OPPORTUNISTIC WHALE HUNTING ON THE SOUTHERN NORTHWEST COAST: ANCIENT DNA, ARTIFACT, AND ETHNOGRAPHIC EVIDENCE

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Two modes of whale use have been documented on the Northwest Coast of North America, namely systematic whale hunting and whale scavenging. Ethnographically, systematic hunting was practiced only by Native groups of southwestern Vancouver Island and the northern Olympic Peninsula of Washington State. This hunting was undertaken with technology specifically designed for the task. Other groups on the Northwest Coast reportedly did not hunt whales but did utilize beached animals. Here we present archaeological evidence of whaling from the northern Oregon coast site of Par-Tee in the form of a bone point lodged in a whale phalange. This hunting likely occurred 1,300 to 1,600 years ago. Ancient DNA extracted from the phalange proves it to be a humpback whale (Megaptera novaeangliae). DNA recovered from the bone point indicates that it is made from elk (Cervus elaphus) bone, and the point’s DNA sequence is identical to that from unmodified elk bone from Par-Tee, suggesting the whale was locally hunted. We present ethnohistorical data from the southern Northwest Coast describing opportunistic whale hunting with a variety of technologies. We argue that many groups along the west coast of North America likely occasionally hunted whales in the past and that this hunting occurred using nonspecialized technologies.

Dos maneras de utilización de las ballenas se han documentado en la costa Noroeste de Norteamérica. Estas son, la cacería sistemática y la utilización de ballenas encontradas muertas en la playa. Etnográficamente, la caza sistemática fue practicada únicamente por grupos Indígenas del sur-oeste de la Isla de Vancouver y la Península Olimpica del estado de Washington. Esta cacería se realizaba con tecnología especialmente diseñada para dicha actividad. Se sabe que otros grupos étnicos de la costa noreste de Norteamérica no cazaban, sino que utilizaban los restos de ballenas encontradas sin vida en la playa. Una punta de hueso alojada en parte de la estructura ósea digital de una ballena, encontrada en Par-Tee, en la costa norte de Oregón, representa la evidencia arqueológica de la cacería de ballenas en este lugar. Esta cacería posiblemente ocurrió hace 1,300 a 1,600 años. Muestras de ADN antiguo extraído de la estructura ósea digital de la ballena sugiere que se trata de una ballena jorobada (Megaptera novaeangliae). El ADN proveniente de la punta de hueso encontrada revela que esta fue hecha de hueso de ciervo (Cervus elaphus). En este trabajo de investigación, presentamos información etnográfica de la caza noreste de Norteamérica describiendo la cacería de ballenas “opportunista”, la cual incluye diversas tecnologías. Según nuestro estudio, muchos grupos de la costa Noroeste de Norteamérica seguramente de vez en cuando cazaban ballenas en el pasado, y dicha cacería se realizó mediante la utilización de tecnología no-especializada.

Two modes of whale use have been documented on the Northwest Coast of North America (following Kroeber 1939), namely systematic whaling and whale scavenging. The first mode of whale use was limited in its distribution during the ethnographic period to a few groups of the central Northwest Coast, namely the Nuu-chah-nulth and Ditidaht peoples of western Vancouver Island, British Columbia and the Makah of the Olympic Peninsula in Washington State (Arima 1983; Curtis 1916; Drucker 1951; Gunther 1942; Jonaitis 1999; Kool 1982; Koppert 1930; Reagan 1925; Sapir et al. 2004; Swan 1870) (Figure 1). These groups systematically hunted whales offshore on a seasonal basis using seaworthy canoes and hunting technology exclusively designed for the task. Neighbors of these groups, including the Clallam of the Strait of Juan de Fuca and the Quileute and Quinault of the western Washington coast also hunted whales (Hajda 1990:507; Pow-

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Figure 1. Northwest Coast culture area with the distribution of ethnographically documented systematic whaling groups encircled. Other ethnographic groups and locations mentioned in the text also indicated.
Whaling was adopted by the Quileute from the Makah in the 1800s (Frachtenburg 1921:322), and the Quinault reportedly practiced whaling to a lesser extent than the Quileute (Olson 1967:44). The second mode of whale use has characterized all other culture groups on the Northwest Coast, who reportedly utilized beached or drifting whales but never hunted them (but see Acheson and Wigen 2002; Blackman 1981). Whale hunting groups also regularly scavenged drifting and stranded whales (Drucker 1951:39, 255–256).

Archaeological evidence for use of whale products on the Northwest Coast, consisting of whale bones in cultural contexts, extends back at least 4,000 years (Monks et al. 2001). Definite evidence for whale hunting, including the presence of ethnographically documented whaling tools (reviewed below) and strike marks on whale remains in sites, appears as early as 3000 B.P. and has been entirely limited to the Nuu-chah-nulth and Makah area (Monks et al. 2001). Arguments also have been made for precontact whale hunting on the Queen Charlotte Islands based on ethnohistoric data and the relative abundance of whale bone in sites (Acheson and Wigen 2002). However, most researchers working beyond the region where whaling is ethnographically documented have been reluctant to use such information as evidence for precontact whale hunting. This is likely because no whale hunting technology similar to that described ethnographically has been found outside the Nuu-chah-nulth and Makah area of the Northwest Coast, and even there it is rare (McMillan 1999:134; Monks et al. 2001:66). Also, it is often impossible to determine if whale bone in sites represents hunted or scavenged animals. Difficulties involving the archaeological identification of whale hunting are common elsewhere, even where whaling remains a strong living tradition (Black 1987; Freeman 1979; Krupey 1993; McCartney 1980, 1995; Mulville 2002, 2005; Savelle and McCartney 1991; Whitridge 1999).

