Taymāʾ and the sea: marine goods in an Arabian oasis settlement

Abstract: Marine goods found in the oasis of Taymāʾ (Northwest Arabia), 300 km away from the nearest coast of the Red Sea, illustrate the economic importance and prosperity of the site. Excavations of the Saudi-German collaborative project revealed 631 marine specimens of five animal classes: coral, gastropods, bivalves, scaphopods and fish. The finds originate from various contexts (burial ground, public buildings, private houses and agricultural areas) and encompass occupation periods from the 3rd millennium BCE to the 7th century CE on, with an increased incidence of shell artifacts from the 11th to the 9th century BCE. The variety and quantity of these goods within specific contexts urge new reflections on utilisation, commerce and transport.

Key words: Taymāʾ, Saudi Arabia, marine mollusks, fish, bead-processing

INTRODUCTION

At first glance, it is slightly incongruous to talk about marine goods from an ancient settlement in the midst of a harsh desert environment, roughly 300 km as the crow flies from the nearest coast of the Red Sea. And yet it foreshadows a site that was once a prosperous center with long-distance contacts and commercial

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Photo/illustration credits

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exchanges. It is the permanent availability of water that enabled a continuous occupation of the oasis of Taymā' from the 5th/4th millennium BCE to modern times. Located on a branch of the trans-Arabian trading network operating since the early 1st millennium BCE, that is, the "Incense Road", the site was an economic hub for a supraregional exchange of goods between the Arabian Peninsula, Mesopotamia, Egypt and the Levant. Investigations carried out by a Saudi–German collaborative project[1] have led to the distinguishing of 12 major occupation periods (OP) [*Table 1*], covering a timespan from the Late Neolithic (late 7th/early 6th millennium BCE) to modern times (Hausleiter 2017; Hausleiter and Eichmann 2018).

Table 1. Taymā. Occupation periods (OP) (After Hausleiter and Eichmann 2018)

Period	Chronology
Tayma 1	19th century onward
Tayma 2	7th–18th centuries CE
Tayma 3A	4th–6th centuries CE
Tayma 3B	2nd–4th centuries CE
Tayma 4	2nd century BCE–early 2nd century BCE
Tayma 5	5th–3rd centuries BCE
Tayma 6	9th–6th centuries BCE
Tayma 7	11th–9th centuries BCE
Tayma 8	Mid-to-late 2nd millennium BCE
Tayma 9	Early 2nd millennium BCE
Tayma 10	3rd millennium BCE
Tayma 11	Transition from 5th to 4th millennium BCE
Tayma 12	late 7th/early 6th millennium BCE

Archaeological excavations at the site have revealed a notable interest in marine goods in practically every period. While a fish trade is surely not common in an arid hinterland, and Taymā' is no exception, processed shell beads have been found in quantities at various archaeological sites in the Arabian Peninsula and the Near East. At Taymā', marine goods come from various contexts and may reflect a broad usage spectrum, ranging from simply a food source to decorative items and symbols in ritual acts.

PROVENANCE OF MARINE FINDS

The finds discussed in this paper were found in archaeological layers excavated in the following six excavation areas [*Fig. 1*] and chronological contexts:

Al-Nasim (OP 9)

A burial ground of unknown extent is situated south of a walled oasis settlement; the area is designated by this name (Hausleiter and Zur 2016; Zur 2016; Zur and Hausleiter 2018). Salvage excavations uncovered 67 circular graves with inhumation burials, dated to the turn of the 3rd millennium BCE.[2] The local architectural traditions featured in these graves and the possibly rank-related sets of grave goods indicate Levantine burial customs.

1 This collaborative project of the Saudi Commission for Tourism and National Heritage (SCTH) and the Orient Department of the German Archaeological Institute (DAI) has been ongoing since 2004. The main funding for the German component comes from the German Research Foundation (DFG), Bonn. Ricardo Eichmann heads the German component, while fieldwork is co-directed by Arnulf Hausleiter.

2 The German component fully excavated four graves (al-Nasim E-g1–g4) and recorded two secondary burials of considerable size (al-Nasim D-g13 and F-g5; see Hausleiter et al. forthcoming).

Area A (OP 7)

Remains of a small building attached to the outer settlement wall were excavated in the western part of a compound (designated as Compound C) making up part of the walled settlement (Qrayyah) (Eichmann et al. 2006: 103–107). The presence of Early and Middle Iron Age pottery (Hausleiter 2018: 375–377), as well as radiocarbon dates, attribute the archaeo-

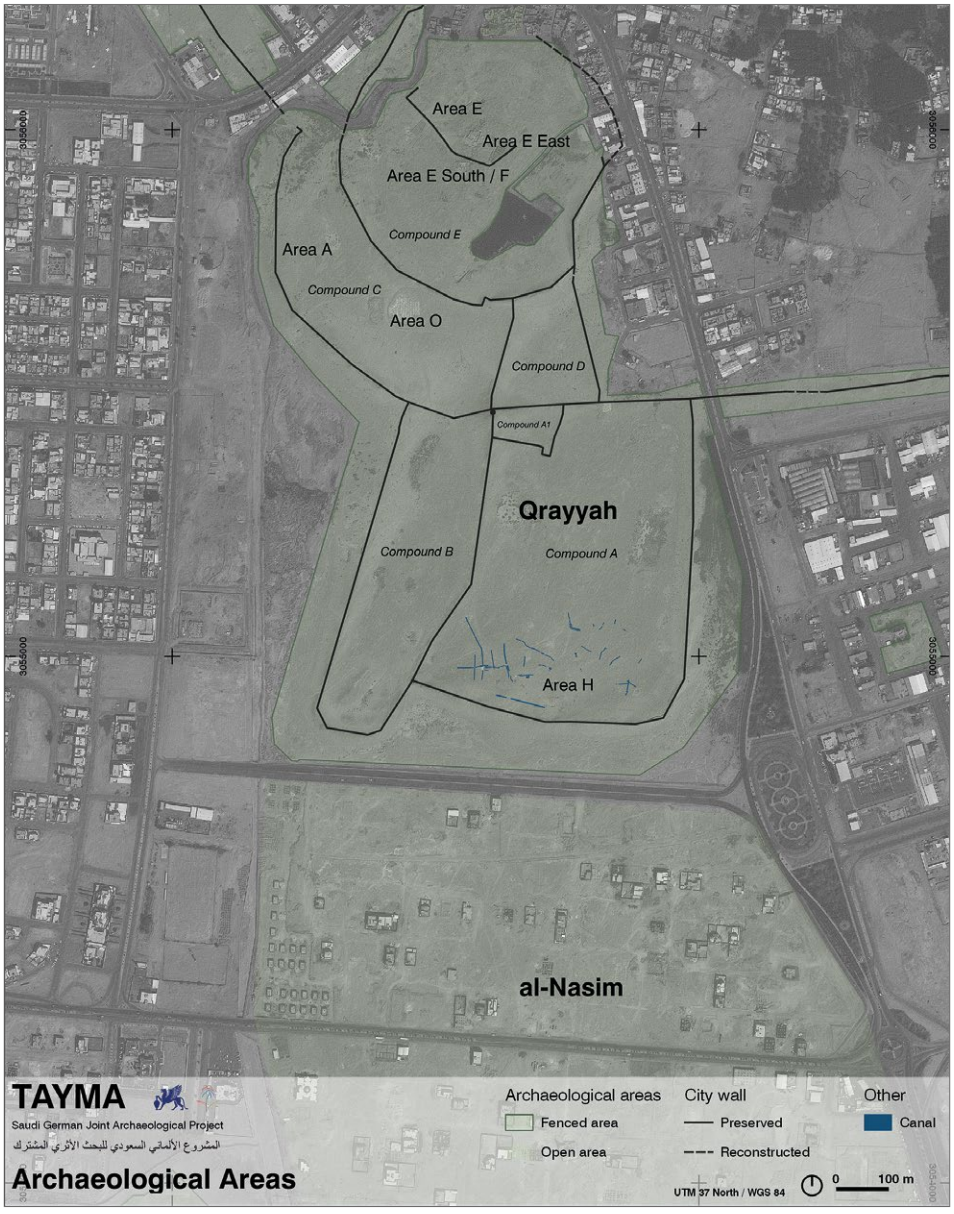

Fig. 1. Taymā: archaeological areas (© DAI Orient Department | S. Lora)

logical remains to OP 7. This building was functionally connected most probably with the settlement wall.

Area E (OP 10 and 5–3a) and Area E-East (OP 10–9, 5, 4, 3b and 1)

Today, the northern part of the core of the ancient settlement (Compound E) is dominated by remains of a large monumental building (Building E-b1), interpreted as a temple on the grounds of characteristic artifacts and architectural features (Lora 2017). Marine goods have been recorded from two of the five major building stages: first the Nabataean period, which is the second construction phase (1st century BCE–2nd century CE, OP 4 and 3b) and then late antiquity (4th–6th centuries CE, OP 3a) when the building was abandoned. The earliest attested occupation in this area can be dated to the early 3rd millennium BCE (OP 10), confirmed by ^{14}C data[3] from a building of yet unknown dimensions (Building E-b14), built on a natural outcrop under the later Building E-b1 (Lora 2017: 20; Hausleiter and Zur 2016: 137, note 20). Additional data on these early occupation periods at Taymā' come from layers in and around Building E-b5 in Area E-East. This small building, approximately 65 m² in size, located farther east of Building E-b1 , is characterised by a "grill-plan" defining five narrow rooms connected by a central passageway. The younger architectural remains in Area E-East (OP 4–OP 1), that is, a well, need to be viewed as connected with Building E-b1. Marine goods found in Area E-East were assigned, according to the local stratigraphic sequences, to OP 9 (early 2nd millennium BCE) and OP 5–1 (5th century BCE through modern times).

Area E-South/F (OP 4–2)

South of Building E-b1,excavations uncovered 1725 m² of a residential quarter displaying several building alterations and expansion. Floors, storerooms, probably kitchens with remains of food, as well as residential facilities, lead to its interpretation as a domestic quarter. Marine goods found within this area cover a timespan ranging chiefly from the Nabataean period to late antiquity.

Area H (OP 7)

This area, up to 6 ha in extent, situated in Compound A in the southern part of Qrayyah, is characterized by an elaborate irrigation system with some building structures scattered loosely in between. The finds presented here all derive from deposits above the rectangular enclosure of Building H-b1, probably material dug out from a substantial well (Friedrich Weigel, personal communication; Hausleiter and Eichmann 2018), and date to the early Iron Age. The area within the walled Compound A may have been used for agricultural purposes.

Area O (OP 7, 5 and 3a)

A public building complex covering some 1000 m², surrounded by a stone enclosure, constitutes the oldest remains of

3 Sample TA 17495 from SU 9778; charred seeds of barley and grape pips, identification by Reinder Neef, Scientific Division at the Head Office of the DAI; Laboratory Code: Poz – 75820 analyzed in the Poznań Radiocarbon Laboratory; radiocarbon date 4185±30 BP; calibrated date 2889–2669 calBC (2σ; 95.4%) with OxCal v 4.2.4.

occupation identified in this area. Many objects of a prestigious nature show early supra-regional contacts with both Egypt and the Levant (Sperveslage 2016), pointing to the particular importance of this building which goes back to the early Iron Age (11th–9th centuries BCE, OP 7). A vast majority of the processed shells came from the excavation of this complex, which succumbed ultimately to a fire (Hausleiter and Eichmann 2018). In the Hellenistic period, between the 4th and 3rd century BCE (OP 5), a burial ground was located in this area (Petiti, Intilia, and Hausleiter 2014; Petiti 2013). The graves were systematically looted before the 5th century CE. Both the graves and the fill of the looting pits provided marine goods, even if in small number.

MATERIAL AND METHODS

All the specimens presented here were recovered by hand; sieving and wet sifting was carried out only exceptionally. Worked shells were treated as artifacts and were documented by the respective excavators. These specimens were examined again to identify the species[4] during the field seasons in 2015–2017. The genus or family were indicated whenever identification to species level was not possible. The taxonomic denotation is based on the World Register of Marine Species (WoRMS). Undetermined specimens are documented as "Gastropoda indet.", "Bivalvia indet." or "Mollusc indet.". The state of preservation for gastropods and bivalves was classified as follows: complete, half, fragmented (less than half preserved). Since the origin of bivalves is unknown—whether collected live or after death from the seashore—each complete valve is counted as a single specimen (Baruch et al. 2005: 133). The minimum number of individuals (MNI) is given in the appended *Table 5*.

Using basic bead type terms (see Bar-Yosef Mayer 2014; Murphy 2011), worked shells are classified as either simple or complex beads, and as pendants. Bead-processing techniques[5] are noted, if identified. The stratigraphic information is based on data given by the excavators as of August 2017 and February 2018; uncertain occupation periods are listed as "OP indet.".

The numerous shells of a small freshwater snail *Melanoides tuberculata* (O.F. Müller 1774) are not included here due to the wide distribution of this species and its frequent occurrence in excavation layers. These shells can be found on sites with permanent water and are also known from desert springs and oases (Elkarmi and Ismail 2007; Ismail and Arif 1993). Specimen distribution in these layers was certainly random, possibly coming with the construction material (mud) collected from the continental *sabkha* located north of the

4 Species identification was conducted based on following literature: Bosch 1982, Bosch et al. 1995, Lorenz Hubert 2000, Rusmore-Villaume 2008.

