The Late Pleistocene Human Settlement of Interior North America: The Role of Physiography and Sea Level Change

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Chapter 11

The Late-Pleistocene Human Settlement of Interior North America: The Role of Physiography and Sea-Level Change

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ABSTRACT
The colonization of interior North America during the late Pleistocene, ca. 20k–10k cal yr BP, would have been profoundly shaped by physiographic features early explorers and settlers encountered, such as the location of major river valleys, mountain ranges, deserts, pluvial and periglacial lakes, and ice-sheet margins, and in coastal areas by the dramatic changes in sea level that were occurring. An examination of the relationship between changes in sea level and the extent of the Gulf and Atlantic Coastal Plains in the vicinity of the southeastern United States indicates that, because of the uneven topography of the now submerged continental shelf, sea-level rise or fall does not closely correspond to the area lost or gained. During some periods, notably MWP-1A (Meltwater Pulse 1A), only small areas of the Coastal Plain were lost, while in others, such as during the Younger Dryas and MWP-1B, much larger areas were affected. The widespread appearance of Clovis in the interior of the Southeast, and the apparent reduction or reorganization of immediate post-Clovis settlement in the Coastal Plain, and an increase in population—or at least no evidence for reduction—farther into the interior of the region may be related to these changes in sea level. Evaluating these ideas will require much new fieldwork and the collection, compilation, and public dissemination of primary archaeological data among the professional community.

KEYWORDS: Younger Dryas, Clovis, Sea-level change, GIS-modeling, Continental shelf, Coastal adaptations

Introduction

How and when people initially settled the Americas, and the timing and routes taken, remain unknown, the subject of much debate. The first unequivocal evidence for widespread human settlement in North America dates to about 13,000 calendar years ago, or cal yr BP, when sites and isolated finds yielding fluted projectile points of the Clovis tradition are widely dispersed over the landscape (Figures 11.1 and 11.2). In spite of claims for an increasingly widespread human presence prior to Clovis, however, unless found in excavation context the archaeological record for pre-Clovis settlement remains all but invisible, owing to an absence of readily identifiable temporally diagnostic artifacts like the fluted Clovis and post-Clovis points, although some candidate point forms have been proposed, as discussed below. Clovis projectile points are characterized by a distinct form of basal thinning, or fluting, are easily recognizable, and are thought, albeit with some debate, to fall within a fairly narrow time interval, currently placed roughly a century to either side of 13,000 cal yr BP (cf. Prasciunas 2008; Waters and Stafford 2007; Haynes et al. 2007). Fluting itself, however, continued to be employed on a variety of presumably later

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forms like Folsom, Cumberland, and Barnes for another millennium (e.g., Goodyear 2010; Meltzer 2009; Miller and Gingerich 2013a, 2013b; Bradley et al. 2009; Miller et al., this volume). As an aside, it has been suggested that the Cumberland form predates Clovis (Gramly 2008, 2009, 2012), but the evidence in support of this remains equivocal. A post-Clovis placement is suggested by the extent of fluting, running the length of the biface on many specimens, making the point a likely part of a widespread "instrument assisted" fluting tradition postulated to have been present in many parts of North America following Clovis (e.g., Goodyear 2006, 2010; Meltzer 2009:284–285). Stratified sites with well-dated Cumberland and Clovis assemblages are needed to resolve this question. Regardless of the dating of specific fluted-point types, all are assumed to be of late-Pleistocene age. The distinctive and technically challenging fluted-point manufacturing procedure, furthermore, was never adopted again in later prehistory, making sites of this time fairly easy to recognize.

But how much earlier in the Pleistocene were the Americas settled, and when did this occur? How, furthermore, did people enter and then disperse over the landscape? What part or parts of the continent did they reach first, and which parts were settled later? Were some areas avoided and others favored, with an emphasis on certain environments or patch types, such as coastal-zone resources, or were certain transportation arteries favored, like major drainages or along shorelines (e.g., Beaton 1991; Surovell 2003; O'Connell and Allen 2012; Erlandson et al. 2007, 2008)? When and where did colonizing peoples first settle down permanently, or at least slow their movement to within regions, rather than between them in a pattern of near-constant movement, as is sometimes been inferred, in what are differentiated as technology-oriented as opposed to place-oriented settlement models (cf. Anderson 1990; Smallwood 2012; Kelly and Todd 1988).

A number of possible entry locations and dispersal routes have been proposed, some considered more likely and supported by more types and greater quantities of evidence than others (e.g., Dixon 1999, 2013; Fladmark 1979; C. Haynes 1969; G. Haynes 2002; Meltzer 2009; Pitblado 2011; Anderson and Gillam 2000; Stanford and Bradley 2012; Goebel et al. 2008). Currently the most widely accepted scenario has New World populations originating in eastern or northeastern Asia, and then passing through the northern Pacific region in the vicinity of the Bering Land Bridge, either overland or along the coast. From there they traveled south into the Americas, either using watercraft or on foot, or both. In this paper the routes that colonists might have used coming into the western half of the continent from Asia, and dispersing over the landscape from there, are given primary consideration. Models based on the colonization of eastern North America from Europe or Africa by people coming across the Atlantic in watercraft are not discussed in detail herein, in spite of the interest and debate attending such scenarios (cf. Shott 2013; Stanford and Bradley 2002, 2012; Eren et al. 2013; Straus et al. 2005). If movement of early peoples from east to west occurred, however, as may have happened during Clovis times if this technology originated in Eastern North America, or if people did come into the Americas from the east earlier, then population dispersal and settlement could have been in the opposite direction (i.e., from east to west) along the movement pathways and for the reasons considered herein.

When Did People Arrive in the Americas?

One thing is becoming increasingly accepted by Paleoindian scholars in recent years, and that is that people were present in the Americas prior to the widespread appearance of Clovis technology, although when initial settlement occurred remains unknown (Kelly 2003a; Meltzer 2009; Wheat 2012; Goebel et al. 2008; Goebel et al. 2008; Goebel et al. 2008). Settlement ca. 1000–1500 years earlier than Clovis has been demonstrated at the site of Monte Verde in coastal Chile, where numerous well-preserved remains have been found, including presumed tent pegs wrapped with twine, a human footprint, and unusual bifaces (Dillehay 1996). A small settlement is inferred, whose peoples made use of both coastal and interior resources. The presence of this site, and indeed increasing numbers of early sites across the South American continent, and particularly in the Southern Cone, supports a date for colonization ca. 14,000–15,000 cal yr BP, as well as the possibility that the first peoples may have moved down the Pacific coastline (Miotti and Magnin 2012; Steele and Politis 2009; Miotti et al. 2012).

People were also present in interior central Alaska several centuries before Clovis, at sites like Broken Mammoth and Swan Point in the Nenana and Tanana rivers area of central Alaska, both of which date to ca. 13,500–14,000 cal yr BP (Bever 2001; Holmes 1996; Yesner 2001; Goebel and Buvit 2011; Hamilton and Goebel 1999; Holmes et al. 1996). Thus, people were living near the likely entry point for the Ice-Free Corridor by about the same time as the earliest widely accepted dates for their presence in southern South America. The questions that immediately arise are, When did people go through the Ice-Free Corridor, and when did they begin moving down the Pacific coastline south of the ice sheets covering portions of northern North America during the late Pleistocene?

The discovery and dating of early sites south of the ice sheets provides one way to answer these questions. Evidence for human presence older than ca. 13,000 years in age, archaeological assemblages popularly known as pre-Clovis sites, have been recorded at a number of locations in the Americas. In the Pacific Northwest an early human presence is documented by the Manis mastodon kill site in Washington State and the presence of human paleofecal remains in the northern Great Basin at Paisley Caves in Oregon, both dating to about 14,000 years ago (Gilbert et al. 2011; Gustafson et al. 1979; Jenkins et al. 2102; Waters et al. 2011). Other well-known pre-Clovis sites in interior North America include Meadowcroft Rockshelter in Pennsylvania, where over 50 radiocarbon dates have been found in logical order (Adovasio et al. 1999). At Cactus Hill in Virginia, blades and bifaces were found below Clovis in deposits that may date between 16,000 and 20,000 years ago (McAvoy and McAvoy 1997). At the Topper site in South Carolina, below a dense Clovis assemblage resulting from the quarrying of chert outcrops, an unusual assemblage was found characterized by bend breaks, flakes, and flake tools (Goodyear 2005; King 2012). Another pre-Clovis site is at Page-Ladson in Florida, well inland from the much reduced Gulf of Mexico, which was much smaller in extent in the late Pleistocene, when sea levels were much lower and continental shelves greatly exposed (Webb 2006). At Page-Ladson a mastodon tusk was found with apparent cutmarks on it, together with a few small flakes and cobbles or cobble fragments. Arguably one of the best documented and dated pre-Clovis sites in the interior of North America is the Debra L. Friedkin site in Texas, where flakes, blades, and bifaces were found in deposits approximately 15,000–16,000 years old (Waters et al. 2010). While the age and archaeological associations of most pre-Clovis sites found in the Americas have long been subject to challenge (e.g., Dincauze 1984; Fiedel 2013; Morrow et al. 2012), most scholars accept that human presence a few centuries to a few millennia prior to Clovis times has been demonstrated (Wheat 2012). Precisely when and along which routes initial entry took place, however, remains unknown.

Unfortunately, no unequivocal diagnostic projectile-point forms or other artifact types have been recognized as of yet to help us easily identify pre-Clovis occupations in North America. The presumed pre-Clovis-age Miller Lanceolate at Meadowcroft Rockshelter, the Early Triangular points at Cactus Hill in Virginia, and the Page-Ladson points from Florida are possible candidates, but are similar to later Paleoindian and Archaic post-Clovis bifaces types and hence are difficult to sort from these later types when found in surface context (Adovasio 1998:524–27; McAvoy and McAvoy 1997; Adovasio et al. 1977, 1999; Hemmings et al. 2004). At present all we know is that appreciable variability characterizes pre-Clovis, Clovis, and immediate post-Clovis industries in North America, even among chipped-stone bifaces, and more fieldwork and analysis will be needed before we can easily recognize and date early occupations. Indeed, the evidence from Manis suggests pre-Clovis populations in North America may have used bone or ivory points, a perishable technology unlikely to be widely preserved save in unusual circumstances (Waters et al. 2011).

