Environment and Archaeology of the Lower Columbia

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ENVIRONMENT AND ARCHAEOLOGY OF THE LOWER COLUMBIA

Elizabeth A. Sobel, Kenneth M. Ames, and Robert J. Losey

The Columbia is the great river of the American West. The interplay of river, ocean, mountains, and climate produced a rich and productive but dynamic environment, and people have lived in and adjusted to this environment for at least 12,000 years. The fourth largest river in North America, the Columbia is exceeded in water volume only by the Mississippi, St. Lawrence, and Mackenzie Rivers. Its source is in British Columbia, on the west slope of the Canadian Rockies. Between there and where it enters the Pacific Ocean, the Columbia flows 1,268 miles (2,040 kilometers), winds through four mountain ranges, descends 2,657 feet (810 meters), drains 257,993 square miles (668,200 square kilometers), generates more hydroelectric power than any other waterway in North America, and historically has supported more salmon than just about any other North American river (Roberge 1985:11–16; Schwantes 1989:12).

The Lower Columbia generally refers to the river’s final 196-mile (315-kilometer) run from the western edge of the Columbia Plateau to the Pacific Ocean. The Lower Columbia begins at The Dalles, a constricted portion of the river channel also called Five Mile Rapids or the Long Narrows. From there to the Pacific, the river flows through four distinct physiographic provinces—Cascade Range, Willamette-Puget Lowland, Coastal Uplands, and Outer Coast.

Below The Dalles, the Columbia cuts 75 miles (120 kilometers) westward through the Cascade Mountains, which extend north from California though Oregon and Washington to British Columbia. At 14,436 feet (4,400 meters), Mount Rainier is the highest peak and is visible from the Columbia River on
a clear day; other high stratovolcanoes visible from the Lower Columbia are Mount Adams, Mount St. Helens, Mount Hood, and Mount Jefferson. Lower peaks in the Cascade Range are generally 3,000–6,500 feet (914–1,981 meters) high. Rainfall is heavy on the Cascades' western slopes, averaging as much as 98 inches (250 centimeters) annually. Dense forests are dominated by Douglas-fir (Pseudotsuga menziesii), western red cedar (Thuja plicata), and western hemlock (Tsuga heterophylla) (Avery 1961:23; Orr et al. 1992:141–48; Schwantes 1989:7–14).

The Columbia River Gorge, where the river passes through the Cascade Range, was created some two million years ago and is defined by steep basaltic walls up to 3,900 feet (1,200 meters) high. The Gorge formerly contained a waterfall and a series of rapids that early Euro-American travelers called the Cascade Rapids, now submerged beneath Bonneville Dam. Tides affect Columbia River water levels as far east as Bonneville Dam, 186 miles (300 kilometers) from the sea. As the only near-sea-level passage through the Cascade Mountains, the Gorge is extremely windy and wet and occasionally very cold, particularly during winter periods when winds push into the Gorge from the east. Moist coastal air moves eastward through the Gorge and upward, over the mountains, generating roughly 71 inches (180 centimeters) of precipitation annually (Orr et al. 1992:153–55; USGS 2008).

After leaving the Gorge, the Columbia takes its 53-mile (85-kilometer) course through the Portland Basin, called the Wapato Valley and Columbia Valley by Meriwether Lewis and William Clark. This lowland—which contains the cities of Portland and Gresham, Oregon, and Vancouver, Washington—is part of the larger Puget-Willamette Lowland, an alluvial plain some 137 miles (220 kilometers) in length and 18 miles (30 kilometers) in average width. The lowland runs south from Puget Sound to southwest Oregon, flanked on the east by the Cascade Range and on the west by the Coast Range. The Puget-Willamette Lowland is humid with a long growing season, high biodiversity, and high biomass. Historically, this biologically rich landscape encompassed multiple habitats, including wetlands, riparian forests, oak woodland savannas, and meadows. The adjoining foothills bore coniferous forest. The Columbia's course through the Wapato Valley is broad and slow, weaving through swampy bottomlands, winding among islands, and diverging into numerous sloughs (Ames and Sobel 2009:2; Hajda 1984:51–55; Orr et al. 1992:203–4; Schwantes 1989:7–14).

