kept on floating.
The small bit of land's name was Qalatl (Kentuck).
It was sticking out.

There the people were assembling.
There all manner of things were assembling.
There were many kinds of animals there among the people.
All kinds of birds were mixed together there in pairs.

They did not know anyone.
Fear was in their hearts.

Nothing was sticking out.
They scattered far away, the people drifted far and wide.
The water carried them far away.

When night came, the people's canoes were fastened.
They were watching their canoes.
They were watching the canoes when they were made fast.

Some of the ropes were short.
Suddenly some were loosed, and they drifted away.

Water carried them away.
Thus in that manner half the people drifted away.
They no longer knew one another.

When it became evening, the water ran down.
Everywhere one person had a canoe that was fastened.
They did not know how to take care of the canoes when the water went
down.

Whenever a canoe caught on a tree limb, they freed that canoe.
Some people didn't watch the canoes.
They did not watch them, they tipped over.

When ever a canoe got hung up, when it became caught on a tree limb,
their canoes tipped over, when evening came.

Thus they worked.
They could not sleep, when they watched their canoes.

When the earth again became dry, the people dropped onto the earth with
their canoes.
So again they returned there.

Everywhere they settled down individually.
One man with one woman.
Thus they settled.

The animals, they again returned to shore, when the earth dried.
Likewise the small birds.
Everywhere the small birds went in pairs.

They did not know the place where they dropped down,
and the people began to go farther away.
They did not know where they dropped down.
Thus the people were scattered.

In this manner is the story being told.



Weaving Long Ropes

Oral Tradition and Understanding the Great Tide

by Jason T. Younker

FIRST A STORY. Not so many years ago, my uncle took me high up on Sundown Mountain, just north of Brookings on the southern Oregon coast. I had just started my first quarter in graduate school at the University of Oregon with no clear career path. It was late in the afternoon, and we had driven halfway up the mountain and hiked to the place we were sitting — on large rocks in a mountain prairie, surrounded by once-deep elk-hunting pits now eroded to shallow basins. We looked toward the ocean as the fog belt grew offshore and watched it slowly weave its way through the valleys below. The sun was making a swift exit; the crimson sky was like the flames that swept over the grassy hills that Native people burned every few years to keep the country open.

“You see, Jason, how the fog is coming in?” he said, gesturing to the valley below. “It wasn’t too long ago when our people learned a great lesson, and a great tide would sweep many of them away. Just like the fog comes in now, the great tide would come in like that.

“They were told by their elders ‘to weave long ropes because you never know when a big tide is coming and you won’t have much time. If you don’t have long ropes when the waters rise you’ll be swept away.’ They were warned over and over, but few paid attention. Many just ignored the warnings and went about their daily business.

“Soon after, an offshore earthquake made a big tide. The waters rushed up the valleys and quickly overwhelmed many in the villages. Only those who had listened to the elders were prepared.

“The waters rose violently. Many of the people were unable to make it to their canoes. Those few who had prepared for the great tide quickly gathered their ropes. The water rose higher and higher until the tops of the tallest trees were visible. Those who had ropes quickly tied their canoes to the treetops. Soon all the trees were covered by the rising water. The water kept coming in — rising even higher. Some didn’t have long enough ropes,

and eventually they too were carried off by the rising waters. Only a few remained, and these were the wiser ones who had heeded the elders' warnings. Others were swept away never to be seen again. The waters eventually receded, and though many died, some people survived."

By the time my uncle finished telling the story, the fog had made its way up the valleys below and only the tallest of trees were visible. The fog kept crawling in as if it were the great tide described in his story. We watched the sun go down, and the fog settled slowly around us.¹

THE OREGON COAST is known for its rugged headlands and sea cliffs pounded by massive waves through winter storms and summer squalls. Seasonal tides and storm surges bring high water into the bays, inlets, and estuaries of the coast, sometimes carrying in logs and other debris choked out of streams from California to Alaska. But nothing in our modern experience is comparable to the great tides that swept over the villages of the Oregon coast more than seven generations ago, long before Euroamerican traders and immigrants reached these shores.

Until recently, geologists knew relatively little about the effects of earthquakes, tsunamis, and coastal subsidence on the peoples and environment on the Oregon coast. There is now a growing body of evidence in the archaeological and geologic records suggesting repeated violent events occurring approximately every five hundred years. No sizable earthquakes have taken place affecting the Oregon coast since European immigration, but similar occurrences and ethnography from around the globe allow us to better understand the cultural reactions to tsunamis and other natural disasters.²

The devastation of tsunamis over the past century is well known from media coverage. Most recently, when the tectonic India Plate shifted under the Burma Plate at 07:58 Western Indonesia standard time on the morning of December 26, 2004, it created a 9.0 magnitude earthquake near Sumatra Island. What followed was a horrific example of the devastation caused by such events. Witnesses to the Indonesian tsunami described repeated waves, walls of water, trees, boats, and people being washed away.³ The greatest devastation occurred in communities on low-lying shores. On some islands, such as Sumatra, entire towns were leveled. Inland areas near tidally influenced rivers and inlets were also affected, but in many cases the tsunami came in the form of a large tidal surge rather than a wave.

In recent decades, researchers in Japan uncovered several contemporary descriptions of the effects of the last Cascadia earthquake and tsunami on the western shore of the Pacific. The Japanese "orphan tsunami," as Brian Atwater and his colleagues refer to it, provides a basis for estimating the



At South Slough of Coos Bay, daily low tides slowly empty the bay of their brackish water. Earthquake-induced tides, which instead rapidly drain affected areas, were often remembered by Native Oregonians as great tides.

scope of the earthquake that caused the tsunami. By making reasonable assumptions about the size and speed of the tsunami and based on Japanese historic accounts, the earthquake would have exceeded 8.5 on the Richter scale.⁴ The resulting wave may have traveled in excess of five hundred miles an hour and reached the Oregon coast at a height of thirty feet or more. According to Japanese records,

At midnight . . . a tsunami struck. . . water running up as if it were a high tide. The water also went into the pine trees. . . the receding water went out very fast, like a big river. It came in about seven times . . . that day and gradually lost its power.⁵

