

## When the Mountain Dwarfs Danced: Aboriginal Traditions of Paleoseismic Events along the Cascadia Subduction Zone of Western North America

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**Abstract.** Geological evidence demonstrates that recurrent great earthquakes have been generated at the Cascadia subduction zone, off the west coast of North America, throughout the Holocene. Such major earthquakes and associated tsunamis would have had devastating impacts on Native villages along this coastline. Native oral traditions of such disasters, along with earthquake figures in myth and ceremony, are examined for evidence of the nature of such past geological events and the impact they had on human populations.

Prior to the arrival of European explorers and traders in the late eighteenth century, the indigenous peoples of the Pacific Northwest relied on oral traditions to maintain the essential elements of their histories and belief systems. Many of these traditions survived into modern times and were recorded during early ethnographic work along the coast. Mythic accounts tell of the ancient past, when powerful transformers put the landscape and the animals into their present forms. Historical narratives set in more recent times also help to situate the people on their landscape, reaffirming their lengthy ties to the lands they occupy. These oral traditions also recount details of past natural catastrophes, including earthquakes and tsunamis, that affected this region. Although they may not meet modern standards of scientific rigor for the study of such phenomena, the oral histories reflect the experiences and perceptions of aboriginal peoples in their lengthy occupation of this land. They provide, along with the archaeological record of the Native past, our only insights into the impact of past seismic events on human populations in this region prior to about two hundred years ago.

In a previous publication we examined the archaeological evidence for

*Ethnohistory* 49:1 (winter 2002)

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village abandonment associated with late Holocene earthquakes in northern Cascadia (Hutchinson and McMillan 1997). Such events would have had catastrophic effects on Native villages, including the collapse of houses through ground shaking, destruction of houses and belongings in mudslides or rockslides triggered by the quake, rapid subsidence of coastal margins, or damage from tsunamis following major earthquakes. Several archaeological sites along the southern Washington and Oregon coasts had previously been shown to have been subsided into the intertidal zone and overrun by a tsunami following a great earthquake about three hundred years ago (Woodward et al. 1990; Cole et al. 1996; Minor and Grant 1996). We argued that recurrent great earthquakes and tsunamis generated at the Cascadia subduction zone had been a major cause of village abandonment throughout this region during the past three thousand years.

In this paper we examine indigenous oral traditions for evidence of such past catastrophic events. We focus on the Native occupants of Vancouver Island and their relatives on the adjacent mainland. On the rugged outer coast of Vancouver Island are the Nuu-chah-nulth, formerly (but erroneously) known as the Nootka, with the closely related Makah to the south, on the Olympic Peninsula in Washington. The Kwakwaka'wakw (once known as the Southern Kwakiutl) hold the northern and northeastern portions of the island and the adjacent mainland; their relatives, the Oweekeno and Heiltsuk, occupy the mainland coast to the north. Various groups collectively known as the Coast Salish occupy southeastern Vancouver Island and the southern British Columbia mainland, including the Fraser Valley, and much of the Washington coast, including the area around Puget Sound. We present additional information on groups to the north and south of this core area, from the central British Columbia coast to northernmost California, roughly corresponding to the coastline along the Cascadia subduction zone. The locations of historic Native groups, as well as of documented earthquake and tsunami traditions, are shown in Figure 1.

Considerable caution has to be employed when generalizing from the ethnographic record. Little ethnographic research was conducted in this area prior to the early twentieth century, by which time many traditions had disappeared. The intensity of ethnographic fieldwork also varies greatly among the groups discussed here. As the ethnographic accounts are incomplete, the absence of recorded traditions of seismic events among particular groups does not mean that such traditions did not exist. Those oral traditions that have been recorded are often compressed, fragmented, or distorted in translation. As the early anthropologists and folklorists tended to view stories and other oral accounts as discrete "things" that could be collected (Cruikshank 1994: 405), much like artifacts, the recorded oral

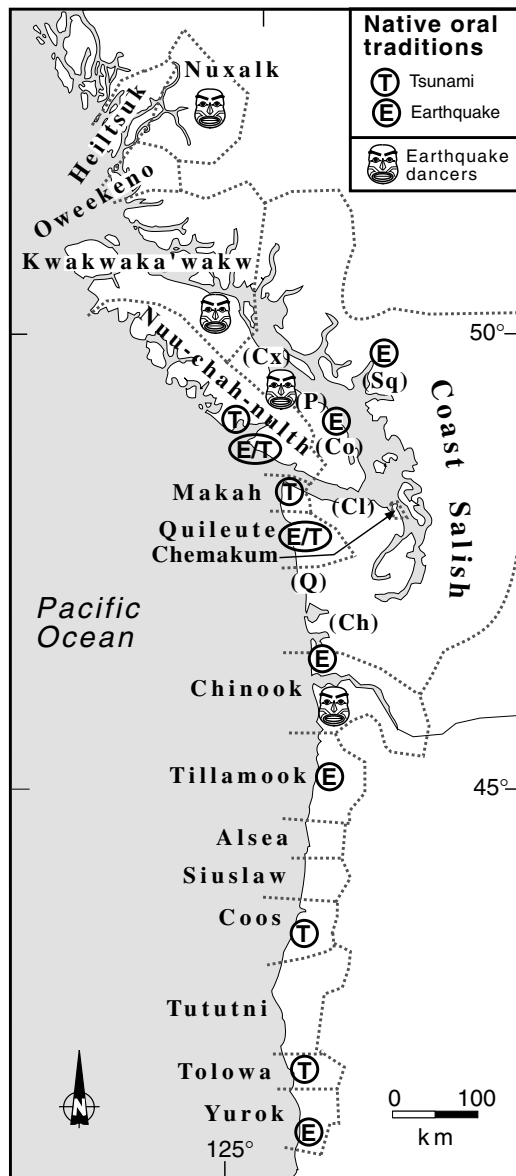


Figure 1. Historic distribution of Native groups, showing locations of specific earthquake and tsunami traditions. Individual Coast Salish groups mentioned in the text are shown in brackets (Cx = Comox, P = Pentlatch, Co = Cowichan, Sq = Squamish, Cl = Clallum, Q = Quinault, Ch = Chehalis).

traditions generally lack the rich contextual detail that once made them meaningful.