5 See the literature on experimental archaeology in bead processing in Ridout-Sharpe 2017: 295, 296.

oasis. The brakish lake from approximately 9300 calBP silted up about 4800 calBP due to a long-term aridisation process among others (Dinies et al. 2015; 2016; Engel et al. 2012). *Melanoides tuberculata*, once part of the gastropod population (Engel et al. 2012: 136), can now be found in large quantities in the area of the *sabkha*. Exploitation of this species for bead processing, for example, can almost certainly be excluded; so far Taymā' has not yielded any worked specimens.

DATA AND RESULTS

Only marine species are presented in this paper. The finds comprise 631 specimens (NSP), of which 600 (NISP) have been classified to a given species or, at least, ascribed to a family-level [see below, ***Tables 2***, **5**]. 66 specimens derive from deposits of uncertain stratigraphic position [***Tables 3***, *5*] and could not be assigned to a specific occupation period (OP indet.). Altogether 37 taxa from five animal classes were documented: Anthozoa (1 taxon), Gastropoda (27 taxa), Scaphopoda (2 taxa), Bivalvia (5 taxa) and Actinopterygii[6] (2 taxa). One species originated from the Mediterranean Sea, the rest are from the Western Indo-Pacific region.

Considering the distance of more than 300 km from the oasis of Taymā' to the nearest Red Sea coast, one is entitled to assume a journey of at least 10 days duration.[7] As a consequence, it is rather improbable that the fresh fish and shellfish were used for food. 83.8% of the entire marine assemblage (NSP 629, excluding fish) is processed (NSP 527). Merely 3.4% are unworked shells (NSP 21) and 12.7% are too poorly preserved to allow comments on the modifications (NSP 80). Consequently, marine goods may have played a significant role as adornment.

Fig. 2. *Tubipora musica* Linnaeus 1758. Area O, TA 16201 (© DAI Orient Department | photo I. Wagner)

6 Fish species were determined by Dr. Henriette Obermaier, Institute of Palaeoanatomy and History of Veterinary Medicine, Ludwig-Maximilian-University, Munich.

7 Based on calculations by Hamilton Dyer (2001: 287) for a journey by donkey or camel from the Red Sea coast to Mons Claudianus/Mons Porphyrites, roughly 70 km inland.

1. ANTHOZOA

Tubipora musica Linnaeus 1758

65 fragments of the Organ Pipe Coral [*Fig. 2*] were found within one stratigraphic unit in Area O (Building O-b1, SU 4122) which is dated to OP 7 (11th–9th centuries BCE). Since it is highly probable that these fragments once formed a coral bunch, they were consequently documented as one item. Organ Pipe Corals can be found in colonies in shallow waters and are widespread in the Indo-Pacific region (Obura et al. 2008). The striking red color of the skeleton is attractive for jewelry-making, but the poor state of preservation precludes any further comments on the processing. This species could be either made into beads or ornaments, or was used as a simple form of decoration without any modification. Finds of the Organ Pipe Coral are also known from Marsa/Wadi Gawasis, near the Egyptian Red Sea coast, dating to the 3rd/mid-2nd millennium BCE (Carannante 2014: 124 Table 11-1).

2. GASTROPODA

This is a conspicuous class in the marine faunal assemblage from Taymāʾ. In general, marine gastropods are attested in several occupation periods and in various contexts. However, most of the shells originated from archaeological layers associated with the representative complex in Area O dated to the early Iron Age (OP 7). The share of processed shells in the finds assemblage is enormous, and the techniques and ready goods also vary. Simple and complex beads prevail, while pendants are rare.

Buccinidae (Family)

Engina mendicaria Linnaeus 1758

Nine specimens of the Striped Engina were found in four excavation areas (al-Nasim, Area E, Area E-East and Area O) and were assigned to six occupation periods. Except for one unworked specimen from Area O (OP 7), all shells were processed: either perforated body or removed apex. Three specimens attest a combination of variants. Irregular holes in the shell bodies indicate hammering or gouging, while smoothed surfaces reveal the removal of an apex by grinding/abrasion [*Fig. 5*, TA 9443]. This minimal processing produced simple beads that could be strung.

The *Engina mendicaria* are known from Neolithic sites and are widespread in Iron Age contexts in the Near East, both burial sites and settlements (e.g., Reese 1991; Wygnańska 2015; Carannante 2014).

Cerithiidae (Family)

Cerithium caeruleum G.B. Sowerby II, 1855

The Cerith sand snail is also widespread in the Indo-Pacific. Two specimens were excavated in Area O: one was found in a looting pit from OP 5 (5th–3rd centuries BCE), the other on the modern surface. Both specimens have perforated bodies with irregular edges, probably made by gouging or hammering, and are categorized as simple beads.

Conidae (Family)

The third most frequent family of marine gastropods found at Taymāʾ is represented by cone shells (NSP 96, MNI 93), a family with various species. Identification down to the species level was feasible in only a very few instances. These shells were found in every area with the exep-

tion of Area A, and in every occupation period with an increased occurrence in earlier times (OP 9 and 7). Most of the shells were intensively processed; huge species (>5 cm) predominate.

Different variants of shell modification reflect different functions. Complete cone shells with perforated apex (NSP 14) are documented in layers of various date in Areas E, E-East and O. Four shells were found in a concentration in Building O-b1 (Area O, SU 4113, OP 7). The average length of these simple beads does not exceed 20 mm; only three specimens are longer (up to 26.5 mm). One specimen, found in Area E-South/F (OP 2), was identified as *Conus* cf. *taeniatus*. These simple beads were certainly strung.

Similar to these are the eight specimens of truncated cone shells, likewise with perforated apex [*Fig. 3*, TA 16279 and TA 9456]. These beads are known as *Conus* tops (Bar-Yosef Mayer 2002: 170) and were usually made of the smaller cones. The species most frequently documented at Taymā' is *Conus vexillum* (NISP 3; found in al-Nasim and Area E-East). The truncation of the shell body was intentional; they were almost halved, tentatively because the objective was to position them in a specific manner. The perforated apex suggests the stringing of these cones.

Conus tops were found in various places. Two specimens were excavated from layers at the al-Nasim burial ground, dated to the 3rd/2nd millennium BCE (OP 9). Large quantities of huge truncated cone shells are reported from burial contexts at al-Nasim, investigated by the Saudi Commission for Tourism and National Heritage (SCTH) (al-Hajri, personal communication; Zur 2016: 47, note 147). Also from a pre-Hellenistic funerary context in Madâ'in Sâlih are 66 cone shells, including *Conus vexillum sumatrensis* (Studer 2015: 100, Fig. 1). These specimens, therefore, seem to be primarily associated with burial customs. One *Conus* top with an intact apex (TA 16279, Area E-East, OP 10) probably represents a semi-finished specimen.

Complete cone shells with perforated body are rare at Taymā'. A single specimen was uncovered in Area O (OP indet.). The combination of perforated body and apex is documented for two specimens, likewise from Area O (OP 7). For both variations, rather small *Conidae* were used, so a categorization as a simple bead is plausible.

Conus apex beads are the most frequent cone shell artifacts (NSP 38). These complex, disk-shaped beads are made of the apical part, while the apex is perforated usually by abrading or else drilling or sawing [*Fig. 3*, TA 8268, TA 19201, TA 6664]. A hole thus created was often enlarged. Some specimens show marks similar to saw marks, probably due to abrading with special tools or on a specific grinding surfaces [*Fig. 3*, TA 8268].Polished specimens have been documented, too (Golani 2013).

Conus apex beads are commonly presented in archaeological reports from Bronze and Iron Age sites (e.g., Glover 1995; Bar-Yosef Mayer 2002; Carannante 2014; Wygnańska 2015; Reese 1991).

Decorated[8] *Conus* apex beads (NISP 15) are basically disk-shaped, but extravagant-

8 The term emphasizes the ornamental differences with regard to ordinary *Conus* apex beads.

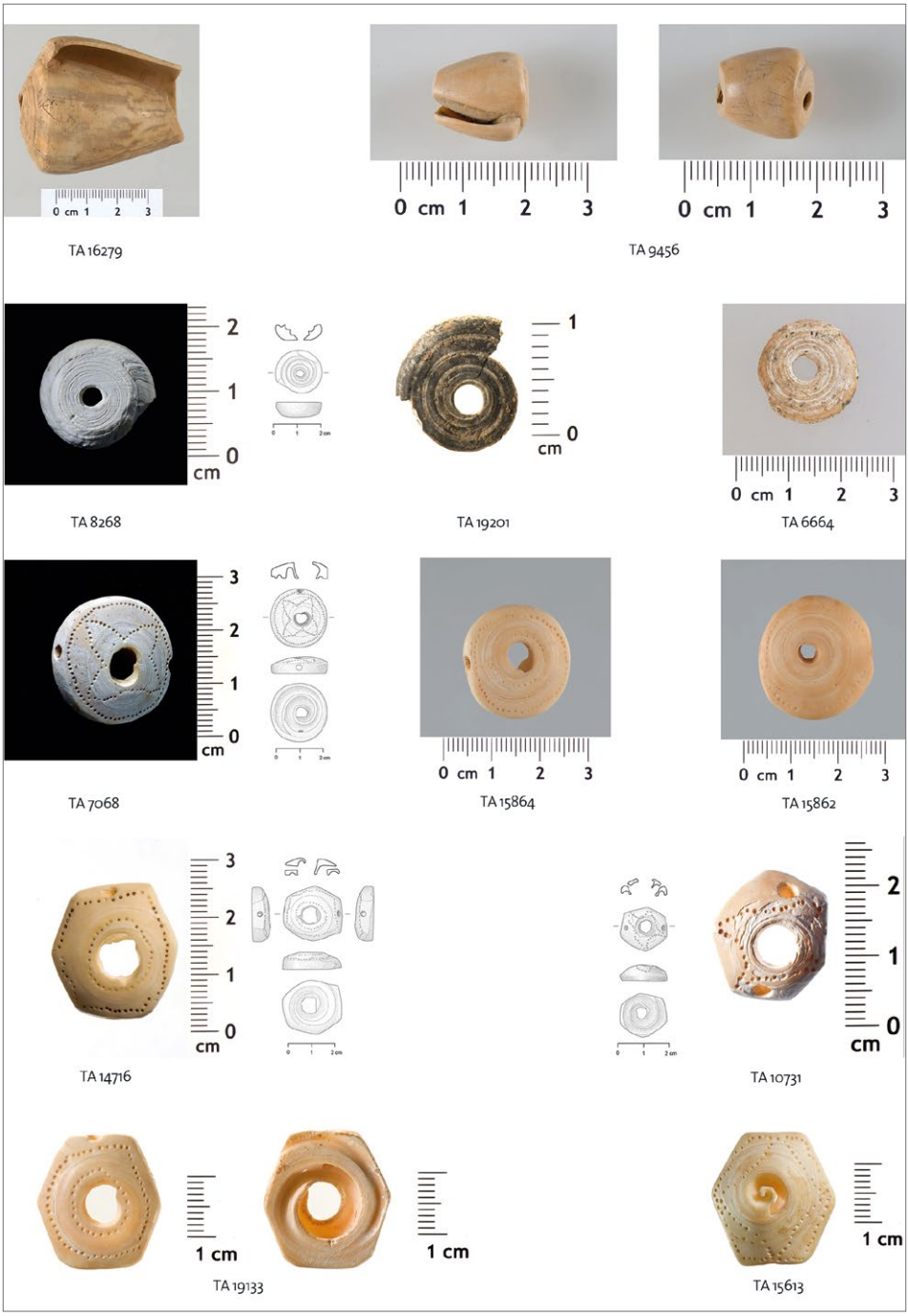

Fig. 3. *Conus* shell artifacts: *Conus* top shells (TA 16279, TA 9456); *Conus* apex beads (TA 8268, TA 19201, TA 6664) and decorated *Conus* apex beads (TA 7068, TA 15864, TA 15862, TA 14716, TA 10731, TA 19133, TA 15613) (© DAI Orient Department, see photo credits in the Acknowledgments)

ly worked [*Fig. 3*, TA 7068, TA 15864, TA 15862, TA 14716, TA 10731, TA 19133, TA 15613). The specimens from Taymā'are either rectangular, rounded or hexagonal in shape, with additional lateral perforations as well as decoration in the form of patterns of dotted lines composed of drilled holes. The average dimensions are: length 18–26 mm, width 10–24 mm; height 6–9 mm; the external diameter of rounded beads is roughly 24 mm. These beads were found exclusively inside the complex in Area O and can thus be dated with certainty to the early Iron Age (11th–9th centuries BCE, OP 7). Nine out of 15 beads come from a single stratigraphic unit (SU 9093, Courtyard 18, east of Building O-b1) and certainly represent remains of one or more objects: these beads were either stitched to a textile, for example, or threaded on a string.

