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The temporality of shell-bearing landscapes at Crystal River, Florida

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ABSTRACT

We employ a landscape perspective to the shell middens at Crystal River (8CI1) and Roberts Island (8CI41), Woodland period (ca. 1000 BC to AD 1000) mound centers on the west-central coast of Florida in the American Southeast. Specifically, we adopt Ingold's (1993: 162) understanding of landscape as the physical incorporation of social life, with all of its complexities of temporality and movement. Mapping, geophysical survey, and coring were used to document the location and scale of the contemporary and ancient landscapes. We followed this with small scale excavations to understand the form and timing of midden deposition. We employ Bayesian chronological modeling of radiocarbon dates from our investigations in the middens at Crystal River and Roberts Island to identify the broader rhythms of human activities. To characterize finer rhythms of social life within these phases, we compare rates of midden accumulation and other quantitative and qualitative measures of the distributions of artifacts and sediments. Our results indicate that the shell-bearing landscape at Crystal River and Roberts Island incorporates activities that fall in four broad phases over the interval from around AD 150 to 1050. These phases are characterized by diverse activities and temporalities, including both repetitive, small-scale refuse disposal and temporally discrete, larger-scale depositional episodes. Consistent with recent work on shell midden variability, both the archaeological deposits and the activities they encapsulate blur the lines between midden and monument.

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1. Introduction

More than two decades have passed since Claassen (1991) cautioned archaeologists against the normative treatment of shell-bearing sites (see also Waslekov, 1987). In recent years, archaeologists in the American Southeast have made great strides in understanding the variation in shell-bearing sites in the region, although they often disagree with regard to how such variation should be interpreted. Some favor practical and materialist understandings for shell deposition, and demand greater evidentiary constraint for claims of intentionality (especially monumentality) in shell deposition (e.g., Marquardt, 2010a,b). Others take intentionality as a given, see evidence for monumentality in relatively subtle details, and downplay materialist explanations (Randall and Sassaman, 2010; Randall, 2011, 2013; Russo, 2004). The debate has informed discussions regarding the interpretation of sites elsewhere in North America (Lightfoot and Luby, 2012) and on other continents (McNiven, 2013).

We take three fundamental lessons from the occasionally acrimonious literature regarding shell-bearing sites in the American Southeast. First, shell monuments and middens are often not clearly differentiated archaeologically. Quotidian discard of shellfish and other debris, in combination with taphonomic processes, may result in archaeological deposits that mimic monumental construction (Marquardt, 2010a; Thompson, 2010: 224); at the same time, monumental construction may take forms that are manifested only very subtly in the archaeological record (Randall and Sassaman, 2010; Randall, 2011, 2013).

Next, while archaeologists often take the terms monument and midden as opposing categories, there is good reason to think that the native peoples of the pre-contact American Southeast did not always consider them so. Specifically, we note that both monuments and middens often took forms that exceeded necessity in both scale and elaboration, and that both likely had symbolic import. The latter point is evidenced most obviously by the fact that both monuments and middens in the region were commonly used as burial facilities (Anderson and Sassaman, 2012). Claassen (2010) takes this a step further and argues that shell middens—like monuments (Knight, 1989)—may have encapsulated broader cosmological references.

Finally, and building on the previous points, the archaeological study of shell-bearing sites is, by necessity, deeply context specific. Indeed, we take as Marquardt's (2010a) central premise the notion

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that the difference between monument and midden must be problematized. To our minds, this requires fine-scale understanding of the temporality, scale, and form of the activities that produce shell-bearing strata, a task best approached through the lens of landscape archaeology. We use the term shell-bearing landscape here to denote a region or place where shell as a material plays a critical role in understanding the history of human action. In this sense, a shell bearing landscape is not so much defined as a place where shell is abundant, but rather a landscape where shell as a material permeates multiple intermeshed dimensions of the lives of people.

We recognize that landscape archaeology is a framing device employed with widely variable meanings, or what Kowalewski (2008: 251) has described as “a bewildering variety of flavors.” Arguably rooted in more empirically-oriented regional analyses—especially those with strong paleoecological underpinnings—landscape has lately come to be associated mainly with more humanistic (often phenomenological) approaches (Anschuetz et al., 2001; David and Thomas, 2008; Fleming, 2006; Johnson, 2007; Knapp and Ashmore, 1999; Thomas, 2012). Given this lack of theoretical and methodological unity, it is incumbent on researchers to clarify what they mean when they say that they do landscape archaeology (Kowalewski, 2008: 251).

We value the contributions of phenomenological and other humanistic approaches to archaeological landscapes (see Johnson (2012) for an even-handed discussion of their strengths and limitations), especially the understanding of landscape as a meaningful medium for human action, rather than simply a backdrop to, or container for such action (Ashmore, 2002; Bender, 1993; Knapp and Ashmore, 1999:8; Lefebvre, 1991; Smith, 2003; Wheatley and Gillings, 2002:8). We are particularly drawn to Ingold’s (1993: 162) definition of landscape as “a pattern of activities ‘collapsed’ into an array of features” and his attendant premise that these activities should be understood as having complex temporalities rooted in the movements of social life (1993: 160–163) (for similar treatments of the temporality of landscape, see Bender (2002), Gosden (1994), and Lucas (2005); for archaeological applications, see Bayliss et al. (2007), Roddick (2013), Sassaman (2012), and Van de Noort (2011)). However, we further believe that the reading of the often ephemeral residue of social actions and their temporal patterns from geoarchaeological features requires grounding in empirical data. At scales approaching landscapes, this further requires data of diverse sources and scale—from geoarchaeological to geophysical and geospatial.

We are not the first to call for greater dialogue between humanistic and scientific approaches to landscape; Thomas (2012: 168) for example, has argued that these may be “complementary…mutually informative, and enriching.” Likewise, there have been other attempts to broach a middle ground in the polemics regarding shell monuments and middens in the American Southeast (e.g., Moore and Thompson, 2012; Thompson and Andrus, 2011: 338; Thompson, 2007, 2010). We may, however, be the first to point out the manner in which these two debates are interrelated and potentially mutually informative.

We implement such an approach to the shell-bearing landscapes at the Crystal River (8CI1) and Roberts Island (8CI41) sites, on Florida’s west central Gulf Coast (Fig. 1). Crystal River is among the most famous sites of the Woodland period in eastern

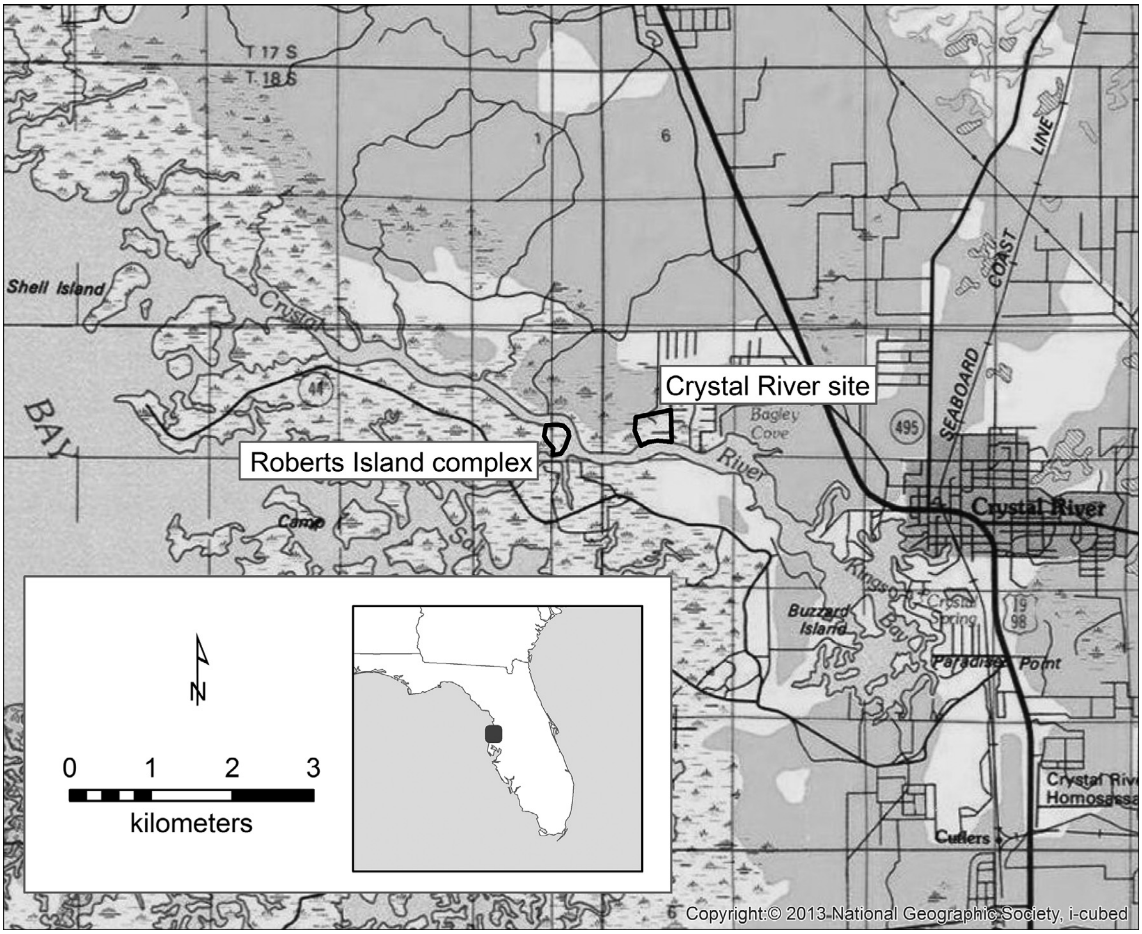

Fig. 1. Location of Crystal River and Roberts Island.

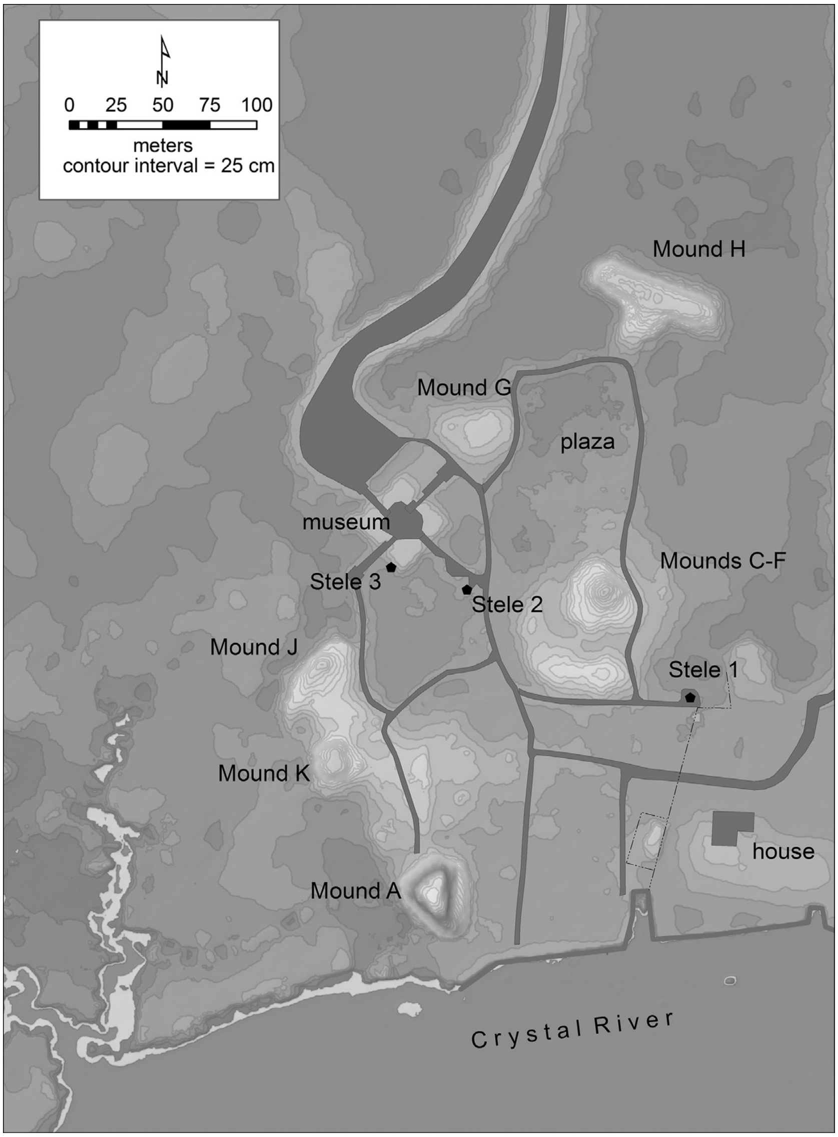

Fig. 2. Map of the Crystal River.

