Stable-isotope Analysis and Subsistence Adaptations along the Gulf Coast of Florida from the Archaic through Safety Harbor Periods

Robert H. Tykot[1], Jennifer A. Kelly[1] and Jerald T. Milanich[2]

[1] *University of South Florida, USA: rtykot@chuma1.cas.usf.edu; jakelly@helios.acomp.usf.edu*
[2] *Florida Museum of Natural History. email: jtm@flmnh.ufl.edu*

Introduction

Stable-isotope and nitrogen analyses of human skeletal remains from archaeological sites along the Florida Gulf Coast were performed to reconstruct indigenous subsistence adaptations prior to European contact, and to compare them with those associated with Mississippian and other cultural groups in the southeastern United States. Previous studies of bone chemistry have concentrated on sites in northern Florida and along the eastern coast of Florida, and suggest that maize agriculture became significant only late in Florida's prehistory, while complex societies like the Calusa in southwest Florida are thought to have developed a chiefdom-level political structure based on the intensive exploitation of marine resources (Willey 1949, Milanich 1994).

The Sites

Permission was granted through the Florida Museum of Natural History, and 123 individuals were selected for analysis from the Bay Pines, Bayshore Homes, Cross Creek, Crystal River, Dunwoody, Horr's Island, Melton Mound I, and Pillsbury sites (Fig. 1). These sites were selected to represent inland, estuarine, and coastal environments as well as a time range from the late Archaic period (~ 2000 BC) through the Safety Harbor period (~ AD 1350), and up to the time of European contact in Florida (AD 1528). Presented here are the preliminary results of an ongoing study. Bone collagen, bone apatite and tooth enamel have been analyzed for the Bay Shore Homes, Cross Creek, and Crystal River sites.

Bayshore Homes (8Pi64): coastal site William Sears' (1960) excavations at this Weeden Island site suggest that a cultural continuum existed between the Deptford period (500 BC) through the Weeden Island period, and into the succeeding central coast Safety Harbor period (to about AD 1100). Shell middens were reported to have contained few animal remains, but most edible species of shellfish were reported. Coastal resources at the Bayshore site were numerous, and included fish such as drum, sharks and sea turtles, birds and shellfish.

Sites such as this are most often multicomponent; some were still occupied through the Safety Harbor period because people continued to use the same locations and resources for hundreds, even thousands of years. Sand burial mounds are present at Bayshore, and all together, the remains of over 400 individuals were removed by Sears.

Cross Creek (8Al2): inland site The Cross Creek site, dating to the Cades Pond cultural period, differs from coastal or estuary sites in terms of its flora and fauna. This site occupies a restricted geographical and physiographical region in north-central Florida. It is situated on a relatively high, wedge-shaped strip of land, nowhere more than four miles wide, between Orange Lake, Lochloosa Lake and Cross Creek, and is about 50 miles from the coast.

Numerous animal bones recovered indicate that Cross Creek Creek populations enjoyed deer, squirrel, rabbit, bear, turtle, and alligator. However, faunal remains from wetland sites suggest that most of the food was obtained from either marsh or lake habitats (Cumbaa 1972). Cades Pond people also had ready access to nearby hardwood and hickory forests which provided deer and other animals, nuts and plants (Milanich 1994).

Crystal River (8Ci1): estuarine site The Crystal River site was first excavated by C.B. Moore in 1903. It is believed that this ceremonial site was occupied prior to the Deptford Culture, that is earlier than 500 BC, through the Safety Harbor period (Weisman 1995, Milanich 1994, Katzmarzyk 1998). Because an estuary system is unique and variable, the animal life in estuary habitats varies greatly. All of the main vertebrate groups are represented.

Waterfowl are found in large numbers, and fish, shellfish, crabs and shrimp take advantage of the large numbers of invertebrates that live on the estuary floor. Hardwood forests and oak hammocks are within a short distance allowing for a diet that included meat, nuts and plants.

Figure 1 Map of Florida showing sites with stable isotope analyses of human skeletal remains.

Stable-Isotope Analysis and Subsistence

Faunal remains are insufficient by themselves for the quantitative measurement of dietary components, and thus for a complete understanding of subsistence variability among prehistoric populations. The preservation and recovery of faunal remains is biased by the type and size of the animal and whether fine screening and flotation methods are used. Deer might tend to dominate the archaeological record at the expense of smaller mammals, birds or fish, while the contribution of plant foods is impossible to estimate based on limited evidence. It is also important to note that documentation by early Spanish chroniclers may have been biased, and should be used with caution. Nevertheless, they remain the only written source of information describing prehistoric Florida natives (Kelly *et al.* 2002).

Stable-isotope analyses, however, used in combination with archaeological evidence and historic documents allow for a more complete reconstruction of prehistoric behavior patterns. Stable-isotope ratios in human skeletal tissue may be used to differentiate between C3 and C4 plants, and the herbivores that consume them, and between marine and terrestrial resources when the latter is dominated by a C3-based ecosystem (Larsen 1997). Nitrogen-isotope ratios may be used to differentiate between terrestrial and marine diets, even when C4 plants are consumed, and in some cases between high and low trophic levels within the marine ecosystem. Studies with rats and pigs have demonstrated that carbon-isotope ratios for bone collagen, a protein, are biased toward the protein components of the diet, while carbon isotope ratios in bone apatite faithfully reflect the whole diet. Nitrogen in bone collagen is derived entirely from protein sources. Bone collagen and apatite represent dietary averages of at least the last several years of an individual's life, while tooth enamel represents the diet at the time of crown formation regardless of age of death.

