MAMMOTH TRUMPET

Center for the Study of the First Americans

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Blossoming blue dicks overlook the Pacific Ocean on a bluff on Santa Cruz Island, one of the North Channel Islands off the coast of California. Lowered sea level during the Ice Age exposed in their place immense Santa Rosae Island. Never connected to land, the parent and child islands were occupied as early as 13,000 years ago by boat people. Hunters stalked marine mammals and birds; gatherers collected shellfish and dug up corms of the blue dick and other plants. See our story on **page 10.** Photo by Kristina Gill

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The hunting weapon that was too efficient

ABUNDANT FOSSIL EVIDENCE testifies that many species of megafauna in the Americas disappeared around the end of the last Ice Age. Where archaeologists disagree is in identifying the cause of the extinctions, which, perhaps coincidentally, coincided with human dispersal from Siberia. Some scientists attribute mass megafauna extinctions to climate change, others to disease or habitat modification.

And still others place the blame squarely on the shoulders of human hunters. The loudest voice in this camp belongs to University of Arizona geoscientist Paul Martin, who 40 years ago asserted that simultaneous megafauna extinctions and human entry to the Americas was no coincidence. His "blitzkrieg" model describes Early American hunters, armed with lethally efficient weapons, devastating populations of mammoths and mastodons and giant sloths "with the efficiency of a German panzer division." North American hunters wielded the fearsome Clovis fluted projectile point, and South American hunters were armed with spears tipped with the equally lethal Fishtail projectile point (FPP). Predation experienced a quantum leap.

You could say that Luciano Prates and Ivan Perez, professors of Anthropology at Universidad Nacional de La Plata in Bueno Aires province and researchers in CONICET, are testing Martin's theory. Their research on megafauna extinction in South America aims the spotlight at humans as the cause, specifically human hunters armed with the deadly FPP.

Extinctions in South America vs. North America

Megafauna became extinct all over the world at the end of the Pleistocene, touching every continent save Africa. In the Americas the loss of biodiversity occurred alongside the influx of humans and climate change. These are factors that Prates and Perez had to consider.

The archaeological record of South America suffers from a dearth of megafauna remains bearing evidence of human intervention. More-

INSIDE

over, South American archaeologists, secure in the knowledge that humans entered the southern continent before the appearance of the Clovis culture in North America, summarily dismissed the role of the FPP in colonizing South America. The greatest challenge of Prates's research is therefore, he explains, "to show conclusive evidence that humans were mainly responsible for extinctions, even when the direct evidence of human processing and consumption of megafauna is scarce in South America."

Prates and Perez harbor no illusions about the difficulty they face in trying to sell their conclusions to the scientific community: "Because we have all grown academically in the shadows of strong criticism of hypotheses defending a central role of humans in extinctions, we don't expect our work to be quickly or easily accepted among scholars, and even less among older generations of archaeologists."

Gauging megafauna and FPP density

Prates and Perez focused their analyses on the "robust estimation of the spatial and temporal dimensions that were the main variables relevant for understanding the problem: human, megafauna, and projectile-point density." They consider the FPP a great "empirical proxy" for exploring the interaction between extinct megafauna and humans, since FPPs were the most abundant, widely distributed tools.

Prates and Perez concentrate their effort on three regions where humans and megafauna are known to have coexisted: the Pampa (Argentinian Pampa, southern Brazil, and Uruguay), southern Patagonia, and Andes. They compared the temporal changes in the density of megafauna and FPPs with the existing human population density to understand the effect on human demography. Their team explored the distribution of FPPs and 10 species that were found in stratigraphic association with humans in the archaeological record in the late Pleistocene. Except for *Glossotherium robustum,* a 1500-kg sloth, and *Doedicurus clavicaudatus,* a 2000-kg ancestor of the armadillo, all species bear evidence of human processing and consumption.

Interpreting the data

"Contrary to what we originally thought," Prates and Perez say, "we found no evidence that the megafauna population was falling in South America after the Last Glacial Maximum." On the contrary, their data showed a marked increase from 18,000 yr B.P. until it abruptly halted and began to decline at around 12,900 yr B.P. , at the time FPPs appeared (see sidebar, p. 4). Megafauna populations declined until they disappeared at the start of the Holocene, about 11,600 yr B.P. Accordingly, FPPs gradually diminished in number and finally disappeared by 10,900 yr B.P. because megafauna extinctions had rendered them useless.

"FPP and megafauna virtually disap-

MAMMOTH TRUMPET

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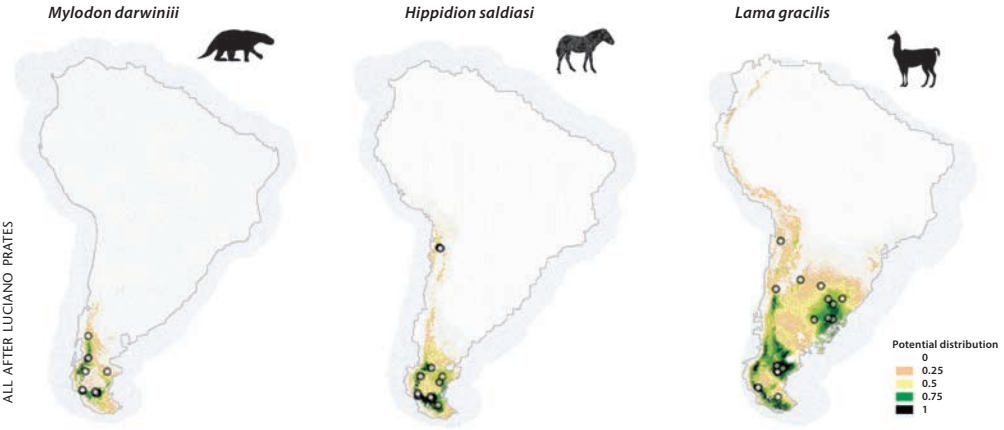
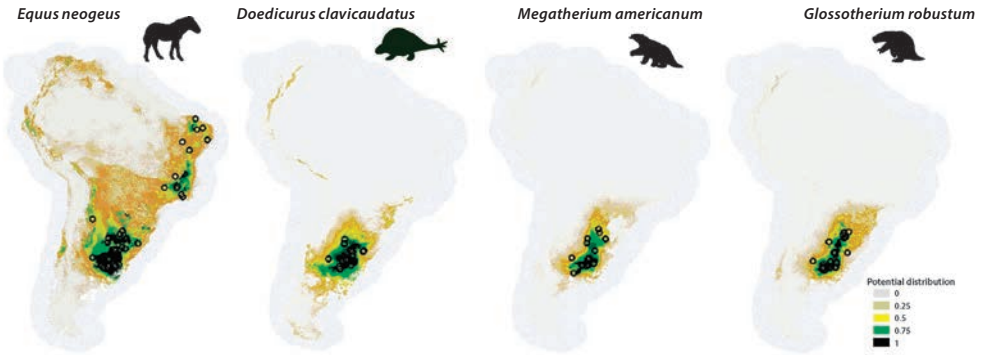
–Michael R. Waters, Director

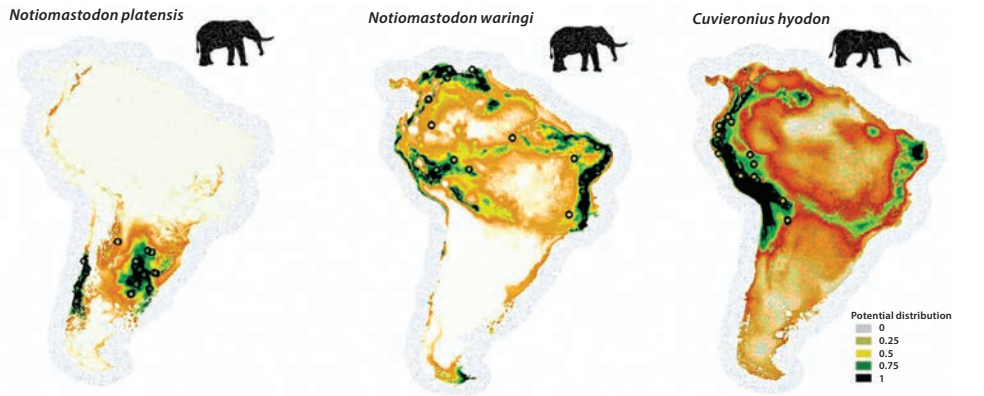
ALL AFTER LUCIANO PRATES



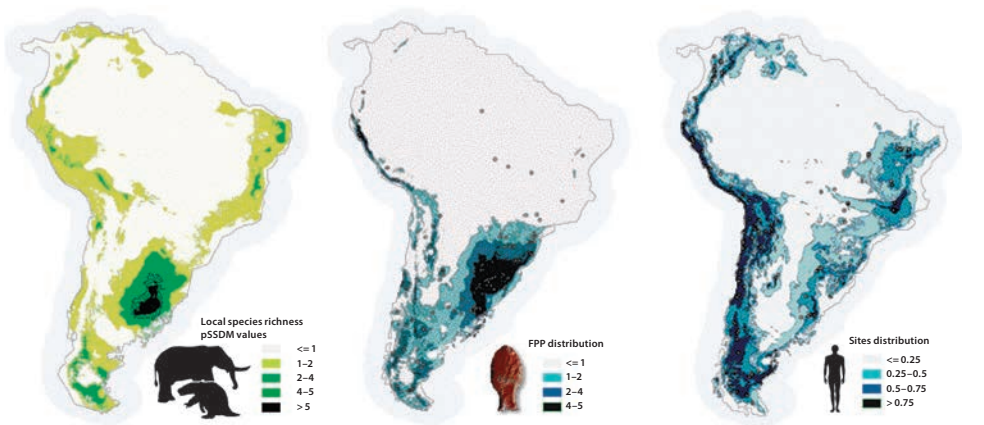
Spatial distribution of southernmost megafaunal species during the late Pleistocene–early Holocene (18,000–9000 yr B.P.).



Spatial distribution of Pampean megafaunal species: potential distribution maps of *Equus neogeus*, *Doedicurus clavicaudatus*, *Megatherium americanum*, and ***Glossotherium robustum*** **during the late Pleistocene–early Holocene (18,000–9000 yr B.P.).**



Spatial distribution of northernmost megafaunal species: potential distribution maps of *Notiomastodon platensis*, *Notiomastodon waringi*, and ***Cuvieronius hyodon*** **during the late Pleistocene–early Holocene (18,000–9000 yr B.P.).**



Spatial distribution of species richness of megamammals (18,000–9000 yr B.P.), FPPs (13,000–10,900 yr B.P.), and archaeological sites (13,000–11,000 yr B.P.).