Perhaps because of the difficulty in working with such materials, few academic researchers have given the evidence of past seismic events contained in the oral traditions much credibility. Thomas Heaton and Parke Snavely (1985) and John Clague (1995) are exceptions, although each of these studies offers only a brief examination of one or two stories. Rick Minor and Wendy Grant (1996) also briefly identify a number of oral traditions that are consistent with their archaeological evidence for site destruction by a great earthquake. In this article, we attempt a broader and more detailed approach to Native oral traditions as independent sources of knowledge of past seismic events.

Oral traditions, however, cannot simply be read as historical records. Considerable academic attention has been directed in recent decades to understanding the relationship between indigenous oral narratives about the past and “history” in the Western sense (e.g., Vansina 1985; Hill 1988). Oral traditions may have multiple levels of meaning, rather than describing a single set of historic events (Cruikshank 1991: 141; Anyon et al. 1997: 81). Julie Cruikshank (1992: 40) points out that oral traditions “are cultural forms that organize perceptions about the world” and are not merely vehicles for historical facts. In addition to any historical insights they may provide, oral traditions speak to such broad issues as how indigenous people make sense of the unpredictable destructive natural forces in their landscape.

### Geological Evidence of Great Earthquakes at the Cascadia Subduction Zone

The Cascadia subduction zone, stretching from the north end of Vancouver Island to Cape Mendocino in California (Figure 2), marks the convergent boundary between the downgoing Juan de Fuca oceanic plate and the overriding continental North America plate. This subduction zone is currently locked and is accumulating strain, which is likely to be released in the future as a great (magnitude [M] 8+) interplate earthquake (Hyndman 1995). Great earthquakes are known to have occurred on this boundary during the recent geological past (Clague 1997). The earliest such event presently documented in the geological record occurred about seventy-five hundred years ago (Nelson et al. 1996), while the most recent shook the coast in A.D. 1700. The latter, which is well documented and precisely dated, is known from geological evidence in more than thirty estuaries and nearshore lakes from northern California to Vancouver Island (Atwater

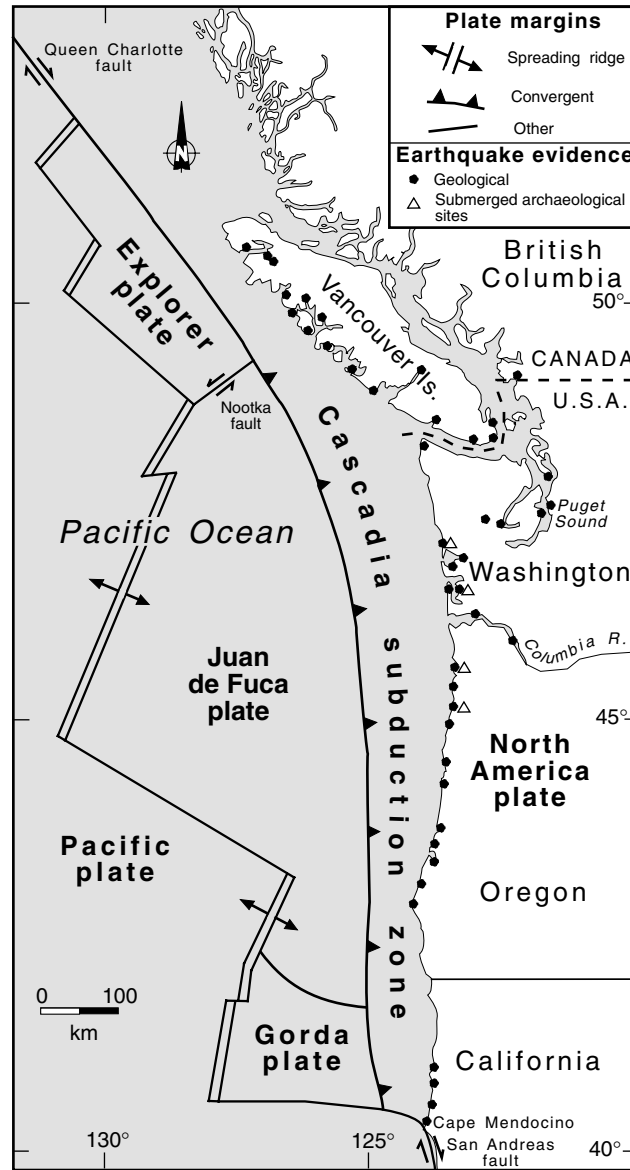


Figure 2. The Cascadia subduction zone, showing tectonic plates and locations where geological evidence for great earthquakes and tsunamis has been found.

et al. 1995; Clague 1997; Jacoby et al. 1997) and from written records of tsunami waves in Japan (Satake et al. 1996).

The damage caused by recent great earthquakes (southern Chile in 1960 [ $M = 9.2$ ] and Alaska in 1964 [ $M = 9.0$ ]) illustrates the severity of the hazard posed by such events, particularly to coastal communities. Not only were buildings destroyed as a result of ground motion during the earthquake and from liquefaction of underlying substrates, but quasi-permanent vertical deformation of the crust led to regional changes of 1–2 m in mean sea level (Plafker 1969, 1972). Large tsunami waves struck coastal towns and villages shortly after the earthquake, causing widespread loss of life and property damage (Plafker 1972; Lander 1996).

