The Roque Island Archaeological Project, Maine, USA: Methodologies and Results

William R. Belcher1,* and David Sanger2

Abstract - Between the early 1970s and the mid-1990s, David Sanger was largely responsible for a series of large-scale regional survey and excavation projects throughout Passamaquoddy Bay (New Brunswick) and the central/Downeast coasts of Maine. While resulting in an important understanding of the paleoenvironment and prehistoric/historic resource exploitation along the Gulf of Maine, these projects also allowed the development of a unified analytical strategy for the excavation of shell middens using column sampling, documentation, and excavation protocols, as well as sediment analysis and classification. This strategy is detailed below along with a summary of excavations from the Great Spruce Island site (61-17) in the Roque Island Archipelago, Downeast region, ME, USA. Pre-European occupation at this specific site ranges from before 3000 years B.P. to ca. 400 years B.P.

Introduction

Documenting a marine adaptation involves more than just the presence of sites on the coast (Sanger 1975, 1981, 1988). In our view, demonstration can only come about by an analysis of food remains in site contexts, not just potential. Secondly, the archaeology should demonstrate a clear orientation to the marine resources, and ascertain whether the focus is seasonal or extends over much of the year. This analysis may be especially important in temperate zones where resources exhibit considerable seasonal variability.

Archaeological sites that feature many discarded shellfish remains, usually called “shell middens”, provide the necessary documentation due to the superior preservation of food remains. Shell middens occur throughout the world in varying degrees of concentration and size. Archaeologists have long recognized the potential of these sites to reveal much about the culture of the shell gatherers; however, as a class of sites, shell middens represent a paradox. On the one hand, these middens afford excellent bone, antler, and tooth preservation due to the nearly neutral environment (pH of ~7.0) from the carbonates leached from the shells through pedogenesis; on the other hand, Maine, USA, sites can exhibit very detailed and complex stratigraphies (Sanger 1981, 1985). These challenges, combined with other research interests, dictated our analytical approach to the Roque Island sites.

This paper will serve as a historical review that clearly lays out the methodology that was developed by Sanger and implemented by his graduate students in terms of thesis research as well as project implementation during the early 1980s to mid-1990s. The classification of the stratigraphic sequences through quantitative analysis and qualitative/semi-quantitative descriptions were intended to recognize the diversity that we observed in shell middens, rather than describing them as relatively homogenous or palimpsest deposits that could yield little in terms of our understanding of maritime adaptations throughout the larger Gulf of Maine region. Additionally, the Great Spruce Island (GSI) site (site 61-17 in the Maine site-designation system), the main focus of the Roque Island Archaeological Project, is used as a case study to demonstrate the use of this analytical system.

Shell middens represent a unique component of the archaeological record of Maine and have a long history of investigation (Bourque 1971, 1975; Moorehead 1922; Sanger 1971, 1979a, 1987). While shell midden deposits may extend back to the Late Archaic Period (ca. 5500 to 4500 years ago), the focus of much of the research is on shell middens that fall within the Ceramic Period as defined by Petersen and Sanger (1991). The Ceramic Period is analogous to the Maritime Woodland Period (e.g., Hrynick and Black 2016). Petersen and Sanger (1991) subdivided the Ceramic Period into 7 sub-periods (CP 1 to CP 7) based on ceramic-surface treatment that temporally ranges from ca. 3000 to 400 years ago. Much of the research on Ceramic Period shell middens has focused on subsistence and settlement (e.g., Sanger 1981, 1983, 1986, 1988, 1996).

Stratigraphic Analysis

Discussions of archaeological stratigraphy cite basic principles worked out by geologists or
geoarchaeologists for non-cultural deposits (Holiday 1990; Stein 1990, 1992). Fundamental to our research is the axiom that shell middens represent cultural activities; in other words, people make shell middens. As such, we regard direct analogies with geological process as inappropriate. However, even as a site is forming, geological, biological, and cultural processes impact both the site and the nature of the archaeological record, with natural and cultural processes that continue after abandonment to the present (e.g., Schiffer 2010). These concerns are reflected in our interest in reconstructing paleoenvironments and in placing archaeological sites in specific cultural and natural settings.

Shell middens are composed of repeated deposits of shells and other debris that could not have accumulated as homogeneous layers over the entire site. The individual deposits into the shell midden consist of dumping areas, or debris piles, whose size and duration of use is determined by the site’s inhabitants, not natural processes. Feature 3 at the GSI site, discussed below, is a rare example of an intact shell pile. Repetitive dumping episodes of coarse shell debris from the same species can be difficult to identify, resulting in deposits that may appear massive or relatively undifferentiated to the naked eye. On other occasions, at the same site, there may be a myriad of visually distinguishable lenses of shells and other deposits, all varying in thickness, length, and orientation to each other. The size of these particles is not determined by natural depositional agencies, such as water or wind. In this respect, traditional sedimentology techniques appropriate for analysis of natural deposits have marginal utility. The different characteristics of house pits and other features, as opposed to shell dump areas, highlight this phenomenon.

Abandonment of a site can result in a mature or formative soil horizon that people again lived on following a hiatus. Under these conditions a near site-wide stratigraphic layer can develop. Such breaks, albeit all too rare, constitute very useful time markers.

