JNA
Journal of Neolithic Archaeology
j-n-a.org

Fishing, Weaving, Matting: Debating the Function of Notched Cobbles in Neolithic Greece

15 July 2022
doi 10.12766/jna.2022.2

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Article history:
Received 18 October 2021
Reviewed 23 November 2021
Published 15 July 2022

Keywords: Notched cobbles, Neolithic, Greece, fishing, weaving, matting

Cite as: Anna Stroulia, Paschalis Tounas, Jérôme Robitaille, Areti Hondroyanni-Metoki, Zisis Kouziakis, Kenneth Wardle, Tatiana Theodoropoulou: Fishing, Weaving, Matting: Debating the Function of Notched Cobbles in Neolithic Greece JNA 24, 2022, 15–46 [doi 10.12766/jna.2022.2]

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Abstract

This article focuses on notched cobbles – pieces of stone with indentations on roughly opposite parts of their periphery. While exhibiting a wide geographic and chronological distribution, these simple artefacts have rarely become the subject of systematic archaeological study. In an attempt to address this gap, we discuss the three main hypotheses regarding the functions of these objects (as weights for fishing, weaving or matting) and evaluate the archaeological and ethnographic evidence that is available for each one of them; provide a detailed presentation of the technomorphological characteristics of the material from the Greek Neolithic site of Varemeni Goulon and compare it to that from the neighbouring site of Servia; expand the comparative framework to include other sites from Greece and elsewhere; and finally reconstruct the uses of both the Varemeni and Servia notched cobbles as fishing gear – the hypothesis that emerged as most likely from our survey. If associated with fishing, notched cobbles represent one of the rare components of fish capture technology preserved from Neolithic Greece.

Introduction

The material category known as macrolithics (or more traditionally ground stone) covers a wide range of artefacts. On one end of this range are formally made objects such as axes and adzes. The form of the raw material, in these cases, was radically altered during the manufacturing process. On the other end are so called *a posteriori* tools, such as pot burnishing pebbles or hide processing cobbles. In these cases, the raw material was put straight to use without prior modification. In between are artefacts whose raw material was only minimally altered by manufacture. It is within this "in between" zone that notched cobbles – the focus of this paper – belong.

The term "notched cobbles" refers to pieces of stone which bear indentations on roughly opposite sides and/or ends. Known also as "waisted weights" or "figure-of-eight weights", these artefacts derive from a large variety of temporal frameworks ranging from the Palaeolithic to the recent past. Moreover, they are found all over the world: from the Baltic Sea to southern Africa and from the Great Lakes to Japan. Despite their wide chronological and geographic distribution as well as frequent mention in the literature, notched cobbles have attracted little scholarly attention. Their morphometric and technological characteristics (and hence the producers/users' choices) have been rarely discussed in detail. Moreover, their

functions have often been assumed rather than problematized on the basis of contextual analysis[1]. Such a superficial approach has left a gap in our understanding of this material that our article aims to address.

This paper is divided into five sections. In the first section, we present the three main hypotheses regarding the function of notched cobbles and discuss the evidence that does (or does not) exist for each one of them. The second section offers a detailed analysis of the material from the Greek Neolithic site of Varemeni Goulon (henceforth Varemeni) and points to the challenges we faced as we sought to evaluate the main functional hypotheses. In the third section, we attempt to overcome these limitations by comparing the Varemeni assemblage to that of the nearby site of Servia, while in the fourth we expand the scope of our study to include the material from other sites in Greece and beyond. Finally, the fifth section reconstructs the function of both the Varemeni and Servia notched cobbles according to the hypothesis that our survey showed to be most likely.

It is important to emphasize that the references made to parts of the world other than Greece and periods other than the Neolithic are not based on assumptions about general commonalities in socioeconomic organization, material culture, etc. Rather we use these comparisons opportunistically to illuminate the functions of the Varemeni and Servia notched cobbles.

Functional hypotheses

Although other interpretations of notched cobbles – as abstract figurines, for example (Gaudron 1951 cited in Berrétrot 1988, 40; Zimmermann 2004) – have been suggested, there is a broad consensus that the opposing indentations were meant to secure a cord around the stone and that these artefacts served as weights. These weights could, of course, have been used in many different ways. Here, however, we focus on the three main functional hypotheses found in the literature:

1. The fishing gear hypothesis

This hypothesis views notched cobbles as sinkers/anchors for fishing nets, lines or traps. We have identified two pieces of solid archaeological evidence for this hypothesis: a) Excavations at the Estonian site of Siivertsi uncovered remains of a Mesolithic net with sinkers consisting of small, notched sandstone blocks (Bērziņš 2008, 236); b) Notched cobbles attached to remnants of a carbonized net were found in a burial pit at the Early Woodland Morrow site in Ontario County, New York (Ritchie 1980, 186–187).

The fishing gear hypothesis is also supported ethnographically. The Mistassini Indians of south-central Quebec used fist-size beach pebbles as fishnet sinkers. As explained by E. S. Rogers (1967, 85–89 cited in Weston 1978, 20), "whenever possible, the pebbles chosen were slightly constricted about the middle. If these could not be obtained, notches were sometimes made in the edges. A string was attached by a slip knot about the middle of the stone, and the other end was tied to the bottom selvage line". Notched cobbles were traditionally used to sink and stabilize fishing nets in Estonia, Finland and Latvia, and indeed nets with such sinkers are included in the collections of the Ethnographic Open-Air Museum of Latvia (Bērziņš 2008, 234–237). Traditionally, if occasionally, notched cobbles were also thus employed in Greece, or so is suggested by the discovery of one such artefact among the rotten remains of nets at a beach on the island of Crete (D. Mylona, pers. comm.). Finally, the use of a notched cobble as anchor for a so-called ring net was observed in the early 1970s on the same island (Carington Smith 1977a, 141).

[1] For a few exceptions, see: Weston 1978; Berrétrot 1988; Bocquet/Berrétrot 1989; Nadel/Zaidner 2002; Bērziņš 2008, 221–273; Prowse 2010; Rosenberg et al. 2016; Casserino 2017; Bamyaci 2018.

It is important to note that un-notched cobbles were also used as fishing weights. References to sinkers and anchors consisting of unmodified, grooved, or perforated[2] cobbles are abundant in both the ethnographic and archaeological literature[3].

2. The weaving equipment hypothesis

This hypothesis views notched cobbles as weights for a specific type of vertical weaving device called a warp-weighted loom. Although notched cobbles could have effectively served as loomweights, the truth is that this hypothesis lacks a solid archaeological basis. We know of no archaeological example of a secure association between notched cobbles and a warp-weighted loom[4]. This is not to say that stone loomweights are absent from the archaeological record all together. Such weights are indeed known. However, they are not notched. For example, a row of eight stone weights were excavated among the carbonized remains of a wooden loom in the Early Bronze Age deposits of Tell 'Abū al-Kharāz in the Jordan Valley. All are donut-shaped (Fischer 2009).

Nor is the weaving equipment hypothesis supported ethnographically. We know of no recent case of a secure association between notched cobbles and a warp-weighted loom. This is not to say that there are no ethnographic examples of stone loomweights. As M. Hoffmann (1964) thoroughly demonstrated, cobbles were thus used in parts of Scandinavia until relatively recently. These, however, were typically unmodified. Only occasionally were they altered: a hole or groove was created to facilitate suspension. Although notched cobbles were not employed as weights in any of the looms described by Hoffmann, her study has apparently inspired the weaving equipment hypothesis (e. g., Berrétrot 1988, 48–52).

3. The matting equipment hypothesis

This hypothesis views notched cobbles as weights for a wooden frame used to make mats and other corded fabrics. Although the association of weights with matting is uncommon, there is solid evidence for the employment of both clay and stone weights in this context. The evidence for the use of ceramic weights is archaeological and comes from Neolithic Switzerland: a number of such artefacts were found roughly in a row and burnt together with pieces of corded fabric at the site of Wetzikon-Robenhausen. The finds and their spatial arrangement leave little doubt that the weights served as part of a wooden mat-making device (Altorfer/Médard 2000; Médard 2000).

There is no archaeological example of a clear association between notched cobbles and matting frames, but ethnographic evidence does exist and comes from Japan. According to K. P. Kent and S. M. Nelson (1976), "small flat pebbles with notches (or grooves)" have been traditionally used by Ainu women "for holding string" in the context of mat-weaving on an erect frame. "The stone weights keep the weft yarn from tangling and also serve as a kind of spool on which weft lengths can be wound until needed." The use of notched cobbles has been successfully tested on even simpler, frameless matting devices. These were made of a single wooden rod or two parallel ones with strands weighted by experimental notched specimens (Reinhard 1992; Médard/Moser 2001; Médard 2010, 87–89; Seiler-Baldinger/Médard 2014).

Of all three, the fishing gear hypothesis is the best documented. It is also the most popular. This explains why terms such as "fishnet sinkers" or just "sinkers" are often used in the archaeological literature instead of the more descriptive or neutral terms "notched cobbles", "waisted weights" or

2 The perforation can be natural or artificial.

3 E.g., Ross 1911, 392; Hornell 1935, 43; Nougier 1951; Stewart 1977, 30–31; Weston 1978, 13–22; Brinkhuizen 1983; Berrétrot 1988, 43–45; Rouskas 1997, 95; Paulin 2007; Bērziņš 2008, 233; 263–268; Prowse 2010; Gabaude 2013, 89; Ruikar 2013; Vincent/Watté 2014; Pétrequin et al. 2015; Pedergnana et al. 2021.

4 What is found quite often (in Neolithic but also younger periods) are loomweights made of clay.

"figure-of-eight weights" (e. g., Kuang-ti 2002; Nadel/Zaidner 2002; Prowse 2010). The weaving equipment hypothesis is less common in the literature and is usually evoked as an alternative to the fishing gear hypothesis (e. g., Evans/Renfrew 1968, 71; Berrétrot 1988). Although rarely cited (again as an alternative to the fishing equipment hypothesis), the matting equipment hypothesis is better documented than the weaving equipment hypothesis. The latter is based on neither archaeological nor ethnographic evidence.