Entering Interior North America: The Ice-Free Corridor

But how did people reach interior North America and get to places like the East and Southeast, where dense concentrations of fluted points occur in the Clovis era? One primary route long suggested was that they came through an opening in the ice sheets in western Canada. This makes perfect sense given that people were present in interior Alaska 14,000 years ago. Geologic maps indicate the Ice-Free Corridor, although apparently closed 15,000 years ago (Figure 11.1), was

Figure 11.1 North America ca. 15,000 cal yr BP. The Ice-Free Corridor was closed, making entry via waterways or along the coast the only way to enter the continent. While evidence for human settlement has been found in a number of locations, given the absence of recognizable diagnostic artifacts the landscape appears to have been largely unoccupied.

open by 14,000 years ago if not somewhat earlier (Dyke et al. 2003; Munyikwa et al. 2011), although how easily it could be crossed is subject to debate (Dixon 2013; Fiedel 2005; Mandryk et al. 2001). It is unlikely, however, that human populations living in late-glacial conditions in central Alaska would have been greatly troubled by the ca. 1200-km journey traversing the corridor would have entailed, especially if they had dogs with them for both transport and food (Fiedel 2005, 2007). In any event, by 13,000 years ago, in Clovis times, the corridor was hundreds of kilometers wide and easily traversable (Figure 11.2). But how would people have subsequently moved, once through the corridor and into the interior of North America? Topographic features like rivers, mountain fronts, ranges and passes, major ecotones, or environments with rich paleosubsistence or toolstone resources unquestionably shaped movement pathways (Anderson 1990, 1995; Jodry 2005; Kelly 2003b; Meltzer 2004; Miller 2011; Speth et al. 2013). Maps depicting Paleoindian colonization showing linear or wave-of-advance movements of people over the landscape with a seeming disregard for topographic features like these—while common in the popular press and older technical papers as a means of depicting broad general movement patterns (e.g., Martin 1973)—are thus unrealistic and serve only as heuristic devices (see Sauer 1944; Anderson and Gillam 2000; and Magnin et al. 2012 for movement pathways based on actual topographic features).

Instead, once people arrived at the mouth of the Ice-Free Corridor, whether they came from Alaska to the north or from the Pacific Northwest coast to the west, human populations would have encountered several major east- and south-trending drainages, such as the Missouri, the Platte, the Arkansas, the Canadian, and the Red. These would funnel people moving along them through the Great Plains and into the Mississippi–Ohio river system, whose tributaries encompass much of eastern North America. People traveling down the Mississippi would also reach the Gulf of Mexico. Travel to the west and south along the Gulf coast would get them to Mesoamerica and northern South America, while moving eastward would bring them to the Florida peninsula, and from there on around to the Atlantic seaboard. When moving along the shoreline of the Gulf of Mexico and the Atlantic, short ocean voyages would allow access to most islands in the Caribbean, which would have been greatly enlarged, given lowered sea levels (Figure 11.3). Another possible route to or from northern South America would thus be through the Greater and Lesser Antilles, although no convincing evidence has been found for such movement in late-Pleistocene times and most researchers assume permanent colonization was during the mid-Holocene (e.g., Alaire 1997; McPhee et al. 2007).

Populations coming through the Ice-Free Corridor, or from

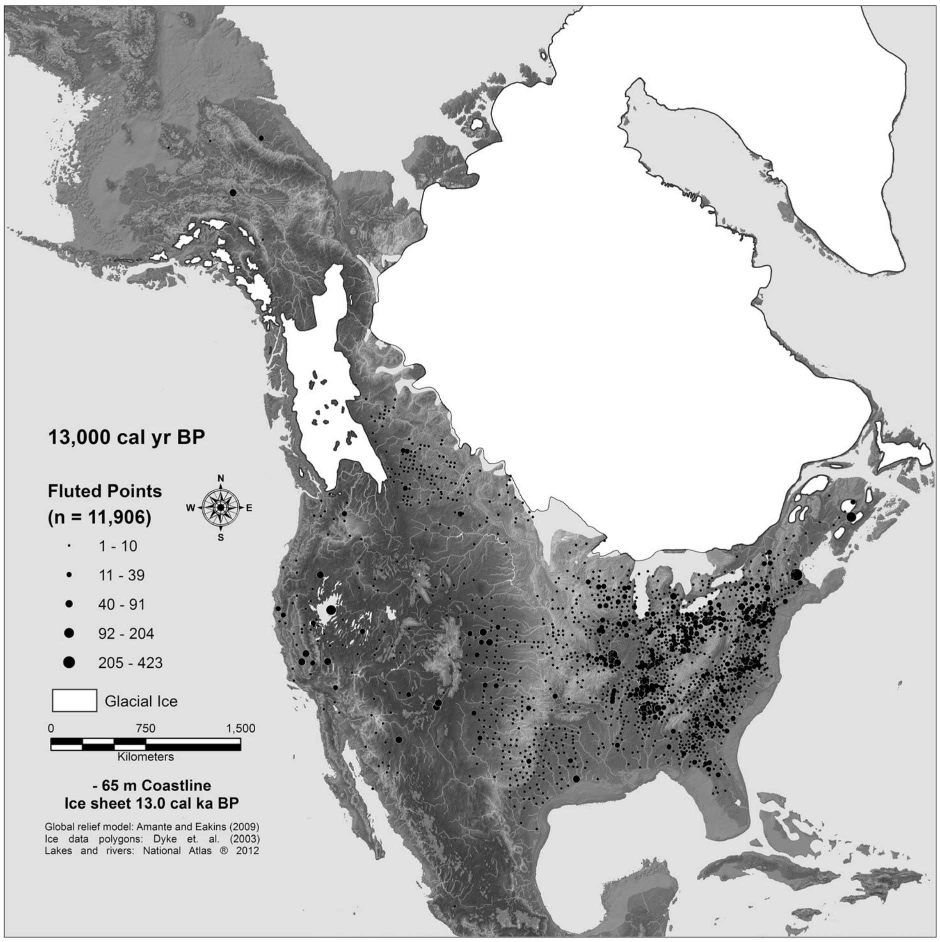

Figure 11.2 North America ca. 13,000–12,000 cal yr BP. Evidence for human settlement is widespread, identified by diagnostic fluted projectile points. (Image adapted from Anderson et al. 2010a). Ice sheets are depicted at 13,000 cal yr BP.

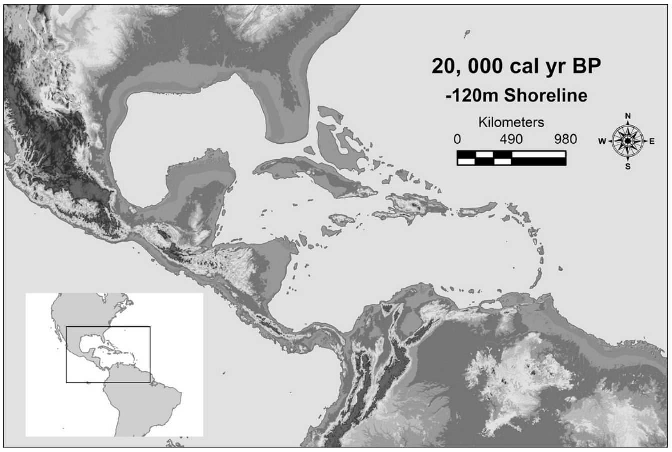

Figure 11.3 The Caribbean and Gulf of Mexico, ca. 20,000 cal yr BP, showing how movement throughout the region would have been facilitated by the greatly reduced sea levels. Map based on bathymetric and elevation data in Lambeck et al. (2002), and elevation/bathymetric data from Amante and Eakins (2009). Image adapted from Anderson et al. 2010b.

points farther west if they moved inland from the Pacific coast, may well have turned or continued eastward and followed the shores of the massive periglacial lakes that were present in southern Canada and the upper midwestern United States, exploiting the aquatic resources that would have been present in these bodies of fresh water, and the plants and animals near their margins. Once these people got farther east, additional resources would include the marine mammals and other game of the great inland St. Lawrence and Champlain seas (Robinson 2009, 2012). It has been suggested that people followed migrating waterfowl south and east through the Ice-Free Corridor and beyond (Fiedel 2007; Dincauze and Jacobson 2001), and that they perhaps followed other herd or migratory animals as well, such as caribou (Ellis 2011; Newby et al. 2005; Spiess et al. 1998). Proboscideans appear to have been a particular target early on, as reflected in probable pre-Clovis-age mammoth kill sites like Schaefer and Hebior in Wisconsin, possibly Hiscock in western New York, and other possible kill/butchery locations well to the south like Burning Tree in Ohio and Coats-Hines in Tennessee (Laub 2003; Overstreet 2005; Deter-Wolf et al. 2003; Fisher et al. 1994). A decline in spores associated with large-herbivore dung and a spike in charcoal particulates indicative of increased burning also occur after ca. 15,000 years ago in northeastern North America (Gill et al. 2009), and offer additional lines of evidence by which the timing of human settlement and perhaps intensity of predation can be explored. The Pacific Northwest may have also witnessed settlement by people coming out of the Ice-Free Corridor, who moved to the west instead of to the east. If this happened, they may have met peoples who had already reached that area by moving along the coast (e.g., Dixon 1999; Beck and Jones 2010), as discussed in the next section.

