

# Textiles and textile production at the Neolithic site of La Marmotta, Anguillara Sabazia, Lazio (Italy)

Mario Mineo, Juan F. Gibaja, Gerard Remolins, Mauro Rottoli, Laura Caruso-Fermé, Vanessa Forte, Berta Morell, Izaro Quevedo-Semperena, and Niccolò Mazzucco

## Zusammenfassung

Textilien und Textilproduktion in der neolithischen Fundstätte von La Marmotta, Anguillara Sabazia, Latium (Italien)

*Die Möglichkeit, an archäologischen Stätten selten erhaltene Materialien zu untersuchen, ergibt sich nur in Ausnahmefällen. Ein solcher Fall ist die frühneolithische Fundstätte von La Marmotta, Anguillara Sabazia, Latium (Italien). Ihre Entdeckung unter Wasser im Braccianosee hat ein Fenster in die Vergangenheit geöffnet. Die Quantität und Qualität der Überreste, die während der Ausgrabungen über fast zwei Jahrzehnte hinweg dokumentiert wurden, sind herausragend. Bei einigen dieser Überreste handelt es sich um Fragmente von Textilien, Tauwerk und Korbwaren sowie um Werkzeuge aus Holz, Knochen und Stein, die wahrscheinlich mit deren Herstellung in Verbindung stehen. Die vorliegende Übersicht über diese Objekte zielt darauf ab, die technischen Prozesse und die chaîne opératoire bei der Herstellung von Textilien zu bestimmen. Dies ist umso wichtiger, als aufgrund der Seltenheit an ethnografischen und archäologischen Parallelen keine Anhaltspunkte bekannt sind, die Aufschluss darüber geben könnten, wie Holzwerkzeuge in die Textilherstellung eingebunden waren. Die hier vorgestellten Vorschläge müssen jedoch möglicherweise überarbeitet werden, sobald mehr Informationen verfügbar sind.*

**Schlagwörter** Textilien, Korbwaren, Tauwerk, Frühneolithikum, Mittelmeerraum

## Introduction

The importance of plant and animal resources used to produce textiles, baskets and cordage in prehistory is inversely proportional to their appearance at archaeological sites. The effect of taphonomic processes has usually deprived us of those types of artefacts whose study, with ethnographic information as a point of reference, would provide important data about past societies: their ways of life, their technology, their knowledge of the environment, their relationship with other communities and, in general, the economic, social and symbolic significance and value of the objects. Only in environments of extreme cold or heat and waterlogged or arid contexts has the reduction of oxygen and bacteria enabled the preservation of this type of material (Ballmer et al. 2025).

## Summary

*The opportunity to study materials rarely preserved at archaeological sites arises only in exceptional cases. One such case is the Early Neolithic site of La Marmotta, Anguillara Sabazia, Lazio (Italy). Its discovery under the waters of Lake Bracciano has opened a window to the past. The quantity and quality of the remains – documented during excavation over nearly two decades – are outstanding. Some of these remains are fragments of cloth textiles, cordage and basketry, as well as wooden, bone and stone implements probably linked to their manufacture. The present overview of these objects aims to determine the technical processes and the chaîne opératoire involved in producing textiles. This is even more important as the scarcity of ethnographic and archaeological parallels means that no points of reference are known that could illuminate how wooden tools were involved in textile manufacture. However, the proposals presented here may require some revision as more information becomes available.*

**Keywords** Textiles, basketry, cordage, Early Neolithic, Mediterranean area

Consequently, remains of textiles, cordage, and basketry are found only at a few prehistoric localities. Some of the earliest evidence comes from Palaeolithic and Mesolithic sites, such as Dzudzuana Cave, Chiatura, Imereti region (Georgia), where remains of linen fibre dated between 36 000 and 13 000 (cal.) years ago were found (Kvavadze et al. 2009), Ohalo II, Northern district (Israel), where 2–3 mm fibre fragments were interpreted as remains of cordage made from monocotyledon plants around 19 000 years ago (Nadel et al. 1994), as well as at Tybrind Vig, Region of Southern Denmark (Denmark; 7400–6000 cal. BP), and Zamostje 2, Moscow Oblast (Russia; c. 8200 cal. BP), where waterlogged conditions allowed the preservation of cord used to make fishing nets and traps, bows, arrows, and ornaments (Fischer 1985; Lozovski/Lozovskaya 2016). In the western Mediterranean, the most