Comparable finds are rare. Similar hexagonal-shaped beads are documented, one per grave, from disturbed Iron Age burials in Wādī Fizḥ, Sultanate of Oman (Düring et al. 2017, pp. 81, 92 Fig. 11, S51_St0_L0_M4) as well as from the archaeological site of Saruq al-Hadid, Dubai, UAE (Weeks et al. 2017: 55 Fig. 23, SF 29933). In the latter case, the artifact, which comes from the Bronze Age/Iron Age layers, shows six lateral drilled perforations. A bead made of *Pleuroploca trapezium* (*Fasciolaria trapezium*), found in a burial mound at the industrial site in Taymā' (Al-Hajri 2006: Pl. 3.11.c.), displays a faint resemblance. The decoration of this specimen is far more elaborate, with geometric and faunal motifs; it shows clear similarities to the beads found in Saruq al-Hadid (Weeks et al. 2017: 55 Fig. 24, GR 12004) and to the shell disks from large Iron Age collective tombs near Daba, Sultanate of Oman (Caputo and Genchi 2016: 43 Figs 3, 4). Caputo and Genchi suggest that the disk beads were used as pendants, brooches, fibulae or buttons, depending on the number of perforations (Caputo and Genchi 2016: 44). It seems that most of these shell disks share a similar context (burial grounds) and date (Iron Age). In this respect, the decorated *Conus* apex beads from a probably public, official Iron Age building in Taymā'are quite notable.

Other types of worked cone shells are represented by three specimens modified into rings (one from Area E, as well as two specimens from Area O). One cylindrical bead, most probably made from a cone, was excavated in Area O (OP 7).

Modified cone shells are reported from numerous archaeological sites of various age from the Neolithic onwards (see references in Carannante 2014: 127; Wygnańska 2015: 493) and come in a variety of types (Bar-Yosef Mayer 2002: 170). Their frequent occurrence in funerary contexts is noteworthy: for example, Hellenistic funerary contexts in Madâ'in Sâlih, Saudi Arabia (Studer and Tardy 2015: 211, Fig. 1), tumuli graves in Al-Subiyah, Kuwait (Wygnańska 2015: 491–493) and Bronze Age *nawamis* tombs in southern Sinai (Bar-Yosef Mayer 2002). Adornment was not the exclusive purpose of the modified shells, because intentional deposition in graves (see Wygnańska 2015: 491) as well as in public or domestic buildings can be assumed in Taymā'. Moreover, simple cone shell beads (Wygnańska 2015: 493)—shells with perforations in the body and/or perforated apex—are rare, too.

Cypraeidae (Family)

Cowry shells are undoubtedly the most popular shell beads (see Reese 1991; Golani 2014). They are found in abundance on archaeological sites in layers of various age and, even nowadays, enjoy popularity as personal adornment and divinatory (devotional?) items in numerous cultures (Poutiers 1998: 497; Claassen 2009: 204). Copies and imitations were manufactured in other materials to tap into their symbolic power (Golani 2014).

Cypraeidae represent the second most frequent group of modified marine gastropods in Taymāʾ(NISP 190). For most items, a determination to species level was not feasible; only three taxa were documented. A complete and unworked specimen (length 8 4 mm/width 51 mm/height 41 mm), found in an undated layer in Area O (OP indet.), was listed as Panther Cowry, *Cypraea pantherina* Lightfoot, 1786. Another 10 individuals, determined as *Cypraea* cf. *pantherina*, come from al-Nasim, Area E, Area E-East, Area E-South/F and Area O. The presumed period when this species was used runs from the 3rd/2nd millennium BCE to the 4th–6th centuries CE (OP 9–3a). Only one out of these 10 specimens reveals no modification (Area O, OP 7), while the poor state of preservation of the others precludes any comments on the technique. Large cowry shells certainly were used as decorative items and obviously were not a staple item in funerary contexts, unlike the *Conidae*. Transcontextual comparisons of finds from the Hellenistic to the post-Roman period in Madâʾin Sâlih (Studer and Tardy 2015: 211, Fig. 1) support this idea.

Most of the cowry shells in Taymāʾ are small species. Three specimens were identified as Ringed Cowry, *Monetaria annulus* (Linnaeus, 1758); the eponymous yellow-orange ring around the dorsum leaves no doubt about its classification [*Fig. 4*: TA 8990). This widespread species lives in shallow waters and is easy to collect as it is "mostly exposed during daytime" (Lorenz and Hubert 2000: 204). All specimens were excavated in Area O, in layers of different age (OP 7 and 5, as well as one undated context). Although the three specimens are insufficiently representative to propose long-lasting use of this taxon, yet the morphological features of numerous undetermined cowries permit the assumption that this species was used predominantly as a bead. 174 specimens were found in nearly every excavation area, with the exception of the al-Nasim burial ground and could be allocated to OP 7–3b and OP 1. Cowry beads were thus in use over a period of at least 4000 years with a clear dominance during the early Iron Age, effected by the general quantity of shell beads within the respective layers in Area O (it should be kept in mind that not all areas were excavated to the same extent as Area O). In Taymāʾ, several specimens (n=2–4) were often found within one stratigraphic unit. A concentration of 57 cowry shells, found in a collapse near a former street (SU 3186, OP 7), south of Building O-b1, stands out. Of these, 23 were found clearly *in situ*, arranged in a manner that suggests a pattern of stitched beads [*Fig. 4* bottom]. SU 3040 with 10 cowry beads and two *Conidae*, thereof one decorated *Conus* apex bead, needs to be mentioned, too. It indicates that the decorated apex beads were also most probably stitched onto

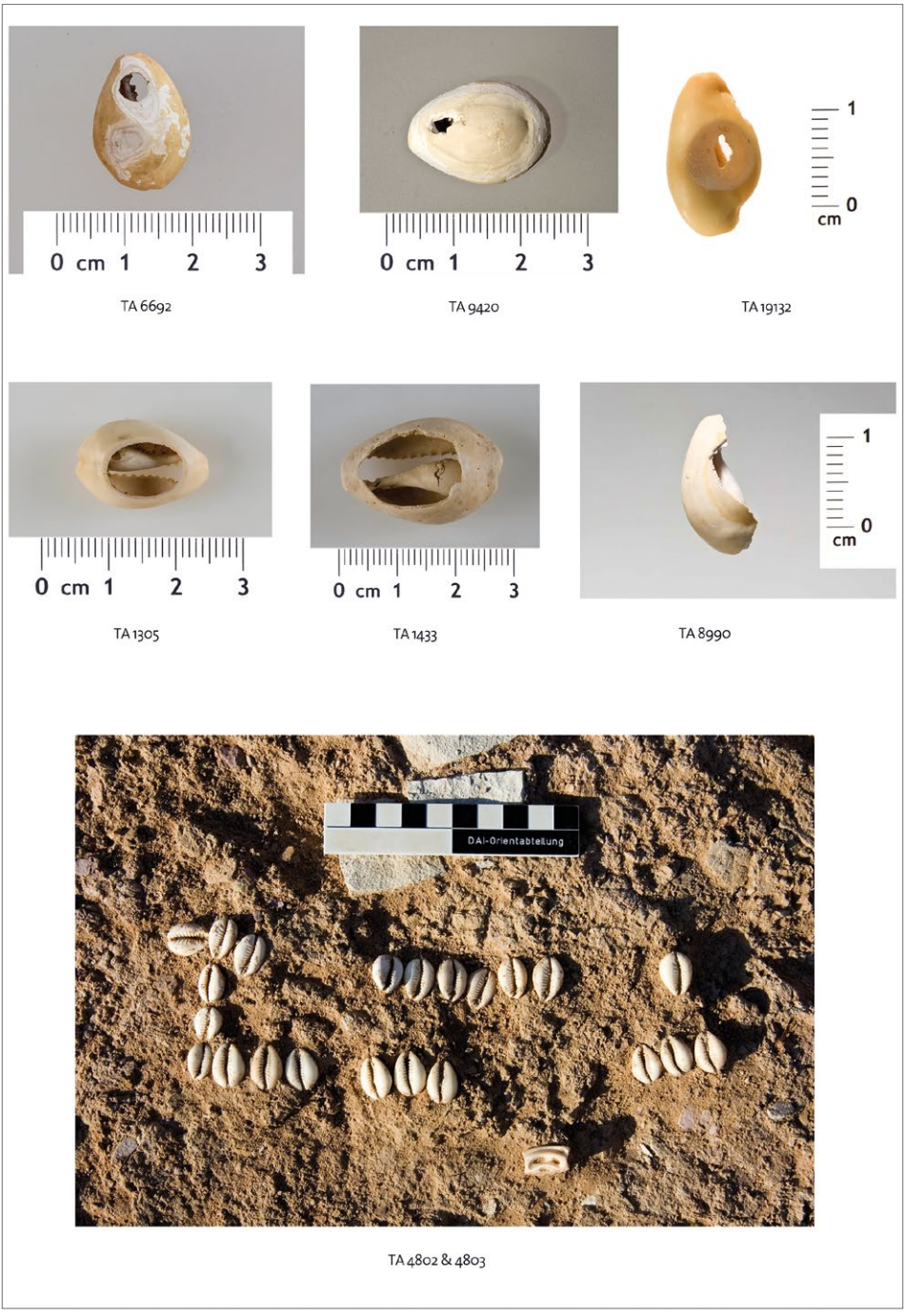

Fig. 4. *Cypraeidae*. Semi-finished(?) beads (TA 6692, TA 9420, TA 19132); modified beads (TA 1305, TA 1433); *Monetaria annulus* Linnaeus, 1758 (TA 8990); modified cowry beads *in situ* in Area O, SU 3186 (TA 4802, TA 4803) (© DAI Orient Department, see photo credits in the Acknowledgments)

textiles as was the case of cowry beads.

Of the 190 cowry shells, 160 were suitably modified by removing the dorsum. Two different techniques were used. One way was to abrade the dorsum on a rough surface until the required dimension of the bead was obtained [*Fig. 4*: TA 19132]. The resulting dorsal edges are regular with a smoothed surface [*Fig. 4*: TA 1305]. Considering the thickness of the robust dorsum, this process may have taken a long time. The second technique consists of making a small hole, either by abrasion of the dorsum or by gouging/hammering the side where the shell body is thinner. The dorsum could then be lifted with a pointed tool and easily removed. Alternatively, the dorsum could be incised, applying pressure after processing the initial small hole. In both cases, the resulting edges are irregular [*Fig. 4*: TA 1433]. Afterwards, the bead could be further smoothed by abrasion to the preferred height. The more uniform the thickness of the cowry beads, the smoother the pattern stitched to a fabric. In Taymāʾ, modified cowry shells with irregular edges are slightly more frequent. Assuming the shells decorated textiles, the dorsal side might not have been visible and thus flattening of the edges was unnecessary. Moreover, specimens with cut-off dorsum can be collected dead at the seashore, requiring no further processing. However, in this case they have regular, smoothed edges due to natural erosion by the sea.

Only two specimens display processing marks of abrasion (Area O, TA 19132, OP 7; Area E-South/F, TA 6692, OP 3b); one of these shows even two traces of intentional perforation [*Fig. 4*: TA 6692]. Another two specimens with perforated dorsum are disputable (Area E, TA 7591, OP 3a; Area O, TA 9420, OP indet.). Both cowries have small irregular perforations, similar to those caused by hammering [*Fig. 4*: TA 9420]. Intentional perforation by percussion, to create simple beads, cannot be completely ruled out, but these perforations may also be of natural origin. The situation is the same for one cowry shell identified as *Purpuradusta gracilis notata* (Gill, 1858), found in Area E-East (TA 15696, OP indet.). This specimen shows a perforation almost identical to holes achieved by hammering/gouging on the simple beads; however, this can also be natural or taphonomic. In this case, special processing is more likely due to the handsome dotted base of this species that is fairly adequate as adornment.

Finally, for completeness, one more specimen not identified to species level, is remarkably larger than *Monetaria annulus* and therefore was listed as *Cypraeidae* (Area O, OP indet).

Fasciolariidae (Family)

Pleuroploca trapezium Linnaeus, 1758

The Trapezium Horse Conch is a thick and heavy shell, up to 28 cm high, generally widespread in the Western Indo-Pacific (WoRMS). After the apex was removed, the shell could be used as a trumpet, which is attested in several cultures (Poutiers 1998: 590). A single specimen was found in Area E-South/F (OP 3a); its poor state of preservation does not allow any comment on possible modification.

The use of *Pleuroploca trapezium* (*Fasciolaria trapezium*) for shell bead production, especially for disk beads (see Caputo

and Genchi 2016), has already been mentioned (see above). Since these beads are more common in earlier periods (Bronze Age, Iron Age), the interpretation of this specimen as raw material is unlikely. Considering the context of the find (domestic quarter), its use as a decorative item is more probable. The date (4th–6th centuries CE) represents the final deposition of the shell; an older age cannot be excluded, same as for almost all of the specimens found in the archaeological deposits.

Marginellidae (Family)

Volvarina monilis Linnaeus, 1758, is also widespread in the Red Sea and the Gulf of Oman. Three specimens of this small gastropod were identified in the analyzed assemblages from Taymāʾ; all were intentionally modified. One single shell is perforated at the apex (Area O, OP 3a), while two other specimens display a perforation in the body, probably abraded (Area O, OP 7; Area E-South/F, OP indet.). They are all listed as simple beads. For at least one specimen, the manner of perforating the shell body is reminiscent of the process of dorsum removal observed on cowry beads. The hole was made wide with regular edges. It is conceivable that the shell was used as an appliqué ornament, maybe in connection with cowry shell beads, although a single specimen of *Volvarina monilis* (Area O, TA 5352, OP 7) was found in a layer together with modified cowries, cone shells and nerites.

