

Evidence for Early Use of Maize in Peninsular Florida

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Glossary

- Crystal River site** An important west-central Florida site located in an estuarine environment with at least five mounds still preserved.
- Ecozones** Areas with different ecological settings based on geological and environmental variation.
- Fontaneda's *Memoirs*** Sixteenth-century written chronicles about the New World, including a section on vegetation and its use by Indians.
- Fort Center** Archaeological site in south-central Florida where some maize pollen grains were found and thought by the excavator to date as early as the Late Archaic period.
- Mangrove swamps** Common in tropical and subtropical coastline areas with brackish to saline tidal waters with trees, shrubs, and other plants as well as many invertebrate and vertebrate animal species.
- Pillsbury site** A Manatee County site dating ca. AD 600–900 on the south side of Tampa Bay where more than 130 individuals were excavated from a single burial mound.
- Weeden Island** The St. Petersburg, Florida, type-site for the far-reaching Weeden Island culture, ca. AD 300–600.

A focus on nine coastal, estuarine, and inland sites is synthesized and combined with ethnohistoric and stable isotope analysis to shed light on the subsistence practices and lifeways of prehistoric Floridians, and how these practices may have changed over time.

Stable isotope analysis of human skeletal remains has profoundly redefined our knowledge of the importance of maize to prehistoric Native Americans in Florida. Although ethnohistoric data are available for the Contact period, paleobotanical remains are rare for all periods. Isotopic data is presented here for the inland sites of Cross Creek and Melton Mound I, the estuarine site of Crystal River, and the coastal sites of Horr's Island, Bay Pines, Pillsbury, **Weeden Island**, Dunwoody, and Bayshore Homes. These sites range from the Late Archaic period through the Late Caloosahatchee period in an effort to more accurately reflect the introduction of maize to populations living along the west-central Gulf Coast and interior Florida from 1000 BC to about AD 1750.

Local ecology often determined subsistence adaptations for ancient groups. Isotope results interpreted in this chapter suggest that areas outside of the local geography were not exploited by specific populations, and that maize was introduced into peninsular Florida, both inland and along the Gulf Coast, perhaps 1000 years before the arrival of Europeans.

INTRODUCTION

The purpose of this research was to investigate dietary adaptations in peninsular Florida, and to reconstruct the lifeways of its prehistoric residents. Specifically, the combination of archaeological evidence, and historic, ethnohistoric, and ethnographic documentation with stable isotope analysis of human skeletal remains, sheds light on the behaviors of the prehistoric populations in this region.

A central part of behavior for all ancient people was their economy. Food procurement strategies are particularly important. Stable isotope analysis of human skeletal remains reflects the diet of an individual, and subsequent interpretation of the results allows us to understand a part of daily prehistoric activity. It further indicates interactions between groups, differences in status within a group that may reflect the formation of polities, or sex and age differences. It may also indicate the reason for such differences.

To reconstruct the behavior of prehistoric peninsular Florida populations, it was necessary to determine subsistence patterns for groups living in similar—Gulf Coast—and different—central interior—environments in Florida. Skeletal remains from these types of sites date to the Late Archaic (2000–1000 BC), Deptford (1000–500 BC), Manasota-Weeden Island, Weeden Island I and II (AD 300–1000), and Late Caloosahatchee phase (after AD 850–ca. AD 1750) in Florida. Stable isotope analysis helps determine if populations living during these cultural time periods may have practiced similar subsistence adaptations, or whether agriculture was introduced into coastal and interior areas at the same time. Comparisons of coastal, estuarine, and inland sites also help to determine if there were differences in dietary consumption based on geography and ecology, or whether prehistoric groups in Florida exploited resources that were not local.

This type of research is significant for interpreting Woodland-related and Mississippian-related cultures in peninsular Florida, and their interactions with other southeastern U.S. cultures. Although there are similar mounds and other aspects of settlement organization, ceramic and lithic styles, and evidence of trade and other contact with the Southeast, it has been hypothesized that the Native Americans of peninsular Florida, in particular along the Gulf Coast, adopted and developed these characteristics of complex societies without adopting maize agriculture. It is not our intention here to broach the subject of chiefdom-level societies, merely to provide quantitative data from which further research may be done. It is, however, our objective to examine the available archaeological evidence, and ethnohistoric (written documents, oral literature, material culture, and ethnographic data) information, and to apply this information to new data obtained from stable isotope analysis all in an effort to further understand the behaviors of the prehistoric people who inhabited the Gulf Coast of Florida, and their place within Southeast archaeology.

THE NATURAL SETTING OF PENINSULAR FLORIDA

For Native Americans, the end of the Ice Age brought about many changes, particularly in subsistence practices. The hunting activities of Paleo-Indians in Florida may have

helped to bring about the extinction of many large animal species such as mastodon, long-horned bison, and giant ground sloth. Beginning about 10,000 BP, changes in projectile points indicate changes in subsistence practices and begin what is known as the Early Archaic stage or period throughout the Southeast. In Florida, pottery first appeared in the Late Archaic around 4000 BP in the form of fiber-tempered Orange wares [7, 8, 50]. The use of pottery, and the dependence on marine, or freshwater food and water resources, indicate that prehistoric Florida groups may have practiced a more sedentary lifestyle. Archaeological evidence for this is reflected in more sites, a greater range of tools, and burials [34].

Following the Archaic, cultural time period classifications begin to take on discrete divisions based on pottery styles and geographic locations. The prehistoric Indians who inhabited Florida during these times were more settled than many earlier groups, and, although hunting remained a part of their subsistence practices, smaller mammals were also collected. Coastal sites in Florida are numerous, and it appears that fishing and gathering shellfish replaced hunting as the main subsistence strategy practiced for many groups beginning during the middle Archaic. Prehistoric inhabitants of the Gulf Coast of Florida, as well as some inland populations, according to stable isotope results that will be discussed later, appear to have eaten what was available locally. That is, they became dependent on their immediate environment which provided their food resources. Florida is unique in that it has nine distinct **ecozones: mangrove swamps**, flatwoods, freshwater swamps, rivers and springs, hardwood forests and hammocks, scrub, sandhills, prairies, and coastal areas [56]. Understanding what types of resources available from within these areas indicates the different types of foods available to coastal and inland prehistoric Floridians. Florida has the longest coastline in the United States—8497 miles. Bays and estuaries are numerous and form highly productive marine habitats. Freshwater and saltwater wetlands within these larger areas contribute to a rich food web [30]. Mangrove communities are particularly important when determining ancient resources because they provide habitats for many species of invertebrates, fishes, amphibians, reptiles, birds, and mammals. Odum and McIvor [44] reviewed the numbers of species reported from Florida mangrove systems, and found listings for 220 species of fishes, 24 species of reptiles and amphibians, 18 species of mammals, and 181 species of birds.