Departing the Wapato Valley, the river flows 62 miles (100 kilometers) through the Coast Range. In Oregon, the crest of the Coast Range averages
1,500 feet (460 meters) in elevation, and some peaks rise more than 4,000 feet (1,200 meters); in Washington, the Willapa Hills have rounded peaks generally less than 200 feet (60 meters) in elevation. The coastal mountains have mild winters, cool summers, and thick vegetation dominated by Douglas-fir, red cedar, and western hemlock (Livingston 1969:1–3; Orr et al. 1992:167–80; Schwantes 1989:7–14). As the Columbia River flows through the Coast Range, it enters its estuary and becomes exceptionally broad, flowing through flat, sandy plains and reaching its maximum width of 9 miles (15 kilometers) about 12 miles (20 kilometers) before reaching the Pacific Ocean.

The river mouth is almost 4 miles (6 kilometers) wide between Cape Adams on the south and Cape Disappointment on the north. The Columbia’s broad entrance, where heavy fogs are typical, prevented European and US explorers from detecting the mouth of the river until 1792, 17 years after the first maritime explorations of the Pacific Northwest; the expeditions that sailed by the river’s mouth during those years thought it was simply a bay (Hajda 1984:35–46; Ruby and Brown 1976:24–58). The Columbia’s mouth is not only large but also exceedingly rough, and entry into the river is treacherous. Since European arrival in 1792, hundreds of individuals have died and some two thousand vessels have sunk trying to cross the river mouth. It is the third most dangerous river entrance on earth and the only US entrance requiring river bar pilots (Dietrich 1995:97).

Most of these environmental features were in place well before European contact. The Columbia Plateau is 17 million years old, and the Cascade Mountains are 2 million years old. Over the past 20 thousand years, the Lower Columbia River area was significantly modified by geological processes, including glacial activity during the Late Pleistocene or Ice Age. Between 19 and 12.5 thousand years ago, glacial Lake Missoula in eastern Montana repeatedly breached ice dams, generating a series of catastrophic floods across eastern Washington and the Lower Columbia River Basin. Carrying ice, huge boulders, and tons of debris, the so-called Missoula Floods scoured eastern Washington and then entered the Columbia River about 81 miles (130 kilometers) east of The Dalles. The floods steepened the walls of the Columbia River Gorge and deposited huge volumes of gravel and other sediments in the Wapato Valley (Orr et al. 1992:209–14).

The most recent large-scale geological events affecting the Lower Columbia are the Cascade Landslides in the Gorge. The latest of these, the Bonneville Landslide, occurred between AD 1400 and AD 1500, and its debris formed a natural dam that temporarily blocked the Columbia. The river
<table>
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<th>Years AD/BC</th>
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**Figure 1.1.** Archaeological cultural phases for the Greater Lower Columbia River

Massive earthquakes have affected the Columbia every 500 years, on average, for at least 3,500 years, the last in 1700 (Jacoby et al. 1997; Losey 2002; Satake et al. 1996; Yamaguchi et al. 1997). Each earthquake triggered a tsunami eventually breached or eroded the dam, possibly causing a significant flood event downstream. Landslide debris on the floor of the river created The Cascades (O’Conner 2004; Pringle et al. 2002; Schuster and Pringle 2002; Bourdeau 2001).
and caused long stretches of the Pacific Coast to abruptly sink below sea level and undergo major flooding (Atwater 1987, 1992; Atwater and Yamaguchi 1991; Darienzo and Peterson 1990, 1995; Shennan et al. 1996, 1998), reconfiguring shorelines throughout the Lower Columbia area (Minor and Grant 1996; Peterson et al. 2000).

The climate and biota of the Lower Columbia also have changed over time. Paleoecological data record these changes during the last 11 thousand years, when humans first entered the region. The most relevant data are from three sites, at Taylor Lake and Lost Lake on the northern Oregon Coast and at Battle Ground Lake in Washington, southwest of Mount St. Helens (Long et al. 2007). During the Early Holocene (from about 10,000 to 7,000 BP), the climate was warmer and drier than it is today, especially during summers. West of the Coast Range, forests were dominated by Douglas-fir, as they are today, but Early Holocene forests were more open and contained more fire-tolerant species. East of the Coast Range, the Wapato Valley was characterized by open oak (Quercus) savanna (Walsh et al. 2008).

In the Middle Holocene, after about 6700 BP, the climate became cooler,
with more effective moisture. West of the Coast Range, a relatively modern forest took over, with Douglas-fir still dominating but species such as Sitka spruce (*Picea sitchensis*), western hemlock, and western red cedar present. East of the Coast Range, the oak savanna declined, replaced at Battle Ground Lake by Douglas-fir and western red cedar (Walsh et al. 2008). Oak savanna did not entirely disappear, however, and was common in the Willamette Valley during the 18th and 19th centuries, partly because of human impacts on the landscape (Boyd 1999a).