North American archaeology (ca. 1000 BC to AD 1050) for its distinctive civic-ceremonial architecture and the large and diverse assemblage of Hopewellian artifacts recovered by C.B. Moore (1903, 1907, 1918) in the early twentieth century. Just downstream from Crystal River is the lesser-known Roberts Island Shell Mound Complex (Weisman, 1995b), which includes three shell platform mounds. That this area constitutes a shell-bearing landscape is evident by the fact that shellfish were a principal component of the cuisine, an important source of building materials, and a raw material for tools. Shell clearly held practical import for the inhabitants of Crystal River; from its frequent accompaniment with burials, we suspect shell was also important symbolically.

Our focus at both sites is on the less frequently problematized shell-bearing deposits conventionally and historically described as "midden." Our investigations began with detailed topographic mapping, geophysical survey, and coring to document the location and scale of the contemporary and ancient landscapes. We followed these with small scale excavations to provide a better window on stratification and thus the form and timing of midden deposition.

Ingold (1993: 157) makes a case that chronology is not temporality, but a phase-based chronology of midden formation forms a first step in understanding the rhythms of human activities that are incorporated in the shell-bearing landscape. We employ Bayesian chronological modeling of radiocarbon dates from our investigations in the middens at Crystal River and Roberts Island to identify the broader rhythms of human activities. To characterize finer rhythms of social life within these phases, we compare rates of midden accumulation and other quantitative and qualitative measures of the distributions of artifacts and sediments.

We can say with confidence that the shell-bearing landscape at Crystal River and Roberts Island incorporates activities that fall in four broad phases over the interval from around AD 150 to 1050. These phases are characterized by diverse activities, including both repetitive, small-scale refuse disposal and temporally discrete, larger-scale depositional episode. Consistent with our observations above, both the archaeological deposits and the activities they encapsulate blur the lines between midden and monument. By decentering static ideas of midden and monument, our analysis serves to better illuminate the role of shellfish in the lives of people.

2. Descriptions of the shell-bearing landscape

The Crystal River site (Fig. 2) is located along the stream of the same name, almost halfway between the river's source at a series of springs and its mouth 9 km to the west at the Gulf of Mexico. The site includes an 8-m high platform mound (A), as well as several smaller platform mounds. One of these (Mound H) anchors a plaza that is bordered by two burial complexes, one discrete (Mound G) and other comprised of several interrelated parts (Mounds C-F). The latter was the source of most of the Hopewellian artifacts recovered by Moore (1903, 1907, 1918). Another small platform mound (K) and an irregularly-shaped mound (J) stand north of Mound A on a portion of the shell ridge or midden that is the focus of this study.

Moore (1903: 379) designated the "low, irregular shell deposit" at Crystal River as feature "B" and described it as beginning at the northwest corner of Mound and extending north before curving east and "extending for some distance along the riverbank." Willey (1949: 41) later more explicitly noted that the shell ridge was about 304.8-m (1000-ft) long and 30.5-m (100-ft) wide, and as high as 60–92 cm (2–3 ft) in some places. He described the composition of the midden as "shells and rich black midden" and suggested that "it undoubtedly represented the refuse remains of prehistoric houses or occupation." A few years later, Bullen (1951: 142) described for the first time another part of the shell ridge "extending nearly 200 feet [61 m] northward from the bend of the shell midden," a section apparently concealed from Moore and Willey by the density of vegetation. He thus amended the earlier descriptions of a linear shell mound to "...a curving shell ridge, shaped like a fishhook with a temple mound where the barb of the fishhook would be..." (Bullen, 1951: 142). Bullen (1951) excavated several test pits in the "shell midden" or "shell ridge" in the 1950s and 1960s, but the coarseness of his methods (a lack of screening and the use of 15-cm [6-in] and 30.5-cm [1-ft] levels) would not permit nuanced understanding even if we had his notes and maps (which are unfortunately missing). The midden at Crystal River apparently maintained the barbed fishhook appearance described by Bullen until the late 1950s, when a portion of the midden (as well as a large chunk of Mound A) that remained in private ownership were destroyed to fill a lagoonal area that came to serve as a mobile home park (Weisman, 1995a). The homes were removed after the state acquired the park property in the wake of its destruction by a storm surge in 1993.

As defined by Weisman (1995b), the Roberts Island Shell Mound Complex (Fig. 3) includes five separate sites originally recorded by Ripley Bullen in 1972 (documents on file at the Florida Master Site File, Tallahassee). Prior to our study, the sites were virtually unknown apart from very limited surface collections, which suggested rough contemporaneity with Crystal River in the Woodland period. Site 8CI41 is the largest site in the complex, and occupies the main area of elevated ground known as Roberts Island. The site includes the largest and best preserved monumental construction in the complex, a rectangular platform mound about 4 m high, with an apparent ramp connecting the summit to a plaza-like area

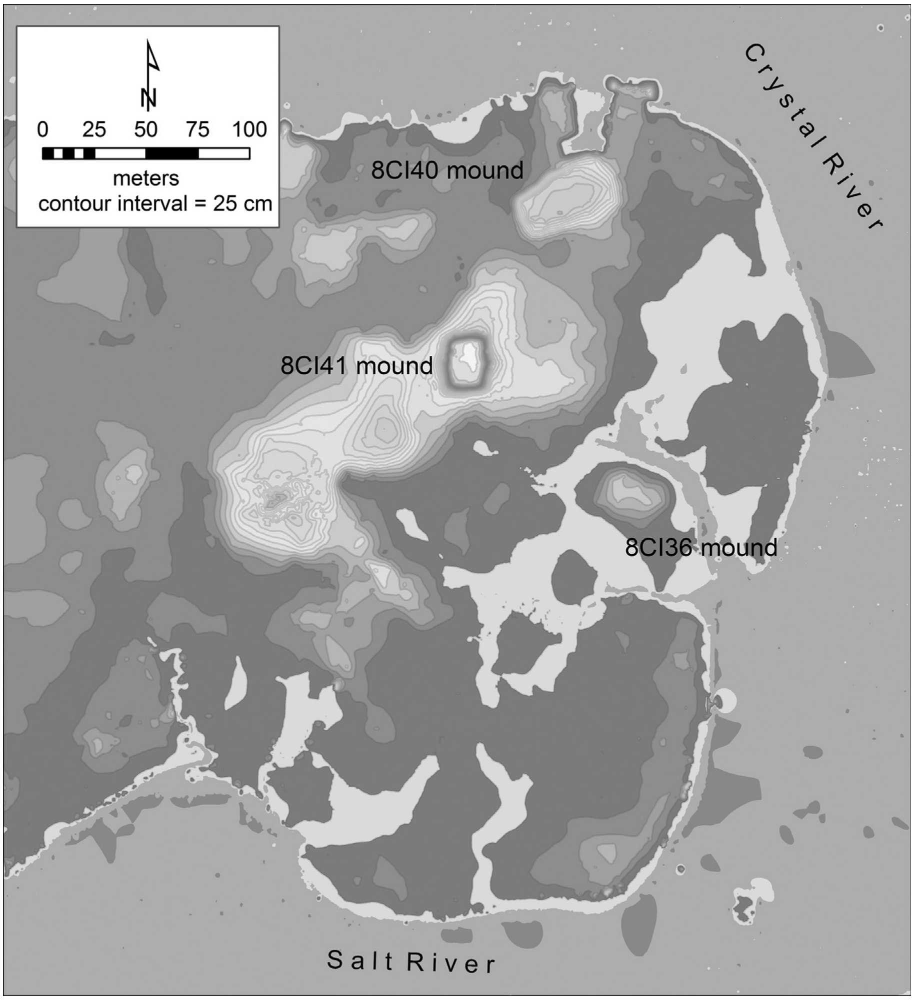

Fig. 3. Map of Roberts Island.

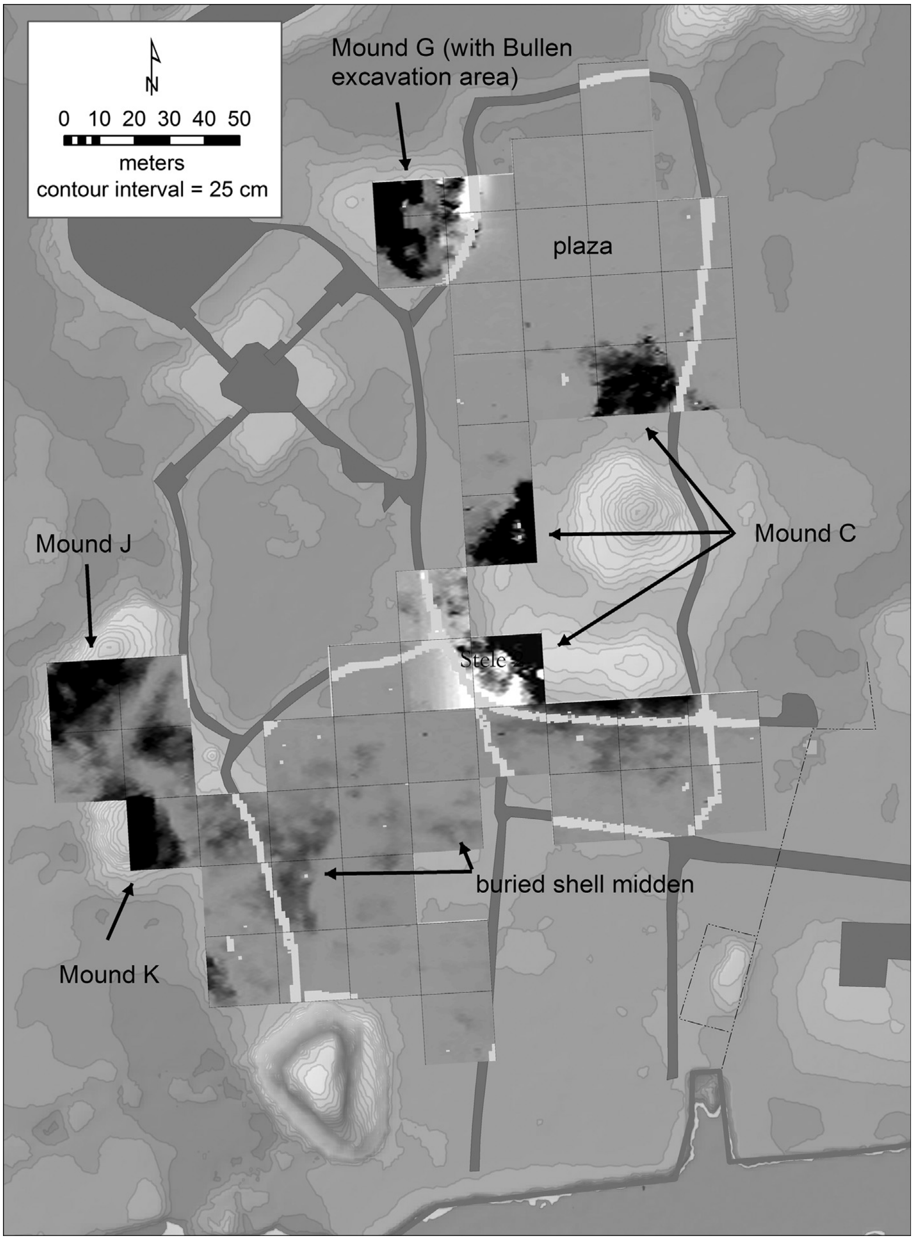

Fig. 4. Electrical resistance survey data for Crystal River.

to its east. A second platform, located to the northeast on site 8CI40, serves as a foundation for a modern home. Recent survey suggests the presence of a third platform mound in a complementary position to the southeast of 8CI41 on site 8CI39.