Despite the lack of solid data for the weaving equipment hypothesis, we chose to include it in the remainder of this paper, given both the close affinities and lack of clear boundaries between the crafts of weaving and matting (e. g., Crowfoot 1954, 414; 417; Carington Smith 1977a, 118–119; Wendrich 1989). For the same reason, we decided to collapse the second and third hypotheses into a single one, which we call the "weaving/matting equipment hypothesis".

One final note before moving on: unfortunately, weight cannot be used as a criterion for favouring one or the other hypothesis. As we determined through our survey of the archaeological, historic, and ethnographic literature, fishing line/net sinkers and net/trap anchors exhibit a wide weight range: from less than 10 g to over 3 kg (e. g., Baranov 1976; Weston 1978; Nun 1993; Prowse 2010; Vincent/Watté 2014). An equally wide and overlapping range characterises loomweights: from about 10 g to over 4 kg (e. g., Hoffmann 1964; Broudy 1993; Firth 2015; Spinazzi-Lucchesi 2018).

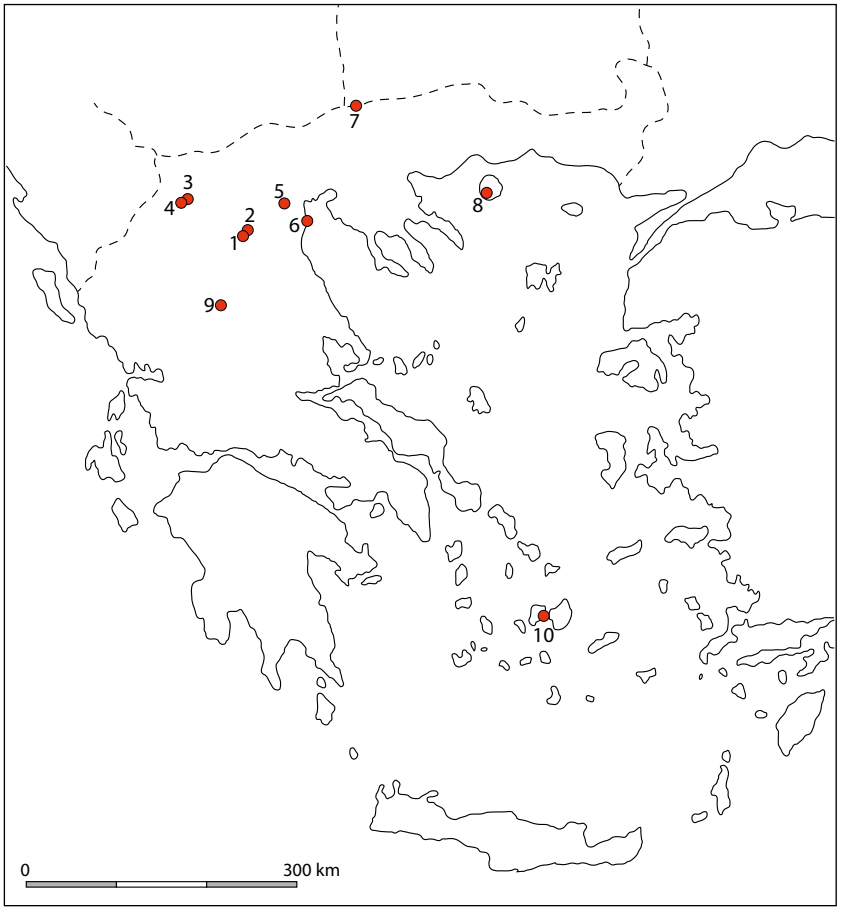


Fig. 1. Sites in Greece with Neolithic notched cobbles: 1 Varemeni; 2 Servia; 3 Dispilio; 4 Avgi; 5 Paliambela Kolindros; 6 Makriyalos; 7 Promachon-Topolniča; 8 Limenaria; 9 Theopetra Cave; 10 Saliagos (Graphics: M. Strezewski).

The notched cobble assemblage of Varemeni

The tell of Varemeni is located in the prefecture of Kozani, west Macedonia, northern Greece. Today the site is submerged within Polyfytos Lake, an artificial body of water created in the 1970s as a result of the damming of the Aliakmon River. In prehistory, however, it consisted of a large open-air settlement less than 1 km south of the river (Figs. 1–2). The site was occupied throughout the Neolithic from the mid-7th to the 4th millennium BC (Hondroyanni-Metoki 1990; 2002; 2009a; 2012a; 2012b; 2012c; 2014). As such, it represents one of the longest-lived Neolithic settlements in the Aegean.

Since the 1980s and during periods of low lake levels, large quantities of artefacts were amassed from the surface of the site by amateur archaeologists and collectors. A significant portion was donated to the Ephorate of Antiquities of Kozani and is currently in storage in the Archaeological Museum of Aiani. Approximately 300 surface artefacts, on the other hand, are on display in the Historical-Folklore and Natural History Museum of Kozani.

In 2001, a salvage excavation was conducted by the Ephorate of Antiquities of Kozani under the direction of A. Hondroyanni-Metoki. Unfortunately, due to erosion, later Neolithic strata were not preserved. Only Early Neolithic and early Middle Neolithic deposits were identified. The former yielded a clay wall and a post-hole, the latter remains of two burnt post-framed houses (Hondroyanni-Metoki 2002; 2012b; 2012c; 2014; 2019).

Fig. 2. Polyfytos Lake with the sites Varemeni (1) and Servia (2). The inset map shows the location of the lake in Greece (Graphics: M. Strezewski).

The surface and excavated material includes pottery, lithics, macrolithics, bone tools, ornaments, figurines, perforated sherds and clay spools. Among the macrolithics are 250 notched cobbles (Fig. 3). Another six specimens represent indeterminate cases since they bear unifacial or bifacial scarring on one or two parts of the periphery but no clear notches. In these instances, it is possible that the notching process was never completed. Alternatively, the scars may be unrelated to the production of notches.

Fig. 3. Notched cobbles from Varemeni: views of both faces (Photos: P. Tounas).

None of the specimens securely identified as notched cobbles derives from the excavated strata. All represent surface finds. All but 28 were examined systematically. Confined in a glass case at the Historical-Folklore and Natural History Museum of Kozani, the exceptions were not available for close examination and are not considered in the following discussion.

The vast majority of the specimens are complete (or nearly so) and of these, all are double-notched. Only 12 (5 %) are fragmentary. Of the latter, six have both notches preserved and must have fractured accidentally during use or between use episodes. One specimen is missing most of one face and part of one notch. The second notch may be unfinished raising the possibility of fracture in the context of manufacture. The remaining five fragments preserve only one notch. Whether breakage occurred during the manufacturing process or after its completion is impossible to tell.

The raw material consists of water-rolled cobbles. These were most probably obtained from the banks and bed of the nearby Aliakmon River where they were available in abundance. The river carried material of various types, forms and sizes, offering plenty of choice. However, the inhabitants of Varemeni were quite selective, or so is suggested by the lithological, morphological and metric characteristics of the assemblage.

The majority of the notched cobbles (at least 60 %) are limestone and marble. Due to surface alteration by hydrochloric acid[5], a macroscopic distinction between the two raw materials was impossible in most cases. The preference for these stone types is probably due to their relative softness, a crucial characteristic in the context of manufacture. The remaining specimens are from gabbro, gneiss, sandstone, schist or other undetermined materials.

If lithology was one criterion in raw material procurement, size was another. This is reflected in the frequency distributions of the dimensions of the 210 complete specimens. These items vary from 5.0 to 11.5 cm in length, with over 80 % falling between 6.0 and 9.0 cm[6]. Their width ranges from 3.7 to 8.7 cm, with close to 90 % between 4.0 and 7.0 cm. The thickness varies from 0.8 to 2.7 cm, with almost 80 % between 1.0 and 2.0 cm. Finally, these specimens fall between 42 and 325 g in weight, but over 90 % are lighter than 180 g. All distributions are fairly narrow, normal and unimodal, with each variable clustering around a small range of values. Moreover, in

5 Unfortunately, a strong HCl solution was used by non-professionals to remove lake sediment attached to the rock surface.

6 Technically speaking, specimens smaller than 6 cm in maximum dimension are pebbles, not cobbles (e. g., Wright 1992). However, for the sake of convenience and given their small number, we chose to refer to all specimens as cobbles.

each case the values are rather low as illustrated in the average dimensions: 7.5 cm for length, 5.6 cm for width, 1.7 cm for thickness and 111 g for weight. Evidently, the inhabitants of Varemeni had quite specific ideas about the appropriate size of the cobbles they targeted. The latter had to be small, thin and light (Figs. 4–5).

Shape was an equally important factor in raw material acquisition. Cobbles of roughly circular or elliptical plan were favoured. Those of a more elongated (ovate, subrectangular, or subtrapezoidal) plan were picked more rarely. This preference is manifested in the low length/width ratio average: 1.3. In addition, the collection process was clearly oriented towards flattish sections. This is illustrated in the high width/thickness ratio average: 3.5 (Fig. 6). The raw material, size and shape data point to a rather homogeneous group and by extension imply a general intention to use these cobbles for similar purposes.

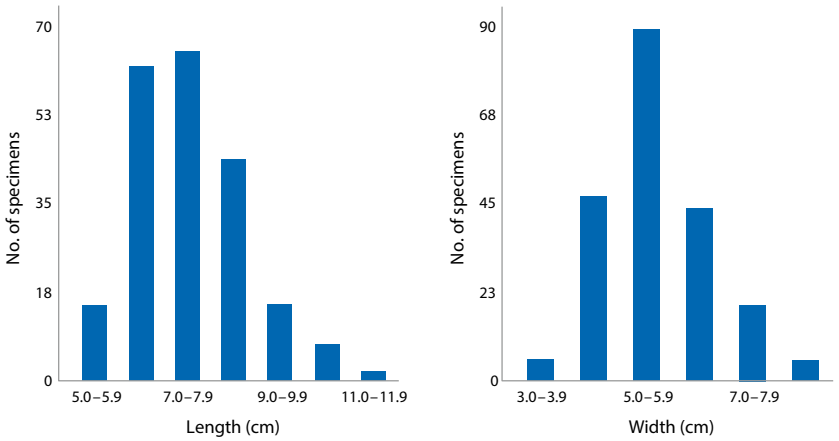


Fig. 4. Length and width distribution of complete notched cobbles from Varemeni (n = 210). Mean length: 7.5 cm; mean width: 5.6 cm (Graphics: A. Stroulia).

