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Where did people forage in prehistoric Trinidad? Testing the utility of a multi-isotope approach for tracking the origins of terrestrial prey

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ABSTRACT

Isotopic analysis of zoological material in archaeological deposits may help identify the origin of predated individuals. Here we assess the utility of carbon, nitrogen, and sulfur isotope values in bone collagen from zooarchaeological remains for determining the degree to which prehistoric Trinidadians relied on terrestrial prey from coastal and inland localities, as well as how this may have changed over time. We analyzed bone collagen from a variety of marine and terrestrial vertebrates from three coastal Ceramic Age sites in southwestern Trinidad. We also collected and analyzed modern foliage from eight sites at varying distances from the ocean to establish expected isotopic values for coastal (< 1.5 km from the ocean), intermediate (1.5 to 10 km from the ocean), and inland (> 10 km from the ocean) environments in the southwestern corner of the island. We anticipated that the earliest human inhabitants at these sites initially exploited marine and local (i.e., coastal) terrestrial prey, but that they eventually depleted local resources, necessitating harvesting terrestrial prey from further inland. Unexpectedly, we find no substantial or consistent isotopic trends over time within sites or among different sites. The majority of harvested prey likely lived 1.5–10 km from the ocean. The combination of nitrogen and sulfur isotope values is effective at distinguishing both plants and terrestrial prey from coastal versus inland localities. Although carbon is less informative at elucidating geographic origin, it is quite effective at distinguishing terrestrial and marine prey and may be useful for separating marine turtles from terrestrial tortoises when working with fragmented material. Results from this study can be used as a model for multi-isotopic research in other island and coastal continental settings.

1. Introduction

The island of Trinidad, which is just 12 km from Venezuela (Fig. 1), contains one of the earliest documented archaeological sites in the Caribbean. Radiocarbon dates from charcoal for this site, called Banwari Trace, indicate it was occupied between ~6200 and 4360 calendar years before present (cal BP; Boomert, 2000). These dates have been used to suggest that Trinidad was the gateway for human colonization of the Caribbean (Boomert, 2000). The island's rich archaeological record provides an opportunity to investigate if humans changed their resource use over time as their populations grew. Somewhat surprisingly, resource use on the island has only been studied sporadically (Ali, 2012; Boomert, 2000; Delsol and Grouard, 2015; Harris, 1973; Wing, 1962). Aside from general faunal analyses and species lists, little is known about the resources targeted by people on Trinidad in the past. While remains from depredated prey can frequently be identified, this is not always the case. Additionally, the origin of terrestrial prey cannot be discerned with typical faunal analysis.

Here we assess the degree to which prehistoric people on Trinidad harvested prey from coastal versus inland localities prior to European arrival using carbon ($\delta^{13}C$), nitrogen ($\delta^{15}N$), and sulfur ($\delta^{34}S$) isotopes in terrestrial zooarchaeological remains. Researchers have primarily used this combination of isotopes to reconstruct paleoenvironment and identify human paleodiet, including quantifying marine inputs (e.g., Bocherens et al., 2011; Craig et al., 2006; Drucker et al., 2011; Hesslein et al., 1991; Kinaston et al., 2014; Nehlich et al., 2010; Privat et al., 2007; Sayle et al., 2013). A few studies have also attempted to use carbon and nitrogen isotopes in terrestrial animals to understand geographic origin and husbandry practices in coastal areas (e.g., Britton et al., 2008; Müldner et al., 2014; Reitsema et al., 2015); the capacity of these isotopes to detect coastal residency appears to vary on a case by case basis. While nitrogen isotope values are much better than carbon at identifying coastal salt-marsh grazers in the United Kingdom (Britton et al., 2008), $\delta^{13}C$ values were better than $\delta^{15}N$ values at detecting cattle and sheep that lived on the Flemish coastal plain (Müldner et al., 2014). Lelli et al. (2012) found no trends for either isotope in