Interplate earthquakes of this sort may cause severe damage, but they are relatively infrequent occurrences. Geological investigations at several estuarine marshes and nearshore lakes suggest that great earthquakes at the Cascadia subduction zone have an average recurrence interval of about five hundred years, with successive events separated by as little as two hundred years to more than a thousand years (Nelson et al. 1996; Atwater and Hemphill-Haley 1997). In contrast, earthquakes generated by fault ruptures in the North American crustal plate are more frequent but of smaller magnitude. Since 1870 nine events with  $M > 6$  have occurred in southwestern British Columbia and Washington state (Clague 1996). Shallow crustal events of this sort may cause severe damage in the vicinity of the epicenter and minor damage within a radius of about 100 km (Clague 1996). If the rupturing fault segment is located beneath the ocean, tsunamis may be generated, which may flood neighboring low-lying areas. Geological evidence indicates that a substantial tsunami was generated by a rupture of the Seattle Fault beneath Puget Sound about a thousand years ago (Atwater and Moore 1992).

These geological data demonstrate that rare great earthquakes, and more frequent minor quakes and tremors, have strongly affected this region. Such geological upheavals would have had major impacts on human populations resident in the area. Evidence that this was the case can be found in the beliefs and traditions of Cascadia's Native inhabitants.

### Earthquakes in Myth and Ceremony

The mountain dwarfs, in Nuuchah-nulth belief, were responsible for the earth shaking. In discussing supernatural beings recognized by the Nuuchah-nulth, Philip Drucker (1951: 154) states: "There were also dwarfs, who had houses inside of mountains, where they enticed the unwary to dance with them around and around a great wooden drum. Sooner or later

he [the unwary visitor] stumbled against the drum, and became afflicted with a peculiar disease called “earthquake foot”—every time he took a step the ground shook. No one with this malady lived long.” This belief is also evident in an oral tradition recorded by Edward Curtis (1970c [1916]: 108). A Nuu-chah-nulth individual named Yahlua, in this narrative, followed a group of supernatural beings into a cave near the village of Yuquot in Nootka Sound. As they prepared to dance, Yahlua kicked a large box drum and felt the earth shake, for “these spirits were those who cause earthquakes by means of their drum.” Yahlua was then an “earthquake man” and “whenever he walked the earth trembled.”

Stories of dwarfs, or “little people” who live in the mountains, are still known among the Nuu-chah-nulth. During fieldwork with the Nuu-chah-nulth near Port Alberni, Alan McMillan was told stories of the little people living in the rocky bluffs, who warned humans when earthquakes were about to occur. Tim Paul, a modern Nuu-chah-nulth artist, was told an earthquake tradition by the late Benedict Andrews, a hereditary Nuu-chah-nulth chief, that was essentially the same as the story given by Drucker. Paul then produced a silkscreen print to depict the earthquake dancers (Figure 3).

Earthquakes also featured in the major Nuu-chah-nulth ceremony, the Wolf Ritual. Although there were no masked dancers representing the earthquake, costumed participants used bull-roarers to imitate its sound (Sapir and Swadesh 1955: 91). Such displays were chiefly ceremonial prerogatives.

These traditions appear to be unique to the Nuu-chah-nulth, although stories involving dwarfs are more widespread. In a Heiltsuk myth from the central British Columbian coast, when the people returned to their ruined village following a great flood they found four little people dancing on the shore (Olson 1955: 340). It is tempting to imagine this flood as a tsunami and the dancing little people as equivalent to the Nuu-chah-nulth earthquake dancers. The Puget Sound Salish also had stories of “earth dwarfs” who went into the mountains, but there is no specific association with earthquakes (Elmendorf 1960: 529).

Inland from the Heiltsuk, along the major inlets that cut into the central coast, are the Nuxalk of the Bella Coola valley. Earthquakes feature prominently in their mythology and ceremonies. According to their beliefs, the earth is held in place with strong ropes held by a giant supernatural being. Earthquakes occur when the ropes slip from this being’s grasp or when he moves his hands to get a better grip (Boas 1975 [1898]: 37; McIlwraith 1948 1:42). Several ceremonial dance groups had this being as their patron. Unlike most Nuxalk dances, which took place during the win-



Figure 3. "Earthquake or Earth Quake Foot," silkscreen print by Nuu-chah-nulth artist Tim Paul, 1977 (black and red on white). The human (*left*) has been enticed into the cave by the supernatural dancer wearing a headdress (*right*). The object between them is a drum. Note the lines denoting movement emanating from the drum and under the feet of the human, who has become afflicted with "earthquake foot." Used with permission of the artist.

ter ceremonial season, the earthquake dancers performed at any time of the year, whenever tremors were felt (McIlwraith 1948 2: 237).

Earthquake dancers also featured prominently in the ceremonial life of the Kwakwaka'wakw. Earthquakes and other natural phenomena were portrayed in a series of dances, closely resembling those of the Nuxalk, which displayed hereditary family privileges (Holm 1972: 40; Hawthorn 1979: 211). Masks used in such performances depicted anthropomorphic beings, some with moving parts such as large visors that tipped down over the dancers' eyes (Figure 4). The use of a plank bench that tilted to unbalance the spectators seated on it, part of the family privilege displayed during this dance, showed the presence of the earthquake and the power of the mask (Hawthorn 1979: 211).

The Kwakwaka'wakw also had the *xwexwe* dance, which was ac-





Figure 4. Kwakwaka'wakw earthquake mask with movable lips and visor (shown open and closed). University of British Columbia Museum of Anthropology A6357.

quired by marriage from the Comox Salish to the south. In a lengthy account describing marriage ties between the two groups, Boas (1921: 951–6) mentions the transfer of four *xwexwe* masks. This distinctive figure, with its projecting eyes and hanging tongue, was associated with both earthquakes and healing power (Hawthorn 1979: 224). Boas (1970a [1897]: 497) describes this performer as an “earthquake dancer,” whose “dance is believed to shake the ground.”