Muricidae (Family)

Representatives of this extensive gastropod family have been used for nutritional purposes, in purple-dye production and, of course, as adornments due to a variety of impressive shells. Furthermore, the opercula of some species were burnt with other extracts in incense burners (Bosch et al. 1995: 112). Muricids live in shallow waters and are easy to collect. The two specimens found in Taymāʾ were identified as *Semiricinula tissoti* (Petit de la Saussaye, 1852) and *Tylothais savignyi* (Deshayes, 1844). Both were found in the residential quarter in Area E-South/F, one of them, *Tylothais savignyi*, in a well-dated layer (OP 3a). Tissot's Rock Shell, *Semiricinula tissoti*, is a small gastropod with a size up to 30 mm and widely distributed in the Western Indo-Pacific, including the Red Sea. The shell found in the domestic quarter has an elongated, irregular hole in its body near the aperture, probably made by gouging or hammering, and may have been used as a simple bead [*Fig. 5*: TA 839]. Taphonomic processes that could have resulted in similar perforations cannot be excluded.

Tylothais savignyi is a small, nodose snail that is widely distributed. The investigated shell is unworked and was either considered as decoration in itself or was possibly envisaged as a base for further shell artifact production.

Nassariidae (Family)

Marine gastropods from this family are mainly tentacled scavengers that live, principally, in shallow waters. The only representative in Taymāʾ is a single specimen of *Tritia gibbosula* Linnaeus, 1758, and was found in an early Iron Age-layer within Area O (TA 14722, OP 7). While the obvious perforation of the apex probably results from taphonomic processes, the body of the shell was intentionally

perforated to make a simple bead [*Fig. 5*: TA 14722]. This species is distributed only in the Eastern Mediterranean (WoRMS). Its one-time presence in the Taymāʾ assemblages, so far from its place of origin, is striking and verifies the existence of a supraregional exchange network in the early Iron Age (see Renzi et al. 2016 for the metal). Whether this "import" to the Taymāʾ oasis resulted from direct contacts with the Mediterranean region or was brought by regional distributors from the Levant, for example, cannot be proved. Beads made of *Tritia gibbosula* are known from the archaeological record already in the Upper Palaeolithic and the Epipalaeolithic (Bar-Yosef Mayer 2008a: 104; Bar-Yosef Mayer 2005: 177).

Fig. 5. Simple beads: *Engina mendicaria* (TA 9443), *Canarium* cf. *mutabile* (TA 979), *Semiricinula tissoti* (TA 839), *Nerita* cf. *orbignyana* (TA 5298), *Nerita* sp. (TA 19217, TA 19136), *Tritia gibbosula* (TA 14722) (© DAI Orient Department | see photo credits in the Acknowledgments)

Neritidae (Family)

This large family of small, globular shells includes both marine and freshwater snails (Dekker 2000: 29). At Taymā', marine gastropods of the *Neritinae* subfamily dominate the shell assemblage and they are also the most abundantly occurring marine gastropod on site (NSP 230). Although species identification was not practicable, two size categories can be distinguished. 17 larger specimens with an average height of 15 mm were documented as *Nerita* cf. *orbignyana* Récluz, 1841. These shells can reach a size up to 20 mm and are distributed in the Red Sea and the Gulf. They were found in several contexts, but mostly in layers of earlier occupation periods (OP 10–7). Eight specimens display perforations in the body, made by percussion, a technique producing irregular edges. Another shell of this family (TA 4830, Area O, OP 7), visibly different from the other shell beads, has a very small and regular rounded hole, leading to the assumption that the perforation was made by a carnivorous gastropod like the *Muricidae*, which could indicate collection of "ready-to-use" dead shells from the seashore (Bar-Yosef Mayer 2014: 92; Ridout-Sharpe 2017: 309, 311). Six nerites show perforations close to the apex [*Fig. 5*: TA 5298]; five specimens were modified by abrasion. One specimen (TA 8522, Area H, OP 7) shows both modifications—perforation of the apex as well as of the body—while another single unworked specimen was found in the fill of a looting pit in Area O (OP 3a).

The second, and undoubtedly largest, group of nerites is composed of 213 very small shells, listed as *Nerita* sp., with an average size of 4–8 mm. With the exception of a single specimen without obvious marks of modification, found in Area E-East (OP 5), all shells were recovered from Area O (OPs 7 and5)—with a conspicuous number occurring in early Iron Age contexts (NISP 212). 209 individuals were modified into simple beads by perforations made in the body [*Fig. 5*: TA 19217, TA 19136]. The irregularity of the holes suggests perforation by hammering/percussion. These small shells were found very often in concentrations, as in stratigraphic unit SU 6069 (inside building O-b1), where 119 specimens were associated with four *Conidae*, 1 *Olividae*, 1 *Nerita* cf. *orbignyana* and 3 *Cypraeidae*. 77 specimens were recovered from four other layers (SU 4101, SU 4113, SU 4115 andSU 4122), both inside and outside Building O-b1, but close together and initially assessed as one feature. These accumulations and the representative nature of the Area O complex, where several additional precious goods were found, may suggest interior decoration (embroidered fabrics, decorative items) rather than personal adornment. Traces of fire, likewise for most of the finds within these units, should be associated with the destruction of the building.

Like *Conidae* and *Cypraeidae*, nerites are found in almost every archaeological shell assemblage and are very common at Neolithic, Bronze Age and especially Iron Age sites (Bar-Yosef Mayer 2002; see sites listed in Carannante 2014: 126). Copious quantities of these shells in Iron Age layers at Taymā' fit this general trend.

Ancillariidae (Family)

Ancilla acuminata G.B. Sowerby II, 1859
This small, oval-shaped gastropod lives only in the Gulf of Aden and the Red

Sea (WoRMS). One specimen was collected from a stratigraphic unit in Area O (SU 6096, OP 7), together with 129 (mostly worked) shells of *Conidae*, *Cypraeidae* and *Neritidae*. Another single specimen was found in the domestic quarter of Area E-South/F (OP 3b). Both shells were modified into simple beads by perforating the apex. Both must have been threaded as well.

Olividae (Family)

Olive shells are widely distributed predatory gastropods represented by a large number of species. In total, 12 specimens, all with perforated apices and therefore categorized as simple beads, were documented in Taymāʾ. Apart from two (one from Area O, OP indet., the other from Area E-East, OP 9), they all come from layers dating to the early Iron Age (OP 7). Six olive shell beads were found in a burnt layer (SU 5844) in Area H; one of these was identified as *Oliva bulbosa* (Röding, 1798). In SU 5844 and two adjacent units(SU 5843, SU 5845), four stone beads were found, similar in size and shape to the worked *Olividae* [*Fig. 6*]. Given the fact that this type of stone bead is extremely rare in Taymāʾ, a special use, maybe in combination with the olive shell beads, may be hypothesized. It is also conceivable that these "replica" beads were produced to make up for the scarcity of adequate marine raw material, similarly to the copies and imitations of cowry beads or Triton shells (Golani 2014; Reese 1990).

Fig. 6. Olive shell beads and beads resembling stone beads, from Area H, early Iron Age (© DAI Orient Department | photos F. Weigel)

Ranellidae (Family)

The most prominent representatives of the Triton or Trumpet shells, are huge impressive individuals like *Charonia*, while smaller predatory sea snails of this family are less known. An almost complete middle-sized marine gastropod (height/width: 137/70 mm) with a highly weathered surface and a perforation in the body was found in Area E-South/F (OP 4).This specimen, assigned to the genus *Cymatium* Röding, 1798, is, allegedly, the largest documented gastropod of the entire assemblage from Taymā' [*Fig. 7*]. The perforation was caused by taphonomic events rather than intentional modification and should be considered as damage. Triton shells in archaeological contexts are well known from the ancient Mediterranean region, especially Crete (Åström and Reese 1990; Reese 1990), but a few specimens are also documented from several Levantine sites of various periods, also, from the Arabian Peninsula as well as from Egypt. Mienis mentions a damaged specimen found in a Byzantine building during excavations on the Temple Mount in Jerusalem and assumes its probable use as a container or symbolic object (Mienis 2003: 159). A Triton shell of the genus *Charonia*, unfortunately undated, was found during excavations in the urban center of Madā'in Sālih (Studer and Tardy 2015: 211, Fig. 1). At least two specimens of *Charonia tritonis* were documented from 3rd/mid-2nd-millennium-BCE layers in Marsa/Wadi Gawasis, Egypt; one of them was modified into a spoon-shaped artifact (Carannante 2014: 124, Table 11-1). Most often, after modification (perforating the apex), the Triton shells were used

Fig. 7. Ranellidae, *Cymatium* sp., Area E-South/F, TA 14256 (two views) (© DAI Orient Department | photos J. Kramer)

as trumpets (Poutiers 1998: 538). However, the discussed specimen is preserved almost complete, excluding such an interpretation. Even if its function as an object within the residential context is unresolved, the special value of Triton shells is undisputed.

Strombidae (Family)

Conchs are widely distributed, especially in the Indo-Pacific region. They can be found in shallow waters or on grassflats and are even today collected for their meat. *Strombidae* are often used in shell craft; modified specimens have been known since the Neolithic (Bar-Yosef Mayer 2000). The six specimens found in Taymāʾ were determined as *Canarium* cf. *mutabile* Swainson, 1821, *Canarium* cf. *fusiforme* G.B. Sowerby II, 1842, as well as *Conomurex fasciatus* Born, 1778. Notably, these shells were collected mainly from layers dating from the 2nd century BCE to the 6th century CE in Area E-South/F (NISP 4). A single unworked specimen was documented from Area O (*Canarium* sp.) and two specimens of *Conomurex fasciatus*, also unworked, from Area E-East. These shells are all undated.

The two specimens of *Canarium mutabile*, the Changeable Conch, found in Area E-South/F, were modified into simple beads by perforating the body through percussion (TA 979, OP 3b) [*Fig. 5*: TA 979] and additionally by removing the apex (TA 17427, OP 3a). Similarly modified into a simple bead by removal of the apex is the specimen of *Canarium* cf. *fusiforme* (TA 2790, Area E-South/F, OP 4). The nearest parallels for the use of *Strombidae* can be found in Madâʾin Sâlih. Studer and Tardy mention one *Canarium* cf. *labiatum* found in a post-Roman layer and one *Conomurex fasciatus* from the Nabataean period, both found in the residential quarter in Area 1 (Studer and Tardy 2015: 211, Figs 1, 2), as well as one additional *Conomurex fasciatus* found in Area 2 in the so-called urban center, too (Studer and Tardy 2015: 211, Fig. 1). It is thus possible that the notable concentration of shells of this family in later occupation periods in Taymāʾ and Madâʾin Sâlih may not be accidental, although nothing comes to mind as a valid and persuasive explanation.

Trochidae (Family)

Its intense red color makes the strawberry top shell, *Clanculus pharaonius* Linnaeus, 1758, an impressive small gastropod. Its habitat is in the shallow waters of the Red Sea, around Madagascar (WoRMS) and in the Gulf of Oman. Two specimens are documented from Taymāʾ: an unworked shell found in Building O-b1 in Area O (TA 16672, OP 7), and one individual with perforation on the body, collected from the burial ground of al-Nasim (TA 16886, OP 9). The latter was clearly modified into a simple bead by abrasion; the surface around the regular hole is smooth.

Shell beads made of *Clanculus pharaonius* are already known from the Pre-Pottery Neolithic B (Bar-Yosef Mayer 2000: 218, Fig. 1) and are seldom found in large quantities. One documented specimen from Madâʾin Sâlih was found within the residential area and can be dated to the post-Roman period (Studer and Tardy 2015). This taxon is also reported from the Roman sites of Mons Claudianus and Mons Porphyrites in the Eastern Desert of Egypt (Hamilton-Dyer 2003).

Turbinidae (Family)

Shells of this family are thick and sometimes heavy, with a wide rounded aperture. These gastropods can be found in shallow-water rocky habitats and are distributed in the Red Sea (WoRMS). A single specimen, from the fill of a room in the residential quarter uncovered in Area E-South/F (OP 3a), was identified as *Turbo radiatus* Gmelin, 1791. The perforation in the body whorl near the aperture was certainly processed intentionally; irregular edges suggest a perforation caused by percussion.

Remains of *Turbo radiatus* are not frequently reported. At Quseir al-Qadim on the Red Sea coast in Egypt, this represents the most frequent species in the Roman and Islamic layers (Hamilton-Dyer 2011). The 46 individuals from the 3rd/mid-2nd millennium BCE, found in Marsa Gawasis, Egypt, were interpreted as food remains (Carannante 2014: 125). Such use should be excluded for the Taymā' assemblages, but then no detailed assessment is possible with just one specimen.

Turridae (Family)

The same can be said of the single individual of a turrid that could not be determined to the species level. This unworked specimen was found in Area E in a layer dated to the 2nd–4th centuries CE (OP 3b). With a height of almost 60 mm, it is one of the larger unworked gastropods found in Taymā'.

