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# Metal-Age Maritime Culture at Jareng Bori Rockshelter, Pantar Island, Eastern Indonesia

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Abstract. The archaeological record of Wallacea remains exceptionally fragmentary. This is especially the case for late Holocene human occupation of the region when lifestyle and culture in marginal island environments is relatively unknown. Here we report on the archaeology of Jareng Bori rockshelter, a Metal-Age site spanning c. 1800 cal. BP up to the late historic period and situated on the eastern coast of Pantar Island in the Lesser Sunda Islands of eastern Indonesia. We use osteoarchaeological (human and vertebrate remains), invertebrate zooarchaeological (crustacean and molluscan remains), technological (lithics, shell, and pottery) and chemical sourcing (obsidian and metal) datasets to discuss networking, migration, and human subsistence strategies during this recent period of history. While some communities were no doubt living in open village settlements where they were producing pottery, the data indicate that aspects of maritime life-ways continued much as in earlier Pleistocene settlements, with people using rockshelters like Jareng Bori to pursue a range of subsistence activities focused on the shoreline. Shellfishing of rocky and reef intertidal species and fishing for mostly small herbivorous and omnivorous fishes was practised, while domestic animals only appear in the late historic period. Wider regional cultural interactions and networking are epitomized by obsidian exchange, dental modification practices, and pottery decorations, while lithic analyses indicates continuity of stone tool technology up until recent times.

**Keywords**: Wallacea; Pantar; Jareng Bori rockshelter; Metal-age; historic period; maritime network
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## Introduction

Maritime culture was present in the tropical island region of Wallacea over several millennia and provides the earliest evidence of open sea crossing capability for our species (Anderson, 2017; Balme, 2013). The region also contains some of the earliest direct evidence of marine resource exploitation in the world (O'Connor *et al.*, 2011, 2017a; Ono *et al.*, 2010; Roberts *et al.*, 2020; Szabó & Amesbury, 2011), and this maritime emphasis continued into the Metal-Age and historic periods (Ono *et al.*, 2018a). By the terminal Pleistocene it appears that this insular region had developed inter-connectedness, as evidenced by analyses of obsidian artefacts recovered from sites on Alor and Timor (O'Connor *et al.*, 2018; Reepmeyer *et al.*, 2011, 2016, 2019), however, the extent of these networks is not well known. The migration of Austronesian cultures beginning c. 3500 BP, followed by a more widespread Indonesian Metal-Age from c. 2500 BP (Bellwood *et al.* 1993, 1998), saw the establishment of complex agricultural societies in the Asia-Pacific (Denham, 2013; Piper *et al.*, 2014; Silva *et al.*, 2015). This, combined with the mobility afforded by more sophisticated water-craft, and possibly spurred by heightening sea levels, resulted in large scale maritime networks and the rapid dispersal of Neolithic, and then Metal-Age cultures throughout the Wallacean region (Bellwood, 1998, 2017; O'Connor, 2015). These dispersals linked material culture, burial practices, and more complex socio-political economic systems (Glover, 1986; Koesbardiati *et al.*, 2015; O'Connor, 2015; O'Connor *et al.*, 2017b; Ono *et al.*, 2018b; Shaffer, 1996).

Into the historic period the Wallacean region continued to see dynamic movements of peoples and cultures, and eastern Indonesia became part of a globalized trade network, particularly the Moluccas where spices were traded as far as India, China, and the Mediterranean after 2000 BP (Miller, 1969). During this pre-Islamic period, kingdoms were established in Wallacea, such as the Bugis on Sulawesi (Hakim *et al.*, 2018). During the 14th century, after a period of trade and conflict between Java and East Nusa Tenggara, a dependency of the Majapahit empire named Galiyao in the Nagarakretagama was established. Barnes (1982) and Rodemeier (1995) identified this dependency with Pantar, or a kingdom that included both Pantar and eastern Alor. Later, Islamic and then Portuguese, British, and Dutch controlled states were established in the region.

Metal-Age sites with published data covering the period of these maritime interactions are widespread, from the Philippines (Bellwood & Dizon, 2013), stretching to the Talaud islands north of Sulawesi (Ono *et al.*, 2018a), Sulawesi (Bulbeck, 2010; Bulbeck *et al.*, 2016), northern Maluku islands (Bellwood *et al.*, 1993; Bellwood, 1998, 2017; Ono *et al.*, 2018b), Timor (Glover, 1986), Bali (Calo *et al.*, 2020a, 2020b), and into east Sumba (Heekeren, 1956), where metal items, glass beads, distinctive Metal-Age earthenware, in some cases Chinese tradeware, and jar burials have been dated from the 5th century B.C. On Bali, archaeological investigations indicated that the Lesser Sunda Islands were part of a wider Trans-Asiatic trade network since the 2nd century B.C. (Calo *et al.*, 2020a, 2020b). At Sembiran harbour, Chinese tradeware was

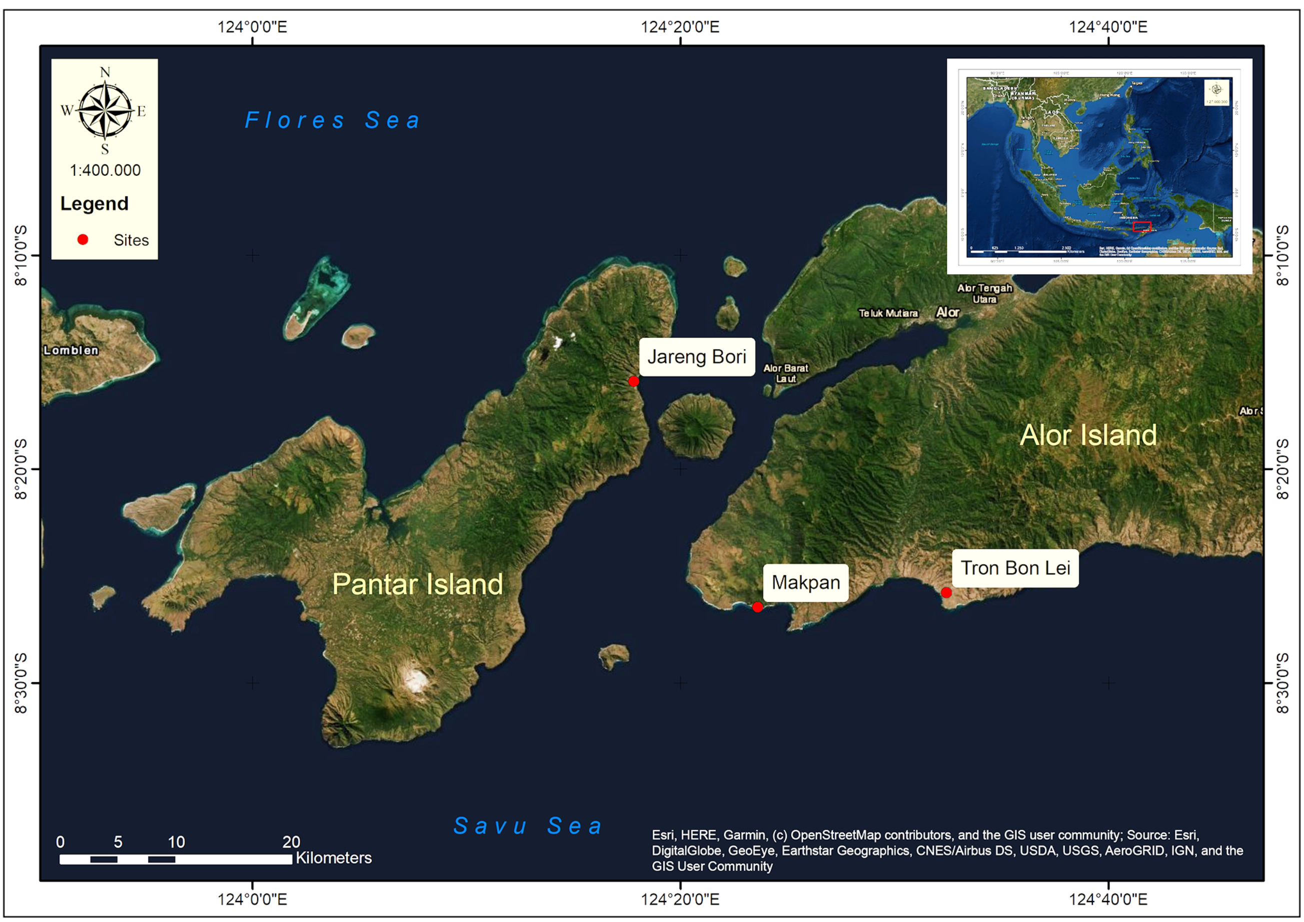


**Figure 1**. Location of Jareng Bori rockshelter, Pantar Island, eastern Indonesia in relation to recent sites excavated on nearby Alor.

prominent by the 8th and 12th centuries A.D., indicating a growth in Chinese trade during this period (Calo *et al.*, 2020a). At Pangkung Paruk, Roman gold beads were found indicating a southern maritime trade route connecting Bali to the wider Indo-Pacific region since the 1st to 4th centuries A.D. (Calo *et al.*, 2020b). Such networks also likely facilitated the dispersal of commensal rodent species, which began to make an appearance from the Neolithic onwards (Aplin *et al.*, 2003, 2011).

Here we discuss archaeological excavations of the Metal-Age rockshelter, Jareng Bori, on the island of Pantar, East Nusa Tenggara, in the eastern Indonesian region of Wallacea (Fig. 1). We discuss our findings at Jareng Bori rockshelter within a context of Wallacean maritime culture. We use multidisciplinary archaeological data, including zooarchaeological analyses of vertebrate and invertebrate remains, artefact analyses (ceramics, lithics, metal, shell) and geochemical analysis of obsidian flakes from a well dated chronostratigraphic context to add knowledge on maritime trade networks, cultural practices, and socioeconomic systems during this historic period of human settlement. This study represents the first archaeological excavation on the island, and its proximity to recent significant discoveries on Alor (Hawkins *et al.*, 2018; O'Connor *et al.*, 2017b; Samper Carro *et al.*, 2016) made the island an attractive target for investigation. Moreover, the archaeological survey that led to this study was informed by a desire for increased knowledge of the faunal history of the region, and in large part spurred by the need, identified by Ken Aplin, for increased sampling of natural and archaeological records, especially of rodents, on Pantar. Ken Aplin had a deep and enduring interest in archaeology and throughout his career made major contributions to our understanding of human subsistence practices, hunting technology, and faunal succession resulting from environmental change in the Wallacean islands (e.g., Aplin & Helgen, 2010; O'Connor & Aplin, 2007; O'Connor *et al.*, 2013). This site report honours Ken Aplin's contribution to the archaeology of this region.

## Physical setting

Pantar Island has a land area of 728 km² and is the second largest island in the Alor Archipelago. Jareng Bori, located by Pantar Timur school (8°15'51.7"S 124°17'55.4"E), is a small rockshelter formed in a large boulder fallen from the ridgeline above. It is situated on the coastal beach flat at the base of a cliff, 40 m north of the school and 120 m from the current shoreline to the east (Fig. 2). The rockshelter has a restricted living floor area of only 40 m².

## Methods and materials

An intensive survey of Pantar Island was conducted by our joint ANU/Universitas Gadjah Mada team guided by local informants in 2015, focusing on uplifted limestone outcrops along the shoreline, as well as rocky ridges. Prospective rockshelters and caves that had potential or observable archaeological and palaeontological deposits, and modern faunal remains were recorded using GPS and camera, while local names for each site were noted for easy relocation (see Louys *et al.*, 2017 for more detail). Isolated human skeletal

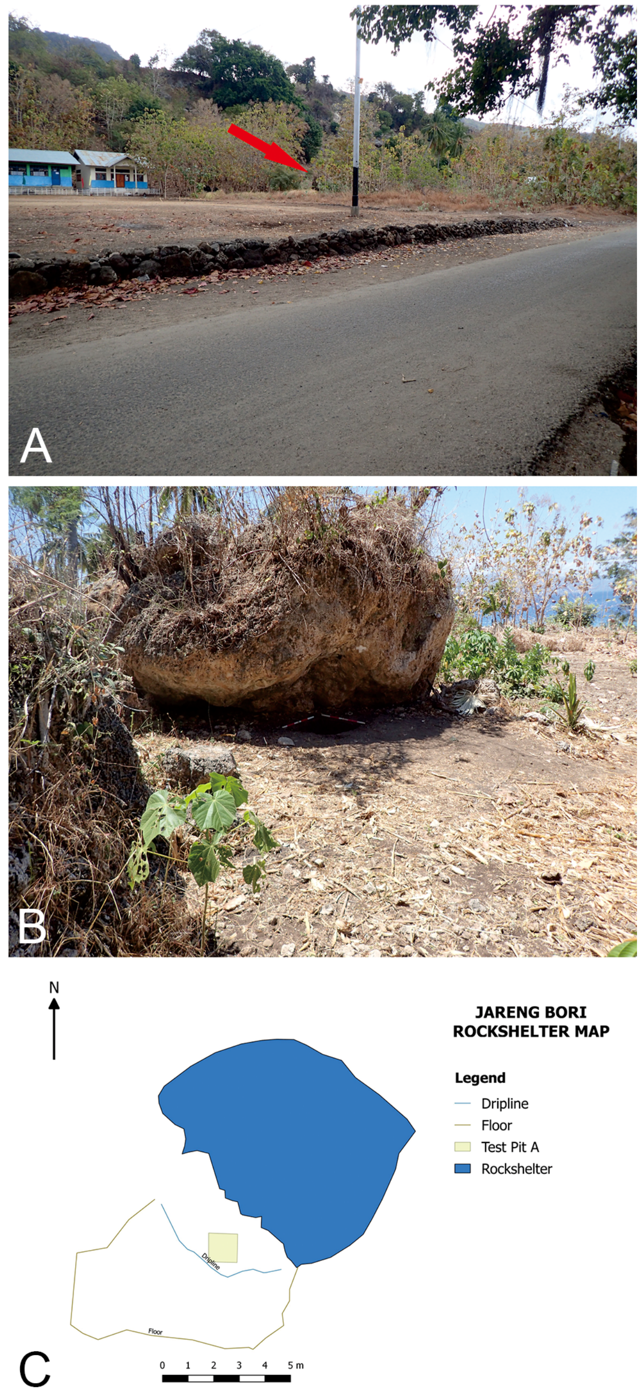


**Figure 2**. Jareng Bori rockshelter, A: view from the beach facing west, B: the rockshelter facing east towards the beach, C: excavation site plan.

material was also found in a niche on the west coast and dated to c. 2200 cal. BP (Louys *et al.*, 2017). However, and despite two weeks of survey, very few sites with potential deposits were identified, of which only two on Pantar Timur (east Pantar), Jareng Bori, and Sindawapa, showed any promise for archaeological deposits.

Excavations were conducted first at Sindawapa Cave situated at Tuabang village. However, the deposit consisted of recent cave infill comprising rubble, goat bones, and goat dung. It was excavated to a depth of 1.5 m before it became unsafe and excavation was discontinued. The decision was then made to relocate to Jareng Bori rockshelter, 2 km south. This rockshelter appeared promising as notched rim pottery was discovered on the surface near the lip of the platform beneath the dripline. Pottery was also observed inland of the beach between the road to the base of the cliff where the shelter is located. Today, this area is used for gardening and grazing goats, which probably accounts for the exposure of much of the pottery.

## Excavations

A 1 m² test excavation was conducted in the shelter in 5 cm spits within sedimentary stratigraphic layers—test pit A (JAR-A). Features once identified in plan were excavated as discrete provenance units. The 3D position of features, finds and charcoal samples discovered *in situ* were recorded using a Leica 800 series total station. All excavated sediment was first dry sieved near the rockshelter and then wet sieved at the adjacent beach using 1.5 mm sieves. Materials were sorted by local field crew under the supervision of students from Universitas Gadjah Mada into general classes (e.g., bone, crustacean, mollusc, sea urchin, charcoal, ceramic, metal, glass bead, and stone artefact). They were later washed in fresh water, re-sorted and analysed in the Archaeology and Natural History (ANH) laboratory at The Australian National University (ANU). *In situ* charcoal samples were dated at the ANU Radiocarbon Dating Centre (Fallon *et al.*, 2010). All dates were calibrated in OxCal 4.2, using Sh Cal 13 (Hogg *et al.*, 2013) to 95.4%.

## Vertebrate fauna

Vertebrate fauna was analysed in the ANH osteology laboratory by morphological comparison with modern and archaeological reference specimens. All specimens were identified to the lowest taxonomic level possible, in many cases only class, order, family or genus was possible owing to the available reference material and high levels of fragmentation. Fish skeletal identifications followed protocols similar to other studies in the Asia-Pacific region (Dye & Longenecker, 2004; Leach, 1997; Ono *et al.*, 2012; Samper Carro *et al.*, 2016) that focus on the five-paired jaw-bones (premaxilla, maxilla, dentary, articular, quadrate) and various special bones including pharyngeal plates, dermal scutes, dermal spines, dorsal spines, and vertebrae. Typically, fish remains in the Pacific are identified only to the family level given the high number of species with morphological similarity. Most elements were highly fragmented or not morphologically distinctive, and these were identified as bony fish specimens (Actinopterygii). Fish feeding behaviour categorization into herbivorous, omnivorous, and carnivorous fish families follows Butler (1994).

Tetrapod remains were identified to various taxonomic levels depending on the presence of diagnostic cranial specimens (e.g., Aplin & Helgen, 2010). The most fragmented bones, lacking diagnostic morphological features (usually long bone shaft fragments), were only identified to superclass (Tetrapoda) or class (Reptilia, Aves, Mammalia). Limited reference material for birds, lizards, snakes, and bats restricted identification of these taxa to higher categories (Passeriformes, Lacertilia, Serpentes, Chiroptera, respectively). However, fruit bat (Pteropodidae) bones are quite distinctive from insectivorous bats and these could often be distinguished based on articulating limb appendages and cranial material. Turtle bones were identified to the superfamily level (Chelonioidea) as extant species worldwide can only be distinguished by mandibles and crania (Wyneken & Witherington, 2001), which were not present. Bones belonging to the Muridae were sorted by size (small or large). More specific identifications to species and genus were made on the maxillae and mandible teeth and tooth rows.

Vertebrates were quantified by the Number of Identified Specimens Present (NISP) and weight. These quantitative methods are independent of aggregated provenance units and avoid the overestimation of rare taxa (Lyman, 2008). Change in fish feeding behavior over time was statistically quantified using Cochrane's test of linear trends, which is a linear chi square test that takes sample size into account (Zar, 2010).

## Invertebrate fauna

Jareng Bori molluscs were identified using the ANH malacology collections at The Australian National University as well as those housed at the Museum and Art Gallery of the Northern Territory (MAGNT). Mollusc remains were quantified by recording the Number of Identifiable Specimens Present (NISP), Minimum Number of Individuals (MNI) and weight (g) of each taxon per spit. The MNI was calculated by selecting the most frequently occurring non-repetitive element (NRE) for each identified taxon; this element was then recorded consistently throughout all spits (Claassen, 1998).

