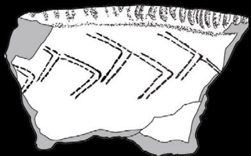

CAUTION BAY STUDIES IN ARCHAEOLOGY 2

The Archaeology of Tanamu 1

A Pre-Lapita to Post-Lapita Site from Caution Bay, South Coast of Mainland Papua New Guinea

Edited by

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Archaeopress Archaeology

This volume is dedicated to our dear friend and colleague Ken Aplin (1958–2019). His vast knowledge and experience, along with his collaborative spirit, humour and friendship, are dearly missed.

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Cover photograph:
Excavation in progress of 2750-2800 cal BP Late Lapita inverted pot, Tanamu 1, Caution Bay, south coast of Papua New Guinea.
Cover drawing:
2750–2800 cal BP Late Lapita sherd from Square AC XU2 at Tanamu 1, south coast of Papua New Guinea. Drawing by Cathy Carigiet.

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Kara Rasmanis produced Figures 1.1 and 1.2, and Cathy Carigiet drew the sherds for Figures 1.8, 3.6, 3.8, 3.10, 3.12, 3.14 and 3.20. Steve Morton took the photographs which appear in Figures 3.7, 3.9, 3.11, 3.13, 3.15, 3.19, 3.21 and 7.2. Steve Morton also took all of the stone artefact photographs which appear in Chapter 4, except for 4.31 for which we thank Les O'Neill. Many of the macro images of worked shell artefacts which appear in Chapter 7 were taken by Claire Perrette, who also did the plate layouts. All other photographs are by the authors unless otherwise stated.

The initial analysis of the shell midden was undertaken by Helene Peck, and although she did not wish to be a contributor in the final report, we thank her for all her hard work and dedication in the production of the dataset.

Chapter 1.
Emerging Out of Lapita at Caution Bay

Bruno David, Ken Aplin, Cassandra Rowe, Matthew Leavesley, Katherine Szabó, Thomas Richards, Ian J. McNiven, Fiona Petchey and Herman Mandui

Introduction

The discovery in 2010 of stratified Lapita assemblages at Caution Bay near Port Moresby, south coast of mainland Papua New Guinea (PNG) (David *et al.* 2011; McNiven *et al.* 2011), brought to the fore a series of important questions (Richards *et al.* 2016), many of which also apply to other parts of Island Melanesia where Lapita sites have been known for many decades. Unlike other parts of Melanesia, however, at Caution Bay some of the Lapita sites also have pre-Lapita horizons. A number are culturally very rich. At Caution Bay, where the oldest confirmed Lapita finds date to no earlier than *c.* 2900 cal BP (McNiven *et al.* 2012a), the major questions do not concern the earliest expressions of Lapita around 3300–3400 cal BP. Rather, here we are concerned more with identifying how assemblages associated with the Lapita cultural complex arrived and transformed along the south coast, after a presence in coastal and island regions to the northeast over the previous 400 years. These concerns contain both spatial and temporal elements: how and when, as a prelude to why, particular cultural traits continued and changed across Caution Bay. Tanamu 1 is the first of 122 archaeological sites excavated in Caution Bay upon which we will report. As a site, it represents the ideal entry point, as being a coastal site which contains pre-Lapita, Lapita and post-Lapita horizons it encapsulates many of the signatures, trends and transformations seen across the >5000 year Caution Bay sequence at large. Of special note in the wider context of Lapita archaeology, the presence of rich pre-Lapita horizons is what makes Caution Bay so important both in and of itself and for the Lapita story.

Defining Lapita

Discussions of transformations into, within and out of Lapita first require an explicit definition of what Lapita *is*. Since the first recognition of Lapita ceramics from different parts of the western Pacific in the 1900s (for reviews, see Sand 2010; Spriggs 1997), Lapita sites have been associated with the initial colonisation of Remote Oceania in the South Pacific. Most models have favoured a proximate Melanesian homeland in islands of Near Oceania (see especially Allen and Gosden 1991; Spriggs 1991), with some arguing for earlier origins in Island Southeast Asia and ultimately Taiwan (e.g., Bellwood 1997) or, as more recently argued, via western Micronesia and the Philippines (e.g., Carson *et al.* 2013). Regardless of routes and ultimate origins, the diaspora that carried people, traditions and objects across much of the western Pacific left behind a material record that is collectively referred to as the Lapita cultural complex (see Green 1992). Lapita peoples carried with them the capacity and technology for horticulture—but whether pigs, dogs and chickens were introduced by early or later Lapita peoples, or immediately post-Lapita is still being debated—and they are generally accepted to have spoken a proto-Oceanic language ancestral to contemporary Austronesian languages of the region (Bellwood 1979). Upon arrival in new locations they built coastal settlements, usually on small unoccupied offshore islands and along sand spits, often over the intertidal zone (Kirch 1997: 162–191; 2000: 106–107; Summerhayes *et al*. 2019). Lapita peoples also produced pottery with iconic dentate-stamped motifs with a highly regulated design structure possibly drawn from other, perishable media (Green 1979). Within 200 years or less of the first dentate-stamped ceramics being made in the Bismarck Archipelago, north of the New Guinea mainland, they appear across Near Oceania and thence into the nascent archaeological record of parts of Remote Oceania (Specht and Gosden 2019).

The primary manifestation of the Lapita cultural complex is earthenware pottery with indented designs stamped with comb or comb-like (tined) tools. On some islands and archipelagos, Lapita assemblages also include motifs made by incision using a sharp-edged tool, and applied relief otherwise known as appliqué (Spriggs 1997: 67). In addition to the decorated pottery, Lapita sites also contain much plainware, but sherds of these do not of themselves usually allow us to definitively identify an assemblage as Lapita. Other artefact classes are also part of the Lapita material repertoire. Most notable are the distinctive axe/adzes commonly made of the hinge section of *Tridacna* sp. clam shells, shell arm bands, and a range of shell fish hooks. Some of these shell artefacts exhibit discrete technologies that are exclusive to, and therefore diagnostic of Lapita (such as *Tridacna* biperforate units in Remote Oceania) (Szabó 2010). Obsidian is also a highly visible part of many Lapita assemblages. Examples originating from sources primarily in the Bismarck Archipelago have been identified at a number of Lapita sites across the western Pacific region and provide evidence of long-

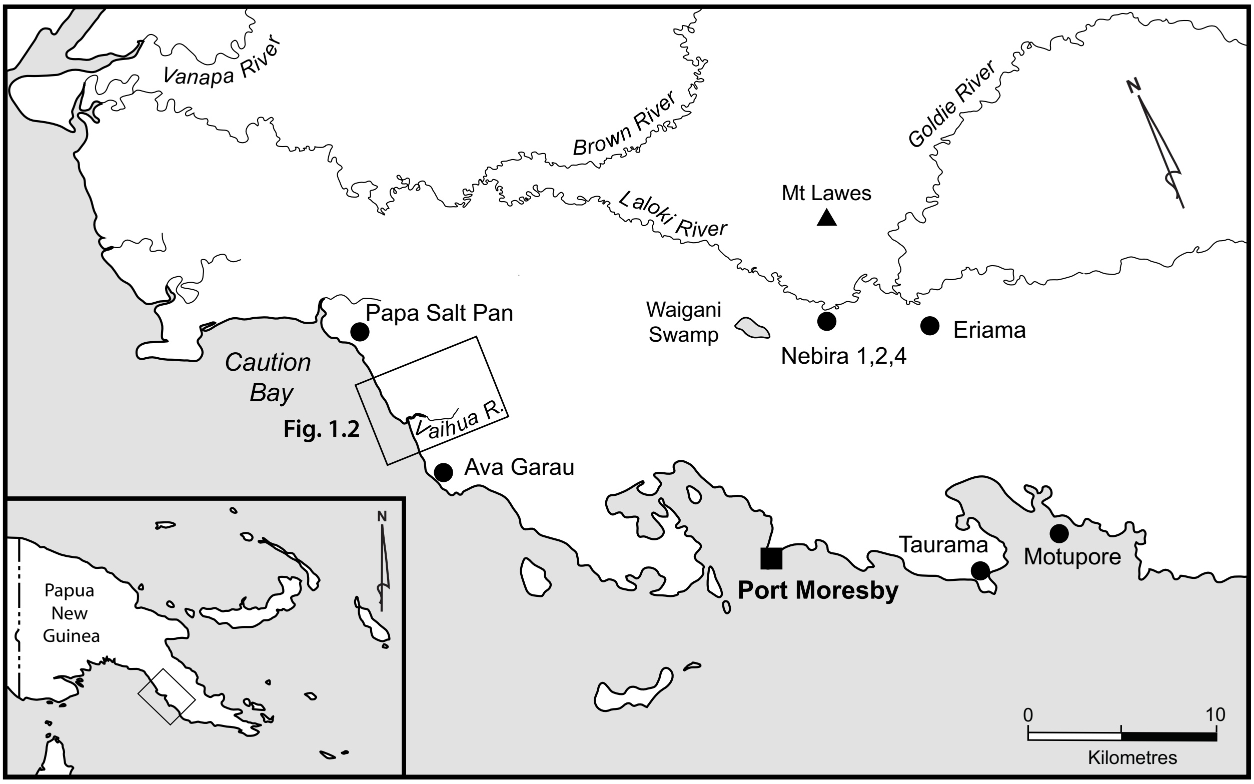

Figure 1.1. Location of Caution Bay showing previously excavated sites in the broader Port Moresby region.

distance travel and contacts. Considered alongside the distribution of dentate-stamped motifs, it is clear that Lapita peoples engaged in large-scale long-distance two-way voyaging (Irwin 1992; Summerhayes 2009) connected as part of what Golson (1961: 176) termed a 'community of culture'.

Following decades of debate as to whether the Lapita cultural complex represented an extension of the Southeast Asian Neolithic (Bellwood 1997) or an *in situ* cultural development in the Bismarck Archipelago (see Allen 1984), Roger Green (1991) developed a framework to conceptualise the origins of Lapita in the Bismarck Archipelago. Termed the Triple-I model, it presupposes that Lapita emerged out of a combination of intrusion from Southeast Asia, innovation within the Lapita cultural complex itself and integration of pre-Lapita Near Oceanic traditions.

For Green's model of intrusion, innovation and integration for the origins and spread of the Lapita cultural complex to be tested, detailed archaeological records are required from sites or site complexes that span periods of time from before Lapita through to its arrival, establishment and florescence. At the opposite chronological end of the Lapita phenomenon, questions regarding the fate of the Lapita cultural complex—whether it underwent breakdown and/or transformation, and whether this occurred in different ways and at different times in different places—once again require cultural deposits that span Lapita to post-Lapita times. Archaeological discoveries at Caution Bay during 2009 and 2010 present regionally unique opportunities to study all of these elements.

To develop our narrative of the Lapita cultural complex at Caution Bay, we need to begin with archaeological assemblages that can unambiguously be identified as Lapita. Archaeological signatures and chronology represent the dual keys. Throughout this monograph we identify demonstrably Lapita sites and Lapita conventions from archaeological objects directly associated with comb dentate impressions applied in bands around ceramic vessels (we sometimes stress both the tool—comb—and the dentate impressions rather than the more conventional term 'dentate stamped' when referring to Lapita, because along the south coast of PNG other forms of [shell] dentate stamping on pottery also exist in much later pottery [see below]. We distinguish between the two to avoid confusion). Our narrowly focused initial characterisation of Lapita on the basis of dentate-stamped ceramics is a necessary first step that enables us to then track how various associated characteristics of Lapita practice transformed through time within the Caution Bay landscape. Of course, Lapita is far more than a ceramic style or tradition; however, what we need is an archaeological definition that enables us to say without ambiguity or doubt from a given site's material record: 'this is Lapita'. Nevertheless, we must

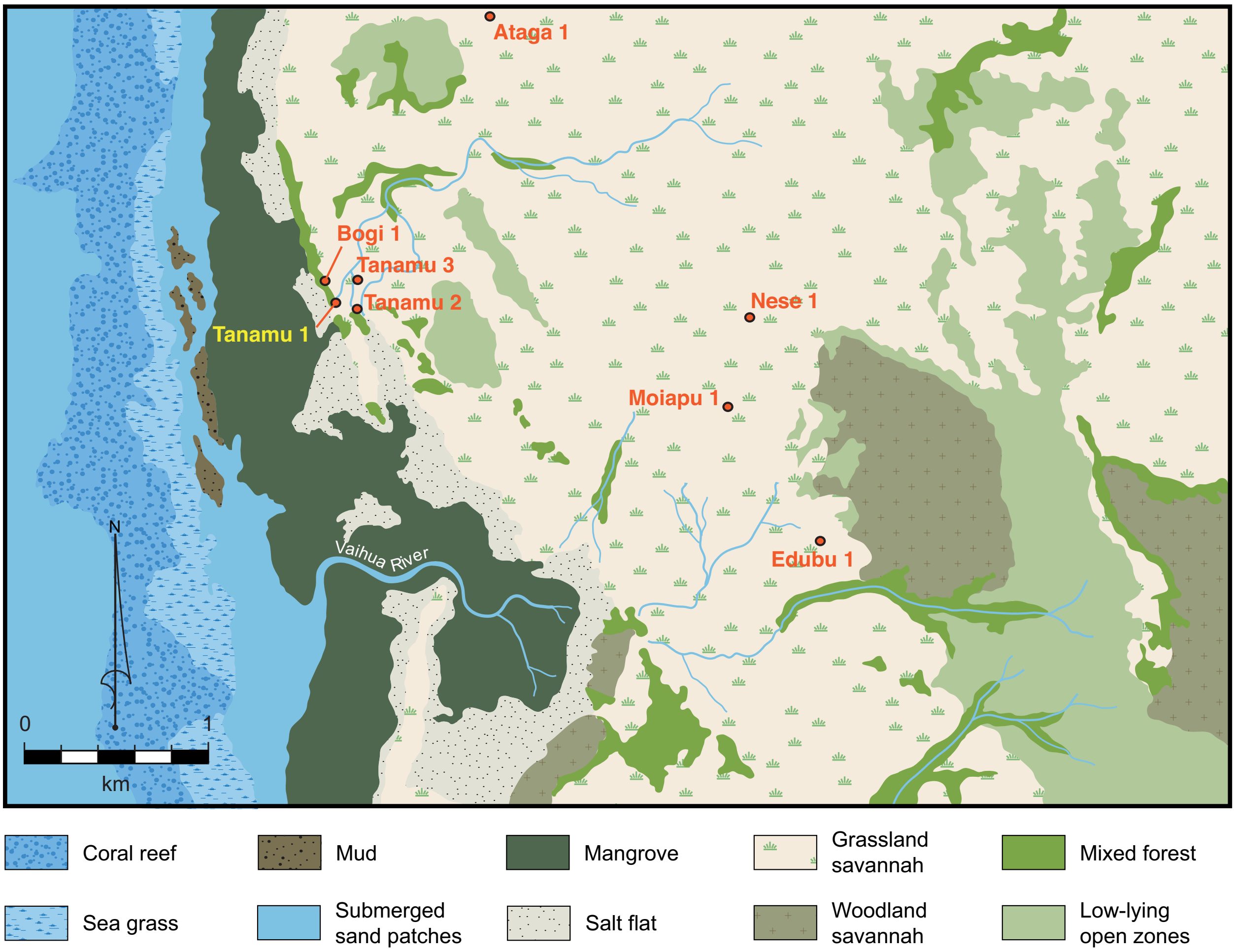

Figure 1.2. Location of Tanamu 1 and other excavated sites mentioned in the text relative to marine and terrestrial environmental zones.

also entertain a range of possible explanatory scenarios into our thinking. One very real possibility is that some archaeological assemblages may have come from Lapita peoples but may not be readily identifiable as such, purely because the traits of the recovered material (e.g., exclusively plainware ceramics; narrow *Rochia* sp. [formerly *Trochus* sp.] shell arm bands) are shared with non-Lapita cultural practices and therefore not singularly 'Lapita'. By taking the only exclusively Lapita material evidence known from Caution Bay as our starting point, we essentially begin with a behavioural datum point evident from the material record—a set of design conventions involving structured comb dentate stamping on ceramics—by which related cultural practices can be seen to have originally been associated and, in some cases, changed through time while others were added or dropped out entirely. Another possibility is that some archaeological assemblages that include some dentate-stamped ceramics were produced by people who were culturally distinct but acquired these objects through local trade or other means. To test for this possibility, for each site we categorise the entire suite of archaeological remains, including lithics, other kinds of artefacts, and all classes of food remains, thereby optimising our chances of identifying contrasts or discontinuities in wider and longer cultural traditions.

Tanamu 1

Tanamu 1, the first site we have chosen to publish in this monograph series, has rich pre-Lapita, Lapita and post-Lapita horizons. It was initially identified from surface archaeological evidence during intensive and systematic pedestrian surveys covering an area 10km^2, spanning a length of 4.4km east-west (largely perpendicular to the coast) by 4.3km north-south (largely parallel to the coast) (for details, see David *et al.* 2016b). The full set of 122 excavated sites recorded during these surveys was entirely contained within an area 3.1km east-west by 2.8km north-south, set inside this survey area (see David *et al.* 2016a). Upon excavation, some sites (such as Tanamu 1) were found to contain a palimpsest of more or less distinctive layers each representing a relatively discrete period of occupation; some sites had a single cultural (artefactual) horizon containing intermixed

Figure 1.3. Location of Tanamu 1 and other nearby excavated sites mentioned in this volume.

cultural deposits spanning a reasonably broad period of time; and some were single-occupation sites with narrow, well-defined calibrated age ranges.

Tanamu 1 was chosen for this monograph because it characterises well the archaeology of a Caution Bay pre-Lapita to post-Lapita sequence. It includes a Late Lapita horizon dating to *c.* 2850–2700 cal BP but also contains a very rich pre-Lapita cultural horizon dating to *c.* 4350–4050 cal BP.

Geography of the Caution Bay sites

Following Aplin *et al.* (2016; also see Mabbutt *et al.* 1965), the environmental zones of Caution Bay incorporate several partly discontinuous land-systems, parallel with the open coast. Progressing inland from the coast, these are a Littoral Plains Zone, an Alluvial Plains Complex and a Coastal Lowlands Complex, and a Hill-Ridge Complex. Tanamu 1 is positioned at the lowest part of the Alluvial Plains Complex, where this environment merges with the seaward Littoral Plains Zone (Figure 1.2) (see Mabbutt *et al.* 1965; Paijmans 1976; and Aplin *et al.* 2016 for detailed descriptions of Caution Bay landforms, ecology and the general environment in wider Port Moresby and lowland PNG context).

The Alluvial Plains Complex of Caution Bay occurs as a narrow coastal terrace and branching inland tracts. A Quaternary geology of fine-textured alluvium predominates, derived from ephemeral streams (typically ill-defined) and the occasional larger perennial stream with associated silty flood zone. The seaward margin of the Alluvial Plain is gently sloping and well drained; by contrast, the central portion of the Alluvial Plain is comparatively poorly drained and prone to seasonal flooding (Aplin *et al.* 2016; Mabbutt *et al.* 1965; Speight 1965). Mabbutt *et al.* (1965) indicate that the sediments of the Alluvial Plain are partly of marine origin, overlain with fluvial deposits.

Seaward of Tanamu 1, the Littoral Plains Complex is represented by sandy beach spits and barrier beaches of combined littoral and aeolian origin. Tanamu 1 is positioned on a sand dune ridge (Figure 1.5). Tidal flats occur in the vicinity of the site. Sediments within

Figure 1.4. Tanamu 2 looking inland towards the hills, excavations in progress 28 November 2009 to provide a visual idea of environmental setting.

Figure 1.5. Oblique landscape view of the relationship between Bogi 1 and Tanamu 1, 2 and 3 in their environmental setting. Image sourced from Google Earth.

this zone are differentiated by the nature of tidal inundation; related sediments range from sandy to clay-dominated. Wave scour and tidal currents tend to remove finer materials where outer inundation is common, and inland-upland-derived detrital material is laid down on, and reworked by, shallower inner inundation, fluvial, and estuarine agents (Aplin *et al.* 2016; Mabbutt *et al.* 1965; Speight 1965).

The Coastal Lowland Complex is an uplifted marine plain, weakly dissected to create low plateaux and undulating surfaces. Soils are predominantly brown lithosols and texture-contrasted. Geology is typically a coarse conglomerate of mixed lithology, but with strong silicification, significant amounts of limestone and soft marl, all of late Tertiary age. Surficial coral rubble of Pleistocene age, presumably derived from uplifted and now degraded reef complexes, also occurs in the area (Löffler 1985; Mabbutt *et al.* 1965; Speight 1965).

Two mangrove communities are found in the vicinity of Tanamu 1. An inner mangrove zone is dominated by *Avicennia* which gives way to *Rhizophora* at greater inundation depths. Hyper-saline mudflats typically occur between the mangrove forest and the terrestrial habitats; these are sparsely vegetated with a hummocked, salt-marsh plant community. The border between mangrove and mudflat is typically abrupt. Landward of the mud flats is a zone of mixed dune scrub and evergreen-deciduous thickets. This grades into grassland that initially provides a dense groundcover, broken in places by moist depressions with herb and shrub recruitment and fringing *Pandanus*. Further inland, the groundcover thins and becomes drier and lower in stature (Aplin *et al.* 2016; Helyligers 1965; Mabbutt *et al.* 1965). Patches of savannah occur across a range of Caution Bay landforms, but it is most typically observed on well-drained Alluvial Plains Complex interfluves, extending up to the low coastal hills. *Eucalyptus* woodland savannah predominates, with a mixture of *E. alba*, *E. confertiflora*, *E. papuana*, and with a grass layer variously dominated by *Themeda*, *Heteropogon* and *Imperata* (Aplin *et al.* 2016; Helyligers 1965).

The problem of dating Lapita

The Caution Bay sites enable us to ask how the Late Lapita designs on ceramics, how the shell and lithic artefacts, and how the pattern of habitat exploitation each compare and contrast with those elsewhere in the Lapita world. Summerhayes (2000) has argued against geographically-based variations in Lapita styles (e.g., Anson 1983), suggesting instead that transformations in decorative style and vessel form are dominantly chronological. This provided a more robust interpretation of the progressive simplification of designs, opening-up of motifs, and the use of coarser-tined tools as one progresses from Early to Late Lapita across the cultural complex's geographical range (see Best 2002 for an alternative, geographical interpretation of variability). Despite this intensive research, there is room for considerable refinement of our understanding of temporal and spatial variation in design structure within and out of Lapita. Interpretations are currently compromised by the small number of published detailed site reports (see also Kirch 2000: 117) and by the poor chronological resolution of many excavated sites. In some places, considerable strides have been towards refining and solidifying radiocarbon sequences (e.g., Bedford 2006). Nevertheless, there are a number of obstacles which require ongoing work and further thought, including problems with post-depositional disturbance; issues of inbuilt age, especially problematic in unidentified charcoal dates (e.g., Allen and Wallace 2007; Nunn and Petchey 2013); the unknown ΔR values that should be applied to local shell species to calibrate radiocarbon determinations (which could vary by >100 years between species within any given region) (Petchey *et al.* 2012, 2013); and coarse-grained excavation methods (especially those applied during the early years of investigation) that limit our ability to refine taphonomic and chronostratigraphic interpretations. For some sites, '[t]he start and end dates for pottery use can only be defined by comparisons with other sites' (Specht 2007: 105), giving potential rise to problems of circular chronological reasoning. Archaeologists across the Pacific are keenly aware of these dating limitations, leading many to review, rethink and in some cases resolve (and in rare cases even reverse) previously established but problematic regional chronologies within and out of Lapita, such as the relationship of Mangaasi to Lapita wares in central Vanuatu (e.g., Bedford 2006; Spriggs and Bedford 2001).

One of the most problematic regional sequences of this kind, chronologically speaking, is also one of the most important and extensive, from the Talasea area of West New Britain Province (Specht and Torrence 2007a). Despite the recording of some 15,000 ceramic sherds from 23 ceramic find-spots with dentate-stamped pottery in this part of the Willaumez Peninsula, including the excavation of 69 test pits on Garua Island alone, uncertainties about the dating of particular finds and layers within individual sequences have led Specht and Torrence (2007a: 147) to conclude that '[t]here are undoubted difficulties with interpreting the relationship between 14C dates and many pottery contexts, particularly for the end of the main part of the Talasea sequence'. The main Lapita pottery sequence 'probably began ca. 3370–3140 cal. BP and ended during the period 2350–1850 cal. BP', as bracketed by the W-K2 and W-K3 tephras aided by a sequence of radiocarbon determinations (Specht and Torrence 2007a: 131).

Considerable post-depositional disturbance is evident at many sites across this tectonically active landscape, and the dating of the end of Lapita is particularly compromised (see also Spriggs 2001a: 240–241). As Specht and Torrence (2007a: 149) point out, '[s]etting a firm end-date for this part of the Talasea pottery sequence is problematic, particularly as we do not know whether it was an event or part of an extended process. Pottery probably ended during the period 2350–1820 cal. BP, before the W-K3 event at 1810–1620 cal. BP'. The dating uncertainties here are symptomatic of similar ambiguities surrounding the chronology for the ending of Lapita elsewhere in the Pacific.

A recent general overview concludes that '[t]he term 'Lapita' is not used for sites or assemblages that continue beyond about 2,000 years ago, but this is not a matter of an abrupt change so much as a gradual transformation' (Bolton 2012: 43). However, most archaeologists working in Island Melanesia would consider an age of 2000 years ago to post-date the end of Lapita by hundreds of years, despite fine-grained uncertainties. The question thus remains as to precisely when, and how, individual recognisably Lapita practices end (i.e., including how they transform out of recognisably Lapita forms) within each site and region, and how each of these local sequences articulates across progressively broader spatial scales to enable a general history of Lapita practices to be developed (see also Sheppard 2009). As emphasised by Spriggs (2003), it is only by accurately depicting archaeological discontinuities and transformations that we may then reach a better understanding of historical trajectories eventually leading into the ethnographic period. Only with better chronostratigraphic resolution of Lapita and descendant sites will we be able to determine whether cultural changes across Island Melanesia took place synchronously within and between Lapita phases (implying widespread cultural influence through renewed contacts between Lapita communities), or establish precisely when they became increasingly isolated or independent as they moved out of Lapita (as would be implied by increasingly regionalised archaeological signatures). The detailed publication of site sequences that include the minutiae of both chronostratigraphy and cultural materials is critical to the determination, independent assessment by researchers, and general acceptance of archaeological patterns and trends. Interpretations that are accountable through the transparent presentation of the evidence is at key.

Dating the Caution Bay Sites

The excavated sites from Caution Bay reported here and elsewhere include several deeply stratified sites such as Tanamu 1 (this volume) and Bogi 1 (McNiven *et al.* 2011), among others. These sites feature excellent stratigraphic separation between major occupation phases—typically due to the accretion of culturally sparse or sterile units—and this makes them particularly useful for cultural sequence-building. In addition, there are a large number of single-occupation sites that appear to be the result of relatively short-term occupation (e.g., Ataga 1, Tanamu 2), most of which were occupied for less than a century and frequently under 50 years. Finally, there are sites with multiple occupations (e.g., Tanamu 3) that are not as well separated vertically as Tanamu 1 or Bogi 1, but where the application of relatively thin excavation units have allowed the separation of different occupations and their secure dating. As a rule these latter sites with narrowly separated or slightly overlapping sequential occupations have been employed only with great caution for sequence-building purposes, as they have a greater potential for mixing than the well-separated deeply stratified or single-occupation sites.

All of the radiocarbon dates reported in this volume were determined by the accelerator mass spectrometry (AMS) method. Typically, we have dated single specks of charcoal or individual marine shells, and aimed for sufficiently dense sample coverage and replication to confidently understand occupation and sediment chronologies. Our objective both with radiocarbon dating, and with other site and artefact analyses, is to try to reach points of redundancy of results so as to be in a position of greater surety of interpretation to enable us to find repeated patterns that satisfy repeated interpretation. Furthermore, the dating of samples every few centimetres vertically allows both a clear characterisation of occupation duration while also alerting us to the presence of possible disturbances through the presence of dating inversions and other out-of-sequence dates. Wherever this occurs, the data from such levels are not used as the primary basis for sequence-building, a luxury we can afford for Caution Bay due to the presence of alternative squares or sites with higher levels of integrity in our large sample of excavated occupation deposits.

From the end of Lapita to the EPP

Prior to the Caution Bay discoveries, the earliest decorated ceramics known from along the southern mainland of PNG were dated somewhat short of 2000 cal BP (e.g., Allen 1977a; Kirch 2000: 121–122; Vanderwal 1973). These were characterised by impressed shell indentations somewhat reminiscent of much earlier comb dentate-stamped Lapita ceramics found in archipelagos hundreds of kilometres to the east and northeast. Ceramics of this kind were recorded by a number of researchers working in different parts of the south coast, separated by hundreds of kilometres of coastline. In each area, subsequent ceramic traditions featured progressive series of new decorative types appearing apparently contemporaneously between regions.

Building on Irwin's (1991) Early Papuan Ware, Summerhayes and Allen (2007) established the concept of Early Papuan Pottery (EPP) to represent the sum of all ceramic styles along the south coast of PNG, from the start of the then-known ceramic sequence at *c.* 2000 years ago to *c.* 1200 BP (see Allen *et al.* 2011 for a re-dating of the beginning of the Oposisi sequence on Yule Island to slightly earlier times). Subsequent to the 'ceramic hiccup'—a phase variably dated within the period *c.* 1200–800 BP, when ceramics appear to have largely ceased being exported to much of the Gulf of Papua west of Port Moresby—ceramic traditions along the south coast of PNG enter a period of pronounced regionalism that leads into the diversity observed in ethnographic times.

The discovery of substantially earlier ceramic traditions at Caution Bay, including both hallmark Lapita wares and others that demonstrate the subsequent transformation of Lapita into later archaeological phases (McNiven *et al.* 2011), led us to pose numerous new questions regarding the meaning and significance of the EPP (David *et al.* 2012). The radiocarbon determinations from the Caution Bay sites bridge the entire period from the newly found Lapita phase through to the production of the shell-impressed decorations at the start of the EPP at Oposisi and Nebira 4. We have previously presented a detailed description of Linear Shell Edge-Impressed ceramics dating to *c.* 2150–2100 cal BP at two squares from Bogi 1 at Caution Bay (David *et al.* 2012). Many other, as yet unpublished sites (and other hitherto unreported squares from Bogi 1) at Caution Bay also have large assemblages of Linear Shell Edge-Impressed ceramics of comparable age (to be reported in forthcoming monographs). The narrow age range of this ceramic tradition at Caution Bay, and the identification of rare sherds of this kind from at least one other previously excavated site near Port Moresby, albeit in association with sherds of other and later styles/traditions (e.g., Nebira 4, Allen 1972: figure 7 item 18 [see Figure 1.6A]), together serve to highlight the potential difficulties of identifying and dating such important but short-lived traditions prior to the application of fine-scale excavation methods and the availability of AMS radiocarbon dating. We also note that the Vanderwal (1973) Style 1 decoration on Type A shell-impressed sherds from Zone IIC at Oposisi—representing the previously oldest known ceramics from the south coast of PNG approaching 2000 cal BP—is akin to that of Caution Bay only in the sense that they are both shell impressions; the technical application of the shell to make an impression, and the designs, are quite different. In fact, these Style 1 shell body and umbo-impressed decorative designs from Yule Island are arguably as different from the Caution Bay Shell Edge-Impressed designs as they are from Lapita comb dentate impressions (Figure 1.7). This leaves open the question as to whether these two types of shell impressions represent regional variations of a common contemporaneous theme, or descendant developments, or more or less independent styles. It also prompts the question as to whether developmental sequence(s) within the EPP (i.e., of all the ceramic styles between *c.* 2000 years ago and *c.* 1200 BP along the south coast of PNG) represent parallel developmental sequences occurring concurrently across regions, or alternatively, incoming traded sherds from a more limited number of manufacturing centres.

The importance of this latter question has long been recognised in the context of archaeological research on the south coast of PNG (e.g., Allen and Duerden 1982; Allen and Rye 1982; Bickler 1997; Irwin 1985; Summerhayes and Allen 2007), with simultaneous developments being critical to (and defining) the full EPP model. However, as Bickler (1997: 152) has noted in relation to south coast ceramic sourcing

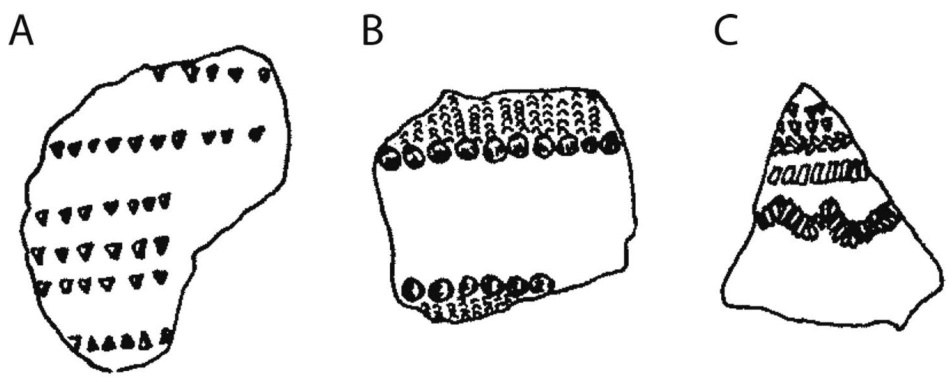

Figure 1.6. Style H ceramics from Nebira 4 (after Allen 1972: figure 7).

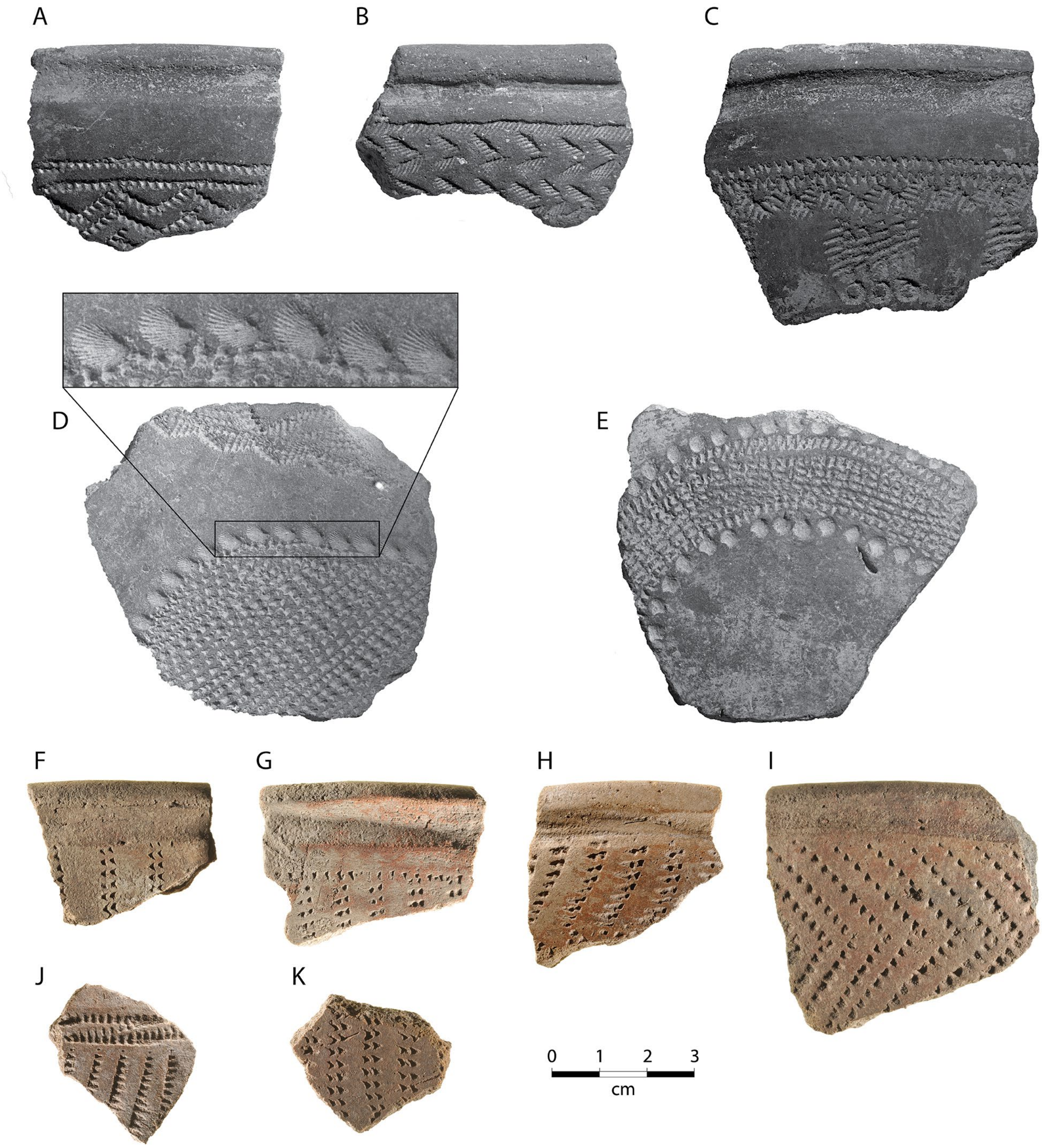

Figure 1.7. Examples of shell-impressed sherds from Oposisi, Yule Island (A–E) and Caution Bay (F–K).
Photographs: A–E courtesy of the School of Culture, History and Language, College of Asia and the Pacific, Australian National University Ron Vanderwal photographic archive; F–K: Steve Morton.

studies prior to the Caution Bay finds, '[l]ack of both tight chronological control and fine-grained stylistic information was a major problem … as most sherds came from surface collections'. Furthermore, these prior attempts at ceramic sourcing have been based on small archaeological sample sets and limited reference source clay and temper collections. It is thus still uncertain whether the earliest, shell-impressed sherds of Vanderwal's Style 1 of Zone IIC at Oposisi and Allen's Style H of Horizon 3 at Nebira 4 are local productions or, in one or both cases, represent goods imported from further afield. This problem is further compounded by the fact that the purported stylistic commonality of shell-impressed designs across regions is by no means established. In this context, Summerhayes and Allen (2007: 112–113) note that 'all the shell impressed samples and the two grooved lip samples' analysed by them from Oposisi and Nebira 4 had comparable fabrics, indicating that the 'seven samples from Nebira ... reflect a similar production to Oposisi and for which the most parsimonious explanation is that the raw materials or much more likely the finished pots came from the Oposisi area'. However, without confirmed sources, all of the vessels in question might have come from elsewhere. What is under consideration here is the possibility that this early phase of the EPP was typified not by a shared tradition of ceramic production from one region to the next across the broader landscape, but rather the movement along the south coast of PNG of ceramic vessels produced in a common source area. This hypothesised movement of shell-impressed ceramics along the south coast at the very onset of the EPP might formerly have made sense if the initial ceramic 'colonisation of the Papuan coast' (Summerhayes and Allen 2007: 98) was around 2000 years ago as originally thought. However, this option for the EPP is now placed in some doubt by the discovery that the EPP was preceded by another 900 years of ceramics at Caution Bay in the Port Moresby area, with no evidence to suggest that any of the decorative styles prior to *c.* 1700 cal BP (i.e., from Lapita to the most recent shell-impressed styles) developed in tandem as locally manufactured products wherever they are found. This leaves open the possibility that these widespread ceramic styles were traded over long distances from a small number of manufacturing centres, so that the spheres of influence do not so much inter-connect the entire coastline in chains of connection, but rather link individual locales to manufacturing centres as wheel-spoked connections. As is the case for ethnographic times, where long-distance maritime (e.g., Motu *hiri*, Mailu) and networked trade resulted in widely distributed ceramic trade wares of common origin, the emerging picture of widespread ceramics of similar style and fabric spread along the south coast some 2000 years ago might be better viewed as evidence of widespread direct or down-the-line trade (but see Summerhayes and Allen 2007; Irwin 1985 for a different view for Mailu to the east of Port Moresby). These widely different potential interpretations of the EPP highlight the great importance of sourcing studies for the Caution Bay ceramics, and therefore for a detailed characterisation of their tempers and clays; a task we do not undertake in the present monograph but which forms the subject of a separate, specialist study through the University of Otago, New Zealand. A detailed understanding of the chronostratigraphy of the Caution Bay sites, as presented here for Tanamu 1, forms a critical prerequisite for the sourcing study.

Some of the Lapita ceramics we have previously published from Caution Bay have raised debate, especially as they relate to Lapita and post-Lapita designs elsewhere in Island Melanesia and the south coast of PNG. Understanding the chronological context of Lapita in multiple sites across Caution Bay is of significance to these debates. For example, the question of the relationship between Lapita and the EPP at Caution Bay is highlighted by questions raised by Specht (2012: 4) about the age of a Bogi 1 sherd (Square K XU13 sherd #1) reported in McNiven *et al.* (2011: figure 5L) (Figure 1.8). This sherd has square comb dentate-stamped designs, a Lapita motif that is highly reminiscent of a similar, apparently later EPP shell-impressed motif (Figures 1.9C, 1.9D). Similar comb dentate-stamped square motifs are known from Lapita sites elsewhere in Island Melanesia, such as the distinctive sherd from Kamgot on Anir (reproduced in Specht *et al.* 2014: figure 3A). The Bogi 1 sherd in question comes from 127.1cm below surface in excavation Square K and is stratigraphically the lowest comb dentate-stamped sherd from that square. It lies 2.3cm below a typical Lapita sherd (Square K XU13 sherd #2) which has two rows of comb dentate impressions above paired arcs of comb dentate impressions. For Squares C and E–Q as a whole (the only squares from Bogi 1 analysed to this depth so far, with excavation of Squares A and B ceasing prior to the Lapita levels), the highest comb dentate-stamped sherd occurs at 109.9cm below the surface, and the deepest occurs at a depth of 144.0cm.

The Bogi 1 Square K XU13 sherd #1 with the comb dentate-stamped square design is firmly located within the well-defined Lapita horizon at that site which does not contain any sherd belonging to any other decorative style (i.e., it does not contain any shell-impressed sherds). We agree with Specht that this particular sherd is highly reminiscent of similar but later shell-impressed sherds attributed to the earliest phase of the EPP from other parts of the south coast of PNG (Bulmer 1978: figures 5.3, 5.4 [see Figures 1.9C, 1.9D]; Vanderwal 1973: figures VI-6, VI-1, VI-9). However, in light of its chronostratigraphic positioning, and of a total absence of other kinds of ceramics in this part of the Bogi 1 sequence, we do not see any reason to question its age. The Bogi 1 sherd unambiguously came from a Lapita comb dentate-stamped ceramic chronostratigraphic context. It is well bracketed by radiocarbon determinations of *c.* 2600 cal BP. As Specht notes, this sherd is thus 'earlier than the current date adopted for EPP by Allen *et al.* (2011)', and its age and characteristics beg elucidation of the cultural relationships between terminal Lapita and the earliest shell dentate-stamped ceramics (and the beginning of the EPP) at Caution Bay.

The discovery of previously unknown Lapita-into-EPP ceramic assemblages at Caution Bay demands a new interpretation of the past 2000 years of occupation along the south coast of PNG. The shell-impressed decoration reported by David *et al.* (2012) is essentially the only kind of ceramic decoration found at Caution

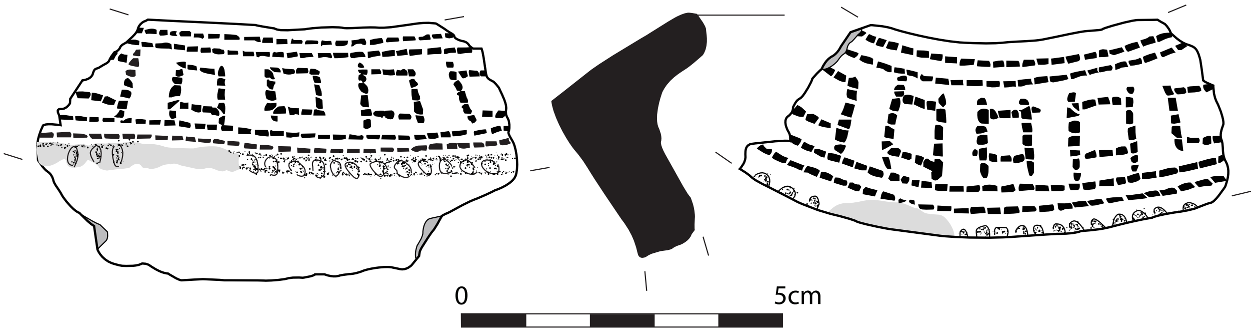

Figure 1.8. Bogi 1 Square K XU13 sherd #1.

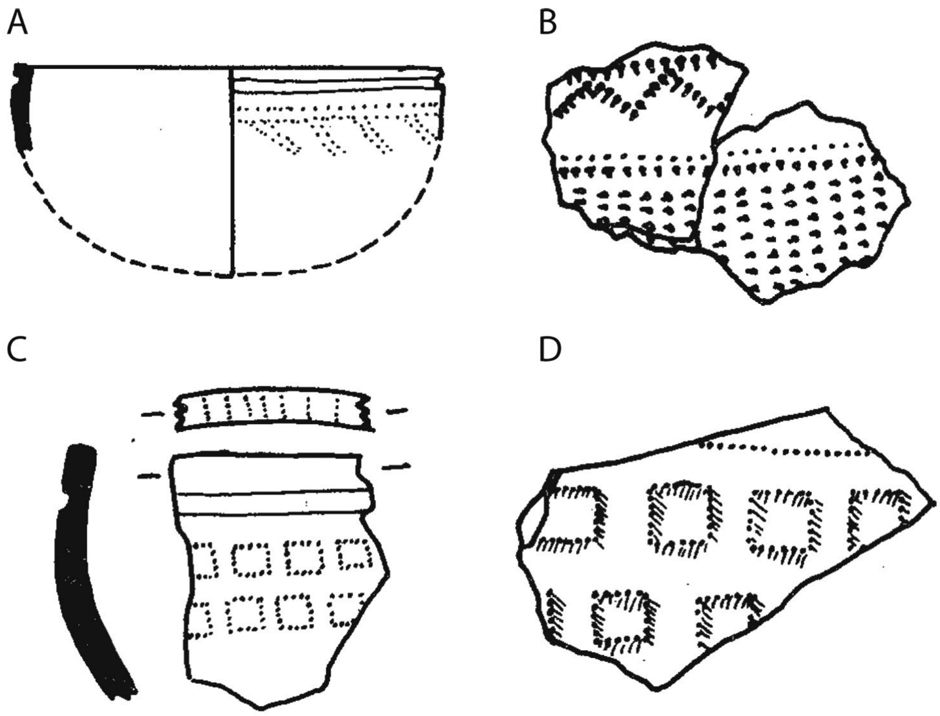

Figure 1.9. Non-Motu pottery of industry B5 from Port Moresby surface sites (after Bulmer 1969: figure 4).

Bay between *c.* 2150 and 2100 cal BP (with red slipping and a finger groove below the lip also occurring on some sherds), and it arguably forms a good precursor style for the previously oldest-known shell-impressed wares of the EPP tradition, beginning some 2000 years ago. The question is now as to whether the shell-impressed decorations found at Caution Bay between *c.* 2150 and 2100 cal BP, and again in the early EPP tradition, represent direct developments out of earlier Lapita traditions along the south coast of PNG, or whether the two are somehow independent. Irwin (2012: 10) appropriately asked for clarification of the 'developmental pottery sequence at Caution Bay from Late Lapita to EPP'. This prompts the research question: 'What is the stylistic and temporal relationship between terminal Lapita dentate-stamped and subsequent shell-impressed ceramics at Caution Bay?'.

In this monograph we contribute to the issue by reporting on Late Lapita at Caution Bay, so as to be in a position in later monographs to investigate how ceramics change between the end of Lapita and the start of the Linear Shell Edge-Impressed ceramics dating to *c.* 2150–2100 cal BP, as described by David *et al.* (2012).

What is also evident from the excavated sites is that the establishment of one or more Lapita colonies at Caution Bay *c.* 2900 cal BP was not a brief, localised or unsuccessful attempt at colonisation. Rather, it resulted in long-term settlements and led to a pattern of landscape change with ramifications that lasted millennia. As Specht (2012: 5) notes in relation to Kasasinabwana (a site on Wari Island in the Massim to the east; see Negishi and Ono 2009) though with broader applicability, 'we enter a controversial field about defining the end of Lapita pottery, and how to subdivide ... EPP into a time-series of styles'. Yet a reliable spatial history for the south coast of PNG as an interconnected region requires a finer-grained picture than is currently available on cultural landscapes and their associated material culture, including ceramics. This is a focus of both this and future Caution Bay monographs currently in progress.

Conclusion

In this monograph we report on the first of many excavations in sufficient detail for independent researchers to know what we found, and to assess for themselves the chronostratigraphic associations of individual finds. In turn, this will allow inter-regional comparisons of pre-Lapita, Lapita and post-Lapita assemblages to be made, the historical tracking of descendant assemblages, and comparisons of temporal trends across space. We begin with a detailed site report of Tanamu 1, followed respectively by specialist chapters on its ceramics, stone artefacts, molluscan remains, non-molluscan faunal remains, and worked shell so that the evidence can be made available to researchers.

Chapter 2.
Tanamu 1:
A 5000 Year Sequence from Caution Bay

Bruno David, Thomas Richards, Ian J. McNiven, Ken Aplin, Fiona Petchey, Katherine Szabó, Jerome Mialanes, Cassandra Rowe, Bryce Barker, Sean P. Connaughton, Matthew Leavesley, Herman Mandui and Chris Jennings

Introduction

Archaeological sites across Caution Bay often contain distinctive artefactual horizons of varying ages, making it possible to investigate cultural trends at a range of spatial and temporal scales over extended periods of time. Tanamu 1 is a site of particular interest because of its three distinct major occupation horizons that start with the pre-ceramic, followed by Lapita, and end with post-Lapita. The aim of this chapter is to report details of the site, focusing on its chronostratigraphy, so that its various cultural materials (reported in detail in Chapters 3–7) can be examined in context.

Tanamu 1, recorded as site JD6 in the field and allocated the official site code ABHA by the PNG National Museum and Art Gallery, is set in a succession of sub-parallel (coast-to-hinterland) environmental zones. From the coast progressively inland, the Caution Bay catchment contains in succession a Littoral Plains Zone, Alluvial Plains Complex, Coastal Lowland Complex and Hill-Ridge Complex which encompass the Papa, Boroko, Fairfax, Hanuabada and Tovobada land-systems of Mabbutt *et al.* (1965) (as outlined in Aplin *et al.* 2016). Each environmental zone has a distinctive geology, pattern of topography, soils and vegetation. From the mangrove and near-shore thicket, grasslands progressively thin with distance from the coast and as rocky substrates, tree proportions and non-eucalypt patch diversity increase.

Tanamu 1 is positioned above the Littoral Plains Zone where the fore-dunes slope to merge with the alluvial plain. Landform elevations increase around 5km and again at 7.2km inland from the site (corresponding with the Coastal Lowland and Hill-Ridge complexes

Figure 2.1. Tanamu 1 excavation in progress.

Figure 2.2. Mudflats and mangroves to the immediate southwest of Tanamu 1 at low tide.

Figure 2.3. Mudflats and mangroves to the immediate southwest of Tanamu 1 at high tide.

respectively). Tanamu 1 itself is located on the edge of an exposed coastal sand dune forming a low, northwest to southeast-trending peninsula (see Figures 1.1–1.2 for site location map). This grassy peninsula is flanked by the Ruisasi Creek estuary to the east and extensive intertidal mudflats and mangrove forest to the west; collectively the Littoral Plains Zone in the vicinity of Tanamu 1 is up to 800m wide. The site is found 5m above the present high water mark, 25m east of the high tide mark near the inland margins of the mangroves (see Figures 2.1–2.3, showing species of *Avicennia*). While Tanamu 1 is located in *Themeda* grassland, sparse stands of *Acacia*, *Eucalyptus* and *Pandanus* are present nearby.

There are no known Motu or Koita oral traditions about Tanamu 1, and indeed the site was unknown prior to its archaeological discovery in 2008. The site was named by the present authors after the Koita word *tanamu*, meaning 'low hill'. A *tanamu* can be of any shape or sediment type and does not necessarily consist of sand or have a linear form. Tanamu 1 is located 140m SSE of the Bogi 1 archaeological site found along the same coastal sand dune (David *et al.* 2011; McNiven *et al.* 2011). Like Bogi 1, Tanamu 1 exhibits three distinct horizons of dense midden material evidencing focused occupation. The lower level is pre-ceramic, the middle Lapita, and the upper post-Lapita (see below).

Methods

Field Methods

Tanamu 1 was discovered by cultural heritage consultant John Dop, Gau Ario of Papa village and archaeologist

Jeremy Ash during systematic archaeological surveys of the southern parts of the Caution Bay lowlands on 19 January 2008 as part of major development impact studies (David *et al.* 2016b). It was identified as a medium-sized, low density surface scatter of shell, pottery sherds and stone artefacts, 20m × 13m in size, with good potential to contain stratified sub-surface cultural deposits. From 3 December 2009 to 19 March 2010, two contiguous 1m × 1m squares (Squares A and B) were excavated to assess the nature of, and to sample, subsurface cultural deposits (Figures 2.4–2.9). The trench was oriented north-south/east-west and each square independently excavated in arbitrary Excavation Units (XUs) following the stratigraphy. XUs averaged 2.1 ± 0.5cm thick in each of Squares A and B. Field and laboratory methods followed the Caution Bay Project methods unless otherwise stated (see David *et al.* 2016a).

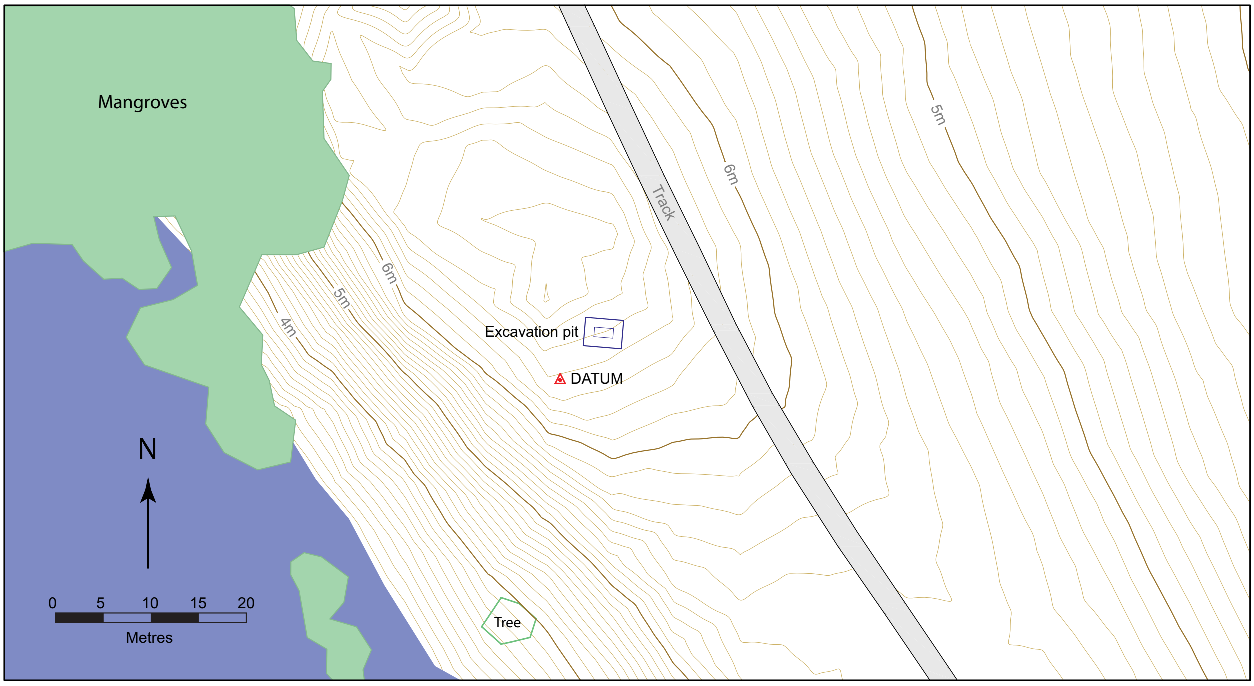

Figure 2.4. Tanamu 1 site map showing location of excavation trench. Contours in 10cm intervals.

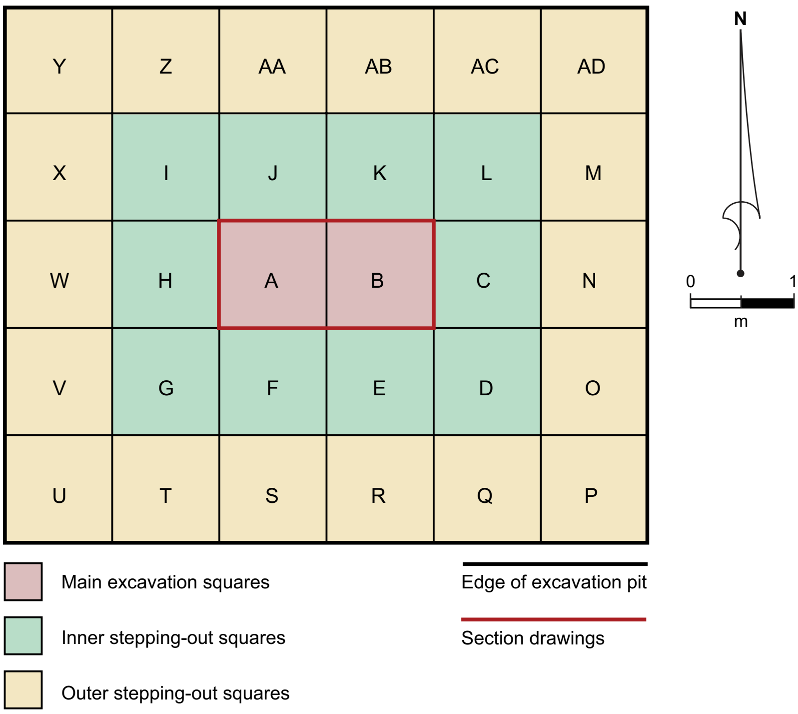

Figure 2.5. Plan of Tanamu 1 trench showing location of each excavation square.

Figure 2.6. Laying out of Tanamu 1 Squares A and B excavation trench showing low density of surface cultural materials.

Figure 2.7. Squares A and B and inner stepping-out squares, early stages of excavation in progress (photograph facing southwest).

Figure 2.8. Details of XUs, Tanamu 1 Square A.

XU	SU	Mean Depth at Top (cm)	Mean Depth at Centre (cm)	Mean Depth at Base (cm)	Mean Thickness (cm)	Weight (kg)	Volume (litres)
1	1	0.0	0.9	1.7	1.7	22.44	22.0
2	1	1.7	2.6	3.5	1.8	22.67	20.0
3	1	3.5	4.6	5.6	2.1	31.63	26.0
4	1	5.6	6.7	7.8	2.2	27.31	22.0
5	1	7.8	8.6	9.4	1.6	28.81	24.5
6	1	9.4	10.6	11.8	2.4	27.87	25.0
7	1	11.8	13.0	14.1	2.3	33.04	28.5
8	1+1a	14.1	15.1	16.0	1.9	30.01	26.5
9	1+1a	16.0	17.0	18.0	2.0	27.88	23.0
10	1+1a+2	18.0	18.9	19.7	1.7	26.05	20.5
11	1+1a+2	19.7	20.7	21.6	1.9	23.71	18.5
12	1+1a+2	21.6	22.9	24.2	2.6	36.89	30.5
13	1+1a+2	24.2	25.0	25.7	1.5	32.38	27.0
14	1+1a+2	25.7	27.4	29.1	3.4	44.41	34.5
15	2	29.1	30.0	30.9	1.8	31.25	22.5
16	2	30.9	32.6	34.2	3.3	39.65	28.5
17	2	34.2	34.3	34.4	0.2	4.80	3.5
18	2	34.4	35.2	36.0	1.6	17.95	13.5
19	2+3	36.0	36.9	37.7	1.7	27.92	20.5
20	2+3	37.7	38.6	39.5	1.8	26.81	19.5
21	2+3	39.5	40.4	41.2	1.7	25.28	18.0
22	2+3	41.2	42.4	43.5	2.3	31.94	22.5
23	2+3	43.5	44.3	45.0	1.5	22.89	18.0
24	2+3	45.0	45.9	46.7	1.7	24.72	20.0
25	2+3	46.7	48.2	49.7	3.0	44.14	37.5
26	2+3	49.7	50.9	52.1	2.4	33.85	24.5
27	2+3	52.1	53.2	54.3	2.2	25.01	19.0
28	3+4	54.3	54.8	55.3	1.0	15.16	11.7[a]
29	3+4	55.3	56.4	57.5	2.2	26.68	17.5
30	3+4	57.5	58.6	59.6	2.1	33.26	23.5
31	3+4	59.6	60.5	61.3	1.7	33.03	15.0
32	3+4	61.3	62.5	63.7	2.4	34.63	23.5
33	3+4	63.7	64.9	66.0	2.3	29.78	21.0
34	3+4	66.0	67.3	68.6	2.6	40.21	28.5
35	3+4	68.6	69.7	70.8	2.2	34.42	27.0
36	3+4	70.8	71.9	73.0	2.2	35.12	34.0
37	3+4	73.0	74.6	76.1	3.1	34.13	26.0
38	3+4	76.1	77.4	78.6	2.5	36.79	26.5
39	3+4	78.6	79.8	81.0	2.4	34.61	25.0
40	4	81.0	81.9	82.7	1.7	29.34	21.0
41	4	82.7	84.4	86.0	3.3	39.70	28.0
42	4+5	86.0	87.6	89.1	3.1	32.28	25.0
43	4+5	89.1	90.3	91.4	2.3	36.91	26.0
44	4+5	91.4	92.7	94.0	2.6	31.40	22.0
45	4+5	94.0	95.3	96.5	2.5	34.86	25.0
46	4+5	96.5	97.6	98.7	2.2	35.00	26.0

XU	SU	Mean Depth at Top (cm)	Mean Depth at Centre (cm)	Mean Depth at Base (cm)	Mean Thickness (cm)	Weight (kg)	Volume (litres)
47	4+5	98.7	99.8	100.9	2.2	29.55	25.0
48	4+5	100.9	103.0	105.0	4.1	47.10	36.5
49	4+5	105.0	106.0	106.9	1.9	28.78	22.0
50	4+5	106.9	108.0	109.1	2.2	21.63	22.5
51	4+5	109.1	110.0	110.8	1.7	21.37	15.5
52	4+5	110.8	111.7	112.5	1.7	34.25	25.5
53	4+5	112.5	113.8	115.0	2.5	35.35	26.5
54	4+5	115.0	115.8	116.5	1.5	22.68	8.0
55	4+5	116.5	117.6	118.7	2.2	31.41	24.0
56	4+5	118.7	119.6	120.4	1.7	32.44	26.0
57	5	120.4	121.7	123.0	2.6	30.01	21.5
58	5	123.0	124.1	125.2	2.2	31.65	27.0
59	5	125.2	126.4	127.6	2.4	37.24	27.0
60	5	127.6	128.5	129.4	1.8	21.21	17.5
61	5	129.4	130.8	131.7	2.3	34.97	26.5
62	5	131.7	132.9	134.1	2.4	34.47	25.0
63	5	134.1	135.2	136.3	2.2	32.38	25.5
64	5+6	136.3	137.8	139.2	2.9	34.67	25.0
65	5+6	139.2	140.2	141.1	1.9	29.02	26.0
66	5+6	141.1	142.8	144.4	3.3	46.42	30.0
67	5+6	144.4	145.3	146.2	1.8	31.66	25.5
68	5+6	146.2	146.7	147.2	1.0	7.47	7.0
69	5+6	147.2	147.9	148.6	1.4	22.94	17.0
70	5+6	148.6	149.5	150.4	1.8	23.00	18.5
71	6	150.4	151.0	151.5	1.1	17.24	12.5
72	6	151.5	152.5	153.5	2.0	23.70	16.5
73	6	153.5	154.7	155.8	2.3	19.66	23.5
74	6	155.8	156.6	157.3	1.5	22.90	17.6[a]
75	6	157.3	158.5	159.7	2.4	39.90	32.5
76	6	159.7	160.6	161.5	1.8	27.53	20.5
77	6	161.5	162.4	163.3	1.8	26.76	23.5
78	6	163.3	164.3	165.2	1.9	33.64	27.0
79	6	165.2	166.1	167.0	1.8	28.83	23.0
80	6	167.0	168.2	169.3	2.3	34.27	26.0
81	6	169.3	170.5	171.6	2.3	29.42	25.5
82	6	171.6	172.6	173.5	1.9	33.21	27.0
83	6	173.5	174.6	175.6	2.1	29.42	25.5
84	6	175.6	176.5	177.3	1.7	29.36	30.5
85	6	177.3	178.4	179.5	2.2	33.47	23.0
86	6	179.5	180.3	181.0	1.5	26.44	22.0
87	6	181.0	182.2	183.3	2.3	40.35	29.0
88	6	183.3	184.3	185.3	2.0	30.76	25.0
89	6	185.3	186.6	187.9	2.6	40.38	31.0
90	6	187.9	188.9	189.8	1.9	29.80	24.5
91	6	189.8	191.0	192.1	2.3	41.13	32.5
92	6	192.1	193.1	194.1	2.0	33.34	25.0
93	6	194.1	195.3	196.5	2.4	37.73	31.0

XU	SU	Mean Depth at Top (cm)	Mean Depth at Centre (cm)	Mean Depth at Base (cm)	Mean Thickness (cm)	Weight (kg)	Volume (litres)
94	6	196.5	197.1	197.7	1.2	18.20[a]	14.0
95	6	197.7	198.5	199.3	1.6	13.25	10.5
96	6	199.3	200.4	201.5	2.2	41.90	35.0
97	6	201.5	202.4	203.3	1.8	25.72	20.5
98	6	203.3	204.4	205.5	2.2	34.87	28.0
99	6	205.5	206.4	207.2	1.7	32.60	26.5
100	6	207.2	208.2	209.2	2.0	29.69	16.5
101	6	209.2	210.3	211.4	2.2	37.50	23.5
102	6	211.4	212.4	213.4	2.0	31.85	25.0
103	6	213.4	214.6	215.8	2.4	30.19	24.0
104	6+7	215.8	216.9	217.9	2.1	37.37	27.0
105	6+7	217.9	219.1	219.3	1.4	28.42	21.0
106	6+7	219.3	220.2	221.1	1.8	29.63	23.0
107	6+7	221.1	222.4	223.7	2.6	40.30	29.0
108	6+7	223.7	224.6	225.5	1.8	26.14	17.0
109	6+7	225.5	226.4	227.3	1.8	26.77	20.0
110	6+7	227.3	228.3	229.3	2.0	32.06	23.0
111	6+7	229.3	230.3	231.2	1.9	29.49	23.5
112	6+7	231.2	232.1	233.0	1.8	34.69	26.0
113	6+7	233.0	234.1	235.1	2.1	30.18	27.0
114	6+7	235.1	236.2	237.3	2.2	32.44	25.5
115	6+7	237.3	238.3	239.2	1.9	34.49	25.5
116	7	239.2	240.5	241.8	2.6	32.67	26.0
117	7	241.8	242.6	243.4	1.6	32.13	25.0
118	7	243.4	244.5	245.6	2.2	32.56	26.0
119	7	245.6	246.8	248.0	2.4	34.34	27.0
120	7	248.0	249.0	249.9	1.9	33.98	25.5
121	7	249.9	250.9	251.9	2.0	34.32	26.5
122	7	251.9	253.2	254.4	2.5	38.08	28.5
123	7	254.4	255.5	256.5	2.1	34.59	25.0
124	7	256.5	257.5	258.4	1.9	31.14	25.0
125	7	258.4	258.6	258.8	0.4	14.41	11.0
126	7	258.8	260.0	261.2	2.4	33.32	26.0
127	7	261.2	262.4	263.5	2.3	33.32	27.0
128	7	263.5	264.9	266.2	2.7	44.10	33.5
129	7	266.2	267.8	269.3	3.1	45.33	33.5
130	7	269.3	270.6	271.8	2.5	42.08	31.5
131	7	271.8	273.4	274.9	3.1	49.54	39.0
132	7	274.9	276.4	277.9	3.0	36.86	32.5
133	7	277.9	278.9	279.9	2.0	32.08	21.5
134	7	279.9	281.0	282.1	2.2	27.34	29.5
Total					2.1	4,169.47	3,223.3

[a] Original values were missing from the excavation records and are here estimated from average weight-volume ratios for the square as a whole.

Figure 2.9. Details of XUs, Tanamu 1 Square B.

XU	SU	Mean Depth at Top (cm)	Mean Depth at Centre (cm)	Mean Depth at Base (cm)	Mean Thickness (cm)	Weight (kg)	Volume (litres)	pH	Organic matter (% weight)	Particles >1000 µm (% weight)	Particle size distribution of particles <1000 µm (% volume)					
											sand (1000–63 µm)	*coarse sand (1000–600 µm)*	*medium sand (600–212 µm)*	*fine sand (212–63 µm)*	silt (63–2 µm)	clay (<2 µm)
1	1	0.0	1.0	1.9	1.9	17.20	16.5	Not available								
2	1	1.9	2.5	3.1	1.2	17.45	18.0									
3	1	3.1	4.3	5.4	2.3	35.97	24.0									
4	1	5.4	6.3	7.2	1.8	27.17	23.0	6.51	3.40	0.3	92.5	*0.4*	*28.8*	*63.3*	4.5	3.0
5	1	7.2	8.2	9.2	2.0	62.15	30.0	6.60	4.38	1.5	88.6	*0.1*	*28.0*	*60.5*	8.4	3.0
6	1	9.2	10.2	11.2	2.0		27.0	Not available								
7	1	11.2	12.6	13.9	2.7	36.68	38.0									
8	1	13.9	15.0	16.0	2.1	37.66	34.0									
9	1	16.0	17.0	17.9	1.9	23.31	25.0									
10	1+2	17.9	18.8	19.7	1.8	27.53	23.5									
11	1+2	19.7	20.6	21.5	1.8	23.24	19.5									
12	1+2	21.5	22.6	23.7	2.2	29.62	27.0	6.44	2.02	0.5	91.9	*0.4*	*29.0*	*62.5*	6.2	1.9
13	1+2	23.7	24.5	25.3	1.6	27.83	26.0	Not available								
14	1+2	25.3	26.6	27.9	2.6	33.33	26.0									
15	2	27.9	29.1	30.3	2.4	31.59	25.0									
16	2	30.3	31.7	33.1	2.8	41.71	30.0									
17	2	33.1	33.6	34.1	1.0	17.98	12.0									
18	2	34.1	35.0	35.8	1.7	23.02	16.5	6.45	1.66	0.4	91.5	*0.3*	*26.6*	*64.6*	6.6	1.9
19	2	35.8	36.8	37.8	2.0	28.10	20.0	6.32	1.73	0.3	91.6	*0.4*	*27.0*	*64.2*	6.7	1.7
20	2	37.8	38.8	39.7	1.9	25.42	18.5	Not available								
21	2	39.7	40.7	41.6	1.9	26.06	19.5	6.42	1.63	0.5	92.5	*1.7*	*28.9*	*61.9*	6.3	1.2
22	2+3	41.6	42.6	43.6	2.0	27.72	20.0	6.35	1.69	0.8	90.0	*0.1*	*25.9*	*64.0*	7.9	2.1
23	2+3	43.6	44.5	45.3	1.7	27.73	22.0	Not available								
24	2+3	45.3	46.3	47.3	2.0	28.13	20.0	6.88	1.78	1.9	88.4	*0.1*	*25.1*	*63.2*	9.8	1.8

XU	SU	Mean Depth at Top (cm)	Mean Depth at Centre (cm)	Mean Depth at Base (cm)	Mean Thickness (cm)	Weight (kg)	Volume (litres)	pH	Organic matter (% weight)	Particles >1000 µm (% weight)	Particle size distribution of particles <1000 µm (% volume)					
											sand (1000–63 µm)	*coarse sand (1000–600 µm)*	*medium sand (600–212 µm)*	*fine sand (212–63 µm)*	silt (63–2 µm)	clay (<2 µm)
25	2+3	47.3	48.6	49.9	2.6	35.92	26.0	Not available								
26	2+3	49.9	50.8	51.7	1.8	21.01	18.0									
27	2+3	51.7	52.7	53.6	1.9	29.90	21.5									
28	2+3+4	53.6	54.5	55.3	1.7	28.94	21.0									
29	2+3+4	55.3	56.4	57.5	2.2	31.49	22.0									
30	2+3+4	57.5	59.0	60.4	2.9	45.28	31.5	7.27	1.66	1.1	91.4	*0.4*	*28.1*	*62.9*	7.2	1.4
31	3+4	60.4	61.2	62.0	1.6	9.52	14.5	7.31	1.59	3.0	90.6	*0.9*	*28.6*	*61.1*	7.9	1.5
32	3+4	62.0	63.4	64.8	2.8	34.57	23.5	7.42	1.50	6.3	82.0	*0.0*	*24.4*	*57.6*	15.4	2.6
33	3+4	64.8	65.8	66.8	2.0	30.82	24.0	Not available								
34	3+4	66.8	68.2	69.6	2.8	45.65	32.0	7.44	1.49	1.3	91.5	*1.7*	*28.1*	*61.7*	6.5	2.0
35	3+4	69.6	70.9	72.1	2.5	29.51	21.0	Not available								
36	3+4	72.1	72.9	73.7	1.6	33.46	24.0									
37	3+4	73.7	74.8	75.9	2.2	30.49	22.0	7.65	1.32	1.7	91.6	*2.4*	*28.2*	*61.0*	6.4	2.0
38	3+4	75.9	77.4	78.8	2.9	41.38	29.0	Not available								
39	3+4	78.8	79.0	81.1	2.3	33.74	25.0									
40	4	81.1	82.3	83.4	2.3	35.80	26.5	7.73	1.26	1.7	91.9	*0.4*	*27.2*	*64.3*	6.1	2.0
41	4	83.4	84.6	85.8	2.4	37.09	27.0	7.67	2.37	1.2	92.9	*1.4*	*28.3*	*63.2*	5.3	1.8
42	4	85.8	86.8	87.7	1.9	28.86	20.0	7.78	1.24	1.5	91.5	*0.5*	*26.5*	*64.5*	6.3	2.2
43	4	87.7	89.0	90.3	2.6	32.15	24.0	7.89	1.24	1.8	91.3	*0.0*	*26.9*	*64.4*	6.6	2.1
44	4	90.3	91.7	93.0	2.7	38.67	29.5	7.83	1.32	1.4	90.5	*0.0*	*24.0*	*66.5*	7.3	2.2
45	4+5	93.0	94.2	95.4	2.4	40.53	30.0	7.86	1.32	2.0	87.3	*0.0*	*18.7*	*68.6*	10.0	2.7
46	4+5	95.4	96.4	97.3	1.9	27.73	22.0	7.92	1.42	3.6	90.3	*0.7*	*26.5*	*63.1*	7.3	2.4
47	4+5	97.3	98.6	99.8	2.5	36.68	27.0	7.77	1.58	1.5	90.4	*0.1*	*25.5*	*64.8*	7.2	2.4
48	4+5	99.8	101.2	102.5	2.7	37.95	27.0	Not available								
49	4+5	102.5	103.6	104.7	2.2	38.98	29.0									
50	4+5	104.7	105.9	107.0	2.3	42.07	24.0	7.84	1.93	2.4	87.7	*0.1*	*27.2*	*60.4*	9.1	3.2
51	4+5	107.0	107.9	108.7	1.7	23.09	18.0	7.87	2.62	4.6	83.7	*0.0*	*21.9*	*61.8*	12.2	4.1
52	4+5	108.7	109.6	110.4	1.7	26.27	19.5	Not available								
53	5	110.4	111.4	112.3	1.9	16.92	21.0	7.85	2.32	1.0	83.7	*0.0*	*26.4*	*57.3*	11.9	4.4

XU	SU	Mean Depth at Top (cm)	Mean Depth at Centre (cm)	Mean Depth at Base (cm)	Mean Thickness (cm)	Weight (kg)	Volume (litres)	pH	Organic matter (% weight)	Particles >1000 µm (% weight)	Particle size distribution of particles <1000 µm (% volume)					
											sand (1000–63 µm)	*coarse sand (1000–600 µm)*	*medium sand (600–212 µm)*	*fine sand (212–63 µm)*	silt (63–2 µm)	clay (<2 µm)
54	5	112.3	113.1	113.9	1.6	31.43	16.0	7.83	1.85	2.8	84.3	*0.0*	*26.5*	*57.8*	11.5	4.2
55	5	113.9	114.8	115.7	1.8	29.44	25.0	7.83	2.55	5.8	83.5	*0.0*	*29.3*	*54.2*	12.5	4.0
56	5	115.7	116.5	117.2	1.5	21.43	16.5	7.84	2.43	2.6	79.2	*0.0*	*23.3*	*55.9*	15.2	5.6
57	5	117.2	118.4	119.6	2.4	31.01	22.0	7.85	2.57	2.4	82.4	*0.1*	*27.1*	*55.2*	12.7	4.9
58	5	119.6	120.7	121.8	2.2	32.06	26.0	7.86	2.51	3.6	80.9	*0.0*	*19.7*	*61.2*	13.8	5.3
59	5	121.8	122.9	123.9	2.1	29.80	22.5	Not available								
60	5	123.9	124.7	125.4	1.5	24.61	19.5	7.98	2.11	3.7	81.8	*0.0*	*24.8*	*57.0*	13.3	4.9
61	5	125.4	126.6	127.7	2.3	32.17	23.5	8.00	2.03	1.8	80.2	*0.0*	*23.3*	*56.9*	13.4	6.4
62	5	127.7	129.0	130.3	2.6	23.53	26.0	7.98	1.97	2.8	85.3	*0.0*	*28.9*	*56.4*	10.1	4.6
63	5	130.3	131.6	132.8	2.5	31.69	23.5	7.97	1.89	4.5	83.0	*0.0*	*22.7*	*60.3*	12.5	4.5
64	5	132.8	134.1	135.3	2.5	34.50	28.0	8.00	1.60	10.6	88.2	*0.2*	*31.0*	*57.0*	8.4	3.4
65	5	135.3	136.3	137.3	2.0	33.90	26.0	8.10	1.50	1.4	89.3	*1.1*	*32.4*	*55.8*	8.0	2.7
66	5	137.3	138.9	140.5	3.2	48.53	33.5	8.10	1.43	1.6	89.5	*1.4*	*33.3*	*54.8*	7.8	2.7
67	5	140.5	141.9	143.2	2.7	44.74	31.0	8.04	1.33	3.5	85.3	*0.3*	*28.2*	*56.8*	11.0	3.7
68	5+6	143.2	143.6	144.0	0.8	10.99	9.0	8.09	1.25	3.0	89.8	*0.2*	*31.1*	*58.5*	7.6	2.6
69	5+6	144.0	145.2	146.3	2.3	22.49	17.0	8.19	1.11	0.9	84.3	*0.0*	*28.4*	*55.9*	12.1	3.6
70	5+6	146.3	146.8	147.3	1.0	27.59	23.5	8.23	0.94	0.4	89.3	*0.0*	*27.5*	*61.8*	8.0	2.7
71	5+6	147.3	148.2	149.1	1.8	25.34	19.0	8.29	0.90	1.9	93.3	*0.5*	*33.9*	*58.9*	4.9	1.8
72	5+6	149.1	150.3	151.4	2.3	30.35	25.0	8.32	0.94	0.2	91.7	*0.1*	*30.1*	*61.5*	6.2	2.1
73	5+6	151.4	152.2	152.9	1.5	27.80	19.5	8.30	0.97	0.3	84.0	*0.0*	*20.9*	*63.1*	13.5	2.5
74	5+6	152.9	154.1	155.2	2.3	33.94	26.5[a]	8.30	0.98	0.3	93.2	*0.7*	*32.1*	*60.4*	5.1	1.7
75	6	155.2	155.8	156.8	1.6	25.42	22.0	8.33	0.91	3.4	85.8	*0.2*	*28.6*	*57.0*	12.3	1.9
76	6	156.8	157.8	158.7	1.9	36.78	27.0	8.40	0.82	0.9	92.8	*0.4*	*32.2*	*60.2*	5.9	1.3
77	6	158.7	159.6	160.4	1.7	16.22	13.5	8.42	0.82	0.3	94.6	*1.0*	*34.7*	*58.9*	4.0	1.4
78	6	160.4	161.2	162.0	1.6	24.48	21.0	8.42	0.89	1.6	90.3	*0.1*	*24.3*	*65.9*	7.9	1.8
79	6	162.0	163.1	164.2	2.2	38.08	32.0	8.43	0.90	0.2	92.9	*1.5*	*33.7*	*57.7*	5.9	1.2
80	6	164.2	165.2	166.2	2.0	27.87	24.5	8.42	0.88	0.5	93.4	*1.6*	*35.2*	*56.6*	5.4	1.2
81	6	166.2	167.3	168.3	2.1	30.47	25.5	8.43	0.90	0.6	94.0	*1.4*	*33.6*	*59.0*	4.6	1.4
82	6	168.3	169.5	170.7	2.4	38.07	32.5	8.36	0.88	0.2	88.9	*0.3*	*29.4*	*59.2*	9.3	1.8

XU	SU	Mean Depth at Top (cm)	Mean Depth at Centre (cm)	Mean Depth at Base (cm)	Mean Thickness (cm)	Weight (kg)	Volume (litres)	pH	Organic matter (% weight)	Particles >1000 µm (% weight)	Particle size distribution of particles <1000 µm (% volume)					
											sand (1000–63 µm)	*coarse sand (1000–600 µm)*	*medium sand (600–212 µm)*	*fine sand (212–63 µm)*	silt (63–2 µm)	clay (<2 µm)
83	6	170.7	171.8	172.8	2.1	30.77	26.0	8.31	0.90	0.7	91.9	*0.5*	*32.1*	*59.3*	6.4	1.7
84	6	172.8	173.9	175.0	2.2	32.23	25.0	8.40	0.89	0.2	89.5	*0.4*	*33.2*	*55.9*	8.6	1.9
85	6	175.0	175.9	176.8	1.8	27.60	23.0	8.38	1.10	0.6	90.0	*0.5*	*34.2*	*55.3*	8.1	1.9
86	6	176.8	177.8	178.7	1.9	32.84	24.5	8.48	0.84	0.8	94.7	*1.6*	*36.4*	*56.7*	3.9	1.4
87	6	178.7	179.9	180.9	2.2	34.18	27.5	8.48	0.83	0.5	91.2	*0.4*	*32.1*	*58.7*	7.2	1.6
88	6	180.9	182.0	183.1	2.2	30.22	25.0	8.54	0.88	0.7	94.5	*0.8*	*37.3*	*56.4*	4.3	1.2
89	6	183.1	184.3	185.4	2.3	39.93	34.0	8.50	0.91	1.3	94.3	*0.7*	*35.5*	*58.1*	4.3	1.4
90	6	185.4	186.6	187.7	2.3	31.15	25.0	8.56	0.93	0.3	94.6	*0.4*	*34.8*	*59.4*	4.1	1.3
91	6	187.7	189.0	190.2	2.5	38.18	32.0	8.52	0.93	0.9	91.6	*1.4*	*37.3*	*52.9*	6.9	1.5
92	6	190.2	191.2	192.2	2.0	33.49	26.5	8.54	1.04	1.0	91.6	*2.5*	*38.6*	*50.5*	7.0	1.4
93	6	192.2	193.4	194.6	2.4	34.63	27.5	8.57	0.95	1.6	93.4	*3.4*	*44.2*	*45.8*	5.4	1.2
94	6	194.6	195.2	195.7	1.1	14.86	12.5	8.60	0.82	3.0	88.8	*1.7*	*39.6*	*47.5*	9.5	1.7
95	6	195.7	196.6	197.4	1.7	19.99	15.5	8.60	0.83	6.4	90.0	*2.5*	*38.6*	*48.9*	8.1	1.9
96	6	197.4	198.3	199.2	1.8	23.86	18.0	8.64	0.73	0.5	88.9	*0.6*	*40.0*	*48.3*	9.3	1.8
97	6	199.2	200.1	200.9	1.7	33.63	25.5	8.65	0.98	5.2	94.4	*4.2*	*46.6*	*43.6*	4.4	1.2
98	6	200.9	201.9	202.9	2.0	35.17	30.0	8.59	0.88	0.4	94.4	*3.4*	*44.2*	*46.8*	4.5	1.1
99	6	202.9	203.8	204.7	1.8	32.65	20.5	8.61	0.91	1.0	94.1	*2.7*	*40.9*	*50.5*	4.6	1.3
100	6	204.7	205.6	206.4	1.7	22.50	26.0	8.57	0.74	1.0	94.5	*3.1*	*42.9*	*48.5*	4.3	1.2
101	6	206.4	207.6	208.8	2.4	29.68	24.5	8.60	0.72	0.9	95.0	*3.5*	*42.4*	*49.1*	3.8	1.2
102	6	208.8	209.7	210.6	1.8	27.60	22.5	8.63	0.73	3.0	95.4	*3.9*	*46.2*	*45.3*	3.5	1.1
103	6	210.6	211.9	213.1	2.5	35.69	29.0	8.61	0.80	1.6	96.3	*4.3*	*47.0*	*45.0*	2.8	0.9
104	6	213.1	213.8	214.5	1.4	22.56	18.0	8.63	0.78	1.8	93.2	*3.7*	*43.1*	*46.4*	5.6	1.2
105	6	214.5	215.6	216.6	2.1	33.61	28.0	8.63	0.80	1.9	92.0	*2.4*	*39.9*	*49.7*	6.4	1.6
106	6	216.6	217.3	218.0	1.4	23.95	20.0	8.62	0.81	4.9	95.1	*3.1*	*48.6*	*43.4*	3.7	1.2
107	6	218.0	219.0	220.0	2.0	32.48	26.5	8.62	0.91	2.8	78.3	*0.0*	*19.5*	*58.8*	18.9	2.8
108	6	220.0	220.9	221.7	1.7	22.00	16.5	8.67	0.92	3.1	88.9	*0.6*	*40.0*	*48.3*	9.3	1.8
109	6+7	221.7	222.6	223.5	1.8	29.52	22.5	8.55	0.87	2.7	95.5	*3.5*	*49.9*	*42.1*	3.3	1.2
110	6+7	223.5	224.6	225.7	2.2	27.85	21.5	8.57	0.91	0.9	96.0	*4.3*	*48.8*	*42.9*	2.9	1.1
111	6+7	225.7	227.0	228.2	2.5	34.84	28.0	8.63	0.96	2.0	95.9	*3.7*	*54.4*	*37.8*	3.0	1.1

XU	SU	Mean Depth at Top (cm)	Mean Depth at Centre (cm)	Mean Depth at Base (cm)	Mean Thickness (cm)	Weight (kg)	Volume (litres)	pH	Organic matter (% weight)	Particles >1000 µm (% weight)	Particle size distribution of particles <1000 µm (% volume)					
											sand (1000–63 µm)	*coarse sand (1000–600 µm)*	*medium sand (600–212 µm)*	*fine sand (212–63 µm)*	silt (63–2 µm)	clay (<2 µm)
112	6+7	228.2	229.0	229.7	1.5	22.43	18.0	8.64	0.93	1.9	95.0	*3.2*	*49.8*	*42.0*	3.7	1.3
113	6+7	229.7	231.0	232.3	2.6	40.58	29.0	8.66	0.94	1.7	94.7	*3.5*	*52.0*	*39.2*	4.0	1.3
114	6+7	232.3	233.3	234.2	1.9	27.59	21.0	8.65	0.92	4.3	95.5	*4.5*	*54.8*	*36.2*	3.4	1.1
115	6+7	234.2	235.1	236.0	1.8	34.12	27.5	8.65	0.97	3.1	95.6	*4.0*	*55.5*	*36.1*	3.3	1.1
116	6+7	236.0	237.3	238.6	2.6	23.80	26.0	8.69	0.97	6.2	95.8	*3.6*	*57.6*	*34.6*	3.2	1.0
117	6+7	238.6	239.5	240.3	1.7	33.29	24.0	8.71	0.95	3.8	96.1	*4.5*	*56.2*	*35.4*	2.9	1.0
118	7	240.3	241.5	242.6	2.3	31.06	24.5	8.69	0.97	3.7	92.5	*3.9*	*51.1*	*37.5*	5.9	1.6
119	7	242.6	243.9	245.2	2.6	36.47	27.0	8.53	1.00	6.0	95.8	*5.2*	*56.3*	*34.3*	3.1	1.1
120	7	245.2	246.2	247.1	1.9	32.02	25.0	3.60	1.00	2.6	94.7	*3.7*	*54.5*	*36.5*	3.9	1.4
121	7	247.1	248.3	249.4	2.3	32.04	25.0	8.61	0.99	4.0	95.6	*5.2*	*55.5*	*34.9*	3.3	1.1
122	7	249.4	250.4	251.4	2.0	33.13	25.0	8.61	0.96	11.3	94.3	*6.4*	*54.2*	*33.7*	4.2	1.5
123	7	251.4	252.3	253.1	1.7	27.22	20.5	8.68	0.99	4.5	94.8	*7.4*	*52.2*	*35.2*	3.8	1.4
124	7	253.1	254.1	255.0	1.9	26.15	20.0	8.65	0.89	1.0	95.2	*7.2*	*54.7*	*33.3*	3.6	1.2
125	7	255.0	255.6	256.2	1.2	21.06	16.0	8.65	0.91	3.3	94.8	*5.6*	*51.0*	*38.2*	3.8	1.4
126	7	256.2	257.1	258.0	1.8	31.25	25.5	8.65	0.94	2.5	97.2	*9.5*	*54.1*	*33.6*	2.1	0.7
127	7	258.0	259.4	260.7	2.7	34.46	26.5	8.66	0.88	2.3	94.3	*9.3*	*51.4*	*33.6*	4.3	1.4
128	7	260.7	262.2	263.7	3.0	43.52	36.0	8.67	0.80	3.6	92.5	*5.2*	*46.2*	*41.1*	5.9	1.6
129	7	263.7	265.2	266.6	2.9	48.96	36.5	8.70	0.71	4.1	94.5	*14.5*	*45.0*	*35.0*	4.4	1.1
130	7	266.6	268.1	269.6	3.0	40.53	33.5	7.67	0.76	2.2	94.9	*14.5*	*45.8*	*34.6*	4.1	1.0
131	7	269.6	271.4	273.1	3.5	51.10	41.0	8.70	0.78	2.9	94.9	*14.9*	*45.2*	*34.8*	4.0	1.1
132	7	273.1	274.3	275.5	2.4	30.19	30.0	8.69	0.75	5.6	93.4	*12.1*	*41.7*	*39.6*	5.4	1.2
133	7	275.5	276.6	277.7	2.2	36.31	29.5	8.72	0.68	3.6	93.9	*10.9*	*42.7*	*40.3*	5.0	1.1
134	7	277.7	278.9	280.1	2.4	45.97	36.0	8.69	0.89	5.7	94.0	*9.8*	*42.7*	*41.5*	5.0	1.0
Total					2.1	4,136.71	3,261.0									

[a] Original values were missing from the excavation records and are here estimated from average weight-volume ratios for the square as a whole.

Figure 2.10. Excavation of the outer stepping-out squares in progress, Tanamu 1.

Construction-related safety protocols required the excavation and shoring of stepping-out squares to allow vertical excavation of Squares A and B to continue deeper than 1.20m (David *et al.* 2016a), so a double-ring of additional 1m × 1m squares totaling 28 squares was excavated around Squares A and B (Figures 2.7, 2.10–2.12). The inner stepping-out ring, Squares C–L, was dug to a maximum 2.15m depth in 21 XUs per square at a mean 9.9 ± 1.1cm thickness per XU. The top 50cm (XU1) of the outer ring, Squares M–Z and AA–AD, were removed by shovel prior to excavating each square with trowel to a maximum 1.03m depth in four further XUs of average 12.1 ± 4.3cm thickness per square (Figure 2.14; see Figure 2.13 for depth of each square). Prior to the stepping-out process, the Squares A and B wall profiles were photographed and drawn. Because of salvage time restrictions and imminent construction developments, the stepping-out squares were expediently excavated without sieving and with only the observed decorated ceramics and selected artefacts plotted and collected as detailed in David *et al.* (2016a).

Figure 2.11. Removing shoring after excavation of the outer ring of excavation squares, Tanamu 1. The central trench (Squares A and B, bottom-right of photo) is covered by a wooden lid.

Figure 2.12. Re-stringing Squares A and B to continue excavation after removal of shoring of the outer stepping-out squares, Tanamu 1.

Figure 2.13. Details of XUs, Tanamu 1 stepping-out squares. Elevations were taken with automatic levels to 1mm precision, except for XU1 of the outer ring Squares M–AD which were calculated by tape measure.

XU	SU	Mean Depth at Top (cm)	Mean Depth at Centre (cm)	Mean Depth at Base (cm)	Mean Thickness (cm)
Square C					
1	1	0	4.9	9.8	9.8
2	1	9.8	15.0	20.2	10.4
3	1+2	20.2	25.1	30.0	9.8
4	2+3	30.0	35.1	40.1	10.1
5	2+3	40.1	44.6	49.1	9.0
6	2+3+4	49.1	54.0	58.8	9.7
7	3+4	58.8	64.2	69.5	10.7
8	3+4	69.5	74.1	78.6	9.1
9	4	78.6	83.7	88.7	10.1
10	4+5	88.7	93.7	98.7	10.0
11	4+5	98.7	103.2	107.7	9.0
12	4+5	107.7	112.8	117.9	10.2
13	5	117.9	123.0	128.0	10.1
14	5	128.0	134.1	140.2	12.2
15	5+6	140.2	143.4	146.5	6.3
16	5+6	146.5	151.1	155.7	9.2
17	6	155.7	161.0	166.2	10.5
18	6	166.2	171.4	176.6	10.4

XU	SU	Mean Depth at Top (cm)	Mean Depth at Centre (cm)	Mean Depth at Base (cm)	Mean Thickness (cm)
19	6	176.6	181.6	186.6	10.0
20	6	186.6	192.2	197.7	11.1
21	6	197.7	200.9	204.1	6.4
Square D					
1	1	0	7.2	14.4	14.4
2	1	14.4	19.2	24.0	9.6
3	1+2	24.0	29.0	34.0	10.0
4	2+3	34.0	38.4	42.8	8.8
5	2+3	42.8	48.2	53.6	10.8
6	2+3+4	53.6	56.9	60.1	6.5
7	3+4	60.1	64.4	68.6	8.5
8	3+4	68.6	74.1	79.6	11.0
9	4	79.6	83.4	87.1	7.5
10	4+5	87.1	93.1	99.1	12.0
11	4+5	99.1	103.8	108.5	9.4
12	4+5	108.5	113.0	117.4	8.9
13	5	117.4	122.6	127.7	10.3
14	5	127.7	132.5	137.3	9.6
15	5+6	137.3	142.3	147.2	9.9
16	5+6	147.2	151.5	155.7	8.5
17	6	155.7	161.1	166.5	10.8
18	6	166.5	171.4	176.3	9.8
19	6	176.3	181.8	187.2	10.9
20	6	187.2	192.6	197.9	10.7
21	6	197.9	201.9	205.9	8.0
Square E					
1	1	0	4.4	8.8	8.8
2	1	8.8	13.9	18.9	10.1
3	1+2	18.9	24.5	30.0	11.1
4	2+3	30.0	34.7	39.4	9.4
5	2+3	39.4	44.5	49.5	10.1
6	2+3+4	49.5	54.6	59.6	10.1
7	3+4	59.6	64.4	69.2	9.6
8	3+4	69.2	73.3	77.4	8.2
9	4	77.4	81.9	86.4	9.0
10	4+5	86.4	91.6	96.8	10.4
11	4+5	96.8	101.7	106.6	9.8
12	4+5	106.6	111.6	116.5	9.9
13	5	116.5	122.1	127.7	11.2
14	5	127.7	131.7	135.6	7.9
15	5+6	135.6	140.3	144.9	9.3
16	5+6	144.9	149.7	154.5	9.6
17	6	154.5	160.0	165.5	11.0
18	6	165.5	170.9	176.2	10.7
19	6	176.2	180.6	184.9	8.7
20	6	184.9	189.8	194.6	9.7
21	6	194.6	199.7	204.7	10.1

XU	SU	Mean Depth at Top (cm)	Mean Depth at Centre (cm)	Mean Depth at Base (cm)	Mean Thickness (cm)
Square F					
1	1	0	5.0	9.9	9.9
2	1	9.9	15.0	20.1	10.2
3	1+2	20.1	25.2	30.2	10.1
4	2+3	30.2	34.8	39.4	9.2
5	2+3	39.4	43.9	48.4	9.0
6	2+3+4	48.4	52.8	57.1	8.7
7	3+4	57.1	62.1	67.0	9.9
8	3+4	67.0	73.5	79.9	12.9
9	4	79.9	84.4	88.9	9.0
10	4+5	88.9	93.6	98.3	9.4
11	4+5	98.3	103.9	109.5	11.2
12	4+5	109.5	114.5	119.5	10.0
13	5	119.5	124.7	129.9	10.4
14	5	129.9	134.6	139.3	9.4
15	5+6	139.3	144.2	149.1	9.8
16	5+6	149.1	153.9	158.6	9.5
17	6	158.6	163.3	167.9	9.3
18	6	167.9	173.8	179.7	11.8
19	6	179.7	184.0	188.3	8.6
20	6	188.3	193.1	197.8	9.5
21	6	197.8	203.3	208.7	10.9
Square G					
1	1	0	5.2	10.3	10.3
2	1	10.3	15.7	21.0	10.7
3	1+2	21.0	25.4	29.8	8.8
4	2+3	29.8	34.2	38.5	8.7
5	2+3	38.5	43.6	48.7	10.2
6	2+3+4	48.7	53.2	57.6	8.9
7	3+4	57.6	62.5	67.3	9.7
8	3+4	67.3	72.5	77.6	10.3
9	4	77.6	82.3	87.0	9.4
10	4+5	87.0	92.8	98.6	11.6
11	4+5	98.6	103.7	108.8	10.2
12	4+5	108.8	104.2	119.6	10.8
13	5	119.6	124.2	128.7	9.1
14	5	128.7	133.8	138.8	10.1
15	5+6	138.8	143.7	148.5	9.7
16	5+6	148.5	153.3	158.0	9.5
17	6	158.0	163.1	168.2	10.2
18	6	168.2	173.5	178.8	10.6
19	6	178.8	183.5	188.1	9.3
20	6	188.1	193.2	198.2	10.1
21	6	198.2	203.4	208.6	10.4
Square H					
1	1	0	4.7	9.4	9.4
2	1	9.4	14.6	19.7	10.3

XU	SU	Mean Depth at Top (cm)	Mean Depth at Centre (cm)	Mean Depth at Base (cm)	Mean Thickness (cm)
3	1+2	19.7	25.1	30.4	10.7
4	2+3	30.4	35.4	40.3	9.9
5	2+3	40.3	44.3	48.2	7.9
6	2+3+4	48.2	53.4	58.6	10.4
7	3+4	58.6	64.0	69.4	10.8
8	3+4	69.4	74.1	78.7	9.3
9	4	78.7	83.4	88.1	9.4
10	4+5	88.1	93.9	99.6	11.5
11	4+5	99.6	105.0	110.3	10.7
12	4+5	110.3	115.0	119.6	9.3
13	5	119.6	124.8	130.0	10.4
14	5	130.0	134.7	139.4	9.4
15	5+6	139.4	144.6	149.7	10.3
16	5+6	149.7	154.8	159.9	10.2
17	6	159.9	164.8	169.6	9.7
18	6	169.6	175.1	180.6	11.0
19	6	180.6	185.2	189.7	9.1
20	6	189.7	195.0	200.2	10.5
21	6	200.2	205.3	210.3	10.1
Square I					
1	1	0	4.8	9.6	9.6
2	1	9.6	14.2	18.8	9.2
3	1+2	18.8	23.5	28.2	9.4
4	2+3	28.2	33.8	39.4	11.2
5	2+3	39.4	44.2	48.9	9.5
6	2+3+4	48.9	54.1	59.3	10.4
7	3+4	59.3	64.6	69.8	10.5
8	3+4	69.8	75.1	80.3	10.5
9	4	80.3	85.4	90.5	10.2
10	4+5	90.5	95.7	100.8	10.3
11	4+5	100.8	105.5	110.2	9.4
12	4+5	110.2	115.3	120.3	10.1
13	5	120.3	125.5	130.7	10.4
14	5	130.7	135.4	140.1	9.4
15	5+6	140.1	145.8	151.4	11.3
16	5+6	151.4	156.7	161.9	10.5
17	6	161.9	167.5	173.0	11.1
18	6	173.0	178.1	183.2	10.2
19	6	183.2	188.3	193.3	10.1
20	6	193.3	197.7	202.1	8.8
21	6	202.1	207.2	212.3	10.2
Square J					
1	1	0	5.0	9.9	9.9
2	1	9.9	14.5	19.0	9.1
3	1+2	19.0	24.2	29.4	10.4
4	2+3	29.4	34.4	39.4	10.0
5	2+3	39.4	44.3	49.1	9.7

XU	SU	Mean Depth at Top (cm)	Mean Depth at Centre (cm)	Mean Depth at Base (cm)	Mean Thickness (cm)
6	2+3+4	49.1	53.9	58.7	9.6
7	3+4	58.7	64.2	69.6	10.9
8	3+4	69.6	74.4	79.1	9.5
9	4	79.1	84.2	89.2	10.1
10	4+5	89.2	94.1	99.0	9.8
11	4+5	99.0	106.3	113.5	14.5
12	4+5	113.5	118.1	122.6	9.1
13	5	122.6	128.1	133.6	11.0
14	5	133.6	138.0	142.3	8.7
15	5+6	142.3	147.8	153.3	11.0
16	5+6	153.3	157.7	162.0	8.7
17	6	162.0	167.0	171.9	9.9
18	6	171.9	177.4	182.9	11.0
19	6	182.9	187.8	192.6	9.7
20	6	192.6	197.7	202.7	10.1
21	6	202.7	207.8	212.9	10.2
Square K					
1	1	0	5.6	11.2	11.2
2	1	11.2	15.2	19.2	8.0
3	1+2	19.2	24.7	30.1	10.9
4	2+3	30.1	35.1	40.0	9.9
5	2+3	40.0	45.3	50.6	10.6
6	2+3+4	50.6	56.0	61.4	10.8
7	3+4	61.4	66.3	71.2	9.8
8	3+4	71.2	76.3	81.4	10.2
9	4	81.4	86.4	91.3	9.9
10	4+5	91.3	96.0	100.6	9.3
11	4+5	100.6	104.6	108.6	8.0
12	4+5	108.6	115.8	123.0	14.4
13	5	123.0	128.1	133.2	10.2
14	5	133.2	137.3	141.4	8.2
15	5+6	141.4	147.7	153.9	12.5
16	5+6	153.9	158.2	162.5	8.6
17	6	162.5	167.5	172.4	9.9
18	6	172.4	177.3	182.2	9.8
19	6	182.2	187.4	192.5	10.3
20	6	192.5	198.2	103.8	11.3
21	6	103.8	108.2	112.5	8.7
Square L					
1	1	0	4.6	9.1	9.1
2	1	9.1	14.4	19.6	10.5
3	1+2	19.6	24.2	28.7	9.1
4	2+3	28.7	33.7	38.6	9.9
5	2+3	38.6	44.1	49.5	10.9
6	2+3+4	49.5	54.6	59.7	10.2
7	3+4	59.7	64.3	68.9	9.2
8	3+4	68.9	73.3	77.7	8.8

XU	SU	Mean Depth at Top (cm)	Mean Depth at Centre (cm)	Mean Depth at Base (cm)	Mean Thickness (cm)
9	4	77.7	83.2	88.6	10.9
10	4+5	88.6	94.0	99.3	10.7
11	4+5	99.3	103.9	108.4	9.1
12	4+5	108.4	113.8	119.2	10.8
13	5	119.2	124.0	128.8	9.6
14	5	128.8	134.4	139.9	11.1
15	5+6	139.9	143.6	147.2	7.3
16	5+6	147.2	153.0	158.7	11.5
17	6	158.7	163.5	168.2	9.5
18	6	168.2	173.5	178.7	10.5
19	6	178.7	184.0	189.2	10.5
20	6	189.2	193.2	197.2	8.0
21	6	197.2	202.3	207.3	10.1
Square M					
1	1+2+3	0	25.0	50.0	50
2	2+3+4	50.0	55.8	61.5	11.5
3	3+4	61.5	66.5	71.4	9.9
4	3+4	71.4	76.7	81.9	10.5
5	4+5	81.9	89.4	96.8	14.9
Square N					
1	1+2+3	0	25.0	50.0	50
2	2+3+4	50.0	55.5	60.9	10.9
3	3+4	60.9	65.9	70.9	10.0
4	3+4	70.9	77.1	83.2	12.3
5	4+5	83.2	89.7	96.2	13.0
Square O					
1	1+2+3	0	25.0	50.0	50
2	2+3+4	50.0	54.3	58.5	8.5
3	3+4	58.5	63.9	69.2	10.7
4	3+4	69.2	74.3	79.3	10.1
5	4+5	79.3	86.3	93.3	14.0
Square P					
1	1+2+3	0	25.0	50.0	50
2	2+3+4	50.0	54.5	59.0	9.0
3	3+4	59.0	64.5	69.9	10.9
4	3+4	69.9	74.3	78.6	8.7
5	4+5	78.6	86.9	95.2	16.6
Square Q					
1	1+2+3	0	25.0	50.0	50
2	2+3+4	50.0	56.5	62.9	12.9
3	3+4	62.9	69.0	73.0	12.1
4	3+4	73.0	76.3	79.5	6.5
5	4+5	79.5	86.4	93.3	13.8
Square R					
1	1+2+3	0	25.0	50.0	50
2	2+3+4	50.0	56.1	62.1	12.1
3	3+4	62.1	67.0	71.8	9.7

XU	SU	Mean Depth at Top (cm)	Mean Depth at Centre (cm)	Mean Depth at Base (cm)	Mean Thickness (cm)
4	3+4	71.8	76.1	80.4	8.6
5	4+5	80.4	86.4	92.3	11.9
Square S					
1	1+2+3	0	25.0	50.0	50
2	2+3+4	50.0	55.3	60.5	10.5
3	3+4	60.5	65.2	69.8	9.3
4	3+4	69.8	74.7	79.5	9.7
5	4+5	79.5	89.0	98.5	19.0
Square T					
1	1+2+3	0	25.0	50.0	50
2	2+3+4	50.0	54.8	59.5	9.5
3	3+4	59.5	64.8	70.0	10.5
4	3+4	70.0	75.1	80.1	10.1
5	4+5	80.1	89.9	99.7	19.6
Square U					
1	1+2+3	0	25.0	50.0	50
2	2+3+4	50.0	54.7	59.4	9.4
3	3+4	59.4	64.7	70.0	10.6
4	3+4	70.0	75.2	80.3	10.3
5	4+5	80.3	91.7	103.0	22.7
Square V					
1	1+2+3	0	25.0	50.0	50
2	2+3+4	50.0	55.5	61.1	11.1
3	3+4	61.1	66.1	71.0	9.9
4	3+4	71.0	76.0	80.9	9.9
5	4+5	80.9	91.7	102.4	21.5
Square W					
1	1+2+3	0	25.0	50.0	50
2	2+3+4	50.0	54.5	58.9	8.9
3	3+4	58.9	63.0	67.0	8.1
4	3+4	67.0	71.6	76.2	9.2
5	4+5	76.2	86.6	97.0	20.8
Square X					
1	1+2+3	0	25.0	50.0	50
2	2+3+4	50.0	54.8	59.6	9.6
3	3+4	59.6	63.4	67.2	7.6
4	3+4	67.2	71.6	75.5	8.3
5	4+5	75.5	86.2	96.8	21.3
Square Y					
1	1+2+3	0	25.0	50.0	50
2	2+3+4	50.0	55.5	61.0	11.0
3	3+4	61.0	65.7	70.4	9.4
4	3+4	70.4	74.5	78.5	8.1
5	4+5	78.5	90.4	102.2	23.7
Square Z					
1	1+2+3	0	25.0	50.0	50
2	2+3+4	50.0	54.8	59.6	9.6

XU	SU	Mean Depth at Top (cm)	Mean Depth at Centre (cm)	Mean Depth at Base (cm)	Mean Thickness (cm)
3	3+4	59.6	64.3	68.9	9.3
4	3+4	68.9	74.0	79.1	10.2
5	4+5	79.1	90.8	102.4	23.3
Square AA					
1	1+2+3	0	25.0	50.0	50
2	2+3+4	50.0	54.8	59.6	9.6
3	3+4	59.6	64.1	68.6	9.0
4	3+4	68.6	74.9	81.2	12.6
5	4+5	81.2	91.9	102.5	21.3
Square AB					
1	1+2+3	0	25.0	50.0	50
2	2+3+4	50.0	54.7	59.4	9.4
3	3+4	59.4	64.2	69.0	9.6
4	3+4	69.0	74.5	80.0	11.0
5	4+5	80.0	89.2	98.4	18.4
Square AC					
1	1+2+3	0	25.0	50.0	50
2	2+3+4	50.0	56.6	63.2	13.2
3	3+4	63.2	66.8	70.3	7.1
4	3+4	70.3	75.5	80.6	10.3
5	4+5	80.6	89.2	97.7	17.1
Square AD					
1	1+2+3	0	25.0	50.0	50
2	2+3+4	50.0	57.0	64.0	14.0
3	3+4	64.0	67.1	70.2	6.2
4	3+4	70.2	75.6	80.9	10.7
5	4+5	80.9	89.5	98.1	17.2

Stratigraphy

Excavation proceeded to 2.84m maximum depth in both Squares A and B. In total 8.3 tons of sediment were excavated from Squares A and B. Tanamu 1 contains seven major Stratigraphic Units (SUs), each continuous across the excavated squares (Figures 2.14–2.21). Some SUs contain lenses or features; these have each been classified as sub-SUs (e.g., SU1a, SU5a, SU5b). A notable example of the latter is SU1a, a localized concentration of white ash (Figure 2.18) that brings to mind the residue of ethnographic low-temperature, open-fire pot making (e.g., May and Tuckson 2000: 61, Figure 2.31). With the exception of SU6 and SU7, which are in many ways similar to each other in terms of colour, texture and contents, all other SUs were clearly distinguishable from overlying and underlying SUs (see Figure 2.22 for details). The interfaces between SUs were generally easy to identify and typically measured *c.* 5cm thick, less commonly up to *c.* 10cm.

Neither bedrock nor basal clays were reached, with the lowermost deposits (SU7) consisting of sandy concretions in sandy sediments; small pieces of charcoal are for the most part present in the uppermost XUs of SU7, as these interface with SU6. SU7 is immediately overlain by sands containing abundant foraminifera, pumice and charcoal pieces (SU6). These sediments suggest low dune and/or beach-line (SU6) overlying beach-line and/or intertidal (SU7) conditions (Figure 2.14).