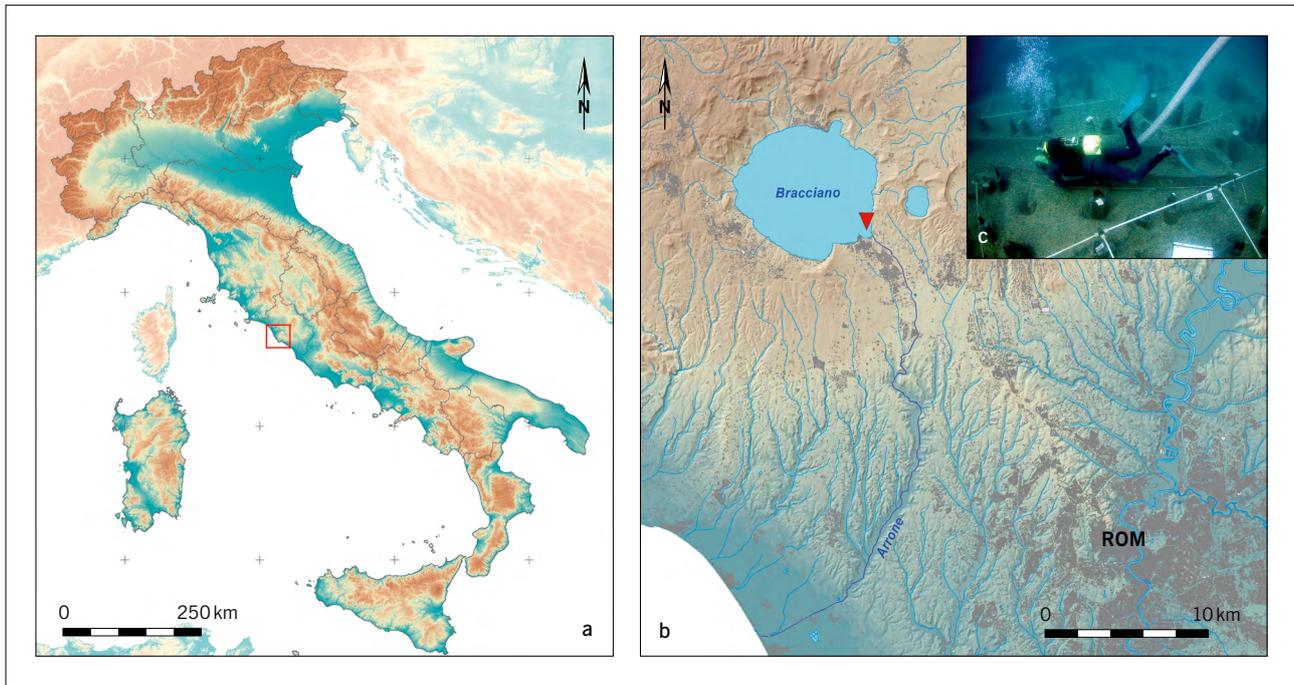


Fig. 1a–c a Location of the settlement of La Marmotta, Anguillara Sabazia, Lazio (Italy); c Lake Bracciano; d photograph of the underwater excavation.

Abb. 1a–c a Lage der Siedlung von La Marmotta, Anguillara Sabazia, Latium (Italien); b Lago di Bracciano; c Foto der Unterwasserausgrabung.

spectacular case is Cueva de los Murciélagos in Albuñol, Prov. Granada (Spain). While some baskets date to the Mesolithic period (c. 8400–8300 cal. BP), other baskets, ropes, and sandals correspond to the Neolithic period (6210–5550 cal. BP; Martínez-Sevilla et al. 2023).

At some of the earliest Neolithic sites, arid or wet conditions were the factors that allowed the conservation of these types of materials. In the Near East, at the mortuary cave of Nahal Hemar, Southern district (Israel), fragments of ropes and baskets made of rushes, reeds, and flax (*Phragmites australis*, *Juncus*, and *Linum usitatissimum*) were dated to 9900 cal. BP (Schick 1986; Shamir 2020). At Çatalhöyük, Prov. Konya (Turkey), evidence of fabrics and basketry is also related to mortuary spaces with an age of c. 7500–7000 cal. BP (Marciniak et al. 2015). In Europe, a large number of remains of cordages, textiles, and baskets have been found at Charavines, on Lake Paladru, Dep. Isère (France; c. 6000 cal. BP), at Arbon-Bleiche 3, canton of Thurgau (Switzerland), next to Lake Constance (c. 5400–5300 cal. BP), at Egolzwil, canton of Lucerne (Switzerland), located on the former Lake Wauwilermoos (c. 6200 cal. BP), which was drained in 1865, at La Draga, Lake Banyoles, Prov. Girona (Spain; c. 6300–6000 cal. BP), or at Cova dels Fems, Prov. Tarragona (Spain; c. 5970–5770 cal. BP)<sup>1</sup>.

