

# Late Holocene Aboriginal Shellfish Production Strategies in Northern Australia: Insights from Prunung (Red Beach), Weipa, Cape York Peninsula

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Recent investigations into the role of shell mounds in late Holocene Aboriginal economies in northern Australia have focussed on one of the key constituents in mound sites: the intertidal bivalve, *Tegillarca granosa* (formerly *Anadara granosa*). Various researchers have suggested that shell mounds were constructed during production activities that were predominantly oriented towards exploitation of estuarine or marine ecosystems, with other resources being of secondary or supplementary importance during these times. Proponents of this model concede that it requires ongoing evaluation in relation to new quantitative data on mound composition, stratigraphy and chronology from shell mound sites across a range of different environmental contexts. At Weipa, in western Cape York Peninsula, recent research has been oriented toward collecting new data necessary for investigating the role of mound sites and the production strategies associated with their formation. In this paper, the results of excavations and analysis of a series of shell mounds at Prunung (Red Beach), to the north of Weipa, are presented. These results support the view that mound construction took place in the context of production activities strategically oriented towards intertidal flats, rather than broadly-based foraging within local site catchments, or a more generalised 'estuarine' orientation.

## Introduction

A considerable focus of north Australian shell mound research relates to understanding the dynamics of Aboriginal food production strategies in coastal environments and how these strategies articulated with local ecosystems throughout the mid-to-late Holocene. While a range of models have been proposed, a common view is that shell mound formation can be directly tied to foraging activities focussed upon the species *Tegillarca granosa*, a marine bivalve commonly found in mound sites (Bourke 2005; Clune and Harrison 2009; Morrison 2003, 2013a; Veitch 1999). For instance, at Point Blane Peninsula, in northeast Arnhem Land (Figure 1), Faulkner (2013) has suggested that ecological changes contributing to the proliferation of *T. granosa* in local environments enabled higher intensity exploitation and an associated shift towards semi-sedentary occupation of locations adjacent to highly productive shell fishing locales. At Albatross Bay, on the other side of the Gulf of Carpentaria (Figure 1), it has been similarly suggested that mound formation was heavily tied to this species (Morrison 2003), but that the scale and intensity of shellfish production was highly variable, shifting in relation to local ecosystem dynamics at multiple time scales (Morrison 2013a).

One issue that has important implications for these models, however, is the increasing number of investigations that illustrate that while *T. granosa* is often very abundant, it can no longer be seen to be the primary emphasis of food production linked to shell mound formation. For instance, on Vanderlin Island, Sim and Wallis (2008:101) report one shell mound where the most common shellfish species were the bivalve *Marcia hiantina* together with *T. granosa*. Similarly, Rosendahl, Ulm *et al.* (2014a) report the occurrence of numerous marine gastropod shell mounds (*Terebralia* spp. and *Telescopium telescopium*) on Mornington Island, in the southern Gulf of Carpentaria, indicating a foraging emphasis on mangrove communities, while other mounds evidence large proportions of *Anadara antiquata* and

*Placuna placenta*. At Weipa, surface observations strongly point to a predominant emphasis on *T. granosa* (Bailey 1994; Morrison 2013a), however, recent work points to subtle internal variations in shellfish composition, with instances where *M. hiantina* comprises between 27% and 39% of shellfish MNI, while *Saccostrea cucullata* comprises between 55% and 30% of total shellfish MNI (Morrison 2013b:181). Several other studies have also shown that mound surfaces sometimes include a limited range of other species – often bivalves collected from intertidal mud and sand flats (Cochrane 2014; Cribb 1986; Hiscock and Mowat 1993). Further afield, shell mounds on the southern Curtis Coast (Ulm 2006) and Booral (Frankland 1990) in central and southeast Queensland are dominated by *Saccostrea glomerata*, with lower proportions of other taxa, including *Anadara trapezia*. Such results highlight the need for ongoing detailed field-based assessments of shell mound chronology, composition and stratigraphy from a diverse range of chronological and environmental settings throughout northern Australia. This will enable the development of more robust models of the dynamic ways in which Aboriginal people have drawn on specific kinds of ecosystems and resources through time, and through that, enable the further evaluation of resource production models.

This paper contributes to this endeavour by reporting on the results of excavation and analysis of shell mound sites at Prunung (Red Beach) (Figure 1), a few kilometres north of Weipa in western Cape York Peninsula. The Prunung study area is a sandy beach ridge plain on the lower reaches of the Mission River. A small complex of shell mound sites occur on the foredune while several more isolated sites occur away from the central mound group (Figure 2). Some of these sites have been subject to previous work (Bailey *et al.* 1994) and some sense of the age structure of the beach ridge exists through earlier geomorphological research (Stone 1995). Excavations at Prunung took place within a regional programme of

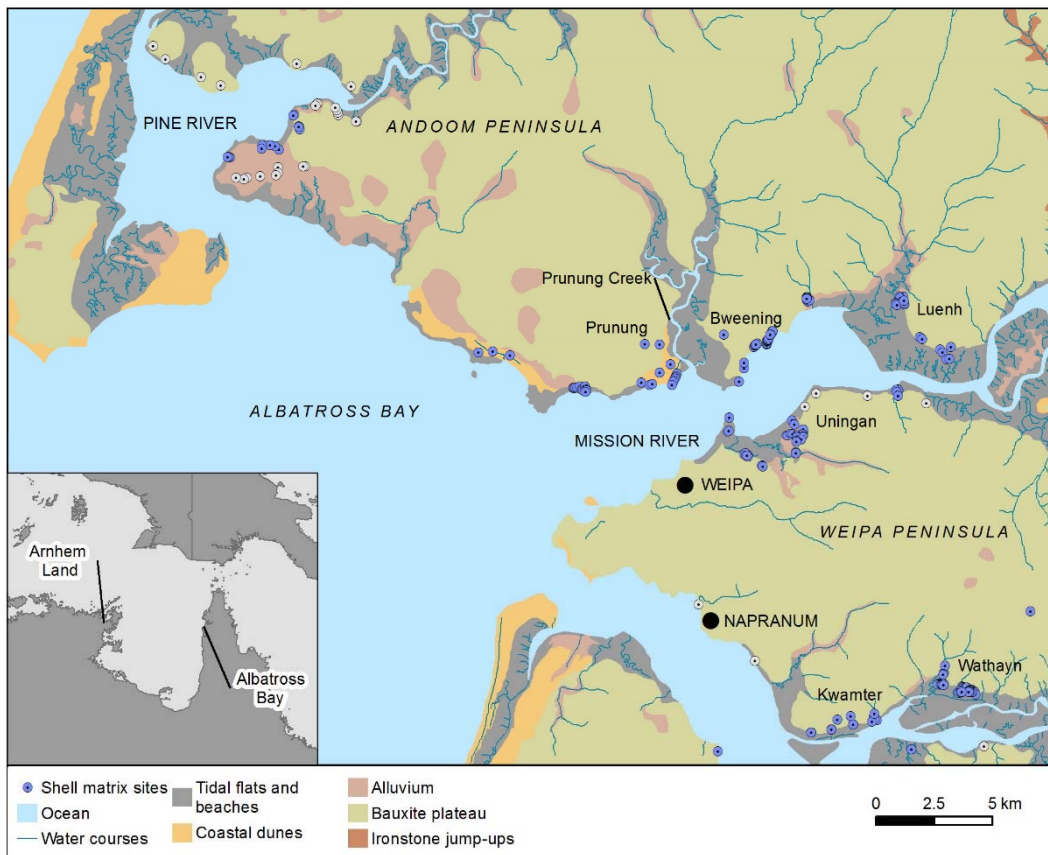


Figure 1. The Mission River showing location of known shell matrix sites and places mentioned in text.

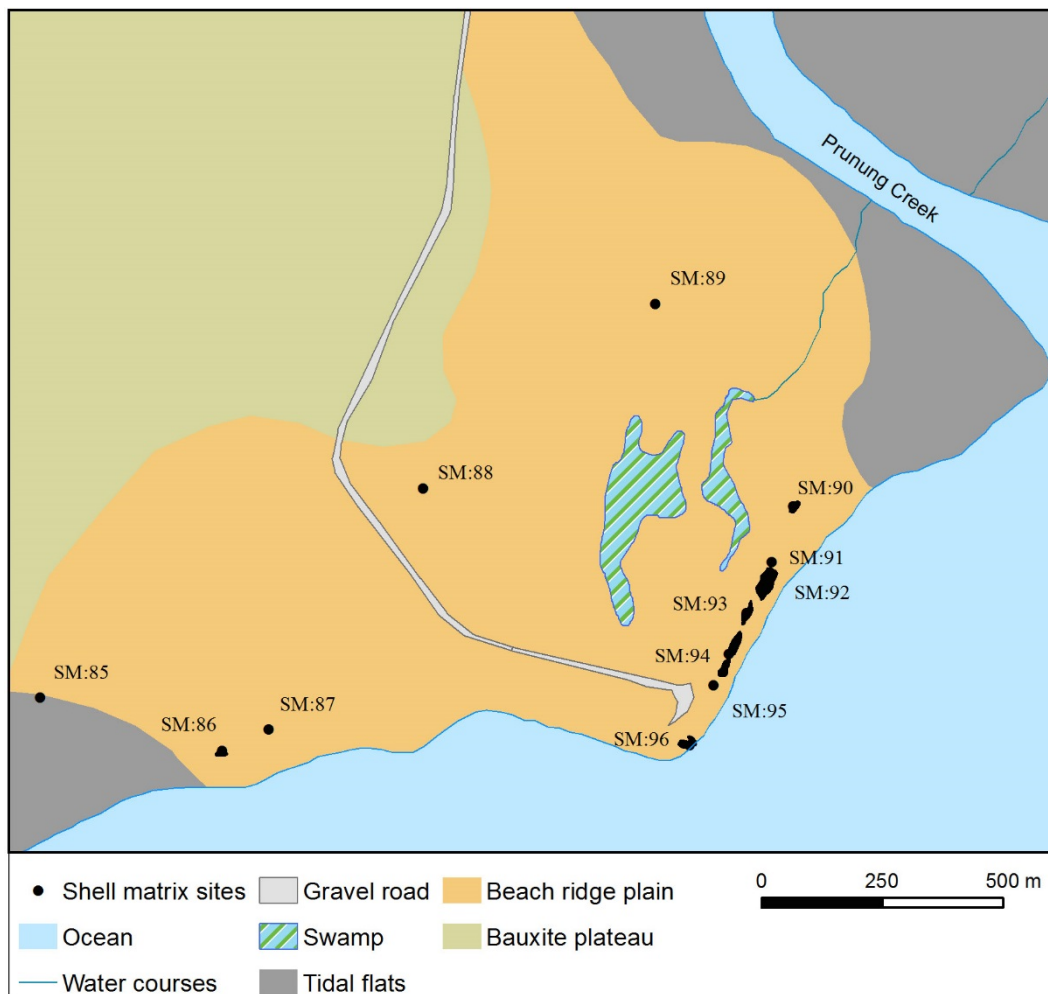


Figure 2. The Prunung study area.

archaeological investigations oriented towards understanding the role of shell mounds in late Holocene Aboriginal societies in the region (Morrison 2010, 2013a, 2013b, 2014) and set out to address three specific aims. Firstly, at the time excavations were conducted (2003), previous excavations at Weipa (Bailey 1977, 1994, 1999; Bailey *et al.* 1994; Wright 1971) had generated limited comparative data on mound composition. As such, the excavations aimed to obtain more detailed comparative data, particularly on mound composition and chronology, to complement similarly oriented research within the adjacent Bweening area (Morrison 2013b). Secondly, most previously excavated sites occur within or near open woodland and either on bauxite-dominant regolith or prograded coastal plains, abutted by mangrove forests and extensive intertidal mudflats. The Prunung sites occur in a very different environmental context – a beach ridge plain within open dune woodland, adjacent to a large semi-permanent freshwater swamp. As such, the second aim of the Prunung excavations were to investigate whether mound composition varied in relation to environmental context within the Albatross Bay catchment. The final aim of this work was to evaluate specific claims by Stone (1995) that mounds at Prunung are wave and wind-sorted chenier deposits and were neither constructed or used by Aboriginal people.

### The Study Area

Prunung is a clan estate within the Thanakwith language area on the lower reaches of the Mission River (Fletcher 2007). The coastal portion of this clan estate is a beach ridge plain that is characterised by a series of low but distinct shore-parallel ridges that have formed adjacent to the Weipa bauxite plateau (Figure 2). These ridges run approximately southeast to northwest and are most distinct in the northwest near Prunung (Andoom) Creek, but converge into one body towards the point (Stone 1995). Surface observations indicate that sediments in these ridges vary from fine dark sand with high proportions of organic material and gravel (mostly bauxite pisoliths) inland, to cleaner yellow and white sands nearer to contemporary shorelines, with greater proportions of whole shell and shell hash. A diverse range of common estuarine and marine shellfish species can be observed in these natural shell deposits, particularly those associated with mud and sand flat environments.

The beach ridge plain is vegetated by dune woodland that is relatively open near the coast and increases in density further to the west. A seasonal swamp occurs on the beach ridge plain and vegetation here varies between *Melaleuca* spp. forest in seasonally inundated areas, to occasional stands of dry notophyll vine forest in more elevated localities. Much of the southwest facing shoreline is undergoing significant erosion which has exposed a long, near-continuous section of the beach ridge substrates and the seaward portion of a single large shell mound. The beach ridge deposit contains distinct *T. granosa*-dominated strata and fine shell hash within a matrix of fine sand.

Between the early 1950s and mid-1970s, Prunung was used as a landing point for small barges transporting mine equipment from Weipa to areas further north and since the late 1970s has been a popular recreation area, particularly for fishing. Both activities have caused distinct impacts including clearing, vegetation removal and vehicle traffic,

all of which seem to have contributed to the destruction and disturbance of some shell matrix sites. Large amounts of gravel have also been used to create a vehicle track into the area across the sandy substrates (Figure 2).

