Scaphopod Shells in the Natufian Culture

Aldona Kurzawska, Daniella E. Bar-Yosef Mayer and Henk K. Mienis

A. Introduction

Mollusk shells were first used by humans as ornaments about 100,000 years ago, during the Middle Paleolithic (*ca.* 250,000-40,000 BP) or Middle Stone Age (Bar-Yosef Mayer 2005; Bar-Yosef Mayer *et al.* 2009; d'Errico *et al.* 2009; Vanhaeren *et al.* 2006). The use of shell beads intensifies in the Upper Paleolithic (*ca.* 45-20,000 BP) and the Epipaleolithic (*ca.* 23-14,500 cal BP) periods (Kuhn *et al.* 2001), and this is when *Dentalium* shells occur for the first time. Beyond the Levant, scaphopods are found in archaeological sites in Europe (*e.g.* Taborin 1993; Hahn 1972), Asia (Bar-Yosef Mayer 2005; Kuhn *et al.* 2001; Sonawane 2002) and Australia (Balme and Morse 2006).

In the Natufian Culture (14,5 - 11,500 cal BP), at the end of the Epipaleolithic period in the Levant, scaphopod shells become very common, so much so, that Garrod (1957), who defined this culture, considered *Dentalium* shells to be one of its hallmarks. The recognition that *Dentalium* shells were used as beads was established more then a century ago (*e.g.* Rivière 1905) and therefore we encounter the terms '*Dentalium* shells' or '*Dentalium* beads'. However, *Dentalium* is the largest genus within the class Scaphopoda, but is not the only one recognized among the shells found at the archaeological sites. In addition, frequent changes in classification and taxonomy cause some of the names to be confusing and no longer valid. Scaphopods are a class of marine mollusks, commonly known as 'tusk' or 'tooth' shells. Their shells have a shape of a tapered tube, open at both ends, usually curved, smooth or sculptured and their lengths range from 2 to 50 mm (but some may reach 130 mm) (Ross and Wells 1998). In this paper, the terms 'scaphopod shells' and 'scaphopod beads', are introduced as more appropriate for the group.

Complete scaphopod shells have usually very narrow apex (1 mm or less in diameter) thus they cannot be strung. Moreover apices are frequently absent in shell assemblages from archaeological sites. Therefore 'scaphopod bead' is a shell where the apex has been removed (either intentionally or naturally; Bar-Yosef Mayer 2008).

Initial studies of scaphopods from Natufian sites determined that some shells originated from the Mediterranean, others from the Red Sea and yet others are from Pliocene geological formations (Avnimelech 1937). Due to uncertainties regarding the origins of these shells, we attempted to re-evaluate the regions from which *Dentalium* shells were collected during prehistoric periods in the Levant. Once we assess from where the shells were brought into Natufian and other archaeological sites, we will be able to better determine the role that trade and exchange played in these past societies, as well as the value of these shells to Natufian and other populations.

B. Methods

B. 1. Species identification and description

Within the framework of this project, the research on archaeological shell assemblages was preceded by a detailed taxonomic study. One of us (AK) studied scaphopods at the Vienna Museum of Natural History. Subsequently selected specimens of scaphopod shells (mainly of the family Dentaliidae) were studied at the mollusk collections of the National Collections of Natural History of Tel Aviv University and the National Collections of Natural History at the Hebrew University of Jerusalem. Initially the study addressed species recently recorded by H.K. Mienis (unpublished) on the '*Revised checklist of mollusks from the SE-corner of the Mediterranean Sea*' and by Dekker and Orlin (2000) on the '*Check-list of Red Sea Mollusca*'. This was followed by a study of fossil specimens (Pliocene and Pleistocene), present in the above-mentioned collections, that was carried out based on descriptions found in Sacco (1897), Caprotti (1961, 1979) and Moshkovitz (1963, 1968).

Classification of Scaphopoda in this study follows Steiner (1992), Steiner and Kabat (2001) and all species names are given after Steiner and Kabat (2004).

B. 2. Database and terminology

We chose to investigate the shell assemblages of the following Late Pleistocene/Early Holocene sites in Israel: Urkan e-Rub IIa (Kebaran) (Hovers *et al.* 1988), Hayonim Cave (Belfer-Cohen 1988), Eynan (Valla *et al.* 2007), Hilazon Tachtit Cave (Grosman and Munro 2007), Raqefet Cave (Nadel *et al.* 2008), Gilgal (Final Natufian and Pre-Pottery Neolithic A) (Bar-Yosef *et al.* 2010) and Ramat Harif (GVIII) (Harifian) (Bar-Yosef Mayer 1999). A total of 5829 scaphopod shells were processed.