Sea grass beds are particularly productive features of marine habitats. They provide refuges from predators and act as nurseries and feeding areas [30]. Salt marshes require moderation of alternating terrestrial and aquatic environments. They have the qualities of marine and terrestrial ecosystems. Species diversity in salt marshes is low, but for those able to adapt, the number of individuals is high [38].

Raccoons are most common; others include marsh rabbits, and cotton rats. Fiddler crabs are common, and several species of snails are a source of food for ducks [22].

It is generally accepted that the plant portion of the diet made up the bulk of diets prehistorically. However, little has been done in the way of paleobotanical research in Florida to substantiate this. Preservation in many areas is poor, and early archaeology lacked the methodology used today. Moreover, most archaeological work in Florida has not specifically addressed the importance of fish and shellfish. General interpretation of diet, based on faunal and floral remains have focused on wild animals and wild plants, and the introduction of agricultural practices, including the spread of maize.

HISTORIC EVIDENCE FOR PLANT FOODS IN FLORIDA

There are numerous accounts by naturalists of plant resources in Florida dating back to the late 1700s [e.g., 4, 5, 12, 47]. Plants and their uses by the Indians are documented in the first written account of the New World, the *Memoir of Hernando D'Escalante Fontaneda on the Country and Ancient Indian Tribes of Florida 1575*. Examples in **Fontaneda's Memoirs** include palms that may be referring to the cabbage tree [11]; cabbage palm (*Sabal palmetto*) [57]; Chamaerops (*Chamaerops humilis*) [47]; palm or palmetto (*Sabal palmetto*) [4, 15]; shrubby palmetto (*Sabal palmetto*) [13]; and saw palmetto (*Serenoa repens*) [5]. Other plants referred to by Fontaneda include Soco (wild vine grapes), Turma (a fungus-like growth compared with truffles), and the coontie plant (*Zamia* sp.). Roots of the coontie were used to make starchy flour from which several tribes, and later European settlers, made bread.

There are many who argue against Spanish narratives that indicate maize agriculture was practiced among the Calusa in southern Florida [17, 18, 32, 33, 36, 40, 52, 64, 67]. However, written ethnohistoric records attributed to members of the Narvaez and DeSoto parties in 1528 and 1539, respectively, supply details about indigenous lifeways in central and Gulf Coast Florida [6, 45, 58, 59]. They indicate that large fields of maize were absent in the central Gulf Coast area. The narratives from de Soto account for little or no maize near Tampa Bay in 1539. Rodrigo Ranjel wrote that:

They came to the plain of Guaçoco, and the soldiers went into the corn fields and gathered the green corn with which they cheered themselves a little, for it was the first they had seen in that country. [6, p. 64]

Reports of intermittent maize fields were noted until they reached Apalachee [45, 58]. When the Spaniards were north of the Withlacoochee River, they found more maize:

Next the governor sent back some of the horsemen with mules that had been brought from Cuba loaded with corn and other provisions for those that were behind, since he had come upon an abundance. . . . The camp was now at Ocale, a village in a good region for corn [6, p. 68].

It appears that maize became increasingly more important as the expedition moved north.

Jacques Le Moyne's images of Florida inhabitants (known to us through the early engravings of Theodore LeBry) give us an idea of what types of subsistence practices existed during the 1500s, and ethnohistoric documents support the theory that plants, including maize, were an important component of prehistoric diets in Florida [34]. However, there is little in the way of archaeological information on the subsistence practices of populations occupying central Florida between AD 600 and 1725. Despite a history of excavations along the Gulf Coast, subsistence information was not sought until recently [e.g., 14, 25]. Little archaeobotanical information is available for late prehistoric and proto-historic period sites; however, a regional database for Florida has increased over the years [41, 42]. Stable isotope analysis helps to fill in these archaeological gaps by indicating whether C₄-based plant foods like maize were a significant part of ancient Florida diets.

STABLE ISOTOPE STUDIES IN FLORIDA

In this research stable isotope analysis was used to determine the diets and any variability in the diets of different groups who lived in prehistoric peninsular Florida. Carbon and nitrogen isotope analysis of bone collagen, and bone and tooth enamel apatite, specifically aided in understanding the roles that marine and terrestrial resources and plants such as maize played in ancient diets. The results of such studies also reveal dietary differences in population subgroups based on sex, social status, and age.

Because of variation in stable isotope abundance and diverse chemical reactions inherent to different ecosystems, paleodiets cannot be reconstructed without reference to the isotopic signatures of other organisms in the same biome [1, 24]. Populations with similar subsistence practices in geographically different areas may produce different isotopic data, especially when marine resources are involved. To provide a context from which to interpret isotope signatures, it would be ideal to consider isotope data from foods collected from the same type of habitat as the human samples. Unfortunately, this type of data is not archaeological available for much of peninsular Florida. Alternatively, comparative data from elsewhere may provide insight for interpretations.

There is now a significant amount of stable isotope data for prehistoric and historic humans in coastal Georgia and

northern Florida [19–21, 31, 53, 61]. Most of the sites studied, however, are located in panhandle Florida and are dated to later contact or mission periods. Other research has focused on the Atlantic Coast of Florida at Archaic Period sites such as Windover Pond, Bay West, and Tick Island. One relevant study [28] has documented stability and changes in diet for native populations in coastal Georgia over a 2500-year period that encompassed the transition to maize agriculture. They demonstrated a trend toward maize use and consumption beginning approximately AD 1100. This trend was emphasized during the mission period, AD 1600–1700.