### Geomorphology

Relatively little geomorphological research has been conducted within the Albatross Bay region although some of the most substantial studies to date have focussed on the formation of beach ridge plains on the Mission River. Hayne (1992) conducted an investigation of a beach ridge at Bowchati, near Prunung (Figure 1) and suggested that accumulation of sandy sediments began here after ~2,500 BP. He argued that the formation of the beach ridge plain was triggered by changes in longshore sediment transport along the Gulf of Carpentaria that led to an increase in deposition of sandy sediments within exposed areas of Albatross Bay at this time. Importantly though, Hayne's work focussed principally on the coastal margin of the plain. Field surveys conducted by the author indicate that this plain extends well inland of the areas sampled by Hayne, and transitions to fine yellow and orange coloured sands that point to an earlier phase of deposition and possibly a relict early Holocene dune system similar to those identified in the southwestern Cape York Peninsula (Rhodes *et al.* 1980).

Stone (1995) undertook a more comprehensive analysis of the formation of the Prunung beach ridge sequence, analysing and dating auger samples taken along three transects. This work revealed a complex depositional environment, with the transect nearest Prunung Point being composed of upper sediments of sand mixed with bauxite pisoliths underlain by shelly sands containing pisoliths and shell fragments, which were interpreted as a former sandy intertidal flat (Stone 1995:85). Towards Andoom Creek the seaward ridges contain larger proportions of *T. granosa* but this diminishes in the more inland ridges. The beach ridge deposits themselves overlay silts and clays. Eight conventional radiocarbon determinations were used as a basis for constructing a chronology for the development of the beach ridges. These indicated that the most seaward ridge on which the shell mound deposits occur was less than 800 years old (Stone 1995:92), while the two most landward ridges were between 2790±80 BP (ANU-8036) and 4530±80 BP (ANU-8038).

Stone noted a series of mound features overlaying these deposits. These included three shell mound features composed mainly of *T. granosa* near the point, and two other mounds that he viewed as being similar despite being composed largely of sand with very low proportions of *T. granosa* and other marine shell. Stone's auguring programme included only two samples on distinct shell mounds, and these were retrieved from cross-section A–B (Stone 1995:87, Figure 6(a)). Neither of these samples targeted the primary mound deposit, and instead appear to have been taken from the landward and seaward margins of the shell mound respectively. This is a major limitation in this sampling programme, since it is highly likely that intermixing of anthropogenic shell and underlying natural sediments occurred at the mound's margin, particularly on the seaward mound face where storm surges are evident today. Despite limited sampling of shell mound deposits, Stone interpreted them as having been naturally formed as a result of the processes that contributed to beach ridge



**Figure 3. Natural and cultural shell deposits at Prunung. Top right, SM:96; top left, SM:88; centre left, exposed beach ridge deposits along southwest-facing shoreline; bottom, foredune area showing major shell mound deposits.**

formation and differential winnowing at the point. He suggested that the mounds occur only at the point because “the terrigenous sediment normally mixed with them diminishes with increasing distance from its source at the mouth of Andoom Creek” and that here in this exposed location, “more effective wave-action also results in better sorting” (Stone 1995:93-94). Stone concluded that these deposits were coarse shell berms formed through geomorphological processes, and “there is no evidence to suggest that any of this shell was collected by Aborigines for food” (Stone 1995:94).

#### **Archaeology**

The history of land-use and disturbance at Prunung introduces some difficulties in terms of identifying anthropogenic shell deposits, particularly at the point where site disturbance has been extensive. A number of surface deposits of shell that occur on the beach ridge plain may be redeposited mound material, while the low elevation of the beach ridge and the proximity of the area to the high water mark means that natural deposits of shell are also likely, as is frequently the case with such substrates (Sullivan and O’Connor 1993). For this reason, in this project, field surveys focussed on identifying distinct

mound deposits rather than scatters. A similar perspective was adopted by Bailey *et al.* (1994).

The most substantial shell mound deposits occur to the north east of Prunung Point, where a series of elongated *T. granosa* dominated shell mounds up to 2m in height occur parallel to the present shoreline (Figure 2). These sites are all partially covered by small thickets of vine forest (Figure 3). Sites SM:90-94 are largely undisturbed by recent activities such as earthmoving or quarrying, however, the area around SM:95 and SM:96 appears to have been subject to ground disturbance, with substantial amounts of likely anthropogenic deposits removed or spread out onto the surrounding substrates. SM:96 has also been the focus of unreported sampling, as a trench approximately 1.5m wide and 5m long has been excavated across its western margins. This occurred prior to work at the site in 1993 by Bailey *et al.* (1994), who also noted its occurrence. Furthermore, quarrying has occurred at the landward face of the mound, removing an estimated 30–50% of the mound deposit. SM:95 has also been heavily modified by ground disturbance, and field assessments undertaken as part of this research found that the surface and margins of this mound were highly irregular with clear evidence of quarrying and the redeposition of mound sediments.

Almost 1,000m due west of Prunung Point is SM:86, a 0.5m high *T. granosa* mound located on a slight natural promontory adjacent to a natural gap in the mangrove forest (Figure 3). A second shell mound, SM:88, was located ~750m northwest of SM:96, at the very rear of the beach ridge plain and on a low distinct ridge that has formed alongside the margin of the bauxite laterite plateau (Figure 3). This site measured 0.75m in height and its surface composition was predominantly *T. granosa* and had been subject to minor quarrying activity in the past. Significantly, sandy substrates around SM:96 have very low amounts of natural shell and contain far more bauxite pisoliths – presumably derived from the immediately adjacent plateau – than those closer to the contemporary shoreline.

## Methods

The author carried out excavations at Prunung during a 10 day field trip in October 2003 with a supplementary six day field trip during October 2004. Analysis of excavated materials took place during 2004 and 2005. The methods used for this work are essentially the same as those reported for earlier research conducted at Bweening (Morrison 2013b:167). This involved controlled excavation of test pits (0.5–1m<sup>2</sup> in size) using small hand tools, with deposits removed in 3–5cm arbitrary spits. All materials excavated were weighed and sieved through 6mm and 2mm nested sieves.

Thanakwith custodians stipulated that efforts be taken to minimise the removal of cultural materials from the site, partly to ensure that the sites could be immediately backfilled and rehabilitated. These efforts were successful as today there is no surface indication of where the excavations took place, an important requirement of Thanakwith Traditional Owners (Richard Barkley, pers. comm., 2003; Stephen Hall, pers. comm., 2003; Grace John, pers. comm., 2003). Excavation revealed that the bulk of mound deposits were *T. granosa* valves and so one of two sampling strategies was used to remove these materials. These strategies have been outlined in detail elsewhere and as such are not discussed again here (see Morrison 2013b:167). In several cases, small 25–30cm<sup>2</sup> test pits were excavated by hand on the flanks of mound sites to obtain preliminary radiocarbon determinations.

Samples for radiocarbon dating were collected *in situ* from exposed sections. *T. granosa* has been the primary sample material used, with each sample consisting of either very large, intact valves where these were available, or alternatively, 2–3 valves selected because of their close spatial arrangement whilst *in situ*. All samples were submitted to the University of Waikato Radiocarbon Dating Laboratory and subject to standard pretreatment procedures for marine shell. All conventional radiocarbon ages (CRAs) were calibrated with CALIB version 6.10 (Stuiver *et al.* 2005) using the SHCAL13 and MARINE13 calibration datasets (Hogg *et al.* 2013; Reimer *et al.* 2013). Marine reservoir correction factors have an important influence on interpretation of calibrated determinations on marine shellfish (Ulm 2002) and this is of special importance where finer chronological trends and patterns are under consideration, as is the case here. Petchey *et al.* (2013) suggest an *Anadara* spp. (including *T. granosa* in their study) correction factor of  $-71 \pm 15$  radiocarbon years for the southeastern coast of Papua New Guinea though

here the more regionally specific Gulf of Carpentaria local  $\Delta R$  value of  $-103 \pm 16$  radiocarbon years (Ulm *et al.* in prep.) is used as per other recent research in the region (Morrison 2013b, 2014; Rosendahl, Ulm *et al.* 2014a; Shiner *et al.* 2013). All calibrated radiocarbon ages are presented here at the  $2\sigma$  (95% confidence) level and individual ages are given as calibrated age ranges. Where relevant, median values for  $2\sigma$  calibrated age ranges, rather than the intercept, are used as the basis of statistical summaries of radiocarbon data (after Telford *et al.* 2004).

## Results

### SM:96

SM:96 is the most prominent shell mound at Prunung and is also the most heavily disturbed (Figure 3). A large proportion of the mound – perhaps half of the original deposit – has been quarried on the landward face while the exposed seaward section is heavily eroded. No new investigations were conducted on SM:96 as part of this project and so the results of previous excavations are presented here in order to provide a clearer picture of broader trends and patterns within the study area. Beaton (1984) had previously obtained several radiocarbon determinations for samples obtained from this mound as part of an unpublished research project though these lack any contextual data (Stone 1995). Bailey *et al.* (1994) obtained further determinations on samples retrieved from the mound along with compositional data from column samples on anthropogenic and natural deposits both at SM:96 and on a sand-dominated mound near Andoom Creek, which they interpret as a megapode mound.

Investigations of SM:96 were focussed on the eroded seaward face of the mound in order to investigate relationships between the shell mound deposit and adjacent substrates (Bailey *et al.* 1994:75) (Figure 4). The stratigraphy is described as comprising layers of relatively clean *T. granosa* alternated with layers of shell-rich, dark earthy matrix (Bailey *et al.* 1994:76). The former layers were interpreted as representing periods of rapid shell deposition and the latter as reflecting periods of slow accumulation. Column sample RB1-11 cut through the SM:96 deposit and into the underlying substrates. Composition and particle size analysis of these samples revealed that shell mound deposit was dominated by *T. granosa* with low proportions of materials often associated with natural deposits including pisoliths, fine shell hash or other materials under 1mm in size. The most marked change in the column is at RB10 and RB11, which are interpreted by Bailey *et al.* (1994) as being natural sandy substrates upon which the shell matrix deposit has accumulated (Figure 5). The RB West column has low proportions of *T. granosa* and moderate to high proportions of sediment <1mm in diameter (Figure 6). Proportions of fine shell hash are similar or lower than those of the RB1-9 column samples and the numbers of pisoliths are similar or greater. The differences between both deposits were statistically highly significant (Bailey *et al.* 1994:76-77) and support the view that SM:96 was sufficiently distinct from surrounding substrates to be an anthropogenic deposit. Similar investigations of a sand-dominated mound adjacent to Prunung Creek also showed statistically strong differences compared with the shell mound deposit, but high similarities with the beach deposits. They interpreted this latter site as a megapode mound.

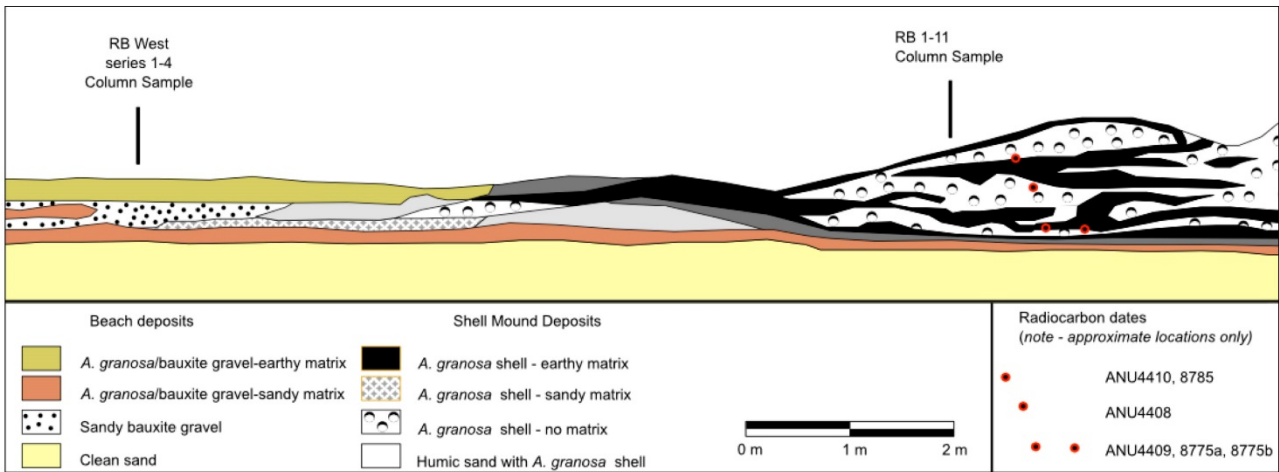


Figure 4. SM:96 section showing relationships between mound and beach ridge deposits (after Bailey *et al.* 1994).

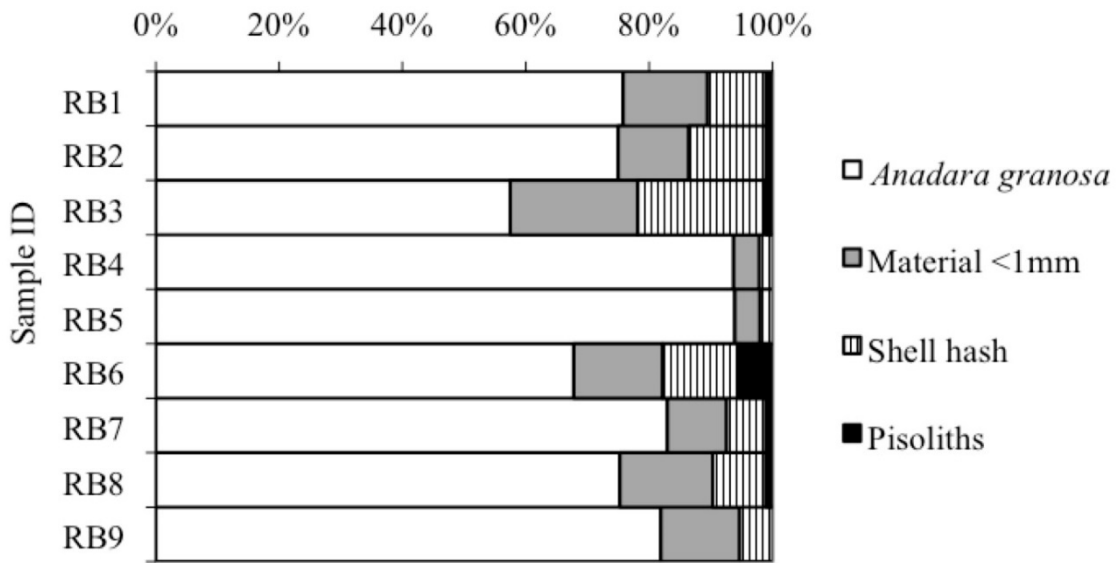


Figure 5. RB1-9 column sample composition, SM:96 (after Bailey *et al.* 1994:Table 2).

