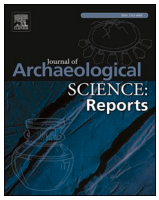
Journal of Archaeological Science: Reports 53 (2024) 104312

Contents lists available at ScienceDirect

Journal of Archaeological Science: Reports

journal homepage: www.elsevier.com/locate/jasrep



From prehistoric shores: Marine shell ornaments, landscape, interaction and the Neolithic transition in Anatolia

Emma L Baysal [a,*], Sera Yelözer [b]

[a] Department of Archaeology, Ankara University, DTCF, Sıhhiye, Ankara, Türkiye
[b] UMR 5199 PACEA, Université de Bordeaux, Bâtiment B2, Allée Geoffroy Saint Hilaire, CS 50023, 33615 Pessac, France

ARTICLE INFO

Keywords:
southwest Asia
Mobility
Personal ornaments
Regional identity
Neolithic transition
Neolithic spread

ABSTRACT

As one of the most portable of artefacts, marine shells used as personal ornaments help archaeologists define the relationships of prehistoric communities with landscapes. The transition from mobile hunter-gatherer to largely sedentary lifeways that lies at the centre of the Neolithic process transformed human-landscape relationships. In this article we collate marine and freshwater shell ornament distribution data and multiple variables in ornament choice and production for the Epipalaeolithic-Neolithic transition period in Anatolia. This produces a diachronic perspective on changes in human interactions with the landscape through the Neolithic transition process. We compare this with existing interpretations of the western spread of Neolithic populations and lifeways to determine both the sustainability of marine resource procurement through the sedentarization process and investigate multi-directional interactions and influences through time.

1. Introduction

Here we explore the relationship between raw material/artefact mobility and preferred habitation practices with the example of marine shell use in ornamentation through the Epipalaeolithic-Neolithic transition in Anatolia. This region encompasses both the incipient stages of the Neolithic process from around 10,000 BCE and the movement of both Neolithic populations and their associated lifeways westward across the Anatolian Peninsula towards Europe as the Neolithic progressed (Haak et al., 2010; Kılınç et al., 2017; Omrak et al., 2016).

The procurement, distribution and use of marine shells as ornaments during the Neolithic is relatively well understood in both Europe (Dimitrijević and Tripković 2006; Ifantidis, 2019; Miller, 1996; Rigaud et al., 2015) and large portions of western Asia (Alarashi, 2010; Bar-Yosef Mayer, 2005; Ridout-Sharpe, 2015). Shell ornaments have long been recognised as an important indicator of identity construction and display, movement of human groups and resource exploitation practices (Reese, 1991; Richter et al., 2011; Stiner, 2014). Research on these artefacts started relatively late in Türkiye, developing significantly only within the last few years (although see for example Reese, 2005), which has made it difficult to assess the importance of, and regional and temporal variations within, these elements of material culture in this large region bridging western Asia and Europe.

Gathering both the published and unpublished datasets for marine and freshwater shell use in personal ornamentation from 20 sites across Anatolia (Fig. 1), we identify a set of parameters to measure the choice of shell species and their adaptation into ornaments through time. We use the data to ask how shell procurement for ornament production and use or the distribution of shell ornaments as ready artefacts was modified with the changing behaviours of the populations of the region at the onset of sedentary lifeways. We also investigate the degree to which both early Neolithic practices and Epipalaeolithic legacy practices were transmitted, adapted and maintained within the multidirectional interactions of Neolithic communities through time. This contextualises the change that took place as Neolithic groups moved to the west as the Neolithic advanced. In addition to the westward movement of Neolithic populations and their lifeways, we explore multidirectional influences on their behaviours in the light of findings from surrounding regions. For example, the possible influence of Aegean communities on those Neolithic groups that settled in western Anatolia, are used in conjunction with existing traditions to draw out patterns of landscape engagement, relating them to both the beginning of the Neolithic process and its progression. Our results allow us to firstly understand the dynamics of shell species choice and use in Anatolia through the Neolithic transition and then begin to situate our findings in relation to the wider interpretation of the Neolithic process. We argue that items of material

* Corresponding author.
E-mail addresses: emmabaysal@gmail.com (E.L. Baysal), serayelozer@gmail.com (S. Yelözer).

https://doi.org/10.1016/j.jasrep.2023.104312
Received 2 August 2023; Received in revised form 4 November 2023; Accepted 16 November 2023

culture that were used close to the human body and were inherent to identity making before the Neolithic add significant nuance to the understanding that has already been developed of the Neolithic process through genetic and stable isotopic studies. We find that, despite the relative lack of research in this area, trends in procurement practices and ornament preferences through time can be defined and that the results challenge preconceptions about directionality of movement of both people and ideas during the Neolithic transition.

2. Late prehistoric lifeways, marine shells and portability

Thanks to both aDNA and isotope studies (Pearson et al., 2023) we have an increasingly detailed picture of large-scale mobility and smaller scale multi-directional interactions and movement of groups and communities through the Neolithic transition in western Asia. During the Epipalaeolithic, groups exploited landscape resources through seasonal routes that were optimised for a combination of food, material procurement and camp sites (Baird et al., 2013; Dubreuil and Nadel, 2015). The associated knowledge sets likely smoothed the gradual process of sedentarization and its accompanying changes in food resource management and landscape interaction long before what is acknowledged as the beginning of the Neolithic. The reasons for this process are debated (for example Gopher et al., 2001; Goring-Morris and Belfer-Cohen, 2011; Verhoeven, 2011). Settling permanently in a single location led to fundamental changes in the relationship between communities and landscape (Abbo and Gopher, 2020; Vigne, 2011). It also changed the organization of raw material procurement. The transition from largely mobile to mostly sedentary lifeways incorporated traditional practices into the new social order. For example, obsidian remained in widespread use, indicating that mechanisms for its long-distance procurement and distribution were adopted into new settlement and subsistence patterns (Ibáñez et al., 2015).

Epipalaeolithic material culture, just as the Upper Palaeolithic that came before, was mobile because the groups who used it were mobile, whether for practical daily tool use such as stone blades or for aesthetic or cultural uses such as figurines. Personal ornaments were small and lightweight, therefore ideally suited as mobile indicators of status and identity attached to the body or to clothing (Baysal, 2019: 28ff). The relationship of the ornaments to the human body renders them a unique opportunity to explore mobility through time. The consistent use of marine shells as items of ornamentation from the Upper Palaeolithic onwards across many regions (Cristiani et al., 2014; Perlès, 2019) means that they are one of the most reliable sources of evidence of movement. The limited material culture evidence from Epipalaeolithic habitation areas in Anatolia indicates the movement of marine shell ornaments with the mobile groups as part of their seasonal activities (Baird et al., 2013; Baysal 2013a, 2013b; Baysal and Erek, 2018) and is reflected at sites across a much wider region (Bertolini et al., 2016; Cristiani et al., 2014; Komšo and Vukosavljević 2011; Perlès, 2019). In some cases, shell procurement has been interpreted as the main reason for site location choice (Miller, 1996; Perlès, 2023).

Within the activities of Epipalaeolithic mobile groups, marine shell adaptation to ornament use was incorporated into seasonal programs of landscape engagement (Baysal and Erek, 2018; Richter et al., 2011). There were preferences in shell species choice that pertained to large geographical areas (Bar-Yosef Mayer, 2005) and may relate to social ties or regular spheres of interaction. Evidence from surrounding regions suggests that elements of established Epipalaeolithic practices, including marine shell procurement, were widely continued in the Neolithic (for example Abu Hureyra, Ridout-Sharpe, 2015; Franchthi, Perlès, 2023). However, there is not always a clear continuity in the choices of shells (Perlès, 2023) or the modes of procurement, which remain largely unknown in sites distant from coastal areas.

The period in question here, the Neolithic transition and progression, was one of significant and consistent sea level rises interspersed with events of rapid rise and the Younger Dryas which temporarily slowed the process. These changes would have been discernible to inhabitants of the region in question here, who at times would have seen significant shoreline changes within a single generation (Benjamin et al., 2017: 43), although there are significant regional variations (Çakırlar, 2015: 118). While this would not have been felt to the same extent everywhere, it would be more evident in the gently sloping shorelines where shells might typically be gathered (see for example eastern Mediterranean submerged Neolithic villages, Ogloblin Ramirez et al., 2023).

The second element of the Neolithic process is the gradual westward progression of Neolithization through both the spread of Neolithic populations and their lifeways westwards across the Anatolian peninsula and via multidirectional interactions and influences. The idea of the "Neolithic package", a set of items and ideas that were core to the Neolithic way of life, has dominated interpretations of the westward spread of the Neolithic way of life (Çilingiroğlu, 2005; Özdoğan, 2011,2014) since Childe coined the idea (Hodder, 2018). Personal ornaments, while potentially fulfilling such a role (see Martínez-Sevilla et al., 2021), also move wherever human groups move, regardless of