A Kwakwaka'wakw tradition recounted by Franz Boas (1935: 27–32) tells of the origin of the *xwexwe* dance. One night, in this story, a man felt the floor of his house shaking, as if in an earthquake. Four times he heard a rumbling noise and felt his floor shake. He was then instructed in a dream to bathe and purify himself. Following such ritual preparations, he entered the ceremonial house from which the rumbling and shaking emanated. Inside the house he viewed a dance in which the female performers changed into red codfish; as their tails struck the ground they caused the earth to shake. Four times the women performed, changing back to their human forms after each dance. Four men wearing *xwexwe* masks and hold-

ing rattles of scallop shells then entered and danced four times around the fire. At the end of this performance, the Red Cod people transferred the rights to this dance to their human guest. He received as a supernatural treasure not just the dance and the songs, but also the ceremonial house, four *xwexwe* masks, four scallop shell rattles, four large wooden drums, and four notched cedar poles to saw across the drums to produce the rumbling noise of the earthquake.

Among the Coast Salish, this distinctive mask and dance performance is known as the *sxwaixwe*. Only the groups along the Strait of Georgia and lower Fraser River had this important ceremonial prerogative; it was absent among the Salish to the south, such as those of Puget Sound (Smith 1941: 202). The dancers wore full costumes, including the unique peg-eyed masks with animal or bird heads for ears and nose, surmounting plumes, a feathered ruff and shirt, and swanskin leggings, and carried rattles of scallop shells strung on hoops of root or withe (Figure 5).

In the traditions of the Fraser River Salish this costume was obtained from the underwater realm, from a lake or the Fraser River (Hill-Tout 1978a [1902]: 63–66; Codere 1948; Duff 1952: 123–5; Barnett 1955: 176; Jenness 1955: 91). At Musqueam, however, First Man received the mask from the “Lord Above” (Jenness 1955: 11), while a Squamish story tells of the ancestral people wearing the masks and carrying the rattles when they came down from the sky (Matthews 1955: 166). The Comox on Vancouver Island also had a tradition that the mask “dropped down from the sky” with their first ancestors (Kennedy and Bouchard 1983: 64). A fuller account of celestial origins comes from the Cowichan, a Salish group on southeastern Vancouver Island. In this tradition, as recorded early in the twentieth century by Curtis (1970a [1913]: 37–38), the ancestral beings descended from the sky wearing the *sxwaixwe* masks and carrying rattles. As the fourth being touched the ground, he caused an earthquake.

For the most part, the ethnographic sources that describe the *sxwaixwe* among the Salish are silent on any association with earthquakes. Wayne Suttles’s (1982) examination of the *sxwaixwe* mask also lacks any such reference. The Cowichan origin story related above, however, plus the close relationship with the Kwakwaka’wakw *xwexwe* and its documented ties to earthquakes, make it evident that such an association exists. Claude Lévi-Strauss (1982: 159), in his study of the meaning behind the masks, firmly links the *sxwaixwe* with earthquakes and states that the dancers had the power to invoke such events. The low rumble of the scallop shell rattles, which were a characteristic feature of the *sxwaixwe* performances, may have represented the sound of the earthquake.

The Chinook of the lower Columbia River also had what may have



Figure 5. Coast Salish (Cowichan) sxwaixwe dancer, showing the distinctive mask, costume, and rattle. Photo by E. S. Curtis, ca. 1912. National Archives of Canada C20825.

been an earthquake performance in their ceremonies. Boas (1894: 148) describes a series of animal dances, including a group of birds who sang, "Our legs are small but we make the ground shake." As the birds danced rapidly, "the house began to shake." Although the evidence is less clear here, Minor and Grant (1996: 778) see this tradition as reflecting past Native experiences with earthquakes.

Stories involving Thunderbird, which are widespread on the central Cascadian coast, may also have relevance to past seismic events. In a Quileute story recorded by Albert Reagan (1934), Thunderbird defeated and destroyed two monstrous killer whales. This violent struggle was followed by a great storm, with lightning and a crashing "thunder-noise" accompanying "a shaking, jumping up and trembling of the earth beneath, and a rolling up of the great waters," which appears to be a specific description of an earthquake and tsunami. In another Quileute story, Thunderbird caused a great flood, which covered the land during his battle with Kwatee, a culture hero among the Quileute and Makah (Reagan 1934). Thunderbird also appears in a Tillamook story from the Oregon coast, in which whales he captured and carried to his mountain home thrashed about, "violently shaking the mountain, so that it was impossible to stand upon it" (Boas 1898: 24). The impact of such events on human populations may be evident in this story from the fate of the human visitor, who was badly injured on Thunderbird's return as he was "unable to stand on his feet when the whale was shaking the mountain, and was hurt by falling trees and stones" (ibid.: 25).

Ethnographic accounts document a range of beliefs regarding earthquakes. In an early study of the Kwakwaka'wakw, Boas (1891: 613) mentions the belief that earthquakes "are produced by ghosts," which requires that people make loud noises and burn goods when such disasters threatened. Another Kwakwaka'wakw story tells how the village dogs brought about an earthquake, collapsing the houses and killing the people in revenge for mistreatment (Boas 1935: 123). Among the Quinault of the Olympic Peninsula, it was movement of the "living earth" that caused earthquakes (Olson 1936: 175). In other places, anthropomorphic beings shook the earth during their wanderings. Among the Upper Chehalis, a Washington Salish group, the individual who "shakes the whole world, for she is earthquake" is Moon's mother (Adamson 1934: 172). Near the southern end of Cascadia, among the Yurok of northern California, Earthquake and Thunder were companions who together wandered the earth and caused the land to shake (Kroeber 1976).