In the Late Holocene, over the past two thousand years, climactic changes led to a warmer, dry period from about AD 850 to AD 1250 (the Medieval Climatic Anomaly) and the subsequent cooler wetter period from AD 1450 to AD 1850 (the Little Ice Age). These shifts affected local vegetation and fire regimes (Long et al. 2007; Walsh et al. 2008), but impacts on humans in the region are less clear.

**CULTURE**

*Earliest Occupants (before 11,500 BC)*

There is no archaeological evidence on or near the Lower Columbia River that tells us about the region’s earliest people. We know that humans were present in the Americas by 11,500 BC (Goebel et al. 2008), so we assume they also were present along the Columbia River by then. There is controversial evidence for an earlier human presence in the Americas—for example, remains from the Monte Verde site in southern Chile that may date to as early as 12,500 BC (Dillehay 1997). In 2008, human feces dating to about 12,300 BC were found at the Paisley Cave site in central Oregon, fairly close to the Columbia River (Gilbert et al. 2008).

Biological evidence, including modern and ancient DNA, shows that modern Native Americans descend from ancient Asian populations that migrated into the Americas. These people probably traveled from Siberia to Alaska by way of Beringia, which stretches between Alaska and Siberia and is now the floor of the Bering Sea. Beringia is often called a land bridge, but it may have been as much as 1,118 miles (1,800 kilometers) wide and included interior Siberia and Alaska. Early migrants may have walked across Beringia into Alaska where, until perhaps 14 thousand years ago, glaciers blocked their way southward into the rest of North America. Alternatively, they may have traveled by boat along the southern coast of Beringia, in which case their way southward along the North American coastline would have been blocked by


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glaciers until perhaps 16 thousand years ago. The coastal migration hypothesis, then, allows for human arrival in the Americas some one thousand to two thousand years earlier than the inland migration hypothesis (Ames and Maschner 1999; Goebel et al. 2008; Roosevelt 2000; Roosevelt et al. 1996; Stone 2003). If the first Americans did move southward along the North American coastline, then the Columbia River was the first available route into the continental interior.

Paleoindian Period (11,500 BC–10,500 BC)

The Paleoindian period is the earliest established period of human habitation in the Americas. The only widespread and well-documented early Paleoindian material culture in North America is the Clovis complex, best known for its Clovis points, which probably functioned as knives and spear tips. Archaeologists typically date Clovis sites to the period between 11,500 and 10,800 BC (Goebel et al. 2008), but the Clovis complex may date to a briefer span of fewer than 400 years, between 11,200 and 10,800 BC (Waters and Stafford 2007). Archaeologists have interpreted Clovis sites as evidence of a highly mobile hunting-gathering people with a subsistence economy centered on megafauna (very large mammals), but recent analyses indicate that at least some peoples in that period did not focus on megafauna and had more sedentary land-use patterns (Collins 2007:59–87; Goebel et al. 2008; Kornfeld 2007; Byers and Ugan 2005; Cannon and Meltzer 2004). Clearly, Paleoindian economies and societies were more diverse than researchers once thought.

The Pacific Northwest has yielded only a scattering of Paleoindian sites, all of them Clovis sites. Along the Lower Columbia River and throughout Washington and Oregon, Clovis sites include mainly flaked stone artifacts (Ames and Maschner 1999:65–66; Croes et al. 2007; Matson and Coupland 1995:66–67; Pettigrew 1990:518–21). All known Clovis sites in the Columbia River region were found on the ground surface or in disturbed subsurface contexts, with one exception: an undisturbed cache of Clovis artifacts from the East Wenatchee site (also known as the Richey-Roberts site) in Washington (Ames and Maschner 1999:65–66; Gramly 1993; Matson and Coupland 1995:66–67). The cache contained some of the largest known Clovis points and a number of bone rods that may have had ceremonial significance (Ames et al. 1998:103). The lack of sites suggests that the region was thinly inhabited during the Paleoindian period, the inhabitants generally did not use Clovis technologies, or both.
Archaic Period (10,500–4,400 BC)

The low density of known Early Archaic (10,500–7,000 BC) sites in the Pacific Northwest and the near absence of storage features and house remains imply that people lived in small, mobile groups and built lightweight houses. Early Archaic remains from the Northwest interior have been assigned to the Windust phase, during which people likely preferred wetlands and used resources that included bison, elk, deer, antelope, rabbits, and fish. Windust points—stemmed, lanceolate flaked stone tools—probably served as spear points, atlatl dart points, or knives. Although no plant remains have been recovered, we assume that Early Archaic peoples used plants as food and raw materials (Ames et al. 1998:103–8). Early Archaic remains are uncommon on the Northwest Coast. Known coastal sites indicate an economy that involved a mix of deep-sea resources, such as halibut; wetland (intertidal, estuary, and river) resources, including shellfish, salmon, flounder, eulachon, seal, sea lion, and beaver; and terrestrial resources, including elk and deer.