This summary of archaeological evidence cannot overlook Ötzi, the Iceman (c. 5300 cal. BP). Found high in the Alps, many items of his equipment were made of lime bast: the dagger sheath, cords, a knotted net of twined strings, and the inner nets of his three-part shoes (Spindler 1995).

### Objectives: the Neolithic settlement of La Marmotta

The Neolithic site of La Marmotta is located under the waters of Lake Bracciano, Anguillara Sabazia, Lazio (Italy). It was excavated from 1992 to 2006 under the supervision of M. A. Fugazzola and the Soprintendenza of the Museo delle Civiltà (Pigorini) (Fugazzola et al. 1993), followed by a final excavation season in 2009 (Fig. 1). The preserved archaeological surface lies about 300 m from the modern shoreline, submerged at a depth of 11 m (8 m of water and 3 m of sediment), which has permitted exceptionally good preservation. The <sup>14</sup>C dates obtained from the remains of charcoal and seeds and the dendrochronological analyses of the wooden piles supporting the houses indicate that the site was in use between approximately 5700 and 5150 cal. BC (Fugazzola/Tinazzi 2010; Mazzucco et al. 2022; Mineo et al. 2023a).

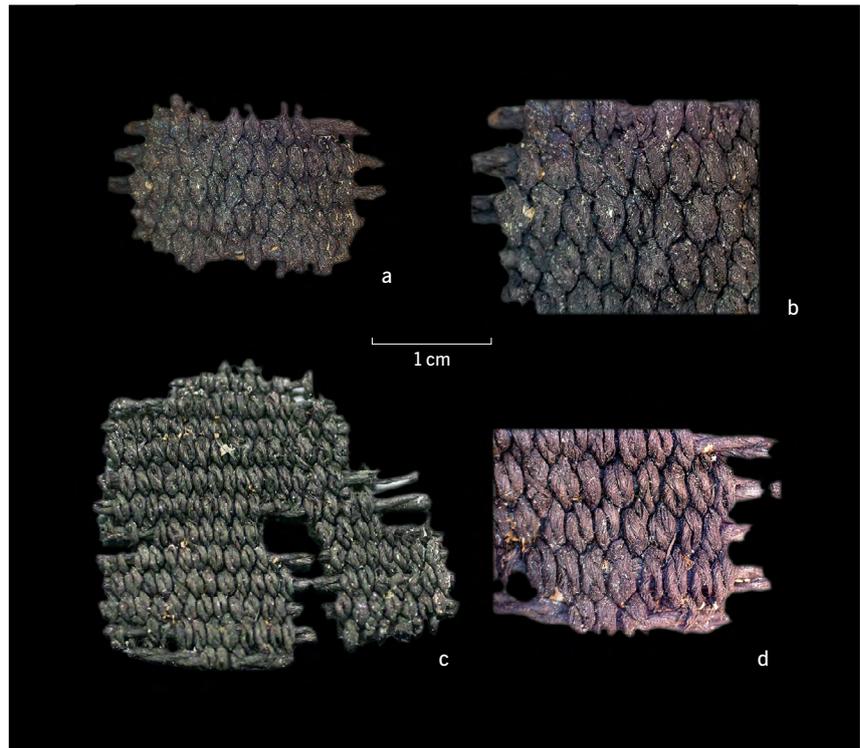
During the excavation, 3400 piles supporting the dwelling structures were found, as well as the remains of the walls, made from wattle and daub, the roofs, thatched with plant remains, and some wooden floors, made of timber or bark. A total of 14 possible rectangular dwellings (8 to 10 m long and 6 m wide) with internal walls and central hearths have been defined.

La Marmotta was based on a consolidated domestic economy in which several animal and plant species were consumed: goats, sheep, cattle, pigs, wheat, barley, and legumes (lentils, broad beans and peas). Although most of the animal (75 %) and plant (65 %) species were domestic, the popula-

<sup>1</sup> Vogt 1951; Médard 2003; Romero et al. 2021a; Romero et al. 2021b.

Fig. 2a–d Textile fragments found at La Marmotta. Detail of the interlacing used in its elaboration. Fragment c has a perforation.

Abb. 2a–d In La Marmotta gefundene Textilfragmente. Detail der Verflechtungen, die bei der Herstellung verwendet wurden. Fragment c besitzt eine Perforation.



tion of La Marmotta also made use of wild resources, such as red deer, wild goats, rabbits, foxes, and different types of fruit (hazelnuts, grapes, sloes and figs). Some plant species were used for other purposes: opium poppy (*Papaver somniferum*) for medical purposes or for its psychotropic effects and flax (*Linum usatissimum*) used to make cloth, together with many other plants, including *Carthamus lanatus*, *Silybum marianum*, *Hypericum perforatum*, *Phragmites australis*, *Persicaria maculosa*, *Prunus spinosa*, and *Sambucus* spp. (Rottoli 1993; Rottoli 2002).