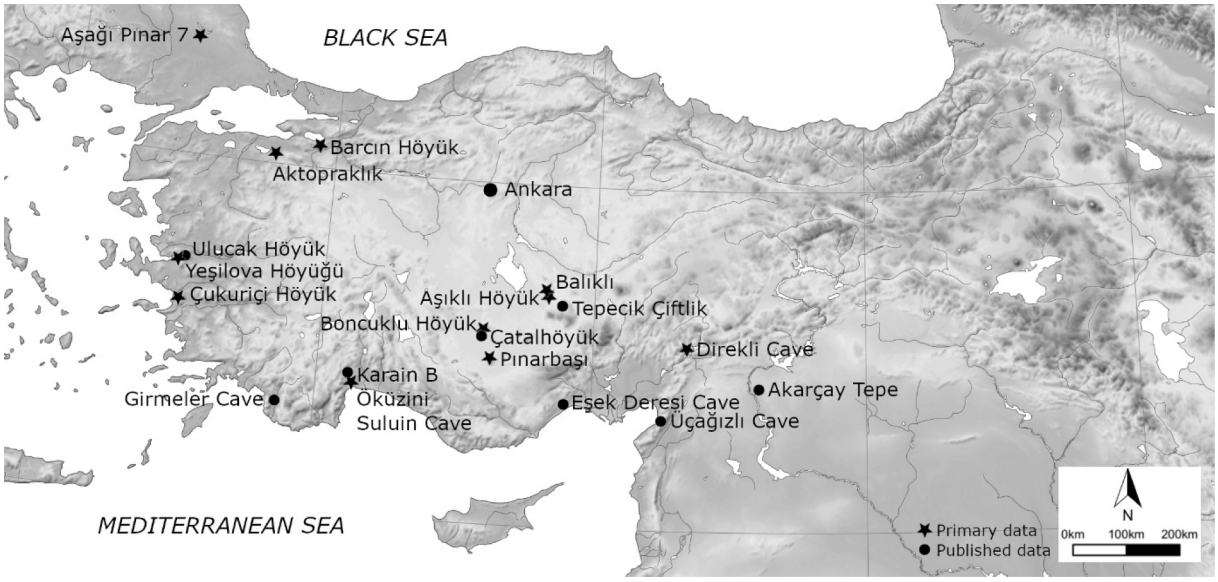


Fig. 1. Map showing sites included in the study.

scale or directionality. The interplay between the large-scale migrations of the Neolithic cultural spread and the small-scale local interactions of daily life is not yet well understood. Preliminary data relating to stone annulets (mostly used as bracelets) indicates that migrations across Europe included a remarkable degree of continuity in both the use of the artefacts and the spread of knowledge required for their manufacture (Martínez-Sevilla et al., 2021).

Through the Neolithization process, existing shell knowledge and procurement practices appear to have been adapted to changing social and subsistence circumstances. Thus, marine shells continued to be part of ornamentation practices throughout the Neolithic transition and into the established Neolithic. As the Neolithic developed, some practices associated with settled life were spread westwards across Anatolia towards the Aegean and continental Europe by established Neolithic groups (Arbuckle et al., 2014; Horejs et al., 2015), while simultaneously communication and exchange of materials and ideas led to the melding of traditions and multidirectional influences. Not all aspects of life or elements of material culture were attributed equal importance in this process (Çilingiroğlu, 2005; Özdoğan, 2011,2014), and not all were universally included by newly established settlers in the west and northwest of the Anatolian Peninsula (see Reingruber, 2011). It is likely that both overland and maritime routes were involved in this process (Fernández et al., 2014; Horejs et al., 2015; Reingruber, 2011). According to the latest genetic data, the two-thousand-year transitional period of Neolithic lifeways and populations from southeast Anatolia to the Aegean and Europe is shown to be a population movement accompanied by complex multi-directional movement for material procurement in a range of areas (Hofmanová et al., 2016; Omrak et al., 2016). Thus, ideas likely spread through a combination of multiple larger scale population movements and localised interactions and communications, "micro-mobilities", possibly forming something akin to nested networks (Reingruber, 2011) of various temporalities. Anatolia has always been a meeting point, identified genetically (Omrak et al., 2016) as well as in the subsistence practices and material culture that display multi-directionality. For our argument, the concurrence of the western Anatolian and Aegean Neolithic dates between 7,000 and 5,500 cal BCE is key. Despite any possible differences in experience of lifeways and different elements of material culture (Brami, 2015: 324), in terms of multi-directional communication and sharing of ideas and practices in the western portion of the Anatolian Peninsula, this correspondence is fundamental.

Continuity in shell use shows a willingness by Neolithic groups to adapt, such that existing traditions were preserved and can be traced through the Neolithic in southwest Asia, the Aegean and Europe (Bar-Yosef Mayer, 2005; Ifantidis, 2019; Perlès, 2023). Archaeologically the place of deposition of marine shell ornaments can be recorded, but not the biographies of the shells before this time, or their interactions with humans during their use life. They offer an insight into the human relationship with the marine environment beyond the procurement of food, giving minimum lengths of travel for the materials, but not modes of interaction or exchange. Nevertheless, they are a vital source of information on the human relationship with the shore environment through time. Given that we know that ornamentation practices are subject to strong and long-lasting localised traditions (e.g., Alarashi, 2016; Rigaud et al., 2015), they offer us the opportunity to explore attitudes to identity defining elements of material culture through times of change. It is the adaptation of these existing "legacy" practices to changing lifeways throughout the Neolithic process that forms the core of our investigation here. We ask to what extent groups experiencing the Epipalaeolithic-Neolithic transition process across Anatolia held on to their traditions and how much they adapted to and were influenced by new circumstances, including varying use of the marine environment for food and raw material procurement. In addition, we compare the experiences of those with a locally developed Neolithic, in the "core" areas, and those who took the Neolithic lifestyle to new regions, aiming to identify degrees of continuity and change. Our aim is to explore the transformation of marine shell use in ornamentation at the Epipalaeolithic-Neolithic transition in Anatolia and the extent to which multi-directional contact, changing ideas and differing relationships with the marine environment can be identified as the Neolithization process progressed westwards using the archaeological marine and fresh water personal ornament shell data currently available.

3. Methodology and data

The dataset included in this study is all the published archaeological shell ornament related data available for the periods in question for the geographic region occupied by modern Türkiye and in addition, primary data gathered by the authors, the detail of which is also used to add nuance to our interpretations (Fig. 2). The data has been standardized using parameters available in all individual data sets using species as the primary classification (see Table SM1). We have developed a methodology based on presence/absence, place and time to account for the issues arising from insufficiently detailed and poorly recorded largely contextually and quantitatively incomparable data sets from different excavation projects. The degree to which a shell was worked before use as an ornament is recorded on a scale of proximity to natural form. Assemblages are thereby evaluated for their technological/time investment requirements for shell ornamentation ranging from natural forms, naturally adapted forms (water worn shells ideal for ornaments) to highly adapted (original shell shape no longer apparent), variations are thus detected both within and between species. For example, *Tritia gibbosula* and *Columbella rustica*, both marine gastropods, have relatively similar forms, and with a low degree of adaptation (or water wear, see Bosch et al., 2019) a potentially similar mode of suspension (Fig. 2: 8 and 9). We do not attempt to account for the purpose of shell ornaments as there is insufficient use-wear data from most sites.

Although our study is centred on marine resource exploitation for ornamentation, freshwater shell species suitable for ornament making were widely available in most regions covered by our study. The use of marine shell species was therefore a deliberate choice. We record whether freshwater shells were also included in ornamentation practices at each of the sites using the same set of parameters. This has implications regarding the specificity of shell species choice, and helps us understand whether continuities through time were based on preference or convenience. We use the data to identify changes in preference for species, forms as well as shell sources, particularly important in the later Neolithic sites where shell raw material was increasingly adapted before use in ornamentation.

Adaptation ratings for each site are determined based on the average adaptation of shells recorded at a site, both overall and for marine and freshwater artefacts. The presence/absence and degree of variety within freshwater shell use is aggregated to the main result to determine sourcing preference alongside ornament form preference as recorded through degree of adaptation. The adaptation ratings are used for temporal and geographical comparisons of adaptation between marine and freshwater species.

Lack of sufficient radiocarbon dates and stratigraphic detail from many sample sites means that dating is restricted to the broad periodization traditionally applied to this region, Upper Palaeolithic, Epipalaeolithic, Pre-Pottery Neolithic and Pottery Neolithic (from approximately 35,000 to 5,000 cal BCE, see Tables SM1 and 2) which, along with geographical location allows for the approximate modelling of change through time. The date of initial settlement of each site is used as the base from which the overall occupation sequence is developed for the westward Neolithic spread.

Distance is recorded as the nearest point on the Mediterranean coastline to the site where the shell was discovered, as the crow flies. Although we know that sea levels were rising during this period (Benjamin et al., 2017), this does not significantly change the likely "days walked" involved in procurement. Mountainous regions and the likely much longer routes that were used in shell procurement make the