The Lower Columbia River area contains only one sizable Early Archaic deposit, dating from about 7,300 BC to 6,000 BC (Butler 1993; Butler and O’Conner 2004). The Windust phase component at the Five Mile Rapids site is located beside an eddy at the upstream end of the Columbia River Gorge, an excellent place for harvesting salmon. In the 1950s, University of Oregon archaeologists under the direction of Luther Cressman excavated some 150 to 200 thousand salmon vertebrae and a range of artifacts, but no apparent fishing gear, from the Windust component (Cressman et al. 1960). In the 1990s, Butler (1993; Butler and O’Conner 2004) re-excavated portions of the site and confirmed that the abundant salmon bones were of cultural—not natural—origin. By the end of the Early Archaic period along the Lower Columbia River, therefore, subsistence economics included riverine resources and, in some cases, may have targeted salmon. In the Lower Columbia River Valley, Early Archaic remains are limited to a number of Windust points found as far downriver as the Wapato Valley (Portland Basin) and possibly some Windust-like points found near the mouth of the Columbia (Ames and Maschner 1999:125; Minor 1984).

Much like their predecessors, Late Archaic (7,000 BC–4,400 BC) peoples across the Northwest lived in small, mobile groups and used a variety of terrestrial, wetland, and marine resources (Ames and Maschner 1999:23–27). The sites in the area are scattered through the Cascade Mountains and foothills, on plateaus in the Wapato Valley, and on the Columbia River flood-

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plain. Most appear to represent short-term habitations or “camps.” Flaked stone tools from these sites reflect a shift from the stemmed, lanceolate points of the preceding period to smaller leaf-shaped points, often called Cascade points. Late Archaic remains also include large leaf-shaped bifaces, such as those found near the mouth of the Columbia at the Youngs River Complex.

Pacific Period (4400 BC–AD 1750)

Pacific Northwest Native cultures developed into their historic form during the Pacific period. Significant changes include the appearance of a subsistence economy based on storing large volumes of food; increased population density, sedentism, and household and community size; escalated warfare; development of canoe-based land-use patterns; more institutionalized social status differences; management of natural resources and landscapes; and a suite of changes relating to European and Euro-American influence.

The few Early Pacific sites (4400 BC–1800 BC) along the Lower Columbia are located mainly in the uplands overlooking the floodplain. The dearth of sites is likely due to the region’s dynamic geological history, which probably destroyed or submerged many sites, as well as the relative paucity of professional archaeology in the area. On the Northwest Coast generally, Early Pacific remains are more abundant and reflect more intensive subsistence strategies than in preceding periods. This pattern is apparent in areas bordering the Lower Columbia, where people exploited tubers in the Willamette Valley and shellfish on the Oregon Coast (Ames and Maschner 1999:89, 107–8, 137–39; Minor 1991).

Along the Lower Columbia River, sites from the Middle Pacific (1800 BC–AD 200/500) are more abundant than sites from any preceding period. Around the river’s mouth and the adjacent coastline, Middle Pacific remains are assigned to the Sea Island phase (Minor 1983), which includes the oldest known shell midden remains (Connolly 1992; Minor 1983, fig. 4) and the oldest known plankhouse remains (800 BC–AD 300) in the region, at the Palmrose site in Seaside, Oregon. Residents at the Palmrose site likely used a range of saltwater, freshwater, and terrestrial habitats in a pattern typical of historic Northwest Coast economies. Palmrose also contains antler objects with carvings resembling designs on later Columbia River artifacts, evidence of the development of the Chinookan Art Style (Ames and Maschner 1999:159, 237; Connolly 1992:97–102; Matson and Coupland 1995:228–29; see also ch. 10 in this volume).
MAP 1.2. Archaeological sites on the Lower Columbia River

In the Wapato Valley, Middle Pacific remains are assigned to the Merry­bell phase (Pettigrew 1981). Here, the oldest known Middle Pacific sites postdate 600 BC, and most postdate AD 1. Multiple Middle Pacific sites in the Wapato Valley contain remains of houses; the most fully excavated is the Kersting site, which contains several rectangular structures dating to about AD 1 (Jermann et al. 1975). Middle Pacific sites in the Wapato Valley generally lack preserved plant and animal remains, but we can infer that the inhabitants focused on wetland and riverine environments (Pettigrew 1981, 1990).