Jareng Bori crustaceans were identified using the ANH reference collection and the marine invertebrate collection at the Muséum national d'Histoire naturelle in Paris. Sea urchin and barnacle remains were quantified by weight (g) per spit at The Australian National University. Crab remains—exoskeleton, cheliped, and dactyl fragments—were quantified by recording the Number of Identifiable Specimens (NISP) and weight of each taxon per spit.

## Bioarchaeology

The human burial was excavated in the southern area of test pit A in accordance with standard field procedures (Bass, 1995; Willis & Tayles, 2009) as a separate feature and was recorded digitally using a digital camera and total station 3-D plotting to determine the burial position and orientation to understand mortuary practices at Jareng Bori during late history. Much of the burial was disturbed by ant nests and tree roots, so the skeletal material was damaged and slightly disarticulated. The skull and most of the upper body and limbs were excavated; however, the rest of the skeleton which extends into the south wall of the pit remains unexcavated. The skeletal material from the burial was first carefully cleaned using ethanol in the Archaeology and Anthropology Quarantine laboratory at ANU to remove encrusted sediment to make observations possible (after Gilbert, 2015).

### Pottery

Data from both metric measurements and non-metric observations were recorded and taken from various attributes in the sherds and simultaneously used in their analysis. These attributes include their weight, sherd thickness, estimated rim diameter, rim form, vessel-forming techniques and associated surface treatment and decoration. All sherds bearing potentially diagnostic characteristics useful for typological identification—such as rim and base form, surface treatment and decoration—were photographed and described in greater detail.

Considering that the identification of attributes on sherds under 1 g is not as accurate as on large sherds, only the sherds ≥1 g were comprehensively analysed in order to avoid biases caused by the highly fragmentary nature of majority of the assemblage. However, decorated and/or slipped and/or rim sherds under 1 g were included in the analysis because of their relative paucity.

All ceramic samples were gently cleaned with fresh water and soft bristle toothbrushes to remove residual sediment and thereafter, individually laid out to dry. The weight of each sherd was measured using a scale with the smallest increment limited to 1 g. Sherd thickness and dimensions were measured using a pair of metal electronic digital callipers to the nearest 0.1 mm. Measurements of rim, orifice and basal diameters were estimated using a rim diameter estimating chart.

### Lithics

Stone artefacts were identified following Hiscock (2007), with flakes, flake fragments, cores, and flaked pieces counted. Heat shatter present on stone artefacts was recognized by crazing, potlids, and crenulated surfaces. No morphological analysis was conducted.

### Geochemical analysis of obsidian flakes

The obsidian artefacts were geochemically fingerprinted by portable X-Ray Fluorescence analysis (pXRF) with a Bruker Tracer III-SD. Manufacturer recommended settings of 40 keV and 42 mA were employed using a 0.1524 mm Cu, 0.0254 mm Ti and 0.3048 mm Al filter in the X-Ray path and a 60 s live-time count at 145 FWHM setting. The raw counts of the pXRF were calibrated using 40 international standards provided by MURR (Glascock & Ferguson, 2012). Each artefact was analysed at two spots. Element concentrations of manganese (Mn), iron (Fe), zinc (Zn), gallium (Ga), thorium (Th), rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), and niobium (Nb) were calculated.

### Metal

A section of the corroded ferrous metal fragment surface was cleaned and a pXRF (Bruker Tracer III–V+) used to examine the composition of the oxidized and parent material. Three analyses were made of the cleaned area and six analyses of the corrosion surface, with measurements for each area averaged. Instrument parameters were 40 keV, 27 µA, using a filter (12 mil Aluminium + 1 mil Titanium + 6 mil Titanium) in the X-ray path and a 180 s live-time count at 185 FWHM. Element fluorescence peaks (Calcium, Ca; Chromium, Cr; Manganese, Mn; Iron, Fe; Strontium, Sr; Molybdenum, Mo) were examined semi-quantitatively with ROI data in the S1PXRF program.

## Results

### Excavations

A total of 21 spits, ranging from 2–6 cm depending on the depth of stratigraphic layers, were excavated to a maximum depth of 120 cm. Seven stratigraphic layers, and one burial feature in the south side of the excavation in plan and extending into the southern wall, were identified (Fig. 3), from which a number of cultural materials (pottery, lithics, animal bone, molluscs, shell artefacts) and charcoal for radiocarbon dating were recovered (Tables 1–2).

Layer 1 (spit 1) is a thin (2–3 cm) topsoil layer of loosely consolidated soft light brown (10 YR 3/4) silty sand and small amounts of limestone rubble inclusions, molluscs, vertebrates, lithics, and an incised rim-sherd. Layer 2 (spit 2: 5–10 cm) occurs in the southern and western sections, with Layer 3 (spit 3: 5–15 cm) apparent in the north and east sections. Layer 2 is a light brown compact silty sand (10 YR 3/4) and layer 3 is a mixed dark brown silty sand sediment less compact than layer 2 with more limestone rubble (10 YR 3/3), including the top of the burial grave feature which was cut through this layer. Both layers contained pottery, lithics, charcoal, bones, and molluscs with signs of insect bioturbation and tree root disturbances in the northwestern corner. Layer 2 was compact silt with a chert flake, human bone, pig bone, and pottery recovered during excavation. Layer 3 was less compact dark brown silty sand with limestone rubble, pottery, charcoal, shellfish, and fishbone.

Layer 4 (spits 4–6) is a light grey moderately compact silty sand layer with (10 YR 5/3) with an average thickness of 5–15 cm. Ant nest disturbance and tree roots became apparent in this layer, which contained shellfish, limestone rubble, and fishbone. In spits 4–6, the human grave cuts through layer 4 about 20 cm deep in the eastern half of the square. This side of the square continued to be excavated separately as a burial deposit once the outline of the burial could be determined. The skeleton's base was c. 40 cm deep, extending from spit 5 to spit 9 (through layers 4–5). The burial was of a small individual which appears in the foetal position lying on the right side with arms tucked in near the rib cage and knees tucked in facing south towards the school (Fig. 4). The lower leg was left unexcavated in the southern baulk. The cervical column was damaged by rockfall and the skull was disturbed by tree roots. The skeletal material was fragile and eroding within the sedimentary matrix of the burial fill. It is poorly preserved with tree roots crushing the skull and neck, and ant nests throughout the burial. The atlas was discovered quite far from the disturbed neck area. The bone was carefully excavated owing to the post-depositional weathering. The burial appears to be a shallow grave with fragmented pottery included in the fill, which as noted below is believed to be an incidental inclusion. There was no sign of grave goods aside from some poorly preserved fragments of *Nautilus* shell which may have been placed with the burial.

Layer 5 (spits 7–9) (10 cm thick) consists of a dark brown alluvial silt sand with increased small limestone rubble (10 YR 3/3). Layer 6 (spits 10–12) (15 cm thick) is a mixed anthropogenic alluvial sediment dark brown with less small limestone rubble (10 YR 3/3), but increasingly larger limestone boulders which covered most of the square. Layer 7 (spits 13–21) is dark brown silt sand sediment (10 YR 2/2) with larger limestone rubble in between bedrock (50 cm thick in places). Sediment gradually declined in volume down to spit 21, by which stage very little sediment was being retrieved and the base was reached. Oven stones were recorded in this layer and pottery was abundant.

### Radiocarbon dating

Twenty *in situ* charcoal radiocarbon samples were recovered and dated (ANU 53113–53139) (Table 1), suggesting three occupation periods. The first covers most of the deposit with spits 1–12 (layers 1–6) and the human burial excavated from layer 3 into layer 4. These contexts all appear modern with 15 dates clustered between 430–0 cal. BP, although there is one inversion in spit 11 c. 1384–1524 cal. BP (ANU 53131). Four of the dates are associated with the burial, including one adjacent to the skull (ANU 53127) 0–304 cal. BP in spit 7, and another from the base of the skull (ANU 53130) 0–423 cal. BP in spit 8; (ANU 53129) 152–429 cal. BP from charcoal in sediment inside the mouth of the skull in spit 7; and (ANU136) 0–420 cal. BP from a charcoal sample under the right arm in spit A9. A middle occupation phase represented by one date gives an age of 1187–1305 cal. BP (ANU 53137) in the upper part of layer 7 in spit 14, while the basal part of layer 7 deposit is dated between 1612–1807 cal. BP with two dates falling within the range (ANU 53138–53139) in spits 18–19.

## Fauna

### Vertebrates

In total 8958 vertebrate remains were recovered from Jareng Bori rockshelter (Table 3). Most of these were concentrated in the lower two layers, 6 (NISP = 1943) and 7 (NISP = 4209) with 19.12 and 17.02 bones respectively per kilogram of sediment compared to 2.64 for layer 1, 2.85 for layers 2 and 3, 4.8 for layer 4, and 7.96 for layer 5 (Table 2). Most of the vertebrate remains were those of noticeably small fish (NISP = 7771) based on the size of jaw bones and vertebrae, including sharks of the family Carcharhinidae and bony fishes (Actinopterygii) that made up 86.8% of the vertebrate assemblage. Mammals were represented in modest quantities including small rats, shrews, and bats. Reptiles included small amounts of small squamate lizards (Lacertilia) and snakes (Serpentes) with very small amounts of marine turtle (Chelonioidea). Bird bones were represented by a single large passerine element. A single amphibian bone was recovered from spit 15 in layer 7. A single shrew (Soricidae) was identified from layer 4 in the late historic period. Fruit bat (Pteropodidae) bones were present in very small numbers between spits 2 to 9 (layers 2–5). Domesticates including pig (*Sus scrofa*) bones were associated with late historic provenances between spits 1–5 in the upper layers. A dog (*Canis familiaris*) canine tooth was recovered from the middle occupation period (1187–1365 cal. BP) in spit 14. Small rat bones were consistently recovered throughout the sequence, of which *Rattus* sp. and *Melomys* sp. were identified to genus.

Only 5% of the fish bones were identified to taxon, including 16 families, dominated by small herbivorous and omnivorous taxa: balistids (triggerfishes), ostraciids (boxfishes), acanthurids (surgeonfishes, tangs, and unicornfishes), diodontids (porcupinefishes), with smaller numbers of carnivorous fish taxa including serranids

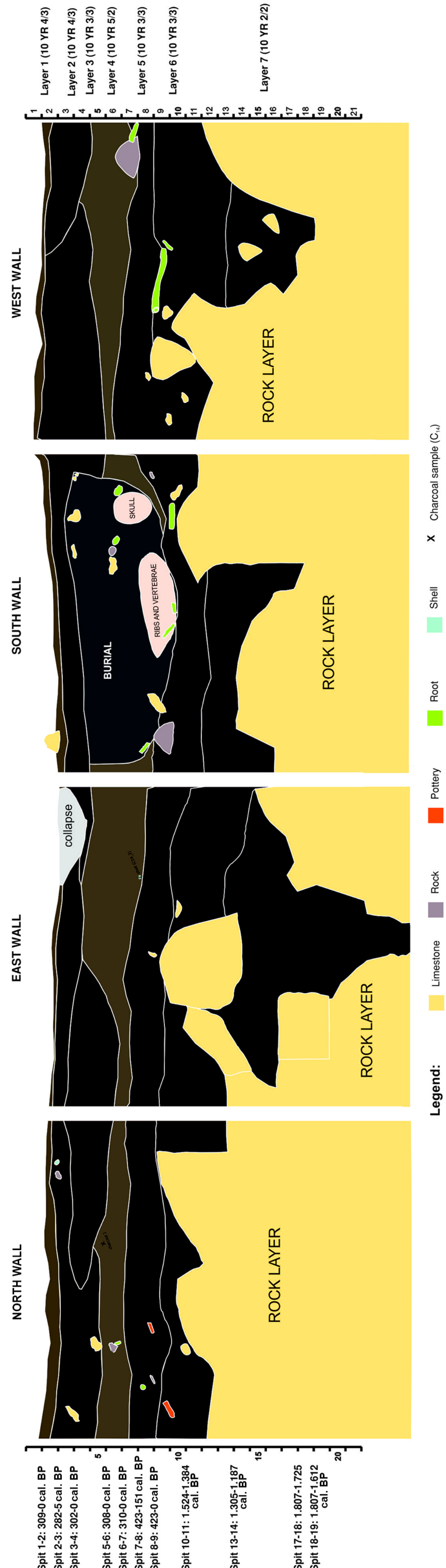


**Figure 3**. Jareng Bori chronostratigraphy.

**Table 1**. Jareng Bori radiocarbon dates by provenance.

| spit (depth) | *in situ* sample number | stratigraphic unit | AMS code | ID | material | radiocarbon age (years) | ± | age range cal. BP (95.4%) |
|---|---|---|---|---|---|---|---|---|
| S16 JAR A2 | C14-1 | 1 | 53113 | 16877 | charcoal | 230 | 23 | 309–0 |
| S18 JAR A2 | n/a | 2–3 | 53114 | 16878 | charcoal | 144 | 24 | 282–5 |
| S19 JAR A3 | C14-2 | 2–3 | 53116 | 16879 | charcoal | 191 | 23 | 293–0 |
| S20 JAR A3 | C14-3 | 2–3 | 53117 | 16880 | charcoal | 175 | 24 | 289–0 |
| S21 JAR A4 | C14-4 | 4 | 53118 | 16881 | charcoal | 205 | 23 | 302–0 |
| S22 JAR A4 | C14-5 | 4 | 53121 | 16882 | charcoal | > Modern | — | — |
| S23 JAR A6 | C14-7 | 4 | 53123 | 16883 | charcoal | > Modern | — | — |
| S24 JAR A6 | C14-8 | 4 | 53124 | 16884 | charcoal | 225 | 23 | 308–0 |
| S25 JAR A6 | C14-9 | 4 | 53125 | 16885 | charcoal | 232 | 23 | 310–0 |
| S26 JAR A7 | C14-11 | 5 | 53126 | 16886 | charcoal | 250 | 23 | 423–151 |
| S27 JAR A7 | C14-12 | 5 | 53127 | 16887 | charcoal | 215 | 23 | 304–0 |
| S28 JAR A7 | C14-13 | 5 | 53129 | 16888 | charcoal | 265 | 25 | 429–152 |
| S30 JAR A8 | C14-14 | 5 | 53130 | 16890 | charcoal | 248 | 24 | 423–0 |
| S27 JAR A7 [a] | n/a | 5 | 53133 | 16902 | charcoal | 208 | 23 | 303–0 |
| S34 JAR A9 | C14-15 | 5 | 53136 | 16894 | charcoal | 242 | 23 | 420–0 |
| S31 JAR A11 | C14-16 | 6 | 53131 | 16891 | charcoal | 1548 | 24 | 1524–1384 |
| S32 JAR A12 | C14-17 | 6 | 53132 | 16892 | charcoal | 236 | 23 | 310–0 |
| S35 JAR A14 | C14-18 | 7 | 53137 | 16895 | charcoal | 1343 | 24 | 1305–1187 |
| S36 JAR A18 | C14-20 | 7 | 53138 | 16896 | charcoal | 1863 | 24 | 1807–1725 |
| S37 JAR A19 | C14-21 | 7 | 53139 | 16897 | charcoal | 1773 | 24 | 1807–1612 |

[a] duplicate

**Table 2**. Jareng Bori materials recovered (bone, marine shell, chert, obsidian, pottery, charcoal, seed, and wood), sediment volume (before sieving/bucket weight) and residue weight (discarded material in field after sieving and field sorting), by spit and layer.

| layer | spit | bone (NISP) | marine shell (NISP) | chert (n) | obsidian (n) | pottery (n) | charcoal (g) | seed (g) | wood (g) | bucket weight (g) | residue (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| surface | — | — | — | — | — | 5 | — | — | — | — | — |
| 1 | A01 | 212 | 52 | 11 | 6 | 86 | 6.3 | 69.3 | 0.02 | 80.3 | 6.4 |
| 2–3 | A02 | 182 | 72 | 1 | 1 | 78 | 2.3 | 84.2 | 0.09 | 57.4 | 5.7 |
| | A03 | 185 | 57 | 1 | 2 | 187 | 13.6 | 91.9 | — | 71.2 | 6.7 |
| 4 | A04 | 322 | 152 | — | — | — | 7.3 | 28.7 | — | 77.6 | 9.8 |
| | A05 | 520 | 259 | 1 | — | 277 | — | 7.1 | — | 66.2 | 9.9 |
| | A06 | 170 | 408 | — | — | 186 | 3.7 | — | — | 67.2 | 10.2 |
| 5 | A07 | 432 | 546 | — | — | 178 | 8.9 | — | — | 62.1 | 11.0 |
| | A08 | 381 | 379 | 3 | 1 | 42 | 3.8 | 0.1 | — | 49.5 | 8.2 |
| | A09 | 402 | 215 | — | — | 355 | 4.2 | — | — | 41.0 | 4.8 |
| 6 | A10 | 693 | 245 | — | — | 216 | 7.6 | 0.1 | — | 25.7 | 8.1 |
| | A11 | 584 | 372 | — | — | 153 | 2.3 | — | — | 41.7 | 5.8 |
| | A12 | 666 | 402 | 6 | 4 | 151 | 3.4 | — | — | 34.2 | 3.6 |
| 7 | A13 | 413 | 171 | — | — | 90 | — | — | — | 30.7 | 3.5 |
| | A14 | 1393 | 676 | 3 | — | 412 | 29.6 | — | — | 60.5 | 9.2 |
| | A15 | 809 | 345 | 2 | 1 | 180 | 9.2 | — | — | 26.7 | 5.6 |
| | A16 | 472 | 182 | 2 | — | 102 | 39.9 | — | — | 28.4 | 4.0 |
| | A17 | 348 | 256 | 1 | — | 52 | 1.9 | — | — | 37.4 | 5.3 |
| | A18 | 144 | 71 | — | — | 17 | 1.4 | — | — | 13.0 | 2.1 |
| | A19 | 360 | 164 | — | 1 | 83 | 40.7 | <0.1 | — | 26.1 | 6.9 |
| | A20 | 146 | 65 | — | — | 16 | 0.2 | — | — | 11.6 | 1.6 |
| | A21 | 124 | 9 | — | — | 5 | — | — | — | 12.9 | 1.8 |
| burial | — | — | 1 | — | — | — | — | — | — | — | — |
| total | — | 8958 | 5099 | 31 | 16 | 2871 | 186.2 | 281.4 | 0.1 | 921.5 | 130.3 |

**Figure 4**. Jareng Bori late historic burial c. 0–429 cal. BP layers 4–5 (spits 6–9). Scale bar: 20 cm units.

(groupers), labrids (wrasses), holocentrids (squirrelfishes), and muraenids (moray eels). The proportions of herbivorous and omnivorous fishes versus carnivorous fishes are higher in the upper three layers, however, there are no statistically significant changes over the course of the entire sequence ($\chi^2_{trend}$ = 2.443, p = 0.118; $\chi^2_{departure}$ = 5.202, p = 0.267).

## Invertebrates

The major molluscan taxa are summarized in Fig. 5 and their habitats in Fig. 6. Table 4 summarizes all results by NISP (see also appendices for results by NISP [Appendix 1], MNI [Appendix 2] and weight [Appendix 3]). Marine shellfish occurred from the surface to the base in spit 21 (square A, total NISP = 5099; MNI = 1176; weight = 3595.1 g), with a peak in MNI, NISP and weight in spit 14, during the middle occupation period. Terrestrial gastropods were found in small quantities throughout, totalling 96.3 g, also peaking in spit 14 (12.2 g). At least 79 species of marine molluscs were identified from a range of marine habitats including rocky and coral reef intertidal zones, deep water, sea grass flats near reefs and mangrove zones. Rocky and coral reef zones dominate throughout the sequence. The most abundant species, *Nerita polita* (NISP 2036, MNI 486, weight 362.1 g), comprised almost half of the assemblage by NISP and MNI, of which many specimens were juvenile, indicating frequent harvesting of this species.

