Investigating Maintenance and Discard Patterns for Middle to Late Magdalenian Antler Projectile Points: Inter-Site and Inter-Regional Comparisons

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ABSTRACT

Projectile points manufactured from antler, bone, ivory, and horn were a significant component of the Pleistocene hunter-gatherer's weapons toolkit. While this situation appears to have been particularly the case for Upper Palaeolithic Europe where thousands of implements from Aurignacian to Azilian contexts have been recovered, elements of osseous technologies are increasingly being identified in Africa, Asia, Australia and North America. Projectile weaponry tipped with osseous raw materials therefore constitute a major dataset for the investigation of technological, subsistence, and social aspects of various and numerous Pleistocene populations.

Having once been described as 'impossible to evaluate', investigation of maintenance and discard patterns for osseous projectile point assemblages has been severely neglected in the archaeological literature. As previous work has generally been restricted to qualitative descriptions of single artefacts exhibiting clear signs of rejuvenation or recycling, our knowledge of 'the keeping' of these toolkits is therefore extraordinarily limited.

This thesis addresses this imbalance through beginning to build a robust methodology for investigating the maintenance, recycling, and discard of osseous projectile weaponry. More than 4,000 whole and fragmentary barbed and unbarbed osseous projectile points recovered from 25 Middle to Late Magdalenian sites located throughout France and southern Germany were examined, and through employing a multi-faceted approach incorporating metric analyses, statistics, use wear analysis, and the examination of contemporaneous depictions of weaponry, inter-site and inter-regional differences in maintenance and discard patterns were successfully identified.

These results are discussed from a regional perspective in order to articulate these new data into interpretations of wider Magdalenian economic and social organisation.

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Dorothy M. Brimble at age 27.
Adelaide, Australia.

RELEVANT PUBLICATIONS

Langley, M.C. 2014 Magdalenian antler projectile point design: Determining original form for uni- and bilaterally barbed points. *Journal of Archaeological Science* 44:104-116.

Langley, M. C., J.-M. Pétillon, and M. Christensen in press Magdalenian projectile weaponry: Technology and change throughout the Late Pleistocene of Western Europe. In M. C. **Langley** (ed.), *Osseous Projectile Weaponry: Towards an Understanding of Pleistocene Cultural Variability*. VERT Series. New York: Springer-Verlag.

Langley, M. C. in press More to the point: Developing an multi-faceted approach to investigating the curation of Magdalenian osseous projectile points. In. R. Iovita and K. Sano (eds) *Multidisciplinary Scientific Approaches to the Study of Stone Age Weaponry*. VERT Series. New York: Springer-Verlag.

Langley, M. C. 2013 A newly discovered horse engraving from La Madeleine (Dordogne), France. *The Proceedings of the Prehistoric Society* 79:337-381.

Langley, M. C. and M. Street 2013 Long range inland-coastal networks during the late Magdalenian: Evidence for individual acquisition of marine resources at Andernach-Martinsberg, German Central Rhineland. *Journal of Human Evolution* 64:457-465.

The Research and Its Context

The design and diversity of projectile weaponry is often central to discussions concerning Pleistocene subsistence practices, technical systems, social systems and even the cognitive abilities of the subject population/s. For the European Upper Palaeolithic, many archaeological cultures are defined, to a large extent, by the morphology of their osseous (antler, bone, ivory) projectile weaponry, which are perceived as having almost continuously changed throughout this period. This diversity and apparently fast rate of change has led to these weapons being dubbed "the most dynamic component of the Upper Paleolithic technologies" (Straus 1993:83).

Objects made from osseous materials have played an important and often central role in many prehistoric cultures, but have consistently received less attention from researchers than other artefact classes, particularly lithic technologies and pottery. It has been suggested that their fragility, and in some contexts rarity, may be the central reasons for the lack of interest in these artefacts, which often receive only cursory description before being relegated to storage (La Moine 1994). However, while these organic technologies may often be rare in the Pleistocene archaeological record, a survey of 59 ethnographic hunter-gatherer societies by Waguespak *et al*. (2009) found that 42.37% employed projectile points manufactured from bone or antler. Thus, these osseous implements, so frequently put aside in favour of their lithic counterparts, can constitute a significant proportion of the hunter-gatherers toolkit and must be examined if archaeologists are to construct thorough and informed understandings of Pleistocene technological systems.

Unfortunately, while the examination of maintenance and discard patterns for lithic technologies is well advanced, with researchers heeding recent calls to undertake studies which articulate the studied material (including broken and exhausted tools, rejuvenation debris, resharpening/reworking tools, etc.) with the complete and

functioning toolkit from which they originated, similar work for osseous projectile technology is still in its infancy. In fact, osseous projectile point maintenance and discard is an aspect that has only ever been briefly mentioned in analyses (see Chapter 1).

This thesis aims to address this imbalance through investigating maintenance and discard patterns for barbed and unbarbed (primarily) antler projectile points recovered from Middle to Late Magdalenian (c.18,700-14,000 cal. BP; 15,500-12,200 BP) contexts. The Magdalenian provides the richest and best documented archaeological assemblages for investigating the maintenance and discard of late Pleistocene osseous projectile points. This situation is owing to both increased population density which occurred during this period, resulting in the deposition of larger quantities of material into the archaeological record, as well as the appeal the vast array of enigmatic artistic works (both parietal and portable) own, has resulted in this Palaeolithic period receiving the lions share of researchers focus over the past 200 years.

Surprisingly, while Magdalenian projectile weaponry has been extensively studied in the past, only a handful of researchers have considered the impact that maintenance and discard practices may have had on the formation of these assemblages, and consequently, our understanding of this technology. Thus, this thesis provides the first focused considerations of maintenance and discard patterns for Magdalenian osseous projectile weaponry yet undertaken.

Detailed examination and consideration of archaeological material from two central case studies is presented and form the central component of this analysis: La Vache (Ariège) and Isturitz (Pyrénées-Atlantiques). These assemblages are exceptionally well preserved, well excavated and available in their entirety (La Vache) or near entirety (Isturitz) for examination, and are therefore the two best assemblages for this kind of analysis thus far excavated. In addition, material from another 23 sites located throughout France and southern Germany were examined and will be considered in the framework of projectile point use life (the second half of the *châine opératoire*). In

total, more than 4,500 whole and fragmented pieces of barbed and unbarbed projectile weaponry were examined.

In order to maximise the utility of the results presented in this thesis, the data will be considered with regard to the wider Magdalenian region rather than solely focusing on smaller areas located within it (such as the Dordogne, the Périgord, or the Ariége), an approach recently advocated by researchers (Jochim 1987; Jochim *et al*. 1999; Langlais 2009, 2011; Pétillon *et al*. 2011; Weniger 1989). It is only through integrating both local and regional perspectives that differences and similarities in Magdalenian assemblages will be identified and perhaps provide insight into any internal variation of technological, economic and social behaviours practiced by this geographically widespread people.

Through this consideration of technological data from a regional perspective, this study aims to move from mere description of the technology (physical characteristics, geographical and temporal distribution of osseous typology), to building an anthropological interpretation of the past behaviours which resulted in the observed archaeological patterns.

Magdalenian Osseous Projectile Weaponry

The Magdalenian is a chrono-cultural classification of a geographically widespread techno-complex dated to between c. 20,700 and 14,000 cal. BP (17,400-12,200 BP uncalibrated). Magdalenian sites are found throughout Western Europe, from southern Spain to Poland, but have been found to be concentrated in France, northern Spain, Belgium and Germany. Deposits are found in a wide variety of topographical settings, from the limestone rockshelters and caves of southern France to the relatively open river valleys and upland plains of northern Europe.

The Magdalenian peoples are best known for their hunting of reindeer and horse, their rich parietal and portable art lexicon, their extensive social and/or trade networks, and their apparently sophisticated social systems which may have included the periodic

aggregation of regionally dispersed groups at 'super sites' as well as hierarchical social organisation (see Bahn 1982, Conkey 1980, Jochim 1987, Vanhaeren and d'Errico 2005 for discussion).

Magdalenian assemblages are rich in osseous weapons technologies and include foreshaft components as well as a vast array of projectile points, including unbarbed points ('*sagaies*'), unilaterally and bilaterally barbed points ('*harpons*'), self-barbed points, fork-based points ('*pointes à base fourchue*'), Half Round Rods (HRRs or '*baguettes demi-rondes*'), *Foënes* and composite antler/lithic implements (see Chapter 3). These technologies are considered indicative of this archaeological culture and, as a technology that is central to subsistence, provide a source of information concerning various aspects of Magdalenian economic and social life.

Rationale: 'Reduction is Good to Know for Many Reasons'

Projectile weaponry are a technical solution ensuring the capture of vital nutritional and raw material resources used in various aspects of life, and thus provide a key component in the investigation and discussion of hunter-gatherer interactions with both the physical and social environment. Understanding not only how and when these implements were made and used, but also where and when they were maintained and discarded is vital for building a comprehensive picture of prehistoric lifeways, as well as cultural attitudes towards projectile technology in prehistory.

Furthermore, differing tool maintenance practices and rates of discard (for both individual implements and tool types) influence the size and composition of archaeological assemblages; with well-maintained types being discarded less often than poorly maintained ones for equal amounts of use (Ammerman and Feldman 1974; Shott 1989; Shott and Sillitoe 2005). In particular, Ammerman and Feldman (1974) have shown that the frequency of a tool class (such as antler bilaterally barbed points or stone scrapers) is the joint product of its use frequency and use life, and that use life is, in itself, an independent factor conditioning the content of archaeological assemblages.

Determining the range and average use life of a projectile point type, how they were maintained, if they were maintained differentially through time and across space and at what point they are commonly discarded may, therefore, provide essential data for building a comprehensive understanding of the archaeological assemblages.

Identifying when, where and how intensively artefacts were rejuvenated, and documenting their use lives from the archaeological record, will therefore allow us to correlate the environmental, economic, logistical and social conditions in which the rejuvenation of projectile technologies was preferred or deemed necessary by past populations. Furthermore, it has been argued that while tool morphologies are unreliable as cultural markers, the techniques and methods of point rejuvenation offer an alternative and arguably more diagnostic method of identifying prehistoric cultural trends. Thus, as Shott and Weedman (2007:1019) so aptly put it, "reduction is good to know for many reasons".

Research Questions and Approach

This study will focus on Middle to Late Magdalenian (c.18,700 to 14,000 cal. BP; 15,500 to 12,200 BP uncalibrated) barbed (uni- and bilaterally barbed) and unbarbed (single and double bevelled) antler projectile points. These particular weapon types were chosen owing to their dominance and ubiquity in Magdalenian assemblages, simultaneously making the dataset as large as possible and most compatible for inter-regional comparisons.

Five main questions will be investigated in this thesis:

1. How were barbed and unbarbed points maintained and recycled during the Middle – Late Magdalenian?
2. Is temporal change in these behaviours evident in the La Vache and Isturitz assemblages?
3. Are inter-site and/or inter-regional differences identifiable in the dataset examined?

4. Can we identify if discard practices were owing to functional constraints and/or cultural attitudes towards the technology?
5. Based on the answers to Questions 1 to 4, what does these data tell us about the technological, economic and social systems of Middle to Late Magdalenian populations?

To answer these questions, two main case studies are presented: La Vache (Ariège) and Isturitz (Pyrénées-Atlantiques). These sites were chosen as they are among the largest, most complete, well curated and well preserved Magdalenian assemblages of osseous artefacts recovered from the archaeological record. While both of these sites are located in southern France, they are located in different areas of the Pyrenees, and represent two different types of site, Isturitz being a 'super site' or aggregation site and La Vache a smaller camp which, for reasons explained herein, may also have seen periodic aggregations of small, technically focused people. Consequently, the La Vache and Isturitz assemblages have the potential to produce different patterns in terms of the maintenance and discard behaviours represented.

Data from an additional 23 sites located across southwest Europe (France: n = 19; southern Germany: n = 4) will supplement the two case studies in order to investigate possible inter-regional difference in maintenance and discard patterns. A deliberate focus on southwest Europe was chosen as, unlike northern Europe which was unoccupied during the Last Glacial Maximum (LGM), and southeast Europe which saw only marginal use of antler for manufacturing various technologies throughout the Upper Palaeolithic, the southwest has an uninterrupted record of hunter-gatherer produced antler technology for some 30,000 years. This situation makes this archaeological record "undoubtedly the longest and best documented technological sequence for this material in the world, and an exemplary case to study long-term technical evolutions in hunter-gatherer societies" (Pétillon and Ducasse 2012:1).

A methodology for examining osseous point repair and reduction is presented which integrates several distinct but related approaches and uses of datasets. Traditional morphological and use wear analysis will play a central role in this study, with

assemblage composition, the location of decorations and striations on an implement, and contemporary depictions of weaponry in Magdalenian art works also being considered. Ethnographic data will fulfil a supportive role. While experimental data will be an important component in future analyses, the time and space constraints of this thesis did not allow for an experiment involving a significant sample of replica points to be undertaken.

While this methodological framework is still in a formative stage of development and will undoubtedly undergo significant revisions in the future, it nevertheless provides a reasonable starting point for investigating the maintenance and discard of osseous projectile technology during the study period. Suggested changes and additions to this approach will be posed at the conclusion of this thesis.

A Note on Terminology

There are several terms which will be used in this thesis that require clarification. The main reason for this situation is that a number of the original terms (often of French origin owing to the long history of Palaeolithic research in that country) for describing osseous tools are now being replaced by others which avoid direct connotations concerning their function. The first of these terms is the use of the term '*harpon*' or 'harpoon' for describing Magdalenian uni- and bilaterally barbed weapon tips. Pétillon (2008) (in particular) has advocated the use of the more neutral term 'barbed point' over 'harpoon' to describe these weapon tips, as it is not yet clear if these items really were harpoons in the truest sense. For this reason, the term 'barbed point' will be used throughout this thesis.

Similarly, those points that are commonly referred to as '*sagaies*' in the Palaeolithic literature will be referred to here as 'unbarbed points'. The term '*sagaie*' is actually a French word describing an entire spear (including point, foreshaft and shaft), rather than just the point element of which we are interested in this study. The term 'unbarbed point' herein includes all points which lack barbs or other protuberances along their

length, and may end in single or double bevels, fork-based, massive-based (etc.) proximal extremities.

These changes in terminology were implemented in order to maximise clarity within the description and discussion of the projectile points under examination in this thesis.

Thesis Structure

This thesis is organised into two sections:

Section I: Osseous Projectile Points in Palaeolithic Archaeology; and

Section II: Archaeological Case Studies.

Section I comprises three chapters (Chapters 1 – 3) in which prior research into osseous projectile point maintenance and discard is outlined (Chapter 1), the physical characteristics and parameters of manufacturing and using antler projectile points is presented (Chapter 2), and the specifics of Magdalenian projectile technologies are described (Chapter 3).

Section II ('Archaeological Case Studies') is comprised of five chapters (Chapters 4 – 8) and presents original research undertaken for this thesis. Chapter 4 presents the methods and methodology used in data collection and analysis, as well as outlining the extent of the dataset examined. The case studies of La Vache (Chapter 5) and Isturitz (Chapter 6) are then presented, followed by the supplementary data on maintenance and discard collected from the additional 23 sites (Chapter 7). Chapter 8 brings to a close the results presented in this thesis through exploring inter-site and inter-regional differences identified in the dataset.

To draw together the preceding sections and conclude the thesis, a summary of the research is provided which highlights its key findings and limitations. Lines of research which have sprung out of this study are outlined and suggestions for future avenues of research are then provided.

Section I
OSSEOUS PROJECTILE POINTS IN PALAEOLITHIC ARCHAEOLOGY

Introduction

Projectile points have captured the interest of archaeologists for five main reasons. First, they are end-products of numerous manufacturing decisions and often involve a considerable amount of skill and effort to produce. These decisions result in a finished implement that can – and has been – argued to embody cultural information including manufacturing and use traditions (Wiessner 1983, 1984; Wobst 1977, 1999). Second, projectile points are not functionally one-dimensional – they are not necessarily used *only* to tip a projectile weapon but may (and often do) serve in a variety of uses (such as a knife or awl). This multidimensionality makes the projectile point interesting as its use was culturally determined and is reflective of its role within the cultural environment (Wiessner 1984). Third, the forms of projectile points are susceptible to various interpretations: is their appearance the result of cultural stylistic ideals, functional ideals or because they have been altered through a process of successive episodes of resharpening (Odell 1996)? Fourth, projectile points and their associated components (spearthrowers, bows, etc.), represent different technical solutions to the acquisition of subsistence resources, and therefore are key elements in the discussion of hunter-gatherer interactions with the physical environment (Pétillon *et al*. 2011). Finally, the history of the projectile point and its delivery system remains the subject of much debate (for European Palaeolithic discussions see: Allain and Rigaud 1992; or see Cattelain 1997 for a general overview).

This study is primarily concerned with this third aspect of projectile point research: identifying repaired and recycled implements, exploring the range of methods used in their maintenance and recycling, and attempting to determine the reasons for their final discard.

The following three chapters outline and discuss previous research undertaken on prehistoric osseous projectile points.

To begin (Chapter 1), the importance of understanding maintenance and discard processes for interpreting past projectile technologies and the lifeways in which they were produced will be outlined. A number of technological and economic aspects which are commonly discussed together under the umbrella of 'curation' will then be explored. This segregated approach is justified owing to the widespread disagreement on what the term, 'curation' actually refers to (see Nash [1996] for discussion), and by disarticulating these aspects, a clear discussion of how various factors may influence the maintenance, recycling, and discard of technologies is enabled. Chapter 1 concludes by presenting previous experimental and archaeological analyses of Pleistocene osseous projectile points along with an outline of ethnographic evidence for more recent osseous weaponry.

Chapter 2 describes the physical parameters of antler as a raw material as well as the functional aspects of antler projectile point manufacture and use. This discussion is continued by outlining the history of the study of Magdalenian osseous projectile points and a presenting a discussion of their typology and function (Chapter 3).

The Big Picture: The Importance of 'Curation' in Understanding Prehistory

As stated in the introduction, how particular technologies were curated in the past must be established if we are to build accurate and comprehensive understandings of these technologies, lifeways, and assemblage formation processes.

Curation, as originally outlined by Binford (1979:263), is "the practice of maximizing the utility of tools by carrying them between successive settlements". Subsequently, however, the use of the term 'curation' in technological analyses came to cover an amalgam of different technological and economic aspects, including: the production of implements in advance of use; the design of implements for multiple uses; the transport of implements from location to location; tool recycling; efficiency; and tool maintenance (see Bamforth 1986; Odell 1996; Shott 1996 for discussions).

The primary aspect of 'curation' that is of interest in this thesis is the maintenance (repaired, resharpened, reworked, etc.) and recycling of projectile points. The possible use of the studied technology in the social arena also gives these items multidimensionality - another aspect commonly grouped under the umbrella of 'curation' (though in a slightly different way then is usually meant). This last aspect is also addressed.

How various technologies were maintained, used, and discarded, and why, can and will vary according to economic and cultural variables particular to the time and place of tool manufacture and use. The most prominent of these variables - communities of practice, the use of projectile points in social signalling, raw material availability, and mobility strategies - will be outlined below.

Following this discussion, I shall consider how artefact use life histories and the recycling of discarded implements impact on the formation of the archaeological record,

before an outline of previous research concerning the maintenance the osseous projectile point is presented. Finally, the chapter will conclude by exploring how ethnographic information can support this area of research.

Communities of Practice or 'Ways of Doing Things'

In their seminal work, *Situated Learning* (1991), Lave and Wenger explored the idea that learning occurs through social interaction within communities, rather than on an individual basis. They argue that the individual undertakes learning through involvement and membership within multiple and various 'fields of participation' in which knowledge is developed and transmitted according to shared values and norms - which are themselves continuously developed and transformed by these communities. Hodder (1986, 1987, 1990) explored a similar idea, in which formal variation within both stone and osseous technologies is largely the result of "ways of doing things" (1990:45).

The importance of this theory for studies of prehistoric technologies lies in understanding how technical traditions are formed, maintained, and changed by the populations who produce them. How tools are manufactured, the designs created, how they are used and repaired, and when and how they are discarded will be determined by the norms and ideals held by each community of practice. As Dobres and Hoffman (1994:214) put it, "technologies are not practiced in a cultural vacuum where physical laws take precedence. Objects are made, reused, repaired and deposited at a variety of sites, and the associated activities and social interactions that took place in these contexts form a meaningful and structuring set of background conditions" (also see Dobres 1995). Technological choices are therefore dynamic operations which can (and often do) reflect the social identity and affiliations of the manufacturer and user of a tool (Lemonnier 1993).

Design theory used in the analysis of prehistoric technology operations along similar lines (e.g. Bleed 1986; Hayden 1998; Horsfall 1987; Kleindienst 1979). In this theory, the central idea is that through making trade offs between various constraints (locational, material, technological, socioeconomic, etc.), it is unlikely that there will be

only a single optimal solution to a given problem. Rather, a number of more or less equally effective solutions will be designed, and the choice of which one is adopted by an individual or community may largely be influenced by cultural tradition, ideological values, style, or idiosyncratic behaviour. Design theory asks researchers to work backwards "through the design process, from finished product to initial problem" where it should then be possible to "reconstruct the logic and structure of the overall technological organization of a tool type, an assemblage, and eventually an entire prehistoric community" (Hayden 1998:9).

Examination of technologies from this perspective - and any other socially focused aspect - in no way "forsakes a commitment to the materiality of technology. In fact, it is only through detailed empirical identification of technical attributes, sequences, and *chaîne opératoires* that a more comprehensive and anthropological understanding of prehistoric technology can emerge" (Dobres and Hoffman 1994:214). Thus, analysis of both the technological and social aspects of a given technology can proceed in concert, with each providing insight into the other creating a more informed understanding of the whole system (Dobres and Hoffman 1994; Ormiston 1986).

Style and Social Signalling in Hunting Weaponry

Leading on from this outline of how designs are constructed and transmitted throughout a community, we must now consider the concept of 'style'.

Sackett (1973) argues that there are two distinct attributes which a worked artefact embodies:

1. *the 'functional' attributes* – those attributes of the tool which are dictated by the raw material from which it is made; and
2. *the 'stylistic' attributes* – those attributes which are the product of choices made by the artisan and selected from among a variety of possible solutions. That is – the chosen 'ways of doing things' resulting in different 'styles' in morphology and/or decoration of an artefact.

It is these stylistic attributes which have the potential to inform on the existence of different communities of practice as well as interaction between these communities through the distribution of various artefact forms and their decoration.

There are two main theory groups which aim to explain spatial and temporal patterning in artefact style: '*social interaction theory*' and '*information exchange theory*'. Social interaction theory has its origins in the 'culture area studies' of the 1930's and sees style as an indicator of the degree of cultural affinity among social groups. This theory defines 'style' as "repetitive behavior that acts as a kind of psychological 'filter' to constrain variety and reduce information overload" (Barton *et al*. 1994). Style is argued to function on the level of the individual and acts passively having been unconsciously learned via enculturation. The design of artefacts is therefore the result of passively shared group norms and values which are similar within spatial and temporal boundaries of identity-conscious social units (Clark 1993).

Information exchange theory, on the other hand, originated with the work of Wobst and Weissner during the late 1970's and early 1980's (discussed below). This approach views style as the result of a conscious act of social communication aimed at various levels of society and is therefore an active process (as opposed to the passive character of style in social interaction theory). Style is argued to have its basis in a fundamental human behaviour where people create personal and social identity through comparison. According to this theory, the volume of style witnessed in the archaeological record indicates the amount of information flowing across the landscape. Put another way, 'style' is the vehicle by which information about the identity of the maker/owner of an artefact is transmitted to observers, and the amount of style invested into artefacts and increased deposition of these artefacts into the archaeological record indicates the quantity of information being communicated between groups of people in the social network (e.g. Gamble 1980, 1982; Wiessner 1983, 1984, 1985; Wobst 1977).

As the 'artefact as information exchange' theory will be used to interpret some of the archaeological data presented in Section II, it is prudent to outline its tenets in more detail. Through her seminal work with the Kalahari San, Polly Wiessner (1983, 1984,

1985) demonstrated that 'ethnic' or social identity can be embedded in the choices made during the manufacture of an artefact and that various attributes of a single artefact can transmit information to different levels of the social network. Both projectile points and beaded headbands were the basis of her analysis and theory building, with her work providing ethnographic examples of these processes occurring in a modern hunter-gatherer society.

Wiessner (1983), on the basis of these studies also proposed a distinction between two types of style: *assertive style* and *emblemic style*. *Assertive style* is said to function on an idiosyncratic level to differentiate individuals from similar others, applying primarily to material culture such as ornamentation or portable art. *Emblemic style*, on the other hand, uses a distinct referent and aims to transmit a particular message to a specific target audience. National flags are the best (if modern) example of this type of style. Both assertive and emblemic style may have been invested into material culture and used to transmit social messages during the Late Pleistocene, a topic which has received attention in the Palaeolithic literature since the inception of these ideas and will now be discussed.

The use of artefacts to convey messages are considered to be most useful (valuable) when used to communicate information to those people in 'the middle distance'. That is, those people not so close to the emitter that the messages are already known (groups 2 and 3 in Figure 1.1) and not so distant that the meaning of the message cannot be deciphered (group 5 in Figure 1.1). This 'middle group' (group 4 in Figure 1.1) – those people who are not encountered everyday but frequently enough that they understand the meaning of displayed symbols, and may include neighbouring groups, trading partners, or other alliance members – is where the majority of symbolic artefacts and stylistic behaviour is believed to be aimed.

As Wobst (1977) explains, because stylistic messages are primarily aimed at 'the middle distance', these messages will mostly concern social integration and social differentiation. Furthermore, as complex messages or messages which are only infrequently emitted require more energy to both make (emit) and interpret (receive),

only simple and frequently used messages will normally be encoded in material culture. The types of messages which will therefore be commonly broadcast include: emotional state, identification (class affinity, social group affiliation, religious affiliation, rank, etc.), authorship and ownership.

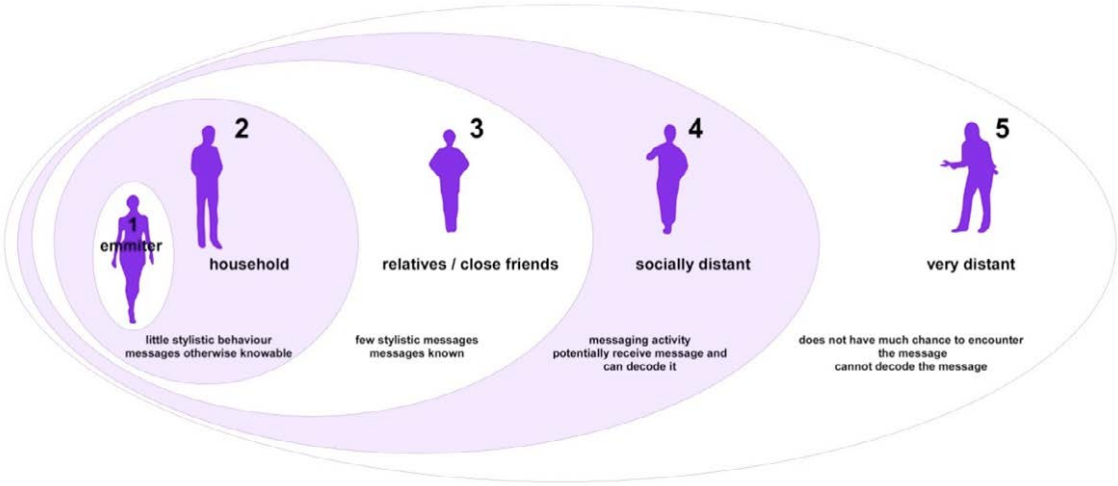


Figure 1.1: Target groups for stylistic messages held in the design and display of material culture (altered after Wobst 1977:325).

The use of material culture to transmit messages between the emitter and those in 'the middle distance' has a number of advantages for both parties. The first of these advantages is the reduction of stress in first encounters between groups as the artefacts broadcast the potential advantages and disadvantages of the encounter before it has occurred (Wobst 1977). An ethnographic example of this advantage was given by Weissner (1983:269), who reported that the San, "although afraid of strangers... said that if a man makes arrows in the same way, one could be fairly sure he shares similar values around hunting, land rights, and general conduct" while "stylistic difference may either signal another set of values and practices, if the two groups are known to each other, or if not, that its maker is foreign and his behaviour is unpredictable".

The second major advantage of using material culture to transmit messages is the ability of these items to bind groups together in times of economic and/or social stress allowing for and encouraging cooperation between related groups and the continued survival of

all parties (Gamble 1982). Conard (2008) has described these artefacts as the social and symbolic 'glue' that held together larger and more complex social groups.

A third advantage is that the emitter of the information (the person who made and/or owns the artefact) does not need to be present for the message to be transferred to the observer. Unlike vocal messages where the emitter and the receiver must be within 'earshot' and last only as long as the sound carries, messages held in artefacts have relative longevity, do not change rapidly, and can be made portable and therefore broadcast their message widely around the landscape and to people who are distant to the emitter (Wobst 1977).

Throughout the late Pleistocene messages held in artefacts were carried (transmitted) along pathways forged by alliance networks which mediated the circulation, control and exchange of information as well as goods and people (Bender 1978, 1985). From an information exchange standpoint then, the temporal and spatial patterns of symbolic material culture can be used to examine the volume and diversity of information flow within and between regions during prehistory. This approach is one which many researchers have followed to examine the development and growth of Pleistocene social networks as well as to attempt to identify when a group/s were under environmental and/or social stress (e.g. Bahn 1982; Barton *et al*. 1994; Conkey 1980; Gamble 1982; Jochim 1983; Vanhaeren and d'Errico 2006).

Hunting weaponry, in particular, is considered an excellent item for social signalling as not only do these artefacts have "widespread social, economic, political and symbolic import" (Wiessner 1983:272), and are highly visible to persons who are both intimately familiar with the individual carrying the implement as well as those encountered on the landscape during the course of subsistence activities (Tostevin 2007). Wiessner (1983) also points out that because projectile points are used in large game hunting, and because this type of hunting often requires the cooperation of several (or more) people, has highly variable returns, and can include meat sharing activities, such items are often used to solidify socio-economic ties.

Additionally, while carried by the *individual* around the landscape, an object's mode of production and morphology will be guided by its *community* of practice (Dobres and Hoffman 1994; Lave and Wenger 1991), and therefore, should conform to cultural ideals regarding manufacturing techniques, form and use, as was discussed above. Because communities generally inhabit and exploit a certain territory (of varying sizes depending on their residential mobility strategy, resource richness, etc.), the 'style' of weapon carried by an individual can become indicative of that region and the people who occupy it. Therefore, because of the production and use of these material culture within cultural constraints, and because of the tendency of weapons to be utilised in a certain way and in a certain (at least semi-) confined spatial area, hunting equipment is a prime item for the transmitting of messages. Furthermore, several researchers have argued that these artefacts can and have played a role in boundary maintenance (e.g. Tostevin 2007).

Indeed, these ideas concerning the use of projectile technology (and other material culture items) in social signalling have already been employed in the study of Magdalenian antler weaponry. In 1980, Margaret Conkey published the findings of her doctoral thesis which presented an examination of Cantabrian barbed points. She concluded that it was possible to propose the identification of Magdalenian aggregation and dispersion sites in this region through an evaluation of the diversity of motif designs engraved on the weaponry. As a greater diversity of motif designs were found to be present within the Altamira assemblage (in conjunction with other lines of evidence), Conkey argued that Altamira had been an aggregation site where regionally dispersed groups came together periodically to engage in economic and social exchange. In other words, point decoration diversity was high in this assemblage because implements belonging to usually dispersed groups of people who each had a unique system of decorating their weaponry, had come together at this one location and discarded the artefacts creating a varied collection.

From this brief discussion of several social aspects (communities of practice, 'style', and social signalling) which can influence not only how tools are designed but also how they are maintained and discarded and hence assemblage variability, it should be

apparent that they are no less worthy of consideration than the economic factors which have traditionally received the lion's share of attention and which will now be discussed.

Raw Material Availability, Residential Mobility Strategies and Scheduling

Three economic factors which have been shown to influence how tools are designed, produced, used, maintained and discarded are raw material availability, residential mobility strategies, and scheduling.

To begin, the mobility of a group has been shown ethnographically and archaeologically to affect the amount of effort expended in tool production, sedentary groups producing an expedient (informal) technology while mobile groups are more likely to develop a formalised technology (see for example Andrefsky 1983, 1991, 1994; Bamforth 1986, 1990; Torrence 1983, 1989). The reasons for these different approaches to tool design lie in the fact that more mobile peoples may not always have access to suitable materials for tool making. Such mobile groups must, therefore, carry with them a versatile technology which includes implements designed to perform multiple functions, tools which can then be rejuvenated or altered to allow for extended use lives, and blanks of quality material for making into new tools when required (Andrefsky 1994).

People who have a more sedentary lifeway, on the other hand, are thought not to have expended increased effort in the production of formal (carefully designed) tools, as access to suitable raw materials is more assured and weight restrictions for tools are no longer a significant factor for consideration (i.e. they are not required to be transported over long distances). Because the tools are made in response to immediate needs, they are usually much simpler in design (and can include expedient tools) than formal tools and are thought to have significantly shorter use lives than those tools of mobile people. Binford (1979:267) referred to these tools as 'situational gear'.

Furthermore, it should be noted that the designs of technology and their rate of curation (maintenance) is not a fixed behaviour, but can be influenced by changes in mobility

strategies which themselves may be caused by changes in environmental and/or social conditions (Rondeau 1996).

In a related argument, Kuhn (1989) has proposed that the frequency of evidence for maintenance and reuse does not provide a measure of the extent to which implements were maintained, but instead reflects the pattern of mobility and land use system employed by the producers of the technology. He termed people who replace implements *when exhausted* as 'foragers' while those who replace implements based on their *probability of failure* as 'collectors'. This 'replace-before-failure' strategy of the 'collectors' would result in individual implements displaying less evidence for repair being discarded. This situation is owing to the fact that they were replaced at a much earlier stage in their use life than those repaired and reused until exhaustion - as done by 'foragers'. Thus, it may be that examination of the quantity and intensity of rejuvenation evidence on tools may inform the researcher more about the mobility patterns practiced by those who produced these forms, rather than the availability of raw materials.

While antler is significantly lighter in weight than stone, and thus, the weight variable may not carry as much significance for the production and use of antler technologies as it does for stone, an individual can still only carry so many whole weapons, replacement components, and blanks. On this topic, Binford (1979:262-263) comments that the Nunamuit carried with them, "deer arrows with antler points, bird arrows with rather large blunt points, and bear arrows with stone points. Some extra shafts and points were generally carried".

What mobility strategy/ies Magdalenian groups utilised has been the subject of debate since Lartet and Christy's excavations during the mid-late 1800s. On the one hand, some researchers advocate short-to-long distance seasonal migrations based on the following of reindeer or horse herds (e.g. Bahn 1977; Clark 1948; Obermaier 1939; Sieveking 1976), while others support a more restricted existence (radiating or rotating between sites in a localised area - i.e. residential mobility) based around the seasonal exploitation of migrating herds (e.g. Bouchud 1966; Jochim *et al*. 1999 ; Lacorre 1951).

New data and analysis is required before researchers can make further headway in this area of research.

If we now focus solely on the availability of workable raw materials, we find that this variable has been particularly cited as a key factor in the size (reduction) of tools at time of discard. It is argued that tools may be discarded at a much earlier stage in their use life if the raw material for their manufacture is readily available, while tools are significantly more reduced if the opposite is the case (Rondeau 1996). For antler technologies, however, it might be suggested that the intensive time, energy and skill required to manufacture a new implement from scratch may have been a more important factor in point reduction intensity than raw material availability. As Towner and Warburton (1990:311) have stated, the "initial energy investment favors additional curation by resharpening and/or rejuvenation of dulled or broken points".

Unlike lithic technology, the season of collection and often manufacture can be determined from the antler raw material itself. Recent studies of manufacturing waste at several Magdalenian sites have suggested that there existed an annual cycle of raw material collection and tool manufacture tied to the types of antler available at certain times of year (Averbouh *et al*. 1999; Chauchat *et al*. 1999).

Averbouh (2005:64, *authors translation*) argues that "there exists two principal periods of raw material acquisition, each followed by a distinct manufacture phase of the collected material". She found that during winter, when adult male reindeer moult, Magdalenians would primarily collect the large shed antler in order to make projectile points (unbarbed points, barbed points, and HRRs as found at the site of La Vache). During spring, however, shed antler from female reindeer (which is smaller in size and does not have as dense a layer of compacta) was collected. This second type of antler was used to manufacture spearthrowers and *bâton percé* as demonstrated by the assemblage recovered from Enlène (Figure 1.2). In addition to these two main manufacturing phases, Averbouh also suggests an 'intermediate production period' between the end of winter and the beginning of spring when antler from young males and adult females constitutes the material available and which might provide raw

material for producing items which were required to be replaced before the appropriate raw material becomes available once again. Along similar lines, Julien (1982) discussed how antler originating from different types of animal (males, females, juveniles) may have dictated the type of projectile point manufactured: unilaterally barbed points from antler of smaller dimensions (female or juveniles), and bilaterally barbed points from the larger antler of adult males.

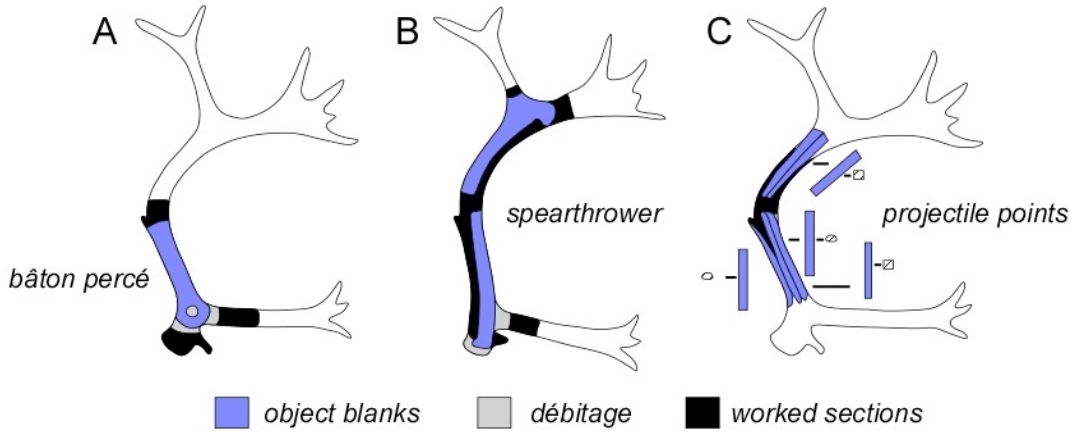


Figure 1.2: Exploitation of antler for the manufacture of projectile (B and C) and tool making (A) technologies. After Averbouh (2005: Figure 3:63 and Figure 4:65).

The most important implication of Averbouh's research for this study is the indication that projectile points (including those types examined herein) appear to have been manufactured only once a year (during winter). These data therefore suggest that a hunter's projectile weapon toolkit was expected to last (at least) a year - from production season to production season.

Ethnographic studies support the validity of an annual production cycle for antler technologies. For example, Torrence (1983) reports that "during the month or so after the autumn caribou migration, some Eskimo groups live off stored food in order to manufacture and repair tools and other equipment.." (see also Damas 1972). Similarly, Drucker (1940:232) reported that for the Tolowa of California, winter "was the time for manufacturing and repairing gear, holding dances and gambling", while Pomo people are reported to have collected "materials essential to the manufacture of tools and

weapons" in autumn (Kniffen 1940:379), as winter was the time when the maintenance of tools was undertaken in anticipation for a busy spring/summer/fall (Keeley 1982). Finally, observation of ethnographic antler technologies also support the annual production hypothesis, as for example, the use life for Ingalik (reindeer hunting arctic people) food extractive technologies was shown to have a mean use life of 1.4±0.3 years (Bousman 2005; Osgood 1940). A bone knife in this same cultural context was similarly reported to have a use life on only one or two years, and furthermore, that these items were seasonally manufactured though ubiquitous in use (Osgood 1940).

The scheduling of tool production and maintenance activities was shown in these, and other ethnographic contexts, to not detract from the small amount of 'pursuit time' available to hunters (Binford 1977; Schoener 1971). Furthermore, "in situations where amounts of time are restricted, there is no room for repair of tools until after the caribou has been safely secured. The result is that large amounts of time and energy are invested in the production and maintenance of hunting equipment, long before their use is required, to ensure that the tools will survive without breakage until the task is complete" (Torrence 1983:12). Binford (1977) termed this process of the scheduled production of weaponry in advance of their use as 'gearing up'.

If Magdalenian tools were indeed replaced only once a year (in general), then we might hypothesise that individual implements may have been carefully repaired until late in the annual cycle when replacement materials would have become available. As replacement time approached, however, a greater range of behaviour might be expected to have occurred depending on situational circumstances and the availability of replacement weapon tips. For example, implements may have been more hastily rejuvenated owing to the fact that they were no longer required to last significant lengths of time. Implements may have been reduced further then was usually practiced or may have been discarded prior to absolute exhaustion ('maximum utility') if replacement weapon tips were still available. Furthermore, it is possible that all of these behaviours were practiced at a single site if access to newly made weaponry was not equally available to all individuals using the technology.

Thus, if Magdalenian osseous weaponry *were* replaced on a yearly cycle, then researchers have been given one of the tool use life variables often unknowable in archaeological contexts. Having a (semi-) fixed time frame in which all observed repair and retooling took place on an implement allows for the identification and comparison of reduction intensity at a much greater level of accuracy (as well as insight) than is usually available for technologies of such time depth.

Artefact Use Life Histories

A concept which is often equated with 'curation' is that of artefact use life. 'Use life' describes the length of service of tool classes in systemic context (Schiffer 1976; Shott 1989). It can be measured through a variety of methods, including the number of strokes or shots fired (e.g. Gallagher 1977; Hayden 1979; Weedman 2000), however, Shott (1989) argues that use life is probably best expressed as a function of time owing to the fact that this treatment ensures agreement between researchers and also because formation rates of archaeological assemblages are examined in this way.

Shott and Sillitoe (2005) have noted that archaeologists often equate use life with curation, "on the logic that things that last long times are highly curated and things that are used and wear out or break quickly are little curated" (2005:654). Theoretically, however, curation and use life are distinct concepts: use life simply being how long an implement lasts and curation being how extensively an implement is reduced to exhaustion before discard. Therefore, an implement can be both short lived and highly curated or long lived and little curated.

A major topic of debate surrounding artefact use lives revolves around the relationship between tool typology and use life (c.f. Bamforth 1991; Dibble 1987, 1988, 1995; Goodyear 1974; Holdaway *et al*. 1996; Rolland and Dibble 1990). At one extreme are those researchers who argue that the majority of tool variability is explicable in terms of morphological change a single implement undergoes during its use life owing to use, breakage and rejuvenation events (e.g. Flenniken and Raymond 1986; Flenniken and Wilke 1989; Hiscock and Attenbrow 2005; Hoffman 1985; Wilke and Flenniken 1991). It is argued that artefact morphology should not be considered as the expression of

mental templates imposed by the artisan, but the unplanned consequence of this sequence of modification events with the shape of a recovered tool not always disclosing the numerous modes of manufacture, maintenance and use that occurred during its use life before deposition. Hiscock and Attenbrow (2005) group these ideas together under the umbrella of 'continuum models'.

At the other end of the spectrum are those researchers who argue that typologies already allow for the range of morphological variation exhibited by a single tool form throughout its use life, and thus, we need make no further allowances for this phenomenon (e.g. Bettinger *et al*. 1991; Rondeau 1996; Thomas 1986). Implement forms are considered to be the result of design rules relevant for their intended use. Morphological types are distinct from each other with each type representing a functional category for which that morphology is efficient. These ideas can be referred to as 'segmented models' (Hiscock and Attenbrow 2005).

The quintessential historical debate on Palaeolithic tool variability focused on the debate between Bordes (1961, 1972, 1973; Bordes and de Sonneville-Bordes 1970) and Binford (1973; Binford and Binford 1966) concerning Mousterian assemblages, and involved assertions about the extent and manner in which implements could be interpreted in terms of their design for particular functions. This line of debate was continued by Dibble (1987, 1988, 1995) who focused on the changes a single Middle Palaeolithic side scraper could have undergone as a result of use and resharpening (Figure 1.3). He makes the important point that "artifacts found in the archaeological record reflect only the last point in what could have been a long and continuous history of reworking" (Dibble 1995:299-300), and while he cautions that not all variability in tool morphology is owing to maintenance, this effect must be seriously considered and taken into account when constructing tool typologies.

This debate over the relationship between tool form, function and reduction continues to be heatedly discussed in the literature, and, while it has been shown that the reduction of tool types during use life is not a universal behaviour, the use of continuum models has been shown to be a powerful explanation for implement variation in a great range of

spatial and temporal contexts (e.g. Andrefsky 1997, 2006; Buchanan 2006; Clarkson and Lamb 2005; Dibble 1995, 1997; Flenniken and Wilke 1989; Gordon 1993; Hiscock 1996; Hiscock and Attenbrow 2005; Holdaway *et al*. 1996; Kuhn 1990, 1992, 1995; McPherron 2000; Neeley and Barton 1994; Rolland and Dibble 1990; Shott and Sillitoe 2004; Shott and Weedman 2007; Weedman 2002), including ethnographic ones (e.g. Cooper 1954; Tindale 1965; Weedman 2000, 2002, 2006) and for antler technologies as reported by Binford for the Nunamiut (pers. comm. March 2011).

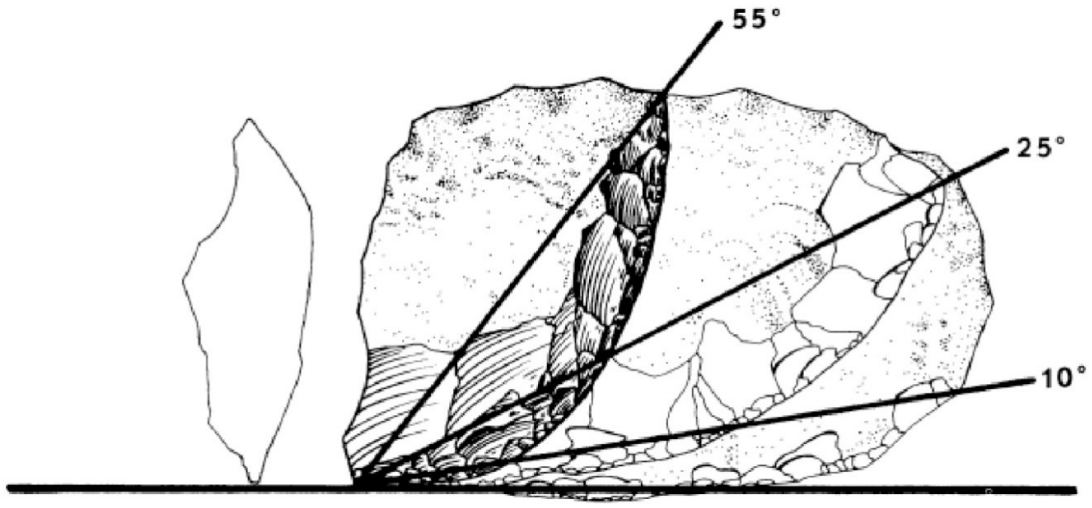


Figure 1.3: Graphical representation of how the working edge angle changes with successive reworking of the active edge on a Middle Palaeolithic side scraper (After Dibble 1987:114, Figure 3).

While these ideas regarding artefact use life have been explored in the Magdalenian context for spearthrowers (Averbouh and Cattelain 2002) and knapping hammers (Averbouh *et al*. 1999), the various types of osseous projectile points produced during this period remain to be considered. Furthermore, it is not the active part of the tool - the working edge - which has been the focus of osseous weapon studies, but rather the base as these parts are considered more important as *fossil directors*. Thus, the use of the above described theories and models are yet to be widely applied to the technology examined herein.

The Impact of Recycling on Assemblage Composition

Another aspect which plays an important role in the efficiency of technological systems is recycling (Bamforth 1986; Nash 1996; Rondeau 1996).

Recycling involves successive stages of modification and/or use of a single artefact sometimes in a variety of functionally different roles. Although the archaeological consequences of resharpening and recycling may be difficult to distinguish from each other, they constitute distinctive behaviours which may be explained by entirely different factors. For example, while resharpening is a maintenance behaviour aimed at extending the use life of an artefact, and can therefore be considered as a economising behaviour, recycling is defined by a phase of discard or sequential break between different use events. It is not the extension of the use life of the artefact, but the beginning of a new use life (so to speak).

Both archaeological and ethnographic studies have tended to explain recycling as a response to raw material scarcity, particularly in lithic studies (e.g. Amick 2007; Dibble and Rolland 1992; Galup 2007; Hiscock 2009; Kelly 1988). As raw material availability can vary over time in response to various environmental and/or social factors, as was discussed above, the intensity of recycling can be expected to change accordingly.

In this sense, recycling would be expected to occur in curated technologies and has even been considered as one of the main aspects of curation (Bamforth 1986). Alternatively, it can also appear in expedient technologies as a way to quickly meet immediate needs when a specific and required tool is missing. Therefore, in my view, recycling should not be associated solely with curated technological systems.

In spite of its potential significance in assemblage formation and artefact morphology, recycling behaviour can be difficult to identify from archaeological data. As some researchers point out (Amick 2007; Galup 2007), recycling was probably more common in prehistoric times than archaeological evidence suggests. Due to these empirical problems, it has even been suggested that recycling is not a useful concept in archaeological interpretation (Odell 1996).

Evidence for the recycling of implements during the Magdalenian is abundant in osseous tool assemblages (as we shall see in Section II) and recent research undertaken on Spanish Magdalenian sites has begun to provide evidence of the recycling of lithics technologies. Through examination of burnt artefacts recovered from Molí del Salt (Spain), Vaquero *et al*. (2012b) were able to identify lithic tools which had been scavenged and recycled after a period of abandonment in which the tools were unintentionally exposed to fire (hearths) and later reworked and reused. The authors argue that the evidence from this site suggests that the gathering of previously discarded blanks was possibly a common provisioning strategy during the Upper Palaeolithic, and that the value of sites may have been partially owing to the quantity of discarded raw materials (blanks, tools, other refuse, etc.) contained at the site which may provide material for the making of new tools (also see Conard and Adler 1997; El Camilli and Ebert 1992; Hiscock 2009; Vaquero *et al*. 2012a).

Introduction of Projectile Points into the Archaeological Record

Artefacts were discarded in prehistory owing to a variety of processes and reasons. In the analysis and discussion of projectile technologies, most researchers argue that the assemblages that we have to study are the product of intentional discard resulting from manufacturing and/or maintenance activities (e.g. Jelinek 1976; Shott 1989). For example, Shott (1989) provides an outline of what he considers to be the major discard processes for projectile points:

(1) breakage in production,
(2) abandonment during or just after production,
(3) loss or breakage in use,
(4) recycling,
(5) abandonment in use, and
(6) depletion.

Obviously, the type and use of an artefact will influence how and why it was discarded, and it may be that processes not commonly considered by projectile point analysts were the cause of a specific artefact's discard (i.e. ritual abandonment). Having said this,

ornaments attached to clothing are more likely to be unintentionally lost than larger tools, while carefully designed and highly maintained items (such as spearthrowers) are more likely to be discarded during or just after production if a quality specimen has failed to be manufactured (Shott 1989). Expedient tools will be discarded straight after and at the site of their use, while projectile technologies may be discarded or lost out on the landscape where hunting has taken place (as will be described in more detail below).

Site occupation intensity and site function will influence the quantity of cultural debris deposited. Binford (1979) provided ethnographic examples for these phenomena by describing the care and discard 'personal gear' received in the Alaskan Nunamuit context. 'Personal gear' - items that were essential to the survival and comfort of the individual were reported to have been carefully inspected and repaired prior to heading out into the field. Consequently, these items were generally discarded "inside a residential camp, not in the field where the activity in which the item was used occurred" (Binford 1979:263). He also observed that projectile points and other items which are frequently used out on the landscape (as opposed to in a camp), on the other hand, may have been discarded in a number of locations under various circumstances. It is because of ethnographic observations such as these, that the type of site and its relationship to surrounding sites must be considered when interpreting the assemblages recovered.

As projectile points are the artefact class being examined in this thesis, the next section will discuss how these items may be introduced to the archaeological record and thus come to be preserved and recorded in assemblages. Projectile points are a class of artefact which (potentially) were manufactured at one location, used on another (the hunting ground), rejuvenated at a third and finally discarded at yet another location (after who knows how many use and rejuvenation episodes at various additional sites in between).

Thanks to ethnographic and experimental studies, models for the introduction of projectile points to archaeological sites have been developed previously (e.g. Chadelle *et al*. 1991; Keeley 1982; Pétillon 2006) (Figure 1.4). While an undamaged projectile

weapon will be returned to a site intact by its owner (unless lost in the field), fragmentary pieces of a point broken in use may enter the archaeological record through several processes, including:

(1) the whole point or point fragments may be recovered from inside a carcass processed in the field and transported back to the site,

(2) mesial-proximal and/or proximal fragments may be returned to the site still bound to the shaft, as the shaft will be retrieved by the hunter,

(3) fragments scattered on the ground may be collected by the hunter in the field and returned on their person, and

(4) whole points or point fragments (distal, distal-mesial) may be returned to the site having been embedded in the carcass and then retrieved once the carcass is butchered at the base camp.

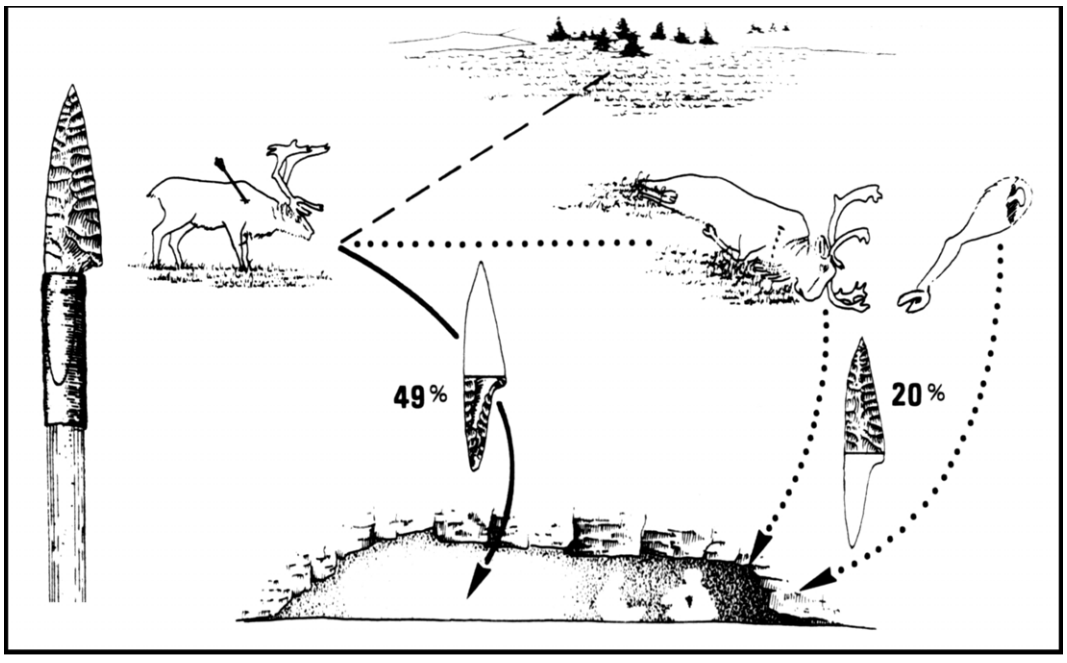


Figure 1.4: Frequency of point segments introduced to a site through haft and carcass – after Chadelle *et al.*'s (1991:Figure 3) experimental work with Solutrean points for the site of Combe Saunière, France.

Ethnographic and archaeological studies have shown that "the rejuvenation of projectile points (and other tools) can be anticipated at locations where lithic material strategies occur whether for scheduling, logistical, or geological reasons" (Towner and Warburton

1990:319). Sites such as base camps where the repair of 'personal gear' is conducted should, therefore, provide the most evidence for maintenance activities. In regards to the repair of specific tool types, Keeley (1987:89) has pointed out that while "hand-held implements tended to be disposed of at or near the location they were last used... hafted tools are disposed of where hafts are being 'retooled'..which is often *not* the location of the implement last use" (also see Keeley 1982). Along similar lines, Allain and Rigaud (1986) point out that as mastics are highly likely to have been used to haft Magdalenian points, the process of retooling would require the heating of the binding to remove the point and this activity would most often be undertaken at camp sites.

Keeley (1987) goes on to say that, "hafted tools are not necessarily 'retooled' when or where they are worn out but may be retooled when it is convenient to do so because time or plentiful lithic raw material are available". Thus, there may be sites at which retooling activities were an important activity, and at which once hafted tools were discarded regularly and consequently have more evidence of the activity occurring. He cautions that the archaeologist must identify which tools were used at the site and which were only being retooled at the site in order to build an understanding of the site functions and technology. Where projectile weapons are concerned we can (generally) conclude that they weren't used at an enclosed (rockshelter/cave) site and thus be reasonably confident that any points recovered from these sites were deposited either during their manufacture, retooling, rejuvenation or in final discard of a broken or exhausted implement.

Conversely, those points found 'in the field' may include points broken in use, points being resharpened for reuse, points lost, or points discarded as exhausted or no longer needed. Several ethnographies have reported that hunters always "gathered up their arrows, devoting much time to searching for them and trying never to lose one. They are too hard to get and cost too much effort to be wasted" (Grinnell 1923:178 on North American hunters; see Lee [1979] and Wiessner [1983] for !Kung San examples). These insights suggest that the majority of broken (as well as intact) projectile weaponry may have been returned to base camps (whether in enclosed or open contexts) in prehistory,

and thus, those assemblages recovered should provide a significant proportion of projectile points intentionally discarded in prehistory.

Previous Research into Osseous Point Maintenance and Use Life

While osseous projectile points recovered from European and North American prehistoric sites have undergone intensive analysis, the vast majority of these studies have focused on exploring the diversity of manufacturing techniques and implement designs, rather than the examination of maintenance and discard patterns. As put by Straus (1992:135), "much of this work has focused, in a rather 'art historical' way, on analysis of the form and decoration of antler artifacts, notably sagaies and harpoons", rather than the utility of these technologies. This situation is in direct contrast with studies undertaken on lithic technologies, experiments on which have explicitly expressed that the focus of the research was to examine "morphological change within a single projectile point as a result of hafting, use, breakage, and rejuvenation during simulated uselife" (Flenniken and Raymond 1986:604).

Previous Analysis of Archaeological Materials

The following sections summarise the contributions made by four main studies which have addressed reduction or recycling of osseous points in some way, as well as outlining previous additional work which has lightly touched on these issues.

Julien (1977, 1982, 1999; Julien and Orliac 2003)

The extensive work of Michèle Julien on Magdalenian barbed points published in her 1982 book, *Les Harpons Magdaléniens*, has been the most comprehensive consideration of these projectile point classes up until present day. Despite this fact, however, detailed description of the methods used to rejuvenate the studied points, the frequency of this evidence in assemblages and the potential impact these processes may have had on the formation of collections was not given the attention it deserves. Instead, Julien largely restricts herself to generalised comments, such as: "when one observes the points which appear complete, one realises how little of the characteristics of initial manufacture must be preserved" (1982:134, *author's translation*).

Julien (1982:134, *authors translation*), while careful to make the point that "calculations carried out on the overall lengths of the harpoons and the proportions of components compared to others, only reveal their state of abandonment rather than the initial design of the implement", only tangentially uses this observation in her interpretations of the collected metric data. For example, in interpreting histograms of total implement length for both uni- and bilaterally barbed points, she suggests a number of possible explanations for the (largely) unimodal distribution pattern - only one of which refers to reduction owing to rejuvenation and reuse. To her credit, however, she also undertook a separate analysis which employed four metric variables to distinguish between "*à extrémité primaire*", those points preserving their initial dimensions and "*à extrémité secondaire*", those points whose dimensions are reduced through utilisation and repair. Further exploration of the effects of rejuvenation and reduction on assemblage variability were not undertaken, though she did discuss the evidence for the reuse of bilaterally barbed points as unilaterally barbed implements.

Returning to the examination of barbed weaponry twenty years later, Julien similarly treated point rejuvenation with minimal attention when analysing the La Vache assemblage (Julien and Orliac 2003). In this study, though, the frequency of rejuvenation stigmata was calculated (22.3%; n = 55/246) and it was noted that evidence for repair was often observed on more than one section (distal, mesial, barbs, proximal) on a single implement.

Pétillon (2002, 2005, 2006)

As part of his analysis of Magdalenian fork-based points recovered from Isturitz, Jean-Marc Pétillon undertook projectile experiments at the Musée du Malgré-Tout (Treignes, Viroinval, Belgium) in January of 2003. The results of these experiments, in which 96 antler forked-based and double bevel based points were replicated, hafted and shot using a bow and spearthrower into ox calf and deer carcass targets, produced data on the performance of these points as weapons, along with impact traces on the bones of the targets and use wear (impact fractures/wear and retrieval cut marks) on the points (Letourneux and Pétillon 2008; Pétillon and Letourneux 2003).

While these experiments did not focus on the reduction and use life of the antler points under analysis, Pétillon's (2002, 2005, 2006) study of the material from Isturitz did specifically address the identification of resharpened, reworked, retooled and recycled implements. Along with describing the range of use wear visible on the archaeological specimens, Pétillon describes possible processes through which these points may have been returned to the site from the hunting field and then rejuvenated into new points or usable tools. Furthermore, in (2002) Pétillon concluded that the identified metric variation in the distal-mesial section in fork-based points from Isturitz, Gourdan and Lorthet was primarily owing to reduction in point length from rejuvenation.

Pétillon's work on fork-based points is currently the most advanced study of osseous projectile point reduction and use life thus far assembled.

Pokines (1993, 1998)

In his 1993 Masters thesis and 1998 *Journal of Archaeological Science* article, James Pokines reported the results of experiments with replicated Cantabrian Lower Magdalenian antler projectile points. His primary focus in these experiments was to better understand the utility of antler as a raw material as well as the durability and potential use life of projectile points when used to hunt large terrestrial mammals.

In the published experiments, 20 projectile points were replicated out of North American elk antler, hafted and hand-thrown at a dead animal target (a dressed goat [*Capra hircus*] carcass minus the head and feet) "until significant damage had accrued" (Pokines 1998:877). Pokines (1998) reports that each point lasted an average of 9.9 strikes into the target or surrounding soil before breakage, and, that in only two cases was the damage induced more substantial than the breakage of a small fraction off the tip of the point. He notes that the majority of points could have been easily resharpened and reused and that the two which broke more substantially (at the haft) could also have been refashioned into smaller points. At no point in his experiment were any of the replicated points rejuvenated and reused, however.

Hence, the results of this experiment provided data on the 'potential' use life of antler projectile points until resharpening or retooling is required, but did not collect data on the how maintenance occurred or prolonged the use life of the points. That is, it did not assess the projectile points 'absolute' use life (or 'maximum utility') which would have been calculated from their use and reuse until absolute exhaustion.

Knecht (1991a, 1991b, 1993a, 1993b, 1997a)

Heidi Knecht (1991a, 1991b, 1993a, 1993b, 1997a) conducted a series of experiments on the manufacture, hafting and use of Early Upper Palaeolithic antler and bone projectile points. While the focus of her research was to elucidate the processes of technological innovation and change in Early Upper Palaeolithic organic technologies, Knecht's work also provided insight into the processes involved in the selection of raw materials, manufacture and successful hafting of a series of Aurignacian and Gravettian organic projectile points (split based points, simple based points, single and lateral beveled points, mammoth rib points).

Throughout the course of her experiments, 113 split based, simple based and single bevel based projectile points were replicated, hafted and shot into a goat carcass using a calibrated crossbow (to standardise the force with which each point was fired). The results of these experiments provided data on the ways in which the raw material used influences projectile point design, manufacture, performance, durability and maintainability.

In her 1997a paper, Knecht states that 'some' of the experimentally made points were "photographed, resharpened, and put back into use to assess morphological patterns related to use and rejuvenation" (Knecht 1997a:196), and that "the net result of resharpening bone and antler points is simply a decrease in length and, for points with bulging midsections, a change in the relative proportions of proximal and distal aspects". She also made the important observation that "reworked bases of bone and antler points are morphologically identical to the original" (Knecht 1997a:205). She continues:

> "due to the location and limited extent of the damage, in most cases it is a simple matter to resharpen the broken tip of an antler point, without even removing it from its haft. Due to the longitudinal morphology of breaks on bone points, resharpening usually involves removal of material from along a greater length of the point than on antler points. In addition, a greater proportion of the length of the piece is lost with each successive break, due to both location and morphology of the damage. Bone points likely will be reduced to a point of inutility in fewer resharpening episodes than will antler points of the same original length".

Knecht concludes that due to the location and nature of breakage, the possibility of repair is more likely for organic points than lithic points, and, that organic materials therefore seem better suited for projectile point production over lithic ones in terms of use life.

Comments regarding archaeological specimens are found in her (1991a) PhD thesis, in which she comments that a number of split based, lozenge-shaped and spindle-shaped points were observed during her examination of French, Belgian and German archaeological material to have shown evidence of resharpening, reworking or retooling. These qualitative statements are the extent of her examination of the reduction and use life of archaeological antler projectile points.

Additional Studies which have Touched on Maintenance and Use Life

Perhaps the earliest study to address use life in osseous projectile points is Tyzzer (1936). Tyzzer replicated a number of Northeastern American Algonkian 'simple bone points' out of cattle long bone and shot these using a 45 pound ironwood bow into the 'rocky loam of a slope at a distance of forty yards' (Tyzzer 1936:267). From his experiments he found that these replicated points generally did not accrue damage when repeatedly fired into the bank, and only commonly broke when striking rock. He reported that one point survived 25 shots into the bank without any significant damage, then another 14 shots before fracturing. Furthermore, and of particular interest to this study, he reported that:

> "As the arrows were shot in rotation without resharpening the points after they became damaged, it was soon seen that even minor imperfections, such as a slight chipping at the tip, greatly increased the incidence of fracture. Thus for example, a point which had withstood ten shots before becoming slightly chipped, would thereafter show a rapid succession of fractures in subsequent shots. Moreover the unsharpened point was from the first fractured at almost every shot. That points with perfect tips should withstand impacts that cause fracture in those with chipped or previously fractured ones showed at once the advantage of keeping the tips sharp and smooth." (1936:267).

And that in the studied archaeological sample:

> "… many of the shorter specimens of this type doubtless represent points that have been shortened by repeated resharpening. The evidence appears conclusive that the bone points were continued in use after being broken, some being resharpened, others merely having the rough edges smoothed off, many being reduced by successive fractures to mere stubs consisting of little more than the unpolished tapering posterior portion" (1936: 264)

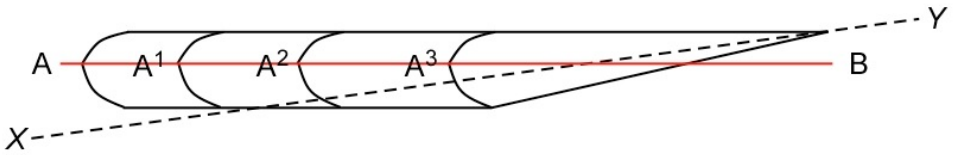


Figure 1.5: Tyzzer's (1936:265) diagram explaining the changing morphology of Algonkian bone points as they are reduced through the resharpening of the tip.

He outlines this process through the use of a diagram (Figure 1.5) and explains that if a bone point is modified by successive resharpening (A^1, A^2, A^3), and its longitudinal axis is represented as the AB axis, while the XY axis is that of the final shortened point, the latter would appear to be sharpened off centre, but if its original form is taken into

account, it will then be seen that it is sharpened on the longitudinal axis of the original, longer point.

The next researcher who has touched on issues of maintenance in osseous points is Liolios (2006) who considered the importance of considering reduction when examining assemblage variability in Aurignacian split based point assemblages. She states that "the successive resharpening and reshaping episodes underwent by these points explain the marked heterogeneity of the corpuses, further compounded by the 'noise' introduced from the beginning by the initial morphology of the reindeer antler, exploited by Aurignacian groups in very flexible ways" (2006:39). The author does not, however, investigate this issue any further.

In the style of Julien's work described above, Christensen and Chollet (2005) presented a study of the osseous technological assemblage from Grotte du Bois-Ragot. In this paper they reported and briefly described implements found to have been rejuvenated though these data were not worked into their interpretations of the collection.

Dobres' (1995) study, on the other hand, took a wider, inter-site perspective. As part of her study of the osseous material from several Magdalenian sites (including needles, awls, polishers, *baguettes*, barbed and unbarbed points), she studied between 15 – 20% of the harpoon assemblage from La Vache. Within this sub-sample, Dobres reported that about 40% of the projectile points exhibited evidence for repair which she notes, in both absolute numbers and proportionally, is significantly more artefact repair than seen at any other site in the region. Furthermore, Dobres found that different artefacts were repaired at different sites: barbed points at La Vache and Montfort, unbarbed points at Bédeilhac, Les Eglises, Montfort, Massat and La Vache. This study therefore demonstrates the potential that comparative analyses of projectile point maintenance within and between sites provides for producing a contextualised understanding of osseous weapons technology during the Magdalenian.

The next study was undertaken by Arndt and Newcomer (1986) who completed experiments with replicated Magdalenian double bevel based points and Mesolithic

bipoints made from antler, bone and ivory. These replicated points were fired using a 49 pound composite bow into a fresh ewe carcass and simulated carcass (lamb shoulder backed up by three scapulae and a pelvis of a *Bos taurus)*, until breakage occurred. While their main aim was to damage the points through hitting bone, and not calculating potential use life of the points in particular, they did make several observations about the possibility of rejuvenation for both the experimental points and an archaeological sample of Magdalenian points from Bruniquel (Tarn-et-Garonne).

In particular, Arndt and Newcomer observed that "breaks at the tip [of a point] are very easy to repair by simply scraping a new point, a matter of a few minutes at most" (1986:167) and that some of the Late Magdalenian double bevel based points from Bruniquel have been 're-pointed' in this manner, resulting in a stouter, squatter silhouette than that of unrepaired points. They also cite Julien's (1982) work on barbed points, which they report were commonly 're-pointed', the characteristic sign being a spatulate form tip just above the final barb, though they note that these points take a greater investment of labour to achieve. In conclusion, they suggest that severely damaged points may be under-represented in archaeological assemblages owing to several factors, one of which being that they may have been repaired or recycled into other tools.

Finally, there has been the odd comment made by researchers on the maintenance of osseous projectile points but which were not followed up by any serious consideration. For example, Hahn (1988) briefly mentioned stigmata indicating the resharpening of some Aurignacian split-based points, while Weniger (2000:82) stated in his examination of Magdalenian barbed points that "original forms are very rare. Even points that seem to be quite well preserved have been reworked because of former damage and do not display a primary form. The Magdalenian barbed points were well prized and once damaged one tried to repair the object or at least to transform it into another secondary form that could be useful". Thus it seems that while it is widely recognised in the literature that osseous weapon tips were rejuvenated - often extensively - detailed comparative analyses of these artefacts, assemblages and technologies are currently lacking.

Experimental Archaeology and Investigating Osseous Weaponry

Experimental archaeology is a sub-field of archaeological research which approaches archaeological questions through the undertaking of controlled imitative experiments in order to replicate past phenomena. Through these experiments, hypotheses are able to be generated and tested in order to provide or enhance analogies for archaeological interpretation (Mathieu 2002).

Projectile technology has a long history in experimental archaeology dating back to the 1920's with the work of Saxton Pope (1923). Despite organic technologies playing "as great, or greater, roles in prehistory than stone" (Guthrie 1983:277 citing Leroi-Gourhan 1967), lithic technologies have had a central place in projectile point experiments. This is not to say that researchers have not undertaken various experiments focused on osseous projectile points.

There are four main aspects of osseous weaponry which have been examined using experimental archaeological techniques; (1) the manufacture of points; (2) the hafting of points; (3) the use effectiveness and durability of points; and (4) the use wear associated with both the manufacture and use of points. In all cases, the main focus of the experiment was to test the functional qualities of, either particular aspects of the point (hafting, depth of penetration, impact resistance, impact traces), or the whole weapon tip. The experimental work undertaken into each of these aspects will be outlined below.

Manufacturing Osseous Points

Researchers have commonly carried out experiments to replicate the osseous projectile points that are the focus of their regional research in order to better understand the processes undertaken to produce these implements.

Perhaps the earliest such study to be reported in the literature is Tyzzer's (1936) experiment discussed above, in which he replicated a number of Northeastern American Algonkian 'simple bone points' out of cattle long bone in order to better understand their form and use. The next experiment which addressed point manufacture was not

reported until almost 20 years later. Briefly mentioned in Clark and Thompson's (1953) classic paper, 'The groove and splinter technique of working antler in Upper Palaeolithic and Mesolithic Europe', it is briefly mentioned that M. W. Thompson undertook experiments into the preparation of antler and the removal of splinters from this raw material in order to produce blanks for point manufacture.

The experimental replication of osseous points to better understand their archaeological counterparts became an increasingly common method of archaeological inquiry from the mid-to-late 1970s onwards. Osseous points have now been replicated from a wide variety of different archaeological contexts and include: Upper Palaeolithic implements recovered from Ksar Akil, Lebanon (Bergman 1987; Newcomer 1974); Aurignacian and Gravettian split based points, simple based points and single bevel based points (Carrère and Lepetz 1988; Knecht 1991a, 1991b, 1993a, 1993b, 1997a; Newcomer 1977; Nuzhnyi 1998); Magdalenian forked-based, simple based, single and double beveled, whittled based, self-barbed points, bi-points and composite points (Allain and Rigaud 1986; Arndt and Newcomer 1986; Bertrand 1999; Newcomer 1977; Nyzhnyi 2007; Pétillon 2005, 2006; Pétillon *et al*. 2011; Pokines 1993, 1998; Pokines and Krupa 1997; Rozoy 1992; Stodiek 1991, 1993, 2000); Magdalenian and Azilian barbed points (Dauvois 1974; Newcomer 1977); Mesolithic bipoints from Syria (Arndt and Newcomer 1986); British Mesolithic barbed points (Elliott and Milner 2010); Northeastern American Algonkian points (Tyzzer 1936); Clovis 'beveled rods' (Boldurian 2007; Redmond and Tankersley 2005); North American single bevel based points (Guthrie 1983); Folsom bone points (Frison and Zeimens 1980); and Late Holocene harpoons, bipoints and drilled points from Low Paraná wetland, Argentina (Buc 2011).

It is through these many and varied experiments that archaeologists have learned the intricacies of preparing the raw material, extracting the blanks from beam or long bone, working that blank down to a preform and finally producing a finished point. The details of these processes will be outlined in detail in Chapter 2 'Antler Projectile Points'.

Hafting Osseous Points

Historically, Palaeolithic osseous point typology has been based on a combination of the overall form of the point and the base (hafting) morphology. While hafting of both lithic and osseous points in prehistory has been a focus of many studies of archaeological material (e.g. Stordeur 1987), only three researchers have used experimental archaeology as a tool for investigating possible ways in which osseous projectile points were hafted and assessed the performance of these hafting methods (Knecht 1991a, 1991b, 1993a, 1993b, 1997a; Nuzhnyi 1998; Tyzzer 1936).

In her 1991a thesis and in a 1993a paper, Knecht outlines how she examined an archaeological sample of Aurignacian split-based points and associated debitage ('tongued pieces'), and having made these observations, proceeded to attempt to reproduce the production and hafting of split-based points with the use of 'tongued pieces' - a wedging mechanism used in the hafting of these points. She concluded that through the observation of archaeological material (including the identification of use wear on the interior of the wings of the points) and experiments in manufacture, hafting and use of these weapon tips, that the use of 'tongued pieces' as part of a wedging mechanism for hafting this particular technology was an effective and likely explanation for the appearance of 'tongued pieces' in archaeological assemblages.

Tyzzer's (1936) experiment deserves another mention here, as when compared with the study of the relevant archaeological material, he noted that the need for a simple, firm and effective attachment to the shaft, which only needs to be bevelled to correspond with the matching surface of the point and then lashed together. He concludes that this hafting method would provide a projectile that could be "more readily withdrawn than one fitted with a point not conforming to the configuration of the shaft" (1936:272). He further states that the 'bent points' could be similarly hafted "but by leaving the posterior end projecting, an effective barb would be afforded, while the penetrating point would at the same time be brought into alignment" (1936:272). In other words, form what is commonly termed a 'self-barbed point' in the European literature.

On the whole, the hafting mechanism of a point has been shown experimentally to be a critical factor in the overall performance of a projectile (Knecht 1997a; Stodiek 2000). Arndt and Newcomer's (1986) experiments indicated that the type and stability of hafting is important where breakage of the point is concerned, while others have noted that a streamlined projectile (one without a 'hilt effect') is important for penetration depth and durability (Frison and Zeimans 1980; Guthrie 1983; Knecht 1991a, 1997a). The type of hafting used (ligature, adhesive, ligature and adhesive) in experiments has also been found to be an important factor in the performance and durability of the point (Arndt and Newcomer 1986; Bergman 1987; Knecht 1991a, 1993a, 1993b, 1997a; Stodiek 2000).

Use Effectiveness and Durability of Osseous Points

Projectile point use efficiency will be determined by several factors including morphology, haft design, relative proportions of projectile point and shaft, projectile mass, velocity and kinetic energy with which the projectile makes contact with the target (Knecht 1997b). It was a long-held view that stone projectile points were vastly superior to their osseous counterparts, and it was this hypothesis which drove a number of researchers to design and run experiments to test the effectiveness and durability of osseous points (Frison and Zeimens 1980; Guthrie 1983; Knecht 1997a; Letourneux and Pétillon 2008; Pétillon 2005, 2006; Pokines 1993, 1998; Pokines and Krupa 1997; Redmond and Tankersley 2005; Rozoy 1992; Stodiek 1991, 1993, 2000). The results of these experiments will be explored in more depth in the following chapter (Chapter 2, 'Antler Projectile Points'); however, in general, these studies found that while stone appears to be the better choice for weapon production in terms of ease of manufacture (time) and of death of the target animal by haemorrhage, osseous points were found to be better in terms of the qualitative features of durability and maintenance.

Pétillon *et al*. (2011) went one step further by running a series of experiments with Lower and Upper Magdalenian composite antler/lithic points (those with an antler core and microlith bladelets on one or more sides). It was concluded that while their experiments needed a number of improvements, the partnership between the antler core and the microlith blades resulted in an extremely efficient killing agent.

Identifying Use Wear and Manufacturing Stigmata

The examination of the cause and extent of damage to antler points allows for a better understanding of the raw materials' physical qualities in terms of performance, durability and maintenance properties, as well as the effects taphonomic factors can have on this medium. Despite the fact that use wear analysis was first used by Semenov in 1964, it is only within the last two decades or so that its application to osseous technology has become commonplace (e.g. Christidou 2008; Gates St. Pierre and Walker 2007; LeMoine 1985, 1991; Maigrot 2008; Olsen 1989). There are three kinds of use wear and stigmata on antler that have been identified and studied by previous researchers: (1) natural use traces, (2) manufacturing stigmata, and (3) use wear accumulated through the use of an artefact over various lengths of time.

Olsen (1989) found that deer (11 species studied) inflicted various kinds of wear (polish, marring, terminal fractures) on their antlers during the annual life cycle prior to shedding. She found that patterns emerge as to the location of these features, and that archaeologists need to be aware of these natural use traces when attempting to identify artefacts (also see Buc 2011). Jin and Shipman (2010) similarly identified that on white-tailed deer antler, scratches, polish, deformation and tip fractures were the most frequently identified natural modifications. These latter authors also cautioned that natural wear needs to be distinguished from human induced wear when identifying artefacts.

Stigmata left on finished artefacts from their manufacture has also been an area of interest. Newcomer (1974) replicated bone points and awls from the Upper Palaeolithic layers of Ksar Akil, Lebanon in order to examine stigmata (chattermarks, striations, etc.) created by flaked stone tools and a sandstone grindstone during the manufacture. His replicated points were made from cattle and sheep long bones (raw and cooked), Red deer antler (soaked and dry), elephant ivory and hippopotamus tooth. He describes both the appearance of the stigmata as well as the processes which produced them during the manufacture of the replica artefacts.

Researchers have also frequently mentioned that various marks from the cutting and grinding of the implements during their manufacture as still being visible on clearly used artefacts in archaeological assemblages. For example, evidence for the groove and splinter technique (mentioned above) has be found on implements that were not ground down completely during manufacture or subsequent reworking, with similar cut marks found on points whose blanks were removed from an antler beam or long bone using an alternative method (Averbouh 2005; Clark and Thompson 1953).

These manufacturing stigmata and use wear will be described and defined in detail in Chapter 4 'Methods and Methodology'.

Ethnographies: What Can They Tell Us?

While the comparison of modern hunter-gatherer cultures to Pleistocene peoples is problematic (Hiscock 2008), it has been argued that ethnographic studies provide the only glimpse of lithic and other technologies in an ongoing cultural context (Dibble 1995). As O'Connell (1995) puts it, archaeologists have only two sources of information from which to explore past human behaviour; (1) the artefacts and patterns within the archaeological record itself, and (2) knowledge of present day human behaviour and the consequences of these behaviours for the materials they use and discard. Focusing on only the former allows for little more than mere description of artefacts along with their spatial and temporal distribution of artefacts. Integrating the latter provides insights into the processes which led to the appearance of these patterns in the archaeological record, allowing the research to build stories around their data.

Probably the most extensive ethnography of osseous technologies is provided by Osgood's (1940) ethnographic account of Ingalik (Alaska) material culture in which he reports the material, construction, place and time of manufacture, manufacturer, method of use, place and time of use, use and length of life of a number of implements. A number of additional ethnographies touch on the use of antler and other osseous projectile points among ethnographically known cultures (e.g. Betts 2007; Binford 1979; Birket-Smith and De Laguna 1938; Cantwell 1889; Curtis 1911; Davidson 1934; De Laguna and McClellan 1981; Emmons 1911; Giddings 1952; Leechman 1954;

MacGregor 1985; McClellan 1981; McKennan 1965, 1981; Morice 1894; Murdoch 1892; Nelson 1899; Osgood 1936, 1937, 1971; Rausch 1951; Rogers and Smith 1981; Skinner 1911; Stefánsson 1914; Townsend 1981); however, all of these studies lack the detail necessary to evaluate the use life of these technologies and not one reports maintenance activities, though we know that these implements were resharpened on a number of occasions, at least in some cultures (the Nunamiut for example: L. Binford pers. comm. March 2011).

This situation is the result of most of the usable ethnographic data being recorded during the 19th and early 20th centuries, when ethnographic hunter-gatherer communities had already been significantly altered by contact with Europeans and other agricultural groups. Their osseous weaponry was quickly replaced with metal types and their hunting methods changed to suit the use of steel traps and shotguns. Additionally, ethnographers were more concerned with recording the details of manufacture and use of osseous projectile points and not with their maintenance and curation.

Ethnographic studies which address the rejuvenation and use life of lithic tools, however, do exist (e.g. Indigenous Australia: Cooper 1954; Gould *et al*. 1971; Hayden 1977, 1979; Tindale 1965; Papua New Guinea Highlands: Shott and Sillitoe 2004, 2005; and south-central Ethiopia: Gallagher 1977; Shott and Weedman 2007; Weedman 2000, 2002a, 2002b, 2002c). These latter studies show that lithic tools, at least, are extensively resharpened throughout their use life and that, because of this continuous process of rejuvenation, the morphology of a tool at the time of discard may be significantly different than when it was first used (see Gould 1980 for an example of wooden spears). Gallagher (1977:411), for example, reported that the Ethiopian scrapers used to work hide were "…used and resharpened until so little of the piece protrudes from the handle that the proper angle for scraping is not possible". From this and other studies, it was therefore found that "the diminution of the size through resharpening is an important consideration for eventual discard of a stone tool" (Dibble 1995:308). Logic allows us to expect this to be the case also for osseous tools.

It has also been observed that people generally preferred to continually resharpen their tools while still held in the haft to the point of exhaustion rather than manufacture a new tool; which is generally explained by an effort to recoup large manufacture and maintenance costs (Hayden 1987; Shott and Sillitoe 2004, 2005). Projectile points, particularly those manufactured from osseous materials, are particularly predisposed to rejuvenation while hafted - especially when damage is confined to the distal tip.

Other ethnographies have given examples of how spears are retooled. For example, Warner (1937) observed that hardwood one-piece spears made and used in Arnhem Land (Northern Territory, Australia) when broken were converted into a composite spear through the addition of a hafted projectile point. Thus, it has been shown that spears which were initially made entirely from wood may have been retooled with a stone or bone projectile point to continue the use life of the expensive wooden shaft - the latter material being considered particularly time-expensive during the European Palaeolithic. In fact, Pétillon and Cattelain (2004) have noted that the use of projectile foreshafts during the Magdalenian was primarily in order to allow the reuse of the wooden shaft and easy replacement of broken points (also see Cattelain 1993).

Ethnographic sources also provide suggestions for how osseous points may have been disposed off and/or entered the archaeological record (some of which were discussed above). For example, the life history of an implement can be an important aspect in its reuse and eventual discard as 'ritualised trash' (McNiven 2011). Specific examples of this kind of discard would be points which were used in warfare (Osgood 1940) or that have successfully killed game (Marshall 1996) and may have been thrown away or completely destroyed (often by fire).

Others were the object of exchange and gifts, which has resulted in a single village having a highly varied assemblage of arrows (Heath and Chiara 1977; Wiessner 1983). Hitchcock and Bleed (1997:350) asked the Kua (of Africa) why they did not manufacture their weaponry as the G/wi did (who they liked to trade weapons with as the G/wi weapons were considered better); they responded that they made them according to 'the way our ancestors made them'. Thus, these few examples provide

socially driven reasons for the appearance of projectile weaponry at different sites and at different stages in their use life.

Summary

In summary, while it seems to be widely recognised that osseous points must have been rejuvenated or recycled throughout prehistory, little quantitative research has been undertaken to thoroughly investigate this aspect of osseous technology. Instead, studies have been largely restricted to either identifying artefacts which exhibit evidence for resharpening, reworking, retooling or recycling, or making qualitative observations about the necessity or ease in which these points can be repaired for reuse during replicative experiments and their general change in overall morphology.

Ethnographic analogy has been shown to be useful in highlighting processes (manufacturing, rejuvenation, retooling, etc.) that need to be considered when analysing archaeological assemblages, though caution must always be used in too tightly articulating these research components.

The following two chapters (Chapter 2 ‘Antler Projectile Points’ and Chapter 3 ‘Magdalenian Osseous Projectile Points’) will provide more specific details regarding the unique properties and characteristics of the antler projectile weaponry examined in this thesis.

Introduction

While archaeologists have traditionally grouped projectile points manufactured from antler, bone, and ivory together under the broad term of 'organic' or 'osseous' projectile technology, studies have shown that these materials were clearly viewed by Palaeolithic manufacturers as materials to be worked and used differently (Knecht 1997b). Around 98% of the implements examined in this study were manufactured from reindeer (*Rangifer tarandus*) antler, the remaining 2% being made up of deer bone, sea mammal bone and ivory. As such, this chapter presents an explanation of the physical properties of antler as a raw material and outlines how Magdalenian antler points were manufactured, hafted and used. To allay all doubts regarding their function, a brief summary of evidence for their use as hunting weaponry concludes the chapter.

Antler: Physical Aspects of the Raw Material

While there has been a tendency in the past to regard antler and other osseous materials as poor substitutes for stone, the physical properties of these materials actually make them supremely suitable for use as projectile hunting technology.

Antlers are found on most members of the deer (Cervidae) family, and, with the exception of reindeer (*Rangifer tarandus*), are limited to stags only, the males using them in display and combat behaviours during the rutting season. Grown annually, antler develops from a small permanent protuberance located on the frontal bones, called pedicles, which usually develop in the first year of an animal's life. Antler forms in the following manner, as best explained by MacGregor (1985:11-12):

> "a form of endoclondral ossification takes place at the growing tips, while a certain amount of tissue is added intramembraneously to the surface of the antler. The rate of growth may be as much as 2cm per day, promoted by immense numbers of osteoblasts which quickly become engulfed in tissue to form bone cells. Blood is supplied internally to the growing antler by way of

the frontal bones and the pedicles, which are highly vascular at the beginning of the cycle, while the soft, hairy skin known as velvet which covers the antler during the growing period carries an external blood supply within its numerous vessels".

Once the antler has reached is full size, the velvet is shed and the distal end of the pedicles gradually erode the tissue along the junction of pedicle and antler beam resulting in the eventual detachment (shedding) of the antler after the conclusion of the mating season (winter).

The rapid growth requirements of antler results in the formation of coarsely woven bone, which in cross section, appears to have two layers: the outer compact tissue known as cortical bone and the inner spongy tissue commonly referred to as spongiosa or cancellous tissue (Figure 2.1). The unbroken canals which are characteristic of the antler spongiosa differ from that found in skeletal bone, making antler easily distinguishable from other bony material.

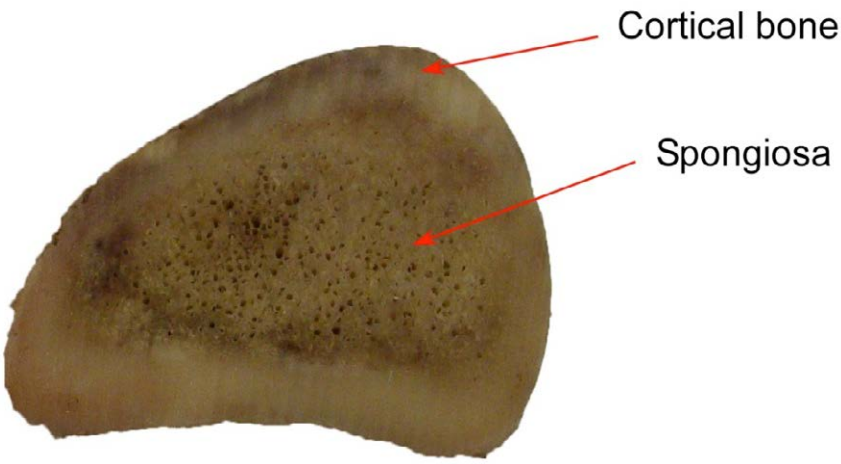


Figure 2.1: Cross section of red deer (*Cervus elaphus*) antler.

While bone collagen may be said to provide tensile strength with the stiffness and compressive strength provided by mineral crystals, antler has a lower mineralization (calcium hydroxyapatite crystals) content making it more resistant to sudden impact

loads (which they must endure during combat between stags) (Currey 1988, 1989; MacGregor 1985). MacGregor (1983) and Currey (1999) found that the amount of work to break (a good indicator for impact resistance) bone and antler differs significantly with the latter (antler) needing about 2 – 3 more times the force than bone (antler: 17,540Jm^2; bone: 6468Jm^2). In other words, antler will endure more plastic deformation and stress before breakage results than will bone. This compositional difference between skeletal bone and antler is what makes antler the superior material for both the manufacturing of implements as well as for use as projectile weaponry.

Manufacturing and Hafting Antler Points

Beginning with the very first step of projectile point manufacture, the raw material must first be prepared so that it is soft enough to work efficiently. If the antler to be worked is not fresh (as in, from a freshly killed and butchered animal) it must be soaked for several days. Clark and Thompson (1953), along with numerous other more recent experimenters (Knecht 1997a), have found that soaking antler for a period of four days was sufficient to soften the material and make it significantly easier to work and straighten with applied pressure. Bone, on the other hand, owing to its differing collagen and mineral content, does not significantly soften for working with any amount of soaking or even boiling (Knecht 1997a; MacGregor 1985).