While the descriptions of the “orphan tsunami” of 1700 echo those of the 2004 Indonesian tsunami, the effects in Japan were far less devastating. This is most likely because of the distance the waves traveled across the Pacific before reaching the Japanese shores. While the Indonesian tsunami of 2004 illustrates the scope of devastation close to a comparable subduction event, especially in outer coast communities, the Japanese records pinpoint the

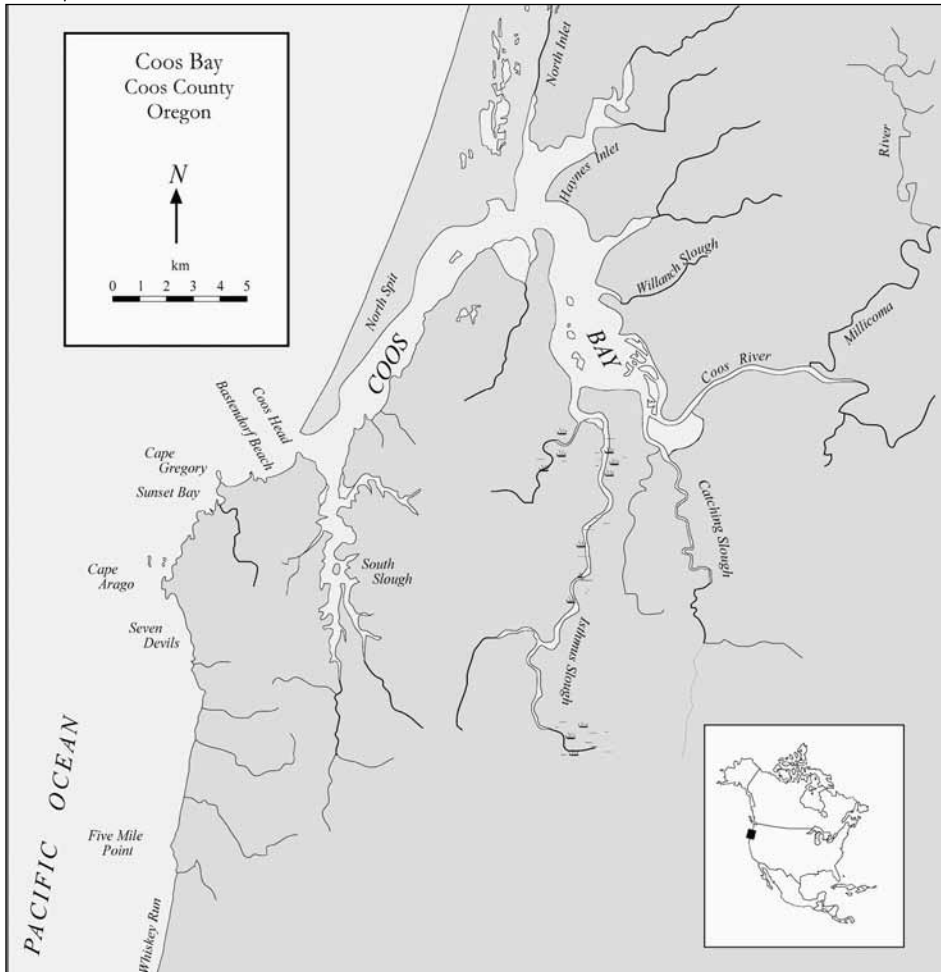
time of the event and confirm that it was large enough to create repeated waves that were still identified as tsunamis after traveling hundreds of miles across the Pacific.

No firsthand accounts of tsunamis appear in the ethnographic record from the southern Oregon coast, but ethnographers in the late nineteenth and early twentieth centuries recorded a few Native oral traditions that describe similar great tides. There is little doubt that such a massive event would have been depicted clearly and prominently in oral literature only a few generations after the loss of so many lives. Like many other parts of the once-great indigenous oral tradition of the Oregon coast, however, only a small number of narratives are still told by elders, a few more are recorded as linguistic or ethnographic texts, and bits and pieces of others survive in transcripts of ethnographic interviews of the early twentieth century.

The apparent loss of large portions of the traditional narratives is most likely due to several historical factors. Deaths from diseases, beginning by the late eighteenth century, may have been comparable to deaths caused by tsunamis along much of the coast. At least nine disease epidemics are thought to have occurred between 1775 and 1853, decreasing the indigenous population by up to 90 percent.⁶ Yet, those losses are not depicted in much of the existing oral literature. One reason may be the widespread reluctance to speak of the recently dead because of beliefs regarding the afterlife. It is also true that the losses of lives continued through the early years of U.S. settlement in the region, followed by boarding school re-education and government efforts to suppress indigenous languages and oral tradition. In some respects, historic tales of many lives lost in a great flood might have seemed comparatively unremarkable to people who had lost so much themselves. Yet, unlike the waves of European diseases that swept across the region, the great tide was a phenomenon that had revisited the region, if infrequently, since time immemorial. The survivors of the 1700 tsunami would have remembered being told of great floods from the ocean by their elders. Unlike the new diseases, this threat fit within a historical context.

As teachings, the accounts explain how to react and survive the great tide through proper behavior when the inevitable event does occur. Some of the accounts that survive today depict a singular historical event, while others depict an event that occurs when conditions, particularly human behavior, bring it about. In either case, we can see that these stories were intended to memorialize the traumatic experience while also providing future generations the knowledge they need to survive. Collectively, the remnant accounts of the great tide and of floods speak across many generations. They present the flood as a result of inexcusable behavior, demonstrating the destructive power of the ocean that parallels its vitality as a source of sustenance.

Courtesy of Mark Tveskov



Earthquake-induced tsunamis would have submerged the upper reaches of Coos Bay and South Slough. Archaeological evidence and oral traditions suggest that such tsunamis have repeatedly occurred along the Pacific Coast.

Whole communities are destroyed and others displaced.⁷ In other aspects of oral tradition, depictions of the forces of nature serve as guides for cultural behavior.

IN A SEPARATE article in this special section, Patricia Whereat Phillips retells some of the most explicit tsunami accounts from Coos Bay. These and a handful of others from the southern Oregon coast present common themes, though they were told (primarily to ethnographers) by at least four different tribal elders. Isolating and understanding the meanings of



The crack in this channel bank is a clastic dike feature, the remains of a crack in the ground that formed during an earthquake in the Nilestun village along the Coquille River. Geologist Curt Peterson stands by loose stones near the crack and the dark midden soil, which are some remains of the village.

ethnographic accounts of tsunamis to a single geographic location or people is problematic, considering the varying histories of European and Indian relations on the Pacific coast. Tsunami stories told by Native peoples to ethnographers were relayed by people who were two or three generations removed from the most recent occurrence of a tsunami, and they were recorded by people more interested in Native linguistics and ethnology than in historical events.