Gastropoda indet.

Several marine gastropods (a total of 25)were modified into artifacts to such an extent that it was not possible to determine the species. Two, found in the assemblages from Area E-East, can be categorized as simple beads: an apically holed shell—most probably an *Olividae* or a small cone—with additional perforation of the body whorl (TA 18077, OP indet.), and one fragile and fragmented specimen with an irregular hole in the shell body (TA 15926, OP 3b) that was caused either by intentional percussion or taphonomic processes.

Simple beads of miscellaneous shapes were found in very few contexts. One biconical (TA 9404) and one rounded hexagonal bead (TA 5813) each originate from early Iron Age strata in Area O; a single cylindrical bead each was found inside grave E-g1 in the burial ground of al-Nasim (TA 16786, OP 9), in Area E (TA 11355, OP 3b) and in Area O (TA 4046, OP indet.).

More elaborate complex beads, resembling *Conus* apex beads, were found in Area E-East (TA 11958, OP 1) and in Area O (TA 4803, OP 7). Another specimen from Area E-East (TA 17753, OP 10) with largely perforated apex could be interpreted as semi-finished perhaps.

Additionally, seven small rings, possibly made of cone shells, are known from Area E-East (TA 11587, OP 1), Area E-South/F (TA 8367,OP 3b; TA 8692, OP 3a; TA 8851, OP indet.), Area H (TA 10012, OP 7) and Area O (TA 5361 and TA 5362, same stratigraphic unit, OP indet.).

A long, rectangular plaque (TA 16784), made from a body whorl, with smoothed edges and pierced on one end, was found inside grave E-g1 in the al-Nasim burial ground.

Finally, with regard to seven further marine gastropods no remarks on modifications could be made due to their poor state of preservation.

3. SCAPHOPODA

Dentaliidae (Family)

Tubular elongated and slightly curved tusk shells were used for bead production already in the Upper Palaeolithic and Epipalaeolithic (Bar-Yosef Mayer 2005: 177; Bar-Yosef Mayer 2008a; 2014: 95; Reese 1991) and are often present in the archaeological record of early occupation periods. Both ends of these small gastropods are open, so the empty scaphopod shells collected at the beach can be threaded at once and used as beads. Usually, they were cut into smaller segments, by sawing for instance. Three *Dentalium* specimens were found in Taymāʾ. A characteristic shape identified one specimen (Area E, TA 3692, OP 3a) as an Octagonal tusk, *Dentalium octangulatum* Donovan, 1804, which is found in the Indo-Pacific, including the Red Sea. One undetermined specimen each (*Dentalium* sp.) comes from Area E-East (OP 4) and Area E (OP indet.). None is complete; the length of the fragments ranges between 10.0 mm and 18.2 mm. The evidence for the cutting technique is unclear.

The presence of tusk shells in periods later than the Iron Age is noteworthy. Many finds are known from Bronze Age graves and grave contexts (Bar-Yosef Mayer 2002: 170; 2008a: 105; Reese 1991; Szeląg 2013; Wygnańska 2015: 491). These beads must have once been part of items of personal adornment, in similarity to the 46 specimens found in pre-Hellenistic funerary contexts in Madāʾin Sālih (Studer and Tardy 2015). Tusk shells contemporary to the finds from Taymāʾ have rarely been reported and the small number of fragments make frequent use rather unlikely.

4. BIVALVIA

In comparison to the marine gastropods, marine bivalves found in Taymāʾ are much less numerous and diverse. Altogether 37 specimens were documented, of which only three were identified to the species level. Heavy fragmentation made it futile to comment on shell working techniques. The oldest finds date to the early Iron Age and even if the bulk of bivalves was expected to come from Area O—like most of the worked marine goods found in Taymāʾ—their presence is balanced between the early periods in Area O and later occupation periods and contexts (Area E, E-East, E-South/F).

Arcidae (Family)

Like most of the marine goods discussed in this paper, this species is distributed in the Red Sea and the Gulf. Arc clams are well known as food (Poutiers 1998: 142). How extensively were they exploited in antiquity as a food resource is not clear. Carannante mentions 34 shells from Marsa/Wadi Gawasis that had apparently been used for food (Carannante 2014: 125). Such dietary use in Taymāʾ is rather improbable given that transport of fresh shellfish over several days is near to impossible. The shells of this family have been known to be used as containers in Mesopotamia (Danti and Zettler 1998: 143) and a similar use might be envisaged for the Taymāʾ specimens. In total, only three specimens were uncovered, all in Area E-South/F. One unworked complete valve was identified as *Anadara antiquata* Linnaeus, 1758, the Antique Ark (TA 15326, OP 3b). Two other specimens of undetermined *Arcidae* are fragmented, showing no traces of processing. Both

were found in superimposed stratigraphic units dating to OP 4. It remains unclear whether both single valves once formed a complete bivalve. Even though bivalves were found exclusively in the residential area, and one arc clam was uncovered in the residential area at Madâ'in Sâlih (Studer and Tardy 2015: 211, Fig. 1) as well, this contextualization should not be overvalued since the number of specimens found at Taymā'—three valves—is too small for any generalizations.

Pteriidae (Family)

Pearl oysters have been used as raw material for adornment in two different ways: both the pearl, if present, and the mother-of-pearl are used. The most frequent recorded species in archaeological reports are the *Pinctada margaritifera* Linnaeus, 1758, the Blacklip pearl oyster, and *Pinctada imbricata radiata* Leach, 1814, the Rayed pearl oyster. Both are widely distributed in the Red Sea and the Mediterranean (WoRMS). The larger species *Pinctada margaritifera* can reach a size up to 25 cm offering more mother-of-pearl as raw material. All the 14 specimens at Taymā' are fragmented valves or finished artifacts (*n*=9).They were not identified to the species level, and therefore have been documented solely as *Pinctada*. Two rings were excavated in Building E-b1, in different stratigraphic layers and thus cannot be associated with a single context. One complete ring (TA 17341,) with an external diameter of 26.6 mm, was assigned to OP 5. The second ring (TA 9929, OP 3b), fragmented, has an external diameter of approximately 29.3 mm. Disk-shaped beads were found in Area H (TA 10008, OP 7)—this specimen was pierced by drilling from both sides—and in Area O (TA 7530, OP 5; TA 14718 and TA 15898, both OP 7; TA 4541 and TA 6707, both OP indet.). All beads are round and their perforations were drilled at their centers; the diameter of the central perforation varies between 2 mm and 4 mm, while the diameter of each bead is between 10.1 mm and 32.0 mm. Five of these *Pinctada* disk beads were found associated with other worked shells: in Area H with six Olive shell beads; in Area O with one *Cypraeidae* and, on a single occasion (TA 15898), with one *Conus* shell and one nerite.

Even though plaques are popular and the most frequently attested form of utilizing pearl oyster shells that is reported in archaeological reports, this utilization was documented only once at Taymā with a specimen found in a preparatory level for a floor in Building E-b1 (TA 8829, Area E, OP 4). The 4-mm-thick plaque is of rectangular shape (4.3 x 2.1 cm) with rounded edges; one side is broken alongside two pierced holes [*Fig. 8*].[9] Both ends were regularly pierced (0.8 mm). One side is partly covered by a 1 mm thick red layer, maybe a kind of resin, applied to a translucent layer, probably an adhesive (S. Lora, personal communication).[10] Further fragmented specimens of *Pinctada*, without traces of artificial

9 Suggested by Dr. Sebastiano Lora, excavator of Area E (Project Taymā, German Archaeological Institute Berlin, Orient-Department).

10 A preliminary assessment was made by the Project Taymā conservator Gereon Lindar, to be confirmed by a residue analysis in progress at the HTW Berlin University of Applied Sciences.

modification, were documented from Areas E (TA 2980, OP 4), E-South/F (TA 3807, OP 3a) and Area O (TA 9517, three specimens of unclear contextual relation, OP 7).

Pearl oysters have seen widespread use globally and are frequently documented in archaeological reports. Finds are known as early as the Epipalaeolithic and early shell artifacts were found in Neolithic layers (Reese 1991: 184). During the Chalcolithic period, mother-of-pearl was a popular raw material used for the production of plaques, pendants or inlays (Bar-Yosef Mayer 2000: 223; 2014: 96). Complete bivalves with decorated inner surface, used as containers or ritual items, were prominent in the Greek and Roman periods (Michaelides 1995; see also the literature in Láng 2006: 152) and were, undoubtedly, considered as luxury goods. Tools, like shell fish hooks (Tosi and Usai 2003: 19, Fig. 11; Bavutti et al. 2015) or spoons (Carannante 2014: 128, Fig. 11-8) were also made of *Pinctada*. Exploitation of the shells for ornaments and personal adornment is surely more popular and particularly attested in funerary contexts (Wygnańska 2015; Reese 1991).

Complete and fragmentary artifacts made of pearl oysters were found at Taymāʾ in various areas and contexts, potentially illustrating exploitation during different occupation levels. Three *Pinctada* artifacts were uncovered in layers assigned to later occupation periods in Area E, within the temple Building E-b1. Four specimens, of which only one was artificially modified, were found in early Iron Age contexts from Areas H and O, the latter particularly rich in finds of various worked shells. Artifacts made from pearl oyster shells are absent from funerary contexts. The number of specimens is too small for a conclusive analysis of exploitation strategies. Finds of similar *Pinctada* from Madâʾin Sâlih—from the post-Roman layers in the residential area, as well as from a Nabataean funerary context (Studer and Tardy: 211 Fig. 1, 212 Fig. 2)—do not seem to support the idea of common use of mother-of-pearl goods between the 2nd century BCE and the 4th century CE. In any case, the han-

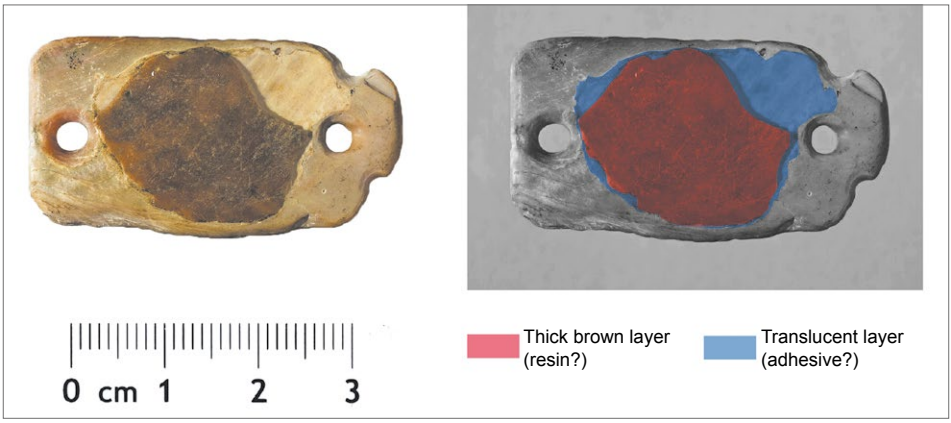

Fig. 8. *Pinctada* sp., plaque, Area E, TA 8829: on right, marking extent of surviving surface deposits (© DAI Orient Department | photos M. Cusin)

dling ofpearl oyster artifacts as valuable commodities does not seem to be in doubt.

Glycymerididae (Family)

The large family of Bittersweet clams comprises roughly 150 species and is distributed worldwide. It is attested in almost every archaeological faunal assemblage that includes marine goods (Light 2017: 353, 354). *Glycymerididae* were collected as early as the Middle Paleolithic (Bar-Yosef Mayer 2005: 177; 2014: 95) and were intensively bartered during the Neolithic.

The assemblages from Taymāʾ revealed two specimens documented as *Glycymeris* sp. They belonged most probably to the species *Tucetona pectunculus* Linnaeus, 1758 (WoRMS; also known as *Glycymeris pectunculus* Linnaeus, 1758), the most frequently reported taxon from the Red Sea and the Gulf. Both specimens display intentional perforations of the umbo caused one by abrasion (TA 10152, Area E-South/F, OP 3a) and the other probably by percussion (TA 10036, Area H, OP 7). Bivalves with naturally holed umbo can easily be picked up on the seashore and used as a pendant or bead.

Lucinidae (Family)

Various genera and species are included in this family of marine bivalves with worldwide distribution. Only one fragmented specimen from Taymāʾ, found in Area E-South/F (OP 4), was identified as *Codakia* cf. *tigerina* Linnaeus, 1758, the Pacific tiger lucine. Artificial modifications could not be observed because of the poor state of preservation. In similarity to the *Glycymerididae*, shells with perforated umbo were used as ornaments. Some species have marked patterns on their body surface and were therefore favored for shell working. Lucinidae are reported in small numbers from 3rd/mid-2nd-millennium-BCE layers at Marsa/Wadi Gawasis (Carannante 2015) and from the Hellenistic-to-post-Roman period in Madâʾin Sâlih (Studer and Tardy 2015: 207: 211 Fig. 1). Like *Tridacna* shells, *Codakia* shells found in the Roman and Islamic layers in Quseir al-Qadim, Egypt, were used as inkpots (Hamilton-Dyer 2011: 165).