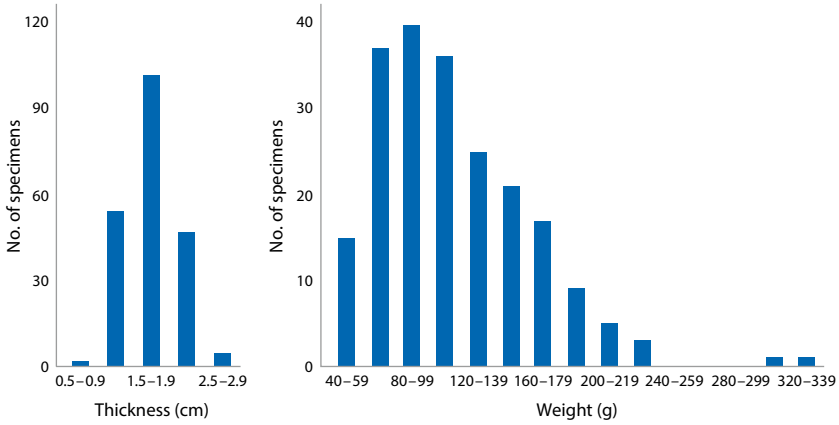


Fig. 5. Thickness and weight distribution of complete notched cobbles from Varemeni (n = 210). Mean thickness: 1.7 cm; mean weight: 111 g (Graphics: A. Stroulia).

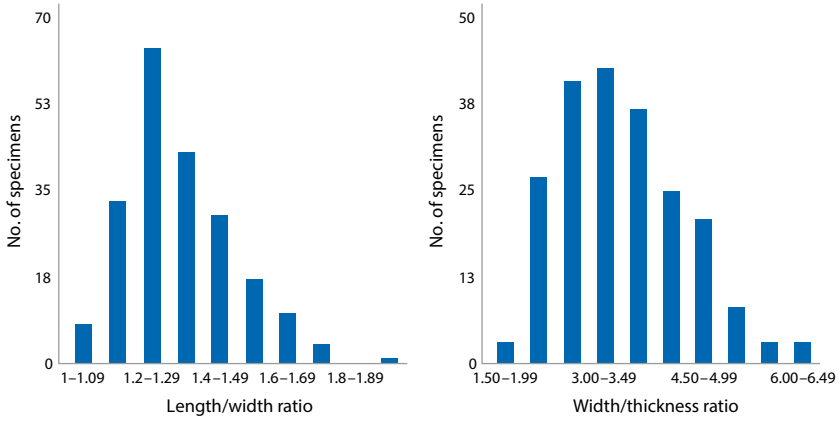


Fig. 6. Distribution of length/width ratio and width/thickness ratio among the complete notched cobbles from Varemeni (n = 210). Mean length/width ratio: 1.30; mean width/thickness ratio: 3.50 (Graphics: A. Stroulia).

Assuming that these artefacts served as weights, one would expect the people of Varemeni to have picked any cobble that fit their weight standards. Apparently, this is not the case. The evidence instead suggests that they followed a strict mental template, taking into consideration not only weight but also a variety of other parameters.

With rare exceptions, the only modification of the raw material consisted of the creation of two roughly opposing notches. The exceptions bear additional scars in parts of the periphery that may have been produced through percussive use or accidentally. One specimen, on the other hand, represents a case of recycling: the notches were fashioned on a fragmentary tool that had probably served as an anvil.

In all specimens, notches are located along the cobbles' current width axis, implying a choice to produce only side-notched specimens and no end-notched ones. However, given the lack of substantial difference between the length and width of the elliptical/circular stones that typically served as raw materials, it is reasonable to assume that the Varemeni folks chose to place notches not so much on the sides but rather on opposing parts of an elliptical/circular periphery (Figs. 3; 7).

All notches were produced by percussion. With a few possible exceptions discussed below, percussion consisted of flaking. Flaking was almost always bifacial, with usually several flakes/chips removed from each face. The process was simple, but as suggested by the experimental manufacture of a dozen notched specimens, it was likely carried out in stages. Although not always necessary, the first stage consisted in reducing the thickness of the area of the intended notch. The next stage consisted in the creation of the actual notch, while the last one consisted in blunting the scar edges and somewhat regularizing the notch (see also Weston 1978, 50). "Somewhat" is the operative word here since notches (as seen below) are seldom completely regular. Notch making appears to have been a quick and dirty process. According to our experiments, it would have taken no more than one or a couple of minutes to produce one of these notches (Fig. 8).

While some notches are in the middle of a side's length, others are not. Moreover, the notches are not always perfectly opposite one another.

Fig. 7. Notched cobbles from Varemeni: views of both faces and sides (Photos: P. Tounas).

Regardless, with rare exceptions, they seem to have been roughly balanced when suspended by a string (see also Nadel/Zaidner 2002). Notches are generally C-shape in plan, with a few exceptions exhibiting a plan that is in between a C and V (Fig. 3). The C shape is often asymmetrical, although, it should be noted, there are notches that look symmetrical on one face but asymmetrical on the other.

Fig. 8. Faces and sides of an experimental notched cobble. Notches produced by flaking (Photos: P. Tounas).

Fig. 9. Faces and sides of an experimental notched cobble. Both notches were produced exclusively through flaking, but one (left side view) looks as if it was fashioned by pecking (Photos: A. Stroulia).

Notch length varies widely – from 0.7 to 6.1 cm – although over 70 % fall between 1.5 and 2.9 cm. Notch depth varies from 0.1 to 2.0 cm, but over 80 % fall between 0.1 and 0.6 cm. The extreme shallowness of some notches suggests their use with thin cords. It also reinforces the impression of an expedient mode of production.

When viewed frontally, notches often have the form of a ridge. The ridge can be straight, diagonal, curving or irregular. It can be thicker or thinner and often does not have the same thickness throughout its length (Fig. 7).

Overall, it appears that the producers could have been more systematic. The fact that they were not indicates that meticulousness was not crucial on functional grounds. Furthermore, this reflects a choice to spend only the minimum amount of effort on notching as well as a lack of concern about the aesthetic appeal of these objects.

The more or less irregular notches described above represent the rule. There are, however, rare instances of more regular notches: their surface bears a few small scars but is otherwise covered with tiny white marks typically associated with pecking. On the basis of our experiments, we doubt that these notches were fashioned by pecking. Instead, we suspect that the pecked-like appearance is the unintentional result of unsuccessful flaking attempts (Fig. 9; see also Prowse 2010).

Notch manufacture could have involved some of the c. 120 percussive tools recovered through excavation or surface collection. These tools consist of globular water-rolled cobbles put directly to use without prior modification. Their raw material, rodingite gabbro, is both hard and tough. Their

maximum dimension typically measures between 6 and 10 cm. As our experiments have shown, with such raw material and size, these hammers would have made perfectly suitable notching tools (Fig. 10). However, given the absence of securely identified unfinished specimens or manufacturing debris, we consider a hypothesis of off-site notched cobble production likely.

Given the lack of context, it is hard to decide whether the notches were meant to convert the river cobbles into weights for fishing or weaving/matting. Even more so, since the technomorphological characteristics of the Varemeni notched cobbles make them suitable for both functions. We can, nevertheless, mention the following relevant information. While the number of securely identified fishbones is miniscule (fewer than ten), there is substantial evidence of fish processing in the form of dozens of primary, mostly limestone, flakes. Use-wear analysis of a sample by one of the authors (J. Robitaille), coupled with experimental work, revealed traces consistent with fish scaling (see also Donnan/Moseley 1968).

As is generally the case with Greek Neolithic sites, remains of woven fabrics (e.g., textiles and mats) have not been preserved at Varemeni. The site did, however, produce indirect evidence of weaving/matting practices: linear mat impressions on clay (D. Urem Kotsou, T. Papadakou and A. Papaioannou, pers. comm.), pierced rounded sherds of the kind that are usually interpreted as spindle whorls, as well as clay artefacts known in the literature as spools or bobbins (Hondroyanni-Metoki 2002). No pierced conical, pyramidal, or cylindrical clay artefacts like those usually identified as loomweights were found.

Fig. 10. Prehistoric percussive tool from Varemeni (top) and experimental percussive tool (bottom): face and side views (Photos: A. Stroulia).

The above evidence or lack thereof raises the following questions: Were the Varemeni notched cobbles used as sinkers to catch the fish processed with the aforementioned flakes? Or were they instead used in the context of weaving/matting, given the absence of ceramic weights? To explore these questions, it is necessary to broaden the scope of our study.

The assemblage of the nearby site of Servia

Approximately 8 km northeast of Varemeni lies the site of Servia. Like Varemeni, Servia is today submerged in Polyfytos Lake, but in prehistory it

consisted of an open-air settlement on the southern bank of the Aliakmon River (Figs. 1–2). Limited digging took place in 1930 under the direction of W. A. Heurtley of the British School at Athens (Heurtley 1939), with a much more extensive salvage excavation conducted by the Greek Archaeological Service and the British School at Athens in the early 1970s. The site was occupied in the Middle and Late Neolithic, remained abandoned during the Final Neolithic, and was reoccupied in the Early Bronze Age. The Neolithic deposits feature several large rectilinear post-framed houses with yards in between (Ridley et al. 2000).