Entering Interior North America: Pacific Coastal Movement

In recent years it has been suggested that the Americas were first colonized, at least from the west, by people moving down the Pacific coastline well before the Ice-Free Corridor opened (Davis 2011; Dixon 1999, 2013; Fladmark 1979; Meltzer 2009:129–31; Erlandson et al. 2007, 2008). The presence of early populations in South America before evidence for widespread populations in North America, at sites like Monte Verde, may reflect rapid movement, with people moving much farther and faster along coastlines than into the interior (e.g., Surovell 2003). In this view, the Pacific Rim and perhaps all coastal environments were considered a "megapatch" of choice (sensu Beaton 1991) by early populations, whose resources were well known and regularly targeted for exploitation. Initial colonizing peoples, in this view, may have been so well adapted to coastal environments that they had little incentive or inclination to move inland. Along the Pacific coast of the Americas, the rich marine resources associated with offshore kelp forests may have been one such megapatch, facilitating movement along as opposed to away from the coast, what Erlandson and colleagues (2007, 2008) have named "the Kelp Highway" hypothesis. This argument helps reconcile the presence of early populations in southern South America at a time when there is only limited evidence for people in interior North America. If people were content to stay on or near the coast, it would help explain why the record of human settlement in the interior of North America is seemingly so sparse until ca. 13,000 years ago. The Clovis adaptation appears directed to the exploitation of interior resources, and that may be what triggered its rapid radiation. That is, the Clovis adaptation may have been the first highly effective adaptation by which interior portions of the continent could be exploited.

To understand movement in coastal areas, precise determination of late-Pleistocene sea-level fluctuations is critical, given the ca. 120-m rise since the glacial maximum that has occurred after ca. 18,000 years ago (Lambeck et al. 2002). Evidence for Pleistocene coastal adaptations in the Americas is fairly minimal, with site loss to sea-level rise a certainty, although underwater archaeology is showing that some early sites may survive in relatively undisturbed content in offshore waters (Davis 2011; Faught 1996, 2004a, 2004b; Adovasio and Hemmings 2011; Faught and Guisick 2011; Guisick and Faught 2011; Illingworth et al. 2010). Our understanding of the colonization of the Americas will remain incomplete until we know the role coastal areas played. High-resolution bathymetric data can be used to infer possible migration routes of Pleistocene populations throughout the world (Anderson and Gillam 2000; Field and Lahr 2006), and are used below to examine how the colonization and settlement of the Americas may have been affected by changes in sea level, with particular attention to the area of the southeastern United States (Anderson et al. 2010b:60; Gillam et al. 2006).

The earliest movements into the Americas from eastern Asia likely took place in the vicinity of Beringia, the exposed landmass connecting Asia and America during the late Pleistocene. Whether this movement was overland or along the coast is unknown, but migration along the southern margin of Beringia is more likely than along the northern coast or perhaps even through the interior (Figure 11.4). A remarkably large number of islands were present along the southern margins of Beringia throughout the late Pleistocene, and environmental conditions may have facilitated early movement, possibly with warmer conditions and richer maritime resources than exist in the area at present (Anderson 2010; Brigham-Grette et al. 2004; Erlandson et al. 2008, Sarnthein et al. 2006; but see Wilson and Ward 2006). These islands were closely spaced, furthermore, allowing for movement between them without likely losing sight of land. The south coast of Beringia thus would have offered a navigable route into the Americas with numerous islands and bays along the way, and would have facilitated and indeed mandated a maritime adaptation. A route through the archipelagoes of southern Beringia to reach southern Alaska and the Pacific Northwest would have been far less dangerous than crossing the Aleutian chain from west to east from Kamchatka, even during periods of greatly reduced sea level. Even at the last glacial maximum, when sea levels were greatly reduced, open water gaps >100 km in extent were present in the Aleutian chain.

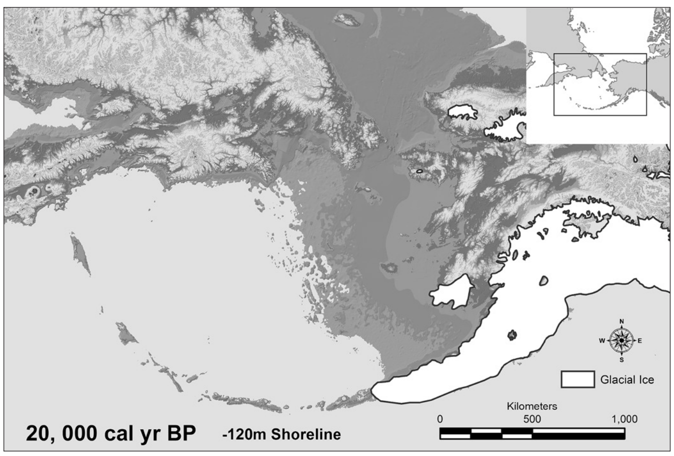

Figure 11.4 The island archipelago of southern Beringia and the greatly enlarged Aleutian chain, ca. 20,000 cal yr BP, where early populations may have passed through or stayed for a time. Map based on sea-level data in Manley (2002) and Lambeck et al. (2002), elevation/bathymetric data from Amante and Eakins (2009), and a mapping approach adapted from Manley 2002 and Brigham-Grette al. 2004 (Image adapted from Anderson et al. 2010b).

Considerable uncertainty exists as to how productive the now-submerged Beringian archipelago may have actually been to human populations. Up to several months of open water, free of sea-ice cover, and providing a rich habitat for marine life, however, has been inferred (e.g., Brigham-Grette et al. 2004; Erlandson et al. 2008). Beringia may thus have been occupied for millennia and could have been where the apparent lengthy separation of Old and New World populations occurred that is indicated by mitochondrial DNA evidence, what has been called the "Beringian Standstill" model (Tamm et al. 2007; see also Perego et al. 2009). That is, the extensive Beringian archipelago, and perhaps portions of the Aleutian chain, may offer possible locations where early populations may have been present, in addition to or instead of in interior Beringia. Genetic evidence indicates Old and New World populations were separated for some time, perhaps as much as 5,000 to 10,000 years, prior to initial colonization south of the ice sheets (Kemp and Schurr 2010). The late survival of mammoths on small islands isolated as Beringia flooded, at least until human hunters arrived in the mid Holocene and exterminated them, however, suggests early Beringian populations were perhaps not quite the skilled mariners sometimes assumed (Stuart et al. 2002; Veltre et al. 2008).

But what happens farther south when people go coastal? Assuming rapid movement coupled with minimal travel into the interior, they could have quickly moved south. The first major drainage into the interior south of the Cordilleran ice sheet in western Canada would have been the Columbia River. This would have been the first route employed by coastal populations that could have taken them deep into the interior of North America, since the headwaters of the Columbia and the Missouri are close to one another. Early sites are found in and near the Columbia River, like the pre-Clovis Manis mastodon kill and the East Wenatchee Clovis cache (Gramly 1993; Mehringer 1988; Waters et al. 2012), as well as sites of the Western Stemmed Tradition, which some scholars have argued is a signature of early colonizing populations, although whether it is coeval with or predates Clovis remains the subject of debate (Beck and Jones 2010, 2012; Fiedel and Morrow 2012; Jenkins et al. 2012). Farther to the south along the west coast of the United States there are few drainages extending well into the interior; the large rivers present, like the Sacramento or San Joaquin, didn't go very far to the east, given mountain ranges like the Sierra Nevada and the interior-draining Great Basin beyond that. The extent of these western drainages south of the Columbia encompasses roughly the same area as that occupied by the Western Stemmed projectile-point horizon, and may signal the extent of inland movement by early coastal populations (Beck and Jones 2010). Once across the Sierra Nevada movement further east would have been facilitated by the numerous pluvial lakes that were present in the late-glacial era; such lakes would have facilitated movement in portions of California, the Great Basin, and the Southwest (Graf 2007; Beck and Jones 1997, 2010; Enzel et al. 2003; Goebel et al. 2011).

Entering Interior North America from the Southwest: The Baja California/Sonora/Colorado River Model

Another way for western coastal peoples to get into the interior of North America to points farther east, assuming they didn't travel down the Columbia River or across the Great Basin, is via the Colorado and Sonora rivers (Anderson 2013:391–94) (Figure 11.5). When early peoples moving down the West Coast reached the end of the Baja California peninsula, they literally ran out of land. Unless they had watercraft capable of making the ca. 130-km-plus crossing to Sinaloa, Mexico, and were even aware of the possibility, they had to turn back to the north. Given evidence for

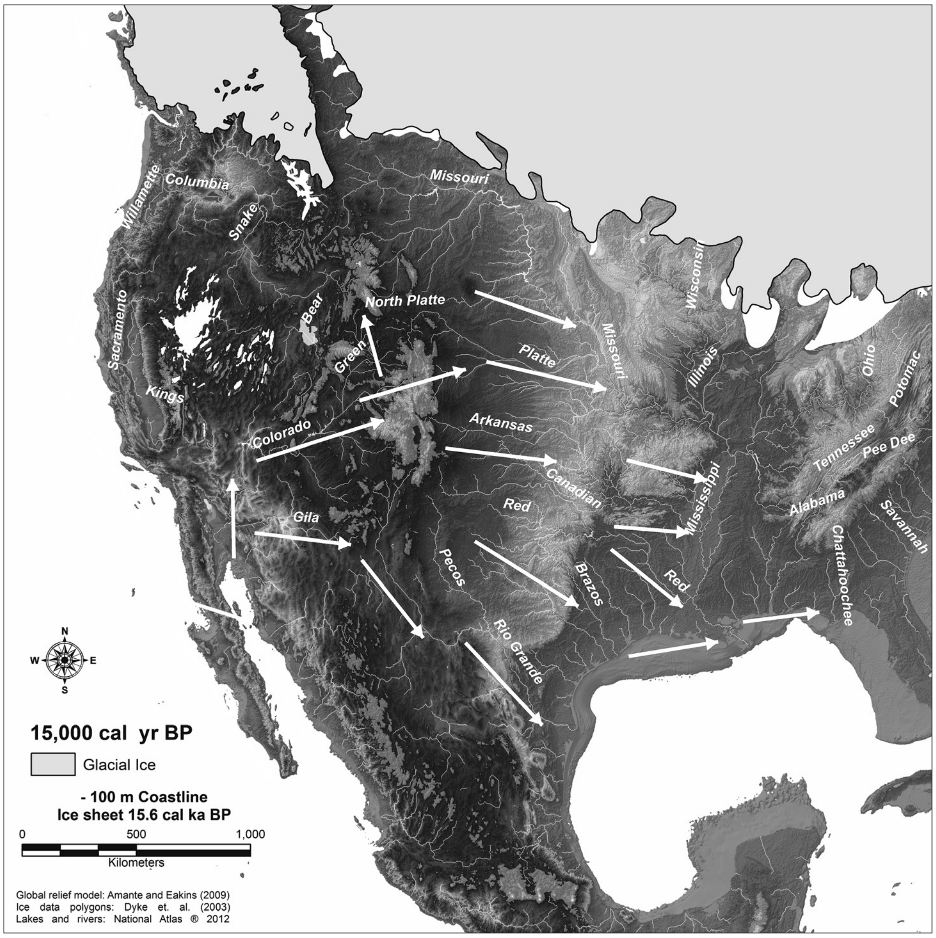

Figure 11.5 The Baja California/Sonora/Colorado River model for the colonization of interior North America (image adapted from Anderson 2013:392).

early settlement on Isla Cedros on the western side of Baja, early people in the area appear to have watercraft capable of crossing a few kilometers of water by ca. 10,000 cal yr BP, when the island became separated from the mainland (Des Lauriers 2006:259; 2012). Whether they had watercraft capable of making the much wider crossing to Sinaloa earlier is unknown.

