Journal of Archaeological Science: Reports 27 (2019) 101985

Contents lists available at ScienceDirect

Journal of Archaeological Science: Reports

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

Bronze Age stone tools in Nuragic Sardinia: The case of the ground-stone tools from *Nuraghe Cuccurada*-Mogoro (Sardinia, Italy)

Valentina Matta[a,*], Riccardo Cicilloni[b]

[a] Aarhus University, Graduate School of Arts, Moesgård Allé 20, 8270 (Højbjerg) Aarhus, Denmark
[b] Cagliari University, Department of Humanities, Languages and Cultural Heritage, Piazza Arsenale 1, 09123 Cagliari, Italy

ARTICLE INFO

Keywords:
Bronze Age
Sardinia
Nuragic civilization
Ground-stone tools
Subsistence economy

ABSTRACT

The use of stone tools has always characterized the everyday life of Nuragic people, the communities that lived in Sardinia (Western Mediterranean, Italy) during the Bronze and Iron Ages. Several archaeological sites on this island attest to the great importance of stone-made instruments, among which are ground-stone tools. Although various studies on Sardinia have focused on the use of tools for food processing or transforming raw materials, they tend to exclude a systematic study of ground-stone tools and their role in Nuragic society. This paper considers a group of 39 ground-stone tools from nuraghe Cuccurada-Mogoro (west-central Sardinia), a Nuragic monument dated to the Bronze Age and re-used in the Iron Age. The study involved several forms of analysis including typology, macroscopic observation of use-surfaces and excavation data. The association of the Cuccurada's stone-tools with cooking instruments suggests the presence of areas devoted to food processing and cooking practices.

The aim of this paper is first to underline the variety of stone tools employed by the Nuragic people, and second to consider the presence of common areas within the nuraghi likely used for everyday activities based on the analysis of the archaeological context in nuraghe Cuccurada-Mogoro and other similar Bronze Age contexts. Ethnographical examples on the use of stone tools provide evidence for the social value of these instruments and the organization of activities within the Nuragic community.

1. Introduction

The study of ground-stone tools and their role in prehistoric societies has become a central topic in the last two decades (e.g. Risch, 1995; Dubreuil, 2002; Mori, 2005, Beller et al., 2016, Tsoraki, 2018). In fact, several studies stress the crucial role of these artefacts in the everyday life of prehistoric communities, showing new elements related to their social and economic organization, especially regarding the subdivision of tasks among men and women in everyday activities (Wright, 1992b; Carter, 2004; Antonovic, 2006; Pérez Jordà et al., 2007; Alonso Martinez, 2016; Beller et al., 2016). However, an overview of the literature in many European and extra-European contexts shows how this specific area of research remains incomplete, even though the necessity of integrating the studying of the ground-stone tools has been emphasized by some (e.g. Wright, 1992a; Delgado Raack, 2008; Adams, 2014; Alonso and Frankel, 2017; Tsoraki, 2018). In fact, the systematic study of stone tools could provide varied information concerning technical and spatial aspects related to the production of artefacts, social organization of everyday activities, but in particular, they give an idea of the production volume within a prehistoric community (Delgado Raack and Risch, 2009). Especially concerning the use of proper spaces to run the activities associated with food production, the existing literature lacks a complete overview of the use of ground-stone tools, although several contributors within the Italian archaeological community have focused on the investigation of other everyday instruments associated with ground-stone tools (Castelletti et al., 2015). For example, they emphasize various forms of pottery connected to cooking (Recchia et al., 2008; Copat and Danesi, 2017) and spaces associated with all these activities. All these studies address significant data from various archaeological sites, especially those located in southern Italy, which indirectly provide information regarding the various ways of transforming the raw material, but most of all, they provide information about the use of space during the Bronze Age. For instance, at the site of Valcorrente di Belpasso in Sicily, archaeologists found large enclosures dating from the end of the Chalcolithic Age to the Early Bronze Age, in which most everyday activities were carried out by the entire community (Palio et al., 2016). Another example comes from the site of Oratino in Molise, where research identified common areas designated

* Corresponding author.
E-mail address: valentina.matta@cas.au.dk (V. Matta).

https://doi.org/10.1016/j.jasrep.2019.101985
Received 20 February 2019; Received in revised form 8 August 2019; Accepted 9 August 2019
2352-409X/ © 2019 Elsevier Ltd. All rights reserved.

for the preparation, treatment and consumption of food (Copat et al., 2012; Copat, 2015). In the Bronze Age settlement of Mursia-Pantelleria, a space was identified that was likely used to transform raw material and for cooking, characterized mainly by grinding-slabs, a mortar and cooking-slabs (Cattani et al., 2016). Within the Sardinian archaeological literature, ground-stone tools are generally associated with food-processing and agricultural practices (e.g. Ucchesu et al., 2014; Lo Schiavo et al., 2015; Cicilloni et al., 2017); however, the investigation never goes beyond a rough typological approach (Cossu, 2005; Basoli, 2007). The study of ground-stone tools in the Sardinian context is little and lacks a suitable method for cataloguing and analyzing them.

Everyday activities during the Bronze Age in Sardinia generally centered around specific rooms within the Bronze Age towers, so-called '*nuraghi*', where usually ground-stone tools are found. These rooms are related to grinding practices and to the consumption of food (Lo Schiavo and Perra, 2017, Lo Schiavo et al., 2015; Campus and Derudas, 2012: 798–799, fig. 1).

Furthermore, several excavations confirmed the presence of rooms destined as *siloi*, storage for conserving foodstuffs. These have been found mainly in towers such as nuraghe *Alvu-Pozzomaggiore*, nuraghe *Arrubiu-Orroli*, nuraghe *Palmavera-Alghero* or nuraghe *Santu AntineTorralba* (Campus and Derudas, 2012). We also know of spaces considered 'real and proper rooms connected to the grinding process and the transformation of products' (Campus and Derudas, 2012: 798). These include the room in hut n. 36 in Barumini (Lilliu, 1955), the tower C in *nuraghe Arrubiu-Orroli* (Perra, 2018; Lo Schiavo et al., 2015), the 'big circular structure in *Monte Zara* Monastir', interpreted as a 'functional area linked to grinding activities' (Ugas, 2001) and the tower D in nuraghe *Cuccurada-Mogoro* (Cicilloni, 2015). Each of these spaces yielded not only remnants of foodstuffs, but also instruments such as sickles, sickle-sharpeners, *dolia* and various types of ground-stone tools.

Considering all the above studies, this paper aims to underline the importance of ground-stone tools in the Sardinian Bronze Age context. We present the archaeological site of *Nuraghe Cuccurada*-Mogoro and its finds as a case study, in order to demonstrate the varied use of stone-tools in Nuragic communities. This paper is divided into three main parts. The first part takes into account the archaeological context of Nuraghe *Cuccurada*-Mogoro. Our analysis highlights the links between the stratigraphy of the Nuragic complex and the artefacts found within, such as pottery. The second part is devoted to the morphometric analysis and macroscopic observation of the ground-stone tools. In order to create a typological subdivision as comprehensive as possible, we have adopted the terminology that Mori (2005) and Adams (2014) devised for these tools. The final part proposes hypotheses concerning the varied and variable use of ground-stone tools and examines ethnographic evidence concerning the social role of these instruments.

We use the following convention that divides the development of the Bronze Age 'Nuragic' culture into four main segments: the Middle Bronze Age (1700–1350 BCE) the Recent Bronze Age (1350–1200 BCE), the Final Bronze Age (1200–950 BCE) and the First Iron Age (950–720 BCE).

1.1. Excavation in Nuraghe Cuccurada-Mogoro: stratigraphy and ground-stone tools

The archaeological site of *Cuccurada* is located in the territory of Mogoro (Oristano, South-West Sardinia) (Fig. 1).

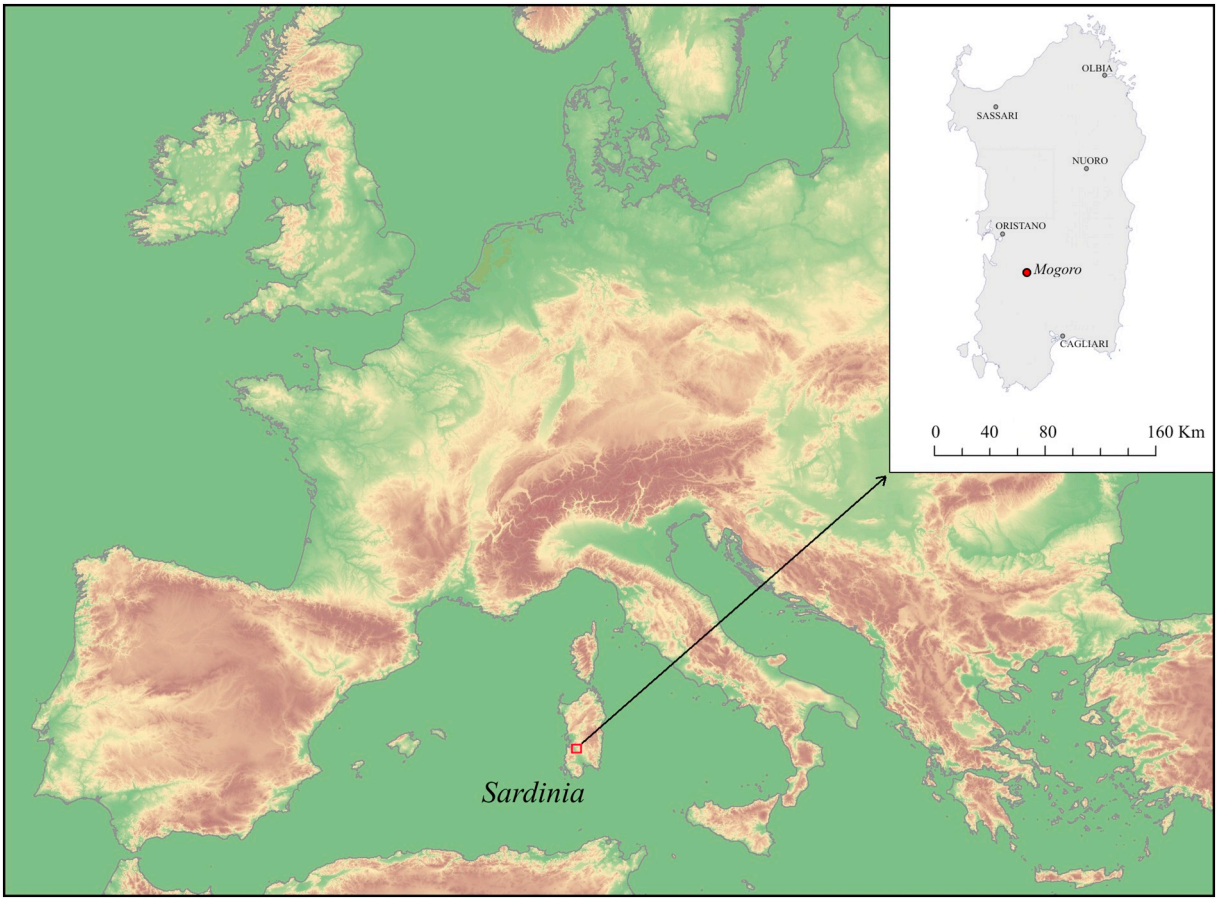


Fig. 1. Sardinia and the study area. The location of the territory of Mogoro, in west-central Sardinia, in red. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)
(Authors' elaboration based on a European Environment Agency raster map.)

Fig. 2. Protohistoric site of Cuccurada-Mogoro (from north-west): 1) chalcolithic semicircular wall; 2) megalithic construction with elliptic plan of uncertain chronological attribution; 3) remains of proto-historic huts, 4) the complex nuraghe Cuccurada B. On the left: the general planimetry of nuraghe Cuccurada.

