



International Erasmus Mundus Master in  
**QUATERNARY AND PREHISTORY**



**Bone and antler tools analysis from the Early Bronze  
Age Site of Oppeano 4C in the Veronese Po Plain**

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## **Introduction**

The completion of my master studies in Human Evolution and Prehistory marks the end of an insightful period, where I learned and stayed in contact with different approaches regarding human evolution, technology, cultural and ritual practices during the period of the prehistory and protohistory as well. A topic that drew my attention was the expression and implementation technological behaviors and how they are represented in archaeological contexts until the present days. This thesis focuses on the study of seventeen bone and antler tools excavated from the Bronze Age site of Oppeano 4C during the two campaigns that were conducted on 2014 and 2015, located in the province of Verona, region of Veneto in Northern Italy. The site, known for its rich archaeological deposits, offers a unique opportunity to explore the material culture of the region during the Bronze Age. The bone and antler tools studied in this case are result of a preventive archaeology activity due to the construction of a gas pipeline. By examining these bone tools, this research aims to uncover the technological and functional aspects of their

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production and use, as well as their role within the broader context of Bronze Age societies in the Italian peninsula. The Bronze Age represents a pivotal period in human history, marked by significant advancements in technology, culture, and society. This era, spanning from approximately 3300 to 1200 BCE, witnessed the widespread use of metal tools and weapons, as well as the development of complex societies and long-distance trade networks. Among the various archaeological discoveries that shed light on this period, bone tools stand out as invaluable artifacts, providing insights into the daily lives, crafts, and subsistence strategies of protohistoric communities. The primary objectives of this thesis are threefold: first, to conduct a detailed typo-logical and technological analysis of the bone tools and antlers; second, to interpret the functions and uses of these artifacts within the daily and ritualistic practices of the community; and third, to situate these findings within the wider cultural and economic networks of the Bronze Age in Europe. Through a comprehensive study of these artifacts, this research seeks to contribute to a deeper understanding of the technological innovations, socioeconomic dynamics, and cultural expressions of the period. The significance of this study lies in its potential to provide new insights into the material culture of the Bronze Age, particularly in the context of northern Italy especially Veneto, a region that played a crucial role in the diffusion of technological and cultural innovations across Europe. By integrating archaeological, anthropological, and different methodologies, this thesis will not only reconstruct the life cycles of these bone tools but also explore their broader implications for our understanding of Bronze Age societies. On the other hand, three tools coming from the Neolithic sites of Masera, Padova Tarrzo in Treviso and the Necropolis of Narde in Frattesina, Rovigo that chronologically belongs to the Bronze Age, are also studied in order to identify some traits of the bone tools in this period and to observe the transition between Neolithic and Bronze Age as it marks a significant shift in

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human prehistory. This transition occurred over several centuries and involved a range of technological, social, and economic changes. The transition from using bone tools to metal tools is an important aspect of technological evolution in prehistory. This transition did not happen overnight and varied significantly across different regions and cultures. As we will see in this thesis, during the Bronze Age in some areas, bone tools continued to be used alongside metal tools for specific purposes or due to the high cost of metal. They continued to be used in various contexts, especially for tasks where their unique properties were advantageous. For example, bone tools remained important in fishing and certain crafting activities. The structure of this thesis is organized as follows: Chapter 1: Objectives and challenges of studying bone and antler tools, The Neolithic Age in region of Veneto and some general reviews on the sites of Masera and Tarrzo. The Copper Age in Italy and the Copper Age in the region of Veneto in Northern Italy, The Bronze Age in Italy and Archaeological Research in Oppeano and the preventive excavations during the 2014 and 2015 campaigns in the so-called site of Oppeano 4c and the Necropolis of Narde in Frattesina as well. This chapter provides an overview of the objectives and challenges of studying bone and antler tools of the Neolithic, Calcolithic and Bronze Age in Italy, highlighting key developments and characteristics of these period. It also details the archaeological research conducted at Oppeano, few aspects of the sites of Masera, Tarrzo and Narde Necropolis in Frattesina including some descriptions of the sites and their significance in the context of Neolithic and Bronze Age studies. The chapter discusses previous findings and the research methodologies employed in excavating and analyzing the site's artifacts. Chapter 2: Geographical and Archaeological Context of sites. This chapter explores the geographical and archaeological context of sites where these bone tools are found, focusing on the site's geomorphology, environmental characteristics and hydrography. It includes a discussion of the

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region's climate, landscape, and natural resources, which have shaped the human occupation and cultural practices of the area. The chapter also reviews the historiography of archaeological research in providing an overview of the key studies and discoveries that have contributed to our understanding of the site. Chapter 3: Methods and materials. This chapter presents a detailed description of the materials and the methodology used. Also this chapter explores the exploitation of bones and antlers on tool making, describes terms of morphometry and morphology, taphonomic modifications and functional analysis. Chapter 4: Typological and technological analysis observed during the laboratory. In this chapter, the functional and cultural significance of the bone tools is interpreted within the broader context of the chronological context. It examines the role of these tools in various aspects of daily life, including subsistence activities, crafts, and potentially ritualistic practices. Chapter 5: In this chapter, I present the results of the taxonomical and zooarchaeological analysis conducted on the collection of bone tools uncovered during the excavation of the Oppeano 4C. The taxonomical analysis involved the identification of the species from which the bones were derived, utilizing morphological characteristics to classify the bones according to their taxonomic categories. This analysis provided insights into the types of animals that were utilized for tool production. The subsequent zooarchaeological analysis focused on understanding the cultural and functional significance of these bone tools within the context of the site. By examining wear patterns, tool modifications, and the broader faunal assemblage, this chapter elucidates the role these tools played in the daily lives of the community, offering a deeper understanding of their subsistence strategies and technological practices. Also in this chapter a comparative analysis between the sites of Farnetto Cave and Oppeano 4C is done, considering that these sites are geographically near and could

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share similarities by the technological point of view. Lastly, the sixth chapter discusses the results and conclusion and the future perspectives of this study case.

## **Chapter 1:**

### **1.1. Objectives and challenges of studying bone and antler tools**

Studying bone and antler industries may be really challenging. One of the difficulties in the analysis of bone tools is the necessity of quantifying and understanding variability within formal morphological types because typology is often defined by species and skeletal part despite similarities in use wear and, thus presumably in function. While some morphological types stick close/y to formal definition others are made in a cruder, more opportunistic fashion on a variety of skeletal elements (Choyke, 1998). One of the objectives is to understand the technological development and to understand the methods used to manufacture these tools, including how bones were selected, shaped, and used. This can reveal information about the technological capabilities of people. On the other hand, they can show how different groups adapted to their environments by creating specialized tools for hunting, processing food, or crafting other items. Changes in tool design over time can also indicate technological innovation (Davis, 1987). Another objective is to reconstruct daily life and subsistence where are reflected everyday activities, such as hunting, fishing, clothing production, and food processing. By studying these tools, archaeologists can gain insights into the daily lives and survival strategies of past

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populations. Also, one tools can provide evidence of the types of animals hunted or domesticated by a community, indicating their diet and the ecological resources available to them (Olsen, 1990). The use and crafting of bone tools can reveal cultural practices and traditions, such as specific hunting techniques or rituals associated with tool use while the differences between their styles and production method can suggest cultural exchange, trade networks, or even the movement of people. Exotic bone materials or distinctive tool styles can indicate connections with other groups while they provide how these communities exploited animal resources, shedding light on hunting practices, animal domestication, and the sustainable use of resources. It is important to note that analyzing wear patterns on bone tools can indicate their specific functions, such as whether they were used for cutting, scraping, drilling, or as hunting implements. In addition to that, some of them also served decorative or symbolic purposes, such as carved bone ornaments or tools with engraved patterns. These artifacts can offer insights into the symbolic or aesthetic values of the culture and may have had ritualistic significance, and studying them can reveal aspects of the spiritual or religious beliefs. It is important to emphasize that aspects of conservation and preservation could be observed by understanding the decomposition how bones preserve in different environments, which helps archaeologists recognize and recover these artifacts effectively during excavations. Analyzing the condition of bone tools can inform conservation practices to preserve these fragile artifacts for future study and exhibition. For instance, bone is an organic material that can degrade over time, especially in acidic soils or environments with high moisture. This can result in a loss of information as many bone tools may not survive long enough to be studied. Even when bones are preserved, they are often found in a fragmented state, making it difficult to reconstruct complete tools or understand their original use. It can be challenging to distinguish between marks made by human activity

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and those caused by natural processes like animal gnawing, trampling, or erosion. This can lead to misinterpretation of the evidence. can be difficult to classify by function because similar tools might have been used for different purposes, or their use may not leave clear wear patterns. Previous studies have shown that there is interpretation limitations may be influenced by contemporary biases or assumptions about past societies, potentially leading to inaccurate conclusions about their use or significance. Without a well-preserved archaeological context, it can be difficult to understand how bone tools fit into the broader cultural and economic systems of the time. The lack of associated artifacts or structures can make it hard to draw firm conclusions. In some regions or periods, there may be a lack of comparative data on bone tools, making it difficult to understand their broader significance or to establish patterns in their use across different cultures. High-quality analysis of bone tools often requires specialized equipment and techniques, such as microscopic wear analysis or isotopic studies, which can be expensive and time-consuming. When the archaeological record is incomplete, and many bone tools may have been lost or were never deposited in contexts that preserved them. This means that our understanding of bone industries is based on a partial record, which can limit the scope of our interpretations. In fact, the significance of bone tools often depends heavily on their archaeological context. Without information on where and how they were found, it is difficult to draw meaningful conclusions about their use or cultural significance. Thus, it can be concluded that these challenges highlight the complexity of studying bone industries in archaeology, requiring careful methodological approaches and cautious interpretation to overcome the inherent limitations of working with this type of material evidence.

## **1.2 Neolithic Age in Veneto**

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The Neolithic Period today marks a complex phenomenon that led humans to be a producer of their own food, the transition from hunting and gathering economy to an economy which was based on cultivation and livestock farming. This period has economic innovations consisting in breeding and agriculture, technological by producing ceramics, different equipment and tools. By the social point of view people were organized in tribes and they developed ideologies expressed in art, such the zoomorphic and anthropomorphic figurines and funerary rituals. During this period societies were organized in tribes which were composed of the permanent union of several families sharing the place of residence and which may or may not coincide with one or more lineages. The first time the term Neolithisation was used was in 1865, when John Lubbock described the changes that had occurred in the lithic industry during prehistory (Trigger, 2006). But it wasn't until the 1930s that the term Neolithisation came into widespread use among archaeologists, mainly thanks to Gordon Childe and his work on the Neolithic revolution. Childe described the Neolithic Revolution as a process in which a large-scale transition of many human cultures occurred during the Neolithic period, from a hunting and gathering way of life to an agricultural one, making possible to supply an increasingly large population. The main social changes development of agriculture and animal husbandry, and the sedentarisation of human groups. During the Neolithic Period, the Veneto region witnessed the establishment of several significant settlements that marked a shift from a nomadic to a sedentary lifestyle. These early communities, such as those at Riva del Garda, Valdastico, and Molina di Malo, were characterized by their permanent structures and advanced agricultural practices. The settlements often featured robust, well-planned dwellings constructed from timber and wattle-and-daub, reflecting an increased emphasis on stability and long-term habitation. Evidence from these sites reveals a sophisticated approach to communal living, with organized layouts and specialized

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areas for different activities. These Neolithic settlements not only highlight the region's adaptation to agriculture but also provide insights into the social organization and daily life of its early inhabitants. The archaeological remains coming from these prehistoric communities continue to offer valuable information about the development of settled societies in the Veneto region. One of the most important sites that makes part of the Neolithic settlements in Veneto and it is very well documented is the case of Lugo di Grezzana in Verona province. This Neolithic site was excavated during 1996-2004 by the Soprintendenza Italiana di Veneto in collaboration with the Laboratorio di Preistoria of the University of Trento and the results were quite important. Relationships with the peninsular area (Catignano and Ripoli 1) are suggested by numerous fragments of flasks with neck surmounted by perforated circular plastic decorations (bugnette) obtained in ceramic figulina and pastes tempered with limestone (Pedrotti, Cavulli, Miorelli, 2000; Moser, 2000). The production of the latter products is certainly local. It is probable that many of the figulina pottery shapes found in Lugo di Grezzana are made on the spot, since there is the presence in the site of some carinated mugs made of figulina pottery (Pedrotti, Cavulli, Miorelli, 2000:119-120, Pedrotti and Salzani 2010). The production of ceramics was highly expressed and many types show contacts with contemporaneous groups of the Po Valley-Alpine area. The «su peduccio» vessels and the truncated cone shaped vessels with two handles and «a tacco» bottom, sometimes decorated with impressed cordons, show contacts with the Vho' group. On the other hand, this site shed light also to lithic industry where a collection of microblades was assembled. As I have mentioned in the preview of the thesis one bone tool of those studied in this thesis comes from the Neolithic site of Masera in Padova (fig 1.2). The discovery took place in June 2023 following the execution of preventive trenches requested by the Superintendency prior to the start of urbanization works in Maserà di Padova, Via Mons. Zane. The archaeological

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company contracted by the property is Malvestio Diego & C. snc of Concordia Sagittaria. The discovery of dating material (in particular a characteristic stone tool known as the "Ripabianca burin") makes it possible to attribute this site to the Early Neolithic. Recent dating of this period is attested in the Neolithic sites of Lugo di Grezzana (VR) and Vicenza-Dal Molin in a chronological span of the last centuries of the 6th millennium (5300-5000 BC). The most likely hypothesis is that this is a settlement context. The abundant presence of fireclay and the discovery of a pit-silos, which is very rich in animal fauna as well as flint processing waste, concur to support this preliminary working hypothesis. The tests were conducted on an area of about 3000 square meters while the area investigated in extent is 13 x 6 m. The most significant building material found is definitely the concoction. The construction technique would appear to be similar to that of other Neolithic settlements: wooden poles driven into holes in the ground formed the frame of the walls to which a tarp was adhered, which in turn was covered with earth. The different quality of flint found at the site is certainly an indication of exchanges. Indeed, alongside the classic reddish, dark-brown Euganean flint is the dull yellow, whitish flint typical of Lessinia and certainly imported here. The abundant presence of fauna reveals the important contribution of animal breeding alongside agriculture. According to the archaeologist and professor Vincenzo Tinè, this new discovery is especially important because of the rarity of such ancient finds in the Padovan area. Regarding the faunal remains found in this site which belong to the Late Neolithic period, an archaeozoological study was given by Umberto Tecchiati (2009). According to him, in the case of Maserà, faunal remains were contained in the fills (US 111, 117, 119, 121, 123) of various pits of different shapes and sizes, interpreted generally as drainage structures. Only slightly less than 10 percent of Maserà's remains came from an anthropogenic layer containing coals, pottery, flint etc. (US 103). The faunal remains are on average very

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fragmentary (average weight at Maserà: 2.7g; g) and are therefore mostly undeterminable ND of Maserà: 76.8%; which also proves the accuracy of the collection). Weathering changes were not observed and cuts left by tools for the operations of carcass handling (slaughtering, skinning, disarticulation etc.) are rarely observed, but still present a bone point tool taken from a diaphyseal knapping not determinable from Maserà make up the picture of the bone tool industry on hard animal matter found during the laboratory study of faunal remains. It is worth noting that the faunal lots analyzed are, in terms of the quantity of remains determined and overall preservation, far from meeting the quality standards required of archaeological faunas for detailed observations. It can generally be assumed that quantities of determinate remain of less than a thousand units are insufficient from a statistical point of view and that the data that can be obtained are exposed to the risk of randomness and aleatoriness. In particular, the counting of the Minimum Number of Individuals (NMI) had to be based exclusively on the calculation of pairs of anatomically homogenous anatomical parts, since loose teeth and mandibles are overall poorly represented or unusable (e.g. premolars in herbivores) and are therefore inadequate for the purpose. The same applies to the determination of the so-called age and sex ratio, conducted essentially on coxals and metapods in the case of oxen, on coxals in the case of goats, and on canines in the case of pigs. The greater number of determinable found in Maserà, has made it possible to document numerous other species that, if completely insignificant from an economic point of view, nevertheless lend themselves to interesting environmental observations. Judging by the variety of species at Maserà, one must assume that the surroundings of the site were characterized by habitats suitable for species that prefer forest vegetation, including woodland coppice (deer, roe deer, wild boar, and certainly also pigs). The presence of wet environments such as low-energy streams or ponds seems to indicate species typical of these environments

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such as the beaver and the freshwater turtle. Another Neolithic and Chalcolithic site that I have taken into consideration in this thesis is the one of Tarzo in the province of Treviso, Northern Italy. The lakes of San Giorgio and Santa Maria are two basins located in a glacial valley, at the foothills of the Veneto Pre-Alps. During a collaboration of a multidisciplinary project of the University of Ferrara and University of Padova, three field campaigns, underwater prospecting, geoarchaeological cores, geophysical acquisitions and archaeological excavations were carried out to identify new settlement areas and reconstruct formation processes and paleoenvironment. Archaeological pre-existences date back to 1923 when a Sauerbrunn bronze sword, followed by other bronze artefacts, was found while excavating an artificial canal. In 1987, the first pile-dwelling remains were discovered. During the 1990s, several excavation campaigns documented a peri-lacustrine settlement dating to the late Neolithic-Eneolithic, with sporadic frequentation during the Bronze Age. The faunal assemblage is characterized by domestic animals, mainly bovines, pigs and sheep/goats, flanked by some wild species like bears and small carnivores. The living continuity of the settlement is further confirmed by the various pottery production, both for daily use and food storage, by the production of necklaces and pendants on bones and teeth, as well as by the procurement of lithic raw material from areas close to the settlement.

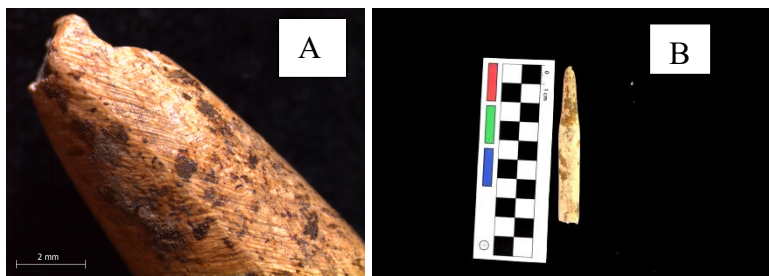


Fig 1.2 A. 0.8 magnification on microscope on a possible pointed bone tool B. picture taken by Andia Shtembari by the site of Masera in Padova

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### 1.3 Calcolithic Age in Veneto

The Copper Age, or Chalcolithic period, in Italy, spanning approximately from 3500 to 2300 BCE, represents a crucial transitional phase between the Neolithic and the Bronze Age. This period is marked by the emergence and gradual adoption of copper metallurgy, leading to significant social, economic, and technological transformations across the Italian peninsula. The adoption of copper metallurgy in Italy was influenced by interactions with neighboring regions, such as the Balkans and Central Europe, where metalworking had already developed. The earliest evidence of copper use in Italy includes simple tools and ornaments, indicating that metal was initially used alongside traditional stone tools. Over time, more complex metalworking techniques, such as casting, began to emerge, though copper remained relatively scarce and precious. The Copper Age in Italy was characterized by considerable regional diversity. In Northern Italy, particularly in the Po Valley and surrounding areas like Veneto and Lombardy, communities were closely connected to wider European networks, facilitating the spread of new technologies and cultural practices. In these regions, archaeological sites such as Remedello in Lombardy show evidence of sophisticated burial practices with grave goods, including copper weapons and ornaments, indicating the beginning of social stratification. Archaeological evidence from the Veneto region during this period reveals a transition from small, dispersed Neolithic settlements to larger, more organized communities. These larger settlements were often strategically located near water sources and fertile lands, supporting both agriculture and animal husbandry. The increase in settlement size and complexity indicates the beginning of social stratification, with certain individuals or groups likely gaining status through control of resources, including copper production. One of the notable features of the Copper Age in Veneto is the appearance of fortified settlements, such as those found at sites like Molina di Ledro and

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Mondeval de Sora. These fortified sites suggest a growing concern with defense and possibly competition over resources, which may have been driven by the increasing value of copper tools and weapons (Peroni, 1996).

## **1.4 An overview of the Italian protohistory**

Protohistory is often characterized as a middle period between prehistory and history in which civilizations, although they did not yet use a proper writing system as a means of narrating their history, were mentioned or partly described by populations with whom they had come into contact. Nowadays it is placed in relation to the social complexity to which it refers for example in Italy, the concept of protohistory it appears to start from the ancient Bronze Age around the end of the 3<sup>rd</sup> millennium. The main traits of this period are the discovery of the metallurgy, copper and the production of weapons, the ideological predominance of the men over the women, socially speaking, the era of a “military” predominance, the partial return to pastoral nomadism, to an ambiguity of figurative complexity, to the appearance of the new cult objects, new communities and villages, the formation of the elites and new settlement patterns such as palaphits and fortified dwellings. The social complexity is increased, and the organization of the society is divided between four main stages according to (Elman Service 1962, Primitive Social Organization).

- Bands that are mobile family groups who collect wild plants and hunt animals; they occupy a range of camps or caves, usually on a seasonal basis

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- Tribes that are characterized by larger social units comprising a number of families who are related through a web of kinship; herders, agriculturalists; nomadic/ permanent
  - villages; informal leadership; some are headed by «Big Men» who sponsor feasts, coordinate defense or cooperative projects.
  - Chiefdoms, or known as “polities” intermediate between tribes and states: control of productive resources by a chief; integration of multiple settlements under a central authority; a hereditary elite. They are particularly visible in the archaeological record for example the case of Stonehenge. In this case populations tend to be from a thousand to tens of thousands.
  - State are larger populations, formal institutions of government, a class- structured society.

Chronologically speaking, in Italy protohistory is divided into the Chalcolithic Age (3600-2200 BC) and Bronze Age (2200-1000 BC). Although it is a rather recent discipline in Italy and seen as a hinge between prehistory and protohistory, in protohistoric communities there are elements of stable socio-economic differentiation, absent in prehistoric ones. These elements of differentiation are the first symptoms of a very articulated process that will lead to the birth of the city and the state. In Italy, the process of socio-economic differentiation socio-economic differentiation includes:

- Bronze Age (the second millennium B.C.)
- The Early Iron Age
- In central-southern Italy ends with the beginnings of Greek colonization (late 8th century B.C.)

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- In northern Italy it ends with the spread in the Po Valley of the Etruscan urban civilization (late 6th century BC)

The Italian protohistory has its own defined and rather unitary even as a separate branch of archaeology the so-called archaeology of weapons. There is a certain way of carrying out reconnaissance, of excavation, of classifying, describing, documenting the finds that is well suited to the Bronze and Iron Ages less so to those periods that precede and follow (Peroni,1996).

On the other hand, Peroni describes Italian protohistory as it follows: *"I believe that the common thread of Italian and European protohistory is to be found in the development of forms of social organization at the beginning of this space of time we find small communities of villages, mostly unstable, lacking within them an established social stratification, and at its conclusion we have before us the city, the state, a society of classes. For such a great development 2000 years is not a long time. Few of us, indeed, if we were to think of an evolutionary process, an insensibly gradual drift. Everything suggests instead that it was a dialectical development, in which established models of social organization were contrasted by n new models that were being prefigured "* (Peroni 1996). On his work Peroni also makes a comparison between European Protohistory and the neighboring regions citing like below:

*"It should not be forgotten that the "barbarian "Europe of the 3rd, II and I millennium B.C. developed in the presence of a world characterized by a far higher civilization and by totally different forms of social organization totally different of that of the Near East and the Eastern Mediterranean. Obviously, the Eastern models of social organization would have been impractical for Europe; however, they had to ceaselessly exert on it an effect of suggestion and stimulus (Peroni,1996)".* Nowadays, the research that has developed since then allows us to

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clarify and partly clarify the statements cited of the father of Italian protohistory: that the development of forms of social organization was indeed a dialectical development, in which new forms were pitted against old ones, but not always in a linear way because we still have many examples of attempts at urban community development that were failed.