Crystal River is one site that offers much to the understanding of lifeways of prehistoric populations. The site was occupied over about 2000 years from Deptford (500 BC–AD 200) through the late Weeden Island or early Safety Harbor (AD 700–1200) periods [35, 66]. Stable isotope analysis was previously performed on just three individuals from Burial Mound G by C. Katzmarzyk [23] and those reports show that stable isotope values suggest three different subsistence practices. However, no apatite values were reported, and, as no faunal remains were analyzed from the site, a baseline for interpretation of the human isotope values was not established.

HUMAN SKELETAL SAMPLES IN THIS STUDY

Human skeletal samples were obtained for this study from the Florida Museum of Natural History with the permission of curator Jerald T. Milanich, and the work was done at the University of South Florida. Initially individuals were chosen in accordance with geography—that is, bone and tooth samples from the inland sites of Cross Creek and Melton Mound I, the estuary site of Crystal River, and the coastal sites of Bayshore Homes, Bay Pines, Dunwoody, Horr's Island, Pillsbury, and Weeden Island (see Figure 18-1). The samples range from the Late Archaic period (ca. 1000 BC) through the Late Caloosahatchee cultural period (after AD 800–ca. AD 1750) in an effort to show change in subsistence practices over time as well as dietary differences that may have been dependent on local environment. Both males and females were chosen when available in order to clarify dietary differences determined by sex.

SITE BACKGROUND

Cross Creek and Melton Mound I (Inland Sites)

Skeletal material was analyzed from the inland site of Cross Creek (8A12) Alachua County. The Cross Creek I mound was excavated by the University of Florida in 1964.



FIGURE 18-1 Map indicating location of coastal, estuarine, and inland sites tested in this study, plus other sites in peninsular Florida.

Human teeth, bone fragments, and what appears to be a skull burial were unearthed from an already heavily disturbed conical-shaped sand mound approximately 8 feet high and 60 feet in diameter. Based on pottery styles, the Cross Creek I mound dates to the early Cades Pond Period, AD 200–400.

Human skeletal remains were excavated from Melton Mound I (8A15) by Fairbanks in 1969. This site dates to the late Cades Pond period, AD 600–800. The area inhabited by these Cades Pond cultures is densely vegetated, but is surrounded by freshwater resources. The environment is that of a wetland, and the habitat is varied and teeming with birds, fish and shellfish, and mammals. Northern Florida is characterized by flatland pine forests and hardwood hammocks separated by rivers, lakes, and swamps, and although the forests would have provided deer and nuts, as well as other animals and plants, the wetlands were the source for most of the meat in the diet [10, 39].

The samples from Cross Creek I and Melton Mound I are from shallow sand burials. All human bone samples are fragmented and balsa wood-like in appearance and texture, however an attempt was made to extract bone collagen from all samples. Although bone apatite samples were obtained for all individuals, only three of the five Cross Creek samples, and only five of seven Melton Mound I samples produced collagen sufficient for isotopic analysis.

Crystal River (An Estuary Environment)

The Crystal River archaeological site (8C11) is located within an estuary environment that emerges through salt marsh estuaries and travels six miles westward into the Gulf

of Mexico. The environment is unique in that numerous species of animals come and go as they are adapted to either saltwater or fresh water habitats; others are specific to the brackish water of the estuary and remain in the area year-round. Crystal River inhabitants probably exploited a wide variety of food resources, including terrestrial mammals that went to the river to drink or lived in the surrounding hammocks. Excavated faunal remains include deer and dolphin.

Twenty-four individuals were selected for stable isotope analysis from the **Crystal River site**, dating to the late Deptford and early Weeden Island periods, ca. AD 100–600. Human remains came from two areas of the site. Ten individuals were selected from the main burial complex—Mounds C, D, E, and F, plus 14 from Mound G (Stone Mound) [66].

Dunwoody, Pillsbury, Bay Pines, Horr's Island, Weeden Island, and Bayshore Homes (Coastal Sites)

Human skeletal remains were obtained from several coastal sites in peninsular Florida. The Dunwoody (8CH61) site in Charlotte County was a large shell midden constructed along the shore on Lemon Bay. Ripley and Adelaide Bullen excavated the partial and fragmentary remains of 18 individuals in 1965. Thirteen samples are represented in this isotope study and date to the Late Caloosahatchee period, sometime after AD 800 [37].

The **Pillsbury site** is located in Bradenton (Manatee County) and includes a temple mound (8Ma31) and a burial mound (8Ma30) located about 60 meters from the shore of Tampa Bay at the mouth of the Manatee River and 1 kilometer west of Shaw's Point. Thirteen of the 134 individuals excavated were chosen for analysis. Artifacts and ceramics contained in the burial and temple mounds suggest it was used during the Manasota-Weeden Island period, ca. AD 600–900. Skeletal remains from the Pillsbury site were not well-preserved, accounting for several lost bone collagen values.

The Bay Pines site (8Pi64), assigned to the Deptford period (ca. 500 BC–AD 200), is located on a peninsula that juts into Boca Ciega Bay in Pinellas County. All 24 individuals were excavated in 1971 by the Suncoast Archaeological Society when it was learned that the shell burial mound would be destroyed to make room for an addition to the Bay Pines Veterans Hospital and were tested in this study. A published report by J. C. Gallagher and L. O. Warren [16] includes a table of faunal remains found. These include fragments of 630 turtle, mammal, and bird bones, 207 fish bones, and 114 stone-crab claws.

Excavations at the Late Archaic site of Horr's Island (8Cr208) have revealed human burials in intentionally built shell mounds [48, 49]. The skeletal remains from these excavations represent seven individuals, in addition to a male in

his 50s removed from the Harris site on Horr's Island. Mound A has been radiocarbon dated to 2000–2500 BC. Studies of fish and shellfish indicate that the Horr's Island population was so heavily reliant on the abundant resources accessible from the 300-acre island that, unlike most Archaic groups, they were sedentary after about 2800 BC [49]. D. Hutchinson [19] bases this on their growing dependency on shellfish. Stable isotope values were obtained for five of the seven skeletons, including the Harris site individual.