Bone-collagen, bone-apatite and tooth-enamel samples were prepared at the University of South Florida following standard procedures which eliminate potential contaminants and identify whether alteration of the original biogenic signals is likely (Tykot 2002). Only one to two grams of bone are required for collagen and apatite preparation. Ten milligrams of tooth enamel were obtained with a dental drill. Samples were analyzed on stable-isotope ratio mass spectrometers. The results are reported relative to the Peedee Belemnitella (PDB) and AIR standards, and have a precision of ± 0.1 ‰.

Analytical Results

Results are reported here for the stable-isotope analysis of bone collagen from three individuals from Cross Creek, an inland site; for ten from Crystal River, an estuary site; and for eleven from Bayshore Homes, a site along the Gulf Coast (Table 1; Fig. 2). Bone-apatite data are also presented for the Bayshore Homes site. Archaeological faunal samples were also obtained from the Florida Museum of Natural History in Gainesville in order to establish a proper isotopic baseline for interpreting the human data. Samples of deer, gopher tortoise, sea turtle and fish were tested, along with modern aquatic fauna.

Table 1 Isotopic analysis of human skeletal remains.

Site	Location	Number	$\delta^{13}C_{collagen}$	$\delta^{15}N_{collagen}$	$\delta^{13}C_{apatite}$
Cross Creek	inland	3	-19.8 ± 0.4	10.2 ± 0.6	-
Crystal River	estuarine	10	-15.5 ± 0.8	10.8 ± 0.5	-
Bayshore Homes	coastal	11	-11.1 ± 0.5	10.2 ± 0.6	-7.1 ± 0.7

Experimental and empirical studies have demonstrated that bone collagen is enriched about 5‰ relative to the diet, while bone apatite is enriched about 10 - 12‰. With C3 plants averaging about -26‰, it is anticipated that herbivores consuming all C3 plants would have collagen values of about -21‰. Omnivores which also consume some of these herbivores should have slightly enriched values. The consumption of marine foods, with more positive carbon-isotope ratios, would result in significantly enriched collagen values. Nitrogen-isotope ratios are typically higher in aquatic resources, and also increase with trophic level by 2 - 3‰.

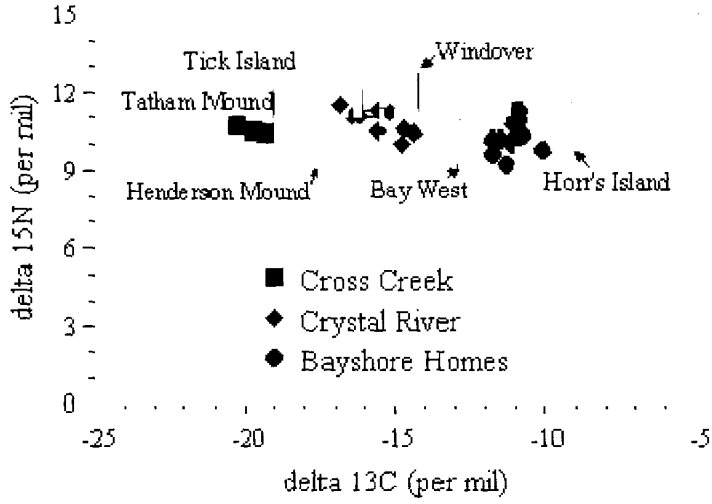

Figure 2 Collagen vs. nitrogen isotope results from this study compared with published and unpublished data.

The average nitrogen values for prehistoric populations at Cross Creek are 10.2‰, suggesting a significant consumption of aquatic resources. The carbon-isotope ratios average -19.8‰, suggesting that these resources were C3-based, and therefore derive from inland and riverine or lacustrine environments. The individuals from Crystal River exhibit similar nitrogen-isotope ratios, but are moderately enriched in carbon-isotope values, averaging -15.5‰. This indicates that the Crystal River people consumed marine fish and shellfish, and/or C4 plants such as maize. Considering the available archaeological evidence and known chronology for the introduction of maize in Florida, the former is more likely. Collagen results for Bayshore Homes indicate nitrogen values in keeping with Cross Creek and Crystal River, but carbon-isotope ratios average -11.1‰ showing a heavy dependence on marine resources. This is corroborated by the bone-apatite data which average -7.1‰, suggesting that marine foods may have constituted half or more of their diet.

Discussion

This study expands on the chronological and geographic range of stable-isotope research in Florida. Previously published and unpublished work has focused, for the most part, on the panhandle of continental Florida, especially during the Contact period (Hutchinson *et al.* 1998).

In peninsular Florida, previous studies have concentrated on Archaic sites including Windover Pond (Tuross *et al.* 1994), Tick Island (Cabanilla 1999), Horr's Island, Bay West (DeLeon 1998) and Henderson Mound (Hutchinson *et al.* 1998). Tatham Mound (Hutchinson & Norr 1994) bridges the contact and imme-diately pre-Contact period.

Archaic sites located some distance from the coast have isotope values somewhat similar to Crystal River, suggesting some consumption of fish. This may have occurred due to local availability or seasonal mobility. Coastal sites, whether Archaic or later, have similar values to Bayshore Homes and demonstrate a similar subsistence adaptation that lasted at least several thousand years.

Continuing stable-isotope analysis on bone apatite and tooth-enamel analyses from the sites in this study will provide more precise data on native Floridian subsistence adadptations, and how they changed over time.

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