The site includes a semicircular chalcolithic wall, a megalithic construction with an elliptical plan of uncertain date, remains of Nuragic huts in the area of an earlier Eneolithic settlement and, finally, a four-tower nuraghe called Cuccurada B (Fig. 2). Since 1994 this site has been subjected to stratigraphic investigation and preserves traces of some chronological phases. The monument has a nucleus consisting of the oldest primitive building (an archaic Nuragic structure typical of the Middle Bronze Age) with a kidney-shaped plan (F in plan). Between the end of the Middle Bronze Age and the Recent Bronze Age there was a general rearrangement of this structure, which led to the construction of a type of nuraghe with an added bastion composed by four perimeter towers connected by straight walls, which delimit a large central courtyard (Atzeni et al., 2015) (Fig. 2).

More recent research in the Mogoro territory, coupled with some archaeobotanical analyses, revealed an intense exploitation of the land, with areas used for agricultural activities, especially for the cultivation of cereals (Cabras, 2015; Cicilloni et al., 2016; Cicilloni et al., 2017).

The ground-stone tools considered in this study belong to 'tower D' of the *nuraghe* (Fig. 2). Located in the south-west sector, this tower is 'the most monumental structure of the entire building' (Atzeni et al., 2015: 45).

The ground-stone tools from tower D belonged to several Stratigraphic Units, dated from the Recent Bronze Age, especially Stratigraphic Units 155, 174 and 175 (Ragucci, 2015), to Stratigraphic Units 48, 132, 138 and 139, related to the Final Bronze Age and Early Iron Age stratigraphy (Fig. 3).

Most of the ground-stones have been found within these units, in association with various types of pottery, such as pots and pans (Ragucci, 2015) (Fig. 3).

Stratigraphic Unit 174 revealed a pile of burnt grain (Ucchesu, 2015), associated with a handstone tools, a cooking-pan and a shell lying on a beaten-floor, which presented rich remnants of cinders and coal (Fig. 3). Also, seeds subjected to radiocarbon dating revealed the following dating: 3030 ± 50 BP (LTL-12137A: 1412–1127 BCE at 95.4%; date modelled in OxCal v.4.2, using IntCal13 calibration curve (Bronk Ramsey, 2009; Reimer et al., 2013; Cicilloni, 2015: 196). Thus, during the Recent Bronze Age until the Early Iron Age, this space may have been used for everyday activities such as heating, cooking and dining (Ragucci, 2015).

Nevertheless, a reorganization of the space was probably associated with a change in its function, from everyday work to sacred activities (Ragucci, 2015). This change appears to be supported by the recovery of a bronze statuette illustrating a hunting scene and a fragment of a votive sword (Atzeni, 2015). The radiometric analysis carried out on some fragments of charcoal taken from Stratigraphic Unit 48, in association with the aforementioned statuette, gave the following date: 2703 ± 45 BP (LTL12135A: 940–790 BCE at 95.4%; date modelled in OxCal v.4.2, using IntCal13 calibration curve (Bronk Ramsey, 2009; Reimer et al., 2013; Cicilloni, 2015:196). These data may indicate that the role of the tower gradually transformed during the Early Iron Age.

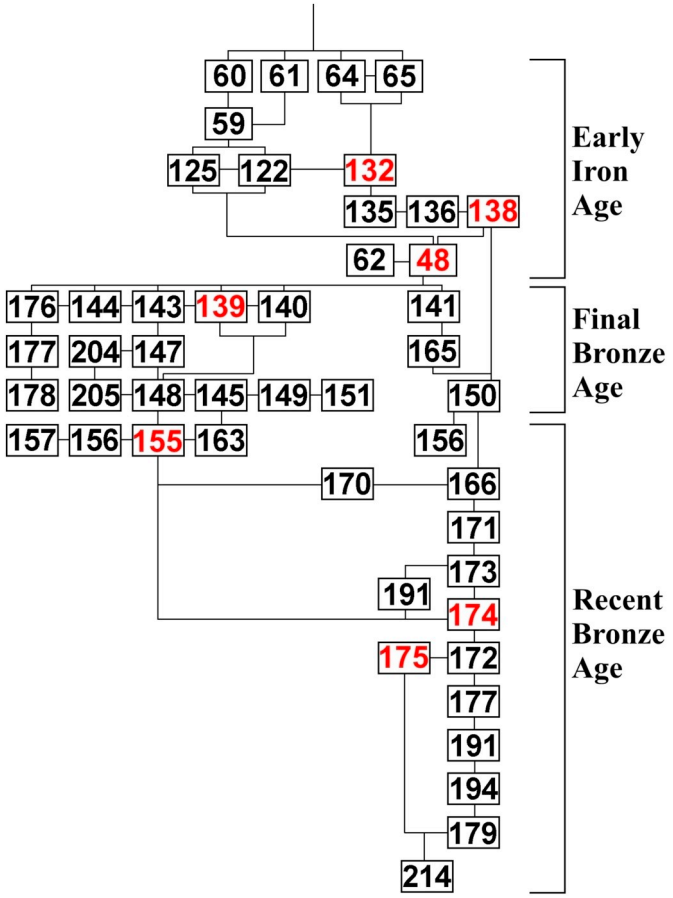


Fig. 3. Nuraghe Cuccurada, D Tower: Harris Matrix referred to Recent/Final Bronze Age and Early Iron Age Stratigraphic Units (the Stratigraphic Units mentioned in the text, in red). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Table 1
Main information of the ground-stone tools from tower D of nuraghe Cuccurada-Mogoro.

ID	Context	SU	Type	Subtype	State of preservation	Chronology
L42/2	Tower D	146	Grinding slab	Flat-topped	Partially fragmented	Final Bronze Age
L64/1	Tower D	149	Grinding slab	Saddle-shaped	Partially fragmented	Recent BA/final BA
L64/2	Tower D	149	Grinding slab	Flat-topped	Fragmented	Recent BA/final BA
L82/1	Tower D	149	Grinding slab	Saddle-shaped	Partially fragmented	Recent BA/final BA
L105/3	Tower D	148	Grinding slab	Saddle-shaped	Partially fragmented	Recent BA/final BA
L122/5	Tower D	178	Grinding slab	Flat	Partially fragmented	Final Bronze Age
L122/7	Tower D	163	Grinding slab	Flat	Partially fragmented	Recent BA/final BA
L105/2	Tower D	48	Grinding slab	Flat	Fragmented	Final BA/Early Iron Age
L143/2	Tower D	175	Grinding slab	Flat	Fragmented	Recent Bronze Age
L143/3	Tower D	139	Grinding slab	Saddle-shaped	Fragmented	Final Bronze Age
L148	Tower D	155	Grinding slab	Saddle-shaped	Partially fragmented	Recent BA/final BA
L42/3	Tower D	146	Grinding slab	Flat-topped	Partially fragmented	Final Bronze Age
L42/6	Tower D	155	Handstone - two handed	Unifacial oval	Partially fragmented	Recent BA/final BA
L105/3	Tower D	148	Handstone - one handed	Unifacial loaf-shaped	Partially fragmented	Final Bronze Age
L105/4	Tower D	148	Handstone	Unifacial oval	Fragmented	Final Bronze Age
L105/4.1	Tower D	148	Handstone	Unifacial oval	Fragmented	Final Bronze Age
L105/4.2	Tower D	148	Handstone - two handed	Unifacial rectilinear	Partially fragmented	Final Bronze Age
L105/5	Tower D	56	Handstone - two handed	Unifacial rectilinear	Partially fragmented	Early Iron Age
L105/6	Tower D	60	Handstone?	Not identified	Fragmented	Early Iron Age
L122/1	Tower D	148	Handstone - two handed	Unifacial oval	Partially fragmented	Final Bronze Age
L122/2	Tower D	178	Handstone - two handed	Unifacial oval	Partially fragmented	Final Bronze Age
L122/3	Tower D	149	Handstone - two handed	Unifacial oval	Partially fragmented	Recent BA/final BA
L122/4	Tower D	149	Handstone - two handed	Unifacial oval	Partially fragmented	Recent BA/final BA
L122/4.1	Tower D	149	Handstone	Unifacial oval	Fragmented	Recent BA/final BA
L122/4.2	Tower D	149	Handstone - two handed	Unifacial oval	Partially fragmented	Recent BA/final BA
L105/7	Tower D	60	Handstone - one handed	Bifacial discoid	Partially fragmented	Early Iron Age
L122/8	Tower D	132	Handstone - two handed	Unifacial oval	Fragmented	Early Iron Age
L123/2	Tower D	155	Handstone - two handed	Unifacial rectilinear	Partially fragmented	Recent Bronze Age
L105/1	Tower D	139	Handstone - one handed	Bifacial discoid	Partially fragmented	Final Bronze Age
L143/3	Tower D	139	Handstone	Not identified	Fragmented	Final Bronze Age
L141/5	Tower D	139	Handstone - two handed	Unifacial rectilinear	Complete (partially fragmented)	Final Bronze Age
L42/5	Tower D	158	Pestle-grinder	Parallelepiped	Complete	Recent BA/final BA
L105/1	Tower D	139	Pounder	Bifacial discoid	Partially fragmented	Final Bronze Age
L105/4	Tower D	148	Pestle	Parallelepiped	Complete	Final Bronze Age
L122/4	Tower D	149	Pestle	Parallelepiped - bell shaped	Partially fragmented	Final Bronze Age
L123/2	Tower D	155	Pounder	Spheroid	Complete	Recent BA/final BA
L123/2.1	Tower D	155	Pounder	Spheroid	Complete	Recent BA/final BA
L141/4	Tower D	155	Pounder	Spheroid	Complete	Recent BA/final BA
L141/4.1	Tower D	155	Pounder	Irregular discoid	Complete	Recent BA/final BA

2. Method

Thirty-nine ground-stone tools were found in reliable stratigraphic positions. Table 1 shows the stratigraphic units where each artefact was found and its chronology.

The typological division is related to the roles of 'upper/active' or 'lower/passive' instruments during the grinding process (Wright, 1992a; Adams, 2002; Mori, 2005). As already stressed in various works, grinding-slabs are considered passive instruments, whereas handstones, pestles and pounders are active tools (Wright, 1992a; Mori, 2005).

In order to fully comprehend the specific role of each tool in the *chaîne operatoire* of the grinding process, it is necessary to give proper attention to the terminology involved to indicate each artefact. According to Adams (2014), a standardized vocabulary (which is now mostly applied to chipped-stone technology) may play a significant role in the analysis.

Table 2
Morphometric data for the grinding slabs from tower D.

ID	Length (cm)	Width (cm)	Weight (kg)	Type	Subtype
L42/2	31.5	17	4.1	Grinding slab	Flat-topped
L64/1	21.5	10	8.4	Grinding slab	Saddle-shaped
L64/2	18.5	14	5.6	Grinding slab	Flat-topped
L82/1	21.3	15	8.2	Grinding slab	Saddle-shaped
L105/3	22	25.3	4.6	Grinding slab	Saddle-shaped
L122/5	16	16	2.8	Grinding slab	Flat
L122/7	21.5	16.4	3.3	Grinding slab	Flat
L105/2	15	21	15.2	Grinding slab	Flat
L143/2	26.8	15	4.3	Grinding slab	Flat
L143/3	22	24.5	7.1	Grinding slab	Saddle-shaped
L148	49.27	26.8	31.2	Grinding slab	Saddle-shaped
L42/3	20	18	3.7	Grinding slab	Flat-topped

Table 3
Morphometric data for handstones from tower D.

ID	Length (cm)	Width (cm)	Weight (kg)	Type	Subtype
L42/6	22	16	2.6	Handstone - two handed	Unifacial oval
L105/3	16	9	1	Handstone - one handed	Unifacial loaf-shaped
L105/4	6	10.5	0.5	Handstone	Unifacial oval
L105/4.1	14	9	0.5	Handstone	Unifacial oval
L105/4.2	19.5	13.5	1.6	Handstone - two handed	Unifacial rectilinear
L105/5	14.5	15.5	2.4	Handstone - two handed	Unifacial rectilinear
L105/6	18	9.5	0.7	Handstone?	Not identified
L122/1	24.8	17.5	3.9	Handstone - two handed	Unifacial oval
L122/2	22	15	1.7	Handstone - two handed	Unifacial oval
L122/3	13	14.5	1.1	Handstone - two handed	Unifacial oval
L122/4	17.6	16.5	2.4	Handstone - two handed	Unifacial oval
L122/4.1	12.5	9.5	1	Handstone	Unifacial oval
L122/4.2	14	15	1.6	Handstone - two handed	Unifacial oval
L105/7	13	10.5	1.2	Handstone - one handed	Bifacial discoid
L122/8	7	14	1.2	Handstone - two handed	Unifacial oval
L123/2	20.5	15.3	2.7	Handstone - two handed	Unifacial rectilinear
L105/1	5.3	11	1	Handstone - one handed	Bifacial rectilinear
L143/3	11.2	13	1	Handstone	Not identified
L141/5	20.5	16.5	2.6	Handstone - two handed	Unifacial rectilinear

Table 4
Morphometric data for pestles and pounders from tower D.

