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BLANK PRODUCTION BY FRACTURATION («DÉBITAGE» BY FRACTURATION) AT THE BEGINNING OF THE COPPER AGE IN SARDINIA (ITALY): THE CASE OF HARD ANIMAL MATERIALS AT THE SU CODDU SITE (SELARGIUS, CAGLIARI)

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The technological analysis of hard animal material industry of the site of Su Coddu (Selargius, Cagliari, Italia) allows to compensate the lack of studies on the early Copper Age in Sardinia. The aim of this paper is to present the results obtained from the analysis of industry coming from the structures excavated between 1994 and 2012 under the direction of Maria Rosaria Manunza. The application of refitting by a default method made it possible to characterize the debitage methods applied for the transformation of blocks. In particular, the elements that allow reconstructing the blank production using a fracturation method are presented. Furthermore, the technological and economical aspects relating to this method of blank production, which is the most attested in the site, are discussed.

Keywords: archaeology, First Copper Age, Sardinia, bone industry, technological analysis, blank production by fracturation method.

The Ozieri II (or sub-Ozieri) is the phase that marks the beginning of the Copper Age in Sardinia (4100–3500 BC). It is situated chronologically between Ozieri I (Recent-final Neolithic, 4100–3500 BC) and Filigosa in northern Sardinia (Middle Chalcolithic, 3000–2500 BC) (Melis, 2000, 2009, 2013) and Monte Claro in southern Sardinia (Middle Chalcolithic, 2900–2200 BC) (Manunza, 2010, 2013). This phase was defined quite recently, and now it has its own distinctive characteristics (Ugas *et al*., 1989a, 1989b; Usai, 1987; Manunza, 2005, 2012; Melis, 2000, 2009, 2013; Melis *et al*., 2007; Lai *et al.*, 2011), especially thanks to the studies on the site of Su Coddu at Selargius (Ugas *et al*., 1989a, 1989b; Manunza, 1994–1996, 2004, 2005, 2012; Manunza, Lecca, 2005–06; Melis, 2009, 2013; Melis *et al*., 2007). Although this work has supplied a lot of important information for understanding the evolution of Sardinian prehistoric societies, there are some remaining aspects that have still yet to be explored.

Thus, the industry on osseous materials is still unknown, despite its frequency in the sites of the first Copper Age, especially in Su Coddu. The objective of this article is twofold: firstly, it aims to characterize the industry in the bone-material during Ozieri II, and secondly it aims to identify the typical aspects of blank production using a fracturation method and to define the role that this method played within the operating system of bone material in the site.

1. The site of Su Coddu (Selargius, Cagliari, Italy)

The prehistoric settlement of Su Coddu is located in the northern and northwestern outskirts of the urban area of Selargius, close to the river of San Giovanni and the pond of Molentargius, and a few kilometers further south (fig. 1: 1). It fits into a landscape whose moderate reliefs amount to a a maximum of twenty meters above sea level.

Discovered during the construction of a housing estate, the site was excavated first by G. Ugas and colleagues between 1981 and 1993 (Ugas *et al*., 1989a; 1989b) (fig. 1: 2) and successively by M. R. Manunza between 1994 and 2012 (Manunza, 1994–96; Manunza, Lecca, 2005-06). Studies have shown that the village was composed of semi-interred or semi-recessed structures from which residential structures, wells, silos, and fireplaces were recognized. Preliminary results of studies on the remains allowed to establish that Ozieri I and Ozieri II phases identified in the 200 structures involved different areas on the site, implanting the Ozieri II structures further west (Manunza, 1994–1996; 2012; Manunza *et al*., 2012), with the exception of few structures used in both phases. The structures were excavated by the *Soprintendenza* and by the collaboration of the Universities of Cagliari (G. Tanda) and Sassari (M. G. Melis) (fig. 1: 2–3).

2. The first Copper Age osseous industry of the Su Coddu site

The bone industry of the Su Coddu site is actually known thanks to the study of the remains from the Badas Lot (Melis *et al*., 2012; Manca, 2012; 2013). According to this study, the bone material industry is obtained exclusively by domestic animals (sheep and cattle), and the anatomical parts selected, the metapodials and tibias, are not very varied. The toolkit product is mainly composed of sharp tools, and the most commonly identified methods of debitage are the blank production by fracturation and the blank production by bipartition (Averbouh, 2000). However, the methods of blank production by extraction and by sectioning were rarely used. The blanks obtained have an exclusively flattened shape and come close to the morphology of finished objects. This is why the shaping method is limited to a restricted part of the blank (Averbouh, 2000) that was generally the most used to shape the active part of the finished objects.

2.1 Composition of the osseous materials corpus and the method used for reconstitution of technical transformation schemes

In this paper, we present the study of the industry excavated under the direction of M. R. Manunza between 1994 and 2012. The analyzed remains come from the collections of the *Soprintendenza di Cagliari* and from a selection made directly in faunal remains.

A total of 205 pieces were selected, of which 73% (150 pieces) are shells (Manca, 2013, 2014) while the remaining 27% (55 remains) of the industry are on bone material (fig. 2: 1). These pieces were found in several structures of the village Ozieri II, with a higher concentration in some areas of the village (especially in the lot Zetadomus, areas A and B) (fig. 2: 2).

The dominant osseous raw material is bone while the antler is rarely attested (fig. 2: 3). The majority of exploited species for the bone industry are from domesticated animals (cattle and sheep). In contrast, pigs are rarely exploited. Wild species are instead attested by a small number of remains belonging to deer and birds (fig. 2: 4). Among the anatomic parts selected, long bones represent 57% of the industry and the flat bones represent 12% of the whole. 31% of the pieces were produced on raw material blocks whose anatomical origin could not be determined (fig. 2: 5).

The largest part of the osseous industry corpus is composed of finished objects (41 pieces); the other types of technical products (roughouts, blanks and waste) are very poorly represented (10 pieces) and indeterminate objects are 4 pieces (fig. 2: 6).

The toolkit is principally composed of sharp tools (fig. 3: 1–3), and smoothers (1 piece; fig. 3: 4), rounded edge tools (fig. 3: 5) and beveled objects (fig. 3: 6) are rarely attested.

These products are ordered into complementary subsets (Averbouh, 2000. P. 40). Their classification is made according to the type of product (finished objects, roughouts, blanks and waste), the raw material (antler or bone) and the modes of transformation employed. This first level of classification allows identifying the type of exploitation related to raw materials represented. The second level of classification, is produced according to a subdivision into various subsets with a different precision scale, in order to reconstruct the same transformation scheme (Averbouh, 2000. P. 40–43; 2001). The subsets are then constituted differently, but they still have a complementary character: typological categories (types of finished objects, types of blanks and other product categories); belonging to the technical transformation sequence (*debitage*, shaping and finishing phases); anatomic origin of the raw material block (Averbouh, 2000. P. 40–43).

The refitting by default thus leads demonstrate the use of blank production by bipartitioning mainly implemented by longitudinal splitting by indirect percussion. The debitage method by sectioning, well attested, could be only partially characterized because of the scarcity of available refitting and the majority presence of finished objects. However, the method of debitage by fracturation has been well characterized by the presence of a greater number of finished objects and some wastes of transformation (fig. 4: 1).