Once the antler has been soaked and is soft enough to work, the process of removing blanks (also referred to as ‘splinters’ or ‘baguettes’) from the beam begins. From examination of the Star Carr (England) material, Clark and Thompson (1953) first described the ‘groove and splinter’ technique for working antler (also known as ‘longitudinal debitage’; Newcomer 1977) (see also Rigaud 1972, 1984; Semenov 1964; Averbouh 2000; Goutas 2009). This technique involves the removal of longitudinal splinters from the beam by cutting parallel grooves through the hard cortical layer and into the softer inner (spongiform) layer (see Figure 2.2 for examples). Once each groove was cut deep into the inner layer, a wedge is used to extract the splinter from the beam. The authors also noted that by undercutting the splinter near the middle, passing a piece of string beneath and pulling it back and forth also efficiently loosened the splinter from the beam.

The groove and splinter technique for blank removal appeared early in the European Palaeolithic (from the early Gravettian ca.28kyr BP; Goutas 2004) and, while an alternative method (the knapping technique) was commonly used during the interceding Badegoulian (Pétillon and Ducasse 2012), the groove and splinter technique reemerged as the primary (and almost exclusive) method for blank production during the Lower Magdalenian. In fact, this method was maximised during this later period through the extraction of multiple parallel blanks from the same segment of antler (Averbouh 2000; Clark and Thompson 1953; Elliot and Milner 2010; Pétillon and Ducasse 2012).



Figure 2.2: Examples of the groove and splinter technique for extracting blanks. Palaeolithic examples: A: Andernach-Martinsberg, B: Gönnersdorf. An experimental example produced by the author is shown in C.

Owing to the curved nature of antler beams, the straightening of blanks to produce projectile points was often necessary. Experiments have shown that it is possible to straighten sections of antler by fixing the blank in a straight position while wet and allowing it to dry. When dry the blank stays in this straightened position (Guthrie 1983). In the Magdalenian context, the *bâton percé* (see examples in the following chapter: Figures 3.7:A and 3.13:A) are often cited as antler straightening tools (Guthrie 1983),

with ethnographic examples of very similar items having been recorded in Northern Alaskan and Copper Eskimo contexts (Jenness 1937).



Figure 2.3: An example of a Magdalenian grindstone, this one recovered from the Pyrenean site of Massat and curated in the *Musée d'Archaéologie Nationale*.

Once the blanks have been produced, the shaping of the implement begins. Where bone has a pronounced unidirectional grain, resulting in little allowance for angular deviation along the longitudinal axis, antler does not have such a pronounced grain, making it possible to produce implements that vary in width along the longitudinal axis (Knecht 1997a). Blanks were commonly reduced into shape through longitudinal scraping, that is the controlled removal of small flakes of material resulting in the formation of the desired form. This task may be completed through the use of lithic tools to scrape away material or by grinding down the surface with the use of a grindstone (Magdalenian examples of grindstones have been found at a number of sites including the famous Parisian basin site of Pincevent; Bodu *et al*. 2006; Figure 2.3). A combination of these techniques is likely, as a polished finish is commonly observed on Magdalenian barbed and unbarbed points requiring the careful grinding of the surface.

Once the shaping of the point is complete, it is carefully hafted to create a streamlined connection between point, foreshaft and shaft, depending on the specific basal structure

(bevelled, forked, HRR, conical, uni- and bilateral protuberances) and intended launch method (mobile or immobile) of the weapon.

Both barbed and unbarbed Magdalenian weaponry display oblique striations on the surfaces of the basal area (and inferior surfaces in the case of half round rods [HRRs]). These striations are unanimously agreed to have been added in order to aid in creating a stable, well adhered haft (Allain 1957; Allain and Rigaud 1986, 1989, 1992; Julien 1982, 1999; Leroi-Gourhan and Allain 1979; Weniger 1992). These striations, however, have also been found along the midsections of points where, in addition to grooves, they are argued to have been utilised to affix lithic bladelets to the weapon (Julien 1999).

Basal striations are most commonly found to be incised at an oblique angle to the axis of the shaft, while transversal (horizontal across the base width) striations are rare and axial (vertical down the base length) exceptionally rare. As these striations increase the effectiveness of adherence between point and foreshaft/shaft through creating friction between the components, as well as a surface to which adhesives will better adhere, it is not be surprising that oblique striations were found to be most common, as this design stops the glue from running straight down (and off) the base (Allain and Rigaud 1986).

Experiments have shown that if a projectile point was hafted with the use of only an adhesive agent or a ligature it is likely to dislodge from its haft on impact with the target (Bergman 1987; Knecht 1991a, 1993b, 1997a; Stodiek 2000), along with resulting in catastrophic fracture of the shaft (Arndt and Newcomber 1986; Stodiek 2000). Using both a ligature and an adhesive, on the other hand, was shown to be a much more stable hafting system (Arndt and Newcomer 1986; Christenson 1997; Knecht 1991a, 1997a; Spencer 1974; Stodiek 2000).

Organic adhesives which may have been used to fasten tools (including projectile points) during the Magdalenian include: sinew, string, resin, pitch, ‘fish glue’, ‘hoof glue’, beeswax, and blood, while inorganic mastics include ochre, lime, and zinc oxide (Allain and Rigaud 1986; Audouin and Plisson 1982; Dinnis *et al*. 2009; Grünberg 2002; Koller *et al*. 2001; Lombard 2005, 2007; Mazza *et al*. 2006; Wadley 2005, 2006).

Evidence for the use of ochre for adhesion on Magdalenian technologies was reported as early as 1957 by Allain who noted the presence of yellow ochre on the bases of certain unbarbed points and the interior of the grooves found on navettes (a tool-making tool). Red ochre has also been found coating the backs of blades recovered from Lascaux (Leroi-Gourhan and Allain 1979). In experimentation, Allain and Rigaud (1986) found that without the inclusion of pigments (ochre) in beeswax and resin based adhesives, the components mixed badly when hot and separated during cooling. Thus, pigment appears to have been a key ingredient in (at least some types of) hafting glues, which can leave detectable coloured traces on the artefacts.

In the case of mobile points (harpoons), which some of the Magdalenian barbed examples may have been, the bulb form base with side (either left, right or both) protuberances is designed to fit into a socket worked into the foreshaft/shaft of a composite weapon. A line (likely made from sinew or woven fibre) tied around the shaft of the base of the weapon tip would have linked the point with the foreshaft/shaft.

While fibre technologies rarely survive in the archaeological record, multiple lines of evidence (namely phytoliths, parietal and portable art images, and impressions of textiles pressed into hut floors or soft cave floors) have demonstrated that they were produced and used by Palaeolithic peoples from at least the Gravettian onwards. Therefore woven lines (string) and even netting were likely components of the Magdalenian tool kit (Bar-Yosef *et al*. 2009; Nadel *et al*. 1994; Soffer 2004; Soffer *et al*. 2000). Similarly, the use of bird feathers for fletching have been suggested from both possible depictions of this technology in Palaeolithic imagery (Allain and Rigaud 1992), and the increasing abundance of avifauna found within Magdalenian layers (Bahn 1983; Laroulandie 2005, 2009; Piette 1889).

Antler Points: Use and Performance

Projectile point use-efficiency is determined by several key factors (Knecht 1997b):

- morphology,
- haft design,
- relative proportions of point, shaft, base,

- projectile mass,
- velocity, and
- kinetic energy.

Christensen (1986) explains that a light, high-velocity projectile will be more accurate than a heavy, low-velocity projectile as the latter requires a higher trajectory to traverse the same distance to the target. This situation is why a weapon launched by a spearthrower is more effective than a hand thrown spear, and the bow and arrow more effective than a spearthrower (in general). Unfortunately, the nature of projectile weapon and shaft used in the Magdalenian is still under debate (see Chapter 3), though there is general consensus that the spearthrower was the main launch system employed in the study period.

While the blade-like edges of lithic projectile points literally cut through tissue and shatter as they move through the target, resulting the splinters causing (usually) lethal haemorrhaging, antler projectile points must cut a path through the target using only kinetic energy. The wound then only opens further if the cross-sectional morphology of the point expands along its length (Knecht 1991a, 1997a). Despite these differences and apparent disadvantages, experiments by Letourneux and Pétillon (2008) and others have shown that antler weapon tips are able to effectively penetrate both dense bone structures such as the distal extremity of a humerus (Figure 2.4) as well as pass through hide and muscle and slide between ribs into the thoracic area, reaching the vital organs - all with little damage to the weapon tip. This same flexibility and durability also results in a point which can withstand the spasmodic movements of a distressed animal with little (or no) damage (Arndt and Newcomer 1986; Knecht 1997a; Letourneux and Pétillon 2008; Pokines 1998; Tyzzer 1936).



Figure 2.4: Examples of impact damage by replica Magdalenian antler fork-based points into an ox calf carcass. Note both the efficiency of the points to penetrate solid bone (left) as well as minimal damage to the points which have passed half way through a carcass (right) (photos reproduced with permission from Letourneux and Pétillon 2008:2855 Figure 3 and 2856 Figure 4).

Elston and Brantingham (2002) presented a concise outline of the key differences between organic and lithic points based on Ellis' (1997) review of 100 hunter-gather ethnographies (Table 2.1). From these data, they concluded that the choice of either organic or lithic weaponry was guided by various factors including temperature and prey type as well as cost and risk. When the potential cost/risk (Bamforth and Bleed 1997; Torrence 1989) of weapon failure was relatively low, lithic points tended to be used, while the more reliable (in terms of breakage) organic implements were employed in high risk situations where weapon failure may result in significant cost (in injury, life, weapon breakage, etc). Researchers have also pointed out that the differences observed in experiments regarding durability and use life between organic and lithic points are likely to be exaggerated in actual hunting situations (Pokines 1998). Thus, while osseous projectile points take more time and effort to manufacture than stone, this investment is recouped through its efficiency and durability in use, along with their ease in maintenance (discussed below) (Pétillon *et al*. 2011; Torrence 1983). Composite

antler/lithic points, of course, take advantage of the central benefits of both antler and lithic technologies.

Table 2.1: Performance characteristics of organic and lithic points (reproduced from Elston and Brantingham (2002:105 Tables 8.1 and 8.2).

Organic Points	Lithic Points
Material limits morphology Considerable time to manufacture Cause less tissue damage More durable: · Unaffected by cold weather · Rarely damaged in transport · Rarely break in use Easily repaired/resharpened Less likely to be used with foreshaft Reusable	More varied morphology possible Can be made relatively quickly Cause great tissue damage, bleeding Less durable: · More brittle in cold weather · Easily damaged in transport · Invariably break on missed shot · Frequently shatter when penetrating prey Difficult or impossible to repair More often used with foreshaft Expendable
Used: · On thrusting spears without foreshafts against herd animals · Against large/dangerous animals without replacement weapons · On thrusting spears used in hand-to-hand fighting · On arrows used in cold weather · On spears cast in heavy brush	**Used:** · When hunting large game · When attacking dangerous solitary animals (bears) · On thrusting spears when danger to user is slight · For killing enemies at a distance

If we now consider the more specific differences between bone and antler for use in manufacturing projectile weaponry, it has been argued that antler is the better raw material for four main reasons (Knecht 1997a). First, when available, antler is less likely to be needed as a resource for other non-technological activities (such as for food) than bone. Second, when compared to bone, the structural and mechanical properties of antler allow for greater ease in workability (as described above). Third, experiments have shown that points made of antler are less likely to be damaged on impact than those made from bone, and, finally, owing to the nature of breakage on antler points, they will likely remain functional through a greater number of rejuvenation episodes than will bone points.

Antler Points: Rejuvenation

As is the case for lithic technologies, the rejuvenation of osseous points is inherently a reductive process where both mass and volume are lost from the originally manufactured piece. Unlike lithic points, however, osseous points must be maintained in impeccable condition in order to prevent catastrophic breakage of the weapon tip. This point has been most effectively demonstrated by Tyzzer's experiments in which "the unsharpened point was from the first fractured at almost every shot. That points with perfect tips should withstand impact that cause fracture in those with chipped or previously fractured ones showed at once the advantage of keeping the tips sharp and smooth" (Tyzzer 1936:267).

Fortunately, experiments have also shown the ease with which bone and antler projectile points can be resharpened and rejuvenated (Arndt and Newcomer 1986; Knecht 1997a; Pokines 1998; Stodiek 2000). In particular, Stodiek (2000) reported that in his experiments slight damage to the tip could be repaired by simply grinding the tip with a suitable piece of sandstone, while more extensive damage was first shaped with a lithic blade or flake before being smoothed over with the use of a grindstone. Stigmata observed on the archaeological material suggest that these same methods were used during the Magdalenian (see Chapter 4 'Methods and Methodology').

As ease of maintenance appears to be one of the main advantages of antler projectile weaponry, it should be briefly considered in the light of the appropriate theory. Bleed (1986) has discussed reliability and maintainability as design alternatives for optimising the availability of weapons.

Reliable systems are constructed so as to be ready-to-use when they are needed, are generally more specialised than maintainable systems, and have their main advantage in that where the period of use is scheduled, construction and maintenance can be performed prior to the event/season. These systems are over designed, under stressed during use, have standby parts that are built into the system, are carefully crafted and fitted, have a repair kit that is generalised and includes basic raw materials, are

maintained and used at different times, and are manufactured and maintained by a specialist craftsperson.

In contrast, maintainable systems are designed for easy repair and modification. These systems are generally lightweight and highly portable, each part of the system has a single unique function, has a specialised repair kit which includes ready-to-use extra components, has a modular design, are repaired and maintained during use, are maintained by the user, and are overall easily repaired.

As we saw above, antler technology has been shown ethnographically to have been preferentially chosen for the hunting of large and/or dangerous creatures owing to their reliability; however, their ability to be quickly rejuvenated also makes them highly maintainable. Thus antler points can be considered to be both 'reliable' and 'maintainable', a conclusion previously drawn by Knecht (1991a) for early Upper Palaeolithic (Aurignacian and Gravettian) weapon tips and one I would also argue for Magdalenian antler projectile technologies.

Evidence for Use as Projectile Points in Prehistory

That the various osseous points recovered from Upper Palaeolithic contexts functioned as the tips of projectile weapons is supported by ethnographic comparisons, the archaeological context of certain key discoveries, fracture patterns on both the points themselves and their targets, and experimental reconstructive studies.

Ethnographies, particularly of peoples from North America, have a long history of use in identifying the function of Palaeolithic osseous projectile points (see Chapter 3). This information has, in particular, been used to elucidate how Palaeolithic weaponry may have been hafted (e.g. Bindon *et al*. 1987; Julien 1982; Weniger 1992, 2000) and used in terms of launch method (e.g. Allain and Rigaud 1992; Cattelain 1997; Pétillon 2008; Weniger 1992, 2000) as it is not always clear if they functioned as harpoons, spearthrower darts or arrows.

Osseous points found wedged in bones are extremely rare within Palaeolithic contexts, with, to my knowledge, only three cases being currently known. The first is from an Aurignacian context within the French cave of Combe-Buisson, where a small distal part of a projectile point was found in a bone, but the exact taxon of the bone is unknown. The second is from the Epigravettian Siberian site of Kokorevo I where an osseous projectile point is wedged in a Bison scapula (Cordier 1990; Letourneux and Pétillon 2008), and the final example was found at the UK site of Poulton-le-Fylde where one unilaterally barbed point was found amongst the ribs of a deer, with another "found lying across the lateral condylar surface of the left metatarsus" (Jacobi *et al*. 2009:15). This latter example was directly dated to 11660±60 (OxA11151) and 11715±50 (OxA13075) and is one of the only examples of indisputable evidence for the use of barbed points (even if only in opportunistic circumstances) as hunting weaponry during the study period.

Another line of research recently undertaken to explore the use of antler weaponry in the Upper Palaeolithic has been to consider the type of weapon tip used to hunt game from the damage sustained by the target. Unfortunately, experimental work completed by Letourneux and Pétillon (2003, 2008) with replicated Magdalenian antler fork based and bevel based points demonstrated that both lithic and antler projectile point produced the same kinds of impact fractures (notches, punctures and perforations) on the skeletons of targeted animals. However, they also noted that since the shape of punctures and perforations tends to reflect the cross section of the projectile used it may still be possible to identify lithic against bone/antler weaponry with further careful examination of faunal material. Such studies of archaeological faunal assemblages are yet to be undertaken and published.

Since the 1980's a significant amount of work which focuses on identifying impact fracture on osseous points has been undertaken, often with the express purpose of demonstrating their use as projectile weapon tips (e.g. Arndt and Newcomer 1986; Knecht 1991a, 1993a, 1993b, 1997a; Pétillon 2005, 2006; Pokines 1993, Pokines 1998; Pokines and Krupa 1997; Redmond and Tankersley 2005; Rigaud 2006; Stodiek 1990, 1991, 1993, 2000; Tyzzer 1936). As was discussed in the previous chapter, the results of

these experimental studies provided the identification of the common and diagnostic impact fractures sustained by bone and antler projectile points during use. These use wear and fracture types will be defined and described in Chapter 4 ‘Methods and Methodology’.

Summary

It is clear from this brief review that both organic (i.e. osseous) and lithic weaponry have a place in a hunter-gatherers’ toolkit. Antler provides a set of properties which make it exceptionally suitable for both the manufacture of and use as projectile weaponry. Experimental studies have shown that antler points have great accuracy and range with use of a spearthrower and/or bow, and are able to deliver effective fatal shots by their ability to flex into the rib cage of a fleeing animal. This same durability allows the antler point to withstand the spasmodic movements of a distressed animal with little (or no) damage to the weapon. Each type of weapon tip, osseous or stone, therefore provides a unique set of pro’s and con’s which suit different hunting and combat situations, making each type as worthy as the other for serious consideration by researchers.

Further elucidation of how Magdalenian barbed and unbarbed points were hafted, used and discarded will be discussed in light of archaeological collections in the following chapter.

Chapter 3: Magdalenian Osseous Projectile Points

Introduction

While osseous projectile points are found in the archaeological record at least as early as the beginning of the Upper Palaeolithic in Europe, the Magdalenian exhibits a range of implements which are more varied and distinctive than all those that came before. Understanding this variability in terms of design and functional differences is essential to building workable knowledge on how these implements were maintained and discarded in prehistory.

This chapter provides a brief history of research into Magdalenian osseous projectile points, followed by an outline of point typology to familiarise the reader with the intricacies of this technology. In this section, the definitions for the barbed and unbarbed points examined in this study will be presented. As the design of barbed points at the time of initial manufacture is a complex issue, the second half of the chapter will present an argument, based on archaeological evidence, for the original form of Magdalenian barbed points.

A Brief History of Magdalenian Osseous Projectile Point Research

From the very beginnings of Magdalenian research, that is, with the excavation of La Madeleine by Lartet and Christy in 1863 to 1865, technology and art made from osseous materials were recovered and examined by archaeologists (Lartet and Christy 1864). It was, in fact, Mortillet's (1869) paper '*Essai d'une classification des cavernes et des stations sous Abri Fondée sur les produits de l'industrie humaine*' which first defined the Magdalenian using osseous projectile technology as '*fossiles directeurs'*.

While unbarbed points, originally termed '*sagaies*', were recognised as projectile weaponry and known to belong to this period since its very discovery and definition, barbed points have a significantly more complex history of research. Like their unbarbed counterparts, barbed points appear early in the story of Palaeolithic research

having been first reported to the *Société de Physique et d'Histoire de Genève* as early as 1838 by F. Mayor (Julien 1982). However, their place in prehistory did not begin to be properly investigated until some 20 or more years later. First termed '*harpons*' ('harpoons') by Prosper Mérimee in a letter to a colleague written during 1853, it was not until E. Lartet's (1861) '*Nouvelles Recherches sur la coexistence de l'Homme et des Grands Mammifères*' that this type of artefact was first academically published (Julien 1982).

From their first discovery, barbed points were considered by the majority of researchers to be a weapon tip for the hunting of land animals, though this consensus was disrupted by Brun in 1867, who suggested that these implements may have instead been used for fishing, or for the manufacture of fabrics and/or nets. This latter idea (use for weaving) was taken up briefly by Piette (1895) but was soon dismissed in the wider literature, as was the idea that they may have served in the realm of ornamentation (Garrigou 1867).

Thus, while it was quickly settled that barbed points most definitely constituted a hunting technology, whether they were used for the exploitation of terrestrial or aquatic species remained debated (discussed below) (e.g. Pétillon 2008a; Pokines and Krupa 1997), as is whether only some or all of the barbed weaponry functioned as true mobile harpoon heads (that is, "a hunting weapon, thrust or thrown, whose tip is mobile and linked by a line to the shaft, to another object or to the user" [Weniger 1995:20]) has continued to be debated up until present day (e.g. Girod and Massénat 1900; Julien 1982; Lartet and Christy 1875; Pétillon 2008a; Piette 1895 Weniger 2000). The uncertainty surrounding the true function/s of these distinctive implements has resulted in researchers recently divorcing these artefacts from their traditional French name of '*harpon*' with all its functional connotations, to the must less presumptuous term, 'barbed point' as was mentioned in the Introduction (Langlais *et al*. 2012; Pétillon 2008a; Weniger 1995).

To move on, the distinctiveness of Magdalenian barbed points and their apparent chronological restriction to the Late Magdalenian resulted in their use as '*fossiles directeurs*'. Piette (1895) was the first to publish a synthesis which used hypothesised

changes in barbed point forms (an evolution of barbed points from simple to more complex types) to propose subdivisions within the Magdalenian and later Azilian periods. Only five years later, however, Girod (1900) concluded that Piette's strict succession of barbed point types could not be upheld, as multiple 'types' were recovered from the same deposits at both Laugerie-Basse (Dordogne) and Maz d'Azil (Ariège).

Another chronological schema which proposed successive and increasingly complex types of osseous projectile points was presented twelve years later by Breuil (1912) in his '*Les Subdivisions du Paléolithique Supérieur*'. This schema underwent a number of subsequent revisions and was widely adopted by researchers until the 1960's, when the frequency of archaeological inconsistencies mounted to the point where the integrity of Breuil's model could no longer be upheld (Combier 1967; de Sonneville-Bordes 1963). No further progress has been made regarding the chronology of Magdalenian barbed weaponry in the intervening 50 years, primarily because sites which hold long sequences of barbed points and which also have good stratigraphic integrity are rarely excavated. This issue will be further discussed in the following sections.

Julien (1982) has pointed out that while barbed points were originally studied in the light of ethnographic analogies, by the time they became '*fossiles directeurs*' they were reduced to items far removed from the social context in which they were both made and used. That is, they became items divorced from the people who made and used them, artefacts with no social history. It is only in the last thirty years, since the work of Julien (1982) and Weniger (2000) in particular, that barbed points have once again been reunited with their human history. Recent studies of Magdalenian barbed points once again rely on ethnographic analogy and while replicative/experimental approaches now heavily dominate the analysis of other prehistoric osseous projectile technologies (see Chapter 1), Magdalenian barbed points are only beginning to benefit from this kind of re-examination (e.g. Pokines and Krupa 1997; Weniger 2000).

To conclude, despite more than 150 years spent studying Magdalenian barbed and unbarbed points, our central research questions remain the same: What and how were

they used and what is their chronology and geographical distribution? It appears that while between 1,500 and 2,000 barbed points and thousands of unbarbed points have been recovered from Magdalenian sites we still know very little about their technological and social importance during this late Pleistocene period.

Types and Typologies

As just mentioned, Magdalenian techno-complexes include a wide variety of projectile points manufactured from osseous raw materials; however, the large majority of assemblages are made up of bevel based (single or double) unbarbed points or barbed (uni- or bilaterally barbed) points. As not every artefact could be included in this study owing to time and space constraints, it was decided that the research focus should be on those types most commonly recovered from the archaeological record, that is bevel based unbarbed points and barbed points. Those types excluded from this study are shown in Figure 3.1 and include: *baguette demi-rondes* or half round rods (HRRs), self-barbed points, Föenes or eel spears, 'forked objects', fork-based points, conical based points, darts, proto-harpoons and Azilian harpoons.

The unbarbed point types examined in this thesis include all those which display either a single or double bevelled proximal extremity, and includes the Lussac-Angles sub-type of single bevel based point which are commonly thought to be largely restricted to the Middle Magdalenian (Bellier and Cattelain 1990) (Figure 3.2). These implements can be decorated or undecorated and may also include grooves down one or more sides which are designed to carry microliths - that is, as a composite lithic/antler weapon tip. Archaeological examples of such weaponry have been recovered in cases of exceptional preservation, such as those found at Grotte Blanchard where remnants of flint bladelets were found still adhering to the groove (Allain and Descouts 1957; Allain and Rigaud 1986) and Pincevent (Leroi-Gourhan 1983; Piel-Desruisseaux 2007).

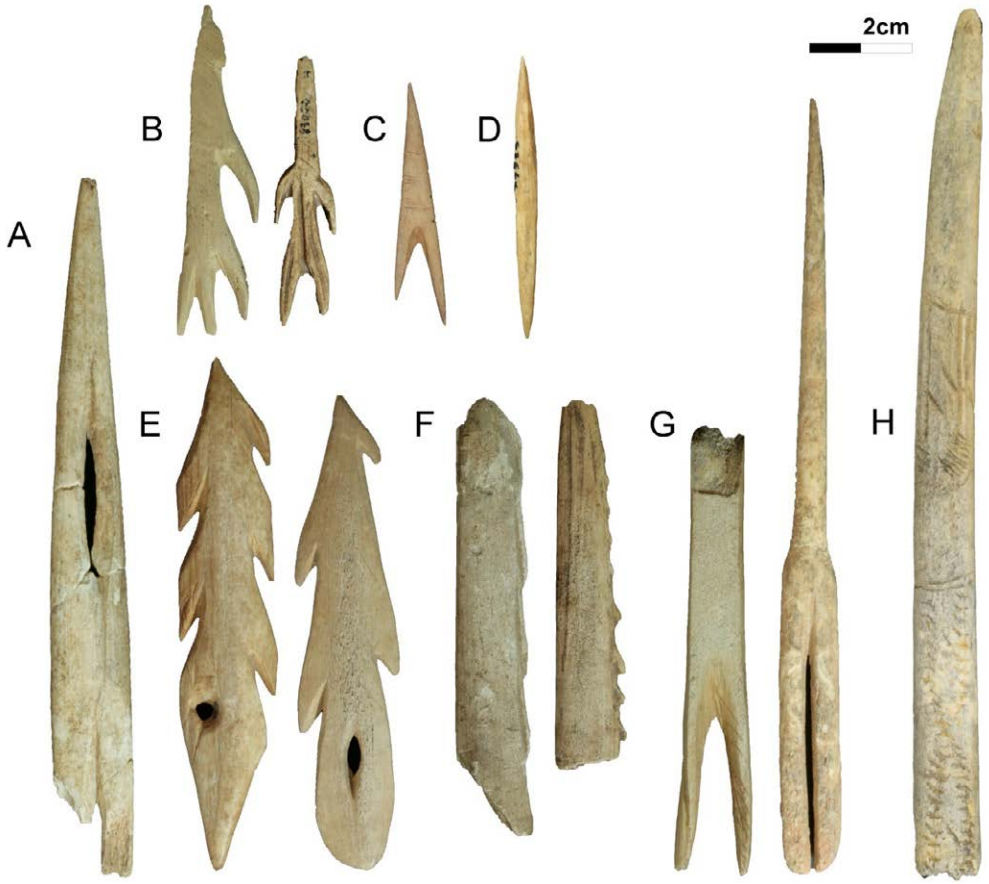


Figure 3.1: Point types not included in the analysis: A & B: Föenes, C: 'Forked object', D: 'Dart', E: Azilian points, F: proto-harpoons, G:Fork-based points, H: *Baguette demi-rondes* (HRR).



Figure 3.2: The unbarbed and bevel based points examined in this thesis. From left to right: a Lussac-Angles point (single bevelled), a single bevel based points, and a double bevel based point.

Julien (1982) suggests that similar grooves found on barbed points also functioned to carry lithic elements, though others have argued that these grooves (on both unbarbed and barbed points) may not always have carried bladelets, but perhaps, in some cases, poisons. This suggestion is supported by the discovery of a small biconical point carefully protected by a osseous case (a diaphyse from an unknown taxa) from the site of La Garenne (Allain and Riguad 1986). The accidental breakage of the case allowed the archaeologists to see that the enclosed point was grooved. Ethnographically, similar transport of poison dipped points have been observed amongst the Boschimans of Africa (Allain and Rigaud 1986, 1992).

All barbed weaponry, either uni- or bilaterally barbed was included for examination in this study. Regional differences in barbed point morphology have been noted previously (e.g. Julien 1982; Weniger 1992), with the dominance of bilaterally barbed points in the Périgord and Quercy regions (roughly corresponding to Zones IV and V in this analysis; see Chapter 4) in contrast to the statistical and numerical dominance of unilaterally barbed points to the south and north of this area (Pyrenees, Spain, southeast France and northern Europe; roughly corresponding to Zones I - III and VI - VII in this analysis). This difference in the popularity of uni- over bilaterally barbed points (or vice versa) is the broadest geographical difference identified by analysts. Other noted regional differences in Magdalenian barbed point technology include the restriction of perforated bases to the northern Spanish coast (commonly known as the 'Cantabrian type') (Weniger 1987), and unilaterally barbed point to the Mediterranean coast of Spain (Villaverde and Roman 2005).

As was mentioned above there are several typologies which have been proposed for organising this barbed technology. For Piette (1895), Breuil (1912) and Goucy (1927), Magdalenian barbed points evolved from less to more complex forms throughout the Magdalenian and could therefore be used as '*fossiles directeurs*'. For Piette, "*les types nouveaux (d'armes et d'outils) naissent des anciens par des perfectionnements continus*" [new types of weapons and tools are born from old ones by continuous improvements] (Piette cited in Julien 1982:11, *author's translation*). He believed that barbed points were largely developed during the '*amas Equidien*' with improvements to

their barbed sections and proximal extremities made throughout the following '*Cervidien*' and '*Élapho-Tarandiennes*' periods.

For Breuil (1912), Magdalenian Phase IV was typified by proto-harpoons of various morphologies. These proto-harpoons were succeeded in Magdalenian Phase V by unilaterally barbed points, the youngest having elongated barbs in the shape of animal claws. At the end of this period, these latter forms were followed by unilaterally barbed points with small and tight barbs (Figure 3.3). Finally, at the end of the Magdalenian (Phase VI), bilaterally barbed points are said to have appeared – first with barbs shaped like long claws and later replaced by those with barbs that were broad and angular.

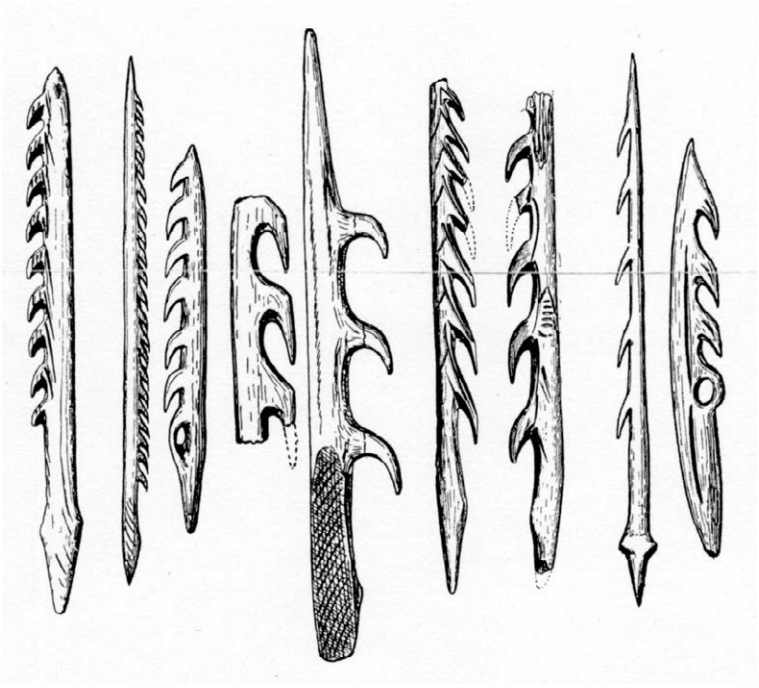


Figure 3.3: Breuil's 'evolution' of unilaterally barbed points (Breuil 1912:53, Figure 32).

Goucy's (1927) proposal for the succession of barbed points is very similar to Breuil's with Magdalenian III having barbed points with small, tightly packed saw-like barbs later followed by implements with barbs which are arched, more widely spaced and hooked during the Magdalenian IV. Those found in Magdalenian V deposits were described as bilaterally barbed with 'elegantly' formed barbs which were sharp-edged, hooked and evenly spaced, sometimes asymmetrically. Goucy defines the Magdalenian

VI as having trapezoidal shaped barbed points with less elegant, less angular barbs but often with a lot of decoration.

As outlined above, Breuil's typology (and use of barbed points as '*fossiles directeurs*') was widely used by researchers until the 1960's when the frequency of inconsistencies amounted to the point where researchers could no longer uphold the integrity of this schema. In more recent times, Julien's (1982, 1995) typology of Magdalenian barbed points has become the most widely used schema in modern research (Figure 3.4).

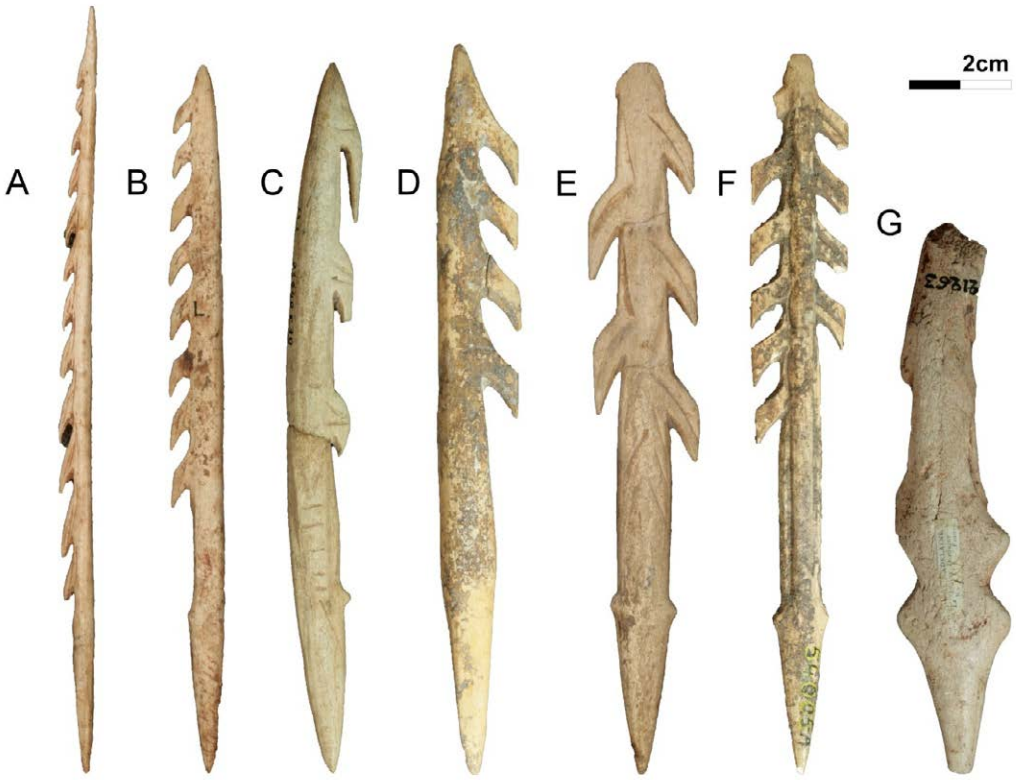


Figure 3.4: Julien's (1982) typology of Magdalenian barbed points. A: Unilaterally barbed type A1 (Courbet); B: Unilaterally barbed type A2 (Courbet); C: Unilaterally barbed type A3 (La Vache); D: Unilaterally barbed type B (La Vache); E: Bilaterally barbed type A (Courbet); F: Bilaterally barbed type B (Laugerie-Basse); and G: Bilaterally barbed type C (La Madeleine).

In her typology, Julien (1982) divided the implements into types according first to whether they were uni- or bilaterally barbed and then according to the size, shape and spacing of barbs. It is worth noting that this schema is based purely on the morphology of the implements and not any perceived functional differences, and thus what Julien

has split into several 'types' may in fact all function in the same manner and therefore actually constitute the same projectile weapon, their morphological differences being merely stylistic.

More recently, Weniger (1992, 2000) has built on Julien's work, through the study of ethnographic barbed technologies and their comparison with Magdalenian examples. Through this comparison he concluded that Magdalenian barbed points can be split into four different functional types based on their barb and base morphology as well as the presence/absence of striations on the proximal extremity. These types are: spears, harpoons, harpoon-arrows, and fixed arrow heads. It is also cautioned that some unilaterally barbed points may have functioned as multi-pronged spears though the evidence for these weapons in the Magdalenian is, as yet, uncertain.

Within these four broad functional categories Weniger found 11 morphological types of unilaterally barbed points (termed R1 by Weniger) which could be split into two wider, over arching groups (Group A and Group B). The bilaterally barbed points were split into five morphological types (termed R2 points by Weniger). A full description of each of the 16 types is not provided in either of the publications reporting this work; however, the broader categories are described in order to suggest their probable functional uses. Figure 3.5 gives examples of barbed points as they fit into these wider functional categories described by Weniger.

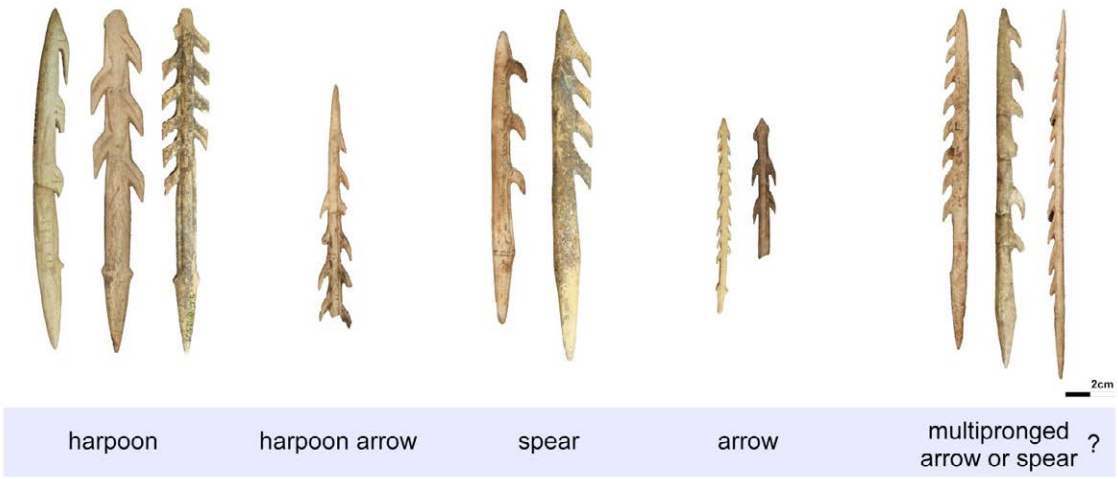


Figure 3.5: Weniger's (2000) functional typology of Magdalenian barbed points. The mostly likely function of each type as suggested by Weniger is provided in brackets.

As this outline of the typologies previously proposed by researchers for Magdalenian technologies demonstrates, the variability observed in Magdalenian barbed points has resulted in confusion over how these weapon tips should be organised and analysed. From the currently available evidence, it appears that not only are there several functional categories present within the wider sample, but also that the wide range of barb designs may reflect either personal and/or regional preferences in design. As will be outlined in Chapter 4 ('Methods and Methodology') it will be Weniger's (2000) typology which will be largely implemented in this thesis as it takes into account both weapon morphology and possible functional categories which allow for the most informed analysis of point maintenance and discard practices.

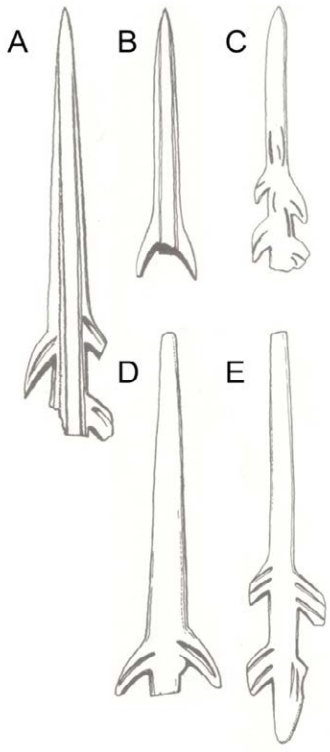


Figure 3.6: Implements Julien (1982) identified as '*pointes de taille exceptionnelle*'. A & B: Rochereil, C: La Madeleine (see Figure 3.9:23 for photograph of same implement), D: Villepin, E: Bruniquel-Plantade.

First Things First: Demonstrating Original Barbed Point Form

In order to determine the extent of rejuvenation a projectile point has undergone to its distal extremity, that section which is most likely to receive maintenance and repair during its use life, the original design of the implement must be known. In order to aid the following discussion of original form for Magdalenian projectile points, a diagram of the implement sections is provided in Figure 3.7 below.

To continue, while the form of the distal extremity is straight forward for unbarbed points (a [usually] conical tip gradually worked up from the main body of the shaft), the original form of barbed point distal extremities is less well understood. Primarily, this situation is the result of initial forms being exceptionally rare in the archaeological record, and "even points that seem to be quite well preserved have been reworked because of former damage and do not display a primary form" (Weniger 2000:83). Thus, analysts have had to speculate on the

original proportions of a barbed point as designed at the time of initial manufacture. The following sections outline previous ideas on barbed point original form and presents a case for differing implement length proportions between uni- and bilaterally barbed points, with distal extremities of bilaterally barbed points exceeding that which has been previously widely accepted.

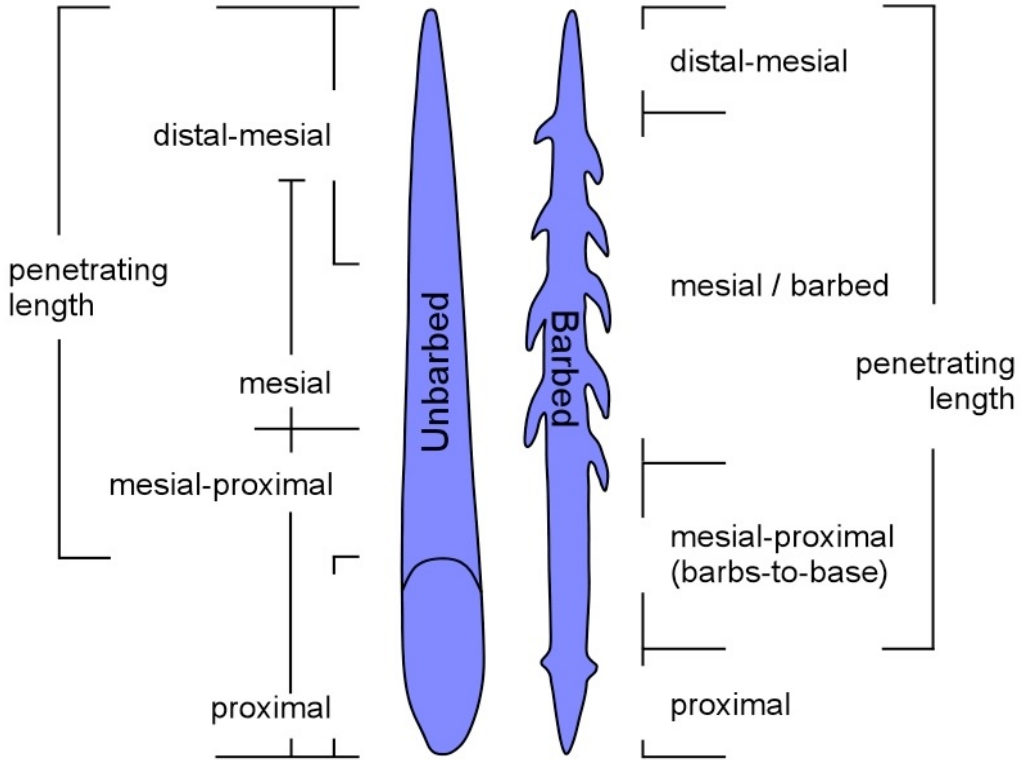


Figure 3.7: Dimensions of the barbed and unbarbed point.

Previous Ideas on Original Design and Distal Extremity Form

As outlined above, Magdalenian barbed points have been the subject of study for the past 150 or more years. With such attention given to their form, function and manufacture it is surprising that only a handful of scholars have clearly articulated what they consider constitutes the original design of a uni- or bilaterally barbed point.

In particular, while significant attention has been given to the mesial and proximal sections of the barbed point (e.g. Julien 1982; Pétillon 2008a; Weniger 1992, 2000) as these sections have formed the basis of past typological classifications, clear description

of what constitutes the original dimensions of the distal extremity has only been described by a few researchers.

Julien's (1977, 1982, 1995) extensive analysis of barbed points has long been the central source of information regarding these implements. In this work, she argues that the original form of the distal extremity on both uni- and bilaterally barbed implements consisted of a point with a circular section worked gradually up from the barb shoulder to a sharp tip. She estimates that the distal extremity constituted between 10 – 15% of the total implement length; the remainder of the weapon tip being made up of 65 – 70% for the shaft and 20 – 25% for the proximal (or base) section. She therefore argues that the proportion each section (distal, mesial, proximal) made up of the total implement length was the same or very similar across the two broad categories.

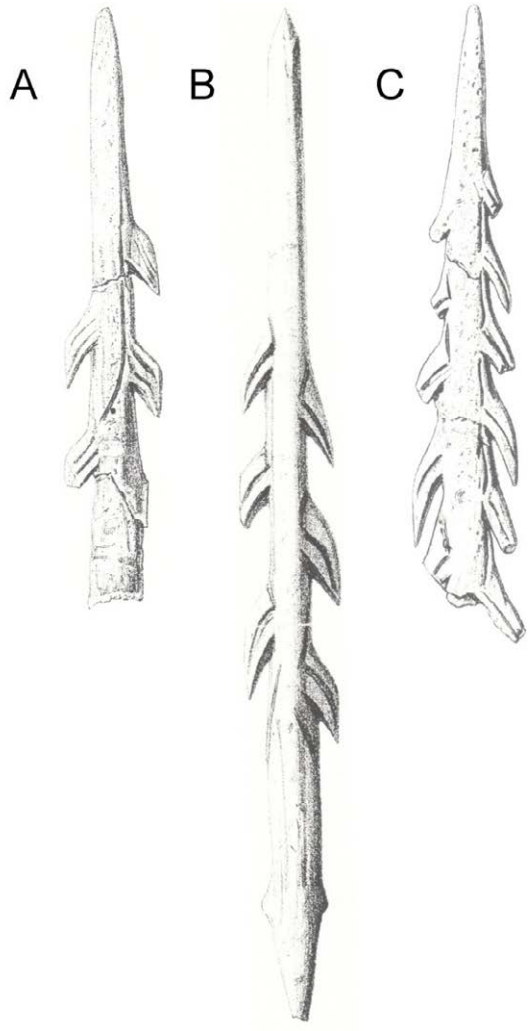


Figure 3.8: Three examples of bilaterally barbed points with extended distal extremities as illustrated by Lartet & Christy (1875: Pl. XIV, no.4, Pl. XXVII, no. 7 and Pl. XXII, no. 5) A: Unknown providence; B. La Madeleine; C. La Madeleine (?).

Weniger (1987) through analysis of both archaeological and ethnographic collections similarly concluded that the original design for Cantabrian unilaterally barbed points consisted of 13 - 14% for the distal section, 51 - 52% for the mesial (barbed) section and 34% for the proximal section. While the estimated proportions for the mesial and proximal sections of Cantabrian points differ from those of unilaterally barbed points found outside this region (due to the regionally distinctive design of these implements in Cantabria), Weniger's estimate of 13-14% for the total length of

the distal section fits well within Julien's (1977, 1982, 1995) more inclusive estimate of 10 - 15%.

However, in the case of bilaterally barbed points there exist examples in which the distal extremity far exceeds the 10-15% bracket given by Julien and Weniger. Julien herself (1982:65) termed these examples as '*pointes de taille exceptionnelle*' (points of exceptional length) (Figure 3.6). While noting that these distal sections conform to the traditional morphology in terms of section shape (circular), she states that these distal ends are "*extrêmement dévelopées*", reaching 1/4 or 1/3 of the overall implement length. She further observes that this distal extremity type is found *only* on bilaterally barbed points with their length varying between 45 – 75 mm, and which terminate in a carefully crafted, perforating tip. She speculates that this distal extremity type ('*pointes de taille exceptionnelle*') may have had a particular function, such as to penetrate prey deeply to reach a vital organ, or that the craftsman who made the implement made a longer point owing to extra length in the blank used to manufacture the tool.

While having made the observation earlier that "the calculations carried out on the overall lengths of the harpoons and the proportions of components compared to others, only reveal their state of abandonment rather than the initial design of the instrument" (1982:134, *author's translation*), Julien does not consider whether the form of the '*pointes de taille exceptionnelle*' may actually be the originally desired design for the distal extremity of *all* bilaterally barbed points.

Looking back at early publications regarding Magdalenian points, we can see that a distal extremity of 10 - 15% (of the total implement length) was not always considered to be what the Magdalenians had originally designed. In their 1875 publication, *Reliquæ Aquitanicæ*, Lartet and Christy include several drawings of bilaterally barbed points with extended distal extremities (PL XXVII no. 7, unknown providence, PLXXII no. 5 La Madeleine?; PL XIV no. 4 and 6 both from La Madeleine; see Figure 3.8). While they do not comment on the design of the first such implement pictured (Figure 3.86: A), they do comment on the other two: "this is a longer, more slender, and rarer form than the foregoing; *it has its original long tapering end* and suddenly sharp

point" (Lartet and Christy 1875:101, emphasis added; Figure 3.8: B), and "eleven grooved barbs belong to the fragment, which retains *the original tapering*, terete, or nearly cylindrical point" (Lartet and Christy 1875:150, emphasis added; Figure 3.8: C). They additionally include a drawing of another bilaterally barbed point recovered from La Madeleine which was examined as part of this study (see Figure 3.12: no. 25) and of which they comment, "The long, tapering, sharp point of a slender harpoon-head, similar in type to fig. 4, but having its barbs far more numerous, close-set, and opposite" (Lartet and Christy 1875:101, PL. XIV no.6). It appears clear from these brief descriptions that Lartet and Christy believed that the original design of the distal extremity of a bilaterally barbed point was of a more extended form – that is, one exceeding 10 – 15% of the total implement length.

Evidence from Portable and Parietal Art

Images of material culture in both parietal and portable art provide an additional source of information for both the appearance and use of implements in Pleistocene contexts (see Welch 1996 for an Australian example). Projectile points are depicted in both Magdalenian parietal and portable art and include multiple examples from Lascaux, Niaux, Cosquer, La Madeleine, Isturitz and La Garenne, with additional examples found at Laugerie-Basse, La Colombière, and Cougnac (Allain and Rigaud 1992; Baffier 1990; Sieveking 1987).

Self-barbed points along with both unilateral and bilaterally barbed points and possibly HRRs may be depicted, sometimes with feathering on the proximal end of the spear shaft suggested to indicate fletching. Unfortunately, the identification of projectiles in Magdalenian art must be undertaken with the greatest caution, and in the majority, those examples that are commonly agreed to be projectiles are too schematised to provide any useful detail about cultural ideals for point dimensions or form. There are, however, a few examples found on portable art which are insightful.

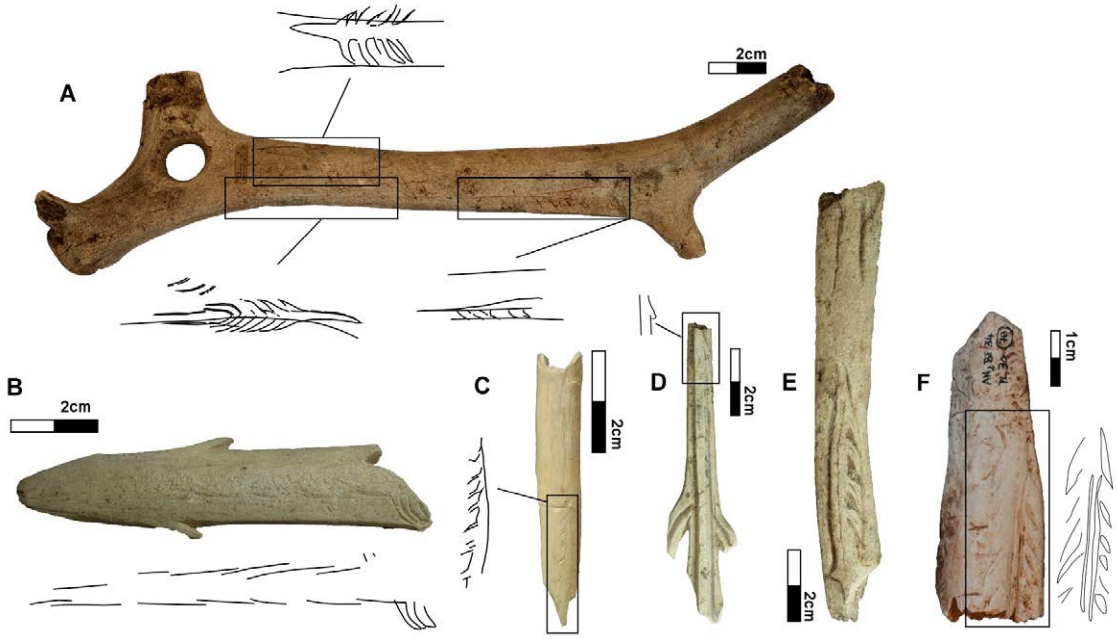


Figure 3.9: Magdalenian engravings of uni- and bilaterally barbed points showing an extended distal extremity on bilaterally barbed points in comparison to the shorter version on the drawn unilateral points: (A) La Madeleine; (B) Laugerie-Basse; (C) La Vache; (D) Gourdan; (E) Isturitz; and (F) Andernach-Martinsberg.

Each of these examples is an engraving, the images having been carved into either bone or antler surfaces. In the first case, an incomplete *bâton percé* recovered from La Madeleine exhibits depictions of two bilaterally barbed points and a single unilaterally barbed point (Figure 3.9: A; Sieveking 1987:22). A second *bâton percé* recovered from this same site has a similar depiction of a bilaterally barbed point, while the inverse side displays an engraving of a head of a reindeer (Figure 3.10; Capitan and Peyrony 1928:48).

The next example was found on a fragment of bird bone from La Vache (Graziosi 1960:191), while three others were identified on fragments of antler recovered from Isturitz (Saint-Périer 1936), Andernach-Martinsberg (Figure 3.9: F) and Courbet (Figure 3.9: G). Finally, a single barbed point from Laugerie-Basse and Gourdan (Figure 3.9: B and D) each display an engraving of a barbed point on their superior face.

In each of these engravings the depictions of barbed points, unilaterally barbed points in the case of the La Vache, La Madeleine, Gourdan, Courbet and Isturitz pieces, and bilaterally barbed points for the *bâtons* from La Madeleine, the barbed point fragment from Laugerie-Basse, and antler fragment from Andernach-Martinsberg, the weapons are shown in a more realistic fashion than those commonly identified in parietal art. Interestingly, on all pieces, unilaterally barbed implements are shown to have relatively short distal points while the bilaterally barbed are shown to have an extended distal section.

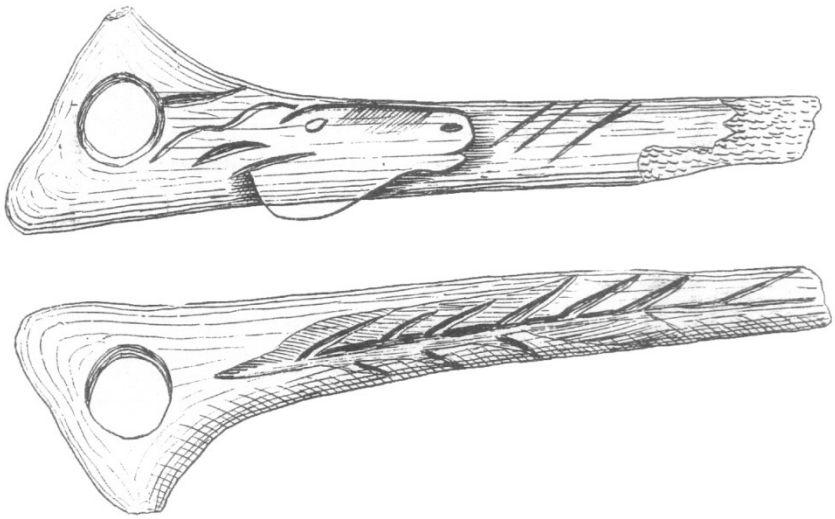


Figure 3.10: Engraved *bâton percé* from La Madeleine (Dordogne), with a depiction of a reindeer head on one side and a bilaterally barbed point with extended distal extremity on the other (original drawing from Capitan and Peyrony 1928:48).

As discussed above, Julien (1982) estimated that the original dimension of the point on both uni- and bilaterally barbed weapon tips was around 10 - 15% of the total implement length at the time of manufacture. These depictions (drawn by Magdalenians themselves), however, suggest that the initial dimensions of barbed point distal extremities may have differed between uni- and bilateral categories, and that those of the latter type may have been significantly longer than the former.

Ethnographic Barbed Implements

While an extensive study of ethnographic implements is beyond the scope of this thesis, it is worth mentioning that a brief survey of the ethnographic literature from around the globe very clearly indicates that there is great variation in distal extremity forms on barbed projectile points (harpoons, multi-pronged spears, barbed spear heads, etc). This observation seems particularly so for unilaterally barbed points, though it is not immediately evident that bilaterally (or even trilaterally) barbed forms generally have a longer distal extremity than their unilateral counterparts.

Thus, even without an exhaustive review of the data, it appears that no simple correlation between bilateral barbed morphology equals longer distal extremity is possible. Cultural ideas about form and efficiency certainly seems to be involved in barbed point design (ethnographically), and therefore, the original design of barbed implements can really only be viewed in terms of their own cultural norms.



Figure 3.11: Distal-mesial fragment of a bilaterally barbed point from Rochereil with decoration on this section (Drawing from Julien 1982:260, Figure 117).

Examples in the Archaeological Sample

In total, 732 'intact' barbed points (i.e. not necessarily with original dimensions preserved but implements which have distal, medial and proximal sections preserved, one or more sections of which may be fractured or have undergone maintenance) or fragments of barbed points were studied over the course of several weeks as part of the larger study presented here. This sample provided a number of artefacts which can be used to produce an informed estimate of original barbed implement dimensions.

Bilaterally Barbed Points

Thirty-six of the 157 'intact' implements or distal-mesial fragments of bilaterally barbed points presented an 'extended' distal form in the sample analysed (Figure 3.12). The La Madeleine (13), Courbet (5) and Laugerie-Basse (5) collections include the largest number of examples, while the largest collection of barbed points studied (La

Vache) had only a single example. The implications of these findings for maintenance will be discussed in detail in Chapters 5 to 7.

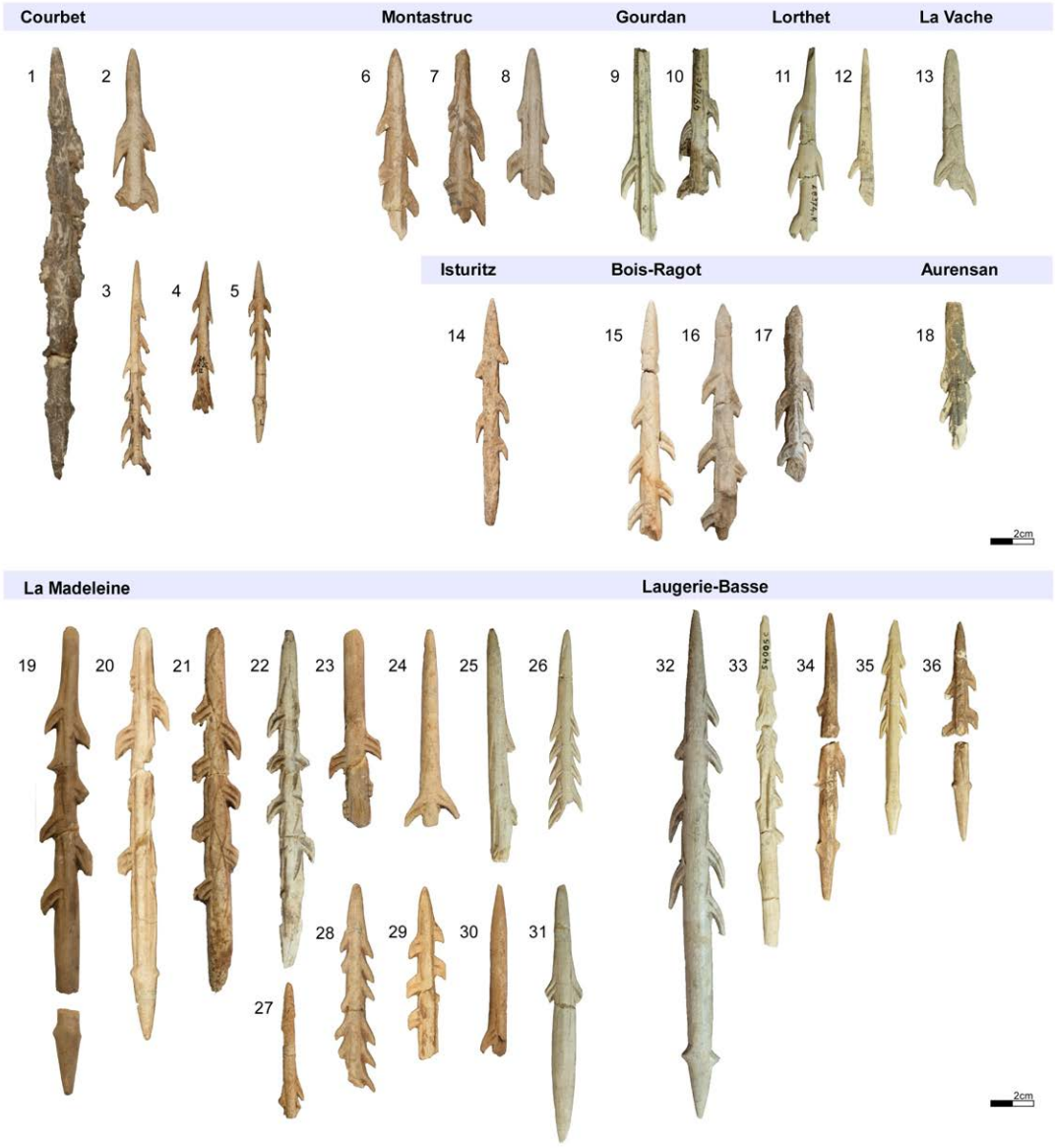


Figure 3.12: Archaeological examples of 'intact' bilaterally barbed points with extended distal extremities. Note that numbers 1 – 3, 5, 6, 11, 12, 14 – 18, 25, 27 – 29, 31 – 36 have had one or more barbs removed in maintenance activities.

Not surprisingly, most of these examples are not complete or 'intact' implements but distal-mesial fragments, 15 having been broken in use as evidenced by the impact fractures to their distal and proximal ends. One of these points also has clear 'retrieval cut marks' (Figure 3.12: 29) on its left side, providing further evidence of its use. No one of the implements survived the archaeological record 'intact' as is common for

projectile points of lengthy dimensions (as opposed to smaller point types such as Lussac-Angles points; see Allain and Rigaud 1986), having suffered post-depositional fractures across their shaft, though a number have been carefully restored by curators (e.g. Figure 3.12: 19, 20, 31, 32, 33, 35).

All but nine of the artefacts have clear evidence for maintenance, either to their distal, mesial (barb removal) and/or proximal sections (Figure 3.12: 1 - 3, 5, 6, 11, 12, 14 – 25, 27 – 29, 31, 32 – 36). The other nine have no clear evidence for maintenance, though we must remember that this does not necessarily mean these implements have not undergone repair during their use lives, only that evidence of this activity may have been obliterated by use-wear and/or post-depositional forces. An example of this 'invisible maintenance' can be found by comparing one of the Montastruc examples (Figure 3.12: 7) which has identical decoration to another found at La Madeleine (Figure 3.12: 22) (discussed below), though with less distance between the distal tip of the point and the start of the decoration on the superior surface suggesting careful resharpening of (at least) the Montastruc example.

Of these 36 identified extended distal point examples, ten exhibit decoration above the first set of barbs (Figure 3.13). This decoration is in the form of engraved designs on the superior surface of the shaft, and in this small sample, the variety of motifs is quite limited.

The aforementioned implements from Montastruc (BM 7) and La Madeleine (MAN 8178; BM CC17) each exhibit two curved lines meeting at a point, with one implement having this design partially erased through resharpening of the tip. A similar design (two parallel lines running down the shaft) is replicated on the example from Gourdan; however, this piece is particularly interesting as it ends in what appears to be a single barb on the right side at the broken tip (MAN 49163). Artefacts from La Vache and Grotte du Bois-Ragot have a series of crosses engraved along the superior surface of shaft and point, while the Courbet artefact along with another implement from La Madeleine (BM CC25) have a series of parallel oblique lines. The final two examples from La Madeleine each have a different design again. The first (BM CC28), having

two curved lines, one on each side of the shaft (above the first barb pair) which curves around onto the superior surface, while the second (BMCC8) has interwoven lines running down from the tip into the mesial section. The final decorated specimen identified in the dataset was recovered from Grotte du Bois-Ragot (MdPL BR512 1094-1098), and differs from the other nine artefacts in that it has small, smoothed 'projections' on the left and right side of the shaft about 15 mm down from the tip. These 'projections' do not appear to be barb scars, but rather a deliberate aspect of design. Engraved crosses down the superior shaft face were also observed.

These ten artefacts are of particular interest for identifying original point form as decorated implements may be argued to be closer to their original design form. From examination of the entire study corpus, it appears that once decoration is partially or entirely erased through maintenance activities, it is rarely if ever replaced by new decoration.

While this aspect of point maintenance will be addressed in Chapters 5 - 8, it should be pointed out here that the large majority of decoration found on or near the penetrating distal edge of artefacts is actually decoration which was engraved on the shaft of the weapon tip but which has subsequently moved onto the active edge through the process of reduction. The examples pictured in Figure 3.13 (also see Figure 3.11 for an additional example) instead offer examples of decoration which were engraved on the original distal section of the implement, and which were 'erased' on rejuvenated weapons thus disappearing from the record.

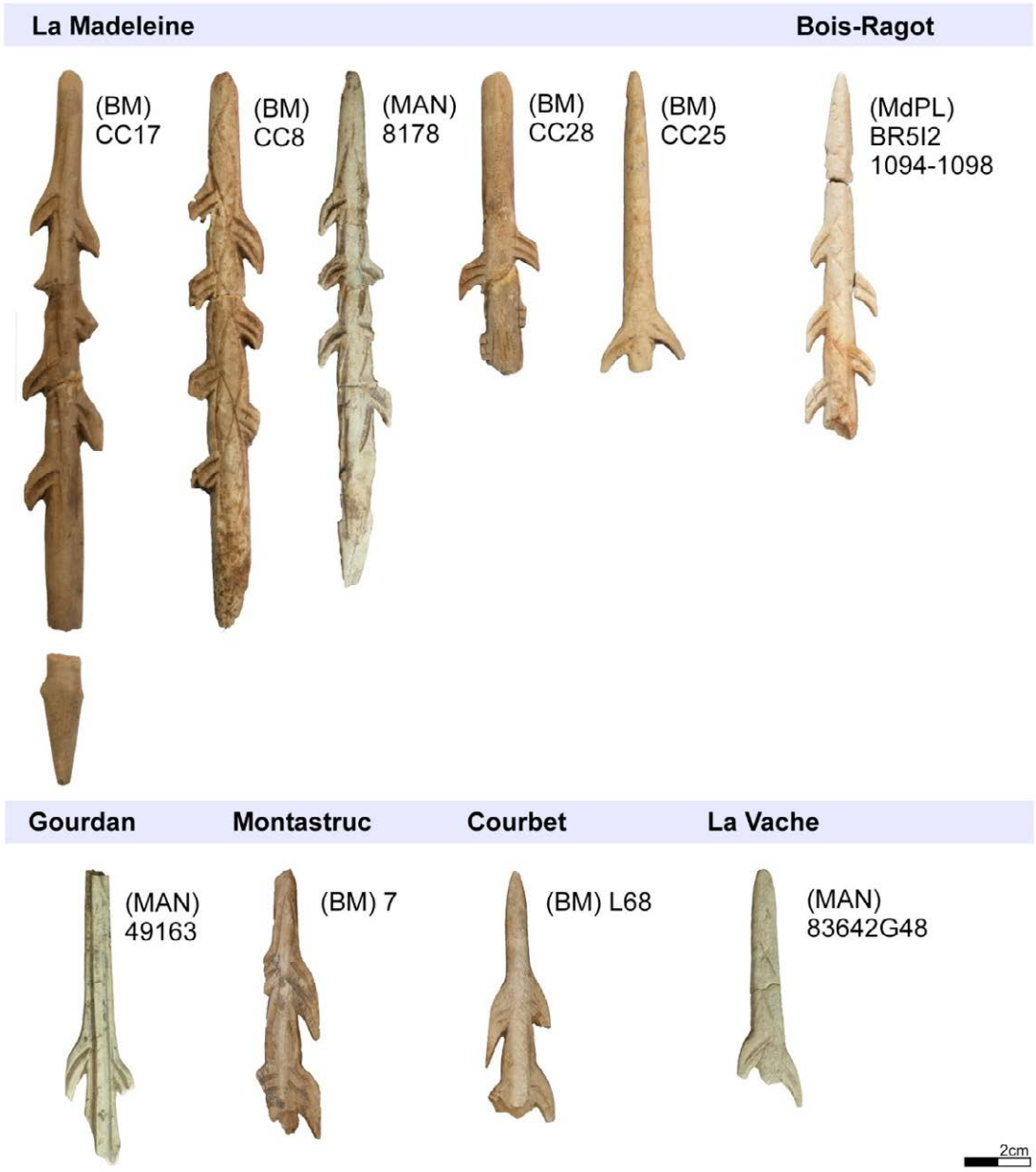


Figure 3.13: Bilaterally barbed point distal-medial fragments with decoration on the distal section indicating near original form. Note that the implements from Gourdan, Montastruc and La Madeleine (BM 8178) have no evidence of maintenance to the tip – all others have resharpening facets and/or chattering indicating resharpening.

Another indicator for distal point design form is careful craftsmanship, indicated by evenly worked sections and smooth, polished surfaces. As previously observed by Julien (1982:65), "if the primary manufacture was careful, the secondary restoration was often hasty" resulting in surfaces which were not ground smooth nor polished, let alone even or symmetrical. While, (as we shall see) in at least some cases, implements

were carefully maintained making it difficult to determine if a particular artefact has been reduced, others were very clearly subject to hasty repair. Each of the examples shown in Figure 3.13, is not only decorated but also even in section and carefully polished, showing careful and skilful craftsmanship. Seven of these ten artefacts also have clear evidence for the rejuvenation of their tips, suggesting that each was originally somewhat longer, a situation also seen for a number of the implements in Figure 3.12 (carefully crafted but with hasty resharpening of the distal tip). Given the evidence for expert craftsmanship and decoration, one could argue that these artefacts may be close to their original dimensions, having undergone only minimal resharpening before breaking in use and discard.

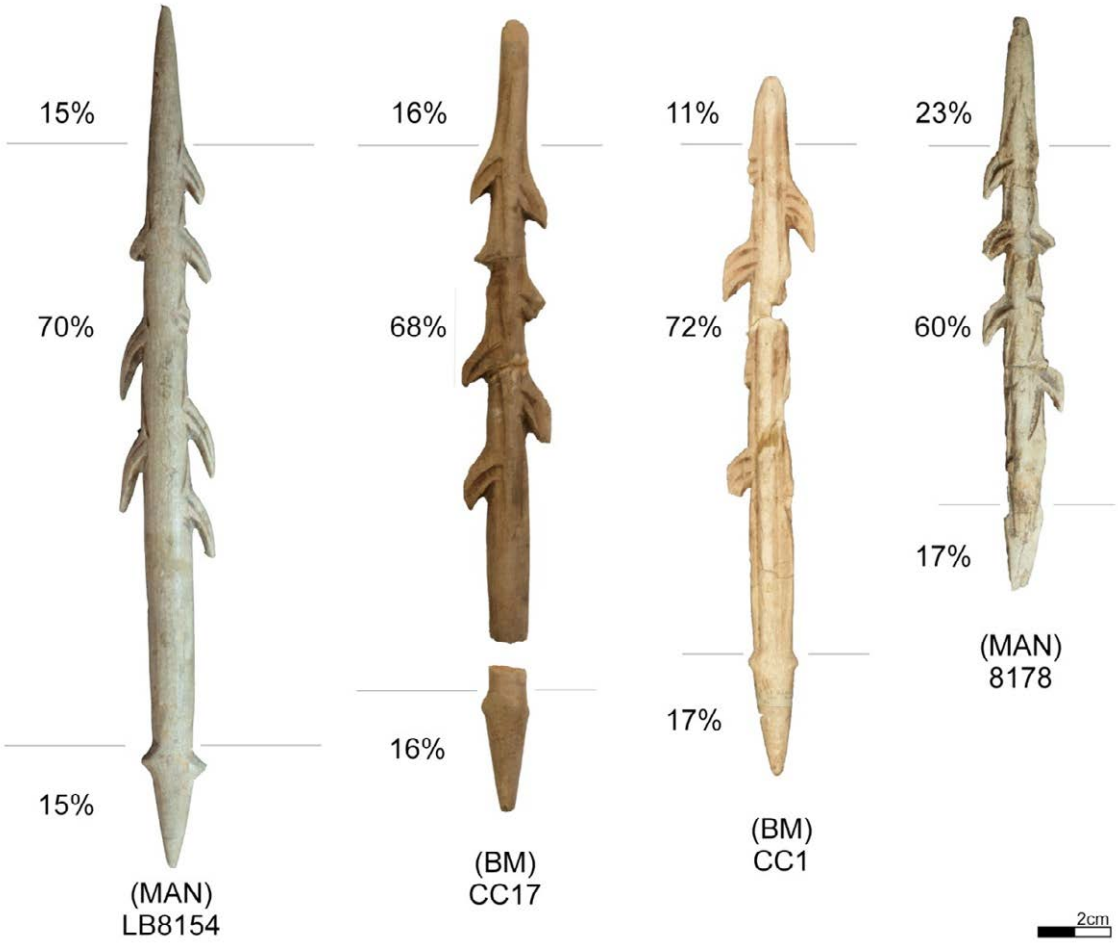


Figure 3.14: Comparison of bilaterally barbed points with similar shaft and barb sizes – 'intact' examples from Laugerie-Basse (left) and La Madeleine.

With so few completely 'intact' examples of bilaterally barbed points surviving to discovery, not to mention the fact that those that are recovered are essentially disposed 'rubbish' (having been broken or considered no longer usable by their owners in prehistory), along with the fact that unresharpened points are rarely recovered from the archaeological record, it is no wonder that estimating original design dimensions for these implements is difficult. Despite these setbacks, however, using the most 'intact' implements identified in conjunction with these decorated distal-mesial fragments, an educated estimate for the original design dimensions might be obtained.

The most 'intact' examples in this sample were recovered from Laugerie-Basse (MAN LB8154) and La Madeleine (MAN 8178; BM CC17; BM CC1). As shown in Figure 3.14, if the proportions for each segment (distal, mesial, proximal) are calculated we find that three of the implements have distal sections which fit well with Julien's (1977, 1982, 1995) 10 – 15% estimate for the distal point, while the last example from La Madeleine (MAN 8178) falls well outside this range at 23%. Similarly, while the proportions of the mesial sections of the first three implements also fall nicely within Julien's 65 – 70% estimate, the La Madeleine example falls outside this range, this time below 60%. Finally, the proximal sections for all four artefacts also fall well outside Julien's 20-25% estimate sitting between 15 – 17%.

Of course, these proportions also do not reflect the initial implement design as all four artefacts display evidence for maintenance (either to their distal tips [BM CC17, BM CC1] and/or barbs [MAN LB8154 and MAN 8178]) and thus, have all been reduced since their initial manufacture. These proportions, which so nicely fit into Julien's estimates (with the exception of MAN 8178), therefore only reflect state of abandonment rather than state of design. Instead, these implements can provide only a starting point for estimating original design dimensions.

Now, if we take the Laugerie-Basse example (as the most complete artefact identified in the sample) and compare it with all the extended form distal-mesial fragments which have similar shaft width/thickness and barb dimensions, we might be able to get an idea of what the original proportion of the distal point was, and therefore, the initial

implement proportions of these tools (Figure 3.15). Use of these particular artefacts to estimate original distal proportion is justified by the aspects described above (extended dimensions, careful craftsmanship and decoration) alongside the evidence of breakage in use and discard (outlined below), all of which argues that these fragments may be closer to their original form than most other distal-mesial fragments identified in the sample.

Each of the artefacts included in this comparison have shaft widths between 9.8 and 12.3 mm, a thickness between 7.6 and 13.2 mm, and barbs of similar dimensions to each other (if not shape as this may be influenced more by style than function). If we assume that each of the distal-mesial examples used in this analysis originally came from implements with similar proportions (within 2 - 4 mm for shaft width/thickness and a similar overall implement length) to the intact Laugerie-Basse piece, and then work out what the distal proportion of each of these fragments would be on an implement of this length, we come up with a range between 13 and 30%.

As with the previous comparison shown in Figure 3.14, each of these distal-mesial fragments have evidence for maintenance (with the exception of the Gourdan piece (MAN 49163). The first example (La Madeleine, BM CC25) even appears to have snapped during a resharpening event (See Chapter 7 for details). The next six fragments (from left to right in Figure 3.15) all exhibit impact fractures to their proximal end suggesting that they were broken in use and were then discarded – probably having been brought back to the site within a carcass and then cut out. This hypothesis is supported by the fact that the La Madeleine example (BM CC57) exhibits a retrieval cut mark on its left side (see Chapters 5 - 7 for additional examples in the wider sample). The final distal-mesial fragment included in this comparison (La Madeleine, BM CC8) also shows damage from impact (crushing to the distal tip), though the proximal end has been fractured post-depositionally. Each of these distal-mesial fragments, with the exception of MAN 49163, has therefore been cycled through at least one maintenance event in which the length of the distal segment was shortened to create a new sharp tip and prevent catastrophic breakage of the weapon.

The 13 – 30% range calculated for distal point length therefore reflects at least some variability caused by the resharpening and reduction of the tip. If we take this maintenance aspect into consideration, we might then reasonably suggest that a 15% proportion for the distal segment might represent the lower limit of original design ideals with a proportion of around 25 - 30% representing the upper limits. This hypothesis nearly doubles the earlier estimates of 10 – 15 % for the distal section.

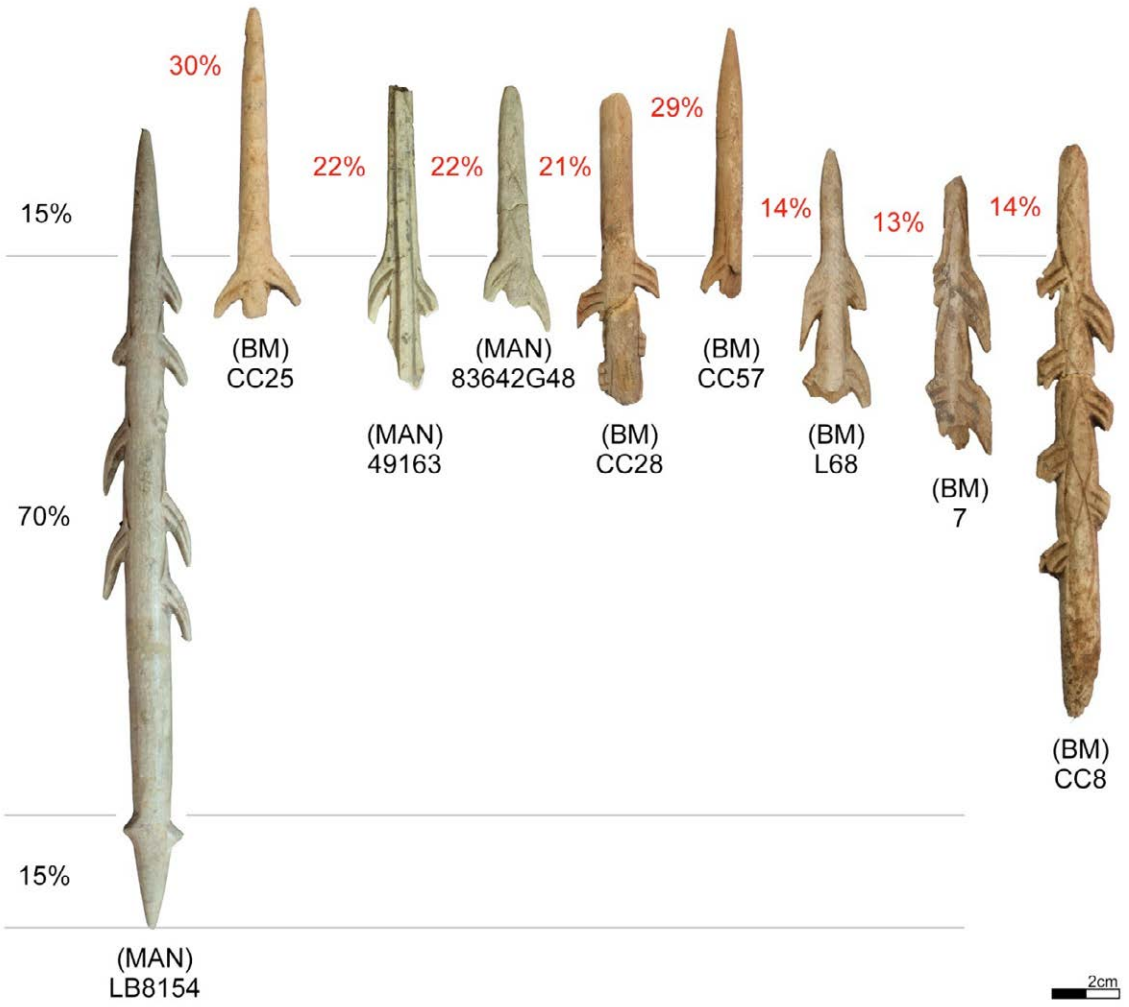


Figure 3.15: Estimating distal extremity dimensions. Note that only the implement from Gourdan (MAN 49163) has no evidence for maintenance.

Of course, it is impossible to know for sure that these pieces are truly comparable, and therefore, that the 15 – 30% estimate remains realistic. However, as argued above, the similarities in the shaft and barb dimensions as well as the condition of these fragments suggests that they are the best examples of original manufactured forms available in this

analysis. This approach, if somewhat roundabout, is probably one of the only ways in which we can attempt to estimate the original form of bilaterally barbed points without recovering a newly made and unaltered implement.

Furthermore, the specimens shown in Figure 3.12 – 3.15 are not the only examples known from published collections. Three other examples described by Lartet and Christy (1875) are illustrated in Figure 3.8 above. Additionally, Julien, in her 1982 monograph, provides drawings of each of the implements included in her extensive analysis with the '*pointes de taille exceptionnelle*' discussed above (see Figure 3.6) providing several more examples. While illustrations provide only limited information, if one reviews these drawings carefully, an additional 17 implements which exhibit such characteristics can be identified. These implements were recovered from Rochereuil, Raymonden-Chancelade, Mas d'Azil, La Madeleine, Lortet, Limeuil, Laugerie-Basse, Kent's Cavern, Fontalès, Bruniquel-Plantade and Les Cambous. Eleven others appear to have been significantly modified through use and maintenance (reworked) to remake an extended distal extremity: Le Soucy, Raymonden-Chancelade, La Madeleine, Laugerie-Basse, Gourdan, and Bruniquel-Courbet. Thus, this extended tip design does not appear to be restricted to either a single site or region, but is instead found in numerous sites spread throughout the Magdalenian territory.

Another indication that a long, piercing point was the original desired form for Magdalenian bilaterally barbed points can be found in several reworked points shown in Figure 3.12. Numbers 25, 27 and 31, all from La Madeleine, and number 34 from Laugerie-Basse are all quite extensively reworked with a new extended point remade. In particular, the first La Madeleine (25) example has had the barbs on its left side carefully abraded away and a long point created. On the next example (27), the top two barbs – one on the left and the other on the right – were ground down to mere 'bumps', likewise creating an extended point above the two next intact barbs. The last example from La Madeleine (31) differs from the previous two in that the proximal end was also reworked. We know that this implement was reduced from a much longer one as the shaft section beneath the lowest pair of barbs flares into a wider oval section, a form common for the barbs-to-base section (between the last (bottom) pair of barbs and the

protuberances which form the top of the base). In this latter, the original base (protuberances and bulb) have been removed and a new conical base worked at the proximal end, while the distal end was also given a conical form point.

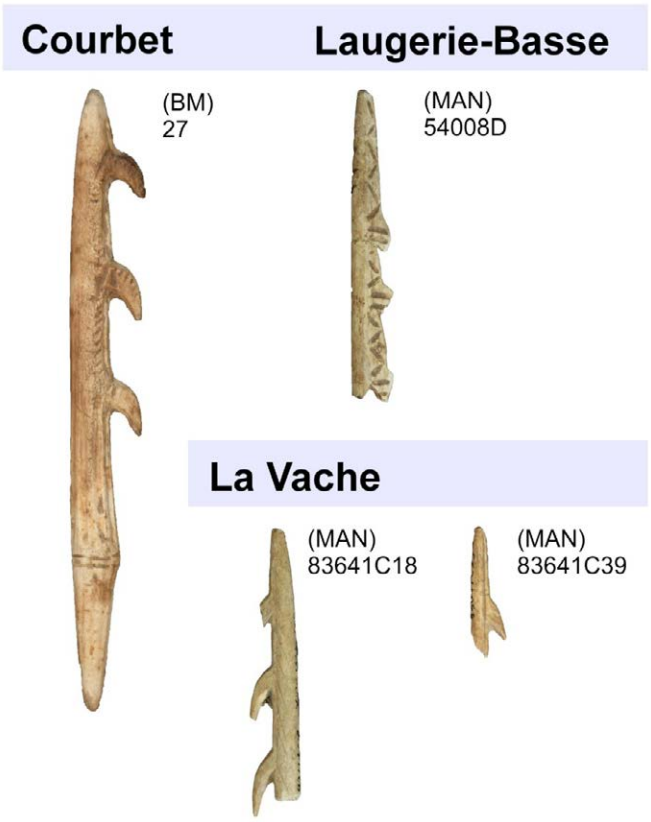


Figure 3.16: Unilaterally barbed points with decorated distal extremities.

For the final example, this one recovered from Laugerie-Basse (no. 34 in Figure 3.12), the point exhibits an uneven surface and partially erased decoration indicating the reduction of the distal edge into the mesial section. In this case, the remade point has resulted in a disproportionately long distal element when compared to the mesial and proximal sections.

Based on the above described and discussed evidence, it can be therefore be argued that rather than Julien's (1977, 1982, 1995) estimate of 10 - 15%, the original distal dimension of Magdalenian bilaterally barbed points might be closer to 20 - 30%. This latter estimate instead agrees with Lartet and Christy's (1875) early observations on original distal form on these artefacts. Thus, with the distal section taking up between 20 - 30% of the total implement length, the mesial section would then constitute around 50 – 60%, and the proximal section between 10 – 20%. These estimates are the dimensions that will be utilised in the analyses presented in this thesis.

Unilaterally Barbed Points

Unfortunately, the original distal form of unilaterally barbed points is even less clear than in the bilaterally barbed implements.

In the sample examined here, 165 unilaterally barbed 'intact' implements or distal-mesial fragments preserved a distal section. Like their bilaterally barbed counterparts, unilateral points are usually collected from the archaeological record as distal-mesial fragments broken and discarded in prehistory, or in several pieces owing to post-depositional breakage. Figure 3.17 presents a sample of those artefacts which exhibited the longest distal sections observed in the dataset. Of these examples, only a handful (between 4 and 7 examples) may be considered as either original or close to original form (no. 12, 13, 15, 18, 19, 22 - 23, 25 in Figure 3.17) based on the same criteria which was employed to identify original form points on bilaterally barbed points (i.e. careful craftsmanship and decoration).

Figure 3.16 presents the only four artefacts which were identified to have decorated distal segments. For these artefacts, no two have the same motif and while all have crushing on their distal tip, only two (MAN LB54008D and MAN 83641C39) have impact fractures on their proximal end – each indicating use in hunting. Not one of these artefacts, however, displays clear signs of maintenance to either their tip or other sections.

While there is no clear evidence for maintenance, each of these weapon tips displays a different distal extremity length. This observation is reinforced in Figure 3.17, where many implements appear to be intact and may also be close to original form as only minor reworking of the distal tip is visible (1-3, 5-6, 11-12, 17, 19-21), and in two cases (12 and 19) barb maintenance undertaken. Overall, in comparison to the previously discussed bilaterally barbed points, the distal sections for unilaterally barbed points do appear shorter. In fact, Julien's 10 – 15% estimate for the original proportion of the distal section seems accurate.

Figure 3.18 presents a number of finer scaled points – those that Weniger would suggest may be for use as arrows or multi-pronged spears – as well as three miniature examples (5, 8, and 9). Only around 40 of the miniature points have thus far been recovered from Magdalenian sites and these artefacts appear to have a restricted geographic

distribution, being found only in southern France and Cantabrian Spain (Lefevbre 2011). It has also been suggested in the literature that these artefacts were children's toys (Politis 1998; see Stapert 2007 for discussion of miniature tools functioning as children's toys). Another possibility is that these miniatures were not functional weapon tips nor toys, but rather examples of 'artisan virtuoso' - where points were are made to demonstrate superior skills in craftsmanship. Thus far we are unable to determine which scenario (functional weapon tip, child's toy or 'artisan virtuoso') is correct.

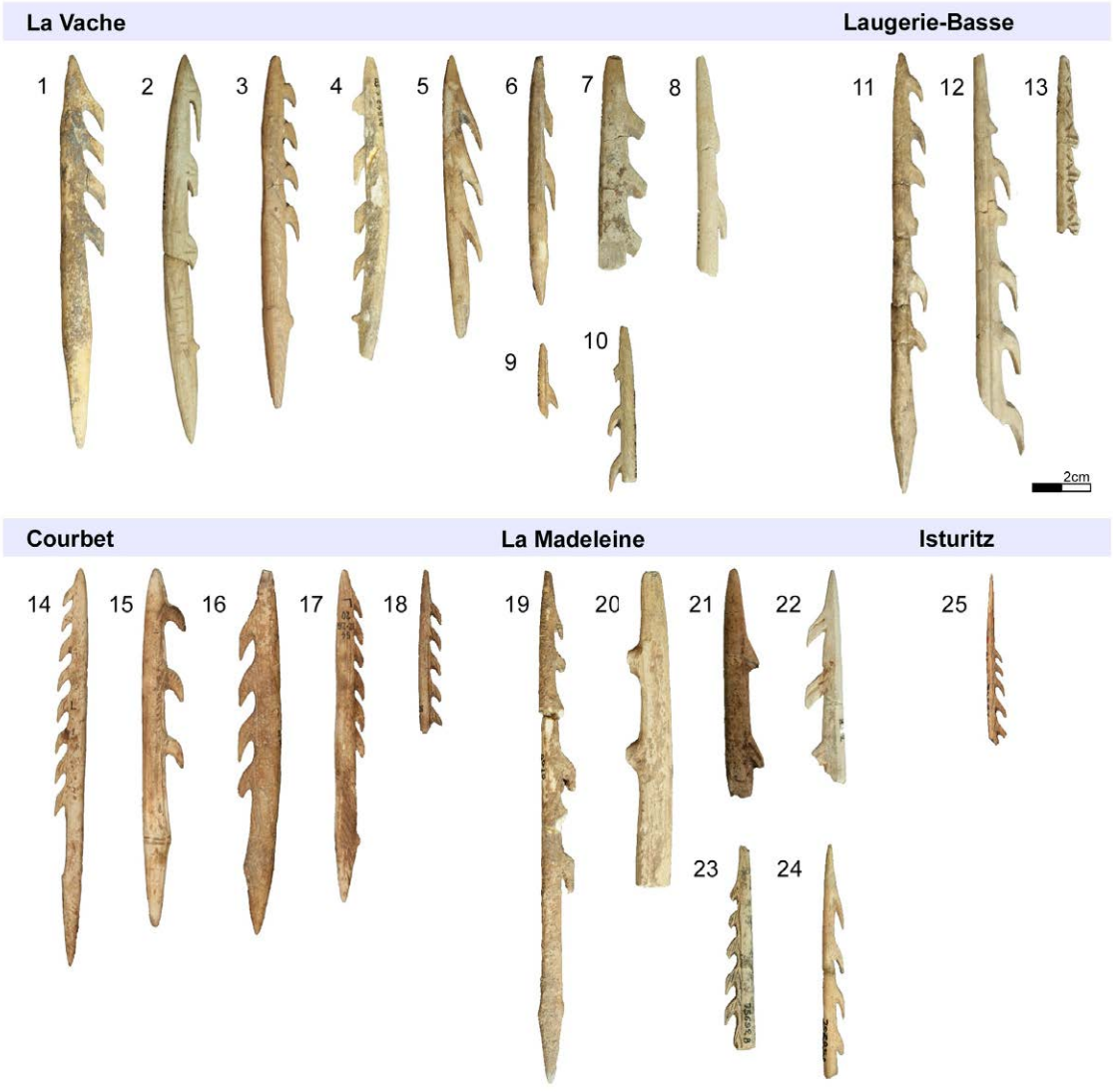


Figure 3.17: Examples of unilaterally barbed points with the longest distal extremities recorded in the sample.

