Human colonization of the Americas: timing, technology and process

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Abstract

Geological and archeological research indicates that humans first colonized the Americas with the use of watercraft along the southern coast of the Bering Land Bridge and the western coast of the Americas. Early dates from a number of archeological sites in the Americas indicate human colonization of the Americas began prior to ca. 13,000 BP. A review of archeological sites in eastern Beringia identifies several distinctive cultural traditions which had developed by 11,000–10,000 BP. Geological, biological, linguistic evidence, and dated human skeletal remains all suggest human occupation of the Americas prior to ca. 11,500 BP. Glacial geology indicates colonization could have begun ca. 14,000–13,000 BP along the western coasts of the Americas and ended about 5000 BP with deglaciation of the Canadian eastern Arctic and coastal Greenland. The use of watercraft and coastal navigation prior to 11,000 BP are inferentially demonstrated. A model for early coastal and subsequent inland colonization of the Americas along large ecological zones best fits current geologic and archeological data.

1. Origins

Humans evolved in the Old World, beginning in Africa and subsequently colonizing Eurasia, Australia, and the Americas. Many archeologists believe that the first humans to enter the Americas came from northeast Asia via the Bering Land Bridge sometime ca. 12,000 years ago about the end of the Wisconsin glaciation, the last glacial stage of the Pleistocene Epoch in North America. However, this is not the only possible time for humans to have reached the New World. Some archeologists (Simpson et al., 1986; Irving et al., 1986; Carter, 1952, 1957 and others) believe humans may have come to the Americas 200,000–150,000 years ago during earlier glacial stages when the Bering Land Bridge formed as a result of lower sea levels (Hopkins, 1973). However, other researchers are of the opinion that humans first arrived in the Americas within the ca. 50,000 years ago during the Happy Interval (Hopkins, 1979, 1982), and more likely within the last 14,000 years (Hrdlička, 1928; Haynes, 1969; Griffin, 1979). Reliably dated human skeletal remains have not been found in the Americas which are older than 12,000 BP. This supports other evidence suggesting that humans first arrived in the Americas toward the end of the Wisconsin glaciation. Research dating late Pleistocene deglaciation indicates that terrestrial connections between eastern Beringia and areas south of the North American continental glaciers were not reestablished until about 11,000 BP (Jackson et al., 1997). This precludes a mid-continental route for human entry until ca. 11,000 BP.

2. Beringia and the ice-free corridor

The Bering Land Bridge has been a cornerstone in American paleontology and archeology for hundreds of years. In addition to explaining the exchange of plants and large terrestrial mammals between Asia and North America, it is presumed that hunters of large terrestrial mammals probably first entered North America from Asia via the Land Bridge. The traditional explanation is that humans then moved south through central western Canada sometime about 11,500 BP, either through a hypothetical ice-free corridor or after the continental glaciers melted (Fig. 1). According to this theory, the pattern of Old World mammoth hunting was transposed to North America near the end of the last ice age by peoples using Clovis, or Clovis-like technology.

There is little evidence to support the traditional paradigm of mammoth hunters “expanding” from the Asian
steppe into Beringia and southward through what is now interior Canada into more southern regions of the Americas. The only places from which there is firm evidence for mammoth hunting is on both sides of Beringia, not Beringia itself (Haynes, 1967; Jennings, 1974; Griffin, 1979; Stanford, 1979). Some of the more important or better known North American sites include Meadowcroft Rock Shelter in Pennsylvania (Adovasio et al., 1977, 1978, 1980), the Dutton and Selby sites in Colorado (Stanford, 1979, 1983; Graham, 1981), the Manis Mastadon site (Gustafson et al., 1979), and Valsequillo in southeastern Mexico (Irwin-Williams, 1967, 1969, 1978). South American sites include Pedra Furada in northeast Brazil (Guidon and Delibrias, 1986; Delibrias et al., 1988; Parenti et al., 1990) Tiama-Tiama in northern Venezuela (Rouse and Cruixt, 1966; Cruixent and Ochesnious, 1979; Bryan, 1979; Bryan and Gruhn, 1979) and Monte Verde in southern Chile (Dillehay, 1989, 1997). While the age or the cultural origin of all these sites are controversial, Monte Verde is accepted as a pre-Clovis site.

Monte Verde, located in south-central Chile, is a campsite reflecting a wide range of human activity including residential structures and exceptionally well-preserved organic remains including bone, wood and other materials. The site has been scientifically excavated under the direction of Dillehay and his fellow researchers (Dillehay, 1997). A series of eight stratigraphic units (labeled youngest to oldest, MV-1 through MV-8) have been described and dated by seven concordant $^{14}$C determinations. Artifacts and other evidence of human occupation have been recovered from MV-7, which is capped by a layer of peat that sealed and preserved the archaeological materials.

Dillehay (1984, 1986, 1997; Collins and Dillehay, 1986) reports the remains of at least 12 dwellings, presumably covered with animal skins, containing shallow clay-lined braziers. Large “communal” hearths were found with the remains of edible seeds, nuts, fruits, and berries, and wood artifacts have been recovered including mortars, wooden hafts containing stone flakes, digging sticks, a pointed lance or spear, and vast amounts of worked wood. Although there are a few well-made bifacially flaked stone tools, most of the lithic industry consists of individual flakes, split pebbles and other stones exhibiting little modification from their natural states. There are many nearly spherical forms, a few of which are grooved and were possibly used as bola weights and/or stones for slings. Although no human remains were recovered, footprints of a child or small adolescent were preserved on the surface of MV-7. No geologic or other noncultural

3. Oldest archaeological sites in the Americas

There is no professional consensus on the time humans first colonized the Americas. There is widespread concurrence that the Clovis complex (11,500–11,000 BP) provides a minimum limiting date for human colonization. Some archeologists believe that the Clovis complex represents the tangible remains of America’s first colonists. However, numerous archeological sites have been reported from North and South America that some archeologists believe predate Clovis and the deglaciation of central northern North America.

North American archeologists have established protocols to test the validity of Pleistocene archeological remains in the Americas (Haynes, 1967; Jennings, 1974; Griffin, 1979; Stanford, 1979). Some of the more important or better known North American sites include Meadowcroft Rock Shelter in Pennsylvania (Adovasio et al., 1977, 1978, 1980), the Dutton and Selby sites in Colorado (Stanford, 1979, 1983; Graham, 1981), the Manis Mastadon site (Gustafson et al., 1979), and Valsequillo in southeastern Mexico (Irwin-Williams, 1967, 1969, 1978). South American sites include Pedra Furada in northeast Brazil (Guidon and Delibrias, 1986; Delibrias et al., 1988; Parenti et al., 1990) Tiama-Tiama in northern Venezuela (Rouse and Cruixt, 1966; Cruixent and Ochesnious, 1979; Bryan, 1979; Bryan and Gruhn, 1979) and Monte Verde in southern Chile (Dillehay, 1989, 1997). While the age or the cultural origin of all these sites are controversial, Monte Verde is accepted as a pre-Clovis site.

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processes have been identified to suggest this suite of evidence could have been produced by any mechanism other than human occupation. Monte Verde meets, or exceeds, the criteria establishing pre-Clovis validity for archeological sites in the Americas (Meltzer et al., 1997).

Two hearth-like features suggest the possibility that there may be an even earlier occupation at the site. They were discovered stratigraphically below unit MV-7, about 70 m north of the main occupation (Dillehay and Collins, 1988; Dillehay, 1997). Two $^{14}$C determinations from these features are 33,370 ± 530 (Beta-6754) and >33,020 (Beta-7825). Scattered about them were 26 naturally fractured stones, which appear to have been used by people. In the absence of other evidence, the investigators are not certain that these features present unequivocal evidence of human occupation.

4. Human remains

Unlike the Old World, the New World lacks human remains anatomically similar to very early human forms such as *Homo erectus*, *Homo sapiens neanderthalensis*, or even Archaic *Homo sapiens*. Human remains found in the New World appear to be completely modern humans, *Homo sapiens*. The only possible evidence to the contrary is the inconclusive identification of a human supraorbital ridge from the Chapala Basin, Mexico, which has been compared to the supraorbital ridge from Old World examples of *Homo erectus*. However, Solorzano (1990; Haley and Solorzano, 1991) cautions that this identification has been made on a small fragment of bone. Other researchers suggest that this bone may not be human, but rather derived from the fragmentary remains of another element from a different species. Another report of pre *Homo sapiens* from the New World is a curious article and illustration of an archaic human calvarium (skull cap) by Bryan (1978, pp. 318–321) which, since his description, has disappeared.