Documenting the extent and diversity of precontact whaling practices on the Northwest Coast is important for several reasons. Large whales can provide an abundance of food and tool-making materials and as such could have been important subsistence and technological resources (Huelsenbeck 1988). Whale products were potential sources of wealth that could be stored, traded, and given away (Drucker 1951), and were one of the means through which individuals could self-aggrandize. Whaling was often high risk but came with substantial rewards, particularly in the form of prestige. To counterbalance risk and to help ensure success, ethnographic whaling on the Northwest Coast was often associated with complex ritual preparation (Curtis 1916; Drucker 1951; Gunther 1942; Jonaitis 1999; Waterman 1967). Beyond this, whaling involved a set of cultural practices associated with the act of hunting whales, the behavior of whalers’ families while crews were at sea, the butchery of whales, and the distribution of their products. Whaling was clearly a group activity, often involving several households or entire settlements, and not just individuals in canoes pursuing whales. Whales found dead or dying on the shore (drift whales) potentially involved many of the same cultural behaviors, but certainly lacked the risks associated with active whaling. Possession of drift whales was often highly contested. At least among some groups, obtaining drift whales was not a passive process, but depended on an individual’s spiritual power to draw dead or dying animals on shore (Drucker 1951:171–173; Jacobs 2003:182–183; Kroeber and Barrett 1960:122–126; SAPIR et al. 2004:147–163, 189–203). Whales were also important mythological figures for virtually every ethnographic Northwest Coast group (Sut- tles 1990).

Whales and whaling were clearly important among some groups on the Northwest Coast during the ethnographic period, and it is reasonable to inquire if other groups in the region hunted whales at some point in the past and how such hunting was accomplished. Presented here is evidence for the use of a previously undocumented form of whaling harpoon or lance on the southern Northwest Coast. This evidence consists of the tip of a bone point lodged in a large whale phalange recovered from the Par-Tee site (35CLT20) on the northern Oregon coast, dating from 800 to 2300 cal. B.P. Mitochondrial DNA extracted from the point identified it as being made of elk (Cervus elaphus) bone, a species found along much of the North American Pacific coastline from roughly Vancouver Island southward to near Point Conception, California (Bryant and Maser 1982:24). The DNA sequence of the point suggests its ultimate origin
is not Vancouver Island, where roughly contemporaneous evidence of whaling previously has been identified, but somewhere further south along the Pacific coast. Its DNA sequence was found to be identical to that obtained from unmodified elk remains recovered from Par-Tee. DNA from the phalange proves it to be humpback whale (*Megaptera novaeangliae*), a common species found in other Northwest whale bone archaeological assemblages, and a commonly hunted whale of the ethnographic period. This is the first direct evidence of whaling in the archaeological record of the Northwest Coast found outside of the area where systematic whaling was ethnographically documented. Also, the tool and its position within the body of the whale do not directly match whale-hunting technologies and practices documented ethnohistorically.

While it may be impossible to determine definitively if the humpback whale was hunted by the inhabitants of Par-Tee, the matching DNA sequences and contextual evidence from the site, including numerous large harpoons and abundant whale bone, suggests this was entirely possible. Furthermore, we present little-known ethnographic and ethnohistoric data from the southern Northwest Coast describing opportunistic whale hunting with a variety of technologies. We argue that any number of hunting weapons used by Pacific coast indigenous groups could have been employed for occasional opportunistic whale hunting. Many groups here potentially hunted whales in the past on an opportunistic basis, but the evidence for such whale hunting will likely be difficult to decipher from the archaeological record.

**Ethnographic and Archaeological Whaling and Whaling Equipment**

Many aspects of systematic whaling, here defined as the recurrent hunting of whales with technology specifically tailored for the task, are well described in Nuu-chah-nulth and Makah ethnographic and ethnohistoric literature. While an array of technology was used by these groups in whaling (Curtis 1961:16–17, 27; Drucker 1951:27–31; Koppert 1930:56–62; Olson 1967:44; Scammon 1874; Swan 1870:19–22; Waterman 1967), we focus here on that used for striking and killing whales, namely harpoons and lances.1

The whaling harpoon is consistently described as a large thrusting implement several meters in length tipped with a three piece toggling head (Figure 2). Attached to the head was a line several meters long leading to a seal skin float that produced drag upon the struck whale. The shaft and foreshaft of the harpoon were constructed of yew (*Taxus brevifolia*) wood. All sources describe the cutting tip of the head as formed from a large mussel (presumably *Mytilus californianus*) shell blade ground to a broad sharp point and having a deeply concave base. Koppert (1930:60) describes it as five inches long by two inches (~5.1 x 12.7 cm) wide. During the historic period, metal blades were sometimes substituted for shell. The blade fit between two valves or “bars” of elk (*Cervus elaphus*) bone or antler, or whale bone (Drucker 1951:28; Koppert 1930:60). These were about 14 cm long (5.5 in) (Koppert 1930:60, width not provided). When fitted together, the tip of the joined valves formed a slot into which the blade was inserted; the pieces were bound together with line and secured with resin. The opposite end of the two bound valves formed a socket into which the foreshaft was inserted. The valves were often decorated with incised designs (Drucker 1951:28; Koppert 1930:60; Sapir 1922:314; Sapir et al. 2004:24), some of which represented Lightning Snake (or Lightning Serpent), a mythological figure associated with the whaling activities of Thunderbird (Sapir 1922:314; Swan 1870:7–8). In total, the harpoon head was probably about 18 cm (7 in long). When a harpoon head struck a whale, it ideally detached from the shaft and remained embedded in the whale. Waterman (1967:32) comments that the valves held the harpoon in the whale, with the mussel shell blade primarily performing the task of cutting for penetration.

Whales were apparently often not killed outright by harpoons and floats, which instead mostly tired the animals so they could be dispatched at a close distance (Drucker 1951:53). Given that the killing of a whale would be extremely dangerous, we speculate it was undertaken only on nearly dead or inactive animals. Drucker (1951:53) details the killing process: “When the time came for the kill, the first paddler took the lance with the broad, flat blade to cut the main tendons controlling the flukes, so that they dropped down useless. When the whale had thus been hamstrung, the same man drove the other
lance in under the flipper.” Elsewhere Drucker (1951:31) describes two lances used in this process: “A pair of lances with long barbless elkhorn points, one tapered to a sharp point for killing, the other with a wide flat chisel-like blade (a “spade,” in modern whalers’ terms) that was used for hamstringing, were very important parts of the whaler’s outfit.” The term “elkhorn” presumably refers to elk antler. We are unaware of any illustrations of these lances.

