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Adaptation, identity, and innovation in Neolithic and Chalcolithic Western Anatolia (6800–3000 cal. BC)

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Adaptation, identity, and innovation in Neolithic and Chalcolithic Western Anatolia (6800–3000 cal. BC): The evidence from aquatic mollusk shells

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ABSTRACT

Western Anatolia, including the eastern Aegean region and the lowlands around the Marmara Sea, is crucial to understand the pivotal transformations of early farmers in the eastern Mediterranean. Most pre-Bronze Age research in western Turkey has focused on understanding the region's role in the dispersal of domesticated plants and animals, largely overlooking the persistence of wild plant and animal exploitation among farmers. As a consequence, despite growing aspirations to explain the region's role in the Neolithisation of SE Europe and increasing interest in its further cultural development in prehistory, important proxy data with significant potential to elucidate life styles, cultural affinities, and innovation in Neolithic and Chalcolithic Western Turkey remain unexplored. Shells of aquatic mollusks are one of the most tangible and archaeologically visible categories of materials that represent (primarily) farming communities' relationship with and approach to non-domestic organic resources in the 'wild'. They are ubiquitous and abundant in Neolithic and Chalcolithic sites in western Turkey. Information from twenty-eight archaeomalacological assemblages from Neolithic and Chalcolithic western Turkey is used to address current debates in the prehistory of the region.

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1. Introduction

Western Anatolia is an arbitrarily defined region which covers the entire eastern coast of the Aegean Sea, its hinterland, and the lowlands around the Marmara Sea. The region is distinguished from the remainder of the Anatolian peninsula and the rest of modern day Turkey with its geographic and climatic characteristics, which are mainly determined by proximity to the sea and temperate Europe. Western Anatolia is a geographical, climatic, cultural, and political frontier between Southwest Asia and Europe. As such, the pivotal role it potentially played in the westward spread of farming in the early Holocene has been recognized (French, 1965, 1967; Özdoğan, 1983). However, for a variety of reasons (history of research, politics of cultural heritage etc.), pre-Bronze Age research in western Anatolia has been somewhat of a backwater until the late 1980s. Since then, it has focused primarily on the emergence of Neolithic life styles in the seventh millennium BC (Özdoğan, 2011). Initial zooarchaeological work on the region's Neolithic has put an

emphasis on understanding the characteristics of animal husbandry in the early days of farming (Röhrs and Herre, 1961; Boessneck and von den Driesch, 1979; Galik and Horejs, 2011; Çakırlar, 2012a, 2012b; Arbuckle et al., 2014). Apart from the case of a cluster of coastal sites in southeast Istanbul, where the presence of aquatic animal remains has been perceived as a sign of continuity of Mesolithic traditions into the Neolithic period (Özdoğan, 1999, 2011; Thissen et al., 2010, a view which has been challenged in; Çakırlar, 2013), the issue of the exploitation of wild resources by early farmers in western Anatolia has remained underexplored.

This paper aims to contribute to redressing this deficiency through a discussion of several assemblages of aquatic mollusk remains dating roughly between 6800 and 3000 BC. Shells of aquatic mollusks found in post-Mesolithic contexts are one of the most tangible and archaeologically visible categories of find materials that represent farming communities' relationship with and approach to non-domestic organic resources in the 'wild'. Shells of aquatic mollusks provide clues about foraging activities and their location, nutritional diversity and specialization, industry, ornamentation, and symbolism. Their ubiquity and abundance in

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Neolithic (6800–5500 BC) and Chalcolithic (5500–3000 BC) sites in western Anatolia provide us with an important opportunity to address three important issues regarding the region's pre-Bronze Age prehistory: (1) What was the role of foraging in early farmer economies?; (2) What were the cultural affiliations of the earliest farmers in the region?; (3) How did people live in western Anatolia during the Chalcolithic period?

2. Chronology and cultural sequences

This paper covers the circa four millennia between the appearance of agriculture and animal husbandry in western Anatolia and the beginning of Troy I, which demarcates the beginning of urbanization in the region. This chronological scope is partly a practical choice determined by two factors: First, excavated pre-Neolithic deposits in western Anatolia are limited to cave sites inland in the Antalya Province – farther east and away from the remainder of the assemblages that are available for this review. Second, detailed discussions of Bronze Age and post-Bronze Age coastal foraging economies based primarily on mollusk evidence (taxonomic, biometric, sclerochronological, and isotopic data) from western Anatolia have been published recently (Çakırlar, 2008, 2009a, 2009b; Çakırlar and Becks, 2009).

