# Chapter Five

# Antler Debitage in Muge Shell Middens: The Collections of the Geological Museum

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## Abstract

As one of the most important Mesolithic sites in Europe the Muge shell middens have been known for 150 years. Much information has been published about the hundreds of human burials, but not much about the lithic and faunal assemblages.

Although the osseous materials present in the Muge shell middens are a very important part of the material culture, their technological analysis is yet to be done. We present here the results of the technological analysis of a sample of antler artefacts that were recovered from Moita do Sebastião and Cabeço da Arruda shell middens in the late 19th and early 20th centuries, and deposited in the Geological Museum in Lisbon. We have registered two fracturing techniques and three wear techniques employed in the manufacture of this osseous industry and four categories of tools made by the Mesolithic hunter-gatherers.

## Introduction

As one of the most important Mesolithic sites in Europe the Muge shell middens have been known for 150 years. The survey in Tejo Valley began in 1863 with Carlos Ribeiro. In Muge, he found a large quantity of human remains, shells, animal remains, charcoal and quartzite in the Cabeço da

Arruda shell midden. In the following year, he and Nery Delgado found Moita do Sebastião and Fonte do Padre Pedro shell middens (Cardoso and Rolão 1999/2000; Detry 2007). In 1880, Carlos Ribeiro carried out more excavations in the Moita do Sebastião and Cabeço da Arruda shell middens from which they recovered dozens of human skeletons and other artefacts and it was all then published in the Proceedings of the IX Session of the International Congress of Anthropology and Prehistoric Archaeology in 1884. After his death, the work in the Muge shell middens continued under the supervision of Paula e Oliveira who took great interest in studying the human remains. He then classified the archaeological site as prior to the Neolithic but still dating to the Quaternary (Cardoso and Rolão 1999/2000; Detry 2007). In 1888, Paula e Oliveira died and for many years the research into the Muge Shell middens stopped until 1930 when Mendes Correa decided to start the excavations again (Cardoso and Rolão 1999/2000). In the 1950s the site of Moita do Sebastião started to be destroyed and only a base layer of the shell midden remains to the present day.

Jean Roche published several articles on the Muge shell middens until 1980 (Cardoso and Rolão 1999/2000; Detry 2007). Later, in 2001 J. Rolão began the work of cleaning, recovery and conservation in Cabeço da Arruda (Cardoso and Rolão 1999/2000; Detry 2007).

The human remains are the most studied in the Muge shell middens, but the archaeological sites also provided several other artefacts like lithics, adornments, faunal remains and osseous industry. These analyses of artefacts were briefly detailed, although they were published in 1865 by Pereira da Costa, in 1884 by Carlos Ribeiro and in 1888 by Paula e Oliveira (Bicho et al. 2010a) and in 1947 Breuil and Zbyszewski published the first review of the Mesolithic industries from Muge also paying attention to the antler and mammal bone artefacts from Cabeço da Arruda and Moita do Sebastião (Breuil and Zbyszewski 1947). In 1986 Lentacker analysed the faunal remains and in 2007 Detry made an extensive study of the faunal remains from the Muge shell middens, focusing on biometrics, taphonomy, paleoecology and paleoeconomics.

Along with beads, lithics and faunal remains, there is a large quantity of osseous materials that were intentionally modified. The recent excavations in the Cabeço da Amoreira shell midden began in 2008 under the research project "Last Hunter-Gatherers of the Tagus Valley–The Muge Shell Middens" directed by Nuno Bicho from the University of Algarve. Presently, the radiocarbon data indicates that the shell middens first appeared by 8200 cal BP in Cabeço da Arruda and their use by

Mesolithic hunter-gatherer-fishers ended by 7400 cal BP when a Neolithic population entered the Tagus Valley (Bicho et al. 2010b; 2013).