Moving north along the east side of Baja, early peoples would have encountered the mouth of the Colorado River at the northern end of the Gulf of California. Rather than continue to exploit the coastal biome—a decision that would have soon had these groups moving south again—some populations may have chosen to follow this mammoth waterway into the interior, where with comparatively little overland travel they would have been at the headwaters or upper reaches of major east-flowing drainages. From the upper Colorado, for example, it is a comparatively brief distance to the Arkansas, Platte, and Missouri river systems, which could have funneled people into eastern North America. Near the mouth of the Colorado, the Gila flows eastward across southern Arizona and New Mexico, and may have offered a particularly rapid route to the Rio Grande, and from there to the Brazos, Pecos, Canadian, and Red rivers, as well as the Gulf of Mexico.

Given the marked reduction in the extent of open water that needed to be crossed to reach Sonora in the vicinity of Isla Ángel de la Guarda and Tiburón Island at the northern end of the Gulf of California, no more than ca. 25 km, some people may have crossed over to Sonora in this area. The large numbers of Paleoindian points and sites found in Sonora may thus be a result of early settlement (Sanchez 2010; Sanchez and Carpenter 2012; Gaines et al. 2009), assuming their incidence does not reflect geological exposure and research bias. From the Sonoran coast, if they did not travel into the interior, people may have moved northward along the east coast of the Gulf of California until they encountered the Colorado River. Other groups may have moved to the south along the western coast of Sonora, Sinaloa, and beyond, eventually reaching western South America. Along the way some people may have crossed Mesoamerica to the Gulf or Atlantic coasts and moved north along the Gulf coast into North America. Some of the earliest populations in the interior of North America, save perhaps for areas in the Pacific Northwest and Alto and Baja California, may have thus been in places easily reached from the Colorado River basin. The vicinity of the Debra L. Friedkin and Gault sites in Texas is one such possibility (Waters et al. 2011). We must thus consider the possibility that Eastern North America, with its remarkable fluted point tradition, may have been initially settled by people coming from the southwest.

The Impact of Sea-Level Fluctuations

Assuming movement along or early settlement of the coastal margin, what was the impact of sea-level change—known to have been extensive in the late Pleistocene and early Holocene—on human settlement? Were coastal areas stable, or were they changing rapidly, and if so, by how much? To examine this, we calculated the amount of land exposed or submerged over time on the continental shelf in the vicinity of the southeastern United States ca. 20,000–10,000 years ago (Table 11.1, Figures 11.6 and 11.7). The area examined comprises the Coastal Plains along the Gulf of Mexico and the lower and middle Atlantic coasts. More specifically, the study boundaries extend from approximately 250 km south of the Texas-Mexico border (directly west across the Gulf of Mexico from the southern extent of the Florida continental shelf) to a point 100 km northeast of Delaware Bay on the Atlantic Coast, directly east of the northern end of the Chesapeake Bay. The total area of the Coastal Plain in this area, including the extent of the exposed continental shelf at the Last Glacial Maximum at 20,218 cal yr BP, is approximately 1,693,270 km^2.

A comprehensive, high-resolution reconstruction of past sea level spanning the past twenty millennia, at an average resolution of 60 years, exists for the northern Gulf of Mexico, based on a combination of radiocarbon-dated geological and archaeological deposits (Balsillie and Donoghue 2004a:Appendix II, 2009). The curve, which is based on 86 data points for the period under consideration here from ca. 20k to 10k cal yr BP, compares favorably with sea-level reconstructions adopted in the same area more recently (Harris et al. 2013), employing both local data and data from other parts of the globe (e.g., Bard et al. 1990, 2010; Gregoire et al. 2012; Siddal et al. 2003). Specific calendar years in the analysis results reported herein, it must be emphasized, refer to sample point estimated ages in the Balsillie and Donoghue (2004: Appendix II) sea-level reconstruction. Because the region surrounding the Gulf of Mexico is appreciably south of the southernmost extent of glacial ice during the last glacial maximum, and "given its geologic stability through the late Quaternary . . . and its relatively low-energy environments" the reconstruction provides data on sea-level change applicable in the general area where it was developed (Balsillie and Donoghue 2004:ix–x). It was used here to explore changes in land area in the Gulf and Atlantic Coastal Plains in the vicinity of the southeastern United States. The reconstruction thus does not suffer unduly from the confounding effects

Table 11.1 Sea-level fluctuations and their impact on the geographic extent of the Gulf and southern Atlantic Coastal Plain, ca. 20k–10k cal yr BP.

Cal yr BP	Sea level (m AMSL)[1]	Total shelf area exposed (km^2) (0 m AMSL baseline)	Interval (yrs)	Δ sea level during interval (m)	Avg. sea-level rise per yr (cm)	Total area lost (-)/gained (+) during interval (km^2)	Avg. area lost per yr (km^2)	Percent of entire Coastal Plain lost (-)/gained (+) during interval[2] (%)
20,218	-121.0	536,192	-	-	-	-	-	
19,139	-112.6	528,111	1079	8.4	0.78	-8081	-7.49	-0.48
18,053	-112.8	528,111	1086	-0.1	-0.01	0	0.00	0.00
16,692	-101.1	519,636	1361	11.7	0.86	-8475	-6.23	-0.50
15,174	-98.4	516,962	1518	2.7	0.18	-2674	-1.76	-0.16
14,308	-92.9	511,582	866	5.5	0.64	-5380	-6.21	-0.32
14,044	-80.0	496,470	264	12.9	4.89	-15112	-57.24	-0.89
13,928	-73.0	485,150	116	7.0	6.03	-11320	-97.59	-0.67
13,499	-71.9	483,075	429	1.1	0.26	-2075	-4.84	-0.12
13,276	-69.1	478,813	223	2.8	1.26	-4262	-19.11	-0.25
13,013	-65.0	468,963	263	4.1	1.56	-9850	-37.45	-0.58
12,933	-67.6	474,218	80	-2.6	-3.25	5255	65.69	0.31
12,525	-48.8	413,988	408	18.8	4.61	-60230	-147.62	-3.56
12,044	-40.4	374,769	481	8.4	1.75	-39219	-81.54	-2.32
11,502	-39.5	368,201	542	0.9	0.17	-6568	-12.12	-0.39
11,016	-42.9	386,361	486	-3.4	-0.70	18160	37.37	1.07
10,509	-31.2	309,837	507	11.7	2.30	-76524	-150.93	-4.52
9,981	-25.0	249,885	528	6.2	1.18	-59952	-113.55	-3.54

[1] Data from Basillie and Donoghue 2004, Appendix II, Gulf of Mexico total dataset: 7-point floating average sea-level curve, absolute age dataset, pp. 52–55.
[2] Extent of Coastal Plain in study area is 1,693,270 km^2

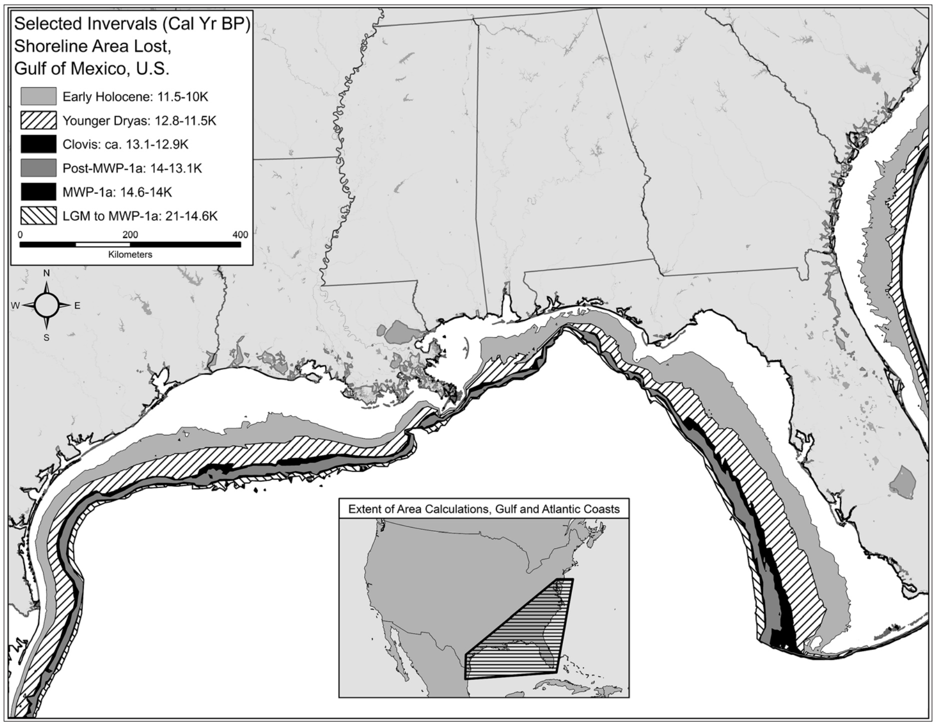

Figure 11.6 Study-area boundaries and shorelines at selected intervals along the Gulf Coast, 20k–10k cal yr BP, based on sea-level data from Balsillie and Donoghue 2004: Appendix II, as presented in Table 16.1.

of substantial isostatic depression and rebound, which are particularly pronounced from the middle Atlantic seaboard northward (Horton 2006; Lowery et al. 2012).

