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TWO PREHISTORIC SEA TURTLE BARNACLE SPECIES FROM SAN SALVADOR, BAHAMAS: ARCHAEOLOGICAL EVIDENCE FOR *CHELONIBIA TESTUDINARIA* AND *CHELONIBIA CARETTA* (A.D. 900-1320)

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ABSTRACT

Recent archaeological excavations at the Minnis-Ward site (SS-3) and North Storr's Lake site (SS-4) on San Salvador, Bahamas have yielded evidence for sea turtle butchery and cooking in pre-Columbian times (ca. A.D. 900-1320) by the indigenous Lucayan people of San Salvador. Thirty-three specimens from two different archaeological sites have been identified as *Chelonibia testudinaria* and *Chelonibia caretta*. Radiometric dates on charcoal, sea turtle bones, and sea turtle barnacles indicate that sea turtle harvesting, cooking, and processing was taking place at Minnis-Ward and North Storr's Lake during the ca. five centuries before the arrival of Columbus on San Salvador. Stable isotope evidence suggests three different dietary patterns detected in the sea turtle skeletal remains (carnivory, herbivory [sea grass], and marine algae diet) suggestive of the presence of at least two sea turtle species and at least three individual marine turtles: loggerhead (*Caretta caretta*), green turtle (*Chelonia mydas*), and immature green turtle, respectively. The sea turtle barnacle, *Chelonibia testudinaria*, is a widespread species today, and represents the majority of the sea turtle barnacles recovered. Recent identification of a few specimens of *Chelonibia caretta* in

the archaeological remains in association with sea turtle bone leans heavily towards the additional consumption or use of hawksbill turtles (*Eretmochelys imbricata*) in addition to loggerheads and greens. The sea turtle remains and barnacles thus indicate exploitation of the loggerhead, green, and hawksbill turtles on San Salvador by the prehistoric inhabitants of the island. This is a rare case in which sea turtle barnacles have been reported in the archaeological record in association with prehistoric sea turtle remains.

INTRODUCTION

The association of sea turtle barnacles in the archaeological record with marine turtle skeletal remains is rarely reported. Whale barnacle, *Coronula diadema*, has been reported in archaeological context in South Africa where a (humpback) whale was beached, providing a source of meat for inland hunter-gatherers (Kandel and Conard 2003). The Lucayans of the Bahamas were maritime hunter-gatherer fisherfolk whose predominant source of protein came from the sea. Marine turtles would have provided a useful portion of dietary protein dominated by fish, followed by land crab, queen conch, iguana, top shell, clam, etc. Keegan (1992:132, Table 6.1) ranks sea turtle as the number one source of protein (kcal/hr) in the pre-Columbian Bahamas, and Blick et al. (2010) suggest it comprised ca. 4-5% (in both quantity and weight) of the vertebrate fauna in the Lucayan diet.

At the Minnis-Ward site (SS-3) (Figure 1), sea turtle barnacles were found in both shovel tests and stratigraphic test pit excavations by Blick and his teams during the years 2003-2010. The distribution of 19 sea turtle barnacle wall plates of *Chelonibia testudinaria* and *Chelonibia caretta* across a 90 m x 30 m area of the site suggests consumption of multiple sea turtles (and likely multiple species) by 5-6 households within the area tested (Figure 2). The area of highest concentration of sea turtle bone and sea turtle barnacles is in the vicinity of the northwest portion of an area that we have designated Household 1 and that has been subjected to the excavation of several stratigraphic test pits (the higher concentration is probably the result of more intensive excavations near Household 1). Thus, it appears no single household had a monopoly on sea turtle consumption and that access to sea turtle was pretty much equal from household to household.