The Late Pacific (AD 200/400–AD 1750) has been more fully studied than other periods of Lower Columbia prehistory. Traditional Chinookan culture was firmly established by the early centuries of the Late Pacific period. Late Pacific sites in the Wapato Valley and Columbia Gorge are included in the Multnomah phase, while those along the mouth of the Columbia River and the adjacent coastline are included in the Ilwaco phase. Late Pacific sites contain smaller flaked stone points, widely interpreted as arrow points (Pettigrew 1990). The prevalence of these small points and the rarity of larger points indicate the use of bow-and-arrow and the abandonment of atlatl technology.

Large-scale excavations of Late Pacific sites have focused on residential sites in the Wapato Valley and Columbia River Gorge (e.g., Ames et al. 1999) and to a lesser extent along Willapa Bay (Kidd 1967; Shaw 1977). Similarities among these sites suggest that by the Late Pacific material culture had become relatively uniform throughout the Lower Columbia region.

Key to map 1.2:
1. 35CLT13 (Avenue Q) 14. 45CL21 (Kersting) 26. 35MU119
2. 35CLT47 (Palmore) 15. 35MU01 (Cholick) 27. 45CL06 (Fisher’s Landing)
3. 45PC35 (Fishing Rocks) 16. 35MU06 (Lyons) 28. 35MU57 (Broken Tops)
4. 45PC05 (Station Camp) 17. 35MU09 (Merrybell) 29. 35MU29 (Spada)
5. Fort Astoria Village 18. 35MU04 (Sunken Village) 30. 35MU32 (Spada)
6. 35CLT34 (Indian Point) 19. 35MU112 (Wild Bee) 31. 45CL406
7. 35CLT33 (Eddy’s Point) 20. 35MU105 (Columbia Slough) 32. 45SA12
8. 45CL01 (Cathlapotle) 21. 35MU44 (St. Johns Portage) 33. 45SA13
9. 45CL04 (Wapato Portage) 22. 35MU46 (St. Johns Complex) 34. 45SA19
10. 35CO03 (Cathlacump) 23. 35MU117 35. 45SA05
11. 35CO05 (Meier) 24. 45CL31 (Old Channel Complex) 36. 45SA11
12. 35CO07 (Pumphouse) 37. 35WS04 (Five Mile Rapids)
13. 35CO34 (Ede) 25. Fort Vancouver
Modern Period (AD 1750–Present)

Before AD 1792, Western and Asian influences reached the Lower Columbia in the form of ship wreckage, horses, disease, and European manufactures (Hajda 1984; Ruby and Brown 1976; see ch. 5 in this volume). Direct contact between Europeans and Lower Columbia Natives began in 1792 with visits by maritime fur traders and occasional exploring parties, including the Lewis and Clark Expedition in 1805–6. The continental fur trade in the Lower Columbia began in 1811 with the establishment of Fort Astoria at the mouth of the river and expanded in 1824 with the construction upriver of Fort Vancouver.

Many European trade items—glass beads and metal bracelets, for example—operated as prestige goods within the Native sphere (Ames 1995; Sobel 2004). European goods were significant for their mechanical or utilitarian functions, and items such as European gunflints and flaked glass projectile points have been recovered from Native trash middens (Ames et al. 2011; Wilson et al. 2009). Projectile points made of glass, cut iron, chipped porcelain, and melted lead are examples of indigenous technological innovation using European trade goods (Ames et al. 2011; Banach 2002; Ozburn 2008; Sobel 2004).

Four extensively excavated contact-era sites—Middle Village at the mouth of the Columbia, Meier and Cathlapotle in the Wapato Valley, and Clahclelah at The Cascades—contain evidence from the fur-trade era. Cathlapotle and Clahclelah show substantial differences between residential units in their access to European manufactures (Sobel 2004). Meier residents were minimally involved in trade with Europeans, and Middle Village residents were heavily involved. Cathlapotle residents fell in between (Ames et al. 2011). Middle Village may have been a Native trade depot, as the deposits are rich in a range of trade goods that is absent or rare upstream and there is a lack of evidence for many domestic and food-getting activities (Wilson et al. 2009). Despite participation in the fur-trade economy, Native material culture and technology in the region remained quite stable, with a continued emphasis on plant and animal products and stone raw materials until the 1840s or later (Ames et al. 2011; Sobel 2004).

