Stone artefact production and exchange among the Northern lesser Antilles
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3 Lithic analysis

3.1 Methodology

3.1.1 Introduction

The analysis of lithic artefacts and related technology dating to the Ceramic period has remained a poorly studied field within Caribbean archaeology. This is in sharp contrast to more abundant knowledge related to Preceramic Age stone tools and their industries (Davis 1982, 1993, 2000; Kozlowski 1974; Lundberg 1989; C. Moore 1982, 1991; Veloz Maggiolo 1991; Wilson *et al.* 1998). To a large extent, this discrepancy can be attributed to the emphasis put on cultural chronology within the regional archaeology. As lithic artefacts form very important cultural remains for the Preceramic period by the virtue of the absence of ceramics, most attention has been directed towards this category. With the appearance of the first ceramics, stone tools are considered to be inferior for this purpose and lost their central research position, especially because of the overall paucity of standardized tool types among flaked stone specimens of the Ceramic Age. It is noteworthy that some of the earlier studies devoted to lithic artefacts from the Ceramic Age had a strong cultural chronological objective (Allaire 1983).

Fortunately a change has been occurring over the past ten years or so, given an increase in research related to lithics (Bérard 1997, 1999a, 2001; De Mille 1996; De Waal 1999b; Haviser 1999; Knippenberg 1995, 1999c; Rodríguez Ramos 2001a,b). Initiated by the important work of Jeff Walker (1980, 1981, 1983), who was one of the first to specifically pay attention to stone tool technology and organization of production, recent research has directed attention toward the production sequences of stone artefacts, rather than merely describing formal tool types or artefact shapes. Unfortunately, the other important part of Walker's work, the determination of the function of tools through use-wear analysis, has not received much emphasis (Crock & Bartone 1998; Berman *et al.* 1999, 2000) and this field still remains largely neglected.[1]

This study analyses the distribution and exchange of lithic materials by focussing on the production of the lithic artefacts. Therefore, a short summary of stone tool production and the range of lithic artefacts among Ceramic Age sites within the region needs to be presented. Furthermore the technologies by which tools were produced, characterisation of the different stages of the production process, and the products and debitage must be considered. In this way, trajectories can be modelled for different stone tool production processes and all possible instances for which materials were transported need to be listed, closely following the work of De Grooth (1991).

Overlooking Caribbean stone tool technology and lithic artefacts in general, a number of recurrent groups of artefacts can be distinguished. These form part of a coherent reduction sequence aimed at the production of a specific set of end products. In addition, there are groups of artefacts that have not undergone such production process and were directly used. Before discussing the wide range of these artefact sets, I first need to define the term "artefact" as used throughout this work. I consider a piece of stone to be an artefact when it was either modified by humans and/or when it was brought to a site by humans as it does not naturally occur in the site area. I regard modification here in the broadest sense. This not only includes general stone working techniques such as flaking, pecking, grinding, and sawing, but also use related modifications as a result of abrading, hammering, and polishing, as well as modifications in shape and colour due to intentional burning of the piece of rock.

To provide a better understanding, I begin with a description and short discussion of the different groups of lithic artefacts. From the above definition it is clear that a first general distinction can be made between artefacts, that have undergone modification and those that have not. The former group of artefacts is further subdivided and discussed below. To the latter group belong all lithic specimens that do not naturally occur within a given site area, and that do not exhibit any form of obvious human modification. These artefacts are often referred to as manuports. Within the Caribbean, basically two groups of manuports occur: (1) various sorts of water-worn stone pebbles, and (2) red ochre.[2]

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[1] Currently, Yvonne Lammers-Keijzers (Leiden University) is studying use-wear on a broad range of artefacts, including different stone materials, pottery, shell, and coral (Lammers-Keijzers 2001b, in prep.).

[2] A third group of artefacts can be potentially added to this group. This is the range of unmodified raw materials, which had not been (yet) reduced. As it is often possible to link such material with artefacts from the same material, that clearly belong to a certain production process, these materials are considered part of such technology and will be classified as unmodified raw material intended for reduction.

The pebble-category is somewhat problematical in its interpretation. Lithic samples from Caribbean sites often contain a large number of water-worn pebbles. Many of these exhibit some kind of modification in the form of use-wear and can be definitely considered as tools (see below). However, there are often some items that do not exhibit such use-wear, even when viewed under a microscope. Two possible interpretations of these specimens can be presented: (1) they served tasks, that did not leave any detectable traces. Either the type of task was responsible for that (see Chapter 5; Stevens 2002; Lammers-Keijzers in prep. for an example of use-residue, which easily could have been removed), or the type of rock made it difficult for use-wear to form; or, (2) these specimens were intended to be used, but were never used. As these items have exotic origins the first option seems more likely.

Red ochre is a raw material used for making paints or pigments. As this material is ground to fine size before being used as a colorant, it will not often enter the archaeological record as a stone material. Sometimes, however, natural pieces or fragments are identified. Due to its low frequency in the archaeological record, little is known about its natural shape, making full interpretation of its modification difficult. Modified pieces can be only identified if they exhibit ground surfaces, and the distinction between a natural unmodified piece or a crushed piece for grinding (which can be considered as human modification) is hard to make.

Regarding the humanly modified items a distinction can be made between: (1) lithic specimens that have been shaped to serve certain tasks; (2) lithic specimens that can be considered as the debitage of that shaping process; (3) lithic specimens that have been only modified through its use, hereafter referred to as use-modified artefacts (see Rodríguez Ramos 2001a; Walker 1997); and (4) lithic specimens that were burnt and not otherwise modified. To start with the latter group, these include intentionally burnt artefacts, such as cooking stones or stones used to prop up pots during cooking. Unintentionally burnt artefacts need to be considered as well. It is often very difficult to distinguish between intentionally burnt stones, or unintentionally and/or naturally burnt stone, if the use-context of the rocks is unknown. The shape of the object will be the best clue to interpretation then. Considering this and the fact that burnt rock, if not fire-cracked, can be difficult to recognize and therefore easily missed when excavating, systematic discussion of these artefacts will be left out of this work.

This brings me to the three other groups of items, that make up the majority of artefacts within Caribbean lithic assemblages. In fact, the first two groups listed above can be contrasted to the third group, the use-modified specimens. In case of this latter group, the process of intentional shaping (the production process) is absent, whereas the other two are inter-related because the second one forms the waste from production of the first one.

Among the use-modified materials, a range of artefacts can be included. These artefacts all share the characteristic that they have been collected as natural rocks and were used without being shaped beforehand by flaking, pecking, sawing or grinding. In the Caribbean, the majority of use-modified artefacts consist of beach or river cobbles, hereafter referred to as water-worn pebbles. Raw materials that are usually found among use-modified tools largely depend on local availability in the direct surroundings, but generally include igneous rock, fine-grained sedimentary rock, and limestone (Knippenberg 1999c; Rodriguez Ramos 2001). Pebbles were used for all kinds of tasks, depending on their natural shape. In addition, more angular rocks are occasionally found. I distinguish the following general types of tools (see Rostain (1994) for a more detailed discussion of use modes):

(1) hammer-stone: active tool for flaking, pecking, or crushing objects. Rock exhibits localised pits as use-wear, often on edges or high points.

(2) anvil stone: passive tool for supporting an object to be flaked or crushed. Generally flat rock surface exhibits localised pits as use-wear.

(3) rubbing/abrading stone or manos: active tool for grinding or abrading an object. Rock exhibits localised abraded or smoothed areas on convex to flat surfaces.

(4) polishing stone: active tool for polishing an object, likely pottery. Rock exhibits polish, often all over, as well as fine striations.

(5) grinding or milling (metate) stone: passive tool against which an object (for example an axe) or a substance (for example red ochre, or food stuffs) is ground. Object exhibits a concave or flat abraded or smoothed surface.

Focussing on shaped pieces and their related debitage, we enter the field of lithic technology. Within this field a distinction is often made between flake or blade tool technology on the one hand and core tool technology on the other (Collins 1975). Within the former technology, flakes, the detached pieces, are the aim of the production and the desired end products are tools in the form of these flakes, with secondary work or not. In core tool technology, the objective piece from which flakes are detached is the aim of production and the desired end products constitute various types of core tools and core objects.[3]

Unlike the Preceramic Age, during which flake as well as blade tool technologies were used (Armstrong 1978; Crock *et al.* 1995; Davis 1982, 1993, 2000; Knippenberg 1999d; Nodine 1991), the Ceramic Age exhibits little variation among flaked stone artefacts as only an expedient flake technology was utilized throughout the region (Bérard 1997, 2001; Berman 1995; Crock & Bartone 1998; De Mille 1996; Knippenberg 1999c; Rodríguez Ramos 2001a; Rostain 1997; Walker 1980, 1985, 1997). A common feature of this technology is the use of direct freehand percussion as well the bipolar flaking technique. In addition, an absence of standardized tool shapes is characteristic and most tools lack intentional retouch. Identified artefacts include cutting, scraping, and drilling tools, as well as grater teeth (Walker 1980, 1983; Berman *et al.* 1999, 2000). Utilized raw materials include flint, chert, jasper, quartz, silicified wood, and silicified tuff (Bérard 1999; Bérard & Vernet 1997; Crock & Bartone 1998; De Mille 1996; Knippenberg 1999c; Rodríguez Ramos 2001a; Walker 1980, 1985, 1997).

Among the core artefacts, different production technologies can be mentioned, each having its own end product. These end products include true tools, hereafter referred to as core tools, as well as decorative and religious items, simply called core objects in this work for lack of proper denomination. Core tool technologies basically comprise axe (celt) or adze production (Crock 1999; Knippenberg 1999c, 2001a; Rodríguez Ramos 2001a; Walker 1985). In addition to these generally formal tool technologies several other utensils can be considered as human shaped core-tools. However, they lack extensive production processes, such as, for example, net-weights (Keegan 1997) or metates (see Chapter 5). Core object technologies comprise bead, pendant, zemi and rare stone collar productions (Cody 1991, 1993; Crock 1999; Crock & Bartone 1998; Murphy *et al.* 2000; Narganes Storde 1999; Walker 1995; Watters & Scaglion 1994). All share the characteristic that the core itself is to be shaped into an end product, either very small in case of beads[4] or very large in case of metates (Knippenberg 2001a). The core tools and core objects are usually referred to as "ground stone" technologies as different from "flaked stone" technologies. Regarding the end products, this distinction is justified to some degree. However, it should be noted that in viewing the whole production sequence ground stone technologies generally start with a flaking stage, and some core tool productions do not include a final grinding phase, as is the case for net-weights and, for example, hand-axes or bifaces, to name a common world-wide non-ground core tool type (Newcomer 1970). Therefore, the major difference between flake tool and core tool technologies within the Caribbean is evident in the type of the core artefacts found in the first place. Important in this respect is to distinguish flake cores from preforms, as well as various finished products such as axes, beads, pendants, etc. Secondly, the presence or absence of use-wear and/or modification of flakes may also be a discriminating feature.

The variety among end products is also evident among their production sequences. Axe, adze, bead, pendant, and zemi technologies can be considered as ground stone technologies, while the metate, net-weight, and edge grinder productions lack a final grinding phase and only involve flaking and perhaps a pecking stage. In some cases the flaking stage might only include a few flake removals, as the original piece naturally resembles the desired end product in shape. This pertains to the production of axes and adzes from water-worn pebbles, and to the metate production, for example (Knippenberg 1999c, 2001a). In the case of net-weights, this is even more evident as the desired end product consists of a water-worn pebble with only two to four flake removals at the middle to make indentations, leaving the remainder of the piece untouched (Keegan 1997).[5]

Considering raw material choice, igneous and metamorphic rocks are generally used for making axes or adzes (Knippenberg 2001a; Murphy 1999; Rodríguez Ramos 2001a; Roobol & Lee 1976; Walker 1980, 1985, 1997). Igneous rock is often used for metates (Knippenberg 2001a), while various rocks, including igneous rock, conglomerate, calcite and limestone are used for zemis. All sorts of semi-precious stones and rock crystals are used for making beads and pendants (Cody 1991, 1993; Murphy *et al.* 2000; Narganes Storde 1995, 1999; Watters & Scaglion 1994).[6]

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[3] In my definition, core tools include axes, adzes, metates, and net-weights. As (core) objects I consider: beads, pendants, and zemis.

[4] It can be argued in general that beads and, in particular, flat discoidal beads were made from small flakes, although Crock & Bartone (1998) clearly show that carnelian beads at the Early Ceramic Age site of Trants were produced from small, blocky core pieces in most cases. The occasional shaping of flakes into beads does not significantly change the overall sequence and taking notion of the grinding process, this production is more similar to a core than to a flake artefact.

[5] The sites of Morel and Anse à la Gourde on Guadeloupe have also yielded examples of non-modified pebbles, probably used as net-weights (see Chapter 5).

[6] To complete this list of materials, shell and coral should be added as well because they were commonly used for making axes, adzes, beads, pendants (all shell), zemis (both shell and coral), and all sorts of active and passive grinding tools (coral) (see H. Kelly 2003; Lammers-Keijsers 2001b, in prep).

3.1.2 Aims

From the preceding, it should be clear that lithic samples from habitation sites include a wide variety of stone artefacts, which form the remnants of different types of production processes. In addition, a large set of stone artefacts did not undergo any production process and was used as is. Following distinctions discussed above, I have divided lithic artefacts into five groups and have named them "technology sets". Subdivisions have been made only within the core tool/core artefact set, as variation in the production process justifies such a division. At the same time, I have grouped them so that each sub-set basically correlates with a recurring group of rock types. Therefore, I have put the production of beads and pendants, which are two different types of core artefacts, within one and the same sub-set because similar materials were used to make both items (Cody 1991; Narganes Storde 1995, 1999). Some core artefact technologies are not included as they rarely occur within the study area, such as net-weights and stone collars.

The following technology sets have been distinguished:

Technology set 1: artefacts related to flake tool technology.
Technology set 2: artefacts related to core tool or core object technology.
 2a: artefacts related to axe or adze production.
 2b: artefacts related to metate production.
 2c: artefacts related to bead or pendant production.
 2d: artefacts related to zemi production.
Technology set 3: use-modified materials.
Technology set 4: manuports, the non-modified exotic pieces of rock.
Technology set 5: burnt-modified artefacts.

It can be argued that these sets oversimplify the rather dynamic process of lithic tool production, which may take many forms, especially if re-use and re-shaping is a recurrent feature. Furthermore, the possibility exists that certain tool technologies yield various artefacts that served totally different tasks. Especially in the case of debitage it is not always possible to classify an artefact into a specific technology set. Considering the expedient nature of flake tool technology, in theory it is likely that proper flakes generated during the manufacture of, for example, an axe may have been used as flake tools. Fortunately, lithic tool production within the Caribbean, at least within the north-eastern Lesser Antilles study area, was relatively formal in its choice of raw materials. I mean here that certain specific rock types were generally chosen to make specific types of tools, despite the presence of alternatives. For example, flint, jasper, and chalcedony were always used for making flake tools, and are not found in the form of axes or adzes (see also Chapter 6 for discussion on the uses of St. Martin greenstone).

In Chapter 1, I emphasized the subtractive nature of stone tool production. This enables the archaeologist to study the whole production sequence (Ammerman & Andrefsky 1982; De Grooth 1991; Torrence 1986). Such a sequence can be divided into different stages or activity sets, which can be considered as specific phases within the production process. The change from one phase to another may correlate with the use of a different flaking technique, or it may signify the change from reducing cores for flake production to reducing the flakes themselves. Such breaks in the stone working sequence potentially form moments before or after which items are transported. Collins (1975) has constructed general reduction sequences for flake tool and core tool productions. I take Collins' reduction sequences as the point of departure and simplify them so that they are applicable and useful for my purposes.

Having defined the different technology sets (TS), I have tabulated the different production trajectories for each set following the general scheme proposed by Collins (1975) (table 3.1). It should be remarked that these trajectories are simplified models of actual lithic artefact production. Furthermore TS 2 will exhibit variation depending on the type of core artefact made and nature of raw material available.

In her study on the organization of blade production during the Dutch Neolithic, De Grooth (1991) listed all the possible flows of flint materials and artefacts when this reduction sequence is coupled with all possible instances when lithic items are transported. She distinguishes transportation within a social group (direct access) and transportation between social groups (exchange). Translated to this case, a division should be made between TS 1 and 2 on the one hand, and TS 3, 4, and 5 on the other, as the sequence of the former sets is more complex and provides more possibilities than the latter ones do. Figure 3.1 presents the possible use-transport sequences for the latter technology sets.

TS 1 Flake tool production	TS 2 Core tool/core artefact production	TS 3 Use-modified tools	TS 4 Manuports	TS 5 Burnt-modified artefacts
Acquisition	Acquisition	Acquisition	Acquisition	Acquisition
I	I	I	I	I
v	v	I	I	I
Primary reduction and core-preparation	Primary reduction and core shaping	I	I	I
I	I	I	I	I
v	v	I	I	I
Core reduction	Secondary reduction	I	I	I
I	I	I	I	I
v	v	I	I	I
Shaping of flake-tools	Grinding/polishing	I	I	I
I	I	I	I	I
v	v	v	I	v
Use	Use	Use	(Use?)	Burning
I	I	I	I	I
v	v	v	v	v
Discard	Discard	Discard	Discard	Discard

Table 3.1. Production sequence, divided into different activity sets for each technology set, modified after Collins (1975).

Using these models as the starting point and bearing in mind the additional information that can be gathered from a subtractive process, the aim of the present technological analysis is to specify which stage(s) of the production process took place at a particular location. Regional comparison between different locations indicates in what form material was transported. This information will be further used in the following chapter to specify in which instances exchange was the mechanism by which items were transported, and what the type of exchange might have been.

3.1.3 Data analysis

Flake tool technology

To reach the goal specified above, I set up a data-collecting program. As this study was centred on flint and chert, in particular on Long Island flint flake tool production and its distributions, my data collecting strategy was organised around reduction of this material. As is clear above flake tool production can be divided into different activity sets, which may have been performed at different localities. All likely localities where these stone materials were worked should be investigated, to obtain a complete view of such a production process and its distribution. Within the Caribbean only two different types of sites at which flint and chert were worked have been reported thus far. These include lithic source areas and their direct surroundings (Pike & Pantel 1974; Van Gijn 1996; Verpoorte 1993), and habitation sites (Crock & Bartone 1998; De Mille 1996; Knippenberg 1999c, 2001a, b; Rodríguez Ramos 2001a; Walker 1980). So far, special flint and chert work camps other than those at lithic sources, have not been reported within the region. The sampling of habitation sites is discussed below in section 3.2.1.

Returning to the sequence of activity sets as proposed by Collins (1975), the data collecting strategy should be set up so that it is possible to determine for each site which parts of the production sequence took place and which parts not, using a specific number of related attributes. The following sections discuss the different broad phases in the production process separately.

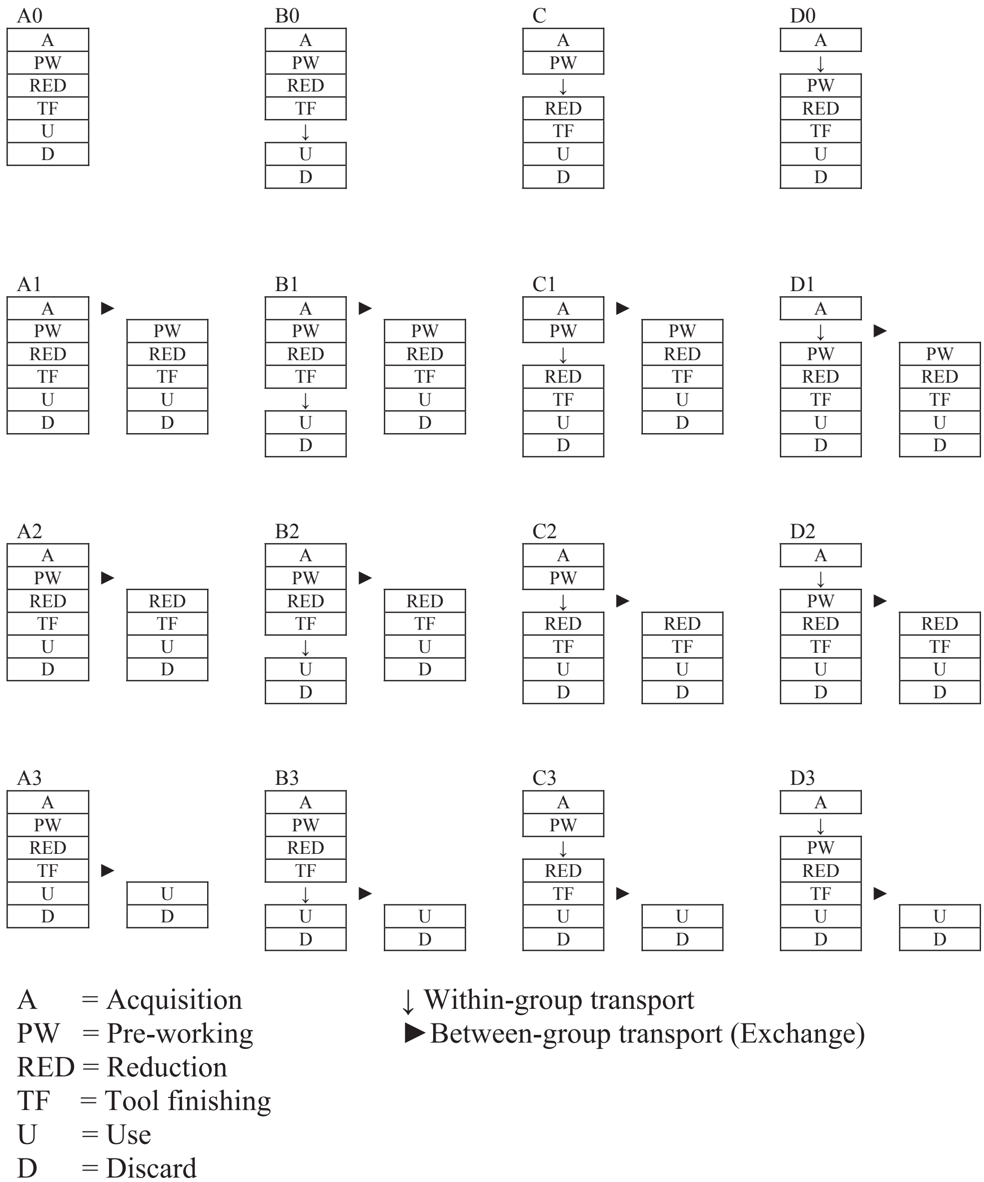
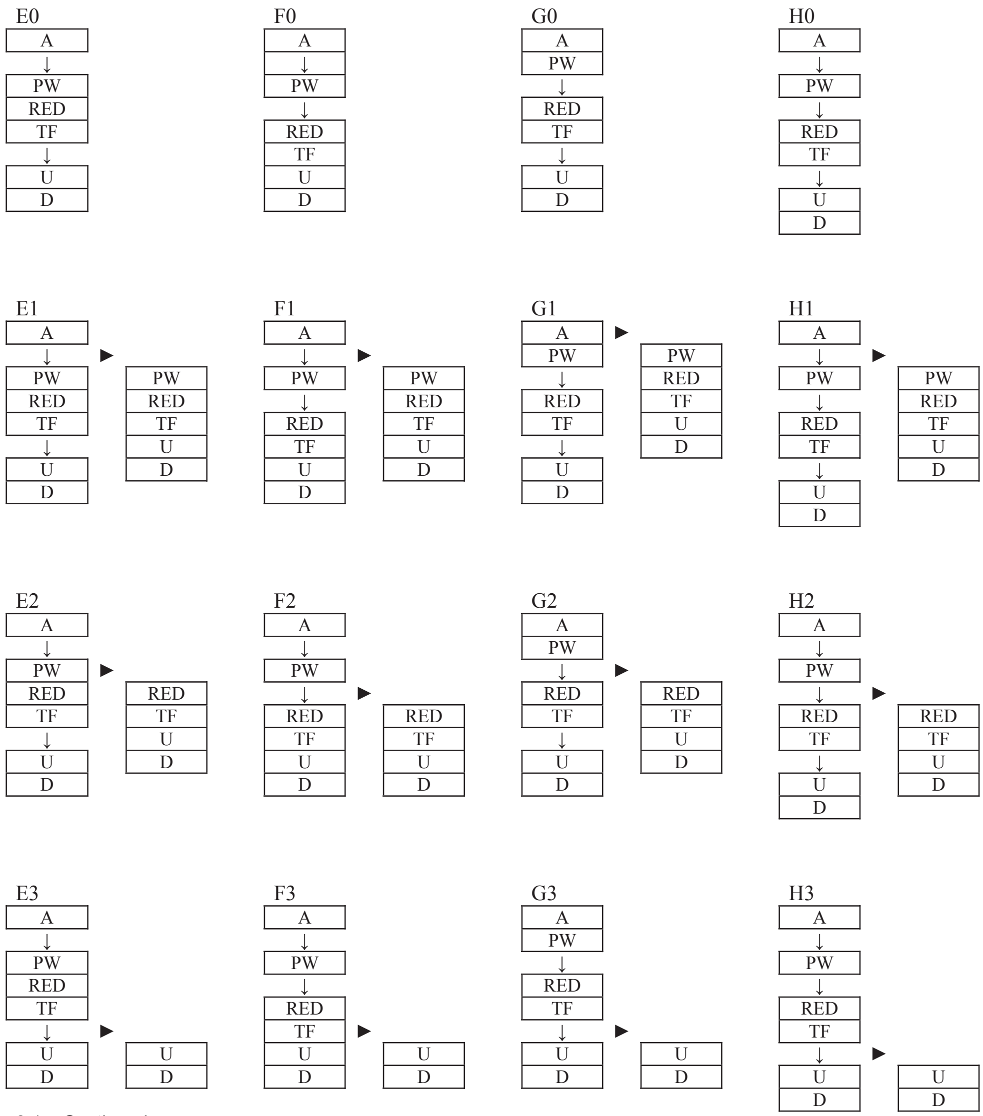


Figure 3.1a. Specific models for acquisition and manufacture of stone tools (flake tools (TS 1) as well core tools (TS2)), allowing for transport at different stages in the production process, and distinguishing within-group en between-group transport (after De Grooth 1991, 170-171, with modifications).



3.1a. Continued.

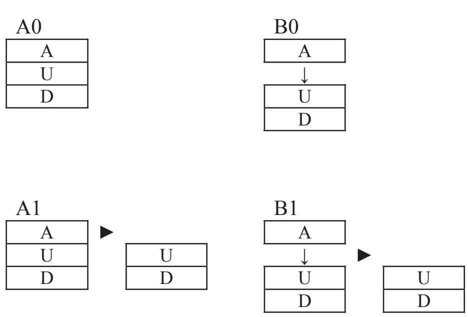


Figure 3.1b. Specific models for acquisition and use of use-modified and burnt rock (TS 3, 4 and 5), allowing for transport at different instances, and distinguishing within-group en between-group transport (see figure 3.1a for explanation).

Acquisition

The first step in the lithic tool production process is the acquisition of raw material. This step needs to be studied at or near the source localities. To be able to make a proper distinction between production stages, detailed knowledge on the nature of the raw material is essential. Therefore the following questions are to be addressed first:

(1) How is the raw material naturally distributed and what are the characteristics of any natural form in which it occurs?
(2) Do the sources provide any evidence of quarrying strategies?

To answer question 1, the natural availability of the lithic material was studied and characteristic occurrences were noted. Special attention was addressed to whether the material was scattered on the surface, or still present in its primary bedrock deposition. Furthermore, shape, size, and outer surface of the natural material were recorded. The former two features significantly influence the nature of the debitage produced in the end. Experimental studies have demonstrated that the relative amount of cortical flakes, and the size and weight of the debitage are affected by the original size, form, and nature of the raw material. Therefore, knowledge on these features is essential when interpreting lithic samples (Amick & Mauldin 1997; Bradbury and Carr 1995). As the outer surface or cortex on flakes plays a significant role in determining the reduction stage, good knowledge of the possible types is crucial for a proper determination.

