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## Bahamian hutia (*Geocapromys ingrahami*) in the Lucayan Realm: Pre-Columbian Exploitation and Translocation

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### ABSTRACT

Bahamian hutia (*Geocapromys ingrahami*) are endemic to The Bahamas. The skeletal remains of this species have been recovered from multiple Lucayan-associated archaeological sites in the region, suggesting that it was an important source of human food. This study explores the role of pre-Columbian indigenous peoples in the geographic distribution of Bahamian hutias, and the possibility of intentional management of the animal. We provide an overview of archaeological occurrences of Bahamian hutia and present new skeletal morphometric data comparing modern museum-curated Bahamian hutia specimens with archaeological specimens from the Palmetto Junction site on Providenciales located in the Turks and Caicos Islands. Bahamian hutia do not exist in the fossil record in the Turks and Caicos, indicating their translocation to the islands by humans. Our data show that individual hutia at Palmetto Junction were larger than modern specimens. This size variation may be due to anthropogenic influence; however, there is limited information regarding either natural size variation within the species or environmental factors possibly influencing size. Continued research on anthropogenic influences related to Bahamian hutia populations, coupled with isotopic studies of the Bahamian hutia diet, may further elucidate the practice of pre-Columbian management of the species.

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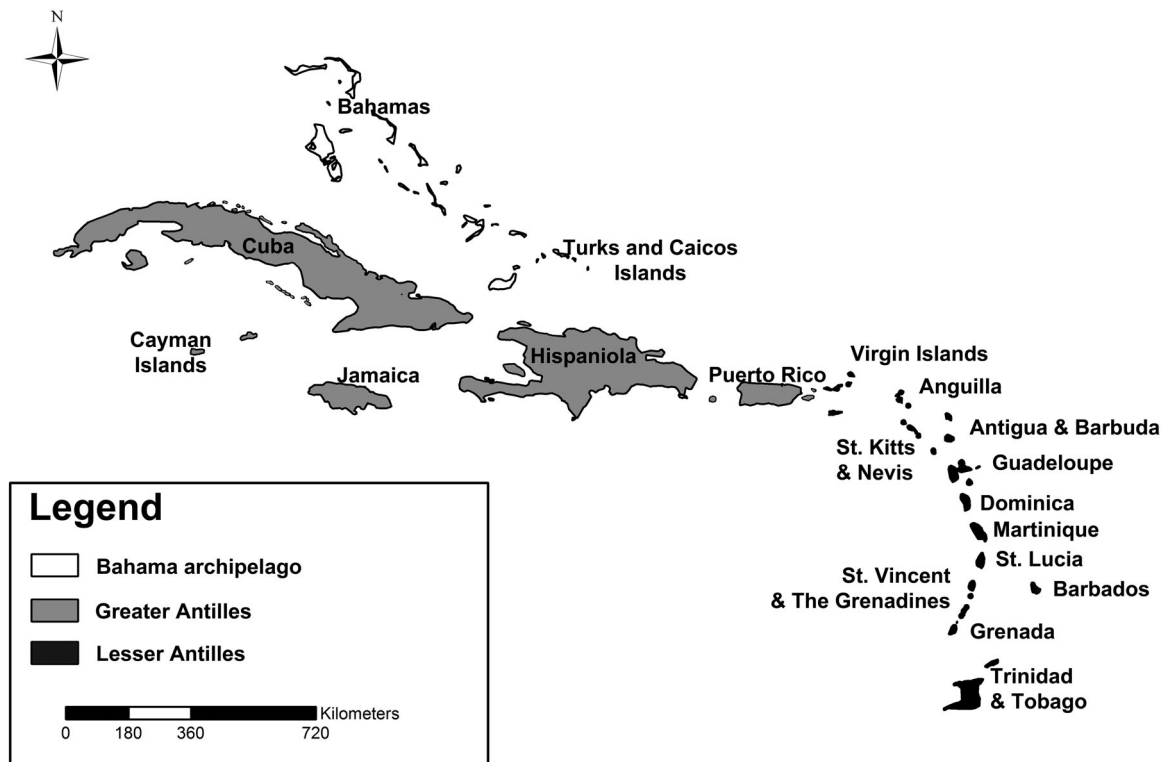
## Introduction

Hutias (Family: Capromyidae) are a group of rodents native to the Greater Antillean and Bahamian islands of the Caribbean (Figure 1). Zooarchaeological records indicate that throughout pre-Columbian history, indigenous peoples living on Cuba, Hispaniola, Jamaica, Puerto Rico, The Bahamas, Turks and Caicos Islands, the U.S. Virgin Islands and elsewhere in the region exploited hutias (Colten and Worthington 2014; Colten, Newman, and Worthington 2009; Deagan 2004; deFrance 1991; deFrance et al. 2010; deFrance and Newsom 2005; DuChemin 2013; Garner 2001; LeFebvre 2015; Newsom and Wing 2004; Quitmyer 2003; Wilkins 2001; Wing 2012). A lack of natural predators and unfamiliarity toward humans made hutias highly susceptible to pre-Columbian human predation and possibly management (Colten, Newman, and Worthington 2009; deFrance and Newsom 2005; Garner 2001; LeFebvre and deFrance 2018; Olsen and Pregill 1982; Wilkins 2001; Wing 1993, 2001, 2008, 2012).

The Bahamian hutia (*Geocapromys ingrahami*) is the only hutia species native and endemic to The Bahamas. Prior to the arrival of indigenous Lucayan groups to these islands around AD 700/800, Bahamian hutia

were not under heavy threat of predation. Here we investigate two aspects of indigenous exploitation of Bahamian hutia among the Lucayan: (1) the role of indigenous peoples in expanding the animal's geographic distribution, and (2) the archaeological evidence supporting intentional management. Our work adds to understandings of Bahamian hutia natural history as well as Lucayan culture history and contributes to broader studies of the archaeological documentation of animal management in the past.

Following a summary of Bahamian hutia distribution, biology and behaviour, we review archaeological records of hutia from The Bahamas and Turks and Caicos Islands. Next, we present zooarchaeological analyses of hutia remains from Crooked Island (The Bahamas) and Providenciales (Turks and Caicos Islands). We provide morphometric comparisons between modern and archaeological Bahamian hutia elements from one assemblage on Providenciales as a basis for discussing possible differences in Bahamian hutia size. Our research shows that across the Bahama archipelago Lucayan groups readily exploited hutias and translocated populations beyond their natural ranges in The Bahamas to the southern extent of the island chain in the Turks and Caicos Islands. The



**Figure 1.** Map of the Caribbean islands including the Bahama archipelago, the Greater Antilles, and the Lesser Antilles. Source: ESRI. Prepared by Debra Wells.

results provide an initial body of archaeological evidence suggestive of human management over Bahamian hutia. We also highlight some of the difficulties in demonstrating intentional human influence or management of hutias using archaeological evidence.

### Bahamian Hutia Distribution, Biology and Behaviour

The island chain commonly referred to as the Bahama archipelago is composed of geologically related islands divided into two politically separate entities, The Bahamas and the Turks and Caicos Islands. The Bahamas are composed of hundreds of low-lying limestone islands and cays extending over 1000 km from Grand Bahama 100 km east of West Palm Beach, Florida to Great Inagua 110 km north of Haiti. South of The Bahamas, the Turks and Caicos Islands are approximately 200 km north of the Dominican Republic and include eight inhabited islands surrounded by hundreds of smaller uninhabited islands and cays (Quinn and Woodward 2015). For clarity sake, in this paper, we use Bahama archipelago to denote the entire island chain, and we use The Bahamas and the Turks and Caicos Islands as points of geographic differentiation between the islands included in each political region.

