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Data Article

Collagen and carbonate isotope data of fauna from pre-Columbian Panama

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A B S T R A C T

Raw isotope data of collagen ($\delta^{13}C_{collagen}$ and $\delta^{15}N_{collagen}$) and carbonate ($\delta^{13}C_{carbonate}$ and $\delta^{18}O_{carbonate}$) of bone, enamel, and dentine of 101 faunal samples from Parita Bay, Panama are presented. These samples were taken from four archeological sites that span a long termporal range beginning with early hamlet agriculture period marked by the introduction of agricultre (circa 6000 BCE), and extending into the time of Spanish contact (1521 CE). The collection represents twelve faunal species of secondary browsers (deer), potentially captive or habituated birds (waterfowl, parrots, guan, among others), and carnivores (ocelot and domesticated dog). One modern deer specimen was also taken to link archeological baselines with known modern environmental data. This data complements our argument, presented in the article "Domesticated landscapes of the Neotropics: Isotope signatures of human-animal relationships in pre-Columbian Panama" [1],

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that stable isotope analysis can be a useful proxy to document degrees to which human-plant/animal co-habitation has created anthropogenic ecosystems in the Neotropics.

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Specifications Table

Subject	Archaeology
Specific subject area	Stable isotope analysis Carbon Nitrogen Oxygen Domestication Zooarchaeology
Type of data	Table
How data were acquired	Costech 4010 Elemental Analyzer coupled to a Thermo Delta V Advantage mass spectrometer Thermo Gas Bench II connected to a Thermo Delta V Advantage mass spectrometer Thermo Nicolet 6700 Fourier-Transform Infrared Spectrometer with the attenuated total reflectance attachment (FTIR-ATR)
Data format	Raw Analyzed
Parameters for data collection	Samples were taken across stratigraphic layers from four site spanning 7500 years of human occupation at Parita Bay, Panama. Consistent element and side were obtained from the same stratigraphic layer. When available, bone, dentine, and enamel from the same individual were taken. 114 collagen and 146 carbonate samples representing twelve species and 101 minimum number of individuals (MNI) were collected.
Description of data collection	Samples were exported with permission from the Panamanian Instituto Nacional de Cultura (National Institute of Culture) (*Resolución No 018–15*) and analyzed at the Smithsonian Museum Conservation Institute Stable Isootpe Mass Spectrometry Laboratory. Extraction protocols followed standard methodologies for collagen [2] and carbonate [3].
Data source location	Institution: Smithsonian Tropical Research Institute City/Town/Region: House in Panama City Country: Panama Latitude and longitude for collected samples/data: Sitio Sierra (AG-3): 8° 8′40.19″N, 80°37′12.32″W Cerro Mangote (Co-40): 8° 8′11.73″N, 80°33′45.41″W Cerro Juan Díaz (LS-3): 7°57′22.0″ N, 80°24′3.5′W Playa don Bernardo (PDB) Pedro González, Island: 8° 23′56′N, 79° 51′W Isla Coiba: 7° 30′58.37″N, 81°45′41.48″W
Data accessibility	With the article
Related research article	Nawa Sugiyama, María Fernanda Martínez-Polanco,Christine A.M. France, Richard G. Cooke, “Domesticated landscapes of the Neotropics: Isotope signatures of human-animal relationships in pre-Columbian Panama”, Journal of Anthropological Archaeology, In press

Value of the data

- As stable isotope analysis is a destructive process, it is important to publish the raw data for archeological samples that usually can only be tested once.
- Carbon and nitrogen isotopic values of two New World domesticates that have not received sufficient attention, domesticated Muscovy duck (*Cairina moschata*) and whistling duck (*Dendrocygna* sp.), are presented here.

- The zooarchaeological samples originate from a wide temporal (7500 years) and spatial (inland, coastal, and island) distribution from Parita Bay in Panama, providing valuable raw data for further inter-site, and inter-regional studies.
- Oxygen isotope values from this collection were not discussed in the related research article and thus this publication is the only primary source of the oxygen dataset from Parita Bay, Panama.
- Zooarchaeological isotopic data can benefit archaeologists, biologists, and environmental scientists interested in anthropogenic landscape alterations.
- Small sample sizes are a notorious problem in archaeology. Despite large-scale sampling, the Neotropical habitat of Panama has significantly affected collagen preservation. There needs to be more robust collagen sampling to obtain more representative sample sizes.