The site yielded 142 notched cobbles (or waisted weights as referred to by the excavators)[7]. Fifty-nine are securely attributed to the Neolithic. Of the latter, the majority (n = 40 or 68 %) date to the Middle Neolithic, fourteen (24 %) are attributed to the Late Neolithic, while the remaining five derive from mixed Middle and Late Neolithic contexts. The Servia specimens became the subject of a chapter published by Carington Smith (2000a) as part of a volume devoted to the site (Ridley et al. 2000). This is the most thoroughly published notched cobble assemblage from Neolithic Greece. The following account is based on this publication as well as a recent reexamination of the material by A. Stroulia, P. Tounas and J. Robitaille.

The Servia assemblage includes no unfinished specimens, byproducts of manufacture, or percussive tools – an indication that manufacture of notched cobbles did not take place on-site.

The Servia specimens exhibit striking lithological, morphological and technological commonalities with those of Varemeni – a reflection of similar choices on the part of the people responsible for the procurement of raw material and manufacture at the two neighbouring sites. The raw material for the Servia specimens very probably derived from the adjacent river as did that for the Varemeni assemblage. Again, limestone and marble are the prevalent lithologies, accounting for 64 % (n = 38) of the specimens. Like their Varemeni counterparts, the Servia residents chose small, light, thin, flattish and mostly elliptical/circular cobbles as attested to by the frequency distributions and averages of the length, width, thickness, weight, length/width ratio and width/thickness ratio of the 54 complete specimens (Figs. 11–14).

All Servia specimens are side-notched and our earlier comment regarding the placement of notches on roughly opposite parts of circular/elliptical peripheries applies here as well. Notches were produced by bifacial flaking, with rare unifacially flaked or pecked-like cases (see above). Manufacture appears to have been simple and was likely carried out in two or three main stages, as at Varemeni. Moreover, like the notches of most Varemeni

Fig. 11. Notched cobbles from Servia: views of both faces (Photos: P. Tounas).

[7] 45 and 97 were recovered from the earlier and later excavations, respectively (Carington Smith 2000a; Heurtley 1939, 64).

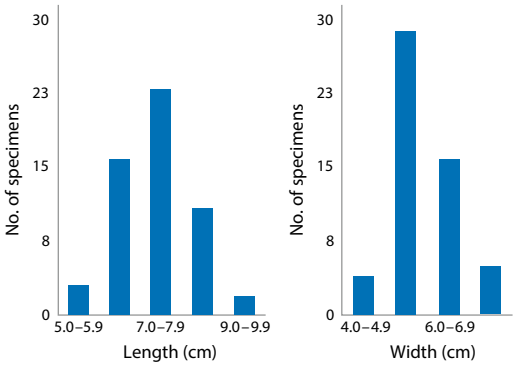


Fig. 12. Length and width distribution of complete notched cobbles from Servia (n = 142). Mean length: 7.2 cm; mean width: 5.7 cm (Graphics: A. Stroulia).

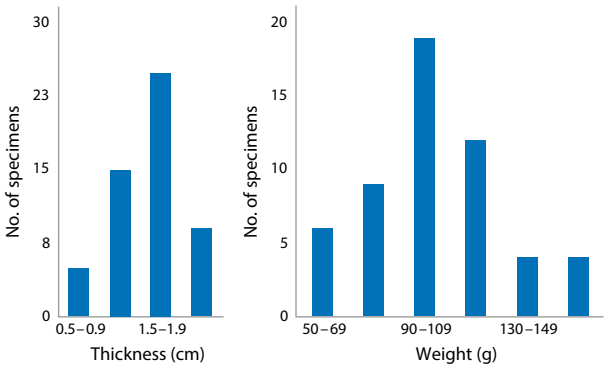


Fig. 13. Thickness and weight distribution of complete notched cobbles from Servia (n = 142). Mean thickness: 1.5 cm; mean weight: 104 g (Graphics: A. Stroulia).

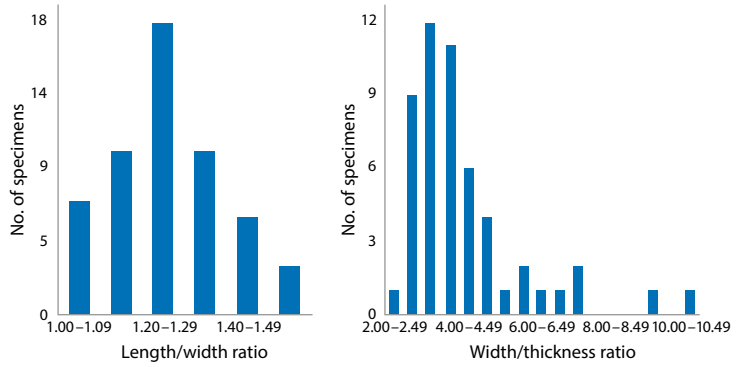


Fig. 14. Distribution of length/width ratio and width/thickness ratio among the complete notched cobbles from Servia (n = 142). Mean length/width ratio: 1.25; mean width/thickness: 4.07 (Graphics: A. Stroulia).

specimens, those in the Servia assemblage are often irregular and asymmetrical, reflecting a quick and expedient mode of production as well as a general lack of aesthetic considerations (Fig. 15).

J. Robitaille examined the notches of all the Servia specimens under low and high magnifications to detect traces of use-wear[8]. Such traces were identified on six specimens. At a macroscopic level (10×–50× magnification), a zone of polish can be seen on the ridges of the notch flake scars (Fig. 16a). The polish is very reflective, but some linear traces (or striations) are visible. At a higher magnification, under a metallographic microscope (100×), the micro-polish appears concentrated on the flake scar ridges (Fig. 16b). The area that it covers, and its morphology are affected by the location and morphology of the scars. Its texture appears smooth, and its contour is sharp. No fracture or extraction of grains is visible. At 200× magnification (Fig. 16c), the distribution of the polish on the surface of the flake scar ridges is concentrated. Regarding the microtopography, only the high topography seems to have been affected. The micro-polish is opaque and highly bright, its density is connected, and its shape in cross-section is domed. This use-wear appears to be the result of the kind of slight friction that occurs when a natural fiber rubs the surface of the stone. The string that was tied around

[8] The protocol used for the description of micro-polish derives from Dubreuil et al. 2015.

these specimens was probably made from a vegetal material. We know of no other notched cobble assemblage that has been subjected to use-wear analysis[9], but macroscopic cordage stains have been noted on specimens from the Neolithic site of Beisamun in Israel (Rosenberg et al. 2016) and the pre-Contact Draper Park site in the Great Lakes region in the Unites States (Weston 1978, 125).

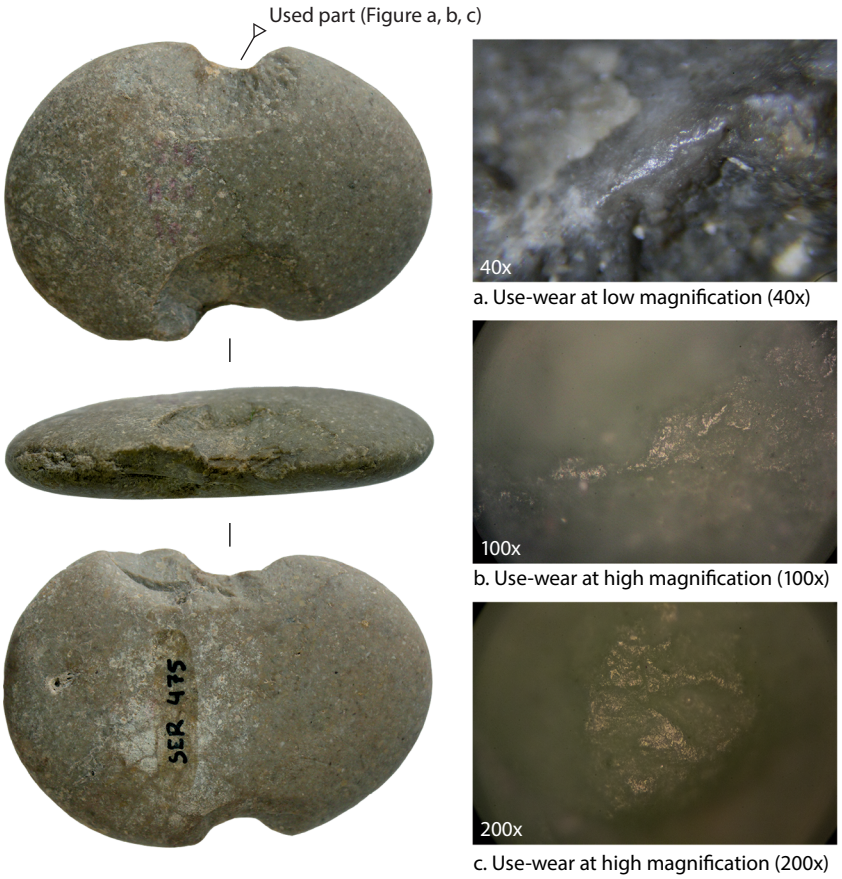
D. Rosenberg and colleagues (2016) used the term "conventions" to refer to patterns reflected in the raw material and technomorphological characteristics of notched cobbles from various prehistoric sites of the Jordan Valley. This term certainly applies to the Varemeni and Servia assemblages. It seems that the inhabitants of the two sites followed similar conventions in the procurement of raw material and manufacture of these artefacts. In fact, similarities in other aspects of material culture, such as celts, pottery and figurines (Hondroyanni-Metoki 1990; 2002; 2009a; Wardle/Vlachodimitropoulou 2000; Stroulia 2018; Urem-Kotsou et al. 2017), coupled with the proximity of the two sites, make it likely that: 1) notched cobbles at both sites had similar functions; 2) the Varemeni specimens are roughly contemporary to the Servia specimens or at least post-date the Early Neolithic. The latter hypothesis is indeed supported by the fact that none of the specimens positively identified as notched cobbles at Varemeni derives from the excavated Early Neolithic and early Middle Neolithic strata.

Fig. 15. Servia notched cobble: views of both faces and sides (Photos: P. Tounas).