ID	Length (cm)	Width (cm)	Weight (kg)	Type	Subtype
L105/1	7.8	8	0.1	Pounder	Irregular discoid
L105/4	10.5	4.5	0.1	Pestle	Parallelepiped
L122/4	12	5	0.3	Pestle	Parallelepiped - bell shaped
L123/2	8	7	0.5	Pounder	Spheroid
L123/2.1	16.4	14.3	2.3	Pounder	Spheroid
L141/4	7.3	5.5	0.1	Pounder	Spheroid
L141/4.1	5.7	5.4	0.1	Pounder	Irregular discoid
L42/5	13	7	0.9	Pestle-grinder	Parallelepiped

Concerning the Italian lexicon, there is currently still a lack of specialized terminology. The summary use of Italian words such as 'macina', 'macinello', 'pestello' is misleading for interpreting instruments that belong to larger and more varied categories. Therefore, this study uses the broader and more specific English vocabulary to define as well as possible the different types and subtypes of ground-stone tools located in the *nuraghe* discussed here.

Each sample has been registered in a database that records the principal morphometric parameters, raw material, type and subtype, state of preservation and finally, macroscopic use-wear traces (Tables 1–4). The method for the typological division is based principally on a scientific drawing of the main character of each tool, combined with photographic documentation. All the different artefacts have been compared to the catalogues defined respectively by Wright (1992a) and Mori (2005). The combination of these data led to the definition of types and subtypes presented below (Table 1, Fig. 4).

According to Adams (2002), use-wear traces have been identified macroscopically, enhancing the classification of artefacts and the identification of the possible use of the instrument. The macroscopic analysis has been realized by describing the use-wear surface with a hand-lens (8–15× magnification) under artificial light.

To analyze the surface topography as impartially as possible, three main features of use-wear traces were recognized and registered: linear traces, pits, and fractures possibly due to a stressing movement over the surfaces, or perhaps to post-depositional factors.

3. Materials and morphometric analysis

3.1. Lower passive stones

The analysis of the morphometric aspects of the ground stone tools has yielded the following results: of a total of 39 samples, 12 are passive stones. All the lower passive stones from tower D belong to the 'grinding slab' type, according to the typology used by Wright (1992a) and Mori (2005). Figs. 5–7 and Table 2 show the different subtypes identified during the morphometric analysis (Figs. 5–7, Table 2).

As shown in the Table 2, Fig. 6 and 7, three samples belong to the *flat-topped grinding-slab* subtype (Fig. 6 Fig. 7- C-G-H). This type is characterized by an oval shape, sometimes tending to an elliptical shape, and the transverse section is plan-convex (Mori, 2005). The use-wear surface is generally plain; in only one case there is a very slight concavity. In most cases, the dorsal face is in its natural state (in a very few examples it has been polished), irregular in shape, and it was probably laid directly on the floor. None of these grinding-slabs have been found complete; all the samples show fractures due to abandonment, to neglect, or to the passage of time.

The second subtype of grinding-slab is referred to as *saddle-shaped* (Fig. 7-A, D, E), and these represent the majority of the samples, as shown in the Tables 3 and 4. Table 2 and Fig. 6 The saddle-shaped grinding-slab is characterized by an oval or elliptical shape with a plan-convex transverse section or a concave longitudinal section (Mori, 2005). One sample presents significant concavity on the use-surface,

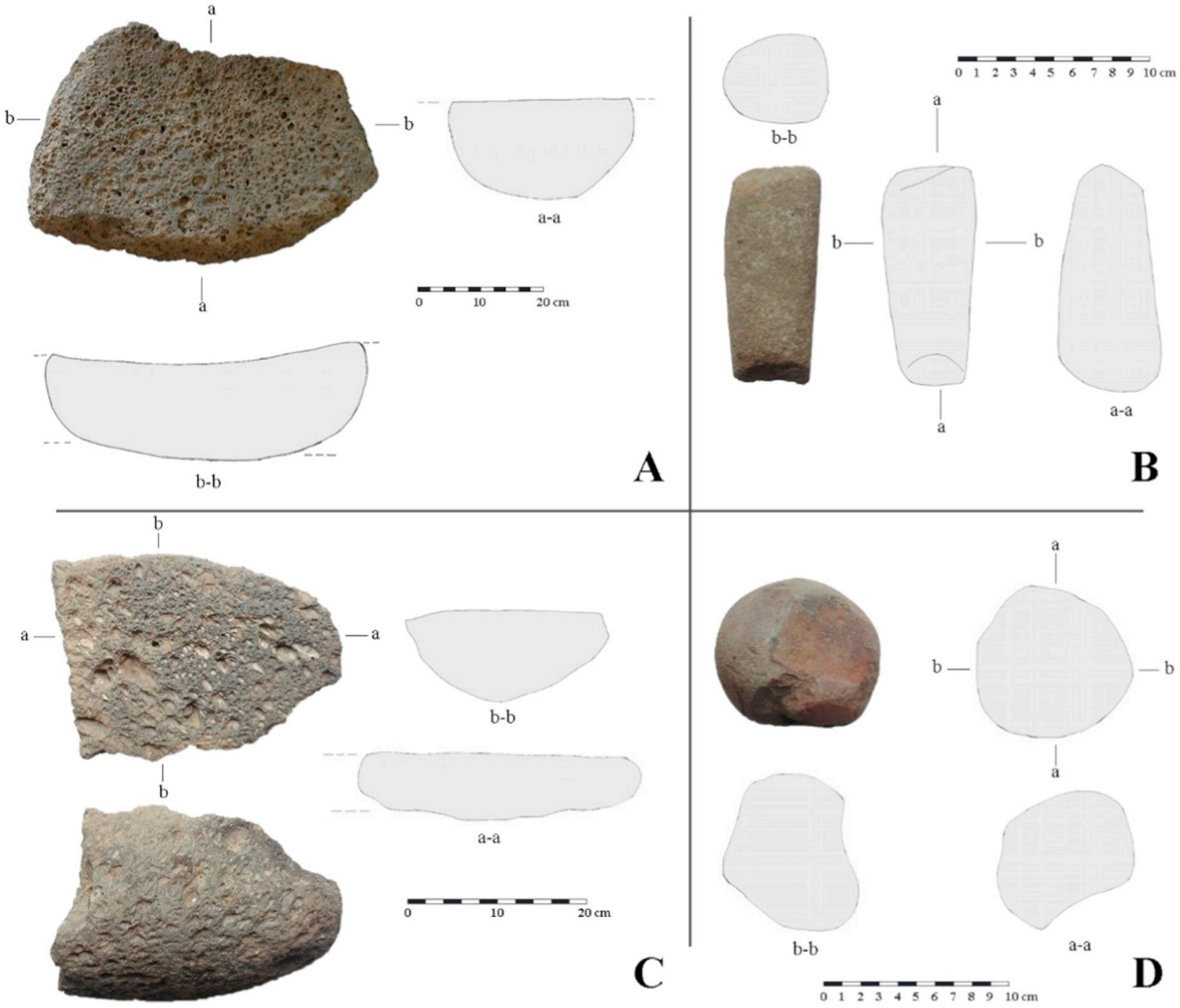


Fig. 4. Some of the samples from tower D in nuraghe Cuccurada: (A) Grinding slab; (B) pestle; (C) handstone; (D) pounder.

which creates an enlarged lip on the superior edge (Fig. 7-E).

The third subtype is the *flat grinding-slab* (Fig. 7-F, B). The main characteristic of this subtype is its flat section, whereas its shape is mainly oval or elliptical (Mori, 2005).

3.2. Active stones

The second part of this study focuses on active tools and in particular *handstones* (Fig. 8), which are employed through active movement during the grinding process (see Wright, 1992a: 67; Mori, 2005: 262). Table 3 displays the morphometric data for handstones.

The analysis has shown the following results: of the 19 handstones considered, 14 belong to the *two-handed handstones* type and three examples fall into the *one-handed handstones* type (Mori, 2005: 264). Two samples were considered 'undefined' due to their extremely fragmented state of preservation (Table 3 and Fig. 9). Seven of these samples fall into the *unifacial oval* subtype (Fig. 10-E, I). This subtype is characterized by a sub-circular or oval shape, and its section is generally plan-convex or biconvex. The use-wear surface is usually plain or slightly convex, whereas the dorsal face is completely convex, and both sides join in a peak, creating a sort of dorsal crest on the top, which probably facilitated the grip on the instrument (Mori, 2005).

Four artefacts belong to the *unifacial rectilinear* subtype (Fig. 10-D, G) which is characterized by an irregular parallelepiped stone block, with a sub-rectangular or rectangular shape, whereas the section is plain-convex (Mori, 2005).

Three ground-stone tools belong to the *one-handed handstone*. Despite the small number of finds, three subtypes exist: *unifacial loaf-shaped*; *bifacial rectilinear*; *bifacial discoid*.

The first subtype, *unifacial loaf-shaped*, usually has an oval shape and a plain or plan-convex section to its classic 'loaf' shape. Generally, there is only one use-surface, and the dorsal face is round, precisely suited to being held in one hand (Mori, 2005).

The second subtype is *bifacial rectilinear*, named after its two use-surfaces, is rectangular or sub-rectangular in shape, similar to the loaf-shaped subtype. It seems less accurate in its realization. In this case, the section is plain (Mori, 2005) and both surfaces reveal use-traces.

Finally, the third group is the *bifacial discoid* subtype (Fig. 10-C). This is characterized by a circular or sub-circular shape, sub-rectangular section and two use-surfaces (Mori, 2005). Generally, these surfaces are flat and smooth; on the edges there are usually use-wear traces, probably related to beating actions (Adams, 2002; Mori, 2005). Lastly, it is necessary to mention two artefacts that have been classified as 'undefined' because of their extremely fragmented state.

The last section of the investigation on ground-stone tools in nuraghe *Cuccurada* considers another class of 'active' tools so-called 'pestles' and 'pounders' (Wright, 1992a) (Fig. 11). The samples were represented by a small number of pounders that belonged to two main subtypes: '*irregular discoid*' and '*spheroid*' (Mori, 2005) (Table 4 and Fig. 12). Tables 4 and Fig. 12 display the morphometric data of the artefacts.

According to Mori (2005), the *irregular discoid* (Fig. 13-B, F) is

Fig. 5. Different grinding-slabs subtypes from tower D. In the background: L-148 (saddle-shaped) and L42/3 (flat-topped). In the foreground from the left: L105/3 (saddle-shaped); L143/2 (flat); L143/3 (saddle-shaped).

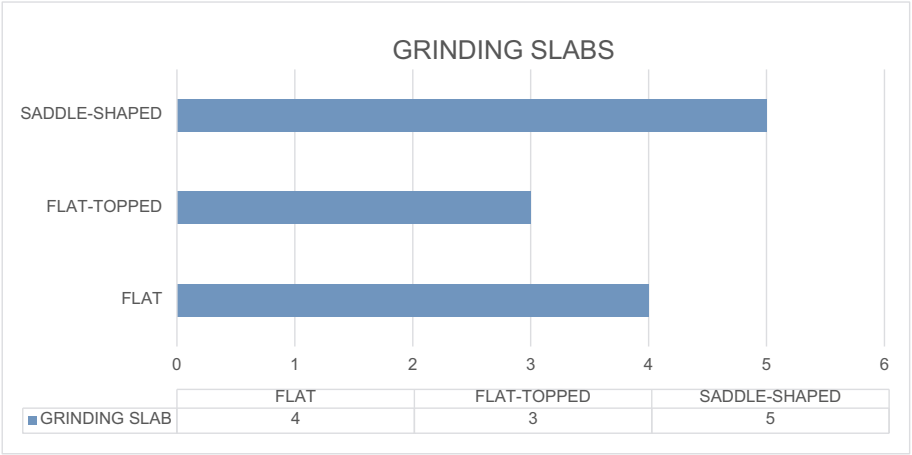


Fig. 6. Graph showing the different grinding-slabs subtypes from tower D. The bars represent the number of artefacts for each category identified.

characterized by a circular shape, but it has an irregular section, which tends to be flattened. Use-wear traces are all over the surface and, in most cases, it presents beating and polishing traces, related to up-and-down and back-and forth movements, as the tool is turned around in the hand several times.