The three oldest sets of reliably dated human remains from north America are from Fishbone Cave, in western Nevada; Arlington Springs on Santa Rosa Island, California; and the Anzick site, Montana. Radiocarbon dates of 11,555 ± 500 BP (no lab # cited) and 10,900 ± 300 BP (L-245) BP were reported from Fishbone Cave by Orr (1956, p. 3) for level 4. This level contains the partial remains of a human skeleton consisting of the burned remains of a left foot, a clavicle, and a fibula.

Two human femora, a humerus and an unidentified bone were found about 37.5 ft (11 m) below the surface on Santa Rosa Island (Orr, 1962, p. 418). Based on the size of the femora, Orr suggested they were the remains of an adult male. These remains have become known as Arlington Man. Chemical analysis demonstrated that the bone was fossilized suggesting considerable antiquity (Oakley, 1963). Charcoal from the stratigraphic unit containing the human remains was $^{14}$C dated to 10,400 ± 200 BP (L-568A) and 10,000 ± 200 (L-650) (Orr, 1962, p. 419). Although the human bone originally submitted was considered unsuitable for $^{14}$C analysis (Morris, cited in Erlandson, 1994, p. 186), Berger and Protsh (1989, p. 59) were able to obtain a $^{14}$C determination of 10,080 ± 810 BP from a long bone of Arlington Man. Controversy over the age of the human remains has focused on the large standard deviation associated with this date and the fact that there was only one $^{14}$C determination. To address the controversy, additional AMS $^{14}$C determinations were run by Johnson and Stafford (1997, pers. comm.) resulting in an AMS $^{14}$C date of 10,970 ± 80 (CAMS-16810) on collagen from the human bone and another AMS $^{14}$C determination of 11,490 ± 70 on *Peromyscus* sp. bone collagen directly associated with the human remains. Arlington Man also provides the earliest evidence for the use of watercraft in North America because Santa Rosa Island was not connected to mainland North America during the last ice age (Erlandson, 1994, p. 183).

The Anzick rock shelter located in Montana was accidentally discovered in 1968 (Jones and Bonnichsen, 1994). The site and context of the artifacts and human remains were largely destroyed by construction activities before they were examined by trained scientists. The burial(s) contained two individuals and an assemblage of more than 100 stone and bone artifacts. Both individuals are described as “subadults” (Wilke et al., 1991). Two very small pieces of human crania, one from each individual, were directly dated by the AMS method. One was bleached white and the other stained with hematite (ochre). The bleached crania dated 8600 ± 90 BP and the ochre-stained bone dated 10,680 ± 50 BP (Stafford, 1990, p. 121; 1994, p. 49–51). More recently a second $^{14}$C AMS date of 11,550 ± 60 (CAMS-35912) has been obtained on gelatin from the ochre-stained crania (Stafford, pers. comm., 1997). It is difficult to explain the difference in these two dates, and resolution of this problem will require additional dating.

Direct AMS dating of human bone provides unequivocal proof and limiting dates for humans in the Americas. The oldest human remains from Anzick, Fishbone Cave, and Arlington Springs appear to be between ca. 11,500–11,000 BP. This indicates that by this time human population density had achieved a level sufficient to assure the survival and discovery of fossil remains over a broad geographic areas and from different depositional environments. Prior to ca. 11,000–11,500 BP the North American human population may have been extremely small or geographically restricted. Toth (1991, p. 55) has suggested that if we assume a model for the colonization of the Americas as ever increasing population over time, the odds of documenting the very earliest evidence of human occupation are very slim.
5. Biological and linguistic evidence

Linguistics and biological anthropology demonstrate that Native Americans most likely came to the Americas from northeast Asia. Turner (1983) has studied the dentition of Native Americans and northeast Asians. Based on about 20 dental traits, such as the shape of tooth crowns and the number of tooth roots, he has defined an overall dental pattern which he calls “Sinodonty”. This distinctive dental pattern is shared among Native Americans and people from northeast Asia. However, Sinodonty is not found in people who originated in southern Asia, Africa, or Europe. Another less complex dental pattern, called Sundadonty, is shared among peoples of Southeast Asia and occurs in some early Native American skeletons including Kennewick Man (Chatters, 1997). Turner (1992, p. 6) concludes that because there has been less dental evolution in the Americas, the New World has been occupied for less time than Asia, and that widespread Sinodonty demonstrates a northeast Asian origin for Native Americans. However, Merriwether et al. (1996) identify Mongolia as a more likely point of origin for New World founding populations based on their analysis of the mitochondrial DNA (mtDNA) of Native Mongolians.

Turner (1983, 1985, 1992) recognizes three subdivisions of Sinodonty based on the dental characteristics, and proposes that colonization of the Americas occurred in three distinct migrations. The first were ancestors of the peoples of South America and southern North America. The second were ancestors of Native Americans residing in interior Alaska and along the Northwest Coast. The third were the Aleut-Eskimo who occupy the coastal fringes of Alaska. Some genetic research may support Turner’s “three wave” model (Williams et al., 1985).

The dental evidence appears to correspond with linguistic data compiled by Greenberg (Greenberg et al., 1986; Greenberg, 1987, 1997). By applying a process called “mass comparison”, he lumped Native American languages into three groups called Amerind, Na-Dene and Eskimo-Aleut. The linguistic data appear to correlate well with the dental evidence. It suggests that the first arrivals to settle the Americas were the ancestors of the Amerinds, the second “wave” were the ancestors of the Na-Dene and the last to emigrate to the New World were the Eskimo-Aleut (Greenberg et al., 1987).

The analysis of nuclear, and mitochondrial DNA has led to alternative conclusions. In analyzing mtDNA from Native Americans, Schurr et al. (1990) recognized four basic mtDNA lineages, or haplogroups, which they labeled A–D. The fact that only four lineages could be identified suggests that the founding population(s) may have been very small. All four lineages occur in all Native American populations, but it is not clear how this information can be interpreted properly. Based on mtDNA analysis, Torroni et al. (1992) conclude that Amerind and Na-Dene populations were founded by two separate migrations. However, research by Horai et al. (1996) draws the conclusion that the four haplogroups are evidence of four respective ancestral populations that migrated to the Americas gradually in different “waves”. On the other hand, Merriwether et al. (1995) reason that because all four founding lineages are found in all Native American populations, the concept of a single migration with all four lineages being derived from the original founding population is probable. Other researchers (Bailliet et al., 1994; Lorenz and Smith, 1996) report evidence suggesting there may have been at least one more haplogroup in Native American populations prior to contact with Europeans. Although the conclusions drawn from this research are controversial, mtDNA research raises serious challenges to the “three wave” migration model based on the analysis of contemporary languages and prehistoric dental traits.

Archeologists have long recognized the difficulty in identifying genetic, ethnic, and linguistic “signatures” in the archeological record. Although much work remains to be done, it is clear that to establish migration of people, it is necessary to document a culture in one region and subsequently document it in another. To do this, it is necessary to identify material traits that can be reliably attributed to a specific culture. The early archeology of eastern Beringia and North America is so poorly understood, that this is impossible to do except at gross levels of comparison.

6. Colonization processes

There is no need to think of human migration as a specific event. Humans may have populated the Americas in small numbers, or migratory “dribbles”, over long periods of time (Meltzer, 1989). Some migrations may have been successful, and others may not have been. Some of these small groups of early migrants could have been genetically swamped by later groups, exterminated by warfare or by the introduction of disease, too small to be viable, or unable to adapt to new environments.

If the earliest immigrants were few in number, had technology derived from perishable organic material, and survived for only a short time, the evidence of their passing would be extremely difficult to detect in the archeological record. This would be even more difficult if these early peoples lacked what archeologists consider to be diagnostic artifact types, such as fluted stone projectile points. There would be no genetic or linguistic evidence in extant populations if the colonists did not survive, and there may not exist a continuous archeological record extending from the Pleistocene to later well-documented North American archeological sites. It is possible that there were sporadic colonization events that are not connected to subsequent development of New World
archaeology. Tracing the migration of specific groups of people is extremely difficult in the archeological record.