In addition to the mound, site 8CI41 includes an extensive midden, described by Weisman (1995b:1–2) as "a broad shell ridge" with "several lower mounded areas" together totaling 15–20 ac (6.1–8.1 ha). At the southern end of the main ridge, there is a depression resembling the enigmatic "water courts" observed with some regularity on shell middens in southern Florida.

3. Recent Investigations of the shell-bearing landscape

3.1. Mapping

To create more detailed maps of the modern landscapes, we combined total station survey with publically-accessible airborne LiDAR data. The former proved particularly important for filling voids in the LiDAR data produced by the misclassification of elevations associated with archaeological surface features, such as mounds and shell middens (see Pluckhahn and Thompson, 2012 for a case study elsewhere). We collected approximately 18,000 surface elevations at Crystal River and 3000 at Roberts Island, then combined these with around 200,000 and 340,000 LiDAR data points (respectively) in ArcMap (ESRI, Inc.) to produce Digital Elevation Models of the contemporary surface of the shell-bearing deposits (see Figs. 2 and 3).

Our mapping indicates that the better-preserved, western extension of the shell ridge at Crystal River, extending from Mound A to Mound J, is elevated approximately 1.8 m above the adjoining marsh, making it somewhat higher than described by Moore and Willey (Pluckhahn and Thompson, 2009; Pluckhahn et al., 2010). The eastern end of the midden has been impacted to some degree by the construction of several homes (the park supervisor's home is shown on our map, and there is another home to the east off park property), but the higher elevations here (about 60 cm above the surrounding ground surface) indicate much of the midden remains intact. The intervening area between these better-preserved segments is generally low as a result of grading for the trailer park, vestiges of which remain in the form of trailer tie downs and utility lines. Even here, however, there are higher elevations suggestive of preserved midden, an interpretation confirmed by work described below.

Our mapping at Roberts Island indicates that the main part of the midden ridge extends northeast to southwest, measuring approximately 200-m long, 20–50-m wide, and around 1.7 ha in total area. From the southwestern end of the ridge there are several much narrower ridges extending southeast. The highest point of the ridge, apart from the mound, has an elevation of around 2.8 m above the surrounding marsh.

3.2. Geophysical survey

Geophysical survey was employed primarily to clarify the distribution of sub-surface midden deposits at Crystal River (Pluckhahn and Thompson, 2009; Pluckhahn et al., 2009; Pluckhahn et al., 2010). Electrical resistance survey proved particularly effective in this regard, and largely confirmed previous accounts of a dense and well preserved linear concentration of shell extending south from Mound A to Mound J (Fig. 4). The signature became less continuous in the area where the midden turned east, consistent with the disturbance introduced by the trailer park. However, the resistance data included anomalies supporting the notion that midden might be preserved in some areas, an observation later confirmed by excavations.

Ground penetrating radar was conducted in selected blocks in the midden area at both Crystal River and Roberts Island. At the former site, although limited by the near 2-m depth of the midden in some areas, the GPR data seemed to indicate a transition in the composition of the midden around 50 cmbs (Fig. 5) (Pluckhahn and Thompson, 2009; Pluckhahn et al., 2010; Thompson and Pluckhahn, 2010). Above this depth, there are many high amplitude reflection surfaces, indicating dense shell. Below this depth, high amplitude reflections tend to be localized, suggesting overall less continuous shell with concentrated deposits possibly indicative of features or feature clusters, an observation later borne out by excavation.

3.3. Coring

To further document the spatial extent of subsurface midden deposits at Crystal River, coring was conducted at 20-m intervals with a GeoProbe Model 6620DT in upland locations and a vibracore in adjacent wetlands. The off-mound cores varied from one to three sections deep, with each section measuring about 116-cm long. The occurrences of shell and ceramics in the cores are probably the best indicators of midden (Fig. 6). The distribution of oyster shell in cores closely tracks the historical descriptions of the midden, with the addition of shell in the former lagoonal area that likely represents material displaced from the grading of Mound A (Blankenship, 2013). Pottery was surprisingly abundant in cores on the northern edge of the former trailer park, again suggesting the possibility that some areas within the former trailer park escaped destruction.

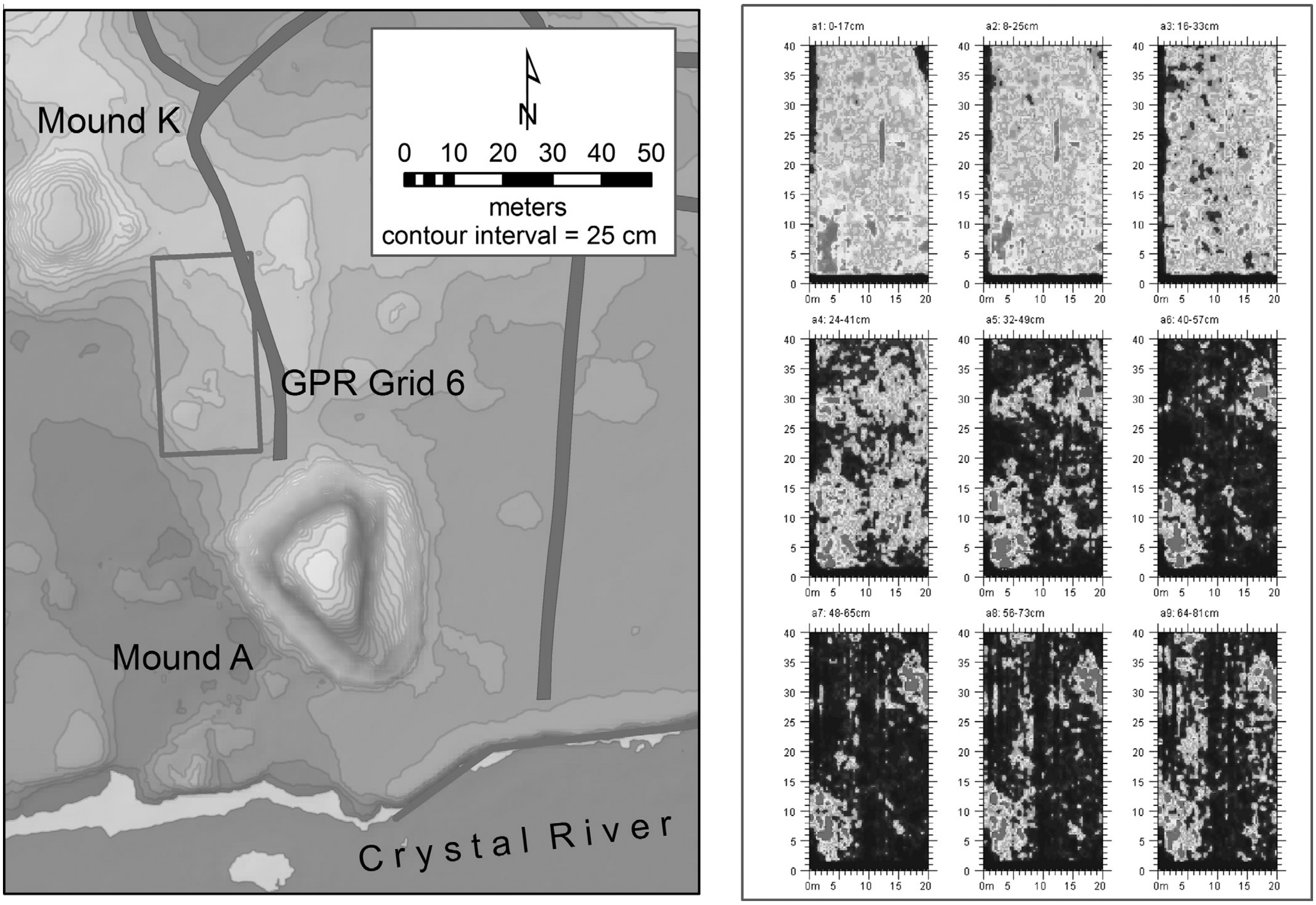

Fig. 5. Location of GPR Grid 6 at Crystal River (left) and time slices (right) (increasing depth from top left to bottom right).

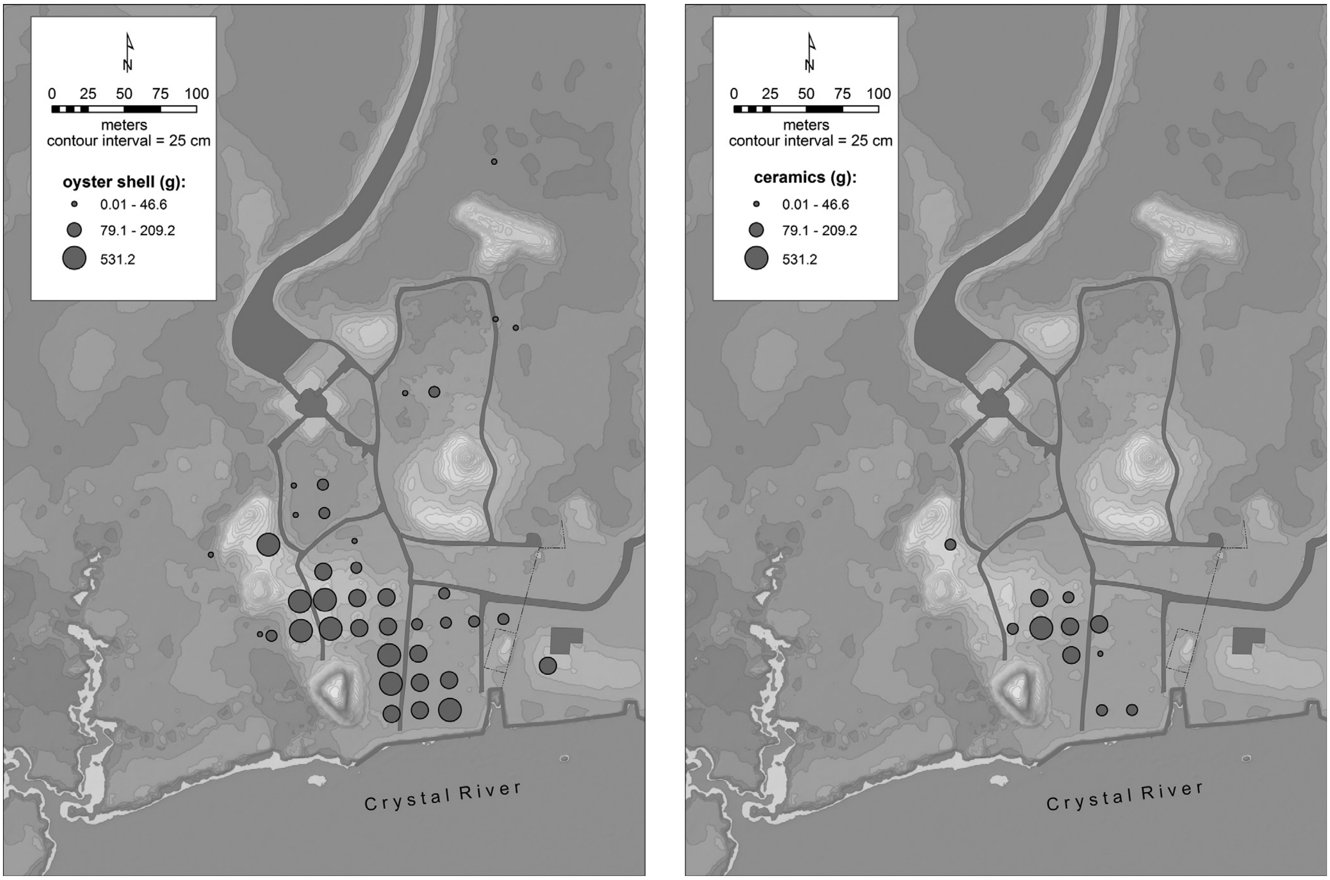

Fig. 6. The occurrence of shell (left) and ceramics (right) in cores at Crystal River.