For each of the archaeological shell assemblages a database was created. It comprises: archaeological context information, species identification, size/measurements (length and diameter); shell shape, shell segment (apical, middle, apertural); apex/aperture features (apical structure and section, following the terminology of Scarabino (1995); shell sculpture (if ribbed – number of primary and secondary ribs), their shape in cross section, characteristic of intercostal structures and presence of growth interruptions.

Shells were measured with a digital caliper. Scaphopods found at archaeological sites consist mostly of segments or fragments of complete shells. We distinguish between segments that are incomplete shells that retain their tube-like form, and fragments that are a part of a shell wall that does not appear as a complete tube or ring. Segments were divided into the following categories: Apical (the narrower end), middle, and apertural (the widest end) segments. This information, along with other species characteristics including number and shape of primary and secondary ribs visible in cross-section, type of intercostal structure (the structure in between the ribs), apex and aperture features, traces of growth interruptions as well as taphonomic observations (presence of holes made by predators and their location, traces of burning, breakages) were entered into the database. The information was gathered while using a stereoscopic microscope (x10 - x40).

C. Results

A total of 5829 scaphopod shells were processed. The main results that pertain to species identifications from these sites are presented in Table 1. In the studied assemblages, seven different species of scaphopods were identified. In addition, some shells

Table 1. Summary of scaphopod shells analyzed during the laboratory research

Species	Origin	Site						
		Hayonim Cave	Eynan	Hilazon Tachtit Cave	Raqefet 06	Urkan e-Rub IIa	Gilgal (I, II, III)	Ramat Harif (GVIII)
Dentalium bisexangulatum	RS	-	-	-	-	-	-	18
Dentalium reevei	RS	11	-	-	1	-	4	89
Dentalium clavus	RS	1	-	-	2	-	1	40
Dentalium reevei complex	RS	6	-	1	2	-	-	56
Antalis dentalis group	MS	1528	188	10	-	16	14	106
Antalis vulgaris	MS	1968	36	360	6	54	6	2
Antalis sp.	MS	836	95	102	4	22	-	38
Fustiaria rubescens	MS	2	-	-	-	-	-	-
Laevidentalium longitrorsum	RS	-	-	-	-	-	-	54
Dentaliidae	RS	-	-	-	-	-	1	31
Scaphopoda	MS/RS/F	49	-	7	14	-	-	48
Other shells	MS/RS/F	135	x	x	2	162	x	x
Total:	**x**	**4536**	**319**	**480**	**31**	**254**	**26**	**482**

(19%) were identified only at genus level (*Antalis* sp.), a few (0.5%) at family level (Dentaliidae) and some (2%) remained at class level without further identification. At one site (Eynan) only three species were present, but at Hayonim Cave and at Ramat Harif at least seven or eight different species of scaphopods were present, both from the Mediterranean and the Red Sea, as well as, possibly, fossil scaphopods.

D. Discussion

D.1. The natural scaphopod fauna

D.1.a.Fossil shells

Scaphopods are known from the Miocene through Pliocene in the Mediterranean basin from what used to be the Tethys sea and they are represented by large and robust members of family Dentaliidae that are characterized by shells with an hexagonal cross-section (*e.g. Dentalium sexangulum* Gmelin, 1791, *Dentalium michelotti* Hörnes, 1856). According to Moshkovitz (1963), who studied them from deep sediment cores, they are common in the Pliocene horizons of the Israeli coastal plain. They are also known from different exposures in Turkey, Syria, Cyprus and Lebanon (Roman 1940; Erünal-Erentöz 1958; Karakuş and Taner 1994; İslamoğlu *et al.* 2009; Bar-Yosef Mayer *et al.* 2010). In Israel they have not been observed in layers younger than the Pliocene, nor are they known from fossil exposures, and they all disappeared at the end of this period.

Fissidentalium rectum (Gmelin, 1791) was considered to be a valid fossil species (Steiner and Kabat 2004:637; see Appendix 1). However, recently, a fresh looking empty shell was found off the coast of Haifa, Israel, at a depth of 1500 m (Mienis 2004:75-76). It is worth noting that some of the fossil species described by Sacco (1897) and Caprotti (1961, 1979) have never been recorded from Israel.