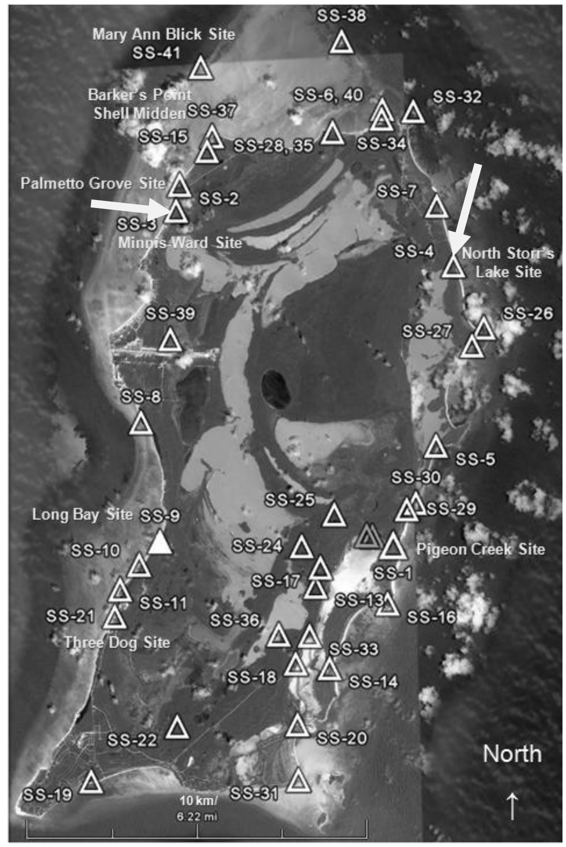

Figure 1. Minnis-Ward (SS-3) and North Storr's Lake (SS-4) sites (arrows) (GoogleEarth 2011).

At the North Storr's Lake site (SS-4), sea turtle barnacles were found in an area that appears to be a sea turtle butchery and cooking location. A single shovel test indicated a high density of vertebrate remains in that locale, so two adjoining 2 x 2 m units were excavated with the goal of recovering faunal remains for paleodietary analysis. In an area of 4 x 2 m, we recovered ~1300 fragments of sea turtle bone and 14 wall plates of *Chelonibia testudinaria*. Stable isotope analysis by Clementz on several sea turtle bone fragments suggests the presence of at least three dietary patterns: carnivory, herbivory (sea grass), and marine algae diet, suggestive of the presence of at least two sea turtle species and at least three individual marine turtles: loggerhead (*Caretta caretta*), green turtle (*Chelonia mydas*), and immature green turtle.

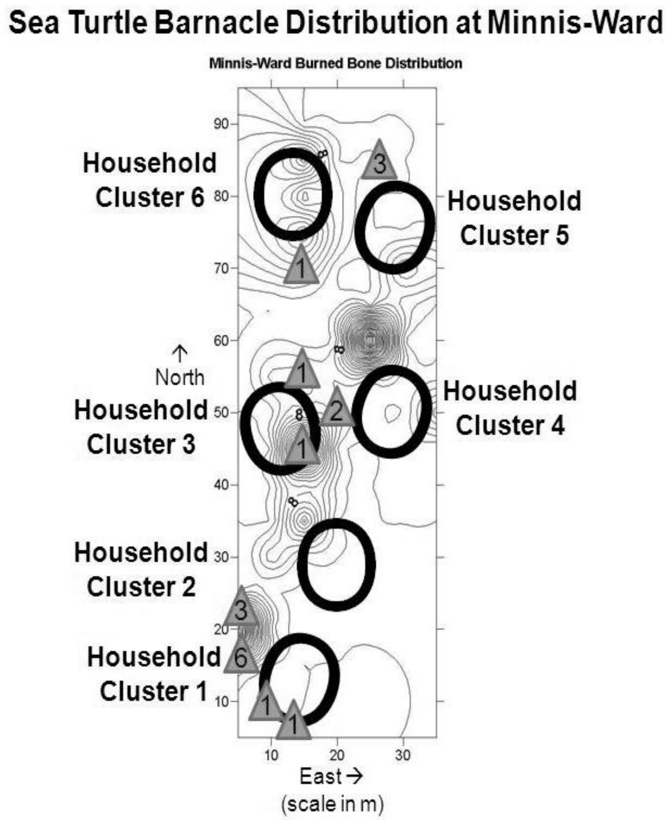

Figure 2. Sea turtle barnacle distribution in shovel tests and excavations at the Minnis-Ward site (SS-3). (Map by J. Blick.)