3. The blank production by fracturation employed during the Ozieri II of Su Coddu

The aim of the blank production by fracturation is to fracture a block by a violent breaking that allows to divide it into various sizes parts (epiphysis extremities, flakes, and splinters). 27 of 55 osseous industry remains are obtained through the application of blank production using a fracturation method.

3.1 The species and anatomic parts exploited

The biggest part of the tools is derived from domesticated animals including cattle and sheep (fig. 4: 1). In contrast, pigs are exploited very little. The exploitation of the long bones of goats, for which no documentation was specifically identified, is probably underestimated. The anatomical and taxonomic identification of the majority of pieces was not possible due to the high degree of reduction suffered by raw material blocks. This imprecision has determined the generic belonging to *Ovis* vel *Capra* for about twenty items, without providing a more accurate indication. The exploitation of long bones of birds is documented by the presence of a pointed object. The dimensions and the morphology of this piece are compatible with those of a humerus of *Phoenicopterus ruber* (L)[1].

Finally, fourteen pieces are divided into two large groups for which we cannot identify the belonging, but which we can classify the animal species by size: large-sized species (mainly cattle and deer) and medium-sized species (mainly sheep and goat). The first group is composed of 8 elements, and the second group is composed of 6 elements. A third category included the integration of small mammals. However, it is not at all represented on the site.

The anatomical parts that are mainly exploited are the long bones. Considering all species, the pieces count 19 elements. The flat bones including ribs and flat bones not more precisely identified are attested by only 2 pieces. For the remaining elements, the anatomy identification could not be determined.

3.2 The identification of production elements

The majority of the transformation products of the osseous industry obtained by the blank production using the fracturation method of debitage are finished objects (23 pieces). Rare wastes (3 pieces) and an unknown element were also identified.

3.2.1 The toolkit

The finished objects are the "*ultimate goals of technical transformation sequence*" (Averbouh, 2000. P. 159). This category is best known among the products of the transformation of the osseous industry. The different types identified obtained by the blank production using the fracturation method of Su Coddu site industry are the pointed and rounded edge objects.

- The pointed objects

Pointed tools are shaped on long or flat bone splinters. Their morphology is very varied, but they have fairly homogeneous dimensions (fig. 4: 2, 3).

Sharp tools on flat blanks were divided into three groups made according to the thickness of compact tissue. This subdivision aims to distinguish even approximately the size of blanks selected because it was rarely possible to arrive at an accurate taxonomic determination. Taking into consideration the maximum thickness of the compact tissue of splinters, it gives us an idea of the size of the original block, even if it fails to provide an accurate indication. Pointed tools of small dimensions correspond to those which the compact tissue thickness is equal or less than 2 mm; pointed

[1] I wish to thank Marco Zedda for his contribution to the taxonomic identification of problematic remains.

medium size tools have between 2.1 and 6 mm in thickness; and pointed large dimension tools are more than 6 mm in thickness.

The majority of all analyzed corpus is composed of pointed tools obtained by medium splinters (12 objects), by large splinters (9 pieces), and by small splinters (1 piece). The length/width ratio of the different types of pointed tools, based on whole pieces (20 on 23 pieces) (fig. 4: 4), shows a marked difference between the large dimension pointed tools, the medium dimension pointed tools, and the small dimension pointed tools. Pieces of the first group have a very variable length and thickness, while the second group has fairly uniform dimensions. Furthermore, taking into account the average, pointed tools of large dimensions cluster in a clearly distinct set in comparison to the others two. Less variety in dimensions is illustrated by the width / thickness ratio (fig. 4, 5) of the pieces. It is however necessary to consider that the thickness (which does not coincide with the thickness of compact tissue) is strongly conditioned not only by the transformed anatomical part but also by the portion of the used bone (that can also have, for example, a concave, a convex, or a rectangular section). This value can vary independently of other dimensional values, without calling into question the distinction established through the length / width ratios.

Four of nine tool splinters of large dimensions were produced on long bones of cattle. The other objects are such that we could not recognize the taxon identity. However, it is possible to say that they are related to large or medium size artiodactyls (bovines or caprines). Splinters that were not possible to determine indicate the transformation of a femur, a rib, and a long bone. Another splinter was undetermined. The general outline of the pieces has a varied shape (rectangular, triangular, or rhomboid) (fig. 5). The profile is often triangular or rectangular. The sections, strictly conditioned by the exploited part of the block, may be triangular, sub-rectangular, trapezoidal, convex-concave, and sub-circular. The morphology of fracture sections indicates that the fracturing action intervened on fresh raw material but no technical traces, as the impact points or percussion rebounds are identified on objects surfaces. So, this absence cannot improve our knowledge about the percussion modalities. However, the absence of spongy tissue on pieces suggests that the splinters are obtained from the diaphysis portion of bone. With the exception of the transformation of the distal part of the blank in order to conform the active part, almost all pointed tools on large dimension splinters are left to the rough state of the debitage phase. Only a tool that is shaped in a more invasive manner concerns the borders of the splinter middle part.

The medium-sized splinters were mainly produced on long bones (metapodials, ulna and undetermined long bones) of undetermined ovine and caprine and *Ovis aries*. Only one piece is obtained by a fibula of small-size *Sus scrofa*, and two pieces have been shaped on splinters of bovine ribs of small dimensions (fig. 6). The outline of these objects is mainly triangular, and it inscribes itself in a triangle or in a rectangle. The profile is also mostly triangular, or it inscribes itself in a triangle, or in a rectangle. The sections are convex-concave with straight edges, internal and external oblique, trapezoidal, triangular, or rectangular with convex edges. In relation to the dimensions of the raw material block used, these medium size splinters occupy a good part of the diaphysis part of bone. The absence of percussion traces may indicate the implementation of a percussion near the epiphysis extremity of bone, which is not always guaranteed to obtain regular and elongated splinters with straight edges. The shaping traces identified on the pieces indicate the preferential use of scraping. Abrasion is used only in rare cases.

The small-sized splinters group is represented by only one object, and the compact tissue is characterized by a whitish colour and a very intense shine (fig. 7: 1). It is obtained by a long bone of a large-sized bird. It has been produced on a femur of *Phoenicopterus ruber* (L.). The outline and profile of this piece inscribe them in a rectangle, and the section is concave-convex. The fracture pans have a straight profile or slightly curved edges. The shaping is carried out by scraping, and it is localized in the distal portion of the tool in order to form the active part in a peripheral position. On the same object, deep scratches located in the proximal part of the lower face attest a gesture made in the longitudinal axis of the piece that was realized in order to remove organic residues.

All pointed tools obtained through the debitage method by fracturation have an active part, which informs us about potentially practiced activities, generally consisting of piercing soft materials.

- Rounded-edge objects

Only one rounded-edge object shaped on a splinter was obtained by a long bone for which we could not identify the species (fig. 7: 2). The thickness of compact bone tissue is 7 mm, indicating its likely belonging to a large animal. The fracture pans have a concave profile on the right edge and strait-convex profile on the left edge. The piece was shaped by a longitudinal abrasion, which helped to shape the active part of the tool. It measures 47 mm in residual length, 15 mm in width, and 12 mm in thickness.