In the 1990s, D.F. Dincauze (1996) proposed using the Harris Matrix system (Harris 1989) to deconstruct the archaeology of Northeast coastal shell middens. While the senior author has used the Harris Matrix system for prehistoric urban archaeology, the Harris Matrix technique was not developed for use with shell middens and generally does not impress us with its utility in extremely complex middens; however, the system has been used in research of northern New England and the Maritime Provinces (Black 1983, 1992). As in any method, the analyst still has to make decisions as to the significance of divisions in the midden. For instance, when the deposit changes from nearly all clam shell to mussel, the choice is easy. But when faced with an ephemeral transition, as is often the case with shell middens, where is the division made? Or does the archaeologist assume that “shell is shell”, no matter what the species, size, or percentage relative to non-shell (mineral) deposit? Bourque (1996) and R.L. Carlson (1993) presented a thoughtful and critical review of the utility of the Harris Matrix system and Stein’s (1992) geological facies perspective applied to shell middens.

Shell Midden Excavation

Research interests and theoretical orientation dictate an archaeologist’s site choice for excavation as well as excavation procedures. We recognize it is highly unlikely that there is a single “best way” to excavate a shell midden, especially when one considers the myriad of definitions of a shell midden. We feel the appropriate technique for a specific problem can only come from a full understanding of the depositional agencies involved, not a dogmatic protocol. Research questions also determine excavation strategies. Sanger and his students developed and used a system of analyses that included facies analysis, written qualitative/quantitative descriptions, whole-unit analysis, and column sampling protocol (Belcher 1988, Carlson 1986, Chase 1988, Skinas 1987). This system of excavation and documentation allowed detailed and controlled analysis of artifactual, faunal, and stratigraphic data sets.

Our excavations proceeded using the standard of an archaeological grid system, followed by its subdivision into 1 m x 1 m excavation units; thus, the 1-m square was the basic point of reference and excavation unit. In the absence of clear stratigraphic separation, as in massive, relatively undifferentiated midden deposits, our approach has been to excavate, by trowel, arbitrary 5-cm levels within a small area or “quadrant” measuring 50 cm x 50 cm, or one-quarter of a 1 m x 1 m excavation unit. When a distinct stratigraphic break occurred, this approach was modified to excavate each different strata separately, but within the same 5-cm level. This enabled us to maintain the stratigraphic context of archaeological data in the complex stratigraphy of the shell midden and allowed us to excavate and document by functionally linked layers.

Stratigraphic interpretation in shell midden archaeology is both visual and tactile. It can be an obvious change from a deposition of coarse *Mya arenaria* (soft-shell clam) composed of whole or
almost whole valves to crushed *Mytilus edulis* (blue mussel), or from relatively dense deposits to extremely loose shell debris. Depending on the extent of the depositional change throughout the site, these transitions in shell species within strata could be significant and indicate a switch that reflects local resource availability. It could also represent nothing more than the debris from lunch versus supper on the same day, and, therefore, be of limited interest for overall culture history. This ambiguity is further complicated by the fact that while the sturdy shells of clams may remain intact, the thin-shelled blue mussel or *Strongylocentrus drobachiensis* (green sea urchin) of Maine middens are more often recovered in tiny fragments, even in the same deposit as the larger soft-shell clam remains.

Preservation of organic remains in shell middens (e.g., faunal remains as well as bone, antler, and tooth artifacts) makes this type of site attractive for study. In many cases, even the smallest of bones, usually fragmented fish or small mammals, are present within these shell deposits. Because recovery of these small bones among the shells can be difficult, we screened all deposits (“whole unit”) through 6.3-mm (1/4-inch) mesh in hopes of mitigating loss of small finds. At the time this was implemented (mid-1970s through the mid-1980s), this was not the standard practice for shell excavation (e.g., Bourque 1995, Spiess and Lewis 2001). Even so, many smaller elements can pass through the mesh (Cannon 1999, James 1997, Shaffer 1992, Shaffer and Sanches 1994). Rather than screen all matrix through 3.1-mm (1/8-inch) or smaller screens—which would greatly increase the necessary time and labor—we saved samples of feature fill as well as samples taken in columns throughout the site, for later laboratory processing.

**Documentation**

Sanger’s experience with literally dozens of shell middens along the Maine–New Brunswick coast led to a protocol for midden description that involves a qualitative/semi-quantitative evaluation of the percentage of shell versus non-shell matrix, together with species of shell and size ranges (see Table 1). Importantly, this approach achieves more than stratigraphic description, with the documentation aiding in interpretation; for example, large, unbroken shells probably indicate a primary dumping episode, whereas highly fractured shell particles may mean secondary or higher redeposition of shells. Extremely small shell pieces (documented by a crushing index/description) may represent trampling. As noted earlier, however, highly crushed mussel shell may not mean the same as crushed clam because mussel shells are highly friable. Shell-free areas or zones (defined as less than 15% shell by mass) within the midden may represent house floors, which typically have a very low shell content, while other shell-free zones could result from house-floor cleaning and redeposition of the matrix. Documentation using an excavation-level form is completed for every level in a 50 cm x 50 cm excavation quadrant of the 1 m x 1 m excavation unit. With experience, excavators can be reasonably consistent at this level of discrimination. Samples returned to the laboratory provide a check on field assessments by comparison of quantitative analysis with the qualitative excavation descriptions.

Artifacts, including fire-cracked rocks, formal lithic tools and ceramics, and worked bone, antler, or tooth materials (when recognized), were piece-plotted on forms designed to record matrix and recovery information (faunal remains and lithic debitage were not normally piece-plotted). These forms were supplemented by horizontal plan drawings, vertical section drawings as well as negative-based photography using both black-and-white and color slides. We have found that good field photography can reveal subtle changes in matrix composition that may not be immediately obvious during excavation, especially where flash photography brings out subtle textures.