Crab occurs from the surface to spit 20 (NISP = 406; weight = 14.0 g). At least nine different taxa were identified from a range of terrestrial (Ocypodidae, Paguroidea), marine (Cirripedia, *Etisus* sp.), and mangrove environments (Portunidae: *Scylla* sp., *Thalamita crenata*). The dominant taxon is Paguroidea (hermit crab) (NISP = 207), representing more than the half of the assemblage. The intertidal dwelling barnacle *Megabalanus* sp. was identified in spits 5, 8 and 10 (total = 2.3 g). Sea urchin was also recovered in small amounts (spits 5, 6, 7, 9, 10–15, 17, 19, 20, total = 4.2 g).

## Late historic burial

The burial (Fig. 4) was poorly preserved, and disturbed post-deposition by rockfall, tree roots, and ant nests. It was first encountered in layer 3 (between spits 6–9) and appears to have been dug as a shallow grave through layer 4 in the southern side of the square. The sediment around the burial was excavated separately within each spit as a burial unit although the burial fill could not be distinguished during excavation. The burial, which had filing of the front teeth (filed labial and occlusal surfaces of the upper first and second incisors) (Fig. 7), was in the flex position. More details of this burial with regards to the specifics of tooth ablation, dietary reconstruction, ancestry, stature, sex, and age will be presented in a subsequent paper.

**Table 3**. Jareng Bori vertebrate fauna. Number of Identified Specimens (NISP) by spit.

| | spit | | | | | | | | | | | | | | | | | | | | | total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| taxon | A01 | A02 | A03 | A04 | A05 | A06 | A07 | A08 | A09 | A10 | A11 | A12 | A13 | A14 | A15 | A16 | A17 | A18 | A19 | A20 | A21 | (NISP) |
| **Fish** | | | | | | | | | | | | | | | | | | | | | | |
| Acanthuridae | 1 | — | — | 1 | 1 | — | 3 | — | 1 | 4 | 7 | 2 | 2 | 5 | 4 | 4 | 4 | — | 3 | — | — | 42 |
| Balistidae | — | — | — | 2 | 4 | — | 10 | 5 | 1 | 4 | 8 | 13 | 6 | 19 | 7 | 1 | — | 2 | 4 | 5 | — | 91 |
| Belonidae | — | — | — | — | — | 1 | — | — | 1 | 1 | — | 2 | 1 | — | 1 | — | — | — | — | — | — | 7 |
| Carangidae | — | — | — | — | — | — | — | — | — | 3 | — | — | — | — | 1 | — | — | — | 1 | — | — | 5 |
| Carcharhinidae | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | 1 |
| Holocentridae | — | — | 1 | — | — | — | 4 | 1 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | — | — | — | 4 | — | — | 24 |
| Diodontidae | 8 | — | 5 | 4 | 6 | — | 3 | 2 | 2 | 4 | 5 | — | — | 1 | 0 | — | — | — | 1 | — | — | 41 |
| Labridae | 1 | — | — | 1 | — | — | — | 1 | 2 | — | 2 | 7 | 1 | 7 | 2 | 1 | 3 | — | — | — | — | 28 |
| Lethrinidae | — | — | — | — | 1 | 1 | 3 | — | 2 | — | 1 | 2 | — | 1 | 0 | — | — | — | — | — | — | 11 |
| Lutjanidae | — | — | — | — | — | — | 1 | — | — | 1 | 2 | — | — | — | 0 | 1 | — | — | — | — | — | 5 |
| Muraenidae | — | — | — | — | — | — | 1 | 1 | — | 1 | 2 | 4 | 1 | — | 2 | — | 3 | — | 4 | 1 | — | 20 |
| Mullidae | — | — | — | — | — | — | — | — | — | — | — | 1 | — | 1 | 1 | — | — | — | — | — | — | 3 |
| Ostraciidae | — | — | — | 1 | 2 | 1 | — | 5 | 4 | 6 | 8 | 4 | 2 | 14 | 2 | — | 1 | 3 | 1 | — | — | 54 |
| Scaridae | — | — | — | 2 | 1 | 1 | 1 | — | — | — | 2 | — | 1 | 6 | 1 | — | — | — | 1 | — | — | 16 |
| Serranidae | 1 | — | 1 | 1 | 1 | — | 3 | 2 | 4 | 4 | 2 | 2 | 1 | 6 | 8 | 1 | 3 | — | — | — | — | 40 |
| Sphyraenidae | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | 1 |
| Actinopterygii | 84 | 98 | 92 | 165 | 287 | 131 | 309 | 293 | 275 | 608 | 506 | 602 | 380 | 1289 | 758 | 459 | 330 | 133 | 325 | 135 | 123 | 7382 |
| **Birds** | | | | | | | | | | | | | | | | | | | | | | |
| Passeriformes large | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| Unidentified | 3 | 2 | 1 | 5 | 5 | 2 | 3 | 1 | 0 | 6 | — | — | — | — | — | — | — | — | 3 | — | — | 31 |
| **Amphibians** | | | | | | | | | | | | | | | | | | | | | | |
| Anura | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | 1 |
| **Reptiles** | | | | | | | | | | | | | | | | | | | | | | |
| Lacertilia | 9 | 8 | 5 | 7 | 5 | — | 2 | 3 | 2 | — | 3 | 4 | 1 | 3 | 7 | 2 | 1 | 1 | 1 | — | — | 64 |
| Chelonioidea | — | — | — | — | — | 1 | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | 2 |
| Serpentes | 9 | 6 | 14 | 6 | 9 | — | 1 | 3 | 2 | 1 | 2 | — | 1 | — | 1 | — | — | — | 3 | — | — | 58 |
| **Mammals** | | | | | | | | | | | | | | | | | | | | | | |
| Chiroptera | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | 1 |
| Pteropodidae | — | 2 | — | — | — | — | — | 2 | 1 | — | — | — | — | — | — | — | — | — | — | — | — | 5 |
| *Sus scrofa* | 1 | 1 | — | 1 | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 4 |
| *Canis familiaris* | — | — | — | — | — | — | — | — | — | — | — | 1 | — | 1 | — | — | — | — | — | — | — | 2 |
| Carnivora | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | 1 |
| *Homo sapiens* | — | — | — | — | — | — | — | — | — | 2 | — | — | — | — | — | — | — | — | — | — | — | 2 |
| Muridae small | 6 | 6 | 11 | 16 | 10 | 1 | 4 | 5 | 7 | 8 | 7 | 4 | 1 | 7 | 4 | 1 | 3 | 2 | 8 | 5 | 1 | 117 |
| Muridae large | — | — | — | — | — | — | — | — | — | — | — | — | — | 3 | — | — | — | — | — | — | — | 3 |
| *Melomys* | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Rattus* | 5 | 7 | 3 | 4 | 5 | 1 | — | — | 1 | 1 | — | — | — | — | — | — | — | — | — | — | — | 27 |
| Soricidae | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| medium mammal | 2 | — | 7 | 10 | 26 | 5 | — | 14 | 6 | 12 | 3 | — | 13 | 18 | 1 | — | — | — | — | — | — | 117 |
| mammal | — | — | — | — | — | — | — | — | — | — | 21 | — | — | — | — | — | — | — | — | — | — | 21 |
| **Tetrapod** | 82 | 52 | 44 | 95 | 155 | 25 | 84 | 43 | 89 | 24 | — | 16 | — | 9 | 4 | 2 | — | 3 | 1 | — | — | 728 |
| total (NISP) | 212 | 182 | 185 | 322 | 520 | 170 | 432 | 381 | 402 | 693 | 584 | 666 | 413 | 1393 | 809 | 472 | 348 | 144 | 360 | 146 | 124 | 8958 |

## Artefacts

### Shell tools

Shell scrapers were found from spits 5–16, manufactured on bivalves (*Asaphis violascens* and *Pitar* sp.) and univalves (*Cellana testudinaria*) (see Fig. 8). Two examples of *Tridacna* were also found, and may represent potential adzes, however, these specimens are too weathered to conclusively ascertain use-wear traces.

### *Shell and glass bead ornaments*

*Nautilus* shell fragments were recovered from spits 4–17 and two *Nautilus* disc-beads, one single hole and one double hole (spit 10), were identified. A single oblate black glass bead was found in spit 4.

### Ceramics

Ceramics were recovered throughout the sequence with the highest concentration in spit 14 during the middle occupation period (Table 5–6). Of the total 2871 samples, 933 were analysed in detail; 836 sherds have weights above or equal to 1 g (29% of the collection), 81 (of which 46 are under 1 g) sherds are decorated, 44 are slipped, 79 are black-burnished and 48 are fragments of vessel rims (Table 5).

**Technology**. The majority of the assemblage analysed (724 sherds; 82%) is composed of medium-paste earthenware vessel fragments with a predominance of medium to fine sand mineral inclusions (0.125–0.25 mm) within their fabric. Occasionally, stray coarse sand (0.5–1 mm) to granule (2–4 mm) mineral inclusions are present, but they are usually low in frequency. This results in a relatively "rough" surface texture on both exterior and interior surfaces, but this "roughness" is often mitigated by smoothing or burnishing (surface treatment does not appear

**Table 4**. Jareng Bori marine molluscs, number of identified specimens (NISP). See Appendices 2 and 3, for MNI and weight.

| taxon | spit | | | | | | | | | | | | | | | | | | | | | | | | | burial | total (NISP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A01 | A02 | A03 | A04 | A05 | A06 | A06 (B) | A07 | A07 (B) | A08 | A08 (B) | A09 | A09 (B) | A10 | A11 | A12 | A13 | A14 | A15 | A16 | A17 | A18 | A19 | A20 | A21 | | |
| *Acanthopleura* sp. | 3 | 5 | 2 | 10 | 26 | 53 | 4 | 52 | 18 | 23 | 10 | 6 | 16 | 25 | 38 | 41 | 16 | 49 | 33 | 14 | 16 | 7 | 6 | 2 | 1 | — | 476 |
| *Cryptoplax* sp. 1 | — | — | — | — | 1 | 3 | — | — | — | 2 | — | 1 | — | — | 3 | 1 | — | — | 1 | 1 | — | — | — | — | — | — | 13 |
| *Cryptoplax* sp. 2 | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Haliotis* sp. | 1 | — | — | 1 | 3 | 2 | — | 3 | — | 2 | 1 | 2 | 1 | 3 | 4 | 3 | 3 | 5 | 1 | 4 | 8 | 2 | 3 | — | — | — | 52 |
| *Patella* sp. | — | — | 2 | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 3 |
| *Cellana testudinaria* | — | — | — | — | 2 | 14 | — | — | — | 4 | — | — | — | 1 | 1 | 2 | — | 4 | — | 1 | — | — | — | — | — | — | 29 |
| *Trochus maculatus* | 3 | — | — | 9 | — | — | 1 | — | 17 | 12 | — | — | 6 | 11 | 14 | — | 13 | 39 | 12 | 15 | 21 | 3 | 14 | 6 | 1 | — | 197 |
| *Trochus* sp. | 1 | 7 | 4 | — | 17 | 34 | — | 11 | — | — | 4 | 1 | — | — | — | 19 | — | — | — | — | — | — | — | 3 | — | — | 101 |
| *Tectus fenestratus* | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 5 | — | — | — | — | — | 6 |
| *Tectus pyramis* | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Rochia nilotica* | — | — | 1 | 6 | 1 | 2 | — | — | — | 15 | — | 3 | — | 8 | 15 | — | — | 14 | 15 | 8 | 6 | 4 | 8 | 2 | 1 | — | 109 |
| *Monodonta canalifera* | 2 | — | — | 3 | 1 | — | — | 2 | — | — | — | — | — | — | 4 | — | 1 | 5 | — | 1 | 1 | — | — | — | — | — | 20 |
| *Turbo chrysostomus* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 3 | — | — | — | — | — | — | — | — | — | — | — | 3 |
| *Turbo setosus* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Turbo* sp. | 3 | — | 1 | — | — | 6 | — | 3 | 1 | 9 | — | — | 2 | 7 | 16 | — | 6 | 13 | 6 | 5 | 1 | — | — | — | — | — | 79 |
| Turbinidae operculum | 2 | 3 | 2 | 10 | 23 | 11 | 1 | 6 | 7 | 11 | 3 | 1 | 1 | 4 | 13 | 10 | 2 | 11 | 4 | 2 | 3 | — | 3 | 1 | — | — | 134 |
| *Lunella cinerea* | — | 2 | 2 | — | — | 2 | — | — | 1 | — | — | — | — | — | — | — | 1 | — | 1 | — | 1 | — | — | — | — | — | 10 |
| *Angaria delphinus* | — | — | 1 | 2 | 1 | — | — | — | — | 1 | 2 | — | — | 1 | — | 1 | — | 3 | — | — | — | — | — | — | — | — | 12 |
| *Liotinaria peronii* | — | 1 | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 |
| *Neritopsis radula* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | 1 |
| *Nerita albicilla* | — | — | 2 | 2 | 4 | 2 | — | — | — | — | — | — | — | 1 | — | 1 | 2 | 6 | — | 4 | — | — | 1 | — | — | — | 25 |
| *Nerita balteata* | 7 | 6 | 3 | 1 | 4 | 9 | 1 | 2 | 4 | 3 | — | 2 | 5 | 2 | 3 | 10 | 1 | 7 | 5 | 2 | — | 5 | 1 | — | — | — | 83 |
| *Nerita chamaeleon* | — | — | 1 | — | 3 | 1 | 1 | 4 | — | 1 | — | — | 2 | 1 | — | 1 | — | — | — | 1 | 1 | — | — | — | — | — | 17 |
| *Nerita exuvia* | 4 | 7 | 1 | 14 | 26 | 15 | — | 24 | 11 | 7 | 5 | 3 | 5 | 20 | 21 | 33 | 13 | 56 | 43 | 17 | 56 | 11 | 31 | 9 | — | — | 432 |
| *Nerita grossa* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | 1 | — | — | — | — | 2 |
| *Nerita plicata* | — | 3 | 1 | 2 | 2 | 15 | 2 | 14 | 4 | 13 | 2 | 26 | 6 | 4 | 14 | 12 | 6 | 19 | 5 | 5 | 3 | — | 6 | — | — | — | 164 |
| *Nerita polita* | 12 | 18 | 15 | 31 | 47 | 133 | 18 | 175 | 61 | 127 | 34 | 26 | 70 | 99 | 124 | 211 | 76 | 321 | 148 | 59 | 97 | 35 | 64 | 31 | 4 | — | 2036 |
| *Nerita undata* | — | — | 1 | 2 | — | 1 | — | — | — | — | 1 | — | — | — | 2 | — | 1 | — | — | — | — | — | 1 | — | — | — | 9 |
| Neritidae operculum | — | — | — | — | — | 2 | 1 | 4 | — | — | — | — | 4 | — | 1 | 16 | 2 | 12 | 8 | 6 | 6 | — | 4 | 5 | 1 | — | 72 |
| *Indomodulus tectum* | — | — | — | — | 1 | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 |
| *Clypeomorus bifasciata* | 2 | — | — | — | — | — | — | — | — | 2 | — | — | — | — | — | — | — | — | 3 | — | — | — | — | — | — | — | 7 |
| *Clypeomorus irrorata* | — | — | — | — | — | 2 | 1 | — | — | — | — | — | — | 2 | — | — | — | — | — | — | — | — | — | — | — | — | 5 |
| *Clypeomorus subbrevicula* | — | — | 1 | 4 | 2 | 3 | — | 3 | — | — | — | — | — | 4 | 6 | — | 4 | — | 1 | — | — | — | — | — | — | — | 28 |
| *Clypeomorus* sp. | — | — | — | — | — | — | — | 2 | — | 3 | 1 | 2 | — | — | 4 | — | — | — | — | — | 4 | — | — | — | — | — | 16 |
| *Opalia* sp. | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Cerithium nodulosum* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 4 | — | — | — | — | — | — | — | — | — | — | — | 4 |
| *Cerithidea* sp. | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Canarium labiatum* | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Gibberulus gibberulus gibbosus* | — | — | — | — | 2 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 | |
| *Strombus* sp. | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | 2 | — | 3 | — | 11 | — | — | — | — | — | — | 17 |
| *Lambis lambis* | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | 1 | — | — | 1 | — | — | — | — | — | 3 |
| Cypraeidae | — | — | 1 | 8 | — | 4 | 1 | 4 | — | 1 | — | — | — | 2 | 2 | 4 | — | 5 | 2 | 5 | 4 | — | 3 | — | — | — | 46 |
| *Turritriton labiosus* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | 1 |
| *Monoplex vespaceus* | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Chicoreus* sp. | — | — | — | — | — | — | — | 2 | — | 1 | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | 4 |
| *Indothais* sp. | — | — | — | — | — | — | — | — | — | 5 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 5 |
| *Thais* sp. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | 1 |
| Muricidae | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 | — | — | — | — | — | — | — | — | 3 |
| *Orania nodosa* | — | — | — | — | — | — | — | — | — | 3 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 3 |
| *Nassa serta* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 | — | — | — | — | — | — | — | — | — | — | — | 2 |
| *Prodotia* sp. | — | — | — | 2 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 |
| *Euplica turturina* | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | 2 |
| *Nassarius albescens* | 1 | — | — | 1 | 2 | 1 | — | 1 | — | — | — | — | — | — | — | 1 | — | 1 | — | — | — | — | — | — | — | — | 8 |
| *Nassarius globosus* | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Nassarius leptospirus* | — | — | 1 | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 |
| *Nassarius shacklefordi* | — | — | 1 | — | — | — | 2 | 2 | 3 | 2 | 1 | — | 1 | 1 | 3 | — | — | — | 1 | — | — | — | 2 | — | — | — | 19 |
| *Latirolagena smaragdulus* | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Vasum turbinellus* | — | — | 1 | — | — | 1 | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | 3 |
| *Oliva* sp. | 2 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 |
| Harpidae | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Cymbiola vespertilio* | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Lophiotoma acuta* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | 1 |
| *Conus litteratus* | — | — | — | — | 1 | — | — | — | — | — | — | — | — | 1 | — | — | — | — | 1 | — | — | — | 1 | — | — | — | 4 |
| *Conus marmoreus* | — | 1 | — | — | 1 | — | — | — | — | — | 1 | — | — | 1 | 1 | — | — | 2 | 3 | — | — | — | — | 1 | — | — | 11 |
| *Conus textilis* | — | — | — | — | 1 | — | — | 2 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 3 |
| *Conus* sp. | 2 | 5 | 2 | 13 | 18 | 19 | — | 5 | 8 | 5 | — | 4 | — | 6 | 24 | 5 | 6 | 11 | 12 | 2 | 7 | 2 | 7 | 3 | — | — | 166 |
| *Siphonaria atra* | — | — | — | 4 | 11 | 9 | — | 9 | 7 | 5 | 2 | 2 | 6 | 5 | 9 | 4 | — | 10 | 6 | — | 3 | — | — | — | — | — | 92 |
| *Barbatia* sp. | — | — | 1 | 4 | 1 | 3 | — | — | 7 | — | — | — | 1 | 9 | — | — | — | 4 | 5 | — | — | 1 | — | — | — | — | 36 |
| *Austriella corrugata* | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Septifer bilocularis* | — | — | — | 1 | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 |
| *Pinna* sp. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 6 | — | — | — | — | — | 6 |
| *Pinctada margaritifera* | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Isognomon ephippium* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | 2 | — | — | — | — | — | — | — | 3 |
| *Codakia* sp. | 2 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 |
| *Vasticardium subrugosum* | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Vasticardium* sp. | — | — | 1 | 1 | 3 | — | — | 1 | — | 3 | 1 | 1 | — | 1 | 3 | 4 | — | 3 | 3 | 1 | 1 | — | 1 | — | — | — | 28 |
| *Tridacna* sp. | 1 | 7 | 5 | 13 | 31 | 16 | — | 10 | 8 | 27 | — | — | — | 9 | 4 | 2 | 5 | 3 | — | 2 | — | — | 1 | — | — | — | 144 |
| *Gari elongata* | — | — | — | 2 | 3 | 2 | — | 17 | 16 | 12 | 2 | 2 | 4 | 8 | 2 | 5 | 1 | 19 | 13 | 10 | 1 | — | — | — | — | — | 119 |
| *Asaphis violascens* | 3 | 2 | 1 | — | 7 | 2 | — | 2 | — | 1 | — | — | — | 6 | 12 | 10 | 5 | 18 | 1 | — | — | — | 7 | — | — | — | 77 |
| *Periglypta puerpera* | — | 2 | 2 | 1 | 6 | 2 | — | 1 | 2 | 5 | 2 | — | — | 2 | 5 | 3 | 3 | — | — | — | — | — | — | — | — | — | 36 |
| *Periglypta* sp. | — | — | — | 2 | — | — | — | — | 2 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 4 |
| *Pitar* sp. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | 1 |
| *Dosinia* sp. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | 1 |
| *Bivalvia* sp. | — | — | — | — | 7 | — | 1 | 1 | — | — | — | — | — | — | 12 | — | 4 | 28 | 6 | 4 | 2 | — | — | 2 | 1 | — | 68 |
| *Nautilus* sp. | — | — | — | 1 | — | — | — | 1 | — | — | 1 | — | — | 1 | — | — | — | — | — | — | 2 | — | — | — | — | 1 | 7 |
| total (NISP) | 52 | 72 | 57 | 152 | 259 | 374 | 34 | 368 | 178 | 306 | 73 | 82 | 133 | 245 | 372 | 402 | 171 | 676 | 345 | 182 | 256 | 71 | 164 | 65 | 9 | 1 | 5099 |