The Timeline of Megafauna Extinction in South America

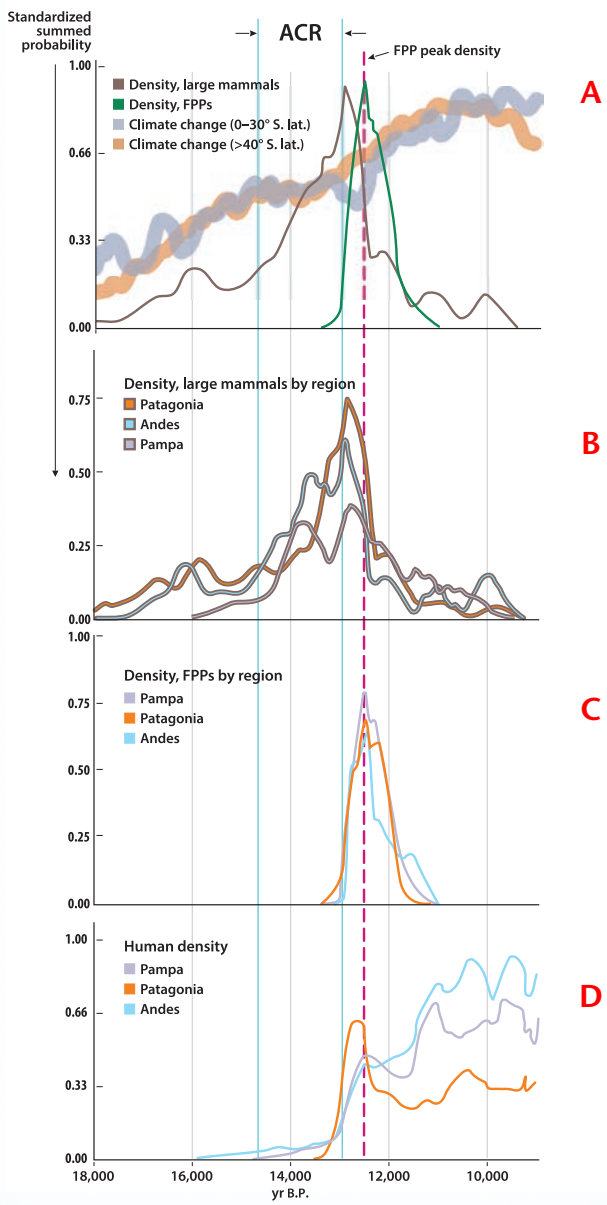
A picture, especially a lucid graph, is still worth a thousand words. These graphs were compiled by Prates and Perez's team by applying Species Distribution Modeling and Summed Probability Distribution, statistical technologies that accurately reveal changes in a species over time and space.

Take climate change, for example, as a possible cause of megafaunal extinction in South America. At the end of the Pleistocene North America was hammered by the Younger Dryas (12,900–11,700 yr B.P.), a period of intense cold that severely stressed animal and human populations. In South America, however, the climate was spared violent excursions even in the southernmost regions (panel **A**), and megamammal populations enjoyed steady growth even through the period of the Antarctic Cold Reversal (ACR), a post-glacial cooling period much less severe than the Younger Dryas of North America. Then, having peaked, the populations suddenly (in geologic time) experienced a precipitous decline. The timing of the downward spiral is critical because it coincides with the introduction of the Fishtail projectile point as the killing weapon of Paleoamerican hunters in South America.

The FPP was the better mousetrap. It exploded in popularity across the width and breadth of the southern continent. This superior weapon in the hands of hunters succeeded in reducing megamammal populations to a mere shadow of their former magnitude, until they completely vanished soon after the start of the Holocene (about 11,650 yr B.P.).

That instant in geologic time when FPPs exerted their enormous influence by efficiently slaughtering game, no matter how massive, is the climacteric, the pivotal point that influenced many disparate events. Across Patagonia, the Andes, and Pampa, megafauna populations uniformly collapsed (panel **B**) when FPPs became prevalent (panel **C**). Coincident with the dwindling megafauna population, the human population of Patagonia was drastically reduced to half its previous maximum number (panel **D**); the human populations of Pampa and the Andes, however, hesitated only temporarily before expanding. The most parsimonious explanation for this diverging trend in population size is that Patagonians appear to have been more dependent upon hunting megafauna for subsistence than were hunter-gatherers in Pampa and the Andes.

Perhaps Prates and Perez haven't conclusively proved that FPPs were the cause of megafaunal extinction in South America, but a scientist arguing the case for climate change, disease, or habitat modification will find it difficult to ignore their conclusions.



pear around the same time," Prates and Perez declare, which supports their hypothesis that megafauna extinction was directly tied to FPP technology. What's more, changes in the density of FPPs affect not only megafauna density but human population growth as well. The rapid and successful spread of FPP technology led to the high population growth of early South Americans.

How do Prates and Perez account for the fact that humans made little impact on megafauna populations for their first 2,000 years of living in South America? From 15,000 to 13,000 yr B.P. human population density was relatively low and megafauna remained relatively unaffected. Prates and Perez reason that if South America was colonized around 15,000 yr B.P., when megafauna were abundant, they remained impervious to humans because humans were generalist hunters and hadn't yet developed a specialized weapon like the FPP capable of subduing enormous animals. Perhaps it wasn't until sometime around 13,000 yr B.P. that a far-thinking toolmaker—a Paleoamerican

endowed with the imagination of Archimedes or Leonardo da Vinci or Thomas Edison—gazed long and hard at a fine piece of toolstone and thought, What if?

Territory is the key

Some questions remain for Prates and Perez: Was the FPP a southern cultural expression of Clovis, or did it develop independent of its northern counterpart? They can only say, with confidence, that human demography in South America at the end of the Pleistocene was directly tied to changes in the density of megafauna and the expansive use of FPPs.

Perez.

Regions of concentrated FPP use are marked by two characteristics, a rich abundance of herbivores and high human density. This makes sense to Prates and Perez because it confirms the presence of essential FPP technology for hunting large-mammal species during the Late Pleistocene.

Prates and Perez's data reveal an increase in the fossil record all over South America shortly after the LGM. This pattern could be linked, they say, to the expansion of herbivores and their predators during the end of the late Pleistocene.

A favorable environment appeared at the end of the LGM, especially in the Pampa region. Their data reveal the highest values for both species abundance and presence of FPPs in the Pampa region and, to an extent, in Patagonia. This is because such environmental zones are predominantly open environments, grassland steppes in the Pampas and grassland cold steppes in Patagonia.

When megafauna were at maximum density in open grassland steppes, hunters armed with FPPs began to prey on them. Around 12,900 yr B.P. the growth of megafauna species abruptly declined. It took a few centuries for this slump to affect humans; by 12,400 yr B.P. the use of FPPs had declined, and they disappeared completely when megafauna became extinct.

The disappearance of megafauna and FPPs ushered in a sudden decline in the growth of human populations, for Prates and Perez an astonishing consequence. "The sudden slowdown in human population growth rate observed around the time of the final Pleistocene megafauna extinctions was a strong indication that extinction could have been linked with humans, which was nothing short of unthinkable for us until then," they explain. "Moreover, we observed the same pattern of change in the human population growth rate at local scale in different areas of South America."

Prates and Perez likewise found no evidence that megafauna populations were declining in South America after the LGM. On the contrary, their data showed a marked increase from 18,000 yr B.P. until growth suddenly stopped and began to decline at about 12,900 yr B.P., "right at the time of FPP emergence," they observe.

Coincidence enough?

FPPs are the culprit

Whereas in North America the initial decline in megafauna numbers happens at 13,000 yr B.P., concurrent with the punishing cold Younger Dryas (and the appearance of the Clovis culture with its fearsome fluted point), in South America the megafauna population actually *increased* throughout the period of the Antarctic Cold Reversal ACR (14,600–12,700 yr B.P.). Researchers constantly emphasize the significance of climate change in contributing to megafauna extinctions, but, as Prates and Perez point out, the end of the ACR in Pampa and Patagonia doesn't coincide with the sudden decline in megafauna 12,900 years ago. They declare emphatically that "there was no clear chronological or spatial adjustment between changes in megafauna density and environmental changes associated with the Antarctic Cold Reversal."

Prates.

Here is the crux of Prates and Perez's argument: In North America megafauna collapse began at the start of the post-glacial cooling period (YD), which coincided with the emergence of the Clovis culture. In South America, however, megafauna collapse began at the *end* of the post-glacial cooling period (ACR), when Fishtail points first appeared. Extinctions therefore aren't linked with climatic changes on the two continents, but instead with the appearance of the first weapons capable of downing megafauna, the Clovis fluted point and the Fishtail point.

Furthermore, grassland habitats in southern South America—the most favorable environment for large megafauna—didn't begin to shrink until 12,400–11,500 yr B.P., 1400–1500 years after megafauna decline in south Patagonia. Take-home point: Animals didn't become extinct until humans armed with FPPs appeared. The irrefutable conclusion for Prates and Perez is that humans were the driving force behind their extinction. FPPs, their specialized hunting tool, were the culprit.

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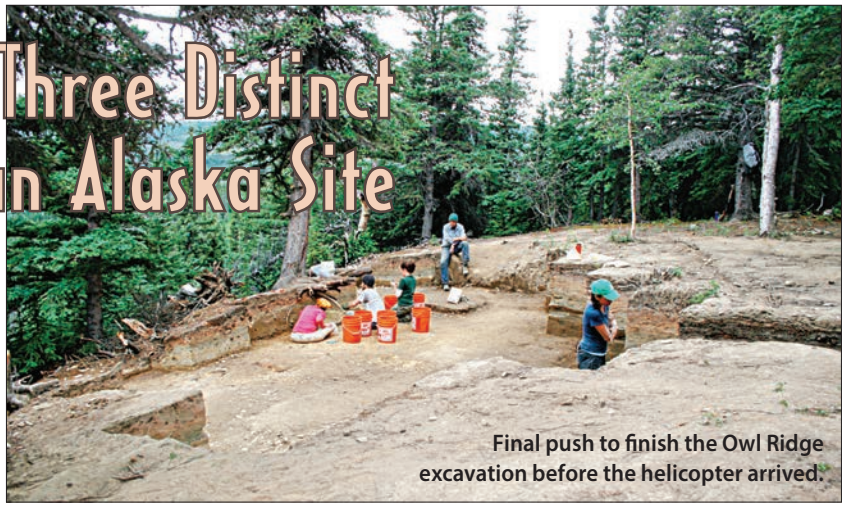
OWL RIDGE

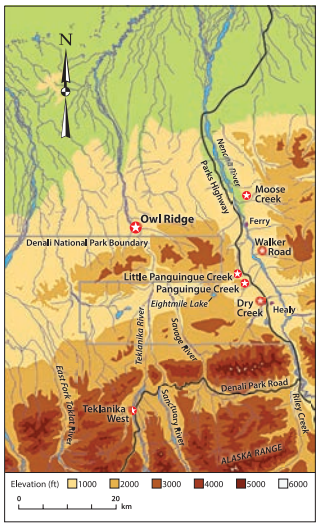
Exploring Three Distinct Occupations at an Alaska Site



Final push to finish the Owl Ridge excavation before the helicopter arrived.

WHEN DEGLACIATION FREED the First Americans from the multi-millennia Beringian Standstill, among the first places on the North American continent they colonized was the interior of Alaska. The time was the terminal Pleistocene, when the climate and landscape were in a state of flux, and so was the human population. Archaeological evidence at the Owl Ridge site, located in the Teklanika River valley, bears witness to 2,000 years of successive occupations of hunter-gatherers, each practicing a distinctive lithic technology. The question begs an answer: Did a single founding population repeatedly modify their hunting toolkit, or were occupants successively displaced by intruding bands of hunter-gatherers?