Four of these finer scale points (4, 5, 7 and 8) have quite extended distal ends, approaching the appearance of those found on bilaterally barbed points. Numbers 1 to 3 in Figure 3.18, however, have much shorter though still carefully crafted tips. It is possible that the latter have undergone maintenance resulting in a shorter distal point, though no evidence for maintenance is visible on any area of the implements. It is also interesting to note that on the three 'artisan virtuoso' miniature implements, the distal section is elongated but worked up from the first barb edge (the pointed tip of the barb) rather than from the barb shoulder (where the barb meets the shaft) (as in Figure 3.18: 6). Here again, with these smaller, finer scaled implements an estimate of 10 – 15% for the distal section seems supported.

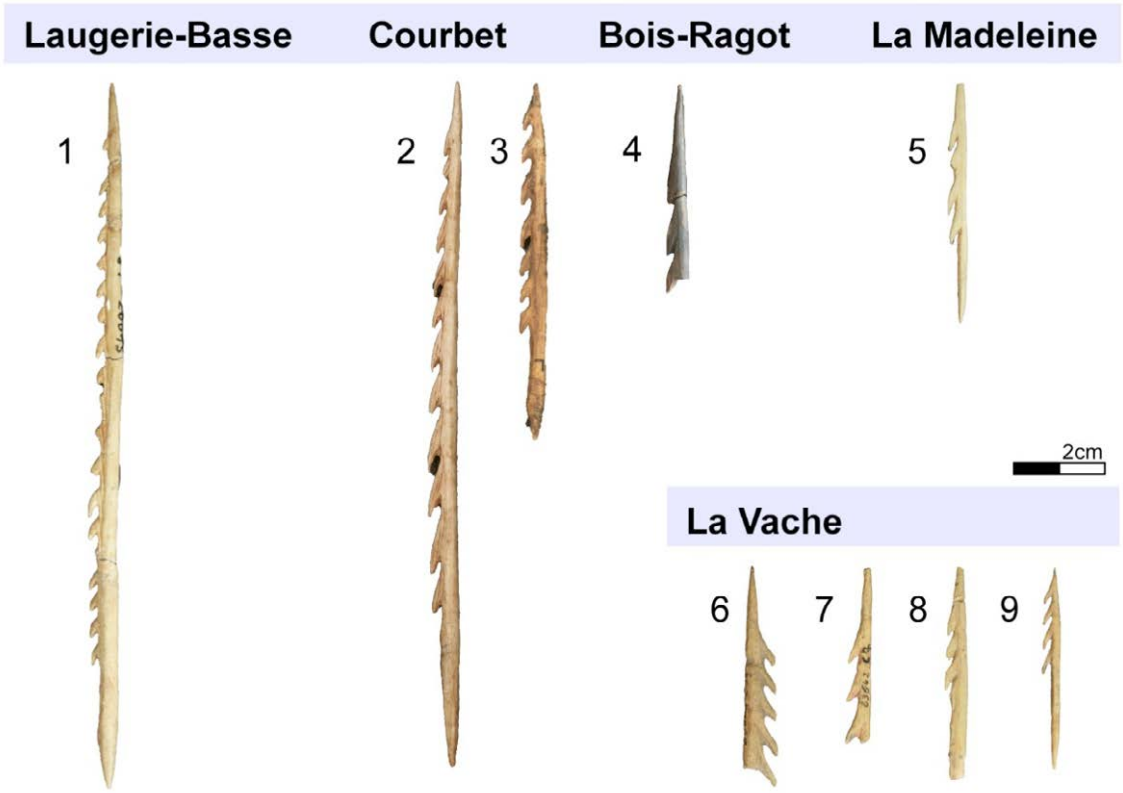


Figure 3.18: Fine scale unilaterally barbed points with intact or near-intact distal sections. Note that numbers 5, 8 and 9 may be examples of artisan virtuoso and may not be functional implements.

From examination of this sub-sample of selected artefacts, as well as the larger dataset, one gets the impression that there may be much greater variability not only in distal

extremity length, but also in the form that these tips take on unilaterally barbed points. For example, some distal tips rise up from the barb shoulder while others are a more triangular form leading from the edge of the first barb. As discussed above, previous research has suggested that two to four functional groups may be contained under the wider unilaterally barbed point grouping, and this situation may well explain the wider variety of distal point forms.

Despite the variability seen in unilateral points, the currently available archaeological evidence (both the artefacts themselves and the contemporary depictions) suggests that, overall, bilaterally barbed points had a much longer tip than unilateral specimens at initial manufacture. From examination of the evidence presented here, Julien's initial estimation of 10 – 15% for the distal segment of both uni- and bilaterally barbed points seems to be only supported for the former (unilateral) type. Bilaterally barbed points, on the other hand, appear to have been originally manufactured with a distal extremity almost twice this length reaching somewhere between 20 – 30% of the total implement length. Experiments with replicas of each of these projectile point types is the next logical step in determining whether these hypotheses are supportable and if so, if there is a functional reason for this apparent difference between barbed types.

Use: Terrestrial or Aquatic Prey?

The great diversity of antler projectile weaponry manufactured during the Magdalenian is suggestive of a flexible toolkit which enabled the exploitation of a great range of fauna. Environmental changes which occurred during this period had an impact on the fauna available during different phases, with reindeer, horse, bison, and saiga antelope being the main prey of the Lower and Middle Magdalenian hunters. However, during the Upper Magdalenian these species progressively left the area and were replaced by ungulates less dependent on cold/dry conditions and open landscapes (by red deer especially). It has also been observed from examination of faunal assemblages, that at the beginning of the Late Magdalenian, there was not only a widening of diet breadth, but a significant increase in the exploitation of small game, especially fish and birds, but also hare, rabbit and marmot (Costamagno and Laroulandie 2004; Jochim 1987; Pétillon 2008a). Furthermore, it has been suggested that Magdalenian territories (in the Pyrenees

at least) may have not simply radiated out (in a circular manner) from the major aggregations sites, but instead flowed perpendicular to the mountain chain in order to offer the occupying groups a range of ecological niches to exploit and thus a wide range of fauna to hunt (Averbouh 2005). Consequently, the variability in the weapons toolkit may not so much be the result of raw material availability as suggested by Julien (1982), but more a response to changing environmental conditions and/or as a deliberate subsistence strategy to exploit a varied fauna.

Determining what type of projectile point was used for which prey is a difficult question to answer without direct association between faunal remains and projectile points. Osseous points found wedged in bones are extremely rare in Palaeolithic contexts with only three cases currently known and none found in Magdalenian contexts (the first is an small distal-mesial fragment of an Aurignacian point found wedged in bone - taxa unknown - from Combe-Buisson. The second from the Epigravettian Siberian site of Kokorevo I where an osseous projectile point is wedged in a scapula of bison. The third are the unilaterally barbed points from Poulton-le-Fylde where one point was found amongst the ribs and another "found lying across the lateral condylar surface of the left metatarsus" [Jacobi *et al*. 2009:15] [Cordier 1990; Letourneux and Pétillon 2008a]). More general associations between archaeological weapons and recovered faunal assemblages might be used to gain insight into their use. For example, the appearance and development of barbed points during the Upper Magdalenian has been linked generally to the intensification of the capture of small animals (birds, fish, lagomorphs etc) at the beginning of this period (Le Gall 1992; Laroulandie 2003; Cochard 2004; Costamagno *et al.* 2008, 2009; Pétillon 2009), though others argue for their use in specialised fishing activities (e.g. Bahn 1983; Weniger 2000).

As mentioned above, ethnographic information has been used to construct typologies of Magdalenian points as well as provide insights into the kinds of prey they were used to exploit. Weniger (1992, 2000) in particular discussed how, ethnographically, harpoons and harpoon arrows are used for hunting sea mammals and fish, arrows for land mammals and multi-pronged arrows/spears for fish and birds (see Magdalenian examples of these types of weapon tips in Figure 3.5 above; also see Pétillon 2008a for

further comparisons between ethnographic and Magdalenian barbed points). Julien (1982) similarly used ethnographic comparison to suggest that the majority of Magdalenian barbed points were probably used in watery contexts, that is, mainly for fishing (also see Allain and Rigaud 1986; Pokines and Krupa 1997; Straus 1992), but also possibly for hunting deer swimming in water, a method that has been observed ethnographically (Rogers and Smith 1981; Townsend 1981).

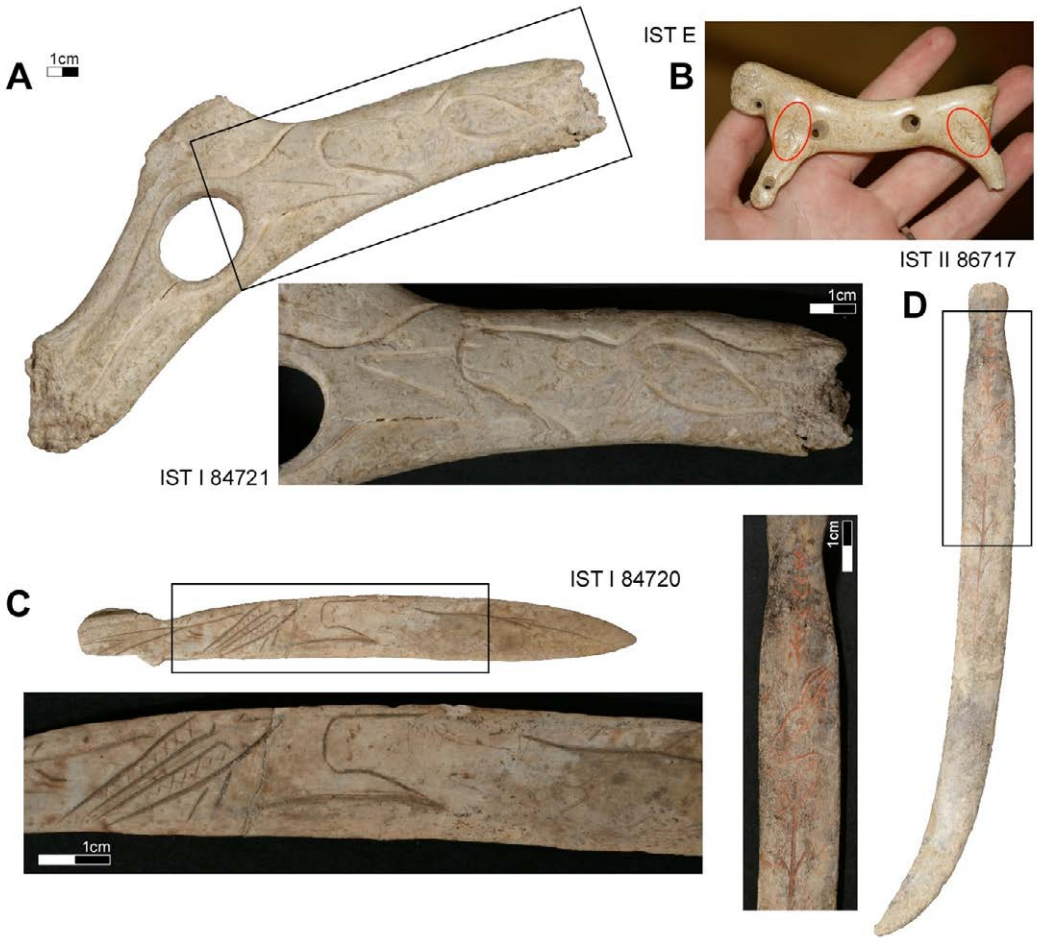


Figure 3.19: Several examples of decorated implements on which 'barbed signs' are shown with terrestrial and aquatic species - all from Isturitz. (A) Bâton percé (possible weapon making tool) with deer; (B) Carved antler cave lion with 'barbed signs' (circled) on its flanks; (C) 'Spatula with' both deer and salmon depicted; (D) 'Spatula' with deer and 'barbed signs'.

Making clear identifications for the use of Magdalenian barbed points is difficult, however, as direct evidence is lacking and even depictions of both land (mostly horse)

and aquatic (salmon) species that are commonly found in association with 'barbed signs' may not be representative (Allain and Rigaud 1992; Baffier 1990; Leroi-Gourhan 1968).

It is also worth considering whether unbarbed points (such as the bevel based points examined herein) might represent a 'versatile' projectile point design where part of its design allowed for its use against a variety of species (Nelson 1997). Barbed points, on the other hand, might represent 'single purpose' points which were neither 'flexible' (in which forms can be altered into new shapes for different functions) nor 'versatile' and were used only for specific targets. Clearly, more data are required before further progress can be made in this area.

How these weapons were launched is another aspect that is still debated among Magdalenian specialists, as there is a documented overlap between the dimensions of ethnographically recorded arrows and spearthrower dart points (Pétillon *et al*. 2011). Despite this, a general consensus exists that the spearthrower ('*propulseur'*) was the key weapon employed (e.g. González Morales and Straus 2009; Julien 1982; Pétillon *et al*. 2011; Szmidt *et al*. 2009). The recovery of spearthrower hooks, the dimensions of the majority of both barbed and unbarbed points, the depiction of these tools in both portable and parietal art, and the advantages of this technology against risk (of both failure and injury) supports the notion that spearthrowers were central to Magdalenian hunting technology. Hand thrown spears are also suggested to have been used (including multi-pronged spears commonly referred to as 'leisters') and there is also some support for the limited use of a basic bow and arrow system (Allain and Rigaud 1992; Breuil 1912; Orliac 1985; Riede 2010; Rozoy 1978; Weniger 1992, 2000).

Summary

Building a useful typology of Magdalenian barbed points and understanding how they functioned in prehistory has proved to be extremely difficult for archaeologists. The great internal variability within those weapon tips grouped under the term, 'barbed points' may be the result of cultural or even individual design preferences, as well as several different functional groups contained within the wider whole. Untangling

functional from design elements in these implements requires extensive ethnographic comparison and experimental testing; however, within the Magdalenian sample examined for this study – it appears that a real and significant difference between the original design form of uni- and bilaterally barbed points exists as far as the distal extremity is concerned. This difference, particularly because it relates to the section of the point most frequently and extensively subjected to maintenance activities, must be taken into account when building a complete and thorough understanding of Magdalenian osseous projectile point *chaîne opératoire*.

Section II
ARCHAEOLOGICAL CASE STUDIES

Introduction

This thesis will begin investigating inter-site and inter-regional patterns of osseous projectile point maintenance and discard through the detailed examination of two archaeological assemblages which are central to our understanding of these Palaeolithic technologies. Chapter 5 describes the Late Magdalenian assemblage recovered from the Ariège site of La Vache, while Chapter 6 presents the Middle to Late Magdalenian assemblage of Isturitz (Pyrénées-Atlantiques). In each chapter, the evidence for weapon maintenance and recycling is described in detail before the possible processes which led to their final discard is discussed.

Chapter 7 ('Twenty-Three Sites: Additional Data on Maintenance and Discard') continues this description of archaeological material through presenting the gathered data from the 23 additional site assemblages, before the total dataset is compared and contrasted in 'Chapter 8: Inter-Site and Inter-Regional Comparisons'.

Before these results are presented, however, the methods used to collect the analysed data and methodology employed to interpret the results must first be outlined. The following chapter ('Chapter 4: Methods and Methodology') will undertake this task.

Introduction

This chapter outlines methods used to collect the data examined in this thesis. Also described are the analyses used to examine these data and the methodological approach taken in interpreting the acquired results.

Methodological Approach

The primary methodological approach implemented in this thesis is the *chaîne opératoire*. This analytical method was proposed by André Leroi-Gourhan (1964, 1968) and built on the pioneering work of the anthropologist Mauss. It examines how an artefact is made, used, and discarded, beginning with the acquisition of the raw materials for manufacture and ending with its final disposal. As well as the manufacturing techniques used to shape the artefact, its mode of use, caching, breakage and repair are all included in this analysis. This method is concerned not only with reconstructing the use life of an object, but also with the decisions made by the society who produced it. The focus is, thus, not only on technological knowledge, but also on individual and community behaviour. The *chaîne opératoire* approach therefore draws together the static material culture that remains to be studied with the dynamic social processes which resulted in their appearance in the archaeological record. This approach has seen widespread implementation in French archaeology since the 1980's (see for example Boëda 1986; Geneste 1985, 1989; Pelegrin *et al*. 1988), and has been increasingly integrated into wider archaeological thought, particularly in studies of lithic technologies.

As stated in the Introduction, this study aims to move beyond the simple description of the morphological form and manufacturing techniques of Magdalenian osseous projectile weaponry, both of which have received ample attention by researchers in the past. Instead, identifying the methods of weapon maintenance and exploring the behaviours which resulted in both this activity and the discard of the implements

constitutes the focus of this work. Of particular interest is whether inter-site and inter-regional differences in antler weapon maintenance and discard were practiced throughout the Middle to Late Magdalenian. Thus, by considering the collated data in the context of Magdalenian technological *and* social systems, this study aims to provide the beginnings of a more comprehensive understanding of Magdalenian life ways. Determining the choices made by the people who used, maintained and discarded the artefacts in this study and exploring the reasons why these choices were made offers greater insights into Magdalenian individual and community views on their technology.

Methods

The following sections describe the strategies used to collate, examine, record and analyse the Magdalenian barbed and unbarbed projectile point dataset presented in this thesis.

Data Sampling Strategy

As was discussed in the previous chapter, both uni- and bilaterally barbed points along with the most common category of unbarbed points from Magdalenian sites will be focused upon in this study. The latter consist of single and double bevel based points, including the regional sub-type of Lussac-Angles points. Thus, five broad categories of osseous projectile points will be examined herein.

Lithic studies have shown that both sizeable site and regional assemblages are central to gaining informed insights into the repair and discard of technology in the past (e.g. Grimes and Grimes 1985; Shott and Sillitoe 2005; Buchanan 2006). In order to construct the most detailed interpretations of the osseous weaponry possible it was necessary to collate the largest dataset possible in the time allowed. This objective was achieved through examination of the extensive collections of Magdalenian osseous weaponry curated in The British Museum (London, UK; [BM]) and the *Musée d'Archéologie Nationale* (St-Germaine-en-Laye, France; [MAN]) over extended study periods. These museums provided not only two of the most suitable archaeological assemblages currently available for research, but also other related collections of well preserved osseous weaponry from a range of geographically dispersed sites.

The sites of La Vache (Ariège) and Isturitz (Pyrénées-Atlantiques) have provided the largest, best preserved, and probably the best excavated assemblages of Magdalenian osseous projectile weaponry recovered to date. In addition to these preservational and sample size factors, Isturitz is a proposed aggregation site ('super site') where regionally dispersed groups are agued to have regularly come together to engage in various social and economic activities. The importance of studying aggregation sites lies in the fact that it was at these locations that "organizational growth or rearrangement and social, as well as material elaboration are most likely to have occurred" (Conkey 1985:318). Furthermore, aggregation sites may have been occupied by large congregations of people and/or for longer periods, increasing the opportunity for broken weaponry (amongst other artefacts) to be deposited and thus larger assemblages to accumulate. Larger assemblages, in turn, have been argued to constitute the best datasets for examining maintenance and discard patterns since it is in larger collections of artefacts that more evidence for rejuvenation should appear and reasons for their discard become apparent (i.e. sample size effect) (e.g. Conkey 1980; Meltzer *et al*. 1992).

In addition to Isturitz, two other sites from which material was examined for this study are also commonly considered to have been aggregation locales: Laugerie-Basse and La Madeleine (Boyle 1996). While the collections examined are only small samples of the larger quantity of material excavated (see below), they can nevertheless provide additional information from sites at which greater diversity of behaviours may be identified.

Finally, it is the increasing belief of the author that La Vache was also an aggregation site, though not for large groups engaged in various and numerous economic and social activities, but rather for smaller groups of (perhaps selected) people focused on the sharing and/or teaching of knowledge regarding projectile point design and manufacture. This idea has only previously been mentioned in passing by Clottes (2003:26), and will be further outlined in Chapter 5 ('Case Study 1: La Vache (Ariège)').

The La Vache collection (curated in MAN) includes all fragments recovered from the site during excavations (see Chapter 5), while that of Isturitz which is curated in the same museum constitutes about 80% of the material excavated from the site. As stated above, these assemblages are the largest collections currently available for archaeological study, and it is primarily for this reason they will form the major case studies in this thesis.

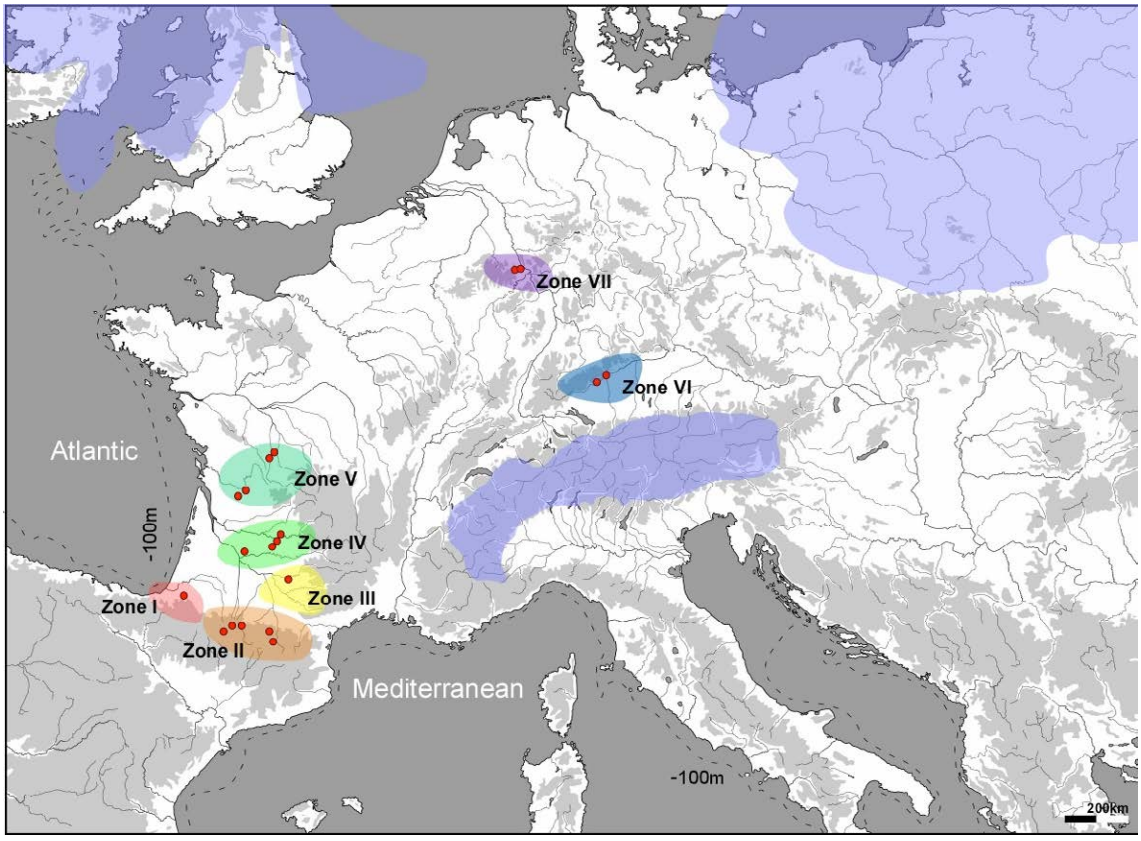


Figure 4.1: The location of sites examined and the extent of each analytical 'Zone'.

To supplement these two central case studies, and to further explore the potential for inter-site and inter-regional differences, a sample of smaller and incomplete assemblages from several regions located around France and southern Germany were also examined. To gather this range of geographically dispersed data, the Pitt Rivers Museum (Oxford, UK) *Musée d'Angoulême* (Angoulême, France), *Musée de Préhistoire* (Lussac-Les-Châteaux, France), *Universität Tübingen* (Tübingen,

Germany), and the *Schloss Monrepos* (Neuwied, Germany) were visited in addition to The British Museum and the *Musée d'Archéologie Nationale*.

Barbed points are far less numerous than unbarbed points in Magdalenian assemblages with only between 1,500 and 2,000 specimens so far recorded in total from all excavated sites (Pétillon 2008). It was therefore decided to examine every available specimen at each of the seven museums visited. This method resulted in the recording of 732 whole and fragmented pieces of barbed weaponry from 18 sites (including those from La Vache and Isturitz) (see Table 4.1 and Figure 7.1). As more than 700 barbed artefacts out of a possible 2,000 were successfully examined and recorded for this study, it can be said that this sample forms a significant proportion of the available Magdalenian dataset.

Unbarbed points, on the other hand, are significantly more numerous in archaeological assemblages and thus one can be more selective concerning which collections to examine. It was decided that the complete (or near complete) assemblages recovered from La Vache and Isturitz (as the largest, best preserved and well excavated collections) should be examined and recorded in their entirety in order to investigate intra-site patterns of point maintenance and discard.

In order to investigate inter-regional differences, collections from several additional sites were required. To this end, the highly weathered (but complete) assemblages of Andernach-Martinsberg and Gönnersdorf (German Central Rhineland), and incomplete site collections curated in various museums and recovered from the sites of La Madeleine, Grotte du Bois-Ragot, Chaire-à-Calvin, La Placard, La Piscine, Grotte de l'Abbé, La Marche, La Tannerie, Fadets, and Hohle Fels were also examined.

In total, an additional 873 whole and fragmented pieces of unbarbed and bevel based points was added to the 1560 pieces found in the La Vache assemblage and the 1582 pieces in the almost complete Isturitz assemblage (Table 4.1).

Table 4.1: The sites from which Middle - Late Magdalenian assemblages of osseous barbed and unbarbed (bevel based) points were examined.

Study Zone	Region	Site	# of Artefacts examined	Types Examined
Zone I Pyrénées - Atlantiques	*Pyrénées - Atlantiques*	Isturitz	1621	Unilaterally barbed Bilaterally barbed Single bevel Double bevel Lussac-Angles
Zone II Pyrénées	*Ariège*	La Vache	1877	Unilaterally barbed Bilaterally barbed Single bevel Double bevel Lussac-Angles
		Mas d'Azil	3	Unilaterally barbed Bilaterally barbed
	Midi-Pyrénées	Aurensan	27	Unilaterally barbed Bilaterally barbed
		Lorthet	2	Bilaterally barbed
		Gourdan	3	Bilaterally barbed
Zone III Tarn	*Tarn*	Courbet	53	Unilaterally barbed Bilaterally barbed
Zone IV Dordogne	*Dordogne*	La Madeleine	455	Unilaterally barbed Bilaterally barbed Single bevel Double bevel Lussac-Angles
		Laugerie-Basse	40	Bilaterally barbed Unilaterally barbed
		Montastruc	8	Bilaterally barbed
		La Tuilière	2	Bilaterally barbed
		Lyveyre	1	Unilaterally barbed
Zone V Poitou-Charentes	*Poitou-Charentes*	La Placard	89	Single bevel Double bevel

Study Zone	Region	Site	# of Artefacts examined	Types Examined
		Grotte du Bois-Ragot	157	Bilaterally barbed Unilaterally barbed Single bevel Double bevel
		Abri de Fieux	1	Barbed point
		Chaire-à-Calvin	112	Single bevel Double bevel Lussac-Angles
		Fadets	2	Single bevel Double bevel
		Le Marche	9	Single bevel Lussac-Angles
		Le Tannerie	4	Lussac-Angles
		Grotte de l'Abbé	12	Single bevel Double bevel
		La Piscine	36	Single bevel
Zone VI Southern Germany	*Swabian Jura*	Hohle Fels	13	Bilaterally barbed Single bevel Double bevel
		Vogelherd	1	Unilaterally barbed
Zone VII: German Central Rhineland	*German Central Rhineland*	Andernach-Martinsberg	124	Unilaterally barbed Bilaterally barbed Single bevel Double bevel
		Gönnersdorf	99	Barbed point Single bevel Double bevel

While perhaps a little haphazard in its design, this sampling strategy resulted in the largest possible sample of accessible barbed points (from the seven visited museums),

as well as sub-samples of unbarbed point data from regionally dispersed Middle - Late Magdalenian sites. In total, 4,751 artefacts were examined for the analyses presented in this thesis.

Measurement, Description and Recording of Artefacts

Both traditional morphometric measurements as well as the examination and description of use wear (including impact fractures) and rejuvenation stigmata were recorded for each of the 4,751 artefacts studied.

Mitutoyo (CD-6″CX) digital calipers with the jaws covered in a layer of plastic coating (commonly known as '*Tool Magic*') to prevent damage to the artefacts were used to measure each implement. The data were entered into a database and photos of each artefact (superior and inferior surfaces plus one or both sides if they exhibited evidence for maintenance, decoration or any other feature of interest) taken at high resolution with a Canon EOS 400D digital camera.

Each piece was first identified as either a barbed point (unilateral, bilateral, or simply 'barbed' if it was impossible to specify further) or an unbarbed point (double-bevelled, single-bevelled, Lussac-Angles, or unbarbed – if the piece was certainly an unbarbed point but further identification was impossible). The dimensions of each section of the artefact and descriptions of evidence for manufacture, maintenance or decoration recorded. Weight was also recorded for every piece. In total, 16 metric measurements were recorded for each artefact as well as 16 qualitative notes (see Table 4.2 and Figures 4.2 and 4.3 for details). Each of these variables has a long history of use in osseous projectile point analysis (see for example Julien 1982; Knecht 1991a; Pétillon 2006), though the identification and description of rejuvenation stigmata largely had to be developed by me.

Table 4.2: Variables recorded for each artefact.

Point Section	Quantitative	Qualitative
General	Total Length	Museum & Museum Number
	Length of Penetrating Section	Excavation
	Maximum Width	Stratum/Square
	Weight	Typology *(Uni- or bilaterally barbed; Single Bevel; Double Bevel; Lussac-Angles; Other Unbarbed)*
		Base Type *(Single Bevel, Double Bevel, Conical, Uni-Ret, Bi-Ret, Triform)*
		Section of Point *(Distal-Mesial, Mesial, Mesial-Proximal, Proximal)*
Distal - Mesial	Point Length	Impact Fracture? & Type
	Point Width	Post Depositional Fracture?
	Point Thickness	Evidence for Maintenance?
		Point Section *(Circular, Elliptical, Flattened Elliptical, Facetted, Quadrangular, Triform)*
Mesial	Shaft Length	Shaft Section *(Circular, Elliptical, Flattened Elliptical, Facetted, Sub-Circular, Triform, Circular-with-Flattened Base)*
	Shaft Width	Impact Fracture? & Type
	Shaft Thickness	Post Depositional Fracture?
	Length of Barbed Section	Decoration?
	Length of Barbs-to-Base Section	Mesial Striations?
		Evidence for Maintenance?
Mesial - Proximal	Length of Base	Base Section *(Quadrangular, Plano-Convex, Concavo-Convex, Biconvex, Triform)*
	Width of Base	System of Retention *(Shoulder, Left Protuberance, Right Protuberance, Left & Right Protuberance, Perforation, None)*

Point Section	Quantitative	Qualitative
	Thickness of Base	Basal Striations?
	Bevel Angle	Impact Fracture? & Type
		Post Depositional Fracture?
		Evidence for Maintenance?

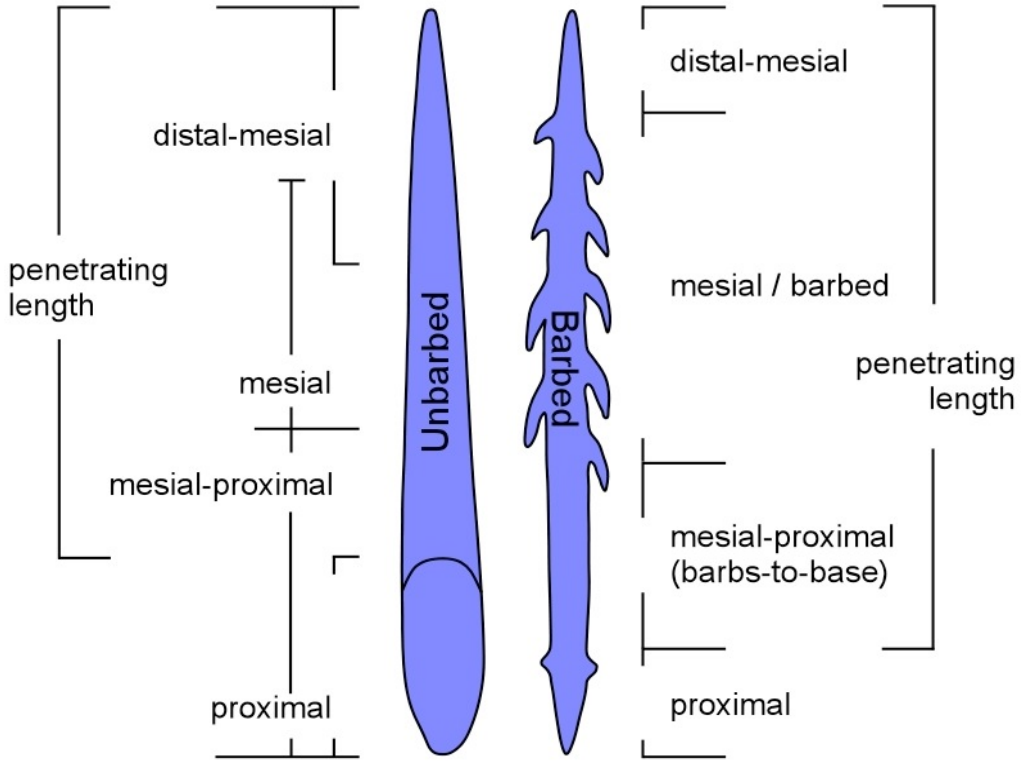


Figure 4.2: Dimensions of the barbed and unbarbed point.

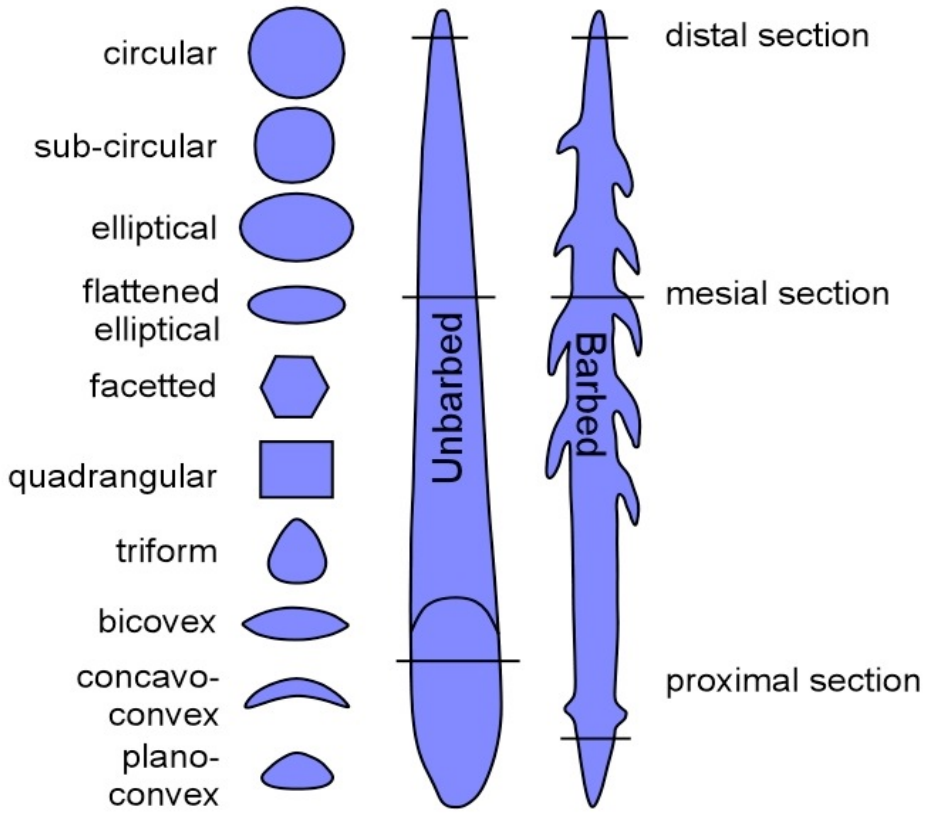


Figure 4.3: Section types for barbed and unbarbed weapon tip: point, shaft, and base.

Identifying Use Wear and Rejuvenation Stigmata

As outlined in Chapter 1, the identification of use wear (including impact fractures) on osseous projectile points is a common aspect of previous technological analyses and experimental programs. Fractures and wear caused by impact with a target are easily identifiable and universally agreed upon by specialists; however, some of these wear patterns (namely crushing, chipping and mushrooming) can also result from other forms of use (such as an awl) and must be considered in conjunction with other aspects of the examined artefact/s (Arndt and Newcomer 1986; Pétillon 2006).

Wear to the distal tip of a projectile point accumulated in use include:

- chipping (Figure 4.4, B): the removal of small, irregular fragments of material blunting the end,
- crushing: the compression of a surface resulting in an uneven and compacted surface, blunting the end (Figure 4.4, C),

- rounding: results from the arrows momentum pushing the tip against the target (Figure 4.4, D), and
- mushrooming (Figure 4.4, E): where the distal edge becomes deformed and takes on a flattened section which shifts material over one or more edges.

Impact fractures suffered by projectile point include:

- bevel fracture (also known as a bending fracture): the detaching of one or more flakes by means of oblique fracture (Figure 4.5, B),
- splinter fracture: a transversal fracture across the shaft which results in a uneven splintered section (Figure 4.5, C). This type of fracture has been referred to as a 'splitting fracture' (Tyzzer 1936), and 'splintering' (Bergman 1987), and
- cleavage fracture (Figure 4.5, D): a longitudinal fracture, having the distal tip for the origin and dividing the point section in two halves.

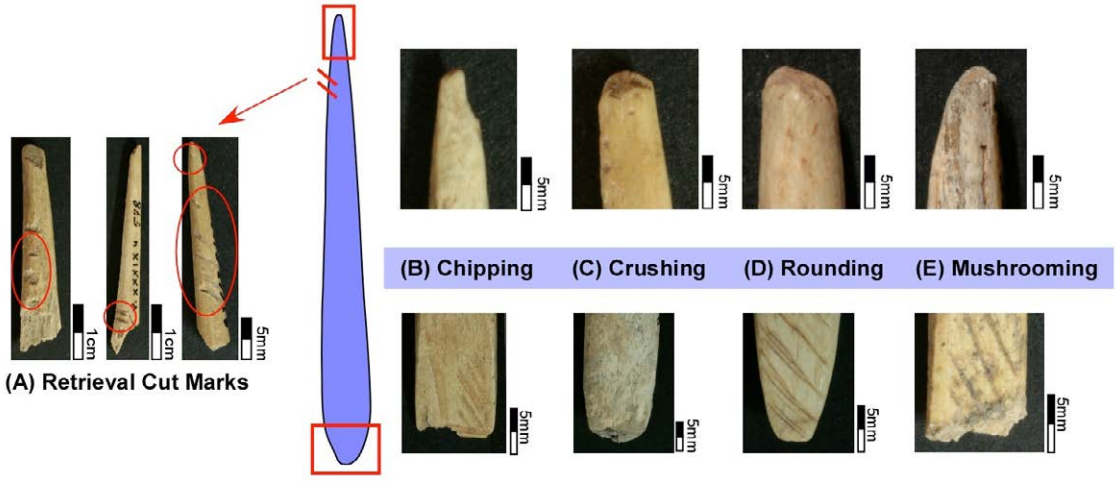


Figure 4.4: Use wear found on osseous projectile points.

Related marks from use as a hafted projectile weapon include:

- retrieval cut marks (Figure 4.5, A): resulting from the accidental 'nicking' of the point while retrieving it from inside a carcass. These cut marks are short, isolated incisions located on the faces and/or edges of the distal-mesial section and are usually oblique in orientation. They are often found superimposed over traces of

manufacture or decoration. These marks were first identified by Pétillon (2006:156-158).

- haft retrieval cut marks: in which the weapon is accidentally 'nicked' while being cut free from its haft, occurring as part of the repair or retooling process (Figure 4.5, A). These cuts, like retrieval cut marks, are short, isolated incisions but are located around the top of the basal section and more frequently perpendicular to the point axis.

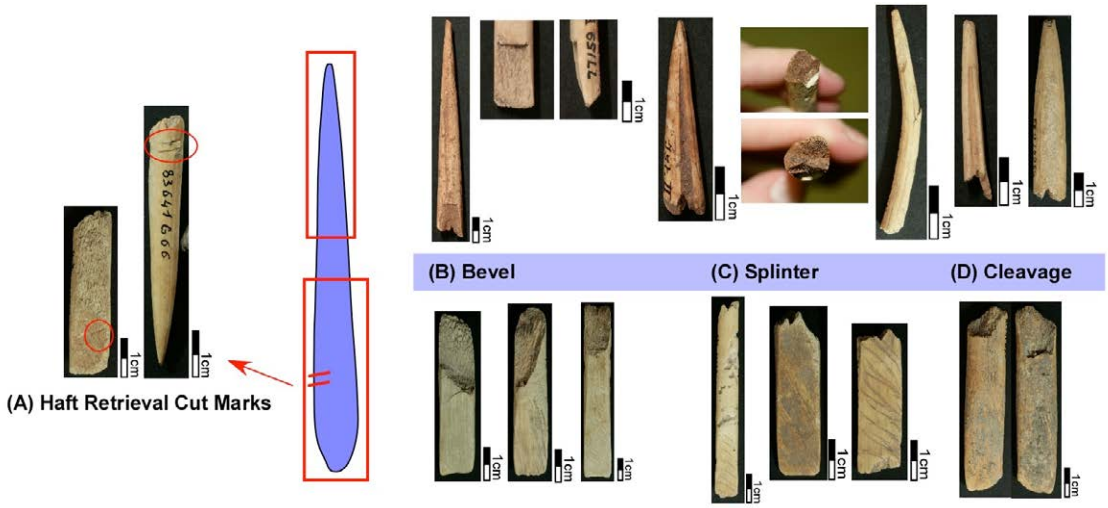


Figure 4.5: Impact fracture types found on osseous projectile points.

These impact fractures and use wear types can occur on one or both the distal and proximal extremities of the projectile point (Figure 4.4 and Figure 4.5). In some cases, several pieces of the same implement which fractured on impact with a target were identified within the assemblage and could be refitted. Post-depositional fractures are also common in assemblages and are usually easily identifiable as they present as a transverse, smooth break across the width of the implement shaft.

For this thesis, an unbarbed point fragment which *did not display a distal tip* (either with or without impact wear such as crushing or rounding) was recorded as a mesial-proximal fragment. Many of these implements exhibited impact fractures on the distal edge, having broken is use and then discarded. Others fractured while in the

archaeological record, had their distal section post-depositionally detached and displaced within the deposit. In some instances the museum staff and/or researchers have matched connecting pieces together; however, in many cases this reuniting of point fragments was impossible resulting in a collection of artefacts which are missing the section (distal point) expected to have been most frequently rejuvenated. Points which still retained their distal tip, on the other hand, were recorded as 'intact' though it must be understood that they did not represent the complete artefact as it was at its time of initial manufacture.

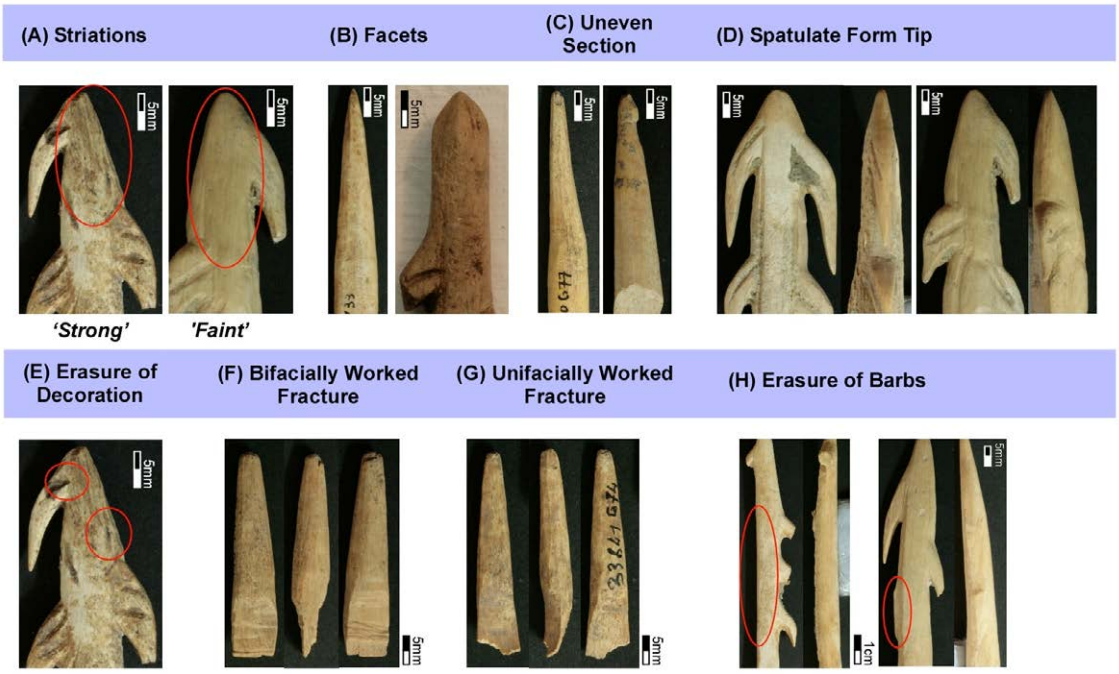


Figure 4.6: Rejuvenation stigmata: evidence for maintenance of osseous projectile points.

While some analysts prefer to use a wide range of terms to describe the rejuvenation and reworking of an osseous projectile point, a minimum of terms will be employed in this thesis. This decision was made in order to simplify discussions and maximise clarity when discussing rejuvenation features which display the same types of stigmata on the distal, mesial and proximal sections of the point. The terms utilised in this study can be defined as the following: *resharpening* is the retouching of a dulled tool to provide a fresh, sharp cutting edge (Hayden 1987; Towner and Warburton 1990), while

rejuvenation is defined as the refurbishing of a broken tool into a functionally equivalent tool. If the product is not functionally equivalent, then it is a 'new' tool that has been created, and has thus been *recycled* (Schiffer 1972; Towner and Warburton 1990).

Rejuvenation stigmata consist of the following:

- striations: these can be split into either 'strong' or 'faint' types (Figure 4.6, A),
- facets (Figure 4.6, B),
- uneven sections (Figure 4.6, C),
- spatulate form distal tips (on barbed points) (Figure 4.6, D)
- full or partial erasure of engraved and/or painted decoration (Figure 4.6, E),
- intentionally worked fractures: either 'bifacially worked' (BWF), commonly known as a '*base raccourcie*' and having been worked by "*sectionnée par rupture après raclage*" (Chauvière and Rigaud 2005) or "s*ectionnement par raclage en diabolo et détachement par flexion*" (Pétillon 2006) (Figure 4.6, F), or 'unifacially worked' (UWF) where the point section is cut from one face only before being snapped (Figure 4.6, G). This type of intentional fracture of a projectile point has also been observed on Half Round Rods (Feruglio 1992; Rigaud 2006). Several reasons have been suggested for the use of this method including the elimination of a broken and/or worn section of the weapon, to shorten its length, waste from manufacture, or to separate a point fixed in the skeleton of game (Bertrand 1999; Chauvière and Rigaud 2005; Mons 1988); and
- full or partial erasure of barbs (on barbed points) (Figure 4.6, H).

As just mentioned, two kinds of striations resulting from the resharpening or rejuvenation of the studied projectile technology were identified in the examined dataset. These different types of marks are likely the result of different techniques and/ or thoroughness of point rejuvenation, though experiments are required to determine exactly what these processes were. A suggested example of different process which may have led to the two broad types of striations (strong and faint) is shown in Figure 4.7 below. It should also be noted here that Newcomer (1974) found in his own experiments in manufacturing bone points, that grindstones "worked well if rather slowly, but

produced striations only and no chattermarks" (1974:150). Redmond and Tankersley (2005) similarly found that striae observed on Paleoindian bone points may be indicative of resharpening or rejuvenation, while Moore and Schmidt (2009) noted that coarse, deep, undulating striations were likely the result of resharpening with a lithic tool on a Paleoindian bone awl. Pétillon (2006) has also cited these long striations found on distal extremities of fork-based points as evidence for the resharpening of the point.

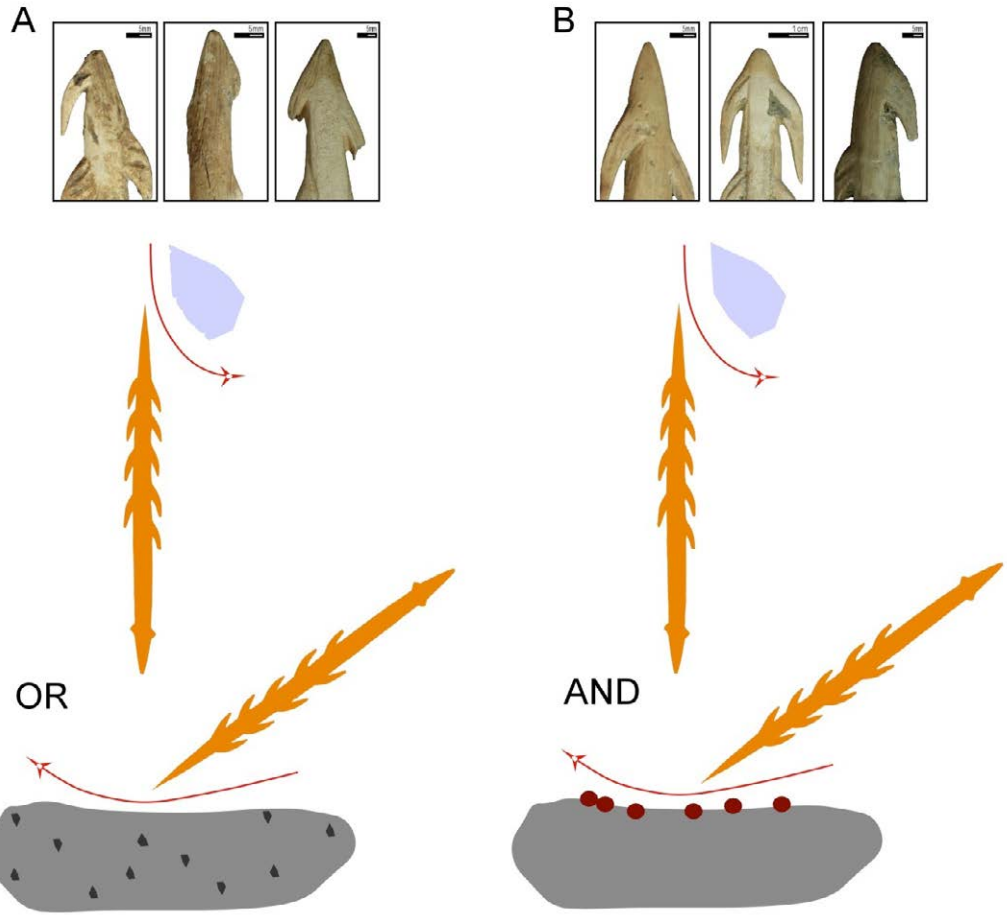


Figure 4.7: Possible methods of distal tip rejuvenation causing the different stigmata observed on artefacts: (A) Causes 'strong' striations: either resharpening with a lithic blade with an uneven edge or grinding using a grindstone with hard inclusions; (B) Causes 'faint' striations: resharpening of point with a lithic blade and then polished with an abrasive such as a grindstone, pigment (or both).

Each osseous projectile point fragment was carefully examined for these above described types of use wear and rejuvenation stigmata, and if identified, the location and extent of wear was recorded. As maintenance strategies are the central focus of this

study, drawings of each weapon tip with evidence for repair were also made in addition to the high resolution photographs previously mentioned.

Data Analysis

As was discussed in Chapter 3, several functional groups may be included in the broader typologies assigned to the Magdalenian barbed and unbarbed projectile weaponry. As such, the examined artefacts will be split into analytical groups in order to attempt to account for these possible functional differences.

In the case of the unbarbed points, both the single and double bevel based point datasets were split into those points with a bevel shoulder width (hereafter abbreviated as 'BSW') below 7 mm and those with a BSW above 7 mm. This 7 mm threshold was chosen as the smaller, slighter implements that could represent arrows or darts all exhibited a bevel shoulder width of 7 mm or below, while the wholly larger implements which are more suitable as spearheads had a bevel shoulder width of 10 mm or above (in the large majority). Few artefacts presented a bevel shoulder width of 8 to 9 mm. This recognition of a smaller sub-set of bevelled points has previously been recognised in the literature (e.g. Allain and Rigaud 1992; Pétillon *et al*. 2011), and is therefore justified in its use for this study.

Barbed points were divided according to their overall morphology using Weniger's (2000) typology. As described in the previous chapter, bilaterally barbed points were found to fall into two broad categories based (primarily) on their overall size. Bilaterally barbed points were therefore classified as either Group A or Group B points, with the former constituting the larger points which could tip either fixed spear heads or mobile harpoons and the latter, the smaller implements which may have been used as arrow points. Unilaterally barbed points were split into Group A (most similar to spear heads), Group B (most similar to multi-pronged spears), or Group C (most similar to arrows) again depending primarily on their overall size. This division of the data allowed for the

identification and differential treatment of the maintenance evidence and discard patterns for each of these possible projectile point types.

To move on to the analysis of the collated data, the first series of analyses focused on the examination of data collected from a single site (principally the La Vache and Isturitz datasets) (intra-site). Each single site dataset was then compared with others on an individual basis (inter-site), before being linked together into regional groupings and compared against neighbouring regions (inter-regional). This hierarchical approach to the analysis follows much the same methodology as those successfully applied in previous studies which have examined both lithic and osseous projectile point analyses in different cultural contexts.

Intra-site and Inter-site Analysis

As was discussed in Chapter 1 ('Osseous Projectile Points in Palaeolithic Archaeology'), the formation of archaeological assemblages that comprise projectile technology is the result of various and numerous economic, technological and social processes. However, it was argued that the majority of projectile point assemblages are the result of and therefore represent retooling activities (rather than caching or accidental loss, etc. in prehistory). As such these assemblages are able to inform on the maintenance and discard behaviours practiced at each site.

In regards to assemblages of debitage that resulted from the rejuvenation of projectile points in particular, Towner and Warburton (1990:319) have pointed out that "because of the relatively small size of a rejuvenation assemblage compared to a production assemblage... rejuvenation debitage may be difficult to identify at habitation sites. It is more likely that such rejuvenation debitage can be identified at locations such as short-term hunting camps where the repair of personal gear is a response to specific situations". While this situation may certainly be the case for lithic technologies, the rejuvenation of osseous weapons results in small slithers of the raw material or even only ground dust, neither which will survive in the archaeological record. We must therefore rely on discarded whole weapons/fragments of weapons as well as the appearance of maintenance tools such as grindstones in site assemblages.

In this thesis, the first aspect considered is the identification of the methods used to repair and recycle the studied weaponry. The common use life (quantitatively) or discard pattern for each of the selected projectile point types (bilaterally barbed sub-groups, unilaterally barbed sub-groups, double bevel based, single bevel based, and Lussac-Angles points) are then considered. Individual tools in a set category could and probably did have different use lives, and therefore, internal variation must be identified and accounted for in determining the common discard pattern for each point category. Mean values for each type may, however, be found (Shott 1989) and these can be used to compare the various point types and site assemblages. By using mean values and common ranges of discard, the problem of identifying where along a use/reduction continuum a particular artefact was located when discarded can be circumvented and a 'collective description' of the technology created (after Shott and Sillitoe 2005). These ranges of common discard will be calculated from the total length of impact fractured (as opposed to post-depositionally fractured) 'intact' and mesial-proximal fragments and presented using bar-and-whisker plots and/or scatter plots.

The second intra-site analysis that will be presented will consist of the proportions of different point types in a single assemblage. Binford (1973, 1977:34) has argued that "important items are maintained and curated, thus their entry into the archaeological record, in terms of frequency, is inversely proportional to the level of maintenance and hence their technological importance, other things being equal." That is, those point types that are rare in an assemblage may reflect types that were carefully maintained and highly curated during prehistory against other point types which were less so (also see Nash 1996). However, popularity of a point type and its frequency of use during prehistory must also be taken into consideration when examining these results.

The abundance of impact fractured fragments for each projectile point category present in an assemblage (e.g. distal-mesial, medial-proximal, proximal sections) along with the frequency of evidence for rejuvenation within and between point section populations are also believed to be informative. For example, when considering unbarbed and bevel based points, a proportionally higher quantity of impact fractured proximal (base)

fragments may indicate that these weapons frequently broke in this fashion during use. Consequently, entirely 'new' bases may be worked onto used points to extend their use life. As these 'new' bases will have erased all indications of any previous base/s, the only evidence of this reworking event will be the fractured fragments returned to the site in the haft (see Chadelle *et al*. 1991; Pétillon 2006 for discussion), though the overall morphology of the point may also be indicative of previous rounds of maintenance. The examination of projectile point section frequency may, therefore, provide evidence for implement rejuvenation, even when rejuvenation stigmata are not evident on the artefacts themselves.

Therefore, for each of the two central case studies (La Vache and Isturitz), the frequency of the following data was recorded:

- projectile point type (uni- and bilaterally barbed, double bevel, single bevel, etc.)
- point section fragments (distal-mesial, mesial, mesial-proximal, etc.),
- fragment measurements (in order to identify pieces considered too short for reworking, recycling, etc.),
- use wear (type and metric distribution), and
- rejuvenation stigmata (type and metric distribution)
- recycled implements (number, secondary use life type, etc.)

In order to investigate possible changes in maintenance and/or discard behaviours through time, the stratigraphic position of each artefact in the La Vache and Isturitz assemblages was recorded (where available). Changing frequencies of projectile point type, fragment types and rejuvenation evidence will be examined and any identified changes presented using histograms.

Intra- and Inter-Regional Analysis

In order to investigate similarities and differences within and between different regions occupied by Magdalenian populations, the studied sites were divided into geographical zones (see Figure 4.1; Table 4.1 above):

- Zone I: Pyrénées - Atlantiques,

- Zone II: Central Pyrénées,
- Zone III: Tarn,
- Zone IV: Dordogne,
- Zone V: Poitou-Charentes,
- Zone VI: Southern Germany, and
- Zone VII: German Central Rhineland.

With the exception of the separation of Pyrenees into two analytical units (Pyrénées - Atlantiques and Central Pyrénées), these analytical zones broadly correspond with commonly utilised groupings of Magdalenian archaeological data, and have a long history of use in inter-regional analyses (i.e. Bahn 1982; Julien 1982). The Pyrenean sites were divided for this study in order to investigate if differences were present and identifiable between those sites which are located more centrally in this mountain chain against those closer to the coastline (i.e. Isturitz).

Owing to the availability of material for study and the time constraints of the DPhil project, the sample size for each region is not equal. Thus, some zones might be represented by only a single site, or in other zones some sites may have complete and/or large assemblages compared to others with only a handful of artefacts. While these samples are clearly not optimum for the purpose, they nevertheless provide the beginnings of a comparative dataset and will hopefully supply indications of functional and/or cultural differences across the Magdalenian landscape which can be further investigated in the future.

Fortunately, on the inter-regional scale, we are able to examine the entire barbed point dataset as a single chronological unit as these weapon tips are currently believed to be restricted to a period of no more than 2,000 years between 13,500BP and 12,000BP (conventional uncalibrated) (Pétillon 2008). Temporal comparison of the unbarbed and bevel based points is more difficult as they are found in both Middle and Late Magdalenian contexts, though there is a change in abundance from single bevel based points during the Middle Magdalenian to double bevel based points during the Late

Magdalenian. Where reliable site chronologies are available, these data will also be compared and contrasted.

For both the intra-regional and inter-regional analyses, the data are compared and contrasted using traditional morphometric (qualitative) comparisons of form and design, as well as statistical comparison of their dimensions and fracture patterns (through the use of scatter plots and box-and-whisker-plots, etc.).

Summary

This chapter has outlined the methods employed to collate and organise the sample of archaeological data examined in this thesis. It summarises the analyses that will be employed along with the methodology used in interpreting the results.

The following four chapters will present these data and acquired results, and will conclude by discussing this information and its implications for the study of Magdalenian osseous projectile weaponry.

Introduction

The La Vache cave is a renowned and intensively studied archaeological site located in the French Pyrenees several kilometres from the Ariège valley (Figure 5.1). Excavated since the mid 19th century, a new room named the 'Salle Monique' was discovered during R. Robert's fieldwork in 1952 and has yielded the vast majority of the osseous projectile elements included in this analysis. The Salle Monique was excavated over a surface area of some 200 m^2 and contained a rich Upper Magdalenian assemblage of osseous implements (c.3,500), lithics (c.36,350) and portable art items in addition to around 142,000 well preserved faunal remains from 29 mammalian and 21 avian species, 90% of which have been identified as ibex (*Capra pyrenaica*) and Ptarmigan (*Lagopus sp*.) (Averbouh 2005; Laroulandie 2000; Pailhaugue 1993, 1995, 1996, 1998).

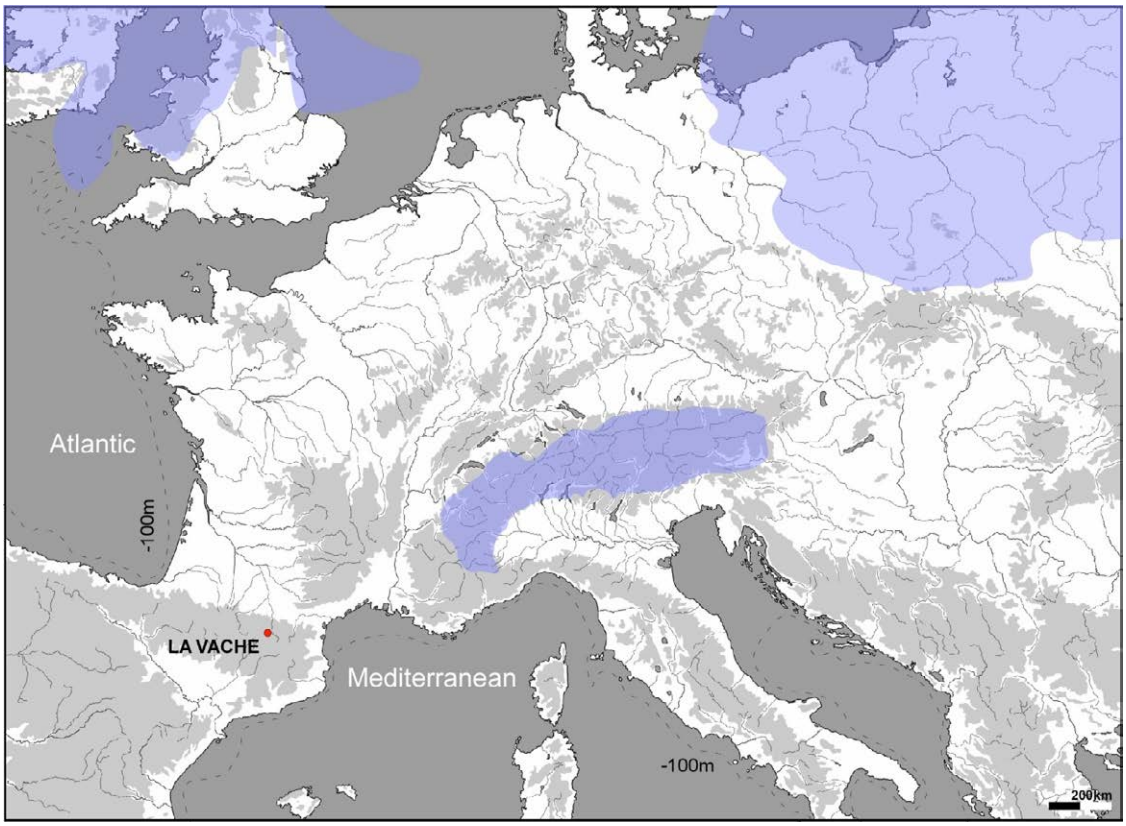
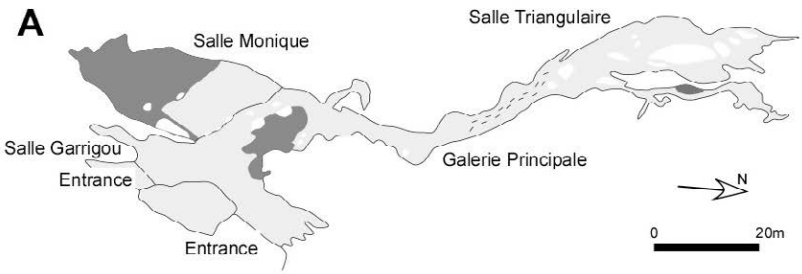


Figure 5.1: Location of La Vache (Ariège), France. Shaded blue areas indicate ice sheets during the LGM. Dotted line indicates the coast line during the LGM.



Date BP	Context	Material Dated	Sample No.
11 650 ± 200		charcoal	Col 336c
12 540 ± 105	Couche 2	charcoal	Gr 2025
12 850 ± 60	Couche 4	charcoal	Gr 2026
12 800 ± 140	Couche 2	bone	Gif 7603
13 490 ± 120	Sq. 269, 109cm	bone	Gif A 96478
13 770 ± 140	Sq. 71, 59.5cm	bone	Gif A 96479
13 650 ± 130	Sq. 71, 115cm	bone	Gif A 96480





Figure 5.2: La Vache: (A) Site map showing the location of the Salle Monique and Salle Garrigou (redrawn after Averbouh 2005); (B) View of the main entrance to La Vache; (C) View of La Vache from the porch of Niaux. La Vache is circled in red. The available ^{14}C dates for the Salle Monique are also shown (Laroulandie 2005).

Analysis of the faunal remains indicates that most of the animals brought to the cave were hunted between September and April (Laroulandie 2000; Pailhaugue 1998). Similarly, examination of the antler debitage indicated that the material originated from adult male reindeer in moult, and was thus collected during winter. The lack of carnivore alteration to the beams indicates that it was used for manufacturing implements shortly after collection (see below; Averbouh 2005). It therefore appears that the Upper Magdalenian use of La Vache was occupied during the autumn and winter seasons of the year.

Lithic raw material acquisition is largely local (Simonnet 1998); however, the presence of *Pecten jacobeus* shells (predominantly a Mediterranean species) along with artefacts manufactured from whale bone (which may have been obtained from either the Atlantic or Mediterranean coast) indicates that exotic raw materials were imported from

distances of more than 100 km (Pétillon 2013). Similarly, fossils were imported from sites up to 200 km or more away to La Vache. Examination of Middle and Upper Magdalenian art styles and lithic technology found throughout southern France also indicates connections between La Vache and sites located at the opposite end of the Pyrenees, as well as the Périgord and Dordogne (Bahn 1982; Delporte 1974). In particular, engravings of ibex and decorated bull-roarers indicate links between La Vache and Isturitz, Lorthet, Lespurgue, and Mas d'Azil, while parietal paintings of animal heads spurting blood are common to both La Vache and Trois-Frères (part of the Volp system of caves) (Gordon 1988). The currently available evidence therefore suggests that La Vache was part of a wide reaching social and economic network during the Late Magdalenian connecting the site, not only with others quite close by, but with sites several hundred kilometres away.

The proximity of La Vache to the famous parietal art site of Niaux (visible across the valley; see Figure 5.2: C), may also play an important role in its use and acquisition of raw material and finished goods, along with the formation of the archaeological assemblages within the site. Investigations at Niaux have shown that both this site and La Vache are contemporaneous (Arnold *et al*. 1992). An interesting observation which has been made by Bahn and Vertut (1997) is that while depictions of animal figures with 'missiles' on or near them are extremely rare in Magdalenian art (only around 3% or 4%) with some caves having not a single example of these images, around a quarter of the animals painted in Niaux have 'missiles' associated with them. The only other cave with this frequency of animal and 'missile' imagery is Cosquer (Marseille) where around 28 of the 142 images are marked. Does this unusual frequency in association between animal and 'missile' imagery at Niaux suggest a connection with the projectile weaponry rich deposits found in nearby La Vache?

Based on the presence of exotic materials, similarities in art forms, site size and deposit density, it has been argued by Bahn (1982) among others, that both Isturitz and Mas d'Azil were the locations of periodic aggregations of usually regionally dispersed peoples. These aggregations are said to have facilitated economic and social activities (such as goods and mate exchange), as well as provide essential opportunities for the

wider community to reinforce social ties reducing risk in hard times. As La Vache has also produced numerous exotic articles, shared art forms and has a dense deposit of faunal and technological debris, it appears that the only difference this site has with the major aggregation 'super-sites' is its physical dimensions (Clottes 2003). Clearly, either individuals or groups of people visited La Vache from a number of locations in the surrounding region (as evidenced by the exotic materials and shared art forms). In fact, it might be suggested that this site was not simply another winter base camp but an aggregation site for a much smaller (more select?) group of people who travelled to the site for specialised meetings on the manufacture and use of osseous projectile weaponry. This theory is suggested not only by the presence of exotic goods and a dense deposit, but by the fact that the raw antler material had to be brought to the site for use (antler was not available 'on the doorstep'; see below) and the variety of stylistic forms the projectile weaponry presents (described below). The proximity to Niaux with its paintings of possible projectile weapons and fauna is also quite suggestive.

While this theory requires more intensive consideration and development (see Langley in prep), the similarities between the projectile technology assemblage recovered from Isturitz (a convincing aggregation site) and that of La Vache (in addition to the above cited reasons) has prompted the treatment of this assemblage as one created by more than one Magdalenian community.

La Vache's Osseous Technology Industry

Analysis of the osseous assemblage has shown that unbarbed points (*sagaie*), barbed points (*harpons*) and *baguette demi-rondes* (half round rods; HRRs) were all manufactured on site, while examples of *bâton percé*, a likely projectile point making tool, were made elsewhere and brought to La Vache (Averbouh 2005). Spearthrowers (*propulseurs*) are, surprisingly, absent from the site. Averbouh (2005) has argued that a seasonal production cycle tied to the cycle of consumption was employed at La Vache with the large majority of unbarbed points, barbed points and HRRs manufactured during the winter from antler beams shed by adult male reindeer. She further argues that these weapon tips were then intended to last until the following winter when replacements would be manufactured. In contrast, *bâton percé* and spearthrowers

manufactured at Enlène (Ariège; around 30-40 km away) are argued to have been manufactured during the spring from antler belonging to female reindeer in moult. These tools are said to have been intended to last significantly longer than a single year.

As was mentioned above, the acquisition of antler for manufacturing technology at La Vache was not readily available on 'their doorstep', instead requiring collection from locations some distance away from the cave (Averbouh 2005). This collection of a raw material central to the Magdalenian toolkit may have been undertaken as part of a 'collective collection framework' in which a number of individuals undertook a cooperative expedition to obtain the required raw materials for the wider groups use (Averbouh 2005) – a suggestion which has also been made for the supply of lithic material (Lacombe 1998). Another suggestion for the acquisition of reindeer antler at La Vache may be trade or social networks between itself and sites where this resource is easily collected (Averbouh 2005). This second suggestion is supported by the appearance of raw materials and finished items brought from the coast, along with an engraving of a seal which itself implies knowledge of the coast more than 100 km away (Bahn 1982). Thirdly, antler may have been collected by the La Vache inhabitants as part of subsistence activities undertaken on the way to the site at the beginning of the autumn (see Bahn [1982] for comments regarding the collection of raw materials during subsistence activities during this period), though additional supplies were likely needed to be procured through either (or both) of the previous two methods once the site was occupied later in the year.

In summary then, in addition to the barbed points, unbarbed points and HRRs manufactured at the site, we should also expect technologies used to hunt and process ibex and ptarmigan (if these are different from those that were manufactured). In addition, technologies for hunting other types of game (if these were not cached at another location prior to their arrival) might also be justifiably expected to be present.

The Barbed and Unbarbed Projectile Points of La Vache

The entire barbed and unbarbed point assemblage which has been recovered from La Vache was examined for this study (100%; barbed n = 321; unbarbed n = 1561) and

included both 'intact' and fragmentary pieces of projectile technology. The implements examined were recovered in majority from the Salle Monique, though a handful of artefacts come from the Salle Garrigou (Figure 5.2).

The following sections will present the results of this analysis, split into 'Barbed Points' and 'Unbarbed Points' and will conclude with an exploration of the implications of these results for the maintenance, reuse, recycling and discard of the antler projectile points at La Vache. These results will be compared and contrasted with those of other sites in Chapter 7 ('Twenty-Three Sites: Additional Data on Maintenance and Discard') and Chapter 8 ('Inter-Site and Inter-Regional Comparisons').

Barbed Points

In total, 321 barbed artefacts were identified and examined. Unilaterally barbed points make up a significant proportion of the La Vache collection (52%; n = 166), with only 11% (n = 34) being bilaterally barbed artefacts (Figure 5.3). Fragments of barbed implements which cannot be positively identified as having belonged to either uni- or bilaterally barbed (37%; n = 116) weapon tips make up the remainder of the assemblage.

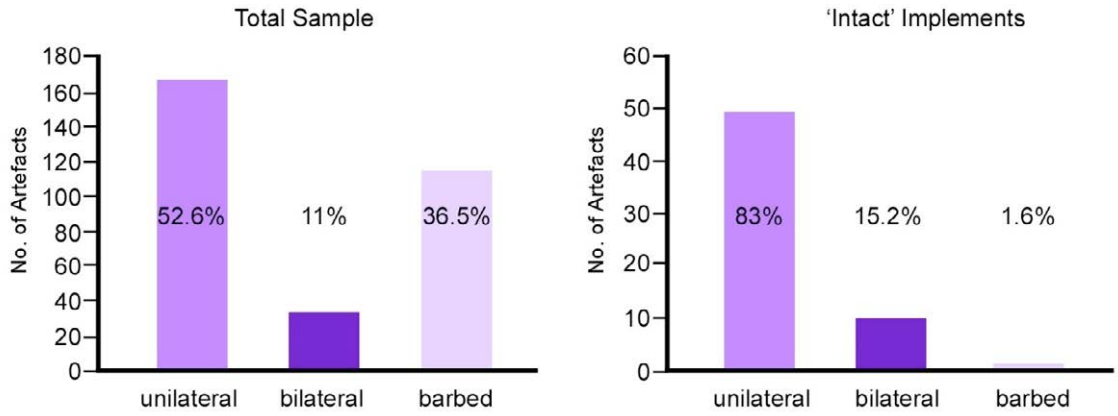


Figure 5.3: Barbed point sample composition for La Vache. Left: Composition of barbed point assemblage. Right: Number of 'intact' implements in each category.

The heavy dominance of unilaterally barbed points in the assemblage reflects the commonly noted regional preference for this technology (over the bilaterally barbed

point) in the Pyrenees. It is importance to note that only two-thirds of the La Vache assemblage can provide useful data regarding the maintenance and discard of barbed weaponry - those unidentified fragments only providing a minimum of data. However, and as will be shown below, this two-thirds of the assemblage provides ample evidence for rejuvenation, re-use and recycling in both uni- and bilaterally barbed implements.

Bilaterally Barbed Points

Only 35 examples of bilaterally barbed points were identified (Figure 5.4) in the La Vache assemblage. As discussed in Chapter 3 ('Magdalenian Osseous Projectile Points') the majority of bilaterally barbed points may belong to a single functional group, and as such, the dataset was split into two categories: Bilateral Group A (n = 34) and Bilateral Group B (n = 1). By splitting the available data into these two sub-groups, it is hoped that any type specific evidence for maintenance and/or discard behaviour will be able to be identified.

Overall, mesial-proximal fragments make up almost half of the bilateral dataset at 41.1% (n = 14), distal-mesial fragments and 'intact' implements constitute another 46.9%, and only four mesial fragments were identified (11.7% of the total dataset). Evidence for maintenance was found on 45.7% (n = 16) of the dataset, while 45.7% (n = 16) exhibit no clear signs of repair. Recycling of these bilaterally barbed weapon tips is quite uncommon, with only 8.5% (n = 3) identified as having had a secondary use life.

The distribution of these projectile points throughout the stratigraphy of the Salle Monique was found to be quite even (Figure 5.4): six artefacts were recovered from Couche 1 (C1), nine from Couche 2 (C2), seven from Couche 3 (C3), and nine from Couche 4 (C4) (from top to bottom of the deposit). Two additional artefacts were recovered from the Salle Garrigou, with the sole example of a Bilateral Group B artefact, unfortunately, designated only to '*toutes couches*' ('all layers') in this room.

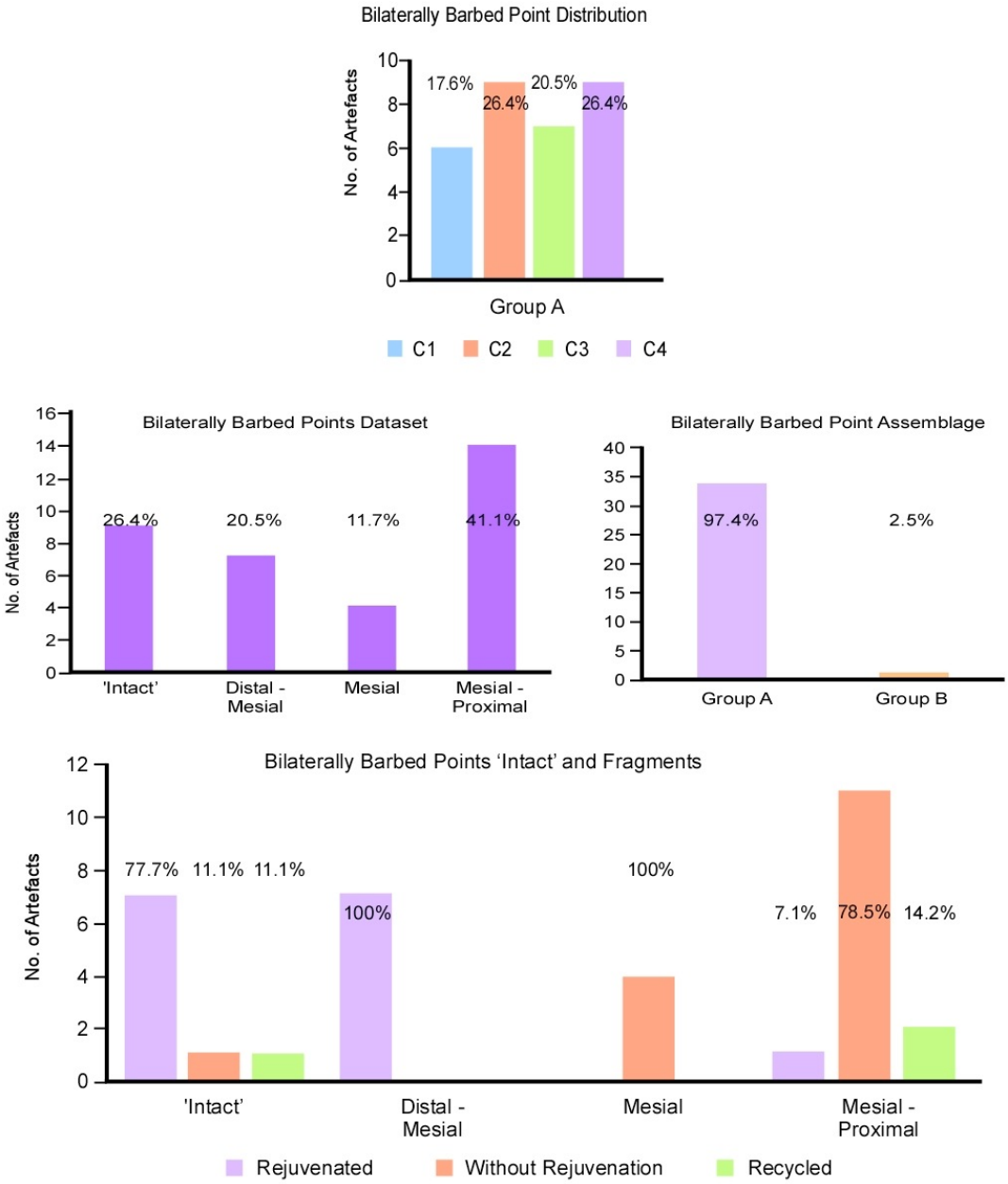


Figure 5.4: La Vache bilaterally barbed point sample composition. Top Left: Composition of the assemblage: (Top Right) Distribution of implements into analytical groups; (Bottom) Occurrence of evidence for rejuvenation, recycling and no evidence for rejuvenation.

Bilateral Group A

Thirty-three 'intact' or fragmentary pieces of Group A bilaterally barbed points were identified in the dataset (Figure 5.5). For such a large site which was repeatedly occupied during the Late Magdalenian, the rarity of this type of antler projectile

weaponry was somewhat surprising, though this result is consistent with regional patterns of barbed point type.

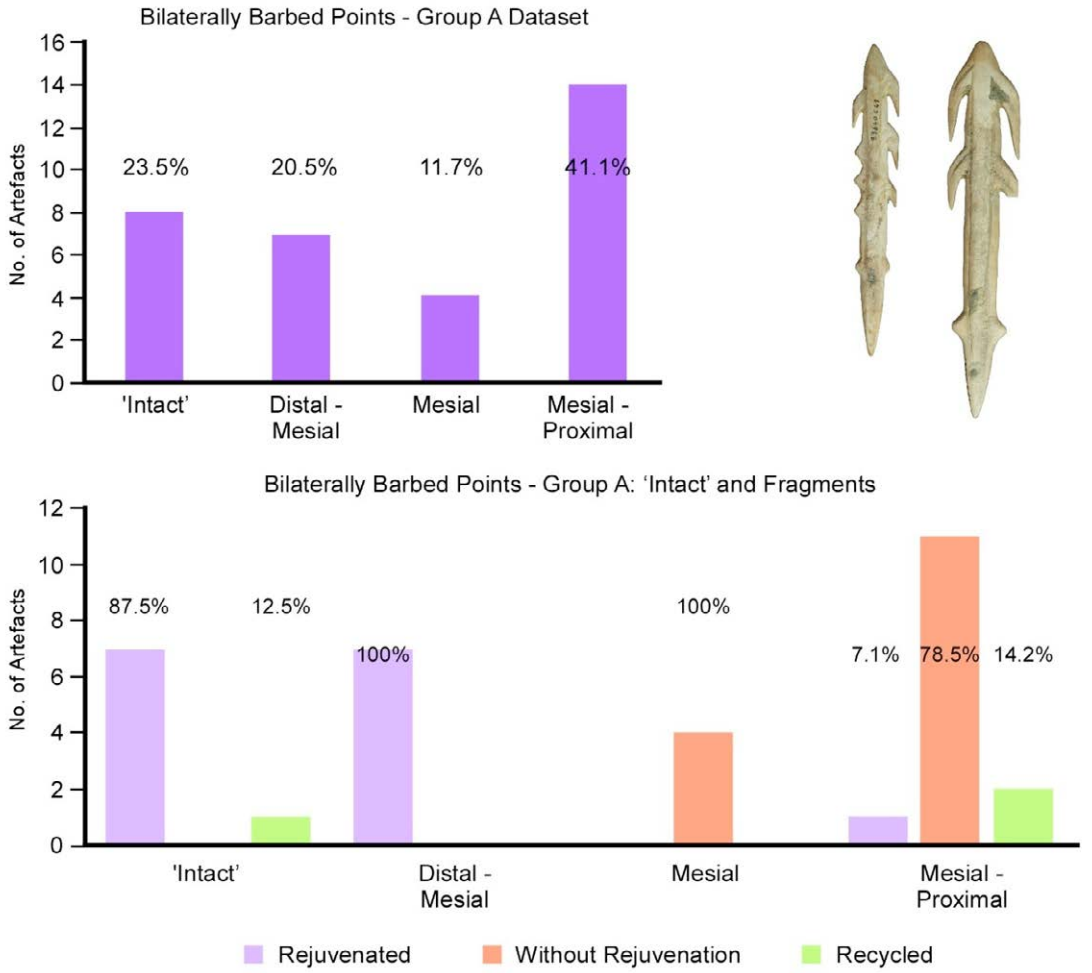


Figure 5.5: Composition of bilaterally barbed Group A dataset: (Top) Composition of the assemblage; (Bottom) Occurrence of evidence for rejuvenation, recycling and no evidence for rejuvenation.

More than 60% of this collection is made up of artefacts classed as 'intact' or mesial-proximal fragments, along with a healthy sample of distal-mesial fragments. These data are consistent with an assemblage created through the discard of used and/or exhausted implements as a result of retooling activities taking place at the site. It is therefore not surprising to find that evidence for maintenance was identified on a high percentage of the 'intact' and distal-mesial fragments, nor is the evidence of recycling weapon tips into tools used to manufacture new weapons (see below).

Methods of Maintenance

Only eight 'intact' Group A points were identified; a single implement from C1, three each from C2 and C3 and one from C4. Each of these more complete implements display clear evidence for rejuvenation, and in several cases, extensive reworking (Figure 5.6).

With the exception of the extensively reworked and recycled mesial fragment which will be described below, the total implement length of the 'intact' Bilateral Group A implements all fall within 24.15 mm of each other (between 95.98 mm and 120.15 mm). Such a small total length range suggests that for this technology, there may be a point at which these weapon tips lost their efficiency in either their function as a weapon and/or a social function (discussed in Chapter 8) and were thus discarded.

Six of the eight 'intact' artefacts exhibit the spatulate form tip typical of resharpened distal tips on barbed technology (Figure 5.7: A, C, D, E, F, G), while two have had barbs carefully removed leaving a scar in the case of MAN 83641C40 (Figure 5.8: A) and a carefully smoothed surface on the left side of MAN 83642C39 (Figure 5.8: B). The original presence of barbs in this space is indicated by the remaining barb at the top left side of the weapon along with the barbs on the right side which would have paired with those removed on the left.

MAN 83641C40 has also had its right bulb protuberance carefully removed (Figure 5.6: A). Evidence for its removal is found both through the simple fact that this implement is a bilaterally barbed point and they were (almost) exclusively manufactured to have bilateral bulb protuberances, but also the partial erasure of an oblique line decoration on the left side of the superior surface. The corresponding line decoration which would have been originally present on the right side (Magdalenian decoration of barbed points being [fortunately] symmetrical) has been completely erased (Figure 5.8: G).

Another example of erased decoration was identified on the top right barb of MAN 83642C44 (Figure 5.7: B), though in this case it was only partially erased, leaving part of the single deep line which was engraved over the barb shoulder.

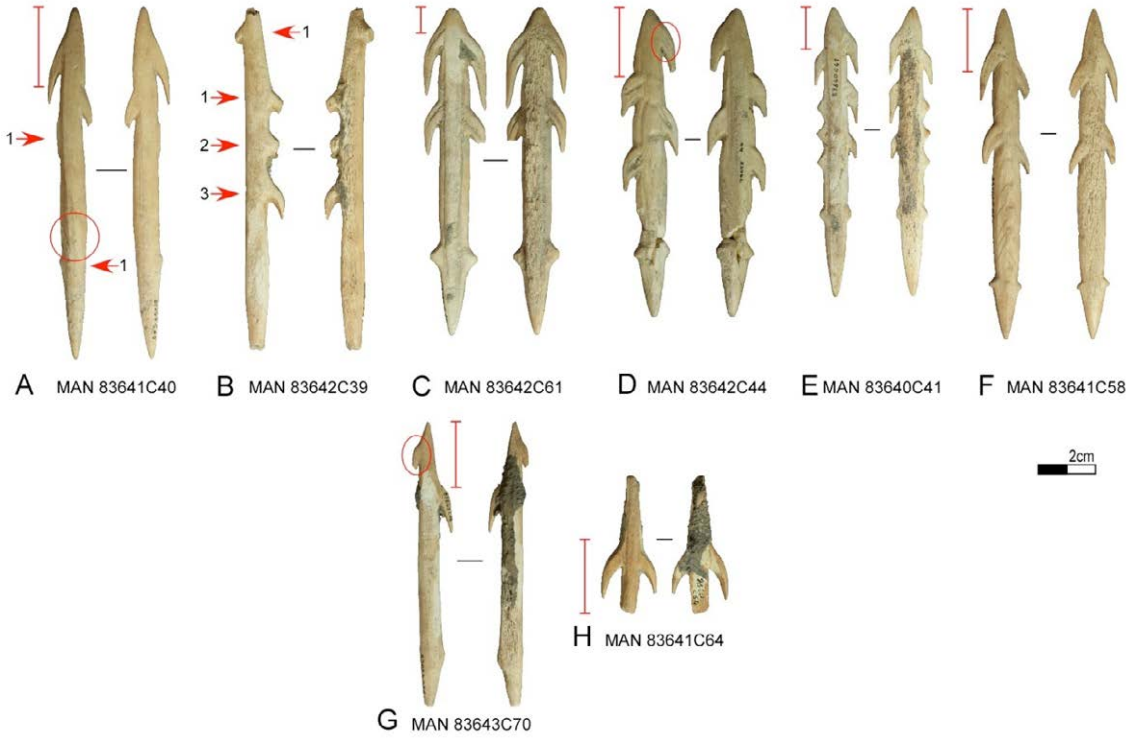


Figure 5.6: 'Intact' bilaterally barbed points recovered from La Vache. Red brackets indicate spatulate tips and lines. Red circles indicate either the erasure of decoration through reworking, or in the case of MAN 83643C70, the working of a new barb.

Three implements are particularly interesting for an examination of maintenance activities at this site. The first is MAN 83643C68 pictured in Figure 5.12 and Figure 5.8: E. This artefact provides a rare example of an implement which has had a single barb altered so that a newly resharpened distal tip can be accommodated. Examination of the other six barbs found that their heights ranged between 7.68 mm and 9.53 mm (average 8.85 mm). The top left barb, however, is only 4.43 mm in height. Additionally, each of the six proximal barbs display two engraved lines on each surface (superior and inferior), while the top barb has only a single line on each surface, along with the remnants of a second line at the very top of the superior surface. This difference in height and evidence for the partial erasure of engravings on each side of the barb therefore indicates the alteration of this part from its original form at the time of manufacture. This very careful reworking of the top barb is in distinct contrast to the hasty resharpening of the distal tip which indicates that these activities may have been undertaken in separate maintenance events.