In the accounts that survive in interview transcripts and published texts, tsunamis are commonly referred to as “great tides” or “ocean floods,” and the scope of devastation is evident. Vast numbers of people perished as the land “sank” and was swept over by a great tide from the ocean. Jim Buchanan (Coos, circa 1840-1933), in “Ma’atł, The Flood,” told of sinking land followed by a “flood tide” and of people fleeing to high ground or “floating land”

where tall trees were located. As the tide retreated, people tied their canoes to the trees so they would not be swept away.⁸ In this and other accounts, the speaker did not explain why the tsunami occurred, but he did describe precautions taken. Some people had maintained long, braided ropes, storing them away in preparation for a flood. The manufacture of long ropes indicates a certain frequency of tsunamis on the Oregon coast — often enough not to be forgotten — and tells us that “flood tides” were real and not exaggerated mythical occurrences. In addition, the pre-tsunami “sinking of land” drew attention to the need to find higher ground. Importantly, it also indicated that land movement was associated with tsunamis, providing a critical warning mechanism. When the land sinks, seek high ground to avoid being swept away.

Other accounts present the disaster as a response of nature and powerful entities to extremely disrespectful behavior. For example, Annie Miner Peterson (Coos, circa 1860-1939) related to Melville Jacobs the story of “Salmon Did Ill to Boys,” told by her grandfather, Minkws. In this account, young men disrespect salmon, an important food resource, and Salmon brings a tsunami to sweep away the disrespectful people. The lesson: If you disrespect food resources, then the consequence is death. An intriguing component of Minkws’s story is that he said he knew an old woman who, as a youth, had survived this great flood. The old woman had clung to branches high up in a tree as the waters receded but severely injured her back in a fall while trying to climb down. This part of the story may have been an effort to communicate that the event was a real one rather than an ancient or myth-era event.⁹

Other versions of great tide narratives have human agency as the cause of the event. Lottie Evanoff (Coos, circa 1870-1945) explained to John P. Harrington that the consequence of disrespecting nature is a flood. In her story, a young boy kills crows, resulting in a flood caused by five days of rain.¹⁰ While the account imparts the need to behave respectfully to other beings, it also teaches the practical lesson that having a canoe at the ready is critical to survival. Given the historical importance of canoes to tidewater communities in this region, this lesson may have applied for reasons beyond tsunami survival.

As are many Native American oral traditions, entertainment value is relative to lesson and literal meaning is of little inconsequence. Collectively, Buchanan, Miner Peterson, and Evanoff were told stories by their elders — stories that had been handed down through many generations — about cultural values, the consequences of inexcusable behavior, and disaster planning. While we now try to understand the meanings of these stories, we cannot be certain why the stories were told. We can only know that they

were told following natural disasters and often to prepare for future events, which in these cases were likely earthquake-induced tsunamis.

Traditional narratives involving earthquakes and great tides were told throughout the Cascadia coastal region, and there are remarkable similarities between the earthquake and tsunami disaster narratives told by peoples to the north and south of Oregon. Traditional narratives from the southern Oregon coast share the use of ropes and canoes in surviving the flood, the diaspora among flood survivors, and the actions of individuals that may have brought about a great tide. Several ethnographic accounts depict extremely large floods, with survivors tying themselves and their canoes to trees to avoid being swept away by the receding waters.¹¹

Anthropologist Robert Losey has related the frequency of Cascadia Subduction Zone earthquakes to the oral traditions of Pacific coast peoples north and south of Oregon.¹² Accounts from regions to the north and south of Oregon more explicitly depict earthquakes, possibly reflecting the greater frequency of these events in those places. On the northern Northwest Coast, dwarfs tricked the Nuu-chah-nulth of Vancouver Island into dancing around the drum. Those who stumbled into the drum were stricken with a disease that caused the ground to shake.¹³ On the northern California coast, among the Yurok and Tolowa, Earthquake travels with his companion Thunder, and earthquake-induced tsunamis were triggered by a variety of human actions (some innocent and some impure). The results were often associated with origination stories or cleansing the land of impurities.¹⁴

Stories at Coos Bay are similar to those told in neighboring coastal areas in that tsunamis were preceded by “sinking land” and the ocean retreating dramatically, followed by a “great tide” or flood. Those who are prepared — and aware of these indicators — will find higher ground and perhaps have long woven ropes to tie themselves to the tall trees. Being swept away or not having a canoe (or some other protective floating device) means certain death. In some cases, the tsunami is a cleansing event.

It is clear that the Indonesian tsunami found people unprepared. Some tourists and residents perished as they inquisitively followed the retreating ocean, only to be swallowed by the ensuing tsunami waves. Those who were inland fled to higher ground, but many still were caught by the recurring waves and swept away. Perhaps now they will tell future generations stories similar to those remembered by the Coos and other Pacific coast peoples.

AS MY UNCLE and I hiked down Sundown Mountain that afternoon, I contemplated the meaning of his story. The elders had warned, “Weave long ropes, be prepared for the great tide. If you are not prepared, you’ll be swept away.” Those who listened to their elders would be spared and not swept

away. As my studies progressed and years passed, I began to understand that the meaning of any story is personal — each individual will interpret what is applicable to his or her lives. Possibly for my ancestors, there were multiple lessons: first, there are certain things you should do in the event of a great tide; second, you should heed the wisdom of your elders; third, you should respect your environment and the resources you rely on; and fourth, you should never forget the lessons you have been taught.

For me, my uncle taught me a life-long lesson — to never stop weaving my rope. As long as I maintain my rope, I will never be swept away and forget where I am from. And perhaps this is the fundamental purpose of many Native American stories told on the Pacific coast, regardless of the circumstance — to never forget where you are from. I will always be tied to the tallest of trees at South Slough of Coos Bay, Oregon.