To reconstruct former shorelines and use those data to calculate changes in land area, the past sea-level estimates from Balsillie and Donoghue (2004, 2009) were combined with high-resolution global bathymetric data contained in the ETOPO1 dataset (Amante and Eakins 2009) developed and made available for use by the National Oceanic and Atmospheric Administration (NOAA). The ETOPO1 1-Arc-Minute Global Relief Model was produced from a variety of sources (Amante and Eakins 2009:3–13) and is provided in two versions: "Ice Surface," which is accurate to the top of the Greenland and Antarctica ice sheets, and "Bedrock," representing elevations at the base of the ice sheets. The latter was used for this study. At 1 arc minute, each cell in the ETOPO1 dataset represents one square nautical mile (1.86 km^2), although actual horizontal resolution varies from 4 km^2 for bathymetric data to 2 km^2 for topographic data; vertical resolution of the ETOPO1 dataset is variable for shallow water environments, but nominally is approximately 1 m (Anderson et al. 2010b:60).

All modeling was accomplished using ESRI ArcGIS 9.3®. The ETOPO1 binary-grid file format was imported and converted to a raster dataset, which included elevation as one attribute. Because the ETOPO1 dataset uses the World Geodetic System 1984 (WGS84) datum, a geographic coordinate system, direct calculation of area in square kilometers using the "Calculate Geometry" option in ArcGIS® required reprojection of the raster to a projected coordinate system (Albers Equal Area Conic for North America). The global raster dataset was then "clipped" to encompass only the area of interest, which provided for faster processing time during the subsequent steps.

In order to recreate each past shoreline, the raster dataset was reclassified, and elevations between the modern coastline (0 m AMSL) and the elevation of the selected depth (e.g., -121 m at 20,218 cal yr BP) were grouped under a single classification value. The reclassified raster was converted to a polygon shapefile, which, when filtered to the appropriate classification value, represented only the area of the continental shelf between the ancient and modern shorelines. The "Calculate Geometry" function in ArcGIS® was used to determine area in km^2 for the region represented by each separate shapefile, and the resulting data were used to calculate total area lost between successive sea-level stands 22,000–10,000 cal years BP. The 18 sea-level stands and 17 intervals reported in Table 11.1, a subset of the total sample, were chosen to simplify reporting; because these points marked the beginning or ending of significant climatic events or sea-level fluctuations that could have a greater impact on human settlement than less-pronounced changes; and because some of them marked major periods of cultural change, such as the apparent ending of the Clovis culture. Because the intervals varied in length, Table 11.1 also provides annual (i.e., standardized) rates of change in sea level and area exposed or submerged, offering additional way to assess what was occurring. Changes in sea level over the period ca. 20k–10k cal yr BP and between successive data points over the entire dataset are presented in Figures 11.8 and 11.9. The total area of the exposed continental shelf (i.e., the extent of the now-submerged shelf that would have been dry land at the time) at the selected sea-level stands delimited in Table 11.1 is given in Figure 11.10, while the amount of area exposed or

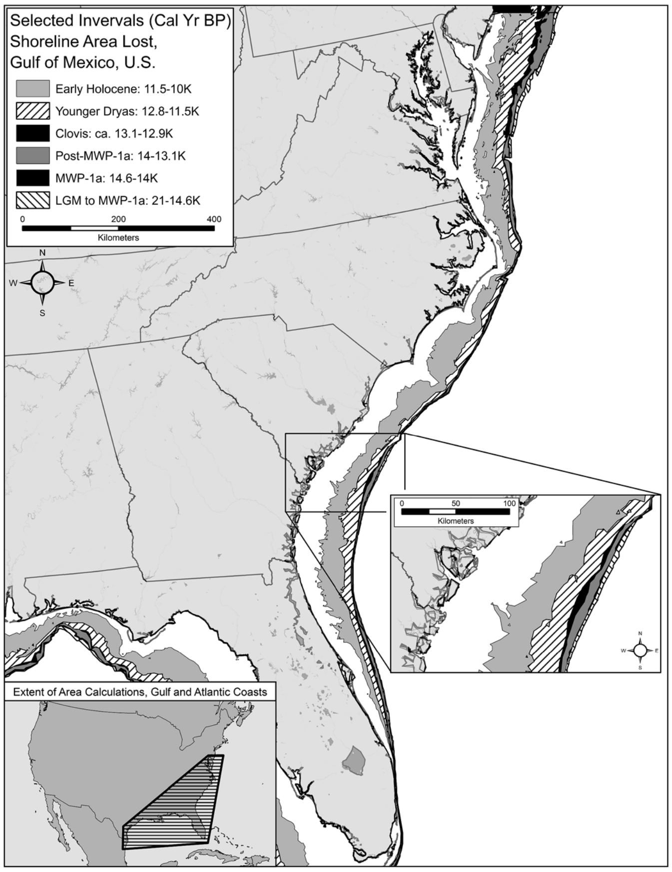

Figure 11.7 Study-area boundaries and shorelines at selected intervals along the Atlantic Coast, 20k–10k cal yr BP, based on sea-level data from Balsillie and Donoghue 2004: Appendix II, as presented in Table 16.1.

lost over the intervals between these stands is given in Figure 11.11. Because the total extent of the Coastal Plain that would have been available for settlement at the Last Glacial Maximum was much larger, by roughly three times, than the area submerged since that time (ca. 1,693,270 vs. 536,192 km^2), the last column in Table 11.1 also gives the percent of this total area that was lost during each interval. These changes in sea level and in the area of the immediate coastal zone lost or gained, we argue, should be evaluated as times when prehistoric peoples would have likely been living near, or moving away from, the margins of the continent.

Inspection of the primary sea-level data, as summarized in Table 11.1 and Figures 11.8 through 11.11, reveals a number of intriguing trends. First, there were periods when the seaward margin of the Coastal Plain was fairly stable, and other times when it was changing rapidly. As expected, rapid sea-level rise is indicated from ca. 14,308 to 13,928 cal yr BP, roughly coincident with Meltwater Pulse 1A (MWP-1A), and afterwards, during the Younger Dryas and initial Holocene, from ca. 12,933 to 9981 cal yr BP, during which Meltwater Pulse 1B (MWP-1B) occurred. The data show, however, that while the average annual rise in sea level was greatest during the MWP-IA interval, the area submerged or exposed on the Coastal Plain, both overall and per year, was much greater during portions of the Younger Dryas and afterwards, after ca. 12,933 cal yr BP. Interestingly, the period of unequivocal initial widespread human settlement during Clovis times, from ca. 13,276 to 12,933 cal yr BP, is one of moderate instability compared with the several centuries immediately beforehand, from ca. 13,592 to 13,276 cal yr BP. Furthermore, examining the detailed record (Figure 11.9), it is also evident that the several centuries prior to this, and immediately after MWP-1A, ca. 13,928–13,592 cal yr BP, were characterized by repeated and fairly pronounced swings (i.e., rises and falls) in sea level over comparatively short intervals, which may have made the immediate coastal margin less attractive for settlement. For much of the period during and prior to Clovis, therefore, the coastal margin would have been an unpredictable environment (see also Holliday and Miller, this volume).

Immediately following Clovis during the initial part of the Younger Dryas, sea-level rise was continuous for several centuries, ca. 12,933–12,299 cal yr BP, which would have likely continued to make the coastal margin unattractive for settlement. In the later part of the Younger Dryas and for roughly half a millennium afterwards, ca. 12,299–10,978 cal yr BP, the coastal zone was again subject to repeated and fairly pronounced swings (i.e., rises and falls) in sea level over comparatively short intervals (Figure 11.9), after which a long period of sea-level rise occurred, ca. 10,978–10,388 cal yr BP, roughly equivalent to MWP-1B. The several hundred years immediately following this interval, ca. 10,388–9981 cal yr BP, was again a period of repeated, if somewhat less pronounced, rises and falls in sea level, albeit still affecting large areas (Figures 11.10, 11.11). These data demonstrate, in fact, that the Younger Dryas/initial Holocene in the vicinity of the southeastern United States was characterized by more-pronounced changes in the amount of area of the Coastal Plain submerged or exposed than any time during the late Pleistocene, greatly exceeding the changes that took place during MWP-1A (Table 11.1, Figures 11.10, 11.11; see also Harris 2013:Table 2).

The analysis minimally shows the critical importance of looking at changes in land area when considering the possible impacts on human populations of sea-level rise or fall. Over the sample examined here, changes in sea level and in land area show an expected modest correlation over the 17 intervals in Table 11.1 ($r = 0.70$). The sample size is low and the correlation suspect as a result, however, but the important point is that the relationship is not direct, meaning one variable (i.e., amount of sea-level rise or fall) cannot accurately predict the other (i.e., amount of land submerged or exposed). We thus need to ask how particular changes in sea level and land area (i.e., at specific times or intervals) could have affected late-Pleistocene human populations living on the Coastal Plain? The rapid rise in sea level associated with MWP-1A and the centuries that followed, for example, may have displaced coastal populations, causing them to move inland, and perhaps helping shape the adaptation represented by Clovis sites and points, which occur widely in the interior. The period following Clovis, in contrast, witnesses continued marked changes in coastal environments, in two