The second interesting case is MAN 83643C70 which appears to have originally been manufactured as a unilaterally barbed point, and only at the end of its use life, was reworked into a bilaterally barbed point (Figure 5.6: G). This change in typology is evident from the reduction in shaft width at the distal end of the implement - undertaken in order to not only produce a new spatulate form tip, but also to construct a small, roughly worked barb on the left side. These two factors in conjunction with the single (right side) basal protuberance, makes it possible to identify the reworking of an implement originally manufactured as a unilaterally barbed weapon tip.

The third implement (MAN 83641C64; Figure 5.6: H) is a short artefact with only a single set of symmetrical barbs and a single bevel with oblique lines on the inferior surface. This form makes it immediately obvious to the analyst that it was either reworked from a mesial fragment (as its total size could easily have fitted into the size bracket common for mesial bilaterally barbed fragments) or a distal-mesial fragment. Furthermore, four short oblique lines are clearly visible on the right side of the superior surface (Figure 5.7: F). These lines are consistent with a common shaft decoration found on Late Magdalenian barbed weaponry and may indicate that the long, conical point was reworked from a mesial fragment. Thus, this point may have been fashioned from either a distal-mesial fragment which had been previously reduced, or purely a mesial fragment scavenged and made use of when no suitable alternative was available.

Thus, while only eight 'intact' implements (those that preserved a distal, mesial and proximal section) were included in this Bilateral Group A dataset, they nevertheless provide a range of information regarding the maintenance of this technology at La Vache.

If we now move on to examine the wider Group A dataset including the fragmented pieces, we find that of the 15 artefacts which preserved a distal-mesial section ('intact' implements and distal-mesial fragments), 12 (80%) display a spatulate form tip. While a series of experiments need to be undertaken in order to be able to better understand the creation of the rejuvenation stigmata evident on these implements (as described in

Chapter 4), it is evident that some weapon tips were more carefully resharpened than others.

Half of the spatulate tips are evenly worked into a symmetrical, curved section point (50%; n = 6) (e.g. Figure 5.6: C; 5.7: C), while the remaining half, were not as carefully executed leaving uneven surfaces and unsymmetrical sections (e.g. Figure 5.7, B, D, E, G). Striations are visible on all but one of the spatulate form tips, MAN 83640C41 (Figure 5.6: E; Figure 5.7: H) which has been carefully resharpened to 7.92mm above the top barb. Both the superior and inferior surfaces of the distal tip on this implement are extremely regular, smooth and sharp. A single facet from the resharpening of this point is visible on the left edge and left side of the inferior face, providing evidence apart from the point's overall morphology that this section has undergone rejuvenation.

Striations from the resharpening of the distal tip are visible on the remaining 11 implements, though their appearance varies somewhat (compare the implements pictured in Figure 5.7: A – G with the exception of F) between 'strong' striations (Figure 5.7: A, D, E, G) and the much fainter striations (Figure 5.7: B, C) found on five others. The three tools which do not display a spatulate tip also do not display striations, though in the first case the artefact has suffered quite severely from post-depositional processes and additionally has a significant portion of its surface covered by breccia (MAN 83640C24, Figure 5.11). The second is the reworked mesial fragment described above and pictured in Figures 5.6: H and 5.7: F. The third and final implement, that is neither spatulate nor exhibits striations on its distal edge is MAN 83642C39 pictured in Figure 5.6: B. The tip of this implement is carefully formed and more conical in section than what would normally be considered 'spatulate', though the top barb is situated close to the edge (less than 1cm) suggesting (in conjunction to the carefully removed barbs described below) that this implement has been reduced through the resharpening of the distal tip. This last implement, then, provides a good example of how one might identify a distal section which has undergone maintenance even though no direct evidence (such as striations or facets) is visible.

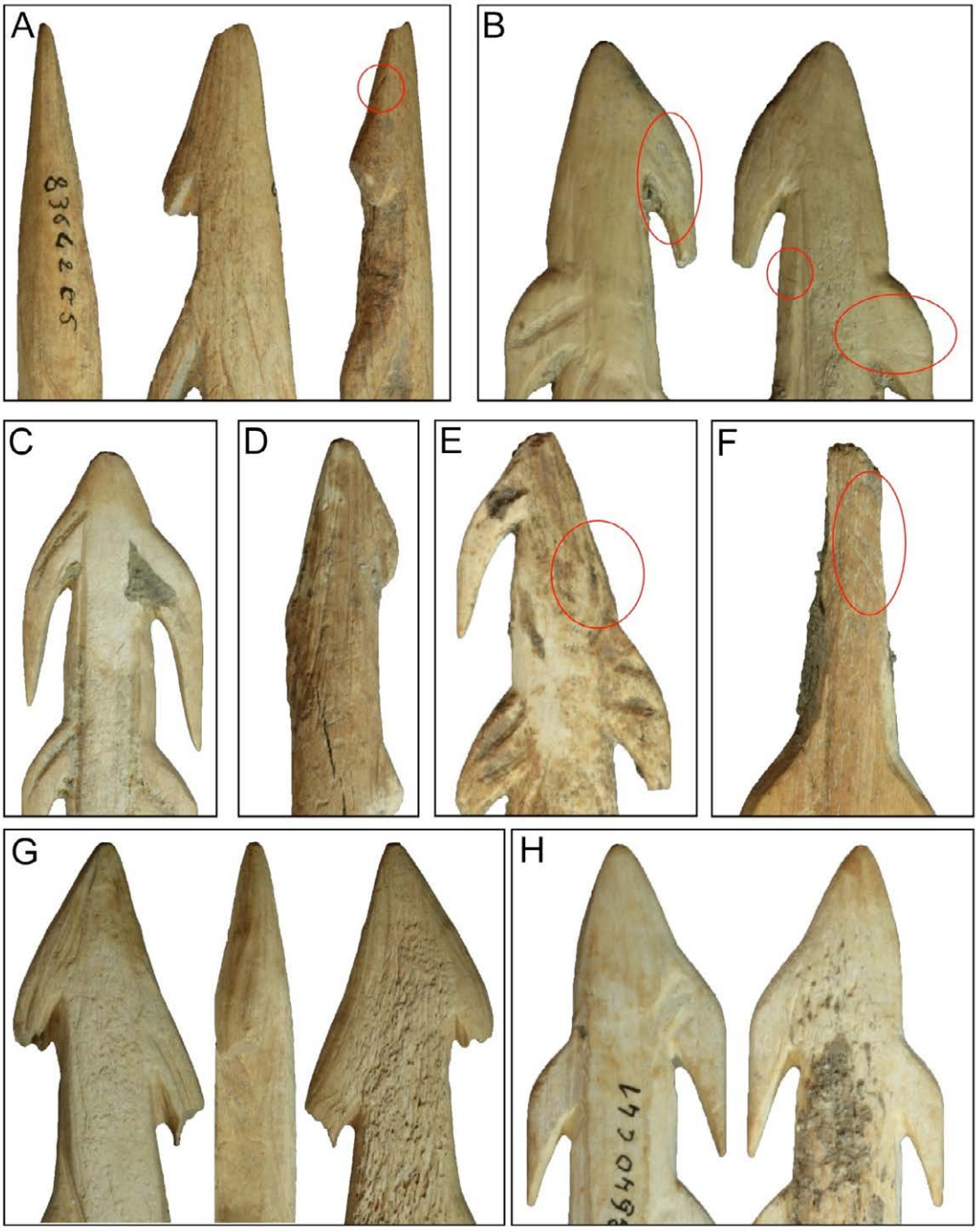


Figure 5.7: Detail of rejuvenation methods to distal-mesial sections of bilaterally barbed points recovered from La Vache. (A) MAN 82642C5, red circle indicates a retrieval cut mark; (B) MAN 83062 – 44, red circle on the superior face outlines the partial erasure of barb decoration, those on the inferior face – retrieval cut marks; (C) MAN 83642C61; (D) MAN 83643C25; (E) MAN 83643C68, circle outlines decoration partially erased; (F) MAN 83541C64, circle outlines former shaft decoration; (G) MAN 83642C36; (H) MAN 83640C41.

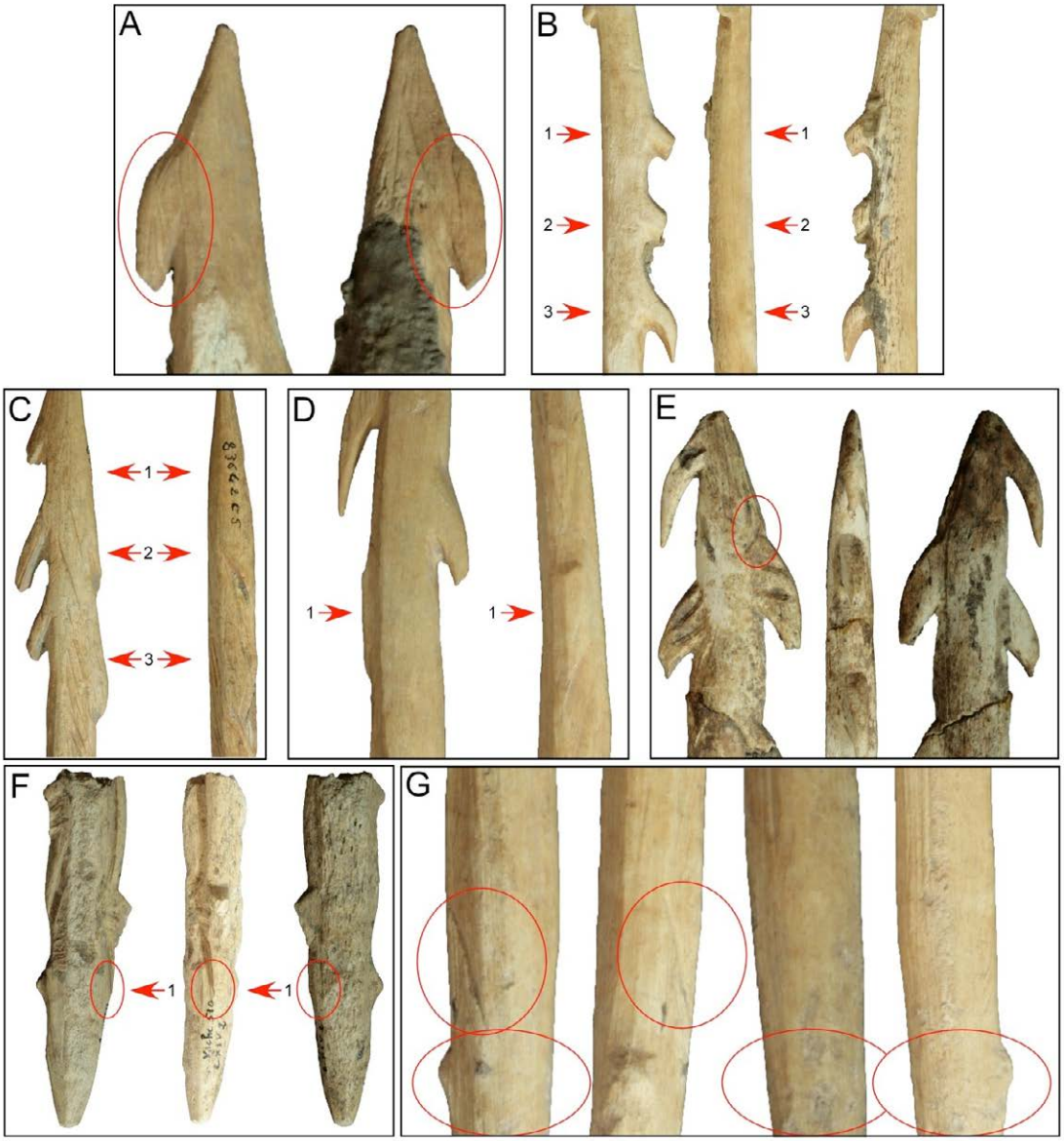


Figure 5.8: Detail of rejuvenation methods to mesial-proximal sections of bilaterally barbed points recovered from La Vache. (A) MAN 83643C70, circles outline newly worked barb; (B) MAN 83642C39, arrows indicate location of removed barbs; (C) MAN 83642C5, arrows indicate location of removed barbs; (D) MAN 83641C40, arrow indicates barb scar; (E) MAN 83643C68, reworked top left barb – circle indicates partially erased shaft decoration; (F) MAN 83641C15, circle and arrow indicate location of removed right bulb protuberance; (G) MAN 83641C40, circles indicate removed right bulb protuberance and partially erased shaft decoration.

We will now move on to the maintenance evidence found on the mesial and proximal sections of the bilaterally barbed points recovered from La Vache. In three separate cases barbs were found to have been carefully removed from implements in the collection. Two of these examples are found on 'intact' implements (MAN 83642C39:

Figure 5.6: A, B; and MAN 83641C40: Figure 5.6: A; Figure 5.8: D) and were described above. The third example, however, was found on a distal-mesial fragment (MAN 83642C5) which exhibits three clearly visible barb scars on the right side and which correspond with the three remaining barbs on the left side (Figure 5.8: C). In this case, as with those found on MAN 83641C40, all evidence of the barb has not been completely removed but instead the (presumably broken) barb shoulders have only been ground smooth leaving a raised scar.

Such careful treatment of barb scars suggests that either (a) Magdalenian hunters disliked the appearance of broken barbs on their antler weapon tips, (b) that the jagged edges of the barb scars were inconvenient when handing the weapon, or (c) the untreated barb scar may have induced a catastrophic fracture across the mesial section of the shaft during the next phase of use. Here again experimental archaeology is required in order to test which of these hypotheses is best supported, though the currently available data gathered from previous experiments demonstrating the importance of carefully maintaining antler weaponry (or else risk catastrophic failure) supports the last of these suggestions.

Finally, the La Vache assemblage provides two clearly identifiable cases of maintenance to the proximal section of bilaterally barbed points. In each case, the left bulb protuberance has been carefully ground away (MAN 83641C15 and MAN 83641C40) (Figure 5.8 F and G). As argued for the removal of barbs, the grinding away of a bulb protuberance broken in use may have been necessary to prevent further damage to the weapon.

Recycling

Apart from the heavily reworked mesial fragment recycled into a completely new (if somewhat small) projectile point which was discussed above, only two of the bilaterally barbed points recovered from La Vache appear to have been recycled. Unlike the mesial fragment, each of these points seem to have been reused in functions other than what they were originally made for (that is, from being projectile points to another functional tool type).

The identification of MAN 83643C18 as a recycled bilaterally barbed point can be made owing to the remains of the paired bulb protuberances, a feature indicative of this technology (Figure 5.9: right). The distal end of this implement exhibits a bevel fracture which appears to have been worn through post-depositional processes, though some crushing of the distal edge is still possible to identify. The proximal half of the implement, on the other hand, has been carefully worked into a double bevel. There are two possibilities for what this implement was recycled into; either it is a wedge or a spatula (or such similar tool). As it is not clear if the distal end has accrued crushing and there is only minimal crushing visible on the proximal tip, the reuse of this tool as a wedge cannot be made with any certainty. Usually, much more severe wear is found on implements reused as wedges (see examples below), and the slight crushing on the proximal end may be explained as having accrued while in use as a projectile point.

From comparison with a similar recycled implement recovered from Courbet (BM 64.12.26 109; Figure 7.6: A) which will be described in Chapter 7, it might be argued that the La Vache implement was more likely reused as a spatula. Unfortunately, any signs of residues which may have helped in the identification of the tools function have been removed with the careful cleaning of this artefact for curation.

The other recycled bilaterally barbed point is curated as MAN 83643C1 (Figure 5.9: left). The secondary function of this recycled weapon is even more ambiguous than the first. A barb on the left side and both bulb protuberances have been ground down, and it is unclear which alterations were undertaken as part of the repair of the implement when functioning as a projectile point and which were made specifically to accommodate the new function of the piece.

What is evident, however, is that the distal end has accrued significant crushing and rounding presumably from this secondary use, while the minimal wear on the proximal end is consistent with that accrued through projectile use damage. It therefore appears that the distal end only was used in a crushing action, and the rounding may be the result of a repeated rotating action. I would therefore suggest that MAN 83643C1 was

reused as some sort of crushing and/or mixing implement for an unknown substance (vegetal, pigments, minerals, etc.), though no apparent residue seems to have survived the archaeological record and consequent curatorial processes.

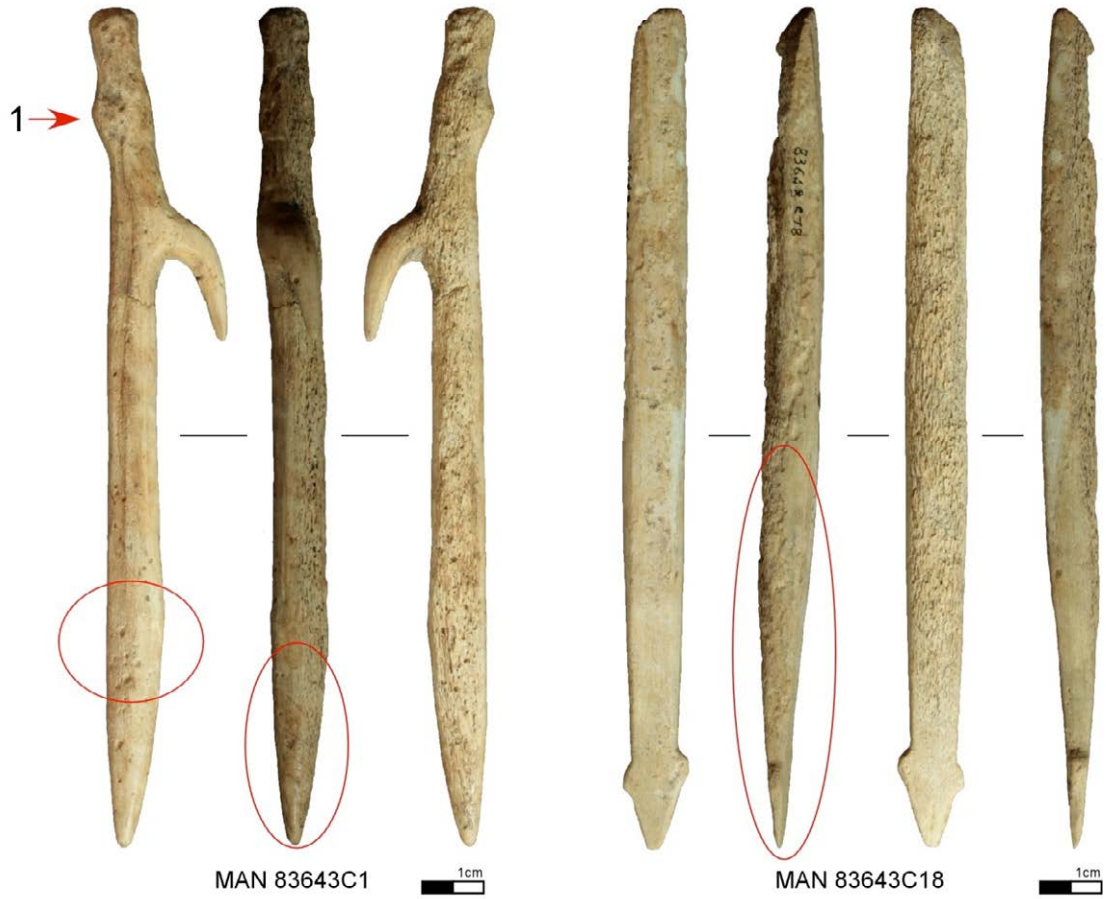


Figure 5.9: The two recycled bilaterally barbed points identified in the La Vache assemblage. The circles overlaid on MAN 83643C1 indicates the removed bulb protuberances and partially erased bulb decoration/hafting striations. That on MAN 83643C18, the created bevel.

The last observation worthy of note for these two recycled bilaterally barbed points is that if their suggested function has been correctly identified, they may have endured quite extended use lives and, arguably, may have belonged to a single individual or family group, as such domestic items have been found to often belong to a single individual or family in ethnographic contexts.

Fracture and Discard

There are two avenues which we can pursue in order to examine fracture and discard patterns for the Bilateral Group A artefacts. The first of these is to consider only those artefacts which display impact fractures on both their distal and proximal extremities, and were not recycled, and can thus can be identified as having been broken in use and discarded as projectile technology.

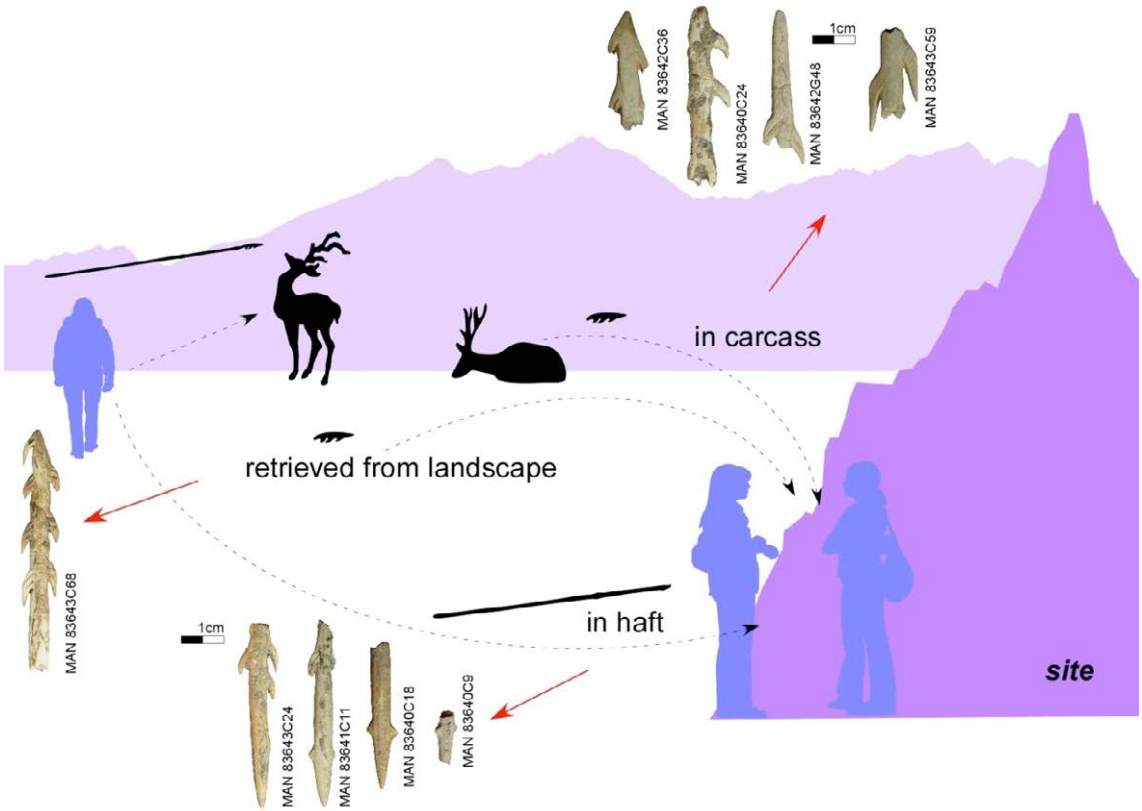


Figure 5.10: Processes leading to the deposition of projectile point elements into the archaeological record with impact fractured bilaterally barbed (Group A) implements illustrating the kinds of fragments likely to be the result.

Shown in Figure 5.10 above, are the nine artefacts identified as having impact fractures on both their distal and proximal extremities: four distal-mesial fragments, one mesial fragment and four mesial-proximal fragments. Of these fragments, MAN 83643C68 (a distal-mesial fragment), is most interesting as the implement appears to have snapped with a particularly clear splinter fracture just above where the bulb is expected to begin. A second fragment, though proximal this time (MAN 83640C9), also appears to have

snapped in this same manner, though these two artefacts do not refit. Thus, this fracture pattern occurred on at least two occasions for those retooling at La Vache.

This pattern of splinter fracture just above the basal bulb is extremely unusual and was rarely observed in the entire dataset examined for this study. Among possible explanations for this pattern may be (a) the breakage of a deeply embedded weapon in a distressed and fleeing target, or (b) the failure of the weapon owing to poor maintenance. This implement has clear evidence for rejuvenation (described above) with not only a roughly shaped spatulate tip, but the top left barb being effectively halved in order to accommodate the new tip. The distal tip has accrued quite significant crushing, and in conjunction with the uneven tip form, may have led to the weapon being unable to effectively penetrate the target, leading to the catastrophic failure of the implement through a fracture in the barbs-to-base section. One can certainly imagine that either the weapon only partially penetrated the target and the struggle of the fleeing animal caused the point to snap, or the point did not penetrate the target instead snapping on impact as the force of the shaft pressed down on its base and the energy was trapped against the weapon tip and the haft rather than being transferred in a forward motion into the target. Collected either from a carcass or off the landscape, it is interesting that this artefact returned to the site, retained more than 100mm in length, but was not rejuvenated or reworked for future use as either a projectile point or another tool.

The three other mesial-proximal fragments (MAN 83641C11; MAN 83643C24; MAN 83640C18) have each fractured much higher along the mesial section of the point; the first two above the first set of lower barbs and the third approximately where these lower barbs might be expected to begin (Figure 5.10). Each of these fragments are examples of a significantly more common fracture pattern for bilaterally barbed points when compared with the total dataset (as will be shown and discussed in subsequent chapters). These fragments, discarded once back at the site, indicate that they were considered of no further use – either for further use as projectile points or recycled into other tools.

The other four fragments to solely display impact fractures are another three distal-mesial fragments and a single mesial fragment (Figure 5.10). The mesial fragment (MAN 83643C59) exhibits splinter fractures on both ends which may occur when strong and sudden pressure is applied to both ends of the weapon tip. This application of pressure most likely occurred through impact with a hard surface (such as a bone or rock). Another possible scenario is that the weapon was embedded in a carcass and snapped when the hunter attempted to retrieve the point by simply pulling and twisting the fixed weapon. This fragment would then likely have been returned to the site still inside the carcass of the hunted animal. Certainly this behaviour (the return and cutting out of projectile fragments) is documented for this site, as indicated by one of the distal-mesial fragments (MAN 82642C5; Figure 5.7: A) which displays retrieval cut marks on its left side.

Of the three distal-mesial fragments yet to be discussed (MAN 83640C24; MAN 83642C36; MAN 83642G48), two exhibit splinter fractures on their proximal extremity consistent with fracture in use and return to the site either in the carcass of the hunted animal or retrieved from the landscape by the hunter. The last implement (MAN 83642G48), however, is the distal-mesial fragment with an extended point, and appears to have snapped not during use, but rather during a maintenance event (Figure 5.11). We can make this suggestion as the very tip of the point exhibits a facet where the maintenance work had begun but was then abruptly abandoned. The proximal extremity terminates in a bevel fracture. This fracture of the weapon could then be explained as occurring when too much pressure was applied to the tip of the point (either from being pressed against a grindstone or a blade) during resharpening. A number of similar cases of weapon tips which have fractured during maintenance activities were identified in the wider dataset and will be described in their relevant sections.

The second way in which we can investigate maintenance and discard patterns for this technology is an examination of total implement length data. These data have already been discussed for the ‘intact’ implements above, so we will now focus on the fragmentary artefacts. Mesial-proximal fragments make up the majority of the La Vache bilaterally barbed sample (41.1%; n = 14), including an additional seven examples to

those pictured in Figure 5.10 above. These additional artefacts have post-depositional fractures and/or significant damage such as burning, and as no distal-mesial fragments were identified as having possibly matched any of these artefacts, it appears that they were not discarded as 'intact' implements but only as fragments of the proximal half of the implement.



Figure 5.11: MAN83642G48: A distal-mesial fragment which may have snapped during a maintenance event.

If this hypothesis is correct, then we are able to suggest that once these weapons were reduced through use and breakage to within a certain length range (average of 65 mm in length at discard), where only a few barbs, the barbs-to-base and bulb remain, they were discarded as exhausted and unable to be usefully reworked for continued use.

Distal-mesial fragments are a different story, however. In total, seven of these fragments were identified in the La Vache assemblage, with three displaying post-depositional fractures to their proximal extremity. These artefacts must have originally been attached to either longer distal-mesial fragments discarded when broken in use or maintenance – as the four examples in Figure 5.10 were – or, were once attached to 'intact' implements discarded at the site and which then broke apart in the archaeological record. The latter explanation seems unlikely, as fragments which may have adjoined these pieces were not recovered, though their existence cannot be ruled out. Evidence in support of the

hypothesis that these fragments were discarded as broken pieces includes the fact that they are similar in total length to those fragments exhibiting impact fractures (post-depositinally fractured: 31.3 – 83 mm; average: 63.9 mm; total dataset impact fractured: 54 mm and 89 mm; average: 79.28 mm). Furthermore, one of these fragments, (MAN 82642C5) displays a retrieval cut mark on its left side (as discussed above), indicating that it was cut out of a carcass.

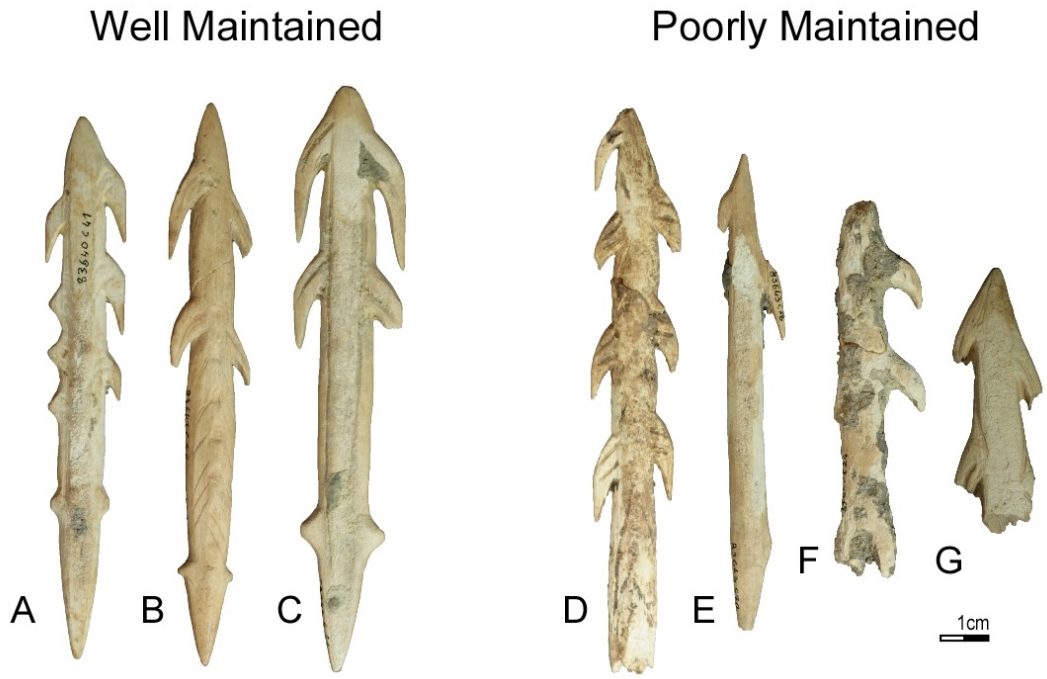


Figure 5.12: Correlation between maintenance quality and size of fragment.

As we saw in Chapter 1, lack of attention to the distal tip will result in the premature and significant fracture of the weapon. It appears from the data presented in this thesis, that the archaeological material also supports this finding. For the La Vache dataset, this phenomenon is demonstrated by the fact that of those implements with evidence for more hasty rejuvenation of the distal tip ('strong' lines, uneven sections, think facets, etc.), five are distal-mesial fragments and only one is an 'intact' implement. The 'intact' implement in this group is the reworked unilateral-to-bilateral point with the addition of a new barb to the left side of the implement through reducing the width of the shaft (MAN 83643C70; Figure 5.6 G; Figure 5.9: A). The slight crushing to the distal tip seems to indicate that this implement was then only used briefly before being discarded,

and therefore, may be considered an outlier in statistical terms. Additionally, the two longest distal-mesial fragments with impact fractures are also those which have the poorest quality maintenance to their distal extremity (Figure 5.12, below).

On the other hand, of the five implements which have been significantly more carefully rejuvenated (only faint - if any - striations, even sections, etc.), four were recorded as 'intact' implements and only one as a distal-mesial fragment (though this particular artefact has been burnt in prehistory and therefore the stigmata evident today may have been much stronger at time of discard).

There therefore appears to be a correlation between implements which entered the archaeological record more complete with carefully executed maintenance and distal-mesial (especially lengthy examples) fragments exhibiting more hasty methods of rejuvenation. These observations, along with the experimental projectile point data previously published, indicates that poor maintenance of (particularly) the distal edge of an antler projectile point will lead to the fracture of the implement significantly further down the shaft than will occur for carefully maintained weapons. Thus, the use life of a single implement will be significantly shorter if poorly maintained than that of a well maintained weapon.

Finally, an important point must be made regarding the implications of these fracture patterns for assemblage composition. As argued in Chapter 3 ('Magdalenian Osseous Projectile Points') bilaterally barbed points at the time of initial manufacture likely exhibited an extended, conical and piercing form distal tip. If this tip fractured above the first set of barbs, it would appear very similar if not identical to a distal-mesial fragment of an unbarbed point. Consequently, these fragments would be classified by a researcher as an unbarbed fragment, creating bias in the sample towards unbarbed point distal-mesial fragments. We must, therefore, keep this possibility in mind when examining the La Vache antler projectile weaponry assemblage as a whole.

Bilateral Group B

Only a single implement was identified as fitting into Bilateral Group B in the La Vache assemblage. This weapon tip (MAN sans no.; Figure 5.13) is significantly smaller in its overall dimensions than the other 34 implements described above, reaching only 77.7 mm in total length, 5.5 mm in maximum width, 2.6 mm in breadth, and 0.7 gm in weight. As discussed in Chapter 3, this type of weapon may have been used as a barbed arrow for use on small prey such as birds, though it may also represent an example of artisan virtuosity.

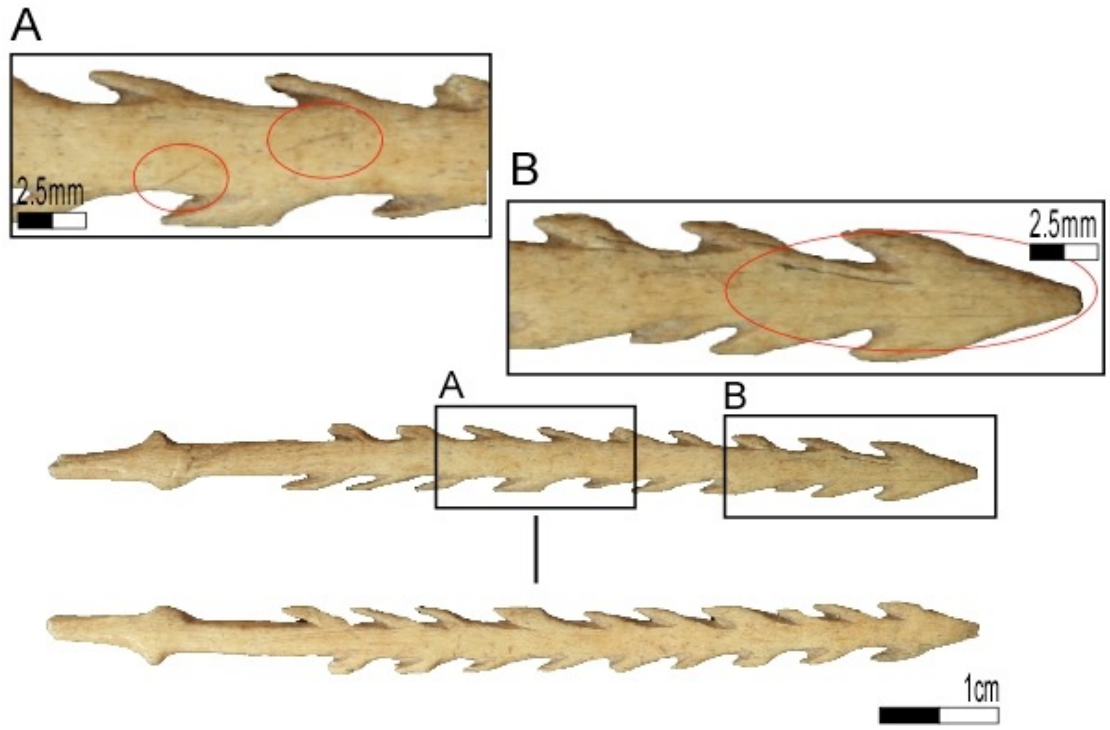


Figure 5.13: The single bilateral Group B artefact from La Vache (MAN sans. no): (A) possible retrieval cut marks; (B) detail of distal extremity with striations from either initial manufacture or rejuvenation.

Apart from some slight crushing on both the distal and proximal tip, this artefact displays no clear signs of use (impact fractures to barbs, etc.) or repair. Two possible retrieval cut marks observed on the superior surface of the shaft and several striations were observed on the distal section, though both of these stigmata may have been inflicted during manufacture or frequent handling in non-utilitarian activities (such as if

hafted in a miniature foreshaft and/or shaft and handled frequently), and not as a result of use in food acquisition.

The tightly knit barbs would be very difficult to produce on such a small scale without fracturing the entire piece which displays great dexterity and control of the medium, though this fact along does not purely support the case for the artefact being an example of artisan virtuosity. However, as La Vache was occupied throughout the autumn and winter months, artefacts that were time consuming to manufacture as well as those made purely to amuse the individual or to display high levels of skill could be expected to have been produced at this site. Additionally, if La Vache was the site of micro-aggregations of technological focused individuals, the production of display items would also be expected. In all then, whether this implement was a functional projectile weapon for small game or made purely for social purposes remains unknown.

Unilaterally Barbed Points

As stated above, points with only one line of barbs make up the majority of the La Vache barbed point assemblage (52%; n = 176). Figure 5.14 below presents the overall composition of the unilaterally barbed point dataset along with their distribution throughout the stratigraphy of the Salle Monique.

For the analysis of this dataset the assemblage was split into three groups (as outlined in Chapter 4 'Methods and Methodology') in order to attempt to account for possible functional differences and differential maintenance treatment of the weaponry. These groups are referred to as Group A, Group B and Group C. Group A, those points which would have been suitable for use as spears or harpoon heads, make up the largest component of the La Vache dataset (68.2%; n = 114). Group B, which may have been used as multi-point spears or arrows (20.3%; n = 43) and Group C, arrows or examples of artisan virtuosity (11.3%; n = 19), were less frequently identified.

In total, the La Vache unilaterally barbed point dataset is composed of almost equal parts of 'intact' implements, distal-mesial, and mesial-proximal fragments, with a small number of mesial fragments also recovered (Figure 5.14). Clear evidence for

maintenance was found on artefacts falling into all categories, as was evidence for the recycling of these implements into other functional tool types. These processes will be described in detail for each analytical group.

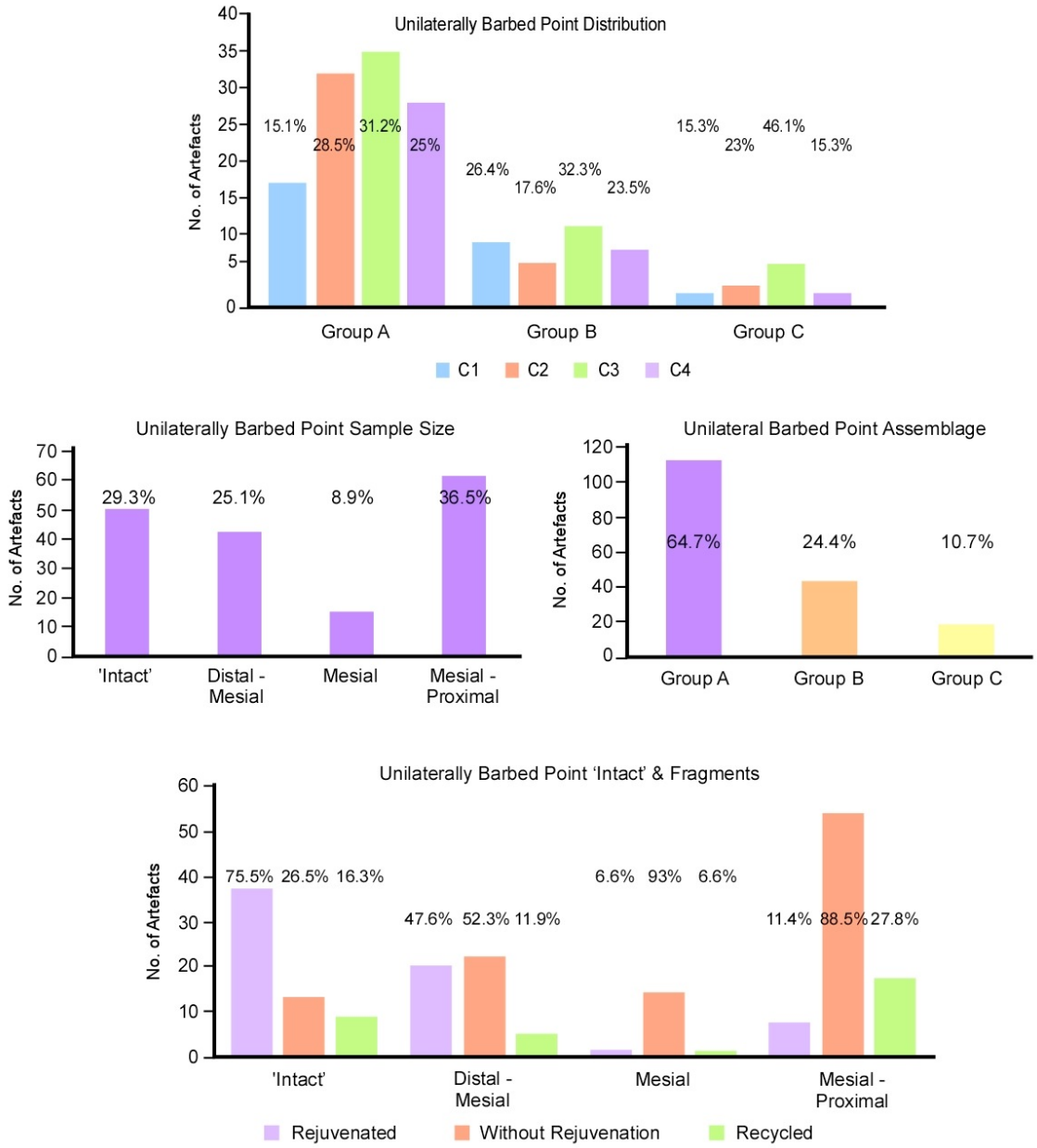


Figure 5.14: La Vache unilaterally barbed point sample composition: (Top) Distribution through the stratigraphy; (Middle Left) Composition of the unilaterally barbed point assemblage; (Middle Right) Distribution of implements into analytical groups; (Bottom) Occurrence of evidence for rejuvenation, recycling and no evidence for rejuvenation.

The distribution of these weapon tips through the stratigraphy of the site is mirrored between Group A and Group C, with the Group B implements more common in Couche 1 rather than Couche 3, as is the case for the former two types (Figure 5.14). Possible explanations for this difference will be discussed at the conclusion of the chapter.

Unilateral Group A

Implements which were categorised as Group A weapon tips were the most frequently identified in the La Vache assemblage, consisting of 42 'intact' implements, 18 distal-mesial fragments, four mesial fragments, and 50 mesial-proximal fragments (Figure 5.15).

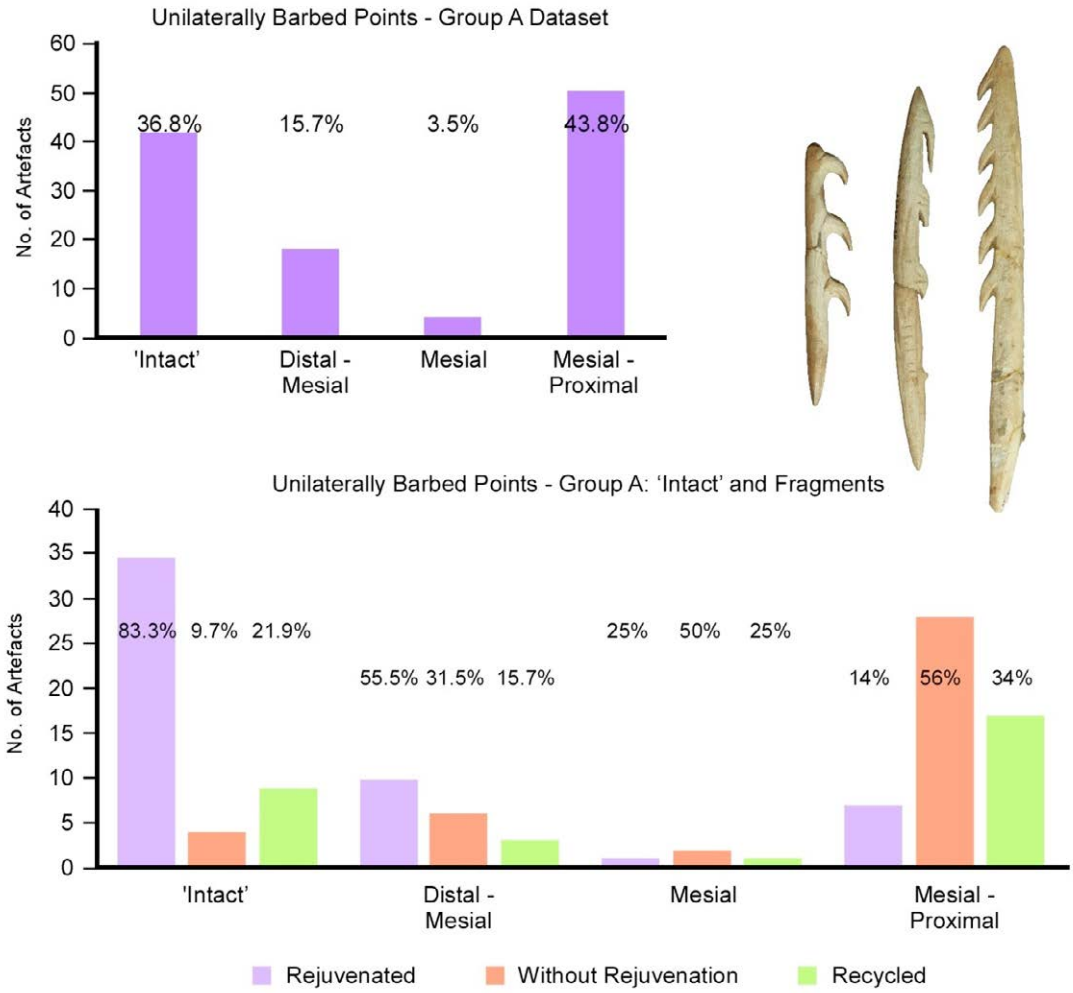


Figure 5.15: Composition of Group A dataset. Top: Composition of assemblage. Bottom: Occurrence of evidence for rejuvenation, recycling and no evidence for rejuvenation.

Evidence for the repair and recycling of these tools was found on all types of fragments ('intact', distal-mesial, mesial, and mesial-proximal), though the frequency of this evidence was found to differ between categories. As expected, evidence for maintenance was most frequently identified on the 'intact' and distal-mesial fragments once again reflecting the attention the distal edge receives in rejuvenation. Also not surprising is the high percentage of mesial-proximal fragments exhibited evidence for recycling, as these are the section of weapon most likely to be returned to a site and retain useful dimensions.

Methods of Maintenance

Of the 114 artefacts included in Unilateral Group A, 46.4% (n = 53) display visible evidence for maintenance. As with the bilaterally barbed implements described above, evidence for repair includes striations, facets, spatulate form tips, the removal of barbs and the rejuvenation of the basal bulb.

As this dataset includes a good sample of 'intact' implements discarded at the site, an examination of their total length at discard is more informative than the same analysis undertaken for the bilaterally barbed points described above. While the different morphologies (or 'styles') of the barb forms and shaft sections makes confidence in statistical analyses less than ideal, if viewed with appropriate caution and in conjunction with use wear descriptions, we can nevertheless learn about how these implements were reduced through use and maintenance cycles.

Figure 5.16 below presents a box-and-whisker plot of the 30 'intact' Group A implements which were rejuvenated but not recycled, and which were not post-depostionally broken. The total length of these implements ranges between 64.6 mm and 154 mm (average: 109 mm; median: 103 mm), with 53.3% falling between 94 mm and 128.1 mm. If the data points for the implements which are considered to be 'more reduced' owing to their morphology (see examples in Figure 5.16: A – F), are compared to those for implements considered 'more complete' (examples G – L), it can be seen that, while there is cross over between the datasets, the 'more reduced' implements fall at the lower end of the total length range, while the 'more complete' implements fall

closer to the upper end. The only exceptions are the three 'more complete' implements which have an overall smaller morphology (though not small enough to be considered as a Group B or C point) and therefore fall at the lower end of the range (see Figure 5.16: G for an example).

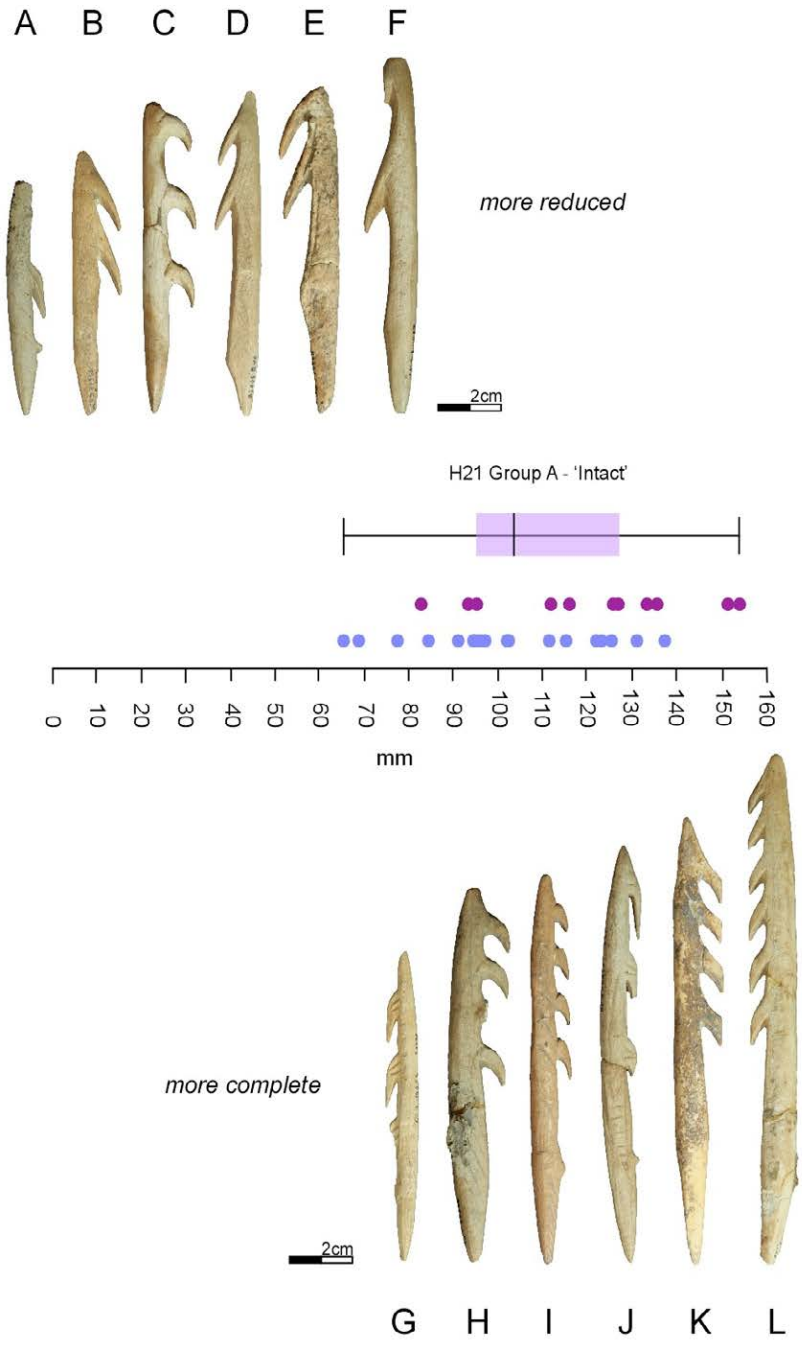


Figure 5.16: Examples of 'intact' unilaterally barbed points (Group A): A – F: Implements whose form indicates intensive reduction; blue dots. G – L: Implements whose form is closer to original from; purple dots. (A) MAN 83641C49; (B) MAN 83642C55; (C) MAN 83643C67; (D) MAN 83641C16; (E) MAN 83642C56; (F) MAN 83641C41; (G) MAN 83640C29; (H) MAN 83642C54; (I) MAN sans no.; (J) MAN 83640C39; (K) 83642C53; (L) MAN 83641C30.

This distribution of data points correlates well with a general hypothesis of reduction in length through use and maintenance, and these results in turn allow us to suggest that Unilateral Group A points were manufactured to an original total length somewhere in the range of 140 – 160 mm. This length was progressively diminished as they were used, fractured and rejuvenated until they are eventually, and finally, discarded at various points down to around 60 mm. Most weapon tips, however, were discarded when they reached 90 – 100 mm in total length.

In total, 60 implements preserve a distal extremity including both 'intact' implements and distal-mesial fragments. Of these 60 artefacts, 44 display evidence for rejuvenation of the distal extremity. As with the bilaterally barbed points described above, the formation of a spatulate form tip was the standard form of maintenance for the reducing distal tip (seen on 36 of the implements). Of the 36 points with a spatulate form tip, 14 exhibit striations or facets left from its formation and three have partial erased decoration (see Figure 5.17 for examples).

Four implements exhibit evidence for barb removal. In each case, the detached barb is situated at the very distal edge of the artefact (having been removed in the process of shaping a new tip) leaving a clear, unground barb scar. Owing to this lack of abrasion, it is possible that the barbs snapped off in use leaving the scar, though this scenario is unlikely as the projectile point would not effectively penetrate a target with such a wide tip cross sectional area as would be produced with a barb still situated at its tip. Furthermore, examination of the wider corpus of barbed point data has shown that barbs located at the distal end will commonly be removed to accommodate a new distal tip. The maintenance on this artefact, therefore, seems to only have been more hastily executed when compared to similar others.

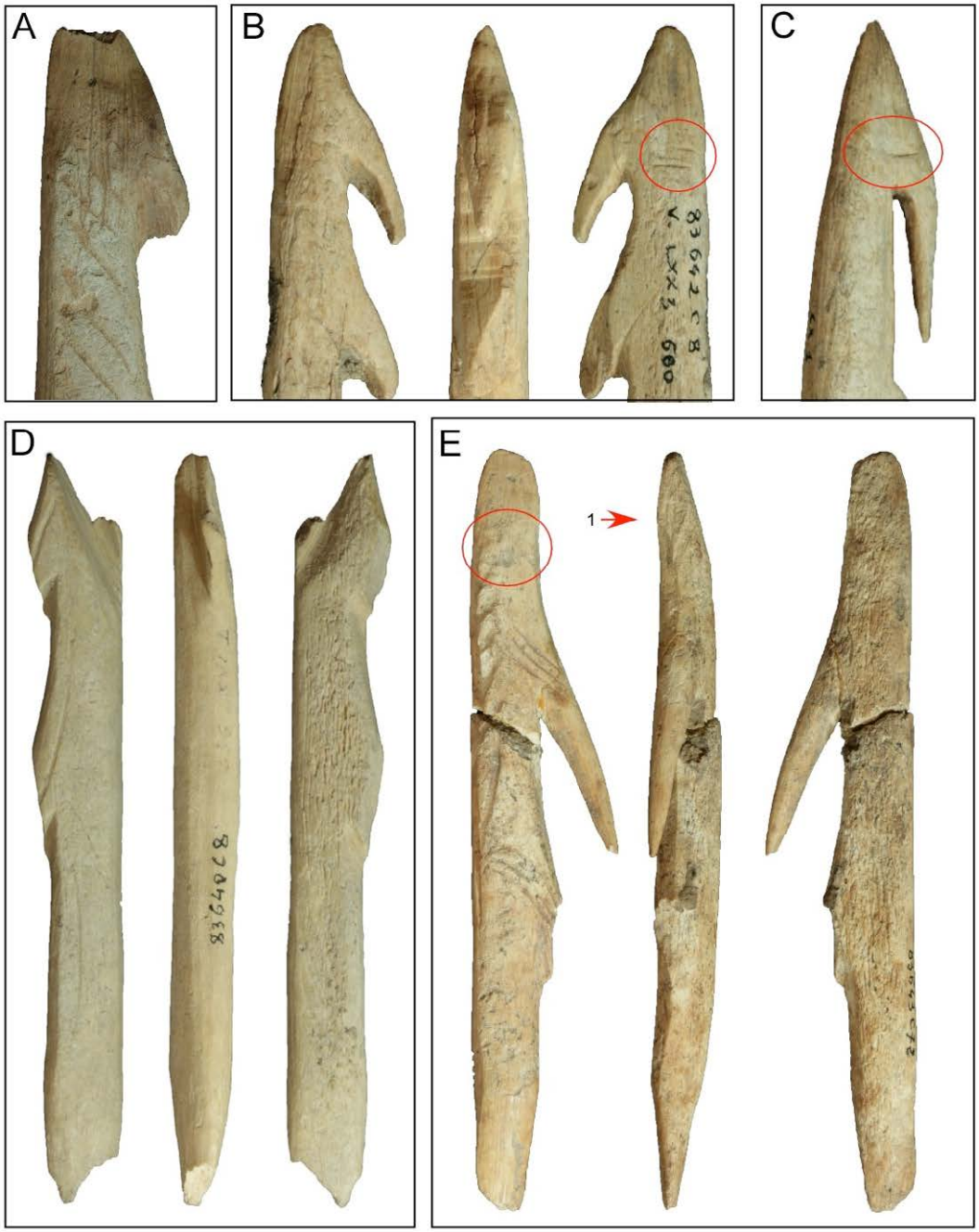


Figure 5.17: Examples of the kinds of rejuvenation stigmata observed on Unilateral Group A points: (A) resharpening lines over shaft decoration: MAN 83643C17; (B) spatulate tip with lines and facets as well as retrieval cut marks: MAN 83642C8 (C) partially erased shaft decoration: MAN 83640C39 (D) bifacially worked fracture: MAN 83640C8; (E) spatulate form tip, barb scar, erased shaft decoration and remade base into double bevel form MAN 83643C72.

If we now focus on maintenance undertaken on the proximal end of these artefacts, we find that several implements appear to have had their base reworked during their use life

as a projectile weapon. In particular, six implements display evidence for the reworking of their proximal extremity from the original basal bulb with unilateral protuberance to a double or single bevel form (Figure 5.18; Figure 5.17: E). In two of these cases, the side protuberance remains visible, only having been ground down on its superior and/or inferior face (A and D in Figure 5.18), though on four of the artefacts, the protuberance has been completely removed leaving no trace of its original existence (B and C in Figure 5.18). That these features were originally present on the base of these latter four artefacts can be seen through the slight widening of the shaft where we would expect to find these elements (as in C in Figure 5.18). Additionally, in all six cases striations from the reworking of the base into a bevel are clearly visible. These striations are restricted to the new bevel, the shaft above this section remaining carefully ground smooth. Furthermore, in three cases the shaft decoration has been partially erased indicating that this working of the proximal end took place after its original manufacture and decoration (A and D in Figure 5.18).



Figure 5.18: Examples of unilateral Group A implements with a reworked base. Striations from the reworking of this section are visible on each: (A) MAN 83642C56; (B) MAN 83641C56; (C) MAN 83643C76; (D) MAN 83641C14.

Finally, an interesting observation was made while examining this dataset. Two of the 'intact' implements (MAN 83643C65 and MAN 83642C30) are extremely similar, so much so that it leads one to wonder whether they may have been manufactured, maintained and recycled by the same individual or community of practice in prehistory

(Figure 5.19). While this suggestion cannot be conclusively proven, there are several reasons for this tentative suggestion.

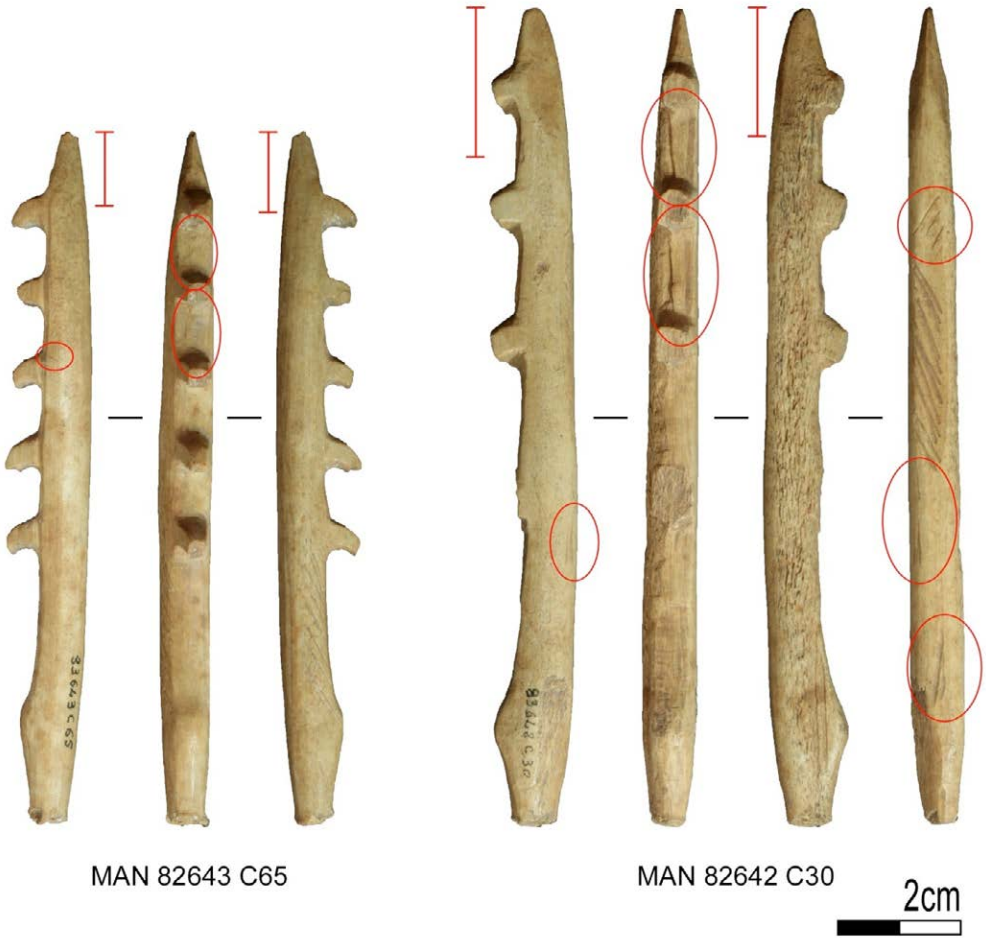


Figure 5.19: Two 'intact' unilateral Group A implements which may have been manufactured, maintained and recycled by the same individual or community of practice in prehistory. Red brackets indicate the extent of the ground resharpening facets. Red circles outline evidence for the original crafting of the barbs and possible retrieval cut marks.

First, while one of these implements is smaller in its overall dimensions, both implements are extremely similar in their proportions (dimensions in length, breadth, and width) as well the barbs carved onto the left side. Second, examination of the space between the barbs found the same type of stigmata left from the original manufacturing of the barbs: a 'bridge' of raw material where the intervals between each barb has been gouged out from both the superior and inferior faces. These 'bridges' are particularly evident on the top two barb intervals on MAN 83642C30. Third, the distal extremities on both points have been rejuvenated using a similar (if not the same) method leaving a

spatulate form tip with a smooth, glossy finish – possibly from polishing the surface with an abrasive such as pigment. Finally, both exhibit retrieval cut marks and were recycled as wedges where they were allowed to accrue around the same amount of damage before being discarded.

On the other hand, there are differences between these two implements. First, while the larger implement has parallel oblique lines on its right side (which are usually argued to be associated with the adherence of lithic bladelets), the smaller implement has no such decorative or functional striations. Secondly, the striations engraved into the inferior surface of the upper bulb and barbs-to-base section on these implements are different: two long parallel vertical lines (MAN 83642C30) and a series of parallel oblique lines (MAN 83642C65). Finally, while one implement was recovered from Couche 3 and the second in Couche 4, it should be noted that La Vache was excavated using artificial spits rather than archaeological or geological layers, and thus these two artefacts were in reality from the same archaeological unit. Without further information regarding their exact position in the site, however, we cannot further investigate this issue, though detailed microscopic use wear analysis of the two implements might further identify similarities and differences in their manufacture, rejuvenation and reuse as wedges.

Recycling

Interestingly, while many of the Group A points were recycled, they were only reused in a single function – as wedges. These were expedient tools used (presumably) to help lever out splinters of antler from a complete beam – and – luckily for the researcher, accrue significant, easily identifiable, and particular use wear indicative of their function (Figure 5.20).

To be effectively reused as a wedge, the implement must have a bevelled extremity, which if not already present as part of the projectile points original morphology, will be worked out of another basal form. The original proximal end of the projectile end will become the chisel and will exhibit severe crushing, chipping and/or some splintering, while the opposing (butt) end which receives the blow from a hammer accrues severe

crushing, chipping, splintering, and in many cases, what is commonly referred to as 'mushrooming' (Figure 5.20).

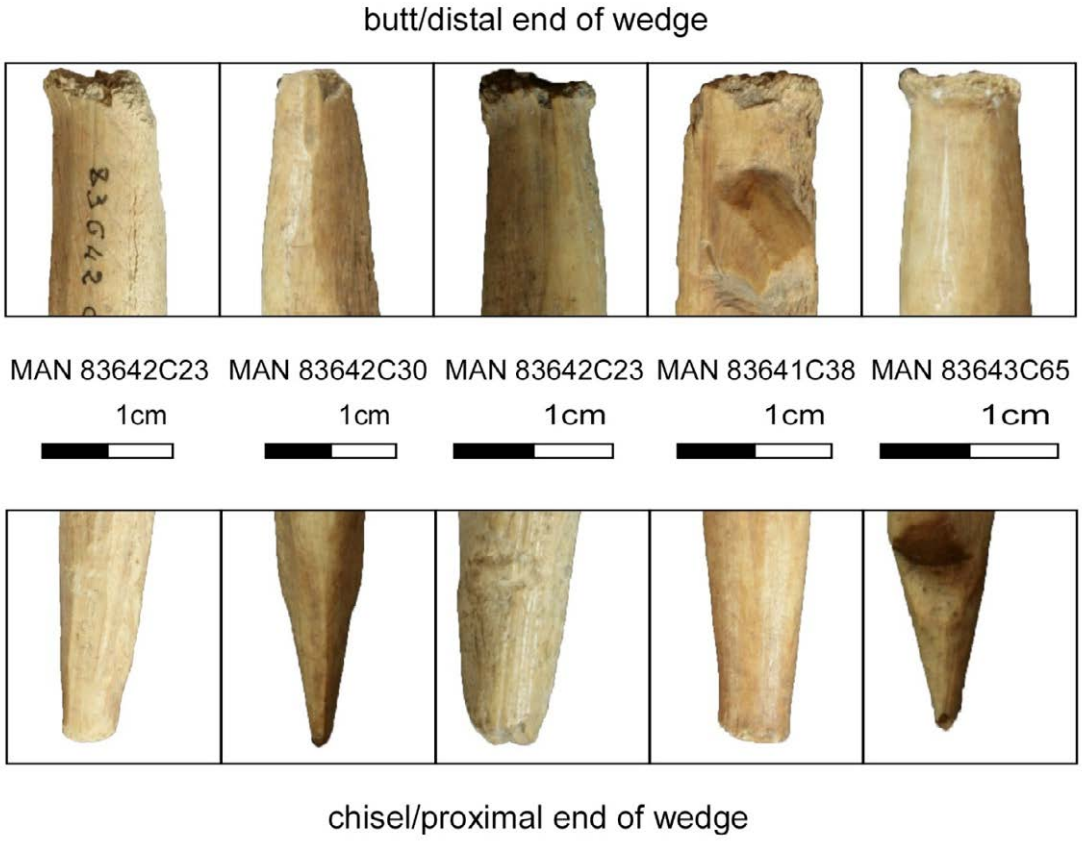


Figure 5.20: Examples of use wear accrued on Unilateral Group A points in reuse as wedges.

As these use traces are easily identifiable they allow us to identify not only complete tools, but also fragments of implements that have broken during reuse as wedges. For example, B and C in Figure 5.21 below, are distal-mesial fragments which display a severity of crushing which would not be allowed to accumulated during their use as projectile tips, as this level of wear would result in the catastrophic failure of the projectile. This severity of wear may only be accrued through their reuse as wedges, and their textbook splinter fractures tell us that they entered the archaeological record after breakage while in this type of reuse.

Twenty-seven Unilateral Group A artefacts were found to exhibit use wear consistent with reuse as wedges. Five of these implements had their proximal extremity reworked into a double bevel particularly for this second use life. As with the rejuvenated bases described above, in each case striations from the reworking of the base into a bevel are clearly visible (Figure 5.22). Obviously, while we cannot completely rule out that these alterations were not made prior to their recycling as wedges, instead executed as part of their maintenance, their reuse in this function supports the hypothesis that the bases were reworked in order to be recycled.



Figure 5.21: Examples of Unilateral Group A points recycled as wedges at La Vache: (A) MAN83641H6; (B) MAN83640C33; (C) MAN83641C34; (D) MAN83641C8; (E) MAN83641C27; (F) MAN83642C23; (G) MAN83641C29; (H) MAN83641C38; (I) MAN83642C42; (J) MAN83640C31; (K) MAN83643C53+C54; (L) MAN83643C13.

Only a single implement, MAN 83643C13, may have been reused in a function other than as a wedge. This implement exhibits a long spatulate distal tip and a rounded, possibly remade base with crushing to its proximal end. While this implement therefore shares characteristics of those points recycled as wedges, what makes this tool different, is that the distal tip shows little damage (no significant crushing, chipping, or mushrooming) and the proximal end, while crushed, is also well and evenly rounded (Figure 5.21: L). This implement may therefore have been used in a similar function as MAN 83643C1 (the recycled bilaterally barbed point described above; Figure 5.9), that is, as a crushing and/or mixing implement. As both of these artefacts were recovered from the same context (Couche 4 of the Salle Monique), it is conceivable that both were recycled for the same or similar functions.

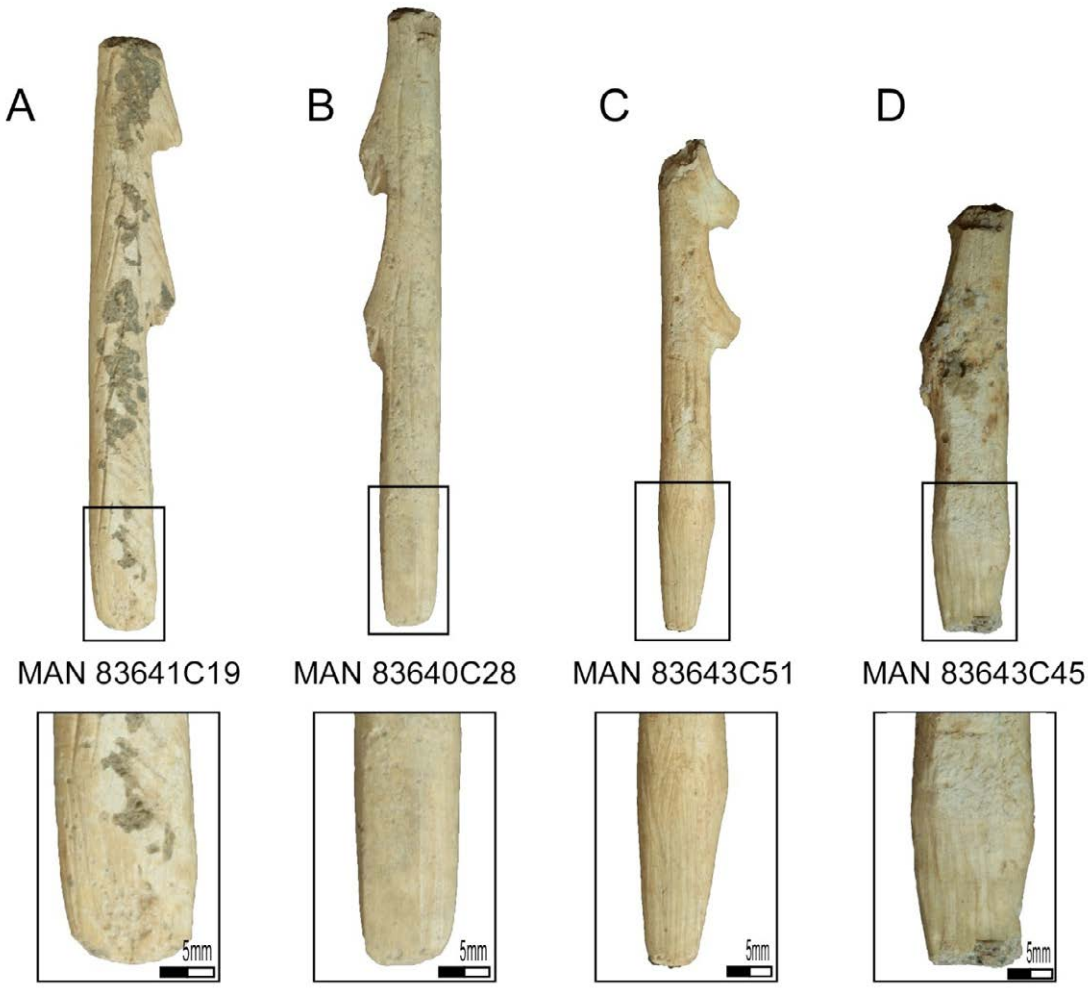


Figure 5.22: Examples of unilateral Group A implements which show evidence for alteration for reuse as wedges.

Fracture and Discard Patterns

The composition of the Unilateral Group A dataset is similar to that of the Bilateral Group A dataset (compare Figures 5.4 and 5.14). These similarities are not surprising as these weapon tips may have been employed in the same or very similar manner of hunting, and therefore, would fracture and be returned to the site in similar circumstances (see Figure 5.10 for examples).

As was discussed above, examination of the total implement length data for the 'intact' weapons indicated that these artefacts were discarded at various stages along the reduction continuum with some discarded relatively early in their use life and others having been significantly reduced through use, rejuvenation and reuse before final discard. It was identified that these points were most commonly discarded in the range of 90 – 100 mm in total length, having possibly been reduced by around 40 – 70 mm through use and maintenance activities (Figure 5.16). However, it was also seen that 'intact' implements were sometimes reduced significantly shorter (sometimes down to only 64.6 mm) indicating that these weapons were effective (at least partially) at a far shorter total length than the range in which they were commonly discarded. Thus, these data appear to indicate that a cultural ideal regarding the discard of Unilateral Group A point may have been functioning at La Vache.

We will now focus on what the fragments included in this assemblage can tell us about fracture and discard patterns. This dataset includes an excellent example of a point in the process of fracturing (MAN 83642C53; Figure 5.23: A). The wide, angular facets (one on each side) and off centre point suggests that this implement was rejuvenated with some level of care on at least one previous occasion, but it also displays crushing at its tip and a splinter fracture in the process of separating the tip from the body of the weapon. It is evident that this fracture occurred in use and was at least one of the reasons for its discard, though one must wonder why the owner abandoned a point which could have been easily rejuvenated and reused. In particular, if the top 10 – 15 mm was removed and a new point fashioned leading from the shoulder of the second barb, this implement would still have measured around 120 mm in total length – 20 mm longer than the range in which Unilateral Group A implements were commonly

discarded. Why then, was this implement disposed of? We can only assume that the person to whom this point belonged had access to enough replacement weapons or raw materials which made keeping it superfluous.

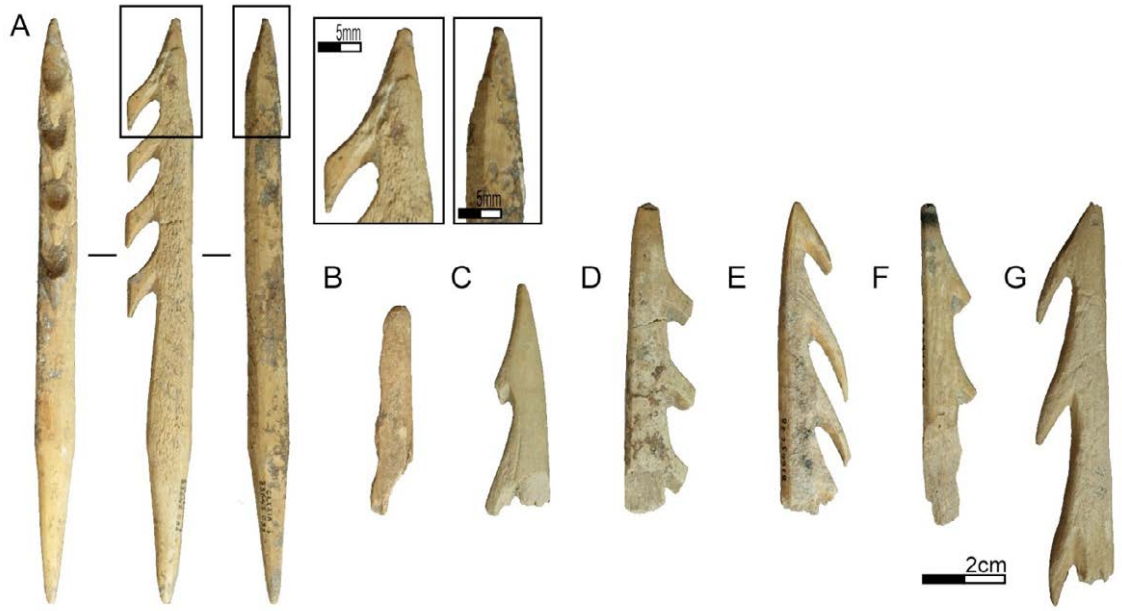


Figure 5.23: The six distal-mesial fragments which display impact fractures on their distal and proximal extremities indicating fracture during use was projectile weaponry: (A) MAN 83642C53; (B) MAN 83640C5; (C) MAN 83641C53; (D) MAN83640C25; (E) MAN83643C28; (F) MAN 83641C12; (G) MAN83642C45.

Of the 18 distal-mesial fragments identified, only six display impact fractures on both distal and proximal extremities (ranging in length between 56.3 mm and 96.3 mm), three others having been recycled as wedges and the remaining eight terminating post-depositional fractures at their proximal end. As discussed for the bilaterally barbed points, it is impossible to know for certain whether these latter fragments were once attached to 'intact' implements or simply longer distal-mesial fragments which were then further fractured in the archaeological record. However, the lack of 'matching' mesial-proximal fragments suggests that they were introduced to the site either inside an animal carcass or from being collected from the landscape. And again, several fragments (both distal-mesial and mesial-proximal) display retrieval cut marks indicating that they successfully brought down game and were later retrieved from the carcass and discarded (Figure 5.24).

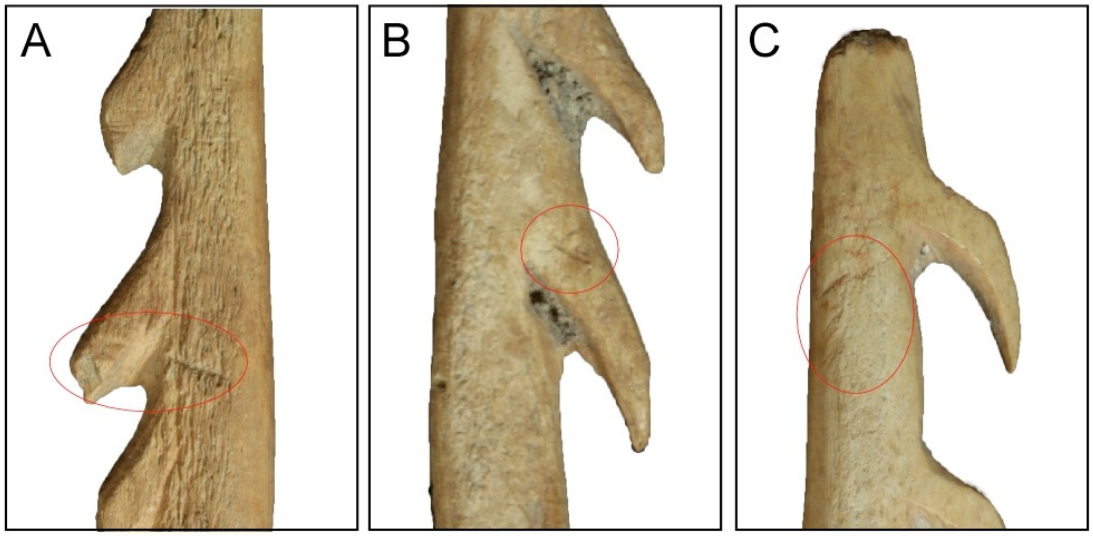


Figure 5.24: Examples of retrieval cut marks identified on Unilateral Group A implements: (A) MAN 83641C25; (B) MAN 83641C29; (C) MAN 83641C51.

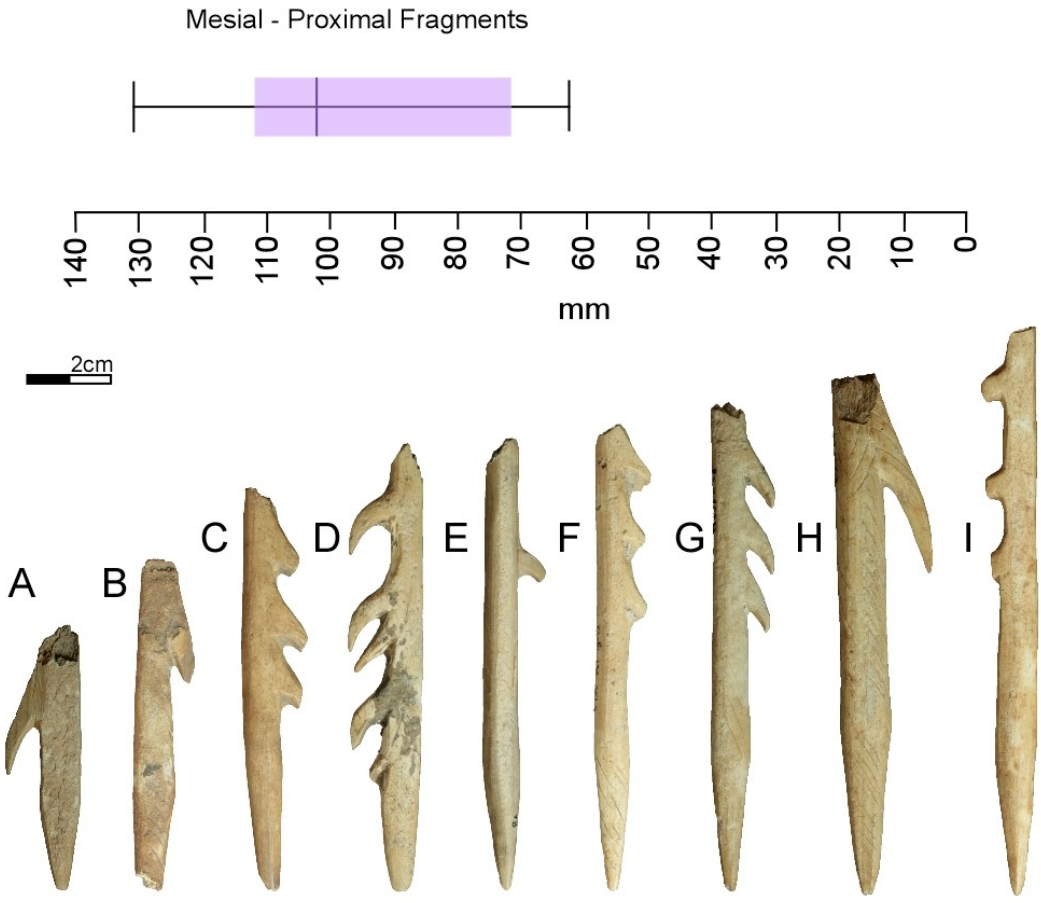


Figure 5.25: Box-and-whisker plot for Unilateral Group A mesial-proximal fragments and examples of unilateral Group A mesial-proximal fragments: (A) MAN 83642C38; (B) MAN 83643C38; (C) MAN 83641C25; (D) MAN 83641C56; (E) MAN 83062C48; (F) MAN 83643C4; (G) MAN 83643C58; (H) MAN 83642C43; (I) MAN 83642C28.

Of the fifty mesial-proximal fragments examined, only 15 can directly provide data on why these fragments were considered irretrievable, usable and were thus discarded. The total length of these 15 implements range between 62 mm and 131 mm with 60% falling between 72 mm and 113 mm (average: 99.2 mm; median: 103.5 mm). Clearly, the lower end of this range is composed of implements which have fractured at a point low along their shaft length, their reason for discard thus being obvious. Those located at the upper end of the range, on the other hand, include a number of implements which one perceives could have been rejuvenated and reused, but were not (for example Figure 5.25: D and G). Others, while having significant length remaining, were clearly not capable of being rejuvenated or reused as barbed points (H in Figure 5.25). Thus, total length is not the only variable that must be considered when investigating maintenance and discard patterns of antler barbed points. Having said this, owing to the data on 'intact' implements which suggest that once a weapon reaches the range of 90 – 100 mm in total length it is usually discarded, it is not surprising that the majority of mesial-proximal fragments were discarded between 113 mm and 72 mm. That is, these fragments were already below this minimum acceptable length or would have been with rejuvenation and therefore were discarded as too short for further use.

On this last point, it is interesting to note that of all the mesial-proximal fragments which were recycled as wedges, only one is longer than 110 mm (MAN 83640C28 at 111.8 mm). It consequently appears that these recycled weapons may also indicate that Unilateral Group A points were 'retired' from their use was projectile weapons once reaching 110 mm in total length.

Unilateral Group B

The second group of unilaterally barbed points found in the La Vache assemblage are those which fit the morphology of points used as multi-spear or multi-arrow weapons, being slimmer in overall dimensions with more tightly packed barbs. This group, Unilateral Group B, consists of 42 artefacts: 4 'intact', 19 distal-mesial fragments, eight mesial fragments, and 11 mesial-proximal fragments. Unlike the bilateral and unilateral Group A datasets, the majority of this dataset is heavily dominated by the distal-mesial fragments (44%) rather than 'intact' or mesial-proximal fragments (Figure 5.26).

As will be detailed below, evidence for repair and recycling of Unilateral Group B implements is far less common than in the previous two described datasets, though this assemblage still provides interesting insights into how antler projectile weaponry was used and recycled at La Vache.

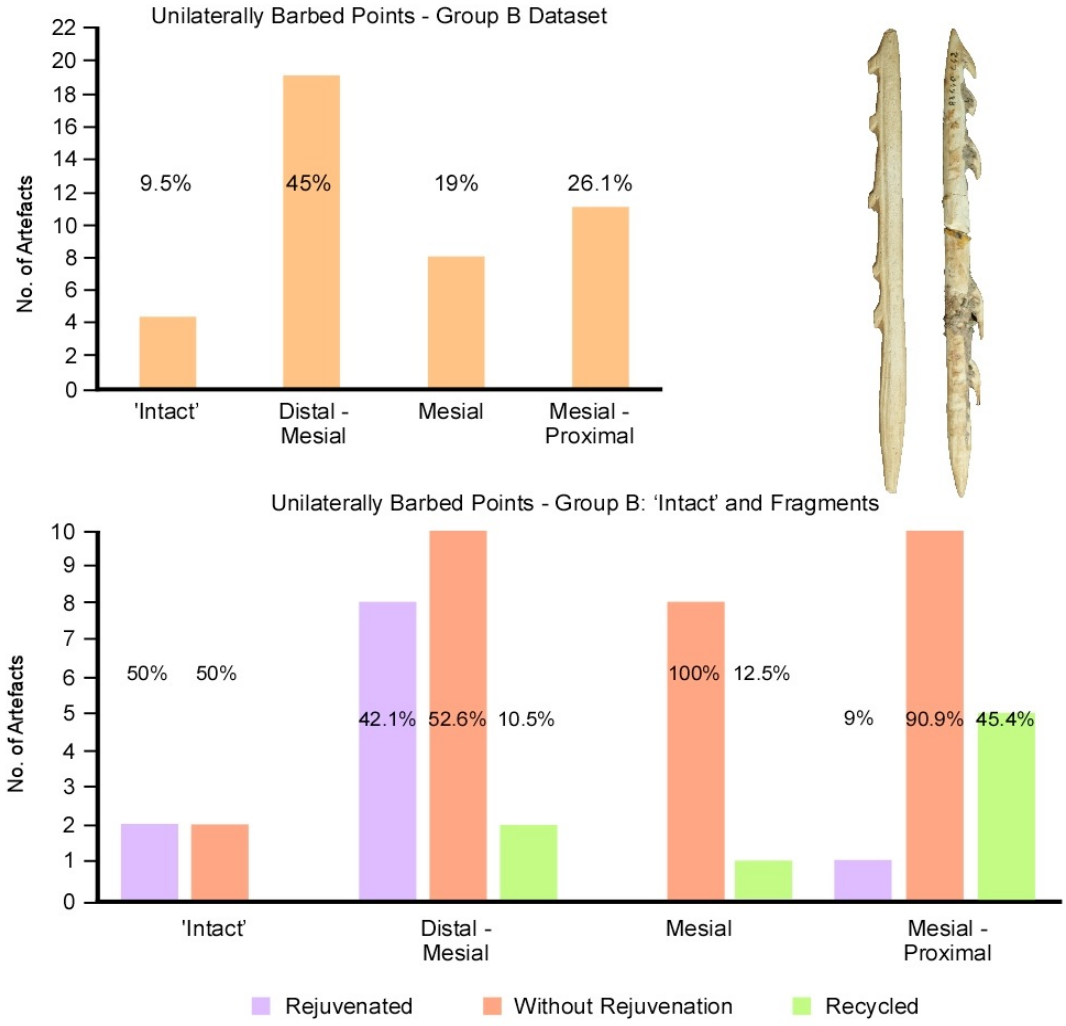


Figure 5.26: Composition of unilateral Group B dataset. Top: Composition of assemblage. Bottom: Occurrence of evidence for rejuvenation, recycling and no evidence for rejuvenation.

Methods of Maintenance

Only ten (out of the 34) Unilateral Group B artefacts identified display evidence for maintenance. This result includes two of the four 'intact' weapons, 19 of the distal-mesial fragments and a single mesial-proximal fragment.

Of the 23 artefacts which preserve their distal point, seven display a spatulate form tip and/or striations on the tip (Figure 5.27: A and C). The striations identified on these seven implements (and possibly on three others) are all fine, indicating that resharpening of the distal tip was carefully undertaken with either a fine grain grindstone or that the process of resharpening was finished with a phase of polishing. Thirteen others show no signs of maintenance to their distal sections at all, being carefully formed and polished, and thus may be the original tips or were very carefully reworked.