Native American Vulnerability and Resiliency to Great Cascadia Earthquakes

by Robert J. Losey

IN JANUARY 1700, Native peoples of the Oregon coast faced two extremely dangerous and abrupt threats, a massive earthquake that caused several minutes of intense ground shaking and, a few minutes later, a tsunami that rapidly flooded low-lying areas. Although you might assume that these



Robert J. Losey and Julia Knowles unload excavation equipment for work at site 35-Tl-1 on the shore of Netarts Bay.

and earlier earthquakes and tsunamis were devastating for those who lived on the coast, an examination of the archaeological record and oral histories is beginning to reveal the complexity of human and environmental responses to these abrupt natural hazards. To adequately understand the role of these events in the histories of Oregon Native coastal peoples, it is necessary to look not just at the characteristics of the hazards but also at the cultural practices that rendered people both vulnerable and resilient to the short- and long-term effects of these earthquakes and tsunamis on architecture, residential patterns, subsistence, high-investment technologies, political structure, labor, and kinship. It is likely that many long-held cultural practices made Native communities quite resilient to these natural hazards, and it is the interplay between vulnerability and resiliency that is examined here.

Off the coast of northern California, Oregon, Washington, and southern British Columbia is the Cascadia Subduction Zone (CSZ), an area where the eastward-moving oceanic Juan de Fuca plate is being pushed under the thicker continental North America plate. The plates become locked, accumulate strain, and generally cause the coastline to uplift, faster in some areas than others. Every few centuries, the strain is abruptly released in an earthquake that causes coastal areas to sink rapidly in relation to sea level. The massive, sudden movement of the seafloor sends surges of water both

out into the Pacific and toward the North American coast. Tsunamis are formed when these rapidly traveling surges reach shallow waters, striking the coast thirty minutes or so after the earthquake.¹

The geographic extent of the earthquakes and their associated land subsidence may have varied considerably over the centuries. Some earthquakes generated from the CSZ almost certainly ruptured its entire length, from southern British Columbia through northern California. This was likely the case in the most recent Cascadia earthquake in 1700, and virtually every Native community in western Oregon would have been subject to some of its effects. Other earthquakes may have been more localized, affecting smaller sections of the coast.² In those cases, communities along one portion of the coast would have suffered the brunt of the earthquake (and perhaps the tsunami), while others would have been much less affected.

Knowing the intensity and duration of ground-shaking associated with these events is critical for understanding how likely it is that homes and other structures were destroyed and that hazardous landslides blocked rivers and caused other difficulties. In all likelihood, those earthquakes that ruptured the entire subduction zone produced minutes of intensive ground-shaking and had the potential to destroy human-built structures and produce numerous landslides. The earthquakes were likely in the magnitude eight to nine range, very similar to the December 26, 2004, earthquake that devastated Sumatra and generated extremely destructive tsunamis.³

Some indication of tsunami run-up heights — that is, water height above some known level — is crucial for determining which areas of ancient landscapes and which Native communities may have been flooded. But accurately determining the run-up heights of past tsunamis, let alone modeling the heights of future tsunamis, is a difficult task.⁴ Numerous characteristics of the earthquake itself, including the length of the fault rupture and the width and vertical extent of seafloor disturbance, determine tsunami height. The location of offshore canyons and reefs, the formation of the seafloor immediately offshore, and the configuration of bay mouths, among other things, also are important variables. Estimates based on the geological examination of tsunami-deposited sands have indicated run-up heights averaging from twenty-three to thirty feet above sea level. Some flooding likely occurred inland to near the head of tide, which in Oregon can be tens of kilometers inland. Therefore, the extent of tsunami flooding was extensive, but it would have varied geographically and from earthquake to earthquake.⁵

The interval between earthquake/tsunami events determines the regularity with which coastal environments had to respond to earthquake and tsunami disturbance. Perhaps most importantly, their frequency would have factored in the ways people chose to deal with them and how great a

threat they were perceived to be. Perhaps it also would have had an effect on how much long-held knowledge a community could draw on. The layers of sediment that slumped from the continental shelf due to extreme shaking, known as turbidites, contain a ten-thousand-year record of large magnitude earthquakes along the Oregon coast.⁶ Shorter records of around three thousand years include abruptly submerged and tsunami-covered soils in estuaries.⁷ These two records indicate that large earthquakes occurred approximately every six hundred years, but they also indicate a period where two earthquakes struck in a two hundred-year span and another period where nearly a thousand years passed without a large earthquake. As such, a minimum of eight human generations and sometimes as many as forty passed between such geological events. People also occasionally faced tsunamis that originated from distant sources, although they were likely smaller than those generated locally.

Finally, the extent of environmental disturbance associated with earthquakes and tsunamis varied in both duration and intensity. When food resources were severely depleted or stored foods were destroyed during an earthquake or tsunami, people faced nutritional stress. Perhaps the best modern analog is the 1964 Alaskan earthquake, which caused widespread uplift and subsidence of coastal lands and generated a massive tsunami in the Prince William Sound/Kodiak Island region. Coastal uplift associated with the earthquake was devastating to marine fauna, particularly sessile shellfish, which were abruptly and permanently raised above the waterline (or at least raised out of their preferred intertidal zone). Spawning fish, such as salmon, were also disturbed as spawning areas were placed out of reach by uplift or were churned or silted in by surging tsunamis and associated erosion. Subsided areas were much less adversely affected, but surging waves of tsunamis still destroyed some shellfish beds and caused widespread erosion and deposition of sediment in fish and shellfish habitat. The tsunami generated from the 1964 earthquake even caused some damage to shellfish populations in Yaquina Bay on Oregon's central coast, perhaps through scouring of the bay floor.