The Weeden Island archaeological site (8Pi1) is located in St. Petersburg, Florida. It is a type-site for what may have been the most far-reaching culture in Florida prehistory, extending across northwestern Florida and the western two thirds of the northern peninsula ca. AD 300–600. Other sites are located from Mobile Bay to Okefenokee Swamp, which are outside the usual boundaries of this culture, and south to north-central Florida, as far south as Manatee County along the Gulf Coast, and into the coastal plain in southeast Alabama and southern Georgia [34, pp. 155–160]. Isotope values were obtained for only two individuals from the Weeden Island site because their remains were inadvertently shelved with Bayshore Homes individuals.

The Bayshore Homes site is located in St. Petersburg, Florida. Today, the site contains two burial mounds, but at one time, also included a large temple mound. This site dates to the Weeden Island II (AD 700–900) and Safety Harbor (AD 1000–1500) period. Ten samples from the Bayshore Homes site are included in this study. They were excavated during the 1956–1958 salvage operation directed by William Sears. It was during this time that Temple Mound A was bulldozed.

PROCESSING AND ANALYZING SKELETAL MATERIAL

Well-established procedures for extracting bone collagen and bone and tooth enamel apatite were performed in the Laboratory for Archaeological Science at the University of South Florida [62]. Whole and fragmented bone and tooth samples were sonicated using ultrasound vibration and distilled water to remove any soil or plant debris remaining. Several samples had been glued. If the preservative interfered with the specific portion of bone or tooth selected to be processed, it was removed with acetone and sonicated a second time. One gram of bone was isolated from the shaft of long bones so as to avoid diagnostic epiphyses and diaphyses. However, not all individuals were represented by long bones, so other samples were used. There were several bone samples indicating healed fractures. These areas were also avoided, not only because they are diagnostic, but because the new bone growth may not reflect the same stable isotope values as bone tissue in the rest of the body. From the 1-gram sample, 10 milligrams of bone powder were

extracted for apatite analysis. Likewise, 10 milligrams of tooth enamel was extracted using a dental drill.

After processing was complete, 1000 μg (micrograms), or one milligram, of bone collagen was weighed out into small tin vials. One milligram of both bone and tooth enamel powder was placed in glass vials for analysis. All samples were measured on Finnegan MAT Delta Plus XL mass-spectrometers at USF, and the collagen values validated by sample yields and C:N ratios to show intact preservation.

Of the 131 individual skeletons, only 16 resulted in no collagen yield, whereas 11 others did not produce reliable mass spectrometer results. Bone collagen, and bone and tooth enamel apatite isotope results are reported on the remaining 104 individuals. The isotopic values from these sites are compared in an effort to determine spatial variation and chronological change in subsistence, and in particular when and where maize may have been introduced in peninsular Florida.

STABLE ISOTOPE RESULTS FOR ALL SITES

The differences between inland, estuary, and coastal foraging patterns are well illustrated by comparing the results obtained for groups of individuals from sites in these areas (Table 18-1). Individuals within the same habitat are fairly clustered, whereas the habitat groups appear to have different subsistence practices. There is virtually no overlap between groups, meaning that the populations from coastal groups were dependent on marine resources, the estuarine groups appear to have relied on local resources, and the inland populations consumed freshwater fish and shellfish (Figures 18-2 and 18-3). There does not appear to have been significant mobility (e.g., seasonal movement between coast and inland) or long distance exchange of seafood products.

There is a significant amount of variation, however, within each of the groups, especially among the coastal inhabitants. This may be due to a broad range of isotope values of different fish and shellfish, whereas the average difference between several sites may be related to their actual location on the coast. For instance, the Bay Pines population may have had easier access to the open Gulf. This is suggested by higher nitrogen values, with more fish or higher trophic level fish in their diets as compared with the Bayshore Homes group from the partially protected Boca Ciega Bay, who may have relied on smaller, or lower trophic-level fish and shellfish.

Cross Creek and Melton Mound I (Inland Sites)

The mean collagen carbon isotope values for Cross Creek ($n = 3$; $\delta^{13}\text{C} = -19.9\text{‰}$; $\delta^{15}\text{N} = 12.0\text{‰}$) are negative. This is best explained by the direct and indirect consumption of only C_3 -based plant foods, along with freshwater fish and shellfish. However, collagen is biased toward the protein portion of the diet, and maize is only about 10% protein. The bone apatite results ($n = 5$; $\delta^{13}\text{C} = -12.4\text{‰}$) indicate something in the diets of this group that is not just C_3 plants and their consumers. Because the collagen values have not been affected, the apatite values are best explained by direct consumption of C_4 , and/or CAM plants that were not significantly eaten by the main hunted animals. If a pure C_3 diet is represented by apatite $\delta^{13}\text{C}$ at least as negative as -14‰ , then the C_4 plant foods eaten may represent at least 5–10% of the total diet.

Similar mean isotopic values from collagen ($n = 7$; $\delta^{13}\text{C} = -19.1$; $\delta^{15}\text{N} = 11.5\text{‰}$) suggest that the Melton Mound I population may be interpreted in the same way. For Melton Mound I, substantially more positive mean values produced from bone apatite ($\delta^{13}\text{C} = -9.8$), and tooth enamel apatite

TABLE 18-1 Summary of Isotope Data for Peninsular Florida Sites Produced in this Study

Site	Date	<i>n</i>	$\delta^{13}\text{C}_{\text{co}}$	$\delta^{15}\text{N}_{\text{co}}$	$\delta^{13}\text{C}_{\text{ap}}$	$\delta^{13}\text{C}_{\text{en}}$
Bay Pines	500BC–AD 200	20,20,19,7	-8.9 ± 1.70	13.2 ± 0.80	-7.0 ± 1.00	-4.8 ± 1.00
Bayshore Homes	AD700–1500	9,9,10,6	-11.9 ± 0.70	11.7 ± 0.50	-7.0 ± 0.80	-7.3 ± 1.10
Cross Creek	AD 200–400	3,3,5,5	-19.9 ± 0.40	12.3 ± 0.20	-12.4 ± 0.60	-3.6 ± 0.20
Crystal River—Main	AD 100–600	10,10,10,10	-15.2 ± 2.20	12.7 ± 0.60	-9.6 ± 1.90	-8.2 ± 0.90
Crystal River—Mound G	?	6,8,11,7	-15.1 ± 1.40	12.7 ± 0.70	-9.7 ± 0.70	-9.2 ± 1.10
Dunwoody	AD 800–1750	12,12,12,10	-8.7 ± 0.50	12.1 ± 0.70	-5.2 ± 0.50	-4.5 ± 0.70
Horr's Island	2000–1000BC	2,2,5,0	-11.7 ± 0.00	13.4 ± 0.10	-6.5 ± 1.50	
Melton Mound I	AD 600–800	7,7,6,4	-19.2 ± 1.40	11.5 ± 0.90	-9.8 ± 0.30	-11.5 ± 0.30
Pillsbury	AD 300–700	18,18,23,10	-10.1 ± 1.30	13.0 ± 1.00	-6.5 ± 0.60	-4.5 ± 1.00
Weeden Island	AD 200–900	1,1,1,0	-11.4	12.0	-7.4	