Scammon (1874) observed native whaling on the Northwest Coast in the 1860s, and provides both a brief description and illustration of a whaling lance. His description of the lance differs from that of Drucker: “The cutting material of both lance and spear was formerly the thick part of a mussel shell, or of the ‘abelone’” (Scammon 1874:30). Scammon’s (1874:plate IV) illustration depicts the lance as tipped with a broad shell blade fixed to a shaft. His description and illustration of the whaling harpoon is identical to that described by Drucker, Koppert, and others cited above.

Curtis (1916:18) provides a somewhat contradictory description of whale killing:

When the wounded whale becomes quiescent, the canoemen paddle up closer and throw into his head small harpoons with small floats of hair-seal skin on two feet of sinew line, in order to buoy up the head and render towing easier. The whale being almost exhausted, they come alongside and hurl into his body harpoons without lines or floats, recovering the shaft by means of a short line; and when the animal ceases to struggle, the first crew draws its line, leaving only the length of the sinew line and its float attached to the harpoon blade.

Curtis provides no description of the “small harpoons” and does not mention the cutting tools documented by Drucker and Scammon. The last clause in his description may indicate the harpoons were fitted with cutting blades.

Large toggling harpoon valves, including specimens with incised designs similar to those
described ethnographically, have been found in Vancouver Island sites and in the well-known wet site of Ozette on the Olympic Peninsula of Washington State (Dewhirst 1980; Huelsbeck 1994:280; McMillan 1999:133; Monks et al. 2001:66). All these occurrences of probable whaling technology seem to fall within the last 1,200 years or so (Monks et al. 2001:66). Where construction material is reported, most are of whale bone, although a few are of antler (Dewhirst 1980:300; McMillan and St. Claire 2005:51). Strike marks in the form of embedded mussel shell blades or probable shell blade impact marks also have been found at sites in this area (Fisken 1994:367; Huelsbeck 1994:280–1; Monks et al. 2001:65). At Ozette, multiple whale bones with mussel shell strike marks have been found (Huelsbeck 1994, number not specified). The site of T'ukw'aa on Barkley Sound, Vancouver Island has produced four whale bones with mussel shell blade strike marks (Monks et al. 2001:66). The nearby site of Ch'uumat'a contains a humpback scapula with a possible strike mark dating as early as 2500 to 3000 cal B.P. (Monks et al. 2001). In these sites, scapulae are the most commonly struck elements, but several vertebrae, a maxilla, intermaxillary, and rib also show strike marks. One humpback whale scapula from Ozette is embedded with three mussel shell blade tips each from separate harpoon heads (Fisken 1994:367), while all other specimens from Ozette and elsewhere apparently have only single strike marks.

The gray whale (Eschrichtius robustus) is the most commonly mentioned large cetacean in the ethnographies of Northwest Coast whaling groups, but other species were reportedly hunted or recognized (Arima 1988; Curtis 1916:18; Drucker 1951:49; Kool 1982; Monks et al. 2001:70–71; Swan 1870:19; Swanson 1956; Waterman 1967:42). Whale bone from the sites of Ozette, T'ukw'aa, and Ch'uumat'a in the Makah and Nuu-chah-nulth areas has been identified to species. At Ozette, gray and humpback whales accounted for around 96 percent of the identified whale bone, with gray whale bone slightly outnumbering humpback (Huelsbeck 1988:4, 1994:271). Other identified large cetaceans at Ozette include finback (Balaenoptera physalus), right (Eubalaena japonica), killer (Orcinus Orca), and sperm (Physeter macrocephalus) whales. At T'ukw'aa and Ch'u-umat'a, humpback whales overwhelmingly dominate the assemblages (83 percent of the total), but gray, minke (Balaenoptera acutorostrata), and right whales were also present (Monks et al. 2001:72–73).

We are unaware of any direct archaeological evidence for prehistoric whaling south of Ozette along the west coast of North America, even in areas where it was documented historically. We are also unaware of any direct archaeological evidence for the use of bone, stone, or wood harpoon heads or lances in whale hunting anywhere on the Northwest Coast. The wet site of Ozette is the only site on the Northwest Coast to produce whaling harpoon shafts, head sheaths, lines, and other possible whaling paraphernalia, including a wood representation of a whale “saddle,” a highly valued whale portion around the dorsal fin (Huelsbeck 1994:280).

The Par-Tee Site

Par-Tee (35 CLT 20) is a large shell midden in Seaside, Oregon (Figure 1). Seaside is at the southern end of a sandy beach that extends 22 km northward to the Columbia River mouth. Just to the south is Tillamook Head, a basaltic headland that rises steeply from the Pacific. Today a small and narrow estuary flows through Seaside, but a more substantial estuary was probably present during the late Holocene (Connolly 1992, 1995). Par-Tee and several other Seaside-area sites were excavated by George E. Phebus and Robert M. Drucker in the 1960–1970s, with assistance from the avocational Oregon Archaeological Society, and a small amount of funding from the Smithsonian Institution, where Phebus was employed. Phebus and Drucker (1979) published only a short preliminary report (~20 pages) on their work at Par-Tee. Nearly all recovered materials were curated by the Smithsonian. While Phebus and Drucker (1979) report excavating around 434 m² at Par-Tee, a review of their fieldnotes and photographs suggests that nearly 550 m² were sampled. It is probably the most extensively excavated site on the Northwest Coast south of Ozette. Excavations were carried out in 5 x 5 ft units and one foot levels, with sediments being screened over 1/4 inch mesh sieves. Nearly 6,300 tools² were recovered during their excavations, accounting for well over half of all artifacts yet recovered through controlled excavations on the
Oregon coast (Lyman 1991:23). Despite the size of the collection, only 7 pages of description and 1 page of tool illustrations were published by Phebus and Drucker (1979). Unit and level information is available for the vast majority of tools and faunal remains. No count is available for the faunal remains recovered, but an inspection of the collection suggests at least 100,000 vertebrate remains are present. Later analyses of the Par-Tee fauna include Colten’s (2002) description of a sample of the non-fish vertebrate remains and Losey and Power’s (2005) examination of the shellfish. Human remains from Par-Tee have been described by Arbolino et al. (2006). In 2003, Losey analyzed the tools from the site curated at the Smithsonian.