Here, by paying special attention to bone surface modifications made during its manufacture and use, we present some preliminary results of the technological analysis of 100 Red deer (*Cervus elaphus*) antler artefacts that were recovered from the Moita do Sebastião and Cabeço da Arruda shell middens during the late 19th/beginning of the 20th centuries and deposited in the Geological Museum in Lisbon.

## Materials and Methodology

We have studied a collection of antler artefacts that belongs to old excavations. The sample is biased by the methods of excavation and by later preservation in the museum. The research objectives at that time were different from those of today–the main goal was to recover and study the human remains. Also the methods of excavation were different and the osseous industry has no indication of its stratigraphical provenience and the artefacts only have an indication of the archaeological site provenience (Bicho et al. 2013; Detry, 2007).

Antler tools were analysed using macro- and micro-wear approaches with the use of a magnification lens (10x-40x) and not just macroscopically (Blumenschine et al. 1996; Dominguéz-Rodrigo et al. 2009; Évora 2008), otherwise some important features would be missed.

We focused our observations on modifications made during production and use activities and also on post-depositional processes. The bone surface analysis methodology was done based on the previous works of several researchers, namely Averbouh (2000), Bertrand (1999), David (2005), d'Errico et al. (1984), d'Errico and Giacobini (1985), d'Errico and Giacobini (1986), d'Errico and Espinet-Moucatel (1986), d'Errico (1993), Goutas (2005), Lyman (1994), Maigrot (1997) and Semenov (1985).

The sample is composed of 100 artefacts from Cabeço da Arruda (n=50) and Moita do Sebastião (n=50), all made from *Cervus elaphus* antler.

## Results

The antler artefacts are present in four categories of products: (1) finished objects; (2) blanks; (3) secondary blocks; and (4) debris. The number of finished objects (n=50) is far greater than the other categories, followed by the debris (n=36) (Fig. 5.1).

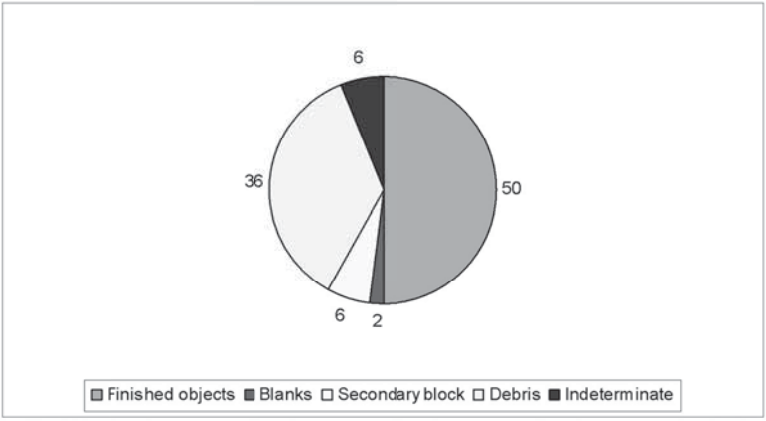


Fig. 5.1. Cabeço da Arruda and Moita do Sebastião antler artefacts categories.

## Finished Objects

This category is composed of several types of tools (Table 5.1) and they were extracted from all parts of the antler, but mainly from the tines.

## Bevelled tools

One of the best represented tools is unifacially bevelled (n=15) (Fig. 5.2). The unifacially bevelled tools vary in total length from 263 mm to 37 mm and their cortical tissue thickness varies from 87 mm to 3 mm. The bevel total length varies from 60 mm to 9 mm and its width varies from 375 mm to 5 mm.

The bifacially bevelled tool is always represented in the sample in conjunction with a handle or a wedge on the opposite end of the tool. The tools vary in total length from 114 mm to 101 mm, and their cortical tissue thickness ranges from 52 mm to 47 mm. The second bevel is much shorter than the other, ranging from 248 mm to 10 mm in total length. They were made from tines and portions of beams. One pedicle (Fig. 5.3) raises doubts of its being debris, as a portion of the beam is still attached and at its distal end the spongy tissue has an active area, very smoothed with fine striations.