**Excavation terminology**

Along with the development of this unique excavation methodology came the development of terms used to distinguish different kinds of deposits, and while some terms are common in archaeology, others have been defined based on experience excavating

<table>
<thead>
<tr>
<th>Size</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Whole</td>
<td>Complete valves or gastropods</td>
</tr>
<tr>
<td>Large</td>
<td>&gt;3.0 cm</td>
</tr>
<tr>
<td>Medium</td>
<td>3.0–1.0 cm</td>
</tr>
<tr>
<td>Small</td>
<td>&lt;1.0–0.5 cm</td>
</tr>
<tr>
<td>Crushed</td>
<td>&lt;0.5 cm</td>
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<table>
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<tr>
<th>Matrix composition</th>
<th>Definition</th>
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<tbody>
<tr>
<td>And</td>
<td>50% composition (i.e., clam and mussel, 50% of each)</td>
</tr>
<tr>
<td>With</td>
<td>25% composition (i.e., clam with mussel; 75% clam and 25% mussel)</td>
</tr>
<tr>
<td>Some</td>
<td>&lt;25%</td>
</tr>
<tr>
<td>Shell-free</td>
<td>Visually no discernible shell or shell fragments; through column sample analysis, this was determined to be &lt;15% shell by weight</td>
</tr>
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Table 1. Written documentation definitions related to size and matrix composition.
shell middens. The word “feature” (or “facilities”) is used in a traditional sense to refer to cultural items such as hearths, walls, or lithic-reduction areas (e.g., Hester et al. 1997:4). In order to differentiate natural deposition units from our excavation control units (arbitrary levels), we use “strata” to refer to non-human caused depositional levels, such as wind or water deposits. Individual strata are labeled as Stratum I, II, etc. from the surface down, or as archaeologists encounter them. Note that this differs from the traditional geological practice of designating strata from the bottom of the section upwards. We use “level” to distinguish our excavation levels—in this case, 5 cm thick—and refer to them as “level 1, 2,” etc., employing Arabic numerals to distinguish them from Strata, for which we use Roman numerals. Soil horizons represent post-depositional soil development, and should not be confused with strata that are depositional by nature. These soil horizons are described and documented using standard soil sciences designations. For example, in the acidic forest soils (spodosols) of Maine, the traditional A, B, C soil horizons often have an elluviated, or E Horizon, a grey, ash-like layer, underlying the A Horizon (Soil Survey Staff 2015).

Column sampling methodology

The methodology of column-sample analysis described here is based upon a system defined by excavation in the Boothbay–Muscongus Bay archaeological projects (Chase 1988, Skinas 1987). Column samples were taken from the walls of excavation units in order to examine the stratigraphy of these areas in greater detail and to obtain fine-screened samples of cultural remains. During the 1982 field season, column samples were 25 cm x 25 cm using 5-cm levels. In 1985, these samples were reduced to 17 cm x 17 cm column-sampling units using 5-cm levels. Simple chi-square test comparisons between 25 cm x 25 cm x 5 cm and 17 cm x 17 cm x 5 cm units revealed little difference in information content. This change offered a significant savings in terms of ease of transport as well as laboratory processing time. A level consists of arbitrary units used to excavate culturally or naturally formed layers. If 2 or more layers occurred within a 5-cm level, each layer was excavated individually and noted with an alpha designator (e.g., Levels 5a and 5b).

After drying, each level of the column sample was sifted through a series of 3 nested sieves: No. 16 (16.0-mm mesh size), No. 6 (6.3-mm mesh size), and No. 3 (2.38-mm mesh size). Matrix smaller than the No. 3 sieve was collected in the pan fraction. From the No. 16 and No. 6 sieves, contents were sorted into various categories and quantified to allow differences in each level and layer to be quantified. Quantification is based on indices in order to compare the mass of specific types of material (i.e., shell species, non-shell materials, pan fraction, etc.). Specific index calculations are presented in Table 2.

Strata classification and typology

Using Skinas’s (1987) system of classification, several strata categories were identified at the GSI site. These categories were based on variables and indices derived from column-sample data described above.

Group I consists of cultural features (as defined above). Group II constitutes shell refuse/dump areas. While soft-shell clam dominates the midden matrix, column sampling allowed us to document in a quantitative manner changes in mollusk species

<table>
<thead>
<tr>
<th>Index</th>
<th>Formula</th>
<th>Comment</th>
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</thead>
<tbody>
<tr>
<td>Size</td>
<td>(\frac{\text{shell wt in 6.3-mm sieve}}{\text{shell wt in 6.3-mm + 16-mm sieves}} \times 100)</td>
<td>This index compares the size of the composition of a sample using the 2 upper sieves.</td>
</tr>
<tr>
<td>Shell</td>
<td>(\frac{\text{shell wt in 6.3-mm + 16-mm sieves}}{\text{total level wt}} \times 100)</td>
<td>This index compares the weight of shell retained in the 2 upper sieves with the total weight to obtain a measure of the amount of shell in the sample.</td>
</tr>
<tr>
<td>Matrix</td>
<td>(\frac{\text{pan wt}}{\text{total level wt}} \times 100)</td>
<td>This index compares the matrix or pan fraction with the entire sample to determine the relative amount of non-shell matrix.</td>
</tr>
<tr>
<td>Artifact</td>
<td>(\frac{\text{Artifact wt by class}}{\text{total level wt}} \times 100)</td>
<td>This index determines how much of the sample is the result of artifactual material by class.</td>
</tr>
<tr>
<td>M/S</td>
<td>(\frac{\text{pan wt}}{\text{total shell wt from all fractions}})</td>
<td>This index provides a rough comparison of the total shell and non-shell matrix.</td>
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</table>
that could represent different exploitation patterns. Group III is characterized by relatively shell-free cultural deposits, containing less than 15% shell by weight; these are thought to represent domestic areas or areas of intensive non-shell related activities, such as lithic reduction. Group IV consists of natural deposits attributed to geologic or pedologic processes; these deposits include the overlying A horizon or forest duff/peat (present-day surfaces) as well as buried A and B horizons separating shellfish strata or at the base of the midden.