While contextual information is missing for the Varemeni specimens, it is available for those from Servia. The majority of the Middle Neolithic specimens were found within structures and in four cases multiple (up to six) specimens were found in the same structure. Five specimens were found in yards, while two were incorporated into walls. About half of the Late Neolithic specimens were recycled into building material, two were found in yards, while another two were discarded in pits. On this basis, Carington Smith (2000a) suggested that the Middle Neolithic was the primary period of use for notched cobbles at the site, with most of the Late Neolithic specimens possibly being residual.

Exploring the function of the Servia specimens, Carington Smith (2000a) considered both the fishing gear and the weaving equipment hypotheses. She favoured an interpretation of these artefacts as fishing net weights, making a reference to local fishermen's use of nets in the Aliakmon River before the creation of Polyfytos Lake. She did not consider the indoor context of recovery of a substantial number of specimens to be incompatible with this hypothesis, pointing out that fishing gear must have been stored indoors when not in use. Not only do we agree but we would add that nets, fishing lines and other related equipment could (or should) have been brought indoors for maintenance and repair, or protection from harsh conditions during the winter months. Two references are relevant in this context. The first is archaeological. At the Neolithic site of Sārnate, in Latvia, remnants of a presumably folded net were found together with floats and sinkers inside a dwelling that contained a hearth (Bērziņš 2008, 238–239; 263–265).

[9] Use-wear and residue analyses, however, have been applied on the grooved stones from the Epipalaeolithic site of Jordan River Dureijat, Israel (Pedergnana et al. 2021).



a. Use-wear at low magnification (40x)

b. Use-wear at high magnification (100x)

c. Use-wear at high magnification (200x)

Fig. 16. Use wear of a Servia notched cobble at low and high magnifications (Photos: J. Robitaille).

The second is ethnographic. According to an account on Maori fishing, "after use, nets were carefully dried and stored on raised platforms, and were protected from the weather" (Paulin 2007, 23).

Carington Smith (2000a), on the other hand, found the idea that the Servia notched cobbles functioned as loomweights rather unlikely given their crude notching. We disagree with this rationale: if these crudely made artefacts were suitable as fishing weights, they would presumably be suited for loomweights as well. This is not an abstract argument. There is data to support it: both the notched cobbles used by the Ainu as weights in the context of matting (Kent/Nelson 1976) and those successfully tested by archaeologists in matting experiments (Reinhard 1992; Médard 2010, 87–89) appear equally coarsely made.

Carington Smith did not elaborate on the broader evidence of fishing and weaving/matting in her chapter on notched cobbles, but relevant information (some authored by herself) is available in other chapters of the Servia volume. More specifically: fishbones were found during the excavation of some of the Late Neolithic pits (Mould/Wardle 2000), but, it should be noted, water-sieving was only used in the final excavation season and only for selected contexts. Although its study is pending, the ichthyological material certainly raises the question as to whether notched cobbles were used in the context of fishing.

Regarding weaving/matting, remains of actual fabrics were not found (as expected). Linear mat impressions were recovered, however, as were spindle whorls and clay spools. By contrast, with one possible exception[10], pierced clay conical, pyramidal or cylindrical artefacts such as those interpreted as loomweights in the Aegean or south-east Europe, were not excavated in the Neolithic strata (Carington Smith 2000b). In the absence of clay loomweights, as for Varemeni (see above), the possibility is raised that notched cobbles served as weights in a weaving/matting context.

[10] The exception is a large conical ceramic Late Neolithic object that is broken at the top where there may have been a suspension hole. The artifact was not available for examination by Carington Smith. Her description is based on a catalogue card and a sketch.

The uncertainty is further augmented by the following finds: 1) Two fragmentary pierced bone tools, which, as Carington Smith (2000b, 248) noted, "could conceivably have been used as needle-shuttles in weaving" but "could also perhaps have been used as netting needles." 2) Approximately 25 so-called ring weights consisting of subspherical masses of reasonably well-fired clay, with large, often eccentrically placed holes. All are small, ranging from 19 to 58 g in weight and, with few exceptions, were found in the same general area. According to Carington Smith (2000b, 224), these artefacts "could, perhaps, be fishing-net weights," but "could also be loomweights". Admitting that these artefacts "are much lighter than loomweights would usually be," she correctly points out that light loomweights are known from other sites and periods. Be that as it may, the almost complete lack of overlap between the weight of these artefacts and that of notched cobbles points to use in the context of different tasks.

Although the Servia notched cobbles derive from an excavation and a majority are accompanied by contextual information, no patterning of use in relation to buildings or other features could be observed. Thus, as with the Varemeni assemblage (which is the product of surface collection), the available evidence does not allow us to choose between the fishing and the weaving/matting hypotheses. At this point, it is necessary to further broaden the scope of the study.

From the Aliakmon River Valley to the rest of Greece and beyond

Varemeni and Servia are two of ten Greek Neolithic sites with notched cobbles of which we are aware. These sites are: Theopetra Cave, Dispilio, Avgi, Makriyalos, Paliambela Kolindros, Promachon-Topolniča, Limenaria and Saliagos (Fig. 1). The amount of information available for these assemblages varies. Some specimens are described in detail: see Avgi (Bekiaris 2018, 262 [vol. 1]) and Theopetra Cave (Kyparissi-Apostolika in press). Most are reported less systematically: see Saliagos (Evans/Renfrew 1968, 71, 157), Makriyalos (Tsoraki 2008, 34; 49–50; 74; 83), Dispilio (Almatzi 2002; Theodoropoulou 2007, 379 [vol. 1]; Theodoropoulou/Stratouli 2009) and Limenaria (Papadopoulos/Malamidou 2008; Maniatis et al. 2009). Yet others are known only from cursory references with or without accompanying illustrations: see Promachon-Topolniča (Koukouli-Chryssanthaki et al. 1996; 2007) and Paliambela Kolindros (D. Urem-Kotsou, pers. comm.).

Obviously, the number of known sites with notched cobbles is very low. We have no doubt that more such artefacts have been recovered elsewhere but remain unreported due to the small number of full-site publications as well as disciplinary biases that have directed attention away from such mundane artefacts. However, the fact that notched cobbles are missing from the fully studied and/or published macrolithic assemblages of Megalo Nisi Galanis (Stroulia 2002; Fotiadis et al. 2019), Kremasti-Kilada (e.g., Stroulia/Chondrou 2013), Stavroupoli (Alisøy 2002), Sitagroi (Elster 2003a; 2003b), Makri (Bekiaris 2007), Prodromos (Moundrea 1975), Kitsos Cave (Perlès 1981), Lerna (Banks 2015), Franchthi Cave (Stroulia 2010), Alepotrypa Cave (Stroulia 2018), Kephala (Coleman 1977), Platia Magoula Zarkou (Stroulia in press), Mavropigi-Fillotsairi (Ninou forthcoming), Drakaina Cave (Bekiaris forthcoming) and Pontokomi Souloukia (Stroulia et al. in press) implies that the scarcity of sites with notched cobbles is real, rather than a result of archaeological biases.

Their scarcity notwithstanding, the geographic distribution of sites with notched cobbles is quite limited. Like Varemeni and Servia, all but one of the sites are situated in northern Greece. Dispilio, Avgi, Makriyalos, Paliambela Kolindros, Promachon-Topolniča and Limenaria are located in various parts of Macedonia, while Theopetra Cave is in the northern part of Thessaly.

The exception is Saliagos, located in the Cyclades, in the southern Aegean. We consider this concentration to be real as well rather than an archaeological construct, since such artefacts are absent from the fully studied/published southern Greek macrolithic assemblages of Franchthi Cave (Stroulia 2010), Lerna (Banks 2015), Kephala (Coleman 1977), Kitsos Cave (Perlès 1981), Alepotrypa Cave (Stroulia 2018) and Drakaina Cave (Bekiaris forthcoming). They are also absent from the published surveys of Dodecanesian macrolithics (Sampson 2003, 48–53; Georgiadis 2017).

A limited geographic distribution is one commonality among the notched cobble carrying sites. Their location on the landscape is another. Like Varemeni and Servia, these sites are found near permanent water sources. Four are situated in the vicinity of rivers: Avgi and Paliambela Kolindros are in the Aliakmon River Valley (as are Varemeni and Servia), Promachon-Topolniča is in the Strymon River Valley, while Theopetra Cave is by Lithaios River. Another three sites are coastal: Makriyalos (on the Greek mainland), Limenaria and Saliagos (both insular). The last site, Dispilio, is found by a lake (Kastoria Lake).

The Servia notched cobbles date to the Middle and Late Neolithic and, for reasons mentioned above, we consider it likely that the Varemeni specimens also post-date the Early Neolithic. The Limenaria assemblage is Middle Neolithic (Papadopoulos/Malamidou 2008), those from Saliagos, Promachon-Topolniča, Makriyalos and Avgi are Late Neolithic (Evans/Renfrew 1968; Koukouli-Chryssanthaki et al. 1996; 2007; Tsoraki 2008; Bekiaris 2018 [vol. 1]), while the Dispilio specimens date mostly to the Middle but also the Late and Final Neolithic (Almatzi 2002; Veropoulidou/Ifantidis 2004, 2; Theodoropoulou 2007, 187 [vol. 2]). With one exception tentatively dated to the Late Neolithic, all the Theopetra specimens derive from deposits that are not well stratified (Kyparissi-Apostolika in press). No information, on the other hand, has been reported regarding the Neolithic phase to which the Paliambela Kolindros specimens belong. Overall, the available information appears to suggest that in Greece notched cobbles represent a post-Early Neolithic artefact type.

As mentioned above, Varemeni and Servia yielded c. 250 and 60 Neolithic specimens, respectively. Concrete quantitative data are available for four of the other assemblages. Among them, that from Makriyalos is the largest, comprising approximately 35 specimens (Tsoraki 2008, 34), while those from Saliagos, Theopetra Cave and Avgi are very small, with nine, four and one specimens, respectively (Evans/Renfrew 1968, 71; 157; Bekiaris 2018, 262 [vol. 1]; Kyparissi-Apostolika in press). Specific numbers have not been published for the remaining assemblages, but general references indicate the recovery of large quantities at Dispilio (Almatzi 2002; T. Bekiaris, pers. comm.) and Limenaria (Maniatis et al. 2009). Despite the sketchiness of the available information, it is safe to assume that the Varemeni and Servia assemblages are two of the largest from the Neolithic Aegean.