The excellent preservation of biotic substances in anaerobic conditions has also allowed the discovery of numerous objects made of wood, such as bows, mattocks, sickles, spoons, and vessels. These are complemented by more than 12 000 lithic tools made from flint and obsidian, numerous axes, adzes and querns, and an array of bone tools (Fugazzola et al. 1993; Mineo et al. 2023a).

### Textiles and manufacturing tools

Owing to the large number of objects and implements possibly related to the production of textiles, cords, and baskets, each category will be described briefly. The reappraisal of the available information and remains stored in the Museo delle Civiltà means that data published in the past must be updated, including tools that had not previously been associated with cloth-making (Mineo et al. 2023a; Mineo et al. 2023b).

### Textiles

Some of the most significant finds are four textile fragments (Fig. 2) discovered in 1995. Their dimensions are relatively small: No. 1, 11.01 mm; No. 2, 27.09 mm (there is a probable hole in it); No. 3, 11.50 mm; and No. 4, 12.92 mm. These well-preserved remains show the broad knowledge acquired by the inhabitants of La Marmotta for the manufacture of textiles and basketry. Scanning electron microscope (SEM) analysis indicated that the textile fragments are made of cellulosic bast fibres (Mineo et al. 2023a).

### Cordage

A total of 29 fragments of cordage of different thicknesses and lengths was found. Their different dimensions would be related to their uses: strings for bows or nets to obtain food, twine to bind implements, such as stone blades, to wooden shafts, and ropes for suspending objects or for use in house construction, among others (Fig. 3). The length and thickness of the cords vary considerably, depending on their original size and the degree of preservation. Thus, both short fragments, a few centimetres long, and a bundle of cord, whose length cannot be calculated because it is coiled up, have been documented. Although information about the types of plants used to make them is still quite limited, initial analyses have identified plants from the *Poaceae* (or *Gramineae*) family of monocotyledonous flowering plants (grasses) (Mineo et al. 2023a) and flax fibres (*Linum* sp.)<sup>2</sup>.

<sup>2</sup> Pers. commun. Maria Rita Giuliani and Giulia Gaietta, ISCR Biological Research Laboratory.

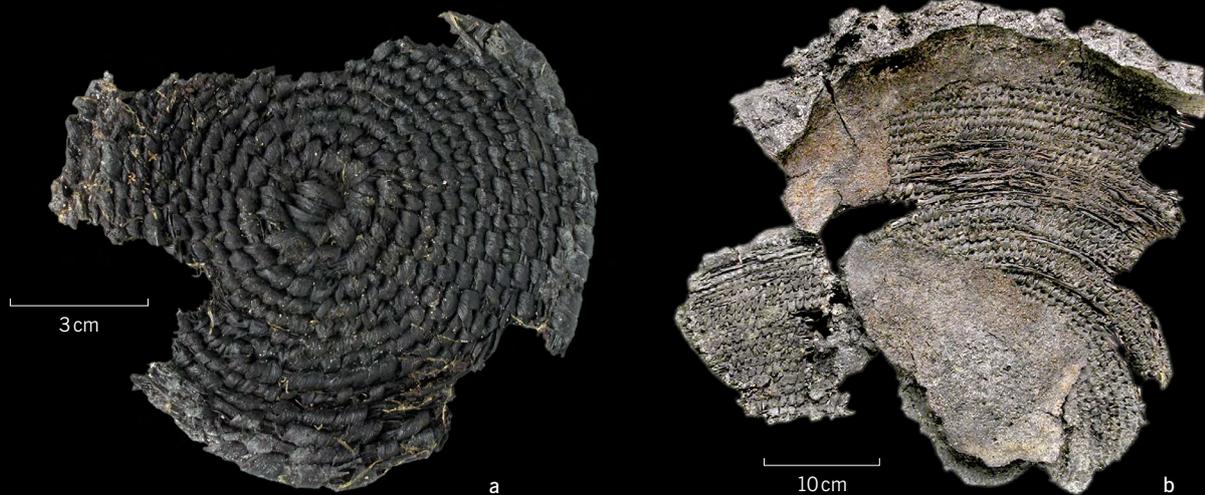


Fig. 3a–b a Bundle of cord; b string, both found at La Marmotta. These two photographs show the state of preservation of the cords and strings.

