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The Role of Barbuda in the Settlement of the Leeward Islands: Lithic and Shell Analysis Along the Strombus Line Shell Midden

Vincent Rousseau[1], Allison Bain[2], Jacques Chabot[2], Sandrine Grouard[3], and Sophia Perdikaris[4]

The Strombus Line is a linear shellfish midden located along the former southwestern shore of the island of Barbuda. In 2011 and 2012, members of the Islands of Change project identified and excavated three Archaic Age sites associated with this structure. The analysis of shells and exogenous chert from these sites allows us to better understand the role of Barbuda, providing new evidence of the activities of resource exploitation and production on the island during the Archaic Age. This article presents the results of the excavations and the lithic and shell analyses and aims to contextualize the importance of Barbuda in the regional economy.

Le Strombus Line est un amas coquillier linéaire situé le long de l'ancien rivage sud-ouest de l'île de Barbuda. En 2011 et 2012, trois sites liés à cette structure datée de l'archaïque ont été localisés et fouillés par une équipe du projet Islands of Change. L'analyse des coquillages et des éclats de chert exogène retrouvés sur ces sites permet de mieux concevoir la place de l'île de Barbuda au cours de la période Archaïque des Petites Antilles du Nord en fournissant de nouvelles données sur les activités d'exploitation des ressources et de production d'outils. Cet article présente les fouilles, examine les résultats des analyses lithiques et malacoarchéologiques tout en contextualisant l'importance de Barbuda pour l'économie régionale.

La "Strombus Line" es un cúmulo de conchas linear que se encuentra en la antigua costa suroeste de la isla de Barbuda, localizada en el norte de las Antillas menores. Entre 2011 y 2012 tres sitios de la era Arcaica asociados con esta estructura fueron localizados y excavados por un equipo del proyecto Islands of Change. El análisis de las conchas y de los fragmentos de sílex exógenos recuperados en estos sitios ha proporcionado información valiosa para la comprensión de la importancia de Barbuda en la región durante la era Arcaica y a proporcionado nuevas evidencias de las actividades de explotación de los recursos y de producción de herramientas. Este artículo presenta los resultados de las excavaciones y de los análisis líticos y arqueomalacologicas con el fin de contextualizar la importancia de Barbuda en la economía regional del periodico arcaico del norte de las Antillas menores.

[1] Université Laval, Québec, Canada, vincent.rousseau.4@ulaval.ca
[2] CELAT, Université Laval, Québec, Canada
[3] Muséum national d'Histoire naturelle, Paris
[4] City University of New York, Brooklyn

Introduction

In the early 1970s archaeologists discovered an aceramic prehistoric site on the island of Antigua (Davis 1973, 1982; Olsen 1971). The Salt Pond site featured conch celt blanks and flint blades, yet no ceramics. As such, the Salt Pond site provided proof of the first known Archaic Age (4000-2000 BP) colonization of the northern West Indies, indicating the settlement of these islands several centuries earlier than previously thought. During the following years, numerous other Archaic Age sites were found, most notably on Antigua but also on other islands of the northern West Indies (Bonnissent 2008; Bonnissent et al. 2016; Bullen 1971; Cherry et al. 2012; Crock et al. 1993; Davis 2000; Hofman and Hoogland 2003; Hofman et al. 2006; Watters 1980). Our current understanding of the archaeology of Antigua is that it was an important center for the Archaic Age, more densely populated than other islands probably due in part to its important lithic sources. While most of the Leeward Islands were settled during this period, the Windward Islands south of Martinique seem to have been voluntarily left out of this wave of colonization (Bright 2011; de Mille 2005; Fitzpatrick 2013; Giovas and Fitzpatrick 2014; Hackenberger 1991; Hofman 2008; Rodríguez Ramos et al. 2013). This absence of sites south of Martinique has been recently nuanced by Siegel and his team (2015) who argued, using paleoenvironmental data, that these islands may have been occupied several centuries earlier than the archaeological sites lead us to believe, and that some sites remained undocumented due to taphonomic or methodological reasons (Siegel et al. 2015). Active coastal erosion and rising sea levels may have also resulted in the absence or lack of visibility of many sites (Cooper 2013).

Specialists disagree on whether these first settlers of the Leeward Islands came from South America, the Greater Antilles or both (Hofman et al. 2006, 2011) but a direct route between South America and the Leeward Islands and Puerto Rico might explain the lack of colonisation evidence from the southern Windward Islands (e.g. Callaghan 1991; 1993, 2003; Fitzpatrick 2013). These populations had developed highly specialised knowledge of both marine resources and seafaring transportation (Callaghan 1991, 1993, 2003; Fitzpatrick 2013; Hofman et al. 2011; Nicholson 1975), and they travelled regularly between islands as they maintained nomadic or semi-nomadic marine-oriented subsistence practices. As the islands of the Lesser Antilles are intervisible, they have a high potential for inter-island network connections (Watters 1980a). According to Mol (2013), the pre-Columbian Caribbean likely consisted of a series of autonomous but interconnected networks and given their geological and ecological diversity, even small islands had resources to offer (Hofman et al. 2007; Mol 2013). Understanding these interconnections is crucial to further our understanding of settlement patterns in the Lesser Antilles as it might help clarify the kinds of activities that prompted people to move in and around the region.