The numerical and relative chronology of the cultural sequences of early farmers in western Anatolia is much debated (Schoop, 2005; Düring, 2011; Çilingiroğlu, 2012; Brami, 2014). Of the extensive literature discussing the synchronization of the material cultures of early farmers in western Anatolia and the radiocarbon dates, two points are relevant for the discussions in this paper.

The first point pertains to the rough periodization of the time period between seventh millennium BC and the third millennium BC in western Anatolia. In Greece, this long period of time is called the Neolithic, with its Early, Middle, Late and Final stages (Perlès, 2001). In Anatolia, the period is divided into 'Neolithic' and the 'Chalcolithic' periods with the partition between the two commonly placed around 6000 BC, following Mellaart's (1970) designation based on Hacilar. The applicability of the term 'Chalcolithic' for the earlier half of the sixth millennium BC to the cultural sequence in both west and central Anatolia has been contested (Biehl et al., 2012; Çilingiroğlu, 2012). The current usage of the term Chalcolithic for western Anatolia covers roughly the period between 5500 and 3000 BC (Düring, 2011). The Chalcolithic is subdivided into Early, Middle, and Late phases, but these have no clear-cut boundaries, largely because very little is known about the Middle Chalcolithic (Düring, 2011). Furthermore, the Dutch working in northwestern Anatolia maintain the use of the term 'Late Neolithic' to refer to the beginning of the Neolithic in this region and 'Early Chalcolithic' for the sixth millennium BC (e.g. Roodenberg, 2013). These correspond to the Early and Middle Neolithic in the Balkans.

The second point is about the beginning of the Neolithic in western Anatolia. Until recently, the emergence of early farming in western Anatolia was radiocarbon-dated to the second half of the seventh millennium BC. Furthermore, the spread of farming west of Çatalhöyük was commonly accepted to involve groups with pottery technology. Since 2012, pre-6500 cal BC dates are available from farmers' villages such as Ulucak Höyük in central western Anatolia (Çilingiroğlu et al., 2012) and Barcın Höyük in northwestern Anatolia (Gerritsen et al., 2013). The accompanying material cultural evidence from both sites is compelling: Layer VI at the bottom of Ulucak Höyük is entirely devoid of pottery or any other clay objects and has architectural remains with wide-ranging parallels especially towards the east (Çilingiroğlu et al.,

2012; Çevik, 2013; Çilingiroğlu and Çakırlar, 2013). Coincidentally, the oldest occupational phase at Barcın Höyük is also called Layer VI, with phases VIe and VI d being at the bottom of the sequence. In Phase VIe, pottery is rare and crude and bears similarities with early pottery types from Çatalhöyük (Gerritsen et al., 2013).

In order to mitigate the confusion that is likely to arise from these differential uses of chronological terms, the synchronization, radiocarbon dates (if available) of the sites mentioned and the chronological terminology adopted in this paper are provided in [Supplementary Table 1](#).

3. Material and methods

In total, twenty-eight archaeomalacological assemblages from fifteen sites in western Anatolia are taken into consideration ([Supplementary Tables 1 and 2](#), [Fig. 1](#)). Thirteen assemblages from seven different sites are presented for the first time. The number of excavated pre-Bronze Age sites in western Anatolia is higher, but here the focus is on sites where (mainly quantitative) information about mollusk assemblages is available and their dating is clear. Excluded are the few Neolithic sites located in western Turkey because of their geographic proximity to the Balkans rather than Anatolia and because well-dated quantitative mollusk data for these sites is currently not available. These sites include Hocaçeşme on the Maritsa River, where pits full of mollusks were abundant (Özdoğan, 2013), the Chalcolithic and Early Bronze Age site of Top-tepe on the western coast of the Marmara Sea, from which a list of species but no chronological subdivision is available (Buitenhuis, 1995). Interpretations building on mollusk ecology, e.g. collection site, derive from modern day observations (Çakırlar, 2009 and the references therein).

With the exception of Ulucak, assemblages were retrieved through hand-collection. At Ulucak, a small proportion of the mollusk assemblages come from sieved contexts. In the majority of cases, mollusk finds have been counted using simple NISP counts. In others, such as Pendik and Fikirtepe, only apices and umbones were counted as a relatively more accurate basis for estimating taxonomic abundances.