After important information about natural availability and physical characteristics of the material has been collected, the next step is to see if any archaeological evidence can be gathered from the source itself to provide insight into the manner in which the material was obtained (question 2). Two types of quarrying are distinguished: (1) collecting surface material, or (2) mining primary deposits. Both types are likely to yield different raw materials.

Reduction and tool finishing

Knowledge gathered about the natural characteristics of the lithic material and the likely form in which it was quarried form the starting point for a proper analysis of lithic reduction and identification of different stages within the reduction process. This part of the analysis addresses for each site, habitation as well as source sites, the following questions:

(3) In which form did material arrive at the site?
(4) Was the material worked at the site, and if so, what stages of production were performed and what specific products were made?
(5) Was the material exported from the site, and if so, in what form was it transported?

In answering questions 3 and 5, the following possible forms of chert material are distinguished: (a) unmodified material, (b) pre-worked cores, and (c) flakes/flake tools. The following possibilities were evaluated as production stages: (a) testing, primary reduction and core-preparation; (b) core reduction; (c1) primary trimming/shaping of tools; (c2) reduction of flakes; and (d) use of tools (Collins 1975).

Due to the expedient nature of Ceramic Age Lesser Antilles lithic technology, the shaping of morphologically standardized flake tool types had not played a role (Bartone & Crock 1993; De Mille 1996). In relation to reduction, Walker (1980) is the only one who has come up with a complete sequence for the tool production within the Caribbean. Supported by replication studies, Walker showed that at the Sugar Factory Pier site on St. Kitts, cores were reduced to produce flakes, which were either used as is or further reduced for the production of smaller flakes to be utilized as grater teeth (Walker 1980). This tool production did not involve any systematic secondary working in the form of edge modification or chipping, but occasionally flakes were modified by one or two flake removals to obtain a better edge. This absence of formal tool shapes poses difficulties in establishing the presence of actual tools at a site. For example, it has been very problematical for correct identification of grater teeth with any certainty (Crock & Bartone 1998).

To answer the questions formulated above, certain attributes were chosen that would yield useful data. Starting with the artefact classification, I have chosen to use the scheme of Sullivan and Rozen (1985). This classification scheme is based on flake breakage patterns, and it was originally presented as an objective scheme for classifying debitage. The proportions of different flake types were seen as indicative of certain reduction technologies, e.g. core reduction, biface reduction, and bipolar reduction. Application of this scheme avoids the use of more subjective typologies.

Sullivan and Rozen's article (1985) has been a great stimulus for interpreting the debitage of lithic samples with respect to type of reduction. Although many lithic specialists questioned their interpretations (Amick & Mauldin 1989; Ensor & Roemer 1989), its less subjective method was subsequently used in many experimental studies to adjust these interpretations (Amick & Mauldin 1997; Ingbar & Bradley 1989; Kuijt *et al.* 1995; Prentiss & Romanski 1989).

Recently it has been questioned whether distinct stages occur within stone tool production processes, and scholars have noted that lithic reduction should be seen more as a continuum (Bradburry & Carr 1995; Shott 1996). From a knapper's point of view one can definitely point out certain stages between which a clear qualitative change occurs (e.g. change of hammer or reduction mode), but these changes can not always be significantly attested within the produced debitage (Shott 1996). Still, experiments have shown that there are some attributes, that show a rough correlation with reduction stage. These make it possible to distinguish early from late reduction phases (Bradbury & Carr 1995; Shott 1996). As best indicators the following attributes are suggested: (1) amount of cortex on dorsal face, (2) scar count on dorsal face, and (3) weight (Andrefsky 1998; Shott 1996). Especially when a multivariate approach is used, high correlations between stage and attribute data are found (Bradbury & Carr 1995). Therefore, these attributes play a central role within the present analysis.

Flaking technique

Determination of the manner of force application is essential for a better understanding of the core reduction technology. Caribbean lithic studies have shown that two manners of force application were used: direct freehand percussion and bipolar reduction (Bartone & Crock 1993; Knippenberg 1995; Walker 1980). Both were used in the course of the same reduction process (Walker 1980).

Debitage will exhibit qualitative differences between these applications of force. Flakes from direct freehand percussion generally have a clear cone of percussion, a pronounced bulb of force, and may be curved in shape, whereas bipolar flakes have a diffuse bulb of percussion, diffuse or well pronounced percussion rings, and often are flat and straight (Kuijt *et al.* 1995). Sometimes, it is hard to distinguish interior from exterior faces on bipolar flakes (Walker 1980). Caution should be used when individual pieces are assigned to either of the two types of reduction because bipolar reduction can produce direct freehand percussion type of flakes and visa versa.

Other technologies

As pointed out above, lithic technology within the Caribbean and elsewhere comprises a number of different production processes. This analysis so far has mainly addressed the methodology for analysis of artefacts related to flake tool production. This section presents the strategy by which artefacts associated with other technologies can be studied. Data presented in Chapter 5 and 6 show that the outcomes relating to other lithic technologies are variable and different from the results from chert and flint research. This is attributed to the poor knowledge about source areas for many of these other materials. This was the case, in particular, at the start of this research, although positive exceptions occurred as well (Knippenberg 1995; Van Tooren and Haviser 1999; see also Chapter 2). Fortunately, this situation has been recently changing as works by Murphy *et al.* (2000), Bérard (1997, 1999), Bérard and Vernet (1997), and Rodríguez Ramos (2001a) have provided valuable new information on natural availability of different raw materials in the Caribbean. Still, crucial data on actual quarry areas is generally lacking since most references only report the general occurrence of specific materials on an island or within a certain geological formation, but without specifying actual quarry locations exploited by pre-Columbian inhabitants.[7] Apart from these new findings, the provenance of many materials remains unidentified. In some cases it is possible to pinpoint areas or specific islands from which material likely originated, but in other cases only a "possibly local" or "possibly exotic" designation is feasible.

In addition to limited knowledge about sources, the low occurrence of a number of materials in the archaeological record hampers a detailed view about how they were worked, where they were worked, and over what distances they were distributed. A third feature that makes analysis of many of these technologies different from flake tool production is the less pronounced formation of technological features on the specimens due to the nature of the materials, as well as the fact that in some cases these features were blurred by later grinding or pecking within the production process.

Despite these inherent problems, an attempt was made to elucidate what stage material arrived at a particular site,

[7] The work of Bérard & Vernet (1997), reporting on stone working at jasper quarry sites on Martinique, is a positive exception.

which stages of the production process took place on-site, and whether any lithic items were transported elsewhere. In this case, a distinction was made between transport of (a) unmodified material, (b) preforms/blanks, and (c) tools or finished core artefacts. Stages were divided into (a) primary reduction of cores, (b) shaping of preforms, and (c) pecking and grinding of tools.

The debitage of the core-artefact production was analysed following the same scheme as was used to classify debitage of the flake tool production. I attempted to include as many of the attributes that were studied for the flake tool related artefacts, as possible. However, this was not always possible because determination of the flaking technique was very difficult in many cases. Furthermore, identification of outer surfaces was hampered due to ignorance about the original nature of such surfaces. Many rocks often lack a clearly distinct outer surface unlike, for example, flint where cortex rinds can be easily differentiated from the flint material itself. Finally, it should be noted that the amount of debitage related to these other productions was very small in many samples, thus complicating interpretation.

3.1.4 The attribute analysis form

To facilitate the analysis, a standard registration form was designed (see Appendix C for a complete presentation of the list of attributes, including definitions and codes). Each artefact was given an individual number and was studied for the following attributes: (a) raw material; (b) specific sub-variety of raw material; (c) artefact type; (d) length; (e) maximal dimension; (f) width; (g) thickness; (h) weight; (i) colour; (j) traces of burning; and (k) probable source.

Some remarks need to be made about the attributes a and b. I encountered a huge variety of rock materials during the analysis of the different lithic artefact collections and these can be attributed to the variable geological nature of the region. Materials include all sorts of igneous, metamorphic, and sedimentary rocks. Proper identification of every rock type would have required microscopic analysis, or the help of geologists familiar with regional rocks in most cases. Apart from the flints and cherts, this was beyond the scope of this research. Therefore general rock classes (e.g., igneous rock, metamorphic rock, and limestone) will often be used to denote raw materials in the following chapters. Only incidentally more specific rock classifications were recorded, if material was easily recognized or microscopic research had been previously performed (see Chapter 2).

After recording these attributes, core artefacts were separated from flake artefacts, and flake tool technology artefacts were distinguished from the artefacts associated with other production technologies. For all flake artefacts, (l) cortex count was coded as well as (m) reduction/modification, and (n) use-wear, if possible. All flake tool debitage was further analysed for the (o) scar count, (p) platform type, (q) distal end, and (r) flaking technique.

The "reduction/modification" and "use-wear" attributes need some additional clarification. Sullivan & Rozen (1985) distinguish debitage from modified flakes. They consider the former to be the debitage of the production and the latter to be tools. This distinction is more difficult to make within Caribbean lithic assemblages because the expedient nature of the flake tool production, in which a portion of the flakes were used ad hoc without any further modification. Still, flakes were further modified in some instances. This modification served two purposes. Some flakes were modified to improve their overall shape or to create a specific edge to be able to (better) perform certain tasks. Other flakes, however, were modified (reduced is a better word in this case), for the production of smaller flakes. In fact, these flakes can be considered as a type of flake core, which Rodríguez Ramos (2001a) has termed "core on flake". To exclude these two types of modified flakes from the true debitage, they were given a special designation under the attribute "reduction". In this way, the modified could be distinguished from the non-modified artefacts.

Actual signs of use-wear were recorded under the "use-wear" attribute. The proper identification of use and function of flaked stone requires specialized analysis, involving different microscopic techniques and related experimental work (Van Gijn 1990). This was beyond the scope of the present study. Therefore, a means was sought to provide a general indication of the degree to which flakes were used. Use-wear in the form of edge damage or use retouch was taken as the measure. Use-wear was defined as a regularly patterned damage along edges in the form of small flake scar negatives or retouch. A distinction was made between intentional retouch, considered to be deliberate secondary working of the edge to improve its working capabilities, and use retouch, considered to be damage produced when an object was used. Discrimination between these two categories was sometimes hard to make, unlike stone tool technologies in other world areas, where clear formal tool types are often recognized. Therefore, an arbitrarily line was drawn between them based on the scar size within the retouch.

All flake cores were categorised according to specific types defined by Hutcheson and Callow (1986). Furthermore, the presence of cortex and use-wear, and the type of flaking technique were recorded for the cores as well. Within the group of other core artefacts and core tools, a distinction was made between complete and fragmented items, as well as finished tools, and preforms. In addition, evidence about the mode of modification, such as pecking, grinding, and flaking, as well as evidence of used faces and type of use-wear was recorded. In the case of chopping tools, axes were distinguished from adzes based on the edge cross-section shape.

3.2 Cultural setting of sampled sites

3.2.1 Sample of sites

Initially the distribution of chert and flint, and Long Island flint in particular, formed the central theme of this dissertation. This distribution forms one of the main databases from which statements about exchange can be deduced. Therefore, the choice of sites to be sampled was made with this issue in mind. Certain considerations played a role in the sampling. First, sites ideally should be distributed in such manner that they would cover the complete pre-Columbian distribution of the Long Island flint material. If such complete coverage could not be reached, then it should be at least possible to say where the distribution likely stopped from the pattern identified. Secondly, considering the fact we are dealing with island environments, an even distribution of sites across as many islands as possible was preferred over an in-depth study of many sites on a single island. Thirdly, the sample should include sites, be they workshops, extraction camps or habitation sites, on the Long Island source itself, keeping in mind the crucial information that can be gathered about the physical characteristics of the raw material, as well as collecting and primary reduction of flint material as discussed above (see section 3.1.3). Fourth, sites on the surrounding islands preferably should be habitation sites as they were the central locus within Amerindian social life. Camp or workshop sites, other than those at or near the source areas, are unlikely to be of major importance, as this study deals with exchange patterns, that result from social relations, rather than subsistence strategies. It should be added that the study of settlement patterns where attention is paid to possible site functional variation related to subsistence strategies is poorly developed within Caribbean archaeology. Most attention is paid to the relative large sites, which are generally considered permanent settlements, while temporary campsites and workshop sites are often neglected (for discussion of small sites, see De Waal 2006).

Regarding the focus on habitation sites, preference was given to sites, that have (a) produced radiocarbon dates, (b) from which a significant sample of lithic artefacts has been gathered, and (c) from which artefacts have been collected in a systematic procedure using screens, for example. Furthermore, (d) artefact samples should originate within similar contexts in a given site. As stated above, these requirements formed the starting point for sample selection and were considered as ideal conditions. In reality the ideal could not always be met and the actual choice of sites was much influenced by available sites that had been studied. Although this local region has had a lot of recent archaeological research (a project like this would not have been possible 20 years ago), there are still considerable gaps. In the first place, not every island has been studied archaeologically. For example, the islands of St. Barths and Dominica still remain relatively unexplored with only a small number of unsystematic site identifications and no large-scale archaeological excavations (Gassies 1999; Honeychurch 1995, 1997). Secondly, some of the islands have been unevenly explored, in which certain areas are systematically surveyed and others are not, as is the case for Guadeloupe, Montserrat and Barbuda. Such uneven focus also can be identified among the sites chosen for excavation. In general, relatively large settlement sites have been preferred, often with an extensive period of occupation such as, for example, Anse à la Gourde and Morel on Guadeloupe (Hofman *et al.* 2001; Hamburg 2000); Trants on Montserrat (Watters 1994; Watters & Petersen 1999); Indian Creek on Antigua (Rouse & Morse 1999); Hope Estate on St. Martin (Hoogland 1999); and Golden Rock on St. Eustatius (Versteeg & Schinkel 1992). Exceptions, however, occur as well, such as small sites on Saba (Hoogland 1996).

In relation to chronology, sites dating to the earliest Ceramic period, i.e. Saladoid occupation, have received relatively more attention. This appears to be the case for St. Eustatius, St. Martin, Montserrat, and St. Kitts, which hosted

Amerindian populations throughout the entire Ceramic period.[8] Still, islands where this research bias is less evident also occur, such as Saba, Anguilla, Antigua, Nevis, and Guadeloupe.

Despite these and other biases more or less detailed archaeological maps exist for many local islands. These maps are in some cases based on a systematic survey in which the survey boundaries and methodology were clearly defined. In other cases, they have been drawn over the past years and are the result of more opportunistic data recovery methods. Still, in many of these latter cases site distribution maps provide almost complete coverage of individual islands and they apparently represent to a large degree the actual site distributions (e.g., Crock 2000).

Despite this variation in archaeological research within the northeastern Lesser Antilles, the past 20 years have certainly provided an enormous amount of new archaeological data, all of which has drastically changed the region's position within Caribbean archaeology (Crock 2000; Crock & Petersen 1999; Hofman 1993; Hofman & Hoogland 1999; Hofman *et al.* 2001; Hoogland 1996; Murphy 1996, 1999; Petersen 1996; Versteeg & Schinkel 1992; Watters 1994; Wilson 1989; for an overview, see Delpuech & Hofman 2004). Until the late 1970s, the northern Lesser Antilles were considered to be a marginal archaeological region between the relatively well-studied Greater Antilles and the Windward Islands. Now, however, they have been much better studied than many of the Windward Islands, and it is now believed that local developments played a much more important role in pre-Columbian times than previously thought (i.e. Hofman & Hoogland 2004; Crock 2000), as born out by this study.

Table 3.2 lists the different sites included within the sample (figures 3.2-3.12 for location of the sites). The specified qualifications described above for the sample to a large degree have been met. In general, the region from eastern Puerto Rico to Martinique, assumed to include the entire distribution of Long Island flint, has been covered and a fair number of islands were included (N=14). These include Vieques, Anguilla, Saba, St. Martin, St. Eustatius, Nevis, Antigua, Long Island, Montserrat, La Désirade, Petite Terre, Guadeloupe, Marie Galante, and Martinique. It should be noted that samples from some of these islands are very limited, as was the case for Nevis, La Désirade, Petite Terre, and Marie Galante. Moreover, in many cases the studied samples only represented portions of the entire lithic artefact inventory excavated. For example, samples from Montserrat, from a number of sites on the main island of Antigua, and from sites on Saba basically only included flake-tool-technology-related artefacts. The main reasons why entire collections were not studied are related to the limited availability of materials at the institutions where they are stored. In a few cases, my analysis only involved the recording of a limited number of attributes due to time restraints. This accounted for samples from Antigua excavated by Fuess, material from La Désirade, Petite Terre, and the Anse à l'Eau, and Cocoyer sites on Guadeloupe and Marie Galante, respectively.

A close look at the distribution of the studied islands reveals that islands surrounding the source area of flint are under-represented, unfortunately. On Barbuda, St. Kitts, and St. Barths, materials were not accessible for varying reasons. To overcome this under-representation to some degree, data from the master's thesis by Jeff Walker (1980) was used to provide useful information from St. Kitts. As Walker is very familiar with the Long Island material, his source classifications are considered reliable. Also, data from sites on Antigua excavated and published by Reg Murphy and Christy De Mille in recent years (De Mille 1996, 2001; Murphy *et al.* 2000), have been used to supplement my finds from Long Island and results from the limited analysis of the Fuess' sites. In relation to published work on lithic materials, studies from Haviser on St. Martin, and Crock and Petersen on Anguilla were very helpful as well (Crock 1999, 2000; Crock & Petersen 1999; Haviser 1987, 1988, 1991, 1993, 1999). In addition, co-operation with Reniel Rodríguez Ramos during my stay on Puerto Rico enabled us to set up an identical coding list of raw material types, with which we classified rock types encountered among the samples from the La Hueca and Sorcé sites on Vieques island, as well as some other Puerto Rican sites such as Punta Candelero and Paso del Indio (Rodríguez Ramos 2001a, b, 2005). We frequently exchanged data from these sites and others in the course of this research.

3.2.2 Chronology

The period between AD 400 and AD 1200 was considered to be most important to this research, because significant social-political changes occurred during this period, which marks the transition from the Saladoid cultural tradition to localized post-Saladoid cultures. When viewing cultural chronology within the Caribbean, I see a fundamental problem for this study.

[8] A superficial evaluation of research on Anguilla and Barbuda might indicate the opposite, as sites under study were almost exclusively post-Saladoid (Crock 2000; Wattters *et al.* 1991). This focus on post-Saladoid sites, however, is not the result of specific research objectives and fully can be attributed to the almost exclusive presence of Late Ceramic Age sites on these islands.

Site	Island	Radio-carbon date	Phase	Type of site	Reference
Trants	Montserrat	500 cal BC – cal AD 400	Early Ceramic A	Settlement	Petersen 1996; Petersen *et al.* 1999; Watters 1994
Vivé	Martinique	cal AD 144 – 440	Early Ceramic A	Settlement	Giraud *et al.* 1999
Hichman's	Nevis	5 cal BC – cal AD 620	Early Ceramic A	Settlement	Wilson 1989, pers. comm. 2001
Sorcé	Vieques	cal AD 136 – 650	Early Ceramic A	Settlement	Chanlatte Baik 1984; Narganes Storde 1991
Morel	Guadeloupe	cal AD 200 – 600	Early Ceramic A	Settlement	Hofman *et al.* 2000
Cocoyer	Marie Galante	no chronometric dates	Early Ceramic A	Settlement	Boomsma & Isendoorn 2001
Doigs	Antigua	cal AD 110 – 405 early cal AD 595 – 800 late	Early Ceramic A Early Ceramic B	Settlement	Fuess 1995, pers. comm... 2001
Diamant	Martinique	cal AD 415 – 725	Early Ceramic B	Settlement	Vidal 1992
Golden Rock	St. Eustatius	cal AD 450 – 850	Early Ceramic B	Settlement	Versteeg & Schinkel 1992
Les Sables	La Désirade	no chronometric dates	Early Ceramic B	Settlement	De Waal 2002, 2006
Kelbey's Ridge 1	Saba	cal AD 655 – 880	Early Ceramic B	Short-term settlement	Hoogland 1996
Anse des Pères	St. Martin	cal AD 750 – 950	Early Ceramic B	Settlement	Knippenberg 1999b
Anse à la Gourde	Guadeloupe	cal AD 500 – 1300	Early Ceramic B Late Ceramic A	Settlement	Hofman *et al.* 2001
Anse à l'Eau	Guadeloupe	no chronometric dates	Early Ceramic B Late Ceramic A	Settlement	Boomsma & Isendoorn 2001
Sandy Ground	Anguilla	cal AD 650 – 1035	(Early Ceramic B) Late Ceramic A	Settlement	Crock 2000
Barnes Bay	Anguilla	cal AD 775 – 1295	Late Ceramic A	Settlement	Crock 2000
Escalier	La Désirade	cal AD 1049 – 1243	Late Ceramic A	Settlement	De Waal 2006
Du Phare	Petite Terre	no chronometric dates	Late Ceramic A	Settlement	De Waal 2006
Spring Bay 3	Saba	cal AD 1000 – 1200	Late Ceramic A	Settlement	Hoogland 1996
Claremont	Antigua	no chronometric dates	Late Ceramic A	Settlement	Fuess 1995, pers. comm.. 2001
Blackman's Point	Antigua	no chronometric dates	Late Ceramic A	Settlement	Fuess 1995, pers. comm.. 2001
Coconut Hall	Antigua	cal AD 935 – 1190	Late Ceramic A	Settlement	Fuess 1995, pers. comm.. 2001
Godet	St. Eustatius	no chronometric dates	Late Ceramic A	Settlement	Hofman pers. comm. 2001; Van der Valk & Putker 1986
Smoke Alley	St. Eustatius	cal AD 1000 – 1160	Late Ceramic A	Settlement	Versteeg *et al.* 1996
Jumby Bay	Long Island	cal AD 1050 – 1250	Late Ceramic A	Settlement	Knippenberg 2001d, see Chapter 4
Anse Trabaud	Martinique	no chronometric dates	Late Ceramic A Late Ceramic B	Settlement	Allaire 1997
Shoal Bay East	Anguilla	cal AD 1005 – 1640	(Late Ceramic A) Late Ceramic B	Settlement	Crock 2000
Sugar Mill	Long Island	cal AD 1300 – 1400	Late Ceramic B	Settlement	Knippenberg 2001d, see Chapter 4
Morne Souffleur	La Désirade	no chronometric dates	Late Ceramic B	Settlement	De Waal 2002, 2006.
Kelbey's Ridge 2	Saba	cal AD 1285 – 1400	Late Ceramic B	Settlement	Hoogland 1996

Table 3.2. Sample of Caribbean sites by period. For each site the range of radio-carbon dates has been specified.

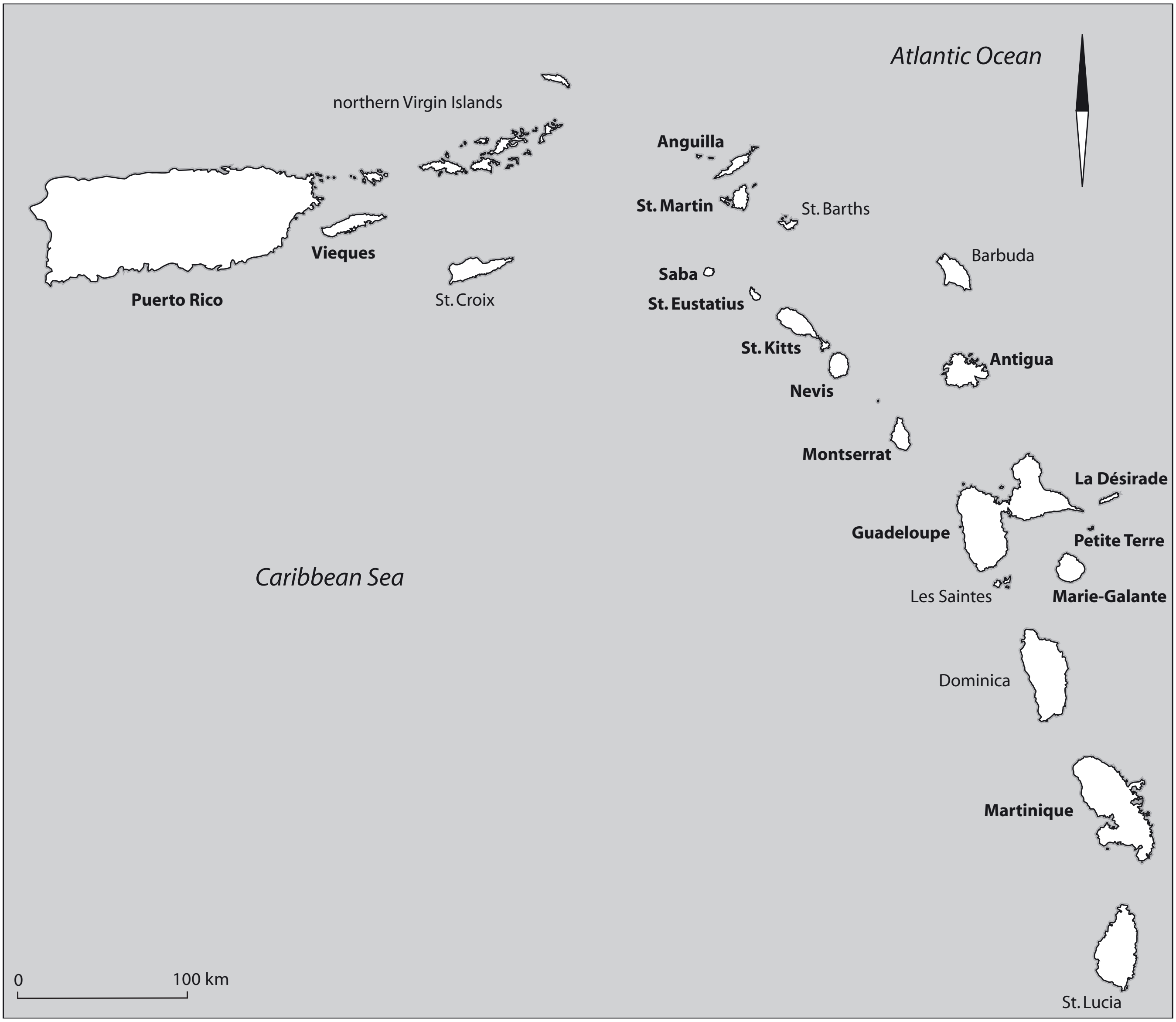


Figure 3.2. Map of the area studied in this work.

Rouse and many other Caribbean archaeologists have divided the chronology of the Caribbean within different cultural traditions, or to use the terminology of Rouse, Ceramic series and sub-series. Based on the absence or presence of certain ceramic modes, sites have been often classified to one of the different series and sub-series. Combined with stratigraphic data, Rouse was able to place these (sub)-series in relative chronological order. With the appearance of radiocarbon dating, this relative chronological division was supplemented and refined by absolute dates. However, rather than using the C14-dates to define and refine his relative chronology, Rouse largely stuck to his original somewhat static cultural divisions and unilinear developments. This created a situation where general cultural traditions over large areas succeeded each other one at a time over large areas, neglecting cases where traditions coexisted within an area, or persisted in isolated regions.