The small island of Barbuda (Figure 1) is Antigua's closest neighbor and contains a handful of Archaic sites, although little is known about Barbuda's Archaic Age peoples. In 2011 and 2012, an international team working on the *Islands of Change* project undertook excavations at three Archaic Age sites

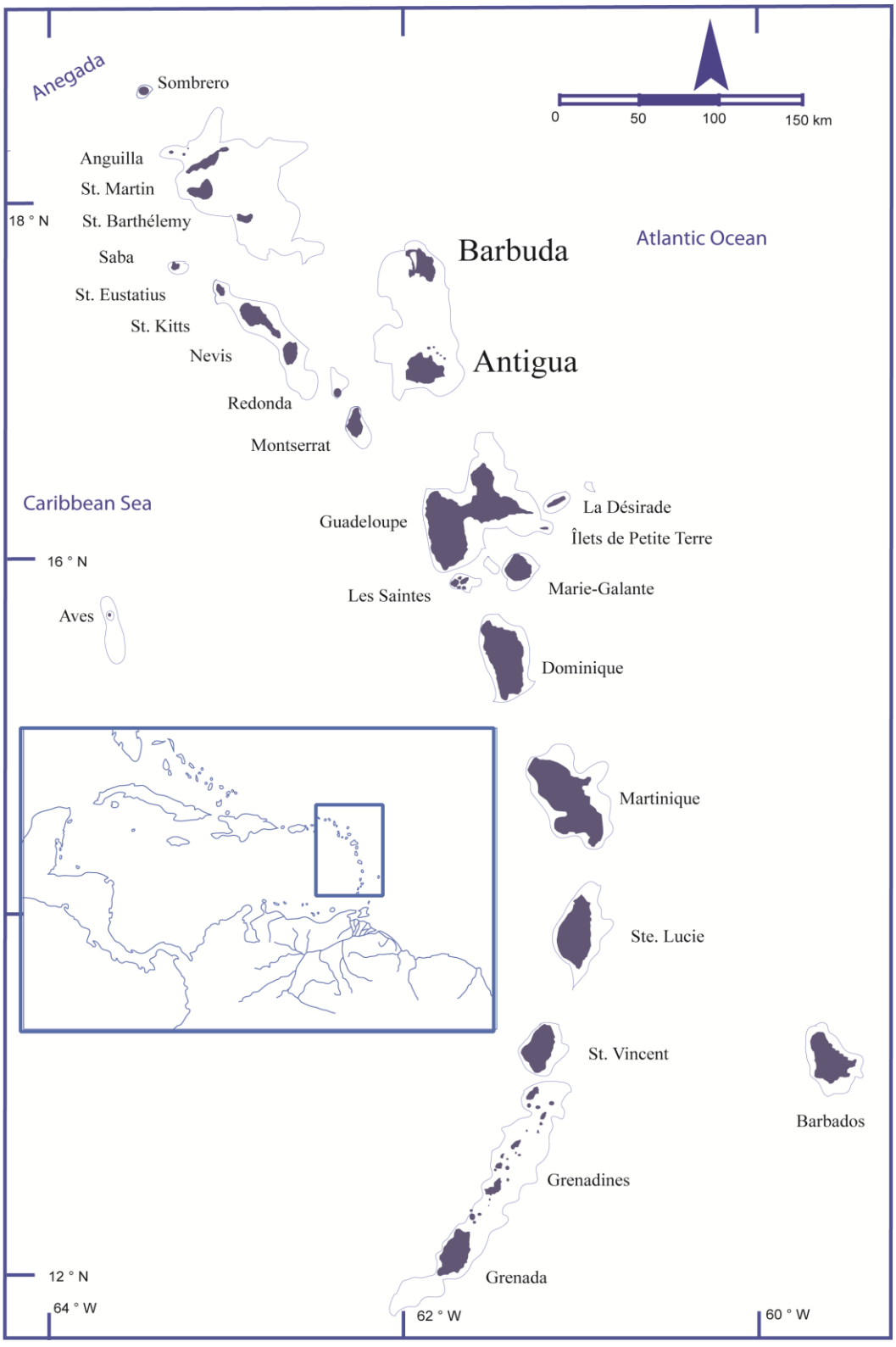

Figure 1. Location of Antigua and Barbuda showing 120 m isobath and maximal land exposure during the Pleistocene.

threatened by development and farming activities. The River site, Cattle Field and Burton's Field sites are located directly on or in close relation with an impressive linear shell midden following the former southwestern shore of the island. This shell midden, called the Strombus Line, composed primarily of *Lobatus (Strombus) gigas* or Queen Conch shells, was first recorded during an archaeological survey in the late 1970s by Watters (1980a, 2001; Watters et al. 1991). The present article aims to provide a better understanding of the exploitation of Barbuda's marine resources during the Archaic Age via the analyses of the results of these excavations, while contextualising the importance of Barbuda in the regional Archaic Age economy of the Lesser Antilles.

The Archaic Age occupation and economy of the Lesser Antilles

The Caribbean is a multicultural and multilingual region and discussions around the chronologies of Caribbean prehistory and terminology are complex (Giraud 2013; Lundberg 1980; Pantel 1988; Keegan et al. 2013; Wilson 2007). The broad chronological periods, initially called Lithic, Archaic and Ceramic have had several names in the last decades (Wilson 2007), though recent research questions the existence of the Lithic Age in the Lesser Antilles (Rodríguez Ramos et al. 2013). There is no entirely satisfactory terminology but for the purposes of this short article, the terms Lithic Age, Archaic Age, and Ceramic Age will be used.

The Lithic Age is best represented on the large islands of the Greater Antilles, including Cuba and Hispaniola, which were settled some 6000 years ago by peoples arriving from the Belize area of Central America (Bullen 1969; Callaghan 1985, 1991; Hofman et al. 2011; Keegan 2000; Murphy 1999; Rodríguez Ramos et al. 2013; Wilson 1995). However, other scholars also propose migrations from different regions of Central and South America including Colombia and Venezuela (Fitzpatrick 2013; Hofman et al. 2011; Kozlowski 2004; Rodriguez Ramos 2010; Rouse 1989). While these groups of mobile fisher-gatherer-foragers of the Lithic Age probably knew of the existence of the Lesser Antilles, they do not appear to have exploited these islands until much later, unless these early sites have yet to be discovered. Some islands closer to the South American mainland like Trinidad (once attached to the mainland) were colonized earlier (around 8000 BP) (Fitzpatrick 2013).