## **1.5 Early Bronze Age in the province of Verona**

The Bronze Age is a highly complex period in which enormous changes in the global viewpoint are observed, with the transition from small, strongly locally bound agricultural and pastoral communities to a complex society characterized by extensive trade contacts and commodity exchanges, which saw the formation of almost political groupings on a large scale, where aspects such as status and power played an important role (Harding, 1998). In Northern Italy the Early Bronze Age could be divided in two important phases that cover a chronological frame starting from 2200-1600 BP, characterized by the Polada Culture (De Marinis, 2001; Bietti Sestieri, 2010). The Polada culture is an archaeological culture that existed during the Bronze Age, approximately between 2200 and 1200 BCE, in what is now northern Italy, including the area around Lake Garda, the Po Valley, and the Veneto region. The culture is named after the site of Polada, near Desenzano del Garda, where significant archaeological findings have been uncovered. This culture reflects a transition from Neolithic societies to more complex Bronze Age communities and is connected to other contemporary cultures in the region, such as the Terramare culture in the Po Valley and the Otzi culture in the Alpine region. The cultural and technological developments of the Polada people influenced subsequent Bronze Age societies in Italy. The use of metal tools improved agricultural techniques, and the establishment of larger, more permanent settlements indicate a growing societal complexity. Polada sites are known for

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their characteristic pile dwellings, which were built on stilts over waterlogged areas or lakeshores. This method of construction helped protect the inhabitants from flooding and facilitated easy access to water resources. One of the most known settlements patterns are the “palaphites”. In archaeology, it indicates the remains of dwellings and other constructions from prehistoric times, which have been preserved in the form of piles, or entire fields of piles, or other wooden construction elements along the shores of lakes, or submerged, or in wetlands. The chronology of the villages covers a very broad time span from the Neolithic to the Iron Age (5000-500 BC). The Italian sites identified to participate in the project total 19 five regions: Lombardy (10), Veneto (4), Piedmont (2), Friuli Venezia Giulia (1) and Trentino Venezia Giulia (1) and Trentino Alto Adige (2) (Fasani, 2002). In northern Italy, the oldest structures date back to the early Neolithic (Biandronno-Isolino Virginia, ca. 5000 BC) but the phenomenon intensified during the Early and Middle Bronze Age (2200-1400 BC) to end towards the end of the 2nd millennium BP. The greatest concentration of pile dwellings is located on the shores of Lake Garda, where more than 30 settlements are known, but there are also important sites in the intramarine basins or in the small Alpine lakes of Trentino and in the basins of Piedmont. Pile-dwelling settlements are also known in the Po Valley in the resurgence belt or along rivers and in the foothills of Friuli Venezia Giulia. The “palafitte” settlements in the province of Verona are part of a broader set of prehistoric pile dwellings found in the Alps and their surrounding regions. These structures provide invaluable insights into early human life, settlement patterns, and environmental adaptations in the area. Some of these ancient pile dwellings are recognized as UNESCO World Heritage Sites under the designation "Prehistoric Pile dwellings around the Alps." This includes various sites across the alpine regions of Switzerland, Austria, Germany, France, Italy, and Slovenia. The sites in the Verona area, along with others around the Alps, are noted for their

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outstanding preservation and significance in understanding prehistoric and protohistoric cultures. They provide evidence of early human ingenuity in construction and adaptation to the environment, showcasing a rich history that continues to be explored and appreciated today. Oppeano 4C it is considered to be another relevant site which during its excavation has brought to light evidences of this particular culture. The occupation of the site can be dated to the Early Bronze Age and is evidenced by the preservation in a humid environment of wooden habitation structures, associated with dump heaps containing anthropogenic material and faunal remains.

## **1.6 Middle Bronze Age in the province of Verona**

The northern Italian Middle Bronze Age communities based their economy mainly on agriculture, herding, and metalworking, exploiting the available Alpine copper ores. Extensive trade involving luxury objects (e.g., amber, imported pottery) with Central Europe, the Balkans, the eastern Mediterranean world, and the Baltic area are very well documented in the Terramare sites, as well as cultural contacts testified by the distribution of metal artifacts. The Middle Bronze Age in the Province of Verona, in the Veneto region of Northern Italy is characterized by a number of significant archaeological sites that provide insight into the region's prehistoric past. There are listed some notable sites from that period:

Nogarole Rocca which is located to the northeast of Verona (fig. 1.6). According to the archives of Soprintendenza Italiana di Veneto, this site contains abundant material that can be dated, on the basis of type, between the Middle Bronze Age and the Final Bronze Age: they include ceramic material (keeled bowls, dolii, ollae, horned handles, enigmatic tablet decorated with figures

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reproducing a spectacle pendant) and bronze. To the Middle Bronze Age (XVI-XIV century B.P.) belongs an axe with short flaps and a median choke, while a small dagger with a ring-ended base is referred to Late Bronze (XIII-XII century B.p.) and another axe with median flaps and a pronounced shoulder is referred to Late Bronze (XI-X century B.P.).



**fig. 1. 6** a Nogarole Rocca site as taken by Google Earth images

Another archaeological site which has evidence from the Middle Bronze Age Period is Costermano, a municipality of 3,614 inhabitants located in the north-western part of the province of Verona, in the Garda hinterland between Torri and Garda. The municipal territory covers an area of 16.91 square kilometers. The highest point of the municipality is represented by the altitude of about 665 meters south of Sperane, on the western slope of Mount Belpo, while the lowest point is in the Garda plain at 113 m. The first settlements of which certain evidence remains in the Costermano area belong to the Bronze Age (1,800 - 1,000 B.C.) and are represented by the ceramic elements found in the locality of Maoni: Shards with lunate and handles and from biconical vases. It was probably a modest agricultural and pastoral center consisting only of a few huts, located on a morenic spur dominating the Valle dei Mulini. The

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site of the Oppeano represents one of the sites with the relevant archaeological findings. Archaeological domestic contexts, with their hearths, ovens, pits, and waste heaps inside and outside dwellings represent an important source of information on the use of plants and of space by ancient communities. The potential of this information increases especially in the presence of well-preserved archaeological levels, which have undergone fire events, rapid burial or are located in waterlogged sites. These exceptional conservation conditions were met at the site of Oppeano Via Isolo "4D" (Verona, N-E Italy), an important multi-phase settlement dated to the Middle Bronze Age 1650-1350 BP (Cardarelli, 2010). Most of the archaeological sites that are located in the province of Verona show a continuity to the other periods as well, including the Late Bronze until the Iron Age. On the other hand next to the province of Verona, in Rovigo, is located one of the most important archaeological sites of Italian protohistory. The Necropolis of Narde, located in Frattesina, is a significant archaeological site reflecting the cultural and funerary practices of the Late Bronze Age in northern Italy. Excavated extensively since the late 1960s, Narde comprises two primary sectors, yielding over 800 cremation urns and a smaller number of inhumations, with burial practices dating from approximately 1150 BC to 925 BC. This necropolis is noted for its wealth of artefacts, including items that suggest a high degree of social stratification among the buried individuals, indicating the presence of elite classes within the society. Frattesina itself functioned as a vital trade hub, strategically positioned along ancient trade routes, which facilitated the exchange of goods and cultural influences between the Mediterranean and central Europe. The findings from Narde not only enhance our understanding of local customs but also highlight the broader socio-economic dynamics of the region during this period (Bietti Sestieri et al., 2019). But what would be the role of the bone tools in a funerary context? Most of the times, bone tools in a funerary context hold significant cultural and

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symbolic meaning, often reflecting the beliefs and practices of a society regarding death and the afterlife. These artifacts, which may include items like needles, awls, and scrapers, serve both practical and ritualistic purposes (fig. 1.6 b)



fig. 1.6 b burned bone artifact from Narde Necropolis tomb 198, classified as an awl. Since it burned we could not clearly understand if it was functional or only symbolical photo: Andia Shtembari

## 1.7 Historiography of the archaeological research in the site of Oppeano (VR)

Considered one of the most important sites in Italian archaeology, Oppeano offers a wide series of useful data for understanding the population dynamics that have seen human presence in a discontinuous mode from at least the final phases of the Neolithic to the Roman period (Saracino and Guidi, 2008). The settlement of Oppeano, which has been the subject of research for about 140 years (Ferrari 2008) and has become a case study for the possibilities and potential offered by the limited anthropisation of the archaeological sites, fits well into this scenario (Candelato et al. 2015; Guidi and Salzani 2008) (fig 1.7). The municipality of Oppeano is about 20 km south of Verona, a territory rich in archaeological evidences spanning from Bronze to the Iron Age. In a stretch of floodplain named Bussè (close to Vallese di Oppeano) and reclaimed during the 12th

century AD (Bosco 2015:150), the Feniletto Late Bronze Age pile dwelling (ca. 13th-12th century BC) is known since the end of the 19th century AD (De Stefani 1869; Alfonsi 1919).

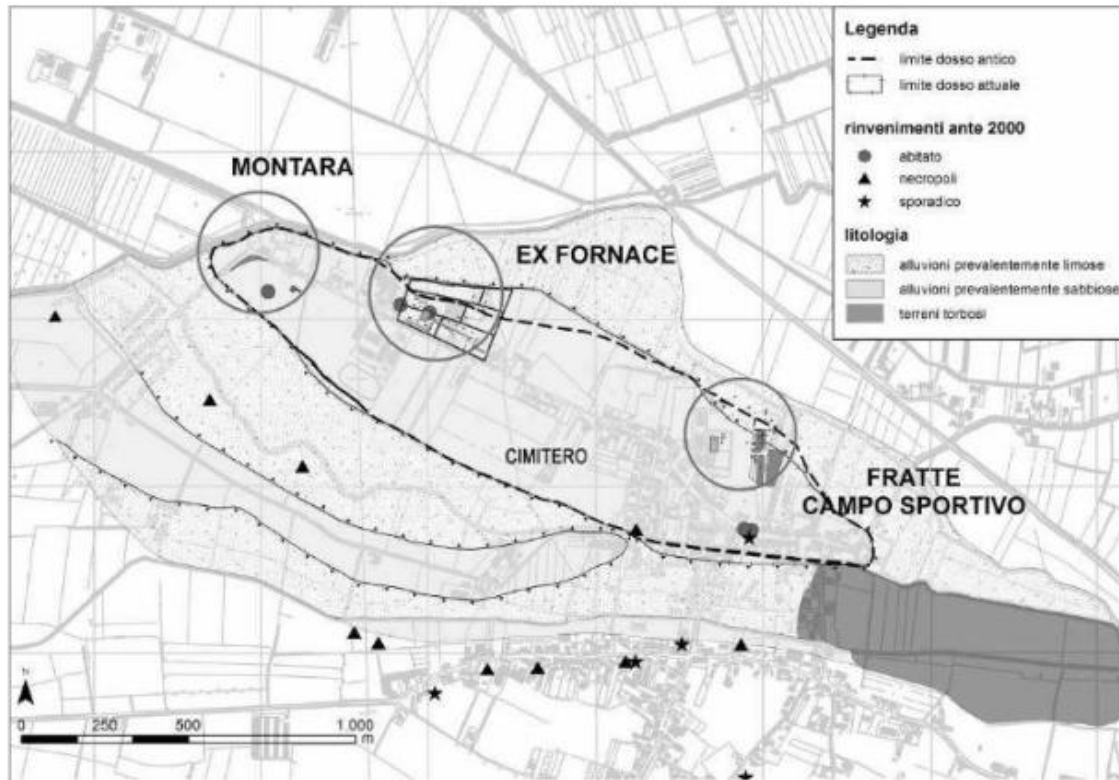


Fig. 1.7 Oppeano, plan with the positioning of the finds prior to 2000 (asterisks indicate emergency excavations and sporadic finds that are not well placed) and with the new excavation areas investigated (elaboration F. Candelato).

## 1.8 Preventive excavations at the sites of Oppeano 4C and 4D

The discoveries of Oppeano 4C and 4D (fig. 1.8a & 1.8b) add to the growing body of knowledge about Bronze Age settlements in northern Italy, offering insights into the daily lives, economic activities, and social structures of the people who lived there. The methodical approach to its

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discovery and excavation reflects the careful work of archaeologists dedicated to uncovering and preserving the past. In 2014, during preventive archaeology operations linked to the construction of the Zimella-Cervignano D'Adda pipeline, two new settlements were discovered. Unfortunately, an incision by a natural channel cut the stratigraphic direct relationship between the two sites. Site 4C, to the east, dates to the Early Bronze Age. Site 4D, on the west, dates to the Middle Bronze Age (Gonzatto et.al, 2021). The first excavation activities in the sector named 4C were conducted July 2014. On this occasion, the staff in charge of archaeological assistance found the emergence of anthropic deposits in the eastern portion of the pit at picket 251, at a depth of approximately 3.5 metres in depth. The discovery was reported to Dr. Federica Gonzato of the Veneto Archaeological Heritage Superintendency, who proceeded to suspended the excavation and indicated the preventive and operational investigation methodology. Firstly, it was proposed to carry out mechanical shovel surveys and core drilling in the area between pickets 213 and 270, in order to preliminarily assess the consistency of the archaeological deposit and the presence of further sites. To be taken into consideration is the extraordinary removal of the archaeological stratigraphy of site 4C, without planning an archaeological excavation stratigraphic excavation due to the apparent excessive depth of the anthropic layers identified during the first phase of excavation for the laying of the pipe; this concession was tied to the possibility of concurrently carrying out adequate documentation of the archaeological layers during the trenching phases and the execution of mechanical and manuals for the study of the complete archaeological stratigraphic sequence. What emerges from this initial collection of data from the archaeological work conducted at site 4C, is that excavation activities have profoundly affected a pile-dwelling site of considerable size and importance. The very high number of piles surveyed the thickness of the anthropic deposit, the clear presence of complex

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structures and the chrono-cultural attribution given by the materials, suggest that the site may be a palaphite. Despite the limited surface area investigated, which does not allow for an extensive reconstruction of the ancient appearance of the area, the test conducted at site 4C allowed the identification of a pile-dwelling type settlement chronologically framed during the Early Bronze Age. The composition of the sediments, predominantly peaty in nature for almost all of the period of frequentation of the settlement, allows us to assume that the area in question, during the life of the settlement, was a wetland environment. On the basis of the stratigraphic sequence emerged from the excavation operations, it was possible to identify four main phases of settlement life, of which the first and oldest appears to have ended with a traumatic event testified by traces of an extensive fire. The location of the village has made it the subject of periodic and frequent alluvial flooding phenomena, as attested by the presence of sediments of clear natural origin, formed by the overflowing of ancient watercourses. The retreat of the water caused the deposition of sediments consisting of organic silts (gyttja) responsible for the erosive phenomenon of cumuliform structures clearly recognizable as drainage mounds that characterize the utilization plans of the different phases. The small number of vertical wooden elements, moreover, suggests that we are in the presence of an area only marginally affected by the presence of living structures. The presence of reiterated piles of waste within the area of investigation supports this hypothesis, since these structures were formed precisely by the accumulation of waste and discarded material thrown over the perimeter of the raised decks that formed the base of the dwellings (Redolfi Riva, 2016). The Bronze Age in Italy is characterized by a great cultural phenomenon called “Pile-Dwelling–Terramare”. In agreement with Cupitò et al. (2012), this is marked by two principal components: pile dwelling and Terramare that blend at a certain point of their history. The team found evidence of a Bronze Age settlement, which

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included pottery, tools, and other artifacts, indicating that the area had been inhabited for a significant period while the findings at Oppeano 4C have been crucial in understanding the broader patterns of human settlement in the Po Valley during the Bronze Age.

**Fig. 1.8 a (Vallese Oppeano, site 4C, excavation 2015: Phase 4, base copyright Gonzatto et. Al)**



**Fig. 1.8b Oppeano, site 4D: a detail of Unit F, Phase 2a.**

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## 1.9 Stratigraphy of the site Oppeano 4C

The site uncovered by the excavation activities presents a very complex archaeological stratigraphy. Basically, it is possible to distinguish 8 main units which were practically recognized along the excavation works (fig. 1.9)

- 0 (natural 0÷-40 cm): current top soil
- 2 (natural 40÷-100 cm): peat and gravel deposit
- 3 (natural -100÷-250 cm): alluvial silt-clayey medium grey deposit. It should be noted that on the top of this unit, 10 m east of P 251, there was a yellowish silty-sandy layer of probable alluvial origin characterized by the presence of a numerous sherds attributable to the Late Bronze Age, scattered in a restricted area 6 x 6 m approx. in the absence of structural traces.
- 4 (-250÷-290 cm): light grey silty clayey alluvial deposit. To the west of the trench, between units 3 and 4, another peaty level appeared.
- 5 (-290÷-310 cm): light grey silty frank deposit containing charcoal dispersed, flowing fragments of plaster and altered limestone pebbles. Moment of stagnation following the abandonment of the site by humans, with consequent alteration of the surface of the anthropogenic deposit.
- 6 (ANT 1 -310÷-330 cm): medium grey silty loam deposit characterized by the presence of abundant carbonated lumps, plaster fragments and fragments of pottery that often form slow or thin layers. This unit has been defined as Anthropoc 1.

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- 7 (ANT 2; -330÷-390 cm): peaty layer characterized by the presence of abundant archaeological artefacts and vertical piles. This unit has been defined as Anthropoc 2.
  - 8 (ANT 3; -390 cm÷ end of excavation): Peat with a very abundant brown silty matrix. This unit, although only marginally incised, has revealed archaeological artefacts and vertical piles. The team labeled this unit as Anthropoc 3.

Along the excavation sections and on top of the anthropogenic deposit, traces were recognized traces of probable structures. Approximately 20 m east of P 251, on the north wall, a lenticular sediment accumulation was identified a lenticular accumulation of sediment (maximum thickness 1.5 m) exceptionally rich in piles, coals, artefacts, ecofacts and faunal remains (animal bones and seeds). At this case could also be seen from the plan of distribution of the piles - there was a clear concentration of vertical piles. Such evidence suggested that it may be the remains of a dwelling unit, or an area in any case close to this type of structure. Continuing eastwards, along the northern section, several areas were recognized and characterized by the presence of sequences of silt levels, rubefaction clay and fragments of plaster. These accumulations alternate with small concentrations of vertical piles. The presence in the piles of materials used specifically for the construction of residential buildings would also indicate the existence of such structures in the immediate vicinity. At the eastern portion of the excavation, on the roof of ANTHROPIC 2 rubble and pebbles surrounded by some horizontal boards and vertical poles. Lastly, ca. 47 m to the east of the area where the first piles were found, a structure consisting of two double rows of piles with NW/SE orientation separated by an accumulation of pebbles. To the east of this last emergence, the anthropogenic deposit deepened or ended, and along the trench were recognized exclusively deposits of natural origin



fig 1.9 stratigraphical sequence of the site Oppeano 4c courtesy of Soprintendenza per i Beni Archeologici del Veneto

## Chapter 2:

### 2.1 Climate during Neolithic Age in Northern Italy

It is important to be aware of the natural features of the study area because they have a direct influence on the humans and animals present on the sites. Knowing the climate, paleoenvironment, environment and geomorphology, it is easier to interpret the faunal assemblage and understand the taphonomic processes that affected the bone material. Italy, given its substantial latitudinal extent, exhibits an extraordinary diversity of landscapes and shows a varied topography that, moving from north to south, includes coastlands, plains, and high mountain chains such as the Alps and the Apennines. Mountainous and hilly areas prevail over lowlands, although the Po Valley covers a large part of northern Italy (Marchetti et al., 2017). The altitudinal gradient ranging from the highest peak of Mont Blanc (4810 m above mean sea

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level) to the lowest point at Le Contane, Jolanda di Savoia (3.4 m below mean sea level) results in marked differences in terms of climate and vegetation composition. The main mountain chains influence the climate in the peninsula, given that the Alps protect the Po Plain from the cold winds of central Europe, while the Apennines contain the maritime humid air from the Tyrrhenian Sea (Fratianni & Acquotta, 2017). Average annual rainfall shows a latitudinal gradient with values exceeding 2500 mm in the Alps and Apennines and as low as 238 mm at the shores of Capo Carbonara in southern Sardinia (Marchetti et al., 2017). While the Po Valley dominates most of northern Italy, the Apennine range divides the rest of the Italian peninsula longitudinally and represents a physical barrier between the Tyrrhenian and the Adriatic side. The paleoclimate during the Neolithic Period in Italy, which spans approximately 10,000 to 4,500 BCE, was characterized by a general trend of warming following the end of the last Ice Age, leading to significant environmental changes that affected human societies. The climate during the early Neolithic was still influenced by the cooler and wetter conditions of the late Pleistocene, but it was gradually warming. Temperatures were rising, leading to the retreat of glaciers and an increase in sea levels. This warming trend allowed for the expansion of deciduous forests in the northern and central parts of Italy, dominated by oak, hazel, and elm. The Mediterranean region saw the spread of scrubby vegetation and early stages of Mediterranean forests. As the climate became more stable, early agricultural practices began to emerge. The warming climate supported the cultivation of cereals like wheat and barley, and the domestication of animals such as sheep and goats. During the Middle Neolithic Age, the climate was generally warm and stable, with a slight increase in aridity, especially in the southern and coastal regions. This period is often associated with the Holocene Climatic Optimum, which was a time of warmer and more stable temperatures globally. Forests were well-established across

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much of Italy, particularly in the north and central regions, with a mixture of deciduous and Mediterranean vegetation. The southern regions, particularly near the coast, began to see more open landscapes with scattered trees due to both natural and human influences. Agriculture became more widespread, with more sophisticated farming techniques and the development of permanent settlements. The stable climate supported larger communities, and there was a greater reliance on farming and herding. The cultivation of new crops and the introduction of pottery also marked this period. The late Neolithic saw a continuation of the generally warm and stable conditions, but with increasing evidence of climatic fluctuations towards the end of the period. There was a slight cooling trend, particularly towards the transition to the Bronze Age, which may have led to changes in agricultural practices and settlement patterns. However, the late Neolithic period's climatic fluctuations may have begun to challenge these early societies, setting the stage for future developments in the Bronze Age (Zanchetta, G., et al., 2007).

## **2.2 Climate during the Chalcolithic Age Northern Italy**

The paleoenvironment setting of Copper Age in Northern Italy happens after the middle Holocene which is subdivided into five chronological phases, showing an environmental evolution and climatic transition across the centuries (Ravazzi and Pini 2013). The first half part of Holocene is characterized by the presence of wide spreading forests, in a landscape mainly shaped by natural agents. The recorded climate for this period is not yet stable, although it results to be temperate and in certain phases warmer than the current one. Right after the Atlantic period and the beginning of Sub-boreal phase between 4548-4357 cal. BC, a declined in climatic conditions is noticed and consequently in the landscape. During this phase, another important cause of environmental change is the anthropic impact on the landscape management. It is noted

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that during the transition from the Neolithic and Copper Age new human adaptation strategies contributed to deep change in the profile of the natural environment (Ravazzi and Pini 2013).

### **2.3 Climate during the Bronze Age Northern Italy**

Bronze Age often involves the rise of early states and complex societies. Climate conditions during this period can shed light on how environmental factors influenced the transition from small, simple communities to larger, more complex ones. Different data have shown that climate variations have often influenced the rise and fall of civilizations. For instance, prolonged droughts or cooling periods could have led to agricultural failures, migrations, and societal collapses. Understanding these climatic factors helps explain major historical events and transitions. Climate conditions directly affect the availability of resources like water, food, and raw materials, influence site formation processes, including erosion, sedimentation, and preservation. This includes how a specific group adapted to climate changes, managed resources, and developed technologies in response to climatic conditions. Paleoclimate records suggest that in the Early Holocene the climate of the Italian peninsula was drier and then switched toward wetter conditions after ~ 8500 cal yr BP. At most sites, the climate was wetter during the mid Holocene than in late Holocene times. According to the application of Summed Probability Distribution (SPD) a statistical method used in archaeology and paleoclimatology to analyze the distribution of radiocarbon dates over time, in northern Italy, population grew dramatically in the Early Bronze Age and peaked during the Middle/Late Bronze Age (c.3600–3200 cal yr BP ) with the establishment of the Terramare culture, characterized by large pile-dwelling settlements that spread from the central part of the Po Valley down to the Apennines (Fasani, 2002; Bernabò Brea, 2009:11; Nicolis, 2013:696–697; Capuzzo et al., 2018:15–16). This abrupt and substantial

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population growth could have been triggered by the introduction of new technologies such as the plough, crop rotation, stabling and the switch from fire–fallow cultivation to irrigated crops (Cremaschi, 2009; Nicolis, 2013:697).