D.1.b. Mediterranean shells

At the beginning of the Pleistocene the above mentioned scaphopods were replaced by completely different species, considerably smaller in size and characterized by 8-12 primary ribs. This group is represented by two species: *Antalis inaequicostata* (Dautzenberg, 1891), confined in its distribution today to the Mediterranean Sea, and *Antalis novemcostata* (Lamarck, 1818) that occurs nowadays in the Eastern Atlantic (and some authors consider *A. inaequicostata* as the Mediterranean subspecies of the Atlantic *A. novemcastata*). Another species that appeared during the Pleistocene, *Antalis vulgaris* (Da Costa, 1778), is characterized by multiple ribs with as many as 30 at the apex that vanish towards the aperture (Moshkovitz 1968). Its recent distribution is confined to the Eastern Atlantic (Steiner and Kabat 2004). *Antalis rossati* (Caprotti, 1966) and *Antalis panorma* (Chenu, 1842) are additional Mediterranean scaphopods that are characterized by longitudinal ribs near the apex (vanishing and/or changing into striae toward the aperture) (Caprotti 1966a; Poppe and Goto 2000:34).

The following scaphopod species occur nowadays in the Eastern Mediterranean:

Family Fustiariidae Steiner, 1991
- Genus *Fustiaria* Stoliczka, 1868
  - *Fustiaria rubescens* (Deshayes, 1826)

Family Dentaliidae Gray, 1834
- Genus *Antalis* H. and A. Adams, 1854
  - *Antalis dentalis* (Linnaeus, 1758)
  - *Antalis inaequicostata* (Dautzenberg, 1891)
  - *Antalis panorma* (Chenu, 1842)
  - *Antalis rossati* (Caprotti, 1966)
  - *Antalis vulgaris* (Da Costa, 1778)

The term *Antalis dentalis* group relates to two similar species: *Antalis dentalis* (Linnaeus, 1758) and *Antalis inaequicostata* (Dautzenberg, 1891). Due to difficulties in distinguishing between them, particularly when they are subfossil and often fragmentary, both species names were replaced by one in this report.

D.1.c. Red Sea shells

In the Red Sea, the third source of scaphopod shells in the Levant, there are five species that belong to two families. The family Dentaliidae, is represented by four species in the genus *Dentalium* Linnaeus, 1758, and the family Laevidentaliidae by one species in the genus *Leavidentalium* Cossman, 1888. In the genus *Dentalium* there are three very similar heavily ribbed species. Two of them, *D. reevei* and *D. clavus*, are difficult to distinguish from one another, in particular when they are found as segments or fragments of complete shells. Therefore they are termed *Dentalium reevei* complex (following Singer 2003). One species, frequently mentioned in archaeological reports, *Dentalium elephantinum* Linnaeus, 1758 is confined in its distribution to the Indian Ocean (excluding the Red Sea), and another, *Dentalium octangulatum* Donovan, 1803, was also recently precluded from

the Red Sea (for discussion see: Scarabino 1995; Singer 2004:3-5). The following is the revised list of scaphopods present in the Red Sea:

Family Dentaliidae Gray, 1834
- Genus *Dentalium* Linnaeus, 1758
  - *Dentalium bisexangulatum* Sowerby, 1860
  - *Dentalium cookei* Sharp and Pilsbry, 1897
  - *Dentalium reevei* P. Fischer, 1871
  - *Dentalium clavus* Cooke, 1886

Family Laevidentaliidae Palmer, 1974
- Genus *Laevidentalium* Cossman, 1888
  - *Laevidentalium longitrorsum* (Reeve, 1842)

D.2. Inconsistencies in shell identification

It was not always possible to distinguish between the various species. Mediterranean Sea scaphopod shells, of which the size is suitable and convenient for use as beads, are of adult specimens measuring no less than 20 mm in length. This is reflected in the archaeological record, in which two Mediterranean species predominate: *Antalis vulgaris* (Fig. 1) and *Antalis dentalis* group (Fig. 2).

All of the Mediterranean species are common on the Eastern Mediterranean shore nowadays, however, the subfossil (archaeological) scaphopods differ considerably in shell features from recent specimens. In the case of *Antalis vulgaris* the differences are in shell thickness and size – some of the shells found at the archaeological sites seems to be thicker and larger than the recent specimens.

The case of the *Antalis dentalis* group is more complicated: The subfossil shells are not only larger and have thicker walls but also the number of ribs counted near the apex exceeds 10 in the case of *A. dentalis* (where it should be 10) (Caprotti 1965; Steiner 1997), yet another cause for confusion in species identification. Caprotti (1965:342) observed that *A. inaequicostata* is very similar in size and shell features to *A. dentalis* from the Italian Pliocene. Sacco (1897:104-105) distinguished between several varieties of *A. dentalis* and named them according to the different numbers of primary ribs (that exceeds 10) and the sculpture of the secondary ribs. Due to these confusions and the on-going uncertainty related to the identification of these

Fig. 1. *Antalis vulgaris* - beads (Hayonim Cave).

species, the term "*Antalis dentalis* group" was chosen until further explanation for the subfossil specimens will be made.