The Bahamian hutia is one of six recognised *Geocapromys* species among the Caribbean islands, including three described species (*G. ingrahami*, *G. brownii* and *G. thoracatus*), one extinct species from fossil deposits on Cuba (*G. columbianus*) and two extinct

species from the Cayman Islands (*Geocapromys* sp. 1, *Geocapromys* sp. 2) (Borroto-Páez et al. 2012; Morgan 1989). It is the only non-volant mammal native to The Bahamas (Allen 1891; Goodall 2012; Jordan 2012). Archaeological, palaeontological and historical evidence recovered from Pleistocene and Holocene contexts indicates that Bahamian hutia were once widespread across The Bahamas region (Burden 1986; Campbell 1978; Jordan 2012; Steadman et al. 2007; 2017); including hutia fossil, subfossil and bone specimens reported from Great Abaco, Eleuthera, Great Exuma, Little Exuma, Long Island, San Salvador and Crooked Island. As reviewed by Turvey et al. (2017; see also Borroto-Páez et al. 2012), two extinct subspecies of Bahamian hutia are recognised from Quaternary fossil records on Great Abaco (*G. i. abaconis*) as well as Crooked Island, Eleuthera, Great Exuma, Little Exuma and Long Island (*G. i. irrectus*). In contrast to a pattern of wide distribution in the past, today, the Bahamian hutia is listed as a vulnerable species on the International Union for Conservation of Nature Red List (Turvey et al. 2017; Turvey and Dávalos 2008), with only one remaining ostensibly naturally occurring population present on East Plana Cay. Bahamian hutia groups have since been introduced from East Plana Cay to Little Wax Cay in 1973 (Clough 1972; Clough and Fulk 1971; Jordan 1989, 2012) and on Warderick Wells in 1981 (Jordan 1989; Turvey et al. 2017; Woods 1989) (Figure 2). Although remains of Bahamian hutia are found in archaeological contexts on the Turks and Caicos

Islands directly south of The Bahamas (see Figure 2), thus far, there is no palaeontological evidence for the natural occurrence of the Bahamian hutia in this island group (Turvey et al. 2017). Therefore, (ancient/pre-Columbian) human transport from The Bahamas was probably responsible for their introduction and subsequent archaeological presence in this region.

The East Plana Cay hutias were first documented and described by Allen (1891) based on specimens observed and collected by E. Ingraham (Campbell, Lowell, and Lightbourn 1991; Clough 1972; see also Allen 1891). Today, the vast majority of what is known about Bahamian hutia biology and ecology is based on studies of the modern wild populations on East Plana Cay by Clough (1972, 1974) and Little Wax Cay by Jordan (1989, 2012). East Plana Cay located in the southern portion of The Bahamas, is a small island totalling 465 hectares (Clough 1972; Jordan 2012). As described by Clough (1972), the cay is a coral atoll covered in semiarid vegetation without a fresh water source, except for puddled rainfall. The landscape can be characterised as consisting of rocky surfaces with caves and crevices conducive for hutia habitation (Clough 1972). Little Wax Cay is located southeast of Nassau and is approximately 19 hectares in area with semiarid vegetation (Jordan 1989). The landscape includes both rocky and sandy shorelines, as well as multiple ponds and mangrove areas (Jordan 2012).

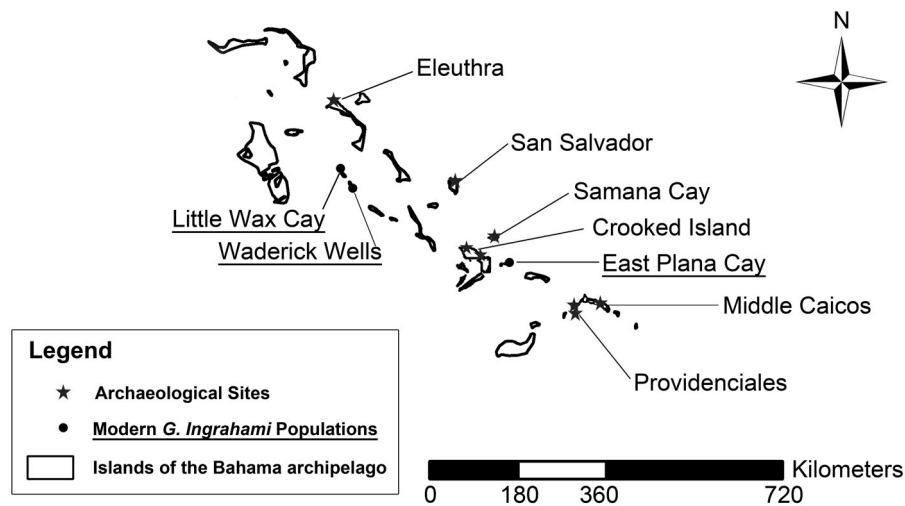
Many aspects of Bahamian hutia biology are documented. Bahamian hutia have an average life span of 9 years. They reach reproductive maturity by 1 year of age, producing between one and three litters of one or two individuals per annum (Jordan 2012). Roughly the size of a rabbit, adult hutia from East Plana Cay weigh an average of 700 g (Eisenberg and Woods 2012; Jordan 2012). However, Bahamian hutia exhibit size variation within the species. For example, individuals from introduced populations on Little Wax Cay were larger overall than those from East Plana Cay, with some individual weights recorded at 946 and 1000 g (Jordan 1989). However, what size variation indicates in regard to Bahamian hutia natural history is not clear. In her description of hutia remains from five islands (East Plana Cay, Great Abaco Island, Eleuthera, Long Island and Crooked Island), Lawrence (1934) details differences in cranial feature sizes (e.g. frontal length, premaxillary length and molar sizes). Lawrence argues that three subspecies of *G. ingrahami* are represented across the study region, including *G. ingrahami ingrahami*, *G. ingrahami irrectus* and *G. ingrahami abaconis*. Lawrence (1934) explains that the subspecies are the result of variability in early distribution patterns of the rodent resulting in localised differentiation within the species. Alternatively, Jordan (2012) suggests that size variation may likely be the result of differences in resource access and nutrition,

noting that the available foraging habitats of East Plana Cay are inferior to those on Little Wax Cay and support a far smaller hutia population overall in both size and number.

As nocturnal herbivores, Bahamian hutia favour leaves (i.e. folivores) as well as bark from a wide range of plant taxa (Borrito-Páez and Woods 2012, 85; Campbell, Lowell, and Lightbourn 1991; Clough and Fulk 1971; Jordan 1989). They are not good swimmers nor are they particularly quick on their feet, preferring to forage for food on the ground or in trees (Clough 1972; Jordan 2012). In terms of shelter, they prefer locations near freshwater, seeking out rock crevices or lying under silver palm (*Coccothrinax argentata*) leaf piles during the day (Borrito-Páez and Woods 2012; Clough 1972; Jordan 2012). However, Bahamian hutia are able to tolerate limited access to freshwater, absorbing sufficient amounts of water through food consumption (Borrito-Páez and Woods 2012; Eisenberg and Woods 2012; Howe and Clough 1971). Although hutia are vulnerable to human predation, anthropogenic habitat loss and introduced animals (e.g. cats and dogs), natural predation of Bahamian hutia is not common in the wild outside of occasional predation by ospreys (*Pandion heliatus*) and falcons (*Falco* sp.) (Jordan 2012). Known to consume rats and bats, native Bahamian boa constrictors (*Chilabothrus* sp.) may have been a source of predation among hutias in the past.

Regarding Bahamian hutia social behaviour, there is some debate as to whether or not Bahamian hutias are territorial in terms of population size and space. Based on observations of both wild and captive hutia, Clough (1972) concludes that hutia are not overly territorial and generally not aggressive with one another. Clough describes observing hutia interactions in the wild on East Plana Cay where the majority of interactions involved just two individuals. The interactions mostly consisted of one hutia pursuing another, some sniffing and then parting. He recounts only one instance of a short-lived aggressive encounter between two individuals. Clough (1972, 818) specifically notes a lack of bite marks on captured and examined hutia, concluding that they are not aggressive even when captured and penned for study.

Conversely, in a comparative review of Clough's (1972, 1973) observations and his own, Jordan (2012) presents evidence suggesting possible territoriality and aggressive behaviour between groups of hutias. First, Jordan argues that the hutia on Little Wax Cay organise themselves in colonies with distinct territorial boundaries, exhibiting home territory fidelity, and intercolonial aggression (Jordan 2012). Second, Jordan (2012, 138–139) describes a group of six hutias separated into two groups during their capture and journey from East Plana Cay to the University of Florida in Gainesville, Florida for further study. Upon the



**Figure 2.** Islands of the Bahama archipelago with archaeological records (stars) and modern populations (names underlined) of Bahamian hutia. Source: ESRI. Prepared by Debra Wells.

completion of the journey and acclimation to their new surroundings, the two hutia groups were reunited. The reunion resulted in one group composed of three individuals dying from wounds sustained from fighting with the other group of three hutias. Jordan argues that over the course of the transport the two groups formed distinct fidelities and fought to maintain these groups once reunited in a confined space. In addition to this instance of aggression between groups of hutia, Jordan (2012, 139) concludes that after widespread observations of wild hutia from East Plana Cay and Little Wax Cay with ear scars ‘exactly the width of a hutia’s paired incisors’ that aggression and territoriality are likely structured around resource provisioning (e.g. ground substrate and water sources).