Cardiidae (Family)

The thick and heavy shells of the subfamily *Tridacninae* represent the largest recent Bivalve species. Two taxa are frequently mentioned in archaeological reports: *Tridacna maxima* Röding, 1798, the Small Giant Clam, which appears in the Red Sea and the Gulf, and *Tridacna squamosa* Lamarck, 1819, the Fluted Giant Clam, which is distributed in the Red Sea and Indo-Pacific Basin, but not in the Gulf.[11] Both reach a size of up to 35–40 cm and can be found attached to coral reefs (Poitiers: 263, 271, 272). The 16 specimens found in Taymāʾ were assigned to *Tridacna maxima*. Only three of them are evidently unworked, including one complete valve found in Area O (TA 5825, OP 7), the only one from a context prior to the 2nd century BCE. The other two specimens are fragmented valves with no traces of modification (TA 14567, Area E, OP indet.; TA 498,

11 SeaLifeBase: *Tridacna squamosa* [http://www.sealifebase.org/summary/Tridacna-squamosa.html].

Area E-East, OP 1). In these instances, we can assume single individuals. Another 13 specimens, too fragmented for any comments on the shell handcrafting, were found in various areas and stratigraphic units. Nevertheless, all were excavated in deposits dated from the 2nd century BCE onwards. No shell was found in burial contexts.

The most popular *Tridacna* shells from archaeological contexts are those that are engraved (Brandl 2001; Ridout-Sharpe 2017: 299).[12] Their habitats are spread between the Gulf and Etruria. According to Rolf A. Stucky, these shells, which are supposed to have functioned as containers were commonly found in residential quarters in the Near East, whereas in Greece, most of the finds derived from sanctuaries (Stucky 2014–2016: 135). At Taymā', none of the finds was engraved or contained any residue. Four out of 16 specimens were uncovered in the residential Area E-South/F, while the nine fragmented *Tridacna* shells uncovered in Area E and E-East could be linked to the temple Building E-b1. The function of these bivalves is not clear, but their use as a vessel, a container or simply decoration seems most probable. Parallels can be found in the archaeological record of Madâ'in Sâlih, where four specimens are documented from the residential area, dating to the Hellenistic-to-post-Roman periods, and one specimen from a Nabataean funerary context (Studer and Tardy 2015: 211 Fig. 1). The use of *Tridacna* shells as containers for various substances like pitch, ink or paint is recorded at the Roman sites of Mons Claudianus and Mons Porphyrites (Hamilton-Dyer 2003). Nowadays, dried *Tridacna* meat is still consumed in Egypt (Hamilton-Dyer 2003: 90) and this particular use should also be taken into account for the more ancient periods.

Bivalvia indet.

A single fragment of a bivalve found in Area O (OP 7) cannot be determined to species level because of its poor state of preservation. It is likely a *Pinctada* Röding, 1798. It shows no visible traces of modification.

5. ACTINOPTERYGII

Ray-finned fish are a subclass of bony fish and indeed, finding remains of any kind of marine fish is quite uncommon so far away from the coast. Two specimens were uncovered in Area E.

Scaridae (Family)

Scarus cf. *ghobban* Forsskål, 1775, the Blue-barred parrotfish, inhabits coral reefs and is widespread in the Indo-Pacific, including the Gulf and the Red Sea. This large-bodied parrotfish can reach a size up to 90 cm, while the average size is around 30 cm (Choat 2015). Parrotfishes are characterized by often impressive colors. Even nowadays, the Hareed Festival, a parrotfish-catching contest on the Farasan Island, is a "key tourist festival in the region" (http://www.sauditourism.sa/en/ExploreKSA/AttractionSites/Farasan-Island/Pages/Alhareed.aspx) and reveals the high local importance and long tradition of the catching of this species.

12 Brandl suggests a limited timespan between 630 and 580 BCE (Brandl 2001: 58).

The bone found in Building E-b1 (TA 19303, Area E, OP 3a: 4th–6th century CE) is an *Os pharyngeum inf.* (total length approximately 45 cm). Being part of the skull, it implies that a complete fish had once been brought to Taymā'.

Serranidae (Family)

This large species-rich family of meaty fishes is caught mainly for food. Like the parrotfish, groupers inhabit reefs of tropical and subtropical zones and are an integral component of several archaeozoological fish assemblages.

One specimen—a *Vertebra praecaudalis* (height 9.6 mm, width 12.2 mm, length 12.3 mm, total length about 50 cm)—was found in a large deposit in Area E, Building E-b1 (TA 17310, OP 3b: 2nd–4th centuries CE). It could not be identified to species level.

Fish were an essential part of the diet of coastal societies and trading fish to inland settlements was surely an important factor in local and regional economies (Beech 2004; Cleuziou 1996: 61; Van Neer et al. 2004). Fish trade to desert settlements is a particularly well known process in Roman times (Hamilton-Dyer 2011: 269). Rare finds of huge impressive species in remote areas far away from the coast were often interpreted as precious goods intended for consumption by the elites; however, production and transport of preserved fish was well established and more common than suggested from a present-day perspective (Van Neer and Ervynck 2004).

The finds from Taymā' were most probably brought from the nearest coast, which would be the Red Sea, but imports from the Gulf of Oman or the Gulf cannot be excluded. Reported finds from the Roman port/Islamic settlement of Myos Hormos/Quseir al-Qadim on the Egyptian Red Sea coast show similarities with the marine goods found at Taymā'. The most frequent fish species recorded in archaeological layers were parrotfish and groupers, obviously processed for transport (Hamilton-Dyer 2011). Likewise, major quantities of both these species are attested at Roman Berenike on the Egyptian side of the Red Sea-coast (Van Neer and Ervynck 1998). In the faunal assemblages of the 1st/2nd-century-CE quarry settlements at Mons Claudianus and Mons Porphyrites in the Egyptian Eastern Desert, parrotfish and groupers dominated and appear to have been transported to the sites both preserved and also as fresh meat, together with oysters and clams (Hamilton-Dyer 2001; 2003). According to Hamilton-Dyer, transportation over a distance of 70 km from the Red Sea was managed in two or three days by either donkey or camel (Hamilton-Dyer 2001: 287). At the same speed, transport over 300 km between the Red Sea coast and Taymā' would have taken between nine and 13 days, making the transport of fresh seafood and fish for consumption impractical. So, the fish found in Taymā' must have been transported either dried—the most probable method due to its convenience—salted, pickled or smoked. ElMahi mentions grilling as a method of preserving that keeps fish edible for two or three days (ElMahi 2000), which is also unlikely in the case of finds from Taymā'. When drying medium and large fish, the skulls are usually split (Beech 2004: 208–2011) or removed (ElMahi 2000: 103), and also

Table 2. Taymā. Marine faunal assemblages. Number of specimens (NSP) referring to **excavation areas/context**
*65 fragments gathered from one stratigraphic unit and therefore counted as 1 specimen;
** Bivalvia: single valves counted as 1 specimen

Class	Family	Taxon	A	Al-Nasim	E	E-East	E-South/F	H	O	Total
Anthozoa	Tubiporidae	*Tubipora musica* Linnaeus 1758							65*	1*
Anthozoa total									65	
Gastropoda	Buccinidae	*Engina mendicaria* Linnaeus 1758		2	1	1			5	9
	Cerithiidae	*Cerithium caeruleum* G.B. Sowerby II 1855							2	2
	Conidae	Conidae Fleming 1822		11	8	18	3	1	55	96
		Conus cf. *taeniatus* Hwass in Bruguière 1792				1	1			2
		Conus vexillum Gmelin 1791		1		1				2
	Cypraeidae	*Cypraea pantherina* Lightfoot 1786							1	1
		Cypraea cf. *pantherina* Lightfoot 1786		1	2	1	2		4	10
		Cypraeidae Rafinesque 1815 (size *Monetaria annulus*)	3		14	2	15	3	137	174
		Cypraeidae Rafinesque 1815							1	1
		Monetaria annulus Linnaeus 1758							3	3
		Purpuradusta gracilis notata Gill 1858				1				1
	Fasciolariidae	*Pleuroploca trapezium* Linnaeus 1758					1			1
	Marginellidae	*Volvarina monilis* Linnaeus 1758					1		2	3
	Muricidae	*Semiricinula tissoti* Petit de la Saussaye 1852					1			1
		Tylothais savignyi Deshayes 1844					1			1
	Nassariidae	*Tritia gibbosula* Linnaeus 1758							1	1
	Neritidae	*Nerita* cf. *orbignyana* Récluz 1841		1	1	1	1	1	12	17
		Nerita sp.				1			212	213
	Ancillariidae	*Ancilla acuminata* G.B. Sowerby II 1859					[1]		1	2

Gastropoda	Olividae	*Oliva* cf. *bulbosa* Röding 1798						1		1
		Olividae Latreille 1825				1		6	4	11
	Ranellidae	*Cymatium* (?) Röding 1798					1			1
	Strombidae	*Canarium* cf. *mutabile* Swainson 1821					2			2
		Canarium cf. *fusiforme* G.B. Sowerby II 1859					1			1
		Canarium sp.							1	1
		Conomurex fasciatus Born 1778				2				2
	Trochidae	*Clanculus pharaonius* Linnaeus 1758		1					1	2
	Turbinidae	*Turbo radiatus* Gmelin 1791					1			1
	Turridae	Turridae (?) H. Adams & A. Adams 1853 (1838)			1					1
	Gastropoda	Gastropoda indet.	1	2	2	6	3	1	10	25
Gastropoda total			4	19	29	36	35	13	452	588
Scaphopoda	Dentaliidae	*Dentalium octangulatum* Donovan 1804			1					1
		Dentalium sp.			1	1				2
Scaphopoda total					2	1				3
Bivalvia**	Arcidae	*Anadara antiquata* Linnaeus 1758					1			1
		Arcidae Lamarck 1809					2			2
	Pteriidae	Pinctada Röding 1798			4		1	1	8	14
	Glycymerididae	*Glycymeris* sp.					1	1		2
	Lucinidae	*Codakia* cf. *tigerina* Linnaeus 1758					1			1
	Cardiidae	*Tridacna maxima* Röding 1798			6	3	4		3	16
	Bivalvia indet.	Bivalvia indet.							1	1
Bivalvia total					9	3	10	2	12	37
Actinopterygii	Scaridae	*Scarus* cf. *ghobban* Forsskål, 1775			1					1
	Serranidae	Serranidae Swainson, 1839			1					1
Marine goods										631

Table 3. Taymā. Marine faunal assemblage. Number of specimens (NSP) referring to **occupation periods**
*65 fragments gathered within one stratigraphic unit and therefore counted as 1 specimen;
** Bivalvia: single valves counted as 1 specimen

Class	Family	Taxon	OP 10	OP 9	OP 7	OP 5	OP 4	OP 3b	OP 3a	OP 2	OP 1	OP indet.	Total
Anthozoa	Tubiporidae	*Tubipora musica* Linnaeus 1758			65*								1
Anthozoa total					65*								1
Gastropoda	Buccinidae	*Engina mendicaria* (Linnaeus 1758)		2	2	1	1	1	1			1	9
	Cerithiidae	*Cerithium caeruleum* G.B. Sowerby II 1855				1						1	2
	Conidae	Conidae Fleming 1822	2	15	40	4	7	5	5		6	12	96
	Conidae	*Conus* cf. *taeniatus* Hwass in Bruguière 1792								1	1		2
	Conidae	*Conus vexillum* Gmelin 1791	1	1									2
	Cypraeidae	*Cypraea pantherina* Lightfoot 1786										1	1
	Cypraeidae	*Cypraea* cf. *pantherina* Lightfoot 1786		1	1	1	2	1	1			3	10
	Cypraeidae	Cypraeidae Rafinesque 1815 – (size *Monetaria annulus*)			117	7	5	12	12		1	20	174
	Cypraeidae	Cypraeidae Rafinesque 1815										1	1
	Cypraeidae	*Monetaria annulus* (Linnaeus 1758)			1	1						1	3
	Cypraeidae	*Purpuradusta gracilis notata* (Gill 1858)										1	1
	Fasciolariidae	*Pleuroploca trapezium* (Linnaeus 1758)							1				1
	Marginellidae	*Volvarina monilis* (Linnaeus 1758)			1				1			1	3
	Muricidae	*Semiricinula tissoti* (Petit de la Saussaye 1852)										1	1
	Muricidae	*Tylothais savignyi* (Deshayes 1844)							1				1
	Nassariidae	*Tritia gibbosula* (Linnaeus 1758)			1								1
	Neritidae	*Nerita* cf. *orbignyana* Récluz 1841	1	1	12			1	2				17
	Neritidae	*Nerita* sp.			209	3						1	213
	Ancillariidae	*Ancilla acuminata* (G. B. Sowerby II 1859)			1			1					2