Analysis terminology

These analytical groupings as discussed below should not be interpreted to represent a single, seasonal occupation, but instead are more in line with the general use of “component” in archaeology. A component usually reflects an occupation of a site by a distinct cultural entity; thus, the time spans represented by these groups are not equal.

A collection of artifacts and other indicators of cultural activity in a site, when reasonably bound by time, is called a “cultural zone”, or “zone” for short. This is equivalent to the term “assemblage” or “component” (e.g., Willey and Phillips 1958). Zone is not necessarily equivalent to a single, seasonal occupation; although it could represent a one-time stay, more likely it is formed by repetitive occupation. We number zones from the most recent to the oldest. Zones are numbered, not named, because they correspond to a specific site. In other words, Zone 1 at a particular site may or may not have equivalence with Zone 1 at another site (see Stein 1990 for a similar discussion concerning “ethnozones”).

It should be emphasized that we do not wish to equate cultural zones with “phases” in the Willey and Phillips (1958) scheme. This approach to terminology is in general accord with that used by others working in the area with the sole exception of the Late Archaic unit known as the “Moorehead phase” (Bourque 1995). This terminology focuses on stratigraphic classification and groupings of materials into temporally-spatial stratigraphic units that are tied together into these cultural zones that then can be related to human behavior. Zones are artificial divisions of a site’s history used in analysis, discussion, and generalizations. From these zones, generalizations about the site’s occupants and their local adaptation and activities can be made.

Specialized areas and dwellings

Most archaeologists would anticipate that a site will contain functionally specialized areas; shell middens are no different. For example, Maine middens tend to be deeper towards the front (sea-ward) side and thin towards the land-ward portion of the site. In many Maine coastal sites, the sea-ward side was the primary dumping area. Manufacturing areas, when recognized, tend to be further back in the sites.

G.F. Mathew (1884) noted circular, shell-free depressions at the Bocabec Village site, Passamaquoddy Bay, NB, Canada. He speculated they represented dwellings. Excavations from 1969 through 1975 by Sanger in Passamaquoddy Bay confirmed the idea. Continued research in the region continues to confirm that these deposits represent dwellings (Bishop 1983; Black 1983, 1992; Davis 1978; Hrynick, et al. 2012; Hrynick and Black 2016; Sanger 1971, 1976, 1986, 1987) using the term “house pits”. Since the late 1800s, house pits have been documented at a number of Downeast archaeological sites, but rarely west of the Penobscot River (Hamilton 1985, Sanger 2010). Typically, houses are located at the rear of sites, not among the massive piles of shells and other debris. House pits tend to sit in a depression dug into the sediment beneath the site, or may be dug through an older layer of shells. In shape, they are rarely round, but rather oval, measuring approximately 3 m x 4 m. Construction details vary from site to site, but some houses have remains of posts or post “walls” (using rocks to support posts) around the circumference, and a fire hearth at the rear of the house. The houses are assumed to have been covered in bark and conical in shape. House floors tend to be shell-free, and frequently consist of clean pea-sized gravel brought up from the beach and scattered over the bottom of the depression. Depending on season of use, concentrations of artifacts may occur on floors, although exceptions do occur. For example, the Knox site (30-21) appears to have been occupied during the warm part of the year; thus, concentrations of lithic debitage in house pits are not seen (Belcher 1988). However, at the GSI site, lithic debitage is concentrated and found in house-pit deposits (Sanger 2010, Sanger and Chase 1983).

The Great Spruce Island Site (61-17)

This large, impressive shell midden sits in a protected, southward-facing cove on the north end of GSI in an area locally called the Bear’s Foot (Figs. 1, 2). The GSI site was first documented in 1978, and formal excavations took place in 1982 and 1985 (Sanger 1979b, Sanger and Chase 1983). Approximately 40 m² of surface area, almost evenly divided between 1982 and 1985, have been excavated at the GSI site.

The site overlies bedrock and, thus, has suffered relatively little erosion. The central portion of the
Excavation summary

Exploratory excavations units (1 m x 1 m) were dug during the 1978 survey (Sanger 1979b). Primary excavations were conducted at the GSI site during 1982 and 1985 (Sanger and Chase 1983). Areas of interest that were identified in 1978 and 1982 were expanded in 1985 to gain a fuller understanding of the cultural activities of the site.

Areas examined in 1982 appeared to represent dumping, manufacturing, and living areas. In 1985, a large dumping area, first examined in 1982, was expanded in several directions, and eventually exposed a discrete shell-dump mound, nearly 6 m across. A dense concentration of stone flakes and broken bifaces was recognized in an apparent manufacturing locus in 1982, and exploration of this area was expanded in 1985. North of this lithic reduction area, and at the back of the site, a house pit was partially excavated in 1982. In 1985, in order to locate additional dwellings, two 50-cm–wide trenches (Trenches 1 and 2) were excavated in alternating 1.0 m x 0.5 m excavation units along the back edge of the site. These efforts allowed us to search for tell-tale house pit profiles without disturbing much
of the contents. This specific type of search pattern allowed a large area to be examined and used minimal resources during the excavation plan.