Making sense of human life in this seminal period in the peopling of the Americas and of the climatic vagaries that afflicted them is the task Kelly Graf has set for herself. Over three field seasons Graf, Associate Professor of Anthropology at Texas A&M and faculty associate of the Center for the Study of the First Americans, plumbed the sediments of Owl Ridge for clues to the identity of the human settlers and for a clear picture of the climate and environmental conditions in eastern Beringia at the end of the Pleistocene.



Birth pains of an archaeological site

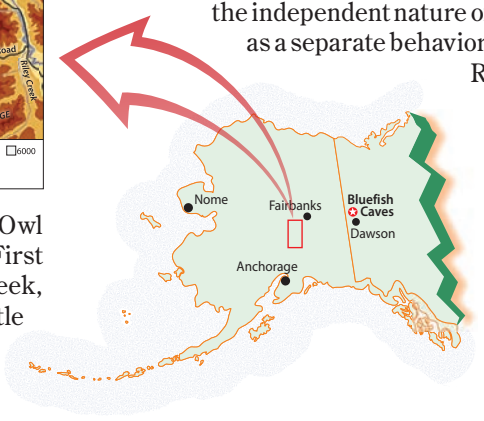
Graf isn't the first scientist to visit Owl Ridge. The site was discovered in 1976 by scientists D. C. Plaskett and R. M. Thorson while exploring alluvial terraces of the Teklanika River. Owl Ridge sits 80 m above the confluence of the river with First Creek. Like sister sites in the Nenana Valley—Dry Creek, Moose Creek, Walker Road, Panguingue Creek, and Little Panguingue Creek—it was a campsite deliberately chosen for its commanding view of surrounding territory for spying game and suspicious foot traffic. Plaskett and Thorson dug test pits, which revealed two possible cultural components. Non-intensive explorations of the site in the '70s produced little more than a cobble feature and the conclusion that the stratigraphy of sediment deposits of the site was eolian in origin.

A major breakthrough in comprehending the nature of the site came in 1982 and 1984, when the team of P. G. Phippen excavated an area of 26 m^2 and discovered three cultural components, their lithic assemblages totaling fewer than 1,000 artifacts. In the absence of diagnostic artifacts, Phippen radiocarbon dated organic matter from each component and thus defined its cultural affiliation:

- Component 1: Nenana complex, about 13,300 yr B.P.
- Component 2: Denali complex, about 11,000–8000 yr B.P.
- Component 3: nonspecific complex later than 8000 yr B.P.

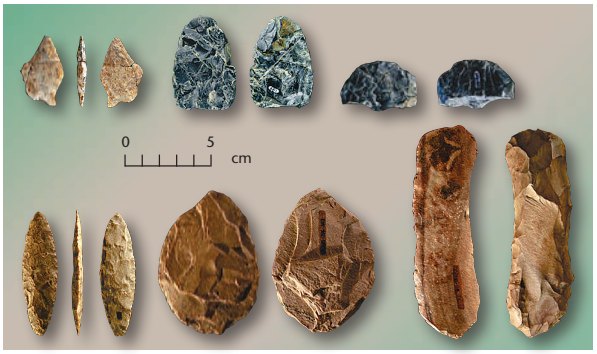
Those problematic components at Owl Ridge

A precept of archaeology dictates that discrete areas suggest that people used the site differently through time, supporting the independent nature of the accumulation of each as a separate behavioral depositional event. Owl Ridge conforms to this prescription: Activity areas of the three components don't directly overlap across space, and the patterning of horizontal refits within each component indicates that the components represent three single-occupation events.



Further research has refined the chronology of the three occupations at Owl Ridge during the Pleistocene-Holocene transition: a Nenana-complex occupation 13,380–12,800 yr B.P., and Denali-complex occupations 12,540–11,430 and 11,270–11,200 yr B.P. Although the site functioned as a short-term camp through time, Graf found evidence of significant behavioral differences between components. During Component 1 occupation, hunters stayed for very short visits. They brought a Nenana-complex hunting toolkit with Chindadn-type projectile points and several bifaces, but no unifacial processing tools. Debitage verifies that they retooled at Owl Ridge with local toolstone. During Component 2 occupation, hunters brought lanceolate projectile points and processing tools, the nuts and bolts of a Denali toolkit, and used both local and exotic toolstone. During Component 3 occupation, toolmakers used a processing toolkit with no projectile points.

Tools from Component 1.



Tools from Component 2.

For Graf, the material evidence from the three components confirms that First Americans, the occupants of Owl Ridge, were becoming increasingly familiar with the site and its environment over time.

Why the change in lithic technology?

Nenana and Denali, the lithic technologies that identify the components at Owl Ridge, are quite dissimilar. Powers and Hoffecker (1989) coined the term Nenana complex to describe the Allerød-age assemblages they found at Dry Creek, a nearby site in interior Alaska (**MT 33-4. 34-1,** "Dry Creek"). Nenana-complex lithic technology is characterized by small triangular and teardrop-shaped bifacial projectile points and unifacial flake tools, often accompanied by small endscrapers and gravers. Walker Road and Moose Creek are the only other late-Pleistocene sites in central Alaska where artifacts of the Nenana complex have been found.

The Denali complex is characterized by burins, wedge-shaped cores, and, most recognizably, microblades. The Denali-complex lithic technology discovered at Owl Ridge constitutes a unique regional variation on a technology seen in Upper Paleolithic sites across Asia.

The transition from Nenana to Denali lithic technology required toolmakers at Owl Ridge to spend more time making and maintaining highly specialized microblade weapons. The reasoning behind the technological transition is hotly debated in the scientific community. Nevertheless it was a time-intensive process that must have paid off in the end; otherwise toolmakers would have discontinued the technology. Considering recent discoveries by geneticists that two or perhaps three populations occupied Beringia at the end of the Pleistocene, Graf is inclined to believe that "perhaps these two technological signatures could represent two different groups of people. However, we won't be able to find proof of this interpretation unless we find human ancient DNA preserved in layers with these two different technologies present." Without ancient DNA, it's impossible to know whether a switch in technologies reflects new population groups or merely new modes of behavior.

Both these complexes are present in sites across Beringia, from Alaska to Kamchatka in Siberia. Strangely, around 13,700 yr B.P. microblades disappear, then reappear at 12,500 yr B.P. and continue into the Holocene. The geological context at Owl Ridge helps define the chronology of Nenana and Denali. Graf reasons that if Component 1 was occupied by a group of people genetically different from those in Components 2 and 3, that confirms that the site was simply attractive to all hunters because of its vantage point high above the river. "Although hunter-gatherers who first occupied the site and those who visited the site at the beginning of the Holocene (about 12,000–11,000 yr B.P.) may have employed a different hunting technology or strategy, the location of Owl Ridge was very important."

Tools from Component 3.

Of all sites in the region, "Owl Ridge is the only site that preserves all three of these occupation events, time-wise, at

a single location," Graf notes. "Dry Creek has the old one and the late one, Moose Creek has the old one and the middle one, and Walker Road has only the old one." That underscores why Owl Ridge plays a critical role in our understanding of the late-Pleistocene settlement of east Beringian.

Graf admits that work remains to be done in precisely delimiting the components of Owl Ridge. "We weren't able to find the borders of each cultural component, especially Component 3," she says, "so in the future someone can go back and attempt to find the extent of this occupation event, especially near the hearth feature."

Am impressive inventory of lithic assemblages

Graf's team found 1,038 artifacts in Component 1, 1,386 in Component 2, and 1,904 in Component 3. The team also found a hearth feature in Component 3.

Component 1 yielded fragments of at least three ultra-thin triangular-shaped bifacially worked projectile points. In Component 2 Graf found three bifacial projectile points: one lanceolate-shaped, one concave-based and heavily reworked, and a point tip. A microblade was found (previous investigations had found two). These diagnostic artifacts render Component 2 consistent with the Denali technocomplex. In Component 3 no projectile points were found, but researchers found a microblade and a technical spall related to reducing wedge-shaped microblade cores, which makes this component consistent with Denali.

A nearly complete triangular point ▲ found in three pieces while excavating component 1.

Close-up of the corner. ▶

Graf also conducted a refit analysis of the entire Owl Ridge assemblage, finding a total of 119 refits: 32 within component 1, 17 within component 2, and 69 within component 3.

"The Owl Ridge excavation was fairly straightforward without any really crazy finds," Graf tells us. "One thing we found that was different and interesting was the concave-based lanceolate point from Component 2. It's unlike many others of this period that have been found because it was heavily reworked with a shoulder on one side."

Landscape shaped by climate

Colonizers arrived in Alaska during the Bølling–Allerød interstadial, an abrupt warm and moist period that occurred during the final stages of the Ice Age. Before humans entered Alaska the central Alaskan landscape was herb-tundra, the product of a cold, dry climate. The faunal community was dominated by now-extinct species (mammoth and horse).

By 14,000 yr B.P. temperatures had warmed and vegetation shifted to shrub-tundra. Birch populations thrived in this climate, providing plenty of fuel resources for humans, and extant species of game animals (bison, wapiti, and sheep) provided an adequate food supply.

Hard on the heels of the Bølling–Allerød came the Younger Dryas (YD), 12,800–11,700 yr B.P. Pollen samples from sites in central Alaska show that this period was marked by lower temperatures and a drier climate. Herbaceous plant populations increased again with this short-term climate shift. Coincident with the change in climate came cultural changes, evident in modified lithic technology seen in occupational components at Owl Ridge that precede and follow the onset of the YD. What's undetermined is the role the climate shift of the YD played in influencing these behavioral changes. Graf considers it possible that the technological shift simply reflects successive occupations of Owl Ridge by two different populations, each using its preferred technology, instead of a response to climate change.

A capricious climate for Owl Ridge occupants

The eolian-dominated deposits at Owl Ridge tell us that through time the site experienced dry conditions; occasional spikes in the sand indicate brief episodes of increased windiness. Two paleosols in the late-Pleistocene deposits register periods of stability with minimal depositional activity and milder climatic conditions, a respite from the typically windy and dry conditions. The beginning of the early Holocene ushered in a period of increased precipitation, with colluvial

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Graf, K. E., A. K. Gore, J. A. Melton, T. Marks, L. DiPietro, T. Goebel, M. R. Waters, D. Rhode 2020 Recent excavations at Owl Ridge, interior Alaska: Site stratigraphy, chronology, and site formation and implications for late Pleistocene archaeology and peopling of eastern Beringia. *Geoarchaeology: An International Journal 35(1):3–26.*

Hoffecker, J. F., W. R. Powers, P. Phippen 1996 Owl Ridge. In *American Beginnings: The Prehistory and Palaeoecology of Beringia,* edited by F. H. West, pp. 353–55. University of Chicago Press, Chicago.

sediment moving downslope from melting snow and summer rains. Vegetation cover was sparse at this time.

The Owl Ridge site preserved only meager paleobotanical data. Based on the regional paleoecological record and geoarchaeological evidence from Owl Ridge, the site had light vegetation cover throughout the terminal Pleistocene until trees, first Populus, then spruce, moved into the North Alaskan Range after 11,000 yr B.P. Natural charcoal and charcoal produced by humans in hearth fires were exclusively of willow origin before 11,000 yr B.P., then became spruce. That occupants of Component 3 chose willow for fuel indicates that by 11,200 yr B.P. larger woody species like Populus or spruce weren't yet available at the site. By 5200 yr B.P. spruce was definitely growing at Owl Ridge, but regional pollen records suggest it may have been present 3000–5000 years before then.