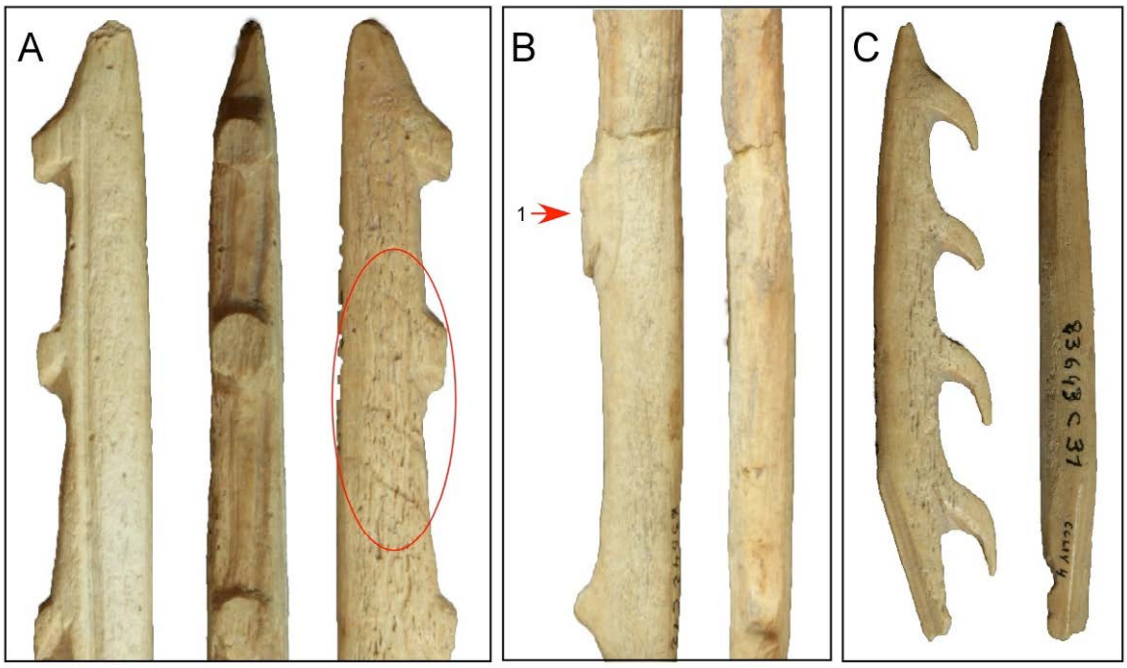


Figure 5.27: Examples of evidence for rejuvenation on unilateral Group B implements: (A) Spatulate form tip with resharpening lines and retrieval cut marks circled in red; MAN 83643C44; (B) Abraded barb scar; MAN 83642C12+C14; (C) Bifacially worked fracture at proximal extremity; MAN 83643C31.

On only two artefacts was maintenance to a barb identified. In the first case, found on a long mesial-proximal fragment (MAN 83642C12+C14), the lowest barb was broken and the scar abraded to leave a smooth section (Figure 5.27: B). This implement also displayed four additional barb scars, though none of these latter scars appear to have been altered (ground) after their fracture and it is unknown whether their separation from the main implement occurred during use or post-depositionally. To determine

which scenario was the case (impact fracture or post-depositonal fracture), experiments must be undertaken. However, in this specific case, if the four barbs *had* broken in use it might explain the discard of an implement greater than 175.2 mm in length - the loss of four barbs being considered too significant damage for the weapon to continued in use.

The second example of barb maintenance was found on one of three artefacts which had been intentionally removed from a larger implement through the use of the bifacially worked fracture (BWF) method which will be addressed next. On this second artefact (MAN83640G99), between two and three barbs were ground away leaving even and smooth scars in their place.

In each of the three cases of BWF identified in this dataset, the portions removed were distal-mesial sections measuring between 41.4 mm and 59.5 mm in length (see Figure 5.27: C for one such example). While one of these artefacts had suffered from post-depositional damage and it was therefore impossible to accurately determine the degree of wear which had accrued on the distal tip, the other two artefacts had clearly been rejuvenated - one having two to three barb ground scars (as just described) and the other a spatulate form tip (shown in Figure 5.27: C). These fragments, intentionally removed and discarded in prehistory, demonstrate that significant point length (up to 60 mm) was sometimes intentionally removed during the repair process. While the removal of a damaged distal section in order to rejuvenate the implement is easily understood, it is less clear why distal-mesial sections which appear well and carefully maintained were removed – as is the case for the implement pictured in Figure 5.27 above.

Recycling

Unlike the bilateral and unilateral Group A points, the Unilateral Group B artefacts were not recycled as wedges, spatulas or other non-projectile tools. Their thinner morphology may explain why this type of barbed projectile point was not suitable for reuse as a wedge (they could be too easily snapped), though it is interesting that these implements were not reworked into *any* other type of tool. Instead, it was found that other projectile point types were recycled into these barbed point type.



Figure 5.28: The eleven *baguette demi-rondes* (HRRs) elements recycled into Unilateral Group B barbed points.

Identified as such were eleven examples of HRRs recycled into Unilateral Group B implements (Figure 5.28). Eight of these examples were recovered from Couche 3, the remainder found in Couche 1 (one example) and Couche 2 (two examples). The fact that most of these artefacts were found in Couche 3 suggests that either (a) there was more of an emphasis on the reuse of raw materials during the earlier occupation of the site, or (b) there was an increased emphasis on the 'purity' of typologies during the later occupation of La Vache. These hypotheses will be explored at the end of this chapter in regards to La Vache as a single site and within the wider regional context in Chapter 7.

It is also noteworthy that not one example of a HRRs recycled into another barbed point type was identified at La Vache. This restriction of the reuse of HRRs into Unilateral Group B points may be due to their physical dimensions - they would have been too thin to have been reworked into either bilaterally barbed points or Unilateral Group A points.

Fracture and Discard Patterns

As with the previously described projectile points, it is not surprising that a significant proportion of the Unilateral Group B assemblage is composed of distal-mesial and mesial-proximal fragments – these sections being most often carried back to the site either inside the carcass of a hunted animal or in the haft of the broken projectile weapon. It is also not surprising to find that only four 'intact' implements were recovered, as the elongated dimensions and slim shaft of these weapons would have made their survival as intact objects in the archaeological record unlikely (see Chapter 1 for discussion). In fact, three of these implements were broken post-depositionally with fractures across the shaft (see Figure 5.29: A, B and D) and reconstructed by museum staff.

Due to the small sample size of this dataset, we cannot undertake the kind of total length analysis which was completed for the previous unilateral dataset, however, the tight range of the total implement lengths for the four 'intact' implements (which fall between 110.2 mm and 124.2 mm) suggests that Unilateral Group B points may also have been subjected to a cultural and/or functional factor which dictated their time of discard. Though, in the case of the Group B points this discard range is at least 10 mm greater than that identified for the Group A points (Group A: 90 - 100 mm; Group B: 110 - 124 mm).

Quick analysis of the distal-mesial fragment lengths shows that, overall, these fragments are around 15 mm on average shorter than the larger Group A counterparts (falling between 23.5 mm - 71.8 mm; average: 41.6 mm), while the mesial-proximal fragments (with impact fractures on both extremities) are again shorter than the Group A examples (falling between 39.1 and 52.6 mm in total length). These differences in fragment length are thought to be primarily the result of the slighter dimensions against the more robust dimensions of the Group A points.

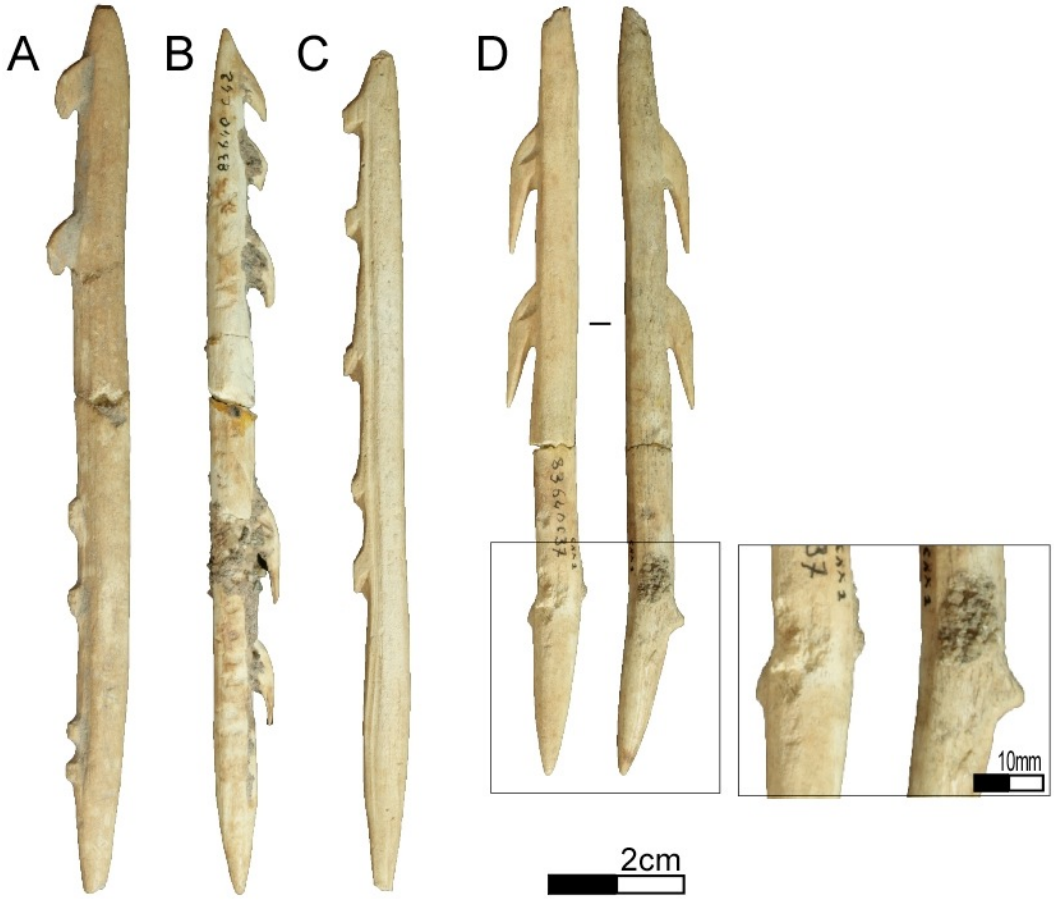


Figure 5.29: The four 'intact' unilateral Group B implements included in the La Vache assemblage: (A) MAN 8306247; (B) MAN 83640C42; (C) MAN 83643C44; (D) MAN 83640C37 with detail of proximal end in process of fracturing.

In particular, the analyst should note that these slighter points appear to have a more restricted total length range in which they must remain to function efficiently. If these implements were indeed components of multi-spear or multi-arrow weapons, it would make sense that if one of the tips fractured in use, it would be discarded at an earlier stage in its use life than those points which are categorised as Unilateral Group A points and which may have functioned as a solo weapon tip. The three (or more) prongs which make up the multi-prong weapon head would be needed to be of similar length if the weapon was to function most effectively, as broken and shortened tips could potentially allow the targeted prey to escape being penetrated and caught. Hence, it would be logical that these implements would be discarded without having undergone significant alteration and at an earlier stage of possible reduction. Again, this is a line of thought which require a series of experiments to test the proposed hypotheses and assumptions.

Finally, one particular artefact (MAN 83640C37; Figure 5.29: D) allows us to identify why it was discarded, and thus deserves detailed description. This implement is the shortest of the 'intact' Group B points, and has clearly undergone maintenance to its distal edge (as evidenced by the spatulate tip). The most interesting aspect of this artefact, however, is the proximal extremity which is in the process of snapping just above the basal bulb. This kind of fracture can be considered a catastrophic fracture for barbed weaponry, especially where there is not enough shaft length left to remake the base and still leave enough penetrating length for the weapon to function effectively. This fracture, which is the same type as that discussed for the Bilateral Group A points above, along with the already diminished length of the implement therefore likely constitutes the reasons for which it was discarded when returned to La Vache.

Unilateral Group C

Group C unilateral barbed points number only 13 in total and include five 'intact' examples. These artefacts were found in all four stratigraphic levels of the Salle Monique, but were also recovered from the Salle Garrigou. Each of the three implements recovered from the latter chamber are fragmentary (one distal-mesial fragment; one mesial fragment; one mesial-proximal fragment). Unfortunately, three of the five 'intact' examples were labelled only as coming from '*toutes couches*' in the Salle Monique, and subsequently provide little information regarding any potential temporal clustering of these artefacts. The two remaining 'intact' examples were recovered from Couche 3 and an unknown provenance, respectively (Figure 5.30).

As can be seen in Figure 5.31 below, each of these tiny implements have three or four barbs and, in four cases (A – D), a distinct point crafted above the top barb. Two of the implements (A and C) have been more carefully created, with the former being particularly delicate, but each requiring an expert hand to create. Two of the implements (C and E) display basal bulbs, though in the latter case the 'bulb' is only a slight widening of the shaft width. The remaining three artefacts show no widening of the base, simply finishing in a sharp, conical point or blunt edge.

Two of these implements are decoration (MAN LXXXIII3 and MAN XXI2, B and C in Figure 5.31). While MAN XXI2 has a series of slightly oblique lines engraved down its left side, the second implement (MAN LXXXIII3) has only two rough lines on the superior surface just below the lowest barb. These incisions may be a kind of brief reference to the more complex designs often inscribed on the larger (Group A and B) implements (see examples above).

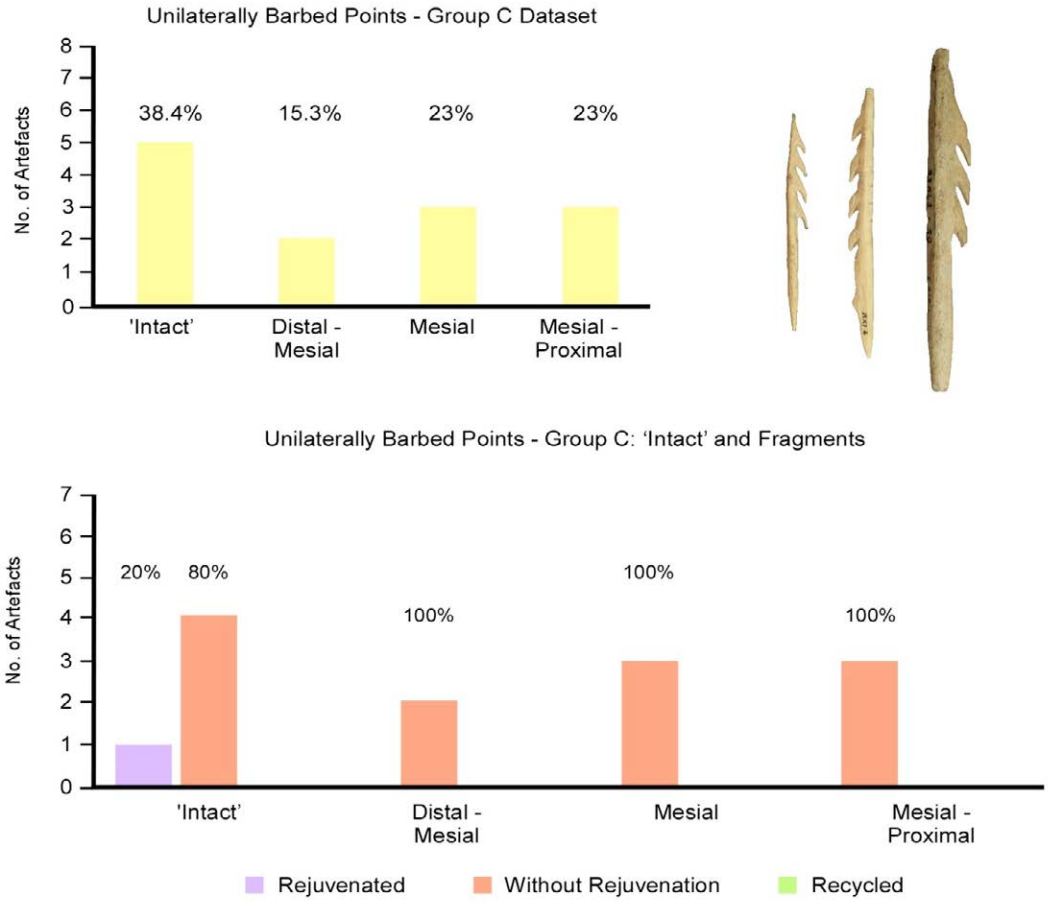


Figure 5.30: Composition of unilateral Group C dataset. Top: Composition of assemblage. Bottom: Occurrence of evidence for rejuvenation, recycling and no evidence for rejuvenation.

Evidence for maintenance was found on only a single implement and not one of this small artefacts was found to have been recycled.

Methods of Maintenance

As just stated, only one implement displays evidence for rejuvenation. This is an 'intact' specimen (MAN XXIX) which appears to have been discarded while in the process of rejuvenation. This interpretation is suggested by the unfinished reworking of the distal extremity, which if completed, would have removed the top barb and blunted tip (Figure 5.31: E). This same reduction-to-a-knob morphology is also seen in a number of unbarbed point cases detailed below. The fact that the almost removed barb is at the very tip of the implement in addition to the disproportionate length of the barbs-to-base section in comparison to the barbed section also indicates that this implement had previously undergone rejuvenation – at least on one previous occasion – in which the distal point was reduced. Additionally, the other four 'intact' implements have three (in two cases) and four (in two cases) barbs each, suggesting that this implement may originally have had at least three barbs below an extended distal point which had since been removed.

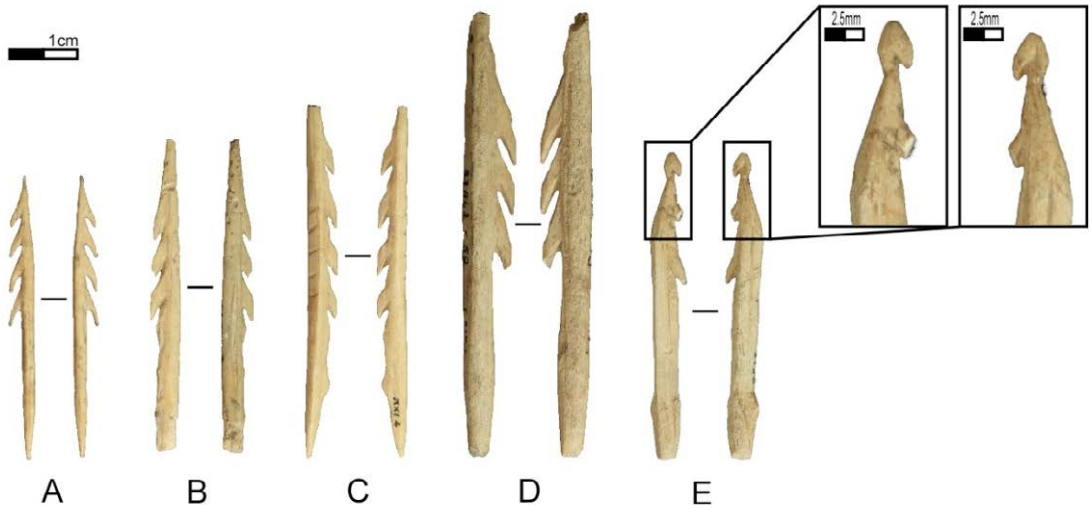


Figure 5.31: The four 'intact' Group C implements: (A) MAN sans no.; (B) MAN LXXXIII3; (C) MAN XXI2; (D) MAN 83642C58; (E) MAN XXIX. Distal extremity in process of rejuvenation has been enlarged.

Considering the very small amount of material left to work, the fact that this particular point was undergoing yet another cycle of rejuvenation suggests that the owner of the

point may have been limited by the availability of replacement points or that this particular artefact had value of some other sort.

Recycling

Not one of the Group C implements recovered from the Salle Monique or Salle Garrigou showed evidence for having been recycled, either as another functional projectile weapon type or tool. Obviously the tiny stature of the Group C implements prohibits the kinds of extensive reworking seen on the larger unilaterally barbed point types (Groups A and B) as does their reuse in the functional categories common for the larger points (i.e. wedges, spatulas). Small bipoint 'darts' less than 6cm in length and 5mm in width are known in the La Vache assemblage, however, and it is conceivable that Group C implements could have been recycled into these tools but, again, there is no evidence that the inhabitants of La Vache did so.

Fracture and Discard

Unfortunately, the fragmentary pieces of Group C points are too few to be able to provide more than the most basic of insights into how these implements fractured and discarded. Two distal-mesial fragments, three mesial fragments, and three mesial-proximal fragments were identified in the La Vache assemblage, with all but one mesial fragment displaying impact fractures on their extremities. Interestingly, the fragments recovered are all of similar length (23.6 – 47.0 mm, average: 35.3 mm) despite being different fragmented sections of the implement.

Given the minuscule dimensions of these artefacts, one must ask the question: if the splinter and bevel fractures on these same implements were sustained through use as projectile tips or in another way? The slim dimensions of these points would make them vulnerable to accidental snapping if handled too roughly, and as was discussed for the tiny bilaterally barbed point above, it is possible that these artefacts were no functional food gathering weaponry at all, but rather examples of artisan virtuosity or perhaps children's toys.

Unbarbed Points

In total 1561 ‘intact’ and fragmentary pieces of unbarbed points were identified and examined, constituting 100% of the bevel based point assemblage recovered from La Vache.

Of these 1561 artefacts, 1104 were recorded and photographed in detail. The remaining 433 artefacts were mesial fragments which were checked for signs of maintenance or recycling, and tallied into size range groups (<4 cm; 4 – 8 cm; >8 cm). These mesial fragments were not recorded and photographed in detail owing to time constraints and the fact that these fragments offer little information regarding how the antler unbarbed weaponry was maintained. Any mesial fragment which was found to have evidence for maintenance was recorded in detail, photographed, and will be discussed below.

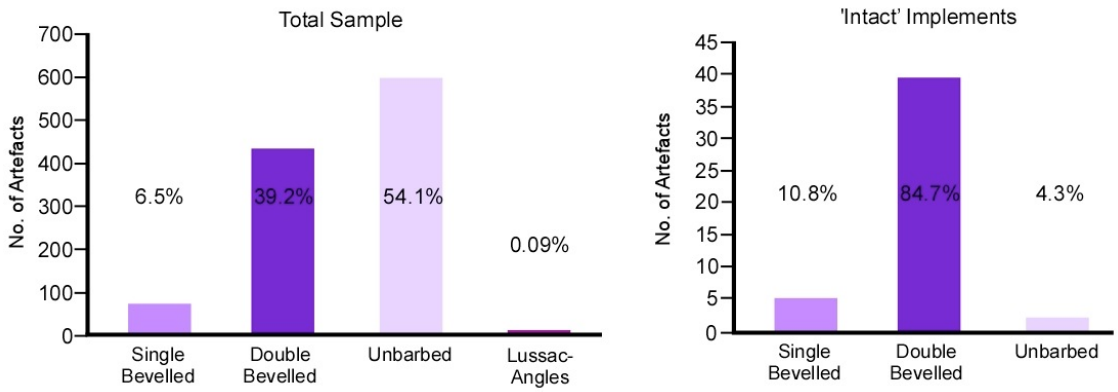


Figure 5.32: Unbarbed point sample composition for La Vache: (Left) Composition of unbarbed point assemblage; (Right) Number of ‘intact’ implements in each category.

At La Vache, single bevelled points make up 6.5% (n = 72) of the recorded assemblage (1104 out of 1561), double bevelled 39.2% (n = 433), and unbarbed elements (those pieces which were unable to be identified further) 54.1% (n = 598). Additionally, a single Lussac-Angles point fragment was identified (0.09%). Five-hundred-and-fifty-four distal-mesial fragments which may have come from any of the unbarbed point types were also recorded. These latter fragments will be described in the ‘Fracture and Discard Pattern’ section at the conclusion of this chapter.

'Intact' implements are few in the unbarbed assemblage as these points tend to exhibit more severe fractures (splinter, bevel, etc.) to their distal extremity than do barbed points, which as we saw above, which were often discarded having accrued only light use wear (such as crushing). Out of the 433 double bevelled elements identified, only 39 were considered 'intact' (6.6%), as were five single bevelled implements (19.6%). An additional two 'intact' implements were identified and recorded, though it was unclear whether the base had been a single or double bevel, and as such were recorded as simply 'unbarbed'.

Upon examination of the bevel based implements, it became evident that there may exist more than one typological and/or functional category within the single and double bevelled point assemblages based on overall point dimensions. As such, it was decided that both the single and double bevel datasets would be split into two groups for analysis to attempt to account for these possible categories: those points whose bevel shoulder width is less than 7 mm (<7mm BSW) and those whose bevel shoulder width is greater than 7 mm (>7mm BSW). This separation of the dataset split those points which were significantly slighter in overall morphology from those that were generally more robust.

As it was observed that all of the bevel based points had similar fracture patterns, and thus this aspect of the entire unbarbed point dataset will be discussed together after the maintenance and recycling patterns for each subset are described. In this way, repetition of ideas and points are minimised.

Double Bevelled Points

Four-hundred-and-thirty-three 'intact', mesial-proximal or proximal fragments of double bevelled points were identified and recorded in the La Vache assemblage. Fifty-one implements fell into the <7mm BSW category (11.80%), with the remaining 381 falling into the >7mm BSW category (88.19%) (Figure 5.33).

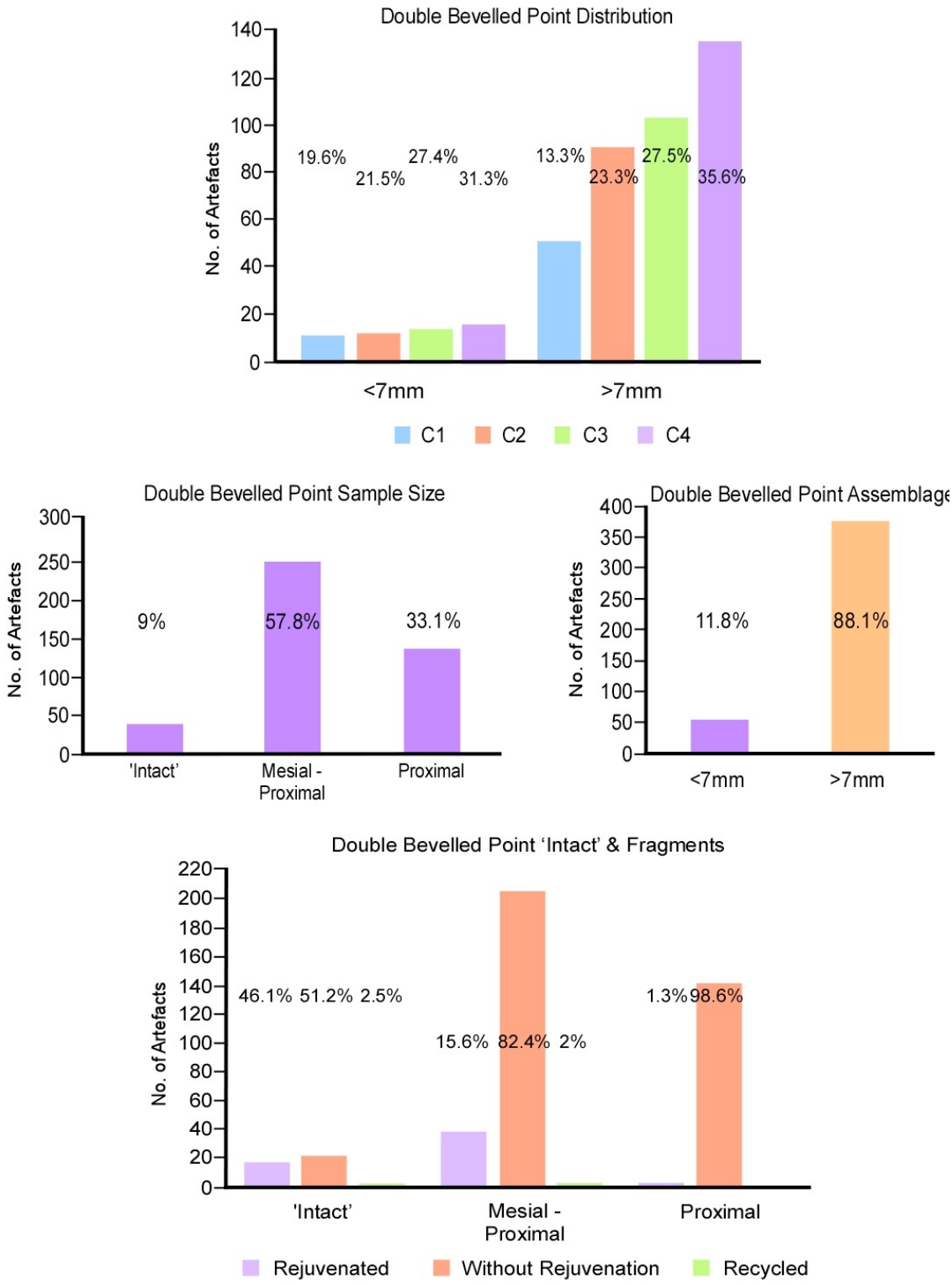


Figure 5.33: La Vache double bevelled point sample composition. Top: Distribution of double bevelled points through the stratigraphy in order of depth; Middle Left: Composition of the double bevelled point assemblage. Middle Right: Distribution of implements into analytical groups. Bottom: Occurrence of evidence for rejuvenation, recycling and no evidence for rejuvenation in the double bevelled point assemblage.

'Intact' implements make up only 6.6% of the double bevelled dataset, with mesial-proximal and proximal fragments making up the remaining 90.9%. Evidence for rejuvenation on these implements is most commonly identified on the 'intact' implements (46.1%) with only 15.6% of the 250 mesial-proximal fragments showing clear evidence for repair. Evidence for rejuvenation on proximal fragments is even rarer (1.3%). Recycling of double bevelled points was also found to be rare with only 1.3% of the total dataset exhibiting evidence for a second use life.

While the distribution of <7mm BSW points is relatively even throughout the four stratigraphic units of the Salle Monique, there is a gradual decrease in the number of >7mm BSW points being deposited through time (Figure 5.33). These results will be discussed in conjunction with the other bevel based datasets at the conclusion of this chapter.

Double Bevelled Points: <7mm Bevel Shoulder Width Group

As just stated, the <7mm BSW dataset is a small group of 51 artefacts. Of these implements, 21.5% (n = 10) were classified as 'intact' as they displayed only minimal damage to their distal tip (such as crushing), 52.9% (n = 27) as mesial-proximal fragments, and 27% (n = 14) as proximal fragments (Figure 5.34).

Evidence for the repair of these finer projectile points was found on half of the 'intact' specimens and 22.2% of the mesial-proximal fragments (n = 6). Not one of the 14 proximal fragments exhibited evidence for rejuvenation or recycling, which is consistent with the pattern observed for the entire dataset of unbarbed points examined for this study. Of the entire <7mm BSW dataset, only a single artefact appears to have been recycled.

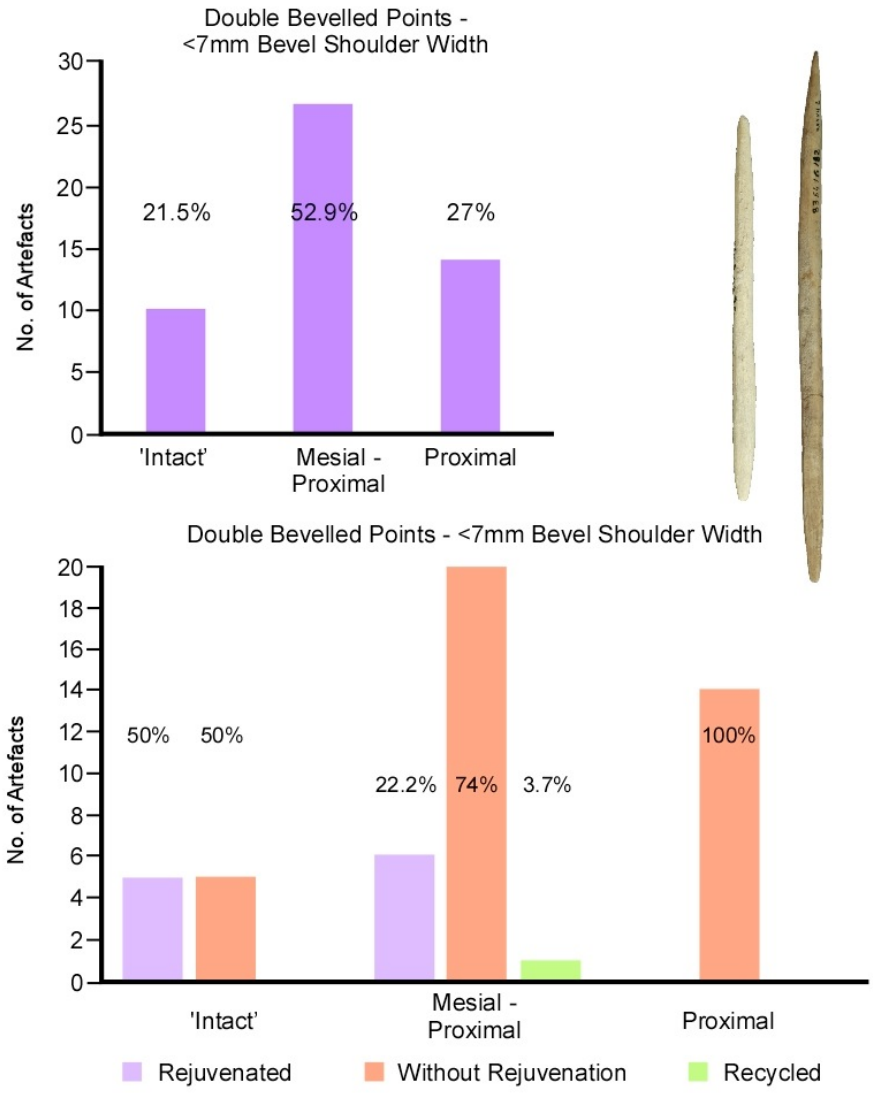


Figure 5.34: Composition of <7MM BSW dataset. Top: Composition of the double bevelled point – <7MM BSW – assemblage. Bottom: Occurrence of evidence for rejuvenation, recycling.

Methods of Maintenance

Evidence for the maintenance of unbarbed points comes in all the same forms observed on the barbed points of La Vache, but with the addition of that applied to barbs broken or removed in use. For those 51 whole and fragmented double bevel <7mm BSW pieces included in the La Vache assemblage, 21.5% (n = 11) exhibited evidence for maintenance.

As might be expected, the large majority of maintenance evidence identified on these slighter points is found on the distal section of the point (63.6%; n = 7). As was seen on

the barbed points, evidence for the resharpening of the distal tip consists of stigmata generated by the use of a lithic blade or grindstone being dragged along the surface (lines, facets, uneven surfaces, etc.). These same stigmata were all identified on this sub-sample of unbarbed points (striations: three examples; facets: two examples; uneven surface: one example) (Figure 5.35, A). As decoration is far less common on unbarbed points than their barbed counterparts, it is not surprising that only a single example of decoration having been partially erased in the resharpening of the tip was observed.

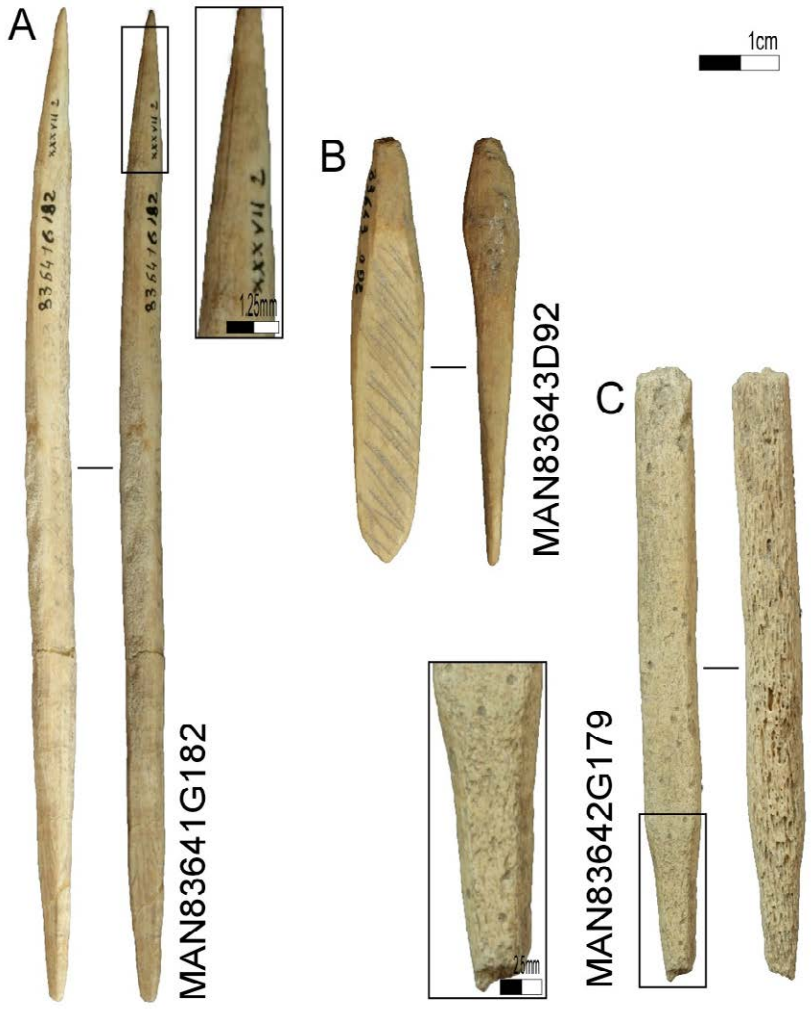


Figure 5.35: Examples of rejuvenated double bevel based points (<7mm BSW): (A) resharpening of distal tip – uneven axis and resharpening lines; (B) mesial-proximal fragment removed using the BWF technique; and (C) remade base.

Two examples of bifacially worked fractures (Figure 5.35, B) were identified on the <7mm BSW points, as were two examples of remade bases (Figure 5.35, C). As will be seen, each of these rejuvenation methods mirror those used on the larger >7mm BSW points.

Recycling

Only a single artefact (MAN 83641D53) that appears to have been recycled was identified in amongst the <7mm BSW double bevel points. Given the small dimensions of these weapon tips, it is not surprising that they were not often recycled into other tools.



Figure 5.36: The single <7mm BSW double bevel based point with evidence for recycling (MAN 83641D53). The inset box highlights a retrieval cut mark.

Shown in Figure 5.36, the identified recycled artefact has had a c.10 mm facet roughly carved into its left and right sides. The distal extremity terminates in a splinter fracture and a retrieval cut mark is visible on the right side (shown in the inset box in Figure 5.36), which are both consistent with use and retrieval as a projectile point.

The proximal edge of the double bevel displays chipping (a common wear pattern from use as a projectile point), though it has been worn smooth. This secondary wear of the bevel, suggests that the artefact may have been reused as a spatula (or similar). Unfortunately, owing to the common practice of cleaning all artefacts (especially those artefacts recovered in early excavations), there is little chance of residues being positively identified and able to be used to determine the secondary use life of this artefact.

Double Bevelled Points: >7mm Bevel Shoulder Width Group

The large majority of the double bevel based points recovered from La Vache have a bevel shoulder width of more than 7mm (n = 381; 88.1%). For this dataset, bevel shoulder width ranges between 7.01 and 37.17 mm with 50.6% falling within only c. 2mm of each other (8.52 to 10.65 mm). This level of standardisation is to be expected as points would have been replaced at a faster rate than the accompanying foreshaft/shaft. Thus the proximal dimensions of the replacement point were required to fit the foreshaft or shaft continuing in use.

As with the smaller scale double bevelled points (those with a BSW <7mm), the majority of the dataset is made up of mesial-proximal fragments (n = 223; 58.5%), though 129 proximal fragments were also identified, in addition to 29 'intact' implements (Figure 5.37).

Again, recycling was rarely observed with less than 2% (n = 5; 1.3%) of artefacts displaying evidence for a secondary use life. Similarly, evidence for repair was found on only 48 of the 381 implements (12.5% of the dataset) (Figure 5.37).

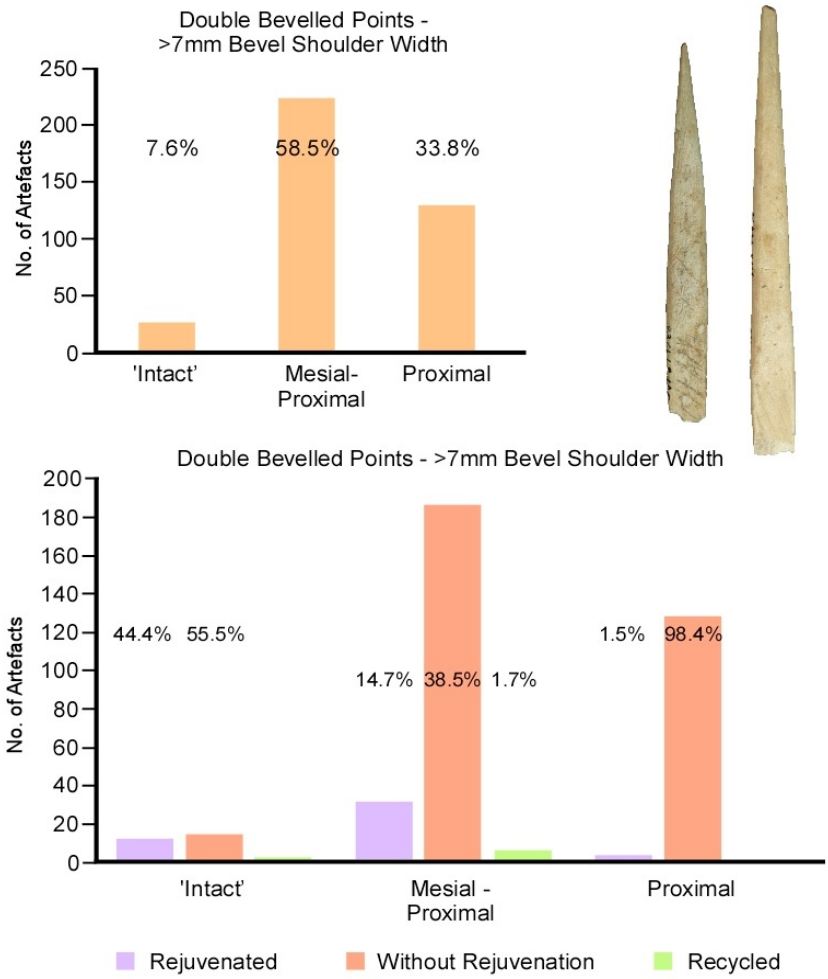


Figure 5.37: Composition of >7MM BSW dataset. Top: Composition of the double bevelled point – >7MM BSW – assemblage. Bottom: Occurrence of evidence for rejuvenation, recycling.

Methods of Maintenance

As described in Chapter 3, unbarbed points - including those with a single or double bevelled base – are believed to have been designed with a conical, piercing point and an original length in the vicinity of >200 mm. Only those double bevelled points that were recovered 'intact', that is, those points with 'minimal' wear on their extremities can be examined for evidence for the resharpening of the distal-mesial section (for obvious reasons).

Of the 29 'intact' double bevelled implements, 17 (58.6%) have evidence for distal tip resharpening in the form of striations (n = 5 cases), facets (n = 6 cases), an uneven surface (n = 4 cases), or the partial erasure of decoration (found on only one example).

In another case, a small bevel fracture sustained at the tip of the weapon appears to have been hastily smoothed over with no further effort to repair the damaged tip. As we have seen in Chapter 2, the removal of even the smallest use wear (impact damage) is essential to prevent the failure of the weapon. This last instance, therefore, is a good example of minor, quickly executed, maintenance of the point in order to simply remove the rough edges of the fracture in an effort to prevent further damage to the weapon.

While the overall morphology of the point base has received significant attention by analysts in the past, less attention has been paid purely to the proximal edge design of the bevel. While examining the La Vache bevel based point assemblage, it became apparent that there may be as many as four different bevel shape designs (Figure 5.38). These differences in bevel edge were important to note in order to identify the various stages of wear accrued in use, as well as repaired or remade bases.

As can be seen in Figure 5.38 below, the proximal edge of the bevel can be divided into four groups which will be referred to here as:

- 'arrow based' bevel
- 'square based' bevel
- 'curved based' bevel; and
- 'pointed base' bevel.

Pétillon (2006:67-68; Figure 40) had previously also noted these differences in bevel edge design, dividing this same dataset into three more or less similar types: *concave* (arrow based here), *droite* (square based here), and *loncéloée* (curved based here). He did not, however, interpret what these differences might imply.

Those examples shown in Figure 5.38 represent some of the most intact bevel edges identified in the dataset, the points on which they were made having fractured before significant damage had accrued along the edge. As these examples show, bevel edges were carefully crafted sections of the weapon with even angles and striations engraved

on the superior and inferior faces to assist in the hafting of the point to the foreshaft/ shaft.

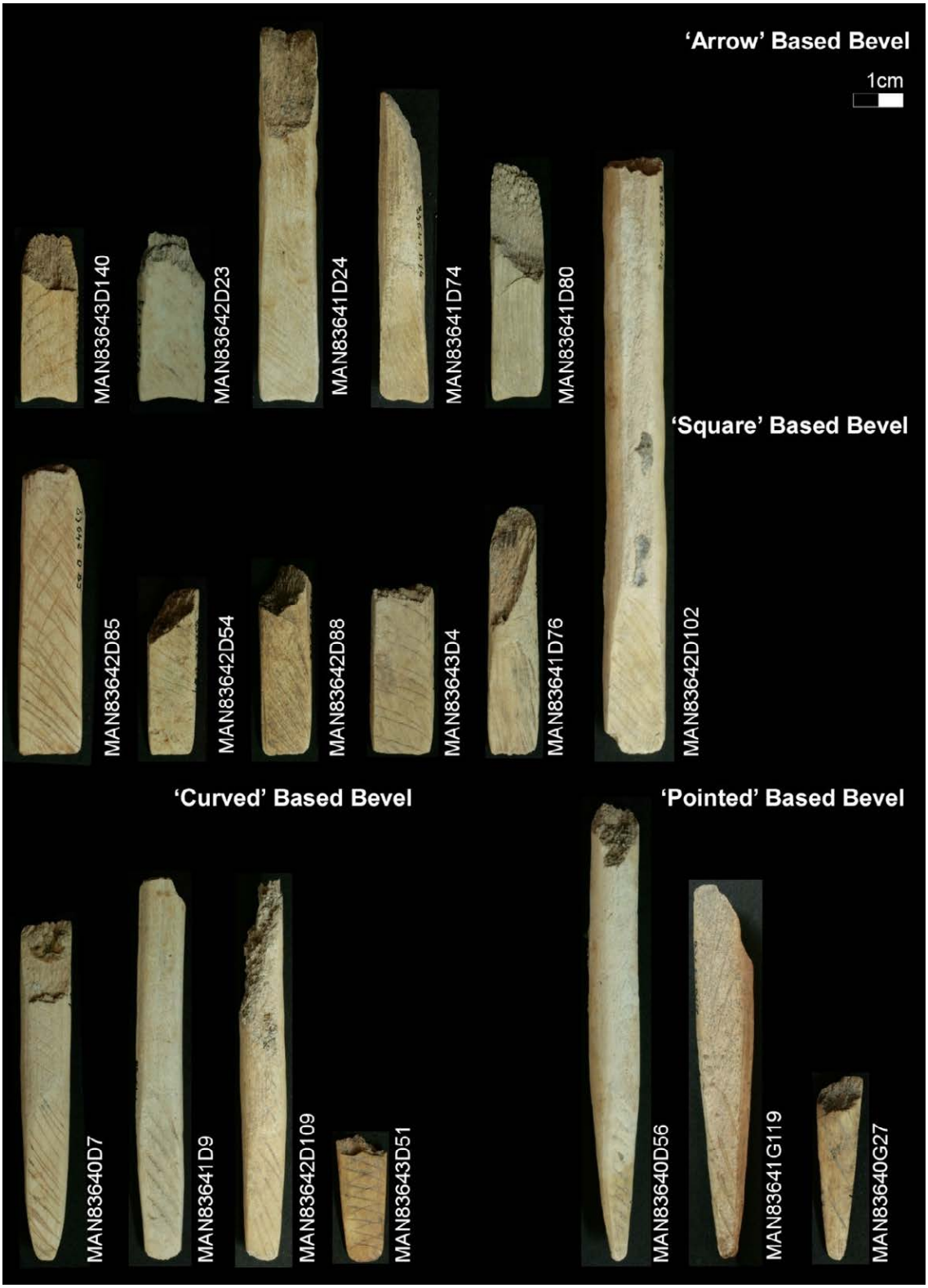


Figure 5.38: Examples of the four double bevel base edge types identified in the La Vache assemblage.

It is important to note that these bevel edge types were not found to correlate to a specific stratum or strata, but were instead mixed together throughout the stratigraphy of the site.

The La Vache >7mm BSW dataset includes 352 bevels in total. As will be described in detail below, the bevel base has been shown experimentally and archaeologically to frequently dislodged in its haft – and thus can often result in the fracture of the proximal extremity to varying lengths above the bevel shoulder. Where the remaining distal-mesial fragment is of sufficient length (again, discussed below), a new base may be constructed in order for the implement to continue in use. Unfortunately, where the base was carefully recreated with the same level of detail as that originally carved, we will be unable to identify its secondary (or even later) nature. This situation is a point which has been previously been made for Aurignacian weapon tips by Knecht (1997a:205) who stated, "reworked bases of bone and antler points are morphologically identical to the original". Fortunately, we *can* identify poorly or hastily remade bases.

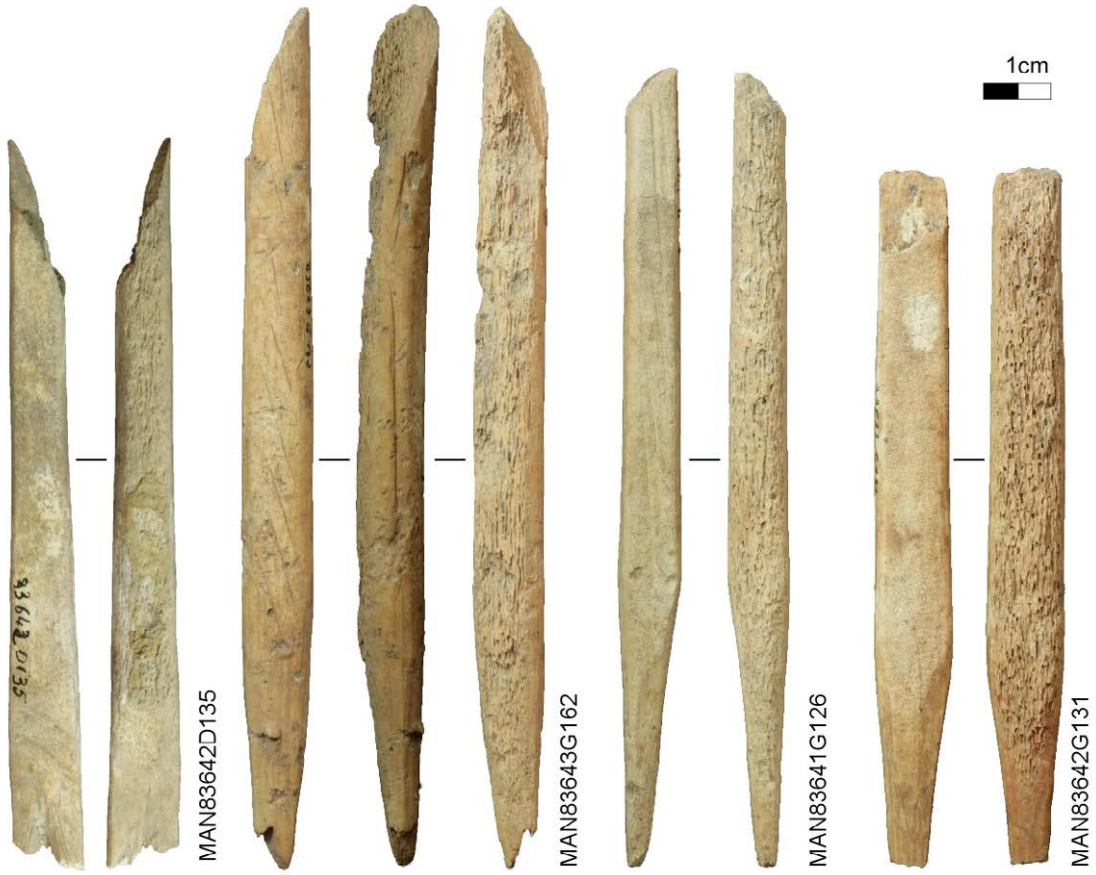


Figure 5.39: Several examples of hastily 'remade' bases.

As mentioned above, two such remade bases were identified for the <7mm BSW double bevel based points. For the larger dataset, 15 remade bases were identified. It was observed that with only a couple of exceptions each of these artefacts had been categorised within the museum collection as distal-mesial fragments presumably owing to the pointed form of the extremity. Upon close examination, however, it was found that these artefacts were in fact mesial-proximal fragments that displayed a hastily remade base (Figure 5.39).

This re-identification of the artefacts was based on two central characteristics which will now be outlined. First, the width of the shaft decreases away from the shoulder of the new base, indicating that the tip of the weapon was located at the opposite end to the worked area. And secondly, the worked areas on these 15 examples were hastily executed with nowhere near the quality of maintenance usually undertaken when the distal tip of a weapon was rejuvenated. In all but one case, the new base is (very) roughly elliptical in section (as opposed to the quadrangular section usual for bevel bases) and rarely has striations added to its surfaces. One wonders if the rough surfaces of the new base were considered by the repairer to provide sufficient traction for hafting, and thus the additional of striations were not necessary.

As only 15 remade bases were identified out of the 352 mesial-proximal and proximal fragments included in the assemblage, it might be hypothesised that either bases were not often remade on bevel based points, or replacement bases were usually crafted with as much care as the original base and we can therefore not identify that they are a replacement as the hastily remade examples in Figure 5.39 were. As mentioned above, however, experimental studies have shown that double bevel based points frequently dislodge in use which can lead to the fracture of the base, and as will be argued below, the sheer number of proximal fragments included in the assemblage argues for their somewhat frequent fracture and thus replacement.

Finally, it is interesting to note that 12 of the 15 remade bases were recovered from Couche 3 (n = 4) and Couche 4 (n = 8), with the each of the <7mm BSW examples also recovered from these levels.

Recycling

Interestingly, despite many of the discarded double bevelled points retaining sufficient material to have been recycled into a variety of different tools, only five instances of recycling were identified, and in each case, the recycled point was reused as a wedge (Figure 5.40). Additionally, four of the five instances were recovered from Couche 2 (the last from Couche 4), which suggests that some change (environmental, social, technological, etc.) may have occurred resulting in the recycling of this technology where it was not previously.

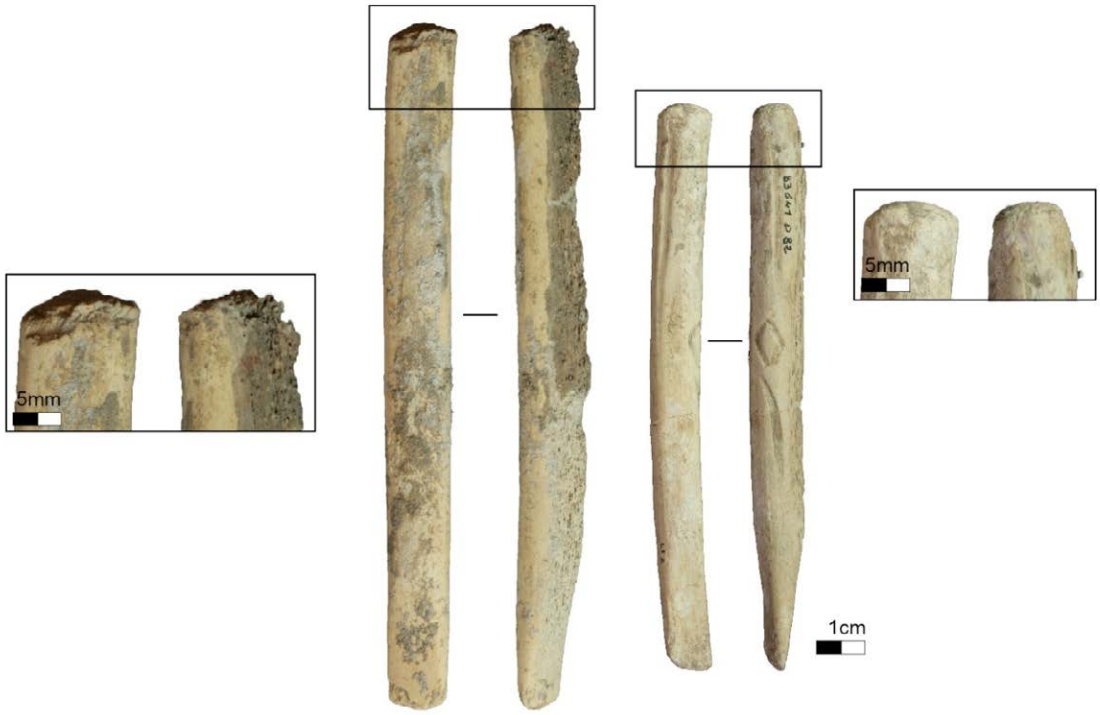


Figure 5.40: Two examples of double bevel based points having been recycled as wedges: (Left) MAN83643D2; (Right) MAN83641D82.

In each identified case, the recycled point falls at the upper end of the total implement length range (77 – 189.54 mm in total length) of mesial-proximal fragments and displays the characteristic use wear for wedges described above for those barbed points recycled in this fashion (i.e. crushing, mushrooming, rounding, chipping, etc.). Unlike

the barbed points which were reused as wedges at this site, the bevel based points did not require to be altered before reuse in this fashion – their basal form providing the perfect working edge. This fact alone makes it interesting that they were not recycled more often as minimal effort was required for their reuse.

Single Bevelled Points

The 72 unbarbed points with a single bevel base make up only 6.5% of the total bevel based assemblage of La Vache. Ten of these implements have a bevel shoulder width below 7mm (13.8%), the remaining 62 (86.1%) falling into the >7mm BSW category.

This smaller bevel based dataset has a similar composition to that composed of the larger double bevel based points, with 'Intact' implements constituting 6.9% (n = 5), of the assemblage, mesial-proximal fragments 70.8% (n = 51), and proximal fragments: 22.2% (n = 16).

As was seen for the double bevel dataset above, the number of >7mm BSW single bevel points recovered is greatest in Couche 4 and decreases through the deposit towards the surface. Those single bevelled points with bevel shoulder widths below 7mm were found tobe more ephemeral throughout the deposit (Figure 5.41).

While only a single implement exhibits evidence for having been recycled in the whole single bevel assemblage, evidence for maintenance was found on 46.2% of the dataset.

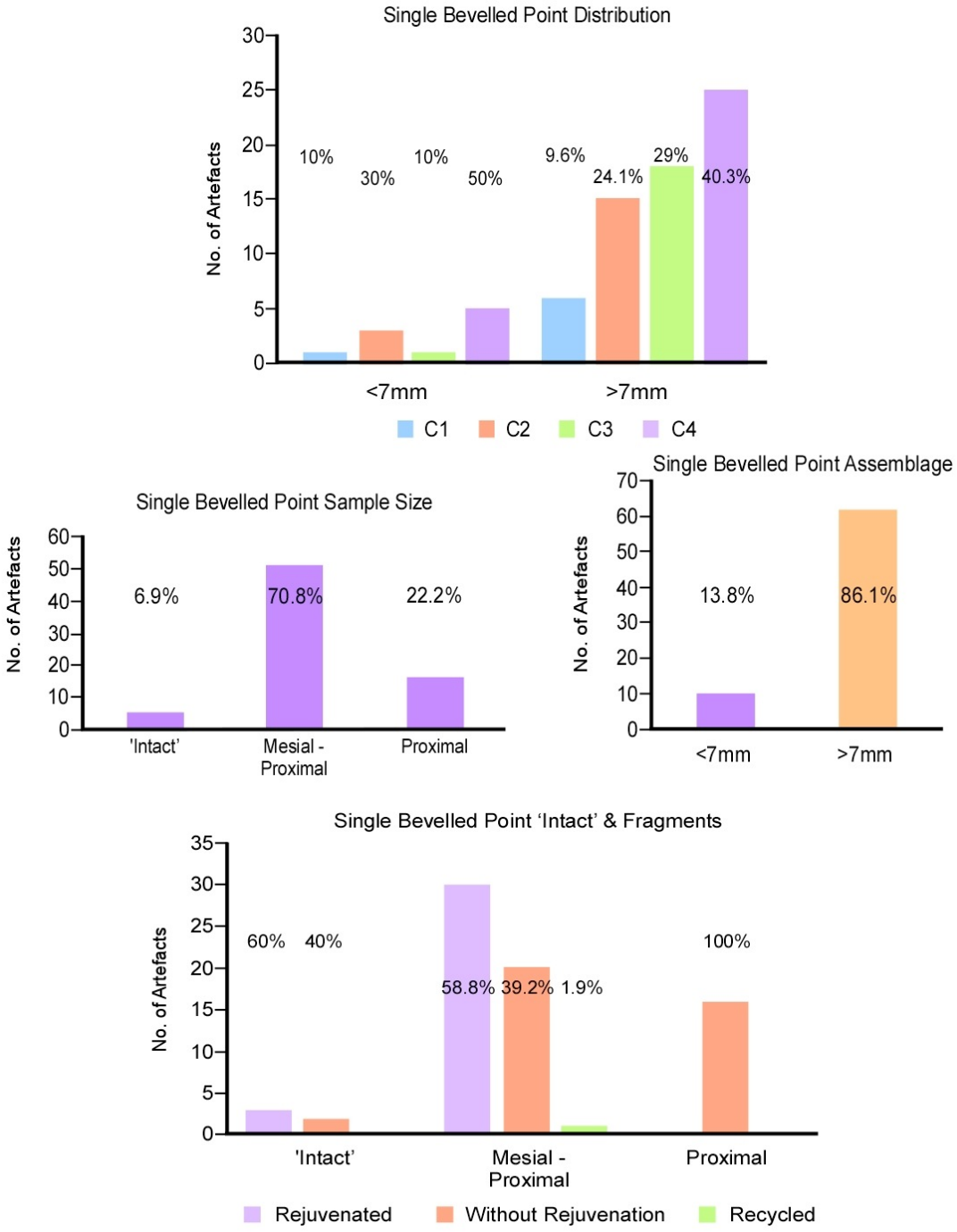


Figure 5.41: La Vache single bevelled point sample composition. Top: Distribution of single bevelled points through the stratigraphy in order of depth; Middle Left: Composition of the single bevelled point assemblage. Middle Right: Distribution of implements into analytical groups. Bottom: Occurrence of evidence for rejuvenation, recycling and no evidence for rejuvenation in the single bevelled point assemblage.

Single Bevelled Points: <7mm Bevel Shoulder Width Group

As just stated, only ten implements with a bevel shoulder width below 7 mm were identified in the La Vache collection. Not a single 'intact' example was identified, and no evidence for any of these artefacts as having been recycled was observed. Five of the mesial-proximal fragments display evidence for repair however.

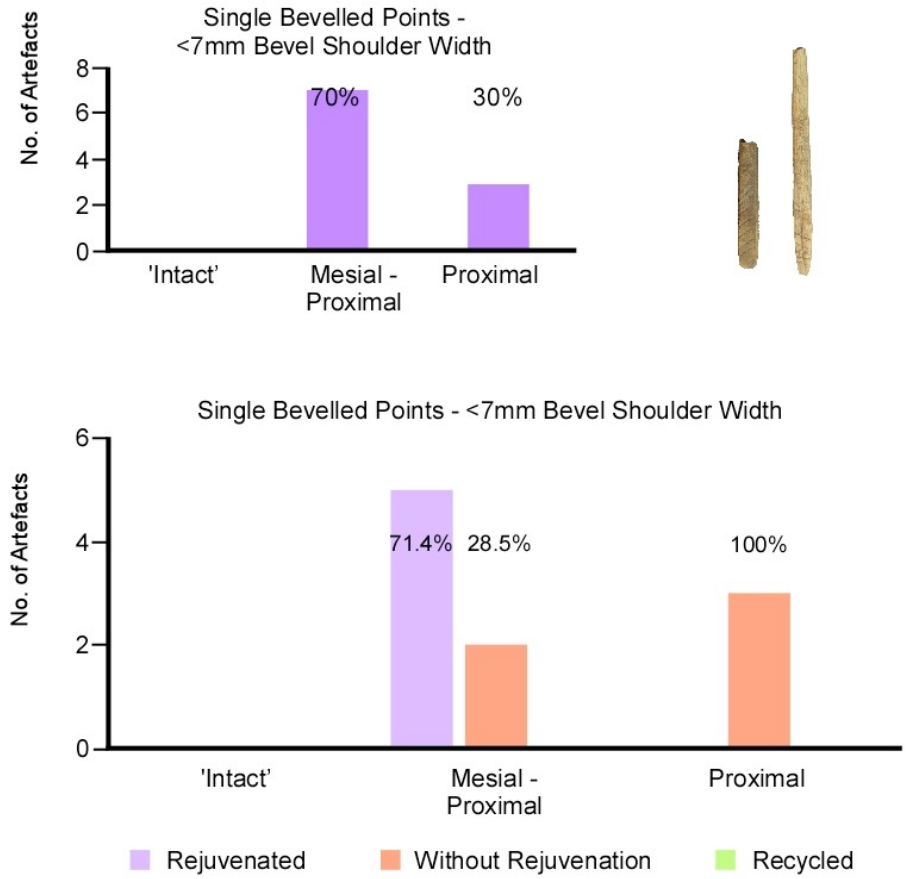


Figure 5.42: Composition of <7mm BSW dataset. Top: Composition of the single bevelled point – <7mm BSW – assemblage. Bottom: Occurrence of evidence for rejuvenation, recycling.

Methods of Maintenance

As was described for the double bevelled points above, the remaking of a bevel base was found to also be a commonly identified type of maintenance in the single bevel based dataset, including those of the <7mm type. In each of these four cases, the remade base was identified by the haphazard nature of the workmanship, which while more 'pointed' in overall shape, were still roughly single bevelled in morphology. A new bevel was roughly carved, in one case erasing part of the shaft decoration (Figure 5.43,

D), and resulted in an uneven section. In another case (MAN83643G236; Figure 5.43, C), a single vertical line was engraved down the superior face after the new base was constructed. This new incision is irregular and poorly executed, especially when compared to the carefully engraved decoration found on the barbed and unbarbed points recovered from this site. Of additional note, one of these artefacts (MAN 83641E3) has a distal section with several wide facets indicating that the tip may have been resharpened prior to its discard, though the distal tip itself is missing.

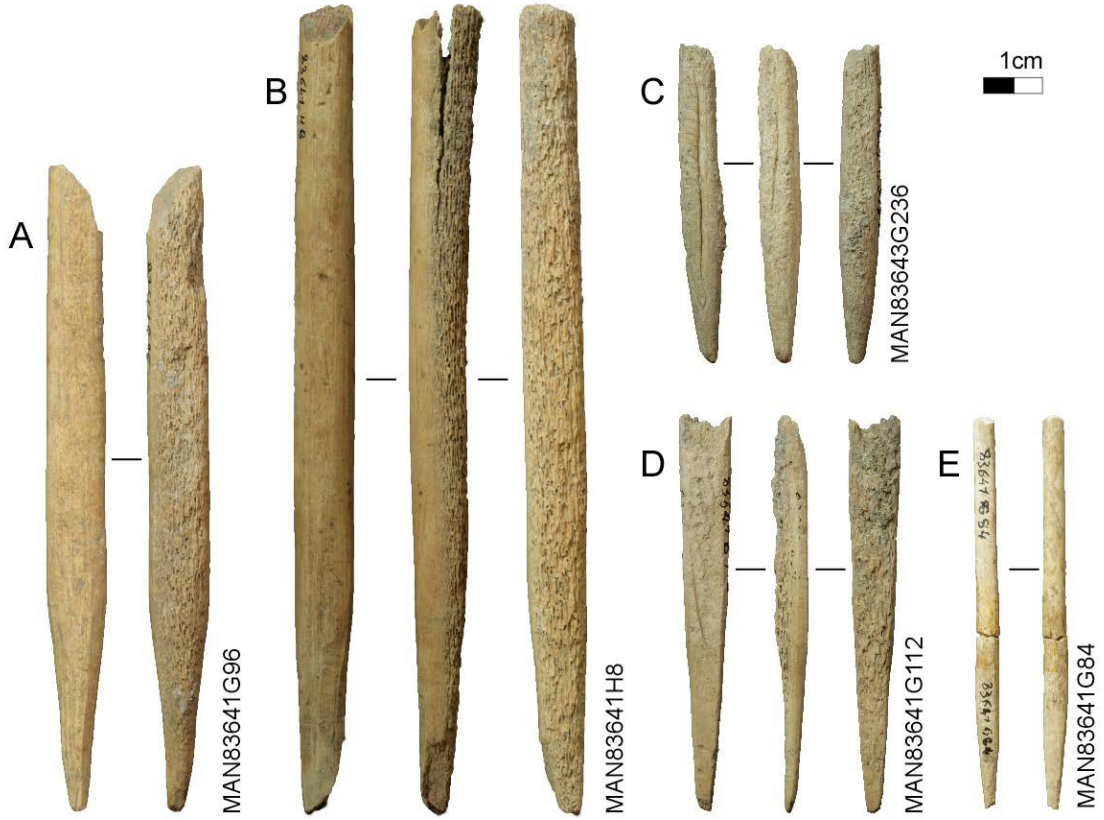


Figure 5.43: Examples of single bevel points with remade bases: (A, B, D) >7mm and (C and E) <7mm.

Single Bevelled Points: >7mm Bevel Shoulder Width Group

The majority of the single bevel points found at La Vache had bevel shoulder widths of more than 7 mm (n = 62; 86.1% of the total single bevel based dataset). Five 'intact' examples of >7mm BSW single bevel points were identified in the assemblage, along with 44 mesial-proximal fragments (70.9%) and 13 (20.9%) proximal fragments.

Only two artefacts of this larger type were identified as having been recycled, though evidence for maintenance was found on 45.1% (n = 28) of this sub-set (Figure 5.44).

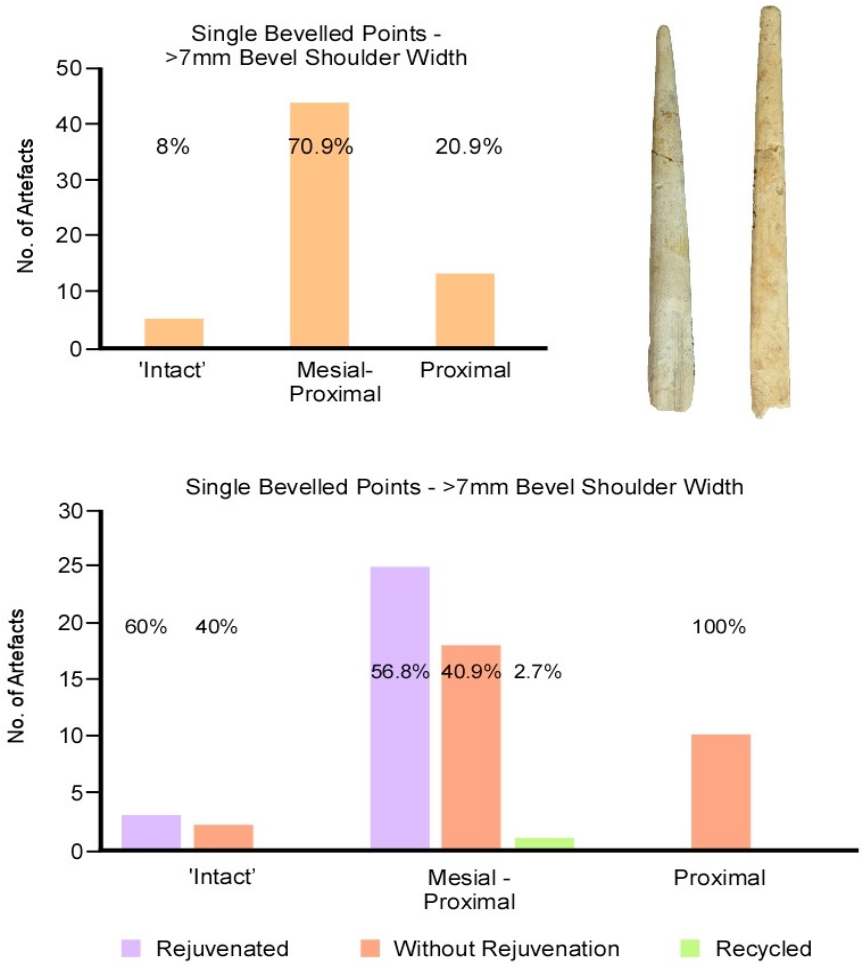


Figure 5.44: Composition of >7mm BSW dataset. Top: Composition of the single bevelled point – >7mm BSW – assemblage. Bottom: Occurrence of evidence for rejuvenation, recycling.

Methods of Maintenance

Of the five 'intact' single bevelled points identified, three exhibited evidence for the resharpening of their distal tip: two displaying striations, two an uneven section, and one, facets. The remaining evidence for maintenance was located on mesial-proximal fragments.

Evidence for repair located on the mesial-proximal fragments included cases where the base was remade in the same fashion described for the double bevelled and <7mm BSW

single bevelled points. In each of the 24 identified cases of remade bases, clear facets and uneven sections are seen (see three examples in Figure 5.43: A, B and D). In several cases, entry cut marks – where the lithic blade used to make these changes cut into the antler in order to start a downward stroke were still clearly visible. Two such examples are shown in Figure 5.45 below.

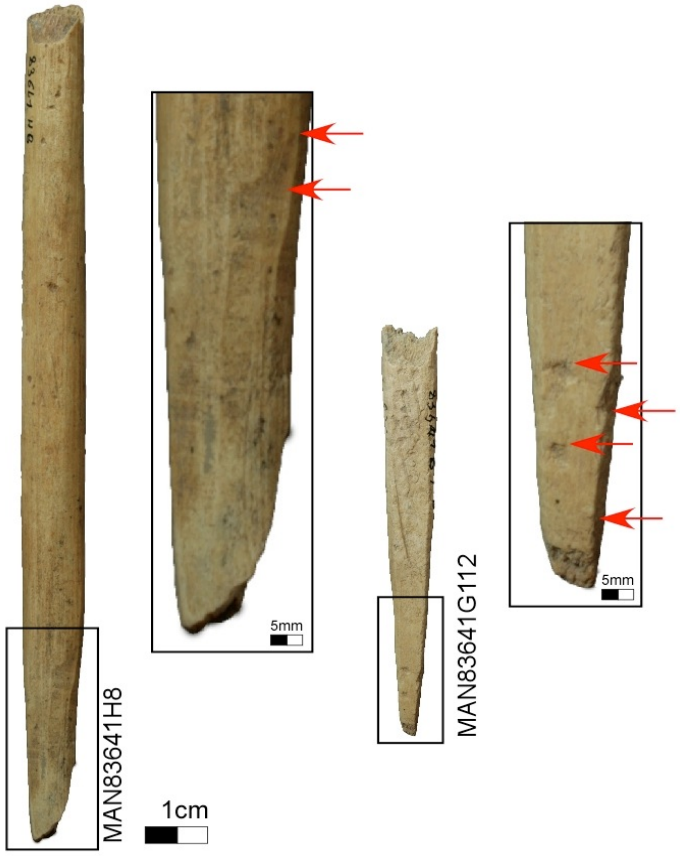


Figure 5.45: Examples of entry cut marks resulting from the remaking of the base. Red arrows indicate the start of the cut marks.

Another single bevelled artefact, (MAN83643G13) exhibits a unifacially worked fracture across its bevel (Figure 5.46). The circumstances that led to the bevel being cut through from the inferior face and then snapped along this cut are ambiguous, though it might be argued that this artefact had been recycled as another tool owing to the very short length of the distal-mesial section and the significant amount of crushing, rounding and chipping accumulated on the distal tip. This damage is more than that

usually allowed to accumulate on projectile points as previously discussed. Several researchers have warned that an awl also produces crushing, rounding and chipping on its working edge (e.g. Pétillon 2006), and it therefore seems possible that this artefact had been reused in the manner of an awl or perhaps as a pressure flaker (or similar) before being discarded.



Figure 5.46: The sole example of a single bevelled point with a worked fracture. Inset box shows the worked section in detail.

Recycling

The second single bevelled artefact that appears to have been recycled was reused in the common manner at this site, that is, as a wedge. MAN83641H4 (shown in Figure 5.47 below) displays the characteristic crushing use wear on its distal and proximal ends, making this identification unambiguous. Interestingly, this artefact is one of the only decorated single bevel based points in the La Vache assemblage identified, with four parallel oblique lines engraved on its left side. This is a design found on a number of the La Vache barbed points. It seems an unlikely coincidence that a rare decorated single bevelled point had been given an extended use life (through reuse as a wedge), and perhaps it was this decoration that led this particular projectile point to being selected for recycling.

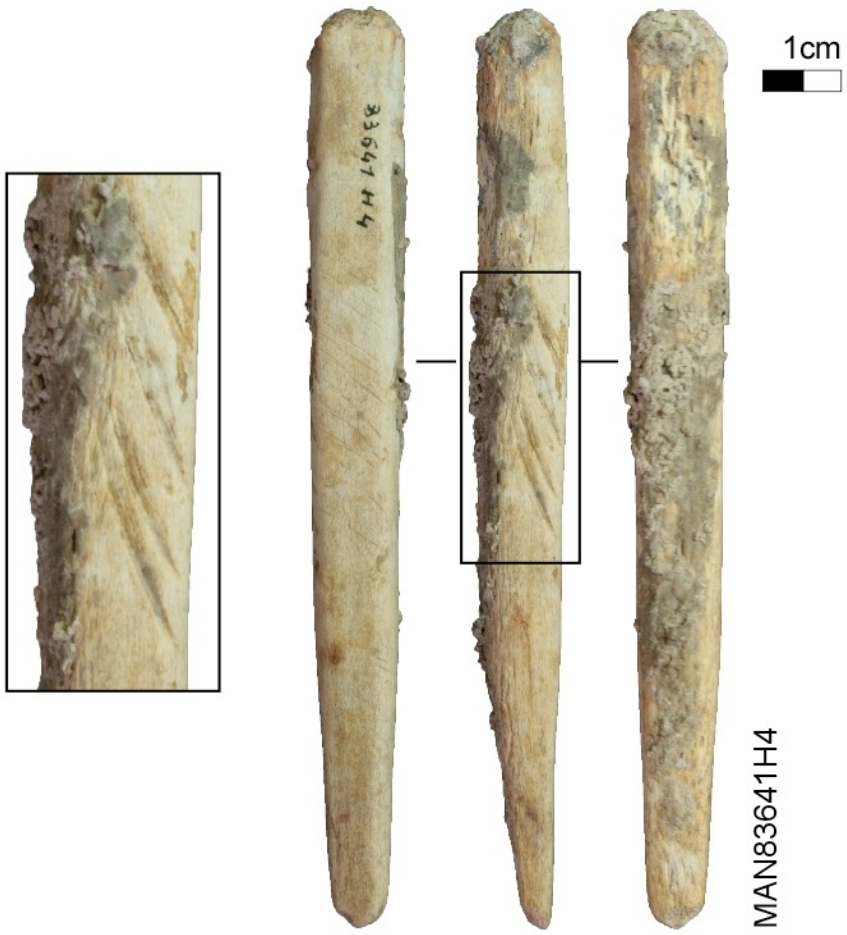


Figure 5.47: MAN83641H4: The sole recycled single bevelled point identified in the La Vache assemblage.

Single Bevelled Points: Lussac-Angles

What appears to be a single Lussac-Angles point was identified in the La Vache assemblage (MAN 83643G231). Lussac-Angles points are small, single bevel based projectile points which typically have a rounded but triangular section and display a single engraved vertical line down the superior (and sometimes also the inferior) face of its shaft. The artefact described here is a distal-mesial fragment measuring 41.57 mm in total length (Figure 5.48).

From the impact fractures sustained on both its distal and proximal extremities (a splinter fracture at its distal end and a bevel fracture at its proximal end), along with the series of particularly clear retrieval cut marks (see inset box in Figure 5.48), it is apparent that this weapon tip was shot into a target during which it fractured and was

lodged. This point was later retrieved from the carcass, possibly during the butchering of the captured animal, during which it was accidentally cut several times by a lithic tool (as evidenced by the 'V' shaped cross-section of the cuts) before being discarded.



Figure 5.48: The possible Lussac-Angles point identified in the La Vache assemblage (MAN 83643G231). Inset box details the series of retrieval cut marks evidence on the implements left side.

As these weapons are considered to be a chronological maker of the first half of the Middle Magdalenian (Szmidt et al. 2009), a period not represented at this site, it is surprising to find this artefact in the assemblage and it is very possible that MAN 83643G231 is not a Lussac-Angles point at all, but rather another bevel based point fragment with similar decoration. If this artefact is in fact a Lussac-Angles point, however, it may represent yet another link with other Magdalenian sites in the wider region (Pétillon and Averbouh 2013). Lussac-Angles points are most common in the Vienne-Charentes region of France (around 400 km to the northwest of La Vache), though these artefacts have also been found in significant numbers outside of this region. Thus, it is possible that this implement came to be discarded at La Vache through either of several possible social processes: (1) an individual (or group) from the

Vienne-Charentes area had travelled to La Vache with their weaponry, where upon it was used and discarded at the site; (2) an individual (or group) of people from the region surrounding La Vache had travelled to the northwest where upon locally made projectile points were obtained and brought back to La Vache for use; (3) an individual (or group) of people travelled to the northwest, observed the Lussac-Angles type points and later replicated this technology at La Vache; or (4) Lussac-Angles points were traded 'down-the-line' to people in the La Vache region where upon this implement was used and discarded at La Vache. Determining which of these possibilities is more likely to account for the appearance of this implement will be further discussed in Chapter 8.

Fracture and Discard Patterns for Bevelled Points at La Vache

The vast majority of the La Vache unbarbed dataset is made up of distal-mesial fragments which may have originated from either bilaterally barbed points or any type of unbarbed point. Of the 554 distal-mesial fragments found in the La Vache assemblage, 113 (20.3%) have some evidence for rejuvenation of the tip (striations, facets, uneven section, etc.), three may have been from recycled implements (a wedge, a spatula, and a burnisher respectively), and 106 (18.9%) have been cut (usually using the BWF technique, but sometimes only cut through from one face [UWF]) across their proximal extremity.

Of these 554 distal-mesial fragments, 363 have impact wear and/or fractures on both their distal and proximal extremities indicating that they fractured in use. Examination of these data found that 50.4% fall between 30.7 mm and 54.6 mm in total length (Figure 5.49), most likely indicating the most common length of distal point fractured in use.

Another 106 of the distal-mesial fragments were intentionally removed from the body of the point (either through the BWF or UWF technique), either because: (1) the tip had become too damaged to repair and was removed in order to construct an entirely new tip to the surviving point; or (2) the point had become embedded in a bone within a captured target and the tip was cut through in order to retrieve the spear and/or remaining point.

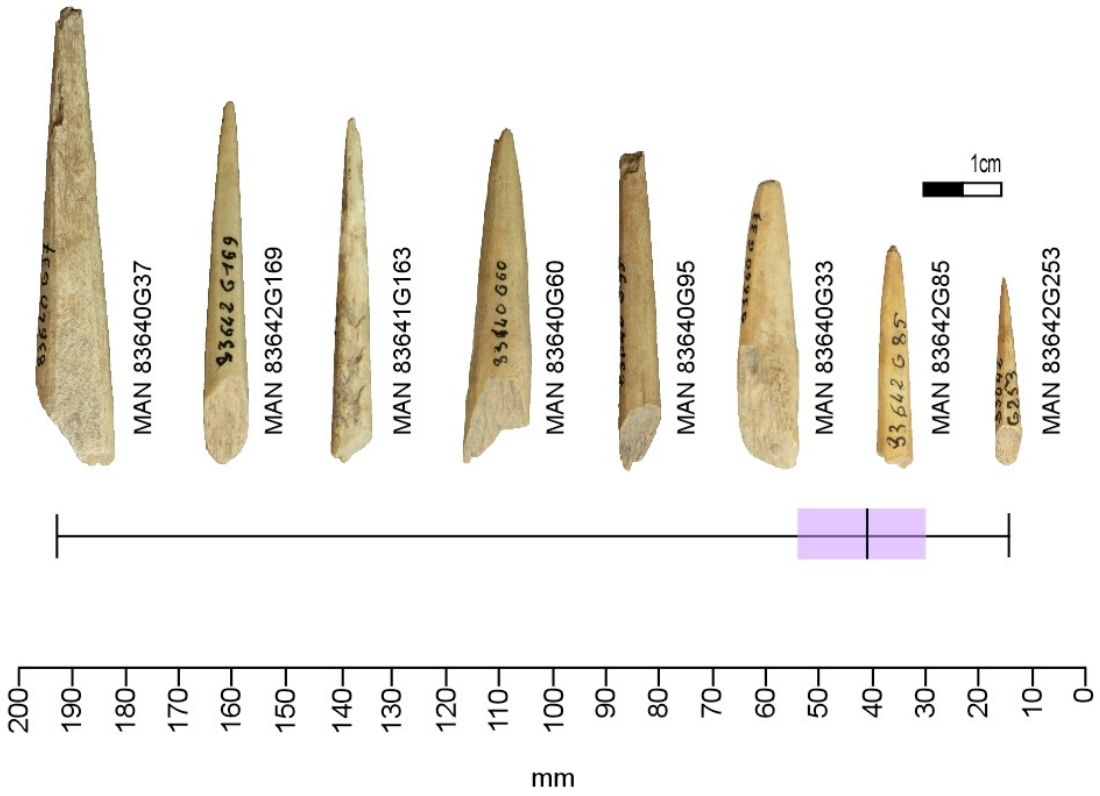


Figure 5.49: Box-and-whisker plot for the total length of unbarbed distal-mesial fragments with impact fractures with examples of these fractured pieces.

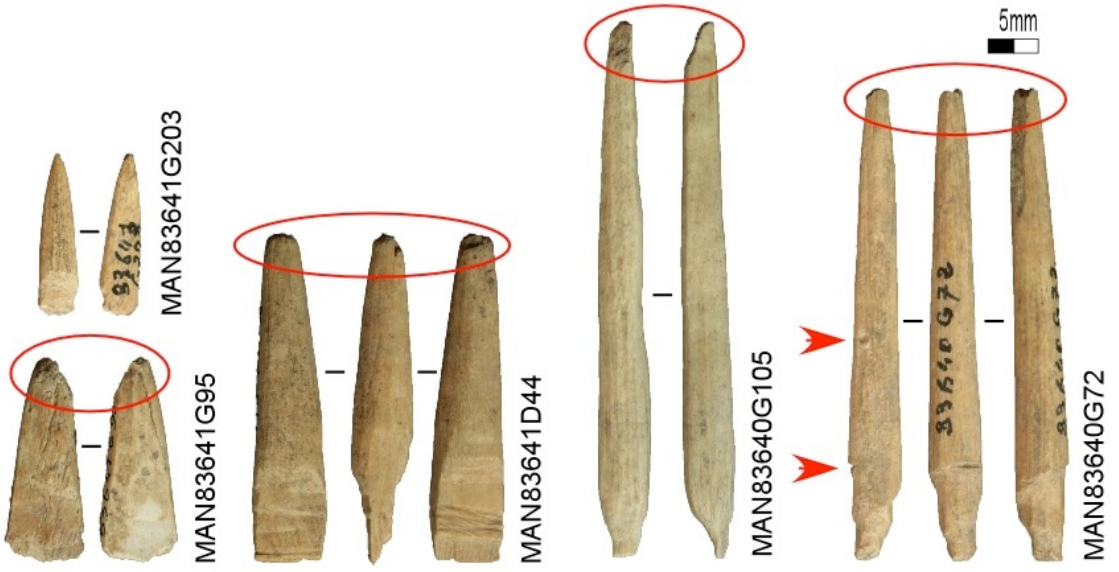


Figure 5.50: Intentionally removed distal tip sections as part of the maintenance of the weapon tip. The red circles outline use wear and fractures, while the arrows indicate retrieval cut marks.

It is clear on a great many of these artefacts that they were removed owing to severe wear and/or fractures which had accumulated on the distal tip (see examples in Figure 5.50). Removing a section of the tip would allow for a completely new distal tip to be made which had not been weakened by asymmetry caused by the grinding away of damaged sections. Generally, one would expect that the length of the distal section removed would be dictated by the extent of damage suffered by the point. The longest removed distal section in the La Vache dataset reaches 146.44 mm, the smallest only 16.77 mm long and the dataset has a median of 45.32 mm, where 57.2% of the intentionally removed distal-mesial fragments fall between 33.23 and 59.33 mm. Many of these artefacts therefore appear to be products of maintenance activities, though it should also be noted that 23 of these tips also exhibited retrieval cut marks, suggested that they were cut out of a target on at least one occasion, and may have been removed from the larger weapon tip in order to free it from a carcass.

This information regarding fracture patterns, retrieval cut marks, and use wear constitutes the sum total of data on maintenance and discard which we can draw from these distal-mesial fragments.

As mentioned above, mesial-proximal fragments make up the majority of the bevel based assemblage (DB: 57.8%; SB: 70.8%). This result is not surprising when viewed in the light of recent projectile experiments undertaken by Pétillon and colleagues (Pétillon 2006) with replica fork- and bevel-based points. During these experiments, it was observed that the detachment or dis-alignment of the point is more frequent for double bevelled points than for fork-based points, and that the former had a tendency to slip in their hafting socket. Similar observations of bevel based points fracturing at the haft during experimentation have been reported by Arndt and Newcomer (1986), Guthrie (1983), Bergman (1987), Tyzzer (1936), Knecht (1997a) and Pokines (1993, 1998), who also noted that “these could have been re-fashioned into smaller points, which is known to happen among archaeologically recovered points” in Cantabrian Magdalenian collections (Barandiarán 1987; Pokines 1993). Arndt and Newcomer (1986) also mention that broken bevel bases are common within the Bruniquel

assemblage, “presumably returning to the site still attached to the wooden shafts of spears or arrows” (1986:172).

This movement of the weapon tip within its haft reportedly results in the splinter or bevel fracture of the proximal end at or just above the bevel shoulder, and this behaviour of the bevel based point is reflected in the La Vache assemblage. Here points were found to have fractured around 48.76 mm (median; lower quartile: 32.02 mm) above the bevel shoulder (see examples in Figure 5.51).

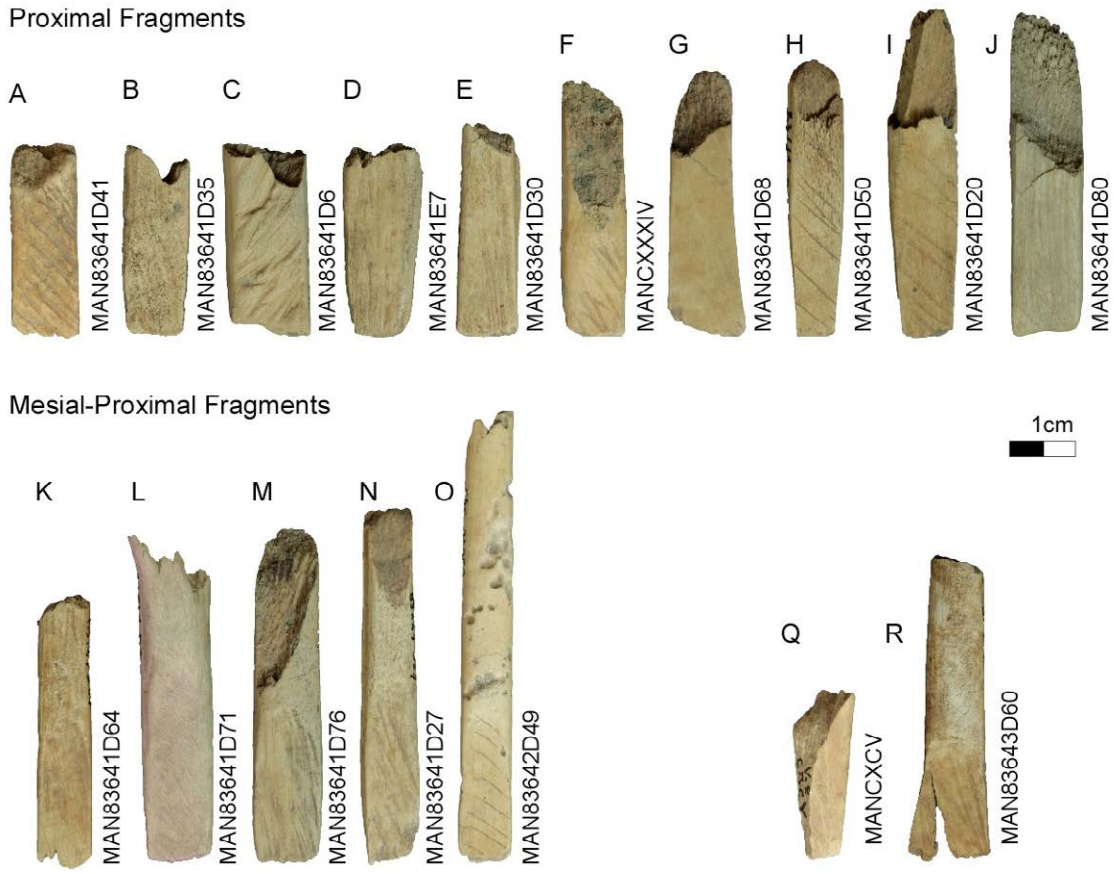


Figure 5.51: Examples of >7mm double bevel fragments: (A – J, Q - R) Examples of proximal base fracture pattern; (K – O) Examples of fractures above base shoulder.