Abb. 3a–b a Kordelbündel; b Schnur, beide gefunden in La Marmotta. Diese beiden Aufnahmen zeigen den Erhaltungszustand der Kordeln und Schnüre.

Fig. 4a–b Examples of basketry found at La Marmotta. a base of a basket; b bottom of a basket to which food remains still adhere.

Abb. 4a–b Beispiele für Korbwaren, die in La Marmotta gefunden wurden. a Boden eines Korbes; b Boden eines Korbes, an dem noch Essensreste haften.



## Basketry

Baskets could be used for various purposes: gathering and processing food, as well as storing and transporting products. Among the 49 remains of baskets at La Marmotta, several techniques have been identified, from weaving and pseudo-weaving to sewn spirals and binding (Fig. 4; Mineo 2019). The most common technique is weaving in concentric spiral circles using the method of ›continuous growth‹. The spiral begins with a bundle of rigid material around which straw is wound and stitched together, probably using a bone needle. In some cases, as shown in Fig. 4b, food remains are still preserved at the bottom of the basket. The preservation of the remains varies greatly, from small pieces to large fragments belonging to the walls or bases of the containers.

## Brushes

Two small brushes were discovered in La Marmotta. The first (Number 14398, Level II, Square D142) consists of a bundle of plant stems (the species has not yet been determined) tied by string in their proximal and medial parts (Fig. 5). While the string in the proximal part creates a rounded shape that would be held in the hand, the one in the middle holds together the active part of the brush. It is 141 mm long and 39.5 mm wide. The two strings have a similar width, between 4.9 and 4.0 mm.

The second brush (Number 22232, Level I, Square A132) is quite similar. It also consists of a bundle of plant stems, tied only in the middle by a string that wraps around the stems three times. The stems are folded over in the mid-

Fig. 5a–b Brushes found at La Marmotta. They have a similar morphology and both are tied with cords at one end.

Abb. 5a–b In La Marmotta gefundene Besen. Sie haben eine ähnliche Struktur und sind beide an einem Ende mit Schnüren gebunden.



dle and secured with the string, forming a brush with a rounded proximal part and the loose ends of the stems in the active part. It is 124 mm long and 54 mm wide. At its broadest, the string is about 5 mm wide.

## Tools for textile production

### Spindles

The spindles found at La Marmotta would have been used to spin thread. The central part is a small piece of wood, slightly conical in shape and pointed at the ends. Nine examples have been documented, one complete and eight fragments with or without the remains of thread (Fig. 6).

One of the best-preserved specimens is number 6762 (level I, square D299–D250). With a length of 256 mm and a width of 35 mm, it is a cylindrical piece of wood with thread wound around in a biconical shape. It demonstrates the technical ability of the first Neolithic communities in the production of textiles. These are exceptional objects because few similar objects are known from European pre-history. However, some spindles with a different morphol-

ogy have been found at sites such as Fivavé, Trentino (Italy; Bronze Age) (Perini 1987; Bazzanella et al. 2003).

### Spindle whorls and loom weights

Spindle whorls and loom weights are objects commonly associated with textile production (Rast-Eicher 2005; Forte/Lemorini 2017). During the study of the archaeological material excavated at the site of La Marmotta, 81 weights and 3 spindle whorls were identified (Fig. 7).

The spindle whorls are biconical in shape with a length range of 28–31 mm and a weight range of 3.6–3.8 g, while the diameter of the central vertical hole measures 5 mm in each. A horizontal polished area above the rim of the hole suggests prolonged use caused by repeated contact between the whorl and the spindle (Forte/Lemorini 2017). The loom weights vary more in size and shape than the whorls. They include tube-shaped and cylindrical weights (long and short shapes, respectively) with a round longitudinal hole, circular flat weights with a transversal hole, and a group of varied shapes (triangular, trapezoidal, rhomboid morphologies) with a transversal hole. Their weights range from a minimum of 0.9 g to a maximum of 29 g.



Fig. 6a–b Spindles from La Marmotta. a the best preserved spindle from La Marmotta; b a fragment of spindle that has lost part of the cord and the wood inside is very deteriorated.

Abb. 6a–b Spindeln aus La Marmotta. a Die am besten erhaltene Spindel aus La Marmotta; b ein Spindelfragment, das einen Teil der Schnur verloren hat und dessen Holz im Inneren stark beschädigt ist.