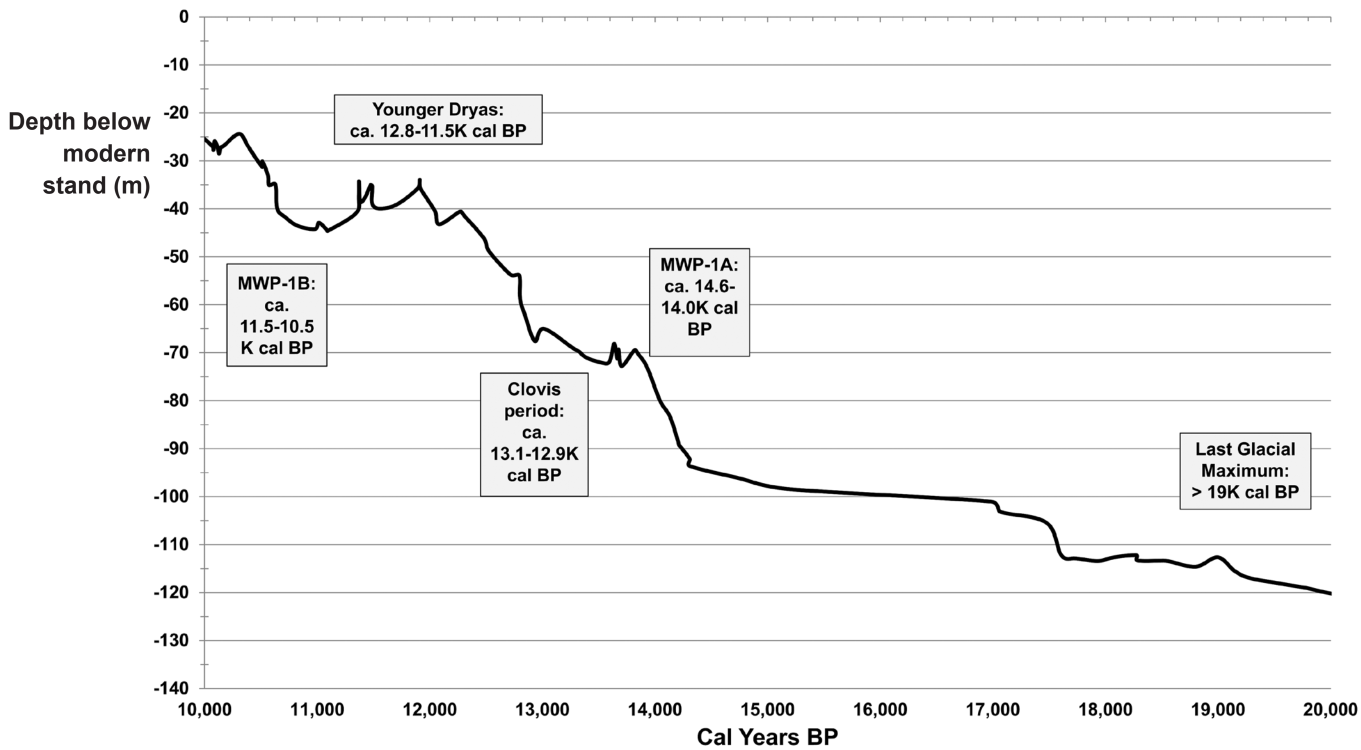

Figure 11.8 Change in sea level ca. 20k–10k cal yr BP, based on all data points (n=86) during this period in Balsillie and Donoghue 2004:Appendix II.

major pulses of sea-level rise associated with the first part of the Younger Dryas and the terminal Pleistocene/initial Holocene. During the intervening millennium, additionally, one of the only major reversals during the entire span occurred, with a substantial increase (18,160 km^2) in the areal extent of the Coastal Plain occurring ca. 11,502–11,016 cal yr BP. These changes may have made the Younger Dryas and immediately afterward a very difficult time for people living near

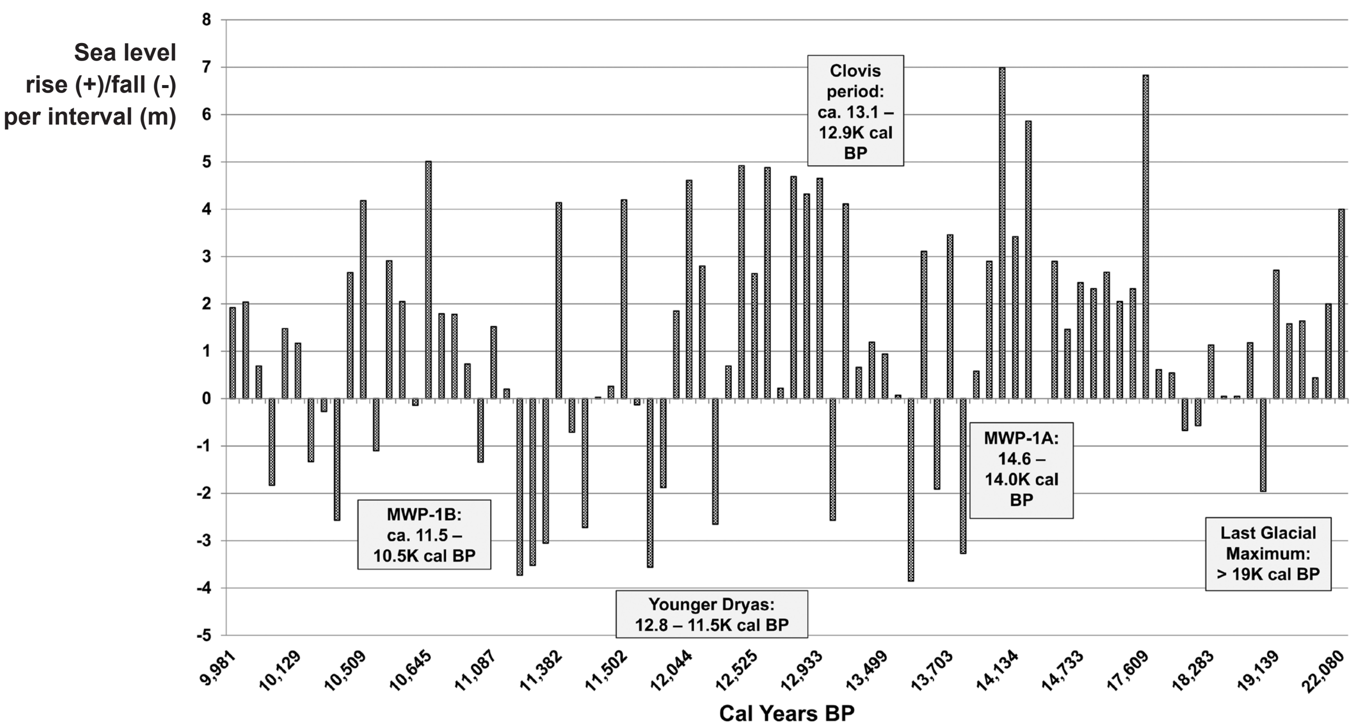

Figure 11.9 Change in sea level between intervals, ca. 20k–10k cal yr BP, based on all data points (n=86) during this period in Balsillie and Donoghue 2004:Appendix II.

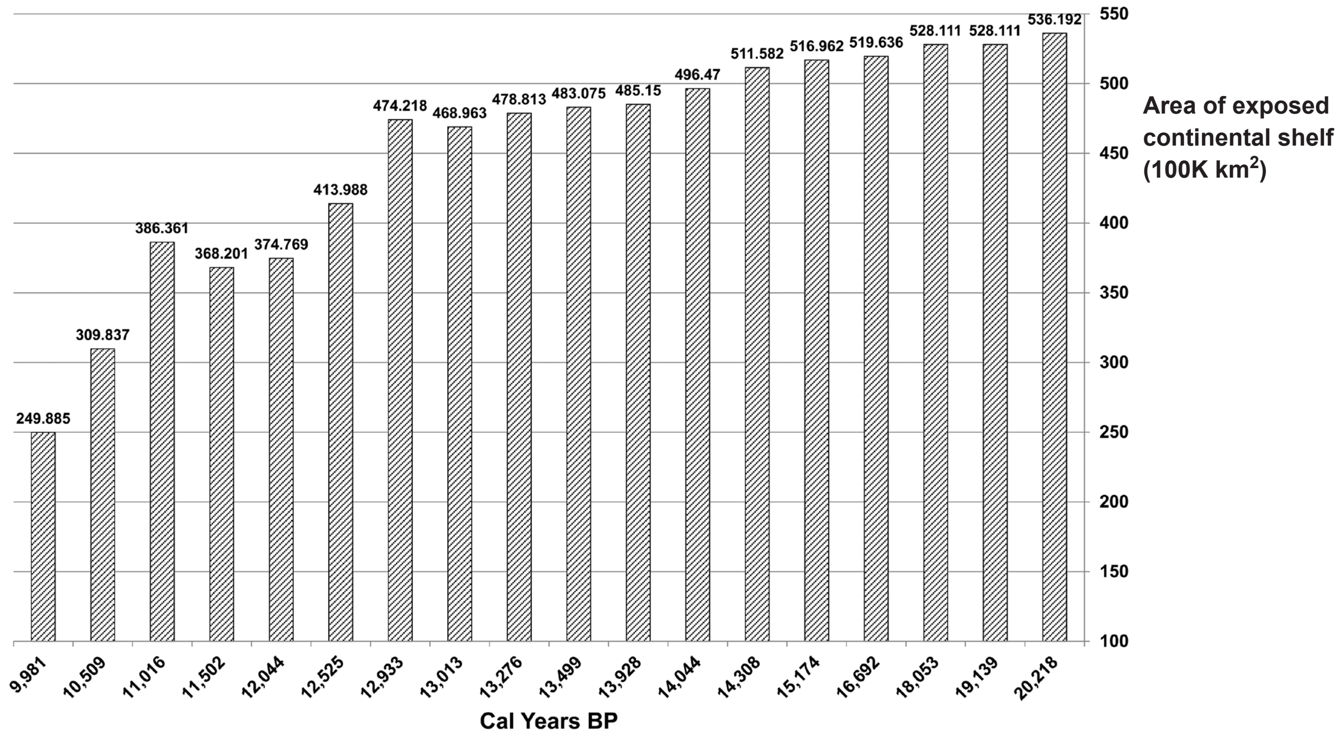

Figure 11.10 Extent of the exposed continental shelf in the study area, at specific times, ca. 20k–10k cal yr BP (based on the data in Table 16.1, derived from sea-level values in Balsillie and Donoghue 2004: Appendix II).

the coast in the southeastern Coastal Plain. Changes in settlement reported early in the Younger Dryas—notably apparent declines in numbers of diagnostic projectile points across the region as well as possible decreases in group annual ranges (Anderson et al. 2010a:73–74, 77–78)—may be related to these changes in sea level. A closer examination of these trends, in fact, shows that settlement well into the interior, in the Midsouth, may have been affected little if at all. Changes