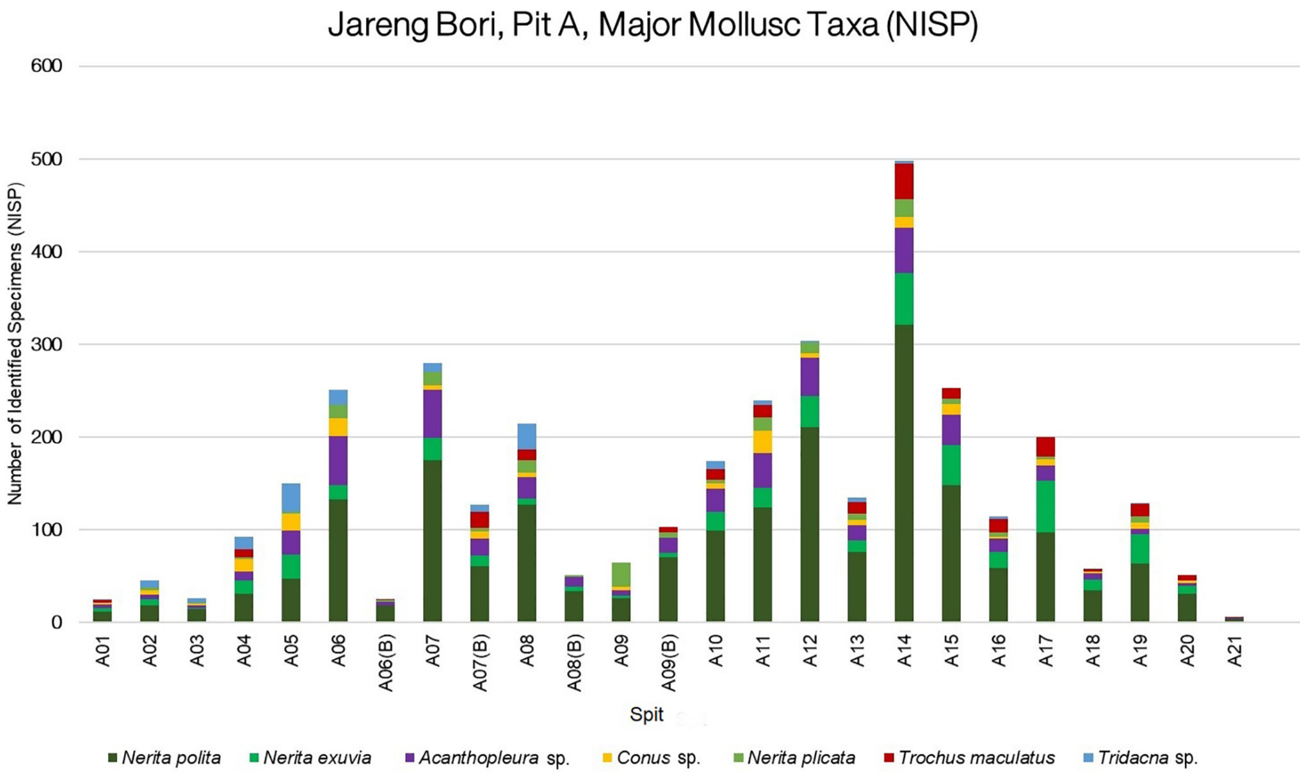


**Figure 5**. Major mollusc taxa (NISP) at Jareng Bori.

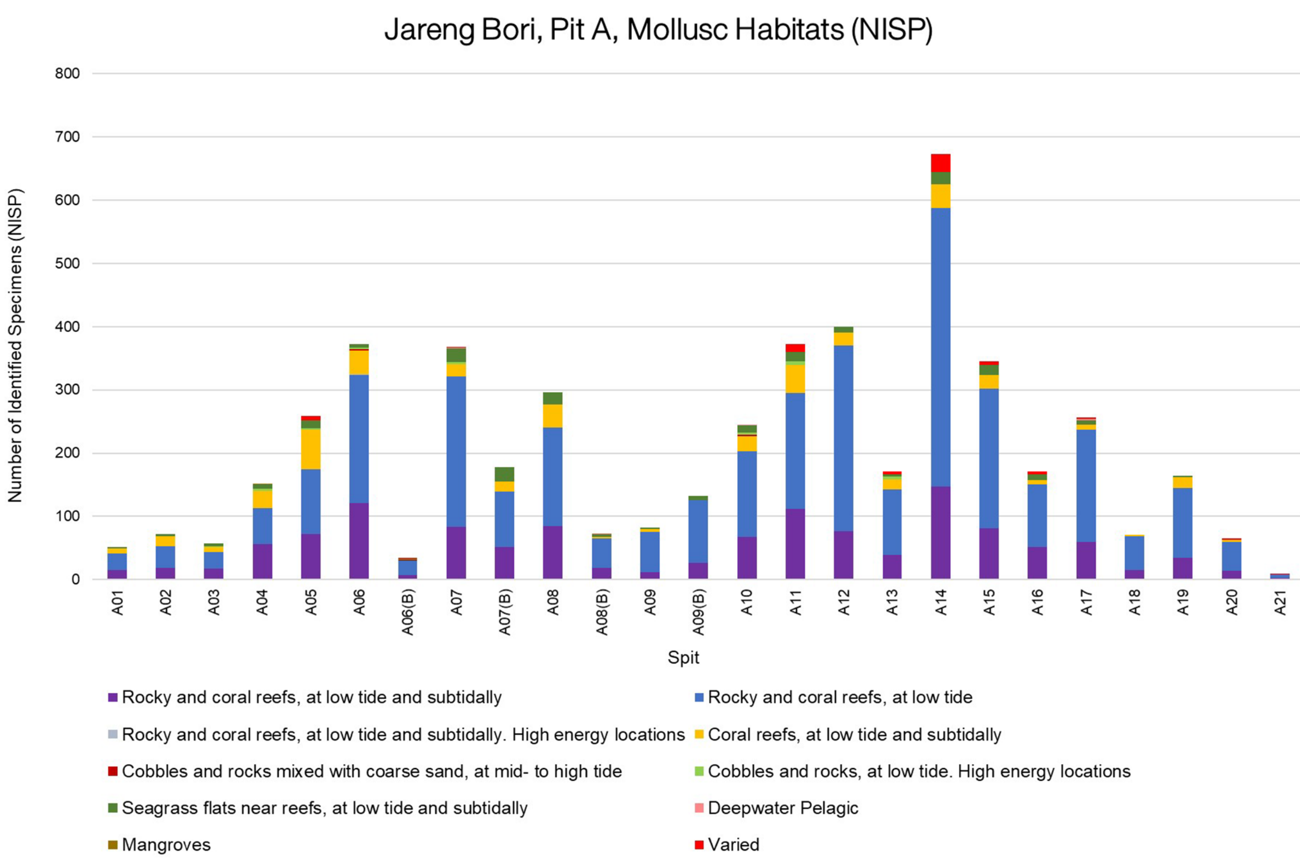


**Figure 6**. Mollusc habitats (NISP) at Jareng Bori.


**Figure 7**. Cultural dental filing of the labial and occlusal surfaces of the upper first and second incisors recorded on the human burial at Jareng Bori (photo: Fayeza Shasliz Arumdhati).

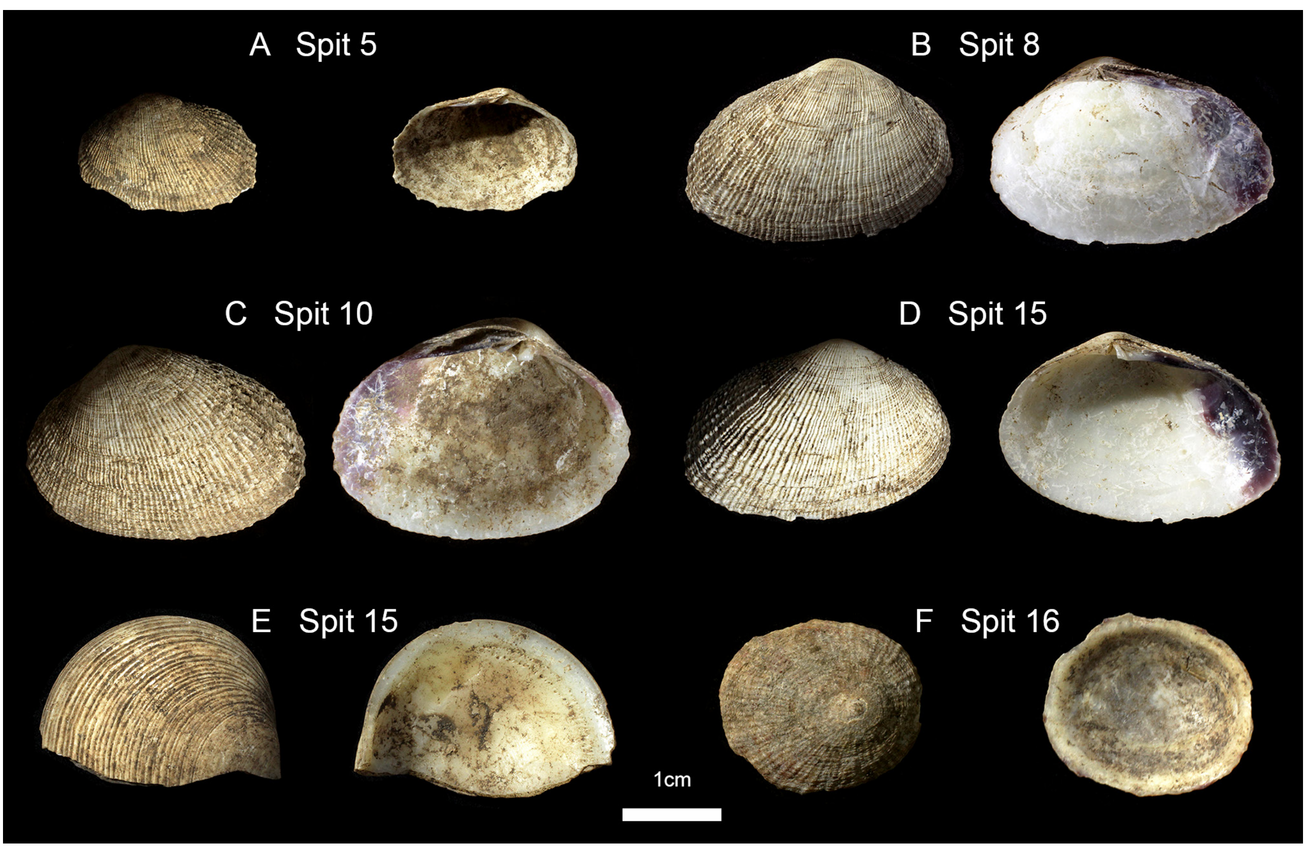


**Figure 8**. Shell scrapers manufactured from (*A–D*) *Asaphis violascens* (spits 5, 8, 10 and 15); (*E*) *Pitar* sp. (spit 15); and (*F*) *Cellana testudinaria* (spit 16) from Jareng Bori.

**Table 5**. Jareng Bori ceramics by layer and spit.

| $^{14}$C date | layers/context | spits | sherds >1g | | decorated sherds | slipped sherds | rim sherds |
|---|---|---|---|---|---|---|---|
| | | | number | weight | number | number | number |
| 430–0 cal. BP (Period 3) | surface | surface | 5 | 160 | 4 | | 3 |
| | 1 | A01 | 24 | 51.6 | 3 | 2 | 3 |
| | 2 | A02 | 22 | 43.7 | 1 | | |
| | 3 | A03 | 55 | 95 | 6 | 2 | 4 |
| | 4 | A04 | | | | | |
| | | A05 | 76 | 153.5 | 3 | | 2 |
| | | A06 | 67 | 182.9 | 5 | 1 | 4 |
| | 5 | A07 | 51 | 135.8 | 6 | 3 | 3 |
| | | A08 | 12 | 62 | 4 | 1 | 1 |
| | | A09 | 115 | 221.3 | 8 | 2 | 7 |
| | burial | A07–A09 | 28 | 58 | 8 | | |
| | 6 | A10 | 54 | 87 | 9 | 2 | 3 |
| | | A11 | 24 | 53 | 2 | 1 | 2 |
| | | A12 | 38 | 89.9 | 3 | 1 | 1 |
| — | 7 | A13 | 29 | 73.3 | 2 | 1 | |
| 1365–1187 cal. BP (Period 2) | | A14 | 120 | 294.8 | 6 | 3 | 8 |
| — | | A15 | 45 | 101.4 | 5 | 4 | 3 |
| | | A16 | 31 | 70.2 | 1 | 8 | 4 |
| | | A17 | 15 | 35.3 | 2 | 1 | |
| | | A18 | 3 | 9.8 | 1 | | |
| | | A19 | 15 | 25.2 | 2 | 10 | |
| 1807–1612 cal. BP (Period 1) | | A20 | 6 | 9.7 | | 2 | |
| | | A21 | 1 | 1.6 | | | |
| | | total | 836 | 2015 | 81 [a] | 44 [b] | 48 [c] |

[a] 31 sherds under 1 g
[b] 20 sherds under 1 g
[c] 11 sherds under 1 g

**Table 6**. Jareng Bori ceramic decoration data by spit, number of ceramic sherds.

| spit | appliqué | black matrix with white flat inclusions | painting | impressing | incising | moulding | moulding and incising | punctuation | painted and pointillé | moulding-carving | moulding-carving and impressing | moulding-carving and incising |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| surface | — | — | — | — | — | — | — | — | — | 3 | — | 1 |
| A01 | — | — | — | — | 2 | 1 | — | — | — | — | — | — |
| A02 | — | 1 | — | — | — | — | — | — | — | — | — | — |
| A03 | — | — | 2 | 1 | 1 | 1 | — | — | — | 1 | — | — |
| A05 | — | 2 | — | — | 1 | — | — | — | — | — | — | — |
| A06 | — | 1 | 1 | 1 | 1 | 1 | — | — | — | — | — | — |
| A07 | — | — | 1 | — | 2 | — | — | 1 | — | 1 | 1 | — |
| A08 | — | — | — | — | 3 | — | — | — | — | 1 | — | — |
| A09 | — | 4 | — | 1 | — | 1 | — | 1 | — | 1 | — | — |
| A10 | — | — | 1 | 2 | 1 | 2 | — | — | — | 3 | — | — |
| A11 | 1 | — | — | — | 1 | — | — | — | — | — | — | — |
| A12 | — | — | — | — | 1 | 1 | — | — | — | 1 | — | — |
| A13 | — | — | — | — | 2 | — | — | — | — | — | — | — |
| A14 | 1 | — | — | — | 2 | 1 | 1 | — | 1 | — | — | — |
| A15 | — | — | — | — | 4 | — | 1 | — | — | — | — | — |
| A16 | — | — | — | — | 1 | — | — | — | — | — | — | — |
| A17 | — | — | — | 1 | 1 | — | — | — | — | — | — | — |
| A18 | — | — | — | — | — | — | — | 1 | — | — | — | — |
| A19 | — | — | — | — | 1 | 1 | — | — | — | — | — | — |
| total | 2 | 8 | 5 | 6 | 24 | 9 | 2 | 3 | 1 | 11 | 1 | 1 |

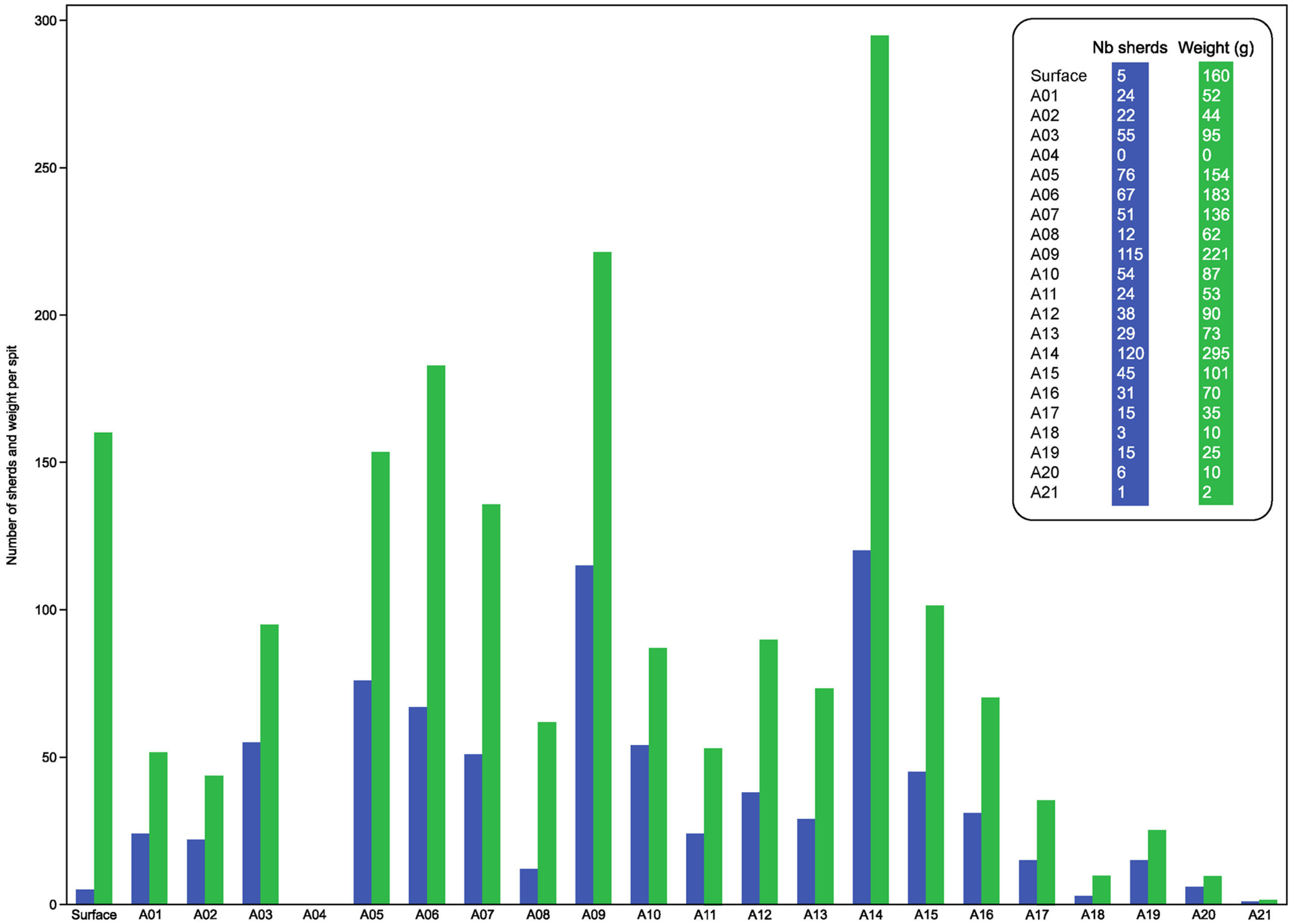


**Figure 9**. Vertical distribution of ceramics from Jareng Bori for sherds over 1 g.

to display any similar diachronic distribution patterns). Most share broadly similar technological features and are designated as the "general" variety of medium-paste earthenware. They are highly variable in sherd thickness (from 0.8–17.9 mm).