To the degree that we can tell from the often scant textual and/or visual data, some of the conventions followed by the Varemeni and Servia assemblages are also evident in the other assemblages. The raw material consists of locally available water-rolled cobbles. Marble, a prominent material in the Varemeni and Servia assemblages, is also common in those from Makriyalos, Limenaria and Saliagos. Three other materials known from Varemeni and Servia – schist, gneiss and sandstone – were also used at these three sites as well as Avgi (Evans/Renfrew 1968, 71; Papadopoulos/Malamidou 2008; Tsoraki 2008, 83; Bekiaris 2018, 262 [vol. 1]). None of these lithologies is particularly hard.

On the basis of the available information, the notched cobbles from the other sites are comparable in size to those found at Varemeni and Servia. More specifically, they are small, thin and light as seen in: the specimens from Theopetra Cave, which range from 6.3 to 8.0 cm in length, from 3.3

to 4.6 cm in width, from 1.4 to 2.0 cm in thickness and from 54 to 104 g in weight (Kyparissi-Apostolika in press); those from Saliagos which are c. 8–13 cm long, c. 2.5–7.0 cm wide, and "usually … less than 2 cm in thickness" (Evans/Renfrew 1968, 71; 157 fig. 87); the single one from Avgi, which measures 4.5 × 2.8 × 1.0 cm (Bekiaris 2018, 262 [vol. 1]); and the few illustrated specimens from Promachon-Topolniča, Limenaria and Makriyalos, measuring from c. 6.5 to 11.5 cm in length and from c. 4.5 to 10 cm in width (Koukouli-Chryssanthaki et al. 2007, 72 fig. 49; Papadopoulos/Malamidou 2008, 443; Tsoraki 2008, pl. 4,23). There is an exception, however: Certain specimens from Limenaria are c. 30 cm long (Papadopoulos/Malamidou 2008).

The curvilinear plan, predominant in the Varemeni and Servia assemblage, appears to be the norm in the other assemblages, too. This is expected, given the water-rolled nature of the raw material. Moreover, flattish specimens are common not only at Varemeni and Servia but also Theopetra Cave, Saliagos, Dispilio, Avgi and (judging from the available illustration) possibly also Promachon-Topolniča (Evans/Renfrew 1968, 71; Almatzi 2002; Koukouli-Chryssanthaki et al. 2007, 72 fig. 49; Theodoropoulou 2008; Bekiaris 2018, 262 [vol. 1]; Kyparissi-Apostolika in press). This does not apply to the Makriyalos notched cobbles whose transverse sections are described as "ovate/spherical" (Tsoraki 2008, 74).

Like the specimens from Varemeni and Servia, those found at the other sites are side-notched, or so is suggested by the reported information. Regarding the manufacturing techniques, all that can be said is that notches were produced exclusively by flaking in the Avgi specimen and the illustrated specimens from Limenaria and Dispilio (Papadopoulos/Malamidou 2008; Theodoropoulou 2008; Theodoropoulou/Stratouli 2009; Bekiaris 2018, 93 fig. 181 [vol. 2]). At Makriyalos, pecking was the main notching technique[11], with flaking used in a smaller number of cases (Tsoraki 2008, 74).

The comparison between the Varemeni and Servia notched cobbles and those from other Greek Neolithic sites has revealed general technomorphological similarities that point to similar functions. Although no specific contextual data have been reported for the specimens found at these sites, it is important to note that all of them yielded fish remains[12].

With respect to weaving equipment, ceramic artefacts like those usually identified as loomweights were uncovered at four of these sites: Promachon-Topolniča, Limenaria, Dispilio and Theopetra Cave (Malamidou/Papadopoulos 1994; Touloumis 2002; Koukouli-Chryssanthaki et al. 2007; Theodoropoulou 2007, 373–379 [vol. 1]; Papadopoulos/Malamidou 2008; Kalogiropoulou 2013; Kyparissi-Apostolika in press). For the most part, this material has not been studied systematically. No such artefacts were excavated at Avgi (T. Bekiaris, pers. comm.) or Saliagos (Evans/Renfrew 1968, 78), while the evidence for Makriyalos is rather ambiguous (Pappa 2008). Finally, no relevant published information was located for Paliambela Kolindros.

Hypotheses regarding the function of notched cobbles as fishing gear or weaving/matting equipment have been proposed in several cases. The specimens from Promachon-Topolniča were interpreted as fishing net weights (Koukouli-Chryssanthaki et al. 2007), while those from Limenaria were considered as "probably related to fishery" (Maniatis et al. 2009, 441). The rationale behind this interpretation is by no means transparent, but the recovery of ceramic "loomweights" at both sites is probably significant. The Saliagos notched cobbles were considered by the excavators as "suitable, for example, as weights for looms or fishing nets" (Evans/Renfrew 1968, 71). That clay loomweights were not recovered probably explains the dilemma. The Makriyalos report mentions both hypotheses too, but in the end favours the fishing-related one: "These weights probably were not used in weaving as the crudely worked notches would damage a fine string attached. Instead, they suggest a use as net stones. The location of Makriyalos near the sea could justify this interpretation" (Tsoraki 2008, 105). The argument

[11] The possibility, however, that the pecked-looking notches of the Makriyalos specimens were actually produced through unsuccessful flaking attempts (as we consider it likely for a few specimens from Varemeni and Servia; see above) should not be ruled out.

[12] For Promachon-Topolniča, see Theodoropoulou 2007, 393–405 [vol. 2]; Limenaria, see Theodoropoulou 2007, 293–328 [vol. 2]; 2012; Dispilio, see Theodoropoulou 2007, 183–238 [vol. 2]; 2008; Theodoropoulou/Stratouli 2009; Avgi, see Stratouli et al. 2020; Makriyalos, see Pappa et al. 2013; Theopetra Cave, see Theodoropoulou in press; Saliagos, see Renfrew et al. 1968; Paliambela Kolindros, D. Mylona, pers. comm.

echoes that offered by Carington Smith for the notched cobbles from Servia (see above). Clay artefacts that could be confidently identified as loomweights were not excavated at Makriyalos (see Pappa 2008, 75; 49; 205; 308). Finally, at Dispilio notched cobbles were found in concentrations in different areas and interpreted as weights for fishing nets and lines. Pierced clay artefacts like those typically identified as loomweights were also found but interpreted by at least some of the Dispilio scholars as fishing weights as well (Almatzi 2002; Theodoropoulou 2008).

Unfortunately, the available information is too insufficient to allow a proper evaluation of the interpretations offered for notched cobbles at the above sites. As paradoxical as it may sound, it may be helpful at this point to look at the many more Greek Neolithic sites that yielded no notched cobbles.

At most of these sites, clay artefacts that could be interpreted as loomweights were not uncovered; see Ftelia (Vakirtzi 2018), Kephala (Carington Smith 1977b; Coleman 1977), Alepotrypa Cave (Papathanassopoulos 2011, 120–126; V. Katsipanou, pers. comm.), Lerna (Banks 2015), Kremasti-Kilada (Hondroyanni-Metoki 2009b, 375–377) and Megalo Nisi Galanis (Fotiadis/Hondroyanni-Metoki 1993; Fotiadis et al. 2019). This absence points to weaving/matting practices with devices which did not involve weights, such as the horizontal ground loom, backstrap loom, or vertical two-beam loom (see, for example, Barber 1991, 80–91; Andersson Strand 2018; Sarri 2020). The alternative hypothesis, that loomweights were made of unfired clay and thus not preserved, cannot be ruled out, but is certainly weaker: The fact that a number of unfired clay items, including weights, have been identified at various sites – even by early investigators who practiced field archaeology with much cruder methods than those employed today – suggests that for the most part the absence of evidence represents evidence of absence (see also Perlès 2001, 249).

A small number of sites, on the other hand, did produce clay objects identified as loomweights; see Sitagroi (Carington Smith 1977a, 135–136; Adovasio/Illingworth 2003; Elster 2003c) and Knossos (Evans 1964; Carington Smith 1977a, 180–182). The presence of these artefacts points to weaving/matting practices that involved the warp-weighted loom or other weight-carrying devices.

If the absence or presence of clay weights is associated with specific weaving/matting devices at sites without notched cobbles, then perhaps similar associations can be assumed at sites with notched cobbles. According to this rationale, weaving/matting was practiced with devices that did not involve weights at sites such as Varemeni, Saliagos and Avgi, but with weight-involving devices at sites such as Limenaria, Promachon-Topolniča and Dispilio. To go one step further, we consider it plausible that at sites such as Varemeni, Saliagos and Avgi, notched cobbles were used as fishing gear, while woven textiles and mats were produced without the help of weights. At sites like Limenaria and Promachon-Topolniča, on the other hand, we envision a certain division of labour, according to which notched cobbles functioned as fishing gear, while clay weights operated in a weaving/matting context. That said, it is important to emphasize that use in the context of fishing in no way precludes the occasional use of a notched cobble as a substitute for a damaged or lost clay loomweight. The reverse possibility – the occasional use of a loomweight instead of a notched cobble in a fishing context – should not be ruled out either.

If our rationale is correct, it offers an argument in favour of the fishing gear hypothesis for the notched cobbles found at Varemeni, Servia and other Greek Neolithic sites. This hypothesis is supported by the proximity of all these sites to substantial bodies of water mentioned above. It is also supported by the locations of Aegean sites that yielded specimens dating to the Bronze Age. One of them is Servia itself. Twenty-three specimens from this site have been attributed to this period (Carington Smith 2000a). Other

sites include Rakhmani, a Thessalian site located close to the Pinios River (Wace/Thompson 1912, 41) and Dhaskalio on the Cycladic island of Keros (Rowan et al. 2013).