For the study of exchange networks, the primary objective of this research, we need to know the contemporaneity of sites within a certain period and that is much more important than knowing their cultural similarity or affinity. Therefore, what is needed is an absolute site chronology, rather than a cultural chronology. This all seems very straightforward, but looking at Caribbean archaeological studies it can be noted that cultural divisions are still used to make temporal divisions,

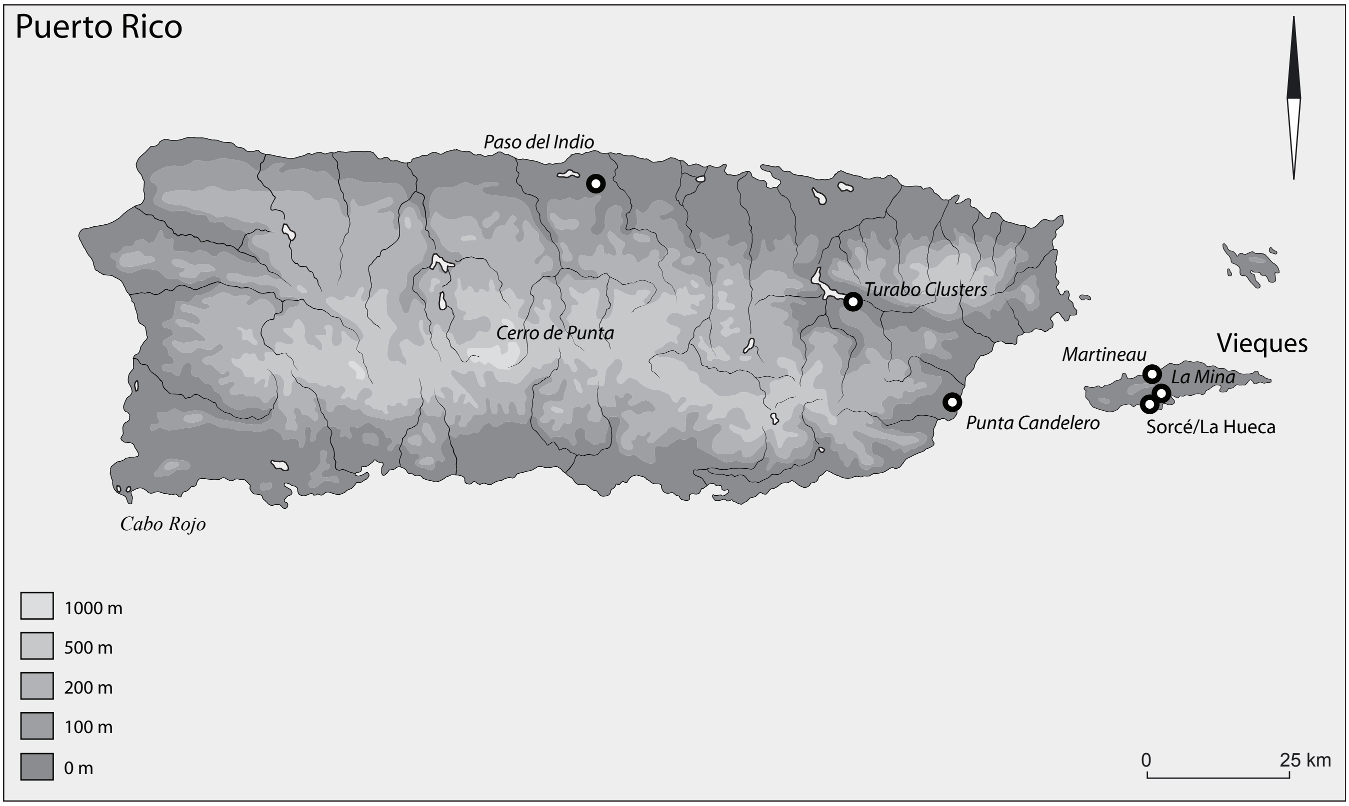


Figure 3.3. Map of Puerto Rico and Vieques showing the sites mentioned in this work. In normal font sites studied by myself, and in italic sites studied by others.

as in the case of the Saladoid and post-Saladoid period, which is based on ceramic traits, rather than on absolute dates. Therefore, in this study I distinguish certain phases in absolute years (see also Hofman 1993), which will lack a cultural connotation. Although they broadly follow the cultural chronology of Rouse, I avoid using terms such as the Saladoid period, for example. When I speak of Saladoid or Ostionoid sites, I mean sites that have produced ceramics possessing Saladoid or Ostionoid modes/traits, rather than sites belonging to the Saladoid or Ostionoid period.

I distinguish the following phases for the northern Lesser Antilles, following Hofman (1993, 28; see also Hofman and Hoogland 2004) to some extent and keeping in mind the aims of the present study:

The Preceramic Age: 3500 – 400 BC; during which ceramics were absent and fishermen and shell-fish collectors inhabited the islands.

The Early Ceramic A (early phase): 400 BC – AD 400; period, during which the first horticulturalists arrived, and during which Huecan and Cedrosan Saladoid ceramics co-existed.

The Early Ceramic B (late phase): AD 400 – AD 850; this period corresponds with the final phase and end of the Cedrosan Saladoid sub-series and the appearance of the first post-Saladoid ceramic styles.

The Late Ceramic A (early phase): AD 850 – approx. 1250; this period corresponds with the decline of ceramic features, commonly grouped among the general name of post-Saladoid, and development of more localized styles.

The Late Ceramic B (late phase): approx. AD 1250 – 1492/early Historic period: period corresponds with a revival of pottery art and the full development of chiefdoms in the Greater Antilles. Especially during the later part, foreign styles within the Lesser Antilles made their first appearances.

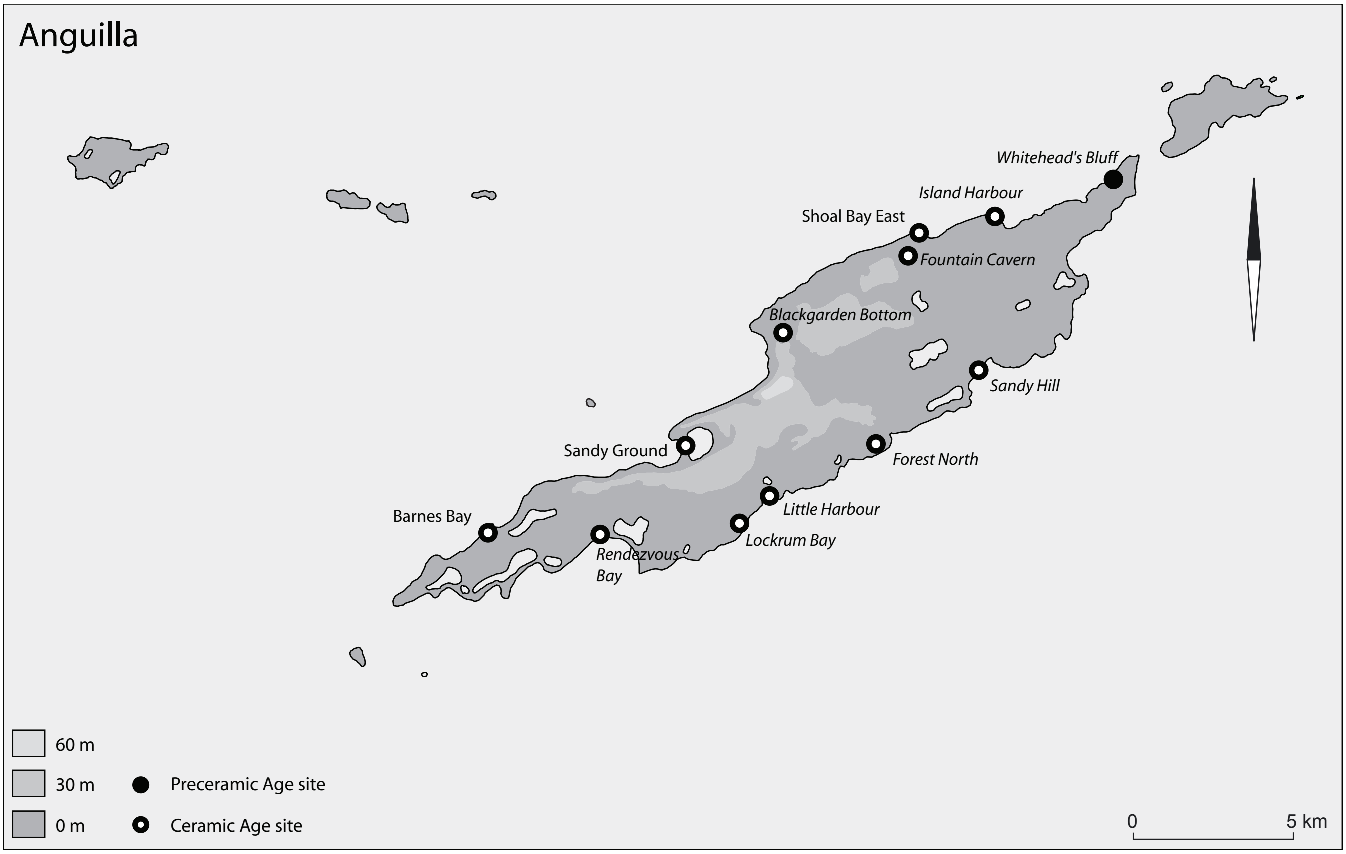


Figure 3.4. Map of Anguilla showing the sites mentioned in this work. In normal font sites studied by myself, and in italic sites studied by others.

Here, I mainly deal with the period extending from the Early Ceramic A to the Late Ceramic A phases, as they mark the period from Saladoid domination toward decline followed by local post-Saladoid developments. Attention is also devoted to the Late Ceramic B phase. However, knowledge about this phase is still poorly developed in the northern Lesser Antilles and mainly relates to materials from a very small number of sites.

Table 3.2 lists the absolute chronology of the different sites discussed in this study. The tabulated dates are associated with the material samples that were studied. So, in some cases these dates do not cover the entire period of occupation of a site, because the studied samples only formed a part of the total excavated collection. This is the case for Sorcé, Shoal Bay East, and Trants. In some cases absolute dates were not available, and sites were then given a probable date based on close similarities in ceramic modes with dated neighbouring sites. This is the case for Smoke Alley, Godet, Blackman's Point, Claremont, Anse à l'Eau, Cocoyer, and Anse Trabaud.

Trants, Vivé, Sorcé, Morel, Hichman's, and the early occupation at Doigs are the earliest sites used in this study, partly preceding AD 400 and therefore falling into the Early Ceramic A phase. Cocoyer has been placed within this period as well on basis of stylistic similarities. Late Saladoid sites belonging to the Early Ceramic B include Diamant, Golden Rock, Kelbey's Ridge 1, Anse des Pères, and the late occupation at Doigs. Les Sables has been classified as Late Saladoid as well on the basis of ceramic features. Multi-component sites with the earliest occpations during this same period are Sandy Ground, Anse à la Gourde, and Anse à l'Eau. Exclusive post-Saladoid sites belonging to the Late Ceramic A include Barnes Bay, Spring Bay 3, Smoke Alley, Escalier, Coconut Hall, and Jumby Bay. Godet, Blackman's Point, Claremont, Du Phare, and Anse Trabaud may be assigned to this period as well based on ceramic traits, although Anse Trabaud may also have been part of the Late Ceramic B. The excavators tentatively have dated this site between AD 1000 -1500 (Allaire 1997). The samples from Shoal Bay East, Kelbey's Ridge 2, and Sugar Mill are among the latest sites belonging to the Late Ceramic B, with the former extending to the early contact period. Morne Souffleur has been dated to this period as well on basis of strong similarity with Morne Cybèle, which has been radiocarbon dated between AD 1200 – 1460.

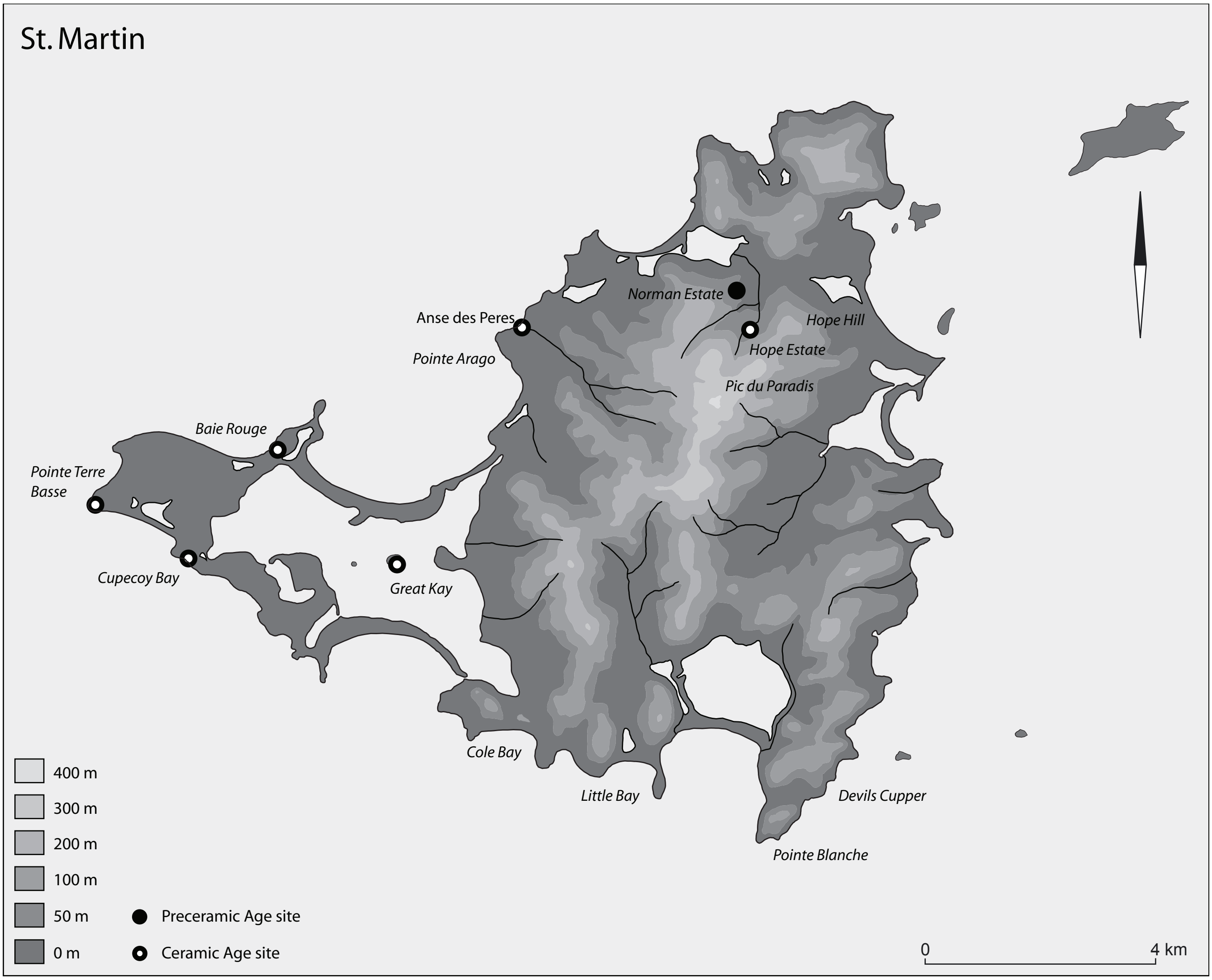


Figure 3.5. Map of St. Martin showing the sites mentioned in this work. In normal font sites studied by myself, and in italic sites studied by others.

3.2.3 Sampling and bias

Site sample

Above I explained the considerations that guided the selection of sites to be incorporated within the present research. It became clear that the amount of archaeological work done was limited for some islands, despite the significant overall increase of excavations during recent years in the region. This meant that site choice was generally dictated by availability of excavated material, and that sample taking did not follow rigid statistical procedures. Such a limited choice is not ideal because it hampers insight into sample bias. In order to get a better idea of what type(s) of sites were part of the sample and which were not, I looked at the results of archaeological survey work performed at the Pointe des Châteaux peninsula on Grande Terre, Guadeloupe (De Waal 2001, 2006), on Anguilla (Crock 2000; Crock & Petersen 1999; Watters 1991) and on Saba (Hoogland 1996). Research on most of these islands has resulted in an almost complete knowledge of site distribution and variation on whole islands (Saba and Anguilla) or parts of them (Pointe des Chateaux on Grande Terre). These data enabled me to place the sites from these islands within my sample, against the complete population of these islands, and by doing that identify certain biases.

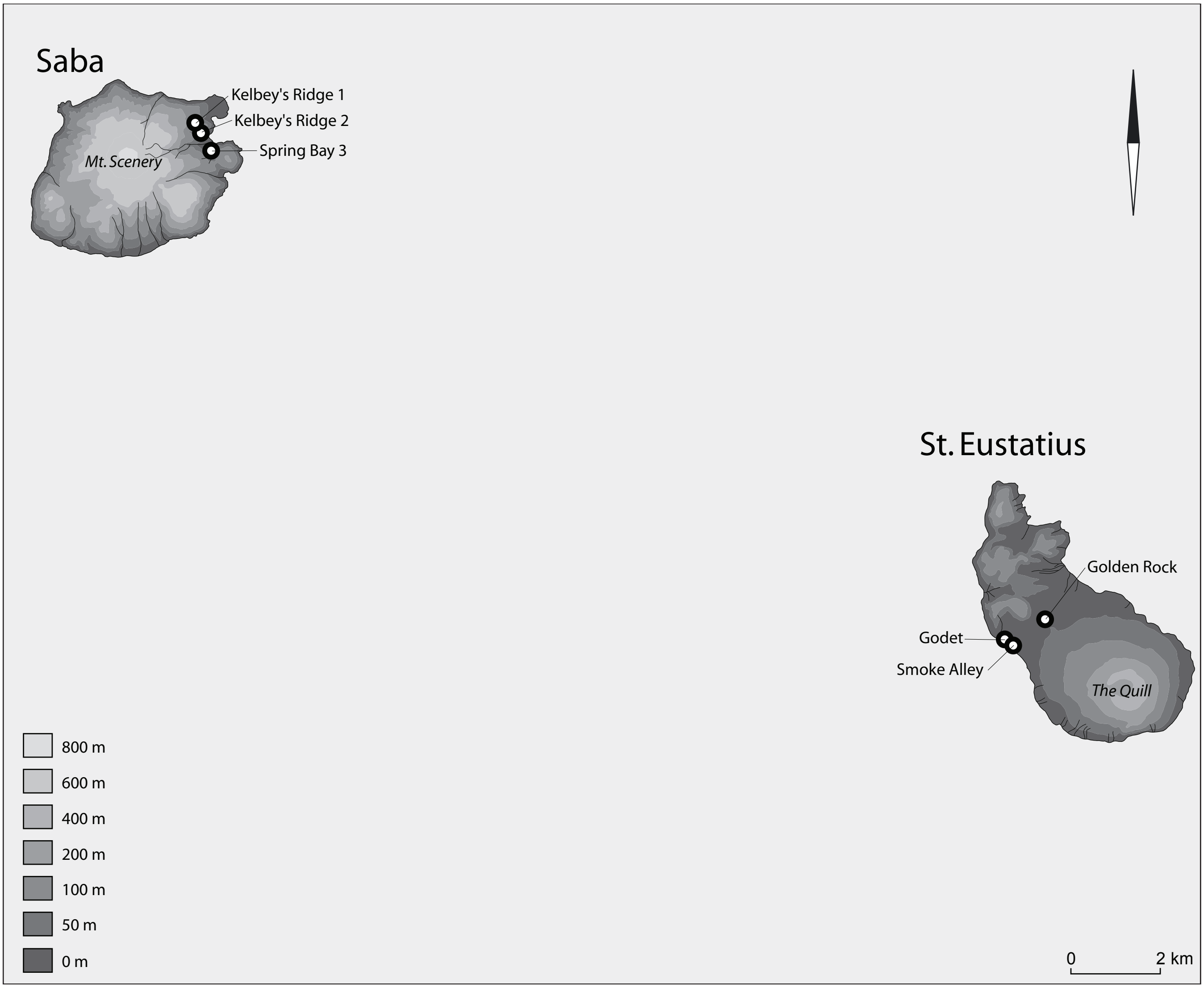


Figure 3.6. Map of Saba and St. Eustatius showing the sites mentioned in this work. In normal font sites studied by myself, and in italic sites studied by others.

The Anse à la Gourde site, for example, is a site within my sample situated on the Pointe des Chateaux peninsula on Grande Terre. It is a large settlement site dated between AD 500 and 1300 (Hofman *et al.* 2001). From the survey work by Maaike de Waal we know that this site can be considered as a major site within the near region, as none of the surrounding sites did equal Anse à la Gourde in size and, in particular, duration of occupation (De Waal 2001, 2006).

A similar situation exists for the island of Anguilla (Crock & Petersen 1999; Crock 2000), where a long period of successive efforts by different researchers has led to a good knowledge of its site distribution (Crock 2000; Crock & Petersen 1999; Dick *et al.* 1980; Douglas 1986, 1991). On this island too, excavation work has been directed at the relatively large and long occupied sites, as is evident from recurrent work at the large site of Rendezvous Bay (Watters & Petersen 1993) and John Crock's sample choice for his dissertation research (Crock 2000, 50-53). The latter deliberately chose the larger and longer occupied sites from the available sample to gain insight into site hierarchy through time (Crock 2000). As a result, sites included in my sample follow this bias as well.

The situation is somewhat different on Saba (Hofman 1993; Hoogland 1996). In the first place, Saba has not produced large sites, as can be found on Guadeloupe, Anguilla, and St. Eustatius (Hoogland 1996, 208-13). Bearing this in

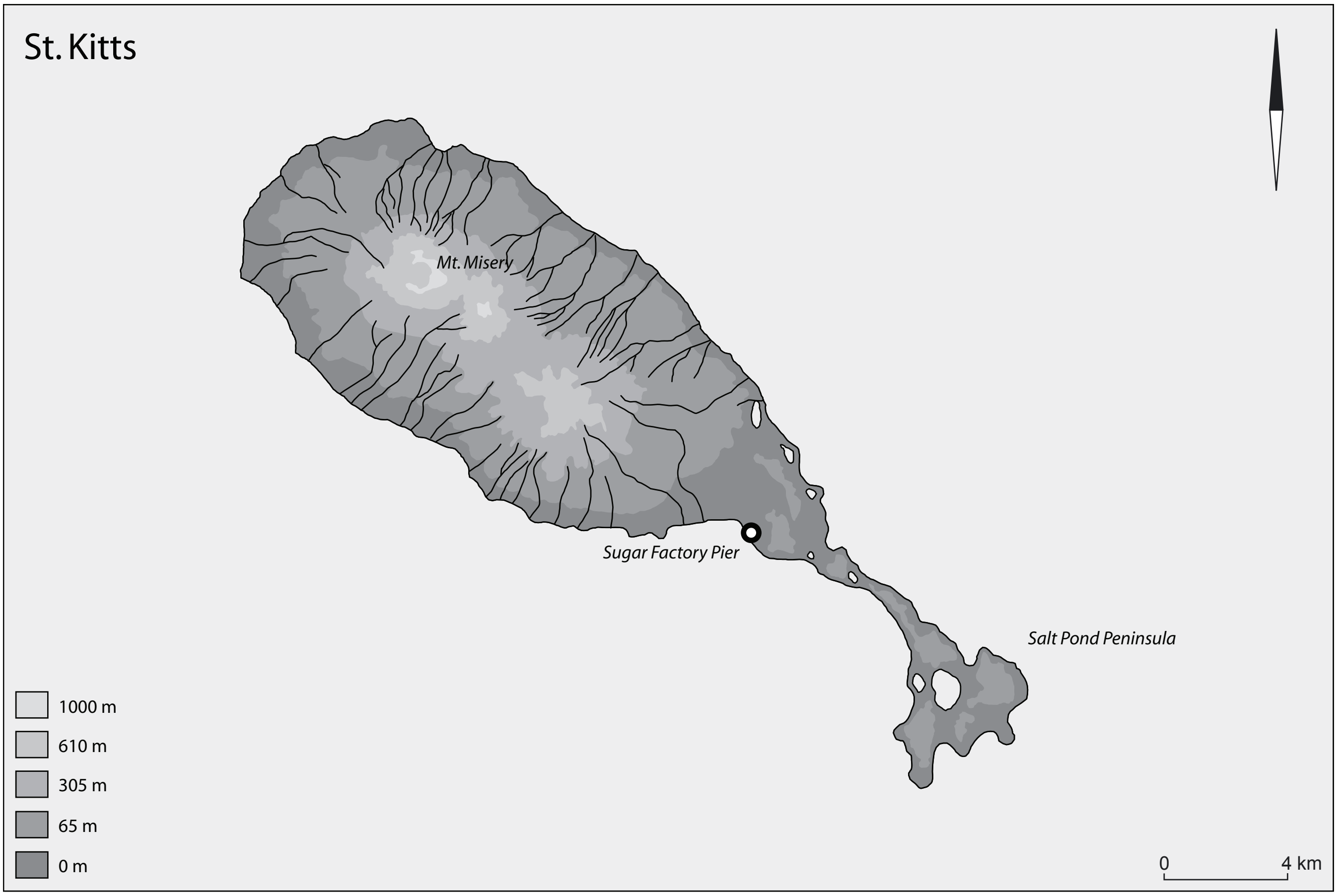


Figure 3.7. Map of St. Kitts showing the sites mentioned in this work. In normal font sites studied by myself, and in italic sites studied by others.

mind, the sample of settlement sites studied by Hofman and Hoogland probably forms a better representation of the total population of available sites on the island than is the case elsewhere. Both small sites, such as Kelbey's Ridge 1, as well as relatively large sites, such as Kelbey's Ridge 2, were included (Hoogland 1996, 208-13), but of course smaller populations may have been present on Saba.

Summarising, the relatively short history of archaeological research within the northeastern Lesser Antillean region has resulted in an overrepresentation of large and long-term occupied habitation sites. Small settlement sites are in general by-passed, but exceptions do occur as was shown by the research of Hofman and Hoogland on Saba (Hoogland 1996). Sites that are almost completely neglected in Caribbean archaeology include special activity sites (see for discussion De Waal 2006). Only on Anguilla a cave site was studied in more detail, the Fountain Cavern (Watters 1991; Petersen & Watters 1991). This cave contains a fresh water source as well as a sculptured limestone stalagmite, and it has been interpreted as a place of ritual significance (Watters 1991).

An apparent bias toward large and long-term occupied settlements therefore is also represented within my sample of sites, and as such may hamper complete knowledge of the organization of stone tool production, involving the whole range of likely places were stone tools were worked and used. I have already noted that habitation sites form the most important localities when studying exchange in small-scale societies. Furthermore, only those special activity sites that are directly related to stone working or stone acquisition should be considered. As Torrence (1986) has shown, the organization of stone working sites is to a large extent related to the degree in which people have access to raw material sources, which is crucial for understanding of production and exchange. So, they all should be included when investigating exchange. These sites are often found near lithic source areas within small-scale societies. This is also the case for the Caribbean, where sites interpreted as stone working sites have never been reported outside source areas.