SEA TURTLE BARNACLE DESCRIPTIONS

A total of 33 fragments of subfossil barnacle wall plates were excavated from two study sites on San Salvador, Bahamas. Comparison of the remains with contemporary barnacle specimens (Figures 3 and 4) confirmed their identity as the disarticulated mural compartments (wall plates) of two different turtle-associated barnacles, *Chelonibia testudinaria* and *C. caretta* (Figures 5 and 6). Compartments of *C. testudinaria* were found in much higher relative abundance (93.9%), though both are common epibionts of marine turtles (Frick, Williams and Robinson 1998). The fragments were preserved well enough to also diagnose their corresponding position in the organism (Figures 3-4 and Table 2). The wall plates of chelonibiid barnacles are composed of eight compartments (Frick and Ross 2001; Figure 4): anterior rostrum; posterior carina; R and L rostro-lateral plates; R and L lateral plates; and R and L carino-lateral plates (Anderson 1994, Darwin 1854). The sutures between plates can be clearly distinguished during early growth (Zardus and Hadfield 2004); however, when fully grown they appear as six compartments due to the firm concrescence of the rostrum and rostro-lateral compartments (Darwin 1854). In one instance we found the rostrum and rostro-lateral compartments still joined in the subfossil state. Barnacles were recognized in the field and in previous excavations conducted by Blick and subsequently identified by Zardus. Sea turtle barnacles were measured by Zardus using digital calipers and weighed on an Ohaus 1010 precision balance (±.01 g).

Figure 3. A modern specimen of the sea turtle barnacle, Chelonibia testudinaria, *with wall plates labeled in proper anatomical position for orientation. Note that in this specimen the rostrum is fused with the R and L rostro-lateral plates. (Photo by J. Zardus).*

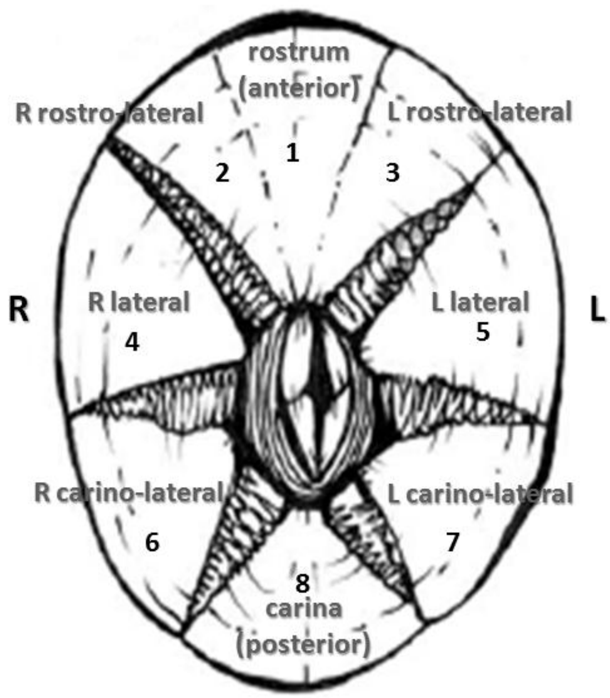

Figure 4. The sea turtle barnacle, Chelonibia testudinaria, *with wall plates labeled in proper anatomical position for orientation (modified from ERC 2007:34, Fig. 4A). Anterior at top. R=Right, L=Left. Note: This figure corrects, clarifies, and supersedes Blick, Zardus and Dvoracek (2011:179, Fig. 2).*

A Proposed Standardized Nomenclature, Numbering, and Abbreviation System for Sea Turtle Barnacle Morphology

Due to some confusion in the literature and differences in terminology generally thought to be interchangeable, we realized a standardized nomenclature and numbering system for sea turtle barnacle morphology (at least for the inexperienced archaeologist) was needed. The standardized nomenclature, numbering system, and abbreviations are proposed as follows:

1) rostrum (r)
2) right rostro-lateral (Rrl)
3) left rostro-lateral (Lrl)
4) right lateral (Rl)
5) left lateral (Ll)
6) right carino-lateral (Rcl)
7) left carino-lateral (Lcl)
8) carina (c)

Rationale for the nomenclature and numbering system:

1) anterior (head) is 1 (rostrum or "snout")
2) adjoining the rostrum are numbers 2 and 3
3) right side wall plates would be given even numbers (2, 4, 6)
4) left side wall plates would be given odd numbers (3, 5, 7)
5) posterior (rear) is 8 (carina or "keel")
6) direction of motion is toward anterior with dorsal surface attached to host

Gross Comparisons of
C. testudinaria and *C. caretta*

The following brief table, Table 1, distinguishes the six major differential traits of the sea turtle barnacles *Chelonibia testudinaria* and *Chelonibia caretta*; see Figures 5 and 6 for visual comparison.