3.4. Excavation

Mapping, geophysical survey, and coring provided information about the scale and location of midden deposition, but larger excavations were required to define midden composition and timing. At Crystal River, we placed four trenches across the extent of the midden (Fig. 7). The trenches varied from 1-x-2 to 1-x 6-m and were excavated by 1-x-1-m units with a combination of natural and arbitrary 10-cm levels. The fill was sifted through .32-cm (.125-in.) mesh. In two of the trenches, we excavated 25-x-25-cm column samples in levels not exceeding 4 cm.

We focus first on Trench 1, located on the highest and best preserved part of the shell ridge, a short distance east of Mound K (Fig. 8). Shell-rich strata (I-III) at the top of the profile transitioned abruptly to an underlying organic-rich layer (Stratum IV) (a possible A horizon) with relatively little shell. Several post molds and small pits originate at this stratum, a pattern corresponding closely with the GPR data. This horizon appears to represent a period of intensive occupation, but with little *in situ* shell disposal. These features intrude into a dense shell deposit (Stratum V) suggestive of a period of rapid deposition. We noted no obvious stratigraphic changes or features within this shell-dense layer, although variation in the quantity of oyster by level suggests that there may have been breaks in the deposition.

The stratification we observed in other trenches represents variations on the theme of Trench 1. Trench 2 was located to the east of the first trench in the area of the former trailer park (Fig. 9). The uppermost portion of the midden was truncated by grading and a layer of yellow sand (Stratum II) added for a mobile home pad. Below this, however, the midden was well preserved. As in Trench 1, a layer of dark sediment with moderately dense shell gave way to a zone of much reduced shell content and noticeably darker color (Stratum III). Also as in Trench 1, there are a number of features originating at this surface. Here, however, we were able to observe features originating at slightly different depths, indicating their formation across a prolonged period. Radiocarbon dates (UGA-15476, UGA-15477, UGA-15478) on three distinct features confirm this, and demonstrate temporal equivalence with the feature-rich strata in Trench 1. The features intruded into an underlying layer of dense shell similar to those in Trench 1, although here the shell appeared to have been deposited in overlapping shell-filled pits rather than a “sheet” of midden. In the lowermost level of Trench 2, we encountered a dark layer of sediment (Stratum IV) which was almost completely free of both shell and artifacts but which included a series of post features. A date (UGA-14113) on soil-charcoal here is only 10 years removed from a stratigraphically equivalent sample from Trench 1 (UGA-12950).

Trench 3 was located on the western ridge to the south of Trench 1 and just north of Mound A (Fig. 10). Here again dense shell layers (Stratums I and II) near the surface gave way to a dark sediment with reduced shell content (Stratum III) similar to those observed in Trenches 1 and 2. As in those trenches, this dark layer likewise represented a surface from which several features originated. However, radiocarbon dates (UGA-15479, UGA-15480) indicate the reduced-shell layer here dates a little later. The layer of dark sediment was underlain by a horizon comprised of dense shell (Stratum IV), but unlike in Trenches 1 and 2 this layer included very little sediment other than shell and no stratigraphic breaks or features. This would appear to represent a relatively rapid depositional episode, perhaps a deliberate attempt to expand the shell ridge south in association with the construction of Mound A.

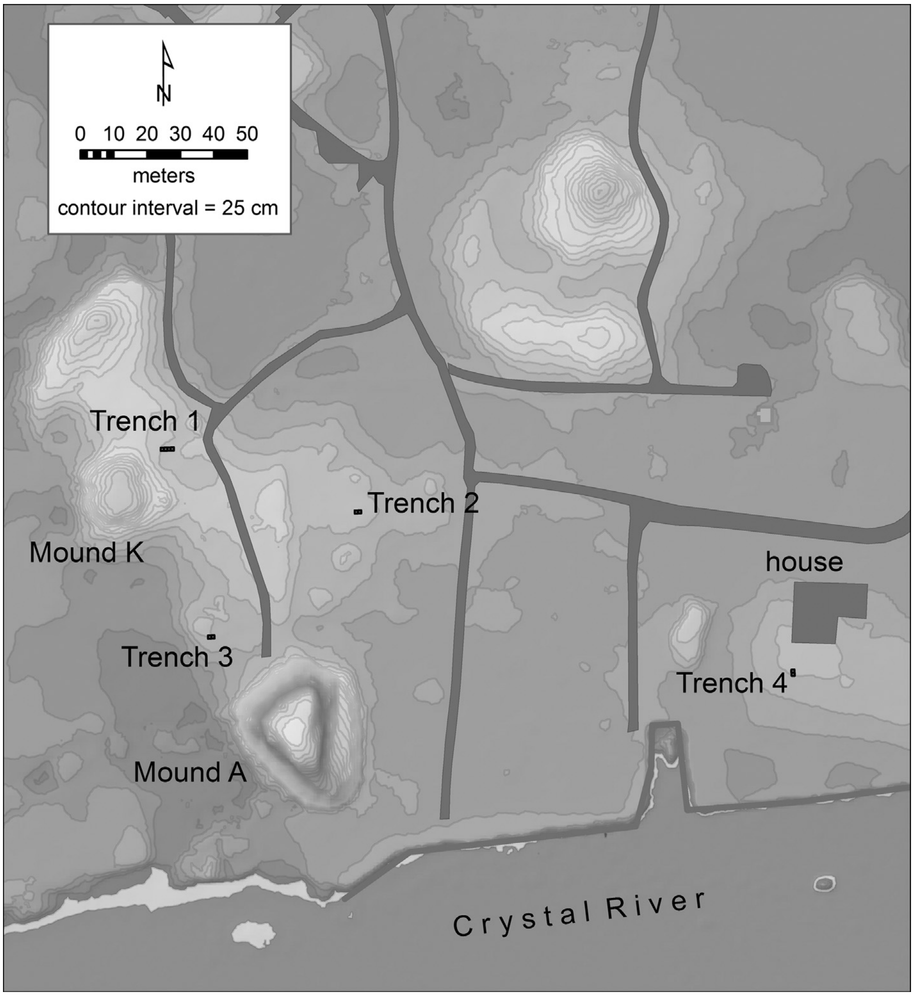

Fig. 7. Locations of trench excavations at Crystal River.

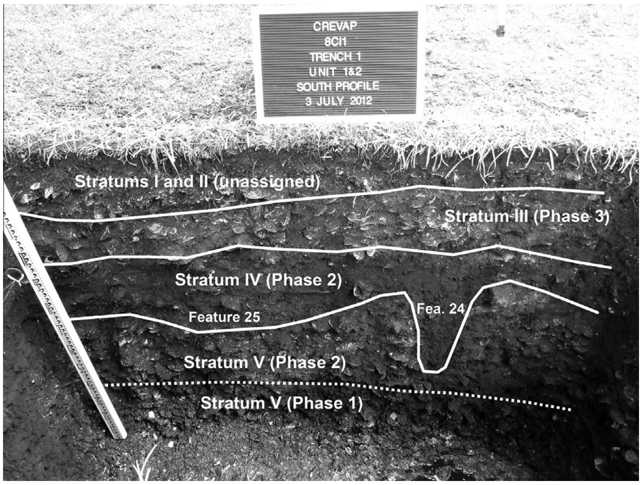

Fig. 8. The south profile of Trench 1 at Crystal River.

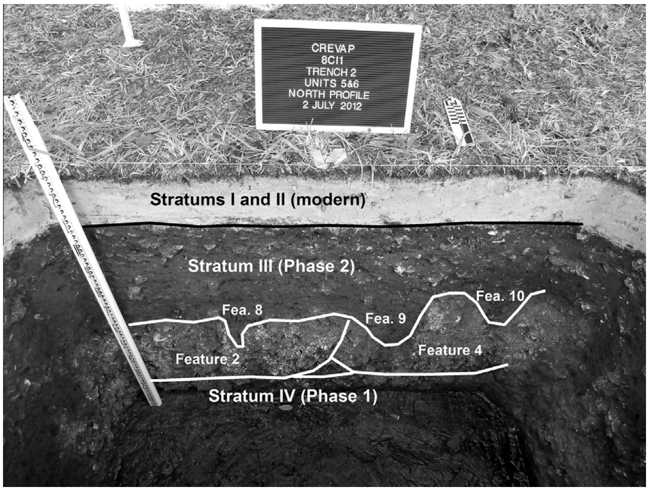

Fig. 9. The north profile of Trench 2 at Crystal River.

Finally, Trench 4 was positioned at the eastern edge of the shell ridge (Fig. 11). Surficial shell-rich layers (Stratums I and II) gradually gave way to darker sediments with significantly less shell (Stratums III and IV) that continued deep into the unit. The relatively narrow temporal spread of three radiocarbon dates (UGA-15481, UGA-15482, UGA-15483) on soil-charcoal sample of variable depths (from 40 to 102 cmbs) suggests a period of continuous midden formation akin to and coeval with that in Trenches 1 and 2. Near the base of this trench we encountered a layer of even darker sediment (Stratum V) with dense shell and several features. A soil-charcoal sample from this layer returned a date (UGA-15484) only slightly later than the dates on the lowermost

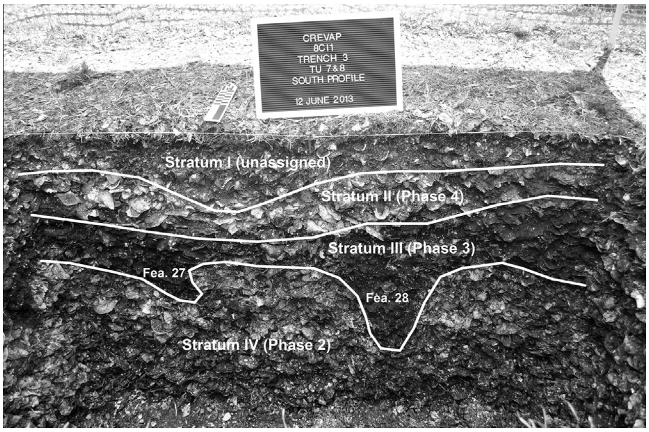

Fig. 10. The south profile of Trench 3 at Crystal River.

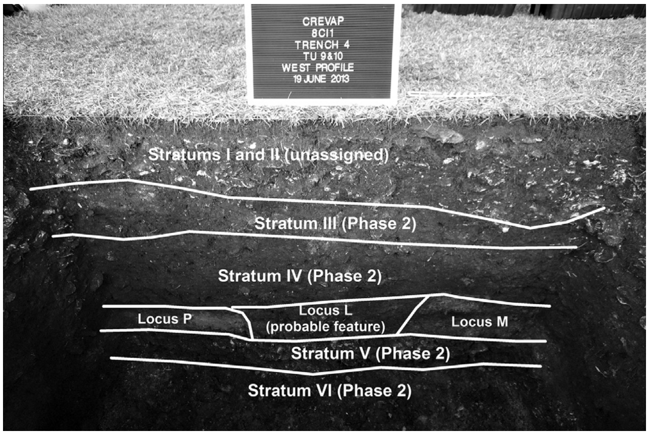

Fig. 11. The west profile of Trench 4 at Crystal River.

midden layers in Trenches 1 and 2. The lowermost stratum (VI) consisted of a lighter colored riverine sand mainly devoid of oyster and other artifacts.

At Roberts Island, we employed shovel tests and a single trench to sample the midden. The shovel tests measured 50-x-50 cm and were placed at 20-m intervals (Fig. 12). Trench 2 was located in the area of the presumed "water court." We excavated in arbitrary 10 cm levels to a depth of 1 m where possible, and sifted the fill through 0.32-cm (0.125-inch) mesh. Where conditions permitted we used a post hole test to extend the floor of the units an additional 30–50 cm. The excavations indicated that the island is almost completely anthropogenic in origin, with midden deposits extending below the modern water, to depths of more than 1 m in some areas. Even more so than many areas at Crystal River, the midden here is comprised principally of oyster shell. However, we noted A horizons with comparatively little shell but abundant artifacts buried 70–100 cmbs in shovel tests both east (Shovel Tests 4 and 6) and west (Shovel Test 7) of the mound; Fig. 13 documents this layer (Stratum III) in Shovel Test 4. Radiocarbon dating of soil-charcoal from Shovel Test 6 produced a date (UGA-13546) consistent with those from the uppermost midden layers in Trenches 1 and 3 at Crystal River, indicating the initiation of settlement at Roberts Island coincided with the decline there. The buried midden layer west of the mound dated slightly later and overlaps substantially with radiocarbon and OSL dates from both the midden and mound above, suggesting that the shell-bearing deposits above the midden layer were deposited relatively quickly.