4. At the beginning: Pre-6500 BC layers

The earliest radiocarbon-dated farming contexts in western Anatolia have been uncovered at the inland settlements of Ulucak Höyük VI (6800–6500 cal BC) and Barcın Höyük VIe (6600–6400 cal BC) (Çilingiroğlu et al., 2012; Çevik, 2013; Gerritsen et al., 2013). The sites are located at 10 and 55 km from the present coastline respectively. Considering the counter-acting effects of sea-levels and alluviation (Kayan, 1995; Çilingiroğlu et al., 2004), these settlements would have been located at similar distances from the coast during the Early Holocene to present day. Both distances involve steep elevations (between 250 and 300 m above sea-level) which would make trips on foot tiresome. The sites are located on floodplains.

Although the Layer VI exposure at Ulucak is limited to 100 m² and archaeomalacological studies at neither site have been finalized, present data indicate that aquatic mollusks were exploited only for non-dietary purposes at both settlements. Both settlements' inventories are limited to largely, perhaps fully ornamental assemblages ([Table 1](#)). The uncertainty is due to the state of research. The published non-ornamental mollusk assemblages from Barcın come from the post-VIe layers of the site (Galik, 2013), whereas the publication discussing the mollusk beads of Neolithic Barcın does not specify which finds come from which level of Layer VI of the site (Baysal, 2014).

Fig. 1. Sites mentioned in the text.

At Ulucak VI, finds include perforated fragments of mother-of-pearl producing bivalves, perforated *Nassarius*, *Columbella* and *Conus* shells, and *Monodonta* shells that may have been shaped into rings. The uncertainty with the latter comes from the fact that all

Monodonta specimens have been found in exfoliating states, which has produced natural forms that resemble rings. In contrast to reported *Monodonta* 'rings' from the Aegean, which all come from Bronze Age contexts (Reese, 1984), in Ulucak fragmented 'rings' are

Table 1

Summary table of aquatic mollusks from Ulucak Layer VI.

Taxa	Description of preservation/artefact status	NISP
<i>Monodonta</i>	Exfoliating	1
	Ring	1
	Ring fragment	3
	Ring manufacturing waste	6
	Natural	10
<i>Nassarius</i>	Apex perforated by scrubbing	1
	Natural	3
<i>Columbella</i>	Apex perforated by scrubbing and polish. Shell base also worked the same way (to widen existing hole?)	1
	Asymmetrically flat on body below shoulder	2
	Hole on apex (natural or by scrubbing). Base also worked the same way	1
	Lip (probably) flattened	1
	Natural hole on apex and body. Smooth surface suggests wear	1
	Natural hole on apex.	1
	Perfectly preserved, with color	1
	Very smooth surface -due to polishing or wear?	1
	Natural	1
<i>Conus</i>	Hole on apex	1
<i>Mytilus</i>	Natural	1
<i>Pinna</i>	Natural	2
<i>Donax</i>	Natural	4
Unionidae	Flat bead	2
	Work waste?	1
	Tooth fragment (work waste?)	2
	Work waste? Straight cut?	1
	Natural	13
Total		62

found in Layer V as well as Layer VI. The other types are common in other Epipalaeolithic and Early Neolithic ornamental mollusk assemblages from inland and epi-coastal Anatolia (Otte et al., 1995; Bar-Yosef, 2013; Baysal, 2013a, 2013b; Takaoglu et al., 2014) and farther beyond to the east (e.g. Serrand et al., 2005; Colonese et al., 2011). Perforated mother-of-pearl shells from Ulucak VI are nearly identical to those from Barcin VI (Baysal, 2014, Fig. 6) and from Çatalhöyük in Central Anatolia (Bar-Yosef, 2013, Fig. 16.12). At Ulucak VI, there are two mother-of-pearl fragments cut in a manner similar to the *Unio* examples at this site and others, but are made out of *Pinna*, nacreous marine bivalves. Nacreous fragments of *Pinna* can be distinguished from *Unio* by their yellowish color and wavy surface.

Further differences between the assemblages of Barcin VI and Ulucak VI are also noteworthy. *Dentalium* and *Spondylus* beads, which are hallmarks of shell bead production in the Balkan Neolithic and Chalcolithic (Baysal and Erdoğan, 2014) and the Epipalaeolithic and Neolithic in the Levant (Bar-Yosef, 2008) are absent from both Ulucak VI and the subsequent settlement layers of this site (Table 2). Besides these, it may be significant that no waste products or unfinished shell objects have been reported from Barcin VI (Baysal, 2014), whereas examples at different stages of production are common in Ulucak VI. For example, some examples of *Columbella* are flattened on the body whorl just below the shoulder, most likely as a result of rubbing on a surface in order to produce the holes observed on finished examples, while others remain completely unmodified.