Interestingly, less than a year after the 1964 event, surveys of subsided areas of the Alaska coastline revealed that new shellfish beds were forming. Salmon seem to have recovered within a few years, as spawning beds developed in new areas and, in rare cases, the raised water levels following subsidence allowed fish to reach streams that had been inaccessible because of impassible waterfalls. Many salmon were probably unaffected in the immediacy of the earthquake because they were far out to sea and returned to spawning beds months or even years after the disturbance. The environmental disturbance from earthquakes and tsunamis may be short

term from a geological and archaeological perspective, but from a human perspective such problems may have been sufficiently long-lived to cause serious problems. It takes only a few weeks of food shortages to cause severe health problems or even death.⁸

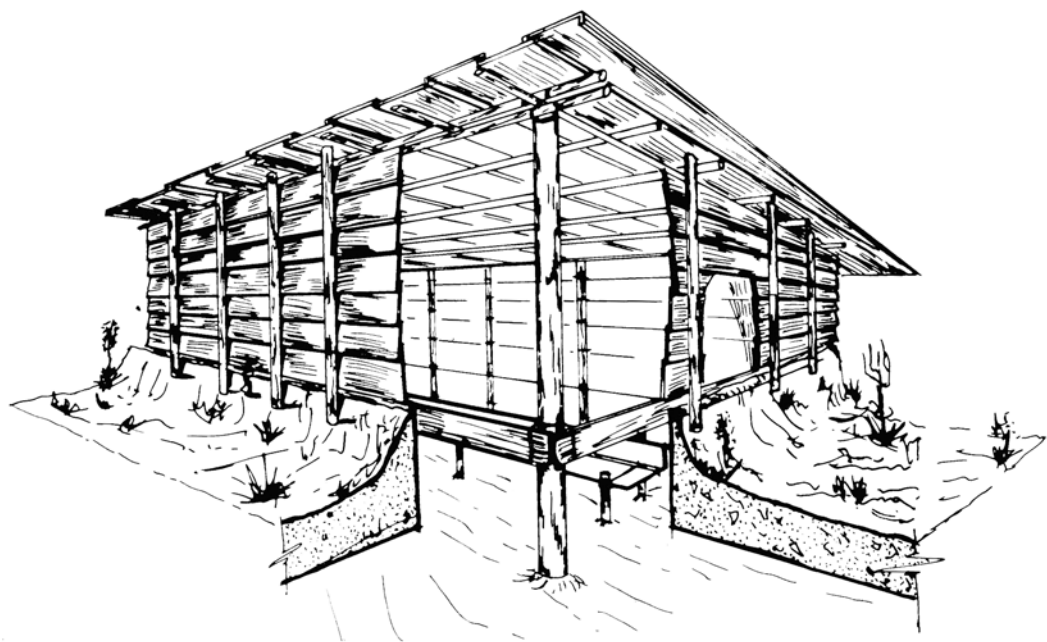
Earthquakes and tsunamis are not of themselves disasters or catastrophes. They are perhaps best viewed as hazards — events that present dangers of various scales and durations. Disasters, hazard researchers have recognized, are partly the products of human action; hazards become disasters when people place themselves and their livelihoods in harm's way.⁹ While this perspective can seem to be a case of blaming the victim, it can also be turned on its head. Through their habitual day-to-day actions and long-held cultural practices, people can render potentially disastrous situations much less devastating than might otherwise be the case. Cultural mechanisms that exist for a multitude of functions, such as kinship practices, may also provide avenues of support and knowledge during such crucial periods. Some habitual and long-held cultural practices of Oregon coast Native peoples can be difficult to ascertain directly from the archaeological record, and the best sources for such information are undoubtedly ethnohistoric records. Others, such as settlement patterns, architectural styles, and subsistence are more directly address with archaeological data. I begin here with house architectural styles.

HOUSE ARCHITECTURE

Housing styles on the Oregon coast undoubtedly varied through time, and a reasonably clear archaeological record of houses dates to only the last three thousand years or so.¹⁰ The general form and size of these archaeological houses are quite similar to those in use during the early contact period, from the late 1700s and early 1800s; the characteristics of earlier houses are unknown.

Styles of Native house architecture on the Oregon coast varied geographically, seasonally, from family to family, and according to relative affluence. Temporary, lightly built structures were used primarily for shelter during the warmer and drier months of the year. They lacked heavy beams and posts, presented little threat upon collapse, and could be easily replaced. More relevant here are the heavier post-and-plank houses that were built primarily for winter habitation, although many were also inhabited during warmer months.

Recent observations of earthquakes' effects on buildings has revealed a number of key architectural features that prevent or at least reduce the chances of collapse.¹¹ Mud brick structures, those with walls having debris-filled interiors, and those with stone veneers are all particularly susceptible



Tillamook houses of coastal Oregon, shown here in a sketch based on an Oregon Historical Society three-quarter scale reconstruction, were about sixty feet long and twenty feet wide and were built in pits four to six feet deep. (Sketch by Inaky San Martin, from Space, Style and Structure, ed. Thomas Vaughan, OHS Press, 1974)

to earthquake-induced collapse. Buildings that are irregular in outline, asymmetrical, or constructed with a variety of building materials (stone, wood, rubble) have also proven to be hazardous. Multiple-story buildings are more dangerous than single-story structures.

Native house styles on the Oregon coast were designed and constructed in ways that, consciously or unconsciously, minimized their risk of collapse during an earthquake. There is no evidence that people used brick or mortar in house construction, and rock appears to have been used primarily for post footings and little else.¹² Houses were apparently symmetrical and regular in outline, either square or rectangular. There is no evidence for true multi-story structures, although rafters were widely used for storage and meat curing. Construction materials typically consisted of wooden planks, several feet in length, set over a post-and-beam framework; beams were set in notches, and cordage was used to secure both beams and planks. Houses often were built over pits that ranged in depth from four to six inches to nearly five feet. All of these factors probably allowed the structures to shift and slump during earthquakes, reducing the likelihood of catastrophic collapse.

Perhaps the biggest danger to house occupants during an earthquake was falling or collapsing overhead architectural elements or stored items. Given that overall house size should correlate with the size or weight of the overhead elements (beams, roofing, and so forth), the general characteristics of house size might provide some coarse estimation of the relative dangers posed by house collapse. Archaeological houses on the northern Oregon coast reach about 60 feet in length; the south coast is characterized by much smaller houses, most no more than 16 feet in width or length.¹² Houses over 130 feet in length were present along the Columbia River in the Portland area upstream to The Dalles.¹³ All other things being equal, those houses on the south coast would have been less hazardous than those on the north coast, while those found inland on the Columbia River might have presented the most risk (although they might have been subject to less intensive ground-shaking).