The second subtype is the '*spheroid*' pounders (Fig. 13-D, E), which are characterized by an irregular shape tending to the circular or sub-circular, and use-wear traces are present over the entire surface (Mori, 2005).

The last type of 'active' instrument is the pestles (Fig. 12). The morphometric analysis revealed that the entire sample belongs to the '*parallelepiped-pestle*' subtype (Fig. 13-A, C), although one might fall also into the '*pestle-grinder*' subtype. Elongated in shape, with a rectangular or sub-rectangular section, this type of pestle presents use-surfaces at both poles, whereas the *pestle-grinder* also has use-traces on the shaft (Mori, 2005). Moreover, one of the samples has a bell shape (Fig. 13-C).

4. Macroscopic analysis of use-surfaces

Macroscopic analysis demonstrates that even a superficial level of investigation may highlight several and varied traces that aid understanding the movements applied during the grinding activities (Adams, 2002; Adams et al., 2009). At this level of observation, linear traces seem to be the features that guarantee abundant information about the type of movement used and its possible direction. Concerning the grinding-slabs, these traces usually cover the entire surface, creating

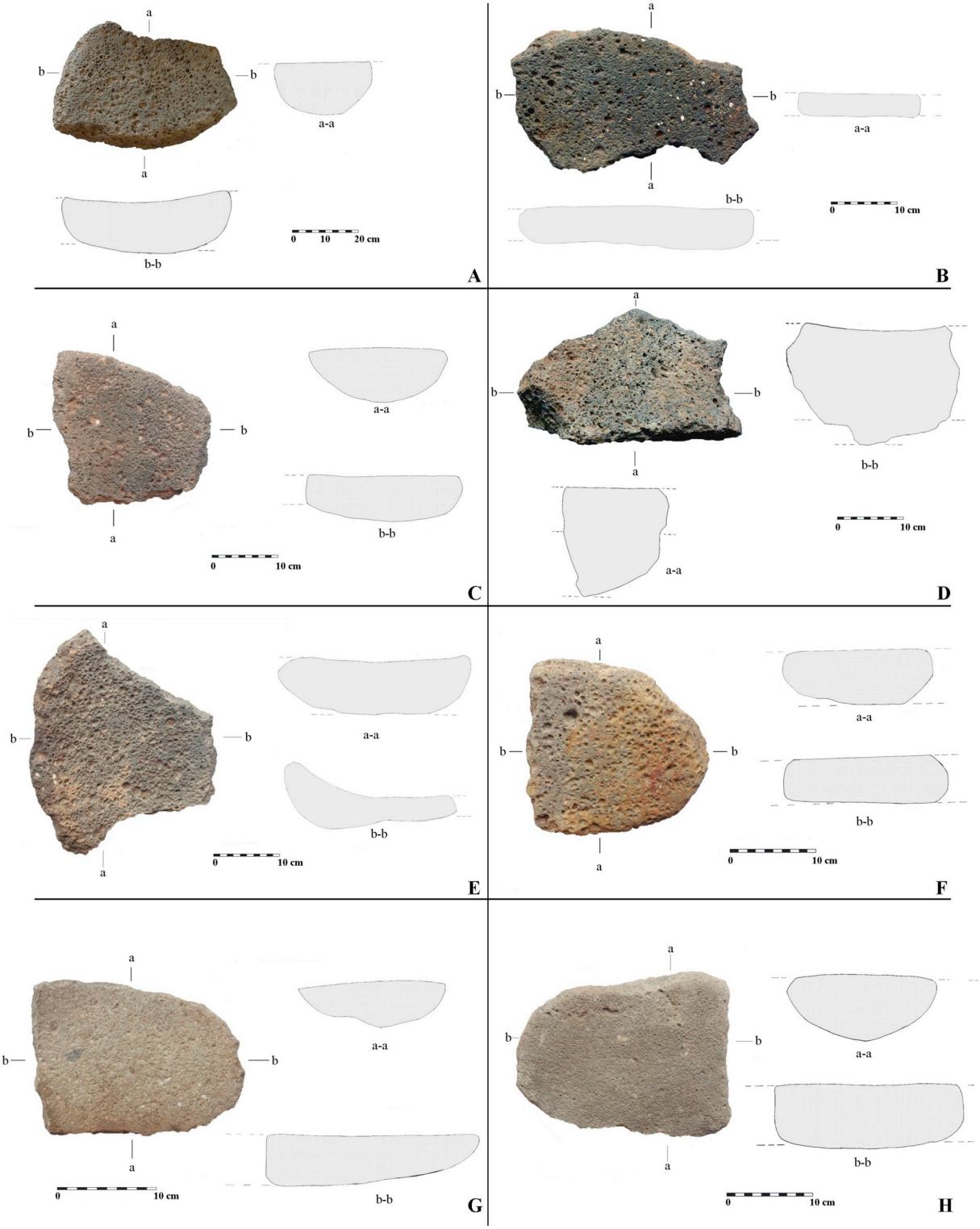
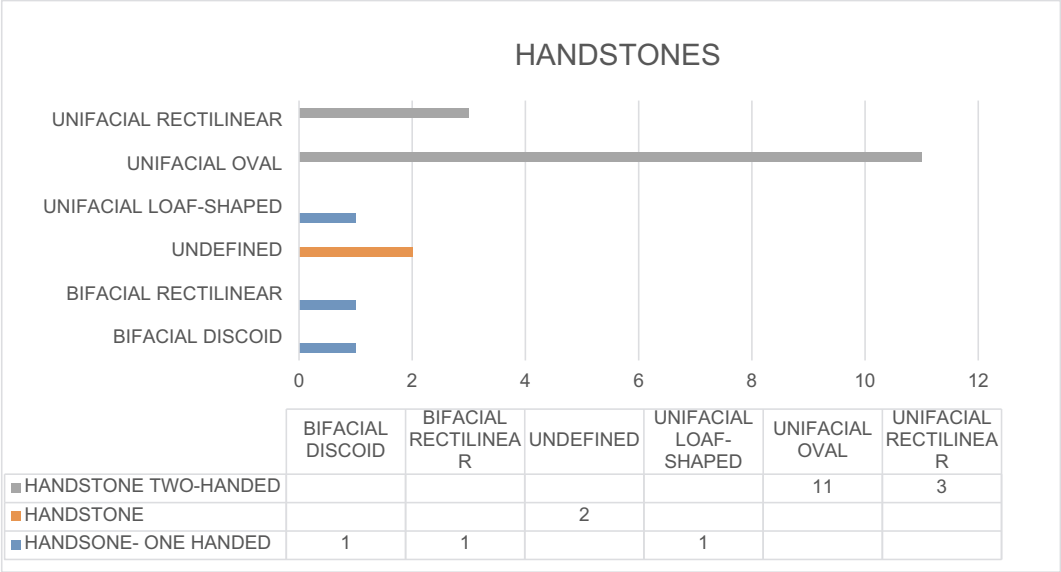


Fig. 7. Different subtypes of grinding slabs form tower D. Saddle-shaped (A; D; E); flat-topped (C; G); flat (B; F; H).

superficial grooves. Fig. 14 shows the disposition and orientation of the linear traces on the grinding-slabs. Generally, in the majority of the grinding-slabs the disposition of the traces displays parallel lines with either longitudinal or oblique orientation (Figs. 14 and 16).

The same linear traces have been underlined also on handstones with the following results. All the samples regardless their subtype, present linear traces that completely cover the use-surface. As shown in Fig. 15, the *two-handed* handstones in particular display a parallel disposition of the linear traces but an oblique orientation; whereas the *one-handed* handstones mostly display a parallel disposition with a longitudinal orientation of the linear traces. The remaining samples show a varied disposition and orientation of linear traces on the use-surface (Fig. 15). The linear traces on handstones' use-surface, in general are rather shallow. The reason may be related to three main aspects: the raw material, mainly vesicular basalt (see § 4.1 Raw material), the active role of the instrument during the grinding process and

Fig. 8. Different subtypes of handstones from D tower. In the background from the left: L122/4 (unifacial oval); L123/2 (unifacial rectilinear). In the foreground from the left: L105/4.2 (unifacial rectilinear); L105/1 (bifacial rectilinear); L141/5 (unifacial rectilinear); L105/3 (unifacial loaf-shaped).



	BIFACIAL DISCOID	BIFACIAL RECTILINEAR	UNDEFINED	UNIFACIAL LOAF-SHAPED	UNIFACIAL OVAL	UNIFACIAL RECTILINEAR
HANDSTONE TWO-HANDED					11	3
HANDSTONE			2			
HANDSONE- ONE HANDED	1	1		1		

Fig. 9. Graph showing the handstones subtypes from tower D. The bars represent the number of artefacts for each category identified.

the presence of intermediate elements between the handstones' surface and the slab (such as grains of wheat, seeds, spices), that are relatively soft and do not deeply scratch the use-surface of the active tool. Furthermore, the manner of handling the tool itself may have contributed to the disposition and orientation of the traces.

Regarding those artefacts made of vesicular basalt (see § 4.1 Raw material), it seems that the orientation of use-traces corresponds to the alignment of pits on the use-surface. Thus, the orientation of pits already existing in the block of basalt may have influenced its choice as a raw material, and it may also have influenced the development of the linear traces and striations on the use-surface. Figs. 16 and 17 show two different examples of correlations between linear traces and alignments of pits.

Finally, it seems that there is a significant correlation between the traces identified on surfaces and the type of tool used. Also, longitudinally-orientated traces found on grinding-slabs, and the oblique signs on handstones, may reflect the position of the tool when in use. In order to confirm these hypotheses, it would be necessary to add an