Seventy-nine medium-paste earthenware sherds appear to be fragments of "black-burnished" vessels with black exterior/interior surfaces and reduced cores. All but two of "black-burnished" sherds are body sherds with a relatively small range of sherd thicknesses varying from 1.4–6.2 mm. Only two black-burnished sherds are rim fragments and they have a comparably small range in thicknesses (from 2.8–6.2 mm). The rim diameter of one sherd is around 20 cm, whereas the other sherd was too small to derive a rim diameter estimate. Three "black-burnished" sherds display decorations, i.e., paint or punctation, the latter likely impressed through "rouletting" in one case.

Forty-four medium-paste earthenware sherds are slipped; 20 of them with black slips, 20 with red slips and four with light brown slips. Twelve samples have distinctively fine fabrics comprising of relatively small mineral inclusions (fine to very fine sand sizes 0.062–0.125 mm).

**Vertical distribution**. Ceramic artefacts were recovered across all seven stratigraphic layers except for spit 4 (Fig. 9). Most of the pottery analysed (645 sherds, 69%) was recovered from the latest occupation period (from the surface to spit 12). The vertical distribution of the pottery by weight and number of sherds per spit reveals the same pattern: a continuous occupation of the site from 1807–1612 cal. BP with two periods characterized by distinctively intensive pottery-related activity.

The initial occupation of the site is associated with very few pottery sherds (spits 20 to 21). The number of sherds per spit then gradually increases until it reaches its highest concentration in spit 14, dated to 1305–1187 cal. BP, which corresponds with the middle occupation period. There was then a sudden decline in ceramic frequency in spits 11–13, before a sharp increase in spits 9–10 that peaks with the most intensive phase of occupation during the late period dated to 430–0 cal. BP (spits 11–13 to 2). The low number of sherds recovered from spit 8 probably relates to the presence of the burial and therefore it is likely that the gap in frequency between both spits 12–9 and spits 7–3 does not represent two distinctive occupation episodes, as also suggested by the distribution of molluscan remains. Density of pottery remains is relatively stable throughout the late historic period, with a slight decreasing trend over time.

A wide range of decoration types can be found on the exterior surfaces of body sherds such as appliqué, burnishing, combing-incising, incising, impressing, moulding, moulding-carving, and painting (Table 6; Fig. 10). Regarding the distribution of decorative techniques across the stratigraphy, a few decorative types are associated with specific occupation periods (Table 6). Black-matrix-white-inclusions, moulding-carving, and painting are

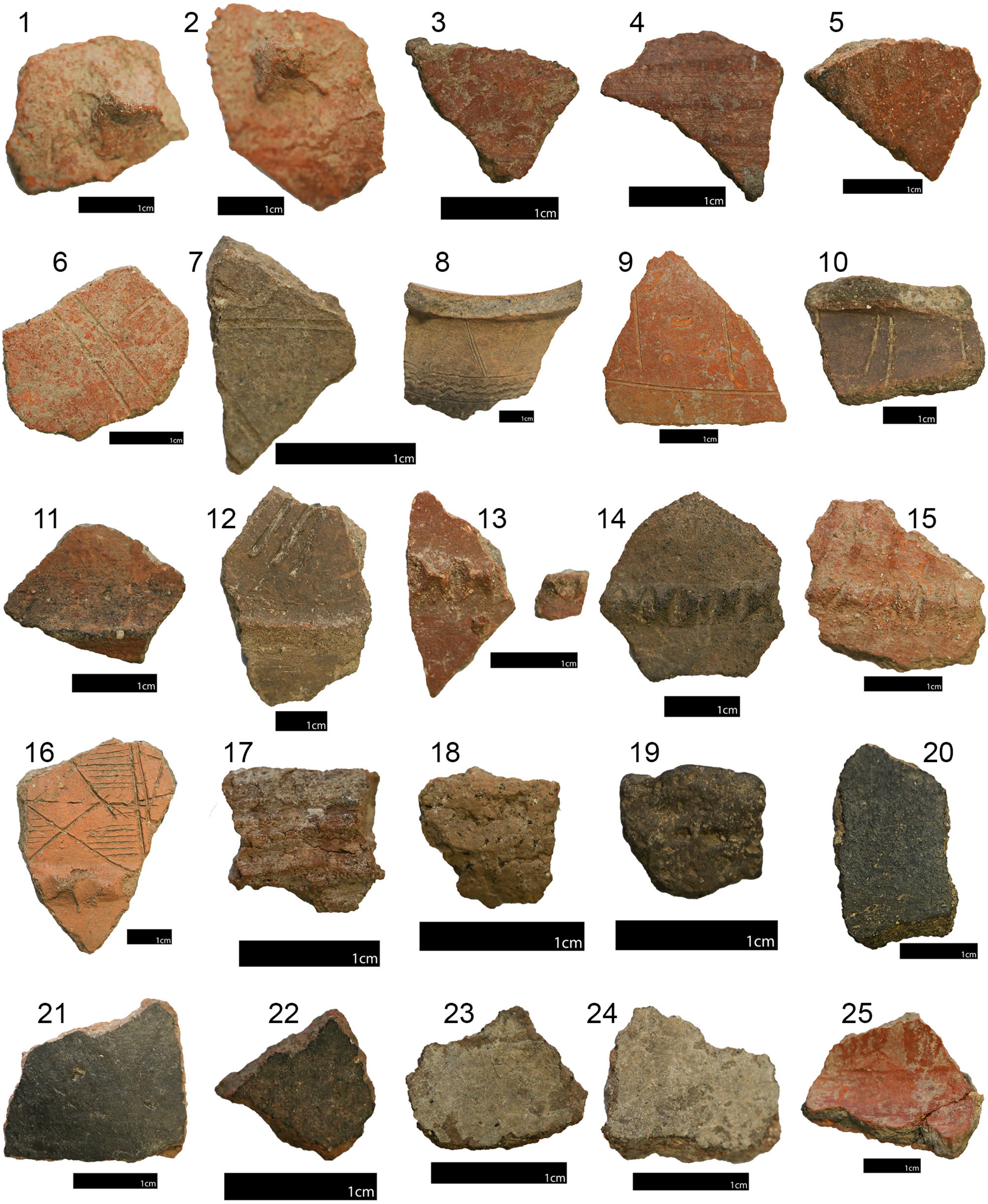


**Figure 10**. Representative sherds for the decorative styles on pottery from Jareng Bori: Appliqué (1–2); Burnishing (3–5); Incising (6–10); Moulding (11); Moulding & Incising (12); Moulding-carving (13–15); Moulding-carving & Incising (16); Impressing (17–18); Punctation (19); Black-burnished (19–20); Black slipped (21–22); Grey slipped (23–24); Red slipped (25).

found only in spits associated with the latest occupation period. On the other hand, the samples displaying appliqué and painted-pointillé are recorded only during period 2. No significant pattern can be identified from the other decorative techniques as they are found across the stratigraphy. Among other attributes noticeably changing through time, it is worth noting that there was a general trend for a slight increase in sherd thickness (Fig. 11) and more slipped samples, particularly with red slip, were recorded during occupation period 2 (Fig. 12).

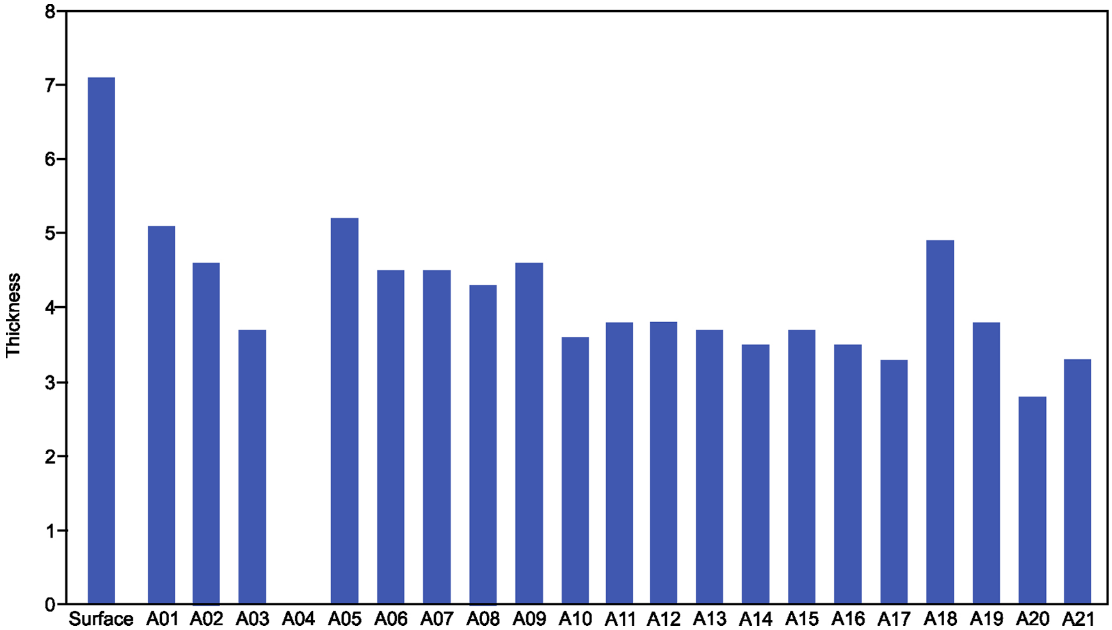


**Figure 11**. Average sherd thickness (mm) by spit at Jareng Bori.

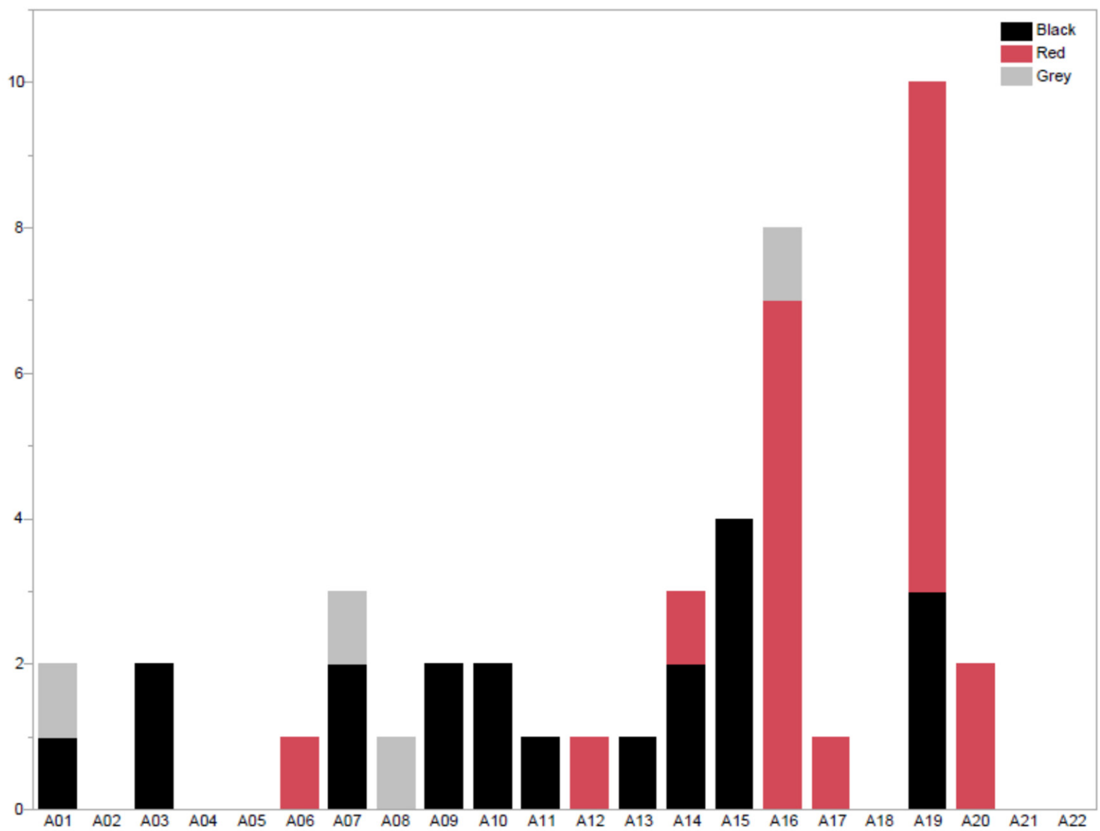


**Figure 12**. Slipped sherds by spit at Jareng Bori.

**Vessel form**. Only one base sherd has been preliminarily identified within the "general" medium-paste earthenware assemblage. Most of the estimated rim diameters appear to range from 13–20 cm, while the remainder have either small diameters measuring 10 cm or large diameters ranging from 30–38 cm. Even though few rim sherds are large enough to be informative of the vessel form, three main vessel forms are identified throughout the sequence (Fig. 13). Vessels with incurving rims, amongst which is one bearing a notched "pie-crust" lip (830), are recorded exclusively from the latest occupation period, in spits 6 and 7. The two other main vessel forms are recorded in spits 14 and 16 and are characterized, respectively, by out-curving rims with wide flat lips (836, 824, 2691) and inverted rims with a sharp angle on the exterior surface (841, 831, 828). Another element worth highlighting is the concave break


**Figure 13**. Rim sherds illustrating the range of straight, incurving, and out-curving rims at Jareng Bori. With the exception of the incurving notched pie-crust lip (844), out-curving rims (Surface) with wide flat lips (824, 2691) and inverted rims (841, 828), the fragmentary nature of the assemblage prevents further identification of vessel forms.

on the rim sherd 2407 that suggests that the lip was applied as a coil for some of the vessels.

A total of 28 earthenware sherds over 1 g were recovered from the burial context, however significant disturbance of the burial suggest that some are post-depositional intrusions. None of the generally very small sherds appear to belong to the same vessel. Their fragmentary nature suggests that these sherds are probably waste ceramics that were mixed into the grave fill during the process of excavating and backfilling the grave.

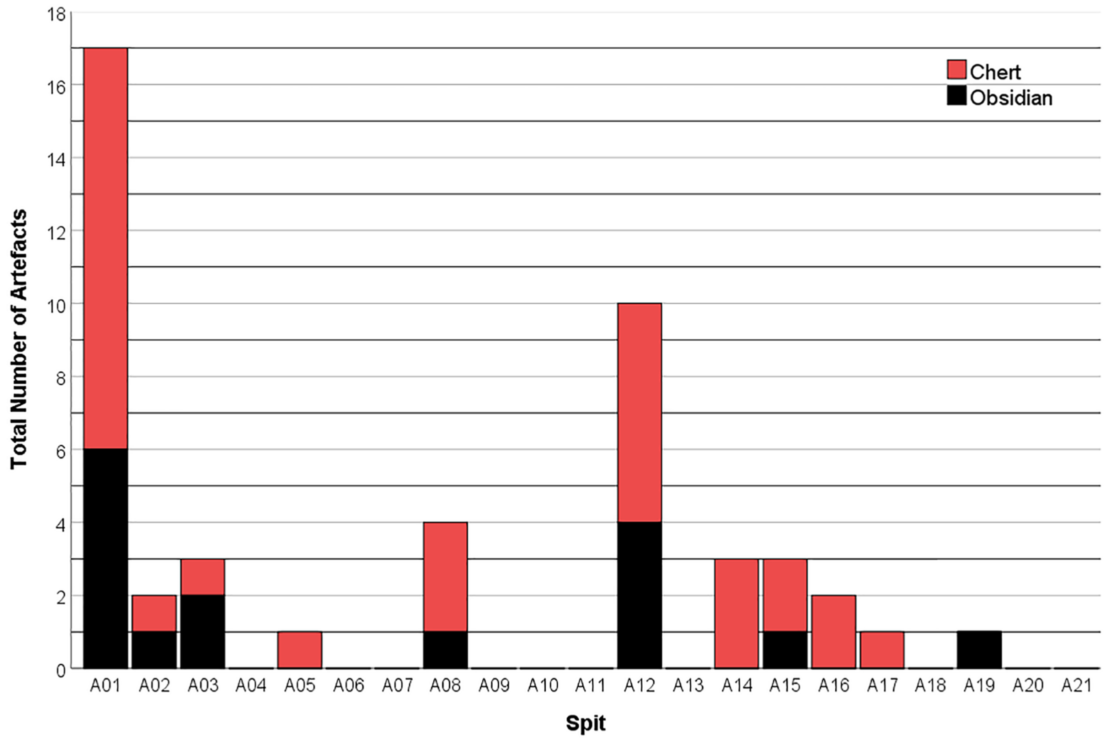


**Figure 14**. Total number of lithic (chert and obsidian) artefacts by excavation unit (5 cm spit) at Jareng Bori.

### Lithics

The lithic assemblage includes a stone pounder recovered from spit 10, and a concentration of three basalt stone pounders in spit 14 (complete with clear indentations). Small obsidian artefacts were found during the wet sieving and sorting from spit 1 onwards, as were chert artefacts between spits 1–17. A total of 47 flaked lithic artefacts were recovered from Jareng Bori rockshelter; composed of a very fine-grained black chert (n = 31) and obsidian (n = 16). Most of these artefacts were recovered either in the upper two spits, or below spit 12 (Fig. 14). The assemblage contains a single core and only eight complete flakes, one of which is bipolar. The assemblage is dominated by flake fragments (20%), and flaked pieces (49%), with four pieces of heat-shattered chert. The size of obsidian artefacts is small, with a maximum length of 10.4 mm. A single chert flake was recovered within the burial units of spit 8.