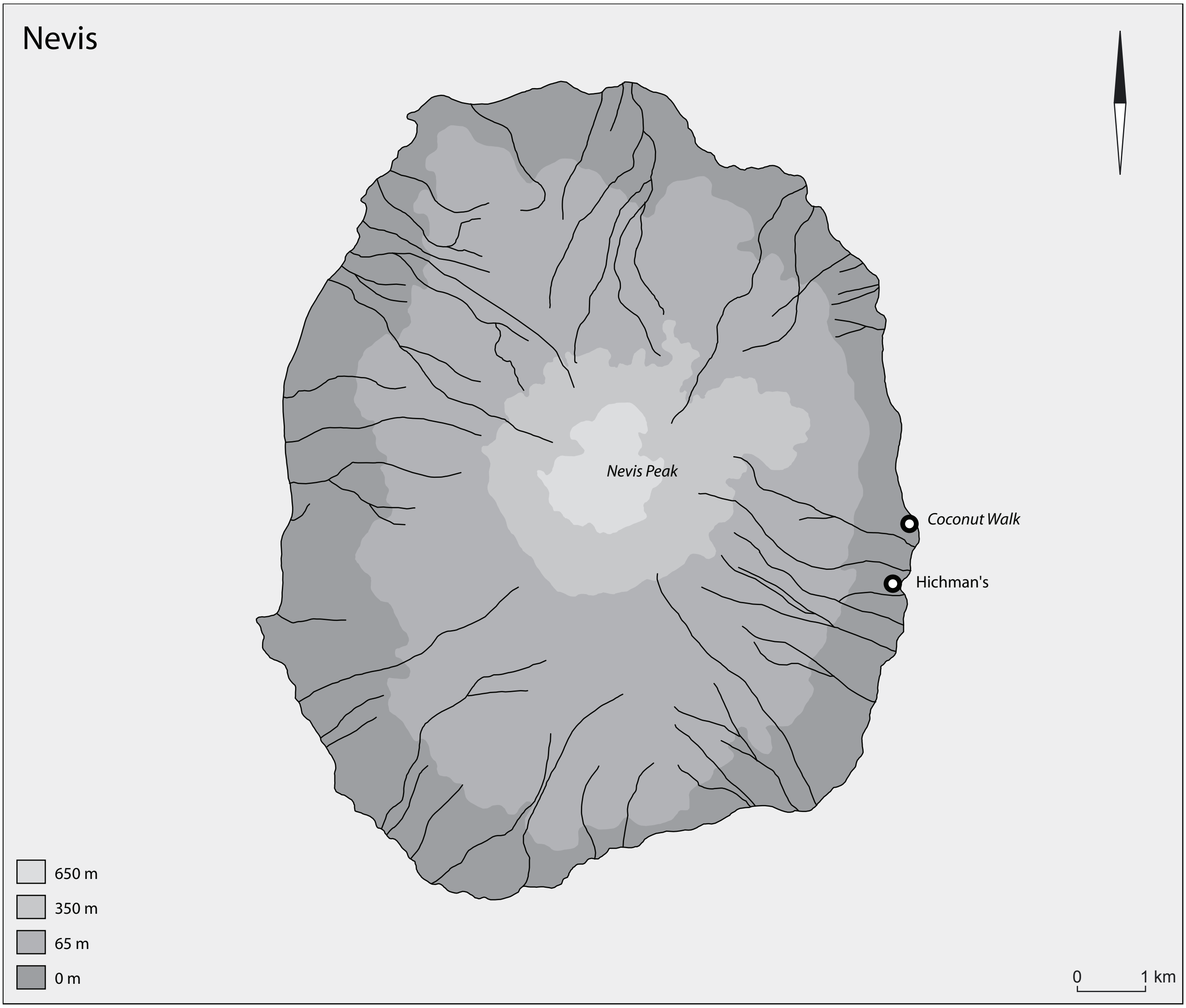


Figure 3.8. Map of Nevis showing the sites mentioned in this work. In normal font sites studied by myself, and in italic sites studied by others.

On the other hand, activity sites not directly related to stone working such as, for example, ritual places, water collecting localities, or camp sites where specific food resources were exploited will provide general knowledge about where material was worked and used within local societies. It will inform us about the different functions and values that the people attributed to stone. Such information is useful to the study of exchange, as it contributes to interpretation on another level, namely the motives behind the exchange systems at work. For this study, however, I am initially interested in the type of exchange that was responsible for the distribution of the lithic materials. So, the general behaviour toward production and use of the stone tools is my main focus.

As discussed above, I will evaluate whether cost-control devices were applied. Such an application will not necessarily exhibit variation between special activity sites and permanent settlement sites within small-scale societies as in the Caribbean. Therefore, in neglecting such special activity camps, other than stone workshop sites, the analysis of settlement sites should provide sufficient information on my initial purposes and there is no reason to state beforehand that excluding such special activity camps will significantly bias my results. This leaves a bias towards the larger settlements within the sample. Fortunately, some of the smaller sites on Saba are included.

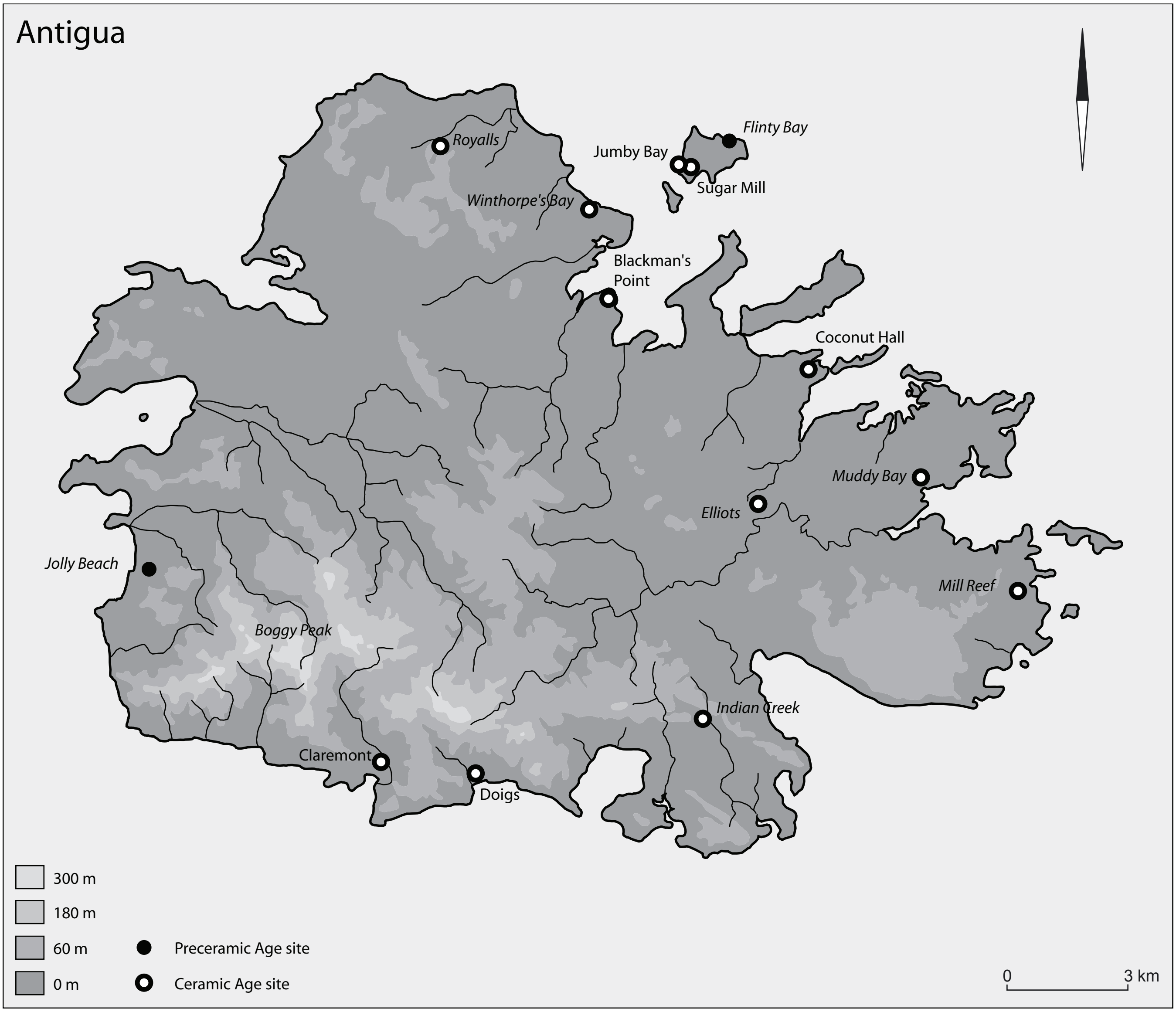


Figure 3.9. Map of Antigua showing the sites mentioned in this work. In normal font sites studied by myself, and in italic sites studied by others.

Excavation methodology

On another level, sampling bias can arise from variation within the excavation methodologies applied at different sites. This may well be a significant factor, considering the many different researchers and research institutions working within the region. I limit myself here to the discussion of the methodology that was used for the excavation of the lithic samples discussed within this study. This only involves the systematic excavation of test-units, varying in size from 0.5 x 0.5 m to 4 x 4 m, as my samples only originated from such units. The methodology used when clearing large areas for house plan reconstruction need not be dealt with.

The common archaeological excavation methodology within the Caribbean is sometimes cynically called “phone booth archaeology” (Keegan 1994). This name is used to emphasize the total reliance on the excavation of (a limited number of) arbitrarily chosen test-units, preferably ranging from 1 x 1 to 2 x 2 m, within large densely concentrated site areas. It was much employed by Rouse in the early days as a quick means to collect materials for his cultural chronological

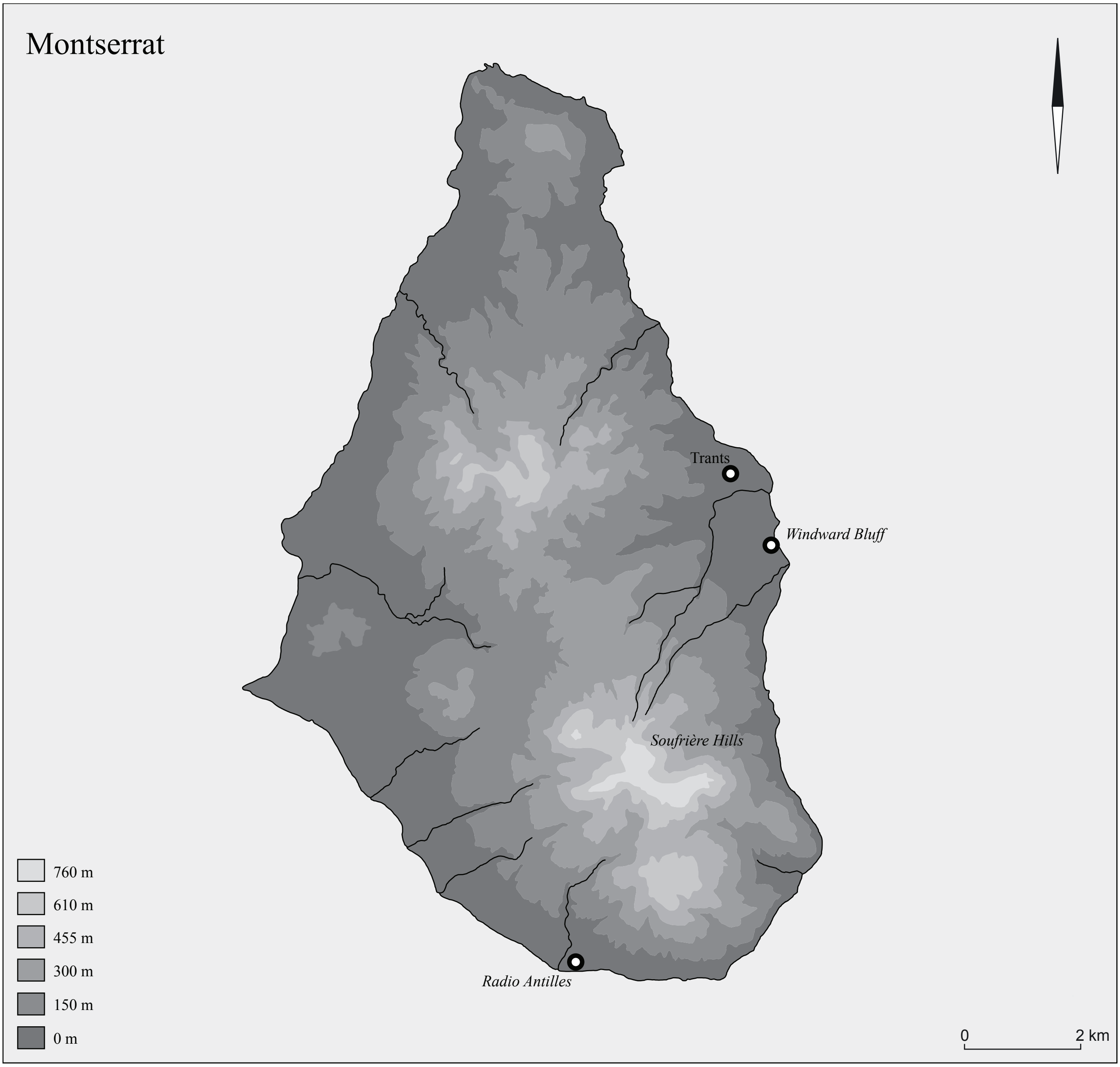


Figure 3.10. Map of Montserrat showing the sites mentioned in this work. In normal font sites studied by myself, and in italic sites studied by others.

characterisation, but it is an excavation method that is still widely used within the region for practical reasons. Nowadays, more systematic sampling (Crock 2000; Hoogland 1996; Versteeg & Schinkel 1992; Watters 1994) and occasionally random sampling (Knippenberg 1999b) are also guiding the location and number of test-units excavated. Furthermore, excavation of test units is in many cases combined with clearing of larger areas for reconstruction of house plans and studying burial areas (Hofman *et al.* 2001; Hoogland 1996; Versteeg & Schinkel 1992; Watters & Petersen 1999). These latter trends result from changing research objectives, shifting from an emphasis on cultural chronology toward an emphasis on social behaviour (e.g., Hoogland 1996; Keegan 1992).

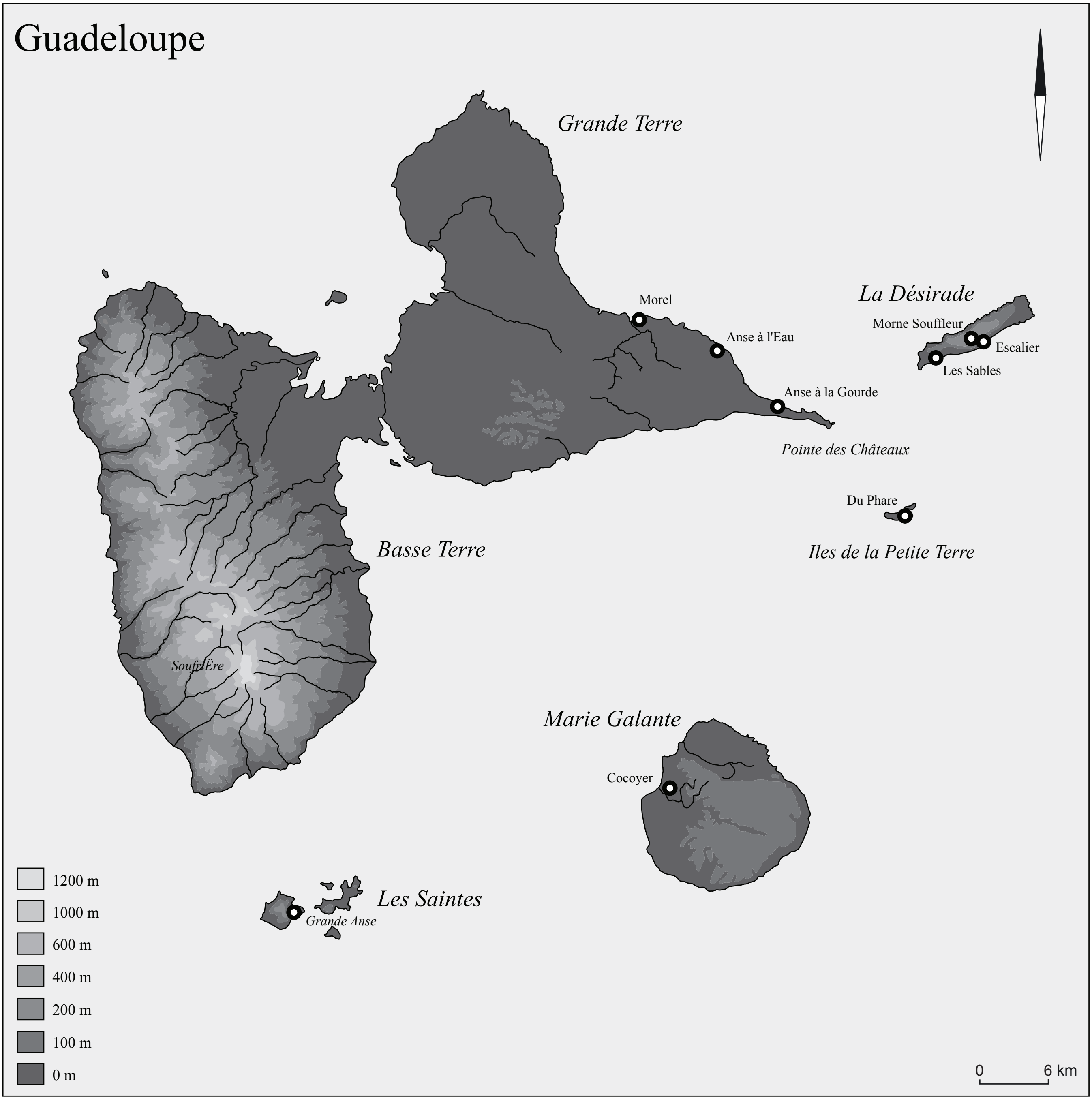


Figure 3.11. Map of Guadeloupe, La Désirade, Petite Terre, Marie Galante and Les Saintes showing the sites mentioned in this work. In normal font sites studied by myself, and in italic sites studied by others.

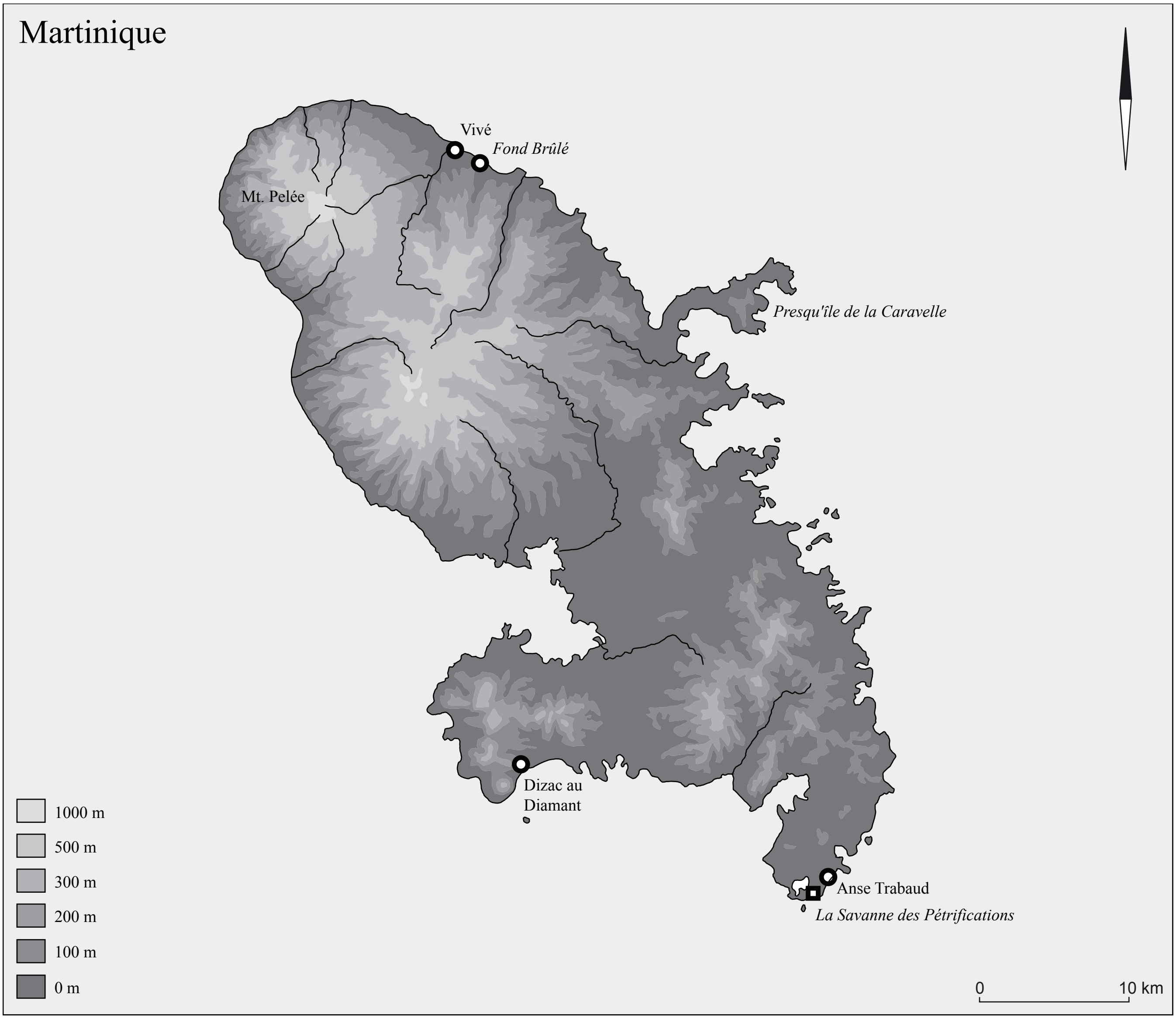


Figure 3.12. Map of Martinique showing the sites mentioned in this work. In normal font sites studied by myself, and in italic sites studied by others.

The continuous and frequent use of the test-unit excavation methodology is still a standard procedure in the region, in particular when excavating within deep, densely concentrated refuse areas. This provides an excellent situation where material has been collected in relatively similar manner and from similar contexts. Therefore, it makes it very useful for my present comparative purposes. Another concern regards whether the procedures followed in the field when excavating test-units are comparable. The following similarities are discerned, in the reports on the different sites used in this study (listed in table 3.2):

(a) all units were excavated in arbitrarily chosen levels (in some cases within natural strata);
(b) mesh screens were systematically used during excavation; and
(c) a similar range of materials was collected, including pottery, stone artefacts, shell artefacts, shell subsistence remains, coral, animal bone, and crab remains

These similarities justify the comparability of collected samples. A number of differences, however, are noted as well:

(a) units varied in size from 0.5 x 0.5 m to 4.0 x 4.0 m, including 1.0 x 1.0 m, 1.0 x 2.0 m, and 2.0 x 2.0 m sizes;
(b) mesh size of screens varied from 2 mm to 12 mm, including 2.9 mm, 3.2 mm, 6.4 mm, and 10 mm sizes;
(c) depth of arbitrary levels varied from 10 to 20 cm;
(d) some excavators started new levels when a different archaeological/geological layer would start, making the level thinner than the average 10 or 20 cm, but they could be combined within 10 cm levels in some cases, while others systematically stuck to the 10 or 20 cm levels;
(e) some excavators systematically included a sample square in each test unit for collecting small sized animal bone through fine mesh screening, while others sampled a small number of entire test units for this purpose.

These differences, especially the variation in mesh size, may well have a biasing effect. Therefore, I attempted to obtain some idea about how mesh size differences might bias the data. For this purpose the material from the Barnes Bay site, Anguilla, was subjected to a more detailed analysis, as it provided the best characteristics for such a test. Test-units at Barnes Bay were sub-divided into a fine sample part and a normal part (Crock 2000, 128). The fine sample part, a 0.5 x 0.5 m square, was sieved through a 3.2 mm mesh-screen, while the remaining larger portion was sieved through a 6.4 mm mesh-screen. All possible stone artefacts were collected from both residues. These were compared in this case with respect to proportions of raw materials and types of flake artefacts. Furthermore, it was tested from what minimum size samples could be considered similar. In other words, I looked at which size classes of artefacts had to be excluded before both samples can be believed to be the same. This latter inquiry was designed to make the different samples comparable on a detailed level, as will be required in Chapter 6.

Looking at raw material percentages, three main raw materials were worked at Barnes Bay. These include chert, St. Martin greenstone, and calci-rudite (Crock 2000; see also Chapter 5). The first was used for flake tool production, the second for axe production, and the third for zemi production. All three materials produced debitage, and related flake cores and core artefacts. When comparing the mesh residues it was noted that the percentage of flake tool related material is significantly higher within the finer mesh residue when compared to the other two materials (table 3.3). When one considers that the flake tool production was aimed at producing small flakes, occasionally incorporating flake reduction, then this relative increase within the finer mesh residues follows one's expectations. The finer mesh screens also produced higher proportions of flake fragments (table 3.4). This was also expected, bearing in mind the broken nature of these types of flakes, which in general will be smaller.

The other test is described in Appendix E in more detail. The data suggest that 3.2 and 6.4 mm mesh screen residues become comparable if one excludes all artefacts, that either have a maximum dimension or a width smaller than 12 mm. Although this number is significantly different than 6.4 mm, the largest mesh size, this discrepancy to a large degree can be explained by shape variation of the artefacts and the fact that with a 6.4 mm mesh screen the largest opening amounts to 9.1 mm, which is the diagonal between the corners of one mesh square opening ($(6.4)^2 + (6.4)^2 = (9.1)^2$). Thin, 6.4 by 6.4 mm artefacts, may then pass through the screen, while thick specimens with the same maximal dimensions will remain. Still, the preferred size from which a sample should be equal would be 9.1 mm by 9.1 mm, or 10 by 10 mm, if one takes rounding into account.[9] Apparently, certain processes cause the items in size just larger than this maximum mesh-opening to be under-represented within the residue. This might be ascribed to mesh-size variation within a screen (not all squares are equal squares, and occasionally iron wires of meshes can be broken), and collecting bias in which smaller items in a residue will be picked out less likely than larger items.

If we extrapolate these data to coarser mesh-screens, then in the case of a 12 mm mesh (the coarsest one found in this study), the maximum (diagonal) opening would be 17.0 mm and residues would be only comparable from a 19 by 19 or 20 by 20 mm or larger size class. It may be argued, however, that this difference between largest mesh-opening (17 mm) and preferred size class (19 or 20 mm) in this case might be smaller, as collecting bias will diminish when meshes become coarser, and as a consequence, artefacts become larger.

Another bias not mentioned yet involves collecting criteria. These are often closely related with the objective of the research and the definition of an artefact. The procedures concerning lithic artefact collection are usually not mentioned in excavation reports, despite the fact that criteria about what is an artefact are not as straight forward as for example in case of pottery, and may vary from site to site within the region. To a large degree this can be ascribed to differences in geological surroundings

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[9] 9 mm can stand for 8.5 to 9.4 mm, when measuring size of an artefact. So, this includes a number of smaller artefacts than 9.1 mm. Therefore, to be sure that all artefacts are definitely larger than 9.1 mm it is best to take the 10 mm size class, which includes 9.5 to 10.4 mm specimens.

Raw material	Unit 401/418		Unit 402/423		Average	
	6.4 mm	3.2 mm	6.4 mm	3.2 mm	6.4 mm	3.2 mm
	%	%	%	%	%	%
	N=135	N=125	N=102	N=139	N=237	N=264
Flint and chert	37.8	65.6	41.2	63.3	39.6	64.5
St. Martin greenstone	12.6	7.2	13.7	10.1	23.2	8.7
St. Martin calci-rudite	17.0	1.0	8.8	5.8	12.9	3.4
Igneous rock	1.5	-	-	1.4	0.8	0.7
Limestone	5.2	1.0	13.7	4.3	9.5	2.7
Calcite	21.5	25.6	19.6	10.1	20.6	17.9
Other rock	4.4	-	2.9	5.0	3.7	2.5
	100.0	100.0	100.0	100.0	100.0	100.0

Table 3.3. Barnes Bay. Raw material count and percentages by mesh-size.