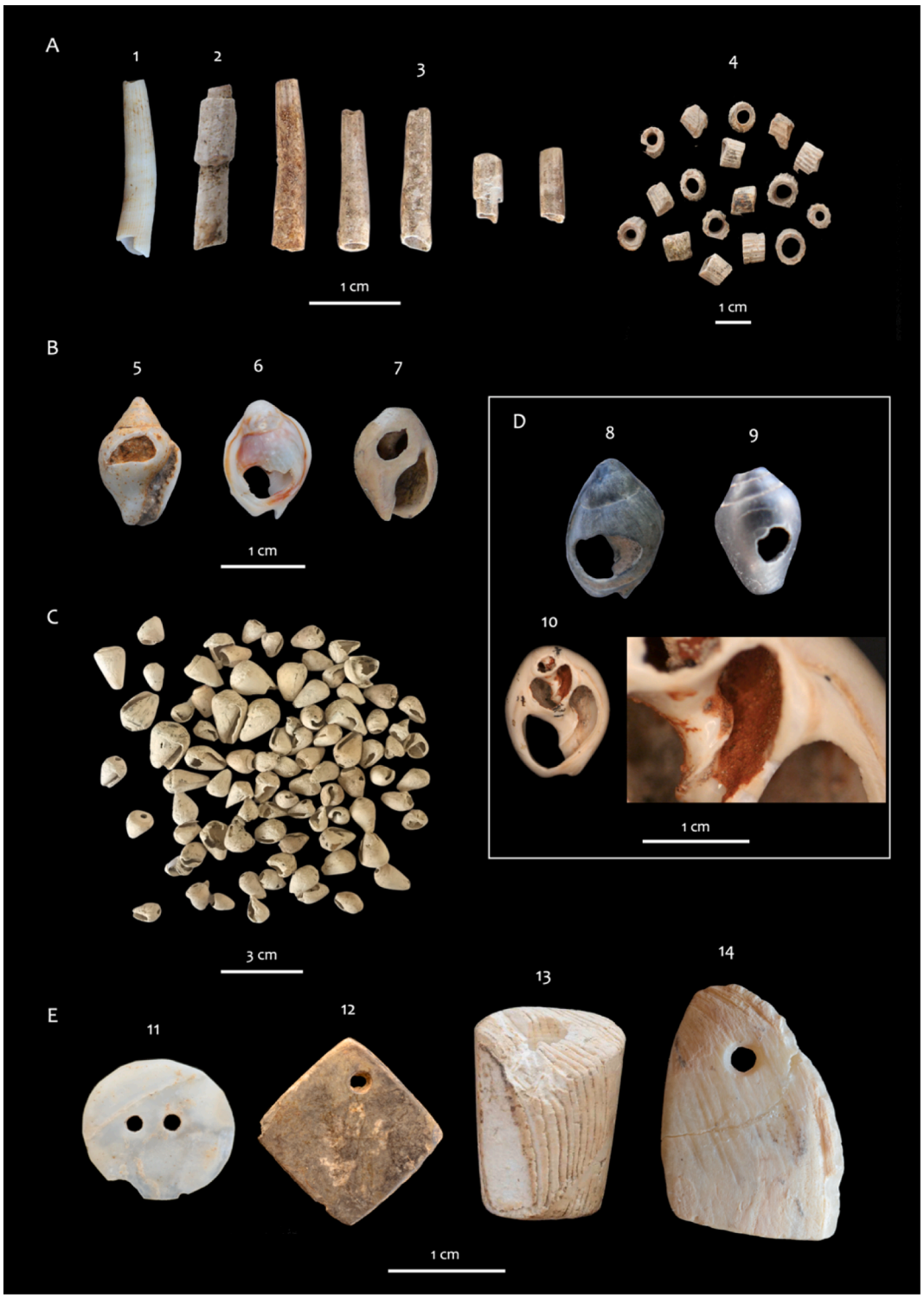


Fig. 2. Shell beads from select Anatolian sites dating to the Epipalaeolithic, Pre-Pottery Neolithic and Pottery Neolithic periods. A: Scaphopods from Direkli Cave, Epipalaeolithic (Cevdet Merih Erek, Direkli Excavation Archive) (1), Boncuklu Höyük (Douglas Baird, Boncuklu Höyük Excavation Archive) (2) and Balıklı (Güneş Duru; Nigel Goring-Morris and Mihriban Özbaşaran, Balıklı Excavation Archive) (3), Pre-Pottery Neolithic and Barcın Höyük (Rana Özbal and Fokke Gerritsen, Barcın Excavation Archive) (4); B: *Columbella* and *Tritia* sp. shell beads from Direkli Cave, Epipalaeolithic (5–6), *Tritia* bead with a perforation similar to contemporary Cypriot examples, Boncuklu Höyük, Pre-Pottery Neolithic (7); C: *Conus* and *Columbella*shells from Aşıklı Höyük, all deposited in a single grave, Pre-Pottery Neolithic; D: Colour treatment of shells by heating and pigmentation during the Epipalaeolithic (8) and Pre-Pottery Neolithic (9–10) (10: Yelözer, 2018: Fig. 10); E: completely modified *Unio* and *Spondylus* shell beads during the Pottery Neolithic, Barcın Höyük examples (Rana Özbal and Fokke Gerritsen, Barcın Excavation Archive) (11–14). Photos by authors unless otherwise stated.

use of least cost pathways attractive, however this method is likely unhelpful as Epipalaeolithic camp site locations show that low-cost routes were not preferred (Eşek Deresi, Altınbilek-Algül et al., 2022 and Direkli Cave, Baysal and Erek, 2018). There were likely other rationales involved in route planning including seasonal climate, suitable stopping places, food and water procurement as well as exchange and interactions that facilitated movement. The distances calculated do not necessarily reflect possible place of collection, as that was tied to a wider set of procurement activities that are not well understood, however they provide an absolute minimum distance of travel for the shells from their natural environment to their place of deposition.

The data sets are then compared with shell-related activities in surrounding regions with particular focus on the Aegean to determine the potential regions of influence on ornamentation practices through time and assess the dynamics of material and idea movements. The degree of multi-directionality in species choice, degree of shell adaptation and localised "fashions" in material diversity are assessed. Our aim is to build a framework that might continue to be expanded on and further compared with other areas of material culture in the same periods and regions.

4. Results: Marine-sourced ornament choice and procurement

Documenting the presence and absence of shell species per site, region and period reveals some patterns in spatial and temporal relationships. The data can be found in the Appendix: Supplementary Material (Tables SM1-4). Below, we highlight our observations.

1) In Anatolia, shell species diversity decreases from the Upper Palaeolithic into the Epipalaeolithic and Pre-Pottery Neolithic periods. Then, we see a great increase during the Pottery Neolithic Period (Table 1; Fig. 3A). There are exceptions to the general trend, particularly Çatalhöyük which shows the greatest overall diversity of marine and freshwater shells in ornamentation, possible reasons for this are explored in the discussion. We note that data for the Upper Palaeolithic are presently inadequate, a higher site sample size is needed.
2) There is no correlation between species diversity and distance from closest coast in either marine or freshwater species (Fig. 3B and Fig. 4). While this does not explain mechanisms of procurement and transportation, it demonstrates that distance was not a limiting factor in species movement from the Mediterranean. It also indicates that inland sites were not making up for lack of marine shells with locally available freshwater varieties. Even at Çatalhöyük, which has the greatest overall shell diversity, and is relatively distant from the sea, marine shell species remain predominant.
3) Certain gastropods (*Columbella rustica, Tritia gibbosula, Conus ventricosus* and the Cypraeidae shells), bivalves (*Glycymeris* and *Cerastoderma* sp.) and scaphopods were preferred since the Upper Palaeolithic and continue into the Pottery Neolithic periods (Fig. 3C). These species make up the most familiar forms of Neolithic shell bead ornamental repertoire. The continuous presence of freshwater shells in similar forms (e.g., *Theodoxus* sp.) also indicates a deliberate tendency towards familiar forms even when the usually preferred marine species/sources were not available. Therefore, we suggest that the visual characteristics of certain species/forms mattered to bead-makers and users as early as the Upper Palaeolithic and similar preferences continued into the Neolithic periods.
4) With the Epipalaeolithic and into the Neolithic, new species/forms appear (e.g., *Nerita* sp.) or become more common (e.g., the globular cowries), while some species known during the Upper Palaeolithic disappear (Table SM1 and 2). Interestingly, although the cowries are present within the assemblages, Anatolian sites have far fewer cowrie shells overall in comparison to the Northern Levant (Alarashi, 2010).
5) The main characteristic of Pre-Pottery Neolithic shell species selection for early sedentary Anatolian populations reflects a strong continuation of certain species/forms known since the Upper Palaeolithic and Epipalaeolithic periods. This can be characterized as a long tradition-based phase of shell use. This preference continues well into the Pottery Neolithic, however, most strikingly, we see a diverse selection of shell species for ornamental purposes in Aegean Anatolia alongside the traditional species. The new introductions fundamentally differ from inland Anatolia in terms of species/forms selection.
6) Adaptation of shells from their natural forms increases with time (Fig. 5). The major trends we observed regarding the adaptation of shells into simply suspended beads versus completely modified new forms suggests that overall adaptation decreases with distance from the coast. However, adaptation is overall much higher in the Pottery Neolithic than in previous periods, and it would be higher still without the anomalous camp/herding site of Pınarbaşı. Adaptation correlates with the increased Pottery Neolithic preference for freshwater shells. Coastal Pottery Neolithic sites of the western Anatolian Peninsula are much more strongly influenced by freshwater shell adaptation practices than most inland Pottery Neolithic sites. This may indicate differentiation in contact between groups in different areas and a changing landscape of interactions that was not as strongly linked to marine resources as might be expected.
7) The aggregate of shell species diversity (including marine and freshwater species) with adaptation rating shows similar patterns to our other overall findings. Epipalaeolithic and Pre-Pottery Neolithic assemblages are broadly similar, while we see a considerable increase in diversity during the Pottery Neolithic, which is still slightly greater even when Çatalhöyük is removed from the calculation (Figs. 3 and 5).

Table 1
Shell species diversity used for ornamental purposes per period in Anatolia, based on data from the sites provided in Table SM1.