All SUs are sandy, with the uppermost SU1, SU3, and SU5 (the Upper, Middle, and Lower Horizons respectively) containing rich cultural deposits (Figures 2.15, 2.17, 2.19); these three rich cultural layers are separated by the culturally more sparse SU2, SU4 and basal SU6–SU7 (e.g., Figures 2.16, 2.18, 2.20). While the sandy nature of the deposits made excavation relatively easy, most layers were moderately to well consolidated and compact (see Figure 2.22 for details). SU4 and SU6 contain numerous

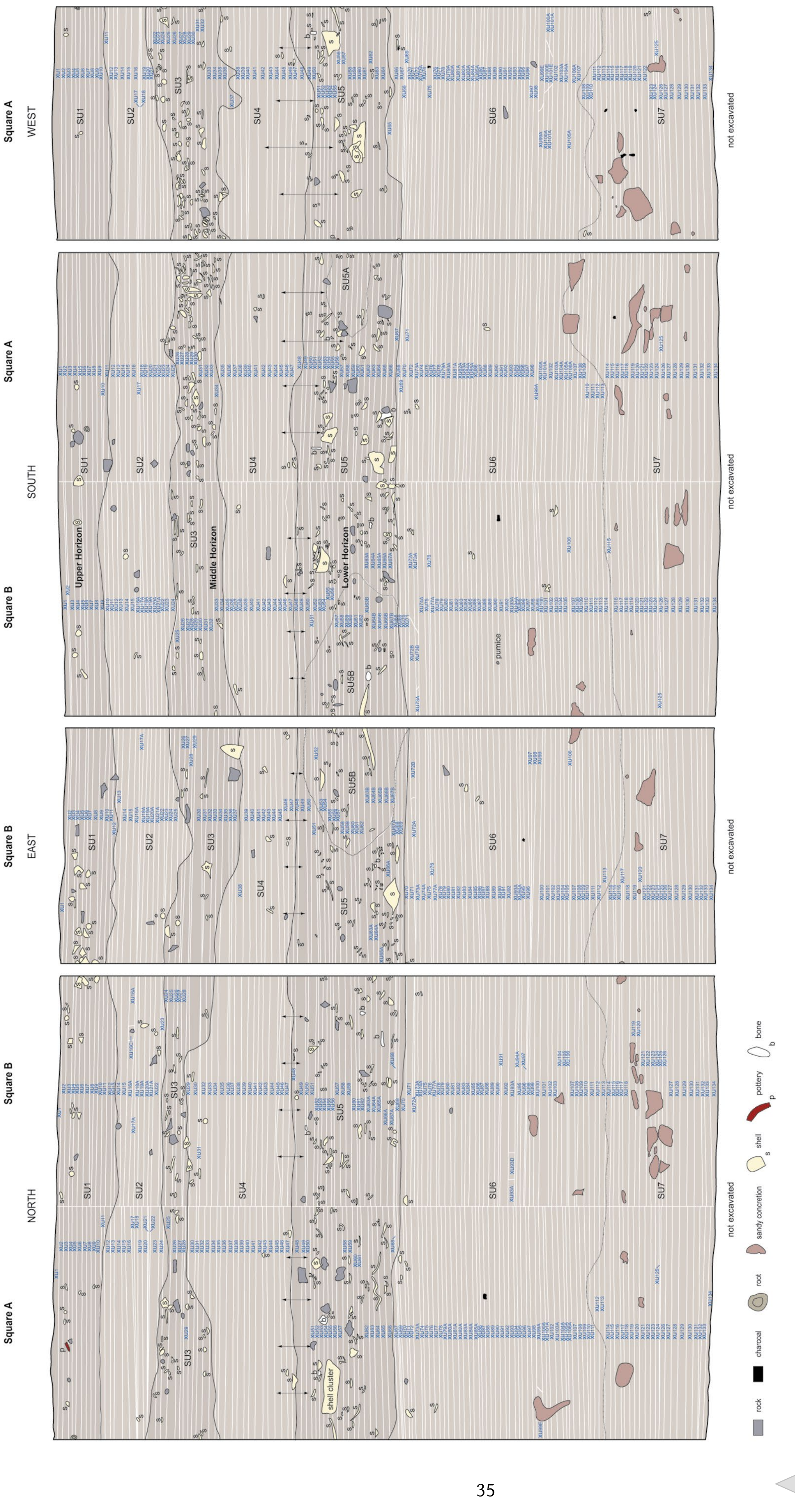

Figure 2.14. Section drawing, Tanamu 1 Squares A and B. The XU lines were plotted from the elevation readings.

linear sub-vertical but diffuse, whitish sediment stains, consistent with geochemical alteration of sediments associated with grass root staining, indicating the presence of ancient land surfaces at the base of SU3 and SU5 respectively (in each case representing the upper limits of the root-stained horizons). The lowermost SU7 contains abundant clasts of concreted sand caused by elevated moisture levels. Cultural deposits are present in all SUs, although these are noticeably less abundant in SU7.

There is no archaeological or ethnographic evidence that the vicinity of Tanamu 1 was ever used for gardening activity. For a dune deposit, the Tanamu 1 sediments show good chronostratigraphic integrity, with the radiocarbon determinations showing no significant reversals between cultural phases (see Radiocarbon Dating).

We note that termite larvae husks and recent grass seeds are only present in numbers within SU1, while below this they were noted during excavation as post-depositional blow-ins on windy days (always as one-off instances or in very low numbers).

Radiocarbon dating

Fifty-nine radiocarbon dates have been obtained from Squares A and B (Figure 2.23). All are accelerator mass spectrometry (AMS) dates on single pieces of charcoal (34 dates) or shallow-water marine shell (25 dates). Two species of shell were dated, *Anadara antiquata* and *Gafrarium tumidum,* with ΔR values for each species

Figure 2.15. Excavation in progress within the dense Upper Horizon of SU1, Square B after excavation of XU4. The pink stringline marks the south side.

Figure 2.16. Excavation in progress in Square B (after completion of XU22) showing the localised concentration of cultural materials (the Upper Horizon of SU1) a short distance below the present-day surface (top of photo). The culturally-poor sediments between the Upper and Middle Horizons are evident beneath this upper concentration of cultural materials. The uppermost shells of the Middle Horizon are appearing at the base of the excavation as this dense Lapita level is just starting to be exposed.

Figure 2.17. Excavation in progress within the dense Middle Horizon of SU3 (Lapita horizon), Square A after excavation of XU29.

Figure 2.18. Excavation in progress in the culturally-sparse SU4 below the Middle Horizon, Square A after completion of XU41. The distinctive localised white band of SU1a is clearly visible in the upper part of the excavation pit's back wall, as are the light-coloured sub-vertical root stains in SU4 just below the culturally rich Middle Horizon.

Figure 2.19. Excavation in progress within the dense Lower Horizon of SU5 (pre-ceramic horizon), Squares A and B after excavation of XU66.

Figure 2.20. Excavation in progress in SU6 immediately below the Lower Horizon, Squares A and B after excavation of XU77.

Figure 2.21. Excavation after completion of XU94 (mid-levels of SU6) in Squares A and B, showing diffuse charcoal-rich patches on the north wall.

Figure 2.22. Stratigraphic Units, Tanamu 1.

SU	Typical depth below ground (cm)	Dry Munsell	Description
1	0–20	10YR 3/2	This SU contains the culturally dense Upper Horizon concentrated especially in the SU's upper half. Soft, humic, very dark greyish brown aeolian sand with dense shell, stone artefact and pottery concentration in the NE part of Square B. Grass rootlets are abundant. The very dark grey colouring is probably due in part at least to organic decomposition and staining as typical of local topsoil development. Fairly compact. SU1a (see Figure 2.18) is a localized white horizontal band of indeterminate ash, or possibly shell carbonate, at the base of SU1 along and into the very edge of the south wall of Square A and, to a much lesser extent, Square B, where it delimits the base of SU1. As only the very edge of this sub-SU was exposed, without significantly sampling SU1a in the excavation itself, we are not certain whether it represents a hearth or a shell lens. SU1a has a very distinct boundary with the underlying SU2. Elsewhere SU1 typically grades into SU2 over a thickness of *c.* 5cm.
2	20–50	10YR 4/3 to 10YR 4/4	Culturally sparse, soft, dark greyish brown to dark yellowish brown aeolian sand, lighter in colour than SU1, with some whole shells noted *in situ*. Boundary with underlying SU3 is fairly distinct, typically grading over a thickness of *c.* 5cm. SU2a: Towards the base of SU2 in Square B, isolated as XU16b–XU21b and XU16c–XU17c, and measuring a maximum *c.* 50cm × 20cm in size, is a well-defined area of loose and similarly coloured but slightly darker sand than the rest of the square. It is located just NE of the centre of the square (it does not feature in the section drawings as it does not cross into any of the square's walls). It is likely to be an in-filled animal burrow. No cultural materials were seen within this feature during excavation, and it is restricted to SU2.
3	50–70	10YR 4/3	Middle Horizon. Rich, compact but relatively unconsolidated cultural layer composed of dark greyish brown aeolian sand and high quantities of whole and fragmented shell, pottery sherds and stone artefacts. Boundary with underlying SU4 is distinct, in the main grading over a thickness of *c.* 5cm.
4	70–110	10YR 5/2	Soft, greyish brown aeolian sand with high quantities of comminuted shell and some whole shells. Boundary with underlying SU5 is diffuse, typically grading over a thickness of *c.* 10cm but sometimes more. SU4 contains numerous sub-vertical patches or pockets of light-coloured sandy sediments that are more compact than surrounding sediments and reminiscent of root staining. The SU4/SU5 interface consists of greyish brown aeolian sand with occasional whole shell in its upper sections, grading down to a grey to greyish brown loamy sand. Small amounts of small, degraded pottery sherds occur in this underlying level.

SU	Typical depth below ground (cm)	Dry Munsell	Description
5	110–150	10YR 5/1 to 10YR 5/2	Lower Horizon. SU5 is a grey to greyish brown loamy sand with compact, light-coloured patches and copious amounts of larger-sized shell (whole and broken), animal bone and stone artefacts. The high density and high diversity of shell stands it apart as a distinct cultural horizon, as does the complete absence of ceramics. Sediments are compact, with shell fragments often tending to cement together. Charcoal is present. Pumice, coral and rock are also present in moderate quantities. Some small roots also occur. Sediments are easy to excavate. SU5's lower boundary is distinct, in the main grading with SU6 over a thickness of *c.* 5cm. SU5a is a poorly-defined patch of aeolian sand with small quantities of fragmented shell. It is soft and homogeneous in colour and texture, and appears to be a local variation of SU5. SU5b is a loamy sand with some ash, burned shell (whole and broken), animal bone, coral, pumice, charcoal and stone artefacts. The shell in particular is burned. Sediment is compact and homogenous in colour and texture. SU5b is similar to SU5 in terms of contents but different in colour, texture and general appearance. It is interpreted as a hearth or oven. It occurs in the southeast parts of Square B in XU49–XU70, where it was only isolated during excavation in its lower levels, at XUs 63b–XU67b and XU72b–XU74b.
6	150–240	2.5YR 6/2	SU6 is a light brownish grey sand. Cultural materials are sparse but continue to occur in most XUs. Small charcoal fragments occur throughout. The sparse comminuted shell fragments are typically 2–4mm long with sub-rounded edges. Pumice and foraminifera are present throughout. SU6 contains numerous compact, light-coloured clayey sand patches or vertical pockets reminiscent of the marks of roots/rootlets. The boundary with SU7 is indistinct. SU6a is a small, localized but diffuse patch of hard, light-coloured sediment with *in situ* charcoal restricted to within SU6. It is *c.* 40cm × 30cm in size. It occurs near the northeast corner of Square A but does not feature in any of the section walls. It was isolated during excavation as XU79c–XU85c and may be the remnants of a hearth. SU6b is a localized but diffuse patch of hard, dark sediment with *in situ* charcoal. It is *c.* 30cm × 30cm in size and continues into the west wall of Square A. It is present in XU96–XU101 of Square A, where it was only isolated *in situ* in XU99e–XU101e. It is likely to be the remnants of a hearth. Other charcoal-rich patches of similar contents occur elsewhere in Squares A and B at this stratigraphic level but have not been demarcated on the section drawings because they are diffuse.
7	>240	2.5YR 6/2 to 2.5YR 6/3	SU7 is a moist, soft, fine light brownish grey to light yellowish brown sand. Sediments are compact, and coral fragments and concreted sand and shell are present. Coral fragments vary in length from 2–10cm. Some small fragments of crustacean and shell (broken and whole) occur but are not abundant. Patches or vertical pockets of compact, lighter-coloured clayey sand occur within the upper levels of SU7. Dried roots were found within some of these patches/pockets. Although some small charcoal fragments are evident at the SU6–SU7 interface; SU7 contains sparse cultural materials.

being calculated separately for this part of Caution Bay: -1 ± 16 ^{14}C years for *Anadara antiquata* and 67 ± 16 ^{14}C years for *Gafrarium tumidum* (see David *et al.* 2016a; Petchey *et al.* 2012, 2013 for details of the Caution Bay shell ΔR program).

The charcoal samples were typically millimetre-scale in length, amorphously sub-spherical in shape, and weighed on average 0.1 ± 0.1g, whereas the shell samples were a few centimeters long, flat shell valves (or valve fragments) that averaged 5.7 ± 5.2g in weight. These different sample characteristics allow for future taphonomic assessments of the radiocarbon-dated sequence by investigating the chronostratigraphic integrity of dated materials relative to sample weights and shapes, with the small charcoal samples having greater potential to post-depositionally move through the deposit than the larger and flatter shell samples which tended to lie sub-horizontally in the ground. Nevertheless, at Tanamu 1 the dated sequence is in good chronostratigraphic order irrespective of the size of the sample or whether small charcoal samples or larger, flat shell valves were used for dating (with charcoal samples containing small in-built old wood ages; see below); more detailed taphonomic analyses have therefore not been undertaken. The only date significantly out of sequence is Wk-32535 (2971 ± 30 BP) on shell from XU8 at the base of SU1 in Square B, an horizon otherwise only containing dates more recent than 700 cal BP. Wk-32535 is a shell sample obtained from 14–16cm below ground, separated by only 4cm from the broad horizon of that age below it (the top of which is at 20cm depth). Here the indication is thus of an age reversal over a depth of 4cm only, within the depth of sediment mixing evident by visually observed stratigraphic interfaces at Tanamu 1.

The radiocarbon determinations indicate that the basal excavated SU7 sediments accumulated around 5000 cal BP. The *c*. 90cm-thick sediments of SU6 then began to build up rapidly as dune sands sometime between 4700 and 4450 cal BP, at an average rate of 60cm/100 years (for purposes of calculation taking 4500 cal BP as the start of accumulation of SU6, and 4350 cal BP as dating the top of SU6, with calibrated ages having been rounded to the closest 50 years). In SU6 on the whole, the shell dates appear to be slightly younger than the charcoal dates, suggesting small inbuilt (old wood) ages for the charcoal. This implies that SU6 is of a similar age to the lower part of SU5 (*c.* 4300 cal BP). SU6 represents the peak period of dune-building at Tanamu 1, suggesting that seaward of the dune the site was an open landscape during this period (i.e., devoid of shielding mangroves separating the beach from the land), conducive to the aeolian accumulation of beach-bordering sand dunes.

Next, between 4350 and 4050 cal BP, a dense cultural shell midden accumulated as the SU5 Lower Horizon on the then 90 cm-high beach-bordering sand dune. During this time some 40cm of cultural deposits built up over a 300 year period (at an average rate of 13cm/100 years). During this prolonged period there is no evidence of site abandonment in the stratigraphy, suggesting the persistence of a permanent or semi-permanent settlement over this span of time. However, within SU5 the radiocarbon determinations show a jump from *c.* 4300–4350 to *c.* 4100 cal BP over a shallow stratigraphic zone around XU60 in both squares, but there is no hint of a corresponding change in sediment characteristics in the sections. It could be that part of the picture is missing in the dates and that the upper and lower parts of SU5 (*c.* 4100 and *c.* 4300–4350 cal BP respectively) and SU6 just represent continued occupation over *c.* 300 years.

Following cessation of the SU5 settlement, some 40cm of dune sands continued to slowly accumulate at an average rate of 3cm/100 years between 4050 and 2800 cal BP (representing SU4). Cultural materials in SU4 are sparse, and may represent post-depositional intrusions from overlying (SU3) and underlying (SU5) dense occupation deposits, rather than *in situ* cultural materials.

Dense Lapita occupation deposits dated to the period *c.* 2800 to 2750 cal BP, comprise the Middle Horizon. During this time, *c.* 20cm of rich cultural deposit accumulated as SU3 at an average rate of *c.* 40cm/100 years on top of what was then a 1.7m-high sand dune. This horizon represents the arrival of the first ceramicists at Tanamu 1. The dense Middle Horizon shows no chronostratigraphic evidence of abandonment during this period, and thus signals the presence of a permanent settlement at Tanamu 1.

Around 2750 cal BP, SU3 deposition ceased as Lapita peoples abandoned their settlement at Tanamu 1. However, Lapita ceramicists remained in the area, as indicated by occasional Lapita ceramics in the overlying *c.* 30 cm-thick culturally sparse sands of SU2, dated from 2750 to 700 cal BP and suggestive of slow sand accumulation. The presence of a Lapita settlement lasting until 2600 cal BP at Bogi 1, 140m to the NNW of Tanamu 1, is consistent with the presence of post-2750 cal BP ceramics in SU2 at Tanamu 1 (McNiven *et al.* 2012a). The period covered by SU2 is also notable for spanning close to 2050 years, incorporating the period *c.* 2150–2100 cal BP that saw dense occupation during a phase of Linear Shell Edge-Impressed ceramics at Bogi 1 nearby (David *et al.* 2012). But unlike Bogi 1, at Tanamu 1 that phase is not marked as a distinct stratigraphic horizon. Rather, the SU2 sediments accumulated at an average rate of 1cm/100 years, indicating that by the end of the Lapita period Middle Horizon, dune building had virtually ceased. The presence of a single Linear Shell Edge-Impressed sherd from Square B XU19 (see Chapter 3)—located some two-thirds of the way down in SU2 (36–38cm below ground)—of a ceramic type firmly dated to 2150–2100 cal BP at Bogi 1 (David *et al.* 2012), followed by more recent ceramics in overlying XUs, supports the interpretation of SU2 resulting from the continued slow buildup of sediments during the post-Lapita period, rather than an archaeologically instantaneous accumulation of sediments immediately post-dating the termination of the Middle Horizon around 2750 cal BP.

The Tanamu 1 dune-top appears to have remained relatively stable from 2750 to 700 cal BP. During this time little cultural activity is evident, although post-depositional mixing at the SU1–SU2 stratigraphic interface makes it difficult to distinguish cultural materials attributable to any particular period. The subsequent accumulation of SU1 sediments (the Upper Horizon) after 700 cal BP first saw the buildup of fairly sparse cultural sediments between 700 and *c.* 200 cal BP (Upper Horizon A), followed in upper SU1 by dense ceramic deposits dated from *c.* 200 to 100 cal BP, just prior to the ethnographic period (late 1800s AD) (Upper Horizon B). The *c.* 20cm-thick SU1 accumulated between 700 and *c.* 100 cal BP at an average rate of *c.* 3cm/100 years.

Cultural materials

The quantities and vertical distributions of the different cultural material classes are briefly discussed here relative to site stratigraphy and chronology; Figures

Figure 2.23. Radiocarbon determinations, Tanamu 1.
All ^{14}C ages are AMS. Calibrations undertaken using OxCal 10.4.1 (charcoal calibrations: INTCAL09 curve selection; shell calibrations: MARINE09 curve selection, *Anadara antiquata* ΔR = -1 ± 16; *Gafrarium tumidum* ΔR = 67 ± 16) (Bronk Ramsey 2013; Petchey *et al.* 2013; Reimer *et al.* 2009).

Square	XU	SU	Depth (cm)	Wk-Laboratory Code	Material Dated	δ^{13}C‰	% Modern	^{14}C Age (years BP)	Calibrated Age BP (68.2% probability)	Calibrated Age BP (95.4% probability)	Median Calibrated Age BP
B	2	1	2.8	29957	charcoal	-24.7 ± 0.2	98.6 ± 0.3	117 ± 30	270–220 150–60 50–20	270–180 150–10	120
A	4	1	4.2	29966	charcoal	-25.1 ± 0.2	98.5 ± 0.4	123 ± 30	270–210 150–60 40–20	280–170 160–10	120
B	3	1	3.1–5.4	32532	*Anadara antiquata* shell	-2.4 ± 0.2	92.9 ± 0.3	593 ± 25	290–220 210–190 170–140	300–130	240
B	4	1	5.4–7.2	32533	*Anadara antiquata* shell	-2.2 ± 0.2	93.1 ± 0.3	575 ± 25	270–180 170–140	290–120	210
A	4	1	7.3	27504	charcoal	-26.5 ± 0.2	97.6 ± 0.2	193 ± 30	290–260 220–140 20–-10	310–250 230–130 30–-10	180
B	5	1	7.2–9.2	32534	*Anadara antiquata* shell	-2.7 ± 0.2	93.5 ± 0.3	538 ± 25	240–130	270–60	180
A	5	1	8.8	29967	charcoal	-25.5 ± 0.2	98.6 ± 0.4	117 ± 30	270–220 150–60 50–20	270–180 150–10	120
A	7	1	12.5	29968	charcoal	-24.5 ± 0.2	90.9 ± 0.3	769 ± 30	730–670	740–660	700
B	8	1	13.9–16.0	32535	*Anadara antiquata* shell	0.6 ± 0.2	69.1 ± 0.3	2971 ± 30	2780–2710	2830–2680	2750
B	9	1	16.7	29958	charcoal	-26.1 ± 0.2	99.2 ± 0.4	66 ± 33	260–220 140–110 80–30	260–220 150–20	100
A	9	1	17.4	27505	charcoal	-24.4 ± 0.2	90.2 ± 0.1	826 ± 30	770–690	790–680	730
B	10	1–2	20.0	29959	charcoal	-27.1 ± 0.2	98.1 ± 0.4	158 ± 30	290–250 230–130 30–0	290–60 40– -10	170
B	11	1–2	19.7–21.5	32536	*Gafrarium tumidum* shell	1.3 ± 0.2	68.5 ± 0.2	3042 ± 26	2780–2710	2830–2690	2750
B	15	2	27.9–30.3	32537	*Anadara antiquata* shell	-0.7 ± 0.2	68.4 ± 0.2	3053 ± 28	2860–2760	2920–2740	2820
B	22	2–3	41.6–43.6	32538	*Anadara antiquata* shell	0.8 ± 0.2	68.2 ± 0.3	3080 ± 31	2900–2780	2950–2750	2850
B	25	2–3	47.3–49.9	32540	*Gafrarium tumidum* shell	0.5 ± 0.2	68.9 ± 0.3	2990 ± 31	2750–2680	2790–2590	2710
B	25	2–3	47.3–49.9	32539	*Anadara antiquata* shell	0.4 ± 0.2	68.9 ± 0.3	2993 ± 31	2800–2720	2850–2700	2760
B	28	2–3–4	53.6–55.3	32541	*Anadara antiquata* shell	1.1 ± 0.2	68.8 ± 0.2	3000 ± 27	2810–2730	2850–2710	2770

Square	XU	SU	Depth (cm)	Wk-Laboratory Code	Material Dated	δ¹³C‰	% Modern	¹⁴C Age (years BP)	Calibrated Age BP (68.2% probability)	Calibrated Age BP (95.4% probability)	Median Calibrated Age BP
B	31	3–4	60.4–62.0	32542	*Anadara antiquata* shell	0.5 ± 0.2	68.2 ± 0.2	3078 ± 26	2890–2780	2940–2750	2840
B	34	3–4	66.8–69.6	32543	*Anadara antiquata* shell	0.1 ± 0.2	68.6 ± 0.2	3024 ± 26	2830–2740	2870–2720	2790
A	35	3–4	70.5	27506	charcoal	-26.7 ± 0.2	70.2 ± 0.2	2842 ± 30	3000–2920 2910–2880	3070–2860	2950
B	37	3–4	73.7–75.9	32544	*Anadara antiquata* shell	0.4 ± 0.2	68.4 ± 0.2	3055 ± 27	2860–2760	2920–2740	2820
B	40	4	81.1–83.4	32545	*Anadara antiquata* shell	0.1 ± 0.2	68.5 ± 0.2	3035 ± 28	2840–2750	2890–2720	2800
B	43	4	87.7–90.3	32546	*Anadara antiquata* shell	0.8 ± 0.2	68.6 ± 0.2	3024 ± 29	2830–2740	2880–2720	2790
B	46	4–5	95.4–97.3	32547	*Anadara antiquata* shell	0.5 ± 0.2	65.9 ± 0.2	3350 ± 26	3280–3160	3330–3100	3220
B	49	4–5	102.5–104.7	32548	*Anadara antiquata* shell	0.1 ± 0.2	60.2 ± 0.2	4076 ± 27	4180–4060	4230–3990	4120
B	53	5	110.4–112.3	32549	*Anadara antiquata* shell	-0.2 ± 0.2	60.5 ± 0.2	4032 ± 29	4110–3980	4170–3920	4050
A	53	4–5	115.8	27508	charcoal	-25.2 ± 0.2	62.8 ± 0.1	3734 ± 30	4150–4070 4040–3990	4220–4200 4160–3980	4090
B	58	5	122.1	29961	charcoal	-26.3 ± 0.2	63.0 ± 0.2	3715 ± 30	4150–4120 4100–4060 4050–3980	4150–3970	4050
B	60	5	124.6	29962	charcoal	-26.0 ± 0.2	62.1 ± 0.2	3829 ± 30	4290–4270 4260–4150	4410–4310 4300–4140 4120–4100	4230
A	59	5	125.1	29969	charcoal	-26.2 ± 0.2	61.9 ± 0.2	3858 ± 32	4410–4320 4300–4230 4200–4180	4420–4220 4210–4150	4290
B	65b	5	135.1	29963	charcoal	-24.1 ± 0.2	61.8 ± 0.2	3864 ± 32	4410–4320 4300–4230	4420–4220 4210–4150	4300
A	66	5–6	144.9	27714	charcoal	-25.6 ± 0.2	61.4 ± 0.2	3919 ± 30	4420–4350 4340–4290	4430–4240	4360
A	75	6	159.1	27643	charcoal	-26.3 ± 0.2	61.6 ± 0.2	3895 ± 30	4410–4290	4420–4240	4340
A	80a	6	167.7	29970	charcoal	-26.0 ± 0.2	61.0 ± 0.2	3968 ± 31	4520–4470 4450–4410	4530–4380 4370–4350 4330–4290	4440
A	81a	6	172.6	27644	charcoal	-24.8 ± 0.2	61.2 ± 0.2	3941 ± 30	4440–4380 4370–4350 4330–4290	4520–4470 4450–4280 4270–4250	4390
A	83c	6	174.4	29341	charcoal	-24.5 ± 0.2	61.0 ± 0.3	3968 ± 39	4520–4460 4450–4400	4530–4290	4440
A	83a	6	175.8	29340	charcoal	-26.7 ± 0.2	60.4 ± 0.2	4053 ± 30	4580–4510 4490–4440	4790–4760 4620–4420	4530
A	85a	6	177.3	28805	charcoal	-23.4 ± 0.2	60.6 ± 0.3	4021 ± 33	4530–4430	4570–4410	4480
B	87	6	178.7–180.9	31008	*Anadara antiquata* shell	0.0 ± 0.2	58.8 ± 0.2	4268 ± 25	4440–4320	4500–4270	4380

Square	XU	SU	Depth (cm)	Wk-Laboratory Code	Material Dated	δ¹³C‰	% Modern	^{14}C Age (years BP)	Calibrated Age BP (68.2% probability)	Calibrated Age BP (95.4% probability)	Median Calibrated Age BP
B	87	6	178.7–180.9	31007	*Gafrarium tumidum* shell	0.8 ± 0.2	58.7 ± 0.2	4285 ± 25	4390–4270	4420–4210	4320
B	87	6	178.7–180.9	31009	*Anadara antiquata* shell	-0.3 ± 0.2	58.5 ± 0.2	4313 ± 25	4500–4400	4540–4340	4440
A	89	6	186.2	27645	charcoal	-24.5 ± 0.2	60.5 ± 0.2	4042 ± 30	4570–4440	4790–4760 4610–4600 4590–4420	4500
A	90	6	188.1	27646	charcoal	-26.0 ± 0.2	60.7 ± 0.2	4012 ± 30	4520–4430	4570–4550 4530–4410	4480
A	93	6	198.1	27647	charcoal	-26.5 ± 0.2	60.5 ± 0.2	4037 ± 30	4570–4560 4530–4430	4780–4760 4580–4420	4490
A	97	6	202.3	29971	charcoal	-25.9 ± 0.2	61.0 ± 0.2	3969 ± 32	4520–4470 4450–4410	4530–4380 4370–4350 4330–4290	4440
A	102	6	212.1	29977	charcoal	-25.0 ± 0.2	61.2 ± 0.2	3949 ± 30	4520–4480 4450–4400 4370–4350 4330–4300	4520–4460 4450–4290	4420
A	103a	6	214.1	29972	charcoal	-26.3 ± 0.2	60.9 ± 0.2	3978 ± 31	4520–4470 4450–4410	4530–4400 4370–4350 4330–4300	4470
A	106a	6–7	220.0	29978	charcoal	-25.7 ± 0.2	61.0 ± 0.2	3965 ± 32	4520–4470 4450–4410	4530–4350 4330–4290	4440
B	111	6–7	225.7–228.2	32550	*Gafrarium tumidum* shell	1.1 ± 0.2	58.4 ± 0.3	4318 ± 37	4420–4290	4490–4230	4360
A	109	6–7	227.3	28604	charcoal	-24.9 ± 0.2	60.2 ± 0.2	4071 ± 30	4790–4760 4610–4510 4470–4440	4810–4760 4700–4670 4650–4510 4490–4440	4560
B	113	6–7	229.7–232.3	32551	*Anadara antiquata* shell	0.2 ± 0.2	60.6 ± 0.2	4029 ± 27	4100–3970	4160–3920	4050
A	111	6–7	231.2	29974	charcoal	-30.8 ± 0.2	61.2 ± 0.2	3949 ± 30	4520–4480 4450–4400 4370–4350 4330–4300	4520–4460 4450–4290	4420
A	112	6–7	232.3	29984	charcoal	-26.0 ± 0.2	59.6 ± 0.2	4154 ± 27	4820–4780 4770–4750 4730–4620	4830–4780 4770–4580	4700
B	114	6–7	232.9	29964	charcoal	-24.5 ± 0.2	61.0 ± 0.2	3971 ± 30	4520–4480 4450–4410	4530–4400 4370–4350 4330–4290	4450
B	116	6–7	238.8	29965	charcoal	-25.5 ± 0.2	60.1 ± 0.2	4093 ± 30	4790–4760 4630–4520	4810–4750 4710–4510 4470–4440	4600
A	118	7	244.8	29212	charcoal	-24.5 ± 0.2	60.1 ± 0.3	4091 ± 35	4790–4760 4630–4520	4820–4750 4710–4510 4490–4440	4600
B	127	7	258.0–260.7	32552	*Anadara antiquata* shell	0.2 ± 0.2	55.2 ± 0.2	4766 ± 30	5120–5090 5080–4940	5200–4880	5020
B	130	7	266.6–269.6	32553	*Gafrarium tumidum* shell	0.0 ± 0.2	55.5 ± 0.2	4727 ± 30	4920–4820	4990–4800	4880

2.24 and 2.25 quantify the cultural materials excavated from Squares A and B by XU. Detailed analyses of the ceramics, stone artefacts, shell, non-molluscan fauna, and worked shell are presented in Chapters 3–7 respectively. In Figure 2.26 the Tilia-Tiliagraph program suite was used for the diagrammatic presentation of data (Grimm 1991); the zone boundaries follow the stratigraphically-constrained classification sub-routine (CONISS dendrogram) that is part of the Tilia program. All archaeological categories in Figure 2.22 were used as input into CONISS.

In both Squares A and B charcoal is consistently present in moderate quantities in virtually all XUs in SU1 (the Upper Horizon) and SU6 (Figure 2.24). Charcoal is sporadically found in all other SUs, but in markedly lower quantities.

A total of 1171 pottery sherds totaling 1942.5g were excavated from Squares A and B. One hundred and twenty-one of these (10.3% by number) are ≥3cm long. A further 52 sherds ≥3cm long, plus a near-complete vessel, were retrieved from the stepping-out squares. The lowermost ceramic sherd ≥3cm long comes from 72–74cm below surface, in XU36 of Square B at the very base of the Middle Horizon (SU3/SU4 interface). Fifteen sherds <3cm long came from SU4, mainly from the interface with SU3, where vertical root stains connecting the two SUs are abundant (see Figure 2.15). We thus conclude that the first ceramics at Tanamu 1 relate to the base of the SU3 Middle Horizon, dating to *c.* 2800 cal BP. All the ceramics in SU3 (2800–2750 cal BP) are Lapita. In contrast, ceramics from the Upper Horizon (700–100 cal BP) are markedly different in character—plain wares, occasionally with maker's marks, and with vessel forms similar to the ethnographic *uro*. The decorative characteristics and vessel forms of the Tanamu 1 ceramics are described in detail in Chapter 3.

A total of 2317 stone artefacts collectively weighing 1661.6g were excavated from Squares A and B. These are distributed throughout the excavated sediments, with notable concentrations in the Upper, Middle and Lower Horizons and several lesser ones in SU6 (Figure 2.26). A notable feature of the Lapita Middle Horizon (SU3) stone artefact assemblage is its high degree of thermal alteration in comparison with assemblages from the other stratigraphic units. The small ground-stone industry, made on various igneous materials, includes a possible grinding stone and an adze blank that were found in SU1 and SU7 respectively. Most of the flaked stone assemblage was made on chert, with a small representation of chalcedony and basalt, as well as single quartz and obsidian items, the latter found in mid-SU2. The lowermost stone artefacts (all cherts) came from 276–278cm depth, in XU133 (Squares A and B) at the base of SU7. Their presence, albeit in low numbers in levels dating to *c.* 5000 cal BP, signals the earliest documented human occupation of Tanamu 1 (see Chapter 4).

Molluscan remains recovered during the excavation are the most abundant category of cultural material recovered from Tanamu 1 by far, with a total shell sample of 127,356g. Of these, 80% could be identified to family, genus or species level. Squares A and B yielded a combined total MNI of 14,665. The greatest amount of cultural shell by both MNI and weight is found at the SU5/SU6 interface in Square A and at the base of SU5 in Square B, although cultural shell is found in varying quantities throughout the deposit down to the base of SU6. The Upper Horizon SU1 is meager in both shell abundance and diversity (only 20 species) when compared with the Lapita period Middle Horizon SU3 (60+ species) and the pre-ceramic Lower Horizon SU5 (90+ species). Details of the molluscan taxonomic analysis and quantification results, and the indicated range of habitats exploited as represented by the assemblages from each SU, are presented and discussed in Chapter 5.

Squares A and B at Tanamu 1 produced a total 2758g of bone, 840g of crustacean (crab) exoskeleton, 8g of cuttlefish endoskeleton, 5g of echinoderm (urchin) exoskeleton, and 0.1g of avian eggshell (see Chapter 6). The highest concentration of bone was found in SU5 (Lower Horizon), although bone was present in most XUs throughout the excavation down to the base of the excavation in SU7. The other remains had more restricted distributions. Aside from small numbers in upper SU1 (Upper Horizon B), crab was only present in most XUs from about the middle of SU3 (Middle Horizon) down to the base of SU7, and like bone, concentrated in SU5 (Lower Horizon). Unlike bone and crab, urchin was concentrated in SU3 (Middle Horizon) and SU4, with sporadic occurrences in SU1, SU5 and SU6, down to XU105 in Square A. Although some variation is observed in the extent of bone surface corrosion through the profile, at no point in the sequence are the remains so degraded as to suggest a major quantitative loss through post-depositional processes.

Tanamu 1 contains a sizable worked shell assemblage, with items recovered from SU3, SU4, SU5, and SU6, and thus in association with both Lapita and pre-Lapita levels. The majority, however, were found in unambiguously pre-Lapita levels, with only a single piece of worked *Rochia nilotica* recovered from the Lapita-age SU3 (Middle Horizon). Two shell artefacts were recovered from SU4, ten from SU5 (Lower Horizon), and six from SU6 (see Figures 2.24–2.25). The positioning of the worked shells in the stratigraphy, the general limited evidence for downward movement of materials, and the nature of the shell artefacts themselves all indicate that the strong trend of association of most of the shell artefacts with pre-Lapita deposits is reliable (see Szabó *et al.* 2021). Full details of all shell artefacts are presented in Chapter 7.

Conclusion

SU1, SU3, and SU5 thus contain chronologically well-defined, vertically discrete, rich occupation deposits that are bounded by the relatively culturally sparse sediments of SU2, SU4 and SU6. The three stratigraphic

Figure 2.24. General list of excavated materials by XU, Tanamu 1 Square A.

XU	Shell	Non-Human Bone	Crab	Sea Urchin	Cuttlefish	Human Bone	Charcoal	Ceramic Sherds		Stone Artefacts		Worked Bone	Worked Shell		Land Snail Shell	Foraminifera	Pumice	Termite Larvae Husks	Seeds (Other than Modern Grass)
	g	g	g	g	g	g	g	#	g	#	g	g	#	g	g	g	g	g	g
1	397.7	0.02	0.37					9	8.6	6	1.9							0.04	19.2[a]
2	127.5	0.5	0.01					22	19.7	24	20.0							0.38	
3	548.5	3.79					0.15	46	51.4	69	39.5							2.37	
4	1,034.9	12.1					1.40	76	166.4	68	57.4							10.58	
5	1,911.2	17.25		0.04			6.36	23	80.2	49	68.4				0.10			8.09	
6	670.0	4.57	0.01				1.65	15	12.2	31	4.7				<0.01				
7	50.4	3.81		0.41			2.55	4	14.0	20	27.0				<0.01			1.90	
8	51.6	6.93					1.03	11	9.1	23	1.6							0.38	
9+10	57.3	3.63					0.97	13	22.7	23	0.8							0.52	
11	22.7	1.25					0.09	1	0.4	24	4.1							0.05	
12	43.2	3.97						9	26.4	9	5.6							0.09	
13	14.5	2.86						12	8.7	12	0.5							0.01	
14	34.9	4.71						12	14.4	42	11.5								
15	26.9	8.5						11	10.3	23	2.2								
16	65.6	3.78						11	14.2	11	6.4								
17	2.1	0.28								5	0.5								
18	66.0	2.44						7	7.6	15	3.5								
19	35.9	1.97						12	6.4	32	4.1								
20	10.9	3.16						3	1.8	16	11.4								
21	36.0	3.63						8	12.6	13	7.3								
22	209.0	2.68						2	6.0	9	0.7								
23	511.8	4.72						4	2.7	12	1.0								
24	666.2	6.53						7	30.5	1	<0.1								
25	1,352.7	4.63						19	24.7	13	4.3								
26	1,376.4	4.61	0.02	0.05				11	6.1	9	3.8		1	24.6					
27	1,227.6	3.32		0.06				6	34.1	7	59.9								
28	998.4	2.76						1	13.0	5	0.8								
29	1,859.0	2.63	0.47	0.27				21	8.7	7	4.3				0.10				
30	2,388.0	4.1	0.34	0.12				12	46.2	10	0.3								
31	1,093.1	3	0.21	0.09						12	16.2								
32	1,850.1	3.99	0.02	0.20			0.14	1	16.8	6	0.7				0.01				
33	2,588.2	1.07	0.55	0.14				1	15.6	8	87.2				0.10				

XU	Shell	Non-Human Bone	Crab	Sea Urchin	Cuttlefish	Human Bone	Charcoal	Ceramic Sherds		Stone Artefacts		Worked Bone	Worked Shell		Land Snail Shell	Foraminifera	Pumice	Termite Larvae Husks	Seeds (Other than Modern Grass)
	g	g	g	g	g	g	g	#	g	#	g	g	#	g	g	g	g	g	g
34	2,593.9	1.46	0.61	0.11				1	0.2	3	0.8	0.09							
35	804.0	4.61	0.32	0.62			0.43								0.10				
36	367.0	0.95	0.81	0.06			0.11			11	1.2				0.04				
37	306.4	1.26	0.33	0.26						3	0.2				0.03				
38	224.9	0.5	0.22	0.03						4	0.9				0.03				
39	197.2	0.73	0.24	0.01						6	3.2				0.01				
40	145.4	4.23	0.32	0.01						8	0.9				0.05				
41	236.6	4.71	0.23	0.20				1	0.4	1	0.1				0.07				
42	213.4	4.97	2.85	0.07						3	0.1				0.04				
43	345.1	2.82	0.21							12	4.7				0.03				
44	315.3	4.64	0.27	0.02				1	0.2	11	4.4				<0.01				
45	425.9	1.75	0.14							12	0.3				0.02				
46	218.0	3.21	0.79	0.19						4	0.3				0.11				
47	308.6	3.22	0.16							6	1.2				<0.01				
48	886.1	9.33	1.78	0.01						5	0.2		1	0.2					
49	415.0	7.06	1.87	0.06						10	0.3		1	<0.1					
50	588.0	7.02	0.68							10	0.4								
51	1,017.1	9.45	0.40							6	1.4						0.12		
52	2,259.6	76.16	1.73							12	0.7								
53	2,477.9	38.76	3.71				0.04			5	1.9				0.02		0.09		
54	1,299.0	15.18	8.25			0.60				5	3.2				<0.01		0.01		
55	1,857.4	22.5	3.95							13	86.0		1	0.1			6.08		
56	1,568.9	23.64	3.18							5	3.7				0.11				
57	1,280.3	18.39	1.15							13	0.9								
58	1,355.7	39.58	2.23							10	0.8				0.02				
59	1,979.1	74.56	15.43				0.09			10	0.8				<0.01				
60	1,352.8	8.44	3.25							8	4.6						0.29		
61	1,706.3	29.97	7.17							11	0.9		1	0.4			0.01		
62	87.5	40.4	0.25				0.59												
63	1,143.7	39.47	10.63							7	20.5								
64	1,780.2	30.52	30.51				0.07			10	121.0		1	0.9					
65	1,601.1	22.37	16.05							6	0.3						0.07		
66	2,684.8	48.57	101.43				0.10			11	23.4		1	0.2	0.01	0.01	0.06		
67	1,100.4	8.16	28.54				0.15			6	5.5				<0.01		0.05		
68	178.0	0.31	2.30							1	<0.1								
69	638.9	7.73	7.70							3	<0.1				0.12		1.85		
70	700.8	6.3	7.25							6	1.1				<0.01				
71	336.4	3.75	2.63							2	14.7				<0.01	0.05			
72	261.4	5.78	3.30				0.03			4	0.4					0.01			
73	159.9	6.77	8.85							6	0.4				0.01	0.01			
74	111.7	5.53	5.95				0.19			2	1.6								
75	115.9	20.15	3.24				0.28			7	1.8				0.01				

XU	Shell	Non-Human Bone	Crab	Sea Urchin	Cuttlefish	Human Bone	Charcoal	Ceramic Sherds		Stone Artefacts		Worked Bone	Worked Shell		Land Snail Shell	Foraminifera	Pumice	Termite Larvae Husks	Seeds (Other than Modern Grass)
	g	g	g	g	g	g	g	#	g	#	g	g	#	g	g	g	g	g	g
76	64.7	4.34	3.70				0.05			4	0.2						0.61		
77	53.6		2.18				0.04			3	0.3								
78	47.0	3.11	4.29				0.95			5	0.2					0.01	0.08		
79	41.3	1.09	2.16				0.22			6	0.8					0.01			
80	70.2	2.26	3.68				0.06			5	0.2						0.42		
81	68.1	2.65	3.35				0.56			3	2.6						0.76	0.01	
82	68.0	1.82	5.48				0.61			7	1.7					0.01	2.38		
83	74.8	5.86	3.68				1.03			3	0.7				<0.01	0.01	0.24	0.01	
84	56.5	2.28	4.15				0.52			1	0.2						0.34	0.01	
85	155.3	5.48	0.99				1.08			8	0.7						0.46		
86	81.5	6.94	1.41				0.55			2	46.8						0.65		
87	57.6	9.61	3.03		1.65		0.60			5	0.3					0.01			
88	37.4	3.44	5.02				0.41			2	0.1					0.03	0.91		
89	59.0	2.33	2.80				0.30			5	0.3					0.01	0.81		
90	26.3	3.39	4.21		0.11		1.28			3	0.1								
91	48.9	1.24	3.22		0.58		0.32			4	2.7				0.02	0.04	1.14		
92	27.1	3.18	2.14				0.24			1	0.2						1.42		
93	33.6	0.78	0.65				0.33			2	0.8				<0.01	0.05	0.16		
94	19.8	0.48	0.17				0.25			2	<0.1						0.18		
95	9.1	0.31	0.31	0.06						2	<0.1								
96	24.6	0.59	0.60				0.01			3	0.1								
97	13.3	0.89	0.06				0.25			5	0.2								
98	65.0	0.77	0.91							5	0.2						1.01		
99	48.7	1.79	3.14							9	99.7					0.01	0.73	0.01	
100	22.7	2.68	0.35							5	0.3					0.01	0.24		
101	49.3	1.40	1.40				0.03			2	0.5				<0.01	0.01	0.34		
102	56.2	2.24	4.53				0.36			6	0.9				0.02		0.01		
103	69.8	1.35	8.03				0.47			2	1.3					0.01	0.08		
104	49.8	3.22	4.01				0.01			3	0.3					0.01	1.31		
105	75.0	1.87	0.90	0.02			1.26			4	0.2					0.03	0.07		
106	35.7	1.99	2.99				1.23			2	0.2					0.15	0.27		
107	22.7	3.68	2.28				0.16									0.07	0.27		
108	48.8	2.61	2.25				0.41			1	0.1					0.08	0.01		
109	42.6	1.31	1.12				0.44			4	0.1					0.06			
110	78.6	4.03	0.53				0.08			4	47.3				0.01				
111	48.1	3.06	0.95				0.21			5	0.1				<0.01	0.09			
112	75.4	0.41	1.40				0.06			1	0.1					0.01			
113	31.5	1.55	2.06				0.29			2	0.7								
114	21.4	0.51	0.90												0.02				
115	21.4	0.53	4.00				0.04												
116	32.4	0.26	8.72				0.60								0.01	0.03	0.38		
117	31.5	1.13	4.64							3	1.0								

XU	Shell	Non-Human Bone	Crab	Sea Urchin	Cuttlefish	Human Bone	Charcoal	Ceramic Sherds		Stone Artefacts		Worked Bone	Worked Shell		Land Snail Shell	Foraminifera	Pumice	Termite Larvae Husks	Seeds (Other than Modern Grass)
	g	g	g	g	g	g	g	#	g	#	g	g	#	g	g	g	g	g	g
118	62.2	1.18	6.20				0.08			2	0.3					0.11			
119	12.3	0.16	1.18							1	<0.1								
120	19.1	0.58	0.19							1	0.1								
121	21.6	0.31	0.16							1	0.1				0.01				
122	30.3	0.07	0.39							1	0.1						0.03		
123	25.1	0.19	0.93							1	0.1				<0.01	0.01			
124	28.4	0.02	0.03							2	0.1								
125	19.8	0.01								1	<0.1								
126	35.5	0.25	0.31							3	<0.1						0.04		
127	29.5	0.05	0.74							1	<0.1								
128	70.8	0.08	1.27							1	0.1					0.11			
129	68.3		0.30							6	0.5								
130	65.9		1.01																
131	109.2	0.46	1.44													0.36			
132	84.8		1.29							3	0.3								
133	87.0		1.04							4	0.1					0.87			
134	159.0	0.53	2.74				0.16									1.01			

[a] Coconut shell.

Figure 2.25. General list of excavated materials by XU, Tanamu 1 Square B.

XU	Shell	Non-Human Bone	Crab	Sea Urchin	Cuttlefish	Eggshell	Human Bone	Charcoal	Ceramic Sherds		Stone Artefacts		Worked Shell		Land Snail Shell	Foraminifera	Pumice	Termite Larvae Husks	Seeds (Other than Modern Grass)
	g	g	g	g	g	g	g	g	#	g	#	g	#	g	g	g	g	g	g
1	190.1	0.21	0.82						46	22.9	13	6.4							
2	277.9	0.02						0.06	46	58.2	10	3.0							
3	1,314.0	14.87	1.87						173	311.5	129	52.5						0.48	
4	2,348.2	25.05	5.50					0.04	94	305.6	145	96.8						6.40	
5+6	2,437.2	33.19	0.81					5.41	56	183.7	30	19.2			<0.01			?	
7	190.6	2.98						0.68	11	33.3	19	6.7						1.98	
8	78.6	3.79							20	17.3	24	3.1						0.93	
9	12.1	0.74						0.13	10	10.9	21	5.4						0.32	
10	87.0	1.67						0.70	16	44.0								0.26	
11	20.5	1.92							7	13.1	6	1.8						0.01	
12	25.8	2.35							8	8.1	14	4.0						0.06	
13	15.3	2.79							10	6.9	23	12.8						0.04	

XU	Shell	Non-Human Bone	Crab	Sea Urchin	Cuttlefish	Eggshell	Human Bone	Charcoal	Ceramic Sherds		Stone Artefacts		Worked Shell		Land Snail Shell	Foraminifera	Pumice	Termite Larvae Husks	Seeds (Other than Modern Grass)
	g	g	g	g	g	g	g	g	#	g	#	g	#	g	g	g	g	g	g
14	41.5	4.39							13	6.2								0.01	
15	13.5	6.59							9	5.8	27	6.6						0.01	
16	31.7	9.27						0.16	20	10.9	32	1.8						0.01	
17	4.1	4.11							21	5.3	14	1.5							
18	19.7	3.09							21	11.5	22	0.9							
19	22.3	6.53							10	9.1	10	1.9							
20	27.2	5.94							11	5.8	18	2.8						0.06	
21	32.5	4.84							10	2.5	9	0.7						0.02	
22	125.4	7.82									22	2.0							
23	52.0	6.23						0.03	6	8.7	17	1.9							
24	298.5	6.56									18	3.5						0.01	
25	812.2	9.87	1.02	0.14					7	5.2	36	5.4							
26	400.2	5.37	0.04						25	12.8	7	0.7							
27	759.1	3.31							31	28.6	6	0.1							
28	401.9	4.04	0.21						16	13.4									
29	860.7	4.67	0.78					0.01	21	71.1	18	5.1							
30	1,892.4	4.64		0.13					29	18.7	23	1.6							
31	641.3	1.43	0.24	0.01							3	0.1			0.01				
32	1,181.7	3.28		0.37							4	2.2							
33	738.3	22.16		0.02					17	7.6	6	0.2							
34	757.4	1.90		0.02							4	0.1							
35	212.0	1.47	0.06	0.04							2	0.1			0.12				
36	285.9	2.43	0.02						2	3.3	3	0.8							
37	176.8	3.19	0.43	0.01					3	1.4	5	0.6			<0.01				
38	314.1	4.12	0.01	0.01							1	<0.1			0.13				
39	186.2	2.06	0.06	0.09			0.06	0.07	4	1.0	9	0.3			0.10				
40	223.9	3.24	1.42	0.02							5	0.3	1	<0.1	0.13				
41	194.1	5.50	0.01	0.13							18	0.5	1	<0.1	0.01				
42	270.4	5.79	0.72						3	2.2	9	0.3			0.13				
43	228.8	1.59	0.70	0.16					2	3.6	9	0.1			0.14				
44	370.4	13.29	0.55								24	1.4			0.10		0.02	0.01	
45	222.5	10.40	0.05	0.01							2	1.4			<0.01				
46	420.3	12.82	0.13	0.04							1	0.1							
47	599.6	7.76	2.89								7	2.9							
48	703.4										22	0.6			0.10		0.10	0.01	
49	977.0	8.29	0.81								5	9.1			0.01				
50	1,619.3	13.41	3.47								11	1.5			0.09		3.78		
51	1,270.7	15.45	0.71								3	0.1			0.01				
52	1,201.5	10.70	1.15								7	1.9							
53	1,549.3	34.32	1.45					0.06			3	0.3	1	0.8			1.86		
54	1,956.4	22.1	0.61								1	0.2							1.12
55	1,603.4	48.78	0.75								9	1.2	1	<0.1					

XU	Shell	Non-Human Bone	Crab	Sea Urchin	Cuttlefish	Eggshell	Human Bone	Charcoal	Ceramic Sherds		Stone Artefacts		Worked Shell		Land Snail Shell	Foraminifera	Pumice	Termite Larvae Husks	Seeds (Other than Modern Grass)
	g	g	g	g	g	g	g	g	#	g	#	g	#	g	g	g	g	g	g
56	1,282.3	17.33	1.97	0.10							14	0.7			0.07		0.71		
57	1,360.1	40.88	5.28	0.03							9	0.9	1	21.0					
58	1,457.2	14.73	4.22					0.05			12	2.2							
59	1,753.0	11.8	1.04								20	98.4			0.02				
60	1,179.8	20.34	3.31					0.07			11	0.5							
61	3,476.3	33.93	28.44								17	11.1			0.01				
62	2,816.1	238.32	18.16								18	6.3			0.03				
63	1,429.0	363.80	12.56					0.61			7	0.3			0.17	0.01			
64	2,428.7	81.50	23.37								1	<0.1			0.02		3.83		
65	1,751.4	115.34	53.44					0.03			7	71.5			<0.01		2.47		
66	3,412.2	313.07	21.22					0.08			21	4.1			0.10		0.40		
67	4,669.7	18.70	51.89	0.01				0.07			6	23.7			0.01	0.01	0.50		
68	609.8	6.29	10.36	0.39							5	0.1	1	0.6	0.02		0.02		
69	492.2	6.89	12.13					0.01			10	1.1				0.01			
70	852.0	13.68	16.54					0.22			9	2.7			0.14	0.02			
71	562.0	10.41	10.48					0.04			10	0.9	3	1.4	0.13	0.01	0.38		
72	387.1	5.38	6.71								4	54.2			0.02		0.10		
73	247.8	3.49	7.45					0.08			5	0.1			0.15		0.01		
74	179.9	4.79	6.45					0.59			17	0.5				0.03	2.32		
75	112.3	3.89	2.19								6	1.1	1	<0.1	0.01		0.65		
76	119.9	4.92	3.03								8	0.7			<0.01	0.01	0.38		
77	53.2	2.18	2.12					0.04			2	1.0			<0.01		0.30		
78	66.6	3.58	2.43					0.01							1.20	0.01	0.48		
79	118.8	1.63	6.17					0.31			11	1.1				0.01	0.25		
80	93.1	1.22	1.22					0.01			4	0.2			0.11	0.03	0.15		
81	96.6	4.19	4.85			0.06		0.04			11	0.2				0.01	0.57		
82	110.9	4.48	3.53					0.93			2	<0.1			0.01	0.03	0.17		
83	82.8	2.25	1.66					0.08			5	0.3				0.01	0.30		
84	115.8	4.36	3.81					0.03			5	0.3			0.01	0.04	0.67		
85	63.0	2.80	6.17					0.74			8	0.3	1	0.5		0.01	2.69		
86	112.2	3.17	5.32					0.15			9	2.4			0.02	0.06	0.25		
87	140.5	4.46	3.69					0.29			5	0.2			0.04	0.05	1.36		
88	122.4	1.90	4.40					0.15			8	38.9			0.01	0.04	0.99		
89	132.5	2.01	2.78					0.04			11	67.6	1	13.0		0.03	4.26		
90	75.3	3.29	5.42					0.43			14	1.0			0.12	0.01	2.22		
91	227.4	0.56	3.97					1.35			3	0.1			0.08	0.09	6.78		
92	47.8	2.43	1.68					0.29			2	1.9			0.06	0.25	4.21		
93	89.3	0.94	3.15					0.08			4	0.2			<0.01	0.08	3.57	0.01	
94	80.3	0.29	0.26					0.01			3	0.3			<0.01		0.11		
95	97.4	1.98	0.75					0.08			3	0.4			0.01	0.10	0.28		
96	46.9	1.82	0.05								1	<0.1			0.01	0.05	1.54		
97	56.8	2.65	1.65	0.04				0.01			3	<0.1			0.02	0.01	1.71		

XU	Shell	Non-Human Bone	Crab	Sea Urchin	Cuttlefish	Eggshell	Human Bone	Charcoal	Ceramic Sherds		Stone Artefacts		Worked Shell		Land Snail Shell	Foraminifera	Pumice	Termite Larvae Husks	Seeds (Other than Modern Grass)
	g	g	g	g	g	g	g	g	#	g	#	g	#	g	g	g	g	g	g
98	76.8	3.19	4.15	0.02				0.13			4	0.1				0.03	3.30		
99	54.5	2.28	0.39													0.08	0.01		
100	53.0	2.62	1.72					0.01			3	0.5			0.01	0.02	2.38		
101	59.7	2.83	0.14					0.17			3	0.3				0.04	0.60		
102	64.0	3.54	0.85								2	<0.1				0.01	0.25		
103	38.4	3.02	1.25								1	<0.1				0.05	0.32		
104	168.8	1.65	0.89	0.01	5.27			0.67			2	0.5			0.01	0.02	0.38		
105	30.7	1.88	1.05					0.01			4	0.3			0.06	0.02	0.55		
106	26.0	0.89	1.54								1	0.3			0.01	0.03	0.10		
107	31.4	1.49	2.08		0.29			0.01							0.04	0.05	1.79		
108	16.7	0.29	0.59					0.12			2	0.1				0.04			
109	31.4	0.68	0.39					0.08								0.22	0.52		
110	33.9	0.33						0.01									0.05		
111	31.0	1.81	1.65					0.03			2	0.2				0.01	0.12		
112	19.1	0.20	1.27					0.08								0.08	0.20		
113	50.0	0.10	0.95					0.01			2	0.7					0.30		
114	50.7							0.01											
115	50.6	0.13	2.15								2	1.3				0.01	0.01		
116	26.6	1.69	2.02					0.54			1	<0.1					0.01		
117	14.1	0.44	0.43																
118	38.1	0.01									2	<0.1					0.01		
119	33.4	0.40	1.96								1	<0.1					0.06		
120	65.2	0.02	0.65					0.01											
121	17.7	0.09																	
122	32.3	0.13	0.04								2	0.1					0.03		
123	30.4	0.09	1.20												0.05				
124	34.6	0.16									1	<0.1				0.01			
125	0.1																		
126	23.1	0.06	0.47																
127	39.9	0.11	0.10								1	0.1				0.04	0.01		
128	62.5	0.01	2.46													0.07			
129	15.8		1.19																
130	35.8		0.81													0.31			
131	43.6		3.11					0.01			3	0.1				2.53			
132																			
133	78.6		0.72								1	<0.1				1.13			
134	66.1		1.16																

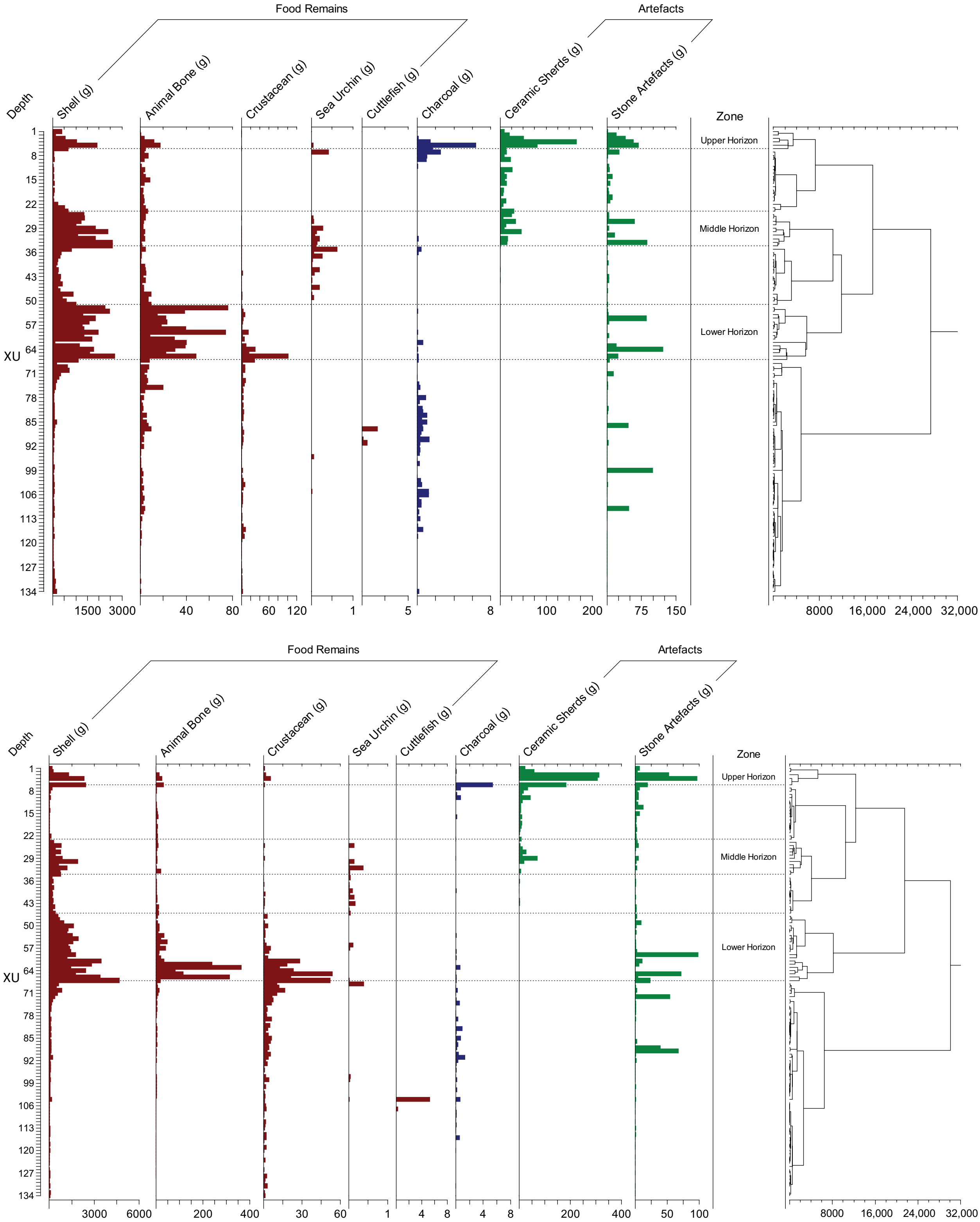

Figure 2.26. Distribution of cultural materials by XU, Tanamu 1 Squares A (top) and B (bottom).

units containing dense occupation deposits associated with former stable land surfaces, SU1, SU3, and SU5, are characterized respectively as:

- Upper Horizon (SU1, XU1–XU10), *c.* 700–100 cal BP. Ceramics are plain wares, occasionally with maker's marks, and with vessel forms similar to the ethnographic *uro*. The Upper Horizon is subdivided into: Upper Horizon A (XU7–XU10), *c.* 700–200 cal BP, corresponding to the onset of deposition of SU1; and Upper Horizon B (XU1–XU6), the densest occupation deposits of SU1 with the proto-ethnographic period age of *c.* 200–100 cal BP, probably immediately pre-dating European colonialism based on the absence of European-manufactured materials.
- Middle Horizon (SU3, XU24–XU34), 2800–2750 cal BP. The first *in situ* ceramics come from this horizon. These are all Lapita wares, and are characterized by collared and carinated vessels predominantly decorated with a narrow range of curvilinear comb dentate-stamped designs. A significant introduced mammal species, the pig (*Sus scrofa*), first appears in the record in the upper part of the Middle Horizon, shortly after the first appearance of ceramics.
- Lower Horizon (SU5, XU48–XU68), 4350–4050 cal BP. The lowermost dense occupation horizon contains abundant faunal remains and stone artefacts, and a notable quantity of worked shell, but ceramics are completely absent. The faunal evidence suggests a strong emphasis on marine resources including exploitation of an exceptionally wide array of shellfish and the regular exploitation of fish, reef crab, and turtles, the latter possibly on a seasonal basis. Despite the presence of a rich faunal assemblage in the Lower Horizon, pig and dog (*Canis familiaris*) remains are notably absent.

The cultural contents of SU2 and SU4 resulted from occasional visits to the site between major occupation periods, as well as from material that has moved slightly down or up the section from the major occupation deposits (i.e., SU1, SU3, and SU5). Thus, unlike the three major horizons described above, the cultural material in SU2 and SU4 is generally not assignable to any particular but brief occupation period (the exception being pottery that has decoration of a kind securely dated elsewhere at Caution Bay). They are instead identified to much broader temporal ranges, spanning 2050 years for SU2 and 1250 years for SU4, making them less useful for cultural sequence-building. Nevertheless, the sparse material in SU2 and SU4 does contribute to the understanding of the occupation history of Tanamu 1.

While some of the cultural material in upper SU6 has possibly moved down a short distance from the major occupation deposit of the Lower Horizon (SU5), cultural material concentrations throughout SU6 probably represent small-scale, short term occupations of the site area during a period of rapid dune building when the fronting coastline was more open than it is today, and largely or totally devoid of mangroves. The small quantities of cultural material in SU7 are the result of episodic minor occupations on fore-dune sediments proximal to high tide level that characterized the excavated site area *c.* 5000 cal BP.

Archaeological evidence of human occupation at Tanamu 1 extends to the deepest excavated levels of SU7. It is unknown if this basal cultural evidence overlies unexcavated earlier cultural deposits at deeper levels. If so, the lower SU7 sediments would indicate intertidal beach deposits at the time of such earlier occupation.

The excavation shows that a Lapita settlement was established around 2800 cal BP at Tanamu 1, disappearing around 50 years later but continuing some 140m to the NNW at Bogi 1 where a contemporaneous Lapita village or, more likely, extension of the same village site already existed. At Bogi 1, occupation by Lapita ceramicists continued for a further *c.* 150 years after the abandonment of Tanamu 1, until *c.* 2600 cal BP when here too the village was abandoned (McNiven *et al.* 2012a).

The specialist chapters to follow (Chapters 3–7) present the full material record of human occupation at Tanamu 1, and discuss details of cultural practices relating to each occupation horizon.

Chapter 3.
The Ceramics of Tanamu 1

Bruno David and Holly Jones-Amin

Introduction

Tanamu 1 is of particular interest to investigations of Lapita into post-Lapita ceramic transformations at Caution Bay, because it contains relatively large sherds with uncontroversially Lapita decoration dating to 2800–2750 cal BP (see Chapter 2 for chronostratigraphic details). Although the decorated assemblage is small, it allows us to characterise what Caution Bay's early ceramics were like, both decoratively and, to a lesser extent, in terms of vessel shapes. The good chronostratigraphic resolution—including the presence of a rich Middle Horizon dating to 2800–2750 cal BP clearly relating to Lapita times and containing unambiguous Lapita ceramics—not only gives a secure starting point for ceramics in this part of the site, but also allows us to ground the Lapita to post-Lapita regional sequence with a firmly dated assemblage, especially useful for the characterisation of transformations out of Lapita.

This chapter is based on three kinds of ceramic data, the methodology for which has been presented in detail in David *et al.* (2016a):

1. *All the sherds ≥3.0cm maximum length from Squares A and B*: This includes both the material collected *in situ* (and thus plotted in three dimensions during excavation), and the sherds retrieved from the 2.1mm-mesh sieves. These sherds are analysed by Excavation Unit (XU) without reference to sub-XUs, because post- excavation analysis concluded that the sub-XUs do not represent distinctive depositional or post-depositional layers or intrusions that would affect the chronology or analyses.
2. *All the sherds <3.0cm long from Squares A and B*: The decorated body and rim sherds of this group are analysed for their decoration, and the number of total rim sherds are quantified. All other sherds <3.0cm long—the plain body sherds—were only counted and weighed by XU without further analyses.
3. *The sherds collected from the stepping-out squares*: These sherds were analysed in the same way as 1 and 2 above (see Chapter 2 for details of Squares A and B versus stepping-out squares).

The excavated sherds

The excavated ceramics are discussed via a number of themes. Figures 3.1 and 3.2 present summary data on some of these themes for Squares A and B. Figure 3.3 presents details of the individual sherds from the stepping-out squares. The significance of these finds is discussed in the Conclusion below.

Vertical Distribution of Ceramics

Square A

A total of 393 sherds weighing 692.3g were excavated from Square A (Figure 3.1). Forty-three (10.9%) of these, weighing 409.1g (59.1%), are ≥3.0cm long.

Ceramic sherds are consistently found from XU1 down to 69cm depth in XU34 (lower levels of SU3) (Figures 3.1, 3.4). Peak ceramic numbers and weights occur from XU1 to XU6 (SU1, Upper Horizon B), with a lesser peak in XU23 to XU30 (Middle Horizon). Sherds are consistently present between these two peaks, indicating either continued deposition, post-depositional mixing between the two dense cultural horizons of SU1 and SU3, or both. Sherds ≥3.0cm long only occur down to XU33 in lower SU3, with single sherds <3.0cm long found in each of XU41 and XU44 in SU4. Notwithstanding the two tiny sherds in XU41 and XU44, ceramics cease abruptly below the base of SU3 (the Middle Horizon), indicating that SU3 represents the commencement of ceramics at Tanamu 1. Root stains extending from SU3 into SU4 (see Figure 2.18) suggest a source of limited post-depositional disturbance that resulted in a few small sherds moving from SU3 down into SU4.

Square B

Square B contains 778 sherds weighing 1250.2g (Figure 3.2). Seventy-eight (10.0%) of these, weighing 725.4g (58.0%), are ≥3.0cm long.

Sherds were found in most XUs from XU1 down to 67cm depth in XU33 (Figures 3.2, 3.4). Peak ceramic numbers and weights occur from XU1 to XU6 (Upper Horizon B), with a lesser peak in XU26 to XU30 (Middle Horizon). Sherds are present in most XUs between these two

Figure 3.1. Summary data on pottery sherds by XU, Tanamu 1 Square A.

XU	SU	Total sherds		Average weight of sherds	Sherds with comb dentate stamping		Impressed (continuous line) body sherds		Incised body sherds		Indeterminate incised or impressed body sherds		Sherds ≥3.0cm long	
		#	g	g	#	g	#	g	#	g	#	g	#	g
1	1	9	8.6	0.96										
2	1	22	19.7	0.90										
3	1	46	51.4	1.12									4	16.8
4	1	76	166.4	2.19									13	127.0
5	1	23	80.2	3.49									5	61.8
6	1	15	12.2	0.81										
7	1	4	14.0	3.50									2	12.7
8	1+1a	11	9.1	0.83										
9+10	1+1a+2	13	22.7	1.75									1	8.7
11	1+1a+2	1	0.4	0.40							1	0.4		
12	1+1a+2	9	26.4	2.93									1	17.7
13	1+1a+2	12	8.7	0.73										
14	1+1a+2	12	14.4	1.20									2	9.6
15	2	11	10.3	0.94							1	0.8		
16	2	11	14.2	1.29	2	1.0	1	2.1					1	6.3
17	2													
18	2	7	7.6	1.09										
19	2+3	12	6.4	0.53										
20	2+3	3	1.8	0.60										
21	2+3	8	12.6	1.58	1	2.2								
22	2+3	2	6.0	3.00									1	4.4
23	2+3	4	2.7	0.68										
24	2+3	7	30.5	4.36									2	25.0
25	2+3	19	24.7	1.30	1	2.4	1	4.9	1	2.4	1	5.7	2	10.6
26	2+3	11	6.1	0.55										
27	2+3	6	34.1	5.68	1	2.6	1	22.2					2	25.3
28	3+4	1	13.0	13.00	1	13.0	1	13.0					1	13.0
29	3+4	21	8.7	0.41										
30	3+4	12	46.2	3.85	3	33.7							4	38.0
31	3+4													
32	3+4	1	16.8	16.80									1	16.8
33	3+4	1	15.6	15.60	1	15.6							1	15.6
34	3+4	1	0.2	0.20										
35	3+4													
36	3+4													
37	3+4													
38	3+4													
39	3+4													
40	4													
41	4	1	0.4	0.40										
42	4+5													

XU	SU	Total sherds		Average weight of sherds	Sherds with comb dentate stamping		Impressed (continuous line) body sherds		Incised body sherds		Indeterminate incised or impressed body sherds		Sherds ≥3.0cm long	
		#	g	g	#	g	#	g	#	g	#	g	#	g
43	4+5													
44	4+5	1	0.2	0.20										
Total		**393**	**692.3**	**1.76**	**10**	**70.5**	**4**	**40.1**	**1**	**2.4**	**3**	**6.9**	**43**	**409.1**

Figure 3.2. Summary data on pottery sherds by XU, Tanamu 1 Square B.

XU	SU	Total sherds		Average weight of sherds	Impressed (continuous line) body sherds		Incised body sherds		Indeterminate incised or impressed body sherds		*Tegillarca granosa* shell end-impressed sherds		Sherds with finger groove below the lip		Sherds ≥3.0cm length		≥3.0cm sherds with paddle-edge marks on external surface		≥3.0cm sherds with dimple marks on internal surface	
		#	g	g	#	g	#	g	#	g	#	g	#	g	#	g	#	g	#	g
1	1	46	22.9	0.50																
2	1	46	58.2	1.27			2	23.3							2	23.3				
3	1	173	311.5	1.80											22	148.7	1	13.4		
4	1	94	305.6	3.25			1	9.4							20	233.8			3	33.4
5+6	1	56	183.7	3.28											13	141.7			3	64.0
7	1	11	33.3	3.03											2	23.6				
8	1	20	17.3	0.87											1	9.6				
9	1	10	10.9	1.09											2	9.2				
10	1+2	16	44.0	2.75			1	17.1					1	1.8	2	32.6				
11	1+2	7	13.1	1.87	1	1.8									1	4.9				
12	1+2	8	8.1	1.01											1	3.5				
13	1+2	10	6.9	0.69																
14	1+2	13	6.2	0.48																
15	2	9	5.8	0.64											1	3.1				
16	2	20	10.9	0.55																
17	2	21	5.3	0.25																
18	2	21	11.5	0.55																
19	2	10	9.1	0.91							1	4.8			1	4.8				
20	2	11	5.8	0.53																
21	2	10	2.5	0.25																
22	2+3																			
23	2+3	6	8.7	1.45											1	3.6			1	3.6
24	2+3																			
25	2+3	7	5.2	0.74																
26	2+3	25	12.8	0.51					1	0.3										
27	2+3	31	28.6	0.92											1	15.7				

XU	SU	Total sherds		Average weight of sherds	Impressed (continuous line) body sherds		Incised body sherds		Indeterminate incised or impressed body sherds		*Tegillarca granosa* shell end-impressed sherds		Sherds with finger groove below the lip		Sherds ≥3.0cm length		≥3.0cm sherds with paddle-edge marks on external surface		≥3.0cm sherds with dimple marks on internal surface	
		#	**g**	**g**	**#**	**g**	**#**	**g**	**#**	**g**	**#**	**g**	**#**	**g**	**#**	**g**	**#**	**g**	**#**	**g**
28	2+3+4	16	13.4	0.84																
29	2+3+4	21	71.1	3.39	3	32.9									6	58.7				
30	2+3+4	29	18.7	0.64											1	6.0				
31	3+4																			
32	3+4																			
33	3+4	17	7.6	0.45																
34	3+4																			
35	3+4																			
36	3+4	2	3.3	1.65											1	2.8				
37	3+4	3	1.4	0.47																
38	3+4																			
39	3+4	4	1.0	0.25																
40	4																			
41	4																			
42	4	3	2.2	0.73	1	1.5														
43	4	2	3.6	1.80																
Total		**778**	**1,250.2**	**1.61**	**5**	**36.2**	**4**	**49.8**	**1**	**0.3**	**1**	**4.8**	**1**	**1.8**	**78**	**725.4**	**1**	**13.4**	**7**	**101.0**

Figure 3.3. Summary data for the sherds from the stepping-out squares.

Sherd # Sherd Length ≥3.0cm	Sherd # Sherd Length <3.0cm	Depth Below Ground (cm)	Weight (g)	Max. Length (mm)	Lip Thick. (mm)	Rim Thick. (mm)	Neck Thick. (mm)	Collar Thick. (mm)	Carination Thick. (mm)	Undiff. Rim/ Collar/ Body Thick. (mm)	Orifice ∅ (cm)	% Vessel ∅	Orientation Angle	Inclination Angle	Lip Profile	Rim Course	Rim Profile	Rim Length (cm)	Has Body Decoration	Decoration & Comments
Square C XU1																				
1		8	29.01	59.34	9.80	7.57					24	5	355		Round	Straight	Gradually thickening			
2		13	40.00	62.88			11.91			7.16										
Square C XU3																				
1		23	10.73	43.56	5.07	8.06							55		Flat	Concave	Gradually thinning			Lip: Stick(?) impressions across lip.
Square C XU6																				
1		57	32.52	54.44						15.16									Yes	Body: Needlepoint dentate-stamped paired horizontal lines crossed by paired diagonal lines. Small, 3.5 mm-diameter impressed circles are located in the spaces between the crossing dentate-stamped lines.
Square D XU4																				
	1	32	2.14	n/a																Lip: Stick(?) impressions across lip.
Square D XU5																				
1		52	5.21	35.68						5.68										
2		50	48.31	102.33						8.07										Anvil dimple marks present on inner surface.
3		53	14.23	69.39						4.67										Burnished.
Square E XU1																				
1		8	12.81	42.45						8.74										
Square E XU6																				

Sherd # Sherd Length ≥3.0cm	Sherd # Sherd Length <3.0cm	Depth Below Ground (cm)	Weight (g)	Max. Length (mm)	Lip Thick. (mm)	Rim Thick. (mm)	Neck Thick. (mm)	Collar Thick. (mm)	Carination Thick. (mm)	Undiff. Rim/ Collar/ Body Thick. (mm)	Orifice ∅ (cm)	% Vessel ∅	Orientation Angle	Inclination Angle	Lip Profile	Rim Course	Rim Profile	Rim Length (cm)	Has Body Decoration	Decoration & Comments
1		56	25.95	57.92	5.49	10.30					18	5	30	135	Round	Convex	Gradually thinning		Yes	Body: Double row of paired impressed double-arcs below lip, row of small overlapping impressed arcs below. Lip: Stick(?), shell(?) or finger-tip(?) impressions across lip.
Square F XU1																				
1		0–10	7.49	45.72						7.15										
2		0–10	12.11	41.61						7.63										
3		4	24.22	54.41	14.11	7.22					25	5	30		Flat					Lip: Short parallel slanted incisions internally just below apex of ridge of lip. Note: Lip is thickened and internally slants downwards.
Square F XU4																				
1		30–39	14.36	43.03						8.72										
Square F XU5																				
1		39–48	38.85	50.56	5.79	6.81										Straight	Parallel-sided		Yes	Lip: Stick(?)-impressed notches tapering towards external edge. Body: Paired impressed lines below neck. Note: This sherd is broken into 10 conjoining pieces.
Square G XU7																				
1		64	30.74	81.15			9.11			9.08										
Square H XU2																				
1		12	11.15	45.60	9.55	8.84							65		Round	Straight	Parallel-sided	9.82		Lip: Parallel lines impressed across much of the lip with fingernail(?) or thin-edged tool.
Square H XU5																				
1		62	37.58	69.59					13.93	7.83										

Sherd #		Depth Below Ground	Weight	Max. Length	Lip Thick.	Rim Thick.	Neck Thick.	Collar Thick.	Carination Thick.	Undiff. Rim/ Collar/ Body Thick.	Orifice ∅	% Vessel ∅	Orientation Angle	Inclination Angle	Lip Profile	Rim Course	Rim Profile	Rim Length	Has Body Decoration	Decoration & Comments
Sherd Length																				
≥3.0cm	<3.0cm	(cm)	(g)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(cm)							(cm)		
Square J XU1																				
1		0–10	11.57	42.00	11.20						22	5	5		Round					
2		0–10	13.07	42.49						7.45										
3		0–10	76.98	98.65						7.42										Anvil dimple marks present on inner surface.
Square J XU2																				
1		10–19	13.56	47.32			7.17			6.79										
2		10–19	11.45	54.30						5.36										
Square K XU1																				
1		0–11	20.18	57.92	5.49	8.06					16	10	355		Round	Concave	Gradually thinning			
2		0–11	17.12	56.97	5.27	7.87	7.01						0		Round	Straight	Gradually thinning			Note: Rim is gradually tapering towards the lip from external surface.
3		0–11	4.49	34.61						5.89										
Square K XU6																				
1		57	121.23	12.21			14.00	14.65	11.47										Yes	Body: Rim or collar sherd (without lip) from a carinated pot. The pot is 40 cm diameter at the carination (orifice diameter not available as the sherd does not contain a lip). This large, 12.2 cm-long sherd is of irregular curve and irregular, 6.1–10.0 mm wall thickness along the rim or collar. Not enough of the body below the carination has survived to determine the shape of its base, but the uppermost preserved curvature indicates a likely globular body. Repeated impressed parallel arcs on the rim or collar, each arc being 15.8 mm long (measured from

Sherd # – Sherd Length ≥3.0cm	Sherd # – Sherd Length <3.0cm	Depth Below Ground (cm)	Weight (g)	Max. Length (mm)	Lip Thick. (mm)	Rim Thick. (mm)	Neck Thick. (mm)	Collar Thick. (mm)	Carination Thick. (mm)	Undiff. Rim/ Collar/ Body Thick. (mm)	Orifice ∅ (cm)	% Vessel ∅	Orientation Angle	Inclination Angle	Lip Profile	Rim Course	Rim Profile	Rim Length (cm)	Has Body Decoration	Decoration & Comments
																				end to end in a straight line). At the neck below, this zone marker consists of overlapping impressed arcs, each arc being 13.9 mm long: a single thin, curved tool was used to create these overlapping arcs. Immediately below these overlapping arcs, approximately 4.7 mm below the neck and 22.8 mm above the carination, the wall is thickened (i.e., raised) as a blank zone some 8mm wide. Below this is a second band of overlapping arcs of same dimensions as the first, and therefore made with the same tool and in the same manner. Two parallel horizontal lines then separate this band from the final set of decorations located 16 mm from the carination to the carination edge. This consists of a set of repeated parallel arcs again 15.8 mm long – made with the same tool as the paired arcs on the rim or collar. All tool edges used for decoration are of uniform thinness.
Square L XU1																				
1		7	32.68	64.22	11.16	12.28					25	5	10		Round	Straight	External thickenning			
Square L XU6																				
1		62	31.52	74.32					10.08	7.16									Yes	Body: Sets of three curved lines impressed with a thin tool, repeated as a row immediately above the carination.

Sherd #		Depth Below Ground	Weight	Max. Length	Lip Thick.	Rim Thick.	Neck Thick.	Collar Thick.	Carination Thick.	Undiff. Rim/ Collar/ Body Thick.	Orifice ∅	% Vessel ∅	Orientation Angle	Inclination Angle	Lip Profile	Rim Course	Rim Profile	Rim Length	Has Body Decoration	Decoration & Comments
Sherd Length																				
≥3.0cm	<3.0cm	(cm)	(g)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(cm)							(cm)		
2		63	14.13	50.35	8.47	6.34					24	5	75		Flat	Convex	Parallel-sided		Yes	Lip: Stick(?) or finger(?) impressions across lip. On the internal surface at the base of the lip, individual thin vertical lines are fingernail-impressed, separating the individual lip notches. Body: Curved impressed arcs juxtaposed to form a pattern on the rim.
Square M XU1																				
1		9	14.48	57.70	7.51	8.68					18	5	15		Round	Straight	Gradually thinning		Yes	Body: Incised angled ‘ladder’ motif on rim internal surface just below the lip.
Square N XU1																				
1		0–50	7.39	40.83						5.60										
2		0–50	5.37	43.50						4.89										
3		0–50	6.08	49.89						4.87										
4		0–50	4.18	36.59						4.75										
5		0–50	7.47	41.15						4.67										
6		0–50	2.48	34.34						3.88										
7		0–50	3.71	35.86						3.72										
8		0–50	4.97	36.55						5.47										
9		0–50	3.54	30.59						4.20										
10		0–50	7.85	42.52						4.46										
11		0–50	16.37	67.20						6.62										

Sherd #		Depth Below Ground	Weight	Max. Length	Lip Thick.	Rim Thick.	Neck Thick.	Collar Thick.	Carination Thick.	Undiff. Rim/ Collar/ Body Thick.	Orifice ∅	% Vessel ∅	Orientation Angle	Inclination Angle	Lip Profile	Rim Course	Rim Profile	Rim Length	Has Body Decoration	Decoration & Comments
Sherd Length ≥3.0cm	Sherd Length <3.0cm	(cm)	(g)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(cm)							(cm)		
	1	0–50	9.96	n/a																
	2	0–50																		
	3	0–50																		
	4	0–50																		
	5	0–50																		
	6	0–50																		
Square N XU2																				
1		50–61	9.70	63.03	7.27	6.10									Flat	Straight	Gradually thickenning			Lip: Stick(?) or finger(?) impressions across lip.
2		61	1175.47	338	7	5	3	10	8		32		60	90	Flat	Straight	Gradually thickenning	4.30		Top of pot = 42 cm below present ground surface, base at 61 cm. Carinated pot with thickened collar. Lip: Stick(?) or finger(?) impressions across lip.
	1	50–61	2.66																	Lip: Stick(?) or finger(?) impressions across lip.
	2	50–61	7.05	n/a																
	3	50–61	4.78	Lip: Stick(?) or finger(?) impressions across lip.																
	4	50–61	2.74	Lip: Stick(?) or finger(?) impressions across lip.																
	5	50–61																		
Square O XU1																				
1		50	20.21	46.26						13.01									Yes	Body: Impressed zig-zagging lines above, and impressed parallel curvilinear lines below thickened collar.
Square P XU1																				

Sherd # Sherd Length ≥3.0cm	Sherd # Sherd Length <3.0cm	Depth Below Ground (cm)	Weight (g)	Max. Length (mm)	Lip Thick. (mm)	Rim Thick. (mm)	Neck Thick. (mm)	Collar Thick. (mm)	Carination Thick. (mm)	Undiff. Rim/ Collar/ Body Thick. (mm)	Orifice ∅ (cm)	% Vessel ∅	Orientation Angle	Inclination Angle	Lip Profile	Rim Course	Rim Profile	Rim Length (cm)	Has Body Decoration	Decoration & Comments
1		9	38.61	50.94																Perforated disc. The perforation was undertaken prior to firing. The perforation is 9.63 mm Ø, 10.80 mm from the proximal edge and 30.10 mm from the distal edge of the disc. The proximal edge is 15.15 mm thick and the distal edge is 9.48 mm thick.
Square R XU1																				
1		9	53.77	88.39	7.72	10.09	12.07				23	10	10		Round	Straight	Parallel-sided			
Square T XU2																				
1		54	7.71	40.16	5.94	5.36							20		Flat	Convex	Parallel-sided			Lip: Stick(?) or finger(?) impressions across lip.
2		54	36.92	71.81	8.60	8.90									Flat	Convex	Gradually thinning		Yes	Lip: Stick(?) or finger(?) impressions across lip, with thin groove incised along middle of lip. Fingernail impressions occur at base of lip on internal surface between and immediately below lip notches. Body: Row of paired arcs impressed above juxtaposed row of paired arcs.
3		54	22.29	57.60				12.33	10.00										Yes	Body: Decoration on collar consists of comb dentate-stamped horizontal line above row of impressed overlapping thin arches above collar thickening. Below this is a row of impressed overlapping thin arches above a thin incised line above a row of needlepoint comb dentate-stamped paired arcs occurring immediately above the carination.
Square U XU2																				

Sherd # Sherd Length ≥3.0cm	Sherd # Sherd Length <3.0cm	Depth Below Ground (cm)	Weight (g)	Max. Length (mm)	Lip Thick. (mm)	Rim Thick. (mm)	Neck Thick. (mm)	Collar Thick. (mm)	Carination Thick. (mm)	Undiff. Rim/ Collar/ Body Thick. (mm)	Orifice ∅ (cm)	% Vessel ∅	Orientation Angle	Inclination Angle	Lip Profile	Rim Course	Rim Profile	Rim Length (cm)	Has Body Decoration	Decoration & Comments
1		53	9.34	35.96					10.88	7.71									Yes	Body: Row of paired impressed arcs immediately above carination.
Square AB XU2																				
1		51	77.26	88.69				16.44											Yes	Body: 2 parallel horizontal bands of decoration between carination and collar thickening. Decoration consists of an impressed cross-hatched band, and a possibly impressed cross-hatched band, each bounded by indeterminate incised or impressed horizontal lines above and below the cross-hatching. The sherd surface is very weathered and the decoration is indistinct for the most part.
Square AC XU2																				
1		53	54.10	85.33	9.48	11.00					30	10	45		Flat	Convex	Parallel-sided		Yes	Lip: Stick(?)- or fingernail(?)-impressed grooves across lip. Body: Repeated, two-tiered series of paired comb dentate-stamped arcs around the rim. The impressions appear to have been made with a single, thin tool.
Square AD XU1																				
1		33	33.99	81.22	9.96	4.57					19	15	10		Round	Straight	Parallel-sided			Note: Lip is externally thickened.

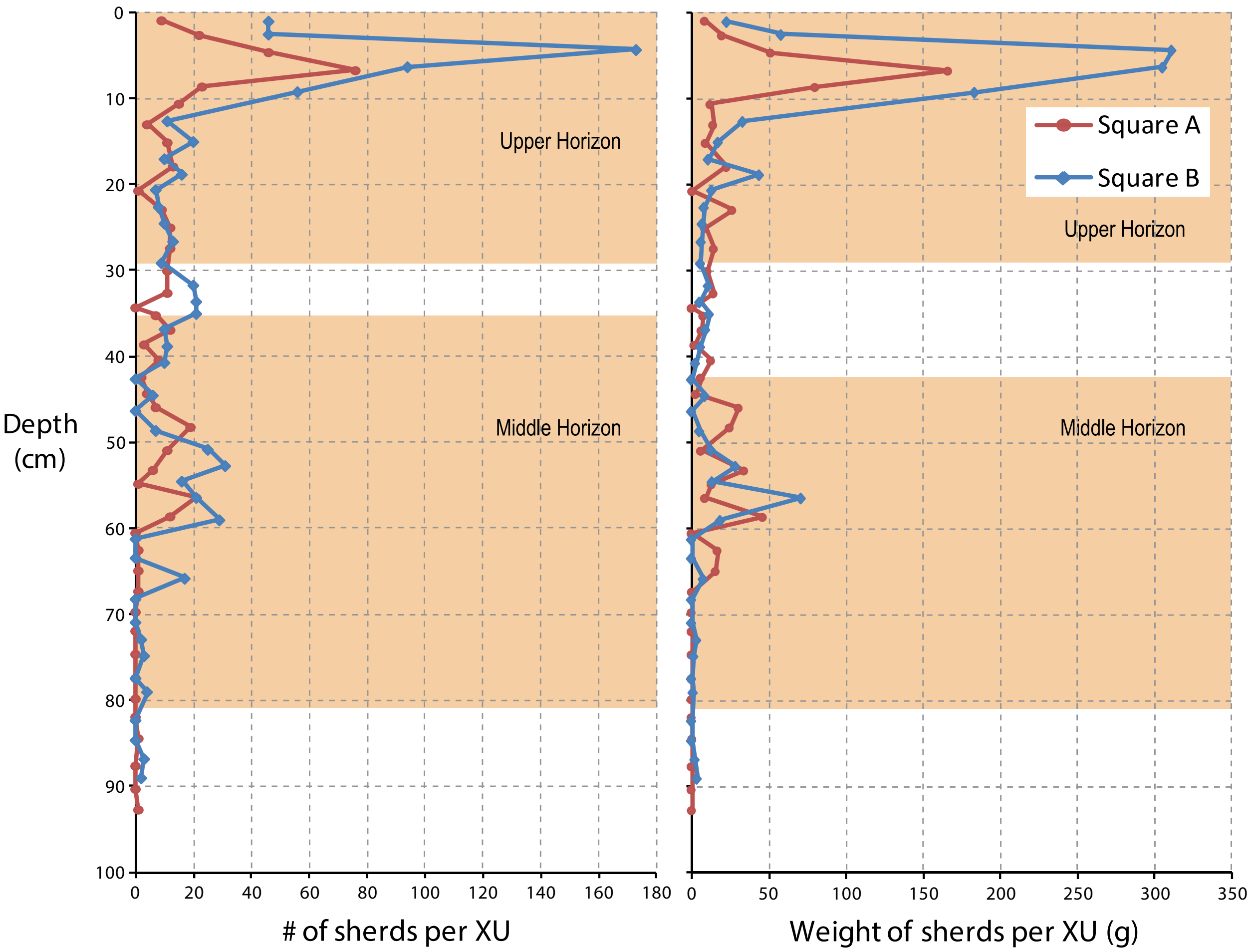

Figure 3.4. Number of sherds per XU, shown by depth of each XU, Squares A and B. A: By number; B: By weight. The two orange horizons on the left-hand side represent the depth of the Upper and Middle Horizons in Square A, and on the right-hand side those of Square B.

peaks. The deepest sherd ≥3.0cm in length was found at 72–74cm depth in XU36, at the SU3–SU4 interface. Eight sherds <3.0cm long were found in XU36, XU37 and XU39, all from the SU3–SU4 interface. A further five sherds <3.0cm long were found in XU42 and XU43, in upper SU4. As with Square A, ceramics in Square B sharply cease below SU3 (the Middle Horizon), despite the few small sherds that have moved down into the upper levels of SU4 through limited post-depositional disturbance.

Discussion

The base of SU3, the Middle Horizon, is mainly considered as XU35 for both squares, at 71cm depth in Square A and 72cm depth in Square B (see Chapter 2). Although some SU3 sediment is present down to XU39 in both squares due to the uneven nature of the interface between SU3 and SU4, XUs below XU35 predominantly consist of SU4 sediments. In Square A, *in situ* ceramics were noticed during excavation down to 69cm depth in XU34 and to 67cm depth in Square B XU33, thus firmly establishing the commencement of ceramic deposition at Tanamu 1 as coincident with deposition of the dense SU3 midden layer, the Middle Horizon, dated to 2800–2750 cal BP (see Chapter 2). The deepest *in situ* sherd collected from the surrounding stepping-out squares came from 64 cm depth in Square G (XU7 sherd #1), indicating that the stratigraphic position of the deepest sherds in Squares A and B is consistent with that of other squares. The sherds <3.0cm long that were found down to 94cm in Square A (XU44) and 90cm depth in Square B (XU43), appear to be post-depositional intrusions from the base of SU3.

Taphonomic Considerations

Square A

The Square A sherds are relatively large compared to other Caution Bay assemblages, averaging 1.8g for the assemblage as a whole, and 2.8 ± 4.2g by XU. As sherd numbers tend to be low, no clear stratigraphic patterning in fragmentation is apparent. However,

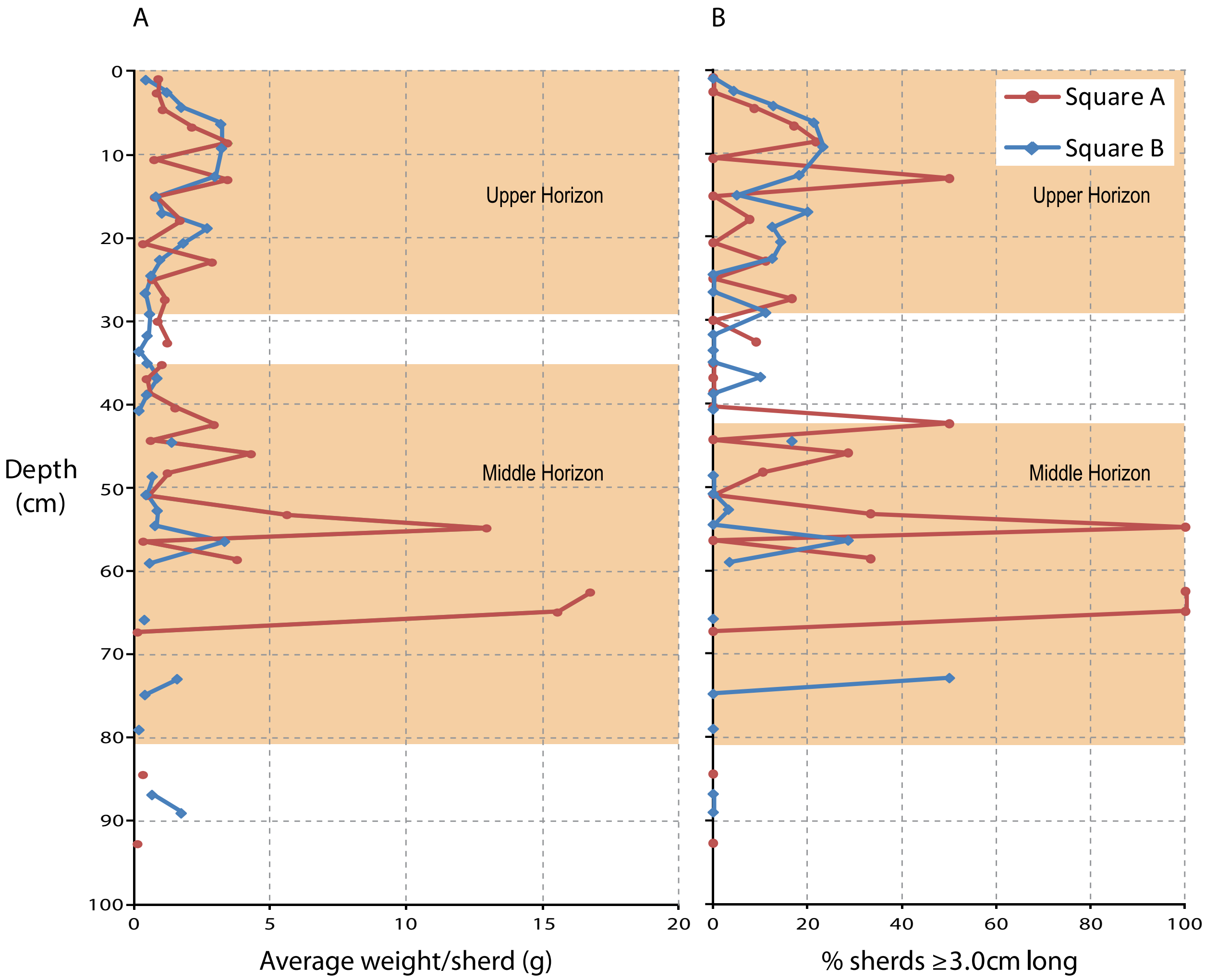

Figure 3.5. Fragmentation of sherds in Squares A and B. A: Average weight of sherds by XU; B: % of sherds ≥3.0cm long, by XU. The two orange horizons on the left-hand side represent the depth of the Upper and Middle Horizons in Square A, and on the right-hand side those of Square B.

the 77 sherds of the uppermost three XUs tend to be exceptionally small (average weight = 1.0g), in each of these three XUs averaging only one-third the average of all the other sherds as a whole and thus suggesting enhanced post-depositional disturbance within the top 6cm (average depth of base of XU3) below ground (Figure 3.5A). This depth corresponds well with the present treadage zone. This pattern of small sherds in the uppermost XUs signalling heightened levels of post-depositional fragmentation is confirmed by the absence of sherds ≥3.0cm long in the top two XUs, whereas they account for 11.9% of total sherds by number and 61.7% by weight in all other XUs from XU3 to XU39 (Figure 3.5B). We interpret these data to indicate that the sherds from the uppermost 6cm, and particularly from the top 4cm of Square A have suffered significant breakage from treadage and prolonged surface or near-surface exposure.

There are nevertheless two more or less pronounced peaks in average sherd weights down the sequence: a lesser peak from XU4 to XU12, in the main representing SU1 and the Upper Horizon; and a major peak from XU21 to XU33, mostly coincident with the SU3 Middle Horizon (Figure 3.5A). These two peaks largely correspond with dense cultural horizons where maximum quantities of ceramics were deposited.

Square B

Comparable with Square A, the Square B sherds average 1.6g in weight for the assemblage as a whole, and 1.2 ± 0.9g by XU. The uppermost XU1 sherds (0cm to 2cm depth) in particular are noticeably smaller than those of the rest of SU1—and typically less than half the average weight of all the other sherds of the Square B assemblage, indicating a shallow treadage zone represented by the present ground surface (Figure

3.5A). Below this, the sherds from XU2 to XU12 (average weight = 2.2g), mostly representing SU1, average three times the weight of the other sherds of Square B (average weight = 0.8g). A smaller peak in average sherd weight occurs in SU3, in XU23–XU29 (average = 1.3g). These two peaks stratigraphically correspond with those of Square A, and largely represent the peak ceramic depositional zones of the Upper and Middle Horizons respectively.

Discussion

While the Tanamu 1 sherds are typically small, averaging 1.7g/sherd for Squares A and B combined (Square A = 1.8g; Square B = 1.6g), this is noticeably larger than the average weight of 0.5g for the 26,033 sherds analysed so far from Bogi 1 Squares A–C, located 140m to the northwest along the same sand dune as Tanamu 1. The Bogi 1 ceramics are thus on average more than three times as fragmented (by weight) as those of Tanamu 1, and contain more than 14 times the density of sherds (8260 sherds/m^2 at Bogi 1 Square C—the only square so far analysed to the start of the lowermost ceramic horizon at that site—versus 1171 sherds/m^2 at Tanamu 1 Squares A and B). In addition, Tanamu 1 also contains some large sherds, as evident in some of the stepping-out squares, and most particularly by the near-complete Lapita pot from stepping-out Square N XU2 (see below). This suggests that treadage and other factors have affected the Tanamu 1 deposits less than they have at Bogi 1, where both rates of sherd deposition and degrees of fragmentation are noticeably higher. The implication is that Tanamu 1 was probably on the edge of a settlement; located in a geomorphological setting with more rapid sediment deposition enhancing the protection of cultural deposits; subject to lower levels of foot traffic; or a combination of both.

Red Slip/Paint

Unlike other excavated ceramic assemblages from Caution Bay (e.g., David *et al.* 2011, 2012; McNiven *et al.* 2011), none of the Tanamu 1 sherds show any sign of red slip or red painting, despite relatively intact sherd surfaces, including in the Lapita period.

Red slip is often said to be a hallmark of early Austronesian decorative traditions across island Southeast Asia (including the Philippines), parts of Micronesia, and Melanesia-western Polynesia where Lapita is found (e.g., Shutler 1999). Although red-slipped sherds are found in other sites of the Lapita period at Caution Bay, throughout this region red slip is more commonly found in post-Lapita than in Lapita levels (see also Skelly and David 2017).

Bulmer (1969, 1978) has signalled the presence of a rich red-slipped ceramic tradition in Port Moresby and along much of the south coast of mainland PNG, where she originally coined what was, at the time, the earliest known ceramic tradition for the region: 'Red Slip' ware. This was despite such ceramics consisting of a mixture of red-slipped and unslipped wares (see Vanderwal 1978 for a critique). We now know that Bulmer's 'Red Slip' style, along with Allen's (1972) equivalent Styles F and G from Nebira 4, and Vanderwal's (1973) Types E–W from Oposisi on Yule Island further to the west, post-date the Tanamu 1 Lapita ceramics by a thousand years. The Tanamu 1 archaeological trends presented here, coupled with the above-cited earlier excavations, indicate that rather than a linear progression from commonly to rarely red-slipped ceramics commencing with Lapita, continuing with Bulmer's 'Red Slip' style (her Major Category C, which she later renamed Style I and subsequently Laloki style [Bulmer 1978, 1999]) and ending with recent times, we find a different pattern: at Caution Bay and the broader Port Moresby area, Lapita wares dating to 2900–2600 cal BP were only occasionally red-slipped (for evidence from Bogi 1, see McNiven *et al.* 2011, 2012a), followed by an increased incidence of red-slipping with Linear Shell Edge-impressed wares beginning *c.* 2150 cal BP and, presumably but uncertainly onto the shell back-impressed and often umbo-bordered wares of Vanderwal's (1973) Zone IIC-Type A-Style 1, Allen's (1972) Horizon 3-Style H, Irwin's (1985) Early Period, and the earliest part of Swadling's (1980) Early Period (see David *et al.* 2012 for a discussion). This trend of increasing red-slipped ceramics continues onto Bulmer's subsequent 'Red Slip' style, when the incidence of red slipping flourished, until 1200–1000 cal BP after which it became less common.

Body Decoration

We refer to decoration located on a sherd surface other than the lip as 'body decoration'.

In total 40 sherds with body decoration were excavated at Tanamu 1 (Square A = 16; Square B = 11; stepping-out squares = 13). These are limited to comb dentate impressions ('dentate stamped'), impressions made with continuous-edged tools, incisions, *Tegillarca granosa* shell-edge impressions and a single finger groove below the lip. The comb dentate impressions and impressed continuous lines are by far the predominant forms of decoration. We describe these decorative conventions individually below.

Comb Dentate Impressions

Square A contains 10 body sherds with comb dentate impressions:

- XU16 (the uppermost sherds with comb dentate stamping): <3.0cm long sherds #3 and #4 contain the ends of three comb dentate-impressed parallel lines or arcs, and small sections of two comb dentate-impressed parallel lines or arcs, respectively (Figures 3.6A, 3.6B, 3.7A, 3.7B).

- XU21: <3.0cm long sherd #1, a body sherd with small sections of three broad-tined comb dentate-impressed lines (Figures 3.6C, 3.7C).
- XU25: <3.0cm long sherd #1, a body sherd with, progressing from top to bottom, cross-hatched comb dentate impressions, a horizontal line of comb dentate impressions, a row of paired comb dentate-impressed arcs, an incised line, and cross-hatched comb dentate impressions (Figures 3.6D, 3.7D).
- XU27: <3.0cm long sherd #1, a body sherd with what appear to be the ends of parallel arcs meeting at near-right angles. The centres of the arcs fade because of lighter pressure during impression (Figures 3.6E, 3.7E). A more complete example of the design is found on sherd #4 from XU30 (see below).
- XU28: Sherd #1, 38.1mm long, a carinated sherd with cross-hatched comb dentate impressions above a horizontal line of comb dentate impressions, above a zone of double-arcs impressed by a non-tined, thin tool juxtaposed at near-right angles to each other. There is no decoration below the carination (Figures 3.6F, 3.7F).
- XU30: Sherds #3 and #4, 49.3mm and 48.9mm long respectively, each with two rows of paired comb dentate-impressed arcs. Sherd #1 contains the very ends of two sets of paired dentate-impressed arcs (Figures 3.6G–3.6I, 3.7G–3.7I).
- XU33: Sherd #1, 57.0mm long, a carinated sherd with two rows of paired comb dentate-impressed arcs above the carination (Figures 3.6J, 3.7J).

The motif shapes, and the nature of the dentition, suggest that a total of five comb-impressed vessels are represented—although we recognise that Lapita pots often contain multiple forms of decoration on different parts of a vessel wall, making the identification of numbers of represented pots from small sherds difficult:

Vessel 1: Figures 3.6A and 3.6B (XU16).

Vessel 2: Figure 3.6C (XU21).

Vessel 3: Figure 3.6D (XU25).

Vessel 4: Figure 3.6F (XU28).

Vessel 5: Figures 3.6E and 3.6G–3.6J (XU27, XU30–XU33).

These sherds are too small to determine the shapes of any of the vessels. The great similarity of design and execution of decoration on the five Vessel 5 sherds indicate that in Square A the stratigraphic zone covered by XU27–XU30 (52cm to 66cm depth, the mid-lower SU3 Middle Horizon) contains a contemporaneous assemblage including sherds from a single vessel or group of closely related vessels.

Combining Squares A and B with the stepping-out squares, 13 sherds contain comb dentate impressions. Ten of these come from Square A, the other three from stepping-out squares C, T and AC. The comb dentate-impressed sherds are therefore spread across the excavated area. Stratigraphically, in Square A the highest comb-impressed sherd comes from XU16 (XU depth = 31–34cm) and the lowest from XU33 (65cm depth). The comb dentate-impressed sherds from the stepping-out squares come from 53cm to 57cm depth. All comb dentate-impressed sherds come from the SU3 Middle Horizon (2800–2750 cal BP) or the lower levels of SU2 (2750–700 cal BP).

The comb dentate-impressed sherds exhibit a range of designs, including stacked, paired arcs (e.g., Figures 3.6H–3.6L, and probably 3.6E, 3.6G) and parallel angled lines (Figures 3.6C, 3.6D) that could be part of angled designs akin to the paired arcs. The paired arcs were made with tined tools whose individual teeth measured from 1.0–1.1mm (e.g., Figure 3.6K) to 1.2–1.4mm in length (e.g., Figures 3.6E, 3.6G–3.6J, 3.6L). Square C XU6 sherd #1 contains needlepoint dentate impressions terminating with circle impressions (Figure 3.6M).

Sets of paired arcs, along with triple arc forms, are also a dominant theme of the Lapita horizons from other sites we have excavated at Caution Bay. Indeed such paired or triple arcs, sometimes found as comb dentate impressions and sometimes as impressions made with thin continuous (non-tined) tools (see below), is *the* most repeated pattern of the Caution Bay Lapita decorated sherds, and, more than any other design, can be said to best characterise the 'Lapita tradition' of Caution Bay. At Tanamu 1, such designs occur exclusively on sherds from 52–60cm depth (within the SU3 Middle Horizon) which dates to 2800–2750 cal BP (excluding the uncertain decoration designs of Square A XU21 <3.0cm long sherd #1 and Square A XU25 <3.0cm long sherd #1; Figures 3.6C, 3.6D).