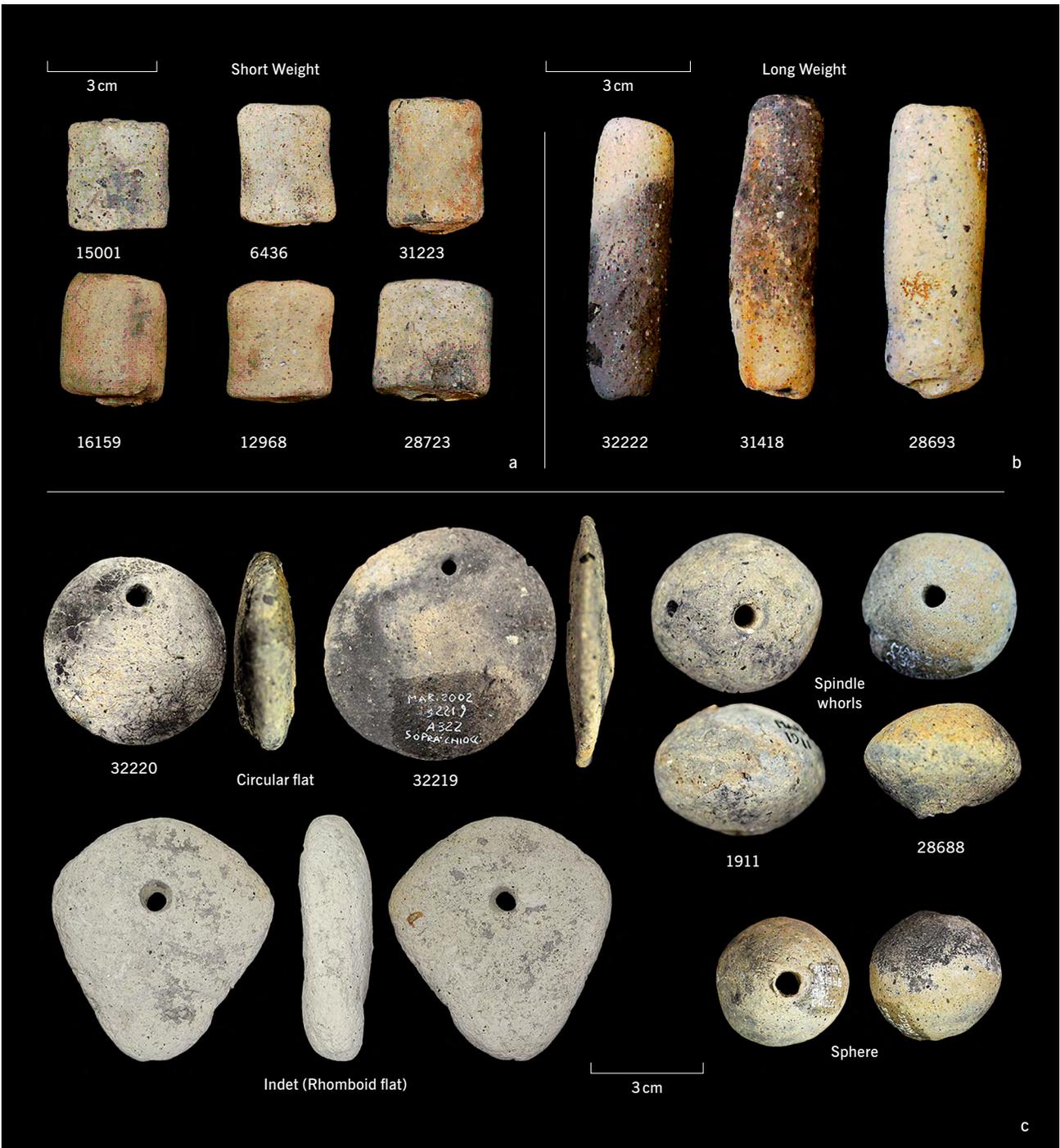




Fig. 8a–c Weaving swords found at La Marmotta. Size and preservation are varied. Piece a and c are complete with the handle at one end.

Abb. 8a–c Webschwerter, gefunden in La Marmotta. Die Größen und Erhaltungen sind unterschiedlich. Die Stücke a und c sind vollständig mit dem Griff an einem Ende erhalten.

The position of use-wear in specific places around the holes could suggest the use of suspended weights, as in the case of looms. Nevertheless, the peculiar shape of the tubular weights, along with the lack of localised use-wear around the hole, could even suggest the use of these weights as net sinkers. Similar clay weights were used by the Islamic populations in the Iberian Peninsula in the 8<sup>th</sup> century AD (Merino 1986).

### Weaving swords

Some of the most exceptional wooden tools found at La Marmotta are the weaving swords. 42 complete or fragmented

Fig. 7a–c (left page) Spindle-whorls and loom-weights used in weaving. All made of clay, they have different forms and weights. They could have been used for different activities.