To pinpoint what inter-site similarities and differences mean is difficult. Is the absence of shell manufacture waste at Neolithic Barcin in contrast to its abundance in Ulucak VI telling about site function in terms of marine shell procurement and production of shell objects? Do these two sites represent two different steps in a multi-tiered network of procurement, production, and exchange within their own sub-regions? Or is the sample size from Barcin simply too limited to speak definitively of an absence of local shell industry? Did Ulucak remain outside of the cultural sphere that shared a common symbolism manifested by the use of *Dentalium* and *Spondylus* beads? Satisfactory answers to such questions can be provided only when several more assemblages dating to the early seventh millennium BC from the region between and around these two sites are studied.

5. Neolithic on the coast

The earliest dates for the radiocarbon and relative dated settlements on the coasts of western Anatolia start around or after 6500 BC. Earliest-dating Neolithic sites have been found accidentally during development activities, underneath several meters of alluvial sedimentation (e.g. Yenikapı in Istanbul and Yeşilova in İzmir). Most of the settlements dating to the latter half of the seventh millennium BC continue to be occupied until 5700–5500 BC, forming low-lying tells. Excavated sites with archaeomalacological records cluster around Istanbul in north-western Turkey and in the province of İzmir in central western Anatolia. In both regions all sites are located in estuarine environments (Boessneck and von den Driesch, 1979; Özdoğan, 1983; Kayan, 2000, 2015; Algan et al., 2011; Sağlamtimur, 2011).

According to excavators' accounts, mollusks are abundant at all these sites (Sağlamtimur, 2011; Derin, 2012). When indices of find densities are missing from excavation accounts, which are usually the case in archaeological practice in Turkey, one way of quantitatively estimating mollusk abundance at archaeological sites is to compare the proportion of mollusk remains with the proportion of other animal remains (Çakırlar, 2009). In the case of coastal Neolithic sites in western Anatolia, quantifying the proportion of mollusks vs. animal bones is currently possible for only Fikirtepe

and Pendik in Istanbul. At these sites, mollusk remains make up 30–40% of all animal remains in specimen counts (Çakırlar, 2013, Fig. 3). These figures do not mean much by themselves; for example, they cannot be used as direct measures of the contribution of mollusks to the diet. However, when they are compared with similar figures from inland or later settlements, it becomes clear that they do provide a rough estimation of mollusk abundance in the archaeological matrix and hence a means to speak about intensity of exploitation. For instance, mollusks make up to 65% of the faunal remains in Troy's Bronze Age layers, whereas the post-Bronze Age faunal remains of the same site contain ca. 12% mollusks in NISP (Çakırlar, 2009b: 63–64); palaeoenvironmental and other palaeoeconomic evidence suggest that this significant decrease in the proportion of mollusks is related to the gradually increasing distance between the settlement and brackish waters where shellfish gathering took place (Çakırlar, 2009b: 132–135).

The taxonomic compositions of the mollusk remains at coastal Neolithic sites indicate that availability and proximity determined gathering behavior and strategies. In the north, *Mytilus* dominates the assemblages, followed by *Ostrea* and *Cerastoderma*; in the south, *Cerastoderma* (Ege Gübre, Yeşilova) and *Arca* (Çukuriçi VIII) are by far the most frequent taxa in the Neolithic deposits. Regional differences between taxonomic abundances can be explained by regional biogeographical differences. *Mytilus* and *Ostrea* live on gravelly to rocky bottoms in fully marine environments or environments with significant influx of saline marine waters, thriving with high water velocity. The frequency of these two taxa at Neolithic Istanbul sites probably reflects the abundance of suitable natural habitats, which still partly exist and host a sizable population of *Mytilus* and which used to host healthy populations of *Ostrea* until the mid-twentieth century (Deveciyan, 1926).

Differences among assemblages in the same region can be explained by the differences in the hydrological and geographical properties of the estuary each settlement used to gather shellfish. *Arca* shells live on sandy to rocky bottoms in relatively deep, saline bays with little, preferably no freshwater influence, whereas *Cerastoderma* requires calm and protected niches in lagoon-like aquatic environments although it has a high salinity tolerance. Probably, the mixed bottoms of the vast, open bay near Çukuriçi (what is today the delta of the Small Meanders River; Kayan, 2015) that were closer to the open sea were colonized by *Arca* and the more protected areas of the bay were colonized by *Cerastoderma*. In the cases of Yeşilova and Ege Gübre alluvial sedimentation may have been already more effective in the Early Holocene in filling the bays and creating protected sandy areas, which would have led to the colonization of these habitats by *Cerastoderma* populations.