Antalis rossati (Caprotti, 1966) and *Antalis panorma* (Chenu, 1842) were encountered at some archaeological sites, *e.g.* at Eynan (Mienis 1987:161) but only as isolated specimens. Due to the similarity of *A. rossati* to *A. dentalis* there might be confusions between them.

The archaeological specimens of *Laevidentalium longitrorsum* from Ramat Harif (GVIII) seemed different from the recent specimens at the Tel Aviv University mollusc collection, in that the ancient shells have thicker walls. Similarly to the case of *A. vulgaris* mentioned above, this will be investigated at a later stage. One should also note that shells of *Dentalium cookei* that are thin and fragile were not encountered in the archaeological assemblages.

We were unable to identify one group of large and thick-walled shells that were found mostly at

Fig. 2. *Antalis dentalis* group - beads (Hayonim Cave).

Hayonim Cave and to a lesser extent also at Raqefet Cave and Hilazon Tachtit Cave. Their outer surface including the ribs and intercostals structure was completely worn and no longer visible, hampering their identification. We presume they might be of Mediterranean, Red Sea, or a Pliocene formation origin. If they are indeed of Pliocene age, then their state of preservation is worse than that of other shells found in the same archaeological context, especially when compared to the more delicate "*A. dentalis* group", suggesting that they were probably collected in this condition by the Natufians. Therefore, it is possible that they are indeed heavily beach-worn fossils, their original location of gathering as yet unknown.

Just as we face problems with identifying some of the species, probably prehistoric humans did too, however, they did differentiate between certain scaphopod shells and chose specific ones to be used as beads. Archaeologically, the scaphopod "repertoire" can be divided into two main types. The first is characterized by presence of ribs. Among the Mediterranean species those include: *Antalis dentalis, Antalis inaquicostata* and *Antalis rossati*. The second type, are beads made of plain shells of *Antalis vulgaris* and probably *Fustiaria rubescens.* Because *Antalis panorma* has ribs only on the apical segment it is not clear in which category they belong, but only a few specimens of the species were found at the sites. The same differentiation of types is evident among the Red Sea shells. Beads made of *Dentalium reevei, Dentalium clavus* and *Dentalium bisexangulatum* represent the ribbed type, and shells of *Laevidentalium longitrorsum* constitute the plain type. Ribbed Red Sea and/or Pliocene scaphopod shells that are isolated finds in the assemblages where Mediterranean species predominate are unique because they were probably acquired by means of exchange.

D. 3. Geographic distribution of scaphopods in archaeological sites

Scaphopod shells are common in all sites of the Natufian culture (*e.g.* Bar-Yosef 1991).

Geographic location of archaeological sites obviously determined which scaphopod species were used, as humans throughout prehistory acquired scaphopod shells from nearby sources. At the sites situated in Northern Syria, e.g. Dederiyeh Cave (Natufian, Y. Nishiaki pers. com.), at Tell Sabi Abyad (Neolithic; pers. observation) or in Turkey, e.g. Üçа gızlı Cave (Upper Paleolithic, Stiner and Kuhn 2003), and Çatalhöyük (Neolithic) many if not most of the scaphopod shells are fossil. Mediterranean scaphopods predominate in sites situated in the direct proximity to the Mediterranean Sea, e.g. Ksar Akil (Late Paleolithic level 9 and 8) in Lebanon and, Hayonim Cave, Hilazon Tachtit Cave, Raqefet Cave (all Natufian) in Israel. However, they are also found in the Jordan River basin at Urkan e-Rub IIa (Kebaran) and at Eynan (Natufian). Further south from the Mediterranean the more Red Sea shells appear in the archaeological assemblages, e.g. at Wadi Juheira, site 102 and 212 (pers. observation), Wadi Mataha (Natufian) (Janetski 2005) in Jordan and Ramat Harif (Harifian) in Israel.

Shells of the Mediterranean *Antalis dentalis* group and *Antalis vulgaris* were most frequently used to produce beads. They predominate among other scaphopod shells in the Natufian assemblages of Hayonim Cave, Hilazon Tachtit Cave, and Eynan. It seems that humans distinguished between the two species (the plain *A.vulgaris* and the ribbed *A.dentalis* group) and chose specific types of ornaments for the burials especially during the Early Natufian (Fig. 3 and see Table 2).

At sites more distant from the Mediterranean coast, like Urkan-e-Rub IIa, Ramat Harif (GVIII), and Gilgal II, *A. dentalis* group and *A. vulgaris* appear to be the only Mediterranean species present. At Ramat Harif and Gilgal there was a high percentage of Red Sea scaphopods. The paucity of *Fustiaria rubescens* (Deshayes, 1826) in the Early Natufian levels of Hayonim Cave (Fig. 4) is probably due to their thin, fragile, and translucent shell. Large specimens of *F. rubescens* were probably brought to the site together with other scaphopod shells (possibly taken for *A. vulgaris*) and were made into beads (middle segments of the shells). They might be infrequent also due to their absence on the seashore, or simply due to human preference.