Artefact type	Unit 401/418			Unit 402/423		
	6.4 mm	3.2 mm	Total	6.4 mm	3.2 mm	Total
	%	%	%	%	%	%
	N=51	N=82	N=133	N=42	N=87	N=129
complete flake	7.8	4.9	6.0	21.4	10.3	14.0
split flake	2.0	-	0.8	-	1.1	0.8
broken flake	2.0	1.2	1.5	2.4	-	0.8
flake fragment	37.3	65.9	54.9	33.3	55.2	48.1
shatter	25.5	17.3	20.3	11.9	23.0	19.4
modified flake	3.9	3.7	3.8	11.9	2.2	5.4
unidentified flake artefact	11.8	4.9	7.5	9.5	6.9	7.8
flake core	5.9	-	2.3	7.1	1.1	3.1
unidentified	3.9	2.5	3.0	2.4	-	0.8
	100.0	100.0	100.0	100.0	100.0	100.0

Table 3.4. Barnes Bay, Anguilla. Number of flint and chert artefacts by type by mesh size.

of given sites, causing variation in raw material availability. This variation is best explained by an example. Anse à la Gourde, one of the major sites on Guadeloupe, is situated in an area completely consisting of limestone. Any non-limestone object therefore should be considered as an artefact (see my definition of an artefact in section 3.1.1), even if it does not exhibit any signs of use-wear or shaping. This is the case for many of the small igneous pebbles. These pebbles probably served in tasks that did not leave any traces, or in which case any traces were blurred (see Chapter 5). In addition, the Anse à la Gourde site has produced many small non-modified limestone pebbles, apart from flaked and use-modified examples. These pebbles are locally available near the site. This presents the problem that if one considers these pebbles as natural rock one may neglect the possibly used ones (used for functions similar to the igneous pebbles). In contrast, if one considers them as artefacts, then one may over-represent the used ones. This problem of interpretation is even more difficult at Anse des Pères on St. Martin, where the vast majority of all pebbles is locally occurring in the site area (Knippenberg 1999c).

To obtain a better insight into what may be deliberately collected and what not, raw material proportions of naturally occurring material can be compared with the proportions found within the archaeological samples. To my knowledge, such in-depth analysis of natural background scatters has not been performed within Caribbean archaeology to date. This last bias will mainly involve artefacts related to categories of use-modified, manuports and burnt rock (TS 3, 4, and 5), as they are often hard to identify as artefacts based on their shape alone. This is easier to do in case of flakes, flake cores, axes, and zemis, for example.

Another significant form of sample bias relates to the actual sample size of artefacts on which certain parameters are based such as, for example, average length and weight of flakes, percentage of chert types among chert artefacts, percentage of cortical flakes, etc. Sample size is surely a significant factor in archaeology, which is not always dealt with. To a large degree this may be a result of the nature of archaeological research. It is generally the case that excavation at a site can only be performed a single time. As a consequence, data are final for such a site and cannot be easily supplemented. Furthermore, in many cases sample size could not always be estimated a priori based on survey research.

My research was to a large degree dependent on existing collections, and only in certain instances could evaluate and determine the sample size of the artefacts to be studied. In many cases, the number of lithic artefacts studied equalled the total number of stone items excavated, but in other cases sub-samples of collections were chosen due to limited time available during a visit to foreign institutions where artefact collections were kept.

In order to obtain some idea of how accurate a certain sample size would be as an estimator of the true artefact population at a site, I performed a detailed analysis of the flake tool material from Golden Rock, St. Eustatius. Due to the fact that the refuse area at this site was systematically excavated in 1 x 1 m test unit squares, I could easily construct a number of sub-samples ranging in size (see Appendix E).

Comparing the results of these sub-samples showed that sample sizes exceeding 100 artefacts generally provide accurate results, that is, the difference with the results from the complete sample of artefacts (here considered as the total population) remains small in such cases, most often not exceeding more than 10%. Only the determination of average weight still exhibits considerable variation. In the case of the average maximum dimension and the percentage of Long Island flint, for example, smaller samples (down to 50 artefacts, and even 25 for average maximum dimension) produced generally accurate results as well.

The following Chapters will show that a number of samples produced fewer than 100 flake-tool associated artefacts in total, and in many cases less than 25 Long Island artefacts in particular. For these samples the final outcomes considering the different parameters should be treated with caution, as the difference between the sample value and the actual population value may be large.

4 Acquisition and lithic reduction at the source: Long Island

4.1 Introduction

Situated on the north coast of Antigua, Long Island has been recognized as an important prehistoric flint source since the early 1970s. After several visits, Desmond Nicholson and Fred Olson were the first to report on the island's abundant flint and the special place in the region it likely had during prehistory (Nicholson 1974, 1976; Olson 1973). Since Jeff Walker's Master thesis on stone tool technology at the Sugar Factory Pier site on St. Kitts (Walker 1980a, b, 1981) followed by Crock & Bartone's (1998) research on Montserrat and my own on St. Martin (Knippenberg 1999a, c), the presence of Long Island flint has been attested outside the Antigua area. This proved that Long Island functioned as a source of fine-grained stone with regional significance. Geo-chemical results discussed in Chapter 2 confirmed this. As is evident below, the present study shows that Long Island flint remained the most abundant flaked lithic material among the surrounding islands during the entire pre-Columbian era, despite the availability of other fine-grained siliceous materials on different locations in the region. Therefore, a close examination at pre-Columbian activities on this small island related to the exploitation of flint is justified.

This Chapter presents a discussion of prehistoric exploitation of flint and related activities on Long Island itself to provide knowledge about the initial stages of the flint production trajectory, namely quarrying and possible first stages of reduction. A discussion about further reduction and tool production among the surrounding islands follows in the next Chapters.

From examination of the natural distribution of flint on Long Island (Appendix A), it is clear that flint was mainly available in secondary form, that is, as individual pieces of rock, that had eroded out of the limestone bedrock. Two main environments can identified: one consists of a number of small cobble beaches along the northern coast, and the other consists of the inland part of the island, where a clayey soil of varying thickness covers the limestone bedrock. Both environments had different effects on the shape and appearance of the flint (see Chapter 2). This distinction is blurred to some extent by the erosion of the coast, resulting in the appearance of characteristic "inland" material, exhibiting typical features such as brown cortex, on the beaches. This mixing of material is probably not just a recent process, and likely occurred ever since Long Island appeared above sea level and flint began to erode out of the bedrock. However, it can be argued that the speed at which erosion occurred increased significantly as a result of disappearing vegetation during historic times. Nonetheless, if we assume that this mixing also took place during pre-Columbian times, the type of outer surface on flint is only partly indicative of a specific collecting environment. In case of water-worn surfaces, the likely collecting place would be the beach, while "inland" types of outer surface, such as brown and white chalky surfaces, could have both originated from the beach, where they ended up after erosion, or from a more inland location proper.

In addition to these secondary occurrences, flint can be found in primary context in the limestone bedrock in rare locations. Such in-situ occurrences are concentrated in the middle part of the Flinty Bay coast line, where ring-shaped flints are exposed to the surface. Other very isolated and small primary outcrops are situated along the coast between Buckley Bay and Cistern Point, and along the northern portions of Pond Bay and Pasture Bay (figure 4.1).

4.2 Previous archaeological research on Long Island

Despite its regional significance, Long Island has experienced only small-scale archaeological work, which can be dated to the last 40 years. The first archaeologist to do any research there was Charles Hoffman in 1963. As part of his Master's research, Hoffman conducted small-scale test-excavations at three localities on the southwestern part of the island (Hoffman 1963, 32-35). Two of these localities proved to be Ceramic Age sites. He was not sure whether both localities belonged to one and the same site given their close proximity. Now, it is at least clear that the westernmost locality (LI 2) can be considered as the Jumby Bay site, which was later named by Desmond Nicholson, one of the members of the Archaeological and Historical Society of Antigua (Nicholson 1974). The other locality where Hoffman excavated (LI 1) most likely corresponds to the Sugar Mill site, situated to the southeast of the old Estate House (see below). From Hoffman's presentation of the ceramic data, we can conclude that both sites produced ceramics displaying similarities to the local Mill Reef style (Hoffman 1963, 32-33).

Following Hoffman's work, Desmond Nicholson and Fred Olson occasionally visited the island and reported

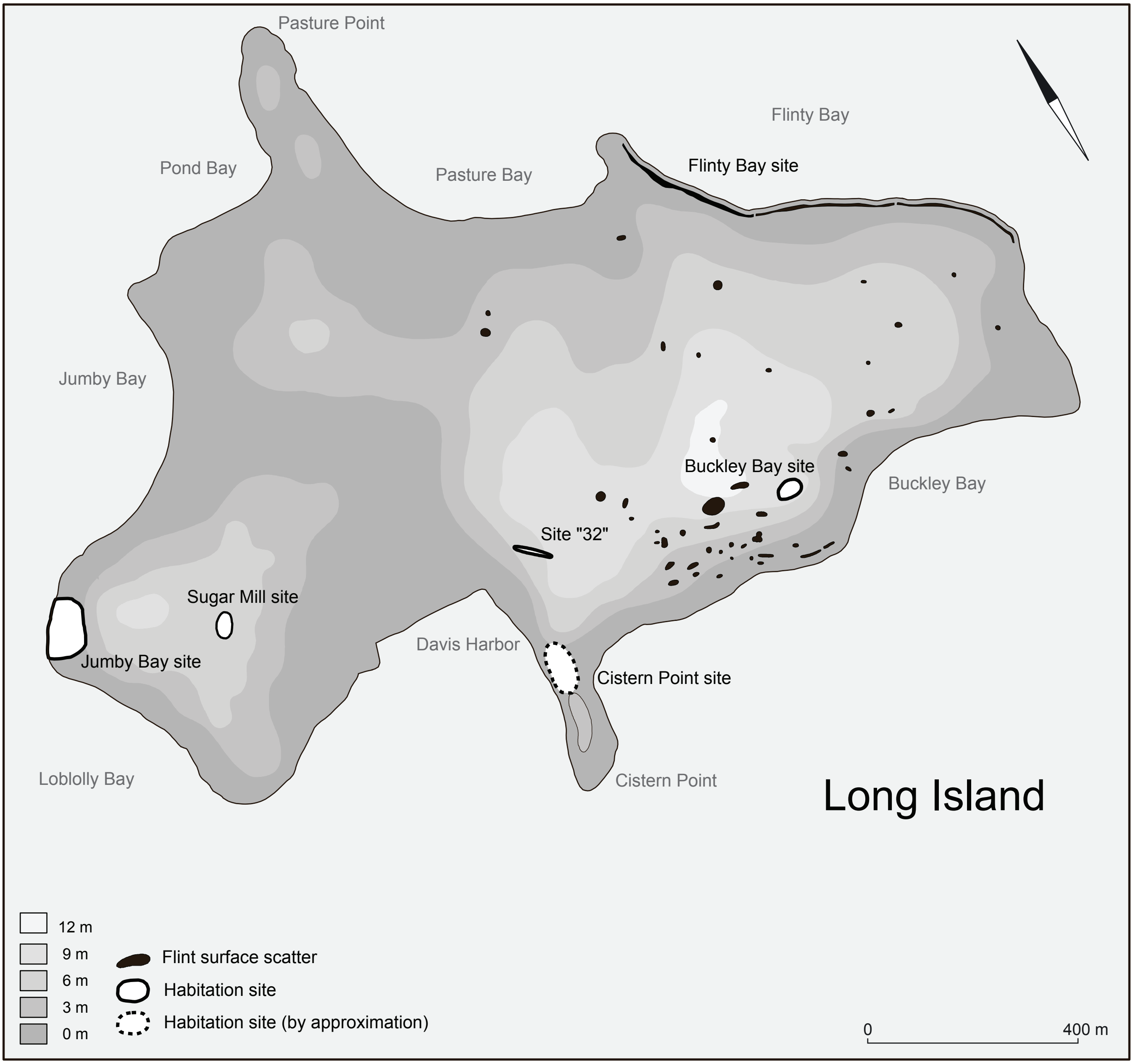

Figure 4.1. Map of Long Island showing location of archaeological sites (map partly based on Van Gijn (1996, fig.2)).

pre-Columbian sites during the early 1970s. In addition to Jumby Bay, they identified a "Ciboney" workshop site along Flinty Bay, a shell scatter at Cistern Point, scattered flint concentrations at Pasture Bay, Buckley Bay, and Highest Point, as well as a Ceramic Age site just to the north of Cistern Point (Nicholson 1974; Olson 1973). They also located a site on the south coast of the island, which disappeared after construction of the Dockyard (Olson 1973). Using the data from this site reconnaissance, Dave Davis decided to carry out a small-scale test-excavation at Cistern Point, a Preceramic Age habitation site as part of his research on the Archaic occupation of Antigua (Davis 1974, 2000). In his later monograph on Jolly Beach, Davis compares the Cistern Point flint assemblage with that from Jolly Beach, and he discerned such strong similarities that he concluded that both industries belong to a similar complex. As the greater blade length and thickness at Cistern Point were comparable with material from the younger deposits at Jolly Beach, he considered the former to be younger in age (Davis 2000, 76-77).

In response to an invitation from Desmond Nicholson, a team of archaeologists from Leiden University executed a small-scale research campaign on Long Island in 1989 (Van Gijn 1996; Verpoorte 1993). Supervised by Annelou van Gijn, in co-operation with Corinne Hofman and Menno Hoogland, this team concentrated on the eastern part of Long Island, which is the less disturbed part. They mapped all surface scatters of flint that exhibited any signs of human activities in the form of working. Furthermore, they explored primary flint deposits. This mapping resulted in the reconnaissance of many flint concentrations, of which the majority produced debris related to a blade technology. Finally, the Leiden team conducted small-scale test-excavations at the most interesting site locations. These were the large workshop site along Flinty Bay and a Ceramic Age midden scatter, called "Site 32" (see figure 4.1). Data from the Flinty Bay site confirmed the earlier assumptions of Olson and Nicholson: it was an activity area where presumably Preceramic Age flint knappers pre-worked high quality blade cores. "Site 32" is one of the very few settlement sites on Long Island. The shallow deposit produced a mixture of flake tools, blades, shell tools, shell subsistence remains, and pottery. Based on the co-occurrence of pottery and different flint working technologies, Site 32 was interpreted as a mixed Preceramic and Ceramic Age site (Van Gijn 1996; Verpoorte 1993).

From the resulting archaeological map of Long Island, it was clear that construction work and limestone quarrying already had a serious impact on the number of sites still present then. Furthermore, the Leiden team questioned the validity of the mapped scatters, as colonial agriculture and land clearing probably disturbed the original distribution. Another difficulty concerned the dating of the Flinty Bay workshop site, since no conventional ^{14}C dating material was available (Van Gijn 1996).

4.3 The 2000-field campaign

Apart from work at Jumby Bay and "Site 32", all previous excavation research on Long Island was mainly directed toward the Preceramic Age, or sites yielding evidence of blade working. Data on the activities there during the Ceramic Age remain scarce, especially when one takes into account that the mixed nature of "Site 32" hampered detailed knowledge of that period, and the low number of flint artefacts first reported from Jumby Bay (Hoffman 1963, 32-35) suggest incomplete artefact collecting methods. Confronted with this I decided to set up a small-scale research project to study archaeological remains that could be related to activities during the Ceramic Age. As my time in the field was limited, I had to pinpoint areas of interest on the island beforehand, rather than extend earlier survey work in search of new sites by field-walking unstudied areas. The usefulness of such an extension would have been very questionable, bearing in mind the disturbed nature of large parts of the island, as suggested by Van Gijn (1996) and Verpoorte (1993). Furthermore, the majority of unstudied areas, located in the western part of the island, was covered by grassland, making surface inspection unreliable. A more reliable sub-surface method of systematically digging shovel test pits there was too time-consuming, and not feasible, since private hotel plots could be only minimally investigated.

Therefore I decided to base my research on the earlier work of Nicholson and the Leiden team. The work of Nicholson, in particular, provided the advantage that he had visited the island in the 1970s when destruction of sites by construction activities had just begun. Nicholson was still able to inspect areas, that were built over by the time of the 1989 research. A drawback of this earlier work was the unsystematic nature of the island inspection, making it likely that some sites were missed.

Even the 1989-survey does not claim to be systematic in the true sense of sampling in archaeology. Van Gijn (1996) admits that due to dense bush not all areas on the eastern part of the island could be systematically field-walked. Furthermore, she states that the mapping of surface scatters was a difficult and subjective process as the island was covered with a background of extensive flint debris, in particular in the interior, hampering proper identification of human-produced scatters. Therefore, the 1989-team focussed on lithic scatters near the coast-lines, while the centre of the island was inspected less thoroughly.

From the previously mapped sites, I choose possible Ceramic Age, preferably single component, sites for closer examination. I considered two characteristics important, for establishing a Ceramic date. These are: (1) the presence of pottery, and/or, (2) the presence of flint tools and debitage exclusively related to a flake tool technology. Concerning the latter characteristic, some precautionary remarks must be added. Within Caribbean prehistory, archaeologists make a clear distinction between Preceramic and Ceramic Age chipped stone technologies. The former can be characterized as a blade tool industry, while the latter is an expedient flake tool industry. However, this distinction is only applicable to some degree. All blade industries are definitely Preceramic in age, since a true blade technology has never been reported from Ceramic Age sites, but not all expedient flake assemblages are Ceramic in age. Especially in the Lesser Antilles some flaked stone samples from Preceramic Age sites have typical characteristics of expedient flake tool technologies. On that basis, they are grouped within the Ortoiroid series (Hofman & Hoogland 2003; Knippenberg 1999d; Lundberg 1989, 1991; Nodine 1990; Nokkert *et al.* 1999; Rouse 1992). Detailed inspection has revealed that the use of the bipolar flaking technique, which was commonly used by people from the Ceramic Age, only played an insignificant role or was completely absent within Preceramic Age flake tool assemblages, but this difference is difficult to distinguish in the field. Such a distinction will be even harder to make at workshop sites near a lithic source, if one also bears in mind the following: the application of the bipolar industry was mainly directed towards the production of small flakes as grater teeth that could be inserted in a wooden board. This will not be an issue if one is only pre-working material at the source for further transport. Therefore, all sites or scatters yielding flake tool technologies are of interest to the present research. These include (see figure 4.1):

(a) The Jumby Bay site, which is designated in field notes of Desmond Nicholson as a true single component Ceramic Age site;

(b) The Sugar Mill site. During the 2000 field work an additional Ceramic Age site was discovered as a result of pipe-line construction near the "old" Sugar Mill, in the centre of the island;

(c) Scatter 36 at Buckley Bay, which also produced pottery (Verpoorte 1993, 51);

(d) "Site 32", located just to the north of Cistern Point; and

(e) The interior of the eastern part of the island. Although the large majority of the scatters in this part of Long Island were related to blade production, after discussion with Annelou van Gijn it was decided that they should be re-examined to see whether flake tool related material could be also identified there.

The aim of the 2000 field-campaign was to establish whether sites or scatters could be dated to the Ceramic Age and if so, to which particular phase. If a Ceramic Age date was established, the main objective was to determine what the purpose of flint production was at that specific location. The following three options were considered:

1) Flint was worked to prepare cores or flakes/flake tools for further transport. This would have resulted in a relatively high percentage of cortical flakes, a low number of cores compared to number of flakes, and the cores present would be predominantly exhausted, and should display flaws that made them unsuitable for further reduction (see Van Gijn 1996; Verpoorte 1993);

2) Flint was worked into tools for local use on Long Island only. This would have resulted in a sample suggesting that full reduction had occurred at the site, including the following features: (a) high numbers of cortical as well as non-cortical flakes; (b) high numbers of cores compared to flakes; (c) fully or at least significantly reduced cores, including flakes reduced as cores as well; and (d) clear presence of utilized flakes; and

3) A combination of options 1 and 2. Flint was worked both for further transport as well as local use on Long Island: this would have resulted in sample including the features mentioned for option 2. The difference with this option would predominantly lie in a relatively lower number of cores, if cores had been transported, or a relatively lower number of tertiary flakes, if flakes or tools had been transported.

4.4 Results of the 2000-field campaign

4.4.1 Jumby Bay

Introduction

In the early 1960s Charles Hoffman conducted test excavations at a Ceramic Age site at the southwest corner of Long Island (Hoffman 1963). Desmond Nicholson later called it the Jumby Bay site during his site reconnaissance. Nicholson marked a large site area in his field notes, almost completely covering this southwest point. Annelou van Gijn also mentions this site in her field notes, but did not include it within the 1989 field campaign (Van Gijn 1996). Upon my arrival in 2000, a dense shell scatter including pottery, flint, coral and animal bone, was identified along the coast immediately to the south of Jumby Bay beach. In one restricted location, a midden deposit up to 50 cm thick was visible within a rocky section eroded by the sea. The coast there is formed by a rocky shoreline, which slopes slightly in eastern direction toward one of the relatively higher points of the island around 9 m above sea level (figures 4.1 and 4.2). This relatively high point is marked by a flag

Figure 4.2. The Jumby Bay site facing south.

and lies adjacent to the old Estate House, originally the residence of the former owner of the island and nowadays one of the central buildings of the Jumby Bay Hotel resort. The areas surrounding this house belong to the hotel and are covered with grassland, while bush is still present in the coastal areas. Following this coastline to the south, the area has been used as modern refuse dump by the hotel, evidenced by piles of concrete, wood, iron and plastic. If one continues to walk along the coast one comes across the only remaining mangrove area of Long Island at Loblolly Bay.

To determine the extent of find distribution and preserved midden deposits, it was decided to systematically excavate 0.5 x 0.5 m shovel test pits with 10 m intervals along transect lines (figure 4.3). As most of the archaeological material was situated along the coast a trench of shovel test pits was laid following the coastline. In addition, three transects were directed toward the top of the low hill perpendicular to the first line. The number of shovel test pits excavated totalled 28. Test pits were dug in arbitrary 10 cm levels, and dirt was sieved through 8 mm mesh screens. After the shovel test pits, one 1 x 1 m test-unit was excavated in the area with the thickest midden deposit. In addition to the procedures that were followed for the shovel test excavations, a 2.9 mm mesh screen was used to sieve a 0.5 x 0.5 m column for recovering small faunal remains.

In the areas that produced artefacts the characteristics of the cultural remains are similar in spite of variation in the thickness of the archaeological deposits. Shell material, predominantly bivalves, was the most abundant, followed by flint artefacts and pottery. Only low concentrations of animal bone, coral, worked shell, and other worked stone materials were found.

The shovel testing showed that finds were scattered over an area of approximately 2500 m² at Jumby Bay. The thickest deposits were found in the northern part, where a dense shell midden ranging in depth between 30 to 60 cm, extended for approximately 20 m in a north-south direction and for only 11 m in an east-west direction (figure 4.4). Finds were more dispersed along the slopes of the hill to the east. No real midden was identified there and archaeological material was only present in a thin layer. Following this sloping part of the terrain to the south, the number of finds gradually increased and the cultural deposits became thicker. The deposit finally approached a depth of 25 cm adjacent to an area where recent activities related to garbage dumping and clearing had destroyed the original distribution.[1] It is clear that this area of finds partly encircled an archaeologically empty space along the shoreline. The disturbed southern part impedes complete knowledge of the exact shape of the artefact distribution, as well as the dimensions of the empty space. It is likely that archaeological deposits continued south up to the coast, fully enclosing this vacant area. This configuration of a centre with hardly any finds surrounded by an area with typical refuse material, might reflect the place where the site's inhabitants

1 Within this southern coastal area hotel workers have recently cleared refuse from the surface. In doing this they have initially removed all topsoil, after which the area was levelled again with soil from the direct surroundings. The soil apparently originated from a concentrated archaeological deposit, as the whole cleared part was covered with concentrations of all sorts of archaeological material on the surface. A number of auger tests was cored in this area to see if the original context of this material could be relocated. They did not provide any contextual information as topsoil had been disturbed down to the sterile chalk weathered bedrock. The location of archaeological material somewhere within this area would suggest that the scatter of material indeed continued to the south, where it probably stopped upon reaching the coastline.

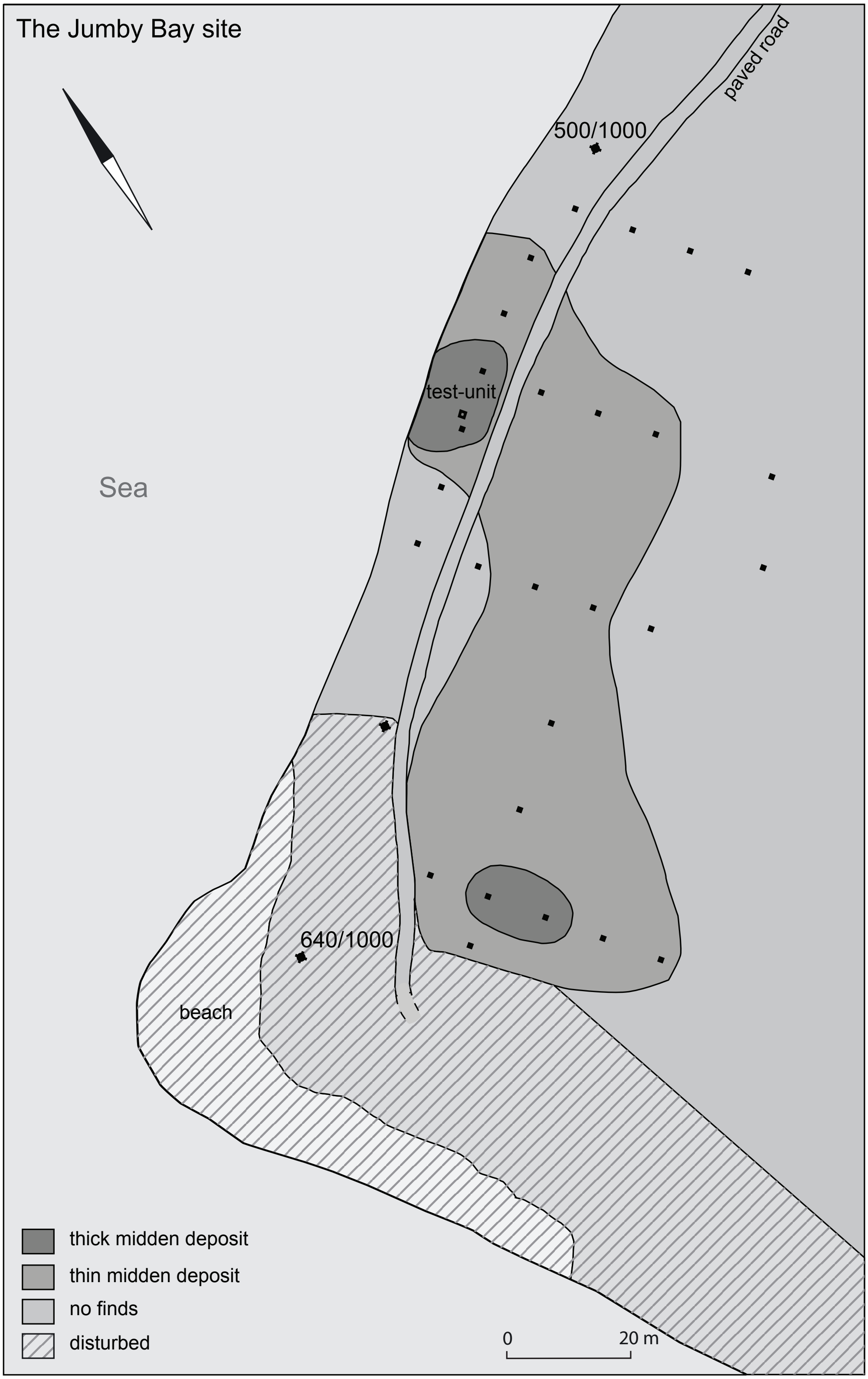

Figure 4.3. The Jumby Bay site with the location of the test pits (small rectangles) and the test-unit (large rectangle). The crosses indicate the location of site grid points.