## **2.4 Geomorphology and hydrography of the Northern Italy**

Northern Italy, with its diverse landscapes ranging from the Alps to the Po River plain, has a rich hydrological history that has significantly shaped both the environment and the cultures that developed there. During the last Ice Age, the Alps were heavily glaciated. These glaciers played a crucial role in shaping the hydrology of Northern Italy. As they advanced and retreated, they carved out valleys and deposited large amounts of sediment. When the glaciers began to melt, they released vast quantities of water, which flowed down from the mountains into the plains below, creating large proglacial lakes and extensive river systems. The Po River, the longest river in Italy, is central to the region's hydrology. It originates in the Alps and flows eastward across the Po Valley before emptying into the Adriatic Sea. During prehistoric times, the Po River and its tributaries were much more dynamic than today. The river's course frequently shifted due to sedimentation, tectonic activity, and changes in water flow caused by varying climate conditions. These shifting river courses would have created a mosaic of wetlands, floodplains, and fertile alluvial soils, which were vital for early human settlements. Northern Italy was home to numerous lakes, many of which were remnants of glacial activity. For example, Lake Garda, the largest lake in Italy, was formed by glacial action and has a significant prehistoric hydrological history. The lake levels fluctuated over time due to climatic changes, influencing human settlement patterns around its shores. Wetlands were also abundant, particularly in the low-lying areas of the Po Valley. These wetlands provided rich resources for

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prehistoric peoples, including fish, reeds, and fertile land for agriculture. However, they were also challenging environments due to the risk of flooding, which would have required early communities to adapt their living strategies accordingly. The end of the last Ice Age brought about a warmer and wetter climate, which led to the retreat of glaciers and the expansion of forests and wetlands. During the Holocene, the climate gradually stabilized, leading to more predictable water flows in rivers and lakes. However, periods of climatic instability, such as the Little Ice Age, would have caused fluctuations in water levels and altered river courses, impacting prehistoric communities (Magny, 2004). Evidence suggests that people actively managed water resources, particularly during the Neolithic and Bronze Ages. For instance, they constructed settlements on elevated ground to avoid floods, dug canals for irrigation, and possibly even altered river courses to suit their needs. The fertile floodplains of the Po Valley, enriched by riverine silt deposits, became a cradle for early agricultural communities, laying the foundations for the complex societies that would emerge in later millennia. This hydrographic landscape played a crucial role in the development of early human societies in the region, influencing settlement patterns, resource availability, and the overall evolution of the environment (Cremaschi and Pizzi, 2007). Understanding this ancient hydrography provides valuable insights into how prehistoric peoples interacted with and adapted to their natural surroundings.

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## Chapter 3:

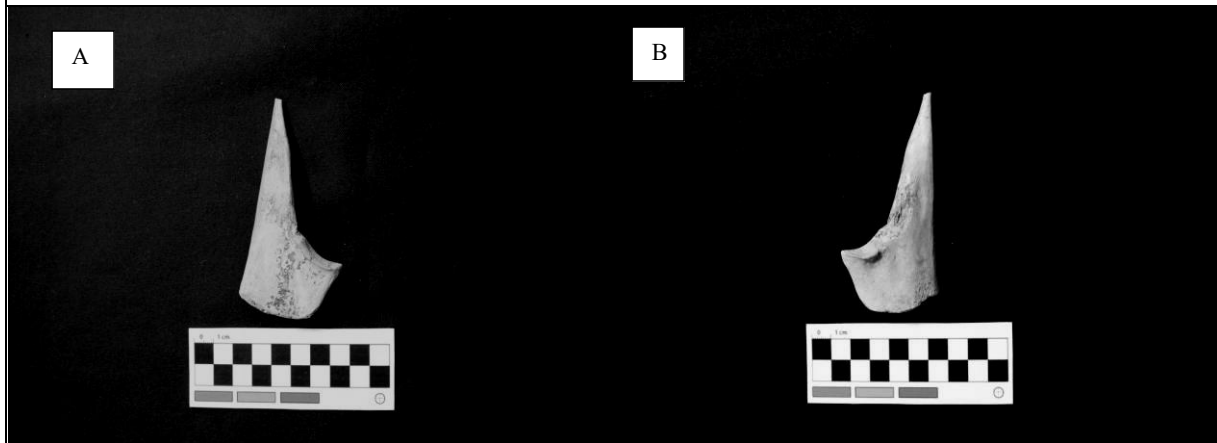
### 3.1 Materials and methods

To write this thesis, a total of 21 bone and antler tools were used, where 18 of them originated from the archaeological site of Oppeano 4C<sub>(tab 1-18)</sub>, as a result of the rescue excavations carried out in 2014 and 2015 by the Soprintendenza Italiana of the Veneto Region. The excavation results of 2014 include a collection of 6 tools which belong to the Early Bronze period, while the other 11 tools belong to the campaign of 2015 which belong to the same chronology. In the collection of tools that come to us from Oppeano 4C, in total only four tools are made of deer antlers and have been identified. In addition to the main collection, which consists exclusively of tools from the Oppeano 4C site, three other tools belong to the Neolithic-Copper period and come from the sites of Masera and Tarzo, where excavations were carried out in 2023 and 2022, respectively. Another utensil comes from the necropolis of Narde Frattesina, an archaeological site dating back to the Bronze Age. The study of these artifacts was carried out in the premises of the University of Ferrara where each tool is stored in a bag with the label and the corresponding archaeological site in the laboratory of taphonomy and archaeozoology. Regarding the tools of the Oppeano 4C collection, a database created by the colleague Lucilla Angeletti was taken as a reference, which has documented in the Excel 2007-2013 program the faunal remains that come from this site and has described in detail the features of these artifacts. The artifacts are presented in a very good state of conservation and have been cleaned previously. A few of them still show some soil concretions. The tools are almost finished and completed and the first step of the documentation consisted of a completed photographic macro documentation by using a Canon Eos 600 D camera. The camera lens is an EFS 18-55 mm type with macro size. 0.25 m/0.8 ft. A

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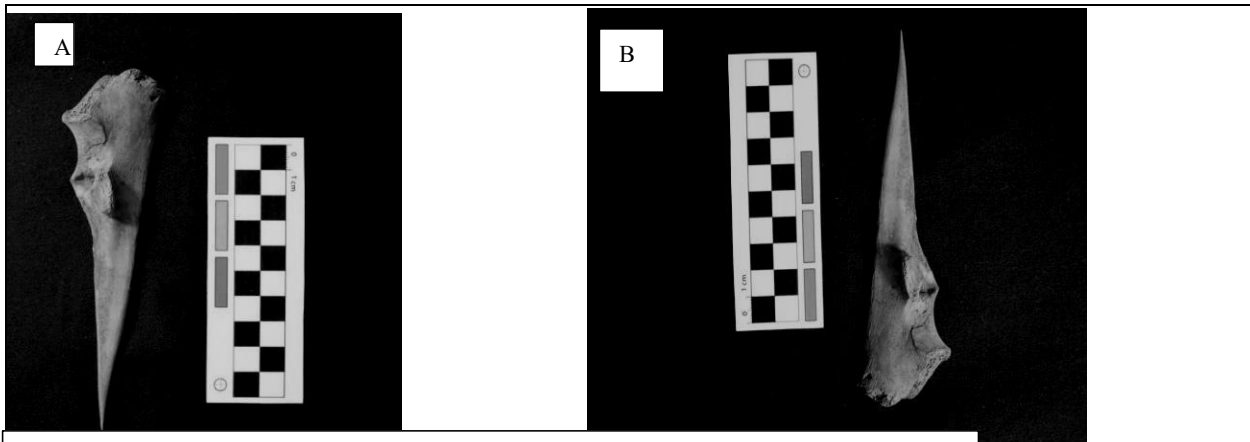
microscope was used for the microscopic analysis of the bone and antler tools. The type of microscope used during the documentation is Leica S6D Greenough reflected light stereomicroscope with magnification from 0.75-70 x with Leica EC3 digital camera, L.A.T. In the service of this thesis, various reference collections of the Laboratory of Taphonomy and Archaeozoology were very valuable for the identification of the artifacts and needed to be mentioned as well the volumes of “Fiches typologiques de l'industrie osseuse préhistorique”. For the zooarchaeological and taxonomical analysis, as a reference was used the Data Base provided by the colleague Lucilla Angelletti worked on Excel. The graphics were created by the help of the programme PAST. Past is free software for scientific data analysis, with functions for data manipulation, plotting, univariate and multivariate statistics, ecological analysis, time series and spatial analysis, morphometrics and stratigraphy.

**Bone and antler tools from the Oppeano 4 C sites campaigns of 2014 and 2015**

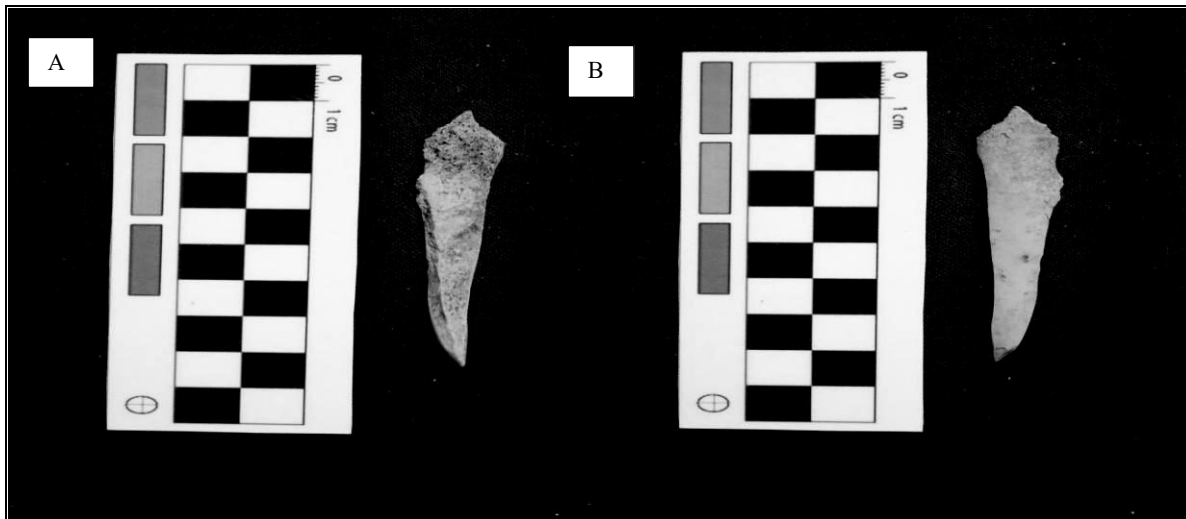


Archaeological Site: Oppeano 4C 2015 US: 67 Sector: A Nr. 580 Pointed tool on ulna dx bos

A. Ventral View B. Dorsal view tab.1

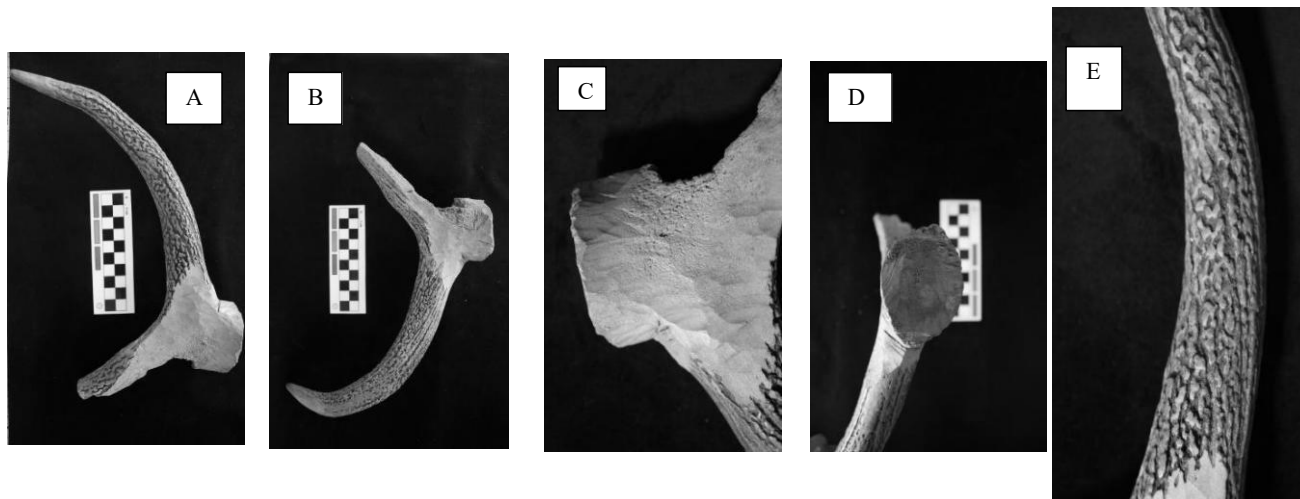


Archaeological Site: Oppeano 4C 2015 US:46 Nr. 480 Chronology: Early Bronze Age  
Pointed tool on deer ulna A. proximal part B. distal part tab. 2



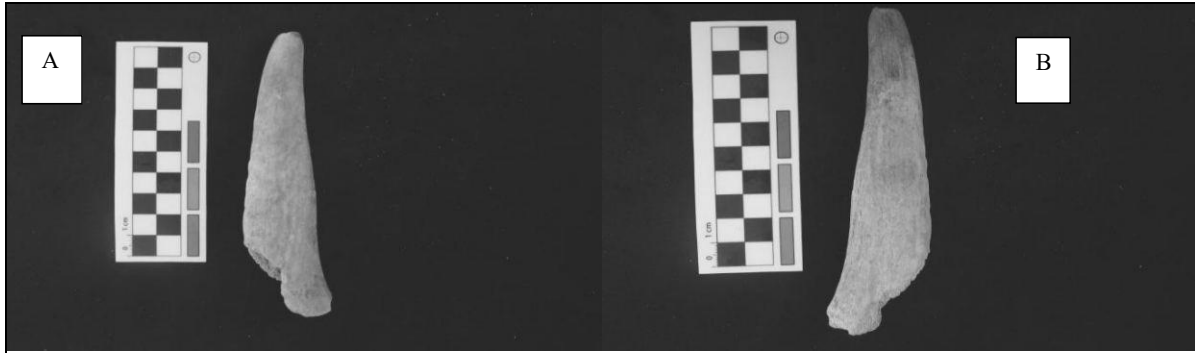
Archaeological Site: Oppeano 4C 2015 US:69 Sector: 1 Nr. : 594 Chronology: Early Bronze Age Diaphysis Fragment A. left lateral view B. right lateral view tab. 3

A. Left lateral view B. right lateral view tab. 3

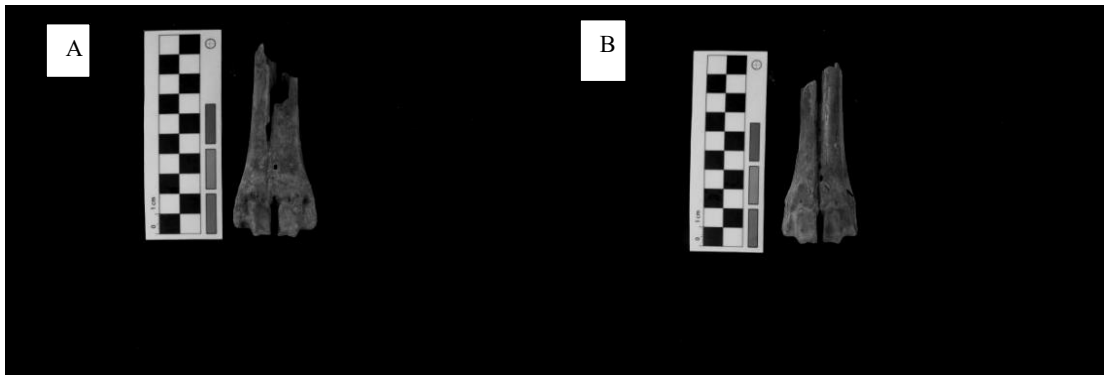


Archaeological Site: Oppeano 4C 2014 US: 6 Sector: 7 Nr.:30 Chronology: Early Bronze Age

Left part of Antler Crown tab. 4



Archaeological Site: Oppeano 4C 2014 US:13 Sector:9 Nr. 202 Chronology: Early Bronze Age Bevel ended tool on antler A. left lateral view B.right lateral view tab. 5



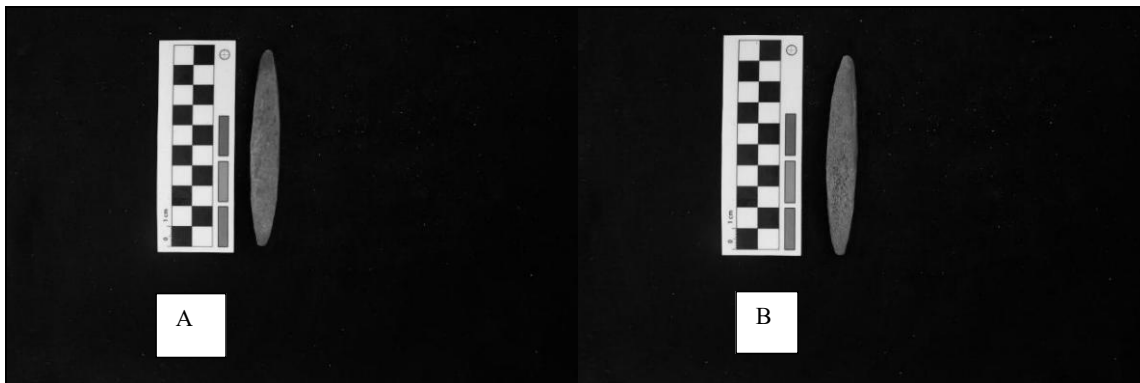
Archaeological Site: Oppeano 4C 2014 US: 13 Sector 9 Nr. 175 Chronology: Early Bronze Age Metapodial A. Dorsal View B. Ventral view

A. Dorsal view B.Ventral view tab. 6

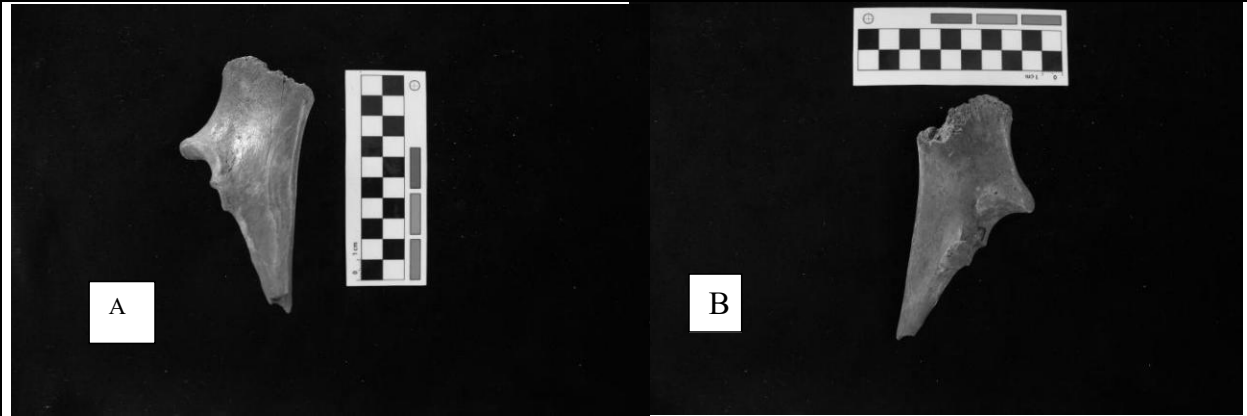


Archaeological Site: Oppeano 4C 2015 US:60 Sector:A Nr:523 Chronology: Early Bronze Age

A. Dorsal view B. ventral view tab. 7

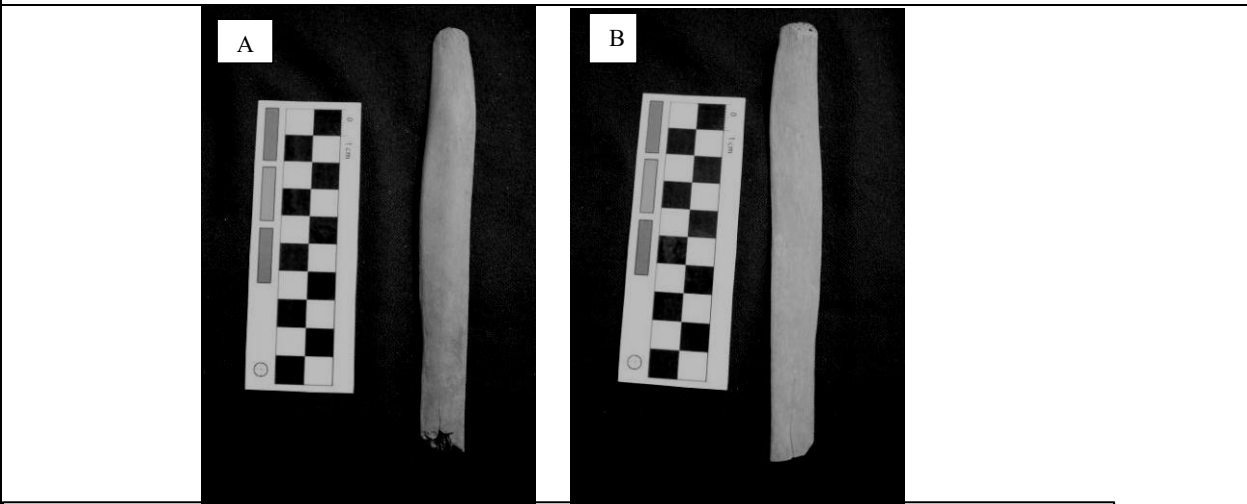


Archaeological Site: Oppeano 4C 2014 US: 9 Sector: 8 Chronology: Early Bronze Age Nr.142 Double pointed tool on antler A.  
Dorsal view B. Ventral view tab. 8



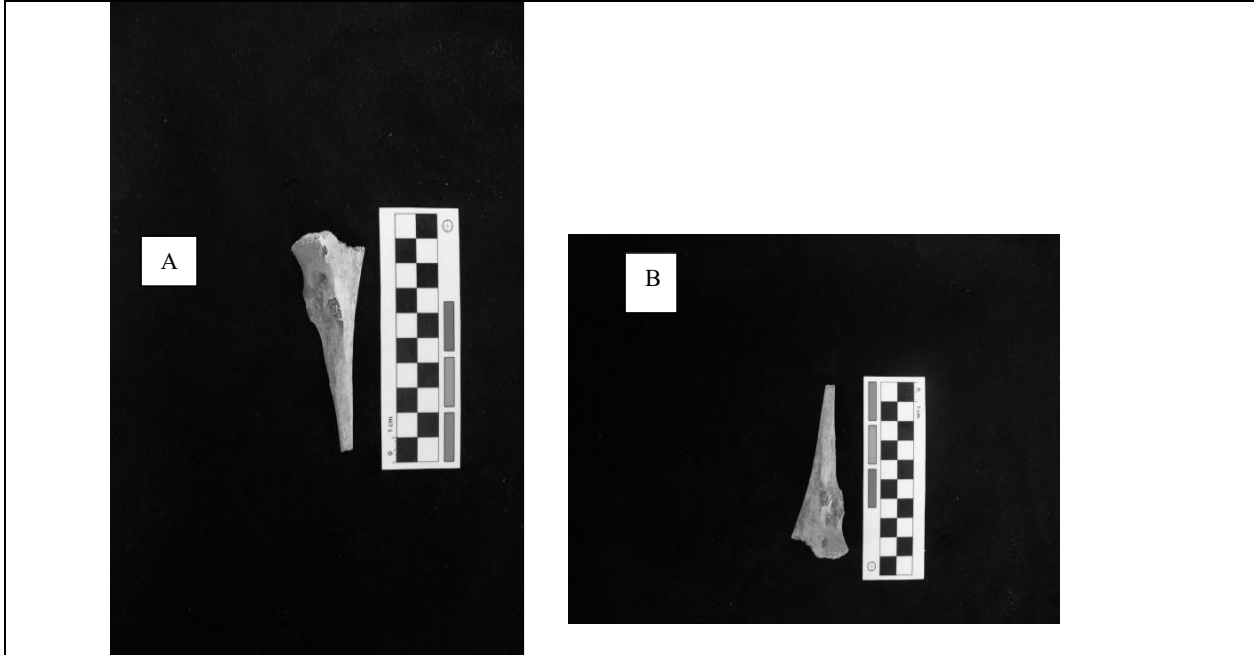
Archaeological Site: Oppeano 4C 2014, US:16 Sector:11 Nr.:306 Chronology: Early Bronze Age