Furthermore, Jordan (2012, 138) suggests that Bahamian hutia probably live in territorial-based colonies and engage in group antagonistic behaviour as a means to encourage ‘colonial boundaries.’ He further suggests that when removed from a home territory, as was the case with captured and transported

hutia individuals, hutias are not as inclined to fight over foreign space. Rather, new groups or colonies may form among displaced individuals. And, as was the case with the transported hutia, new antagonistic and territorial interactions may develop. Also, in a review of captive hutia studies, Eisenberg and Woods (2012) note that wounding is more likely to occur in captive settings when fighting individuals cannot retreat from the other as they would in the wild. From an archaeological perspective, while hutia may have experienced territorial behaviour aggression, empirical evidence of such interactions would not be evident in the archaeological record beyond bone trauma possibly attributed to intra-species violence.

### The Lucayan Realm and Bahamian Hutia Archaeological Records

Current evidence indicates that humans first arrived in the Bahama archipelago in the seventh or eighth

**Table 1.** Archaeological reports of *Geocapromys ingrahami* (Bahamian hutia).

Country/Territory	Island	Site	NISP	MNI	Reference
Bahamas	Crooked Island	Pittstown Landing (CR-14)	24	2	deFrance (1991); this paper
Bahamas	Crooked Island	Major’s Landing (CR-8)	111	6	deFrance (1991); this paper
Bahamas	Crooked Island	McKay’s Bluff Cave (CR-5)	128	–	Steadman et al. (2017)
Bahamas	Samana Cay	Samana Cay 2	2	1	Wing (1987)
Bahamas	Samana Cay	Samana Cay 7	6	1	Wing (1987)
Bahamas	San Salvador	Palmetto Grove	3	1	Wing (1969, 1987)
Bahamas	San Salvador	Long Bay	1	1	Berman (1994), Newsom and Wing (2004)
Bahamas	San Salvador	Pigeon Creek	2	1	Whyte, Berman, and Gnivecki (2005)
Bahamas	Eleuthera	Preacher’s Cave	22	7	Gualtieri (2014)
Bahamas	Eleuthera	Garden Cave	8	2	This paper
Turks and Caicos Islands	Middle Caicos	MC-6	1	1	Newsom and Wing (2004), Wing (1987), Wing and Scudder (1983)
Turks and Caicos Islands	Providenciales	Palmetto Junction	423	26	DuChemin (2005); this paper
Turks and Caicos Islands	Providenciales	Providenciales 1	10	2	Analysis by Sylvia Scudder; Data on file with Environmental Archaeology, Florida Museum of Natural History
		Total	741	51	

century AD from either Cuba or Hispaniola, or from both (Berman and Gnivecki 1995; Berman, Gnivecki, and Pateman 2013; Carlson 1999; Keegan and Hofman 2017; Sears and Sullivan 1978). The Spanish identified the natives as Lucayan, and this name is in common use today (Keegan and Carlson 2008, 1). The Lucayans were horticulturalists who cultivated maize, manioc and a variety of fruits in slash-and-burn gardens. They grew cotton, harvested wild plants (e.g. *Zamia* sp.) and captured a variety of marine (e.g. sea turtles, fishes, molluscs) and terrestrial (e.g. iguana, crocodile, tortoise, pond turtle, birds) animals (Keegan 1992; Newsom and Wing 2004). Hutia exploitation was part of a broad-spectrum subsistence economy. Infertile sandy soils contributed to the frequent movement of gardens so most Lucayan sites have shallow midden accumulations. Recent investigations point to a high degree of mobility that contributed to the creation of a variety of special purpose sites. Functional variability may explain why hutia are not found at all Lucayan sites. In comparison to marine fish remains, hutia specimens are less common in Bahamian archaeological sites (Newsom and Wing 2004, 187).

To date, published sources indicate there are at least 741 individual Bahamian hutia bone specimens (NISP) representing a minimum of 51 individuals reported from 13 archaeological sites on 6 islands across the Bahama archipelago (Table 1; Figure 2). The summary data of hutia occurrence reported in Table 1 are based on published literature, original analysis by the authors and unpublished reports. In terms of specimen abundance, the greatest quantity of analysed remains is from Major's Landing, Pittstown Landing and McKay's Bluff Cave located on Crooked Island in The Bahamas, and Palmetto Junction located on Providenciales in the Turks and Caicos Islands (deFrance 1991; DuChemin 2005; Steadman et al. 2017).

Since Bahamian hutia are not native to the Turks and Caicos Islands, their archaeological presence indicates that they were human-introduced during the pre-Columbian Era. The record of hutia (NISP= 423) from Palmetto Junction on Providenciales is particularly intriguing because it is thus far the largest reported concentration of Bahamian hutia remains in the greater Bahama Archipelago. Additionally, 10 hutia specimens representing a minimum of 2 individual animals have been recorded from the Providenciales 1 site located to the north of Palmetto Junction (Data on file, Florida Museum of Natural History; see also Sullivan 1981). One hutia specimen is reported from the MC-6 site on Middle Caicos (Newsom and Wing 2004, 260). In contrast, the Coralie site, located on Grand Turk, has a rich faunal assemblage but no hutia remains (Carlson 1999). And hutia are not reported from faunal assemblages at other sites in the Turks and Caicos Islands, including Pine Cay, MC-12, MC-16 and MC-32 on Middle Caicos (Newsom

and Wing 2004; Wing and Scudder 1983; MC-16 and Pine Cay data on file Caribbean Archaeology, Florida Museum of Natural History).

Contextually, the vast majority of Bahamian hutia remains have been recovered from middens and not in direct association with archaeological features (e.g. pits, hearths, ritual deposits). One exception to this pattern is hutia remains recently recovered by Keegan from Garden cave on Eleuthera in The Bahamas. Eight post-cranial hutia elements representing a minimum of two individual hutias were discovered in association with Lucayan burials within the cave. Another possible exception to the discard of hutia remains in middens is an ulna fragment identified as 'probably *Geocapromys ingrahami*' recovered from a cave containing pre-Columbian burials on New Providence (Winter 1991, 154). However, the archaeological context of this single specimen is questionable because Winter (1991) notes that its presence in the cave may be incidental rather than purposefully associated with the human remains; the same may be true for Garden Cave. At the Pigeon Creek site on San Salvador in the Bahamas, Whyte, Berman, and Gnivecki (2005) report a mandibular incisor with evidence of polish, suggesting it may have been used as a tool.

Chronologically, while most archaeological hutia remains are associated with pre-Columbian occupations, several reports demonstrate the presence of Bahamian hutia populations and their exploitation into the Historic Era (post 1492). Steadman et al. (2017, Table 1) report the results of direct AMS <sup>14</sup>C dating of hutia remains from various cave sites on Crooked Island in The Bahamas. An individual from the Crossbed Cave site yielded a calibrated AMS <sup>14</sup>C range of AD 1465–1645, suggesting the continuity of Bahamian hutia on the island into the seventeenth century. On Eleuthera, calibrated radiocarbon dating of the Lucayan burial remains associated hutia bones in Garden Cave produced a date range from AD 1430 to 1520 and 1590 to 1620. Hutia remains from Preacher's Cave, also on Eleuthera, are all from seventeenth century historic contexts associated with British Puritan settlers who emigrated from Bermuda (Gualtieri 2014).

It is important to note that the accounts of archaeological Bahamian hutia are artefacts of sample size, states of preservation, sampling biases, recovery methods and/or under reporting of hutia remains throughout the region.<sup>1</sup> In comparison to the overall areal extent of the Bahama archipelago, the available data are limited in terms of the number of islands represented (see Figure 2). However, with the exception of the northern reaches of the archipelago (e.g. Grand Bahama and Abaco Island), the data provide a regionally representative sample of hutia exploitation within the Lucayan realm including archaeological sites from the central and southern extents of the region.

## Materials and Methods

The majority of archaeological Bahamian hutia remains have been recovered from sites on two islands, Crooked Island and Providenciales (see Table 1). We report zooarchaeological analyses of hutia remains from Major's Landing, Pittstown Landing and Palmetto Junction. All archaeological specimens discussed are curated in either the Environmental Archaeology Laboratory or the Caribbean Archaeology Collection at the Florida Museum of Natural History (FLMNH), University of Florida, Gainesville. Zooarchaeological analysis was conducted at the FLMNH using modern Bahamian hutia skeletons from the FLMNH Mammalogy and Environmental Archaeology comparative collections. Analysis included the recording of specimen element, side, age markers (e.g. epiphyseal fusion), condition (e.g. trauma, pathology) and bone measurements. The number of individual specimens (NISP) was tabulated and specimen weight (g) recorded (Supplemental Data Tables 1–3).