**Table 5.1. Tools and Debris quantities and their anatomical provenance.**

| Anatomical provenience | Unifacial | Uni/Bifacial | Uni/Bifacial | Wedge | Pointed | Hammer | Handle / | Debris |
|---|---|---|---|---|---|---|---|---|
| palmation base | | | | | | | | 1 |
| beam B | 1 | 1 | 1 | 1 | | | | 1 |
| beam A and B | 2 | | | | | | | 1 |
| beam A | 1 | | | 1 | | 1 | | |
| indeterminate beam | | 2 | | | | | 1 | 2 |
| middle tine | | | | 3 | 1 | | | 2 |
| bez tine | 1 | | | | | | | 1 |
| eye tine | 2 | | 2 | 4 | | 3 | | 2 |
| indeterminate tine | 8 | | 1 | 4 | 3 | | 1 | 12 |
| pedicle | | | | | | | | 11 |
| burr | | | | | | | | 2 |
| indeterminate | | | | 2 | | | | 1 |
| total | 15 | 3 | 4 | 15 | 4 | 4 | 2 | 36 |

Could it have been used as a digger tool or in processing hides?. There is a similar artefact from the Polderweg Mesolithic site in the Netherlands that according to Van Gijn was used as a hide scraper (Van Gijn 2007).

Fig. 5.2. Bevelled antler tools from Cabeço da Arruda and Moita do Sebastião shellmiddens.

Fig. 5.3. Pedicle with distal bevel.

## Wedges

Another type of finished object is the wedge. Wedges are mainly made from tines, and some could be determined as from the eye tine and from the middle tine. The total length varies from 189 mm to 49 mm, with a cortical tissue thickness ranging from 63 mm to 35 mm showing that some wedges are very robust. All tools used as wedges have small impact marks on their active part. One of these tools has impact marks and small withdrawals on the distal end and also a small lateral perforation on the mesial area (Fig. 5.4).

Fig. 5.4. Wedge with negative withdrawals on the proximal end.

## Pointed Tools

Pointed tools are represented in small quantities (n=4) and are made from tines. Their total length varies from 201 mm to 77 mm. These tools have on their distal end an active area with fine striations that have a random or circular orientation and are quite localized around the distal end of the tool.

## Hammers

The hammers (n=4) are made from eye tine and beam. Their total lengths vary from 184 mm to 103 mm. They all have impact marks on the proximal end surface.

## Handles/Axes

Handles (n=2) are made from tine and beam. They have a total length of 126 mm and 85 mm. The one made from a tine had the spongy tissue extracted and a saw-type fracture. There are another two handles, but these are in conjunction with a uni/bifacially bevelled tool. The handle of one of these tools has the spongy tissue removed to insert another tool, and in that way, its bevel could have been used as an axe (Fig. 5.5). Their cortical tissue thicknesses are 63 mm and 56 mm, so they are robust tools.

## Blanks

We have registered only two blanks in this sample. One came from the beam, measuring 93 mm in total length and 46 mm in its cortical tissue thickness. Another blank came from a tine, has a total length of 198 mm and a cortical tissue thickness of 54 mm.

## Debris

Debitage debris is the second most represented artefact category in this sample (n=36). The majority of the debris consists of pedicles and tines. The pedicles came from hunted Red deer antler (n=7) and from shed antler (n=5). Most of the pedicles from hunted animals are still attached to the cranial bone on one end and have the burr and outer burr on the other end (Fig. 6). The tines are mostly indeterminate and the debris, in a general way, originated from several parts of the antler as seen on Table 5.1.

## Secondary Blocks

This artefact category is represented by 6 objects, mainly extracted from the beam, bez tine and/or middle tine. Their total lengths range from 126 mm to 90 mm and their cortical tissue thicknesses vary from 6 mm to 5 mm.