	Olividae	*Oliva* cf. *bulbosa* (Röding 1798)			1									1
	Olividae	Olividae Latreille 1825		1	9								1	11
	Ranellidae	*Cymatium* (?) Röding 1798					1							1
	Strombidae	*Canarium* cf. *mutabile* (Swainson 1821)						1	1					2
	Strombidae	*Canarium* cf. *fusiforme* (G. B. Sowerby II 1859)					1							1
	Strombidae	*Canarium* sp.											1	1
	Strombidae	*Conomurex fasciatus* (Born 1778)											2	2
	Trochidae	*Clanculus pharaonius* (Linnaeus 1758)		1	1									2
	Turbinidae	*Turbo radiatus* Gmelin,1791							1					1
	Turridae	Turridae (?) H. Adams & A. Adams1853 (1838)						1						1
	Gastropoda	Gastropoda indet.	1	2	6	1		4	1		3	7		25
Gastropoda total			5	24	402	19	17	27	27	1	11	55		588
Scaphopoda	Dentaliidae	*Dentalium octangulatum* Donovan, 1804							1					1
	Dentaliidae	*Dentalium* sp.					1					1		2
Scaphopoda total							1		1			1		3
Bivalvia**	Arcidae	*Anadara antiquata* (Linnaeus 1758)						1						1
	Arcidae	Arcidae Lamarck 1809					2							2
	Pteriidae	Pinctada Röding 1798			6	2	2	1	1			2		14
	Glycymeridi-dae	*Glycymeris* sp.			1				1					2
	Lucinidae	*Codakia* cf. *tigerina* (Linnaeus 1758)					1							1
	Cardiidae	*Tridacna maxima* (Röding 1798)			1		1	1	4		2	7		16
	Bivalvia indet.	Bivalvia indet.			1									1
Bivalvia total					9	2	6	3	6		2	9		37
Actinopterygii	Scaridae	*Scarus* cf. *ghobban* Forsskål 1775							1					1
	Serranidae	Serranidae Swainson 1839										1		1
Marine goods														631

before the salting process, the fish is usually filleted. With just one cranial and one vertebral element one cannot presume to say anything on the techniques of preservation, which are generally hard to recognize in archaeozoological assemblages. The pharyngeal bones of parrotfish, with many lined up pharyngeal teeth, are solid and therefore more resistant than the fragile elements of the axial skeleton. And, of course, the preservation of fish remains in s hyperarid climate, as well as the lifting method during excavation, drastically limits the number of recoverable fish remains. Last but not least, the fish transported to Taymāʾ must have been preserved, but their origin remains speculative.

EXPLOITATION OF MARINE GOODS AT TAYMĀʾ: FOOD, ARTIFACTS, RAW MATERIAL AND TRADE

Marine goods can be exploited in numerous ways: as food, tools, raw and building materials, containers, decorative elements, to be made into medicine or burned as fragrance, as symbols in ritual acts and to signify social identity (Claassen 2009: 196; Bosch et al. 1995;Dubin 2009: 23; Trubitt 2003: 260–263; Kuhn et al. 2001). The marine goods found in Taymāʾ, an oasis settlement 300 km away from the Red Sea coast, which is the nearest, comprise 631 specimens of at least 590 individuals of five animal classes: coral, gastropods, bivalves, scaphopods and fish. These finds were collected from different contexts: burial grounds, public buildings, domestic contexts and agricultural areas, and span a chronological sequence from the early 3rd millennium BCE to the 7th century CE at the very least [see *Tables 2, 3*]. 73.7% of all the finds (NSP 465) were uncovered in Area O, especially in Building O-b1, which dates to the early Iron Age. The diverse features of each context, whether domestic, public, official, or ritual, as well as their respective occupation periods

Table 4. Ratio (NSP) of artifacts, semi-finished goods and unmodified specimens (fish excluded) referring to contexts

	Al Nasim	A	E	E-East	E-South/F	H	O	Total
Artifacts	16	3	26	19	29	14	415	522
Unworked specimens			2	5	2		12	21
Semi-finished good				1	1		1	3
Semi-finished good(?)			1				1	2
Natural modifications							1	1
No data available	3	1	12	15	13	1	35	80
Total	19	4	41	40	45	15	465	629

prevent an intra-site comparison of the marine and faunal assemblages from Taymā'.

Fish are exceptional among the finds. At least one was brought complete to the settlement and consumption purposes immediately come to mind. Trading preserved fish as food to inland settlements, even in desert regions, was a common practice and diversified the local diet. However, the poor preservation of such remains in the archaeological record limits the discussion. Singular remains of impressive fish species found within the temple complex further the interpretation of preserved fish as either a decorative element, a trophy or a curiosity. This interpretation is surely not the most obvious one, but it should not be excluded.

By contrast, direct consumption of fresh seafood is very unlikely due to the impracticality of carrying the goods a long distance. The high frequency of worked shells, indicates that decorative artifacts were the predominant form of exploiting marine resources. In total, 83% of all marine goods, fish excluded, were worked specimens. Separated by context, the amount of worked shells was always significantly greater than that of unworked specimens or of specimens for which no comments on the modification could be made [*Table 4*].

Corals, scaphopods, gastropods and bivalves were primarily used as decorative items, as adornments, and as beads. Only 21 of 629 specimens were not processed; five specimens can be classified as semi-finished goods. Production waste so typical of carnelian bead processing at Taymā' (Haibt 2013) is completely absent in the case of shells.

Many unworked specimens belong to species which are frequently found modified into shell beads, like *Engina mendicaria*, *Conidae*, *Cypraeidae*, *Neritidae*. These unworked shells are mostly single finds and therefore they appear isolated, unique, outstanding instead of associated with other semi-finished goods or "work pieces", which can be interpreted as such. Consequently, based on the current investigations, shell bead production on site is highly improbable. It appears more probable that all these processed shells reached the oasis as finished goods, for example, as embroidered textiles, objects with inlaid work, jewelry or single beads/pendants for individual processing. It is also conceivable that specialized craftsmen visited the oasis (Bar-Yosef Mayer 2008b: 202).

In particular, the associated finds from Building O-b1 (Area O, OP 7) suggest elaborate interior decoration.Similar finds can be expected within the confines of a temple—here, temple Building E-b1 in Area E; they would have been lost presumably during subsequent building alterations.

Individual shell assemblages, even if consisting of a limited number of specimens, correspond well to Bronze and Iron Age grave goods, as well as Roman and Nabataean settlement finds from the Arabian Peninsula and the Levant. Nevertheless, the number of specimens and the variety of worked shells within an Iron Age building complex is noteworthy and unique in the northwestern Arabian Peninsula, not the least because this building complex itself is exceptional and unequalled in the region.

Dating the worked shells, namely the more elaborate shell beads, is quite difficult. Items of personal adornment, symbolic pieces, rare goods or goods of personal importance could have been handed down over several generations. The value and rarity of such finds are hard to judge in a settlement located at the junction of a complex network of trade routes, where presumably prized objects would have commonly been swapped. Specifically, the value itself cannot be objectively ascertained from a present-day perspective. The unique character of some objects, like the decorated *Conus* apex beads, as well as the small number of some artifacts may indicate their role as "precious goods". Then again, worked shells of specific taxa, like simply holed nerites or cowries, are reported in quantity from several sites and seem to have been a kind of "basic fashionable equipment" in various periods. Modes of exchange, of prestigious goods that is, derive from the number and quantity of the different species, distance from their respective places of origin, as well as usage and archaeological situation (Ridout-Sharpe 2017: 301). However, they do not give a satisfying account of the value, rareness, economic and cultural importance of marine goods in a desert environment.

These marine goods surely indicate a regional and long-distance exchange. All species, except one, can be found in the Western Indo-Pacific Basin, including the Red Sea, the Gulf and the Gulf of Oman. Imports from the Red Sea coast can be suggested as the most probable based on the current state of research, although contacts with the southern region of the Arabian Peninsula cannot be excluded. Investigations of the provenance of various stone beads could bring useful results, some of the beads from the Indus valley being well distributed in Saudi Arabia and Mesopotamia (Wygnańska 2015: 528; Kenoyer 2008). A steady, extensive network system and hence a supraregional exchange with Egypt, Mesopotamia and the Levant are attested for Taymāʾ from the early Bronze Age (Hausleiter and Zur 2016; Luciani 2016; Renzi et al. 2016; Sperveslage 2016; Tourtet et al. in press). And even without an exposed location on a trade route, the complexity of the circulation of traded goods has been demonstrated for various sites since the Epipalaeolithic, ultimately reaching also the remote areas (Bar-Yosef Mayer 2005; Bar-Yosef Mayer 2008b; Richter et al. 2011; Ridout-Sharpe 2015; Trubitt 2003; Dubin 2009, foreword by R.K. Liu pages 9, 10). A simple bead made of *Tritia gibbosula*, a species distributed only in the waters of the Eastern Mediterranean, probably reached Taymāʾ as a finished good from the Levant, but via several intermediaries because direct contacts with this region have yet to be proved.

The geographic setting of the oasis and its function as a hub in the long-distance exchange network of the "trans-Arabian trade" created a situation in which traded goods reached the site steadily and passed through it, which is how marine goods found their way into the hyperarid hinterland. Considering the continuous occupation of the oasis from at least the 5th millennium BCE and the steady presence of traded goods, one is persuaded regarding the growing economic importance and prosperity of the oasis in the midst of the Arabian Desert.

APPENDIX

Table 5. List of marine faunal assemblages with notes on area, occupation period and modifications; OP – occupation period; NSP – Number of Specimens; MNI – Minimum Number of Individuals
*65 specimens gathered from one stratigraphic unit counted as 1 specimen

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Taymāʾ and the sea: marine goods in an Arabian oasis settlement

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SUPPLEMENTARY MATERIAL
APPENDIX

Table 5. List of marine faunal assemblages with notes on area, occupation period and modifications; OP – occupation period; NSP – Number of Specimens; MNI – Minimum Number of Individuals
*65 specimens gathered from one stratigraphic unit counted as 1 specimen

	Area	OP	Modification	TA-No.	NSP	MNI
			1. **Anthozoa**			
Tubipora musica Linnaeus, 1758	O	7	No data available	TA 16084 (3), TA 16201 (59) TA 16337, TA 16389 (2)	65*	1
			2. **Gastropoda**			
Engina mendicaria Linnaeus, 1758	Al-Nasim	9	Apex perforated, perforation in body	TA 16860		
	Al-Nasim	9	Perforation in body	TA 16861		
	E	4	Apex perforated	TA 2450		
	E-East	3b	Perforation in body	TA 10280		
	O	7	Perforation in body	TA 7073		
	O	7	Unworked specimen	TA 16673		
	O	Indet.	Perforation in body	TA 9443		
	O	5	Apex perforated, perforation in body	TA 8992		
	O	3a	Perforation in body	TA 9167	9	9
Cerithium caeruleum G.B. Sowerby II, 1855	O	5	Perforation in body	TA 6094		
	O	Indet.	Perforation in body	TA 6064	2	2

	Area	OP	Modification	TA-No.	NSP	MNI
Conidae Fleming, 1822	Al-Nasim	9	*Conus* apex bead	TA 16708, TA 16752, TA 16761, TA 16762, TA 16864, TA16893, TA 16896, TA 17003		
	Al-Nasim	9	*Conus* top, apex perforated	TA 16862		
	Al-Nasim	9	No data available	TA 16863, TA 16873		
	E	10	Complete *Conus*, apex perforated	TA 17492		
	E	5	*Conus* top, apex perforated	TA 7353		
	E	4	*Conus* apex bead	TA 10387, TA 11668, TA 17831		
	E	4	No data available	TA 12239		
	E	3b	*Conus* apex bead	TA 6241		
	E	3b	Ring	TA 18364		
	E-East	10	No data available	TA 18121		
	E-East	9	*Conus* apex bead	TA 16258		
	E-East	9	No data available	TA 15936, TA 15942, TA 15747		
	E-East	5	*Conus* apex bead	TA 16278		
	E-East	4	*Conus* top, apex perforated	TA 15593		
	E-East	4	No data available	TA 15595		
	E-East	3b	*Conus*, complete, apex perforated	TA 10266		

	Area	OP	Modification	TA-No.	NSP	MNI
	E-East	1	*Conus* apex bead	TA 9365, TA 10299, TA 10638		
	E-East	1	*Conus*, complete, apex perforated	TA 2832		
	E-East	1	No data available	TA 13501, TA 10640		
	E-East	Indet.	*Conus* apex bead	TA 15585, TA 15662		
	E-East	Indet.	No data available	TA 16015		
	E-South/F	4	Conus apex bead	TA 3733		
	E-South/F	3b	*Conus* apex bead	TA 6664		
	E-South/F	3b	*Conus*, complete, apex perforated	TA 11746		
	H	7	*Conus* apex bead	TA 8523		
	O	7	*Conus*, complete, apex perforated	TA 4322, TA 5259, TA 5641, TA 5812, TA 5933 (2), TA 16311		
	O	7	*Conus* apex bead	TA 5351, TA 5353, TA 5386, TA 7097, TA 7907, TA 9410, TA 9424, TA 9613, TA 11900, TA 12501, TA 15893, TA 16076		
	O	7	*Conus* apex bead, decorated	TA 4500, TA 7068, TA 10731, TA 11890, TA 14716, TA 15613, TA 15860, TA 15861, TA 15862, TA 15863, TA 15864, TA 15865, TA 15866+15867+15868 (1), TA 15877		
Conidae Fleming, 1822	O	7	*Conus*, complete, apex perforated, perforation in body	TA 5257		
	O	7	Cylindrical bead	TA 4329		
	O	7	Ring	TA 11249		
	O	7	No data available	TA 15895, TA 16677		
	O	7	Unworked specimen	TA 7681		
	O	5	*Conus* top, apex perforated	TA 14743		
	O	5	No data available	TA 16679		
	O	3a	*Conus*, complete, apex perforated	TA 6076		
	O	3a	*Conus* apex bead	TA 8268, TA 8273		
	O	3a	*Conus* top, apex perforated	TA 5394, TA 12029		
	O	Indet.	*Conus*, complete, apex perforated	TA 10658		
	O	Indet.	*Conus* top, apex perforated	TA 15274		
	O	Indet.	*Conus* apex bead	TA 8919, TA 19201		
	O	Indet.	*Conus* apex bead, decorated	TA 19133		
	O	Indet.	*Conus*, complete, perforation in body	TA 10750		
	O	Indet.	Ring	TA 19203		
	O	Indet.	No data available	TA 9421, TA 10748	96	93