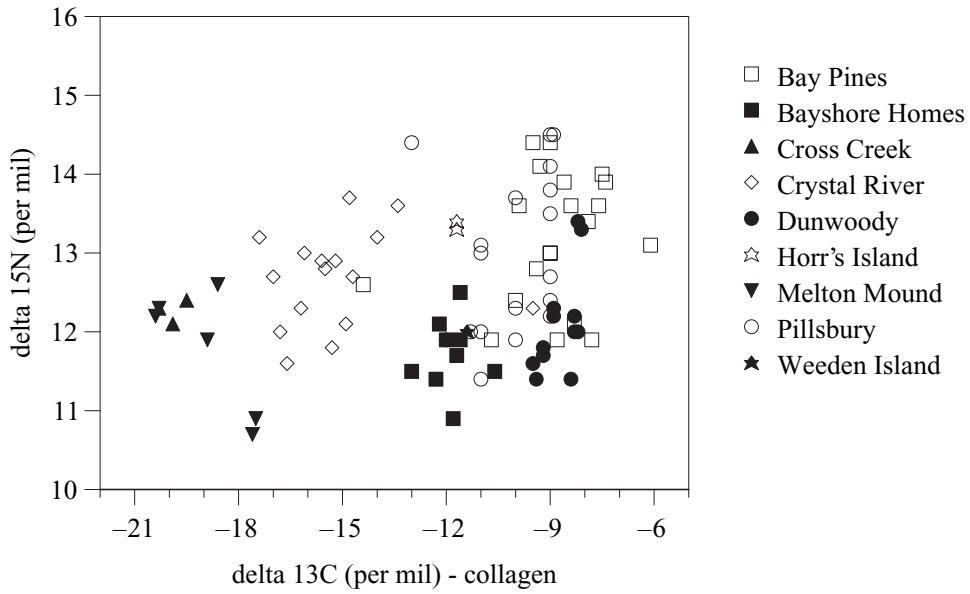


FIGURE 18-2 Plot of stable carbon and nitrogen isotope data for human bone collagen samples tested.

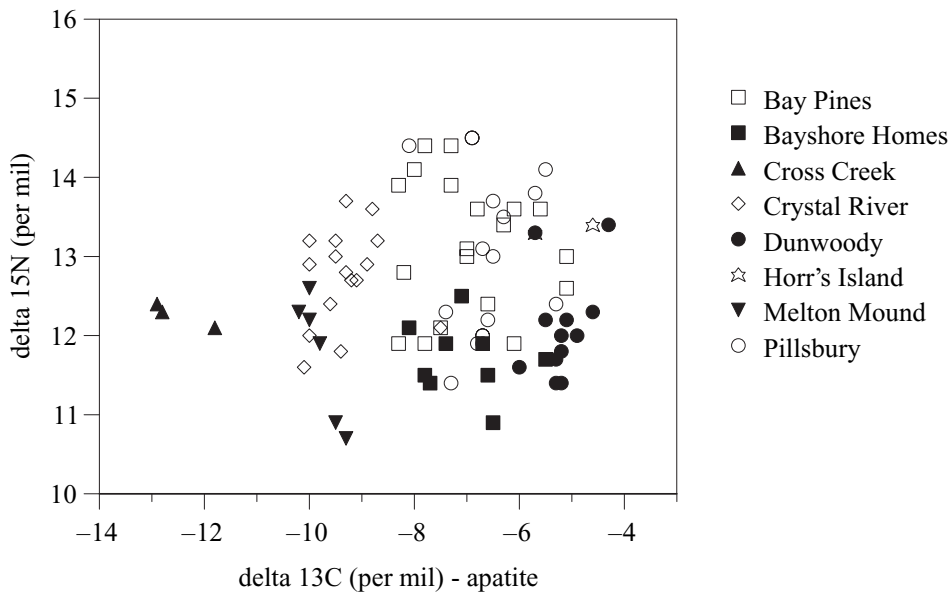


FIGURE 18-3 Plot of human bone apatite carbon versus collagen nitrogen isotope values for human samples tested.

($\delta^{13}\text{C} = -11.5\text{‰}$) are best explained by C_4 or CAM plants in the diet, and only a minor percentage of the protein portion of the diet. In particular, this indicates that the C_4 , or CAM plants, such as prickly pear, were not significantly consumed by animals subsequently eaten by humans. In other words, the more positive apatite values are likely due to domesticated plants eaten by humans directly.

Crystal River (Estuarine Site)

Average stable isotope values from the Crystal River human remains ($n = 23$; $\delta^{13}\text{C} = -13.9\text{‰}$; $\delta^{15}\text{N} = 12.0\text{‰}$) are consistent with a diet that was dependent on local resources. The location of this site allowed for diet rich in marine and riverine resources, including fish and shellfish that were localized in the brackish water of the Crystal River. Mammal bones such as deer have been found, indicating that terrestrial fauna were also a part of the diets of the Crystal River individuals. Human apatite values (mean $\delta^{13}\text{C} = -9.6\text{‰}$) are also intermediate between those of most coastal and inland sites. It is clear that the main difference is in protein values (i.e., freshwater and terrestrial versus mixed versus marine values).

As mentioned previously, stable isotope results allow a closer look at differences in diets within one population. On a rare occasion, the human remains excavated from a site have been analyzed to determine age, sex, and pathologies. Individuals from Burial Mound G at Crystal River had previously been researched [23], so comparisons may be made between males and females, and between the diets of the groups buried in the two different burial mounds.