Some researchers believe that ecological disequilibrium may result in human dispersals and that initial contact between humans and select species may cause their extinction. Paul S. Martin (1967, 1973, 1974) has advanced the “overkill hypothesis” which postulates that the first human hunters to enter the Americas were responsible for the extinction of approximately 70 genera. According to this scenario, as humans moved into the Americas, they encountered large mammals that had developed no effective means of evading intelligent and sophisticated human predators, and humans quickly hunted these large mammals to extinction.

Kelley and Todd (1988; Kelly, 1996) have advanced a variation of Martin’s model. They suggest that the first Paleoindians were technologically based foragers. Unlike modern foragers who are geographically based and generally confined by neighboring foraging groups, the earliest human groups in North America may have relied more on knowledge of animal behavior and technology rather than knowledge of geography. This may have enabled them to move from region to region exploiting various species, some of which may have been preferred. Such a subsistence strategy could result in comparatively rapid human “migration” and the extinction of select species.

Aquatic metaphors such as “waves”, “trickles”, “dribbles”, and “drift” are frequently used to describe the peopling of the Americas. However, these “terms” tell us little, if anything, about the actual processes of human colonization. Currently there exist very few models for the peopling of the Americas. Mosimann and Martin (1975) demonstrated that humans could have colonized both North America and South America in approximately 1000 years and concurrently killed off the large Pleistocene mammals. Some scientists counter that dramatic change in climate caused the extinction of ice age mammals, while others suggest that a combination of both climatic change and human predators were the cause.

Wormington (1983, p. 192) believed that human colonization of the Americas took much longer than the model proposed by Mosimann and Martin. In her view, early hunters and gatherers needed more time to develop familiarity with their environment and its resources, and once they had gained this knowledge they were reluctant to move. She regarded environmental change and population pressure as the causal mechanisms for human groups to move. This type of model requires a much greater amount of time for humans to colonize the American continents than that advocated by Mosimann and Martin (1975).

In their attempt to model the human colonization of the Americas, Mosimann and Martin (1975) rely heavily on the work of Birdsell (1957), who derived his statistics from his research of human population expansion on Pitcairn — a remote Pacific island that was uninhabited until 1790, when it was colonized by nine mutineers from HMS Bounty and 19 Polynesians. While these data may be correct and useful in the contexts of the ecology of small islands, Beaton (1991a) suggests it is not applicable for Australia, a large land mass of continental proportion similar to the Americas. It may be inappropriate to extrapolate the human environmental impact from small Pacific islands to continental land masses.

Furthermore, it is necessary to emphasize that the scale of investigative resolution fit the scale of the problem (Beaton, 1991a, p. 220). In other words, when attempting to address human colonization of continents, such as the initial peopling of the Americas or Australia, it is more useful to look at large, or macro, environmental zones. Such large environmental zones, or biomes, include regions such as coastlines, rather than smaller ecological areas such as estuaries or headlands. These macroenvironmental regions, or biomes, are what Beaton (1991a) calls “megapatches”, which are large environmental zones or areas such as coasts, forests, deserts, and mountains.

The major physiographic and ecological regions of the Americas tend to be oriented linearly from north-south. For example, the western cordillera of North America form a huge mountainous “spine” extending from Alaska to Arizona, the plains extend from Alberta, Canada to northern Mexico, and the western coastal coniferous forest stretches from Alaska to California.

The bow wave model proposed by Mosimann and Martin (1973) is illustrated in Fig. 2. It is characterized by bow-shaped lines, or “waves”, symbolizing the sequential advance of the human population at approximately the same latitude. By comparison, the ecological zone model illustrated in Fig. 8 is characterized by more vertical lines that parallel the major environmental zones, such as the coast and the western Cordillera.

Linear north-to-south colonization could have also occurred along ecotones, which are zones of transition between two or more biomes. These transitional environments may have been the “megapatch of choice”, possibly being more productive than either of the adjacent biomes and possibly permitting people access to resources in adjacent biomes. On a very large (continental) level of analysis the coastal zone could be regarded as an ecotone, where the resources of both the marine and terrestrial biomes are available.

In relatively linear environmental zones such as river systems or coastal margins, colonization might be expected to be rapid, possibly resulting in high-velocity settlement in conjunction with the use of watercraft. In other types of ecological settings, colonization may have occurred at a much slower rate. With colonization occurring along major environmental zones, it may be
reasonable to assume that different environmental regions of the Americas were colonized at different times. For example, coastal zones may have been inhabited long before the interior plains or deserts.

7. Early archeology of eastern Beringia

Three archeological traditions and two complexes have been identified in eastern Beringia and the Pacific Northwest. The earliest is the Nenana complex (older than 11,600–10,500 BP), discovered at several sites in Interior Alaska. Archeologists have not ascertained the origins of the Nenana complex.

The second major cultural development is called the American Paleoarctic tradition (10,500–8,000 BP). It is derived from Asia and has its technological roots in the late Upper Paleolithic microblade industries of Eurasia. The hallmark of this tradition is microblade technology. The American Paleoarctic tradition is subdivided here into three regional variants: (1) the first retains the original name, the American Paleoarctic tradition, (2) the Denali complex, and (3) the Northwest Coast Microblade tradition.

The third major cultural development in eastern Beringia is the Northern Paleoindian tradition (ca. 10,500–8,500 BP), believed to be a northern manifestation of the Paleoindian tradition of western North America. The American Paleoarctic tradition, the Northern Paleoindian tradition, and Denali complex are co-traditions. Co-traditions existed when people living in adjacent regions practiced different ways of life.
and made different types of tools during the same period of time. Each of these traditions is reviewed briefly to demonstrate how they support a coastal colonization model.

8. Nenana complex (ca. > 11,600–10,500 BP)

The Nenana complex (greater than 11,600 BP–10,500 BP) is defined on the basis of stone artifacts which date to the same time period found in Alaska’s Nenana River valley (Powers and Hoffeecker, 1990). Field research in the upper Tanana River Valley in the early 1990s discovered similar artifact assemblages (Fig. 3). Nenana complex peoples may have been confined to interior Alaska prior to melting of Brooks Range glaciers (Hamilton and Goebel, 1999). Artifact types that define the Nenana complex are: (1) triangular and “teardrop-shaped” projectile points and knives, (2) straight- or concave-based lanceolate projectile points, (3) perforators, (4) end and side scrapers, (5) burins, (6) hammer and anvil stones, (7) unifacial knives and scrapers. Flakes, small stone wedges (piec esquille’ e), and lithic debitage are also associated with these sites. These diagnostic types of stone artifacts have been found at Component I at the Dry Creek site, the Walker Road site and the Moose Creek site. Another Nenana complex site in the Teklanika River valley has been dated to 11,340 ± 150 BP and contains the same types of artifacts (Phippen, 1988).

Radiocarbon dates from Components I at the Walker Road and Dry Creek sites range between ca. 11,800 and 11,000 BP, averaging ca. 11,300 BP (Powers and Hoffeecker, 1990, p. 278). Nenana complex sites are found near the bottom of thick sections of windblown sediments that began to accumulate during the early Birch interval (ca. 14,000 BP).

The earliest firmly dated archeological remains ascribed to the Nenana complex come from sites located in Alaska’s Tanana River Valley: the Broken Mammoth, Mead, and Swan Point sites. Extensive excavations have not been conducted at the Mead site. The oldest paleosol identified at the site is dated to ca. 11,600 BP, from which a cylindrical ivory object, a scraper, a few biface fragments and waste flakes, and possibly a small projectile point fragment were recovered.

The Broken Mammoth site has yielded more information. This site is important because it is well stratified, contains four major periods of cultural occupation, and exhibits concurrent 14C determinations. It is possibly

![Fig. 3. Map depicting the location of important archeological sites and site components ascribed to the Nenana complex (modified from Dixon, 1993 and reproduced with permission of University of New Mexico Press).](image-url)
the oldest reliably dated site in Alaska. A series of nine $^{14}$C determinations indicate Cultural Zone IV was occupied between ca. 11,700–11,000 BP. Cultural remains from Zone IV include waste flakes, a quartz “chopper/scaper/plane”, retouched flakes, biface thinning flakes, scrap fossil ivory, and a cache of tools made of fossil ivory consisting of two cigar shaped “points” and a possible handle (Yesner, 1996).