Red Sea species predominate over Mediterranean scaphopod shells only at one site that we studied, Ramat Harif (also called G-VIII), most probably because of its location in the Negev highlands and its relative proximity to the Red Sea shore. At that site ribbed shells of *Dentalium reevei, Dentalium clavus* and *Dentalium bisexangulatum,* and plain shells of *Laevidentalium longitrorsum* were identified. At other Natufian sites where Mediterranean species predominate, there are usually isolated specimens of these Red Sea scaphopods (Fig. 5). These Red Sea scaphopods derived exclusively from the Late Natufian context at Hayonim Cave, Raqefet Cave and Hilazon Tachtit Cave. Two Red Sea shells were found in the Early Natufian context of Hayonim Cave, however, they were found in locus 8 very close

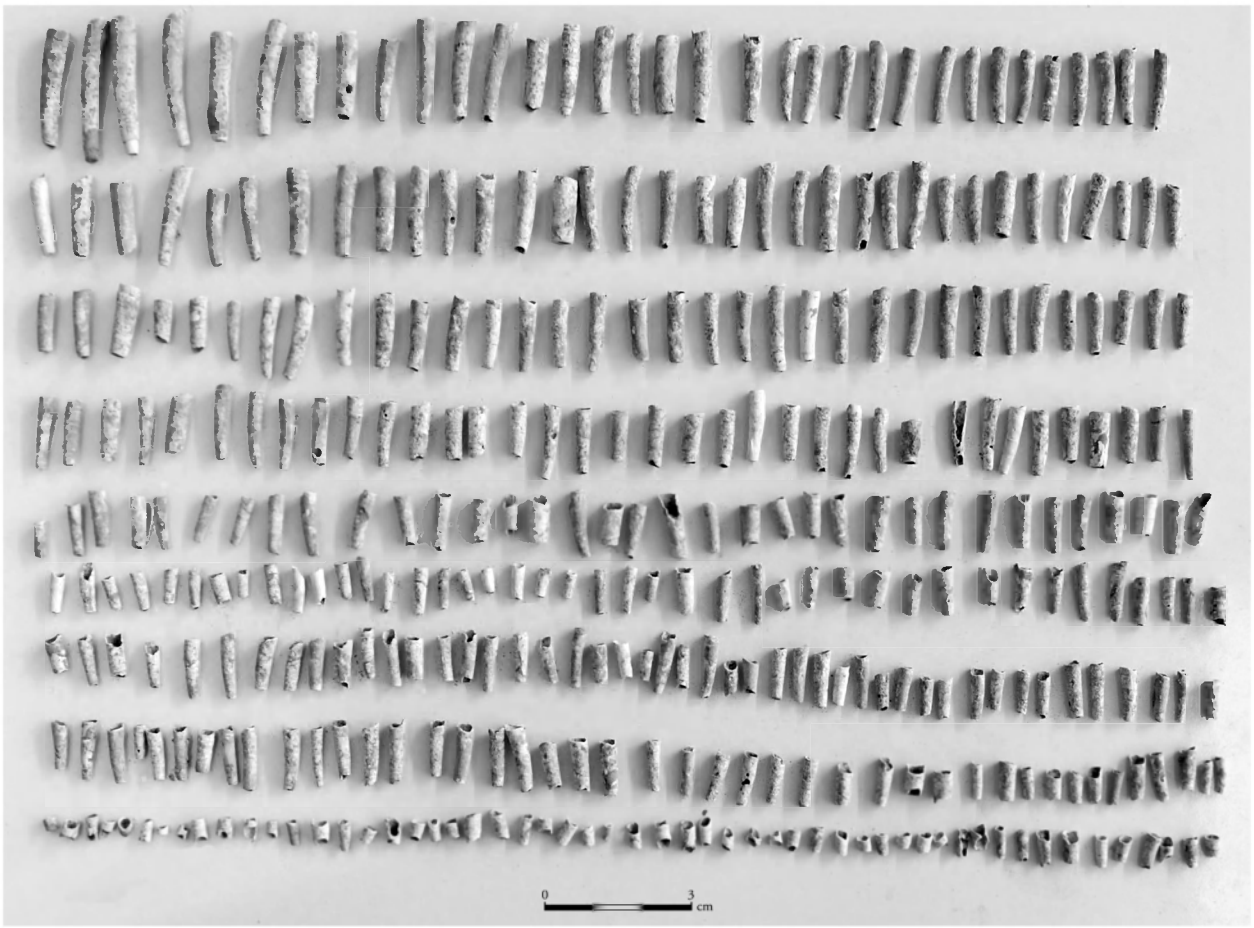

Fig. 3. Scaphopod beads from Hayonim Cave Grave XIII (from a single burial of Homo 33).