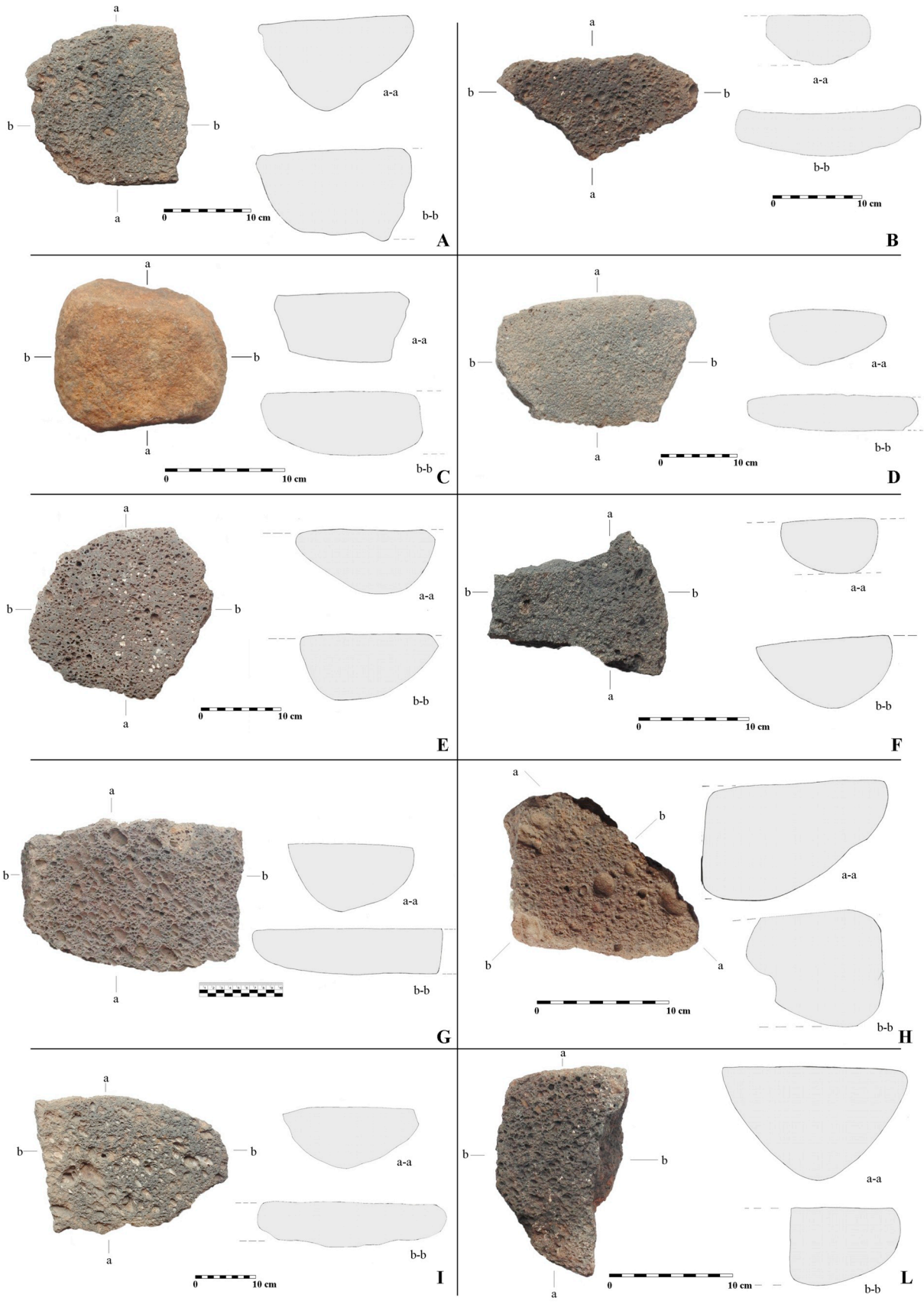
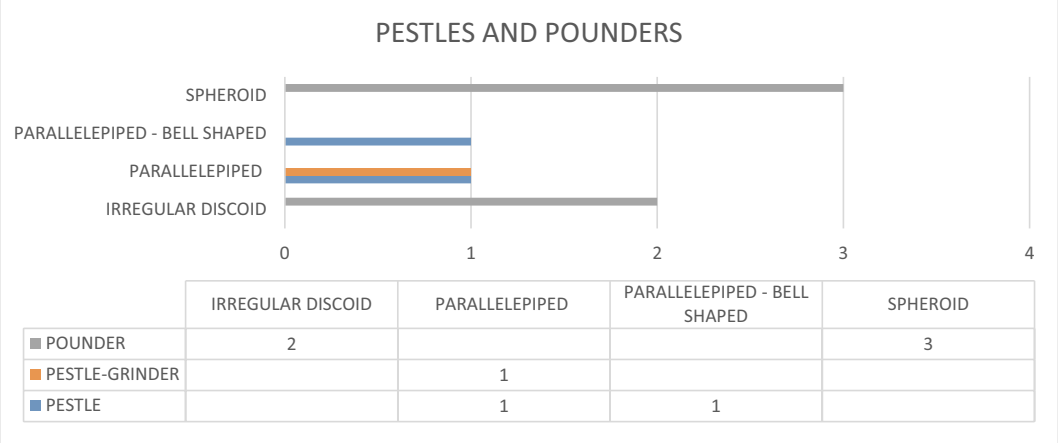


Fig. 10. Different subtypes of handstones from tower D: Unifacial rectilinear (A; D; G; L); unifacial oval (E; I); bifacial discoid (C).

Fig. 11. Pestles and pounders from tower D. From the left: L123/2.1 (spheroid); L141/4 (spheroid), L141/4.1 (irregular discoid); L123/2 (spheroid); L105/1 (irregular discoid); L105/4 (parallelepiped); L42/5 (parallelepiped pestle-grinder).



	IRREGULAR DISCOID	PARALLELEPIPED	PARALLELEPIPED - BELL SHAPED	SPHEROID
POUNDER	2			3
PESTLE-GRINDER		1		
PESTLE		1	1	

Fig. 12. Graph showing the different pestles and pounders subtypes. The bars represent the number of artefacts for each category identified.

experimental phase coupled with microscopically surface analysis of these archaeological artefacts.

In the category of pestles and pounders, percussive marks are located at both poles (inferior and superior) or on their axes (*shaft*), especially of the pestle-grinder. They seem to be related to a beating movement.

However, these signs appear extremely close together and are interconnected, probably due to the up-and-down movement on same point of the use-surface (Fig. 18).

4.1. Raw material

Basalt is the raw material employed for most of the ground-stone tools. The use of this type of rock may be explained by two main reasons: the first concerns its intrinsic properties of tensile resistance, strong compressive strength and high resistance to deformation. Also, vesicular basalt has a natural roughness that requires minimal maintenance and makes for long-lasting tools (Wright, 1992a). The second reason is related to the great availability of this raw material in the territory surrounding Mogoro, especially in the north-eastern and southern areas, which are characterized by the significant presence of basalts and andesite means, fully formed by Oligo-Miocene volcanic activity (Costa, 2015: 31–33).

Concerning handstones, one granite sample has been recorded. This type of stone is not present in the territory of Mogoro, thus it is supposed that it comes from another area, presumably from the nearby Monte Linas massif, in south-western Sardinia (Costa, 2015). Although it has some useful properties, such as hardness, granite is a very difficult

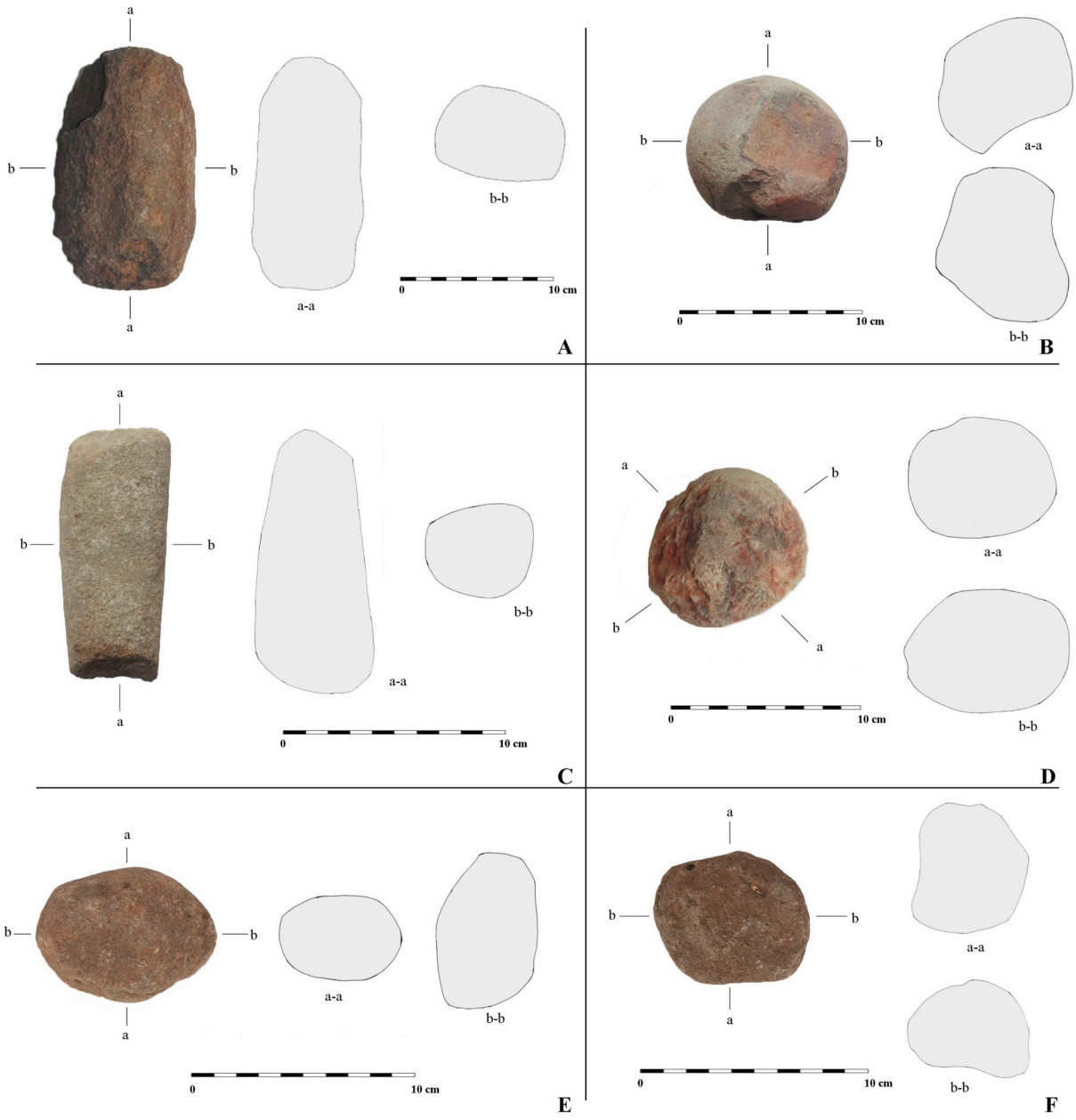


Fig. 13. Pestles and pounders subtypes: Parallelepiped pestle (A; C); Spheroid (D; E); Irregular discoid (B; F).

raw material to work, and this probably explains the low percentage of examples among the samples.

Lastly, in most cases the pestles and pounders are made of basalt. Nevertheless, the analysis reported one sample made of limestone and one made of a hard stone, perhaps a hard quartz-bearing stone. (Fig. 19).

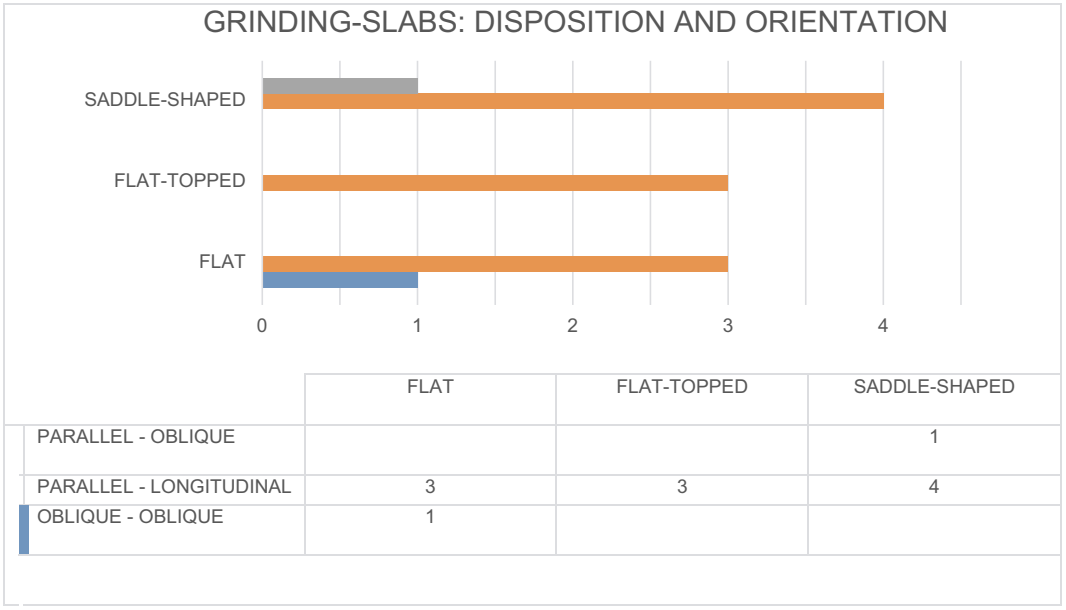
Due to authorization problems, specific petrographic analyses could not be performed. However, the macroscopic and observational analysis of the basaltic material shows that the artefacts taken into consideration in the study are, with very high probability, obtained from local basaltic rock. The site is in fact located on the edge of a vast Plio-Pleistocene basalt plateau referable to the volcanic apparatus of Monte Arci (Costa, 2015). Consequently, on the site itself there was a great abundance of rocky outcrops usable both for the construction of the monuments present in the area, such as, for example, the imposing nuraghi (Fig. 20), and for the realization of everyday objects, such as the ground-stone tools.