Trait	*C. testudinaria*	*C. caretta*
Color	white or gray	white or gray
Surface	smooth, polished	rough, chalky
Size	up to 100 mm diam.	up to 50 mm diam.
Shape	oval, symmetrical	less symmetrical
Height	squat, low profile	tall, high profile
Basal Margin	smooth, does not cut scute	jagged, sharp, cuts scute

Table 1. Gross comparisons of Chelonibia testudinaria *and* Chelonibia caretta.

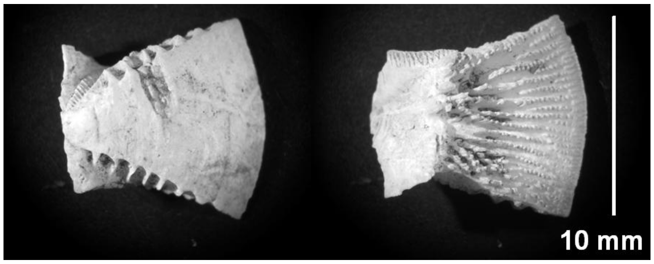

Figure 5. Chelonibia testudinaria*, L lateral, superior and inferior, width 10.5 mm, from the North Storr's Lake (SS-4) sea turtle processing site (SS-4/06-1.1). (Photos by J. Zardus.)*

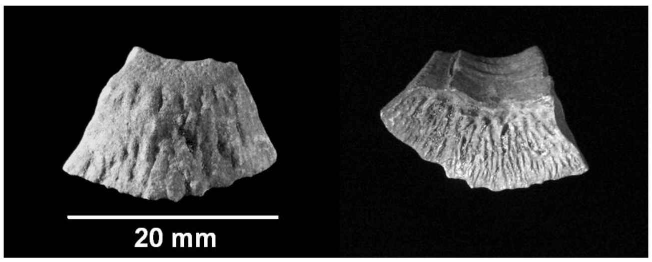

Figure 6. Chelonibia caretta*, L rostro-lateral, superior & inferior, width 20.5 mm, from the 2010 excavation at Minnis-Ward (SS-3), Household 1 midden (SS-3/10-2.1).(Photos by J. Zardus.)*

AMS RADIOCARBON DATES ON THE BARNACLES

Wall plates of the sea turtle barnacles *C. testudinaria* and *C. caretta* have been found in archaeological contexts at Minnis-Ward (SS-3) dating to 990±40 B.P. (1σ) calibrated to cal AD 980-1160 (2σ). Archaeological deposits at Minnis-Ward generally span ca. A.D. 950-1450. Direct dates on four *C. testudinaria* barnacles from North Storr's Lake (SS-4) reveal barnacle ages of 1280±30, 1290±30, 1330±30, and 1340±30 B.P. (1σ) (cal AD 900-1320, 2σ). Direct dates on 11 fragments of marine turtle bones range in age from 930-1330±30 B.P. (cal AD 900-1550). AMS dates on eight charcoal fragments found in association with the sea turtle barnacles and bones span the period cal AD 890-1280 (2σ), generally confirming the ages of the sea turtle barnacles and skeletal remains. The marine reservoir correction (Stuiver, Reimer and Reimer 2010) was applied to all marine species (ΔR = 25±30).

DISCUSSION

Archaeological deposits at Minnis-Ward and North Storr's Lake span ca. A.D. 900-1550. Remains indicate sea turtle processing localities at both sites based upon large quantities of turtle bones, some with burn and cut marks, and barnacles in middens associated with several pre-Columbian houses (Blick, Zardus and Dvoracek 2011). Marine turtles were apparently roasted on their backs with a fire started on their underbellies or they may have been suspended over a fire to aid in removing scutes for the manufacture of tortoiseshell items (Hewavisenthi 1990), including pre-Columbian jewelry (Frick, personal communication, 2011). Most specimens at both sites are *Chelonibia testudinaria*, a widespread species commonly found on *Chelonia mydas* (green turtle) and *Caretta caretta* (loggerhead) today. In addition, identification of two specimens of *Chelonibia caretta* in the archaeological deposits at Minnis-Ward (SS-3) in association with marine turtle remains leans heavily toward the consumption or use of hawksbill turtles (*Eretmochelys imbricata*) (Frick, personal communication, 2011) as well as the previously reported loggerhead (Winter 1980) and green turtles.