Another common fracture pattern for bevel based points is the severing of bevel corners from the main base section. Several examples of this fracture pattern were identified in the La Vache collection in which the corner had either already separated or was in the

process of fracturing from the base (see two examples in Figure 5.51, Q and R). It is likely that the fracture of the base corner/s would further destabilise the point in its haft and require the base to be remade. This hypothesis seems to be supported by the presence of several artefacts with a missing base corner which have fractured much higher up along the shaft, when compared to the other mesial-proximal fragments with more complete bases (see several additional examples in Figure 5.53 below). While it needs to be tested experimentally, an unstable base seems likely to result in a fracture high on the shaft.

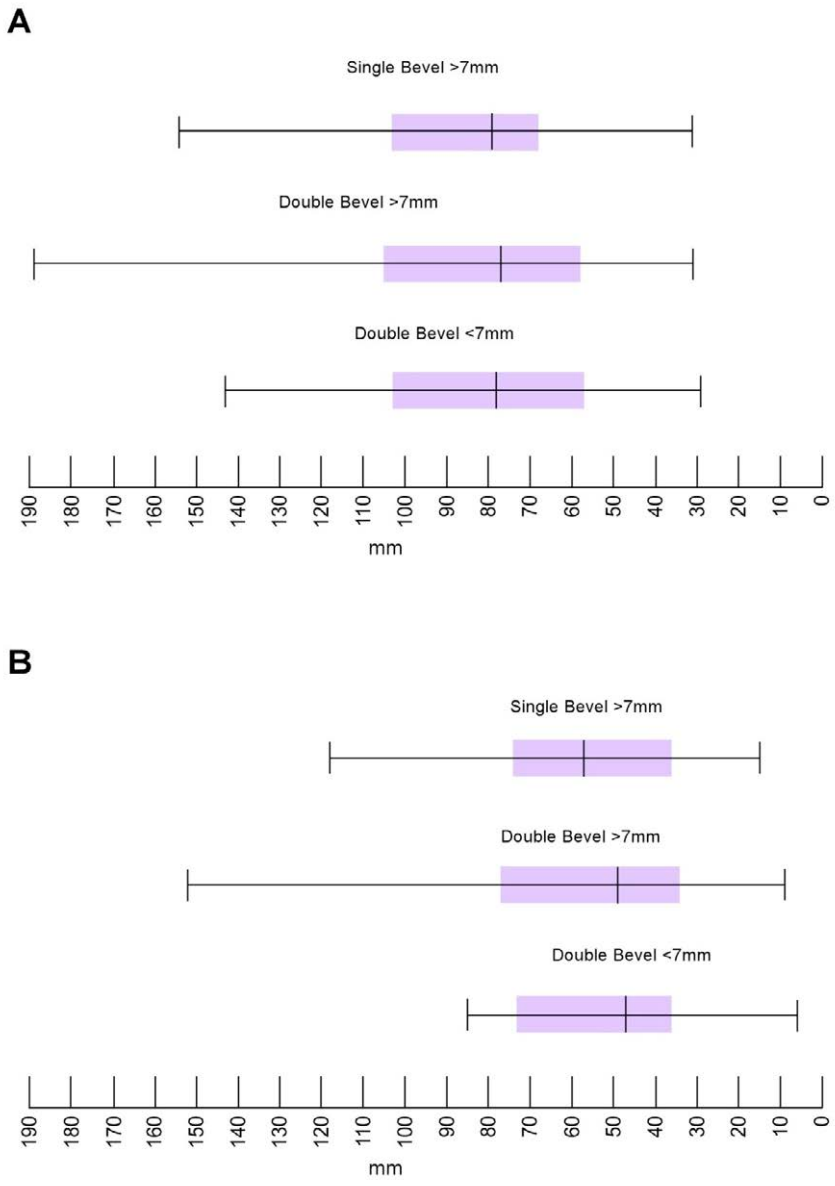


Figure 5.52: Box-and-whisker plots for La Vache double and single bevelled points: (A) total length of 'intact' and mesial-proximal fragments; (B) Penetration length for mesial-proximal fragments.

As can be seen in Figure 5.52 below, the total implement length at time of discard for the slighter double bevelled points (which displayed impact wear and fractures) measure between 51.1 and 143.65 mm with 60% falling between 68.46 and 115.64 mm, while the double bevel >7mm BSW dataset range between 34.57 and 189.54 mm with 57.14% falling between 117.9 and 76.33 mm. For single bevel >7mm BSW points, the range is 31.1 and 163.98 mm with 56% falling between 68.4 and 103 mm. As only five data points were available for single bevel <7mm BSW points, these data were not able to be included in this analysis.

As mentioned previously, unbarbed points recovered from various Magdalenian sites have shown that these projectile points can reach total lengths of up to between 230 mm to 450 mm. The longest example identified from La Vache (MAN83641D103) reaches 189.54 mm, though it also has evidence for its tip having been resharpened (striations) as well as possibly having been reused as a chisel. Thus, even this lengthy artefact displays evidence for having been reduced from its original dimensions.

If we select the lower end of the spectrum of total point lengths taken from archaeological examples – 230 mm – a conservative (and minimum) estimate of point reduction can be made. The amount of material length removed through use and maintenance activities may therefore be in the order of:

* DB <7mm BSW – 114.36 and 161.54 mm; average: 134.12 mm; or 58.31%
* DB >7mm BSW – 112.1 and 153.7 mm; average: 131.14 mm; 57.01%
* SB >7mm BSW – 158.57 and 66.02 mm; average: 117.34 mm; 51.01%

And, as can be seen in Figure 5.52, the average discard length range and overall average for each of the three bevelled points is very similar:

* DB <7mm BSW: 76.31 mm
* DB >7mm BSW: 83.8 mm; and
* SB >7mm BSW: 86.34 mm

Both these data and the maintenance stigmata described throughout this chapter indicate that while the base form may be different (single versus double bevel), the reduction of

these point forms followed the same processes and were discarded at around the same point along the reduction continuum.

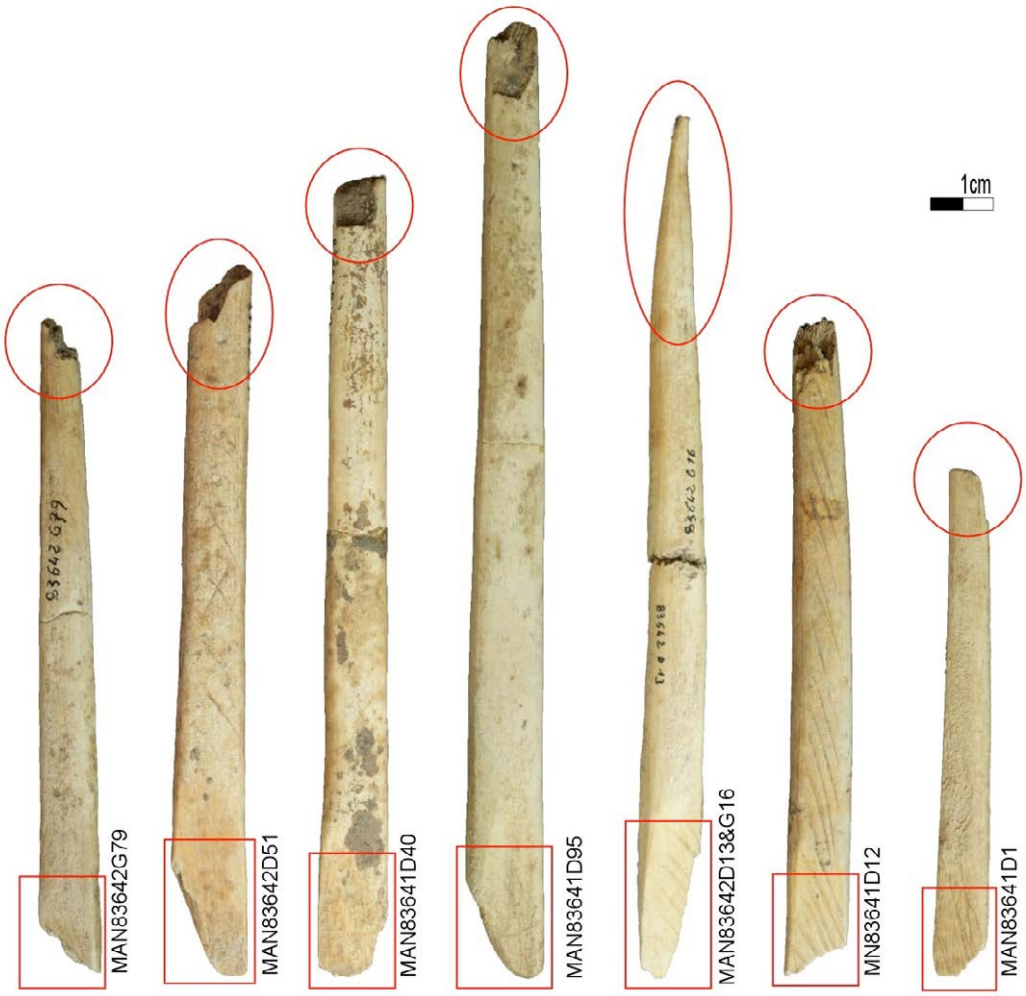


Figure 5.53: Double bevel base points <75 mm in total length and which suffered from impact fractures/wear on both their distal and proximal extremities.

Finally, it is an interesting observation that a number of the longest discarded double bevelled points exhibit both extreme wear/impact fractures on their distal extremity as well as a fractured and/or worn proximal extremity (see Figure 5.53). It might be suggested that these implements were discarded owing to the fact that not only was extensive rejuvenation of the tip required, but also the remaking of the base. The longest of these examples reach to around 70-75 mm, situating them at the bottom end of the common discard range. The maintenance of both the distal and proximal extremities on

these pieces would result in the removal of a significant amount (perhaps in around 15 to 30 mm) of the total implement length, resulting in these particular points becoming (considered) too short for use. Whether this threshold is owing to functional or cultural parameters is currently unknown.

Summary of La Vache's Antler Projectile Technology

The La Vache osseous projectile point assemblage is the largest dataset thus far recovered from any Magdalenian context. The 321 barbed and 1561 unbarbed projectile point fragments included in this collection allow for the most intensive analysis of maintenance and discard patterns for this technology in a single Magdalenian site.

Not surprisingly it was found that the same techniques and methods were utilised to rejuvenate the distal tip and basal sections of both barbed and unbarbed points, though it appears that barbed points may have been more carefully maintained (overall) than their bevelled counterparts. Given the extra time and skill required to craft the former, this result, while expected, is nevertheless interesting to consider in the wider context of Magdalenian osseous projectile point technology.

It was established that both barbed and bevelled points were discarded when they had reached a certain length range, and that this range was extremely similar for each of the bevel based point types (between 65 and 100 mm in total implement length). More variation was identified between the barbed point categories, with Unilateral Group A falling between 10 and 90 mm, Unilateral Group B between 110 - 124 mm and the Bilateral Group A points falling between these two previous groups at 95 - 120 mm.

Differences between the recycling of barbed and bevelled points were also identified. While barbed weapon tips were recycled into either wedges (15.56% of the total dataset) or spatulas, bevel based points were only recycled as wedges. Similarly, barbed points were recycled at a significantly higher rate than the unbarbed weaponry (barbed: 16.91%; unbarbed: 1.38%).

Thus, while the barbed and unbarbed weapon tips were maintained using the same techniques and methods, each category was reduced according to rules specific to that type. If and how these projectile points were recycled appears also to have been at least partially guided by their typology, which may or more not reflect their function.

As stated in the Introduction of this chapter, there is a possibility that La Vache was the location of 'focus groups' which met and exchanged knowledge about projectile point design and manufacture. Now that the antler barbed and bevelled weaponry has been described, the existence of several possible examples of artisan virtuosity (the Group C unilaterally barbed and Group B bilaterally barbed points) can be added to the several reasons cited previously, as can the presence of four bevel base edge types that may represent several different communities of practice meeting together at the site. Certainly, it would make logical sense that craftspersons meeting together would produce items what would demonstrate their collective skill in working the discussed medium as well as discarding weapons manufactured according to their communities' guidelines.

Introduction

Isturitz is a large cave site located at the northwestern end of the Pyrenees Mountains, and is presently 40 km from the coast line at an elevation of 150 m. During the Middle and Upper Magdalenian, however, the sea level was between 80 and 100 m lower, and the site then between 50 and 60 km from the coastline. Occupation levels dating to the Mousterian, Proto-Aurignacian, Aurignacian, Gravettian, Upper Solutrean, Middle and Upper Magdalenian, and finally, the Azilian have all been identified in the cave's deposits.

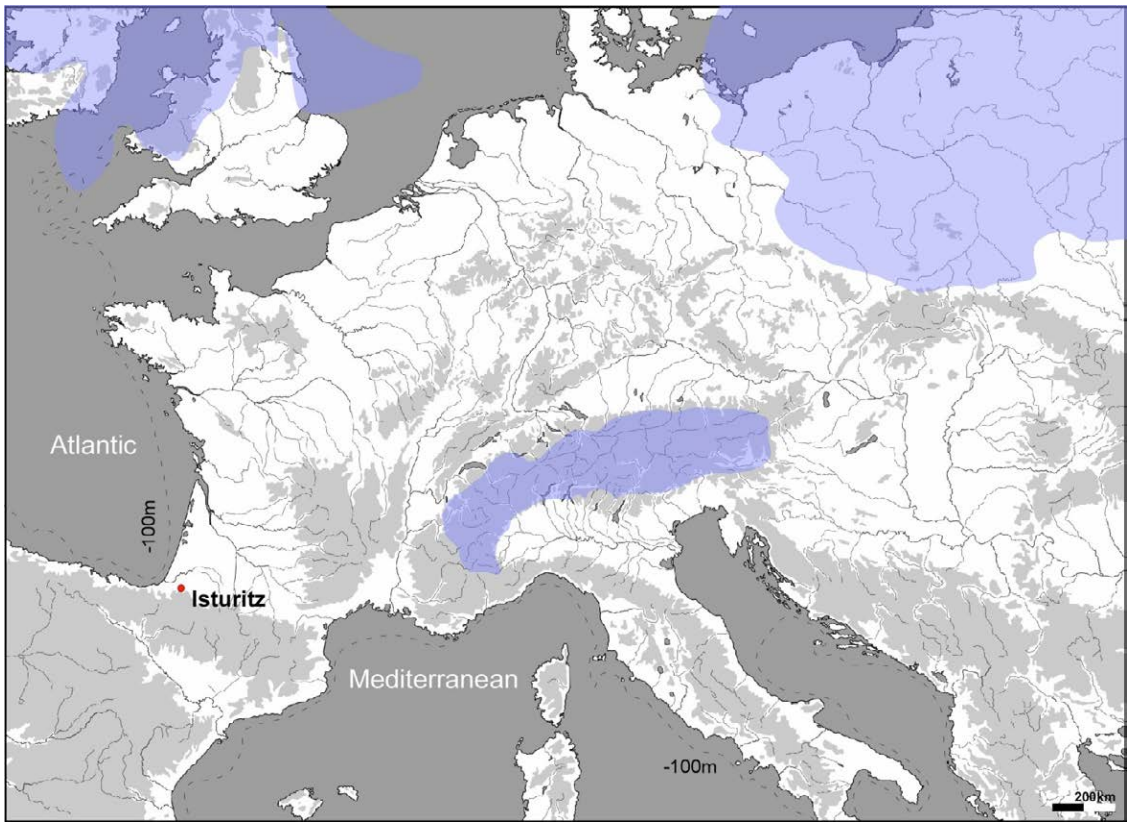


Figure 6.1: Location of Isturitz (Pyrénées-Atlantiques), France.

The two main chambers of the cave, the Grande Salle (also referred to as the Salle d'Isturitz) and the Salle de Saint-Martin, yielded dense Middle and Upper Magdalenian deposits that were excavated by Passemard and Saint-Périer during the early to mid

twentieth century (Figure 6.2; Passemard 1924, 1944; Saint-Périer 1930, 1936; Saint-Périer and Saint-Périer 1952). In the Grande Salle, two Magdalenian layers were identified: an Upper Magdalenian layer (I/F1) and a Middle Magdalenian layer (II/E), while only a Middle Magdalenian layer (SI/Eω) was identified in the Salle de Saint-Martin. These layers were rich in occupational debris, and, along with the size of the shelter (around 2,500 m^2), and the presence of highly decorated or stylised material culture items, has led researchers to argue that this location was an aggregation site (e.g. Bahn 1982).

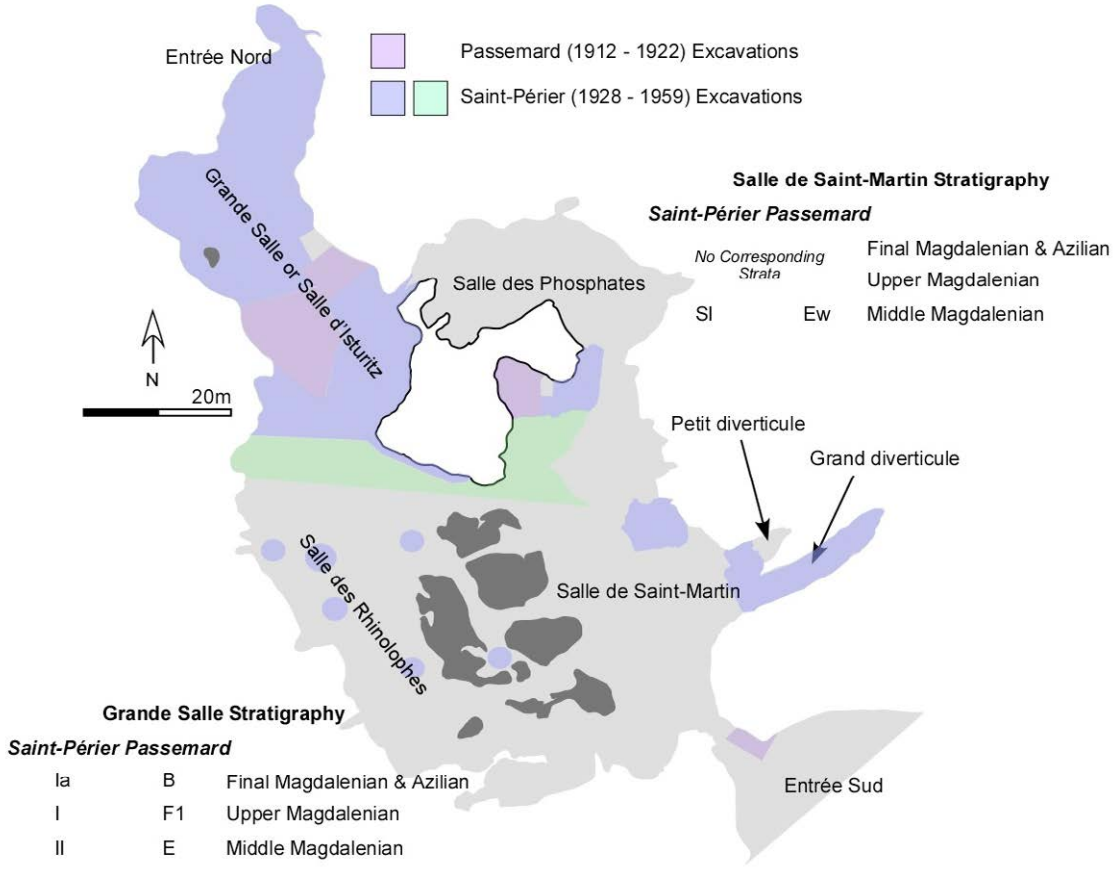


Figure 6.2: Map of Isturitz with the excavations of Passemard and Saint-Périer indicated and the correlation of their respective stratigraphic designations for the Magdalenian levels (redrawn after Pétillon 2006).

Reindeer is the dominant fauna recovered from the Upper Magdalenian layers, though horse, red deer, boar, and bovines are also present (Langlais *et al*. 2012; Letourneux in Pétillon 2006). This information has enabled researchers to argue that Isturitz was

mainly occupied during the winter months, as was the case for La Vache (Letourneux in Pétillon 2006; Saint-Périer 1930).

Isturitz's Osseous Technology Industry

The osseous projectile point industries of Isturitz have played a key role in the understanding of Upper Palaeolithic weaponry. An example which is of particular interest for this study is found as early as the beginning of the last century. In 1917, Passemard suggested that the smallest of the unbarbed points found in this assemblage were the result of rejuvenation after use. However, this early observation concerning the possible impact of rejuvenation on implement form was only followed up with more intensive analysis in 2006 - this time by Pétillon who focused on the fork-based points (as discussed in Chapter 1).

Despite the crude methods employed in the very early excavations at Isturitz, localised work areas for flint knapping and antler working were identified (Pétillon 2006; Saint-Périer 1930), and included the stockpiling of antler presumably for use in manufacturing the various osseous technologies recovered from this site (Bahn 1979, 1982, 1984). More recently, Pétillon (2006) determined that owing to the high presence of waste and the low levels of implement recycling that the occupying population had an economic context in which there was a surplus of production. As we shall see, this determination will have important implications for the rejuvenation and discard of the osseous weaponry discussed in this chapter.

As mentioned above, Isturitz has been suggested to have been a focal point in Magdalenian economic and social life. The presence of exotics such as lithics, amber, marine shells, and green steatite, along with similarities in lithic and antler tool morphologies, and 'art' styles between this and many other surrounding sites (Bahn 1982) has supported this idea. Its role as a 'super site', which (presumably) brought groups of people originating from different regions together periodically, may therefore have resulted in material culture – including projectile technologies – foreign to the site and/or region entering the archaeological record at this location. This assemblage of projectile technology, like that from La Vache, therefore needs to be considered in the

light of having been formed by not just one Magdalenian community, but potentially several communities.

The inventory of osseous material culture recovered from Isturitz is extensive and includes artefacts manufactured from a wide range of raw materials. For example, items that were manufactured from deer antler include: barbed points, *baguettes demi-rondes* (HRRs), *bâton percé*, wedges, and spatulas. Projectile technologies (points and foreshafts) were also manufactured from sea mammal bone - mostly likely collected from beached whales (Pétillon 2008b). Other domestic items were manufactured from bone and include awls, needles, engraved and grooved pieces of bone, and burnishers for leather working. Personal ornamentation in the form of pierced animal teeth and shells have also been recovered, as has an array of impressive portable artworks.

Many of these items, both domestic and for hunting, are intricately decorated with engravings and pigments. Those decorations found on the projectile technology vary greatly in design, which is consistent with the proposal that peoples from various regional groups (bringing their weaponry or design ideas with them) came together at this site.

The Barbed and Unbarbed Projectile Points of Isturitz

Around 80% of the barbed and unbarbed projectile point assemblage which has been recovered from Isturitz was examined for this study (i.e. the collection held by MAN; barbed n = 39; unbarbed n = 1252). In the large majority, these artefacts were excavated from the Grand Salle, though a handful of artefacts were recorded as having been found in the Salle de Saint-Martin.

The following sections will present the result of the analysis of these implements, split into ‘Barbed Points’ and ‘Unbarbed Points’. The maintenance methods utilised, how the points were recycled and when they were discarded will be described for each of the point sub-types. These results will be compared and contrasted with those of the other studied sites in Chapters 7 and 8.

Barbed Points

For such an intensively occupied site and large osseous assemblage, it is somewhat surprising that so few barbed projectile points were recovered (n = 39; 2.9% of the studied assemblage). This paucity can be somewhat explained by around 25 to 30% of the barbed point assemblage recovered and published by Passemard and Saint-Périer having been lost, with particular implications for the most 'beautiful' artefacts (most complete, highly decoration, carefully made, etc) which would have made up this collection. Possible social reasons for this rarity of barbed technology will be discussed in Chapter 8 ('Inter-Site and Inter-Regional Comparisons').

As with the La Vache assemblage described in the previous chapter, the majority of the Isturitz barbed point dataset is made up of unilaterally barbed points (n = 27; 69.2%). Only eight bilaterally barbed points were identified, with a further three barbed point fragments which may have originally been part of either uni- or bilaterally barbed implements (Figure 6.3). Finally, a single, intact implement which has a morphology completely distinct from all others examined was also examined and will be described separately.

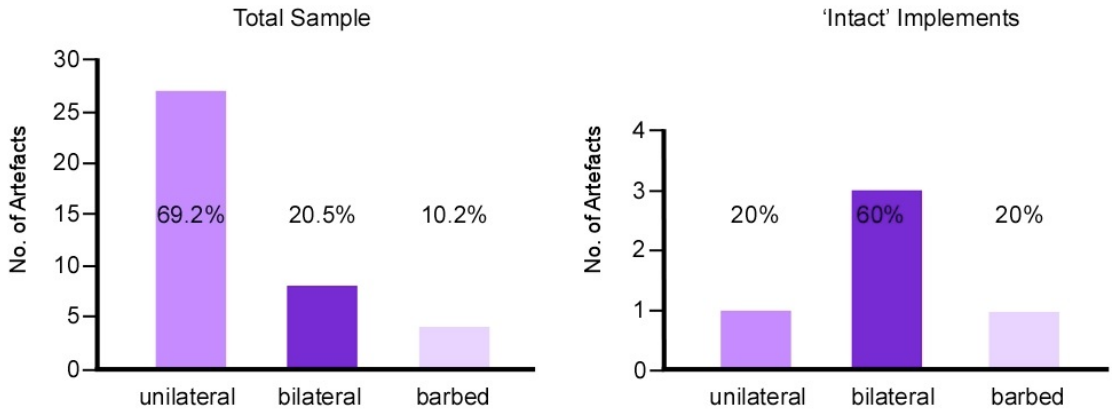


Figure 6.3: Barbed point sample composition for Isturitz. Left: Composition of barbed point assemblage. Right: Number of 'intact' implements in each category.

Bilaterally Barbed Points

Bilaterally barbed points are few in the Isturitz assemblage, with only four 'intact' implements and four fragments recorded in total (Figure 6.4). Interestingly, all but one

of these artefacts were recovered from a single stratigraphic unit (I – Upper Magdalenian), the final artefact from the Middle Magdalenian level in the Grande Salle (E). All eight artefacts fall into the Bilateral Group A morphology.

Despite the small sample, it was found that each of the four 'intact' artefacts displayed evidence for maintenance, as did one of the mesial-proximal fragments (Figure 6.4). A single example recycling was also identified and will be described below.

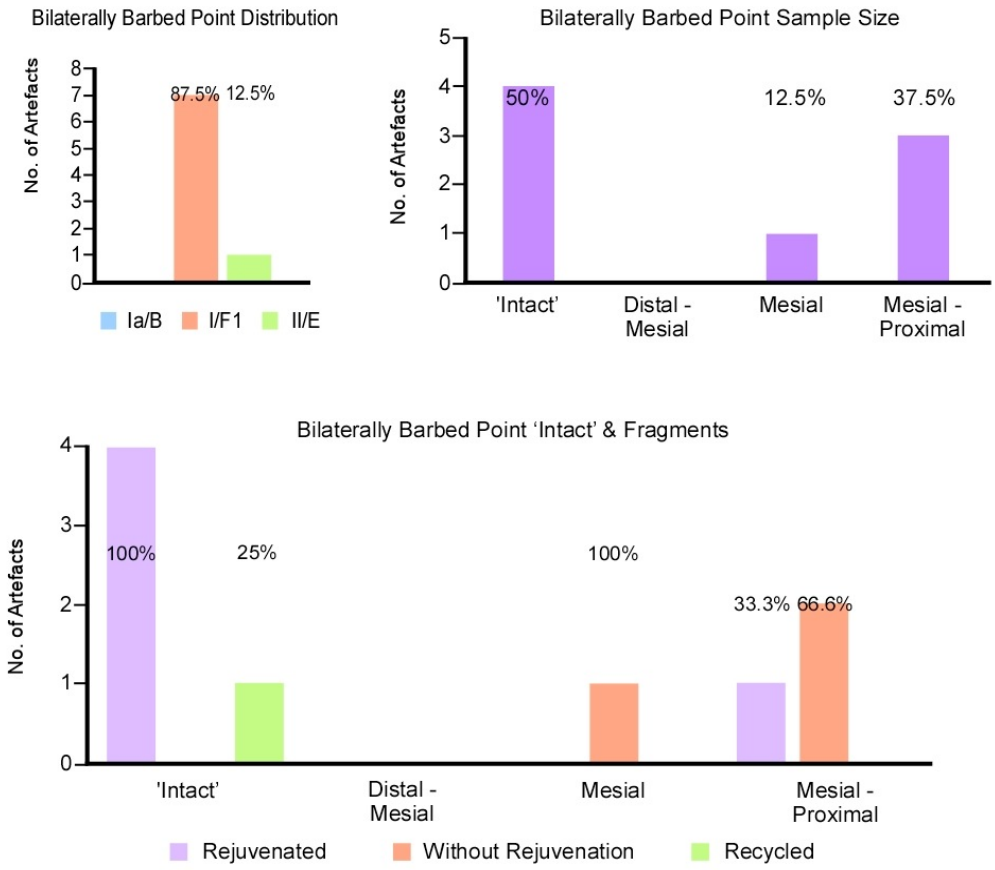


Figure 6.4: Isturitz bilaterally barbed point sample composition: (Top Left) Distribution of points through stratigraphy; (Top Right) Number of 'intact' and fragments; (Bottom) Occurrence of evidence for rejuvenation, recycling and no evidence for rejuvenation.

Methods of Maintenance

Despite there being only eight bilaterally barbed artefacts included in the Isturitz assemblage, a range of rejuvenation stigmata and maintenance activities was identified in the dataset.



Figure 6.5: Bilaterally barbed points with evidence for maintenance: (A and C) MAN IST86494: Spatulate form tip and partially erased decoration; (B and F) MAN IST I 1935: Spatulate form tip, barb removal and partially erased decoration; (D) MAN 75293A: Removed base protuberance; (E) MAN IST I 1933: Remade base.

As no distal-mesial fragments were found, we have only the four 'intact' implements from which we can examine how the Magdalenians of Isturitz rejuvenated the distal extremity of their bilaterally barbed projectile points. On each of these four implements, a spatulate form tip is present (Figure 6.5: A and B), and in one case a barb has been removed from the left side in order to accommodate this new tip (MAN sans no.; Figure 6.5: B). This same artefact also appears to have decoration partially erased at its proximal end, just above the base. Shown in Figure 6.5: F, this implement has two parallel slightly oblique lines engraved on the left side of the superior surface, just above the base. The corresponding lines which we would expect to find on the right side are missing, suggesting that they were removed during a rejuvenation event in the life

history of this implement. There is no clear evidence for the rejuvenation of the proximal end of the implement, however, so it is unclear exactly why this section of the point received attention.

The partial erasure of engraved decoration was also observed on MAN IST86494 (Figure 6.5: A and C). This alteration likely occurred in the process of grinding the new spatulate tip smooth.

There are two additional cases in which the base of these projectile points was altered. In the first case, MAN 75293A (Figure 6.5: D) has had its right bulb protuberance carefully ground down leaving only a smoothed surfaced and some chattering where it was carved away. In the second case, (Figure 6.5: E) the base appears to have been completely remade. Both the left and right bulb protuberances have been removed leaving both cut and scrape marks visible on each side. A wide horizontal groove or notch has also been roughly scraped out of the inferior face of the shaft at about this same level and it is likely that this groove was intended to facilitate the hafting of the implement.

Thus, while this collection of bilaterally barbed (Group A) points is much smaller in comparison to the La Vache assemblage, evidence for the rejuvenation of the distal extremity through the formation of a smooth, spatulate form tip, the removal of bulb protuberances, the complete reworking of an implement's base in order to continue its use life, and the erasure of decoration in these rejuvenation events are all present.

Recycling

While not one of the eight bilateral artefacts display evidence for having been recycled into an implement other than that of projectile weaponry, one of these artefacts appears to have been heavily reworked so that its use life could be extended.

MAN IST74943 (Figure 6.6) appears to have begun its use life as a bilaterally barbed point, before being reworked into a double bevel based and unbarbed point. This artefact was found inadvertently curated with the double bevelled points, demonstrating

that careful examination of entire assemblages is required in order to be certain that all reworked and recycled barbed points are identified.

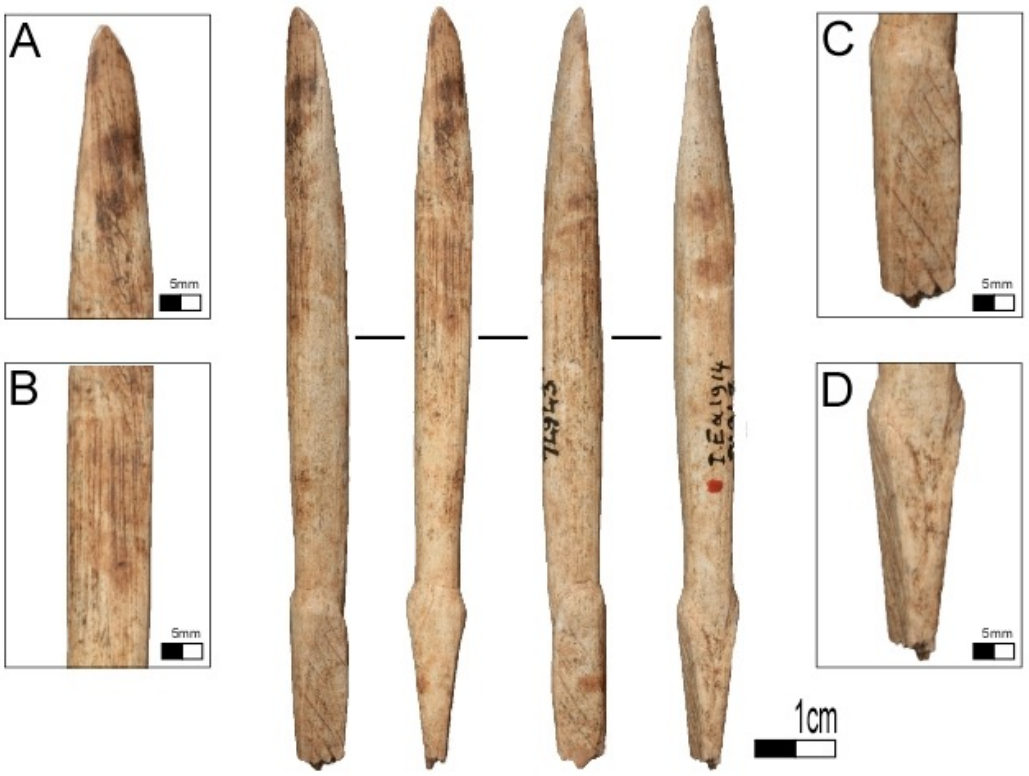


Figure 6.6: MAN IST74943 - a bilaterally barbed point which was reworked into a double bevelled unbarbed point: (A) Detail of spatulate form tip with striations; (B) Rejuvenation striations on shaft; (C and D) Detail of the reworked base.

At a total length of 88.9 mm, this implement can be identified as having been originally manufactured as a bilaterally barbed point through two key points; (1) it displays bilateral protuberances at its proximal end (Figure 6.6: D), and (2) the shaft width decreases from the midsection towards the proximal end which is consistent with the morphology of the barbs-to-base section on bilaterally barbed points.

There is a multitude of rejuvenation stigmata (mostly striations) clearly visible on the distal half of this artefact where the point has been reworked into a spatulate form tip and any remnants of barbs were removed (Figure 6.6: A and B). Similarly observable is the grinding down of the left and right sides of the former bulb shaped base into a double bevel (Figure 6.6: C and D). The top of the new bevel base is formed by the

remnants of the base protuberances with the proximal edge terminating in a splinter fracture, sustained after this base was transformed into a bevel. Oblique striations (to assist in hafting) have been added to each face of the bevel as was common practice for both single and double bevel based points.

Fracture and Discard Patterns

Interestingly, no distal-mesial fragments were identified in the Isturitz bilaterally barbed dataset. As we saw in the previous chapter, 20.5% of the La Vache bilaterally barbed point assemblage is composed of distal-mesial fragments, so the complete absence of these artefacts at Isturitz is puzzling. This result is especially perplexing when compared to the fact that 55.5% of the unilateral barbed dataset from this site is composed of distal-mesial fragments (see below).

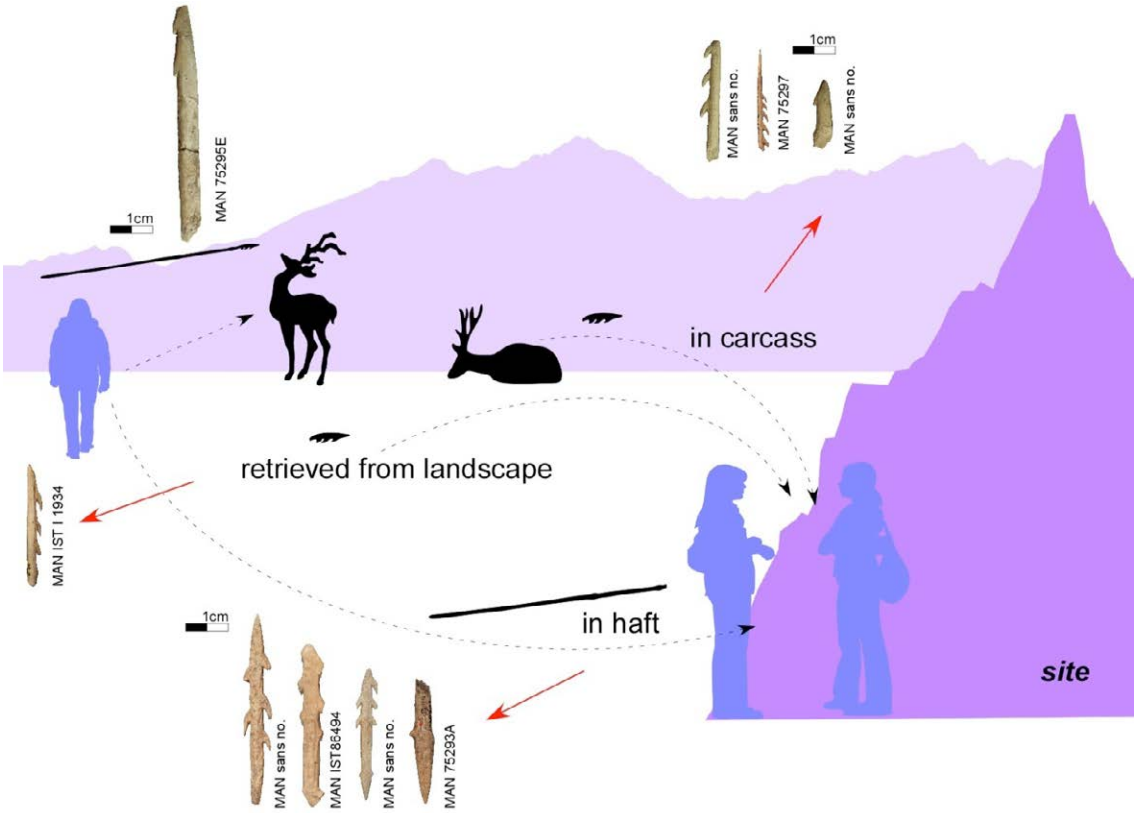


Figure 6.7: Examples of uni- and bilaterally barbed points recovered from Isturitz with impact fractures and possible processes which lead to their deposition in the site.

One possible reason for this lack of distal-mesial fragments at Isturitz may be that game was butchered elsewhere, and therefore, point fragments were discarded away from the site. Alternatively, game may have been butchered at Isturitz and the point fragments retrieved, but discarded elsewhere or even thrown into fires, a behaviour which has been recorded ethnographically (see Chapter 1).

Despite the suggestion that butchering activities were undertaken outside of the site, the appearance of both 'intact' and mesial-proximal fragments is consistent with retooling activities having occurred at this site. Each of the four 'intact' implements may have been intentionally discarded and replaced. Only one of the three mesial-proximal fragments recovered was not broken post-depositionally, instead displaying an impact (splinter) fracture at its distal end. This fracture implies that it too was likely returned to the site still bound to the shaft where it was removed and discarded.

Unilaterally Barbed Points

As was the case for La Vache, the unilaterally barbed point assemblage from Isturitz is the larger dataset of barbed weapon tips. In total, 27 'intact' or fragmentary pieces of unilaterally barbed weaponry were identified (Figure 6.8). Examples of only the first two of the three analytical categories (Group A and Group B) employed in this analysis were identified, though the majority (n = 21) fell into Group A.

No unilaterally barbed points were recovered from the most recent (Final Magdalenian) archaeological level (Ia/B), as was the case for bilaterally barbed points, though two-thirds of the implements were recovered from the Upper Magadalenian layer, I/F1 (Figure 6.8). Clearly, there was an increased use of barbed point technology – both uni- and bilaterally barbed - from the Middle Magdalenian to the Upper Magdalenian occupation of Isturitz. The cause for this change in behaviour may have its source in either environmental/subsistence or social/cultural aspects, and must be viewed alongside multiple lines of evidence in order to be most accurately interpreted.

Again, while this dataset is quite small, evidence for the rejuvenation of the unilateral weaponry as well as its recycling into other implements was identified. In fact, each of

the ‘intact’ points were found to have evidence for repair, as was more than half of the distal-mesial fragments and a third of the mesial-proximal fragments (Figure 6.8). Evidence for the reuse of these weapon tips was most commonly identified on distal-mesial fragments (20%), though examples were also identified on mesial and mesial-proximal fragments.

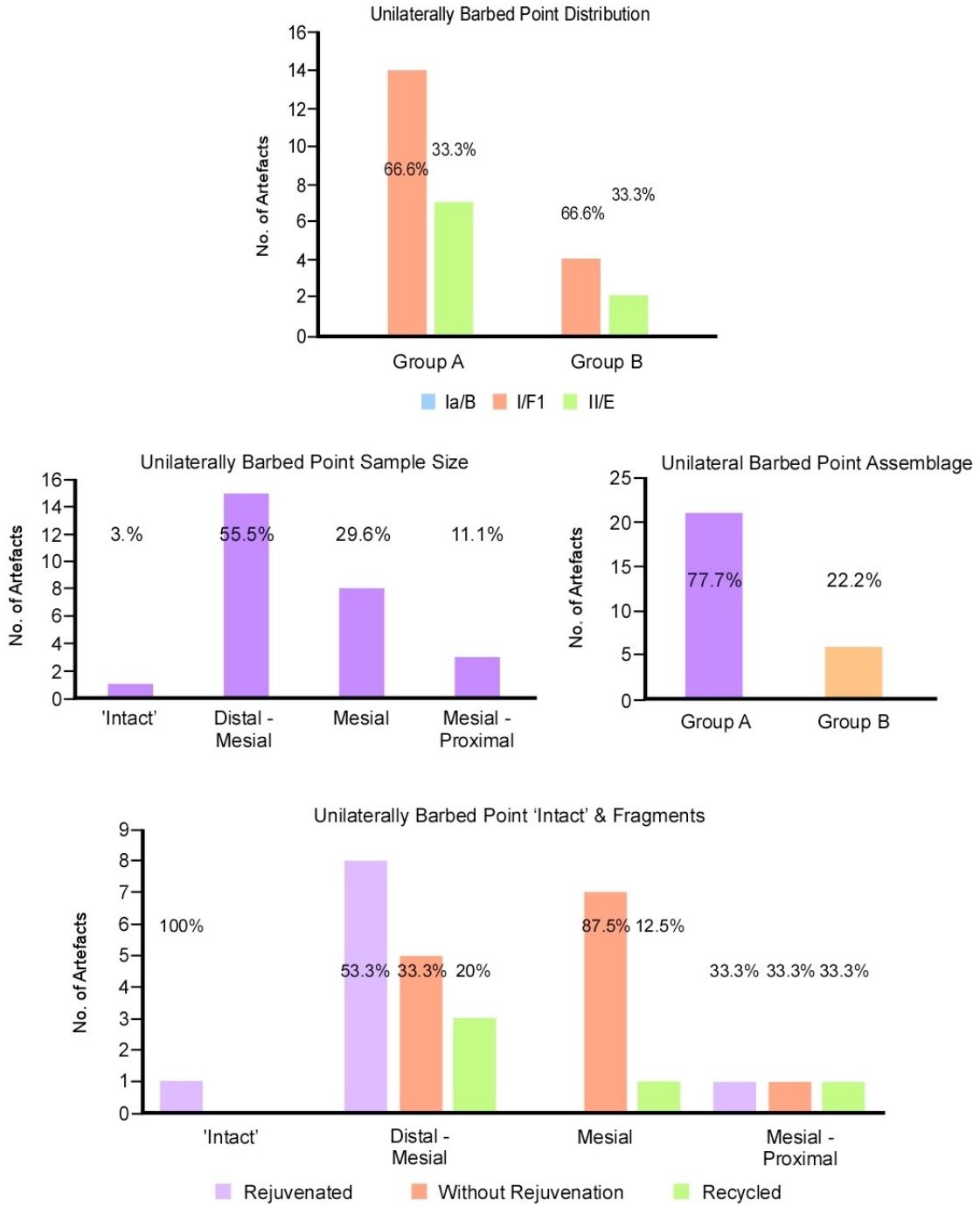


Figure 6.8: Isturitz unilaterally barbed point sample composition: (Top) Distribution of points by stratigraphic layer; (Middle Left) Number of ‘intact’ and fragments; (Middle Right) Distribution of implements into analytical groups; (Bottom) Occurrence of evidence for rejuvenation, recycling and no evidence for rejuvenation.

Unilateral Group A

Unfortunately, not a single 'intact' Unilateral Group A point was identified in the Isturitz collection. More than half the dataset is composed of distal-mesial fragments (n = 11) with mesial fragments comparatively well represented (n = 7). Three mesial-proximal fragments were also identified.

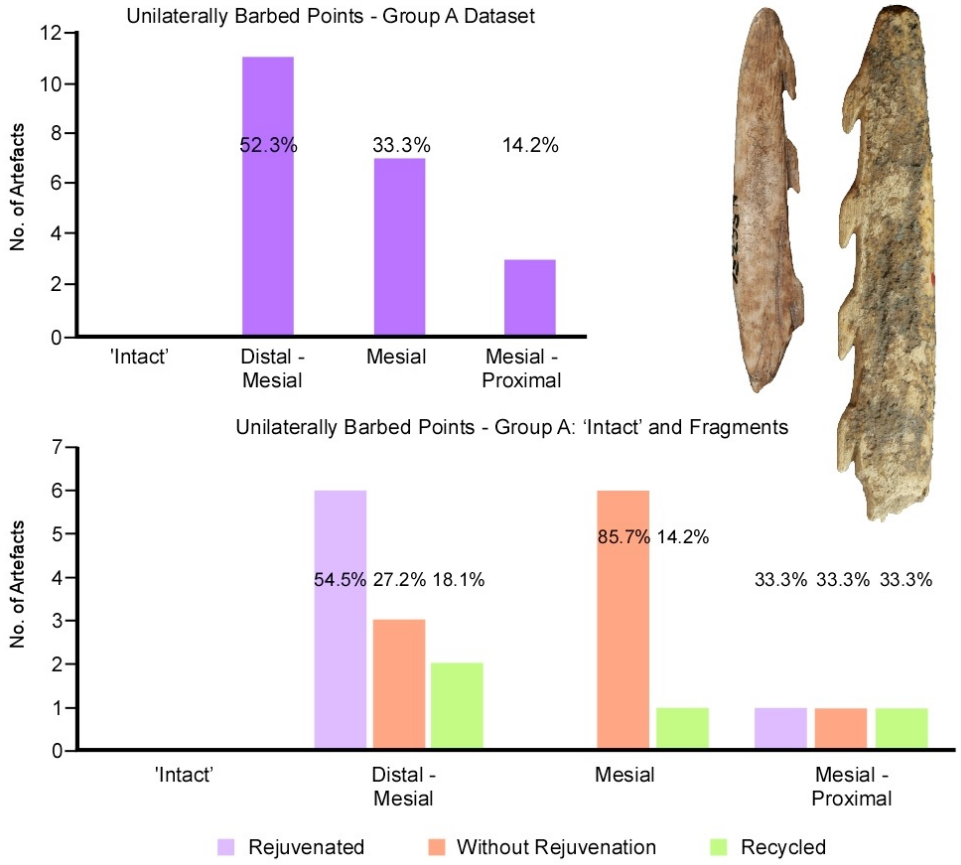


Figure 6.9: Composition of the Isturitz Unilateral Group A dataset: (Top) Number of section fragments; and (Bottom) Occurrence of evidence for rejuvenation and recycling.

As has now become commonly demonstrated, evidence for maintenance was most frequently identified on the distal-mesial fragments, though a single mesial-proximal fragment also exhibited rejuvenation stigmata. Evidence for the recycling of this category of unilateral point was found on four artefacts, spread across the three fragment types represented in this assemblage.

Methods of Maintenance

Repair of the distal edge was, unsurprisingly, the most common type of implement maintenance identified in the Group A dataset. The rejuvenation of the tip was undertaken using the same approach used at La Vache: that is, by constructing a spatulate form point through scraping a lithic blade and/or a grindstone across the superior and inferior surfaces. Striations (both 'faint' or 'strong') from these actions are visible on five of the six distal-mesial fragments with a rejuvenated distal edge (Figure 6.10: A, C, D).

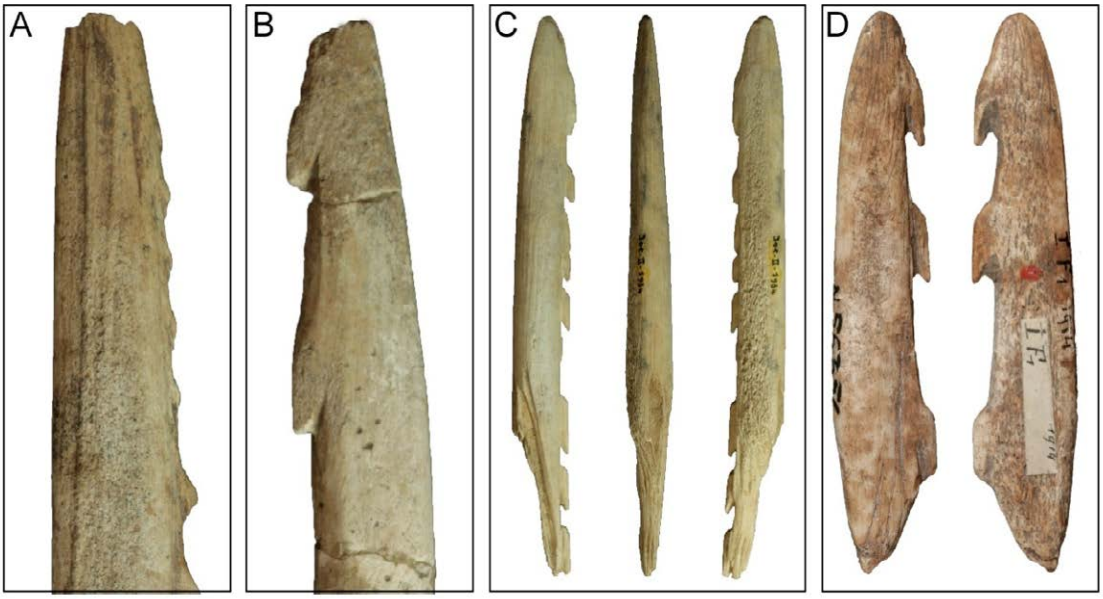


Figure 6.10: Examples of the evidence for rejuvenation on Unilateral Group A implements: (A) MAN 75295G: Striations; (B) MAN 75295E: Change of axis along the right side of the distal extremity; (C) MAN 75295G: Striations; (C) MAN IST II 1934: Distal-mesial section removed through BWF; (D) MAN 75295N: Distal-mesial section removed through the BWF method.

If we now look at the mesial-proximal fragments, we find that on two of the three artefacts (MAN IST I 1934 and MAN 75295B shown in Figure 6.11 below) barbs were altered from their original shape. In the first case (MAN IST I 1934), the three remaining barbs have been ground down and smoothed over, possibly in the act of reworking the implement for use as a wedge (described below). In the second case, (MAN 75295B), the lowest barb appears to have been removed leaving only a slight

scar (raised section) on the left side of the implement. The remaining two barbs on this same implement also appear to have been ground down/smoothed over, which was also likely the result of its recycling into another functional implement. That only the bottom barb has been completely removed while the other two remain clearly visible indicates that this last barb likely fractured in use as a projectile and the more complete treatment was a result of this artefact still functioning in its primary use.

The most interesting evidence for weapon maintenance at this site, however, is the intentional removal of distal-mesial point sections from the remainder of the implement through the use of the BWF technique. Two examples were identified and are shown in Figure 6.10 above. In the first case (MAN IST II 1934; Figure 6.10: C), a diagonal groove has been cut into both the superior and inferior faces, across the shaft. Once the groove had reached a sufficient depth, the 134.3 mm length of point was snapped apart from the shaft.

The second example (MAN 75295N; Figure 6.10: D), has been worked slightly differently. The shaft seems to have first been reduced in width along a section of about 15 mm, and then (primarily) the superior surface has been cut into before the piece was snapped to detach it from a larger piece. This second fragment measures 75.6 mm in total length. Experiments will be required along with further examination of archaeological assemblages to determine why such lengthy pieces of apparently well maintained weaponry were intentionally removed. One possible reason may be that the fragment was firmly wedged in a carcass, and as the animal was not to be butchered at the kill site and the complete weapon (point, foreshaft, and shaft) could not be transported back to the site still wedged inside it, the point was quickly detached at the point where it was immediately accessible to the hunter. We know from experiments undertaken by Pétillon and colleagues that antler points can become wedged inside thick bones of prey, so such a scenario is plausible.

Recycling

As mentioned above, four Unilaterally Group A artefacts displayed evidence for having been recycled into other functional tools (Figure 6.11). Two implements were clearly

reused as wedges (MAN 75295D and MAN IST I 1934; Figure 6.11: Left), as evident by both their morphology and the extreme crushing suffered by the distal extremity (Figure 6.11: Inset box A). In the case of the latter example, a bevel base was constructed particularly for this reuse, and as mentioned above, this artefact has also had three barbs ground smooth which would have facilitated the comfortable handling of this implement as it was hammered into a antler beam in the process of removing a new blank.

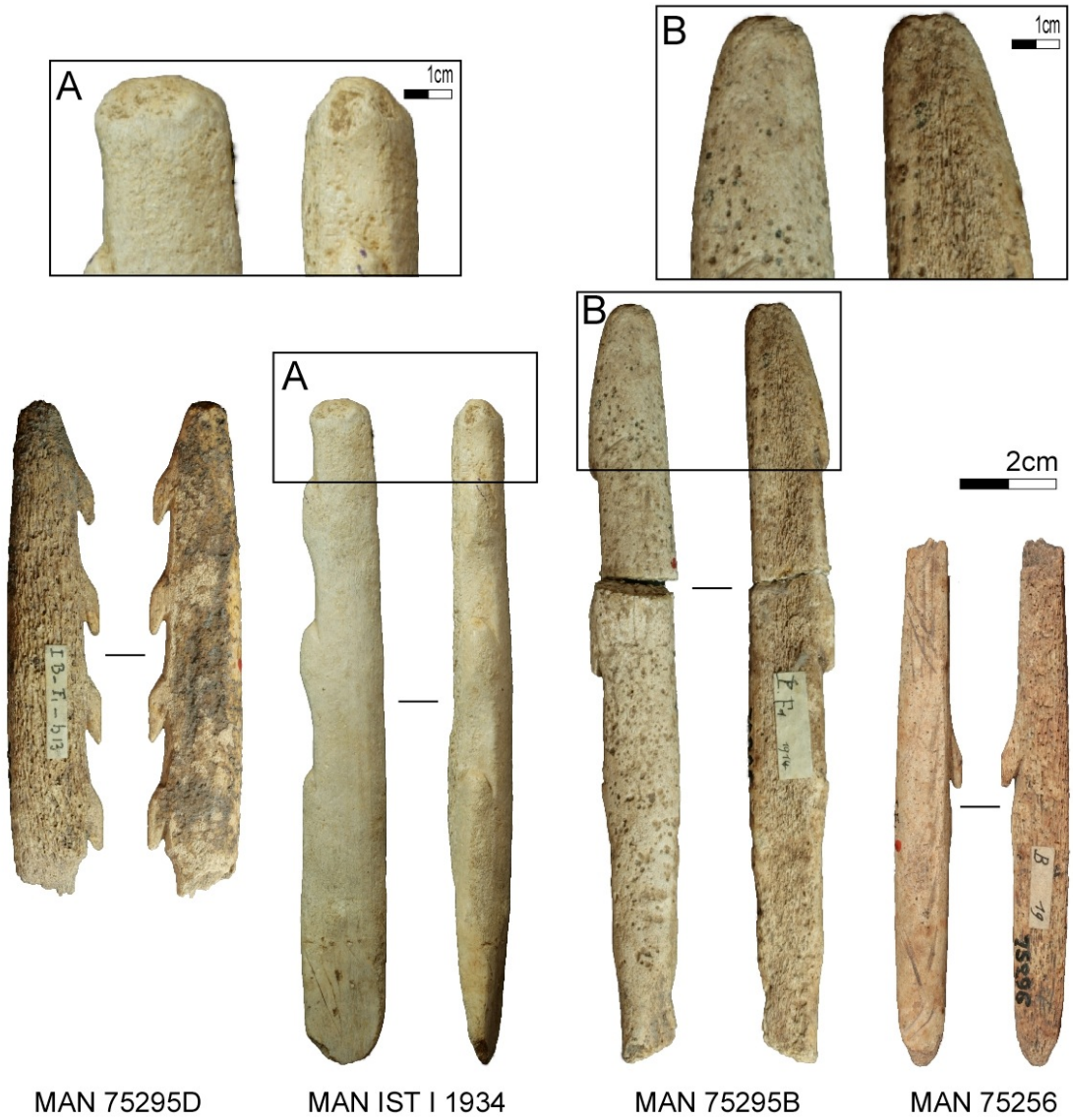


Figure 6.11: Unilaterally barbed implements identified as having been recycled: (Left two artefacts) Recycled as wedges; (Right two artefacts) Recycled as burnishers.

The proximal end of the other implement which was recycled as a wedge (MAN 75295D; Figure 6.11: Far left) terminates in a splinter fracture, having broken in this secondary use. This latter artefact also provides another example of where careful examination of distal-mesial and mesial-proximal fragments is required in order to identify all cases of the recycling of projectile point technologies.

The other two implements may have been recycled as 'burnishers' ('*lissoirs'*), a tool which was used to rub smooth and polish leather for use in constructing clothing, tents or any other item made from this material. Use wear which is indicative of this type of reuse includes a smooth, rounded, and often glossy extremity which would have been the active end of the tool. This type of use wear was found on these implements and is particularly visible on MAN 75295B (Figure 6.11: Inset box B). As with those points recycled into wedges, those reused as possible burnishers often display a splinter fracture at one end where the tool broke during this secondary activity, as was the case for MAN 75256.

Fracture and Discard Patterns

As only 27 unilaterally barbed points were found in the Isturitz assemblage in total, the fracture and discard patterns for the whole unilateral dataset will be discussed together here.

Unfortunately, only a single 'intact' unilaterally barbed implement was identified, and thus, no statistical examination of total implement length at time of discard can be undertaken for this site. Fortunately, however, this implement (MAN IST I 1934 shown in Figure 6.13: A) has clear signs of use (retrieval cut marks; Figure 6.13: D) as well as repair, and the splinter fracture evident on its proximal extremity suggests a reason for this weapon's final discard: having been rejuvenated and reduced, this final impact fracture suffered in use resulted in its discard back at the site.

Unlike the bilaterally barbed points found at this site, unilateral distal-mesial fragments were identified, and in the case of the Group A points make up the majority of the dataset (n = 11; 52.3%). Not one of these fragments exhibited retrieval cut marks,

though the most probable process in which they were transferred back to the site still remains their transport inside the carcass of captured game (Figure 6. 7 above). That they were instead picked up off the landscape and carried back to the site remains another likely possibility.

Of the 15 distal-mesial fragments identified, those which display impact fractures on both distal and proximal extremities range between 69.31 and 131.34 mm in total length for Group A points and 58.15 and 119.12 mm for Group B points. Thus, while the dataset is really too small for obtaining meaningful statistical results, the available data indicates that distal-mesial fragments belonging to both Groups A and B fractured and discarded within a similar range of length at Isturitz. This range (while requiring more intensive statistical scrutiny) falls significantly higher than that determined for these same artefacts at La Vache, which fell between 23.54 and 96.38 mm (see previous chapter) (Isturitz average: 88.49mm; La Vache average 50.02 mm). Thus, it might be tentatively suggested that unilaterally point fragments were discarded more freely, that is, longer pieces were not rejuvenated, reused, or recycled as frequently as those discarded at La Vache. This conclusion is in agreement with Pétillon's (2006) assessment of the Isturitz economy functioning in a production surplus.

Most of the mesial fragments examined had suffered from post-depositional breakage on at least one of their extremities, and thus their usefulness for investigating discard patterns is extremely limited. Impact fractures observed on these fragments included both bevel and splinter fractures, sometimes at the distal end and sometimes at the proximal end of the piece. The total length of these fragments can then only be used to indicate the very minimum length of material that was discarded at Isturitz. Interestingly, these fragments are again quite long in comparison to those discarded at La Vache (Isturitz: 35.71- 135.66 mm, average 78.75 mm; La Vache: 25.94 – 77.16 mm, average 51.30 mm).

Finally, only one of the mesial-proximal fragments provide information on the circumstances surrounding its final discard, the others having been recycled (as wedges) or broken post-depostionally. This implement terminates at the distal end in a bevel

fracture and was most likely returned to the site still held within the haft of the weapon (see Figure 6.7 above).

Thus, the unilaterally barbed weaponry at Isturitz only provides the very minimum of data regarding their fracture in use and discard; however, these data do suggest that these weapon tips were discarded at an earlier stage in their use life than these same projectile point types at La Vache.

Unilateral Group B

Only six Unilateral Group B artefacts were identified in the Isturitz collection, including a single 'intact' implement, four distal-mesial fragments and a mesial fragment (Figure 6.12). Of these few artefacts, more than half were found to display evidence for maintenance while no evidence for their reuse as another functional tool was identified.

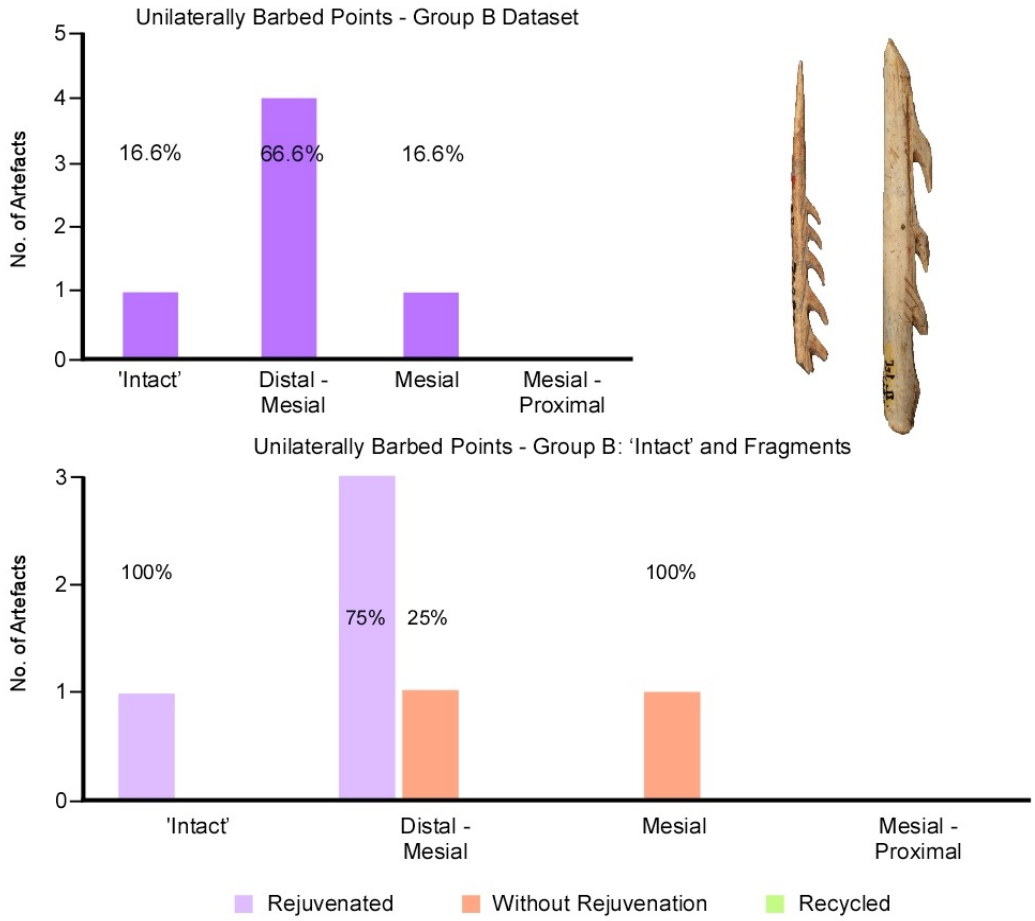


Figure 6.12: Composition of the Isturitz Unilateral Group B dataset: (Top) Number of 'intact' and fragmentary pieces; and (Bottom) Frequency of evidence for rejuvenation and recycling.

Methods of Maintenance

Of the five artefacts on which the distal-mesial extremity has survived, four exhibit clear evidence of tip rejuvenation. As with the Unilateral Group A artefacts found at this site, this maintenance resulted in striations and the formation of a spatulate form extremity (Figure 6.13: A, B, C). The only artefact for which no evidence for repair could be identified was MAN 75297 (shown in Figure 6.12: Left). This artefact appears to have entered the archaeological record very early in its projectile use life. The near perfect conical shape of the distal tip and lack of evidence for maintenance on this fragment suggests that this piece may be close to original form and therefore likely fractured in use before rejuvenation of the tip was considered necessary.



Figure 6.13: Example of evidence for the maintenance of Unilateral Group B points: (A) MAN IST I 1934: 'Intact' implement with evidence for the rejuvenation of the distal tip; (B) MAN IST sans. no: Striations; (C) MAN IST sans. no.: Spatulate form tip; (D) MAN IST I 1934: Retrieval cut marks on the right side of the implement.

As no mesial or mesial-proximal fragments belonging to this group of weapon tips were identified in the Isturitz dataset, we have only these distal-mesial fragments as well as the sole 'intact' artefact to inform us on how the mesial and proximal sections were maintained at this site; however, no evidence for maintenance of the mesial or proximal sections was identified on these artefacts.

An Additional Barbed Point

As mentioned above, an artefact which doesn't appear to be a functional projectile weapon tip was also examined (Figure 6.14). MAN IST II 86713 has no known parallels in Magdalenian assemblages anywhere in Western Europe. As an aggregation site where scenarios in which craftspeople displayed their skill or individuals displayed distinctive weaponry (and other material culture) for use in social signalling, it should not be surprising that such an unusual artefact should be recovered.



Figure 6.14: MAN IST II 86713: An unusual bilaterally 'barbed' point recovered from the Middle Magdalenian level of Isturitz.

This artefact appears to be a highly stylised bilaterally barbed point. The tip is the usual conical shape for bilaterally barbed points; however, this is where similarities to other Magdalenian bilaterally barbed weaponry ends. Each of the four 'barbs', two on each

side are roughly oval in shape with four (five, in the case of the lower left barb) slightly oblique lines engraved into its surface. These 'barbs' in no way would act to keep the weapon lodged in a target and therefore are not really barbs in the functional sense at all. Instead, these features are only indicative of their more functional cousins.

The base is made up of two sets of nested 'arrows', one on each of its superior and inferior faces, and which combined, create a notched base. In fact, one wonders if and how this point would have been hafted to a foreshaft or shaft. It certainly would have been difficult to haft the point securely enough to make it a functional projectile weapon, which is another reason for the suggestion that this artefact functioned only in the social sphere.

Whether this artefact was functional as a weapon tip or only used to display manufacturing skill, group or individual identity or some other social aspect, it nevertheless provides an enigmatic example of material culture used at Magdalenian aggregation locations.

Unbarbed Points

In total 1257 unbarbed and bevelled point fragments were identified and examined in the Isturitz assemblage (96.9% of the sample). As was the case for La Vache, distal-mesial and mesial fragments which may have originated from any unbarbed point type (single or double bevelled, Lussac-Angles, etc.) make up the majority of the collection (n = 838; 66.7%). Double bevel and single bevel points constitute similar proportions of the assemblage (DB: n = 202, 16%; SB: n = 160, 12.7%), with the 58 Lussac-Angles points identified making up the remaining 4.6% of the dataset (Figure 6.15). Very few <7mm BSW implements (either double or single bevel based) were found in the assemblage: 25 double bevelled and 7 single bevelled.

The large majority of the unbarbed points studied were recovered from the Middle Magdalenian layer II/E (n = 907; 72.2%), with 26.3% recovered from the Upper Magdalenian layer I/F1 (n = 331), and only 18 artefacts from the Final Magdalenian and Azilian layer Ia/B (1.4%).

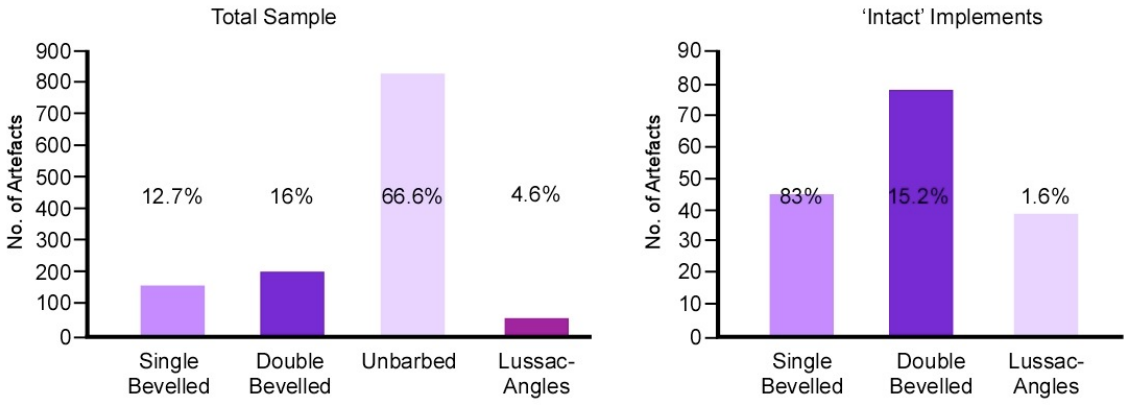


Figure 6.15: Composition of the unbarbed point assemblage from Isturitz.

Implements which were recorded as 'intact' make up 12.3% of the total unbarbed dataset. Of these artefacts, 48.1% are double bevel based (n = 78), 27.7% single bevel (n = 45) and 24% (n = 39) are Lussac-Angles points.

Double Bevelled Points

Two-hundred-and-two fragments of double bevel based points were identified in the MAN Isturitz collection, with 25 of these artefacts falling into the <7mm BSW category (12.3% of the double bevel dataset) (Figure 6.16). The majority of the double bevel fragments were classed as mesial-proximal sections (n = 108; 53.4%), with more 'intact' examples making up 38.6% of the dataset (n = 78). Only 16 proximal fragments (7.9%) were identified and recorded.

In all, 52.9% of the double bevel points were recovered from the Upper Magdalenian layer (I/F1), 44.5% from the Middle Magdalenian layer (II/E) and only 1.9% from the Final Magdalenian/Azilian layer (Ia/B). Similarly, the majority of the <7mm BSW double bevel points were recovered from the Upper Magdalenian layer (I/F1; 72%), with the remaining examples found in the Middle Magdalenian layer (II/E; 30%). This clustering of smaller weaponry in the Upper Magdalenian layer may reflect the broadening in subsistence (to include small game such as rabbits and avifauna) known to have occurred in this latter phase.

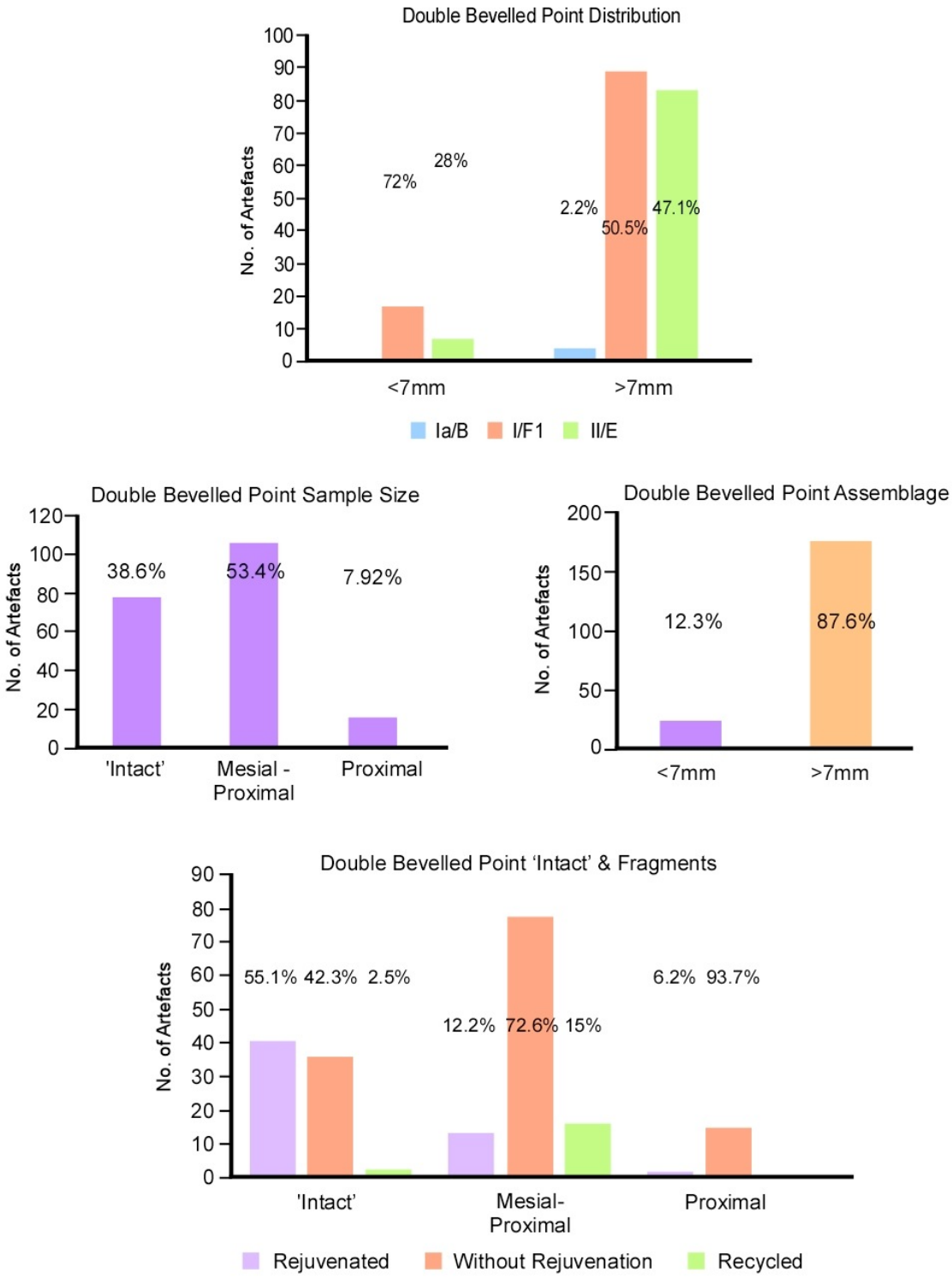


Figure 6.16: Composition of the Isturitz double bevel based point dataset.

Evidence for the maintenance of double bevelled points was identified on 28.7% (n = 58) of the total dataset, with another 8.9% exhibiting evidence for having been recycled.

Breaking these data down further, we find that 55.1% of the 'intact' implements, 12.9% of the mesial-proximal fragments and 6.2% of proximal fragments display evidence for repair. Evidence for recycling was found on only 2.5% of the 'intact' implements and 14.8% of mesial-proximal fragments.

Double Bevelled Points: <7mm Bevel Shoulder Width Group

As stated above, only 25 double bevelled based points with a bevel shoulder width less than 7mm were identified in the Isturitz assemblage. No proximal fragments are included in this dataset, with 14 of the implements being 'intact' (58.3%), and the remaining 11 being mesial-proximal fragments (Figure 6.17).

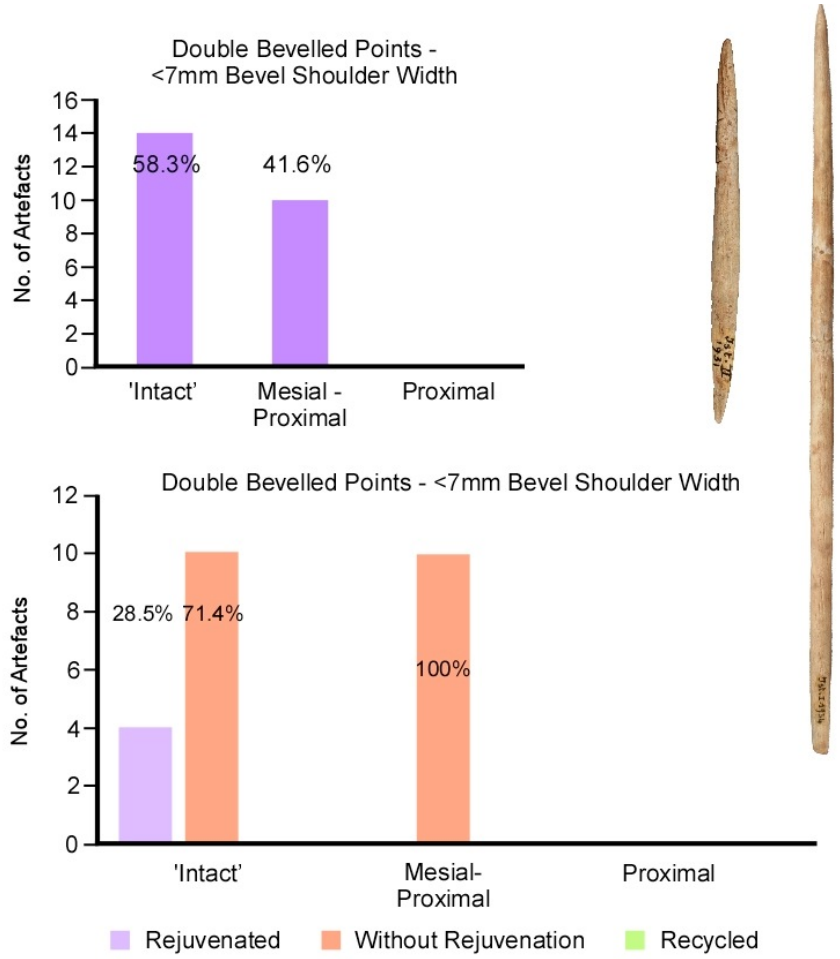


Figure 6.17: Composition of the Isturitz <7mm BSW double bevel based point dataset.

No evidence for the recycling on these slighter points was found, though eight of the implement's displayed evidence for rejuvenation (32%) and will described in the following section.

Methods of Maintenance

Of the eight <7mm BSW double bevelled points exhibiting evidence for repair, three have identifiably remade bases. In two of these cases, a double bevel base was hastily remade (Figure 6.18: E) with the striations from this maintenance being clearly visible on the artefact's surfaces. In the third case, however, a roughly formed fork has been carved into the proximal extremity. Carved into the bevel from both the superior and inferior faces, this work appears to have been undertaken with the use of a (lithic) blade, the edge leaving striations, grooves and an uneven section which is far from the carefully formed bases manufactured on fork-based points (Figure 6.18: D). This artefact is the only example of a bevel based point (either double or single) which has been rejuvenated in this fashion.

The remaining five implements have been resharpened, leaving the usual rejuvenation stigmata (striations, facets, uneven sections, etc.) (Figure 6.18: A - C), though it should be noted that uneven sections are more commonly observed on these smaller points than their larger counterparts. This observation is perhaps owing to an apparent disinterest in keeping the distal end of the shaft symmetrical at this late stage in the implements use life. The artefact shown in Figure 6.18: C is a good example of this type of repair.

Each of the eight rejuvenated points exhibit accumulated impact wear on their distal tips (severe crushing, chipping, small bevel fractures, etc.) which can be clearly seen in the three of the examples shown in Figure 6.18 (A - C). That such severe wear has been allowed to accumulate on these implements indicates that their owners did not intend for these points to last much longer. This intention to soon discard the weapon tips might also be responsible for their hasty rejuvenation.



Figure 6.18: Examples of evidence for the resharpening of the distal point and rejuvenation of the base on <7mm BSW double bevelled points.

Double Bevelled Points: >7mm Bevel Shoulder Width Group

Double bevel based points with a bevel shoulder width of more than 7 mm make up the majority of the identifiable unbarbed point dataset for this assemblage. In total, 177 of these artefacts were identified and examined, with 90.9% being either mesial-proximal fragments or 'intact' examples (n = 64 'intact'; n = 97 mesial-proximal). Only 16 proximal fragments were identified.

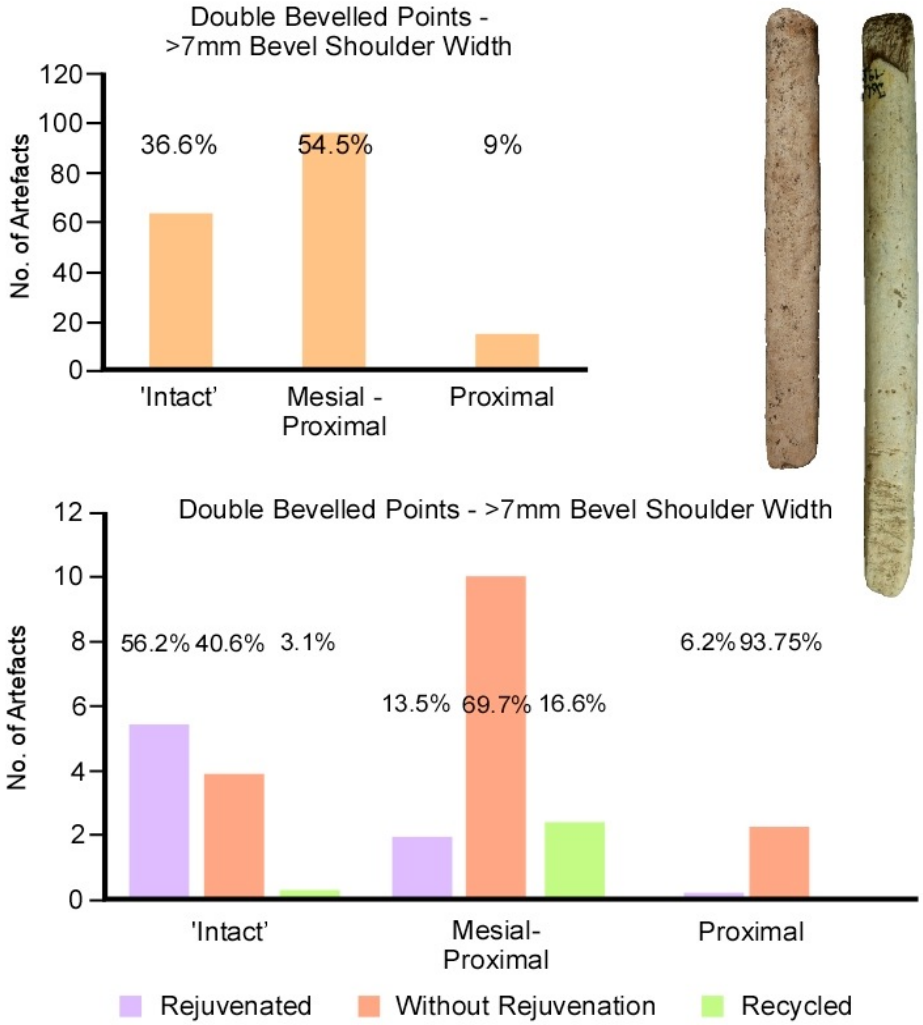


Figure 6.19: Composition of the >7mm BSW double bevelled points from Isturitz.

Evidence for the maintenance of these weapon points was commonly observed on the more complete specimens (the 'intact' implements) with 36 of the 64 (or 56.2%) exhibiting rejuvenation stigmata. An additional 13 mesial-proximal fragments and a single proximal fragment also displayed evidence for having undergone maintenance.

In total, 18 of these double bevel based points were recycled into a second use life (10.1%). Most of these examples were found amongst the mesial-proximal fragments, though two 'intact' implements were also identified as having been reused.

Methods of Maintenance

Not surprisingly, the majority of repair evidence found in the double bevel based (>7mm BSW) dataset was located on the distal extremity (n = 39 instances; 74.9%) of the implements, indicating the resharpening of the 'active' part of the weapon (the point).

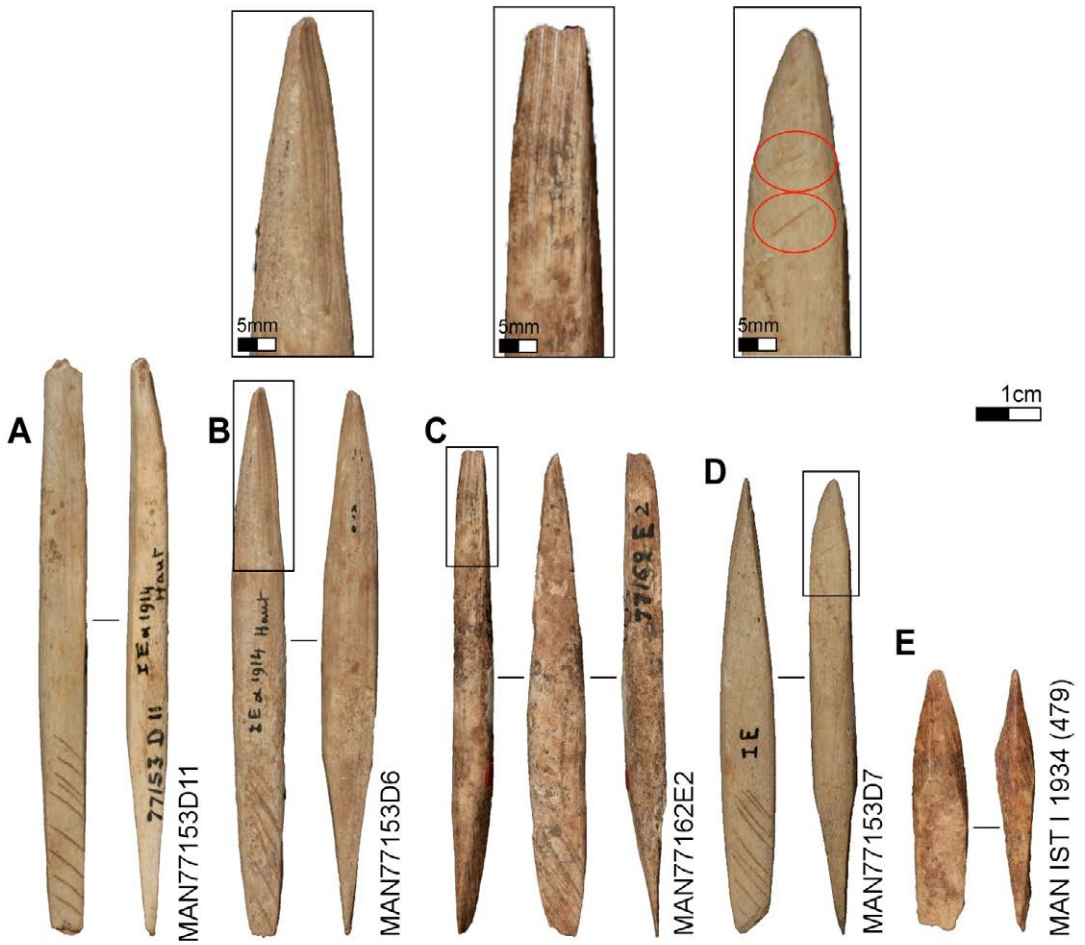


Figure 6.20: Examples of rejuvenated double bevelled >7mm BSW points found in the Isturitz assemblage. Each of the implements shown here displays striations, facets and uneven sections. MAN77153D7 also exhibits two retrieval cut marks on its left side (circled in red).

As with the other assemblages examined in this thesis, striations were the most common rejuvenation stigmata identified on the distal-mesial section (48%), with facets (18%) and uneven sections (12%) less frequently observed. As was found in the La Vache assemblage, striations could be either 'strong' or 'faint' depending on the method of

rejuvenation used and the care taken in resharpening the point. Several examples of particularly ‘strong’ striations are shown in Figure 6.20 (B - C, E) above. Similarly, facets constituted either fine and thinly carved sections carefully scraped (or ground) away, or wide and hastily removed portions like that seen on Figure 6.20: C above.

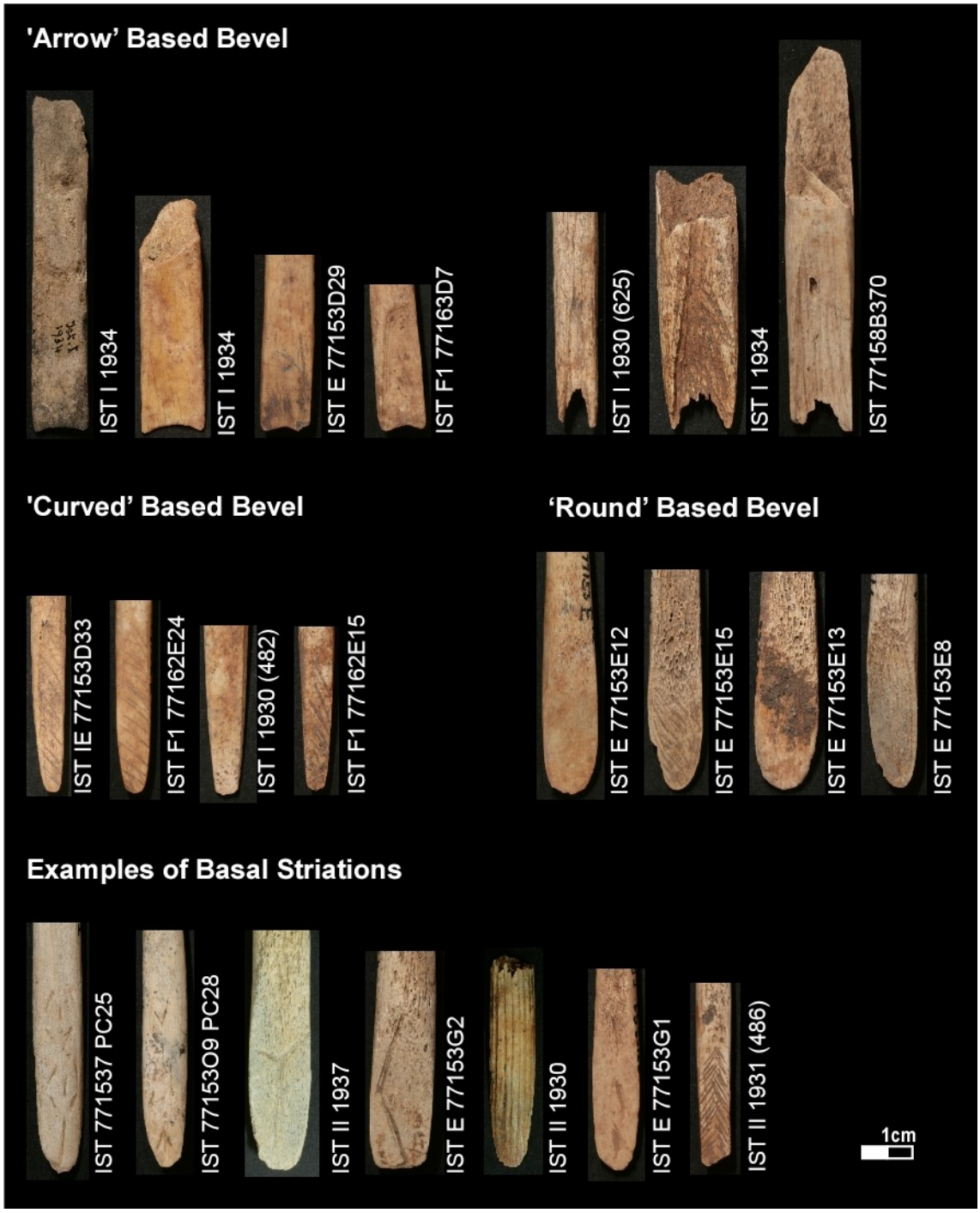


Figure 6.21: Examples of the three bevel edge types identified in the Isturitz assemblage. Also shown are several examples of the basal striation varieties observed.