Graf at finished excavation.

Component 1 occupants arrived at Owl Ridge at the end of the Bølling–Allerød, when shrub-tundra dominated the landscape. They had a canny eye for choosing a good location for a hunting camp.

Component 2 occupants were present during the last centuries of the YD. The presence of Sand 1, a chronostratigraphic marker of the YD event (it separates Components 1 and 2), signals brutal living conditions for humans at Owl Ridge. Humans camping at the site would have been buffeted by sand driven by fierce winds.

Component 3 occupants enjoyed the longest stay at Owl Ridge. This component dates to the early Holocene immediately following a regional colluvial event, when substantial precipitation deposited coarse-grained sediment over a thinly vegetated surface.

During all three occupations vegetation was sparse and visibility high. Paleosols found in Components 1 and 2 identify periods of less windy conditions, and the willow-wood charcoal present in these paleosols show that shrubs were there for fuel. Humans visited the site as the local climate shifted from heavy precipitation to drier conditions. Graf believes the site was abandoned and never revisited after 11,200 yr B.P. Perhaps this departure was made necessary when the overgrown boreal forest occluded the wonderful view that had originally made the site so desirable.

Goals accomplished . . . and then some

The mission of Graf's team was to assess the stratigraphy and geological integrity of the deposits and cultural components, and to refine the emerging chronology of the site and thereby enhance our understanding of how humans settled into the region and adjusted their ways of life there.

Graf refined site chronology by obtaining, reporting, and analyzing 20 new radiocarbon dates to supplement previously reported dates. Dates from within and between occupation components were consistent and established a reliable chronology for depositional events and the dating of human occupations. Moreover, these data define the separation between the Nenana complex and Denali complex at Owl Ridge, which supports a pattern for the greater Nenana Valley.

Although Owl Ridge isn't the oldest site in interior Alaska, it nonetheless provides valuable information about the initial population of the Teklanika Valley. It's a prime example of an early hunting campsite of the Nenana culture that's contemporaneous with Clovis across North America.

"More work continues with comparing the lithics from this site with others in the region," Graf says. "It would be good to go back one day and test other spots in the vicinity of the site to assess if there are other sites located in the Teklanika river valley that can replicate the pattern we found at Owl Ridge, and the similar pattern found at the sites in the adjacent Nenana river valley (such as Dry Creek, Moose Creek, and Walker Road). It would be interesting to know if Owl Ridge was the only hunting camp on the western outskirts of a core area centered in the Nenana valley or if there are other sites like Owl Ridge in the Teklanika valley."

Oh yes, we forgot to mention other brief occupations at Owl Ridge, two visits by bears. The second time a bear visited the site overnight while Graf's team were at camp. "It got down into the excavation," Graf recalls, "leaving prints in the floor and profile wall, as well as in the back dirt."

Whatever else you can say about practicing archaeology in Alaska, it ain't boring. MT

–Katy Dycus

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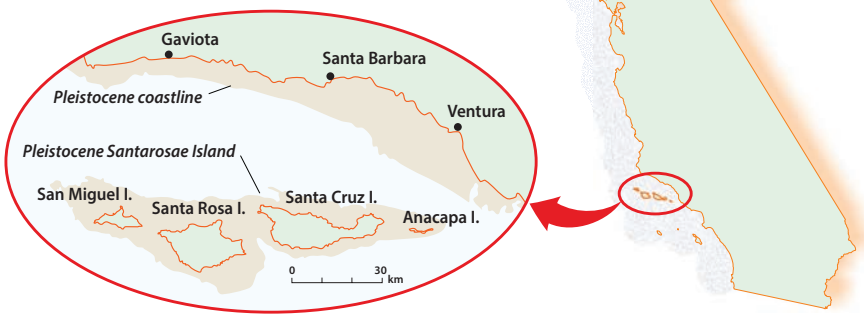
Paleocoastal Living

Earning a Living on Santarosae Island

At the end of the Ice Age, when Clovis and, later, Folsom people were colonizing the width and breadth of North America and wresting a living by killing mammoth and bison—and probably any animal that didn't eat them first—other hunter-gatherers were benefiting from the bounty Nature provided on the Pacific shore. These were boat people who established a long-term occupation on an island created by greatly lowered sea level. Santarosae Island, just a few hours' paddling from shore, offered everything needed for subsistence: a supply of freshwater, fish, shellfish, birds, seals and other marine mammals, plant cover for greens (and, we now find, nutritious foodstuff underground). These settlers created a culture with a distinctive lithic technology, which Jon Erlandson, Professor Emeritus of Anthropology and Director of the Museum of Natural and Cultural History at University of Oregon, has investigated for decades.



AFTER AGENBROAD, JOHNSON, MORRIS, AND STAFFORD (2005)

Santarosae Island, a stopover on the Kelp Highway

During the last Ice Age (around 20,000 yr B.P.), the four northern Channel Islands (NCI)—Anacapa, Santa Cruz, Santa Rosa, and San Miguel islands—were united as Santarosae, a 125-km-long island whose eastern edge was separated by just 6–8 km from the mainland coast. Recent reconstructions of Santarosae and its paleogeography reveal that rising post-glacial sea levels reduced the landmass by as much as 70%–75%, thus forming the four individual islands 11,000–9000 years ago.

In the early 1990s Erlandson started gathering proof that San Miguel Island was inhabited more than 10,000 years ago—and possibly as early as 13,000 years ago—at a time when sea levels were lower and the NCI formed a single mega-island. He concluded that ancient humans used Santarosae as a steppingstone in their migration down the Pacific Coast as they traveled in boats from northeastern Asia into the Americas along what he called "the Kelp Highway," hunting and fishing in coastal kelp forests as they went along. A series of finds on the four northern Channel Islands confirms his theory. For example, a skeleton found on Santa Rosa Island, Arlington Springs Man—found on Santa Rosa in 1959—dates back 13,000 years, making it one of the oldest human remains ever dated in the Americas (**MT 21-4,** "First lady of the New World: Arlington Springs Woman." {The remains were initially identified as male, then as female. In 2006 physical anthropologist Patricia Lambert definitively classified them as male. –Ed.]

Amol point from Santa Rosa Island, ca. 11,600 yr B.P .

Islands reshaped by fluctuating sea levels

Santa Rosa, the second largest of the NCI, lies about 42 km off the coast of Santa Barbara, California. Its terrain consists of rolling hills, deep canyons, and a coastal lagoon—a hiker's dream.

Site CA-SRI-26 presides on a bluff about 60 m above sea level. Islanders would have enjoyed commanding views of the coastal lowlands, wetland habitats, and nearshore waters. Around 11,700 years ago the sea level at the NCI was 60 m below present and the site was separated from the outer coast by 4–6 km. Rapidly rising post-glacial waters formed an embayment at the mouth of nearby Arlington Canyon, which would have provided access to freshwater and a variety of resources.

The site was first recorded in the 1940s by Phil Orr of the Santa Barbara Museum of Natural History, and Erlandson later revisited these midden sites in the early '90s, collecting radiocarbon samples. He showed that all contained early-Holocene components dated to 9300–7700 yr B.P. He returned in 2010 to collect chipped-stone artifacts: crescents, along with Channel Island Amol (CIA) and Channel Island Barbed (CIB) points buried beneath 2 m of alluvium. Calculating dates from a weathered California mussel, red abalone shell, and purified collagen extracted from a goose bone, Erlandson securely dated the site to roughly 11,700 yr B.P.

A battle with erosion, sometimes precarious

Erlandson's research at CA-SRI-26 was conducted by permit under the Archaeological Resources Protection Act. Because the portion of CA-SRI-26 that he excavated was severely eroded by a deep gully, his team had to be content with limited excavations.

Although the excavated sample from the site was small (only around 0.38 m^3), it was supplemented by artifacts and faunal remains collected from eroding gully walls. "The deep gullies that were gradually destroying the site had very sheer walls and were pretty precarious to work on," Erlandson says. "One day early on I spotted with binoculars a CIB point that was adhering to a high gully wall. Having no ladders in this remote location, I had to carve a series of footholds and climb the gully wall until I could reach the point. That was a bit harrowing, but fun."

Excavated soils were dry-screened over 1/16-inch mesh in the field; screened residuals were sent to the University of Oregon for further analysis. The excavations, along with the study of extensive gully wall exposures within the boundaries of the site, revealed that the low-density Paleocostal component at the site constitutes a single occupation.

NCI artifacts and the Western Stemmed Tradition

Early Americans were prospering on and commuting to the NCI at the same time Clovis and Folsom cultures were flourishing on the mainland. "Arlington Springs Man is contemporaneous with Clovis or earliest Folsom, and later shell middens dated to 12,200 to 12,000 years ago overlap with late Folsom," Erlandson tells us.

Neither Arlington Springs (CA-SRI-173) nor a terminal-Pleistocene component at Daisy Cave (CA-SMI-261) produced diagnostic artifacts, but recent work at the nearby CA-SRI-512 and the Cardwell Bluffs site complex on eastern San Miguel Island has shown that islanders were equipped with finely made stemmed points and chipped-stone crescents similar to those found in Western Stemmed Tradition (WST) sites of western North America.

"The CIA and CIB points seem to be specialized maritime variants of the stemmed points found throughout the WST, an idea supported by the many chipped-stone crescents found in early NCI sites (**MT 29-4,** "Elusive crescentics"; **MT 25-3.** Studing crescentics; Form or function?"). Most CIA and CIB points are relatively small and delicate, however, ultra-thin

Eating Green on the Northern Channel Islands

MODERN HUMANS congratulate ourselves when we eat a nutritious salad instead of a cholestrol-rich hamburger. Yet long before the advent of agriculture Early Americans on Santarosae Island were enjoying the benefits of a plant-based diet. Research scientist Kristina Gill at the University of Oregon Museum of Natural and Cultural History discovered the remains of geophytes and other archaeobotanical specimens at 11,500-year-old site CA-SRI-997/H on Santa Rosa Island, one of the four northern Channel Islands (NCI) that were exposed when post-glacial rising sea level inundated Pleistocene Santarosae Island. The site currently serves as the earliest evidence for geophyte consumption in North America.

Geophytes: Why are they important?

Geophytes are plants with underground storage organs that retain water and protect valuable nutrients. You see them at the grocery store and nursery—onions, garlic, carrots, potatoes, ginger, tulips, hyacinths. Buds in the soil are protected from heat, cold, fire, drought, and predation by most animals.

ALL PHOTOS: KRISTINA GILL

Freshly dug *Calochortus* bulbs.

Geophytes generally store energy in the form of carbohydrates. The plants are tasty because their nutrients are lodged in their storage organ, and that's the part we eat. Tuberous geophytes are especially important today to agricultural economies. Hundreds of different varieties of potatoes are cultivated in Peru, and yams are important for sustenance in many African countries. What's more, geophytes have been harvested by modern humans for many millennia. In South Africa carbonized remains of starchy rhizomes were identified in Border Cave strata dated to approximately 170,000 years ago. In Southeast Asia the remains of yam and taro were discovered in levels of Niah Cave dated to 50,000 years ago. In Australia geophyte remains were found in the basal levels of Madjedbebe Rockshelter dated to about 53,000 years ago. Hearths dated to 14,000 years ago at Monte Verde II in Chile contained the remains of wild potato. And don't ignore camas plants, which grow wild in western and northwestern North America; throughout the Holocene they were a staple of hunter-gatherers, who learned that cooking the bulbs in earth ovens produced a sweet, nutritious food that could keep for years (**MT 22-1**, "Fire-cracked rocks and the carbohydrate revolution").