	Area	OP	Modification	TA-No.	NSP	MNI
Conus cf. *taeniatus* Hwass in Bruguière, 1792	E-East	1	Unworked specimen (?)	TA 10634		
	E-South/F	2	*Conus*, complete, apex perforated	TA 8549	2	2
Conus vexillum Gmelin, 1791	Al-Nasim	9	*Conus* top	TA 16750		
	E-East	10	*Conus* top, apex perforated	TA 16279	2	2
Cypraea pantherina Lightfoot, 1786	O	Indet.	Unworked specimen	TA 4306	1	1
Cypraea cf. *pantherina* Lightfoot, 1786	Al-Nasim	9	No data available	TA 16718		
	E	3b	No data available	TA 9595		
	E	Indet.	No data available	TA 8768		
	E-East	Indet.	No data available	TA 7294		
	E-South/F	4	No data available	TA 17975, TA 7579		
	O	7	Unworked specimen	TA 13090		
	O	5	No data available	TA 9417		
	O	3a	No data available	TA 5384		
	O	Indet.	No data available	TA 10673	10	10
Cypraeidae Rafinesque, 1815 – (size M. *annulus*)	A	7	Dorsum removed	TA 172, TA 1444, TA 7575		
	E	5	Dorsum removed	TA 3668, TA 11694		
	E	4	Dorsum removed	TA 11108, TA 9341		
	E	3b	Dorsum removed	TA 1305, TA 6886, TA 6887, TA 6888, TA 8839		
	E	3a	Dorsum removed	TA 1433, TA 7581, TA 11656, TA 19034		
	E	3a	Dorsum perforated (natural? semi-finished product?)	TA 7591		
	E-East	4	Unworked specimen	TA 13754		
	E-East	1	Dorsum removed	TA 15693		
	E-South/F	4	Dorsum removed	TA 14971, TA 15505		
	E-South/F	3b	Dorsum removed	TA 886, TA 954, TA 1066, TA 2786, TA 8391		
	E-South/F	3b	Dorsum abraded, semi-finished product	TA 6692		
	E-South/F	3b	No data available	TA 10492		
	E-South/F	3a	Dorsum removed	TA 3831, TA 8865		
	E-South/F	Indet.	Dorsum removed	TA 840, TA 844, TA 10088, TA 10100		
	H	7	Dorsum removed	TA 6915, TA 8529, TA 8889		

	Area	OP	Modification	TA-No.	NSP	MNI
Cypraeidae Rafinesque 1815 – (size *M. annulus*)	O	7	Dorsum removed	TA 4319, TA 4321 (4), TA 4330 (3), TA 4501 (3), TA 4538, TA 4800 (6), TA 4801 (28), TA 4802 (23), TA 4814, TA 4829, TA 5256, TA 5296, TA 5354, TA 5372, TA 5637, TA 5640, TA 5843, TA 5930 (2), TA 6719, TA 7544, TA 7545, TA 9436, TA 9447, TA 9448, TA 9449, TA 9450, TA 9503, TA 9520, TA 10524, TA 10732, TA 10733, TA 11875, TA 12526, TA 13068, TA 13070, TA 13071, TA 14706, TA 16055, TA 16088, TA 16089, TA 16205, TA 16231, TA 16312, TA 16388		
	O	7	Dorsum abraded, semi-finished product	TA 19132		
	O	7	Unworked specimen	TA 5803, TA 9536		
	O	7	No data available	TA 9518, TA 15879		
	O	5	Dorsum removed	TA 6093, TA 7540, TA 9757, TA 10526		
	O	5	No data available	TA 8991		
	O	3a	Dorsum removed	TA 4627, TA 5650, TA 5907, TA 9846		
	O	3a	No data available	TA 6747		
	O	Indet.	Dorsum removed	TA 4537, TA 4632, TA 6067, TA 6708, TA 7523, TA 7913, TA 12519, TA 13051, TA 16669, TA 16684, TA 16685,		
	O	Indet.	Dorsum perforated – semi-finished product(?)	TA 9420		
	O	Indet.	No data available	TA 6080, TA 7532, TA 9179, TA 9180	174	167
Cypraeidae Rafinesque, 1815	O	Indet.	No data available	TA 6081	1	1
Monetaria annulus Linnaeus, 1758	O	7	Unworked specimen	TA 16204		
	O	5	No data available	TA 8990		
	O	Indet.	Unworked specimen	TA 7659	3	2
Purpuradusta gracilis notata Gill, 1858	E-East	Indet.	Dorsum perforated	TA 15696	1	1
Pleuroploca trapezium Linnaeus, 1758	E-South/F	3a	No data available	TA 6772	1	1
Volvarina monilis Linnaeus, 1758	O	7	Perforation in body	TA 5352		
	O	3a	Apex perforated	TA 9199		
	E-South/F	Indet.	Perforation in body	TA 8542	3	3

	Area	OP	Modification	TA-No.	NSP	MNI
Semiricinula tissoti Petit de la Saussaye, 1852	E-South/F	Indet.	Perforation in body	TA 839	1	1
Tylothais savignyi Deshayes, 1844	E-South/F	3a	Unworked specimen	TA 2449	1	1
Tritia gibbosula Linnaeus, 1758	O	7	Perforation in body	TA 14722	1	1
Nerita cf. *orbignyana* Récluz, 1841	Al-Nasim	9	Apex perforated	TA 16742		
	E	3b	Perforation in body	TA 7811		
	E-East	10	Perforation in body	TA 17175		
	E-South/F	3a	Perforation in body	TA 17988		
	H	7	Apex perforated, perforation in body	TA 8522		
	O	7	Apex perforated	TA 4320, TA 5298, TA 5261, TA 11874, TA 15799		
	O	7	Perforation in body	TA 5297, TA 9647, TA 16077, TA 16078, TA 19136		
	O	7	Perforation in body – scavenger(?)	TA 4830		
	O	3a	Unworked specimen	TA 10740	17	17
Nerita sp.	E-East	5	No data available	TA 16277		
	O	7	Perforation in body	TA 5638 (28), TA 5639 (12), TA 5810, TA 5925 (15), TA 5931 (14), TA 6720, TA 7893, TA 7894, TA 9535 (6), TA 9540 (9), TA 9605 (76), TA 9628 (4), TA 9637 (3), TA 9656, TA 9659 (2), TA 9683 (8), TA 9684 (8), TA 10534 (4), TA 10536 (4), TA 16072 (2), TA 16081, TA 16091, TA 6092, TA 16093, TA 16203, TA 16229		
	O	7	No data available	TA 5810, TA 9656 (2)		
	O	5	Perforation in body	TA 12515		
	O	5	No data available	TA 15612		
	O	Indet.	Perforation in body	TA 19217	213	213
Ancilla acuminata G.B. Sowerby II, 1859	E-South/F	3b	Apex perforated	TA 6692		
	O	7	Apex perforated	TA 9622	2	2
Oliva cf. *bulbosa* Röding, 1798	H	7	Apex perforated	TA 8899	1	1

	Area	OP	Modification	TA-No.	NSP	MNI
Olividae Latreille, 1825	E-East	9	No data available	TA 19182		
	H	7	Apex perforated	TA 8896, TA 8897, TA 8898, TA 10001, TA 10006		
	H	7	No data available	TA 17994		
	O	7	Apex perforated	TA 9543		
	O	7	No data available	TA 9543 (2)		
	O	Indet.	Apex perforated	TA 10671	11	11
Cymatium(?) Röding, 1798	E-South/F	4	No data available	TA 14256	1	1
Canarium cf. *mutabile* Swainson, 1821	E.South/F	3b	Perforation in body	TA 979		
	E-South/F	3a	Apex perforated, perforation in body	TA 17427	2	2
Canarium cf. *fusiforme* G.B. Sowerby II, 1859	E-South/F	4	apex perforated	TA 2790	1	1
Canarium sp.	O	Indet.	unworked specimen	TA 6068	1	1
Conomurex fasciatus Born, 1778	E-East	Indet.	Unworked specimen	TA 15133, TA 17776	2	2
Clanculus pharaonius Linnaeus, 1758	Al-Nasim	9	Perforation in body	TA 16886		
	O	7	Unworked specimen	TA 16672	2	2
Turbo radiatus Gmelin, 1791	E-South/F	3a	Perforation in body	TA 891	1	1
Turridae (?) H. Adams & A. Adams, 1853 (1838)	E	3b	Unworked specimen	TA 15408	1	1
Gastropoda indet.	A	7	No data available	TA 178		
	Al-Nasim	9	Plaque	TA 16784		
	Al-Nasim	9	Cylindrical bead	TA 16786		
	E	3b	No data available	TA 15432		
	E	1	Cylindrical bead	TA 11355		
	E-East	10	*Conus* apex bead – semi-finished good	TA 17753		
	E-East	3b	Perforation in body(?)	TA 15926		
	E-East	3b	No data available	TA 11755		
	E-East	1	*Conus*(?) apex bead	TA 11958		
	E-East	1	Ring	TA 11587		
	E-East	Indet.	Apex perforated, perforation in body	TA 18077		

	Area	OP	Modification	TA-No.	NSP	MNI
Gastropoda indet.	E-South/F	3b	Ring	TA 8367		
	E-South/F	3a	Ring	TA 8692		
	E-South/F	indet	Ring	TA 8851		
	E-South/F	3a	Unworked specimen	TA 2449	1	1
	H	7	Ring	TA 10012		
	O	7	Biconical bead	TA 9404		
	O	7	Rounded hexagonal bead	TA 5813		
	O	7	*Conus*(?) bead	TA 4803		
	O	7	No data available	TA 16646		
	O	5	No data available	TA 7886		
	O	Indet.	Cylindrical bead	TA 4046		
	O	Indet.	Ring	TA 5361		
	O	Indet.	Ring	TA 5362		
	O	Indet.	No data available	TA 4825, TA 10674	25	18
3. **Scaphopoda**						
Dentalium octangulatum Donovan, 1804	E	3a	No data available	TA 3692	1	1
Dentalium sp.	E	Indet.	No data available	TA 12745		
	E-East	4	No data available	TA 15901	2	2
4. **Bivalvia**						
Anadara antiquata Linnaeus, 1758	E-South/F	3b	Unworked specimen	TA 15326	1	1
Arcidae Lamarck, 1809	E-South/F	4	No data available	TA 14260		
	E-South/F	4	No data available	TA 14293	2	2
Pinctada Röding, 1798	E	4	Plaque	TA 8829		
	E	4	No data available	TA 2980		
	E	5	Ring	TA 17341		
	E	3b	Ring	TA 9929		
	E-South/F	3a	No data available	TA 3807		
	H	7	Disk bead	TA 10008		
	O	5	Disk bead	TA 7530		
	O	7	Disk bead	TA 14718, TA 15898		
	O	7	No data available	TA 9517 (3)		
	O	Indet.	Disk bead	TA 6707, TA 4541	14	9
Glycymeris sp.	E-South/F	3a	Umbo perforated	TA 10152		
	H	7	Umbo perforated	TA 10036	2	2
Codakia cf. *tigerina* (Linnaeus, 1758)	E-South/F	4	No data available	TA 17961	1	1

	Area	OP	Modification	TA-No.	NSP	MNI
Tridacna maxima (Röding, 1798)	E	4	No data available	TA 19049		
	E	3b	No data available	TA 9564		
	E	3a	No data available	TA 3660		
	E	Indet.	Unworked specimen	TA 14567		
	E	Indet.	No data available	TA 1532, TA 11356		
	E-East	1	Unworked specimen	TA 498		
	E-East	1	No data available	TA 14321		
	E-East	Indet.	No data available	TA 12551		
	E-South/F	3a	No data available	TA 3840, TA 10075		
	E-South/F	Indet.	No data available	TA 2146, TA 8854		
	O	7	Unworked specimen	TA 5825		
	O	3a	No data available	TA 5281		
	O	Indet.	No data available	TA 6740	16	16
Bivalvia indet.	O	7	No data available	TA 9529	1	1
5. **Actinopterygii**						
Scarus cf. *ghobban* Forsskål, 1775	E	3a	–	TA 19303	1	1
Serranidae Swainson, 1839	E	3b	–	TA 17310	1	1
TOTAL					**631**	**608**