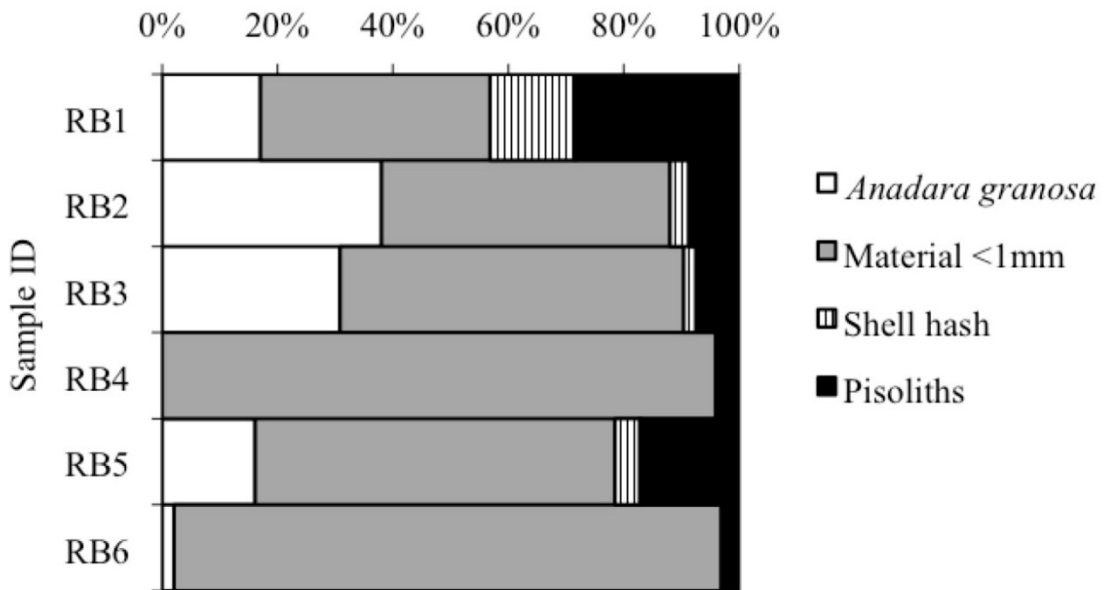


Figure 6. RB West column sample composition (after Bailey *et al.* 1994:Table 2).

**Table 1. Radiocarbon determinations and calibration data for Prunung.**

Site	Lab. No.	<sup>14</sup> C Age (years BP)	δ <sup>13</sup> C (‰)	Calibrated Age Range (2σ Cal. BP)	Position	Sample	Depth
SM:86	Wk-13787	738±40	-1.7	381–539	Lower	<i>T. granosa</i>	30cm
SM:88	Wk-14508	633±38	-1.6	289–463	Upper	<i>T. granosa</i>	21cm
SM:88	Wk-14509	780±35	-1.5	431–560	Lower	<i>T. granosa</i>	65cm
SM:90	Wk-14506	980±32	-1.8	559–708	Lower	<i>T. granosa</i>	40cm
SM:91	Wk-13788	469±43	-1.7	1–4	Upper	<i>T. granosa</i>	25cm
SM:92	Wk-14507	898±37	-1.5	518–649	Lower	<i>T. granosa</i>	75cm
SM:93	Wk-11861	1096±42	-1.9	658–859	Lower	<i>T. granosa</i>	97cm
SM:93	Wk-11862	901±42	-2	515–654		<i>T. granosa</i>	63cm
SM:93	Wk-11863	853±46	-1.6	487–636	Upper	<i>T. granosa</i>	23cm
SM:96	ANU-4408	790±60	-1.6	412–628		<i>T. granosa</i>	Middle
SM:96	ANU-4409	760±75	-2	324–616	Lower	<i>T. granosa</i>	Basal
SM:96	ANU-4410	360±100	-1.5	1–276	Upper	<i>T. granosa</i>	Surface
SM:96	ANU-8775a	790±110	0	297–664	Lower	<i>T. granosa</i>	Base
SM:96	ANU-8775b	1060±130	0	1220–1257	Lower	Charcoal	Base
SM:96	ANU-8785	890±70	0	479–681	Upper	<i>T. granosa</i>	Surface

A range of radiocarbon determinations are available for SM:96 (Table 1). Beaton initially obtained three determinations from the site (see Stone 1995); those from the base and middle returned calibrated ages of 324–616 cal BP (ANU-4409) and 412–628 cal BP (ANU-4408) while a third surface sample was 1–276 cal BP (ANU-4410). Bailey *et al.* (1994) obtained additional radiocarbon samples from the mound. Two of these were basal dates: one obtained on a charcoal sample returned an age of 1220–1257 cal BP (ANU-8775b) and a second on *T. granosa* was 297–664 cal BP (ANU-8775a). A near-surface sample returned an age of 479–681 cal BP (ANU-8785).

A number of irregularities exist in the determinations on SM:96. The most significant of these is that calibrated determinations for the paired samples ANU-8775a and ANU-8775b do not overlap within 2σ age-ranges. This can partly be explained as a disparity caused by the marine reservoir effect (Morrison 2014). Secondly, ANU-8775a is approximately 1m lower in the section than ANU-8785, yet the calibrated determinations – both of which were from samples of *T. granosa* – are effectively contemporaneous, possibly indicating relatively rapid accumulation and the imprecision of a 2σ age span. In addition, Beaton obtained near contemporaneous dates on *T. granosa* samples taken from the middle and basal layers of the section (ANU-4408 and ANU-4409). Taken together, these inconsistencies suggest that intermixing of older and younger deposits have occurred on this site during or subsequent to its formation. Today, SM:96 has the highest degree of exposure to storm surges and high winds from the west and this is likely to have been the case during its period of formation. As such, it is conceivable that older deposits have been redeposited on the upper mound surface, or that more recent deposits were reworked into older ones. Further, as described earlier, quarrying activity and storm surges have had a severe impact on the site (Figure 3) and this may have also led to intermixing or redeposition from other parts of the mound; for example, through movement of the deposit seaward as earth moving equipment worked on the landward face of the site.

Given these issues, chronological data from SM:96 are used cautiously here and the anomalous determination

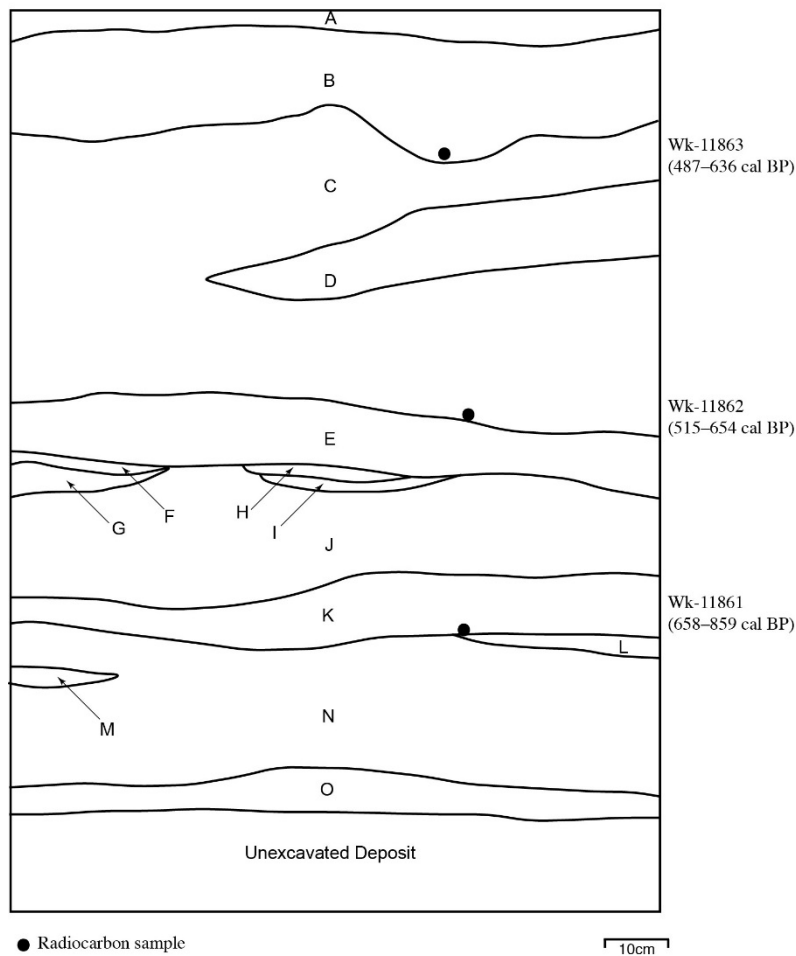
(ANU-8775b) on charcoal is rejected. Basal determinations indicate that the site commenced forming by at least 297–664 cal BP with upper deposits accumulating relatively rapidly. This is consistent with Stone’s (1995) suggestion that the underlying beach deposits were established only after 800 BP. Cessation of site accumulation appears to have occurred within the lower limit of the calibration curves.

#### SM:93

SM:93 is a low elongated shell mound 50m long, up to 18m in width, and is oriented roughly parallel with the adjacent shoreline (Figure 2). The site overlies the gradually sloping face of the most seaward beach ridge and is a maximum of 1.8m high, with its peak occurring near the centre of the site. At the time of excavation, the surface of the site appeared to have only minor surface disturbances caused by shallow animal burrowing and fallen trees. Approximately 30% of the surface of the site was covered by a thicket of dry notophyll vine forest and up to 20cm of humic material had accumulated in many areas. The remainder of the mound surface was exposed, clean white-grey shell with little surface vegetation beyond occasional grasses or low shrubs.

A single 1m<sup>2</sup> test pit was excavated on a relatively level area on the upper surface of SM:93 to a depth of 120cm below the site surface (Figure 7), revealing a deposit consisting primarily of densely-packed shell. Variations in the proportions or colour of soil, degree of shell fragmentation and the presence of ashy sediments were the basis for defining various strata within the section. These consisted of an upper surface layer of densely-packed and highly fragmented shell in a matrix of fine dark soil, with frequent rootlets and humic matter (Layer A). Underlying deposits consisted of loosely-packed shell that varied only in terms of the proportions of fine sediment including ash (Layers B, C, D, I, J L) with fine lenses of yellow sand (Layers E, G and K) and ash-rich fine sediment (Layers F and H). The lower deposits of the site abruptly transitioned to yellow-brown then white sands with frequent bauxite pisoliths and negligible marine shell. No marine shell was observed in the basal layer (Layers N and O).

SM:93 Section Profile (east)



**Figure 7. Section Profile, SM:93 (east).**

Layer Descriptions: (A) Densely-packed shell, highly-fragmented with dark fine soil matrix and frequent fine roots. (B) Layer of loosely-packed and mostly whole shell dominated by *T. granosa* (Tg) with occasional *M. hiantina* (Mh). Negligible soil matrix, sparse roots. (C) Loosly-packed shell (Tg and Mh), mostly whole but with higher proportions of fine dark soil similar than in B. (D) Mostly fragmented shell with large proportions of dark soil matrix. (E) Intrusion of yellow sand containing frequent bauxite pisoliths. (F) Small intrusion of very ashy material containing large amounts of highly-fragmented shell and charcoal. (G) Intrusion of yellow sand containing frequent bauxite pisoliths. (H) Small intrusion of very ashy material containing large amounts of highly-fragmented shell and charcoal. (I) Ashy sediment containing frequent fragmented shell and higher proportions of dark soil matrix than adjacent layers. (J) Shell dominated layer of mostly whole shell (Tg and Mh). Little sediment. (K) Intrusion of yellow sand containing frequent bauxite pisoliths. (L) Densely-packed brittle shell (Tg and *S. cucullata*). Small amounts of fine yellow sandy sediment throughout. (M) Yellow to brown sand with frequent bauxite pisoliths. Negligible marine shell. Culturally sterile deposit. (N) White to yellow fine sand with frequent bauxite pisoliths. No marine shell. Culturally sterile deposit. (O) As per N, but with fewer bauxite pisoliths.

Three samples of *T. granosa* were collected and submitted for radiocarbon determinations from SM:93. Calibrated ages suggest accumulation of the deposit commenced around 658–859 cal BP (Wk-11861). Wk-11862 was obtained from the base of Layer C, approximately the middle of the section, and returned a determination of 515–654 cal BP. The third radiocarbon sample was obtained from the interface between the upper limit of Layer C and the lower portion of Layer B; the resulting determination was 487–636 cal BP (Wk-11863). The most recent deposits at the surface were not dated.

The most frequently occurring cultural material recovered in the 6mm sieve residues was marine shellfish (Tables 2 and 3). The proportions of non-diagnostic shellfish are highest in the upper 15cm of deposit and this correlates with the observation of more highly fragmented shell in the upper layers of the section profile. Excavation Units (XUs) 4 through 13 evidenced the highest

proportions of diagnostic shellfish, and this correlates with the layers of densely-packed mostly whole shell that were observed in the stratigraphic section. The proportions of non-diagnostic shell steadily increase with depth below XU12.