Geophytes constituted a significant portion of the occupants' diet 11,500 years ago on Santarosae Island. "I would say that geophytes and marine resources on the islands were complementary," says Gill. "Fats and proteins from the abun-

with elaborate serration or barbs. We suspect they were used in hunting or fishing in island waters."

Some scholars maintain that early Paleocoastal people on the NCI may have been mainlanders traveling to the islands seasonally. Yet more than 100 Paleocoastal sites have now been identified on the islands, and the distinctive stemmed CIA and CIB points they used have no exact parallel in assemblages from adjacent mainland sites.

The CA-SRI-26 assemblage, although smaller, resembles the assemblages from nearby CA-SRI-512 and, to an extent, Cardwell Bluffs. An ultra-thin stemmed and serrated CIA point found on an eroded surface immediately north of the site is one of only around 25 CIA points currently known from the NCI. In the only two cases where CIA points have been found in situ, they come from shell-midden deposits dated to around 12,000 yr B.P. Several fragments or preforms of CIB points were also recovered at CA-SRI-26, along with fragments of three chipped-stone crescents.

Chipped-stone crescents are a unique and rare artifact found in early sites of the western US, from Baja and Alta California to the Great Basin and Pacific Northwest, Erlandson says. These crescents are associated with wetland habitats, and on the NCI they were probably used as transverse projectile points for hunting seabirds (**MT 29-4,** "Elusive crescents"; **MT 25-3,** "Studying crescentics; Form or function?"). The CIA and CIB points may have been used for bird hunting as well, but they were more likely used as dart tips for fishing or for hunting sea otters and seals.

CIB points range in size from large dart points to points so small they could be confused with arrowheads. Unlike Clovis or Folsom points, they have a long tang and share other traits as well with points found along the Pacific Rim from Japan to South America. In fact, Erlandson finds they have a lot in common with points from the Incipient Jomon period in Japan (16,000 yr B.P.). Similar points have also been found in late-Pleistocene contexts on Sahkalin Island, in Kamchatka, the Pacific Northwest, California, and throughout South America.

dant marine resources like fish, shellfish, sea mammals, and birds are nicely balanced with the carbohydrate-rich geophytes and other plant foods. Geophytes appear to have been a staple food for millennia."

Archaeobotanist Seetha Reddy and Jon Erlandson reported carbonized geophyte remains (Brodiaea-type) from several strata at Daisy Cave dated to 10,000–3000 yr B.P. Gill identified carbonized Brodiaea-type corms from another 10,000-year-old shell midden on San Miguel Island and from an 8,000-year-old site on Santa Rosa Island. She also documented islanders' reliance on these geophytes at a site on Santa Cruz Island spanning the last 6,000 years.

Gill believes harvesting and cooking geophytes on the island was a community effort "especially at larger scales or in areas with denser populations." Men, women, and children were involved. Stone weights foragers used to drive digging sticks into the soil are a common artifact found on the islands. Harvests lasted from early spring to late fall, and the haul was cooked in large earth ovens. Ethnohistoric accounts tell us that earth ovens were used communally.

Processed corms of blue dicks, ready for roasting and eating.

The geophyte fragments at CA-SRI-997/H were recovered from a feature that was likely a hearth or earth oven in which corms and bulbs were roasted, Gill says. Radiocarbon dates from geophyte remains place occupation at roughly 11,500 years ago, an age consistent with artifacts recovered in and around the feature.

Diverse plant sources at CA-SRI-997/H

Archaeobotanical remains recovered from the site indicate that islanders harvested plants from a wide range of habitats: coniferous forests, chaparral/scrub, and grassland/prairie. Gill has identified eight plant taxa among harvested geophytes, nutshell, and seeds. "Recovering two types of geophytes and other plant foods that consistently dated to 11,500 years ago was awesome," she remembers. "We discovered that carbonized termite coprolites (poo) could be dated as well, and they were consistent with the other dates."

Gill identified two geophyte taxa, Brodiaea-type corm (also called blue dicks, or *Dipterostemon capitatus*) and Calochortus bulb (which persist today on Santa Rosa Island in two species, the Globe lily and the Catalina mariposa lily). Blue dicks and Catalina mariposa lily have been recently observed growing together in coastal grasslands/prairies on the NCI and mainland coast. Blue dicks are especially prolific; each parent corm produces upward of 15 cormlets annually. The Catalina mariposa lily reproduces less vigorously.

Was digging geophytes worth the effort?

Blue dicks today on the NCI are much more abundant and their corms considerably larger than their counterparts on the mainland. Gill explains that for millennia their abundance, size, ubiquitous presence, low processing costs, and availability during different seasons made them a top-ranked food on the islands.

To calculate the return rate and determine the energy yield of blue dicks, Gill and Erlandson harvested blue dicks on western Santa Cruz Island. Guided by ethnographic accounts for the timing of har-

Seafaring islanders

Early arrivals to Santarosae would have needed boats to get there. And if they had the technology to build such boats and the maritime skill to traverse open waters, then the Coastal Migration theory becomes undeniably plausible.

The Kelp Highway Hypothesis, a corollary to the coastal migration theory, argues that coastal refugia, rich in birds, fish, seals, and seaweeds, offered a perfect route for human migrants. For Erlandson and his colleagues it helps explain the early peopling of the Americas and the presence of pre-Clovis sites like Monte Verde in Chile and Paisley Caves in Oregon.

"By 13,000 years ago the eastern end of Santarosae Island was only about 9 km from the mainland coast, so the distance isn't that great," Erlandson says. However, these waters are sometimes dangerous, and "cross-currents were likely stronger with a narrower deep-water channel, so they were definitely seafarers. Reed-bundle boats aren't out of the question for such crossings and coastal foraging, but they may have used more seaworthy wood or skin boats. There are no depictions or remains of the boats they used, so we simply don't know." It's pleasant to imagine early coastal Americans braving the waves, heading out to sea for their next big catch, en route to their next home, or maybe just out for the thrill.

It's also interesting to imagine how early islanders may have "networked" with one another. Erlandson says the earliest clear evidence of interaction comes from CA-SRI-512, not far from CA-SRI-26, where an obsidian flake was found in a 11,700-year-old midden. "The obsidian came from deep in the California interior, where shell beads of similar age attest to trade at a very early date. We suspect these are just 'tip of the iceberg' and that exchange and interaction between islanders and mainlanders was a regular thing." Islanders, Erlandson is convinced, really got around.

Diverse subsistence

The bones of waterfowl and seabirds, fish, and marine mammals, along with small amounts of shellfish document a diverse subsistence strategy at CA-SRI-26. In total, researchers, they conducted experimental harvests in spring, late summer, and fall. They were careful to observe traditional harvesting protocols to ensure an abundant future crop: the fibrous outer coating of each corm collected was stripped, and cormlets were removed and replanted.

Carbonized Brodiaea-type corms viewed under a microscope.

"We conducted experimental harvests to get a sense of return rates, because the broader corpus of literature on the subject (optimal foraging theory) relies on return rate data to test ideas about foraging theory," Gill explains. Among plant foods geophytes tend to rank low, but two important qualifications apply. First, the return rate for any given food is typically calculated according to the quantity of calories that can be obtained in a given period of time, less the calories expended in harvesting and processing. Foods prized for high caloric value score higher than blue dicks. Nevertheless, on Santarosae Island marine foods supplied abundant calories; Gill and Erlandson therefore argue that geophytes were probably targeted for their carbohydrate value instead of their caloric yield. Second, Gill points out that "previously the only published return-rate data on blue dicks came from the Mojave Desert, which was low. Those return rates, even when extrapolated to elsewhere in California, weren't comparable to the North Channel Islands either in terms of archaeological data or from casual observations on digging them up. So we decided we needed experimental return-rate data from the islands to show the potential of island geophyte resources. And we weren't disappointed!"

Eat high-carb!

For coastal people who rely on shellfish and other lean meats, carbohydrates are essential for effectively metabolizing such meats. According to Gill's calculations, the mean carbohydrate return rate (CHO) for NCI blue dicks is 202.3 CHO/hour, a yield equivalent to twice the recommended daily requirement of carbohydrates for modern children and non-lactating adults. Geophytes were a source of carbohydrates critical to satisfying the Islanders' daily dietary requirements.

–Katy Dycus

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Suggested Readings

Gill, K. M., et al. 2021 Earliest evidence for geophyte use in North America: 11,500-year-old archaeobotanical remains from California's Santarosae Island. *American Antiquity* 86.3:625–37.

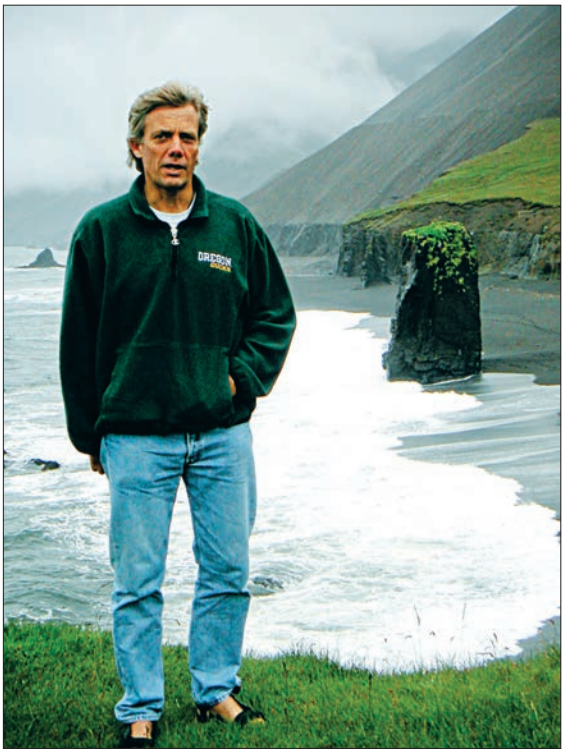
Gill.

searchers found 715 animal bones (or fragments), weighing 91.59 g, along with 82.11 g of marine shell representing 2 shellfish species: red abalone and California mussel. The vertebrate assemblage is obviously much more diverse than the shellfish.

As is the case at CA-SRI-512, the abundance of geese and waterfowl, which are migratory and visit the NCI from late fall to early spring, suggests that CA-SRI-26 was occupied during the relatively wetter and cooler winter season.

Yet the diversity and abundance of food sources indicates that humans would have been easily sustained all year long. The menu ranged "from abalone, mussels, clams, and other shellfish, nearshore and kelp forest fish, marine mammals like seals, and both waterfowl and seabirds, including a now extinct flightless duck known as *Chenytes lawi,*" Erlandson says.

To determine the subsistence regimen of the islanders, Erlandson extrapolates from the bone and shell weights of the likely prey species to determine edible meat yields. From recovered faunal remains he estimates that about 54% of edible meat was derived from birds, which is consistent with crescents found among bifaces from the site. Fish supplied about 29% of dietary meat, marine mammals 12%, and shellfish just 5%.