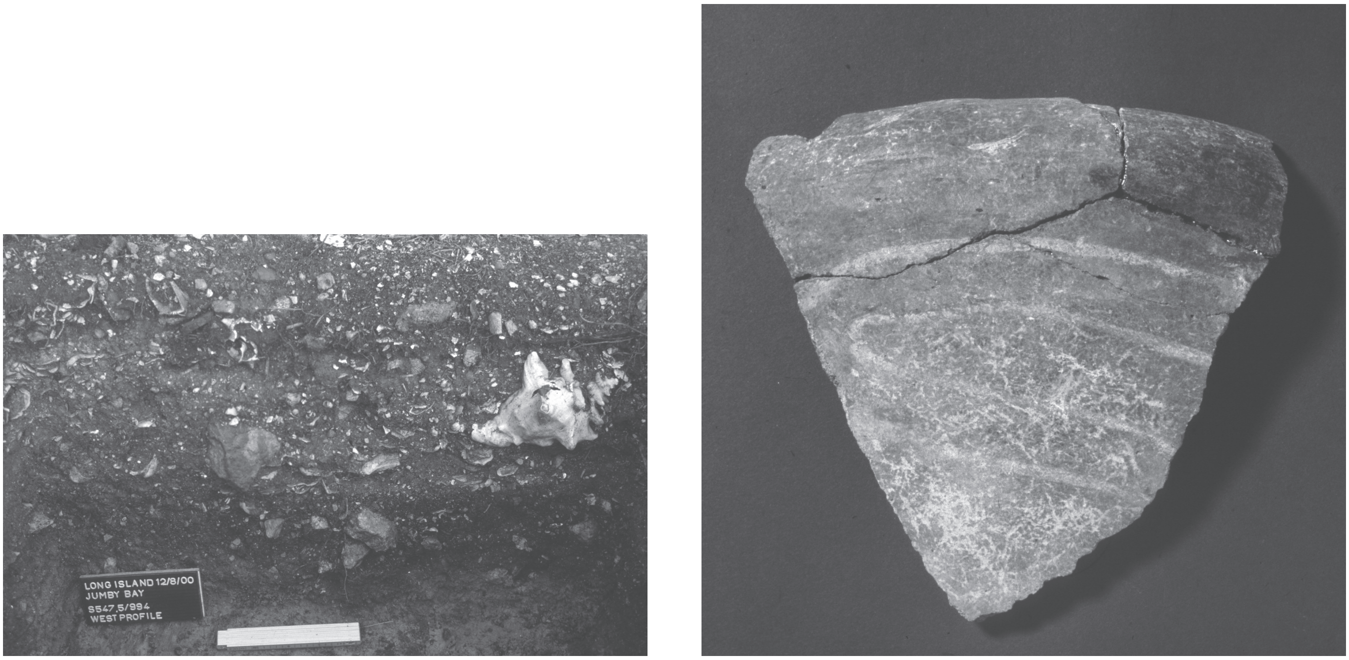

Figure 4.4. Section of the shell midden deposit exposed in the 1 x 1 m test-unit at Jumby Bay (left). Large wall fragment with white line decoration (right) (fragment has a maximum dimension of 176 mm). (right photo Jan Pauptit)

had erected their dwelling structure or other structures, similar to the situation found at Anse à la Gourde on Grande Terre and Trants on Montserrat (Hofman *et al.* 2001; Petersen 1996). As the 2000-field campaign was not aimed at studying house plans and intra-site organization, no effort was put into locating any habitation remains.

Since intra-site analysis demonstrated that different parts of the site do not exhibit much variation in the type of shell species nor in the characteristics of the pottery and flint technologies, this site was considered to be single component. Therefore, the cultural remains have been lumped and treated as one sample.

Absolute dating

One charcoal sample from a lens of burnt material within the 1x1 m test-unit at the Jumby Bay site was submitted for AMS-radiocarbon dating. It produced a ^{14}C-age of 860 ± 60 BP (GrA-18850). Calibrated, it falls between AD 1035 and 1275, when a 95% confidence interval is used.[2] This date places the site in the Late Ceramic A phase, approximately corresponding with the late part of the local Mamora Bay style (Nicholson 1994; Rouse 1992), and contemporaneous with the Muddy Bay site on the nearby main island of Antigua (Murphy 1996, 1999; Murphy & Healy 1999).

Ceramics

The ceramic sample from the Jumby Bay site consists of 762 sherds weighing 14 181 g, of which 488 pieces originate from excavated contexts (307 from the different shovel test pits and 181 from the test unit) and 274 from unsystematic surface collections.[3] This sample of pottery is too small to provide sufficient knowledge of its typo-morphological characteristics. In general, it consists of plain pottery sherds, with relative crude surface finishing, which is typical of post-Saladoid ceramics. Scratching is a very rare feature, however. Within the excavated and screened sample, three modes of decoration were

[2] Stuiver *et al*. Intcal. 98 calibration curve was used, available in cal25, the Groningen Radiocarbon Calibration Program (1998).
[3] The pottery sample was analysed during the fieldwork by Tom Hamburg and Martijn van den Bel, following the methodology as described in Hofman (1993).

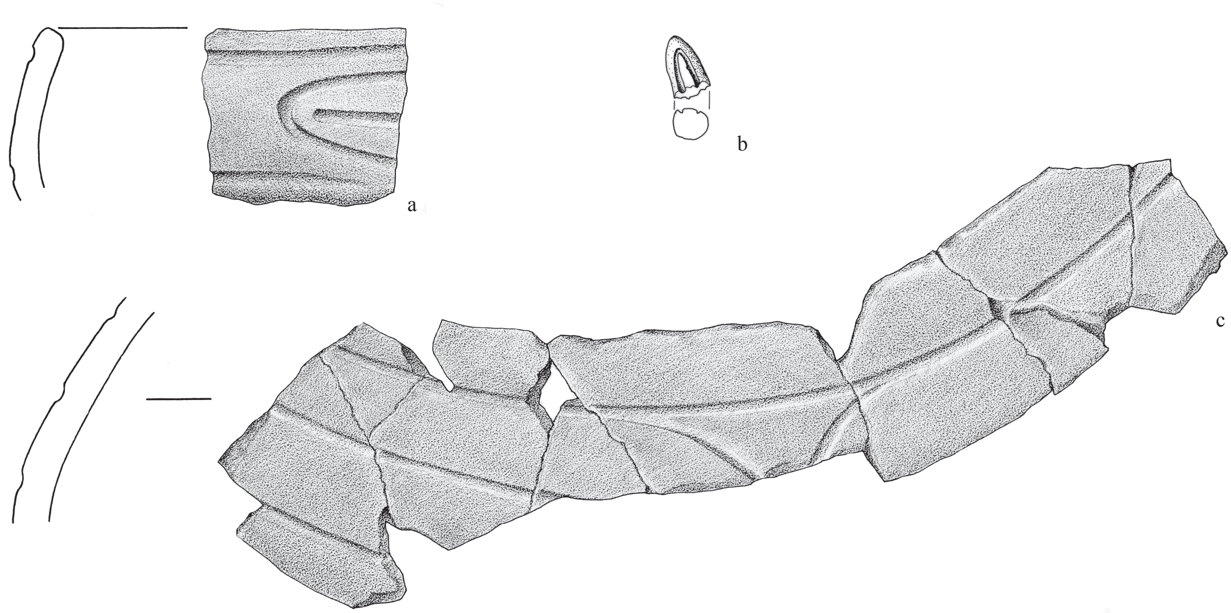

Figure 4.5. Jumby Bay. Broadline incision on a rim and wall sherd (a and c), and a body stamp fragment (b). (Drawings Erick van Driel (a and c) and Raf Timmermans (b))

identified. These include White-on-Red painting, or WOR (1.2% of the total sample), incision (0.8%), and red slip (19.1%) (figure 4.6). The WOR painting mainly consists of thin white lines on a red slip or paint. On one specimen the white line is clearly curvilinear (see figure 4.4). All incision is broad-lined (figure 4.5), except for one sherd where a shallow incision has been cut just underneath the rim, probably to accentuate it. Among the surface material, similar decoration modes were identified. One curvilinear broad-lined incised specimen should be mentioned, as similar specimens were not encountered among the excavated sample.

Only two vessel shapes could be made out in the excavated sample: an unrestricted vessel with simple contour (67%) and an independent restricted vessel with a composite contour (27%) (figure 4.6). These also predominate among the surface material, although two other shapes can be added as well: a restricted vessel with a simple contour and an independent restricted vessel with a complex contour. Base shapes include the following types in order of diminishing frequency: concave, flat, and convex. The surface sample included one pedestal base.

In addition to the vessel sherds, several griddle fragments were also found. Among the excavated sample, two shapes were recorded, straight and overhanging, while the surface material includes two fragments of a legged griddle and one rounded griddle. Other non-vessel ceramics are spindle whorls and one fragment of a body stamp (see figure 4.5).

The presence of griddles, the predominance of non-decorated sherds, and spindle whorls among the ceramic assemblage, indicates that domestic activities occurred at the Jumby Bay site and may further support the presence of dwelling structures, as suggested above.

Based on the decoration modes, the material has both Mill Reef and Mamora Bay characteristics. White line designs on red paint or slip are common among Mill Reef style material (Hoffman 1963; Nicholson 1994; Rouse & Morse 1999), although it also persisted within the later Mamora Bay style. Broad line incision on the other hand is more typical of the Mamora Bay style. Still, it can be found on Mill Reef ceramics, where it had its first appearance (Rouse & Morse 1999). During the 2000 field campaign, it was decided to compare the pottery in more detail with ceramics from the radiocarbon dated Muddy Bay site (AD 1100 – 1300)[4], after discussion with Murphy (Reg Murphy, personal communication 2000). Both sites exhibit close similarity in the presence of WOR painting, broad line incision, a high occurrence of red slip, crude surface finishing, and

4 Using the same calibration program as used for the Jumby Bay and Sugar Mill dates (note 2), the four dates from Muddy Bay cover the range from 999 – 1397 cal AD (95% interval).

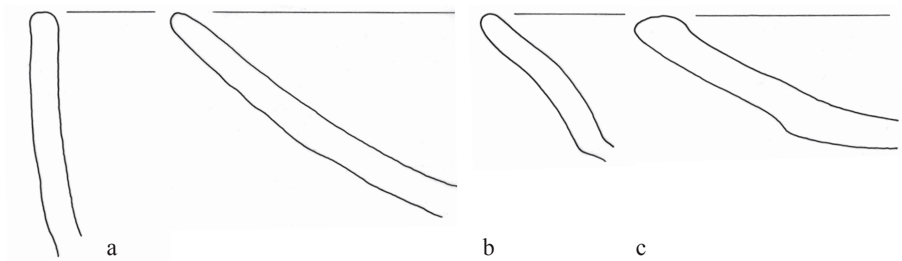

Figure 4.6. Jumby Bay. Vessel shapes (scale 1:2): a and b. unrestricted simple contour; c and d. independent restricted composite contour. (Drawings Raf Timmermans)

similar vessel shapes (Murphy 1996, 42-69).[5] This similarity is supported by its contemporaneity, as is evident from the ^{14}C date.

In addition to the Jumby Bay site another Late Ceramic Age site (GE-01, along Winthorpe's Bay)[6] resembled the Muddy Bay and the Jumby Bay materials. Interestingly, this site lies along that part of the northern coast of Antigua that faces Long Island. One radiocarbon sample yielded a slightly younger date than that of the Jumby Bay site, but older than the one from Sugar Mill (Murphy personal communication 2003).

Subsistence remains

Shell debris made up the majority of the subsistence remains from the Jumby Bay site, while the quantity of animal bone varied significantly between the different excavated units. The analysis of shells has been very basic, only directed toward reconstructing the habitats that were exploited. For this purpose each shell was classified to the level of species and total weight, Minimum Number of Individduals (MNI), and Number of Identified Species (NISP) for each species was determined using the forms composed by Nieweg (2000).

Measuring and weighing individual shells for reconstructing diet has not been attempted. Although there is some variation in relative MNI counts per shovel test pit, the list of most frequent species is very similar for each test pit. Bivalves make up the large majority of the shells by MNI. Most important species by MNI are *Chama* sp*., Arca zebra*, and *Pinctada imbricata*. (tables 4.1 and 4.2) Other recurrent bivalve species are *Anadara floridana* and *Brachidontes modiolus*, while recurrent gastropods are *Crepidula aculeate*, *Petaloconchus varians, Nerita versiculor* and *Nerita tessellata*. The majority of these species point to a rocky littoral zone as the exploitation area. This environment can be found in the waters surrounding the island. Notable is the scarcity of *Cittarium pica* among the archaeological samples. This species is often well represented among shell subsistence remains from Ceramic Age sites (Brokke 1996, 1999a; Nieweg 2000; Taverne & Versteeg 1992). Whether this low occurrence can be ascribed to poor natural availability or particular human choice is unclear. The list of most frequent shellfish species strongly correlates with that of the Muddy Bay site, situated along Antigua's northeastern coast in a similar low-lying limestone region with abundant reefs nearby (Murphy 1996), suggesting similar shell collecting behaviours.

In relation to the study of animal bone and crab material, Sandrine Grouard analysed a sample from the single 1 x 1 m test-unit excavated, as well as one from one shovel test pit (550/995) (Grouard 2002). This total sample included both 2.9 mm and 8.0 mm mesh residues collected from one 0.5 x 0.5 m square in the test-unit, and an 8.0 mm mesh residue only originating from the shovel test pit. In addition to the determination of MNI and NISP and evaluation of habitats exploited, Grouard looked at diversity and richness of taxa, completeness of skeletons, and average size of the animals that were caught.

The Jumby Bay site produced almost 10 000 bone fragments. Grouard's results show that the sample consists of

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[5] During the 2000 field campaign, time was spent on comparing recently discovered sherds from both sites. The similarity in reported data was also supported by this visual examination.

[6] This site has not been reported in detail and therefore should not be confused with the neighbouring site of GE-06, situated along Winthorpe's Bay as well. Murphy has more extensively investigated and discussed this latter site in his Ph.D. dissertation (Murphy 1999).

Shell species	T547.5 994 N=514	S550 995 N=116	S540 995 N=159	S620 1025 N=127	S620 1035 N=49	Overall
Pinctada imbricata	14.8	19.0	28.9	9.4	18.4	18.0
Arca zebra	13.4	14.7	30.2	17.3	28.6	20.8
Chama sp.	15.6	23.3	17.0	49.6	46.9	30.5
Chama macerophylla	1.6	1.7	3.1	-	-	1.3
Anadara floridana	1.2	2.6	1.9	4.7	0.0	2.1
Brachidontes modiolus	8.6	0.0	0.0	-	-	1.7
Codakia orbicularis	1.0	2.6	0.0	0.8	0.0	0.9
Isognomon alutus	1.2	-	-	-	-	0.2
Donax denticularis	0.8	-	-	-	-	0.2
Lopha frons	0.0	0.0	0.0	0.8	0.0	0.2

Table 4.1. Jumby Bay, Long Island. % MNI of bivalves by shovel (S) and test-unit (T). N comprises the total number of all shell MNI.

Shell species	T547.5 994 N=514	S550 995 N=116	S540 995 N=159	S620 1025 N=127	S620 1035 N=49	Overall
Nerita versicolor	19.5	0.8	-	-	-	4.1
Nerita tessellata	3.5	3.4	-	-	-	1.4
Crepidula aculeata	4.9	6.0	6.9	1.6	-	3.9
Petaloconchus varians	3.1	1.7	3.8	11.0	0.0	3.9
Tectarius muricatus	2.1	1.7	-	-	-	0.8
Cerithium litteratum	1.6	3.4	-	-	2.0	1.4
Cerithium sp.	1.2	6.9	3.1	-	-	2.2
Cittarium pica	0.4	0.8	0.0	-	0.0	0.2
Strombus gallus	0.4	0.0	0.0	-	0.0	0.1
Strombus gigas	0.2	0.0	0.6	0.0	0.0	0.2
Murex (phyll.) pomum	0.4	0.8	1.3	4.7	0.0	1.4
Murex florifer	0.2	-	-	-	2.0	0.4
Columbella mercatoria	0.4	-	1.3	-	2.0	0.7
Chione paphia	0.0	0.8	0.6	-	-	0.3

Table 4.2. Jumby Bay, Long Island. % MNI of gastropods by shovel (S) and test-unit (T). N comprises the total number of all shell MNI.

more than 90% (NISP) fish. Of the fish-bones that could be identified to the family or species level, the following families were attested, in decreasing order (by MNI): Scaridae (Parrotfish), Acanturidae (Surgeonfish), Haemulidae (Grunts), Lutjanidae (Snapper), and Serranidae (Seabass). This suggests that predominantly reefs and rocky banks were exploited. Species caught in an offshore-pelagic habitat contributed less than 3% of the total. In addition to fish, very small amounts of remains of crab, mammals, birds, reptiles, and amphibians were also identified.

The representation of skeletal parts found in the samples showed that entire reef fish and crabs were taken to the site. The limited sample of offshore-pelagic fish, as well as rodents, on the other hand, suggests that these animals were trimmed of their less edible parts, before being transported to the site. The small size of especially the reef-fish suggests that nets were used for catching them.

Flint working

The lithic sample from the Jumby Bay site almost exclusively consists of flint artefacts. In addition, a small number of other lithic artefacts was found. These include 29 flakes, 4 shattered pieces and 1 core piece, all made out of limestone, a St. Martin greenstone axe fragment, 2 calcite crystal pieces, an igneous rock flake, and one quartz-diorite bead. All flint was counted and weighed. In total, 1896 flint artefacts were collected from all shovel test pits and the test-unit. These all belong to the 8 mm

artefact category artefact type		flint chert	greenstone	igneous rock	plutonic rock	limestone	calcite	total
flaked stone								
flake		532	-	1	-	29	-	562
shatter		42	-	-	-	4	-	46
flake core		39	-	-	-	-	-	39
flaked piece		-	-	-	-	1	-	1
ground stone								
fragment of axe		-	1	-	-	-	-	1
complete bead		-	-	-	1	-	-	1
used water-worn pebbles								
complete hammerstone		3	-	-	-	-	-	3
non-used water-worn pebbles								
non-modified water-worn pebble		4	-	-	-	-	-	4
other used rock								
-		-	-	-	-	-	-	-
other rock								
natural rock		2	-	-	-	-	2	4
fragment natural rock		1	-	-	-	-	-	1
unidentified		341[a]	-	-	-	-	-	341
Total	N	964	1	1	1	34	2	1003
	%	96.1	0.1	0.1	0.1	3.4	0.2	100.0

Table 4.3. Jumby Bay, Long Island. Number of artefacts by type and by raw material. [a] predominantly includes fire-cracked flint rock.

mesh-screen residues. A subsample from a well-defined midden context was chosen for more detailed analysis (table 4.3).[7]

The subsample consisted of 964 flint artefacts. These were studied in more detail following the methodology described in Chapter 3. The flint analysis was hampered by the high proportion of fire-cracked pieces. Especially in test-unit 547.5/994, part of the deposit had been burnt, probably as the result of a hearth there. This hearth or burnt layer cannot be related to heat-treatment of flint material. In the first place the expedient technology with which the flint was worked without making formal tools does not require a subtle technique such as heat-treatment, which is of use in sophisticated biface reduction. Furthermore the fact that many pieces were cracked in tens of small pieces indicates that the burning was too intense to be of any help in improving the flint quality for working. Another indication is the wide variety of artefact types exposed to the firing, which points to an absence of deliberate choices in artefact selection. This is highly uncommon for heat-treatment. Therefore, it is most likely that these firing locations were related to either food preparation or refuse burning activities.[8]

As expected the large majority of the flint had a local Long Island origin. However, there are a few pieces (1.1%), that originated either definitely outside Long Island, as their characteristics are different from Long Island material, or which might be non-local, where a Long Island-origin is still a possibility. One dull white chert piece, resembling quartz, and three pieces of translucent cherts, likely from a re-crystallized coral as evidenced by their internal structure, are definitely not from Long Island, but probably come from the main island of Antigua. Among the “probable exotic” flint pieces are coarser varieties or those possessing different inclusions than the common Long Island flints.

This small number indicates that the flint knappers at Jumby Bay almost solely relied on Long Island flint. Although such reliance would conform to expectations, some sites on Antigua situated in areas where other raw materials occur do not exhibit such exclusive utilization of local material, as discussed below in Chapter 5.

The outer surface of the Long Island flint artefacts points to different types of raw material. The majority consists of a dark grey flint, with a white “chalky” cortex. In addition, specimens with dark grey cores surrounded by brown bands, or completely brown specimens occur, both possessing a more brown “chalky” cortex. Both the white as well as the brown cortex have been worn to some degree, indicating that original cobbles were from secondary contexts, and not cut from the

7 This sample comprised those shovel test pits that were situated in areas that had a clear shell deposit, which varied in thickness from 5 cm to 60 cm. This sampling ascertained that material came from undisturbed Amerindian contexts. The following test pits and test-unit were included: S 540/995, S 550/995, S 570/1015, S 570/1025, S 620/1035, S 620/1045, S 620/1055, S 628/1025, and test-unit 547.5/994.

8 These fire-cracked pieces were only counted and not further analysed, as this post-depositional alteration reshaped the object and blurred original flaking characteristics. Burnt pieces that were not cracked were included, however, as burning in these cases did not have any negative effect on the identification of original flaking characteristics.

limestone bedrock. Occasionally, some of these pieces also had white and brown patinated surfaces on faces where cobbles had been naturally broken. As already mentioned, these particular outer surfaces were originally formed within the inland part of the island. However, whether they were actually collected within these areas cannot be determined, as erosion might have moved them to the cobble beaches. Cobble beaches were certainly exploited, as suggested by the presence of water-worn outer surfaces on many flakes and the use of flint pebbles as hammerstones.

In addition to these natural types of raw material, the Jumby Bay site also produced previously flaked material. Among the overall sample, there is a small number of completely white patinated artefacts (N=5). This complete patination distinguishes them from the large majority of artefacts that are not patinated at all, or which only exhibit patination on (part of) their dorsal face. In the case of complete coverage, the patination must have developed after flaking. Therefore, it suggests that flaking occurred earlier than is the case with the majority of the other (non-patinated, or partly patinated) artefacts, as the find contexts can be considered similar.

The origin of these white artefacts was easily found, as surface scatters on the eastern part of the island, mapped by the 1989 Leiden-team, contain many patinated pieces. Considering that most of these scatters are associated with a blade technology (Verpoorte 1993), these artefacts would be dated to the Preceramic Age. Apart from the patination there is another feature, less clear and therefore subject to more discussion, that points to a Preceramic origin. This is the more sophisticated flaking technology by which these artefacts were produced. All patinated flakes are relatively large, thin, and regular in shape, and possess a regularly shaped platform. Furthermore, their bulb of force and cone of percussion are clearer and more pronounced than is generally the case for the other lithic artefacts. Finally, none of the five flakes have been further reduced, a feature commonly found among Ceramic Age flaked material. I have noted such difference in flaking characteristics between Preceramic and Ceramic Age technologies on St. Martin (Knippenberg 1999c, d), as well as during a recent analysis of Preceramic Age material from Barbuda (Watters 2001; Watters *et al.* in prep.). Although others have reported scavenging of Preceramic Age material within a Ceramic Age context on Antigua (De Mille 1996; Murphy 1999), the presence of these Preceramic Age artefacts does not necessarily point to such behaviour in this case. The wide occurrence of scattered Preceramic Age material on Long Island makes it likely that the patinated artefacts at Jumby Bay just represent material that ended up in the deposits by accident after clearing parts of the site area. Furthermore, there is no evidence on the artefacts themselves, such as secondary working that suggests re-use of these items during the Ceramic Age. Such edge working was identified on a blade at the Ceramic Age site of Royall's on the main island of Antigua, for example (Murphy 1999, 158-159).

In any case, the variation in outer surfaces suggests that Amerindians at Jumby Bay did not prefer a specific type of raw material, as has been reported for knappers at Flinty Bay (Van Gijn 1996). Furthermore, the few slightly reduced cores at Jumby Bay are relatively small in size, minimally indicating that large nodules were not specifically desired. Such choice is similar to choices made at sample area 36 near Buckley Bay, where small nodules of an inferior quality flint were used (Verpoorte 1993). This behaviour directly may have been a result of the scarcity of large nodules there, which were widely used during the Preceramic Age.

If we look at the technological features of the sample, the flint was clearly worked using an expedient flake tool technology. Cores were reduced from any platform available and flakes were used *ad hoc* or only after minimal modification in the form of one or two flake removals (figure 4.7). Another aim of reducing flakes was to produce smaller flakes.

Typical intentional retouch in which edges were systematically chipped to shape and strengthen them is absent. Formal tool shapes have not been identified. Only 4.3% of the flakes had use wear in the form of small edge retouch (figure 4.8). One core exhibited such retouch as well. In addition, four artefacts (0.7 %) had retouch, that was considered to be intentional based on size of the scar negatives. However, it lacked a regular pattern.

The use of hard hammer percussion is evidenced by clear points and cones of percussion on many flakes. The application of this technique was supported by the presence of several flint pebbles with pitted areas at their sides or ends, clearly indicating use as hammer-stones (figure 4.9). Direct freehand percussion flaking was the predominant flaking technique. The majority of the flakes had a pronounced bulb of force, were curved in shape, and had single scarred platforms. Unlike many Ceramic Age sites, the use of the bipolar technique only played a minor role in core reduction at Jumby Bay. Out of the studied flakes, only 5 % was identified as truly bipolar flakes, possessing a flat bulb of force and being straight in shape. Also, the low occurrence of pointed and edge type of striking platforms suggest the minor significance of this flaking technique. However, the site produced a number of flakes, that were bipolarly split. They were placed on an anvil either on their dorsal or ventral face, and struck into more pieces.

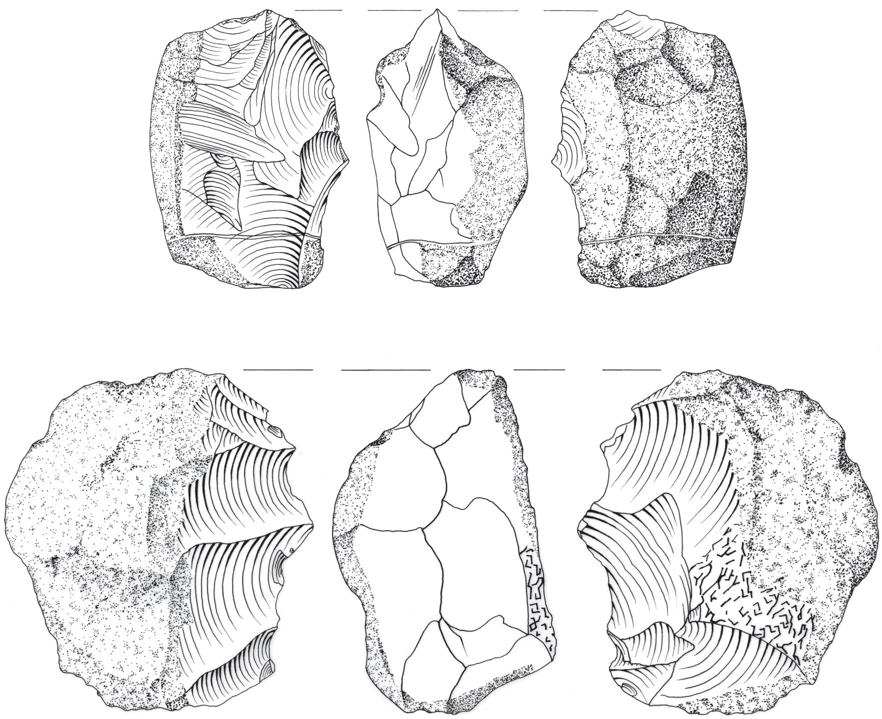

Figure 4.7. Jumby Bay. Expedient flint cores (scale 1:2). (Drawings Raf Timmermans)

The characteristics of the flint sample from Jumby Bay clearly point to an expedient production of flakes for local use. The whole repertoire belonging to such a production was recovered including cores, shatter, and primary, secondary and tertiary flakes, as well as flakes with use wear. If we consider the settlement context of the materials associated with this production, then the local use of the flint does not present an anomaly. Still, it is a possible that in addition to the production for local use people at Jumby Bay were pre-working material for transport to or exchange with other sites. In other words, it should be studied whether there is evidence for the missing or under-representation of certain artefact categories. The flake/core ratios of the different clusters vary between 5 and 20. Such low values do not indicate that cores are underrepresented in the sample and therefore, it is not likely that they were taken somewhere else. Rather, such a low ratio would suggest the opposite, that flakes were transported. For this latter option, however, additional evidence is hard to find. The low values may be understood in view of the small size of the cores and the initial reduction stage in which some of these cores were found. Furthermore, the possibility that some of the cores originally were flakes should also be considered, which would decrease the ratio as well. With the absence of formal tool types, tertiary flakes would be the most likely candidate for further transport, as they generally possess the most suitable working edges. The frequency distribution of cortical flakes, however, shows that tertiary flakes are well represented at Jumby Bay, and that there is no clear evidence for systematic displacement of such flakes (table 4.4). Infrequent transport of individual flakes cannot be excluded with these numbers, however. In

cortex count	N	%
0%	75	37.3
1-24%	52	25.9
25-49%	34	16.9
50-74%	25	12.4
75-99%	9	4.5
100%	6	3.0
total	201	100.0

Table 4.4 Jumby Bay. Cortex count on complete flakes including old patinated surfaces.