5. Ground-stone tools and chronology in tower D

Several significant data are displayed in Fig. 21 which shows the different ground-stone subtypes and their chronology: the majority of the artefacts have been found in layers dated to the transition from the Recent Bronze Age and the Final Bronze Age and in layers dated to the Final Bronze Age. Very few finds are related to the Early Iron Age (Fig. 21). This first information perfectly matches with the chronology of pottery associated to the ground-stone tools (Ragucci, 2015), the archaeobotanical analysis and radio-carbon dating applied on the burnt seeds found in the tower D (Cicilloni, 2015; Ucchesu, 2015).

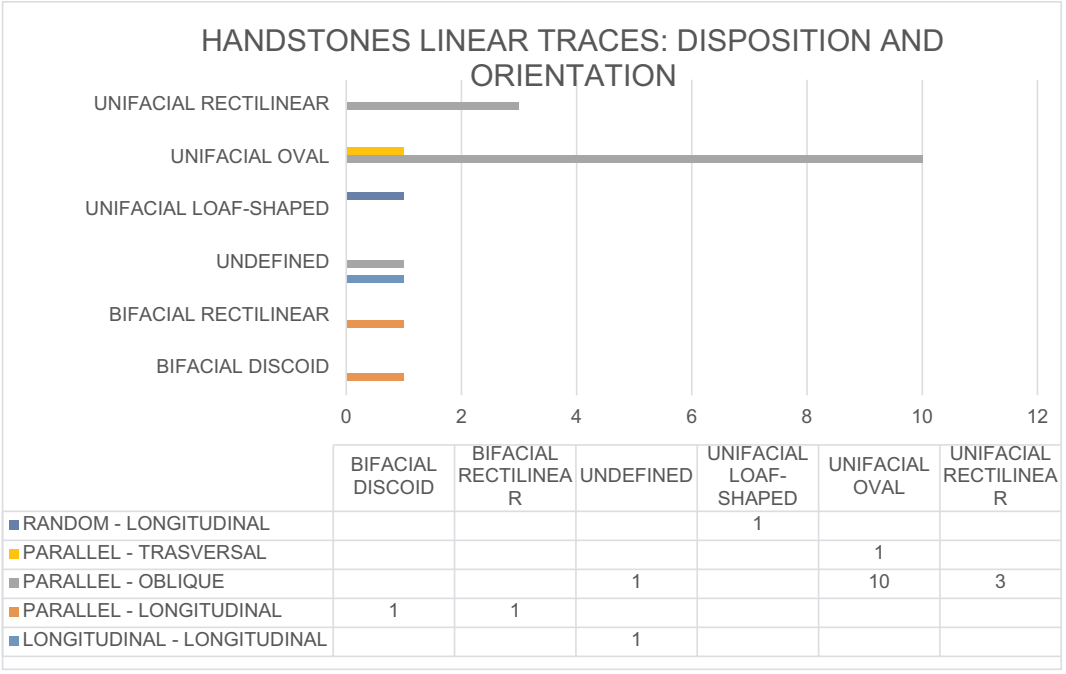
Therefore, the data from the ground-stones analysis support the hypothesis regarding the use of the tower D in nuraghe *Cuccurada* as a space for food production, cooking and consumption from the Recent to the Final Bronze Age.

Other significant data are related to subtypes and chronology (Fig. 21). In fact, despite the low number of finds, it is certainly interesting to underline the use of different subtypes during different



	FLAT	FLAT-TOPPED	SADDLE-SHAPED
PARALLEL - OBLIQUE			1
PARALLEL - LONGITUDINAL	3	3	4
OBLIQUE - OBLIQUE	1		

Fig. 14. Disposition and orientation of linear traces on the surfaces of grinding-slabs. The bars represent the number of artefacts with the identified linear traces.



	BIFACIAL DISCOID	BIFACIAL RECTILINEAR	UNDEFINED	UNIFACIAL LOAF-SHAPED	UNIFACIAL OVAL	UNIFACIAL RECTILINEAR
RANDOM - LONGITUDINAL				1		
PARALLEL - TRASVERSAL					1	
PARALLEL - OBLIQUE			1		10	3
PARALLEL - LONGITUDINAL	1	1				
LONGITUDINAL - LONGITUDINAL			1			

Fig. 15. Disposition and orientation of linear traces on hardstones' surfaces. The bars represent the number of artefacts with the identified linear traces.

times, especially for those which are not used after a certain period. For example, the majority of the *saddle-shaped* grinding-slabs are related to the transition from the Recent Bronze Age to the Final Bronze Age. The same is for the pounders (Fig. 21). The *flat* grinding-slabs, and both *unifacial rectilinear* and *unifacial oval* handstones cover all the periods, while the *parallelepiped* pestles and *one-handed* handstones are mostly related to the Final Bronze Age and Early Iron Age.

6. Discussion

Studying and cataloguing grinding artefacts assumes a fundamental role when the results are used to understand the grade and the type of social and economic organization within a prehistoric community (Risch, 2008; Dubreuil, 2001; Delgado Raack et al., 2008; Adams, 2014; Alonso Martinez, 2014). This study attempted to demonstrate the variety of tools that were employed for grinding activities in nuraghe *Cuccurada*-Mogoro throughout the Bronze Age.

This complexity plays a fundamental role that is necessary for understanding the living conditions of a community, especially when we refer to the concept of 'social production' (Risch, 2008). Therefore, what kind of social implications might the use of ground-stone tools have had within *nuraghe Cuccurada*?

Within the context of nuraghe *Cuccurada*, the association of the ground-stone tools with cooking pottery, support the idea that those tools were used for the transformation of food such as grain, seeds, herbs to flour, spices and other products.

Despite the limited number of samples, the use of the methodology applied by Wright (1992a, 1992b), Mori (2005) and Adams (2009,

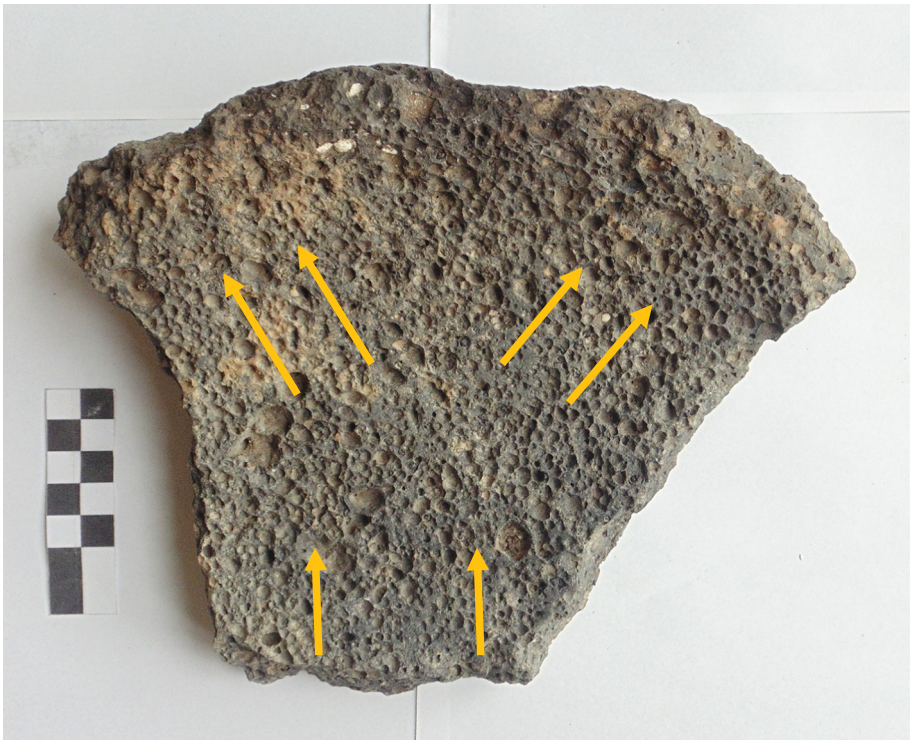


Fig. 16. Use-wear traces orientation and distribution patterns on a grinding-slab (L105/3). The yellow arrows indicate the orientation of the linear traces on the use-surface in correlation with the orientation of the pits. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Fig. 17. Use-wear traces orientation and distribution patterns on a handstone (L42/6). The yellow arrows indicate the orientation of the linear traces on the use-surface in correlation with the orientation of the pits. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

2014) and, especially the application of a proper terminology supported the identification of the different subtypes employed in the tower D.

The macroscopic analysis on the use-surface gave some hint regarding the possible movement and its direction, applied on the different tools. However, this aspect would benefit from an additional investigation which employs microscopic use-wear analysis combined with experimental archaeology.

Regarding the raw material and the state of preservation of the tools, the extensive degree of fragmentation seems to apply more to handstones than to grinding-slabs. Especially for grinding-slabs, they look like they were not used to the point of material exhaustion. This aspect is certainly connected to the use of basalt as raw material, the properties of which have already been discussed. Certainly, significant data were provided by the chronological and stratigraphic analysis of the ground-stone tools. The reason for the persistence of particular subtypes throughout the time may be due to several reasons, including the life-history of the tool and its resistance. Generally, ground-stone tools are long-lasting artefacts and the ground-stones from tower D reflects this feature. However, the presence in higher quantity of certain subtypes in particular moments of the Bronze Age, may reflect also different techniques used in the grinding process. Therefore, it is interesting to see that, for example, during the Recent-Final Bronze Age transition there is a high number of *saddle-shaped* slabs, *unifacial oval* handstones and *spheroid* pounders which may be associated to a particular food-processing or *chaîne operatoire* that involved those artefacts.

The relationship between the production of artefacts and spaces reveals diverse information on socio-economic aspects, coupled with some information regarding the division of work in a prehistoric

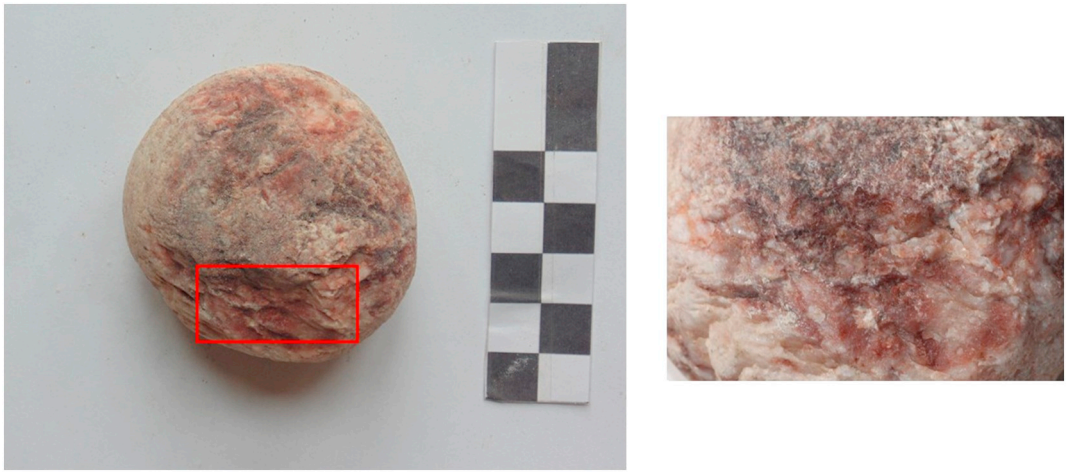
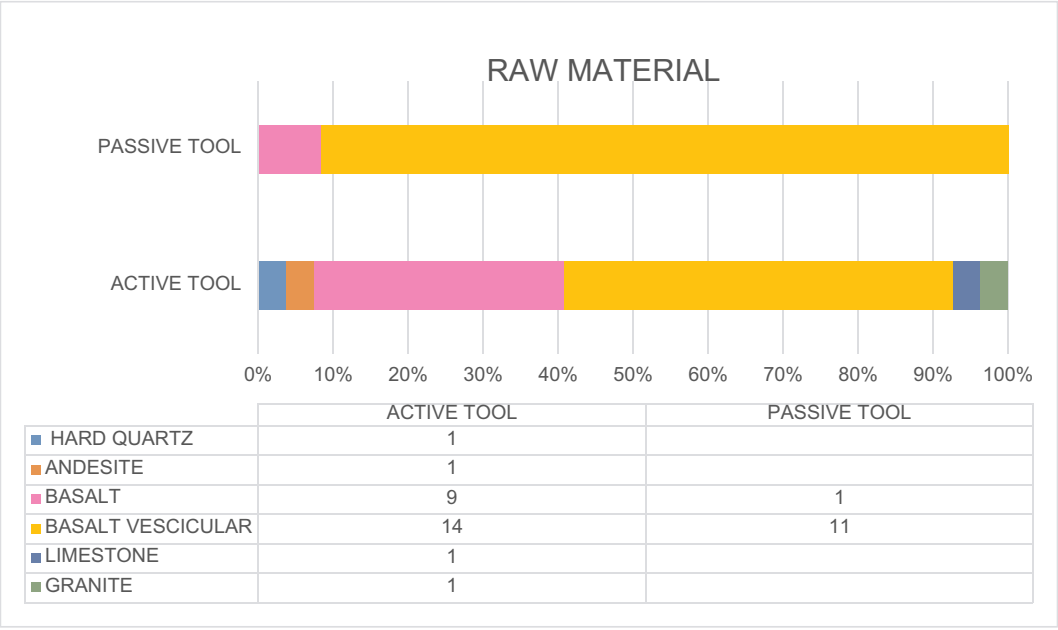


Fig. 18. Beating traces on a pounder (L 141/4.).