**Stratigraphy and component analysis**

For purposes of discussion, we divide the GSI site into 2 areas: a Western Area that includes the northwestern portion of the site, containing Trenches 1 and 2, the HP 1 area, and all excavation units west of the central disturbed area; and, an Eastern Area that includes the scattered test pits east of the disturbance. Most of the cultural deposits at the GSI site are described as shell refuse (Group II). We interpret these deposits as areas where shell and other materials (primarily faunal remains and broken tools/ceramics, etc.) were discarded. Little other concentrated activity appears to have occurred here. However, the midden is not homogeneous with respect to shellfish species composition.

In general, 3 larger groupings of distinct layers exist throughout the site: (1) an uppermost layer of almost entirely complete or nearly complete soft-shell clam shells; (2) an intermediate layer of fragmented soft-shell clam shell mixed with blue mussel; and (3) a bottom layer of fragmented soft-shell clam shell, *Modiolus modiolus* (horse mussel), and low quantities of blue mussel. The bottom 2 layers are separated by a thin, buried peat horizon that has been dated between 1808 and 1553 cal years B.P. (SI-6524, peat) that may represent a period of site abandonment (see Radiocarbon dates subsection below).

**Group I components**

*Feature 1: formed hearth.* This feature consists of 12 fire-cracked rocks and is located in the Western Area in Shell-Free Zone A (SF-A, discussed below) (Fig. 3). Debitage, small triangular bifaces, and a

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Figure 2. Great Spruce Island Archaeological Site (61-17). Locational designations keyed in text. CS represents representative column samples discussed in text. Base map drawn by S. Bicknell.
barbed bone point are associated with this feature. Two radiocarbon dates are associated with this feature (discussed below in Radiocarbon dates subsection).

**Feature 2: scattered hearth.** This feature consists of a discontinuous circle of fire-cracked rocks, with a size range of 10 cm to 20 cm across, and is located in the Eastern Area, associated with Shell-Free Zone C (SF-C). Several fragments of both pottery and bone and a small area of burned blue mussel shell occur within the feature. This feature is undated.

**Group II components**

While shell discard areas are present throughout the Eastern Area, the most distinguishable of these dumping areas is characterized as Feature 3. Again, since our methodology and terminology were evolving, this seems inconsistent; however, this 6-m dumping area represents a discrete mound of diachronic, disposal activities.

**Feature 3: shell mound.** This unusual feature is located in the Eastern Area (Fig. 4). The surface contours of the site suggested mounding in the eastern area. On a relatively flat pre-midden surface, soft-shell clam shells were deposited, forming a thin stratum. Over this stratum, a large number of blue mussel and soft-shell clam shells were deposited, followed by abandonment during which an Ao horizon developed. A final, pure clam-dumping episode terminated the cultural accumulation. Peat up to 70 cm in thickness covers the uppermost shell deposits of Feature 3 (Fig. 5).

**Group III components**

Four shell-free zones occur at the GSI site. Shell-free zones consist of those areas with a dark brown to black soil color and coarse sandy texture, with less than 15% of shell by weight or low absolute quantities of shell (Skinsas 1987).

**House Pit 1 (HP 1).** A large shell-free zone occurs in the Western Area, behind shell refuse areas. The sediment of HP 1 consists of dark sand and gravel (Figs. 6, 7). The shell-free zone is contained within an ovoid depression, estimated to measure 4 m x 3 m and 15–25 cm deep. A double row of large (>20 cm) rocks lines at least one side along the depressions perimeter. These may have supported poles for the dwelling superstructure. Crushed clam shell exists around the perimeter of HP 1. Shell-refuse deposits occur in the area bordering HP 1. Underlying a thick peat layer, an upper layer of soft-shell clam and a lower level of fragmented soft-shell clam and mussel occurs, separated by black sandy loam. HP 1 truncates these shell-refuse deposits along its southern border and appears to have been dug into this earlier deposit.

The depression is interpreted to be a prehistoric house pit (Sanger 2010), originally excavated into subsoil (re-worked till) to the north and an earlier shell-refuse deposit to the south. The occurrence of shell-tempered, fabric-impressed ceramics in HP 1 and 2 earlier dentate-stamped ceramics in the pre-house shell-refuse, supports this interpretation.

**Shell-Free A (SF-A).** This shell-free zone occurs in the Western Area. The outline is discontinuous, but it measures approximately 3 m x 2 m, north to south. The sediment consists of black, coarse sand with moderate to heavy amounts of medium-sized gravel. Near the northern and western perimeters of this shell-free zone, coarse sand overlies a layer of medium and small clam shell. A black, silty sediment, interpreted as an Ao horizon, lies beneath this shell layer (Fig. 8). A small lens of crushed shell underlies this black silty soil with subsoil (re-worked till) beneath (Fig. 7). Feature 1 is associated with this shell-free zone.

Two column samples were taken in SF-A: Column...
Sample 7 originates from the north wall of excavation unit N39 W52, while Column Sample 3 comes from unit N38 W51 (see Fig. 2; location designated by CS3, CS6, and CS7). Both samples were associated with the highest concentration of broken and complete non-stemmed broken bifaces and debitage at the site, just outside of HP 1. In Column Sample 7 (see Fig. 8), the break between an upper clam zone and a lower clam/mussel zone occurs at 30 cm below surface (b.s.). In Column Sample 7, a black silty layer occurs from 10 to 15 cm b.s. This layer is thought to represent a buried Ao horizon. SF-A occurs between 20 and 50 cm b.s. The matrix of SF-A is brown to black in color and possesses a sandy loam texture with 10 to 15% medium rounded gravel. Subsoil occurs below SF-A.