The first Archaic Age settlers to the northern Lesser Antilles arrived around 5000 years ago. Originating either from northern South America (Bonnissent 2008; Bonnissent et al. 2016; Bullen 1961, 1969, 1971; de Mille 2005; Fitzpatrick 2013; Giraud 2013; Haviser 2001; Keegan 2000; Lundberg 1991; Olsen 1971), from the eastern Greater Antilles (Davis 1973; Giraud 2013; Gross 1975; Rodriguez Ramos et al. 2013) or from both (Hofman et al. 2006, 2014; Siegel et al. 2015; Watters et al. 1991), these settlers arrived with new plants and technologies. Manioc, maize, sweet potato, avocado and beans, are believed to have been introduced during this period to some of the islands of the Greater Antilles including Cuba and Puerto Rico (Pagán Jiménez 2011; Pagán Jiménez and Rodríguez Ramos 2007; Rodriguez Ramos et al. 2013).

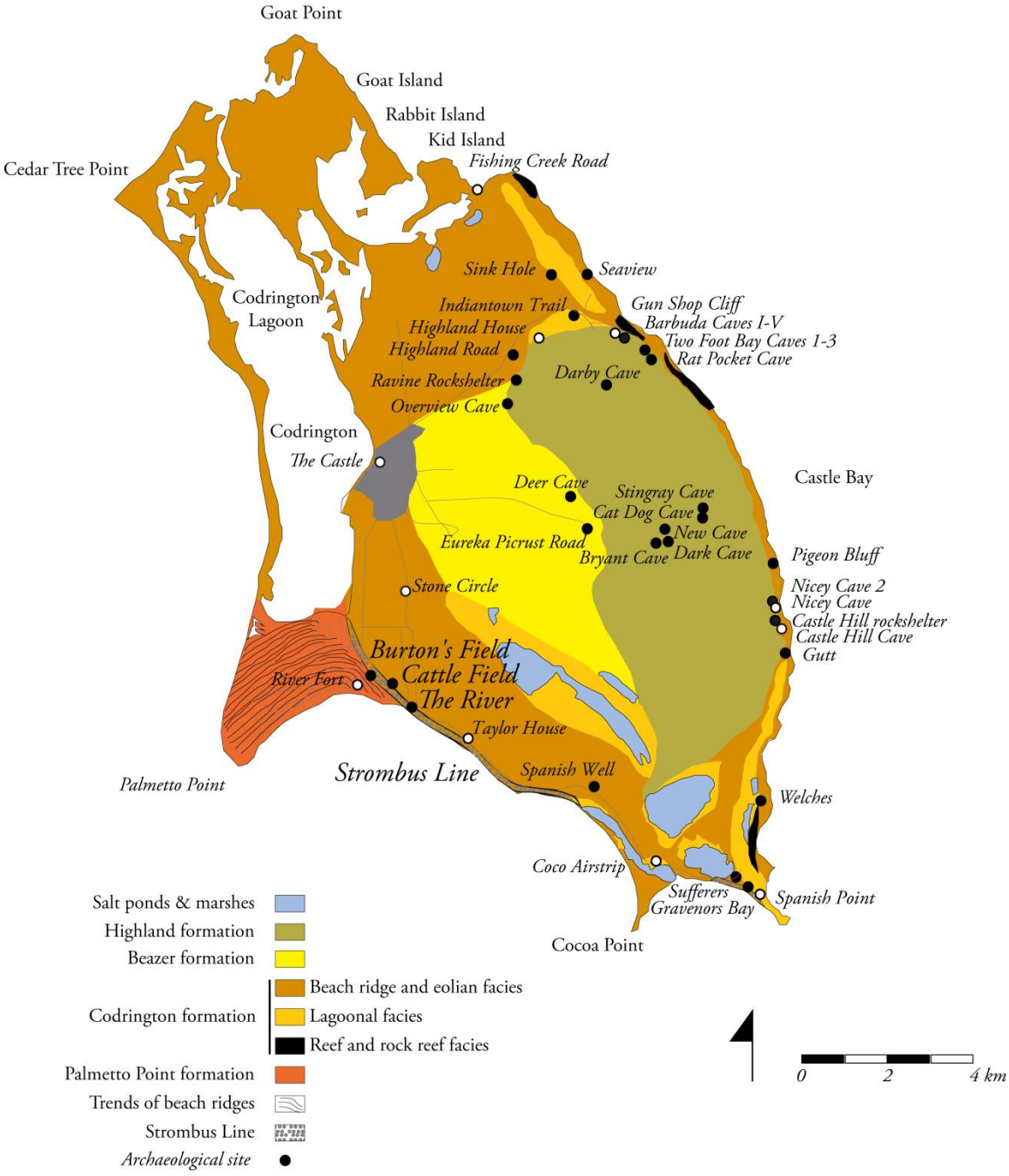

Figure 2. Geological map of Barbuda (modified from Brasier and Mather 1975) with sites mentioned in the text.

Archaic Age peoples are believed to have been organized into small highly mobile marine-oriented groups, who established seasonal or sporadically occupied settlements on most of the northern West Indies and on the Greater Antilles where they fished, collected shellfish and wild plants, and were involved in plant cultivation and management (Hofman et al. 2006;

Keegan et al. 2008; Newsom and Wing 2004; Rodríguez Ramos et al. 2013). There is ample evidence of regional exchanges between the islands of the northern West Indies, notably high-quality Antiguan flint, suggesting frequent expeditions between islands (de Mille 2005; Hofman and Hoogland 2003; Hofman et al. 2006, 2011, 2014; Knippenberg 2001, 2006, 2007). In contrast with other Leeward Islands, Antigua appears to be unique as it has several high quality flint sources, many sheltered bays, a rich biodiversity and extensive reef environments (Davis 2000; Knippenberg 2006; Murphy 1999; van Gijn 1993). Antigua houses some of the oldest and largest Archaic Age sites in the region (Hofman et al. 2006; Nicholson 1994) which suggests the potential archaeological significance of Archaic Age sites recently identified on the neighboring island of Barbuda.