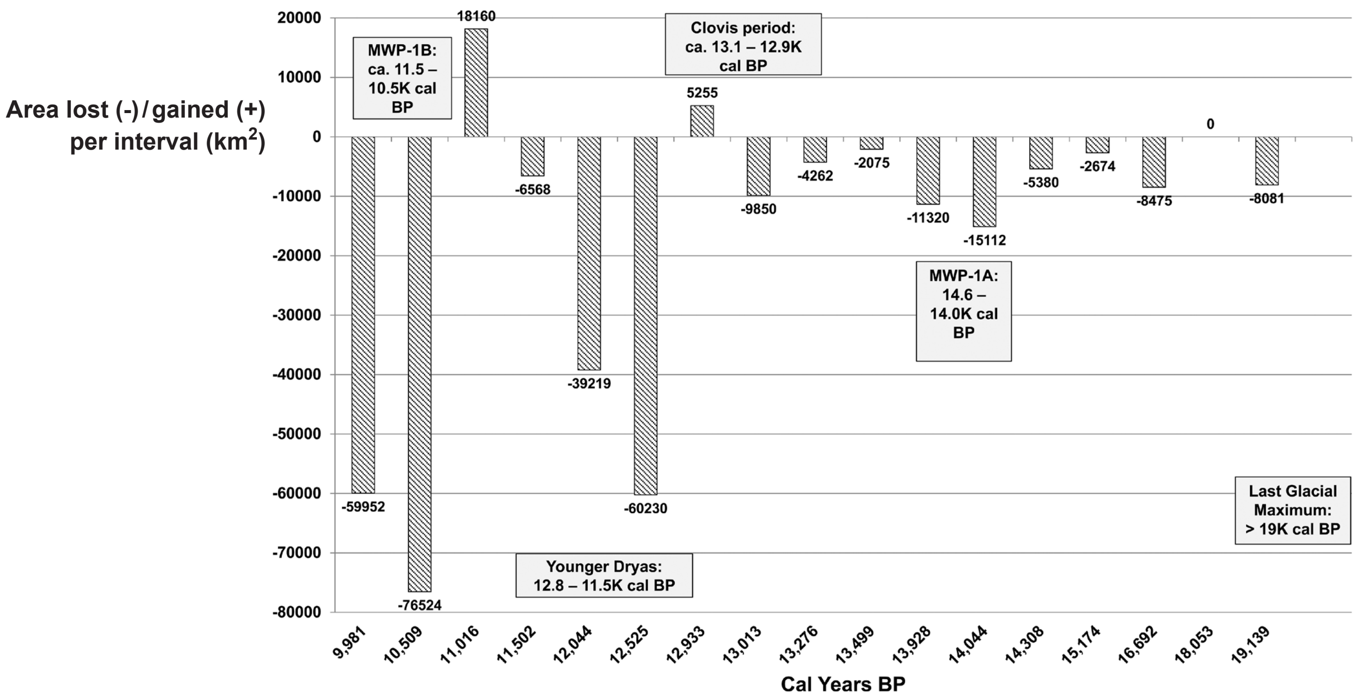

Figure 11.11 Area in km^2 of the Coastal Plain lost or gained in the study area during specified intervals, ca. 20k–10k cal yr BP (based on the data in Table 16.1, derived from sea-level values in Balsillie and Donoghue 2004:Appendix II).

in the numbers of Clovis and immediate post-Clovis forms are nowhere near as pronounced as they are in more coastal areas or over the region as a whole (cf. Goodyear 2006; Miller and Gingerich 2013a; Anderson et al. 2010a:77–78; Broster et al. 2013:306–07; Driskell et al. 2012:262–63). Given that the Midsouth is well removed from the Coastal Plain, their peoples may never have ranged anywhere near the coast, and hence may not have been as affected as people living in closer proximity to the ocean.

Analyses directed to large geographic scales like the one presented here encompassing the entire southeastern Coastal Plain can suggest general patterns of human response to changes in sea level and land area. But detailed high-resolution documentation and examination of offshore topography and coastal environments and how they can change, as well as thorough testing with archaeological data, are essential if we are to better understand the impact of sea-level change on human settlement in specific areas. A particularly elegant example of the kind of research needed is that by Harris and his colleagues (2013), a fine-grained examination of offshore continental-shelf topography at a number of locations in the South Atlantic region using an array of remote-sensing procedures. This research documented the locations of former river channels and scarps, and suggested they were specific areas where evidence of early human occupation might be found. Likewise Lowery and colleagues (2012) examined the width of the submerged and modern Coastal Plain and the occurrence of fluted points, showing these variables were related along portions of the Eastern seaboard. Yet another systematic and fine-grained study of offshore topography, in this case encompassing the entire Southern and Middle Atlantic seaboard, by Sain (2013), showed that far more fluted points were found in areas where the now-submerged Coastal Plain was comparatively wide and where large rivers ran into it than where it was narrower and only small drainages were present. Much more work along these lines is, of course, needed, given the comparable changes in sea level facing the modern world. Of direct relevance to our modern civilization, Donoghue (2011) has provided a detailed discussion of how minor changes in sea level may play out in terms of area lost and numbers of people who will need to relocate in the Southeast in the near future, while Dasgupta et al. (2009) look at the same variables at a global scale. Hopefully the resilience our ancestors showed in making it through such changes, and archaeological resolution of how they did so, will provide lessons for the future.

Geographic Methods for Delimiting Early Dispersal Routes in the Americas

Another particularly useful means of determining how and why people may have moved over the landscape is least-cost-pathway analysis (Anderson 2012; Anderson and Gillam 2000; White and Surface-Evans 2012). A number of insights result from use of this procedure. First, the pathways differ depending on where the analysis starts, or where people initially enter the continent. Some pathways run through major site and artifact concentrations, such as along major river valleys in eastern North America. Second, examining these routes with other kinds of information, such as morphological, genetic, or linguistic diversity data, may suggest how people moved or where they settled early. A least-cost-pathway analysis in South America suggested early movement east of the Andes might have occurred; the area has great linguistic diversity, suggesting ancient settlement, something that can be evaluated archaeologically (Dahl et al. 2011; see also Miotti and Magnin 2012 and Magnin et al. 2012 for recent and much more detailed GIS modeling in the examination of the colonization of South America). Aceituno (2012) has provided a good recent discussion of early peopling and cultural diversity in Columbia, showing interior populations were present early. There are, of course, many factors that can promote linguistic diversity in a given area other than age, such as high population density and intergroup competition, physiographic factors, resource availability, and the nature of the economic and organizational systems present (Nichols 1990:484–89; see also Dahl et al. 2011:216–21 for a consideration of some of these factors in the South American case).

Finally, knowing when and where shorelines, ice sheets, and pluvial lakes were and how their boundaries changed over time is critical to reconstructing migration pathways and settlement systems (Anderson et al. 2010b). Almost 300,000 km^2 of the coastal landscape of the southeastern United States, we have seen, was submerged by rising sea levels in the late Pleistocene and initial Holocene between 20k and 10k cal yr BP (Table 11.1, Figure 11.10). Much of the upper Midwest and Northeast was under ice or massive periglacial lakes and seas, and pluvial lakes occupied large portions of the Great Basin, the Southwest, and California (Figures 11.1 and 11.2). These physiographic features may have proved formidable barriers or offered easy routes and resources to early populations moving over the landscape. Archaeologists have long explored the margins of these features for early sites, and in recent years have examined submerged terrain in the eastern Gulf of Mexico along old river channels and ancient shorelines, although most of the work to date has been in fairly shallow waters (Faught 2004a, 2004b; Faught and Guisick 2011; Guisick and Faught 2011). Work is most recently being directed to much deeper waters, including the shoreline during the last glacial maximum, in waters some 400 ft deep (Adovasio and Hemmings 2011; Illingworth et al. 2010). Former terrestrial sites found intact at such depths, or indeed anywhere beyond the Clovis-era shoreline, would be compelling evidence for an earlier entry by people into North America. That is, sites and artifacts found in the areas once covered with ice sheets or pluvial or periglacial lakes almost certainly have to be younger in age, while those submerged by rising sea levels, barring loss from vessels, date before the time these areas were inundated. One area where maritime Paleoindian adaptations may be documented in terrestrial and not submerged contents, in part because of post-glacial uplift, may be along the former Champlain Sea shorelines in Vermont and New York, where Clovis or slightly later Paleoindian archaeological sites have been found (Robinson 2009, 2012). Archaeology can thus help us date geological features, and the latter can help us understand when people reached given areas.

Possible movement patterns can also be discerned by examining the occurrence and density of sites and artifacts over large areas. Gradual versus rapid patterns of movement have been hypothesized along inferred movement corridors in the Americas (e.g., Surovell 2003; Anderson and Gillam 2000). At least for the Clovis period, the dense but widely separated concentrations of projectile points found in North America suggest these populations used a leapfrogging movement strategy; that is, moved rapidly between widely separated points (sensu Anthony 1990:902–03; Anderson and Gillam 2000:58–59), rather than gradually expanding over the landscape. It seems logical to expect even earlier populations in the Americas to employ such a strategy, moving rapidly over the landscape looking for especially favored "staging" areas to occupy, regroup, and either settle in or move on from (Anderson 1990, 1995; Beaton 1991; Meltzer 2003, 2004, 2009).