Impressed Continuous Lines

Four Square A body sherds have impressed continuous lines:

- XU16: <3.0cm long sherd #1, with a row of three juxtaposed impressed arcs and a row of two thin parallel impressed straight lines on either side of a part of the vessel with wall thickening (Figures 3.8A, 3.9A).
- XU25: Sherd #1, 37.3mm long, containing a row of thin, straight, parallel impressed lines;

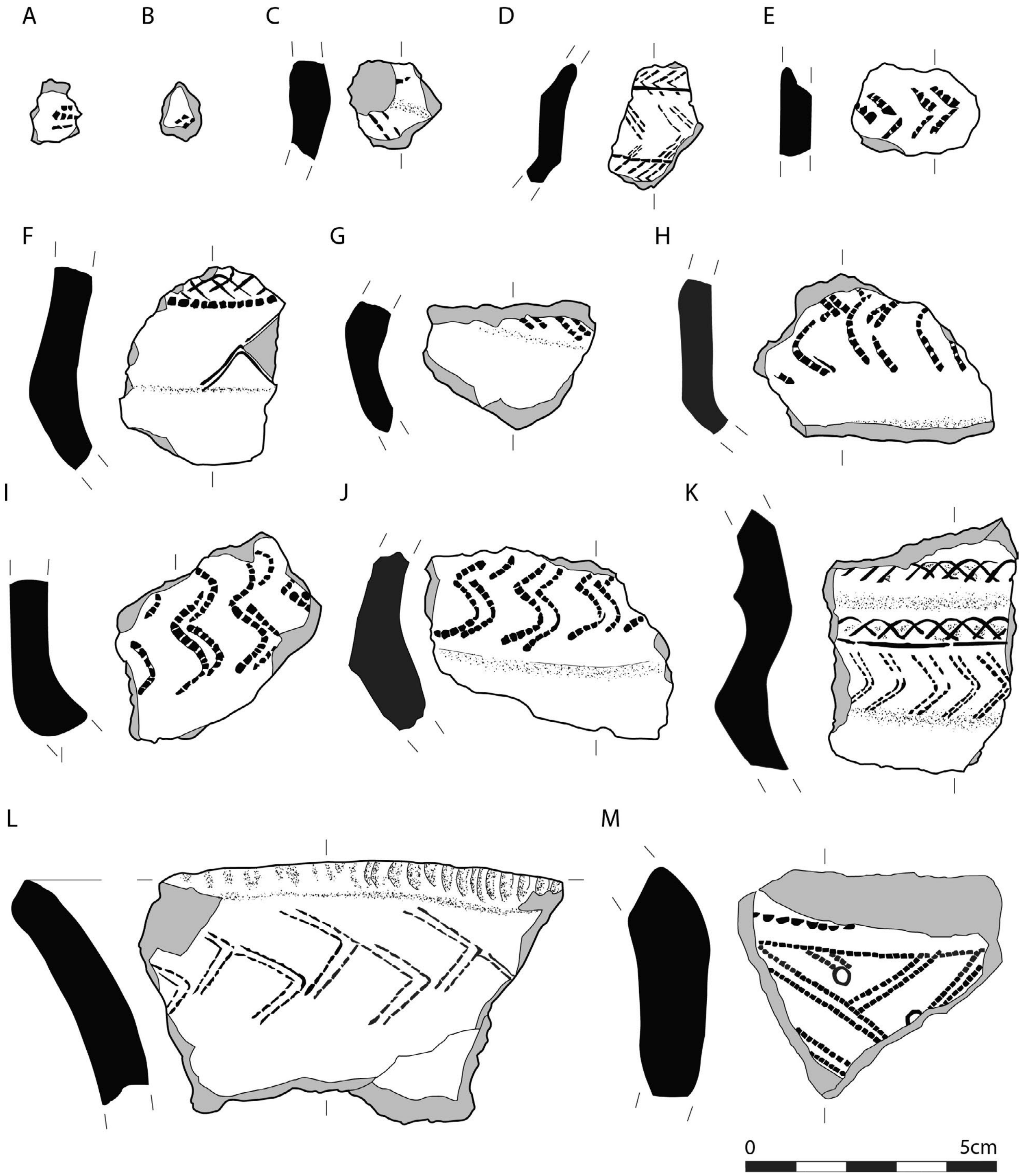

Figure 3.6. Comb dentate-impressed sherds. A: Square A XU16 <3.0cm long sherd #3; B: Square A XU16 <3.0cm long sherd #4; C: Square A XU21 <3.0cm long sherd #1; D: Square A XU25 <3.0cm long sherd #1; E: Square A XU27 <3.0cm long sherd #1; F: Square A XU28 sherd #1; G: Square A XU30 sherd #1; H: Square A XU30 sherd #3; I: Square A XU30 sherd #4; J: Square A XU33 sherd #1; K: Square T XU2 sherd #3; L: Square AC XU2 sherd #1; M: Square C XU6 sherd #1.

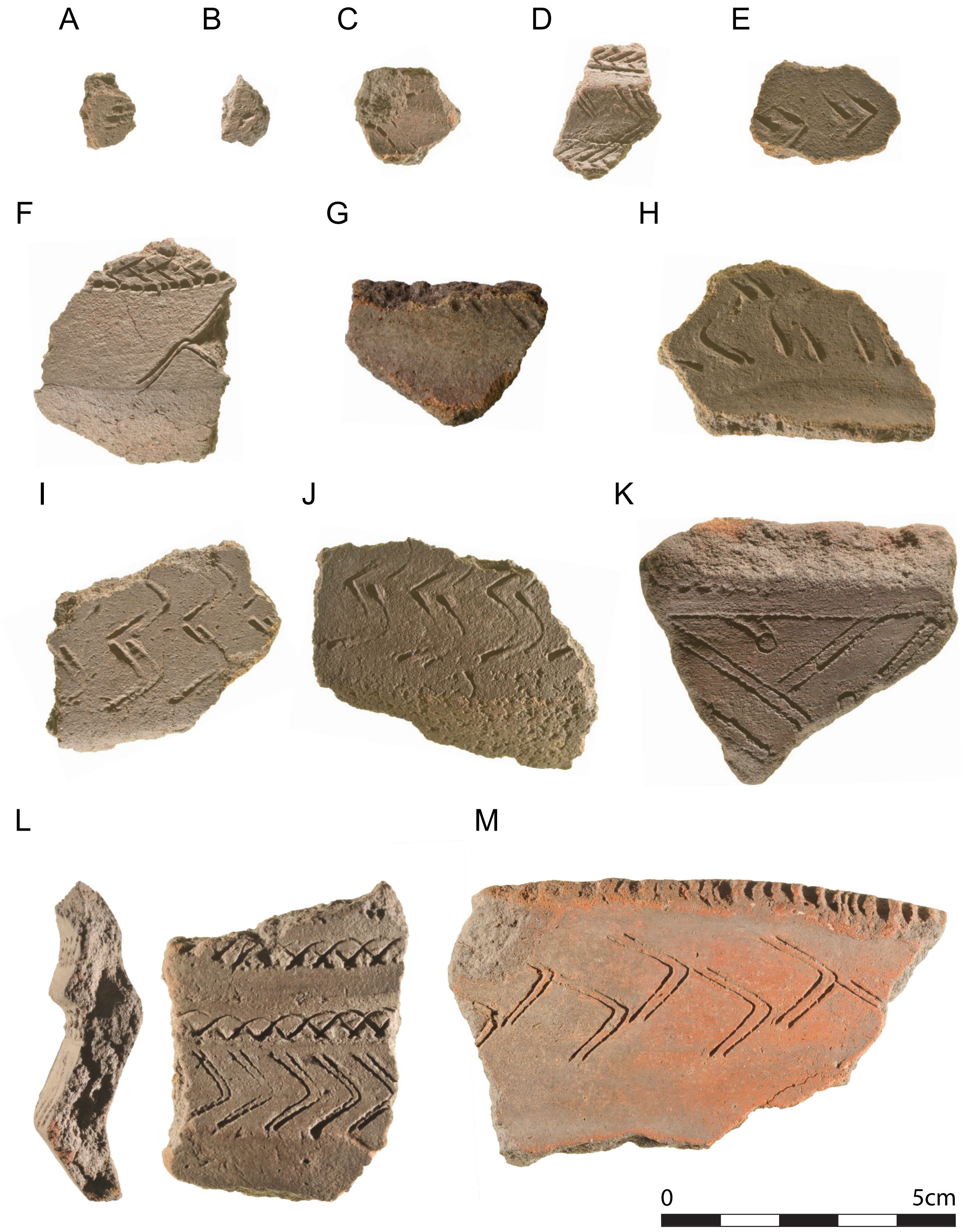

Figure 3.7. Comb dentate-impressed sherds. A: Square A XU16 <3.0cm long sherd #3; B: Square A XU16 <3.0cm long sherd #4; C: Square A XU21 <3.0cm long sherd #1; D: Square A XU25 <3.0cm long sherd #1; E: Square A XU27 <3.0cm long sherd #1; F: Square A XU28 sherd #1; G: Square A XU30 sherd #1; H: Square A XU30 sherd #3; I: Square A XU30 sherd #4; J: Square A XU33 sherd #1; K: Square C XU6 sherd #1; L: Square T XU2 sherd #3; M: Square AC XU2 sherd #1.

and thin criss-crossing lines, on either side of a thickening on the vessel's collar (Figures 3.8B, 3.9B).

- XU27: Sherd #1, a 58.2mm-long carinated body sherd with paired, sharply-angled impressed arcs immediately above the carination. The lines are unevenly pressed, sometimes making finely overlapping impressions (Figures 3.8P, 3.9O).
- XU28: Sherd #1, a 38.1mm-long carinated sherd. This sherd has already been described under 'comb dentate impressions' above; it signals that at Caution Bay impressed continuous lines and dentate impressions can occur on the same carinated vessels (Figures 3.6F, 3.7F).

In Square B, five body sherds have impressed continuous lines:

- XU11: <3.0cm long sherd #1, with two impressed lines, at least one of which curves sharply to form a right angle (Figures 3.8C, 3.9C).
- XU29: Sherd #5, 31.1mm long, containing thin, parallel impressed arcs immediately above (or below given that in the absence of a lip, collar or neck the orientation is not certain) the vessel's carination. The impressions include multiple lines showing evidence of tool repositioning or slippage during decoration. Sherd #6, 66.1mm long, has three rows of short linear impressions on either side of wall thickening on the vessel's collar. One other sherd, <3.0cm long sherd #2, has two, and possibly three, parallel impressed lines (Figures 3.8D, 3.8E, 3.8I, 3.9D, 3.9E, 3.9I).
- XU42: <3.0cm long sherd #1 has two sets of angled and possibly intersecting arcs (Figures 3.8F, 3.9F).

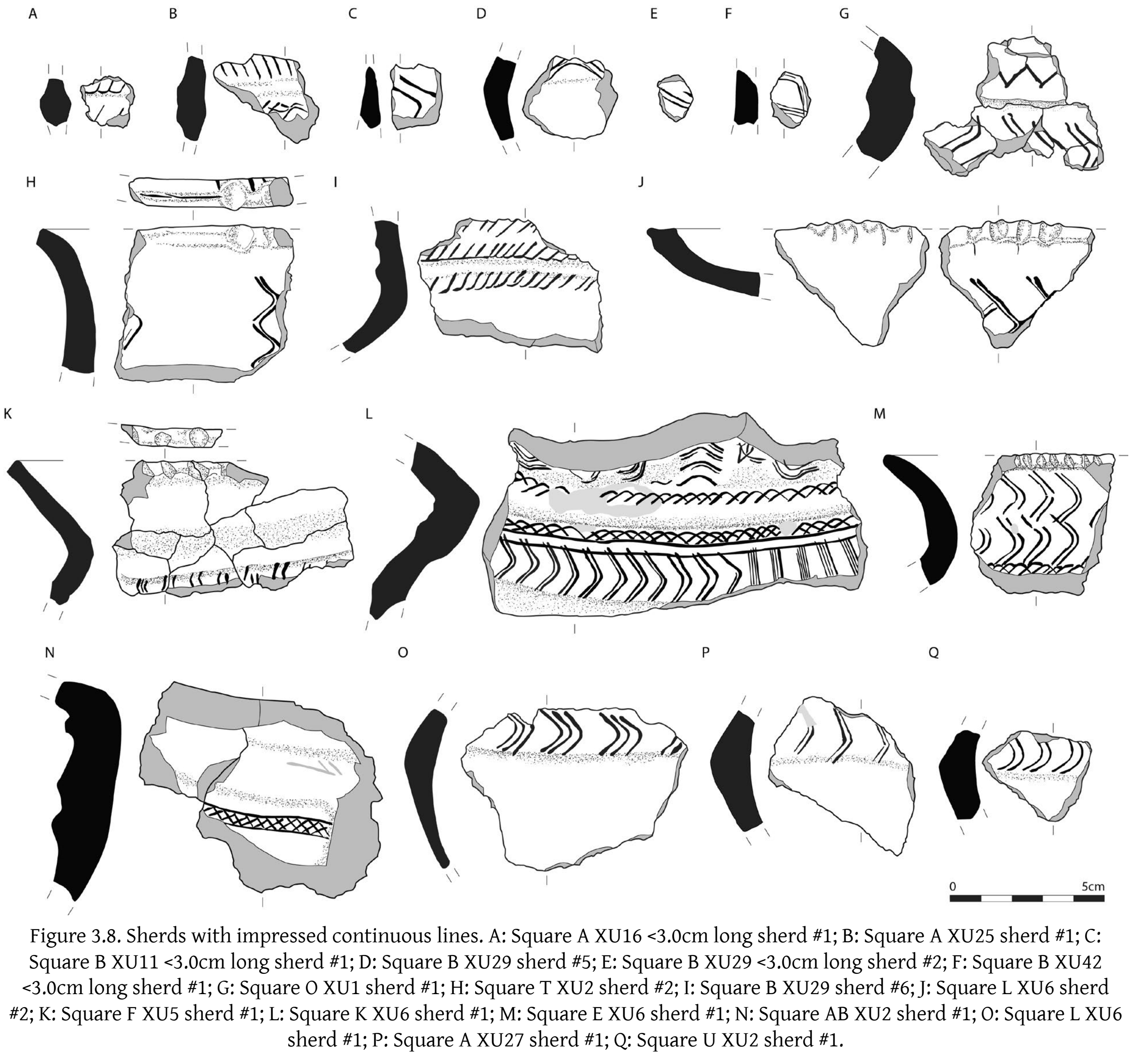

Figure 3.8. Sherds with impressed continuous lines. A: Square A XU16 <3.0cm long sherd #1; B: Square A XU25 sherd #1; C: Square B XU11 <3.0cm long sherd #1; D: Square B XU29 sherd #5; E: Square B XU29 <3.0cm long sherd #2; F: Square B XU42 <3.0cm long sherd #1; G: Square O XU1 sherd #1; H: Square T XU2 sherd #2; I: Square B XU29 sherd #6; J: Square L XU6 sherd #2; K: Square F XU5 sherd #1; L: Square K XU6 sherd #1; M: Square E XU6 sherd #1; N: Square AB XU2 sherd #1; O: Square L XU6 sherd #1; P: Square A XU27 sherd #1; Q: Square U XU2 sherd #1.

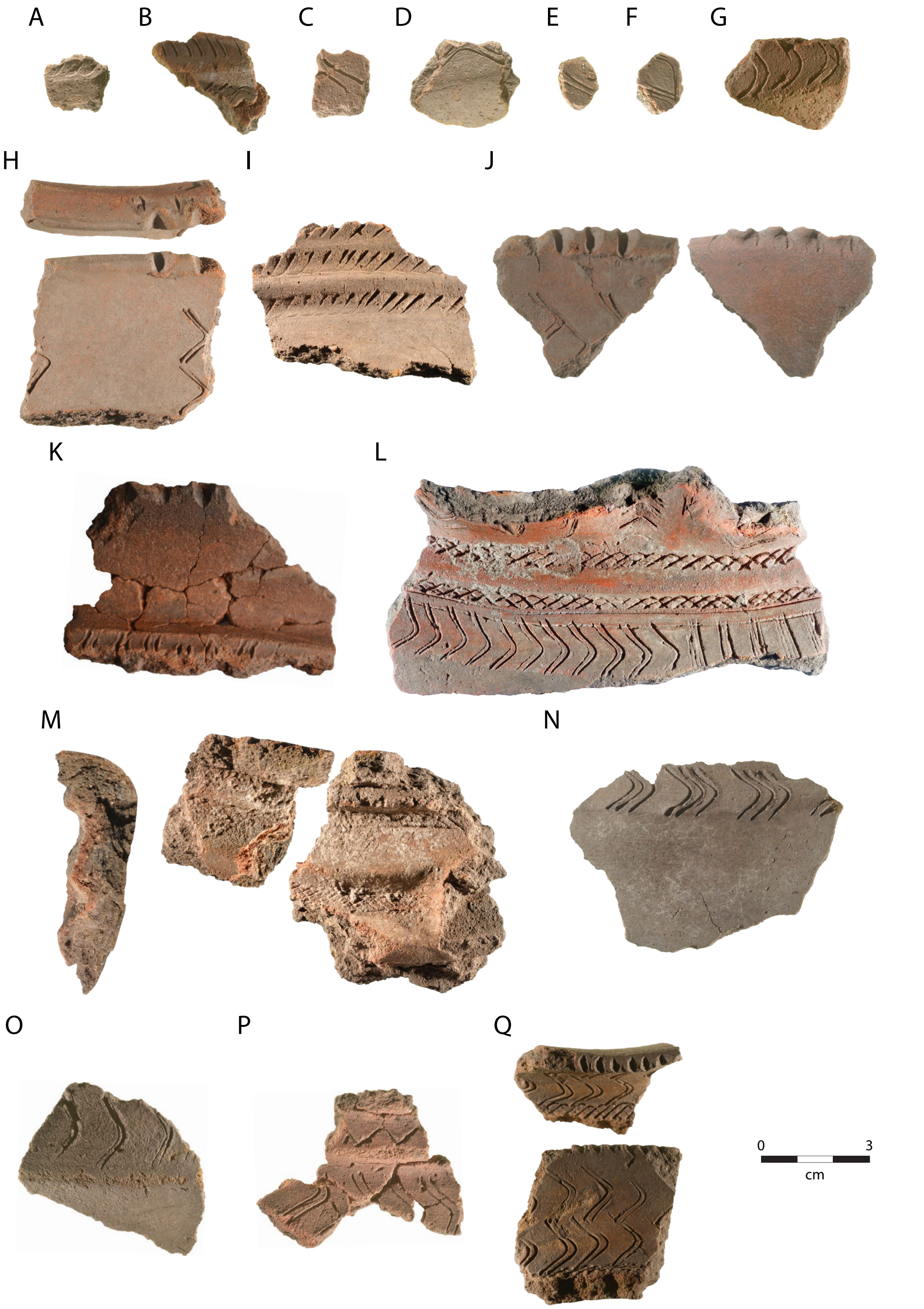

Figure 3.9. Sherds with impressed continuous lines. A: Square A XU16 <3.0cm long sherd #1; B: Square A XU25 sherd #1; C: Square B XU11 <3.0cm long sherd #1; D: Square B XU29 sherd #5; E: Square B XU29 <3.0cm long sherd #2; F: Square B XU42 <3.0cm long sherd #1; G: Square U XU2 sherd #1; H: Square T XU2 sherd #2; I: Square B XU29 sherd #6; J: Square L XU6 sherd #2; K: Square F XU5 sherd #1; L: Square K XU6 sherd #1; M: Square AB XU2 sherd #1; N: Square L XU6 sherd #1; O: Square A XU27 sherd #1; P: Square O XU1 sherd #1; Q: Square E XU6 sherd #1.

All of these impressed sherds come from the SU3 Middle Horizon and, to a noticeably lesser degree, SU2 or the upper part of SU4. We interpret the SU4 sherd from Square B XU42 as a post-depositional intrusion from SU3 (see Discussion below).

Combining Squares A and B with the stepping-out squares, a total of 19 sherds contain impressions made by thin tools with continuous (not tined) edges (Figures 3.6F, 3.6K, 3.8). Four of these sherds come from Square A, five from Square B and 10 from stepping-out squares E, F, K, L, O, T, U and AB. The largest and most extensively decorated example is Square K XU6 sherd #1 (57cm depth) (Figures 3.8L, 3.9L). It contains a repeated pattern of impressed parallel arcs on the rim or collar, each arc being 15.8mm long (measured from end to end in a straight line). At the neck below is a zone marker consisting of overlapping impressed small arcs, each arc being 13.9mm long: a single thin, curved tool was used to create the overlapping arcs. A roulette was not used (cf. Ambrose 2007). Immediately below this overlapping arc pattern, approximately 4.7mm below the neck and 22.8mm above the carination, the wall is thickened (i.e., raised) as a blank zone some 8mm wide. Below this is a second band of overlapping arcs of the same dimensions as the first, and therefore presumably made with the same tool and in the same manner. Two parallel impressed or incised horizontal lines then separate this band from the final set of decorations located 16mm from the carination to the carination edge. This consists of a set of repeated parallel arcs again 15.8mm long—made with the same tool as the paired curves on the rim or collar—which gives way to vertical lines. All tool edges used for decoration are of uniform thinness. This incised and (non-dentate) impressed sherd is of unequivocal Lapita decorative design (especially the bands above the carination), as seen, for example, in Specht and Torrence (2007b: figures 12AB, 12AC) from the Bismarcks and Bedford *et al.* (2007: figure 9) from Vanuatu, among many other occurrences elsewhere.

Like the comb dentate-impressed sherds, those that are impressed with continuous lines are also found across the spatial extent of the excavated area. Stratigraphically, in Square A the highest sherd with impressed continuous lines comes from XU16 (XU depth = 31–34cm) and the lowest from XU28 (55cm depth); in Square B they range from XU11 (XU depth = 20–22cm) to XU42 (XU depth = 86–88cm); and in the stepping-out squares from Square F XU5 sherd #1 (39–48cm depth) to Square L XU6 sherd #2 (63cm depth). Sherds with impressed continuous lines tend to occur within the same ceramic horizon as those with comb dentate-impressed sherds (i.e., the SU3 Middle Horizon, with occasional sherds immediately above and below towards the base of SU2 and top of SU4). Two sherds (Square A XU28 sherd #1; Square T XU2 sherd #3) each contain both forms of decoration, emphasising their stratigraphic and chronological contemporaneity (see Figures 3.6F, 3.6K). Also in common with the comb dentate-impressed sherds, a predominant motif is pairs of parallel arcs, which occur on eight (42%) of the impressed continuous lines whose decorative designs are complete enough to determine. Other impressed motifs include overlapping small arcs creating rows of curvilinear cross-hatching (e.g., Figures 3.6F, 3.6K, 3.8L, 3.8M) and one sherd with a row of zig-zagging lines (Figure 3.8G).

Dentate Shell Impressions and Finger Grooves

One shell end-impressed sherd from Square B XU19 (sherd #1) has four paired rows or columns (orientation of sherd uncertain) of *Tegillarca granosa* shell indentations (Figures 3.10A, 3.11A). It measures 34.7mm long. Another sherd from Square B XU10 (<3.0cm long sherd #1) possesses a single, 6.7mm wide finger groove located 5.4mm below and running parallel to the lip. This latter sherd's surface is too weathered to determine whether or not it contained shell impressions (Figure 3.10B, 3.11B). These two sherds are classic examples of Linear Shell Edge-impressed ceramics, whereby shell end-impressions are typically associated with a single finger groove below the lip, as reported in David *et al.* (2012).

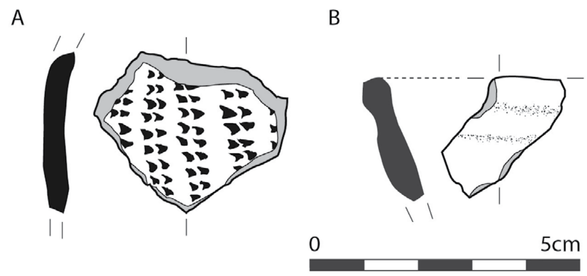

Figure 3.10. Sherds with dentate shell impressions or a finger groove below the lip. A: Square B XU19 sherd #1; B: Square B XU10 <3.0cm long sherd #1 (orientation angle is uncertain).

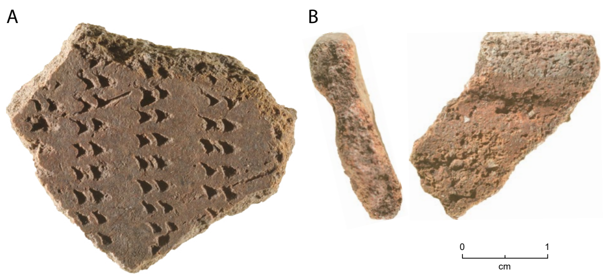

Figure 3.11. Sherds with dentate shell impressions or a finger groove below the lip. A: Square B XU19 sherd #1; B: Square B XU10 <3.0cm long sherd #1 (orientation angle is uncertain).

At Tanamu 1 Linear Shell Edge-impressed ceramics are limited to these two sherds, but at Bogi 1 they are very common in a stratigraphic horizon (SU2) dated to 2150–2100 cal BP. The stratigraphic positioning of the two sherds at Tanamu 1 places them in levels dated to between 2750 cal BP and 700 cal BP, consistent with the Bogi 1 age determinations where this period of the sequence is better dated due to its finer chronostratigraphic resolution. It is noteworthy that the presence of a dense cultural layer representing an ancient village site dating to 2150–2100 cal BP at Bogi 1 is absent at Tanamu 1 a mere 140m away, where the only diagnostic signs of this period are the two sherds from SU2 sandwiched between underlying 2800–2750 cal BP Lapita SU3 (Middle Horizon) and overlying 700–100 cal BP SU1 (Upper Horizon) sediments.

Incisions

There are also seven sherds with indeterminate impressed or incised lines (Square A XU11 <3.0cm long sherd #1, XU15 <3.0cm long sherd #1, XU25 sherd #2; Square B XU26 <3.0cm long sherd #1; Square K XU6 sherd #1; Square T XU2 sherd #3; Square AB XU2 sherd #1) (Figures 3.6K, 3.8L, 3.8N, 3.12C–3.12F, 3.13G–3.13J), and six sherds with incised lines (Square A XU25 <3.0cm long sherd #1; Square B XU4 sherd #1; Square M XU1 sherd #1; Square B XU2 sherd #1 and sherd #2; Square B XU10 sherd #2) (Figures 3.6D, 3.12A, 3.12B, 3.12H, 3.13B–3.13F). Square AB XU2 sherd #1 contains a row of impressed cross-hatched lines bounded by an indeterminate incised or impressed horizontal line on each side, on either side of a thickened collar (with one of the bands, probably consisting of cross-hatching, being very indistinct due to advanced weathering) (Figure 3.8N).

The incised decorations consist of:

- A horizontal line demarcating a band of comb dentate impressions immediately above and below it (Square A XU25 <3.0cm long sherd #1; Figure 3.6D).
- Three conjoining sherds each containing a horizontal line along its internal surface (the two rim sherds each have the line 3.0cm below the lip) (Square B XU2 sherds #1 and #2, and XU10 sherd #2; Figure 3.12H).
- Two sherds each with a slanted 'ladder' motif (Square B XU4 sherd #1; Square M XU1 sherd #1; Figures 3.12A, 3.12B).

Apart from the sherds with single horizontal lines separating comb dentate impressions and/or continuous impressed lines, which occur in the SU2–SU4 zone focused at the Middle Horizon, all incised lines occur in SU1 (the Upper Horizon). These include the two sherds with slanted 'ladder' motifs on the inner rim surface, which come from 7cm (Square B) and 9cm (Square M) depth (Figures 3.12A, 3.12B). Such designs are typical of ethnographically documented Motu maker's marks commonly placed on pots by women (manufacturers) when handing over pots to male relatives (traders) on long-distance *hiri* maritime trade expeditions (see e.g., David *et al.* 2016c for a discussion of ethnographic pottery making and exchange for the study area). At Tanamu 1, no such maker's marks are present on ceramic vessels deeper than 9cm depth in SU1 (Upper Horizon B), and thus both the excavated examples date to the proto-ethnographic 200–100 cal BP period.

Lip Decoration

A total of 55 sherds with the lip present (thereby constituting 'rim sherds') were excavated (32 from Squares A and B, 23 from the stepping-out squares). Twenty-four (44%) of these have decorated lips (Figures 3.14, 3.15). Only two of the 32 sherds with undecorated lips (3%) occur below 22cm depth. Apart from a single example—Square AD XU1 sherd #1, from 33cm depth—all other sherds with plain lips are from the SU1 Upper Horizon or its interface with SU2 below, and thus date to <2750 cal BP; the majority date to <700 cal BP. No plain lip sherd contains any body decoration other than simple incisions or a finger groove below the lip. Although numbers are low, these results suggest that vessel lips were typically decorated 2800–2750 cal BP, and typically undecorated in the past *c.* 700 cal BP. Tanamu 1 does not have sufficient chronostratigraphic resolution to meaningfully determine the status of lip decoration for the intervening period.

The decorated lips consist of:

- One sherd with short, thin, parallel incised diagonal lines just below the apex of an unusual, thickened lip (Square F XU1 sherd #3) (Figure 3.14B). It comes from 4cm depth and dates to 200–100 cal BP.
- One sherd with parallel stick(?) impressions across its thickened round lip (Square A XU4 <3.0cm long sherd #2). It comes from 6–8cm depth and thus dates to 200–100 cal BP (Figure 3.14R).
- Three sherds with thin impressions in some cases closely-spaced and in others widely-spaced across the lip, made by an indeterminate tool (fingernail?) (Square A XU14 sherd #1; Square B XU16 <3.0cm long sherd #1; Square H XU2 sherd #1) (Figures 3.14G, 3.14I, 3.14L). They come from 12–33cm depth from mid-SU1 to the top of SU2 and date to sometime between 2750 and 200 cal BP.
- One comb dentate-impressed sherd with curvilinear impressions across the lip (Square

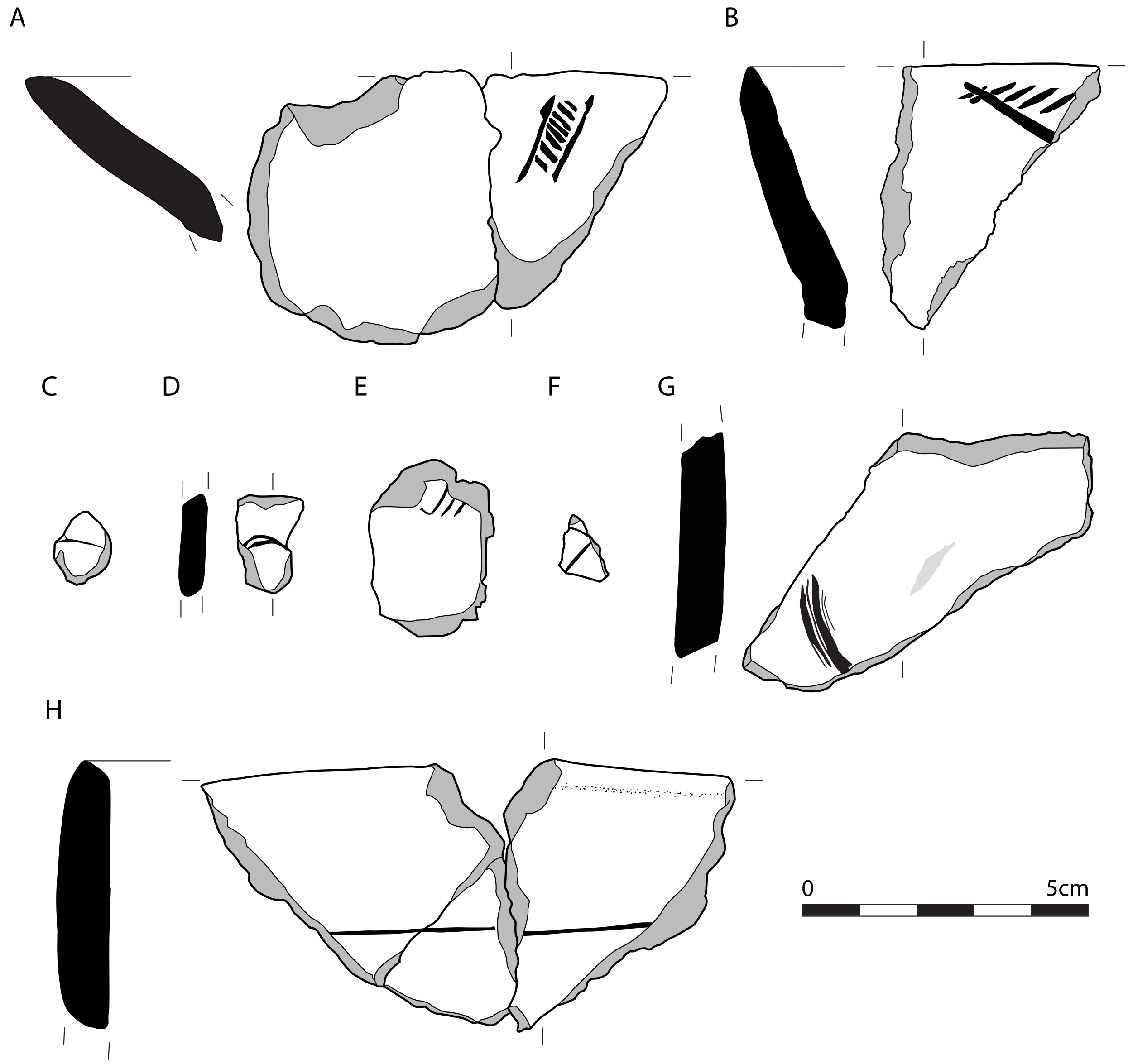

Figure 3.12. Sherds with tool markings, incisions and indeterminate incisions or impressions. A: Square B XU4 conjoined sherds #4 (left) and #1 (right); B: Square M XU1 sherd #1; C: Square A XU11 <3.0cm long sherd #1 (indeterminate incised or impressed); D: Square A XU15 <3.0cm long sherd #1 (indeterminate incised or impressed); E: Square A XU25 sherd #2; F: Square B XU26 <3.0cm long sherd #1 (indeterminate incised or impressed); G: Square A XU12 sherd #1 (sherd with non-decorative tool marks from vessel production); H: (left to right) Square B XU2 sherd #2, XU2 sherd #1, XU10 sherd #2.

AC XU2 sherd #1) (Figure 3.6L). It comes from 53cm depth and dates to 2800–2750 cal BP.

- One sherd with fine stick(?) impressions spaced a short distance apart along the external edge of the lip (Square A XU9+10 sherd #1) (Figure 3.14D). It comes from 16–20cm depth at the base of SU1 or top of SU2 and dates to sometime between 2750 and 700 cal BP.
- Four sherds with relatively wide, straight and regularly spaced stick(?) impressions across the lip (Square B XU9 sherd #2; Square B XU16 <3.0cm long sherd #2; Square C XU3 sherd #1; Square D XU4 <3.0cm long sherd #1) (Figures 3.14E, 3.14K, 3.14P, 3.14S). They all come from 16–33cm depth, spanning from lower SU1 to mid-SU2, and date to sometime between 2750 and *c.* 700 cal BP.
- One sherd with moderately-spaced finger(?) or stick(?) impressions across the lip. Thin vertical incisions made by fingernail(?) or another, indeterminate tool occur from the internal edge of the lip down the very top of the rim, separating each lip impression (Square L XU6 sherd #2) (Figure 3.8J). The sherd also contains paired arc impressions along the lower sections of the rim. It comes from 63cm depth and dates to 2800–2750 cal BP.
- One sherd with two adjacent finger(?) or stick(?) impressions across the lip, and a thin,

Figure 3.13. Sherds with tool markings, incisions and indeterminate incisions or impressions. A: Square A XU12 sherd #1 (sherd with non-decorative tool marks from vessel production); B: Square B XU4 sherd #1; C: Square M XU1 sherd #1; D: Square B XU2 sherd #2; E: Square B XU2 sherd #1; F: Square B XU10 sherd #2; G: Square A XU11 <3.0cm long sherd #1 (indeterminate incised or impressed); H: Square A XU15 <3.0cm long sherd #1 (indeterminate incised or impressed); I: Square A XU25 sherd #2; J: Square B XU26 <3.0cm long sherd #1 (indeterminate incised or impressed).

incised groove along the lip's centre-line. Thin vertical incisions made by fingernail(?) or other, indeterminate tools occur from the internal edge of the lip down the very top of the rim, separating each lip impression (Square T XU2 sherd #2) (Figure 3.8H). This sherd has paired arc impressions along the collar. It comes from 54cm depth and dates to 2800–2750 cal BP.

- Nine sherds with juxtaposed unknown tool(?) or finger(?) impressions across the width of the lip (Square A XU16 <3.0cm long sherd #2; Square B XU25 <3.0cm long sherd #1; Square E XU6 sherd #1; Square N XU2 sherd #1, XU2 sherd #2, XU2 <3.0cm long sherd #1, XU2 <3.0cm long sherd #2, XU2 <3.0cm long sherd #3; Square T XU2 sherd #1) (Figures 3.8M, 3.14A, 3.14C, 3.14F, 3.14H, 3.14M, 3.14N, 3.14O, 3.14Q). They all come from 50–61cm depth and date to 2800–2750 cal BP.
- One sherd with stick(?) or finger(?) impressions tapering from the internal to the external lip edge (Square F XU5 sherd #1) (Figure 3.8K). It contains paired arc impressions below the rim, along what appears to be a collar. It comes from 39–48cm depth and dates to 2800–2750 cal BP.
- One sherd with juxtaposed finger(?) or stick(?) impressions along the internal edge of the lip

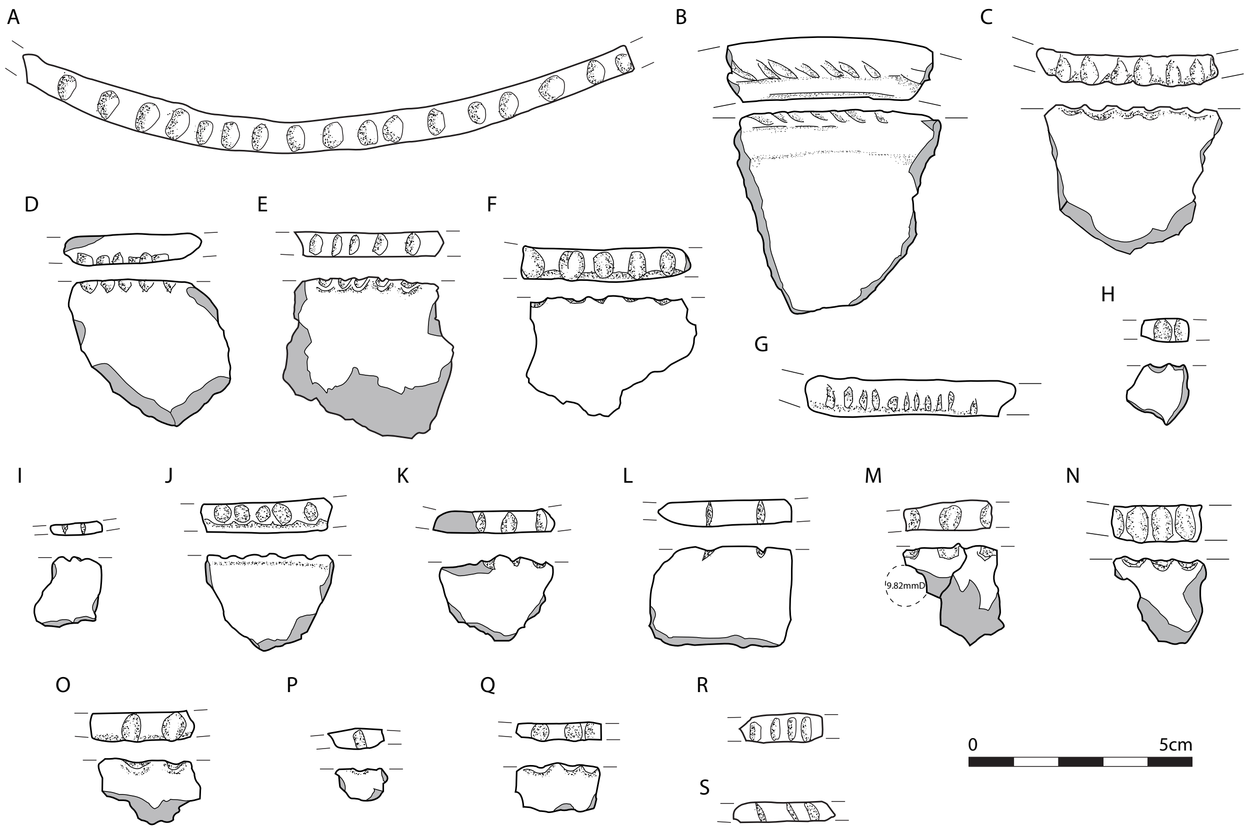

Figure 3.14. Sherds with lip decoration. A: Square N XU2 sherd #2; B: Square F XU1 sherd #3; C: Square T XU2 sherd #1; D: Square A XU9+10 sherd #1; E: Square C XU3 sherd #1; F: Square N XU2 sherd #1; G: Square H XU2 sherd #1; H: Square A XU16 <3.0cm long sherd #2; I: Square B XU16 <3.0cm long sherd #1; J: Square B XU29 <3.0cm long sherd #1; K: Square D XU4 <3.0cm long sherd #1; L: Square A XU14 sherd #1; M: Square N XU2 <3.0cm long sherd #3; N: Square N XU2 <3.0cm long sherd #1; O: Square N XU2 <3.0cm long sherd #2; P: Square B XU16 <3.0cm long sherd #2; Q: Square B XU25 <3.0cm long sherd #1; R: Square A XU4 <3.0cm long sherd #2; S: Square B XU9 sherd #2.

(Square B XU29 <3.0cm long sherd #1) (Figure 3.14J). It comes from 55–58cm depth and dates to 2800–2750 cal BP.

Vessel Shape and Size

Because of the small size of most sherds, information on vessel shape and size is limited. We present details of lip, rim and vessel shapes and orifice diameters separately, with analysis of these variables restricted to the sherds that are ≥3.0cm long.

Lips

Only nine sherds from Square A (2.3%) and 23 from Square B (3.0%) are rim sherds; 2.7% of the combined Squares A and B assemblage are rim sherds. Eighteen of these are ≥3.0cm long, plus 19 others from the stepping-out squares. Of these 37 ≥3.0cm long rim sherds, four lip profiles have been identified (Figure 3.16):

- Round (Square A XU4 sherds #12 and #13, XU5 sherd #3; Square B XU3 sherd #1, XU4 sherd #2, XU5+6 sherd #2, XU11 sherd #1; Square C XU1 sherd #1; Square E XU6 sherd #1; Square H XU2 sherd #1; Square J XU1 sherd #1; Square K XU1 sherds #1 and #2; Square L XU1 sherd #1; Square M XU1 sherd #1; Square R XU1 sherd #1; Square AD XU1 sherd #1).
- Slanting flat (Square B XU2 sherd #2, XU4 sherds #1, #3 and #4, XU5+6 sherd #1, XU7 sherd #2, XU10 sherd #2).
- Slanting flat with external protrusion or thickening (Square A XU5 sherd #5; Square F XU1 sherd #3).
- Flat (Square A XU9+10 sherd #1, XU14 sherd #1; Square B XU9 sherd #2; Square C XU3 sherd #1; Square F XU5 sherd #1; Square L XU6 sherd #2; Square N XU2 sherds #1 and #2; Square T XU2 sherds #1 and #2; Square AC XU2 sherd #1).

Close to half (45.9%) the rim sherds have round lips, about a quarter (29.7%) have flat lips, and the rest (24.3%) have different configurations of slanted lips. Of these, all except for two of the 17 round lips occur above 22cm depth in SU1 or the SU1–SU2 interface. The

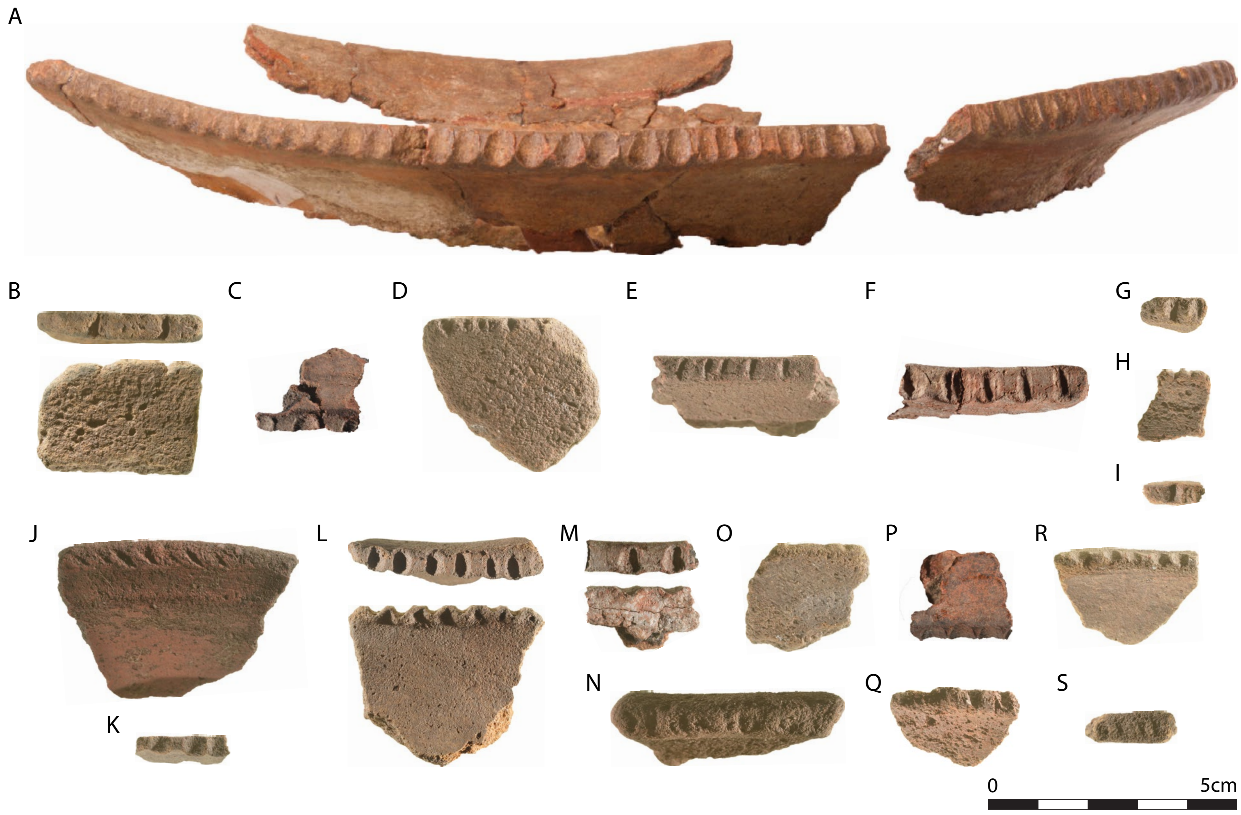

Figure 3.15. Sherds with lip decoration. A: Square N XU2 sherd #2 (only section of reconstructed pot to base of rim is shown); B: Square A XU14 sherd #1; C: Square N XU2 <3.0cm long sherd #3 (viewed from inner rim surface); D: Square A XU9+10 sherd #1; E: Square C XU3 sherd #1; F: Square N XU2 sherd #1; G: Square A XU16 <3.0cm long sherd #2; H: Square B XU16 <3.0cm long sherd #1; I: Square B XU16 <3.0cm long sherd #2; J: Square F XU1 sherd #3; K: Square B XU25 <3.0cm long sherd #1; L: Square T XU2 sherd #1; M: Square N XU2 <3.0cm long sherd #2; N: Square H XU2 sherd #1; O: Square B XU9 sherd #2; P: Square N XU2 <3.0cm long sherd #1 (viewed from inner rim surface); Q: Square D XU4 <3.0cm long sherd #1; R: Square B XU29 <3.0cm long sherd #1; S: Square A XU4 <3.0cm long sherd #2.

two exceptions occur at 33cm (Square AD XU1 sherd #1) and 56cm depth (Square E XU6 sherd #1). Round lips are thus predominantly a late phenomenon dating to <2750 cal BP, and especially to <700 cal BP.

Of the 11 flat lips, six are found between 50cm and 63cm depth in the SU3 Middle Horizon (2800–2750 cal BP). One comes from 39–48cm depth (Square F XU5 sherd #1). The other four come from 16–29 cm depth, spanning basal SU1 to mid-SU2 in Squares A, B and C (2750–700 cal BP).

All of the slanted lips come from less than 20cm depth, and thus date to <700 cal BP.

The pattern is clear and consistent with earlier observations for the Port Moresby region made by other authors (e.g., Allen 1972; Bulmer 1978): flat lips are a predominantly early phenomenon, although they continue through time; round lips a late one. Better definition of their chronology will be addressed in future reports on Caution Bay sites containing components with finer chronological resolution within the 2750–700 cal BP period.

Rims

For rim sherds ≥3.0cm long, information was obtained where possible on rim length, rim course and rim profile. Orientation angles are presented under 'Vessel Form and Size' below. Rim length was measured only on those sherds where the entire rim from the lip to the neck, carination or other change in curvature at the base of the rim could clearly be distinguished. Five rim sherds were large enough to measure rim length: Square B XU2 sherd #2 and XU10 sherd #2, each with a 3.0cm long rim; Square B XU3 sherd #1, with a 2.6cm long rim; Square H XU2 sherd #1, with a 1.0cm long rim; and Square N XU2 sherd #2 with a 4.3cm long rim. In each of the three Square B examples, the change in vessel wall orientation was represented by the top of the vessel's neck.

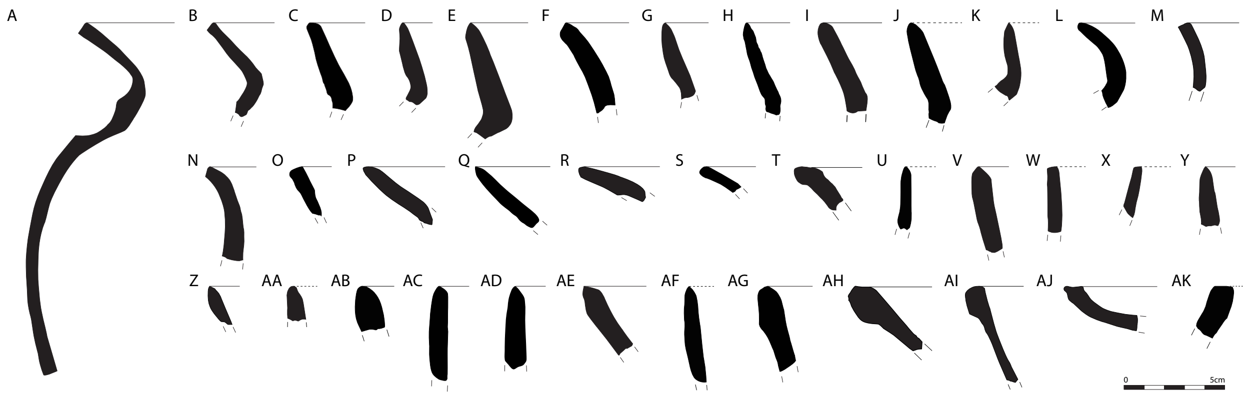

Figure 3.16. Profiles of all rim sherds ≥3.0cm long. Dotted lines across orifice diameters indicate that orientation angles are uncertain. A: Square N XU2 sherd #2; B: Square F XU5 sherd #1; C: Square A XU5 sherd #5; D: Square K XU1 sherd #2; E: Square R XU1 sherd #1; F: Square AC XU2 sherd #1; G: Square K XU1 sherd #1; H: Square M XU1 sherd #1; I: Square A XU4 sherd #13; J: Square B XU4 sherd #2; K: Square B XU3 sherd #1; L: Square E XU6 sherd #1; M: Square T XU2 sherd #1; N: Square T XU2 sherd #2; O: Square N XU2 sherd #1; P: Square B XU4 sherd #1; Q: Square B XU4 sherd #4; R: Square C XU3 sherd #1; S: Square A XU14 sherd #1; T: Square H XU2 sherd #1; U: Square B XU11 sherd #1; V: Square C XU1 sherd #1; W: Square A XU9+10 sherd #1; X: Square B XU9 sherd #2; Y: Square A XU4 sherd #12; Z: Square A XU5 sherd #3; AA: Square B XU5+6 sherd #2; AB: Square J XU1 sherd #1; AC: Square B XU10 sherd #2; AD: Square B XU2 sherd #2; AE: Square B XU5+6 sherd #1; AF: Square B XU4 sherd #3; AG: Square L XU1 sherd #1; AH: Square F XU1 sherd #3; AI: Square AD XU1 sherd #1; AJ: Square L XU6 sherd #2; AK: Square B XU7 sherd #2.

Rim Course

Rim course was identified on 30 rim sherds ≥3.0cm long (Figure 3.16):

- *Convex rims*: Square A XU4 sherd #13; Square E XU6 sherd #1; Square L XU6 sherd #2; Square T XU2 sherds #1 and #2; Square AC XU2 sherd #1.
- *Concave rims*: Square A XU5 sherd #5; Square B XU2 sherd #2, XU4 sherd #1, XU5 sherd #1, XU7 sherd #2; Square C XU3 sherd #1; Square K XU1 sherd #1.
- *Straight rims*: Square A XU9+10 sherd #1, XU14 sherd #1; Square B XU3 sherd #1, XU4 sherds #2–#4, XU10 sherd #2, XU11 sherd #1; Square C XU1 sherd #1; Square F XU5 sherd #1; Square H XU2 sherd #1; Square K XU1 sherd #2; Square L XU1 sherd #1; Square M XU1 sherd #1; Square N XU2 sherds #1 and #2; Square R XU1 sherd #1.

The chronostratigraphic distribution of these sherds indicates that convex (n = 6) and straight rims (n = 17) occur throughout the sequence, with no apparent preference for particular cultural horizons, while all but one sherd with concave rims (n = 7) coming from above 14cm depth in SU1, and dating to <700 cal BP, with one found at 23cm depth in upper SU2, thus dating within the 2750–700 cal BP period.

Rim Profile

Rim profile was identified on 33 rim sherds (Figure 3.16):

- *Parallel-sided rims*: Square A XU4 sherd #13, Square B XU4 sherds #1 and #4, XU5 sherd #1, XU7 sherd #2, XU9 sherd #2, XU10 sherd #2; Square F XU5 sherd #1; Square H XU2 sherd #1; Square L XU6 sherd #2; Square R XU1 sherd #1; Square T XU2 sherd #1; Square AC XU2 sherd #1; Square AD XU1 sherd #1.
- *Rims gradually thinning towards the lip*: Square A XU4 sherd #12, XU5 sherds #3 and #5; Square B XU2 sherd #2, XU4 sherd #3, XU11 sherd #1; Square C XU3 sherd #1; Square E XU6 sherd #1; Square K XU1 sherd #1; Square M XU1 sherd #1; Square T XU2 sherd #2.
- *Rims tapering curvilinearly towards the lip from the external wall*: Square K XU1 sherd #2.
- *Rims gradually thickening towards the lip*: Square A XU14 sherd #1; Square C XU1 sherd #1; Square N XU2 sherds #1 and #2.
- *Externally bulging rims*: Square B XU3 sherd #1, XU4 sherd #2; Square L XU1 sherd #1.

Parallel-sided rims (n = 14), rims gradually thinning towards the lip (n = 11), and rims gradually thickening towards the lip (n = 4) are each found throughout the sequence; rims tapering curvilinearly towards the lip from the external wall (n = 1) and externally bulging rims (n = 3) are only found above 7cm depth in SU1, and thus date to 200–100 cal BP (Upper Horizon B) at Tanamu 1.

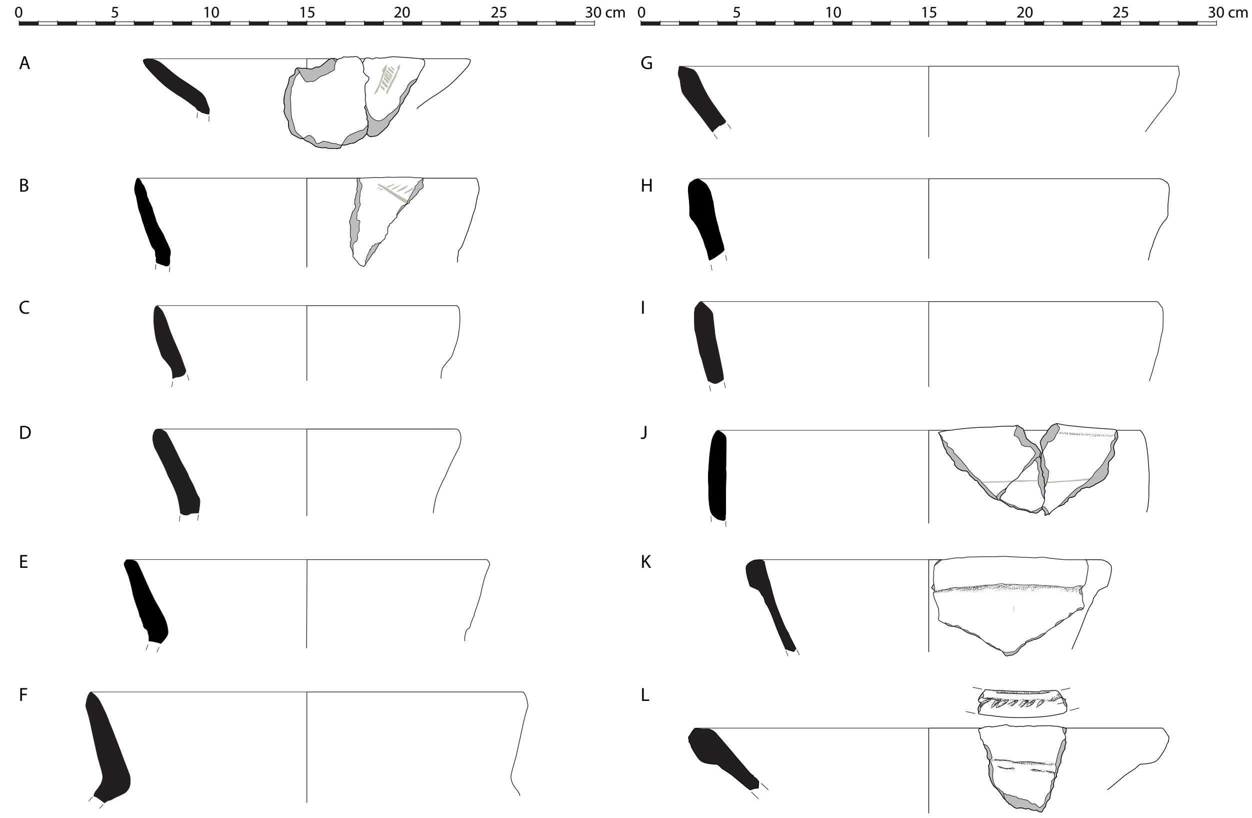

Figure 3.17. Forms of the upper parts of vessels, based on rim sherds ≥3.0cm long with measurable orifice diameters and orientation angles. These are from SU1, dating to the past 700 cal BP, and principally to the past 200 cal BP. A: Square B XU4 sherds #1+2; B: Square M XU1 sherd #1; C: Square K XU1 sherd #1; D: Square A XU4 sherd #13; E: Square A XU5 sherd #5; F: Square R XU1 sherd #1; G: Square B XU5+6 sherd #1; H: Square L XU1 sherd #1; I: Square C XU1 sherd #1; J: Square B XU2 sherds #1+2 and XU10 sherd #2; K: Square AD XU1 sherd #1; L: Square F XU1 sherd #3.

Vessel Form and Size

Six plain sherds ≥3.0cm long (Square A XU4 sherd #13; Square B XU3 sherds #1 and #15, XU4 sherd #2; Square K XU1 sherd #2; Square R XU1 sherd #1) possess necks. The Square A XU4 and Square R XU1 sherds each have orientation angles of 10°, indicating that they came from indirect, everted vessels; the Square K XU1 sherd has an orientation angle of 0°. The Square A XU4 vessel had an orifice diameter of 16cm, and the Square R XU1 vessel's was 23cm (Figures 3.17D, 3.17F). The Square B XU3 sherd has a 2.6cm–long rim. These sherds came from vessels akin to ethnographic *uro* pots (see Bulmer 1978 for details).

Five sherds (Square A XU25 sherd #1; Square B XU29 sherd #6; Square K XU6 sherd #1; Square O XU1 sherd #1; Square T XU2 sherd #3) decorated with impressed continuous lines and/or comb dentate impressions are from thickened collars. Eight sherds with body decoration consisting of comb dentate impressions, impressed continuous lines (including paired arcs), or a combination of both are carinated: Square A XU27 sherd #1, XU28 sherd #1, XU33 sherd #1; Square B XU29 sherd #5; Square K XU6 sherd #1; Square L XU6 sherd #1; Square T XU2 sherd #3; Square U XU2 sherd #1. These are either too small to determine orifice diameters or orientation angles or are non-rim sherds. One carinated sherd does not contain body decoration (Square H XU5 sherd #1). Two sherds (Square K XU6 sherd #1; Square T XU2 sherd #3) decorated with impressed designs, one sherd with impressed and indeterminate incised or impressed decoration (Square AB XU2 sherd # 1), and one plain sherd with lip decoration (Square N XU2 sherd #2) contain both thickened collars and carinations (Figure 3.18A).

Six other rim sherds without necks, collars or carinations are large enough to shed light on various aspects of vessel form. These include two sherds from a direct (i.e., without neck, collar or carination) vessel from SU1, each internally decorated with a single line at the base of the near-vertical rim (Square B XU2 sherd #2 and XU10 sherd #2, with orientation angles of 0° and 350°, and with orifice diameters of 24cm and 20cm respectively). The two sherds conjoin, and thus indicate that materials within SU1 (stratigraphically spanning XU2 to XU10 in Square B) contain intermixed

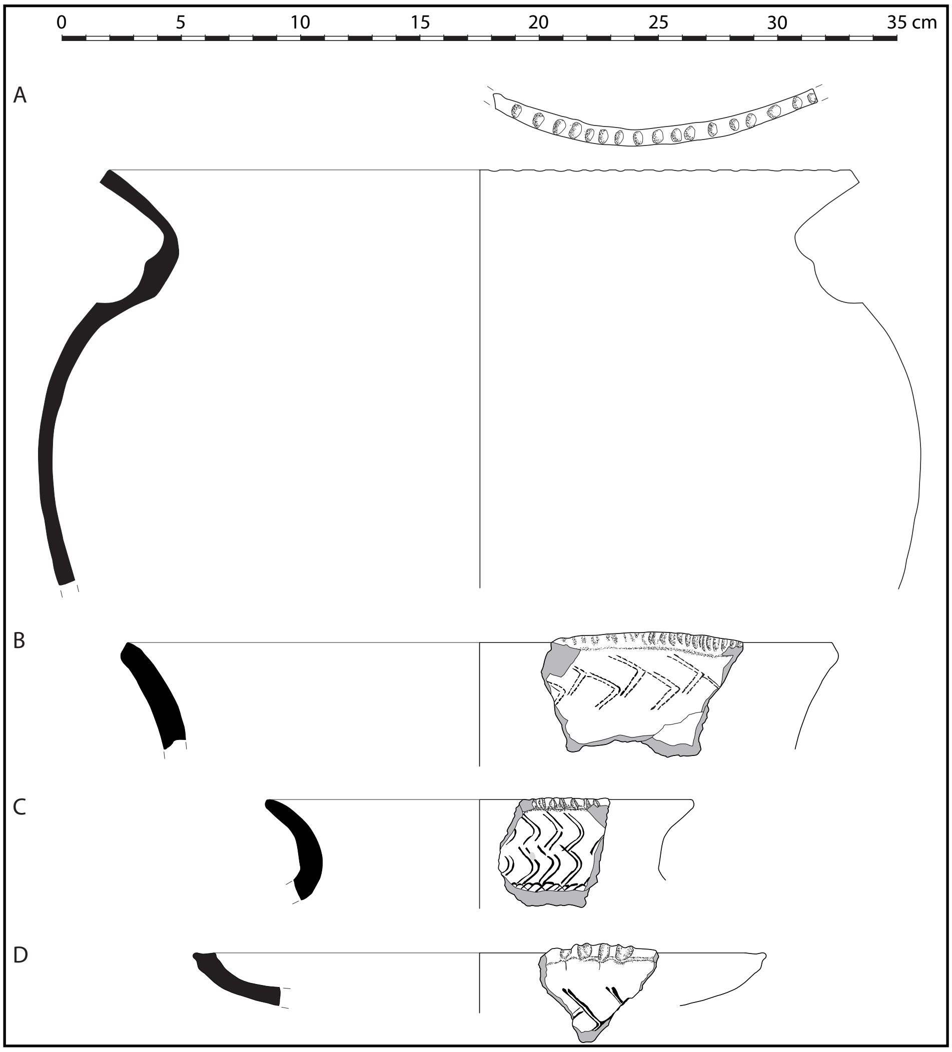

Figure 3.18. Forms of the upper parts of vessels, based on rim sherds ≥3.0cm long with measurable orifice diameters and orientation angles. These are all from Lapita levels, and date to 2800–2750 cal BP. A: Square N XU2 sherd #2; B: Square AC XU2 sherd #1; C: Square E XU6 sherd #1; D: Square L XU6 sherd #2.

materials from within this period of time. Square B XU4 sherd #1, which has a 'ladder' maker's mark on its inner rim surface, is a small everted bowl with an orientation angle of 45° and orifice diameter of 17cm. Two plain sherds from Square B XU5+6 (sherds #1 and #2) are from everted bowls or pots with orientation angles of 5° and 15° and orifice diameters of 26cm and 24cm, respectively. Although these sherds are too small to determine whether they came from vessels with necks, they are typical of rim sherds expected of ethnographic *uro* pots, which commonly have such orifice diameters and orientation angles. One plain sherd from Square B XU11 (sherd #1) is from a slightly everted vessel with orientation angle of 5°.

In summary, the only plain, indirect, straight to everted sherds, or sherds with necks but uncertain orientation angles coming from vessels akin to ethnographic *uro*, come from <11cm depth in the SU1 Upper Horizon B dating to 200–100 cal BP. In contrast, the 11 carinated and/or collared sherds with impressed decoration including comb dentate impressions, the one carinated and collared sherd with indeterminate decoration, and the two carinated and/or collared plain sherds—that is, sherds from vessels with both decoration and pot shapes akin to Lapita vessels known from elsewhere in the Pacific—come from 47–66cm depth at Tanamu 1, in the SU3 Middle Horizon dating to 2800–2750 cal BP. The only definitely carinated and/or collared sherd with measurable vessel orifice diameter (of 32cm) is the near-complete pot from Square N XU2 sherd #2.

Twelve sherds coming from <11cm depth, i.e. from the Upper Horizon B and dating to 200–100 cal BP, have measurable orifice diameters ranging from 16cm to 26cm (16cm, 16cm, 17cm, 18cm, 22cm, 23cm, 24cm, 24cm, 24cm, 25cm, 25cm, 26cm). The only four sherds with measurable orifice diameters from the Middle Horizon dating to 2800–2750 cal BP measure 18cm, 24cm, 30cm and 32cm. From vessels with orifice diameters of 19cm and 20cm, two sherds come from intervening levels of lesser chronostratigraphic resolution. Thus, although sample sizes are very small, there is a suggestion that the Lapita period at Tanamu 1 may include wider vessels (or higher proportions of large vessels) than those of the proto-ethnographic period (*c.* 200–100 cal BP) at the site.

Perforated Sherd

One sherd containing a drill hole (Square N XU2 sherd <3.0cm long #3), while not a conjoining sherd, almost certainly came from the Square N XU2 sherd #2 pot. The hole is 9.8mm in diameter and found immediately below the lip. The function of the hole, and of the pot, is uncertain. The hole could represent attempts at curating a breaking or broken pot or a means to attach string by which to hang the pot (an absence of other holes on the large sections of the reconstructed pot indicate that it was unlikely to have been a perforated steaming or smoking pot or sieve). However, no string groove is seen on the perforation, suggesting that it may not have served to pass string for hanging the pot or for reparation.

The Near-Complete Pot from Square N

Because of the rarity of complete or near-complete archaeological vessels from the south coast of mainland PNG—let alone a Lapita pot—we here briefly describe the Square N XU2 pot from the SU3 Middle Horizon (described in detail in David *et al.* 2013: 160–162). This major *in situ* find (David *et al.* 2013: figure 7) has been subject to significant conservation and reconstruction (see David *et al.* 2016a, for a description of conservation methods employed on Caution Bay pottery; Jones-Amin 2014). The recovered sherds have been reconstructed into a vessel consisting of much of the lip and rim, thickened collar and body of an everted, collared, and shoulder-carinated, globular pot with the base missing. It is estimated to have stood approximately 28cm high, with an orifice diameter of 32cm. The pot has a finger(?) or stick(?) impressed notched lip and plain body (Figure 3.19). It is red-brown in colour, low-fired earthenware, with a slightly variable Munsell surface colour depending on location, typically 10YR 4/3. The wall thickness varies throughout the vessel, generally in the 5–8mm range, but as little as 3mm at the neck and up to 13mm at the collar.

Other Ceramic Finds

Two other ceramic artefacts were excavated from Tanamu 1 (Figures 3.20, 3.21):

- A single small, fired ceramic lug was excavated from the Middle Horizon XU30 (<3.0 cm long sherd #1) of Square B, and thus dates to 2800–2750 cal BP (Figure 3.20B, 3.21B). It is a small, near-cylindrical piece measuring 12.1mm × 6.5mm × 4.0mm. A similar lug was found at Bogi 1 in Square C XU62 (<3.0cm long sherd #1) at 138–142cm depth, near the base of the *in situ* Lapita levels dated to *c.* 2850 cal BP and thus roughly contemporaneous with the Tanamu 1 lug. It implies that at Caution Bay some vessels

Figure 3.19. The Square N XU2 pot after conjoining of multiple sherds and conservation treatment.

probably had appliqué decoration, although its limitation at Tanamu 1 to a single, very small lug, and similar rarity at Bogi 1 indicate that appliqué designs were not common.

- A fired perforated clay disc from 9cm depth (the SU1 Upper Horizon B) in Square P XU1 (sherd #1) (Figure 3.20A, 3.21A). The disc is 5.1cm in maximum dimension, tapers from a maximum thickness of 1.5cm at one end to a minimum 0.9cm at its opposite end, with the 9.6mm diameter drill hole located 1.1cm from the thickest end. The hole was created while the clay was wet. Numerous other similar clay discs were excavated at Caution Bay. At Bogi 1 such clay discs were only found from 115–142cm depth in stepping-out squares G, J, K, and PP, where they are firmly associated with Lapita to immediate post-Lapita horizons dated from 2850 cal BP to 2450 cal BP (David 2021). The Tanamu 1 disc is dated to 200–100 cal BP by stratigraphic association. During the Caution Bay excavations, local members of the Motu and Koita communities at Porebada, Boera and Papa villages identified such fired perforated clay discs as net sinkers.

Manufacturing Tool Marks

One sherd from Square A (XU12 sherd #1) shows two sets of small, elongated impressions and shallow scratches on the sherd's external surface which are likely to be manufacturing (tool) marks caused by the moving of the unfired pot with tongs, or by pressure from objects such as wood or palm fronds during firing (Figure 3.12G). In Square B, seven sherds >3.0cm long show tell-tale traces of manufacture by paddle-and-anvil technique. Sherd #8 from XU3 has paddle-edge marks on its external surface, while three sherds from XU4 (sherds #5, #8 and #19) and three from XU5+6 (sherds #4, #6 and #8) each has tool dimple marks on its internal surface. Tool dimple marks are also found on the internal surfaces of Square D XU5 sherd #2 and Square J XU1 sherd #3. All of these sherds except for Square D XU5 sherd #2 come from <11cm depth in the SU1 Upper Horizon B. The Square D XU5 sherd comes from 50cm depth, in the Middle Horizon. Evidence for paddle-and-anvil manufacture at Tanamu 1 is thus most evident in the proto-ethnographic 200–100 cal BP period, but also apparent in Lapita levels; the rarity of tool dimple marks on internal surfaces, and absence of paddle edge impressions on external surfaces during Lapita times, may be due to the smooth finishing of Lapita vessels at

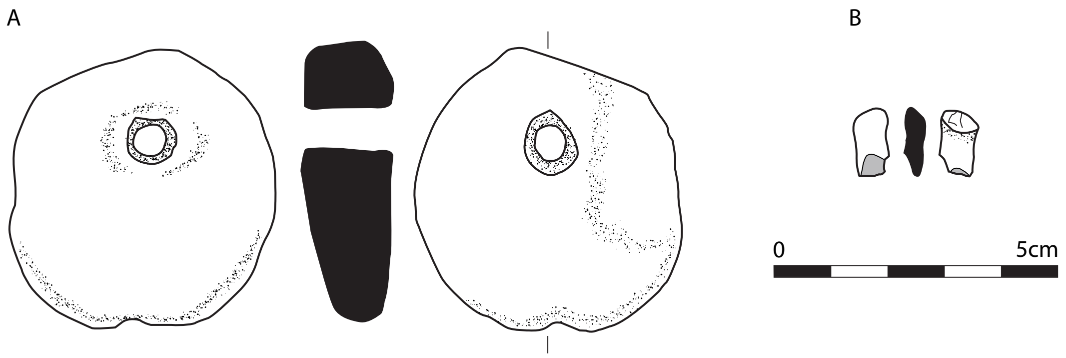

Figure 3.20. Other ceramic finds. A: Perforated disc from Square P XU1 sherd #1; B: Lug from Square B XU30 <3.0cm long sherd #1.

Figure 3.21. Other ceramic finds. A: Perforated disc from Square P XU1 sherd #1; B: Lug from Square B XU30 <3.0cm long sherd #1.

Figure 3.22. Summary ceramics data for Squares A and B.

	Square A	Square B
Total # of sherds	393	778
Total weight of sherds (g)	692.3	1250.2
Average weight/sherd (g)	1.76	1.61
% of sherds (by #) ≥3.0cm length	10.9	10.0
% of sherds (by weight) ≥3.0cm length	59.1	58.0
% of sherds (by #) that are rim sherds	2.3	3.0
% of rim sherds (by #) ≥3.0cm length	66.7	52.2
Depth of deepest sherd below ground (cm)	94	90
Depth of Upper Horizon (including stratigraphically visible upper and lower interfaces) (cm)	0–20 (0–29)	0–20 (0–28)
Thickness of Upper Horizon (including stratigraphically visible upper and lower interfaces) (cm)	20 (29)	20 (28)
Depth of Middle Horizon (including stratigraphically visible upper and lower interfaces) (cm)	41–71 (36–81)	42–72 (42–81)
Thickness of Middle Horizon (including stratigraphically visible upper and lower interfaces) (cm)	30 (45)	30 (39)
Depth of highest incised sherd (cm)	47[a]	2[a]
Depth of deepest incised sherd (cm)	50[a]	20[a]
Depth of highest *Tegillarca granosa* shell edge-impressed sherd (cm)	n/a	36[a]
Depth of deepest *Tegillarca granosa* shell edge-impressed sherd (cm)	n/a	38[a]
Depth of highest sherd with finger groove below lip (cm)	n/a	18[a]
Depth of deepest sherd with finger groove below lip (cm)	n/a	20[a]
Distance from lip to top of finger groove (mm)	n/a	5.4
Width of finger groove (mm)	n/a	6.7
Depth of highest sherd with impressed continuous line (cm)	31[a]	20[a]
Depth of deepest sherd with impressed continuous line (cm)	55	88[a]
Depth of highest comb dentate-impressed sherd (cm)	31[a]	n/a
Depth of deepest comb dentate-impressed sherd (cm)	65	n/a
Depth of highest sherd with lip decoration (cm)	6[a]	16[a]
Depth of deepest sherd with lip decoration (cm)	34[a]	58[a]
Depth of highest sherd with (anvil) dimple marks on internal surface (cm)	n/a	5[a]
Depth of deepest sherd with (anvil) dimple marks on internal surface (cm)	n/a	45[a]
Depth of highest sherd with paddle-edge marks on external surface (cm)	n/a	3[a]
Depth of deepest sherd with paddle-edge marks on external surface (cm)	n/a	5[a]
Depth of highest sherd with maker's mark (cm)	n/a	9
Depth of deepest sherd with maker's mark (cm)	n/a	9

[a] Sherd recovered from sieve, i.e. = depth of top (highest) or base (deepest) of XU in which item was found.

Figure 3.23. Summary ceramics data from the stepping-out squares: Depths below ground (cm).

Square	Body Decoration					Lip Decoration		Other	Vessel shape		Manufacture
	Incision	Maker's mark (incised ladder motif)	Continuous linear impression	Dentate comb-impression	Motif: Impressed concentric arcs	Impressed grooves	Incised grooves	Perforated disc	Carination	Collar	Anvil dimple marks on internal surface
	Highest	Highest	Highest	Highest	Highest	Highest	Highest	Highest	Highest	Highest	Highest
C				57		23					
D						32					50
E			56		56	56					
F			39[a]–48[a]			39[a]–48[a]	4				
H						12			62		
J											10
K	57		57		57				57		
L			62–63		62–63	63			62		
M		9									
N						49–61			61	61	
O			50		50						
P								9			
T	54		54	54	54	54			54	54	
U			53		53				53		
AB			51							51	
AC				53	53	53					

[a] Sherd recovered from XU but not individually plotted, i.e. = depth of top (highest) or base (deepest) of XU in which item was found.

Tanamu 1. No evidence of coil technique has been seen on any sherd (i.e., no sherd breakage along coil seams has been seen).

Conclusion

A total of 1171 ceramic sherds weighing 1942.5g were systematically excavated from Tanamu 1 Squares A and B. These were chronostratigraphically differentiated by the use of 2.1cm thick (on average) XUs in each of Squares A and B (see Chapter 2 for excavation details). In addition, 65 sherds weighing 2415.8g came from stepping-out squares. Figure 3.22 presents summary data on the ceramics from each of the two major excavated squares; Figure 3.23 presents summary data on the sherds from the stepping-out squares.

At Tanamu 1 there is a complete chronostratigraphic and stylistic separation of 1) a Lapita Middle Horizon dated to 2800–2750 cal BP containing sherds with dentate comb impressions and/or continuous line impressions, often characterised by rows or fields of paired or triple parallel arcs, from 2) a much later Upper Horizon dated to 700–100 cal BP of generally undecorated ceramics that sometimes contain simple line incisions, with a few occurrences of slanted 'ladder' motifs (representing maker's marks), the latter exclusively in the proto-ethnographic Upper Horizon B, dated to 200–100 cal BP. The Lapita-period rim sherds are usually decorated with finger(?) or stick(?) impressions across flat lips; all the determinate vessels of this period were collared and carinated, and include both plain and extensively decorated pots, although the decoration does not generally appear to extend below the carination. In contrast, ceramics of the Upper Horizon are often everted indirect pots with necks, akin to the ethnographic *uro* of Motu and Koita fame. These Upper Horizon vessels are usually plain wares with round lips and straight or concave rims, occasionally decorated with maker's marks or a single linear incision around the circumference at the base of the inner rim surface. At stratigraphic levels between these two horizons where chronostratigraphic resolution is poor, and thus dating to some indeterminate time between 2750 cal BP and 700 cal BP, rare Linear Shell Edge-impressed sherds (containing dentate shell impressions and/or a single finger groove below the lip, as typical of that ceramic tradition) have been found, consistent with the dating of identical forms of decoration 140m away at Bogi 1 to 2150–2100 cal BP. In those intervening levels are also found rim sherds with stick(?) impressions with square-angled edges, and possibly fingernail(?) impressions, across the lip.

Ceramic traditions changed significantly between the Lapita Middle Horizon (2800–2750 cal BP) and the Upper Horizon (700–100 cal BP) at Tanamu 1. However, some continuity in cultural practice is evident in the presence of fired perforated clay discs that are indistinguishable in appearance but date from 2850 cal BP to 2450 cal BP at Bogi 1 and 200–100 cal BP at Tanamu 1. These are thought to relate to the manufacture of fishing net sinkers throughout this nearly three millennia-long period, and thus to the longstanding and ongoing presence and presumably high significance of fishing nets (see Groves 2011 for a discussion of the significance of fishing nets in ethnographic Motu culture).

Chapter 4.
The Stone Artefacts of Tanamu 1

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Introduction

Tanamu 1 has a long cultural sequence, one of the oldest known for the south coast of Papua New Guinea (PNG). This sequence spans pre-ceramic, Lapita and post-Lapita horizons into the ethnographic period (David *et al.* 2016a; see Chapter 2). A study of the stone artefacts from this site thus promises to substantially enhance our knowledge of stone tool technology at Caution Bay, from raw material acquisition to artefact discard, and will allow us to assess chronological change in stone tool manufacture and intensities of site use as measured by artefact deposition rates.

Background to stone analyses along the south coast of PNG

After some 30 years of inactivity, the Port Moresby region has recently undergone focused archaeological research (David *et al.* 2011; McNiven *et al.* 2011, 2012a). Until this recent work, the oldest known archaeological site from the south coast was Kukuba Cave dated to 3980 ± 105 BP (ANU-395a) and 3920 ± 90 BP (ANU-395b) (Vanderwal 1973). Prior to the Caution Bay project, Kukuba Cave was the only known pre-ceramic site. Its lithic industry was characterized by notched stones (n = 18), utilized flakes (n = 71) and waste flakes (n = 224) made from low-quality chert along with some roughly shaped adzes (Vanderwal 1973: chapter 7). In the 1960s and 1970s when Kukuba Cave and the other excavated sites predating the Caution Bay project were excavated, lithic analyses in Melanesia were usually restricted to typological rather than technological analyses, and tended to focus exclusively on retouched artefacts and formal implement types (see also Allen 1972). As both pre-ceramic and Lapita lithic assemblages usually contained few retouched artefacts, the bulk of the excavated lithic material consisting of unretouched flakes was unreported.

Research questions also drove the types of analyses performed on stone artefacts. With archaeological issues centred on the timing and direction of human migration and mobility across the Pacific (Shaw *et al.* 2010; Summerhayes 2003, 2009; Summerhayes and Allen 1993), stone artefact analyses were not seen to help answer such questions. The exception was obsidian for which a small number of well-defined sources began to be identified. Information on stone assemblages was thus largely restricted to material type and stone tool function.

The potential for technological approaches to lithic analysis in Melanesia, and along the south coast of mainland PNG in particular, for examining temporal and spatial variability thus remain largely unrealised. Such approaches can reveal previously unknown information on techniques of stone artefact manufacture both in their local and regional settings—a particularly useful avenue of enquiry when considering the distinctiveness and connections between local pre-ceramic, Lapita and post-Lapita cultural practices, including the kinds of research questions emanating from Green's (1991) Triple I model of cultural developments (Allen 2017; Clarkson and Schmidt 2011; Gaffney and Summerhayes 2019; Hanslip 2001; McCoy 1982; Mialanes *et al.* 2016; Pavlides and Kennedy 2007; Reepmeyer *et al.* 2011; Sheppard 1993; Symons 2003; Torrence 2011). Such investigations can also be coupled with functional analyses, as many of the unretouched flakes exhibit signs of use-wear and residue (Kononenko 2011). A technological analysis was thus conducted on the Tanamu 1 stone artefacts with these aims in mind.

The Tanamu 1 stone artefacts

A total of 1056 stone artefacts weighing 955.3g were recovered from Square A and 1258 stone artefacts weighing 676.4g from Square B. Their distribution by Excavation Unit (XU) is presented in Figure 4.1. The majority of the stone assemblage was discarded between XU2 and XU23 in Square A, with the highest (by number) occurring in XU3 and XU4 in both squares. The distribution by weight is similar, except for peaks which can be explained by the presence of relatively heavy hammerstones and anvils, particularly between XU55 and XU72.

Given our concern to describe fine-grained changes in the lithic assemblage of Tanamu 1 through time, the lithic sequence was grouped according to Stratigraphic Units (SUs) and radiocarbon determinations as

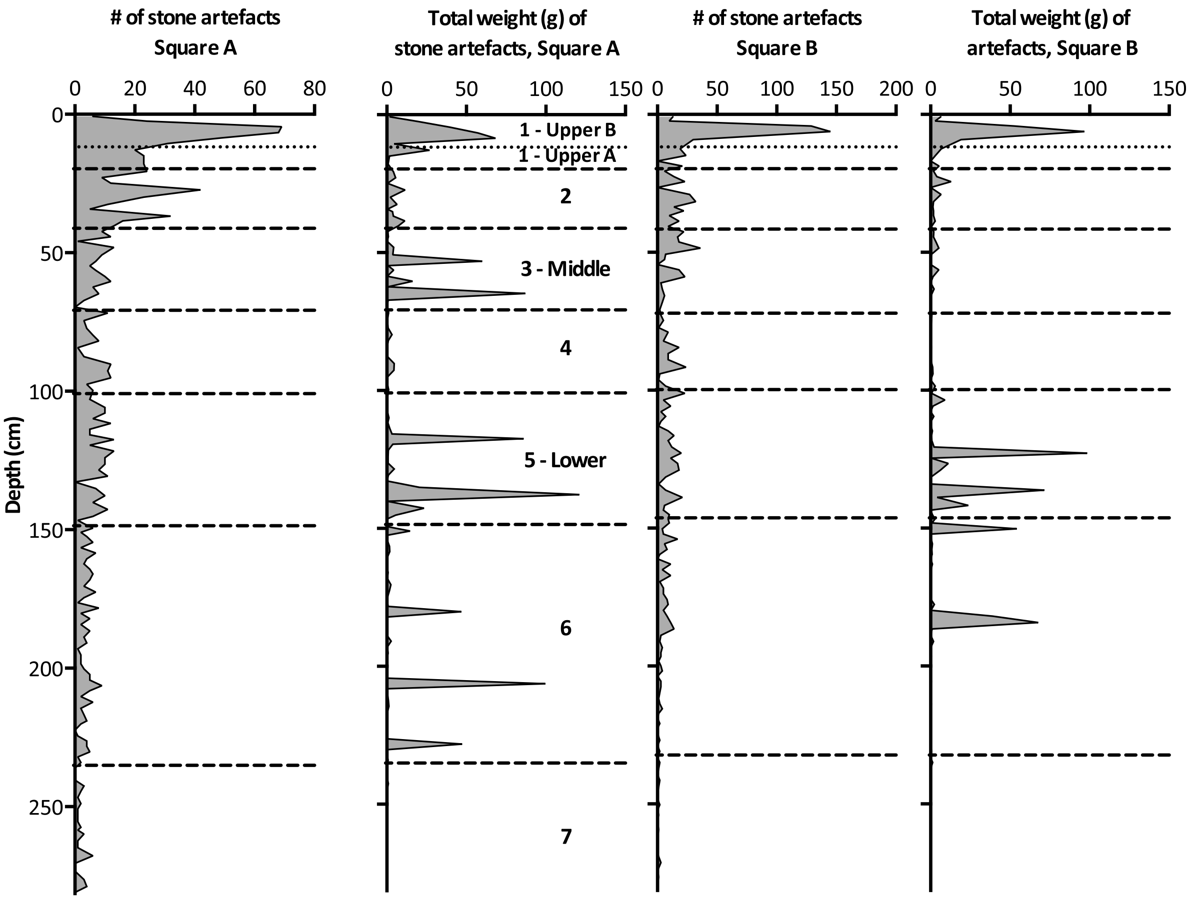

Figure 4.1. Stone artefact distribution by number and by weight with depth, Tanamu 1 Squares A and B.

Figure 4.2. Stratigraphic Units for Squares A and B, Tanamu 1. The main cultural horizons are in bold.

Stratigraphic Unit	Horizon	Square A	Square B	Duration (Years)
1B (*c.* 200–100 cal BP)	**Upper B**	**XU1–6**	**XU1–6**	**100**
1A (*c.* 700–200 cal BP)	**Upper A**	**XU7–10**	**XU7–10**	**500**
2 (*c.* 2750–700 cal BP)		XU11–21	XU11–21	2050
3 (*c.* 2800–2750 cal BP)	**Middle**	**XU22–35**	**XU22–35**	**50**
4 (*c.* 4050–2800 cal BP)		XU36–47	XU36–47	1250
5 (*c.* 4350–4050 cal BP)	**Lower**	**XU48–69**	**XU48–69**	**300**
6 (*c.* 4500–4350 cal BP)		XU70–113	XU70–113	150
7 (*c.* 5000–4500 cal BP)		XU114–134	XU114–134	500

described in Chapter 2 of this volume (Figure 4.2). These include the culturally-rich SU1, SU3 and SU5 (the Upper Horizons A and B, the Middle Horizon and the Lower Horizon respectively), and the less culturally rich SU2, SU4, SU6 and SU7. SU 2 and SU4 effectively represent transitional phases between major cultural phases at the site, and provide strong chronostratigraphic separation and thus control by which to examine major changes between local pre-ceramic, Lapita and post-Lapita cultural practices.

The stone artefacts of Squares A and B were made from six different types of raw materials. Their provenance is discussed in greater detail in David *et al.* (2016a). Stone artefacts made from chert are the most numerous, followed by chalcedony, metamorphic, igneous, quartz and obsidian materials (Figures 4.3, 4.4). By weight, chert is the most common raw material followed by metamorphic (amphibolite, metavolcanic, mafic schist) and igneous materials (basalt, dolerite/fine gabbro, and unidentified igneous). Chert artefacts dominate in each SU of each square, supplemented with minor amounts of metamorphic, chalcedony, igneous, quartz, and obsidian artefacts (Figures 4.5, 4.6).

Figure 4.3. Proportions of raw materials in Square A, Tanamu 1.

Raw Material	#	%	g	%
Chert	1045	99.0	622.17	63.2
Chalcedony	6	0.6	3.25	0.3
Igneous	5	0.5	329.89	36.5
Total	1056	100	955.31	100

Figure 4.4. Proportions of raw materials in Square B, Tanamu 1.

Raw Material	#	%	g	%
Chert	1212	96.3	536.78	79.4
Chalcedony	14	1.1	16.24	2.4
Quartz	1	0.1	0.33	<0.1
Obsidian	1	0.1	0.03	<0.1
Metamorphics	30	2.4	123.00	18.2
Total	1258	100	676.38	100

Figure 4.5. Raw material proportions (with quantities in brackets) by SU, Tanamu 1 Square A.

SU	Chert	Chalcedony	Igneous
1B	99.6 (246)	0.4 (1)	
1A	98.5 (64)	1.5 (1)	
2	100 (199)		
3	97.1 (99)	1.0 (1)	2.0 (2)
4	100 (81)		
5	98.8 (165)	0.6 (1)	0.6 (1)
6	97.5 (159)	1.2 (2)	1.2 (2)
7	100 (32)		

Figure 4.6. Raw material proportions (with quantities in brackets) by SU, Tanamu 1 Square B.

SU	Chert	Chalcedony	Obsidian	Quartz	Metamorphics
1B	100 (324)				
1A	100 (64)				
2	98.9 (173)		0.6 (1)		0.6 (1)
3	84.3 (140)			0.6 (1)	15.1 (25)
4	98.9 (92)	1.1 (1)			
5	96.8 (213)	2.7 (6)			0.5 (1)
6	96.5 (192)	2.0 (4)			1.5 (3)
7	100 (14)				

The Chert Artefacts

Distribution and Fracture Types

Since chert represents more than 96% of the entire stone artefact assemblage by number in both squares, the stratigraphic distribution of chert artefacts also shapes the trend observed for the overall total of stone artefacts (see above). In general, the chert artefacts are quite small, averaging 0.7g in weight with a mean length of 8.8mm in Square A, and 0.5g with a mean length of 7.9mm in Square B. In Square A, 65.5% (n = 684) of the chert artefacts weigh less than 0.1 g, and 9.9% (n = 103) weigh less than 0.01g. In Square B, 70.3% (n = 851) weigh less than 0.1g, and 14.5% (n = 175) weigh less than 0.01g. Such large numbers, and proportions, of small to tiny artefacts indicate that stone artefact manufacture took place on-site in each of the four horizons (see Figures 4.7, 4.8).

A modified version of Hiscock's (2002) Minimum Number of Flakes (MNF) calculation (see David *et al.* 2016a for definition) was used to estimate knapping intensities at Tanamu 1. The most intensive phase of occupation, as signalled by MNF calculations, was the most recent period of occupation *c.* 200–100 cal BP (SU1, Upper Horizon B) (Figure 4.9). The second-most intensive phase occurred during the Lapita phase *c.* 2800–2750 cal BP (SU3, Middle Horizon). Of the main occupation periods, the least intensive phase is the pre-ceramic Lower Horizon, dated to *c.* 4050 and 4350 cal BP (SU5). It is also worth noting that the MNF count for SU6 (4500–4350 cal BP) immediately below the Lower Horizon was higher. This unexpected result is curious given the comparative richness of all cultural materials

Figure 4.7. Chert artefact proportions by weight category (with quantities in brackets) by SU, Tanamu 1 Square A.

SU	<0.1g	0.1–1.0g	>1.0g
1B (*c.* 200–100 cal BP)	51.6 (127)	35.0 (86)	13.4 (33)
1A (*c.* 700–200 cal BP)	87.5 (56)	10.9 (7)	1.6 (1)
2 (*c.* 2750–700 cal BP)	81.3 (135)	18.8 (54)	1.6 (10)
3 (*c.* 2800–2750 cal BP)	64.6 (64)	29.3 (29)	6.1 (6)
4 (*c.* 4050–2800 cal BP)	72.8 (59)	22.2 (18)	4.9 (4)
5 (*c.* 4350–4050 cal BP)	64.8 (107)	22.4 (37)	12.7 (21)
6 (*c.* 4500–4350 cal BP)	69.2 (110)	25.8 (41)	5.0 (8)
7 (*c.* 5000–4500 cal BP)	81.3 (26)	18.8 (6)	

Figure 4.8. Chert artefact proportions by weight category (with quantities in brackets) by SU, Tanamu 1 Square B.

SU	<0.1g	0.1–1.0g	>1.0g
1B (c. 200–100 cal BP)	58.0 (188)	30.9 (100)	11.1 (36)
1A (c. 700–200 cal BP)	68.8 (44)	25.0 (16)	6.3 (4)
2 (c. 2750–700 cal BP)	72.8 (126)	23.7 (41)	3.5 (6)
3 (c. 2800–2750 cal BP)	77.9 (109)	20.0 (28)	2.1 (3)
4 (c. 4050–2800 cal BP)	79.3 (73)	19.6 (18)	1.1 (1)
5 (c. 4350–4050 cal BP)	63.4 (135)	30.5 (65)	6.1 (13)
6 (c. 4500–4350 cal BP)	72.9 (140)	24.5 (47)	2.6 (5)
7 (c. 5000–4500 cal BP)	85.7 (12)	7.1 (1)	7.1 (1)

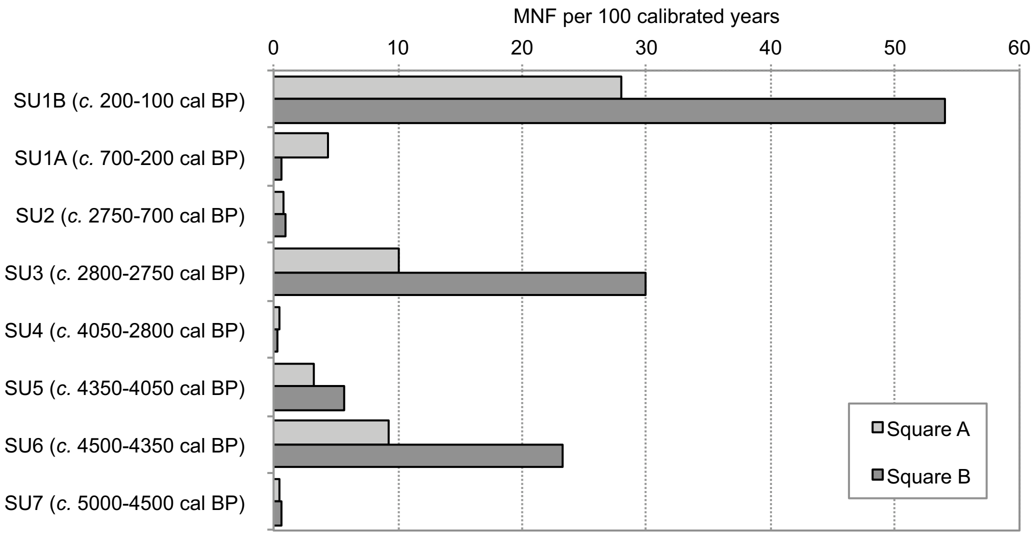

Figure 4.9. Minimum Numbers of Flakes (MNF) per 100 calibrated years by Stratigraphic Unit, Tanamu 1 Squares A and B.

within the Lower Horizon (see Chapter 2). It is plausible that here the MNF results reflect changing conditions in the preservation of artefacts—the rapid build-up of dune sands and lower occupation intensities in SU6 may mean that artefacts were less exposed to fire alteration and treadage than during the formation of the dense SU5 shell midden, but this is merely a possibility.

In both squares, the majority of chert artefacts consist of broken flakes and flaked pieces, and show only slight

Figure 4.10. Chert fracture type proportions (with quantities in brackets), Tanamu 1 Square A.

SU	Broken flake (other)	Complete flake	Distal flake	Medial flake	Proximal flake	Flaked piece	Unipolar core	Potlid
1B	51.2 (126)	10.6 (26)	6.5 (16)	2.4 (6)	7.3 (18)	20.7 (51)	1.2 (3)	
1A	57.8 (37)	3.1 (2)	9.4 (6)		1.6 (1)	26.6 (17)	1.6 (1)	
2	48.7 (97)	4.5 (9)	4.0 (8)	3.5 (7)	2.5 (5)	36.7 (73)		
3	54.5 (54)	2.0 (2)	3.0 (3)		1.0 (1)	39.4 (39)		
4	53.1 (43)	3.7 (3)	2.5 (2)	3.7 (3)		37.0 (30)		
5	57.0 (94)	1.8 (3)	3.0 (5)	1.2 (2)	4.2 (7)	31.5 (52)	1.2 (2)	
6	50.3 (80)	3.1 (5)	5.0 (8)	3.1 (5)	5.7 (9)	30.8 (49)	1.3 (2)	0.6 (1)
7	37.5 (12)	3.1 (1)	3.1 (1)			46.9 (15)		
Total	**52.0 (543)**	**4.9 (51)**	**4.7 (49)**	**2.5 (26)**	**3.9 (41)**	**31.2 (326)**	**0.8 (8)**	**0.1 (1)**

Figure 4.11. Chert fracture type proportions (with quantities in brackets), Tanamu 1 Square B.

SU	Broken flake (other)	Complete flake	Distal flake	Medial flake	Proximal flake	Axial flake	Flaked piece	Unipolar core	Potlid
1B	57.4 (186)	11.7 (38)	4.3 (14)	6.2 (20)	4.3 (14)	0.6 (2)	13.9 (45)	1.5 (5)	
1A	57.8 (37)	3.1 (2)	1.6 (1)	3.1 (2)	1.6 (1)		32.8 (21)		
2	43.4 (75)	6.4 (11)	2.9 (5)	2.9 (5)	1.7 (3)	1.2 (2)	41 (71)	0.6 (1)	
3	45 (63)	5.7 (8)	5 (7)		1.4 (2)		42.1 (59)		0.7 (1)
4	60.9 (56)	2.2 (2)	2.2 (2)	5.4 (5)			29.3 (27)		
5	59.6 (127)	3.3 (10)	3.3 (7)	4.2 (9)	1.9 (4)		24.4 (52)	0.5 (1)	1.4 (3)
6	59.4 (114)	9.4 (15)	9.4 (18)	5.7 (11)	4.7 (9)	1.5 (3)	11.5 (22)		
7	57.1 (8)	7.1 (1)	7.1 (1)		14.3 (2)		14.3 (2)		
Total	55 (666)	7.2 (87)	4.5 (55)	4.3 (52)	2.9 (35)	0.6 (7)	24.7 (299)	0.6 (7)	0.3 (4)

variations between SUs (Figures 4.10, 4.11). Appendices A and B list in greater detail the distribution of chert fracture types by XU. Chronological changes in fracture type frequencies are statistically significant in Squares A and B (Figure 4.12). Among artefact types, flaked pieces and broken flakes contribute the most to the chi-squared value. Two significant patterns are highlighted by the chi-squared adjusted residuals. While SU1B (*c.* 200–100 cal BP) is marked by peak proportions of complete flakes and a relatively low proportion of flaked pieces, the distribution of fracture types in both SU2 (*c.* 2750–700 cal BP) and SU3 (*c.* 2800–2750 cal BP) have a relatively low proportion of broken flakes and high proportion of flaked pieces. While these last results could be expected from mixed units such as SU2, the high proportion of flaked pieces in SU3—one of the most intensive phases of occupation at Tanamu 1—is puzzling. In the absence of major changes in stone artefact manufacture (such as a switch to bipolar percussion), post-depositional factors need to be considered. These are addressed below.

Figure 4.12. Chi-squared analysis of the frequency of main fracture types for each SU, with adjusted residuals in brackets, Tanamu 1 Squares A and B.

SU	Complete flakes	Flaked pieces	Broken flakes
1B	64 (5.94)	96 (-6.63)	402 (3.26)
1A	4 (-1.46)	38 (0.51)	85 (0.25)
2	20 (-0.68)	144 (5.11)	207 (-4.49)
3	10 (-1.33)	98 (4.81)	130 (-3.88)
4	5 (-1.87)	57 (1.53)	111 (-0.50)
5	13 (-2.35)	104 (0.01)	255 (1.18)
6	20 (-0.36)	71 (-3.41)	257 (3.41)
7	2 (-0.52)	17 (1.38)	27 (-1.04)

Critical value (df = 14, α = 0.05) = 23.69
χ^2 = 117.96, p <0.001

Chert Colours

Chert is present in a wide range of colours (see David *et al.* 2016a for a description of method and colour values), with colour values #6 (Munsell: 10YR 6/6) and #5 (10YR 8/2) being the most common, representing >40% of the chert assemblage in both squares (Figure 4.13). Since several chert artefacts exhibit both colour values #5 and #6 on the same artefact, these two colour values were grouped together during analysis.

The grey and black cherts are of good flaking quality and, unlike the brown chert artefacts, never display inclusions or flaws. The quality, colour and sometimes translucency of this chert was such that further chemical analysis was required to determine whether some may have been obsidian (Figure 4.14). Eighteen such artefacts from Square A and four from Square B were thus analysed further by Portable X-Ray Fluorescence (pXRF) in order to determine their lithologies.

Figure 4.13. Chert colour values and corresponding Munsell® colour (Geological Rock-colour Chart), Tanamu 1 Squares A and B.

				Square A		Square B	
#	Colour	Munsell colour code	Munsell colour name	n	%	n	%
1		5YR 3/4	Moderate Brown	12	1.4	14	1.2
2		5YR 5/2	Pale Brown	6	0.7	36	3.0
3		10YR 4/6	Moderate Reddish Brown	12	1.4	44	3.6
4		10R 6/6	Moderate Reddish Orange	5	0.6	10	0.8
5		10YR 8/2	Very Pale Orange	161	18.6	141	11.6
6		10YR 6/6	Dark Yellowish Orange	286	33.0	370	30.5
7		10YR 6/2	Pale Yellowish Brown	29	3.3	3	0.2
8		10Y 4/2	Greyish Olive	1	0.1		
10		5YR 4/1	Brownish Grey	58	6.7	63	5.2
11		5YR 2-2	Dusky Brown	1	0.1		
16		N3	Dark Grey	75	8.7	111	9.3
17		5R 4/2	Greyish Red	36	4.2	306	25.3
18		5R 5/4	Moderate Red	99	11.4	68	5.6
19		10R 5/4	Pale Reddish Brown	76	8.8	34	2.8
21		5Y 8/1	Yellowish Grey	6	0.7	8	0.7
22		N1	Black	4	0.5	2	0.2

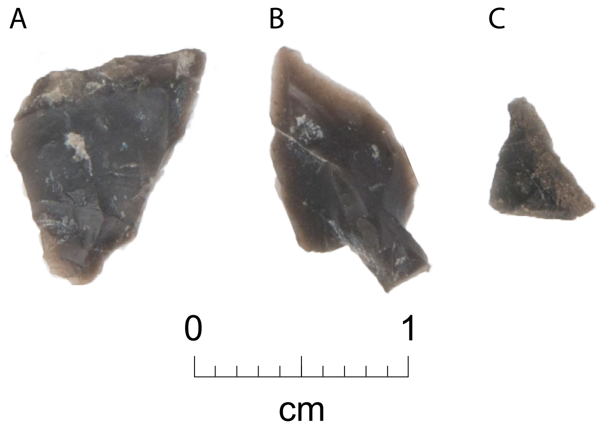

Figure 4.14. Black chert and obsidian, Tanamu 1. A: Broken chert flake (other) (Square A XU77 #844); B: Distal chert flake (Square A XU83A #873); C: Broken obsidian flake (other) (Square B XU16A #466).

pXRF Analyses: Methodology

All pXRF analyses undertaken for this volume were conducted at the Department of Anthropology and Archaeology, University of Otago, and followed the same protocol. A Bruker Tracer III-SD pXRF was employed. Optimal instrument settings for mid-Z trace elements, particularly Rb, Sr, Y, Zr, and Nb, were used: (40 kV, 30μA) with a filter (12 mil Al + 1 mil Ti + 6 mil Cu), for a 300 second run time. A pelletized USGS basalt standard (BHVO-2) was used as a control and shot before each pXRF run to test accuracy (Figure 4.15 indicates error range in this project). Calibration to parts per million (ppm) was a two-step process: first, the raw data were processed using Bruker's obsidian (OB40) calibration in S1CalProcess (Speakman 2012). These results were then improved by applying a linear regression based on twelve pelletized international standards (AGV-2, BCR-2, BIR-1a, BHVO-2, DNC-1a, GSP-2, QLO-1, SDC-1, SDO-1, SRM 278, SRM 688, W-2a), each shot three times using the same settings as for the archaeological samples.

All artefacts with visible surface dirt were washed prior to analysis. Standard analysis protocol involved placing the flattest surface possible on the analytical window, as surface morphology of stone artefacts can be a source of error in element concentrations. Another potential source of error is the overall small size of the artefacts in the Tanamu 1 assemblage (see Davis *et al.* 2011; Golitko *et al.* 2010; Shackley 2011 for discussions of problems with artefact size). For accurate analysis, samples must be larger than the analytical window of the pXRF spectrometer (in our case, 4mm × 3mm for the Bruker Tracer III-SD). Thickness is also of concern, as the infinite thickness required for most of the mid-Z elements is approximately 3mm. To identify the role that size plays in the geochemical results, all artefacts were measured for their maximum length, width and thickness to understand potential issues caused by 'undersized' artefacts (artefacts under the recommended size of 4mm × 3mm × 3mm). Based on the analysis of 4689 obsidian artefacts from 30 sites in Caution Bay, we have concluded that while of concern, size does not sufficiently result in the alteration of chemical data to cause misidentification to a source (for details, see Mialanes et al. 2016).

Results of the pXRF Analyses

Of the 22 black stone artefacts shot by pXRF, 21 were shown to be black chert and one (from Square B XU16A) obsidian. Comparison with obsidian source data from PNG indicates that this piece of obsidian originated from West Fergusson Island (Figure 4.16).

Taphonomy

Indicators of thermal alteration and weathering were recorded during analysis (Hiscock 1985, 1990; Sheppard and Pavlish 1992). While in each square less than 1% of chert artefacts exhibit signs of weathering, fire-altered chert flakes, whether from natural or intentional processes, was determined by changes in colour values and by the presence of potlid scars. Several tests were conducted to examine the potential impacts of fire on artefacts, whether heating was undertaken as an intentional raw material enhancement strategy, and for taphonomic considerations (e.g., causes of fragmentation). Stone artefacts were examined for evidence of fire alteration and coded by colour.

Figure 4.15. Results of basalt standard (USGS BHVO-2) analysis using pXRF.

BHVO-2	Mn	Fe	Zn	Rb	Sr	Y	Zr	Nb
USGS recommended, ppm	1290	86300	103	9.8	389	26	172	18
University of Otago pXRF, ppm	1230.80	85622.87	106.67	13.21	359.28	25.31	158.81	16.39
Standard Deviation, ppm	50.83	596.01	7.64	0.49	4.94	0.81	1.35	0.35
RSD (%)	4.13	0.70	7.16	3.70	1.37	3.18	0.85	2.14

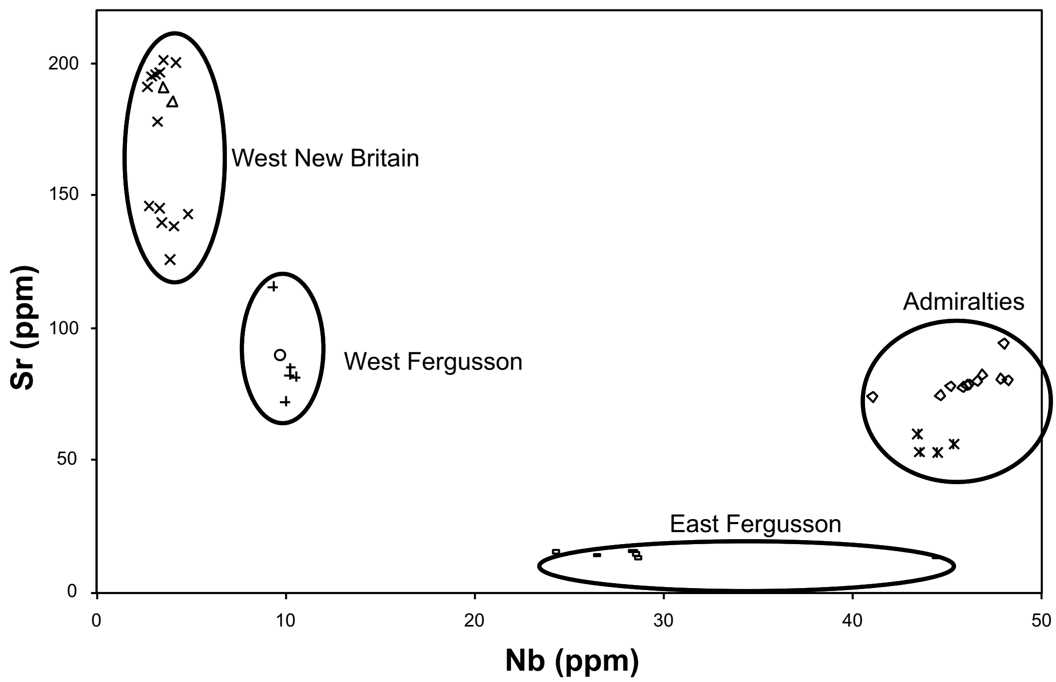

Figure 4.16. Bivariate plot of strontium and niobium concentrations matching artefacts to source using pXRF.

Potlid scars on ventral surfaces indicate that fire alteration took place after removal of a flake from the core, and should not be mistaken for heat treatment, which is the intentional process of applying heat to stone material or to artefacts in order to enhance their fracturing (flaking) qualities. None of the fire-altered artefacts were reused after firing, confirming that heat application took place after flaking and use and was thus unintentional (or at least, not related to the manufacture and use of the artefacts; whether it was intentional to its discard is not known). Even though some colours appear to have resulted from heating (colour values #1, #3, #4 and #15), these were not treated as fire-altered colours as indicators of fire alteration such as potlid scars were not observed on those artefacts. Since these colour values do not represent a significant number or proportion of the sample, they do not significantly impact on the results (discussed below).

Although potlid scars are common on heat-altered chert artefacts from Tanamu 1, potlids themselves are uncommon. Only one potlid, of colour value #17, was identified in Square A (in XU88, *c.* 4500-4350). In Square B, four potlids were identified (in XU24, XU48, XU60 and XU61) and are of colour values #17, #18 or #19. Recovered potlids in Squares A and B have a mean maximum dimension of 5.5 ± 0.6mm. A cursory look at the potlid scars suggests that their dimensions are mostly much smaller than 5mm long, and it is likely that most potlids passed through the 2mm sieve. While clearly the presence of a few large potlids indicates that fire alteration indeed took place *in situ*, their density through the sequence cannot be reliably used as a way to quantify fire alteration.

In Square A, the majority of potlid scars are located on both dorsal and ventral surfaces (72%, n = 26) rather than on dorsal surfaces (17%, n = 6) or ventral surfaces only (11%, n = 4). Potlid scars are more common on chert artefacts with colour values #17–19 than with any other colour values. Although other colour values exhibit reddish hues, only chert artefacts #17–19 have a combination of reddish hue and potlid scars. In Square A, potlid scars were most common on colour value #17 (70%, n = 25) and, to a lesser extent, on colour values #18 (11%, n = 4) and #19 (8.5%, n = 3). In Square B, they are located on both dorsal and ventral surfaces (85%, n = 33), but some are found on dorsal or ventral surfaces only (7.5%, n = 3 for each). Here potlid scars were most common on colour value #17 (67%, n = 28) and, when reddish colours are grouped together, account for 90% of the total number of artefacts with potlid scars. The presence of potlid scars on non-complete flakes is not suitable for quantifying fire alteration, as other taphonomic processes such as treadage or fire alteration itself could increase the proportions of broken flakes exhibiting potlid scars. Due to the small sample of complete flakes in Squares A and B, fire alteration was thus also assessed through colour distribution and the incidence of colour modifications.