As they had during the Pacific period, multifamily households operated as basic social, political, economic, and demographic units. Competition among households for control over trade with Europeans and household production of goods sought by fur traders likely increased, as did the wealth
and prestige stemming from that control (Sobel 2004, 2006, 2012). At Cathlapotle, for example, postcontact deposits contain a markedly high quantity of scrapers, probably used to process elk hides sought by fur traders visiting the Lower Columbia during the Early Modern period (Ames et al. 2011; Smith 2006). Several archaeological studies have examined the effects of Euro-Americans on Native subsistence. Analyses of Cathlapotle mammalian faunal remains show stability between precontact and postcontact deposits in mammal consumption (Harpole 2006; Zehr 2002), though Butler’s (2000b) study of faunal remains from a suite of Columbia River sites indicates a postcontact increase in Native consumption of mammals and large-bodied fish. This shift could reflect Native depopulation due to epidemics of introduced diseases and a consequent decrease in competition for preferred animal foods. Studies at Meier and Cathlapotle detected possible postcontact shifts in household organization, suggested by changes in the sizes and locations of hearths (Gardner-O’Kearney 2010). The bone and antler tool assemblages from these sites also yielded evidence of technological responses to contact (Fuld 2011). Archaeological and ethnohistoric data have been used to argue that some Kathlamets persisted as a local group in the Columbia River estuary into the 1850s (Minor and Burgess 2009).

CURRENT ARCHAEOLOGICAL ISSUES

A fundamental problem in the archaeology of the Lower Columbia River is that we do not yet have a strong grasp of the times and places of major cultural and social developments. Archaeological coverage of the Lower Columbia is geographically sparse and temporally spotty. While the earliest radiocarbon date for the region dates to almost 6,600 years ago, only 28 dates (8.5 percent) of some 330 fall between 6,600 and 2,500 years ago; the remainder fall between 2,500 years ago and the present. As a result, we are especially ignorant of human habitation in the Lower Columbia prior to 2,500 years ago. Most professional archaeology in the Lower Columbia complies with cultural resource preservation laws, which is restricted mainly to locations affected by federal projects. Compliance archaeology is necessarily limited, since it was primarily designed to ascertain how proposed development projects would affect archaeological sites. Answering archaeological research questions is secondary, and compliance projects rarely involve long-term or large-scale excavations. Gaps in our knowledge of Columbia River culture
also result from the deterioration of archaeological sites before they are systematically studied.

The region's dynamic geological history also creates archaeological gaps. The sea-level rise from about 16 to 2 thousand years ago affected environments at the mouth of the Columbia and farther inland (Losey 2003); in Portland, the Columbia River rose 100–230 feet (Peterson et al. 2011). The resulting changes in water level and sedimentation likely inundated early human habitation sites, eroded some, and buried others so deep that archaeologists have not found them (Ames and Maschner 1999:51; Peterson et al. 2011; Pettigrew 1990:539). Melting Pleistocene glaciers also caused the massive Missoula Floods, which between 19,000 and 12,500 years ago would have pulverized, eroded, and buried sites along the Columbia River (Waitt 1980). During the Holocene, multiple earthquakes and their attendant tsunamis caused subsidence of some shoreline areas on the coast, burying the archaeological record and submerging it below sea level, where it is difficult to detect and study (Losey 2007; Minor and Grant 1996). At least some of these quakes caused landslides in the Columbia River Gorge (Pettigrew 1990:523–25).

An additional problem limiting our study of Lower Columbia peoples during the postcontact period is that traditional views of this time period privilege historical and ethnographic records over archaeological data. The historical and ethnographic records were produced mainly by Europeans, and so reflect European colonial attitudes. Researchers (e.g., Sobel 2012) have just begun to use archaeological data as an independent, empirical line of evidence to identify and correct these Eurocentric biases.

The resulting gaps in our knowledge leave us actively working to answer a number of major questions:

**What was the nature of the earliest human occupation in the region?** Evidence from other parts of North America suggests that early populations throughout the continent were small, thinly scattered, and highly mobile. In the Lower Columbia area, when did human habitation begin, and how did it compare to early human occupations elsewhere in the Americas?

**When and why did recent economic, social, and political patterns develop?** We think these patterns developed during the Middle Pacific period. To more conclusively answer this question, we must answer related questions: When and why did Native populations achieve their historic size and density? When and why did the storage and processing of large volumes of food, including salmon, become economic and social mainstays? When and why did people begin organizing themselves into large corporate households? How did
Lower Columbia peoples become the nexus of a large-scale exchange system? How did their technologies evolve over time? How does all this relate to the development of economic, social, and political systems?