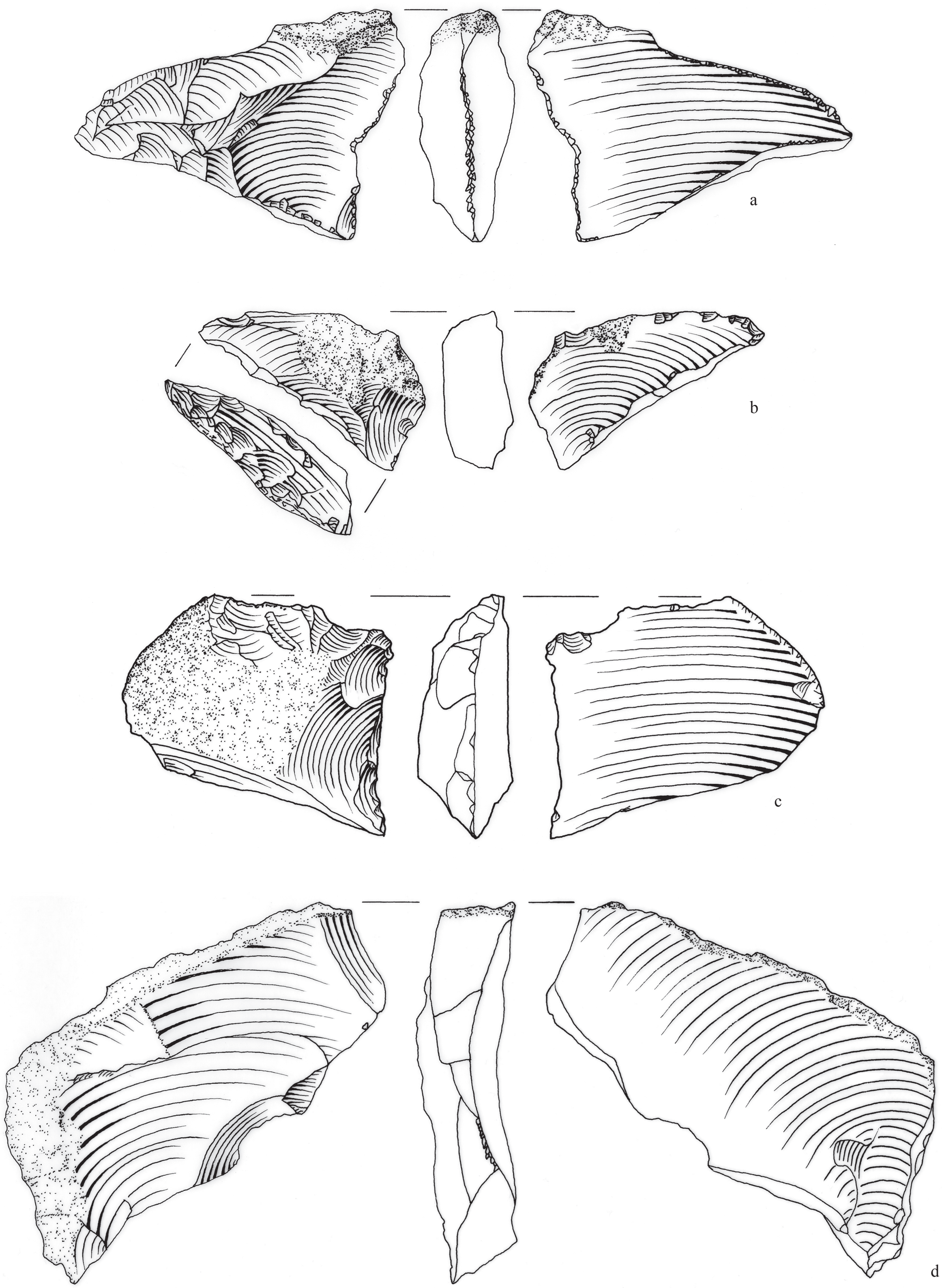
a
b
c
d

Figure 4.9. Jumby Bay. Flint pebble hammerstone (scale 1:2). (Drawing Raf Timmermans)

light of these considerations, it should be concluded that there is no clear evidence that people staying at Jumby Bay were involved in systematic flint working of cores or flakes to be transported to or exchanged with other sites. The data support on-site production and use of expedient flake tools.

Other stone and coral

The other stone materials form only a very small portion of the lithic sample, less than 3%. Raw materials include limestone, greenstone, igneous rock, calcite, and diorite. Limestone is most abundant, comprising 29 flakes, 4 shatter pieces and 1 core artefact. Most likely, the material was local to Long Island, as its medium coarse-grained homogeneous texture is common there. The flakes suggest that limestone was worked at the Jumby Bay site, but it is hard to specify the purpose behind this reduction. The only core artefact is not very indicative. It is an irregularly shaped cobble with a few flake removals, likely an initial flake core. The flakes suggest that limestone was not reduced much, as most of the pieces have remnants of outer surface on their dorsal face. In fact, it is possible that some of these cortical pieces actually were removed from flint cobbles with a thick cortex rind, as they closely resemble flint cortex. Still, some flakes do not exhibit such a similarity. From the low numbers, it is clear that limestone working did not play an important role at Jumby Bay.

In addition to the local limestone, two calcite crystal fragments were found. These might have a local provenance, although no calcite has been identified on the island yet. Having only two pieces and because it is unclear if they were modified, the use of calcite is hard to explain. From Saladoid sites on Antigua we know that this material was used for making beads (Murphy *et al.* 2000). On Anguilla, a predominantly limestone island, this material was also found at a number of other sites, mainly in crystal or unmodified form (Crock 2000; see Chapter 5). Rare examples of calcite bead pre-forms suggest bead production there as well.

Obvious exotic artefacts include the diorite bead, the greenstone axe fragment, and the igneous rock flake fragment. Being finished items and lacking any material that might point to production, the former two suggest that these artefacts were imported in this form. The diorite resembles bead material at other local sites, such as the Elliot's site (Murphy *et al.* 2000). However, its source is unknown. The axe fragment, in the form of an edge bit, has a typically corroded surface, which is common for the greenstone variety originating from St. Martin (see Chapter 2). The igneous flake fragment consists of dark coloured rock, with small light mineral inclusions. Its provenance is unknown. Having only one piece, it is hard to tell if this rock was worked at the Jumby Bay site and for what purpose.

In addition to stone, coral material was also collected to be used as tools (table 4.5). Among the collected pieces, a small portion displayed evidence of use-wear, predominantly in the form of abraded areas present on restricted parts of the often fragmented items.[9] Identified species exhibiting such use-wear are in the majority *Acropora palmata*, *Acropora cervicornis*, and *Porites* sp. In addition, only a single *Montastrea annularis* artefact was identified. The cylinder-shaped branches with a

Figure 4.8. Jumby Bay (opposite page). Flint flakes showing evidence of utlization. a. flint fragment with bifacial use retouch; b. modified flake with intentional retouch; c. modified flake with unifacial steep use retouch; d. flake fragment (scale 1:1). (Drawings Raf Timmermans)

9 The identification of use-wear was made using the naked eye or a hand lense (up to 10x magnification).

Coral species	Tool type	N	N[a] pos.	N total	N species
Acropora cerviconis	dril	10	3	13	
	rasp	6	18	24	
					37
Acropora palmata	abrading/grinding tool	10	4	14	
	active abrading/grinding tool	1	-	1	
	passive abrading/grinding tool	3	-	3	
					18
Porites sp.	rasp	7	23	30	
	rubbing/polishing tool	2	-	2	
					32
Montastrea annularis	abrading tool	1	1	2	2
Montastrea an./Siderastrea sidera sp.	abrading tool	-	1	1	1
	total				90

Table 4.5. Jumby Bay. Number of identified coral tools by species from test-unit and shovel excavations. [a] This column tabulates possible artefacts, for which use-wear is not very pronounced.

slightly pointed top of the *Acropora cerviconis* coral almost all display parts with abraded areas completely surrounding the branch, suggesting that the tools were used as drilling devices. Rare pieces, however, exhibit abraded surfaces on one side only, suggesting use as an active abrading tool, e.g. a rasp (see also Steenvoorden 1992).

The flattened branches of the *Acropora palmata* predominantly display abrasion on a single face. Both concave as well as convex faces possessed this use-wear, suggesting that this species was used as an active and a passive grinding/abrading tool. In case of the *Porites* sp., the identification of any possible use-wear was complicated by the presence of less pronounced protruding polyps. Cylinder-shaped and flat items were seen among the used specimens. Most artefacts suggest use as an active abrader.

Summary

From this small scale field research, it is evident that the area to the south of Jumby Bay was settled for some time during the Late Ceramic A, somewhere between AD 1100 and 1200. The material remains point to domestic activities related to exploitation of local resources. Rocky inter-tidal habitats close to the shore were exploited for collecting shells and catching fish. The abundant flint available on the island was primarily worked at the site for local purposes. Small cores were reduced following an expedient technology for the production of sharp-edged flakes, which underwent little if any secondary working before use. Clear evidence for systematic pre-working of cores or flakes to be transported to or exchanged with other sites is lacking.

4.4.2 Sugar Mill

Introduction

The Sugar Mill site only lies approximately 270 m to the east of the Jumby Bay site, at the other end of the highest point in this area of Long Island. The site is located on a slightly sloping grassland bordered by the Old Estate House to the west and a replication of an old Sugar Mill to the north (figure 4.1 and 4.10). About 250 m to the southwest the present dockyard is situated. This site probably corresponds with locality LI 1 of Hoffman's fieldwork in the 1960s. However, Nicholson was not familiar with the presence of an archaeological site at this specific location (Nicholson, personal communication 2000), although in his field-notes he indicates a wider distribution of the Jumby Bay site, which partly includes the area of the Sugar Mill site. Sugar Mill was discovered during initial inspection of the island as preparation for the field-work in 2000. A small

Figure 4.10. The Sugar Mill site facing north.

trench dug for pipeline construction uncovered a concentrated Amerindian midden deposit. Lots of shell debris in addition to pottery, flint, and small amounts of coral could be identified on the spoil heap. Inspection of the trench profiles showed that archaeological material did not go deeper than 30 to 40 cm below the surface and that the higher concentration only extended for approximately 10 m, while more dispersed concentrations could be found over a length of 80 m.

It was decided to place a 10 m grid over the site area, and systematically excavate 0.5 x 0.5 m shovel test pits every 10 m, as the laying-out of a grass-field had hidden archaeological material on the surface in the surroundings of the trench. Each test pit was excavated in arbitrary 10 cm levels, using 8 mm mesh screens, similar to the methodology employed at Jumby Bay. Figure 4.11 shows the location of the 18 shovel test pits. The extension of the grid was limited to the west by the presence of a putting green and the beginning of a stone pavement as part of the Old Estate House. No obstructions were present in the other directions.

Figure 4.11 also shows the extension of the shell deposit as identified, which has an approximate size of 20 to 28 m. This is believed to represent the original extent of the deposit, despite the fact that the shovel test pits in the western area revealed considerable disturbances, likely associated with the construction of the old Estate House and connecting stone paths. However, it is possible that additional shell deposits or scatters are situated further to the west, as test pits produced archaeological material in disturbed topsoil there.

The cultural deposit can be considered rather shallow at the Sugar Mill site never exceeding 25 cm in thickness. In the eastern part it resides on a dark humic clayey subsoil, which gradually becomes more chalky to the west, likely associated with the rise of the terrain in this direction. In the higher parts surrounding the old Estate House, only relatively thin topsoil covered limestone bedrock. The clayey deposits in the lower surroundings, therefore are likely to be slope-wash. The inhabitants of the Sugar Mill locality probably placed their dwellings in the higher parts and threw their refuse to the low-lying peripheries.

Disturbance from recent and Historic times are also visible in the area of the shell deposit itself. These are localised, however. At test pit 1029/510, an erosive transition was noted between the topsoil and the beginning of the shell deposit. Here the topsoil contains hundreds of small flint pebbles, in addition to some colonial artefacts, such as fragments of mortar, brick, glass, and glazed pottery. The fact that none of the small pebbles exhibit any signs of use wear or reduction, that they are highly concentrated, and that they all fall within a restricted size range suggest that they might be related to construction activities, in which they functioned as some sort of foundation or filling material. In addition to this shovel test pit other test pits also produced colonial material in the top 10 to 20 cm of the soil. In these cases, however, the erosive transition between topsoil and archaeological material is not apparent, which indicates that later activities did not intrude much into the Amerindian deposit.

Figure 4.11. The Sugar Mill site with the location of the test pits (small rectangles) and site grid points.

Absolute dating

One charcoal sample from a lens of burnt material within shovel test 1045/495 has been submitted for AMS-radiocarbon dating for the Sugar Mill site. This sample produced a ^{14}C age of 600 ± 60 BP (GrA-18849). Calibrated, the date falls between AD 1291 and 1421, when a 95% confidence interval is used. This places the site within the Late Ceramic B phase, corresponding with the local Freeman's Bay style (Nicholson 1994).

Ceramics

The ceramics of the Sugar Mill site have a similar low occurrence compared to shell debris, as found at Jumby Bay. The total excavated sample consists of 277 sherds. In addition, 148 ceramic pieces were collected from the heap that resulted from the pipeline trench.[10] The characteristics of the Sugar Mill pottery[11] resemble those from the Jumby Bay site based on the following features: relative crude surface finishing on the majority of the pottery, a high occurrence of red slip (27.1%), a low occurrence of other forms of decoration (1.8%), and the predominance of the same two vessel shapes (figure 4.12). A notable difference is the absence of WOR painting within the Sugar Mill material, which only produced broad line and

[10] Considering the clear association of this spoil heap with the archaeological deposits identified in the profile sections of the trench, this material definitely can be ascribed to this site.

[11] The ceramics were analysed during the fieldwork by Tom Hamburg and Martijn van den Bel, following the methodology described by Hofman (1993).

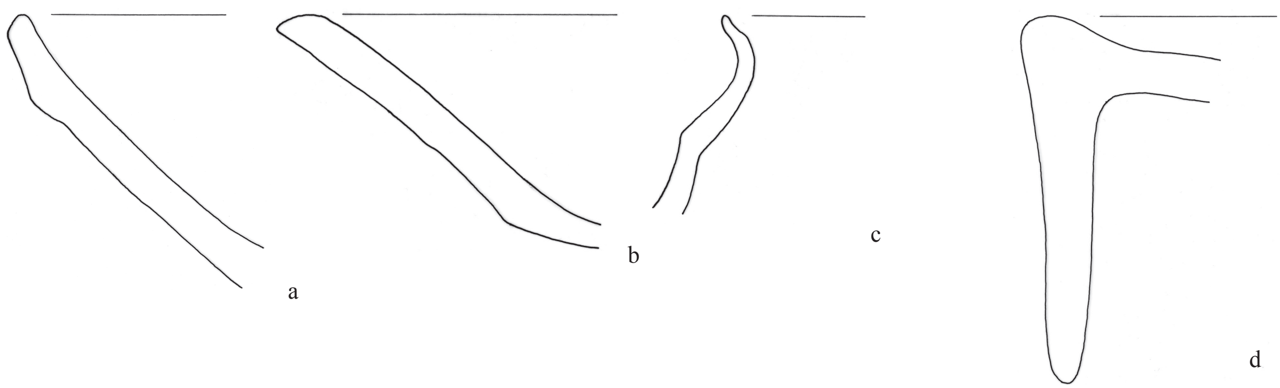

Figure 4.12. Sugar Mill. Unrestricted simple contour vessel shapes (a and b), restricted complex vessel shape (c) and a legged griddle (d) (scale 1:2). (Drawings Raf Timmermans)

fine line incision as decoration modes. It has to be mentioned that the small sample size, particularly in case of the Sugar Mill material, hampers sound statistical comparison and therefore, these differences and similarities have to be treated with caution.

The absence of WOR is supportive of the later occupation at Sugar Mill relative to Jumby Bay and Muddy Bay, despite the many similarities. On the other hand the sample does not typically represent the Freeman Bay style, as is suggested by its ^{14}C date. Rather, the occurrence of broad line incision places it in the earlier Mamora Bay style. Murphy (1999) has recently pleaded for redefinition of the local pottery styles, as the recent data do not correlate well with the original distinction of three subsequent post-Saladoid styles originally brought forward by Rouse (1992; see also Rouse & Morse 1999).

Subsistence remains

A close similarity between Jumby Bay and Sugar Mill is also evident within the shell subsistence remains (table 4.6 and 4.7). Bivalves predominate and the three most common species by MNI are the same: *Chama* sp., *Arca zebra*, and *Pinctada imbricata*. The relative proportions differ, however, with *Pinctada imbricata* occurring more and *Chama* sp. less at Sugar Mill. Among the other less common species a close similarity is noticed again; of a list of around 30 species present at both sites, only three species exhibit significantly different proportions by MNI. In addition, each site yielded nine species that do not occur at the other site, but these species are so rare that this difference likely can be attributed to sample bias. Table 4.7 shows that the common *Cittarium pica* is also relatively rare at Sugar Mill. From the species identified, the rocky littoral zone again appears as the most commonly exploited habitat, which is quite similar to both Jumby Bay and Muddy Bay (Murphy 1996).

The amount of animal bone and crab remains at Sugar Mill are much smaller than the samples from Jumby Bay. This can be largely attributed to the use of only an 8 mm mesh-screen when collecting bone material from Sugar Mill. The residues from two test pits were analysed, following a similar methodology as for the Jumby Bay material (Grouard 2002). The total number of analysed bone specimens inlcuded 648 pieces.

The results from this limited sample display many similarities to the Jumby Bay results. Fish, almost exclusively caught from the reefs and rocky banks, forms the predominant animal class present at the Sugar Mill site (more than 95% by NISP). Identified fish species belong to similar families as at Jumby Bay, including in decreasing order by MNI: Scaridae (Parrotfish), Acanturidae (Surgeonfish), Haemulidae (Grunts), Serranidae (Seabass), and Lutjanidae (Snapper). In addition, very small amounts of crab, mammal bone and bird bone were found as well (Grouard 2002).

Flint working

Like the Jumby Bay site, the Sugar Mill site produced a high quantity of flint artefacts as compared to other stone materials. From the shovel test pits, 1207 flint artefacts were collected, while only 36 limestone, one calcite crystal piece, and one

Shell species	S1045 495 N=303	S1045 505 N=102	S1035 495 N=223	S1035 505 N=107	S1035 515 N=91	S1029 510 N=57	Overall
Pinctada imbricata	17.8	21.6	29.1	32.7	24.2	29.8	25.9
Arca zebra	22.8	27.5	19.7	26.2	36.3	21.1	25.6
Chama sp.	19.1	23.5	16.1	14.0	14.3	15.8	17.1
Anadara floridana	2.0	-	0.4	0.9	3.3	3.5	1.7
Brachidontes modiolus	7.6	2.0	1.3	0.0	0.0	0.0	2.0
Codakia orbicularis	4.0	2.0	4.5	4.7	3.3	1.8	3.4
Anadara notabilis	-	3.9	-	-	-	-	0.7
Donax denticulatus	-	1.0	5.4	-	-	-	1.1
Modiolus americanus	1.0	0.0	0.0	0.0	0.0	0.0	0.2

Table 4.6. Sugar Mill, Long Island. % MNI of bivalves by shovel (S). N comprises the total number of all shell MNI.

Shell species	S1045 495 N=303	S1045 505 N=102	S1035 495 N=223	S1035 505 N=107	S1035 515 N=91	S1029 510 N=57	Overall
Nerita versicolor	0.3	-	2.2	1.9	-	5.3	1.6
Nerita tessellata	1.7	4.9	-	5.6	5.5	3.5	4.2
Crepidula aculeate	6.6	3.9	4.5	2.8	5.5	1.8	4.2
Petaloconchus varians	1.0	-	2.2	2.8	0.0	0.0	1.0
Tectarius muricatus	3.6	2.9	1.3	2.8	4.4	3.5	3.1
Cerithium litteratum	1.3	-	2.7	0.9	-	1.8	1.1
Cerithium sp.	1.7	-	-	-	-	1.8	0.6
Cittarium pica	0.3	0.0	0.9	1.9	0.0	0.0	0.4
Strombus gigas	2.3	1.0	-	0.0	-	1.8	0.9
Strombus gallus	-	1.0	-	-	-	-	0.2
Strombus sp.	2.0	0.0	0.9	0.0	-	0.0	0.5
Murex florifer	1.0	-	0.4	-	-	-	0.2
Murex (phyll.) pomum	0.7	1.0	0.4	0.9	-	3.5	1.1
Acmaea antillarum	0.3	-	0.9	0.9	-	1.8	0.7
Astraea caelata	-	1.0	-	-	-	-	0.2
Astaea phoebia	-	-	-	-	-	1.8	0.3
Fissurella nimbosa	-	2.0	-	0.9	3.3	-	1.0
Lucapina aegis	-	-	2.2	-	-	-	0.4
Nodilittorina tuberculata	-	-	1.3	-	-	-	0.2
Oliva reticularis	0.3	-	-	-	-	1.8	0.4
Turbo casteana	-	1.0	-	-	-	-	0.2

Table 4.7. Sugar Mill, Long Island. % MNI of gastropods by shovel (S). N comprises the total number of all shell MNI.

igneous pebble hammerstone were retrieved.[12] A sample of flint artefacts was analysed following similar procedures as for the Jumby Bay site[13] (table 4.8). This sample consists of 427 flint artefacts in total. Again, many of the artefacts are fire-cracked, impeding analysis. The percentages of fire-cracked material within the test pits vary between 11 and 76%.

The flint sample in many other ways resembles that from Jumby Bay as well. Sugar Mill displays a 100 % use of local flint material; no exotic flint or chert varieties were identified. The sample also contains a very small percentage of Preceramic Age material in the form of two flakes. They do not exhibit secondary working, similar to the Jumby Bay material. Therefore, they may not have been left at Sugar Mill as a result of deliberate scavenging, but rather their presence may be attributed to clearing habitation areas. Among the flake material, the outer surface types include the wide range found

12 In addition, many shovel test pits yielded high quantities of small (in general, not larger than 3 cm) flint pebbles. As these probably date to the later historic period, they are not included in the discussion.
13 Shovel test pits, which were excavated within the shell refuse deposit, were selected. The analysis included the following ones: 1027/525, 1029/510, 1035/495, 1035/505, 1035/515, 1035/525, 1045/495, 1045/505, 1045/515, 1055/495, and 1071.5/495.

artefact category artefact type	raw material	flint and chert	igneous rock	limestone	calcite	total
flaked stone						
flake		199	-	35	-	234
shatter		22	-	-	-	22
flake core		13	-	-	-	13
flaked piece		-	-	1	-	1
ground stone						
-						
used water-worn pebbles						
complete hammerstone		-	1	-	-	1
non-used water-worn pebbles						
non-modified water-worn pebble		1	-	-	-	1
other used rock						
-						
other rock						
natural rock		-	-	-	1	1
unidentified		197[a]	-	-	-	197
Total		432	1	36	1	470
%		91.9	0.2	7.6	0.2	100

Table 4.8. Sugar Mill, Long Island. Number of artefacts by type and by raw material. a predominantly includes fire-cracked flint.

on Long Island, such as water-worn, brown and white patinated, and white and brown chalky surfaces. The majority of the flint is dark grey in colour, but brown banded and completely brown varieties were also identified.

From the few slightly reduced cores it is evident that size of raw material is not very large, at least for part of the material. These cores can be largely considered as poor in quality. This poorness does not reflect flaking properties, but rather has to do with the low flint content of the cobbles, as indicated by relatively thick cortex rinds compared to their small overall size. This wide variety in cortex and small size of sometimes poor cobbles indicates that the knappers at Sugar Mill did not select specificly large or high grade flint nodules, as, for example, was done by the Preceramic Age knappers at Flinty Bay. Such behaviour might be related to the expedient nature of the reduction at Sugar Mill, aimed at the production of flakes for use as ad-hoc tools, as was the case at Jumby Bay.

Only 3.5% of the Sugar Mill flakes possess use retouch, and one artefact was found with intentional retouch around a steep angled edge. This specimen probably functioned as a scraper. The percussion tool was a hard hammer, evidenced by clear percussion points and pronounced cones. The flaking technique was predominantly direct freehand percussion, although 9.3% of the flakes exhibit features that indicate bipolar reduction. For the flake cores this percentage is even higher, 35.7%. Many of the flake cores are small in size, suggesting that this flaking technique was applied during the later stages of reduction.

It is very unlikely that cores were systematically pre-worked at Sugar Mill for further transport, considering the relative high number of cores. The ratio of flakes/cores is around 15:1. The presence of some hardly reduced cobbles with only a few scar negatives, is responsible for this low ratio value; these were probably tested and discarded without much flaking on them.

Looking at the proportions of cortical flakes the percentage of non-cortical flakes is relatively small, only 30% (table 4.9). This can imply three things: (a) the reduction of cores was not done exhaustively; (b) only small cobbles were reduced; or (c) tertiary flakes were transported to other locations. The presence of a few hardly reduced small cobbles suggests that a combination of (a) and (b) is responsible for these low frequencies of tertiary flakes. Jeff Walker (1980a) also found similar

cortex count	N	%
0%	20	30.0
1-24%	21	30.4
25-49%	10	14.5
50-74%	9	13.0
75-99%	5	7.2
100%	4	5.8
total	69	100.0

Table 4.9. Sugar Mill. Cortex count on complete flint flakes excluding one possible pre-Ceramic artefact.

proportions during his reduction experiments using small St. Kitts nodules. However, if larger nodules were also reduced at Sugar Mill, which cannot be completely excluded, then it is likely that some tertiary flakes were transported from this site to other localities.

Other stone and coral

The number of other stone materials is small compared to flint at Sugar Mill. Materials include limestone, calcite, and igneous rock. Limestone is present in the highest number, including 35 flakes and 1 core piece. As is the case with Jumby Bay, it is difficult to specify the purpose of working the limestone. The absence of indicative core artefacts is primarily responsible for this. The only core-specimen present is a limestone cobble with one flake removal. Again, this raises the question whether we are dealing with the debris of a specific separate production or with the debris belonging to the testing and initial reduction of flint cobbles, during which occasionally limestone pieces were tested as well. The latter option is quite possible, considering the close resemblance of many of the limestone flakes to the cortex of the flint, and the high percentage of outer surface on the dorsal face.

The only calcite piece has a crystal structure, on which modification is difficult to identify. Use of this piece may be related to bead making, as suggested for similar material from the Jumby Bay site. The remaining artefact is an elongated igneous pebble used as a hammerstone. Unlike Jumby Bay where flint pebbles were used for this purpose, Sugar Mill has not produced any such specimen, apart from only a few unused specimens.