At Swan Point the oldest cultural level (ca. 11,660 BP) contains worked mammoth tusk fragments (probably scavenged “fossil” ivory dated to 12,060 ± 70 (NSRL-2001, CAMS-17045)), microblades, microblade core preparation flakes, blades, split quartz pebble chopper/planes, dihedral burners, and red ochre. The next oldest occupation, dated by one $^{14}$C determination to 10,230 ± 80 BP, (BETA-56666, CAMS-4251) (Holmes et al., 1996), lacks microblades and contains small lanceolate points with convex/straight bases, thin triangular points, gravers made on broken points and quartz pebble choppers or hammers. Although the ca. 11,660 year old component appears anomalous based on the presence of a microblade technology, the later occupation dating to ca. 10,230 BP is consistent in its artifact assemblage with other Nenana complex sites.

Swan Point is an anomaly because it appears to have a microblade industry more than a thousand years earlier than anywhere else in Interior Alaska, even earlier than similar assemblages from western Beringia. The Denali complex at Swan Point is dated by two $^{14}$C samples. One was from mammoth ivory dating to 12,060 ± 70 (CAMS-17045) which was probably older scavenged ivory (Holmes et al., 1996, p. 323). The other dates, 11,660 ± 70 BP (BETA-56667, CAMS-4252) and 11,660 ± 60 BP (BETA-71372, CAMS-12389), were run on willow and poplar charcoal derived from a cultural hearth associated with the microblades (Holmes et al., 1996, p. 321). Goebel and Hamilton (1999) suggest that the microblades may have been mixed with older charcoal immediately after the deposition of a pebbly fluvial layer and immediately before the overlying loess began to accumulate. The older dates could also result from other factors such as burning older “fossil” wood. Swan Point is still in the early stages of investigation and additional research is required to resolve the age of the early microblade component and its relationship to the Nenana complex.

The Healy Lake Village Site contains distinctive “tear drop”-shaped bifaces, called “Chindadn” points, found in the lower levels (Cook, 1969, 1996). Chindadn points are generally small and occasionally ground on one lateral edge, suggesting they were dulled for hafting and used as knives. This distinctive artifact occurs in Nenana complex type sites, and other sites in the Tanana valley. Component I of the Owl Ridge site also has been ascribed to the Nenana complex and radiocarbon dated to 11,340 ± 150 BP (Beta-11209) (Phippen, 1988).

The relationship between the Nenana complex and somewhat earlier Tanana Valley sites is not well understood. Preliminary data suggest that both groups of sites share a number of common traits, and may be regional and temporal variants of a larger tradition or complex. With the notable exception of Swan Point, all lack evidence of microblade technology. All contain small triangular bifacially flaked projectile points, some of which have concave bases and are basally thinned, and many sites contain distinctive pointed ovate “Chindadn” bifaces.

Except for the few gastroliths, the original evidence from Dry Creek suggested that Nenana complex peoples were big game hunters primarily hunting elk and sheep. However, additional data from the Broken Mammoth site demonstrates a more generalized opportunistic gathering economy which included harvesting waterfowl, gathering eggs, and hunting and/or trapping small mammals. Large mammal hunting, particularly for bison, elk and sheep, was important. Proboscidean remains (mammoth or mastodon ivory) resulted from collecting fossil ivory rather than mammoth or mastodon hunting.

Trace element analysis indicates that obsidian from the Wrangell Mountains occurs in the lowest levels at Broken Mammoth and Walker Road sites. Obsidian from the Batza Tena source on the south side of the Brooks Range also occurs in Tanana valley Nenana complex sites. These discoveries demonstrate that a widespread trade network was already in place in interior Alaska probably as early as ca. 11,700 BP (Hamilton and Goebel, in press).

All sites ascribed to the Nenana complex were small camps generally located on bluffs with panoramic views. They appear to have been occupied by small groups of people for brief periods of time. No human remains or evidence of structures have yet been found and fires appear to have been built directly on the surface of the ground with little or no preparation of the area. Charcoal is generally scattered and relatively scarce for dating purposes. Minute unidentifiable calcined bone fragments have been recovered frequently from these hearths, suggesting bone was burned as fuel, for ritual purposes, or to keep camps clean. Red ochre has been reported associated with several Nenana complex occupations (Goebel and Powers, 1989; Phippen, 1988, p. 118; Powers and Hoffercker, 1990, p. 281, Holmes et al., 1996).

Most sites were probably open-air camps probably using skin tents or temporary tent-like structures. Although no structural remains were discovered, the spatial distribution of more than 130 artifacts around a circular clay-lined hearth at the Walker Road site were interpreted to be the location of a circular tent about 5 m in diameter (Goebel and Powers, 1989; Powers et al., 1990). The full range of the Nenana complex settlement pattern and subsistence cycle is still poorly understood.
Fig. 4. Map depicting the location of important archeological sites and site components ascribed to the American Paleoarctic tradition (modified from Dixon, 1993 and reproduced with permission of University of New Mexico Press).

9. American Paleoarctic tradition (ca. 10,500–7000 BP)

Anderson (1970, p. 69) first defined the American Paleoarctic tradition to include the Akmak and Band 8 assemblages from the Onion Portage site, the early microblades from the Trail Creek Caves, and various undated assemblages from the Brooks Range characterized by wedged-shaped microblade cores, microblades, and other artifact types. Since that time the American Paleoarctic tradition has been used to lump a wide variety of early microblade and microcore assemblages which are widely dispersed throughout eastern Beringia (Fig. 4).

Because so many regional variants and different economic systems have been subsumed under the American Paleoarctic tradition, the term has lost much of its descriptive utility and is no longer very useful as a tradition in classic definition of the term. It has been divided into three basic units: (1) the American Paleoarctic tradition, (2) the Denali complex, and (3) the Northwest Coast Microblade tradition (Dixon, in press).

The diagnostic lithic artifacts associated with the American Paleoarctic tradition include wedge-shaped microblade cores, microblades, blades and blade cores, core bifaces, antler arrow points slotted to receive microblades, grooved stone abraders, and waste flakes. The geographic distribution includes the coastal margins of Bering and Chukchi Seas, the Arctic Ocean, and adjacent terrestrial environments. It extends south roughly to the limit of winter sea ice. Economically, it probably had two aspects, (1) marine mammal hunting, including winter sea ice hunting and (2) exploitation of adjacent non-coastal regions to fish and hunt for terrestrial mammals. When moving inland from the coast, it is difficult to identify where economies based solely on interior environments begin and coastal economic practices are abandoned. Perhaps these different economies are best viewed as gradational, with greater and greater reliance placed on non-marine resources as one moves away from the coast toward the interior.

The archeological record is obscured along Bering and Chukchi Sea coasts because of Holocene sea level rise. However, the persistence of the American Paleoarctic tradition is suggested along the Bering Sea coast. For example, Anderson (1986, p. 313) suggests that the Lower Bench site at Cape Krusenstern may be a transitional microblade assemblage between the American Paleoarctic tradition and the later Arctic Small Tool tradition. Shortly after sea level stabilized, there is widespread recognition of the Arctic Small Tool tradition along the Bering and Chukchi Sea coast. In regions where tectonic uplift or isostatic rebound have outpaced sea level rise, such as Anangula Island, it is clear from the location of the sites adjacent to the sea that they were adapted to a marine economy.

A single $^{14}$C determination from Locality I at the Gallagher Flint Station may suggest that American Paleoarctic populations may have been in place in interior areas adjacent to the coast possibly as early as ca. 10,500 (Dixon, 1975). On the Alaska Peninsula, Paleoarctic tradition occupations are documented from the lowest levels of the Ugashik Narrows site and at Kvichak Bay (Dumond, 1977; Dumond et al., 1976; Henn, 1978). Five radiocarbon determinations indicate that these assemblages range between ca. 9000 and 7000 BP. The Ugashik Narrows site, located along a river with a major salmon run, where large mammals such as caribou and moose may easily cross the river, suggests that fishing and large-mammal hunting were important economic activities.