Estimates of relative species abundance based on MNI calculations demonstrate that *T. granosa* is by far the most frequently occurring shellfish species throughout the deposit (Table 3 and Figure 8). *T. granosa* consistently represents over 70% of the total shellfish MNI in XUs 1 to 18. The lower XUs 19-23 have overall lower numbers of shellfish and *T. granosa* makes up a smaller proportion of the total MNI for each of these layers. No diagnostic shellfish occurred in the sand-dominated basal layers. *Marcia hiantina* is the second-most frequently occurring shellfish species based on MNI estimates, and peaks in the proportions of this species as a percentage of the total shellfish MNI occur in XUs 1 and 2 (17-18%), 10-15 (20-

Table 2. Summary data, SM:93.

XU	Mean Depth (cm)	Gross (g)	6mm Shell (g)	Non-Diagnostic Shell (g)	Diagnostic Shell (g)	Charcoal (g)	Other Stones (g)
1	2.86	41900	26337.30	18009.50	8327.80	-	59
2	8.07	48200	42111.10	25562.00	16549.10	0.6	56
3	12.86	50700	48712.10	21042.50	27669.60	3.0	31
4	18.15	35200	27510.60	2794.50	24716.10	2.0	5
5	23.05	39700	34010.21	3529.50	30480.71	3.0	3
6	27.73	42700	32893.01	5727.51	27165.50	14.7	9
7	33.00	36400	29954.01	3796.90	26157.11	5.5	122
8	36.25	12400	11732.71	1995.90	9736.81	3.0	13
9	39.45	36000	31504.70	4673.00	26831.70	6.0	7
10	44.86	37000	34880	6597.00	28283.00	2.5	22
11	50.81	43000	41188.80	5245.00	35943.80	7.0	20
12	56.40	46900	39258.50	5632.00	33626.50	12.5	18
13	60.64	35700	21575.80	4940.00	16635.80	24.0	419
14	65.55	50700	28283.40	9974.00	18309.40	28.0	40
15	70.56	37200	16559.30	7260.00	9299.30	20.0	61
16	75.31	46400	23858.10	8157.50	15700.60	32.0	12
17	79.48	33000	18708.22	4255.02	14453.20	49.0	86
18	84.54	46000	25489.50	8106.00	17383.50	37.0	13
19	89.61	43600	17376	7462.00	9914.00	12.0	17
20	93.80	50400	17544.60	6238.00	11306.60	35.0	117
21	99.38	49200	4657.50	1193.00	3464.50	5.0	415
22	104.61	41000	2199	1282.00	917.00	2.0	631
23	109.09	41900	702.50	443.00	259.50	1.0	407
24	116.06	87900	-	-	-	-	-

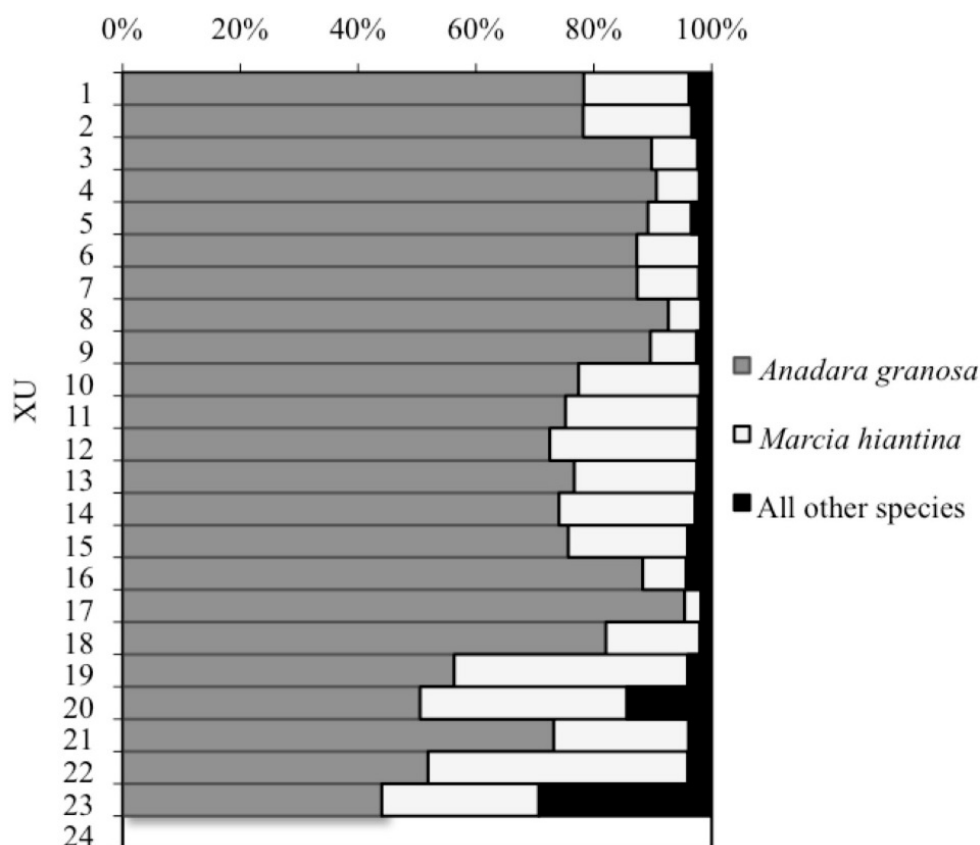


Figure 8. Shellfish MNI data, SM:93.

Table 3. Shellfish quantification data, SM:93.

XU	Mean Depth (cm)	XU Totals		<i>Tegillarca granosa</i>				<i>Marcia hiantina</i>				All other species			
		MNI	Weight (g)	MNI	MNI (%)	Weight (g)	Weight (%)	MNI	MNI (%)	Weight (g)	Weight (%)	MNI	MNI (%)	Weight (g)	Weight (%)
1	2.9	868	8328	680	78	8000	96	155	18	253	3	34	4	75	0.90
2	8.1	1714	16549	1341	78	16000	97	316	18	482	3	58	3	67	0.41
3	12.9	2379	27670	2136	90	27000	98	187	8	578	2	57	2	92	0.33
4	18.2	2021	24716	1832	91	24129	98	147	7	529	2	43	2	58	0.24
5	23.1	2682	30481	2392	89	29704	97	198	7	651	2	93	3	126	0.41
6	27.7	2689	27166	2348	87	26254	97	286	11	822	3	55	2	90	0.33
7	33.0	2439	26157	2131	87	25417	97	256	10	632	2	53	2	108	0.41
8	36.3	980	9737	908	93	9525	98	54	6	138	1	18	2	74	0.76
9	39.5	2386	26832	2139	90	26045	97	186	8	513	2	62	3	274	1.02
10	44.9	2632	28283	2037	77	25952	92	545	21	2053	7	50	2	278	0.98
11	50.8	3148	35944	2367	75	32909	92	712	23	2607	7	69	2	428	1.19
12	56.4	2778	33627	2015	73	30148	90	697	25	2708	8	66	2	771	2.29
13	60.6	1574	16636	1207	77	15330	92	328	21	1032	6	40	3	274	1.65
14	65.6	2049	18309	1518	74	16662	91	474	23	1330	7	58	3	317	1.73
15	70.6	1134	9299	858	76	8416	91	230	20	749	8	46	4	134	1.44
16	75.3	1543	15701	1363	88	15145	96	114	7	246	2	67	4	310	1.97
17	79.5	1583	14453	1510	95	14257	99	44	3	107	1	29	2	89	0.62
18	84.5	2528	17384	2074	82	15857	91	403	16	1281	7	51	2	246	1.41
19	89.6	1727	9914	972	56	7736	78	685	40	1778	18	70	4	400	4.03
20	93.8	1633	11307	825	51	8699	77	573	35	1601	14	235	14	1007	8.90
21	99.4	564	3465	413	73	3184	92	129	23	212	6	22	4	69	1.98
22	104.6	174	917	90	52	695	76	77	44	162	18	7	4	60	6.54
23	109.1	38	260	17	44	110	42	10	27	26	10	11	29	124	47.59
24	116.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 4. Non-molluscan faunal remains, SM:93.

XU	XU Weight (kg)	Bone (#)	Bone Weight (g)	Crab Weight (g)	Otoliths (#)	Combined Bone/Crab (g/kg)
1	41.9	-	-	-	-	-
2	48.2	4	3.4	-	-	0.07
3	50.7	4	1.5	-	-	0.03
4	35.2	2	10.0	-	-	0.03
5	39.7	3	1.5	-	-	0.04
6	42.7	5	6.0	1.00	-	0.16
7	36.4	3	1.0	0.03	-	0.03
8	12.4	-	-	-	-	-
9	36.0	-	-	-	-	-
10	37.0	-	-	0.50	-	0.01
11	43.0	4	5.0	-	-	0.11
12	46.9	1	0.1	0.50	-	0.01
13	35.7	17	6.0	-	-	0.17
14	50.7	12	2.0	1.00	1	0.06
15	37.2	2	1.5	-	-	0.04
16	46.4	2	0.1	-	-	0.00
17	33.0	-	-	-	-	-
18	46.0	1	0.5	-	-	0.01
19	43.6	6	3.0	-	-	0.07
20	50.4	-	-	3.00	-	0.06
21	49.2	4	1.5	-	-	0.03
22	41.0	-	-	-	-	-
23	41.9	-	-	-	-	-
24	87.9	-	-	-	-	-
<b>TOTAL</b>	<b>1033.1</b>	<b>70</b>	<b>34.1</b>	<b>6.03</b>	<b>1</b>	



Figure 9. Shell artefact 1, SM:93.



Figure 10. Shell artefact 2, SM:93.

**Table 5. Summary data, SM:91.**

XU	Mean Depth (cm)	Gross Weight (g)	6mm Residue (g)	2mm Residue (g)	Soil (g)	Charcoal (g)	Stones/Rocks (g)
1	4.2	11500	4811	3000	3689	1	260
2	3.35	13000	4932	2500	5568	1	365
3	3.6	13000	4637	2500	5863	3	230
4	4.25	15000	4673	2500	7827	5	205
5	2.8	12500	3001	3000	6499	2	295
6	4.5	14250	3384	2500	8366	2	395
7	3.4	13000	3062	2000	7938	1	370
8	4.75	16500	4026	4000	8474	0	475

25%) and 19-23 (22-44%). The contribution of all other species to the composition of the site is less than 10% for all but two XUs where they represent 14% (XU20) and 29% (XU23) of the total shellfish MNI. This correlates with a dramatic reduction in overall shellfish MNI and weights. The proportions of other species in the deposit vary but most frequently included *S. cucullata*, *Polymesoda erosa*, *Nerita lineata*, *Telescopium telescopium*, *Volema cochlidium*, *Melo* spp., *Balanus* spp., *Cerithium* spp., *Ellobium* spp. and *Terebralia* spp.

A restricted range of other faunal remains were recovered in the 6mm sieve residues (Table 4). These included fragments of mammal bone, as well as occasional crab claw fragments and a single fish otolith. Two cranial skeletal elements were recovered in the excavation including a small fragment of a mandible and a small piece of tooth. Identification was not attempted on these because of their small size and incomplete state, although the mandible fragment is likely to be that of a macropod (Matthew McDowell, pers. comm., 2014). A total of 63 post-cranial bone fragments were recovered. These were all very small and generally less than 10mm in length. Bone materials recovered in the excavation weighed less than 34g in total for all pits combined. The crab claw fragments were very small, with often only the claw tip being identified, and are tentatively identified as *Scylla* spp., though precise identification is not possible due to their small, fragmented nature. These amounted to around 5g for the entire excavation. The single fish otolith was 12mm in diameter and identification is not likely to be possible due to its fragile and damaged condition.

A small number of shell and stone artefacts were recovered in SM:93. These included three small quartz fragments, the largest measuring a maximum of 21mm in length and 12mm in width. All were highly angular with few clear diagnostic attributes. In addition, two distinctive shell artefacts were recovered, one each from XUs 9 and 10. Both items are less 2–3 mm thick, flat pieces of an unknown species of shell 30mm by 27mm and 32mm by 26 mm in size respectively (Figures 9 and 10). Both are broken at one end and ground to form a smooth, rounded edge at the other.

#### **SM:91**

SM:91 is a small shell mound situated immediately to the north of SM:92 with a maximum height of 30cm and up to 5m in diameter on a sandy substrate containing frequent bauxite pisoliths and high proportions of shell, including *T.*

*granosa* valves of a range of sizes, frequent fine shell hash and small species such as *Cerithium* spp. (Tables 5 and 6). This is likely due to the exposed location in which SM:91 occurs: unlike other sites at Prunung, no vegetation buffer occurs between it and the active beach which is approximately 30m away.

A single 0.5m<sup>2</sup> test pit was excavated on the highest part of the SM:91 mound surface. Approximately 35cm of shell-dominated deposit was excavated before reaching sandy deposits containing little to no shell. The stratigraphy consisted of a 3–5cm upper layer (A) comprising whole and fragmented shell with moderate proportions of dark humic soil. Sand and bauxite pisoliths occurred in moderate proportions within this upper layer. A second layer (B) up to 18cm in depth consisted of densely packed *T. granosa* valves 3–5 cm in length. Small numbers of bauxite pisoliths occurred here along with small proportions of light sand. The basal layer (C) consisted of yellow to orange coloured sand with frequent bauxite nodules and low proportions of shell. This latter layer was interpreted as culturally sterile due to the low proportions of shell and their more fragmented nature.