The Strombus Line and the Archaic Age occupation of Barbuda

First occupied over 3800 years ago, Barbuda differs from other islands in the Northern West Indies. While the vast majority of this island chain is made up of geologically diverse hilly or mountainous volcanic islands, Barbuda is a flat atoll-like calcareous island. This directly influences the amount of annual rainfall and, subsequently, the nature and density of its vegetation. The island thereby has a more arid climate, limited fresh water (Mather 1971) and shallow sandy soil. During the Colonial Period the arid climate, lack of fresh water and poor shallow soils were not conducive to sugar cane cultivation which signifi-cantly transformed many Caribbean landscapes. As the island was used primarily for farming and grazing, several large Barbudan archaeological sites remain intact. About 1600 people currently live on the in the single village of Codrington.

Barbuda is surrounded by coral reefs that shield its coasts from erosion (Brasier and Donahue 1985) and provide marine resources. There is no barrier reef along the southwestern coast rendering it easily accessible by boat. Waters close to the coast are characterized by sandy and grassy sea beds, an ideal ecological niche for the Queen conch (*Lobatus gigas)* (Antczak et al. 2008; Ehrhardt and Valle-Esquivel 2008; Frankiel and Aldana Aranda 2007; McCarthy 2007; OPR 2013; Ray and Stoner 1995; Serrand 2002; Theile 2001). This sandy shallow coast was exploited by Archaic Age peoples for conch harvesting during more than a millennium, resulting in the creation of a linear shell midden over three kilometres long: the Strombus Line.

Watters first documented the Strombus Line in 1978 (Watters 1980a). He initially interpreted it as the result of a natural phenomenon. Given that the vast majority of the shells are Queen Conch, and that many show signs of conch meat extraction (removal of the apex or a simple puncture hole near the apex), the Strombus Line was eventually understood to be a cultural feature. However, since Watters did not identify any associated domestic structures, he suggested that the Strombus Line was primarily used for conch meat extraction and the production of conch shell tools, and that domestic sites may be located further inland (Watters 2001). On his second survey trip to the island Watters found exogenous flint at the Archaic Goat Pen site located slightly north of the Strombus Line. Flint was sub-sequently found at seven other locations along the Strombus Line notably near

the port in a location called the River (Figure 3).

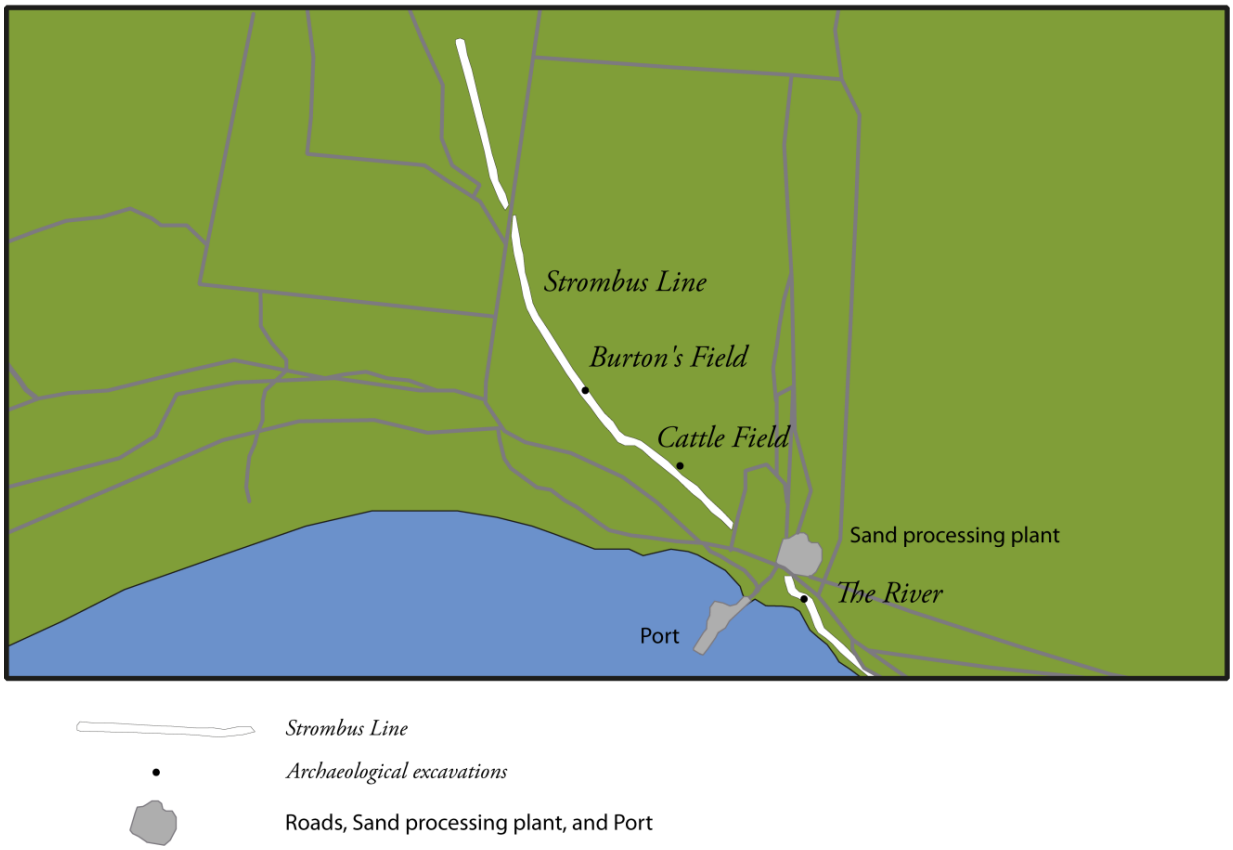

Figure 3. Map of the Strombus Line, and the River, Burton's Field (BuF 12) and the Cattle Field (CaF 12) sites.