Resistance to tsunamis is another matter. The December 26, 2004, earthquake-generated tsunami in Indonesia clearly showed the devastating effects of surging waters on buildings. In some areas, structures that were not built of brick were destroyed and even brick buildings were often undermined by erosion. Similar effects, although of a much smaller scale, were seen in Crescent City, California, following the arrival of tsunami waves generated by the 1964 Alaskan earthquake.¹⁴ In all likelihood, no Native houses on the Oregon coast would have provided safe haven for people during a tsunami. To survive intact, houses would have had to be situated outside the tsunami flood zone.

Replacing plank-and-beam houses lost to tsunamis or earthquakes would have been a costly affair, both in materials and time. Archaeological excavations at Netarts Bay, for example, have shown that houses there were on average around 40 by 16 feet and probably required about 6,000 board feet of lumber (modern two-story American homes require on average 10,000 to 12,000 board feet of lumber).¹⁵ Procuring and processing such a quantity of planks and posts using only stone, wood, and bone tools likely took weeks, if not months, of occasional labor. Less permanent structures could be used during the construction period, but they would not provide the same degree of shelter from the elements and storage space provided by plank houses.

RESIDENTIAL PATTERNS

The most obvious way for people to avoid threats posed by great earthquakes and tsunamis is to live outside the affected area. Given that great earthquakes caused strong ground motions across western Oregon, every Native group would have been within the affected area, regardless of any seasonal movement away from the coast. Ground motions during an earthquake are often amplified or dampened depending on a number of factors,

but especially important are local soil conditions, particularly the presence of soft, wet sediments. Although there have been no systematic studies on this question, archaeologists generally find that village sites are more often located on higher, well-drained terraces near shorelines rather than on low wetland soils. Stabilized sand dune settings, where houses were often built, likely would have slumped.

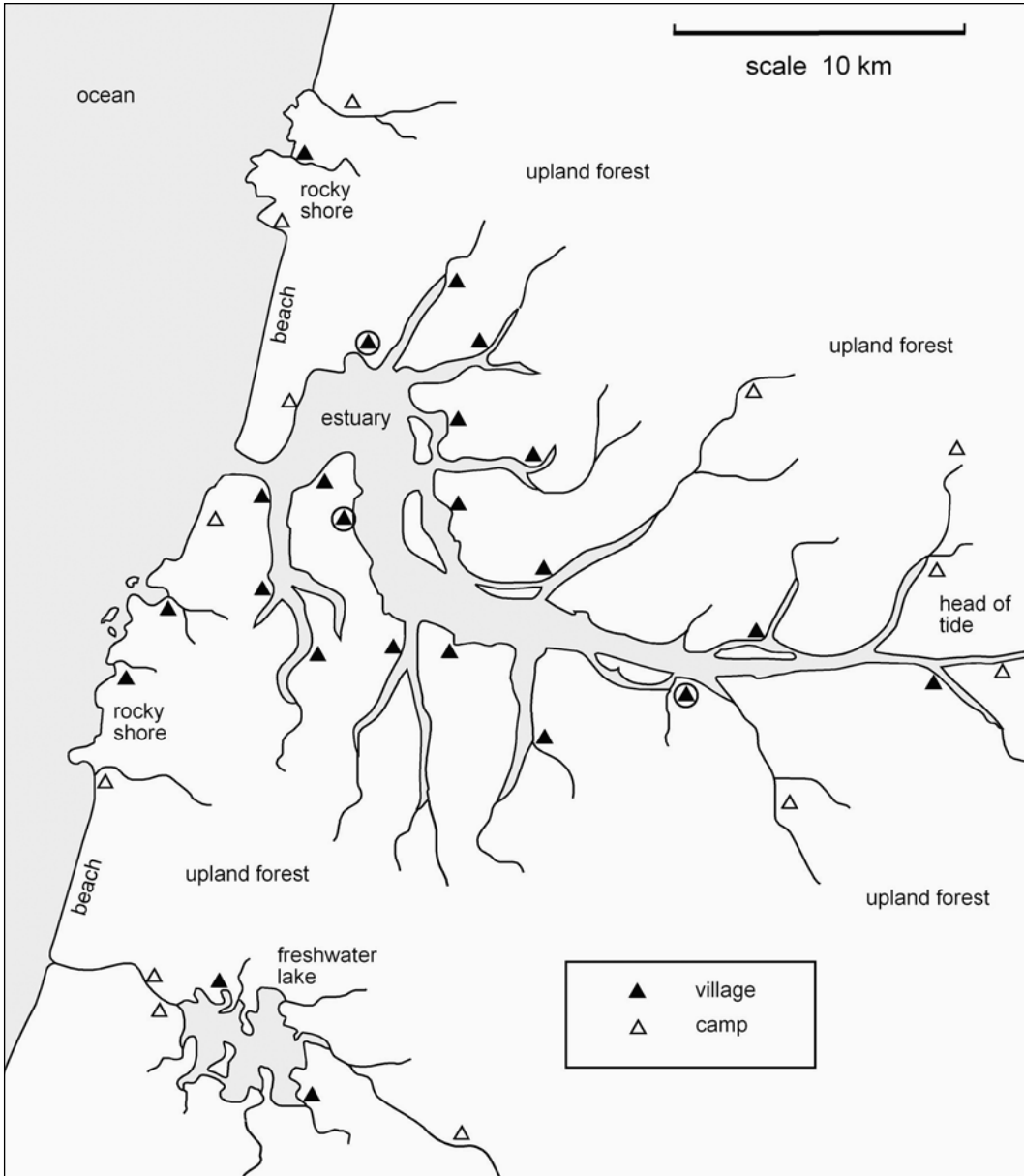
Compared with earthquakes, tsunami flooding obviously affected a smaller area of the landscape — the immediate coastline, the margins of estuaries, and low-lying areas of tidal regions of rivers. Geographic residential patterns in western Oregon undoubtedly varied geographically and temporally, but there are a number of commonalities in most archaeological and ethnographic models.¹⁶

First, coastlines, estuary margins, and tidal portions of rivers were the most densely populated settings in the region.¹⁷ These areas were the most productive portions of the landscape in terms of subsistence, and direct access to waterways was crucial for groups whose primary means of travel and transportation was watercraft. Numerous archaeological habitation sites are found in these zones, most no more than few hundred feet from water's edge; and most were positioned at only a few feet in elevation.¹⁸