Table 2. Examples of beads concentrations found in Early Natufian graves

Site	Grave/homo	*Antalis dentalis* group	*Antalis vulgaris*	*Antalis* sp.	Total
Hayonim Cave	Grave 7 Homo 11 around right hand	-	67	15	82
	Grave 8/9 Homo 17 around left hand	2	88	18	108
	Grave 13 Homo 33 Single burial	-	294	65	379
Eynan	Homo 174	28	1	15	44
	Homo 176	77	-	2	79
	Homo 177	38	1	6	45

to grave XII that was dug through the locus 8 and it is possible that the shells may derived from the grave.

During the Late Natufian Red Sea shells appear in the Mediterranean zone shell assemblages and Mediterranean shells in southern sites. This phe-

Fig. 4. *Fustiaria rubescens* - beads (Hayonim Cave).

Fig. 5. *Dentalium reevei* complex - beads (Hayonim Cave).

nomenon appears along with the sudden absence of shells in the Late Natufian burials, and might reflect increased mobility or exchange of goods, by comparison to the Early Natufian. This matter certainly requires further investigation.

E. Conclusions

To conclude, large amounts of subfossil scaphopod shells in the archaeological record, with shell features that differ from present day specimens, suggest changes in ecological and climatic conditions as well as sea-level fluctuations that may be the cause for changes in the available fauna. The absence of fossil outcrops with large amounts of Pleistocene scaphopod shells in Israel may indicate that the shells were acquired in the Late Epipaleolithic period (16 - 11,000 cal BP) either from the seashore or from the exposed dry sea bottom. It is likely that during the Kebaran cultural complex (*ca.* 21 - 14,500 cal BP; Belfer-Cohen and Goring-Morris 2007) that coincides with the Last Glacial Maximum and a sea level drop to -120 m, scaphopods were exposed on the sea bottom for a certain period (Avital *et al.* 2004). Subsequently, the rising of sea level may have washed ashore large numbers of empty scaphopod shells.

This paper presents the first step of a project that intends to re-evaluate the role of scaphopod shells in prehistoric societies in the Levant. Clearly, the investigation of the precise taxonomy will enhance our understanding of the origins of the shells. Many other aspects, touched upon in this research deserve further investigation. Those include the taxonomy of the subfossil shells of "*A. dentalis* group", in order to determine their source as it pertains to the question of shell availability (Mienis 2005). Dating by measuring strontium isotopes (Shackleton and Elderfield 1990; Vanhaeren *et al.* 2004) of several samples would be helpful in order to determine if they were collected from the Mediterranean shores or from fossil outcrops.

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Appendix A: Main Characteristics of Scaphopods discussed in this paper