### Geochemical analysis

In total, 16 artefacts fulfilled size requirements for pXRF analysis. Geochemical data were compared with known source locations in Island Southeast Asia (ISEA). None of the known source locations matched the geochemistry present in the samples. The dataset (Table 7) was then enhanced with two unknown obsidian source locations from the nearby vicinity. These two source locations have so far only been reported in archaeological sites in the area, Group 1 and 2 obsidian sources (Maloney *et al.*, 2018; Reepmeyer *et al.*, 2016, 2019). Fourteen artefacts matched Group 2 obsidian, which is believed to be located on Alor Island. Two artefacts (#28 and #29) show very low counts of Rb and high counts of Y and remain unsourced.

### Metal

A small iron fish-hook was recovered from spit 2, and a single rusty metal fragment was found in spit 12 at the proto-historic to late Metal-Age interface (Fig. 15). The fragment is 5.9 × 2.4 × 0.7 cm in size and weighs 7.3 g with a red, outer ferrous crust c. 0.7–1.1 mm thick. The fragment may be part of a metal blade as it has a straight margin (spine) tapering to a point. The exposed interior of the fragment has a flattened elliptical core surrounded by a second layer of metal bearing a heavily oxidized exterior. Cobalt (Co, 6.93 keV) is an important additive to steel that could not be accurately measured with pXRF due to spectral overlap with Fe (6.93 keV) and Ni (7.48 keV).

## Discussion

Our survey and excavation program for Pantar did not reveal Pleistocene human settlement of the island, as was reported from Alor where dates of c. 21 ka have been found (Samper-Carro *et al.*, 2016), or Timor-Leste, where radiocarbon ages greater than 40 kyr have been recovered from several caves (Hawkins *et al.*, 2017a; O'Connor *et al.*, 2010, 2011). This is likely an artefact of archaeological sampling strategies and taphonomic bias, as no large caves with probable cultural deposits were located during the Pantar survey. In ISEA, archaeological research often relies on caves and rockshelters as focal points for human settlement; however, on many Wallacean islands these are often young caves and rockshelters that rarely preserve archaeological remains (Louys *et al.*, 2017). Our findings from Jareng Bori indicate a late Holocene occupation from the Metal-Age c. 1800 BP to the late historic period. The data indicate that the Jareng Bori rockshelter was occupied by small pottery-making communities that used marine resources, wild animals such


**Figure 15**. Ferrous metal artefact cf. knife from Jareng Bori.

**Table 7**. Summary data of obsidian pXRF analysis.

| | MnKa1 | FeKa1 | ZnKa1 | GaKa1 | ThLa1 | RbKa1 | SrKa1 | YKa1 | ZrKa1 | NbKa1 |
|---|---|---|---|---|---|---|---|---|---|---|
| JAR Alg 1 | 834 | 9933 | 57 | 22 | 28 | 138 | 161 | 21 | 117 | 11 |
| JAR Alg 2 | 924 | 9266 | 80 | 21 | 30 | 137 | 160 | 20 | 116 | 11 |
| JAR A3 2 | 1172 | 12559 | 112 | 25 | 31 | 154 | 173 | 20 | 125 | 14 |
| JAR A1 #1 | 836 | 11103 | 82 | 25 | 31 | 157 | 166 | 19 | 127 | 14 |
| JAR A1 #2 | 835 | 9521 | 55 | 23 | 31 | 148 | 164 | 22 | 126 | 13 |
| JAR A3 #9 | 974 | 10915 | 52 | 26 | 29 | 167 | 179 | 21 | 133 | 14 |
| JAR A1 #13 | 810 | 9851 | 82 | 18 | 32 | 141 | 155 | 19 | 122 | 12 |
| JAR A1 #14 | 1236 | 14947 | 136 | 27 | 43 | 166 | 183 | 19 | 121 | 13 |
| JAR A1 #15 | 764 | 9218 | 116 | 17 | 23 | 112 | 138 | 13 | 101 | 9 |
| JAR A1 #16 | 1030 | 10258 | 82 | 21 | 33 | 144 | 159 | 20 | 122 | 11 |
| JAR A8 #25 | 1017 | 11459 | 70 | 25 | 32 | 161 | 186 | 25 | 132 | 14 |
| JAR A12 #26 | 669 | 8139 | 32 | 15 | 24 | 125 | 139 | 20 | 116 | 11 |
| JAR A12 #27 | 757 | 8163 | 60 | 18 | 23 | 132 | 151 | 20 | 116 | 10 |
| JAR A12 #28 | 1207 | 19870 | 115 | 17 | 4 | 52 | 202 | 45 | 164 | 9 |
| JAR A12 #29 | 1123 | 19507 | 129 | 20 | 3 | 50 | 182 | 44 | 161 | 7 |
| JAR A15 #35 | 1041 | 12287 | 105 | 21 | 22 | 149 | 165 | 18 | 116 | 11 |

as fruit bats, and domestic animals, with some subsistence change recorded over the occupation period.

The lack of botanical evidence precludes a discussion of plant resource utilization in the human diet at Jareng Bori, however, unidentified seeds were present in the site and agriculture is indicated by the presence of small numbers of stone pounders and domestic animal bones. The dog tooth in spit 14 (layer 7), associated with a date of c. 1305–1187 cal. BP is not unanticipated, considering dog remains have been recovered from Matja Kuru 2 in Timor-Leste at c. 3000 BP (Gonzalez *et al.*, 2013). Domesticated pigs are thought to have entered ISEA between 4–3 ka (Dobney *et al.*, 2008). The late appearance of pig bones at Jareng Bori (spits 1–5) indicates either that domestic animal production was not a major focus of Pantar communities during the early years of rockshelter use, or more likely, that the rockshelter assemblage reflects occasional casual shoreline foraging and fishing by people living mostly in open village settings, much as occurs today.

Fishing was concentrated on noticeably small inshore herbivorous fishes with secondary importance of small carnivores, indicating the use of mass harvesting techniques on the adjacent and extensive rocky reef. These methods and technologies were observable on the island during fieldwork and included traps, spearing, and nets, but poisons may also have been used (see Ono, 2010 for detailed discussion of ethnoarchaeology of fishing on Borneo that may be comparable). These fishing practices did not significantly change during the cultural sequence, and appear to be a continuation of similar fishing strategies that were occurring since the early to late Holocene elsewhere in Wallacea, e.g., at Here Sorot Entepa rockshelter on Kisar Island (O'Connor *et al.*, 2018) and Tron Bon Lei rockshelter on Alor (Samper Carro *et al.*, 2016). Metal-Age subsistence studies comparable to Jareng Bori are rare in Wallacea. At Leang Buida and Bukit Tiwing in the Talaud Islands, marine resources and domesticated animals were exploited since A.D. 1000 (Ono *et al.*, 2018a), suggesting widespread mixed economic systems continued into the Metal-Age. However, there were significant changes in fishing intensity over time at Jareng Bori, as fish remains were far more abundant in the lower levels of layers 6 and 7 and declined over time, indicating that either occupation intensity declined, or site use changed.

Mollusc harvesting returned a diverse assemblage with over 79 marine species dominated by rocky reef species, with a large number of juvenile *Nerita polita* suggesting frequent harvesting. The broad spectrum of rocky reef taxa exploited could potentially reflect a division of labour that was able to target a variety of shellfish sources, thus boosting protein returns, provisioning offspring, and reducing risk while balancing energy return trade-offs (Codding *et al.*, 2011). Crabs were present in low numbers indicating use of terrestrial, marine, and mangrove environments, but the assemblage was dominated by terrestrial hermit crabs which typically disturb archaeological sites post-deposition and are unlikely to reflect human subsistence (Walker, 1989).

The presence of fruit bats, often targeted for food in the Asia-Pacific region (Hawkins *et al.*, 2016), suggests that these larger bats were consumed by the late historic occupants of the rockshelter. Our findings at Tron Bon Lei rockshelter on Alor and Laili Cave in Timor-Leste indicate that the very small quantities of small murids, lizard, bat, snake, and birds recovered from Jareng Bori were likely deposited by barn owls rather than people (Hawkins *et al.*, 2017b, 2018).

The earthenware reveals two distinct intensive phases of occupation. The initial occupation of the site is associated with relatively few sherds associated with spits 21–16 and refitting of sherds across these spits indicates a synchronous temporal unit. The middle and late periods of occupation saw not only significant increases in pottery abundance by weight and sherd number but also a slight increase in sherd thickness over time (Fig. 11). The surface treatments and decorations borne by the pottery assemblage at Jareng Bori appear to be relatively commensurate with those found on ceramic assemblages across many other sites in Indonesia. For instance, the application of burnishing, slipping, and painting as surface treatments and decoration were also adopted by both prehistoric and historic potters in Timor, Sulawesi, and other sites across Indonesia (Bulbeck & Clune, 2003; Glover, 1986: 35–40; Latinis & Stark, 2003; McKinnon, 2003; Mundardjito *et al.*, 2003; Soegondho, 2003). All decoration types identified on the rim and body sherds, as well as carinations and flat bases, in the Jareng Bori ceramic assemblage are also commonly found on earthenware sherds across various Metal-Age sites in Indonesia (Bellwood, 1998; Bulbeck & Clune, 2003; Glover, 1986: 210–212; Latinis & Stark, 2003; McKinnon, 2003; Mundardjito *et al.*, 2003; Ono *et al.*, 2018b; Soegondho, 2003). As such, no specific type of surface treatment, decoration, and vessel-constituent (i.e. rim, body or base) morphology—as a variable on its own—appears to be specific to Jareng Bori. At the same time, the relatively low proportions of "black-burnished," "slipped", and "fine-paste" ceramics may be indicative of their relatively higher economic values compared with "general" medium-paste earthenware ceramics. Fine-paste earthenware ceramics, in particular, are thought to have a higher value than their medium paste counterparts (Ueda *et al.*, 2017: 67) presumably because of the scarcity of fine-paste clay deposits in Southeast Asia as well as their exchange and circulation in the region through intra-regional maritime trade (Jutimoosik *et al.*, 2017; Miksic & Yap, 1988–1989; Ueda *et al.*, 2017). Similarly, both "black-burnished" and "slipped" medium-paste vessels are likely to have higher values than their "general" cousins because of the additional production steps taken—in burnishing, slipping, and reduction-firing—and higher energy expenditure in their respective *chaînes opératoires*.

There was a change in pottery style from more Appliqué and Painted Pointillé during the middle period 1305–1187 cal. BP to more frequent deposition of painted earthenware vessels with a mostly black matrix decorated by incising, impressing, moulding, and carving during the later 430–0 cal. BP period. Ethnographic examples of traditional uses of earthenware ceramics in ISEA indicate several different uses by different cultural groups that were present in Nusa Tenggara. These include the storage of the placenta during birthing ceremonies, as ritual vessels during weddings, and as offerings or burial jars during funerals. Fine-paste earthenware vessels in the form of "kendis" (spouted vessels), in particular, are strongly associated with Hindu-Buddhist culture where they were used as ritual vessels for "sprinkling lustral water in Brahmanic or Buddhist ceremonies" (Groslier, 1981; Khoo, 1991).

The lithics included only small amounts of chert and obsidian flakes, the former often heat shattered. Geochemical analyses of the obsidian indicate some mobility in the region, probably between Alor and Pantar, that continues today. A new obsidian source not previously identified in previous regional studies (Reepmeyer *et al.*, 2011, 2016, 2019) was observed in the Jareng Bori assemblage, and this may be a local Pantar source as volcanic activity is locally present at Sirung mountain.

Tools of note recovered during excavation at Jareng Bori include shell scrapers, a small iron fish-hook in spit 2, and a ferrous metal artefact in spit 12 at the interface between the late and middle periods. Metal appeared in eastern Indonesia sometime after 2500 BP coinciding with the late Neolithic period (Bellwood, 1998), while shell tools have been used in the region since the late Pleistocene (Szabo *et al.*, 2007). The *Nautilus* disc beads from Jareng Bori are similar to those found in the archaeological record in Timor-Leste and Kisar Island since the terminal Pleistocene (O'Connor, 2015; O'Connor *et al.*, 2018) demonstrating a continuous cultural tradition within the region. These shell beads clearly continued to be used, alongside glass beads, into the late historic period of the last 400 years at Jareng Bori.

The incomplete burial in flex position dated to the last 400 years has tooth modifications similar to those found in burials from Java, Bali, Sumba, and Flores during the same time period, which has been interpreted as the unique cultural practice of the latest population arriving in the eastern Indonesian region (Kasnowihardjo *et al.*, 2013; Koesbardiati *et al.*, 2015; Suriyanto *et al.*, 2012). This suggests a culture of shared ritualistic beliefs as well as indicators of social status (Domett *et al.*, 2013). Burial goods were not noted in association with the burial, although several ceramics were mixed in the burial fill, probably post-deposition.

## Conclusions

Our analyses of artefacts, mortuary practices, and fauna provide an extensive dataset that allows comparison with other sites in the wider Wallacea region, providing opportunities to investigate ecological adaptations and potential socio-cultural and economic relationships and interactions. Early occupation of Jareng Bori appears to reflect casual use of the shelter as a stopover for exploiting and eating resources obtained from the nearby shoreline. Jareng Bori preserves no evidence of the far reaching Trans-Asiatic trade network seen on Bali since the 1st century A.D., although Metal-Age pottery, metal, beads, shell artefacts, and introduced fauna indicates that Pantar was connected to regional networks within Wallacea during the last 2000 years. More specifically the obsidian sourcing and dental modification evidence indicates links between the inhabitants of Jareng Bori with Java and neighbouring islands in the Lesser Sunda Islands.

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**Appendix 1**. Number of identified specimens present (NISP), Jareng Bori mollusc assemblage.