Today, Par-Tee is roughly 200 m from the open Pacific Ocean coast, but the beach has likely accreted westward since the site was abandoned. Phebus and Drucker’s photographs of the site excavation reveal midden deposits resting on cobble ridges, which are likely storm beach deposits stranded by the westward accreting beach (Darienzo 1992; Rankin 1983). Shellfish remains from Par-Tee are strongly dominated by estuarine clams, although a small portion of this unsystematically collected assemblage consists of species such as razor clam (Silvula patula) and California mussel (Mytilus californianus) that prefer high energy marine environments. This pattern of shellfish use is consistent with other partially contemporaneous sites in the Seaside area (35 CLT 47, 35 CLT 13), suggesting all were situated on an estuary, but open coast environments were relatively close by. Elk were the most commonly identified terrestrial mammal and sea otters (Enhydra lutris) the most commonly identified sea mammal in the Par-Tee fauna (Colten 2002:20). Phebus and Drucker obtained 25 radiocarbon dates for the site, and 6 additional dates were obtained for this study. These dates indicate the primary site occupation spanned from around 2300 cal B.P. to 800 cal B.P.

**Whale Use at Par-Tee**

The use of whale products at Par-Tee is evidenced by its faunal assemblage and materials used in tool construction. Colten (2002) presented a brief discussion and basic quantification data (NISP) of fauna from six of the units excavated at Par-Tee (~7 percent of the units excavated; total NISP of 6,362). His data suggest the vertebrate remains are dominated by sea mammals, with pinnipeds, sea otters, and cetaceans accounting for nearly 65 percent of the assemblage by meat weight contribution. The mesh size of the screens employed during excavation likely results in small fauna such as fish being underrepresented in these calculations. Of the 945 sea mammal specimens identified to family level, 154 (16.3 percent) are cetaceans. Those identified in this subsample include minke whale (NISP = 4), harbor porpoise (Phocoena phocoena; NISP = 25), pantropical spotted dolphin (Stenella attenuata; NISP = 1), and bottlenose dolphin (Tursiops truncatus; NISP = 4). Forty-six undifferentiated Delphinidae specimens are also present, and additional unidentified cetacean remains are subdivided into large (“whale-sized”; NISP = 61) and undifferentiated (dolphin or porpoise-sized; NISP = 13) categories (Colten 2007). Minke whale is the largest of the identified cetaceans, with a maximum length of 10.1 m and weight of 9,000 kg (Minasian et al. 1984:54; Stewart and Leatherwood 1985). These whales are fast swimmers and commonly inhabit inland waterways such as Puget Sound and areas of the continental shelf. The dolphins and porpoise identified are much smaller on average, with the largest of the three being the bottlenose, which can reach a maximum size of about 4 m and 650 kg (Minasian et al. 1984:125). All are very fleet swimmers and can enter inland saltwater waterways.

At least 350 modified whale bones are in the Par-Tee tool assemblage. These include several large unbarbed bone points, two barbed harpoon heads, rod-shaped fragments, a possible spindle whorl, ornaments, a platter or large dish, a zoomorphic atlatl weight, and portions of over 20 atlatls constructed entirely of whale bone. Numerous modified whale bones too fragmentary to classify were also present. No large toggling harpoon valves of whale bone or other material were identified, but 148 smaller valves of terrestrial mammal bone and antler (~1 cm wide, 3.5 to 11 cm long) are present. These are of two general forms, one consisting of two symmetrical valves armed with a bone pin, the other a self-armed variety formed by two asymmetrical valves. Many bone pins likely used to arm the first form of toggling harpoon are present. No ground slate or mussel shell points are present in the assemblage.

Use of sea mammals is also suggested through the presence of numerous single-piece barbed har-
poon heads and "fixed" barbed points (those without line attachment holes or projections; Figures 3a and 3b). A total of 324 complete and fragmented harpoon heads are present, some being quite large. Fourteen are of terrestrial mammal bone, two of cetacean bone, and the remainder of antler. Only one harpoon head in the collection has a tip slotted for an end blade; all others with intact tips are self-armed. The longest harpoon is just over 20.5 cm long and 15 others are over 15 cm long, many of them incomplete specimens. The widest in the collection is 3.8 cm and 49 others are over 2 cm wide. None are as wide as the blades of the whaling toggling harpoons described by Drucker and Koppert, but over 15 were likely as long or longer than the whole whaling toggling harpoon heads (valves and blade together) they describe. Ten of the harpoon heads were embellished with simple cross-hatched or parallel incised lines (see Figure 3a); six of the ten embellished specimens were of bone, the other four were of antler. Many unbarbed bone and antler tools with sharply pointed tips were also present, but whether they functioned as hunting implements or other forms of piercing technology is unclear.

Obviously, none of these characteristics of the Par-Tee assemblage definitively indicate whales were hunted by the site's inhabitants. All cetacean bones could have derived from drift whales and the harpoons could have been used for hunting pinnipeds, sea otters, and other fauna.3 The best evidence for whale hunting at Par-tee was found while scanning the uncatalogued faunal remains at the Smithsonian for tools missed by Phebus during initial cataloguing of the collection. Hundreds of modified bones were found, including 84 pieces of whale bone (included in figures above). Among these items was a whale phalange (SI catalog #A556355; Figure 4) 16.5 cm long with a bone point deeply embedded in it near its distal end. The phalange was excavated from level 4 of unit 21F in the southwest portion of the site. Charcoal samples from the same level in two adjacent 5-x-5-ft units were dated by Phebus and Drucker and produced ages of 1195 ± 80 (SI-4967) and 1295 ± 70 (SI-4966), suggesting the phalange likely was deposited between cal A.D. 650 and 950.4 Unfortunately, no profiles for this area of the site are available. Tools were collected from two 1 ft levels immediately above that containing the phalange, suggesting it was recovered at least two feet below the surface. Excavator's notes indicate that 11 other tools were recovered from this unit and level, but it is unclear if they were directly associated with the phalange.