Expanding on Watters work, The *Islands of Change* project systematically documented historic and prehistoric archaeological sites on Barbuda and partially excavated three Archaic Age sites (River site, Cattle Field and Burton's Field). In January 2011, a small team located and documented extant portions of the Strombus Line which extends almost 2 km west of the sand processing plant near the port (Figure 3) (Friðriksson et al. 2011). Although the majority of the Strombus Line east of and adjacent to the port was destroyed by road construction, intermittent traces were identified along a 1 km section. This suggests that the Strombus Line may have continued to Cocoa Point or even Gravenors Bay (Vésteinsson 2011). Following the former shoreline, the Strombus Line sits on the limit between the darker soils of the older Codrington Formation and the paler and younger sands of the Palmetto Point Formation. At a few locations, such as around the Burton's Field and Cattle Field archaeological sites, it is upwards of 30 meters in width and forms a slightly raised bulge on the otherwise flat terrain. However, intact sections that have not

been altered or destroyed by recent activities such as road construction, farming and building vary greatly in width.

In the immediate vicinity around the port, a small team excavated the River site (BAA04) first identified by Watters (1980a). This site was partly destroyed and heavily threatened by seasonal erosion (Friðriksson et al. 2011). Located directly in the mouth of a seasonal stream, the River site mainly consists of a washed out midden and a few isolated and intact stratified deposits. Approximately 3.5 sq. m of stratified deposits, identified as areas A, B, and C were excavated (Friðriksson et al. 2011).

Area A, a natural deposit created by fluvial erosion, was excavated in order to understand the stratigraphic sequence and geomorphologic processes. This revealed several relatively shallow layers of aerial and fluvial deposits which accumulated over the darker cultural layers rich in shells (Friðriksson et al. 2011).

Area B, a small *in situ* island of archaeological and organic material protected from fluvial erosion by mangrove roots, was the primary focus of our excavations at the River site. Approximately 1.75 sq. m were excavated and allowed us to recover several thousand shell fragments, almost exclusively of *Lobatus gigas*, along with some exogenous flint flakes and fire cracked rocks. Modern debris was found in association with artefacts in the upper layers, while the deeper cultural layers were highly disturbed by mangrove roots and inhibited sampling for radiocarbon dating (Friðriksson et al. 2011).

The location of a good context for radiocarbon dating and further geomorphologic analyses were the main objectives of area C. Its stratigraphic sequence revealed several episodes linked to fluvial action, consistent with its location in the middle of a stream delta subject to heavy seasonal rains, and at times, tropical storms and hurricanes (Friðriksson et al. 2011). A cultural layer was identified for radiocarbon sampling and two radiocarbon dated fragments of *Lobatus gigas* place the River site occupation between 3280±35 cal BP and 2790±35 cal BP[5]. Below this layer with its sandy matrix, a dark organic natural layer is believed to be the decomposed remains of a mangrove forest. This organic layer was also identified the following year on the Burton's Field site.

In 2012, Dr. David Watters participated in the ongoing survey of the Strombus Line. Small excavations were undertaken on two of the best preserved sections and the team attempted to identify Watters' Goat Pen site. The survey documented the destruction of large sections of the Strombus Line over the last 30-40 years. Many sections documented by Watters have been ploughed under, leveled by machinery, flooded or used by locals for waste disposal. Furthermore, the Goat Pen site could not be located. It was probably destroyed between 2003 and 2009 when a large wooded area west of the modern sand plant was bulldozed and transformed into pasture.

The Burton's Field site contains a short section of the Strombus Line (approx. 80 m by 30 m) and is situated between a cattle pasture and vegetable fields (Figure 3). This area is fenced off which appears to have spared it from recent agricultural and grazing activities.

[5] SUERC-33604 (GU-23530) and SUERC-33605 (GU-23531), dates calculated with OxCal3 using ΔR = 0

The Strombus Line has been removed to leave only a slight surface mound. A small test unit (1 sq. m) was excavated for comparison with the contents and stratigraphy of the River Site. The unit was established in the middle of the Strombus Line where several flint flakes were visible on the surface. Several thousand whole and fragmented conch shell fragments, some of which were punctured, were found along with flakes of primarily Long Island flint. Two radiocarbon dated fragments of shell taken in different layers of the Burton's Field excavation place this site between 3232-3367 cal BP (2 σ) and 2153-2310 cal BP (2 σ)[6].

Located just a few metres north of the Strombus Line, the Cattle Field site was identified in the 2012 survey (Figure 3). Over an L-shaped area of approximately 500 sq. m, sporadically distributed shell and flint scatters varied between 1 m and 3 m in diameter. Between 2003 and 2009, it was bulldozed to create pasture and while the upper layers of the site are gone, this serendipitously revealed its archaeological potential. A single square metre was placed in order to straddle surface deposits and the adjacent grassy area. While the grassy area contained little to no archaeological data, the cultural deposit contained abundant bivalve shells and flint flakes. Contrary to the Strombus Line where Queen Conch makes up the vast majority of the shell fauna, the Cattle Field malacoarchaeological collection is dominated by the Atlantic Pearl Oyster (*Pinctada imbricata*). A radiocarbon sample taken on an Atlantic pearl oyster fragment from the lower layer of this site provided a date of 3073 – 3230 cal BP (2 σ)[7].

Methodology

All excavations followed standard Barbuda Research Center/ NABO (North Atlantic Biological Organization) procedures, including the recovery of all lithics, shells and organics. At the Burton's Field site, the entire square contents were sieved using a 4 mm mesh and bulk samples were taken for each stratigraphic layer and water sieved using a 2 mm mesh to ensure the collection of smaller lithic fragments, shells, bones and charcoal. At the Cattle Field site, the entire contents were wet-sieved at the research station using a 2 mm mesh. During excavation, natural stratigraphic layers were recorded along with shell density and soil color. Bulk soil samples were taken along with shell samples for radiocarbon dating and precise coordinates and altitudes were recorded with GPS units.

Shells from the 2012 campaign were counted and identified as precisely as possible and separated into categories reflecting the different shell parts (following Serrand 2001). They were then counted to obtain a Minimum Number of Individuals (MNI) and a general idea of conch meat weight. Given time constraints, shell volumes from the lower layers (101 to 103) of the Burton's Field sieving residues were estimated based on the results and volume of the top layer (100). Shells from the 2011 excavation of the River Site were not subjected to a detailed study.