### Crooked Island: Major's Landing and Pittstown Landing

Located in the central moist tropical zone of The Bahamas, Crooked Island is approximately 450 miles

**Table 2.** Palmetto Junction Units A and C Bahamian hutia element representation, NISP, and MNI.

	Unit A	Unit C	Total	
<b>Crania</b>				
Cranial	0	0	0	
Bulla	5	0	5	
Maxilla	26	3	29	
Mandible	27	7	34	
Molars	56	8	64	
Incisors	21	2	23	
	135	20	155	
<b>Axial</b>				
Atlas	0	0	0	
Axis	1	0	1	
Cervical vertebra	0	0	0	
Thoracic vertebra	5	0	5	
Lumbar vertebra	15	0	15	
Centrum	5	0	5	
Sacrum	1	0	1	
	27	0	27	
<b>Forelimb</b>				
Scapula	12	1	13	
Humerus	34	10	44	MNI – 19 rt humerus
Radius	19	8	27	
Ulna	27	10	37	
	92	29	121	
<b>Hindlimb</b>				
Innominate	26	3	29	
Femur	26	11	37	MNI 7 lf femur
Tibia	20	9	29	
	72	23	95	
<b>Hindfoot</b>				
Astragalus	4	1	5	
Calcaneus	13	3	16	
	17	4	21	
<b>Foot</b>				
Metapodial	3	0	3	
<b>Total</b>	<b>346</b>	<b>76</b>	<b>422</b>	

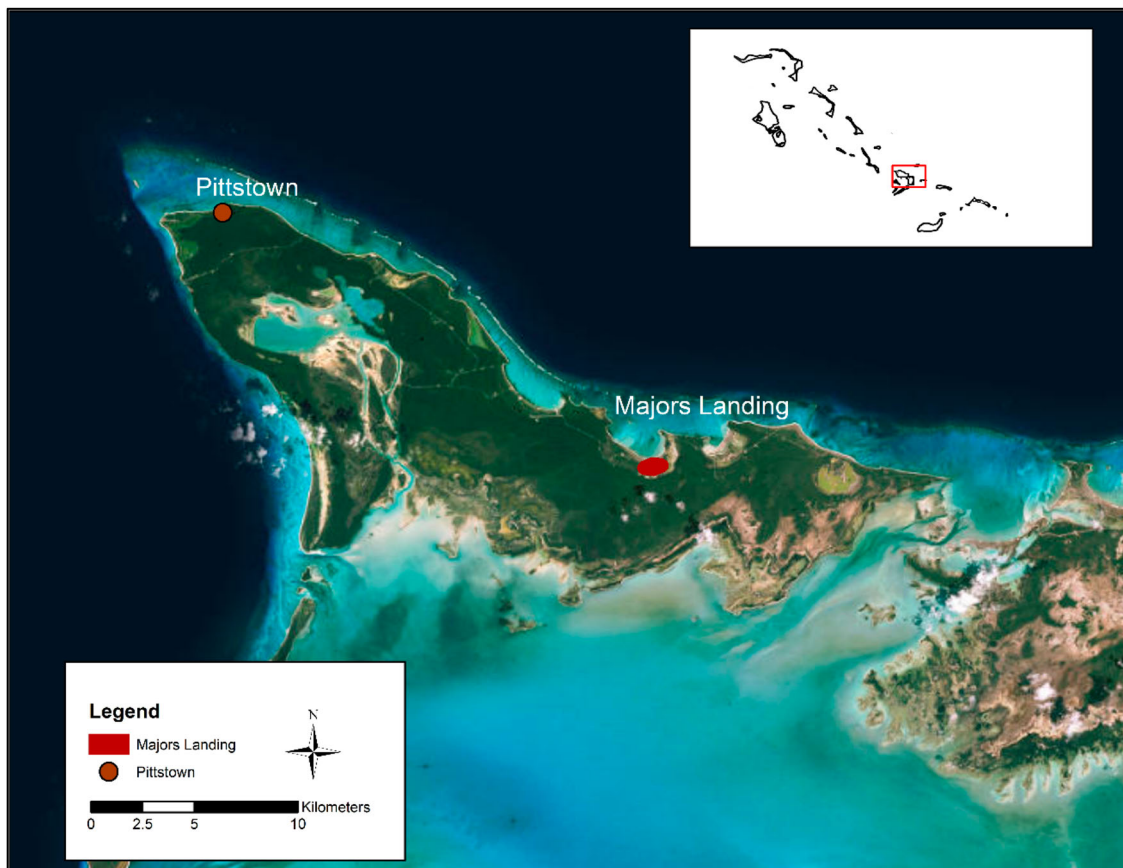
Note: rt: right; lf: left (Specimens unidentifiable to the element are not included.)

southeast of Miami, Florida. Like the other islands of the region, Crooked Island is today nearly devoid of terrestrial fauna, especially native mammals. Under the direction of Keegan, Crooked Island was surveyed for archaeological sites in 1983 and excavations at three sites were conducted in 1987. Upon completion of the fieldwork, deFrance (1991) conducted a zooarchaeological analysis on select vertebrate samples from two excavated sites, Major's Landing and Pittstown Landing (Figure 3). The samples selected were from single deposition midden contexts (Keegan 1988). The midden sampled at Major's Landing was denser in faunal remains than the midden at Pittstown Landing. At each site, the faunal samples were recovered from 1 m<sup>2</sup> test pits excavated in 5 cm arbitrary levels (Keegan 1988).

In addition to deFrance's (1991) analysis, LeFebvre recently analysed specimens from additional levels recovered from the same test pits from Major's Landing and Pittstown Landing. Combining data from all contexts at Major's Landing, there are 111 individual bone and tooth specimens with a minimum of six individual hutias represented (see Table 1). From Pittstown Landing, there are 24 individual bone and tooth specimens recorded, representing a minimum of two individual hutias (see Table 1). Cranial and post-cranial elements, as well as teeth, are recorded from each site. Direct AMS <sup>14</sup>C dating of one Bahamian hutia specimen from Major's Landing dates the remains to cal AD 1330 to 1340 (cal BP 620 to 610) and cal AD 1395 to 1440 (cal BP 555 to 510). Steadman et al. (2017, Table 1) report a <sup>14</sup>C date of an archaeological crocodile femur from Pittstown Landing as cal AD 1050 to 1250.

### Providenciales: Palmetto Junction

Palmetto Junction was discovered in 2004 during the construction of a road on the western portion of the island (Figure 4). Palmetto Junction is characterised by large shell middens, containing predominantly queen conch (*Lobatus gigas*) as well as Palmetto Ware pottery, for which the site is named. That same year, archaeologists from the University of Florida performed a survey of the site on behalf of the Turks and Caicos Department of Coastal Resources. The team identified a midden containing a deposit of dense vertebrate remains that had been exposed by the construction activities. The crew excavated two 1 m<sup>2</sup> test pits (Units A and C) in the midden. A third test pit (Unit B) was excavated in the road in order to determine the impact of its construction on the midden; however, it contained little fauna. Excavated material was screened through 1/4-inch-mesh (6.4 mm), and two 50 × 50 × 10 cm soil samples from Unit C were further screened through 1/16-inch (1.6 mm) mesh (DuChemin 2005).



**Figure 3.** Location of Major's Landing and Pittstown Landing on Crooked Island, Bahamas. Source: ESRI, DigitalGlobe, GeoEye, Earthstar Geographics, DNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community. Prepared by Debra Wells.