The base of the point in the phalange was apparently snapped off when the tool was relatively fresh, leaving an irregular cross section exposed. A few centimeters of the whale bone itself have crumbled away where the point entered the phalange; it is therefore impossible to determine if the phalange had healed around the embedded tool. The tool itself is oval in cross section, clearly of dense cortical bone, and its exposed end is 1.6 x .8 cm in maximum dimensions. The small exposed portions of its lateral edges were well rounded and no embellishments were evident on its faces. A CT scan of the phalange (Figure 4) reveals the point fragment is about 3-4 cm long, sharply pointed, composed solely of bone, lacked barbs, and nearly penetrated through the phalange. Attempts were made to refit the point fragment to fragmented bone tools of similar size in the collection, but no match was found. However, many of the harpoon heads and other bone implements in the collection have intact tips of roughly the same size and shape.

**DNA Analyses**

Many species of whale in the Pacific migrate long distances, some traveling from arctic seas to the tropics. We considered the possibility the phalange was from a whale struck by a harpoon somewhere else in the Pacific that by random chance washed up near Par-Tee and then was scavenged. One goal thus was to identify the species of whale represented. Lacking access to a cetacean comparative skeletal collection, we sought to identify the phalange to species through sampling of its DNA. A second goal was to try to determine if a local animal was used to produce the bone tool lodged in the phalange.

Because extracting ancient DNA is a destructive process, the Smithsonian sampling committee suggested we first sample unmodified faunal remains from the site to determine whether ancient DNA might be preserved in the tool and phalange. Three unmodified elk metapodial fragments were sampled for DNA extraction and PCR amplification in the dedicated ancient DNA laboratory of the Department of Archaeology at Simon Fraser Uni-
Figure 3a (upper). A selection of unilaterally barbed harpoon heads from Par-Tee. The fifth specimen from the right is embellished with an incised cross-hatched design. Figure 3b (lower). Three of the larger bilaterally barbed harpoon head fragments from Par-Tee.
Figure 4. Humpback whale phalange with embedded elk bone point recovered from Par-Tee; (upper) phalange with point exposed near its distal (upper right hand) end; (lower) close-up of embedded bone point.
Vigorous contamination controls were exercised throughout the process of the DNA analysis. For decontamination, the bone surface was first polished with a sandpaper and was further wet-wiped with 100 percent bleach solution using a Q-Tip. For each sample, a clean Dremel drill bit was used to drill a hole to generate bone dust for DNA extraction. DNA was extracted using the silica-based spin column method (Yang et al. 1998) and polymerase chain reaction (PCR) was used to amplify and analyze an approximately 181 base-pair D-loop fragment using forward primer F136 (5’-TAGTACATTATATTATGCCCATGC-3’) and reverse primer R316 (5’-CGGTTGCTGGTTTACAG-3’). PCR was set up in a 30 uL reaction with 2U TaqGold and run for 60 cycles in an Eppendorf Mastercycler Personal. PCR products were purified using Qiagen’s MinElut purification kit and were subjected to direct sequencing. All three samples yielded positive PCR amplification and the obtained DNA sequences indicate that the metapodials are indeed of elk (Cervus elaphus).

With evidence that ancient DNA was present in the Par-Tee fauna, sampling of the bone point and phalange began. A hole was drilled into the broken face of the point and the resulting bone dust was collected. A sterile scalpel was used to cut a 1.5 x 1.5 cm square of bone from the distal articular end of the whale phalange for DNA extraction. For decontamination purposes, this sample was then subjected to 100 percent bleach solution, 1N HCL and 1N NaOH treatments (Yang et al. 2004; Yang and Watt 2005), while the dust sample from the point was rinsed with 100 percent bleach. Both the point and whale bone sample were further split into two sets of samples to conduct parallel comparisons for reproducibility test. DNA extraction and PCR amplification follow the same procedure as used in the processing of metapodial samples.

To obtain more informative DNA sequences from the bone of the point, another mtDNA D-loop fragment (approximately 170 base pair) of elk was also amplified and analyzed using forward primer F54 (5’-TCAAGGAGGAAGCCATGCC-3’) and reverse primer R217 (5’-TTGAGTGTGGAGTGAAGGCACGTCG-3’). This new D-loop fragment was also amplified for the metapodial DNA samples in order to obtain the equivalent DNA sequence data. For PCR analysis of whale phalange DNA, both cytochrome b (Cytb) and D-loop fragments were targeted using published primers, F1 and R182 for a 182bp Cytb fragment, and F22 and R258 for a 237 base-pair D-loop fragment (Yang and Speller 2006). As expected, both the harpoon and the whale phalange yielded positive PCR amplifications. The parallel comparison of the two sets of samples produced the same DNA sequences, strongly indicating the authenticity of the ancient DNA data.

The CytB and D-loop mtDNA fragments of the whale DNA sample revealed the species to be humpback whale. The highly conserved CytB and hypervariable D-loop should be adequate to secure a species ID for the whale phalange (Yang and Speller 2006). Since humpback is a migratory species, the same population potentially can be found anywhere from Alaska to California. We could not determine an origin of this particular whale due to the lack of a “region-specific” DNA pattern along the Northwest Coast of North America.

From the two mtDNA fragments, the point could be confidently identified to the species level, namely elk. An effort was also made to determine subspecies using phylogenetic analysis of the obtained ancient DNA sequences combined with those modern reference sequences from GenBank. A phylogenetic tree (Figure 6) shows the point DNA is clustered with those of Tule elk (Cervus elaphus nannodes), Rocky Mountain elk (Cervus elaphus nelsoni), and even one Manitoban elk (Cervus elaphus manitobensis), but not with Roosevelt elk (Cervus elaphus roosevelti), the only elk...
subsidiary reported on the Northwest Coast during the historic period (Murie 1979:20). However, caution is warranted in taking this distribution at face value because elk populations were much depleted in the late 1800s when subspecies’ ranges were identified, and it is often unclear how subspecies designations were made or how many animals were examined when making distribution maps.