10. The Denali complex (10,500–8000 BP)

Throughout Interior Alaska and the Yukon Territory, a number of archeological sites have been documented date between ca. 10,500 and 8000 BP and contain bifacial biconvex knives, end scrapers, large blades and blade-like flakes, prepared microblade cores, core tablets,
microblades, burins, burin spalls, worked flakes, and retouched flakes. This suite of artifacts was defined by West (1967, 1974) as the Denali complex. Since that time the list of associated lithic traits has been increased to include large blade cores, straight and convex based projectile points with constricting sides, elongate bifaces, spokeheads, and abraders. The term Denali complex is retained here because it has priority in the literature and is applied to a restricted region (interior regions of eastern Beringia lacking a coastal/marine economic component).

Component II at Dry Creek suggests that the Denali complex first appears in interior Alaska ca. 10,690 ± 250 based on the overall site stratigraphy and 14C dating (Powers and Hoffecker, 1989). Component II at nearby Pangingue Creek has several 14C determinations bracketing this occupation between 8500 and 7500 BP (Powers and Maxwell, 1986; Goebel and Bigelow, 1996). West (1996, pp. 375–380; West and others, 1996, pp. 381–408) reports numerous sites from glacial terrain in the Tangle Lakes region of the southcentral Alaska Range which contain typical Denali complex assemblages. All are relatively shallow sites (less than 50 cm deep) primarily situated on the top of glacial features, some of which appear to have reliable radiocarbon determinations dating Denali complex occupations between ca. 10,500 and 8000 BP. Numerous other sites containing Denali complex occupations have been reported throughout the interior, including the Healy Lake Village site (Cook, 1969; Cook and Mckennan, 1970). In the upper Susitna River drainage, Dixon and Smith (1990) identified six sites which they ascribed to the Denali complex based on typological traits, stratigraphic position within a series of regional tephras, and radiocarbon dating. The Campus Site is now considered to be late Holocene in age based on a reevaluation of the site and associated artifacts by Mobly (1991).

Numerous Denali complex sites have been reported from a variety of ecological settings throughout interior eastern Beringia. The ecological setting of interior sites indicate an economy which included large mammal hunting and freshwater aquatic resources. Faunal remains from Component II at Dry Creek include bison and sheep. Many of the sites in the Alaska Range and Susitna River drainage are ideally situated for caribou hunting. Although data are sketchy, most sites are relatively small, lacking evidence of structures or other features which might be indicative of permanent or semi-permanent settlements. Organic artifacts are rare and little is known about these residents of the interior.

11. The Northwest Coast Microblade Tradition (ca. 10,500–< 7000 BP)

This tradition was first called the Early Boreal tradition (Borden, 1969, 1975), and later given a variety of names, including the Early Coast Microblade complex (Fladmark, 1975), the Microblade tradition (Carlson, 1979, 1981), Early Coast and North Coast Microblade complex (Fladmark, 1982), the Marine Paleoarctic tradition (Davis, 1989), and the Maritime Paleoarctic tradition (Jordan, 1992). Rather than add to this confusing nomenclature, this presentation simply uses the term Northwest Coast Microblade tradition, which is in keeping with Fladmark (1975) and descriptively includes both the geographic area and hallmark technological trait, the shared use of microblade technology. These sites extend from the Kodiak Archipelago southeastward along the Pacific Rim through Southeast Alaska, British Columbia, Washington, Oregon and the northern Great Basin (Dumond, 1962).

A marine economy is indicated for most sites by faunal remains, ecological settings and isotope analysis of human remains from Prince of Wales Island (Dixon et al., 1997). The northern geographic limit of this tradition is difficult to ascertain, but could extend to the south side of the Alaska Peninsula where there is no winter pack ice. Marine subsistence in the Northwest Coast Microblade tradition is adapted to year round open water, rugged forested coasts characterized by fjords, islands, and rocky headlands, calving glaciers, major salmon runs, salt water fishing and intertidal shell fish resources.

It has not been determined when this tradition first appeared along the Northwest Coast. Rising sea level inundated most coastal areas older than ca. 9500 BP. Preserved sites include Beluga Point ca. 7000–8000 BP (Reger, 1996, p. 434). Craig Point, 7790 ± 620 BP (Jordan, 1992), Component III, Ground Hog Bay 2, 10,180 ± 800 and 9130 ± 130 BP (Ackerman et al., 1979; Ackerman, 1996a, b). Hidden Falls, Component I, ca. 9000 BP (Davis, 1989, p. 194), Locality 1 at the Chuck Lake, Locality 1, ca. 8200 BP (Ackerman et al., 1985), Rice Creek, ca. 9000 BP (Ackerman, 1996a, b, p. 127 and 130), and the Thorne River site ca. 7500 BP (Holmes, 1988; Holmes et al., 1989). Obsidian from Hidden Falls and Ground Hog Bay is from Sumez Island (adjacent to Prince of Wales in the Alexander Archipelago) and Mt. Edziza (upper Sitkine River, northern British Columbia) (Nelson, 1976, cited in Ackerman, 1996a, b). This early trade in obsidian required the use of water craft (Ackerman, 1992; Davis, 1989; Erlandson et al., 1992), and implies that the area must have been occupied earlier in order to discover these obsidian sources and develop trade networks.

PET-408 is located on the northern end of Prince of Wales Island, southeast Alaska. Human skeletal remains from this site have been 14C dated to ca. 9800 BP. (Dixon et al., 1997). Isotopic values for the human bone indicate a diet based primarily on marine resources and δ13C values for the human bone are similar to those obtained for ringed seal, sea otter, and marine fish. These data indicate a diet based primarily on sea foods and that the marine carbon reservoir has affected the accuracy of the


The use of watercraft is inferentially demonstrated by the widespread trade in obsidian, fishing for off-shore bottom fish, marine mammal hunting, and the location of sites on islands and other settings accessible from the sea.

12. Northern Paleoindian tradition (ca. 10,500-8000 BP)

Fluted projectile points and related lanceolate forms have been found throughout eastern Beringia (Fig. 5). The fluted projectile points from eastern Beringia have come from sites which either have not been dated or for which the dating is ambiguous. Most scholars have assumed a historical relationship between Paleoindian projectile points from eastern Beringia and those from the southern Plains of western North America based on their morphological similarity. Fluted projectile points have been found primarily in the northern areas of Beringia along the north and south sides of the Brooks Range. A few examples are also reported from regions in central interior Alaska.

Numerous sites containing fluted projectile points from eastern Beringia are part of the larger North American Paleoindian tradition usually associated with the western United States (Dixon, 1993, pp. 15-23). By including the northern examples within the larger Paleoindian tradition the underlying assumption is made that the peoples who made and used these tools in eastern Beringia were part of a larger population of peoples who shared a similar way of life and economic system. This assumption is supported by the fact that most of the northern sites appear to be situated in locales best suited for big game hunting, a strong economic focus of Paleoindians to the south.

There are three hypotheses which address the relationships between the northern and southern Paleoindian assemblages (Clark, 1984a, b): (1) northern Paleoindian artifacts were left by the first humans to reach Alaska and later moved southward, (2) fluted projectile points developed in the more southern regions of North America and spread northward into eastern Beringia, or (3) fluted points were independently invented in eastern Beringia thousands of years after those to the south. This technology could also have developed rapidly from the Nenana complex as it spread south (Goebel et al., 1991). While some Paleoindian sites are known to contain large blades and blade like flakes, Paleoindian tradition peoples did not manufacture microblades or use side blade insets.

Comparative analysis using cumulative percentage curves and cluster analysis demonstrates a close relationship between the Nenana and Clovis complexes suggesting two explanations for the similarities: (1) (following Haynes, 1987 and others) that humans crossed the Bering Land Bridge sometime between 12,000 and 13,000 BP and rapidly moved south “through the Ice-Free Corridor” and that both Clovis and the Nenana complexes...
were derived from this migration, or (2) that both complexes are technologically derived from an earlier migration which hypothetically took place before the "closing of the Ice-Free Corridor" ca. 22,000–25,000 BP (Goebel et al., 1991).