Lithic collections were studied at the lithic laboratory at Université Laval

[6] UCIAMS-107937 (ULA-3253) and UCIAMS-107937 (ULA-3252), dates calculated with CALIB REV7.1.0 using ΔR = 0

[7] UCIAMS-107939 (ULA-3254), dates calculated with CALIB REV7.1.0 using ΔR = 0

in Quebec City, Canada. Morphological characteristics and spatial considerations were the main foci of the lithic analyses. Sourcing was also attempted using Knippenberg's (2006, 2007) descriptions of Northern Lesser Antilles lithic materials. Finally, an unsuccessful use-wear analysis attempt was conducted on the lithics from the 2012 excavations and on the shell tools collected during survey. This will be briefly presented in the lithics section below.

Results

The River site, Burton's Field and Cattle Field yielded shell, flint and coral exclusively. The following section presents results from the analysis of the collections recovered at all three sites, grouped by material.

Lithic analysis

A total of 294 flint artefacts were found on these sites: 75 from the River site, 153 from Burton's Field and 66 from Cattle Field. They all present similar characteristics and suggest similar technological processes. Given the lack of local sources, all flint recovered is exogenous and was brought to the island. The vast majority of the flint, according to its colour, form, texture and inclusions, appears to be from Antigua or the adjacent Long Island, just off of Antigua's northeastern coast (approximately 42 km south of Barbuda). These results are based on previous analyses conducted on chert from Blackman's point in Antigua by Knippenberg (2006), and a consultation with Dr. Reg Murphy. The high percentage of cortex identified in all three collections indicates this flint was brought to Barbuda and then knapped locally. Similar to many sites in the region (Bonnissent et al. 2001; Briels 2004; de Mille 2005; Hofman et al. 2011; Lammers-Keijsers 2005; Nokkert et al. 1995; Pantel 1991; Rostain et al. 2007; Walker 1980), opportunistic or *ad hoc* flake production using direct percussion with a hard hammer (probably also made of flint) seems to have been the standard knapping technique employed on all three sites. This lithic technology was simple, quick and efficient and sought to satisfy the immediate needs of a skilled knapper. It allows for the production of flakes with highly variable sizes, shapes and angles (Figure 4), and used all available parts of the cores. Tools are easily replaced and are discarded upon task completion (e.g. woodworking, shell working, butcher-ing, meal preparation, rope making, etc. see Briels 2004; van Gijn et al. 2008; Walker 1981) or when the tool loses its efficiency. The ratio of flake to angular waste production at these sites is fairly close to 50/50, especially at the Burton's Field and Cattle Field sites (Rousseau 2014). A few small exhausted cores were found, suggesting the importance of every gram of raw material brought to Barbuda. Voluntary retouching of flakes or angular waste was absent in all assemblages and wear was found on less than 20% of artefacts in each collection.

Figure 4. Lithic Flakes from the River, Burton's Field and Cattle Field sites.

Even if all three sites present similar lithic collections, the River site presents significant post-depositional alteration. While 24% of the flakes of River showed white patina and none showed traces of contact with fire, 72% of the Burton's Field and Cattle Field combined flakes had a heavy patina and 20% showed signs of prolonged exposition to high heat. The heavy patina, especially on some artefacts from Cattle Field, sometimes masked all traces of knapping and use to the point where it was impossible to see the original color and texture of the flake.

High magnification use wear analysis was attempted on several of the unaltered or less altered flakes from Barbuda, shell celts and some blades from Antigua. However, an artificial polish, likely the result of movement in the salt water and sandy environment near and on the Strombus Line obscured any potentially diagnostic surfaces and therefore precluded any attempts for use-wear analysis.

Archaeomalacological Results

The primary activity responsible for the formation of the Strombus Line was conch collection. Although Archaic Age middens often suggest a "dependency on a restricted number of species" (Hofman et al. 2006), 95% of the Strombus Line is made up of Queen Conch. By contrast, shell fauna from the Cattle Field site, adjacent to but not directly on the Strombus Line, is dominated by the Atlantic Pearl Oyster which accounts for 89% of the collection. The pH of the soil matrix around the Strombus Line is almost neutral, fluctuating between 6.5 and 7, which would not be a significant factor of decay for bones or more fragile shells. In all three collections, only one badly damaged fish bone fragment was found in the River Site assemblage, and fishing is therefore not considered to be an

activity that contributed to the creation of the Strombus Line. On the Burton's Field and River sites, both located directly on the Strombus Line, the low diversity of species suggests the strategic exploitation of Queen Conch.

The Queen Conch (*Lobatus gigas*, Linnaeus, 1758) has been collected for millennia by local populations for its meat and shell and is one of the most important mollusks of the prehistoric Antillean diet (Antczak and Antczak 2005; Antczak et al. 2008; Keegan et al. 2003). The Queen Conch is the largest gastropod of the Caribbean area, measuring up to 30 cm long and 20 cm wide, and weighing up to 2.3 kg. The meat weight varies between 50 g and 350 g with mean and median meat weights around 135 g to 160 g per adult conch (CFMC and CFRAMP 1999, Ehrhardt and Valle-Esquivel 2008, McKillop 1984, OPR 2013, Theile 2001). The Queen Conch is generally found between the intertidal zone and in depths of up to 20 m on sandy or seagrass beds where it feeds on algae and microorganisms (Ehrhardt and Valle-Esquivel 2008, Frankiel and Aldana Aranda 2007, McCarthy 2007, OPR 2013, Ray and Stoner 1995, Serrand 2002, Theile 2001). Conchs bury themselves in sand during the winter, and are more easily taken between March and November when they are more active and visible (Doran Jr. 1958, Theile 2001), suggesting spring through fall harvesting.