As was described for the La Vache assemblage in Chapter 5, a variety of bevel edge types was observed in the Isturitz assemblage (Figure 6.21). At this latter site, three different edge types were identified, 'arrow', 'curved', and 'rounded', with the latter only found on single bevelled points. A wide range of bevel striation designs were also observed, a sample of which are shown in Figure 6.21 above. It is somewhat surprising that fewer types of bevel base edge designs were identified at Isturitz against La Vache as the former is considered an aggregation 'super site', though the variety in basal striations is not an unexpected result for this same reason. These observations will be considered further in Chapter 8.

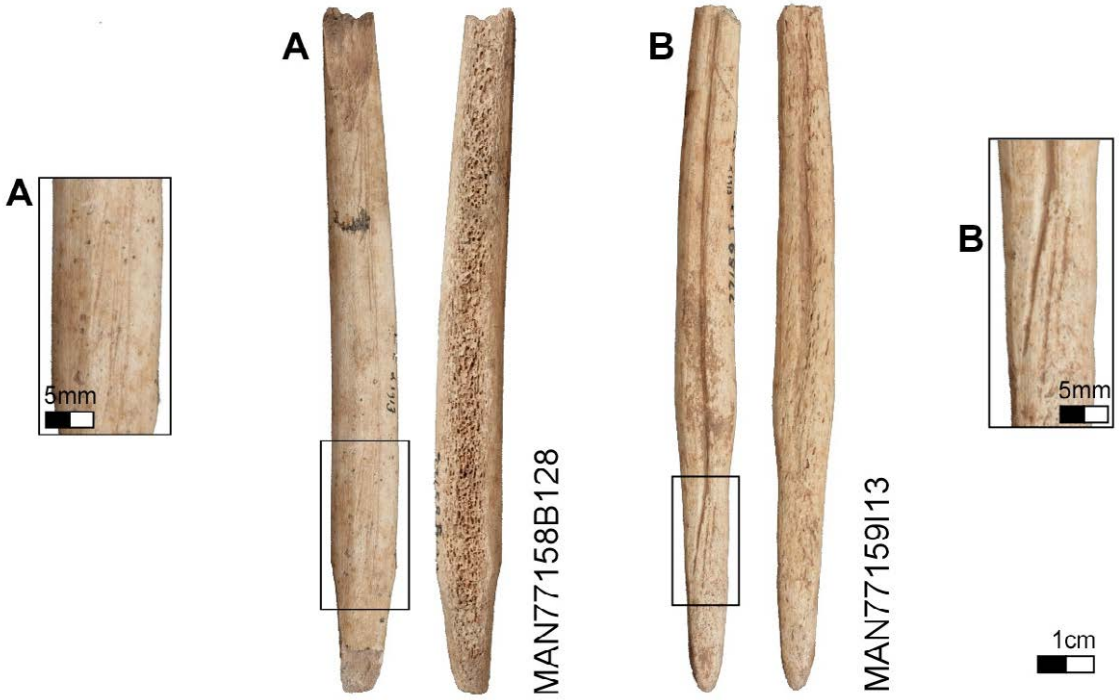


Figure 6.22: Two examples of remade bases observed in the double bevel based (>7mm BSW) dataset. Inset boxes outlining striations from the reworking of the section (A) and the partial erasure of shaft decoration (B).

Having identified the morphology of carefully manufactured bevel bases at this site, it was then possible to distinguish those bases that had been hastily remade. Nine implements with remade bases were identified of which the majority (seven of the nine)

were actually curated in the museum as '*Sagaie: Distaux*' fragments - likely owing to their overall morphology/superficial appearance as distal-mesial fragments. This misidentification of weapon tips with remade bases as distal-mesial fragments has no doubt resulted in the lack of recognition of this maintenance form in the past - a point made previously for the La Vache examples in the previous chapter.

For future reference, the identification of remade bases (such as on these seven implements labelled as distal-mesial sections) was based on:

- their length (typically much longer than true distal-mesial fragments);
- the decreasing shaft width from the reworked section (incorrectly identified as the distal point) towards the true distal end;
- the morphology and appearance of the reworked section (average basal length, wide and flattened elliptical section, the presence of striations, facets, uneven section and/or partial or full erasure of shaft decoration).

When brought together, these characteristics make their identification as mesial-proximal fragments with hastily remade bases possible. The two implements which were curated with other mesial-proximal fragments were only identified as having been remade due to the poorly executed character of their bevels.

In regards to the behaviour which produced these artefacts, it seems apparent that the person who executed the work was mainly concerned with producing a rough form which would fit into the haft (foreshaft or shaft) and not with producing a good quality base. It might be suggested that these repairs were made either out in the field while undertaking hunting activities or at another time when careful point repair was not possible, or alternatively, by an individual who was not skilled in (or did not usually undertake) weapon repair.

Recycling

Double bevelled points were reused almost exclusively as wedges at Isturitz. Seventeen of the 18 recycled implements were reused in this manner and exhibit the severe crushing and mushrooming of their distal and/or proximal extremities indicative of

these tools (Figure 6.23). Interestingly, decorated weapons appear to have been preferentially selected for recycling. Analysis of the entire corpus of wedges (those made from double and single bevelled points as well as distal-mesial fragments with diagnostic use wear) found that 55% were decorated with either engravings or both engravings and paintings. One of the most beautiful examples on which a reindeer is shown with a spiral symbol in front of its muzzle (sometimes interpreted as a symbol for either sound or breath) is shown in Figure 6.23. Another extremely interesting example is shown in Figure 6.24. Engraved on this latter point is a series of oblique lines under which three bosses have been worked into the right side of the weapon tip. It is clear that this point is not in the process of being reworked into a barbed point, but instead has simply been decorated so as to invoke the idea of a barbed weapon.



Figure 6.23: Examples of double bevelled points recycled as wedges. Far Left: An example of a distal-mesial fragment which fractured in reuse as a wedge. This artefact is also one of the examples of a decorated weapon being recycled.



Figure 6.24: IST II 1933: Another example of a decorated bevel based point recycled as a wedge. This artefact has extremely unusual decoration which seems invocative of a barbed weapon tip.

The single double bevelled point which was not recycled as a wedge appears to have been reworked and reused instead as a foreshaft (Figure 6.25). That this implement (MAN IST II 1930) was originally manufactured as a double bevel point is evident from the well constructed double bevel with oblique striations on each side (superior and inferior faces as well as left and right sides of the bevel). The distal extremity, on the other hand, has been carefully reworked into a single, slightly asymmetrical bevel. Oblique striations have been added to the inferior surface of the distal bevel face, presumably to aid in the hafting of this component to a single bevel based point (see Figure 6.25 below).



Figure 6.25: The double bevelled point (IST II 1930) reworked into a foreshaft or similar such tool.

Single Bevelled Points

Single bevel based points make up a smaller (though roughly similar) component of the studied Isturitz dataset (12.7%), with 160 fragments identified and examined. Only seven of these implements had a bevel shoulder width below 7 mm (4.3% of the sample), though four of these artefacts were considered near complete ('intact'). The remaining 153 single bevelled points all had bevel shoulder widths greater than 7 mm, with 41 artefacts near complete ('intact') (Figure 6.26).

As was found for the double bevel based points described above, mesial-proximal fragments - that is, implements with a significant proportion of their distal end missing (either fractured in use or in the archaeological record) - make up the largest proportion of the dataset (64.3%). Only 16 proximal fragments were identified and recorded.

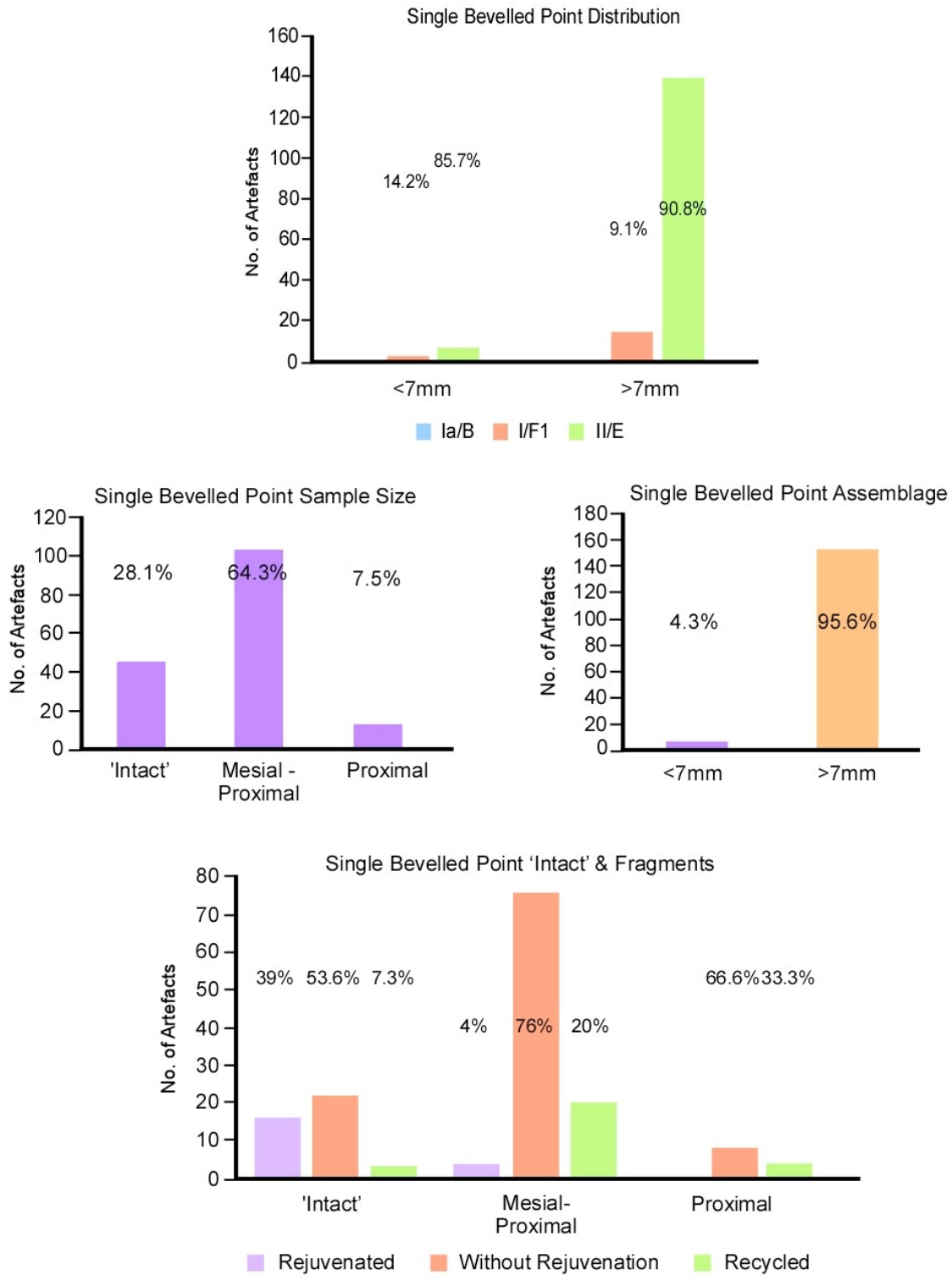


Figure 6.26: Composition of the Single Bevelled point dataset from Isturitz.

As was found for the <7mm BSW double bevel based points, the slighter single bevel points cluster in one particular stratum. However, while the slight double bevel points

clustered in the Upper Magdalenian layer (I/F1; 72%), the single bevelled variety were recovered in the majority from the Middle Magdalenian layer (II/E; 85.7%). This pattern is mirrored by the larger (>7mm BSW) single bevel artefacts which were also recovered largely from II/E (90.8%). The prevalence of single bevel based points during the Middle Magdalenian before the double bevelled variety become more common in the Upper Magdalenian is a pattern commonly observed from excavated Magdalenian sites.

Recycling of single bevel based weaponry was found to be quite uncommon in the Isturitz collection, with only 16.8% of the implements showing evidence for reuse (n = 3 'intact'; n = 20 mesial-proximal fragments; and n = 4 proximal fragments). Evidence for maintenance was even less frequently observed, with only 13.1% (n = 21 in total) of the artefacts displaying rejuvenation stigmata. Most of this evidence was found on the 'intact' implements (n = 17).

Single Bevelled Points: <7mm Bevel Shoulder Width Group

As just stated, only seven single bevelled points with a bevel shoulder width less than 7 mm were identified in the MAN Isturitz collection. Four of these artefacts were judged to be near complete ('intact') while the remaining three are mesial-proximal fragments, having lost their distal extremity post-depositionally (an example is shown in Figure 6.27 below). No proximal fragments were identified.

Despite the small sample size, evidence for the repair of these tiny weapon tips was identified - though in this case it was on only a single artefact (discussed below). No evidence for the reworking and recycling of these weapon tips was observed.

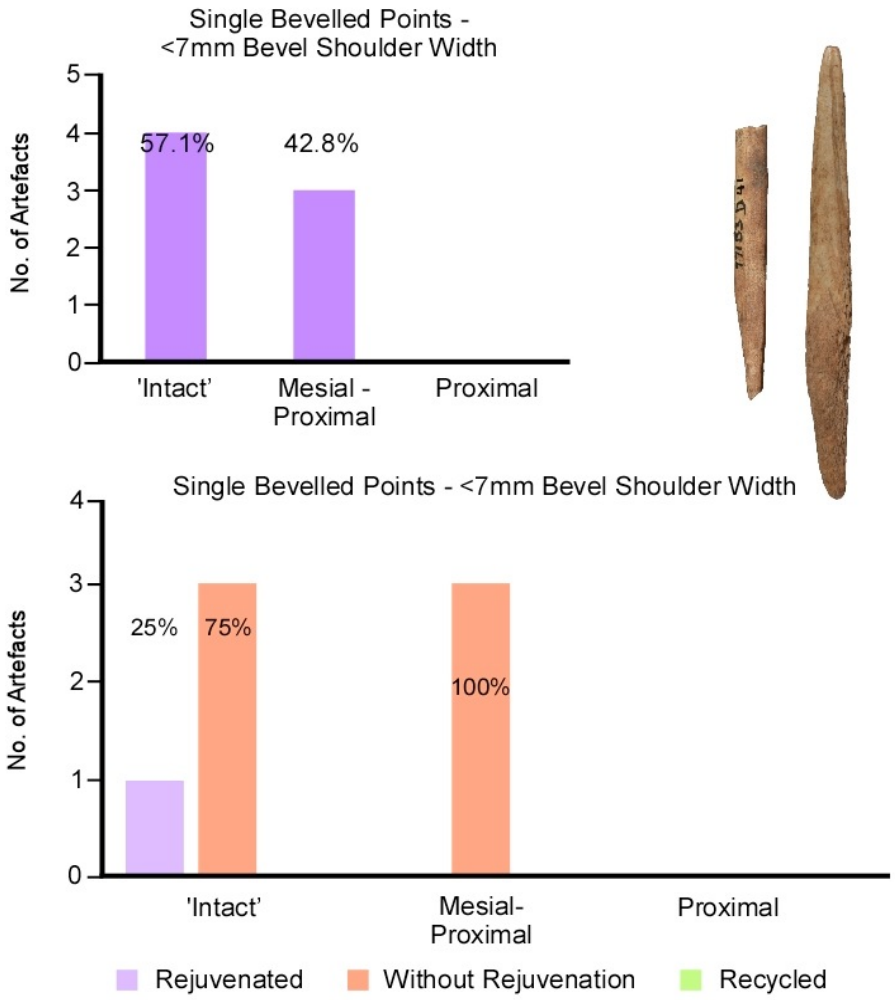


Figure 6.27: Composition of the <7mm BSW single bevelled point dataset from Isturitz.

Methods of Maintenance

The only evidence for the rejuvenation of single bevel <7mm BSW implements was observed on an 'intact' specimen (MAN IST II 1933) (Figure 6.28). This implement displays striations over its entire surface, but particularly around the distal tip. The section of the distal segment is also uneven and has been constructed using thin facets. The base of this implement is also roughly hewn, suggesting that it was remade. If this artefact is not simply a very roughly made single bevelled point, then it may constitute another example of a point having identifiable evidence for the resharpening of its distal tip in addition to the remaking of its base.

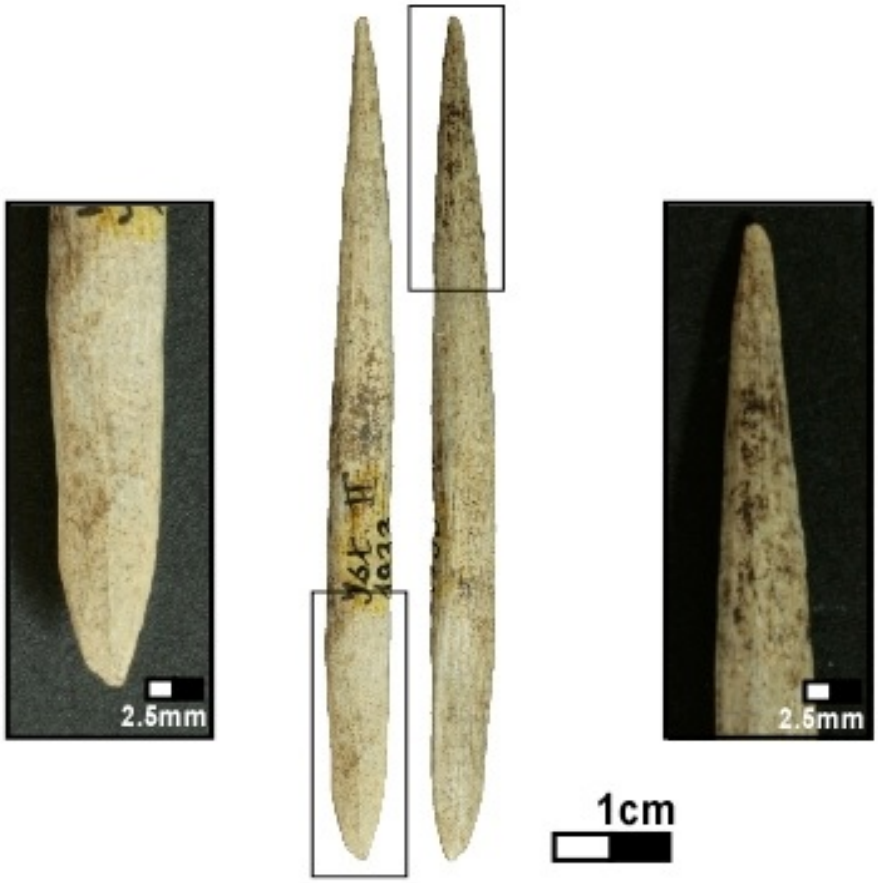


Figure 6.28: MAN IST II 1933: Evidence for the maintenance of single bevel points with a BSW below 7mm. The inset boxes highlight the possibly remade base and striations on the distal end of the tool.

Single Bevelled Points: >7mm Bevel Shoulder Width Group

In total, 153 single bevel points with a bevel shoulder width higher than 7 mm were identified and recorded from the Isturitz assemblage. Of these artefacts, only 12 (7.8%) were proximal fragments, 100 (65.3%) were mesial-proximal fragments and the last 41 (26.7%) were near complete or 'intact' implements.

Evidence for the recycling of these projectile points was found on 17.6% (n = 27) of the assemblage, with most instances identified on mesial-proximal fragments. Evidence for their maintenance was less common with only 20 out of the total 153 implements having observable stigmata (13%). Again, the vast majority of the evidence was found on the distal section of the artefacts, and therefore, on the 'intact' implements.

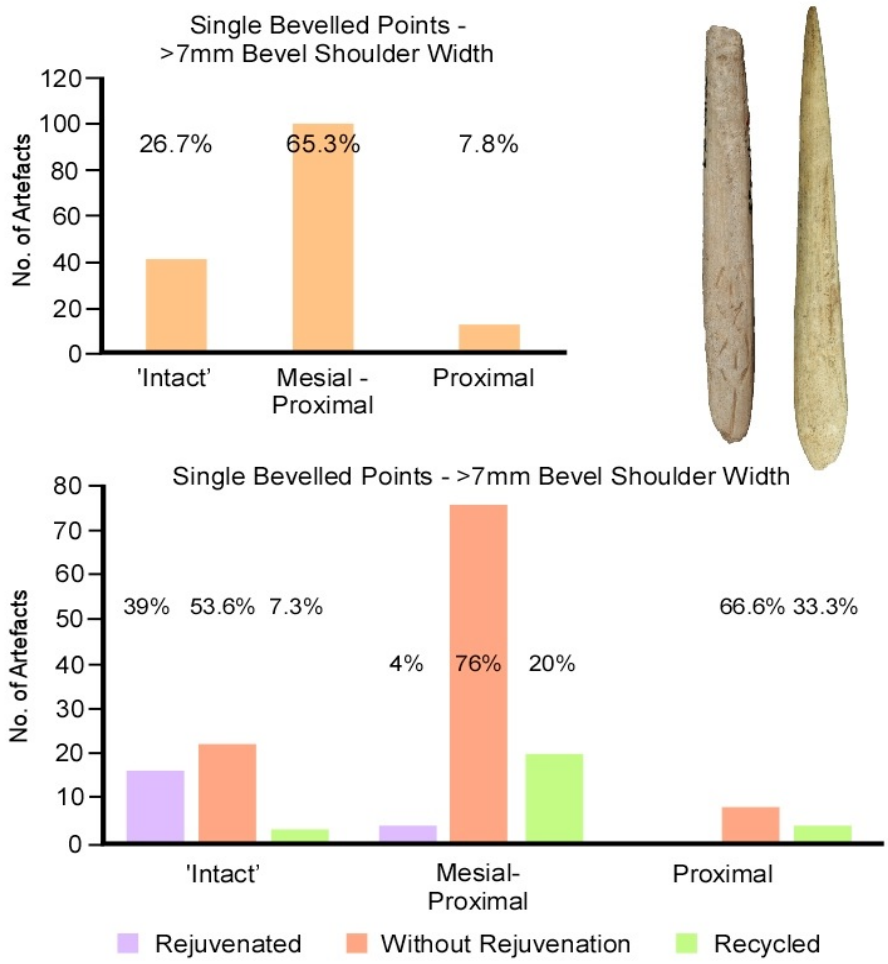


Figure 6.29: Composition of the Isturitz >7mm single bevelled point dataset.

Methods of Maintenance

Stigmata indicating the resharpening of the distal tip constituted the large majority of the observed evidence for point repair. Striations (n = 12 instances), facets (n = 6 instances), uneven sections and obviously reduced morphology (n = 4 instances) constituted the types of stigmata identified on the examined distal-mesial sections (Figure 6.30).

Perhaps the most interesting example of projectile point maintenance identified in this dataset was found as an 'intact' specimen (MAN IST I 1930 [385]). This artefact was recorded as a single bevel based point, but it is uncertain to what typology it belonged at the beginning of its projectile use life, though Pétillon (2006: 48-49, 167-168) has interpreted this artefact as a recycled fork-based point (Figure 6.30). This uncertainty is

owing to the clearly remade base which has been worked out of what was once the mesial section of a larger implement. We can know that the base was remade for two main reasons: (1) the bevel is orientated left to right rather than the usual superior to inferior design; and (2) while the left side (which forms the back of the bevel) is smooth and carefully worked and may date from the weapon's original manufacture, the right side of the bevel is roughly gouged out leaving an uneven surface covered in striations.

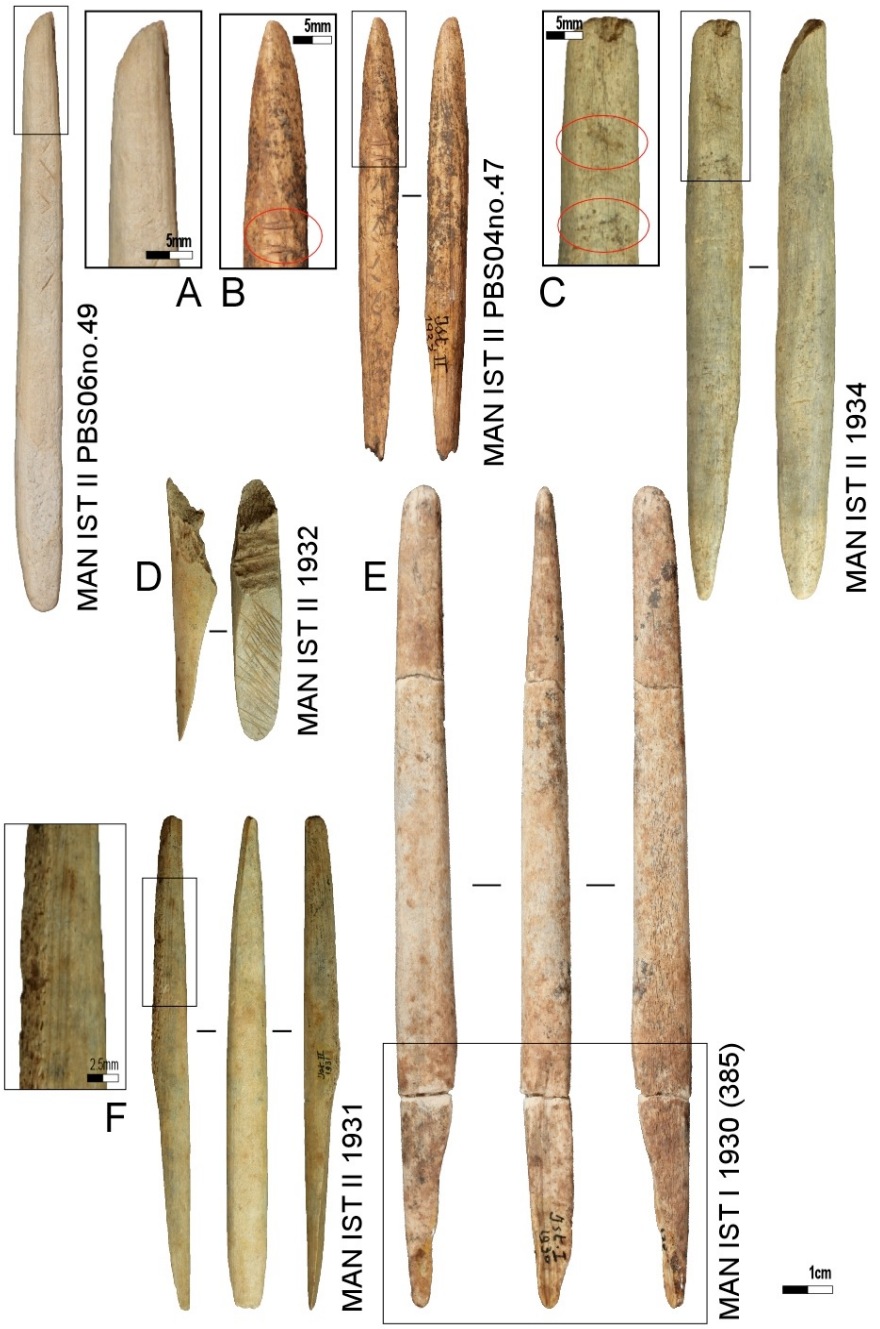


Figure 6.30: Evidence for maintenance identified on the Isturitz >7mm single bevelled points.

Thus, the maintenance of the single bevel based points of Isturitz mirrors that described for not only the other bevel based points recovered from this site, but also those recovered from La Vache and discussed in the previous chapter.

Recycling

Single bevel based points (>7mm BSW) were recycled into two completely different technologies. The first is the most common reuse of bevelled weaponry, reuse as wedges. Eighteen of the single bevelled implements were found to have the characteristic use wear (severe crushing, mushrooming, etc.) accrued in reuse as a wedge. As was discussed above, there was a preferential selection of decorated projectile points for recycling as wedges, and in the specific case of single bevelled implements, 49% (n = 7) were decorated.

More interesting (and perhaps one of the most interesting aspects of the recycling of the Isturitz's projectile weaponry) is the alteration of nine points for use as pendants. Each of these artefacts are shown in Figure 6.31 (A - H) below, along with a number of additional pierced projectile points. Also shown are a number of pendants that were considered to be of similar appearance to the pierced projectile points and which were observed during data collection. These additional artefacts include two HRR examples (J and K), a distal-mesial fragment of an unbarbed point (M), a worked piece of antler tine which is suggestive of the other artefacts (L), and a carefully worked linear pendant which is reminiscent of the HRR examples (I).

It is interesting that each of the nine examples identified, all were of the single bevel variety with not a single double bevelled example altered in this manner was identified, especially as there is no lack of double bevel based points in the assemblage. Four of these artefacts were made from proximal fragments, with the other five were mesial-proximal fragments. Three display clear splinter fractures at their distal extremity (D – F), two were intentionally removed from a more complete implement through the use of the BWF technique as evidenced by the chatter marks and associated splinter fracture (C and H), and the final example has been carefully worked to create a smooth and

symmetrical tip (G), erasing any indication of whether it was fractured in use as in the first three examples or deliberately removed as in the next two.

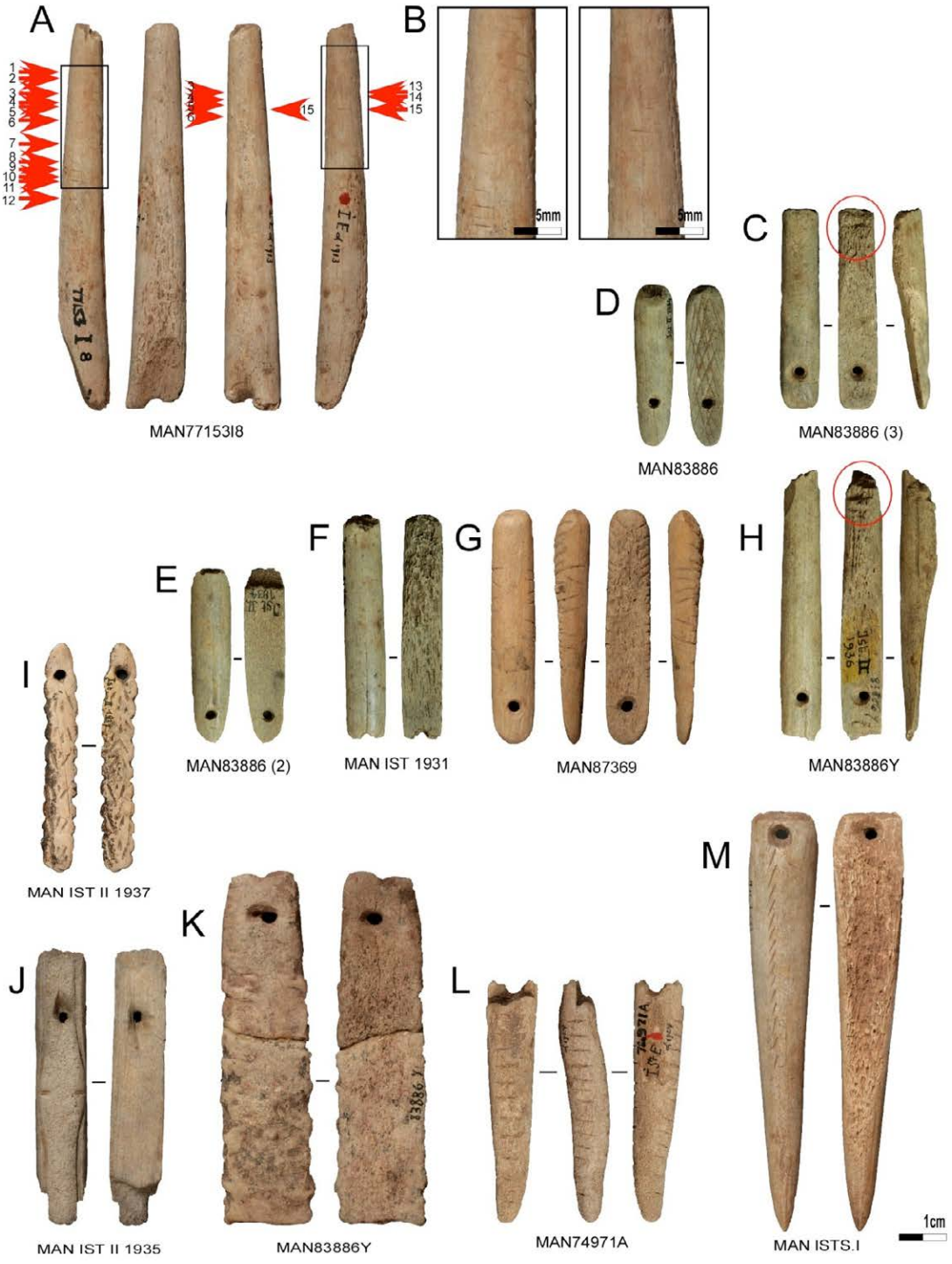


Figure 6.31: Projectile points and pseudo-projectile points transformed into ornamentation. (A - B): unbarbed point distal-mesial fragment with multiple retrieval cut marks (red arrows indicating); (C – H): Single-bevelled points. C & H display BWF at their distal extremity – circled in red; (I) Decorated flat form pendant; (J – K): HRR; (L – M) Worked antler tines.

The holes used to string the ornaments were drilled from both sides (superior and inferior) of the artefact and through the bevel of the implement in each case. Four out of the six implements have smoothed/rounded distal and proximal ends (C – E, G), while another has some rounding of the distal end, but the proximal extremity has been fractured and it cannot be determined whether this end too was rounded as in the other four examples (F). Only a single example (MAN83886Y; H) shows no signs of smoothing of the extremities; however the proximal end has been fractured – again removing any evidence of rounding if it had been originally present. While there is some post-depositional rounding of artefacts at this site, each of these examples appear to have been smoothed/rounded anthropogenically. This grinding down of the jagged and sharp edges would be necessary in order to stop the pendant from scratching exposed skin or catching on fabrics.

On these six examples; there is no convincing evidence that any *additional* decoration has been added to the pendants. The striations and/or lines visible on the artefacts are all consistent with being original hafting striations.

As can be seen in Figure 6.31, the single bevelled pendants are all of a similar size. The splinter fractures on MAN8388, MAN83886 and MAN IST 1931 are consistent with fracture during use as projectile weapons, as we have seen above. MAN87369 has been completely smoothed over from two sides (superior and inferior faces) so this artefact may also have originally had an impact fracture that has since been carefully removed, whereas the last two (MAN 83886 and MAN83886Y) have been intentionally cut from a larger fragment or complete implement. Additionally, MAN 83886 and MAN83886Y and possibly MAN87369 may have been cut to be consistent with other examples which fractured in use and therefore had their size predetermined.

The last example of a functional unbarbed point transformed into a piece of ornamentation is MAN7715318 (Figure 6.31: A – B). While the previous six examples were reported by Saint-Périer (1936), this example appears to have not been identified. A distal-mesial fragment with no less than 15 clear retrieval cut marks on its left and

right sides (indicated by the red arrows in Figure 6.31: A - B), this point exhibits a splinter fracture consistent with breakage in projectile use, while the proximal end has been shaved down on the inferior surface and a hole drilled from the superior face. A single curved line near the hole on this face may have been left during the drilling of the hole and suggests the use of a burin with a shoulder which carved into the antler during drilling. The proximal end has been fractured and then rounded (presumably post-depositionally).

Considering the large quantity of retrieval cut marks visible on this particularly piece - a great many more than usually present in the study sample (usually between one and four) - it seems reasonable to consider whether this projectile point was regarded as particularly 'successful' or 'lucky' by the owner/user and were therefore converted into an ornament to be kept as a charm or talisman. Certainly, if this item was considered particularly 'lucky' it would account for its transformation into an item which could be worn on the body.

In addition to the unbarbed point pendants identified in the assemblage, two HRR's were also transformed and reused as pendants (Figure 6.31: J – K). These two weapon fragments are significantly longer than the unbarbed point examples and the holes appear to have been more roughly gouged out than the carefully drilled holes of the unbarbed points.

Also examined from the Isturitz assemblage were two worked antler tines (L and M) which had a series of lines added as decoration. Saint-Périer (1936: Pl. VII) presents photographs of these two examples along with two very similar others, which given their similarity to MAN7715318 discussed above, one might argue that these antler tine tips were modified to resemble unbarbed projectile point pendants. The lines added might be a simple reference to retrieval cut marks - a sign of a successful weapon. This interpretation is merely a suggestion, however, given that projectile weapon tips were found to be reused as ornamentation only at Isturitz (in the sample – the wider distribution of this behaviour needs to be investigated) these artefacts may have constituted a commodity and 'imitations' (of recycled projectile points) may have been

produced much like the shell and animal tooth facsimile beads made from stone or ivory recovered from Aurignacian sites (White 2007).

Saint-Périer (1936: Pl. VII) includes another artefact that clearly appears to be a perforated unbarbed projectile point fragment, though in this case it is a distal-mesial fragment, while another example appears to be a distal fragment of a whale bone implement. Also shown is a pendant whose morphology is reminiscent of the proximal half of a bilaterally barbed point. These artefacts were not able to be examined for this study, and as such, whether they are additional examples of weaponry recycled into ornamentation remains undetermined. However, from the photos in the publication it seems likely that these artefacts, perhaps with the exception of the possible reworked bilaterally barbed point example, are also recycled examples of projectile weaponry.

Single Bevelled Points: Lussac-Angles

As Lussac-Angles points are generally considered to have originated in the Poitou-Charentes regions of central France (Zone V in this analysis), it is somewhat surprising that 58 such artefacts were identified in the Isturitz assemblage some few hundred kilometres to the south. However, since this site is also suggested to have been an aggregation site, the presence of regionally distinctive and 'exotic' projectile point types can thus be explained.

The large majority of the Lussac-Angles points are 'intact' or near complete mesial-proximal fragments, with only a single distal-mesial fragment and mesial fragment included in the dataset. Additionally, all but three of the artefacts exhibit impact fractures rather than post-depositional breakage, likely owing to their small stature. Interestingly, all but four of these weapons were recovered from the Middle Magdalenian layer (II/E).

These weapon tips are exceptionally well preserved, and their careful manufacture and maintenance is particularly easy to identify thanks to the reduction of the points in only one direction - from distal tip towards the proximal edge (as opposed to the larger bevel

based points described above which were reduced from both the distal and proximal ends towards the middle).

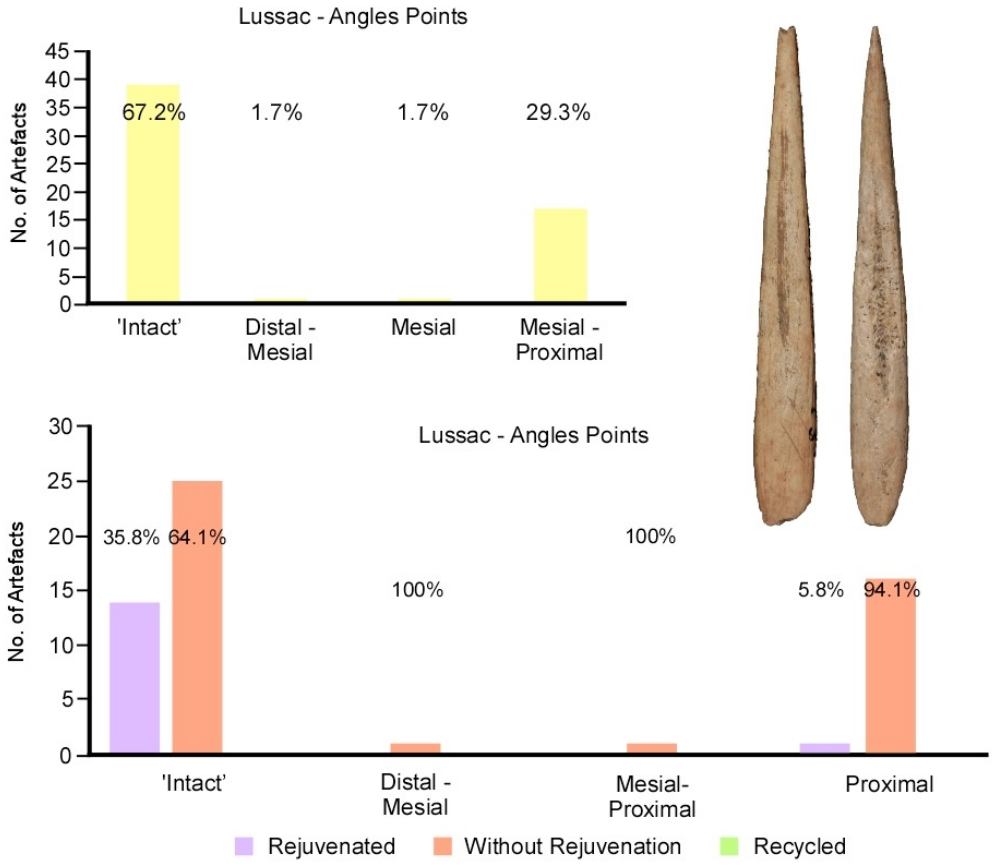


Figure 6.32: Composition of the Isturitz Lussac-Angles point dataset.

Methods of Maintenance

Evidence for the repair of these Lussac-Angles points consists of the same stigmata identified on the other types of bevelled points examined from Isturitz. The distal extremity was resharpened leaving striations or an uneven axis, as well as the partial erasure of the diagnostic groove on the superior and/or inferior face. Unlike the other bevelled points, however, the morphology of the artefact is highly informative for identifying the extent of implement reduction.

As these weapon tips have a more standardised morphology and the process of reduction through rejuvenation is more straight forward than for the other bevel based points, the process by which these weapons changed morphologically can be better

understood. In general, as the Lussac-Angles point is resharpened, the main body of the point (the distal-mesial segment) becomes increasingly squatter and proportionally too short when compared to the bevel base (see examples in Figure 6.33). The diagnostic groove incised on the superior or inferior face of the weapon tip was encroached upon and became partly erased, making the changing axis of the point clearly visible to the analyst (see the example in Figure 6.33: B). On several artefacts, the point has been so intensively reduced that the distal-mesial section has become little more than a pointed 'stub' situated on an disproportionately long single bevel base.

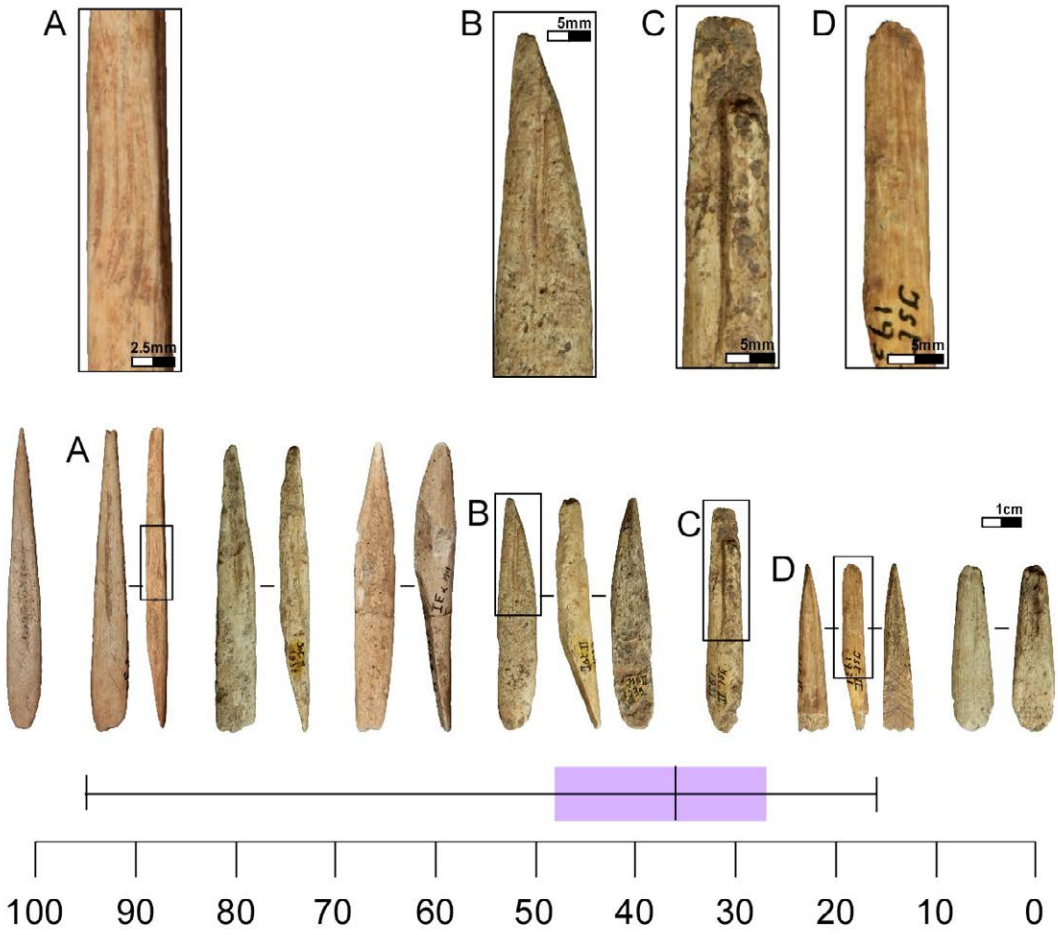


Figure 6.33: Box-and-whisker plot for Lussac-Angles point discard and examples of points at various stages of reduction.

Fracture and Discard Patterns for Bevelled Points

In total, an additional 846 fragments of unbarbed points were examined from the Isturitz MAN collection. Of these artefacts, 19 were 'intact' unbarbed points with conical or tri-

form bases and were thus excluded from the analysis. Similarly, of the 500 distal-mesial fragments examined and recorded, a number were classified as 'robust' owing to their significantly larger dimensions compared to the majority of the assemblage. These artefacts exhibited use wear indicative of use as burnishers (or similar) and as these implements appeared not to be (clearly) projectile points they were removed from the dataset. Hence, 457 distal-mesial fragments make up the sample examined and discussed below.

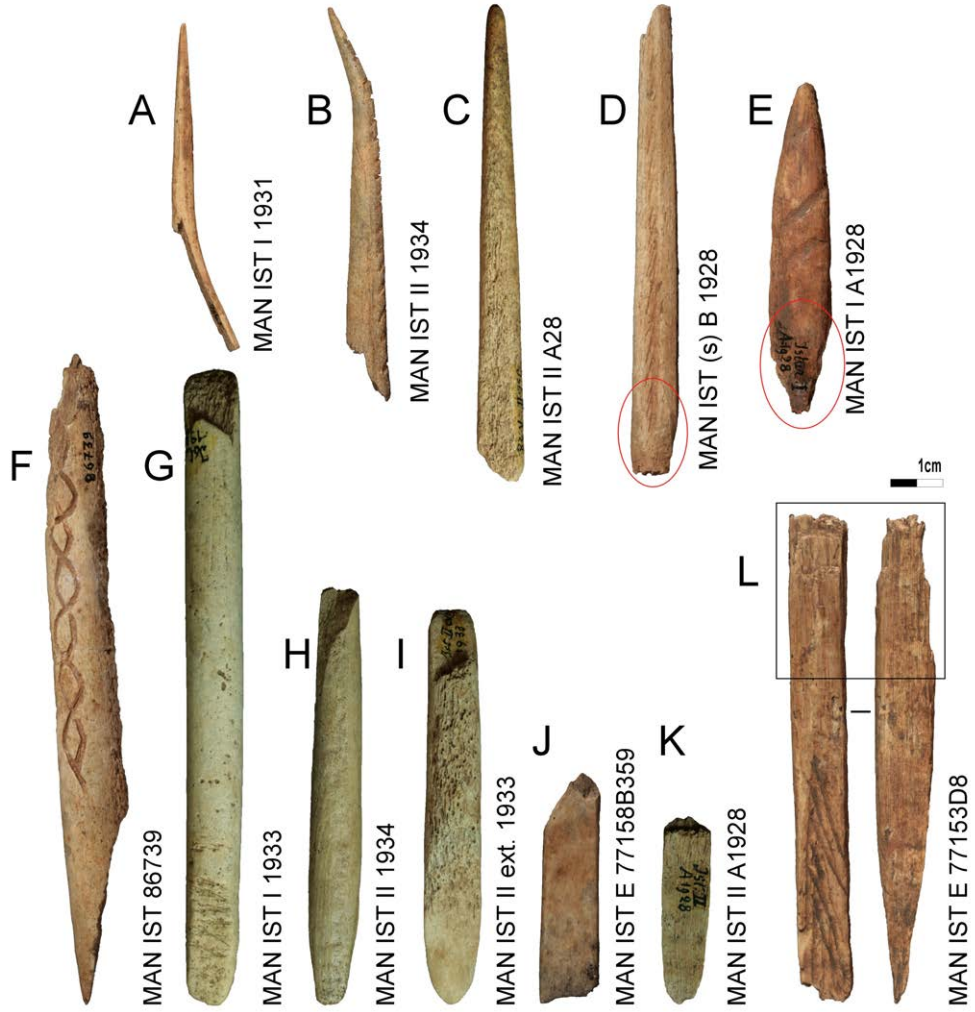


Figure 6.34: Examples of impact fractured and intentionally fractured unbarbed point fragments found in the Isturitz MAN assemblage: (A - C): Distal-mesial fragments fractured in projectile use; (D - E): Detached distal-mesial fragments through use of the BWF technique; (F - K): Examples of impact fractured mesial-proximal and proximal fragments; (L): A double bevel mesial-proximal (whale bone) fragment intentionally detached (BWF).

Distal-mesial fragments were largely made of antler, though a number of terrestrial bone (n = 9; 1.9%), cetacean bone (n = 20; 4.3%), and ivory (n = 1; 0.2%) examples were also recorded. Evidence for the resharpening of the tip (striations, facets, uneven section, etc.) was found on 126 (27.5%) of the points, with a further 26 implements displaying evidence for reuse as wedges, in one case as an awl, another as a spatula and four as pendants. These latter artefacts were described above with the single bevel based pendants (5.6% of the dataset).

Of the 457 distal-mesial point fragments examined, 248 exhibited impact fractures on both their distal and proximal extremity allowing for their inclusion in an analysis of fracture and discard behaviours. More than 50% of these distal-mesial impact fractured fragments measure between 51 and 89 mm (53.6%) in total length, which is around 20 mm higher than the La Vache dataset presented in the previous chapter. If we remember back to the discussion regarding the discard of the bevel based point fragments above, it was found that these fragments were also significantly longer than their La Vache counterparts. Thus, the distal-mesial point fragments also reflect the surplus of production circumstance proposed by Pétillon (2006).

The intentional removal of the distal tip which had accumulated significant damage was also practiced at Isturitz as it was at La Vache. Forty-seven points which had been intentionally removed from a larger implement in antiquity through the use of the BWF or UWF technique (10.28%) were identified - around 8% less than that seen in the La Vache dataset. If this result is a true representation of the character of the entire assemblage recovered from Isturitz, then this result may indicate another inter-site difference in osseous weapon maintenance between La Vache and Isturitz.

In the Isturitz dataset, the longest intentionally removed fragment measured 147.09 mm in total length, with the shortest reaching only 39.51 mm. Overall, 53% of the implements measured between 52.19 and 85.01 mm, with a median of 61.71 mm (average: 71.79 mm). Again this dataset differs somewhat from that of La Vache. While the longest fragment removed in either dataset is very similar in total length (La Vache: 146.44 mm; Isturitz 147.09 mm), the shortest differs by around 20 mm (La Vache: 16.77

mm; Isturitz: 39.51 mm), further emphasising this inter-site difference in discard behaviour.

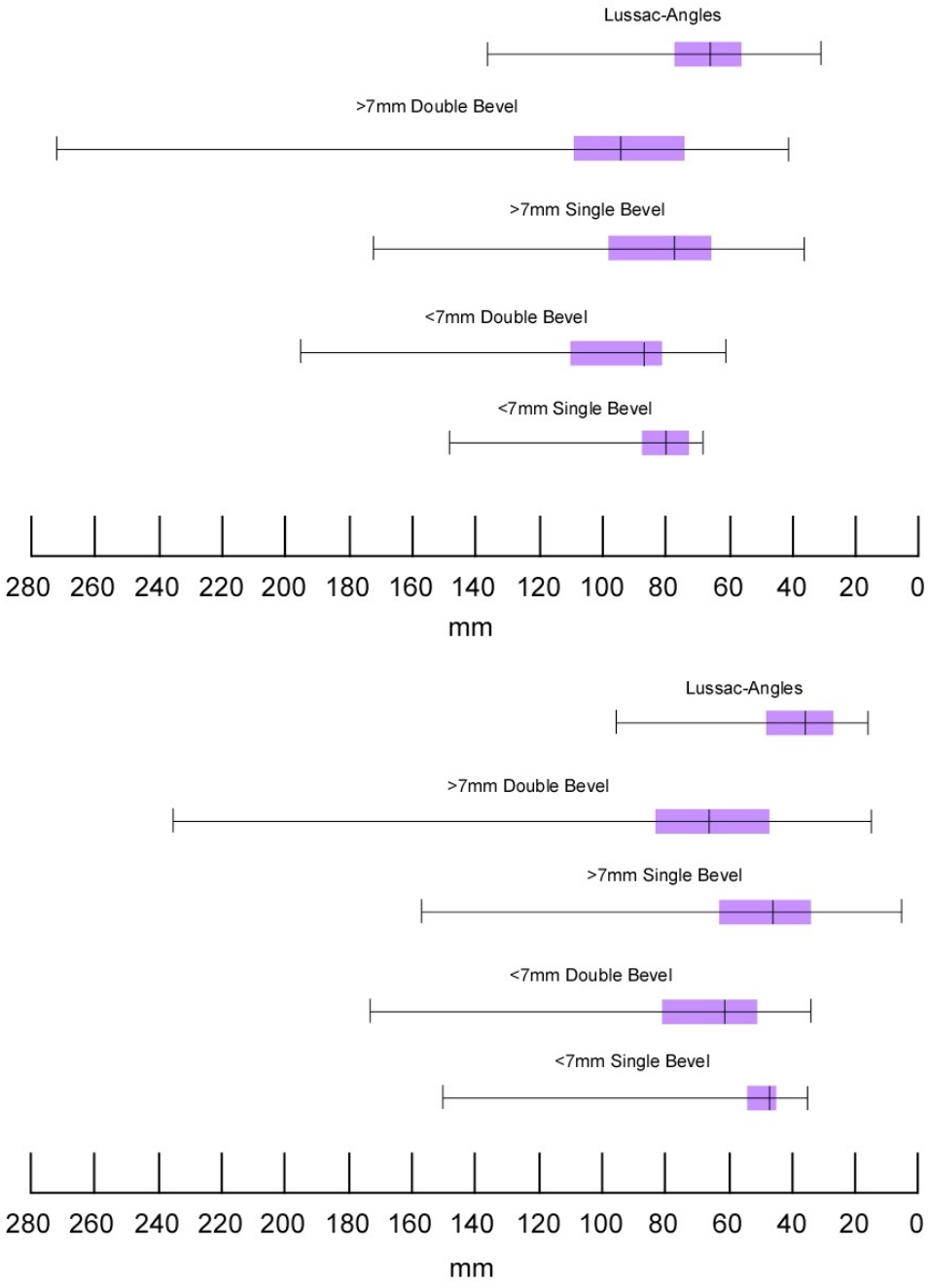


Figure 6.35: Box-and-whisker plots for the Isturitz single and double bevelled points: (A) total length of 'intact' and mesial-proximal fragments; (B) Penetration length for mesial-proximal fragments.

If we now focus on the mesial-proximal fragments, it was shown that these sections make up the majority of the Isturitz bevel based point dataset (DB: 53.4%; SB: 65.3%;

L.-A.: 29.31%). Again, this result is not surprising considering that these elements would have been transported back to and discarded at the site during retooling activities.

Figure 6.35 above, presents the total implement and mesial-proximal fragment length for the single and double bevel based points examined. In comparison, it is immediately evident that both the <7mm and >7mm BSW single bevel point datasets are shorter in both total and common discard range than their double bevel based counterparts.

These data therefore suggest that while the single bevel based weapon tips were commonly discarded within the range of 72.44 to 87.7 mm for the <7mm BSW implements' and 65.34 - 98 mm for the larger >7mm BSW implements, the double bevel based points have a range which is some 20 mm longer (<7mm: 81.25 - 110.9 mm; >7mm: 74.29 - 109.97 mm). While these ranges overlap, they are not as closely aligned between the implement types as those recovered from La Vache (compare with Figure 5.54 in Chapter 5).

For this assemblage, we also have a significant number of Lussac-Angles points to consider. Comparison of these data with that of the other bevel based implements finds that these weapon tips, while being a shorter (though not thin) type in overall morphology to begin with, were reduced further and discarded later than all of the previously discussed unbarbed points.

Thus, it was found that overall, 'intact' implements, distal-mesial fragments and mesial-proximal fragments were discarded at an earlier stage than those discarded at La Vache. Numerous fragments, including those which were carefully and laboriously decorated, and which could have easily been rejuvenated and continued in use were either recycled into use as wedges or simply discarded. The state of surplus of production at this Pyrenean site has clearly resulted in the hunters being able to discard broken weaponry with less concern for the maximisation of the implements' utility.

Summary of Isturitz's Antler Projectile Technology

When examining the Isturitz MAN collection of barbed and unbarbed projectile points, one gets the distinct impression that the weaponry is extremely well and carefully made. With such excellent preservation conditions at this site, much of the weaponry looks rarely used or maintained with such care that traces are less obvious to the untrained eye. In fact, the paucity of identifiable remade bases in this assemblage may be a testament to the quality of weapons maintenance undertaken at Isturitz.

Nevertheless, all of the rejuvenation stigmata identified in the La Vache assemblage were also present in the Isturitz sample. Considerable differences, however, were identified between the sites in regards to length of fragments discarded, and these observations will be further discussed in Chapter 8 alongside the data collected from the additional 23 sites examined.

Chapter 7: Twenty-Three Sites: Additional Data on Maintenance and Discard

Introduction

In addition to the case study datasets of La Vache and Isturitz presented in the previous two chapters, implements from another twenty-three sites located throughout France and southern Germany were examined for indications of repair and recycling. These additional sites provide the beginnings of a regionally diverse dataset against which we can compare the results of the Pyrenean assemblages.

Each of these additional site datasets are significantly smaller than those of La Vache and Isturitz and, with the exception of Gönnesdorf and Andernach-Martinsberg (both located in the German Central Rhineland), are far from being complete assemblages. The Gönnesdorf and Andernach-Martinsberg assemblages, however, while examined in their entirety have suffered considerably from post-depositional damage removing most traces of manufacture, use, and maintenance. Consequently, these assemblages also only provide a very minimum of data for the present study. Owing to these factors, much of the additional maintenance and discard data will be outlined and discussed together within this chapter, though more attention will be given to the larger datasets examined.

Barbed Points

Of the 23 additional site collections from which implements were available to be studied, 14 included barbed points. Fortunately, these additional 14 site assemblages are scattered throughout the study area, thereby providing the beginnings of a regionally diverse dataset (Figure 7.1).

In total, 376 barbed implements were examined from these additional sites, adding 23 ‘intact’ and 51 fragments of unilaterally barbed points, 70 ‘intact’ and 141 fragmentary bilaterally barbed points, and 91 barbed (those which may have originated from either uni- or bilaterally barbed points) fragments to the dataset examined for this study

(Figure 7.2). Of these 14 sites, four had more than 40 barbed points available for examination (Laugerie-Basse: n = 40; Courbet: n = 53; Grotte du Bois-Ragot: n = 89; and La Madeleine: n = 131). These larger datasets will be considered in detail before the data obtained from the remaining ten sites are presented, from which only 64 barbed artefacts were examined in total (Andernach-Martinsberg, Aurensan, Gönnesdorf, Gourdan, Hohle Fels, La Tuilière, Lorthet, Mas d'Azil, Montastruc, and Vogelherd).

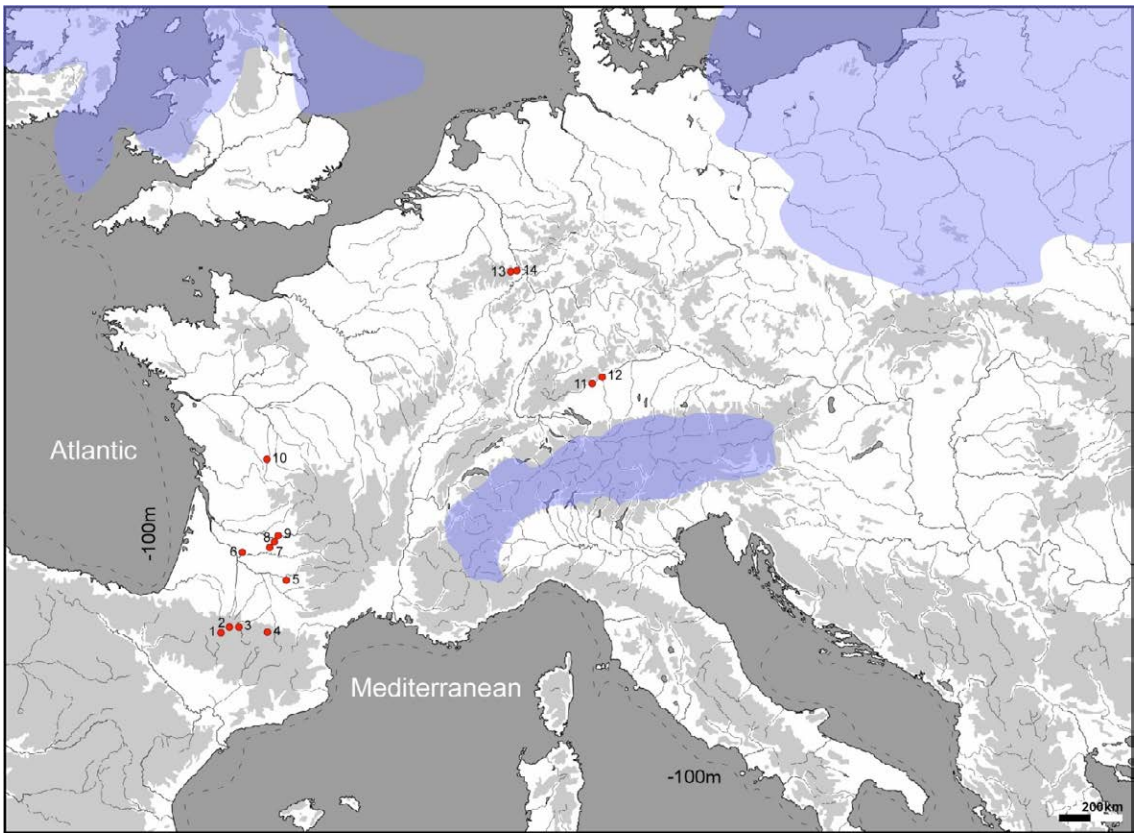


Figure 7.1: Geographical distribution of the fourteen sites for which additional barbed point data was collected: (1) Aurensan; (2) Lorthet; (3) Gourdan; (4) Mas d'Azil; (5) Courbet; (6) Montastruc; (7) Laugerie-Basse; (8) La Madeleine; (9) La Tuliere; (10) Grotte du Bois-Ragot; (11) Hohle Fels; (12) Vogelherd; (13) Gönnesdorf; and (14) Andernach-Martinsberg.

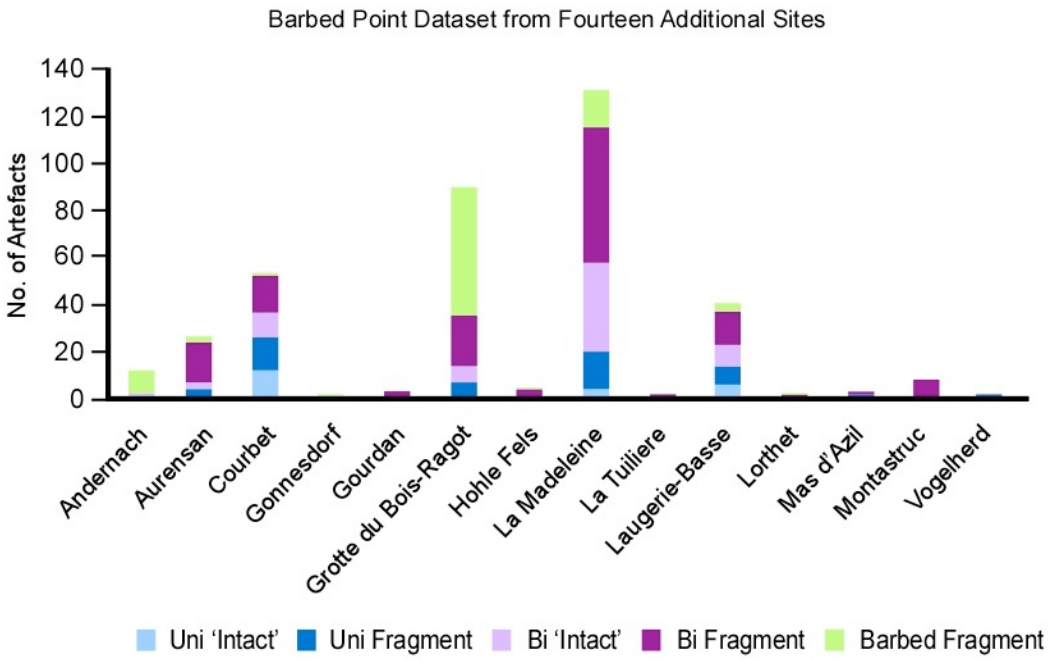


Figure 7.2: Composition of the barbed implements examined from the additional 14 sites.

Courbet (Tarn)

Fifty-three barbed weapon tips from the site of Courbet (Tarn) were examined. Curated in The British Museum (London), these artefacts were collected by the site owner and excavator, the Vicomte de Lastic, during his exploration of the site in 1860. This small collection includes 26 unilateral (20 Group A and 6 Group B) and 26 bilateral (all Group A) barbed points, along with a single barbed fragment which may have originally come from either implement type (Figure 7.3).

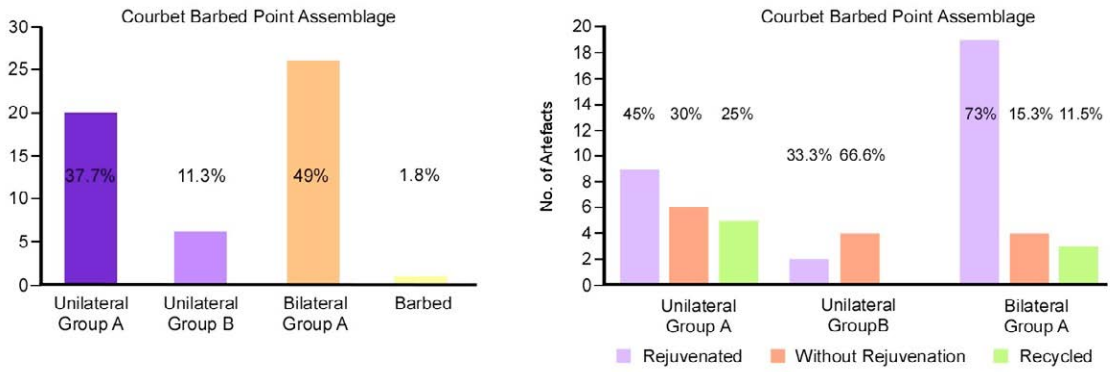


Figure 7.3: Composition of the Courbet barbed point dataset.

Methods of Maintenance

Evidence for point maintenance was easily identified on the Courbet implements owing in part to their excellent level of preservation. Rejuvenation stigmata was found on all three types of barbed point included in the sample (Unilateral Groups A and B; Bilateral Group A), and consisted of the same stigmata identified in the La Vache and Isturitz assemblages (striations, facets, uneven sections, etc.).

In detail, the distal tip was rejuvenated using the scraping or grinding of the tip leaving the characteristic striations and/or facets, along with a spatulate form tip. This type of evidence was found on 18 of the 26 bilaterally barbed points (Figure 7.4: A, B, C), and 11 of the unilaterally barbed points (Figure 7.5: C, E). The careful removal of barbs was also identified on a single unilaterally barbed point (Group A) and five bilaterally barbed implements. While mesial-proximal areas were preserved on both 'intact' and mesial-proximal fragments, no evidence for the repair of this section was identified.

Like the barbed points of La Vache and Isturitz, the more complete implements recovered from Courbet display maintenance that has been expertly executed: carefully ground smooth spatulate form tips (Figure 7.4: B, C, G; Figure 7.5: B, E), precise grinding of broken barb scars (Figure 7.4: E, F; Figure 7.5: D), and in one case, a barb was thinned in order to accommodate a new distal tip (Figure 7.4: G). This latter technique for extending the use life of a point was also found on one of the La Vache implements (see Chapter 5).

Fortunately, the Courbet BM collection hasn't significantly suffered from post-depositional processes and the majority of the examined artefacts terminate in impact fractures on both their distal and proximal extremities. These artefacts therefore allow for basic statistical data pertaining to the relationship between fracture patterns and rejuvenation quality to be undertaken as it was in the previous two chapters.

Implements which appear (owing to their overall reduced morphology) to be closer to the end of their use life, as well as the fragments that have broken in use, on the other hand, display maintenance which has been hastily and poorly executed. For example,

the rejuvenation of the distal point instead of being carefully ground into a smooth, rounded spatulate form, was formed by the cutting of wide facets where the striations from their creation are still clearly visible (Figure 7.4: A; Figure 7.5: A, C). This poor method of repair was no doubt partially responsible for the fracturing of the weapon in use shortly after this round of maintenance was executed.



Figure 7.4: Examples of evidence for maintenance identified on bilaterally barbed points from Courbet: (A) BM103: Striations, facets, and partial removal of decoration; (B) BM91: Spatulate form tip with striations; (C) BML68: Change in tip axis with striations; (D) BM81: Change in tip axis; (E) BM95: Barb removal; (F) BM64.12.26.11: Barb removal; (G) BM105: Alteration of barb to accommodate a new tip.

The total length data for the 'intact' and fragmentary pieces of the Courbet barbed points are provided in Table 7.1 below. Examination of these data show that both implements recorded as 'intact', as well as lengthy fragmentary pieces, were discarded at Courbet. While a number of these implements appear to have been significantly reduced (indicated by the overall morphology of the implement), their total length is often still above 100 mm. While it is likely that shorter fragments were also discarded at this site and the nature of the artefact collection during the mid 1860's (along with the

collection interests of The British Museum) did not allow for inclusion in this collection, we are still able to determine that weapon tips which could have continued to be reduced and used were discarded. Comparison of these data with the other 24 sites included in this study will be undertaken in the following chapter.

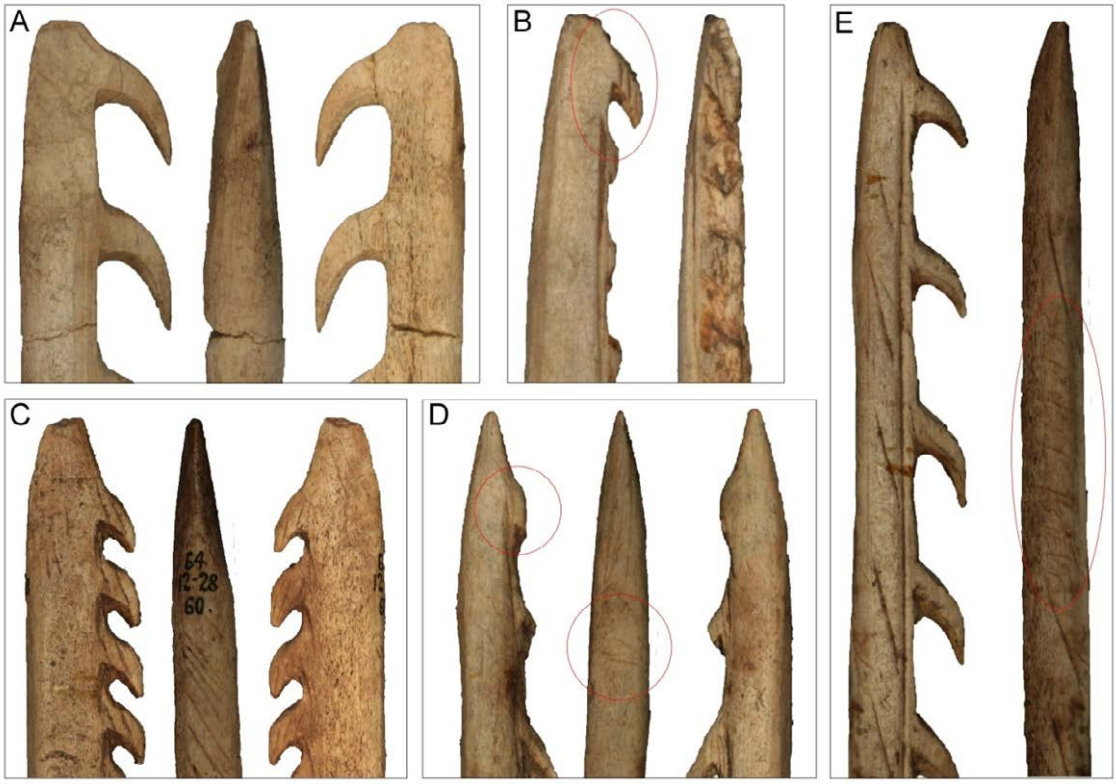


Figure 7.5: Examples of maintenance evidence on unilaterally barbed points from Courbet: (A) BM117: Spatulate form tip with facets and partial shaft decoration erasure; (B) BM64.12.26.25: Spatulate form tip with partial erasure of shaft decoration; (C) BM64.12.26.60: Spatulate form tip with lines; (D) BM64.12.26.54: Spatulate form tip, with top barb ground down (in top red circle) and retrieval cut marks on the left side (bottom red circle); (E) BM64.12.26.52: Spatuate form tip with lines and possible retrieval cut marks on the left side (in red circle).

Table 7.1: Total implement lengths for the Courbet barbed point artefacts.

	'Intact'	Distal-Mesial Fragments	Mesial- Proximal Fragments
Bilateral Group A	81.78 - 197.91 mm average: 131.70 mm	37.53 – 102.92 mm	c.90 – c.170 mm
Unilateral Group A	111.99 –134.48 mm average: 123.20 mm	54.86 – 104.33 mm	c.90 mm
Unilateral Group B	75.45 – 145.69 mm average: 112.40 mm	34.94 – 197.44 mm	NA

Recycling

Evidence for the recycling of barbed weaponry at Courbet is also evident in the BM collection. Three of the implements, two uni- and one bilaterally barbed point, have been heavily reworked for reuse as 'spatulas'. On each of these three implements, barbs have been ground down to leave only a series of smooth bumps, in addition to the reworking of the distal end of the point which became the active part of the new tool (the 'spoon'). In two cases, the shaping of this latter section was achieved through the creation of a bevel – on the inferior face in the case of BMC65 (Figure 7.6: C), and both the superior and inferior faces of BMC109 (Figure 7.6: A). On BMC31 instead of a flat, bevelled face, a section has been carefully scooped out and striations added to the inside surface (Figure 7.6: B). While it is possible that these barbed points were recycled into a tool other than a spatula, the use wear does not support their reuse as other projectile elements, wedges or any other tool which was subjected to high impact.

The next implement identified as recycled may have originally been either a uni- or bilaterally barbed point, as not enough of the artefact remains to make a positive identification (Figure 7.6: D). This implement (BMC127) has had a double bevel worked onto the top 37.42 mm of its distal extremity with striations (similar to those used for assisting in hafting/the addition of bladelets) added to all four sides of the bevel, including the remaining barb's shoulder. This sole remaining barb has been 'tidied', that is, the edges and extremity have been ground smooth. The proximal end appears to have been the original base when used as a projectile point and shows no clear signs of alteration. Given that the bevelled extremity was (likely) the hafted part in the reuse of this artefact, this tool must then have been reused in the manner of a double bevelled projectile point, a foreshaft, or as another tool where the (now distal) point was the active part such as a pressure flaker. The reuse of this artefact as a burnisher (or similar) seems likely owing to the heavily layered and glossy polish located on both extremities and the identification of similar residue patterns on ethnographic implements.

Finally, BMC42 and BMC23 were recycled as wedges (Figure 7.6: E and F) - the most common form of projectile point recycling during the Magdalenian. The former artefact

(BMC42) was most likely originally a bilaterally barbed point owing to its paired basal protuberances, while the other is a near complete Unilateral Group A point. Both of these implements exhibit the characteristic crushing and mushrooming use wear, with the proximal end of BMC42 having this wear severely accumulated. Furthermore, it is evident that this latter tool broke during reuse as a wedge owing to the splinter fracture at its distal extremity.

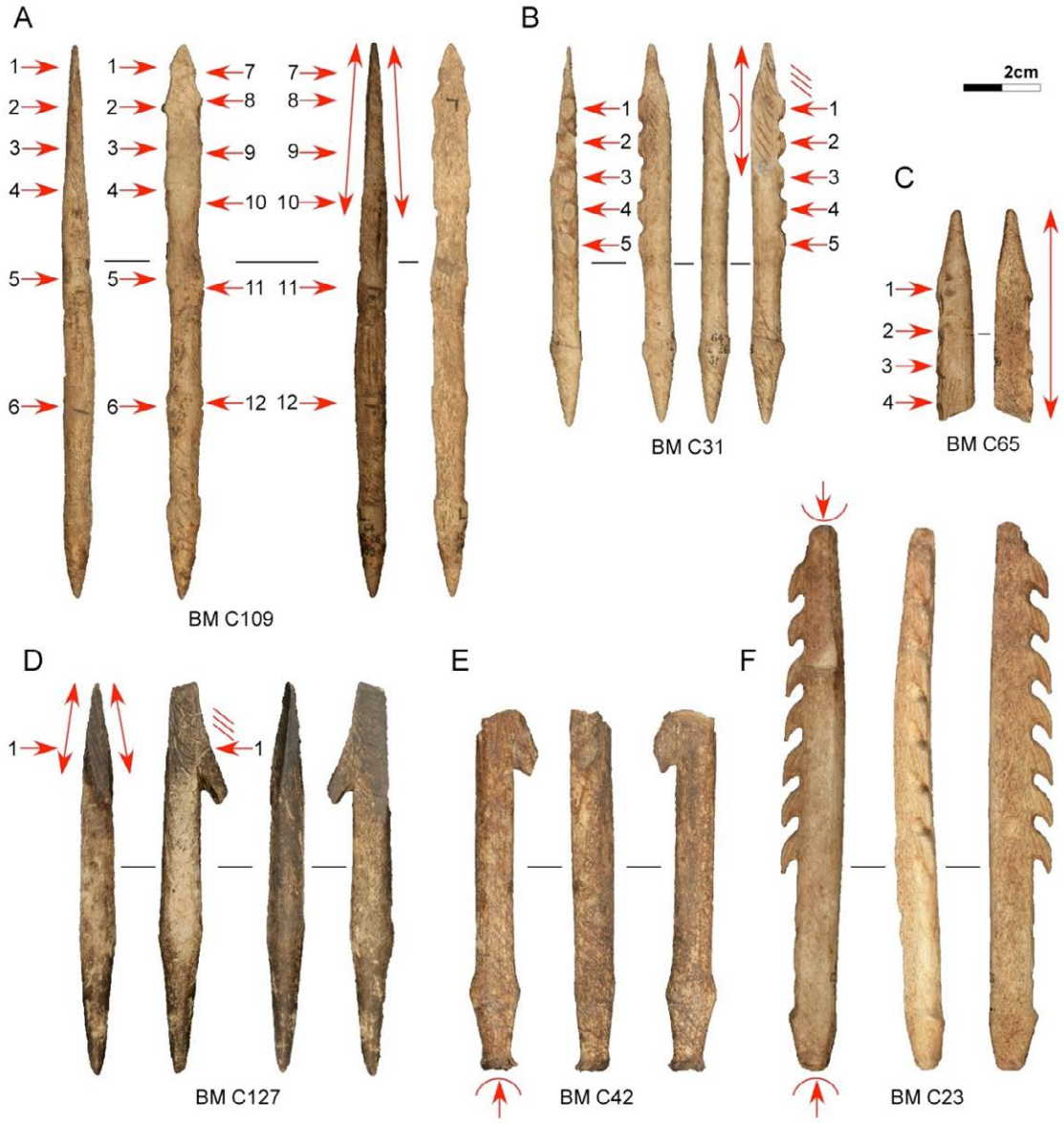


Figure 7.6: Implements identified as recycled from Courbet: (A – C) 'Spatulas'; (D) Possible burnisher, pressure flaker or other hafted tool; (E – F) Wedges.

It is most interesting to note that three of the recycled barbed points (BMC109; BMC31; BMC23) appear to have been recycled into other functional tools even though they were

likely still fully functional as projectile points when transformed. It might be suggested, however, that in the case of the two spatulas, several barbs may have fractured during projectile use, causing them to be moved into a secondary function. In the case of BMC23, however, all the barbs are present and intact, making one wonder why a seemingly functional point was recycled as a wedge before it became inefficient or unusable as a projectile.

Thus, while The British Museum's collection of Courbet barbed points is small and likely composed of 'cherry picked' artefacts of exceptional preservation and/or interest to the collector and researcher, it nevertheless provides insightful evidence for the maintenance and discard behaviour of the Magdalenians who once occupied this site.

Grotte du Bois-Ragot (Vienne)

Two levels (*Niveaux 5* and *6*) are attributed to the late Magdalenian at the Vienne site of Grotte du Bois-Ragot. The collection is curated in the *Musée de Préhistoire* in Lussac-Les-Châteaux (France), and consists of 89 barbed artefacts.

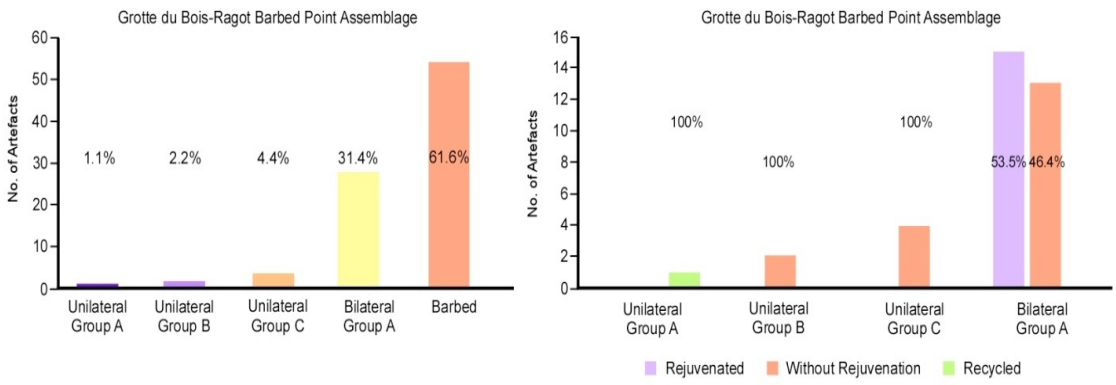


Figure 7.7: Composition of the Grotte du Bois-Ragot barbed point assemblage.

The osseous artefacts recovered from this site have suffered from post-depositional breakage and the assemblage is, therefore, largely composed of implement fragments which may have originally belonged to *either* uni- or bilaterally barbed points (n = 54; 61.6%) with no further identification possible. More complete artefacts (those which

have been able to be pieced backed together by the curators) include seven unilaterally barbed points (Groups A, B and C) and 28 bilaterally barbed points (all Group A) (Figure 7.7).

Methods of Maintenance

Of the seven unilaterally barbed points examined, not one displayed evidence for having been repaired. As four out of these seven points fall into Group C, those artefacts which are so tiny that they may not be functional projectile weapon tips (as discussed for those implements identified in the La Vache assemblage), this result might not be entirely unexpected. That no evidence for maintenance was found on either of the two larger form distal-mesial fragments or the three mesial-proximal fragments is somewhat more surprising, though their absence could probably be explained as a function of the small sample size.

Evidence for the repair of bilaterally barbed points in the collection, on the other hand, is significantly more common with 53.5% of the total sample displaying rejuvenation stigmata. Every 'intact' implement and distal-mesial fragment in the sample exhibited evidence for the rejuvenation of the distal tip. Rejuvenation of the point involved the usual methods of the scraping or grinding away of material from both the superior and inferior faces until a new spatulate form edge was constructed (Figure 7.8). Additionally, there is evidence that there was an effort to reconstruct or continue the original extended, conical section tip design described in Chapter 3.

On a number of artefacts, a long, piercing point similar to that argued to be the original design for these weapons has been (re)constructed (Figure 7.9 below). The presence of barb scars on both the left and right sides of the shaft indicate that this new tip has been worked out of what was originally the mesial section of the weapon. Thus, the distal tip on these rejuvenated weapons are not those originally carved at the time of manufacture, but rather the result of maintenance. That is, rather than the common spatulate form tip being made, the repairer has chosen to remove a number of barbs in order to reconstruct the original piercing form.

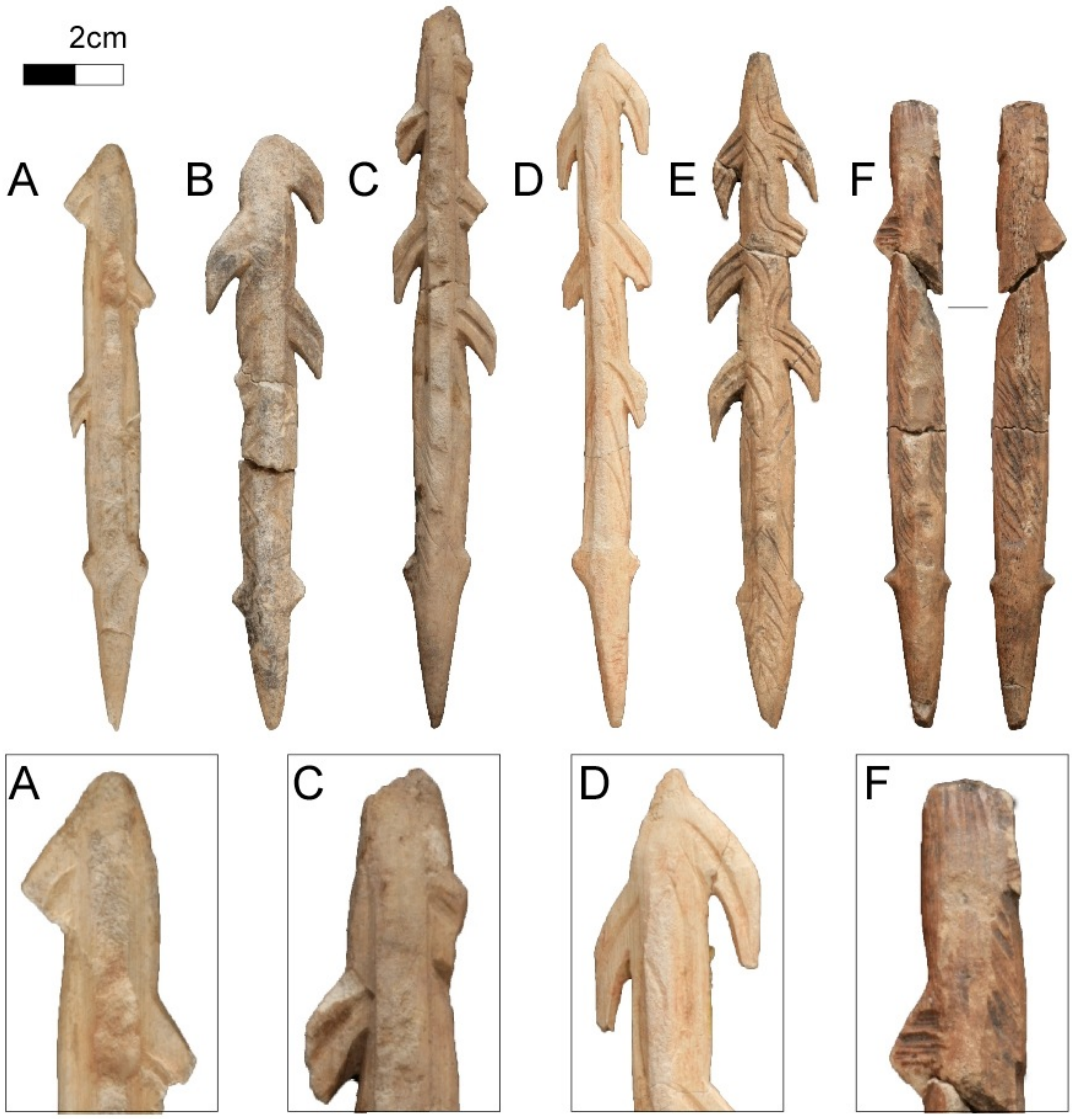


Figure 7.8: Examples of repaired bilaterally barbed points recovered from Grotte du Bois-Ragot: (A) BR5G4125; (B) BR5G4298; (C) BR5G3993&994; (D) BR5G3347; (E) BR6G4480; (F) BR6G4354.

One might tentatively extrapolate from these observations that repair to bilaterally barbed weapons at the site of Grotte du Bois-Ragot initially involved the minimal resharpening of the distal tip, followed by the removal of barbs to keep an extended (piercing) point on the weapon as long as enough length to do so remained. Once the implement became reduced to a certain length (unfortunately the nature of the fragmented dataset does not allow for an educated estimate to be made), any further rejuvenation of the distal edge involved the shaping of the more economical spatulate form tip.

Evidence for the repair of the lower sections of bilaterally barbed weapons from this site is restricted to a single instance of barb removal (away from the distal edge), and in a second case, the intentional removal of the proximal portion of a weapon through the use of the BFW method described in previous chapters.