It is also possible that the Nenana and Clovis complexes are inland adaptations derived from an earlier migration along the western coast of the Americas near the end of the Pleistocene ca. 13,500 BP (Dixon, 1993). This hypothesis is strengthened by evidence indicating that Clovis peoples may have used the coast. Several Clovis or Clovis-like sites have been reported near or adjacent to the west coast of North America. The Richie Roberts Clovis cache near Wenatchee, Washington is less than 150 km from the ocean. Clovis points have been reported from a coastal site in Mendocino County, California (Simons et al., 1985) and on the coast near Santa Barbara (Erlandson et al., 1987; Erlandson and Moss, 1996). Because sea level was lower at the time these sites were occupied their distance from the coast would have been somewhat greater than it is today.

The Mesa site has 14 radiocarbon determinations ranging between ca. 11,660 and 9730 BP, derived from 15 hearths at the site (Kunz and Reanier, 1996). Only two dates (derived from the same "split" charcoal sample) exceed 11,000 BP. They appear to be statistical outliers, possibly resulting from burning fossil wood (Hamilton and Goebel, in press). All the remaining dates cluster around 10,000 BP, suggesting this is an accurate date for the Mesa occupation. The projectile points are typologically similar to Agate Basin projectile points from the high plains (Frison and Stanford, 1982). The two pre-11,000 BP dates and the geographic location of the site have led some researchers to suggest that Mesa "culture" may be ancestral to Agate Basin sites from more southern areas of North America (Kunz et al., 1994, 1995; Kunz and Shelley, 1994; Kunz and Reanier, 1996).

The Putu site has two localities which frequently have been treated as separate sites, the Putu and Bedwell sites (Alexander, 1974, 1987; Morlan, 1977; Dumond, 1980; Clark and Clark, 1983; Clark, 1984a, b, 1991; Kunz and Reanier, 1994). The lower component at the Putu locality...
contains fluted projectile points. A single radiocarbon date of 11,470 ± 500 was originally believed to date the fluted points, but reevaluation by Reanier (1995, 1996) demonstrates that two other dates, 8450 ± 130 and 8810 ± 60, probably more accurately date the lower component. Reanier (1995, 1996) obtained an AMS 14C date on charcoal collected during the original excavation of the Bedwell locality which dated to 10,490 ± 70 (Beta 69895, CAMS-11032). Based on comparison of the projectile points with similar specimens from the Mesa site, Reanier suggests this 14C determination may date the Bedwell occupation.

Spiein Mountain extends the range of the Northern Paleoindian tradition to Southwestern Alaska (Ackerman, 1996a, b), and is dated to 10,050 ± 90 (BETA-64471, CAMS-8281). The site lacks microblades or evidence of microblade technology and contains bifacially flaked lanceolate projectile points with constricting bases and other artifact types attributable to the Northern Paleoindian tradition that are similar to artifacts from the Mesa Site and Bedwell sites (Ackerman, 1996a, b, p. 460).

There are a number of isolated surface finds typologically characteristic of Northern Paleoindian tradition projectile points that have been found throughout Alaska and the Yukon Territory. In addition, Northern Paleoindian sites have been excavated in central interior Alaska which date between 10,500 and 8500 BP. These are Component I at the Carlo Creek site dating to ca. 8500 BP (Bowers, 1980), the Jay Creek Ridge site occupied ca. 9500 BP based on six 14C AMS determinations (Dixon, 1993, pp. 85–87), the Eroadaway site (Holmes, 1988), the Eroadaway site dated to 8640 ± 170 BP (WSU-3683) (Holmes, 1988, p. 3), and Component II at the Owl Ridge site dated by four 14C determinations between 7500 and 9500 BP (Phippen, 1988). Yesner et al. (1992) report occupations dating ca. 7500 BP from the Broken Mammoth and Mead sites which also lack evidence of microblade technology but which contain bifacial stone tools. Although component II dating ca. 8600 and 7000 BP at Panguinge Creek (Powers and Hoffecker, 1989, p. 276, Powers and Maxwell, 1986) has been ascribed to the American Paleoarctic tradition, this component does not contain microblade technology but does contain bifacial tools.

A series of four 14C determinations suggests that Cultural Zone III at the Broken Mammoth site was occupied ca. 10,300 BP. Zone III contains waste flakes, point fragments, two small “trianguloid” basally ground projectile points, large biface and point fragments, quartz hammer stones, and a small eyed bone needle (Holmes and Yesner, 1992b; Yesner et al., 1993; Yesner, 1996; Hamilton and Goebel, in press). At the Swan Point site, cultural component III dated to 10,230 ± 80 BP (Beta-56666, CAMS-4252) contains strait and convex-based small lanceolate projectile points as well as thin triangular points.

Two exceptionally well-preserved bone projectile points recovered from Pit I-G, on Goldstream Creek were reported by Rainey (1939, p. 393). Two AMS 14C radiocarbon determinations indicate they were probably manufactured ca. 8500 BP. These specimens were not slotted to receive microblade insets and they are probably atlatl dart points (Dixon, 1999).

Sites and site components ascribed to the Northern Paleoindian tradition all contain projectile points similar to Paleoindian sites elsewhere in North America. All lack evidence of a microblade industry. Several sites, including Carlo Creek and Eroadaway, suggest that the Northern Paleoindian tradition persisted for a considerable length of time in eastern Beringia. Although some of these sites might represent a continuum from the Nenana complex in Alaska’s interior (Dixon, 1993), it is equally plausible that they are later regional manifestations of the Northern Paleoindian tradition, possibly incorporating both Nenana complex and Northern Paleoindian tradition technological traits.

Because the earliest reliable 14C determinations for the Northern Paleoindian tradition are no older than ca. 10,500 BP, the Paleoindian tradition is younger in eastern Beringia than in more southern areas of North America. It appears that Paleoindian projectile point types derived from the northern Plains may have arrived in eastern Beringia beginning ca. 10,500 BP, following partition of the continental ice. This interpretation is supported by the discovery of a Clovis component at Charlie Lake Cave in northeastern British Columbia dated to ca. 10,550 BP (Fladmark et al., 1986; Driver, 1996; Driver et al., 1996), and at Vermilion Lake in Banff National Park in Alberta, Canada (Fedje et al., 1995). At Vermilion Lake, Fedje et al. (1995) have documented an assemblage ascribed to the “Late Fluted Point tradition” possibly dating as early as 10,800 BP based on 14C determinations from other typologically similar sites.

Northern Paleoindian projectile points do not exhibit the full typological array of Paleoindian projectile points from the more southern regions of North America. While most of the early fluted types exhibit multiple flutes, concave bases and edge grinding, among the northern assemblages large Clovis points are rare and classic Folsom points have not been found. Later lanceolate forms resemble tapering stemmed forms similar to Agate Basin and Hell Gap points. These differences led some archeologists (Wormington, 1968; Dixon, 1976) to propose the south to north spread of Paleoindian technology based on the fact that the northern examples looked typologically later than the those found on the western plains. Dixon (1976) suggested the south to north spread of this technology may have occurred ca. 10,000 BP, but more contemporary data suggest it may have been earlier, probably ca. 10,500 BP.
13. Archeological summary

The earliest archeology of eastern Beringia is ascribed to the Nenana complex, characterized by triangular bifacial projectile points and ovate knives. Widespread trade in obsidian was already established indicating occupation of Alaska prior to that time. The occurrence of “scavenged fossil ivory” at several sites implies that mammoth or mastodon remains were being scavenged by ca. 11,600 BP. No mammoth or mastodon kill sites have been found in eastern Beringia, although controversial blood residue analysis of fluted projectile points suggests that mammoth may have persisted until ca. 10,500 BP in some areas of eastern Beringia (Dixon, 1993; Loy and Dixon, 1998).

The Nenana complex begins sometime prior to 11,600 BP and persists until ca. 10,500 at which time it becomes difficult to distinguish from the Northern Paleoindian tradition in interior Alaska. This suggests a possible “blending” of technological traits of the Nenana complex and Northern Paleoindian tradition. Although not entirely conclusive, it appears that the Nenana complex did not manufacture microblades. The Northern Paleoindian tradition existed in regions of eastern Beringia as a co-tradition with the American Paleoarctic tradition between ca. 10,500–8000 BP. This tradition spread northward into eastern Beringia from the northern Plains.

Distinctive microblade technologies were introduced into eastern Beringia sometime around 10,500 BP and are contemporaneous with the Northern Paleoindian tradition. The Denali complex represents an inland adaptation by microblade using peoples. The American Paleoarctic and Northwest Coast Microblade traditions are found in near coastal areas suggesting subsistence activities related to coastal and adjacent inland resources. Trade in obsidian, site locations, and faunal remains inferentially demonstrate the use of watercraft prior to 10,000 BP along the Northwest Coast.