What role did Lower Columbia River people play in the broader cultural history of the Pacific Northwest and western North America over past millennia? The Columbia River was a major trade and travel route, and its residents interacted extensively with other groups. How did the relationship of the Lower Columbia to the broader region unfold?

How have European and Euro-American contact and colonization affected indigenous culture and society? European and Euro-American colonization was relatively early and intense in the Lower Columbia compared to surrounding regions. How did this colonization influence Native society, economy, politics, and religion? How and why did Native peoples maintain practices and beliefs in the wake of colonization? What are the ongoing consequences of early white-Native interaction?

Human Relationships with the Natural Environment

Environmental conditions posed challenges to Native people of the Lower Columbia. Some environmental changes seem to have constrained human opportunities, whereas others expanded them. Rising sea levels created productive estuaries, small landslides formed rapids and falls that became prime fishing locations, and climatic shifts created forests rich in culturally important plant species. Native peoples did not live in an untouched wilderness but modified their environments in intentional and unintentional ways.

The intentional modifications to natural environments included burning areas to increase yields and improve game forage (e.g., Boyd 1999a). When Euro-Americans arrived in the Lower Columbia region, the dominant habitat of the Willamette and Wapato Valleys was oak grassland, a parklike environment that later attracted thousands of Oregon Trail pioneers. Scholars debate the origin and extent of Native burning. Research on contact-era anthropogenic burning carries an implicit assumption that deliberate burning began several millennia ago and had major impacts (e.g., Boyd 1999a), but others suggest that it began recently and had little effect on the ecosystem (e.g., Whitloock and Knox 2002). A more nuanced model of Native burning based on pollen records indicates that anthropogenic burning may have begun in the Middle Holocene and that it was localized, which means it could appear in some paleoenvironmental records but not in others (Walsh 2008).
The impact of harvesting on animal and fish stocks is also controversial. Some researchers suggest that Native peoples overharvested large animals and as a result had to spend more time and effort finding, harvesting, and processing smaller fish and game (Butler 2000a; Martin and Szuter 1999a; Laliberte and Ripple 2003; but see Lyman and Wolverton 2002). In this scenario, people’s efforts to feed themselves became less efficient over time, particularly in areas with large human populations. But the most comprehensive study to date of archaeological fish and animal remains from the last several thousand years in the Columbia River area found no evidence of over-exploitation (Butler and Campbell 2004).

Native responses to changing sea levels and coastal geomorphology have been examined at several sites in the Seaside area, on the coast just south of the Columbia River. At the Palmrose and Avenue Q sites, a shellfish-rich bay was present 3,500 years ago (Connolly 1992, 1995; Losey in prep.; Losey and Power 2005); but as sea level rise slowed four to five thousand years ago, deposition outpaced erosion and Columbia River sand nearly filled in the Seaside estuary, reducing its size and shellfish productivity and causing a decrease in Native shellfish harvesting. The history of Native shellfish harvesting elsewhere near the mouth of the Columbia River is related to landscape changes of this kind.

Archaeologists and others have also explored the effects of earthquakes and tsunamis on the Lower Columbia. The earthquakes with the most potential to affect Native peoples were those generated by the Cascadia Subduction Zone, an offshore area where the continental and Juan de Fuca tectonic plates meet. Roughly every 5 hundred years for at least the last 10 thousand years, massive earthquakes generated tsunamis that raced both eastward toward the North American coastline and westward into the Pacific. The earthquakes caused the coastline to sink in relation to sea level (Atwater 1987; Atwater et al. 2005; Atwater and Hemphill-Haley 1996).

Oral traditions of groups who lived in the Cascadia Subduction Zone recall earthquakes and tsunamis, particularly the most recent in AD 1700 (Carver 1998; Hutchinson and McMillan 1997; Losey 2002; Ludwin et al. 2005). Some low-lying villages were probably flooded and destroyed, while others were permanently submerged and rendered uninhabitable. Significant population loss likely occurred, and any number of political and social changes might have followed in the wake of such losses (Losey 2007; Losey et al. 2000; Minor and Grant 1996). Food resources, including salmon that spawn in small streams near the ocean and shallow-water shellfish, must have
been damaged by surging tsunami waters and erosion, but it is unclear how long such environmental changes persisted (Losey 2005). Farther inland, earthquakes may have generated landslides, blocking rivers and fish runs and producing food shortages. In the decades and centuries after earthquakes, some estuaries were deepened and widened, perhaps becoming more productive over the long term. Native oral traditions sometimes depict earthquakes and associated submergence of the coast as beneficial and link them to the transformation of coastal prairies into saltwater bays and lagoons that became important places for harvesting fish and other subsistence resources (Carver 1998; Kroeber 1976).