SF-B. Trenches 1 and 2, designed to “prospect” for additional house pits, lie in the rear landward portion of the site, just east of the HP 1 area. Beneath a thick peat layer, discontinuous layers of clam refuse midden overlie a dark brown to black coarse sand with medium gravel. A pseudo-scallop shell-impressed sherd and a stemmed biface are associated with SF-B. Although only a small portion of SF-B was tested, it may be a house pit.

SF-C. This shell-free zone occurs in the southwestern corner of Feature 3 and measures at least 2.5 m x 2 m. SF-C occurs beneath the upper buried Ao horizon associated with Feature 3 (see Figs. 4, 5). Feature 2 and a pseudo-scallop shell vessel are associated with SF-C.
Figure 5. Column Sample 6 indices graph (Feature 3). Table 2 presents the formulas that are used to calculate these indices. Feature 3 is a shell dump feature in the Eastern Area of the site. The indices show the relationship between shell debris and the non-shell deposits. The graph shows a spike of non-shell matrix that represents a break between the Middle and Late Ceramic Periods.

Figure 6. (A) Shell-free zone/HP 1, Western Area, Site 61-17 (photograph view is grid south). (B) Plan map based on original by T. Chase and D. Sanger, 29 June 1982. Photography by Stephen A. Bicknell.
Group IV components

As discussed above, these components represent the natural soil horizons present throughout the site. These occur in 2 obvious places: the pre-site occupation, indicated as spodosols at the base of the GSI site shell midden overlying the bedrock surface, as well as the post-site occupation, represented by natural peat (or “forest duff”) overlying the shell midden. Intermediary soil horizons occur throughout the site. Based on radiocarbon dating (see below) and ceramic association, this stratum appears to represent an abandonment period sometime between 1808 and 1553 calibrated years B.P.

Figure 7. Shell-free zone/HP 1 plan view and section drawing, Site 61-17; North Wall, N48 W51-52.5. From original section drawing by T. Chase, 28 June 82.

Figure 8. Column Sample 7 indices graph (SF-A). Table 2 presents the formulas that are used to calculate these indices. Shell-free A is thought to represent a house pit that occurs in the Western Area of the site, back behind the main shell dumping areas. The indices show a general lack of any kind of shell debris based on weight of each level from the column.
Radiocarbon dates

Two main problems seemed to have affected the use of radiocarbon at the GSI site: organic contamination (i.e., rootlets) and the reservoir effect in marine shells (Taylor and Bar-Yosef 2014). A specific example from HP 1 focuses on the re-dating of a single charcoal sample due to contamination originating from small, modern rootlets. Additionally, the reservoir effect occurs when organic specimens are drawing carbon from a non-atmospheric carbon reservoir; in this case, marine shells are drawing carbon from an oceanic source. Atmospheric and oceanic reservoirs are not in equilibrium, causing measured dates from marine shells to be older than those from comparably aged charcoal specimens. This can explain the differences in the dates from marine shell and charcoal from the same feature or stratigraphic unit (Rick et al. 2005). All data are initially reported as uncalibrated radiocarbon years (RCY) B.P. Table 3 displays provenience, uncalibrated RCY BP, as well as calibrated BC/AD and BP dates using ΔR of 93 as appropriate for marine shell samples.

**Housepit 1 (HP 1).** Two radiocarbon dates are associated with HP 1: 1060 ± 50 uncalibrated RCY B.P. (SI-5488a, charcoal) and 675 ± 60 uncalibrated RCY B.P. (SI-5488, charcoal). Both dates originate from the same sample of charcoal. Sample SI-5488 returned a date much younger than was expected based on the ceramic association. Sample SI-5488a was subjected to a more rigorous pre-treatment procedure to remove small rootlets that appeared to have contaminated the sample. We feel that SI-5488a is a more accurate date given the introduction of modern carbon evident in sample SI-5488. The calibrated date for SI-5488a is 1170–820 cal years B.P. at a 95.4% probability.

**Feature 1.** Feature 1, a formed hearth, occurs in SF-A; two radiocarbon dates are associated: 590 ± 40 uncalibrated RCY B.P. (SI-5486, charcoal) and 1165 ± 75 uncalibrated RCY B.P. (SI-5487, soft-shell clam). While attempts were made to use the reservoir carbon database (McNeely et al. 2006), we feel that the date on the soft-shell clam should be rejected. The calibrated date for the carbon sample is 654–534 cal years B.P. at a 95.4% probability.

**Peat.** In Column Sample 1, adjacent to Feature 1 and below charcoal sample SI-5487, a date of 1695 ± 60 uncalibrated RCY B.P. (SI-6367, soft-shell clam) appears to support this sequence, but due to the reservoir effect, may read older than the actual depositional event. The corrected and calibrated date is 1685–1355 cal years B.P. at a 95.4% probability. A peat sample from level 11 (100–110 cm b.s.) of Column Sample 1 produced the oldest date from this area: 1745 ± 45 uncalibrated RCY B.P. (SI-6524, peat). This sample represents the soil horizon between the upper soft-shell clam midden and the lower soft-shell clam and blue/horse mussel midden. Its corrected and calibrated date is 1808–1553 cal years B.P. at a 95.4% probability.

**Stratigraphic summary**

Shell refuse is present throughout the site, but appears to be concentrated in the Eastern Area. Feature 3 is an excellent example of shell refuse and discard in the form of an artificially built mound. While not meant to suggest that the shell deposits are homogeneous over the site, 2 major divisions can be seen through visual observations as well as column sample analysis.

The major divisions seen in shell refuse is an upper layer of clam shell with blue mussel shell and a lower zone of clam and mussel (both blue and horse). A period of abandonment is suggested by the Ao horizon that separates these 2 major layers. The calibrated date of 1808–1553 years B.P (sample SI-6524, peat) represents the time of this abandonment.