Period	Upper Palaeolithic	Epipalaeolithic	Pre-Pottery Neolithic	Pottery Neolithic
Total number of different shell species	25	13	15	30

5. Discussion: Implications for mobility and landscape interactions

In response to our main questions about the modification of shell procurement and ornamentation practices in conjunction with changing lifeways at the onset of the Neolithic, and the role of legacy practices, we have several major findings. Our comparative results show a conservatism in the approach to shell species choice in ornamentation throughout the Epipalaeolithic and Pre-Pottery Neolithic periods that was likely a legacy of Upper Palaeolithic ornamentation and material procurement practices (Fig. 6). A somewhat similar approach was used by Stiner et al. (2013) to categorize the shell forms in the Üçağızlı 1 Upper Palaeolithic and Epipalaeolithic ornament assemblages. The authors detected a uniformity and consistency in form preferences, and despite the high species variety, *Tritia* and *Theodoxus* shells were dominant, suggesting their core place in long-lasting ornamental traditions of the late Pleistocene and early Holocene communities in Anatolia (Stiner et al., 2013: 396). Indeed, these species continue well into the Pre-Pottery Neolithic as dominant parts of assemblages with regional or sub-regional particularities (e.g., *Theodoxus* shells were rather common during the Natufian and the PPNA in the northern Levant and southeastern Anatolia, see Alarashi, 2014). Bar-Yosef Mayer (2013a: 331) has also already noted the apparent continuity from the Palaeolithic period evidenced at Çatalhöyük as well as the apparent similarity to the eastern Mediterranean traditions. What we do not see in Anatolia, however, is

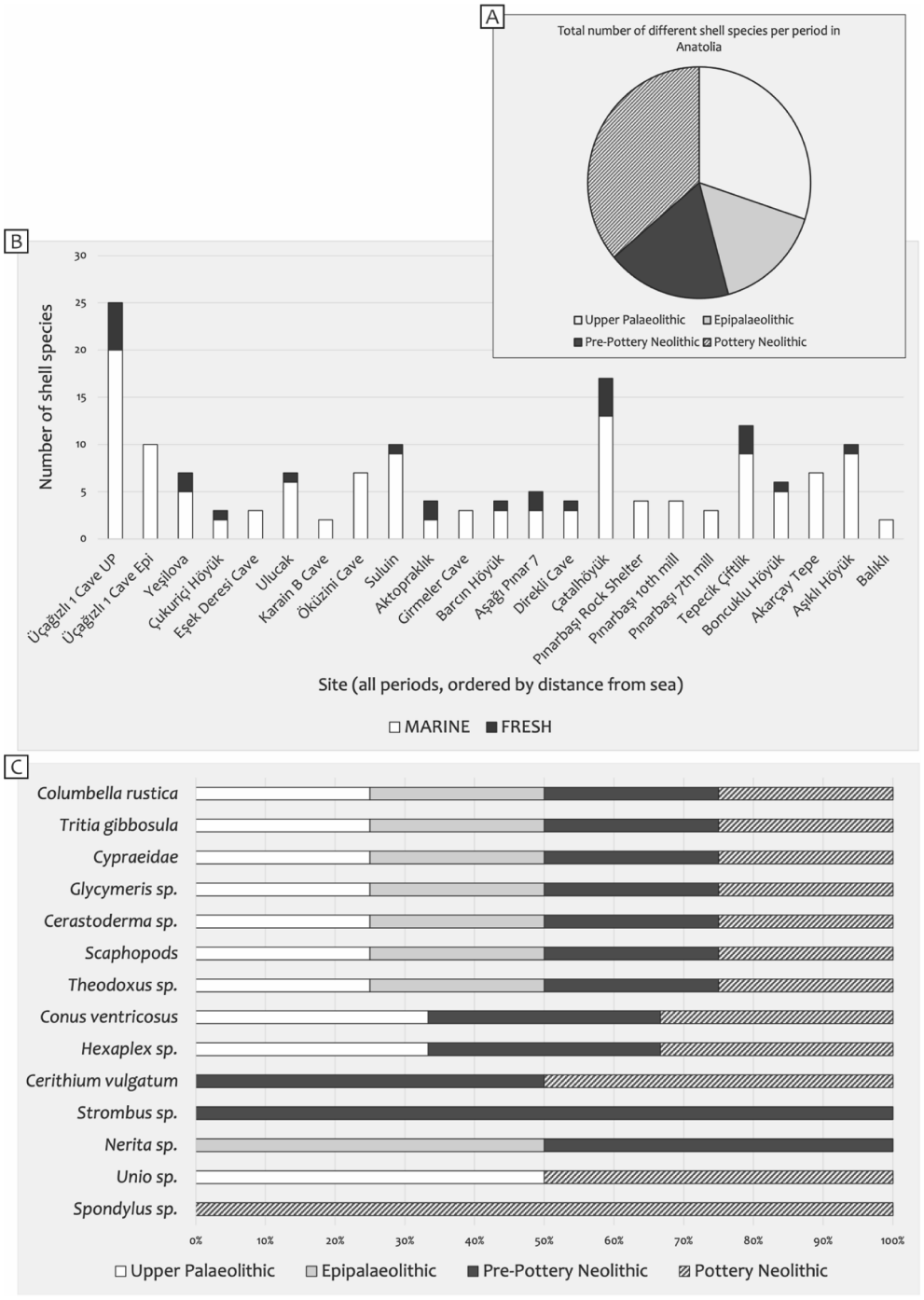


Fig. 3. Pie chart showing the distribution of different shell species per period in Anatolia (A); bar chart showing variety of marine and freshwater shell species present at sites included in this study according to distance from sea (B); bar chart showing the distribution of most common marine and freshwater shell species used for ornamental purposes per period in Anatolia from the Upper Palaeolithic to the Pottery Neolithic (C) (the dataset, sites and references are provided in the Supplementary Material).

the proliferation of marine shell species used as ornaments, particularly the use of larger marine bivalves, during the Pre-Pottery Neolithic. While overall similar forms and species were preferred both in Anatolia and the Levant during the Pre-Pottery Neolithic, and despite the circulation of stone beads between these regions (e.g., the butterfly beads: Alarashi, 2016; Yelözer, 2018), particular marine shell elements that were ubiquitous in the Levant are much fewer in Anatolian sites (e.g., cowrie shells, see for example Alarashi, 2010). This may reflect certain networks within which different materials were circulating or the preferences of communities within the different areas. Combining these previous views with our own observations, we suggest a continuous preference for certain forms in shell procurement and use from as early as the Upper Palaeolithic and into the Pottery Neolithic periods in Anatolia.

The data for high species diversity during the Upper Palaeolithic comes mostly from the Üçağızlı 1 assemblage (Stiner et al., 2013). The site's proximity to the coast, as well as the high mobility of forager groups during this period, may explain the high diversity. In the long-term, one plausible explanation is that as the mobility of human populations in Anatolia decreased throughout the Neolithic transition, shell

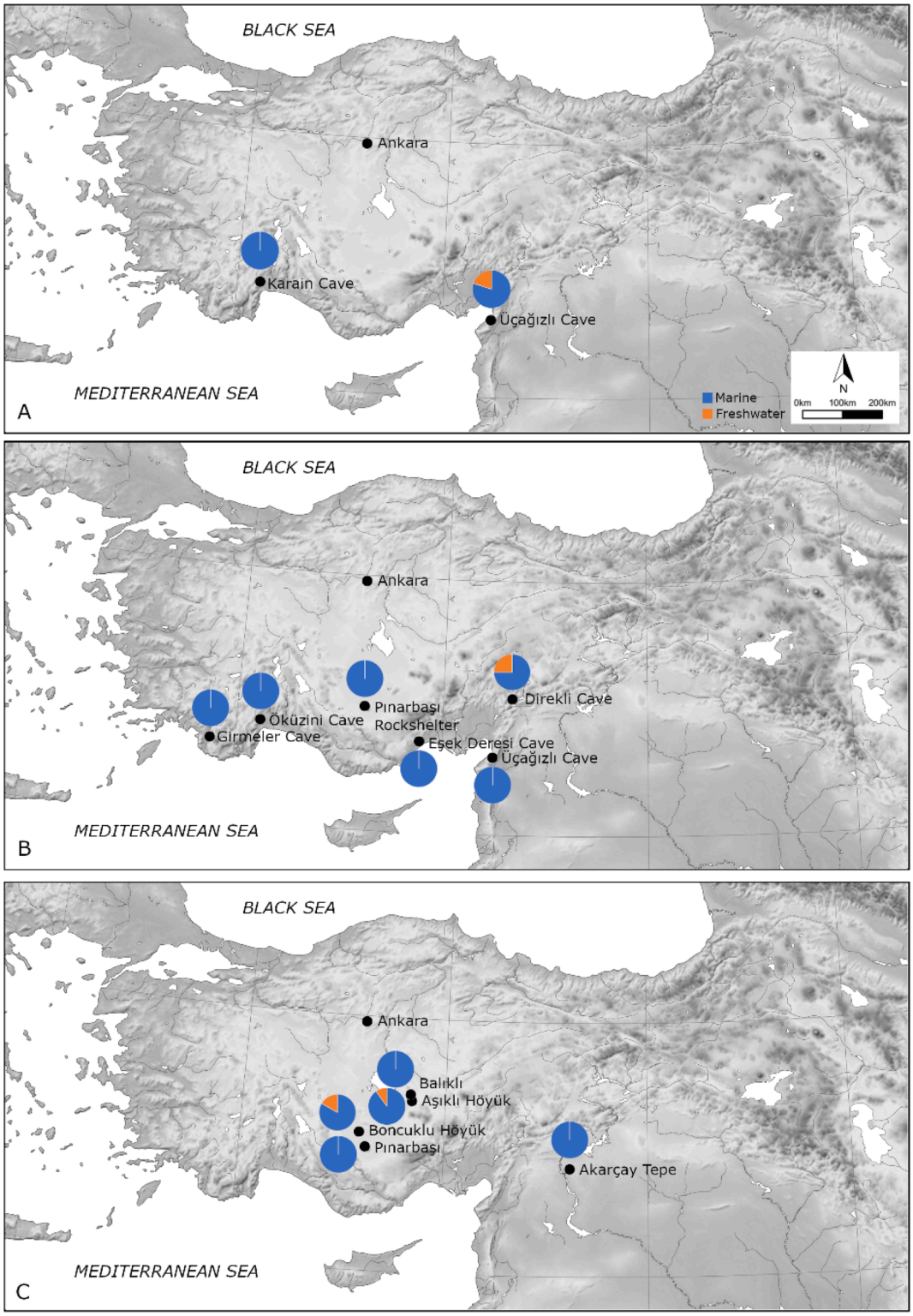


Fig. 4. Proportion of marine and freshwater shell species used in personal ornamentation at the study sites during the Upper Palaeolithic (A), Epipalaeolithic (B), Pre-Pottery Neolithic (C), Pottery Neolithic (D) (the dataset, sites and references are provided in the Supplementary Material).

procurement became more and more restricted to certain species. As most of our Pre-Pottery Neolithic data comes from inland regions, either mobile population elements engaged in targeted procurement or a down-the-line procurement model could be considered, where mostly certain species were in circulation. Further data is required from coastal Anatolian sites to test shell distribution models.