3.2.2 The wastes

As for the finished objects, identifying wastes at the other end of the chain is important for achieving the refitting by default and then for the reconstitution of the operational scheme. Different types of likely wastes were selected from faunal remains. This is debitage wastes documenting the first phase of transformation made on the long bones of caprines and larger-sized ungulates.

The first element is a diaphyseal part of long bone of large/medium-size animal metapodial (near deer size). It presents very regular straight fracture planes (fig. 7: 3). The bending technical traces are associated with a removal scar and indicates that the transversal percussion is caused by fracturing.

The production of elongated splinters on long bone is probably documented by a second element: a fragment of radius with two impact points located on the cranial face (fig. 7: 4).

The third waste is also constituted by a distal fragment of a metacarpal of *Bos taurus* (fig. 7,5). It has an oval morphology removal scar from which is visible the negative of the tool used to hit the block. Similar fracture planes were experimentally reproduced using a large hammer, of which the active part is convex (fig. 7: 6–7). This type of fracture, obtained on fresh bone and surrounded by small splinters, was produced by several repeated blows on the same point. The block, instead of breaking with sharp fractures planes, crushed in the central part.

3.2.3 The indeterminate elements

An indeterminate piece probably belongs to a finished object (fig. 8: 1). The morphology and technical traces of fracture scars indicate the obtaining of a blank by a fracturation debitage method; the scraping striations, located in bilateral position and oriented parallel to the main axis of the piece, are related to shaping operations. The piece was produced from a long bone of indeterminate large-sized mammal.

4. The reconstruction of blank production by fracturation method: technical and economical aspects

On a practical level (techniques and procedures), the blank production by the fracturation method was implemented by a single technique: breaking by direct percussion (fig. 8: 2). The blocks are both large and medium sized, without being possible to distinguish a preferential selection of standard dimensions blocks. With regards to the location of the impact points, lack of faunal data on bones fracturing in a dietary purpose limits us from distinguishing any differences between the technical chain of the bone industry and the food chain. For this reason, the identified potential wastes with impact points may be related to a food fracturing goal. However, one intention does not exclude the other: it is possible to fracture a bone to extract the marrow and recover splinters to produce tools and vice versa. Even in the absence of direct refitting, but taking into account the technical characteristics of the products identified in the faunal remains, it is possible to assume that the fracturing of the blocks was performed at the fresh state of raw material (morphology and texture of fracture planes sections) and that breaking by direct percussion was performed with large (fig. 7: 5) and small dimension hammers (fig. 7: 3–4) related to the dimensions of exploited blocks.

At a conceptual level, the blank production using the fracturation method is to produce blanks with non-standard dimensions and morphology. However, a selection of splinters having certain morphological and dimensional characteristics can take place after the block fracturing. At Su Coddu, in the absence of blanks, the only possible observations concern identified finished objects. It was possible to see that the splinters, always elongated, can be grouped into two size classes: the first group includes the large-size blanks that are selected and recovered on large-size blocks; the second group consists of smaller dimensions blanks, indifferently chosen from the products of large and small dimensions blocks.

With regards to the productivity of debitage, the use of the blank production using the fracturation method for obtaining of splinters from diaphysis parts of blocks translated a possible recovery of several blanks obtained on the same block. These elements and the fact that the raw material should be available in the immediate vicinity of the site allow supposing that the exploitation of the blocks is not conducted with the intention of producing several objects at once, probably because of the abundance of available resources. The exploitation appears to be more related to the satisfaction of immediate requirements or to the immediate availability of raw materials that cannot be stoked.

Conclusions

Blank production using a fracturation method leaves some open questions. The main problem of the characterization of the blank production using a fracturation method is the difficulty of identifying manufacturing wastes and other products that are difficult to distinguish in a faunal assemblage. Nevertheless, studies identifying the technical traces of intentional fracturing of bone material blocks (e.g., fracture planes and their characterization, techniques and instruments applied) are now numerous. Studies have been conducted with the goal to distinguish human technical traces to actions of numerous taphonomical agents that can cause the fracturation of bones (Binford, 1981; Lyman Lee, 1994; Anconetani, 1999; Peretto *et al*., 1996; Fisher, 1995. P. 21–25; Bonnichsen, Will, 1980; Johnson, 1985; Morlan, 1983).

Thus, several experimental studies on fracturation of cattle, deer, and sheep long bones have been published (Blumenschine, 1988; Brugal, Defleur, 1989; Capaldo, Blumenschine, 1994; Pickering and Egeland, 2006; Sadek-Kooros, 1972; Thiébaut *et al*., 2009; Manca, 2013).

Faced with this bibliographical wealth, works seeking to identify the products of fracturation of bones applied on the osseous industry during the Neolithic are not systematic. This fact severely limits the characterization of footwork implemented to break the blocks, often identified as being simple and deprived of elements for characterizing an industry from a technical point of view. In fact, technical variants can be defined in each phase of the operation chain: in the choice of raw material, in the location of the impact points, in the instruments used, in the morphology and dimensions of the blanks chosen, in the shaping methods used, and in the typological and functional variety of finished objects. In the current state of research on osseous Sardinian industries, data are lacking, and it is not possible to define potential regional variants or cultural peculiarities in the context of the application of the blank production using a fracturation method. The study of a larger number of series and the systematic application of refitting by default methods are necessary to obtain comparative data in order to better understand the techno-economic aspects of Sardinian prehistoric groups.

REFERENCES

Anconetani P. An experimental approach to intentional bone fracture: a case study from the Middle Pleistocene site of Isernia La Pineta. *In:* S. Gaudzinski, E. Turner (eds.). The role of early humans in the accumulation of European Lower and Middle Palaeolithic bone assemblages. Monographien; 42. Bonn; Mainz: Verlag des Römisch-Germanischen Zentralmuseums, 1999. P. 121–138.

Averbouh A. Technologie de la matière osseuse travaillée et implication palethnologique; l'exemple des chaînes d'exploitation du bois de cervidé chez les magdaléniens des Pyrénées, PhD, Université de Paris I Panthéon-Sorbonne, 2000. 500 p.

Averbouh A. Methodological Specifics of the Techno-Economic Analysis of Worked Bone and Antler: Mental Refitting and Methods of Application. *In*: A M. Choyke, L. Bartosiewicz (eds.). Crafting Bone: Skeletal Technologies through Time and Space, Proceedings of the 2nd meeting of the ICAZ, Worked Bone Research Group, Budapest, 31 August–5 September 1999. BAR International Series; 937. Oxford: Archaeopress, 2011. P. 111–121.

Binford L.R. Bones: ancient men and modern myths. New York: Academic Press, 1981. 320 p.

Blumenschine R.J. An experimental model of the timing of hominid and carnivore influence on archaeological bone assemblages. *In:* Journal of Archaeological Science. 1988. No 15, 5. P. 483–502.

Bonnichsen R., Will R.T. Cultural modification of bone: The experimental approach in faunal analysis. *In:* B. M. Gilbert (ed.). Mammalian Osteology. Laramie: B. M. Gilbert Pub., 1980. P. 7–30.