In this case, there does not appear to be any differences between the two mounds that would indicate status differences ($n = 10$; $\delta^{13}\text{C} = -15.1\text{‰}$ versus $\delta^{13}\text{C} = -14.6\text{‰}$). This does not seem to be the case either for males versus females from Crystal River, with carbon isotope values ranging from -13.4‰ to -16.8‰ , and nitrogen isotope values from 11.6 to 13.6. The variation in the diets of both men and women indicates that they relied on resources that were available locally.

Bay Pines, Dunwoody, Pillsbury, Bayshore Homes, Weeden Island, Horr's Island (Coastal Sites)

Horr's Island

During the Florida Archaic, it is clear that possible sources of protein that would result in the observed $\delta^{13}\text{C}$ values include marine resources, and deer and other terrestrial fauna. Previous isotope data from Horr's Island ($\delta^{15}\text{N} = 11.1\text{‰}$; $\delta^{13}\text{C} = -10.2\text{‰}$) suggest that some individuals had intermediate $\delta^{13}\text{C}$ values [19, 21]. Their interpretation suggests more terrestrial protein. Bone apatite values are

reported by the same authors to be the result of a wide range of terrestrial and marine resources, including a variety of C_3 and some CAM or C_4 plants. Some consumption of C_4 grasses may have occurred because they have been found in southern Florida archaeological deposits at Horr's Island and Useppa Island [40, 51, 52], but the isotope results suggest that they were not a substantial dietary item [19].

Bay Pines

Food resources at Bay Pines were available from both Boca Ciega Bay and the Gulf of Mexico. The mean values of the collagen ($n = 20$; $\delta^{13}\text{C} = -8.9\text{‰}$; $\delta^{15}\text{N} = 13.2\text{‰}$) suggest that the people may have been divided when it came to eating habits. Excavated faunal remains also indicate that deer and other mammals were part of the diets for this group. Bone and tooth enamel apatite values help to fill in the missing carbohydrate portions of the diet. In the case of the Bay Pines population, the apatite values ($n = 19$; $\delta^{13}\text{C}_{\text{ap}} = -7.0\text{‰}$) suggest a C_4 component in the diets of this coastal group.

Dunwoody

The Dunwoody site dates to the Late Caloosahatchee cultural period, ca. after AD 800–1750 [37]. During this time, many sites in Florida underwent significant changes in dietary practices, specifically the introduction of maize. The average collagen isotope values obtained from the Dunwoody individuals ($n = 12$; $\delta^{13}\text{C} = -8.7\text{‰}$; $\delta^{15}\text{N} = 12.1\text{‰}$) reflect mainly a marine diet for this coastal population, whereas less negative apatite values most likely indicate the presence of a C_4 plant such as maize.

Pillsbury

The Pillsbury site dates from about AD 600 to about AD 900. The average collagen isotope values from the Pillsbury ($n = 22$; $\delta^{13}\text{C} = -12.9\text{‰}$; $\delta^{15}\text{N} = 10.1\text{‰}$) individuals reflect much lower nitrogen and carbon ratios than the temporally later Dunwoody site. This would indicate a diet with less significant, or lower trophic-level seafood, and/or some C_4 , or a combination of the two. The location of the site would have allowed for exploitation of both marine and riverine resources. Bone apatite and tooth enamel values ($\delta^{13}\text{C} = -6.5\text{‰}$, and $\delta^{13}\text{C} = -4.4\text{‰}$) support the consumption of a mixed economy—marine and riverine—and of C_4 plant foods.

Weeden Island

Only two individuals were analyzed from the Weeden Island site in Pinellas County. These individuals date to the

Manasota-Weeden Island period (AD 300–750). The collagen and bone apatite values ($n = 2$; $\delta^{13}\text{C}_{\text{co}} = -11.4\text{‰}$; $\delta^{15}\text{N} = 12.0\text{‰}$; $\delta^{13}\text{C}_{\text{ap}} = -7.4\text{‰}$) may be compared with those in the following section on Bayshore Homes as there is no significant difference.

Bayshore Homes

The stable isotope results for Bayshore Homes ($n = 10$; $\delta^{13}\text{C}_{\text{co}} = -11.3\text{‰}$; $\delta^{15}\text{N}_{\text{co}} = 11.7\text{‰}$; $\delta^{13}\text{C}_{\text{ap}} = -7.4\text{‰}$; $\delta^{13}\text{C}_{\text{en}} = -7.2\text{‰}$) are significantly different in nitrogen isotope values, which are the lowest of the sites tested with the exception of Melton Mound I, an inland site. Carbon values, however, remain much the same. The collagen $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values at Bayshore Homes indicate that the individuals may have exploited more shellfish or lower trophic-level fish. It is difficult to say what the waterways might have been like a thousand years ago. The coastline adjacent to where the Bayshore village might have stood has changed over the course of time. The same storms and wave action that moved the coastline could have also blocked or hindered access routes to the Gulf; thus the Bayshore inhabitants may have relied heavily on the bay for their food as opposed to the Gulf, like Bay Pines individuals. It is likely that the resources from the bay were quite different from those in the Gulf and resulted in different isotope values. However, another interpretation may be made here.

The nitrogen isotope values for Bayshore Homes are less than any other coastal site analyzed, and the apatite values suggest a C_4 component in the diets. Direct archaeological evidence does not exist for maize along the Gulf Coast, but lower nitrogen values are often indicative of less animal protein in the diet, a common result of maize, or agriculture in general.

On average, males from Bayshore Homes reflect higher nitrogen values than females, suggesting that males had greater access to higher trophic-level fish, or that females were the ones who consumed more C_4 . The analysis of one female child in this group resulted in collagen values closest to those of the men, which is at least partially a result of breast-feeding contributing to her diet.

DISCUSSION

Archaeological evidence for maize will always be limited in Florida, but with the use of stable isotope analysis, we are beginning to get an indication of when it was used, and how significant, or insignificant, it may have been to precontact populations. There are, however, claims for maize in south-central Florida that must be argued at this point.

Fort Center is located in the Okeechobee region of south-central Florida. The site was first occupied during the Late Archaic period, between 1000 and 500 BC [34, p. 287].