### Oral Traditions of Seismic Events

The mythic and ceremonial references to earthquakes seem deeply rooted in Northwest Coast cultures, presumably reflecting repeated experiences with such destructive phenomena. Some oral traditions, however, describe what may have been specific historical events. A good example of such a narrative was collected at the beginning of the twentieth century among the Cowichan on Vancouver Island. A severe and prolonged earthquake “in the days before the white man” shook apart houses and caused rockslides from the mountains (Hill-Tout 1978b [1907]: 158). One village was completely destroyed in such a slide. The shaking of the earth was so pronounced that the people could neither stand nor sit upright. The old people pounded the ground with their stone mauls, chanting a song to the spirit of the earth to stop the shaking.

In a similar tradition, the Squamish, a Salish group on the southern British Columbia mainland, tell of being camped in the coastal mountains, along what is today Rubble Creek, when an earthquake struck (Reimer 1998). Many of the people were killed and buried by a rockslide that was caused by this earthquake. Geological study of the Rubble Creek debris indicates that a major slide in the mid-nineteenth century covered the remains of an earlier slide (Moore and Mathews 1978). As historic records show no major earthquake corresponding to the timing of the nineteenth-century event, the Squamish tradition may refer to the earlier slide, which apparently occurred prior to about six hundred years ago (Evans and Savigny 1994: 269).

Slides of rocks or mud from the slopes behind the villages were constant threats to the people who occupied this stretch of the coast. The shaking of the ground during earthquakes may have triggered many such disasters. The mudslide that crushed and buried a number of houses at the Makah village of Ozette, for example, may have had such a cause. Although archaeological research at this site has focused on the house remains sealed under mud from a slide shortly before contact with Europeans, Makah oral traditions tell of recurring problems with such events (Renker and Arnold 1988: 303).

The destructive force of an earthquake followed by a tsunami is evident in the oral history of a Nuuchahnulth village on Pachena Bay, just south of Barkley Sound. The story is told in the words of the late Chief Louie Clamhouse:

This story is about the first !Anaqtl'a or “Pachena Bay” people. It is said that they were a big band at the time. . . . Their village site was

Loht'a; they of Loht'a lived there. I think they numbered over a hundred persons. They were members of the Pachena Bay tribe. . . . There is now no one left alive [from this village] due to what this land does at times. They had practically no way or time to try to save themselves. I think it was at nighttime that the land shook. . . . They were at Loh't'a; and they simply had no time to get hold of canoes, no time to get awake. They sank at once, were all drowned; not one survived. . . . It is said no one ever knew what happened. I think a big wave smashed into the beach. The Pachena Bay people were lost. . . . But they . . . who lived at Ma:lts'a:s, "House-Up-Against-Hill," the wave did not reach because they were on high ground. . . . Because of that they came out alive. They did not drift out to sea along with the others. (Arima et al. 1991: 230-1)

Major earthquakes can also be associated with sudden and dramatic changes in landforms. Destruction of Native villages by coastal subsidence has been documented archaeologically (e.g., Minor and Grant 1996) and can be detected in the oral traditions. In an 1865 manuscript, George Gibbs (in Clark 1955: 321) reported such accounts among the Chinook: "At Shoalwater [now Willapa] bay, where evidence of elevation and depression of the land, apparently at no very ancient date, are visible, the Chinooks, it is said, have traditions of earthquakes that have shaken their houses and raised the ground." The story of "how the ocean went far into the land," collected among the Coos of southern Oregon (Jacobs 1940), may also reflect coastal subsidence following earthquakes. Yurok traditions also describe such events (Kroeber 1976: 460-5). In the story of "how the prairie became ocean," Earthquake and Thunder were wandering across the land, discussing the form it should take. When they decided that the ocean should come farther inland, Earthquake told his companion, "It will be easy for me to do that, to sink this prairie." So as they traveled together, "They kept sinking the ground. The earth would quake and quake again and quake again. And the water was flowing all over" (Kroeber 1976: 463).

### Oral Traditions of Tsunamis and Great Floods

Stories involving great floods feature prominently in the mythologies of human societies around the world (Dundes 1988). Such traditions are found among Native groups all along the Cascadian coastline (Eells 1878; Gibbs, in Clark 1955: 322). Only a few of these events, however, are specifically identified as tidal waves or tsunamis. Only in the Nuuchahnulth story of how the Pachena Bay village was destroyed does an earthquake specifically

precede the tsunami. In other cases tsunamis could have been generated by earthquakes far from the Cascadia subduction zone. A recent example is the 1964 Alaskan earthquake, which produced a tsunami that caused extensive damage to homes and properties in coastal communities on western Vancouver Island (White 1966) and as far away as northern California.

In addition to the Pachena Bay tsunami, traditions of rapid surges of water, specifically described as “tidal waves,” were collected among the Coos (Jacobs 1939: 53) and Tolowa (Dubois 1932: 261) on the southern Oregon coast. Both accounts describe great loss of life. As at Pachena Bay, in the Tolowa tale an entire village was destroyed (“Everything was swept away clean”). Such an event was also recounted by a Fraser River Salish elder, who described “a big tidal wave” rushing up the Fraser Valley from the sea (Wells 1987: 191–2).