Brugal J.P., Defleur A. Approche expérimentale de la fracturation des os des membres de grands mammifères *In* : Outillage peu élaboré en os et en bois de Cervidés. Vol. 3. No 7. Treignes: CEDA, 1989. P. 14–20.

Capaldo S.D., Blumenschine R.J. A quantitative diagnosis of notches made by hammerstone percussion and carnivore gnawing on bovid long bones. In: American Antiquity. 1994. No 59. P. 724–748.

Fisher J.W. Bone Surface Modifications in Zooarchaeology. *In:* Journal of Archaeological Method and Theory. 1995. No 2, 1. P. 7–68.

Johnson E. Current developments in bone technology. *In:* M. B. Schiffer (ed.). Advances in Archaeological Method and Theory. Vol. 8. New York: Academic Press, 1985. P. 157–235.

Lai L., Fonzo O., Tykot R. H., Goddard E., Hollander D.J. Le due comunità di Scabà ‘e Arriu (Siddi): clima e risorse alimentari nella Sardegna del III millennio a.C. indagate tramite analisi isotopiche dei tessuti ossei. Studio antropologico dei reperti umani. *In:* Atti della Riunione Scientifica dell’Istituto Italiano di Preistoria e Protostoria. 2011. Vol. 43. P. 401–408.

Lyman Lee R. Vertebrate taphonomy, Cambridge manuals in Archaeology. Cambridge: Cambridge University, 1994. 527 p.

Manca L. L’industria in materia dura animale dell’Eneolitico. Analisi morfo–tipologica e tecnologica. Un caso studio. *In:* Atti della Riunione Scientifica dell’Istituto Italiano di Preistoria e Protostoria. 2012. Vol. 44. No 2. P. 557–562.

Manca L. Fonctionnement des sociétés de la fin du néolithique au début de l’âge du cuivre en Sardaigne. Une approche inédite a partir de l’étude des productions en matières dures animales. PhD, Université de Provence, dir. of A. Averbouh. 2013. 764 p.

Manca L. The individuation of a new type of shell tools during Early Chalcolithic in Sardinia: the bevelled tools on oyster valves. An experimental approach to reconstruct the operational sequences. *In:* M. Margarit, G. Le Dosseur, A. Averbouh (eds.). Prehistoric exploitation of hard animal material. An overview of the exploitation of hard animal materials during the Neolithic and Chalcolithic. O privire asupra exploatării materiilor dure animale de–a lungul Neoliticului şi Calcoliticului, Proceedings of the GDRE PREHISTOS Work–Session in Târgovişte, Romania, november 2013. Târgovişte: Cetatea de Scaun, 2014. P. 153–180.

Manunza M.R. Selargius, località Su Coddu (Cagliari). *In:* Bollettino d’Archeologia. 1994–96. No 41–42. P. 235.

Manunza M.R. L’industria litica dai nuovi scavi (1994–2003) nel villaggio di Su Coddu–Canelles (Selargius, CA). *In:* L’ossidiana del Monte Arci nel Mediterraneo. La ricerca archeologica e la salvaguardia del paesaggio per lo sviluppo delle zone interne della Sardegna, Atti del 2° Convegno Internazionale, Pau, 28–30 novembre 2003. Cagliari, 2004. P. 249–253.

Manunza M.R. Cuccuru Cresia Arta. Indagini archeologiche a Soleminis. Dolianova: Grafica del Parteolla, 2005. 307 p.

Manunza M.R. Bau su Matutzu, Serdiana: segni del potere in una sepoltura del III millennio a. C. Cagliari: Scuola Sarda, 2010. 264 p.

Manunza M.R. Nuovi scavi a Su Coddu–Canelles (Selargius-CA): notizia preliminare. *In:* Quaderni della Soprintendenza archeologica per le province di Cagliari e Oristano. 2007–2012. No 23. 2012. P. 8–27.

Manunza MR. Corredi funerari di cultura Monte Claro a Gannì (Quartucciu-CA). Notizia preliminare. *In:* Quaderni della Soprintendenza archeologica per le province di Cagliari e Oristano. 2013. No 24. P. 39–76.

Manunza M R., Lecca A. Lo scavo del lotto Deiana nel villaggio di Su Coddu-Selargius (CA). *In:* Quaderni della Soprintendenza archeologica per le province di Cagliari e Oristano. 2005–06. № 22, 1. P. 3–49.

Manunza M.R., Melis M.G., Cicilloni R., Fenu P. L'insediamento eneolitico di Canelles–Selargius. *In:* Atti della Riunione Scientifica dell'Istituto Italiano di Preistoria e Protostoria. 2012. Vol. 44. No 3. P. 1265–1270.

Melis M.G. L'età del Rame in Sardegna: origine ed evoluzione degli aspetti autoctoni. Villanova Monteleone: Soter, 2000. 373 p.

Melis M.G. L'Eneolitico antico, medio ed evoluto in Sardegna: dalla fine dell'Ozieri all'Abealzu. *In:* Atti della Riunione Scientifica dell'Istituto Italiano di Preistoria e Protostoria. Quaderni della Soprintendenza archeologica per le province di Cagliari e Oristano. 2009. Vol. 44. No 1. P. 81–95.

Melis M.G. Problemi di cronologia insulare. La Sardegna tra il IV e il III millennio BC. *In:* D. Cocchi Genick (ed.). Cronologia assoluta e relativa dell'età del rame in Italia, Incontro di studi, Università di Verona, 25 giugno 2013. Verona: Quiedit, 2013. P. 197–211.

Melis M.G., Quarta G., Calcagnile L., D'Elia M. L'inizio dell'età del Rame in Sardegna. Nuovi contributi cronologici. *In:* Rivista di Scienze Preistoriche. 2007. No 57. P. 185–200.

Melis M.G., Zedda M., Manca L. Marine and Inland Water Resources in Eneolithic Communities. New Data from Sardinia (Italy). *In:* Journal of Life Sciences. 2012. No 6. P. 679–693.

*Morlan R.*C., *Peretto E.* Spiral fractures on limb bones: Which ones are artificial? *In:* G. M. LeMoine, A. S. Mac Eachern (eds.). Carnivores, Human Scavengers and Predators: A Question of Bone Technology. Proceedings of the Fifteenth Annual Conference. Calgary: University of Calgary, Archaeological Association, 1983. P. 241–269.

Peretto C., Anconetani P., Crovetto C., Evangelista L., Ferrari M., Giusberti G., Thun Hohenstein U., Vianello F. Approccio sperimentale alla comprensione delle attività di sussistenza condotte nel sito di Isernia la Pineta (Molise, Italia). La fratturazione intenzionale *In:* I reperti paleontologici del giacimento paleolitico di Isernia la Pineta. L'uomo e l'ambiente. Istituto Régionale per gli studi Storici del Molise V. Cuoco / C. Peretto. Isernia: Cosmo Iannone, 1996. P. 187–452.

Pickering T.R., Egeland C.P. Experimental patterns of hammerstone percussion damage on bones: implications for inferences of carcass processing by humans. *In:* Journal of Archaeological Science. 2006. *No* 33. P. 459–469.

Sadek-Kooros H. Primitive Bone Fracturing: A Method of Research. *In:* American Antiquity. 1972. No 37. 3. P. 369–382.