4. The temporality of the shell-bearing landscape at Crystal River and Roberts Island

We now have 43 new radiocarbon dates from excavations in the middens, including 36 from Crystal River and 7 from Roberts Island (Table 1). Given its relatively clear and undisturbed stratigraphy, we elected to use Trench 1 to anchor our chronological efforts. While we were obviously concerned with dating the midden, we also wanted to establish a chronology that would be useful for dating the mounds, where the limited size of the cores prevented the quantities of charcoal or terrestrial vertebrate bone we would have preferred for radiocarbon dating. Intending to develop a local correction for oyster shell, given that it is plentiful in both mounds and midden, we dated stratigraphically equivalent samples of oyster shell, terrestrial mammal bone, and charcoal from Trench.[1]

In total, we dated 22 samples from Trench 1, including 10 soil-charcoal, eight oyster shell, and four terrestrial mammal bone collagen samples. The bone collagen samples ranged from about 173 cal BC to cal AD 575 and soil-charcoal from cal AD 92 to 638. In contrast, the shell dates ranged from 162 to 1368 cal BC. The consistently older, but stratigraphically erratic dates on shell suggest the introduction of other effects on this material, perhaps a hard water effect introduced from the limestone substrate, as we discuss in more detail elsewhere (Cherkinsky et al., 2014).

Although oyster shell proved too variable to be of chronological value, both bone and soil-charcoal samples displayed good correspondence both with each other and by depth. Fig. 14 plots the 14 soil-carbon and bone collagen samples by depth. As we noted above, there is a clear trend toward greater age with depth. However, the pattern is not linear, suggesting periods of both slower and more rapid deposition. Two dates (UGA-12518 and UGA-12133)—both on bone—clearly stand out as outliers, a point we return to below.

We recognize that soil-carbon is often considered suspect for dating archaeological contexts, due to possible biases introduced by the old wood effect, the mixing of charcoal of different ages, and the downward transport of humic acids (Nolan, 2012; Pettitt et al., 2003). We attribute the positive results here to several factors. First, small fragments of charcoal are abundant in the midden at Crystal River, allowing us to date very small samples of sediment (typically no more than 2 g). Next, the midden is generally very compact and high in shell density, factors which together may impede the vertical displacement of materials through the profile by ants and other organisms (see Pluckhahn et al., 2015; Tschinkel et al., 2012). These latter factors may also account for the reasonably good correlation of dates on bone both with depth and with soil-carbon dates, given that we dated disarticulated specimens instead of the articulated skeletons that would be preferred for radiocarbon dating were they available.

To model the distribution of radiocarbon dates, we utilized the Bayesian statistical capabilities of OxCal 4.2 (©Christopher Bronk Ramsey, Bronk Ramsey, 2009). OxCal and other similar Bayesian statistical modeling programs calculate posterior probability densities for radiocarbon dates and other absolute chronological information based on a priori information (Bronk Ramsey, 2009; McNutt, 2013; Schilling, 2013). Bayesian modeling used Bayes' Theorem, a theory that a posterior probability (the probability of a calculation after the likelihood and prior information are considered through Bayesian calculation) is proportional to the product of an observed likelihood and prior probabilities. In phase

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[1] The obtained 14C ages were converted to calendar dates using OxCal 4.2 with the IntCal13 curve for soil and bone collagen samples and the Marine13 curve for shell samples (Reimer et al., 2013). For the shell, we applied a ΔR value of 106 ± 26, the mean ΔR calculated by Thomas (2008) for shell samples from the Florida-Carolina coast; no such values have been published for the eastern Gulf Coast.

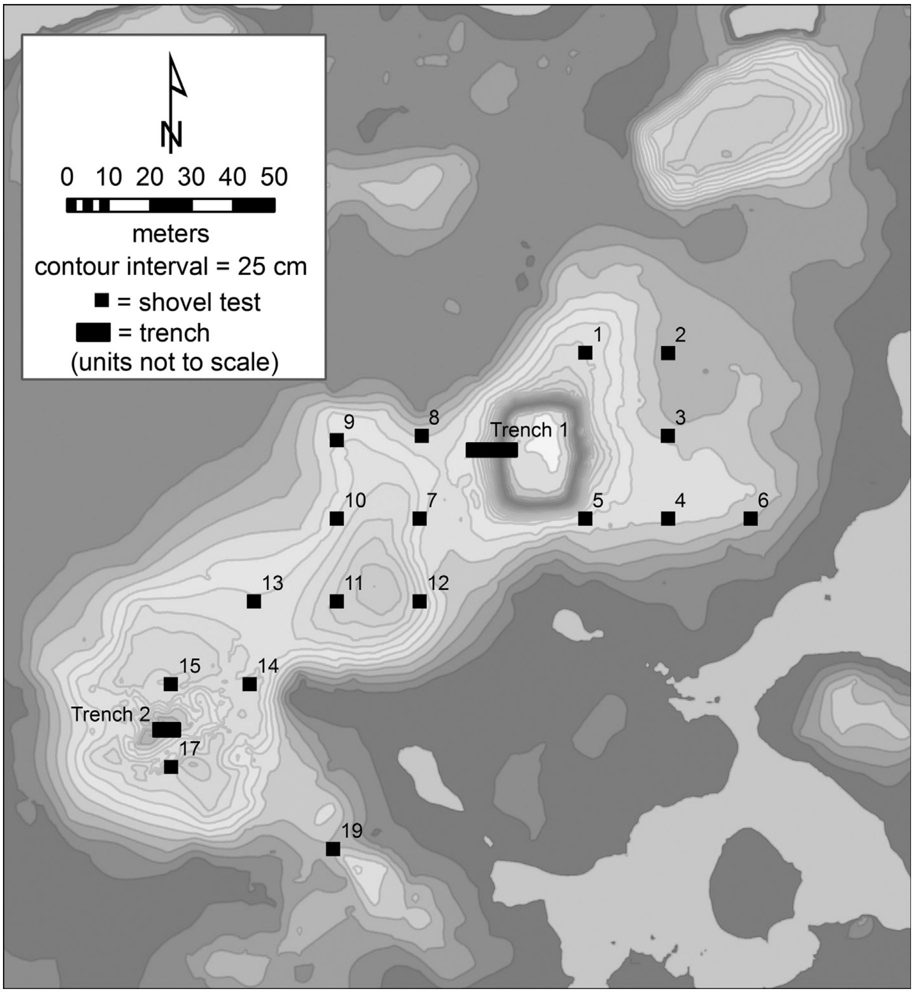

Fig. 12. The locations of shovel tests at Roberts Island.

modeling, the proposed phases are used as prior certainties and calibrated radiocarbon dates are observed likelihoods (Schilling, 2013). The probabilities are multidimensional, so OxCal uses a Markov Chain Monte-Carlo (MCMC) to build up a representative sample of possible solutions (Bronk Ramsey, 2014). The extent to which it is able to do so is measured by Convergence (C); good convergence is indicated by a value above 95. However, good convergence does not necessarily indicate a representative solution. The solution is also evaluated using an agreement index to determine if the data are consistent with the model (Bronk Ramsey, 1995). OxCal calculates agreement indices for individual dates (A), the model (A_{model}), and the overall agreement between the agreement indices (A_{overall}). The critical value for these results, or $A'c$, is 60.0; anything above this is considered significant agreement.

We began by using the sequence model in OxCal to determine the degree to which the dates from Trench 1 form a logical stratigraphic sequence. Here the two outliers became apparent; with these included OxCal was unable to resolve the sequential ordering leading to a null distribution. With these two omitted, the sequence model improved ($A_{\mathrm{model}} = 55.6$; $A_{\mathrm{overall}} = 56.2$), but remained below critical values largely because of the relatively poor agreement of two additional dates (UGA-12944 and UGA-12946).

The sequence model provides justification for the omission of the two outlying dates, but the lack of a clear sequential ordering by depth was not unexpected, since multiple dates from the same or closely related stratigraphic layers might be expected to overlap or even be slightly out of order. We thus focused primarily on modeling phases in the radiocarbon data, running various numbers and combinations of sequential phases. For Trench 1, a three-phase solution yielded the best agreement indices ($A_{\mathrm{model}} = 104.1$; $A_{\mathrm{overall}} = 103.6$), with these falling well above critical values.

The three radiocarbon phases match generally with the stratigraphy of Trench 1 (see Fig. 8). Phase 3 corresponds with the shell-rich Strata III near the top of the profile. The Phase 2/3 transition matches nicely with the break between this and Stratum IV, the underlying A horizon with comparatively little shell. There is a seeming disjunction between the radiocarbon phase modeling and stratigraphy in our Phase 2, which includes both the relatively shell-free Stratum IV and the top of the underlying dense shell deposits (Stratum V). This would seem to indicate a period of rapid deposition early in Phase 2 succeeded by a period of intensive occupation but little *in situ* shell disposal later in this phase, as we discuss in more detail below. The Phase 1/2 transition is also not clearly represented in terms of stratigraphy, but there is a correlation with a decline in oyster density in Levels 11 and 12 (Phase 1).

Other classes of artifacts also support our three-phase model of midden deposition for Trench 1. Pottery, for example, is essentially trimodal in its distribution by level, with prominent peaks in Levels 2 and 6 (corresponding with Phases 2 and 3, respectively) and a slighter third peak in Level 12 (Phase 1). Deptford Check Stamped

Fig. 13. The west profile of Shovel Test 4 at Roberts Island.

pottery (the earliest clear diagnostic type at Crystal River) was found only in Levels 13–15 (consistent with Phase I) while other decorated types were limited to Levels 1–10 (corresponding with Phases 2 and 3).

Our next task was to expand the chronology from Trench 1 to incorporate other areas of the midden at Crystal River and the midden at Roberts Island. For Trench 4, we dated soil-carbon from regular increments in the column sample in much the same manner as we did for Trench 1. For Trenches 2 and 4 at Crystal River, where the stratification was interrupted by features, we selectively dated soil-carbon from levels and features of varying depths. At Roberts Island, because of the preponderance of shell, we selectively dated soil-carbon from layers with higher organic content.

We discounted the eight dates on shell, as well as the two outlying bone dates from Trench 1, for the reasons described above. We also excluded three dates (UGA-13545, UGA-13547, and UGA-13549) on soil-charcoal samples from higher elevations in the midden at Roberts Island; these dates are much more recent than would be expected based on other radiocarbon dates or artifact assemblages, reflecting probable contamination from more recent charcoal.

Modeling of the 26 remaining dates suggested that the best solution is a four-phase, sequential ordering, which produced agreement indices well above critical values ($A_{\text{model}} = 101.7$; $A_{\text{overall}} = 102.0$). Table 2 lists the modeled 68% and 95% probability ranges for these 26 radiocarbon dates. Table 3 summarizes the 68% and 95% probability ranges for the modeled start and end dates for the four phases. Models using other numbers of phases, other combinations of dates, and contiguous rather than sequential phase modeling, failed to produce indices above critical values.

We repeat our earlier recognition that chronology is not temporality. However, phase-based modeling is useful for characterizing the broader rhythms of social life that are incorporated into the shell-bearing landscape at Crystal River and Roberts Island. For the shorter rhythms of human activities, we turn to observations of stratification. A useful quantitative measure for understanding the tempo of midden deposition within phases is the rate of accumulation, as defined by Stein and Deo (2003). Briefly, the Rate of Accumulation is determined by the Total Accumulation (the difference in depths between samples, in cm) divided by the Duration of Accumulation (the difference between radiocarbon ages between samples, in years). The levels in our trenches and shovel tests were assigned to phases based on the radiocarbon dates and stratification. Total accumulation of midden was quantified by summing the thickness of the levels assigned to each phase. For duration of accumulation, we used the span tool in OxCal to model the length of each phase, then used the mid-point of the modeled 95% probability range. Table 4 summarizes the accumulation rates by phase for each unit for which we have radiocarbon dated strata.