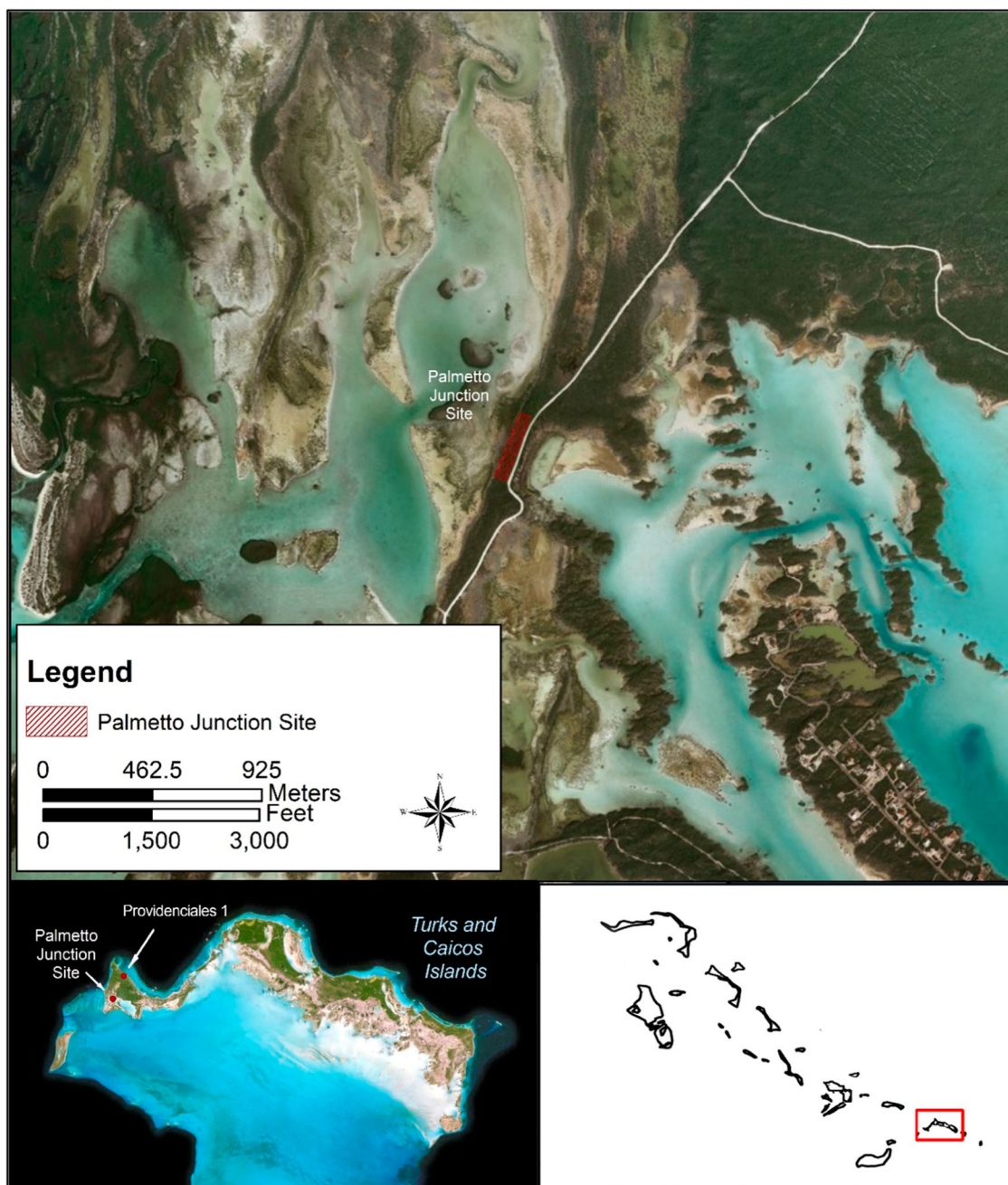
The initial zooarchaeological analysis, performed by DuChemin (2005), was augmented with further analysis by LeFebvre and Walczesky. The results of the analyses indicate that a total of 423 hutia specimens were recovered, representing a minimum of 26 individual animals (Tables 1 and 2). Direct AMS  $^{14}\text{C}$  dating of one specimen from Palmetto Junction dates the remains to cal AD 1425 to 1450.

During the identification of the Palmetto Junction specimens, analysts observed that the archaeological hutia skeletal elements appeared to be larger-sized than the modern comparative specimens. In order to determine if the archaeological hutia remains were larger, we measured and compared the sizes of a sample of the hutia remains from Palmetto Junction with modern hutia comparative specimens<sup>2</sup>. Based on element preservation, abundance (i.e. sample size) and portion present, we selected long bones along with mandibular and maxillary elements from Units A and C for analysis. All measurements were taken following guidelines for rodent measurements in von den Driesch (1976). Eleven modern Bahamian hutia skeletons were selected for comparative measurements based on taxonomic identification and skeletal completeness (Supplemental Data Table 4). The modern specimens were collected from The Bahamas during the 1980s and are curated in the Division of Mammals at the FLMNH. All

measured modern elements were from fused adult specimens with the exception of mandibular and maxillary tooth row measurements.

In order to describe the size variability between the archaeological and modern specimens, we produced log-ratio diagrams following Simpson (1941). We calculated the common log of various measurements and used the median value as the standard (0). Although the original application of this technique relied on a single measurement to establish the standard (Simpson 1941), the use of the median value of several specimens to establish a standard can help account for size variability among various bone specimens. In another study of the animal size, the use of the mean value of bone measurements as a standard was successfully applied to fossil canid remains to demonstrate size variability (see Tedford, Wang, and Taylor 2009). In this study, the median values rather than mean was used to account for the greater range in size values in the modern samples. The modern skeletal measurements used to derive the median values used for the standard are presented in Supplemental Data Table 4. Comparative measurements were made by taking the natural log of the archaeological hutia measurements and subtracting them from the log value for the standard and then plotting them as either larger or smaller than the standard.



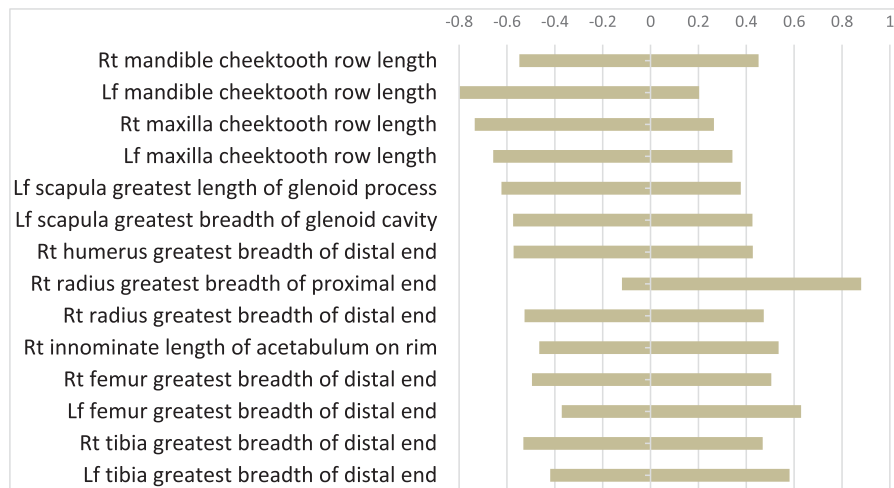


**Figure 4.** The location of the Palmetto Junction site on Providenciales, Turks and Caicos Islands (shaded in the top image). Source: ESRI, DigitalGlobe, GeoEye, Earthstar Geographics, DNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community. Prepared by Debra Wells.

**Table 3.** Florida Museum of Natural History hutia specimens log minimum and maximum of skeletal measurements.

Element	Min	Max
Rt mandible cheektooth row length	-0.167	0.138
Lf mandible cheektooth row length	-0.211	0.054
Rt maxilla cheektooth row length	-0.204	0.074
Lf maxilla cheektooth row length	-0.217	0.113
Lf scapula greatest length of glenoid process	-0.121	0.073
Lf scapula greatest breadth of glenoid cavity	-0.191	0.142
Rt humerus greatest breadth of distal end	-0.144	0.107
Rt radius greatest breadth of proximal end	-0.020	0.148
Rt radius greatest breadth of distal end	-0.113	0.101
Rt innominate length of acetabulum on rim	-0.138	0.158
Rt femur greatest breadth of distal end	-0.086	0.088
Lf femur greatest breadth of distal end	-0.068	0.115
Rt tibia greatest breadth of distal end	-0.134	0.118
Lf tibia greatest breadth of distal end	-0.092	0.128

A log-ratio diagram of the archaeological specimens compares measurements of various archaeological hutia measurements to the median value of several modern hutia specimens. As is shown in Table 3 and Figure 5, the sample of modern hutia measurements from museum specimens exhibits substantial size variability. Because we did not control for population variables including sexual dimorphism or other factors, we do not know what factors are responsible for the size range of the modern individuals. The log-ratio diagram comparing a sample of the archaeologically recovered hutias from Palmetto Junction to the median value of the modern specimens shows that six of the archaeological elements from various parts of the



**Figure 5.** Modern museum Bahamian hutia specimen minimum and maximum size log plot for 14 measurements from 8 elements ( $n = 11$  except for tibia and Rt radius greatest breadth of the distal end ( $n = 10$ )).

skeleton (mandible, humerus, radius, innominate, femur and tibia) are consistently larger in size than the modern standard (Table 4 and Figure 6). The measurement data support our initial empirical observation that the archaeological hutia are larger than modern hutia comparative specimens.