At 2 or 3 years, the juvenile *Lobatus gigas* reaches sexual maturity and develops a thick flared lip that was used for the production of polished celts (axes and adzes), as it is highly resistant (Kamat et al. 1999). Although no such shell tools were found *in situ* during excavations, six shell celts were found during Strombus Line walking surveys. These were measured and characterised using a combination of Lammers-Keijsers' (2007) and Serrand's (2001, Serrand and Bonnissent 2005) methods. These tools may have been used for multiple purposes, including cutting and carving wood, as well as splitting it when used as wedges (as suggested by Lammers-Keijsers 2005, 2007), digging, or for other purposes (see also Nieuwenhuis 2008 for wear and residue analyses). The removal of conch meat and the manufacture of celts results in several by-products with recognisable shapes. Accordingly, Conch fragments from Burton's Field were classified according to their shape and form (following Serrand 2002) (Table 1).

Due to time constraints, the Burton's Field and Cattle Field sites collections were analysed more thoroughly than those of the River site. Around 40 000 fragments were recovered from the single square metre excavated at the Burton's Field site. Of those, over 99% were identified as *Lobatus gigas* (N=39 838). In fact, only 218 other fragments, representing at least 14 different species including the bivalves *Pinctada imbricata* (N=135, Atlantic Pearl Oyster) and *Arca zebra* (N=5, Turkey Wing), the gastropods *Cittarium pica* (N=3, West Indian Top Shell), *Murex* sp. (N=3) and *Fissurella nimbosa* (N=2) and some marine wormlike creatures, *Petaloconchus varians* and *Siliquaria squamata* (Table 2) were recovered. Conch fragments were classified in 14 different morph-ological categories to determine MNI and were compared to the shell celt *chaîne opératoire* proposed by Serrand (2001, Serrand and Bonnissent 2005). Using the siphonal canal as a marker for the calculation of the MNI, 988 Queen

Conch were found at Burton's Field. Some shells had been exposed to intense heat, a practice often discussed in conch meat extraction techniques (see Bonnissent et al. 2001; Hofman and Hoogland 2011; Hoogland and Hofman 2015), however, it could also be the result of post depositional burning related to the historic lime kilns just a few meters off the site. Shells burned in the kilns to produce quicklime were exported from Barbuda (Watters 1980b) and burned shell cannot be confidently associated with the Archaic occupation at Burton's Field.

Table 1: Queen Conch forms from Burton's Field 2012 excavation

Morphology	Layer				
	100	**101**	**102**	**103**	**104**
Whole	0	3	2	5	0
Punctured	0	2	4	9	1
No lip, no puncture	4	2	14	27	2
No lip, punctured	4	18	26	50	1
Preform 1	45	50	85	122	23
Preform 2	21	33	15	7	2
Preform 3	5	6	12	2	0
Lip fragment	77	40	44	21	3
Tool	0	0	0	0	0
Apex	34	13	16	18	3
Bottom	178	142	219	151	23
2 spines	13	14	29	60	5
Waste	10 734	11 505[1]	9 115[2]	4502[3]	236

[1]9000 estimated small waste fragments
[2]6750 estimated small waste fragments
[3]2500 estimated small waste fragments

The Cattle Field malacological assemblage portrays a different picture of Archaic Age subsistence activities on Barbuda. Unlike the Strombus Line, this site contains little evidence of conch exploitation. Very few had a fully formed flared lip and almost none had the thick shell typical of adult conch, suggesting most were juvenile. Instead, it is the Atlantic Pearl Oyster (*Pinctada imbricata*) that stands out in this site's assemblage of 4226 shell fragments. This bivalve species represents 89% (N=3767, MNI of 626) of the shell collection while the mostly juvenile conch fragments represent less than 7% (N=283, MNI of 13) of the faunal collection. The Atlantic Pearl Oyster thrives in rocky bottoms and coral reefs suggesting that diverse environments were exploited by Barbuda's Archaic Age peoples. Other species living in rocky shores or coral reefs, like the Turkey Wing (*Arca zebra*) or the patella (*Fissurella nimbosa*), were found on both Cattle Field and Burton's Field and corroborates this behavior. Furthermore, mangrove oyster (*Crassostrea rhizophorae*) shells were identified suggesting opportunistic shellfish collecting behavior.

Table 2. Species represented in Burton's Field and Cattle Field 2012 excavations			
Site	Number of fragments per species		
	Lobatus gigas	*Pinctada imbricata*	Other[1]
Burton's Field	39 838	135	83
Percentage of assemblage	99,45%	0,34%	0,21%
MNI	988	20	
Cattle Field	283	3 767	176
Percentage of assemblage	6,70%	89,14%	4,16%
MNI	13	626	

[1]Other species include *Arca zebra*, *Crassostrea rhizophorae*, *Cittarium pica*, *Murex* sp., *Fissurella nimbosa*, *Petaloconchus varians, Siliquaria squamata* and unidentified species.

The differences in the faunal assemblages of these contemporary sites may be explained by the slightly inland setting of the Cattle Field site. While the meat of the heavy Queen Conch was processed directly on the shore where it was collected (as suggested by Keegan et al. 2003), lighter bivalves like the Atlantic Pearl Oyster appear to have been carried past the beach to a small domestic processing area where the meat would be extracted and processed or consumed. A substantial portion of the conch meat could also have been brought inland to be processed for later consumption (drying, salting or smoking) (Antczak et al. 2008).

To appreciate the impressive volume of conch meat that was harvested from the conch deposited in the Strombus Line feature, the Burton's Field results and minimal measurements of the Strombus Line taken in the largest and best preserved agricultural sector were subjected to further mathematical calculations. Using a meat weight of 148 g per conch individual, an approximate meat weight of 146.22 kg was consumed from the shells recovered from the 1 sq. m excavated at Burton's Field. Taking into account that the excavation took place at the highest point of the Strombus Line (which decreases in height on both sides, see Rousseau 2014) and that the width of the feature is relatively stable around 10 m, a MNI of 4 220 736 Queen Conch make up the 800 m long agricultural sector of the Strombus Line, representing 624 669 kg of conch meat. Using the radiocarbon dates currently available for this sector (cal. 3367-2153 BP), 722.16 kg of conch meat may have been consumed annually over a period of 865 years. Despite this convoluted extrapolation based on the excavation of a single square metre, these numbers are impressive and represent only one approximately 800 m long sector of the Strombus Line (which is at least 3 km in length, but may be to 8 or 9 km long), highlighting the importance of this linear feature as well as the magnitude of the Queen Conch population.