Among the coral material, a small number of the pieces exhibit traces of usage in the form of abrasion (table 4.10). Similar to Jumby Bay, *Acropora cervicornis* and *Porites* sp. are the predominant species used as tools. In contrast to Jumby Bay, *Acropora palmata* is much more rare. Among the *Acropora cervicornis* artefacts the abrading type of tool, exhibiting abrasion on a single face, outnumbers the drill-type. However, among the former tools, use-wear is less pronounced and in some cases more doubtful than among the latter type. This accounts as well for the *Porites* sp. rasps, which predominantly display minor abrasion. The two *Acropora palmata* artefacts both display use-wear on one of the single flat faces, suggesting utilization as grinding or abrading tools.

Summary

Archaeological fieldwork at Sugar Mill resulted in the discovery of a restricted area where refuse was deposited, mainly in the form of shell debris, flint, and pottery. This area likely belonged to small-scale settlement activities on Long Island. A dated sample suggests occupation sometime between AD 1300 and 1400, which is later than the settlement at Jumby Bay. Similar to Jumby Bay, activities At Sugar Mill were related to the use of local resources. Shell and bone remains point to the exploitation of the rocky inter-tidal habitat close to the shore and commonly available around the island. Flint exploitation and working was primarily related to purposes on site, and cannot be associated with systematic pre-working of material for transport to or exchange with other sites.

4.4.3 Buckley Bay

Alexander Verpoorte (1993, 51) mentions the occurrence of pottery, along with shell, coral and flint at “sample area 36” near Buckley Bay (see figure 4.1; Van Gijn 1996, fig.2). The overall dimension of the scatter of the finds there is reported to be 30 by 30 m, with a modest concentration of archaeological material. Upon arrival during the 2000-campaign, major construction activities had taken place near this scatter. At the east side closer to the coast, a house has been built including the pavement of a drive-way, that runs along the south side of the scatter. In the area of the previous finds, the land had been cleared for future gardening. With this clearing, approximately 25 cm of topsoil had been removed, as is evident by the higher level of the ground surface around several large trees, that were left standing. Despite the removal of topsoil, archaeological material is still lying on the surface. Low concentrations of pottery, coral, shell and flint were identified.

As some archaeological material was still present, six 0.5 x 0.5 m shovel test pits were excavated at locations where surface material was most abundant to see if any in situ archaeological deposits could be identified. In addition, the surface was inspected for the presence of pottery as relative dating material.

Coral species	Tool type	N	N[a] pos.	N total	N species
Acropora cerviconis	dril	3	-	3	
	rasp	-	10	10	
					13
Acropora palmata	abrading/grinding tool	2	-	2	
	active abrading/grinding tool	-	-	-	
	passive abrading/grinding tool	-	-	-	
					2
Porites sp.	rasp	1	10	11	
	rubbing/polishing tool	-	-	-	
					11
	total				26

Table 4.10. Sugar Mill. Number of identified coral tools by species from test-unit and shovel excavations. [a] Tabulates possible artefacts, for which use-wear is not very pronounced.

The subsurface tests showed that true midden deposits or clear distinct occupation layers are no longer present. The western area of the present surface scatter did not produce any finds. A sterile deposit of grey clay is the topsoil at this point. More to the east the topsoil consists of dark humic sandy clay, 25 cm thick with low concentrations of artefacts throughout the layer. This covers a sterile fine-grained chalk dust layer, which is the weathered top layer of the chalk bedrock. This dispersed distribution of finds suggests a mixed horizon, likely a plough-zone or the base of one.

The collected pottery sample is very small, including only 44 sherds from the shovel excavations and an additional 26 pieces from unsystematic surface collections. This small sample limits proper comparison with other samples in the region. The pottery sample basically consists of undecorated and crudely finished sherds. No decorated pottery was excavated from the test pits and the surface collecting yielded only one body sherd with broad line incision. In addition, five sherds from the test pits, 11.4 % of the total, and one sherd from the surface have red slip. The presence of broad line incision and relative crude finishing of most of the undecorated sherds suggest a post-Saladoid attribution. Both the local Mill Reef and later Mamora Bay styles include such broad line incision, which especially became an important decoration mode during the latter one (Nicholson 1994). Based on this, the site must be dated somewhere between AD 600 - 1200.

The sample of flint collected from this site is also very limited. The shovel test pits produced mostly naturally broken, fire cracked and un-worked cobbles. Between 15 to 25% was classified as true artefacts. The number of diagnostic core artefacts, which provide some data on type of technology, is small. Most of the cores are either shapeless (see Appendix D for definition), possessing only one or two flake removals, or multi-directional. These cores are rather small cobbles, not greater than 10 cm. These characteristics suggest that only initial stages of flake core reduction are represented, as expected for the Ceramic Age date of this site. Verpoorte (1993, 51) also noted the high number of burnt and naturally broken flint pieces. However, he remarked that small flakes predominate among his collected sample, which is contradicted by my findings. This difference may be attributed to the recent post-depositional activities, since the site was less disturbed when he studied it.

Another difference concerns the finding of blade technology artefacts during the 2000-fieldwork. Within test pit 834.7, one clear patinated blade was recovered. In addition, two flakes, which are likely related considering their similar nature and degree of patination, were found in that test pit. In the view of the patination and blade technology, these artefacts can be ascribed to the Preceramic Age. More patinated artefacts, including blades were seen on the surface during the 2000-campaign. On the contrary, Verpoorte explicitly states that blades or blade related materials were absent within the surface scatter that he inspected. This difference likely is attributed to one of the following reasons: (a) blade material was originally present in the deeper strata and therefore was not seen by the 1989-team; (b) recent construction activities after 1989 have disturbed the site more than previously thought, and have completely mixed material from nearby surface scatters with site material to a considerable depth; or (c) the small sample studied by Verpoorte biased his results, making it likely that the low percentage of blade material was not identified. Of these three possibilities, at least the second one probably can be excluded, as material seems only to have been removed and not added to the site. Furthermore the test pits excavated do not indicate that the topsoil was completely disturbed and mixed very recently, in this case only one to three years ago. In relation to the first and third possibilities, it is more difficult to decide how they may be relevant.

Based on this, we can assume that the Buckley Bay site is a multi-component one, with a mixture of Preceramic and Ceramic Age occupation remains. However, this disregards the possibility that the Preceramic Age blades, which are abundantly available locally, might have been collected by Ceramic Age settlers and used without modification. Such behaviour has been suggested for the occurrence of true "Preceramic" Age blades within Ceramic Age archaeological contexts at Muddy Bay (De Mille 1996) and Royall's (Murphy 1999). As Buckley Bay lacks intact archaeological deposits now, such re-use is difficult to prove or disprove. In any case, the Muddy Bay and Royalls examples only concern a few individual pieces out of a sample of a few hundred and these bear signs of re-use in the form of secondary working, while here the proportion is higher, and the artefacts do not display any evidence of re-use. Since blade material is abundantly present on this part of the island Preceramic Age evidence at Buckley Bay can likely be related to these occurrences. This suggests that material from at least two distinct periods of occupation are mixed at this site.

In addition to these artefacts, the test pits yielded subsistence debris in the form of shells, a few animal bones, and some crab fragments. Only the shell were classified into species and counted. Keeping in mind that the amounts of shell are relatively small, the major species by MNI include *Nerita tessalata, Nerita versicolor, Tectarius muricatus, Chama species, Donax denticulatus, Cittarium pica, Arca zebra*, and *Strombus gigas* (table 4.11). The majority point to the exploitation of a rocky littoral zone, whereas *Donax denticulatis* indicates collecting on a sandy littoral zone and the *Strombus gigas* suggests exploitation of sea grass beds (Murphy 1996; Nieweg 2000). These zones are well represented near Long Island. Comparing these species with the most common species within the Sugar Mill and Jumby Bay sites shows that although all samples are similar in types of species, proportions differ at Buckley Bay. At Buckley Bay, gastropods form the most important shells, such as the *Nerita,* C*ittarium* and *Strombus* species, whereas at Jumby Bay and Sugar Mill bivalves predominate and the gastropods only make up a small part of the total sample. Considering this predominance of gastropods, the shell debris is likely related to the Ceramic Age component of this site, as during the Preceramic Age shell exploitation was mainly directed toward collecting bivalves (Brokke 1996). Furthermore, this predominance resembles shell collecting behaviour of early Ceramic Age sites on the main island of Antigua and elsewhere (Brokke 1999a; Murphy 1999; Taverne & Versteeg 1992), but also some Late Ceramic Age sites (Nieweg 2000). This difference is likely the result of changing preferences, if it is assumed that shell-fish availability was similar for the occupants of different sites on this small island. This may suggest that the occupation at Buckley Bay occurred at a different time than at Jumby Bay and Sugar Mill, probably earlier. Combined with the pottery characteristics, an early Late Ceramic A date is most probable for Buckley Bay.

My concluding remarks remain limited for this site, due to the absence of intact archaeological deposits. The collected materials suggest that this location was probably used both during the Preceramic and the Ceramic Ages, likely the later phases. Post-depositional processes such as ploughing and plant growth first disturbed the original deposits and mixed up finds from different periods. Disturbance was continued by recent land clearing and removing of part of the topsoil.

Most activities during the Preceramic Age were probably related to flint working and are similar to those at many other flint scatters distributed across this part of the island. For the Ceramic Age, the co-occurrence of pottery, flint, coral, shell, and animal bone suggests settlement at this location. These activities must have been very small-scale and short-term, based on the small distribution originally seen by the 1989-team, the dispersed nature of the finds identified in 2000, and the absence of a concentrated midden deposit. A one-time campsite is a likely possibility for the Ceramic Age. The small sample of flint material suggests only initial reduction of poor quality cobbles. There is no indication that specific items were taken elsewhere.

4.4.4 "Site 32"

The Leiden team discovered a relatively elongated surface scatter of flint material, pottery, and shell remains, approximately 240 m² in size, along the south side of an unpaved road near Cistern Point in 1989 (see figure 4.1; Van Gijn 1996; Verpoorte 1993).[14] Threatened by new road construction, the team decided to systematically collect all material from the surface in 1 x 1 m squares and excavate a 1 x1 m test-unit for establishing the depth of the cultural deposits. The subsoil testing confirmed the

[14] Desmond Nicholson told me that a group of students worked on the locality of "Site 32" in 1972 as part of a Proctor Academy summer camp (Nicholson personal communication 2000). Unfortunately, I was not able to study reported results and therefore this work is left out of this discussion.

Buckley Bay	834.7/1186.5 all levels		850.5/1193.4 all levels		849.5/1186.0 all levels		all shovels	
Species	MNI	weight	MNI	weight	MNI	weight	MNI	weight
Bivalves								
Anadara notabilis	-	-	-	2	-	-	-	2
Arca zebra	-	7	-	44	2	51	2	102
Chama sp.	-	40	3	46	1	19	4	105
Donax denticulatus	1	1	1	1	1	1	3	3
Pinctada imbricata	-	2	-	18	-	11	-	31
Tellina fausta	-	-	1	48	-	-	1	48
Gastropodes								
Astraea caelata	-	-	-	2	-	1	-	3
Cittarium pica	-	170	2	352	-	84	2	606
Murex (phyll.) pomum	-	-	-	15	-	-	-	15
Murex sp.	-	1	-	-	-	-	-	1
Nerita tessellata	1	1	9	11	12	9	22	21
Nerita versicolor	-	-	4	4	5	6	9	10
Nerita sp.	-	-	-	-	-	2	-	2
Purpura patula	-	-	-	1	-	-	-	1
Strombus gigas	-	-	1	1656	-	12	1	1668
Strombus sp.	-	120	-	-	-	2	-	122
Tectarius muricatus	-	-	4	3	2	2	6	5
Chitons								
Acanthopleura granulata	-	1	-	3	-	1	-	5
Chiton sp.	-	1	-	22	-	17	-	40
Minimal Total number of kinds of species	2	10	8	16	6	14	9	19

Table 4.11. Buckley Bay, Long Island. MNI and weight (g) of shell remains by species and by shovel.

earlier assumption that material was largely located on the site surface.

Upon my re-visit in 2000, significant construction activities were evident in the area. A new road was paved on the track of the former one. This construction also incorporated some digging work for widening and laying out road foundations. In addition to the road construction, a pipeline for water transport had been laid out in the site area. After close inspection of the site surface it appeared that most of it had been destroyed, as indicated by recently disturbed topsoil. Only toward the southern border of the area were still low concentrations of flint identifiable, not extending more than 40 m² in size. The subsoil seemed different in nature in this area, and may have remained undisturbed. Therefore two 0.5 x 0.5 m shovel test pits were excavated. One test pit excavated within an undisturbed context produced hardly any finds, only a few flint artefacts were found. The other test pit yielded more flint artefacts, but the topsoil was very loose and most probably thrown up. Both test pits did not produce any pottery and shell remains were almost absent. From these findings it is clear that recent construction activities basically destroyed this site and only a very low artefact concentration remained in the southern area.

This situation means that the data from Van Gijn's article and Verpoorte's thesis are the only information available for "Site 32" (Van Gijn 1996; Verpoorte 1993). They both reported that this locality was probably a multi-component site. The co-occurrence of pottery, small in number, and blade production strongly points to this. In addition, an expedient flake tool technology, and shell remains, including two conch celts, were identified. Due to its shallow nature, the different site components could not be separated on the basis of stratigraphy. Verpoorte attempted to distinguish the different flint technologies on basis of raw material choice. Hampered by the patinated nature of the artefacts, he still could see an association of blades and blade cores with what he called "raw material unit 1" (RMU 1). Some flake cores were also assigned to RMU 1, and they were interpreted as "failed pre-worked blade cores" (Verpoorte 1993, 43). Most artefacts could not be grouped to a specific RMU due to patination, but they exhibited mutually similar characteristics and therefore, were considered to represent an undefined RMU (nr.9). A small portion of the sample was classified to RMU 2, a raw material originating from the hard ledges near Buckley Bay, basically consisting of brown coloured small sized nodules (Verpoorte 1993, 24). Unfortunately no core artefacts were included in the small RMU 2-group. The absence of blades within this RMU, minimally suggests that this material was not used for blade production.

After having studied a sample from the 1989 collected material more closely, Verpoorte (1993, 48) concluded that the debris can be ascribed to two types of technologies. One is related to the production of blades, of which a part exhibits traces of use-wear that suggests use at the site and the other is an expedient flake tool technology, including many small, almost exhausted cores. The first sequence is associated with RMU 1, while the second probably includes RMU 2, among other raw materials. Verpoorte noted that the specific blade production is different from the one found at Flinty Bay with respect to reduction stage. At Flinty Bay, the high proportions of artefacts suggesting initial reduction, such as primary blades, secondary blades, and core caps, sharply contrast with the proportions found at "Site 32", where core caps are scarce and tertiary blades predominate. Therefore, "Site 32" is interpreted as an occupation site where flint was worked for local use, whereas Flinty Bay can be considered as a flint workshop site, solely for the preparation of blade cores that were further transported elsewhere. The flake tool technology at "Site 32" exhibits a similar exhaustive use of material indicated by the small flake cores. In this respect, both technologies suggest reduction for local use.

Not being able to spatially separate both technologies and unfamiliar with Ceramic Age flake tool production, Verpoorte did not assign the samples to specific occupation periods (Verpoorte 1993, 48; Van Gijn 1996, 190-1). With the new available data from Ceramic Age sites, Jumby Bay and Sugar Mill on Long Island, as well as experience with Ceramic Age flint working on surrounding islands, I have tried to date the material. I inspected part of the material stored at Leiden University to do this. This examination did not involve systematic coding of artefacts, but was addressed toward qualitative aspects of the sample.[15]

From this re-study of the material, I conclude that the blade technology artefacts and the majority of the flake technology artefacts must be ascribed to the Preceramic Age. Only a very small portion, likely to be less than 10%, can be assigned to the Ceramic Age. The following arguments were decisive in this assignment. First, most artefacts are patinated. As all artefacts from the Jumby Bay and the Sugar Mill site do not exhibit such patination, this suggests that either artefacts at "Site 32" were exposed to weathering processes for a considerable longer time, or that the weathering processes operating at "Site 32" were different from those at the other two sites, resulting in a faster patination. Considering that non-patinated artefacts also occurred at "Site 32" and assuming that all artefacts at this site experienced the same weathering, this implies that the period of weathering was different for both groups (the patinated and non-patinated), and that the patinated ones thus originated from an older occupation. The technological features of the patinated artefacts provide additional support for this time differentiation. These features are different from those common among Ceramic Age flake technologies. Most striking characteristics of the patinated artefacts at "Site 32" are predominance of single to multifaceted striking platforms on flakes, pronounced bulbs of force, more regularity in flake shape, and larger average size of flake scars on the cores.

Within Ceramic Age flake technologies the use of the bipolar technique resulted in the formation of edged or pointed platforms, less pronounced bulbs of force, a large variety of flake shapes, and exhaustive use of the flake cores, often possessing very small flake scars and scars with hinged distal ends. A difference between Preceramic and Ceramic Age expedient flake tool technologies is also reported on St. Martin for the Preceramic Norman Estate site and the Saladoid Anse des Pères site (Knippenberg 1995). Recent study of Preceramic flaked stone assemblages from Barbuda further supports this difference (Watters 2001; Watters *et al.* in prep.). In general, it can be said that Preceramic expedient flake tool technologies exhibit more control in the reduction process, which can be likely attributed to the absence of the bipolar technique. When examining the few non-patinated cores from "Site 32" with these characteristics in mind they exhibit more similarities to features associated with the Ceramic Age. This correlation between the presence and absence of patina and specific technological features supports the correlation between the degree of patination and age in the case of this site.[16]

Knowing that most flint artefacts are Preceramic in age, it is justifiable to ask how the co-occurrence of blade and flake technologies can be explained. There are a few possible solutions: (a) they were two different technologies serving different demands by the occupants of the site; (b) they belong to two different groups of people, possessing different kinds of stone working protocols; or (c) the flake technology represents the last stages of a reduction sequence that started as a blade technology. The evidence is too limited to provide any definite answer, but the co-occurrence of both technologies is not uncommon at Preceramic Age settlement sites on Antigua. For example, Davis reports such a situation for the Jolly Beach

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15 As only a part of the original collected sample was taken to Leiden University, there was no use in quantitatively studying the remains. The sample that was inspected included the excavated test unit (Verpoorte 1993), the only unit that was completely shipped to Leiden University, as well as some additional surface collected units to see if the findings from the excavated unit were consistent with the rest of the material. Furthermore, all cores were studied.

16 I am aware that this correlation is not a general one, as each site may provide different weathering conditions. Therefore within each context it should be tested anew.

site, as well for Cistern Point, which is situated only 100 to 200 m from “Site 32” (Davis 2000). Although Davis does not specifically indicate whether this flake technology has to be considered apart from the blade technology, his size comparison of blade and flake cores suggests such a case, as both artefact categories are similar in this respect. Flake cores would have been smaller if they were to be associated with the last stages of reduction. On the other hand, Crock *et al.* (1995) present a case from Anguilla, Whitehead’s Bluff, where they identified a flake technology, that likely started as a blade technology, indicated by blade-like scars on a small portion of the cores.

If we combine the limited data from “Site 32”, the following probable scenario emerges. During the Preceramic Age, a group of foragers settled this location for a some period of time. Considering their exhaustive reduction of flint material, this stone was used for purposes on site that were related to habitation and subsistence activities, including shell-fish consumption. As such, this site must have been similar to the Cistern Point site excavated by Davis (1974) and interpreted as a small Preceramic Age settlement. During the Ceramic Age this location was also visited, but less extensive. As the amount of Ceramic Age associated flint material is small, and there are few ceramics, site activities must have been limited, i.e. short term camping, similar to Buckley Bay.

4.4.5 Flint scatters in the eastern area of Long Island

The 1989 field-campaign had put a lot of effort in mapping surface scatters of worked flint material on the eastern part of Long Island (see figure 4.1; Van Gijn 1996, fig. 2). Verpoorte (1993) listed these in more detail. Based on estimated proportions of cores, primary, secondary and tertiary flakes and blades, he categorised the scatters according to predominant reduction stage (Verpoorte 1993, 63). Scatters where cobble testing and initial reduction were performed made up the majority, while another significant group is formed by scatters where all stages of production are represented. Verpoorte mainly attributed these scatters to blade producing knappers, as evidence of systematic flake core reduction is scarce.

During the 2000-field campaign the previously listed scatters were hard to relocate due to dense and long grass covering most of the area. In addition, large areas in the middle of the island had been significantly disturbed, as evidenced by large erected piles of flint, likely attributed to land clearing. Certain scatters, however, were found and inspected in 2000. These confirmed the interpretations of Verpoorte.

In addition, transect lines, which were cleared in the eastern part of the island to designate plot boundaries, were field walked. Not hampered by any vegetation, these transects clearly affirmed the difficulties the 1989-team faced in distinguishing artefact scatters, as flint cobbles and artefacts are lying everywhere, with occasionally higher concentrations of material. Furthermore, the inspection of the cleared transects showed that blade related artefacts also exhibit this same overall distribution, suggesting that pre-working of this material was probably responsible for the majority of the artefact distributions. Evidence of systematic flake core reduction was not identified. Therefore, Verpoorte (1993) saw this distribution as typical of open quarry sites where people paid recurrent visits to collect, test, and pre-work material, leaving a “back ground noise” of flint debris widely scattered.

If any occasional pre-working of flake cores had taken place within this area, it would be very difficult to ascertain considering the disturbed nature of the area in which ploughing affected the original artefact distribution and the fact that the overall presence of blade working makes it hard to isolate flake production from it. In any case, it is clear from the 1989 survey and my own inspections that there is no evidence of systematic flake core preparation or reduction within this part of Long Island, as was found at Flinty Bay for blade core preparation.

4.5 Discussion of results

The data presented above and elsewhere (Davis 1974, 2000; Hoffman 1963; Nicholson 1974, 1976; Olson 1973; Van Gijn 1996; Verpoorte 1993) enable me to provide a general picture of flint working activities on Long Island through time. An extraordinary case exists there in that the least known period within the Lesser Antilles, the Preceramic Age, is relatively well represented and documented on this small island. Based on the assumption that blade industries are Preceramic in age, an assumption well shared among Caribbean archaeologists (e.g., Keegan 1994; Rouse 1992; Veloz Maggiolo 1991), a number of Preceramic Age localities have been identified on Long Island. As true sites, Cistern Point, “Site 32”, and Flinty Bay are so designated. At the former two, the co-occurrence of subsistence remains in the form of shells and animal bone, and blade technology flint debris suggests local settlement of Preceramic Age shell fish collectors and fishermen on the island. Flint was worked for local use at these sites. Flinty Bay only produced flint debris and has been interpreted as a flint workshop site. The high percentage of primary and secondary blades, the absence of retouched implements, and the presence of many blade cores, most of which bear some sort of flaw, is supportive of the interpretation that blade cores were pre-worked at this locality for transport elsewhere (Van Gijn 1996, 191-3). Furthermore, small variation in the size of the blades and platforms, as well as among flaking angles, all suggest a large degree of standardisation within this technology (Verpoorte 1993).

For the subsequent Early Ceramic Age (400 BC – AD 850, Phases 2 and 3) there is an absence of clear evidence. Typical Saladoid ceramics have not been found on Long Island. Despite similarities in shell collecting behaviour at Buckley Bay to some Saladoid sites, including the Antigua site of Royal's, this site was more post-Saladoid-like in its pottery characteristics. Furthermore the identified flint scatters do not suggest that Ceramic Age knappers performed systematic reduction at their workshop sites. Still, it cannot be excluded that some of the scatters with evidence of raw material testing might be attributed to Early Ceramic Age knappers. However, in these cases it will not be necessarily possible to distinguish between Early Ceramic and Late Ceramic Age activities, bearing in mind the similar technologies that were employed throughout the whole Ceramic Age (see Chapter 5). It is also important to note that on the nearby island of Antigua there are still few known Saldoid sites relative to Preceramic and Late Ceramic Age sites (*cf.* Davis 1982, 2000; Murphy 1999).

In contrast to an apparent absence of evidence of Saladoid activities on Long Island, the Late Ceramic Age (Phases 4 and 5) has demonstrated settlement activities at Jumby Bay and Sugar Mill, at least sometime between AD 1100 and 1400. Occupation might have occurred earlier at Buckley Bay, and "Site 32". Generally this was small-scale settlement, although Jumby Bay can be considered a site of some significance. As Long Island lacks permanent natural water sources, it is puzzling that people settled there at all. This immediately raises the question whether we are dealing here with more permanent forms of settlement or with short-term visits to Long Island. The dispersed scatters of archaeological remains and their restricted distribution at Buckley Bay and "Site 32" as well strongly suggest the latter option. Jumby Bay and Sugar Mill, however, are larger sites with a high find density. So, it can be concluded that settlement must have been more extensive at these latter sites than at Buckley Bay or "Site 32". This may have been the result of a longer period of occupation or a larger group of people inhabiting these sites. As we do not possess information on dwelling structures, we must solely rely on size of the deposits. When compared to other sites on the main island of Antigua, the Long Island sites are relatively small. For example, at the settlement of Muddy Bay, which likely is contemporary with one of the sites on Long Island, a thick shell midden was identified, that covers an area of nearly 20 000 m² (Murphy 1999, 222). From this it seems justified to consider the Jumby Bay and Sugar Mill sites, either as a short term occupied sites or a repeatedly visited campsites. The clear discrepancy in dates between the Jumby Bay (1035 – 1275 cal AD) and Sugar Mill (1291 – 1421 cal AD) sites suggests that occupation on the island remained small-scale with habitation activities at only one site at a time, probably relating to the minimal basic resources that were provided.

Assuming this short-term settlement on Long Island, one may wonder what the purpose was of being there. It is quite clear from the present study that Long Island flint was highly valued as raw material for flake tool production in this region, as is evidenced by its wide distribution among the surrounding islands (see Chapters 5 and 6). Therefore Long Island must have been visited many times for exploiting this fine-grained material. From the above discussion, it is clear that during the Ceramic Age these exploitation activities did not leave any evidence in the form of pre-working raw material in the areas of natural raw material distribution and related habitation sites. Flint was probably collected and mainly exported from the island in unmodified form at this time.

If the settlement activities cannot be related to flint reduction activities, how then can we explain their occurrence on Long Island? Based on the available evidence from the shovel test pits and other excavations, shell collection and fishing seem to have played a significant role. One would be inclined to suggest that local settlement might have been related to the abundance of shells and fish in the surrounding waters. During the Ceramic Age, an increase in reliance on marine resources is noticed through time and it is especially apparent within the Late Ceramic Age (Petersen 1997). The beginning of this period marked a considerable increase in the number of sites on the various local islands, such as for example Anguilla, Nevis, and la Désirade (Crock 2000; Crock & Petersen 1999; De Waal 1999a, 2006; Wilson 1989). Furthermore, we see the appearance of an overall distribution of sites on all regional islands, including ones that were formerly unoccupied (Crock 2000; Petersen 1997; Watters 1980). In such a scenario, where all primary resource areas have become occupied, the settlement of less desirable small islands, with no fresh water resources but situated within shell and fish rich areas is easily comprehensible and this may in part pertain to Long Island. These settlements must then be considered as a means to guarantee subsistence returns in situations where demands on surrounding environments became considerable larger.

Another possible scenario relates to the presence of flint in a more indirect manner. In this scenario, the settlement is seen as some sort of outpost from where the source of valued material was controlled, or guarded. There are numerous examples from ethnography that mention the territorial control of local resources (e.g., McBryde 1984). Such control has effects on the access to local raw materials, which would become more restricted. Whether the settlement at Jumby Bay, Sugar Mill, or Buckley Bay was associated with local resource control is difficult to prove by analysing the data from these sites alone. The small scale of the archaeological investigations at each makes it very difficult to find evidence to support such an explanation. It can be even doubted whether such control would leave specific evidence on Long Island itself, if it only concerned small camps where people stayed and guarded the lithic source. It would be more rewarding to study this from a regional perspective. If it indeed was the case that Long Island became controlled by a specific community during the Late Ceramic Age who limited access to it, then this should become visible by changes in distribution of the material and changes in degree of its use at sites further away (Torrence 1986; see below).