Fig. 5.5. Handle/Axe: with a circular perforation on the proximal end and saw type fracture on the distal end.

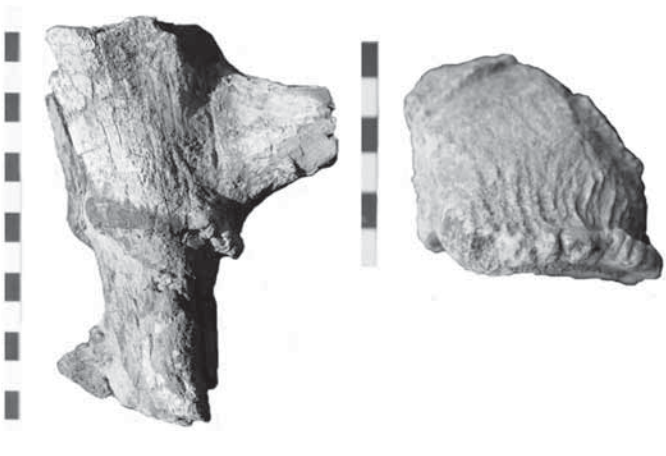

Fig. 5.6. Debris: Pedicle and Burr

## Fracturing and Wear Techniques

In the antler debitage we registered two breaking techniques (1) direct percussion; and (2) breaking by bending; and three techniques (1) sawing; (2) double longitudinal grooving; and (3) scraping.

### Fracturing Techniques

Those two techniques were used, mainly together, to separate the pedicles, the beams, the middle and eye tines and the burr. The stigmata can be seen in the artefacts and debris that present impact marks left by direct percussion with a cutting edge tool (Fig. 5.7) and the negative of the bending in their bone surfaces. The fracture planes are irregular.

### Wear Techniques

We have observed three techniques. The sawing (Fig. 5.8) technique was applied transversely to the longitudinal axis of the object, and in some artefacts sawing was used in conjunction with direct percussion and bending. It was used mostly to separate tines. The fracture plane varies according to the methods used.

Double longitudinal grooving was registered in only 6 artefacts, all made from beams (Fig. 5.9), leaving a regular fracture plane. The scraping technique was applied on the manufacture of the bevelled tools and it is limited to its active part and does not extend to the rest of the bone surface.

## Discussion

Antler artefacts are present in small and medium knapped fragments and also as entire tools. All the antler parts are represented in this sample, indicating that hunter-gatherers took advantage of all antler morphology to manufacture their bone toolkit. The resources of Red deer antler came from shed antler and also from hunted animals, as attested by several pedicles and burrs.

Fig. 5.7. Marks of direct percussion with a cutting edge tool on a tine.

Fig. 5.8. Sawing marks all around the proximal end of a tine and negative of bending.

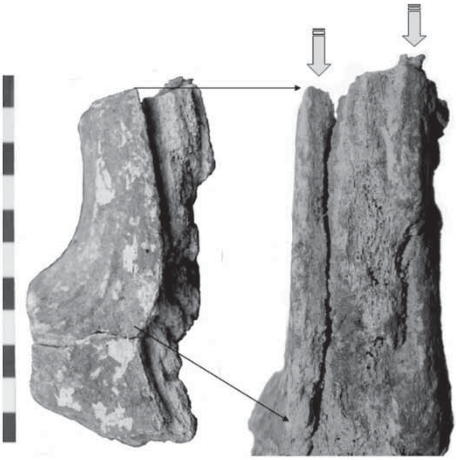

Fig. 5.9.Antler beam: the arrows indicate the double longitudinal grooving.