1. Data description

Carbon, nitrogen, and oxygen isotope data were derived from archeological faunal samples spanning 7500 calendar years of human occupation across four sites in Parita Bay, Panama. One modern sample from Isla Coiba was also included. The samples were extracted from collections curated at the Smithsonian Tropical Research Institute in the Archaeology Laboratory by N. Sugiyama, R. Cooke, and M.F. Martínez-Polanco. The samples were exported with permission from the Panamanian Instituto Nacional de Cultura (National Institute of Culture) under the document *Resolución N° 018–15*. As summarized in Table 1, the sites are distributed across a broad chronological range from the Hamlet agriculture period (6000–500 BCE) to the Village agriculture and social differentiation period (500 BCE-1520 CE). The sites represent diverse adaptations to maize agriculture and fauna acquisition strategies since the introduction of milpa cultivation across inland, coastal, and island ecosystems.

Bone and tooth collagen ($\delta^{13}C_{collagen}$ and $\delta^{15}N_{collagen}$) and carbonate ($\delta^{13}C_{carbonate}$ and $\delta^{18}O_{carbonate}$) data from twelve vertebrate species suspected to be potential proxies of human anthropogenic alteration are presented. They represent species either potentially habituated to human settlements (e.g. captivity) or garden raiding pests. Avian species included; waterfowl, such as the domesticated Muscovy duck (*C. moschata*) and whistling duck (*Dendrocygna* sp.), alongside other waterfowl that may have also been habituated alongside domesticated animals. Parrots (*Amazona* spp., and *Ara macao*), for example, are known to have been valuable pets due to their brilliant plumage. A couple of domesticated dogs (*Canis familiaris*) and other wild carnivores (*Puma concolor* and *Leopardus paradlis*) were also sampled. Deer (primarily *Odocoileus virginianus*) were the most abundant species sampled, both because of their prolific distribution in the zooarchaeological record, providing a robust dataset spanning the entire span of human occupation, but also because they are known to maintain symbiotic relationship with human settlements as secondary browsers that raid milpa plots. Table 2 lists the full species diversity represented in this study. Samples from the same site and layer selected consistent element and side, while we attempted to obtain representation across stratigraphic layers from the same site.

The raw data is presented in Supplementary Table, Appendix A are sorted by internal lab NS#. Each unique NS number represents an animal. If multiple elements of the same individual were sampled, they were distinguished by putting a letter after the NS number; B-bone, D-dentine, or e-enamel (e.g. NS 96B, 96d, and 96e). If no letter accompanies a NS number, only bone was analyzed. The table also lists the site, context, bone number, and site number, alongside details of the type of bone/tooth, common and scientific name of the animal, as well as the general animal category used to create the box plots interpreted in the article (Sugiyama et al., in press: Fig. 2–5). Collagen data include not only the raw $\delta^{15}N_{collagen}$ (‰, AIR) and $\delta^{13}C_{collagen}$ (VPDB) values, but also the%N weight,%C weight, the C:N ratio, and% collagen yield used for diagenesis testing. Similarly, the carbonate raw data reports the $\delta^{13}C_{carbonate}$ (VPDB) and $\delta^{18}O_{carbonate}$ (V-SMOW) values alongside the C/P and IR-SF values calculated based on the FTIR data. All data highlighted in yellow were omitted from the descriptive statistics because they

did not pass the diagenesis test. Tables 3a (bone) and 3b (enamel) provide a summary of the descriptive statistics of the samples from Panama (this dataset), alongside comparative datasets from other published works from Panama on humans [4], Maya region [5–7] and Teotihuacan [6]. Table 4 details the bone and tooth isotopic values of deer for each site across the Hamlet Agriculture (HA) (6000–500 BCE) to Village Agriculture (VA) (500 BCE-1520 CE) periods.