Erlandson

Birds and fish dominate the islanders' prey animals: Along with marine mammals, they contributed an overwhelming 95% of edible meat.

Erlandson acknowledges, however, that apparent yields may be influenced by the Schlepp effect, which cautions that field butchering of some animals far from a site may result in some taxa being under-represented. Consider, for example, seals and other large marine mammals, which were likely butchered on or near the beach and only prime cuts carried to the site.

At CA-SRI-997, an 11,500-year-old site on eastern Santa Rosa Island, recent analysis of carbonized plant materials shows that geophytes—corms, bulbs, and tubers—were an important source of calories and carbohydrates that complemented the marine diet (see sidebar). Seaweed may also have been consumed. Such recent discoveries suggest that the dearth of carbonized plant remains found at both CA-SRI-26 and CA-SRI-512 is likely due to poor preservation rather than a lack of plant use by the site inhabitants.

The early islanders' diverse menu indicates that these people were fully adapted to Channel Island ecosystems and knew how to exploit them. During the late Holocene marine fishes, mammals, birds, and plants like geophytes supported dense populations with exchange networks.

Bottom line: Early islanders were eating well, and thus living well.

What's next?

Although scholars continue to debate the routes and timing of the initial colonization of the Americas, a coastal route is now a more viable option than ever. Given the fact that NCI Paleocoastal sites postdate the earliest arrival of people in the Americas by a few thousand years, CA-SRI-26 doesn't confirm the coastal peopling of the Americas; rather, it verifies that maritime adaptations were well established alongside Clovis and Folsom traditions in the American interior. With post-glacial sea level rise, unfortunately, evidence for earlier coastal sites is likely submerged.

More work remains to be done at CA-SRI-26, but Erlandson is currently monitoring erosion to see if features or more substantial deposits become exposed. He acknowledges that the National Park Service and the Chumash people, whose ancestors lived on the islands for millennia, "are key partners in deciding what future salvage work, if any, should be done. With sea-level rise accelerating again, many island sites are threatened by marine and other erosion, so we are engaged in a kind of archaeological triage on a massive scale."

With support from Bureau of Ocean Energy Management and other funders, Erlandson has been working for five years with Todd Braje, Amy Gusick, and an interdisciplinary team to model and explore the submerged landscapes around the Channel Islands. Erlandson promises that "we've got some exciting results to share and preliminary results are published, in press, or in process, but that's another story."

–Katy Dycus

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Suggested Readings

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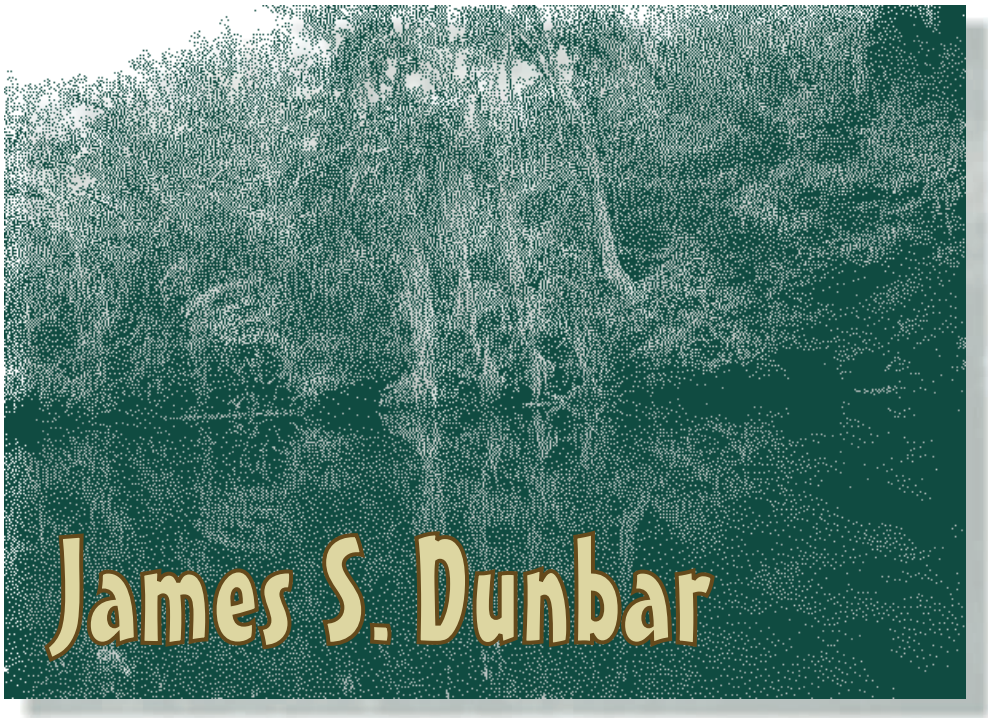


CHARLENE CHANDLER

The Master Archaeologist of Florida

IF IT'S A PALEOINDIAN SITE in Florida, you can bet Jim Dunbar has been there. During his 35 years of research, Dunbar has developed a masterful understanding of early peoples in Florida, the geography of their settlements, and the food sources they exploited. His research has shone a fresh perspective on the distant past and invigorated a new way of thinking about early life in Florida.

He earned a Ph.D. in Anthropology with emphasis on Archaeology from Florida State University in 2012 and has been chairman of the board of Aucilla Research Institute since 2015. Dunbar retired in June 2011 after 35 years of service with the Division of Historical Resources, Bureau of Archaeological Research, Public Lands Archaeology. He's certainly no newcomer to Florida archaeology, which in great measure he helped shape. Perhaps *rescue* is a better word for his accomplishments, for early archaeological investigations in Florida were fraught with indecision and frustrating sidetracks to dead ends. Consider, for example, the Vero Beach and Melbourne sites, where early in the 20th century human remains and lithic artifacts were found. At the time the finds were controversial and raised many unanswered questions about their antiquity and possible association with Pleistocene megafauna. The answers didn't come until many years later.

A site on a troublesome river

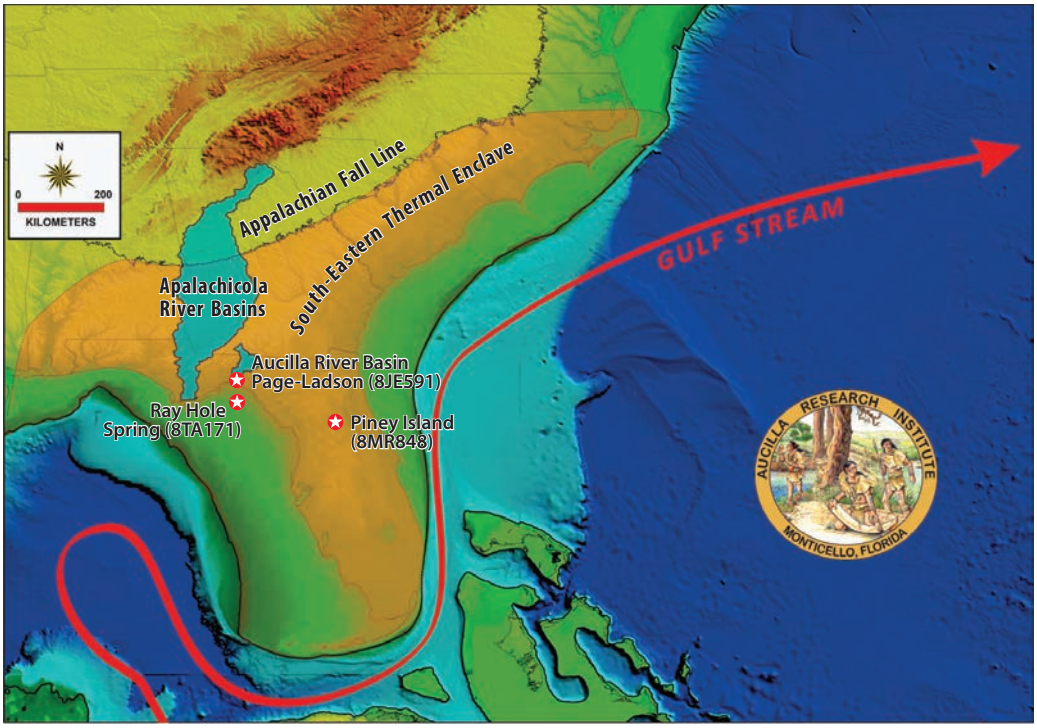
The Page-Ladson site in the Big Bend region of Florida ranks high in the record of Dunbar's achievements. It lies on the Aucilla River, a capricious karstic waterway. In places the Aucilla River runs entirely underground through eroded limestone, then surfaces before again disappearing underground. The Page-Ladson site, a mid-channel sinkhole under 9 m of water, contains stratified deposits of late-Pleistocene and early-Holocene human artifacts and animal bones. It was the first pre-Clovis site discovered in southeastern North America: Radiocarbon dating places its age at 14,200–14,550 yr B.P., 1,000 –1,500 years before the advent of the Clovis culture.

In 1983 Dunbar and paleontologist S. David Webb undertook a survey of the section of the river called Half-Mile Run, where scuba divers had discovered artifacts and Pleistocene animal bones bearing cutmarks made by human butchers. Under the auspices of the Aucilla River Prehistory Project, Dunbar and Webb continued to lead excavations, and in 1993 they found new ways of recording underwater stratigraphy. Archaeological excavation resumed with the aim of finding the earliest dates for human remains and artifacts. The lowest strata, dating to the late Pleistocene, contained the skeletal remains of mastodon, mammoth, horse, ground sloth, and paleolama, and mats of masticated vegetation (proboscidean digesta). More ivory spearpoints have been found in the Aucilla River than at any other site in North America (**MT 32-2,** "The Page-Ladson site").

Dunbar with volunteers at the display area of the field lab during the 2017 project at Wakulla Springs State Park.

The Page-Ladson site richly enlarges our understanding of

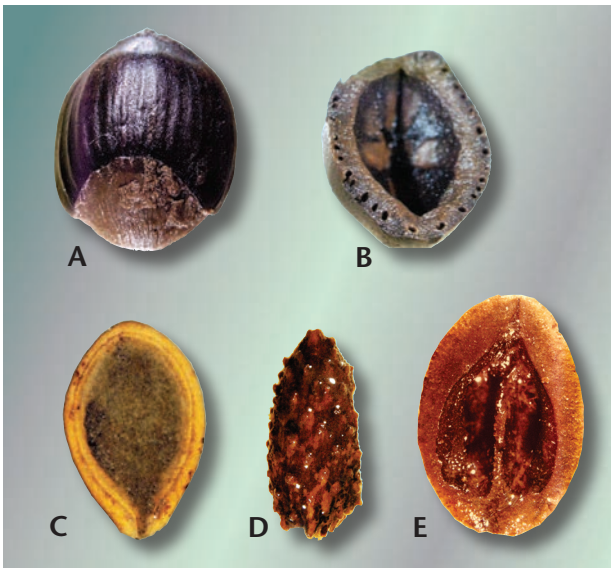
the first people to colonize the Americas. We now know they coexisted with and exploited megafauna for 2,000 years before they became extinct. Recent investigations of inundated and wetland archaeological sites continue to broaden our understanding of Paleoindian lifeways in the Southeast. These sites are especially revealing because inundated environments preserve organic matter—bone, botanical substances, and occasionally



Florida land surface during and shortly after the Last Glacial Maximum, the extent of the South-Eastern Thermal Enclave of the late Pleistocene, and the extent of today's Apalachicola River (Flint, Chattahoochee, and Apalachicola) versus that of the Aucilla River.

even soft animal tissue. "Building on the rich record at Page-Ladson," Dunbar explains, "I attempt in the chapters of *First Floridians and Last Mastodons: The Page-Ladson Site in the Aucilla River* to more accurately understand the constraints placed on populations who lived during the various late glacial and postglacial climactic intervals. The site spans some six millennia of human prehistory from latest Pleistocene into the early Holocene."