The conservatism seems to last throughout the period that can be characterized as the establishment of Neolithic lifeways, the long process of developing sedentism, agriculture and animal husbandry. It seems that the beginning of the Neolithic and the more sedentary lifeways that it brought resulted in a temporary narrowing of marine shell use, but not in the complete cessation of supply. This is juxtaposed with

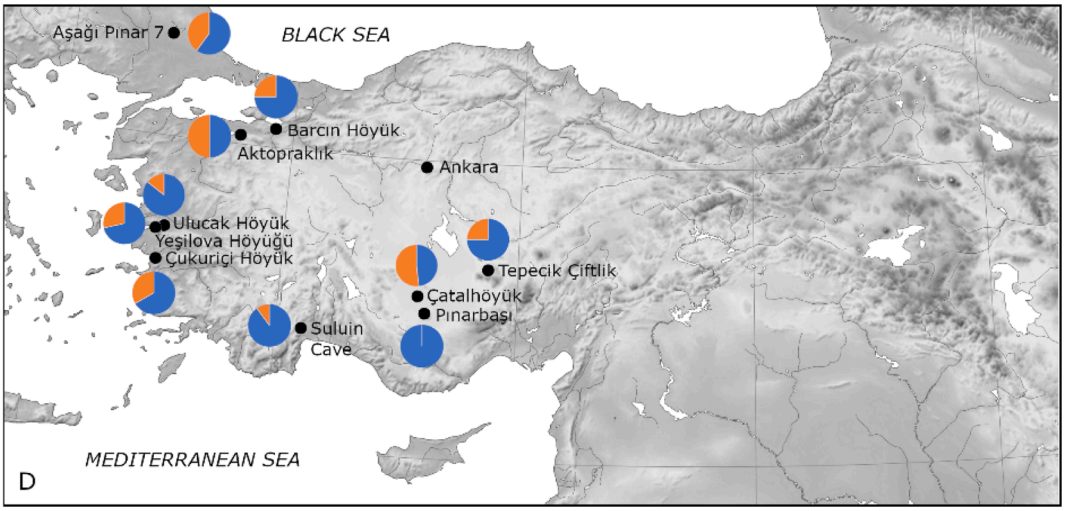


Fig. 4. (*continued*).

the expansion of stone bead making and experimentation with new materials, technologies, forms and colour combinations, ostensibly a time during which ornamentation saw both expansion and diversification (e.g., Alarashi, 2016; Bar-Yosef Mayer 2013b; Baysal, 2019; Baysal and Yelözer, 2023; Wright et al. 2008; Yelözer, 2018). The effects of technological and typological diversification and complexity in the use of shell as a raw material to produce abstract geometric forms of adornment took place later during the Pottery Neolithic, especially in Aegean Anatolia and the Marmara region, coinciding in chronology with similar developments happening towards the west in mainland Greece (e.g., at Franchthi, Perlès 2023).

For the central Anatolian plateau, the low genetic diversity of the Pre-Pottery Neolithic populations, coupled with the archaeological evidence, indicates an endemic, local pathway to the establishment of Neolithic lifeways in the region (Baird, 2012; Feldman et al., 2019; Kılınç et al., 2017; Özbaşaran, 2011; Stiner et al., 2022). The conservatism seen in shell species choice fits perfectly with the idea of indigenous foragers in transition to sedentism, plant cultivation, and animal management. During the Pottery Neolithic, on the other hand, in both central Anatolia and the Marmara region, archaeogenetic studies suggest a more diverse genetic pattern that could be explained with multiple gene flows (e.g., from central Anatolia to Marmara), and admixture with local populations (Kılınç et al., 2017). Shell data, however, does not provide a clear picture of a direct ornamental influence from central Anatolia towards the Marmara region in the west, but rather corroborates the idea of multi-directional movement of ideas, objects, or people within and between regions. Another plausible explanation could be that indigenous communities persisted in their ornamental preferences while sharing some "outside" objects and concepts and allowing their admixture into their own repertoire.

For Aegean Anatolia, stone ornaments from the basal level of Çukuriçi Höyük dating to the early 7th millennium BCE are techno-typologically similar to chronologically earlier and contemporaneous southeastern and central Anatolian examples, which led the researchers to suggest a maritime route connecting populations from the south towards the Aegean Anatolian coast (Horejs et al., 2015). However, this alone could not be an indicator of the "westward expansion" of early farming communities (*sensu* Özdoğan, 2011), as the shell assemblages tell a different story. There are some changes within the Pottery Neolithic shell ornament assemblages in Anatolia, including central Anatolia (Çatalhöyük and Tepecik Çiftlik, Karakaş 2019; Veropoulidou, 2021), the Marmara region (Barcın, Aktopraklık and Aşağı Pınar 7, Baysal, 2014,2016, forthcoming) and Aegean Anatolia (Yeşilova and Çukuriçi Höyük, this study, see also Horejs et al., 2015) from the early 7th millennium BCE onwards. This is seen in the shared usage of *Spondylus* sp. (marine) and *Unio* sp. (freshwater) shell beads across these regions and further beyond the Aegean, serving as raw material for geometric forms (e.g., disc or cylindrical beads, bracelets/bangles/annulets and rings and geometric pendants). The use of shell as a raw material begins contemporaneously at Aegean sites where disc beads of Cardiidae and *Spondylus* sp., geometric beads of *Spondylus* sp. and bangles of *Spondylus* sp. as well as sliced scaphopod beads come into use in the second quarter of the 7th millennium BCE among others at Franchthi, Çukuriçi and Barcın (Baysal, 2014; Horejs et al., 2015: Fig. 6; Perlès 2023; see also Ifantidis, 2019 for more extensive examples). Meanwhile at Çatalhöyük similarities are seen in the sliced scaphopods, round *Unio* beads, geometric pendants of *Unio* and *Spondylus* beads with double perforations (Veropoulidou, 2021).

The previous "core components" of marine and freshwater shell ornament assemblages (e.g., perforated *Tritia* and *Theodoxus* sp. shells, *sensu* Stiner et al., 2013) continue their presence in central Anatolian sites, however, they are almost absent in Aegean Anatolia and the Marmara region. We suggest this change was influenced by the west, as Anatolian populations interacted with the Aegean communities living on both sides of the coast (see for example the use of *Spondylus* in Franchthi and Dispilio from the 7th to the 6th millennia BCE: Ifantidis, 2011, Perlès 2023), which was perhaps a result of multi-directional and long-term population movements or interactions as opposed to the overall long-term westward expansion during the Neolithization process.

The greater diversity seen during the Pottery Neolithic at Çatalhöyük in the Konya Plain requires further consideration. It has already been discussed for the Upper Palaeolithic and Epipalaeolithic assemblages of Üçağızlı 1 Cave that ornamental shell species diversity could be related to fluctuations or increase in the number of population, coupled with the changes in the social structure and choices of individuals within communities through time, where Stiner et al., (2013: 395) suggest that "*more people and/or longer occupations may increase the probability of accumulating odd shell types…*". The high number of shell beads at Çatalhöyük, as well as the diversity of both marine shell species and freshwater and fossil shells, can be explained with socio-economic changes through time (Bar-Yosef Mayer, 2013; Veropoulidou, 2021). We suggest that shell procurement networks expanded at the same time with an increase in population movements or movements of individuals or small groups for various socio-economic purposes in the landscape, such as for herding and raw material procurement. A similar model has previously been suggested by Bains (2012) also, for raw material procurement for stone bead production at Çatalhöyük. Likewise, the increased variety of shells at some sites may relate to the multi-directionality of contacts or networks and the potential "hub"-like