Thiébaut C., Claud E., Costamagno S. et al. Des traces et des hommes – Projet interdisciplinaire pour interpréter les comportements techno-économiques des Néandertaliens. *In :* Les Nouvelles de l'Archéologie. 2009. No 118. P. 49–55.

Ugas G. Le radici prenuragiche e nuragiche di Selargius. *In:*G. Camboni (ed.). Selargius, L'antica Kellarius. Milano: Silvana, 1997. P. 49–61.

Ugas G., Lai G., Usai L. L'insediamento prenuragico di Su Coddu (Selargius–Ca). Notizia preliminare sulle campagne di scavo 1981–1984. *In:* Nuovo Bullettino Archeologico Sardo. 1989a. No 2. P. 7–40.

Ugas G., Usai L., Nuvoli M.P., Lai G., Marras M.G. Nuovi dati sull'insediamento di Su Coddu. *In:* L. Campus (ed.). La Cultura di Ozieri. Problematiche e nuove acquisizioni, Atti della Riunione Scientifica dell'Istituto Italiano di Preistoria e Protostoria, del I convegno di studio, gennaio 1986–aprile 1987. Ozieri: II Torchietto, 1989b. P. 239–278.

Usai L. Il villaggio di età eneolitica di Terramaini presso Pirri Cagliari. *In:* Atti della Riunione Scientifica dell'Istituto Italiano di Preistoria e Protostoria, del IV convegno Nazionale di Preistoria e Protostoria, Preistoria d'Italia alla luce delle ultime scoperte, Pescia 8–9 dicembre 1984. Vol. 4. Pescia: Benedetti, 1987. P. 175–192.

About the authors:

Manca Laura. Ph.D. UMR 7209 - Archéozoologie, archéobotanique: sociétés, pratiques et environnements, Muséum national d'histoire naturelle et CNRS (France); GDRI prehistos member. 55 rue Buffon (CP 57), F-75005 Paris, France; laura.manca@mnhn.fr

Manunza Maria Rosaria. PhD. Soprintendenza Archeologia della Sardegna. 09124, Italy, Cagliari, Piazza Indipendenza 7; mariarosariamanunza54@gmail.com

ПРОИЗВОДСТВО ЗАГОТОВОК ФРАКТАЦИЕЙ («ДЕБИТАЖ» ПУТЕМ ФРАКТАЦИИ) В НАЧАЛЕ ЭНЕОЛИТА В САРДИНИИ (ИТАЛИЯ): НА ПРИМЕРЕ ТВЕРДЫХ МАТЕРИАЛОВ ЖИВОТНОГО ПРОИСХОЖДЕНИЯ НА СТОЯНКЕ СУ КОДДУ (СЕЛАРГИУС, КАЛЬЯРИ)

Л. Манка, М. Р. Манунза

Технологический анализ индустрии костяной индустрии поселения Су Кодду (Селаргиус, Кальяри, Италия) компенсирует отсутствие исследований по раннему энеолиту в Сардинии. Цель этой статьи состоит в том, чтобы представить результаты анализа артефактов, полученные в ходе раскопок 1994 и 2012 под руководством Марии Росарии Манунзы. Применение авторами метода аппликации позволило охарактеризовать технику дебитажа, которой пользовались для обработки заготовок из костного сырья. В частности, представлены элементы, которые позволяют восстанавливать производство заготовок с помощью техники фрактационного дебитажа. Также в статье рассмотрены технологические и экономичные его аспекты.

Ключевые слова: археология, ранний энеолит, Сардиния, костообрабатывающее производство, технологический анализ, производство заготовок фрактационным методом.

Информация об авторах:

Манка Лаура, доктор, UMR 7209 – лаборатория археозоологии, археоботаники: сообщества, практики и окружающая среда, Музей естественной истории, CNRS (France), член международной исследовательской группы GDRI prehistos; laura.manca@mnhn.fr

Манунза Мария Росария, доктор, Главное управление Археологии Сардинии (г. Кальяри, Италия); mariarosariamanunza54@gmail.com

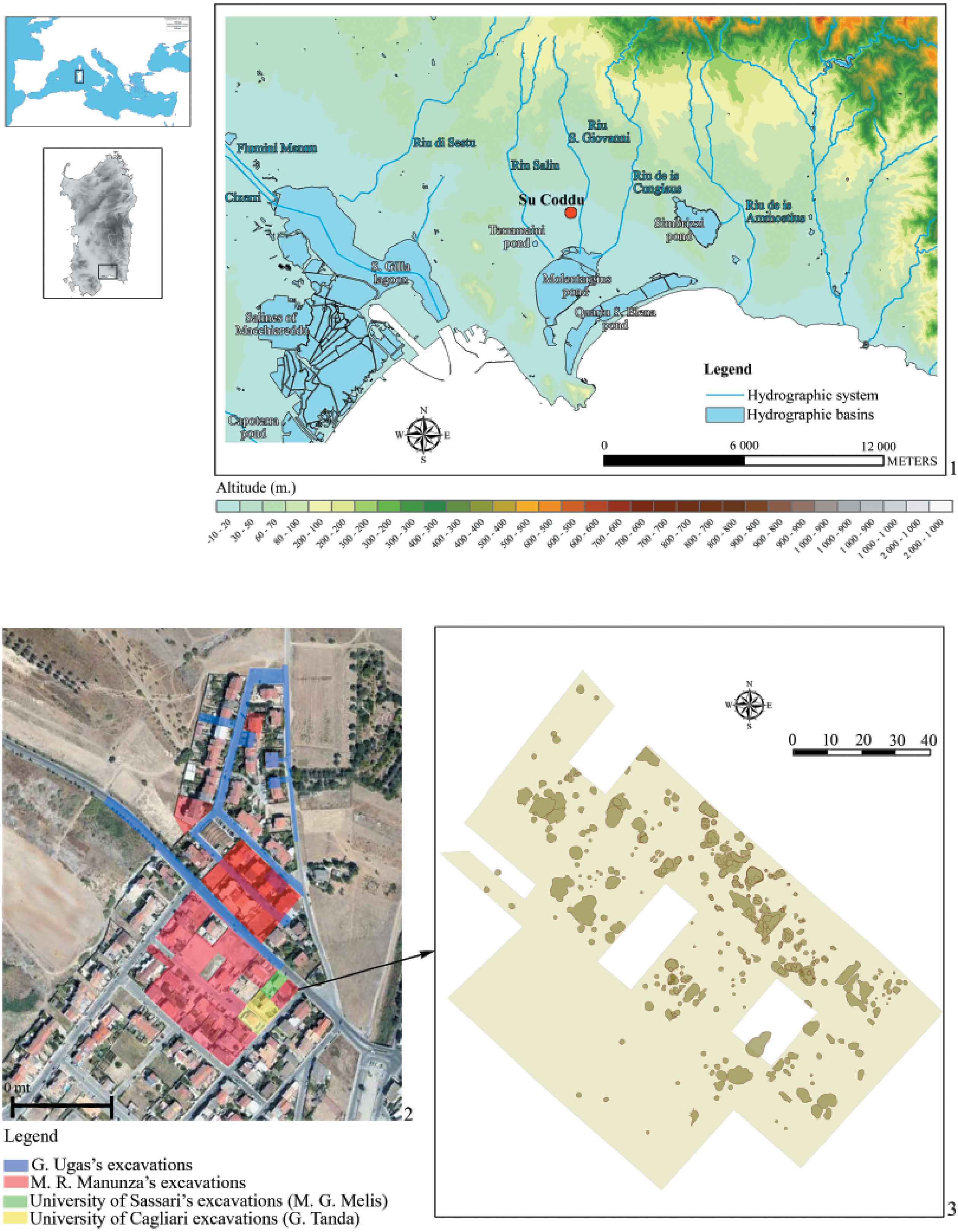

Fig. 1. 1. – hydrological Map of the Cagliari area with the location of the site of Su Coddu; 2. – site of Su Coddu: aerial photo of the excavated area; 3-4. – area excavated by the Soprintendenza and the Universities of Cagliari and Sassari.