These tools on osseous material represent several completed artefacts (n=47). Despite that, some tools are incomplete and represented as mesial or proximal parts. Distal fragments are less represented (n=8). Manufacture and use traces are common. The preferred fracturing techniques were removal by direct percussion with a cutting edge tool and breaking by bending. The wear techniques used were sawing, double longitudinal grooving and scraping. All these techniques left visible *stigmata* on the bone surface such as impact marks made from a cutting edge tool, negatives of bending, and the negative of longitudinal grooving. Some tools were used as wedges as their distal active area has small impact marks and on the proximal end there are small negative withdrawals of the bone surface. Together with wedges, the bevelled tool is the most representative in Muge shell middens, some carrying long and large bevels and the great majority with *stigmata* resulting from impacts on the distal end, characterized by saw type fractures and short withdrawals. Others have a smooth bevel area with fine striations that could have resulted from scraping or from their use. The functional aspects of the bevelled tools are controversial as noted by Griffitts and Bonsall (2001). The authors refer that most bevelled tools are thought to have been used for working wood, processing hides or grinding tools. After an experimental study they concluded that this type of tool could have been used to collect and process limpets that are the dominant components of the shell middens in Western Scotland (Griffitts and Bonsall 2001). In the Muge shell middens the dominant component shells are from estuarine areas: cockles (*Cerastoderma edule*) and clams (*Scrobicularia plana)* (Detry 2007). The length of the tools are also different: the Muge bevelled tools are much longer and more robust, made from the beam and from tines and have a thick cortical tissue on average, as opposed to the bevelled tools from Western Scotland shell middens, that are made from antler and mammal bone splinters. So, we can infer different tasks for the Muge bevelled tools. These artefacts may suggest intensive woodwork, due to the number and the large size of some wedges (axes?) and handles since it could reflect an exploitation of forest resources, common during the Tardiglacial (Childe 1944; David 2005). Muge bevelled tools share some characteristics with bevelled tools from the Mesolithic sites of Dudka 1, Pobiel 10 in Poland and Hohen Viecheln 1 and Friesack 4 in Germany, with the same fracturing techniques (percussion and double longitudinal grooving, although not the prevalent ones there), wear techniques (sawing), and also the antler portions used as hammers, handles, bevelled tools were made from tines (Pratsch 2011). Some other parallels are seen with the Mesolithic osseous industry of Mullerup 1 and Lundby II in Denmark (David 2005). These Danish sites have bevelled tools similar to some bevelled tools from Muge shell middens, mainly adzes with longitudinal hafting, although the Danish tool is made from an auroch's metatarsals and the Muge tool is made from antler tine, but the hafting mode is the same and morphologically they are similar. Also similar are the hammers made from antler in both Portuguese and Danish sites. Muge bevelled tools may also suggest the treatment and processing of hides, since in the faunal analysis from the Muge shell middens, bones like the astragalus, tibia, radius and calcaneum are present in high frequencies and this could indicate the use of hides and tendons from hunted animals like Red deer, wild boar, rabbit and hare which are all present in the faunal assemblage from Muge (Detry 2007).

## Conclusions

We have presented here a preliminary analysis of a sample of osseous industry made from Red deer antler. The fact that these artefacts have no stratigraphic provenience prevents us from registering the evolution of the techniques in the manufacture of this equipment along with the human occupation of the Muge shell middens, as opposed to other studies of Mesolithic bone industries. On the other hand, its value is that it has permitted a reconstruction of the *chaine operatoire* used for the production of antler tools. Artefacts show abundant features that ethnographically and experimentally were recurrently associated with direct percussion and breaking by bending. Also, it registers the importance of this industry in the daily life of Mesolithic hunter-gatherer-fishers, by showing the role of this resource in the manufacture of their toolkits, surely made on the site (attested by the high frequency of debitage debris) and the importance to their economy, since Red deer was the most hunted mammal in Muge (Detry 2007).

More research is needed in this area, since there are also tools made on mammal bones that were superficially presented in articles published in the last century. Comparison with other Mesolithic sites with osseous industry in Portugal is, to our knowledge, not yet possible since that is not published.

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