Recent DNA analyses reveal that elk subspecies are poorly understood, perhaps due to relatively recent divergence, genetic bottlenecks during the early historic period, and more recent relocation of animals outside of their “traditional” ranges. For example, DNA studies of modern elk populations suggest that Rocky Mountain elk and Manitoba elk are likely not genetically distinct enough to be considered separate subspecies (Polzien et al. 2000), and Rocky Mountain elk and Roosevelt elk genotypes are currently present in both Oregon, Washington, and the southwestern mainland of British Columbia (Quayle and Brunt 2003; Oregon Department of Fish and Wildlife 2003). Only Roosevelt elk are currently present on Vancouver Island and they are genetically very distinct from other elk populations, perhaps being separated from them for nearly 7,000 years (Polzien et al. 2000). If other subspecies of elk were indeed present on Vancouver Island during the late Holocene, some trace of their presence should have appeared in genetic
assessments of modern elk on the island; such evidence has failed to appear (Polziehn et al. 2000). The DNA sequence from the Par-Tee bone point does not cluster closely with any Roosevelt elk and given this the Vancouver Island elk population likely can be excluded as an ultimate source for the point.

Another approach employed for assessing the origin of the Par-Tee elk bone point was to compare its DNA sequence with those of the three unmodified elk metapodials from the site. The sequence comparison shows that they indeed share the identical DNA sequence as the point and thus also cluster with the Rocky Mountain/Manitoban and Tule clade. Although sharing the same DNA sequence cannot be used as absolute evidence to conclude the point was made from local elk bone, it clearly cannot refute such a possibility. More importantly, the “non-Roosevelt” subspecies identification of the remains can now be more confidently believed to be an elk indigenous to the region.

The DNA data obtained in ancient DNA studies have to be carefully authenticated before being accepted as valid (Yang and Watt 2005; Yang et al. 2005). This is particularly true for our study since all four elk DNA samples are identical. Hypothetically, this pattern can be caused by contamination. If all four Par-Tee samples were contaminated from the same source, one would expect an identical sequence for all of the analyzed DNA samples. The possibility of contamination can be effectively excluded here by the careful research design employed and vigorous contamination controls: (1) although the Par-Tee elk DNA sequence matches some modern DNA references (see the tree in Figure 6), it is distinct from other elk DNA sequences previously analyzed in our DNA facility (for example, five other elk bone samples from Banff Park were analyzed in a previous study but the bones yielded different DNA sequences [Monsalve et al. 2007]; (2) the metapodials and the harpoon were analyzed at different times (~6 months apart), significantly reducing the chance of cross-sample contamination; and (3) contamination controls have been exercised in the SFU ancient DNA lab as demonstrated by the fact that over 400 ancient bone samples have been analyzed in the lab with occurrence of few contaminations.

A Drift Whale?

Could the phalange be from an animal hunted by the Makah or Nuu-chah-nulth that simply washed up near Par-Tee? If the whale was struck near Ozette, the southernmost whaling village known archaeologically, it would have swum or drifted at least 275 km south to arrive at Par-Tee.5 Tracking of modern humpback whales has documented migrating individuals traveling as much as 250 km in a day (Mate et al. 1998). At this rate, even slowly traveling wounded whales could reach Par-Tee within a few days of being struck by the more northerly whaling groups.

If long-distance drift or travel of struck whales was common, why has archaeological evidence for strike marks on whale bones been limited to areas where whaling was documented ethnohistorically? Two issues may be to blame. First, the most commonly hunted species of whales on the Northwest Coast, grays and humpbacks, tend to sink after dying. This was clearly recognized by native Northwest whalers, who took steps to ensure dead and dying whales stayed afloat (e.g., Drucker 1951:53; Waterman 1967:44). Commercial whalers on the Northwest Coast of the early twentieth century avoided hunting these whales for this reason, and harvested them in large numbers only after the development of technologies for suspending or raising struck and submerged whales (Scammon 1874:45–46; Webb 1988:121–125). Undoubtedly, some whales would resurface from increased buoyancy due to gasses developing through decomposition, but this process was probably unpredictable (Webb 1988:123). Therefore, it is likely that whales did not drift too far beyond the area where they perished.

It is possible, secondly, that distantly hunted whales were used by many non-whaling groups as drift whales, but the products taken from them (and deposited in sites) did not include bones with strike marks or embedded tools. Processes involving the deposition of whale bone in sites are complex and likely relate to distances between habitations and where whales were landed, technological uses of bone, oil extraction from bone, meat versus blubber use, and even the display of struck bones by whalers as trophies (Huelsbeck 1988; Monks 2001; Monks et al. 2001; Monks 2003). The use of drift whales would entail initial processing of animals
wherever they happen to land and might result in less-intensive use of whale products compared to cases where whales were towed by hunters directly to habitation sites. The rancid condition of many drift whales probably also played a role in whale product use; blubber might remain in edible condition long after meat had gone bad (Monks 2003:194). Using whales solely for their blubber would likely result in fewer bones being deposited in sites than would using whale meat and the oil contained in bone. It is also possible that collecting struck whale bones was generally not important to those scavenging whales; these signs of hunting prowess may not have had the symbolic value they had to those groups actually engaged in the hunting.