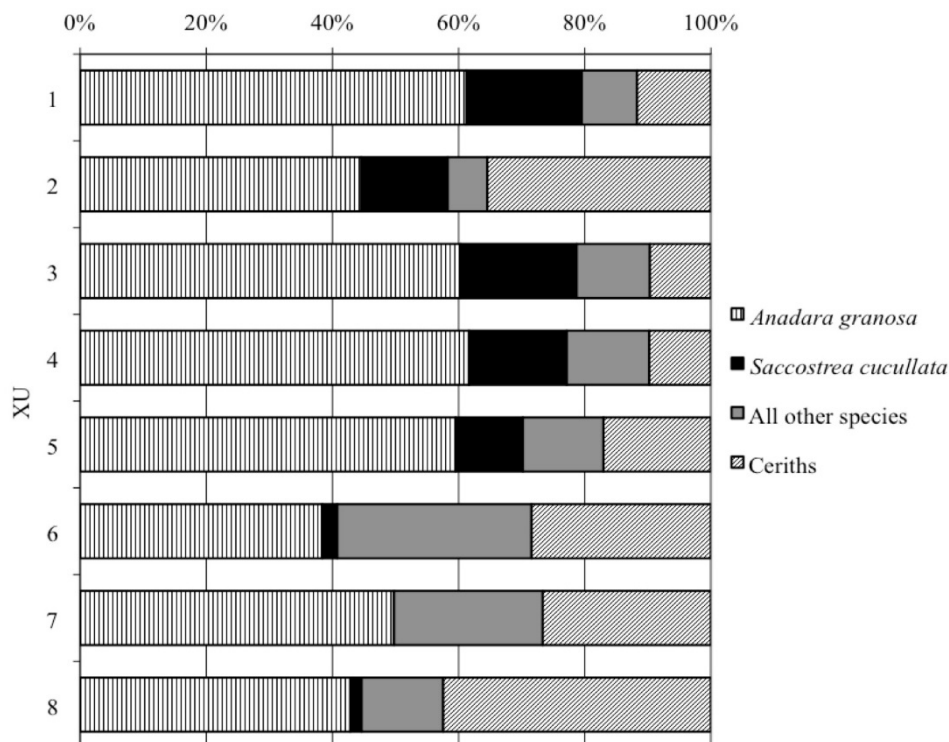
A single sample of *T. granosa* valves were retrieved from the interface between Layers B and C, approximating the lowest level of shell deposit. The resulting determination of 469±43 BP (Wk13788) was found to be modern when calibrated (Table 1).

One hundred percent of the *T. granosa* and a sub-sample (25–50%) of the remaining 6mm sieve residues were quantified (Strategy B in Morrison 2013b). *T. granosa* is the most frequently occurring shellfish species across all XUs at SM:91 representing 38-61% by MNI (Table 6, Figure 11). *S. cucullata* and *Cerithium* spp. are the next most frequently occurring species, with the former representing 10-18% of the MNI in the upper four XUs, and the latter species most frequent at 17-42% in the lower XUs. *Cerithium* spp. are a small gastropod generally <15mm in length which commonly inhabit intertidal flats. Their presence in reasonable numbers is of significance and considered here to reflect the influence of storm surges washing over this very low, exposed site. They are also commonly located in naturally formed beach ridge deposits at Prunung, and the high proportions of *Cerithium* spp. in XUs 6, 7 and 8 likely reflect intermixing of anthropogenic shell with the underlying natural substrate.

Only a small amount of non-molluscan faunal material was recovered in the 6mm residues from SM:91 (Table 7). This included a total of 2g of crab fragments and 3g of

**Table 6. Shellfish quantification data, SM91. \* All *T. granosa* valves for each XU quantified. MNI and weight values are the unmodified figures. Adjusted MNI and weight (rows 7-10) are adjusted to reflect the overall sample size subject to systematic quantification in the laboratory (percentage values in row 2). All other shellfish weights and MNI data based on counts of the sample investigated in the lab (i.e. rows 1 and 2).**

XU		XU1	XU2	XU3	XU4	XU5	XU6	XU7	XU8
<b>Sample Information</b>	Sample weight	773	939	698	670	516	650	514	669
	Sample % of total	27.93	29.19	25.24	25.95	27.80	27.45	25.02	25.59
	Combined shellfish MNI - Sample	68.39	87.47	51.68	61.26	46.94	63.29	48.77	84.84
	Combined diagnostic shellfish weight - Sample	702.53	666.59	574.57	666.57	379.33	361.89	290.25	390.37
<i>Tegillarca granosa</i> *	MNI	150	133.5	123.5	145.5	100.5	88.5	97	142
	Weight	2043	1715	1872	2089	1145	1016	1008	1412
	Adjusted MNI	41.89	38.97	31.18	37.76	27.94	24.29	24.27	36.34
	Adjusted MNI %	61.25	44.55	60.33	61.64	59.52	38.38	49.77	42.83
	Adjusted Weight	570.53	500.59	472.57	542.07	318.33	278.89	252.25	361.37
<i>Saccostrea cucullata</i>	Adjusted Weight %	81.21	75.10	82.25	81.32	83.92	77.06	86.91	92.57
	MNI	12.5	12	9.5	9.5	5	1.5	0	1.5
	MNI %	18.28	13.72	18.38	15.51	10.65	2.37	0.00	1.77
	Weight	100	125	70	85	47	5	0	2
<b>Cerithiidae</b>	Weight %	14.23	18.75	12.18	12.75	12.39	1.38	0.00	0.51
	MNI	8	31	5	6	8	18	13	36
	MNI %	11.70	35.44	9.68	9.80	17.04	28.44	26.65	42.43
	Weight	2	6	1	2	2	3	3	7
<b>All other species</b>	Weight %	0.28	0.90	0.17	0.30	0.53	0.83	1.03	1.79
	MNI	6	5.5	6	8	6	19.5	11.5	11
	MNI %	8.77	6.29	11.61	13.06	12.78	30.81	23.58	12.97
	Weight	30	35	31	37.5	12	75	35	20
<b>All other species</b>	Weight %	4.27	5.25	5.40	5.63	3.16	20.72	12.06	5.12



**Figure 11. Shellfish MNI data, SM:91.**

**Table 7. Non-molluscan faunal materials, SM:91.**

XU	Crab Fragments (g)	Other Bone (g)
1	-	-
2	-	0.5
3	1	1.5
4	1	1
5	-	-
6	-	-
7	-	-
8	-	-
<b>Total</b>	2	3

**Table 8. Artefacts, SM:91.**

XU	Raw Material	Type	Cortex (%)	Length (mm)	Width (mm)	Thickness (mm)
1	Silcrete	Broken flake	1-50	35	19	10
5	Green Glass	Flake	na	13	9	2.6



**Figure 12. Glass artefact recovered from SM:91, XU5.**

small non-diagnostic bone fragments, both recovered in XUs 2–4. Two artefacts were recovered in SM:91 (Table 8): the first was a small broken silcrete flake recovered near the surface in XU1 and the second was a small fragment of green glass 13mm in length recovered from XU5 (Layer B), 16–18cm below surface. A series of enlèvement scars suggest this may be a small piece of debitage (Figure 12).

#### **SM:92**

SM:92 is an elongated shell mound that is part of the primary group of sites at Prunung Point. The site is 30m long, 10m wide, and up to 1.4m in height and is situated immediately to the northeast of SM:93 (Figure 2). Excavations at this site aimed to obtain an indicative radiocarbon determination for the basal deposits while causing minimal disturbance to the site. To this end, a small 30cm x 30cm pit was excavated to a depth of 75cm below surface.

The site had a 5–10cm upper layer of fragmented shell, principally *T. granosa*, with a matrix of fine sediment and dense roots, beneath which a ~50cm layer of mostly whole *T. granosa* shell with little sediment occurred. The underlying basal layer contained more sediment and ashy deposit, but shellfish was nevertheless the dominant constituent. The substrate on which the deposit occurred consisted of fine yellow to orange coloured sand with essentially no shell hash or other shell.

A single sample of *T. granosa* valves retrieved from the basal cultural layer of SM:92 returned an age span of 518–649 cal BP (Wk-14507) (Table 1).

#### **SM:90**

SM:90 is a slightly elongated shell mound 28m long, 15m wide and up to 70cm in height. It is located at the northeastern end of the primary complex of shell mounds (Figure 2). Work on this site aimed to obtain a sample suitable for radiocarbon dating with minimal disturbance to the site. A 30cm x 30cm pit was excavated on its seaward flank to a depth of 55cm.

The stratigraphy of SM:90 consisted of a 15cm upper layer of highly fragmented shell, principally *T. granosa*, in a matrix of dark organic soil. Below this, a 30cm layer of whole and fragmented shell occurred; this contained little soil or sediment and consisted of large proportions of *T. granosa* valves that had a relatively ‘clean’ appearance compared with the overlying deposits. The basal layer was less than 10cm in depth and consisted of whole and fragmented shell, ashy sediment and frequent fine sand with occasional bauxite pisoliths. The underlying substrate consisted of fine beach sand with moderate proportions of bauxite pisoliths.

A single sample of *T. granosa* valves from the basal cultural layer of SM:90 returned a calibrated age span of 559–708 cal BP (Wk14506).

Brief field inspections indicated that the composition of SM:90 was predominantly *T. granosa*. Moderate proportions of *M. hiantina* were also recovered, along with occasional *P. erosa*, *N. lineata* and *V. cochlidium*. No detailed quantification work was carried out on these samples. Preliminary investigation of SM:90 suggests this is a cultural deposit dominated by large proportions of *T. granosa* valves. The anthropogenic deposit is distinct in relation to the underlying substrate, which consists of large

proportions of fine beach sand, bauxite pisoliths and infrequent fragmented shell.

#### **SM:86**

SM:86 is a 50cm high mound with maximum basal dimensions of 15m x 25m located approximately 1km directly west of SM:96 (Figure 2) on sandy sediments containing large numbers of bauxite pisoliths and infrequent shell. The area in which SM:86 occurs is unique in the Prunung study area because of the occurrence of a slight promontory comprised of hard bauxite pisoliths and ironstone conglomerate pavement. This pavement slopes gently downward from the flat, sandy dune substrates approximately 1.5m above water level to the mudflats exposed at low tides. This pavement has restricted mangrove growth on either side of SM:86 and therefore provides a natural access point through the mangroves to the mudflats.

A single 50cm<sup>2</sup> square test pit was excavated 48cm through the mound deposit and into the underlying sandy substrates (Table 9). Excavated 6mm samples for XUs 5 and 6 are unavailable for analysis because these along with some less crucial soil and sediment samples were lost while being transported by a freight company from Weipa to Townsville (Table 9). Data on these units are therefore omitted here. The stratigraphy of SM:86 consisted of two distinct layers with the upper layer (A) consisting of loosely-packed shell interspersed with dark sandy matrix. This was up to 35cm in depth and numerous small roots and rootlets occurred throughout. A single large root 6–10cm in diameter was removed from the northern portion of the square in this layer. Whole and fragmented *T. granosa* valves were the primary shellfish species observed in the section. The second layer (B) was up to 20cm in depth and consisted of compact yellowish sand with infrequent shellfish. Occasional fine rootlets also occurred. A distinct intrusion of primarily *T. granosa* shell occurred in the southern portion of the square (C) and this was up to 5cm in depth and 14cm long. A single sample of *T. granosa* valves were obtained from the basal layer of SM:86 and returned a calibrated age span of 381–539 cal BP (Wk-13787).

Sampling strategy B was used on XUs 1–3 to minimise the need to remove cultural deposits (see Morrison 2013b). All other XUs were fully analysed. Shellfish remains were the primary cultural material recovered in the site and quantification of available 6mm samples from SM:86 (Table 10, Figure 13) indicate that *T. granosa* comprises between 44% and 98% of overall MNI. *M. hiantina* is the next most frequently occurring species, ranging from 5 to 52% of each XU’s total MNI. The proportions of *M. hiantina* increase over time and are present in greater proportions than *T. granosa* in XU1. Other species frequently represented included *S. cucullata*, *N. lineata* and *V. cochlidium*. Several *Balanus* spp. fragments were also recovered.

#### **SM:88**

SM:88 is a dome-shaped shell mound deposit up to 75cm high with a maximum basal diameter of 18m that is located approximately 450m south of the contemporary shoreline and 800m northwest of the main group of shell mounds at Prunung Point (Figure 2). The site occurs on a

**Table 9. Summary data, SM86. Darkened cells represent samples lost during transport as discussed in text. XUs 1-3 were quantified with sampling strategy B. Other XUs were fully analysed.**

XU	1	2	3	4	5	6	7	8	9	10	11
Mean Depth (cm)	6	2.65	6.3	5.7	3.6	2.6	2.7	3.2	3.4	4.4	7.5
Gross Weight (g)	10000	11500	10500	8500	9500	9000	10000	9500	13300	15000	16000
6mm Residue (g)	4840	5783	4590	3970			4457	4177	3036	1183	1038
2mm Residue (g)	2500	3500	3500	3500	3000	3500	700	200	400	500	3600
Soil (g)	2660	2217	2410	1030	6500	5500	4843	5123	9864	13317	11362
Stones/Rocks (g)	8	10	5	18			2	2	14	20	65
Charcoal (g)	4	8	5	12			5	5	3	3	2

**Table 10. Shellfish quantification data, SM:86. Note: 6mm residues for XUs 5 and 6 were not available for analysis.**

		XU1	XU2	XU3	XU4	XU7	XU8	XU9	XU10	XU11
<b>Sample Information</b>	Sample weight	795.0	489.0	243.0	521.0	565.0	269.0	387.0	400.0	-
	Sample % of total	26.6	28.0	25.2	100.0	100.0	100.0	100.0	100.0	100.0
	Total MNI - Sample	90.4	121.2	84.8	256.0	420.5	497.5	378.0	103.5	5.5
	Total Weight - Sample	579.0	1207.8	977.5	3539.8	4034.0	3950.0	2699.0	853.5	15.0
<b><i>Tegillarca granosa</i></b>	MNI (Actual)	152.0	292.0	239.0	226.0	395.5	488.0	361.5	85.0	-
	Weight (Actual)	1848.0	4035.0	3627.0	3449.0	3892.0	3908.0	2649.0	783.0	-
	Adjusted MNI	40.4	81.7	60.3	226.0	395.5	488.0	361.5	85.0	-
	Adjusted MNI %	44.7	67.4	71.1	88.3	94.1	98.1	95.6	82.1	-
	Adjusted Weight	491.0	1128.8	915.2	3449.0	3892.0	3908.0	2649.0	783.0	-
	Adjusted Weight %	84.8	93.5	93.6	97.4	96.5	98.9	98.1	91.7	-
<b><i>Marcia hiantina</i></b>	MNI	47.0	27.5	17.5	23.5	20.5	8.0	11.5	17.5	5.5
	MNI %	52.0	22.7	20.6	9.2	4.9	1.6	3.0	16.9	100.0
	Weight	80.0	60.0	55.0	80.0	70.0	20.0	20.0	70.0	15.0
	Weight %	13.8	5.0	5.6	2.3	1.7	0.5	0.7	8.2	100.0
<b>All other species</b>	MNI	3.0	12.0	7.0	6.5	4.5	1.5	5.0	1.0	-
	MNI %	3.3	9.9	8.3	2.5	1.1	0.3	1.3	1.0	-
	Weight	8.0	19.0	7.3	10.8	72.0	22.0	30.0	0.5	-
	Weight %	1.4	1.6	0.7	0.3	1.8	0.6	1.1	0.1	-