A variety of other aquatic molluscs occur in the archaeomalacological assemblages of coastal Neolithic sites in western Anatolia, but their relatively low frequencies suggest that they were collected opportunistically and were probably relatively rare in the environs of the sites in question. There is also little evidence to suggest that they served any non-dietary function; perforated or otherwise worked examples are rare, apart from *Cerastoderma* valves that are rather crudely holed on their body (Derin, 2012, Fig. 19). All the sites in question had access to sizable freshwater bodies; in the case of Istanbul sites remains of freshwater fish are abundant (Boessneck and von den Driesch, 1979; Çakırlar, 2013). Despite this, evidence for shellfish gathering in fully freshwater environments is extremely rare apart from the occasional *Unio* and *Melanopsis*.

6. Inland and epi-coastal Neolithic after 6500 BC

The inland sites where settlement began in the first half of the seventh millennium BC continue to be occupied during the first half

of the sixth millennium BC, like the coastal sites discussed above, and several new inland and epi-coastal (10–30 km from the coast) settlements are established in the second half of the seventh millennium BC (Çilingiroğlu and Çakırlar, 2013; Özdoğan, 2013).

The transportation of marine shells to inland and epi-coastal sites for ornamental purposes seems to increase during this period. Some marine mollusks are brought to the sites apparently empty and worked there. It is likely that these were collected on the beach. The clearest examples of this activity come from Ulucak. For example, irregular parts of *Pinna* shells close the bivalve's hinge occur commonly in Ulucak Layers V and IV. These are interpreted as the work waste of mother-of-shell bead manufacture which took place at the site since the early seventh millennium BC (See above). *Cerastoderma* 'pendants' start occurring at Ulucak as they do at coastal sites. A unique set of finds represent the use of *Bolinus brandaris* shells to manufacture a type of object with an unmistakable resemblance to clay stamps, also called 'pintaderas', which are very common in the seventh and sixth millennium BC Neolithic contexts of the Balkans and Anatolia (Lichter, 2011; Çilingiroğlu, 2012). Finished products of *Bolinus* 'stamps' at Ulucak come from Level IV (Fig. 2) and they are nearly identical to the example from the Neolithic settlement of Ege Gübre on the coast (Sağlamtimur, 2012, Fig. 26).

Table 2

Summary table of aquatic mollusks from Ulucak Layer V and IV.

Taxa	Description of preservation/artefact status	NISP	
		V	IV
<i>Patella</i>	Natural		1
<i>Monodonta</i>	Natural	2	2
	Ring?	2	
<i>Cerithium</i>	Water-worn		1
<i>Bolinus</i>	"Pintadera" (Fig. 2)		3
	Natural	3	
<i>Hexaplex</i>	Water-worn	2	1
	Natural	2	
<i>Nassarius</i>	Apex perforated	1	
<i>Columbella</i>	Natural		3
	Apex perforated		17
<i>Arca</i>	Water-worn	3	
	Perforated	2	
	Hole in mid body. Artificial?	1	
	Encrusted		1
	Natural	11	14
<i>Mytilus</i>	Natural	3	
<i>Pinna</i>	Work waste?	2	
	Natural	6	1
<i>Spondylus</i>	Natural	3	
	Water-worn	1	1
<i>Ostrea</i>	Natural	13	2
<i>Acanthocardia</i>	Natural	1	
<i>Cerastoderma</i>	Water-worn	1	
	Perforated umbo		2
	Perforated		1
	Accumulation/Midden	18	
<i>Mactra</i>	Natural	72	61
	Accumulation/Midden	211	
	Natural	7	
<i>Solen</i>	Natural	7	1
	Accumulation/Midden		30
<i>Donax</i>	Natural	15	2
<i>Veneridae</i>	Natural	2	1
<i>Chamelea</i>	Natural	1	
<i>Tapes</i>	Natural	1	6
<i>Sepia</i>	Natural	1	
<i>Melanopsis</i>	Accumulation/Midden	6	
	Natural	7	
<i>Unionidae</i>	Natural	15	4
Total		422	155
Grand total			577

Fig. 2. *Bolinus brandaris* 'pintadera' from Ulucak IV, excavated in 2001. Photo by Ç. Çilingiroğlu.