### Specimen Condition and Fusion/Age

None of the specimens from the three sites exhibited obvious evidence of pathology or trauma sustained during life. While the impact of preservation biases on bone and tooth condition cannot be ruled out, the data thus far do not indicate evidence of readily identifiable physical hardship, compromised health, or physiological changes among human-associated Bahamian hutia populations at Major's Landing, Pittstown Landing and Palmetto Junction.

DuChemin (2005) suggests that epiphyseal fusion of hutia elements at Palmetto Junction may indicate selection of some individuals based on age. Based on our analysis of DuChemin's data and the expanded sample, approximately 18% of the Palmetto Junction study specimens include unfused epiphyses. However, the identification of possible age-related exploitation or culling based on epiphyseal fusion is complicated because specific fusion rates of Bahamian hutia skeletal elements are unknown. Among biologists working with other caviomorph rodents, epiphyseal fusion is accepted as an indication of maturation. For example, a recent study on the skeletal morphology and locomotion of Ctenohystrican rodents, including capybaras (*Hydrochoerus hydrochaeris*), define adult individuals as those with fused proximal and distal femora (Wilson and Geiger 2015, 515). On the other hand, as is the case with other mammals (e.g. opossums (Geiger et al. 2014), Jamaican hutia (*Geocapromys brownii*) limbs have been shown to remain unfused well into sexual maturity (Wilkins 2001, 531).

Modern studies are equivocal in regard to the age of maturity for hutia. While Jordan (2012) reports that Bahamian hutia reach sexual maturity by 1 year of age, Clough (1974) observed that young hutia stay close to their mothers for as long as 2 years, at which time skeletal epiphyses fuse, sexual maturity is reached and reproduction begins (Clough 1974). At Palmetto Junction, it appears that adult, and to a lesser extent full-sized subadult hutia, were targeted for exploitation. However, the results of our morphometric study indicate that archaeological hutia at Palmetto Junction were larger than those of recent populations, but we are unable to determine specific ages of individuals. More precise estimates of hutia age using skeletal fusion will only be possible with a systematic study of the timing of skeletal fusion in hutia populations.

### Discussion

Consideration of the role of humans in modifying the natural distribution of animals in the Bahama archipelago must take into account the natural diversity of the various islands and how they changed through time. The richness of flora and fauna occurring in the West Indies has made its islands ideal settings for the study of biogeography, particularly historical biogeographical studies that pertain to phylogeny, genetic drift and speciation (Hedges 2001). The first plant and animal populations in the West Indies arrived via land bridges or upon the oceanic currents between islands or from the South American mainland (Hedges 2001; Iturralde-Vincent and MacPhee 1999). Successful, newly established populations would have experienced a genetic bottleneck, or founder effect as genetic drift was greatly reduced, or, in many cases, halted (Hedges 2001; Whittaker and Fernández-Palacios 2007). These populations often experienced island-specific adaptations, such as changes in body size or the slowing of metabolism (McNab 2001).

**Table 4.** Measurements of modern museum *Geocapromys ingrahami* (Bahamian hutia) for log-ratio calculations.

Element	Museum specimens				Archaeological Specimens			
	<i>n</i>	Median <sup>a</sup>	Min	Max	<i>n</i>	Median	Min	Max
Rt mandible cheektooth row length	11	15.6	13.2	17.9	21	16.3	14.5	18.2
Lf mandible cheektooth row length	11	16.3	13.2	17.2				
Rt maxilla cheektooth row length	11	15.7	12.8	16.9	8	16.9	12.9	17.8
Lf maxilla cheektooth row length	11	15.9	12.8	17.8				
Lf scapula greatest length of glenoid process	11	7.9	7	8.5	10	8.55	5.4	9.6
Lf scapula greatest breadth of glenoid cavity	11	4.6	3.8	5.3	10	4.6	4.1	5.4
Rt humerus greatest breadth of distal end	11	9.7	8.4	10.8	16	10.7	9.4	11.9
Rt radius greatest breadth of proximal end	11	5	4.9	5.8	21	5.6	3.9	6.2
Rt radius greatest breadth of distal end	10	5.15	4.6	5.7	8	5.25	4.9	9.4
Rt innominate length of acetabulum on rim	11	7	6.1	8.2	15	8.1	6.6	10.6
Rt femur greatest breadth of distal end	11	10.9	10	11.9	2	11.95	11.4	11.8
Lf femur greatest breadth of distal end	11	10.7	10	12				
Rt tibia greatest breadth of distal end	10	6.4	5.6	7.2	14	7.85	6.9	12.4
Lf tibia greatest breadth of distal end	10	6.25	5.7	7.1				

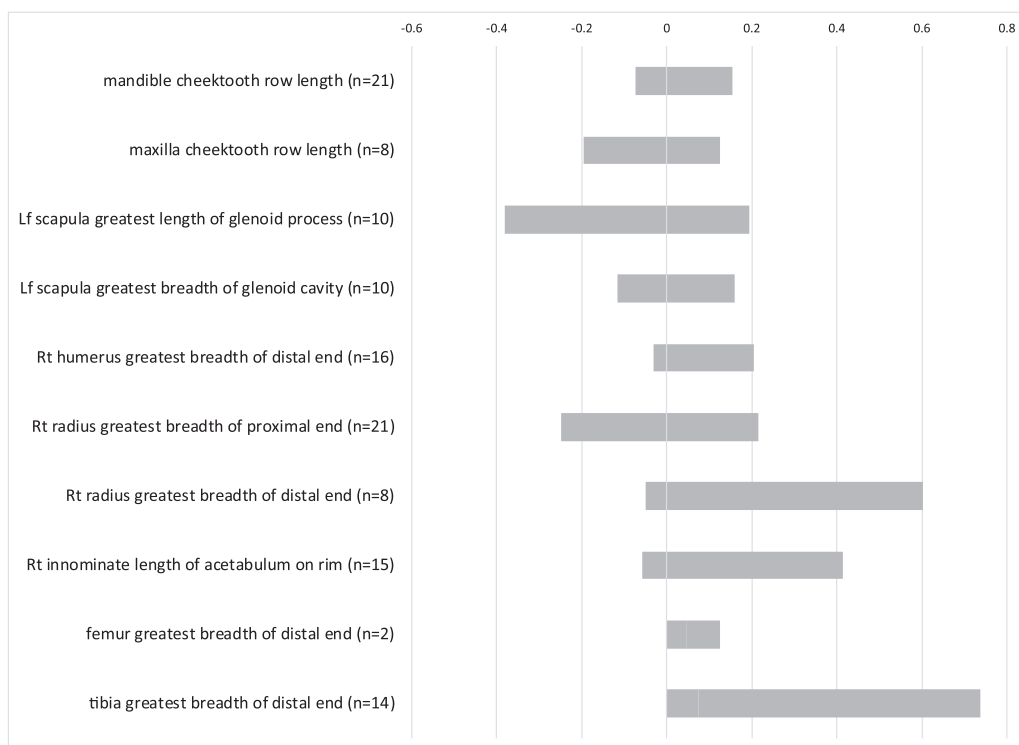
<sup>a</sup>Median used as O. Archaeological specimens are plotted against the museum median log value.

Moreover, on small islands, such as those associated with The Bahamas and Turks and Caicos, circumscribed animal populations are particularly susceptible to stress when changes in environmental or ecological factors occur, which over time can result in selective adaptation (MacArthur and Wilson 1967; Whittaker and Fernández-Palacios 2007).

The isolation of hutia populations on different islands may account for the observed size and morphological variation in animals between islands. As discussed above, Lawrence (1934) interpreted the Bahamian hutia species size and morphological variation between different island populations as evidence for different subspecies, possibly the results of founder's effects from the isolation of naturally variable traits that existed within the initial colonising

populations, or as the result of environmental differences in resource availability across islands. The recovery and analysis of additional hutia assemblages, from sites across Providenciales, such as Providenciales 1, and surrounding islands could potentially elucidate the impact of isolation on introduced hutia populations

Nonetheless, current zooarchaeological records show that pre-Columbian Bahamian hutia populations were exploited by the Lucayans throughout The Bahamas and introduced to the Turks and Caicos Islands. Prior to the arrival of Lucayan hunter/forager/fisher groups to the archipelago during the seventh/eighth centuries, Bahamian hutia were widespread in The Bahamas and not subjected to heavy predation (Burden 1986; Campbell 1978; Jordan 2012). Bahamian hutia are opportunistic folivores with a generally broad



**Figure 6.** Palmetto Junction archaeological hutia specimen minimum and maximum size log plot against the modern museum specimen median log value (0).

palate and tolerance to drought. These characteristics coupled with their generally docile and human-naïve nature may have made their exploitation, translocation and possible management attractive to Lucayans – especially since hutia provided one of the few terrestrial sources of dietary protein available in the region. Comparatively, ethnohistorical records from Hispaniola describe hutia hunting among indigenous groups as ‘simple and expeditious’ (Lovén [1875] 2010, 434).