Long-time colleague Mary Glowacki says of Dunbar, "Jim never met an archaeological project he didn't like! I've been a friend and colleague of Jim Dunbar for more than 20 years through the Florida Bureau of Archaeological Research, Panhandle Archaeological Society at Tallahassee, and the Aucilla Research Institute. Many think of him as a Paleoindian guy, but his breadth of Florida archaeological knowledge is far greater—from historic shipwrecks and Civil War saltworks, to Deptford and Weeden Island mound complexes, and more. Few realize his extensive contribution to Florida archaeology as he continues to add to the corpus, being more active now than ever before."



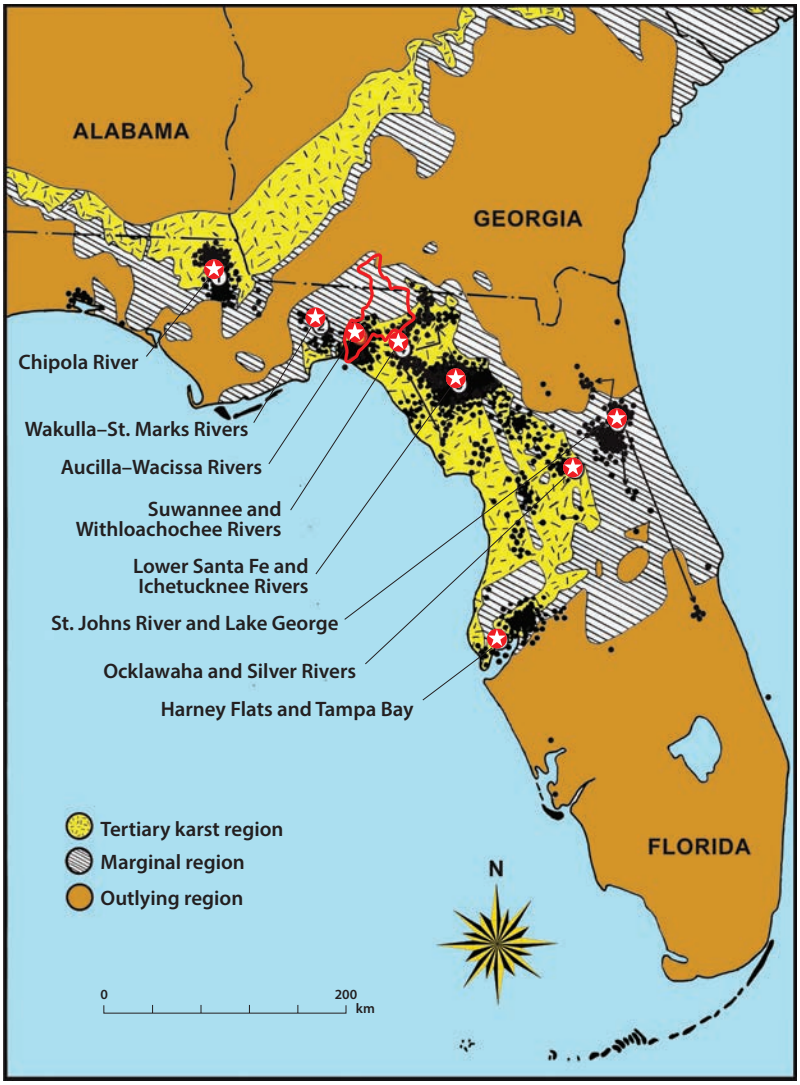
Tree seeds from Unit 3 (the early-Paleoindian level) at the Page-Ladson site: A–B, *Coryleus americana* (hazelnut) half nut shell; C, *Cucurbita sp.* (round gourd) seed; D, *Xanthium sp.* (cocklebur) seed; E, *Carya sp.* (hickory) half nut shell. The hazelnut became extirpated from Florida by the end of the Pleistocene. *Cucurbita* gourds have also been found with mastodon remains at another Aucilla River site that dates to about 38,000 yr B.P. Cocklebur and hickory are still extant in Florida.

Identifying the source of Paleoindian artifacts

Site-distribution studies are prima facie evidence that Paleoindian settlements in the Southeast outnumber those in the Southwest. Three distinctly different geohydraulic regions are recognized in Florida, but only the Tertiary karst region hosts concentrations of Paleoindian sites. Its attraction was a large groundwater system, captured by the limestone of the Tertiary karst regions, which invited human occupation. Chert within the limestone was valued by toolmakers.

Evidence that extinct Pleistocene animals and humans coexisted in the Southeast was found in 1915, when artifacts and human remains were recovered from a stratified fossil deposit at Vero, Florida. The Vero Man and Melbourne Man sites were widely reported by State geologist E. H. Sellards and J. W. Gidley of the Smithsonian Institution, but the sites nevertheless stirred up controversy. Then gradually the number of known projectile-point types accumulated. The Simpson point was the third lanceolate projectile-point type found in Florida identified as early Paleoindian,

along with Clovis and Suwannee types. By the mid-1960s there was no doubt that humans had occupied Florida during the late Pleistocene; witness an impressive assemblage of projectile points and related stone and ivory artifacts. The fossil record in the Tertiary karst regions shows that drought-tolerant animals like the peccary abounded in dry grasslands and savannah habitats; megaherbivores like mammoth, bison, tapir, and Jefferson sloth preferred lowland habitats. The majority (90%) of Clovis/Suwannee sites are found in the Tertiary karst regions of Florida, which underscores the importance of these features to Clovis/Suwannee peoples. Favorable environmental conditions during the late Pleistocene created stable habitats that supported grazing animals and made possible exploitation by human hunters in settlements by karst rivers.



Generalized distribution of Paleoindian lanceolate points in Florida (one dot = one point). In yellow areas chert-bearing limestone occurs at or near the surface and the Floridan Aquifer is exposed in many places as a potable water source. In the marginal region chert-bearing limestone is mostly buried but is nevertheless exposed in open caves and karst collapses. In the outlying region chert-bearing limestone is rarely found except at Warm Mineral and Little Salt Springs in southwest Florida. The red outline denotes the area encompassed by the Aucilla River basin including its tributary, the Wacissa River.

The Quarry Cluster approach to chert provenance

The Quarry Cluster concept, developed in the early 1980s, associates lithic artifacts with geographic locations that share outcrops of chert with similar characteristics. Two major types of chert are found in Florida. The Miocene Hawthorn group, which forms in beds of clay with opaline diatoms, is distinctive owing to its greasy-looking shine. Only a few Paleoindian artifacts were made of opaline chert. By far the most common chert in Southern Coastal Plain is silicified limestone. Since it forms near the surface and therefore requires only the removal of a thin layer of ground cover, it was easily accessible to generations of Paleoindian toolmakers. Quarry cluster thus defines as an area a region where silicification of a texturally and geologically distinctive rock type occurs. The Quarry Cluster concept assigns provenance to a chert artifact by identifying its region of origin, rather than a specific quarry.

Recent attempts to improve the Quarry Cluster concept method have focused on refining the geographic boundaries of defining regions and the visual criteria that characterize the types of chert. Visual criteria will likely continue to be the standard by which most archaeologists assign chert artifacts to a source area.

A change in point morphology

A transition in toolmaking in the Southeast was executed when Paleoindian lanceolate projectile points were abandoned in favor of Early Archaic notched-point forms. In sites found in the coastal states of the U.S. the Bolen notched-point type replaced older lanceolate forms by about 10,000 RCYBP (about 11,400 yr B.P.). Early- and middle-Paleoindian toolkits often consisted of an assortment of multi-purpose stone tools including bifaces and unifaces. Bolen tools were often fitted with antler handles about 10 cm long to create a variety of tools like burins, endscrapers and sidescrapers, and spokeshaves.

By the beginning of the Holocene the climate dramatically shifted. The water table throughout Florida dropped several meters below its already low level seen in late Younger Dryas period. The floor of the Page-Ladson sinkhole consequently became dry, and toolmakers worked there to produce woodworking tools. Woodworking appears to have been the principal reason humans occupied the sinkhole floor.

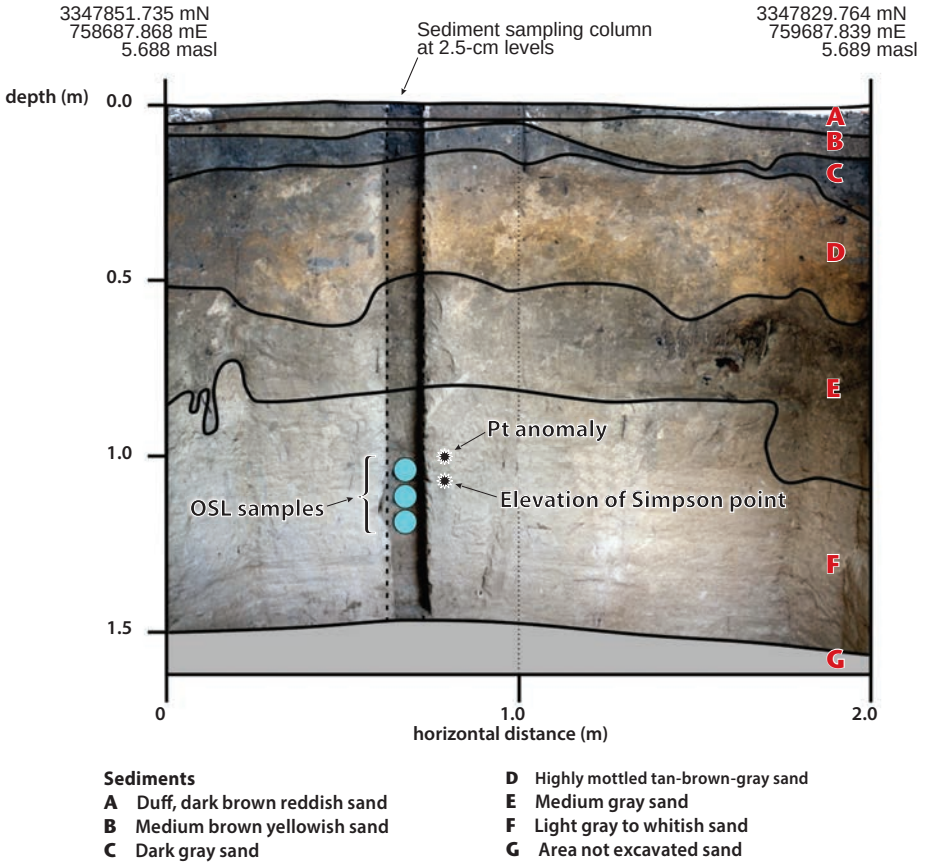
Refining age estimates

Investigations of the Wakulla Springs Lodge site by Dunbar's team have identified three Early Archaic and at least five

Paleoindian components, thus ranking it among the most prolific Early Archaic and Paleoindian sites in Florida. Dating the site, however, has proved problematic. Attempts in 2017 and 2018 to date by OSL and radiocarbon yielded varied results. Then Chris Moore and Mark Brooks conducted geochemical sampling to determine if a Younger Dryas chronostratigraphic marker was present in the sediment column. Rare-earth platinum anomalies, which had been identified elsewhere in the Southeast, were also identified at the Wakulla Springs Lodge site. Occupation of the site was thus fixed at the time of the onset of the Younger Dryas, about 12,800 yr B.P. This evidence suggests that Simpson and Page-Ladson point types found at the Wakulla Lodge site are actually pre-Clovis.