There is nothing surprising about objects made out of marine mollusks occurring in inland sites. The prevalence of natural, unmodified marine mollusks in epi-coastal and inland sites of western Anatolia, such as Ilıpınar, Barcın, and Ulucak is more intriguing. At Ilıpınar, an epi-coastal site about 15 km east of the present-day coast of Marmara, marine shells, especially *Mytilus* shells have been commonly encountered at all Neolithic layers (Buitenhuis, 2008). According to a 1995 report (Buitenhuis, 1995), marine mollusks make up ~50% of the entire faunal assemblage in NISP, and the *Mytilus:Unio* ratio is 1.3:1. *Mytilus* shells are also relatively common in the Neolithic assemblage of Barcın, which is located about 55 km away from the sea. The *Mytilus:Unio* ratio at this site is ~1.2:1 (Galik, 2013). No archaeological records exist of objects made of *Mytilus* shells; unless they were brought inland to serve an archaeologically invisible function, e.g. for scooping.

At Ulucak, *Cerastoderma*, *Arca*, and *Mactra* shells are found throughout Layers V and IV, mostly accumulated in small middens (Fig. 3). Accumulations of *Mactra* at Ulucak are unique; *Mactra* are abundant on sandy and muddy bottoms in lagoonal environments but their archaeological occurrence is rare (Theodoropoulou, 2012). They seem to have never become popular a food resource in the

Fig. 3. A Neolithic shell 'midden' at Ulucak. Photo by Ç. Çilingiroğlu.

ancient Mediterranean. To my knowledge, ornaments made of *Macra* shells do not exist in the archaeological record. At Ulucak some of the *Cerastoderma* and *Macra* bivalves were recovered intact with both valves present.

The lack of signs of post-mortem sand and wave abrasion, context, low taxonomic diversity, and negative correlation with taxa recovered at contemporary coastal settlements nearby indicate that these certain taxa were brought to inland and epi-coastal sites while still alive and presumably to be consumed as food. The comparison of the marine habitats exploited in Çukuriçi VIII and Ulucak V and IV as represented by NISP proportions of marine mollusks that live in those habitats reveal an interesting inverse relationship between the ecological zones that were accessible for coastal dwellers and inland farmers, except those used for the procurement of *Cerastoderma* (Fig. 4).

The mechanisms behind this apparent pattern are difficult to determine. Several scenarios are possible. Coastal dwellers may have been directly involved in the transportation of low calorie marine foods between coastal and inland regions, and they may have pre-selected the types of marine foods that they would exchange or present as gifts. Pre-selection preferences may have been dictated by weight (*Arca* are heavier than *Cerastoderma*.) or by culinary value (*Arca* live deeper in coastal waters and contain more calories per individual, factors which may have increased its relative value.) Conversely, *Cerastoderma* may have been in higher demand by inland farmers, who occasionally perforated their valves in order to produce suspended objects. Alternatively, competition for resources rather than their exchange between coastal and inland dwellers may have caused the pattern observed. User groups commonly compete for productive shellfishing grounds and claim ownership of shallow coastal waters where shellfishing takes place (e.g. de Alessi, 2012; Whitaker and Byrd, 2014).

7. The Chalcolithic

The long Chalcolithic period is very poorly known in the archaeological record of western Anatolia. Nevertheless, luckily for our purposes, one more region of archaeological investigation is added to the list of archaeomalacological assemblages that can be examined to track down the record of pre-Bronze Age aquatic mollusk exploitation in the region. This is the Troad, where pre-Troy sites around the Trojan Bay have been investigated through surveys and small-scale excavations.

The evidence for the abundance of shell middens is strong in Chalcolithic Troad. At least in some coastal Chalcolithic sites, mollusk remains outnumber animal bone remains. Sivritepe was one of these sites (Boessneck, 1986). For two other sites, Kumtepe and Alacalıgöl, no specimen counts are available to calculate the proportion of bone vs. shell finds. While the faunal study of Kumtepe is yet to be finalized, Alacalıgöl was investigated through surface survey. At Alacalıgöl, the visibility of shells on the surface is extremely high (Fig. 5). All three sites had easy access to two bays, both fed by estuaries, and to the Aegean coast. *Ostrea*, *Mytilus*, and *Cerastoderma* shells are abundant, reflecting the exploitation of varied aquatic niches available to the communities who inhabited these sites.

In central western Turkey, the exploitation of estuaries and lagoons for mollusk resources continue in the fifth and fourth millennia, with an apparent decrease in the abundance of *Mytilus* and *Ostrea* accompanied by an even stronger focus on *Cerastoderma*. Most of the Chalcolithic occupations investigated by excavation in central western Turkey are those that overlay the Neolithic settlements discussed hitherto. An interesting exception is a cave site in the south of the region, Malkayası, where present evidence suggests that mollusk remains are also more abundant than mammal remains, with *Cerastoderma* and *Patella* dominating the 5000–4500 BC deposits (Benecke, pers. comm.).