Seven maize pollen grains were identified from several contexts at the site: a lime-based paint on a wooden carving, paleofeces, and soil samples. The pollen was reported by Sears [55, pp. 177–178] to be from the same fill as pottery that dates to 500 BC. Subsequently, Sears dated maize agriculture at the Okeechobee site to 452 BC. This date is not widely accepted by the archaeological community, yet the evidence exists. There are many arguments that can be made against maize cultivation during this time period [17, 67]. There was an attempt to resolve the controversy using stable isotope analysis; however, the human skeletal samples he tested were poorly preserved, making them unusable for paleodietary reconstruction. Further isotope analyses are now planned.

The limited evidence available suggests that maize was minimally used in central and southern Florida before the arrival of Europeans [41, 42]. As we have seen by the isotope results in this study, however, maize may have been consumed earlier than previously thought at some Gulf Coast and inland sites.

Inland Sites

It is common to unearth degraded prehistoric human remains, particularly in Florida. During the Cades Pond period, shallow sand burial mounds were constructed in areas of Alachua County. Skeletal materials excavated from these types of mounds are not well preserved, and isotopic data are sometimes difficult to obtain from bone tissue. Human remains from Cross Creek and Melton Mound I are characteristic of interior sites. Bones are friable and teeth are extremely worn, some leaving little enamel to analyze. Nevertheless, results were obtained from several individuals, and a discussion follows on what appears to, perhaps, be a conversion to maize.

Collagen values from the sites of Cross Creek (AD 200–400) and Melton Mound I (AD 600–800) suggest that a change in subsistence was taking place during the Cades Pond period. This is significant considering the early time period at Cross Creek, but maize use is present in northern Florida by AD 800, and indicates the need for more precise chronology at sites like Cross Creek. Remarkably, the collagen isotope values from the Melton Mound I site suggest that individuals from Burials 1, 2, and 7 ate a diet that consisted almost solely of C_3 plants. Collagen values for the four remaining individuals suggest some C_4 component in their diets. However, bone and tooth enamel apatite results for all seven are all positive, suggesting a C_4 component in the diets of all seven individuals. This is interpreted to be a maize component, and may be reflecting a shift in the diets of the Late Cades Pond population of Melton Mound I.

When few human samples are available for isotope analysis, it is not possible to interpret dietary practices for a

whole population. Previous research may help to fill in these gaps by adding more information, and the isotope values given for Melton Mound II are indicative of a C₄ component in the diet. D. Magoon and colleagues [31] suggest that the collagen values for Melton Mound II were due to the consumption of prickly pear, along with C₄ grasses consumed by terrestrial mammals, such as deer, and in turn eaten by the inland population. This should be tested further using apatite analysis as done for Melton Mound I. Analysis of fauna, such as deer, would also indicate whether C₄ plants were indeed consumed by animals. Importantly, a big question would be why animal and/or human values change at this time if not due to the introduction of maize.

Some ethnohistoric reports [4, 5, 13, 15] indicate that prickly pear may have been an important part of the diet for some prehistoric Florida natives. It was noted that during some seasons the only fruits available were palmetto, sea grape, and prickly pear. Other types of C₄ plants native to central Florida include tropical grasses, and plants such as chenopods, setarias, and some amaranths. Bone and tooth enamel apatite reflect the whole diet, so even if small amounts of C₄ plants were ingested by Cross Creek and Melton Mound I groups, the isotopic values would reflect it. CAM plants, like prickly pear, result in carbon isotope ratios that are similar to those of C₄ plants. If prickly pear was eaten in excessive quantities, it might account for maize-like values, but it is doubtful that the diets of Melton Mound I individuals consisted of 25–30% CAM and other wild C₄ plants. Therefore, the best interpretation is that a domesticated C₄ plant, most likely maize, was introduced to peninsular Florida in the first half of the first millennium AD and used as a food source along with C₃ plants, mammals, and lacustrine resources for the people who inhabited the Cross Creek and Melton Mound I sites.

Crystal River

With regard to estuarine environments like that of Crystal River, it is important to establish baseline isotope data from the potential food sources in order to interpret the human values. Isotope values from flora and fauna tested were intermediate between marine and freshwater resources. Marine fish tend to be larger, and therefore carry higher nitrogen signatures than do smaller fish. Also varied are the food resources that the fish eat, thus resulting in a broad, intermediate range of $\delta^{13}\text{C}$ values.

Katzmarzyk [23] reports only collagen $\delta^{13}\text{C}$ isotope data for three individuals from Mound G. These individuals were radiocarbon dated as well. In view of the dates from the individuals, and the location of Crystal River, the use of maize at Crystal River was not expected, however Katzmarzyk's results indicate that the three individuals she analyzed had three different diets. She further explains that this may be due to human preference for one type of food over another.

This is possible, and considering the isotope values from the food resources, it is likely that the varied isotope results reflect that the people of Crystal River exploited a wide range of food resources, including marine, riverine, estuary (brackish), and terrestrial.

Subsistence strategies—hunting, gathering, and fishing—assigned to Weeden Island and Safety Harbor cultures along the Gulf Coast are consistent with the isotopic results in this study. It is evident that the tidal pools, salt marshes, and rivers supplied fish such as catfish, sharks, and mullet, and shellfish including oysters and mollusks. Bottlenose dolphin vertebrae have been recovered from the Crystal River site, and manatee rib fragments from a nearby shell midden indicate that marine mammals represented a portion of the diet [10].

The inland hammocks were a source for edible plant foods such as berries and nuts, and terrestrial animals like white-tailed deer, panther, raccoon, opossum, rabbit, gopher, bear, bobcat, and tortoise [34]. Neither collagen nor apatite results from previous research or this study indicate any evidence of C₄ plant foods in the diets of the late Deptford–early Weeden Island Crystal River population with the exception of Katzmarzyk's [23] burial 35, which is contemporary with Cross Creek.

Coastal Sites

During the Florida Archaic, it is clear that possible sources of protein that would result in the observed $\delta^{13}\text{C}$ values include marine resources, deer, and other terrestrial fauna. Previous isotope data from Horr's Island ($\delta^{13}\text{C} = -10.2\text{‰}$; $\delta^{15}\text{N} = 11.1\text{‰}$) suggest that some individuals had intermediate $\delta^{13}\text{C}$ values [19, 21]. Their interpretation suggests more terrestrial protein. Bone apatite values are reported by the same authors to be the result of a wide range of terrestrial and marine resources, including a variety of C₃ and some CAM or C₄ plants. Some consumption of C₄ grasses may have occurred because they have been found in south Florida archaeological deposits at Horr's Island and Useppa Island [40, 52], but the isotope results suggest that they were not a substantial dietary item [19].