A good example of the widespread flood traditions, containing many of the common elements, was collected among the Makah in the late nineteenth century:

A long time ago, but not at a very remote period, the water of the Pacific flowed through what is now the swamp and prairie between Waatch village and Neeah Bay, making an island of Cape Flattery. The water suddenly receded, leaving Neeah Bay perfectly dry. It was four days reaching its lowest ebb, and then rose again without any waves or breakers, till it had submerged the Cape, and in fact the whole country, excepting the tops of the mountains at Clioquot. The water in its rise became very warm, and as it came up to the houses, those who had canoes put their effects into them, and floated off with the current, which set very strongly to the north. Some drifted one way, some another; and when the waters assumed their accustomed level, a portion of the tribe found themselves beyond Nootka, where their descendants now reside. . . . Many canoes came down in the trees and were destroyed, and numerous lives were lost. The water was four days regaining its accustomed level. (Swan 1870: 57)

The neighboring Quileute and Chemakum, two linguistically related but geographically isolated groups on the Olympic Peninsula, gave the same story to J. G. Swan (1870: 57), using it to explain how they had become separated. Similar versions of this tradition were recorded among the Quileute by Leo Frachtenberg (1921: 351), M. J. Andrade (1931: 201–3), and Reagan (1934: 34). Swan did not doubt that this story was based on real historical events, pointing to the beach sand that immediately underlies the turf in the Waatch prairie today, which “shows conclusively that the water of the Pacific once flowed through it.” In reviewing this tradition, Heaton

and Snively (1985: 1459) conclude that “the description of water receding from Neah Bay and then returning in a strong current is clearly suggestive of a tsunami,” although they consider the extent and duration of the flood as specified in the story to be highly exaggerated. The rapid uplift of the land in this tradition suggests crustal deformation associated with a major seismic event generated on the Cascadia subduction zone.

A very similar story was recorded in the 1860s among the Nuu-chah-nulth of Barkley Sound (Sproat 1987 [1868]: 124–5):

A most curious phenomenon of nature occurred. The tide ebbed away from the shores of the sound and left it dry, and the sea itself retreated a long distance. This continued for four days, and the Sheshaht [Tseshaht, a Nuu-chah-nulth group in central Barkley Sound] made light of the occurrence. There was one, however, Wispohahp, who, with his two brothers, did not do so. After a mature consideration of the circumstance, he thought it likely that this ebb would be succeeded by a floodtide of corresponding height and power. Accordingly, he and his brothers spent three days in the forest collecting material for a rope of cedar inner bark, which when made, was so large as to fill four boxes. There was a rock near the village, from the base of which sprang a group of bushes. Round these bushes Wispohahp fastened one end of his rope, attaching the other to his canoe . . . and thus prepared they waited for the result. After four days the tide began to flow, and crept slowly up to about halfway between the point of its furthest ebb and the houses. At this point, its pace was suddenly quickened, and it rushed up at fearful speed. The Sheshaht ran to their canoes. . . . They were all soon caught by the rising water; and while Wispohahp rode safely at anchor, the Sheshaht, unable to resist its force, drifted in their canoes to distant parts. Finally, the water covered the whole country, except Quossakt, a high mountain near the Toquaht, and Mount Arrowsmith. . . . At the end of four days, the flood tide began to abate.

Like the Neah Bay story, the initial great ebb of the water was followed by a correspondingly high return, flooding all the land but the mountaintops. In both cases the duration was four days. Other traditions, such as a Heilt-suk story of a great ebb and return of the water (Boas 1974 [1895]: 382), also describe the event as lasting four days. As Heaton and Snively (1985) note, this would be an unprecedented duration for a tsunami. The number four, however, was of ritual importance along the Northwest Coast, which may result in significant events being phrased in such intervals.

Traditions of huge floods among the Barkley Sound Nuu-chah-nulth were also recorded early in the twentieth century by Edward Sapir. In a



story from the Ucluelet people, the flood was again preceded by a great ebb of the sea, allowing the people time to make preparations. Some dug underground shelters, while others climbed to the mountaintops (Sapir n.d.: 43). In a Tseshaht narrative, the people were feasting after a successful whale hunt when the flood occurred; it was the power of the whale that kept them from drifting too far out to sea (Sapir 1919).

Numerous common features run through the flood traditions, from the central British Columbian coast to southern Oregon. As the flood waters rose, the people took to their canoes, tying themselves with strong ropes of cedar bark or twisted cedar boughs to heavy anchors or to the mountaintops. When the flood waters reached their maximum, only the mountaintops remained of the land. In addition to the Nuuchahnulth, Makah, and Quileute versions given above, such stories were recorded among the Nuxalk (McIlwraith 1948 2:502-4; Boas 1974 [1895]: 400), Heiltsuk (Olson 1955: 340), Oweekeno (Storie 1973: 59), Kwakwaka'wakw (Boas 1976 [1935]: 137-8; Curtis 1970b [1915]: 254-5; Assu and Inglis 1989: 3-5), and the various Coast Salish groups of British Columbia and Washington (Eells 1878; Gunther 1925: 119; Adamson 1934: 1-3; Clark 1953: 44; Jenness 1955: 33; Hill-Tout 1978b [1907]: 157; Wells 1970: 19, 1987: 88; Boas 1974 [1895]: 156; Kennedy and Bouchard 1983: 107; Mohs 1990: 8-12). To the south, similar stories occurred among the Tillamook (Jacobs and Jacobs 1959: 83-84), the Coos (Frachtenberg 1913: 45-49; Jacobs 1939: 58), and the Alsea (Frachtenberg 1920: 115). The Cowichan Salish laid planking across canoes to create rafts on which they piled their belongings (Hill-Tout 1978b [1907]: 157); the Salish of the Fraser River (Wells 1987: 191-2) and the Tillamook of the northern Oregon coast (Jacobs and Jacobs 1959: 83-84) also constructed rafts as the waters rose. All those who did not make it into some form of watercraft died.