Is the bone point from Par-Tee one of the ethnographically described whale killing implements, and if so, was it used in a manner described in these accounts? The point is clearly not equipped with a cutting blade as described by Curtis or Scammon. The point is also not the spatulate cutting tool Drucker describes, but it could be the sharply pointed lance he mentions, albeit of bone, not antler. Drucker described the pointed lance as being used after whales were “hamstrung.” The placement of the lance is specific—“under the flipper” (Drucker 1951:53), presumably for striking vital organs. Humpback whales have the longest pectoral fins relative to body size of any cetacean, reaching lengths of up to 5.2 m, or roughly 1/3 the total body length (Clapham 1996:21). In the process Drucker describes, it is conceivable that a lance could become embedded in a phalanx, but this does not seem likely. Given that long flailing pectoral flippers would have been very dangerous to whalers in canoes, an experienced whaler would likely stay well away from them and lance a whale only after it was largely immobile. Strike marks from lancing would most likely be seen on the anterior ribs and upper limb bones, but might show up on phalanges if the flipper had abruptly swung into the path of a lance. Note that all previously identified strike marks on archaeological whale bone have been found on elements of the head, upper arm, and ribs; none are on phalanges.

We suspect the point in the phalange resulted from the activities of inexperienced individuals striking a whale in an attempt to capture it, or the harpooning by experienced whalers using a form of technology undocumented in the ethnographic literature. Either is significant, because both potentially expand the scope of knowledge about ancient whale hunting practices. We now present ethnographic and ethnohistoric evidence for whale hunting on the southern Northwest Coast beyond the area where it is traditionally viewed as being practiced and with tools not previously recognized as whaling equipment.

Etnohistoric Whaling on the Southern Northwest Coast

The Native groups of the Northwest Coast south of the Quinault region of western Washington State are often described in widely cited ethnographic literature as non-whaling cultures that only made use of whale products acquired through trade or from stranded animals (Drucker 1937; Elmandorf and Kroeber 1960:107; Hajda 1990:507; Kroeber and Barrett 1960:122–126; Silverstein 1990:537; Zenk 1990:573). Archaeologists working in this area have generally echoed these statements (Aikens 1993:140; Erlandson et al. 1998:12–13; Gould 1975:154; Hall 1995:201; Lyman 1991:150; Tveskov 2000:134). It appears that no ethnographers saw Native peoples of the region engaged in whaling, but most ethnographic work occurred here well into the twentieth century, long after even the Makah and Nuu-chah-nulth had ceased whaling. An examination of ethnographic and ethnohistoric accounts, however, reveals that while whale hunting on the southern Northwest Coast may not have been as systematic or as economically and socially important as it was among groups to the north, it was nonetheless occurring and in at least one case, observed firsthand by outsiders.

Accounts regarding whale hunting are brief but appear to describe episodes of opportunistic hunting with whatever equipment was at hand. For example, Elmandorf and Kroeber (1960:107) describe the Twana’s (Figure 1) use of whales: “The Twana did not hunt whale, except in a single historical instance when a party of porpoise hunters harpooned a whale. The hunters were unable to bring the struck whale to shore until a man was obtained who knew a song from Grays Harbor (probably a Lower Chehalis) to drive the whale to the beach.” Notably, the Lower Chehalis are not described in ethnographic sources as whale hunters.
This whale was perhaps taken using technology designed for porpoise hunting.

On the Oregon coast two ethnohistoric accounts mention whale hunting in the mid-1800s. The earliest account was made by N. Scholfield, an early prospector and settler on Oregon’s central coast. In 1854 Scholfield was approximately 8 km up the Siuslaw River (Figure 1) from its mouth and had just borrowed a canoe at an Indian village:

But as we were starting, a whale was discovered, leisurely spouting himself into notice; and our canoe was required by the Indians, who endeavored to capture this specimen of ichthyology, by shooting, lancing, and otherwise maltreating him. Being hotly pursued by some half-dozen canoes, his whaleship, totally disgusted, left the river [Scholfield 1854].

This account describes a chance encounter with a whale and an attempt to hunt it with nonspecialized technology. A remarkable aspect of this account is the presence of the whale fairly far up a narrow estuary; today the Siuslaw River 8 km from its mouth is 1 km across at its widest point. Two years later John J. Milhau (1856), in a letter to the ethnologist George Gibbs, describes whale hunting practices of the Alsea and "Yakoner" (Yaquina) of the central Oregon coast (Figure 1): "They have very large canoes similar to those in Puget Sound, go out to sea in them, and do not hesitate to harpoon whales and get fast to them and kill them." Milhau’s account describes open-ocean whaling involving the use of harpoons of unspecified form.

Beverly Ward, a woman of Coos and Coquille descent (south central Oregon coast; Figure 1) born in 1909, provides a third description of whale use on the Oregon coast:

Oregon tribes weren’t whalers like the Indians in the north. They watched the whales migrating along the coast, and they sometimes found one on the beach. They took several canoes after a whale that got close to shore. They drove arrows and harpoons into the huge monster and tried to hit a vital spot. They often went far out to sea, before they made the kills. Then they towed the whale to shore with their canoes [Ward 1986:24].

Ward’s statement suggests she was fully aware of the whaling practices of more northerly Native groups and that she viewed these as distinct from those once employed in Oregon. As in the above accounts, this description suggests opportunistic hunting of nearshore whales using at least two types of hunting implements, bow and arrow, and harpoons.

Finally, Kroeber and Barrett (1960:125–126) discuss "alleged" accounts of whale hunting on the northern California and far southern Oregon coasts. The authors dismiss several accounts regarding local whaling due to confusion about the location of the observed whaling—several of the accounts almost certainly refer to Native whaling in Washington or British Columbia, not northern California. However, these authors cite G.W. Hewes’s ([1947] in Kroeber and Barrett 1960:125) dissertation where he reports that "some of the old Tolowa had spoken of a time when their people went out to sea in their canoes and harpooned the whale. To the harpoon line was attached one or two sea-lion paunches as floats. These floats were sufficient to prevent, or at least discourage, the whale from sounding." Kroeber and Barrett (1960:126) argue that Tolowa whaling was highly unlikely because they historically lacked oceangoing canoes, and their harpoons were of insufficient size for whale hunting. They speculate that knowledge about such practices may have been derived through contact with European, American, and Russian whalers working along the coast. Given the above accounts from Washington and Oregon dating to the mid-1800s, one might consider their dismissal of Tolowa whaling premature.