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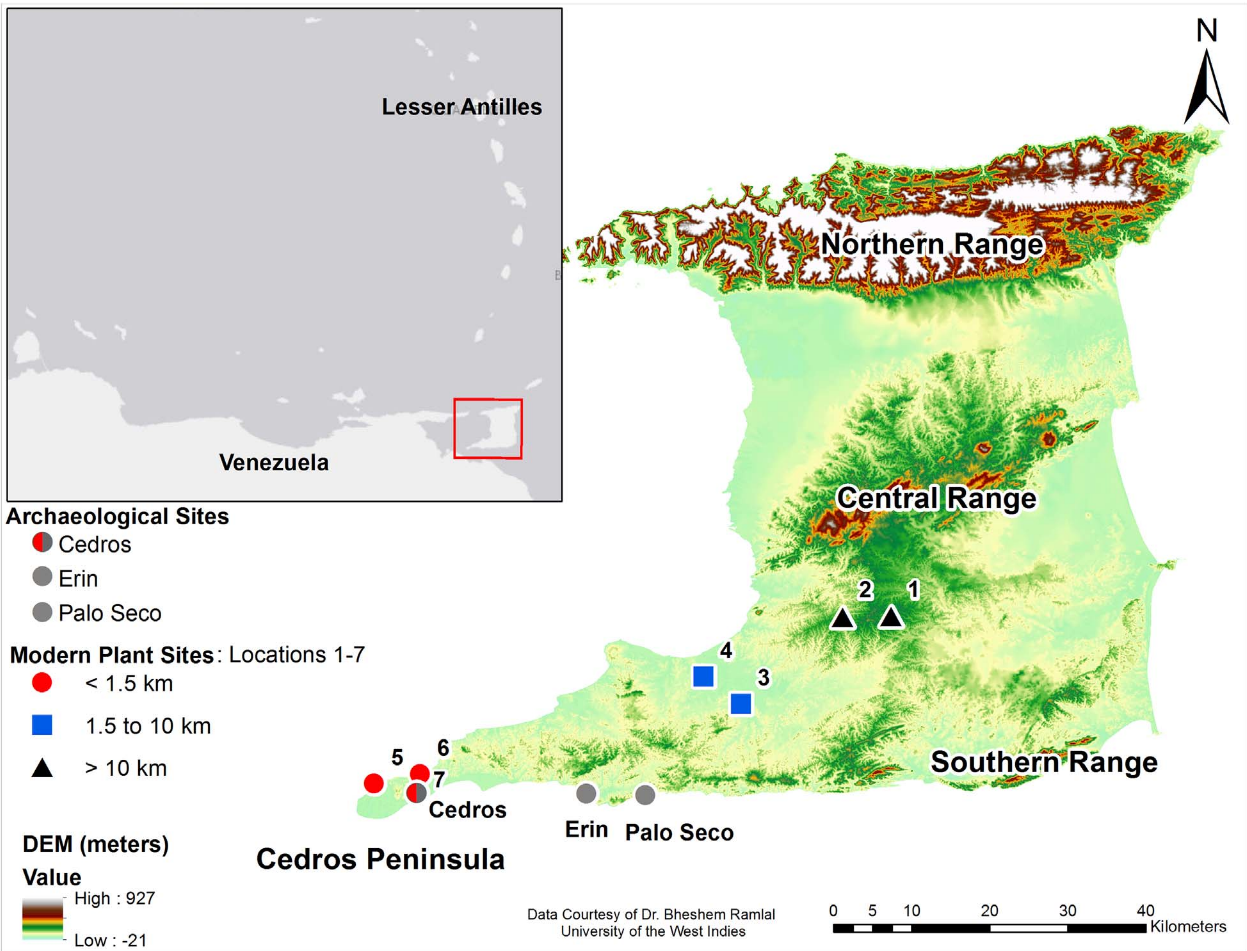

Fig. 1. Regional map of the greater Caribbean showing the location of Trinidad, and a digital elevation model of Trinidad showing both archaeological and plant collection sites. Symbols for plant sites indicate their distance from the ocean. Radiocarbon dates for each site that were obtained in this study are presented in calibrated years before present (cal BP).

domesticated caprids (or other mammals) from coastal versus inland locations in Italy and Croatia. Just one study has explored how $\delta^{34}S$ values in animals vary with coastal proximity (Zazzo et al., 2011). These authors found elevated $\delta^{34}S$ values in wool from sheep that lived close to the windward, western coast of Ireland. The utility of a multi-isotope approach (including carbon, nitrogen, and sulfur) for identifying the origin of terrestrial prey has not been previously explored.

We focus on three archaeological sites, Cedros, Palo Seco, and Erin, on Trinidad's southern coast, which is relatively exposed and dry (Fig. 1). These sites, which have similar bedrock geology and environmental conditions, contain well-preserved and abundant zooarchaeological remains that date to the Ceramic Age (2450 to 452 cal BP; Table 1). We anticipate that the earliest human inhabitants at these sites exploited marine and local terrestrial (i.e., coastal) prey, but that they eventually depleted local terrestrial resources and had to rely on prey acquired from more distant inland localities. Accordingly, we predict that remains from terrestrial prey from the oldest deposits at each site will have elevated $\delta^{13}C$, $\delta^{15}N$, and $\delta^{34}S$ values (reflecting the local coastal environment), and that values will decrease and become more variable in younger material (reflecting an increasing reliance on prey from a range of localities).

Table 1
Date ranges and the defining characteristic of different cultural time periods that occurred on Trinidad. For calendar years before present (cal BP), "present" is defined as 1950 CE.

Cultural period	Date range (cal BP)	Date range (BCE/CE)	Defining characteristic
Lithic	8000 to 6000	6050 to 4050 BCE	Worked stone tools
Archaic	6000 to 2450	4050 to 500 BCE	Ground stone and shell artifacts
Ceramic	2450 to 452	500 BCE to 1498 CE	Horticulture and pottery making
Historic	452 to 150	1498 to 1800 CE	Arrival of Europeans

2. Archaeological context

There are four recognized Amerindian cultural time periods in the Caribbean. The oldest period, called the Lithic, occurred from ca. 8000 to 6000 cal BP (Table 1). This period is poorly represented on Trinidad, although a single stemmed spearhead found in the Central Range suggests that people were present during this time (Boomert et al., 2013). The next cultural time period, called the Archaic, began about 6000 cal BP and continued until around 2450 cal BP. Banwari Trace dates to this time. The Ceramic Age followed the Archaic, and lasted from ca. 2450 cal BP until 452 cal BP. The transition from the Archaic to the Ceramic Age is marked by the appearance of pottery and horticulture (Boomert, 2000; Boomert et al., 2013). The final cultural period, the Historic, commenced with the arrival of Europeans to Trinidad (452 cal BP) and continued until about 150 cal BP (Boomert, 2000; Boomert et al., 2013).

Subsistence information for prehistoric people on Trinidad has primarily been drawn from tools used for hunting, fishing and food processing, or zooarchaeological analyses. While tools can provide insight into the breadth of resources exploited and the methods used to obtain them, zooarchaeological analyses offer more information concerning