In Caribbean archaeology, records of hutia exploitation and translocation are often linked to assertions of human management and tending (e.g. Olsen and Pregill 1982; Wing 2008). For example, originally native and endemic to western Hispaniola, the remains of now extinct Puerto Rican hutia (*Isolobodon portoricensis*) have been recovered from archaeological deposits on Puerto Rico, Vieques and St. John Island, leading scholars to argue that their introduction and relative abundance are the result of human transport and direct influence (e.g. tending, captive management) (DuChemin 2013; Garner 2001; Newsom and Wing 2004, 244; Wing 1993). While translocation of the Puerto Rican and other hutia clearly demonstrates intentional efforts to introduce the animals beyond their natural ranges, many questions remain regarding the environmental circumstances and anthropogenic factors that may have resulted in hutia isolation and adaptation, and in turn, human exploitation and management (Olsen and Pregill 1982).

Understanding the possible role of humans in Bahamian hutia distributions and frequencies is hampered by a lack of comparative hutia data from palaeontological or archaeological sites elsewhere on either Providenciales or on neighbouring Turks and Caicos Islands to compare with the Palmetto Junction assemblage. The lack of other hutia assemblages may be the result of multiple factors including inadequate sample sizes and poor preservation as well as unexcavated archaeological assemblages. It is also possible that Bahamian hutia either never existed in the Turks and Caicos Islands naturally or native populations were eradicated prior to human settlement (e.g., hurricanes, post-Pleistocene environmental changes [Olsen 1982]). These various possibilities and lack of comparative data make it impossible to determine whether the significant population size of the Palmetto Junction archaeological hutia assemblage is a unique natural occurrence following their human introduction and naturalisation on the island or the result of human manipulation following their translocation to the island.

A scenario in which hutia isolation in the Turks and Caicos Islands could have occurred through human action is possible where changes in selective factors (resource availability, reproductive selection, environmental/climate factors) may have been manipulated by humans. This could have been achieved first by the relocation of a hutia population to an island on

which they did not occur naturally, and then by purposefully or otherwise, transforming the landscape and providing food resources and habitat. At the Palmetto Junction site a variety of natural barriers near the human settlement, such as a bay and a natural water channel, would have helped naturally limit the hutia population’s movement (see Figure 4), thus making them more easily available for human capture.

The apparent large body size of the Palmetto Junction hutia population, as indicated by our data and in comparison to other archaeological sites, may have been the result of a founder’s effect, followed by intentional human resource manipulation and isolation. However, when dealing with ancient animal populations, it must be determined that morphological differences are not part of normal variation within the species (Chaplin 1969); therefore, we cannot unequivocally assume human management is responsible for the size of the Palmetto Junction hutia. Similarly, it is also possible that the size of the Palmetto Junction hutia reflect a ‘normal’ size range of Bahamian hutia in the past and that modern wild Bahamian hutias are smaller than ‘normal’ due to cumulative impacts of past environmental factors, a long history of isolation and human selection pressures. The biological identification of hutia morphology that is the product of either intentional or unintentional human effort will become more feasible as more data about hutia morphology and size ranges are collected from other archaeological sites in the region, as well as from palaeontological fossil and modern bone assemblages.

Despite a lack of comparative data specifically for archaeological Bahamian hutia, previous studies are available that address possible physical changes and adaptation of other hutia taxa as a result of pre-Columbian indigenous human exploitation. In a thorough treatment of possible ancient indigenous tending and captive management of Jamaican hutia, Wilkins (2001) compared archaeological specimens to modern specimens. Specifically, Wilkins (2001) compared observations of morphological and age variability between archaeological Jamaican hutia specimens recovered from the Bellevue site (White Marl period, circa AD 800–1600) with specimens from modern, captive-bred Jamaican hutias. Wilkins (2001) correlated mandibular tooth row (MTR) measurements with size and age among modern individuals and then compared the tooth row data as well as post-cranial element measurements with a sample of zooarchaeological specimens. The results indicate that hutia remains at the Bellevue site did not reflect culling strategies commonly associated with captive management (e.g. concentrations of primarily young individuals with shifts in age structure over time). Rather, Wilkins (2001, 539–540) argues that the Bellevue hutia population was consistent in

terms of estimated ages and abundance over a hundred-year time span, suggesting that other biological and/or environmental factors may have influenced population stability at the site.

A more recent investigation of animal exploitation among indigenous groups during the White Marl period (circa AD 800–1600) on Jamaica by Carlson (2012) is more ambiguous regarding possible human management of or influence over hutia populations. Following Wilkins (2001) method, Carlson (2012) compared MTR measurements from Jamaican hutia specimens across three archaeological sites: the Green Castle Site, Colerain Site and the Wentworth Site. The results suggest that hutia exploitation from Green Castle and Wentworth may have been focused on reproductive subadult individuals older than 1 year (e.g. an average of 13 months old [Carlson 2012, Tables 3 and 4]) but not yet full adults (> 3-years old). The hutia from Colerain were a bit older with an average age range of 18 months to 2 years old. Carlson (2012) concludes that while Jamaican hutia populations may have been abundant enough in the past to support age-targeted exploitation across the sites, the MTR measurement data may also be indicative of management via culling strategies.

In a similar vein, Garner's (2001) study of possible human management and/or incipient domestication among translocated Puerto Rican hutia on St. John (USVI) focused on morphological differences between archaeological and palaeontological hutia specimens. Garner (2001) compared alveolar tooth row lengths between zooarchaeological samples from Cinnamon Bay (AD 1000–1490) and Calabash Boom (AD 740–1460) with palaeontological assemblages from Rancho de la Guardia (late Pleistocene to early Holocene; Garner 2001 citing personal communication with Gary Morgan) in the Dominican Republic and Trou Woch SaWo (3775–10,320 BP; Garner 2001) in Haiti. Concentrated on documenting size differences between the temporal contexts (i.e. palaeontological and archaeological) and possible geographic differences between the Greater Antilles and the Virgin Islands, Garner's (2001) reports that zooarchaeological specimens were from larger-sized hutias overall, but with a smaller size range when compared to palaeontological individuals. Garner (2001) concluded that it was not possible to discern if the size difference (and contracted size range) was due to human selection or founder's effect among the introduced (i.e. zooarchaeological) population(s) on St. John.

In the case of the Palmetto Junction assemblage, our study indicates that Bahamian hutia were larger, on average, than modern specimens housed at the Florida Museum of Natural History. Artificial selection is a probable explanation for our sample of larger-sized individuals. The museum specimens were wild and captured individuals from the last remaining

extant populations. They are the result of generations of habitation on very small islands with little human interference or predation, as well as environmental isolation and resource limitations. On the other hand, the pre-Columbian hutia that lived at Palmetto Junction were transported to the Turks and Caicos where no wild populations of hutia previously existed. These newly established animals encountered abundant natural resources along with a lack of initial resource competition among individuals as well as a lack of previously established territoriality. Although hutia may have been selected for translocation for a variety of cultural reasons, the most parsimonious archaeological explanation for hutia translocation to Providenciales and the site of Palmetto Junction is as a food resource for the colonists. As such, it is possible that large individuals, as well as smaller-sized juveniles, would have been selected for transport and the establishment of viable populations (e.g. Garner 2001). The resulting genetic founder's effect and lack of competition could have resulted in the overall larger hutia at the site as the population established itself on the island.

In a situation similar to the modern populations on Little Wax Cay (Jordan 2012), if given enough time free of human hunting, the introduced hutia at Palmetto Junction would have been able to reach sustainable population densities naturally. Palmetto Junction is characterised by narrow patches of land bordered on two or more sides by bays and natural channels (see Figure 4). The natural environment is suitable for hutia, providing the appropriate habitat and resources. If translocated hutia were released into the wild upon arrival on the island, the natural barriers near Palmetto Junction could have facilitated human control over or maintenance of the newly introduced hutia population.