As can be seen in Figure 4.17, there is a high proportion of grey (colour value #10), to dark grey (colour value

#16) in SU5 (*c.* 4350–4050 cal BP) and SU6 (*c.* 4500–4350 cal BP) in both Squares A and B. Black chert (colour value #22) is present in SU5 and SU6 only. Comparisons were made of the distribution of three major chert colour groups, colour values #5 and #6 (brownish, unaltered), colour values #17 to #19 (reddish, thermally altered) and colour values #10, #16, and #22 (greyish to black, unaltered) across all SUs in both excavation squares. Due to the small sample of complete flakes, this colour analysis includes also broken flakes and flaked pieces. Although combining artefact types in this way solves sample size issues, it does inflate the number of artefacts with signs of thermal alteration, as some of the broken flakes and flaked pieces were probably created by heating. In the unlikely event that no flakes were fractured by thermal alteration, chert brittleness nevertheless increased by heating, making artefacts more susceptible to breakage by other taphonomic processes such as treadage.

A chi-squared test reveals that differences in colour group frequencies between SUs are not due to chance (Figure 4.18). Chi-squared adjusted residuals indicate that grey to black colours and reddish colours vary significantly between SUs: the pre-ceramic phase (SU5–SU6) consists mainly of grey, dark grey, and black cherts, compared with their lesser importance in Lapita and post-Lapita levels. These differences could be interpreted in a number of ways, such as: (1) The emergence of restrictions in access to certain chert procurement zones accompanying the establishment of new social networks following the onset of Lapita settlements *c.* 2900 cal BP at Caution Bay. (2) Alternatively, or additionally, from Lapita times onwards a preference for brown cherts changing to reddish colours upon heating, at the expense of grey and black cherts may be at play. An increase in the frequency of reddish chert confirms an increase in fire activity during Lapita times and suggests that thermal alteration was responsible for increasing the size of the chert assemblage by increasing the degree of stone fragmentation. As a direct consequence of this increasing fragmentation, it is also likely that mean measurements taken on complete flakes underestimate the size of complete flakes prior to thermal alteration.

These results need to also consider the effects of differential rates of sedimentation on surface-exposed assemblages. Stratigraphic Units with slow sedimentation rates would result in artefacts being exposed to post-depositional fire alteration through bush or grass fires for longer periods of time than would be the case with faster sedimentation rates (Hiscock 1985).

Despite high sedimentation rates, chert artefacts were subjected to more frequent and/or more intense episodes of heat alteration between *c.* 2800-2750 cal BP (SU3) than in any other period. However, peak thermal alteration of chert during the Lapita phase is unlikely to be solely explained by longer exposure to bush or grass fires. While such fires could explain thermal alteration during periods of sparser occupation (such as during SU2 *c.* 2750-700 cal BP, or SU4 *c.* 4050-2800 cal BP), the fact that fire extensively altered the Lapita chert assemblage requires further explanation. While thermal fragmentation was recognized from various levels at Tanamu 1, it is unlikely that bush or grass fires ran through the site during periods of such intensive occupation, and the evidence of heating could thus relate to an intensive period of human-related fire activities. This could include fires for pottery manufacture commencing with the arrival of Lapita peoples.

Core Reduction and Flake Production

Core measurements and attributes are presented in Figure 4.19. All cores from Squares A and B were made of chert and reduced by unipolar percussion (Figures 4.20D, 4.20E). Eight cores were recovered from Square A and seven from Square B. None possess cortical surfaces. The vast majority of cores were made on chert of colour values #5 and #6 (86.7%, n = 13) and, more rarely, colour values #7 (6.7%, n = 1) and #16 (6.7%, n = 1). Cores were generally smaller during Lapita and post-Lapita than in pre-ceramic times. Changes in core weight were identified between SU1B and SU5–SU6. Results from a Welch's t-test indicate that core weight is significantly lower in SU1B than in SU5+6 ($t = 3.05$, $df = 4.27$, $p = 0.03$). This result has to be taken with caution since it is based on small samples, and corroborating evidence is required before interpreting this decrease in core mean weight during the post-Lapita occupation of Tanamu 1 as a marker of increasing reduction intensity. Other comparisons were not made due to an absence of cores or samples sizes which were too small in other SUs (SU1A, SU2 to SU4, SU7), which is itself of interest as not enough cores were recovered to produce the flakes and flaked pieces recovered from Squares A and B. This situation could be explained if cores and/or flakes originated off-site (i.e., if initial reduction took place off-site), if part of the Tanamu 1 assemblage is the product of maintenance activities performed on larger flakes, or if cores were broken by fire alteration (low core numbers observed in SUs where fire alteration was at its most intense). As will be seen below, no primary reduction flakes were recovered on-site (Figures 4.20A–4.20C), confirming that initial (decortication) stages were performed elsewhere.

Core rotation can also be measured by quantifying the number and orientation of flake scars on the dorsal surfaces of complete flakes. As can be seen in Figure

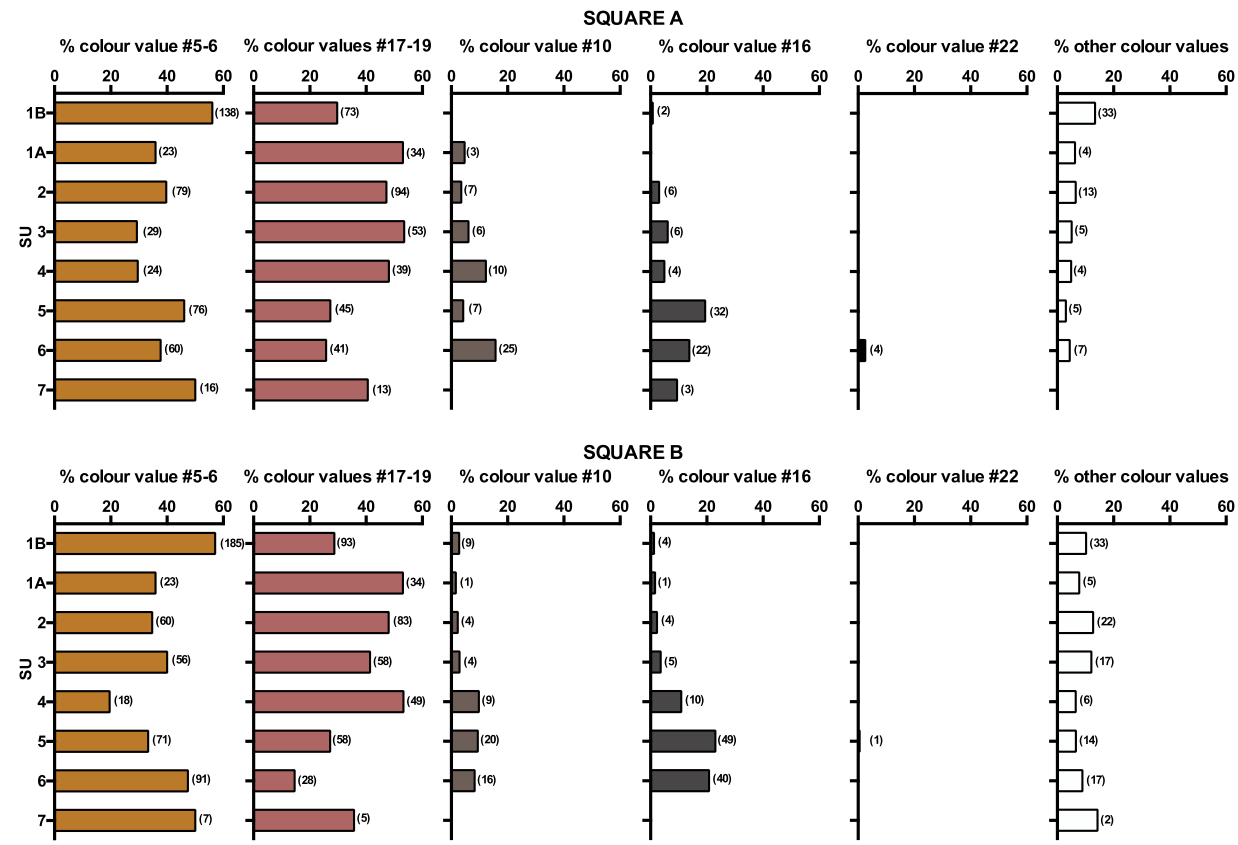

Figure 4.17. Relative proportions for chert colour values (with quantities in brackets), by Stratigraphic Unit, Tanamu 1 Squares A and B.

Figure 4.18. Chi-squared analysis of the frequency of chert grouped by colours for each SU, with adjusted residuals in brackets, Tanamu 1 Squares A and B.

SU	Colour values #5, #6	Colour values #10, #16, #22	Colour values #17, #18, #19	Other colour values
1B	323 (8.00)	15 (-9.00)	166 (-3.65)	66 (3.30)
1A	46 (-1.51)	5 (-3.37)	68 (4.31)	9 (-0.53)
2	139 (-2.13)	21 (-5.04)	177 (5.35)	35 (0.86)
3	85 (-2.25)	21 (-2.42)	111 (3.76)	22 (0.55)
4	42 (-5.01)	33 (2.04)	88 (4.41)	10 (-1.24)
5	147 (-1.50)	109 (9.19)	103 (-3.65)	19 (-2.52)
6	151 (0.27)	107 (9.76)	69 (-6.73)	24 (-1.07)
7	23 (1.06)	3 (-1.46)	18 (0.53)	2 (-0.98)

Critical value (df = 21, α = 0.05) = 32.67
χ^2 = 369.12, p <0.001

Figure 4.19. Weight, dimensions and attributes of chert cores by SU, Tanamu 1 Squares A and B.

SU	Mean weight (g) ± 1SD	Mean length (mm) ± 1SD	Mean striking platforms number (Min–Max)	Mean scars number ± 1SD (Min–Max)	Mean largest scar length (mm) ± 1SD	n
1B	8.9 ± 3.3	26.1 ± 5.5	2.5 ± 0.9 (1–4)	5 ± 2.6 (2–9)	8.4 ± 4.2 (3.5–16.6)	8
1A	7.5	26	1	1	12.7	1
2	11.0	31	4	9	10.6	1
3						
4						
5	27.5 ± 12.9	33 ± 7.8	2 (2–2)*	3.5 ± 2.1 (2–5)	13.9 ± 1.5 (12.8–14.9)	3
6	29.6 ± 21.2	39 ± 9.9	4.5 ± 0.7 (4–5)	5.5 ± 0.7 (5–6)	6.6**	2
7						

*One core with battered platforms was excluded.

**Due to concretions covering the core surface, scar measurement on one core could not be undertaken.

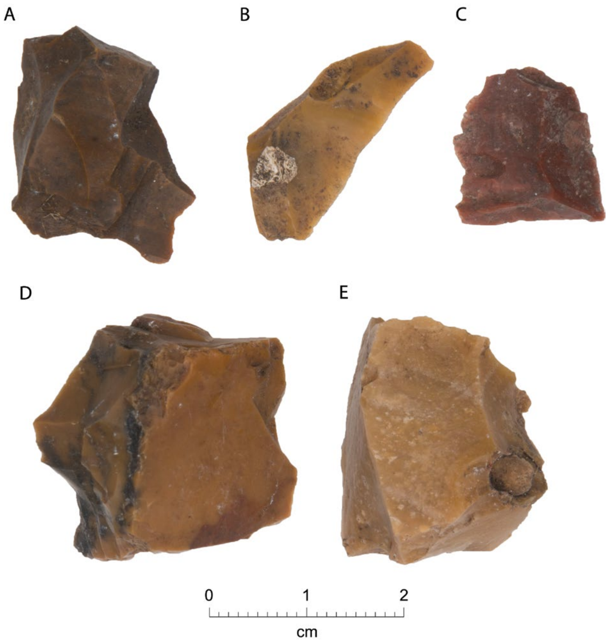

Figure 4.20. Chert artefacts from Tanamu 1. A: Complete flake (Square B XU3 #148); B: Complete flake (Square B XU3 #110); C: Distal flake, note the colour and potlid scars (Square B XU3 #144); D: Unipolar core (Square B XU4 #524); E: Unipolar core (Square B XU4 #223).

4.21, dorsal scars are not common on the complete flakes. A chi-squared test was performed in order to compare the frequency of dorsal scar numbers (none, one, two, three or more) between SU1B and SU5+6. No significant differences were observed ($\chi 2 = 0.991$, $df = 3$, $p = 0.80$). Inferred core rotations from dorsal scar orientations on complete flakes (Figure 4.22) show that core rotation was not common in any SU. The presence of redirecting flakes (flakes exhibiting the remnants of old striking platforms on dorsal surfaces) was also low (three in Square A and seven in Square B). Altogether, these results indicate no major changes in core rotation through the Tanamu 1 sequence.

Figure 4.21. Frequency of complete chert flakes by number of dorsal scars by SU, excluding flakes <5mm in both length and width, Tanamu 1 Squares A and B.

SU	0	1	2	3+
1B	25	15	14	7
1A	1	1		
2	10	4	1	2
3	2	1	2	
4		1	1	
5	3	1	5	3
6	5	4	2	1
7			1	1

Figure 4.22. Inferred numbers of core rotations based on flake scar orientation on the dorsal surface of complete flakes by SU, Tanamu 1 Squares A and B.

SU	0	1	2	Non-diagnostic
1B	47	11	2	2
1A	2	1		
2	15	2		
3	4	1		
4	2			
5	7	5		
6	11	1		
7	1	1		

Figure 4.23. Proportion of chert artefacts with cortex (with quantities in brackets) by SU for Square A and Square B, Tanamu 1.

SU	Square A	Square B
1B	1.2 (3)	1.2 (4)
1A		
2		
3	1.0 (1)	1.4 (2)
4	1.2 (1)	1.1 (1)
5	1.2 (2)	0.9 (2)
6	1.3 (1)	
7		

Cortex

Remnants of cortical surfaces are not common on the chert artefacts (Figure 4.23). Although no cores show any evidence of cortex, seven flakes (five broken and two complete flakes) and one flaked piece have parts of their dorsal surfaces covered with cortex in Square A. On complete flakes, cortex covers less than 25% of dorsal surfaces. In Square B, cortex is present on eight broken flakes and one flaked piece. Cortex never represents more than 1.4% of chert artefacts in any SU (Figure 4.23). Artefacts with cortex are notably absent from SU1A, SU2, and SU7.

In Squares A and B, cortical platforms were identified on 4.2% (n = 1) of the total number of platforms in SU5 (*c.* 4350–4050 cal BP) and 6.3% (n = 6) of the total number of platforms in SU1B (*c.* 200–100 cal BP). The minimal amount of cortex found on complete flakes, and the small number of cortical platforms, indicate that cores reached the site with minimal amounts of cortex and, consequently, that major decortication procedures took place elsewhere, probably close to the source and as a way of testing the quality of the raw material.

Complete Flakes

Mean measurements for unretouched non-cortical complete flakes are presented in Figure 4.24. A series of Welch's t-tests was used to assess the significance of changes in complete flake weights, dimensions, and shapes between SU1B (*c.* 200–100 cal BP) and SU5+6 (*c.* 4500–4050 cal BP). Complete flakes were significantly heavier and larger in SU1B than in SU5+6, whereas their elongations did not vary significantly (Figure 4.25).

Figure 4.24. Unretouched non-cortical chert complete flakes, dimensions by SU (excluding flakes <5mm in both length and width), Tanamu 1 Squares A and B.

SU	Mean weight (g) ± 1SD	Mean length (mm) ± 1SD	Mean width (mm) ± 1SD	Mean thickness (mm) ± 1SD	Mean elongation (mm) ± 1SD	n
1B	0.88 ± 1.58	12.3 ± 5.5	11.5 ± 6.2	3.1 ± 2.0	1.2 ± 0.5	60
1A	0.63 ± 0.69	11.7 ± 8.4	10.1 ± 4.0	3.5 ± 1.6	1.1 ± 0.4	3
2	0.30 ± 0.36	9.1 ± 4.3	8.6 ± 3.7	2.3 ± 1.2	1.2 ± 0.6	16
3	1.31 ± 1.89	11.4 ± 6.1	14.8 ± 12.5	3.5 ± 2.6	0.9 ± 0.4	5
4	1.03 ± 1.39	17.5 ± 18.8	11.0 ± 5.8	3.8 ± 3.4	1.3 ± 1.0	2
5	0.14 ± 0.14	8.0 ± 3.0	8.3 ± 3.2	1.7 ± 0.9	1.1 ± 0.5	12
6	0.18 ± 0.25	7.8 ± 2.5	7.3 ± 2.1	2.0 ± 1.3	1.1 ± 0.5	12
7	0.07	5.4	2.9	0.7	1.9	1

Figure 4.25. Welch's t-tests comparing complete flake weights and dimensions of SU1B against SU5+6 (excluding flakes <5mm in both length and width), Tanamu 1 Squares A and B.

	t	df	p
Weight	3.46	63.66	0.001***
Length	4.90	78.44	<0.001****
Width	3.81	81.39	<0.001***
Thickness	3.86	74.57	<0.001***
Elongation	0.76	46.03	0.45

Platforms

Single-flaked platforms are the most common platform type in each SU, followed by multiple-flaked platforms, crushed platforms and cortical platforms (Figure 4.26). Possible chronological changes in single-flaked platform dimensions were also evaluated (Figure 4.27). To assess changes in the dimensions of single-flaked platforms, a Welch's t-test was performed on their widths and thicknesses for SU1B and SU5+6. Single-flaked platforms are significantly wider (t = 2.37, df = 110.8, p = 0.02) and thicker (t = 2.90, df = 111.4, p < 0.001) in SU1B than in SU5+6. Similarly, multiple-flaked platforms were significantly wider (t = 4.42, df = 12.36, p < 0.001) and thicker (t = 4.13, df = 11.26, p = 0.002) in SU1B than in SU5+6. These results are in accordance with previous observations made on the size of complete flakes.

Figure 4.26. Frequency of chert platform types by SU, Tanamu 1 Squares A and B.

SU	Cortical	Crushed	Single flaked	Multiple flaked
1B	6	6	69	14
1A			6	
2		4	19	5
3		1	11	1
4			5	
5	1	3	18	2
6		8	28	2
7			4	

Figure 4.27. Chert platform dimensions by SU, Tanamu 1 Squares A and B.

	Mean platform width (mm) ± 1SD	Mean platform thickness (mm) ± 1SD	n
Cortical platforms			
SU1B	9.5 ± 4.7	4.5 ± 2.6	5
SU5	3.5	3.2	1
Single flaked platforms			
SU1B	5.2 ± 3.1	2.2 ± 1.7	71
SU1A	3.8 ± 1.2	1.4 ± 0.9	6
SU2	5.5 ± 3.7	1.7 ± 1.1	19
SU3	4.6 ± 5.3	1.7 ± 2.6	11
SU4	5.7 ± 5.0	2.1 ± 2.3	5
SU5	4.1 ± 1.9	1.6 ± 0.8	18
SU6	3.9 ± 2.7	1.4 ± 1.1	28
SU7	5.2 ± 3.3	1.9 ± 1.2	4
Multiple flaked platforms			
SU1B	10.7 ± 4.5	4.4 ± 2.5	14
SU1A			
SU2	6.4 ± 4.3	2.5 ± 1.7	5
SU3	4.4	2.1	1
SU4			
SU5	3.8 ± 0.8	1.2 ± 0.5	2
SU6	3.2 ± 1.8	1.2 ± 0.6	2
SU7			

Platform Preparation

Platform preparation was assessed through the presence/absence of evidence for platform overhang removal (Figure 4.28). Platform preparation was not a common occurrence. A chi-squared test comparing changes in the frequency of overhang removal between SU1B, SU3, and SU5+6 revealed no statistically significant changes ($\chi 2$ = 0.035, df = 2, p = 0.98), indicating that levels of platform preparation remained low throughout much of the Tanamu 1 sequence.

Terminations

Feather terminations are the most common type of termination identified in both squares, followed closely by abrupt terminations (feather and step terminations). This high frequency of abrupt terminations is

Figure 4.28. Proportions of overhang removal on chert platforms (with quantities in brackets), by SU, Tanamu 1 Squares A and B.

SU	% overhang removal
1B	31.9 (29)
1A	16.7 (1)
2	32.0 (8)
3	23.1 (3)
4	20.0 (1)
5	31.8 (7)
6	34.4 (11)
7	25.0 (1)

Figure 4.29. Chert termination types, frequencies by SU, Tanamu 1 Squares A and B.

SU	Feather	Hinge	Outrepassé	Step	Retouched away
1B	49	36	4	3	
1A	8	1		2	
2	17	14	2		
3	12	5	2	1	
4	5	2		1	
5	11	9	2	2	1
6	24	13		6	1
7	2	1			1

indicative of late-stage reduction. Termination types by SU are presented in Figure 4.29. A chi-squared test examining changes in frequencies of feather versus abrupt terminations between SU1B, SU2, SU3, SU5 and SU6 revealed no significant differences ($\chi 2$ = 1.173, df = 4, p = 0.88).

The Chalcedony Assemblage

All chalcedony artefacts were reduced using unipolar freehand percussion. Only six chalcedony artefacts (five flakes and one flaked piece) were recovered from Square A and 14 from Square B (13 flakes and one flaked piece), from SU1B to SU6. Most occurred in SU5 and SU6.

The Metamorphics Assemblage

A total of 27 flakes (n = 19) and flaked pieces (n = 8) were recovered from Square B only, with the majority occurring in SU3 (n = 25) and the rest in SU2 (n = 1) and SU6 (n = 1). Flakes were quite small, with a mean weight of 0.15g and a mean maximum length of 7.75mm.

The Obsidian Assemblage

Only one obsidian artefact was recovered. The broken flake (0.03g) was found in Square B XU16A (Figure 4.14C), in the culturally sparse SU2 dating to *c.* 2750–700 cal BP (SU2). Also within SU2, the identification of a pottery sherd whose style dates to *c.* 2150–2000 cal BP provides a more accurate age range for its discard.

Flaked Assemblage from the Stepping-out Squares

Square E

Two chert flaked pieces (8.5g and 8.6g) from XU1 exhibit potlid scars.

Square F

Two complete chert flakes (XU1: 3.11g and XU5: 3.70g) and one broken chert flake (XU1: 2.80g) were recovered.

Square J

One broken chert flake (1.03g) was recovered from XU1.

Square K

Two broken chert flakes (one distal fragment weighing 1.30g and an undetermined broken flake weighing 5.36g) were recovered from XU1. A unipolar chert core (47.g), partially heat-altered (colour values #5 and #18) and exhibiting alternate platforms and eight flake scars was recovered from XU13.

Implements

Retouched Flakes

A total of 21 retouched artefacts, all made of chert, were recovered from Squares A and B (Figure 4.30). Most were found in SU5 and SU6, including an edge-rejuvenation flake and a retouching flake indicating that retouching took place on-site. Retouched flakes never account for more than 2.2% of each SU assemblage. Retouching was mostly observed on broken flakes (n = 12) and complete flakes (n = 3).

Overall these results indicate that flakes were rarely retouched at Tanamu 1, unmodified edges being

Figure 4.30. Proportions of retouched artefacts (with quantities in brackets) by SU, Tanamu 1 Squares A and B.

SU	Retouched artefacts
1B	0.5 (3)
1A	
2	0.8 (3)
3	
4	1.2 (2)
5	2.1 (8)
6	1.1 (4)
7	2.2 (1)

Figure 4.31. Hammerstone, Tanamu 1 Square J XU14.

preferentially utilized or that selected flakes for retouching were taken elsewhere.

Hammerstones

In Square A, two hammerstones were recovered from SU5 (*c.* 4350–4050 cal BP) and SU6 (*c.* 4500–4350 cal BP). The SU5 hammerstone is made from a mafic, igneous rock that has been subjected to considerable metamorphism and alteration. It is possibly a dolerite or fine gabbro. The SU6 hammerstone is finer grained than the one from SU5 and is possibly made on basalt. In Square B, one hammerstone made from igneous material was recovered from SU5 (*c.* 4350–4050 cal BP). Four hammerstones made from igneous or metamorphic rocks were also recovered from stepping-out squares:

- In Square C, one hammerstone was found in XU18, in levels dated to *c.* 4500–4350 cal BP.
- In Square F, one hammerstone and one possible hammerstone were found in XU1 (*c.* 200–100 cal BP) and XU14 (*c.* 4350–4050 cal BP) respectively.
- In Square J, one hammerstone was identified in XU14 in levels dated to *c.* 4350–4050 cal BP. This hammerstone was made from amphibolite and has intense crushing at both ends.
- In Square K, one hammerstone/punch came from XU14 in levels dated to *c.* 4350–4050 cal BP (Figure 4.32). This long thin green metavolcanic cobble has a diamond cross section and is blunt at both ends. Use-wear consists of percussion marks on both the distal and proximal ends, as well as flake removals from both ends. Longitudinal splitting, where cracks are visibly present running from both the distal and proximal end, is also consistent with impact occurring to both ends of the artefact. A similar hammerstone/punch was recovered at Waredaru, approximately 400 km northwest of Caution Bay (David *et al.* 2015). Altogether this evidence suggests the use of this artefact as a punch for indirect percussion.

Figure 4.32. Hammerstone/punch, Tanamu 1 Square K XU14.

Anvils

Two anvils from SU3 (*c.* 2800–2750 cal BP) and one from SU6 (*c.* 4500–4350 cal BP) in Square A were made on igneous material. They each exhibit pitting marks on flat surfaces. In Square C, one anvil was recovered from XU19 in levels dating to *c.* 4500–4350 cal BP. The recovery of hammerstones and anvils indicates that knapping took place on-site.

Grinding stone

A possible grinding stone (266.0g) made from igneous material was recovered from XU1 in Square E, from levels dating to the last 200 years.

Manuport

Three manuports were recovered from Tanamu 1. A mafic schist was identified from XU18 in Square K, from a level dating to *c.* 4500–4350 cal BP, and two amphibolite cobbles from Square G XU4 (*c.* 2800–2750 cal BP) and Square F XU7 (*c.* 2800–2750 cal BP). Although there is no evidence of modification or use, they are all raw materials that are exotic to the Caution Bay area and have therefore clearly been imported into the site for future intended use, possibly as hammerstones or as blanks for axe/adzes.

Summary

Pre-ceramic (SU7) Phase: c. 5000–4500 cal BP

The initial occupation of Tanamu 1 was marked by low quantities of chert artefacts probably reflecting infrequent, low intensity occupation (chert MNF averaging 0.5 per 100 years). No other stone materials were found.

Pre-ceramic (SU6) Phase: c. 4500–4350 cal BP

This phase is marked by an increase in the quantity of stone artefacts discarded on site (chert MNF of 16.3 per 100 years) and the appearance of igneous and chalcedony materials. Fire alteration of artefacts as indicated by colour change on chert was low in comparison to later periods. Grey to black cherts represent a significant part of the lithic assemblage. A grey core was identified during this phase, confirming on-site knapping of grey chert. The recovery of hammerstones, an adze blank and one igneous flake possibly derived from hammerstone use together indicate that axe/adze maintenance activities were performed on site.

Lower Horizon Pre-ceramic (SU5) Phase: c. 4350–4050 cal BP

The highest concentration of grey to black chert was recovered from this phase, although knapping events were less common here (chert MNF of 4.5 per 100 years) than during earlier pre-ceramic, subsequent Lapita and post-Lapita phases. This suggests that people worked stone sporadically in this part of Tanamu 1. The majority of hammerstones recovered from Tanamu 1 were found in this phase.

Pre-ceramic to Lapita (SU4) Phase: c. 4050–2800 cal BP

This is a mixed horizon marked by a decrease in stone artefacts and a low chert MNF (0.35 flakes per 100 years), suggesting a drastic decrease in occupation.

Lapita (SU3) Phase: c. 2800–2750 cal BP

This period was marked by the arrival of Lapita ceramicists at Tanamu 1. It is characterized by an increase in stone artefact manufacture (chert MNF of 20 flakes per 100 years) and by a noticeable increase in thermal alteration of stone artefacts. Thermal alteration strongly impacted on the lithic assemblage, resulting in increases to the original assemblage size, and possibly an underestimation of original flake sizes which has in turn limited our characterization of the stone tool technology. However, thermal alteration is not solely responsible for this situation. Since early reduction stages took place off-site, the absence of cores from the assemblage and the low quantity of complete chert flakes means that critical information for characterizing stone tool manufacture is absent from this part of the site.

This period is also marked by a significant increase in flakes made from igneous rock and by a significant decrease in the proportion of grey to black chert. Although this decrease could be explained by an increase in fire alteration masking the presence of grey and black-coloured stone, the fact that the latter do not reappear in later phases, when the incidence of heat alteration once again decreases, suggests that heating is not a sufficient explanation for the archaeological trends. We suggest instead that the archaeological pattern reflects a major change in access to grey and black chert, whether this was caused by limited access to the sources themselves or cultural (preferential) selection for other colours. These options may signal territorial reorganization of resource zones, with new constraints in access to grey-black cherts upon the arrival of Lapita peoples in largely coastal settlements.

Lapita to Post-Lapita (SU2) Phase: c. 2750–700 cal BP

This is another mixed zone containing a small stone assemblage (chert MNF = 0.9 per 100 years). However, the recovery of the only obsidian flake dating to a stratigraphic level also containing a pottery sherd of a style dated to *c.* 2150–2000 cal BP indicates that people still traded obsidian with communities further to the east, where the obsidian originated.

Post-Lapita (SU1A) Phase: c. 700–200 cal BP

This phase covering the post-Lapita period is marked, like the previous one, by small quantities of stone artefacts (chert MNF = 2.5 per 100 years). The low number of stone artefacts does not permit a finer characterization of the assemblage.

Ethnohistoric (SU1B) Phase: c. 200–100 cal BP

This is the most recent period of occupation. Stone artefact discard was at its most intense *c.* 100–200 cal BP (chert MNF = 41 per 100 years). In terms of stone tool manufacture, the greatest amount of information for Tanamu 1 relates to this period, as the vast majority of cores and diagnostic flakes came from this phase. Although this period is represented by an increase in chert complete flake lengths and in platform thicknesses for flat and multiple-flaked platforms (compared with the *c.* 4500–4050 cal BP pre-Lapita phase), this change in flake size more likely represents changes in site function, from stone tool maintenance to stone tool manufacture.

Conclusions

These results represent only a partial image of stone tool manufacture at Tanamu 1, as small sample sizes for the pre-ceramic phases and increases in the incidence of thermal alteration during the Lapita phase limit what we can say about temporal trends in technology and occupational intensities. We also need to keep in mind that different parts of the site may have been the location of different zones of activity, so that the excavated squares may have sampled changing activity areas through time. Despite these limitations, no major technological changes are apparent for the 5000 years of occupation at Tanamu 1, with stone artefact manufacture using unipolar freehand percussion on locally available chert being predominant throughout. The chert assemblage seems to be the result of late reduction stages performed *in situ*. Tanamu 1's flaked assemblage can be characterized by:

- Off-site primary reduction stages during most of the site occupation, based on the rarity of flakes exhibiting cortical surfaces and/or cortical striking platforms. These initial stages possibly took place near chert sources, probably as a way of testing chert quality.
- Low numbers of cores and of large flakes, suggesting that most of the secondary reduction stages were performed elsewhere.
- High quantities of small flakes (<5mm) and flaked pieces consistent with *in situ* knapping.
- Low levels of core rotation, and platform preparation consistent with expedient modes of reduction.
- High proportions of abrupt termination types, which are consistent with late-stage reduction.
- An absence of bipolar percussion, which is not surprising considering that the vast majority of the assemblage is made on chert, a local material readily available in close proximity to Tanamu 1.
- There is a total absence of flaked artefact types elsewhere associated with the Lapita cultural complex (Sheppard 2010).

Nevertheless, an important feature of the pre-ceramic phases between 4500 and 4050 cal BP is the presence of black chert, which drastically decreased in importance when Lapita ceramicists began to establish a coastal settlement at Tanamu 1 around 2800 cal BP. At present, it is unknown whether this change indicates the use of different procurement zones and a concomitant territorial restructuring with the arrival of Lapita peoples who established new permanent coastal settlements somewhat short of 3000 years ago. Systematic sourcing of raw materials will be required to answer these questions.

Of interest in this regard is the presence of metamorphic and volcanic artefacts during pre-ceramic and Lapita horizons only. This suggests that inland (non-Austronesian language-speaking) peoples with access to metamorphic and volcanic sources occupied coastal areas or interacted with coastal communities for short-duration events prior to the arrival of the first Lapita settlers at Tanamu 1. Following the establishment of Lapita villages, metamorphic and volcanic materials from inland sources continued to reach the coast, signalling ongoing connections (e.g., through trade) between inland and coastal groups.

Interpreting the Lapita occupation phase is more problematic, as the vast majority of its lithic assemblage is thermally altered, making technological comparisons with other phases difficult. Although this high degree of thermal alteration during the Lapita phase could be post-depositional, high sedimentation rates make this explanation less likely and open up the possibility that chert was deliberately burnt during Lapita occupation. More work needs to be done in identifying chert sources and their colour values prior to alteration, as well as in conducting experiments to determine how local cherts react to thermal alteration. Such experiments would help separate artefacts unintentionally burnt during bush or grass fires from those intentionally burnt in focused fires.

A further important feature of the Tanamu 1 lithic assemblage is the presence of only one obsidian flake. Clearly, this is not a sampling issue; the scarcity of recovered obsidian almost certainly indicating procurement difficulties in importing an exotic material whose closest source is located some 400km to the east, on Fergusson Island. Considering that stone tool manufacture was never intensive at Tanamu 1, even at the height of occupation, the low quantity of obsidian at this site may be due to the use of this part of the site as a specialized pottery and/or subsistence activity area, with limited use or maintenance of stone implements. However, the fact that this site contains multiple phases of occupation, each separated by a period of low-level occupation or even disuse, suggests otherwise: that is, the low quantity of obsidian likely reflects a general paucity for Caution Bay for those periods covered by the Tanamu 1 sequence.

Chapter 5.
The Molluscan Remains of Tanamu 1: Subsistence and Resource Habitats

Brit Asmussen, Patrick Faulkner, Katherine Szabó and Sean Ulm

Introduction

For millennia coastal populations of Papua New Guinea (PNG) have exploited the rich shellfish resources of open coast, estuarine and riverine environments. People have utilised these resources for food, the manufacture of tools, and the production of shell valuables as items of prestige and exchange (for examples from the south coast of mainland PNG, see Allen 1977a; Bulmer 1978; McNiven *et al.* 2011). However, the nature of landscape engagements in the region have up until relatively recently been largely unknown, and the advent of the Caution Bay research programme has more than doubled the known antiquity of human presence in the Port Moresby region, extended the number of sites excavated, and re-invigorated palaeoenvironmental research (for a recent review, see McNiven *et al.* 2012b; see also David *et al.* 2011; McNiven *et al.* 2011). Given the lacuna of details on past landscape engagements, analyses of temporal trends in molluscan remains found in archaeological sites are likely to contribute significantly to a better understanding of subsistence patterns and resource exploitation strategies; in particular the relative importance of individual species and the resource zones used for subsistence or other purposes. Such data can also inform on the nature of local habitats and signal changes in environmental conditions over time (e.g., Anderson 1981; Bird *et al.* 2002; Bourke *et al.* 2007; Morrison and Cochrane 2008; Szabó 2009).

Tanamu 1

The molluscan assemblage reported here is from Tanamu 1 at Caution Bay, an archaeological site dating from *c.* 5,000 cal BP to *c.* 100 cal BP. Two 1m × 1m squares (A and B) were excavated in 2.1 ± 0.5cm excavation units (XUs) to 2.82m depth, with all excavated materials retained in 2.1mm mesh sieves undergoing systematic analysis in dedicated archaeological laboratories (see Chapter 2 for excavation details). The 134 XUs at Tanamu 1 are partitioned into seven major stratigraphic horizons or units (SUs), each continuous across the two contiguous main excavated squares (A and B). SU1 (700–*c.* 100 cal BP), SU3 (2800–*c.* 2750 cal BP) and SU5 (4350–4050 cal BP) consist of rich cultural deposits (the Upper, Middle and Lower Horizons respectively); which are separated by the culturally sparser SU2, SU4 and basal SU6–SU7. SU1, SU3 and SU5 contain pronounced and distinct shell concentrations: XU3–XU6 (Upper Horizon); XU24–XU35 (Middle Horizon) and XU48–XU69 (Lower Horizon). In each of these, the total shell weight is on average >2000g for each XU from Square A and Square B combined. These dense shell horizons correspond with the three dense occupation horizons identified for the site as a whole, associated with pre-ceramic, Lapita and post-Lapita occupation periods (see Chapter 2).

Excavation at Tanamu 1 produced a total shell sample of 127,355.6g, with Square A containing 62,270.3g and Square B 65,085.3g. While the majority of these shells represent discarded food remains, a number of shell artefacts were also recovered. The shell artefacts are presented separately in Chapter 7. However, they are included in the weights and MNI counts reported here. The clearly stratified Tanamu 1 cultural sequence provides an ideal opportunity to investigate change over time in the use of molluscan resources.

Methods

The shells were analysed using the standard Caution Bay Archaeology Project procedures detailed in David *et al.* (2016a). All shells >2.1mm long and shell fragments irrespective of size were identified to the lowest possible taxonomic level using a specifically developed, regionally-derived modern and archaeological shell reference collection and in comparison with photographs and descriptions in several reference texts (Abbot and Dance 1982; Hinton 1972; Lamprell and Healy 1998; Lamprell and Whitehead 1992; Poutiers 1998). While names of some taxa are currently under review, all nomenclature used here is consistent with the World Register of Marine Species (WORMS) database (as of 16 September 2019).

Four quantification methods were used: minimum number of elements (MNE), minimum number of individuals (MNI), number of identified specimens (NISP) and shell weight (for strengths and limitations of each method, see Claassen 2000; Giovas 2009; Glassow 2000; Mason *et al.* 1998, 2000; Nichol and Williams 1981).

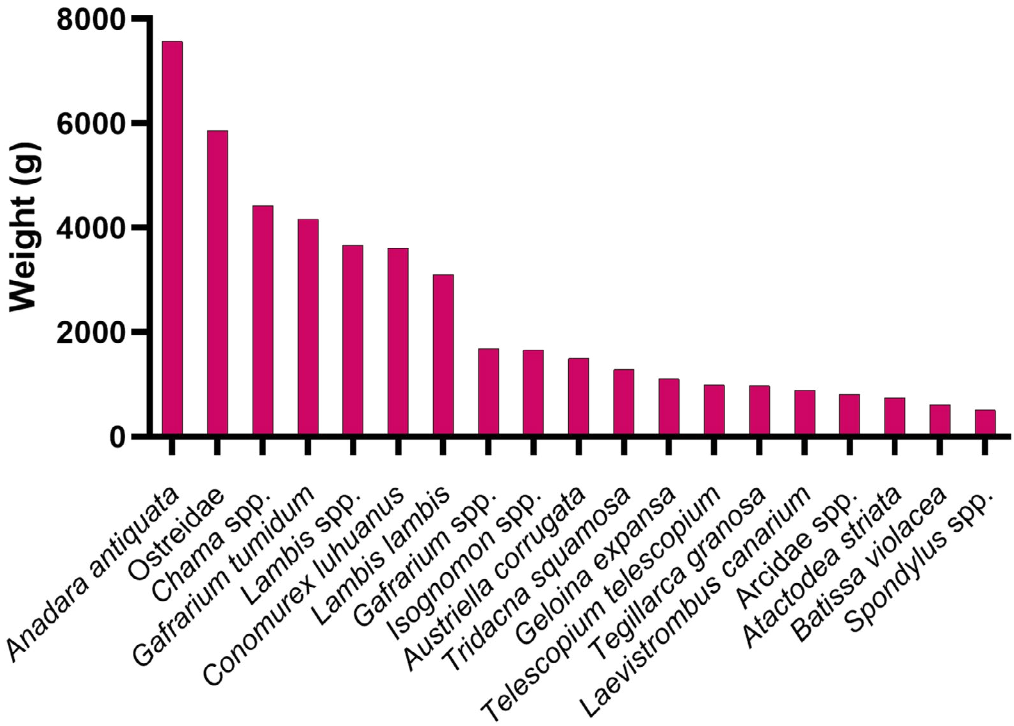

Figure 5.1. Molluscan taxa represented by >500g identified from Square A, Tanamu 1.

The majority of analyses are based on MNI and weight. Counts of non-repeating elements (NRE) were used to calculate MNI values, and NREs were held constant for each taxon throughout all XUs to avoid inflation of counts.

Results—Square A

Summary of Taxa Quantities

In total 83% of all shell by weight in Square A was identified to family, genus or species level. This comprises 36,088.5g (58%) from 55 bivalve taxa, and 15,609.0g (25%) from 96 gastropod taxa. Appendix C provides the total weight per XU for each taxon recorded for Square A. Figure 5.1 shows the relative abundance by weight of each taxon with a combined total of 500g of shell or more.

By weight, 10,572.8g (17%) of shell were not identified to class, family, genus or species due to their high degree of fragmentation and/or weathering. In XUs where shell is present, total shell weight ranged between 2.1g (XU17) and 2662.2g (XU66) per XU. (Note: shell from XU9 and XU10 was combined during excavations). In addition, small quantities of Cirripedia (barnacle, 57.2g), Polyplacophora (chiton, 8.7g) and polychaete (wormtube, 11.1g), Camaenidae and Subulinidae (land snails, 1.3g) were also identified in the sequence. When viewed as a whole, 25 species account for almost three quarters (75%) of the total Square A assemblage by weight.

The 10 most abundant taxa by weight account for 72% of the identified assemblage. These comprised *Anadara antiquata* (7567.2g, 15%), Ostreidae (5866.9g, 11%), *Chama* spp. (4429.1g, 9%), *Gafrarium tumidum* (4173.0g, 8%), *Lambis* spp. (3664.7g, 7%), *Conomurex luhuanus* (3613.1g, 7%), *Lambis lambis* (3108.2g, 6%), *Gafrarium* spp. (1690.1g, 3%), *Isognomon* spp. (1656.6g, 3%) and *Austriella corrugata* (1498.5g, 3%).

Square A yielded a total MNI value of 7644. Appendix D shows MNI values for each taxon by XU for Square A. Bivalves (MNI = 5026) clearly dominate the assemblage over gastropods (MNI = 2618). Figure 5.2 shows the taxa with 100 or more individuals (MNI) each.

When analysed by MNI, the Square A shell assemblage is clearly dominated by Ostreidae, which has a MNI of 773 (10%). The 10 most abundant taxa by MNI account for 58% of the total assemblage: *Gafrarium tumidum* (MNI 674, 9%), *Isognomon* spp. (MNI 602, 8%), *Anadara antiquata* (MNI 595, 8%), *Atactodea striata* (MNI 465, 6%), *Gafrarium* spp. (MNI 340, 4%), *Conomurex luhuanus* (MNI 332, 4%), *Nerita* spp. (MNI 264, 3%), *Pinctada maculata* (MNI 207, 3%), and *Chama* spp. (MNI 186, 2%).

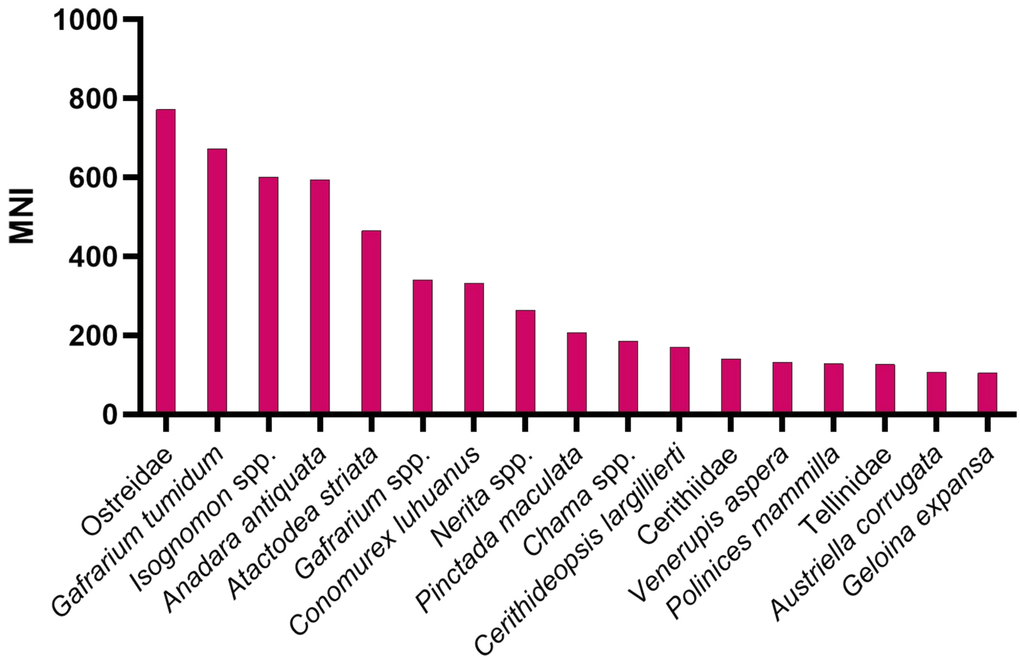

Figure 5.2. Molluscan taxa represented by 100 or more MNI identified from Square A midden deposits, Tanamu 1.

Results—Square B

Summary of Taxa Quantities

In total 77% of all shell by weight in Square B was identified to family, genus or species level. The assemblage consists of 33,728.2g (52%) from 48 bivalve taxa, and 16,398.4g (25%) from 91 gastropod taxa. Appendix E shows the weight for each taxon by XU.

By weight, 14,958.8g (23%) of the molluscan assemblage could not be identified due to advanced stages of fragmentation and/or weathering. Shell weight per XU varied from 0.1g (XU125) to 4710.4g (XU67). (Note: shell from XU5 and XU6 were combined during excavation and XU132 contained no shell). Small quantities of Cirripedia (barnacle, 33.3g), Polyplacophora (chiton, 6.9g), polychaete (wormtube, 2.7g), Camaenidae and Subulinidae (land snails, 3.8g) were also identified in the sequence. Twenty-five mollusc taxa account for 71% of the total assemblage by weight. Figure 5.3 shows the taxa that each have 500g of shell or more.

The 10 most abundant species by weight account for 55% of the total assemblage: *Anadara antiquata* (7509.7g, 12%), Ostreidae (5855.4g, 9%), *Chama* spp. (5379.3g, 8%), *Lambis* spp. (4566g, 7%), *Conomurex luhuanus* (3591.4g, 6%), *Lambis lambis* (2352.8g, 4%), *Gafrarium* spp. (2027.9g, 3%), *Telescopium telescopium* (1806.7g, 3%), *Geloina expansa* (1501.5g, 2%), and *Austriella corrugata* (1481.7g, 2%).

Square B yielded a total MNI of 7021 (presented by XU). Appendix F provides MNI values for each taxon by XU. As was the case in Square A, bivalves (MNI = 4417) dominate the assemblage over gastropods (MNI = 2604). Figure 5.4 shows the taxa with MNI values of 100 or more; these make up 70% of Square B's total MNI count.

When analysed by MNI, the Square B shell assemblage is clearly dominated by Ostreidae, which contribute 829 (12%) of the Square's total MNI. The 10 most abundant species by MNI together account for 58% of the total assemblage: *Isognomon* spp. (MNI 548, 8%), *Atactodea striata* (MNI 538, 8%), *Anadara antiquata* (MNI 495, 7%), *Gafrarium* spp. (401 MNI, 6%), *Conomurex luhuanus* (322 MNI, 5%), *Pinctada* sp. (MNI 263, 4%), *Cerithideopsis largillierti* (MNI 227, 3%), *Nerita* spp. (MNI 222, 3%), and *Chama* spp. (MNI 214, 3%).

Discussion

Squares A and B are adjacent, and SUs are continuous across the squares. Given this, the two data sets are combined in the following discussion. A notable feature of the sample is the rich variety of taxa. Most (84% by weight) taxa are represented in each of the three dense cultural horizons (the Upper, Middle and Lower Horizons: see Chapter 2, this volume).

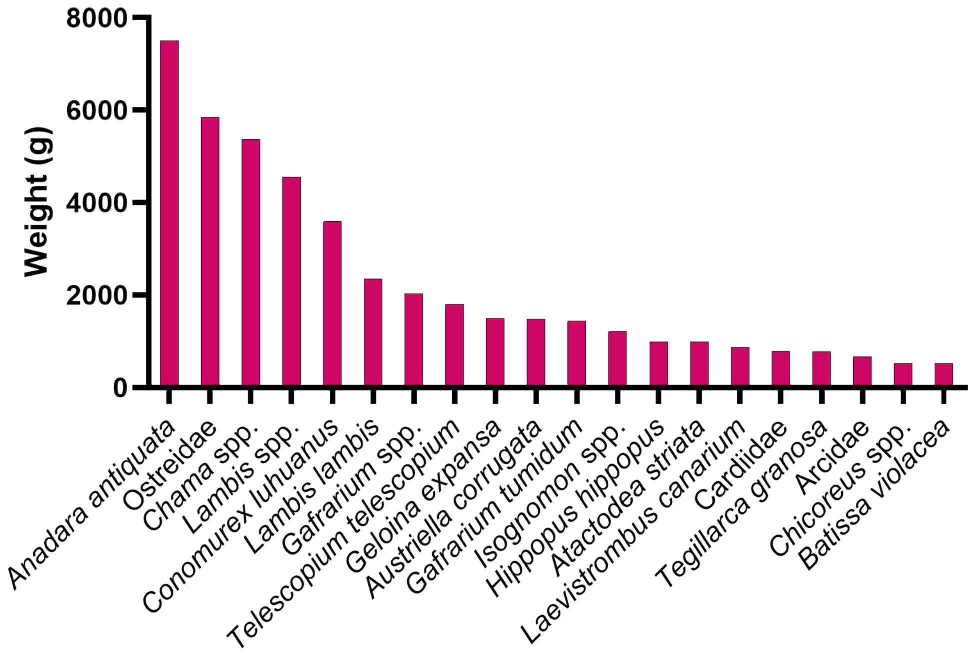

Figure 5.3. Molluscan taxa represented by >500g identified from Square B, Tanamu 1.

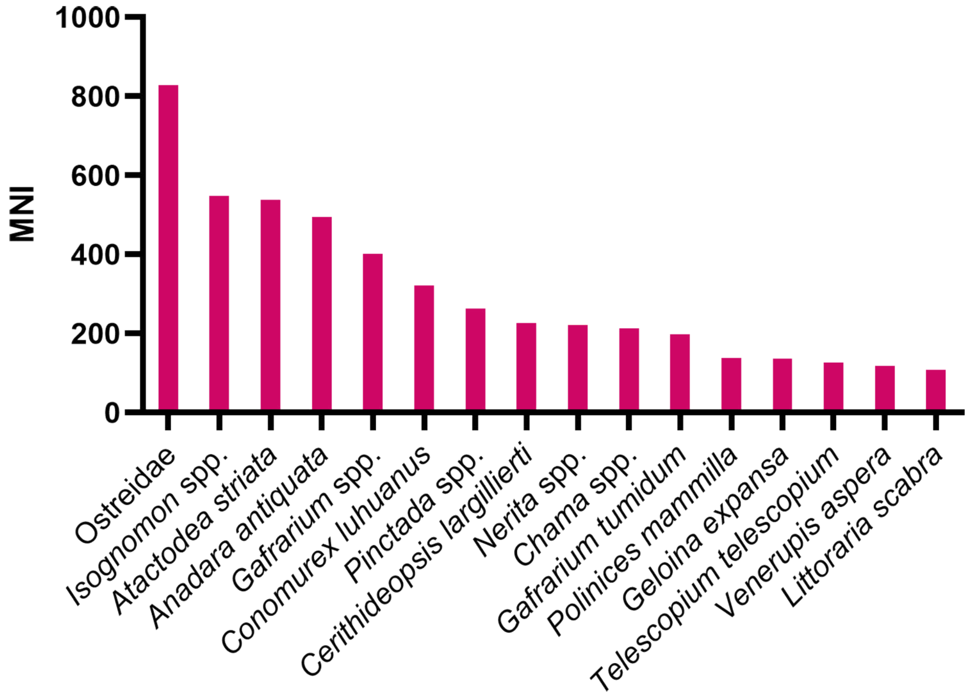

Figure 5.4. Molluscan taxa represented by 100 or more MNI identified from Square B midden deposits, Tanamu 1.

Subsistence Value of Most Common Taxa

The predominant taxa exploited at Tanamu 1 range significantly in average size and meat weight, from ≥1g (e.g., *Atactodea striata*) to 35g (e.g., *Lambis* spp.) (Bird *et al.* 2002: 462; Thomas 2002: 198). Oysters (Ostreidae) have the highest representation (based on MNI) in Tanamu 1 and, depending on size, an oyster specimen can yield 6–15g of edible meat (Sydney Fish Market 2008). A *Conomurex luhuanus* specimen contains on average 2g of edible meat (Thomas 2001: 83; Szabó 2011). Some taxa found in large quantities have low meat weights (estimated at 1g or less) (e.g., *Cerithideopsis largillierti*, *Littoraria scabra*, *Nerita* spp., *Planaxis sulcatus* and *Tellina* spp.). However, despite the small meat weight per specimen, the sheer number of shells from these species throughout the Middle and Lower Horizons suggests that they were of subsistence importance.

A small proportion of the taxa (approximately 4%) is most likely non-economic (i.e., not deliberately collected for food or other economic purposes). These are taxa (e.g., Ellobiidae, *Hemitoma* spp.) measuring less than 10mm in length that are regarded in this instance as having been introduced to the matrix by natural processes, or brought in incidentally (e.g., attached to larger shells) (Gill 1951: 251; but see Rowland 1994).

A careful examination of all shells indicates that some may represent shell valuables, artefacts in the making or detritus from the manufacture of shell tools or valuables. These are presented in Chapter 7. Many of the important shell taxa favoured by Pacific shell-workers (Szabó 2010: 116), such as giant clams (Tridacnidae), pearl oysters (*Pinctada* spp.), cone shells (Conidae spp.), conch shells (Strombidae), cowries (Cypraeidae spp.) and top shells (*Rochia nilotica*), appear to have been readily available at Caution Bay. Notably the majority of these favoured taxa were found in SU1, SU3 and SU5; the three dense cultural horizons. *Placuna placenta* was found in small numbers in the SU3 Lapita Middle Horizon, with one modified specimen coming from XU64 in the SU5 Lower Horizon.

Chronological Changes

Figure 5.5 shows the proportional distributions of major shell taxa in each of the three cultural horizons. SU1 (Upper Horizon) is associated with post-Lapita occupation, SU3 (Middle Horizon) is associated with Lapita occupation and SU5 (Lower Horizon) is associated with pre-ceramic occupation.

SU1 (XU3–XU6) is relatively meagre in both shell abundance and number of taxa (30 taxa) when compared with SU3 (XU24–XU35) (104 taxa) and SU5 (XU48–XU69) (130 taxa). This suggests that shell gatherers during the SU1 period either 1) deliberately targeted fewer species; 2) saw altered environments (see below for discussion); or 3) that the lower number of taxa observed here is a function of smaller sample size. The highest densities of shell in SU1 occur in XU3 to XU5–XU6. Predominant species during this time are *Conomurex luhuanus*, *Telescopium telescopium*, Ostreidae, *Geloina expansa* and *Lambis lambis*. Small amounts of *Cypraea* spp., *Pinctada* spp. and *Tridacna* sp. were also occasionally collected, possibly for shell-working (e.g., Szabó 2010: 116).

Both the Middle Horizon (SU3) and the Lower Horizon (SU5) contain a diverse range of mollusc species. The shell in these SUs is densest from XU24 to XU35 and again from XU48 to XU69. During these phases, large quantities of *Anadara antiquata*, *Atactodea striata*, *Chama* spp., *Gafrarium* spp., *Isognomon* spp. and Ostreidae were exploited (Figure 5.5). The range and relative abundance of taxa is similar in SU3 and SU5, suggesting that many targeted shellfish during Lapita times were comparable to earlier (pre-Lapita) exploitation strategies. However, there are also notable differences.

Relatively similar amounts of *Anadara antiquata* occur in SU3 and SU5 by MNI (SU3 MNI 443; SU5 MNI 454), however by weight this taxon is represented to a far greater degree in SU5 (SU3 3017.1g; SU5 9783.2g). This discrepancy is accounted for by the fact that whole shell valves in SU3 are slightly smaller than those of SU5. A similar pattern is also evident for all other Arcidae species in the sample. Larger gastropods such as *Laevistrombus canarium*, *Conomurex luhuanus, Lambis* spp. and *Gibberulus gibberulus* are present in greater quantities in SU3 than in SU5. During the Lapita phase, more *Gafrarium* spp. bivalves were collected than earlier on. *Conomurex luhuanus* is among the most common taxa of Tanamu 1. Its percentage contribution to the total shell assemblage, by both MNI and weight, suggests that it was an important subsistence resource. However, *C. luhuanus* largely occurs in the top 47 XUs (101 cm and above) in both Squares A and B, with only two individuals appearing in XUs 48 and 58 in Square A. The question remains as to whether the relative absence of *C. luhuanus* from SU5 to SU7—keeping in mind also that SU5 is a dense shell horizon—indicates cultural choice or environmental change.

In contrast to the situation with *C. luhuanus*, SU5 contains three times more *Atactodea striata* than SU3 by MNI. Other species more common in SU5 than SU3 include *Batissa violacea*, *Geloina expansa*, *Chama* spp., *Venerupis aspera,* Ostreidae, *Isognomon* spp. and *Pinctada* spp. Common gastropods in SU5 include *Chicoreus* spp., *Conus* spp., *Terebralia* spp., *Cypraea* spp. and small species that are only economical for subsistence in high numbers, such as *Calliostoma* spp., *Nerita* spp., *Oliva* spp., *Nassarius* spp., *Cerithideopsis largillierti* and *Littoraria* spp.

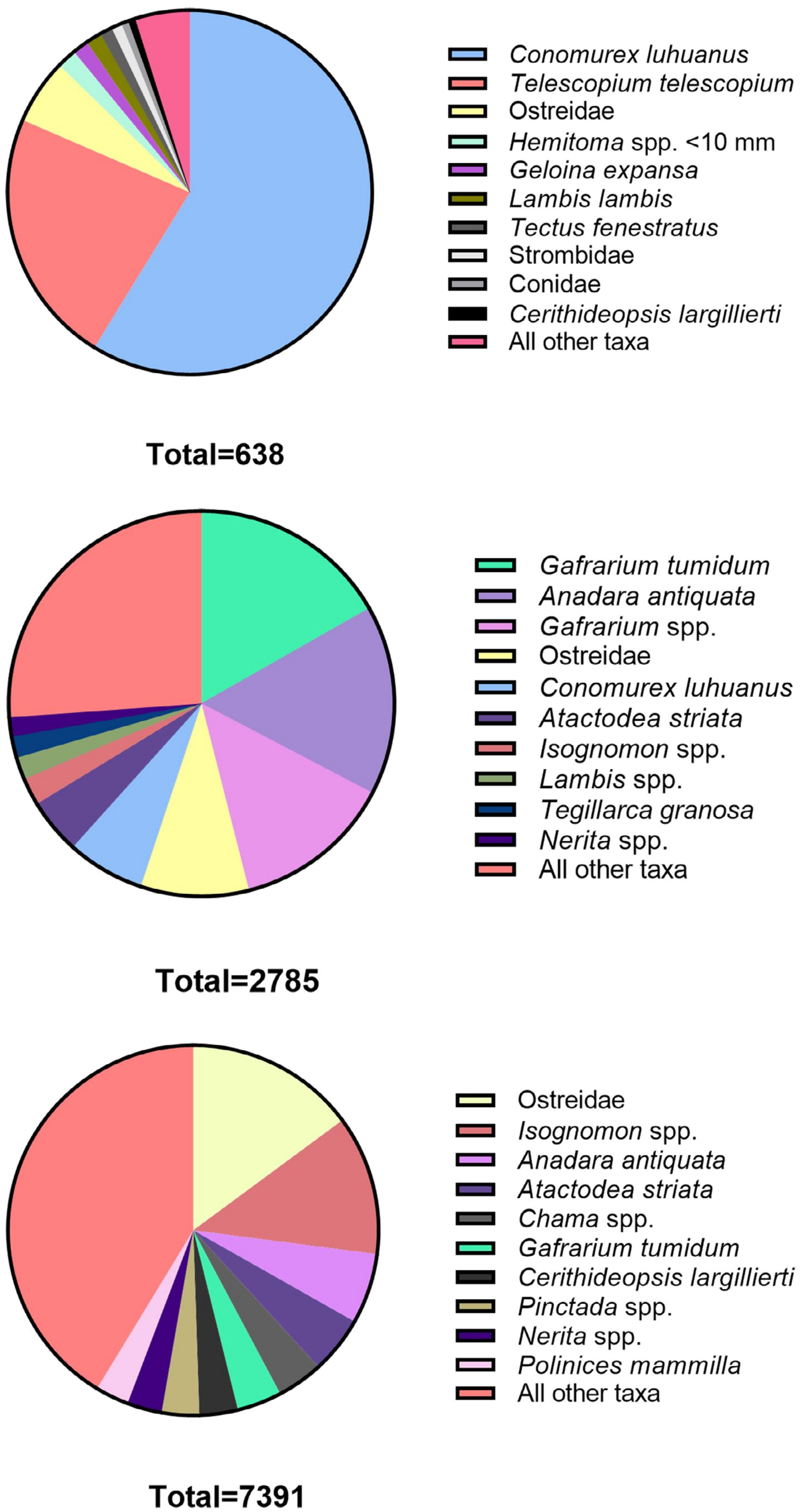

Figure 5.5. Percentage distributions of midden shell taxa in SU1 (top), SU3 (middle) and SU5 (bottom), as calculated from MNI values.

In SU3 these shellfish may have been considered too small to provide worthwhile meat yields and passed over.

Low quantities of shell recovered from XU10 to XU23 indicate that SU2 saw an approximately 2000-year hiatus following site abandonment by Lapita peoples around 2750 cal BP and prior to renewed settlement during post-Lapita times sometime after *c.* 700 cal BP. There are relatively few shells in SU4, although here the decrease in abundance is not as pronounced as in SU2. As indicated by the radiocarbon dates, SU4 probably contains a post-depositional mixture of Lapita-period (SU3) and pre-Lapita shells. There does not appear to be a great reduction in the number of taxa, although fewer of the robust specimens are present, and in particular there is a complete absence of giant clams (*Tridacna squamosa* and *Hippopus hippopus*) and large conch shells (*Lambis* spp.). In SU6 and SU7, the lowest levels of the site (between XU70 and XU134), all of the most common species (e.g., *Anadara antiquata*, Ostreidae, *Gafrarium* spp., *Geloina expansa, Telescopium telescopium*, *Atactodea striata*, *Nerita* spp., *Cerithideopsis largillierti*, Tellinidae) represent resources that were readily available by foraging the inshore tidal flats, mangroves and rocks. The presence of these molluscs in SU6 suggests that people have been using the local environment fronting the beach dune for at least 4700 years.

Site Environment and Habitats

Today, Caution Bay is a mangrove-fringed embayment fed by the Lea Lea River and flanked by the Vaihua River. Present-day marine habitats within the bay include coral reefs, seagrass beds, intertidal mangroves, and subtidal and intertidal muddy and sandy substrates (Coffey Natural Systems 2009). Large areas of seagrass occur in Caution Bay, generally on the flat, sandy seafloor between the mangroves and the fringing reef (Coffey Natural Systems 2009: 13.3.1.2). Sandy beaches occur in small patches along the coast in regions not supporting mangroves (Coffey Natural Systems 2009: 13.3.1.1).

Tanamu 1 is located on the edge of an exposed coastal sand dune flanked by open tidal mudflats to the east and an extensive intertidal mangrove forest to the west. However, the coastline has been continuously changing since the sea-level highstand at *c.* 6000 BP into the Late Holocene (Pain and Swadling 1980). Initially the landscape was a dynamic open coastline conducive to the aeolian accumulation of beach-bordering sand dunes (David *et al.* 2012). Coral reef growth was active until the reef caught up with sea level and blocked ocean swells and wave action. The reef progressed seaward with the lowering of sea level (Hope and Haberle 2005: 548). A pronounced fall in sea levels *c.* 2000 cal BP (Lewis *et al.* 2012) and resultant lower tides initiated rapid siltation, enabling a *Rhizophora* mangrove forest to colonise and dominate the tidal mudflats *c.* 2000–1700 cal BP, as indicated by pollen-sediment cores from Caution Bay (Rowe *et al.* 2013).

Inland erosion associated with human land-use activities likely contributed to shoreline changes and mangrove development through deposition of terrestrial sediments in the intertidal zone (McNiven *et al.* 2012b: 150). As outlined in Volume 1 (Rowe *et al.* 2013), inland, the coastal thicket and forest dominated until *c.* 2000 cal BP, after which there was a decline in tree cover and a transition towards coastal scrub. Charcoal records also indicate an increase in burning between *c.* 2000 and 1400 cal BP. After *c.* 1000 cal BP a spike in sedimentation resulted in less frequent tidal inundation, consequential changes to mangrove composition, and establishment of a saltmarsh and unvegetated mudflat (Rowe *et al.* 2013). Consequently, the availability of marine resources has altered substantially over the past 5000 years as a result of changing habitats, and impacts on local subsistence practices may have been considerable.

The wide array of habitats represented by the Tanamu 1 cultural shells include intertidal rocky substrates, sandy habitats and seagrass meadows, muddy tidal flats and mangroves, coral reefs and freshwater environments (Figure 5.6). This indicates that, over time, Caution Bay communities exploited a broad range of tidal habitats with different substrates. A brief overview of preferred habitats for the more common taxa follows.

Intertidal Rocky Substrates

Tanamu 1 taxa commonly associated with intertidal rocky shore environments include oysters (Ostreidae), *Planaxis sulcatus*, *Nerita* spp. and *Lunella cinerea*.

Shallow Sandy Seafloor and Seagrass Beds

Anadara antiquata is a poor burrower and prefers sandy gravels and shallow lagoon bottoms (Carpenter and Niem 1998). *Gafrarium* spp. also favour shallow, sandy habitats and seagrass meadows of the high intertidal zone. The Strawberry Conch (*Conomurex luhuanus*), along with other strombid species (e.g., *Gibberulus gibberulus* and *Laevistrombus canarium*), reside in shallow waters in muddy-sand habitats and in seagrass beds (Carpenter and Niem 1998: 475; Coleman 2003). In Figure 5.6, *C. luhuanus* is presented in the sandy seafloor and seagrass bed category.

Estuaries, Mangroves, and Upper Tidal Mudflats

Common species at Tanamu 1, including *Tegillarca granosa*, *Geloina expansa*, *Austriella corrugata* and

Telescopium telescopium inhabit the muddy bottoms of mangroves and tidal flats. *Isognomon* spp. live in dense colonies, attached to rocks or trees and other hard substrates in muddy estuaries and mangroves (Carpenter and Niem 1998: 190).

Coral Reef Flats

The jewel-box shell (*Chama* spp.) and pearl oyster (*Pinctada* spp.) are commonly found attached to coral and rock reefs in the littoral and sublittoral zones. Giant clam shell (*T. squamosa*, *H. hippopus*) and top shell (*Rochia nilotica*) are obtained from clear, shallow waters of coral reefs. Relatively large conch shells (*Lambis* and strombid species) also inhabit reef flats and coral rubble bottoms of the intertidal and subtidal zones (Carpenter and Niem 1998: 467).

Freshwater Environments

Taxa from freshwater environments include *Batissa violacea* and small neritid gastropods (e.g., *Neripteron violaceum)* (Lamprell and Healy 1998: 180–182).

Chronostratigraphic Trends in Mollusc Collection

Figure 5.6 shows the frequency and relative proportions of taxa (by MNI) by habitat. The array of habitats and relative frequencies of shell from particular resource zones confirm that the peoples of Caution Bay exploited a wide range of tidal habitats with different substrates—sand, rock, mud, coral reef and mangrove. However, not all these habitats were equally targeted at all periods of time. An analysis of the chronostratigraphic trends in habitat utilisation indicates minimal change through time in the general habitats exploited, but with some notable changes over the past 4350 years.

SU7 (*c*. 5000–4500 cal BP): In the lowest level of the site, the most abundant taxa (e.g., Tellinidae, *Calliostoma* spp., *Nerita* spp., Ostreidae, and *Gafrarium* spp.) came from rocky and sandy intertidal habitats. About half of these specimens are water-worn, indicating water-rolling and thus at least periodic submergence below high tide. Other taxa occurring in high numbers are those under 10 mm long (e.g., Arcidae, *Cerithideopsis largillierti* and *Fragum* spp.), indicating the presence of storm surge or intertidal sediments. All of this is consistent with topographic and stratigraphic evidence for SU7 partially representing natural beachline sediments, with much of the SU7 molluscan assemblage unlikely to be cultural.

SU6 (*c*. 4500–4350 cal BP): The majority of cultural taxa in SU6 represent resources that were readily available by foraging the intertidal sand and mudflats, mangroves and rocky shore. Sandy substrate bivalves (e.g., *Atactodea striata*, Tellinidae, *Gafrarium* spp. and *Venerupis aspera*) account for 44% of the SU6 assemblage; 31% is a mix of bivalve and gastropod species (*Austriella corrugata*, *Geloina expansa* and *Cerithideopsis largillierti*) from muddy substrates of intertidal flats and mangrove habitats. Small rocky substrate specimens in SU6 comprise turbo snails (*Lunella cinerea*), rock oysters (Ostreidae) and numerous nerite species.

SU5 (*c*. 4350–4050 cal BP): Inshore habitats (i.e., intertidal sand and mudflats, mangroves and rocks) represent the most heavily exploited environment by in pre-ceramic times of the Lower Horizon. Taxa from these environments make up 88% of the SU5 shell assemblage. Three additional habitats, seagrass beds, freshwater and reef flats, are also exploited. *Venerupis aspera*, *Atactodea striata* and *Asaphis violescens* continue to be actively collected from sandy flats. People also

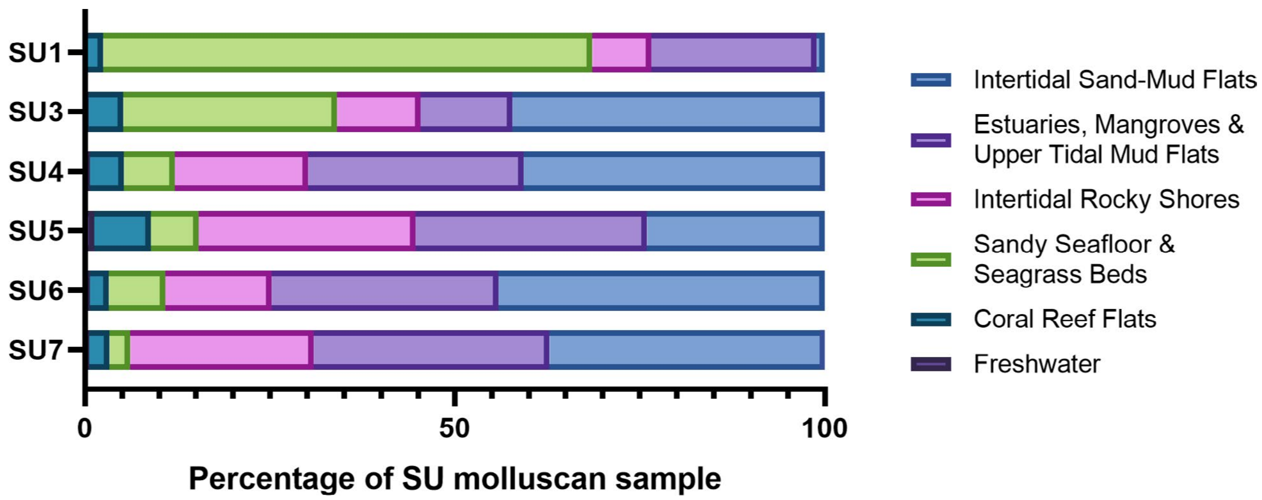

Figure 5.6. Proportions of molluscs deriving from different aquatic habitats for each Tanamu 1 SU, as calculated from MNI values.

persisted with collecting oysters and nerites from rocky shores, also collecting the jewel-box shell (*Chama* spp.). Taxa from muddy substrates that exhibit high numbers in SU5 include *Geloina expansa*, *Austriella corrugata*, *Cerithideopsis largillierti* and *Terebralia* spp. Exploitation of fresh/brackish water habitats is demonstrated by larger numbers of *Batissa violacea*. The presence of murex shells (*Chicoreus* spp.), cone shells (Conidae spp.) and cowries (Cypraeidae spp.) indicate that people were also venturing further out to rock and reef platforms for shellfish resources. The presence of a few specimens of top shell (*Rochia nilotica*) and giant clam shell (Tridacnidae) indicates that people were accessing the clean edges of coral reef systems.

SU4 (*c.* 4050–2800 cal BP): Inshore locales continue to be the most heavily exploited habitats, but we see in this SU a shift toward sandy substrate taxa (41% of the SU4 assemblage), away from rocky shore (18%) and muddy substrate mangrove-associated species (29%). There also continues to be evidence for increased access to resources from reef flats. Although minimally occurring in SU5, *Conomurex luhuanus*, a species that inhabits sandy substrates and intertidal-seagrass meadows, forms a substantive component of the SU4 assemblage (from XU47). The fact that this species is minimally represented to absent from the culturally rich SU5 Lower Horizon and into SU6 and SU7, suggests a major shift in exploitation of resource zones. Whether this also involved environmental change is not clear from the Tanamu 1 archaeological evidence.

SU3 (c. 2800–2750 cal BP): There are some notable differences between the dense cultural horizons of SU5 and SU3, indicating either that environmental conditions or targeted resource zones changed between *c.* 4350 cal BP (pre-Lapita) and 2800 cal BP (Lapita). *Laevistrombus canarium* (muddy-sand bottoms and seagrass meadows), *Gibberulus gibberulus* (sandy reef flats) and *Conomurex luhuanus* (sandy substrates and seagrass meadows) are present in greater quantities in SU3 than in SU5. Also occurring in greater numbers in SU3 are species from clean coral reef environments. Following the trend commenced in SU4, in SU3 quantities of harvested taxa are greatest from intertidal sand and mudflats (SU4: 41% of MNI; SU3: 42% of MNI) than from any other habitat. Here *Gafrarium tumidum*, *G. pectinatum*, *Anadara antiquata*, *Atactodea striata* and Tellinidae predominate. The rocky substrate taxa Ostreidae and *Chama* spp. are still present in reasonably high numbers, but unlike SU5, *Isogonomon* spp. and small nerites are only found in minor quantities. Similarly, the mangrove gastropods *Terebralia* spp. and cerithiids are represented in low numbers. These notable differences suggest not so much a change in the range of exploited habitats as in the proportional exploitation of habitats (with increased targeting of intertidal sand and mudflats, and reef environments) with the first signs of Lapita at Tanamu 1 *c.* 2800 cal BP (SU3) or slightly beforehand (within the period of SU4, as suggested by slightly earlier dates of around 2900 cal BP for the arrival of Lapita ceramics at Bogi 1 *c.*140m away (see McNiven *et al.* 2011)).

SU2 (*c.* 2750–700 cal BP): This SU contains insufficient quantities of shell from which to adequately determine environmental data.

SU1 (*c.* 700–100 cal BP): Post-Lapita peoples of the past 700 years targeted a significantly reduced variety of taxa. The indication is for a more intensive focus on gathering Strawberry Conch (*Conomurex luhuanus*), commonly collected from sandy substrates and intertidal seagrass beds, and Spider Conch (*Lambis lambis*), which inhabit reef flats and coral-rubble bottoms. Mangrove-associated species were once again utilized, with *Telescopium telescopium*, *Geloina expansa* and *Terebralia* spp. well represented. Rock oysters were a staple throughout occupation of the site and continue to be targeted into SU1.

The evidence from Tanamu 1 confirms that peoples of Caution Bay targeted a wide range of littoral habitats with different substrates (e.g., sand, rock, mud, coral reef and mangrove trees) for subsistence. This was supplemented with mollusc resources from reef flats, intertidal seagrass meadows and freshwater environments. The variation in habitats targeted over time may be an indication of different cultural strategies or it could be a reflection of changing environments or a combination of both. Notable differences between the three major cultural horizons are:

1. During pre-ceramic times (SU5 Lower Horizon), people obtained their resources in similar quantities from a variety of intertidal habitats, and had already begun to venture offshore for some prized specimens (e.g., occasional giant clams and nacreous top shells).
2. During Lapita (SU3 Middle Horizon) times, there was a greater focus on sandy and rocky intertidal rather than mangrove species, and more time was spent offshore accessing the clean coral reef environments.
3. More than half of the post-Lapita, proto-ethnographic (SU1 Upper Horizon) assemblage consists of a single species (*C. luhuanus*) collected from sandy substrates and intertidal seagrass beds.

Conclusions

A broad picture of shell exploitation strategies through time has been gleaned from the molluscan assemblage of Tanamu 1. Shell taxa in SU6 and SU7 indicate that the site was initially subject to intertidal conditions, as the array and size of specimens are consistent with those normally found in beach-line sediments (e.g., Rowland 1994; Sullivan and O'Connor 1993). Culturally sparse SU2 witnessed a slow sediment build-up largely devoid of shell, while SU4, also from a period of relatively infrequent cultural activity at Tanamu 1, nevertheless exhibits a large amount of shell.

The distribution of shell from the early cultural layers (SU7 to SU5) suggests the relatively consistent exploitation of a core set of species, with further exploitation of other species from a wide range of habitats. Around 39 bivalve and 72 gastropod taxa contributed to the diet and/or had other social value during this time.

Subsistence economies of pre-ceramic and Lapita populations at Tanamu 1 had a strong focus on marine resources, as reflected by the 68,474.6g of mollusc shell recovered from SU5 (Lower Horizon) and the 27,743.5g of shell from SU3 (Middle Horizon) respectively. Such a focus on marine resources suggests that both pre-Lapita and Lapita peoples at Tanamu 1 were marine specialists who exploited a diverse range of coastal to shallow marine and freshwater habitats including estuaries, mangroves, the sandy seafloor, seagrass beds and coral reefs. The use of watercraft may have been necessary to access and transport shellfish such as *Tridacna squamosa* and *Rochia nilotica* collected from the outer reef edge and deeper waters up to 2 km away (Coffey Natural Systems 2009). While an increase in the abundance of shells originating from seagrass beds and mangrove habitats is evident in the SU1 Upper Cultural Horizon, people also continued to exploit other habitats.

Regional and local biogeographic patterns and cycles of resource abundance must also be considered when explaining and interpreting faunal assemblages (Moss 2012: 2). Resource characteristics of the intertidal zones that were most accessible to people are reflected in the composition of the shellfish assemblage. Higher percentages of subtidal resources in the SU3 and SU5 assemblages indicate that pre-ceramic and Lapita peoples regularly accessed submerged marine habitats, suggesting that people had better access to the bay before mangroves choked the shoreline. These results are best interpreted in conjunction with other cultural materials from Square A and Square B for a better understanding of the Tanamu 1 overall site context.

Chapter 6.
The Non-molluscan Faunal Remains of Tanamu 1: Implications for Site Taphonomy, Environmental Change, and Resource Exploitation

Ken Aplin

Introduction

This chapter reports on the non-molluscan faunal remains recovered from archaeological deposits at Tanamu 1, including marine, freshwater and terrestrial resources. Although molluscan remains are presented in Chapter 5, cephalopod remains are included here. Analysis of the non-molluscan fauna follows the chronostratigraphic sequence defined in Chapter 2, with the well-dated, short duration and dense cultural deposits of the Upper, Middle and Lower Horizons being the focus of discussion, although material from the other stratigraphic units (SUs) is also considered.

Analytical methods

The non-molluscan faunal assemblage from Tanamu 1 include two main categories of remains:

1. Vertebrate bone, potentially including the remains of frogs, fish, reptiles including turtles, mammals and birds;
2. Cytoskeleton of invertebrates including exoskeleton of crustaceans and urchins, and endoskeleton of cuttlefish.

Each of these categories of remains is readily distinguished in the excavated assemblages reported herein. Different procedures were used to characterize each category, as detailed in David *et al.* 2016a.

Results

Total Assemblage and Stratigraphic Distribution of Remains

The total non-molluscan faunal assemblage comprises 1853.9g of vertebrate bone, 430.0g of crab exoskeleton, 1.8g of urchin exoskeleton, and 5.6g of cuttlebone. Faunal remains are present in every XU down to XU134 in at least one of the two excavated squares.

The vertical distribution of each major category of remains is summarized graphically in Figure 6.1 (and see Appendices G and H). Vertebrate bone and crab remains both show major peaks corresponding to the Lower Horizon (SU5), smaller peaks for the Upper Horizon (SU1; Square A only for crab remains) and no obvious peak for the Middle Horizon (SU3). Urchin remains, by contrast, show a peak corresponding to the Middle Horizon in both squares but peaks for the Upper and Lower Horizons only in Squares A and B, respectively.

Rather than following the SUs that differentiate the deposits stratigraphically, I took my lead from the vertical distribution and physical condition of the non-molluscan remains themselves in conducting further analysis (see Figure 6.2). In some instances, these broadly follow SU divisions, with SU5, SU6 and SU7 remaining relatively discrete. For the ceramic-associated portions of the sequence, the noted depositional distinction between SU1A and SU1B held for the non-molluscan faunal assemblage, and thus the two were treated as separate categories for statistical purposes. SU2–SU4 were grouped together as a single analytical unit for calculations, with the interface of SU4 and SU5 forming another distinct category. Asmussen *et al.* (Chapter 5, this volume) followed a different approach for the analysis of molluscan remains and used selected blocks of XUs from the densest parts of the cultural horizons to represent each of the three main occupation phases. This latter approach has advantages as it avoids zones of potential stratigraphic admixture. However, if applied to the non-molluscan remains, this method would reduce sample sizes to inadequate levels.

For the majority of the analyses, the samples are pooled across the two adjacent squares, thereby increasing the sample sizes for each SU or combined SU category.

Taphonomic Observations

The physical condition of the bone is relatively good through the entire profile, but with marked variations in the degrees of burning, surface corrosion and encrustation.

Variations in burning state are summarized graphically in Figure 6.3 for each of the fish and mammal categories from Square A (and see Appendix I).

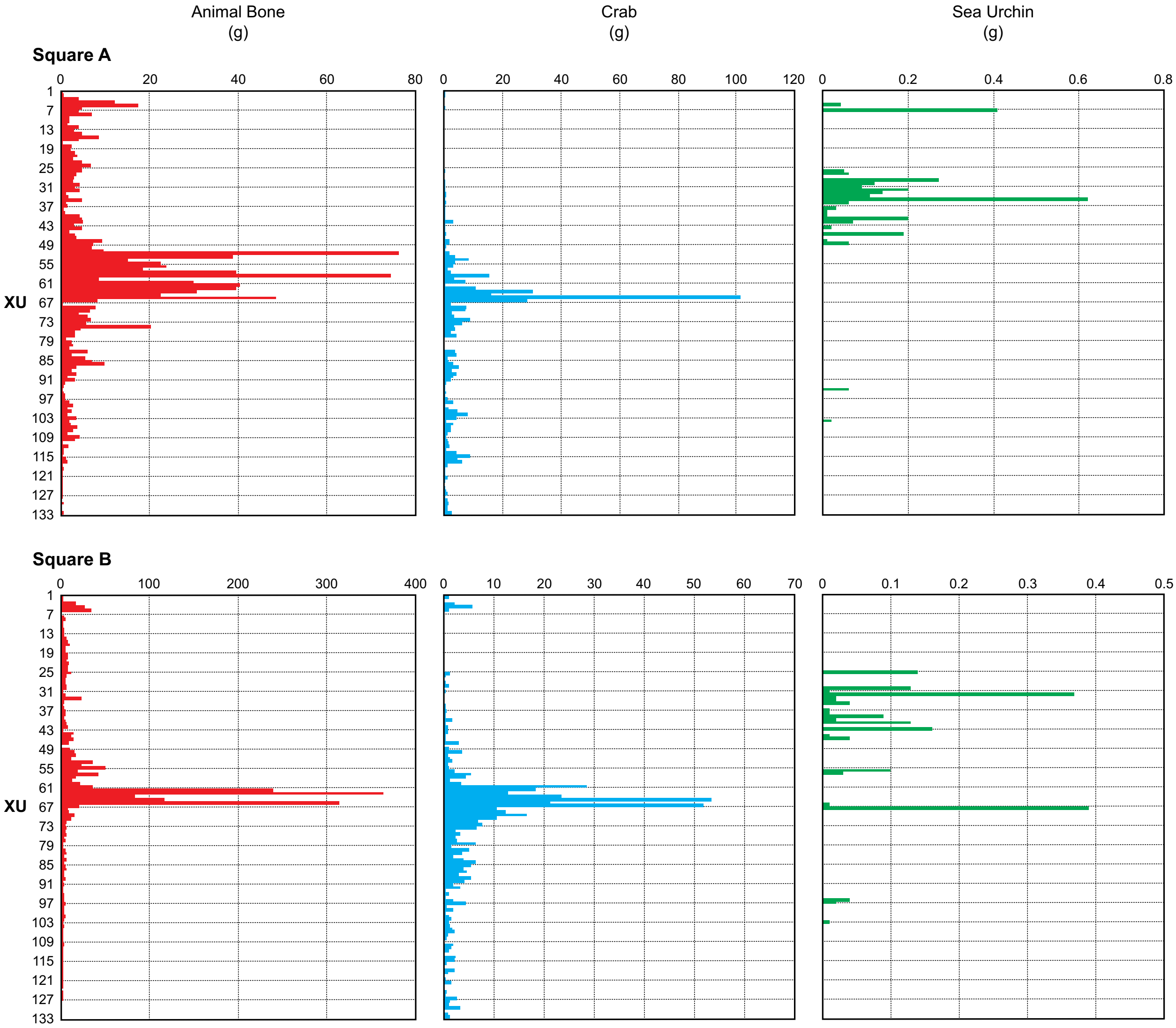

Figure 6.1. Distribution of animal bone, crab and sea urchin exoskeleton by XU, Tanamu 1.

Figure 6.2. Analytical units for Squares A and B informed by stratigraphy (SUs), non-molluscan faunal vertical distributions and physical condition.

Analytical units and their correspondence to SUs	Square A	Square B	Duration (years)
SU1B (*c.* 200–100 cal BP)	XU1–6	XU1–6	100
SU1A (*c.* 700–200 cal BP)	XU7–10	XU7–10	500
SU2–SU4 (*c.* 2800–700 cal BP)	XU11–45	XU11–45	2100
SU4/SU5 Interface (*c.* 4050–2800 cal BP)	XU46–50	XU46–48	1250
SU5 (*c.* 4350–4050 cal BP)	XU51–75	XU49–75	300
SU6 (*c.* 4500–4350 cal BP)	XU76–113	XU76–113	150
SU7 (*c.* 5000–4500 cal BP)	XU114–134	XU114–134	500

Abrupt changes in burning state correspond fairly well with the major stratigraphic units. In SU6 (XU76 and below) the bone (mostly fish in this unit, see below) shows a consistently high proportion of burning, including both the 'burnt' and 'calcined' categories. A sharp break is observed at the transition of SU6 to SU5, at which point the overall rate of burning drops sharply, and the calcined category in particular. A more or less constant burning composition is maintained through SU5. Through the SU4/SU5 interface and into the lower levels of SU2–SU4 (XU50–XU28), overall proportions of burnt and calcined bone are at slightly higher levels but with minimal calcination. Further increases in burning rate and a return to more frequent calcination are observed in the upper part of SU2–SU4 and in SU1A (XU28–XU7), though these are still more heavily burnt than the SU6 assemblage. The small samples from the very top of the site (SU1B) show variable but generally low proportions of burnt and calcined bone. These

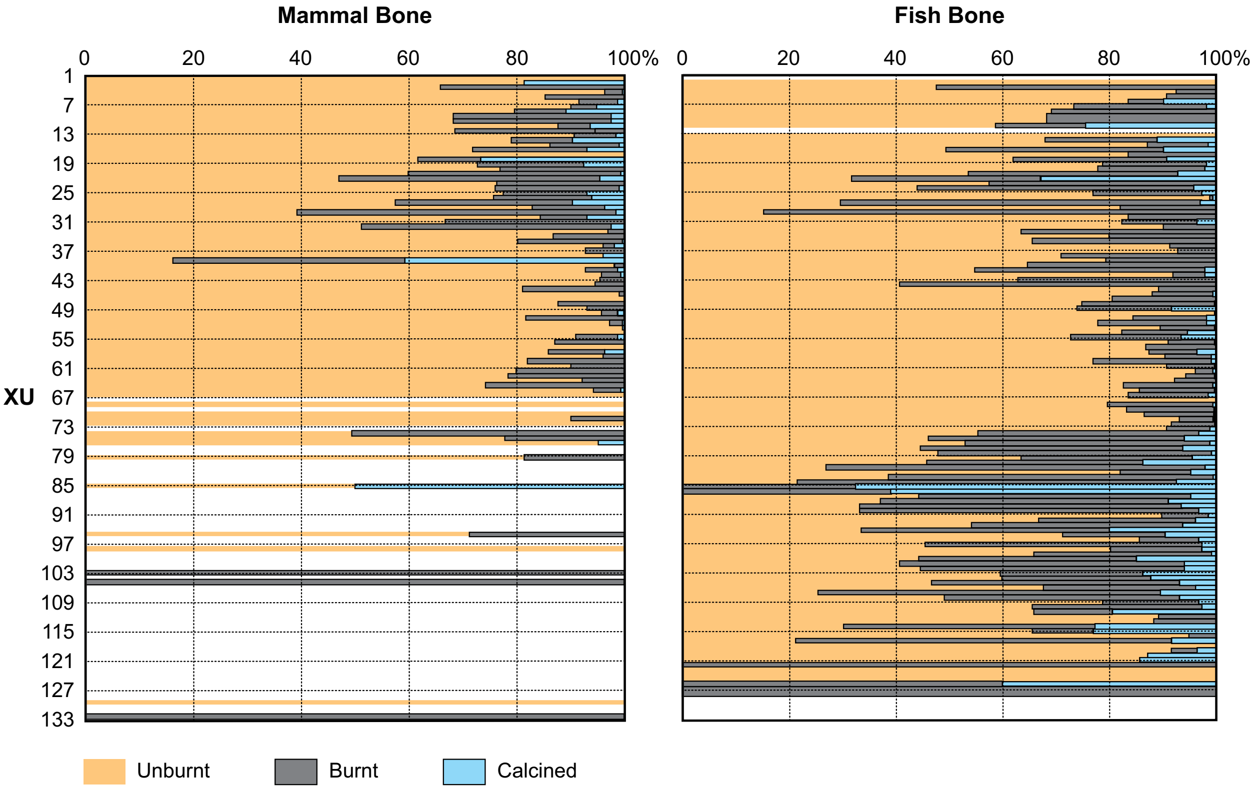

Figure 6.3. Distribution of unburnt, burnt (carbonised) and calcined mammal and fish bone by XU, Tanamu 1.

Figure 6.4. Contrasting proportions of unburnt, burnt and calcined bone in Square A Stratigraphic Units (SUs) for three different classes of vertebrates.

SU	Fish			Turtle			Mammal		
	unburnt	burnt	calcined	unburnt	burnt	calcined	unburnt	burnt	calcined
SU1B	89.1%	10.1%	0.7%				87.3%	11.6%	1.0%
SU1A	68.8%	31.2%		100.0%			75.9%	16.1%	7.9%
SU2–SU4	66.8%	29.2%	3.9%	81.3%	9.0%	9.7%	77.5%	19.0%	3.5%
SU4/SU5 interface	82.6%	14.9%	2.4%	100.0%			93.6%	6.1%	0.3%
SU5	88.1%	11.0%	0.9%	97.6%	2.4%		91.1%	8.5%	0.4%
SU6	45.2%	39.4%	15.4%	63.9%	36.1%		64.4%	34.3%	1.4%
SU7	63.2%	29.9%	6.9%				46.5%	53.5%	0.0%

contrasts in the burning condition of remains from each SU category are summarized in Figure 6.4 where it can be seen that the patterns are observed in both the fish and mammal remains in SU5 and above, where mammal remains occur in sufficient abundance to allow comparisons.

The physical condition of the burnt and calcined bone varies little through the profile, reflecting the largely inorganic nature of these categories. By contrast, the unburnt bone shows marked variation in physical condition, especially in the degree of surface corrosion and encrustation. Corrosion in the form of dendritic root marks and pitting is particularly well developed in the unburnt bone from XU7–XU15, corresponding to SU1A into SU2, and from XU21–XU23, within the body of SU2. Above and below these horizons, the unburnt bone shows less corrosion. Some light carbonate encrustation of the unburnt bone is present at XU25–XU26, at the interface of SU2 and SU3, but not again until XU80–XU85, when another band of light encrustation is observed. From XU113 to the base of the deposit, encrustation is consistent and becomes progressively heavier. Despite the encrustation, unburnt bone from

Figure 6.5. Representation (weight in g) of the major categories of vertebrate remains through SU1B to SU7 of the stratigraphic profile. The values are totalled for Squares A and B combined.

SU	Fish	Crocodile	Turtle	Dugong	Terrestrial mammal	Squamate	Bird
SU1B	25.59	0	0.93	0	87.22	1.64	0
SU1A	2.53	0	0.11	1.12	15.58	0.4	0
SU2–SU4	98.52	1.6	25.66	0	169.04	3.38	0.58
SU4/SU5 interface	23.58	0	7.56	0	19.24	0.04	0
SU5	640.89	0	872.45	349.8	190.75	5.72	0
SU6	169.33	0	4.67	0	7.43	1.25	0
SU7	8.83	0	0	0	0.99	0	0
TOTAL	969.27	1.6	911.38	350.92	490.25	12.43	0.58

the lower SUs of the deposit feels light and may have lost most or all of its original organic content through microbial biodegradation and possibly also some of its mineral content through leaching.

Despite the evidence of corrosion at certain levels, the degree of degradation is not so severe as to suggest that much of the original faunal assemblage has been lost through post-depositional degradation.

Mode of Accumulation of the Vertebrate Remains

The character of the assemblage is consistent with a predominantly cultural origin for the remains. This is evident from the emphasis on known human food categories, including both aquatic and terrestrial resources, and from the physical condition of the assemblage, a significant proportion of which is burnt.

Rat bones, most referable to a small burrowing species (*Rattus gestri*; see below), are present in many levels through the profile and the majority are unburnt and relatively little fragmented. The physical condition of these remains suggests that some at least are the product of natural deaths in burrows within the deposit, with subsequent dispersal of the skeletons through bioturbation.

Taxonomic Composition of the Vertebrate Remains

The broad taxonomic composition of the vertebrate remains is summarized in Figure 6.5 and Figure 6.6. Fish make the largest contribution of the total assemblage by weight (34.0%), followed by terrestrial mammals (33.2%), turtles (24.2%), dugong (7.5%), squamates (0.9%), crocodile (0.2%) and bird (<0.1%).

Examination of the broad taxonomic composition through the stratigraphic profile (Figure 6.6) reveals two noteworthy trends. The first is the strong concentration of turtle remains in SU5, with much smaller amounts in SU6 and a progressive reduction in proportional abundance from SU5 to SU1. The second is the steady increase from SU6 to SU1A in the proportional abundance of terrestrial mammal remains, with a corresponding decrease in fish remains. Also of note is the restriction of dugong remains to SU5 and the slight decrease in proportional abundance of squamate reptile remains at the SU4/SU5 interface and in SU5 compared with levels above and below these horizons.

Terrestrial Vertebrates

The terrestrial vertebrate remains include members of four families of mammals, two families of lizards, at least two families of snakes, and an unidentified bird (Figure 6.7; see also Appendix J). The land mammal families, in order of overall abundance of frequency are: wallabies (Macropodidae), rats (Muridae), bandicoots (Peramelidae), and pig (Suidae). Pig remains are present in SU1B in both squares and the upper part of SU2–SU4 in Square B. However, they are only abundant (22.2% of total NISP for terrestrial mammals) in SU1B.

Three species of wallabies are represented (Figures 6.8, 6.9): the Grey Forest Wallaby (*Dorcopsis luctuosa*), the Dusky Pademelon (*Thylogale brunii*), and the Agile Wallaby (*Macropus agilis*). The pademelon is the rarest of the three; its remains were positively identified only from SU5 though others may be present among the fragmentary remains referred to either of the smaller wallabies (*Dorcopsis* or *Thylogale*). The Agile Wallaby, a larger-bodied species that is naturally abundant in savannah habitat and avoids wetter, closed forests, is most abundant overall; however, while this species is certainly present throughout the sequence (or at least from SU6–SU1B), it is considerably more abundant in SU2–SU4 (76.3% of all identifiable macropodids) than in SU5 (31.8%) or SU1B (37.5%). The two smaller species (Dusky Pademelon and Grey Forest Wallaby) are both

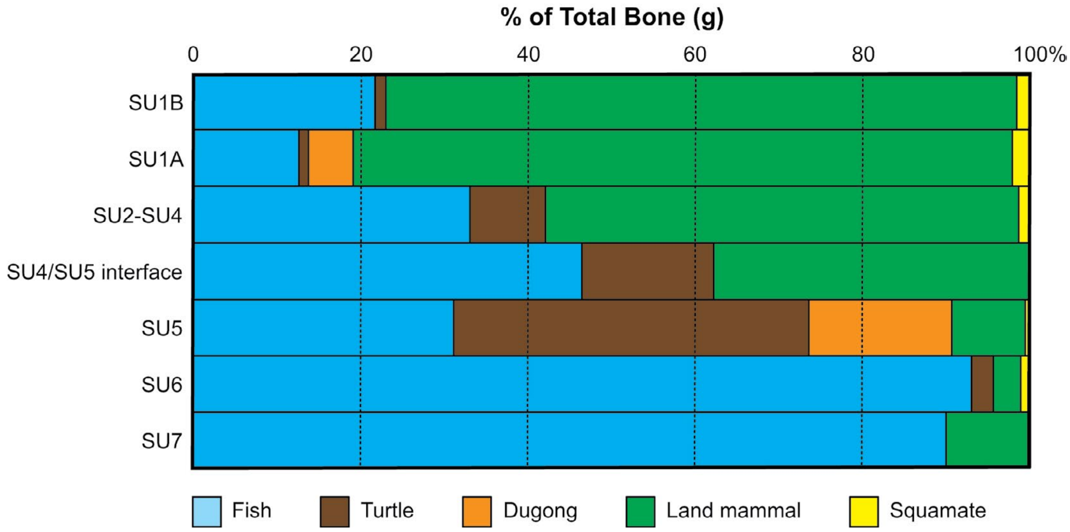

Figure 6.6. Relative contribution of bone by major taxonomic category, by SU, Tanamu 1.

Figure 6.7. Distribution of the identified families of terrestrial vertebrates through the stratigraphic profile. The values are NISPs and the results are combined for Squares A and B. Also shown is the total weight (g) of terrestrial verterbrate bone from each of the SU categories.

SU	Suidae	Peramelidae	Macropodidae	Muridae	Agamidae	Varanidae	Snakes (incl. Boidae, Colubroidea)	Chelidae	Total NISP	Bone wt (g)
SU1B	10	9	19	7	1	3	15	0	64	85.61
SU1A	0	1	1	10	0	0	10	1	23	19.23
SU2–SU4	3	9	66	38	1	5	9	8	139	174.86
SU4/SU5 interface	0	1	5	2	0	0	1	0	9	19.28
SU5	0	10	72	6	1	8	34	1	132	216.91
SU6	0	1	7	1	0	2	3	0	14	7.93
SU7	0	0	0	0	0	0	0	0	0	0.99
Total	**13**	**31**	**170**	**64**	**3**	**18**	**72**	**10**	**381**	**524.81**

indicative of dense forest or scrub habitats, and the Grey Forest Wallaby, probably of gallery rainforest specifically.

Two species of bandicoots are represented, a Short-nosed Bandicoot (*Isoodon macrourus*) and an unidentified Echymipera (*Echymipera* sp.). Both are present in the lower part of the sequence (SU4/SU5 interface and lower) but only the Short-nosed Bandicoot, an indicator species for savannah habitat, is definitely present above the SU4/SU5 interface. All species of *Echymipera* are restricted to moist habitats, although *E. kalubu* occurs elsewhere in New Guinea in kunai (*Imperata cyclindrica*) grassland as well as rainforest (Flannery 1995a).

At least two species of murid rodents are represented (see Appendix E). A Giant White-tailed Rat (*Uromys* cf. *caudimaculatus*), an inhabitant of closed forests, is present in small numbers in SU5 and SU2–SU4. Much more abundant is a species of *Rattus*, very likely *R. gestri*—a member of the *Rattus sordidus* group and an indicator species for savannah habitat. While this species is present in all horizons from SU1B–SU6, it is relatively scarce in SU5–SU6, becomes increasingly more abundant in SU2–SU4, and is present in peak

Figure 6.8. Distribution of the genera and species of wallabies and bandicoots throughout the stratigraphic profile. The values are NISPs and totals for Squares A and B are combined.

SU	*Dorcopsis veterum*	*Thylogale brunii*	*Dorcopsis* or *Thylogale*	*Macropus agilis*	*Isoodon macrourus*	*Echymipera* sp.	*Isoodon* or *Echymipera*
SU1B	3	0	7	6	4	0	5
SU1A	0	0	0	1	0	0	1
SU2–SU4	3	0	6	29	3	0	6
SU4/SU5 interface	1	0	0	1	0	1	0
SU5	7	6	17	14	2	1	6
SU6	0	0	4	1	0	0	1
SU7	0	0	0	0	0	0	0
Total	**14**	**6**	**34**	**52**	**9**	**2**	**19**

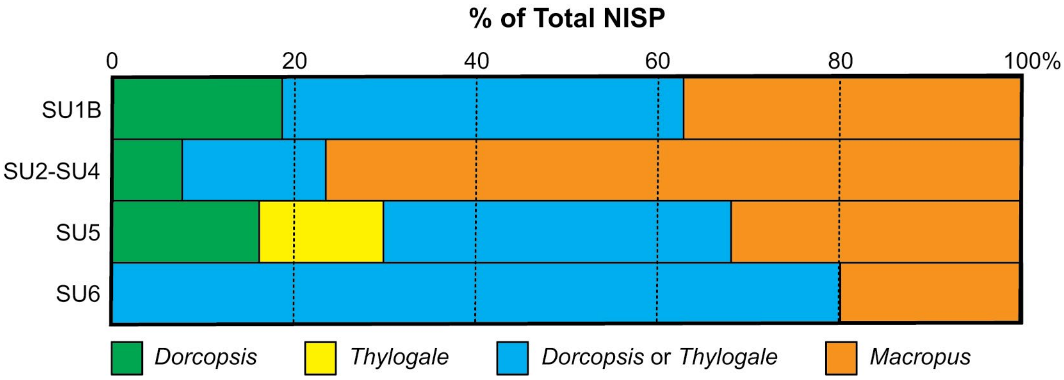

Figure 6.9. Proportions of macropod NISPs, by SU, Tanamu 1.

proportional abundance in SU1A. As noted above, the majority of rat bones in all levels of the site are unburnt and often relatively complete. The physical condition of these remains suggests that some at least are the product of natural deaths in burrows within the deposit, with subsequent dispersal of the skeletons through bioturbation. This species is abundant today in subsistence garden habitats around Port Moresby, where it digs shallow burrow systems among the roots of trees and shrubs (Aplin personal observations, October 2005).

At least four families of squamate reptiles are represented (Figure 6.7 and Appendix J). Snake remains are distributed throughout SU1–SU5 but are most abundant in SU1B and the upper part of SU1A. Most identifiable fragments are from small to medium-sized pythons (Boidae) with fewer examples of venomous colubroid snakes (Elapidae or Colubridae). Smaller numbers of fragments, scattered through SU1–SU6, represent small to medium-sized goannas (Varanidae) and dragons (Agamidae).

Less frequently occurring taxa include freshwater turtles (Chelidae) represented in SU1A, SU2–SU4 and SU5 (with the greatest number in SU2–SU4), and an unidentified small bird (in SU1A; Square B XU19) (Figure 6.5). The chelid remains are too fragmented to support even generic assignment.

Large Marine Vertebrates

Remains of marine turtles, dugong, and crocodiles are present in the assemblage, in that order of abundance. Fragments of marine turtle carapace were recovered in SU2–SU4 to SU6 of Squares A and B (Figure 6.5; see also Appendix G), and several of the stepping-out squares, the latter in contexts corresponding to lower SU4/

SU5 interface or SU5 (Appendix K). All of the remains are highly fragmented and it has not been possible to determine the species of turtle.

Dugong remains are present only in SU5 in Squares A and B (Figure 6.5; see also Appendix G). Additional scattered remains were recovered from several of the stepping-out squares in contexts corresponding with lower SU4/SU5 interface or SU5 (Appendix K).

Crocodile bone was identified only in SU2–SU4 of Square A (see Appendix G). However, additional fragments of crocodile bone were recovered from several of the stepping-out squares, in contexts corresponding with the lower SU4/SU5 interface or SU5 (e.g., Square H XU14 and Square L XU12; Appendix K). The remains are of a size consistent with either freshwater or saltwater crocodile, and are too fragmentary to determine the species on morphological criteria.

Fishes

At least nine families of bony fishes are represented (Balistidae, Labridae, Lethrinidae, Ostraciidae, Pomadyasidae, Scaridae, Scombriade, Serranidae, and Sparidae; see Appendix L), along with rays (Daypeltidae) and sharks (as yet unidentified to taxon). Pending more detailed studies of the fish remains across multiple sites, the representation of each family has not been quantified beyond simple presence/absence for each XU. However, even this simple mode of representation shows strong patterning through the stratigraphic profile.

To summarize this pattern, for Square A I calculated the proportion of XUs within each SU category that contained remains of each of the major groups of fishes (Figure 6.10). The results show that only remains of Ostraciidae, Scaridae and rays/skates were deposited regularly in SU6, with less frequent examples of Balistidae (5% of XUs), Pomadyasidae and unidentified sharks (both 3% of XUs). In the short period covered by SU5, remains of Balistidae (43% of XUs), Ostraciidae (100%), Scaridae (87%), and ray/skate (43%) were commonly deposited, with less frequent remains of Labridae (13%), Scombridae and sharks (each 9%), Lethrinidae, Pomadyasidae and Serranidae (each 4%). The profile for the SU4/SU5 interface is similar to that of SU5 but for the more regular occurrence of Labridae (up from 13% to 60%) and sharks (up from 9% to 20%), and the less regular occurrence of Ostraciidae (from 100% to 60%) and rays (from 43% to 20%). Remains of Scombridae and Serranidae were not deposited again above SU5. SU2–SU4 has less fish remains overall and all taxa are less frequently represented. Scaridae are the most commonly represented (74% of XUs), followed by Ostraciidae (32%), Balistidae (21%), Labridae (12%), Sparidae (6%), Pomadyasidae, rays/skates and sharks (all 3%). Three families only are represented in the small quantities of fish bone from SU1A—Scaridae (100% of XUs), Labridae (67%), and Balistidae (33%). SU1B has only four families represented, Scaridae in 29% of XUs, and Balistidae, Ostraciidae and sharks each in 14%.

The major trends observed are: 1) a steady decrease in the regularity of occurrence of Ostraciidae, Balistidae, and rays/skates; 2) more constant occurrence for Scaridae and all other minor families. The majority of the bony fish families in the assemblage are comprised of reef-dwelling fishes. Exceptions include rays/skates, which are more typically found in shallow water on sandy or muddy substrates, Serranidae which are more typical of estuaries and mangroves, and Scombridae which are usually deeper water fishes. The latter two families are confined to SU5 and are not abundant, even there. Notable absences from the fish assemblage are groups typical of estuarine and freshwater conditions including catfishes of the families Ariidae and Plotosidae, and mullets (Mugulidae).

Marine Invertebrates

Crab remains were recovered throughout the lower part of the deposit, from SU7 to partway through SU2–SU4 (Figures 6.1, 6.2). They are absent from the upper levels of the SU2–SU4 category and all of SU1A, but reappear again in small quantities in SU1B. There is a pronounced peak in abundance of crab remains in SU5.

Urchin remains are much less abundant overall (Figures 6.1, 6.2). They also show a quite different pattern of vertical distribution, with peak quantities in the lower half of the SU2–SU4 category, and only irregular occurrences above and below that horizon.

Cuttlefish was found only in small quantities and in the restricted context of SU6 (XU87 to XU91 in Square A; XU104 and XU107 in Square B; see Appendix G).

Taxonomic Composition of the Marine Invertebrate Remains

Eight different kinds of crabs were distinguished during sorting of the Square A remains (see Appendix L). The regularity of occurrence of crab remains was quantified in the same way as fish remains (Figure 6.11).

The most abundant crab taxon through much of the deposit is the Mud Crab, *Scylla serrata*, a widespread member of the family Portunidae. This species has robust claw elements with a distinctive arrangement of grinding plates and lateral pores. It is scarce in SU6, reaches its most regular occurrence in SU5, and then undergoes a progressive decline at the SU4/SU5 interface into SU2–SU4. The largest examples of *S. serrata* are from the SU4/SU5 interface and the upper

Figure 6.10. Summary of the distribution of fish families through the Square A deposits. The values are the proportions (as %) of XUs in each SU category that produced identifiable remains for each family of fish.

SU	Number of XUs	Balistidae	Labridae	Lethrinidae	Ostraciidae	Pomadyasidae	Pomadyasidae	Scombridae	Serranidae	Sparidae	Dasypeltidae	Shark
SU1B	6				16.7		16.7					16.7
SU1A	4	50.0	50.0		25.0		100.0					
SU2–SU4	34	20.6	11.8		32.4	2.9	73.5			5.9	2.9	2.9
SU4/SU5 interface	5	40.0	60.0		60.0		80.0				20.0	20.0
SU5	23	43.5	13.0	4.3	100.0	4.3	87.0	8.7	4.3		43.5	8.7
SU6	37	5.4			29.7	2.7	27.0				16.2	2.7
SU7	20											

Figure 6.11. Summary of the distribution of crab taxa through the stratigraphic sequence of Square A. The values are the proportions (as %) of XUs in each SU category that produced the identifiable remains of each taxon of crab.

SU	Number of XUs	*Scylla serrata*	Other Portunids	Sesarmidae	*Ocypode* sp.	Type A	Type B	Type C	Type D	Type E
SU1B	6									
SU1A	4									
SU2–SU4	34	20.6			2.9			2.9	11.8	
SU4/SU5 interface	5	60.0								
SU5	23	87.0	13.0	69.6	4.3			8.7	8.7	
SU6	37	8.1	29.7	56.8	2.7		2.7	8.1	5.4	
SU7	20				5.0	5.0	5.0			5.0

XUs of SU5. By contrast, the remains from SU2–SU4, the lower levels of SU5, and SU6 are all from smaller individuals.

Several species of crabs occur quite regularly in SU6 and SU5 but do not appear above this level. These include a moderately large species of the Family Sesarmidae (mangrove or marsh crabs) and one or more smaller species of portunid crabs. Two other species of crab are confined to SU6, one of unknown family (Type B) and the other an unidentified large portunid (Type E). Another unidentified crab (Type A) is represented only in SU7.