4.1. Phase 1

The first phase of midden deposition has a modeled start date of *cal AD 65–224* and end date of *cal AD 143–265* (95% probability ranges). This phase has a modeled length of 37 years at 95% probability.

The timing of this phase coincides with the third quarter of the Roman Warm period. Walker (2013: 39), summarizing the global climate reconstructions and their application to southwestern Florida, describes this a time of "…warmth and raised sea level but punctuated with shorter-term relatively cooler events and slowed or lowered sea level." The elevation of the Phase 1 strata within the contemporary tidal zone suggests sea level remained at least a meter below present.

We present recent radiocarbon dates from mounds elsewhere (see Pluckhahn et al., 2015), but note here that oldest reliable dates for midden formation fall several centuries after some of the earliest dates on human remains from the two burial mounds. Assuming the latter are reliable, Crystal River may have begun as a vacant ceremonial center for a population dispersed across the surrounding landscape.

There is radiocarbon evidence for Phase 1 midden deposition on the western portion of what would come to be the Midden B shell ridge (as evidenced by two samples from Trench 1) and in the central portion on the fringes of the former lagoon (one sample from Trench 2) (Fig. 15). We also have equivalent (and even slightly earlier) dates from the lower sections of a core in Mound J. Current radiocarbon evidence suggests midden formation began slightly later (in Phase 2, discussed below) in the area of Trench 4, to the east. We also have no evidence for Phase 1 occupation in Trench 3. Together, the evidence suggests that the earliest midden was an abbreviated version of its later crescent-shape, extending from the Mound J area at the north to the northern fringes of the lagoon.

This first phase of midden formation at Crystal River included relatively rapid midden deposition, as indicated by an overall RA of 1.08 and an RA of .81 in Trench 1, where this occupation is best expressed. However, the Phase 1 midden layers in Trench 1, while rich in shell and bone, contain relatively few other artifacts. Features were associated with this phase only in our Trench 2, where the presence of several posts could indicate a structure of some sort on the edge of the lagoon.

Further study of subsistence remains will clarify the picture, but existing data suggest occupation in Phase I may have been seasonal, perhaps associated with mortuary ceremonies and burial events. If so, shellfish were likely consumed in feasts, including those associated the interment of the dead in burial mounds. Moore (1903: 382–383) noted that many of the interments in the Main Burial Complex (the fill of which was largely devoid of

Table 1
Recently-retrieved radiocarbon dates from the middens at the Crystal River and Roberts Island sites.

Sample no.	Provenience	Material	13C, 0/00	14C BP	±	pMC	±	2-sigma calibrated	Notes
UGA-12943	8CI1, Column 1, Level 15 (32–34 cmbs)	Soil-charcoal	−24.6	1490	25	83.02	0.24	cal AD 538–638	
UGA-14103	8CI1, Column 1, Level 15 (32–34 cmbs)	Oyster shell	−4.6	2490	20	73.36	0.21	322–118 cal BC	Omitted from phase modeling
UGA-12135s	8CI1, Unit 1, Level 5 (42–52 cmbd)	Soil-charcoal	−22.7	1540	20	82.58	0.23	cal AD 427–575	
UGA-12136	8CI1, Unit 1, Level 5 (42–52 cmbd)	UID mammal bone collagen	−21.4	1610	20	81.81	0.23	cal AD 396–535	
UGA-12944	8CI1, Column 1, Level 20 (42–44 cmbs)	Soil-charcoal	−23.7	1730	20	80.65	0.23	cal AD 250–381	
UGA-14104	8CI1, Column 1, Level 20 (42–44 cmbs)	Oyster shell	−4.9	2780	25	70.74	0.21	714–444 cal BC	Omitted from phase modeling
UGA-12945	8CI1, Column 1, Level 25 (52–54 cmbs)	Soil-charcoal	−24.2	1720	25	80.77	0.23	cal AD 251–389	
UGA-14105	8CI1, Column 1, Level 25 (52–54 cmbs)	Oyster shell	−4.1	2680	20	71.59	0.21	501–359 cal BC	Omitted from phase modeling
UGA-12946	8CI1, Column 1, Level 29 (63–67 cmbs)	Soil-charcoal	−23.5	1650	25	81.43	0.24	cal AD 335–528	
UGA-14106	8CI1, Column 1, Level 29 (63–67 cmbs)	Oyster shell	−8.3	2930	25	69.49	0.2	806–726 cal BC	Omitted from phase modeling
UGA-12133	8CI1, Unit 1 Level 9 (82–92 cmbd)	UID mammal bone collagen	−11.5	2070	25	77.25	0.23	173–2 cal BC	Omitted from phase modeling
UGA-12133s	8CI1, Unit 1 Level 9 (82–92 cmbd)	Soil-charcoal	−23.2	1680	20	81.15	0.23	cal AD 264–413	
UGA-12947	8CI1, Column 1, Level 33 (79–83 cmbs)	Soil-charcoal	−21.5	1720	25	80.68	0.23	cal AD 251–389	
UGA-14107	8CI1, Column 1, Level 33 (79–83 cmbs)	Oyster shell	−7.7	3350	25	65.92	0.2	1368–1171 cal BC	Omitted from phase modeling
UGA-12948	8CI1, Column 1, Level 36 (91–95 cmbs)	Soil-charcoal	−20.4	1750	25	80.44	0.23	cal AD 232–380	
UGA-14108	8CI1, Column 1, Level 36 (91–95 cmbs)	Oyster shell	−6	2520	25	73.03	0.22	342–162 cal BC	Omitted from phase modeling
UGA-12949	8CI1, Column 1, Level 39 (103–107 cmbs)	Soil-charcoal	−20	1760	25	80.33	0.23	cal AD 215–380	
UGA-14109	8CI1, Column 1, Level 39 (103–107 cmbs)	Oyster shell	−5.3	2800	25	70.53	0.21	729–487 cal BC	Omitted from phase modeling
UGA-12950	8CI1, Column 1, Level 41 (111–115 cmbs)	Soil-charcoal	−20.4	1830	25	79.61	0.24	cal AD 92–246	
UGA-14110	8CI1, Column 1, Level 41 (111–115 cmbs)	Oyster shell	−4.6	3130	25	65.71	0.2	1052–865 cal BC	Omitted from phase modeling
UGA-12518	8CI1, Unit 1, Level 13 (122–132 cmbd)	UID mammal bone collagen	−21.7	1690	20	81.01	0.23	cal AD 260–406	Omitted from phase modeling
UGA-12520	8CI1, Unit 1, Level 14 (132–142 cmbd)	UID mammal bone collagen	−21.8	1860	20	79.29	0.22	cal AD 85–222	
UGA-12517	8CI1, Unit 1, Level 13 (122–132 cmbd)	Oyster shell	−4.9	3210	25	67.09	0.2	1184–972 cal BC	Omitted from phase modeling
UGA-12519	8CI1, Unit 1, Level 14 (132–142 cmbd)	Oyster shell	−5.8	2710	25	71.38	0.21	550–372 cal BC	Omitted from phase modeling
UGA-12134	8CI1, Unit 1 Level 9 (82–92 cmbd)	Oyster shell	−4.9	2600	25	72.31	0.21	390–228 cal BC	Omitted from phase modeling
UGA-12135	8CI1, Unit 1, Level 5 (42–52 cmbd)	Oyster shell	−4.2	2730	25	71.2	0.21	601–381 cal BC	Omitted from phase modeling
UGA-14113	8CI1, Unit 5, Level 11	Soil-charcoal	−23.5	1820	20	79.69	0.22	cal AD 132–241	
UGA-15476	8CI1, Trench 2, Unit 5, Feature 7	Soil-charcoal	−25.8	1710	20	80.81	0.23	cal AD 256–393	
UGA-15477	8CI1, Trench 2, Unit 5, Feature 8	Soil-charcoal	−26	1540	20	82.59	0.24	cal AD 427–575	
UGA-15478	8CI1, Trench 2, Unit 6, Feature 11	Soil-charcoal	−25.3	1600	25	81.95	0.23	cal AD 404–537	
UGA-15479	8CI1, Trench 3, Unit 8, Feature 26	Soil-charcoal	−25.7	1350	20	84.54	0.24	cal AD 646–686	
UGA-15480	8CI1, Trench 3, Unit 8, Feature 27	Soil-charcoal	−26.2	1220	20	85.87	0.24	cal AD 713–885	
UGA-15481	8CI1, Trench 4, Column 2, Level 8, 50–54 cmbd	Soil-charcoal	−25.3	1620	20	81.71	0.23	cal AD 387–535	
UGA-15482	8CI1, Trench 4, Column 2, Level 15, 78–82 cmbd	Soil-charcoal	−24	1710	20	80.83	0.23	cal AD 256–393	
UGA-15483	8CI1, Trench 4, Column 2, Level 25, 118–122 cmbd	Soil-charcoal	−25.3	1720	20	80.75	0.23	cal AD 253–387	
UGA-15484	8CI1, Trench 4, Column 2, Level 28, 130–134 cmbd	Soil-charcoal	−25.5	1760	25	80.36	0.23	cal AD 215–380	
UGA-13545	8CI41, Shovel Test 6, Level 5 (40–50 cmbs)	Soil-charcoal	−25.2	220	25	97.27	0.3	cal AD 1644–present	Omitted from phase modeling
UGA-13546	8CI41, Shovel Test 6, Level 10 (90–100 cmbs)	Soil-charcoal	−22.01	1310	25	84.95	0.28	cal AD 658–768	
UGA-13547	8CI41, Shovel Test 7, Level 3 (20–30 cmbs)	Soil-charcoal	−24.11	550	25	93.34	0.28	cal AD 1316–1430	Omitted from phase modeling
UGA-13548	8CI41, Shovel Test 7, Level 10 (90–100 cmbs)	Soil-charcoal	−24.14	1080	25	87.41	0.28	cal AD 895–1018	
UGA-13549	8CI41, Test Unit 7, Level 3 (30–40 cmbd)	Soil-charcoal	−24.85	390	25	95.29	0.29	cal AD 1441–1624	Omitted from phase modeling
UGA-17620	8CI41, Unit 8, Level 4 (40–50 cmbd)	Deer bone collagen	−20.5	1170	20	86.44	0.23	cal AD 774–897 (88.7%), cal AD 926–943 (6.7%)	
UGA-17622	8CI41, Shovel Test 11, soil sample from 100 cmbs	Soil-charcoal	−23.4	1140	20	86.77	0.23	cal AD 777–790 (3.1%), cal AD 809–818 (1.1.%), cal AD 826–842 (2.3%), cal AD 863–977 (88.9%)	