Furthermore, the ecological behaviour of animals in circumscribed areas depends upon stress brought on by limited resources (MacArthur and Wilson 1967). The territoriality and aggression observed by Jordan (2012) may have been the result of limited space (captivity) for a foraging species resulting in aggression to perceived competitors. By contrast, the non-captive hutia observed by Clough (1972) were neither aggressive nor territorial, as the competition was low. Non-captive hutia, given adequate space, could respond to limited resource stress by resource partitioning (Giller 1984; Losos and Parent 2009, 425). Social grouping, territoriality and evidence of mild aggression observed by Jordan (2012) among non-captive populations may have been the result of this common ecological response (Giller 1984). A transported and released population of hutia at Palmetto Junction could have been controlled within a limited, but non-captive space, minimising the need for partitioning or territoriality, especially if food resources were supplemented through provisioning.

Provisioning, either through purposeful feeding or via gardens and/or horticultural areas upon which hutia could feed opportunistically, may have been beneficial, or even necessary, to ensure the successful establishment of the translocated hutia population. Experimental provisioning of spiny rats (*Proechemys semispinosus*), which like hutia are tropical caviomorph rodents, on isolated islands off Panama resulted in a significant increase in reproductive success as evidenced by elevated birthrates among provisioned populations (Adler 1998). Adler's study pertains specifically to aspects of ecology and biogeography of circumscribed animal communities, where resource availability is a limiting factor for successful reproduction. The abundance of hutia recovered from only 2 m<sup>2</sup> at Palmetto Junction is a strong indication of a successful population that may have been maintained and managed through spatial control, provisioning and artificial selection, perhaps with minimal effort on the part of the human inhabitants of the site.

The significance of the Palmetto Junction specimen size data, however, are more difficult to interpret given the relatively small sample sizes of both archaeological and modern Bahamian hutia specimens available for study and a lack of comparative palaeontological data. Also, at this time, little is known about the relationship between bone fusion rates and age, as well as possible sexual dimorphism in skeletal elements. It is also difficult to control for issues of equifinality impacting hutia size over time. It is possible that Lucayan management of hutia on Palmetto Junction favoured the growth of larger-sized individuals in the ancient past. The introduction of hutia into the Turks and Caicos provided the animals with previously uninhabited areas that proved conducive to their growth. Ongoing research on hutia diet using stable isotopes of carbon and nitrogen may help to determine if human management, such as feeding or dietary supplementation helped to foster the growth of larger-sized individuals (LeFebvre et al. 2017). In addition, geographically comprehensive aDNA analysis of archaeological Bahamian hutia remains may reveal possible genetic shifts between populations and correlate with trends in diet and size profiles.

More broadly within the Lucayan realm, the indigenous people visiting and emigrating to The Bahamas from Cuba or Hispaniola would have been familiar with hutia due to various hutia taxa present on those islands during pre-Colonial history (e.g. *Capromys pilorides*, *Geocapromys* sp., *Isolobodon portoricensis*, *Plagiodontia aedium*). Archaic and post-Archaic archaeological contexts on Cuba reveal a long history of hutia exploitation during Cuba's pre-Columbian past (Colten and Worthington 2014; Colten, Newman, and Worthington 2009). At some sites in Cuba (e.g. Vega del Palmar) hutia, such as *Geocapromys* sp., were a major focus of exploitation and consumption (Colten

and Worthington 2014). Colten, Newman, and Worthington (2009, 81) suggest that some hutia species in Cuba were possibly bred in captivity or possibly domesticated. The incorporation of Bahamian hutia within Lucayan subsistence strategies may have been an extension of homeland traditions and preferences.

Despite many appealing characteristics and possible cultural connections to indigenous groups in Cuba and Hispaniola, the abundance of Bahamian hutia remains reported from Lucayan archaeological sites is relatively low, especially in comparison to fish and mollusc remains (Newsom and Wing 2004). Hutia remains, as reported thus far, are not commonly recovered in great abundance from gradually accumulated middens or from discrete depositional contexts (e.g. single deposition pit features with the exception of the two burial contexts discussed above). One possible explanation for the general lack of hutia remains in midden refuse is differential processing and deposition of hutia skeletons that was distinct from the disposal of common animal food animal waste, such as fish, lizards and molluscs. Therefore, hutia discard events may not be preserved archaeologically or they are yet to be discovered at a broad enough scale to recognise patterns of deposition within and across sites.

Another possibility is that Bahamian hutia were not standard or preferred everyday subsistence fare among all Lucayan populations. The transport and introduction of Bahamian hutia within the Bahama archipelago was likely conducted through a multi-cultural network of interaction and mobility between The Bahamas, the Turks and Caicos Islands and the Greater Antilles. As reviewed by Berman, Gnivecki, and Pateman (2013, 264), 'Disentangling the linguistic, ethnic, archaeological, and political origins and identities of the Lucayans is complicated because the archaeological data and ethnohistoric accounts are incomplete.' As such, it is possible that culturally heterogeneous, or multi-ethnic, foodways are reflected in the disparate hutia records. Although difficult to demonstrate archaeologically, a cultural preference by some populations and avoidance by others is plausible given a host of cultural and social reasons people worldwide do and do not eat particular animals (e.g. food taboos, ideological beliefs, expressions of identity [Mintz and Du Bois 2002; Salmón 2012; Sutton 2001; Twiss 2007]).

The translocation of Bahamian hutia to Palmetto Junction demonstrates that the hutia were intentionally sought after, embedded in networks of interaction and mobility and possibly managed via a combination of natural and anthropogenic circumstances. Yet, the archaeological documentation of animal management, incipient domestication and full domestication is a complex endeavour, often necessitating multiple lines of evidence and consideration of dynamic culture histories (Larson and Fuller 2015; LeFebvre and deFrance forthcoming; Russell 2002; Terrell et al. 2005; Zeder

2006, 2015). Approaching Bahamian hutia zooarchaeological records through a multidisciplinary framework of investigation – expanding zooarchaeological and morphometric analyses, incorporating biochemical analysis, and comparisons with palaeontological records – will provide additional methodological bases from which to identify and interpret human–Bahamian hutia interactions in the past (e.g. LeFebvre et al. 2017).

## Conclusion

The zooarchaeological record shows that Lucayan groups exploited Bahamian hutia across the region. Thus far, the largest zooarchaeological assemblages are reported from Crooked Island and Providenciales, both located in the southern portion of the Bahama Archipelago. Archaeological contexts of recovery suggest hutia were exploited primarily as food. In at least three instances, records show that hutia were transported beyond their natural geographic range into the Turks and Caicos Islands (MC-6 on Middle Caicos, and Palmetto Junction and Providenciales 1 on Providenciales).

The assemblage from the site of Palmetto Junction is unique for its abundance and location beyond the natural range of Bahamian hutia. Our data show human introduction of hutia to the island, and that the hutia were larger than modern museum-curated skeletal specimens. As is the case in many archaeological studies of human influence over wild animals, the documentation of Bahamian hutia management and possible cultural significance(s) are challenging to elucidate. With an incomplete understanding of natural hutia size variation and the relationship between bone fusion, sexual maturity and age, we cannot easily discern between possible environmental and anthropogenic variables impacting hutia body size and abundance in neither the past nor the present. Contemporary studies of Bahamian hutia biology, ecology and behaviour suggest that hutia have qualities that would have made them suitable for translocation and human influence in the past, including a broad herbivore diet, resiliency to drought and a predisposition to non-aggressive behaviour. Isotopic studies aimed at elucidating the Bahamian hutia diet may help to identify human influenced dietary regimes or supplementation (Kamenov et al. 2016). Moreover, increased samples and more morphometric data will help determine how and when (or under which circumstances) hutia management may have been practiced in the Bahama archipelago.

## Notes

1. At both Major's Landing and Pittstown Landing (both on Crooked Island in The Bahamas), soil from one 5-

cm level was processed through two sizes of screen, a 1/4-inch mesh (6.4 mm) and 1/16-inch mesh (1.6 mm). At Major's Landing the majority (65%,  $n = 19$ ) of hutia remains ( $n = 29$ ) were recovered via the larger mesh screen. Similarly, at Pittstown Landing, the majority (81%,  $n = 9$ ) of hutia remains ( $n = 11$ ) were recovered in the 1/4-inch screen (deFrance 1991). These results indicate that use of 1/4-inch mesh is adequate for the recovery of hutia remains from archaeological contexts, although the use of finer screen mesh (1/8- or 1/16-inch) remains important for the recovery of smaller sized elements such as loose teeth.

2. Crooked Island specimens were also measured during zooarchaeological analysis. Unfortunately, the state of preservation and overall small sample size of preserved elements precluded comparative study with Palmetto Junction and modern Bahamian hutia skeletal elements. Similarly, the small sample sizes of other archaeological Bahamian hutia reported here, such as those from Providenciales 1, were also fragmentary and could not be measured.

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## Disclosure statement

No potential conflict of interest was reported by the authors.

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