| | spit / context | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| taxon | 1 | 2 | 3 | 4 | 5 | 6 | 6 (B) | 7 | 7 (B) | 8 | 8 (B) | 9 | 9 (B) | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | burial | total (NISP) |
| *Acanthopleura* sp. | 3 | 5 | 2 | 10 | 26 | 53 | 4 | 52 | 18 | 23 | 10 | 6 | 16 | 25 | 38 | 41 | 16 | 49 | 33 | 14 | 16 | 7 | 6 | 2 | 1 | — | 476 |
| *Cryptoplax* sp. 1 | — | — | — | — | 1 | 3 | — | — | — | 2 | — | 1 | — | — | 3 | 1 | — | — | 1 | 1 | — | — | — | — | — | — | 13 |
| *Cryptoplax* sp. 2 | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Haliotis* sp. | 1 | — | — | 1 | 3 | 2 | — | 3 | — | 2 | 1 | 2 | 1 | 3 | 4 | 3 | 3 | 5 | 1 | 4 | 8 | 2 | 3 | — | — | — | 52 |
| *Patella* sp. | — | — | 2 | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 3 |
| *Cellana testudinaria* | — | — | — | — | 2 | 14 | — | — | — | 4 | — | — | — | 1 | 1 | 2 | — | 4 | — | 1 | — | — | — | — | — | — | 29 |
| *Trochus maculatus* | 3 | — | — | 9 | — | — | 1 | — | 17 | 12 | — | — | 6 | 11 | 14 | — | 13 | 39 | 12 | 15 | 21 | 3 | 14 | 6 | 1 | — | 197 |
| *Trochus* sp. | 1 | 7 | 4 | — | 17 | 34 | — | 11 | — | — | 4 | 1 | — | — | — | 19 | — | — | — | — | — | — | — | 3 | — | — | 101 |
| *Tectus fenestratus* | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 5 | — | — | — | — | — | 6 |
| *Tectus pyramis* | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Rochia nilotica* | — | — | 1 | 6 | 1 | 2 | — | — | — | 15 | — | 3 | — | 8 | 15 | — | — | 14 | 15 | 8 | 6 | 4 | 8 | 2 | 1 | — | 109 |
| *Monodonta canalifera* | 2 | — | — | 3 | 1 | — | — | 2 | — | — | — | — | — | — | 4 | — | 1 | 5 | | 1 | 1 | — | — | — | — | — | 20 |
| *Turbo chrysostomus* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 3 | — | — | — | — | — | — | — | — | — | — | — | 3 |
| *Turbo setosus* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Turbo* sp. | 3 | — | 1 | — | — | 6 | — | 3 | 1 | 9 | — | — | 2 | 7 | 16 | — | 6 | 13 | 6 | 5 | 1 | — | — | — | — | — | 79 |
| Turbinidae operculum | 2 | 3 | 2 | 10 | 23 | 11 | 1 | 6 | 7 | 11 | 3 | 1 | 1 | 4 | 13 | 10 | 2 | 11 | 4 | 2 | 3 | — | 3 | 1 | — | — | 134 |
| *Lunella cinerea* | — | 2 | 2 | — | — | 2 | — | — | 1 | — | — | — | — | — | — | — | 1 | — | 1 | — | 1 | — | — | — | — | — | 10 |
| *Angaria delphinus* | — | — | 1 | 2 | 1 | — | — | — | — | 1 | 2 | — | — | 1 | — | 1 | — | 3 | — | — | — | — | — | — | — | — | 12 |
| *Liotinaria peronii* | — | 1 | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 |
| *Neritopsis radula* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | 1 |
| *Nerita albicilla* | — | — | 2 | 2 | 4 | 2 | — | — | — | — | — | — | — | 1 | — | 1 | 2 | 6 | — | 4 | — | — | 1 | — | — | — | 25 |
| *Nerita balteata* | 7 | 6 | 3 | 1 | 4 | 9 | 1 | 2 | 4 | 3 | — | 2 | 5 | 2 | 3 | 10 | 1 | 7 | 5 | 2 | — | 5 | 1 | — | — | — | 83 |
| *Nerita chamaeleon* | — | — | 1 | — | 3 | 1 | 1 | 4 | — | 1 | — | — | 2 | 1 | — | 1 | — | — | — | 1 | 1 | — | — | — | — | — | 17 |
| *Nerita exuvia* | 4 | 7 | 1 | 14 | 26 | 15 | — | 24 | 11 | 7 | 5 | 3 | 5 | 20 | 21 | 33 | 13 | 56 | 43 | 17 | 56 | 11 | 31 | 9 | — | — | 432 |
| *Nerita grossa* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | 1 | — | — | — | — | 2 |
| *Nerita plicata* | — | 3 | 1 | 2 | 2 | 15 | 2 | 14 | 4 | 13 | 2 | 26 | 6 | 4 | 14 | 12 | 6 | 19 | 5 | 5 | 3 | — | 6 | — | — | — | 164 |
| *Nerita polita* | 12 | 18 | 15 | 31 | 47 | 133 | 18 | 175 | 61 | 127 | 34 | 26 | 70 | 99 | 124 | 211 | 76 | 321 | 148 | 59 | 97 | 35 | 64 | 31 | 4 | — | 2036 |
| *Nerita undata* | — | — | 1 | 2 | — | 1 | — | — | — | — | 1 | — | — | — | 2 | — | 1 | — | — | — | — | — | 1 | — | — | — | 9 |
| Neritidae operculum | — | — | — | — | — | 2 | 1 | 4 | — | — | — | — | 4 | — | 1 | 16 | 2 | 12 | 8 | 6 | 6 | — | 4 | 5 | 1 | — | 72 |
| *Indomodulus tectum* | — | — | — | — | 1 | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 |
| *Clypeomorus bifasciata* | 2 | — | — | — | — | — | — | — | — | 2 | — | — | — | — | — | — | — | — | 3 | — | — | — | — | — | — | — | 7 |
| *Clypeomorus irrorata* | — | — | — | — | — | 2 | 1 | — | — | — | — | — | — | 2 | — | — | — | — | — | — | — | — | — | — | — | — | 5 |
| *Clypeomorus subbrevicula* | — | — | 1 | 4 | 2 | 3 | — | 3 | — | — | — | — | — | 4 | 6 | — | 4 | — | 1 | — | — | — | — | — | — | — | 28 |
| *Clypeomorus* sp. | — | — | — | — | — | — | — | 2 | — | 3 | 1 | 2 | — | — | 4 | — | — | — | — | — | 4 | — | — | — | — | — | 16 |
| *Opalia* sp. | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Cerithium nodulosum* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 4 | — | — | — | — | — | — | — | — | — | — | — | 4 |
| *Cerithidea* sp. | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Canarium labiatum* | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Gibberulus gibberulus gibbosus* | — | — | — | — | — | 2 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 |
| *Strombus* sp. | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | 2 | — | 3 | — | 11 | — | — | — | — | — | — | 17 |
| *Lambis lambis* | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | 1 | — | — | 1 | — | — | — | — | — | 3 |
| Cypraeidae | — | — | 1 | 8 | — | 4 | 1 | 4 | — | 1 | — | — | — | 2 | 2 | 4 | — | 5 | 2 | 5 | 4 | — | 3 | — | — | — | 46 |
| *Turritriton labiosus* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | 1 |
| *Monoplex vespaceus* | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Chicoreus* sp. | — | — | — | — | — | — | — | 2 | — | 1 | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | 4 |
| *Indothais* sp. | — | — | — | — | — | — | — | — | — | 5 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 5 |
| *Thais* sp. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | 1 |
| Muricidae | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 | — | — | — | — | — | — | — | — | 3 |
| *Orania nodosa* | — | — | — | — | — | — | — | — | — | 3 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 3 |
| *Nassa serta* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 | — | — | — | — | — | — | — | — | — | — | — | 2 |
| *Prodotia* sp. | — | — | — | 2 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 |
| *Euplica turturina* | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | 2 |
| *Nassarius albescens* | 1 | — | — | 1 | 2 | 1 | — | 1 | — | — | — | — | — | — | — | 1 | — | 1 | — | — | — | — | — | — | — | — | 8 |
| *Nassarius globosus* | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Nassarius leptospirus* | — | — | 1 | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 |
| *Nassarius shacklefordi* | — | — | 1 | — | — | — | 2 | 2 | 3 | 2 | 1 | — | 1 | 1 | 3 | — | — | — | 1 | — | — | — | 2 | — | — | — | 19 |
| *Latirolagena smaragdulus* | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Vasum turbinellus* | — | — | 1 | — | — | 1 | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | 3 |
| *Oliva* sp. | 2 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 |
| Harpidae | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Cymbiola vespertilio* | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Lophiotoma acuta* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | 1 |
| *Conus litteratus* | — | — | — | — | 1 | — | — | — | — | — | — | — | — | 1 | — | — | — | — | 1 | — | — | — | 1 | — | — | — | 4 |
| *Conus marmoreus* | — | 1 | — | — | 1 | — | — | — | — | — | 1 | — | — | 1 | 1 | — | — | 2 | 3 | — | — | — | — | 1 | — | — | 11 |
| *Conus textilis* | — | — | — | — | 1 | — | — | 2 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 3 |
| *Conus* sp. | 2 | 5 | 2 | 13 | 18 | 19 | — | 5 | 8 | 5 | — | 4 | — | 6 | 24 | 5 | 6 | 11 | 12 | 2 | 7 | 2 | 7 | 3 | — | — | 166 |
| *Siphonaria atra* | — | — | — | 4 | 11 | 9 | — | 9 | 7 | 5 | 2 | 2 | 6 | 5 | 9 | 4 | — | 10 | 6 | — | 3 | — | — | — | — | — | 92 |
| *Barbatia* sp. | — | — | 1 | 4 | 1 | 3 | — | — | 7 | — | — | — | 1 | 9 | — | — | — | 4 | 5 | — | — | 1 | — | — | — | — | 36 |
| *Austriella corrugata* | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Septifer bilocularis* | — | — | — | 1 | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 |
| *Pinna* sp. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 6 | — | — | — | — | — | 6 |
| *Pinctada margaritifera* | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Isognomon ephippium* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | 2 | — | — | — | — | — | — | — | 3 |
| *Codakia* sp. | 2 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 |
| *Vasticardium subrugosum* | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Vasticardium* sp. | — | — | 1 | 1 | 3 | — | — | 1 | — | 3 | 1 | 1 | — | 1 | 3 | 4 | — | 3 | 3 | 1 | 1 | — | 1 | — | — | — | 28 |
| *Tridacna* sp. | 1 | 7 | 5 | 13 | 31 | 16 | — | 10 | 8 | 27 | — | — | — | 9 | 4 | 2 | 5 | 3 | — | 2 | — | — | 1 | — | — | — | 144 |
| *Gari elongata* | — | — | — | 2 | 3 | 2 | — | 17 | 16 | 12 | 2 | 2 | 4 | 8 | 2 | 5 | 1 | 19 | 13 | 10 | 1 | — | — | — | — | — | 119 |
| *Asaphis violascens* | 3 | 2 | 1 | — | 7 | 2 | — | 2 | — | 1 | — | — | — | 6 | 12 | 10 | 5 | 18 | 1 | — | — | — | 7 | — | — | — | 77 |
| *Periglypta puerpera* | — | 2 | 2 | 1 | 6 | 2 | — | 1 | 2 | 5 | 2 | — | — | 2 | 5 | 3 | 3 | — | — | — | — | — | — | — | — | — | 36 |
| *Periglypta* sp. | — | — | — | 2 | — | — | — | — | 2 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 4 |
| *Pitar* sp. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | 1 |
| *Dosinia* sp. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | 1 |
| *Bivalvia* sp. | — | — | — | — | 7 | — | 1 | 1 | — | — | — | — | — | — | 12 | — | 4 | 28 | 6 | 4 | 2 | — | — | 2 | 1 | — | 68 |
| *Nautilus* sp. | — | — | — | 1 | — | — | — | 1 | — | — | 1 | — | — | 1 | — | — | — | — | — | — | 2 | — | — | — | — | 1 | 7 |
| total (NISP) | 52 | 72 | 57 | 152 | 259 | 374 | 34 | 368 | 178 | 306 | 73 | 82 | 133 | 245 | 372 | 402 | 171 | 676 | 345 | 182 | 256 | 71 | 164 | 65 | 9 | 1 | 5099 |

**Appendix 2**. Minimum number of individuals (MNI), Jareng Bori mollusc assemblage.

| | spit / context | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| taxon | 1 | 2 | 3 | 4 | 5 | 6 | 6 (B) | 7 | 7 (B) | 8 | 8 (B) | 9 | 9 (B) | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | burial | total (MNI) |
| *Acanthopleura* sp. | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 9 | 1 | 2 | 1 | 1 | 2 | 5 | 2 | 6 | 2 | 5 | 3 | 2 | 4 | < 1 | 2 | < 1 | < 1 | — | 56 |
| *Cryptoplax* sp. 1 | — | — | — | — | < 1 | < 1 | — | — | — | < 1 | — | < 1 | — | — | < 1 | < 1 | — | — | < 1 | < 1 | — | — | — | — | — | — | 0 |
| *Cryptoplax* sp. 2 | — | — | — | — | — | — | — | — | < 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0 |
| *Haliotis* sp. | 1 | — | — | 1 | 1 | < 1 | — | 1 | — | 1 | 1 | < 1 | 1 | 1 | 1 | < 1 | < 1 | < 1 | 1 | 2 | < 1 | < 1 | 1 | — | — | — | 13 |
| *Patella* sp. | — | — | 2 | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 3 |
| *Cellana testudinaria* | — | — | — | — | 2 | 13 | — | — | — | < 1 | — | — | — | < 1 | 1 | 1 | — | 4 | — | 1 | — | — | — | — | — | — | 22 |
| *Trochus maculatus* | < 1 | — | — | < 1 | — | — | < 1 | — | 1 | 2 | — | — | 1 | < 1 | < 1 | — | 1 | 3 | < 1 | 1 | < 1 | < 1 | 2 | < 1 | < 1 | — | 11 |
| *Trochus* sp. | 1 | < 1 | 1 | — | 1 | 2 | — | 1 | — | — | < 1 | 1 | — | — | — | 3 | — | — | — | — | — | — | — | 2 | — | — | 12 |
| *Tectus fenestratus* | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 4 | — | — | — | — | — | 5 |
| *Tectus pyramis* | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Rochia nilotica* | — | — | < 1 | < 1 | < 1 | < 1 | — | — | — | < 1 | — | < 1 | — | < 1 | < 1 | — | — | < 1 | < 1 | < 1 | 2 | < 1 | < 1 | < 1 | < 1 | — | 2 |
| *Monodonta canalifera* | < 1 | — | — | 2 | < 1 | — | — | 2 | — | — | — | — | — | — | < 1 | — | 1 | 3 | — | 1 | < 1 | — | — | — | — | — | 9 |
| *Turbo chrysostomus* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Turbo setosus* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Turbo* sp. | < 1 | — | < 1 | — | — | 2 | — | < 1 | 1 | 3 | — | — | 1 | 2 | 6 | — | < 1 | 1 | < 1 | < 1 | < 1 | — | — | — | — | — | 16 |
| Turbinidae operculum | 2 | 2 | 2 | 6 | 10 | 8 | 1 | 4 | 7 | 7 | 1 | 1 | 1 | 4 | 8 | 9 | 1 | 8 | 3 | 2 | 3 | — | 3 | 1 | — | — | 94 |
| *Lunella cinerea* | — | 2 | 2 | — | — | 2 | — | — | 1 | — | — | — | — | — | — | — | 1 | — | < 1 | — | 1 | — | — | — | — | — | 9 |
| *Angaria delphinus* | — | — | 1 | 1 | 1 | — | — | — | — | < 1 | < 1 | — | — | < 1 | — | 1 | — | 1 | — | — | — | — | — | — | — | — | 5 |
| *Liotinaria peronii* | — | 1 | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 |
| *Neritopsis radula* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | 0 |
| *Nerita albicilla* | — | — | < 1 | < 1 | 1 | < 1 | — | — | — | — | — | — | — | < 1 | — | < 1 | 1 | 1 | — | 1 | — | — | 1 | — | — | — | 5 |
| *Nerita balteata* | 2 | 2 | 1 | 1 | 4 | 6 | < 1 | 2 | 3 | 3 | — | < 1 | 2 | 2 | < 1 | 4 | 1 | 3 | 5 | 2 | — | 2 | 1 | — | — | — | 46 |
| *Nerita chamaeleon* | — | — | 1 | — | 2 | 1 | < 1 | 2 | — | < 1 | — | — | 1 | < 1 | — | < 1 | — | — | — | 1 | < 1 | — | — | — | — | — | 8 |
| *Nerita exuvia* | < 1 | < 1 | < 1 | 2 | 6 | 2 | — | 2 | 5 | 7 | < 1 | < 1 | 1 | 2 | 5 | 3 | 2 | 6 | 7 | 6 | 8 | < 1 | 6 | 1 | — | — | 71 |
| *Nerita grossa* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | 1 | — | — | — | — | 2 |
| *Nerita plicata* | — | 3 | < 1 | < 1 | < 1 | 1 | < 1 | 4 | 1 | 5 | 1 | < 1 | < 1 | 1 | 4 | 2 | 4 | 4 | < 1 | 2 | < 1 | — | 3 | — | — | — | 35 |
| *Nerita polita* | 2 | 2 | 7 | 11 | 30 | 41 | 6 | 33 | 30 | 42 | 12 | 5 | 12 | 25 | 41 | 22 | 13 | 69 | 30 | 11 | 11 | 3 | 18 | 9 | 1 | — | 486 |
| *Nerita undata* | — | — | 1 | 2 | — | 1 | — | — | — | — | 1 | — | — | — | 2 | — | 1 | — | — | — | — | — | 1 | — | — | — | 9 |
| Neritidae operculum | — | — | — | — | — | < 1 | 1 | 4 | — | — | — | — | 2 | — | 1 | 5 | 2 | 10 | 7 | 6 | 4 | — | 4 | 3 | 1 | — | 50 |
| *Indomodulus tectum* | — | — | — | — | 1 | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0 |
| *Clypeomorus bifasciata* | 2 | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | 3 | — | — | — | — | — | — | — | 6 |
| *Clypeomorus irrorata* | — | — | — | — | — | 2 | 1 | — | — | — | — | — | — | < 1 | — | — | — | — | — | — | — | — | — | — | — | — | 3 |
| *Clypeomorus subbrevicula* | — | — | 1 | 4 | 2 | 2 | — | 2 | — | — | — | — | — | 2 | 6 | — | 4 | — | < 1 | — | — | — | — | — | — | — | 23 |
| *Clypeomorus* sp. | — | — | — | — | — | — | — | 2 | — | 3 | < 1 | 2 | — | — | 1 | — | — | — | — | — | 4 | — | — | — | — | — | 12 |
| *Opalia* sp. | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0 |
| *Cerithium nodulosum* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Cerithidea* sp. | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Canarium labiatum* | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Gibberulus gibberulus gibbosus* | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Strombus* sp. | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | < 1 | — | < 1 | — | < 1 | — | — | — | — | — | — | 1 |
| *Lambis lambis* | — | — | — | — | — | — | — | < 1 | — | — | — | — | — | — | — | — | — | 1 | — | — | < 1 | — | — | — | — | — | 1 |
| Cypraeidae | — | — | 1 | < 1 | — | 2 | < 1 | < 1 | — | < 1 | — | — | — | < 1 | < 1 | < 1 | — | 1 | 1 | < 1 | < 1 | — | 1 | — | — | — | 0 |
| *Turritriton labiosus* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | < 1 | — | — | — | — | — | — | — | 0 |
| *Monoplex vespaceus* | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0 |
| *Chicoreus* sp. | — | — | — | — | — | — | — | 1 | — | < 1 | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | 0 |
| *Indothais* sp. | — | — | — | — | — | — | — | — | — | < 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0 |
| *Thais* sp. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | < 1 | — | — | — | — | — | — | — | — | — | — | 0 |
| Muricidae | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | < 1 | — | — | — | — | — | — | — | — | 1 |
| *Orania nodosa* | — | — | — | — | — | — | — | — | — | 3 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0 |
| *Nassa serta* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | 0 |
| *Prodotia* sp. | — | — | — | 2 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 |
| *Euplica turturina* | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | 2 |
| *Nassarius albescens* | 1 | — | — | 1 | 2 | 1 | — | 1 | — | — | — | — | — | — | — | 1 | — | 1 | — | — | — | — | — | — | — | — | 8 |
| *Nassarius globosus* | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Nassarius leptospirus* | — | — | 1 | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 |
| *Nassarius shacklefordi* | — | — | 1 | — | — | — | 2 | 2 | 3 | 2 | 1 | — | 1 | 1 | 3 | — | — | — | < 1 | — | — | — | 2 | — | — | — | 18 |
| *Latirolagena smaragdulus* | — | — | — | — | — | < 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0 |
| *Vasum turbinellus* | — | — | < 1 | — | — | 1 | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | 2 |
| *Oliva* sp. | < 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0 |
| Harpidae | — | — | — | — | — | — | — | — | — | — | — | — | — | — | < 1 | — | — | — | — | — | — | — | — | — | — | — | 0 |
| *Cymbiola vespertilio* | — | — | — | — | < 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0 |
| *Lophiotoma acuta* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | 0 |
| *Conus literattus* | — | — | — | — | 1 | — | — | — | — | — | — | — | — | 1 | — | — | — | — | < 1 | — | — | — | 1 | — | — | — | 3 |
| *Conus marmoreus* | — | < 1 | — | — | < 1 | — | — | — | — | — | < 1 | — | — | < 1 | < 1 | — | — | < 1 | < 1 | — | — | — | — | < 1 | — | — | 0 |
| *Conus textilis* | — | — | — | — | < 1 | — | — | < 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0 |
| *Conus* sp. | 1 | < 1 | < 1 | 1 | < 1 | 3 | — | 2 | < 1 | 6 | — | < 1 | — | < 1 | 1 | < 1 | < 1 | 1 | 8 | < 1 | < 1 | < 1 | 1 | < 1 | — | — | 24 |
| *Siphonaria atra* | — | — | — | 2 | 7 | 8 | — | 8 | 5 | 5 | 2 | 2 | 1 | 3 | 5 | 1 | — | 5 | 6 | — | 3 | — | — | — | — | — | 63 |
| *Barbatia* sp. | — | — | 1 | < 1 | 1 | 1 | — | — | 1 | — | — | — | < 1 | < 1 | — | — | — | 1 | 2 | — | — | < 1 | — | — | — | — | 7 |
| *Austriella corrugata* | — | — | — | < 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0 |
| *Septifer bilocularis* | — | — | — | < 1 | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Pinna* sp. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | < 1 | — | — | — | — | — | 0 |
| *Pinctada margaritifera* | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 |
| *Isognomon ephippium* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | < 1 | < 1 | — | — | — | — | — | — | — | 0 |
| *Codakia* sp. | < 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0 |
| *Vasticardium subrugosum* | — | < 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0 |
| *Vasticardium* sp. | — | — | < 1 | < 1 | < 1 | — | — | < 1 | — | 1 | < 1 | < 1 | — | < 1 | < 1 | < 1 | — | < 1 | 1 | < 1 | < 1 | — | < 1 | — | — | — | 2 |
| *Tridacna* sp. | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | — | 1 | < 1 | < 1 | — | — | — | < 1 | < 1 | < 1 | < 1 | < 1 | — | < 1 | — | — | < 1 | — | — | — | 1 |
| *Gari elongata* | — | — | — | < 1 | < 1 | < 1 | — | 1 | < 1 | 4 | 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | 3 | < 1 | 1 | < 1 | — | — | — | — | — | 10 |
| *Asaphis violascens* | < 1 | < 1 | < 1 | — | < 1 | < 1 | — | < 1 | — | 1 | — | — | — | 1 | < 1 | < 1 | < 1 | < 1 | 1 | — | — | — | < 1 | — | — | — | 3 |
| *Periglypta puerpera* | — | < 1 | < 1 | < 1 | < 1 | < 1 | — | < 1 | — | < 1 | < 1 | — | — | < 1 | < 1 | < 1 | < 1 | — | — | — | — | — | — | — | — | — | 0 |
| *Periglypta* sp. | — | — | — | < 1 | — | — | — | — | < 1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0 |
| *Pitar* sp. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | < 1 | — | — | — | — | — | — | — | 0 |
| *Dosinia* sp. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1 | — | — | — | — | — | — | 1 |
| *Bivalvia* sp. | — | — | — | — | < 1 | — | < 1 | < 1 | — | — | — | — | — | — | < 1 | — | < 1 | < 1 | 1 | < 1 | < 1 | — | — | < 1 | < 1 | — | 0 |
| *Nautilus* sp. | — | — | — | < 1 | — | — | — | < 1 | — | — | < 1 | — | — | < 1 | — | — | — | — | — | — | < 1 | — | — | — | — | < 1 | 0 |
| total (MNI) | 13 | 14 | 24 | 37 | 74 | 102 | 11 | 79 | 58 | 97 | 20 | 11 | 27 | 45 | 90 | 52 | 32 | 127 | 78 | 39 | 40 | 6 | 45 | 16 | 2 | — | 1176 |