Abb. 7a–c (linke Seite) Spinnwirtel und Gewichte, die beim Weben verwendet wurden. Alle sind aus Ton gefertigt und haben unterschiedliche Formen und Gewichte. Sie könnten für verschiedene Arbeiten verwendet worden sein.

examples of weaving swords have been documented. From a morphological viewpoint, they are all very similar: a long, narrow spatulate form with a sharp side and lenticular cross-section. One of the ends is always narrower, creating a handle; in fact, the handle surfaces have been smoothed, perhaps by hand contact. These handles sometimes end in a pommel, enabling the user to hold the tool more easily. The completely preserved weaving swords are sometimes considerably larger, up to 1340 mm long, 73 mm wide, and 14 mm thick (Fig. 8).

Communities that used traditional looms employed long wooden tools to press down each row of the woven weft. In the 20<sup>th</sup> century in northern Italy, an instrument like a wooden knife was used to work the textiles (Scheuermeier 1980). However, this interpretation should be accepted with caution because those looms imply a much more complex and advanced technology than is assumed for the Neolithic period. Similar objects have been discovered at other waterlogged sites, albeit of later chronology. For example, weaving swords have been cited at locations in Switzerland (Greifensee, canton of Zurich, Niederwil-Egelsee, canton of Thurgau, and Wetzikon-Robenhausen, canton of Zurich), Italy (Fiavé)



Fig. 9a–c Three of the best-preserved *draghetti* from La Marmotta. They all have the same morphology with a perforation in the handle.

Abb. 9a–c Drei der am besten erhaltenen nicht genau definierten Holzgeräte (*draghetti*) aus La Marmotta. Sie haben alle die gleiche Gestalt mit einer Perforation im Griff.

and China (Tianluoshan, Prov. Zhejiang) (Bazzanella et al. 2003; Cameron/Guoping 2022).

### Draghetti

Other, rather enigmatic, wooden tools are the *draghetti* (so-called because their toothed shape resembles a dragon's back). In total, seven complete or fragmented *draghetti* have been documented at La Marmotta. They all display the same morphological characteristics (Fig. 9). They are composed of two parts, one straight and the other curved. The former is a straight, broad, perforated handle. The latter forms a concave inner surface and a convex outer face with a line of triangular teeth. The curved active part of the *draghetti* display two very different surfaces: the internal concave surface is smooth and worn by use, while the external convex face displays a series of aligned triangular teeth, some with longitudinal striations and distinct rounding, also probably caused by use.

Although the completely preserved specimens are between 230 and 255 mm long, one of the broken examples (Number 12240, Level I, Square D241) must have been much

larger: it is 245 mm long despite missing much of its distal end. The proximal parts of these tools are between 48 and 65 mm wide, while their convex distal parts vary from 55 or 65 mm in their widest section to 20 or 30 mm near the pointed end. The proximal parts are 11–16 mm thick, and the distal parts 22–28 mm thick.

Rather similar objects have been found at the Neolithic waterlogged site of La Draga. The difference is that while some of the items found there do not possess the toothed convex part (in the case of objects No. 35 and 85), others seem to display some teeth (No. 37 and 86; Bosch et al. 2006).

Different hypotheses concerning the use of these tools have been put forward. Whereas researchers at La Draga state that they may have been hooks used to suspend other objects, M. A. Fugazzola (2023) has recently proposed that the concave part of these items was used to smooth the walls of canoe-shaped ceramic artefacts that have been found at La Marmotta. Based on the abrasion and striations documented on these tools' concave and convex (toothed) parts, we think they may have been used for working with plant matter, such as flax. However, more specific functional studies are required to establish their use.

### Possible combs

Two possible teeth from combs have also been found among the wooden remains. These are small objects (46 x 4 x 3 mm and 49 x 6 x 6 mm) with a pointed end. Although they may also belong to some other type of tool, if we bear in mind the magnificent, almost complete combs recovered at such sites as La Draga (Bosch et al. 2006), this hypothesis should not be discarded.

### Tensioners

The study of pottery remains at La Marmotta has documented some perforated objects that might be interpreted as tensioners or weaving artefacts used to thread cloth or twine. Two of these are rounded in shape; a third specimen is irregular. Whereas the round ones are between 60 and 90 mm in diameter and between 7 and 12 mm thick, the irregularly-shaped one measures 62 x 40 x 35 mm (Fig. 10). Similar types of ceramic objects have been found at the sites of La Draga (Neolithic) and El Cerro de la Virgen de Orce, Prov. Granada (Spain; Bell Beaker period) (Schüle 1980; De Diego 2023). On the other hand, finds of similar appearance but made from *Spondylus* were found at the Makriyalos, Crete (Greece), Neolithic site and have been interpreted as buckles/buttons (Pappa/Veropoulidou 2011).