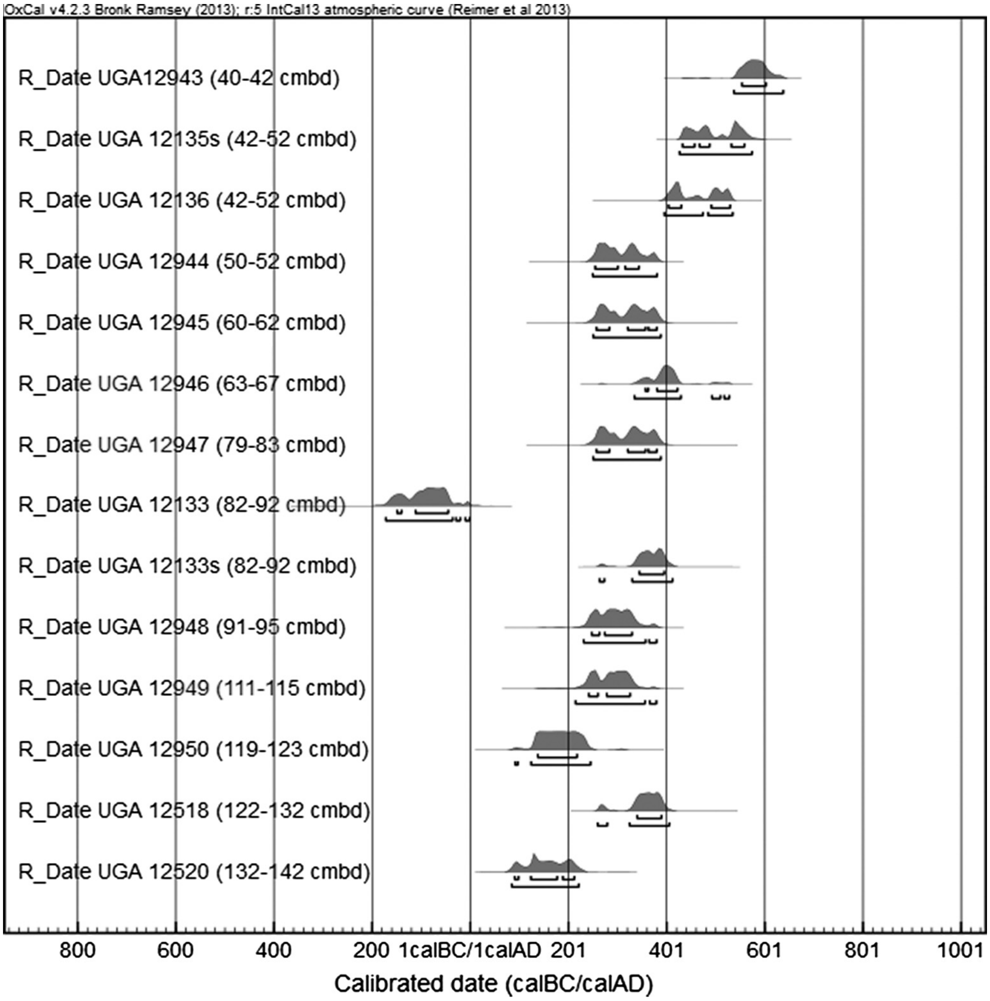

Fig. 14. Plot of calibrated radiocarbon dates (bone and soil-charcoal) by depth for Trench 1 at Crystal River.

shell) were covered by shellfish, and that the base of the central mound was comprised of "a ledge of shell 2 feet [61-cm] high and 20 feet [6.1-m] abroad." The co-occurrence of these two tasks—feasting in off-mound areas and ritual interment in mounds—linked these areas together into an integrated landscape.[2]

4.2. Phase 2

Phase 2 is the longest of our four phases, with a modeled start and end dates of *cal AD 221–321* and *cal AD 435–544*, respectively, and a median modeled length of 190 years (95% probability ranges). This phase corresponds closely with the final quarter of the Roman Warm period (Walker, 2013: 38–39). We currently have only limited pollen data from Crystal River, but the analysis of a sample from the Phase 2 strata in Trench 1 identified cattail (*Typha latifolia*-type), consistent with the vegetation in the marsh that surrounds the site today (Cummings and Varney, 2013). The pollen assemblage from the Phase 2 sample is otherwise dominated by weedy annuals and grasses consistent with increasing anthropogenic activity, including cheno-ams, members of the sunflower family (Lowspine and High-spine Asteraceae), a member of the mustard family (Brassicaceae), wild buckwheat (*Eriogonum*), and grasses (Poaceae). Tree taxa represented consist of pine and (*Pinus*) and oak (*Quercus*).

Phase 2 is represented by nine dates from Trench 1, three dates from Trench 2, and four dates from Trench 4. We have no dates from this interval in Trench 3, but presume that the massive deposit of oyster in this trench dates to the later part of Phase 2 based on later dates on the superimposed A horizon. Based on its strong representation in these four trenches, we can say that during Phase 2 the midden at Crystal River was expanded to form a longer, crescent-shaped ridge (Fig. 16).

There are clear indications that the tempo of midden deposition changed fundamentally with Phase 2; the RA for this phase is higher than for any other at Crystal River. While this is partly due of the greater areal extent of the midden, the relatively high RA rates in the Phase 2 levels from each trench excavation indicate that midden deposition increased not only in areal extent but also in rate. We interpret this as indicative of larger population or more permanent settlement, or a combination of these.

The dense shell layer in Trench 1 was deposited during the early portion of Phase 2—perhaps in a deliberate effort to raise the height of the ridge. This resulting surface appears to have been

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[2] Claassen (2010) has drawn a connection between shell middens and the Milky Way, a celestial phenomenon that was important to later Native Americans as the "path of souls," or the route of departed spirits to their final resting place in the south (Lankford, 2007b). An important constituent of the Milky Way for native people was the curving constellation we know as Scorpio, which appears just above the southern horizon in the summer months and which may have been represented in later Mississippian iconography as a curving serpent (Lankford, 2007a). While it is obviously difficult to assign such specificity to beliefs and rituals in the more remote past, the shape of the shell midden at Crystal River is reminiscent of both the constellation and its later iconographic referent.

Table 2
Modeled radiocarbon dates by phase.

Phase	Sample	One sigma modeled range *cal AD*	Two sigma modeled range *cal AD*	Agreement
Phase 4	UGA-17622	880–944	784–972	100.5
	UGA-17620	830–895	778–944	103
	UGA-15480	832–884	772–889	93.9
	UGA-13548	891–927	887–992	86.2
Phase 3	UGA-12943	566–617	552–642	89.7
	UGA-15479	654–670	647–683	100.2
	UGA-13546	661–692	653–761	110
Phase 2	UGA-12135s	428–461	423–494	96.9
	UGA-12136	398–435	391–513	106.7
	UGA-12944	269–376	260–381	95.6
	UGA-12945	270–384	260–389	99.2
	UGA-12946	382–422	340–428	104.4
	UGA-12947	269–384	260–389	99.4
	UGA-12133s	347–396	330–414	101.6
	UGA-12948	280–336	249–380	100.5
	UGA-12949	283–332	244–377	103.3
	UGA-15476	328–384	259–394	101.9
	UGA-15477	429–461	423–494	96.9
	UGA-15478	405–460	394–508	91.6
	UGA-15481	400–428	385–510	117.7
	UGA-15482	328–384	259–394	101.8
	UGA-15483	269–382	258–388	97.9
	UGA-15484	283–333	245–377	103.3
Phase 1	UGA-12950	157–217	133–231	107.9
	UGA-12520	156–216	125–230	100.4
	UGA-14113	156–219	135–230	103.6

Table 3
Phases of midden formation modeled from radiocarbon dates.

Phase	Modeled 68% probability ranges *cal AD*		Modeled 95% probability ranges *cal AD*	
	Start	End	Start	End
4	779–867	902–982	723–881	891–1060
3	521–605	671–747	478–634	663–810
2	238–292	441–499	221–321	434–544
1	125–199	180–242	69–225	144–265

Table 4
Midden accumulation rates for Crystal and Roberts Island.

Provenience	Phase 1 DA = 37		Phase 2 DA = 190		Phase 3 DA = 94		Phase 4 DA = 100	
	TA	RA	TA	RA	TA	RA	TA	RA
8CI1, Trench 1	30	.81	80	.42	12	.13		
8CI1, Trench 2	10	.27	90	.47				
8CI1, Trench 3			60	.37	20	.21	20	.12
8CI1, Trench 4			100	.52			–	–
8CI41, Shovel Test 6					20	.21	60	.6
8CI41, Shovel Test 7							80	.8
8CI41, Shovel Test 11							80	.8
8CI41, Trench 2							40	.4
Total	40	1.08	330	1.74	52	.55	280	2.8

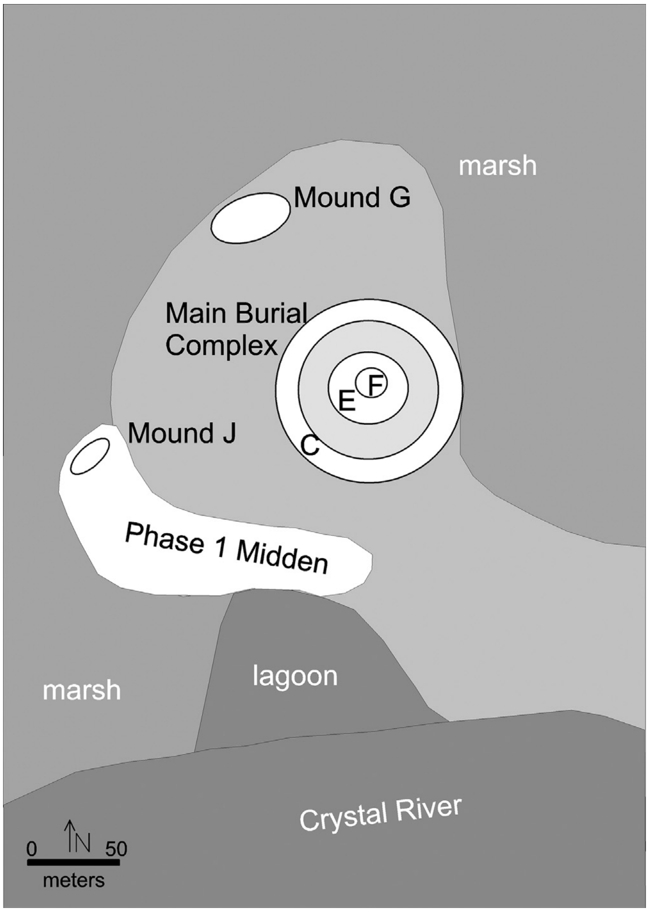

Fig. 15. Map of Crystal River showing the extent of midden and architectural features during Phase 1.

occupied more intensively later in Phase 2, as indicated by the organic-rich sediment layer with higher densities of ceramics and most other artifacts (except oyster) and the presence of a number of features. The same pattern of activities appears to have played out in the Trench 2 area, with a dense layer of shell deposited early in Phase 2 coming to serve as a surface for an occupation that included less *in situ* shell disposal, but more artifacts and features. We have less evidence for intensive occupation in the form of features in the Phase 2 layers of Trench 3, but there was nevertheless substantial midden accumulation, as indicated by the spread of radiocarbon dates across depths in our column sample. The relative lack of oyster in the later Phase 2 strata may be another indication of more permanent settlement if we assume that sedentism encouraged disposal of such food remains elsewhere.

"Elsewhere" may have included several of the mounds at the site; recent radiocarbon dating suggests that both Mounds H and K were constructed during Phase 2 (Norman, 2014; Pluckhahn et al., 2015). Mound K was built on the shell ridge and primarily of oyster shell (Pluckhahn and Thompson, 2009), suggesting the interconnectedness of mound and midden. Food remains also appear to have been discarded on the flanks of the shell ridge, as evidenced by the massive deposit of oyster in Trench 3. We hypothesize that this dense deposit of oyster shell reflects both refuse disposal and a deliberate attempt to expand the ridge to the south and encircle the lagoon, creating a more formal entrance to the community for visitors coming by way of canoe. It is also possible that the midden was expanded in anticipation of the construction of Mound A (in our subsequent phase), as a substrate to cover the otherwise low-lying land in this area. In any case, the expansion led to the barbed appearance of the midden as described by Bullen (1951: 142).

4.3. Phase 3

Phase 3 has a median modeled length of 94 years, with a modeled start date of *cal AD 479–634* and end date of *cal AD 663–809* (95% probability ranges). This phase corresponds to the first half of the Vandal Minimum, which Walker (2013: 41) has described

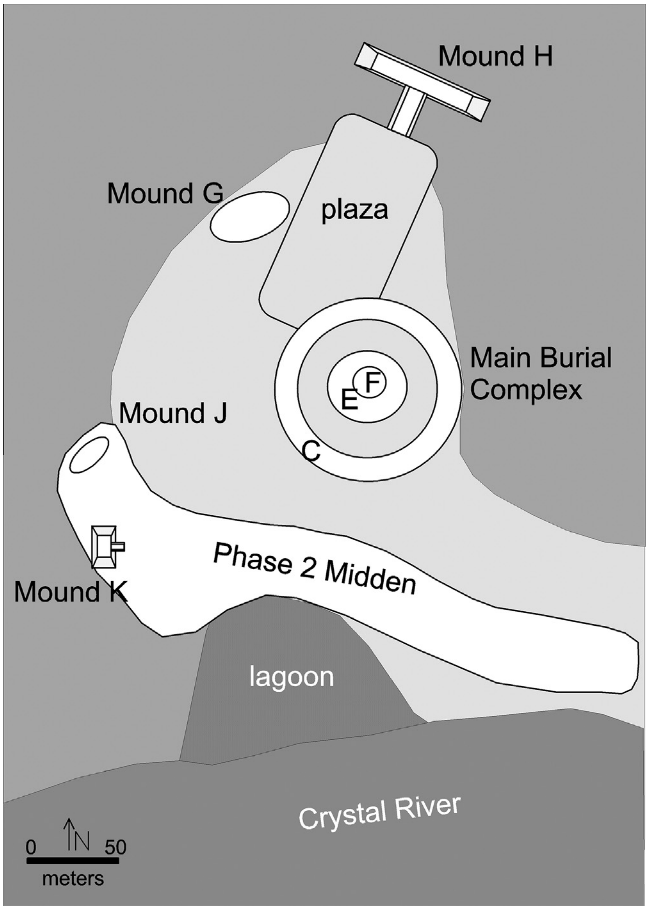

Fig. 16. Map of Crystal River showing the extent of midden and architectural features during Phase 2.

as a time of "…general coolness and lowered sea level, but punctuated with shorter-term, relatively warmer events." While the overall trend may have been to lower sea level and drier conditions, a pollen sample from Phase 3 strata in Trench 1 includes cattail, suggesting continued marshy vegetation in the vicinity of the site. Overall the pollen sample suggests a heavier growth of grasses relative to the Phase 2 sample (Cummings and Varney, 2013). Tree taxa represented include oak and basswood (Tilia).