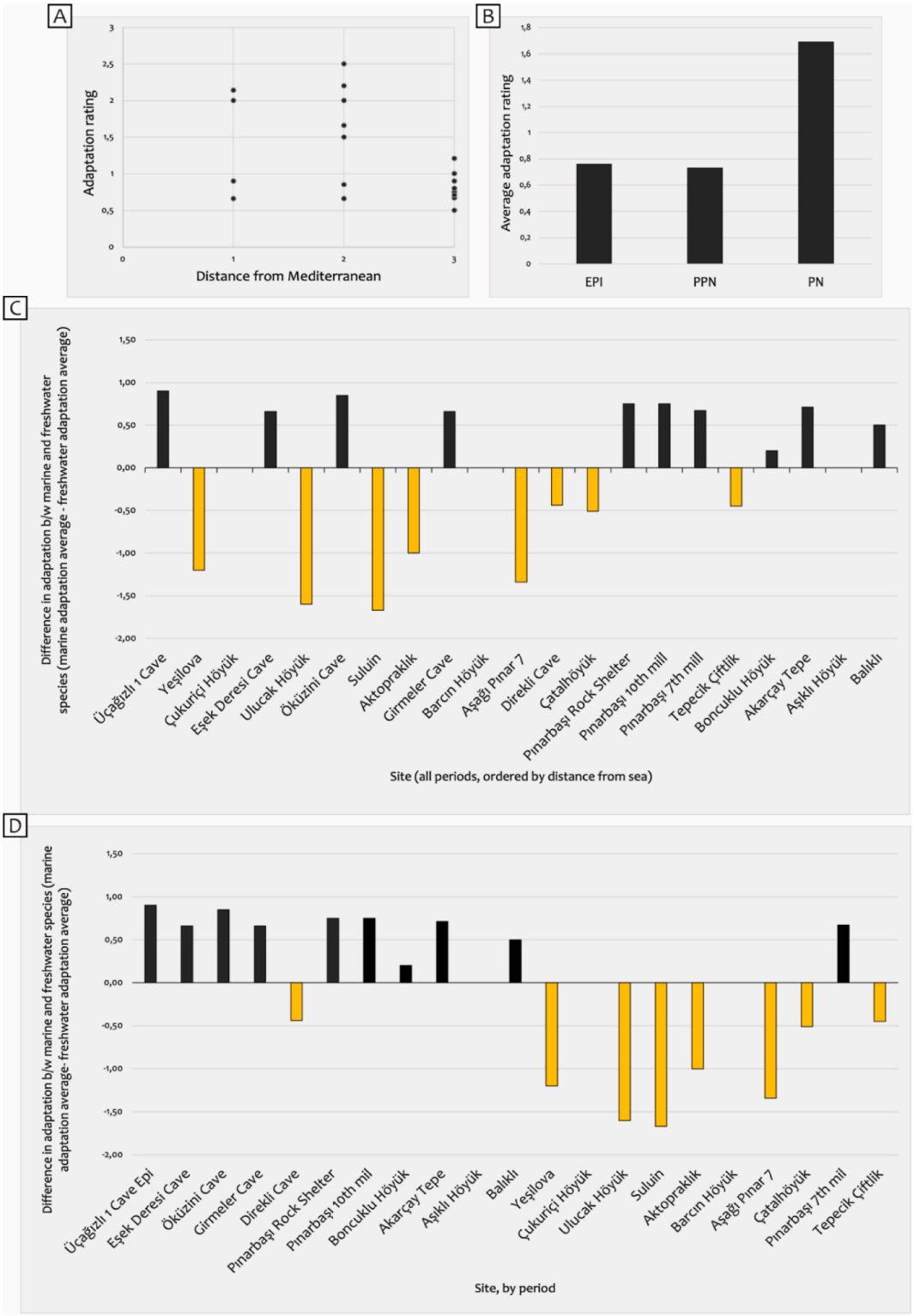


Fig. 5. Adaptation rating according to distance from the closest shore, scatterplot (A), average adaptation rating for each period (B), difference in adaptation rating between marine and freshwater species for the study sites, negative values indicate greater freshwater shell adaptation, bar graph by distance from sea (C) and period (D) (the dataset, sites and references are provided in the Supplementary Material).

quality of especially well-connected places. In this regard the exceptionally large site of Çatalhöyük is likely an atypical example that had exceptional connectivity at a time of generally intensifying east–west/west-east contacts that we see reflected in the increasing Aegean influence.

Finally, if we summarize the long-term trends in shell ornament use and distribution through time, we see that:

1) The ornamental traditions of the communities during this long transitional period were composed of juxtaposed practices, incorporating tradition and innovation, as well as the juxtaposition of eastern "traditional" Neolithic and influences from the Aegean

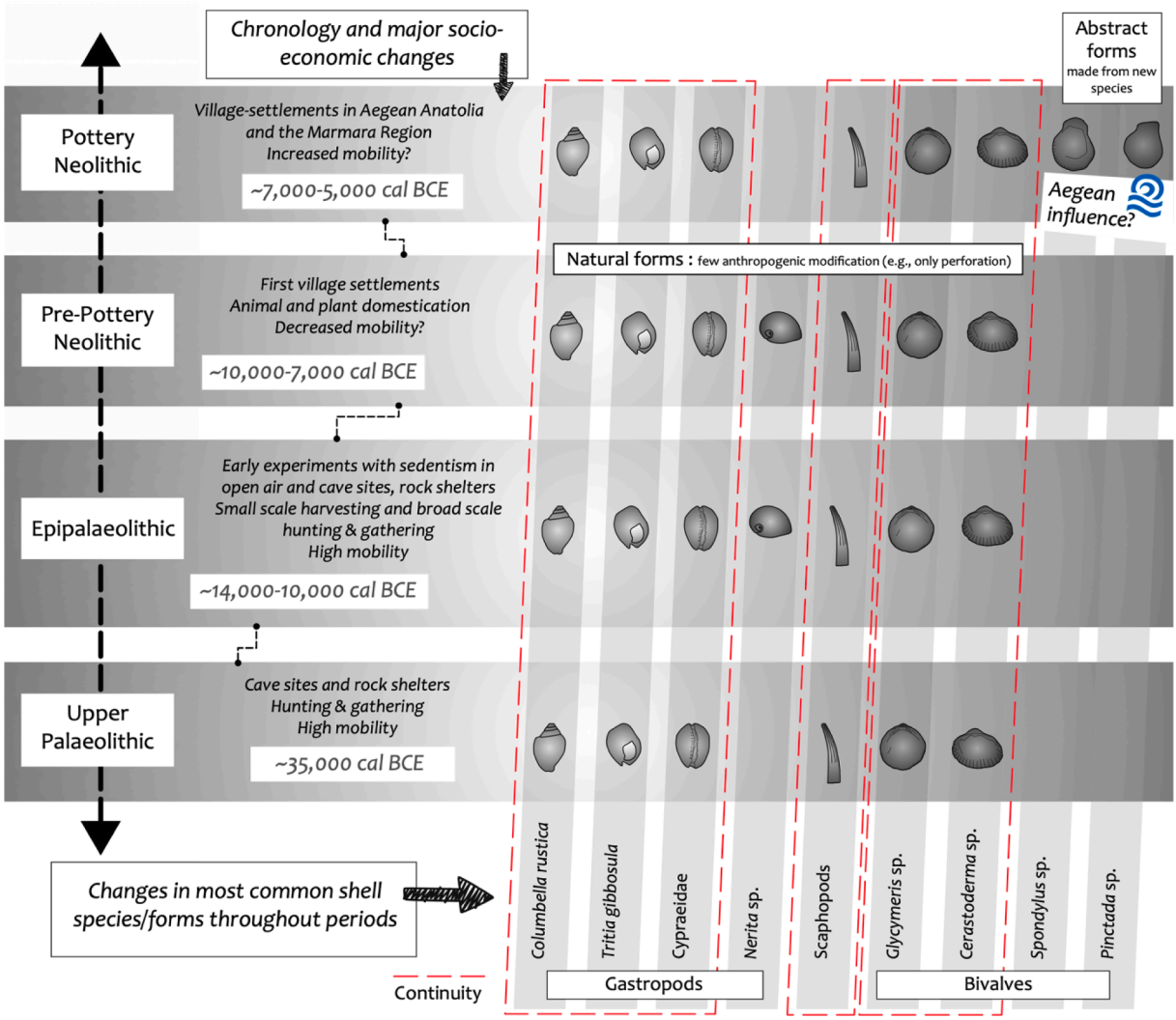


Fig. 6. Schematized summary illustration of select shell species changes and continuities through time with accompanying socio-economic changes in Anatolia from the Upper Palaeolithic to the Pottery Neolithic periods.

region in the west of Türkiye. Our region-wide comparison shows a difference between shell ornament preferences in the Aegean coast and Marmara versus southeastern Anatolia, while inland communities such as Çatalhöyük acted as a melting pot, blending both new and old concepts and ideas. These may hint at regional and deeply-rooted identities of indigenous communities throughout the Neolithization process. However, more contextual and use-wear data is necessary for a deeper understanding of the role of shell ornaments in constructing and signifying social identities and differentiation within and between communities.

2) Considering the mechanisms of distribution, distinctive adaptation practices, for example Cypriot traditions (Serrand et al., 2005: 126) provide the best evidence of shared places of production and transportation of beads, rather than raw materials, to different locations. This is illustrated by the evidence coming from Pre-Pottery Neolithic central Anatolia (Baysal 2013a). During the Pottery Neolithic, shell assemblages provide an alternative narrative against the overwhelming "westward expansion" framework that is very often used in explaining the Neolithization process. We suggest the appearance of new species and their use for geometric bead forms such as the *Spondylus* sp. case in inland, Marmara and Aegean Anatolian sites indicate a western influence and source with implications for multi-directional and long-term population and object movements, the influence of which reaches at least as far as Çatalhöyük.

3) The Pottery Neolithic shell raw material trend appears to be enforced with time as Chalcolithic ornamentation is largely characterised by the use of highly adapted shell products. Although there is even less data for Chalcolithic ornament use, that available shows that western influences become important in inland Anatolia and the Aegean and Balkan practices encroach gradually eastwards. The combining of the eastern stone bangle tradition, and the western Balkan/Aegean marine shell bangle tradition is a good example of the mingling of materials and ideas that characterises this period (Baysal and Erdoğu, 2014; Baysal et al., 2015; Dimitrijević and Tripković 2006; Ifantidis and Nikolaidou, 2011). Chalcolithic examples thus far support the hypothesis that changes in aesthetic choices eventually affected procurement practices, reducing the relationship between ornamentation and marine sources gradually, placing greater importance on colour and appearance rather than material, but not entirely eradicating the relationship of ornamentation with the marine environment (Baysal, 2017).

6. Conclusion

In conclusion, the results we offer here are one element of a wider conversation about communication, material choice and ornamentation practices in the Neolithic transition that shows that the Neolithization process, the long development of radically different ways of living, was a

time of conservatism as well as innovation. Practices fundamentally linked to the mobility of pre-Neolithic populations transitioned into or were adapted to new ways of life and were never completely superseded by innovations coming from other areas as time progressed. Distance of a site from the marine environment did not, in any of our study periods, have an effect on the ability of the inhabitants to procure marine shells for ornamentation, nor did it increase the likelihood of freshwater shells being used as replacements. This implies also that the routes by which shell materials or ornaments were procured were subject to adaptation during this process. Although the advancing Neolithic is associated with the westward movement of populations and their possessions and ideas towards Europe, ornaments allow us to glimpse the multi-directional communication that was taking place at the same time. Here we have presented wider evidence of a set of traits hinted at in the results of a number of sites in Türkiye and supported by trends in the Aegean showing that there were significantly different developments in the Aegean and the western Anatolian Peninsula than in central and southeast Anatolia. Çatalhöyük appears to have acted as a mega hub site and shows largely anomalous traits as a result, however, it also shows that practices likely stemming from the Aegean made their way as far as Central Anatolia during the Pottery Neolithic. Limited Chalcolithic evidence from the region suggests that this continued through the Chalcolithic.