Indeed, our survey of the literature has revealed that the use of notched cobbles by littoral communities goes beyond Aegean prehistory. This is rather a global and diachronic pattern, and the following examples illustrate it well.

The Levant yielded the earliest known specimens[13]. These date to the Upper Palaeolithic (19,500 BP) and come from Ohalo II, a site located on the shore of Lake Galilee (Nadel/Zaidner 2002). Natufian specimens derive from 'Ain Mallaha and Abu Hureira by Hula Lake and the Euphrates River, respectively (Perrot 1960; Moore 2000). Pre-Pottery Neolithic specimens were found at 'Ein Dishna, west of the Sea of Galilee, Neolithic specimens were recovered at sites such as Beisamun by Hula Lake and Munhata in the Jordan Valley, while Chalcolithic or Bronze Age specimens derive from Beit Yerach, also in the Jordan Valley, and Ugarit, on the Mediterranean coast (Rosenberg et al. 2016).

Beyond the Levant but also in southwest Asia, notched cobbles dating to the Neolithic and later periods have been reported from sites on the Anatolian coast (Bamyaci 2018) and the southeastern coast of the Arabian Peninsula (Beech 2003; Cavulli/Scaruffi 2011). Farther east, notched cobbles have been found at sites on the Yangtse River, in Szechwan China (Te-K'Un 1967, 76), as well as coastal, riverine and lakeside sites in Taiwan (Kuang-ti 2002), Japan (Akazawa 1988), Korea (Barnes 2015, 115; 279) and northeastern Russia (Dikov 2003, 61; 106).

Thousands of notched cobbles have been found in Europe. Most come from lacustrine sites dating to the Neolithic period and, to a lesser extent, the Mesolithic or Bronze Age; see, for example, Saint Blaise and Auvernier by Lake Neuchâtel, Cham-Eslen by Lake Zug, Cortaillod-Est by Lake Constance (all in Switzerland), Charavines by Lake Paladru (France), Abora I by Lubāns Lake and the Zvejnieki Cemetery near Lake Burtnieks (both in Latvia) (Nougier 1951; Berrétrot 1988; Bērziņš 2008, 234–236; Huber 2018). Other notched cobbles were recovered at sites located close to rivers: see, for example, the Neolithic sites of Belovode and Velesnica in the Danube River Valley (Serbia), Purciems by the River Daugava (Latvia) and the cave sites of Figuier and Sain-Vérédème by the Gardon River (France) (Nougier 1951; Antonović 2003, 83; 121; 141; Bērziņš 2008, 234). Yet others derive from coastal sites; see, for example, the Neolithic site of Kroodi (Estonia) as well as those in Brittany that are dated to the Mesolithic-Neolithic period (Le Pache 1995; Chevalier 2000; Bērziņš 2008, 234). Finally, there are several Neolithic or, to a smaller extent, Mesolithic sites that are (or were) located close to two or all three of these aquatic environments: see Sārnate (Latvia), Siivertsi (Estonia), Sventoji and Šarnelė (both in Lithuania) (Bērziņš 2008, 234–237).

Notched cobbles have also been reported from North America: see for example, the pre-contact sites of Amaknak-D in the Aleutian Islands, the riverside Votaw site in Washington State or Draper Park, Sand Point and Morrow sites in the Great Lakes region (Bank 1953; Weston 1978, 24, 71; Mounier 2002, 67; Andrefsky 2007; Prowse 2010). They are known from South America, too: see, for example, the coastal or insular sites of Punta Catalina 3, Marazzi 30 and Wulaia 15 in the Fuego-Patagonia area (Torres 2007).

Regarding Africa, about three dozen notched cobbles of unknown date were found on the bank of a river near Mariental in Namibia (Sandelowski 1971). These artefacts are also known from Egypt (Pharaonic Period), but unfortunately we were not able to locate information about the specific sites, in which they were found or their distance from fish-bearing watercourses (Spinazzi-Lucchesi 2018, 130–131). Finally, we located no notched cobble-related references for Australia.

[13] Specimens recovered at Maedun Cave, a coastal site in South Korea, were claimed to be 29,000 years old and thus the earliest ever found. However, this early date has been questioned (DeCou 2018).

The above list represents just a sample of the ancient sites in which the use of notched cobbles has been documented. Many more are found in the literature, and to the best of our knowledge, none was located at a considerable distance from a substantial aquatic source. The pattern is so overwhelming that leads us to suggest that notched cobbles largely represent a simple technological adaptation to freshwater and marine environments, one which developed in different parts of the world at different times to facilitate the exploitation of fish resources.

Back to the Aliakmon River Valley: Notched cobbles as fishing equipment at Varemeni and Servia

If the fishing gear hypothesis is the most likely for the notched cobbles from Varemeni and Servia, we offer here a glimpse as to what their specific uses may have been.

As mentioned earlier, at both sites the quantities of fish remains are extremely small. Only those from Varemeni were studied. They consist of carp (*Cyprinus carpio,* in Greek: *γριβάδι* or *κυπρίνος*) and possibly also catfish (*Silurius glanis*, in Greek: *γουλιανός* or *γατόψαρο*). However, judging from the large ichthyological assemblages of two other west Macedonian sites – Avgi, in the upper portion of the Aliakmon River Valley and Dispilio by the Kastoria Lake[14] – it is likely that the inhabitants of Varemeni and Servia consumed other fish types as well (e.g., bream, rudd, roach and tench). All are found in the Aliakmon River today, with carp and catfish being among the most sought-after by fishermen.

There is no published account on traditional fishing practices in the Aliakmon River. However, we were able to obtain relevant information through interviews with Asterios Prassas, Manolis Karamanolas, Stilianos Margaritis and Iordanis Hrisostomidis, four local men who were active in fishing before the damming of the river and the creation of Polyfytos Lake. Our reconstruction is moreover based on two books on traditional freshwater fishing in areas that are not far from the one that makes up the focus of our study. The first – "The Old Fishermen of the Pinios River" (Gourgioti 1993; in Greek) – is written by a folklorist and to the best of our knowledge represents the only account on traditional riverine fishing for the area of Greece. The Pinios River runs through the region of Thessaly to the south of Macedonia. The aforementioned fish species exploited in the Aliakmon River in the Neolithic were traditionally exploited in the Pinios River as well (see also Apostolidis 1892). Written by a local historian and folklorist, the second book is titled "The Boat of Kastoria" (Rouskas 1997). It consists of a thorough presentation of traditional fishing methods at Kastoria Lake and the related customs. Finally, our reconstruction is based on ethnographic and archaeological sources on fishing in other parts of Greece and the world.

There is an almost endless variety of fishing techniques, but generally speaking, communities around the world have caught their prey using the following methods: with bare hands, by diving, by harpooning, with portable traps, with weirs, with nets, by angling and by poison[15]. Weights are involved only in fishing with portable traps, lines and most types of nets. These are the methods on which we focus here.

Portable traps. They are known from the Aliakmon River, Pinios River and Kastoria Lake under terms such as *νταούλια*, *κιούρτος*, *κοφίνια* and *βολκοί*. Some are tubular devices consisting of nets that are stretched around wooden or reed frames. Others consist of baskets, wooden containers, or terracotta pots. The traps are lowered into the water and anchored at specific locations with wooden poles or weights. They are later retrieved (see Stewart 1977, 111–118; Powell 1996, 94–101; Gabriel et al. 2005, 215; 229; Theodoropoulou 2007, 379–381 [vol. 1]).

[14] For Avgi, see Stratouli et al. 2020; for Dispilio, see Theodoropoulou 2007, 183–238 [vol. 2]; 2008.

[15] E.g., Brinkhuizen 1983; Powell 1996, 77–166; Gabriel et al. 2005; Theodoropoulou 2007, 362–385 [vol. 1]; Sahrhage 2008a; 2008b; 2008c; Morales Muñiz 2010.

Line and hook. Several variations are known from the Aliakmnon River, Pinios River and Kastoria Lake by terms such as *πετονιά*, *βουτηστή*, *σαπκάζια*, *τσεβίλια* and *πολυάγκιστρα*. In its simplest form, this type of fishing involves a line, to which a baited hook and a sinker are attached. Alternative or more complex variations include a gorge or multiple hooks (e. g., Gabriel et al. 2005, 86–87; Theodoropoulou 2007, 370–373 [vol. 1]). Line fishing targets mostly carnivorous/omnivorous species (Powell 1996, 122–166; Morales Muñiz 2010) and could have been used prehistorically in the Aliakmon River to catch carp and catfish.

There are four main types of nets: dipnet or scoop nets, casting nets, seine nets and stationary nets. All but the first operate with the help of sinkers and are presented below in their simplest forms:

Casting or throwing net. This net type is referred to as *αμφίβληστρον* in Oppian's[16] *Άλιευτικά* (Alfaro Giner 2010) and as *πεζόβολο* by the Aliakmon River, Pinios River and Kastoria Lake fishermen. It can be described as a relatively small, typically circular net that is cast over a school of fish usually in shallow waters. Weights around the periphery ensure that the net will sink quickly, trapping the fish. This type of net requires clean waters without rocks or plants that could facilitate the fish's escape. The idea is simple, but the successful execution requires a high degree of skill. Of the three net types presented here this is the only one operated by a single individual (e. g., Nun 1993, 51–52; Gabriel et al. 2005, 321–323; Kuang-ti 2002; Theodoropoulou 2007, 374 [vol. 1]; Alfaro Giner 2010; Morales Muñiz 2010; Stroulia 2014, 97; Troche 2016).

Seine net. It is referred to as *σαγήνη* by Oppian (Bekker-Nielsen 2005) and *ζαγάζα* by the Kastoria Lake fishermen. The Aliakmon River fishermen remember using it in the old days but did not refer to it by a specific term. This net type operates like a wall, corralling the fish and then moving them *en masse* to the shore or another location where they can be gathered. To prevent the fish from escaping, the net must be kept close to the bottom as it is moved. This is accomplished by sinkers that are attached at regular intervals to the net's footrope. Floats attached to the headrope at equally regular intervals keep the net upright (Nun 1993, 39; Powell 1996, 102; Gabriel et al. 2005, 431; Theodoropoulou 2007, 376 [vol. 1]; Bērziņš 2008, 267; Prowse 2010; Troche 2016).