### Lithic and bone instruments

Lithic and bone tools also had a role in the processing of vegetal fibres (Guilbeau et al. 2023). This can be determined through the study of use-wear traces conserved on their surfaces. Functional analyses were performed on a sample of 770 lithic artefacts, of which 418 had been used. Of these, many were employed in working with plant matter: 115 to harvest cereals, 67 to cut, and 86 to scrape indeterminate non-woody plants. In the case of blades forming part of a sickle, they are unretouched or only slightly retouched at both ends. Many of these objects with cereal use-wear display retouched active edges because they were frequently re-sharpened to prolong the sickle's life. This large number of tools used for harvesting and working with indeterminate non-ligneous plants indicates the importance of plants in the craft activities performed by the community at La Marmotta.

Among the implements made of bone, an initial study of 39 tools has been carried out. It is difficult to identify evidence of use-wear in the bone assemblage because of the poor conservation of cortical surfaces. Nevertheless, five of the six robust awls exhibited clear evidence of their use. However, it was only possible in one case to determine that it had been employed in working with plant matter, probably fibres, using a predominantly transverse movement. The other tools had probably been used, but their state of conservation does not allow this to be definitively affirmed.



Fig. 10a–b Possible tensioners or parts of looms, perforated around their perimeters.

Abb. 10a–b Mögliche Spannelemente oder Webstuhlteile, die an den Rändern perforiert sind.

## Conclusions

Undoubtedly, one of the most significant gaps in our knowledge of prehistoric communities is related to the raw materials used, the different working processes, and the diversity of the tools employed to produce textiles, cordage, and basketry. Unfortunately, because these were made with biotic materials, no direct evidence is preserved at most sites, and we can only conceive of them through, for example, functional analysis of lithic and bone tools. Nature only opens a window to the past in a few exceptional cases, such as the site of La Marmotta, where we can identify and interpret the diversity of the artefacts and the range of tools linked to textile manufacturing. The remains briefly described here reflect both the diversity of the perishable materials used and the technical complexity and

knowledge demonstrated by the first Neolithic societies in the production of textiles.

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2 M. Mineo  
3–10 J. F. Gibaja

## Addresses

Mario Mineo  
Museo delle Civiltà di Roma (Italy)  
Piazza Guglielmo Marconi 14  
00144 Roma  
Italy  
mmineo55@gmail.com  
ORCID: 0000-0003-1402-2705

Juan F. Gibaja  
Institución Milá y Fontanals en Humanidades  
Consejo Superior de Investigaciones Científicas (Spain)  
C/Egipciaques 15  
08001 Barcelona  
Spain  
fgibaja@imf.csic.es  
ORCID: 0000-0002-0830-3570

Gerard Remolins  
ReGiraRocs, S.L.  
Plaza Homilies 6  
25794 Organya, Lleida  
Spain  
info@regirarocs.com  
ORCID: 0000-0001-8529-5757

Mauro Rottoli  
Laboratorio di Archeobiologia dei Musei Civici di Como  
Piazza Medaglie d'Oro 1  
22100 Como  
Italy  
arceobotanica@gmail.com  
ORCID: 0000-0001-7337-938X

Laura Caruso-Fermé  
Instituto Patagónico de Ciencias Sociales y Humanas (IPCSH-CONICET)  
Boulevard Alte Brown 2915  
9120 Puerto Madryn, Prov. de Chubut  
Argentina  
lcarusoferme@gmail.com  
ORCID: 0000-0002-0799-2634

Vanessa Forte  
Dipartimento di Scienze dell'Antichità  
Sapienza Università di Roma  
Piazzale Aldo Moro 5  
00185 Roma  
Italy  
vanessa.forte@uniroma1.it  
ORCID: 0000-0002-7499-367X

Berta Morell  
Institución Milá y Fontanals en Humanidades  
Consejo Superior de Investigaciones Científicas (Spain)  
C/Egipciaques 15  
08001 Barcelona  
Spain  
bertamorell@imf.csic.es  
ORCID: 0000-0002-3998-1921

Izaro Quevedo-Semperena  
Institución Milá y Fontanals en Humanidades  
Consejo Superior de Investigaciones Científicas (Spain)  
C/Egipciaques 15  
08001 Barcelona  
Spain  
iquevedo@imf.csic.es  
ORCID: 0000-0002-2887-3562

Niccolò Mazzucco  
Università di Pisa  
Dipartimento di Civiltà e Forme del Sapere  
Via dei Mille 19  
56126 Pisa  
Italy  
niccolo.mazzucco@unipi.it  
ORCID: 0000-0002-9315-3625