The Bonneville Landslide, which occurred between about AD 1400 and AD 1500, was the most recent environmental phenomenon to have significant repercussions on Native settlement and subsistence. Chinookan oral tradition recalls a “Bridge of the Gods” that crossed the Columbia River and fell with the Bonneville Landslide (e.g., Clark 1953; Bunnell 1933). Debris initially blocked the Columbia River, and one theory proposes that the river suddenly breached the blockage, causing a catastrophic flood that destroyed downstream settlements, particularly in the Portland Basin (Pettigrew 1990). Alternatively, the blockage gradually eroded away without causing catastrophic flooding and obliterating towns (Bourdeau 2001). Whether sudden or gradual, much of the landslide debris ultimately eroded away, and the remainder created The Cascades of the Columbia, one of the river’s most productive fisheries.

The Bonneville Landslide also may have affected Native fisheries by impeding salmon migration upstream over the short term. Although it probably took only a few months for the Columbia to breach the landslide blockage, clearing enough debris for salmon to make their way upstream took longer (O’Conner 2004). Much landslide debris was redeposited in the Wapato Valley, where it remains, causing a rise in upstream water levels. Some researchers speculate that by raising water levels the debris greatly improved fish passage over Celilo Falls (Condon 1969; O’Conner 2004). If so, the implications for Native subsistence are profound. The huge salmon runs of Celilo Falls and the intensive Native fishing of these runs might have developed since the Bonneville Landslide.

Preservation and Public Education

Our ability to continue learning about the past through archaeology depends on the preservation of archaeological remains. Along the Lower Columbia
River, this means limiting the impacts of development and relic hunting on archaeological sites. Since the Lower Columbia River traverses federal, state, county, city, and private lands, a patchwork of laws and regulations govern archaeological sites along the river (King 2004). Federal laws and regulations are relatively strong, Washington and Oregon state laws are comparatively weak, and county and municipal laws are weaker or nonexistent (with the exception of Clark County, Washington). Consequently, the preservation of archaeological sites on nonfederal lands along the Columbia often depends on the activism of tribes, residents, and archaeologists. Some sites are saved, but many are lost.

Relic hunting also causes the destruction of archaeological sites. Often referred to as "pot hunting," "collecting," and "looting," relic hunting is the unprofessional and often illegal collection or other disturbance of materials at archaeological sites. Relic hunting irrevocably damages a site, decreasing or destroying its structure and content and diminishing its potential to yield information through systematic archaeological study (Clewlow et al. 1971; Hollowell-Zimmer 2003; LaBelle 2003:115–27; Neusius and Gross 2007:615–17; Sheets 1973).

Relic hunting has substantially damaged archaeological sites along the Lower Columbia, and pothunters may have taken hundreds of thousands of artifacts from The Dalles area alone (Butler 2007:627). In recent years, tribes have established cultural committees, developed archaeological programs, and hired archaeologists; and an increasing number of Native people are now working as archaeologists. Native involvement is further facilitated by federal and state agencies' consultation with tribes prior to the initiation of projects that might affect archaeological remains. As a result, archaeologists and Natives increasingly collaborate to preserve archaeological sites along the Lower Columbia.

Archaeological site preservation has also been enhanced through heightened public awareness. The Oregon Archaeological Society, for example, is comprised of avocational archaeologists committed to protecting archaeological sites along the Columbia and working with professionals to study them. Interpretive facilities that educate the public about Lower Columbia archaeology and heritage include the Chinookan plankhouse at the Ridgefield National Wildlife Refuge, the Columbia Gorge Discovery Center, the Columbia Gorge Interpretive Center Museum, the Yakama Nation Museum, the Museum at Warm Springs, Fort Vancouver National Historic Site, Fort Clatsop Lewis & Clark National Historical Park, Horsethief Lake State Park,
and a number of historical societies and local museums. Several agencies organize public presentations, develop websites, and produce publications promoting the preservation of Lower Columbia archaeological sites (e.g., Daehnke and Funk 2005). Nevertheless, more public outreach and activism is needed for the long-term preservation of the archaeological resources of the Lower Columbia River.