Stationary or gill net. This net type was used in the Aliakmon River, the Pinios River and Kastoria Lake under terms such as *βρόχι*, *δίχτυ* or *πλατικόδιχτο*. It works by ensnaring the fish as they attempt to swim through the mesh. Stationary nets are kept vertical in the water with the help of sinkers and floats. They are fixed to a certain location with stakes or anchors attached to their ends. Unlike the seine net, the stationary net is selective since the mesh size determines the size of fish that will be captured. Stationary nets are typically spread in the evening and drawn the following morning. They are most effective in clear calm waters lacking vegetation that can potentially clog the mesh (Powell 1996, 103; Bērziņš 2008, 266; Morales Muñiz 2010; Prowse 2010; Troche 2016). Both seine and stationary nets are operated by groups of people. Harvesting and processing the resulting large catches is often a communal activity, too, usually involving a division of labour (Weston 1978, 102–103).

All the above capture devices could have been employed by the Varemeni and Servia communities, but, as Z. Kouziakis (the only fishing expert among us) emphasized, only in locations where the river flow was not too swift and only at periods when the water level was not too high.

With their average dimensions (c. 7.5 cm long, 5.5 cm wide, 1.5 cm thick and weighing 110 g) and under the above water conditions, the Varemeni and Servia notched cobbles could have functioned as sinkers for both seine and stationary nets. Likewise, as shown by a test conducted by Kouziakis with an experimental notched cobble of comparable size to that of

[16] This is the name of a 2nd century AD Graeco-Roman poet.

the prehistoric specimens, the latter would have been efficient sinkers for fishing lines (Fig. 17). Their flattish shape, moreover, would have been advantageous since it would allow them to sit flat and thus stabilize on the river bottom, while their curvilinear plan and water-rolled surfaces would have made them less prone to entanglement in vegetation. The Varemeni and Servia specimens, on the other hand, are not sufficiently heavy to have functioned as net anchors, but if used in groups, they could have been able to anchor a trap (see also Nadel/Zaidner 2002). Finally, on the basis of the literature (Nun 1993, 51–52; Powell 1996, 106–107), it appears that only the five Varemeni specimens weighing less than 50 g could have been light enough to serve as weights for casting nets. The light subspherical clay artefacts from Servia (referred to as ring weights) could have been suited for this purpose, however.

While the stone weights have survived, the nets, lines, hooks and floats that presumably accompanied them are all missing from the Varemeni and Servia archaeological record. It is possible, nevertheless, to offer certain hypotheses as to the materials from which they were made. The Aliakmon River and Pinios River fishermen traditionally used cotton to knit their nets, while those of the Kastoria Lake employed this material as well as linen and

Fig. 17. One of the authors (Z. Kouziakis) uses an experimental notched cobble attached to yarn to demonstrate that the Varemeni and Servia specimens would have been suitable as fishing line sinkers (Photos: P. Tounas).

hemp. There is no evidence for the use of cotton or hemp in the Neolithic (Carington Smith 1977a, 117; Alfaro Giner 2010; Grömer 2016, 42; 47–49), but flax that may have been used to produce fibers, oil or both, has been identified among the botanical remains of several Greek Neolithic sites including Servia (Housley 2000; Hubbard 2000; Hubbard/Housley 2000; Valamoti 2011). Tree bast or nettle fibers were not traditionally employed for net making in Greece, but nets of such materials are known both archaeologically and ethnographically from other parts of the world[17]. Similar materials could have been used for fishing lines.

Floats could have been fashioned of light wood or bark as are the floats preserved at the Neolithic site of Sārnate or others known ethnographically (Stewart 1977, 59–61; Paulin 2007; Bērziņš 2008, 222–231; Alfaro Giner 2010; Prowse 2010).

Only a small number of fishhooks are known from the Greek Neolithic. They are made from bone and antler and derive from sites such as Dispilio, the Cave of the Cyclope, Franchthi Cave, Nea Nikomedeia and Stavroupoli (Payne 1975; Powell 1996, 158; Grammenos/Kotsos 2002, 24; Moundrea-Agrafioti 2003; Theodoropoulou 2007, 373 [vol. 1]; Stratouli 2002, 2008). We suspect that other communities, including Varemeni and Servia, manufactured hooks from perishable materials such as wood, thorns or fishbone. Gorges could have been made of wood as well[18].

Finally, for most of its length the Aliakmon River is not navigable and boats were traditionally used for neither transportation nor fishing. We assume that this was also the case in the Neolithic (Hondroyanni-Metoki 2012a).

Epilogue

Likely due to their simple forms and manufacturing processes, relatively little scholarly attention has been devoted to notched stone weights found in Greek Neolithic sites or prehistoric sites in other parts of the world, for that matter. This article represents an attempt to address this gap.

We first reviewed the hypotheses that have associated notched cobbles with fishing or the production of woven fabrics and mats. Then we offered a detailed analysis of the technomorphological characteristics of the specimens from the Neolithic site of Varemeni and shed light on the criteria that governed raw material selection and modification. We concluded that, although simple, these artefacts are the result of very specific choices. In exploring whether the Varemeni notched cobbles served as fishing gear or weaving/matting equipment, context was of no help – all the Varemeni specimens consist of surface finds. We thus opted for a comparative approach. In this context, we placed the Varemeni assemblage in a regional framework by comparing it to the excavated assemblage of the nearby site of Servia; a supra-regional framework by comparing both assemblages to those from other Greek Neolithic sites; and finally, a global framework. In the end we concluded that the Varemeni and Servia notched cobbles as well as those from other Greek Neolithic sites are more likely to have been used in a fishing context than one related to weaving/matting. If associated with fishing, notched cobbles represent the only preserved components of the Greek Neolithic fishing technology along with a few fishhooks and scaling tools.

Assuming, however, that notched cobbles were part of such a technology, one wonders why they have been uncovered at so few Greek Neolithic sites, given the large number of communities situated in the vicinity of aquatic environments and known to have practiced fishing, e. g., Franchthi Cave, Sitagroi and Agios Petros (Mylona 2003). To address this question, much more contextual detail is necessary, but we can offer at least a few hypotheses: 1) stone (and suitable varieties for that matter) may not have been readily

[17] E. g., Stewart 1977, 79–81; Weston 1978, 16–17; 36–38; Turner 1998; Bērziņš 2008, 238–239; Alfaro Giner 2010; Martinussen 2010; Prowse 2010, 72–73; Grömer 2016, 50–53; Meunier 2019.

[18] For one archaeological and several ethnographic examples of such hooks and gorges, see Anell 1955, 73–144; Stewart 1977, 32–55; Brinkhuizen 1983; Gabriel et al. 2005, 88; Paulin 2007; Lozovskaya/Lozovski 2016.

available to all littoral communities; 2) notched cobbles may have been discarded on the shore (along with the nets, lines and traps to which they were attached) and were thus not recovered; 3) unmodified cobbles may have been used but were not identified as fishing gear; 4) grooved or perforated cobbles may have been utilized – a hypothesis proposed, for example, for some specimens from Nea Nikomedeia (Pyke 1993); 5) notched sherds could have been employed – a hypothesis proposed, for example, for the site of Stavroupoli (Grammenos/Kotsos 2002, 22). In fact, some of these hypotheses would explain the equally intriguing small number of notched cobbles found at certain sites, i. e., Avgi, Saliagos and Theopetra Cave.

As Z. Kouziakis has strongly conveyed to us again and again and as studies around the world have demonstrated (e. g., Stewart 1977; Gabriel et al. 2005; Theodoropoulou 2007; Morales Muñiz 2010; Stroulia 2014), fishing is an extremely complex technology that not only requires a deep understanding of the variety of available species, their specific behaviours and ecological requirements, the particulars of the aquatic landscape and intricacies of weather patterns, but also relies on a whole range of other crafts, processes and techniques, such as basketry (for making portable traps), fiber processing and spinning (for making thread for nets and fishing lines), building and woodworking (for making permanent traps, boats, fishing spears, etc.), flintknapping (for making fishing spear points or scaling tools), as well as food processing and preservation. As such, it must have directly or indirectly involved a large portion (if not all) of the community. We are nowhere near to acquiring a detailed picture of this complexity or of the relationship of fishing to other subsistence activities (e. g., cultivation and animal husbandry) in Neolithic Greece, but if the mundane notched cobbles help in this direction, they deserve to become the subject of systematic study.

Acknowledgments

We are grateful to Asterios Prassas, Manolis Karamanolas, Stilianos Margaritis and Iordanis Hrisostomidis for sharing with us their memories of fishing in the Aliakmon River. Our thanks also to: Dimitra Mylona, Sophia Vakirtzi, Odysseas Kakavakis, Nina Kyparissi-Apostolika and Mike Strezewski for constructive feedback on earlier versions of the paper; Vesna Vučković, Kosmas Touloumis, Varvara Katsipanou, Tasos Bekiaris, Dushka Urem-Kotsou, Trisevgeni Papadakou, Anna Papaioannou, Rozalia Christidou, Kalliope Sarri, Giorgos Toufexis and Eva Magouretsiou for offering unpublished information on various sites or discussing various aspects of the paper; Takis Gouliafas for assisting with the experiments; Stella Souvatzi for providing an important reference; Niki Stavridi for help with translation; and Strezewski for putting together the illustrations. The study of the Varemeni notched cobbles and the reexamination of the material from Servia were made possible through a grant from the Mediterranean Archaeological Trust (to Stroulia).

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Imprint

ISSN 2197–649X

Layout draft: Agnes Heitmann
Technical edition: Agnes Heitmann

Published by the Institute of Prehistoric and Protohistoric Archaeology, Kiel University.
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