The remaining three types of crab are found in small numbers in each of SU6 to SU2–SU4. One of these is a species of *Ocypode* (Family Ocypodidae; ghost crabs), an inhabitant of sandy beaches, while the other two (Types C and D) are currently unidentified at family level.

The urchin test remains from Tanamu 1 are highly fragmented and most would not be taxonomically diagnostic in themselves. However, the assemblage is internally consistent in morphology and consistent with the much larger assemblage from Edubu 1 (McNiven *et al*. 2012b). The urchin test remains from the latter site have not been subject to previous taxonomic determination but were re-examined to clarify the identity of the remains from both sites. All of the urchin remains from both sites are here allocated to the Collector Urchin, *Tripneustes gratilla*, which has the diagnostic attributes of its pore pairs being in three distinct columns throughout combined with relatively small spine pedicles (Smith 2010). This species was not recorded in Caution Bay during marine surveys in 2007–2008 (CNS 2008) but Pernetta and Hill (l981: 178) recorded it as 'common on reef flat areas and in sea grass beds, wherever these occur along the coast' and added that it 'appears to have been widely used for food.'

A different species of urchin, a member of the genus *Diadema*, was recorded by the 2008 survey team as common on the fringing reef at Caution Bay (Coffey Natural Systems 2008: 36). The test morphology of this group of urchins is radically different from any of the remains in the archaeological sites, with uniserial pore pairs and much more prominent spine pedicles (Coppard and Campbell 2006).

Discussion

The non-molluscan fauna from Tanamu 1 provides important new insights into the Mid- to Late Holocene history of environmental changes on the south-central coast of PNG, the first evidence for the economic base of a pre-ceramic human population living in the period 4350–4050 cal BP, and the first evidence of the economic base of a founder Lapita population occupying the same area at 2800–2750 cal BP. The site is located close to the Late Lapita into post-Lapita locality of Edubu 1 which spans the period *c.* 2650–2350 cal BP and for which the non-molluscan fauna was previously reported by McNiven *et al.* (2012b).

Environmental Changes in Caution Bay

The palynological record from Caution Bay is currently restricted to the last 2000 years (Rowe *et al.* 2013). The archaeofaunal record reported here covers more than twice this time span, with the earliest remains dating to *c.* 5000 cal BP and the earliest sizeable faunal assemblage, from SU5 and the SU4/SU5 interface, dating to the interval 4700–4050 cal BP.

The local marine environment during the period 4700–4050 cal BP probably included all of the major substrates found in the contemporary environment—muddy intertidal flats, a fringing reef, sandy inshore substrates, and sandy beaches—and very likely an extensive mangrove community. The presence of muddy intertidal flats is indicated by the occurrence of several kinds of portunid crabs including Mud Crab (*Scylla serrata*). Sandy beach habitat is indicated by the occurrence of a ghost crab (*Ocypode* sp.) and sandy near-shore substrates by the predominance of Ostraciidae (box fishes) and daypeltid rays among the fish remains. Fringing reef habitat is indicated by the predominance of Scaridae (parrotfishes) among the fish remains and the secondary abundance of Balistidae (trigger fishes). The presence of dugong remains in these horizons suggests the likely occurrence of a substantial sea grass community in the bay, while the regular occurrence of marine turtle remains raises the possibility that one or more species were entering Caution Bay to lay eggs. Nesting turtles would require more extensive sandy beaches than are present today in the immediate vicinity. The predominance of sesarmid crabs in SU6 and SU5 may indicate the early occurrence of a mangrove community in the bay. Regionally, the family Sesarmidae comprises mainly terrestrial crabs of the upper tidal zone; many of the larger species are arboreal, climbing into mangroves to escape predation.

Despite the presence of these many familiar elements, the overall configuration of marine environments and resources during the period of SU5–SU6 clearly was not the same as during later periods. In particular, sandy beach habitats and sandy offshore habitats appear to have been more extensive, possibly due to lower sediment fluxes down the local drainages from the immediate hinterland of Caution Bay, and perhaps also down the Laloki River with its larger catchment covering land between the coast and the foothills of the Owen Stanley Range.

The terrestrial environment during SU5–SU6 times already supported a mosaic of dry open forests, probably not dissimilar to the contemporary savannah woodlands, and wetter, more closed lowland rainforests, the latter most likely concentrated along the watercourses. Wet forest patches would have supported populations of Grey Forest Wallaby (*Dorcopsis luctuosa*) and Dusky Pademelon (*Thylogale brunii*), with the pademelon emerging from the dense forest at dusk to forage over grassland. *Echyimpera* bandicoots also lived in the denser, wetter habitats, with the Short-nosed Bandicoot (*Isoodon macrourus*) found in the dryer habitats. The wetter forest habitats probably also supported populations of Southern Lowland Cuscus (*Phalanger interscastellanus*), Spotted Cuscus (*Spilocuscus maculatus*), Striped Possum (*Dactylopsila* cf. *trivirgata*), and White-tailed Giant Rat (*Uromys* cf. *caudimaculatus*), though only the latter is represented in the archaeological deposit. Colonies of flying foxes almost certainly visited the local rainforest patches as well as the mangrove forest at this time, and may have roosted in either area. Their remains were not found in either Tanamu 1 or Bogi 1, though they are represented in low numbers in Edubu 1 (McNiven *et al.* 2012b).

The evidence for savannah grassland habitats before 4000 cal BP considerably extends the known history of this ecological community. McNiven *et al.* (2012b: 147) posited that these savannah and grassland habitats were maintained, at least in part, by anthropogenic firing regimes similar to those recorded historically, and were initiated during the Lapita settlement of the coast sometime between 2900 and 2500 years ago when inland peoples became more attracted to this coastline for its new trade and other opportunities for social interaction generated by the newly established Lapita settlements at Bogi 1 and other nearby locations.

However, they also left open the possibility that landscape firing at Caution Bay might have a much longer history, pointing to the use of fire in the landscape as early as 40,000 years ago in the broader Port Moresby region (Hope 2009) and to the possible maintenance of grasslands and savannah in the Markham Valley on the northeast coast of Papua New Guinea by anthropogenic burning over the past 9000 years (Garrett-Jones 1979; Hope *et al*. 1983: 41).

The new faunal data presented here firmly support the notion that grassland and savannah habitats on the south-central coast of Papua New Guinea are older than any ceramic tradition in this area. However, this evidence alone cannot answer the obvious next question of whether or not these habitats are a product of anthropogenic firing or under edaphic and/or climatic control; nor can they tell us whether any burning activity was connected in any way to agricultural practices rather than being a means of altering the landscape for ease of movement or for enhancing and/or hunting wallaby populations, especially the Agile Wallaby. To resolve these questions it will be necessary first, to obtain independent and longer environmental records including direct evidence of fire histories, and second, to derive independent evidence for early agriculture in lowland New Guinea to match that available for highland New Guinea (Denham *et al*. 2003).

The next major part of the Tanamu 1 faunal record relates to the brief period of intensive occupation of the site at 2800–2750 cal BP, during which time quantities of Lapita ceramics were deposited on the site. The ceramic evidence is unequivocal here: the period 2800–2750 cal BP represents a Lapita settlement at Tanamu 1, with no other type of ceramic decoration represented during this period. Significant changes in both the marine and terrestrial environments had occurred by this time. In the marine realm, the crab community had changed considerably with a decline to rarity or local extinction of the formerly common sesarmid crab, and a rise to dominance of the Mud Crab (*Scylla serrata*) and another unidentified crab (Type D). Marine turtles and dugongs were both rarely if ever captured locally during this period, and their remains were not recovered in the excavation. Fish were taken less frequently in SU2–SU4 times relative to terrestrial animals than during accumulation of the Lower Horizon (SU5); furthermore, they came more often from the reef, rather than from other local environments. Overfishing might be one reason for this; however, it is also likely that greater sediment flux from the immediate hinterland of Caution Bay was causing a reduction in sandy inshore habitats and a muddying and loss of productivity of estuarine waters. The brief period of economic focus during SU4/SU5 interface and early SU2–SU4 times on the sea urchin *Tripneustes gratilla*, an occupant of seagrass meadows, also suggests changes in this context. Even more intensive use of this species was documented at Edubu 1 over the period immediately post-dating SU2–SU4 at Tanamu 1 (at a time not well represented at Tanamu 1), with peaks in the early (*c*. 2600 cal BP) and later (*c*. 2400 cal BP) phases of occupation (McNiven *et al*. 2012b).

By SU2–SU4 times, savannah grassland habitats had expanded at the expense of wetter, denser communities. Captures of the Agile Wallaby now greatly outnumbered those of the smaller, closed forest species, and the rainforest bandicoot had become rare in hunting returns. The most likely mechanism for this expansion is regular seasonal firing of grassland habitats, causing the steady retreat of wet forest margins. Other possible mechanisms are direct clearance of wet forest for gardens and a more gradual degradation of forest habitats through removal of firewood and/or building timbers.

Another change in the terrestrial fauna is the marked increase in abundance of the grassland rat, *Rattus gestri*. Remains of this species had found their way into the deposit in small numbers during SU6 to SU4/SU5 interface times, but in SU2–SU4 they become far more numerous. I attribute this to the presence of gardens in the vicinity of the site, and possibly even on the site, during this period of its history, with the rats at high density due to the local availability of food in the form of tuber crops, potentially including taro and yam. Judging from their condition, many of the rat bones probably derive from natural deaths in burrows.

Finally, pig remains appear for the first time in the upper levels of SU2–SU4, though only in Square B and only in small quantities. Whether or not these remains genuinely date from SU2–SU4 times will be addressed below.

The small faunal assemblage from SU1B documents the environment of the last few centuries of occupation of the site. The marine component of the fauna is limited, with no crab or urchin remains, and only a restricted range of fishes among which reef (Scaridae and Balistidae) and sandy substrate (Ostraciidae) groups both feature. Agile Wallaby remains are less abundant than those of the smaller species in SU1B, but the sample size is too small to know whether this reflects any change in the nature of regional forest cover. Pig remains are proportionally more abundant in this small assemblage than in SU2–SU4.

Pre-ceramic Exploitation of Animal Resources

The faunal assemblages from SU6 and SU5 provide the earliest evidence of pre-ceramic exploitation of animal resources in the south-central lowlands of Papua New Guinea.

The relatively sparse remains from SU6, covering the period from *c.* 4700 to 4350 cal BP, appear to document occasional use of the site by people exploiting a variety of marine and terrestrial resources. The primary focus appears to have been on marine resources, including the capture of fish from several different habitats including the fringing reef (Scaridae, Balistidae), sandy inshore substrates (Ostraciidae, dasypeltid rays), and river mouths or mangroves (Scombridae, Serranidae). Crabs were harvested from mudflat and/or mangrove habitats, with the captures mainly comprising small portunids and sesarmids, the latter probably derived mainly from within mangrove forest. Occasional kills of turtles were made. Only small numbers of terrestrial animals derived from the hinterland of the site were consumed and disposed at Tanamu 1. Whether these animals were obtained by hunting or by trade with other groups of people is unknown. However, from their scarce remains it is clear that hunting was taking place in both savannah and rainforest habitats, though in what proportions is unknown.

The much larger assemblage from SU5 (Lower Horizon) paints a picture far richer in detail. The primary focus of economic activity from the site continued to be on marine resources, with fish taken from both reef and sandy inshore habitats, and crabs harvested from the mudflats and mangroves. For the first time, Mud Crabs (*Scylla serrata*) featured among the harvest, probably reflecting an expansion of the sub-tidal mudflats. Turtles were taken more frequently than in SU6 times. Given the evidence for exploitation of reef and inshore fishes, this increase in turtle captures is unlikely to reflect a change in accessibility due to technological innovation. A more plausible scenario is that turtles of one or more species began to visit Caution Bay in larger numbers, perhaps following establishment of local seagrass communities or of turtle breeding sites in the local area. The fact that dugongs also first feature in the food remains during SU5 times, albeit only in small numbers, may favor the former of these explanations.

The contribution of terrestrial animals to the faunal assemblage is only slightly higher during SU5 times than before. However, with the much larger quantity of remains available for study, it is possible to speculate on the nature of the hinterland habitats and their use. From the wallaby remains, it is clear that the area supported a mosaic of wet, closed rainforests and drier, more open savannah woodland, with the former supporting populations of the Grey Dorcopsis and the Dusky Pademelon, and the latter representing the primary habitat of the Agile Wallaby and secondary foraging habitat for the Dusky Pademelon. This interpretation is supported by the presence of two different groups of bandicoots, also with strongly contrasting associations with rainforests (*Echymipera* spp.) and open woodland or grassland (*Isoodon macrourus*). The occasional White-tailed Giant Rat (also a rainforest associate) and small numbers of snakes and lizards make up the remainder of the terrestrial faunal component. Evidence for exploitation of hinterland freshwater habitats during this period is limited to a single carapace fragment of a chelid turtle in Square A XU75.

A final noteworthy feature of the SU5 assemblage is the lack of evidence for exploitation of various other terrestrial animal resources that were very likely available to the early occupants of the Tanamu 1 site, including arboreal marsupials (cuscuses, striped possum), fruit bats (*Pteropus* spp.), and birds, including the eggs of mound-building megapodes. All of these groups are represented in other Caution Bay assemblages including those dating to the period *c.* 2600 to 2400 cal BP at Edubu 1 (McNiven *et al.* 2012b). The absence of these groups in the large assemblage from SU5 at Tanamu 1 is not explicable in terms of environmental change but must instead reflect a lack of either access or emphasis on the arboreal members of the forest animal community. One significant possibility is that the bias against these groups reflects a process of selective exchange of food items between the more inland and more coastal communities at this time, with bandicoots and wallabies preferred over other taxa. This hypothesis will be tested by future analyses of a wider range of assemblages drawn from across the regional Caution Bay landscape.

The small assemblage from the SU4/SU5 interface shows a slight increase in emphasis of terrestrial over marine resources, with less frequent capture of turtles and much reduced use of crabs. The Collector Urchin (*Tripneustes gratilla*) was harvested more consistently during this period than before, though not in particularly large quantities.

These patterns indicate that whatever drew pre-ceramic peoples to the coast, whether it was access to food resources or to some other resource such as social networking, the communities were adept at living off the coastal and off-shore resources, including fishes, crabs, urchins, dugongs, and sea turtles.

Lapita Period Exploitation of Animal Resources

Despite the dramatic addition of ceramics to the wider cultural assemblage of SU2–SU4, the composition of the non-molluscan fauna from this period is not radically different from the preceding periods. Paradoxically, given the dominant view that Lapita peoples were tethered to coastal resources, the most pronounced difference between the SU5 and SU2–SU4 assemblages is the further increase in emphasis on terrestrial over marine resources including fish. This represents a continuation of the trend already observed between SU6 and the SU4/SU5 interface, rather than a sharp break in practices as might be anticipated.

Among the fish represented in SU2–SU4, there is a marked decrease in groups derived from sandy substrates (Ostraciidae and dasypeltid rays), with a proportional increase in reef fish (Scaridae and Balistidae). Compared with fish remains from earlier periods, those from SU2–SU4 also appear to be generally of smaller size, with few if any large individuals represented. This trend may reflect a shift either in the particular species being caught, or in the age profile within shared species. Further work is needed to quantify this observation and to discriminate between these two interesting possibilities.

Turtles were taken infrequently during SU2–SU4 times, and dugongs apparently not at all. Crabs were no longer in such frequent use as before, and the Mud Crabs harvested over this period were noticeably smaller than those obtained during the preceding period of the SU4/SU5 interface and SU5. Harvesting of urchins also declined through this period.

Among the terrestrial animal remains, there is a further increase in the abundance of Agile Wallabies compared with the closed forest species, and in *Isoodon* over *Echymipera* among the bandicoots. Both of these shifts indicate an increased areal extent or a greater emphasis on open savannah and grassland communities. As suggested in an earlier section, the marked increase in abundance of *Rattus gestri* during SU2–SU4 times is interpreted as further evidence of the expansion of open habitats in the general area, and as a more specific indicator that gardens were present close to the site of Tanamu 1.

Overall, the observed changes between SU5 and SU2–SU4 are strongly suggestive of diminishing local animal resources, most likely due to a combination of overexploitation of major prey items including turtles, dugongs, mud crabs and both in-shore and reef fish communities, and progressive siltation of in-shore habitats through destabilization of hinterland habitats under regular firing (see McNiven *et al.* 2012b). The human response to these changes appears to have included an increasing reliance on terrestrial animal resources, especially exploitation of the Agile Wallaby, and possibly also an increase in food production through more intensive agriculture and arboriculture.

Timing and Mode of Arrival of Pigs and Dogs

As has been argued recently by O'Connor *et al.* (2011), feral pigs are so ubiquitous in lowland habitats across mainland New Guinea, including both dry and wet forest habitats, and in both primary and disturbed forests, that feral populations almost certainly would have become widely established within centuries (if not decades) of their first arrival on the main island of New Guinea, irrespective of point(s) of initial entry. O'Connor *et al.* (2011) further argued that sites in the northern lowlands of New Guinea that have produced large faunal assemblages but no pig remains from well-dated contexts dating prior to 5500 cal BP represent *prima facie* evidence for the general absence of pigs in New Guinea, thereby refuting claims (e.g., Bulmer 1975, 1982; Golson and Hughes 1980) that pigs were introduced to New Guinea prior to the Mid-Holocene.

By the same argument, the absence of pig remains from the large faunal assemblage from the SU4/SU5 interface and SU6 at Tanamu 1 is strong evidence for a post-4000 cal BP introduction of this species. To pin the date of introduction down more precisely, we need to consider the available records in more detail. As reported by McNiven *et al.* (2012b), pig remains were recovered from multiple levels of the Edubu 1 site, from contexts dated to *c.* 2500–2350 cal BP (McNiven *et al.* 2012b). At Tanamu 1 the majority of the pig remains were recovered from SU1B and most likely date to within the last few hundred years. In Square A no pig remains were recovered from any deeper context. However, Square B produced single pieces of pig bone or tooth from three XUs in the upper portion of SU2–SU4—XU14, XU15 and XU21. While it is possible that each of these is intrusive from the upper levels of the site, pending the results of direct dating of each specimen, I prefer to regard them as more likely *in situ*.

Taken at face value, the evidence from Tanamu 1 suggests that pigs were introduced to south coastal New Guinea (and potentially to the island as a whole) around 2800 cal BP, toward the end of the Middle (Lapita) Horizon of occupation at the site. However, their rarity in the SU2–SU4 deposit, compared with their greater abundance in each of the deposits dating to the past few hundred years at Tanamu 1 and at Edubu 1, suggests that the earliest occurrences are not related to local pig husbandry but rather derive from the hunting of wild pigs that had filtered into the area following an initial introduction elsewhere in

Figure 6.12. Synthesis of major shifts and trends in the pattern of exploitation of animal resources through the Tanamu 1 cultural sequence. The following symbols are used: '>' means 'is more abundant than'; '=' means 'is approximately equal in abundance to'; '<' means 'is less abundant than'; multiples of > or < symbols give greater emphasis, i.e. '>>>' means a greater imbalance in abundance than a single '>'.

SU	Crabs	Urchin	Ratio marine (M) to terrestrial (T) vertebrates (bone weight)	Fish families with >15% occurrence	Marine turtle	Dugong	Small rodents	Dominant bandicoot	Dominant wallaby	Pig
SU1B	None	Very occasional use	M << T	Scaridae > Balistidae = Ostraciidae = sharks	None	None	Common usage	*Isoodon* only	*Dorcopsis* and/ or *Thylogale*	Common usage
DEPOSITIONAL HIATUS										
SU1A	None	None	M << T	Scaridae > Labridae > Balistidae	None	None	Common usage	*Isoodon* only		
SU2–SU4	Smaller *Scylla*	Occasional usage	M << T	Scaridae > Ostraciidae > Balistidae	Very occasional usage	None	Common usage	*Isoodon* only	*Macropus agilis*	Occasional usage
DEPOSITIONAL HIATUS										
SU4/SU5 interface	*Scylla* dominant, including large individuals	Common usage	M = T	Scaridae > Labridae = Ostraciidae > Balistidae > Dasypeltidae = sharks	Occasional usage	None	Rare usage	*Isoodon* and *Echymipera*	Equal numbers of *Macropus agilis* and *Dorcopsis* and/ or *Thylogale*	None
SU5	Small *Scylla* and a sesarmid	None	M >> T	Ostraciidae > Scaridae > Balistidae = Dasypeltidae	Common usage	Occasional usage	Rare usage	*Isoodon* and *Echymipera*	*Dorcopsis* and/ or *Thylogale*	None
SU6	Small *Scylla* and a sesarmid	Very occasional usage	M >>> T	Ostraciidae> Scaridae > Dasypeltidae	Very occasional usage	Occasional usage	Rare usage		*Dorcopsis* and/ or *Thylogale*	None
SU7	Sandy shore spp.	None	M >> T	None diagnostic	None	None	None	None	None diagnostic	None

New Guinea. This hypothesis can and will be tested by examination of other assemblages excavated at Caution Bay, the systematic use of direct dating of remains, and isotopic analysis to differentiate between pigs reared in village contexts and hunted feral pigs.

The absence of dog remains in the Tanamu 1 faunal assemblage contrasts with the recovery of several fragments of dog teeth from Edubu 1, from contexts dated *c.* 2500 cal BP (McNiven *et al.* 2012b) and their presence in other, as yet unreported sites in the Caution Bay site complex (unpublished data). Feral dogs appear to be much less ubiquitous than feral pigs in lowland New Guinea, and they are unlikely to be a target for hunting, except perhaps as a means of obtaining pups. As a rule, the bones and teeth of dogs are much less abundant than those of pigs in recent New Guinean archaeological sites, hence much larger total quantities of faunal remains are needed to be confident that an absence of evidence is genuine evidence of absence. For the Tanamu 1 sequence the greatest confidence regarding absence pertains to SU5 (*c.* 4350–4050 cal BP) that yielded the largest quantity of vertebrate faunal remains (2080g) without any trace of dog remains. SU2–SU4 yielded a much smaller total quantity of vertebrate faunal remains (299g), hence I am less confident about the absence of dog remains during this period (2800–2750 cal BP). How much less confident is difficult to say. However, I note that the total analyzed faunal assemblage from Edubu 1 was only 283.3g, from which individual fragments of dog bone and tooth were identified from five XUs. Accordingly, I regard the lack of dog remains from SU2–SU4 at Tanamu 1 as suggestive but not compelling evidence for an introduction of dogs to southern New Guinea in the interval 2750–2500 cal BP. This is consistent with the recent publication of a dog mandible stratigraphically associated with a radiocarbon determination of 2702–2573 cal BP from the inland Caution Bay site of Moiapu 1, representing the oldest known dog remains on the island of New Guinea (Manne *et al.* 2020).

Summary of Trends in Non-molluscan Faunal Remains

The major shifts and trends observed through the Tanamu 1 sequence in the non-molluscan faunal remains are summarized in Figure 6.12. This broad-based framework represents the first step toward construction of a detailed narrative of patterns of environmental exploitation by people living at Caution Bay over the past 5000 years or more, and toward understanding their impact on local animal communities. With the addition of further sites that fill temporal gaps and that occupy different positions within the landscape, this narrative will grow in both resolution and dimensionality, and holds promise of rare insights into human-landscape interactions over a critical period of regional history.

Chapter 7.
The Worked Shell of Tanamu 1

Katherine Szabó

Introduction and background

Worked shell was recovered from many of the Caution Bay sites, but the assemblage from Tanamu 1 was larger than most thus far analysed. Nineteen pieces of worked shell were identified in total, either during excavation or post-excavation analysis of shell midden material. Notably, only one piece firmly derives from the Lapita period context of SU3, with all other worked shell being recovered from the pre-ceramic, pre-Lapita SU4, SU5 and SU6 (see Chapter 2) (Figure 7.1).

In discussions of the cultural basis of the Lapita cultural complex, shell artefacts have figured prominently in both arguments for cultural development *in situ* within Near Oceania (Gosden *et al.* 1994; Smith 2001; Smith and Allen 1999) and the opposing view which posits an Island Southeast Asian derivation (e.g., Bellwood 1997, 2002; Green 1991; Kirch 1997). The Tanamu 1 pre-Lapita worked shell assemblage has a great deal to contribute to these discussions. In this chapter, I focus on a discussion of the technical details of the artefacts following the methods described in David *et al.* (2016a). I further consider how the diversity of materials and technical approaches to shell-working fit within broader known patterns of pre-Lapita and Lapita shell-working.

Worked shell identified from Tanamu 1

Many of the raw materials within the Tanamu 1 worked shell assemblage are well-known and broadly utilized

Figure 7.1. Worked shell from Tanamu 1.

SU	Square	XU	Species	Artefact
6	B	89	*Conus* sp.	Adze
6	B	85	*Oliva* cf. *irisans*	Perforated shell
6	B	75	*Nautilus* sp.	Disc bead
6	B	71	*Rochia nilotica*	Ring preform fragment
6	B	71	*Rochia nilotica*	Ring preform fragment
6	B	71	*Rochia nilotica*	Ring preform fragment
5	B	68	*Vasticardium vertebratum*	Perforated valve
5	A	66	*Conus* cf. *pulicarius*	Ground spire
5	A	64	*Placuna placenta*	Hewn perforated disc
5	A	61	*Rochia nilotica*	Ring preform fragment
5	B	57	*Rochia nilotica*	Ring preform fragment
5	B	55	*Monetaria annulus*	Abraded fragment
5	A	55	*Conus* sp.	Ground spire
5	B	53	*Vasticardium vertebratum*	Perforated valve
5	A	49	Bivalve sp.	Ground disc bead
5	A	48	*Conus* cf. *eburneus*	Abraded spire
4	B	41	*Conus* sp.	Ground spire bead preform
4	B	40	*Oliva picta*	Perforated shell
3	A	26	*Rochia nilotica*	Shaped body fragment

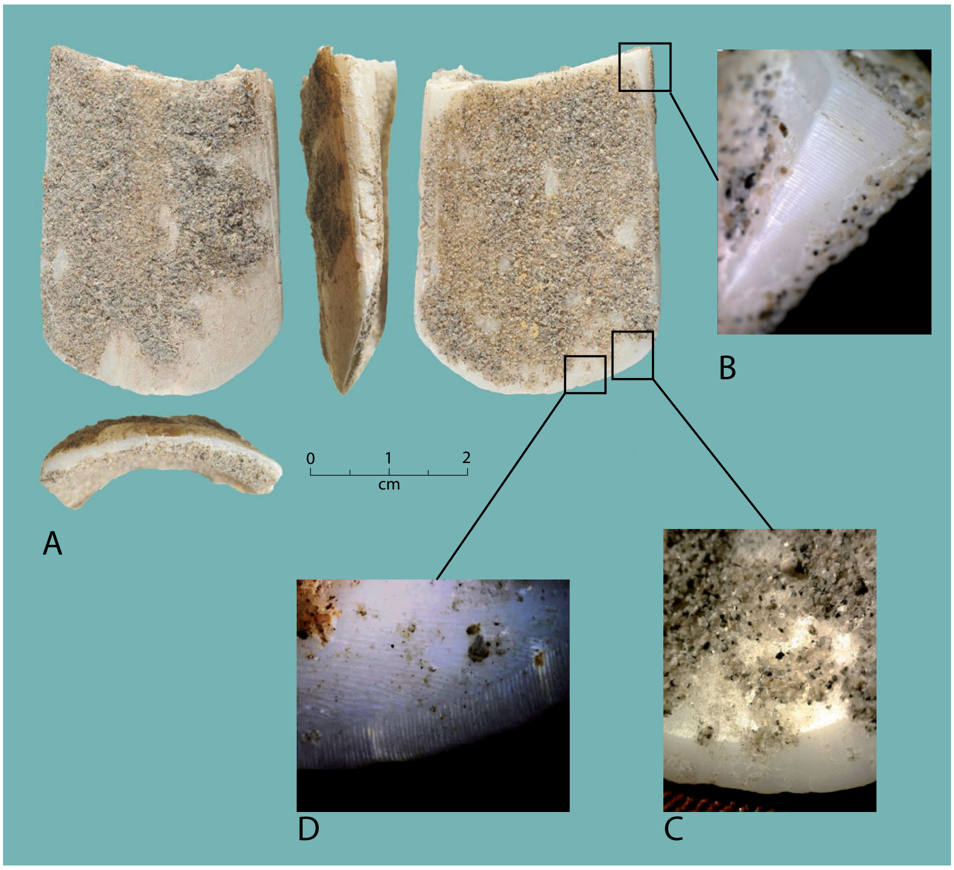

Figure 7.2. *Conus* sp. adze recovered from Square B XU89 (SU6). Magnified views inset: B: Grinding at the poll end of the adze, ×60 magnification; C: Ground bevel, ×35 magnification; D: Exposed microstructure on bevel, ×35 magnification.

within Melanesian archaeological sites, but others are uncommon. Rather than initially considering the assemblage stratigraphically, I discuss here the various pieces of worked shell recovered in categories of raw materials.

Worked Conus *spp. Shell*

Four artefacts in *Conus* shell were recovered from pre-Lapita layers, including an adze (SU6), three ground or partially ground spires (SU5) and a small ground bead preform (SU4).

The adze was recovered from XU89 and charcoal within this XU in Square A was radiocarbon dated to 4440–4570 cal BP (68.2% probability) (Figure 2.23). Although large parts of the artefact's surface are covered in concreted sand, clear traces of working can be isolated with the naked eye and under magnification. The adze is constructed from a triangular portion of the robust body whorl of a large *Conus* sp. shell, with the bevel end oriented towards the spire (see Figure 7.2A). The bevel has been ground on a single facet on the inner surface of the shell, with the parallel series of lines running perpendicular to the cutting edge being the internal shell microstructure exposed by grinding rather than striation marks left by working (Figures 7.2C, 7.2D). Light abrasion accentuated by use-wear on the opposing outer shell surface has created a slightly curved acute cutting edge. The inner surface, excepting the bevel, is unmodified, but there are grinding facets visible in patches along both lateral margins of the adze (Figure 7.2B). The poll end and part of one of the lateral margins have broken off, and it was potentially this which led to the discard of the artefact.

The three ground *Conus* spp. spires from SU5 all derive from different species. The deepest example (Square A XU66) has been identified as *Conus* cf. *pulicarius* in accordance with the size, faint evidence of patterning and the regular nodules that wind all the way around the whorls of the elevated spire (Figure 7.3A). The spire has been detached from the body of the shell, but any evidence of how this process was undertaken has been removed by the grinding of the body whorl surface on a single facet. The apex and central spire on the opposing face have also been ground on a single facet indicating abrasion using a grindstone rather than freehand abrasion using a file or handheld abrading block. The grinding of the elevated spire would have produced a

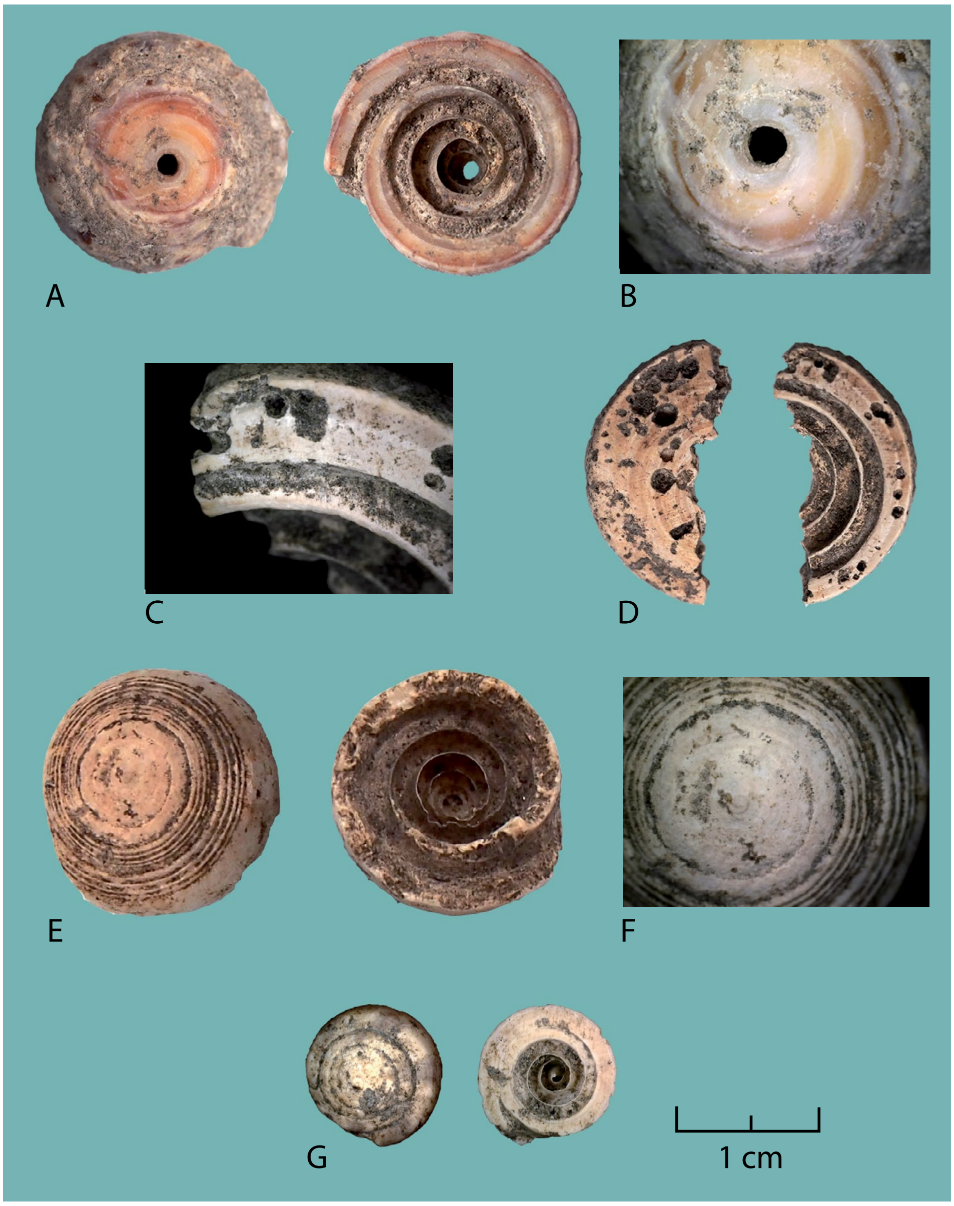

Figure 7.3. *Conus* spp. worked spires. A: *Conus* cf. *pulicarius* spire with grinding on both spire and body surfaces, Square A XU66 (SU5); B: Detail of perforation of *Conus* cf. *pulicarius* spire, ×40 magnification; C: Detail of taphonomic condition of broken, ground *Conus* sp. spire, Square A XU55 (SU5), ×45 magnification; D: Broken, ground *Conus* sp. spire, Square A XU55 (SU5); E: Minimally-worked *Conus* cf. *eburneus* spire, Square A XU48 (SU5); F: Detail of deliberate abrasion to the apical area of the *Conus* cf. *eburneus* spire, ×40 magnification; F: Ground spire of a small *Conus* sp. shell, Square B XU41 (SU4).

small central perforation, but close examination of the hole indicates that it was enlarged through drilling from the outer spire face, as evidenced by the bevel around the hole's circumference (Figure 7.3B). The roughness of the very interior of the hole suggests that the drill bit broke through the final layers of shell, as is common with the drilling of brittle materials from a single direction as opposed to countersinking. This roughness further indicates that the perforation had not been abraded through stringing and that it is likely unfinished.

Half of a fully ground *Conus* sp. spire was recovered from Square A XU55 (Figure 7.3D). Although the condition appears poor, the damage visible on both faces was a feature of the original material and not the result of the action of post-depositional processes. The extensive pitting and boreholes have been caused by boring sponges (*Cliona* spp.) and small worms which excavate into shell and other calcareous materials (see Vermeij 1993). These processes only happen in an underwater environment meaning that the original raw material must have been collected in this bio-eroded state.

Figure 7.4. Artefacts in *Rochia nilotica*. A: Ground whorl edge of a ring preform, Square B XU71 (SU6), ×40 magnification; B: Broken ring preform, Square B XU71 (SU6); C: Possible fishhook blank, Square A XU26 (SU3); D: Broken ring preform, Square B XU71 (SU6); E: Close-up of ground periphery with traces of clionid sponge borings, ×30 magnification; F: Broken ring preform, Square A XU61 (SU5); G: Broken ring preform, Square B XU71 (SU6); H: Broken ring preform, Square B XU57 (SU5).

The fact that some of these boreholes penetrate the inner shell surfaces further indicates that the shell was collected post-mortem (Figure 7.3C), and thus was collected deliberately as a raw material rather than primarily as a food item. As well as both faces of the spire having been extensively ground, the periphery of the spire has also been ground. Smoothing and polish on the higher-relief parts of the inner spire surface, as well as rounding of the edges of ground surfaces, shows that the artefact was handled and used.

The detached spire of a *Conus* cf. *eburneus* shell (Square A XU48) (Figure 7.3E) shows less intensive working. There is no evidence of grinding but the apex and inner spire area have been intentionally abraded (Figure 7.3F). The outer spire sculpture as well as break surfaces at the body whorl are still relatively crisp, ruling out the action of general weathering and mechanical taphonomic processes.

The final *Conus* sp. artefact is a small ground spire recovered from Square B XU41, within SU4 (Figure 7.3G). The preform derives from a small species of *Conus* that has faint concentric rings around the spire and dark blotched patterns around the interface with the body. The spire face has not been worked and is still elevated with some erosion at the apex. However, the body face has been ground flat on single facet. Based on current understandings of *Conus* shell reduction patterns, this artefact would appear to be a preform for a *Conus* sp. bead (Szabó 2005, 2010).

Worked Rochia nilotica *Shell*

A total of five worked *Rochia nilotica* artefacts are all preform fragments from the production of large rings. Three were recovered from Square B XU71 within SU6 (Figures 7.4B, 7.4D, 7.4G), with a further two artefacts from SU5 (Square A XU61 and Square B XU57) (Figures

7.4F, 7.4H respectively). None of the pieces appear to derive from the same preform.

The three ring fragments from Square B XU71 all show evidence of having been chipped out of the shell with a sharp point as well as varying degrees of grinding and abrasion. The largest example (Figure 7.4B) takes in part of the body and second whorls of the shell and is ground flat on the second whorl edge (Figure 7.4A). The two smaller examples (Figures 7.4D, 7.4G) only retain the second whorl part of the preform as both have split at the suture line during production. The artefact shown in Figure 7.8D has also been abraded around the periphery—one of the final stages in *R. nilotica* ring production (Figure 7.8E). As with the ground *Conus* sp. spire from Square A XU55 discussed above, extensive clionid sponge borings indicate that the *R. nilotica* shell used was collected post-mortem. The two examples from SU5 show evidence of being chipped into a preform, but neither shows evidence of the grinding or abrasion that follows this first step.

A further fragment that does not relate to ring production was the only piece of worked shell recovered from the Lapita horizon SU3 (Square A XU26). It is not in as good a state of preservation as the *R. nilotica* artefacts recovered from lower horizons, with slightly chalky and crumbling surfaces and edges. This makes the identification of any traces of working challenging. Nevertheless, the body whorl edge indicates that this fragment has been deliberately detached from the shell, and the general morphology of the fragment corresponds to those seen in *R. nilotica* one-piece fishhook blanks (see Smith 1991; Smith and Allen 1999; Szabó 2005, 2007) (Figure 7.4C). Beyond the preparation of the blank, there is no visible further working in the form of abrasion, grinding or the chipping out of the interior fishhook surface.

Worked **Nautilus** *sp. Shell*

A single disc bead in *Nautilus* sp. shell was recovered from Square B XU75 within SU6 (Figure 7.5). It appears to have cut out of the main body whorl of the shell

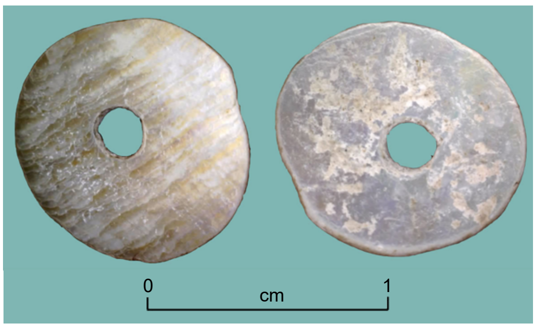

Figure 7.5. *Nautilus* sp. bead, Square B XU75 (SU6).

rather than one of the inner septal walls that separate the shell's buoyancy chambers. The bead is entirely nacreous, with the outer spherulitic-prismatic cream and brown layer of the shell having been removed, and the central perforation has been countersunk. Rounding around the periphery of the bead as well as edge of the perforation indicates that the bead was used.

Worked **Oliva** *spp. Shell*

Two perforated *Oliva* spp. shells were identified within the Tanamu 1 shell assemblage. An *Oliva* cf. *irisans* with a hewn perforation through the ventral body whorl and the apex removed (Figure 7.6A) was recovered from Square B XU85 in SU6. There is evidence of rounding through use at both the anterior and posterior (spire) ends of the ventral surface hole (Figure 7.6B), with an abraded notch at the posterior end. There is also rounding observable on half of the apical hole facing the ventral surface (Figure 7.6C). This suggests that this artefact was strung through both holes along the ventral face. The posterior half of the internal architecture (columella) has been broken with only the anterior remnant remaining; this means the inside of the shell is largely hollow. The outer lip and anterior portion of the aperture have been smoothed and rounded through use, and the remaining visible colour and patterning on the dorsal face of the body whorl indicates that such rounding and polish is restricted to the ventral surface.

From Square B XU40 in SU4 a worked example of the much smaller species *Oliva picta* was identified (Figure 7.6F). As well as the apex of the shell having been deliberately removed, two opposing patches of the posterior body whorl have been ground flat on a single facet (Figure 7.6D). Multiple notches and patches of rounding at the periphery of the apical hole indicate stringing and an extended period of use (Figure 7.6E).

Worked **Placuna placenta** *Shell*

A fragile disc of *Placuna placenta* with a central perforation hewn out was recovered in two conjoining fragments from Square A XU64, within SU5 (Figure 7.7A). *P. placenta* shells are typically very thin and comprised of foliated calcite sheets *c.* 6μm thick with only *c.* 1% organic material being incorporated into the shell matrix (Li and Ortiz 2013). Despite this seeming fragility and brittleness, mechanical indentation experiments have demonstrated that *P. placenta* shells resist radial fracture with damage restricted to the immediate surrounds of points of loading (Li and Ortiz 2013). It is perhaps this property of *P. placenta* shell which explains how it is possible to roughly hew a perforation from the centre of a valve and trim the edges without causing radial cracking, shearing and/or structural failure.

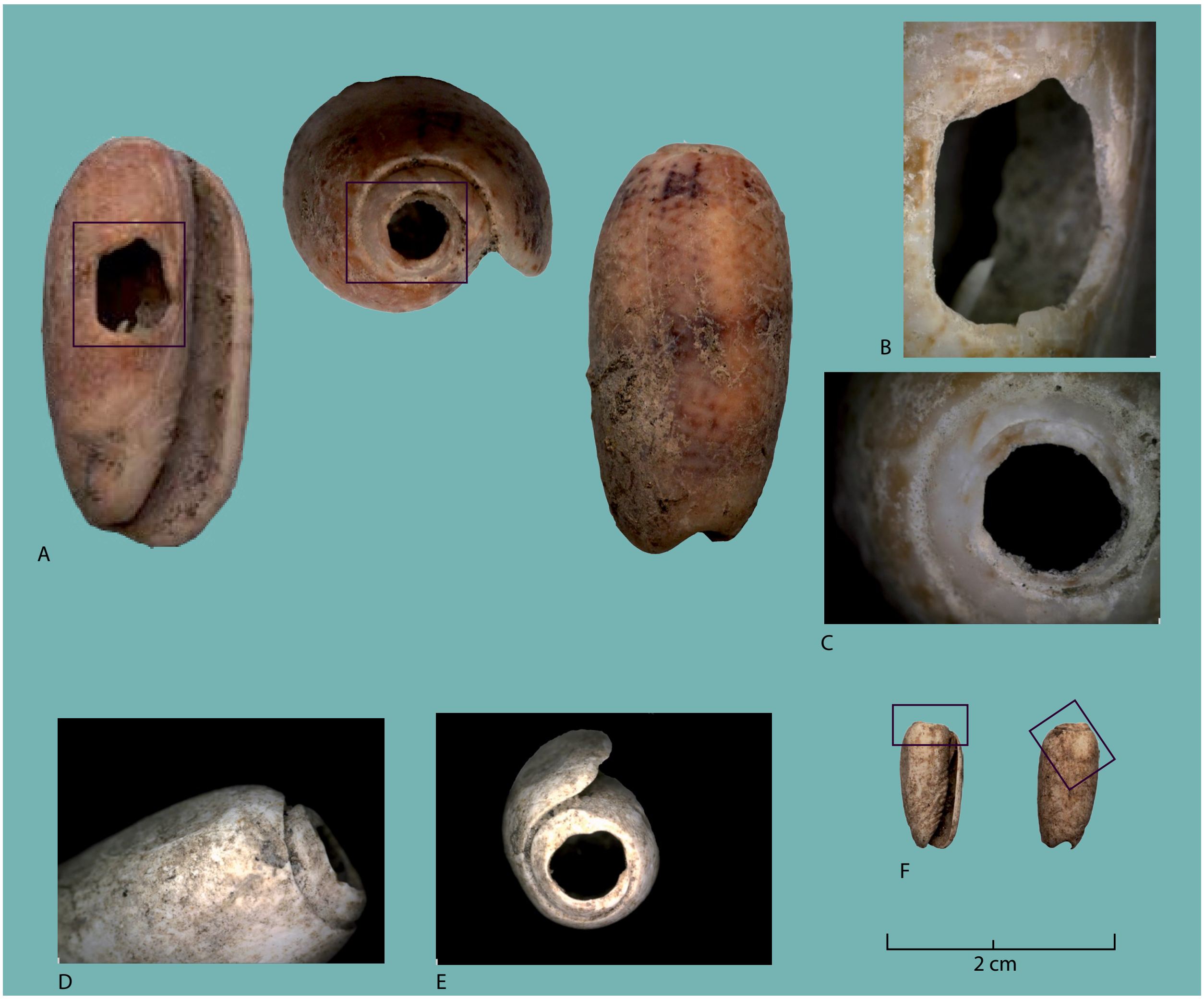

Figure 7.6. Perforated *Oliva* spp. artefacts. Boxes show the location of the microscope pictures. A: *Oliva* cf. *irisans*, Square B XU85 (SU6); B: Detail of the body whorl perforation of *Oliva* cf. *irisans*, ×40 magnification; C: Detail of apical perforation of *Oliva* cf. *irisans*, ×40 magnification; D: Detail of lateral ground facet on *Oliva picta*, Square B XU40 (SU4), ×40 magnification; E: Detail of apical perforation on *Oliva picta*, ×30 magnification; F: *Oliva picta*, Square B XU40 (SU4).

In contrast to the natural edges of *P. placenta* valves, which are very lamellar and acute (see Figure 7.7B), the outer margins of the Tanamu 1 disc have been trimmed (Figure 7.7C). The irregularity of the outline of the central perforation indicates rough cutting, but the abrasive action of the cutting itself has dulled and rounded the exposed edges (Figure 7.7D).

Worked Vasticardium vertebratum *Shell*

Two complete right valves of the cockle species *Vasticardium vertebratum* with perforations hewn near the hinge and use-wear on the valve bodies were recovered from Square B XU68 (Figure 7.8A) and Square B XU53 (Figure 7.8F)—both within SU5.

The XU68 example has two distinctive zones of wear on the body. The first zone is the elevated ribs in the central, most inflated portion of the valve exterior where the small ridges of the ribs have been abraded smooth (Figure 7.8B). The wear in this zone contrasts with the rough texture of the ribs elsewhere on the valve. The pattern of wear suggests that the valve has seen prolonged use using a smoothing or burnishing action. The second zone of wear is along the central portion of the ventral margin, where the tips of the ribs have been abraded into flattened facets. This pattern of wear implies that the valve has been held at the hinge area with the opposing ventral margin being used in a scraping, cutting or abrading action (Figure 7.8C). The edges of the perforation near the umbo are relatively fresh indicating breakage that is more recent than the modifications seen on other surfaces.

The XU53 valve does not show the same use-wear pattern at the ventral margin, but does have the smoothed wear

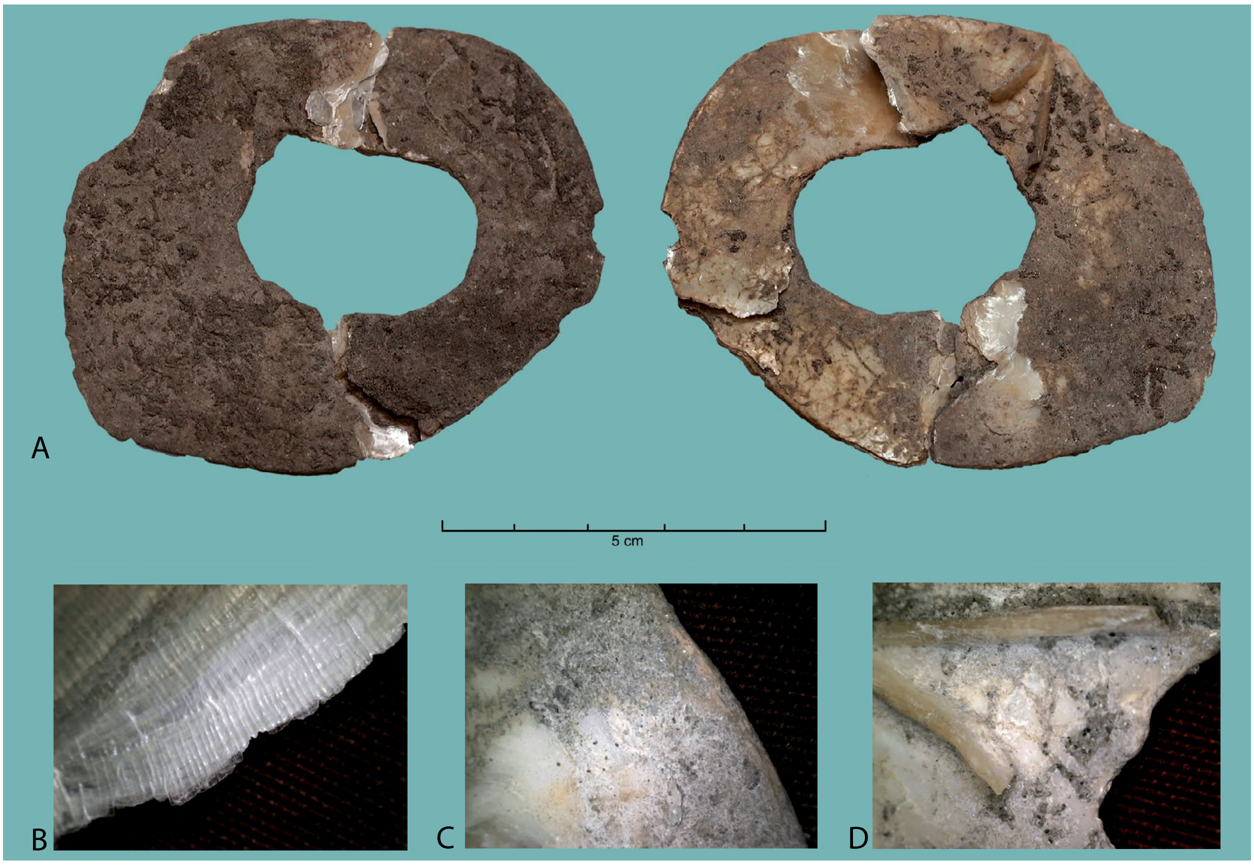

Figure 7.7. Hewn, perforated disc in *Placuna placenta*. A: *P. placenta* disc, Square A XU64 (SU5); B: Natural margin of a modern *P. placenta* shell collected live from Cooya Beach north of Cairns, north Queensland, Australia; C: Detail of trimmed margin of Tanamu 1 disc, ×25 magnification; D: Detail of hewn perforation at hinge area, ×25 magnification.

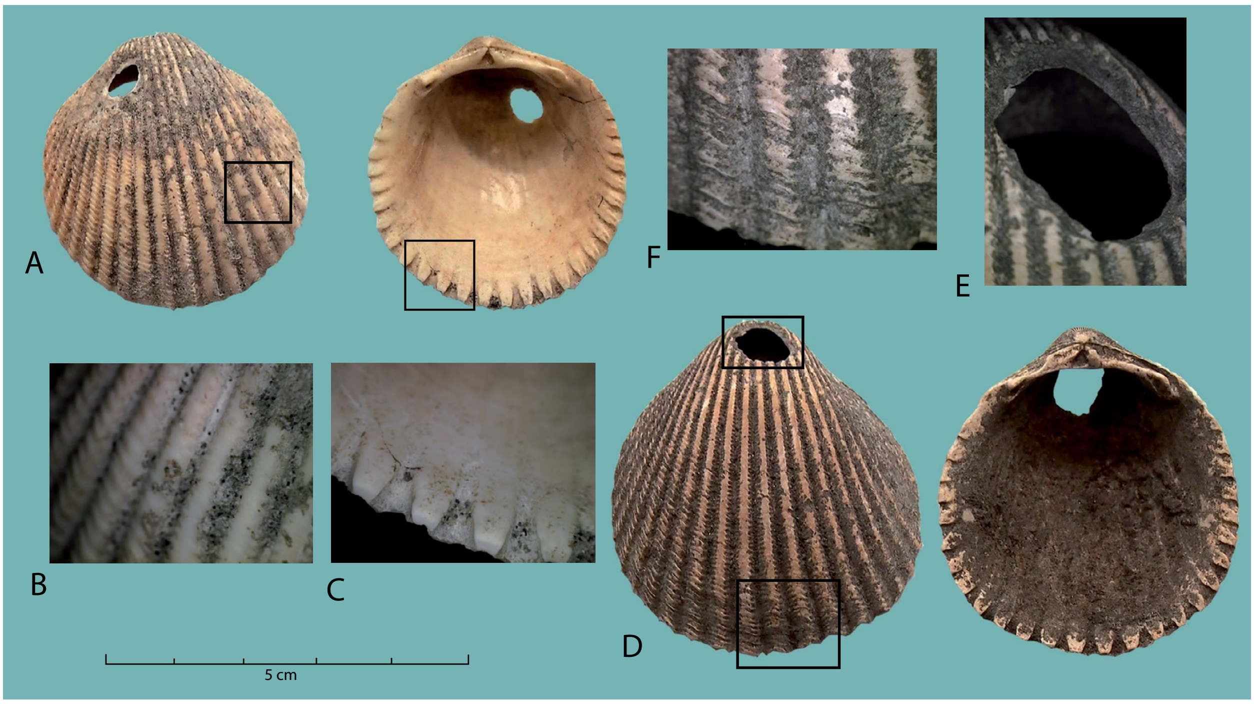

Figure 7.8. Perforated valves of *Vasticardium vertebratum*. A: Perforated *V. vertebratum* valve, Square B XU68 (SU5); B: Detail of abraded ribs on body of valve, ×35 magnification; C: Faceting of the ends of the ribs, ×30 magnification; D: Perforated *V. vertebratum* valve, Square B XU53 (SU5); E: Detail of abraded ribs on body of valve, ×35 magnification; F: smoothing and polish on ribs at the perforation, ×35 magnification.

patch along the ribs of the most inflated zone of the valve (Figure 7.8E). In contrast to the recent perforation of the XU68 valve, the pierced hole near the umbo on the XU53 specimen is old and half the perimeter is well rounded through abrasion (Figure 7.8F).

Worked Monetaria annulus *Shell*

A worked half shell of the small species of cowrie *Monetaria annulus* was recovered from Square B XU55, within SU5 (Figure 7.9A). The dorsum of the shell has been removed and the remaining break line has been abraded, as opposed to ground, smooth around the entire remaining periphery (Figure 7.9B). The ventral surface is unworked. A similar example recovered from Square B XU44, within SU4, has lost too much surface detail through the action of taphonomic processes to indicate whether it was worked in the same manner.

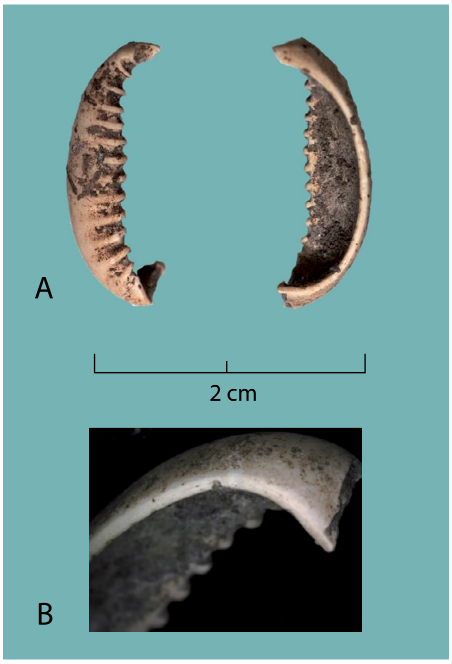

Figure 7.9. Reduced and abraded *Monetaria annulus* shell. A: *M. annulus* artefact, Square B XU55 (SU5); B: Detail of abraded break surface at dorsum, ×43 magnification.

Bivalve Disc Bead

A small (4.32mm maximum diameter) fully-ground disc bead was recovered from Square A XU49, within SU5 (Figure 7.10). The central perforation has been countersunk with wide bevels on each face indicating the use of a fairly obtuse drill-bit. The periphery has been fully freehand abraded and thus is convex though entirely smooth. Growth structures and directions of the shell visible under magnification confirm that the bead is not manufactured from a gastropod spire and that the raw material is most likely bivalve, but the complete removal of surface features precludes firm identification beyond Class level.

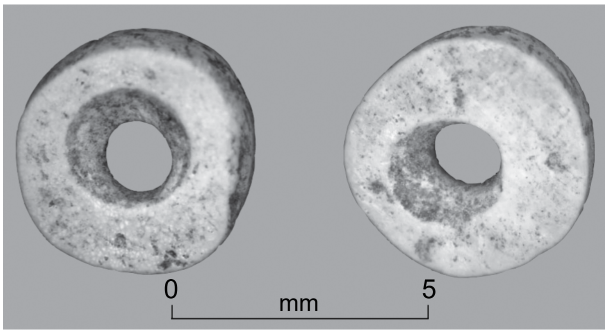

Figure 7.10. Fully ground bivalve disc bead, Square A XU49 (SU5).

Discussion

The spatial distribution of worked shell within the Tanamu 1 deposits is relatively consistent, with pieces occurring in both Squares A and B at a range of depths. There is no evidence of caching. What is perhaps most notable in terms of temporal distributions is the virtual absence of worked shell in SU1 to SU3. The relatively poor condition of the worked *R. nilotica* piece recovered from SU3 could suggest that any further worked shell in these upper levels has been taphonomically altered to an extent that it would not have been recognized. However, this attenuation in worked shell through time in the Tanamu 1 sequence may reflect actual patterns of deposition rather than the effect of post-depositional processes as late Lapita sites tend to be less rich in worked shell than early Lapita deposits.

Broadly speaking, Lapita sites with the greatest numbers, and greatest diversity, of shell artefacts are those from the Early Lapita phases in Near Oceania (Specht *et al.* 2014: 103; Szabó 2010).). This is likely partly to do with biogeography, with natural occurrences of important raw materials such as *Turbo marmoratus* and *Tridacna gigas* being restricted to the western-most South Pacific Islands, and thus being unavailable for use in the remote Pacific. Despite this, this trend seems more generally to be a restriction of forms and quantities produced through time, with later Lapita sites in the Bismarck Archipelago having considerably smaller shell artefact inventories than those seen in their Early Lapita counterparts (see discussion and examples in Green 2003: 107–108). This observation also holds in various locales in Remote Oceania, where attenuation in shell artefact types and quantities through time has been noted (e.g., Bedford and Spriggs 2002 for Vanuatu). Thus, given the chronological range for the Lapita horizon at Tanamu 1 it is not surprising that there would be a dearth of worked shell: this is a general characteristic of Late Lapita sites.

This diminution in the range of raw materials utilized and artefact forms produced is even more pronounced at Tanamu 1 than when comparing most pre/Early/Middle/Late/post-Lapita sequences. This is because the worked shell in the Tanamu 1 pre-Lapita layers encompasses materials and forms not generally seen in Lapita sites. *Oliva* spp. shells were not used in Lapita shell artefact production, and species such as *Placuna placenta* and *Nautilus* sp. only very rarely. Given the close links between particular reduction techniques and specific raw materials (Szabó 2008) what this further means is that this contraction through time in raw materials also maps onto a corresponding reduction in the range of shell-working techniques applied.

With only one piece of worked shell identified for the SU3 Lapita horizon, and none at all for post-Lapita deposits, the story of shell-working at Tanamu 1 is centred on the pre-Lapita phases of occupation. This pre-Lapita assemblage contributes key pieces of evidence to a number of regional debates and indeed questions the basis of current heuristics for thinking about the 'origins' of the Lapita cultural complex (see also Szabó *et al.* 2021). The presence of a *Conus* sp. adze and hewn *Placuna placenta* disc parallel distinctive artefacts identified within the early Lapita Kamgot assemblage (Szabó and Summerhayes 2002). Except for Tanamu 1, these artefacts have no known archaeological correlates outside of Lapita sites. Beads in *Oliva* spp. and pieces of worked *Nautilus* sp. have been identified from pre-Lapita sites in Near Oceania (Spriggs 2001b; Szabó 2005; Wickler 1990) as well as Timor (Glover 1986; O'Connor 2010), with worked *Nautilus* sp. also having been identified from pre-ceramic deposits on Flores and Gebe Island (Szabó 2013; Szabó *et al.* 2007; van den Bergh *et al.* 2009). Large rings manufactured from *Rochia nilotica* shells are well recognized to have a production history that spans from pre-Lapita to post-Lapita periods, and indeed ethnohistorical times in some Near Oceania locales (Green 2000; Sand 2001; Smith 2001; Spriggs 2001b). Three fragments of *R. nilotica* rings are known from Timor (Glover 1986), although these are the only pre-ceramic occurrences of this artefact type in Island Southeast Asia. For the remaining artefact types recovered from pre-Lapita levels of Tanamu 1, too little reliable published information exists to assess potential spatio-temporal relationships. A more in-depth discussion of these contextual data is provided in Szabó *et al.* (2021).

Tanamu 1 is rare in having pre-Lapita deposits as part of an open site (see Gosden 1991: 266; Specht *et al.* 2014: 103) and rarer still in yielding well-preserved bone and shell assemblages of such an age. The worked shell assemblage is at once revealing in the links it shows to both pre-ceramic Near Oceania and eastern Island Southeast Asia, and confounding in that the New Guinea south coast has never before featured in discussions and models of the origins of the Lapita cultural complex. Exactly how the Tanamu 1 worked shell assemblage is allied to different regions where the pre-ceramic shell assemblages seemingly have little in common with each other, such as Timor and the Bismarck Archipelago, is an interesting question. As work continues on the analysis of the Caution Bay worked shell, including the study of further pre-ceramic assemblages, expanded evidence will hopefully help to throw the nature of these connections into sharper focus.

Chapter 8.
Tanamu 1:
Conclusions and Future Directions

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Introduction

Tanamu 1 presents a cross-section of some of the major time periods represented in the Caution Bay archaeological landscape, and as such provides a useful starting point for the detailed publication of the results of excavations by which to eventually bridge the space between site-specific and landscape-scale patterns and trends. Across three broad phases of occupation, the site provides a window onto the extent and shape of pre-ceramic occupation in the *c.* 1700 years leading up to the emergence of the Lapita cultural complex in the Bismarck Archipelago *c.* 3300 cal BP (e.g., Denham *et al.* 2012), the nature of the terminal Lapita period which ends at 2600–2550 cal BP at Caution Bay (David *et al.* 2019), and the past 2750 years leading into the ethnographic present. In this volume we have presented detailed data and analyses of the ceramics, stone and shell artefacts, and vertebrate and invertebrate animal remains, and all have yielded their own particular insights. While conclusions about the long-range cultural history of both Tanamu 1 and Caution Bay can be drawn from the data presented here, we also see this as an opportunity to isolate and frame research issues to be pursued in subsequent volumes of the Caution Bay archaeological project.

Insights and questions generated by the Tanamu 1 data

Occupation

The Tanamu 1 archaeological sequence has revealed three dense cultural horizons—*c.* 5000–4050 cal BP pre-ceramic, 2800–2750 cal BP Lapita, *c.* 700–100 cal BP post-Lapita—each separated by periods of much sparser occupation. While the density of cultural materials fluctuates across the major occupational stratigraphic units (SUs), and the types of dominant materials shift through the sequence, the three major horizons all clearly represent sustained cultural presence at Tanamu 1. The array of remains, including large faunal and material culture assemblages, in an open setting suggests successive villages through time, however no structural evidence of dwellings, such as post-holes, has been archaeologically documented for any horizon at this site. On the present-day ground surface, Tanamu 1 appears as a discrete part of the larger landscape of Caution Bay. However, both the dense pre-ceramic (SU5) and Lapita (SU3) horizons are contemporaneous with similarly dense, temporally overlapping horizons at other sites nearby, suggesting that Tanamu 1 is but one part of a larger, spatially shifting settlement during those times. The stratified Bogi 1 site is only 140m away on the same ancient spit, for example, just as numerous other archaeological sites across Caution Bay also interdigitate with and supplement the Tanamu 1 sequence. As we add further data to the Caution Bay picture in forthcoming monographs with the results from other sites, we will continue to explore the nature of settlements and their connections between Caution Bay locales through time.

Ceramics

The trends observable in the Tanamu 1 ceramics sometimes map on to contemporaneous assemblages elsewhere, and sometimes provide new or augmented narratives. The well-preserved albeit often highly fragmented nature of the ceramic sherds allows for detailed observations about surface decoration and treatment, including assessment of the proportion of red-slipped wares, various forms of decoration, and the identification of makers' marks.

The Tanamu 1 Lapita ceramics (2800–2750 cal BP) reveal no evidence of red slip at all; a pattern of scarcity of red-slipping reproduced across the other Lapita sites of Caution Bay generally (BD, unpublished observations). Whether the later increased frequency of red-slipping is also seen in other Caution Bay ceramic assemblages will be assessed as further analyses are presented in forthcoming volumes. At Tanamu 1, decorative incised lines also become the principle kind of body decoration after *c.* 200 cal BP (albeit plainwares predominate then), although there is a paucity of cultural horizons between Late Lapita and recent times at this site, so it is not possible to determine the precise nature of ceramic assemblages in between—the presentation of results from other Caution Bay sites will fill this gap. While incised lines are present on occasion within the Tanamu 1 Lapita ceramic assemblage, these are consistently zone markers; single lines which serve to delineate decorative fields around vessels, especially to separate rows of comb dentate impressions or impressed continuous lines.

The range of Lapita decorative design conventions at Tanamu 1 is limited, and is fairly represented as a subset of the broader range found in contemporary Lapita sites elsewhere in the southwestern Pacific (see e.g., Summerhayes 2000), keeping in mind nonetheless that most so-called 'Late Lapita' sites elsewhere are disturbed and of poor chronostratigraphic resolution (see also Garling 2007). Through until 2750 cal BP, the end of the Tanamu 1 Lapita assemblage, the techniques are largely limited to comb dentate-impressions with straight and curvilinear tools, and continuous-edged tools. Finger grooves below the lip and *Tegillarca granosa* shell-edge impressions do not feature at all in Lapita assemblages, and are a much later, post-Lapita convention dating closer to 2150 cal BP, about 400 years after the end of Lapita at Caution Bay (see David *et al.* 2012). The key repeated design conventions noted for the Tanamu 1 Lapita pottery sherds are double and triple parallel arcs aligned in rows, and more rarely as off-set patterns, and made with coarse-tined combs or comb-like tools, or with thin continuous-edged tools. Whether the design repertoire recorded for Tanamu 1 is expanded by the inclusion of results from other Caution Bay sites will be explored in subsequent volumes, although already we can tell that while a few additional designs can be added, the main designs are retained in these other sites (BD, unpublished observations).

Carinations were noted for Tanamu 1 Lapita vessels, which sometimes also have collars. Neither feature is recorded for any of the post-Lapita pottery from the site. Where body decoration occurs on carinated vessels, it is only ever above the carination. Vessels devoid of body decoration are present during Lapita times, however most, if not all, appear to have had lip decoration in the form of stick or finger impressions to make closely-spaced, shallow impressed notches along the lip.

Maker's marks only occur in the uppermost ceramic horizon at Tanamu 1. In the late 1800s to mid-1900s, such maker's marks were put on pots by female potters who would then give the pots to male seafarers during long-distance maritime exchanges with villagers up to *c.* 400 km west of Caution Bay, especially during *hiri* trade expeditions (see below). Ethnographically, the *hiri* trade pots were highly standardised in form, and almost entirely plainwares (see Skelly and David 2017). At Tanamu 1, the plainware everted pots with necks most typical of ethnographic *hiri* trade wares (called *uro* by 19th to 21st-century Motu and Koita peoples of the Port Moresby region including Caution Bay), only occur after *c.* 200 cal BP (for a description of the range of ethnographic *hiri* pot types, see Skelly and David 2017: 26–32).

The presence at Tanamu 1 of both Lapita and known ethnohistorical wares allows us to explore distinctions and what these might mean. The highly standardised plainware *uro* pots with maker's marks, which occur only in contexts dating to the past *c.* 200 years, can be contextualised *via* ethnohistorical information (see Skelly and David 2017). The social organisation which mobilised ethnographic Caution Bay pottery across hundreds of kilometres of coastline required the trade pots to be identified to their particular makers: men would carry the pottery of female kin for trade in an arrangement known by the Motu of Caution Bay as *siaisiai* (Groves 1960: 19; see Skelly and David 2017: 32–34). In contrast, the Lapita pottery lacks maker's marks which would serve to individualise pots, and the decoration of the pots is a strikingly-notable feature of a generally less-standardised ware despite the limited range of Lapita design conventions at Caution Bay. The prominence of decoration in the Lapita pottery gives high visibility to the symbolic dimension of vessels, a feature of Lapita decoration well noted by previous Lapita researchers (e.g., Chiu 2019; Kirch 1997). During Lapita times the objective does not appear to have been identifying the individual maker. Rather, the emphasis in Tanamu 1's Lapita wares appears to have been more on group/community-scale symbolism (such as lineage or 'house' designs [*sensu* Chiu 2019]) of highly visible decorations of a narrow range of motifs and styles, in contrast to standardised functional forms with trademarks discretely inside the pot and trade with personal exchange partners of ethnographic wares.

Faunal Remains

The Tanamu 1 sequence is rich in both molluscan and non-molluscan faunal remains, with clear patterning through time providing insights into both cultural relationships with animals and the dynamic nature of the Caution Bay environment.

The pre-ceramic SU7–SU5 deposits are strongly marine-focussed, and indeed the most marine-focussed of all time-periods evidenced at Tanamu 1. Dugong remains are restricted to SU5, and this SU also has the strongest representation of marine turtle in the Tanamu 1 sequence. Fish remains are also most strongly represented in the pre-ceramic SUs, with Lapita and post-Lapita layers containing fewer fish remains in proportional terms as well as reduced diversities. Fish taxa are dominantly reef-associated, with the exceptions being rays/skates, scombrids and serranids which are all restricted to pre-Lapita levels. Non-molluscan invertebrates are also most common in pre-

Lapita deposits, with crab remains peaking in SU5. This is of great interest given that Lapita peoples have long been characterised for their association with the sea, implicitly in contrast with earlier communities whose maritime associations have remained more ambiguous (largely due to a paucity or absence of pre-Lapita to Lapita sequences across the Lapita domain). At Caution Bay it is apparent that pre-Lapita occupation was at least as much oriented towards the sea as during Lapita times, at least for those periods represented by Tanamu 1. More will be said on this following the publication of other excavated sequences across the Caution Bay landscape.

In counterpoint to the strong marine focus of the pre-ceramic faunal assemblages, terrestrial components come to dominate in the upper SUs, with macropods becoming the most prevalent category of vertebrate remain. The increasing numbers of Agile Wallaby, Short-nosed Bandicoot and *Rattus gestri* further indicate that the proliferation is not just in terrestrial fauna, but specifically those characteristic of savannah habitats. As Aplin notes in Chapter 6, however, in cultural terms the shift from marine to terrestrial/savannah resources is not simply based on changing resource availability. He demostrates the presence of a mosaic of terrestrial environments through the time period covered by SU7–SU5 and observe that, despite evidence for the presence of forested patches via ground-dwelling fauna, there is no evidence that pre-ceramic occupants of Tanamu 1 captured and consumed arboreal fauna such as cuscus and Striped Possum, although such animals were presumably present in the local environment.

The notion of 'fishing for wallabies', developed by Allen (1977b) specifically for the island of Motupore and its nearby shores 35 km to the southeast of Caution Bay as the crow flies (and 40–50 km following the coast), also leads us to ask whether the hunting of wallabies as a specialised trade strategy emerged from recognisable earlier historical antecedents (see also McNiven *et al*. 2012b: 145–148). While Tanamu 1 does not permit us to answer this question, it is worth noting that wallaby remains are abundant at the site from the SU5 pre-ceramic horizon, and the savannah-dwelling Agile Wallaby (*Macropus agilis*) even more so from SU4 onwards. Thus it would appear that communal hunting of wallabies for consumption at Caution Bay can be tracked back to at least 4350–4050 cal BP. Such a long-standing focus on wallaby hunting, presumably for local consumption given the prevalence of wallaby habitats across Caution Bay, suggests that wallaby hunting was, initially at least, not about trade (and by definition, certainly not about trade for pots as wallaby hunting began in pre-ceramic times). The Tanamu 1 data further suggest that the preference for wallaby in this region, where the open savannah grasslands provide an expansive wallaby habitat, predates the occupation of the off-shore islands like Motupore. Wallaby, as an item of consumption at Tanamu 1, pre-dates the introduction of trade specialisation as described by Irwin (1991) for pots. However, with the later specialised production and trade in pottery on Motupore, on this offshore island wallaby ceases to be acquired through direct procurement and becomes a commodity of trade. Our Tanamu 1 evidence does not speak on the topic of whether wallaby hunting itself becomes a specialised occupation of those on the mainland who are not involved in pot production, but forthcoming comparisons of inland versus coastal Caution Bay sites might. How the role of wallaby hunting developed through time across the Caution Bay landscape (largely for local subsistence, or for trade as in 'fishing for wallabies' or 'trading for pots') remains an intriguing question for future study as more Caution Bay sites are published.

The data from the dense shell layers are complementary to the narrative provided by the non-molluscan faunal remains. The greatest diversity and balance in terms of originating habitats is seen in the pre-ceramic levels, with an array of hard and soft shore habitats drawn upon to source molluscan resources. This is again consistent with the maritime focus of Tanamu 1's pre-Lapita occupation. Through the Tanamu 1 sequence there is an increasing reliance on a narrowing range of soft-shore taxa. Indirectly, the subsistence shell data would seem to support Aplin's (Chapter 6) view of the diminishing availability of larger marine prey items through time: the increase of seagrass and silty sand-associated mollusc remains through the sequence (e.g., *Conomurex luhuanus*) is not matched by the continued availability and use of dugong and turtle. Additionally, the pivot towards increasing incorporation of terrestrial resources, which is visible in the non-molluscan faunal record, is matched in the molluscan remains sequence by an overall contraction in assemblage size through time.

An enduring question in the archaeology of New Guinea is the timing of the arrival of the domesticated pig (*Sus scrofa*), dog (*Canis familiaris*) and chicken (*Gallus gallus*), and the excellent chronostratigraphic integrity and large faunal assemblages of Tanamu 1 allow us to investigate this. Pig is categorically not present in the pre-ceramic levels of Tanamu 1, making its first appearance in low numbers in the upper part of the SU2–SU4 assemblage, as Lapita sediments interface with early post-Lapita layers. It is uncertain whether their presence here is due to *in situ* deposition of pig remains (by whatever means), or later intrusions from pig-rummaging. Pig is only common, however, in the past few hundred years, and this in turn suggests that the earliest pig at Tanamu 1 derives from the hunting of feral pig rather than pig husbandry. There is no trace of dog at all in the Tanamu 1 faunal assemblages, although they are generally much less common in New Guinea deposits and sample sizes for the ceramic-associated levels could be a factor in their absence. Evidence that dogs were present from 2702–2573 cal BP comes from the nearby Moiapu 1 site (Manne *et al.* 2020) and at *c.* 2500 cal BP from Edubu 1 (McNiven *et al.* 2012b). Chicken is entirely absent from the Tanamu 1 sequence and close attention will be paid to whether it occurs, and if so when, at other Caution Bay sites. *Rattus exulans*, the Polynesian or Pacific Rat, is also absent at Tanamu 1.

Stone and Shell Artefacts

The interplay between stone and shell artefacts at Tanamu 1 is an interesting one. Tracking broadly alongside absolute abundances of food-shell remains, worked shell artefacts are most common and diverse in the pre-ceramic phase of the sequence and tail off through time. Indeed, no worked shell at all was identified within the culturally rich SU1 deposits. In contrast, stone artefacts are sparser in the pre-ceramic deposits and increase in density through the sequence to their largest representation in the most recent sediments (SU1). These conclusions regarding the frequency of stone artefacts, however, are balanced by observations about the frequency of burning and thermal alteration. Evidence of these processes increases during Lapita times, which to at least some degree contributes to fragmentation and higher overall totals of stone artefacts. Concomitantly, it is entirely possible that the increasing use of fire could have obscured evidence of Lapita and post-Lapita shell-working through causing taphonomic deterioration and fragmentation of shell structures, surfaces and edges, although the very large shell assemblages suggest that this is unlikely to be a sufficient explanation.

Despite differences in sample sizes between phases of occupation, and differential exposure to fire in the stone artefact sample, Mialanes *et al.* (Chapter 4) observe that no major technological changes are seen through the course of the Tanamu 1 sequence. Similar assessments cannot be made for shell-working, as only a single shell artefact was identified from ceramic-associated phases. The lack of worked shell associated with Late Lapita ceramics is perhaps not surprising (see Chapter 7), however Mialanes *et al.* (Chapter 4) note that that the Lapita stone artefact assemblage does not align with Lapita flaked stone artefact assemblages described from other locales. Whether these patterns hold as further results from across the Caution Bay archaeological landscape are published will be of interest.

Conclusion

The discovery of a stratified site containing deposits associated with the Lapita cultural complex, a rich pre-ceramic assemblage dating back to 5000 cal BP, from *c.* 1700 years before the appearance of Lapita sites elsewhere, and post-Lapita deposits stretching through to the ethnohistoric period would be an important find in itself, but to find this on the south coast of Papua New Guinea far removed from known Lapita sites, and as part of an interlocking archaeological landscape, is remarkable.

The sequence of rich faunal and artefactual assemblages, anchored via a robust and clear chronostratigraphy, allows for clear assessments of change and continuity across phases to build up a nuanced local picture. It also further facilitates comparative analysis with more distant sites and landscapes.

The results from Tanamu 1 presented in this volume have given a picture of sequential occupations which have drawn upon—sometimes selectively—a landscape which was demonstrably dynamic over the course of 5000 years. The presence of Lapita pottery and the window on to linkages provided by the worked shell component speak of connections with other places and peoples, but this is in contrast with the single piece of obsidian and reliance on local sources of chert revealed by the stone artefacts. Some archaeological materials signal distant connections, others local activities, and the patterns between them shift through time.

With the forthcoming publications of results from the excavation of so many sites across the Caution Bay landscape, we have no wish to be too hasty or categorical about patterns and interpretations here. Rather, we see Tanamu 1 as a starting point which lays the foundations for the exploration of pre-ceramic, Lapita, and post-Lapita lifeways at Caution Bay.

Appendix A.

Chert Fracture Types by XU, Tanamu 1 Square A.

	Broken flake (other)		Complete flake		Distal flake		Flaked piece		Medial flake		Potlid		Proximal flake		Unipolar core		Total	
XU	#	g	#	g	#	g	#	g	#	g	#	g	#	g	#	g	#	g
1	2	0.2	2	1.2	1	0.3	1	0.3									6	1.9
2	14	12.8			1	<0.1	4	1.7	1	3.6			4	1.8			24	20.0
3	44	19.7	6	9.3	5	2.2	12	2.7					2	5.6			69	39.5
4	28	4.6	10	14.2	2	0.1	17	27.7	3	0.3			7	4.1	1	6.4	68	57.4
5	21	2.4	7	5.9	7	2.3	8	34.6					3	3.5	2	19.3	48	68.0
6	17	2.9	1	0.3			9	0.9	2	0.4			2	0.1			31	4.7
7	11	0.3	2	0.1			4	0.5							1	7.5	18	8.4
8	11	0.6			2	0.1	10	1.0									23	1.6
9+10	15	0.4			4	0.3	3	0.1					1	<0.1			23	0.8
11	10	0.5			1	0.2	8	1.8	2	0.1			2	0.2			23	2.8
12	5	0.2					3	4.1									8	4.3
13	5	0.3					7	0.2									12	0.5
14	16	1.2	2	0.2	1	5.7	20	4.2	3	0.2							42	11.5
15	14	0.8	1	<0.1	3	1.1	4	0.2					1	0.1			23	2.2
16	7	5.2	1	0.8	1	0.1	2	0.3									11	6.4
17	4	0.4					1	0.1									5	0.5
18	6	0.1	2	0.9	1	1.1	6	1.4									15	3.5
19	15	2.7	3	0.4			13	0.8	1	0.2							32	4.1
20	8	0.9					6	1.7					1	<0.1			15	2.6
21	7	4.3			1	0.5	3	1.1	1	0.1			1	1.3			13	7.3
22	6	0.4					3	0.2									9	0.7
23	7	0.4			1	0.1	4	0.5									12	1.0
24	1	<0.1															1	<0.1
25	6	0.9					7	3.4									13	4.3
26	3	1.0	2	0.1			3	0.1									8	1.2
27	4	1.8			1	0.2	1	<0.1									6	2.0
28	3	0.2					2	0.7									5	0.8
29	1	0.1			1	<0.1	5	4.2									7	4.3
30	7	0.3					2	<0.1					1	<0.1			10	0.3
31	5	6.4					7	9.8									12	16.2
32	6	0.7															6	0.7
33	2	<0.1					5	0.2									7	0.2
34	3	0.8															3	0.8
35																		
36	6	0.9					5	0.3									11	1.2
37	1	0.1					2	0.1									3	0.2
38	2	0.8	1	0.1			1	<0.1									4	0.9

	Broken flake (other)		Complete flake		Distal flake		Flaked piece		Medial flake		Potlid		Proximal flake		Unipolar core		Total	
XU	#	g	#	g	#	g	#	g	#	g	#	g	#	g	#	g	#	g
39	4	1.1	1	2.0			1	0.2									6	3.2
40	3	0.4					3	0.2	2	0.4							8	0.9
41							1	0.1									1	0.1
42	2	0.1					1	<0.1									3	0.1
43	7	0.7			1	0.9	4	3.1									12	4.7
44	6	0.9					4	1.4	1	2.1							11	4.4
45	7	0.2	1	<0.1	1	<0.1	3	0.1									12	0.3
46	3	0.2					1	0.1									4	0.3
47	2	0.2					4	1.0									6	1.2
48	4	0.2					1	<0.1									5	0.2
49	7	0.3					3	0.1									10	0.3
50	6	0.1					4	0.3									10	0.4
51	4	0.1					2	1.3									6	1.4
52	10	0.6			1	<0.1	1	0.1									12	0.7
53	3	1.8					1	<0.1					1	0.1			5	1.9
54	3	3.1					2	0.1									5	3.2
55	6	10.2			1	27.5	4	6.2	1	<0.1					1	42.1	13	86.0
56	2	0.1	1	0.4			2	3.2									5	3.7
57	7	0.7					5	0.2					1	<0.1			13	0.9
58	4	0.2					3	0.2					2	0.3			9	0.6
59	4	0.3					5	0.4					1	0.1			10	0.8
60	3	0.1			2	1.8	3	2.7									8	4.6
61	5	0.2	1	0.3			3	0.4	1	0.1			1	<0.1			11	0.9
62																		
63	5	3.0					1	<0.1							1	17.5	7	20.5
64	7	6.3					2	74.5									9	80.8
65	3	0.1	1	0.1			2	<0.1									6	0.3
66	5	0.1			1	21.0	5	2.3									11	23.4
67	4	1.7					2	3.8									6	5.5
68							1	<0.1									1	<0.1
69	2	<0.1											1	<0.1			3	<0.1
70	4	0.7					2	0.4									6	1.1
71			1	0.1											1	14.6	2	14.7
72	2	<0.1			1	0.3	1	<0.1									4	0.4
73	3	<0.1					3	0.4									6	0.4
74	2	1.6															2	1.6
75	3	1.7			1	0.1	2	<0.1									6	1.8
76	3	0.2							1	<0.1							4	0.2
77	1	0.2					1	<0.1					1	0.1			3	0.3
78	5	0.2															5	0.2
79	4	0.7											2	0.1			6	0.8
80	4	0.1					1	0.1									5	0.2

	Broken flake (other)		Complete flake		Distal flake		Flaked piece		Medial flake		Potlid		Proximal flake		Unipolar core		Total	
XU	**#**	**g**	**#**	**g**	**#**	**g**	**#**	**g**	**#**	**g**	**#**	**g**	**#**	**g**	**#**	**g**	**#**	**g**
81	1	0.7			1	0.5	1	1.5									3	2.6
82	5	1.4					1	0.1					1	0.3			7	1.7
83	1	0.4			1	0.2							1	0.2			3	0.7
84	1	0.2															1	0.2
85	2	<0.1	1	<0.1			2	0.1	2	0.5			1	0.1			8	0.7
86	1	0.3															1	0.3
87	4	0.3					1	<0.1									5	0.3
88									1	<0.1	1	<0.1					2	0.1
89	3	0.2					2	0.1									5	0.3
90	1	0.1					2	<0.1									3	0.1
91	3	2.7											1	<0.1			4	2.7
92	1	0.2															1	0.2
93	1	<0.1					1	0.7									2	0.8
94	1	<0.1	1	<0.1													2	<0.1
95			1	<0.1			1	<0.1									2	<0.1
96	2	<0.1															2	<0.1
97							5	0.2									5	0.2
98	2	0.1					3	0.1									5	0.2
99	5	0.9					3	0.4									8	1.3
100	1	0.1			1	<0.1	3	0.2									5	0.3
101	1	<0.1					1	0.5									2	0.5
102	1	<0.1			1	0.2	2	0.6	1	<0.1			1	<0.1			6	0.9
103							2	1.3									2	1.3
104	3	0.3															3	0.3
105	2	0.2					1	<0.1					1	<0.1			4	0.2
106	1	0.1					1	0.1									2	0.2
107																		
108					1	0.1											1	0.1
109	1	<0.1			1	<0.1	2	0.1									4	0.1
110	1	0.1	1	0.9			1	1.8							1	44.6	4	47.3
111	2	<0.1					3	<0.1									5	0.1
112	1	0.1															1	0.1
113	1	0.7					1	<0.1									2	0.7
114																		
115																		
116																		
117	1	<0.1					1	0.7	1	0.3							3	1.0
118	1	0.2					1	<0.1									2	0.3
119	1	<0.1															1	<0.1
120					1	<0.1	1	<0.1									2	0.1
121							1	<0.1									1	<0.1
122	1	0.1															1	0.1

	Broken flake (other)		Complete flake		Distal flake		Flaked piece		Medial flake		Potlid		Proximal flake		Unipolar core		Total	
XU	**#**	**g**	**#**	**g**	**#**	**g**	**#**	**g**	**#**	**g**	**#**	**g**	**#**	**g**	**#**	**g**	**#**	**g**
123							1	0.1									1	0.1
124							1	0.1	1	<0.1							2	0.1
125	1	<0.1															1	<0.1
126	1	<0.1					2	<0.1									3	<0.1
127							1	<0.1									1	<0.1
128							1	0.1									1	0.1
129	3	0.1					3	0.4									6	0.5
130																		
131																		
132	1	<0.1	1	0.1					1	0.1							3	0.3
133	2	<0.1					2	<0.1									4	0.1
Total	**543**	**122.4**	**51**	**37.6**	**49**	**67.0**	**326**	**216.7**	**26**	**8.4**	**1**	**<0.1**	**41**	**18.2**	**8**	**152.0**	**1045**	**622.2**

Appendix B.

Chert Fracture Types by XU, Tanamu 1 Square B.

	Broken flake (other)		Complete flake		Distal flake		Flaked piece		Axial flake		Medial flake		Potlid		Proximal flake		Unipolar core		Total	
XU	#	g	#	g	#	g	#	g	#	g	#	g	#	g	#	g	#	g	#	g
1	3	0.2	2	2.6			4	2.2			1	<0.1							10	5.1
2	7	1.8	1	0.8	2	0.4													10	3.0
3	74	30.3	15	11.2	7	0.4	15	3.2	2	1.6	11	4.9			5	1.1			129	52.5
4	86	24.4	16	7.8	5	2.6	23	11.3			6	0.5			5	7.2	4	43.1	145	96.8
5+6	16	10.3	4	2.0			3	2.3			2	0.2			4	2.3	1	2.1	30	19.2
7	9	5.5					10	1.2											19	6.7
8	16	0.9	2	1.8	1	0.1	4	0.2			1	0.1							24	3.1
9																				
10	12	1.3					7	3.9			1	<0.1			1	0.1			21	5.4
11	2	0.6	1	0.1			3	1.2											6	1.8
12	7	1.5	1	1.1			4	0.3	1	1.0									13	3.8
13	9	0.4					13	1.4									1	11.0	23	12.8
14																				
15	13	2.5	3	0.1			8	3.9	1	<0.1	1	<0.1			1	<0.1			27	6.6
16	14	0.4	1	0.2	2	0.2	14	0.9			1	<0.1							32	1.8
17	7	0.8	1	<0.1			6	0.7											14	1.5
18	11	0.4	2	0.2	2	0.1	5	0.3			1	<0.1			1	<0.1			22	0.9
19	3	0.5	2	0.9			5	0.5											10	1.9
20	6	0.4			1	2.0	9	0.3			1	0.1			1	0.1			18	2.8
21	3	0.2					4	0.4			1	<0.1							8	0.6
22	12	0.8	1	<0.1	1	0.2	7	1.0							1	<0.1			22	2.0
23	8	1.3	1	<0.1	1	<0.1	7	0.6											17	1.9
24	6	1.2					10	2.0					1	<0.1					17	3.2
25	7	0.2	1	1.6	2	0.9	6	0.5											16	3.2
26	2	0.1					4	0.3											6	0.3
27	4	<0.1					2	<0.1											6	0.1
28																				
29	8	0.2	1	4.5	2	0.1	3	0.2											14	5.0
30	7	0.3	3	0.4			13	0.8											23	1.6
31			1	<0.1			2	0.1											3	0.1
32	2	2.1					2	0.1											4	2.2
33	4	0.1					2	0.1											6	0.2
34	3	0.1					1	<0.1											4	0.1
35					1	<0.1									1	<0.1			2	0.1
36	2	0.6					1	0.2											3	0.8
37	3	0.5	1	<0.1	1	0.1													5	0.6
38	1	<0.1																	1	<0.1
39	5	0.1					4	0.1											9	0.3
40	4	0.3					1	<0.1											5	0.3
41	12	0.4	1	<0.1			3	0.1			2	0.1							18	0.5
42	5	0.2					4	0.1											9	0.3

	Broken flake (other)		Complete flake		Distal flake		Flaked piece		Axial flake		Medial flake		Potlid		Proximal flake		Unipolar core		Total	
XU	#	g	#	g	#	g	#	g	#	g	#	g	#	g	#	g	#	g	#	g
43	6	0.1			1	<0.1	2	<0.1											9	0.1
44	14	0.5					8	0.9			2	<0.1							24	1.4
45	1	0.2									1	1.3							2	1.4
46	1	0.1																	1	0.1
47	2	1.1					4	1.5											6	2.6
48	12	0.2	1	0.1	1	0.2	6	0.2			1	<0.1	1	<0.1	1	<0.1			23	0.8
49	1	0.8			1	0.1	3	8.3											5	9.1
50	8	1.1			1	0.1	2	0.4											11	1.5
51	3	0.1																	3	0.1
52	5	1.4					1	0.4			1	0.2							7	1.9
53	2	0.3					1	0.1											3	0.3
54	1	0.2																	1	0.2
55	8	1.0					1	0.2											9	1.2
56	10	0.5					4	0.1											14	0.7
57	4	0.2	2	0.3			2	0.1							1	0.3			9	0.9
58	7	0.8	2	0.5	1	0.1	1	0.8			1	0.1							12	2.2
59	12	25.5	1	0.1			5	6.2			1	0.1							19	31.9
60	6	0.3	1	<0.1			2	0.1			1	<0.1	1	<0.1					11	0.5
61	9	1.9					4	6.1					1	<0.1	1	<0.1			15	8.1
62	13	2.9					4	1.7			1	1.7							18	6.3
63	3	0.1	1	<0.1	1	<0.1					2	0.2							7	0.3
64																				
65					1	0.4	4	60.1											5	60.4
66	12	2.9	1	0.2	1	0.1	5	0.7							1	0.2			20	4.1
67	2	0.1					3	0.7									1	22.9	6	23.7
68	3	0.1					2	<0.1											5	0.1
69	6	0.9	1	<0.1			2	0.1			1	0.1							10	1.1
70	5	0.9	1	0.1			2	<0.1							1	1.7			9	2.7
71	7	0.7	1	0.2			1	<0.1			1	<0.1							10	0.9
72	3	0.6																	3	0.6
73	2	<0.1	1	<0.1			1	<0.1											4	0.1
74	12	0.4	1	<0.1			2	<0.1			1	<0.1							16	0.5
75	4	0.9					1	0.1			1	0.1							6	1.1
76	3	0.2					2	<0.1			1	<0.1			1	0.2			7	0.4
77							2	1.0											2	1.0
78																				
79	7	0.6	1	0.1					2	0.1					1	0.3			11	1.1
80	2	0.1	2	0.1															4	0.2
81	6	0.1			3	0.1	2	<0.1											11	0.2
82	2	<0.1																	2	<0.1
83	1	0.1					1	<0.1			1	<0.1			2	0.1			5	0.3
84	2	<0.1	1	<0.1			1	0.1	1	0.2									5	0.3
85	6	0.2					1	<0.1			1	<0.1							8	0.3
86	5	1.5			1	<0.1	1	0.7			1	0.2			1	<0.1			9	2.4
87	1	<0.1	1	0.1	2	<0.1													4	0.1
88	6	38.7			2	0.2													8	38.9

	Broken flake (other)		Complete flake		Distal flake		Flaked piece		Axial flake		Medial flake		Potlid		Proximal flake		Unipolar core		Total	
XU	**#**	**g**	**#**	**g**	**#**	**g**	**#**	**g**	**#**	**g**	**#**	**g**	**#**	**g**	**#**	**g**	**#**	**g**	**#**	**g**
89	7	67.4			2	0.1	1	<0.1			1	<0.1							11	67.6
90	10	0.3	1	0.3											1	<0.1			12	0.7
91	2	<0.1			1	<0.1													3	0.1
92	1	<0.1													1	1.8			2	1.9
93	3	0.1									1	0.1							4	0.2
94	2	0.3	1	<0.1															3	0.3
95	1	0.3	1	<0.1	1	0.1													3	0.4
96	1	<0.1																	1	<0.1
97	2	<0.1			1	<0.1													3	<0.1
98	2	0.1	1	<0.1			1	0.1											4	0.1
99																				
100	2	0.5													1	<0.1			3	0.5
101	1	<0.1			1	0.2	1	0.1											3	0.3
102	1	<0.1			1	<0.1													2	<0.1
103	1	<0.1																	1	<0.1
104					1	0.1	1	0.4											2	0.5
105	3	0.2			1	0.2													4	0.3
106			1	0.3															1	0.3
107																				
108			1	0.1			1	<0.1											2	0.1
109																				
110																				
111	1	<0.1									1	0.2							2	0.2
112																				
113					1	0.4					1	0.3							2	0.7
114																				
115															2	1.3			2	1.3
116			1	<0.1															1	<0.1
117																				
118	2	<0.1																	2	<0.1
119					1	<0.1													1	<0.1
120																				
121																				
122	2	0.1																	2	0.1
123																				
124	1	<0.1																	1	<0.1
125																				
126																				
127	1	0.1																	1	0.1
128																				
129																				
130																				
131	1	<0.1					2	<0.1											3	0.1
132																				
133	1	<0.1																	1	<0.1
Total	**666**	**248.7**	**87**	**37.7**	**55**	**9.5**	**299**	**131.3**	**7**	**2.8**	**52**	**10.6**	**4**	**0.1**	**35**	**16.9**	**7**	**79.2**	**1212**	**536.7**

Appendix C.

Mollusc Weight (g) per XU for Tanamu 1 Square A.