Discussion: How Barbuda relates to neighboring islands

Although several shell middens have been studied across the Caribbean (e.g. Antczak and Antczak 2005; Antczak et al. 2008, Bonnissent et al. 2001, 2016; Keegan et al. 2003, 2008, Murphy 1995, 1999; Serrand 2001), the Strombus Line is unique. Other shell middens have been found to have the same linear shape (heaps and scatters are also common, see Antczak et al. 2008 and Keegan et al. 2003), but few rival the Strombus Line in its dimensions. Further, the Strombus Line is notable in that it composed almost exclusively of conch shells in a region where middens tend to contain a variety of mollusks (Davis 1982, 2000; Edwald et al. 2012; Keegan et al. 2003; Murphy 1999), with the exception of the Baie Orientale site in St. Martin (2790 BP – 1930 BP), which is also dominated by Queen Conch (Bonnissent et al. 2001, 2016). A careful open area excavation of the Baie Orientale site identified shell celt production, as well as conch cooking techniques involving stone beds (Bonnissent et al. 2001; Serrand 2001). Similar cooking techniques seem to have also been found on the ABC islands in the southern Caribbean region (Hofman and Hoogland 2011; Hoogland and Hofman 2015). On Barbuda, areas dedicated to the production of celts and cooking were not identified, likely due to the limited extent of excavations. Future open area excavations on and adjacent to the Strombus Line may locate specialised activity areas. It should also be noted that both the Strombus Line and Baie Orientale sites were excavated using a standardized sampling methodology. Standardized field and analyses practices on future projects would also ensure the comparability of collections.

All Archaic Age sites excavated on Barbuda appear to be consistent with the interpretation of Archaic peoples as mobile fishing-collecting-foraging populations (Armstrong 1980; Bonnissent et al. 2016; Briels 2004; Hofman 2008; Hofman et al. 2006, 2011, 2014; Murphy 1999; Nicholson 1975a). Barbuda appears to have been integrated into a specialized and highly mobile economic model where specific activities took place on each island, exploiting the inequitably distributed resources (Bonnissent 2008; Bonnissent et al. 2001, 2007; Crock et al. 1993; Gross 1975; Hofman et al. 2006, 2011, 2014; Keegan et al. 2008; Lundberg 1980, 1991; Murphy 1999). This exploitation pattern resulted in the creation of specialised features like the Strombus Line and the Baie Orientale midden. In this economic system, the islands of Long Island and Antigua were exploited for their flint sources suitable for toolmaking (Knippenberg 2006; van Gijn 1993), while the island of Saba (Plum Piece site) might have provided wood for the production of canoes (Hofman et al. 2006, 2011, 2014; Hofman and Hoogland 2003; Nieuwenhuis 2008; van Gijn et al. 2008). Since Barbuda is neither particularly luxuriant nor fertile, and since neither lithic sources nor potable water are readily available, the large conch populations of its southeastern bank appear to be the main resource attracting Archaic Age peoples to the island. It is also possible that hardwood trees like such as lignum vitae (*Gaiacum officinalis*) and other species, were also exploited (Faucher, forthcoming), explaining the presence of shell celts found along the Strombus Line.

The three lithic collections of the Barbudan sites studied contain elements suggestive of the "down the line" model of distribution proposed by Knippenberg for the Ceramic Age (2007, 2013; Knippenberg and Zjilstra 2008). In this model, people travelled to the lithic source (usually Antigua for the immediate region), and directly acquired the raw materials, before transporting them to be knapped at their destination. On Barbuda, this is represented by the high percentage of cortex found on nearly 40% of the lithic collections analysed at all three sites (Friðriksson et al. 2011; Rousseau 2012, 2014).

During the Archaic Age, the southwestern shores of Barbuda should be seen as dotted with exploitation and processing stations, integrated to a wider regional system where each island had something to offer and was exploited by a highly mobile population (Hofman et al. 2006, 2011, 2014; Keegan et al. 2008).

Conclusions

The Strombus Line and the associated sites discussed in this paper provide evidence of the first known occupation of Barbuda more than 4000 years ago. They also suggest an integrated regional economy, which included the movement of populations and the exchange of resources between the islands of the Northern West Indies, and extending to the larger Caribbean region (Bonnissent 2008; Bonnissent et al. 2001, 2007; Hofman et al. 2006, 2011, 2014; Lundberg 1980, 1991). The rich seagrass beds of the Barbuda Bank allowed for an abundant Queen Conch population, and the Strombus Line reveals the importance of this resource in the diet of Archaic Age peoples.

The analysis of the Cattle Field faunal assemblage suggests the exploitation of multiple marine environments in which additional mollusk varieties likely supplemented conch, along with plant resources. Furthermore, the archaeomalacological signature of the Cattle Field site might indicate a possible domestic function. The site may have been used for several short stays or represents the accumulated refuse of several mollusk collecting expeditions. The Cattle Field assemblage may further suggest that Archaic Age groups also likely consumed smaller mollusks and plants during a relatively short time spent on Barbuda for conch collecting, processing and tool production, and that they dried, salted or smoked a portion of the conch meat to be consumed on other islands during other tasks.

The excavation and analyses of lithic and archaeomalacological remains from the River, Burton's Field and Cattle Field sites represent more than 70,000 mollusk fragments and almost 300 exogenous flint fragments. These artefacts and ecofacts add to the understanding of tools created and used by Archaic Age peoples and of the occupation and exploitation of the region. Concrete measures should be taken to protect what is left of this exceptional archaeological feature, as future excavations could provide a better understanding of occupation and abandonment of this coastal area. Barbuda and its Strombus Line represent the material remains of a mobile fisher/gatherer/foraging community that occupied the Northern West Indies and exploited resources scattered between its islands. As a station for conch collecting and processing, Barbuda was manifestly an important island for the mobile populations of the Archaic Age.

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