Second, some portion of or entire Native communities shifted settlement location on a seasonal basis, partly in response to the availability of food resources. This pattern of movement apparently varied widely, both between communities and in them, but one commonality was that estuaries were used as areas of winter settlement and often year-round residence. Tidewater villages often held the largest population aggregations when people gathered for the important winter ceremonial season. During other seasons, people were often more dispersed, moving to the outer coast, upriver to falls or plant-gathering and hunting areas, or elsewhere on the margins of estuaries. Clearly, at least some people were living in harm's way during any season, but villages upriver would have been better off than those at bay shores and on the outer coast. Given the seasonal movement of people on the landscape, the season of earthquake and tsunami occurrence would have been a major factor in the scope of these events on Native peoples. Of the numerous earthquakes that have struck the Oregon coast over the last ten thousand years, seasonality is only known for the most recent event, which occurred in winter, the worst possible scenario.¹⁹

FOOD

Earthquakes and tsunamis likely caused damage to subsistence resources, particularly marine fauna such as shellfish and anadromous fish such as salmon. To what extent did Native people use these resources? How did



Ethnohistoric accounts — including tribal oral histories, Indian agency reports, and other documents — allow researchers to understand how Native people lived on the Oregon coast from the 1820s through the 1850s, and likely for several centuries before. This generalized map diagram, which does not represent a specific place, shows the kinds of places Native Americans built residential sites (villages). Estuary shores held the largest population centers, but villages and seasonal camps were located in several different settings.

this vary seasonally and geographically? Little is known about subsistence patterns along the Oregon coast during the earliest periods of its occupation, largely due to the dearth of early sites and the paucity of food remains in them.²⁰ Much more is known about these patterns over the last three thousand years, when sites become more numerous and faunal and floral remains are better preserved.²¹

An examination of faunal and floral remains from Native habitation sites along the Oregon coast reveals that an extensive array of foods was on the menu.²² Marine and anadromous foods were particularly important, but on-land foods were also extensively used. The options on this menu varied geographically and seasonally. For example, some terrestrial plant foods, such as acorns, appear to have been far more important on the south coast than on the north coast due to the natural distribution of oaks. Some estuaries such as the Nehalem River are shellfish poor, while others, such as Netarts Bay, are shellfish rich, a pattern reflected in food remains found in habitation sites on these bays. Some salmon species, such as chum, were found in abundance in rivers on the north coast but were rare on the central and south coasts. Despite this variability, a suite of resources was universally important on the Oregon coast, particularly salmon, shellfish, elk, deer, pin-nipeds, and an array of berries, shoots, and roots. Seasonal food use also varied depending on location, conditions, and needs, but one commonality was the reliance on stored foods during the winter, which typically included dried meats (salmon, elk, clams), dried berries, and rendered sea mammal and fish oils.²³ Such foods were probably stored in the overhead areas and subfloor cellars of winter houses.

Clearly, Native peoples of the Oregon coast were eating foods that were susceptible to earthquake and tsunami disturbance. People also were seasonally dependent on stored foods, which could easily be destroyed in tsunami flooding. As such, some level of nutritional stress was a strong possibility in the immediate aftermath of a great earthquake. If environmental disturbance was long-standing, then extensive population loss, either through starvation or migration, is also a possibility.

TECHNOLOGIES

The loss of crucial technologies that could not be easily replaced would also place strain on people coping with an earthquake or tsunami. Plank houses were clearly a high-investment technology, both in terms of raw materials and time. Used for shelter and as storehouses, smokehouses, and workshops, their loss would have widespread repercussions.

Given the placement of settlements near waterways, canoes were also undoubtedly crucial in the lives of Oregon Native peoples, who used dugout

canoes on rivers, lakes, estuaries, and the open ocean.²⁴ They allowed people to forage relatively long distances from a central point, to access a variety of aquatic and terrestrial resources, and to transport heavy loads.²⁵ Canoes were used for any number of other transportation needs and undoubtedly were a major way to exchange information and goods. Their loss would at least temporarily limit subsistence practices, hinder the evacuation of affected areas, and slow the exchange of critical information, such as where temporary shelter or food might be found.

Other relatively high investment items included baskets, nets, and fish weirs or traps. For all of these technologies, the gathering and processing of construction materials were probably more time-consuming than their actual construction.²⁶ Large fish nets were probably the most expensive, followed by weirs and baskets. Nets and baskets stored in houses could be lost to tsunami flooding, and weirs or traps could be rendered ineffective by changes in water level or damaged by surging waves. Cheaper technologies (in terms of materials and time), such as hooks and lines, dipnets, small weirs, or baskets of expedient materials, might be substituted in the short term. The loss of such technologies would probably not be life-threatening, but it certainly would decrease the efficiency of many daily activities and cause additional economic stress.

POLITICAL ORGANIZATION, LABOR, AND KINSHIP

Northwest coast Native societies often are described as some of the most socially complex hunter-gatherer groups in history.²⁷ Little definitive assessment can be made about social complexity on the Oregon coast in earlier times, but it is reasonable to suspect that there is some degree of similarity between ethnographic patterns and those of the last thousand years. During the early contact period, societies in present-day Oregon often had a limited number of elite individuals or families, a broad base of commoners, and some slaves. These social levels were likely relatively permanent, passing from generation to generation, but there was generally no strong centralized political organization on most of the Northwest coast, including western Oregon.²⁸

The basic political unit on the Oregon coast was the household, a group of often-related individuals who in some cases lived in a single house. Households on the northern coast and the Columbia River often consisted of several families, while those on the south coast were smaller, often based around a single small family.²⁹ Household units could be fluid, with individuals and families free to withdraw from a household and to join or form others.³⁰ Households were also free to break from a village group and form their own settlements or join existing ones. Household sizes could be increased or decreased to meet labor needs.

It is only possible to speculate on the ways that political and labor organization played out in the aftermath of Cascadia earthquakes and tsunamis. The lack of centralized power in these societies likely meant that decisions in the face of disaster were made on a household or family level. In those villages suffering from population loss, however, households and families would have faced serious turmoil and likely would have been significantly reconfigured. The fluid nature of villages and households would allow any number of responses, from population dispersal into individual families, to consolidation of families into large households, or some combination of the two. The choices made would be variable and situational. Critical factors would include the pre-existing political situation, the extent of population loss, labor needs, the extent and duration of environmental disturbance, the season of occurrence, and even an individual's social position. It is also possible that the loss of material wealth, such as boats and houses, and decreased household size was a leveling process, at least in the short term, which left formerly well-to-do individuals or families with little means of maintaining their positions. Personal charisma and authority, however, may have allowed some individuals to continue in or even increase their sway over others. Notably, individuals with little or no status — slaves, for example — and those who had little to gain from group cooperation might take the opportunity to escape their former positions.