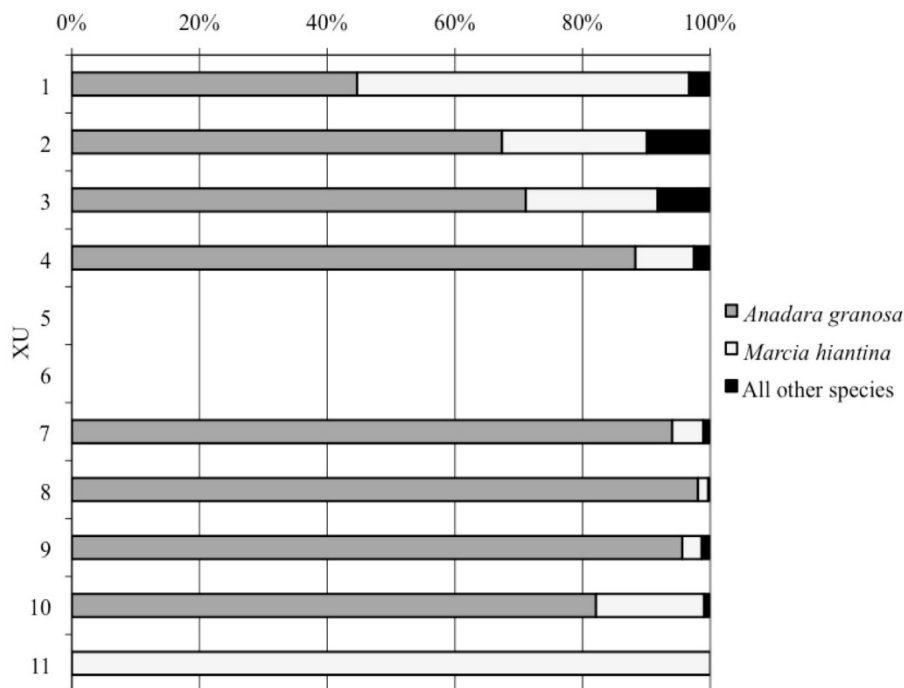


Figure 13. Shellfish MNI data, SM:86.

narrow sand ridge between the margin of the bauxite plateau and the inland limits of a seasonal swamp. Much of the surrounding area becomes inundated during the wet season. A large 2m x 2m depression occurs approximately 10m to the north of SM:88 and has been constructed in recent times, probably for use as a well after the 1960s (Richard Barkley, pers. comm., 2004). A 3m x 4m area of deposit has been removed from the shell mound through quarrying, however, the remaining deposit appeared undisturbed. The site's unusual location away from the coast meant that it was a priority for investigation and so a 50cm<sup>2</sup> test pit was excavated on an undisturbed portion of the site to approximately 70cm below surface.

The stratigraphy of SM:88 consisted of three broad layers. A 15cm deep upper layer (A) was comprised of large proportions of mostly fragmented and whole *T. granosa* shell interspersed with dark humic materials and a dense layer of rootlets. Beneath this a further layer dominated by *T. granosa* shell occurred (B); this contained larger proportions of whole shell and high proportions of soil of a darker colour than in Layer A and was 45-50cm deep. Layer B overlaid a layer of fine sandy sediments containing large proportions of bauxite pisoliths (C). Shell was infrequent, and these deposits are considered to be culturally sterile substrates. This layer was excavated to a depth of around 15cm and shell proportions decreased with depth. Summary excavation data show a proportional increase in fine sediments in XU 7 (Table 11).

Two samples of *T. granosa* were collected for radiocarbon determinations. These were obtained from the interface between Layers A and B (21cm BS) and the interface between Layers B and C (65cm BS), the base of the lower cultural layer. The basal determination returned a calibrated age span of 431–560 cal BP (Wk-14509). During the physical pretreatment stages the laboratory observed that the upper radiocarbon dating sample had undergone calcite recrystallisation. Aragonite was selected

for dating and, due to the reduction in sample size, AMS measurement was required. The resulting determination was 289–463 cal BP (Wk-14508).

Sampling strategy B was used to calculate shellfish data for SM:88 and MNI data are based on subsamples of the 6mm residues. These represented between 12% and 51% by weight of the 6mm residues after diagnostic *T. granosa* had been removed (Table 12, Figure 14). *M. hiantina* was the dominant shellfish species across all XUs, though in many cases it occurred in only marginally greater proportions comprising 43-61% of each XU, while *T. granosa* variously comprises 27-48% by MNI. Other species comprise up to 14% by MNI in some XUs, and this is primarily due to the greater proportions of *V. cochlidium* and *S. cucullata* in some XUs; however, this is not consistent throughout all XUs.

Small numbers of crab, bone and otoliths were recovered in the excavation of SM:88 (Table 13). As noted above, all of the 6mm samples were sorted in order to maximise chances of recovering these materials. While only one otolith was recovered in XU4, both crab fragments (typically small fragments of claw) and non-diagnostic bone were found consistently through XUs 2–5. No more than 5g of bone and 5g of crab were found in any one layer, and overall weights were 21g for crab and 14g for bone. Three stone artefacts were recovered from SM:88 (Table 14). A broken silcrete flake was recovered near the surface of XU1, a broken quartz flake recovered in XU2 and a small angular fragment of quartz was recovered in XU4. This is viewed here to be an artefact because quartz does not naturally occur in the surrounding sediments. No identifiable shell or bone artefacts were recovered.

#### 2mm Residue Sampling

As with previous work at Bweening (Morrison 2013b), investigations of 2mm residues at Prunung selectively targeted those XUs with the highest proportions of non-

Table 11. Summary data, SM:88.

	XU1	XU2	XU3	XU4	XU5	XU6	XU7
Mean Depth (cm)	7.27	11.78	11.95	10.22	9.23	9.52	7.28
Gross Weight (g)	21700	24400	24500	24900	26000	27500	16000
6mm Residue (g)	9455	8601	8168	8555	9727	7012	3452
2mm Residue (g)	3000	3700	3500	3500	3400	2500	6500
Soil (g)	9245	12099	12832	12845	12873	17988	6048
Stones and Rocks (g)	495	205	130	130	400	405	655

Table 12. Shellfish quantification data, SM:88.

		XU1	XU2	XU3	XU4	XU5	XU6	XU7
Sample Information	Sample weight	938	3260	2875	1439	1700	1852	818
	Sample % of total	12.8	49.4	50.8	25.6	25.9	34.2	25.9
	Estimated total MNI	67	286	306	177	207	210	26
	Estimated total Weight	407	1461	1669	1019	1117	1072	140
<i>Tegillarca granosa</i>	MNI (Actual)	224	197	247	329	357	170	35
	Weight (Actual)	2120	1998	2503	2939	3153	1604	288
	Adjusted MNI	28.7	97.4	125.3	84.3	92.3	58.2	8.9
	Adj MNI %	42.7	34.0	41.0	47.7	44.5	27.8	34.4
	Adjusted Weight	271.1	986.4	1270.3	753.1	815.3	549.3	74.5
	Adj Weight %	66.6	67.5	76.1	73.9	73.0	51.2	53.0
<i>Marcia hiantina</i>	MNI - sample	29	174	157	85	101	125	14
	MNI - %	43.2	60.8	51.2	47.8	48.7	59.6	54.0
	Weight - Sample	60	380	310	218	240	365	33
	Weight - %	14.7	26.0	18.6	21.4	21.5	34.0	23.5
All other species	MNI - Sample	10	15	24	8	14	27	3
	MNI - %	14.1	5.2	7.8	4.5	6.8	12.6	11.6
	Weight - Sample	76	95	89	48	62	158	33
	Weight - %	18.6	6.5	5.3	4.7	5.5	14.7	23.5

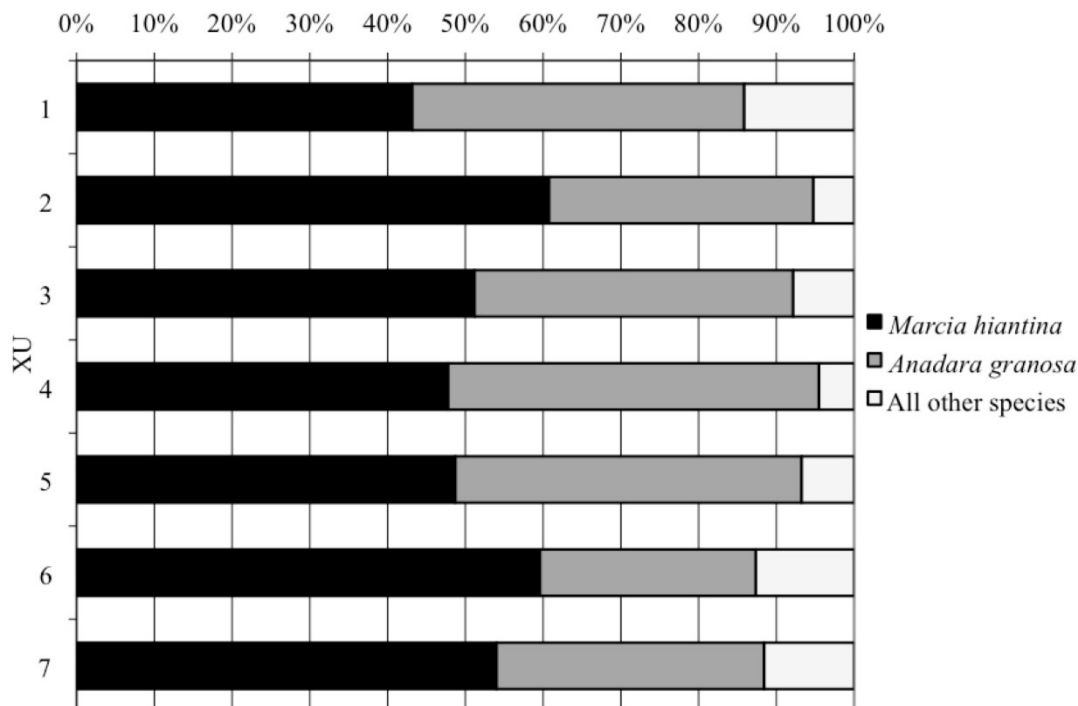


Figure 14. Shellfish MNI data, SM:88.

**Table 13. Non-molluscan faunal materials, SM:88.**

	XU1	XU2	XU3	XU4	XU5	XU6	XU7	Total
<b>Otoliths (#)</b>	-	-	-	1	-	-	-	1
<b>Crab Fragments (g)</b>	-	5	5	5	5	1	-	21
<b>Other Bone (g)</b>	-	5	2	3	4	-	-	14

**Table 14. Stone artefacts, SM:88.**

XU	Raw Material	Type	Cortex (%)	Length (mm)	Width (mm)	Thickness (mm)
1	Silcrete	Broken flake	51-99	36	32	13
3	Milky Quartz	Broken flake	0	13	13	8
4	Quartz	Angular fragment	0	12	8	5

**Table 15. Summary of results of 2mm residue analysis, Prunung.**

Site /XU	2mm Residue	Charcoal/ Vegetation	Bone		Stone Artefacts		Crab		Ceriths		Land Snail		<i>M. hiantina</i>		Trochus	
			#	g	#	g	#	g	MNI	g	MNI	g	MNI	g	MNI	g
SM:88 XU2	2547	4	12	0.45	2	0.02	9	0.03	8	<1	35	0.6	30	6	1	<1
SM:91 XU2	2662	18	82	3.2	4	0.7	-	-	375	23	7	<0.5	16	2.8	-	-
SM:93 XU6	3752 (50% or 1904g sorted)	94	10	0.7	-	-	1	<0.5	37	2.8	10	<1	27	11	1	<1

molluscan faunal remains in the 6mm residues. A single XU from sites SM:88, SM:91 and SM:93 were investigated. SM:88 yielded the greatest proportions of non-molluscan fauna when 6mm residues were investigated (Table 15), however, results of 2mm analysis from XU2 did not generate any significant new insights. Less than 0.8g of highly fragmented bone and crab shell were found along with two very small angular quartz flakes and a small number of diagnostic *M. hiantina* (MNI=30) which had a weight of only 6g in total. Thirty-five complete land snails, eight small *Cerithium* spp. and a single small (<5mm) probable *Trochus* spp. shell were also recovered.

Reasonable numbers of bone fragments were recovered from SM:91 (n=82 fragments), however, these were very small and weighed a total of just 3.2g. A large number of *Cerithium* spp. were also recovered with 375 diagnostic specimens identified in the deposit. Four pieces of quartz debitage and a small number of *M. hiantina* (MNI of 16) and unidentified species of land snail (MNI=7) were also recovered. The third sample investigated was XU6 of SM:93 which yielded less than 0.7g of fragmented, non-diagnostic bone.

Results of analysis of a subsample of 2mm residues are consistent with the results of more in-depth analysis of 6mm residues. The key point of difference is that a large number of *Cerithium* spp. were recovered in SM:91, with 31 individuals recovered in 6mm residues and 375 in 2mm residues. This clearly has implications for our understanding of shellfish composition of this XU and the entire site. Implications of this are explored in more detail below.