The Concept of Staging Areas

Once people reached the Americas, resource-rich regions, whether along the major river systems of the midcontinent in North America, or along the Pacific, Gulf, or Atlantic coasts, or areas near rich lake or marine environments, could have served as staging areas, places where people stayed or settled for longer periods of time, and likely formed the core of permanent occupations in these regions (Anderson 1990:187–96). Such locations would have been ideal bases from which the exploration and settlement of the rest of the region could have occurred. Populations moving out from such locations would know where people and resources were located on the landscape behind them, offering a place to return to in the event of problems, to share information, and maintain mating, kinship, and ceremonial networks. Dense concentrations of Clovis and immediate post-Clovis fluted points are found in a number of such areas of North America, supporting such an approach to the colonization and settlement of the continent (Anderson 1990, 1995; Meltzer 2004, 2009; Anderson et al. 2010). An early place-oriented approach to modeling settlement envisioned people arriving in the midcontinent after coming in from the west (Figure 11.12). Archaeological research directed to examining whether such a model was viable have found some support for it (e.g., Miller 2011; Smallwood 2011, 2012). In light of the arguments presented above, a number of possible additional areas can be delimited where early population "staging areas" in the Americas might be found (Figure 11.13; see also Collins et al., this volume). The numbering system on Figure 11.13 may be a logical chronological order in which these areas could have been settled by people moving along and perhaps subsequently forced off the coast by sea-level rise. But there are many possibilities, including people moving west to east along the glacial margins, or down the major river systems draining the Great Plains—perhaps after reaching these drainages by following the Columbia River eastward or the Colorado/Gila rivers to the north and east. They might have even entered the region from the south, if people first reached the Atlantic coast via a crossing somewhere in Latin America.

Where Do We Go from Here?

Obviously, the ideas advanced herein about possible routes, areas, and chronologies for early settlement will require vast amounts of primary archaeological field and collections work to evaluate. Indeed, it might be argued that the purpose of

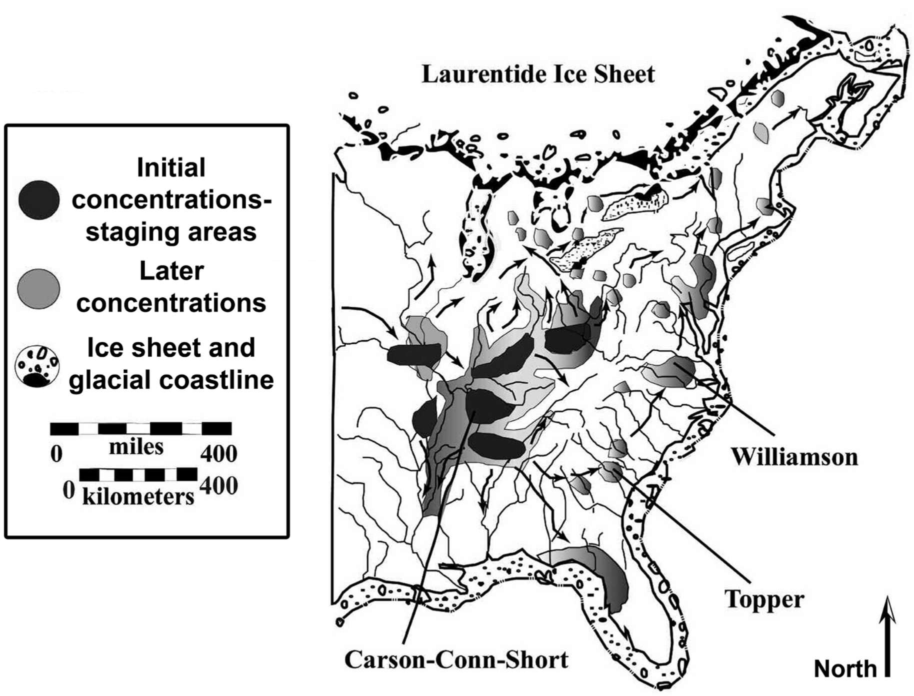

Figure 11.12 Staging areas in eastern North America, showing inferred settlement chronology. Biface assemblages from the three labeled sites were examined by Ashley Smallwood in a test of the staging-area model (Smallwood 2011, 2012:690, adapted from Anderson 1990:190; image used courtesy of the author, Ashley M. Smallwood, and the Society for American Archaeology).

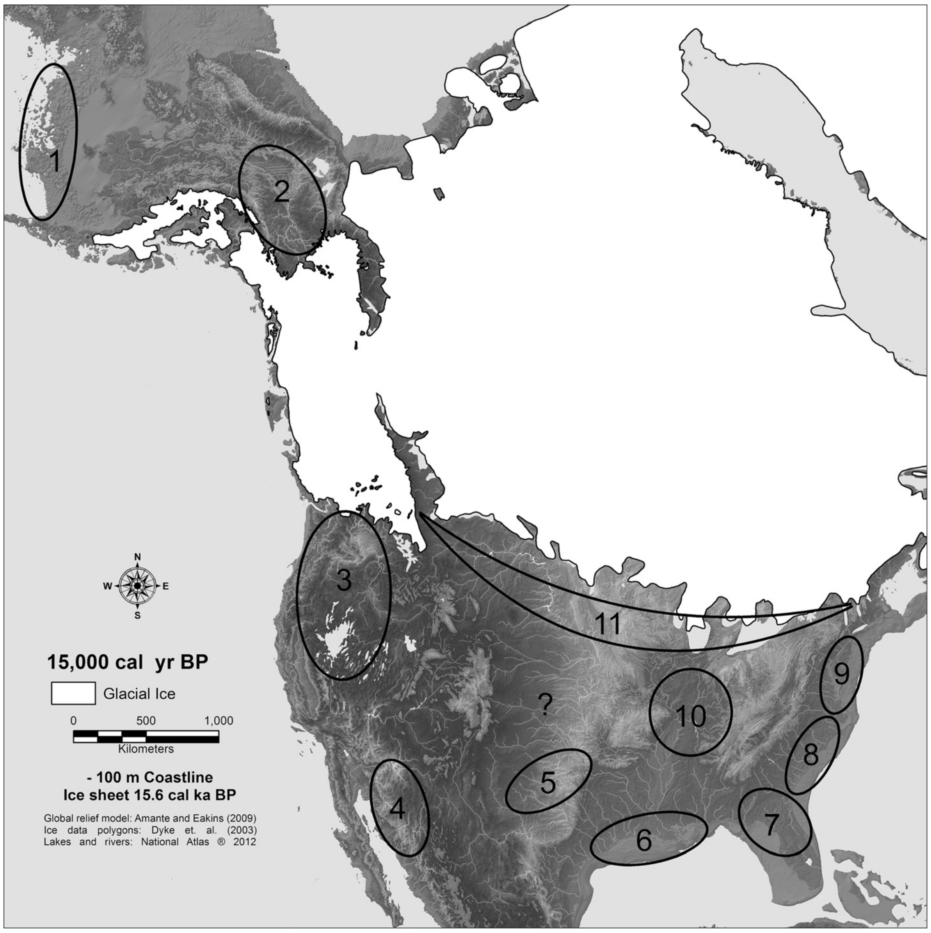

Figure 11.13 Hypothetical staging areas/locations of early settlement in North America: **1**, Beringian archipelago/south coast of Beringia; **2**, Interior Alaska; **3**, Pacific Northwest near the Columbia River/area of the Western Stemmed Tradition; **4**, Sonora/lower Southwest; **5**, Southern Plains around Gault/Friedkin; **6**, western Gulf Coastal Plain/margin near the mouth of the Mississippi; **7**, northern and western Florida; **8**, south Atlantic slope; **9**, middle Atlantic slope; **10**, midcontinent in the vicinity of the Tennessee, Cumberland, and Ohio rivers; **11**, Ice-sheet margin/tundra/pluvial lakes; and possibly (?) Central/Southern Plains.

papers like this is that they sometimes inspire people to go out and collect the data necessary to test them (e.g., Smallwood 2011, 2012), or suggest areas on the landscape where careful examination might prove informative, such as along the lower Colorado River and in Sonora, or areas along the margins of the now-submerged southeastern Coastal Plain that were comparatively stable at certain periods during the late Pleistocene. This paper, like many others in recent years, has attempted to demonstrate that information important to understanding the record of early settlement of the Americas almost certainly lies offshore on the now submerged landscapes of the continental shelf. As important as conducting archaeology in that setting will be understanding past environmental conditions on those landscapes, and how the sea-level changes affected biota and physiography in ways important to human populations.

If pre-Clovis diagnostic bifaces or other artifact forms are present in any incidence on the landscape, multiple examples of them have probably already been collected and are awaiting recognition. Detailed quantitatively based comparative analyses of artifact assemblages, ideally with imaging software allowing thorough yet rapid documentation of large numbers of artifacts, may be a way to recognize heretofore unrecognized patterning (e.g., Thulman 2007, 2012; Lenardi and Merwin 2007; Shott and Trail 2010). Recovery of artifacts and assemblages in excavation context, preferably in stratified, well-dated, and minimally disturbed deposits, will of course be essential to determining the age and associations of the materials left behind by the early occupants of the Americas. Furthermore, these sites and assemblages will need to be written up, the collections curated for the long term, and as much primary data as possible made widely available.

As we have tried to show here, GIS technology offers tremendous potential for generating elegant models about how the initial colonization and settlement of the Americas might have occurred. GIS/simulation modeling exercises only offer possibilities, or hypotheses to be tested, however, that should not be confused with past reality, and that must ultimately be tested with archaeological evidence (e.g., Meltzer 2009:197; R. L. Kelly: pers. comm. 2013). For many important questions and models, unfortunately, we currently lack the archaeological data, or least data in a form useful to analysis, to adequately test them. By recording primary data on early sites, dates, and assemblages, as has been attempted by projects like the Paleoindian Database of the Americas (PIDBA), the Canadian Archaeological Radiocarbon Database (CARD), or in areas like eastern North America (e.g., Martin-Siebert 2004; Miller and Gingerich 2013a, 2013b; Anderson et al. 2010a; Gajewski et al. 2011), such information can be used to conduct such tests, and learn much more about the early settlement of the Americas. While a vast amount of information has been gathered, however, much remains to be collected and compiled, and initial efforts along these lines, like PIDBA, while admirable and informative, have a long way to go before they can reach their full potential (cf. Anderson 2010a; Prasciunas 2011; Shott 2002, 2005). Hopefully in the years to come the Paleoindian archaeological community will mount the massive coordinated effort necessary to compile and share primary data. Once we get better at knowing where sites and artifacts are, both on the landscape and in our collections, and have a better sense of where else we need to look for them, our understanding of the early colonization of the Americas should clarify quickly.

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