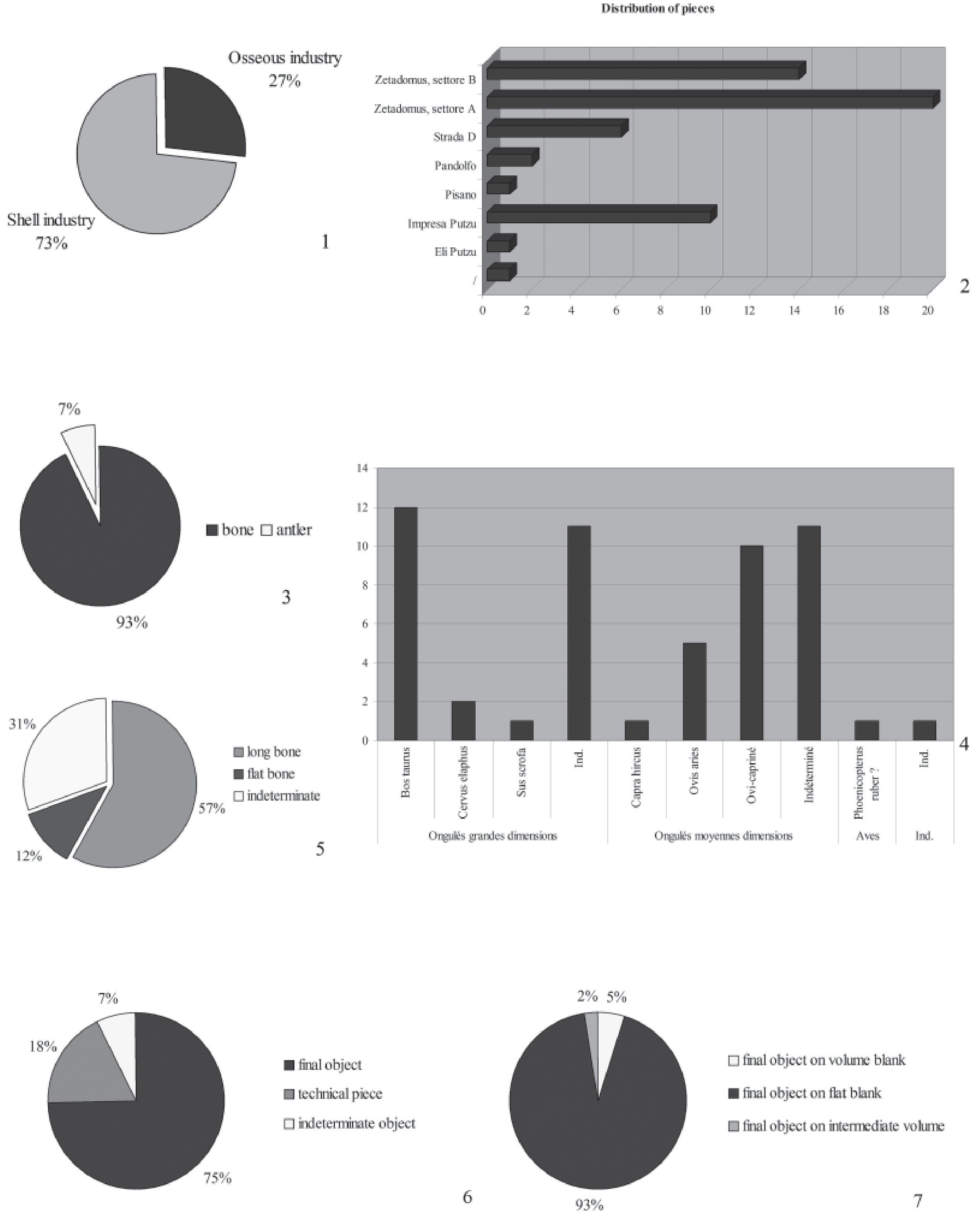

Fig. 2. 1. – industry composition of hard materials of animal origin of Su Coddu (total of 205 pieces); 2. – distribution of the pieces in the excavated structures (total 205 pieces); 3. – bone materials exploited (total of 55 pieces); 4-5. – species (4) and anatomical parts (5) exploited that compose bone industry (total of 55 pieces); 6. – distribution of identified products (total of 55 pieces); 7. – distribution of the blank categories identified (total of 55 pieces).

Fig. 3. Various types of final objects identified (out of 55 pieces).