All but one of the shell-free zones occur in the Western Area. It is here that one of the best examples

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<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Material</th>
<th>Provenience</th>
<th>Uncalibrated RY BP</th>
<th>Reservoir corrected (AR 93)</th>
<th>Calibrated date AD 95.4% probability</th>
<th>Calibrated date BP</th>
</tr>
</thead>
<tbody>
<tr>
<td>SI-5486</td>
<td>Charcoal</td>
<td>Feature 1, N38 W51, Level 5</td>
<td>590 ± 40</td>
<td>N/A</td>
<td>1296–1416 cal AD</td>
<td>654–534 cal BP</td>
</tr>
<tr>
<td>SSI-5487</td>
<td>Mya arenaria</td>
<td>Feature 1, N38 W51, Level 5</td>
<td>1165 ± 75</td>
<td>1072 ± 75</td>
<td>771–1154 cal AD</td>
<td>1179–796 cal BP</td>
</tr>
<tr>
<td>SI-5488</td>
<td>Charcoal</td>
<td>HP1</td>
<td>675 ± 60</td>
<td>N/A</td>
<td>Contaminated N/A</td>
<td>Contaminated N/A</td>
</tr>
<tr>
<td>SI-5488a</td>
<td>Charcoal</td>
<td>HP1</td>
<td>1060 ± 50</td>
<td>N/A</td>
<td>780–1148 cal AD</td>
<td>1170–802 cal BP</td>
</tr>
<tr>
<td>SI-6367</td>
<td>Mya arenaria</td>
<td>Col. 1, N38 W51, Level 8</td>
<td>1695 ± 60</td>
<td>1602 ± 60</td>
<td>265–595 cal AD</td>
<td>1685–1355 cal BP</td>
</tr>
<tr>
<td>SI-6527</td>
<td>“Peat”</td>
<td>Column Sample 1, Level 11</td>
<td>1745 ± 45</td>
<td>N/A</td>
<td>142–397 cal AD</td>
<td>1808–1553 cal BP</td>
</tr>
</tbody>
</table>
of a house pit along the Maine coast exists (HP 1; Belcher 1988), which is thought to date between 1170 and 802 calibrated years B.P. An additional house pit may have been encountered in Trenches 1 and 2. A concentrated area of lithic tools and debitage occurs at about 10 m to the west of SF-A and Feature 1, which is thought to date between 654 to 534 calibrated years B.P.

Cultural Zones

The artifacts from the GSI site have been assigned to 4 cultural zones that reflect different temporal occupations. From the earliest (oldest) to most recent they are: Zone 4 - Late Archaic Period; Zone 3 - Early Middle Ceramic Period; Zone 2 - Late Middle Ceramic Period; and Zone 1 - Late Ceramic Period. Artifacts from these zones, the cultural activities, and, with some limitations, subsistence will be discussed for each assemblage. Primary ceramic analysis followed protocols in Belcher (1988) with chronological assignments following Petersen and Sanger (1991).

Zone 4: Late Archaic Period—ca. unknown to 3000 B.P.

Assemblage 1 occurs in disturbed contexts as surface or shore finds. No substantive information on this zone can be offered due to the general lack of context. Two celts fragments were recovered from the site and represent the sole artifacts tentatively assigned to this component. It evidently represents an occupation that appears to have been eliminated by shore erosion.

Zone 3: Early Middle Ceramic Period (CP2)—2150 to 1650 B.P.

Zone 3 represents a major utilization and occupation of the GSI site. A single radiocarbon date and its association with a possible abandonment of the site gives a terminus for Zone 3 between 1800 and 1500 calibrated years B.P.

Artifacts. Thirteen ceramic vessel lots are assigned to Zone 3. These are small-toothed, simple and rocker dentate-stamped vessels as well as pseudo-scallop shell (simple and rocker-stamped)-impressed surface treatments. A single bone point, probably an awl, and 2 fragments of worked bone are associated with this zone. Stone tools include a stemmed biface base, a stemmed biface, 2 non-stemmed bifaces, a biface tip, and an end-scraper.

Activity areas. Two shell-free zones (SF-B and SF-C) are grouped into Zone 3. The lower portion of Feature 3 shell deposits is also associated with Zone 3, representing much of the shell refuse accumulation during this time period. The lower portion of the shell midden is composed of soft-shell clam, blue mussel, and horse mussel. Much of Feature 3 (shell mound) began as a horizontal dump during this time frame. SF-B and SF-C may represent Zone 3 house pits.

SF-B occurs along the back edge of the site. A pseudo-scallop shell-decorated ceramic fragment (Vessel 18; see Fig. 9) was recovered from this shell-free zone along with a broken, stemmed biface. SF-C occurs adjacent to Feature 3 and encompasses Feature 2 (hearth). Later shell accumulation caused Feature 3 to expand over SF-C.

Towards the end of the Zone 3 occupation, the site area appears to have been abandoned for some time. A thin peat horizon has developed over the shell deposits throughout most of the site, thus creating a clear division in the stratigraphy. The abandonment appears to have occurred between 1808 and 1553 calibrated years B.P.

Figure 9. Pseudo-scallop shell ceramic sherd from SF-B, Site 61-17. Scale is in cm. Photograph by Stephen A. Bicknell.
Zone 2: Late Middle Ceramic Period (CP 3)—1650 to 1350 years B.P.

Zone 2 is only represented by materials and deposition found in the Feature 3 shell mound area. However, it is thought that much of the shell deposition began during this time period, based on the stratigraphic analysis of Feature 3.