A. Left lateral view B. Right Lateral View tab. 9

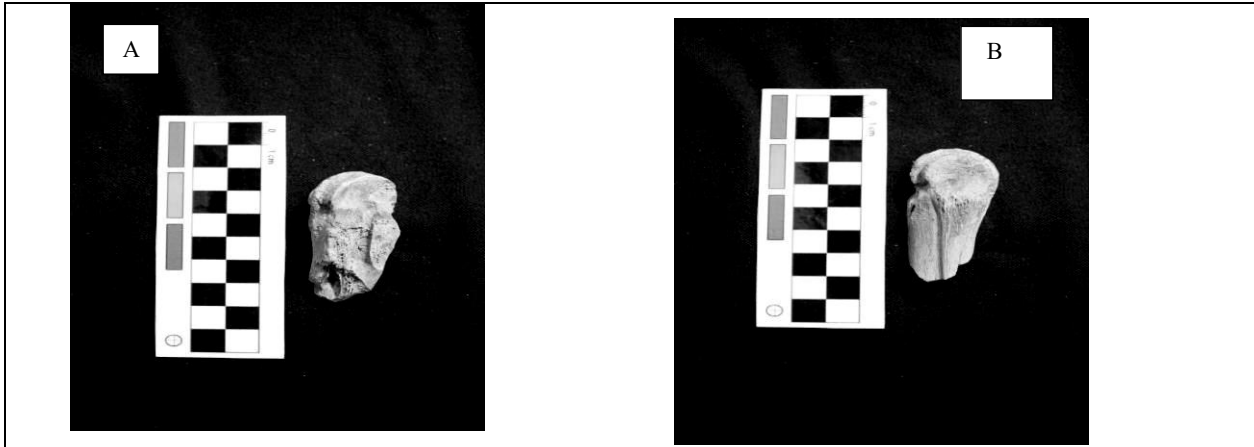


Archaeological site: Oppeano 4C 2015 US:64 Chronology: Early Bronze Age Nr. 560 Anatomical part and taxa: Cervid Rib  
Handle tool

A.Dorsal view B. Ventral view tab. 10



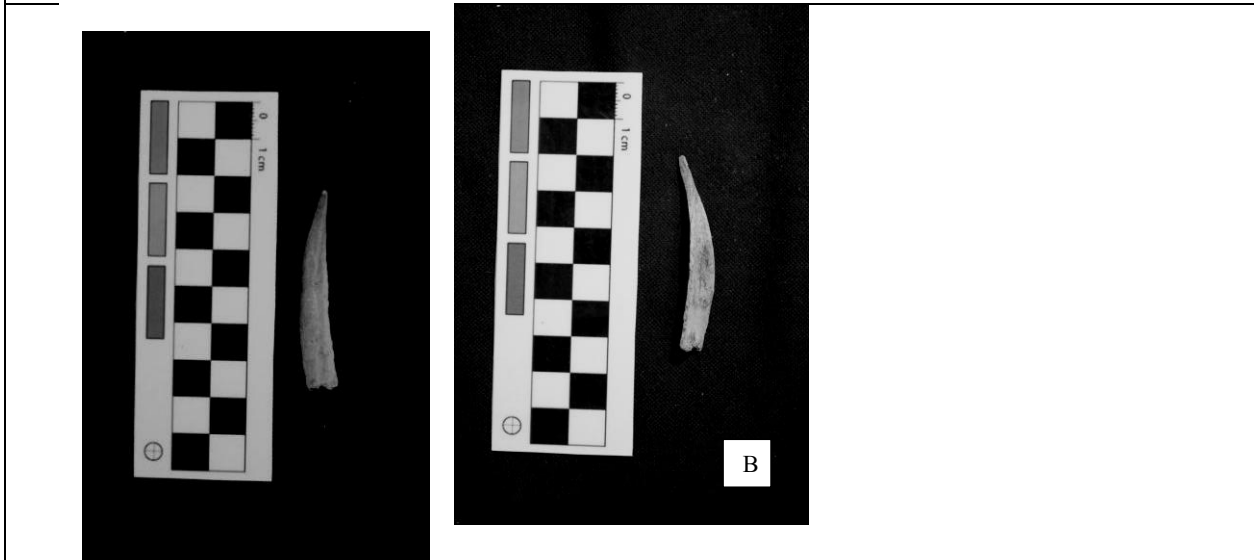
Archaeological Site: Oppeano 4C 2014 Sector:7 Nr.:60 Chronology: Early Bronze Age A. Handle view B. Distal view  
tab.11



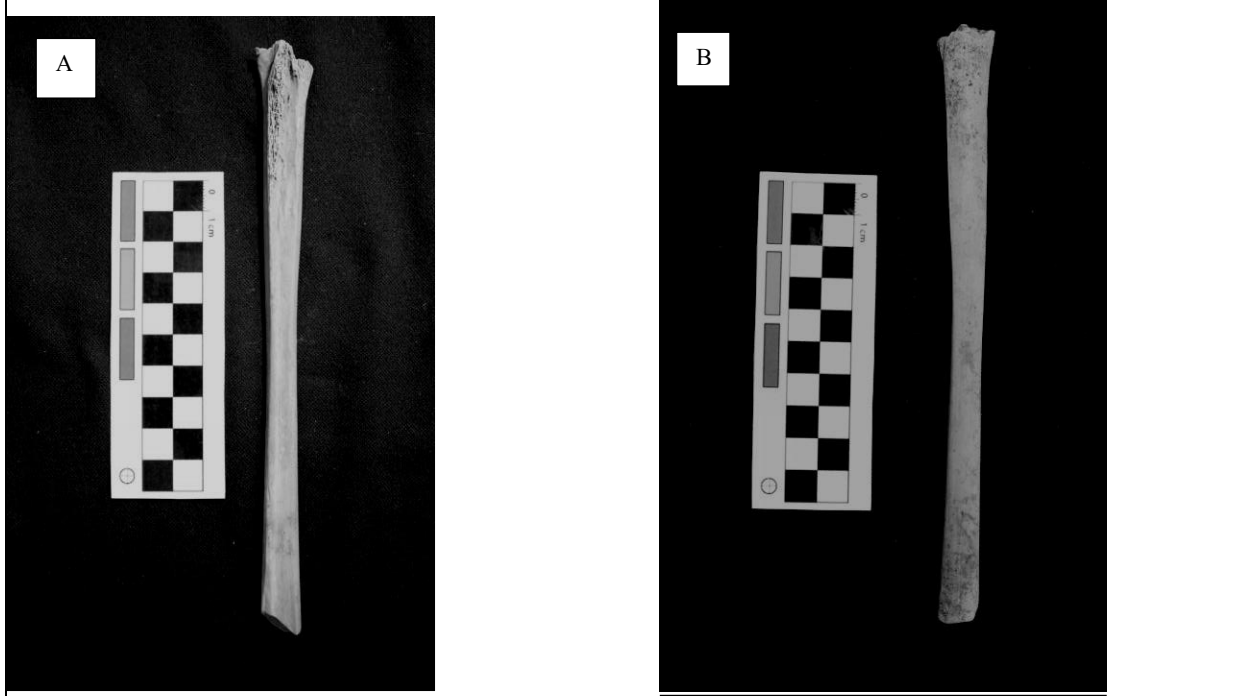
Archaeological Site: Oppeano 4C 2015 US:11 Sector: 2A Nr. 5 Chronology: Early Bronze Age Metapodial  
Cervid A.Ventral View B. Dorsal View tab. 12



Archaeological Site: Oppeano 4C 2014 Nr. 833 Chronology: Early Bronze Age bevel-ended tool in deer antler A. Ventral view B. Dorsal view tab. 13

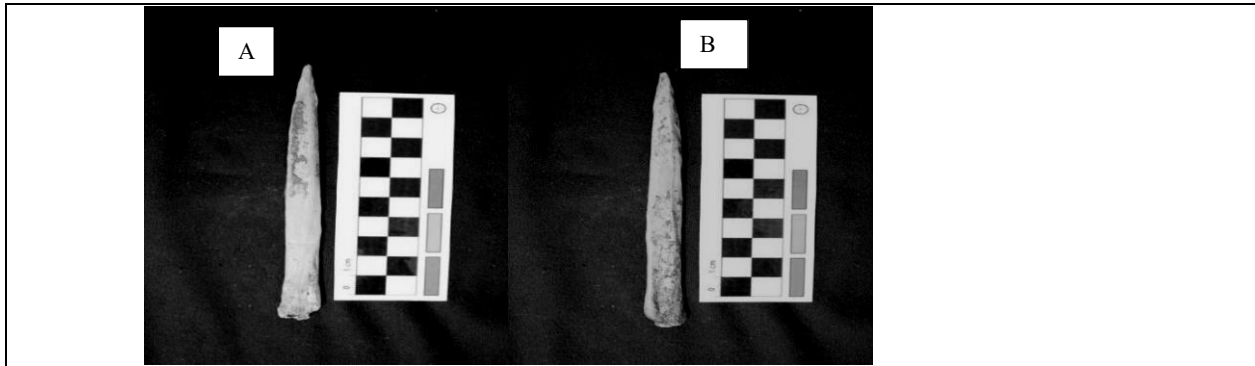


Archaeological Site: Oppeano 4C 2015 US: 58 Nr.: 522 Chronology: Early Bronze Age  
A. Dorsal View B. Ventral View tab. 14



Archaeological Site: Oppeano 4C 2015 US:35 Sector: A Chronology: Early Bronze Age Nr.: 451 Deer Metapodial

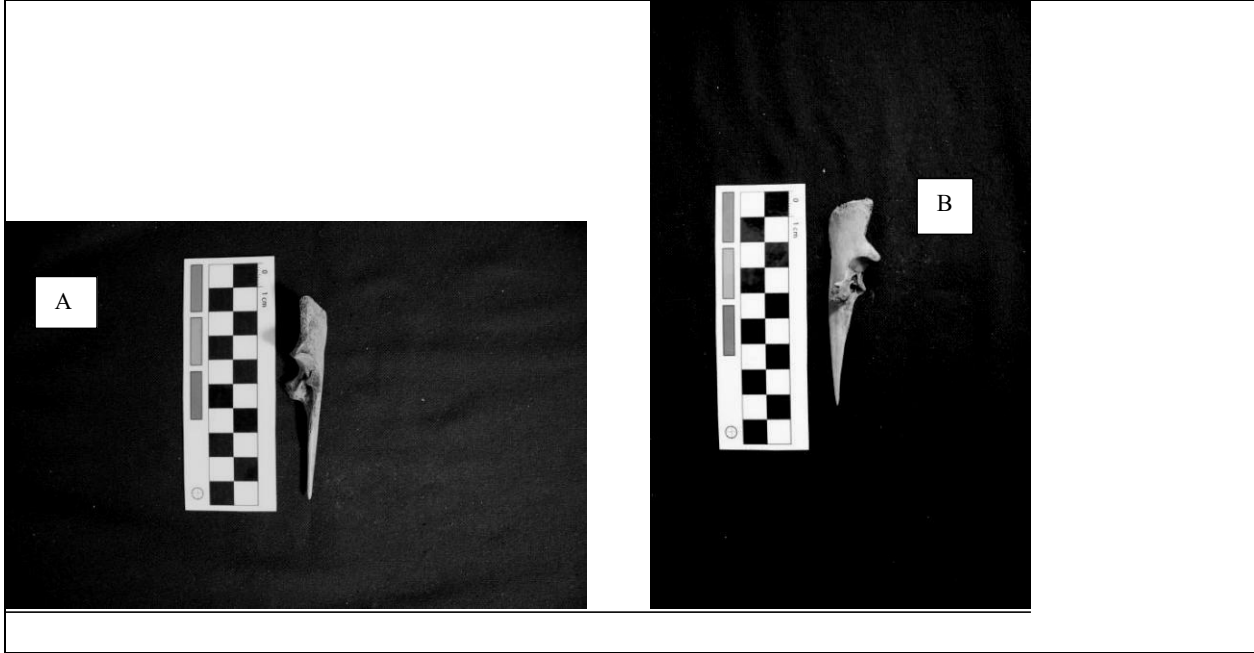
A. Ventral View B. Dorsal View tab. 15



Archaeological Site: Oppeano 4C 2015 US: 63 Sector A Nr.:550 Anatomical Part and Taxa: Metapodial/Ungulate

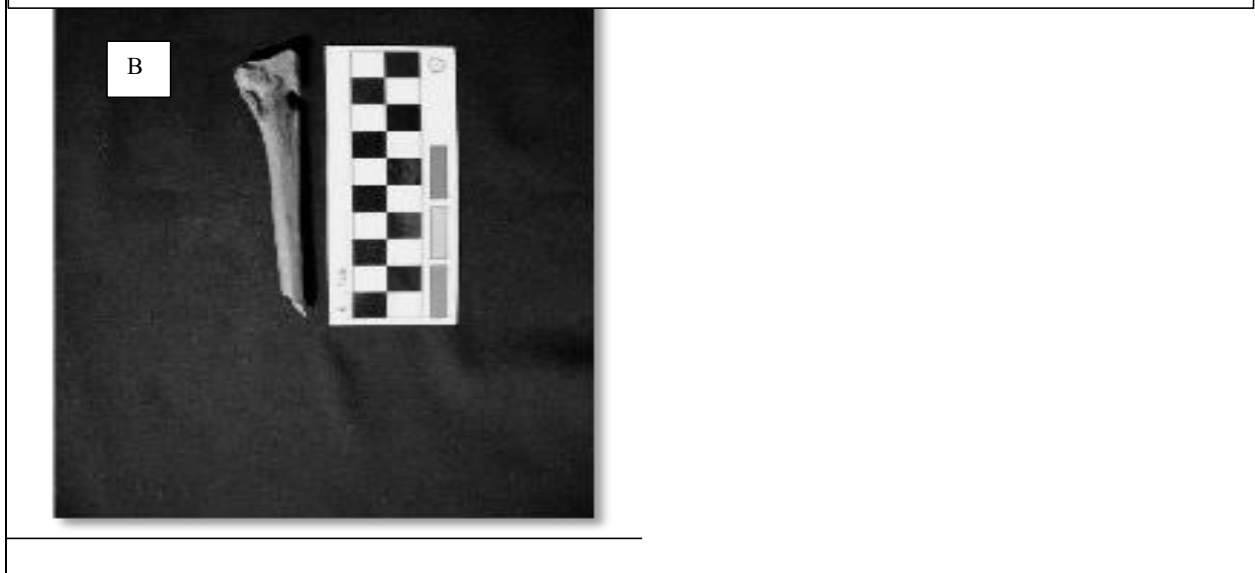
A: Dorsal B: Ventral View tab. 16

Archaeological site: Oppeano 4C 2015 US: 35 Sector: A Nr. 450 Chronology: Early Bronze Age Pointed tool on ulna dx bos A. Left lateral view B. right lateral view tab. 17





Archaeological Site: Oppeano 4C 2015 US: 13 Sector: 1B Nr. 363 Chronological Age: Early Bronze Pointed tool on metapodial sin. Cervid A  
Ventral View B dorsal view tab. 18



### 3.2 Bones composition and tool making

What makes the study of bones interesting is the fact that they were once part of living animals.

Studying bones in every dimension remains a complex and interesting topic which stimulates

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curiosity about different taphonomic processes and how they have reached the present state in our hands and in the laboratory to become an object of study. When making tools from bones, certain properties of the bones are particularly useful, contributing to their effectiveness and versatility. Bones have a high tensile strength due to their fibrous structure, which makes them resistant to stretching forces. This property is especially useful for tools like awls, needles, and points that need to be thin yet strong. On the other hand, they can withstand significant compressive forces, allowing them to be used in tools that need to bear weight or pressure, such as handles or blunt instruments. The outer layer of bone, known as the cortical bone, is particularly hard and dense. This hardness makes it suitable for creating sharp edges or durable tips for tools. Tools like arrow points, knives, and chisels benefit from this property. They have a certain degree of elasticity, meaning it can bend slightly without breaking. This property allows bones to be used in tools that require some flexibility, such as fishing hooks or toggles. The flexibility also means that bone tools are less likely to shatter under stress compared to stone tools, making them reliable for repetitive tasks. In general, bones are easier to shape than harder materials like stone. They can be carved, ground, and polished with relative ease using simple tools. This property is particularly useful for creating intricate or finely detailed tools, such as needles, combs, and ornaments. While having a grain-like structure, and when worked with the grain, they can be shaped into fine points or edges without splitting. Understanding the grain helps in producing durable and effective tools. It is noted that the porosity of bone contributes to its lightweight nature. This makes bone tools easier to handle and transport, especially in tasks where a lighter tool is advantageous. In addition, the porous nature of bone allows it to absorb substances or be hollowed out, which can be useful in creating tools like whistles, tubes, or other items where internal cavities are beneficial. Another advantage is that bones are naturally

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biocompatible, meaning they are non-toxic and safe to use in tools that come into contact with food, skin, or other biological materials. This makes bones ideal for making needles, spoons, or other items used in daily life and they could be easily glued or bound with other materials like sinew or hide. This property is useful in creating composite tools, such as harpoons or weapons, where bone is combined with other materials. However, it should be considered that bones are often readily available as a byproduct of hunting or scavenging, making them a convenient material for tool-making in many cultures and is a renewable resource in the sense that it is continually produced by animals. This makes it a sustainable option for making tools, especially in comparison to stone or metal. A notable observation is while bones are organic and can burn, they can withstand some degree of heat, making them useful for tools exposed to moderate heat, like fire-hardened points and can be softened by boiling or heating, which allows them to be bent or shaped more easily before cooling and hardening again. This property is used to create curved or fitted tools. Furthermore, it is evident that bones could be polished to a smooth, glossy finish, which is not only aesthetically pleasing but also functional, reducing friction in tools like needles or hooks while their surface, can be carved or etched with designs, adding both decorative and cultural significance to the tools. Although some concepts are specifically scientific, it is the duty of the scientific researcher who deals with the study of bones, to have some basic concepts that belong to osteology. Bones are primarily composed by two elements, organic and inorganic. The main organic component is collagen, which makes up about 30% of the bone by weight. Collagen is a protein that provides bone with its flexibility and tensile strength while the inorganic part which constitutes about 70% of the bone by weight, is primarily composed of hydroxyapatite, a crystalline form of calcium phosphate. This mineral gives bones their rigidity and structural strength. In his book *"The Archaeology of Animal Bones,"* O'Connor (2000) (fig.

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3.2) discusses bone composition in the context of how bones survive and degrade in archaeological contexts. He emphasizes that the balance between these components influences the bone's durability and how it interacts with its environment after the death of the organism. The mineral component is more resistant to decay, which is why bones often survive in archaeological sites long after other tissues have decomposed. However, he also notes that bones can undergo diagenetic changes where the mineral component can be altered by the surrounding soil chemistry, affecting the preservation of bones in different archaeological contexts.

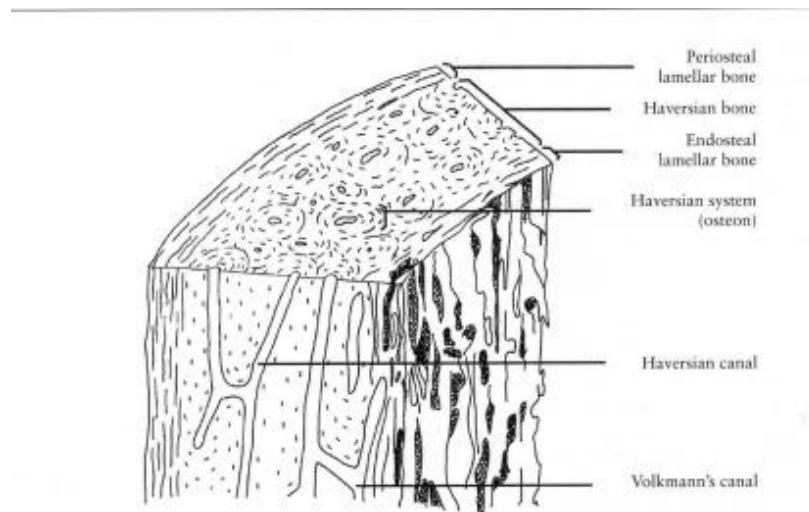


fig. 3.2 (bone

components *The Archaeology of Animal Bones*, O'Connor (2000)

### 3.3 Selection of the bones on tool making

When making bone tools, specific parts of bones are typically selected based on their shape, density, and durability. Here are the common parts of bones used for various types of bone tools (LeMoin, 1997) (**fig. 3.3**):

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### **Long Bones (e.g., Femur, Tibia)**

Properties: Dense and sturdy with a long, straight structure.

They are often used for making awls, needles, spear points, and handles for tools. The shaft of long bones is particularly favored for its strength and straightness, which makes it ideal for making pointed tools and implements that require a sharp edge.

### **Ribs**

Properties: Flat and curved, somewhat flexible.

Uses: Used to create scrapers, splints, and certain types of fish hooks. Ribs are valued for their natural curve, which can be adapted to tools that require a gentle bend or a scraping edge.

### **Scapula (Shoulder Blade)**

Properties: Broad, flat, and relatively thin.

Commonly used for making digging tools, such as hoes, or for creating large scrapers. The flat surface of the scapula can be ground down to create a sharp, broad edge, useful in agricultural or woodworking tasks.

### **Metapodials (Metacarpals and Metatarsals)**

Properties: Strong and somewhat cylindrical.

Often used to craft tools that require a cylindrical shape, such as handles, clubs, and small chisels. The natural shape of metapodials lends itself to use without significant modification, making it a convenient choice for straightforward tool-making.

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## Skull Fragments

Properties: Thick and curved, varying in density.

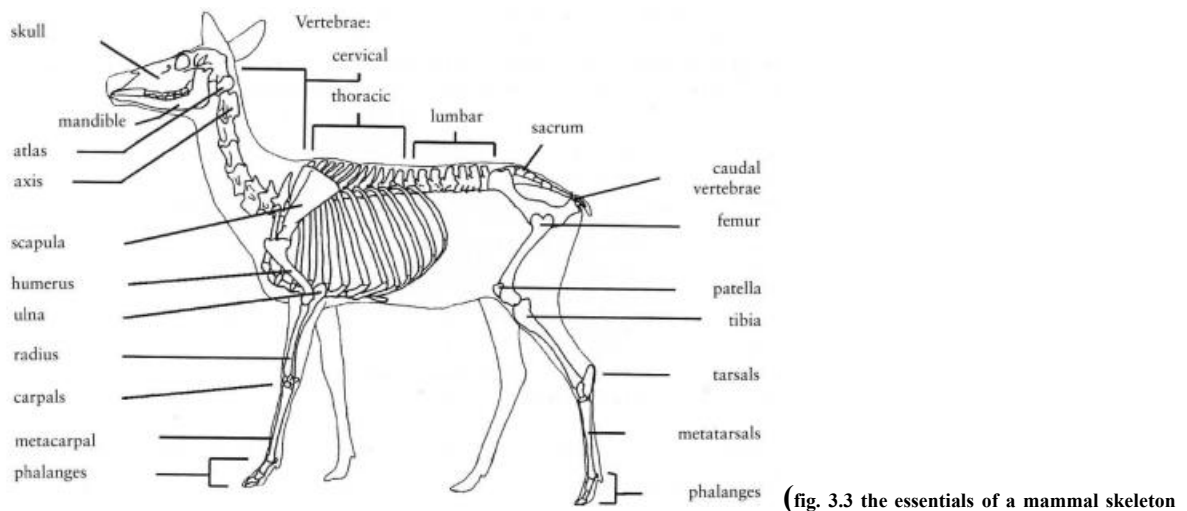
Uses: Used less commonly than other parts, but when used, they can be fashioned into tools like cups, containers, or ornamental objects. The thickness of skull bones provides durability, though they require more shaping to be useful.