This analysis does not support the traditional Bering Land Bridge theory of human migration to the Americas, which postulates that hunters of large terrestrial mammal using Clovis-like projectile points crossed the Bering Land Bridge and descended from Beringia to the Plains of North America ca. 11,500 BP. Archeological research demonstrates that pre-Clovis sites exist at Monte Verde, in eastern Beringia, and probably at other sites throughout the Americas. The northern movement of the Paleoindian tradition ca. 10,500 BP demonstrates that humans were south of the continental glaciers prior to deglaciation ca. 11,000 BP and that the Clovis complex is an independent New World cultural development. Technological similarities between the contemporaneous Nenana and Clovis complexes may result from the fact that both are derived from a common cultural predecessor.

14. Weapon systems

The width of the projectile point at the place where it is hafted helps to define the size of the shaft to which it was attached. This along with the size and weight of Nenana, Clovis, and later Paleoindian projectile points suggests that they were attached to atlatl darts and not used to tip arrows. These projectile points are conceptually very different than composite projectile points manufactured by setting microblades in organic points. The American Paleoarctic tradition used thin parallel sided stone microblades struck from specially prepared stone cores to create cutting edges. The microblades were inset along longitudinal grooves incised in bone, antler, or ivory projectile points to form razor-sharp cutting edges along the margins of projectile points manufactured from organic materials (Fig. 6).

The bifacial stone and composite projectile point manufacturing techniques are fundamentally different approaches to producing the same type of artifact, the projectile point (Dixon, 1993). These two contrasting conceptual approaches to the manufacture of weapon systems suggest that other profound differences in technological and social concepts existed between these peoples.

The manufacture of microblades and composite projectile points are geographically restricted to Eurasia, Alaska and northwest Canada. The vast region of interior Alaska and adjacent Canada was a transitional
area between more Eurasian oriented microblade traditions and non-microblade bifacial traditions of North America. The boundaries between these technological traditions shifted repeatedly over time and consequently some archaeological sites provide a sequence of non-microblade/microblade technologies when viewed at a single geographic locale.

15. Colonization events

From a technological perspective, there appear to be two major colonizing events in the Americas. The first was an early migration by the ancestors of the Clovis/Nenana complexes sometime before ca. 11,500 BP and possibly as early as ca. 13,500 BP. These people use atlatl darts tipped with bifacially flaked stone end blades lashed to harpoon-like heads seated on bone foreshafts. They did not manufacture microblades and did not use the bow and arrow. The atlatl remained the primary weapon system in South America and temperate and southern regions of North America until Archaic times.

The second colonization event was by peoples bearing the American Paleoarctic tradition ca. 10,500 BP. Although they probably used the atlatl, they also introduced the bow and arrow. This included the complex technique of manufacturing composite projectile points which were characterized by insetting razor sharp stone microblades along the sides of bone and antler projectile points.

Although both populations required effective projectile points essential in hunter/gather societies, each developed unique approaches to manufacturing them. Nenana/Clovis peoples relied primarily on reducing a lithic core by flaking away excess rock to create a flaked stone projectile point, or biface. American Paleoarctic peoples engaged in a complex technological sequence of "building" projectile points by inserting microblades in slots carved along the sides of cylindrical bone or antler projectile points. These conceptually complex and different approaches successfully solved the same problem, suggesting that the differences result from learned behavior passed from generation to generation. Other profound differences may have existed between these two groups, possibly including biological and linguistic traits, as well as technological and social concepts.

The limited physical anthropological data also imply two distinct human groups emigrated to the Americas. Steele and Powell (1992) have concluded that the human cranial and facial characteristics from the Americas that are over 8500 BP are distinctively different than later Native Americans. Distinguishing features identified by physical anthropologists for these very early New World peoples are: longer, more narrow faces; and smaller more narrow nasal apertures (Steele and Powell, 1992; Chatters, 1997; Jantz and Owsley, 1997). These early remains from the Americas tend to display craniofacial features which are more similar to southern Asian and European populations.

They were followed by a second population bearing greater resemblance to contemporary northern Asians and Native Americans. Although rapid evolutionary change could explain the differences between the earlier (older than ca. 8000 BP) and later Native American populations, they more likely represent two distinct populations. The older group has been described as being more “Caucasoid” in appearance and they resemble the Ainu of northern Japan. If these comparisons are accurate, then both early technological evidence and physical anthropological data might suggest a possible point of origin for the earliest Americans in the maritime regions of northeast Asia.

16. Coastal migration

Prior to the early 1970s, it had been assumed that the Cordilleran ice extended westward to the margins of the continental shelf thus creating a barrier to human migration (Coulter et al., 1965; Nasmith, 1970; Prest, 1969). More recent geologic and paleoecologic studies document deglaciation and the existence of ice-free areas throughout major coastal areas of British Columbia by ca. 13,000 BP (Blaise et al., 1990; Bobrowsky et al., 1990). It is now clear that areas of continental shelf and offshore islands were not covered by ice during and toward the end of the last glacial. Vast areas along the coast may have been deglaciated beginning about 16,000 BP. Except for a 400-km coastal area between southwest British Columbia and Washington State, the Northwest Coast of North America was largely free of ice by ca. 16,000 years ago (Mann and Peteet, 1995). The exposed continental shelf and offshore islands were available as a migration route between 13,500 and 9500 BP (Josenhans et al., 1995, 1997), possibly enabling people to colonize ice-free regions along the continental shelf exposed by lower sea level.

Because of the misleading early geologic interpretations, the region has not been subject to research equivalent to that which has occurred in non-coastal eastern Beringia, but significant advances are now being made. The remains of large omnivores, such as black and brown bears, and other land animals, including caribou, have been found in Southeast Alaska dating between 12,500 and 10,000 BP (Heaton, 1995, 1996; Heaton and Grady, 1993; Heaton et al., 1996) demonstrating that sufficient subsistence resources were available to support humans (Dixon, 1995). The Northwest Coast Microblade tradition is documented as early as 10,000 BP in British Columbia and Southeast Alaska. Archeological sites ascribed to this tradition share the use of microblades, and exhibit a marine economy documented by limited
faunal remains and isotopic analysis of human remains (Dixon et al., 1997), and the ecological setting of the sites (Fig. 7).

17. The model

The model for human colonization of the Americas suggested by the most current data are coastal migration with inland movement and settlement within broad environmental zones, or megapatches that extend from north to south throughout the Americas. Migration probably occurred in many directions at the same time. For example, some people may have been moving more rapidly southward along the Pacific Coast of the Americas while others were colonizing more slowly eastward from the coast to the interior of the continents.

This model is drastically different than the traditional Beringian crossing and subsequent unidirectional “migration” from north to south, cross-cutting environmental zones and a wide array of physical obstacles. Colonization along large environmental zones is more consistent with New World archeological data and enables seemingly conflicting evidence to be reconciled into a single rational model for colonization of the Americas.

Fig. 8 schematically portrays how colonization may have occurred along major environmental zones at arbitrary 500 year intervals beginning at ca. 13,000 BP. Extreme northeast North America and Greenland were not sufficiently deglaciated to permit colonization until about 5000 BP.

This alternative model proposes that initial human colonization of the Americas may have begun ca. 14,000–13,500 BP along the southern margin of the Bering Land Bridge and then southward along the Pacific Coast of the Americas. With the use of watercraft, the human population moved rapidly southward along the coastal–intertidal Pacific biome, or “megapatch”. Even though evidence of this early migration may be obscured by rising sea level at the end of the last ice age, evidence might be expected to be found in adjacent areas of the interior, such as Monte Verde. Although it would have been somewhat further from the sea at the time it was occupied than it is today, Monte Verde is located along a river drainage only 15 km northeast of the Pacific Ocean. If this model is correct, the Pacific Coast of the Americas could have been occupied thousands of years before the continental ice in North America melted.