In many versions of these stories, the canoes became separated and the people drifted apart, accounting for the dispersal of related groups today. In addition to the separation of the Makah and Nuuchahnulth (Swan 1870: 57) and the Quileute and Chemakum (Swan 1870: 57; Frachtenberg 1921: 351; Andrade 1931: 201-3; Reagan 1934: 34) in catastrophic floods, such events scattered the Nuxalk (McIlwraith 1948 2:502-3) and Kwakwaka'wakw (Boas 1976 [1935]: 137-8) tribes and also separated the latter from the related Haisla, Heiltsuk, and Oweekeno (Assu and Inglis 1989: 5; Storie 1973: 59). Separation of the Coast Salish into various widely scattered groups is also explained in this manner (Eells 1878: 70; Clark 1953: 44; Jenness 1955: 33; Curtis 1970a [1913]: 129). The Coos of the Oregon coast also have a tradition of population dispersal following the great flood (Frachtenberg 1913: 47-49).

Tangible reminders of these ancient events are also noted in many accounts. Fraser River Salish stories tell of the discovery of “old cedar ropes” on the tops of high mountains (Jenness 1955: 33; Wells 1970: 19, 1987: 88), and some tell of the remains of rafts (Wells 1987: 91–92). The Cowichan Salish describe a great anchor stone (Hill-Tout 1978b [1907]: 157), while the mainland Comox refer to both an anchor stone and cedar bark ropes (Kennedy and Bouchard 1983: 154) remaining on mountaintops in their territories. “Relics” of a floodtime camp were found on a mountaintop among the Nuxalk (McIlwraith 1948 2: 504). Among the Oweekeno, marks on the mountaintop where the ropes were tied can still be seen (Storie 1973: 59). Modern Nuuchahnulth informants identified a prominent rock in the intertidal zone of Barkley Sound as the “anchor” where they tied their canoes with long ropes during the flood (Arima et al. 1991: 164). Beach sand, marine shells, and the bones of marine mammals found far from the beach, often in elevated locations, have also been used as evidence of ancient floods (Gibbs, in Clark 1955: 323; Colson 1953: 47).

As coastal flooding clearly resulted from a variety of natural factors, caution must be used in attributing flood traditions to the impact of tsunamis. Some of the stories refer to continuous rain, rather than giant waves, as the source of the flooding (e.g., Gunther 1925: 119; Adamson 1934: 1; Jacobs 1939: 58; Jenness 1955: 33; Curtis 1970a [1913]: 128). Others seem more characteristic of fluvial floods, which are unrelated to seismic events. Traditions that Beaver caused the great flood have been recorded among the Clallum Salish (Gunther 1925: 119–20), the Salish around Willapa Bay (Curtis 1970a [1913]: 128–9), and the Tillamook of the northern Oregon coast (Jacobs and Jacobs 1959: 83–84). Both Woodward et al. (1990: 57) and Minor and Grant (1996: 778), however, use the Tillamook story as evidence of a past seismic event in that region. As the story lacks any clear indications that the flooding was tsunami-related, this assumption does not appear to be warranted.

A few of the oral traditions, however, do appear to reflect past experiences with tsunamis. Certainly the accounts of village destruction by huge waves among the Nuuchahnulth and Tolowa seem to describe the disastrous consequences of major seismic events. Traditions involving a major retreat of the sea, followed by a rapid return to unprecedented heights, may also be descriptions of ancient tsunamis. Such traditions have been recorded among the Nuuchahnulth (Sapir n.d.: 43; Sproat 1987 [1868]: 124–5), Makah (Swan 1870: 57), Quileute (Reagan 1934: 33–34), and the Pentlatch Salish on eastern Vancouver Island (Boas 1974 [1895]: 156). Although such narratives have become embellished with details that preclude direct acceptance as historic accounts, they seem to stem from actual

events. Clague (1995) has attributed several of the better-known Nuu-chah-nulth and Makah flood traditions to tsunamis generated by great earthquakes, a conclusion with which we concur. Although the widespread flood stories almost certainly stem from a variety of factors, the repeated occurrence of major seismic events evident in the geological record suggests that at least some of the oral traditions reflect the impact of tsunamis.

### Discussion

Traditions of severe earth shaking, rapid subsidence or uplift of coastal margins, earthquake-induced landslides, and the impact of huge tsunamis all indicate past experiences with major seismic events. These would have ranged from relatively minor tremors resulting from plate rupture to periodic great earthquakes generated off the Cascadia subduction zone. Such events are also evident in the geological and archaeological records. These must have had severe impacts on Native coastal communities, involving destruction of entire villages and considerable loss of life.

The oral traditions provided one vehicle for indigenous people to organize perceptions and experiences with these unpredictable and uncontrollable forces of nature. Another was the incorporation of earthquake figures into their ritual performances and beliefs. As such, these must be considered primarily as general awareness of these periodic destructive forces, rather than as historic accounts of specific events. Another level of meaning may be involved, as stories often were used to reinforce moral codes; for example, the “tidal waves” that destroyed villages among the Tolowa and Coos followed breaches of accepted behavior (Dubois 1932: 261; Jacobs 1939: 53) and an earthquake among the Kwakwaka’wakw was a result of mistreating the village dogs (Boas 1935: 122–40). We argue, however, that some oral traditions, such as the Nuu-chah-nulth account of the disaster at Pachena Bay, are so specific in their details that they can be interpreted as historical narratives of particular catastrophic seismic events.

A major problem, however, is one of chronology. Mythic traditions “float in time,” frustrating most Western academics, who require a precisely dated geological sequence. In addition, multiple past experiences with seismic events may have become conflated into a single mythic tradition. Some possible chronological clues, however, can be gleaned from the narratives, which contain suggestions of different ages.

Some of the historical narratives appear to describe relatively recent events. Gibbs, writing in 1865, described Chinook traditions of an earthquake “apparently at no very ancient date” (Clark 1955: 321). In Swan’s (1870: 57) account, the great flood that affected the Makah and Qui-

leute took place “a long time ago but not at a very remote period.” In a similar nineteenth-century account, a Reverend Eells (1878: 70) reports a Clallum Salish myth of a great flood “not very long ago, perhaps not more than three or four generations.” An earthquake that destroyed a Kwakwaka’wakw village was said to have occurred seven generations prior to the story’s collection around 1930 (Boas 1935: 122).