What happened in shell use is part of a wider trend in presentation of the human body towards larger, more obvious ornaments and a change in colour preferences towards lighter and potentially more eye-catching items as the Pottery Neolithic progressed. The favouring of larger surface areas and the shine of mother of pearl gave greater flexibility too in ornament shape and application, likely often on clothing as much as in necklaces and bracelets. This appears to be the true advent of shell as a raw material as opposed to shells as a finished product in their own right and may be the explanation behind the greater flexibility between marine and freshwater shells and the overall increase in bivalve use and move away from a reliance on marine resources. We therefore see the Pottery Neolithic as the beginning of the true transition away from the original Palaeolithic relationship with marine shells, and whatever meanings they carried that drove their long-distance procurement over many millennia. This is not to say that traditions were entirely abandoned, but that significant augmentation to existing practices was established only in the Pottery Neolithic.

We hope that our results will be the first step in joining the data sets of surrounding regions to produce a coherent and detailed picture of both ornamentation practices and wider material culture during this important transitional period. While there is still much to be done in terms of data collection, particularly in fully incorporating ornamentation related artefacts into wider archaeological research, the outstanding questions about the social and economic values of different materials that can be answered using this material are now well defined.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgements

The authors extend their sincerest thanks to the excavation directors whose shell assemblages are included in their study, listed here in alphabetical order: Çiler Altınbilek-Algül, Douglas Baird, Zafer Derin, Güneş Duru, Cevdet Merih Erek, Fokke Gerritsen, Nigel Goring-Morris, Barbara Horejs, Rana Özbal, Mihriban Özbaşaran, Mehmet Özdoğan, Harun Taşkıran. We would also like to thank the reviewers and editors for their constructive comments.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jasrep.2023.104312.

References

Abbo, S., Gopher, A., 2020. Plant domestication in the Neolithic Near East: the humans-plants liaison. Quat. Sci. Rev. 242, 106412.
Alarashi, H., 2010. Shell beads in the Pre-Pottery Neolithic B in central Levant: Cypraeidae of Tell Aswad (Damascus, Syria). Munibe 31, 88–98.
Alarashi, H., 2016. Butterfly beads in the Neolithic Near East: evolution, technology and socio-cultural implications. Camb. Archaeol. J. 26 (3), 493–512.
Alarashi, H., 2014. La parure épipaléolithique et néolithique de la Syrie (12e au 7e millénaire avant J.-C.) : techniques et usages, échanges et identités. PhD thesis, Lyon: Université Lumiére – Lyon 2.
Altınbilek-Algül, Ç., Kayci, O. and Balcı, S., 2022. A new Epipalaeolithic site in the central Taurus mountains: Eşek Deresi cave (Mersin/Turkey). *ArchéOrient - Le Blog*, 18 février 2022, [Online] https://archeorient.hypotheses.org/17313.
Arbuckle, B.S., Kansa, S.W., Kansa, E., Orton, D., Çakırlar, C., Gourichon, L., Atıcı, L., Galik, A., Marciniak, A., Mulville, J., Buitenhuis, H., 2014. Data sharing reveals complexity in the westward spread of domestic animals across Neolithic Turkey. PLoS One 9 (6), e99845.
Bains, R., 2012. The social significance of Neolithic stone bead technologies at Çatalhöyük. University College London, London. PhD thesis,.
Baird, D., 2012. The Late Epipaleolithic, Neolithic, and Chalcolithic of the Anatolian plateau, 13,000–4000 BC. In: Potts, D.T. (Ed.), A Companion to the Archaeology of the Ancient near East. Chichester, West Sussex, Wiley-Blackwell, pp. 431–466.
Baird, D., Asouti, E., Astruc, L., Baysal, A., Baysal, E., Carruthers, D., Fairbairn, A., Kabukcu, C., Jenkins, E., Lorentz, K., Middleton, C., 2013. Juniper smoke, skulls and wolves' tails. The Epipalaeolithic of the Anatolian plateau in its South-west Asian context; insights from Pınarbaşı. Levant 45 (2), 175–209.
Bar-Yosef Mayer, D.E., 2005. The exploitation of shells as beads in the Palaeolithic and Neolithic of the Levant. Paléorient 176–185.
Bar-Yosef Mayer, D.E., 2013. Towards a typology of stone beads in the Neolithic Levant. J. Field Archaeol. 38, 129–142.
Bar-Yosef Mayer, D.E., 2013a. Mollusc exploitation at Çatalhöyük. In: Hodder, I. (Ed.), *Humans and landscapes of Çatalhöyük: reports from the 2000-2008 seasons*. Çatalhöyük Research Project Series, Vol. 8, BIAA Monograph No.47, Monumenta Archaeologica 29, Cotsen Institute of Archaeology Press, pp.329-338.
Baysal, E.L., 2013a. A tale of two assemblages: early Neolithic manufacture and use of beads in the Konya plain. Anatol. Stud. 63, 1–15.
Baysal, E.L., 2013b. Epipalaeolithic marine shell beads at Pınarbaşı: central Anatolia from an Eastern Mediterranean perspective. Anatolica 39, 261–276.
Baysal, E.L., 2014. A preliminary typology for beads from the Neolithic and Chalcolithic levels of Barcın Höyük. Anatolia Antiqua, XXII, pp. 1–10.
Baysal, E.L., 2016. Beads at the place of white earth - Late Neolithic and Early Chalcolithic Aktopraklık, northwestern Turkey. Beads: Journal of the Society of Bead Researchers 28, 50–59.
Baysal, E.L., 2017. Reflections of faraway places: the Chalcolithic personal ornaments of Canhasan I. Anatol. Stud. 67, 29–49.
Baysal, E.L., 2019. *Personal ornaments in prehistory, an exploration of body augmentation from the Palaeolithic to the Early Bronze Age*. Oxbow Books.
Baysal, E.L., Baysal, A., Turkcan, A., Nazaroff, A., 2015. Early specialized production? A Chalcolithic stone bracelet workshop at Kanlıtaş, Eskişehir. Turkey. *Oxford Journal of Archaeology* 34 (3), 235–257.
Baysal, E.L., Erdoğu, B., 2014. Frog in the pond: Gökçeada (Imbros), an Aegean stepping stone in the use of Spondylus shell. Proc. Prehist. Soc 80, 363–378.
Baysal, E.L., Erek, C.M., 2018. Material movement in the Near Eastern Epipalaeolithic: implications of the shell and stone beads of Direkli Cave. Turkey. *Journal of Field Archaeology* 43 (8), 591–603.
Baysal, E.L., Yelözer, S., 2023. Searching for the individual: characterising knowledge transfer and skill in prehistoric personal ornament making. J. Archaeol. Method Theory 30, 172–202.
Baysal, E.L., forthcoming. Aşağı Pınar Layer 7 personal ornaments. In: Aşağı Pınar Layer 7.
Benjamin, J., Rovere, A., Fontana, A., Furlani, S., Vacchi, M., Inglis, R.H., Galili, E., Antonioli, F., Sivan, D., Miko, S., Mourtzas, N., 2017. Late Quaternary sea-level changes and early human societies in the central and eastern Mediterranean Basin: an interdisciplinary review. Quat. Int. 449, 29–57.
Bertolini, M., Cristiani, E., Modolo, M., Visentini, P., Romandini, M., 2016. Late Epigravettian and Mesolithic foragers of the eastern Alpine region: animal exploitation and ornamental strategies at Riparo Biarzo (Northern Italy). Quat. Int. 423, 73–91.
Bosch, M.D., Buck, L.T., Strauss, A.M., 2019. Location, location, location: investigating perforation locations in Tritia gibbosula shells at Ksâr'Akil (Lebanon) using micro-CT data. PaleoAnthropology 52–63.
Bosch, M.D., Buck, L.T., Strauss, A., 2023. Perforations in Columbellidae shells: Using 3D models to differentiate anthropogenic piercing from natural perforations. J. Archaeol. Sci. Rep. 49, 103937.