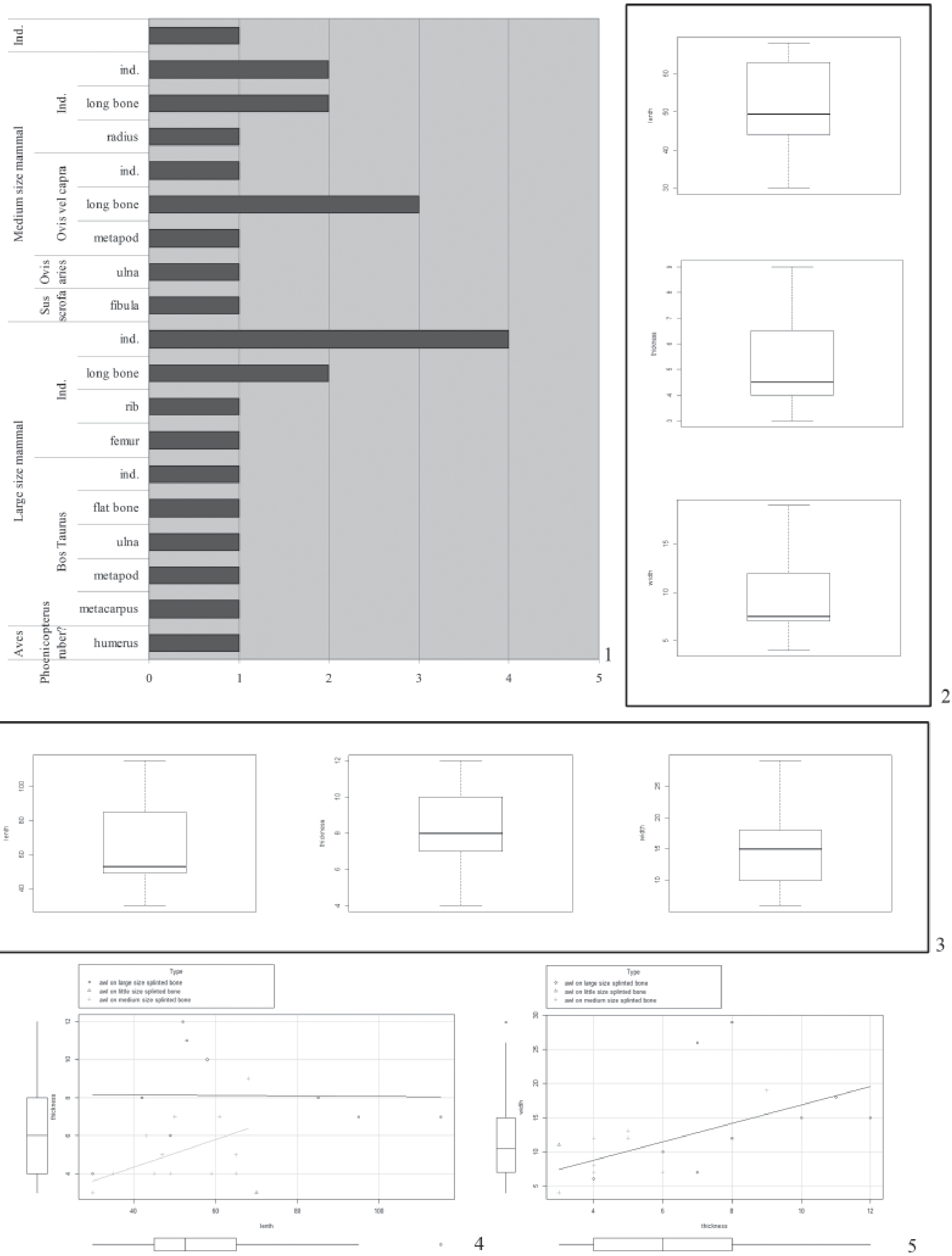

Fig. 4. Method of debitage by fracturation. 1. – species and anatomical parts exploited (total of 27 pieces); 2. – dimensions of large-size pointed tools; 3. – dimensions of medium-sized pointed tools; 4. – length/width ratio of pointed tools ordered by size; Width/thickness ratio of pointed tools ordered by size.

Fig. 5. Large-sized pointed tools.

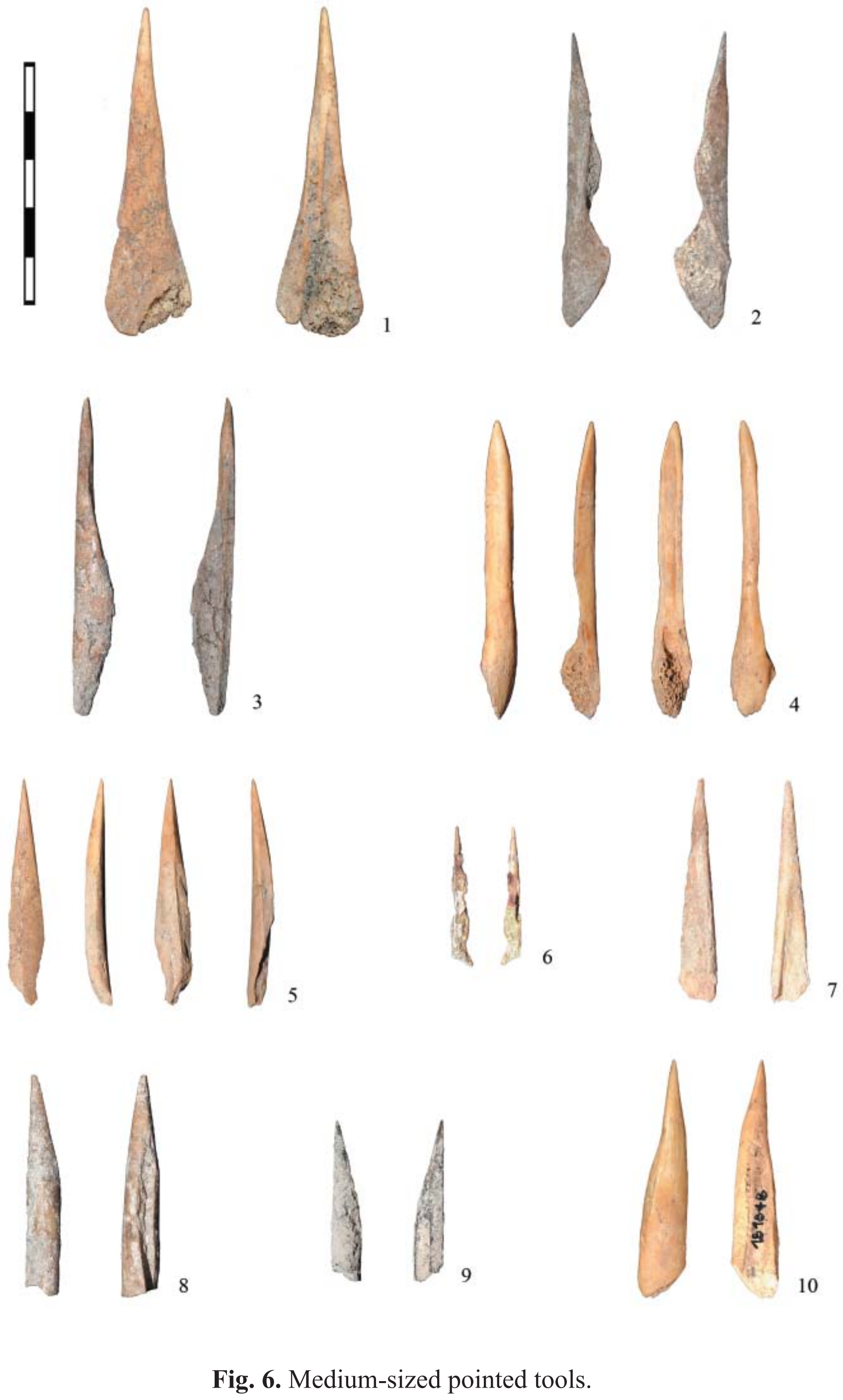

Fig. 6. Medium-sized pointed tools.