	ACTIVE TOOL	PASSIVE TOOL
HARD QUARTZ	1	
ANDESITE	1	
BASALT	9	1
BASALT VESCICULAR	14	11
LIMESTONE	1	
GRANITE	1	

Fig. 19. Raw material for ground-stone tools in tower D, type and percentage.

community (Alonso Martinez, 2016: 24–30). In fact, as we have already presented (see §1 Introduction) several excavations confirmed the presence of towers used such as food storages or production areas, for example: nuraghe *Alvu-Pozzomaggiore*, nuraghe *Arrubiu-Orroli*, nuraghe *Palmavera-Alghero* or nuraghe *Santu Antine-Torralba*, the room in hut n. 36 in Barumini, the tower C in *nuraghe Arrubiu-Orroli*, the 'big circular structure in *Monte Zara*-Monastir'. Each of these spaces yielded not only remnants of foodstuffs, but also instruments such as sickles, sickle-sharpeners, *dolia* and various types of ground-stone tools (Campus and Derudas, 2012; Lilliu, 1955; Perra, 2018; Lo Schiavo et al., 2015; Ugas, 2001).

Concerning the social aspect, grinding activities may be considered as individual tasks, or these may have been tasks for several people who worked together in common areas of the village (Zamagni, 2008; Alonso Martinez, 2014). The subdivision of tasks between men and women is associated with various factors such as work specialization, arrangement of activities within a determined space, the introduction of animal husbandry or the population density and fertility (Risch, 2008: 524; Alonso Martinez, 2016: 26–29). Thus, the several findings connected to grinding activities within the Sardinian Nuragic towers may be interpreted in light of these aspects.

The role of ethno-archaeology becomes central to the comprehension and hypothesis of the 'social role' of grinding tools. Various examples come from the study of archaeological artefacts found in extra-European contexts, which are then compared with instruments used today by communities that still live in those regions. One example comes from the archaeological site of *Aghram Nadarif* (North Africa), compared to the village of the *Fewet* oasis, where women still engage in grinding activities with ground-stone tools (Mori, 2005). More data comes from several villages in Anatolia, among them the village of *Kizilkaya*, or those discovered in Mauritania and Nepal (Zamagni, 2008; Alonso Martinez, 2014: 117). In all these contexts the grinding activities are restricted to female sphere (Hamon and Le Gall, 2013).

7. Conclusions

In conclusion, considering all the above aspects, the presence of several instruments, such as grinding-slabs, handstones, pestles and pounders in association with cooking pottery, may be related in this case to agricultural practices and food-processing. These data are

Fig. 20. Example of local basalt used to build nuraghe Cuccurada-Mogoro.

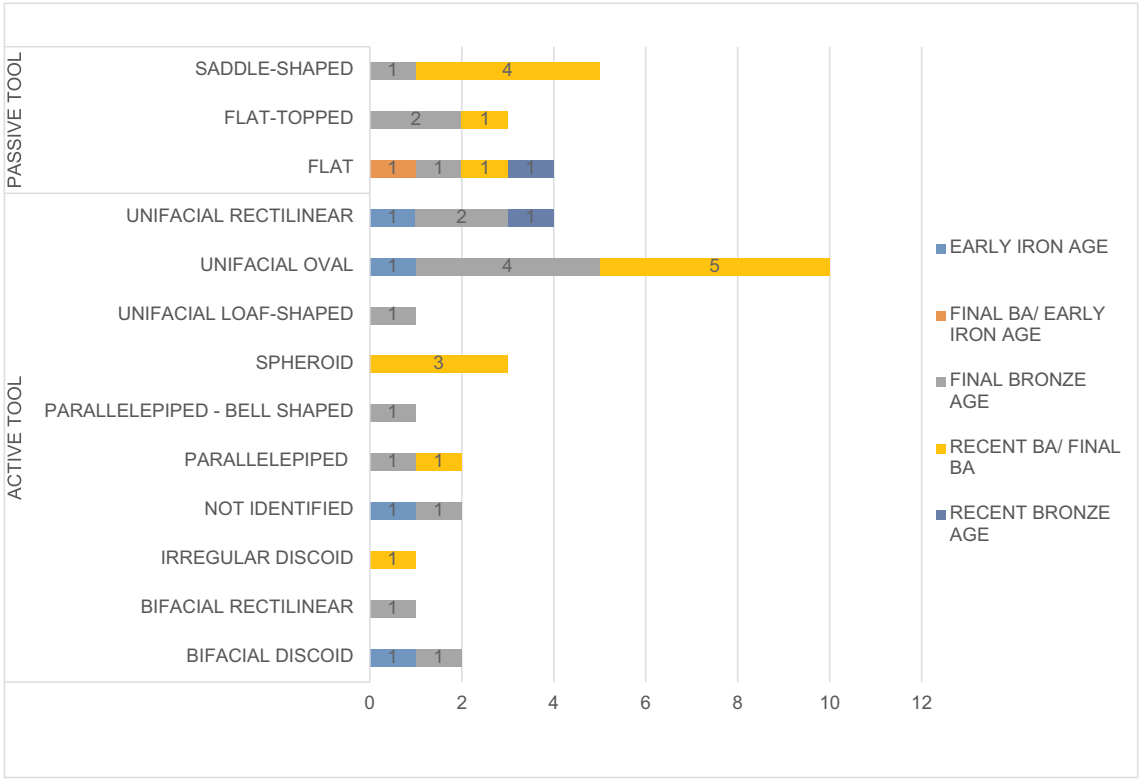


Fig. 21. Chronology of the ground-stone tools used during the different Bronze Age phase in relation to the subtypes.

supported by archaeobotanical analysis (Cicilloni et al., 2017). Nevertheless, there is no certainty that tasks such as preparing and cooking food were managed exclusively by the women of the village, although research and the ethnographic data suggest that this was the case (Wright, 2000; Mori, 2005; Hamon and Le Gall, 2013; Mori and Lemorini, 2013; Zamagni, 2008). A significant fact is the presence of

spaces specially designed for transformation of raw materials such as grain, seeds, and fruits. These spaces are present not only in the *Cuccurada* nuraghe, but also in other contexts, such as the *Arrubiu* nuraghe in Orroli (Lo Schiavo et al., 2015). This element suggests a production organization that included 'community activities' carried out within the nuraghi. In fact, some spaces of nuraghe may have been areas for storing foodstuffs and perhaps at the same time, group centers where there existed a subdivision of tasks among men and women, who together managed all the everyday activities.

Acknowledgments

The authors would like to express their gratitude to Professor Carlo Luglié for his valuable and constructive suggestions during the development of this work. They extend their thanks to Doctor Sandra Carta for her help during the work at the laboratory in Mogoro. The authors would like to thank the anonymous reviewers and the editors of *Journal of Archaeological Science Reports*, for valuable comments and suggestions that improved this article significantly.

References

Adams, J.L., 2002. Ground Stone Analysis: A Technological Approach. The University of Utah Press and American Southwest, Salt Lake City.

Adams, J.L., 2014. Ground stone use-wear analysis: a review of terminology and experimental methods. J. Archaeol. Sci. 48, 129–138.

Adams, J., Delgado, S., Dubreuil, L., Hamon, C., Plisson, H., Risch, R., 2009. Functional analysis of macro-lithic artefacts: a focus on working surfaces. In: Sternke, F., Eigeland, L., Costa, L.J. (Eds.), Non-flint Raw Material Use in Prehistory. Old Prejudices and New Directions. Proceedings of the XV UISSP World Congress (Lisbon, 4–9 September 2006) (British Archaeological Reports International Series 1939). Archaeopress, Oxford, pp. 43–66.

Alonso, N., Frankel, R., 2017. A survey of ancient grain milling systems in the Mediterranean. In: RAE-Revue Archéologie de l'Est, pp. 1–14.

Alonso Martinez, N., 2014. Etnoarqueología del proceso de molienda manual de cereales: grañones, sémolas y harinas. In: Rivista d'Arqueología de Ponent. 24. pp. 113–136.

Alonso Martinez, N., 2016. En la busca del trabajo de las mujeres en la agricultura pre- y protohistórica. In: Delgado Hervás, A., Picazo Gurina, M. (Eds.), Los trabajos de las mujeres en el mundo antiguo- Cuidado y mantenimiento de la vida. 8. Institut Català d'Arqueología Clàssica- Hic et Nunc, pp. 23–36.

Antonovic, D., 2006. Stone Tools From Lepenski Vir (Cahiers des Portes de Fer Monographies 5). Institute of Archaeology, Belgrade.

Atzeni, E., 2015. Il bronzetto con scena di caccia. In: Cicilloni, R. (Ed.), Ricerche archeologiche a Cuccurada-Mogoro (Sardegna centro-occidentale). Morlacchi Ed. U.P, Perugia, pp. 389–390.

Atzeni, E., Carta, S., Cicilloni, R., Ragucci, G., Usai, E., 2015. Il Nuraghe Cuccurada di Mogoro (Sardegna Archeologica 58). Carlo Delfino, Sassari.

Basoli, P., 2007. Una macina dal nuraghe Palonalzu o Barunalzu (San Lorenzo- Osilo). In: Nota sull'agricoltura in età nuragica. 4 Corsica et Baleares antiquae, Sardinia 6976.

Beller, J.A., Greenfield, H.J., Shai, I., Maeir, A.M., 2016. The life history of basalt ground stone tools from early urban domestic contexts: a chronicle from EBAIII of Tell es-Safi/Gath, Israel. J. Lithic Stud. 3, 31–55.

Bronk Ramsey, C., 2009. Bayesian analysis of radiocarbon dates. Radiocarbon 51, 337–360. https://doi.org/10.1017/S0033822200033865.

Cabras, M., 2015. I Nuraghi del territorio: analisi spaziali in ambiente GIS. In: Cicilloni, R. (Ed.), Ricerche archeologiche a Cuccurada-Mogoro (Sardegna centro-occidentale). Morlacchi Ed. U.P, Perugia, pp. 77–94.

Campus, F., Derudas, P., 2012. L'agricoltura in età nuragica. Luoghi Strumenti Prodotti. In: Luglié, C. (Ed.), La Preistoria e la Protostoria della Sardegna. II. Istituto Italiano di Preistoria e Protostoria, Firenze, pp. 797–803 (Comunicazioni. Atti della XLIV Riunione Scientifica dell'Istituto Italiano di Preistoria e Protostoria (Cagliari, Barumini, Sassari 23-28 novembre 2009).