			XU												
Class	**Family**	**Taxon**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9–10**	**11**	**12**	**13**	**14**
Bivalvia	Arcidae	Arcidae					6.7		1.1			0.3	4.0	3.2	2.9
		Arcidae <10mm													
		Anadara antiquata													
		Anadara rufescens													
		Arca ventricosa													
		Barbatia foliata													
		Tegillarca granosa			1.1		0.5	2.1			0.9		0.4		0.6
	Cardiidae	Cardiidae						1.1							
		Fragum spp.													
		Fragum unedo													
		Hippopus hippopus													
		Tridacna spp.													
		Tridacna squamosa													
		Vasticardium flavum													
	Chamidae	*Chama* spp.													
	Corbulidae	*Corbula* sp.													
	Cyrenidae	Cyrenidae													
		Batissa violacea									8.2				
		Geloina expansa	5.7	13.3		6.9	11.2	3.6							2.5
	Glauconomidae	*Glauconome rugosa*													
	Gryphaeidae	*Hyotissa hyotis*													
	Lucinidae	*Anodontia edentula*													
		Austriella corrugata													
		Codakia tigerina													
	Mactridae	*Mactra* spp.													
		Mactra cuneata													
	Malleidae	*Malleus* spp.					16.5								
	Mesodesmatidae	*Atactodea striata*													
	Mytilidae	Mytilidae													
		Septifer bilocularis													
	Noetiidae	Noetiidae													
	Ostreidae	Ostreidae	2.5	5.0	35.1	87.4	259.1	119.3	0.3	19.6					
	Pectinidae	Pectinidae <10mm													
	Pinnidae	Pinnidae													
	Placunidae	*Placuna placenta*													
	Psammobiidae	*Asaphis violascens*													
		Gari occidens													
	Pteriidae	Pteriidae					3.0								
		Isognomon spp.					0.3								
		Pinctada spp.													
		Pinctada maculata													

			XU												
Class	**Family**	**Taxon**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9–10**	**11**	**12**	**13**	**14**
	Spondylidae	*Spondylus* spp.			10.7			11.8							
	Tellinidae	Tellinidae					0.3								
		Quidnipagus palatam													
	Trapezidae	*Neotrapezium sublaevigatum*													
	Veneridae	Veneridae													
		Anomalodiscus squamosus													
		Dosinia sp.													
		Gafrarium spp.		0.6	0.7		0.4	3.7		0.5	1.6		0.7	0.7	2.2
		Gafrarium pectinatum													
		Gafrarium tumidum													
		Irus carditoides <10mm													
		Periglypta puerpera					14.7	2.5							
		Pitar pellucidus													
		Protapes gallus													
		Venerupis aspera													
Gastropoda	Amathinidae	*Amathina tricarinata* <10mm													
	Angariidae	*Angaria delphinus*													
	Bullidae	*Bulla ampulla*							0.1						
	Calliostomatidae	*Calliostoma* spp.													
	Cerithiidae	Cerithiidae													
		Cerithiidae <10mm													
		Cerithium citrinum													
		Cerithium coralium													
		Cerithium nodulosum													
		Cerithium zonatum													
		Clypeomorus batillariaeformis													
		Rhinoclavis vertagus													
	Chilodontaidae	*Euchelus atratus* <10mm													
	Columbellidae	Columbellidae													
		Mitrella scripta													
	Conidae	Conidae				20.0	4.6	2.9							
		Conus arenatus													
		Conus flavidus													
		Conus lividus													
		Conus tessulatus													
		Conus textile													
	Costellariidae	*Vexillum vulpecula*													
	Cymatiidae	Cymatiidae				1.2									

			XU												
Class	**Family**	**Taxon**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9–10**	**11**	**12**	**13**	**14**
		Monoplex vespaceus													
	Cypraeidae	Cypraeidae			8.6	1.0		53.5							1.6
		Mauritia arabica													
		Monetaria annulus													
	Ellobiidae	Ellobiidae													
		Ellobiidae <10mm													
		Cassidula spp.													
		Ellobium spp.													
		Ellobium aurisjudae													
	Epitoniidae	Epitoniidae <10mm													
	Fissurellidae	*Hemitoma* spp. <10mm					0.2	<0.1							
	Littorinidae	*Littoraria* spp.													
		Littoraria spp. <10mm													
		Littoraria filosa	0.7												
		Littoraria scabra													
	Muricidae	Muricidae													
		Chicoreus spp.													
		Chicoreus capucinus													
		Drupella margariticola													
	Nassariidae	*Nassarius* spp.													
		Nassarius coronatus													
		Nassarius crematus													
		Nassarius olivaceus													
		Nassarius pullus													
	Naticidae	Naticidae													
		Mammilla sebae													
		Notocochlis gualtieriana													
		Polinices mammilla													
	Neritidae	Neritidae													
		Neripteron violaceum													
		Nerita spp.													
		Nerita albicilla													
		Nerita balteata													
		Nerita chamaeleon													
		Nerita costata													
		Nerita planospira													
		Nerita polita													
		Nerita undata													
	Olividae	Olividae													

			XU												
Class	**Family**	**Taxon**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9–10**	**11**	**12**	**13**	**14**
		Miniaceoliva miniacea													
		Oliva elegans													
		Oliva oliva													
		Oliva reticulata													
		Oliva vidua													
	Patellidae	Patellidae													
		Patellidae <10mm													
	Pisaniidae	*Cantharus* sp.													
	Planaxidae	Planaxidae				0.7									1.6
		Planaxis sulcatus													
	Potamididae	*Cerithideopsis largillierti*	0.7				0.1	1.9							
		Pirinella cingulata													
		Telescopium telescopium	20.5	5.9	100.1	248.4	362.9	109.9	11.3	6.4	7.2	4.9			
		Terebralia spp.													
		Terebralia palustris	290.9	12.5		2.0									
		Terebralia sulcata													
	Strombidae	Strombidae					0.4	4.3	2.3		4.6				
		Canarium labiatum													
		Canarium urceus													
		Conomurex luhuanus	30.0	24.7	315.6	599.7	997.8	146.4	6.7	14.5	3.5	16.3	23.0	4.3	12.4
		Euprotomus aurisdianae													
		Gibberulus gibberulus									5.2			4.0	
		Laevistrombus canarium													
		Lambis spp.	30.1	21.8	35.5	14.0	118.7								
		Lambis crocata													
		Lambis lambis						169.4							
	Tegulidae	Tegulidae													
		Rochia nilotica					3.5								
		Tectus fenestratus				3.8	8.9	0.8	5.5		0.5				
	Terebridae	Terebridae													
	Tonnidae	*Tonna* sp.													
	Trochidae	Trochidae					2.0								
		Monodonta labio													
	Turbinellidae	*Vasum* sp.													
		Vasum turbinellus									10.3				
	Turbinidae	*Lunella cinerea*													
		Turbo spp.													
	Vermetidae	Vermetidae													
Indeterminate	Indeterminate	Unidentified Shell	16.6	43.7	41.1	50.2	102.6	36.8	23.1	10.6	20.5	1.2	15.1	7.8	11.1
Total			**397.7**	**127.5**	**548.5**	**1035.3**	**1914.4**	**670.0**	**50.4**	**51.6**	**62.5**	**22.7**	**43.2**	**20.0**	**34.9**

			XU												
Class	**Family**	**Taxon**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**
Bivalvia	Arcidae	Arcidae	2.9	0.8			1.6		5.7	5.8	5.3	9.1	18.4	38.4	19.2
		Arcidae <10mm													
		Anadara antiquata						0.5	1.5	13.8	28.9	70.6	89.8	142.4	185.8
		Anadara rufescens													
		Arca ventricosa													
		Barbatia foliata													
		Tegillarca granosa		0.5			8.6	1.3		20.6	96.4	35.5	163.5	79.8	25.7
	Cardiidae	Cardiidae											6.8	0.4	0.7
		Fragum spp.											4.2		
		Fragum unedo											4.5		2.6
		Hippopus hippopus								20.1			8.7		
		Tridacna spp.													
		Tridacna squamosa													
		Vasticardium flavum													
	Chamidae	*Chama* spp.									2.8		0.8	15.2	23.8
	Corbulidae	*Corbula* sp.													
	Cyrenidae	Cyrenidae													
		Batissa violacea												8.0	2.0
		Geloina expansa											133.3	15.4	20.8
	Glauconomidae	*Glauconome rugosa*												0.3	
	Gryphaeidae	*Hyotissa hyotis*													
	Lucinidae	*Anodontia edentula*										3.5	5.9	0.8	
		Austriella corrugata									0.9	4.1	51.4	9.7	11.0
		Codakia tigerina													43.2
	Mactridae	*Mactra* spp.										0.4		0.5	
		Mactra cuneata											2.8		
	Malleidae	*Malleus* spp.						1.5					21.7		19.5
	Mesodesmatidae	*Atactodea striata*							1.0	0.4	0.1	1.2	4.9	6.6	3.5
	Mytilidae	Mytilidae										0.2			
		Septifer bilocularis													
	Noetiidae	Noetiidae													
	Ostreidae	Ostreidae					2.6	1.1		44.0	11.1	269.3	36.4	34.9	72.8
	Pectinidae	Pectinidae <10mm													
	Pinnidae	Pinnidae										1.3			
	Placunidae	*Placuna placenta*							0.3		20.1	12.5	71.3	2.1	0.3
	Psammobiidae	*Asaphis violascens*							0.3						4.0
		Gari occidens													
	Pteriidae	Pteriidae													
		Isognomon spp.								0.1	0.6		3.8	6.8	1.9
		Pinctada spp.													
		Pinctada maculata										7.4	0.6	0.1	0.5

			XU												
Class	**Family**	**Taxon**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**
	Spondylidae	*Spondylus* spp.													
	Tellinidae	Tellinidae													
		Quidnipagus palatam													0.8
	Trapezidae	*Neotrapezium sublaevigatum*													
	Veneridae	Veneridae													
		Anomalodiscus squamosus									1.4			1.2	
		Dosinia sp.													
		Gafrarium spp.	2.4	7.1		1.6	1.2	0.5	2.2	6.5	7.0	22.1	44.4	50.6	53.7
		Gafrarium pectinatum													0.3
		Gafrarium tumidum							4.0		2.9		98.6	111.4	106.5
		Irus carditoides <10mm													
		Periglypta puerpera											0.3	0.2	
		Pitar pellucidus											0.6		0.3
		Protapes gallus											1.4	2.2	0.6
		Venerupis aspera													
Gastropoda	Amathinidae	*Amathina tricarinata* <10mm													
	Angariidae	*Angaria delphinus*										7.9		12.3	1.1
	Bullidae	*Bulla ampulla*											0.2	0.1	0.3
	Calliostomatidae	*Calliostoma* spp.										<0.1			0.2
	Cerithiidae	Cerithiidae												0.3	
		Cerithiidae <10mm											0.2		
		Cerithium citrinum									0.4				
		Cerithium coralium													
		Cerithium nodulosum													
		Cerithium zonatum													
		Clypeomorus batillariaeformis													0.3
		Rhinoclavis vertagus													0.8
	Chilodontaidae	*Euchelus atratus* <10mm													
	Columbellidae	Columbellidae											0.3		
		Mitrella scripta													
	Conidae	Conidae								3.8		6.3			5.7
		Conus arenatus													
		Conus flavidus													
		Conus lividus													
		Conus tessulatus													
		Conus textile												8.4	

			XU												
Class	**Family**	**Taxon**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**
	Costellariidae	*Vexillum vulpecula*													
	Cymatiidae	Cymatiidae											0.2	1.7	
		Monoplex vespaceus													
	Cypraeidae	Cypraeidae				12.2			0.8	0.4			0.3	4.3	
		Mauritia arabica													
		Monetaria annulus													
	Ellobiidae	Ellobiidae													
		Ellobiidae <10mm													
		Cassidula spp.													
		Ellobium spp.										0.2		0.7	
		Ellobium aurisjudae													1.3
	Epitoniidae	Epitoniidae <10mm													
	Fissurellidae	*Hemitoma* spp. <10mm											0.3	<0.1	0.2
	Littorinidae	*Littoraria* spp.													
		Littoraria spp. <10mm													
		Littoraria filosa													
		Littoraria scabra													
	Muricidae	Muricidae													
		Chicoreus spp.										1.9	0.4		
		Chicoreus capucinus													3.6
		Drupella margariticola													
	Nassariidae	*Nassarius* spp.												0.4	
		Nassarius coronatus													
		Nassarius crematus								3.3	3.9	0.9			1.0
		Nassarius olivaceus												0.5	
		Nassarius pullus													
	Naticidae	Naticidae									1.2	1.2	0.8	0.7	
		Mammilla sebae													
		Notocochlis gualtieriana													
		Polinices mammilla											1.2		2.1
	Neritidae	Neritidae											0.6		
		Neripteron violaceum													
		Nerita spp.									2.1	0.7	2.0	0.2	2.4
		Nerita albicilla												1.7	2.0
		Nerita balteata												0.3	
		Nerita chamaeleon												0.4	
		Nerita costata													
		Nerita planospira													

			XU												
Class	**Family**	**Taxon**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**
		Nerita polita													
		Nerita undata													2.4
	Olividae	Olividae													1.1
		Miniaceoliva miniacea													
		Oliva elegans													
		Oliva oliva													
		Oliva reticulata													
		Oliva vidua													
	Patellidae	Patellidae													
		Patellidae <10mm													
	Pisaniidae	*Cantharus* sp.													
	Planaxidae	Planaxidae													
		Planaxis sulcatus											0.2	0.9	
	Potamididae	*Cerithideopsis largillierti*											0.6		
		Pirinella cingulata													
		Telescopium telescopium								0.4	1.3	0.2	2.6	0.1	5.5
		Terebralia spp.						0.6							
		Terebralia palustris													
		Terebralia sulcata					0.5						0.5	0.2	
	Strombidae	Strombidae					0.6			4.1		3.3	3.4	13.4	7.9
		Canarium labiatum													
		Canarium urceus											3.2		
		Conomurex luhuanus	10.9	33.9	1.6				5.5	15.8	25.7	113.4	163.5	257.7	88.5
		Euprotomus aurisdianae													
		Gibberulus gibberulus								4.0		4.1	20.9	0.3	3.6
		Laevistrombus canarium								16.0	7.1	6.6	45.0	34.8	37.4
		Lambis spp.		3.1			0.4			22.3	232.6	6.2	145.3	190.6	195.9
		Lambis crocata													
		Lambis lambis												129.3	112.0
	Tegulidae	Tegulidae													
		Rochia nilotica												24.8	
		Tectus fenestratus											0.3	1.4	0.7
	Terebridae	Terebridae													
	Tonnidae	*Tonna* sp.													
	Trochidae	Trochidae								1.5			1.1		
		Monodonta labio													
	Turbinellidae	*Vasum* sp.										1.5			
		Vasum turbinellus													
	Turbinidae	*Lunella cinerea*													1.4
		Turbo spp.									0.1		0.2		

			XU												
Class	**Family**	**Taxon**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**
	Vermetidae	Vermetidae										0.2		0.1	
Indeterminate	Indeterminate	Unidentified Shell	10.7	20.2	0.5	52.2	20.4	8.6	14.7	26.1	60.0	74.6	185.3	163.9	150.7
Total			**26.9**	**65.6**	**2.1**	**66.0**	**35.9**	**14.1**	**36.0**	**209.0**	**511.9**	**666.4**	**1352.7**	**1376.5**	**1227.6**

			XU												
Class	**Family**	**Taxon**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
Bivalvia	Arcidae	Arcidae	41.6	31.7	51.5	23.4	17.1	10.3	8.2	7.7	6.2	2.4	3.0	1.3	1.8
		Arcidae <10mm												<0.1	
		Anadara antiquata	173.2	381.5	455.9	272.8	161.5	95.9	77.3	26.2	9.0	21.2	7.8	4.8	1.5
		Anadara rufescens				15.7									
		Arca ventricosa													
		Barbatia foliata													
		Tegillarca granosa	19.8	56.3			8.1	39.5	27.8	3.8			2.0		
	Cardiidae	Cardiidae	1.2	0.6		0.4	22.1	0.8			1.0		0.4		2.4
		Fragum spp.			0.8										
		Fragum unedo		8.3	11.0				0.1						
		Hippopus hippopus							5.5						
		Tridacna spp.						70.2							
		Tridacna squamosa						680.9							
		Vasticardium flavum	1.7	0.8	5.4				4.5	3.3	3.9				
	Chamidae	*Chama* spp.	14.5	68.9	23.1		28.8	60.2	195.4	60.4		5.1		16.7	1.9
	Corbulidae	*Corbula* sp.			1.0										
	Cyrenidae	Cyrenidae													
		Batissa violacea			58.6		23.9	1.1			16.0				
		Geloina expansa	31.5	38.5	3.5		3.8	6.3		13.7					0.7
	Glauconomidae	*Glauconome rugosa*					0.1								0.3
	Gryphaeidae	*Hyotissa hyotis*													
	Lucinidae	*Anodontia edentula*		0.2		0.2	0.5	2.0	1.2			0.1			5.1
		Austriella corrugata	6.5	13.2	13.0	1.5	18.5	9.9	28.9	5.0	8.1	4.2	3.4	2.5	3.1
		Codakia tigerina													
	Mactridae	*Mactra* spp.				0.6		1.6		1.0				1.0	
		Mactra cuneata					1.2	2.3			11.3				2.6
	Malleidae	*Malleus* spp.					3.2								
	Mesodesmatidae	*Atactodea striata*	7.2	9.4	19.5		21.6	22.1	27.2	12.3	6.1	4.0	6.2	7.0	4.3
	Mytilidae	Mytilidae	0.1	0.2	0.3		0.5		0.1						
		Septifer bilocularis													
	Noetiidae	Noetiidae													
	Ostreidae	Ostreidae	54.0	143.3	229.6	117.1	211.8	173.7	339.1	37.3	30.2	15.4	5.7	8.6	7.5

			XU												
Class	**Family**	**Taxon**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
	Pectinidae	Pectinidae <10mm													
	Pinnidae	Pinnidae				0.4							0.1		
	Placunidae	*Placuna placenta*		25.6	10.4	1.6	9.1								
	Psammobiidae	*Asaphis violascens*		0.4	0.4	0.8	0.7	2.3	1.5	3.7	1.8	0.5		0.4	
		Gari occidens							0.4						
	Pteriidae	Pteriidae													
		Isognomon spp.	16.5	7.1	35.1	7.8	81.0	5.5	6.8	1.4	5.4	2.1	0.9	1.4	3.3
		Pinctada spp.													
		Pinctada maculata	5.2	0.5	1.1	1.1	1.9	0.8	4.0	0.5	0.4	0.6		0.1	0.6
	Spondylidae	*Spondylus* spp.	77.4		83.2		21.7		115.4						
	Tellinidae	Tellinidae													
		Quidnipagus palatam		1.2	0.8						0.9				
	Trapezidae	*Neotrapezium sublaevigatum*													
	Veneridae	Veneridae													
		Anomalodiscus squamosus			0.2	2.0	1.3	2.4							
		Dosinia sp.													
		Gafrarium spp.	64.8	71.1	114.5	87.3	115.7	155.3	164.0	51.2	43.3	31.7	18.9	14.2	12.1
		Gafrarium pectinatum	1.9	9.5	6.3	7.7	2.6	2.0	3.8	3.5		1.8			
		Gafrarium tumidum	117.6	222.4	214.7	204.7	499.5	392.8	432.2	139.5	45.2	58.1	46.6	29.9	2.8
		Irus carditoides <10mm													
		Periglypta puerpera	1.1		1.0		0.7	0.3	1.7	2.3	0.1				
		Pitar pellucidus		0.2	4.5		2.4							0.1	1.3
		Protapes gallus	3.9	0.9	10.3	0.5	6.2	11.6	2.2	7.5					1.4
		Venerupis aspera	0.8	0.9		0.5	4.6	0.5	0.8	0.9		1.0	1.0	0.3	0.2
Gastropoda	Amathinidae	*Amathina tricarinata* <10mm									<0.1				
	Angariidae	*Angaria delphinus*				0.4				0.9					
	Bullidae	*Bulla ampulla*		0.5	0.3		0.8	0.4	0.4	0.2			0.1	0.2	
	Calliostomatidae	*Calliostoma* spp.			0.3		<0.1						0.3		
	Cerithiidae	Cerithiidae		0.4									0.1		
		Cerithiidae <10mm	<0.1				<0.1				<0.1	0.2			
		Cerithium citrinum		0.6				0.2							
		Cerithium coralium							3.2		0.4				
		Cerithium nodulosum						40.8							
		Cerithium zonatum	0.2				0.6	0.1							
		Clypeomorus batillariaeformis	0.5	1.2	0.4		1.3	1.3					0.4		

			XU												
Class	**Family**	**Taxon**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
		Rhinoclavis vertagus								1.3					
	Chilodontaidae	*Euchelus atratus* <10mm						0.1							<0.1
	Columbellidae	Columbellidae													
		Mitrella scripta													
	Conidae	Conidae	0.4	0.1						3.8	1.0	3.4			
		Conus arenatus													
		Conus flavidus													
		Conus lividus													
		Conus tessulatus													
		Conus textile													
	Costellariidae	*Vexillum vulpecula*													
	Cymatiidae	Cymatiidae			0.4	0.7	<0.1					0.7			
		Monoplex vespaceus					2.1								
	Cypraeidae	Cypraeidae	11.3		0.5		0.1								
		Mauritia arabica													
		Monetaria annulus													
	Ellobiidae	Ellobiidae													
		Ellobiidae <10mm					<0.1								
		Cassidula spp.													
		Ellobium spp.	0.6		2.2	0.5	0.1	0.9	0.4					<0.1	0.4
		Ellobium aurisjudae													
	Epitoniidae	Epitoniidae <10mm													
	Fissurellidae	*Hemitoma* spp. <10mm		0.2	0.3	0.2		0.1	0.1					0.1	<0.1
	Littorinidae	*Littoraria* spp.		0.3	0.2								0.3		
		Littoraria spp. <10mm													
		Littoraria filosa								0.2					
		Littoraria scabra					0.1		0.6	0.3	<0.1				
	Muricidae	Muricidae													
		Chicoreus spp.						0.4	0.4	0.7	0.8		3.0	0.6	1.9
		Chicoreus capucinus			11.1										
		Drupella margariticola													
	Nassariidae	*Nassarius* spp.					0.2					0.1			
		Nassarius coronatus													
		Nassarius crematus		0.9							0.2			0.4	
		Nassarius olivaceus				0.5	1.0		1.2	0.4					
		Nassarius pullus													0.6
	Naticidae	Naticidae	1.3		1.5		0.1		0.9		0.1	0.5	0.3	1.3	1.3
		Mammilla sebae													
		Notocochlis gualtieriana		0.6	1.2	0.7									

			XU												
Class	**Family**	**Taxon**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
		Polinices mammilla		0.7		2.6	0.7	2.9		1.2		0.5			
	Neritidae	Neritidae													
		Neripteron violaceum													
		Nerita spp.	2.1	1.8	4.5	1.3	2.1	3.0	3.9	4.5	0.7		1.5	0.8	0.9
		Nerita albicilla								0.3		0.1			0.8
		Nerita balteata					1.3	0.5	0.6					0.5	0.1
		Nerita chamaeleon		2.9	1.8	0.5						0.6		1.4	0.4
		Nerita costata													
		Nerita planospira	0.8	0.2			1.2				0.7				0.2
		Nerita polita													
		Nerita undata		0.7		0.7									
	Olividae	Olividae			0.6										
		Miniaceoliva miniacea													
		Oliva elegans													
		Oliva oliva													
		Oliva reticulata													
		Oliva vidua													
	Patellidae	Patellidae													
		Patellidae <10mm													
	Pisaniidae	*Cantharus* sp.													
	Planaxidae	Planaxidae							0.4						
		Planaxis sulcatus		0.3		0.6		1.8						0.3	
	Potamididae	*Cerithideopsis largillierti*	0.2		0.4		0.1	0.8	0.3	0.2	0.4			0.3	0.1
		Pirinella cingulata													
		Telescopium telescopium		0.9	1.2	1.8	5.3	0.6	4.4	2.1	0.6	1.5	0.9	0.7	0.5
		Terebralia spp.													
		Terebralia palustris													
		Terebralia sulcata			0.4		0.5	3.3	1.3	2.0	0.2		2.0	1.6	5.4
	Strombidae	Strombidae	5.5	2.3	15.7			15.0		2.4		3.1		0.8	1.1
		Canarium labiatum				0.4	0.5								
		Canarium urceus													
		Conomurex luhuanus	63.1	178.1	96.2	129.4	55.4		72.9	8.8	30.6	18.1			
		Euprotomus aurisdianae													
		Gibberulus gibberulus	6.3	3.7	29.6										
		Laevistrombus canarium	54.7	69.6	92.2		73.2	26.8		0.9		18.5			
		Lambis spp.	109.1	321.5	382.5	0.8	263.1	185.1	499.6	104.2	34.2	40.7	19.3	8.0	9.4
		Lambis crocata													
		Lambis lambis	13.5		157.7			203.1	329.1	76.5					

			XU												
Class	**Family**	**Taxon**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
	Tegulidae	Tegulidae													
		Rochia nilotica													
		Tectus fenestratus		3.4		0.3	0.1	0.2	0.2	0.5	0.3	0.4		0.1	
	Terebridae	Terebridae													
	Tonnidae	*Tonna* sp.													
	Trochidae	Trochidae							0.4			0.2			
		Monodonta labio					1.0		0.3						
	Turbinellidae	*Vasum* sp.			7.9									3.0	
		Vasum turbinellus								48.8		3.0			
	Turbinidae	*Lunella cinerea*													
		Turbo spp.			0.4			0.3	0.4	0.3	0.1	0.6			0.8
	Vermetidae	Vermetidae		0.1	0.4	0.2	0.2	0.5	0.8	0.3		0.2			
Indeterminate	Indeterminate	Unidentified Shell	88.3	170.6	224.8	205.3	168.1	275.4	290.6	142.9	120.4	84.1	100.5	88.9	68.6
Total			**998.4**	**1854.3**	**2390.4**	**1093.1**	**1849.3**	**2513.9**	**2660.5**	**784.9**	**379.6**	**324.7**	**224.8**	**197.3**	**145.4**

			XU												
Class	**Family**	**Taxon**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**
Bivalvia	Arcidae	Arcidae	1.6	5.1	6.8	11.1	3.7	4.5	5.3	28.6	10.3	9.7	12.8	17.3	42.0
		Arcidae <10mm													
		Anadara antiquata	5.1	2.3	1.9	3.0	13.4	6.8	22.2	92.4	41.3	98.0	173.9	461.4	332.7
		Anadara rufescens												5.2	
		Arca ventricosa													
		Barbatia foliata								0.2				4.1	0.7
		Tegillarca granosa					0.5	2.9		8.1		116.6	21.1	12.3	35.2
	Cardiidae	Cardiidae	0.5			4.2	1.8	0.6	5.2	13.3	1.6	5.4	4.3		4.5
		Fragum spp.	12.7						0.7						
		Fragum unedo													
		Hippopus hippopus													
		Tridacna spp.												89.8	
		Tridacna squamosa											309.2		291.1
		Vasticardium flavum												13.1	12.4
	Chamidae	*Chama* spp.	16.1	0.3	1.3	4.1	5.3	1.5	12.1	72.2	4.1	21.3	44.2	93.0	103.1
	Corbulidae	*Corbula* sp.													
	Cyrenidae	Cyrenidae								3.2					0.9
		Batissa violacea					5.3		6.6	2.9	10.3	3.0	11.9	48.0	48.9
		Geloina expansa						6.4	12.5	38.2	14.1	18.7	40.2	72.6	44.6
	Glauconomidae	*Glauconome rugosa*	0.1						0.1	0.2		0.2		0.1	2.1
	Gryphaeidae	*Hyotissa hyotis*												115.9	

			XU												
Class	**Family**	**Taxon**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**
	Lucinidae	*Anodontia edentula*	0.1										0.2	1.3	2.8
		Austriella corrugata	6.8	6.8	6.8	5.5	3.2	3.4	14.0	35.8	21.0	11.5	53.5	62.4	76.1
		Codakia tigerina													
	Mactridae	*Mactra* spp.	0.2		0.1			0.5	1.6		0.5	0.8	0.2	0.5	0.7
		Mactra cuneata								1.7					
	Malleidae	*Malleus* spp.													
	Mesodesmatidae	*Atactodea striata*	2.4	6.2	3.5	6.6	10.8	4.4	2.9	7.8	5.4		4.0	7.1	13.4
	Mytilidae	Mytilidae		0.2	0.1	0.4	0.1			0.1			0.2	0.1	
		Septifer bilocularis													
	Noetiidae	Noetiidae													
	Ostreidae	Ostreidae	4.4	22.9	64.8	66.4	16.2	19.0	22.6	86.5	37.8	34.0	112.8	267.0	347.6
	Pectinidae	Pectinidae <10mm													
	Pinnidae	Pinnidae								0.3			4.2		
	Placunidae	*Placuna placenta*	0.2						0.7						
	Psammobiidae	*Asaphis violascens*	0.5		0.6			0.8	0.5			0.5	7.7		2.4
		Gari occidens													
	Pteriidae	Pteriidae													
		Isognomon spp.	3.4	4.3	12.1	4.9	10.6	9.0	11.0	31.2	9.3	34.9	31.0	136.2	255.7
		Pinctada spp.								9.3			0.9		
		Pinctada maculata	1.4	1.3	0.6	1.4	2.0	2.4	2.9	5.5	9.3	4.1	1.7	18.4	22.5
	Spondylidae	*Spondylus* spp.												2.5	32.4
	Tellinidae	Tellinidae									0.2		0.1		
		Quidnipagus palatam			0.4						0.8		0.2		
	Trapezidae	*Neotrapezium sublaevigatum*		0.1											
	Veneridae	Veneridae													5.0
		Anomalodiscus squamosus						0.3		1.0					
		Dosinia sp.												0.5	
		Gafrarium spp.	13.6	13.3	20.3	13.6	12.5	7.5	12.7	26.6	14.0	11.6	10.1	24.3	28.1
		Gafrarium pectinatum	0.4	0.4						2.6	1.3	1.1	11.5		
		Gafrarium tumidum	30.5	10.5	7.1	13.9			4.7	18.5	25.3	28.2	14.5	112.4	189.9
		Irus carditoides <10mm													
		Periglypta puerpera				0.2					5.0				0.4
		Pitar pellucidus						0.1					2.3	0.1	
		Protapes gallus	0.5	0.1			4.5			8.5			1.8		1.6
		Venerupis aspera	0.4	1.0	0.9	2.5	2.5	2.0	1.0	6.0	4.7	1.3	7.4	18.0	12.2
Gastropoda	Amathinidae	*Amathina tricarinata* <10mm												<0.1	

			XU												
Class	**Family**	**Taxon**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**
	Angariidae	*Angaria delphinus*													
	Bullidae	*Bulla ampulla*		0.5			0.2								
	Calliostomatidae	*Calliostoma* spp.	0.2	<0.1			0.2			0.2			0.2	0.4	
	Cerithiidae	Cerithiidae		0.1					0.3					0.7	0.7
		Cerithiidae <10mm	<0.1						0.1					0.2	
		Cerithium citrinum								0.3			0.4	0.1	
		Cerithium coralium	0.3			0.3			0.4		0.3			0.2	
		Cerithium nodulosum													
		Cerithium zonatum													
		Clypeomorus batillariaeformis						0.6		0.4	0.6	0.4	0.3		0.8
		Rhinoclavis vertagus							3.7						
	Chilodontaidae	*Euchelus atratus* <10mm	0.1	<0.1	0.1			0.8							
	Columbellidae	Columbellidae													
		Mitrella scripta					0.2			0.6					
	Conidae	Conidae	1.8		0.5					4.8	6.0				6.7
		Conus arenatus													
		Conus flavidus													
		Conus lividus													
		Conus tessulatus													2.0
		Conus textile													
	Costellariidae	*Vexillum vulpecula*						0.6						0.3	
	Cymatiidae	Cymatiidae			5.2										
		Monoplex vespaceus													
	Cypraeidae	Cypraeidae			0.5		0.3		1.0					2.4	1.4
		Mauritia arabica													
		Monetaria annulus													
	Ellobiidae	Ellobiidae						0.9							
		Ellobiidae <10mm	<0.1											0.2	
		Cassidula spp.													
		Ellobium spp.	0.5		1.0	0.4	0.2	1.2	0.5	2.2	1.3	1.7	0.6		
		Ellobium aurisjudae											0.5	5.1	4.6
	Epitoniidae	Epitoniidae <10mm													
	Fissurellidae	*Hemitoma* spp. <10mm	0.1		0.1	0.1	<0.1	<0.1							0.2
	Littorinidae	*Littoraria* spp.			0.1							0.3			
		Littoraria spp. <10mm					<0.1								

			XU												
Class	**Family**	**Taxon**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**
		Littoraria filosa													0.6
		Littoraria scabra	0.2						0.4	0.2				1.2	1.5
	Muricidae	Muricidae													
		Chicoreus spp.	4.0	0.4	0.3	0.8	2.2	2.7	3.7	16.1	9.1	6.2	16.7		15.4
		Chicoreus capucinus												19.3	
		Drupella margariticola													0.5
	Nassariidae	*Nassarius* spp.						0.2	0.3		0.3	0.4	0.3		
		Nassarius coronatus													
		Nassarius crematus			1.0					1.3				0.9	2.7
		Nassarius olivaceus		0.9					1.0	0.6	0.8		1.7	0.5	1.2
		Nassarius pullus								0.5					
	Naticidae	Naticidae		0.2		0.9	0.3	0.4	0.1		0.3			0.1	0.2
		Mammilla sebae													
		Notocochlis gualtieriana													
		Polinices mammilla			0.8	5.1		1.1	1.3	2.2	1.1	1.3	6.4	8.9	8.2
	Neritidae	Neritidae													0.2
		Neripteron violaceum													
		Nerita spp.	1.2	3.5	1.1	0.7	2.0	2.7	1.4	7.3	6.9	1.8	4.6	6.5	5.7
		Nerita albicilla				0.1	0.1		0.4	0.8	0.3		1.6	3.3	3.2
		Nerita balteata						0.6		0.9	0.9		0.9	1.4	0.9
		Nerita chamaeleon							0.8	0.4	0.6	1.2	0.6	1.7	0.8
		Nerita costata									0.9				
		Nerita planospira	1.4	0.1	0.5	0.2				0.2				0.9	0.3
		Nerita polita													
		Nerita undata									0.8			0.7	4.5
	Olividae	Olividae	0.3						1.5	2.2		1.2	0.3	5.7	11.5
		Miniaceoliva miniacea													
		Oliva elegans													
		Oliva oliva													
		Oliva reticulata													
		Oliva vidua													
	Patellidae	Patellidae													
		Patellidae <10mm													
	Pisaniidae	*Cantharus* sp.													
	Planaxidae	Planaxidae													
		Planaxis sulcatus						0.9		1.8		0.6	0.3	0.1	
	Potamididae	*Cerithideopsis largillierti*	0.4	0.1	0.1	<0.1	0.1	0.3	0.5	2.0	1.7	0.4	0.2	1.6	2.6
		Pirinella cingulata		0.1											

Class	Family	Taxon	XU 41	42	43	44	45	46	47	48	49	50	51	52	53
		Telescopium telescopium	2.3	0.6	3.8	6.4	16.2	8.6	3.2	4.6	0.9	0.5	0.2	6.0	0.4
		Terebralia spp.											0.5		
		Terebralia palustris													
		Terebralia sulcata	5.1	2.1	6.2	6.9	2.3	1.4	3.3	4.7	3.9	0.8	3.8	5.1	10.6
	Strombidae	Strombidae	0.8		0.4	1.3		0.3		5.3	2.3	1.9			0.7
		Canarium labiatum								0.8					
		Canarium urceus													
		Conomurex luhuanus	16.1				1.7			10.9					
		Euprotomus aurisdianae											1.9		
		Gibberulus gibberulus				1.2	0.6	0.4		6.5					
		Laevistrombus canarium		29.0	14.2	52.5					1.6			74.3	18.6
		Lambis spp.	22.2	19.0	56.0	7.1	28.1	10.4	4.3	15.1	6.3	15.8	4.6	73.3	
		Lambis crocata													
		Lambis lambis			0.9		164.7							95.1	173.9
	Tegulidae	Tegulidae									1.2				
		Rochia nilotica													
		Tectus fenestratus						0.5							8.4
	Terebridae	Terebridae													
	Tonnidae	*Tonna* sp.													
	Trochidae	Trochidae	0.3			0.5					0.3				4.1
		Monodonta labio			0.1									0.4	
	Turbinellidae	*Vasum* sp.													
		Vasum turbinellus	3.9		16.8		4.1			5.5					
	Turbinidae	*Lunella cinerea*		1.2			1.8	1.3		2.0	1.0	0.3	1.8	2.3	0.5
		Turbo spp.			0.6			0.2		1.6	0.4		0.7	4.8	
	Vermetidae	Vermetidae	<0.1	<0.1			0.7	0.1	<0.1		0.2	0.2			0.1
Indeterminate	Indeterminate	Unidentified Shell	61.8	78.5	107.5	93.0	108.2	113.8	140.9	284.1	149.2	152.3	178.8	351.3	280.0
Total			**223.9**	**211.1**	**345.1**	**315.3**	**426.6**	**222.2**	**308.4**	**886.8**	**415.5**	**588.2**	**1109.8**	**2258.6**	**2482.7**

Class	Family	Taxon	XU 54	55	56	57	58	59	60	61	62	63	64	65	66
Bivalvia	Arcidae	Arcidae	28.1	16.6	18.0	11.4	27.1	12.5	14.8	15.7		14.6	6.4	7.6	3.0
		Arcidae <10mm													
		Anadara antiquata	207.3	226.1	344.2	97.1	237.4	432.4	231.6	261.0		141.3	148.9	122.4	329.5
		Anadara rufescens			3.6								7.6	7.5	10.2

			XU												
Class	**Family**	**Taxon**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**
		Arca ventricosa													
		Barbatia foliata	0.1	4.0		0.5	0.2			2.2		2.7			
		Tegillarca granosa	5.4	54.8	52.7	31.4		1.1	1.2	15.0			9.5		
	Cardiidae	Cardiidae	1.0	5.5	15.0	0.8		1.4	1.0	1.0		6.5	1.5		
		Fragum spp.													
		Fragum unedo													
		Hippopus hippopus				137.4		137.4						42.0	
		Tridacna spp.	84.4	94.8				3.6							
		Tridacna squamosa													
		Vasticardium flavum	5.9				16.8	6.4	39.9	4.4		34.1	8.7	11.1	18.0
	Chamidae	*Chama* spp.	131.2	36.6	189.5	146.7	167.4	15.8	388.2	408.0		134.9	235.7	514.0	695.5
	Corbulidae	*Corbula* sp.													
	Cyrenidae	Cyrenidae			5.8										
		Batissa violacea	39.7	71.4	19.2	4.6	38.0	46.0	25.1	14.7		14.3	3.9		10.1
		Geloina expansa	39.9	90.3	12.4	20.8	21.8	40.7	8.2	71.5		19.0	28.3	40.7	38.4
	Glauconomidae	*Glauconome rugosa*						3.4	0.2	0.2			2.7		0.2
	Gryphaeidae	*Hyotissa hyotis*											174.9		
	Lucinidae	*Anodontia edentula*	0.4	7.1								14.5	4.4		25.4
		Austriella corrugata	26.2	68.4	52.5	51.0	63.7	77.9	32.8	55.4		58.6	62.3	111.1	111.8
		Codakia tigerina													
	Mactridae	*Mactra* spp.	0.2	2.9			0.3		1.6	0.3		1.4	0.4	6.2	4.5
		Mactra cuneata						3.4					5.5	5.2	13.8
	Malleidae	*Malleus* spp.											25.9	4.9	23.5
	Mesodesmatidae	*Atactodea striata*	2.8	9.0	7.8	3.8	4.9	18.4	9.3	8.0		13.6	19.6	14.3	42.8
	Mytilidae	Mytilidae		0.4	0.2	0.2	0.6	0.3	<0.1	0.4		0.2	<0.1	0.1	0.1
		Septifer bilocularis													
	Noetiidae	Noetiidae							0.1						
	Ostreidae	Ostreidae	264.1	307.3	159.8	76.7	161.7	332.0	114.8	190.4		167.8	163.8	83.1	129.1
	Pectinidae	Pectinidae <10mm													
	Pinnidae	Pinnidae							3.8				7.0		0.5
	Placunidae	*Placuna placenta*											8.8		
	Psammobiidae	*Asaphis violascens*	0.5	0.5	5.4	0.2	0.6	0.1	0.8	1.3		2.2	2.2	0.4	2.1
		Gari occidens													
	Pteriidae	Pteriidae													
		Isognomon spp.	93.3	124.7	123.5	67.5	73.5	77.8	43.8	40.0		22.6	32.0	14.0	18.6
		Pinctada spp.		3.3					4.4				44.0	36.9	
		Pinctada maculata	11.1		42.4	28.4	12.1		7.2	12.8		12.6	10.5	11.0	40.4
	Spondylidae	*Spondylus* spp.		36.9									89.6		
	Tellinidae	Tellinidae				2.7	0.3							0.1	
		Quidnipagus palatam		0.1			0.6	1.7	3.3	0.5				0.1	

			XU												
Class	**Family**	**Taxon**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**
	Trapezidae	*Neotrapezium sublaevigatum*													
	Veneridae	Veneridae													
		Anomalodiscus squamosus													
		Dosinia sp.													
		Gafrarium spp.	17.6	23.3	14.0	15.5	24.0	32.6	11.7	27.8		26.7	18.2	14.7	11.4
		Gafrarium pectinatum	1.1	5.6	2.6		4.3	3.7	3.5			6.8	0.7	11.2	13.4
		Gafrarium tumidum	28.6	67.5	67.2	45.1	50.9	154.7	30.3	73.8		29.8	29.5	49.7	53.2
		Irus carditoides <10mm												<0.1	
		Periglypta puerpera					0.8	25.1						3.4	
		Pitar pellucidus					0.4	0.4							
		Protapes gallus		2.2								1.2	4.0		
		Venerupis aspera	5.6	12.4	8.1	5.8	8.0	13.6	5.6	13.0		8.6	6.1	11.1	13.8
Gastropoda	Amathinidae	*Amathina tricarinata* <10mm			0.1	0.1				0.1					
	Angariidae	*Angaria delphinus*													
	Bullidae	*Bulla ampulla*								0.1		0.1	0.1		
	Calliostomatidae	*Calliostoma* spp.	<0.1	0.3	0.3	0.3		0.4	0.3	1.3					
	Cerithiidae	Cerithiidae											<0.1		
		Cerithiidae <10mm					<0.1		0.1					0.1	
		Cerithium citrinum	0.4	0.5	0.2	0.2		0.1	1.1			0.3		0.7	
		Cerithium coralium								0.3		0.3			0.4
		Cerithium nodulosum													
		Cerithium zonatum													
		Clypeomorus batillariaeformis	1.2	0.4	0.5	0.3	0.6	0.9	0.5			1.3	0.4	0.8	
		Rhinoclavis vertagus													
	Chilodontaidae	*Euchelus atratus* <10mm				0.1	0.2			0.1		0.3			
	Columbellidae	Columbellidae													
		Mitrella scripta	0.5												
	Conidae	Conidae	2.5	5.9				2.4					2.1	35.0	44.4
		Conus arenatus		0.1								0.4			9.1
		Conus flavidus	7.2												
		Conus lividus													33.1
		Conus tessulatus								4.5					
		Conus textile													
	Costellariidae	*Vexillum vulpecula*													
	Cymatiidae	Cymatiidae													

			XU												
Class	**Family**	**Taxon**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**
		Monoplex vespaceus													
	Cypraeidae	Cypraeidae			2.1	0.1				9.1					6.8
		Mauritia arabica						4.2							
		Monetaria annulus					1.4								
	Ellobiidae	Ellobiidae													
		Ellobiidae <10mm	<0.1	0.1	0.1							<0.1			<0.1
		Cassidula spp.													
		Ellobium spp.	0.6		2.3	3.8				4.1				0.1	5.9
		Ellobium aurisjudae		4.3			3.1	6.8	2.5			6.4	7.0	3.2	
	Epitoniidae	Epitoniidae <10mm													
	Fissurellidae	*Hemitoma* spp. <10mm	<0.1	0.1										0.1	<0.1
	Littorinidae	*Littoraria* spp.										0.2			
		Littoraria spp. <10mm													
		Littoraria filosa								0.1					
		Littoraria scabra		0.9	0.7	0.9	0.7	1.8	0.4	1.5		0.3	1.1	2.1	1.8
	Muricidae	Muricidae													
		Chicoreus spp.	13.8	12.4	18.5	6.6	18.1	34.2	11.7	19.1		11.4	13.7	17.5	21.2
		Chicoreus capucinus											11.7		
		Drupella margariticola													
	Nassariidae	*Nassarius* spp.		0.3	0.4	0.8	<0.1	0.7				0.6		0.3	1.6
		Nassarius coronatus													
		Nassarius crematus					0.4		1.2	0.2			3.0		
		Nassarius olivaceus		0.1	2.7	0.4	0.9	0.4	0.3			1.8	1.3	1.4	1.7
		Nassarius pullus			0.3									0.8	
	Naticidae	Naticidae		0.2	0.9	1.3	1.8	1.8	1.1	0.8		0.2	2.0		0.3
		Mammilla sebae								4.2					
		Notocochlis gualtieriana				1.6									
		Polinices mammilla	1.1	3.5	6.5	5.0	5.6	8.7	2.8	10.9		7.5	6.8	12.5	11.5
	Neritidae	Neritidae		<0.1			0.1								0.8
		Neripteron violaceum											<0.1		
		Nerita spp.	4.5	3.9	9.1	8.9	9.8	11.9	7.3	7.7		3.3	5.9	7.8	7.7
		Nerita albicilla	7.6	4.5	13.6	2.4	2.0		0.7	8.8		6.8	1.1		1.2
		Nerita balteata	4.1	2.2	2.1	6.7	1.1	1.2		1.5		1.9	3.1	1.0	6.4
		Nerita chamaeleon		1.9		3.5		4.2	2.2			3.5		1.9	
		Nerita costata													
		Nerita planospira	1.9	1.4	0.2	0.4	0.9	0.6	0.5	4.8		1.5		0.6	3.3

			XU												
Class	**Family**	**Taxon**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**
		Nerita polita													
		Nerita undata	1.5	1.3	1.1	1.4	2.5	1.4	0.7	0.2		1.5	1.0	0.7	3.6
	Olividae	Olividae		6.5				7.8				1.9	1.6	0.1	0.9
		Miniaceoliva miniacea		5.5											
		Oliva elegans							3.6						
		Oliva oliva													1.9
		Oliva reticulata			2.3								13.7		
		Oliva vidua							3.0						
	Patellidae	Patellidae													
		Patellidae <10mm													
	Pisaniidae	*Cantharus* sp.								0.5					
	Planaxidae	Planaxidae													
		Planaxis sulcatus			0.3	0.3	0.7	1.8	0.2	1.5		0.4	0.8		
	Potamididae	*Cerithideopsis largillierti*	1.8	5.3	0.5	2.3	2.1	4.7	1.0	2.2		3.9	4.4	5.1	5.7
		Pirinella cingulata					0.3						0.1		
		Telescopium telescopium	0.3	1.8	1.6		5.6	1.4		0.2		0.2	0.3	1.0	0.1
		Terebralia spp.													
		Terebralia palustris													
		Terebralia sulcata	5.3	4.6	4.2	6.3	6.7		9.9	10.6		8.0	1.9	3.9	4.0
	Strombidae	Strombidae			1.1		7.7			5.6		0.4	0.2		
		Canarium labiatum													
		Canarium urceus													
		Conomurex luhuanus					20.4								
		Euprotomus aurisdianae													
		Gibberulus gibberulus	0.7												
		Laevistrombus canarium	11.4	45.1		23.0		16.2	43.2			17.4	22.0	1.9	5.4
		Lambis spp.	11.1	16.2	43.2		11.5	14.4		80.6			128.7	14.0	44.3
		Lambis crocata													131.4
		Lambis lambis		148.3		136.1	99.6		68.7			91.6	128.0	200.1	291.6
	Tegulidae	Tegulidae													
		Rochia nilotica				5.5		24.8		7.0				5.5	122.2
		Tectus fenestratus													
	Terebridae	Terebridae						0.1							
	Tonnidae	*Tonna* sp.													
	Trochidae	Trochidae	0.6		2.9				2.0			3.5	2.6	0.6	3.9
		Monodonta labio						0.5	0.2						0.2
	Turbinellidae	*Vasum* sp.													
		Vasum turbinellus													

			XU												
Class	**Family**	**Taxon**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**
	Turbinidae	*Lunella cinerea*			2.1	1.0	0.1	5.1	0.6	7.1				1.0	
		Turbo spp.	0.6	0.6	0.8	1.6	4.5	0.9	0.5	0.1		1.3	7.6	1.1	0.3
	Vermetidae	Vermetidae	<0.1	0.4		0.1			1.8	0.2			0.1	0.3	0.9
Indeterminate	Indeterminate	Unidentified Shell	225.7	307.5	304.3	311.8	231.8	377.6	203.4	284.1	87.5	231.5	245.3	157.5	279.3
Total			**1299.0**	**1857.8**	**1568.9**	**1280.4**	**1355.7**	**1979.4**	**1354.7**	**1696.5**	**87.5**	**1143.7**	**1780.3**	**1601.4**	**2662.2**

			XU												
Class	**Family**	**Taxon**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**
Bivalvia	Arcidae	Arcidae	8.4		2.8	5.4	1.1	6.9	0.8	1.9	4.4	1.2		0.2	
		Arcidae <10mm						<0.1					0.1		
		Anadara antiquata	141.8	59.1	229.7	344.3	129.6	55.0	50.7	1.4		4.2	19.4	0.7	3.5
		Anadara rufescens	5.7		4.0										
		Arca ventricosa													
		Barbatia foliata								0.3	1.3		0.2		
		Tegillarca granosa									2.5				
	Cardiidae	Cardiidae		5.9		0.9	0.9	1.1			0.9				
		Fragum spp.			0.6										
		Fragum unedo													
		Hippopus hippopus													
		Tridacna spp.													
		Tridacna squamosa													
		Vasticardium flavum													
	Chamidae	*Chama* spp.	139.0	23.3	125.7	73.7	38.6	36.2	10.8	0.6				1.7	0.7
	Corbulidae	*Corbula* sp.													
	Cyrenidae	Cyrenidae									0.8				
		Batissa violacea	1.9		14.5			2.3		7.8					
		Geloina expansa				39.6	10.1			15.3					
	Glauconomidae	*Glauconome rugosa*	0.2		0.2	0.6			0.1						
	Gryphaeidae	*Hyotissa hyotis*													
	Lucinidae	*Anodontia edentula*			0.3								0.4		2.4
		Austriella corrugata	41.7	4.1	1.2	7.1	1.5	9.7	4.1	14.0	5.2	5.1	2.6	1.6	3.1
		Codakia tigerina													
	Mactridae	*Mactra* spp.						0.7	1.9		0.5			0.2	1.7
		Mactra cuneata	14.3	3.3	7.8	6.5				7.2					
	Malleidae	*Malleus* spp.													
	Mesodesmatidae	*Atactodea striata*	34.5	9.3	33.6	53.5	44.9	46.0	18.4	7.8	18.6	11.0	3.3	4.9	2.9
	Mytilidae	Mytilidae	0.4			0.1	0.2	0.1			0.3	0.1			

			XU												
Class	**Family**	**Taxon**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**
		Septifer bilocularis									1.4			3.4	
	Noetiidae	Noetiidae													
	Ostreidae	Ostreidae	94.8	7.0	28.2	10.4	10.2	6.7	3.7	1.9	4.3	0.7	2.4	0.4	
	Pectinidae	Pectinidae <10mm													
	Pinnidae	Pinnidae	0.2												
	Placunidae	*Placuna placenta*													
	Psammobiidae	*Asaphis violascens*	7.2	0.3	1.7				0.2		1.9				
		Gari occidens									0.2				0.2
	Pteriidae	Pteriidae													
		Isognomon spp.	8.0	2.1	8.9	5.0	1.3	2.3	3.9	12.9	3.5	1.8	2.1		3.2
		Pinctada spp.				0.8	0.7	1.3	0.4	0.9					
		Pinctada maculata	3.6	10.2	1.0						4.2				
	Spondylidae	*Spondylus* spp.			31.1										
	Tellinidae	Tellinidae				0.8			0.3	0.4	0.2				
		Quidnipagus palatam													
	Trapezidae	*Neotrapezium sublaevigatum*													
	Veneridae	Veneridae													
		Anomalodiscus squamosus													
		Dosinia sp.													
		Gafrarium spp.	6.2	8.1	3.7	5.1	4.2	0.6	1.5	0.4		0.6	2.1	2.2	0.4
		Gafrarium pectinatum	3.2		1.3	2.0					2.2				
		Gafrarium tumidum	70.4	19.6	17.8	7.6	11.9	21.1			1.9	14.7			
		Irus carditoides <10mm	<0.1								0.1				
		Periglypta puerpera		5.2											
		Pitar pellucidus	1.8						0.1						
		Protapes gallus			2.8	5.8									
		Venerupis aspera	10.0	0.7	2.2	1.4	4.8	3.8	1.2	0.7	1.8	0.5	1.5	0.4	0.4
Gastropoda	Amathinidae	*Amathina tricarinata* <10mm													
	Angariidae	*Angaria delphinus*													
	Bullidae	*Bulla ampulla*	0.1												
	Calliostomatidae	*Calliostoma* spp.	0.2								0.3				
	Cerithiidae	Cerithiidae												<0.1	
		Cerithiidae <10mm							0.1						
		Cerithium citrinum	<0.1												
		Cerithium coralium	0.2		0.5										

			XU												
Class	**Family**	**Taxon**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**
		Cerithium nodulosum													
		Cerithium zonatum	1.0												
		Clypeomorus batillariaeformis				0.4	0.2								
		Rhinoclavis vertagus													
	Chilodontaidae	*Euchelus atratus* <10mm								0.1					
	Columbellidae	Columbellidae													
		Mitrella scripta													
	Conidae	Conidae	2.7			2.7	0.8								
		Conus arenatus													
		Conus flavidus													
		Conus lividus													
		Conus tessulatus													
		Conus textile													
	Costellariidae	*Vexillum vulpecula*													
	Cymatiidae	Cymatiidae	1.0												
		Monoplex vespaceus													
	Cypraeidae	Cypraeidae	1.1		3.2	0.1									
		Mauritia arabica													
		Monetaria annulus													
	Ellobiidae	Ellobiidae													
		Ellobiidae <10mm						0.1							
		Cassidula spp.													
		Ellobium spp.		0.1		1.6	0.4	0.8	0.1	0.1		0.3	0.5		
		Ellobium aurisjudae	1.2		1.7										
	Epitoniidae	Epitoniidae <10mm													
	Fissurellidae	*Hemitoma* spp. <10mm													
	Littorinidae	*Littoraria* spp.													
		Littoraria spp. <10mm													
		Littoraria filosa	0.2												
		Littoraria scabra	2.0		0.5	0.5	<0.1		0.4	0.5		0.4			
	Muricidae	Muricidae													
		Chicoreus spp.	12.8	1.2	7.4	6.8	6.6	1.7	1.0	2.1	0.7				0.2
		Chicoreus capucinus													
		Drupella margariticola													
	Nassariidae	*Nassarius* spp.		0.1	0.6			0.1				0.3			
		Nassarius coronatus													
		Nassarius crematus	1.2			1.2									

			XU												
Class	**Family**	**Taxon**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**
		Nassarius olivaceus				0.3	0.5			0.3					
		Nassarius pullus											0.4		
	Naticidae	Naticidae	2.4		0.7		0.6	1.1							
		Mammilla sebae													
		Notocochlis gualtieriana													
		Polinices mammilla	5.0			1.9	0.6	1.0	1.6				1.0		
	Neritidae	Neritidae													
		Neripteron violaceum													
		Nerita spp.	7.9	1.6	1.2	4.9	2.3	3.0	2.2	2.4	0.9	1.6		0.7	1.0
		Nerita albicilla	4.6					1.9	2.6						
		Nerita balteata	1.5		0.3	0.8		0.4							
		Nerita chamaeleon	3.3		1.1	0.5					0.9				
		Nerita costata													
		Nerita planospira	0.3			0.6	0.1	0.5	0.2		1.1				
		Nerita polita													
		Nerita undata	2.2	0.8	0.7			1.7	0.1		0.8			1.5	0.6
	Olividae	Olividae				2.6			0.3						
		Miniaceoliva miniacea													
		Oliva elegans					4.2								
		Oliva oliva	1.4												
		Oliva reticulata													
		Oliva vidua													
	Patellidae	Patellidae													
		Patellidae <10mm													
	Pisaniidae	*Cantharus* sp.													
	Planaxidae	Planaxidae													
		Planaxis sulcatus	0.6		0.3	0.4	0.3				0.1				
	Potamididae	*Cerithideopsis largillierti*	3.8	0.7	2.7	6.1	2.4	2.9	2.9	0.6	1.1			0.4	0.4
		Pirinella cingulata													
		Telescopium telescopium	0.1			1.2		0.2						0.5	0.5
		Terebralia spp.					0.3	0.3	0.3			0.3			
		Terebralia palustris													
		Terebralia sulcata	2.1		0.1	0.9					5.7				
	Strombidae	Strombidae					0.1								
		Canarium labiatum													
		Canarium urceus													
		Conomurex luhuanus													

			XU												
Class	**Family**	**Taxon**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**
		Euprotomus aurisdianae													
		Gibberulus gibberulus													
		Laevistrombus canarium	0.8			7.2			6.4				1.1		
		Lambis spp.	3.2	2.1	1.9	11.7	16.6	6.0	0.3						
		Lambis crocata													
		Lambis lambis	319.0												
	Tegulidae	Tegulidae													
		Rochia nilotica													
		Tectus fenestratus													
	Terebridae	Terebridae													
	Tonnidae	*Tonna* sp.	6.1			0.3									
	Trochidae	Trochidae	1.4							1.8	1.5	1.6	1.0	0.3	0.7
		Monodonta labio				2.1						0.2			
	Turbinellidae	*Vasum* sp.													
		Vasum turbinellus													
	Turbinidae	*Lunella cinerea*		0.8		5.1		3.6					0.1	0.3	
		Turbo spp.	0.4			0.2	1.0	0.6	0.4						0.6
	Vermetidae	Vermetidae	<0.1												
Indeterminate	Indeterminate	Unidentified Shell	117.1	12.4	97.1	70.7	39.4	41.7	43.0	28.1	46.8	20.5	15.4	27.6	18.8
Total			**1100.3**	**177.9**	**639.1**	**701.4**	**336.4**	**261.4**	**160.0**	**109.5**	**116.1**	**65.1**	**53.6**	**47.0**	**41.3**

			XU												
Class	**Family**	**Taxon**	**80**	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**
Bivalvia	Arcidae	Arcidae	1.8	2.6	0.3	11.1	9.4	8.7	11.2	5.1	4.6	7.0	0.9		
		Arcidae <10mm	0.3	0.2											
		Anadara antiquata		5.4	0.1	15.7	2.6	108.3	37.9	11.7	1.5	0.4	0.2		
		Anadara rufescens													
		Arca ventricosa													
		Barbatia foliata		5.8											
		Tegillarca granosa													
	Cardiidae	Cardiidae					0.1	0.8	0.3	0.5		0.2			
		Fragum spp.													
		Fragum unedo													
		Hippopus hippopus													
		Tridacna spp.													
		Tridacna squamosa													
		Vasticardium flavum													

			XU												
Class	**Family**	**Taxon**	**80**	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**
	Chamidae	*Chama* spp.	4.8		3.0			0.6	7.3				1.2		
	Corbulidae	*Corbula* sp.													
	Cyrenidae	Cyrenidae	0.6												
		Batissa violacea							4.7			3.4			
		Geloina expansa	2.0			3.4		11.9	4.8	3.3		3.9			
	Glauconomidae	*Glauconome rugosa*													
	Gryphaeidae	*Hyotissa hyotis*													
	Lucinidae	*Anodontia edentula*		0.3											
		Austriella corrugata	20.6	3.2	3.7	2.5	3.1	4.4	7.0	3.6	2.6	0.9	3.7	0.7	6.0
		Codakia tigerina													
	Mactridae	*Mactra* spp.		0.8	2.1	1.6									1.3
		Mactra cuneata	0.4					2.6	1.5	3.6					
	Malleidae	*Malleus* spp.													
	Mesodesmatidae	*Atactodea striata*	2.7	7.3	5.9	2.0	2.9	3.5	0.7	1.8	1.4		3.8		1.8
	Mytilidae	Mytilidae			0.3	0.4		0.1	1.2						
		Septifer bilocularis						3.8	3.7			1.8			
	Noetiidae	Noetiidae													
	Ostreidae	Ostreidae	3.0	0.8	5.3	0.1	0.8	0.3	0.4	1.2	0.6			0.2	0.2
	Pectinidae	Pectinidae <10mm													
	Pinnidae	Pinnidae													
	Placunidae	*Placuna placenta*													
	Psammobiidae	*Asaphis violascens*													
		Gari occidens													
	Pteriidae	Pteriidae													
		Isognomon spp.	0.9	4.3	4.7	0.2	0.3					0.2			1.0
		Pinctada spp.							0.3			0.3		0.7	
		Pinctada maculata													
	Spondylidae	*Spondylus* spp.													
	Tellinidae	Tellinidae		0.4	0.6				0.2			0.1			
		Quidnipagus palatam		0.2											
	Trapezidae	*Neotrapezium sublaevigatum*													
	Veneridae	Veneridae													
		Anomalodiscus squamosus													
		Dosinia sp.													
		Gafrarium spp.	0.7	0.2	3.3	1.3	3.8	2.5	2.7	0.8	1.4	1.6	1.2	2.1	1.7
		Gafrarium pectinatum						6.3	1.1						
		Gafrarium tumidum		8.6				8.5	0.3	3.2	9.7	4.1	1.7	23.5	
		Irus carditoides <10mm				<0.1									
		Periglypta puerpera			0.3		0.2		8.3					0.7	

			XU												
Class	**Family**	**Taxon**	**80**	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**
		Pitar pellucidus													
		Protapes gallus						2.2	0.8						
		Venerupis aspera	0.4	0.8	0.8	0.4	0.8	1.4		0.5			0.4		0.7
Gastropoda	Amathinidae	*Amathina tricarinata* <10mm													
	Angariidae	*Angaria delphinus*													
	Bullidae	*Bulla ampulla*													
	Calliostomatidae	*Calliostoma* spp.						0.2				2.1			
	Cerithiidae	Cerithiidae								0.1		0.8			
		Cerithiidae <10mm								<0.1					
		Cerithium citrinum	<0.1						<0.1						
		Cerithium coralium													
		Cerithium nodulosum													
		Cerithium zonatum													
		Clypeomorus batillariaeformis							0.4						
		Rhinoclavis vertagus													
	Chilodontaidae	*Euchelus atratus* <10mm							0.1			0.2			
	Columbellidae	Columbellidae													
		Mitrella scripta													
	Conidae	Conidae		0.4											
		Conus arenatus													
		Conus flavidus													
		Conus lividus													
		Conus tessulatus													
		Conus textile													
	Costellariidae	*Vexillum vulpecula*													
	Cymatiidae	Cymatiidae													
		Monoplex vespaceus													
	Cypraeidae	Cypraeidae								<0.1					
		Mauritia arabica													
		Monetaria annulus													
	Ellobiidae	Ellobiidae												0.1	
		Ellobiidae <10mm													
		Cassidula spp.													
		Ellobium spp.		2.1	0.9	5.3	0.3			0.7		0.4		0.4	0.4
		Ellobium aurisjudae						5.6							
	Epitoniidae	Epitoniidae <10mm													

			XU												
Class	**Family**	**Taxon**	**80**	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**
	Fissurellidae	*Hemitoma* spp. <10mm													
	Littorinidae	*Littoraria* spp.					0.2								
		Littoraria spp. <10mm									<0.1	<0.1		<0.1	
		Littoraria filosa													
		Littoraria scabra	<0.1												
	Muricidae	Muricidae			0.1										
		Chicoreus spp.		0.7	0.4		0.3			0.7					0.3
		Chicoreus capucinus													
		Drupella margariticola													
	Nassariidae	*Nassarius* spp.	0.2		0.2				0.2						
		Nassarius coronatus					0.6								
		Nassarius crematus													
		Nassarius olivaceus				0.6					0.5	0.9			
		Nassarius pullus													
	Naticidae	Naticidae										0.6			
		Mammilla sebae													
		Notocochlis gualtieriana													
		Polinices mammilla	1.8	1.0	1.1		4.1					2.4			
	Neritidae	Neritidae													
		Neripteron violaceum													
		Nerita spp.	0.4	1.0	1.3	0.9	0.1	1.1	1.4	1.0		0.8		0.2	
		Nerita albicilla													
		Nerita balteata													
		Nerita chamaeleon			1.6									1.4	1.9
		Nerita costata													
		Nerita planospira				0.7									
		Nerita polita													
		Nerita undata				4.1									
	Olividae	Olividae		0.4											
		Miniaceoliva miniacea													
		Oliva elegans													
		Oliva oliva													
		Oliva reticulata													
		Oliva vidua													
	Patellidae	Patellidae													
		Patellidae <10mm		<0.1											
	Pisaniidae	*Cantharus* sp.													
	Planaxidae	Planaxidae													
		Planaxis sulcatus	0.2												

			XU												
Class	**Family**	**Taxon**	**80**	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**
	Potamididae	*Cerithideopsis largillierti*	1.6	0.2	0.6	0.7	1.2		0.3			1.0			0.2
		Pirinella cingulata						0.1							
		Telescopium telescopium		0.1			0.1		0.4	0.3					0.2
		Terebralia spp.					0.4	0.2							
		Terebralia palustris													
		Terebralia sulcata													
	Strombidae	Strombidae							1.0					0.9	
		Canarium labiatum													
		Canarium urceus													
		Conomurex luhuanus													
		Euprotomus aurisdianae													
		Gibberulus gibberulus													
		Laevistrombus canarium	0.2		6.7							2.5			
		Lambis spp.		0.8				0.5							
		Lambis crocata													
		Lambis lambis													
	Tegulidae	Tegulidae													
		Rochia nilotica													
		Tectus fenestratus													
	Terebridae	Terebridae													
	Tonnidae	*Tonna* sp.													
	Trochidae	Trochidae			1.6								0.9		
		Monodonta labio													
	Turbinellidae	*Vasum* sp.													
		Vasum turbinellus													
	Turbinidae	*Lunella cinerea*					0.3			1.0					
		Turbo spp.		0.7		0.9	0.1								
	Vermetidae	Vermetidae							0.2	1.4	1.3			<0.1	
Indeterminate	Indeterminate	Unidentified Shell	28.0	21.4	28.2	24.2	24.8	27.1	30.2	30.6	16.6	23.8	13.7	19.0	11.4
Total			**70.6**	**69.7**	**73.1**	**76.1**	**56.5**	**200.7**	**128.6**	**71.2**	**40.2**	**59.5**	**27.7**	**50.0**	**27.1**

			XU												
Class	**Family**	**Taxon**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**
Bivalvia	Arcidae	Arcidae	0.6	0.4	0.3	1.2				0.7	0.2	3.7	7.0	2.3	1.2
		Arcidae <10mm		<0.1				0.1							
		Anadara antiquata				15.9		3.2					20.1		
		Anadara rufescens													

			XU												
Class	**Family**	**Taxon**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**
		Arca ventricosa													
		Barbatia foliata													
		Tegillarca granosa													
	Cardiidae	Cardiidae													
		Fragum spp.													
		Fragum unedo													
		Hippopus hippopus													
		Tridacna spp.													
		Tridacna squamosa													
		Vasticardium flavum													
	Chamidae	*Chama* spp.													
	Corbulidae	*Corbula* sp.													
	Cyrenidae	Cyrenidae													
		Batissa violacea				5.1									4.7
		Geloina expansa										7.6	1.4		
	Glauconomidae	*Glauconome rugosa*													
	Gryphaeidae	*Hyotissa hyotis*													
	Lucinidae	*Anodontia edentula*													
		Austriella corrugata	1.4	0.7	0.8	1.7	0.3	1.0	1.1	0.3	1.0	4.4	3.8	12.0	2.7
		Codakia tigerina													
	Mactridae	*Mactra* spp.	0.2					0.2						0.5	
		Mactra cuneata									1.1				
	Malleidae	*Malleus* spp.													
	Mesodesmatidae	*Atactodea striata*			1.2		2.2					3.6	1.6	1.0	2.6
	Mytilidae	Mytilidae						0.3							
		Septifer bilocularis													
	Noetiidae	Noetiidae													
	Ostreidae	Ostreidae						0.2		1.0	1.0	0.8	2.6	0.6	
	Pectinidae	Pectinidae <10mm													
	Pinnidae	Pinnidae													
	Placunidae	*Placuna placenta*													
	Psammobiidae	*Asaphis violascens*													
		Gari occidens													
	Pteriidae	Pteriidae													
		Isognomon spp.	9.4		0.9	0.3		47.8	27.1	0.3	7.6				
		Pinctada spp.										2.6	1.1		
		Pinctada maculata													
	Spondylidae	*Spondylus* spp.													
	Tellinidae	Tellinidae	0.5			0.3		0.4		1.2	0.8	0.4			
		Quidnipagus palatam													
	Trapezidae	*Neotrapezium sublaevigatum*													
	Veneridae	Veneridae													

			XU												
Class	**Family**	**Taxon**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**
		Anomalodiscus squamosus													
		Dosinia sp.													
		Gafrarium spp.					2.9					1.0		1.9	0.3
		Gafrarium pectinatum	2.0					1.6							
		Gafrarium tumidum	8.0	3.1							19.4				8.4
		Irus carditoides <10mm													
		Periglypta puerpera													
		Pitar pellucidus													
		Protapes gallus					5.6					7.7		9.8	8.0
		Venerupis aspera	0.1										0.2		
Gastropoda	Amathinidae	*Amathina tricarinata* <10mm													
	Angariidae	*Angaria delphinus*													
	Bullidae	*Bulla ampulla*				4.7								0.7	
	Calliostomatidae	*Calliostoma* spp.					0.2	<0.1	0.1						
	Cerithiidae	Cerithiidae					0.4		0.3						
		Cerithiidae <10mm					0.1				0.1				
		Cerithium citrinum												0.5	
		Cerithium coralium													
		Cerithium nodulosum													
		Cerithium zonatum													
		Clypeomorus batillariaeformis									0.6		0.8		
		Rhinoclavis vertagus													
	Chilodontaidae	*Euchelus atratus* <10mm							<0.1	0.2		<0.1		<0.1	
	Columbellidae	Columbellidae													
		Mitrella scripta													
	Conidae	Conidae													
		Conus arenatus													
		Conus flavidus													
		Conus lividus													
		Conus tessulatus													
		Conus textile													
	Costellariidae	*Vexillum vulpecula*													
	Cymatiidae	Cymatiidae													
		Monoplex vespaceus													
	Cypraeidae	Cypraeidae													0.3
		Mauritia arabica													
		Monetaria annulus													

			XU												
Class	**Family**	**Taxon**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**
	Ellobiidae	Ellobiidae													
		Ellobiidae <10mm													
		Cassidula spp.													
		Ellobium spp.	0.7					0.4	2.1					4.3	0.9
		Ellobium aurisjudae													
	Epitoniidae	Epitoniidae <10mm													
	Fissurellidae	*Hemitoma* spp. <10mm													
	Littorinidae	*Littoraria* spp.					1.0								
		Littoraria spp. <10mm						<0.1				<0.1		<0.1	
		Littoraria filosa													
		Littoraria scabra								0.2	0.1				
	Muricidae	Muricidae													
		Chicoreus spp.						1.0					0.3	5.1	
		Chicoreus capucinus													
		Drupella margariticola													
	Nassariidae	*Nassarius* spp.					0.5	0.4							
		Nassarius coronatus													
		Nassarius crematus						0.6							
		Nassarius olivaceus													
		Nassarius pullus													
	Naticidae	Naticidae													
		Mammilla sebae													
		Notocochlis gualtieriana													
		Polinices mammilla													5.4
	Neritidae	Neritidae													
		Neripteron violaceum													
		Nerita spp.	0.1	0.4		<0.1		1.2	1.5	5.4	0.1	0.4	3.5	1.0	0.5
		Nerita albicilla													
		Nerita balteata								0.3					
		Nerita chamaeleon												2.2	
		Nerita costata													
		Nerita planospira													
		Nerita polita							1.3						
		Nerita undata													
	Olividae	Olividae													
		Miniaceoliva miniacea													
		Oliva elegans													
		Oliva oliva													
		Oliva reticulata													

			XU												
Class	**Family**	**Taxon**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**
		Oliva vidua													
	Patellidae	Patellidae					0.1	0.1							
		Patellidae <10mm						<0.1							
	Pisaniidae	*Cantharus* sp.													
	Planaxidae	Planaxidae													
		Planaxis sulcatus													
	Potamididae	*Cerithideopsis largillierti*				<0.1									
		Pirinella cingulata													
		Telescopium telescopium				0.4				0.5		0.3	0.2	0.7	
		Terebralia spp.								0.2					
		Terebralia palustris													
		Terebralia sulcata													
	Strombidae	Strombidae									0.3				
		Canarium labiatum													
		Canarium urceus													
		Conomurex luhuanus													
		Euprotomus aurisdianae													
		Gibberulus gibberulus													
		Laevistrombus canarium												1.7	
		Lambis spp.													
		Lambis crocata													
		Lambis lambis													
	Tegulidae	Tegulidae													
		Rochia nilotica													
		Tectus fenestratus													
	Terebridae	Terebridae													
	Tonnidae	*Tonna* sp.													
	Trochidae	Trochidae													
		Monodonta labio													
	Turbinellidae	*Vasum* sp.													
		Vasum turbinellus													
	Turbinidae	*Lunella cinerea*		10.8											
		Turbo spp.				1.0								0.3	
	Vermetidae	Vermetidae											0.1		
Indeterminate	Indeterminate	Unidentified Shell	11.1	4.7	5.9	9.9	6.5	12.0	16.7	14.5	16.9	28.1	27.2	40.3	24.9
Total			**34.1**	**20.2**	**9.1**	**40.5**	**19.7**	**70.5**	**50.3**	**24.7**	**49.2**	**60.6**	**69.9**	**85.0**	**59.9**

			XU												
Class	**Family**	**Taxon**	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**
Bivalvia	Arcidae	Arcidae		0.4	6.5	0.5	2.1	9.5	0.8		0.1	1.8			<0.1
		Arcidae <10mm										0.1	<0.1	0.1	
		Anadara antiquata			7.3		15.7								
		Anadara rufescens													
		Arca ventricosa													
		Barbatia foliata													
		Tegillarca granosa													
	Cardiidae	Cardiidae				0.4									
		Fragum spp.													
		Fragum unedo													
		Hippopus hippopus													
		Tridacna spp.													
		Tridacna squamosa													
		Vasticardium flavum													
	Chamidae	*Chama* spp.							0.1						
	Corbulidae	*Corbula* sp.													
	Cyrenidae	Cyrenidae	4.0												
		Batissa violacea			3.8			18.1							
		Geloina expansa							17.3						
	Glauconomidae	*Glauconome rugosa*		1.8											
	Gryphaeidae	*Hyotissa hyotis*													
	Lucinidae	*Anodontia edentula*													
		Austriella corrugata	1.2	2.1	2.1	4.7	2.0	1.5	1.7	1.6	0.2	1.7	1.9	4.7	2.6
		Codakia tigerina													
	Mactridae	*Mactra* spp.												0.6	
		Mactra cuneata							13.9						
	Malleidae	*Malleus* spp.													
	Mesodesmatidae	*Atactodea striata*			4.9		2.8			1.5	0.5				0.7
	Mytilidae	Mytilidae						0.1		0.1					
		Septifer bilocularis													
	Noetiidae	Noetiidae													
	Ostreidae	Ostreidae						5.6	0.3		0.2	0.2			
	Pectinidae	Pectinidae <10mm													
	Pinnidae	Pinnidae													
	Placunidae	*Placuna placenta*													
	Psammobiidae	*Asaphis violascens*													
		Gari occidens													
	Pteriidae	Pteriidae													
		Isognomon spp.				0.2							<0.1		21.4
		Pinctada spp.													
		Pinctada maculata													

			XU												
Class	**Family**	**Taxon**	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**
	Spondylidae	*Spondylus* spp.													
	Tellinidae	Tellinidae	0.3	0.2			1.0		0.2			0.6			0.3
		Quidnipagus palatam													
	Trapezidae	*Neotrapezium sublaevigatum*													
	Veneridae	Veneridae													
		Anomalodiscus squamosus													
		Dosinia sp.													
		Gafrarium spp.		0.2			8.6		0.5	2.4	0.4		0.5	2.2	1.1
		Gafrarium pectinatum				2.3									
		Gafrarium tumidum		4.6		14.2	18.8		6.7						
		Irus carditoides <10mm													
		Periglypta puerpera													
		Pitar pellucidus													
		Protapes gallus													
		Venerupis aspera													
Gastropoda	Amathinidae	*Amathina tricarinata* <10mm													
	Angariidae	*Angaria delphinus*													
	Bullidae	*Bulla ampulla*		0.3				0.1							
	Calliostomatidae	*Calliostoma* spp.						0.3							
	Cerithiidae	Cerithiidae													
		Cerithiidae <10mm	<0.1	0.5				0.1					0.1	0.1	
		Cerithium citrinum													
		Cerithium coralium													
		Cerithium nodulosum													
		Cerithium zonatum													
		Clypeomorus batillariaeformis													
		Rhinoclavis vertagus													
	Chilodontaidae	*Euchelus atratus* <10mm		0.2											
	Columbellidae	Columbellidae													
		Mitrella scripta													
	Conidae	Conidae													
		Conus arenatus													
		Conus flavidus													
		Conus lividus													
		Conus tessulatus													
		Conus textile													

			XU												
Class	**Family**	**Taxon**	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**
	Costellariidae	*Vexillum vulpecula*													
	Cymatiidae	Cymatiidae													
		Monoplex vespaceus													
	Cypraeidae	Cypraeidae					6.4								
		Mauritia arabica													
		Monetaria annulus													
	Ellobiidae	Ellobiidae													
		Ellobiidae <10mm													
		Cassidula spp.													
		Ellobium spp.	0.2							0.6				0.4	
		Ellobium aurisjudae													
	Epitoniidae	Epitoniidae <10mm													
	Fissurellidae	*Hemitoma* spp. <10mm													
	Littorinidae	*Littoraria* spp.													
		Littoraria spp. <10mm		<0.1	<0.1								0.1		<0.1
		Littoraria filosa													
		Littoraria scabra													
	Muricidae	Muricidae													
		Chicoreus spp.		0.7										0.9	
		Chicoreus capucinus													
		Drupella margariticola													
	Nassariidae	*Nassarius* spp.				0.3				0.3	0.3				0.2
		Nassarius coronatus													
		Nassarius crematus													
		Nassarius olivaceus													
		Nassarius pullus													
	Naticidae	Naticidae													
		Mammilla sebae													
		Notocochlis gualtieriana													
		Polinices mammilla					1.7								
	Neritidae	Neritidae											0.1	0.1	
		Neripteron violaceum													
		Nerita spp.		1.9	0.5	1.2	0.8	2.2	0.9	1.8	2.8	0.6	2.2		0.3
		Nerita albicilla													
		Nerita balteata						1.1							
		Nerita chamaeleon							1.6		1.5				0.9
		Nerita costata													
		Nerita planospira													

			XU												
Class	**Family**	**Taxon**	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**
		Nerita polita						1.9							
		Nerita undata												2.3	
	Olividae	Olividae													
		Miniaceoliva miniacea													
		Oliva elegans													
		Oliva oliva													
		Oliva reticulata													
		Oliva vidua													
	Patellidae	Patellidae							0.6						
		Patellidae <10mm				<0.1		<0.1			0.2	0.1		0.6	
	Pisaniidae	*Cantharus* sp.													
	Planaxidae	Planaxidae												0.4	
		Planaxis sulcatus													
	Potamididae	*Cerithideopsis largillierti*			0.2								0.8		
		Pirinella cingulata													
		Telescopium telescopium		0.5		0.5	0.2	0.2	0.4		0.2	0.3	0.2		1.8
		Terebralia spp.													
		Terebralia palustris													
		Terebralia sulcata													
	Strombidae	Strombidae									0.3				1.3
		Canarium labiatum													
		Canarium urceus													
		Conomurex luhuanus													
		Euprotomus aurisdianae													
		Gibberulus gibberulus													
		Laevistrombus canarium								0.5					
		Lambis spp.													
		Lambis crocata													
		Lambis lambis													
	Tegulidae	Tegulidae													
		Rochia nilotica													
		Tectus fenestratus													
	Terebridae	Terebridae									0.6				
	Tonnidae	*Tonna* sp.													
	Trochidae	Trochidae													
		Monodonta labio													
	Turbinellidae	*Vasum* sp.													
		Vasum turbinellus													
	Turbinidae	*Lunella cinerea*													
		Turbo spp.				0.2			1.0						
	Vermetidae	Vermetidae										0.1			

			XU												
Class	**Family**	**Taxon**	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**
Indeterminate	Indeterminate	Unidentified Shell	29.2	25.7	23.7	22.0	5.0	22.6	29.4	22.6	16.0	16.2	27.5	19.0	31.5
Total			**34.9**	**39.1**	**49.0**	**46.5**	**65.1**	**63.3**	**75.5**	**31.4**	**23.3**	**21.7**	**33.4**	**31.3**	**62.2**

			XU												
Class	**Family**	**Taxon**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**	**127**	**128**	**129**	**130**	**131**
Bivalvia	Arcidae	Arcidae												1.2	
		Arcidae <10mm	0.1	<0.1		0.2	<0.1	0.1			0.3	0.6		0.2	0.6
		Anadara antiquata							0.1	1.6		19.1	3.2		
		Anadara rufescens													
		Arca ventricosa											0.7		0.6
		Barbatia foliata													
		Tegillarca granosa									14.4				
	Cardiidae	Cardiidae													
		Fragum spp.													
		Fragum unedo								0.2					
		Hippopus hippopus													
		Tridacna spp.													
		Tridacna squamosa													
		Vasticardium flavum													
	Chamidae	*Chama* spp.								0.1			0.2		0.2
	Corbulidae	*Corbula* sp.													
	Cyrenidae	Cyrenidae													
		Batissa violacea													
		Geloina expansa													
	Glauconomidae	*Glauconome rugosa*													
	Gryphaeidae	*Hyotissa hyotis*													
	Lucinidae	*Anodontia edentula*													
		Austriella corrugata	0.1	0.8		0.1			1.1			0.8			
		Codakia tigerina													
	Mactridae	*Mactra* spp.	0.9	0.1				0.1				4.1		0.7	
		Mactra cuneata					2.3								
	Malleidae	*Malleus* spp.													
	Mesodesmatidae	*Atactodea striata*		3.0											0.2
	Mytilidae	Mytilidae		<0.1						0.5					
		Septifer bilocularis													
	Noetiidae	Noetiidae													
	Ostreidae	Ostreidae	2.2	0.2	0.7	0.1	0.9	0.4	0.5	0.4	0.4	2.0	1.3	3.4	7.5
	Pectinidae	Pectinidae <10mm													
	Pinnidae	Pinnidae													
	Placunidae	*Placuna placenta*													

			XU												
Class	**Family**	**Taxon**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**	**127**	**128**	**129**	**130**	**131**
	Psammobiidae	*Asaphis violascens*													
		Gari occidens													
	Pteriidae	Pteriidae													
		Isognomon spp.	<0.1	<0.1			2.0								
		Pinctada spp.													
		Pinctada maculata													
	Spondylidae	*Spondylus* spp.													
	Tellinidae	Tellinidae		0.3	1.2	1.8		0.2	0.2	0.1	1.4	1.4	0.7	1.5	3.7
		Quidnipagus palatam									0.1				
	Trapezidae	*Neotrapezium sublaevigatum*													
	Veneridae	Veneridae													
		Anomalodiscus squamosus													
		Dosinia sp.													
		Gafrarium spp.				3.4		0.6	1.0	3.1	<0.1	0.2	0.3	<0.1	0.6
		Gafrarium pectinatum													
		Gafrarium tumidum													
		Irus carditoides <10mm													
		Periglypta puerpera													
		Pitar pellucidus													
		Protapes gallus													
		Venerupis aspera						0.2				0.9			
Gastropoda	Amathinidae	*Amathina tricarinata* <10mm													
	Angariidae	*Angaria delphinus*													
	Bullidae	*Bulla ampulla*	0.1	0.1			0.1		<0.1	0.3		0.1			
	Calliostomatidae	*Calliostoma* spp.				0.7	0.4	<0.1		0.3	0.2	1.2	0.6		
	Cerithiidae	Cerithiidae		0.2		1.2		0.1		0.3		0.6			0.3
		Cerithiidae <10mm					0.4			0.1		0.1	0.4	<0.1	0.3
		Cerithium citrinum													
		Cerithium coralium													
		Cerithium nodulosum													
		Cerithium zonatum													
		Clypeomorus batillariaeformis													
		Rhinoclavis vertagus													
	Chilodontaidae	*Euchelus atratus* <10mm		0.1		<0.1	<0.1			<0.1		<0.1	<0.1		0.2
	Columbellidae	Columbellidae													
		Mitrella scripta													
	Conidae	Conidae													
		Conus arenatus													

			XU												
Class	**Family**	**Taxon**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**	**127**	**128**	**129**	**130**	**131**
		Conus flavidus													
		Conus lividus													
		Conus tessulatus													
		Conus textile													
	Costellariidae	*Vexillum vulpecula*													
	Cymatiidae	Cymatiidae				0.2									
		Monoplex vespaceus													
	Cypraeidae	Cypraeidae													
		Mauritia arabica													
		Monetaria annulus													
	Ellobiidae	Ellobiidae													
		Ellobiidae <10mm													
		Cassidula spp.											0.8		
		Ellobium spp.		0.1							1.4				
		Ellobium aurisjudae													
	Epitoniidae	Epitoniidae <10mm													<0.1
	Fissurellidae	*Hemitoma* spp. <10mm									0.1				
	Littorinidae	*Littoraria* spp.				<0.1	0.1					0.7			0.4
		Littoraria spp. <10mm		<0.1	<0.1	0.4	0.2			0.1		0.1		<0.1	
		Littoraria filosa													
		Littoraria scabra							0.3	0.2					
	Muricidae	Muricidae													
		Chicoreus spp.													
		Chicoreus capucinus													
		Drupella margariticola													
	Nassariidae	*Nassarius* spp.		0.3	0.6	0.6						0.1			
		Nassarius coronatus													
		Nassarius crematus													
		Nassarius olivaceus													
		Nassarius pullus													
	Naticidae	Naticidae			2.0										
		Mammilla sebae													
		Notocochlis gualtieriana													
		Polinices mammilla													
	Neritidae	Neritidae					0.3								0.1
		Neripteron violaceum													
		Nerita spp.	0.5	0.8	0.9	0.3	1.4	0.3		1.1	1.0	0.9	0.2	0.1	10.4
		Nerita albicilla													
		Nerita balteata										0.3			

			XU												
Class	**Family**	**Taxon**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**	**127**	**128**	**129**	**130**	**131**
		Nerita chamaeleon	1.5								1.3				
		Nerita costata													
		Nerita planospira													
		Nerita polita													
		Nerita undata											2.8		
	Olividae	Olividae													
		Miniaceoliva miniacea													
		Oliva elegans													
		Oliva oliva													
		Oliva reticulata													
		Oliva vidua													
	Patellidae	Patellidae						0.2		0.2					
		Patellidae <10mm	0.1			0.1					0.2	0.1	0.1		0.2
	Pisaniidae	*Cantharus* sp.													
	Planaxidae	Planaxidae													
		Planaxis sulcatus	<0.1			0.2							0.1	0.6	
	Potamididae	*Cerithideopsis largillierti*						<0.1				<0.1		<0.1	
		Pirinella cingulata													
		Telescopium telescopium	0.4	0.3	0.4							0.4			1.7
		Terebralia spp.													
		Terebralia palustris													
		Terebralia sulcata													
	Strombidae	Strombidae											1.2		
		Canarium labiatum													
		Canarium urceus													
		Conomurex luhuanus													
		Euprotomus aurisdianae													
		Gibberulus gibberulus						0.8							
		Laevistrombus canarium	1.8												
		Lambis spp.												1.4	
		Lambis crocata													
		Lambis lambis													
	Tegulidae	Tegulidae													
		Rochia nilotica													
		Tectus fenestratus				0.1						<0.1			
	Terebridae	Terebridae													
	Tonnidae	*Tonna* sp.													
	Trochidae	Trochidae													
		Monodonta labio													
	Turbinellidae	*Vasum* sp.													
		Vasum turbinellus													
	Turbinidae	*Lunella cinerea*													
		Turbo spp.		0.6											

			XU												
Class	**Family**	**Taxon**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**	**127**	**128**	**129**	**130**	**131**
	Vermetidae	Vermetidae	<0.1	<0.1			<0.1				<0.1	0.3		0.1	0.1
Indeterminate	Indeterminate	Unidentified Shell	14.2	12.1	15.8	20.8	25.6	16.5	10.4	30.2	23.3	38.2	53.9	54.3	83.4
Total			**22.0**	**19.1**	**21.6**	**30.2**	**33.8**	**19.5**	**13.6**	**38.8**	**44.1**	**72.3**	**66.5**	**63.6**	**110.5**

			XU			
Class	**Family**	**Taxon**	**132**	**133**	**134**	**Total**
Bivalvia	Arcidae	Arcidae		0.3	4.5	**807.3**
		Arcidae <10mm	0.2			**3.2**
		Anadara antiquata		2.3		**7567.2**
		Anadara rufescens				**59.5**
		Arca ventricosa			0.3	**1.6**
		Barbatia foliata				**22.3**
		Tegillarca granosa				**979.5**
	Cardiidae	Cardiidae		0.2		**125.2**
		Fragum spp.				**19.0**
		Fragum unedo				**26.7**
		Hippopus hippopus				**351.1**
		Tridacna spp.				**342.8**
		Tridacna squamosa				**1281.2**
		Vasticardium flavum				**190.4**
	Chamidae	*Chama* spp.	0.2	0.4	1.0	**4429.1**
	Corbulidae	*Corbula* sp.				**1.0**
	Cyrenidae	Cyrenidae				**15.3**
		Batissa violacea				**608.0**
		Geloina expansa				**1110.6**
	Glauconomidae	*Glauconome rugosa*				**13.1**
	Gryphaeidae	*Hyotissa hyotis*				**290.8**
	Lucinidae	*Anodontia edentula*				**79.1**
		Austriella corrugata				**1498.5**
		Codakia tigerina				**43.2**
	Mactridae	*Mactra* spp.		3.0	1.6	**50.8**
		Mactra cuneata				**114.3**
	Malleidae	*Malleus* spp.				**116.7**
	Mesodesmatidae	*Atactodea striata*		0.9		**742.6**
	Mytilidae	Mytilidae		0.1	0.1	**9.4**
		Septifer bilocularis				**14.1**
	Noetiidae	Noetiidae				**0.1**
	Ostreidae	Ostreidae	11.6	8.5	4.3	**5866.9**
	Pectinidae	Pectinidae <10mm			0.1	**0.1**
	Pinnidae	Pinnidae				**17.8**
	Placunidae	*Placuna placenta*				**163.0**
	Psammobiidae	*Asaphis violascens*				**57.4**
		Gari occidens				**0.8**
	Pteriidae	Pteriidae				**3.0**
		Isognomon spp.	0.2			**1656.6**
		Pinctada spp.				**107.9**

			XU			
Class	**Family**	**Taxon**	**132**	**133**	**134**	**Total**
		Pinctada maculata				**306.4**
	Spondylidae	*Spondylus* spp.				**512.7**
	Tellinidae	Tellinidae	2.6	3.8	2.6	**34.3**
		Quidnipagus palatam	0.3			**12.0**
	Trapezidae	*Neotrapezium sublaevigatum*				**0.1**
	Veneridae	Veneridae				**5.0**
		Anomalodiscus squamosus				**9.8**
		Dosinia sp.				**0.5**
		Gafrarium spp.			0.2	**1690.1**
		Gafrarium pectinatum			0.3	**131.9**
		Gafrarium tumidum				**4173.0**
		Irus carditoides <10mm	0.2			**0.4**
		Periglypta puerpera				**74.5**
		Pitar pellucidus				**14.5**
		Protapes gallus				**115.8**
		Venerupis aspera	0.4			**220.5**
Gastropoda	Amathinidae	*Amathina tricarinata* <10mm				**0.3**
	Angariidae	*Angaria delphinus*			<0.1	**22.6**
	Bullidae	*Bulla ampulla*		0.8	5.0	**16.9**
	Calliostomatidae	*Calliostoma* spp.	1.0	0.6	2.8	**16.2**
	Cerithiidae	Cerithiidae	0.2	0.6	1.6	**9.3**
		Cerithiidae <10mm		0.2	0.6	**4.1**
		Cerithium citrinum			<0.1	**6.1**
		Cerithium coralium				**6.8**
		Cerithium nodulosum				**40.8**
		Cerithium zonatum				**1.9**
		Clypeomorus batillariaeformis				**17.8**
		Rhinoclavis vertagus				**5.8**
	Chilodontaidae	*Euchelus atratus* <10mm	0.2		0.2	**3.6**
	Columbellidae	Columbellidae				**0.3**
		Mitrella scripta				**1.3**
	Conidae	Conidae				**170.7**
		Conus arenatus				**9.6**
		Conus flavidus				**7.2**
		Conus lividus				**33.1**
		Conus tessulatus				**6.5**
		Conus textile				**8.4**
	Costellariidae	*Vexillum vulpecula*				**0.9**
	Cymatiidae	Cymatiidae	0.2		3.1	**14.6**
		Monoplex vespaceus				**2.1**
	Cypraeidae	Cypraeidae			0.2	**129.6**
		Mauritia arabica				**4.2**
		Monetaria annulus				**1.4**
	Ellobiidae	Ellobiidae				**1.0**
		Ellobiidae <10mm				**0.6**
		Cassidula spp.		0.2		**1.0**
		Ellobium spp.				**57.8**
		Ellobium aurisjudae				**53.3**
	Epitoniidae	Epitoniidae <10mm	0.1			**0.1**
	Fissurellidae	*Hemitoma* spp. <10mm				**2.6**
	Littorinidae	*Littoraria* spp.			0.3	**4.1**

			XU			
Class	**Family**	**Taxon**	**132**	**133**	**134**	**Total**
		Littoraria spp. <10mm	<0.1	<0.1		**1.2**
		Littoraria filosa				**1.8**
		Littoraria scabra				**21.8**
	Muricidae	Muricidae				**0.1**
		Chicoreus spp.				**336.8**
		Chicoreus capucinus				**45.7**
		Drupella margariticola				**0.5**
	Nassariidae	*Nassarius* spp.			0.1	**12.3**
		Nassarius coronatus				**0.6**
		Nassarius crematus				**24.3**
		Nassarius olivaceus			<0.1	**24.4**
		Nassarius pullus				**2.6**
	Naticidae	Naticidae	0.4		0.4	**32.3**
		Mammilla sebae				**4.2**
		Notocochlis gualtieriana	1.0			**5.1**
		Polinices mammilla				**159.3**
	Neritidae	Neritidae				**2.3**
		Neripteron violaceum				**<0.1**
		Nerita spp.	0.6	3.4	12.4	**269.3**
		Nerita albicilla	2.2			**74.7**
		Nerita balteata				**44.9**
		Nerita chamaeleon				**51.0**
		Nerita costata				**0.9**
		Nerita planospira				**26.3**
		Nerita polita			2.5	**5.7**
		Nerita undata				**44.3**
	Olividae	Olividae				**46.5**
		Miniaceoliva miniacea				**5.5**
		Oliva elegans				**7.8**
		Oliva oliva				**3.3**
		Oliva reticulata				**16.0**
		Oliva vidua				**3.0**
	Patellidae	Patellidae				**1.2**
		Patellidae <10mm		0.1	0.1	**1.9**
	Pisaniidae	*Cantharus* sp.				**0.5**
	Planaxidae	Planaxidae				**3.1**
		Planaxis sulcatus				**16.6**
	Potamididae	*Cerithideopsis largillierti*				**86.0**
		Pirinella cingulata				**0.6**
		Telescopium telescopium				**987.5**
		Terebralia spp.				**3.1**
		Terebralia palustris				**305.4**
		Terebralia sulcata				**148.3**
	Strombidae	Strombidae			0.8	**124.1**
		Canarium labiatum				**1.7**
		Canarium urceus				**3.2**
		Conomurex luhuanus				**3613.1**
		Euprotomus aurisdianae				**1.9**
		Gibberulus gibberulus				**91.9**
		Laevistrombus canarium				**887.5**
		Lambis spp.				**3664.7**

			XU			
Class	**Family**	**Taxon**	**132**	**133**	**134**	**Total**
		Lambis crocata				**131.4**
		Lambis lambis				**3108.2**
	Tegulidae	Tegulidae				**1.2**
		Rochia nilotica				**193.3**
		Tectus fenestratus				**36.4**
	Terebridae	Terebridae				**0.7**
	Tonnidae	*Tonna* sp.				**6.4**
	Trochidae	Trochidae			0.5	**37.8**
		Monodonta labio				**5.0**
	Turbinellidae	*Vasum* sp.				**12.4**
		Vasum turbinellus				**92.4**
	Turbinidae	*Lunella cinerea*				**52.6**
		Turbo spp.				**39.4**
	Vermetidae	Vermetidae	0.1	0.1	0.3	**12.3**
Indeterminate	Indeterminate	Unidentified Shell	62.8	64.6	115.8	**10572.8**
Total			**84.5**	**90.1**	**161.7**	**62270.3**

Appendix D.

Mollusc MNI per XU for Tanamu 1 Square A.

			XU																			
Class	**Family**	**Taxon**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9–10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
Bivalvia	Arcidae	Arcidae					1															1
		Arcidae <10mm																				
		Anadara antiquata																				
		Anadara rufescens																				
		Arca ventricosa																				
		Barbatia foliata																				
		Tegillarca granosa						1			1											
	Cardiidae	Cardiidae																				
		Fragum unedo																				
		Tridacna squamosa																				
		Vasticardium flavum																				
	Chamidae	*Chama* spp.																				
	Corbulidae	*Corbula* sp.																				
	Cyrenidae	Cyrenidae																				
		Batissa violacea									1											
		Geloina expansa	1	1		1	2	1							1							
	Glauconomidae	*Glauconome rugosa*																				
	Gryphaeidae	*Hyotissa hyotis*																				
	Lucinidae	*Anodontia edentula*																				
		Austriella corrugata																				
		Codakia tigerina																				
	Mactridae	*Mactra* spp.																				
		Mactra cuneata																				
	Malleidae	*Malleus* spp.					1														1	
	Mesodesmatidae	*Atactodea striata*																				1

			XU																			
Class	**Family**	**Taxon**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9–10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
	Mytilidae	Mytilidae																				
		Septifer bilocularis																				
	Noetiidae	Noetiidae																				
	Ostreidae	Ostreidae		1	1	2	11	6	1	1											1	
	Pectinidae	Pectinidae <10mm																				
	Placunidae	*Placuna placenta*																				1
	Psammobiidae	*Asaphis violascens*																				
		Gari occidens																				
	Pteriidae	*Isognomon* spp.																				
		Pinctada spp.																				
		Pinctada maculata																				
	Spondylidae	*Spondylus* spp.			1																	
	Tellinidae	Tellinidae																				
		Quidnipagus palatam																				
	Trapezidae	*Neotrapezium sublaevigatum*																				
	Veneridae	Veneridae																				
		Anomalodiscus squamosus																				
		Dosinia sp.																				
		Gafrarium spp.														1						1
		Gafrarium pectinatum																				
		Gafrarium tumidum																				1
		Irus carditoides <10mm																				
		Periglypta puerpera					1															
		Pitar pellucidus																				
		Protapes gallus																				
		Venerupis aspera																				
Gastropoda	Amathinidae	*Amathina tricarinata* <10mm																				
	Angariidae	*Angaria delphinus*																				
	Bullidae	*Bulla ampulla*							1													
	Calliostomatidae	*Calliostoma* spp.																				
	Cerithiidae	Cerithiidae																				

			XU																				
Class	**Family**	**Taxon**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9–10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
		Cerithiidae <10mm																				
		Cerithium citrinum																				
		Cerithium coralium																				
		Cerithium nodulosum																				
		Cerithium zonatum																				
		Clypeomorus batillariaeformis																				
		Rhinoclavis vertagus																				
	Chilodontaidae	*Euchelus atratus* <10mm																				
	Columbellidae	*Mitrella scripta*																				
	Conidae	Conidae				1	1	1														
		Conus arenatus																				
		Conus lividus																				
		Conus tessulatus																				
		Conus textile																				
	Costellariidae	*Vexillum vulpecula*																				
	Cymatiidae	Cymatiidae				1																
		Monoplex vespaceus																				
	Cypraeidae	Cypraeidae			1			1														1
		Mauritia arabica																				
	Ellobiidae	Ellobiidae																				
		Ellobiidae <10mm																				
		Cassidula spp.																				
		Ellobium spp.																				
		Ellobium aurisjudae																				
	Epitoniidae	Epitoniidae <10mm																				
	Fissurellidae	*Hemitoma* spp. <10mm					1	3														
	Littorinidae	*Littoraria* spp.																				
		Littoraria spp. <10mm																				
		Littoraria filosa	2																			
		Littoraria scabra																				
	Muricidae	*Chicoreus* spp.																				

			XU																			
Class	**Family**	**Taxon**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9–10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
		Chicoreus capucinus																				
		Drupella margariticola																				
	Nassariidae	*Nassarius* spp.																				
		Nassarius coronatus																				
		Nassarius crematus																				
		Nassarius olivaceus																				
		Nassarius pullus																				
	Naticidae	Naticidae																				
		Notocochlis gualtieriana																				
		Polinices mammilla																				
	Neritidae	Neritidae																				
		Neripteron violaceum																				
		Nerita spp.																				
		Nerita albicilla																				
		Nerita balteata																				
		Nerita chamaeleon																				
		Nerita costata																				
		Nerita planospira																				
		Nerita polita																				
		Nerita undata																				
	Olividae	Olividae																				
		Miniaceoliva miniacea																				
		Oliva elegans																				
		Oliva oliva																				
		Oliva reticulata																				
		Oliva vidua																				
	Patellidae	Patellidae																				
		Patellidae <10mm																				
	Pisaniidae	*Cantharus* sp.																				
	Planaxidae	Planaxidae				2									1							
		Planaxis sulcatus																				

			XU																			
Class	**Family**	**Taxon**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9–10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
	Potamididae	*Cerithideopsis largillierti*	3				1	3														
		Pirinella cingulata																				
		Telescopium telescopium	3	1	7	17	16	10	2	1	1	1										
		Terebralia spp.																			1	
		Terebralia palustris	13	1		1																
		Terebralia sulcata																				
	Strombidae	Strombidae					2		1		2									2		
		Canarium labiatum																				
		Canarium urceus																				
		Conomurex luhuanus	3	3	27	47	79	14	1	2	1	2	4	1	3	4	4	1				2
		Gibberulus gibberulus									1			1								
		Laevistrombus canarium																				
		Lambis spp.		1			1															
		Lambis crocata																				
		Lambis lambis						1														
	Tegulidae	*Rochia nilotica*																				
		Tectus fenestratus				1	2															
	Terebridae	Terebridae																				
	Tonnidae	*Tonna* sp.																				
	Trochidae	Trochidae																				
		Monodonta labio																				
	Turbinellidae	*Vasum turbinellus*									1											
	Turbinidae	*Lunella cinerea*																				
		Turbo spp.																				
Total			**25**	**8**	**37**	**73**	**119**	**41**	**6**	**4**	**8**	**3**	**4**	**2**	**5**	**5**	**4**	**1**	**0**	**2**	**3**	**8**

			XU																				
Class	**Family**	**Taxon**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**
Bivalvia	Arcidae	Arcidae	1	2	1	3	5	4	1	11		1				1							
		Arcidae <10mm																		1			
		Anadara antiquata	3	9	8	8	16	29	30	62	61	41	22	14	9	6	2	3	1	1			1
		Anadara rufescens										1											
		Arca ventricosa																					
		Barbatia foliata																					
		Tegillarca granosa	1	5	3	7	5	2	2	3			2	2	2	1			1				
	Cardiidae	Cardiidae								1									1				
		Fragum unedo				1		1		1	1				2								
		Tridacna squamosa												1									
		Vasticardium flavum							1	1	1				1	1	1						
	Chamidae	*Chama* spp.		1			3	3	1	4	2		4	2	8	4		1		1	1	1	
	Corbulidae	*Corbula* sp.									1												
	Cyrenidae	Cyrenidae																					
		Batissa violacea					1	1			3		1				2						
		Geloina expansa				1	1	1	1	1	1		2	4		2					2		
	Glauconomidae	*Glauconome rugosa*					1						1									1	
	Gryphaeidae	*Hyotissa hyotis*																					
	Lucinidae	*Anodontia edentula*			1	1	2			1		1	3	1	2			1			1	1	
		Austriella corrugata				3	2	1		3	1		1	2	3	2	2	1	1		1		1
		Codakia tigerina						1															
	Mactridae	*Mactra* spp.			1		1					1		2		1				1			
		Mactra cuneata				1							1	1			1				1		
	Malleidae	*Malleus* spp.				4		2					1										
	Mesodesmatidae	*Atactodea striata*	1	1	2	3	3	3	4	8	11		15	12	14	5	4	3	3	4	5	3	3
	Mytilidae	Mytilidae																					1
		Septifer bilocularis																					
	Noetiidae	Noetiidae																					
	Ostreidae	Ostreidae	4	1	5	7	10	7	9	12	24	15	27	21	32	6	9	3	1	1	1	4	6
	Pectinidae	Pectinidae <10mm																					
	Placunidae	*Placuna placenta*		2	3	9	4	1		6	1	2	5									1	

			XU																				
Class	**Family**	**Taxon**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**
	Psammobiidae	*Asaphis violascens*						2						1	1	1	1						
		Gari occidens													1								
	Pteriidae	*Isognomon* spp.		1		4	4	2	6	3	8	9	3	3	2	1	2	1	1		1	1	5
		Pinctada spp.																					
		Pinctada maculata				1		1	2			2	1	1		2	2			1		3	3
	Spondylidae	*Spondylus* spp.							1		1		1		1								
	Tellinidae	Tellinidae																					
		Quidnipagus palatam						1															
	Trapezidae	*Neotrapezium sublaevigatum*																					1
	Veneridae	Veneridae																					
		Anomalodiscus squamosus		1			1				1	1	1	1									
		Dosinia sp.																					
		Gafrarium spp.		2	5	8	13	7	18	12	17	18	25	22	24	10	8	8	7	3	4	5	3
		Gafrarium pectinatum						1	1	6	6	5	2	2	2	1		2				1	1
		Gafrarium tumidum		1		17	22	20	18	38	38	42	80	61	72	21	10	11	10	5	1	7	2
		Irus carditoides <10mm																					
		Periglypta puerpera																					
		Pitar pellucidus				1		1		2	1		2							1	1		
		Protapes gallus				2	2	1	1	1	3	3	4	3	1	1						2	1
		Venerupis aspera										1	4		1	1		1					
Gastropoda	Amathinidae	*Amathina tricarinata* <10mm															1						
	Angariidae	*Angaria delphinus*			2		1																
	Bullidae	*Bulla ampulla*						1		1						1			1				1
	Calliostomatidae	*Calliostoma* spp.			1			1			1		1						3				
	Cerithiidae	Cerithiidae					2			2									2				
		Cerithiidae <10mm				1			1				2				1	1				1	
		Cerithium citrinum		1						1				1									
		Cerithium coralium															1					1	
		Cerithium nodulosum												1									
		Cerithium zonatum							1				2	1									
		Clypeomorus batillariaeformis						1	1	3	1		3	1					2				

			XU																				
Class	**Family**	**Taxon**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**
		Rhinoclavis vertagus						1								1							
	Chilodontaidae	*Euchelus atratus* <10mm																			1		1
	Columbellidae	*Mitrella scripta*																					
	Conidae	Conidae	1		1			1		1												1	
		Conus arenatus																					
		Conus lividus																					
		Conus tessulatus																					
		Conus textile					1																
	Costellariidae	*Vexillum vulpecula*																					
	Cymatiidae	Cymatiidae																					
		Monoplex vespaceus											1										
	Cypraeidae	Cypraeidae	1				1		1														
		Mauritia arabica																					
	Ellobiidae	Ellobiidae																					
		Ellobiidae <10mm											1									1	
		Cassidula spp.																					
		Ellobium spp.							1											1			
		Ellobium aurisjudae						1															
	Epitoniidae	Epitoniidae <10mm																					
	Fissurellidae	*Hemitoma* spp. <10mm					1			2	1	2		4	1					1	2	3	
	Littorinidae	*Littoraria* spp.								1	1								1				
		Littoraria spp. <10mm																					
		Littoraria filosa														1							
		Littoraria scabra											1		2	1	3					1	
	Muricidae	*Chicoreus* spp.			1														1		1	1	
		Chicoreus capucinus						1			1												
		Drupella margariticola																					
	Nassariidae	*Nassarius* spp.					1											1					
		Nassarius coronatus																					
		Nassarius crematus	1	1	1			1		1							1			1			
		Nassarius olivaceus					1					1	1		1	1							1

			XU																				
Class	**Family**	**Taxon**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**
		Nassarius pullus																			1		
	Naticidae	Naticidae		1		1	2		1		1		1		1		2		2	1			1
		Notocochlis gualtieriana								1	2	1											
		Polinices mammilla				1		1		1		3	1	3		1		1					
	Neritidae	Neritidae				1																	
		Neripteron violaceum																					
		Nerita spp.		1	1	1		1	1	5	3	2	3	2	3	4	2		3		1	1	1
		Nerita albicilla					1	1								1		1			1		
		Nerita balteata					1						2	1	1					1	1		
		Nerita chamaeleon					1			2	2	1						1		1	1		
		Nerita costata																					
		Nerita planospira							1	1			1				2				1	2	1
		Nerita polita																					
		Nerita undata						3		1		1											
	Olividae	Olividae						1															
		Miniaceoliva miniacea																					
		Oliva elegans																					
		Oliva oliva																					
		Oliva reticulata																					
		Oliva vidua																					
	Patellidae	Patellidae																					
		Patellidae <10mm																					
	Pisaniidae	*Cantharus* sp.																					
	Planaxidae	Planaxidae																					
		Planaxis sulcatus				1	2			1		1		2						1			
	Potamididae	*Cerithideopsis largillierti*				1			1		1			1		1	2			1	2		
		Pirinella cingulata																					1
		Telescopium telescopium		1				1								1	1					2	
		Terebralia spp.																					
		Terebralia palustris																					
		Terebralia sulcata												1	1	1			1	1	2	2	2

			XU																				
Class	**Family**	**Taxon**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**
	Strombidae	Strombidae				2	3		1		2					1		1			1		
		Canarium labiatum										1	1										
		Canarium urceus				1																	
		Conomurex luhuanus	1	6	12	18	29	9	3	16	12	12	5		4	1	2	1				1	
		Gibberulus gibberulus	1		1	4	1	1	2	1	5												
		Laevistrombus canarium	1	1		2	2	2	3	4	5		3	1		1		1					1
		Lambis spp.		2	1	4	2	2	2	5	3		6	3	2	1	2	1				2	1
		Lambis crocata																					
		Lambis lambis					1	1			3			1	3	1							
	Tegulidae	*Rochia nilotica*																					
		Tectus fenestratus				1				1													
	Terebridae	Terebridae																					
	Tonnidae	*Tonna* sp.																					
	Trochidae	Trochidae																					
		Monodonta labio																					
	Turbinellidae	*Vasum turbinellus*														2							
	Turbinidae	*Lunella cinerea*						1															1
		Turbo spp.		1		1					1				1	1	1	1			1		
Total			**16**	**41**	**50**	**121**	**149**	**124**	**116**	**227**	**227**	**168**	**243**	**179**	**198**	**89**	**65**	**45**	**42**	**28**	**35**	**49**	**40**

			XU																				
Class	**Family**	**Taxon**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**
Bivalvia	Arcidae	Arcidae		1	2			1			1		4		2		2		2	2	1		
		Arcidae <10mm																					
		Anadara antiquata			2	1	2	7	4	5	8	29	13	8	8	15	5	11	17	8	12		7
		Anadara rufescens										1				1							
		Arca ventricosa																					
		Barbatia foliata										1	1	2	2		1	1			1		2
		Tegillarca granosa			1	1		1		1	2	2	2	1	3	3	2				1		
	Cardiidae	Cardiidae									2					1							1
		Fragum unedo																					
		Tridacna squamosa																					
		Vasticardium flavum										1	1	1				2	1	2			2
	Chamidae	*Chama* spp.	1	1			1	3	2	1	4	2	6	3	3	3	4	5	8	14	14		4
	Corbulidae	*Corbula* sp.																					
	Cyrenidae	Cyrenidae						3					2			1							
		Batissa violacea			1		1	2	1	1	2	5	5	3	6	2	2	4	5	2	2		2
		Geloina expansa				1	4	3	2	1	3	4	3	3	7	5	3	4	5	5	4		4
	Glauconomidae	*Glauconome rugosa*					1	1		1		1	2						1	1	1		
	Gryphaeidae	*Hyotissa hyotis*										1											
	Lucinidae	*Anodontia edentula*									2	1	2	1	1								3
		Austriella corrugata			1		2	2	2	1	1	2	3	2	2	3	2	3	4	2	1		4
		Codakia tigerina																					
	Mactridae	*Mactra* spp.	1			2	1		3	1		1	2	1	1			1		1	1		3
		Mactra cuneata						1											2				
	Malleidae	*Malleus* spp.																					
	Mesodesmatidae	*Atactodea striata*	2	2	7	5	3	4	5		2	5	9	4	6	6	4	5	10	5	3		8
	Mytilidae	Mytilidae		1												1	1	1	1		2		
		Septifer bilocularis																					
	Noetiidae	Noetiidae																		1			
	Ostreidae	Ostreidae	6	11	5	6	6	18	12	5	15	33	41	28	35	21	13	35	49	18	31		25
	Pectinidae	Pectinidae <10mm																					
	Placunidae	*Placuna placenta*					1																

			XU																				
Class	**Family**	**Taxon**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**
	Psammobiidae	*Asaphis violascens*								1	1		1	1	1	2			1				
		Gari occidens																					
	Pteriidae	*Isognomon* spp.	10	6	9	21	5	16	15	14	26	53	56	25	48	34	16	37	27	2	19		9
		Pinctada spp.						1			6												
		Pinctada maculata		3	2	4	5	7	6	6	2	19	14	12		15	16	13		4	18		7
	Spondylidae	*Spondylus* spp.										1	1		1								
	Tellinidae	Tellinidae							2		2						1	1					
		Quidnipagus palatam																			1		
	Trapezidae	*Neotrapezium sublaevigatum*																					
	Veneridae	Veneridae											1										
		Anomalodiscus squamosus						1															
		Dosinia sp.										1											
		Gafrarium spp.	8	2	2	1	4	7	3		1	5	5	5	4	4	2	3	5	2	6		4
		Gafrarium pectinatum						2	1	1	3			1	2	2		1	1	2			3
		Gafrarium tumidum	2	3			2	4	6	5	4	15	21	6	10	8	8	7	13	5	8		5
		Irus carditoides <10mm																					
		Periglypta puerpera																	1				
		Pitar pellucidus				1					1	1						1	1				
		Protapes gallus			1			1			1		1		1								1
		Venerupis aspera	2	1	1	1	2	4	1	2	4	11	6	4	7	6	6	2	9	2	7		6
Gastropoda	Amathinidae	*Amathina tricarinata* <10mm										1				1	1				1		
	Angariidae	*Angaria delphinus*																					
	Bullidae	*Bulla ampulla*																			1		
	Calliostomatidae	*Calliostoma* spp.			1			2			1	1		1	1	1	2		1	1	2		
	Cerithiidae	Cerithiidae					1					1	2										
		Cerithiidae <10 mm					2					3						2		1			
		Cerithium citrinum						1			2	1		1	2	2	1		1	1			1
		Cerithium coralium		1			1		1			1									1		2
		Cerithium nodulosum																					

			XU																				
Class	**Family**	**Taxon**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**
		Cerithium zonatum																					
		Clypeomorus batillariaeformis				1		1	1	1	1		2	3	1	1	1	1	1	1			3
		Rhinoclavis vertagus					1																
	Chilodontaidae	*Euchelus atratus* <10mm	1			2											1	1			1		1
	Columbellidae	*Mitrella scripta*			1			1						1									
	Conidae	Conidae	1					1	1				1	1	1				1				
		Conus arenatus																					
		Conus lividus																					
		Conus tessulatus																			1		
		Conus textile																					
	Costellariidae	*Vexillum vulpecula*										1											
	Cymatiidae	Cymatiidae	1																				
		Monoplex vespaceus																					
	Cypraeidae	Cypraeidae					1					1				1					1		
		Mauritia arabica																	1				
	Ellobiidae	Ellobiidae				1																	
		Ellobiidae <10mm										1		1	1	1							1
		Cassidula spp.																					
		Ellobium spp.	1		1		1	2		2	1						1						
		Ellobium aurisjudae									1	1	2		1			2	4	1			1
	Epitoniidae	Epitoniidae <10mm																					
	Fissurellidae	*Hemitoma* spp. <10mm	2	1	1	1							1	1	1								
	Littorinidae	*Littoraria* spp.								1													
		Littoraria spp. <10mm			1																		
		Littoraria filosa											1										
		Littoraria scabra					2	1				3	6		6	2	5	1	1	1	5		4
	Muricidae	*Chicoreus* spp.		1			1	2	2	2	4		2	1	2	5	2	2	3	2	2		3
		Chicoreus capucinus										3											
		Drupella margariticola											1										
	Nassariidae	*Nassarius* spp.				2	1			2					3		1	1	1				1

			XU																				
Class	**Family**	**Taxon**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**
		Nassarius coronatus																					
		Nassarius crematus	1					2				2	4					1		1			
		Nassarius olivaceus					2	2	1		6	1	3		1	5	1		1	1			4
		Nassarius pullus						1								1							
	Naticidae	Naticidae		1	1		1		1			1	1		1	1		1	3	1	1		1
		Notocochlis gualtieriana															2						
		Polinices mammilla	1	4		1	1	2	2	2	5	8	7	1	3	5	4	3	7	2	9		7
	Neritidae	Neritidae											1		1			1					
		Neripteron violaceum																					
		Nerita spp.	2	2	2	5	2	3		2	2	9	3	3	2	6	5	7	5	6	8		2
		Nerita albicilla		2	1		1	1	1		2	2	2	4	2	7	3	2		1	2		3
		Nerita balteata				1		1	1		1	2	2	3	2	2	2	2	2		3		3
		Nerita chamaeleon					1	1	1	1	1	2	1		3		2		3	3			3
		Nerita costata							1														
		Nerita planospira	2					1				3	2	3	3	1	4	3	3	1	4		4
		Nerita polita																					
		Nerita undata							3			1	7	3	3	3	2	3	3	3	1		4
	Olividae	Olividae					1					2	2										
		Miniaceoliva miniacea													1								
		Oliva elegans																		1			
		Oliva oliva																					
		Oliva reticulata																					
		Oliva vidua																		1			
	Patellidae	Patellidae																					
		Patellidae <10mm																					
	Pisaniidae	*Cantharus* sp.																			1		
	Planaxidae	Planaxidae																					
		Planaxis sulcatus				1		2		1	1	1				1	2	1	4	1	3		1
	Potamididae	*Cerithideopsis largillierti*	1		2	2	2	5	2	1		1	6	4	8	3	5	2	9	1	3		10
		Pirinella cingulata																1					
		Telescopium telescopium			2													1					

			XU																				
Class	**Family**	**Taxon**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**
		Terebralia spp.																					
		Terebralia palustris																					
		Terebralia sulcata	3	2	2		2	3	3	1	3	4	4	3	6	2	3	1		4	1		1
	Strombidae	Strombidae	1					1					1					1					1
		Canarium labiatum						1															
		Canarium urceus																					
		Conomurex luhuanus						1										1					
		Gibberulus gibberulus			1			1						1									
		Laevistrombus canarium	1	3					1			4	1	1	3		1		1	3			1
		Lambis spp.				1	1	1	1						1	1					2		
		Lambis crocata																					
		Lambis lambis			1								2		2		3	2					1
	Tegulidae	*Rochia nilotica*																					
		Tectus fenestratus											2										
	Terebridae	Terebridae																	1				
	Tonnidae	*Tonna* sp.																					
	Trochidae	Trochidae																					
		Monodonta labio	1																				
	Turbinellidae	*Vasum turbinellus*	1					1															
	Turbinidae	*Lunella cinerea*			1			2	1	1	1	1	2			1	1		2		4		
		Turbo spp.	2			1		1	3		1	3		2	1	2	2	4	3	1	1		4
Total			**54**	**48**	**52**	**63**	**65**	**133**	**92**	**63**	**126**	**260**	**273**	**149**	**212**	**188**	**145**	**184**	**224**	**117**	**191**	**0**	**167**

			XU																				
Class	**Family**	**Taxon**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**	**82**	**83**	**84**
Bivalvia	Arcidae	Arcidae				2		1						1	1							1	1
		Arcidae <10mm									1					1			1	1			
		Anadara antiquata	8	4	13	8	5	9	13	8	3	3			1	1	1	1		1		2	1
		Anadara rufescens	1	2	2	1		1															
		Arca ventricosa																					
		Barbatia foliata											1	1		1				1			
		Tegillarca granosa	1																				
	Cardiidae	Cardiidae																					
		Fragum unedo																					
		Tridacna squamosa																					
		Vasticardium flavum	1	1	1																		
	Chamidae	*Chama* spp.	9	14	17	5	2	3	5	1	2	1					1						
	Corbulidae	*Corbula* sp.																					
	Cyrenidae	Cyrenidae												1					1				
		Batissa violacea	2		2	1		1			1		1										
		Geloina expansa	5	2	3				2	1			1						1			1	
	Glauconomidae	*Glauconome rugosa*	2		1				1														
	Gryphaeidae	*Hyotissa hyotis*																					
	Lucinidae	*Anodontia edentula*	1		2			1								1		1		1			
		Austriella corrugata	3	5	7	4	1	1	1		2	1			1			1	1	1	1		2
		Codakia tigerina																					
	Mactridae	*Mactra* spp.	1		2						1			1			1	1			1	1	
		Mactra cuneata	1	3	3	1	1	2	3				2						1				
	Malleidae	*Malleus* spp.	1	1	1																		
	Mesodesmatidae	*Atactodea striata*	8	8	21	23	5	20	33	26	30	11	6	14	8	2	4	2	2	6	4	2	2
	Mytilidae	Mytilidae																					
		Septifer bilocularis												1			1						
	Noetiidae	Noetiidae																					
	Ostreidae	Ostreidae	31	17	26	18	1	4	2	2	2	2	2	1	1					1	1	1	1
	Pectinidae	Pectinidae <10mm																					
	Placunidae	*Placuna placenta*	1																				

Class	Family	Taxon	XU																				
Class	**Family**	**Taxon**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**	**82**	**83**	**84**
	Psammobiidae	*Asaphis violascens*	1	1	1	1																	
		Gari occidens												1				1					
	Pteriidae	*Isognomon* spp.	18	15	8	10	2	8	4	3	3	2	2	2	5	1		2	1	1	2		1
		Pinctada spp.	1	1					2		2	1	1										
		Pinctada maculata	11	10	7	5								2									
	Spondylidae	*Spondylus* spp.	2					1															
	Tellinidae	Tellinidae							2			1	1							1	1		
		Quidnipagus palatam																					
	Trapezidae	*Neotrapezium sublaevigatum*																					
	Veneridae	Veneridae																					
		Anomalodiscus squamosus																					
		Dosinia sp.																					
		Gafrarium spp.	3	7	2	2	2	1	1		1						1						3
		Gafrarium pectinatum	1	4	5	1		1	1					1									
		Gafrarium tumidum	7	9	8	7	4	3	1	2	3			1	1					1			
		Irus carditoides <10mm		1		1								1								1	
		Periglypta puerpera																					
		Pitar pellucidus				2						1											
		Protapes gallus	1					1	1														
		Venerupis aspera	3	7	7	4			2	3	2	1	2	1		1			1	1	2		1
Gastropoda	Amathinidae	*Amathina tricarinata* <10mm																					
	Angariidae	*Angaria delphinus*																					
	Bullidae	*Bulla ampulla*																					
	Calliostomatidae	*Calliostoma* spp.				2								1									
	Cerithiidae	Cerithiidae	1														1						
		Cerithiidae <10mm		2								1											
		Cerithium citrinum		1		1													1				
		Cerithium coralium			1	1		1															
		Cerithium nodulosum																					
		Cerithium zonatum				1																	
		Clypeomorus batillariaeformis	1	2					1	1													