East vs. west of the Mississippi

From his vantage point high atop an Everest of sites dating to Clovis and before, Dunbar cannily wonders why Clovis and Folsom sites west of the Mississippi remain the standard by which all Paleoindian sites in the Americas are judged. After all, he observes, the transition from Paleoindian to Early Archaic had a distinctly different outcome in Southeastern U.S. compared with the Southwest. Whereas the Southwest for the most part suffered no major disruptions, data indicate that the Southeast experienced rapid and significant disruptions in both faunal and floral communities. In Florida it appears likely that cultural adaptation from Paleoindian to Archaic lifeways began toward the end of Suwanneepoint times and was completed by the advent of the Bolen point.



East wall stratigraphic profile of excavation unit P-25 at the Wakulla Lodge site, showing the relationship of the Pt (rare earth platinum) anomaly to the Simpson point recovered about 10 cm below it. Positions of the pit corners are in UTM Zone 16 metric coordinates with elevations referenced to sea level. Control points on the site were established by survey-grade GPS units with all features and specimens shot in using a total station tied into those controls.

Piney Island

Situated on the outer edge of an oxbow in the Oklawaha River in Marion County, Piney Island is particularly significant because erosion is destroying the prehistoric site as heavy summer rains change the course of the river. Attempts to minimize loss of materials have been undertaken by an avocational archaeological diving group, who originally discovered the site in 1985 and, working closely with professional archaeologists, have systematically monitored its condition.

Only through search and survey of the river topography and its margins can the unknowns of the site be identified, quantified, and finally recorded, Dunbar tells us. "Piney Island is probably just one of many such sites dating to the Greenbriar/Bolen period in the Oklawaha River, but it could

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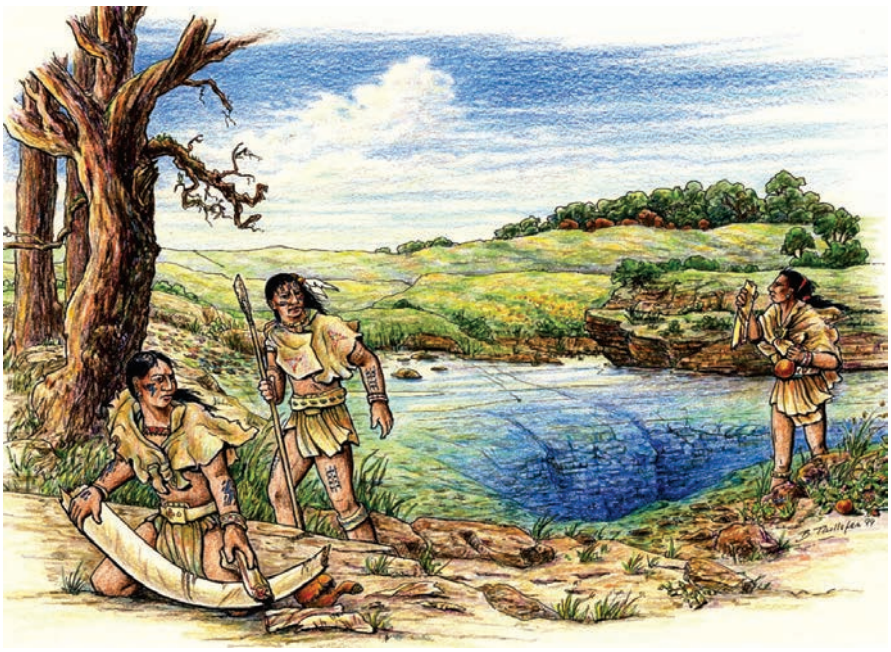
also be a rarity that is eroding away, much to our misfortune." A diagnostic artifact assemblage recovered from the site includes a Bolen side-notched biface, fragments of hafted spokeshaves, and a large variety of Greenbriar/Bolen-age unifacial tools. Worked bone and charcoal, extremely well preserved, indicate that the site occupation dates clustered around 10,500–9000 yr B.P. Dunbar expects that human remains found eroding from the river bank will likely prove to be a Greenbriar burial site. After less than three years the site shows signs of extreme deterioration. About 100 m^2 of the land has disappeared into the river channel, including an area where test augerings had detected the presence of cultural material.



Activity at an Aucilla Basin paleo sinkhole envisioned by Barbara Jean Taillefer after several conversations about Pleistocene Florida and what it may have looked like. A bison herd is seen at the distant tree line. Like many limestone outcrops where the Floridan Aquifer is exposed, its water is transparent.

Accolades aplenty

We would expect that a scientist who for more than three decades steered the course of Florida archaeology may have attracted the attention and respect of an impressive host of colleagues, and we would be right.

"It's hard to overstate how important Jim's work to assemble the known Paleoindian data in Florida has been to all of us at a continental scale," says Florida archaeologist and colleague Andy Hemmings. "Jim's seminal chapter in *Clovis Origins and Adaptations* (published by CSFA in 1991) literally put Florida on the map as a place filled with Paleoindian sites and information, as opposed to many rather idiosyncratic books on finds or specific sites published up to that time. Since then Jim has continued to generate mountains of new data and published numerous articles and books about sites, Page-Ladson and Wakulla Springs being just two of the more prominent. Further, data collected by Jim, and others too, have been used to continually revise our views on the complex pre-Clovis, Simpson, Clovis, Suwannee, and other Paleoindian cultures that flourished in Florida across the Pleistocene-Holocene boundary 10,000 to 15,000 years ago, and beyond. To understand what kind of die-hard researcher Jim really is, you'd have know that, until his retirement a few years ago, the bulk of his Paleoindian and underwater work was done in his spare time above and beyond fulfilling his duties for the state of Florida."

Colleague Ervan G. Garrison remembers that "my professional affiliation with Jim began in the fall of 1986. I participated in a brief but funded exploration of the Ray Hole Spring located 32 km offshore in Apalachee Bay, Florida. Jim, at the time, was an employee of the Bureau of Archaeological Research of the

State of Florida. He incorporated his interest in submerged prehistory into his "day job" in Tallahassee. Jim and I teamed up as dredge operators at the Ray Hole Spring, which after our exploratory research and discoveries became known as the Ray Hole Spring site." MT

–Martha Deeringer

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The too-efficient hunting weapon

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Extinction was a selective event

Researchers pillory Prates and Perez with questions about species extinction. Why, they ask, did so many South American species that weren't targeted by humans became extinct in the late Pleistocene? And why did guanaco, likely the most hunted species, escape extinction?

Prates and Perez answer from encyclopedic knowledge and informed guessing: Guanaco was more widely distributed across South America than other species, which may have contributed to its survival. Or perhaps the endemic Patagonian guanaco did in fact become extinct, but was supplanted by a subspecies from the central Andes. Similar things, they assure us, have happened before.

Prates and Perez emphasize that many factors, some of them unseen, played a part in determining which species were vulnerable to extinction. Large-mammal populations were already adaptively vulnerable in South America owing to climate and environmental changes, partly because most of them had low reproductive rates, and relatively moderate or even low levels of human predation would therefore have impacted trophic networks. We're reminded by Brazilian scientist Dimila Mothé (**MT 37-1,** "First evidence of S. A. megafauna killed by humans") that proboscideans, like today's elephants, had a long gestation period and probably gave birth to only one calf every 5 to 10 years. Hunting would therefore have profoundly impacted the mastodon population and perhaps even contributed to their extinction.

"It's necessary to explain the fact that the evidence of Pleistocene megafaunal processing and consumption by humans is restricted to a few species," Prates and Perez tell us. Their research team was guided by Mathias Pires, Assistant Professor of Ecology, Universidade Estadual de Campinas, who argues the case for indirect effects for megafauna extinctions. Prates and Perez are convinced that "hunting a few megafaunal species, using a very efficient projectile-point technology, could generate the collapse of an entire megafaunal paleo-community."

Herein lies the significant difference between Paul Martin's thesis and Prates and Perez's conclusions. Martin argued that human hunters perpetrated wholesale slaughter on many, perhaps all, extinct species. Prates and Perez, on the other hand, submit that "moderate predation of a few species could have driven to extinction the megafauna community."

Late-Pleistocene environmental changes in combination with the indirect effect of humans on the ecological web generated the conditions that prompted megafauna extinctions. Future studies, Prates and Perez say, should center on individual population densities of specific species and their ties to climatic and human demographic changes. Prates and Perez hope to study "the differences in techno-functional characteristics and performance for hunting megafauna with the FPP and other earlier projectile points from South America." Moreover, "Additionally, we are modeling and exploring the importance of indirect effects for megafauna extinctions on a local scale in the Pampas, in the context of the changing environment of the Pleistocene-Holocene transition."

A final note: Imagine a great lecture hall filled to capacity with scientists eager to hear Luciano Prates and Ivan Perez deliver a joint address on "The Cause of Megafauna Extinctions in South America." Now imagine applause, polite applause from those not wholly convinced, as Prates and Perez conclude and ask for questions. A sharpshooter in the audience stands and yells, "Professors Prates and Perez, is it true that in Siberia mammoths lived together with human beings for around 30,000 years, yet they didn't become extinct until the end of the last glacial age. If it's true, how do you account for that?" It's easy to imagine Prates taking a breath and replying, "Yes, it's true." Perez waits until murmurs in the audience subside, then adds, "But Siberian hunters didn't have the Clovis fluted point or the Fishtail projectile point, did they?" MT

–Katy Dycus

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Universidad Nacional de La Plata
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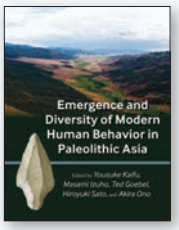

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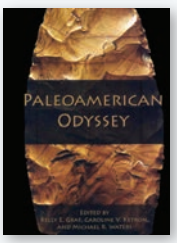

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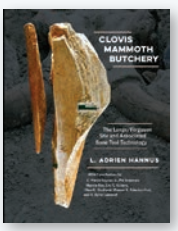

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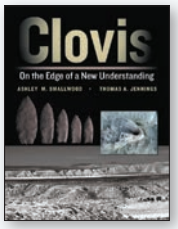

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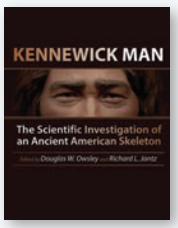

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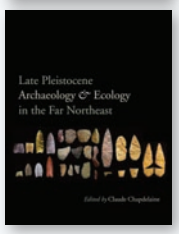

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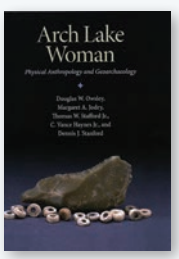

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