## Discussion

Excavation, analysis and radiocarbon dating of six shell mound sites at Prunung, together with previous work by others (Bailey *et al.* 1994), provide important insights into the patterns of shell mound development and the focus of Aboriginal food production strategies. In this concluding discussion key trends in these data are highlighted with particular attention given to shell mound composition and the chronological relationships between sites.

### *Spatial and Temporal Patterns*

The results presented above provide important new data on spatial and temporal patterns in shell mound deposition at Prunung, though these data are not without limitations. Of most concern is that several of the sites at Prunung (namely SM:96 and SM:93) are large, complex features whose depositional histories are unlikely to be fully understood through the limited dating programme conducted to date. Chronological data for SM:96 illustrates this problem well, because a number of inconsistencies appear in the determinations. While recent human disturbance and natural processes may account for anomalies on this exposed and heavily impacted site, it still highlights the likely complex depositional history associated with the formation of larger mounds: simply put, linear (or upward) accumulation should not be assumed but instead needs to be demonstrated (see also Stein and Deo 2003). The radiocarbon determinations obtained for SM:93 and SM:92 do not indicate any obvious anomalies in accumulation, although given their large basal dimensions (50m x 30m and 30m x 10m, respectively) it is unlikely these dates

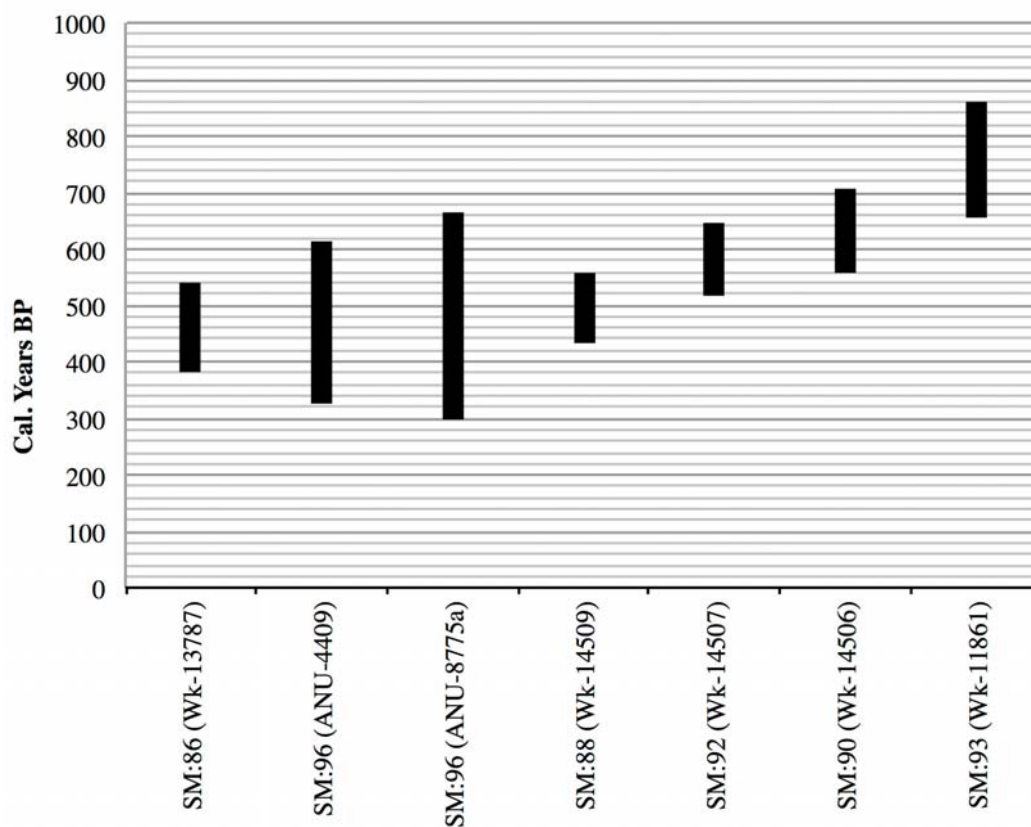
encapsulate the potential complexity of discard activities in these areas. A more thorough assessment of accumulation rates across the mound is required and this would necessarily involve a more extensive dating programme; however, this would necessitate more invasive work which was undesirable from the point of view of Thanakwith custodians. The smaller sites of SM:91, SM:90, SM:88 and SM:86 pose fewer difficulties in terms of interpreting radiocarbon dates as deposition has been more constrained and focussed upon a smaller area. While these are more likely to reflect vertical accumulation, it is nevertheless the case that their broad basal dimensions do not rule out the possibility of spatial and temporal discontinuities in mound accumulation.

Despite these issues it is possible to develop a broad, preliminary framework of spatial and temporal patterns of shell mound formation at Prunung. Available calibrated age spans for basal radiocarbon determinations (Figure 15) suggest initial deposition on the northeastern-most sites between ~500 and ~850 cal BP, evidenced by the basal age estimates for SM:93, SM:90 and SM:92. Following this, there appears to have been concentrated discard activity across a 500m area for at least the past ~550–600 calendar years, with SM:96 possibly developing more recently than those to the northwest. Furthermore, it seems likely that development of this group of sites did not occur in succession: that is, discard in a new area does not seem to have started following abandonment of an earlier site. Instead, occupation appears to be archaeologically contemporaneous. After ~550–380 cal BP, two new discrete deposits are established: SM:86 and SM:88, both of which are located in unique contexts away from the primary complex of sites. SM:86 is located adjacent to a stone pavement which provides a natural access point through dense mangrove forest to open mudflats. SM:88 is located 500m inland from the nearest shoreline but in an area which is immediately adjacent to messmate woodlands. Current determinations on the underlying substrates, obtained by Stone (1995), suggest that the mound was not linked to use of the area when the shoreline was further inland, so it is clearly the case that people elected to transport shell a short distance inland, despite the occurrence of contemporaneous mounds adjacent to the shoreline.

Importantly, radiocarbon data for Prunung provides clear evidence of continued use of the area up until the most recent part of the radiocarbon calibration curve (i.e. they are modern). SM:91 was constructed on the northern margins of SM:92 and a single determination yielded an essentially modern calibrated age estimate. This result, together with the discovery of a small glass flake in the near basal deposits of this site, supports the proposition that deposition continued in this area for at least a short time after the arrival of Europeans in the region after the 1880s.

### *Site Stratigraphy and Composition*

Stone (1995:94) argued that the *T. granosa*-dominated mounds that occur parallel to the shoreline at Prunung are natural phenomena and that there was no evidence they were collected as food by Aboriginal people. It is argued here that his interpretation of shell mound deposits at Prunung is based on spurious data. He used column samples obtained across the beach ridge sequence in three transects (Stone 1995:Figure 6a). Only one of these



**Figure 15. Calibrated age spans for basal radiocarbon determinations, Prunung.**

transects (A-B) included a distinct shell mound deposit, while the remaining two (C-D and E-F) were a further 300m and 800m to the northeast (towards Prunung Creek), where no shell deposits interpreted as anthropogenic have been recorded. According to Stone's (1995:Figure 6) results, only one column was obtained from a potential anthropogenic deposit. In this case, his column sample appears to have been taken from this feature's landward lower flank, where intermixing with natural substrates is likely to be greatest, yet no comparative data on the composition of this column sample in relation to surrounding substrates are provided. Importantly, such detailed comparative work has been carried out by others, and clearly illustrates the distinctive nature of these deposits in relation to the substrate; this has supported conclusions that these sites are of anthropogenic origin (Bailey 1993; Bailey *et al.* 1994).

New data from a wider range of sites presented here also refute Stone's claims about the natural origin of shell mound sites at Prunung. A clear attribute of the SM:93, SM:91, SM:86 and SM:88 sites is their compositional and stratigraphic distinctiveness compared with their underlying substrates. In all cases shell mound substrates were sand-dominated with negligible amounts of whole large shell and large proportions of bauxite pisoliths. Shell hash, small whole shells and sparse *T. granosa* were occasionally noted, particularly in the substrates on which SM:93 and SM:91 were found. However, shell mound deposits were composed of a restricted range of species of known economic importance, alongside small proportions of species of no known economic importance, such as *Cerithium* spp., discussed below. These deposits contained overall low proportions of bauxite pisoliths and lacked the

sand-dominated matrix evident in the site substrates. Furthermore, there are strong similarities in site stratigraphy with those sites excavated at Bweening, where any influence from naturally-deposited shellfish has been previously ruled out (Morrison 2013b).

The site SM:88 also provides perhaps the strongest support for the claim that shell mound deposits at Prunung are of anthropogenic origin. This site occurs in an area that is above or beyond the influence of any substantial marine deposition processes within the past few thousand years as it is located over 400m from the modern shoreline inland of a substantial seasonal swamp. The site occurs on an inland sand ridge that is likely to be at least 2401–2833 cal BP (ANU-8036) based on Stone's (1995) own chronology for beach ridge formation. If this site had a natural origin then it would need to be composed of naturally occurring shells from the surrounding substrate, and of a similar age to its substrates. Furthermore, the possibility that SM:88 is the result of a scrub fowl scraping non-mounded anthropogenic shell deposits into a mound is also not considered to be applicable. At best, only very sparse shell is found within the surrounding substrates and there are no remnants of non-mounded anthropogenic shell deposits in the area that scrub hens could have scraped into a mound.

There is little question that Aboriginal people were responsible for constructing shell mound sites at Prunung. This is supported by their close similarities with anthropogenic mounds at Bweening, the contrast in their composition compared with underlying substrates and their overall stratigraphy and appearance. This does not imply a lack of any influence of natural processes on these sites for it is clear that some have at times been influenced by coastal deposition process. For example, several fine lenses

or layers of sand occurred in SM:93 (see Figure 7) and both this site and SM:91 had larger proportions of small *Cerithium* spp. than SM:86 or SM:88, which are less exposed to coastal processes. Furthermore, both sites evidence increasing proportions of these species with depth and this indicates they were deposited when the shell mounds were lower in height when they were possibly more exposed to storm surges.

The occurrence of small proportions of *Cerithium* spp. in other deposits away from the influence of marine processes, including at the adjacent study area of Bweening (Morrison 2013b), also hints at the addition of what could be best described as ‘by catch’ to the mounds. *Cerithium* spp. are relatively small (often <15mm long) and are at times found in very large numbers on intertidal flats, so could be easily intermixed with sediment attached to other shellfish species and incidentally transported to the site. At SM:91, investigation of 2mm residues clearly demonstrated that a reliance on 6mm residues alone clearly has a potential to miss large numbers of *Cerithium* spp. This has implications for future sampling strategies, particularly where mound origins are questionable. The implications of this for quantifying shellfish consumption through time are discussed in more detail below.

Although broadly similar, there are minor stratigraphic variations between the sites excavated and analysed at Prunung. The most variable stratigraphic attribute is the proportion of soil and humic material observed in section: some sites, notably SM:96 and SM:93, evidence clear alternating layers of whole clean shell with layers of more fragmented shell and higher proportions of soil and humic materials. SM:88, however, had high proportions of soil or humic material throughout but lacked the distinct alternating layers. Conversely, SM:86 and SM:91 had no such layers and only evidenced whole, relatively clean shell. It is clear that in the case of Prunung, shell mound size has an obvious relationship to the presence of the distinctive layering, with larger and more complex features more likely to demonstrate this layering, an observation also made at Bweening (Morrison 2013b).

While greater mound size seems to lend itself to the preservation of soil-rich versus soil poor layers, it is also likely related to the presence or absence of vegetation in the surrounding environment and on the mound itself. For example, the two smallest sites (SM:91 and SM:86) – which lacked the distinctive alternating soil-rich and soil-poor strata – both occurred in relatively open settings, with little surface vegetation other than grasses and sparse trees in close proximity. They also had little humic material on their surfaces. Conversely, SM:88, SM:96 and SM:93 all occurred within or in close proximity to small thickets of dry notophyll vine forest and subsequently had variable proportions of humic material on their surfaces, though this was not consistent across their surfaces. It was also observed that organic materials tended to collect in depressions and in areas sheltered from wind by trees, grasses and low shrubs. The existence of dark humic strata within mounds might therefore reflect periods where shell accumulation was not occurring, at least on a portion of a former mound surface, enabling enough time for the accumulation of humic materials at the surface and their eventual interpenetration into the underlying shell-rich matrix.

These organic-rich strata are later buried by subsequent shell accumulation, contributing to the distinctive stratigraphic pattern of dense shell matrix with little soil and more frequent whole shell, alternated by strata with greater proportions of soil and more fragmented shell. It follows then that these strata also post-date the deposition of shell matrix that they have interpenetrated, as their formation requires two preconditions: a lack of shell discard and the existence of vegetation in the surrounding environment – or on the mound itself – in order to create the rich humic layers at the mound surface. This may complicate the interpretation of charcoal-derived radiocarbon determinations, since there is a high possibility that charcoal samples recovered from these strata are natural and potentially post-date the accumulation of shell. The location of these organic strata also needs to be taken into account in reconstructing the formation histories of mound sites, together with other possible indicators of former mound surfaces, such as magnetic susceptibility (Rosendahl, Lowe *et al.* 2014b) or systematic analysis of fragmentation rates (Faulkner 2013; Shiner *et al.* 2013).