Carter, T., 2004. The stone implements. In: Soles, J.S., Davaras, C., Bending, J., Carter, T., Kondopoulou, D., Mylona, D., Ntinou, M., Nicgorski, A.M., Reese, D.S., Sarpaki, A., Schoch, W.H., Soles, M.E., Spatharas, V., Stos-Gale, Z.A., Tarling, D.H., Witmore, C. (Eds.), Mocholos IC. Period III. Neopalatial Settlement on the Coast: The Artisan's Quarter and the Farmhouse at Chalinomouri. The Small Finds (Prehistory Monographs 9). INSTAP Academic Press, Philadelphia, pp. 61–108.

Castelletti, L., Motella De Carlo, S., Corti, C., Rampazzi, L., Piccoli, A., 2015. L'alimentazione nella Preistoria dell'Italia settentrionale: casi di studio e metodi di indagine. In: Paper Presented at the 50th Scientific Meeting of the Italian Institute of Prehistory and Protohistory, Rome, 5–9 October 2015.

Cattani, M., Debandi, F., Magri, A., Peinetti, A., Tusa, S., 2016. Mursia (Pantelleria, Prov. Di Trapani). Notiziario di Preistoria e Protostoria 3, 87–90.

Cicilloni, R., 2015. Le fasi di frequentazione del sito. In: Cicilloni, R. (Ed.), Ricerche archeologiche a Cuccurada-Mogoro (Sardegna centro-occidentale). Morlacchi Ed. U.P, Perugia, pp. 185–196.

Cicilloni, R., Ragucci, G., Cabras, M., Mossa, A., 2016. New approaches in landscape analysis of the Bronze Age in Central-Western Sardinia: the Area of Mogoro (Oristano–Italy). In: Burgers, G.J., Tetteroo, C., Pelgrom, J., Mcgrath, M. (Eds.), Multi-, Inter- and Transdisciplinary Research in Landscape Archaeology, LAC2014. Proceedings 3rd International Landscape Archaeology Conference (Roma 17–20 Settembre 2014). University Library, Amsterdam, pp. 1–12.

Cicilloni, R., Ucchesu, M., Carannante, A., Chilardi, S., 2017. Il nuraghe Cuccurada di Mogoro. Vita ed economia di un insediamento dell'Alta Marmilla dalla Preistoria al Medioevo. In: Serreli, G., Melis, R.T., French, C., Sulas, F. (Eds.), Sa Massarìa. Ecologia storica dei sistemi di lavoro contadino in Sardegna. ISEM-CNR, Cagliari, pp. 405–425.

Copat, V., 2015. The sensorial experience of food preparation and consumption in the Late Bronze Age site of Oratino-La Rocca (Campobasso-Southern Italy). In: Gheorghiu, D., Bouissac, P. (Eds.), How Do We Imagine the Past? On Metaphorical Thought, Experientiality and Imagination in Archaeology. Cambridge Scholar Publishing, Cambridge, pp. 27–48.

Copat, V. & M. Danesi. 2017. Il sito della Rocca di Oratino (CB) nel contesto del versante Adriatico meridionale, in F. Radina (ed.), Preistoria e Protostoria della Puglia. Atti della XLVII Riunione Scientifica dell'Istituto Italiano di Preistoria e Protostoria (Ostuni, 9-13 ottobre 2012): 1005-1009. Firenze: Istituto Italiano di Preistoria e Protostoria.

Copat, V., Danesi, M., D'oronzo, C., 2012. Nuovi dati sulla frequentazione appenninica del sito di Oratino–La Rocca (CB). In: Gravina, A. (Ed.), Atti del 32° Convegno Nazionale sulla Preistoria, Protostoria, Storia della Daunia (San Severo 12-13 novembre 2011). Archeoclub d'Italia, Sede di San Severo, San Severo, pp. 171–202.

Cossu, T. 2005. Il pane in Sardegna dalla preistoria all'età romana, in P. Piquereddu (ed.), Pani. Tradizioni e prospettive della panificazione in Sardegna: 52-59. Nuoro: Ilisso.

Costa, M. 2015. Il territorio di Mogoro dal punto di vista geologico e geomorfologico, in R.Cicilloni (ed.) Ricerche archeologiche a Cuccurada-Mogoro (Sardegna centro-occidentale): 31-39. Perugia: Morlacchi Ed. U.P.

Delgado Raack, S., 2008. Prácticas ecónomicas y gestión social de recursos (macro)líticos en la Prehistoria reciente (III-I milenios a.C.) del Mediterráneo occidental. Universitat Autonoma de Barcelona, Unpublished PhD dissertation.

Delgado Raack, S. & R. Risch. 2009. Towards a systematic analysis of grain processing technologies, in M. de Araùjo Igreja & I. Clemente Conte (ed.), Recent Functional Studies on Non Flint Stone Tools: Methodological improvements and Archaeological Inferences. Proceedings of the Workshop (Lisboa, 23-25 May 2008), 1-20. Available at:http://asome.uab.cat/Delgado_Risch_2009.pdf (accessed 10 september 2018)

Delgado Raack, S., D. Gomez Gras & R. Risch. 2008. Las propriedades mecánicas del los artefactos macrolíticos: una base metodológica para el análisis functional, in S. Rovira Llorens, M. Garcia-Heras, M. Gener Moret & I. Montero Ruiz (ed.), Actas del VII Congreso Ibérico de Arqueometría (Madrid 8-10 de Octubre 2007): 330-45. Madrid: CSIC.

Dubreuil, L., 2001. Functional studies of prehistoric grindingstones: a methodological research. Bulletin du Centre de Recherche Français de Jérusalem 9, 73–87.

Dubreuil, L., 2002. Etude fonctionelle des outils de broyage natoufiens: nouvelle perspectives sur l'émergence de l'agriculture au Proche-Orient. Doctoral Thesis of the University Bordeaux, Bordeaux, pp. I.

Hamon, C., Le Gall, V., 2013. Millet and sauce: the uses and functions of querns among the Minyanka (Mali). Journal of Anthropology and Archaelogy 32, 109–121.

Lilliu, G., 1955. Il nuraghe di Barumini e la stratigrafia nuragica. Studi Sardi XII-XIII 89–469.

Lo Schiavo, F., Perra, M. (Eds.), 2017. Il nuraghe Arrubiu di Orroli. Volume 1. La torre centrale e il cortile B: il cuore del gigante rosso. Cagliari, Arkadia.

Lo Schiavo, F., M. Perra & P. Marinval. 2015. Il Pane nella Sardegna Nuragica. Paper Presented at the 50th Scientific Meeting of the Italian Institute of Prehistory and Protohistory, Rome, 5–9 October 2015.

Mori, L. 2005. The groundstone tools, in M. Liverani (ed.), Aghram Nadharif. The Barkat Oasis (Sha'abiya of Ghat, Libyan Sahara) in Garamantian Times. The Archaeology of Libyan Sahara Volume II (Arid Zone Archaelogy 5): 259-84. Firenze: All'Insegna del Giglio.

Mori, L. & C. Lemorini. 2013. Macro-lithic tools from Fewet, in L. Mori (ed.), Life and Death of a Rural Village in Garamantian Times. Archaeological Investigations in the Oasis of Fewet (Libyan Sahara) (Arid Zone Archaeology 6): 93-107. Firenze: All'Insegna del Giglio.

Palio, O., Todaro, S.V., Turco, M., 2016. Valcorrente (Belpasso, Prov. di Catania). Notiziario di Preistoria e Protostoria 3, 59–61.

Pérez Jordà, G., Alonso Martínez, N., Iborra Eres, M., 2007. Agricultura y ganadería protohistóricas en la península ibérica: modelos de gestión. In: Rodríguez Díaz, A., Pavón Soldevila, I. (Eds.), Arqueología de la tierra. Paisajes rurales de la protohistoria peninsular, Cáceres. Universidad de Extremadura, Servicio de Publicaciones, pp. 327–373.

Perra, M., 2018. Alla mensa dei Nuragici. Mangiare e bere al tempo dei nuraghi. Carlo Delfino, Sassari.

Ragucci, G., 2015. La torre D. In: Cicilloni, R. (Ed.), Ricerche archeologiche a Cuccurada-Mogoro (Sardegna centro-occidentale). Morlacchi Ed. U.P, Perugia, pp. 206–218.

Recchia, G., V. Copat & M. Danesi. 2008. L'uso dello spazio nell'insediamento sub-appenninico di Oratino: note preliminari, in A. Gravina (ed.), Atti del 28° Convegno Nazionale sulla Preistoria, Protostoria, Storia della Daunia (San Severo 25-26 novembre 2007): 252-74. San Severo: Archeoclub d'Italia, Sede di San Severo.

Reimer, P.J., E. Bard, A. Bayliss, J.W. Beck, P.G. Blackwell, C. Bronk Ramsey, C.E. Buck, H. Cheng, R.L. Edwards, M. Friedrich, P.M. Grootes, T.P. Guilderson, H. Haflidason, I Hajdas, C. Hatté, T.J. Heaton, D.L. Hoffmann, A.G. Hogg, K.A. Hughen, K.F. Kaiser, B Kromer, S.W. Manning, M. Niu, R.W. Reimer, D.A. Richards, E.M. Scott, J.R. Southon, R.A. Staff, C.S.M. Turney & J. van der Plicht. 2013. IntCal13 and Marine 13 radiocarbon age calibration curves 0–50,000 years cal BP. Radiocarbon 55: 1869–87. doi:https://doi.org/10.2458/azu_js_rc.55.16947

Risch, R., 1995. Recursos naturales y sistemas de producción en el Sudeste de la Península

Ibérica entre 3000 y 1000 ANE. Tesis Doctoral de la Universidad Autónoma de Barcelona. www.tesisenxarxa.net/TDX-0507108-164458/.

Risch, R., 2008. From production traces to social organisation: towards an epistemology of functional analysis. In: Longo, L., Skakun, N. (Eds.), "Prehistoric Technology" 40 Years Later: Functional Studies and the Russian Legacy (British Archaeological Reports International Series 1783). Archaeopress, Oxford, pp. 519–527.

Tsoraki, C., 2018. 10. Ground stone technologies at the Bronze Age settlement of Sissi, in J.Driessen, I. Schoep, M. Anastasiadou, F. Carpentier, I. Crevecoeur, S. Déderix, M. Devolder, F.Gaignerot-Driessen, S. Jusseret, C. Langohr, Q. Letesson, F. Liard, A. Schmitt, C. Tsoraki & R.Veropoulidou, Excavations at Sissi III: Preliminary Report on the 2011 Campaign. Presses Universitaires de Louvain, Louvain-la-Neuve, pp. 201–221.

Ucchesu, M., 2015. Le analisi paleobotaniche. In: Cicilloni, R. (Ed.), Ricerche archeologiche a Cuccurada-Mogoro (Sardegna centro-occidentale). Morlacchi Ed. U.P, Perugia, pp. 416–421.

Ucchesu, M., Peña Chocarro, L., Sabato, D., Tanda, G., 2014. Bronze Age subsistence in Sardinia, Italy: cultivated plants and wild resources. Vegetation History and Archaeobotany 24, 34355.

Ugas, G. 2001. Torchio nuragico per il vino dall'edificio laboratorio n. 46 di Monte Zara in Monastir, in Ass. Cult. Filippo Nissardi (ed.), Architettura, arte e artigianato nel Mediterraneo dalla Preistoria all'Alto Medioevo. Atti della Tavola Rotonda Internazionale in memoria di Giovanni Tore (Cagliari, 17-19 dicembre 1999): 77-142. Oristano: S'Alvure.

Wright, K.I., 1992a. A classification system for ground stone tools from the prehistoric Levant. Paléorient 18, 53–81.

Wright, K.I., 1992b. Ground Stone Assemblage Variations and Subsistence Strategies in the Levant, 22,000 to 5,000 BP. Unpublished PhD dissertation, Yale University.

Wright, K.I., 2000. The social origins of cooking and dining in early villages of Western Asia. Proceeding of the Prehistoric Society 66, 89–121.

Zamagni, B., 2008. La macinatura dei cereali. Aspetti tecnici e sociali. Mundus, rivista didattica della storia I 138–143.