Species	Description	Max. length	Earliest fossil	Depths	Habitat	Distribution	References
Family: Fustiariidae Steiner, 1991							
Fustiaria rubescens (Deshayes, 1826)	Shell is slender, moderately curved, translucent, surface completely smooth, glossy, subtransparent. No longitudinal structure. Aperture circular. Some of the specimens might have a long linear slit on the convex side. Species unchanged from Pliocene to present.	35mm	Miocene	4-618m	On hard-sandy and sandy bottoms, in mud and algae-ground.	Eastern Atlantic, Mediterranean: Europe, North Africa.	Caprotti 1965: 349-350, Pl. 1: 12, 14; Caprotti 1966f: 86 Aa 05 Caprotti 1979: 241, Tav. XII, figs. 3, 4; Ludbrook 1954: 105-106, Pl. 1, fig. 9; Pilsbry & Sharpe 1897: 105-106, Pl. 19, Fig. 2; Poppe & Goto 2000: 34-35, Pl. 1.9; Sacco 1897: 111-112, Tab. X, fig. 21-23; Steiner & Kabat 2004: 639;
Family: Dentaliidae Gray, 1834							
Antalis dentalis (Linnaeus, 1758)	Slightly curved, striated shell. Sculpture of about 10 longitudinal ribs near the apex that become doubled toward the aperture. Ribs are narrow and sharp in relief. Secondary ribs are of the same height as primary. Aperture circular. Intercostals smooth much wider than the ribs.	24mm	Miocene	0-300m	In muddy and sandy bottoms, sometimes with corals and shells.	Eastern Atlantic, Mediterranean.	Caprotti 1965: 341-343, Pl. 1: 7-11; Caprotti 1966b: 86 Aa 01; Caprotti 1979: 229, Tab. VII, figs. 8-11; Pilsbry & Sharpe 1897: 53-54, Pl. 9, figs.55-57; Poppe & Goto 2000: 33, Pl. 1.2; Sacco 1897: 104, Tab. VIII, fig. 71-80; Steiner 1997: 98, Figs. 4. B; Steiner & Kabat 2004: 583;
Antalis inaequicostata (Dautzenberg, 1891)	Solid, opaque, dull shell, moderately or slightly arcuate, with 9-12 strong primary ribs. Secondary and tertiary ribs also present. All ribs become obsolete toward the aperture. Narrow intercostals. Frequent growth interruptions. Apex truncated, polygonal, with short central pipe (in adults). Aperture polygonal. Colour light rose to orange sometimes with transversal stripes. The species might be conspecific with the Atlantic *Antalis novemcostata* (Lamarck, 1818).	60mm	Miocene or Pliocene	5-120m	In the mud and sand, in coralliferous sandy bottoms, in a grey costal mud.	Eastern Atlantic, Mediterranean.	Caprotti 1965: 343-346, Pl. 1: 4-5; Caprotti 1966d: 86 Aa 03; Caprotti 1979: 233-234, Tab. VII, figs. 1-7; Pilsbry & Sharpe 1897: 52-53, Pl. 9, figs. 49-51; Poppe & Goto 2000: 33, Pl. 1.4-5; Sacco 1897: 103, Tab. VIII, fig. 63-64; Steiner 1997: 98-99, Figs. 4. D; Steiner & Kabat 2004: 601;

Antalis panorma (Chenu, 1842)	Shell is slender moderately curved, rather solid. Around 11-14 narrow, sharp in relief ribs at the apex multiply and changing into striae toward the aperture. Apex sometimes with short, central pipe. Aperture circular. Creamy white or yellow in colour that pale toward the aperture. This is the largest European scaphopod.	70mm	Pliocene	54-350m	In sandy mud.	Eastern Atlantic, Mediterranean: Europe, North Africa.	Caprotti 1965: 346-347, Pl. 1: 3; Caprotti 1966e: 86 Aa 04; Caprotti 1979: 235, Tav. VIII, figs. 3; Pilsbry & Sharpe 1897: 54, Pl. 9, figs. 38-39; Poppe & Goto 2000: 34, Pl. 1.7; Steiner & Kabat 2004: 626;
Antalis rossati (Caprotti, 1966)	Shell is moderately curved, translucent, with 10-11 ribs at the apex vanishings toward the aperture. Large intercostal spaces. White in colour with pink in the centre. Aperture circular.	50mm	Pleistocene	3-25m	In sandy mud	Mediterranean.	Caprotti 1966a: 194-196; Caprotti 1966g: 86 Aa 07; Caprotti 1979: 236-237, Tav. VIII, figs. 1-2; Poppe & Goto 2000: 34; Steiner & Kabat 2004: 639;
Antalis vulgaris (Da Costa, 1778)	Shell is solid, lightly curved, usually opaque white, frequently with a pink apex and/or roseate zone in the apical segment. Around 30 striae near the apex increasing in number by intercalation, but all obliterating toward the aperture. Aperture is circular.	60mm	Miocene	5-1000m	Muddy bottoms.	Eastern Atlantic, Mediterranean: Europe, North Africa.	Caprotti 1965: 347-348, Pl. 1: 13; Caprotti 1966c: 86 Aa 02; Caprotti 1979: 238-239, Tav. IX, figs. 1-7; Pilsbry & Sharpe 1897: 41, Pl. 8, figs. 22-24, Pl. 9, figs. 53-54; Poppe & Goto 2000: 34, Pl. 1.8; Sacco 1897: 98, Tab. VIII, fig. 1-5; Steiner & Kabat 2004: 662;
(†) *Fissidentalium rectum* (Gmelin, 1791)	Large in size shell with thick walls, almost straight, densely ribbed (around 12 – 15 sharp ribs in the apical segment). Shell is polygonal in section, apex with fissure, intercostals are narrow and its reticule structure is visible under the microscope.	117mm	Pliocene	1500m (?)	Mud	Mediterranean.	Caprotti 1979: 223-224, Tab. X, figs. 1-5; Mienis 2004: 75-76; Pilsbry & Sharpe 1897: Pl. 3, figs. 32-34; Sacco 1897: 110, Tab. X, fig. 1-6; Steiner & Kabat 2004: 637; Vera Pelaez et al. 1993: 129-130;
Family: Dentaliidae Gray, 1834							
Dentalium bisexangulatum (Sowerby, 1860)	Shell is solid, well curved with 11-12 distinct, narrow ribs. No secondary ribs. Apex circular with a shallow notch on the convex side. Aperture is angulated by ribs. Growth striae are fine and superficial. Milky white in colour.	89 mm	Pleistocene	1-720m	Sand	Indo-Pacific: Red Sea, East Africa to Australia, Java, Philippines, Japan.	Boissevain 1906: 22, Pl. 1, fig.7; Cox, 1931: 6-7; Lamprell & Healy, 1998: 65, figs. 64a, 65a-b; Ludbrook 1954: 92; Newton, 190: 546; Pilsbry & Sharpe 1897: 15, Pl. 2, fig. 25; Scarabino 1995: 202-203, figs. 10, 16j; Singer 2003: 9-10;