**Discussion**

The common perception of whale use on the Northwest Coast as involving either systematic and intensive whale hunting or only whale scavenging is probably too simplistic. Peoples of many areas of the coast likely hunted whales at various times in the past on an opportunistic basis, a practice Whitridge (1999) has termed “low level” whale hunting. Northwest Coast hunters likely employed a variety of technologies in this opportunistic hunting, including forms of harpoons, lances, and other projectiles not utilized by the groups that systematically practiced whale hunting (as whale-hunting implements). A variety of whaling techniques and
technologies were clearly used in the Arctic during the ethnographic period (Whitridge 1999), and it is likely that this could have been the case along the west coast of North America. In other words, there is no reason to assume that occasional whale hunting would have required the same suite of tools ethnographically documented among the Northwest Coast’s systematic whalers.

Why not occasionally hunt whales? Obviously whale hunting could be a high risk activity, and would sometimes require seaworthy boats and a well-prepared and an organized hunting party, Also, a captured whale would require considerable time to process. However, prior to industrialized whaling activities, these animals likely constituted substantial portions of the marine biomass (Evans 1987:293; Schultz 1990:94–95), and it is difficult to believe that nearby animals would have been totally ignored, especially by cultures reliant to a large degree on marine resources. Whale populations that have recovered from the devastating effects of industrialized whaling are now often found in abundance in nearshore waters. For example, of the numerous migrating gray whales that pass south along the Oregon coast in March, 40 percent can be found less than one mile (~1.6 km) from the shore (Herzing and Mate 1984). On their return northward, 97 percent of the gray whale cow-calf pairs pass within .8 km (.5 mile) of shore, often just beyond the surf zone. If such patterns existed in prehistory, literally thousands of whales passed along the coast well within the reach of even relatively simple watercraft. Ethnographic and ethnohistoric accounts also clearly indicate whales occasionally entered estuaries and other sheltered waterways where they were even more vulnerable to hunters.

The return rendered in capturing a whale can be enormous, both in terms of prestige and food. Even among the Northwest Coast’s systematically whaling groups, whaling was the prerogative of a select few and conferred upon them considerable prestige. During the early ethnographic period even the ability to cause whales to drift ashore was considered an exemplary skill. Much of this prestige may have related to the risks inherent in whale hunting, but some of it also likely related to the potential food returns. For example, Whitridge (2001:42–43) estimated that a 6,350 kg (7 ton) bowhead whale (Balaena mysticetus), if totally rendered for food, could provide the caloric needs for around 60 people for six months. Adult humpback whales are over three times this size (Winn and Reichley 1985:243). A single whale could provide multiple households with months of food and probably substantial excess for trade, feasting, and other forms of aggrandizing.

Struck whale bones have yet to be identified in other sites in the region, perhaps as a result of several factors. First, sample size issues may partially be to blame. Few sites on the southern Northwest Coast have been extensively excavated and had their faunal remains fully analyzed. The current sample of one struck bone was found in what may be the most-extensively excavated site in the region. In other words, struck bones may be present in other sites, but they have yet to be identified. Clearly, whale bone has been found in numerous other sites on the southern Northwest Coast, sometimes in abundance (e.g., Lyman 1991:150, 273). Second, struck bones may be very rare to begin with, especially when the hunting technologies used were not designed for the purpose. Even in the core area of ethnographic whaling, only a handful of struck bones have been found outside of the remarkably well-preserved “wet site” of Ozette. Perhaps only in the largest and most well-studied assemblages will they be evident.

Finally, we suspect that much whale bone has been ignored or little studied when it has been recovered from sites outside the core region of ethnographic whaling. This is likely due to several factors, including the rarity of comparative cetacean skeletal collections (Monks 2005). Rather than misidentify whale remains, investigators appear to be labelling them as cetacean and doing very little else with them. Also, the heavy reliance in Northwest Coast archaeology on standard ethnographic sources may be leading to assumptions that whaling never occurred in many areas, even on an occasional basis. Many of the standard southern Northwest Coast ethnographies (Barnett 1937; Boas 1923; Drucker 1937, 1939; DuBois 1932; Elmandorf and Kroebner 1960; Jacobs 2003; Kroebner and Barrett 1960; Olson 1967; Taylor 1974) involved interviews with only a few individuals and lack any Native “voice,” except when oral tradition is presented. Dissenting opinions on standard cultural practices are typically not provided, and a homogenized picture is often presented. These ethnographic sources probably present an overly
narrow picture of past subsistence practices, even as they existed post-Euro-American contact.

To better understand whale use on the Northwest Coast, additional research is needed on the many unanalyzed faunal and tool assemblages. Whale bone assemblages need to be analyzed with the same level of detail often given to cervid and pinniped remains. Undoubtedly, problems with the identification of whale remains from sites will remain, but the application of ancient DNA techniques should go far in resolving basic identification problems. Definitively proving whale hunting was occurring anywhere will remain difficult because there is simply no way of determining from archaeological data who was actually doing the hunting and where this hunting was carried out. We believe we have made a convincing case for the possibility of whale hunting outside the core region where it was documented ethnographically on the Northwest Coast. We encourage other investigators to more fully engage in the study of the region’s numerous whale bone assemblages.

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Notes

2. Count excludes chipped stone debitage.
3. It is certainly possible that bone points, both barbed and unbarbed, were employed in hunting birds, terrestrial mammals, and fish. However, we suspect that those points equipped with line attachment features were used on aquatic animals, particularly fish and sea mammals.
4. The radiocarbon dates derive from units SW21G and SW20G and were corrected for isotope fractionation. The dates are published here for the first time. Data provided courtesy of Risa Arbolino from the Smithsonian Archives, R.U. 387, Box 11. Dates were corrected for isotopic fractionation and were calibrated with Calib 5.0 (Stuiver and Reimer 1993). Calibrated age range is at one sigma.
5. While it is theoretically possible the phalange was obtained via trade from another group, we are unaware of any accounts of the exchange of unmodified whale bone on the Northwest Coast. Whale bone was certainly a traded item, but apparently only after it was extensively modified.

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