## Phalanges (Finger and Toe Bones)

Properties: Small and relatively dense.

Uses: Used for small, detailed tools like needles, small awls, or even buttons. Their small size makes them ideal for fine work.

The selection of a specific bone part for tool-making often depends on the intended use of the tool and the availability of materials. In prehistoric and ancient societies, these materials were chosen for their functional properties, with long bones being particularly favored for their strength and durability, and flat bones being selected for their broad surfaces and ease of modification (Lyman, 1994).



(fig. 3.3 the essentials of a mammal skeleton

as illustrated by a red deer)

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### **3.4 Antler composition and tool making**

An antler is a bony, often branched structure that grows on the heads of members of the deer family (Cervidae) (fig. 3.4). Unlike horns, which are permanent and found on animals like cows and goats, antlers are typically shed and regrown annually. They are primarily made of bone, and their growth is driven by hormones, particularly testosterone. They are composed mainly of bone tissue, covered initially by a soft, vascular skin known as "velvet." The velvet supplies blood and nutrients to the growing antlers. Once the antlers reach their full size, the velvet is shed, revealing the hardened bone structure underneath. Antlers grow rapidly during the spring and summer months. In autumn, after the mating season (rut), the levels of testosterone drop, causing the antlers to weaken at the base and eventually fall off. The cycle repeats with new antlers beginning to grow in the following spring. Although antlers are not technically bones, they are widely used for making tools during prehistoric and protohistoric times. They are hard and durable and somehow flexible. Frequently used for making pressure flakers for flint knapping, picks, and other tools where a combination of toughness and resilience is required. Antlers are particularly valued in prehistoric tool-making for their ability to hold a sharp point and for their workability. There is a wide typology of tools made of antlers and we can summarize it like the following:

#### **Pressure Flakers**

Antlers were commonly used in flint knapping, specifically as pressure flakers. The fine tip of an antler tine was used to apply precise pressure to stone flakes, allowing the toolmaker to create sharp, refined edges on blades, arrowheads, and other stone tools. Crabtree (1970) discusses the

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use of antler pressure flakers in replicating ancient flint tools, emphasizing the control and precision they offer in shaping stone.

### **Axes and Adzes**

Antler beams (the main part of the antler) were sometimes used as handles for stone or metal axe heads. The natural curve and strength of the antler make it a durable and ergonomic choice for hafting tools. LeMoine (1997) explains the use of antlers in crafting heavy-duty tools like axes and adzes, highlighting their strength and the ease with which they can be shaped to fit tool heads.

### **Digging Tools**

Large sections of antler were used as digging tools, particularly in early agricultural societies. The pointed tips of antlers were effective for breaking up soil and uprooting plants. O'Connor (2000) notes that the pointed and sturdy nature of antlers made them ideal for use in digging implements, especially in contexts where metal tools were not available.

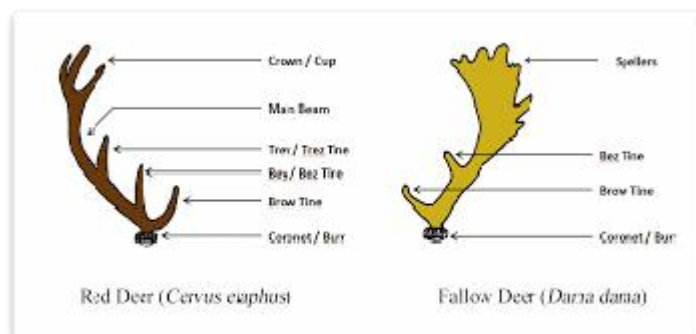


Fig. 3.4 the basic anatomy of antlers courtesy of Putman, 1988

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### 3.5 Taphonomic Modifications

Archaeology as a discipline of study tends to reveal useful information about the past and to decode actions of our ancestors, how they dealt with their daily life, how they survived, found food and shelter. In order to do that, other fields of study may be helpful to better results. Sometimes we tend to be more anthropocentric, forgetting the important role of our relationship with animals and how we use our environment in the favor of our benefits. Archaeology itself cannot do that without the help of other disciplines. One of this is the discipline study of taphonomy. According to the classic concept of what taphonomy is, is the science that studies the processes undergone by a fossil from the moment it is deposited until its recovery (Olsen, 1980), being of great contribution in disciplines such as paleontology, archaeology etc. In 1940, Efremov, a Russian scholar established a concept of what taphonomy means and is the most common used. Efremov introduced the concept to describe the study of the processes that affect animal and plant remains as they become fossilized. This includes everything that happens to an organism from the moment of death to its discovery as a fossil, covering decomposition, transport, burial, and eventual preservation. He coined the term "taphonomy" from the Greek words *taphos* (burial) and *nomos* (law), to describe the laws governing the transition of biological material from the biosphere to the lithosphere, essentially from life to fossilization. Taphonomic traces are important to record the preservation of the tools surfaces. Taphonomic traces refer to the physical and chemical changes or marks left on biological remains (such as bones, teeth, shells, or plant material) due to the processes they undergo from the moment of death to their discovery. These traces help researchers understand the post-mortem history of the remains, including environmental conditions, interactions with other organisms, and the timeline of decomposition. Here are some common types of taphonomic traces:

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## **Weathering**

The process of exposure to environmental elements such as sunlight, wind, and rain can cause bones to crack, flake, or bleach.

Traces: Surface cracking, exfoliation, and color changes (bleaching or darkening).

## **Bioerosion**

Erosion caused by biological organisms, including bacteria, fungi, or scavenging animals.

Traces: Small holes or tunnels (from bacteria or fungi), gnaw marks from rodents or carnivores, and scratch marks from scavengers.

**Carnivore Marks** Damage caused by carnivores, either during consumption or as part of feeding behavior.

Traces: Tooth marks, punctures, pits, scoring, and chewing damage. These can indicate the type of carnivore involved based on the pattern and size of the marks.

## **Cut Marks**

Incisions or marks left by stone tools or other implements used by humans or hominins.

Traces: Straight or curved incisions, striations, or chop marks, often with a characteristic V-shaped cross-section.

## **Trampling Marks**

Marks left on bones due to being stepped on or crushed by animals or humans.

Traces: Random, often superficial scratches or grooves that can be confused with cut marks, but usually lack the precision and patterning of tool marks.

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## **Burning**

Exposure to fire, which can happen accidentally or intentionally (as in cooking or cremation).

Traces: Color changes (blackening or calcination), cracking, warping, and shrinking of bones.

## **Root Etching**

Chemical etching caused by plant roots growing in contact with bones.

Traces: Wavy or irregular grooves and pits on the surface of bones, often with a branching pattern reflecting root growth.

## **Diagenetic Changes**

Chemical, physical, and biological changes that occur to bones and other remains while buried.

Traces: Mineral staining, fossilization, changes in bone density, and the formation of concretions.

## **3.6 Technological Analysis**

The technological analysis of the bone tools is crucial in archaeology and anthropology for several reasons. It helps in understanding not only the methods and techniques used by past societies but also their cultural practices, resource management, and technological evolution. By analyzing the manufacturing techniques of bone tools, we can reconstruct the methods used by the tool makers. This includes studying how bones were selected, shaped, and used, which can reveal the level of skill and knowledge in tool-making. The identification of specific techniques like grinding, scraping, or polishing can indicate the toolmaker's familiarity with the material properties of bone and their ability to produce functional and durable tools. Technology in its general sense consists of systematic capabilities of benefices and materials built by human hands that also include the relationship with nature. However, it should be noted that archaeological

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studies have not managed to provide one more precise definition related to technology. Perhaps, the most articulated is Tim Ingold's definition who describes technology as a corpus of knowledge acquired and transmitted in culture, expressed in production and use (1979). He emphasizes that character must be observed to socio-cultural perspectives and the connections with the superstructure in the Marxist sense together with other types of knowledge transmitted through culture. It should also be noted that technology means: Knowledge related to technique, so technology is to technique what linguistics is to language. Technology is thus a theory about techniques. Cultural learning it depends especially on the development and capacity of the human being to use symbols or signs without any natural connection with the things they stand for or take on meaning. Cultural learning is about people's ability to create, remember and share idea. They collect and apply specific systems of symbolic understanding. On the other hand, Langdon Winner, a political science researcher notes two main problems with archaeologists when dealing with technology. The first is the technological somnambulism which sees techniques as either irrelevant or unaffected by social organization and culture. According to him, technical implements are simply built to be used and tell very little about how people think or act. The second is related to technological determinism which sees every element of culture and social organization as connected with technology is considered an important and independent agent that dictates models of social and cultural life'. As artifacts, technologies and techniques are cultural products that form continuous processes in society and cannot be studied separated from it. Techniques configure our relationships between a group, but on the other hand, they are relationships that configure the techniques. It remains clear that the lithic and osseous technology affected society and culture in a very fundamental way. What is really interesting for the archaeologists, is not only the techniques themselves but what were the skills that those

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hominids have engaged for certain reasons, how they are transmitted and distributed and the meaning of this culture and social organization. As Pfaffenberger suggests, technology that usually is seen as doctrine related to appropriate techniques can also be studied as a form of ideology. Techniques are related to behavior and knowledge system and as such they should be studied as ideologies. The assignment of cultural attributes varies depending on the environment in which they develop. If individuals acquire habits from others through learning or imitation, then adaptation of cultural transmission can gradually accumulate over many generations. For example, if one man learns how to use a cleaver, he passes this practice on to his son, or daughter. At the same time if the son, or the daughter start seeing in a neighbor or someone else in society how to knap and create tools they start applying this by themselves. Both of these practices (knapping and using the tools) the son or the daughter passes to their children. Understanding culture requires perceiving it in a way accumulative (habits acquired diachronically and synchronically). When it comes to the methods and techniques of manufacturing bone tools, several have been identified and thoroughly researched in archaeology. Below is a comprehensive list of these methods and techniques:

### **Grooving and Splintering**

This technique involves scoring the bone with a sharp tool (often a stone or metal blade) to create a deep groove. The bone is then split along the groove to create long, narrow pieces that can be further shaped into tools (fig. 3.6a) (LeMoine, 1997).



fig. 3.6 a picture courtesy of Eleonora Gargani experimental activity on grooving

## Flaking

Similar to stone tool production, flaking involves striking the bone to remove small pieces or flakes, creating sharp edges or points ( Newcomer, 1986)

## Percussion

Involves striking the bone with a hammerstone or other hard objects to shape it or break it into pieces. It is used in the initial stages of tool production to rough out the desired shape (Clark and Kurashina, 1981).

## Grinding and Abrading

A finishing technique that involves rubbing the bone against an abrasive surface, like a stone, to create a smooth and even surface (Olsen, 1988)

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## **Polishing**

After shaping, the bone is polished using fine abrasives or leather to create a smooth, shiny surface. This technique can increase the durability of the tool and is often used for decorative items (Driver, 1999).

## **Carving and Incising**

Using sharp tools, artisans carved intricate designs or cut away material to create detailed shapes or functional components. Incising involves cutting shallow lines or patterns into the surface.

## **Piercing and Drilling**

Creating holes or perforations in bones using sharp points or drills, often done with hand-powered tools like a bow drill. This method is essential for making beads, pendants, and tools that require attachment, such as handles.

## **Burnishing**

A finishing technique that involves rubbing the bone with a smooth tool to compact the surface, enhancing its durability and creating a glossy finish.

## **Soaking and Softening**

Soaking bones in water or other liquids to soften them, making it easier to bend or carve them into the desired shape without breaking (Schick and Toth, 1993).

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### 3.7 Functional analysis

Functional analysis in the context of bone tools refers to the study of the form and use of these tools by examining their physical characteristics, wear patterns, and contextual associations (Lyman 1994; Odell 2004). The goal is to understand how these tools were used in the past, what tasks they were employed for, and how effective they were in performing those tasks. There are some key components while studying the functional analysis, one of them being the morphological analysis. This involves studying the shape, size, and design of the bone tool. Researchers assess how the morphology of a tool relates to its potential function. For instance, the pointed end of a bone tool might indicate it was used for piercing or engraving. On the other hand, the use wear analysis focuses on identifying and interpreting wear patterns on the surface of the tool. These patterns, such as striations, polish, or chipping, provide clues about the type of material the tool was used on ( hide, wood, or stone) and the specific actions performed ( cutting, scraping, or drilling). In addition, by examining the bone tools under a microscope, we could detect fine details of wear patterns that are not visible to the naked eye. This can help in identifying the specific materials worked on by the tool and the direction and intensity of use. Even though an experimental activity would be very valuable in this study case, in the end it was not conducted. That would have been very useful by comparing the wear patterns on experimentally used tools with the studied artifacts. On the other hand, I tried to do a contextual analysis by highlighting the context in which the bone tools were found, such as their association with other artifacts, ecofacts, or features (hearths, animal remains), that can provide important clues about their function. This includes the location within a site, the types of activities inferred to have taken place there, and the broader cultural or environmental setting. Also a comparative analysis is held by comparing different bone tools coming from the same chronological context

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and regions that are nearby Oppeano 4C. The macro and microtraces has been recorded in the Database and in order to do this a microscope has been used located at the Laboratory of Taphonomy and Archaeozoology in the University of Ferrara. The type of microscope used during the documentation is Leica S6D Greenough reflected light stereomicroscope with magnification from 0.75-70 x with Leica EC3 digital camera. Some of the macrotraces identified are the following:

- **Cut Marks and Grooves:** These are linear incisions or grooves that indicate the shaping or modification of bones. They result from the use of sharp tools to carve or shape the bone into the desired tool form.
- **Polishing:** Polishing appears as a smooth, glossy surface on the bone tool, which is often the result of prolonged use. The repeated contact with soft materials, such as leather or plant fibers, can produce this type of wear.
- **Impact Damage:** Fractures or splintering on the bone tools suggest they were used for striking or chopping. The location and pattern of these fractures can help identify the exact function of the tool, such as whether it was used as a hammer or a chisel.
- **Edge Wear:** This refers to the rounding or blunting of the tool's edge, indicating it was used for cutting, scraping, or other repetitive actions.
- **Striations:** These are fine linear marks that may run parallel, perpendicular, or at various angles to the tool's edge. Striations can result from contact with hard materials, such as stone or wood, and help in reconstructing the tool's use.
- **Burnishing:** This refers to areas where the bone has been polished to a shine, typically due to repetitive use against soft materials like hides. It's similar to polishing but often localized to specific areas of the tool.

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Micro traces on bone tools and antler tools from the Oppeano 4C site provide a more detailed view of how these tools were used. These microscopic wear patterns and residues offer insight into the materials the tools were used on and the specific tasks they performed. Here are some of the micro traces identified:

- **Micropolishing:** Similar to the macroscopic polishing but observable under a microscope, micro polishing is a fine, glossy surface that develops due to contact with soft materials like hide, wood, or plant fibers. The presence and pattern of micro polishing can indicate the type of material worked and the tool's function.
- **Microstriations:** These are very fine, linear marks that occur at the microscopic level. Microstriations result from abrasive contact with materials such as stone, sand, or hard plant fibers. The direction and density of these striations can help identify the movement and pressure applied during tool use.
- **Residue Analysis:** Microscopic residues from materials like plant fibers, blood, or other organic substances can be trapped in the surface of the bone tools. By analyzing these residues, archaeologists can determine what substances the tools came into contact with, offering direct evidence of their use in activities like butchering, hide processing, or plant processing.
- **Edge Rounding:** Under magnification, the edges of bone tools may show rounding due to repeated use. This microtrace is often associated with tools used for scraping or cutting softer materials.

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- **Pitting and Microfractures:** Small pits or microfractures on the surface of the bone can occur due to impact or pressure during use. These are particularly common in tools used for heavy-duty tasks like chopping or hammering.
  - **Abrasive Wear:** This includes fine wear patterns that result from the tool's use against abrasive materials. The texture and extent of abrasive wear can help identify the type of material worked and the intensity of use.
  - **Microchipping:** Small chips or flakes missing from the edge of the bone tool, visible only under a microscope, can indicate a tool's use in cutting or scraping harder materials, or from repeated impact.

### **3.8 Morphologic and morphometric aspects of the bone tools**

The study of bone tools in prehistoric contexts involves detailed analysis of their morphology, morphometry, and tool orientation, which collectively provide insights into their functional applications and manufacturing techniques. Morphology refers to the form and structure of bone tools, including aspects such as shape, size, and surface texture. This structural examination is crucial for understanding how specific features facilitate particular tasks, such as cutting or scraping. Morphometry, on the other hand, quantitatively analyzes the dimensions and proportions of these tools, allowing researchers to identify patterns of variability and standardization within toolkits. This analysis can reveal information about the production methods employed by ancient craftsmen and the intended uses of the tools. Tool orientation relates to the positioning and alignment of tools during their use, which can significantly influence their effectiveness and efficiency. Variations in orientation can indicate different techniques employed by users, reflecting the adaptability of tool use to various materials or tasks.

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Together, these elements contribute to a comprehensive understanding of the technological practices and cultural behaviors of prehistoric societies, as well as their interactions with the environment. The two main categories that are identified according to their morphological features are the pointed tools and the bevel-ended tool. According to the definition based to the “Fiches typologiques de l’industrie osseuse préhistorique” (Camps and Febrer, 1990, 2008, Barge-Mahieu et. Al), a pointed tool is a type of implement characterized by a tapered or sharp end designed primarily for piercing, puncturing, or drilling into various materials. These tools can be made from various materials, including bone, stone, metal, and synthetic substances. Pointed tools are commonly used in various applications.

- Tapered Tip: The defining feature of a pointed tool is its sharply tapered end, which allows for concentrated force application. The point facilitates penetration into soft or hard materials, depending on the tool's intended use.
- Length and Profile: Pointed tools generally exhibit a longer length relative to their width, providing a slender profile that enhances maneuverability and precision.

#### Functionality

- Piercing and Puncturing: These tools are designed to create holes or openings in materials such as wood, leather, or fabric. For example, awls and needles are common pointed tools used for stitching or joining materials.
- Drilling: Pointed tools can also serve as drills to create holes, especially when powered by hand or mechanical means. This is seen in various historical and modern drilling tools.

The general morphology of pointed tools, particularly those made from materials like bone, stone, or metal, encompasses several key structural features that define their shape, function, and usability.

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## **Tip**

- **Tapered Point:** The most distinctive feature of pointed bone tools is their sharply tapered tip. This design allows for effective piercing and penetration into various materials, such as animal hides, wood, or plant fibers.
- **Apex Shape:** The apex can vary in shape, being either conical or more rounded, depending on the tool's intended function and the material it is designed to interact with.

## **Body**

- **Length and Slender Profile:** Pointed bone tools typically have a long and slender body, which enhances their precision and control during use. The elongated shape is particularly advantageous for tasks requiring fine motor skills, such as sewing or drilling.
- **Diameter Variation:** The diameter of the tool's shaft may taper gradually from the base to the tip, creating a balanced design that is easier to manipulate.
- **Cross-Sectional Shape:**
- **Triangular or Oval Cross-Sections:** The cross-section of pointed bone tools can be triangular or oval, affecting the tool's strength and piercing capabilities. A triangular cross-section may provide sharper edges, while an oval shape offers more comfort in handling.

**Flat Surfaces:** Some tools may have flat surfaces, particularly if they are designed for scraping or cutting in addition to piercing.

## **Surface Texture:**

- **Wear Patterns and Polish:** The surfaces of pointed bone tools often show distinctive wear patterns, polish, or striations resulting from use. These features can provide valuable information about the materials worked and the specific tasks performed.

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- **Manufacturing Marks:** Evidence of the crafting process, such as scraping or grinding marks, can indicate the techniques used to shape the tool and the skill of the maker.

#### **Edge Configuration:**

- **Cutting Edges:** In addition to the pointed tip, many pointed bone tools may feature sharp edges along the shaft, allowing for multi-functional use as both a piercing and cutting implement.
- **Retouching Evidence:** Pointed tools may display retouching marks that indicate maintenance or adaptations made to enhance their sharpness or adjust their shape for specific uses.
- **Grip and Handling Features:**
- **Notches or Holes:** Some pointed bone tools may include notches or holes at the base for attaching handles or providing a better grip, improving control during use.
- **Ergonomic Considerations:** The design of pointed bone tools may incorporate ergonomic features to fit comfortably in the user's hand, enhancing usability.

#### **Material Characteristics:**

- **Bone Type:** The type of bone used can influence the tool's size, strength, and flexibility. Tools made from larger, denser bones (e.g., from large mammals) tend to be sturdier and more robust.
- **Condition and Treatment:** The condition of the bone before crafting, such as whether it was dried or treated, impacts the final morphology and effectiveness of the tool.

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### **Functional Aspects:**

- **Specialized Uses:** Pointed bone tools may be designed for specific tasks, such as sewing, piercing holes, or engaging in various crafting activities, which is reflected in their morphological adaptations.
- **Multifunctionality:** Many pointed tools exhibit features that allow them to perform multiple functions, thereby increasing their utility in prehistoric toolkits.

On the other hand, a bevel-ended tool is a type of implement characterized by its specifically shaped working end, which is formed at an angle or with a sloped edge. This design allows for various applications depending on the tool's intended use.

### **Beveled Edge**

- The defining feature of a bevel-ended tool is its angled or sloped working edge. This bevel can be found on one or both sides of the tool's tip.
- The angle of the bevel influences the tool's cutting, scraping, or shaping capabilities, allowing for precision in various tasks.

### **Functional Design**

- Bevel-ended tools are often designed for specific functions, such as cutting, scraping, or carving. The bevel helps facilitate these actions by providing a sharp edge that engages effectively with the material being worked.
- They are commonly used in activities such as woodworking, leatherworking, and other crafting tasks where precise shaping or removal of material is required.

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### **Types of Bevel-Ended Tools:**

- Chisels: Often used in woodworking, chisels have a beveled edge that allows them to cut and shape wood effectively.
- Scrapers: Tools with bevel-ended designs may be employed to scrape surfaces smooth or remove unwanted material.
- Knives: Some knives feature a bevel at the edge, enhancing their cutting ability for various materials, including food and fabric.
- Bone Tools: In archaeological contexts, bone tools may also have bevel-ended shapes, which were used for tasks such as scraping hides or cutting materials.

### **Morphometric aspects**

The morphometric aspects of bone tools provide valuable insights into their functionality, manufacturing techniques, and cultural significance. By analyzing measurements such as length, width, thickness, cross-sectional shape, and other geometric characteristics, researchers can better understand the technological practices of ancient societies and how these tools were adapted for specific tasks. This morphometric analysis contributes to a deeper appreciation of the craftsmanship and ingenuity involved in the creation of bone tools throughout history.

- Length:
- Total Length: The overall length of a bone tool can vary significantly depending on its intended use. For example, awls and needles tend to be relatively long, while scrapers may be shorter and broader.
- Functional Variation: Different types of tools (e.g., pointed tools versus scrapers) will have distinct length characteristics that influence their usability and handling.

- 
- Width:
  - Maximum Width: This measurement refers to the widest part of the tool and can impact its strength and cutting efficiency. Wider tools are generally more robust, while narrower tools may allow for more precise actions.
  - Width Variation: Tools can also exhibit varying widths along their length, affecting their overall profile and functionality.
  - Thickness:
  - Cross-Sectional Thickness: The thickness of the tool along its length can influence durability and handling. Thicker tools may provide more strength and resistance to bending, while thinner tools might be more suited for delicate tasks.
  - Profile Variation: Changes in thickness throughout the tool can create different ergonomic properties, affecting how the tool is held and used.
  - Cross-Sectional Shape:
  - Shape Characteristics: The cross-sectional shape (e.g., triangular, oval, or flat) affects the tool's strength, cutting capability, and how it interacts with the material being worked.
  - Edge Configuration: The shape of the edges can vary, influencing how the tool performs specific tasks, such as cutting or scraping.
  - Tip Geometry:
  - Tapering: The degree of tapering at the tip is an important aspect for pointed tools. A sharper taper may enhance penetration, while a more rounded taper may provide greater stability.
  - Tip Angle: The angle of the tip can also affect the tool's effectiveness in piercing or cutting.