			XU																				
Class	**Family**	**Taxon**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**	**82**	**83**	**84**
		Rhinoclavis vertagus																					
	Chilodontaidae	*Euchelus atratus* <10mm											1										
	Columbellidae	*Mitrella scripta*																					
	Conidae	Conidae		1	1				1														
		Conus arenatus			1																		
		Conus lividus			1																		
		Conus tessulatus																					
		Conus textile																					
	Costellariidae	*Vexillum vulpecula*																					
	Cymatiidae	Cymatiidae				1																	
		Monoplex vespaceus																					
	Cypraeidae	Cypraeidae			1	1		1															
		Mauritia arabica																					
	Ellobiidae	Ellobiidae																					
		Ellobiidae <10mm			1						1												
		Cassidula spp.																					
		Ellobium spp.			2				1		1	1	1							1			1
		Ellobium aurisjudae	4			2		1															
	Epitoniidae	Epitoniidae <10mm																					
	Fissurellidae	*Hemitoma* spp. <10mm		1	1																		
	Littorinidae	*Littoraria* spp.																					1
		Littoraria spp. <10mm																					
		Littoraria filosa																					
		Littoraria scabra	4	11	10	9		2	1	1		1	1		2				1				
	Muricidae	*Chicoreus* spp.	1	4	3	2	1	1	1	1	1			1									
		Chicoreus capucinus	2																				
		Drupella margariticola																					
	Nassariidae	*Nassarius* spp.			1		1	1			1				1				2				
		Nassarius coronatus																					1
		Nassarius crematus	1						1														
		Nassarius olivaceus	3	3	2				1	1			1									1	

			XU																				
Class	**Family**	**Taxon**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**	**82**	**83**	**84**
		Nassarius pullus		1												1							
	Naticidae	Naticidae	5		2	1				1	2												
		Notocochlis gualtieriana																					
		Polinices mammilla	6	11	8	4			2	1	1	1				1			1	1	1		2
	Neritidae	Neritidae			3																		
		Neripteron violaceum	1																				
		Nerita spp.	12	9	4	9		1	5	3	2	2	1	2	1		1	1	1	1	7	2	
		Nerita albicilla	1		2	1					2	3											
		Nerita balteata	2	1	3	2		1	2		1												
		Nerita chamaeleon		2		3		2	1					1							2		
		Nerita costata																					
		Nerita planospira		2	4	1			1	1	1	1		1								1	
		Nerita polita																					
		Nerita undata	2	1	7	4	1	1			1	1		1			2	1				2	
	Olividae	Olividae	1		1																		
		Miniaceoliva miniacea																					
		Oliva elegans								1													
		Oliva oliva			1																		
		Oliva reticulata	1																				
		Oliva vidua																					
	Patellidae	Patellidae																					
		Patellidae <10mm																		1			
	Pisaniidae	*Cantharus* sp.																					
	Planaxidae	Planaxidae																					
		Planaxis sulcatus	3			1		1	1	1				1					1				
	Potamididae	*Cerithideopsis largillierti*	12	10	10	6	1	5	10	5	6	4	1	3			2	1	3		1		1
		Pirinella cingulata	1																				
		Telescopium telescopium																					
		Terebralia spp.													1								1
		Terebralia palustris																					
		Terebralia sulcata			2	1		1	1					2									

			XU																				
Class	**Family**	**Taxon**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**	**82**	**83**	**84**
	Strombidae	Strombidae	1																				
		Canarium labiatum																					
		Canarium urceus																					
		Conomurex luhuanus																					
		Gibberulus gibberulus																					
		Laevistrombus canarium	2		1				1												3		
		Lambis spp.	1		1	1																	
		Lambis crocata			1																		
		Lambis lambis	1	3	2	1																	
	Tegulidae	*Rochia nilotica*			2																		
		Tectus fenestratus																					
	Terebridae	Terebridae																					
	Tonnidae	*Tonna* sp.				1																	
	Trochidae	Trochidae																					
		Monodonta labio													1								
	Turbinellidae	*Vasum turbinellus*																					
	Turbinidae	*Lunella cinerea*		1			2		3		1					1	1						
		Turbo spp.	3	1	1	1			1	3	1	1						2					1
Total			**196**	**179**	**219**	**153**	**29**	**77**	**109**	**66**	**75**	**40**	**25**	**42**	**24**	**11**	**16**	**14**	**19**	**20**	**26**	**15**	**20**

			XU																				
Class	**Family**	**Taxon**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**
Bivalvia	Arcidae	Arcidae	1	2			1							1				1				1	
		Arcidae <10mm										1				1							
		Anadara antiquata	8	4	2	1								1		1					1		
		Anadara rufescens																					
		Arca ventricosa																					
		Barbatia foliata																					
		Tegillarca granosa																					
	Cardiidae	Cardiidae																					
		Fragum unedo																					
		Tridacna squamosa																					
		Vasticardium flavum																					
	Chamidae	*Chama* spp.		1																			
	Corbulidae	*Corbula* sp.																					
	Cyrenidae	Cyrenidae																					
		Batissa violacea		1			1							1									1
		Geloina expansa	1	1			1													1			
	Glauconomidae	*Glauconome rugosa*																					
	Gryphaeidae	*Hyotissa hyotis*																					
	Lucinidae	*Anodontia edentula*																					
		Austriella corrugata	2	1			2			1	1	1	1				1						
		Codakia tigerina																					
	Mactridae	*Mactra* spp.								1	1												
		Mactra cuneata	1	1	2														1				
	Malleidae	*Malleus* spp.																					
	Mesodesmatidae	*Atactodea striata*	2	1	1	1		1		1			1		1					1	1	1	1
	Mytilidae	Mytilidae																					
		Septifer bilocularis	1	2			1																
	Noetiidae	Noetiidae																					
	Ostreidae	Ostreidae			1																1		
	Pectinidae	Pectinidae <10mm																					
	Placunidae	*Placuna placenta*																					

			XU																				
Class	**Family**	**Taxon**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**
	Psammobiidae	*Asaphis violascens*																					
		Gari occidens																					
	Pteriidae	*Isognomon* spp.					1			1	1		1			1	1						
		Pinctada spp.		1					1											3	1		
		Pinctada maculata																					
	Spondylidae	*Spondylus* spp.																					
	Tellinidae	Tellinidae		1			1				1			1		1		2	1				
		Quidnipagus palatam																					
	Trapezidae	*Neotrapezium sublaevigatum*																					
	Veneridae	Veneridae																					
		Anomalodiscus squamosus																					
		Dosinia sp.																					
		Gafrarium spp.	1				2		1						1					1		1	
		Gafrarium pectinatum	1	1							1					1							
		Gafrarium tumidum	2	1	1	1	1	1	3		2	1							1				
		Irus carditoides <10mm																					
		Periglypta puerpera																					
		Pitar pellucidus																					
		Protapes gallus	2	1											1					1		1	1
		Venerupis aspera	1																				
Gastropoda	Amathinidae	*Amathina tricarinata* <10mm																					
	Angariidae	*Angaria delphinus*																					
	Bullidae	*Bulla ampulla*												1									
	Calliostomatidae	*Calliostoma* spp.	2				1								1	1	1						
	Cerithiidae	Cerithiidae					1								1		1						
		Cerithiidae <10mm			1										3				1				
		Cerithium citrinum		1																		1	
		Cerithium coralium																					
		Cerithium nodulosum																					
		Cerithium zonatum																					
		Clypeomorus batillariaeformis		1															1		1		

			XU																				
Class	**Family**	**Taxon**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**
		Rhinoclavis vertagus																					
	Chilodontaidae	*Euchelus atratus* <10mm		1			1										1					1	
	Columbellidae	*Mitrella scripta*																					
	Conidae	Conidae																					
		Conus arenatus																					
		Conus lividus																					
		Conus tessulatus																					
		Conus textile																					
	Costellariidae	*Vexillum vulpecula*																					
	Cymatiidae	Cymatiidae																					
		Monoplex vespaceus																					
	Cypraeidae	Cypraeidae																					
		Mauritia arabica																					
	Ellobiidae	Ellobiidae							3														
		Ellobiidae <10mm																					
		Cassidula spp.																					
		Ellobium spp.									1						1						
		Ellobium aurisjudae	1																				
	Epitoniidae	Epitoniidae <10mm																					
	Fissurellidae	*Hemitoma* spp. <10mm																					
	Littorinidae	*Littoraria* spp.													2								
		Littoraria spp. <10mm				1	1		1							2				1		1	
		Littoraria filosa																					
		Littoraria scabra																1	1				
	Muricidae	*Chicoreus* spp.																				1	
		Chicoreus capucinus																					
		Drupella margariticola																					
	Nassariidae	*Nassarius* spp.		1											1	1							
		Nassarius coronatus																					
		Nassarius crematus														1							
		Nassarius olivaceus				1	1																

			XU																				
Class	**Family**	**Taxon**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**
		Nassarius pullus																					
	Naticidae	Naticidae																					
		Notocochlis gualtieriana																					
		Polinices mammilla					1																1
	Neritidae	Neritidae																					
		Neripteron violaceum																					
		Nerita spp.	1	1	2		1		1		1	2		1		2	1	2	2	1	1		2
		Nerita albicilla																					
		Nerita balteata																1					
		Nerita chamaeleon							1	1												2	
		Nerita costata																					
		Nerita planospira																					
		Nerita polita															1						
		Nerita undata																					
	Olividae	Olividae																					
		Miniaceoliva miniacea																					
		Oliva elegans																					
		Oliva oliva																					
		Oliva reticulata																					
		Oliva vidua																					
	Patellidae	Patellidae																					
		Patellidae <10mm														1							
	Pisaniidae	*Cantharus* sp.																					
	Planaxidae	Planaxidae																					
		Planaxis sulcatus																					
	Potamididae	*Cerithideopsis largillierti*					2																
		Pirinella cingulata	1																				
		Telescopium telescopium																					
		Terebralia spp.																2					
		Terebralia palustris																					
		Terebralia sulcata																					

			XU																				
Class	**Family**	**Taxon**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**
	Strombidae	Strombidae																					
		Canarium labiatum																					
		Canarium urceus																					
		Conomurex luhuanus																					
		Gibberulus gibberulus																					
		Laevistrombus canarium																				1	
		Lambis spp.																					
		Lambis crocata																					
		Lambis lambis																					
	Tegulidae	*Rochia nilotica*																					
		Tectus fenestratus																					
	Terebridae	Terebridae																					
	Tonnidae	*Tonna* sp.																					
	Trochidae	Trochidae																					
		Monodonta labio																					
	Turbinellidae	*Vasum turbinellus*																					
	Turbinidae	*Lunella cinerea*			1							1											
		Turbo spp.																				1	
Total			**28**	**24**	**11**	**5**	**20**	**2**	**11**	**5**	**9**	**6**	**3**	**6**	**11**	**13**	**8**	**9**	**8**	**9**	**6**	**12**	**6**

			XU																				
Class	**Family**	**Taxon**	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**
Bivalvia	Arcidae	Arcidae			1			1			1	1			1								
		Arcidae <10mm										1	1	1		1	1		2	1	1		
		Anadara antiquata			1		1															1	1
		Anadara rufescens																					
		Arca ventricosa																					
		Barbatia foliata																					
		Tegillarca granosa																					
	Cardiidae	Cardiidae																					
		Fragum unedo																					1
		Tridacna squamosa																					
		Vasticardium flavum																					
	Chamidae	*Chama* spp.							1														1
	Corbulidae	*Corbula* sp.																					
	Cyrenidae	Cyrenidae																					
		Batissa violacea			1			1															
		Geloina expansa							1														
	Glauconomidae	*Glauconome rugosa*		1																			
	Gryphaeidae	*Hyotissa hyotis*																					
	Lucinidae	*Anodontia edentula*																					
		Austriella corrugata		1	1	1	1																
		Codakia tigerina																					
	Mactridae	*Mactra* spp.												1			1				1		
		Mactra cuneata							1											1			
	Malleidae	*Malleus* spp.																					
	Mesodesmatidae	*Atactodea striata*			2		1			1	1				1		2						
	Mytilidae	Mytilidae																					
		Septifer bilocularis																					
	Noetiidae	Noetiidae																					
	Ostreidae	Ostreidae																					
	Pectinidae	Pectinidae <10mm																					
	Placunidae	*Placuna placenta*																					

			XU																				
Class	**Family**	**Taxon**	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**
	Psammobiidae	*Asaphis violascens*																					
		Gari occidens																					
	Pteriidae	*Isognomon* spp.													1								
		Pinctada spp.																					
		Pinctada maculata																					
	Spondylidae	*Spondylus* spp.																					
	Tellinidae	Tellinidae	1	1			1		1			1			1		2	1	4		2	1	1
		Quidnipagus palatam																					
	Trapezidae	*Neotrapezium sublaevigatum*																					
	Veneridae	Veneridae																					
		Anomalodiscus squamosus																					
		Dosinia sp.																					
		Gafrarium spp.					2								1				1		1	1	1
		Gafrarium pectinatum				1																	
		Gafrarium tumidum		1		1	1		1														
		Irus carditoides <10mm																					
		Periglypta puerpera																					
		Pitar pellucidus																					
		Protapes gallus																					
		Venerupis aspera																					
Gastropoda	Amathinidae	*Amathina tricarinata* <10mm																					
	Angariidae	*Angaria delphinus*																					
	Bullidae	*Bulla ampulla*						1								1	2			1		1	
	Calliostomatidae	*Calliostoma* spp.						1											1	2	1		3
	Cerithiidae	Cerithiidae															1		1		1		3
		Cerithiidae <10mm	1	3				4					2	2						4			1
		Cerithium citrinum																					
		Cerithium coralium																					
		Cerithium nodulosum																					
		Cerithium zonatum																					
		Clypeomorus batillariaeformis																					

			XU																				
Class	**Family**	**Taxon**	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**
		Rhinoclavis vertagus																					
	Chilodontaidae	*Euchelus atratus* <10mm															1		1	1			1
	Columbellidae	*Mitrella scripta*																					
	Conidae	Conidae																					
		Conus arenatus																					
		Conus lividus																					
		Conus tessulatus																					
		Conus textile																					
	Costellariidae	*Vexillum vulpecula*																					
	Cymatiidae	Cymatiidae																					
		Monoplex vespaceus																					
	Cypraeidae	Cypraeidae					1																
		Mauritia arabica																					
	Ellobiidae	Ellobiidae																					
		Ellobiidae <10mm																					
		Cassidula spp.																					
		Ellobium spp.												1									
		Ellobium aurisjudae																					
	Epitoniidae	Epitoniidae <10mm																					
	Fissurellidae	*Hemitoma* spp. <10mm																					
	Littorinidae	*Littoraria* spp.																		1			
		Littoraria spp. <10mm		2	2								2		1		1	2	3	7			5
		Littoraria filosa																					
		Littoraria scabra																				2	1
	Muricidae	*Chicoreus* spp.																					
		Chicoreus capucinus																					
		Drupella margariticola																					
	Nassariidae	*Nassarius* spp.				1				1	1				2		1	1	1				
		Nassarius coronatus																					
		Nassarius crematus																					
		Nassarius olivaceus																					

			XU																				
Class	**Family**	**Taxon**	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**
		Nassarius pullus																					
	Naticidae	Naticidae																1					
		Notocochlis gualtieriana																					
		Polinices mammilla					1																
	Neritidae	Neritidae											1	1						2			
		Neripteron violaceum																					
		Nerita spp.		1	1	2	3	1	3	2	2		3		2	1		1	1	2	2		1
		Nerita albicilla																					
		Nerita balteata																					
		Nerita chamaeleon							1		1				1	1							
		Nerita costata																					
		Nerita planospira																					
		Nerita polita						1															
		Nerita undata												1									
	Olividae	Olividae																					
		Miniaceoliva miniacea																					
		Oliva elegans																					
		Oliva oliva																					
		Oliva reticulata																					
		Oliva vidua																					
	Patellidae	Patellidae																					1
		Patellidae <10mm				1		1			2	1		1		1			1				
	Pisaniidae	*Cantharus* sp.																					
	Planaxidae	Planaxidae												1									
		Planaxis sulcatus														1			1				
	Potamididae	*Cerithideopsis largillierti*																			1		
		Pirinella cingulata																					
		Telescopium telescopium																					
		Terebralia spp.																					
		Terebralia palustris																					
		Terebralia sulcata																					

			XU																				
Class	**Family**	**Taxon**	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**
	Strombidae	Strombidae													1								
		Canarium labiatum																					
		Canarium urceus																					
		Conomurex luhuanus																					
		Gibberulus gibberulus																			1		
		Laevistrombus canarium								1													
		Lambis spp.																					
		Lambis crocata																					
		Lambis lambis																					
	Tegulidae	*Rochia nilotica*																					
		Tectus fenestratus																	1				
	Terebridae	Terebridae									1												
	Tonnidae	*Tonna* sp.																					
	Trochidae	Trochidae																					
		Monodonta labio																					
	Turbinellidae	*Vasum turbinellus*																					
	Turbinidae	*Lunella cinerea*																					
		Turbo spp.				1			1								1						
Total			**2**	**10**	**9**	**8**	**12**	**11**	**10**	**5**	**9**	**4**	**9**	**9**	**12**	**6**	**13**	**6**	**18**	**22**	**11**	**6**	**21**

			XU								
Class	**Family**	**Taxon**	**127**	**128**	**129**	**130**	**131**	**132**	**133**	**134**	**Total**
Bivalvia	Arcidae	Arcidae							1	8	**78**
		Arcidae <10mm	3	6		3	8	3			**39**
		Anadara antiquata		1	1				1		**595**
		Anadara rufescens									**10**
		Arca ventricosa			1		2			2	**5**
		Barbatia foliata									**15**
		Tegillarca granosa	1								**60**
	Cardiidae	Cardiidae									**6**
		Fragum unedo									**7**
		Tridacna squamosa									**1**
		Vasticardium flavum									**19**
	Chamidae	*Chama* spp.			1			2	1	4	**186**
	Corbulidae	*Corbula* sp.									**1**
	Cyrenidae	Cyrenidae									**8**
		Batissa violacea									**69**
		Geloina expansa									**105**
	Glauconomidae	*Glauconome rugosa*									**17**
	Gryphaeidae	*Hyotissa hyotis*									**1**
	Lucinidae	*Anodontia edentula*									**32**
		Austriella corrugata		1							**108**
		Codakia tigerina									**1**
	Mactridae	*Mactra* spp.		1		2			1	1	**45**
		Mactra cuneata									**32**
	Malleidae	*Malleus* spp.									**12**
	Mesodesmatidae	*Atactodea striata*					2		2		**465**
	Mytilidae	Mytilidae									**8**
		Septifer bilocularis									**6**
	Noetiidae	Noetiidae									**1**
	Ostreidae	Ostreidae		3	1	1	2	1	3	5	**773**
	Pectinidae	Pectinidae <10mm								1	**1**
	Placunidae	*Placuna placenta*									**37**

			XU								
Class	**Family**	**Taxon**	**127**	**128**	**129**	**130**	**131**	**132**	**133**	**134**	**Total**
	Psammobiidae	*Asaphis violascens*									**18**
		Gari occidens									**3**
	Pteriidae	*Isognomon* spp.									**602**
		Pinctada spp.									**21**
		Pinctada maculata									**207**
	Spondylidae	*Spondylus* spp.									**11**
	Tellinidae	Tellinidae	14	6	5	7	14	16	17	11	**127**
		Quidnipagus palatam						1			**3**
	Trapezidae	*Neotrapezium sublaevigatum*									**1**
	Veneridae	Veneridae									**1**
		Anomalodiscus squamosus									**7**
		Dosinia sp.									**1**
		Gafrarium spp.		1	3	1	3			1	**340**
		Gafrarium pectinatum								1	**69**
		Gafrarium tumidum									**674**
		Irus carditoides <10mm						1			**5**
		Periglypta puerpera									**2**
		Pitar pellucidus									**17**
		Protapes gallus									**41**
		Venerupis aspera		1				1			**133**
Gastropoda	Amathinidae	*Amathina tricarinata* <10mm									**5**
	Angariidae	*Angaria delphinus*								1	**4**
	Bullidae	*Bulla ampulla*							1	3	**18**
	Calliostomatidae	*Calliostoma* spp.	2	5	5			2	7	24	**83**
	Cerithiidae	Cerithiidae		3			2	4	3	3	**36**
		Cerithiidae <10mm		7	7	1	10		7	32	**104**
		Cerithium citrinum								1	**22**
		Cerithium coralium									**12**
		Cerithium nodulosum									**1**
		Cerithium zonatum									**5**
		Clypeomorus batillariaeformis									**39**

			XU								
Class	**Family**	**Taxon**	**127**	**128**	**129**	**130**	**131**	**132**	**133**	**134**	**Total**
		Rhinoclavis vertagus									**3**
	Chilodontaidae	*Euchelus atratus* <10mm		1	1		2	1		2	**25**
	Columbellidae	*Mitrella scripta*									**3**
	Conidae	Conidae									**18**
		Conus arenatus									**1**
		Conus lividus									**1**
		Conus tessulatus									**1**
		Conus textile									**1**
	Costellariidae	*Vexillum vulpecula*									**1**
	Cymatiidae	Cymatiidae								2	**5**
		Monoplex vespaceus									**1**
	Cypraeidae	Cypraeidae									**14**
		Mauritia arabica									**1**
	Ellobiidae	Ellobiidae									**4**
		Ellobiidae <10mm									**9**
		Cassidula spp.			1				1		**2**
		Ellobium spp.									**22**
		Ellobium aurisjudae									**22**
	Epitoniidae	Epitoniidae <10mm					1	1			**2**
	Fissurellidae	*Hemitoma* spp. <10mm	1								**32**
	Littorinidae	*Littoraria* spp.		2			5			5	**20**
		Littoraria spp. <10mm		8		1		1	4		**47**
		Littoraria filosa									**4**
		Littoraria scabra									**93**
	Muricidae	*Chicoreus* spp.									**57**
		Chicoreus capucinus									**7**
		Drupella margariticola									**1**
	Nassariidae	*Nassarius* spp.		1						1	**34**
		Nassarius coronatus									**1**
		Nassarius crematus									**21**
		Nassarius olivaceus								1	**49**

			XU								
Class	**Family**	**Taxon**	**127**	**128**	**129**	**130**	**131**	**132**	**133**	**134**	**Total**
		Nassarius pullus									**5**
	Naticidae	Naticidae						1		1	**43**
		Notocochlis gualtieriana						1			**7**
		Polinices mammilla									**129**
	Neritidae	Neritidae					2				**13**
		Neripteron violaceum									**1**
		Nerita spp.	2	3	3	1	7	1	3	20	**264**
		Nerita albicilla						1			**51**
		Nerita balteata									**47**
		Nerita chamaeleon	1								**51**
		Nerita costata									**1**
		Nerita planospira									**56**
		Nerita polita								3	**5**
		Nerita undata			2						**68**
	Olividae	Olividae									**8**
		Miniaceoliva miniacea									**1**
		Oliva elegans									**2**
		Oliva oliva									**1**
		Oliva reticulata									**1**
		Oliva vidua									**1**
	Patellidae	Patellidae									**1**
		Patellidae <10mm	1	2	1		4		2	3	**23**
	Pisaniidae	*Cantharus* sp.									**1**
	Planaxidae	Planaxidae									**4**
		Planaxis sulcatus			1	1					**40**
	Potamididae	*Cerithideopsis largillierti*		1		1					**170**
		Pirinella cingulata									**4**
		Telescopium telescopium									**68**
		Terebralia spp.									**5**
		Terebralia palustris									**15**
		Terebralia sulcata									**66**

			XU								
Class	**Family**	**Taxon**	**127**	**128**	**129**	**130**	**131**	**132**	**133**	**134**	**Total**
	Strombidae	Strombidae			3					1	**29**
		Canarium labiatum									**3**
		Canarium urceus									**1**
		Conomurex luhuanus									**332**
		Gibberulus gibberulus									**22**
		Laevistrombus canarium									**56**
		Lambis spp.									**52**
		Lambis crocata									**1**
		Lambis lambis									**29**
	Tegulidae	*Rochia nilotica*									**2**
		Tectus fenestratus		1							**9**
	Terebridae	Terebridae									**2**
	Tonnidae	*Tonna* sp.									**1**
	Trochidae	Trochidae								1	**1**
		Monodonta labio									**2**
	Turbinellidae	*Vasum turbinellus*									**5**
	Turbinidae	*Lunella cinerea*									**30**
		Turbo spp.									**58**
Total			**25**	**54**	**36**	**19**	**64**	**38**	**54**	**138**	**7644**

Appendix E.

Mollusc Weight (g) per XU for Tanamu 1 Square B.

			XU												
Class	**Family**	**Taxon**	**1**	**2**	**3**	**4**	**5–6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Bivalvia	Arcidae	Arcidae	1.1	1.0	2.0	3.1	2.2		1.4		1.2	0.7	0.4		
		Arcidae <10mm													
		Anadara antiquata			7.3	23.9	14.3		1.4						1.6
		Anadara rufescens													
		Barbatia foliata					0.3								
		Tegillarca granosa					0.9					2.2			2.1
	Cardiidae	Cardiidae										0.4			
		Fragum spp.													
		Fragum spp. <10mm													
		Fragum unedo													
		Hippopus hippopus													
		Tridacna spp.				10.2									
		Tridacna maxima					52.0								
		Vasticardium flavum													
	Chamidae	*Chama* spp.													
	Cyrenidae	*Batissa violacea*													
		Geloina expansa	60.6	71.6	42.5	13.4	11.8								1.9
	Glauconomidae	*Glauconome rugosa*													
	Lucinidae	*Anodontia edentula*													
		Austriella corrugata						1.4							
	Mactridae	*Mactra* spp.													
		Mactra cuneata													
	Malleidae	*Malleus* spp.													
	Mesodesmatidae	*Atactodea striata*													
	Mytilidae	Mytilidae													
		Septifer bilocularis													
	Ostreidae	Ostreidae	6.1	7.0	69.5	267.9	387.4	2.9						0.3	
	Pinnidae	Pinnidae													
	Placunidae	*Placuna* spp.													
	Psammobiidae	*Asaphis violascens*													
	Pteriidae	*Isognomon* spp.													
		Pinctada spp.				8.8	4.8	9.3							
		Pinctada maculata													
	Spondylidae	*Spondylus* spp.													
	Tellinidae	Tellinidae													
		Quidnipagus palatam													
	Trapezidae	*Neotrapezium sublaevigatum*													
	Veneridae	Veneridae													
		Anomalodiscus squamosus													
		Dosinia sp.													
		Gafrarium spp.			1.1	4.9	1.4	2.4		1.0	0.2	4.7	0.1		1.1
		Gafrarium pectinatum													
		Gafrarium tumidum													

			XU												
Class	**Family**	**Taxon**	**1**	**2**	**3**	**4**	**5–6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
		Irus carditoides <10mm						0.5							
		Marcia hiantina													
		Periglypta puerpera				4.4									
		Pitar pellucidus													
		Protapes gallus													
		Tapes literatus													
		Venerupis aspera													
Gastropoda	Amathinidae	*Amathina tricarinata*													
	Angariidae	*Angaria delphinus*					23.6								
	Architectonicidae	*Architectonica* sp. <10mm													
	Bullidae	*Bulla* spp.													
		Bulla ampulla													
	Calliostomatidae	*Calliostoma* spp.													
	Cerithiidae	Cerithiidae													
		Cerithiidae <10mm													
		Cerithium citrinum													
		Cerithium coralium													
		Cerithium echinatum													
		Cerithium nodulosum													
		Cerithium zonatum													
		Clypeomorus batillariaeformis													
	Chilodontaidae	*Euchelus atratus* <10mm													
	Conidae	Conidae					<0.1		9.3	2.6					
		Conus arenatus													
		Conus coronatus													
		Conus textile													
	Costellariidae	*Vexillum rugosum*													
	Cymatiidae	Cymatiidae									0.2				
	Cypraeidae	Cypraeidae			2.5	0.2									
		Cypraea tigris					8.3								
	Ellobiidae	*Cassidula* spp.													
		Ellobium spp.													
		Ellobium aurisjudae				3.9	2.2								
	Fissurellidae	*Hemitoma* spp. <10mm				0.2	0.1								
	Littorinidae	*Littoraria* spp.													
		Littoraria spp. <10mm													
		Littoraria filosa				0.2									
		Littoraria scabra													
	Lottiidae	Lottiidae													
	Mitridae	Mitridae													
		Mitra sp.													
		Chicoreus spp.													
		Chicoreus capucinus													
		Drupella margariticola													
		Thais sp.													8.0
	Nacellidae	*Cellana rota*													

			XU												
Class	**Family**	**Taxon**	**1**	**2**	**3**	**4**	**5–6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
	Nassariidae	*Nassarius* spp.													
		Nassarius coronatus													
		Nassarius crematus													
		Nassarius distortus													
		Nassarius olivaceus													
		Nassarius pullus													
	Naticidae	Naticidae													
		Mammilla sebae													
		Notocochlis gualtieriana													
		Polinices mammilla													
		Polinices peselephanti													
	Neritidae	*Neripteron violaceum*													
		Nerita spp.													
		Nerita albicilla													
		Nerita balteata													
		Nerita chamaeleon													
		Nerita costata													
		Nerita planospira													
		Nerita polita													
		Nerita undata													
	Olividae	Olividae													
		Oliva annulata													
		Oliva reticulata													
		Oliva tricolor													
	Patellidae	Patellidae													
	Pisaniidae	*Cantharus* sp.													
	Planaxidae	*Fissilabia decollata*													
		Planaxis sulcatus													
	Potamididae	Potamididae	5.4	5.1											
		Cerithideopsis largillierti	0.6												
		Pirenella cingulata													
		Telescopium telescopium	16.0	33.0	288.4	669.4	514.9	65.3	2.5		27.8	8.4	1.2	0.1	
		Terebralia sulcata	25.7												
	Strombidae	Strombidae	5.1	5.2	20.6	18.7	0.9		0.8	7.6		0.4	15.7	2.2	
		Canarium labiatum													
		Conomurex luhuanus	32.5	77.4	478.0	968.1	1123.0	78.5	51.1		15.3	2.9	5.5	10.5	12.5
		Euprotomus aurisdianae				4.5									
		Gibberulus gibberulus					14.0								5.9
		Laevistrombus canarium													
		Lambis spp.	2.0	18.3		34.5	52.1	0.9			34.7				
		Lambis lambis			169.7	174.2	99.0								
	Tegulidae	Tegulidae													
		Rochia nilotica													
		Tectus fenestratus		0.6	8.6	7.3									
	Terebridae	Terebridae													
	Tonnidae	*Tonna* sp.				5.6									
	Trochidae	Trochidae					8.2								

Class	Family	Taxon	XU												
			1	2	3	4	5–6	7	8	9	10	11	12	13	14
		Rochia nilotica													
	Turbinellidae	*Vasum* sp.				6.3									
		Vasum turbinellus					5.3								
	Turbinidae	Turbinidae												<0.1	
		Lunella cinerea													
		Turbo spp.													
	Vermetidae	Vermetidae				0.1			<0.1						
Indeterminate	Indeterminate	Unidentified Shell	34.9	58.4	223.8	118.5	111.7	29.4	12.1	0.9	7.6	0.8	2.9	2.3	8.3
Total			**190.0**	**277.6**	**1314.0**	**2348.3**	**2438.4**	**190.6**	**78.6**	**12.1**	**87.0**	**20.5**	**25.8**	**15.4**	**41.4**

Class	Family	Taxon	XU												
			15	16	17	18	19	20	21	22	23	24	25	26	27
Bivalvia	Arcidae	Arcidae	7.1	0.7	0.2			2.7	0.4		0.2	11.6	10.1	6.8	11.7
		Arcidae <10mm													
		Anadara antiquata				0.3	1.4		1.5	33.8	11.2	25.5	57.3	81.6	74.0
		Anadara rufescens													
		Barbatia foliata													
		Tegillarca granosa		3.5		1.6	6.4	1.6	1.5	9.3		11.4	78.7	29.3	5.6
	Cardiidae	Cardiidae					<0.1						1.0	2.1	1.5
		Fragum spp.													
		Fragum spp. <10mm													
		Fragum unedo													
		Hippopus hippopus													
		Tridacna spp.													
		Tridacna maxima													
		Vasticardium flavum													
	Chamidae	*Chama* spp.													5.9
	Cyrenidae	*Batissa violacea*													
		Geloina expansa										2.1	13.1		12.5
	Glauconomidae	*Glauconome rugosa*													
	Lucinidae	*Anodontia edentula*													
		Austriella corrugata								0.4		0.3	29.7	4.9	3.9
	Mactridae	*Mactra* spp.													
		Mactra cuneata													
	Malleidae	*Malleus* spp.													
	Mesodesmatidae	*Atactodea striata*										0.5		3.4	
	Mytilidae	Mytilidae													
		Septifer bilocularis													
	Ostreidae	Ostreidae				0.2				8.7	1.4	7.5	1.9	10.9	26.5
	Pinnidae	Pinnidae													
	Placunidae	*Placuna* spp.										10.9	228.4	90.8	33.3
	Psammobiidae	*Asaphis violascens*													
	Pteriidae	*Isognomon* spp.								0.2		0.2	16.8	1.1	0.8
		Pinctada spp.							4.1		1.7		2.6	0.3	
		Pinctada maculata													
	Spondylidae	*Spondylus* spp.													137.5
	Tellinidae	Tellinidae													

			XU												
Class	**Family**	**Taxon**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**
		Quidnipagus palatam													
	Trapezidae	*Neotrapezium sublaevigatum*													
	Veneridae	Veneridae													
		Anomalodiscus squamosus													0.3
		Dosinia sp.													
		Gafrarium spp.	0.1	5.0	0.7	1.3	0.4	0.5	2.2	14.5	8.1	12.1	27.8	14.9	47.4
		Gafrarium pectinatum													
		Gafrarium tumidum										6.3			19.3
		Irus carditoides <10mm													
		Marcia hiantina													
		Periglypta puerpera													
		Pitar pellucidus													
		Protapes gallus													
		Tapes literatus													
		Venerupis aspera													0.3
Gastropoda	Amathinidae	*Amathina tricarinata*													
	Angariidae	*Angaria delphinus*						2.3						0.1	
	Architectonicidae	*Architectonica* sp. <10mm													
	Bullidae	*Bulla* spp.													
		Bulla ampulla													
	Calliostomatidae	*Calliostoma* spp.													
	Cerithiidae	Cerithiidae													
		Cerithiidae <10mm													
		Cerithium citrinum													
		Cerithium coralium													0.5
		Cerithium echinatum													
		Cerithium nodulosum										62.2			
		Cerithium zonatum								0.3					0.3
		Clypeomorus batillariaeformis													
	Chilodontaidae	*Euchelus atratus* <10mm													
	Conidae	Conidae								0.6		4.6	5.3		
		Conus arenatus													
		Conus coronatus													
		Conus textile												8.0	
	Costellariidae	*Vexillum rugosum*													
	Cymatiidae	Cymatiidae											2.1		
	Cypraeidae	Cypraeidae													
		Cypraea tigris													
	Ellobiidae	*Cassidula* spp.													
		Ellobium spp.										0.4			
		Ellobium aurisjudae													
	Fissurellidae	*Hemitoma* spp. <10mm													
	Littorinidae	*Littoraria* spp.													
		Littoraria spp. <10mm													

			XU												
Class	**Family**	**Taxon**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**
		Littoraria filosa													
		Littoraria scabra													
	Lottiidae	Lottiidae													
	Mitridae	Mitridae													
		Mitra sp.													
		Chicoreus spp.													
		Chicoreus capucinus													
		Drupella margariticola													
		Thais sp.								2.3					
	Nacellidae	*Cellana rota*													
	Nassariidae	*Nassarius* spp.							0.1		1.7				
		Nassarius coronatus													
		Nassarius crematus													2.2
		Nassarius distortus													
		Nassarius olivaceus													
		Nassarius pullus													
	Naticidae	Naticidae									0.5		1.7		
		Mammilla sebae													
		Notocochlis gualtieriana													
		Polinices mammilla													
		Polinices peselephanti													
	Neritidae	*Neripteron violaceum*													
		Nerita spp.										0.4	1.1	0.7	0.1
		Nerita albicilla													
		Nerita balteata													
		Nerita chamaeleon													
		Nerita costata													
		Nerita planospira													
		Nerita polita													
		Nerita undata													
	Olividae	Olividae													
		Oliva annulata													
		Oliva reticulata													
		Oliva tricolor													
	Patellidae	Patellidae													
	Pisaniidae	*Cantharus* sp.													
	Planaxidae	*Fissilabia decollata*													
		Planaxis sulcatus													
	Potamididae	Potamididae													
		Cerithideopsis largillierti													
		Pirenella cingulata													
		Telescopium telescopium				0.4				0.3	1.2	0.7	0.3	0.2	2.8
		Terebralia sulcata								0.8					
	Strombidae	Strombidae	0.7	1.4				0.5	0.7	0.5		4.3	0.7	1.9	4.8
		Canarium labiatum													
		Conomurex luhuanus	4.2	14.5	1.6	9.2	6.1	13.2	8.1	12.8	11.1	19.1	60.1		65.1

			XU												
Class	**Family**	**Taxon**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**
		Euprotomus aurisdianae													
		Gibberulus gibberulus										7.1		2.6	6.4
		Laevistrombus canarium								0.8			12.8		16.1
		Lambis spp.	1.4					0.4	4.6	0.6	1.0	2.7	117.2	78.8	47.9
		Lambis lambis										33.5			144.1
	Tegulidae	Tegulidae													0.5
		Rochia nilotica													
		Tectus fenestratus											0.9	0.7	0.3
	Terebridae	Terebridae													
	Tonnidae	*Tonna* sp.													
	Trochidae	Trochidae											0.4		
		Rochia nilotica													
	Turbinellidae	*Vasum* sp.											1.3	17.8	
		Vasum turbinellus										2.4			
	Turbinidae	Turbinidae												0.5	
		Lunella cinerea										1.1		0.8	
		Turbo spp.													
	Vermetidae	Vermetidae													0.1
Indeterminate	Indeterminate	Unidentified Shell		6.6	1.2	7.1	7.6	6.0	9.3	39.8	14.8	72.2	140.9	52.1	90.6
Total			**13.5**	**31.7**	**3.7**	**20.1**	**21.9**	**27.2**	**32.5**	**125.7**	**52.9**	**299.1**	**812.2**	**410.2**	**762.3**

			XU												
Class	**Family**	**Taxon**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
Bivalvia	Arcidae	Arcidae	23.0	18.7	21.0	3.5	8.4	7.6	8.2	9.4	4.7	2.5	8.0	3.3	6.9
		Arcidae <10mm													
		Anadara antiquata	44.4	151.7	249.6	58.1	83.1	39.5	15.3	4.1	24.0	9.2	5.1	9.8	3.8
		Anadara rufescens													
		Barbatia foliata				1.5		0.1					0.6	<0.1	
		Tegillarca granosa	9.1	77.9	88.4		10.2	12.4	48.5				6.8		
	Cardiidae	Cardiidae	<0.1	0.2	5.0	1.4	1.6	1.2	0.6	1.4	0.3		3.5		
		Fragum spp.		0.1					0.1						
		Fragum spp. <10mm								<0.1	<0.1				<0.1
		Fragum unedo			11.9										
		Hippopus hippopus					1.8								
		Tridacna spp.		3.3											
		Tridacna maxima			96.7										
		Vasticardium flavum				2.6			2.1						
	Chamidae	*Chama* spp.	7.0	9.5	28.8	40.7	10.3	15.2	43.5		7.3		7.9	0.1	2.7
	Cyrenidae	*Batissa violacea*		9.1	5.5	23.3		6.5	15.2					4.2	16.9
		Geloina expansa	6.3	20.3	92.8	34.7	25.1		18.7				0.4	5.6	
	Glauconomidae	*Glauconome rugosa*													
	Lucinidae	*Anodontia edentula*			0.1			0.3		3.8					

			XU												
Class	**Family**	**Taxon**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
		Austriella corrugata	3.5	6.6	6.8	9.2	10.5	7.5	7.4	0.7	3.6	3.0	5.5	1.7	0.4
	Mactridae	*Mactra* spp.	0.4	1.1											
		Mactra cuneata													
	Malleidae	*Malleus* spp.	2.3	1.9			4.2								
	Mesodesmatidae	*Atactodea striata*	0.8	5.9	6.9	16.1	14.8	16.3	12.6	3.0	3.1	1.3	3.4	2.2	3.0
	Mytilidae	Mytilidae				0.1							0.1		<0.1
		Septifer bilocularis													
	Ostreidae	Ostreidae	16.9	59.9	175.9	51.5	234.6	65.1	92.4	12.3	11.0	12.0	59.4	3.1	6.4
	Pinnidae	Pinnidae	0.7	0.3							0.2				
	Placunidae	*Placuna* spp.	6.5	16.9	50.0									0.7	
	Psammobiidae	*Asaphis violascens*	1.7	0.7	1.7	0.1	0.5	0.1	0.8				0.1		
	Pteriidae	*Isognomon* spp.	0.3	4.8	3.6	8.8	2.7	4.3	9.7	1.6	5.0	4.6	10.5	1.9	2.5
		Pinctada spp.	3.7	4.4	3.3	3.4	5.4	4.9	13.6		2.3		2.2	0.1	1.6
		Pinctada maculata	7.2												
	Spondylidae	*Spondylus* spp.													
	Tellinidae	Tellinidae	<0.1						0.1						
		Quidnipagus palatam													
	Trapezidae	*Neotrapezium sublaevigatum*												0.2	
	Veneridae	Veneridae	0.8		0.7	0.8			0.4						
		Anomalodiscus squamosus	0.3	2.2	1.3	0.1	2.3	1.6							1.8
		Dosinia sp.													
		Gafrarium spp.	66.4	104.2	139.9	42.6	118.6	199.5	163.8	51.9	42.5	17.6	21.6	27.5	17.3
		Gafrarium pectinatum													
		Gafrarium tumidum		13.8	76.0		71.4	86.7	31.1				9.6		
		Irus carditoides <10mm													
		Marcia hiantina	1.6												
		Periglypta puerpera		0.7											
		Pitar pellucidus		4.5	3.3				2.0					0.1	
		Protapes gallus		0.1				4.0	3.0			0.3			
		Tapes literatus		0.3		0.2	0.6				0.1	0.1			
		Venerupis aspera			1.9		1.0	0.3		0.5	0.1		0.3	0.4	0.2
Gastropoda	Amathinidae	*Amathina tricarinata*						0.2							0.1
	Angariidae	*Angaria delphinus*					0.5								
	Architectonicidae	*Architectonica* sp. <10mm													
	Bullidae	*Bulla* spp.													
		Bulla ampulla	0.1						1.8			0.9	0.2		
	Calliostomatidae	*Calliostoma* spp.											<0.1	<0.1	<0.1
	Cerithiidae	Cerithiidae	0.1		0.2		<0.1	0.2	1.0		0.5	0.2			
		Cerithiidae <10mm												<0.1	
		Cerithium citrinum				0.3									
		Cerithium coralium								0.2			0.2		
		Cerithium echinatum					0.4					0.5			

			XU												
Class	**Family**	**Taxon**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
		Cerithium nodulosum													
		Cerithium zonatum													
		Clypeomorus batillariaeformis		0.7				0.6	0.5		1.2		0.6	0.3	0.2
	Chilodontaidae	*Euchelus atratus* <10mm								0.2					<0.1
	Conidae	Conidae		12.9	2.4			0.9	5.4	0.5		1.3		0.1	0.9
		Conus arenatus													
		Conus coronatus													
		Conus textile													
	Costellariidae	*Vexillum rugosum*													<0.1
	Cymatiidae	Cymatiidae		0.8		0.2									
	Cypraeidae	Cypraeidae	5.0										0.9		
		Cypraea tigris													
	Ellobiidae	*Cassidula* spp.													
		Ellobium spp.	0.6	0.3							0.1	0.5	0.3		
		Ellobium aurisjudae													
	Fissurellidae	*Hemitoma* spp. <10mm		<0.1	<0.1		0.2	0.2	<0.1	<0.1		<0.1	<0.1		
	Littorinidae	*Littoraria* spp.			<0.1									<0.1	<0.1
		Littoraria spp. <10mm													
		Littoraria filosa													
		Littoraria scabra													
	Lottiidae	Lottiidae													
	Mitridae	Mitridae													
		Mitra sp.													
		Chicoreus spp.			1.1	0.8		3.0		2.0		1.1	1.5	5.2	0.2
		Chicoreus capucinus													
		Drupella margariticola													
		Thais sp.					1.5								
	Nacellidae	*Cellana rota*													
	Nassariidae	*Nassarius* spp.			0.1		<0.1		0.2			0.3	0.5	0.5	
		Nassarius coronatus													
		Nassarius crematus	0.5	1.0											
		Nassarius distortus					0.2								
		Nassarius olivaceus			0.2		0.3		0.5				0.3		
		Nassarius pullus													
	Naticidae	Naticidae	0.1											0.2	
		Mammilla sebae													
		Notocochlis gualtieriana		0.3			0.6								
		Polinices mammilla									0.9				
		Polinices peselephanti	1.3												
	Neritidae	*Neripteron violaceum*													
		Nerita spp.	2.8	1.9	2.3	0.8	3.2	1.4	4.2	0.8	1.6	0.9	2.0	1.1	2.6
		Nerita albicilla	1.7		0.3								0.6		

			XU												
Class	**Family**	**Taxon**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
		Nerita balteata		0.4										0.4	
		Nerita chamaeleon	1.0	0.6	0.4										
		Nerita costata													
		Nerita planospira	0.4					0.9					0.4		<0.1
		Nerita polita													
		Nerita undata			0.7			0.3					0.2		0.9
	Olividae	Olividae									0.2				0.3
		Oliva annulata													
		Oliva reticulata													
		Oliva tricolor													
	Patellidae	Patellidae													
	Pisaniidae	*Cantharus* sp.													
	Planaxidae	*Fissilabia decollata*													
		Planaxis sulcatus				0.1	1.2		0.7				0.9		
	Potamididae	Potamididae										0.4			
		Cerithideopsis largillierti	0.2	0.1		0.4	0.1	0.1	0.6		0.1	0.4	0.4	1.3	<0.1
		Pirenella cingulata													
		Telescopium telescopium	1.4	1.4	3.3		0.8	0.4	0.2	9.0	0.5	1.2	6.0	0.1	1.6
		Terebralia sulcata			0.7		1.3		0.5	4.0			2.3	0.9	0.9
	Strombidae	Strombidae	0.4	8.3	10.2	3.4	3.7	8.1	2.5	5.5	0.8	4.7	0.6	1.7	2.1
		Canarium labiatum													
		Conomurex luhuanus	42.5	64.5	197.2	17.1	50.9		26.0		5.3	21.4	11.9		
		Euprotomus aurisdianae				15.2									
		Gibberulus gibberulus		4.5		8.2			6.2						
		Laevistrombus canarium		9.9	15.3	100.9	13.0		21.8						0.3
		Lambis spp.	24.8	85.9	279.5	112.1	369.9	98.2	97.2	27.8	81.2	12.1	7.2	8.5	45.9
		Lambis lambis			55.6			0.4							0.5
	Tegulidae	Tegulidae													
		Rochia nilotica													
		Tectus fenestratus	0.4	0.1	0.8	<0.1	0.2	1.2	8.1				0.2		
	Terebridae	Terebridae						0.4							
	Tonnidae	*Tonna* sp.													
	Trochidae	Trochidae	0.4			12.0	2.2								4.3
		Rochia nilotica													
	Turbinellidae	*Vasum* sp.													
		Vasum turbinellus													
	Turbinidae	Turbinidae							0.6	0.2		0.1			
		Lunella cinerea					<0.1								
		Turbo spp.													
	Vermetidae	Vermetidae	<0.1						<0.1						<0.1
Indeterminate	Indeterminate	Unidentified Shell	110.0	149.7	252.8	81.6	115.4	146.1	90.1	81.9	80.8	80.4	137.0	99.3	105.9
Total			**396.7**	**862.4**	**1894.3**	**651.8**	**1172.7**	**735.7**	**757.3**	**220.9**	**277.4**	**176.9**	**319.2**	**180.6**	**230.3**

			XU												
Class	**Family**	**Taxon**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**
Bivalvia	Arcidae	Arcidae	4.3	5.8	6.4	9.3	16.4	20.4	25.9	23.6	22.6	25.6	13.2	10.5	22.8
		Arcidae <10mm													
		Anadara antiquata	6.4	1.9	8.3	8.4	6.3	28.6	71.6	114.1	129.1	243.8	250.8	102.5	309.6
		Anadara rufescens							10.1						
		Barbatia foliata	0.2						1.0	8.1	3.0			17.2	
		Tegillarca granosa								2.5	19.5	33.2	14.6	6.6	79.8
	Cardiidae	Cardiidae	0.2	0.2	0.4	5.4	1.8	2.3	4.1	4.3	1.4	8.6	2.8	5.5	2.3
		Fragum spp.													
		Fragum spp. <10mm		<0.1				0.1					0.1	0.1	
		Fragum unedo													
		Hippopus hippopus													
		Tridacna spp.												38.4	
		Tridacna maxima													
		Vasticardium flavum		3.1						18.0		10.8	10.7	2.7	8.2
	Chamidae	*Chama* spp.		2.9		11.7	12.2	14.3	42.0	21.0	27.1	97.9	16.3	33.9	64.7
	Cyrenidae	*Batissa violacea*				25.7		21.9	28.9		22.8	41.3			29.4
		Geloina expansa				4.5	1.3	11.2	6.4	1.8	6.2	34.0	17.5	88.8	27.5
	Glauconomidae	*Glauconome rugosa*													
	Lucinidae	*Anodontia edentula*					1.6		0.6			0.4			
		Austriella corrugata	0.9	0.4	2.5	6.2	18.8	17.3	26.5	13.5	32.4	44.0	25.3	53.2	8.6
	Mactridae	*Mactra* spp.											0.3		
		Mactra cuneata											0.2		
	Malleidae	*Malleus* spp.													
	Mesodesmatidae	*Atactodea striata*	2.8	2.0	7.5	1.1	2.7	10.9	11.4	7.3	9.1	10.2	6.9	6.9	5.0
	Mytilidae	Mytilidae	<0.1	0.1		0.1		0.1	0.1		0.1	0.1			
		Septifer bilocularis								0.1					
	Ostreidae	Ostreidae	16.1	25.8	4.5	16.5	24.6	19.2	68.9	42.8	76.1	136.2	412.3	219.5	235.5
	Pinnidae	Pinnidae													
	Placunidae	*Placuna* spp.									0.2	25.3		5.0	
	Psammobiidae	*Asaphis violascens*	0.2	0.4	0.6			1.9	2.0	0.8	0.6	2.1	3.9	2.9	2.1
	Pteriidae	*Isognomon* spp.	2.9	6.6	1.6	10.7	9.0	9.5	36.9	22.7	36.4	59.6	38.2	52.6	86.1
		Pinctada spp.	1.2	2.5		5.0	1.9	5.4	3.9	4.0	5.1	8.2	13.4	10.8	8.2
		Pinctada maculata													
	Spondylidae	*Spondylus* spp.													
	Tellinidae	Tellinidae								0.3				<0.1	
		Quidnipagus palatam							2.3		0.5	3.9	0.2		1.5
	Trapezidae	*Neotrapezium sublaevigatum*													
	Veneridae	Veneridae						0.2							0.2

			XU												
Class	**Family**	**Taxon**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**
		Anomalodiscus squamosus	<0.1												
		Dosinia sp.													
		Gafrarium spp.	10.8	25.1	20.8	15.8	7.8	26.8	53.4	34.9	39.6	95.6	25.7	6.0	34.4
		Gafrarium pectinatum								0.3					
		Gafrarium tumidum				5.3	4.3			20.5	10.7		19.7	59.5	28.9
		Irus carditoides <10mm													
		Marcia hiantina								0.5					
		Periglypta puerpera		0.1						5.2		2.6		1.1	1.1
		Pitar pellucidus						2.3			0.2		2.6	1.5	
		Protapes gallus			0.7							4.3			
		Tapes literatus												9.4	0.3
		Venerupis aspera	0.3	0.5		0.1	0.8	1.0	3.2	3.1	2.0	1.3	2.1	1.5	1.1
Gastropoda	Amathinidae	*Amathina tricarinata*													
	Angariidae	*Angaria delphinus*													
	Architectonicidae	*Architectonica* sp. <10mm													
	Bullidae	*Bulla* spp.													
		Bulla ampulla	0.1		0.1							0.1			
	Calliostomatidae	*Calliostoma* spp.		<0.1				0.2		0.1	0.1				0.1
	Cerithiidae	Cerithiidae	0.2				0.9		0.2	0.3			0.6		0.2
		Cerithiidae <10mm													
		Cerithium citrinum								1.2		0.1		0.5	
		Cerithium coralium				0.1							0.2		
		Cerithium echinatum													
		Cerithium nodulosum													
		Cerithium zonatum													
		Clypeomorus batillariaeformis				0.3	0.4		0.3		0.7	0.5			0.7
	Chilodontaidae	*Euchelus atratus* <10mm			<0.1							1.1	0.2		
	Conidae	Conidae								1.5	4.8		0.9		
		Conus arenatus											2.7		
		Conus coronatus													
		Conus textile													
	Costellariidae	*Vexillum rugosum*													
	Cymatiidae	Cymatiidae													
	Cypraeidae	Cypraeidae	2.9			0.1					0.2	0.5			
		Cypraea tigris													
	Ellobiidae	*Cassidula* spp.													
		Ellobium spp.	0.3							1.0	4.2	1.9		0.7	0.2

			XU												
Class	**Family**	**Taxon**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**
		Ellobium aurisjudae													
	Fissurellidae	*Hemitoma* spp. <10mm	0.1		<0.1			0.1							
	Littorinidae	*Littoraria* spp.								0.1			0.1		
		Littoraria spp. <10mm													
		Littoraria filosa				0.4		0.5							
		Littoraria scabra			0.5		0.4			0.1	0.9	2.1		1.4	0.4
	Lottiidae	Lottiidae						0.3							
	Mitridae	Mitridae													
		Mitra sp.													
		Chicoreus spp.	1.1		2.3		2.7	10.5	12.0	14.5	7.3	15.6	24.0	11.5	17.3
		Chicoreus capucinus													
		Drupella margariticola							0.5						
		Thais sp.													
	Nacellidae	*Cellana rota*													
	Nassariidae	*Nassarius* spp.	0.3		0.1		1.2		0.2	0.2	0.1	0.6	0.3	0.3	0.1
		Nassarius coronatus											0.5		<0.1
		Nassarius crematus						0.3							
		Nassarius distortus												0.4	
		Nassarius olivaceus	0.3			0.8				0.4	0.7	0.7			0.8
		Nassarius pullus													
	Naticidae	Naticidae			0.1				0.5	0.7					1.7
		Mammilla sebae									0.5				
		Notocochlis gualtieriana				0.3						0.6		0.8	
		Polinices mammilla						2.3	2.0		2.1	3.1	1.7	7.2	8.8
		Polinices peselephanti													
	Neritidae	*Neripteron violaceum*													
		Nerita spp.	1.0	2.4	0.3	3.8	2.2	4.5	5.9	5.7	3.7	10.1	2.5	9.2	2.2
		Nerita albicilla		0.5	1.0				4.8	2.7	6.2	0.2	7.4	5.5	0.9
		Nerita balteata													
		Nerita chamaeleon							0.6			1.2	1.3	2.9	
		Nerita costata					1.2				1.2				
		Nerita planospira			0.6		<0.1	<0.1	1.9	0.1		1.0		0.2	0.2
		Nerita polita	0.8					0.7	1.3			2.3			1.3
		Nerita undata							3.5						
	Olividae	Olividae	0.9			0.8				5.1	1.9	2.1	1.2	0.5	5.0
		Oliva annulata													
		Oliva reticulata													
		Oliva tricolor													
	Patellidae	Patellidae													

			XU												
Class	**Family**	**Taxon**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**
	Pisaniidae	*Cantharus* sp.										2.2			
	Planaxidae	*Fissilabia decollata*			0.5					0.9					
		Planaxis sulcatus	0.4						0.5	0.5	0.2	2.3	0.4	0.3	0.3
	Potamididae	Potamididae													
		Cerithideopsis largillierti			<0.1	0.4	0.2	0.2	3.5	0.3	1.3	1.7	0.4	1.1	2.1
		Pirenella cingulata					0.2								
		Telescopium telescopium	3.0	7.0	0.6	8.9	9.3	2.0	13.5	11.4	5.0	7.8	4.9	2.1	9.6
		Terebralia sulcata		0.5		3.7	3.8	6.3	4.5	4.8	2.3	3.8		2.4	2.9
	Strombidae	Strombidae	3.5	0.3	2.1		5.0		0.2	3.4		4.6	10.3	6.3	0.6
		Canarium labiatum											1.9		
		Conomurex luhuanus	10.6	11.8	8.9	17.1	6.0		19.8						
		Euprotomus aurisdianae													
		Gibberulus gibberulus		5.0		4.1		0.4							
		Laevistrombus canarium		14.0		12.8	0.8		16.6		0.4	41.6	14.6		
		Lambis spp.	8.0	27.3	30.1	22.8		6.7	10.7	6.0	0.5	44.5	6.8	51.4	101.3
		Lambis lambis													
	Tegulidae	Tegulidae											1.5		
		Rochia nilotica													
		Tectus fenestratus	0.4							0.6					12.9
	Terebridae	Terebridae		1.2											
	Tonnidae	*Tonna* sp.													
	Trochidae	Trochidae												3.6	
		Rochia nilotica													
	Turbinellidae	*Vasum* sp.						3.8							
		Vasum turbinellus		7.3											
	Turbinidae	Turbinidae			<0.1		0.1	0.4					0.6		
		Lunella cinerea				0.2			3.6	0.3	1.7				1.4
		Turbo spp.								0.6		1.6			
	Vermetidae	Vermetidae	0.1	0.1				<0.1							
Indeterminate	Indeterminate	Unidentified Shell	111.0	119.8	122.0	176.6	79.0	180.3	108.9	294.7	480.3	589.6	305.5	356.4	427.2
Total			**191.3**	**274.6**	**222.5**	**378.9**	**222.9**	**413.0**	**614.7**	**706.6**	**971.0**	**1632.5**	**1267.2**	**1200.8**	**1555.5**

			XU												
Class	**Family**	**Taxon**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**
Bivalvia	Arcidae	Arcidae	16.8	4.7	14.6	14.8	19.2		9.4	10.0	8.1	5.9	20.8	0.6	14.5
		Arcidae <10mm													
		Anadara antiquata	360.4	219.0	139.4	155.6	430.8	413.0	123.1	263.9	497.8	116.4	93.0	242.8	465.0

			XU												
Class	**Family**	**Taxon**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**
		Anadara rufescens				4.2				4.0		8.1			
		Barbatia foliata	0.2					2.8		3.3	1.2	1.2	0.1	<0.1	0.2
		Tegillarca granosa	43.3	67.0	13.7	13.8	25.1		33.4				1.4		17.9
	Cardiidae	Cardiidae	8.3	2.8	3.7	6.0	25.4	16.5	2.5	10.1	8.2	2.5	1.7	3.0	2.5
		Fragum spp.													
		Fragum spp. <10mm				<0.1									
		Fragum unedo													
		Hippopus hippopus	35.2	62.2		165.1							731.3		
		Tridacna spp.													
		Tridacna maxima													
		Vasticardium flavum	19.5	6.2		30.1	17.1			30.4	4.1	10.0	27.2	16.3	22.6
	Chamidae	*Chama* spp.	102.5	46.0	8.9	90.2	99.7	129.6	124.7	422.3	468.5	176.5	533.2	448.5	710.4
	Cyrenidae	*Batissa violacea*	30.2	5.6	1.2		3.3	25.7	57.7	24.1	11.4	37.4	6.1		25.6
		Geloina expansa	67.3	78.1	17.5	10.6		26.6	37.8	92.0	94.1	35.9	50.8	63.6	45.5
	Glauconomidae	*Glauconome rugosa*										0.1			
	Lucinidae	*Anodontia edentula*								3.1		0.5	5.7		
		Austriella corrugata	53.1	22.8	40.0	30.7	42.2	63.7	33.5	52.7	164.9	132.7	59.1	78.0	70.6
	Mactridae	*Mactra* spp.		0.2				0.2			0.2				
		Mactra cuneata		4.9		5.2				11.9	1.7	2.7	17.0	13.8	76.3
	Malleidae	*Malleus* spp.													
	Mesodesmatidae	*Atactodea striata*	3.1	1.8	2.9	7.3	5.3	11.0	12.6	22.3	26.4	9.4	30.7	16.3	93.5
	Mytilidae	Mytilidae	0.6	0.6	0.2	0.1	0.1	0.3		0.1	1.0	0.1	0.1	0.1	0.1
		Septifer bilocularis											0.5	1.5	5.8
	Ostreidae	Ostreidae	220.9	161.7	96.6	166.3	77.5	148.1	208.1	455.7	312.3	137.9	78.9	118.5	266.8
	Pinnidae	Pinnidae													
	Placunidae	*Placuna* spp.													2.0
	Psammobiidae	*Asaphis violascens*		0.9	1.0					6.3	0.4		2.4	0.5	
	Pteriidae	*Isognomon* spp.	102.7	58.1	64.6	38.2	32.5	32.5	26.6	6.9	126.4	47.5	9.7	22.5	74.1
		Pinctada spp.	11.4	11.0	12.0	14.3	5.2	4.8	7.7		18.0	7.9	4.8	6.7	91.9
		Pinctada maculata													
	Spondylidae	*Spondylus* spp.	35.5						26.9		59.3				42.5
	Tellinidae	Tellinidae									0.1				
		Quidnipagus palatam	0.9	2.9		2.2	9.7	3.0				0.3			2.7
	Trapezidae	*Neotrapezium sublaevigatum*													
	Veneridae	Veneridae													
		Anomalodiscus squamosus		1.9											
		Dosinia sp.													
		Gafrarium spp.	29.2	32.6	19.4	26.6	23.3	16.0	14.3	5.3	38.7	13.9	17.0	14.3	16.7
		Gafrarium pectinatum					2.9		3.7	2.1	3.8	10.0	6.7	4.2	6.2

			XU												
Class	**Family**	**Taxon**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**
		Gafrarium tumidum	33.3	33.5	37.8	46.5	26.6	16.6	47.0	51.3	91.9	43.2	61.7	62.9	106.5
		Irus carditoides <10mm													
		Marcia hiantina													
		Periglypta puerpera					4.6	2.0						0.1	40.3
		Pitar pellucidus								0.3	5.5				
		Protapes gallus		2.4	6.3								7.3	2.6	
		Tapes literatus								5.2					
		Venerupis aspera	4.9	7.4	2.0	4.6	6.3	3.6	6.7	12.4	4.9	15.9	14.6	19.6	6.5
Gastropoda	Amathinidae	*Amathina tricarinata*	0.2	0.2											
	Angariidae	*Angaria delphinus*													9.9
	Architectonicidae	*Architectonica* sp. <10mm													
	Bullidae	*Bulla* spp.													
		Bulla ampulla													
	Calliostomatidae	*Calliostoma* spp.	<0.1	0.5		0.3	0.9			0.6	0.8		0.1	1.3	0.3
	Cerithiidae	Cerithiidae						0.3				0.3		0.2	0.1
		Cerithiidae <10mm													
		Cerithium citrinum	0.2	0.3		0.1			0.2	0.4	1.0		0.5		
		Cerithium coralium	0.3	0.2	0.1						0.4		0.5		0.6
		Cerithium echinatum													
		Cerithium nodulosum													
		Cerithium zonatum													
		Clypeomorus batillariaeformis	1.1	1.1	0.4	0.7	0.6		0.2	1.0	1.2	0.9	1.1		1.3
	Chilodontaidae	*Euchelus atratus* <10mm	0.9												
	Conidae	Conidae	2.3	16.4	6.3						27.6		1.0	0.1	
		Conus arenatus													
		Conus coronatus			2.5										
		Conus textile													
	Costellariidae	*Vexillum rugosum*												0.3	
	Cymatiidae	Cymatiidae													
	Cypraeidae	Cypraeidae		0.3		0.4	2.9							1.2	
		Cypraea tigris													
	Ellobiidae	*Cassidula* spp.	0.7												
		Ellobium spp.	6.1	1.5	0.7	1.7	2.7	1.1	2.3	3.2	4.0	4.9	4.6	0.7	11.6
		Ellobium aurisjudae													
	Fissurellidae	*Hemitoma* spp. <10mm								0.1					
	Littorinidae	*Littoraria* spp.		0.1				0.1	0.1	1.4	<0.1	0.7		0.1	0.3
		Littoraria spp. <10mm													

			XU												
Class	**Family**	**Taxon**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**
		Littoraria filosa	0.1		0.1							0.4			
		Littoraria scabra	0.5		0.3	0.3	0.1	0.2	0.4	2.9	2.8	1.5	2.2	3.4	0.7
	Lottiidae	Lottiidae													
	Mitridae	Mitridae													
		Mitra sp.													
		Chicoreus spp.	19.0	23.9	11.7	12.5	8.1	30.9	28.1	2.3	59.1	17.0	20.5	6.0	45.6
		Chicoreus capucinus								18.9					
		Drupella margariticola													
		Thais sp.													
	Nacellidae	*Cellana rota*													
	Nassariidae	*Nassarius* spp.		0.1	0.4	0.3	0.8	0.5	<0.1	0.4	0.5	0.5	0.1	2.1	
		Nassarius coronatus													
		Nassarius crematus			1.0		1.8	1.2		0.8			0.8		2.6
		Nassarius distortus		0.3			0.2		0.3		0.1				0.3
		Nassarius olivaceus	0.4	0.4		0.4	1.2	0.7		0.7	1.9		0.4	0.4	
		Nassarius pullus													
	Naticidae	Naticidae	2.8		0.5		0.3		0.1			0.1			1.2
		Mammilla sebae													
		Notocochlis gualtieriana			0.5		0.2		0.5				0.4		0.5
		Polinices mammilla	8.0	9.1	7.0	3.3	10.3	8.2	4.2	11.4	13.8	6.8	3.6	16.3	4.0
		Polinices peselephanti													
	Neritidae	*Neripteron violaceum*					1.2	0.6			0.4				
		Nerita spp.	6.4	5.1	5.1	4.9	6.5	5.9	6.7	12.1	18.7	10.2	20.8	13.8	36.1
		Nerita albicilla	2.5	0.5	0.8	2.5	3.1	3.5	2.6	5.4	5.1	0.5	2.0	4.1	10.9
		Nerita balteata			3.4					4.8	5.7	0.2	4.6	2.8	1.8
		Nerita chamaeleon	0.5	1.8	1.5	0.6	1.5	1.7	1.1	1.6	2.5	2.0	1.0		1.9
		Nerita costata													
		Nerita planospira	0.5	0.7			0.9		3.0		1.2	0.8	1.1	1.3	3.3
		Nerita polita			1.6	0.6		0.7		1.5	6.0	0.6	3.6	1.4	3.5
		Nerita undata									4.0	2.1	1.2		
	Olividae	Olividae	3.2			9.3		3.5	2.6	3.1	1.4				7.1
		Oliva annulata													
		Oliva reticulata													8.0
		Oliva tricolor										3.8			
	Patellidae	Patellidae													
	Pisaniidae	*Cantharus* sp.													
	Planaxidae	*Fissilabia decollata*													
		Planaxis sulcatus		0.8	1.4			0.6	0.1	0.5	4.9				1.2
	Potamididae	Potamididae													
		Cerithideopsis largillierti	1.9	1.1	0.2	1.9	2.9	0.9	2.0	4.9	5.7	5.3	3.9	9.7	2.8

			XU												
Class	**Family**	**Taxon**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**
		Pirenella cingulata													
		Telescopium telescopium	9.2	3.4		5.9	8.1	5.7	0.5	1.9	4.5	0.2		0.1	0.2
		Terebralia sulcata	7.2	3.8	6.1	0.5	3.5	6.8	3.5	10.7	11.6	5.4	5.8	6.6	22.8
	Strombidae	Strombidae			9.0	8.3		13.5	4.4		9.9	3.3	1.5	0.8	27.1
		Canarium labiatum							0.6						
		Conomurex luhuanus													
		Euprotomus aurisdianae													
		Gibberulus gibberulus					6.6								
		Laevistrombus canarium	15.5	39.6	68.9	62.3	33.0	53.9	43.1	5.1	46.6		4.7	32.6	20.5
		Lambis spp.	62.0		69.5	9.7	9.6	43.4	8.3	619.2	93.3	73.5	116.7	102.7	224.3
		Lambis lambis		128.0	302.3			187.8		967.6			90.1		
	Tegulidae	Tegulidae										<0.1			
		Rochia nilotica												30.3	
		Tectus fenestratus	0.4			1.0							2.8		4.7
	Terebridae	Terebridae													
	Tonnidae	*Tonna* sp.													
	Trochidae	Trochidae				26.8				8.5					
		Rochia nilotica			56.0										
	Turbinellidae	*Vasum* sp.													
		Vasum turbinellus													
	Turbinidae	Turbinidae			0.4			0.5	0.4		0.7	1.5			
		Lunella cinerea				8.9		2.3		1.6	9.5		3.2	3.1	5.9
		Turbo spp.	5.4			0.7		1.1	1.1	1.0	0.3	0.2	0.4	1.9	0.7
	Vermetidae	Vermetidae								0.2					<0.1
Indeterminate	Indeterminate	Unidentified Shell	623.3	519.2	294.9	359.4	462.2	462.4	280.5	388.4	533.2	456.4	350.1	366.7	751.9
Total			**1960.0**	**1592.6**	**1334.4**	**1355.7**	**1425.9**	**1754.0**	**1172.7**	**3578.0**	**2827.4**	**1415.1**	**2431.1**	**1746.5**	**3420.4**

			XU												
Class	**Family**	**Taxon**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**
Bivalvia	Arcidae	Arcidae	27.5	4.3	18.3	4.4	10.1	3.7	2.5			11.3		0.6	2.0
		Arcidae <10mm													
		Anadara antiquata	476.8	138.8	88.0	159.2	122.7	142.9	82.4	30.8	29.7	6.7	4.7	12.4	15.6
		Anadara rufescens			8.3										
		Barbatia foliata							3.3		0.2				
		Tegillarca granosa							5.7						
	Cardiidae	Cardiidae	299.1	0.4		334.0	2.0								0.6

			XU												
Class	**Family**	**Taxon**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**
		Fragum spp.													
		Fragum spp. <10mm				<0.1	<0.1			<0.1	<0.1				
		Fragum unedo													
		Hippopus hippopus													
		Tridacna spp.													
		Tridacna maxima													
		Vasticardium flavum	11.1	22.3			14.2								
	Chamidae	*Chama* spp.	1239.0	14.3	65.5	43.3	22.3	8.8	28.1	3.3				1.5	
	Cyrenidae	*Batissa violacea*	11.7				7.3			1.7					
		Geloina expansa	74.5	2.4		2.8	5.2	9.0	9.4	12.4	9.7				5.3
	Glauconomidae	*Glauconome rugosa*													
	Lucinidae	*Anodontia edentula*	7.1	2.0											
		Austriella corrugata	42.4	5.7	9.3	13.9	4.6	12.2	9.9	3.4	2.0	3.1	0.9	0.9	3.7
	Mactridae	*Mactra* spp.						0.4							
		Mactra cuneata	79.7	0.4	4.4	4.2	3.4	3.9		0.3			1.6	0.6	
	Malleidae	*Malleus* spp.			17.7										
	Mesodesmatidae	*Atactodea striata*	125.8	13.1	18.7	65.9	85.3	70.9	30.5	17.8	14.6	12.4	10.0	2.2	4.0
	Mytilidae	Mytilidae	0.1				<0.1					0.3			0.2
		Septifer bilocularis									1.1		0.9		
	Ostreidae	Ostreidae	284.0	47.8	40.8	21.2	13.5	2.4	5.1	7.7	0.4	1.6	0.2	0.5	
	Pinnidae	Pinnidae	0.7												
	Placunidae	*Placuna* spp.													
	Psammobiidae	*Asaphis violascens*	14.7		0.7					0.4					
	Pteriidae	*Isognomon* spp.	23.4	6.0	5.4	5.6	4.2	1.5	1.5	7.6	6.7	1.3	4.9	0.1	<0.1
		Pinctada spp.	10.6	0.7	1.0	0.6	0.4		0.4	0.6		0.8	0.1		
		Pinctada maculata													
	Spondylidae	*Spondylus* spp.													
	Tellinidae	Tellinidae							0.5	0.1					
		Quidnipagus palatam													
	Trapezidae	*Neotrapezium sublaevigatum*													
	Veneridae	Veneridae													
		Anomalodiscus squamosus									0.5				
		Dosinia sp.													
		Gafrarium spp.	51.0	8.7	5.4	13.7	4.9	3.8	2.1	3.4	0.5	0.8	1.2	0.6	2.7
		Gafrarium pectinatum	8.3	4.3			0.3	2.0	1.3		0.5				
		Gafrarium tumidum	98.5	6.5	27.6	13.5	25.6	21.4		2.5	1.7	7.7		4.7	30.7
		Irus carditoides <10mm													
		Marcia hiantina													
		Periglypta puerpera												1.4	

			XU												
Class	**Family**	**Taxon**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**
		Pitar pellucidus													
		Protapes gallus			7.9										
		Tapes literatus	0.3												
		Venerupis aspera	15.6	0.4	2.1	4.8	6.9	3.7	3.5	0.4	0.2	2.4		0.3	1.0
Gastropoda	Amathinidae	*Amathina tricarinata*					0.4								
	Angariidae	*Angaria delphinus*													
	Architectonicidae	*Architectonica* sp. <10mm													
	Bullidae	*Bulla* spp.													
		Bulla ampulla													
	Calliostomatidae	*Calliostoma* spp.	0.3						<0.1					0.1	<0.1
	Cerithiidae	Cerithiidae													
		Cerithiidae <10mm										<0.1			
		Cerithium citrinum	0.6		0.2						0.5				
		Cerithium coralium	0.9						0.4						
		Cerithium echinatum													
		Cerithium nodulosum													
		Cerithium zonatum													
		Clypeomorus batillariaeformis	0.2		0.6			0.5							
	Chilodontaidae	*Euchelus atratus* <10mm													
	Conidae	Conidae	9.4	14.9		1.9									
		Conus arenatus													
		Conus coronatus													
		Conus textile													
	Costellariidae	*Vexillum rugosum*													
	Cymatiidae	Cymatiidae													
	Cypraeidae	Cypraeidae					1.9								
		Cypraea tigris													
	Ellobiidae	*Cassidula* spp.													
		Ellobium spp.	13.8	26.2	1.4	0.7	4.2	1.0	<0.1	0.6	1.3	1.2		<0.1	
		Ellobium aurisjudae													
	Fissurellidae	*Hemitoma* spp. <10mm													
	Littorinidae	*Littoraria* spp.	0.3	0.1	0.1		0.1			<0.1	<0.1	<0.1	<0.1	0.1	
		Littoraria spp. <10mm													
		Littoraria filosa	0.6							0.5					
		Littoraria scabra	2.6	0.3	0.1	3.5	0.3	0.6	0.4			0.3			
	Lottiidae	Lottiidae													
	Mitridae	Mitridae													
		Mitra sp.													
		Chicoreus spp.	69.7	6.2	3.4	4.5	3.4	1.4			1.6	6.5	0.6	0.3	

			XU												
Class	**Family**	**Taxon**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**
		Chicoreus capucinus													
		Drupella margariticola													
		Thais sp.													
	Nacellidae	*Cellana rota*													
	Nassariidae	*Nassarius* spp.	0.6					0.3	1.6	0.1			0.1		
		Nassarius coronatus													
		Nassarius crematus			1.6										
		Nassarius distortus	0.3		0.1								0.3		
		Nassarius olivaceus	1.2		0.6					0.3				0.3	
		Nassarius pullus	0.4		0.7				0.8						
	Naticidae	Naticidae	0.4	3.0	3.9		0.2	1.1				1.0			
		Mammilla sebae													
		Notocochlis gualtieriana		1.1											
		Polinices mammilla	8.8	0.6	0.9	3.6	1.7	1.2	0.4				0.7		1.6
		Polinices peselephanti									2.2				
	Neritidae	*Neripteron violaceum*													
		Nerita spp.	40.2	4.2	3.3	3.8	3.4	3.8	2.6	3.4	2.6	1.2	0.4	0.3	2.7
		Nerita albicilla	10.5	0.7	1.5			2.2						1.5	
		Nerita balteata	2.0	2.9	0.2										
		Nerita chamaeleon	2.8	0.2		0.7		0.7	0.9					0.3	
		Nerita costata													
		Nerita planospira	2.4		0.8						0.9				
		Nerita polita	2.6		1.6	0.8	0.2		0.4	0.8		0.5			0.6
		Nerita undata	0.1		0.4		0.8								
	Olividae	Olividae	15.1	1.7	9.3	3.8		3.9							
		Oliva annulata													
		Oliva reticulata													
		Oliva tricolor													
	Patellidae	Patellidae													
	Pisaniidae	*Cantharus* sp.													
	Planaxidae	*Fissilabia decollata*													
		Planaxis sulcatus	1.9	0.3		1.2	0.4							0.1	
	Potamididae	Potamididae													
		Cerithideopsis largillierti	7.6	1.3	3.2	3.8	5.5	4.8	4.7	2.0	0.5	1.2	0.7	2.2	1.3
		Pirenella cingulata				0.3									
		Telescopium telescopium		0.1		0.1	0.1		0.3						0.1
		Terebralia sulcata	20.9	4.0	4.3	2.3	1.0			0.3	1.1	0.9			0.7
	Strombidae	Strombidae	12.7	1.0			1.2							3.2	

			XU												
Class	**Family**	**Taxon**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**
		Canarium labiatum													
		Conomurex luhuanus													
		Euprotomus aurisdianae													
		Gibberulus gibberulus													
		Laevistrombus canarium	18.1	18.3			20.9			0.6		12.6		0.5	
		Lambis spp.	941.0	154.4		4.7	63.6	4.6	0.6						
		Lambis lambis													
	Tegulidae	Tegulidae													
		Rochia nilotica				29.8									
		Tectus fenestratus					1.0			0.4					
	Terebridae	Terebridae													
	Tonnidae	*Tonna* sp.													
	Trochidae	Trochidae	13.8		<0.1		14.2	8.4							4.2
		Rochia nilotica													
	Turbinellidae	*Vasum* sp.													
		Vasum turbinellus													
	Turbinidae	Turbinidae	1.2												
		Lunella cinerea	9.1		1.2	4.4				2.4	0.1	0.5	0.1	2.4	
		Turbo spp.	1.2	3.3		0.2	3.1	0.1	3.1			0.5			0.8
	Vermetidae	Vermetidae	0.3												0.8
Indeterminate	Indeterminate	Unidentified Shell	594.8	75.0	131.9	128.2	84.6	96.8	48.9	75.1	31.4	45.9	24.9	31.9	43.7
Total			**4710.4**	**597.9**	**492.4**	**885.4**	**545.1**	**418.0**	**251.4**	**178.9**	**110.0**	**120.8**	**52.3**	**69.0**	**122.3**

			XU												
Class	**Family**	**Taxon**	**80**	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**
Bivalvia	Arcidae	Arcidae		2.8	4.3		15.4	3.0			1.7	5.0	0.9		1.6
		Arcidae <10mm												<0.1	
		Anadara antiquata	6.7		12.2	13.3	22.5	14.3	19.2	13.3	25.1	21.4	8.8	83.8	10.5
		Anadara rufescens													
		Barbatia foliata				0.4	0.5		0.7			<0.1			
		Tegillarca granosa													
	Cardiidae	Cardiidae									<0.1				
		Fragum spp.													
		Fragum spp. <10mm	<0.1							<0.1		<0.1			
		Fragum unedo													
		Hippopus hippopus													

			XU												
Class	**Family**	**Taxon**	**80**	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**
		Tridacna spp.													
		Tridacna maxima													
		Vasticardium flavum													
	Chamidae	*Chama* spp.									47.0	<0.1			
	Cyrenidae	*Batissa violacea*		5.2						11.3		7.1			
		Geloina expansa	9.5	8.5	2.3					46.4		45.9	5.8		
	Glauconomidae	*Glauconome rugosa*										4.6			
	Lucinidae	*Anodontia edentula*	0.1		0.6		0.5								
		Austriella corrugata	7.5	8.6	6.6	4.2	19.6	4.6	15.3	19.8	5.2	4.6	2.3	0.8	0.5
	Mactridae	*Mactra* spp.					0.4							0.8	
		Mactra cuneata							0.6			0.4			
	Malleidae	*Malleus* spp.													
	Mesodesmatidae	*Atactodea striata*	4.7	2.8	8.1	8.5	1.0	0.7	4.2	2.4	3.0	7.1	19.3	1.3	
	Mytilidae	Mytilidae			0.1										
		Septifer bilocularis		0.6		0.8	1.1				1.1	0.3			
	Ostreidae	Ostreidae	5.6			0.6		4.8	1.8	1.2	0.3	<0.1		0.3	0.4
	Pinnidae	Pinnidae													
	Placunidae	*Placuna* spp.													
	Psammobiidae	*Asaphis violascens*		1.5										0.1	
	Pteriidae	*Isognomon* spp.		0.9	0.1	1.4			0.4			<0.1	0.1		0.2
		Pinctada spp.													
		Pinctada maculata													
	Spondylidae	*Spondylus* spp.													
	Tellinidae	Tellinidae													
		Quidnipagus palatam													
	Trapezidae	*Neotrapezium sublaevigatum*													
	Veneridae	Veneridae												1.1	
		Anomalodiscus squamosus													
		Dosinia sp.													
		Gafrarium spp.	7.3	15.8	1.8	3.5	2.3	0.5	7.3		5.3	4.5		3.7	0.9
		Gafrarium pectinatum													
		Gafrarium tumidum						2.6	9.5	3.8	2.7			32.2	
		Irus carditoides <10mm													
		Marcia hiantina													
		Periglypta puerpera				0.4							0.1		

			XU												
Class	**Family**	**Taxon**	**80**	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**
		Pitar pellucidus													
		Protapes gallus													
		Tapes literatus													
		Venerupis aspera			0.3	2.7		0.1							
Gastropoda	Amathinidae	*Amathina tricarinata*													
	Angariidae	*Angaria delphinus*													
	Architectonicidae	*Architectonica* sp. <10mm											<0.1		
	Bullidae	*Bulla* spp.						0.3							
		Bulla ampulla													
	Calliostomatidae	*Calliostoma* spp.							0.3	0.4			0.5		
	Cerithiidae	Cerithiidae				0.2									
		Cerithiidae <10mm													
		Cerithium citrinum													
		Cerithium coralium							0.2						
		Cerithium echinatum													
		Cerithium nodulosum													
		Cerithium zonatum													
		Clypeomorus batillariaeformis											0.3		
	Chilodontaidae	*Euchelus atratus* <10mm													
	Conidae	Conidae						0.4							
		Conus arenatus													
		Conus coronatus													
		Conus textile													
	Costellariidae	*Vexillum rugosum*													
	Cymatiidae	Cymatiidae													
	Cypraeidae	Cypraeidae													
		Cypraea tigris													
	Ellobiidae	*Cassidula* spp.													
		Ellobium spp.	0.4	0.5	3.3	1.7	2.9				1.8	1.3	1.4	2.4	0.7
		Ellobium aurisjudae													
	Fissurellidae	*Hemitoma* spp. <10mm													
	Littorinidae	*Littoraria* spp.												0.1	
		Littoraria spp. <10mm						<0.1	<0.1	<0.1			<0.1		
		Littoraria filosa											0.1		
		Littoraria scabra			0.3		0.1							<0.1	<0.1

			XU												
Class	**Family**	**Taxon**	**80**	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**
	Lottiidae	Lottiidae	<0.1							0.2					
	Mitridae	Mitridae					0.4								
		Mitra sp.			0.1										
		Chicoreus spp.	2.1	0.8	0.3	0.5			7.2	0.2					0.6
		Chicoreus capucinus													
		Drupella margariticola													
		Thais sp.													
	Nacellidae	*Cellana rota*													
	Nassariidae	*Nassarius* spp.											0.2	0.1	
		Nassarius coronatus													
		Nassarius crematus													
		Nassarius distortus	0.8												
		Nassarius olivaceus							0.2						
		Nassarius pullus													
	Naticidae	Naticidae					0.6			0.4					
		Mammilla sebae													
		Notocochlis gualtieriana													
		Polinices mammilla			2.1		0.8		1.5						
		Polinices peselephanti					0.8								
	Neritidae	*Neripteron violaceum*													
		Nerita spp.			1.0			1.0	0.8	0.1	0.8	0.7	0.3	1.4	2.2
		Nerita albicilla													
		Nerita balteata						1.1	1.0						
		Nerita chamaeleon													
		Nerita costata	2.7							3.5					
		Nerita planospira													
		Nerita polita	0.7											2.8	
		Nerita undata		1.9			2.7							1.1	
	Olividae	Olividae													
		Oliva annulata						4.9							
		Oliva reticulata													
		Oliva tricolor													
	Patellidae	Patellidae												<0.1	
	Pisaniidae	*Cantharus* sp.													
	Planaxidae	*Fissilabia decollata*													
		Planaxis sulcatus						0.2		0.1					
	Potamididae	Potamididae													

			XU												
Class	**Family**	**Taxon**	**80**	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**	**91**	**92**
		Cerithideopsis largillierti		0.5	1.0		2.8	0.8		0.1	1.1	0.3		0.1	0.1
		Pirenella cingulata													
		Telescopium telescopium				1.3		0.5	0.1		0.1			0.5	0.1
		Terebralia sulcata													
	Strombidae	Strombidae		0.6											
		Canarium labiatum													
		Conomurex luhuanus													
		Euprotomus aurisdianae													
		Gibberulus gibberulus													
		Laevistrombus canarium		6.4	9.4				13.5				15.7		
		Lambis spp.				0.7									
		Lambis lambis													
	Tegulidae	Tegulidae							<0.1						
		Rochia nilotica													
		Tectus fenestratus	0.1												
	Terebridae	Terebridae													
	Tonnidae	*Tonna* sp.							0.6						
	Trochidae	Trochidae													0.3
		Rochia nilotica													
	Turbinellidae	*Vasum* sp.													
		Vasum turbinellus													
	Turbinidae	Turbinidae			0.4										
		Lunella cinerea		1.7											
		Turbo spp.				0.2									
	Vermetidae	Vermetidae													
Indeterminate	Indeterminate	Unidentified Shell	40.6	38.4	55.4	43.7	39.4	23.9	28.4	37.4	27.3	29.2	19.6	95.4	29.6
Total			**88.9**	**97.5**	**109.6**	**84.1**	**113.8**	**63.6**	**112.8**	**140.6**	**122.5**	**132.5**	**75.5**	**227.9**	**47.7**

			XU												
Class	**Family**	**Taxon**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**
Bivalvia	Arcidae	Arcidae	2.4			8.0	3.2							0.9	
		Arcidae <10mm		<0.1											
		Anadara antiquata	14.6	0.4	22.8			36.0	7.4	7.5	7.6			1.1	
		Anadara rufescens													
		Barbatia foliata												0.3	

			XU												
Class	**Family**	**Taxon**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**
		Tegillarca granosa													
	Cardiidae	Cardiidae													
		Fragum spp.													
		Fragum spp. <10mm		0.1			0.1							0.1	0.1
		Fragum unedo													
		Hippopus hippopus													
		Tridacna spp.													
		Tridacna maxima													
		Vasticardium flavum													
	Chamidae	*Chama* spp.	2.2									6.1	0.4		
	Cyrenidae	*Batissa violacea*													
		Geloina expansa													
	Glauconomidae	*Glauconome rugosa*													
	Lucinidae	*Anodontia edentula*							1.0			0.9			
		Austriella corrugata	13.5	6.3	1.3	7.8	9.3	4.1	2.4	3.3	0.5	0.5	3.0	1.9	0.8
	Mactridae	*Mactra* spp.													
		Mactra cuneata													
	Malleidae	*Malleus* spp.													
	Mesodesmatidae	*Atactodea striata*	0.9		4.3					5.1		6.9		9.0	
	Mytilidae	Mytilidae		<0.1	0.3			<0.1							
		Septifer bilocularis													
	Ostreidae	Ostreidae	10.4	4.8	0.3		5.4		0.4	0.1			1.4		0.1
	Pinnidae	Pinnidae													
	Placunidae	*Placuna* spp.													
	Psammobiidae	*Asaphis violascens*													
	Pteriidae	*Isognomon* spp.	0.5						0.1					5.1	
		Pinctada spp.													
		Pinctada maculata													
	Spondylidae	*Spondylus* spp.													
	Tellinidae	Tellinidae													
		Quidnipagus palatam						0.2							
	Trapezidae	*Neotrapezium sublaevigatum*													
	Veneridae	Veneridae													
		Anomalodiscus squamosus										2.1			
		Dosinia sp.													
		Gafrarium spp.	0.5	0.1	9.0	3.8		2.1	8.8	3.8	0.4		1.1		4.8
		Gafrarium pectinatum													
		Gafrarium tumidum									19.3	6.2		5.6	
		Irus carditoides <10mm													<0.1
		Marcia hiantina													
		Periglypta puerpera				4.3		0.8			0.8				
		Pitar pellucidus													
		Protapes gallus								1.7					

			XU												
Class	**Family**	**Taxon**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**
		Tapes literatus								0.4					
		Venerupis aspera													
Gastropoda	Amathinidae	*Amathina tricarinata*													
	Angariidae	*Angaria delphinus*													
	Architectonicidae	*Architectonica* sp. <10mm													
	Bullidae	*Bulla* spp.													
		Bulla ampulla													
	Calliostomatidae	*Calliostoma* spp.		0.1						0.2					<0.1
	Cerithiidae	Cerithiidae						0.2			0.2			0.1	
		Cerithiidae <10mm	0.1												
		Cerithium citrinum													
		Cerithium coralium													
		Cerithium echinatum													
		Cerithium nodulosum													
		Cerithium zonatum													
		Clypeomorus batillariaeformis													
	Chilodontaidae	*Euchelus atratus* <10mm													
	Conidae	Conidae	8.8												<0.1
		Conus arenatus													
		Conus coronatus													
		Conus textile													
	Costellariidae	*Vexillum rugosum*													
	Cymatiidae	Cymatiidae		0.7											
	Cypraeidae	Cypraeidae													
		Cypraea tigris													
	Ellobiidae	*Cassidula* spp.													
		Ellobium spp.	0.3	<0.1		<0.1	0.1	0.5	0.3	3.7	0.1		0.7		
		Ellobium aurisjudae													
	Fissurellidae	*Hemitoma* spp. <10mm													
	Littorinidae	*Littoraria* spp.										<0.1		0.2	
		Littoraria spp. <10mm	<0.1												
		Littoraria filosa						0.1							
		Littoraria scabra			<0.1	<0.1									<0.1
	Lottiidae	Lottiidae							<0.1						
	Mitridae	Mitridae													
		Mitra sp.													
		Chicoreus spp.			0.4										
		Chicoreus capucinus													
		Drupella margariticola													
		Thais sp.													
	Nacellidae	*Cellana rota*													
	Nassariidae	*Nassarius* spp.			<0.1	0.5							<0.1		

			XU												
Class	**Family**	**Taxon**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**
		Nassarius coronatus													
		Nassarius crematus							0.4						
		Nassarius distortus													
		Nassarius olivaceus													
		Nassarius pullus													
	Naticidae	Naticidae								0.7					
		Mammilla sebae													
		Notocochlis gualtieriana	0.5												
		Polinices mammilla								1.6					
		Polinices peselephanti													
	Neritidae	*Neripteron violaceum*													
		Nerita spp.	0.4	0.1	0.8		3.6	3.3		0.2	0.6	0.6	1.2	0.7	
		Nerita albicilla													
		Nerita balteata							1.2						
		Nerita chamaeleon													
		Nerita costata													
		Nerita planospira	2.7												
		Nerita polita													
		Nerita undata	0.7								1.9				
	Olividae	Olividae													
		Oliva annulata													
		Oliva reticulata													
		Oliva tricolor													
	Patellidae	Patellidae		0.1											
	Pisaniidae	*Cantharus* sp.													
	Planaxidae	*Fissilabia decollata*													
		Planaxis sulcatus													0.9
	Potamididae	Potamididae													
		Cerithideopsis largillierti	<0.1								0.6				
		Pirenella cingulata													
		Telescopium telescopium	0.2		0.4		0.2		0.3	0.7	0.1		2.4	0.7	1.0
		Terebralia sulcata													
	Strombidae	Strombidae		0.1							0.4				
		Canarium labiatum													
		Conomurex luhuanus													
		Euprotomus aurisdianae													
		Gibberulus gibberulus													
		Laevistrombus canarium	2.1		38.4										
		Lambis spp.											0.5		
		Lambis lambis													
	Tegulidae	Tegulidae													
		Rochia nilotica													
		Tectus fenestratus													

			XU												
Class	**Family**	**Taxon**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**
	Terebridae	Terebridae													
	Tonnidae	*Tonna* sp.													
	Trochidae	Trochidae			0.3										
		Rochia nilotica													
	Turbinellidae	*Vasum* sp.													
		Vasum turbinellus													
	Turbinidae	Turbinidae													
		Lunella cinerea													
		Turbo spp.								0.5					
	Vermetidae	Vermetidae					<0.1			<0.1	0.1				
Indeterminate	Indeterminate	Unidentified Shell	28.0	67.5	19.8	22.1	35.1	29.3	32.8	26.4	26.1	40.6	30.1	141.4	23.3
Total			**88.9**	**80.4**	**98.1**	**46.5**	**57.1**	**76.6**	**55.1**	**55.9**	**58.7**	**63.9**	**40.8**	**167.1**	**31.0**

			XU												
Class	**Family**	**Taxon**	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**
Bivalvia	Arcidae	Arcidae		1.8								3.2			
		Arcidae <10mm													
		Anadara antiquata	1.3				5.7			8.4					
		Anadara rufescens													
		Barbatia foliata		0.1			0.1								
		Tegillarca granosa													
	Cardiidae	Cardiidae											0.3		
		Fragum spp.								0.1					<0.1
		Fragum spp. <10mm					0.1	0.1	<0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1
		Fragum unedo													
		Hippopus hippopus													
		Tridacna spp.													
		Tridacna maxima													
		Vasticardium flavum													
	Chamidae	*Chama* spp.		12.2								<0.1			
	Cyrenidae	*Batissa violacea*													
		Geloina expansa													
	Glauconomidae	*Glauconome rugosa*													
	Lucinidae	*Anodontia edentula*													
		Austriella corrugata			0.3	0.5	1.5	1.8	0.4		0.3				2.6
	Mactridae	*Mactra* spp.													

			XU												
Class	**Family**	**Taxon**	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**
		Mactra cuneata													
	Malleidae	*Malleus* spp.													
	Mesodesmatidae	*Atactodea striata*	0.9					4.7		1.9		1.8	1.6		0.7
	Mytilidae	Mytilidae					0.3							0.1	
		Septifer bilocularis													
	Ostreidae	Ostreidae				1.3					0.3	2.3	1.1	0.8	0.7
	Pinnidae	Pinnidae													
	Placunidae	*Placuna* spp.													
	Psammobiidae	*Asaphis violascens*													
	Pteriidae	*Isognomon* spp.	0.3						0.7	1.2			3.9	1.1	
		Pinctada spp.										0.1			
		Pinctada maculata													
	Spondylidae	*Spondylus* spp.													
	Tellinidae	Tellinidae													
		Quidnipagus palatam													
	Trapezidae	*Neotrapezium sublaevigatum*													
	Veneridae	Veneridae													
		Anomalodiscus squamosus													
		Dosinia sp.									13.2				
		Gafrarium spp.	0.3			0.9		4.3	<0.1			1.4			
		Gafrarium pectinatum													
		Gafrarium tumidum													
		Irus carditoides <10mm													
		Marcia hiantina													
		Periglypta puerpera													
		Pitar pellucidus													
		Protapes gallus													
		Tapes literatus													
		Venerupis aspera		2.1						1.7		0.3		0.6	
Gastropoda	Amathinidae	*Amathina tricarinata*													
	Angariidae	*Angaria delphinus*													
	Architectonicidae	*Architectonica* sp. <10mm													
	Bullidae	*Bulla* spp.								<0.1					
		Bulla ampulla													
	Calliostomatidae	*Calliostoma* spp.													
	Cerithiidae	Cerithiidae									0.5	<0.1			
		Cerithiidae <10mm											<0.1		0.1

			XU												
Class	**Family**	**Taxon**	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**
		Cerithium citrinum													
		Cerithium coralium													
		Cerithium echinatum			1.4										
		Cerithium nodulosum													
		Cerithium zonatum													
		Clypeomorus batillariaeformis													
	Chilodontaidae	*Euchelus atratus* <10mm													
	Conidae	Conidae								<0.1					
		Conus arenatus													
		Conus coronatus													
		Conus textile													
	Costellariidae	*Vexillum rugosum*													
	Cymatiidae	Cymatiidae													
	Cypraeidae	Cypraeidae													
		Cypraea tigris													
	Ellobiidae	*Cassidula* spp.													
		Ellobium spp.		0.1		<0.1			<0.1			<0.1	<0.1		
		Ellobium aurisjudae													
	Fissurellidae	*Hemitoma* spp. <10mm													
	Littorinidae	*Littoraria* spp.													
		Littoraria spp. <10mm													
		Littoraria filosa													
		Littoraria scabra				<0.1		0.1						0.3	
	Lottiidae	Lottiidae												0.1	
	Mitridae	Mitridae													
		Mitra sp.													
		Chicoreus spp.													
		Chicoreus capucinus													
		Drupella margariticola													
		Thais sp.													
	Nacellidae	*Cellana rota*													
	Nassariidae	*Nassarius* spp.													
		Nassarius coronatus													
		Nassarius crematus													
		Nassarius distortus		0.4											

			XU												
Class	**Family**	**Taxon**	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**
		Nassarius olivaceus													
		Nassarius pullus													
	Naticidae	Naticidae													
		Mammilla sebae													
		Notocochlis gualtieriana													
		Polinices mammilla													
		Polinices peselephanti													
	Neritidae	*Neripteron violaceum*													
		Nerita spp.			0.2	1.2				0.5	0.2	5.0			1.8
		Nerita albicilla													
		Nerita balteata													
		Nerita chamaeleon		0.2											
		Nerita costata													
		Nerita planospira													
		Nerita polita													
		Nerita undata													
	Olividae	Olividae													
		Oliva annulata													
		Oliva reticulata													
		Oliva tricolor													
	Patellidae	Patellidae													
	Pisaniidae	*Cantharus* sp.													
	Planaxidae	*Fissilabia decollata*													
		Planaxis sulcatus													
	Potamididae	Potamididae													
		Cerithideopsis largillierti													
		Pirenella cingulata													
		Telescopium telescopium	0.4	0.1	1.7	1.3	1.1	0.2		0.1	0.2		0.3		4.6
		Terebralia sulcata													
	Strombidae	Strombidae										4.9			
		Canarium labiatum													
		Conomurex luhuanus													
		Euprotomus aurisdianae													
		Gibberulus gibberulus													
		Laevistrombus canarium													

			XU												
Class	**Family**	**Taxon**	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**
		Lambis spp.					0.2								
		Lambis lambis													
	Tegulidae	Tegulidae													
		Rochia nilotica													
		Tectus fenestratus													
	Terebridae	Terebridae													
	Tonnidae	*Tonna* sp.													
	Trochidae	Trochidae					<0.1							<0.1	
		Rochia nilotica													
	Turbinellidae	*Vasum* sp.													
		Vasum turbinellus													
	Turbinidae	Turbinidae					0.1						<0.1		
		Lunella cinerea													
		Turbo spp.													
	Vermetidae	Vermetidae								0.1					
Indeterminate	Indeterminate	Unidentified Shell	22.2	14.1	14.7	25.7	24.7	18.8	17.7	36.1	36.0	31.4	19.7	10.8	32.2
Total			**25.4**	**31.1**	**18.3**	**31.0**	**33.8**	**30.0**	**18.9**	**50.2**	**50.8**	**50.4**	**26.9**	**13.8**	**42.7**

			XU												
Class	**Family**	**Taxon**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**	**127**	**128**	**129**	**130**	**131**
Bivalvia	Arcidae	Arcidae					2.5								
		Arcidae <10mm													
		Anadara antiquata									0.7				
		Anadara rufescens													
		Barbatia foliata				0.2				<0.1	0.2		0.1		
		Tegillarca granosa													
	Cardiidae	Cardiidae								0.1					
		Fragum spp.													
		Fragum spp. <10mm	0.1		<0.1	0.1	<0.1	0.1			0.1	0.1		0.1	
		Fragum unedo													
		Hippopus hippopus													
		Tridacna spp.													
		Tridacna maxima													
		Vasticardium flavum													
	Chamidae	*Chama* spp.						<0.1		0.3	0.1	0.1	0.4		0.6
	Cyrenidae	*Batissa violacea*													
		Geloina expansa													
	Glauconomidae	*Glauconome rugosa*													
	Lucinidae	*Anodontia edentula*									0.7				
		Austriella corrugata	2.1					5.3							
	Mactridae	*Mactra* spp.													

			XU												
Class	**Family**	**Taxon**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**	**127**	**128**	**129**	**130**	**131**
		Mactra cuneata													
	Malleidae	*Malleus* spp.													
	Mesodesmatidae	*Atactodea striata*						<0.1		1.0	0.1				
	Mytilidae	Mytilidae		0.1	0.1			<0.1							
		Septifer bilocularis													
	Ostreidae	Ostreidae		5.1		0.3	0.9			0.5	2.9	0.4	2.4	2.2	8.3
	Pinnidae	Pinnidae													
	Placunidae	*Placuna* spp.													
	Psammobiidae	*Asaphis violascens*													
	Pteriidae	*Isognomon* spp.		38.2			0.1	0.1							
		Pinctada spp.													
		Pinctada maculata													
	Spondylidae	*Spondylus* spp.													
	Tellinidae	Tellinidae													
		Quidnipagus palatam													
	Trapezidae	*Neotrapezium sublaevigatum*													
	Veneridae	Veneridae													
		Anomalodiscus squamosus													
		Dosinia sp.													
		Gafrarium spp.					0.1			0.2	0.1	0.5		2.5	1.0
		Gafrarium pectinatum													
		Gafrarium tumidum													
		Irus carditoides <10mm												<0.1	
		Marcia hiantina													
		Periglypta puerpera													
		Pitar pellucidus													
		Protapes gallus													
		Tapes literatus													
		Venerupis aspera													
Gastropoda	Amathinidae	*Amathina tricarinata*													
	Angariidae	*Angaria delphinus*													
	Architectonicidae	*Architectonica* sp. <10mm													
	Bullidae	*Bulla* spp.	<0.1												
		Bulla ampulla			0.6										1.6
	Calliostomatidae	*Calliostoma* spp.				0.5								0.2	0.7
	Cerithiidae	Cerithiidae				0.3	<0.1								
		Cerithiidae <10mm													
		Cerithium citrinum													
		Cerithium coralium													
		Cerithium echinatum													
		Cerithium nodulosum													
		Cerithium zonatum													

			XU												
Class	**Family**	**Taxon**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**	**127**	**128**	**129**	**130**	**131**
		Clypeomorus batillariaeformis													
	Chilodontaidae	*Euchelus atratus* <10mm													
	Conidae	Conidae													
		Conus arenatus													
		Conus coronatus													
		Conus textile													
	Costellariidae	*Vexillum rugosum*													
	Cymatiidae	Cymatiidae													
	Cypraeidae	Cypraeidae												1.9	
		Cypraea tigris													
	Ellobiidae	*Cassidula* spp.													
		Ellobium spp.								0.1	<0.1				
		Ellobium aurisjudae													
	Fissurellidae	*Hemitoma* spp. <10mm	0.1					<0.1		0.1					
	Littorinidae	*Littoraria* spp.													
		Littoraria spp. <10mm													
		Littoraria filosa													
		Littoraria scabra		0.2											
	Lottiidae	Lottiidae											0.1		
	Mitridae	Mitridae													
		Mitra sp.													
		Chicoreus spp.													
		Chicoreus capucinus													
		Drupella margariticola													
		Thais sp.													
	Nacellidae	*Cellana rota*					0.2								
	Nassariidae	*Nassarius* spp.													
		Nassarius coronatus													
		Nassarius crematus													
		Nassarius distortus													
		Nassarius olivaceus				1.0									
		Nassarius pullus													
	Naticidae	Naticidae													
		Mammilla sebae													
		Notocochlis gualtieriana	1.4												
		Polinices mammilla													
		Polinices peselephanti													
	Neritidae	*Neripteron violaceum*													
		Nerita spp.		0.6		2.4		0.6		2.0		0.8			2.7
		Nerita albicilla											1.4		1.1
		Nerita balteata													
		Nerita chamaeleon	0.9												
		Nerita costata													

			XU												
Class	**Family**	**Taxon**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**	**127**	**128**	**129**	**130**	**131**
		Nerita planospira													
		Nerita polita													
		Nerita undata													
	Olividae	Olividae													
		Oliva annulata													
		Oliva reticulata													
		Oliva tricolor													
	Patellidae	Patellidae								<0.1	0.1				
	Pisaniidae	*Cantharus* sp.													
	Planaxidae	*Fissilabia decollata*													
		Planaxis sulcatus													
	Potamididae	Potamididae													
		Cerithideopsis largillierti									<0.1				
		Pirenella cingulata													
		Telescopium telescopium	0.7	0.1	2.4			0.1		0.4			0.1	0.1	
		Terebralia sulcata													
	Strombidae	Strombidae													
		Canarium labiatum													
		Conomurex luhuanus													
		Euprotomus aurisdianae													
		Gibberulus gibberulus													
		Laevistrombus canarium													
		Lambis spp.													
		Lambis lambis													
	Tegulidae	Tegulidae													
		Rochia nilotica							0.1						
		Tectus fenestratus										0.1			
	Terebridae	Terebridae													
	Tonnidae	*Tonna* sp.													
	Trochidae	Trochidae													
		Rochia nilotica													
	Turbinellidae	*Vasum* sp.													
		Vasum turbinellus													
	Turbinidae	Turbinidae													
		Lunella cinerea													
		Turbo spp.													
	Vermetidae	Vermetidae				0.1	0.4				0.1	0.1	0.1		
Indeterminate	Indeterminate	Unidentified Shell	24.2	20.3	16.9	25.1	26.5	28.4	<0.1	18.8	34.5	60.5	11.4	28.8	27.5
Total			**29.5**	**64.6**	**20.0**	**30.0**	**30.7**	**34.7**	**0.1**	**23.5**	**39.7**	**62.6**	**15.9**	**35.8**	**43.5**

			XU			
Class	**Family**	**Taxon**	**132**	**133**	**134**	**Total**
Bivalvia	Arcidae	Arcidae		1.4		678.8
		Arcidae <10mm				<0.1
		Anadara antiquata				7509.7
		Anadara rufescens				34.7
		Barbatia foliata		0.7		47.9
		Tegillarca granosa				784.9
	Cardiidae	Cardiidae				789.3
		Fragum spp.				0.3
		Fragum spp. <10mm		0.1	<0.1	2.0
		Fragum unedo				11.9
		Hippopus hippopus				995.6
		Tridacna spp.				51.9
		Tridacna maxima				148.7
		Vasticardium flavum				289.3
	Chamidae	*Chama* spp.				5379.4
	Cyrenidae	*Batissa violacea*				523.3
		Geloina expansa				1501.5
	Glauconomidae	*Glauconome rugosa*				4.7
	Lucinidae	*Anodontia edentula*				29.0
		Austriella corrugata				1481.7
	Mactridae	*Mactra* spp.				4.0
		Mactra cuneata				233.2
	Malleidae	*Malleus* spp.				26.1
	Mesodesmatidae	*Atactodea striata*				992.9
	Mytilidae	Mytilidae			0.1	6.0
		Septifer bilocularis				13.8
	Ostreidae	Ostreidae		8.6	8.2	5855.4
	Pinnidae	Pinnidae				1.9
	Placunidae	*Placuna* spp.				470.0
	Psammobiidae	*Asaphis violascens*				52.1
	Pteriidae	*Isognomon* spp.				1217.1
		Pinctada spp.				357.1
		Pinctada maculata				7.2
	Spondylidae	*Spondylus* spp.				301.7
	Tellinidae	Tellinidae				1.2
		Quidnipagus palatam				30.3
	Trapezidae	*Neotrapezium sublaevigatum*				0.2
	Veneridae	Veneridae				4.2
		Anomalodiscus squamosus				14.4
		Dosinia sp.				13.2
		Gafrarium spp.		0.1	1.0	2027.9
		Gafrarium pectinatum				56.6
		Gafrarium tumidum				1444.2
		Irus carditoides <10mm		<0.1		0.6
		Marcia hiantina				2.1
		Periglypta puerpera				70.0
		Pitar pellucidus				22.3

			XU			
Class	**Family**	**Taxon**	**132**	**133**	**134**	**Total**
		Protapes gallus				40.6
		Tapes literatus				16.9
		Venerupis aspera				180.5
Gastropoda	Amathinidae	*Amathina tricarinata*				1.1
	Angariidae	*Angaria delphinus*				36.4
	Architectonicidae	*Architectonica* sp. <10mm				<0.1
	Bullidae	*Bulla* spp.				0.3
		Bulla ampulla			3.7	9.2
	Calliostomatidae	*Calliostoma* spp.		0.4	1.6	10.8
	Cerithiidae	Cerithiidae		0.1	0.3	7.4
		Cerithiidae <10mm				0.3
		Cerithium citrinum				6.1
		Cerithium coralium				4.8
		Cerithium echinatum				2.3
		Cerithium nodulosum				62.2
		Cerithium zonatum				0.6
		Clypeomorus batillariaeformis				18.2
	Chilodontaidae	*Euchelus atratus* <10mm				2.5
	Conidae	Conidae				143.1
		Conus arenatus				2.7
		Conus coronatus				2.5
		Conus textile				8.0
	Costellariidae	*Vexillum rugosum*				0.3
	Cymatiidae	Cymatiidae				4.0
	Cypraeidae	Cypraeidae		1.6		22.5
		Cypraea tigris				8.3
	Ellobiidae	*Cassidula* spp.				0.7
		Ellobium spp.				128.6
		Ellobium aurisjudae				6.1
	Fissurellidae	*Hemitoma* spp. <10mm				1.3
	Littorinidae	*Littoraria* spp.				4.0
		Littoraria spp. <10mm				0.1
		Littoraria filosa				2.9
		Littoraria scabra				30.3
	Lottiidae	Lottiidae				0.6
	Mitridae	Mitridae				0.4
		Mitra sp.				0.1
		Chicoreus spp.				528.1
		Chicoreus capucinus				18.9
		Drupella margariticola				0.5
		Thais sp.				11.8
	Nacellidae	*Cellana rota*				0.2
	Nassariidae	*Nassarius* spp.				16.0
		Nassarius coronatus				0.5
		Nassarius crematus				14.2
		Nassarius distortus				3.7
		Nassarius olivaceus				15.1

			XU			
Class	**Family**	**Taxon**	**132**	**133**	**134**	**Total**
		Nassarius pullus				1.9
	Naticidae	Naticidae				21.8
		Mammilla sebae				0.5
		Notocochlis gualtieriana				7.7
		Polinices mammilla				159.6
		Polinices peselephanti				4.3
	Neritidae	*Neripteron violaceum*				2.2
		Nerita spp.		13.9	4.2	361.4
		Nerita albicilla		0.6		94.8
		Nerita balteata				32.5
		Nerita chamaeleon				32.4
		Nerita costata				8.6
		Nerita planospira				25.5
		Nerita polita				36.9
		Nerita undata				22.5
	Olividae	Olividae				82.0
		Oliva annulata				4.9
		Oliva reticulata				8.0
		Oliva tricolor				3.8
	Patellidae	Patellidae		0.1	0.1	0.4
	Pisaniidae	*Cantharus* sp.				2.2
	Planaxidae	*Fissilabia decollata*				1.4
		Planaxis sulcatus				22.4
	Potamididae	Potamididae				10.9
		Cerithideopsis largillierti				104.9
		Pirenella cingulata				0.5
		Telescopium telescopium				1806.7
		Terebralia sulcata				201.9
	Strombidae	Strombidae				282.9
		Canarium labiatum				2.5
		Conomurex luhuanus				3591.4
		Euprotomus aurisdianae				19.7
		Gibberulus gibberulus				71.0
		Laevistrombus canarium				874.0
		Lambis spp.				4566.0
		Lambis lambis				2352.8
	Tegulidae	Tegulidae				2.0
		Rochia nilotica				60.1
		Tectus fenestratus			1.3	55.1
	Terebridae	Terebridae				1.6
	Tonnidae	*Tonna* sp.				6.2
	Trochidae	Trochidae				107.6
		Rochia nilotica				56.0
	Turbinellidae	*Vasum* sp.				29.2
		Vasum turbinellus				15.0
	Turbinidae	Turbinidae				7.7
		Lunella cinerea		0.8		66.3

			XU			
Class	**Family**	**Taxon**	**132**	**133**	**134**	**Total**
		Turbo spp.				28.0
	Vermetidae	Vermetidae		0.1		2.8
Indeterminate	Indeterminate	Unidentified Shell	<0.1	51.0	45.6	14958.8
Total			**<0.1**	**79.5**	**66.1**	**65085.3**

Appendix F.