Conversely, the $\delta^{15}\text{N}$ values obtained in this study suggest a diet richer in marine resources than in terrestrial proteins. The positive $\delta^{13}\text{C}$ values in both studies confirm that the diets of the Horr's Island population were heavily dependent on marine resources. Marine grasses often result in isotopic values similar to those of C₄ plants. This may be reflected in the diets of the people who consumed fish. By no means do the isotope results suggest a maize component during the Florida Archaic at Horr's Island.

Isotope results indicating maize use were not unexpected at the Dunwoody site. Ethnography indicates that maize was not used south of the Tampa area. This site dates to the Late Caloosahatchee period (after AD 800), and although there

are no radiocarbon dates on the skeletal material used in this study, the remains analyzed may date much later, perhaps to 200 years after contact. As mentioned, there is no evidence for maize use by the Calusa; therefore the isotopic results do not support the ethnohistoric documentation. Dating at this site is needed to further establish whether the skeletal remains used in this study date to the prehistoric, proto-historic, or contact period.

The Pillsbury site dates to the Manasota Weeden Island period (AD 600–900). Collagen and apatite $\delta^{13}\text{C}$ values indicate minimal amounts of C_4 plant foods in the diets of the Pillsbury population. The results may be representing a maize component in the diet, or other C_4 and CAM plants that were consumed directly, such as prickly pear, or enriched carbon isotope values obtained through the consumption of terrestrial mammals (that consumed C_4 or CAM plants) or marine fish, or both. Isotope values from the Pillsbury population indicate that at least 70% of their diets consisted of protein either from marine animals or C_4 -based terrestrial protein, or both.

In the case of Bay Pines, the more positive bone and tooth enamel apatite values ($\delta^{13}\text{C}_{\text{ap}} = -7.0\%$; $\delta^{13}\text{C}_{\text{en}} = -4.8\%$) suggest a C_4 component. This interpretation is based on higher apatite values relative to other sites in similar locations, and in earlier periods. The C_4 component is most likely to be domesticated, rather than wild C_4 plants, which would have been directly consumed by animals which were eaten. Therefore, it is likely that there was much variation in the amounts of protein in the diets of Bay Pines population, and that these variations resulted in different isotopic levels reflecting seafood, and terrestrial mammals and maize.

Like Bay Pines, the Bayshore Homes area was abundant in wildlife and fish and shellfish. It was able to support a relatively large population, perhaps 200 individuals by conservative estimates. Faunal remains from previous excavations indicate that the Bayshore group was heavily dependent on marine resources. Charred cobs and other archaeological evidence that would support isotopic evidence for maize have not been found during excavations at Bayshore, as is the case for many sites in south Florida.

Collagen values indicate that the Bayshore population ate lower trophic-level fish than those living near the Bay Pines site. Nitrogen ratios, in particular, are the lowest of any coastal site in this study, and indicate that fish had become less important in general. Both bone and tooth enamel apatite $\delta^{13}\text{C}$ values (-7.0% and -7.2% , respectively) indicate that the cause for this change in subsistence practices is a C_4 plant and that this is likely to be maize. Although there is no archaeological evidence in the way of cobs or cob marked pottery to support this interpretation at this time, the osteological examination by C. Snow [60] revealed dental caries in two molars from children from the Bayshore population. It is rare to see this type of dental disease in prehistoric, premaize populations.

CONCLUSION

The daily activities of the earliest Floridians are difficult to reconstruct. However, using a combination of archaeology, ethnohistory, history, and biochemistry allows us to interpret much more than previously possible. At sites like Bayshore Homes, Bay Pines, Dunwoody, Pillsbury, Weeden Island, Crystal River, Cross Creek, and Melton Mound I, stable isotope analysis helps to fill in gaps where there is a lack of evidence for certain foods, such as seafood and maize. Stable isotope geochemistry has been applied worldwide and has complemented other types of research with regard to subsistence practices of prehistoric populations [3, 9, 20, 26, 27, 29, 43, 46, 54, 63, 65].

This research has made it clear that there were changes in subsistence practices during the late Archaic through the late Caloosahatchee periods in Florida. It appears that, beginning during the late Archaic period, mobile hunting and gathering became less important, whereas fishing and collecting shellfish appear to have become the predominant subsistence practice at these sites. However, differences in stable isotope values of bone collagen, and both bone and tooth enamel apatite strongly suggest an early introduction of maize as a measurable component of the diets, as well as differences in the amounts of maize consumed by the populations who occupied these sites.

If the dates of the inland Cross Creek site and the coastal site of Bay Pines are accurate, then we must consider maize use earlier than previously thought, perhaps as early as AD 200 in the interior and AD 500 or earlier along the Gulf Coast. This is not to say that horticulture or maize agriculture had been adopted in these areas. The labor investment required may have discouraged the adoption of maize agriculture in areas of Florida, or maize may have been restricted to ceremonial use as the Gulf coastal plain was abundant with natural resources like wild plants and animals, and fish and shellfish [2]. This would help to explain the lack of evidence for maize cultivation along the Gulf Coast, and the appearance of the maize pollen found at the Fort Center site and would also begin to address what appears to be maize use as far south as the Dunwoody site.

We note the chronological limitation of this research knowledge (e.g., where dates given to sites are marked by the appearance and changing of ceramic types, with little reinvestigation done on pottery design and style since the 1940s) [68]. We hope that in the future direct AMS radiocarbon dating of some of the skeletal remains tested will provide better chronological understanding of the early importance of maize in peninsular Florida. Nonetheless, this isotope work has provided significant data that strongly supports early maize use along Gulf Coast and interior peninsular Florida, and this reveals important circumstances for changes in prehistoric cultural societies. Further reinvestigation of skeletal material from underresearched sites in

Florida will aid in the understanding of precontact developments and is important for evaluating the impact of European settlement on prehistoric populations.

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