- 
- Curvature:
  - Curvature of the Shaft: Some bone tools may have a curved or bent profile, affecting their handling and application. Curved tools might be better suited for certain types of scraping or cutting tasks.
  - Flexibility: The degree of curvature can indicate the tool's intended use and the materials it was designed to work with.
  - Surface Area:
  - Area of Cutting Edges: The total surface area of the cutting edges can influence the efficiency of the tool in tasks such as cutting or scraping. Larger surface areas may allow for more material to be worked at once.
  - Contact Area: The contact area between the tool and the material being worked can also affect efficiency, with broader edges typically providing better material engagement.
  - Proportional Ratios:
  - Length-to-Width Ratio: This ratio can be indicative of the tool's design and intended use, with specific ratios being associated with different types of tools (e.g., long and narrow for piercing, broader for scraping).
  - Aspect Ratio: This ratio compares different dimensions (length, width, thickness) and can be useful in identifying functional categories of tools.

### **3.9 Continuity and Innovation: The Coexistence of Bone and Metal Tools in the Bronze Age**

During the Bronze Age, the advent of metallurgy marked a profound technological transformation, with societies transitioning from the predominant use of stone tools to the

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innovative application of metal, particularly bronze—a durable alloy of copper and tin (Smith, 2002). This shift allowed for the production of stronger, sharper, and more efficient tools and weapons, fundamentally altering various aspects of daily life, including agriculture, craftsmanship, and warfare. The superior qualities of bronze facilitated advancements in these areas, enabling the development of more complex societies with increased specialization and trade. However, the rise of metalworking did not render older technologies, such as bone tools, obsolete. Instead, the use of bone tools continued alongside metal ones, highlighting the adaptability and pragmatism of Bronze Age communities (White, 2008). Bone tools, while less durable than their metal counterparts, remained valuable for their accessibility, ease of production, and suitability for specific tasks. For example, bone was often preferred for creating fine, delicate items such as needles, combs, and intricate carvings, where the properties of metal were less advantageous (Green, 2010). Moreover, bone tools were often used in contexts where metal was scarce or reserved for more critical functions (Harris, 2010). The persistence of bone tool use alongside the rise of metallurgy reflects a complex interplay between innovation and tradition, where new technologies were integrated into existing practices without entirely displacing older, functional methods (Clark & Miller, 2019). This continuity underscores the resourcefulness of prehistoric societies in maintaining a diverse toolkit that could meet a wide range of needs, ensuring their resilience and adaptability in a rapidly changing technological landscape (Adams, 2011). Bronze tools leave distinct marks on bone, which differ from those produced by stone tools. During different experiments they are identified specific wear patterns, such as V-shaped scratches, that characterize the use of metal tools. These marks are typically sharper and more defined compared to the broader, rounded marks left by stone tools. This distinction provides insight into the efficiency and precision offered by bronze tools in contrast

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to traditional stone implements (Christidou, 2008). While the advent of bronze tools introduced new efficiencies, the use of bone tools and the traditional knowledge associated with them persisted alongside metal tools. This highlights the adaptability of prehistoric societies and their ability to integrate new technologies into established practices.

## **Chapter 4:**

### **4.1 Typological and technological analysis of the tools coming from the site of Oppeano 4C**

This chapter aims to make a summary and typological description of the bone tools belonging to the Oppeano 4C collection. The tools are the product of excavation campaigns carried out in 2014 and 2015. The main categories identified in this collection are the pointed tools, the pointed tools on ulna, pointed tools on metapodial and the pointed tools on diaphysis. A pointed bone tool, often referred to as a bone awl, is an ancient tool made by shaping a bone, typically from an animal, into a sharp, pointed implement. These tools were commonly used in various cultures for tasks such as: piercing, weaving and crafting. The bone selected for these tools often came from anatomical parts of animals like the ulna, tibia, or ribs, chosen for their durability and the ease with which they could be shaped into a fine point with an elongated silhouette and pointed tip into one of the extremities (Camps and Fabrer et. Al. 1990). On the other hand, in the collection is identified pointed tools on ulna, on metapodial and on diaphysis. But what do represent the pointed tools on the metapodials? The metapodials are the long bones in the limbs of animals, specifically the metacarpals in the forelimbs and the metatarsals in the hind limbs. These bones are often used to create tools because of their straight, sturdy structure.

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## **4.2 Types of Bone Tools on Metapodials**

**Bone Awl:** When a metapodial is shaped into a pointed tool, it is often called an awl. Bone awls were used for piercing, sewing, and other detailed work.

**Bone Point:** Metapodials were also fashioned into points that could be used as projectile points (like spear tips), fishing tools, or other implements requiring a sharp tip.

**Bone Needles:** In some cases, a metapodial could be refined into a needle, especially for use in sewing or fine work with hide and other materials.

Another category mentioned are the bone tools worked on the diaphysis. The diaphysis is the shaft or central part of a long bone, such as the femur, tibia, or humerus. Because the diaphysis is typically straight and strong, it provides a good material for creating tools that require a durable, elongated shape.

## **4.3 Types of Bone Tools on Diaphysis**

**Bone Knife:** The diaphysis can be shaped into a sharp-edged tool resembling a knife. This tool would have been used for cutting or slicing tasks, including processing food, skinning animals, or crafting other items.

**Bone Scraper:** A diaphysis could be fashioned into a scraper, a tool used for removing fat or flesh from hides, or for working with wood or other materials.

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Bone Blade: Similar to a knife, a bone blade might be a more general-purpose cutting tool. It could be used in various tasks where a sharp edge is necessary.

Bone Projectile Points: Sections of the diaphysis could also be worked into projectile points for spears or arrows.

We should mark that in the collection there are also double bevel-ended tools worked on the antler. A double bevel-ended tool made from antler is commonly referred to as a billet or pressure flaker in the context of flintknapping, or as a burnisher in other contexts.

#### **4.4 Types of Double Bevel-Ended Antler Tools**

Pressure flakers: In flintknapping, a double-beveled antler tool is used to shape and refine stone tools. The antler's tough yet resilient nature allows the craftsman to apply pressure or strike with precision to remove flakes from a stone core, shaping it into blades, arrowheads, or other sharp tools. The beveled ends allow for controlled force application during the knapping process.

Burnisher: In some cases, a double bevel-ended antler tool might be used as a burnisher. Burnishers are tools used to polish or smooth surfaces, often in leatherworking or pottery. The double bevel allows for different edges or surfaces to be used depending on the task, making the tool versatile for creating smooth, finished surfaces.

#### **4.5 Bone and antler tools from the site of Oppeano 4C**

Overall, there are 18 bone and antler tools in the collection of the Oppeano 4C by the excavations of 2014 and 2015. Each of them has been registered and has its own ID. The campaign of the 2014 had as a result 7 bone and antler tools. Four of them were tools worked on

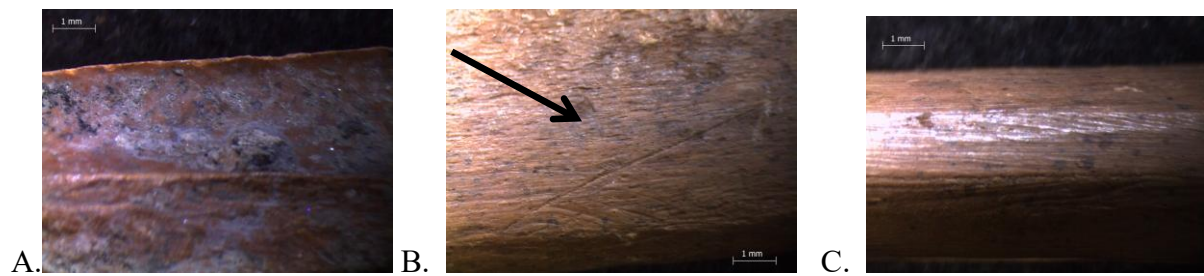
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antler, two of them pointed tools on ulna and one was worked on in a bovid metatarsal. The other 11 artifacts belong to the excavations conducted in 2015 where pointed tools on ulna are 4, 3 are worked on metapodials, 2 on ribs and the rest is part of diaphysis. The data were carried and modified by the colleague Lucilla Angeletti supervised by the professor Ursula Thun-Hohenstein. This database includes The ID is registered automatically by the database used in the archaeological excavation, the name of the site, the year of the campaign, the US that corresponds to the stratigraphic unit, the sector which shows and eventual subdivision of the area of the excavation, the ID of the bag. On the other hand the taxa shows the species, but also the taxa if that is identified. The anatomic element explains the determination of the anatomical element. For example "ulna" or "metapodial". Regarding the cut it shows the size of the animal which would be small or "S" medium or "M", or big "B". This database also includes other elements such as the number of the artifacts, the anatomic details if any, the integrity which expresses the conservation state of the artifact. If it is integrated that means that the artifact is completed. The other conditions would be fragmented and incomplete. The rest of the data describes the side of the tool if identifiable, age, gender and dimensions including length, width and. An observation of the taphonomic data describing the level of calcification was also carried out, other voices such as weathering, exfoliation, erosion, fluctuation. Other marks made out by the carnivorous, rodents. On the other hand another important part of the data base were the anthropic and manufacturing marks and their precise location at the tool.

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## List of tools

**Tool ID 363 (fig. 4.5 a).** Is a tool worked on a deer metapodial of a medium-big size. It belongs to the collection of the 2015 campaign it was located in the sector 1B and the US 27.



**Fig. 4.5 a**

**A. Manganese oxide staining**

**B. .Fragments of long bone showing scraping marks**

**C.Fragments of long bone showing scraping marks**

**D. Precise location of the marks identified**

Scale bar, 1 mm

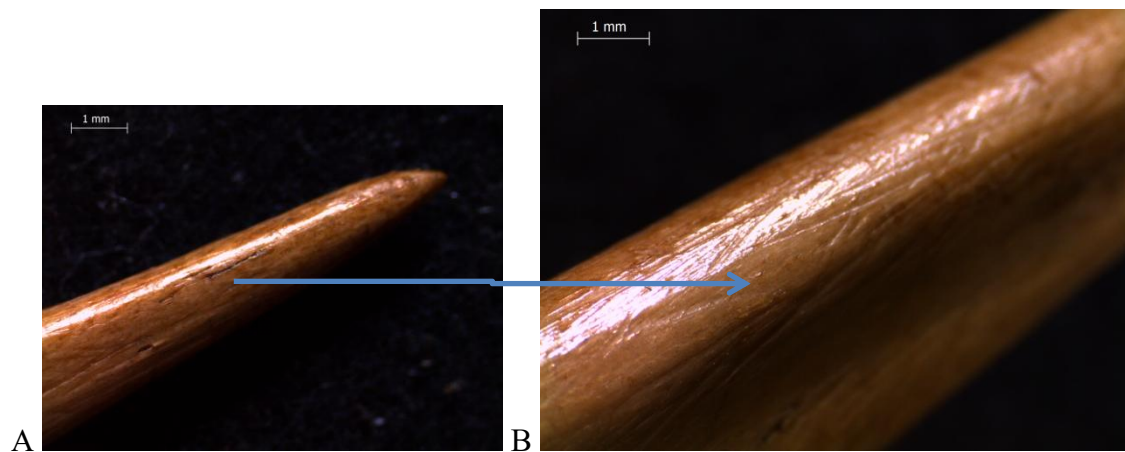
**Length: 102 mm Breadth: 19 mm Depth:15mm**

In this tool there is no erosion identified, the presence of the manganese and iron is widely spread, there are not signs of trampling and weathering and they are anthropic marks identified.

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It would probably be an pointed tool, usually known as awl, but the distal part is fractured. The angle of the tool is oblique, the profile curved and the edge seems to be irregular.

**Tool ID 450 (fig. 4.5 b)** belongs to the collection of 2015 is a fragmented ulna probably of a young bovid. The presence of the manganese and iron is noticed and there no concretions present. There are manufacturing marks n the distal end and cranial margin of the olecranon also striae on the lateral face near the beak of the olecranon (**fig. 4.5b**) The magnification used was 0.8. The angle of the tool is mixed and the edge irregular.



A

B

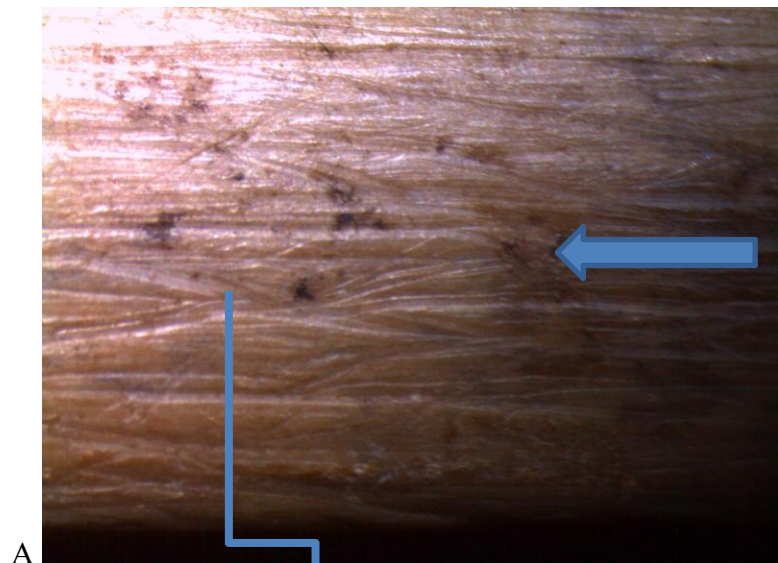


C.

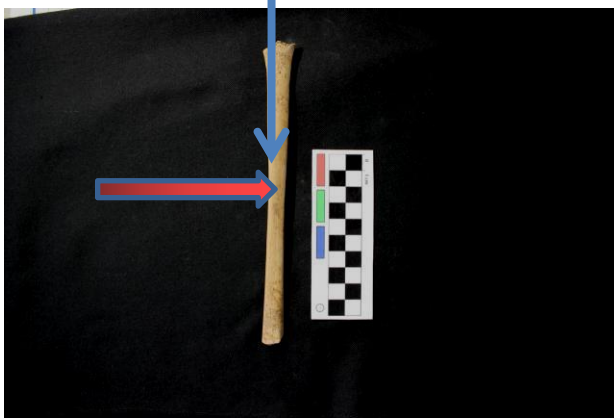
**fig. 4.5b**  
A&B. manufacturing marks  
C Precise location of the marks identified  
Scale bar, 1 mm

**Length: 82 mm breadth:21 mm depth:15 mm**

**Tool ID 451 (fig. 4.5c)** is a tool composed by a metatarsal of a *cervus elaphus* with a size that varies from medium to big. The presence of the manganese and the iron is widely spread and the action of smothering is highly noticed. This tool it may have been used as an awl or an handle. In the context of bone tools, "smothering" refers to a specific type of use-wear pattern that occurs when a bone tool is used in a manner that involves repeated contact with soft materials, such as hides or flesh. This action can lead to the surface of the bone tool becoming polished or exhibiting a smooth texture due to the friction and pressure applied during use.



A



B

**Length: 193 mm**

**Breadth: 20 mm**

**Depth: 11 mm.**

**Fig. 4.5c A, B, C**

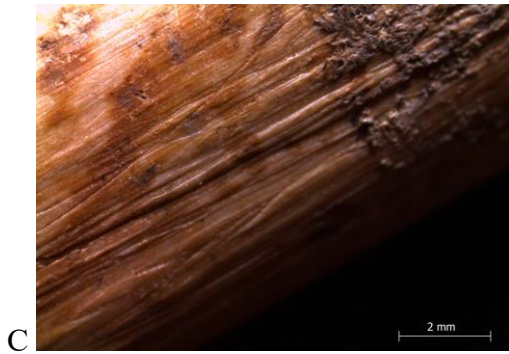
The widest concentration of the anthropic marks is noticed in the mesial part of the tool. There are no concretions and not significant alterations such as weathering or trampling.

**Fig. A** cut marks in the mesial part of the tool

**Fig. B** position of the anthropic marks located at the picture of the tool

**Fig. C** marks of manufacturing in the distal part of the tool

Scale bar, 2 mm



**Tool ID 480 (fig. 4.5 d)** is a tool that belongs to the collection of 2015. It is composed by the left ulna of a *cervus elaphus* and it could be considered as a pointed tool in ulna. The part of the bone is medium to big sized and the manganese and iron is not that widely spread. They might be possible marks of gnawing in the epifysis of the bone. There are anthropic traces identified and the tip of the tool is bevelled **fig 4.5d** The beveled tip on bone tools provided advantages for a variety of tasks like hide processing, pottery decoration, and hole making. The angled edge made the tools more effective for scraping, smoothing, and piercing compared to a straight edge. This design feature was an important part of the functionality of many prehistoric bone tools (Christidou and Legrand 2017) The surface of this tool is quite polished.

**Length: 148 mm**

**Breadth: 41mm**

**Depth: 28 mm**

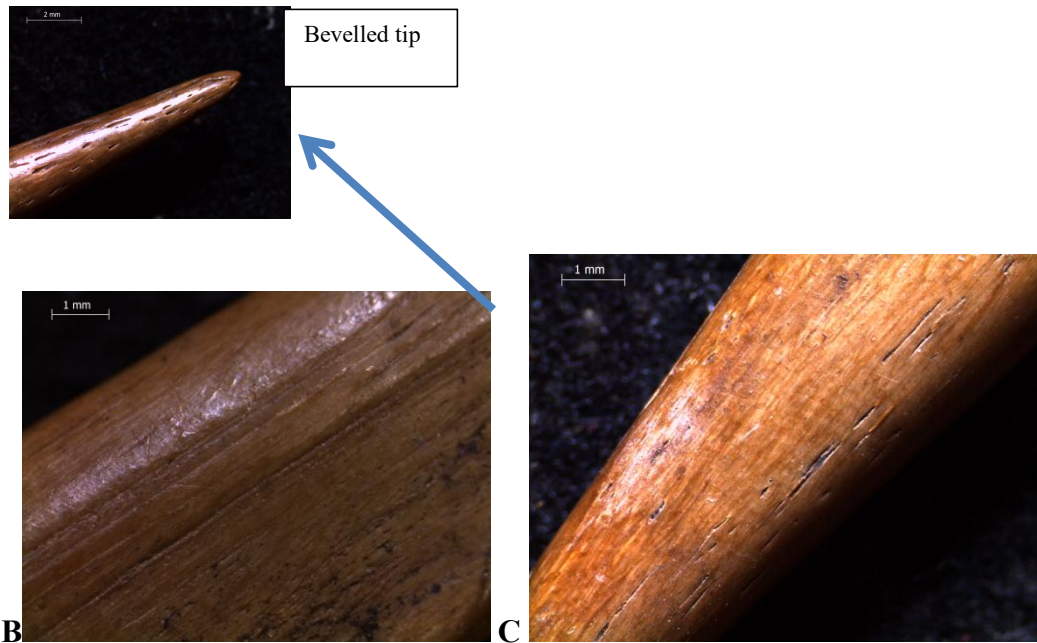
fig. 4.5 d

A bevelled tip of the tool

B Anthropic manufacturing marks

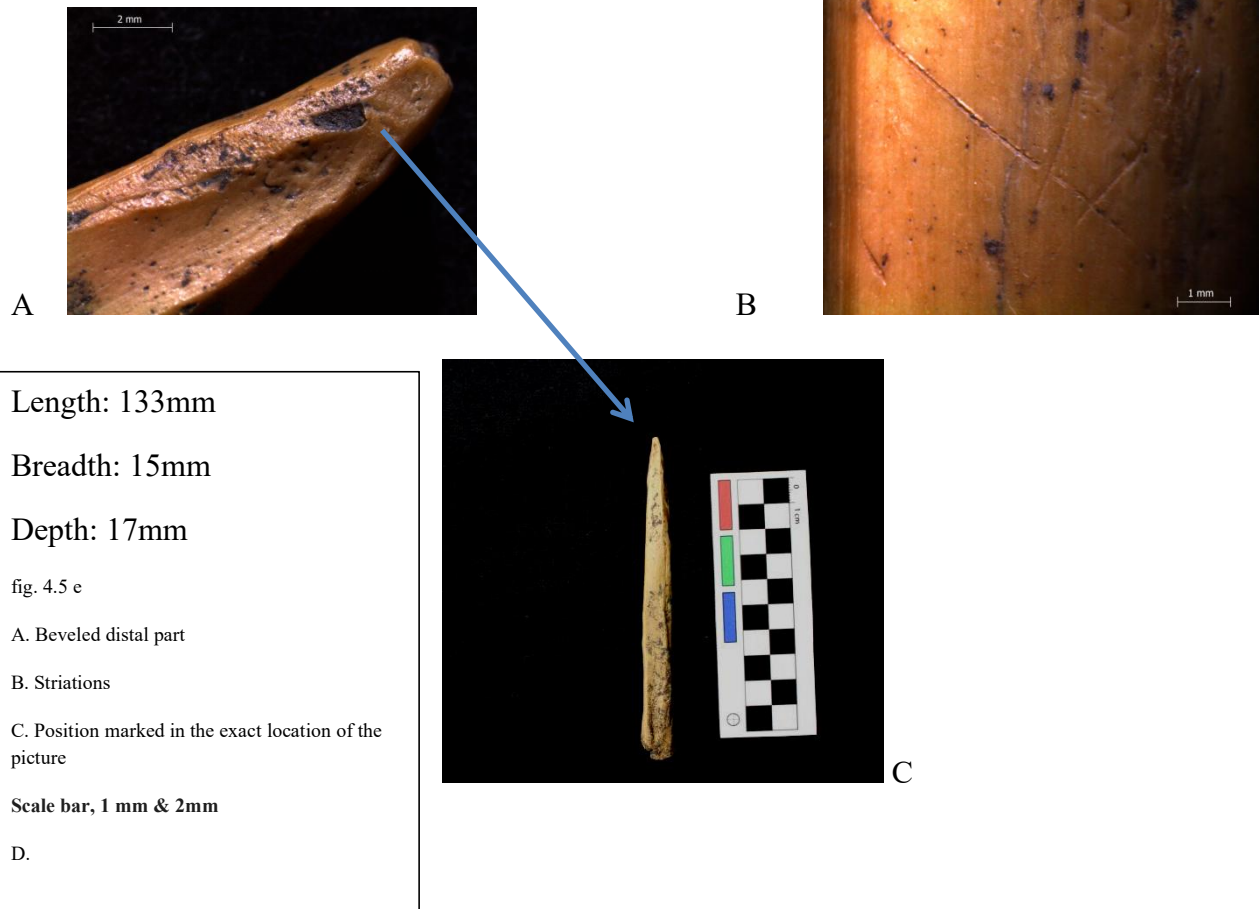
C marks possibly caused by carnivores

Scale bar, 1 mm & 2mm



#### Tool ID 550

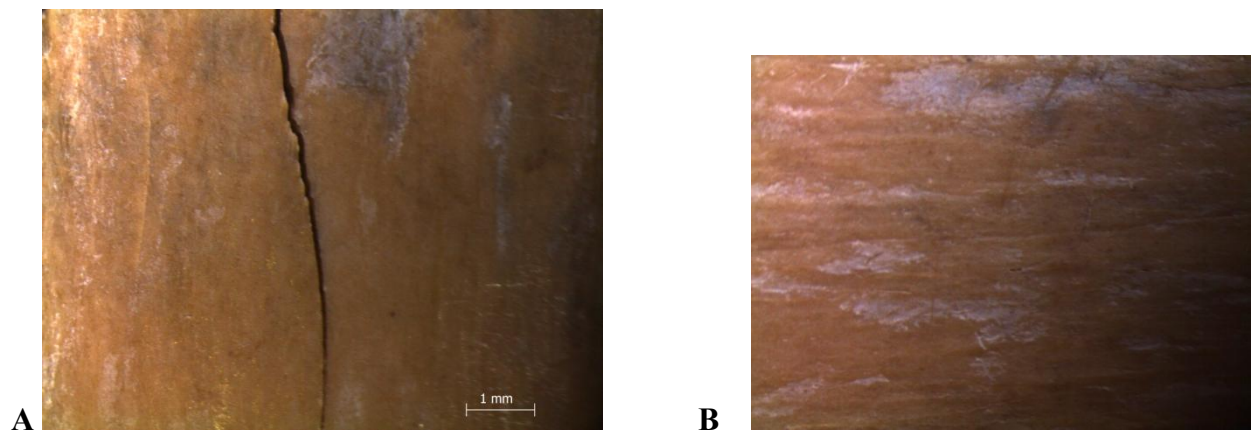
It belongs to the excavation campaign of 2015. It consists of a long bone with a medium cut and belongs to the class of mammals. We may be dealing with the anatomical element of a metapodial which is fragmented. The presence of manganese and iron oxides is shown widely. The cause of fragmentation can be human activity. It could be classified as an awl where the distal part is beveled (fig. 4.5 e) Overlapping striae of varying depths and orientations on this tool suggest it was used for multiple tasks or underwent resharpening over its lifetime (fig. 4.5 e) The surface of the tool is not very well preserved, and a very few little smoothed areas are detected. The remaining non polished surface is characterized by a grainy texture. Striations are still visible in the surface.