The transportation of marine mollusks to inland sites for food consumption continue until the Late Chalcolithic and probably afterwards in both northwestern Anatolia and central western Anatolia (Çakırlar, 2009; Gerritsen et al., 2010). Worked marine shells are also common, with fragmented *Glycymeris* bracelets, a signature of sixth and fifth millennium exchange networks in Europe (Chapman and Gaydarska, 2015), appearing for the first time in the fifth millennium deposits of Ulucak and Kumtepe.

8. Discussion

Interesting patterns emerge from the information discussed above. These patterns have implications far beyond activities involving shellfish gathering and shell use in pre-Bronze Age western Anatolia. For the majority of the sites and phases that have been taken into consideration, mollusk remains constitute one of the few proxies for foraging behavior and the utilization of wild resources to express symbolic meaning. If so, we can come back to the questions we posed in the introduction and probe the data discussed above to address them.

Fig. 4. Comparison of the marine habitats exploited in Çukuriçi VIII and Ulucak V and IV as represented by NISP proportions of marine mollusks that belong to different habitats.

Fig. 5. Detail of the surface of Alacalıgöl in Troad. Photo by S. Blum.

8.1. What was the role of foraging in early farmer economies?

This question is fundamental to answer for a region like western Anatolia where the term Neolithic is essentially synonymous with the appearance of domesticated plants and animals. Until recently, the notion that foraging among early farmers in northwestern Anatolia was a persisting Mesolithic tradition, a relic of a broad spectrum diet, was prevailing among scholars of Anatolian Neolithic. A single argument should suffice to demonstrate that this notion is an assumption: we do not have a single excavated Mesolithic site in western Anatolia that would enable us to even begin to describe the subsequent Mesolithic tradition (see Çakırlar, 2013). Given this, we are able to think about the role of foraging among early farmers only from the known beginning of the Neolithic in the region.

Relative taxonomic abundances coupled with palaeogeographic reconstructions at coastal sites suggest that availability was the primary constraint for shellfish procurement. Indications that low-energy shellfish were transported over up to a day's walk to be consumed as food, however, compels us to think outside of the environmental adaptation box when we consider the role of foraging in Neolithic western Anatolia. Clearly this costly activity could have brought no caloric gain to those who were burdened by it. On the contrary it would be costly unless it was merely a by-product of an excursion with a more profitable goal than collecting shellfish, for example fishing or exchange with coastal communities. Minute amounts of marine fish bones were recovered in Ulucak (Çakırlar, 2012a). Ethnographic observations among contemporary foragers show that shells are separated from the flesh at the collection site before being transported to camps or central places to minimize weight (Bird, Bliege Bird, 1997). There is an advantage to transporting and storing shellfish with its shell. If the body is kept in its shell, the animal remains alive longer, self-storing itself. Moreover, once the shellfish were eaten, the shells attained new functions after small modifications. The transportation of shellfish to inland sites is also known from the Greek Neolithic (Theodoropoulou, 2012). The mechanism behind the movement of live shellfish to inland sites is difficult to reconstruct. Exchange, sharing, competition, parallel but independent activities are all plausible. The contrasting taxonomic compositions of contemporary Ulucak and Çukuriçi may help to tease out the type of social interaction involved, because the inverse pattern suggests that while abundant resources were shared, inland dwellers were procuring taxa which the coastal farmers had perhaps less interest in.

In short, gathering shellfish in Neolithic western Anatolia was done side by side with farming. The present evidence is not sufficient to suggest whether shellfish gathering was subsidiary to other subsistence activities such as herding, farming, hunting, and fishing, or whether shellfish was a staple food. For inlanders, shellfish clearly meant more than subsistence.

8.2. What were the cultural affiliations of the earliest farmers in the region?

The inventory of worked shell objects is limited to a few taxa which are, at least at the beginning of the Neolithic, different from taxa that are targeted as food. The worked shell repertoires of the earliest settlements of Barcın and Ulucak both have affinities with types known from Epipalaeolithic, Neolithic and Chalcolithic Anatolia and the Balkans. The significance of some of these types for the symbolic behavior and spiritual world of the last foragers of Anatolia is evident from their prevalence as grave finds at Epipalaeolithic Pınarbaşı (Baysal, 2013a, 2013b). Whether the overwhelming ubiquity of some of these types represent one or the other tradition symbolizing common approaches to wilderness, the self, and the other, is another matter, however.