2. Experimental design, materials, and methods

In total 114 collagen and 146 carbonate samples representing 101 minimum number of individuals (MNI) were processed at the Smithsonian Museum Conservation Institute Stable Isotope Mass Spectrometry Laboratory by N. Sugiyama and C. France. Table 5 summarizes the relationship between the total specimens sampled from each site by animal category, as well as the total samples that passed diagenesis test. Bone, dentine, and enamel from the same individual was selected to account for differential preservation (for example enamel tends to preserve better over bone), but also because their varied remodeling rates reflect the chemical composition during different stages of the life-history of the organism. Enamel is formed during a brief span of mineralization whereas bone regularly remodels throughout the animal's lifespan [8]. Bone and teeth were either already isolated (broken or lose teeth/bone) or a small sample was cut with a diamond-tip Dremel.

Bone and teeth dentine followed collagen extraction protocols per Login [9] with slight modifications by France et al. [2]. As no glue or consolidants were observed on the samples, samples were cut into 200–800 mg solid fragments. Each fragment underwent surface cleaning through five sonicated washes in ultrapure water (18.2 MΩ-cm) and dried in the convection oven at ~60 °C. The samples were then demineralized in 0.6 M hydrochloric acid soaks at 4 °C, with the solution changed daily until reactions ceased. Neutralization through five ultrapure water soaks was followed by humic acid removal in 0.125 M sodium hydroxide over the course of 24 h at room temperature. After five ultrapure water soaks, the organic material was solubilized by soaking samples in 0.03 M HCl at 95 °C overnight. The solubilized liquid was transferred into a new centrifuge tube and stored overnight in a freezer. Each centrifuge tube wass covered with polyfilm with small air vents and freeze dried over night, lyophilizing the samples into pure collagen. The collagen was then weighed (~0.4 – 0.6 mg) into tin cups and combusted in a Costech 4010 Elemental Analyzer coupled to a Thermo Delta V Advantage mass spectrometer. An internal acetanilide and urea_UIN3 reference materials, both of which are calibrated to USGS40 and USGS41 [10], were used as internal lab standards. Measurement precision of ±0.2‰ (1σ) has been maintained for both carbon and nitrogen values on replicates of the reference material and selected samples. Collagen yield was determined by dividing the final collagen weight from the total sample weight.

Bone, teeth dentine, and teeth enamel samples followed extraction protocols per Bryant et al. [3]. After the ultrapure water sonic washes, a small piece was removed and powered with an agate mortar and pestle into a fine powder. Between 20–30 mg of powder for each sample was weighed into centrifuge tubes. Organic components were removed through soaking in 2–3% sodium hypochlorite (NaClO) solution to react overnight at room temperature. After neutralizing the samples, they were soaked for four hours in 1 M acetic acid buffered with 1 M calcium acetate (pH~4.5) solution that removed secondary carbonate phases [11]. Finally, the neutralized samples were dried in the convection oven, and weighed into Exetainer vials. Vials were pureged with pure helium and sample powders was left to react with concentrated (SG >1.92) phosphoric acid (H_3PO_4) overnight at 25 °C, and analyzed on a Thermo Gas Bench II connected to a Thermo Delta V Advantage mass spectrometer. The $\delta^{13}C_{carbonate}$ and $\delta^{18}O_{carbonate}$ values were calibrated against NBS-19 and LSVEC carbonate reference materials and have an error of ±0.2‰ (1σ) based on replicates of reference materials and selected samples.

Diagenesis test for collagen and carbonate samples were run in accordance to standards established in the literature. Collagen samples were deemed preserved when C:N ratios ranged between 2.8–3.6, the% collagen yield exceeded 1%, and the%N yield was between 11 and 16%

[12,13]. Carbonate processed powders were analysed using a Thermo Nicolet 6700 Fourier-Transform Infrared Spectrometer with the attenuated total reflectance attachment (FTIR-ATR) at the Smithsonian Institute Museum Conservatio Institute. IR-SF (minieral crystallinity index) above 4.0 and C/P ratios (indicating the mineral carbonate phosphate) less than 0.1 were omitted from the analysis [14]. Only 28% of the collagen samples passed the diagenesis test while 95% of the carbonate samples were retained (Table 2).

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships which have, or could be perceived to have, influenced the work reported in this article.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.dib.2020.105974.

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