Brami, M.N., 2015. A graphical simulation of the 2,000-year lag in Neolithic occupation between central Anatolia and the Aegean basin. Archaeol. Anthropol. Sci. 7, 319–327.
Çakırlar, C., 2015. Adaptation, identity, and innovation in Neolithic and Chalcolithic Western Anatolia (6800–3000 cal. BCE): the evidence from aquatic mollusk shells. Quat. Int. 390, 117–125.
Çilingiroğlu, Ç., 2005. The concept of "Neolithic package": considering its meaning and applicability. Documenta Praehistorica 32, 1–13.
Cristiani, E., Farbstein, R., Miracle, P., 2014. Ornamental traditions in the eastern Adriatic: the Upper Palaeolithic and Mesolithic personal adornments from Vela Spila (Croatia). J. Anthropol. Archaeol. 36, 21–31.
Dimitrijević, V., Tripković, B., 2006. *Spondylus* and *Glycymeris* bracelets: trade reflections at Neolithic Vinča-Belo Brdo. Documenta Praehistorica 33, 237–252.
Dubreuil, L., Nadel, D., 2015. The development of plant food processing in the Levant: insights from use-wear analysis of Early Epipalaeolithic ground stone tools. Philos. Trans. R. Soc., B 370 (1682), 20140357.
Feldman, M., Fernández-Domínguez, E., Reynolds, L., Baird, D., Pearson, J., Hershkovitz, I., May, H., Goring-Morris, N., Benz, M., Gresky, J., Bianco, R.A., Fairbairn, A., Mustafaoğlu, G., Stockhammer, P.W., Posth, C., Haak, W., Jeong, C., Krause, J., 2019. Late Pleistocene human genome suggests a local origin for the first farmers of central Anatolia. Nat. Commun. https://doi.org/10.1038/s41467-019-09209-7.
Fernández, E., Pérez-Pérez, A., Gamba, C., Prats, E., Cuesta, P., Anfruns, J., Molist, M., Arroyo-Pardo, E., Turbón, D., 2014. Ancient DNA analysis of 8000 BC Near Eastern farmers supports an early Neolithic pioneer maritime colonization of mainland Europe through Cyprus and the Aegean Islands. PLoS Genet. 10 (6), e1004401.
Gopher, A., Abbo, S., Yadun, S.L., 2001. The "when", the "where" and the "why" of the Neolithic revolution in the Levant. Documenta Praehistorica 28, 49–62.
Goring-Morris, A.N., Belfer-Cohen, A., 2011. Neolithization processes in the Levant: the outer envelope. Curr. Anthropol. 52 (S4), S195–S208.
Haak, W., Balanovsky, O., Sanchez, J.J., Koshel, S., Zaporozhchenko, V., Adler, C.J., Der Sarkissian, C.S., Brandt, G., Schwarz, C., Nicklisch, N., Dresely, V., 2010. Ancient DNA from European early Neolithic farmers reveals their Near Eastern affinities. PLoS Biol. 8 (11), e1000536.
Hodder, I., 2018. Things and the slow Neolithic: the Middle Eastern transformation. J. Archaeol. Method Theory 25 (1), 155–177.
Hofmanová, Z., Kreutzer, S., Hellenthal, G., Sell, C., Diekmann, Y., Díez-del-Molino, D., Van Dorp, L., López, S., Kousathanas, A., Link, V., Kirsanow, K., 2016. Early farmers from across Europe directly descended from Neolithic Aegeans. Proc. Natl. Acad. Sci. 113 (25), 6886–6891.
Horejs, B., Milić, B., Ostmann, F., Thanheiser, U., Weninger, B., Galik, A., 2015. The Aegean in the early 7th millennium BC: maritime networks and colonization. J. World Prehist. 28, 289–330.
Ibáñez, J.J., Ortega, D., Campos, D., Khalidi, L., Méndez, V., 2015. Testing complex networks of interaction at the onset of the Near Eastern Neolithic using modelling of obsidian exchange. J. R. Soc. Interface 12 (107), 20150210.
Ifantidis, F., 2011. *Cosmos* in fragments: *Spondylus* and *Glycymeris* adornment at Neolithic Dispilio, Greece. In: Ifantidis, F., Nikolaidou, M. (Eds.), *Spondylus in Prehistory: New Data and Approaches. Contributions to the Archaeology of Shell Technologies*, BAR International Series 2216. Archeopress, Oxford, pp. 123–137.
Ifantidis, F., 2019. Practices of personal adornment in Neolithic Greece. Archaeopress.
Ifantidis, F., Nikolaidou, M. (Eds.), 2011. *Spondylus in Prehistory: New Data and Approaches. Contributions to the Archaeology of Shell Technologies*. BAR International Series 2216. Archeopress, Oxford.
Karakaş, G., 2019. Tepecik-Çiftlik Höyüğü'nde yumuşakça kabukları. Istanbul University, Istanbul. MA thesis,.
Kılınç, G.M., Koptekin, D., Atakuman, Ç., Sümer, A.P., Dönertaş, H.M., Yaka, R., Bilgin, C.C., Büyükkarakaya, A.M., Baird, D., Altınışık, E., Flegontov, P., 2017. Archaeogenomic analysis of the first steps of Neolithization in Anatolia and the Aegean. Proc. R. Soc. B Biol. Sci. 284 (1867), 20172064.
Komšo, D., Vukosavljević, N., 2011. Connecting coast and inland: perforated marine and freshwater snail shells in the Croatian Mesolithic. Quat. Int. 244 (1), 117–125.
Martínez-Sevilla, F., Baysal, E.L., Micheli, R., Ifantidis, F., Lugliè, C., 2021. A very early "fashion": Neolithic stone bracelets from a Mediterranean perspective. Open Archaeology 7 (1), 815–831.
Miller, M.A., 1996. The manufacture of cockle shell beads at early Neolithic Franchthi Cave, Greece: a case of craft specialization? J. Mediterr. Archaeol. 9 (1), 7–37.
Ogloblin Ramirez, I., Grono, E., Zuckerman-Cooper, R., Langgut, D., Galili, E., Friesem, D.E., 2023. Microarchaeological approach to underwater stratigraphy of submerged settlements: a case study of Atlit-Yam Pre-Pottery Neolithic site, off the Carmel Coast, Israel. Geoarchaeology.
Omrak, A., Günther, T., Valdiosera, C., Svensson, E.M., Malmström, H., Kiesewetter, H., Aylward, W., Storå, J., Jakobsson, M., Götherström, A., 2016. Genomic evidence establishes Anatolia as the source of the European Neolithic gene pool. Curr. Biol. 26 (2), 270–275.
Özbaşaran, M., 2011. The Neolithic on the plateau. In: McMahon, G., Steadman, S. (Eds.), The Oxford Handbook of Ancient Anatolia (10,000–323 BCE). Oxford University Press, Oxford, pp. 99–124.
Özdoğan, M., 2011. Archaeological evidence on the westward expansion of farming communities from eastern Anatolia to the Aegean and the Balkans. Curr. Anthropol. 52 (S4), S415–S430.
Özdoğan, M., 2014. A new look at the introduction of the Neolithic way of life in Southeastern Europe. Changing paradigms of the expansion of the Neolithic way of life. Documenta Praehistorica 41, 33–49.
Pearson, J., Evans, J., Lamb, A., Baird, D., Hodder, I., Marciniak, A., Larsen, C.S., Knüsel, C.J., Haddow, S.D., Pilloud, M.A. and Bogaard, A., 2023. Mobility and kinship in the world's first village societies. *Proceedings of the National Academy of Sciences*, *120*(4), p.e2209480119.
Perlès, C., 2019. Cultural implications of uniformity in ornament assemblages: Paleolithic and Mesolithic ornaments from Franchthi Cave, Greece. PaleoAnthropology 131, 196–207.
Perlès, C., 2023. Ornaments and other ambiguous artifacts from Franchthi. The Neolithic volume 2.
Reese, D.S., 1991. Marine shells in the Levant: Upper Palaeolithic, Epipalaeolithic and Neolithic. In: Bar-Yosef, O., Valla, F.R. (Eds.), *The Natufian Culture in the Levant*, International Monographs in Prehistory, Archaeological Series 1. Michigan, Ann Arbor, pp. 613–628.
Reese, D.S., 2005. The Çatalhöyük shells. In: Hodder, I. (Ed.), Inhabiting Çatalhöyük: Reports from the 1995–99 Seasons. McDonald Institute for Archaeological Research, Cambridge, pp. 123–127.
Reingruber, A., 2011. Early Neolithic settlement patterns and exchange networks in the Aegean. Documenta Praehistorica 38, 291–306.
Richter, T., Garrard, A.N., Allock, S., Maher, L.A., 2011. Interaction before agriculture: exchanging material and sharing knowledge in the Final Pleistocene Levant. Camb. Archaeol. J. 21 (1), 95–114.
Ridout-Sharpe, J., 2015. Changing lifestyles in the northern Levant: late Epipalaeolithic and early Neolithic shells from Tell Abu Hureyra. Quat. Int. 390, 102–116.
Rigaud, S., d'Errico, F., Vanhaeren, M., 2015. Ornaments reveal resistance of North European cultures to the spread of farming. PLoS One 10 (4), e0121166.
Serrand, N., Vigne, J.-D. and Guilaine, J., 2005. Early preceramic Neolithic marine shells from Shillourokambos, Cyprus (late 9th–8th mill. cal. BC): a mainly ornamental set with similarities to mainland PPNB. In: Bar-Yosef Mayer, D. (Ed.), *Archaeomalacology: Molluscs in Former Environments of Human Behaviour*. Oxford, pp.122–29.
Stiner, M.C., 2014. Finding a common bandwidth: causes of convergence and diversity in Paleolithic beads. Biol. Theory 9, 51–64.
Stiner, M.C., Kuhn, S.L., Güleç, E., 2013. Early Upper Paleolithic shell beads at Üçağızlı Cave I (Turkey): technology and the socioeconomic context of ornament life-histories. J. Hum. Evol. 64, 380–398.
Stiner, M.C., Özbaşaran, M., Duru, G., 2022. Aşıklı Höyük: the generative evolution of a central Anatolian PPN settlement in regional context. J. Archaeol. Res. 30, 497–543. https://doi.org/10.1007/s10814-021-09167-z.
Verhoeven, M., 2011. The birth of a concept and the origins of the Neolithic: a history of prehistoric farmers in the Near East. Paléorient 37 (1), 75–87.
Veropoulidou, R., 2021. The shell artefact assemblage at Neolithic Çatalhöyük. In: I. Hodder (Ed.), *The Matter of Çatalhöyük. Reports from the 2009-2017 Seasons*. Çatalhöyük Research Project Series Volume 14, British Institute at Ankara, BIAA Monograph No. 54, Oxbow Books, pp.247-263.
Vigne, J.D., 2011. The origins of animal domestication and husbandry: a major change in the history of humanity and the biosphere. C. R. Biol. 334 (3), 171–181.
Wright, K.I., Critchley, P., Garrard, A., Baird, D., Bains, R., Groom, S., 2008. Stone bead technologies and early craft specialization: insights from two Neolithic sites in eastern Jordan. Levant 40 (2), 131–165.
Yelözer, S., 2018. The beads from Aşıklı Höyük. In: Özbaşaran, M., Duru, G. & Stiner, M. C. (Eds.), *The early settlement at Aşıklı Höyük: essays in honour of Ufuk Esin*. Istanbul: Ege Yayınları, pp.383-404.