**Appendix 3**. The weight (g) of Jareng Bori mollusc assemblage.

| | spit / context | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| taxon | 1 | 2 | 3 | 4 | 5 | 6 | 6 (B) | 7 | 7 (B) | 8 | 8 (B) | 9 | 9 (B) | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | burial | total (g) |
| *Acanthapleura* sp. | 0.17 | 0.32 | 0.3 | 1.1 | 4.5 | 3.9 | 0.3 | 3.74 | 2.62 | 2.4 | 0.9 | 0.6 | 0.5 | 3.9 | 4.2 | 3.62 | 1.8 | 36.7 | 3.5 | 1 | 1.8 | 0.4 | < 0.1 | 0.1 | < 0.1 | — | 78.37 |
| *Cryptoplax* sp. 1 | — | — | — | — | 0.1 | 0.3 | — | — | — | 0.2 | — | 0.2 | — | — | 0.5 | 0.03 | — | — | 0.5 | 0.1 | — | — | — | — | — | — | 1.93 |
| *Cryptoplax* sp. 2 | — | — | — | — | — | — | — | — | 0.18 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0.18 |
| *Haliotis* sp. | 0.16 | — | — | 0.9 | 1.1 | 0.5 | — | 0.84 | — | 1 | 1.8 | 0.2 | 0.1 | 2.1 | 1.8 | 0.12 | 0.5 | 4.4 | 1 | 3.4 | 4 | 0.4 | 4.7 | — | — | — | 29.02 |
| *Patella* sp. | — | — | 0.5 | — | — | — | — | 0.7 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1.2 |
| *Cellana testudinaria* | — | — | — | — | 0.1 | 2.4 | — | — | — | 1.4 | — | — | — | 0.6 | 0.5 | 0.39 | — | 2.5 | — | 5.4 | — | — | — | — | — | — | 13.29 |
| *Trochus maculatus* | 1.72 | — | — | 3.8 | — | — | 0.7 | — | 3.75 | 6.3 | — | — | 3.8 | 5.1 | 9 | — | 5.3 | 12.21 | 3 | 11.5 | 6.8 | 0.4 | 8 | 1.6 | 1 | — | 83.98 |
| *Trochus* sp. | 0.42 | 1.86 | 2.1 | — | 10.7 | 28 | — | 4.87 | — | — | 1.4 | 0.3 | — | — | — | 11 | — | — | — | — | — | — | — | 15.7 | — | — | 76.35 |
| *Tectus fenestratus* | — | — | — | 0.3 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 9.4 | — | — | — | — | — | 9.7 |
| *Tectus pyramis* | 6.44 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 6.44 |
| *Rochia nilotica* | — | — | 3.1 | 2.8 | 0.5 | 0.5 | — | — | — | 3.5 | — | 0.9 | — | 5.1 | 8.5 | — | — | 8.48 | 22.9 | 5.7 | 23.5 | 1.1 | 1.3 | 0.8 | 0.8 | — | 89.48 |
| *Monodonta canalifera* | 0.28 | — | — | 0.5 | 1 | — | — | 0.23 | — | — | — | — | — | — | 1 | — | 0.2 | 3.58 | — | 0.6 | 0.7 | — | — | — | — | — | 8.09 |
| *Turbo chrysostomus* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1.4 | — | — | — | — | — | — | — | — | — | — | — | 1.4 |
| *Turbo setosus* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0.4 | — | — | — | — | — | — | — | — | — | — | — | 0.4 |
| *Turbo* sp. | 1.65 | — | 0.5 | — | — | 4.1 | — | 1.4 | 0.33 | 2 | — | — | 0.9 | 1.2 | 6.4 | — | 0.9 | 7.68 | 5.8 | 2.3 | 0.7 | — | — | — | — | — | 35.86 |
| Turbinidae operculum | 0.13 | 0.51 | 0.5 | 4.4 | 18.5 | 9.36 | 1 | 2.54 | 2.42 | 6 | 1.5 | 0.5 | 0.1 | 1.1 | 5.3 | 2.05 | 3.5 | 11.75 | 7.6 | 2.8 | 5.2 | — | 3.3 | 0.3 | — | — | 90.36 |
| *Lunella cinerea* | — | 1.49 | 1 | — | — | 0.8 | — | — | 0.77 | — | — | — | — | — | — | — | 1.1 | — | 0.4 | — | 1 | — | — | — | — | — | 6.56 |
| *Angaria delphinus* | — | — | 0.4 | 2.1 | 2.7 | — | — | — | — | 0.95 | 3.7 | — | — | 3.1 | — | 1.19 | — | 5.32 | — | — | — | — | — | — | — | — | 19.46 |
| *Liotinaria peronii* | — | 0.64 | — | — | — | 0.5 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1.14 |
| *Neritopsis radula* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2.7 | — | — | — | — | — | — | — | 2.7 |
| *Nerita albicilla* | — | — | 0.5 | 0.7 | 0.5 | 0.3 | — | — | — | — | — | — | — | 0.3 | — | 0.37 | 0.9 | 2.61 | — | 1.5 | — | — | 0.7 | — | — | — | 8.38 |
| *Nerita balteata* | 0.7 | 0.91 | 0.1 | 0.1 | 0.8 | 1.2 | < 0.1 | 0.67 | 0.61 | 0.8 | — | 0.3 | 0.5 | 0.4 | 0.3 | 2.99 | 0.1 | 1.53 | 1.1 | 0.8 | — | 0.9 | 0.9 | — | — | — | 15.71 |
| *Nerita chamaeleon* | — | — | 0.4 | — | 0.5 | 0.4 | < 0.1 | 1.99 | — | 0.6 | — | — | 0.5 | 0.2 | — | 0.41 | — | — | — | 0.9 | 0.3 | — | — | — | — | — | 6.2 |
| *Nerita exuvia* | 0.95 | 0.92 | 0.3 | 2.7 | 3.1 | 5 | — | 3.12 | 27.8 | 5.3 | 0.5 | 0.4 | 1.4 | 4.1 | 5.6 | 4.97 | 2.3 | 9.2 | 9.4 | 8.6 | 10.1 | 1.1 | 5.6 | 2 | — | — | 114.46 |
| *Nerita grossa* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0.2 | — | 1.2 | — | — | — | — | 1.4 |
| *Nerita plicata* | — | 0.86 | 0.5 | 0.8 | 0.2 | 6.3 | 0.6 | 2.37 | 0.57 | 3.1 | 0.5 | 0.3 | 1.3 | 1.1 | 3.1 | 1.31 | 3.5 | 4.35 | 1.4 | 2 | 0.6 | — | 2.5 | — | — | — | 37.26 |
| *Nerita polita* | 1.66 | 3.1 | 4.7 | 5.8 | 11.4 | 26.3 | 3.5 | 25.68 | 18.06 | 29.6 | 8.5 | 5.2 | 8.4 | 20.8 | 22.1 | 23.3 | 11 | 52.34 | 34.2 | 10.9 | 13 | 4.5 | 13.1 | 4.4 | 0.6 | — | 362.14 |
| *Nerita undata* | — | — | 0.9 | 0.8 | — | 0.8 | — | — | — | — | 0.6 | — | — | — | 1.5 | — | 0.1 | — | — | — | — | — | 0.3 | — | — | — | 5 |
| Neritidae operculum | — | — | — | — | — | 0.2 | 0.1 | 0.28 | — | — | — | — | 0.1 | — | 0.1 | 0.58 | 0.7 | 0.57 | 0.3 | 0.4 | 0.1 | — | 0.7 | 0.1 | 0.1 | — | 4.33 |
| *Indomodulus tectum* | — | — | — | — | 0.4 | — | — | 0.44 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0.84 |
| *Clypeomorus bifasciata* | 1.56 | — | — | — | — | — | — | — | — | 2.3 | — | — | — | — | — | — | — | — | 2.1 | — | — | — | — | — | — | — | 5.96 |
| *Clypeomorus irrorata* | — | — | — | — | — | 2.1 | 1.2 | — | — | — | — | — | — | 0.4 | — | — | — | — | — | — | — | — | — | — | — | — | 3.7 |
| *Clypeomorus subbrevicula* | — | — | 0.1 | 2.1 | 2.5 | 2.4 | — | 2.32 | — | — | — | — | — | 3.1 | 3.4 | — | 2.8 | — | 1.1 | — | — | — | — | — | — | — | 19.82 |
| *Clypeomorus* sp. | — | — | — | — | — | — | — | 0.54 | — | 1.2 | 0.3 | 1.1 | — | — | 1.7 | — | — | — | — | — | 1.2 | — | — | — | — | — | 6.04 |
| *Opalia* sp. | — | — | — | — | — | — | — | — | — | 0.4 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0.4 |
| *Cerithium nodulosum* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2.5 | — | — | — | — | — | — | — | — | — | — | — | 2.5 |
| *Cerithidea* sp. | — | 0.68 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0.68 |
| *Canarium labiatum* | — | — | — | — | — | — | — | — | — | — | — | — | 0.5 | — | — | — | — | — | — | — | — | — | — | — | — | — | 0.5 |
| *Gibberulus gibberulus gibbosus* | — | — | — | — | — | 2.5 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2.5 |
| *Strombus* sp. | — | — | — | — | — | — | — | — | — | — | — | — | 0.4 | — | — | < 1 | — | 18.93 | — | 18.7 | — | — | — | — | — | — | 38.03 |
| *Lambis lambis* | — | — | — | — | — | — | — | 0.31 | — | — | — | — | — | — | — | — | — | 18.68 | — | — | 0.6 | — | — | — | — | — | 19.59 |
| Cypraeidae | — | — | 3.9 | 7 | — | 5.3 | 0.6 | 2.78 | — | 0.6 | — | — | — | 1.4 | 2.1 | 1.78 | — | 3.21 | 1 | 3.5 | 2.2 | — | 1.1 | — | — | — | 36.47 |
| *Turritriton labiosus* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0.8 | — | — | — | — | — | — | — | 0.8 |
| *Monoplex vespaceus* | — | — | 0.1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0.1 |
| *Chicoreus* sp. | — | — | — | — | — | — | — | 1.4 | — | 0.6 | — | — | — | — | — | — | — | 2.2 | — | — | — | — | — | — | — | — | 4.2 |
| *Indothais* sp. | — | — | — | — | — | — | — | — | — | 2.8 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2.8 |
| *Thais* sp. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1.87 | — | — | — | — | — | — | — | — | — | — | 1.87 |
| Muricidae | — | 1.04 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1.4 | — | — | — | — | — | — | — | — | 2.44 |
| *Orania nodosa* | — | — | — | — | — | — | — | — | — | 1.2 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1.2 |
| *Nassa serta* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 3.1 | — | — | — | — | — | — | — | — | — | — | — | 3.1 |
| *Prodotia* sp. | — | — | — | 0.1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0.1 |
| *Euplica turturina* | — | — | — | — | 2.4 | — | — | — | — | — | — | — | — | — | 1.2 | — | — | — | — | — | — | — | — | — | — | — | 3.6 |
| *Nassarius albescens* | 0.08 | — | — | 0.1 | 1.2 | 0.5 | — | 0.18 | — | — | — | — | — | — | — | 0.14 | — | 0.2 | — | — | — | — | — | — | — | — | 2.4 |
| *Nassarius globosus* | — | — | — | — | 0.26 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0.26 |
| *Nassarius leptospirus* | — | — | 0.1 | — | — | — | — | 0.23 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0.33 |
| *Nassarius shacklefordi* | — | — | 0.1 | — | — | — | 1.8 | 0.29 | 1.2 | 1.1 | 0.5 | — | 0.4 | 0.5 | 0.5 | — | — | — | 0.1 | — | — | — | 0.6 | — | — | — | 7.09 |
| *Latirolagena smaragdulus* | — | — | — | — | — | 2.1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2.1 |
| *Vasum turbinellus* | — | — | 0.8 | — | — | 0.4 | — | — | — | — | — | — | 9.8 | — | — | — | — | — | — | — | — | — | — | — | — | — | 11 |
| *Oliva* sp. | 0.21 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0.21 |
| Harpidae | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0.4 | — | — | — | — | — | — | — | — | — | — | — | 0.4 |
| *Cymbiola vespertilio* | — | — | — | — | 1.1 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1.1 |
| *Lophiotoma acuta* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0.2 | — | — | — | — | — | — | — | 0.2 |
| *Conus litteratus* | — | — | — | — | 0.8 | — | — | — | — | — | — | — | — | 0.6 | — | — | — | — | 0.3 | — | — | — | 5.8 | — | — | — | 7.5 |
| *Conus marmoreus* | — | 0.21 | — | — | 2.9 | — | — | — | — | — | 0.5 | — | — | 2.6 | 1.4 | — | — | 1.25 | 0.6 | — | — | — | — | 0.9 | — | — | 10.36 |
| *Conus textilis* | — | — | — | — | 1 | — | — | 3.37 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 4.37 |
| *Conus* sp. | 1.9 | 8.97 | 3.1 | 9.1 | 17 | 19.1 | — | 1.75 | 6.74 | 6 | — | 4.9 | — | 31.9 | 24.3 | 2.64 | 6.6 | 35.75 | 23.3 | 1.4 | 5.8 | 3.5 | 13 | 2.9 | — | — | 229.65 |
| *Siphonaria atra* | — | — | — | 0.2 | 2.5 | 2.5 | — | 1.73 | 2.58 | 1 | 0.3 | 1.1 | 0.6 | 0.9 | 3.2 | 0.25 | — | 2.61 | 3.4 | — | 0.5 | — | — | — | — | — | 23.37 |
| *Barbatia* sp. | — | — | 0.1 | 1.2 | 2.2 | 1.5 | — | — | 23.2 | — | — | — | 0.2 | 2.4 | — | — | — | 1.92 | 3.6 | — | — | 0.2 | — | — | — | — | 36.52 |
| *Austriella corrugata* | — | — | — | 0.7 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0.7 |
| *Septifer bilocularis* | — | — | — | 0.2 | — | 1.2 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1.4 |
| *Pinna* sp. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1.1 | — | — | — | — | — | 1.1 |
| *Pinctada margaritifera* | — | — | — | — | — | — | — | 0.5 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0.5 |
| *Isognomon ephippium* | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1.6 | 1.8 | — | — | — | — | — | — | — | 3.4 |
| *Codakia* sp. | 1.8 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1.8 |
| *Vasticardium subrugosum* | — | 0.58 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 0.58 |
| *Vasticardium* sp. | — | — | 0.1 | 0.1 | 1.3 | — | — | 0.3 | — | 6.2 | 0.2 | 0.3 | — | 0.2 | 1.4 | 0.37 | — | 3.3 | 1.5 | 0.4 | 0.8 | — | 0.1 | — | — | — | 16.57 |
| *Tridacna* sp. | 7.96 | 9.87 | 3.8 | 8.7 | 27.2 | 26.8 | — | 30.62 | 6.94 | 28.4 | — | — | — | 4.9 | 7.9 | 5 | 5.5 | 5.8 | — | 45.8 | — | — | 2.7 | — | — | — | 227.89 |
| *Gari elongata* | — | — | — | 0.3 | 0.7 | 1.3 | — | 1.29 | 1.88 | 0.9 | 1.3 | 0.1 | 1 | 0.8 | 0.7 | 0.26 | 0.2 | 3.8 | 1.1 | 2.8 | 0.7 | — | — | — | — | — | 19.13 |
| *Asaphis violascens* | 0.39 | 0.32 | 0.3 | — | 5.7 | 1.3 | — | 1.31 | — | 7.8 | — | — | — | 12.1 | 3 | 3.77 | 0.8 | 14.3 | 8.5 | — | — | — | 2.7 | — | — | — | 62.29 |
| *Periglypta puerpera* | — | 2.66 | 0.5 | 0.5 | 4.5 | 0.7 | — | 0.84 | — | 2.9 | 0.2 | — | — | 0.9 | 7.2 | 0.87 | 0.1 | — | — | — | — | — | — | — | — | — | 21.87 |
| *Periglypta* sp. | — | — | — | 1.3 | — | — | — | — | 1.23 | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 2.53 |
| *Pitar* sp. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 10.7 | — | — | — | — | — | — | — | 10.7 |
| *Dosinia* sp. | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | — | 1.6 | — | — | — | — | — | — | 1.6 |
| *Bivalvia* sp. | — | — | — | — | 2.5 | — | 1.3 | 0.8 | — | — | — | — | — | — | 3 | — | 5.1 | 6.7 | 11.2 | 0.6 | 0.7 | — | — | 0.6 | 0.7 | — | 33.2 |
| *Nautilus* sp. | — | — | — | 0.2 | — | — | — | 0.1 | — | — | 0.4 | — | — | < 0.1 | — | — | — | — | — | — | 0.7 | — | — | — | — | 0.4 | 1.8 |
| unidentified marine shell | 36.01 | 57.23 | 93.5 | 58.7 | 10.3 | 123.5 | 8.2 | 106.05 | 63.2 | 98.8 | 26.3 | 23.1 | 43.8 | 93.1 | 175 | 99.28 | 51 | 136.2 | 75.1 | 48.7 | 24.3 | 15.4 | 41.7 | 9.8 | 13.5 | — | 1531.8 |
| nacre | 1.4 | 0.56 | — | 0.6 | 1.1 | 5.2 | — | 1.42 | 1.3 | 5.5 | 1 | — | 1.4 | 1.3 | 2.4 | 4.61 | 4.1 | 10.7 | 1.5 | 1.6 | 2 | 1.4 | 1.5 | 0.8 | — | — | 51.39 |
| total (g) | 65.4 | 92.4 | 122 | 116.8 | 138.7 | 285.1 | 19 | 203.3 | 162.6 | 228.3 | 49.5 | 38.7 | 75.2 | 202.3 | 311.4 | 169.5 | 106.3 | 395.1 | 237.7 | 182.1 | 116 | 30.1 | 110.3 | 39.9 | 16.7 | 0.4 | 3595.1 |