Mollusc MNI per XU for Tanamu 1 Square B.

			XU																				
Class	**Family**	**Taxon**	**1**	**2**	**3**	**4**	**5–6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
Bivalvia	Arcidae	Arcidae														2							
		Arcidae <10mm																					
		Anadara antiquata			1	1	1															1	3
		Anadara rufescens																					
		Barbatia foliata					1																
		Tegillarca granosa															1						2
	Cardiidae	Cardiidae																					
		Fragum spp.																					
		Fragum spp. <10mm																					
		Fragum unedo																					
		Hippopus hippopus																					
		Vasticardium flavum																					
	Chamidae	*Chama* spp.																					
	Cyrenidae	*Batissa violacea*																					
		Geloina expansa	3	1	4	1									1								
	Glauconomidae	*Glauconome rugosa*																					
	Lucinidae	*Anodontia edentula*																					
		Austriella corrugata																					
	Mactridae	*Mactra* spp.																					
		Mactra cuneata																					
	Malleidae	*Malleus* spp.																					
	Mesodesmatidae	*Atactodea striata*																					
	Mytilidae	Mytilidae																					
		Septifer bilocularis																					
	Ostreidae	Ostreidae		1	2	8	6	1						1									1

			XU																				
Class	**Family**	**Taxon**	**1**	**2**	**3**	**4**	**5–6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
	Placunidae	*Placuna* spp.																					
	Psammobiidae	*Asaphis violascens*																					
	Pteriidae	*Isognomon* spp.																					
		Pinctada spp.				1																	
	Spondylidae	*Spondylus* spp.																					
	Tellinidae	Tellinidae																					
		Quidnipagus palatam																					
	Trapezidae	*Neotrapezium sublaevigatum*																					
	Veneridae	Veneridae																					
		Anomalodiscus squamosus																					
		Dosinia sp.																					
		Gafrarium spp.			1	1		1				1					1			1	1		2
		Gafrarium pectinatum																					
		Gafrarium tumidum																					
		Irus carditoides <10mm																					
		Marcia hiantina																					
		Periglypta puerpera																					
		Pitar pellucidus																					
		Protapes gallus																					
		Tapes literatus																					
		Venerupis aspera																					
Gastropoda	Amathinidae	*Amathina tricarinata*																					
	Angariidae	*Angaria delphinus*					1																
	Architectonicidae	*Architectonica* sp. <10mm																					
	Bullidae	*Bulla* spp.																					
		Bulla ampulla																					
	Calliostomatidae	*Calliostoma* spp.																					
	Cerithiidae	Cerithiidae																					
		Cerithiidae <10mm																					
		Cerithium citrinum																					
		Cerithium coralium																					

			XU																				
Class	**Family**	**Taxon**	**1**	**2**	**3**	**4**	**5–6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
		Cerithium echinatum																					
		Cerithium nodulosum																					
		Cerithium zonatum																					1
		Clypeomorus batillariaeformis																					
	Chilodontaidae	*Euchelus atratus* <10mm																					
	Conidae	Conidae					1																1
		Conus arenatus																					
		Conus coronatus																					
	Costellariidae	*Vexillum rugosum*																					
	Cymatiidae	Cymatiidae																					
	Cypraeidae	Cypraeidae																					
	Ellobiidae	*Ellobium* spp.																					
		Ellobium aurisjudae				1	1																
	Fissurellidae	*Hemitoma* spp. <10mm				4	3																
	Littorinidae	*Littoraria* spp.																					
		Littoraria spp. <10mm																					
		Littoraria filosa																					
		Littoraria scabra																					
	Lottiidae	Lottiidae																					
	Mitridae	*Mitra* sp.																					
		Mitridae																					
	Muricidae	*Chicoreus* spp.																					
		Chicoreus capucinus																					
		Drupella margariticola																					
		Thais sp.												1									
	Nacellidae	*Cellana rota*																					
	Nassariidae	*Nassarius* spp.																				1	
		Nassarius coronatus																					
		Nassarius crematus																					
		Nassarius distortus																					
		Nassarius olivaceus																					

			XU																				
Class	**Family**	**Taxon**	**1**	**2**	**3**	**4**	**5–6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
		Nassarius pullus																					
	Naticidae	Naticidae																					
		Mammilla sebae																					
		Notocochlis gualtieriana																					
		Polinices mammilla																					
		Polinices peselephanti																					
	Neritidae	*Neripteron violaceum*																					
		Nerita spp.																					
		Nerita albicilla																					
		Nerita balteata																					
		Nerita chamaeleon																					
		Nerita costata																					
		Nerita planospira																					
		Nerita polita																					
		Nerita undata																					
	Olividae	Olividae																					
		Oliva annulata																					
		Oliva reticulata																					
		Oliva tricolor																					
	Patellidae	Patellidae																					
	Pisaniidae	*Cantharus* sp.																					
	Planaxidae	*Fissilabia decollata*																					
		Planaxis sulcatus																					
	Potamididae	Potamididae	2	1																			
		Cerithideopsis largillierti	1																				
		Pirenella cingulata																					
		Telescopium telescopium	2	5	15	44	28	8			1		1										
		Terebralia sulcata	1																				1
	Strombidae	Strombidae	1		2		2						1				1						
		Canarium labiatum																					
		Conomurex luhuanus	3	7	24	86	93	5	5		3	1	2	1	3	1	3	1	2	1	2	2	3

			XU																				
Class	**Family**	**Taxon**	**1**	**2**	**3**	**4**	**5–6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
		Euprotomus aurisdianae																					
		Gibberulus gibberulus					2								2								
		Laevistrombus canarium																					1
		Lambis spp.					3																
		Lambis lambis			2	3	3																
	Tegulidae	Tegulidae																					
		Rochia nilotica																					
		Tectus fenestratus			3	1																	
	Tonnidae	*Tonna* sp.				1																	
	Trochidae	Trochidae					1																
	Turbinellidae	*Vasum* sp.				1																	
	Turbinidae	Turbinidae												1									
		Lunella cinerea																					
		Turbo spp.																					
Total			**13**	**15**	**54**	**153**	**146**	**15**	**5**		**4**	**2**	**4**	**3**	**7**	**3**	**6**	**1**	**2**	**2**	**3**	**4**	**15**

			XU																				
Class	**Family**	**Taxon**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**
Bivalvia	Arcidae	Arcidae			1	1		3	2		1	2	1					2			1	1	1
		Arcidae <10mm																					
		Anadara antiquata	1	3	10	11	12	5	18	44	13	13	5	2	1	3	1	1	2	1	1		1
		Anadara rufescens																					
		Barbatia foliata									1		1					2	1		1		
		Tegillarca granosa		1	6	2	1	1	3	2		1	1	3				1					
	Cardiidae	Cardiidae				1					1	1						1					1
		Fragum spp.																					
		Fragum spp. <10mm													2	1				1		1	

			XU																				
Class	**Family**	**Taxon**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**
		Fragum unedo								1													
		Hippopus hippopus																					
		Vasticardium flavum									1			1								1	
	Chamidae	*Chama* spp.					1	1	1	1	3	1	1	2		1		1		1		1	
	Cyrenidae	*Batissa violacea*							1	1	2		1	1					1	1			
		Geloina expansa		1			1	1	1	4	2	1		2				1	1				
	Glauconomidae	*Glauconome rugosa*																					
	Lucinidae	*Anodontia edentula*								1			1		2								
		Austriella corrugata			2					2		1		1				2	1				
	Mactridae	*Mactra* spp.						1	1														
		Mactra cuneata																					
	Malleidae	*Malleus* spp.						1	1			1											
	Mesodesmatidae	*Atactodea striata*		1		2		1	7	5	11	9	7	5	1	3	3	3	3	2	4	2	4
	Mytilidae	Mytilidae																					
		Septifer bilocularis																					
	Ostreidae	Ostreidae		1		3	6	1	7	19	9	10	13	8	1	2	4	8	1		3	3	1
	Placunidae	*Placuna* spp.			8	4	1	2	3	5									1				
	Psammobiidae	*Asaphis violascens*						1		1													
	Pteriidae	*Isognomon* spp.				2	1		2	4	3	1	4	2	1	3	3	7	2	1	4	5	3
		Pinctada spp.								1		1	1			1		1		1	1		
	Spondylidae	*Spondylus* spp.					1																
	Tellinidae	Tellinidae																					
		Quidnipagus palatam																					
	Trapezidae	*Neotrapezium sublaevigatum*																	1				
	Veneridae	Veneridae						1		2	1												
		Anomalodiscus squamosus						1	1	1	1	1	2							1			
		Dosinia sp.																					
		Gafrarium spp.	2	4	5	5	8	16	23	31	6	26	35	24	10	4	3	4	7	2	5	5	3
		Gafrarium pectinatum																					
		Gafrarium tumidum		1			2		2	9		8	12	4				2					
		Irus carditoides <10mm																					

			XU																				
Class	**Family**	**Taxon**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**
		Marcia hiantina						1															
		Periglypta puerpera							1														
		Pitar pellucidus							3	1				1					2				
		Protapes gallus							1				2	3			1						1
		Tapes literatus							1		1	1				1	1						
		Venerupis aspera								1		2										1	
Gastropoda	Amathinidae	*Amathina tricarinata*											1							1			
	Angariidae	*Angaria delphinus*																					
	Architectonicidae	*Architectonica* sp. <10mm																					
	Bullidae	*Bulla* spp.																					
		Bulla ampulla						1						1				1			1		1
	Calliostomatidae	*Calliostoma* spp.																					
	Cerithiidae	Cerithiidae						1		1		1	3	2			1				1		
		Cerithiidae <10mm																	3				
		Cerithium citrinum									1												
		Cerithium coralium					1								1			1					
		Cerithium echinatum										1					1						
		Cerithium nodulosum		1																			
		Cerithium zonatum					1																
		Clypeomorus batillariaeformis							2				1	2		2		2	1	1			
	Chilodontaidae	*Euchelus atratus* <10mm													1					1			1
	Conidae	Conidae							1								1		1	1			
		Conus arenatus																					
		Conus coronatus																					
	Costellariidae	*Vexillum rugosum*																		1			
	Cymatiidae	Cymatiidae																					
	Cypraeidae	Cypraeidae																			1		
	Ellobiidae	*Ellobium* spp.																					
		Ellobium aurisjudae																					
	Fissurellidae	*Hemitoma* spp. <10mm							1	4		2	3	1	3			2			3		1
	Littorinidae	*Littoraria* spp.								1									1	1			

			XU																				
Class	**Family**	**Taxon**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**
		Littoraria spp. <10mm																					
		Littoraria filosa																					
		Littoraria scabra																					1
	Lottiidae	Lottiidae																					
	Mitridae	*Mitra* sp.																					
		Mitridae																					
	Muricidae	*Chicoreus* spp.											1				1		1				
		Chicoreus capucinus																					
		Drupella margariticola																					
		Thais sp.																					
	Nacellidae	*Cellana rota*																					
	Nassariidae	*Nassarius* spp.	1							1		1		1			1	2	1				
		Nassarius coronatus																					
		Nassarius crematus					1																
		Nassarius distortus																					
		Nassarius olivaceus										1		1				1			1		
		Nassarius pullus																					
	Naticidae	Naticidae	1		1			1											1				1
		Mammilla sebae																					
		Notocochlis gualtieriana							1			1											
		Polinices mammilla														1							
		Polinices peselephanti						2															
	Neritidae	*Neripteron violaceum*																					
		Nerita spp.		1	1	1	1	3	1	2	1	1	2	4			1	1	3	1	2	3	
		Nerita albicilla						1		1								1				1	1
		Nerita balteata							1										1				
		Nerita chamaeleon						1	1	1													
		Nerita costata																					
		Nerita planospira						1					1					1		1			2
		Nerita polita																			1		
		Nerita undata								1			1					1		1			

			XU																				
Class	**Family**	**Taxon**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**
	Olividae	Olividae																		1	1		
		Oliva annulata																					
		Oliva reticulata																					
		Oliva tricolor																					
	Patellidae	Patellidae																					
	Pisaniidae	*Cantharus* sp.																					
	Planaxidae	*Fissilabia decollata*																					1
		Planaxis sulcatus									1	2		1				2			1		
	Potamididae	Potamididae																					
		Cerithideopsis largillierti									1	1		1			2	3	2				
		Pirenella cingulata																					
		Telescopium telescopium			1		1	1		1		1	1		1							2	
		Terebralia sulcata										1		1	2			3	1			1	
	Strombidae	Strombidae			1	1	2	1	1	1	2	1	3	1	1	1	1	1		1		2	1
		Canarium labiatum																					
		Conomurex luhuanus	2	5	9		7	5	6	19	2	5		3		1	1	1			1	1	1
		Euprotomus aurisdianae									1												
		Gibberulus gibberulus		1		1	1		1		1			1								1	
		Laevistrombus canarium			1		1		1	1	7	1		2						1		1	
		Lambis spp.			2	1	1	1	2	2	1	5	2	2	2	1				1		1	
		Lambis lambis		1			2			1													
	Tegulidae	Tegulidae																					
		Rochia nilotica																					
		Tectus fenestratus			2	1	1							1									
	Tonnidae	*Tonna* sp.																					
	Trochidae	Trochidae																		1			
	Turbinellidae	*Vasum* sp.				1																	
	Turbinidae	Turbinidae												3	1		1						1
		Lunella cinerea		1		1						1											
		Turbo spp.																					

			XU																				
Class	**Family**	**Taxon**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**
Total			**7**	**22**	**50**	**38**	**54**	**56**	**98**	**173**	**74**	**106**	**106**	**87**	**30**	**25**	**27**	**59**	**39**	**25**	**33**	**33**	**27**

			XU																				
Class	**Family**	**Taxon**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**
Bivalvia	Arcidae	Arcidae		1	1	1		1	4	1	1		2			1	1						3
		Arcidae <10mm																					
		Anadara antiquata	1	1	3	9	4	8	13	10	4	13	16	8	5	7	16	18	7	12	18	6	7
		Anadara rufescens				1										1				3		1	
		Barbatia foliata				1	1	1			2		1					1			1	1	1
		Tegillarca granosa						2	1	1	2	3	2	3	1	1	2		1				
	Cardiidae	Cardiidae	1		1	2	1	1	1				2	1					1				
		Fragum spp.																					
		Fragum spp. <10mm			1					1	2					1							
		Fragum unedo																					
		Hippopus hippopus												1		1							1
		Vasticardium flavum					1		1	2	1	1	1	1		4	2			2	1	1	2
	Chamidae	*Chama* spp.	1	1	1	3	4	2	3	2	2	4	5	3	2	3	3	4	6	15	16	5	14
	Cyrenidae	*Batissa violacea*	2		2	3		3	4			3	3	2	1		1	2	3	2	2	4	2
		Geloina expansa	1	1	1	1	1	2	4	5	4	3	4	5	2	1		5	4	8	8	5	5
	Glauconomidae	*Glauconome rugosa*																				1	
	Lucinidae	*Anodontia edentula*				1			1											2		1	1
		Austriella corrugata		2			4		2	2	2	1	1	2	2	1	1			2	3	7	4
	Mactridae	*Mactra* spp.								1				1				1					
		Mactra cuneata								1				1		2				5	2	1	6
	Malleidae	*Malleus* spp.																					
	Mesodesmatidae	*Atactodea striata*	1	4	6	9	6	7	9	3	3	3	2	2	2	4	5	5	7	16	13	6	16
	Mytilidae	Mytilidae																2			2		

			XU																				
Class	**Family**	**Taxon**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**
		Septifer bilocularis					1																
	Ostreidae	Ostreidae	3	8	6	11	13	17	19	15	27	29	24	20	10	13	10	14	24	192	38	24	17
	Placunidae	*Placuna* spp.							1														
	Psammobiidae	*Asaphis violascens*			1		1		1	2	1	1		1	1					1	1		1
	Pteriidae	*Isognomon* spp.	6	8	6	9	12	24	39	29	38	22	38	31	16	26	22	11	9	7	40	25	5
		Pinctada spp.	4	3	2	7	4	8	19	7	15	13	15	15	11	19	5	9	11		22	9	10
	Spondylidae	*Spondylus* spp.											1						1		1		
	Tellinidae	Tellinidae					1																
		Quidnipagus palatam				1			1					1			1	1					
	Trapezidae	*Neotrapezium sublaevigatum*																					
	Veneridae	Veneridae			1							1											
		Anomalodiscus squamosus												1									
		Dosinia sp.																					
		Gafrarium spp.	3	2	4	8	6	1	13	5	5	6	5	8	2	6	2	3	3		4	4	7
		Gafrarium pectinatum					1										3		2	2	2	3	3
		Gafrarium tumidum	1	2			4	1		4	6	6	4	3	5	7	3	4	5	8	9	7	10
		Irus carditoides <10mm																					
		Marcia hiantina					1																
		Periglypta puerpera					1										2						
		Pitar pellucidus			1			1		1	1									1	1		
		Protapes gallus							1					2	1								3
		Tapes literatus									2	1								3			
		Venerupis aspera				1	4	1	2		1	2	2	6	1	3	2	3	3	7	8	8	12
Gastropoda	Amathinidae	*Amathina tricarinata*											2	1									
	Angariidae	*Angaria delphinus*																					
	Architectonicidae	*Architectonica* sp. <10mm																					
	Bullidae	*Bulla* spp.																					
		Bulla ampulla							1														
	Calliostomatidae	*Calliostoma* spp.			1		1					1	1	1		2	3			1	2		1
	Cerithiidae	Cerithiidae		1		1	5					1						2				2	
		Cerithiidae <10mm																					

			XU																				
Class	**Family**	**Taxon**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**
		Cerithium citrinum					4		2		3		1	1		1			1	1	3		3
		Cerithium coralium	1							2			1	1	1						3		1
		Cerithium echinatum																					
		Cerithium nodulosum																					
		Cerithium zonatum																					
		Clypeomorus batillariaeformis	1	1		1		2	1			2	2	2	1	1	2		1	2	3	1	3
	Chilodontaidae	*Euchelus atratus* <10mm							2	1			1										
	Conidae	Conidae					1						1	1							2		1
		Conus arenatus								1													
		Conus coronatus													1								
	Costellariidae	*Vexillum rugosum*																					
	Cymatiidae	Cymatiidae																					
	Cypraeidae	Cypraeidae							1														
	Ellobiidae	*Ellobium* spp.					1	1	1		2	1	3	2	2	5	4			2	2	2	3
		Ellobium aurisjudae																					
	Fissurellidae	*Hemitoma* spp. <10mm			1															2			
	Littorinidae	*Littoraria* spp.					2			3				1				1	2	7	3	5	
		Littoraria spp. <10mm																					
		Littoraria filosa	1		1								1		1								
		Littoraria scabra		2			1	4	10		6	3	1		1	2	3	1	4	7	5	5	9
	Lottiidae	Lottiidae			1																		
	Mitridae	*Mitra* sp.																					
		Mitridae																					
	Muricidae	*Chicoreus* spp.		1	2	2	2	2	3	7	3	4	4	4	2	2	3	3	6	1	7	3	2
		Chicoreus capucinus																		4			
		Drupella margariticola				1																	
		Thais sp.																					
	Nacellidae	*Cellana rota*																					
	Nassariidae	*Nassarius* spp.		1		1	2	1	2		2			1	2	1		4	1	3	2	1	
		Nassarius coronatus								1		1											
		Nassarius crematus			1										1		1	3		1			1

			XU																				
Class	**Family**	**Taxon**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**
		Nassarius distortus									1			1			1		2		1		
		Nassarius olivaceus	1				1	2	2			1	1	2		1	3	1		2	5		1
		Nassarius pullus																					
	Naticidae	Naticidae				1	3					3	3		2		3		2			1	
		Mammilla sebae						1															
		Notocochlis gualtieriana	1						1		1				1		1		1				1
		Polinices mammilla			2	3		4	2	2	7	5	7	7	6	3	6	5	5	11	11	6	4
		Polinices peselephanti																					
	Neritidae	*Neripteron violaceum*															2	1			1		
		Nerita spp.	2	3	2	1	6	1	7		6	2	6	1	3	3	4	7	2	4	14	5	5
		Nerita albicilla				4	2	4	1	5	2	1	2	1	1	2	2	3	3	4	2	1	1
		Nerita balteata													1					3	3	1	4
		Nerita chamaeleon				1			1	2	3		1	2	2	1	2	3	2	3	4	2	3
		Nerita costata		1				2															
		Nerita planospira		1	1	4	2		1		1	1	1	1			2		5		3	3	2
		Nerita polita			1	2			1			2			1	1		1		4	2	1	4
		Nerita undata				1															1	4	2
	Olividae	Olividae	1				1		1	1		1	1			1				1	1		
		Oliva annulata																					
		Oliva reticulata																					
		Oliva tricolor																				1	
	Patellidae	Patellidae																					
	Pisaniidae	*Cantharus* sp.							1														
	Planaxidae	*Fissilabia decollata*					1																
		Planaxis sulcatus				1	1	1	4	1	1	1		1	2			1	1	2	9		
	Potamididae	Potamididae																					
		Cerithideopsis largillierti	2	1	1	6	1	5	7	3	2	5	3	2	2	5	6	2	6	8	12	12	7
		Pirenella cingulata		1																			
		Telescopium telescopium		1		1	1	1		1		1	2			1		2			2		
		Terebralia sulcata	1	2	2	2	2	3	5		1	2	3	1	3	1	1	6	1	5	4	3	3
	Strombidae	Strombidae		1		1	2		1						2			2			3	1	

			XU																				
Class	**Family**	**Taxon**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**
		Canarium labiatum								1									1				
		Conomurex luhuanus	2	1		2																	
		Euprotomus aurisdianae																					
		Gibberulus gibberulus	1		1												1						
		Laevistrombus canarium	1	1		2		1	3	1			3	3	3	4	3	5	2		3		1
		Lambis spp.			3	1					2	1	1		1					4	1		1
		Lambis lambis												2	2			1		6			1
	Tegulidae	Tegulidae								1												1	
		Rochia nilotica																					
		Tectus fenestratus					1					1											1
	Tonnidae	*Tonna* sp.																					
	Trochidae	Trochidae									1												
	Turbinellidae	*Vasum* sp.																					
	Turbinidae	Turbinidae		1	2					3					1				1			3	
		Lunella cinerea	1			2	1	1				1				2		1		1	3		3
		Turbo spp.					1						1			1		1	1				1
Total			**40**	**53**	**59**	**109**	**116**	**116**	**200**	**128**	**163**	**153**	**181**	**157**	**107**	**141**	**134**	**139**	**137**	**377**	**309**	**183**	**199**

			XU																				
Class	**Family**	**Taxon**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**	**82**	**83**	**84**	**85**
Bivalvia	Arcidae	Arcidae			1	1	1							2			1					1	
		Arcidae <10mm																					
		Anadara antiquata	8	25	33	6	6	9	7	10	4	2	2		2	1	1	1		2	3	2	1
		Anadara rufescens					1																
		Barbatia foliata	1	2							1		1								1	1	
		Tegillarca granosa		1							1												
	Cardiidae	Cardiidae	1																				

			XU																				
Class	**Family**	**Taxon**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**	**82**	**83**	**84**	**85**
		Fragum spp.																					
		Fragum spp. <10mm						1	1			1	1					1					
		Fragum unedo																					
		Hippopus hippopus																					
		Vasticardium flavum	2	3	2	2																	
	Chamidae	*Chama* spp.	8	29	37	2	2	4	1	1	2	1											
	Cyrenidae	*Batissa violacea*		2	1				1			1							1				
		Geloina expansa	5	6	8	2		2	2	2	2	3	2				1	1	2	1			
	Glauconomidae	*Glauconome rugosa*																					
	Lucinidae	*Anodontia edentula*			1	1												1		1		1	
		Austriella corrugata	4	6	5	2	1				1	1	1			1			1		2	1	
	Mactridae	*Mactra* spp.																				1	
		Mactra cuneata	2	22	23	1	5	2	2	2		2			3	1							
	Malleidae	*Malleus* spp.					1																
	Mesodesmatidae	*Atactodea striata*	9	28	38	8	17	37	47	41	17	13	9	6	6	2	3	5	2	4	5	1	1
	Mytilidae	Mytilidae																					
		Septifer bilocularis	1	1									1		1				1		1	2	
	Ostreidae	Ostreidae	28	30	42	11	6	5	7	1	1	2	1	1				2			1		1
	Placunidae	*Placuna* spp.		1																			
	Psammobiidae	*Asaphis violascens*			1																		
	Pteriidae	*Isognomon* spp.	10	25	11	1	2	3	2	3	3	3	2	1	1		1				1		
		Pinctada spp.	7	14	16	1	2	1			1	2		2	1								
	Spondylidae	*Spondylus* spp.		1																			
	Tellinidae	Tellinidae										1											
		Quidnipagus palatam		1																			
	Trapezidae	*Neotrapezium sublaevigatum*																					
	Veneridae	Veneridae																					
		Anomalodiscus squamosus																					
		Dosinia sp.																					
		Gafrarium spp.	4	1	9	2	1	2	2		1	1					2	1	1	1	1	1	
		Gafrarium pectinatum	2	2	4	2			1	2	1		1										

			XU																				
Class	**Family**	**Taxon**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**	**82**	**83**	**84**	**85**
		Gafrarium tumidum	7	17	12	1	2	4	5	4		1	1	2		1	2						1
		Irus carditoides <10mm																					
		Marcia hiantina																					
		Periglypta puerpera		1																			
		Pitar pellucidus																					
		Protapes gallus	1				1																
		Tapes literatus			1																		
		Venerupis aspera	13	5	9		1	3	3	4	3		1	1			1				1		
Gastropoda	Amathinidae	*Amathina tricarinata*							1														
	Angariidae	*Angaria delphinus*		1																			
	Architectonicidae	*Architectonica* sp. <10mm																					
	Bullidae	*Bulla* spp.																					
		Bulla ampulla																					
	Calliostomatidae	*Calliostoma* spp.	3	1	1						1					1	2						
	Cerithiidae	Cerithiidae	2	1																	1		
		Cerithiidae <10mm												3									
		Cerithium citrinum			3		1						1										
		Cerithium coralium		2	3						1												
		Cerithium echinatum																					
		Cerithium nodulosum																					
		Cerithium zonatum																					
		Clypeomorus batillariaeformis		2	1		1			1													
	Chilodontaidae	*Euchelus atratus* <10mm																					
	Conidae	Conidae						1															1
		Conus arenatus																					
		Conus coronatus																					
	Costellariidae	*Vexillum rugosum*	1																				
	Cymatiidae	Cymatiidae																					
	Cypraeidae	Cypraeidae	1																				
	Ellobiidae	*Ellobium* spp.	1	1	2	1	1	2	3	1	1	1	1			2			1	2		1	
		Ellobium aurisjudae																					

			XU																				
Class	**Family**	**Taxon**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**	**82**	**83**	**84**	**85**
	Fissurellidae	*Hemitoma* spp. <10mm																					
	Littorinidae	*Littoraria* spp.	3	2	4	2	2		2			1	1	2	1	1							
		Littoraria spp. <10mm																					1
		Littoraria filosa			1							1											
		Littoraria scabra	8	4	6	1	2	6	1	2	2			1						1		1	
	Lottiidae	Lottiidae																1					
	Mitridae	*Mitra* sp.																		1			
		Mitridae																				1	
	Muricidae	*Chicoreus* spp.	1	5	12	1	1	1		1				1				1	1		1		
		Chicoreus capucinus																					
		Drupella margariticola																					
		Thais sp.																					
	Nacellidae	*Cellana rota*																					
	Nassariidae	*Nassarius* spp.	3		2					1	2	1			1								
		Nassarius coronatus																					
		Nassarius crematus		1			2																
		Nassarius distortus		1	1		1								1			1					
		Nassarius olivaceus	1		2		2					1				1							
		Nassarius pullus			1		1				1												
	Naticidae	Naticidae		2		1	2		1	1				2								2	
		Mammilla sebae																					
		Notocochlis gualtieriana		1		1																	
		Polinices mammilla	14	5	7	1	1	3	1	1	1				1		1			2		1	
		Polinices peselephanti											1									1	
	Neritidae	*Neripteron violaceum*																					
		Nerita spp.	8	20	18	3	2	1	2	3	1	2	1	2			2			2			1
		Nerita albicilla	2	8	9		1			2						1							
		Nerita balteata	2	3	5	2	1																1
		Nerita chamaeleon		5	6	1		1		1	1					1							
		Nerita costata																2					
		Nerita planospira	4	6	5		1						2										

			XU																				
Class	**Family**	**Taxon**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**	**82**	**83**	**84**	**85**
		Nerita polita	2	5	4		1	1	1		1	1		1			1	1					
		Nerita undata			2		1		1										1			1	
	Olividae	Olividae		2	5	1	2			1													
		Oliva annulata																					1
		Oliva reticulata		1																			
		Oliva tricolor																					
	Patellidae	Patellidae																					
	Pisaniidae	*Cantharus* sp.																					
	Planaxidae	*Fissilabia decollata*																					
		Planaxis sulcatus		4	5	1		2	1							1							1
	Potamididae	Potamididae																					
		Cerithideopsis largillierti	19	10	18	4	5	9	6	10	9	7	2	3	2	2	2		1	2		3	1
		Pirenella cingulata						1															
		Telescopium telescopium																					
		Terebralia sulcata	2	9	4	3	1	1	1				1										
	Strombidae	Strombidae	1	1	1				1										1				
		Canarium labiatum																					
		Conomurex luhuanus																					
		Euprotomus aurisdianae																					
		Gibberulus gibberulus																					
		Laevistrombus canarium	2	2	2	1			1			1		1					1	1			
		Lambis spp.	2	3	5																		
		Lambis lambis																					
	Tegulidae	Tegulidae																					
		Rochia nilotica	1					1															
		Tectus fenestratus		1														1					
	Tonnidae	*Tonna* sp.																					
	Trochidae	Trochidae					1																
	Turbinellidae	*Vasum* sp.																					
	Turbinidae	Turbinidae			1															1			

			XU																				
Class	**Family**	**Taxon**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**	**82**	**83**	**84**	**85**
		Lunella cinerea		2	2		1	2				1		1	1	1			1				
		Turbo spp.		1		1			1		1										1		
Total			**196**	**335**	**392**	**68**	**83**	**105**	**105**	**95**	**60**	**51**	**33**	**32**	**21**	**17**	**20**	**19**	**15**	**21**	**19**	**22**	**11**

			XU																				
Class	**Family**	**Taxon**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**	**106**
Bivalvia	Arcidae	Arcidae											1										
		Arcidae <10mm						1			1												
		Anadara antiquata	2	1	3	2	2	6	1	1	1	1			2	1	1	1					1
		Anadara rufescens																					
		Barbatia foliata	1			1															1		
		Tegillarca granosa																					
	Cardiidae	Cardiidae																					
		Fragum spp.																					
		Fragum spp. <10mm		1		1					5			1							1	1	
		Fragum unedo																					
		Hippopus hippopus																					
		Vasticardium flavum																					
	Chamidae	*Chama* spp.			1	1													1				
	Cyrenidae	*Batissa violacea*		2		1																	
		Geloina expansa		1		1	1																
	Glauconomidae	*Glauconome rugosa*				1																	
	Lucinidae	*Anodontia edentula*														1			1				
		Austriella corrugata	1	1				1		1				3									
	Mactridae	*Mactra* spp.						1															
		Mactra cuneata	1			1																	
	Malleidae	*Malleus* spp.																					

			XU																				
Class	**Family**	**Taxon**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**	**106**
	Mesodesmatidae	*Atactodea striata*	1	1	2	3	4	1		1		2					2		3		5		1
	Mytilidae	Mytilidae																					
		Septifer bilocularis			1	1																	
	Ostreidae	Ostreidae						1			3			2								1	
	Placunidae	*Placuna* spp.																					
	Psammobiidae	*Asaphis violascens*																					
	Pteriidae	*Isognomon* spp.	1						1	1											2		
		Pinctada spp.																					
	Spondylidae	*Spondylus* spp.																					
	Tellinidae	Tellinidae																					
		Quidnipagus palatam																					
	Trapezidae	*Neotrapezium sublaevigatum*																					
	Veneridae	Veneridae						1															
		Anomalodiscus squamosus																	1				
		Dosinia sp.																					
		Gafrarium spp.	2		2	1		1	1	1	2	1	1		1	1		1		1		1	
		Gafrarium pectinatum																					
		Gafrarium tumidum	1	1	1			2										2	1		1		
		Irus carditoides <10mm																					
		Marcia hiantina																					
		Periglypta puerpera											1										
		Pitar pellucidus																					
		Protapes gallus															1						
		Tapes literatus															1						
		Venerupis aspera																					
Gastropoda	Amathinidae	*Amathina tricarinata*																					
	Angariidae	*Angaria delphinus*																					
	Architectonicidae	*Architectonica* sp. <10mm					1																
	Bullidae	*Bulla* spp.																					
		Bulla ampulla																					
	Calliostomatidae	*Calliostoma* spp.	1	1			1				2						1					1	

			XU																				
Class	**Family**	**Taxon**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**	**106**
	Cerithiidae	Cerithiidae													1			1			1		
		Cerithiidae <10mm								3													
		Cerithium citrinum																					
		Cerithium coralium	1																				
		Cerithium echinatum																					
		Cerithium nodulosum																					
		Cerithium zonatum																					
		Clypeomorus batillariaeformis					1																
	Chilodontaidae	*Euchelus atratus* <10mm																					
	Conidae	Conidae								1												1	
		Conus arenatus																					
		Conus coronatus																					
	Costellariidae	*Vexillum rugosum*																					
	Cymatiidae	Cymatiidae									1												
	Cypraeidae	Cypraeidae																					
	Ellobiidae	*Ellobium* spp.				3	2	5	6	1	2		1	4	2	2	4	3		4			
		Ellobium aurisjudae																					
	Fissurellidae	*Hemitoma* spp. <10mm																					
	Littorinidae	*Littoraria* spp.						1											1		1		
		Littoraria spp. <10mm	1	1			1			1													
		Littoraria filosa																					
		Littoraria scabra						1	1			1	1									1	
	Lottiidae	Lottiidae		1												1							
	Mitridae	*Mitra* sp.																					
		Mitridae																					
	Muricidae	*Chicoreus* spp.	1																				
		Chicoreus capucinus																					
		Drupella margariticola																					
		Thais sp.																					
	Nacellidae	*Cellana rota*																					
	Nassariidae	*Nassarius* spp.					1	1				1	1							1			

			XU																				
Class	**Family**	**Taxon**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**	**106**
		Nassarius coronatus																					
		Nassarius crematus														1							
		Nassarius distortus																					
		Nassarius olivaceus	1																				
		Nassarius pullus																					
	Naticidae	Naticidae		1													1						
		Mammilla sebae																					
		Notocochlis gualtieriana								1													
		Polinices mammilla	1														1						
		Polinices peselephanti																					
	Neritidae	*Neripteron violaceum*																					
		Nerita spp.	3	1	1	1			1	1	1	1		4	1			1	1	1			
		Nerita albicilla																					
		Nerita balteata	1													1							
		Nerita chamaeleon																					
		Nerita costata		3																			
		Nerita planospira								2													
		Nerita polita						1															
		Nerita undata						1		1								1					
	Olividae	Olividae																					
		Oliva annulata																					
		Oliva reticulata																					
		Oliva tricolor																					
	Patellidae	Patellidae						1			1												
	Pisaniidae	*Cantharus* sp.																					
	Planaxidae	*Fissilabia decollata*																					
		Planaxis sulcatus		1																			
	Potamididae	Potamididae																					
		Cerithideopsis largillierti			1	1																	
		Pirenella cingulata																					
		Telescopium telescopium																		1			

			XU																				
Class	**Family**	**Taxon**	**86**	**87**	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**100**	**101**	**102**	**103**	**104**	**105**	**106**
		Terebralia sulcata																					
	Strombidae	Strombidae																1					
		Canarium labiatum																					
		Conomurex luhuanus																					
		Euprotomus aurisdianae																					
		Gibberulus gibberulus																					
		Laevistrombus canarium	1				2					2											
		Lambis spp.																					
		Lambis lambis																					
	Tegulidae	Tegulidae	1																				
		Rochia nilotica																					
		Tectus fenestratus																					
	Tonnidae	*Tonna* sp.																					
	Trochidae	Trochidae																					
	Turbinellidae	*Vasum* sp.																					
	Turbinidae	Turbinidae																					
		Lunella cinerea																					
		Turbo spp.																					
Total			**22**	**17**	**12**	**19**	**16**	**26**	**11**	**16**	**19**	**9**	**6**	**14**	**7**	**8**	**12**	**11**	**9**	**8**	**12**	**6**	**2**

			XU																				
Class	**Family**	**Taxon**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**	**127**
Bivalvia	Arcidae	Arcidae	1								1												
		Arcidae <10mm																					
		Anadara antiquata				1			1														1
		Anadara rufescens																					
		Barbatia foliata				1												1				1	4

			XU																				
Class	**Family**	**Taxon**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**	**127**
		Tegillarca granosa																					
	Cardiidae	Cardiidae																					
		Fragum spp.							1					1									
		Fragum spp. <10mm				1	1	1	1	1	2	1	1	1	3		1	2	1	1			4
		Fragum unedo																					
		Hippopus hippopus																					
		Vasticardium flavum																					
	Chamidae	*Chama* spp.	1								1											2	2
	Cyrenidae	*Batissa violacea*																					
		Geloina expansa																					
	Glauconomidae	*Glauconome rugosa*																					
	Lucinidae	*Anodontia edentula*																					1
		Austriella corrugata																					
	Mactridae	*Mactra* spp.																					
		Mactra cuneata																					
	Malleidae	*Malleus* spp.																					
	Mesodesmatidae	*Atactodea striata*					1		2		1	1		1						1		1	3
	Mytilidae	Mytilidae				1							1										
		Septifer bilocularis																					
	Ostreidae	Ostreidae			1						1			1					1				1
	Placunidae	*Placuna* spp.																					
	Psammobiidae	*Asaphis violascens*																					
	Pteriidae	*Isognomon* spp.							1			1				1							
		Pinctada spp.																					
	Spondylidae	*Spondylus* spp.																					
	Tellinidae	Tellinidae																					
		Quidnipagus palatam																					
	Trapezidae	*Neotrapezium sublaevigatum*																					
	Veneridae	Veneridae																					
		Anomalodiscus squamosus																					
		Dosinia sp.								1													

			XU																				
Class	**Family**	**Taxon**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**	**127**
		Gafrarium spp.			2		1	1											1			2	3
		Gafrarium pectinatum																					
		Gafrarium tumidum																					
		Irus carditoides <10mm																					
		Marcia hiantina																					
		Periglypta puerpera																					
		Pitar pellucidus																					
		Protapes gallus																					
		Tapes literatus																					
		Venerupis aspera	1						2														
Gastropoda	Amathinidae	*Amathina tricarinata*																					
	Angariidae	*Angaria delphinus*																					
	Architectonicidae	*Architectonica* sp. <10mm																					
	Bullidae	*Bulla* spp.							1						1								
		Bulla ampulla															1						
	Calliostomatidae	*Calliostoma* spp.																1					
	Cerithiidae	Cerithiidae									1							1	1				
		Cerithiidae <10mm										1		2									
		Cerithium citrinum																					
		Cerithium coralium																					
		Cerithium echinatum		1																			
		Cerithium nodulosum																					
		Cerithium zonatum																					
		Clypeomorus batillariaeformis																					
	Chilodontaidae	*Euchelus atratus* <10mm																					
	Conidae	Conidae																					
		Conus arenatus																					
		Conus coronatus																					
	Costellariidae	*Vexillum rugosum*																					
	Cymatiidae	Cymatiidae																					
	Cypraeidae	Cypraeidae																					

			XU																				
Class	**Family**	**Taxon**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**	**127**
	Ellobiidae	*Ellobium* spp.	1		1			1			1	1										1	1
		Ellobium aurisjudae																					
	Fissurellidae	*Hemitoma* spp. <10mm													1					1		1	
	Littorinidae	*Littoraria* spp.																					
		Littoraria spp. <10mm																					
		Littoraria filosa																					
		Littoraria scabra			1								1			1							
	Lottiidae	Lottiidae											1										
	Mitridae	*Mitra* sp.																					
		Mitridae																					
	Muricidae	*Chicoreus* spp.																					
		Chicoreus capucinus																					
		Drupella margariticola																					
		Thais sp.																					
	Nacellidae	*Cellana rota*																	1				
	Nassariidae	*Nassarius* spp.																					
		Nassarius coronatus																					
		Nassarius crematus																					
		Nassarius distortus	1																				
		Nassarius olivaceus																1					
		Nassarius pullus																					
	Naticidae	Naticidae																					
		Mammilla sebae																					
		Notocochlis gualtieriana													1								
		Polinices mammilla																					
		Polinices peselephanti																					
	Neritidae	*Neripteron violaceum*																					
		Nerita spp.		1					1		1			1		1				1		2	
		Nerita albicilla																					
		Nerita balteata																					
		Nerita chamaeleon	1												1								

			XU																				
Class	**Family**	**Taxon**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**	**127**
		Nerita costata																					
		Nerita planospira																					
		Nerita polita																					
		Nerita undata																					
	Olividae	Olividae																					
		Oliva annulata																					
		Oliva reticulata																					
		Oliva tricolor																					
	Patellidae	Patellidae																					
	Pisaniidae	*Cantharus* sp.																					
	Planaxidae	*Fissilabia decollata*																					
		Planaxis sulcatus																					
	Potamididae	Potamididae																					
		Cerithideopsis largillierti																					1
		Pirenella cingulata																					
		Telescopium telescopium																					
		Terebralia sulcata																					
	Strombidae	Strombidae																					
		Canarium labiatum																					
		Conomurex luhuanus																					
		Euprotomus aurisdianae																					
		Gibberulus gibberulus																					
		Laevistrombus canarium																					
		Lambis spp.																					
		Lambis lambis																					
	Tegulidae	Tegulidae																					
		Rochia nilotica																					
		Tectus fenestratus																					
	Tonnidae	*Tonna* sp.																					
	Trochidae	Trochidae				1							1										
	Turbinellidae	*Vasum* sp.																					

			XU																				
Class	**Family**	**Taxon**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**	**118**	**119**	**120**	**121**	**122**	**123**	**124**	**125**	**126**	**127**
	Turbinidae	Turbinidae				1						1											
		Lunella cinerea																					
		Turbo spp.																					
Total			**6**	**2**	**5**	**6**	**3**	**3**	**10**	**2**	**9**	**6**	**5**	**7**	**7**	**3**	**2**	**6**	**5**	**4**	**0**	**10**	**21**

			XU							
Class	**Family**	**Taxon**	**128**	**129**	**130**	**131**	**132**	**133**	**134**	**Total**
Bivalvia	Arcidae	Arcidae						2		**47**
		Arcidae <10mm								**2**
		Anadara antiquata								**495**
		Anadara rufescens								**7**
		Barbatia foliata		1				1		**36**
		Tegillarca granosa								**46**
	Cardiidae	Cardiidae								**17**
		Fragum spp.								**2**
		Fragum spp. <10mm	3		1			6	2	**59**
		Fragum unedo								**1**
		Hippopus hippopus								**3**
		Vasticardium flavum								**32**
	Chamidae	*Chama* spp.	1	1		2				**214**
	Cyrenidae	*Batissa violacea*								**56**
		Geloina expansa								**137**
	Glauconomidae	*Glauconome rugosa*								**2**
	Lucinidae	*Anodontia edentula*								**18**
		Austriella corrugata								**78**
	Mactridae	*Mactra* spp.								**7**
		Mactra cuneata								**85**
	Malleidae	*Malleus* spp.								**4**
	Mesodesmatidae	*Atactodea striata*								**538**
	Mytilidae	Mytilidae								**6**
		Septifer bilocularis								**11**
	Ostreidae	Ostreidae	1	4	3	4		8	4	**829**
	Placunidae	*Placuna* spp.								**26**
	Psammobiidae	*Asaphis violascens*								**15**
	Pteriidae	*Isognomon* spp.								**548**
		Pinctada spp.								**263**
	Spondylidae	*Spondylus* spp.								**5**
	Tellinidae	Tellinidae								**2**

			XU							
Class	**Family**	**Taxon**	**128**	**129**	**130**	**131**	**132**	**133**	**134**	**Total**
		Quidnipagus palatam								**6**
	Trapezidae	*Neotrapezium sublaevigatum*								**1**
	Veneridae	Veneridae								**7**
		Anomalodiscus squamosus								**10**
		Dosinia sp.								**1**
		Gafrarium spp.	2		1	3		1	3	**401**
		Gafrarium pectinatum								**31**
		Gafrarium tumidum								**198**
		Irus carditoides <10mm			1					**1**
		Marcia hiantina								**2**
		Periglypta puerpera								**6**
		Pitar pellucidus								**13**
		Protapes gallus								**18**
		Tapes literatus								**13**
		Venerupis aspera								**118**
Gastropoda	Amathinidae	*Amathina tricarinata*								**6**
	Angariidae	*Angaria delphinus*								**2**
	Architectonicidae	*Architectonica* sp. <10mm								**1**
	Bullidae	*Bulla* spp.								**2**
		Bulla ampulla				1			1	**9**
	Calliostomatidae	*Calliostoma* spp.			1	2		3	2	**39**
	Cerithiidae	Cerithiidae						1	1	**34**
		Cerithiidae <10mm								**12**
		Cerithium citrinum								**26**
		Cerithium coralium								**20**
		Cerithium echinatum								**3**
		Cerithium nodulosum								**1**
		Cerithium zonatum								**2**
		Clypeomorus batillariaeformis								**43**
	Chilodontaidae	*Euchelus atratus* <10mm								**7**
	Conidae	Conidae								**16**

			XU							
Class	**Family**	**Taxon**	**128**	**129**	**130**	**131**	**132**	**133**	**134**	**Total**
		Conus arenatus								**1**
		Conus coronatus								**1**
	Costellariidae	*Vexillum rugosum*								**2**
	Cymatiidae	Cymatiidae								**1**
	Cypraeidae	Cypraeidae			1			1		**5**
	Ellobiidae	*Ellobium* spp.								**98**
		Ellobium aurisjudae								**2**
	Fissurellidae	*Hemitoma* spp. <10mm								**33**
	Littorinidae	*Littoraria* spp.								**51**
		Littoraria spp. <10mm								**5**
		Littoraria filosa								**6**
		Littoraria scabra								**108**
	Lottiidae	Lottiidae		1						**6**
	Mitridae	*Mitra* sp.								**1**
		Mitridae								**1**
	Muricidae	*Chicoreus* spp.								**93**
		Chicoreus capucinus								**4**
		Drupella margariticola								**1**
		Thais sp.								**1**
	Nacellidae	*Cellana rota*								**1**
	Nassariidae	*Nassarius* spp.								**48**
		Nassarius coronatus								**2**
		Nassarius crematus								**13**
		Nassarius distortus								**12**
		Nassarius olivaceus								**36**
		Nassarius pullus								**3**
	Naticidae	Naticidae								**36**
		Mammilla sebae								**1**
		Notocochlis gualtieriana								**13**
		Polinices mammilla								**138**
		Polinices peselephanti								**4**

			XU							
Class	**Family**	**Taxon**	**128**	**129**	**130**	**131**	**132**	**133**	**134**	**Total**
	Neritidae	*Neripteron violaceum*								**4**
		Nerita spp.	1			3		5	6	**222**
		Nerita albicilla		1		1		1		**72**
		Nerita balteata								**30**
		Nerita chamaeleon								**53**
		Nerita costata								**8**
		Nerita planospira								**54**
		Nerita polita								**41**
		Nerita undata								**21**
	Olividae	Olividae								**22**
		Oliva annulata								**1**
		Oliva reticulata								**1**
		Oliva tricolor								**1**
	Patellidae	Patellidae								**2**
	Pisaniidae	*Cantharus* sp.								**1**
	Planaxidae	*Fissilabia decollata*								**2**
		Planaxis sulcatus								**49**
	Potamididae	Potamididae								**3**
		Cerithideopsis largillierti								**227**
		Pirenella cingulata								**2**
		Telescopium telescopium								**127**
		Terebralia sulcata								**84**
	Strombidae	Strombidae								**48**
		Canarium labiatum								**2**
		Conomurex luhuanus								**322**
		Euprotomus aurisdianae								**1**
		Gibberulus gibberulus								**14**
		Laevistrombus canarium								**70**
		Lambis spp.								**52**
		Lambis lambis								**24**
	Tegulidae	Tegulidae								**3**

			XU							
Class	**Family**	**Taxon**	**128**	**129**	**130**	**131**	**132**	**133**	**134**	**Total**
		Rochia nilotica								**2**
		Tectus fenestratus							1	**15**
	Tonnidae	*Tonna* sp.								**1**
	Trochidae	Trochidae								**6**
	Turbinellidae	*Vasum* sp.								**2**
	Turbinidae	Turbinidae								**22**
		Lunella cinerea						1		**32**
		Turbo spp.								**11**
Total			**8**	**8**	**8**	**16**	**0**	**30**	**20**	**7021**

Appendix G.

Non-molluscan Faunal Remains by Weight per XU, Tanamu 1 Square A

Occurrence of major categories of non-molluscan faunal remains by weight for each XU in Square A.
Sub-totals are provided by Stratigraphic Unit (SU) along with a grand total.

XU	SU	Vertebrate bone (g)									Avian eggshell (g)	Invertebrate exoskeleton (g)		
		Fish	Squamate	Turtle	Crocodile	Terrestrial Mammal	Dugong	Bird	Taxon unidentified	All vertebrates		Cuttlefish	Crab	Urchin
1	1B					0.02				0.02			0.37	
2	1B	0.01				0.49				0.5			0.01	
3	1B	0.19	0.04			3.56				3.79				
4	1B	3.76	0.07			8.27				12.1				
5	1B	5.71	0.04			11.5				17.25				0.04
6	1B	0.72	0.2			3.65				4.57			0.01	
Total SU1B		10.39	0.35	0	0	27.49	0	0	0	38.23	0	0	0.39	0.04
7	1A	0.56	0.01			3.24				3.81				0.41
8	1A	0.87	0.07			5.99				6.93				
9	1A	0.11	0.115	0.055		1.535				1.815				
10	1A	0.11	0.115	0.055		1.535				1.815				
Total SU1A		1.65	0.31	0.11	0	12.3	0	0	0	14.37	0	0	0	0.41
11	2–4	0.41	0.02			0.82				1.25				
12	2–4	0	0.12			3.85				3.97				
13	2–4	0.25	0.01			2.6				2.86				
14	2–4	0.81	0.07			3.83				4.71				
15	2–4	0.69	0.01	1.1		6.7				8.5				
16	2–4	0.71				3.07				3.78				
17	2–4	0.12				0.16				0.28				

XU	SU	Vertebrate bone (g)									Avian eggshell (g)	Invertebrate exoskeleton (g)		
		Fish	Squamate	Turtle	Crocodile	Terrestrial Mammal	Dugong	Bird	Taxon unidentified	All vertebrates		Cuttlefish	Crab	Urchin
18	2–4	0.55	0.01			1.88				2.44				
19	2–4	0.56	0.05			1.36				1.97				
20	2–4	0.94				2.22				3.16				
21	2–4	0.28	0.07			3.28				3.63				
22	2–4	0.85				1.83				2.68				
23	2–4	0.47	0.05	0.28		3.92				4.72				
24	2–4	1.25	0.03	0.45		4.8				6.53				
25	2–4	0.39	0.01		0.76	3.47				4.63				
26	2–4	1.45	0.06	0.03		3.07				4.61			0.02	0.05
27	2–4	0.71		0.16		2.45				3.32				0.06
28	2–4	0.11		0.12		2.53				2.76				
29	2–4	0.33		0.06		2.24				2.63			0.47	0.27
30	2–4	0.78	0.04	0.91		2.37				4.1			0.34	0.12
31	2–4	0.56	0.02	0.37		2.05				3			0.21	0.09
32	2–4	0.1	0.08	0.8		3.01				3.99			0.02	0.2
33	2–4	0.41				0.66				1.07			0.55	0.14
34	2–4	0.69				0.77				1.46			0.61	0.11
35	2–4	0.84	0.37	0.27		3.13				4.61			0.32	0.62
36	2–4	0.34				0.53		0.08		0.95			0.81	0.06
37	2–4	0.42				0.84				1.26			0.33	0.26
38	2–4	0.24				0.26				0.5			0.22	0.03
39	2–4	0.24				0.49				0.73			0.24	0.01
40	2–4	0.45		0.26		3.52				4.23			0.32	0.01
41	2–4	0.97	0.35			3.39				4.71			0.23	0.2
42	2–4	0.49				4.48				4.97			2.85	0.07
43	2–4	0.83		0.41		1.58				2.82			0.21	

XU	SU	Vertebrate bone (g)									Avian eggshell (g)	Invertebrate exoskeleton (g)		
		Fish	Squamate	Turtle	Crocodile	Terrestrial Mammal	Dugong	Bird	Taxon unidentified	All vertebrates		Cuttlefish	Crab	Urchin
44	2–4	1.16		0.22	0.84	2.42				4.64			0.27	0.02
45	2–4	0.74				1.01				1.75			0.14	
Total SU2–SU4		20.14	1.37	5.44	1.6	84.59	0	0.08	0	113.22	0	0	8.16	2.32
46	4/5	1.89				1.32				3.21			0.79	0.19
47	4/5	0.46				2.76				3.22			0.16	
48	4/5	3.08	0.04	0.53		5.68				9.33			1.78	0.01
49	4/5	2.83		1.55		2.68				7.06			1.87	0.06
50	4/5	2.39		0.76		3.87				7.02			0.68	
Total SU4/SU5		10.65	0.04	2.84	0	16.31	0	0	0	29.84	0	0	5.28	0.26
51	5	1.8		1.98		5.67				9.45			0.4	
52	5	3.01	0.05	12.92		9.98	50.2			76.16			1.73	
53	5	6.38	0.91	18.3		13.17				38.76			3.71	
54	5	3.43	1.52	2.76		7.47				15.18			8.25	
55	5	5.4		9.25		7.85				22.5			3.95	
56	5	7.31	0.11	9.26		6.96				23.64			3.18	
57	5	6.74	0.05	6.57		5.03				18.39			1.15	
58	5	6.51	0.03	26.21		6.83				39.58			2.23	
59	5	11.93	0.3	56.92		5.41				74.56			15.43	
60	5	2.6	0.26	2.26		3.32				8.44			3.25	
61	5	15.95	0.05	7.37		6.6				29.97			7.17	
62	5	17.64		12.52		2.64	7.6			40.4			0.25	
63	5	19.14		15.09		5.24				39.47			10.63	
64	5	11.71	0.05	13.95		4.81				30.52			30.51	
65	5	7.95	0.07	8.99		5.36				22.37			16.05	
66	5	12.64	0.32	22.14		13.47				48.57			101.43	
67	5	5.93		0.12		2.11				8.16			28.54	

XU	SU	Vertebrate bone (g)									Avian eggshell (g)	Invertebrate exoskeleton (g)		
		Fish	Squamate	Turtle	Crocodile	Terrestrial Mammal	Dugong	Bird	Taxon unidentified	All vertebrates		Cuttlefish	Crab	Urchin
68	5	0.31								0.31			2.3	
69	5	5.68		0.04		2.01				7.73			7.7	
70	5	6.2	0.08	0.02						6.3			7.25	
71	5	2.22				1.53				3.75			2.63	
72	5	4.7		0.17		0.91				5.78			3.3	
73	5	5.8		0.92		0.05				6.77			8.85	
74	5	5.49	0.04							5.53			5.95	
75	5	2.86	0.05	0.11		1.88	15.25			20.15			3.24	
Total SU5		179.33	3.89	227.87	0	118.3	73.05	0	0	602.44	0	0	279.08	0
76	6	2.85				1.49				4.34			3.7	
77	6	1.7		0.29		1.07				3.06			2.18	
78	6	3.11								3.11			4.29	
79	6	1.09								1.09				
80	6	1.99				0.27				2.26				
81	6	2.65								2.65				
82	6	1.82								1.82				
83	6	5.86								5.86			3.68	
84	6	2.28								2.28			4.15	
85	6	5.48								5.48			0.99	
86	6	6.46	0.46			0.02				6.94			1.41	
87	6	9.03	0.58							9.61		1.65	3.03	
88	6	3.44								3.44			5.02	
89	6	2.33								2.33			2.8	
90	6	2.02		1.37						3.39		0.11	4.21	
91	6	1.24								1.24		0.58	3.22	
92	6	3.18								3.18			2.14	

XU	SU	Vertebrate bone (g)									Avian eggshell (g)	Invertebrate exoskeleton (g)		
		Fish	Squamate	Turtle	Crocodile	Terrestrial Mammal	Dugong	Bird	Taxon unidentified	All vertebrates		Cuttlefish	Crab	Urchin
93	6	0.78								0.78			0.65	
94	6	0.48								0.48			0.17	
95	6	0.3	0.01							0.31			0.31	0.06
96	6	0.52				0.07				0.59			0.6	
97	6	0.89								0.89			0.06	
98	6	0.77								0.77			0.91	
99	6	1.47				0.32				1.79			3.14	
100	6	2.68								2.68			0.35	
101	6	1.4								1.4			1.4	
102	6	2.24								2.24			4.53	
103	6	1.35								1.35			8.03	
104	6	2.24				0.98				3.22			4.01	
105	6	1.87								1.87			0.9	0.02
106	6	1.89				0.1				1.99			3.17	
107	6	3.68								3.68			2.28	
108	6	2.61								2.61			2.25	
109	6	1.31								1.31			1.12	
110	6	4.03								4.03			0.53	
111	6	3.06								3.06			0.95	
112	6	0.41								0.41			1.4	
113	6	1.55								1.55			2.06	
Total SU6		92.06	1.05	1.66	0	4.32	0	0	0	99.09	0	2.34	79.64	0.08
114	7	0.51								0.51			0.9	
115	7	0.53								0.53			4	
116	7	0.26								0.26			8.72	
117	7	1.13								1.13			4.64	

XU	SU	Vertebrate bone (g)									Avian eggshell (g)	Invertebrate exoskeleton (g)		
		Fish	Squamate	Turtle	Crocodile	Terrestrial Mammal	Dugong	Bird	Taxon unidentified	All vertebrates		Cuttlefish	Crab	Urchin
118	7	1.18								1.18			6.2	
119	7	0.16								0.16			1.18	
120	7	0.58								0.58			0.19	
121	7	0.31								0.31			0.16	
122	7	0.07								0.07			0.39	
123	7	0.19								0.19			0.93	
124	7	0.02								0.02			0.03	
125	7	0.01								0.01				
126	7	0.25								0.25			0.31	
127	7	0.05								0.05			0.74	
128	7	0.08								0.08			1.27	
129	7	0.05								0.05			0.3	
130	7												1.01	
131	7					0.46				0.46			1.44	
132	7												1.29	
133	7												1.04	
134	7					0.53				0.53			2.74	
Total SU7		5.38	0	0	0	0.99	0	0	0	6.37	0	0	37.48	0
Total all SUs		**319.6**	**7.01**	**237.92**	**1.6**	**264.3**	**73.05**	**0.08**	**0**	**903.56**	**0**	**2.34**	**410.03**	**3.11**

Appendix H.

Non-molluscan Faunal Remains by Weight per XU, Tanamu 1 Square B

Occurrence of major categories of non-molluscan faunal remains by weight for each XU in Square B.
Sub-totals are provided by Stratigraphic Unit (SU) along with a grand total.

XU	SU	Vertebrate bone (g)									Avian eggshell	Invertebrate exoskeleton (g)		
		Fish	Squamate	Turtle	Crocodile	Terrestrial Mammal	Dugong	Bird	Taxon unidentified	All vertebrates		Cuttlefish	Crab	Urchin
1	1B	0.21								0.21			0.82	
2	1B	0.02								0.02				
3	1B	2.01	0.04	0.65		12.17				14.87			1.87	
4	1B	6.22	0.15	0.28		18.4				25.05			5.5	
5	1B	6.18	1.09			25.92				33.19			0.81	
6	1B													
Total SU1B		14.64	1.28	0.93	0	56.49	0	0	0	73.34	0	0	9	0
7	1A	0.82	0.05	1.12		0.99				2.98				
8	1A		0.05			3.74				3.79				
9	1A	0.37				0.37				0.74				
10	1A	0.25				1.42				1.67				
Total SU1A		1.44	0.1	1.12	0	6.52	0	0	0	9.18	0	0	0	0
11	2–4	0.33		0.23		1.36				1.92				
12	2–4	1.13	0.04			1.18				2.35				
13	2–4	0.41	0.03			2.35				2.79				
14	2–4	1.19	0.01	0.75		2.44				4.39				
15	2–4	1.5		0.12		4.97				6.59				
16	2–4	3.58	0.03	0.08		5.22				8.91				
17	2–4	1.21		0.91		1.79			0.2	4.11				
18	2–4	1.58	0.02			1.27		0.16	0.06	3.09				

XU	SU	Vertebrate bone (g)									Avian eggshell	Invertebrate exoskeleton (g)		
		Fish	Squamate	Turtle	Crocodile	Terrestrial Mammal	Dugong	Bird	Taxon unidentified	All vertebrates		Cuttlefish	Crab	Urchin
19	2–4	1.85	0.04	0.63		3.67		0.34		6.53				
20	2–4	2.65	0.18	0.09		3.02				5.94				
21	2–4	2.58		0.21		2.05				4.84				
22	2–4	2.2		3.16		2.46				7.82				
23	2–4	4.14	0.01	0.45		1.63				6.23				
24	2–4	3.51	0.04	0.18		2.83				6.56				
25	2–4	5.07		0.07		4.73				9.87			1.02	0.14
26	2–4	2.47		0.19		2.71				5.37			0.04	
27	2–4	2.57		0.16		0.58				3.31				
28	2–4	2.14	0.02			1.88				4.04			0.21	
29	2–4	3.38				1.29				4.67			0.78	
30	2–4	2.86		1.15		0.63				4.64				0.13
31	2–4	0.16		0.27		1				1.43			0.24	0.01
32	2–4	1		1.3		0.98				3.28				0.37
33	2–4	0.72		0.25		21.19				22.16				0.02
34	2–4	0.11	0.02			1.77				1.9				0.02
35	2–4	0.84				0.63				1.47			0.06	0.04
36	2–4	0.49				1.94				2.43			0.02	
37	2–4	0.76	1.46			0.97				3.19			0.43	0.01
38	2–4	2.75		0.46		0.91				4.12			0.01	0.01
39	2–4	1.55		0.1		0.41				2.06			0.06	0.09
40	2–4	2.28		0.48		0.48				3.24			1.42	0.02
41	2–4	3.81	0.05	0.63		1.01				5.5			0.01	0.13
42	2–4	4.2	0.06	0.17		1.36				5.79			0.72	
43	2–4	0.4		0.05		1.14				1.59			0.7	0.16
44	2–4	9.87		1.86		1.56				13.29			0.55	
45	2–4	3.09		6.27		1.04				10.4			0.05	0.01

XU	SU	Vertebrate bone (g)									Avian eggshell	Invertebrate exoskeleton (g)		
		Fish	Squamate	Turtle	Crocodile	Terrestrial Mammal	Dugong	Bird	Taxon unidentified	All vertebrates		Cuttlefish	Crab	Urchin
Total SU2–SU4		78.38	2.01	20.22	0	84.45	0	0.5	0.26	185.82	0	0	6.32	1.16
46	4/5	10.54		1.67		0.61				12.82			0.13	0.04
47	4/5	2.39		3.05		2.32				7.76			2.89	
48	4/5													
Total SU4/SU5		12.93	0	4.72	0	2.93	0	0	0	20.58	0	0	3.02	0.04
49	5	3.76	0.08	3.98		0.47				8.29			0.81	
50	5	4.13	0.01	8.11		1.16				13.41			3.47	
51	5	10.41	0.04	0.96		4.04				15.45			0.71	
52	5	5.08	0.18	3.05		2.39				10.7			1.15	
53	5	5.86		26.28		2.18				34.32			1.45	
54	5	7.42		13.22		1.46				22.1			0.61	
55	5	4.35	0.11	5.88		2.41	36.03			48.78			0.75	
56	5	14.38		2.58		0.37				17.33			1.97	0.1
57	5	11.48	0.06	27.79		1.55				40.88			5.28	0.03
58	5	9.37	0.01	2.79		2.56				14.73			4.22	
59	5	9.78		1.64		0.38				11.8			1.04	
60	5	13.97		5.87		0.5				20.34			3.31	
61	5	8.97				0.13	24.83			33.93			28.44	
62	5	87.15	0.3	123.71		27.16				238.32			18.16	
63	5	85.11	0.1	250.83		7.32			20.44	363.8			12.56	
64	5	49.89	0.04	27.51		4.06				81.5			23.37	
65	5	14.27	0.63	96.32		4.12				115.34			53.44	
66	5	57.42	0.15	36.8		2.81	214.67		1.22	313.07			21.22	
67	5	14		1.3		3.4				18.7			51.89	0.01
68	5	4.25	0.01	1.65		0.38				6.29			10.36	0.39
69	5	6.46	0.01	0.21		0.21				6.89			12.13	
70	5	12.74	0.08	0.71		0.15				13.68			16.54	

XU	SU	Vertebrate bone (g)									Avian eggshell	Invertebrate exoskeleton (g)		
		Fish	Squamate	Turtle	Crocodile	Terrestrial Mammal	Dugong	Bird	Taxon unidentified	All vertebrates		Cuttlefish	Crab	Urchin
71	5	9.65		0.61		0.15				10.41			10.48	
72	5	5		0.26		0.12				5.38			6.71	
73	5	3.38	0.01			0.1				3.49			7.45	
74	5	0.07	0.01	2.52		2.19				4.79			6.45	
75	5	3.21				0.68				3.89			2.19	
Total SU5		461.56	1.83	644.58	0	72.45	275.53	0	21.66	1477.61	0	0	306.16	0.53
76	6	3.49		1.43						4.92			3.03	
77	6	1.86							0.32	2.18			2.12	
78	6	3.21				0.37				3.58			2.43	
79	6	1.55				0.08				1.63			6.17	
80	6	1.22								1.22			1.22	
81	6	3.94	0.07	0.18						4.19	0.06		4.85	
82	6	4.48								4.48			3.53	
83	6	2.14				0.11				2.25			1.66	
84	6	4.36								4.36			3.81	
85	6	2.8								2.8			6.17	
86	6	2.1		1.07						3.17			5.32	
87	6	4.46								4.46			3.69	
88	6	1.9								1.9			4.4	
89	6	2.01								2.01			2.78	
90	6	3.29								3.29			5.42	
91	6	0.56								0.56			3.97	
92	6	1.94				0.49				2.43			1.68	
93	6	0.73				0.21				0.94			3.15	
94	6	0.29								0.29			0.26	
95	6	1.53				0.45				1.98			0.75	
96	6	1.82								1.82			0.05	

XU	SU	Vertebrate bone (g)									Avian eggshell	Invertebrate exoskeleton (g)		
		Fish	Squamate	Turtle	Crocodile	Terrestrial Mammal	Dugong	Bird	Taxon unidentified	All vertebrates		Cuttlefish	Crab	Urchin
97	6	2.65								2.65			1.65	0.04
98	6	3		0.09		0.1				3.19			4.15	0.02
99	6	2.15	0.13							2.28			0.39	
100	6	1.84				0.78				2.62			1.72	
101	6	2.31				0.52				2.83			0.14	
102	6	3.41		0.13						3.54			0.85	
103	6	3.02								3.02			1.25	
104	6	1.65								1.65		5.27	0.89	0.01
105	6	1.88								1.88			1.05	
106	6	0.89								0.89			1.54	
107	6	1.49								1.49		0.29	2.08	
108	6	0.29								0.29			0.59	
109	6	0.57		0.11						0.68			0.39	
110	6	0.33								0.33				
111	6	1.81								1.81			1.65	
112	6	0.2								0.2			1.27	
113	6	0.1								0.1			0.95	
Total SU6		77.27	0.2	3.01	0	3.11	0	0	0.32	83.91	0.06	5.56	87.02	0.07
114	7	0.11								0.11				
115	7	0.13								0.13			2.15	
116	7	1.69								1.69			2.02	
117	7	0.44								0.44			0.43	
118	7	0.01								0.01				
119	7	0.4								0.4			1.96	
120	7	0.02								0.02			0.65	
121	7	0.09								0.09				
122	7	0.13								0.13			0.04	

XU	SU	Vertebrate bone (g)									Avian eggshell	Invertebrate exoskeleton (g)		
		Fish	Squamate	Turtle	Crocodile	Terrestrial Mammal	Dugong	Bird	Taxon unidentified	All vertebrates		Cuttlefish	Crab	Urchin
123	7	0.09								0.09			1.2	
124	7	0.16								0.16				
125	7													
126	7	0.06								0.06			0.47	
127	7	0.11								0.11			0.1	
128	7	0.01								0.01			2.46	
129	7												1.19	
130	7												0.81	
131	7												3.11	
132	7													
133	7												0.72	
134	7												1.16	
Total SU7		**3.45**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3.45**	**0**	**0**	**18.47**	**0**
Total all SUs		**1295.89**	**10.84**	**1349.16**	**0**	**451.9**	**551.06**	**1**	**44.48**	**3704.33**	**0.12**	**5.56**	**429.99**	**1.8**

Appendix I.

Representation of Burning Categories in Bone by Weight, Tanamu 1 Square A

Representation of the three burning categories (U = unburnt; B = burnt; C = calcined) for each of the major classes of vertebrate remains, by weight for each XU in Square A. Sub-totals are provided by SU along with a grand total.

XU	SU	Fish			Turtle			Squamate			Croco-dile	Terrestrial mammal			Dugong	Bird	All vertebrate bone (g)		
		U	B	C	U	B	C	U	B	C	U	U	B	C	U	U	U	B	C
1	1B											0.02					0.02		
2	1B	0.01										0.4		0.09			0.41		0.09
3	1B	0.09	0.1						0.04			2.35	1.21				2.44	1.35	
4	1B	3.48	0.28					0.07				7.97	0.28	0.02			11.52	0.56	0.02
5	1B	5.17	0.54					0.04				9.83	1.67				15.04	2.21	
6	1B	0.6	0.05	0.07				0.16	0.04			3.35	0.26	0.04			4.11	0.35	0.11
Total SU1B		9.35	0.97	0.07	0	0	0	0.27	0.08	0	0	23.92	3.42	0.15	0	0	33.54	4.47	0.22
7	1A	0.41	0.14	0.01				0.01				2.92	0.16	0.16			3.34	0.3	0.17
8	1A	0.6	0.27					0.07				4.78	0.56	0.65			5.45	0.83	0.65
9	1A	0.08	0.03		0.05			0.11				1.05	0.45	0.03			1.29	0.48	0.03
10	1A	0.07	0.04		0.06			0.12				1.05	0.45	0.04			1.30	0.49	0.04
Total SU1A		1.16	0.48	0.01	0.11	0	0	0.31	0	0	0	9.8	1.62	0.88	0	0	11.38	2.1	0.89
11	2–4	0.24	0.07	0.1				0.01	0.01			0.72	0.05	0.05			0.97	0.13	0.15
12	2–4	0						0.12				2.64	1	0.21			2.76	1	0.21
13	2–4	0.25						0.01				2.36	0.2	0.04			2.62	0.2	0.04
14	2–4	0.55	0.17	0.09				0.07				3.03	0.44	0.36			3.65	0.61	0.45
15	2–4	0.6	0.08	0.01	0.57		0.53			0.01		5.78	0.86	0.06			6.95	0.94	0.61
16	2–4	0.35	0.29	0.07								2.21	0.65	0.21			2.56	0.94	0.28
17	2–4	0.1	0.02									0.16					0.26	0.02	
18	2–4	0.34	0.16	0.05				0.01				1.16	0.22	0.5			1.51	0.38	0.55

XU	SU	Fish			Turtle			Squamate			Croco-dile	Terrestrial mammal			Dugong	Bird	All vertebrate bone (g)		
		U	B	C	U	B	C	U	B	C	U	U	B	C	U	U	U	B	C
19	2–4	0.44	0.11	0.01				0.05				0.99	0.27	0.1			1.48	0.38	0.11
20	2–4	0.73	0.19	0.02								1.71	0.51				2.44	0.7	0.02
21	2–4	0.15	0.11	0.02				0.06	0.01			1.97	1.29	0.02			2.18	1.41	0.04
22	2–4	0.27	0.3	0.28								0.86	0.89	0.08			1.13	1.19	0.36
23	2–4	0.27	0.2		0.28			0.05				2.99	0.93				3.59	1.13	
24	2–4	0.55	0.65	0.05		0.45			0.03			3.65	1.11	0.04			4.2	2.24	0.09
25	2–4	0.3	0.08	0.01				0.01			0.76	2.69	0.54	0.24			3.76	0.62	0.25
26	2–4	1.43	0.01	0.01	0.03			0.06				2.33	0.56	0.18			3.85	0.57	0.19
27	2–4	0.21	0.48	0.02	0.16							1.41	0.81	0.23			1.78	1.29	0.25
28	2–4	0.09	0.02		0.12							2.1	0.34	0.09			2.31	0.36	0.09
29	2–4	0.05	0.28		0.06							0.88	1.33	0.03			0.99	1.61	0.03
30	2–4	0.65	0.13		0.91				0.04			2	0.21	0.16			3.56	0.38	0.16
31	2–4	0.46	0.08	0.02	0.37				0.02			1.37	0.68				2.2	0.78	0.02
32	2–4	0.09	0.01		0.76	0.04			0.08			1.54	1.4	0.07			2.39	1.53	0.07
33	2–4	0.26	0.15									0.64	0.02				0.9	0.17	
34	2–4	0.55	0.14									0.67	0.1				1.22	0.24	
35	2–4	0.55	0.29		0.27			0.35	0.02			2.51	0.61	0.01			3.68	0.92	0.01
36	2–4	0.31	0.03									0.51	0.01	0.01		0.08	0.9	0.04	0.01
37	2–4	0.39	0.03									0.78	0.06				1.17	0.09	
38	2–4	0.17	0.07									0.25		0.01			0.42	0.07	0.01
39	2–4	0.19	0.05									0.08	0.21	0.2			0.27	0.26	0.2
40	2–4	0.29	0.16		0.26							3.46	0.06				4.01	0.22	
41	2–4	0.53	0.42	0.02					0.35			3.15	0.2	0.04			3.68	0.97	0.06
42	2–4	0.45	0.03	0.01								4.3	0.15	0.03			4.75	0.18	0.04
43	2–4	0.52	0.31		0.41							1.51	0.07				2.44	0.38	
44	2–4	0.47	0.69		0.22						0.84	2.29	0.13				3.82	0.82	
45	2–4	0.66	0.08									0.82	0.19				1.48	0.27	

XU	SU	Fish			Turtle			Squamate			Croco-dile	Terrestrial mammal			Dugong	Bird	All vertebrate bone (g)		
		U	B	C	U	B	C	U	B	C	U	U	B	C	U	U	U	B	C
Total SU2–SU4		13.46	5.89	0.79	4.42	0.49	0.53	0.8	0.56	0.01	1.6	65.52	16.1	2.97	0	0.08	85.88	23.04	4.3
46	4/5	1.66	0.22	0.01								1.31	0.01				2.97	0.23	0.01
47	4/5	0.37	0.09									2.76					3.13	0.09	
48	4/5	2.3	0.77	0.01	0.53			0.04				4.99	0.69				7.86	1.46	0.01
49	4/5	2.09	0.5	0.24	1.55							2.5	0.18				6.14	0.68	0.24
50	4/5	2.38	0.01		0.76							3.71	0.11	0.05			6.85	0.12	0.05
Total SU4/SU5		8.8	1.59	0.26	2.84	0	0	0.04	0	0	0	15.27	0.99	0.05	0	0	26.95	2.58	0.31
51	5	1.52	0.25	0.03	1.72	0.26		0				4.64	1.03				7.88	1.54	0.03
52	5	2.34	0.62	0.05	12.92			0	0.05			9.71	0.24	0.03	50.2		75.17	0.91	0.08
53	5	5.7	0.67	0.01	17.62	0.68		0.91				13.15		0.02			37.38	1.35	0.03
54	5	2.82	0.43	0.18	2.76			1.52				7.47					14.57	0.43	0.18
55	5	3.92	1.12	0.36	9.23	0.02		0				7.15	0.62	0.08			20.3	1.76	0.44
56	5	6.65	0.65	0.01	9.26			0.11				6.07	0.89				22.09	1.54	0.01
57	5	5.84	0.9		6.57			0.05				5.03					17.49	0.9	
58	5	5.68	0.59	0.24	23.1	3.11		0.03				5.88	0.7	0.25			34.69	4.4	0.49
59	5	10.78	1.04	0.11	56.92			0.3				5.21	0.2				73.21	1.24	0.11
60	5	2	0.58	0.02	2.26			0.26				2.73	0.59				7.25	1.17	0.02
61	5	14.44	1.46	0.05	6.88	0.49		0.05				5.96	0.64				27.33	2.59	0.05
62	5	16.95	0.61	0.08	12.04	0.48						2.11	0.53		7.6		38.7	1.62	0.08
63	5	18.06	1.05	0.03	14.95	0.14						4.12	1.12				37.13	2.31	0.03
64	5	10.77	0.94		13.95			0.01	0.04			4.44	0.37				29.17	1.35	
65	5	6.57	1.33	0.05	8.99			0.07				3.99	1.37				19.62	2.7	0.05
66	5	10.82	1.77	0.05	22.14			0.32				12.69	0.71	0.07			45.97	2.48	0.12
67	5	4.94	0.9	0.09		0.12						2.11					7.05	1.02	0.09
68	5	0.31															0.31		
69	5	4.51	1.14	0.03	0.04							2.01					6.56	1.14	0.03
70	5	5.15	1.03	0.02	0.02			0.08									5.25	1.03	0.02

XU	SU	Fish			Turtle			Squamate			Croco-dile	Terrestrial mammal			Dugong	Bird	All vertebrate bone (g)		
		U	B	C	U	B	C	U	B	C	U	U	B	C	U	U	U	B	C
71	5	1.92	0.29	0.01								1.53					3.45	0.29	0.01
72	5	4.37	0.3	0.03	0.17							0.82	0.09				5.36	0.39	0.03
73	5	5.3	0.49	0.01	0.92							0.05					6.27	0.49	0.01
74	5	4.98	0.45	0.06				0.01		0.03							4.99	0.45	0.09
75	5	1.58	1.19	0.09		0.11		0.02	0.03			0.93	0.95		15.25		17.78	2.28	0.09
Total SU5		157.92	19.8	1.61	222.46	5.41	0	3.74	0.12	0.03	0	107.8	10.05	0.45	73.05	0	564.97	35.38	2.09
76	6	1.31	1.37	0.17								1.16	0.33				2.47	1.7	0.17
77	6	0.9	0.78	0.02		0.29						1.02		0.05			1.92	1.07	0.07
78	6	1.38	1.54	0.19													1.38	1.54	0.19
79	6	0.52	0.56	0.01													0.52	0.56	0.01
80	6	1.26	0.64	0.09								0.22	0.05				1.48	0.69	0.09
81	6	1.21	1.08	0.36													1.21	1.08	0.36
82	6	0.49	1.29	0.04													0.49	1.29	0.04
83	6	4.8	0.79	0.27													4.8	0.79	0.27
84	6	0.88	1.39	0.01													0.88	1.39	0.01
85	6	1.17	3.91	0.4													1.17	3.91	0.4
86	6	0	2.1	4.36				0.46				0.01		0.01			0.47	2.1	4.37
87	6	0	3.52	5.51				0.58									0.58	3.52	5.51
88	6	1.52	1.76	0.16													1.52	1.76	0.16
89	6	0.86	1.26	0.21													0.86	1.26	0.21
90	6	0.67	1.22	0.13	1.06	0.31											1.73	1.53	0.13
91	6	0.41	0.79	0.04													0.41	0.79	0.04
92	6	2.85	0.28	0.05													2.85	0.28	0.05
93	6	0.52	0.23	0.03													0.52	0.23	0.03
94	6	0.26	0.19	0.03													0.26	0.19	0.03
95	6	0.1	0.14	0.06				0.01									0.11	0.14	0.06
96	6	0.37	0.1	0.05								0.05	0.02				0.42	0.12	0.05

XU	SU	Fish			Turtle			Squamate			Croco-dile	Terrestrial mammal			Dugong	Bird	All vertebrate bone (g)		
		U	B	C	U	B	C	U	B	C	U	U	B	C	U	U	U	B	C
97	6	0.76	0.1	0.03													0.76	0.1	0.03
98	6	0.35	0.4	0.02													0.35	0.4	0.02
99	6	1.18	0.25	0.04								0.32					1.5	0.25	0.04
100	6	1.76	0.9	0.02													1.76	0.9	0.02
101	6	0.62	0.57	0.21													0.62	0.57	0.21
102	6	0.91	1.2	0.13													0.91	1.2	0.13
103	6	0.6	0.67	0.08													0.6	0.67	0.08
104	6	1.33	0.6	0.31									0.98				1.33	1.58	0.31
105	6	1.12	0.52	0.23													1.12	0.52	0.23
106	6	0.88	0.88	0.13									0.1				0.88	0.98	0.13
107	6	2.49	1.05	0.14													2.49	1.05	0.14
108	6	0.66	1.68	0.27													0.66	1.68	0.27
109	6	0.64	0.58	0.09													0.64	0.58	0.09
110	6	3.17	0.73	0.13													3.17	0.73	0.13
111	6	2	0.98	0.08													2	0.98	0.08
112	6	0.27	0.06	0.08													0.27	0.06	0.08
113	6	1.38	0.17														1.38	0.17	
Total SU6		41.6	36.28	14.18	1.06	0.6	0	1.05	0	0	0	2.78	1.48	0.06	0	0	46.49	38.36	14.24
114	7	0.45	0.06														0.45	0.06	
115	7	0.16	0.25	0.12													0.16	0.25	0.12
116	7	0.17	0.03	0.06													0.17	0.03	0.06
117	7	1.07	0.06														1.07	0.06	
118	7	0.25	0.83	0.1													0.25	0.83	0.1
119	7	0.16															0.16		
120	7	0.53	0.03	0.02													0.53	0.03	0.02
121	7	0.27		0.04													0.27		0.04
122	7	0.06		0.01													0.06		0.01

XU	SU	Fish			Turtle			Squamate			Croco-dile	Terrestrial mammal			Dugong	Bird	All vertebrate bone (g)		
		U	B	C	U	B	C	U	B	C	U	U	B	C	U	U	U	B	C
123	7	0	0.19															0.19	
124	7	0.02															0.02		
125	7	0.01															0.01		
126	7	0.25															0.25		
127	7	0	0.03	0.02														0.03	0.02
128	7	0	0.08															0.08	
129	7	0	0.05															0.05	
130	7	0																	
131	7	0										0.46					0.46		
132	7	0																	
133	7	0																	
134	7	0											0.53					0.53	
Total SU7		**3.4**	**1.61**	**0.37**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.46**	**0.53**	**0**	**0**	**0**	**3.86**	**2.14**	**0.37**
Total all SUs		**235.69**	**66.62**	**17.29**	**230.89**	**6.5**	**0.53**	**6.21**	**0.76**	**0.04**	**1.6**	**225.55**	**34.19**	**4.56**	**73.05**	**0.08**	**773.07**	**108.07**	**22.42**

Appendix J.

Terrestrial Vertebrate Taxa per XU, Tanamu 1 Squares A and B

Occurrence of identified terrestrial vertebrate taxa for each XU in Squares A and B. Sub-totals are provided by SU category along with a grand total. Values are NISPs.

Square A

XU	SU	Mammals												Reptiles						Bird	Summary values		
		Sus scrofa	Peramelidae indet.	*Isoodon macrourus*	*Echymipera* sp.	*Dorcopsis veterum*	*Thylogale brunii*	*Dorcopsis* or *Thylogale*	*Macropus agilis*	Macropodidae indet.	*Uromys* cf. *caudimaculatus*	*Rattus gestri*	Muridae indet. (small)	Agamidae	Varanidae	Boidae	Colubroidea	Serpentes indet.	Chelidae	Aves indet.	Number of taxa	NISP all	Terrestrial vertebrates bone (g)
1	1B																				0	0	0.02
2	1B																				0	0	0.49
3	1B															1					1	1	3.6
4	1B	1	1					3					2				1	1			6	9	8.34
5	1B	2	2	1				1	1	1			4	1				2			9	15	11.54
6	1B	1	1							2								3			4	7	3.85
Total SU1B		4	4	1	0	0	0	4	1	3	0	0	6	1	0	1	1	6	0	0	11	32	27.84
7	1A																	1			1	1	3.25
8	1A												3			1		1			3	5	6.06
9+10	1A								1				1					2	1		4	5	3.3
Total SU1A		0	0	0	0	0	0	0	1	0	0	0	4	0	0	1	0	4	1	0	5	11	12.61
11	2–4								2				3					2			3	7	0.84
12	2–4								4									1			2	5	3.97
13	2–4								1												1	1	2.61
14	2–4								2									2			2	4	3.9
15	2–4							3	2			1						1	2		5	9	6.71

XU	SU	Mammals											Reptiles						Bird	Summary values		
		Sus scrofa	Peramelidae indet.	*Isoodon macrourus*	*Echymipera* sp.	*Dorcopsis veterum*	*Thylogale brunii*	*Dorcopsis* or *Thylogale*	*Macropus agilis*	Macropodidae indet.	*Uromys* cf. *caudimaculatus*	*Rattus gestri*	Muridae indet. (small)	Agamidae	Varanidae	Boidae	Colubroidea	Serpentes indet.	Chelidae	Aves indet.	Number of taxa	NISP all	Terrestrial vertebrates bone (g)
16	2–4												1								1	1	3.07
17	2–4								1												1	1	0.16
18	2–4								2	1			1					1			4	5	1.89
19	2–4									1			1								2	2	1.41
20	2–4																				0	0	2.22
21	2–4								1									4			2	5	3.35
22	2–4								3												1	3	1.83
23	2–4								1	2			1					2	1		5	7	3.97
24	2–4									1			1					1	1		4	4	4.83
25	2–4								1					1					2		3	4	4.24
26	2–4												1		1						3	2	3.13
27	2–4								1												1	1	2.45
28	2–4		1																		1	1	2.53
29	2–4																		1		1	1	2.24
30	2–4		1															1	1		3	3	2.41
31	2–4								1								1				2	2	2.07
32	2–4																	2			1	2	3.09
33	2–4					1															1	1	0.66
34	2–4					1															1	1	0.77
35	2–4																	2			1	2	3.5
36	2–4																				0	0	0.61
37	2–4											1									1	1	0.84
38	2–4																				0	0	0.26

XU	SU	Mammals												Reptiles						Bird	Summary values		
		Sus scrofa	Peramelidae indet.	*Isoodon macrourus*	*Echymipera* sp.	*Dorcopsis veterum*	*Thylogale brunii*	*Dorcopsis* or *Thylogale*	*Macropus agilis*	Macropodidae indet.	*Uromys* cf. *caudimaculatus*	*Rattus gestri*	Muridae indet. (small)	Agamidae	Varanidae	Boidae	Colubroidea	Serpentes indet.	Chelidae	Aves indet.	Number of taxa	NISP all	Terrestrial vertebrates bone (g)
39	2–4							1			1										2	2	0.49
40	2–4												1								1	1	3.52
41	2–4									1						1					2	2	3.74
42	2–4									1			1								2	2	4.48
43	2–4																				0	0	1.58
44	2–4									1											1	1	3.26
45	2–4											1									1	1	1.01
Total SU2–SU4		0	2	0	0	2	0	4	22	8	1	3	11	1	1	1	1	19	8	0	14	84	87.64
46	4/5																				0	0	1.32
47	4/5					1															1	1	2.76
48	4/5																	1			1	1	5.72
49	4/5																				0	0	2.68
50	4/5				1					1			1								3	3	3.87
Total SU4/SU5		0	0	0	1	1	0	0	0	1	0	0	1	0	0	0	0	1	0	0	5	5	16.35
51	5		1						1	1											3	3	5.67
52	5							1	1									1			3	3	10.03
53	5				1		2			4								2			4	9	14.08
54	5							2	2									1			3	5	8.99
55	5			1		2		2													3	5	7.85
56	5							1	1									3			3	5	7.07
57	5							1										1			2	2	5.08
58	5		1										1					1			3	3	6.86
59	5					4			1	1					1			3			5	10	5.71

XU	SU	Mammals												Reptiles						Bird	Summary values		
		Sus scrofa	Peramelidae indet.	*Isoodon macrourus*	*Echymipera* sp.	*Dorcopsis veterum*	*Thylogale brunii*	*Dorcopsis* or *Thylogale*	*Macropus agilis*	Macropodidae indet.	*Uromys* cf. *caudimaculatus*	*Rattus gestri*	Muridae indet. (small)	Agamidae	Varanidae	Boidae	Colubroidea	Serpentes indet.	Chelidae	Aves indet.	Number of taxa	NISP all	Terrestrial vertebrates bone (g)
60	5							1		1					1						3	3	3.58
61	5									2								3			2	5	6.65
62	5			1		1				3											3	5	2.64
63	5								1												1	1	5.24
64	5																	1			1	1	4.86
65	5									5								1			2	6	5.43
66	5																				0	0	13.79
67	5																				0	0	2.11
68	5																				0	0	0
69	5							1													1	1	2.01
70	5																	1			1	1	0.08
71	5																				0	0	1.53
72	5									1											1	1	0.91
73	5							1													1	1	0.05
74	5															1		1			2	2	0.04
75	5							1						1		1		1	1		5	5	1.93
Total SU5		0	2	2	1	7	2	11	7	18	0	0	1	1	2	2	0	20	1	0	14	77	122.19
76	6								1	1											2	2	1.49
77	6									1											1	1	0
78	6																				0	0	0
79	6																				0	0	0
80	6							1													1	1	0.27
81	6																				0	0	0

		Mammals												Reptiles						Bird	Summary values		
XU	SU	*Sus scrofa*	Peramelidae indet.	*Isoodon macrourus*	*Echymipera* sp.	*Dorcopsis veterum*	*Thylogale brunii*	*Dorcopsis* or *Thylogale*	*Macropus agilis*	Macropodidae indet.	*Uromys* cf. *caudimaculatus*	*Rattus gestri*	Muridae indet. (small)	Agamidae	Varanidae	Boidae	Colubroidea	Serpentes indet.	Chelidae	Aves indet.	Number of taxa	NISP all	Terrestrial vertebrates bone (g)
82	6																				0	0	0
83	6																				0	0	0
84	6																				0	0	0
85	6																				0	0	0
86	6		1																		1	1	0.48
87	6																				0	0	0.58
88	6																				0	0	0
89	6																				0	0	0
90	6																				0	0	0
91	6																				0	0	0
92	6																				0	0	0
93	6																				0	0	0
94	6																				0	0	0
95	6																1				1	1	0.01
96	6																				0	0	0.07
97	6																				0	0	0
98	6																				0	0	0
99	6							1													1	1	0.32
100	6																				0	0	0
101	6																				0	0	0
102	6																				0	0	0
103	6																				0	0	0
104	6																				0	0	0.98

XU	SU	Mammals												Reptiles						Bird	Summary values		
		Sus scrofa	Peramelidae indet.	*Isoodon macrourus*	*Echymipera* sp.	*Dorcopsis veterum*	*Thylogale brunii*	*Dorcopsis* or *Thylogale*	*Macropus agilis*	Macropodidae indet.	*Uromys* cf. *caudimaculatus*	*Rattus gestri*	Muridae indet. (small)	Agamidae	Varanidae	Boidae	Colubroidea	Serpentes indet.	Chelidae	Aves indet.	Number of taxa	NISP all	Terrestrial vertebrates bone (g)
105	6																				0	0	0
106	6							1													1	1	0.1
107	6																				0	0	0
108	6																				0	0	0
109	6																				0	0	0
110	6																				0	0	0
111	6																				0	0	0
112	6																				0	0	0
113	6																				0	0	0
Total SU6		0	1	0	0	0	0	3	1	2	0	0	0	0	0	0	1	0	0	0	5	8	4.3
114	7																				0	0	0
115	7																				0	0	0
116	7																				0	0	0
117	7																				0	0	0
118	7																				0	0	0
119	7																				0	0	0
120	7																				0	0	0
121	7																				0	0	0
122	7																				0	0	0
123	7																				0	0	0
124	7																				0	0	0
125	7																				0	0	0
126	7																				0	0	0

		Mammals												Reptiles						Bird	Summary values		
XU	SU	Sus scrofa	Peramelidae indet.	*Isoodon macrourus*	*Echymipera* sp.	*Dorcopsis veterum*	*Thylogale brunii*	*Dorcopsis* or *Thylogale*	*Macropus agilis*	Macropodidae indet.	*Uromys* cf. *caudimaculatus*	*Rattus gestri*	Muridae indet. (small)	Agamidae	Varanidae	Boidae	Colubroidea	Serpentes indet.	Chelidae	Aves indet.	Number of taxa	NISP all	Terrestrial vertebrates bone (g)
127	7																				0	0	0
128	7																				0	0	0
129	7																				0	0	0
130	7																				0	0	0
131	7																				0	0	0.46
132	7																				0	0	0
133	7																				0	0	0
134	7																				0	0	0.53
Total SU7		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.99**
Total all SUs		**4**	**9**	**3**	**2**	**10**	**2**	**22**	**32**	**32**	**1**	**3**	**23**	**3**	**3**	**5**	**3**	**50**	**10**	**0**	**21**	**217**	**271.92**

Square B

XU	SU	Mammals												Reptiles						Bird	Summary values		
		Sus scrofa	Peramelidae indet.	*Isoodon macrourus*	*Echymipera* sp.	*Dorcopsis veterum*	*Thylogale brunii*	*Dorcopsis* or *Thylogale*	*Macropus agilis*	Macropodidae indet.	*Uromys cf. caudimaculatus*	*Rattus gestri*	Muridae indet. (small)	Agamidae	Varanidae	Boidae	Colubroidea	Serpentes indet.	Chelidae	Aves indet.	Number of taxa	Total NISP	Terrestrial vertebrates bone (g)
1	1B																				0	0	0
2	1B																				0	0	0
3	1B	1						3	4									1			4	9	12.21
4	1B	1		3		2									1			3			5	10	18.55
5	1B	4	1			1			1				1		2	2					7	12	27.01
6	1B																				0	0	0
Total SU1B		6	1	3	0	3	0	3	5	0	0	0	1	0	3	2	0	4	0	0	10	31	57.77
7	1A		1										4			1		3			4	9	1.04
8	1A												2					1			2	3	3.79
9	1A																				0	0	0.37
10	1A																				0	0	1.42
Total SU1A		0	1	0	0	0	0	0	0	0	0	0	6	0	0	1	0	4	0	0	4	12	6.62
11	2–4																				0	0	1.36
12	2–4															1					1	1	1.22
13	2–4									1			1		1			1			4	4	2.38
14	2–4	1											3					1			3	5	2.45
15	2–4												2								1	2	4.97
16	2–4	1	1					2					1					1			5	6	5.25
17	2–4		1																		1	1	1.99
18	2–4											1									1	1	1.51
19	2–4			1		1							2					1			4	5	4.05

XU	SU	Mammals												Reptiles						Bird	Summary values		
		Sus scrofa	Peramelidae indet.	*Isoodon macrourus*	*Echymipera* sp.	*Dorcopsis veterum*	*Thylogale brunii*	*Dorcopsis* or *Thylogale*	*Macropus agilis*	Macropodidae indet.	*Uromys cf. caudimaculatus*	*Rattus gestri*	Muridae indet. (small)	Agamidae	Varanidae	Boidae	Colubroidea	Serpentes indet.	Chelidae	Aves indet.	Number of taxa	Total NISP	Terrestrial vertebrates bone (g)
20	2–4									1			1			1		3			4	6	3.2
21	2–4	1		1					1				2								4	5	2.05
22	2–4									1		1									2	2	2.46
23	2–4									2			3					1			3	6	1.64
24	2–4		1							3								1			3	5	2.87
25	2–4		1							2			1								3	4	4.73
26	2–4																				0	0	2.71
27	2–4									1	1		1								3	3	0.58
28	2–4									2			1					1			3	4	1.9
29	2–4																				0	0	1.29
30	2–4								1	1											2	2	0.63
31	2–4																				0	0	1
32	2–4									1											1	1	0.98
33	2–4								1												1	1	21.19
34	2–4									1								1			2	2	1.79
35	2–4																				0	0	0.63
36	2–4								1												1	1	1.94
37	2–4											1			1						2	2	2.43
38	2–4																				0	0	0.91
39	2–4																				0	0	0.41
40	2–4																				0	0	0.48
41	2–4			1					1						1						3	3	1.06
42	2–4														1			2			2	3	1.42

XU	SU	Mammals												Reptiles						Bird	Summary values		
		Sus scrofa	Peramelidae indet.	*Isoodon macrourus*	*Echymipera* sp.	*Dorcopsis veterum*	*Thylogale bruni*	*Dorcopsis* or *Thylogale*	*Macropus agilis*	Macropodidae indet.	*Uromys cf. caudimaculatus*	*Rattus gestri*	Muridae indet. (small)	Agamidae	Varanidae	Boidae	Colubroidea	Serpentes indet.	Chelidae	Aves indet.	Number of taxa	Total NISP	Terrestrial vertebrates bone (g)
43	2–4								2												1	2	1.14
44	2–4									2	1										2	3	1.56
45	2–4									2											1	2	1.04
Total SU2–SU4		3	4	3	0	1	0	2	7	20	2	3	18	0	4	2	0	13	0	0	13	82	87.22
46	4/5								1				1								2	2	0.61
47	4/5									2											1	2	2.32
48	4/5																				0	0	0
Total SU4/SU5		0	0	0	0	0	0	0	1	2	0	0	1	0	0	0	0	0	0	0	3	4	2.93
49	5														1						1	1	0.55
50	5		1							1								1			3	3	1.17
51	5																	2			1	2	4.08
52	5									2					1	1					3	4	2.57
53	5																				0	0	2.18
54	5						1			2											2	3	1.46
55	5						1		1									1			3	3	2.52
56	5									1		1									2	2	0.37
57	5								2									1			2	3	1.61
58	5								2							1					2	3	2.57
59	5																				0	0	0.38
60	5							2													1	2	0.5
61	5												1								1	1	0.13
62	5		1									2			1						3	4	27.46
63	5						2	1													2	3	27.86

XU	SU	Mammals												Reptiles						Bird	Summary values		
		Sus scrofa	Peramelidae indet.	*Isoodon macrourus*	*Echymipera* sp.	*Dorcopsis veterum*	*Thylogale brunii*	*Dorcopsis* or *Thylogale*	*Macropus agilis*	Macropodidae indet.	*Uromys cf. caudimaculatus*	*Rattus gestri*	Muridae indet. (small)	Agamidae	Varanidae	Boidae	Colubroidea	Serpentes indet.	Chelidae	Aves indet.	Number of taxa	Total NISP	Terrestrial vertebrates bone (g)
64	5							2			1				1						3	4	4.1
65	5								2	1					1						3	4	4.75
66	5									2					1			1			3	4	2.96
67	5									1											1	1	3.4
68	5															1					1	1	0.39
69	5																	1			1	1	0.22
70	5															1					1	1	0.23
71	5																				0	0	0.15
72	5		1																		1	1	0.12
73	5		1					1										1			3	3	0.11
74	5																				0	0	2.2
75	5																				0	0	0.68
Total SU5		0	4	0	0	0	4	6	7	10	1	3	1	0	6	4	0	8	0	0	11	54	94.72
76	6																				0	0	0
77	6																				0	0	0.32
78	6												1								1	1	0.37
79	6																				0	0	0.08
80	6																				0	0	0
81	6														1						1	1	0.07
82	6																				0	0	0
83	6																				0	0	0.11
84	6																				0	0	0
85	6																				0	0	0

XU	SU	Mammals												Reptiles						Bird	Summary values		
		Sus scrofa	Peramelidae indet.	*Isoodon macrourus*	*Echymipera* sp.	*Dorcopsis veterum*	*Thylogale bruni*	*Dorcopsis* or *Thylogale*	*Macropus agilis*	Macropodidae indet.	*Uromys cf. caudimaculatus*	*Rattus gestri*	Muridae indet. (small)	Agamidae	Varanidae	Boidae	Colubroidea	Serpentes indet.	Chelidae	Aves indet.	Number of taxa	Total NISP	Terrestrial vertebrates bone (g)
86	6																				0	0	0
87	6																				0	0	0
88	6																				0	0	0
89	6																				0	0	0
90	6																				0	0	0
91	6																				0	0	0
92	6																				0	0	0.49
93	6																				0	0	0.21
94	6																				0	0	0
95	6																				0	0	0.45
96	6																				0	0	0
97	6																				0	0	0
98	6																				0	0	0.1
99	6														1						1	1	0.13
100	6							1													1	1	0.78
101	6																				0	0	0.52
102	6																				0	0	0
103	6																				0	0	0
104	6																				0	0	0
105	6																				0	0	0
106	6																				0	0	0
107	6																				0	0	0
108	6																				0	0	0

XU	SU	Mammals												Reptiles						Bird	Summary values		
		Sus scrofa	Peramelidae indet.	*Isoodon macrourus*	*Echymipera* sp.	*Dorcopsis veterum*	*Thylogale brunii*	*Dorcopsis* or *Thylogale*	*Macropus agilis*	Macropodidae indet.	*Uromys cf. caudimaculatus*	*Rattus gestri*	Muridae indet. (small)	Agamidae	Varanidae	Boidae	Colubroidea	Serpentes indet.	Chelidae	Aves indet.	Number of taxa	Total NISP	Terrestrial vertebrates bone (g)
109	6																				0	0	0
110	6																				0	0	0
111	6																				0	0	0
112	6																				0	0	0
113	6																				0	0	0
Total SU6		0	0	0	0	0	0	1	0	0	0	0	1	0	2	0	0	0	0	0	3	4	3.63
114	7																				0	0	0
115	7																				0	0	0
116	7																				0	0	0
117	7																				0	0	0
118	7																				0	0	0
119	7																				0	0	0
120	7																				0	0	0
121	7																				0	0	0
122	7																				0	0	0
123	7																				0	0	0
124	7																				0	0	0
125	7																				0	0	0
126	7																				0	0	0
127	7																				0	0	0
128	7																				0	0	0
129	7																				0	0	0
130	7																				0	0	0

XU	SU	Mammals												Reptiles						Bird	Summary values		
		Sus scrofa	Peramelidae indet.	*Isoodon macrourus*	*Echymipera* sp.	*Dorcopsis veterum*	*Thylogale bruni*	*Dorcopsis* or *Thylogale*	*Macropus agilis*	Macropodidae indet.	*Uromys cf. caudimaculatus*	*Rattus gestri*	Muridae indet. (small)	Agamidae	Varanidae	Boidae	Colubroidea	Serpentes indet.	Chelidae	Aves indet.	Number of taxa	Total NISP	Terrestrial vertebrates bone (g)
131	7																				0	0	0
132	7																				0	0	0
133	7																				0	0	0
134	7																				0	0	0
Total SU7		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total all SUs		**9**	**10**	**6**	**0**	**4**	**4**	**12**	**20**	**32**	**3**	**6**	**28**	**0**	**15**	**9**	**0**	**29**	**0**	**0**	**14**	**201**	**252.89**

Appendix K.

Large Vertebrate Remains Encountered During Excavation of the Stepping-out Squares.

Square	XU	Taxon	Skeletal element	Weight (g)	Burning	Notes
C	13	*Dugong*	femur	13.4	lightly charred on both ends	immature animal
E	11	*Dugong*	rib	39.71	unburnt	cut marks below articular surface
F	14	*Dugong*	thoracic vertebra	133.2	unburnt	
H	14	*Dugong*	humerus	15	unburnt	immature animal
H	14	*Crocodylus*	neurocranial fragment	17.16	unburnt	
J	12	*Dugong*	rib	25.62	unburnt	cut marks below articular surface
J	14	*Macropus agilis*	pelvic	34.97	unburnt	
J	14	a marine turtle	carapace/plastron	10.59	lightly charred on external surface	
K	1	*Canis*	femur shaft	5.64	unburnt	
L	12	*Crocodylus*	six neurocranial fragments	91.12	unburnt	
L	13	*Dugong*	thoracic vertebra	26.23	unburnt	

Appendix L.

Occurrence of Fish Family and Crab Taxa by XU in Square A.

+ = taxon present.

XU	SU	Fish											Crabs									
		Balistidae	Labridae	Lethrinidae	Ostraciidae	Pomadyasidae	Scaridae	Scombridae	Serranidae	Sparidae	Ray	Shark	*Scylla serrata*	Other portunids	Sesarmidae	*Ocypode* sp.	Type A	Type B	Type C	Type D	Type E
1	1B																				
2	1B																				
3	1B																				
4	1B				+																
5	1B			+			+					+									
6	1B																				
7	1A	+			+		+														
8	1A	+					+														
9	1A		+				+														
10	1A		+				+														
11	2–4				+		+														
12	2–4	+																			
13	2–4						+														
14	2–4						+														
15	2–4					+	+														
16	2–4	+					+														
17	2–4						+														
18	2–4						+														

XU	SU	Fish											Crabs								
		Balistidae	Labridae	Lethrinidae	Ostraciidae	Pomadyasidae	Scaridae	Scombridae	Serranidae	Sparidae	Ray	Shark	*Scylla serrata*	Other portunids	Sesarmidae	*Ocypode* sp.	Type A	Type B	Type C	Type D	Type E
19	2–4						+														
20	2–4	+					+														
21	2–4																				
22	2–4	+					+														
23	2–4						+														
24	2–4				+		+														
25	2–4	+					+														
26	2–4	+					+			+											
27	2–4																				
28	2–4																				
29	2–4						+						+								
30	2–4				+		+			+											
31	2–4						+						+								
32	2–4						+						+						+	+	
33	2–4		+																		
34	2–4						+						+			+					
35	2–4		+		+							+									
36	2–4				+		+						+							+	
37	2–4				+		+						+							+	
38	2–4				+		+														
39	2–4																				
40	2–4		+		+		+							+							
41	2–4				+						+									+	
42	2–4						+						+		+						

XU	SU	Fish											Crabs								
		Balistidae	Labridae	Lethrinidae	Ostraciidae	Pomadyasidae	Scaridae	Scombridae	Serranidae	Sparidae	Ray	Shark	*Scylla serrata*	Other portunids	Sesarmidae	*Ocypode* sp.	Type A	Type B	Type C	Type D	Type E
43	2–4						+														
44	2–4	+			+																
45	2–4		+		+									+							
46	4/5	+	+		+		+														
47	4/5	+	+		+		+							+							
48	4/5												+								
49	4/5						+				+	+	+								
50	4/5		+		+		+						+								
51	5		+		+		+					+	+								
52	5	+			+		+						+								
53	5				+		+						+								
54	5	+					+				+		+								
55	5	+			+		+				+		+								
56	5	+			+						+										
57	5	+	+		+		+	+					+		+						
58	5	+	+		+		+				+			+							
59	5	+			+		+	+				+	+		+						
60	5	+			+		+						+		+						
61	5	+			+		+				+		+		+						
62	5	+			+																
63	5				+		+						+		+						
64	5				+		+						+		+						
65	5				+		+						+		+						
66	5				+		+				+		+	+	+						

XU	SU	Fish											Crabs								
		Balistidae	Labridae	Lethrinidae	Ostraciidae	Pomadyasidae	Scaridae	Scombridae	Serranidae	Sparidae	Ray	Shark	*Scylla serrata*	Other portunids	Sesarmidae	*Ocypode* sp.	Type A	Type B	Type C	Type D	Type E
67	5				+								+		+				+		
68	5				+		+				+		+		+						
69	5				+				+		+		+		+						
70	5				+	+	+						+		+						
71	5				+																
72	5				+		+						+		+					+	
73	5				+		+				+		+	+	+	+				+	
74	5				+		+								+				+		
75	5				+		+				+		+		+						
76	6				+	+					+		+		+						
77	6				+																
78	6				+		+				+			+	+					+	
79	6				+		+							+	+					+	
80	6				+									+	+				+		
81	6				+						+				+						
82	6				+						+			+	+						
83	6				+		+								+						
84	6						+								+						
85	6				+		+				+				+						
86	6						+								+						
87	6						+							+	+						
88	6	+									+				+				+		
89	6																				
90	6											+		+							

XU	SU	Fish											Crabs								
		Balistidae	Labridae	Lethrinidae	Ostraciidae	Pomadyasidae	Scaridae	Scombridae	Serranidae	Sparidae	Ray	Shark	*Scylla serrata*	Other portunids	Sesarmidae	*Ocypode* sp.	Type A	Type B	Type C	Type D	Type E
91	6						+							+	+						
92	6														+						
93	6				+									+	+				+		
94	6																				
95	6														+						
96	6														+						
97	6																				
98	6												+	+				+			
99	6												+								
100	6																				
101	6																				
102	6													+	+						
103	6						+								+						
104	6	+			+										+						
105	6															+					
106	6														+						
107	6																				
108	6													+							+
109	6																				
110	6																				
111	6																				
112	6																				
113	6						+														
114	7																				

XU	SU	Fish											Crabs								
		Balistidae	Labridae	Lethrinidae	Ostraciidae	Pomadyasidae	Scaridae	Scombridae	Serranidae	Sparidae	Ray	Shark	*Scylla serrata*	Other portunids	Sesarmidae	*Ocypode* sp.	Type A	Type B	Type C	Type D	Type E
115	7																				
116	7																				
117	7																	+			
118	7																				
119	7																				
120	7																				
121	7																				
122	7																				
123	7																				
124	7																				
125	7																				
126	7																				
127	7																				
128	7																				
129	7																				
130	7																				
131	7																				
132	7															+					
133	7																				
134	7																+				

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