							Steiner & Kabat 2004: 569;
Dentalium cookei (Sharp & Pilsbry, 1897)[1]	Very thin, fragile and narrow shell with a slight curve and pointed apex. There are 12-14 thin, low but protruding, unevenly spaced ribs. In mature shells the ribs may vanish just before they reach the aperture. Growth lines as well as longitudinal striae in some intercostals are visible (at magnification). Shell is almost transparent.	25mm	Pleistocene (?)	75-148m	Sand and mud	Indian Ocean, Red Sea.	Boissevain 1906: 29, Pl. VI, figs. 20-21; Cox, 1931: 6-7; Ludbrook 1954: 92; Pilsbry & Sharpe 1897: 29; Singer 2002: 1-5; Steiner & Kabat 2004: 578-579;
Dentalium reevei (P. Fischer, 1871) [1]	Large, thick walled shell characterized by 8 to 10 (commonly 9) strong, broad ribs prominent along the entire shell. Intercostals with secondary ribs. Juveniles may not have secondary sculpture. Frequently when secondary ribs are well developed primary ribs are bifid. Apices of adult specimens are filled by a plug with a short central pipe. In adult specimens, close to the aperture, growth lines are visible. Aperture is crenulated by ribs. Dirty white in colour.	65mm	Pleistocene (?)	15-120m	Sand and mud	Red Sea.	Boissevain 1906: 25-27, Pl. 5, figs. 25-34; Bosh et al. 1995: 186; Cox, 1931: 6-7; Ludbrook 1954: 98; Pilsbry & Sharpe 1897: 11-12; Scarabino 1995: 204, figs. 12, 16g-h; Sharabati 1984: Pl. 1, fig. 6; Singer 2003: 9-17; Steiner & Kabat 2004: 638;
Dentalium clavus (Cooke, 1886) [1]	Large, thick walled shell with 9-12 (commonly 11) ribs. Secondary ribs are equal in strength to each half of the bifid primary ribs. Close to the aperture primary ribs are of the same size as secondary ribs. All are obsolete toward the aperture. This species frequently decollated the apex. Apex is broad with a very short pipe. Aperture is almost circular. Dirty white in colour.	47mm	Pleistocene(?)	14-60m	Shallow water, sandy bottoms.	Indian Ocean: Red Sea, Africa.	Boissevain 1906: 27; Cox, 1931: 6-7; Ludbrook 1954: 98; Pilsbry & Sharpe 1897: 10; Scarabino 1995: 204 Singer 2003: 9-17; Sharabati 1984: Pl. 1, fig. 7; Steiner & Kabat 2004: 576;

Family Laevidentaliidae Palmer, 1974							
Laevidentalium longitrorsum (Reeve, 1842)	Shell is long, strongly curved, slender, smooth, shining, semitranslucent, thin but solid, white and/or amber in colour. In some specimens short ribs restricted to the apex were noticed (they are quite often lost entirely through decollation). Sometimes growth lines are visible (on the apertural segment). Apex has V-shaped notch and a short pipe. Aperture cir cular.	114mm	?	46-155m	Sandy-mud	Indo-Pacific: Red Sea and eastern Africa to China and Australia.	Boissevain 1906: 52, Pl. 2, figs.33-33a; Bosh et al. 1995: 188; Lamprell & Healy, 1998: 127, figs. 130b-131a-b; Ludbrook 1954: 104; Pilsbry & Sharpe 1897: 111, Pl. 20, fig. 35-36; Scarabino 1995: 227-228, figs. 34, 45a; Singer 2002: 3; Steiner & Kabat 2004: 611;

[1] Each of the species *D. cookei, D. reevei,* and *D. clavus* were sometimes mentioned as Pleistocene fossils under the names *D. Aratorum* and *D. octangulum* (Cox 1931, Hall and Standen 1907, Newton 1900, Newton 1907).