**Tool ID 560 (fig. 4.5 e)**

This tool is composed from the right rib of a mammal where the diaphysis is preserved intact.

The surface of the tool is polished, creating a smooth, lustrous appearance.



The edges of the tool, especially the working edges, are rounded from use. This rounding differs from the natural rounding of edges due to abrasion, which is more uniform across the entire bone surface. In the polished surface there are visible some striations. These striations result from scraping the bone blank with a stone tool during the manufacturing process. Use-related striations tend to be shorter, less parallel, and concentrated in specific areas of the tool.

**Length: 158 mm Breadth: 18mm Depth: 6 mm**

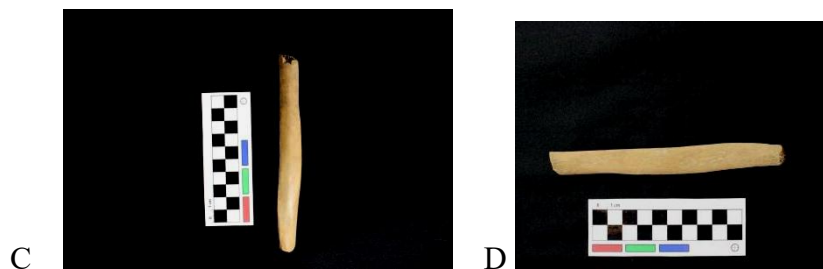


Fig. 4.5 e

A. Weathering cracks

B. Mineral deposits marks probably calcium

C&D. A bone handle comes from the Oppeano 4 C site and it is made on a rib of a mammal. The distal end of the tool shows a perforation, which is parallel to the longitudinal axis. It follows the natural hollow of the bone. In this area, the surface is characterised by a high degree of smooth and a significant shiny aspect.

There are two “tools” on the collection respectively **ID 522** (fig. 4.5 f) and **ID 523** (fig. 4.5 g) which at the beginning were classified as possible awls. Certain taphonomic processes can create pseudo-artifacts on bone that may be mistaken for intentionally modified tools. Carnivore activity, rodent gnawing, natural weathering and abrasion, and animal trampling can all lead to bone modifications that resemble cut-marks, percussion traces, or other signs of human tool manufacture (Behrensmeyer, 1978; Blumenschine, 1995; Domínguez-Rodrigo et al., 2009). To confidently identify anthropogenic bone modifications, researchers employ a configurational approach that considers the context, location, and overall pattern of the alterations, in addition to microscopic features (Olsen & Shipman, 1988). Experimental replication of bone tool manufacture and use-wear analysis are also crucial for establishing criteria to distinguish real artifacts from pseudo-artifacts (Bello & Soligo, 2008). While bone pseudo-artifacts can provide

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evidence of the presence of animals and natural processes at archaeological sites, careful taphonomic analysis is essential to avoid misinterpreting them as intentionally modified tools. For example, striations on bone surfaces can be caused by sediment movement or the action of other animals, while sheen and polish may develop through natural weathering or transport processes

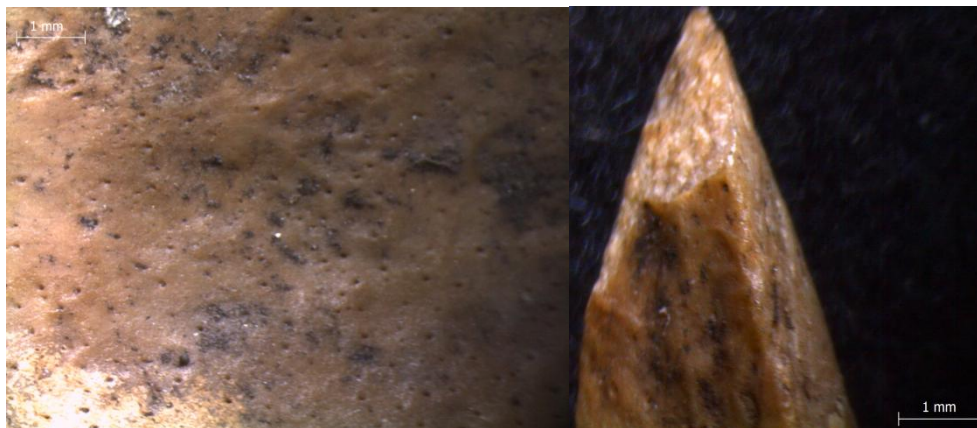
(fig. 4.5 f)



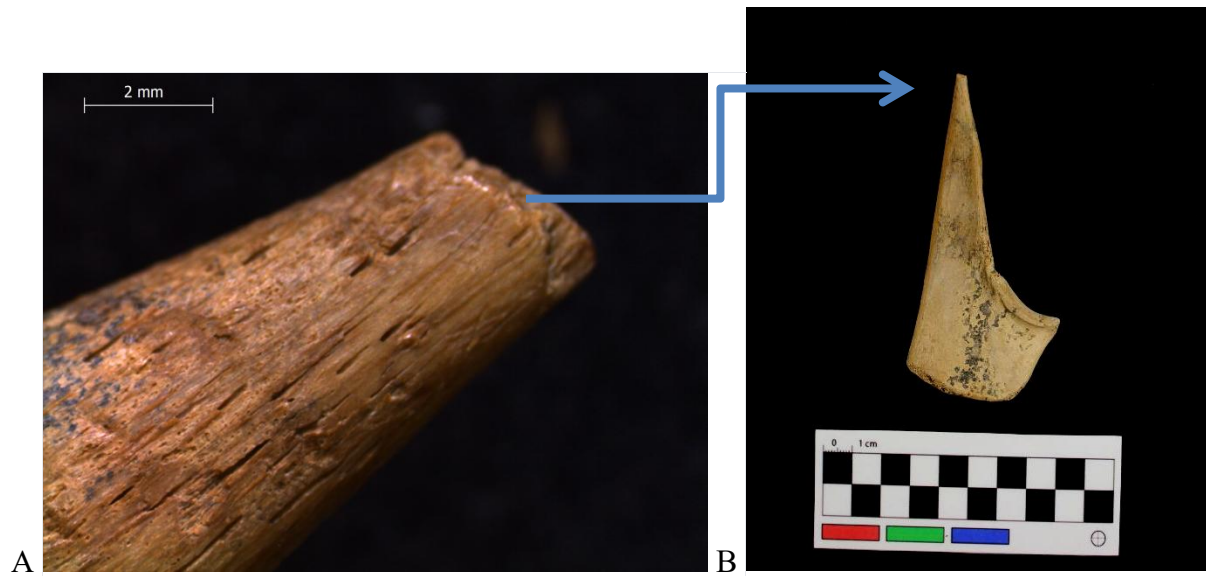
Bones can also be unintentionally modified during other activities, such as during butchery or processing of animal remains, leading to surface changes that might be confused with those resulting from tool-making.



Fig 4.5 g The respective 'tools' show a damage on the surface, not allowing a good analysis. Although the raw material and the anatomical provenance is uncertain and maybe related to different taxa, a recurrence of certain marks is recorded. Distal and active part of the tools is in fact characterised by a maximum of two traces categories, which are longitudinal striations and transversal or oblique striations



**Tool ID 580 (fig 4.5 h)** is a tool of a big cut composed of the right ulna of a *bos sp.* The ulnas of the bovids was a preferred raw material for producing pointed tools with evidence of their use in tasks such as piercing, scraping, and butchering. The pointed ends allow for efficient incision and cutting, while broader edges may facilitate scraping or digging tasks The diaphysis is entirely preserved and the estimated age of the animal is 42 months. There are traces of manufacturing most probably of scrapping and the tip of the distal part is broken. Traces of pits could also be identified.



A

B

Fig. 4.5 h

A. Distal tip broken

B. Photo of the tool showing the precise location

Scale 2 mm

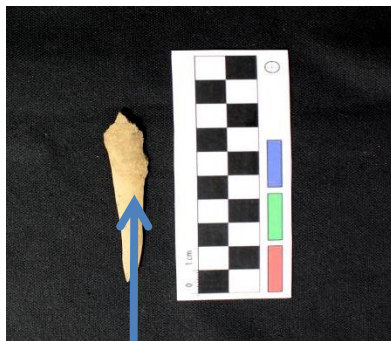
Length: 100 mm

Breadth: 49mm Depth:

17 mm

**Tool ID 594 (FIG 4.5 I).** Is a pointed fragmented tool worked on a diafisis probably of a long bone of a mammal. The cut is medium, there are visible pits and it should have been used as pointed tool, probably an awl.

A.



Length: 73mm

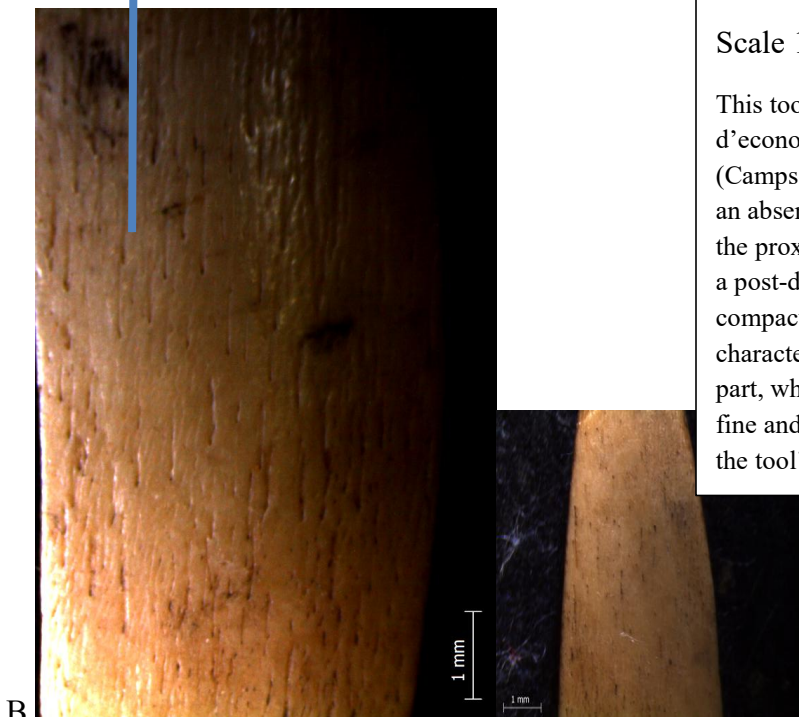
Breadth: 14mm

Depth: 4mm

Fig 4.5 i A&B&C

Scale 1mm

This tool can be related to the group of *pointe d'économie*, largely used during all the Prehistory (Camps Fabrer et al. 1990). It shows a rough aspect and an absence of surface regularisation. I has a fracture in the proximal part, maybe related to the use of tools or to a post-depositional phase. The artefact, is composed on compact bone of uncertain anatomical provenance, is characterised by a faceted surface except on the distal part, which is slightly rounded. The facets show very fine and parallel long striations running longitudinally to the tool's main axis



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**Tool ID 5 (fig. 4.5 j)**

From the collection of 2015, this tool is composed by the metapodial of a *cervus elaphus* of a medium size. In this tool are identified marks of scrapping and grooving.



Length: 59 mm

Breadth: 25 mm

Depth: 20 mm

Scale: 1 mm





**Tools from the excavation campaign of 2014, Oppeano 4C.**

**Tool ID 142 (fig. 4.5 k)**, is a double pointed tool composed by a compact antler of a *cervus elaphus* where the antler is worked in flattened "ellipsoidal" shape. One part scraped with flint, one decorticated. Both the extremities of the tool have traces of use.

**A**



Length: 97 mm

Breadth: 14 mm

Depth: 7mm

**Fig. 4.5 k**

**A, B, C**

**Scale 2 mm**

It is a little double point achieved on compact antler of *cervus elaphus*. The distal tip is characterised by a detachment of material. There is in addition a lack of marks, and the surface results to be smoothed. The proximal tip is regularised, but no traces are detected at low magnification. Instead, very light traces are mostly recorded on the ventral side of the tool, in the mesial portion. Here, short striations, parallel each other cross transversally to the longitudinal axis of the tool



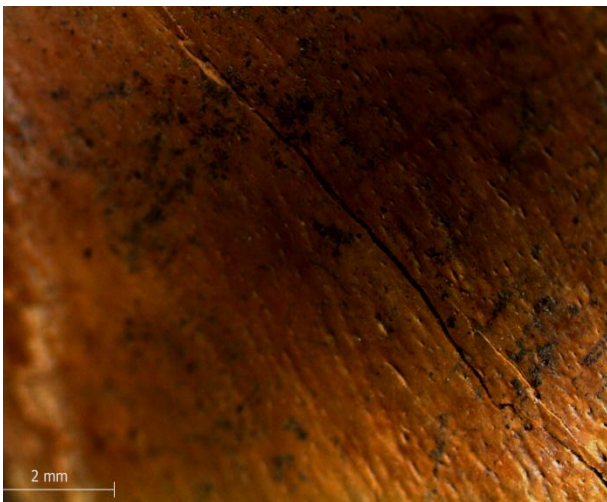
**Tool ID 306 (fig. 4.5 I)** is a tool composed of the right ulna of a *bos taurus*. The cutting size of the bone is big and there are identified. The striae or traces identified to the tool could have been caused by the activities of scrapping and disarticulation. Both dorsal and ventral surfaces are polished and the distal tip is broken. The estimated age of the animal is 4-6 years old.



A



C



B

Length: 127mm

Breadth: 46 mm

Depth: 35 mm

Fig. 4.5 | A, B, C scale: 1 mm, 2 mm

The first recorded typology is composed by transversal striations to the tool's main axis; the traces are fine, short and parallel each other. The transversal linear marks are mostly located on the end of the tip, whereas the longitudinal striations mostly affect a broader area of distal portion.

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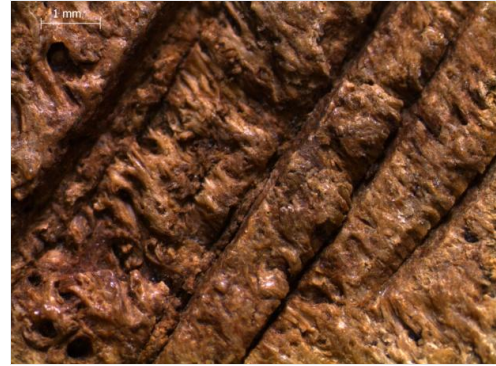
**Tool ID 30 (fig. 4.5 m)** is used the left part of the crown of deer antlers as raw material. The choice of antler tools was related to their specific morphologies, with a wide variety of forms. The exploitation of deer antler, thanks to its physical and mechanical properties (high resistance and elasticity) and the great availability in nature due to its cyclical annual fall (Billamboz, 1979, pp. 101-103; Orłowska and Osipowicz, 2017, p. 103; Vitezović, 2017, p. 210), has progressively played an important role in various prehistoric communities, influencing several aspects of their social lives. It would appear that the gathering activity in the cervids shedding season (February – March for adult individuals) has been preferred to hunting in the Bronze Age, as suggested by a large number of artefacts without bone pedicles attached to the proximal basal part (burr) (Provenzano, 1997; De Marinis *et al.*, 2005; Pasquini, 2005a). This required good knowledge of the surrounding environment (as stags tend to lose their antlers annually in the same area), but mainly the acquisition of forms of social organization related to seasonal collection and antler storage (Provenzano, 1997, p. 535; 2001, p. 98; Vitezović, 2017, pp. 210-212), which needed particular conditions. In our case there are identified rosette and furcation part that are worked and roughened, with numerous striae, and also decorticated traces. Streaks and slashes are also present in the raw material.

Length:342m

Breadth:70mm

Depth: 42 mm

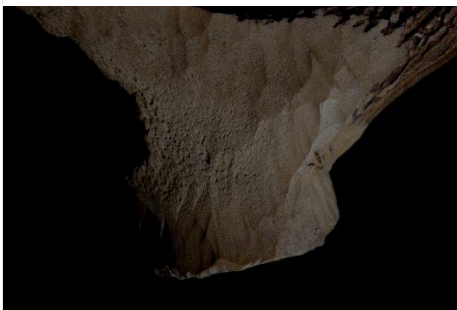
The antler is characterised by a structure of longitudinal, circular and radial blood vessels and a lamellar tissue; a lack of osteons is typical of this structure. During the growth, the antler is crossed by an internal vascular channels and an external velvet. Besides, it is formed by a compact tissue and a cancellous tissue, which is embodied by the former. The percentage of spongiosa in the antler structure varies depending on the taxa, and even depending on which portion of the antler is considered (Christensen 2004).



The antler has a similar proportion to the referring for the bone, with the only difference in a higher percentage of collagen and thus less mineralisation, contributing to a major flexibility.



It is a good material for the heavy duty tools (as mattocks, hoes etc..). it has a negative response to the manufacturing by direct percussion, whereas it yield a very good response in case of exploitation by cutting/entailing techniques (Christensen 2004).



Tool 202 (fig. 4.5 n)



(fig. 4.5 n)

One bevel-ended tool on antler comes from Oppeano 4c site from the campaign of 2014. The tool is made of *cervus elaphus*, : a rounded perforation is recorded on the proximal part; the walls of perforations shows a smooth surface and a striated arrangement, as a result of a possible rotating action. The distal part shows a unifacial bevelled, while the proximal part shows a detachment of the material.



Length: 130 mm

Breadth: 35mm

depth: 25 mm

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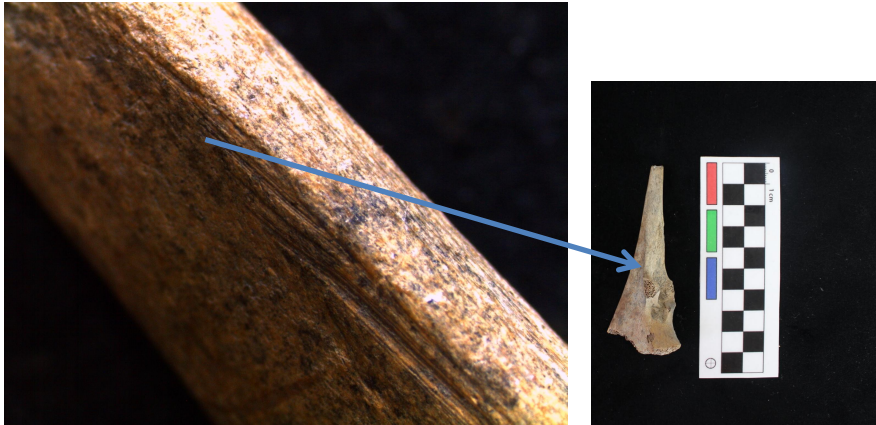
**Tool 833 (fig 4.5 o)**



This pointed tool is probably a dagger crafted from the antler of a red deer, specifically utilizing the dense, durable sections of the antler, such as the tines. The blade is shaped through careful carving and grinding, resulting in a finely honed edge ideal for cutting and piercing.

Length: 117 mm Width: 20 mm Depth: 10 mm

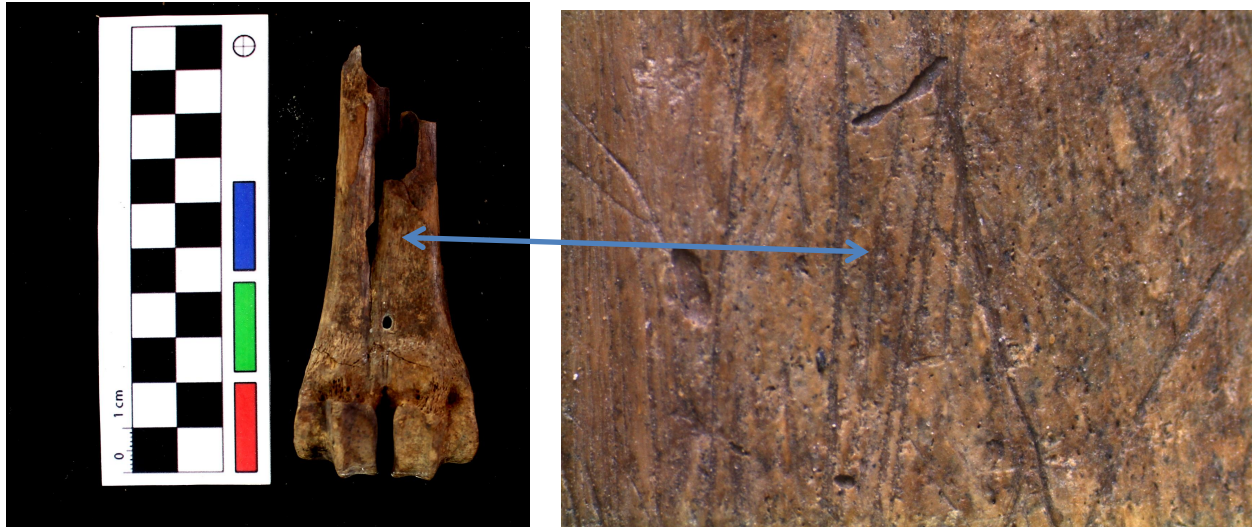
Tool 60 (fig. 4.5 p)



The tool is made from the dense cortical bone of the *bos sp* ulna, which provides the necessary strength and resilience for repeated use. The proximal end (the end closer to the body) is slightly thicker and rounded, while the distal end tapers to a sharp point that is broken. A series of manufacturing striae are identified in the dorsal part of the tool.

length: 82mm width: 35 mm depth: 25 mm.

Tool 175 (fig. 4.5 q)



A pointed tool from a *bos sp* metatarsal, length: 88mm width: 20 mm depth: 15 mm. The body retains some of the natural curvature of the bone, enhancing grip and control during use. In this case the distal tip has a fracture while in the longitudinal axis of the tool a series of parallel striae are identified.

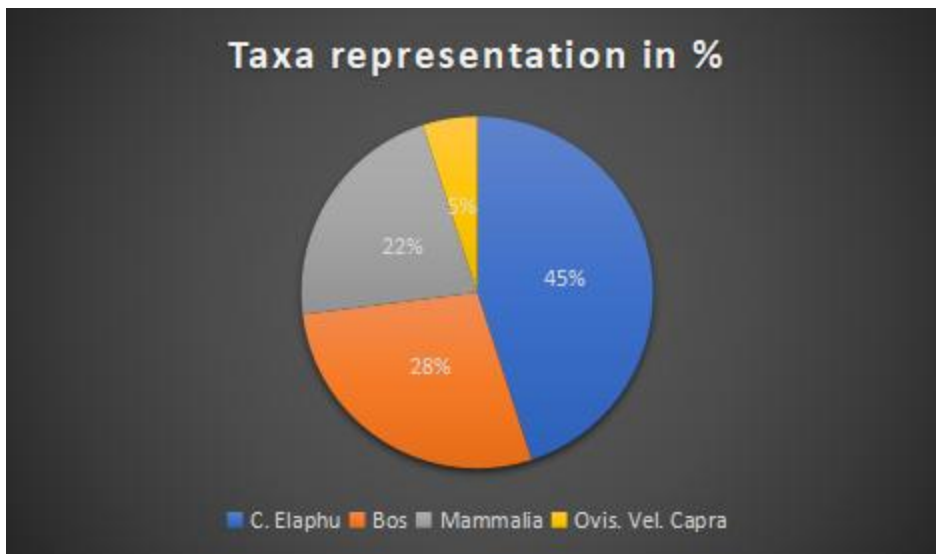
## Chapter 5:

### 5.1 Taxonomical and archaeozoological analysis from the site of Oppeano 4C

During the Bronze Age in northern Italy, following the development of an economic strategy mainly centered on agriculture, hunting is significantly reduced in favor of breeding and aimed at exploiting mostly cervids (red deer, roe deer) and wild boar. New data on the exploitation of wild animals during the early Bronze Age come from the site of Oppeano 4C, a pile dwelling settlement discovered in 2015 in Vallese di Oppeano, in the Bussè valley, which represents the oldest pile-dwelling village in the Veronese Po plain dated to the ancient Bronze Age (between

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the end of EBA 1 and the beginning of EBA 2). From the archaeozoological analysis conducted on the finds from sector 4C, the faunal assemblage is mainly composed of domestic animals with a prevalence of pigs, followed by cattle and goats, but the exploitation, although reduced, of wild animals such as deer and roe deer is also attested, as well as occasional small prey such as beaver, badger and otter for fur recovery.