Phase 3 includes three radiocarbon dates: two from Crystal River and one from Roberts Island (see Table 2). The two dates from Crystal River indicate that occupation continued here, albeit in reduced form. The dates assigned to Phase 3 include one on a feature in Trench 3 and another from high in the column sample in Trench 1. Thus, this phase is represented on the western portion of the shell ridge, but not to the west in Trench 2 (although it may have been graded away) or Trench 4 (although it may not yet be radiocarbon dated). The area of midden deposition appears to have retreated to the ridge at the western end of the former crescent-shaped midden (Fig. 17).

This Phase 3 midden is anchored to the south by Mound A, which both older (Bullen, 1966: 865) and more recent radiocarbon dates suggest was constructed during this interval. The construction of Mound A, with its ramp extending from summit to the lagoon as described by Bullen (1966) and Moore (1903), further elaborated the entrance to the community.

In Trench 1, Phase 3 is represented by a stratigraphic layer with a relatively high density of shell but few artifacts and no features. In Trench 3, features are present and shell density more moderate. Busycon shells and fragments are rare in off-mound areas at Crystal River (Blankenship, 2013), but a slightly higher concentration in Trench 3 suggests the possibility of a specialized activity area or residence associated with Mound A.

The single date from Roberts Island, retrieved from a sample from the buried midden layer observed in shovel tests on the eastern end of the island, indicates that midden deposition here began during Phase 3. The combination of a reduction in the size of the midden at Crystal River and the initiation of occupation at Roberts Island may indicate a broader dispersal of settlement. It seems reasonable to relate this change to lowered sea level, in that movement to Roberts Island would have allowed at least marginally easier access to the Gulf. However, we would be reluctant to

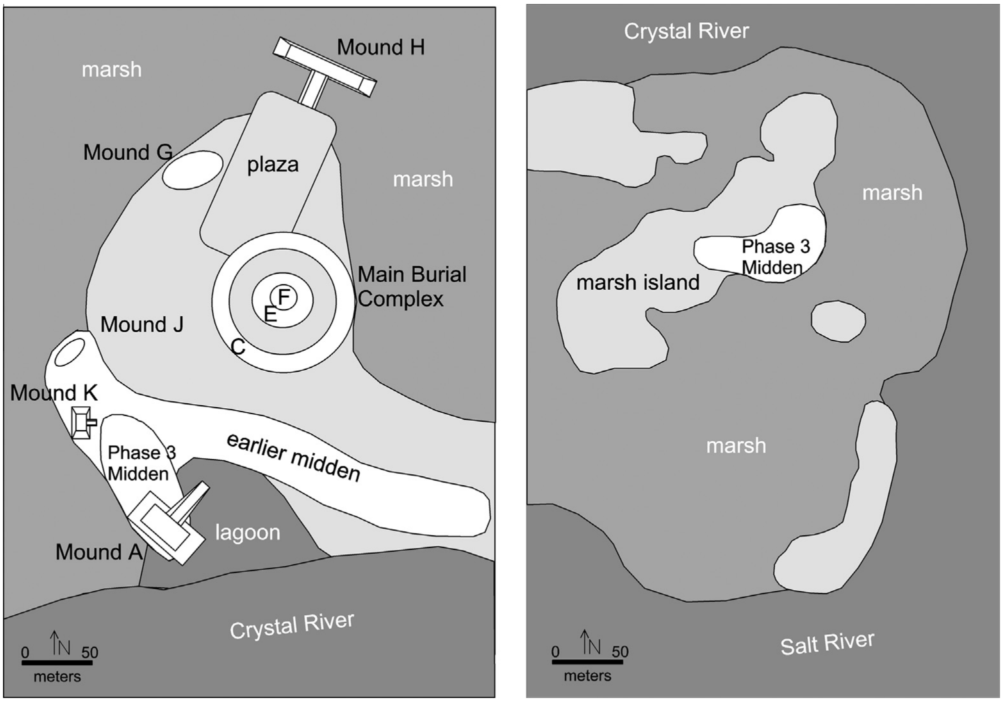

Fig. 17. Map of Crystal River (left) and Roberts Island (right) showing the extent of midden and architectural features during Phase 3.

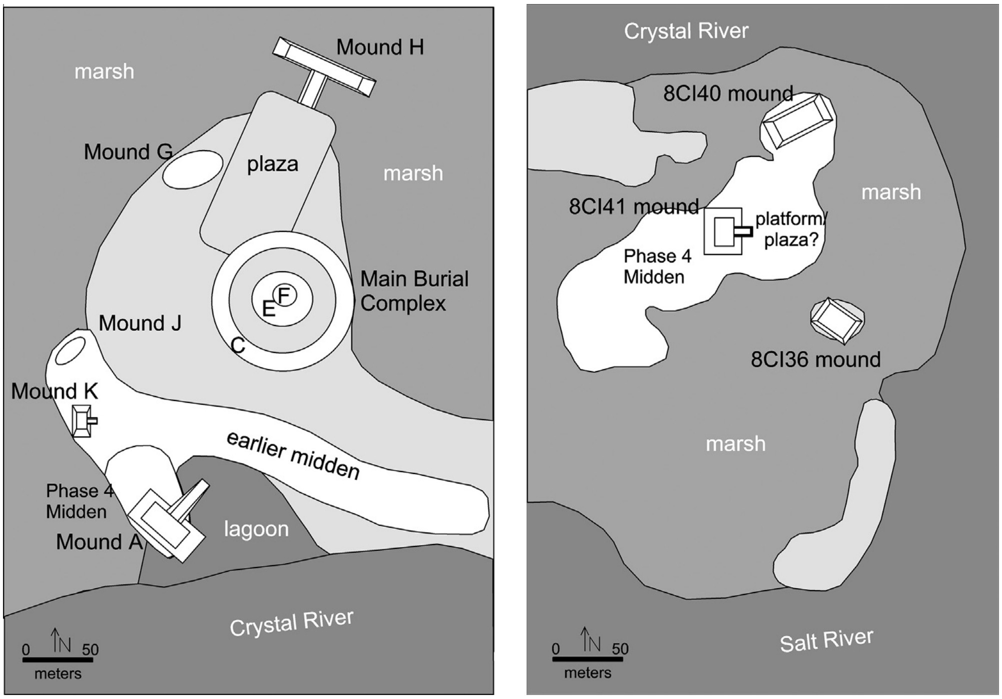

Fig. 18. Map of Crystal River (left) and Roberts Island (right) showing the extent of midden and architectural features during Phase 4.

portray this phase as a period of decline in response to a deteriorating environment, given that it witnessed completion of the largest mound at Crystal River.

4.4. Phase 4

The fourth and final phase has a 95% probability modeled length of 100 years with a start date of *cal AD 722–881* and end date of *cal AD 890–1068*. This coincides with the first half of the Medieval Warm Period, characterized by "general warmth but punctuated by shorter-term, relatively cooler events" (Walker, 2013: 42).

Phase 4 is defined on the basis of four radiocarbon dates, one from Crystal River and three from Roberts Island. The former is from a feature in Trench 3, consistent with a late occupation centered on the area immediately adjacent to Mound A (Fig. 18). The lack of Phase 4 dates from elsewhere at Crystal River, including any of the mounds we have dated, indicates that activity here was waning.

Roberts Island appears to have supplanted Crystal River as a ceremonial hub during Phase 4. The three Phase 4 dates from the midden at Roberts Island include two from a deeply buried midden layer in separate shovel tests on the central portion of the site. Closely equivalent dates were retrieved from a midden layer at a much shallower depth in Trench 2. There are also roughly equivalent Phase 4 radiocarbon and OSL dates from the mounds. This suggests that the entire shell-dense midden above the buried midden layer was deposited during Phase 4. Accordingly, our RA for this phase is higher than that for any other, and may underestimate the true rate of accumulation. As noted above, we believe that some of the midden deposition here—especially the substrate of the plaza-like area east of the mound—may be better understood as a form of monumental platform construction, incorporating food remains from activities conducted to the west.

5. Conclusions

A full exploration of the temporality of the shell-bearing landscape will require greater understanding of shorter rhythms of daily life. Toward this end, subsistence and isotope studies to address seasonality are ongoing. Nevertheless, the extensive radiocarbon dating and Bayesian chronological modeling reported here demonstrates that the shell-bearing landscape was created in four broad phases over the interval from around *cal AD 70 to 1060* (95% probability ranges). Within and across these phases there is a great degree of temporal and spatial variability in midden formation, as indicated by stratification and the rates of accumulation. This variability materializes activities that included both *in situ* refuse disposal and apparently purposeful construction.

Consistent with the first lesson we described emerging from work on shell-bearing sites in the Southeast, the differences between these two formation processes are not always clearly differentiated archaeologically. For example, the massive shell deposit we documented in Trench 3 probably represents the deposition of food remains by people living nearby, but it also likely reflects a concerted effort to extend the shell ridge to the south to define a formal entrance to the site or to provide a substrate for Mound A. A similar blurring of casual refuse disposal and monument construction may be evident in the construction of a shell platform or plaza at the eastern end of the Roberts Island with refuse from activities elsewhere.

Consistent with the second lesson, we think the differences between mound and midden were not meaningful in the social lives of the people whose activities are incorporated in the landscape. As noted above, we see evidence that the shell midden was expanded to create a formal entrance to the community. Further, shell was an important constituent of ceremonial features like burials. Clearly, the activities associated with midden formation often overlapped with tasks relating to monument construction, blurring the distinction for both the people of the past and archaeologists today. In this regard, we borrow from recent landscape approaches in the American Southwest, where the dissonance between Western and non-Western categories and modes of perception are taken as the foundation for fieldwork (Fowles, 2010: 461) (see Moore and Thompson (2012) for an example from the Southeast).

Consistent with the third lesson discussed above, the need for context-specific studies, Claasen's (1991) charge to think critically about shell-bearing sites is as relevant today as twenty years ago. We have examined the shell middens at Crystal River and Roberts Island using the perspective of landscape, specifically Ingold's (1993: 162) understanding of landscape as the physical incorporation of social life with all of its complexities of temporality and movement. To approach the shell-bearing landscape from this perspective, we incorporate diverse datasets; geospatial and geophysical data describe changes in the location and extent of the middens, while geoarchaeological data provides understanding of the temporality of landscape formation. From this perspective, mound and midden were seamlessly integrated in the shell bearing landscape of Crystal River and Roberts Island.

Our attempt to decenter static functional categories like monument and midden by focusing on the temporality of landscape has implications for regions beyond the American Southeast. Researchers working in areas of the world where shell-bearing sites are traditionally thought of as simply "middens" must rethink their assumptions and explore shell-bearing landscapes more critically. Similarly, researchers who work in areas where the monumentality of shell mounds is less contested should also rethink the manner in which the landscape incorporates multiple activities. To us, the archaeological record of shell bearing landscapes must be understood, as Ingold (2012: 432) states, as histories to be told.

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