Coastal environments provide many ecological advantages for generalized foragers, an economic adaptation
best suited for colonizing populations. For example, intertidal resources, such as shellfish, may be harvested by children and the elderly and simply eaten raw. On the other hand, hunters specializing in large terrestrial mammal hunting are more dependent on a few strong adults to bring down large mammals. Large mammal hunting also requires greater territorial movement and presents greater difficulty for human groups which realistically include the elderly, the very young, pregnant women, and the infirm. Current data from some of the earliest sites in the Americas including the Aubery (Ferring, 1989, 1990, 1995), Horn Shelter in Texas (Forrester, 1985; Redder, 1985; Young, 1985; Young et al., 1987), a Clovis age rockshelter near the California–Oregon border (Beaton, 1991b), Lewisville (Stanford, pers. comm.), and numerous other sites, indicate subsistence traditions based on foraging rather than specialized large mammal hunting.

Local abundance of marine and intertidal resources and predictable runs of anadromous fish concentrated human populations in specific locales such as sheltered bays, inlets, estuaries, and salmon spawning streams.

Temperate coastal technological adaptations rely heavily on readily available materials such as drift wood, marine mammal products, beach cobbles, and shell, which in many cases may have been already partially modified by noncultural processes. In such an environment, reliance on sophisticated lithic technologies was probably not as important as in other environments. For example, preshaped and prepolished sling and bola stones, the only lithic material required for two effective, deadly weapons, can be easily and efficiently collected from noncultural beach deposits. Monte Verde provides a rare glimpse into this type of technological adaptation. At Monte Verde people produced and used few bifacially flaked stone tools and relied heavily on simple flakes and organic materials.
From an original and theoretical maritime subsistence strategy, several adaptive trajectories were possible as humans expanded across the landscape. Survival may have been best assured by the continuation of a pattern of general foraging, which could be adjusted or modified based on availability of resources and increasing knowledge of local geography and biological patterns. For example, along the west coast people may have continued their ancient adaptation to shellfish gathering, fishing, and marine mammal hunting. In interior regions of southern California, Arizona and Mexico the pattern of general foraging may have led to an increasing emphasis on harvesting and processing plant products and seed grinding. On the Plains general foraging persisted throughout the Paleoindian period, but people emphasized and refined large mammal hunting, particularly communal mass kills.

Although the initial colonization along the continental margins of the Americas may have occurred rather quickly, subsequent colonization of interior environments probably occurred more slowly. People probably first moved inland from the coast along rivers. As population increased and people adapted to interior environments, colonization probably continued to progress along environmental zones.

Given this scenario, the western plains of North America may have been among the last to be settled as well as one of the least hospitable environmental regions of the continent. Separated from the Pacific coast by the vast Cordillera, adaptation to intervening mountainous regions may have occurred slowly. Classic Clovis sites, such as Blackwater Draw and Murray Springs, containing evidence of spectacular mammoth predation, may be representative of a rather unique cultural, technological and ecological adaptation during late Pleistocene. In other words, the spectacular and well publicized Clovis kill sites may be the least typical and the least useful sites for interpreting the peopling of the Americas and early New World adaptations.

Although Clovis is often associated with mammoth hunting, other data demonstrate that Clovis people may have placed greater emphasis on generalized gathering. Only 12 sites have been documented in North America where Clovis points have been found in association with mammoth remains (Haynes, 1991, pp. 197–197, 206). A more realistic portrayal of Clovis economics suggests that mammoth kill sites occur in marginal habitats that may have been some of the last to be colonized. Although these sites may provide the earliest evidence of human occupation in the western interior of North America, this region may have been among the last to be colonized.

Analysis of Paleoindian dentition (Powell and Steel, 1994) supports the hypothesis that Clovis and other early New World cultures have their adaptive roots as generalized foragers rather than specialized big game hunters.

The characteristics of dental wear in the oldest human remains from the Americas are virtually identical to those of generalized foragers. This demonstrates that these early diets included a broad array of foods and large amounts of plant fiber.

18. Technology

The lithic technology found at Monte Verde is characterized by the selection and use of naturally occurring stone and minimal modification of stones and other useful items found in the natural environment. This type of technological system probably originates from a generalized coastal economy which might have only occasional and comparatively rare need for bifacial projectile points to serve as harpoon end blades or possibly knives.

An intriguing connection between coastal migrations and mammoth hunting may lay in understanding the Clovis weapon system. It is characterized by the atlatl, or spear thrower, used to propel a short light weight spear, or dart. The dart is tipped with bifacially flaked stone Clovis projectile point believed to be mounted in a split-shaft harpoon-like haft, that is attached to a bone foreshaft (Stanford, 1996). The end blade, harpoon, and
The diagnostic trait of basal thinning and consequently adapted to hunting large terrestrial mammals. The Clovis weapon system may have its origins in coastal marine mammal hunting technology that was subsequently adapted to hunting large terrestrial mammals. This type of end blade assembly persisted until historic times among maritime hunters in northwestern North America and northeast Asia.

19. Conclusions

The initial colonization of the Americas used watercraft and occurred about 13,500 BP. This hypothesis is supported by the following:

1. The earliest deglaciated route was coastal. The deglaciated west coast of North America was first available for colonization by ca. 13,500. The interior route was blocked by the continental glaciers until about 11,000 when a deglaciation corridor developed between Beringia and the southern areas of North America ca. 11,000 BP.

2. Monte Verde, and other sites, predate the opening of the mid-continenetal route indicating peoples were south of the continental glaciers prior to deglaciation ca. 11,000 BP.

3. Reliably dated human remains first appear in North American between 11,000 and 11,500 BP, providing limiting minimum dates for human occupation and suggesting human colonization occurred earlier.

4. By about 11,000–12,000 BP regional cultural adaptation was well under way in North America, suggesting an earlier migration.

5. The Paleoindian tradition spread from south to north ca. 10,500 BP, indicating that people were south of the continental ice prior to deglaciation, ca. 11,000 BP.

6. Paleoindian subsistence data indicate an economic system rooted in general foraging, not specialized big game hunting.

7. The New World's first weapon system, the foreshaft/harpoon/end-blade atlatl dart assembly, may trace its origins to coastal marine mammal hunting, rather than large terrestrial mammal hunting.

8. Evidence from other regions of the world demonstrate that humans had watercraft and the ability to navigate near-shore ocean waters prior to 14,000 BP.

9. Technological and physical anthropological evidence suggests at least two major colonizing events, the first beginning possibly by ca. 13,500 BP using the atlatl and the second about 10,500 BP introducing the bow and arrow. However, the relationships, if any, between the two human physical types and the two major technological traditions are not clear.

Although it is imperative that New World archeologists keep their minds open to earlier human colonization of the Americas, the very limited data from the lower level at Monte Verde and controversial discoveries at other sites suggesting human occupation as early as 30,000–35,000 BP, are not adequate to demonstrate an earlier colonization event. A stronger suite of evidence will be required to convince most scientists, and most will be reluctant to accept a third and much earlier (ca. 30,000 BP) human migration to the Americas without additional evidence.

The coastal “corridor” provided the environmental avenue essential for the initial human entry to the Americas. The coast formed part of a continuous northern marine–intertidal ecosystem extending between northeast Asia and northwestern North America. It would have facilitated coastal navigation and provided similar subsistence resources in a continuous ecological zone linking the two hemispheres. Old world adaptations could have enabled rapid colonization without developing new technologies or subsistence strategies.

The intellectual dominance of the interior Beringian model for the colonization of the Americas by Eurasian large land mammal hunters has resulted in little archeological research directed toward New World colonization along the coastal regions of northeast Asia and the western coasts of the Americas. The concept of humans first entering the Americas via a Bering Land Bridge is almost 500 years old and was advanced and strengthened when science lacked the archeological and geologic evidence available today (de Acosta, 1604; Dawson, 1894; Johnston, 1933; Spinden, 1933 and others). Viewed in light of the coastal colonization hypothesis, the Bering Land Bridge played an important, but different, role in the peopling of the Americas. The Bering Land Bridge was essential for human colonization because it provided an uninterrupted marine–intertidal environment that facilitated inter-coastal navigation connecting Eurasia and North America along its southern margin.

Archeological evidence necessary to evaluate the coastal migration hypothesis is difficult to find because rising sea level at the close of the Pleistocene inundated much of the continental shelf. If the coastal migration hypothesis is to be fully evaluated, the late Pleistocene coastal archeology of western North America requires research equivalent to that which has traditionally focused on the late Pleistocene/early Holocene archeology of mid-continental North America.
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