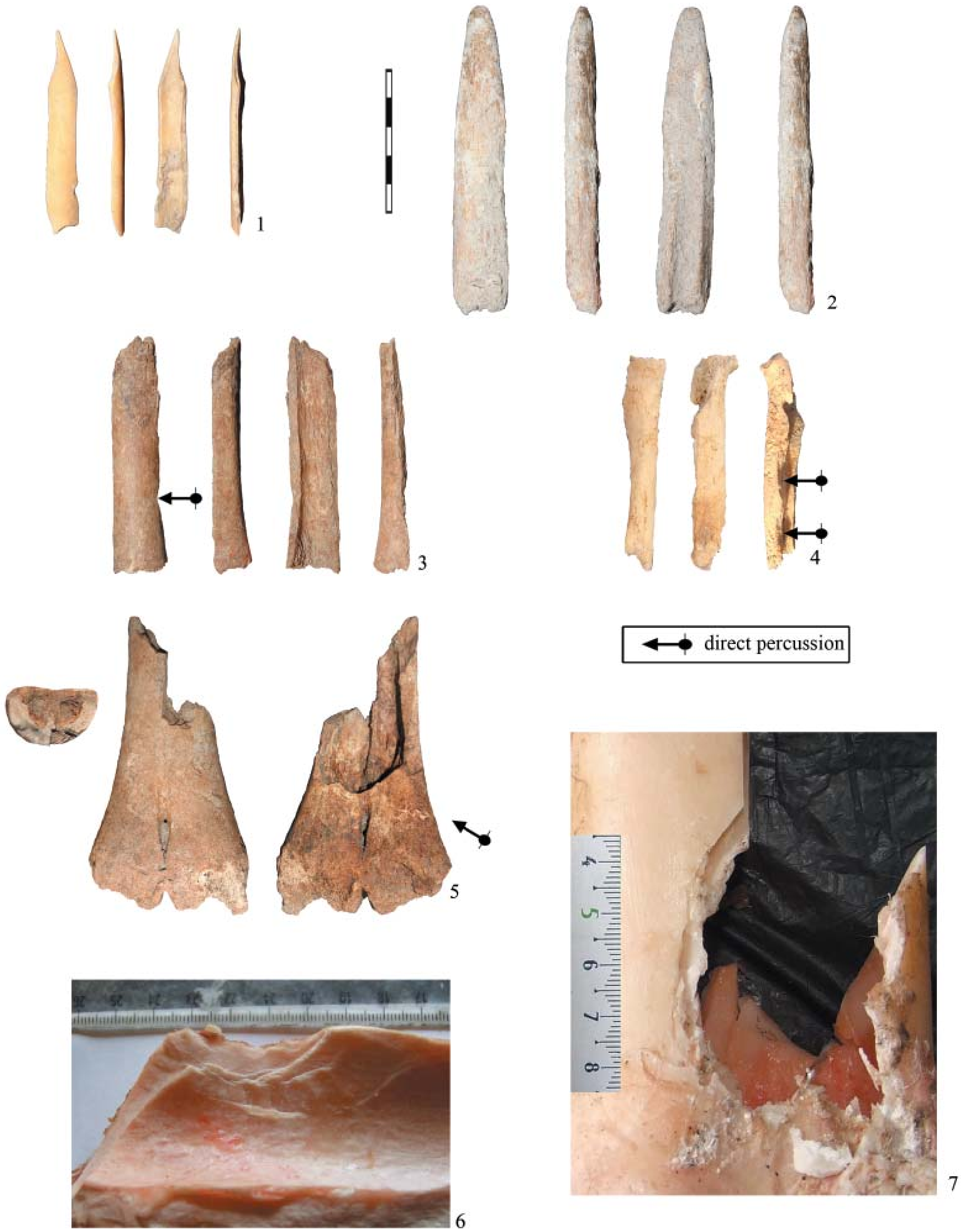

Fig. 7. 1. – pointed object from a long bird bone; 2. – rounded edge active part tool obtained by a large mammal; 3. – diaphyseal fragment with point of impact on a side; 4. – radius of sheep with two points of impact; 5. – bovine metacarpal with a point of impact; 6-7. – examples of experimental traces (photos by L. Manca and G. Dosseur).

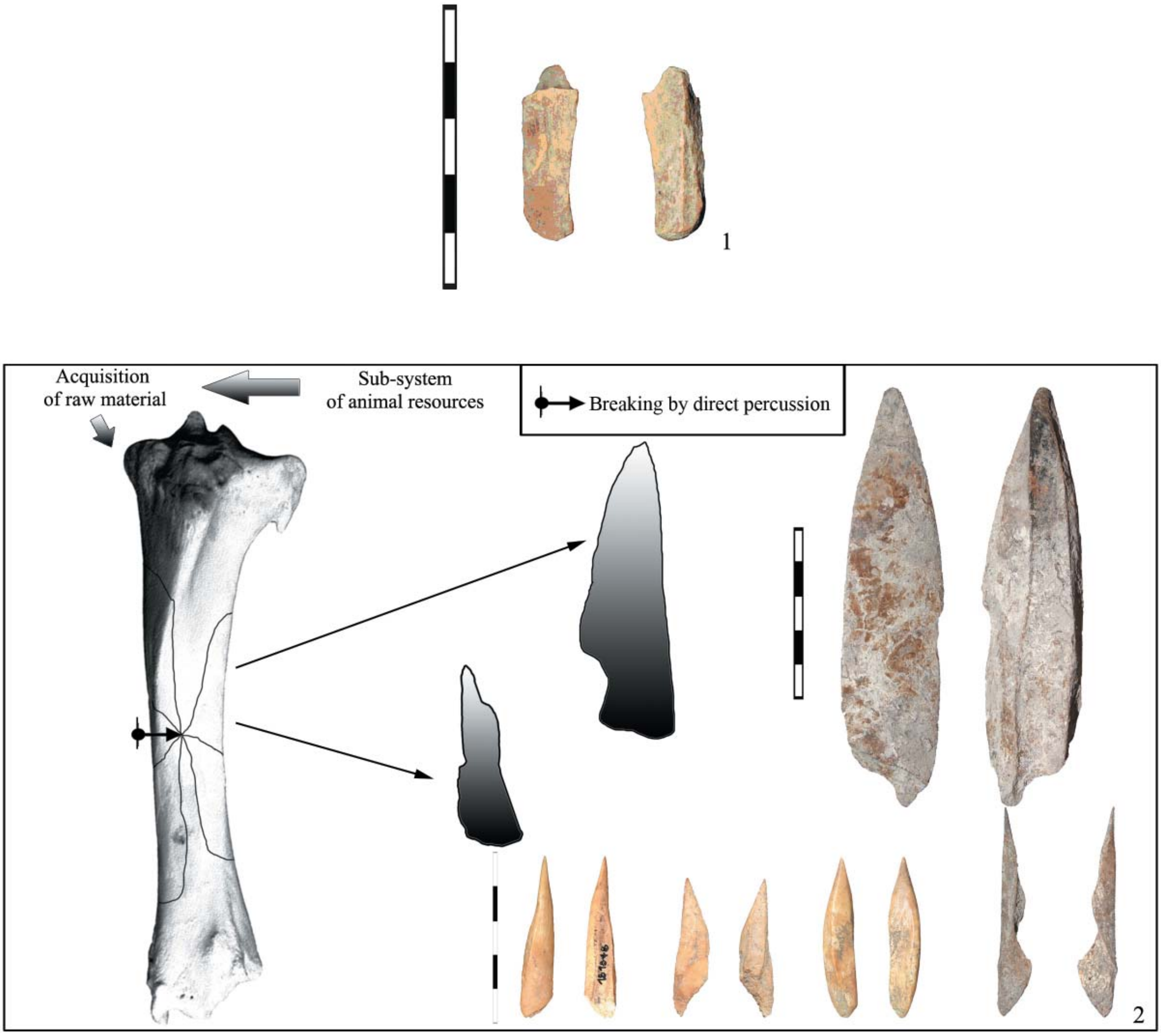

Fig. 8. 1. – undetermined object; 2. – reconstitution of the debitage method by fracturation and types of identified products.