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Award to Blick. M. Frick provided scientific commentary and added significant points to the article. M. Clementz performed stable isotope analyses on sea turtle bone found in the deposits with the barnacles.

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Table 2. Sea turtle barnacle wall plates from Chelonibia testudinaria *and* Chelonibia caretta *from the Minnis-Ward site (SS-3) and the North Storr's Lake site (SS-4), San Salvador, Bahamas. Samples marked by (AMS) have been dated by accelerator mass spectrometry.*

Species	**Sample Code**	**Wall Plate or Compartment**	**Wt (g)**	**Width (mm)**	**Height (mm)**
C. testudinaria	SS-3/03-ST2-2.1	Carina	0.59	14.1	9.3
C. testudinaria	SS-3/03-ST3-9.1	Rostrum	0.40	7.4	14.6
C. testudinaria	SS-3/03-ST4-10.1	left lateral	0.51	11.2	8.9
C. testudinaria	SS-3/03-ST4-10.2	left carino-lateral	0.41	11.4	11.8
C. testudinaria	SS-3/03-ST3-11.1	right rostro-lateral	0.52	8.3	14.1
C. testudinaria	SS-3/03-ST5-12.1	Rostrum	0.42	5.8	13.6
C. testudinaria	SS-3/03-ST5-12.2	right rostro-lateral	0.46	7.0	14.0
C. testudinaria	SS-3/03-ST5-12.3	right lateral	0.50	12.2	9.8
C. testudinaria	SS-3/03-ST3-14.1	right lateral	0.95	13.7	11.2
C. testudinaria	SS-3/04-3.1	right lateral	0.37	8.6	9.6
C. testudinaria	SS-3/09-4.1	right carino-lateral	0.81	13.8	13.1
C. testudinaria	SS-3/09-4.2	left carino-lateral	1.07	19.0	14.3
C. testudinaria	SS-3/09-6.1	left carino-lateral	0.31	8.6	9.3
C. caretta	SS-3/10-2.1	left rostro-lateral (Figure 6)	2.39	20.5	13.2
C. caretta	SS-3/10-2.2	left carino-lateral	1.71	17.1	16.5
C. testudinaria	SS-3/10-4a.1	right lateral	0.13	7.9	6.4
C. testudinaria	SS-3/10-4b.1	left lateral	0.69	11.3	11.8
C. testudinaria	SS-3/10-6.1	left carino-lateral	0.50	11.7	10.4
C. testudinaria	SS-3/10-6.2	left rostro-lateral	0.33	7.1	11.1
C. testudinaria	SS-4/06-1.1	left lateral (Figure 5)	0.51	10.5	11.6
C. testudinaria	SS-4/06-1.2	left rostro-lateral	0.29	5.8	12.7
C. testudinaria	SS-4/06-1.3	left rostro-lateral	0.26	6.4	10.5
C. testudinaria	SS-4/06-2.1	left carino-lateral	0.80	14.9	12.2
C. testudinaria	SS-4/06-2.2	right carino-lateral	0.51	12.3	11.1
C. testudinaria	SS-4/06-11.1	right rostro-lateral, small (AMS)	1.00	14.8	16.9
C. testudinaria	SS-4/06-11.2	Rostrum	1.96	7.3	13.2
C. testudinaria	SS-4/06-12.1	rostrum+left rostro-lateral, small (AMS)	1.00	16.6	16.6
C. testudinaria	SS-4/06-12.2	left carino-lateral	1.49	12.4	12.0
C. testudinaria	SS-4/06-12.3	right carino-lateral	0.66	10.6	11.1
C. testudinaria	SS-4/06-13a.1	right carino-lateral (AMS)	1.00	10.8	11.7
C. testudinaria	SS-4/06-13b.1	right carino-lateral	5.05	21.8	21.5
C. testudinaria	SS-4/06-13b.2	left lateral, small (AMS)	1.00	11.6	9.4
C. testudinaria?	SS-4/06-14.1	rostrum? (fragment)	0.51	4.0	9.0