Artifacts. Most artifacts from this zone are ceramic vessels lots. Five ceramic vessel lots from the site are assigned to Zone 2; these vessel lots are grit-tempered and small, simple and rocker dentate-stamped surface treatments. A single, stemmed biface is associated with this zone as are 3 non-stemmed bifaces. No other items can be positively assigned to the zone.

Activity areas. The upper mounding of Feature 3 is associated with this zone; thus, soft-shell clam and blue mussel represent the dominant shellfish deposits. No shell-free zones are assigned to this cultural period. Substantial shell accumulation occurred during this time as judged by deposits above the “peat” horizon that developed between Zone 2 and Zone 3 deposits.

Zone 1: Late Ceramic Period (CP4 to CP 6)—1350 to 400 years B.P.

This zone marked particularly high prehistoric use of the GSI site. However, the stratigraphic record of this occupation is disturbed and mixed by prehistoric as well as recent historic activities. Root action and tree throws have also mixed much of the upper portions of the site.

Artifacts. Over half (n = 11; 69%; total = 16) of the stemmed bifaces from the GSI site are associated with Zone 1. Almost all non-stemmed bifaces and fragments (including distal tips and midsection fragments) (n = 35; 64%; total = 55) occur in association with Feature 1 (formed hearth)/SF-A and the Lithic Reduction Station (see below) to the east. Worked bone found in association with Zone 1 deposits included tools, such as awls, points, and a tubular bone bead.

Two ceramic vessel lots are associated with Zone 1 features and stratigraphic layers; both are cord-wrapped stick-impressed vessels. One of the cord-wrapped stick vessels dates between 950 and 700 years B.P., based on Petersen and Sanger (1991). Based on the radiocarbon dates from HP 1 and Feature 1 as well as attribute characteristics of the artifacts, most of the occupation occurred between ca. 600 and 1100 calibrated years B.P.

Activity areas. Several activity areas are present at the GSI site, including dwellings, shell dump areas, and a lithic reduction station.

House Pit 1 (HP 1). The most reliable radiocarbon date places this dwelling between 1170 and 802 calibrated years B.P. Ten non-stemmed bifaces and biface fragments, 3 stemmed bifaces, 6 utilized flakes, 2 abraders, and a single hammer stone constitute the artifacts in the house pit deposits.

A large quantity of lithic flakes occurs within this deposit. Approximately 18% (n = 1254) of the total site flake count occurs in this area, which comprises less than 5% of the total excavated area. Many of the flakes occur near the edge of the house pit near the double row of rocks. This concentration of flakes may represent a floor-cleaning activity with sharp objects “swept” to the perimeter of the living area.

Shell dumps. These areas are difficult to fully interpret due to the heavy historic disturbance processes in the central portion of the site. However, based on a few scattered test pits along the eastern side of the disturbed area (Fig. 2), this area appears to have been used primarily for shell refuse. Additionally, shell has been dumped around the perimeter of HP 1 and occurs over the upper portions of Feature 3. Mussel shells have almost completely disappeared as a stratigraphic particle as well as a presumed subsistence item. Thus, Zone 1 deposits are composed of complete and near-complete soft-shell clam valves.

Lithic reduction station. A total of 3671 flakes (55% of the site total) occurs in association with SF-A and Feature 1. The large quantity of broken bifaces, ranging from rough preforms to unstemmed bifaces ready for notching, and a large quantity of flakes suggest that this area represents a lithic reduction station. The dominant material is a type of banded rhyolite that is common throughout the Downeast Region of Maine. A possible quarry site (site 62-13; site 13 on Fig. 1) for the local banded rhyolitic materials exists ~2 km from the GSI site and may have been the source used by the GSI occupants.

Over 54% of the total biface count (n = 39; total = 71) from GSI originated from SF-A and Feature 1. These artifacts include biface tips and midsections, as well as stemmed and non-stemmed bifaces (bases and whole). Those unstemmed bifaces that possess a base appear to be preforms either abandoned or broken during manufacture.

Discussion and Conclusion

Through the detailed processing and documentation of a shell midden excavation, it is possible to derive a more detailed reconstruction of a site. Shell middens by their very nature are extremely complex and require a level of documentation that many other types of archaeological deposits may not require. Through Sanger’s research program and...
continuously developing methodological and analytical strategies, we have created a robust method of analyzing and documenting these deposits.

By 1985, the final year of our field research at Roque Island, we had largely refined our excavation techniques to reflect our interests and overcome many of the problems we recognized in our analysis. This research strategy guided the remainder of research we conducted in East Penobscot Bay and the Downeast region through the 1990s.

We conclude with several thoughts:

1. No two shell middens are identical; therefore, each presents its own set of challenges and problems that must be overcome;
2. We have not fully solved the issue of disentangling the many micro-strata that may, or may not, be significant for interpretation;
3. All excavation is a compromise between excavating enough midden to say something about the site, while conducting the excavations carefully enough to do justice to the site contents;
4. Because excavation technique is dependent on research questions, we would anticipate that changes in the latter will influence future field and laboratory research.

The data described above from the Great Spruce Island site is only a small portion of the data currently being revised for publication, including the detailed faunal, artifact, and debitage analyses for the cultural zones as described above. The creation of this fine-grained data and stratigraphic analysis is a direct result of the development of this typology and component analysis by Sanger and his students (Belcher 1988; Callum 1994; Carlson 1986; Chase 1988; Kellogg 1982, 1991; Mack 1994; Skinas 1987).

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Literature Cited


Bourque, B.J. 1975. Comments on the Late Archaic populations of central Maine: The view from the Turner Farm Site. Arctic Anthropology 12:35–44.