How far back in time and space should we go to trace affinity groups (or identities) based on sea shells? What do pierced *Nassarius* shells tell us about the common aspects of the world views of the Neolithic community in Ulucak (6500–6000 BC), anatomically modern humans in South Africa who were the first to come up with the idea of piercing them and perhaps wearing them 75,000 years ago (Henshilwood et al., 2004), and the Arabs of Antioch who attach pierced *Nassarius* shells on their clothing (especially children's) with the hope of being protected from the evil eye (personal observation)? Nevertheless, if we leave interpretations based on species types and anachronisms aside, and focus back on the technological characteristics of the early Neolithic shell beads at Ulucak, we can see that the undeniable similarities between the manufacturing techniques applied on these and the ones known from contemporary Çatalhöyük and Boncuklu (the Neolithic layers) may indeed refer to common technological traditions.

Other than demonstrating ties to the wide world, the types of worked shells in Neolithic Aegean Turkey support the idea that communities living here were innovatively developing a material culture that was becoming distinctly Eastern Aegean (Çilingiroğlu and Çakırlar, 2013). Well-known types of mollusk ornaments in Neolithic Greece, such as the black *Cyclope* and *Cerastoderma* beads of Mesolithic and Neolithic Franchthi (Miller, 1996; Perlès and Vanhaeren, 2010) are so far not known from the Eastern Aegean. The *Bolinus* stamps found at two Neolithic sites, one coastal and one inland, are so far unique to the eastern Aegean, although they have clear similarities to the widely-distributed clay stamps, especially those with spiral patterns.

8.3. How did people live in western Anatolia during the Chalcolithic period?

The Chalcolithic Period is perhaps one of the least understood periods of the prehistory of Anatolia (Horejs, 2014). Despite scanty evidence, certain perceptions have been formed about the Anatolian Chalcolithic. One of these suggests that farming has become more established than it was in the Neolithic as the main subsistence strategy (Düring, 2011). Animal husbandry and agricultural practices are likely to have been developed during the Chalcolithic, especially in Central Anatolia. For western Anatolia, however, both the archaeomalacological evidence discussed in this paper, and evidence hinting at an increase in the exploitation of other wild or

semi-wild species (e.g. *Dama dama*, fallow deer) (Çakırlar and Atici, forthcoming) suggest that subsistence strategies may have actually become more diversified rather than focused on farming. This need not mean that these communities were less complex than full-time farmers – if such a thing existed – of the Neolithic and the Early Bronze Age. The amount of low-lying open-air settlements (e.g., Alacalıgöl) and cave occupations (e.g. Yarımburgaz) is larger during the Chalcolithic Period. Together with the prominence of foraging activities, this shift in site choice may be pointing at the rise of partly or fully mobile elements or their increased visibility in the archaeological record. Seasonality analysis of common mollusk species at sites like Alacalıgöl can help illuminate this issue.

9. Conclusions

In this paper, I discussed the exploitation of aquatic mollusks, mainly marine mollusks, in Neolithic and Chalcolithic western Anatolia, using the current archaeomalacological evidence as proxy for subsistence strategies, dietary approaches, and cultural affinities. I showed that the pre-6500 BC inventory of worked mollusk shells is likely to indicate the affinity of the earliest Neolithic inhabitants of the region with the wider world of Eastern Mediterranean and Anatolia. While shared tastes continue to manifest themselves through worked shells throughout the Neolithic, types specific to the Eastern Aegean suggest the creation of new, micro-regional affinities. Foraging the coast for food was an important activity for farming communities living on the coast and inland. Although the correlation between geomorphic reconstructions of site locations and habitats of frequent mollusk taxa suggests that optimal foraging strategies dominated shellfish gathering activities, evidence for the transportation of live shellfish to inland sites, presumably for human consumption, speaks against the perception of the role of shellfish gathering as mere environmental adaptation. Furthermore, the scarcity of some taxa, for example freshwater bivalves, cannot be explained by optimal foraging formulae.

Was shellfish gathering a tradition from the Mesolithic past? What did shellfish gathering mean for Neolithic people with animal husbandry and agriculture? Do worked shell types with similarities to objects from distant sites represent shared identities? Was there a return to the wild during the Chalcolithic Period in coastal western Anatolia? Answering these questions properly requires further research. First, we need to be able to describe the Mesolithic life in western Anatolia through excavation; and secondly, we need not only to increase the number and scope of the archaeomalacological assemblages, but also to assess these data in light of other subsistence information from osteoarchaeological, anthropological, and palaeogeographic studies.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.quaint.2015.05.008>.

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