Although assigning any specific date to these accounts would be speculative, they are consistent with the most recent of the great earthquakes on the Cascadia subduction zone, which occurred in A.D. 1700. Tsunami records kept in Japan allow an accurate estimate of the date and time for this event, indicating that the earthquake that generated the tsunami occurred late in the evening (Satake et al. 1996). The fact that both the Nuuchah-nulth account of the destruction of the Pachena Bay village (Arima et al. 1991: 231) and the Cowichan story of the village destroyed by an earthquake and rockslide (Hill-Tout 1978b [1907]: 158) specifically state that the disaster happened at night strengthens the suggestion that this seismic event was responsible. Many of the traditions of widespread destruction may refer to the catastrophic A.D. 1700 event. Archaeology provides further support, as several Native villages on the Oregon and southern Washington coasts are known to have been destroyed by an earthquake and tsunami that occurred at that time (Woodward et al. 1990; Cole et al. 1996; Minor and Grant 1996).

Native beliefs and ceremonies involving earthquakes, however, seem deep-seated, suggesting that familiarity with this phenomenon extends far back in time. In addition, some of the narrative accounts are set in mythic times, possibly indicating considerable age. Gibbs (in Clark 1955: 322) notes that the widespread traditions of a major flood are “connected with the extinction of a former . . . race, not of the present.” Similarly, Boas (1976 [1935]: 137) notes the Kwakwaka’wakw tradition of a great deluge, which took place “before the ancestors of the tribes appeared.” Such traditions may reflect repeated experiences over a considerable period of time.

As aboriginal peoples used their cultural landscapes to maintain their history and sense of identity, the associated oral traditions may have great temporal persistence. Early in the twentieth century, Heiltsuk informants told Boas (1970b [1916]: 883), “In the beginning there was nothing but water and ice and a narrow strip of shore-line,” which is consistent with a people’s initial arrival in a late Pleistocene coastal environment. A Fraser River Salish elder told Gordon Mohs (1990: 9–10) of a great flood that began at the salt water and extended up the Fraser Valley “thousands of years back.” The height of the water indicated in this story corresponds with known sea levels for the saltwater arm that covered the Fraser Valley

during the Pleistocene-Holocene transition (Mohs 1990: 10–11). Another elder told of his ancestors being present in the Fraser Valley at a time “when the world was bare and there was no trees” (ibid.: 12). Similarly, the Gitksan, along the Skeena River in northern British Columbia, have traditions of large glacial lakes, which filled the valleys before trees grew on the land (Harris 1997).

Recent archaeological research offers support for the antiquity of such traditions. At Tsinni Tsinni, far up the Bella Coola Valley in Nuxalk territory, flaked stone tools have been found on a terrace far above the present river level (Hobler 1995). Although this site is undated, saltwater diatoms from the lower cultural strata indicate that the geological deposits were laid down during a marine transgression extending up the Bella Coola Valley at the end of the Pleistocene. Nuxalk oral traditions describe how the ocean extended far up the valleys (Boas 1975 [1898]: 53; McIlwraith 1948 2: 502), in one account warning of dangerous tidal currents in an area of the Bella Coola Valley that is now many miles inland (Hobler 1995: 25). Similarly, archaeological and geological research on the southern Queen Charlotte islands documents rapidly rising sea levels at the end of the Pleistocene, reducing a formerly extensive land mass to the cluster of small rugged islands that exists today, consistent with Haida traditions of rapidly rising seas and people walking across what is today open ocean (Fedje et al. 1996; Josenhans et al. 1997).

Oral traditions tell of major geological upheavals throughout the Holocene. These include volcanic eruptions and lava flows, earthquakes and massive rockslides. A Gitksan oral tradition, read into testimony in the important *Delgamuukw* court case, involves a giant grizzly bear that roared down the valley, uprooting all the trees in its path before disappearing into Seeley Lake (McEachern 1991: 62; Gottesfeld et al. 1991: 1591). The Gitksan, as plaintiffs in the court case, maintain that this account is a historical description of a great landslide that ran into Seeley Lake in the distant past, demonstrating that they have been in the area since at least that time. Geological and paleobotanical analyses confirmed the past existence of a massive landslide and dated the event to about thirty-five hundred years ago (Gottesfeld et al. 1991). Although it is outside the main focus of this essay, this account provides one of the best-documented correlations between aboriginal oral traditions and geological evidence in British Columbia.

The antiquity and breadth of knowledge inherent in the oral traditions are gaining increasing recognition and respect from researchers in a variety of academic fields. Some modern scholars (e.g., Scott 1996; Anyon et al. 1997) reject any separation of “science” and “myth,” stressing that Native

traditional knowledge offers a valid approach to understanding past and present phenomena in their environments. Native writers and commentators also insist that their oral traditions be taken seriously as legitimate perspectives on history. The 1997 Supreme Court of Canada ruling in the *Delgamuukw* case, which required judges to consider oral histories on an equal footing with more traditional types of evidence, provides legal recognition of the value of such accounts. The narratives discussed here provide important independent sources of information on past geological events that affected human societies all along the Cascadian coastline. Along with the growing body of data from geological and archaeological research, Native oral traditions demonstrate the impact of recurring seismic events on this area's human population throughout the Holocene.

### Acknowledgments

We thank Rudy Reimer, archaeologist and Squamish band member, for information on the Squamish tradition of an earthquake and rockslide. We also thank Gordon Mohs for providing an unpublished manuscript on his interviews with Fraser River Salish elders. Ruth Ludwin (University of Washington Geophysics Program) directed us to the references involving the Thunderbird among the Quileute and Tillamook. Several anonymous reviewers offered helpful comments on an earlier draft.

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