Kinship likely played a significant role in the choices made about post-earthquake settlement locations and household organization. Marrying out of one's village was probably common, and relatives would have provided a support network that linked settlements on adjacent estuaries or coastal settlements to those inland.³¹ Relatives would have provided avenues for exchanging information about the reconfigured physical and social environment. Such information might have been critical in the days and weeks following a major earthquake, as people sought out social support, intact homes, and food.

ORAL TRADITIONS

Native oral tradition of the Northwest Coast is both difficult to interpret and laden with a mosaic of cultural information. Nonetheless, numerous recorded accounts provide unique glimpses into the ways people dealt with, explained, and even embraced natural hazards. Prior to Euroamerican contact, Native people of the Northwest coast likely knew and told around one million traditional tales.³² Perhaps only one thousand, or one percent, have been recorded or passed down to us. Despite this enormous loss of oral history, several stories recounting earthquakes and tsunamis have been identified on the Northwest coast, including Oregon.³³

Some recollections of ground-shaking or sudden floods from the ocean appear to refer to the 1700 Cascadia earthquake and tsunami.³⁴ Many other accounts lack such time signifiers and are impossible to associate with geologically known earthquakes or tsunamis. That such stories are recalled at all should not be surprising, given the potential of earthquakes and tsunamis to demonstrate extraordinary powers and to cause a sudden widespread loss of life and considerable landscape change. Given that this oral tradition is found among groups spanning the subduction zone, it is likely there was some level of common experience in dealing with the hazards. Perhaps survivors felt some comfort in sharing their stories with others in the region who had similar experiences.

The first recorded oral traditions about apparent CSZ events date to the 1860s.³⁵ Why did people keep telling these stories more than 150 years after the 1700 earthquake and tsunami? One reason is that the storytellers believed that the events and their effects were worth remembering and that telling the stories might give listeners some means for coping with and understanding future earthquakes and tsunamis. Stories often recall the specific behavior of people who survived. An account of a tsunami at Nehalem Bay, for example, recalls that some individuals were spared the loss of their homes and goods because they heeded the warning of an approaching tsunami and moved their materials up a hill. Similar practical steps to survival are suggested today along the Oregon coast through the numerous “Tsunami Evacuation Route” signs that direct people to higher ground.

Some accounts of tsunamis and earthquakes depict these events as beneficial, at least for the survivors. The Tolowa, Athapaskan speakers of Oregon’s far south coast, have a story that closely ties their origin to an earthquake-generated tsunami that cleansed the earth, leaving only the chosen to populate the area.³⁶ Farther south, ethnographers working among the Yurok of the Klamath River area report in many stories that Earthquake is a personified character.³⁷ In at least one story, Earthquake, along with his partner Thunder, travel along the coast sinking coastal prairies into the ocean, creating estuaries and lagoons. These happenings are described in a positive way — the estuaries and lagoons and the fish and shellfish in them are depicted as essential to Yurok life.³⁸ Such stories are not simple recollections of past events but also elaborate explanations of landscape evolution and the peopling of the known world. They likely reflect the varied roles earthquakes and tsunamis played in the short- and long-term histories of Oregon’s Native peoples.

THE ROLE OF GREAT EARTHQUAKES and tsunamis in the histories of Oregon’s Native peoples is complex. Of the immediate hazards posed to communities by these events, tsunami flooding was the most significant.

While earthquakes likely caused some dangerous landslides and houses to collapse, the surging waters of tsunamis were probably more widespread and life-threatening. Longer-term hazards, such as reduction of the subsistence base through environmental disturbance, are still little understood; but some level of nutritional stress was likely present, particularly in the weeks and months after an earthquake.

Some cultural practices such as living near waterways and reliance on stored foods during winter placed a significant portion of the population at considerable risk. House construction methods and other cultural practices may have minimized some of the risks. Oral histories may have provided critical direction to those facing these hazards, and accounts of positive outcomes may have provided some level of solace to survivors.

Obviously, coastal communities today have some advantages over Native groups three hundred years ago — national and international disaster response networks, a globalized food base, varied forms of transportation, and some ways of warning people (at least for tsunamis). In other ways, however, we are at more risk today than we have ever been. Modern buildings can pose serious risks to inhabitants when they are subject to strong ground motions, and electricity and natural gas have created significant fire hazards. Large populations currently live in tsunami inundation zones, and ports and roads are in harm's way. Today, there is little oral tradition about earthquakes and tsunamis among residents of coastal communities or the thousands of tourists that visit them each year. The detailed examination of the geological record has helped raise awareness of the potential hazards posed by Cascadia earthquakes and tsunamis, at least at a government level. It is my hope that archaeology will heighten this awareness by telling the long-term human history of how people have coped with these incredible hazards through the centuries.



"Catastrophe and Restoration"

by R. Scott Byram

Many of the research projects discussed in this paper would not have been carried out without the support of the Coquille Indian Tribe, for whom I had the honor of serving as consulting archaeologist for several years. The head of the Coquille Cultural Resources Program, Don Ivy, has led several of these collaborative research projects. University of Oregon professors Jon Erlandson and Madonna Moss served on my doctoral committee and set the stage for the intertidal surveys presented here. Loren Davis, Dennis Griffin, Le Gilson, Tom Connolly, Robert Kentta, Mark Tveskov, Rob Witter, Sharon Parrish, Denise Hockema, Nicole Norris, Curt Peterson, Jason Younker, Patricia Whereat Phillips, Shirod Younker, Roy Lowe, Dave Pitkin, Reg Pullen, and Beth Piatote have all contributed greatly to this research. Marianne Keddington-Lang was inspired to create this special section, and I appreciate her energy and expertise in carrying it out. Finally, Robert Losey was called on many times to tap his wealth of knowledge on the subject at hand in reviewing and editing this article.

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"Weaving Long Ropes" **by Jason Younker**

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