(fig 5.1 a) Chart pie illustrating by taxa representation in % worked by Andia Shtembari

A very important way of analyzing bone tools is to look the regularity in the choices of the species and the anatomical part used for manufacture. Even though the sample size is quite small (only 18 bone tools) still we can make some deductions based on the taxa representation. If we look at the chart pie above (fig 5.1 a), we can notice that most of the bone tools in our assemblage are made of rests from *Cervus Elaphus* (8 from 18 or 45%). Other species used for fabricating tools are: *Bos sp.* with 5 (28%), big mammalian with 4 (22%) and one bone tool made from an *Ovis Capra* (5%). It is probable that the 4 tools made from big mammalian bones should fall in the category of either *Cervus Elaphus* or *Bos sp.* but we can't make an assumption without a clear identification of the taxa. This taxa representation doesn't fall very far from other

geographically close sites of the area during the Bronze Age (Provenzano, 1997 in Ramseyer *et al.* 2004, p. 205-218), but it differs a bit in the exploitation of the *caprinae* bones. Normally during the Early Bronze age in the sites of northern Italy we still see a strong neolithic tradition in every aspect of everyday life and production, including bone tools (Provenzano, 1997 in Ramseyer *et al.* 2004, p. 205-218). This means that like in the late Neolithic, we would have expected to have a higher use ratio of *caprinae* bones. But if we analyze all the material coming from the early Bronze Age at Oppeano 4C we can see that there is only one case in which a bone tool was made from an *Ovis* species (tab. 1 ). Again, we should not undermined that this may be due to the small sample size that we are studying, but nonetheless this taxa representation during the Early Bronze age in Oppeano 4C is more closely related to the Middle Bronze Age. In fact, during the middle Bronze age, in the sites in Northern Italy we see a lesser use of *caprinae* bones for manufacturing tools and a much higher use rate for the bones of big ruminants (Provenzano, 1997 in Ramseyer *et al.* 2004, p. 205-218).

ID	Subphase	Taxa	Cut	Anatomic element
OPP4Cn00363	4b	Cervus elaphus	Medium to Big	Metatarsal
OPP4Cn00450	3	Ovis vel Capra	Medium to Big	Ulna
OPP4Cn00451	3	Cervus elaphus	Medium to Big	Metatarsal

OPP4Cn00480	2b	Cervus elaphus	Medium to Big	Ulna
OPP4Cn00541	2a	Bos sp.	Big	Ulna
OPP4Cn00550	1b	Mammalia	Medium	Long bone
OPP4Cn00559	1b	Mammalia	Medium to Big	Rib
OPP4Cn00560	1b	Mammalia	Medium to Big	Rib
OPP4Cn00580	1c	Bos taurus	Medium to Big	Ulna
OPP4Cn00005	4d (abbandonme nt)	Cervus elaphus	Medium to Big	Metapodial
OPP4Cn00594	1b	Mammalia	Medium to Big	Long bone

Tab. Bone tools from the early Bronze Age at Oppeano

The tradition of exploiting mostly bones of big ruminants for the production of tools continued in the middle Bronze age at Oppeano too. As we can see in the table below, tools were made from remains of only two species: *Cervus Elaphus* and *Bos sp.* This is in line with other sites of the region. As we mentioned above, even though *Caprinae* are still the most dominant taxa in the

domestic animals' assemblages, their remains are less and less exploited for making tools, from the early Bronze Age to the Middle Bronze Age.

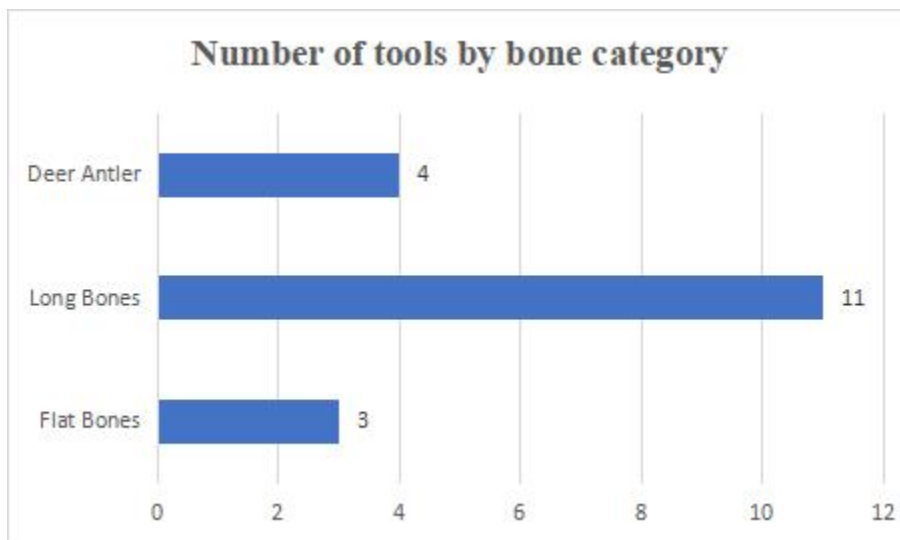
ID	Sector	Taxa	Cut	Anatomic Element
OPP4Cn01080	7	Cervus elaphus	Big	Antler
OPP4Cn01110	7	Bos taurus	Big	Ulna
OPP4Cn01194	8	Cervus elaphus	Big	Antler
OPP4Cn01318	10	Cervus elaphus	Big	Palco
OPP4Cn01370	11	Bos taurus	Big	Antler
OPP4Cn01543	II tronco Pic. 251	Bos sp.	Big	Vertebra
OPP4Cn01544	II tronco Pic. 251	Cervus elaphus	Big	Antler

Tab 1. Bone tools from the Bronze Age at Oppeano 4C

Another important aspect when studying a collection of bone tools is to see what part of skeletal and anatomical element was used in order to manufacture these tools. We know that during

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prehistoric times there was a pre selection of skeletal parts in order to choose which bones were the most adequate to be manufactured into tools. For example, long bones were preferred to flat bones as they were easier to be manufactured and better tools were created out of them. Also, some specific elements were used like deer antlers. In order to do so for the Bronze age tools at Oppeano, we divided them in three categories based on the skeletal part were the bone used to manufacture the tool came from. The 3 categories were: long bones, flat bones and deer antlers. From the total of 18, most of them, 11, came from long bones (Ulna, Metatarsal etc), 4 were fabricated from deer antlers and 3 from flat bones (*Costae*). (tab. 2)



Tab 2. Number of tools made from the 3 bone categories

Given that we had three main bone categories, in order to better understand the skeletal choices made by prehistoric populations at Oppeano 4C, I decided to make a ternary plot. This type of

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graphical representation of a statistical data can make it easier for us to understand these cultural and biological choices because it gives us a constant based on the sum of our three categories. This constant that came out from the skeletal parts used at Oppeano 4C shows us a heat map that clearly leans toward the use of long bones for manufacturing tools. This choice should not surprise us because long bones, like for example big ruminants' ulnas, are more robust and working them for manufacturing tools it's easier as they naturally create a pointy bone.

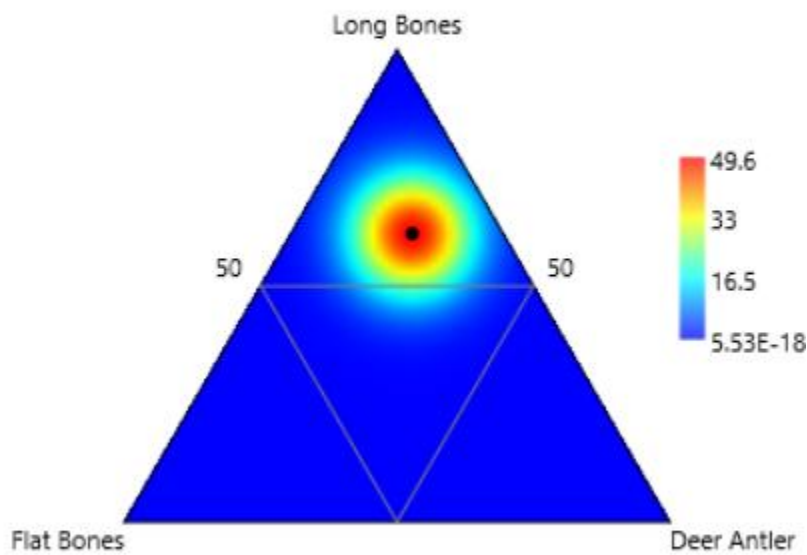


Fig 5.. Ternary plot for the 3 bone categories

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This type of study is important because the selection of raw materials (both taxa and skeletal part) shows us biological and cultural choices made by ancient craftsman. For example, regarding the species selection, normally we would expect that most of the bone tools to be manufactured out of taxa that are the most represented in the zooarchaeological assemblage. The bones of such species were most likely on hand after consumption and one might think that these bones were later used to fabricate the tools. In many sites is so, but at Oppeano 4C we see that in many examples that is not the case. The fact that we have only 1 bone tool made out of *Caprinae* remains while this specie made for most of the meat consumption, show us that the local communities had developed such a knowledge on manufacturing tools that they understood that it was better for them to use bones from big ruminants like *Bos sp.* and *Cervus elaphus*. This is a very important aspect because it shows to us about the cultural and practical choices made based on their own experiences and also that we are in a stage were choices were not made only based on what was easier to have in hand, but also on what was better and more effective.

In general, from the analyses of taxa and skeletal selections we can say that in Oppeano during the Early Bronze Age we have a manufacturing continuum that it could still present in the middle Bronze Age also. This manufacturing traditions are normally present in a site or a group of sites and they represent a process in which tools are made out from the bones of certain species and on particular skeletal parts over a long period of time, which is the case at Oppeano 4C also. This manufacturing continuum results in a selection of raw materials based on certain species and certain skeletal parts, and this might continue even when there might be changes in the species available (Choyke, 1997 in *Anthropozoologica*). Again, this shows how much effort and work was put on the production of bone tools, in order to overcome sometimes even environmental boundaries, because of the cultural and practical choices of prehistoric populations.

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## **5.2 Comparative archaeozoological analysis from the site of Farnetto Cave (BO).**

The Farnetto Cave is a significant archaeological site located in the Park of Bolognese Gypsums and the Abbadessa Gullies, near Bologna, Italy. It was discovered in 1871 by Francesco Orsoni, who conducted the first important archaeological surveys in the area. The cave is most famous for the discovery of several burials dating back to the Copper Age by the renowned Bolognese speleologist Luigi Fantini in the 1960s. These finds are currently on display at the Archaeological Museum of Bologna and the Archaeological and Paleo-environmental Museum of Budrio. Part of archaeological assemblage in Farnetto cave seems to have clear comparisons with the local archaeological evidences related to a Middle Bronze Age phase (Scarani 1971). The most part of archaeological remains have been rescued inside the cave, subdivided into five wide rooms and several tunnels, or in the immediate entrance. Only the most recent discovery of human osteological remains from the rock-shelter suggests a chronological provenance from the Middle and Late Bronze Age, proven by the association of skeletal remains with bronze slags, similar to those already rescued inside the cave (Facchini 1971). Besides, several hearths in stratigraphic sequence including archaeological remains are detected outside the cave, and the radiocarbon datings yielded a frequentation of the area starting in the Middle Bronze Age (Minarini 2008). Bone and antler industry activity is attested as well, in the form of little tools likely used for bark, wood or hide working. The archaeozoological findings at the Farnetto Cave contribute to a broader understanding of prehistoric life in the region. They highlight the importance of large mammals in the diet and culture of Copper Age and Bronze Age communities, reflecting their hunting practices and resource management strategies. The site serves as a crucial link in understanding the interaction between humans and their environment

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during this period. A faunistic and archaeozoological study was conducted by the professor Sala (1980). The zoological assemblage (723 determined remains) of Recent Bronze Age frequentation is described. Among ungulates, *Cervus elaphus* is represented by a high fragmentation, only a right jaw and carpal and tarsal bones have a good state of preservation. *Capreolus capreolus* is recorded, mostly referring to adult individuals; *Sus scrofa*, further subdivided into wild boar and domesticated pig depending on stoutness and morphometry of bones. *Ovis aries* and *Capra hircus* are well represented too, characterised by a high percentage of young individuals and a slight majority of goat than the sheep. Remains of *Bos taurus* are recorded, characterised by an undersized dimension. Some carnivore species are reported as well: *Canis familiaris* referring to medium or small size species; *Canis lupus*, represented by two fragmented jaws referring to two different individuals. *Vulpes vulpes*, with only a fragment of tibia of an adult individual and a right part of palate and a left side of a jaw still retaining deciduous teeth; *Meles meles* represented by two jaws of respectively a juvenile individual and an adult; two fragments of femur related to *Felis silvestris*. The Farneto Cave and the Oppeano 4C site share several similarities, particularly in their archaeological significance and the types of faunal remains bone and antler tools found at each location. Even though, Farnet cave is associated to the Copper Age, the data has shown that also had a continuity during Early Bronze Age. At both sites, archaeozoological studies have revealed a variety of animal remains, indicating the subsistence strategies of the inhabitants. For instance, the Farneto Cave has yielded remains of large mammals such as red deer and wild boar, which were significant for hunting and dietary practices. On the other hand, we find similarities by the technological point of view and most specifically to the manufacturing of the bone and antler tools. Besides, tools on bone and antler have been also recorded, such as spatulas, awl and a hoe in deer antler, firstly

reported by Scarani (1956–1964) (Cavani et al., 2011; Scarani, 1971) The tools exhibit evidence of careful crafting techniques. The bones were shaped through processes such as flaking, grinding, and polishing to enhance their functionality. Just like Oppeano 4C, 16 bone and antler tools are identified from the site of Farneto (fig 5.2). Both the hard animal tools assemblages consist of finished artefacts. The shaping phase has been the most identified phase of reduction sequence. The pointed tools from Farneto are the result of scraping and abrading activities on the active part. The bone point on red deer metapodial (FN1) yielded traces on the proximal part, which could reflect a groove and splinter technique, as widely attested in the region (Provenzano, 1996–1997, 2001) although for more recent but very close period (Early Bronze Age). Bevel-ended tools have been achieved by scraping and abrading the edge of the roughout (bevel ended tool on bovid rib, , or entailed and partially abraded on the distal part (antler tools). The double bevel-ended tools on antler are instead entailed all along the lateral edges and partially scraped (Thun et.al, 2020). (fig. 5.2 bone and antler tools from the Farneto site)

Site	N° remain	Taxon	Anatomical element	Typ. category
Farneto	FN1	<i>Cervus elaphus</i>	Left metatarsal	Pointed tool
Farneto	FN2	<i>Ovis vel Capra</i>	Left ulna	Pointed tool
Farneto	FN3	<i>Bos taurus</i>	Left ulna	Pointed tool
Farneto	FN4	<i>Cervus elaphus</i>	Tine	Bevelled tool
Farneto	FN5	<i>Ovis vel Capra</i>	Right metapodial	Handle
Farneto	FN6	<i>Bos taurus</i>	Left ulna	Pointed tool
Farneto	FN7	<i>Cervus elaphus</i>	Beam	Bevelled tool
Farneto	FN10	<i>Cervus elaphus</i>	N.D. (Cortical antler)	Pointed tool
Farneto	FN11	N.D.	Rib	Bevelled tool
Farneto	FN13	<i>Cervus elaphus</i>	Cortical antler	Double bevelled tool
Farneto	FN14	<i>Cervus elaphus</i>	Cortical antler	Double bevelled tool
Farneto	FN15	<i>Cervus elaphus</i>	Cortical antler	Double bevelled tool
Farneto	FN16	<i>Cervus elaphus</i>	Cortical antler	Double bevelled tool
Farneto	FN17	<i>Cervus elaphus</i>	Cortical antler	Double bevelled tool
Farneto	FN18	<i>Cervus elaphus</i>	Cortical antler	Double bevelled tool
Farneto	FN19	<i>Cervus elaphus</i>	Cortical antler	Double bevelled tool

Since the two sites cover almost the same chronology of occupation and they are nearly geographically connected, a comparison between the bone and antler industries identified at the two sites would be a very relevant information on understanding the technological behaviours and how they were expressed during the Copper and Early Bronze Age in Northern Italy.

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## **Chapter 6:**

### **6.1 Conclusions and results**

The analysis of the 18 bone and antler tools from the Oppeano 4C site offers significant insights into the material culture and subsistence strategies of the inhabitants of this region during the Early Bronze Age corresponding to the archaeological layers uncovered in the 2014-2015 during the preventive archaeology activities campaigns. This conclusion synthesizes the key findings from the typological, technological, and functional analyses conducted on these artifacts, and situates them within the broader context of northern Italian prehistory and protohistory as well. The studied assemblage even though consists only in 18 tools comprises a diverse range of tools, reflecting a well-developed and specialized use of bone and antler as raw materials. The presence of artifacts such as awls, scrapers, and points indicates a variety of activities related to daily subsistence, including hide processing, tool production, and perhaps even aspects of symbolic or social practices. The identification of specific wear patterns, consistent with use in specific tasks such as piercing, cutting, or scraping, corroborates the functional hypotheses made during the initial typological assessment. Furthermore, the choice of materials primarily antler and long bones suggests a deliberate selection process aimed at maximizing the durability and effectiveness of the tools. On the other hand a categorization of tools based on their typology was done. One of the most significant aspects of the Oppeano 4C site is the evidence for the production of bone tools, particularly the crafting of bone awls from the ulnae of various sized ungulates. These bone tools, likely used in daily tasks such as leather working or textile production, illustrate the resourcefulness of the site's inhabitants in utilizing every part of the

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animals they raised or hunted. The campaign of the 2014 had as a result 7 bone and antler tools. Four of them were tools worked on antler, two of them pointed tools on ulna and one was worked on in a bovid metatarsal. The other 11 artifacts belong to the excavations conducted in 2015 where pointed tools on ulna are 4, 3 are worked on metapodials, 2 on ribs and the rest is part of diaphysis. The crafting of these tools from the bones of domestic and wild ungulates suggests a detailed knowledge of the physical properties of different bones and a skillful approach to tool production. The choice of ulnae, a bone known for its strength and shape, highlights the practical knowledge the inhabitants possessed regarding the best materials for creating durable and effective tools. Based on the tools I had on disposal, I have tried to do a Taxonomical and archaeozoological analysis from the site of Oppeano 4C. I decided to create a ternary plot. This type of graphical representation of a statistical data can make it easier for us to understand these cultural and biological choices because it gives us a constant based on the sum of our three categories. This constant that came out from the skeletal parts used at Oppeano 4C shows us a heat map that clearly leans toward the use of long bones for manufacturing tools. This choice should not surprise us because long bones, like for example big ruminants' ulnas, are more robust and working them for manufacturing tools it's easier as they naturally create a pointy bone. Caprines (sheep and goats) and bovines (cattle) are also well-represented, each contributing equally to the subsistence practices at the site. These animals likely provided a range of resources beyond meat, such as milk, wool, and hides, highlighting a diversified approach to animal husbandry. The presence of dogs indicates their role as domesticated companions or possibly in herding, reflecting their integration into daily life. We should mention that Wild fauna, though less prevalent, were also exploited, with remains of deer, roe deer, wild boar, beaver, birds, and even freshwater turtles identified. The presence of these

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species suggests that hunting and foraging remained important supplementary activities, providing a variety of resources including meat, fur, and possibly materials for tool-making. The identification of carnivores such as fox, badger, and otter, though in small quantities, may indicate incidental hunting or trapping, possibly for fur or to protect livestock. The findings from Oppeano 4C contribute to our understanding of Early Bronze Age communities in Northern Italy, particularly regarding their subsistence strategies and material culture. The integration of domestic and wild resources suggests a flexible and adaptive approach to survival, while the crafting of bone tools from available animal materials reflects a continuity of traditional practices alongside emerging technologies. In conclusion, the occupation of Oppeano 4C during the Early Bronze Age reveals a community that skillfully balanced agriculture, animal husbandry, and hunting, while also engaging in the production of tools from animal bones. These practices underscore the adaptability and ingenuity of the site's inhabitants, contributing valuable data to the understanding of prehistoric life in Northern Italy.

## **6.2 Future perspectives**

As I advance this research, my primary goal is to incorporate a robust experimental analysis that will shed new light on the production, use, and significance of bone tools at Oppeano 4C. This next phase will involve replicating the bone tools found at the site using materials sourced as closely as possible to those available during the Early Bronze Age, such as bones from domestic and wild ungulates. By carefully reconstructing the manufacturing processes, I aim to uncover the specific techniques employed by the site's inhabitants, from the initial selection and preparation of raw materials to the final shaping and finishing of the tools. Through these experimental reconstructions, I will be able to assess the time, effort, and skill required to produce these tools, which will, in turn, provide insights into the labor investment and

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technological knowledge of the community. Additionally, this process will allow me to explore the functional properties of the replicated tools in practical scenarios that mirror the tasks they were likely used for, such as leatherworking, hide processing, and textile production. Testing these tools in real-world conditions will enable a more precise understanding of their efficiency, durability, and suitability for various tasks, which can then be compared to the wear patterns observed on the archaeological specimens. Alongside the replication work, I plan to conduct a detailed use-wear analysis on both the original tools and the experimental replicas. This will involve microscopic examination to identify the specific types of wear associated with different activities, allowing me to refine my interpretations of how these tools were used in the daily lives of the Oppeano 4C inhabitants. By comparing the experimental tools with the archaeological examples, I aim to validate and deepen the functional hypotheses previously proposed. This experimental approach is essential for moving beyond traditional typological analysis, as it will provide a dynamic understanding of the tools not just as artifacts, but as functional objects that played a vital role in the community's subsistence and craft activities. The results of this experimental analysis will contribute significantly to broader discussions on technological development and resource utilization in prehistoric Northern Italy, offering a more comprehensive view of the technological choices and cultural practices of the Early Bronze Age. By integrating experimental archaeology with the ongoing study of the Oppeano 4C site, I will be able to offer new, empirically grounded perspectives on the life and labor of its inhabitants. This work will not only enhance our understanding of this specific community but also provide comparative data that can inform the study of similar sites across the region, contributing to a more nuanced narrative of the technological and cultural evolution during the Bronze Age in Northern Italy. In addition to my experimental analysis, I also plan to expand the scope of my

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study by incorporating comparative analysis with bone tools from earlier periods, specifically the Neolithic site of Masera in Padova and the Copper Age site of Tarzo in Treviso (fig. 6.2). Initially, I intended to integrate these three tools one from Masera and two from Tarzo into my research to trace the evolution of bone tool technology from the Neolithic through the Copper Age to the Early Bronze Age in Northern Italy. However, with only three tools, this sample size is too limited to draw definitive conclusions about broader technological trends. Therefore, a key future direction will involve seeking out additional bone tool assemblages from other contemporary Neolithic and Copper Age sites across Northern Italy. By expanding the dataset, I can more effectively analyze changes in tool design, production techniques, and usage patterns over time. This will allow me to contextualize the tools from Oppeano 4C within a longer continuum of technological development. Moreover, integrating these findings with regional archaeological data will help to identify whether observed shifts in bone tool technology reflect broader cultural transitions, environmental adaptations, or localized innovations. Ultimately, by addressing the limitations of the current sample size, I aim to develop a more comprehensive understanding of the evolution of bone tool technology in Northern Italy, providing valuable insights into how prehistoric communities adapted their tool-making practices across different periods.

**Fig. 6.2** Microscope images a possible pointed bone tool from the site of Tarzo



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