### Shellfish Analysis

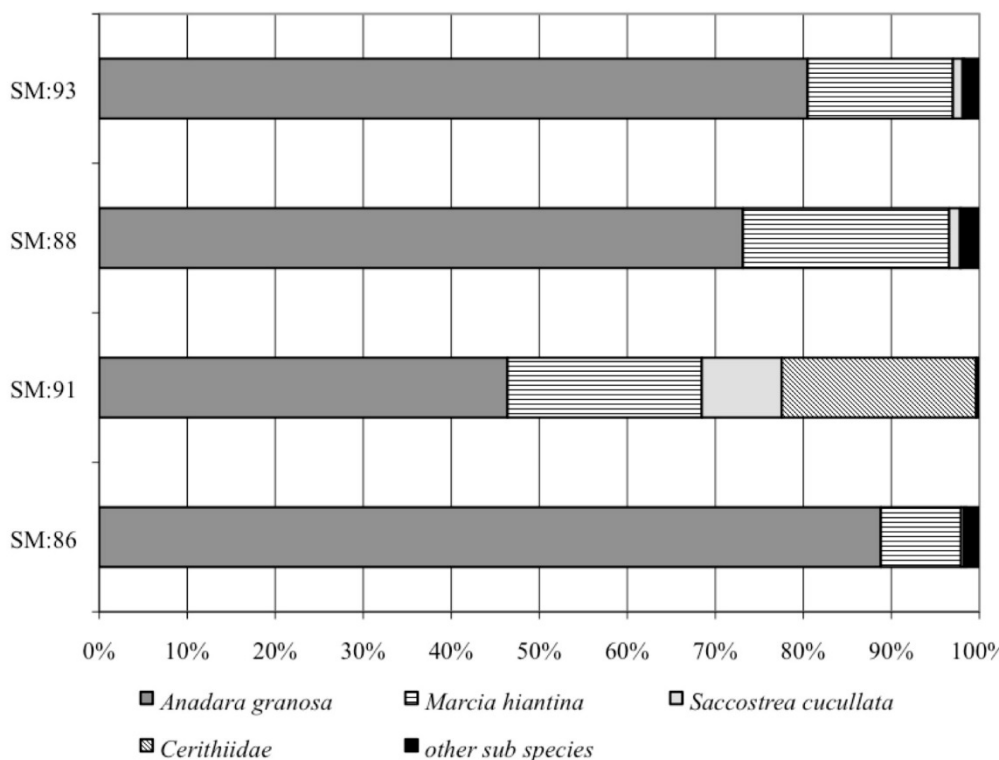
Data on the internal variations in shellfish MNI at each site have been discussed previously and thus here the focus is on MNI data for each site as a whole. As outlined, shellfish estimates at most sites (SM:88, SM:86, SM:91) were calculated from a subsample of 6mm sieve residues and this is an important consideration in discussions of relative species abundance. As such, MNI data are presented together with relevant details on sample sizes here (Table 16, Figure 16).

The presence of substantial proportions of *Cerithium* spp. in deposits of SM:91 are seen here to reflect the influence of storm surges or wave activity on the site. Their presence in larger numbers in 2mm residues is important and highlights the well known problem of the under-representation of small shellfish when only larger sieve residues are investigated (Claassen 1998). *Cerithium* spp. were also present in smaller numbers in SM:93, SM:86 and SM:88. Their presence in SM:93, which is located adjacent to the shoreline, may reflect similar process as suggested for SM:91; that is, the likely occurrence of storm surges in the past. However, as *Cerithium* spp. are considered to be deposited either as by-catch or through natural processes, their under-representation in 6mm sieve residues on which shellfish analyses are based is not seen as particularly problematic for investigating production strategies associated with shell mound formation (see also Faulkner 2013).

*T. granosa* is the most frequently occurring species across all sites ranging between 46% and 89% of total site MNI, with the lowest proportions of the species being found in the smallest site, SM:91. *M. hiantina* is a frequent species in three of four sites at 9-23% of total MNI. In many sites it represents the dominant shellfish species at different times, and it is almost always present in all XUs of all sites. Both *T. granosa* and *M. hiantina* are species that inhabit intertidal mudflats and this is significant given that collectively these species represent 68-97% of total site MNI. Again, the lowest proportions of both species are found in SM:91 where collectively they represent 68% of

**Table 16. Relative shellfish MNI, Prunung.**

Taxa	SM:86		SM:91		SM:88		SM:93	
	MNI	%	MNI	%	MNI	%	MNI	%
<i>T. granosa</i>	1738	88.76	263	46.39	2136	73.15	33173	80.50
<i>M. hiantina</i>	179	9.12	125	22.08	684	23.43	6801	16.50
<i>S. cucullata</i>	7	0.33	52	9.10	36	1.23	449	1.09
<i>P. erosa</i>	-	-	2	0.35	1	0.03	7	0.02
<i>V. cochlidium</i>	9	0.46	-	-	36	1.23	135	0.33
<i>N. lineata</i>	4	0.20	-	-	4	0.14	154	0.37
<i>T. telescopium</i>	1	0.05	-	-	6	0.21	33	0.08
Barnacle	10	0.51	-	-	2	0.07	203	0.49
Cerithiidae	5	0.26	125	22.08	4	0.14	84	0.20
Land Snails	5	0.26	-	-	8	0.27	52	0.13
<i>Ellobium</i> sp.	-	-	-	-	-	-	8	0.02
<i>Melo</i> sp.	-	-	-	-	3	0.10	-	-
Other sub-species	-	-	-	-	-	-	111	0.27
<b>Overall MNI<sup>2</sup></b>	<b>1958</b>		<b>566.14</b>		<b>2919.79</b>		<b>41209</b>	
<b>Overall Sample %<sup>3</sup></b>	<b>46.8</b>		<b>26.84</b>		<b>31.91</b>		<b>100</b>	



**Figure 16. Shellfish MNI summary data, Prunung.**

total site MNI. Here, this lower figure is influenced by the occurrence of much larger proportions of *Cerithium* spp. than in other sites (22%) and as outlined these are thought to be derived from both intermixing with mound substrates and the influence of storm surges depositing material from off site. If *Cerithium* spp. are omitted as a non-economic species – which seems likely given their very small size (cf. Rowland 1994) – then *M. hiantina* and *T. granosa* together represent 90-98% of total MNI for all excavated sites at Prunung.

Conversely, shellfish species common to mangrove forests and rocky shorelines such as *P. erosa*, *V. cochlidium*, *T. telescopium*, *Nerita* spp. and *S. cucullata* are typically represented in very low numbers. The highest proportion of any of these species is a total MNI of ~9% *S. cucullata* in SM:91. In addition to the presence of *Cerithium* spp., a limited range of other small and uncommon shellfish species were recovered, with the greatest proportion of these occurring in SM:93. Those most commonly encountered – albeit in very small amounts – included unidentified species of terrestrial snails, small *Trochus* spp., *Ellobium* spp. and *Balanus* spp. A range of plausible explanations can be found for the incorporation of these and other uncommon species in shell mound deposits. *Balanus* spp., for example, were occasionally observed attached to *T. granosa* shells recovered during excavations and have also been observed on living *T. granosa* and *M. hiantina* shell collected on mudflats. They are also commonly found on mangrove branches with *S. cucullata*, which today at least are a commonly harvested by removing the entire branch. Other less commonly occurring species may have been accidentally collected, introduced by other animals (such as birds) or of course opportunistically targeted by people for unknown purposes – for example, items of adornment or decoration, food or medicine, or as expedient tools.

### Artefacts

Low proportions of artefacts were recovered in shell mound sites at Prunung. None occurred in SM:86, two occurred in SM:91, three in SM:88 and five in SM:93 (Table 17). Artefacts included modified shell, a single glass fragment and a number of small flakes. The greatest number of artefacts was recovered in the site with the largest amount of excavated deposit, SM:93. Stone artefacts were the most common artefact type, though very small in absolute numbers. Raw material was typically quartz or silcrete.

The modified shells are on an unknown species, but are possibly pieces removed from a larger shell such as *Melo* spp. Both items were broken and had significant amounts of edge-grinding and modification on their distal ends and as such are unlikely to be a quickly manufactured expedient tool. Furthermore, the distal edge has been ground so that it is rounded and smooth, but lacks visible edge damage linked to cutting, scraping or prising tasks (Figures 9-10). These artefacts are possibly a part of a tool such as a shell knife or spatulate implement, or an item of personal adornment, such as a shell pendant. No equivalents in museum collections have been identified to date.

The recovery of the glass fragment in SM:91 represented an unusual find. While there is a likelihood that the item may have moved downwards through the deposits,

its presence in basal layers is not considered to be anomalous given the recent age of the site. The presence of a distinct erillure scar and lack of cortex/glass surface suggests that this item is a small flake, probably the by-product of modification or use of a larger piece of glass. In combination with the young age of this site, it clearly supports the assertion that shell mound use continued at least for a short time following European contact in the region.

### Non-Molluscan Fauna

Investigation of 6mm sieve residues indicated low proportions of non-molluscan faunal materials in all sites excavated and analysed (Table 18). While SM:93 had the overall largest weight of non-molluscan fauna, the density per kilogram was similar to that of SM:91. Overall, the highest density of these materials was in SM:88 at ~21g of bone, otoliths and crab shell per 100kg of deposit. The principal reason for this is the presence of 21g of crab claw fragments, typically the dense claw tip, and these are heavier than the small fragments of bone that rarely weighed more than 1-2g per fragment. There are significant problems with solely using weight as a measure to estimate the relative abundance of bone, as different skeletal elements and different non-molluscan faunal materials will be over- or under-represented. However, this was unavoidable given that essentially no diagnostic elements were identified apart from a single fragment of mandible in SM:93.

Realistically, the overall numbers of non-molluscan materials are very low and make identification of trends and patterns difficult. The clearest trend that can be noted is a coarse differentiation between mounds near the foreshore and the single site recorded further inland, SM:88. This site does evidence higher numbers of non-molluscan faunal materials than the foreshore sites. Crab claw fragments are probably from a species of mud crab (*Scylla* spp.), based on visual comparison with modern examples. The bones recovered were small fragments typically less than 10mm in length and the broadest level of identification possible is that they were mammal or reptile bones rather than bird bones. There are overall greater proportions of non-molluscan faunal material in SM:88 (21g per 100kg) compared with other sites (<5g per 100kg) and this is considered to reflect the location of the site adjacent to seasonal swamps and messmate woodland.

Importantly, investigations of selected 2mm residues strongly support the argument that shell matrix sites at Prunung evidence little in the way of non-molluscan faunal remains. Those materials that were found were primarily non-diagnostic with no cranial skeletal elements or any complete skeletal elements recovered. This is not to say that diagnostic elements of non-molluscan fauna are not and will never be found in shell mound sites at Prunung. The key point here is that the numbers of these materials are demonstrably low in those XUs where proportions of 6mm non-molluscan faunal remains are greatest. This, along with the results from Bweening, suggest that screen size bias is not the reason for a lack of these materials in shell matrix sites, a conclusion also made by Faulkner (2013:179) for mounds at Blue Mud Bay.

**Table 17. Artefact data, Prunung.**

Site	Material	Type	Cortex (%)	Length (mm)	Width (mm)	Thickness (mm)
SM:88	Silcrete	Broken flake	51-99	36	32	13
	Milky Quartz	Broken flake	0	13	13	8
	Quartz	Angular fragment	0	12	8	5
SM:93	Quartz	Broken flake	0	10.9	8.2	3.1
	Quartz	Broken flake	0	14.5	8.4	3.8
	Shell	Modified	NA	30	26	2.2
	Shell	Modified	NA	31	25	2.5
	Quartz	Broken flake	1-50	20	10	5
SM:91	Silcrete	Broken flake	1-50	35	19	10
	Glass - Green	Fragment	na	13	9	2.6

**Table 18. Weights and density of non-molluscan faunal materials, Prunung.**

Site	Bone (g)	Crab (g)	Otoliths (g)	Deposit Weight (kg)	Combined (g/100 kg)	Bone (g/100 kg)
SM:93	34.8	6.03	2.00	1033.1	4.1458	3.3685
SM:91	3.00	2.00	-	108.75	4.5977	2.7586
SM:86	-	-	-	122.8	-	-
SM:88	14.00	21	1.00	165	21.8182	8.4848

**Conclusions**

Shell mound formation at Prunung was focussed upon the foreshore area and this has been the case since at least ~800 cal BP, and seems to have continued until the upper limit of effective radiocarbon dating, or within the past 200 years. All of these shell mounds – including the spatial outliers SM:86 and SM:88 – were constructed within the same period of time rather than in succession and this has implications for understanding the production strategies surrounding shell mound formation and use. SM:86 and SM:88 are highly likely to have developed partly due to their unique micro-environmental contexts. The composition of SM:86 suggests it was primarily concerned with exploitation of shellfish species found on intertidal flats and this is supported by its location adjacent to a natural access point to these environments, as well as the lack of non-molluscan faunal materials and stone artefacts.

A similar explanation could also be applied to the complex of sites adjacent to the shoreline near Prunung Point, which are positioned in close proximity to a gentle sloping beach and the deep channel which flows out into Albatross Bay from Prunung Creek. Extensive areas of intertidal flats occur nearby, however, many of these are only accessible with a short water crossing. Here too, the most significant feature of shellfish composition is a strong preference towards species from intertidal flats and negligible use of other resources. Other resources are minimal across all sites: SM:88 had the greatest proportion of non-molluscan fauna present and evidences a subtly different resource base than other mounds located close to the shoreline, however, taphonomic processes affecting the preservation of terrestrial fauna are poorly understood at present. In any case, shellfish are the primary resource used on this site and results presented here are taken to suggest

that other resources were used in a supplementary or incidental manner.

These results add weight to previous interpretations that shell mounds were associated with a highly specialised form of production focussing upon specific ecological niches. Previous work suggested that estuarine or marine ecosystems were the focus (Morrison 2013a), however, this interpretation can now be narrowed: taken together, work at both Bweening (Morrison 2013b) and Prunung clearly indicate that the predominant economic emphasis was on marine shellfish species that could be obtained from intertidal mud and sandflats, while those species from other ecosystems (mangroves, rocky shorelines) are more incidental and vary with local environmental context. *T. granosa* was clearly a major focus of these production systems, however, other species such as *M. hiantina* were also important – at times comprising up to 23% of overall site composition. This indicates that hypotheses about mound formation need to accommodate the fact that *T. granosa* was clearly not the only species of interest, and this revised model accommodates these local variations in site composition that are being documented as more data come to light. Further field research is required to clarify the extent of these local variations and to address questions as to why other resources such as fish or terrestrial fauna are so poorly represented in shell mound sites. Furthermore, a fundamental question that is yet to be explored is what was the role of shell mound sites in the context of these production strategies? Both questions are being explored through ongoing research in the region.

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