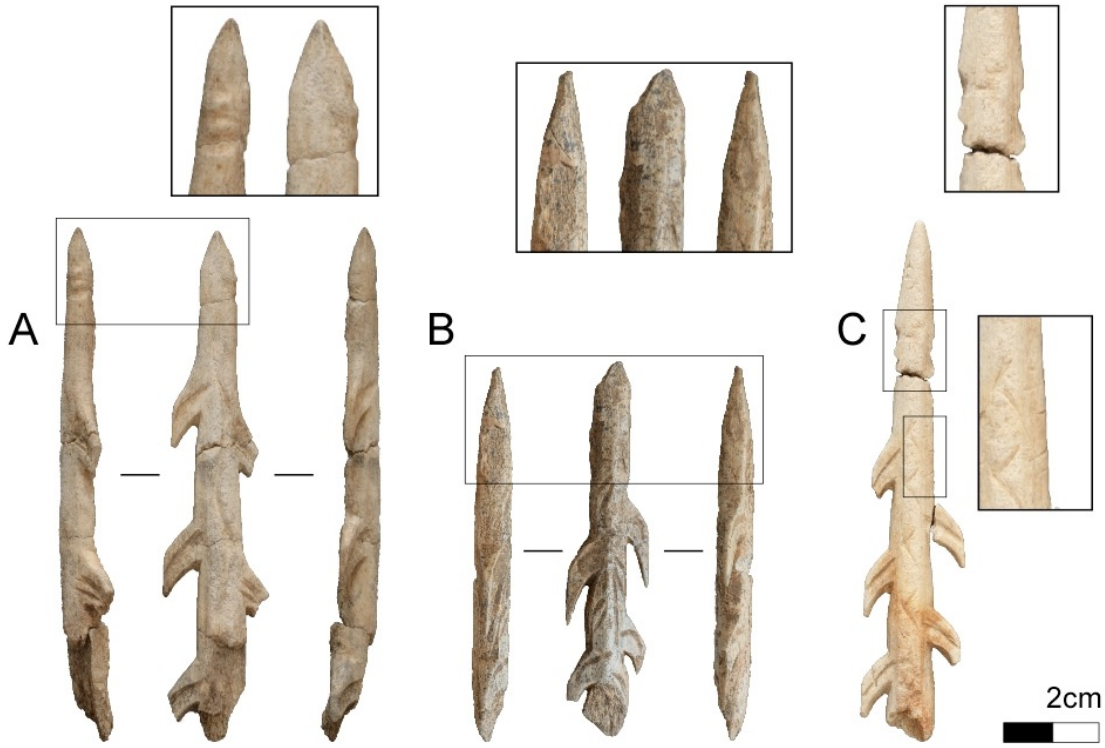


Figure 7.9: Bilaterally barbed points with rejuvenated distal points and removed barbs: (A) BR5G3615; (B) BR5F9224; (C) BR5I21094. Boxes highlight barb scars and retrieval cut marks found on the weapon tips.

If we now look at the total length of the seven 'intact' bilaterally barbed weapon tips from this site, we find that they all fall within 35 mm of each other (ranging between 112.18 and 146.76 mm). As each of these implements had undergone repair before discard, the narrow range of total length suggests that these implements were discarded having reached the common discard bracket for this site and/or region (see Chapter 8 for further discussion). More information on fracture and discard patterns at this site are unable to be drawn owing to the high incidence of post-depositional breakage.

Recycling

Out of the 89 barbed implements examined from this site, only a single, unilaterally barbed (Group A) implement appears to have been recycled during its use life. Labelled BR5H3945, this implement exhibits the severe crushing and rounding use wear to its distal extremity characteristic as having been recycled as a wedge (Figure 7.10). The proximal end has sustained a splinter fracture, which likely resulted in the final discard of this piece.

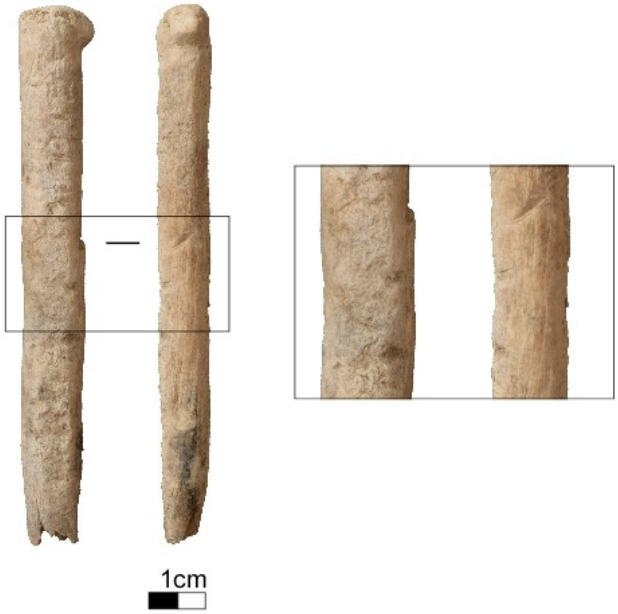


Figure 7.10: The sole recycled barbed point (BR5H3945) identified in the Grotte du Bois-Ragot assemblage.

The barbs on BR5H3945 were ground down and smoothed over, presumably as part of the reworking of this weapon for use as a wedge, though the careful and complete removal of the lower barb suggests that it was removed in maintenance of the point when still in use as a weapon tip. This grinding down of barbs as part of the reworking of a barbed point into a secondary functional tool is an approach also seen at Courbet, as described above, as well as La Vache and Isturitz.

La Madeleine (Dordogne)

La Madeleine, a large rockshelter located on the Vézère River near Tursac (Vézère Valley, Dordogne), is not only rich in osseous projectile weaponry (along with other

osseous artefacts), but is also the type site for the Magdalenian. Subjected to intensive study since its initial excavation by Lartet and Christy who first published their findings in 1875, the archaeologically recovered material for this site is spread amongst numerous museums throughout Europe (and even wider afield). For this study, the collections held in the Pitt Rivers Museum (Oxford), The British Museum (London) and the *Musée d'Archaéologie Nationale* (Saint-Germain-en-Laye, Paris) were examined. In total, 131 barbed points were available for examination and recording.

The sample examined for La Madeleine is, in the large majority, made up of bilaterally barbed points (n = 96; 73.2%) consistent with the prevalence of this technology over its unilaterally barbed counterpart in this region. However, examples of each of the five categories of barbed points (Unilaterally Barbed Groups A, B, and C and Bilaterally Barbed Groups A and B) were identified in the sample (Figure 7.11).

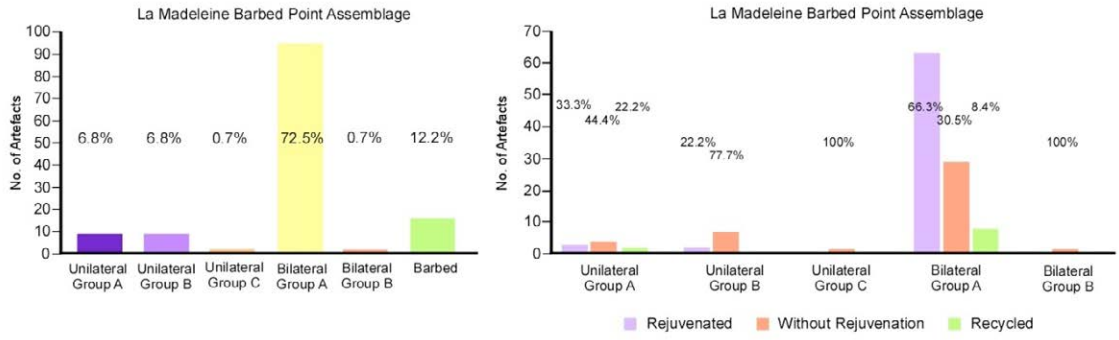


Figure 7.11: Composition of the La Madeleine barbed point dataset.

Methods of Maintenance

Evidence for the repair of the La Madeleine barbed points is common, being found on all but two of the 37 'intact' implements and five of the 26 distal-mesial fragments. Rejuvenation stigmata was also identified on one of the six unilaterally barbed mesial-proximal fragments, six of the 24 bilaterally barbed mesial-proximal fragments, and a single bilaterally barbed mesial fragment.

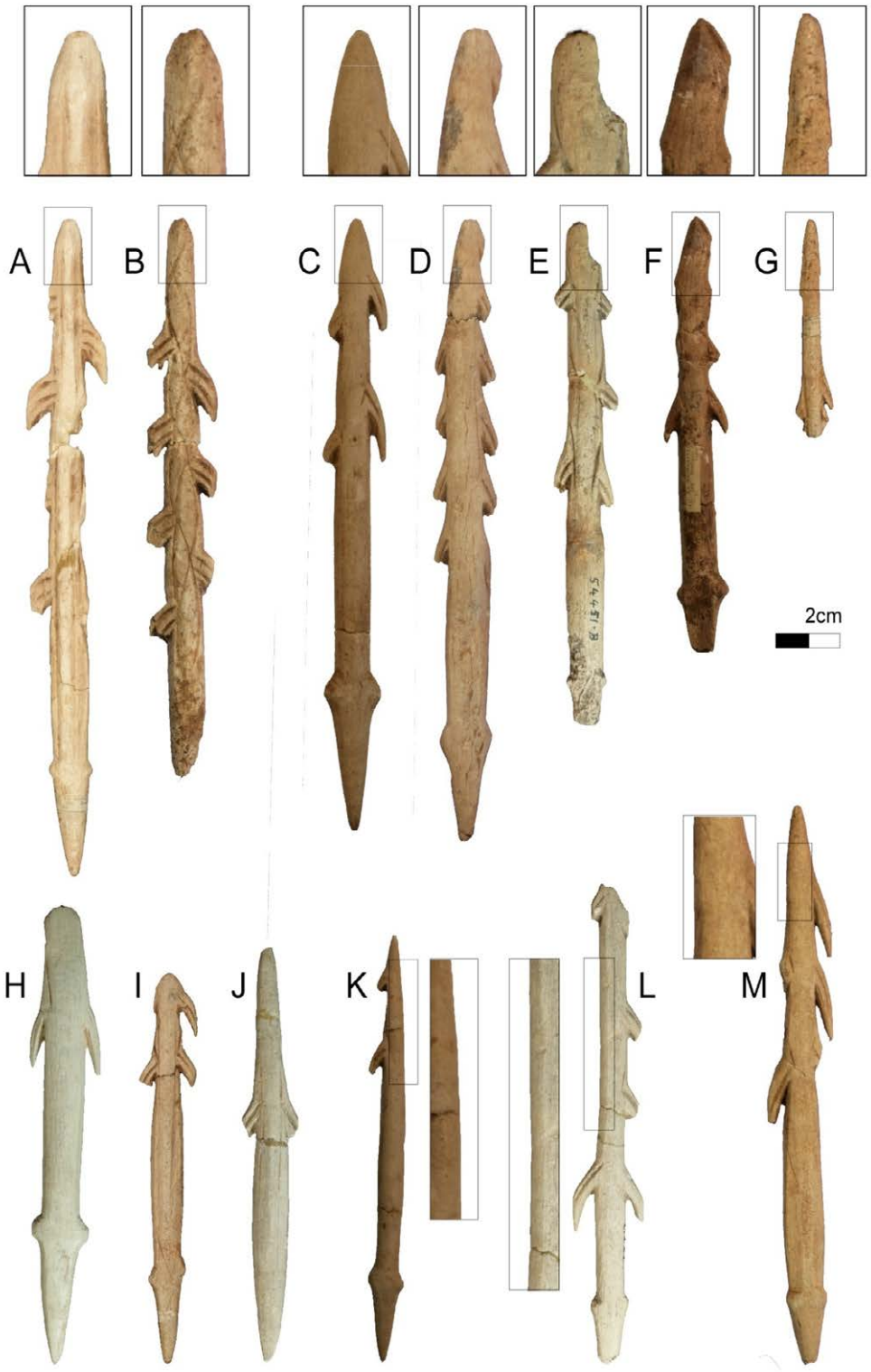


Figure 7.12: Examples of the kinds of maintenance observed on the La Madeleine bilaterally barbed points: (A) BM CC1; (B) BMCC8; (C) BM CC7; (D) BM CC4; (E) MAN 54451.B; (F) BM CC33; (G) BM CC58; (H) MAN 8171; (I) BM CC20; (J) MAN8168; (K) BM CC59; (L) MAN 21252; and (M) BM CC16.

As was found for the Grotte du Bois-Ragot barbed weapons described above, the La Madeleine bilaterally barbed dataset provides evidence that the initial repair of the distal section was aimed at prolonging the original conical section point. At this site, initial repair of the distal tip commonly involved the grinding of four, opposed facets (see examples in Figure 7.12: A and B below). This method is, perhaps, one of a few ways in which the distal tip can be resharpened while also minimising the loss of implement length: this method is also quick and easy, conceivably taking only moments to complete. This type of tip resharpening is found on 6 of the 63 artefacts which exhibited a distal extremity, and furthermore, each of these examples are found on distal sections of extended length: that is, implements whose distal sections are closer to their original length and form at the time of manufacture.

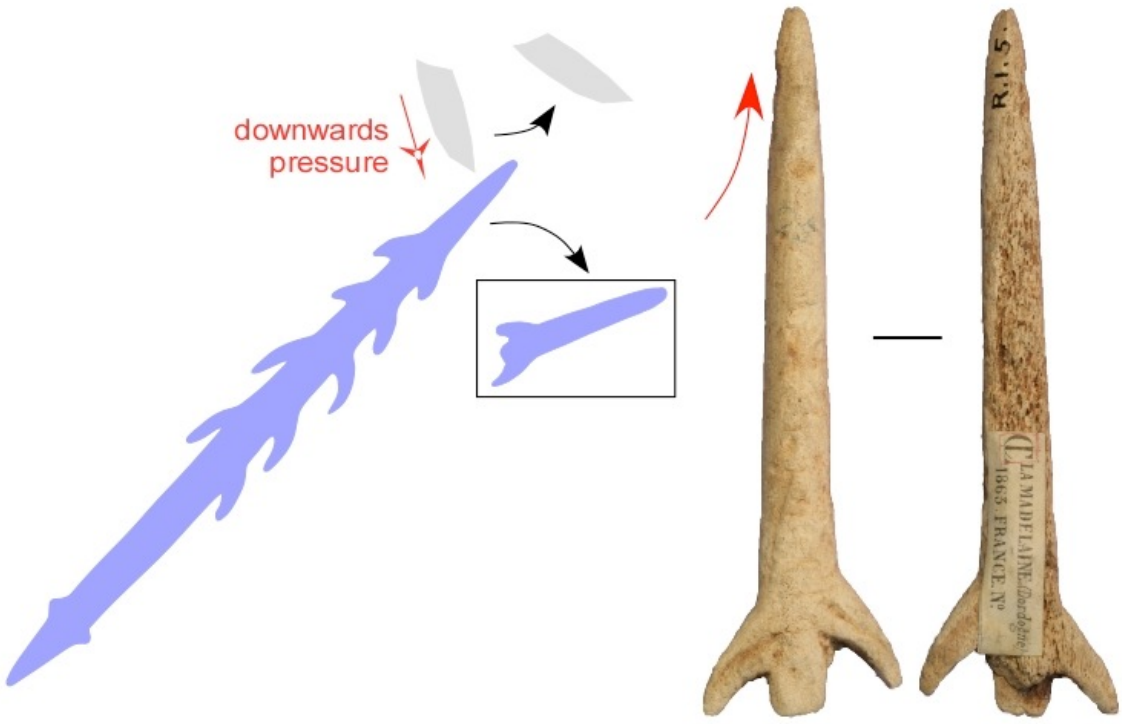


Figure 7.13: One of the three distal-mesial fragments (BM CC25) suggested to have accidentally fracture during resharpening. Note the extreme similarity of this fragment to that reported for La Vache in Chapter 5.

Two other methods of distal tip rejuvenation are present in the La Madeleine sample. Both are spatulate in design, though the first is formed through the grinding/cutting of three facets: one flat across the inferior face and two at 45 degree angles on the left and

right sides of the superior face forming a triform section. This method was observed on four implements in the sample. The other method is the commonly observed round sided spatulate form (Figure 7.12: C - F, H - I) found in the previously discussed assemblages. Within this sample, there doesn't appear to be a correlation between implement reduction and tip rejuvenation method (faceted or rounded), and thus these techniques may have been used interchangeably by the same individual or reflect different approaches to point resharpening by different individuals.

Of particular interest are three distal-mesial fragments which appear to have been in the process of having their tip resharpened before (presumably accidentally) snapping (Figure 7.13). In each of these cases, the artefact exhibits the long, conical point of the original design (BM collection: CC25 and CC85). The third artefact sports carefully removed barbs (leaving two visible barb scars) at the distal end of the implement, these barbs apparently removed in order to (re)create the extended point (Figure 7.12: G). As was described in Chapters 5 and 6 previous, distal points of weapon tips which appear to have accidentally snapped while being resharpened were also identified in the La Vache and Isturitz assemblages.

Barb scars are also commonly observed in this bilateral dataset (found on 'intact', distal-mesial, mesial and mesial-proximal fragments). There are several examples of multiple barbs carefully removed on the same implement (Figure 7.12: F - G, K - L), or only a single barb removed on the remaining portion of a reduced artefact (Figure 7.12: D, M). While a number of these cases were the result of maintenance to the distal tip (as discussed above), others (located further down the shaft) must have been undertaken in order to attend to a barb broken in use.

Finally, the base on three of the bilaterally barbed points exhibit clear signs of repair. In the first case (BM CC14), the left basal protuberance has been ground almost completely away, leaving only a slight bulge and striations from its removal. In the second case (MAN8168), both the left and right basal protuberances have been removed and the barbs-to-base section has been encroached upon in order to form a new base as evidenced by the wider and thicker section of the shaft below the opposed barbs. The

new base is conical in section (seen in Figure 7.12: J), and seems to have been extensively reworked in order to continue the use life of this projectile weapon.

The final example of a repaired base identified in the La Madeleine dataset was found on MAN54451F. In this case both the superior and inferior faces of the base (to just above the basal protuberances) have been ground smooth and flat in order to form a new double bevelled base. It is conceivable that either (a) the base on this implement had suffered damage and its conversion to a double bevel base removed this damage and allowed the points continued use; or (b) that the base had not suffered damage but, instead, its associated foreshaft/shaft was broken while its owner was in the field. Without a sufficient replacement foreshaft/shaft, the weapon tip was altered in order to fit a double bevel hafting system. Thus, this implement may provide evidence not of a damaged point being repaired, but of the breakage of an associated foreshaft/shaft. Of course, without the identification of an associated foreshaft (with damage) this suggestion can be nothing more than that.

The sample of unilaterally barbed points for this site (n = 20) also provides evidence for the maintenance of these projectile weapon tips. Three implements display a spatulate form and/or striations around their distal section indicating the resharpening of the point. One of these artefacts (MAN75692) also exhibits a barb scar and the partial erasure of decoration from the execution of this maintenance.

Interestingly, intentional fractures of the shaft (either through the bi- or unifacially fractured technique) are rare in this dataset with only two barbed implements exhibiting this kind of evidence. The first example is found on the distal end of a mesial-proximal unilaterally barbed fragment (MAN75687), and the second on a barbed point mesial fragment which may or may not have been recycled as an awl (MAN83132c4.22).

Recycling

As with the previously discussed assemblages, the recycling of implements into wedges appears to be the most common reuse of barbed projectile weapons at La Madeleine (Figure 7.14: A). Nine examples of this type of reuse were identified, with a number of

these implements (six of the nine) only exhibiting minimal use wear. One of these implements (MAN sans no. [97]), a unilaterally barbed (Group A) point, while having the distal barb ground carefully down (probably as part of the maintenance of this point) also has two barbs which were fractured in antiquity. Currently we are unable to ascertain if this double barb fracture was as a consequence of use as a projectile, or intentionally fractured to remove these features for the implements reuse as a wedge.

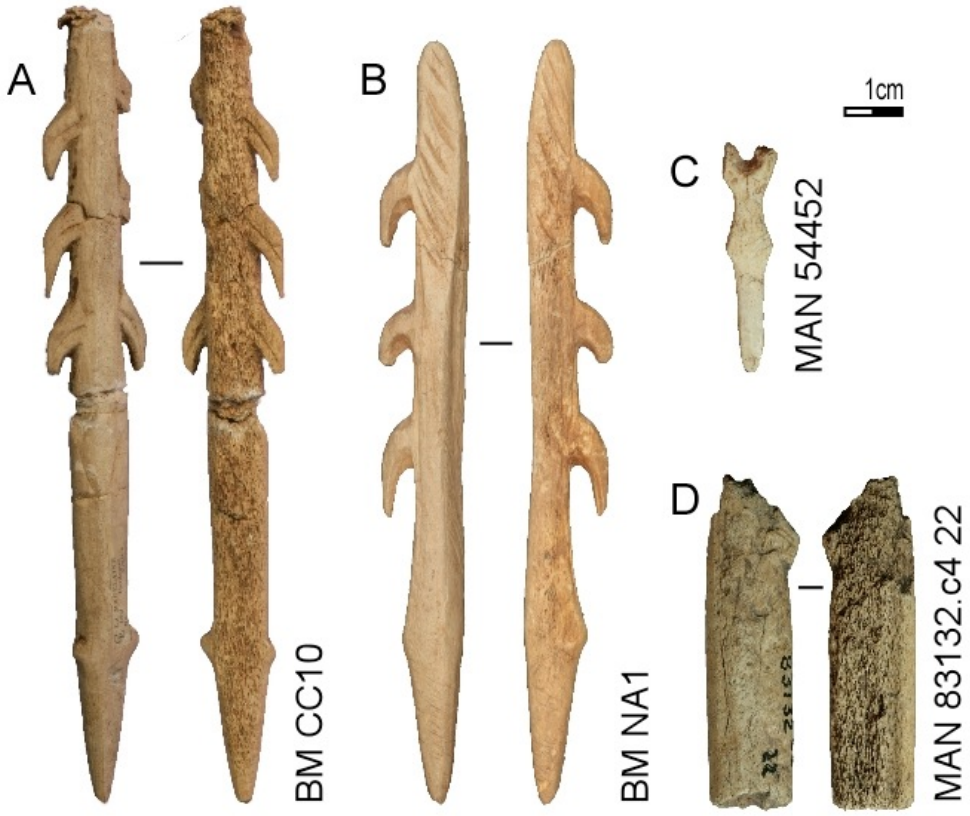


Figure 7.14: Examples of recycled barbed weaponry from La Madeleine: (A) Wedge; (B) Unknown reuse; (C) Possible pendant; (D) Possible pressure flaker or awl.

Also identified in this dataset, was the previously mentioned artefact which may have been reused as an awl or perhaps as a pressure flaker (MAN83132c4.22; Figure 7.14: D). This artefact, along with two others made on single bevel mesial-proximal fragments (see Figure 7.26 below) have had their distal extremity worked from at least three sides to form a small, piercing point. In each case, the point has been very roughly worked and is not consistent with intentionally worked fractures (where the point segment has been cut through from one or both faces to release it from a haft or target,

or to remove a damaged section). It therefore seems that these artefacts have been reworked in order to be recycled, but as to what function they were reused, the evidence is unclear.

Also found was an artefact catalogued as an pendant (‘*pendeloque’*) but which may have started its use life as a bilaterally barbed point. MAN54452, seen in Figure 7.14: C, appears to be a distal-mesial section which has been flattened on both the superior and inferior faces and its barbs smoothed over to create a thin, flat pendant. A single hole has been drilled in from one face using a circular motion. Of course it is very possible that this pendant was not originally a barbed point, but rather was only shaped to invoke the shape of one. The presence of an unbarbed point (MAN 83132.c4[328]) also with a hole drilled into its shaft (as well as possible similar unbarbed point pendants pictured in Capitan and Peyrony (1928:89, Fig. 52) supports the notion that barbed points may have been reused in this fashion. Additionally, comparison of this particular artefact with distal-mesial fragments demonstrates its similarity in overall form to projectile point fragments (for example, MAN LB54005c in Figure 7.14).

The final barbed point which was found to have been recycled was carefully reworked with considerable alteration to its distal extremity (BM CCNA1; Figure 7.14: B). Both the superior and inferior face down to 46 mm from the tip have been flattened into a double bevel before having a series of rough, oblique striations engraved into its surface. It is interesting to note, that the barbs have not been removed. As this form (bevel with striations) is a common feature of hafted sections (as found on foreshafts, the base of bevelled points, etc.), it might be tentatively suggested that this weapon tip had been altered for reuse as a foreshaft or another similarly hafted tool. Another possibility is that a lithic tip was added to the antler weapon in the fashion often observed on ethnographic North American composite harpoons. As the proximal tip does not display significant crushing and/or mushrooming, reuse as a burnisher (or similar) can be ruled out.

Laugerie-Basse (Dordogne)

Forty barbed points recovered from the Dordogne site of Laugerie-Basse and curated in MAN were examined for evidence of maintenance and/or recycling. As can be seen in Figure 7.15 below, examples of Unilateral Group A, Group B, and Group C points along with Bilateral Group A points were included in the sample, though those of the latter type were most numerous. This site also provided what appears, morphologically, to be the most complete (close to original form at the time of initial manufacture) bilaterally barbed point in the whole dataset (MAN LB8154 pictured in Figure 3.10: 32).

Evidence for the repair and recycling of barbed weaponry at this site was found on all but the Unilateral Group C points in line with the patterns presented in the other barbed point assemblages examined.

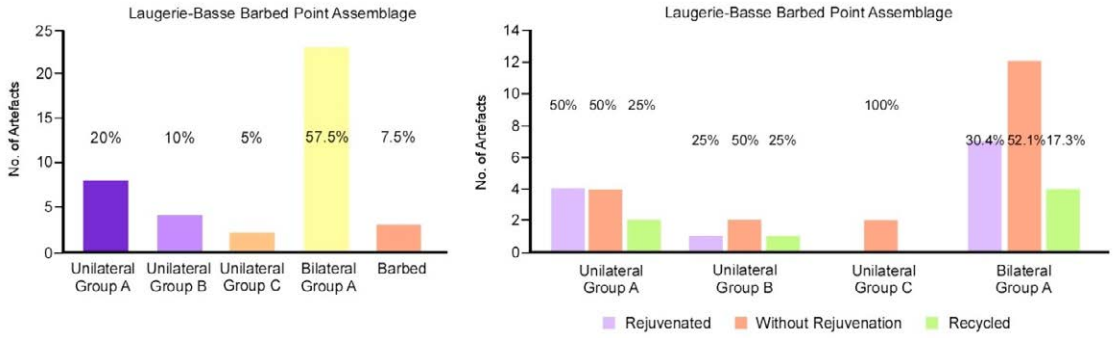


Figure 7.15: Composition of the Laugerie-Basse barbed point dataset.

Methods of Maintenance

Both the uni- and bilaterally barbed points from Laugerie-Basse exhibited evidence for rejuvenation of both the distal extremity and barbed sections of the point. Methods used to rejuvenate the distal tip include the formation of a spatulate form edge through the scraping and/or grinding of the distal section leaving the characteristic stigmata. Several examples of rejuvenated distal tips are shown in Figure 7.16 (B, C, E).

Four implements display ground barb scars on their mesial section. On the sole unilaterally barbed point example (MAN LB54231A; Figure 7.17:A), five consecutive barbs have been carefully and almost completely ground back to the shaft surface on the

implement's right side. The last and lowest barb scar appears not to have been ground, instead the surface of this scar remains the fracture surface - though it is possible that a minimal amount of grinding to the edge of the fracture was executed. As this implement was recycled as a wedge, it is possible that each of these barbs were intentionally removed to facilitate its reuse.

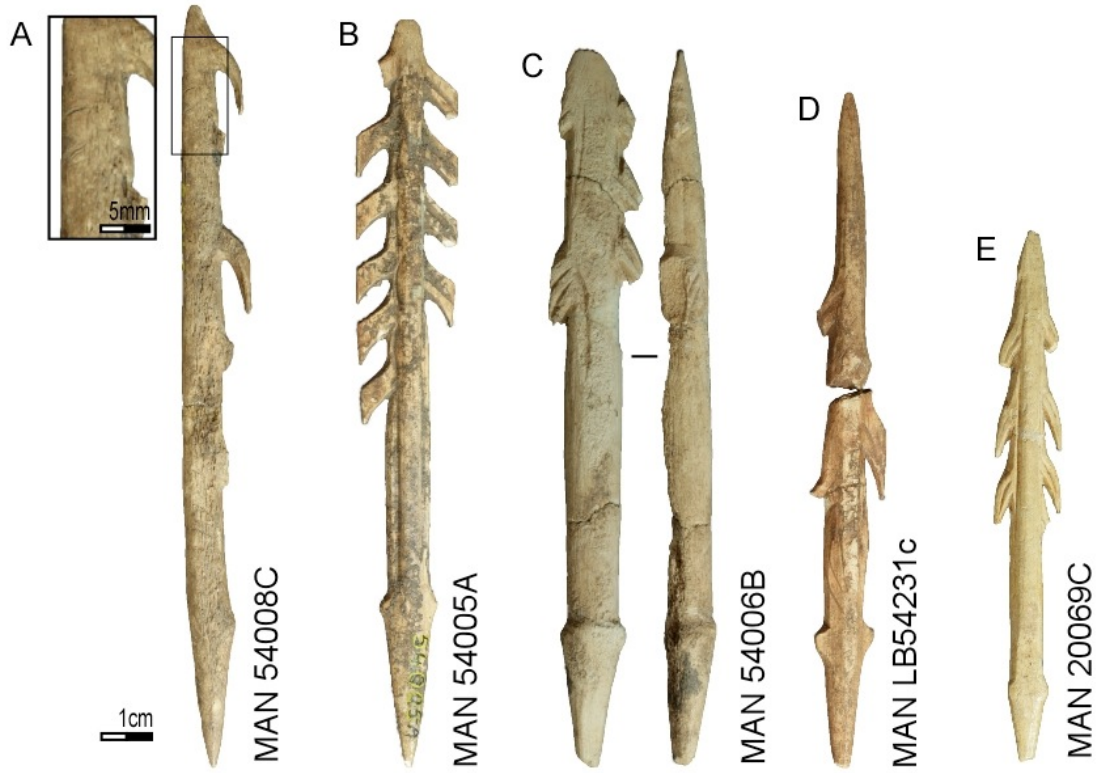


Figure 7.16: Examples of barbed points with evidence for maintenance recovered from Laugerie-Basse.

On the other three implements, the barb/s have been removed as part of the rejuvenation of the distal tip (see two examples in Figure 7.16: C and E). In each case, each barb has been carefully ground down leaving only the last couple of millimetres of their shoulder (in two cases) and the associated decoration on the shaft.

Recycling

Seven of the barbed artefacts in this small dataset displayed evidence for having been recycled. Four of these artefacts were reused as wedges (two are shown in Figure 7.17: A and C). With the exception of the above described implement (MAN LB5423A) on

which at least five barbs were removed and the proximal extremity converted into a single bevel, none of these artefacts appear to have been reworked in order to be recycled. This observation is interesting as, while all are barbed weaponry and therefore have a bulbar base, only the one weapon had its base reworked which is incongruous with the barbed weaponry recycled for this function previously presented. Nevertheless, each of these artefacts display the severe crushing and mushrooming use wear of a wedge.

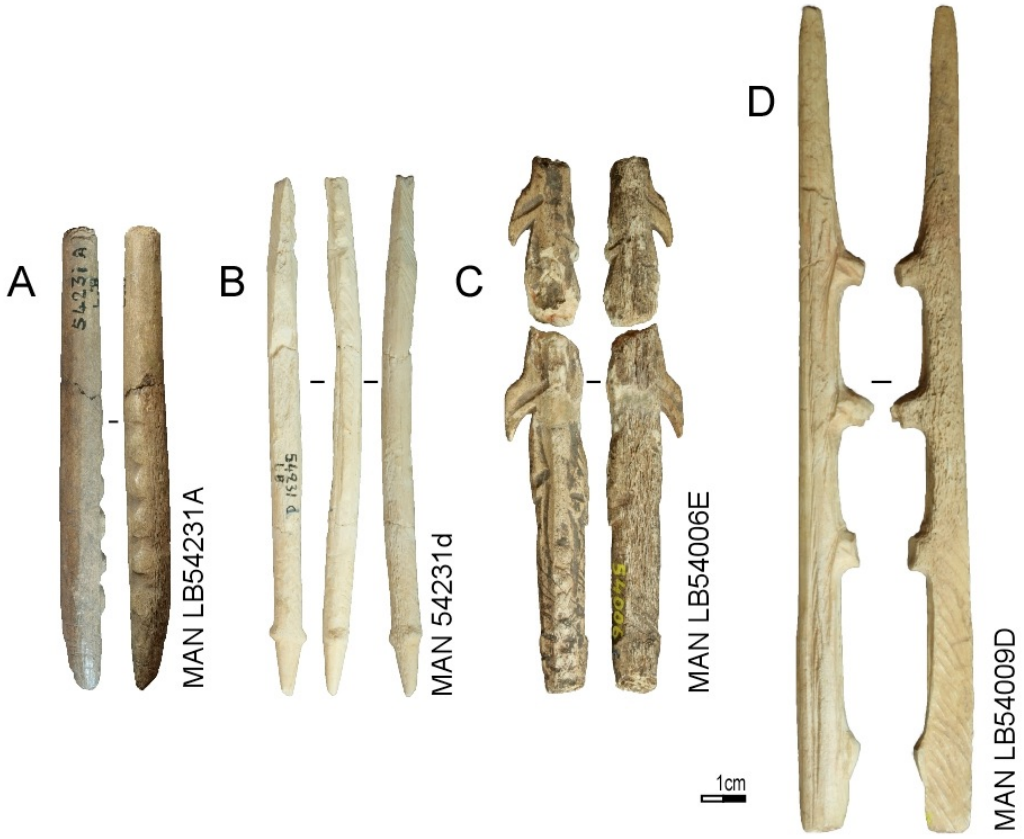


Figure 7.17: Recycled barbed points from Laugerie-Basse: (A) Wedge; (B) Unknown; (C) Wedge; (D) Barbed to bevel weapon tip.

The next recycled implement to be described is MAN LB54009D, a unilaterally barbed point which has had a long single bevel worked onto its proximal extremity. Shown in Figure 7.17: D, this artefact appears to have been transformed into a barbed but single bevel based weapon tip. The distal tip also exhibits a carefully resharpened distal point (facets on both the superior and inferior faces), along with the beginnings of a bevel fracture about 10mm from the top barb's shoulder. It might therefore be suggested that

this weapon tip was abandoned owing to this impact fracture which would have required the complete remaking of the distal tip. With a base which had already been heavily altered, this extra work appears to have been considered too extensive for this particular weapon to continue in use as a projectile point.

The final reworked and recycled barbed weapon tip from Laugerie-Basse was manufactured as a bilaterally barbed point (owing to the paired basal protuberances at the proximal end of the implement), but has been heavily reworked into another, unknown tool. Several barb scars are visible on the top of the left side, though it is uncertain how many barbs have been removed as this area has been significantly reworked. The top c.20 mm of the implement has been reworked into a double bevel with oblique striations engraved onto each of the four surfaces (superior, inferior, left and right sides). No alteration to the proximal extremity is apparent, and there is no sign of significant wear to this area. This implement was, therefore, not recycled as a wedge and with the lack of use wear we are unable to determine how it was reused. Use as a hafted pressure flaker or similar such tool may be a possible suggestion.

Barbed Point Data from the Remaining 10 Sites

The remaining ten sites from which barbed weapon tips were examined all consist of less than 40 artefacts. In fact, the largest of these assemblages numbers only 26 projectile points (Aurensan). Despite the small sample size from these additional sites, evidence for the rejuvenation of barbed weaponry was identified on 52.5% of the bilaterally barbed implements and 28.5% of the unilaterally barbed implements. The recycling of these technologies was less frequently identified but still present in the dataset.

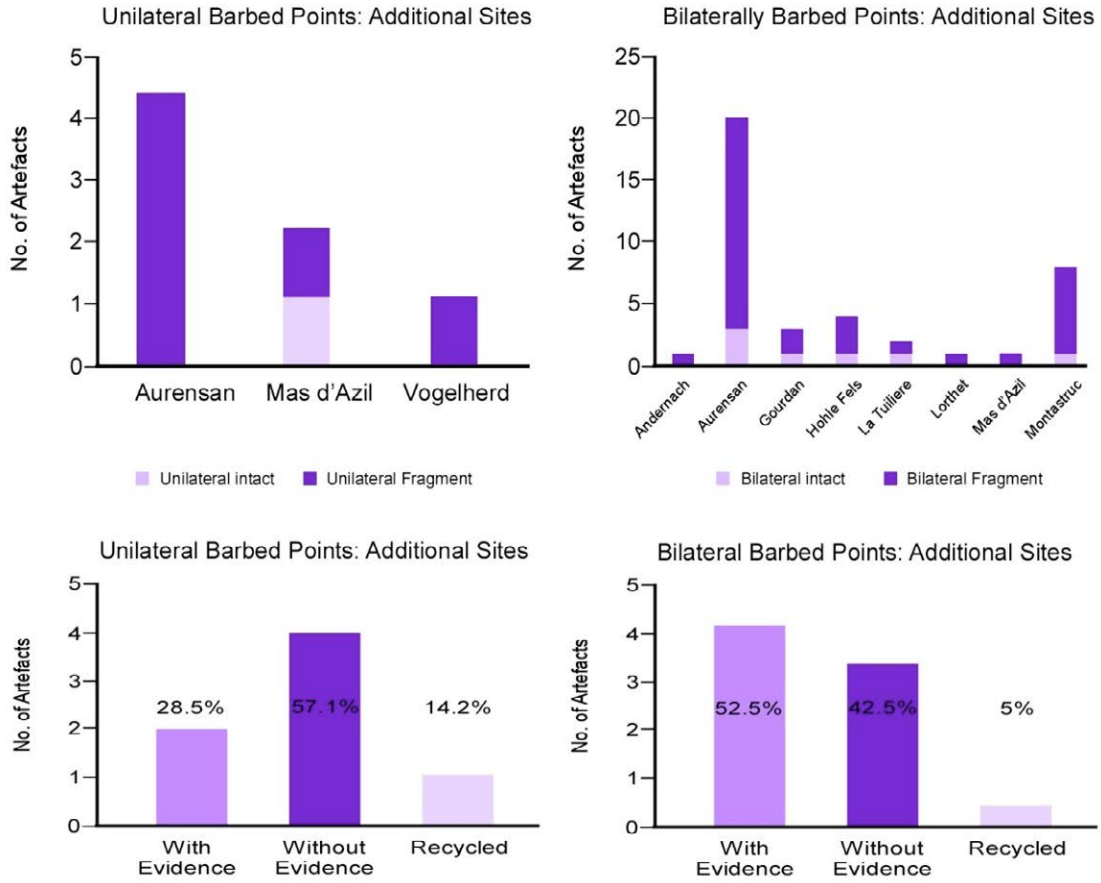


Figure 7.18: Composition of the barbed point data from the remaining 10 sites.

Methods of Maintenance

Evidence for projectile point maintenance identified in this supplementary dataset include each of the previously described stigmata (see Figure 7.19 for examples):

- Distal - mesial section: spatulate form tips generated through the scraping and/or grinding of surfaces; removal of distal barbs; the intentional removal of the distal section through the BWF or UWF technique; partial erasure of decoration;
- Mesial section: removal of barbs broken in use; partial erasure decoration;
- Mesial - proximal section: removal of barbs, remade bases; the intentional removal of the proximal section through the BWF or UWF technique.

While these additional artefacts provide few new details regarding the methods of maintenance practiced at the studied Magdalenian sites, several pieces deserve to be described in more detail.

Of the three implements available for study from Gourdan and curated as part of the Piette collection (MAN, Saint-Germain-en-Laye), only one displays evidence for point repair. MAN 48166 is an 'intact' bilaterally barbed point with symmetrical barbs (Figure 7.17: C, below). This piece has been carefully maintained with both the distal and proximal ends having seen extensive reworking. At the distal end, a single long facet is visible reaching down the inferior face to 43mm from the tip, while another on the superior surface reaches down to 34mm below the distal tip. Both the left and right sides have also been ground down so that the whole distal area is smooth and regular. Engraved decoration on the superior face of the shaft has been erased as part of this process of rejuvenation.

The proximal extremity was not as carefully worked. Each face has visible chattering which was produced when the lithic blade was scraped from the proximal tip back towards the middle of the implement. There is no sign of bulb protuberances and the lines engraved on either side of the superior face of the barbs-to-base section has been partially erased. It is likely that there was severe damage (either in the form of accumulated use wear and/or fracture) to the base of this implement which resulted in the complete reworking of the base in order to keep the tool functional. Very little use wear (very slight crushing visible) has accumulated on the distal tip of this artefact, so it seems that after seeing brief use in this transformed form the implement was finally discarded. This scenario would explain the careful maintenance of the distal tip but hasty repair of the base.

The next two implements to be described have also had their bases altered. In the first case, a small bilaterally barbed point recovered from Hohle Fels (southern Germany) has its bulbar base ground on both the superior and inferior faces to form a new double bevel base (Figure 7.19: B). Striations left over from this reworking are clearly visible on both faces. This method of continuing the use life of a barbed weapon tip (transformation of its base into a bevel form) is a technique previously noted for the Laugerie-Basse example above as well as an example identified at La Vache.

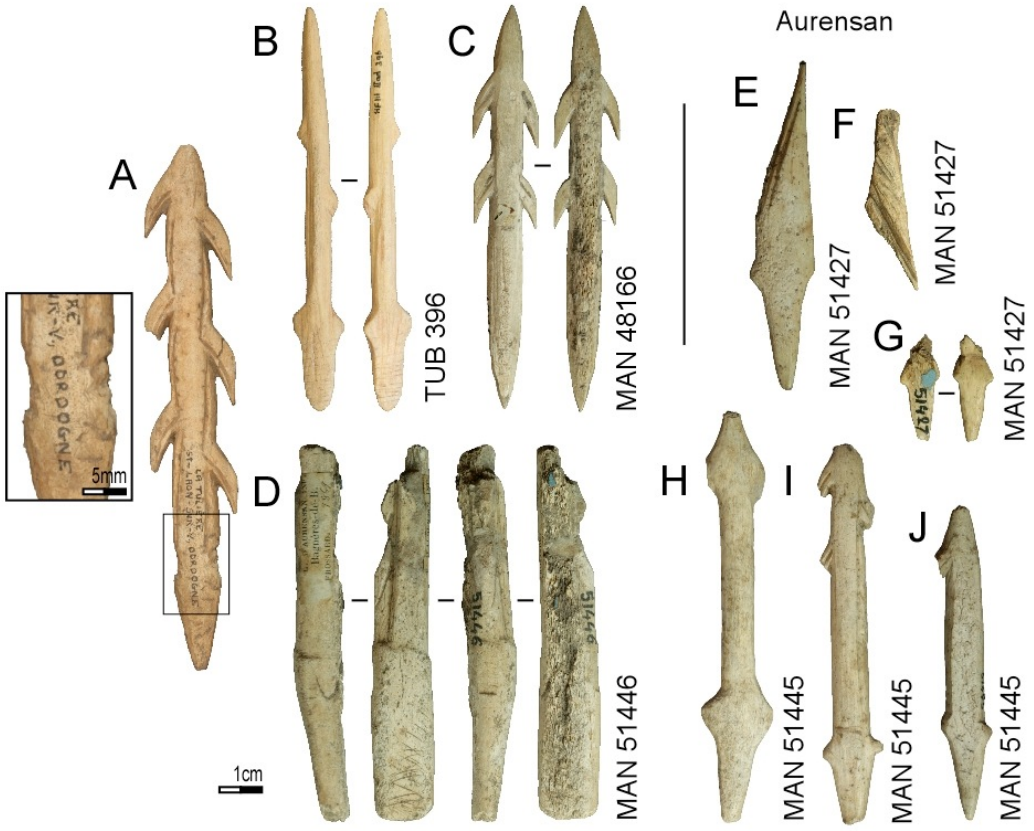


Figure 7.19: Examples of rejuvenated and reworked barbed points from the additional 10 sites: (A - C) Points with remade bases: (A) La Tulière; (B) Hohle Fels; (C) Gourdan; (D - J) Rejuvenated and reworked artefacts from Aurensan.

In the second case, a bilaterally barbed point, this time from La Tulière, has rough notches gouged out of the left and right sides of its shaft and a new bulbar base fashioned (Figure 7.19: A). The most interesting part of this work is the fact that notchers were carved into the shaft just above the new base. Remembering that there is still debate over whether or not these weapon tips were mobile (as in a harpoon) or fixed (as in a spearhead), the fact that notches were added in the place of basal protuberances suggests that a physical obstruction was required at the distal end of the base on these barbed weapon tips. The only logical explanation for these obstructions would be in relation to holding a line between the base of the point and the shaft of the weapon - and therefore - that these weapon tips were mobile harpoons. This implement was the only artefact in the entire dataset examined for this thesis which had this kind of reworking, though as has been described in earlier chapters evidence for the differential

fracturing of bevel based and barbed points also supports the theory that the latter were mobile weapon tips.

To conclude the discussion of this particular artefact, the remaking of the entire basal section suggests that the original base was either severely damaged or was entirely detached from the remaining implement, evidence of this kind of weapon fracture was also found in the La Vache assemblage.

The remaining artefacts of (particular) interest were all excavated from the Hautes-Pyrénées site of Aurensan (Figure 7.19: D - J). The first artefact is a mesial-proximal fragment of a single bevel based point which was abandoned while in the process of being reworked into a unilaterally barbed point (MAN 51446; Figure 7.19: D). Post-depositional damage to the distal extremity is clearly visible, as is the original single bevel with typical oblique striations (for aiding hafting) and crushing along the proximal edge – consistent with other bevelled simple points discussed in previous chapters. Used as a blank, this artefact provides the first clue that antler raw material was less available at this site than at other Middle to Late Magdalenian sites in the region.

The second indication that raw material or newly made barbed weapon tips were in high demand at Aurensan, is the three 'intact' bilaterally barbed point shown in Figure 7.19 (H - J) above. Each of these implements has been extensively reduced - so much so that only a single barb remains on one of these examples. The longest of these points measures only 92.9 mm in total, which is a good 10mm below the La Vache discard range and even more for the more freely discarded Isturitz assemblage. This is a pattern also reflected in the point section fragments which were found also to be short in comparison with the other examined assemblages.

Recycling

Several of the barbed points examined from these additional ten sites were also found to have been recycled, though in each case their secondary function is ambiguous. In both the cases shown in Figure 7.20 below, the barbed weapon tips appear to have been

minimally altered for reuse: the first (TUB) having striations incised across its mesial section on both the superior and inferior faces, while the second (MAN 51444 from Aurensan) has had a bevel created at its distal extremity (inferior face) and striations added to the new bevel face. It is clear that the latter artefact was hafted from what was originally the distal extremity, while the smaller Vogelherd artefact may have been hafted across its middle section. It might be tentatively suggested that the Aurensan artefact was reused as a pressure flaker (or similar) owing to the nature of re-hafting, the use of the previously proximal tip and accumulated crushing use wear. The Vogelherd implement, however, may have been reused as a fish gouge based on its size and the apparent hafting of its mid-section, though other suggestions are just as likely.

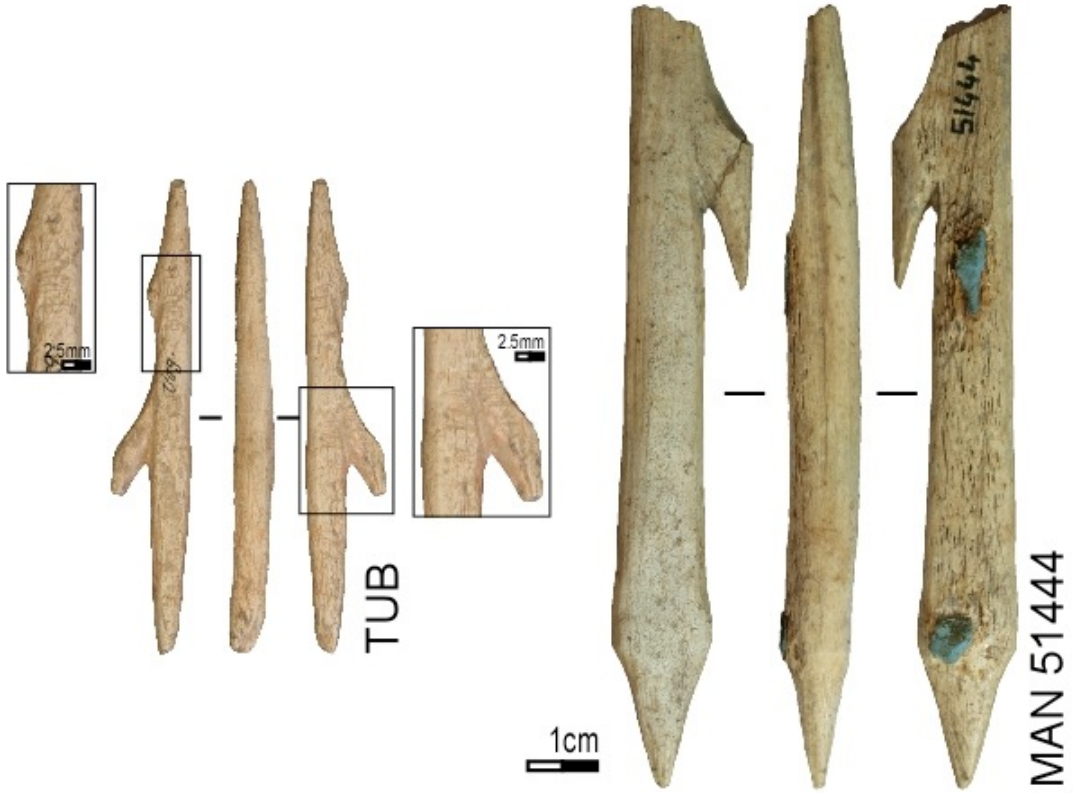


Figure 7.20: Two of the recycled barbed points in the additional sites dataset: (Left) Vogelherd: Possible fish gouge?; (Right) Aurensan: Possible pressure flaker.

Finally, MAN 51427 also from Aurensan (Figure 7.19: E, above), may have been recycled as an awl for two reasons: (1) the new distal tip formed by the cutting away of the mesial section is of a size consistent with awl tips, and (2) the new distal tip has

both crushing and rounding which are consistent with the use of an awl. Another possibility is reuse as a pressure flaker which would also produce this type of use wear.

Unbarbed Points

An additional 873 unbarbed and bevelled points were examined from 12 sites mostly located in central France, though sites as far north as southern Germany were also included (Figure 7.22). The largest sample was taken from La Madeleine (n = 325), though it is far from the whole collection of artefacts recovered from the Dordogne site. As can be seen in Figure 7.21 below, the remaining assemblages examined are significantly smaller in size: the next largest sample having only 112 artefacts examined (Andernach-Martinsberg and Chaire-à-Calvin respectively). Half of the sites in this dataset had below 50 artefacts available for study.

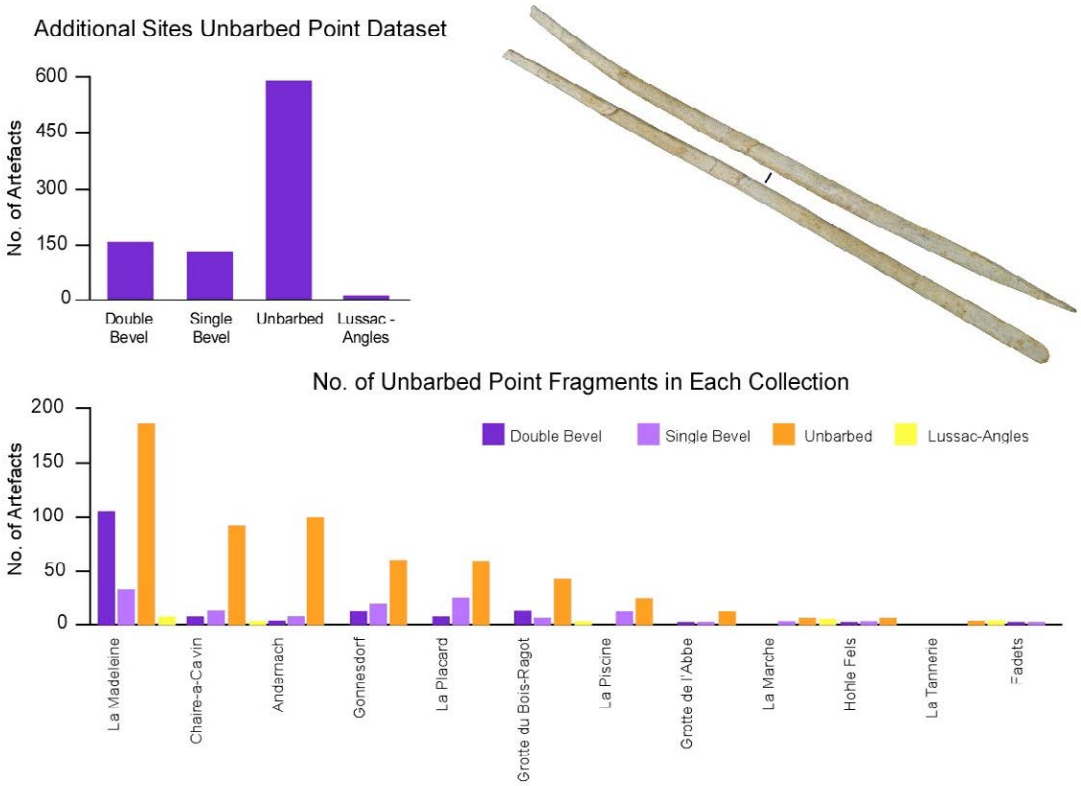


Figure 7.21: Composition of the additional unbarbed and bevel based point dataset.

As mentioned in the introduction to this chapter, while the Andernach-Martinsberg and Gönnesdorf collections were examined in their entirety, each collection has suffered

severely from post-depositional processes minimising the amount of data on osseous projectile point maintenance and discard that can be collected. Consequently, these collections will be discussed along with the sub-sampled assemblages which make up the remainder of this supplementary dataset.

In total, an additional 157 double bevelled, 118 single bevelled, 16 Lussac-Angles, and 582 fragments of unbarbed projectile points were examined and recorded (Figure 7.21). As these artefacts were either only a small part of much larger assemblages and/or degraded to the point where identification of point typology (let alone use wear, etc.) could not be confidently identified, statistics on assemblage composition was impossible. Thus, observations were restricted to the types and range of maintenance techniques identified and tentative suggestions concerning the total length of implements at time of discard.

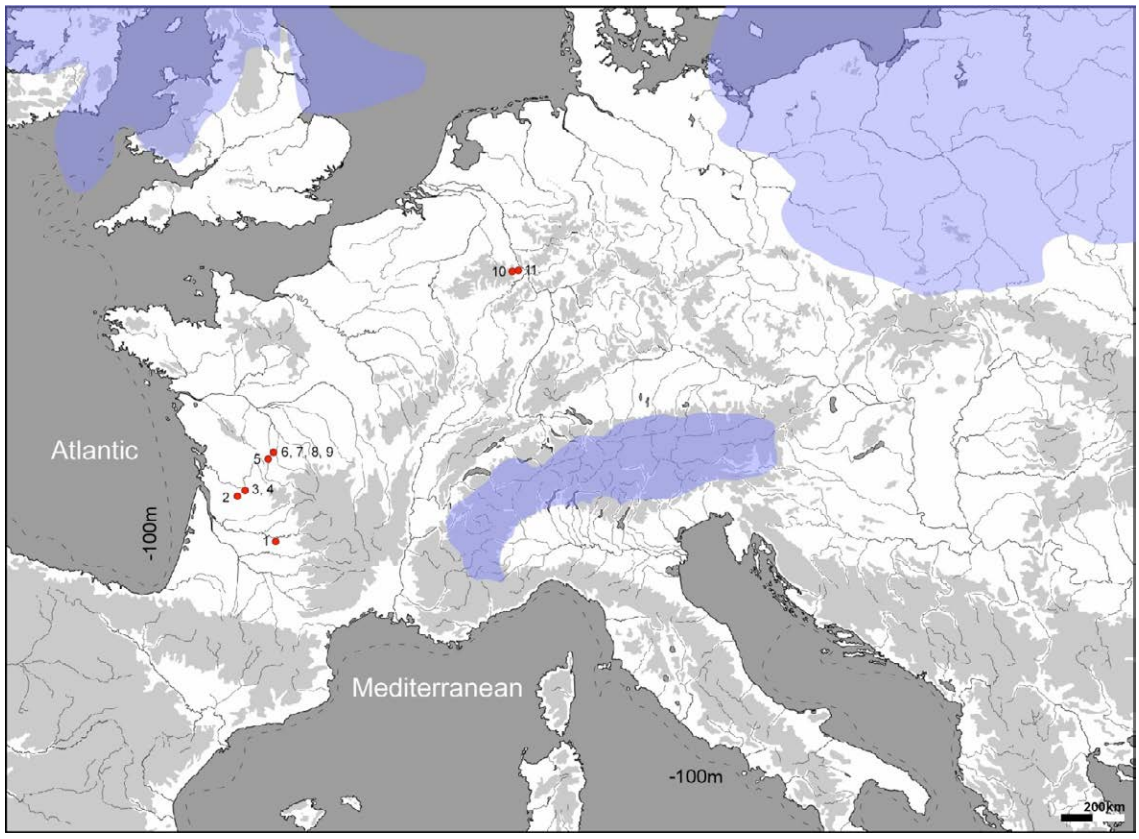


Figure 7.22: Geographical distribution of the thirteen sites for which additional unbarbed point data was collected: (1) La Madeleine; (2) Chaire-à-Calvin; (3) La Placard; (4) Grotte de l'Abbé; (5) Grotte du Bois-Ragot; (6) La Piscine; (7) Grotte de La March; (8) Fadets; (9) La Tannerie; (10) Gonnesdorf; and (11) Andernach-Martinsberg.

Methods of Maintenance

Evidence for the maintenance of bevelled and unbarbed points identified in these additional 12 site samples included each and every type which had been found in the larger assemblages of La Vache and Isturitz. Distal tips were resharpened using the scraping and/or grinding of the point surfaces, leaving facets, striations and uneven sections (see Figure 7.23 for examples). Also identified was another example of a distal-mesial fragment which had accidentally fractured during repair (Figure 7.23: B), this time from Grotte du Bois-Ragot. This latter artefact displays the now recognisable beginnings of tip rejuvenation (change in point axis, facets, undercut distal section) and splinter fracture of the proximal extremity.

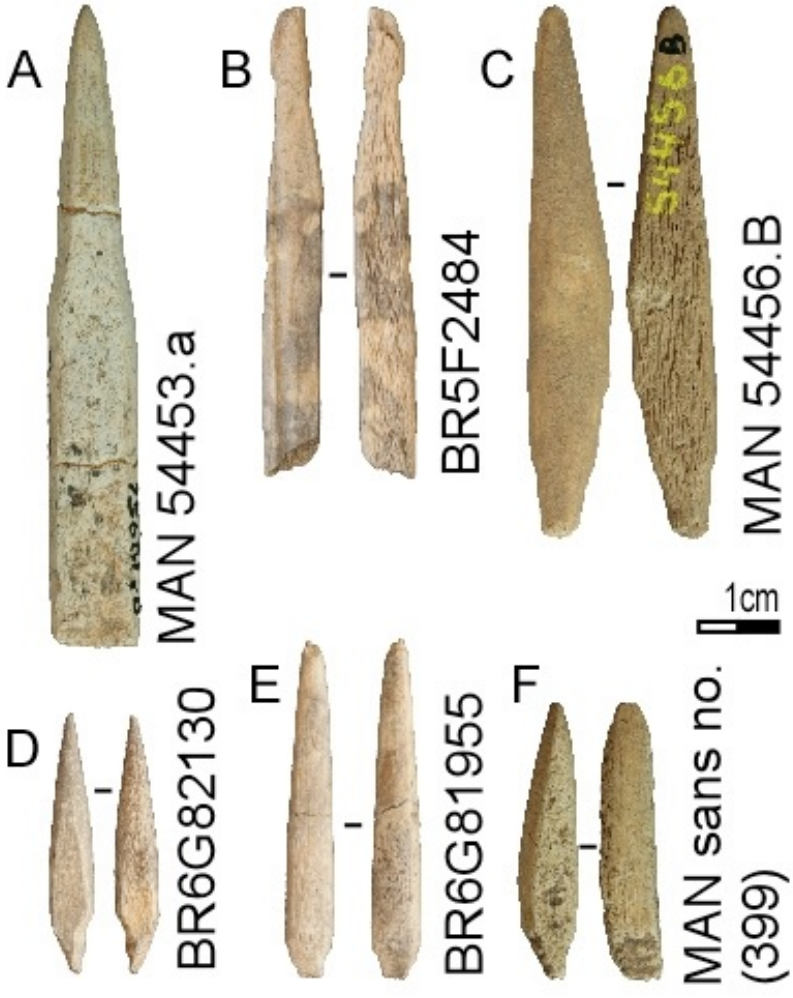


Figure 7.23: Examples of rejuvenated and intentionally removed distal-mesial fragments found within the additional 12 examined assemblages: (A) Facets and an uneven section; (B) Another example of a distal tip accidentally snapped during maintenance; (C - F) Intentionally detached distal-mesial sections. (A, C, F) La Madeleine; (B, D, E) Grotte du Bois-Ragot.

Numerous examples of intentionally detached distal-mesial sections, either through use of the BWF or UWF technique, were identified (total n = 37). The technique used at each site was extremely similar, though some sections were more carefully detached than others (compare Figure 7.23: E with C). Owing to the small number of intentionally detached distal-mesial fragments identified in the site samples, statistical comparison of their total length was unable to be undertaken. However, the available data do demonstrate that distal-mesial fragments of various sizes ranging from under 10 mm and up to almost 90 mm were extracted across the entire dataset (Table 7.2).

As was found for the distal-mesial extremity, both the fracture patterns and maintenance to the proximal extremity of these bevel based points mirrored those artefacts observed in the La Vache and Isturitz assemblages. Impact fractured bases were found in many of these collections (examples shown in Figure 7.24: A - C), with several examples indicating that the fractured base was (at least) partially the reason for the weapons discard (Figure 7.24: D pictures such an example from La Madeleine).

Table 7.2: Distal-mesial fragment length for the additional site samples: impact fractured pieces and intentionally detached fragments.

Site	Fragment Type	Distal - Mesial Fragment Length	Number of Artefacts
La Madeleine	Impact Fractured	30.76 - 232.31 mm	19
	BWF/UWF Fragment	34.21 - 75.94 mm	8
Grotte du Bois-Ragot	Impact Fractured	130.08 mm	1
	BWF/UWF Fragment	9.92 - 69.62 mm	16
Andernach - Martinsberg	Impact Fractured	105.22 - 154.79 mm	2
	BWF/UWF Fragment	13.06 - 44.93 mm	3
Gönnesdorf	Impact Fractured	25.39 - 106.92 mm	7
	BWF/UWF Fragment	10 - 42.84 mm	4
Hohle Fels	Impact Fractured	45.52 mm	1
	BWF/UWF Fragment	NA	NA
Chaire-à-Calvin	Impact Fractured	30.42 - 62.17 mm	4
	BWF/UWF Fragment	31.92 - 51.25 mm	4

Site	Fragment Type	Distal - Mesial Fragment Length	Number of Artefacts
La Placard	Impact Fractured	40.78 - 169 mm	10
	BWF/UWF Fragment	57.41 - 89.7 mm	2
Grotte de l'Abbé	Impact Fractured	25.84 - 124.48 mm	2
	BWF/UWF Fragment	17.63 mm	1
La Piscine	Impact Fractured	30.53 - 96.91 mm	7
	BWF/UWF Fragment	16.64 - 83.46 mm	8

Bases which had been remade were also identified. Interestingly, while most of these remade bases were reworked using a very similar (if not the same) manner to those described for La Vache and Isturitz (Figure 7.24: E and H), most of those found in the La Madeleine collection were constructed differently.

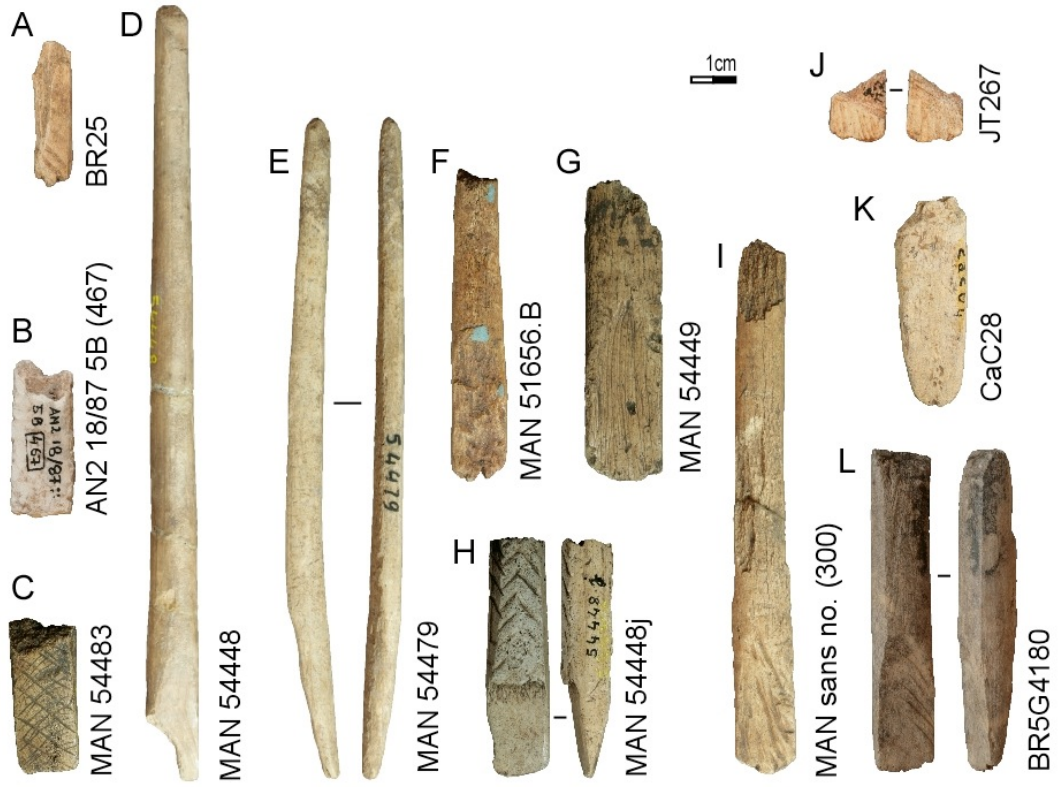


Figure 7.24: Examples of base fracture and remade bases found in the additional sites dataset of unbarbed points: (A - D) Examples of normal basal fracture patterns; (E - I) Remade bases; (J - L) Intentionally removed mesial-proximal sections. (A, L) Grotte du Bois Ragot; (B) Andernach-Martinsberg; (C - I) La Madeleine; (J) Gönnesdorf; (K) Chaire-à-Calvin.

As the examples in Figure 7.24 (F, G, I) show, these secondary bases from La Madeleine were roughly 'hacked out' leaving a very roughly hewn single or double bevel base. Oblique striations were not added to the surfaces of the bevel, though the chattering and 'strong' striations from their creation would have acted in the same manner. It might be suggested that additional striations for hafting were not necessary, and thus, not added. This 'hacking' style of base reworking is a type unique to the La Madeleine collection, and further examination of site assemblages is required to determine if it is truly unique to the individual site, to a wider area (group of sites) or a region. That this method of base recreation was not identified in any of the other Dordogne sites from which material was examined in this study is interesting, though may simply be a result of sample size effect (too small a sample for all characteristics to appear).

Table 7.3: Single bevel mesial - proximal and 'intact' fragment length for the additional site samples: impact fractured pieces and intentionally detached fragments.

Site	Fragment Type	Mesial - Proximal Fragment Length	Number of Artefacts
La Madeleine	Impact Fractured	56.93 - 145.49 mm	14
	BWF/UWF Fragment	NA	NA
Grotte du Bois-Ragot	Impact Fractured	96.3 mm	1
	BWF/UWF Fragment	NA	NA
Andernach - Martinsberg	Impact Fractured	59.4 - 140.82 mm	2
	BWF/UWF Fragment	45.81 mm	1
Gönnesdorf	Impact Fractured	16.67 - 198.15 mm	12
	BWF/UWF Fragment	42.02 mm	1
La Placard	Impact Fractured	76.51 - 170.32 mm	12
	BWF/UWF Fragment	63.41 - 65.09 mm	2
Hohle Fels	Impact Fractured	85.86 - 196.22 mm	2
	BWF/UWF Fragment	NA	NA
Grotte de l'Abbé	Impact Fractured	29.9 - 260.94 mm	3
	BWF/UWF Fragment	NA	NA

Intentionally fractured mesial-proximal fragments were also found in seven of the 12 additional site collections (see examples in Figure 7.24: J - L). Like the distal-mesial fragments described above, how carefully this process was undertaken and which method was used (bifacially or unifacially worked) appears not to be clearly linked to inter-site or regional differences, instead appearing to be more the result of individual preference and workmanship. These detached proximal pieces range in length between 15.21 and 83.78 mm, with the single bevelled dataset having a tighter range (between 42.02 and 65.09 mm) (Tables 7.3 and 7.4). Again, too few data points are available from any of these sites to undertake any meaningful statistical analysis.

Table 7.4: Double bevel mesial - proximal fragment length for the additional site samples: impact fractured pieces and intentionally detached fragments.

Site	Fragment Type	Mesial - Proximal Fragment Length	Number of Artefacts
La Madeleine	Impact Fractured	33.83 - 217.33 mm	55
	BWF/UWF Fragment	50.75 - 69.69 mm	2
Grotte du Bois-Ragot	Impact Fractured	206.02 mm	1
	BWF/UWF Fragment	66.48 - 83.78 mm	2
Andernach - Martinsberg	Impact Fractured	62.41 - 62.6 mm	2
	BWF/UWF Fragment	NA	NA
Gönnesdorf	Impact Fractured	17.4 - 146.43 mm	9
	BWF/UWF Fragment	15.21 - 55.22 mm	2
La Placard	Impact Fractured	53.58 - 110.97 mm	2
	BWF/UWF Fragment	NA	NA

Despite the incomplete and worn nature of these collections, the appearance of implements which were discarded while still retaining significant length provide some suggestions regarding the intensity of projectile point reduction at each of these sites (Tables 7.3 and 7.4). To begin, a number of the 'intact' and mesial-proximal fragments of bevel based points in the La Madeleine collection retain a length of more than 100 mm at time of discard (single bevel: 8/30 fragments; double bevel: 37/100), with several

artefacts being a great deal longer than 100 mm (reaching up to 217.33 mm in total length). The distal-mesial fragments from this site also reach extensive lengths (impact fractured: 232.31 mm; post-depositionally fractured: 254.21 mm), the shortest impact fractured fragment measuring 30.76 mm. These data, while incomplete, nevertheless indicate that unbarbed weapon tips which retained significant length and may have been further reduced through maintenance and use cycles were discarded at La Madeleine.

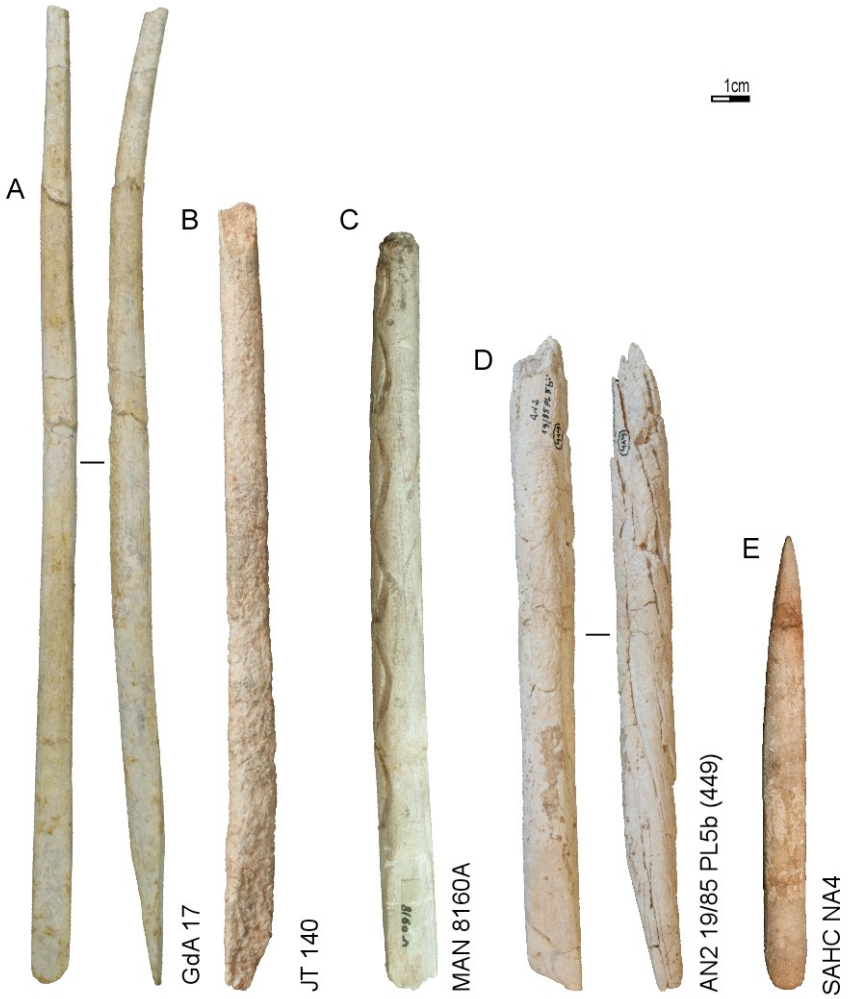


Figure 7.25: Several examples of the longest and/or most 'intact' unbarbed points identified in the additional 12 examined assemblages: (A) Grotte de l'Abbé; (B) Gönnesdorf; (C) La Madeleine; (D) Andernach-Martinsberg; (E) La Placard.

Similar implement total length results were found for the Grotte du Bois-Ragot, Grotte de l'Abbé, Gönnesdorf, Andernach-Martinsberg, and La Placard collections (see several examples of lengthy implements in Figure 7.25). In each collection, the discarded

weaponry had mean values higher than those for the remaining seven collections. Again, while these are not complete assemblages and statistical analyses cannot be confidently undertaken, these coarse differences in discarded implement length may indicate inter-site or regional differences in discard behaviour. These observations will be discussed in more detail in the following chapter.

Recycling

As was found for the La Vache and Isturitz assemblages, the recycling of unbarbed and bevel based points into wedges was found to be the most common reuse of these projectile points across the entire supplementary dataset. For the largest collection examined (La Madeleine), twenty-four of the unbarbed point fragments displayed use wear consistent with reuse in this manner. Additionally, it was observed that a significant number of these recycled wedges from La Madeleine have intricate and carefully executed decoration along their shafts (n = 13) (see examples in Figure 7.26 below). Considering the amount of time and (often) skill required to execute these decorations, it is interesting that these implements were withdrawn from their projectile point use life long before exhaustion and recycled into a high impact - short use life tool. While it is logical to conclude that decorated points which can no longer function as weaponry may be preferentially selected for a secondary use life, the withdrawal of these items from their primary use long before exhaustion is intriguing. One of the most conspicuous suggestions for this behaviour is that there was no shortage of newly manufactured projectile points, and thus these technologies could be retired from their primary function early in the reduction process.

Projectile points recycled as wedges that exhibited decoration were also identified in the Grotte du Bois-Ragot and La Placard collections, suggesting that the preference for recycling decorated artefacts found in the larger assemblages examined may be a wider spread phenomenon during this period.

Bevel based points were also found to have been reworked into pointed objects which may have functioned as awls, pressure flakers or some such similar tool (Figure 7.26: G and H). These artefacts were found not only to have a tip with similar dimensions to

identified awls from these same sites (see an example of a bone awl recovered from La Madeleine in Figure 7.26: I), but also to display use wear consistent with this type of repetitive pressed use (crushing, chipping, mushrooming, etc.).

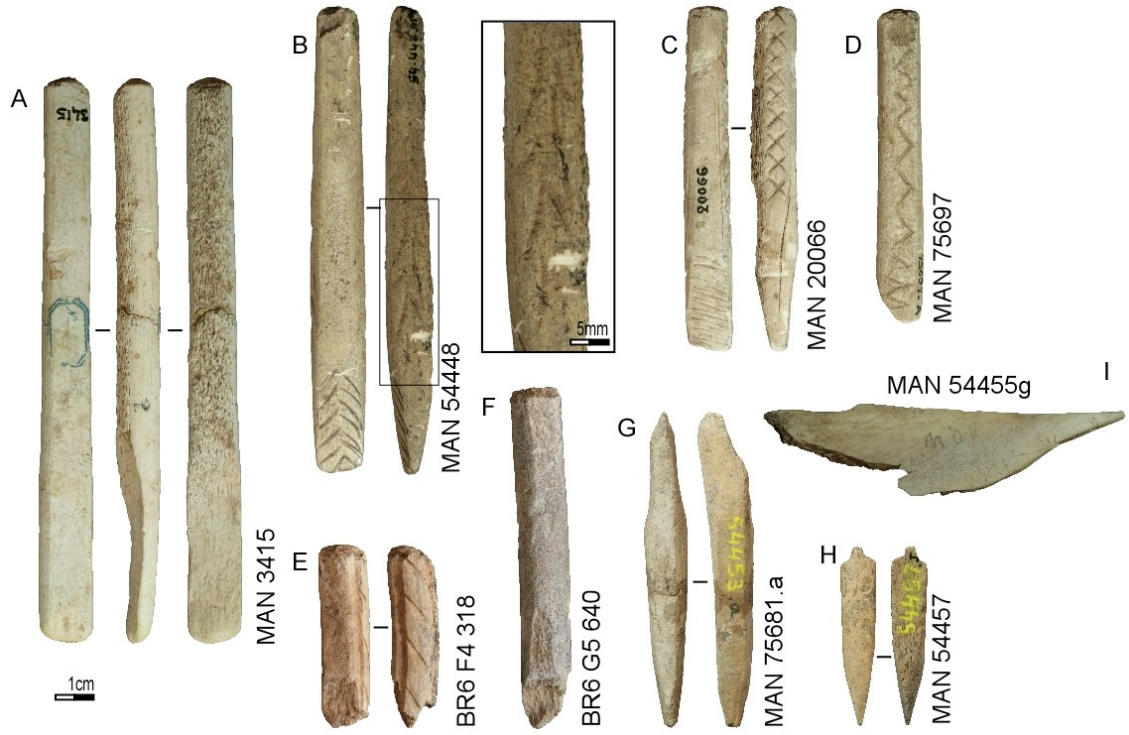


Figure 7.26: Examples of recycled unbarbed points identified in the additional 12 examined assemblages: (A) Spoon or spatula; (B - F) Wedges; (G, H) Possible pressure flaker; (I) Bone awl. (A - D, G - I) La Madeleine; (D - F) Grotte du Bois-Ragot.

Also found were several artefacts which appear to have been transformed into spoons or spatulas. Two such examples were identified in the La Madeleine sample (see MAN 3415 in Figure 7.26: A, above), and on both artefacts a segment has been ground away to form a concavo-convex section at the proximal end of the implement. The distal extremity, on the other hand, has been rounded to a smooth surface. These artefacts are similar to the transformed barbed weaponry described from Courbet (Figure 7.6) and La Vache above, all of which may have been reused in a similar function.

Table 7.5: Types of recycled unbarbed points identified and locations recovered.

Type of Reuse	Sites
Wedge	La Madeleine, Grotte du Bois-Ragot, La Placard; Gönnesdorf
Pressure Flaker (?) or awl (?)	La Madeleine
Spatula	Gönnesdorf, La Madeleine

Summary

These supplementary data collected from an additional 23 sites spread throughout France and southern Germany provide the beginnings of an inter-regional comparative dataset. While the examined collections was either severely impacted by post-depositional processes resulting in the erasure of use wear and/or maintenance stigmata, or only small sub-samples of much larger assemblages, ample evidence for the rejuvenation of both barbed and unbarbed projectile points was identified. Of particular interest was the identification of a method of base recreation practiced at La Madeleine which is different to those practiced at La Vache, Isturitz and the other 11 site from which bevel based points were examined.

Multiple reworked and recycled implements were also identified in many of these collections, demonstrating that the reuse of antler projectile weaponry into various domestic technologies is a behaviour commonly practiced throughout the Magdalenian region.

These data along, with those presented in Chapters 5 and 6, will now be compared and contrasted in the following chapter.

Chapter 8: Inter-Site and Inter-Regional Comparisons

Introduction

Presented in the preceding three chapters were the analysis results for the examination of 25 Middle to Late Magdalenian osseous projectile point assemblages. Ample evidence for Magdalenian maintenance, recycling and discard behaviours were identified in the La Vache and Isturitz assemblages, as did the 23 additional site samples despite their small size or state of preservation.

In this chapter, the repair methods, recycling behaviours and discard behaviours identified within the assemblages recovered from these 25 sites will be compared and contrasted in order to explore the possibility of inter-site and/or inter-regional differences. Following this comparison, data which may provide insights into Magdalenian social organisation will be discussed in order to demonstrate the advantages of articulating technological data to social aspects in the Magdalenian context.

Inter-Site and Inter-Regional Comparisons of Maintenance Activity, Recycling and Discard Patterns.

As described in Chapter 4 ('Methods and Methodology'), each of the sites from which assemblages were examined were organised into regional groupings - referred to here as 'zones'. Zones I to VII are spread over a 1000 km long area between the Pyrenees and the Rhine, and include between one and nine sites depending on the sample that was available for study (Figure 8.1). While the collected data do appear to provide early indications of regional differences in maintenance and discard patterns (which will be outlined below), it must be remembered that the small sample sizes examined (which are a product of the time and length constraints of a D.Phil. thesis) have likely impacted the richness of results. Thus, these observations provide only a starting point for the construction of detailed interpretations of Magdalenian technological behaviour.

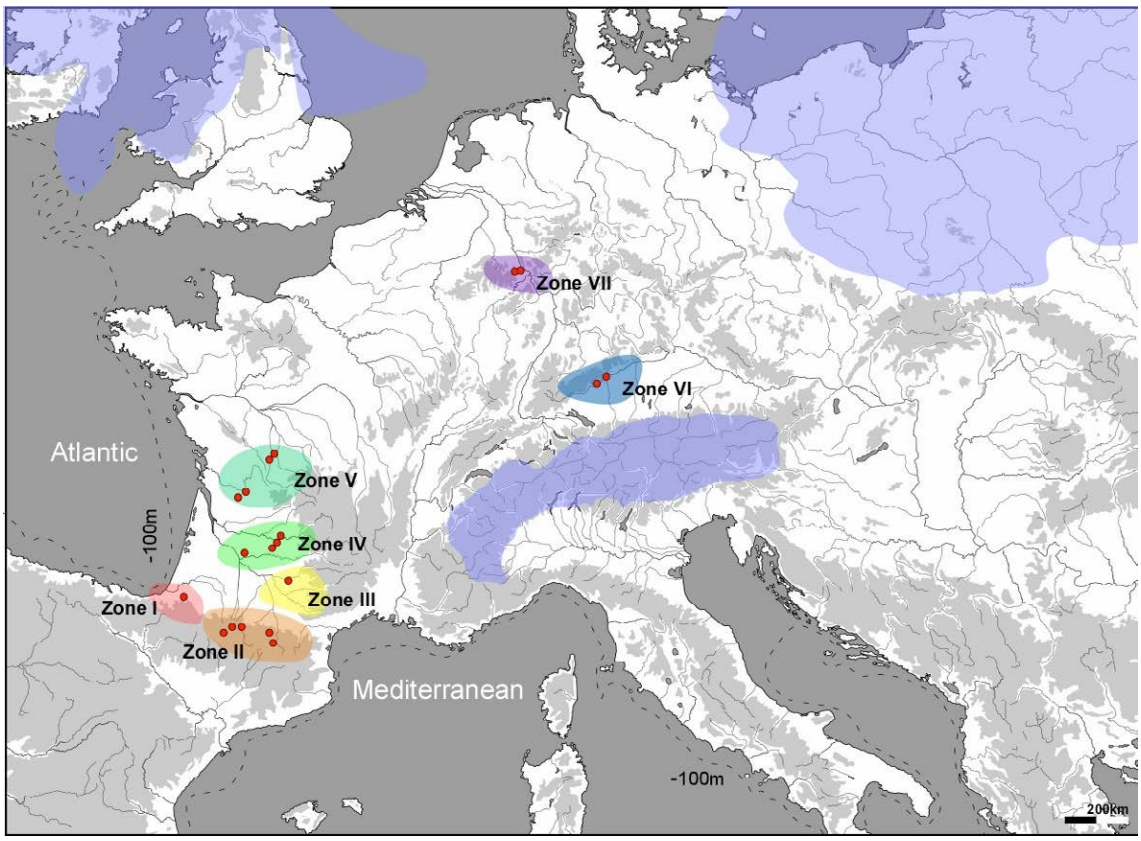


Figure 8.1: Distribution of sites from which material was examined and the location of the analytical zones.

Barbed Points

Fortunately, barbed points have a restricted temporal existence, facilitating their comparison across sites and between regions as a coarse but single chronological unit. Widely believed to have developed at the beginning of the Late Magdalenian (the earliest reliable dates being around 13,500BP), and continued to around 12,000BP before transforming into the Azilian point (Pétillon 2008), these projectile points thus appear to have been deposited over a period of only some 1,500 years - a narrow time range for a late Pleistocene context.

The addition of barbed weaponry to the previously completely unbarbed projectile toolkit of the Early and Middle Magdalenian has been argued to represent a major technological adjustment reflecting changes in game acquisition techniques (Pétillon 2008). However, without direct evidence for the types of prey exploited by each weapon type we cannot investigate specific changes in the use of these points. Furthermore,

while examples of barbed weaponry transformed into unbarbed points were identified in the examined dataset, we are unable to determine if the prey they were used against changed accordingly. Comparison of the barbed point data must, therefore, be restricted to differences in maintenance methods and intensity of reduction before final discard.

Data on barbed points were collected for each of the seven analytical zones, however, as so few barbed implements were identified in the German collections (Zones VI and VII) meaningful comparison of these implements with those recovered from the French sites cannot be confidently undertaken. Thus, the following discussion will focus on the barbed weaponry from Zones I through V (refer to Figure 8.1 above).

Maintenance Activity

As was described in previous chapters, the methods used to rejuvenate or rework barbed weaponry were consistent across the assemblages examined. Distal tips were carefully rejuvenated as wear accumulated through use, and gradually transformed from the long conical form point into the characteristic spatulate form tip. Whole barbs or remnants of barbs were removed either because they were broken in use and thus required to be ground over to reduce the risk of the weapon failure, or because they were located too near the distal edge when a new tip was being worked. The repair or reworking of the proximal extremity on barbed points were found to be extremely rare in all collections examined.

Despite barbed weaponry receiving similar treatment at all of the studied sites, the proportions of identifiably rejuvenated implements were found to differ (Table 8.1). Comparison of the three largest datasets found that repaired unilaterally barbed points were equally common in the La Vache (38.9%) and Isturitz (40.7%) assemblages, though only 20% were identified in the La Madeleine sub-sample. If this 20% figure is a true representation of the whole La Madeleine assemblage, this result would fit neatly with the early retirement of barbed points from their projectile use life; however, it may also simply reflect the small sub-sample which was available for study (i.e. sample size effect).

Similar comparison of the bilaterally barbed point data found that while 44.1% of the La Vache collection was identified as rejuvenated, 62.5% was calculated for Isturitz and 67% for the La Madeleine sample. The difference in artefact distal-extremity abundance (that is, 'intact' and distal-mesial fragments) in the La Vache (47% of assemblage) and La Madeleine (67% of sample) collections is suggested to be the driving force behind this result, and therefore, examination of a larger sample from the latter site is required before inter-site differences in repair patterns can be confidently invoked.

Table 8.1: Proportions of barbed weapons with evidence for maintenance.

Site	Unilaterally Barbed	Bilaterally Barbed	Barbed	Total
La Vache	N = 65/167; 38.9% rejuvenated	N = 15/34; 44.1% rejuvenated	N = 4/116; 3.4% rejuvenated	N = 84/317; 26.4% rejuvenated
Isturitz	N = 11/27; 40.7% rejuvenated	N = 5/8; 62.5% rejuvenated	N = 0/4; 0% rejuvenated	N = 16/39; 41% rejuvenated
La Madeleine	N = 5/20; 20% rejuvenated	N = 63/94; 67% rejuvenated	N = 5/16; 31.2% rejuvenated	N = 73/130; 56.1% rejuvenated

Both carefully worked and poorly (hastily?) executed maintenance was identified in each of the site collections, indicating that (at least at the studied sites) no single site assemblage exhibited better quality maintenance over another. Instead, the quality of the maintenance executed on each individual artefact appears to have been a product of several processes including the skill and/or preference (patience?) of the individual undertaking the work, the time available for the execution of the maintenance (i.e. in the field versus at a base camp), and the stage at which the implement is in its projectile use life (hastier work being more common at the end of a point's use life).

Recycling Activity

While barbed points were found to be recycled at similar rates in each of the La Vache (11.3%), Isturitz (12.8%) and La Madeleine (10%) assemblages (Table 8.2), the types of tools into which points at these sites (along with the other studied collections) showed greater variation.

The recycling of barbed points into tool making tools was the most commonly practiced method of reuse in the studied collections. Wedges were identified in six of the 16 barbed point collections examined, constituting the most common secondary use life for barbed weaponry (Table 8.3). As all but four of the studied collections are far from being the complete assemblages recovered from the excavated deposits, it is likely that this type of recycling was even more prevalent during the Magdalenian than was identified here.

Table 8.2: Numbers of recycled barbed weaponry in the three largest datasets examined.

Site	Unilaterally Barbed	Bilaterally Barbed	Barbed	Total
La Vache	N = 32/167; 19.1% recycled	N = 3/34; 8.8% recycled	N = 1/116; 0.8% recycled	N = 36/317; 11.35% recycled
Isturitz	N = 4/27; 14.8% recycled	N = 0/8; 0% recycled	N = 1/4; 25% recycled	N = 5/39; 12.8% recycled
La Madeleine	N = 4/20; 20% recycled	N = 8/94; 8.5% recycled	N = 1/16; 6.2% recycled	N = 13/130; 10% recycled

Table 8.3: Tool types into which barbed points were recycled.

Tool Type	Sites (Unilaterally Barbed)	Sites (Bilaterally Barbed)	Sites (Barbed)
Wedges	La Vache, Isturitz, La Madeleine, Laugerie-Basse, Courbet, Grotte du Bois-Ragot	La Vache, La Madeleine, Laugerie-Basse, Courbet	
Spatulas or Spoons	La Vache, Laugerie-Basse, Courbet	La Vache, Courbet	Isturitz, Aurensan
Awls, Pressure Flakers or Similar	Vogelherd	Aurensan, Courbet	La Madeleine
Burnishers	Isturitz		
Pendants		La Madeleine	
Other Unidentified	La Madeleine	Laugerie-Basse, Aurensan	Courbet

The other tool making tools into which these points were transformed and reused were awls, pressure flakers, burnishers or some other such pressure inducing tool (as identified by the type and accumulation of use wear on the implements active tip). These artefacts were identified in the Isturitz, La Madeleine, Aurensan, Courbet, and Vogelherd collections. Considering that either the distal or proximal tip of a barbed point provides the perfect working edge for these kinds of pressure inducing activities, it should not be surprising that barbed points were recycled in this manner.

Another tool into which barbed points appear to have been frequently reworked are spoons or spatulas. These arguably more domestic tools were identified in the La Vache, Laugerie-Basse, Aurensan, Isturitz, and Courbet collections, and each specimen had been heavily reworked for use. Considering this extensive and careful reworking and the function in which these items were employed, it might be suggested that their second use life (as a spoon, spatula, etc.) could have been quite extensive. On the other hand, it might also be suggested that they may only have been transformed into these tools owing to a lack of the required utensils at a particular time. These recycled points would then only have been used for a short time before being discarded in favour of the correct equipment.

If this second scenario was indeed the situation in which the barbed points had been recycled, this behaviour would appear to indicate the 'cannibalisation' of the weapons toolkit while the individual or group was mobile. Analysis of lithic assemblages have been shown to have higher rates of remodeling when groups are in a mobile phase of their subsistence strategy (e.g. Jacobi 2007; Kuhn 1991). However, given the extensive time and skill required to manufacture a barbed point it might be argued that such a scenario is unlikely for these particular artefacts, unless the group was soon to receive newly made weapons as replacements.

Finally, several barbed points were reworked into less commonly identified tool forms, while for others their new function was unable to be positively identified. These artefacts were identified for La Madeleine (a possible pendant and a foreshaft), Courbet

(a possible foreshaft), Laugerie-Basse (another possible foreshaft or perhaps a point transformed into a composite lithic/antler weapon), and Aurensan (a possible awl).

Thus, while a similar rate of the recycling of barbed weaponry was identified (about a rate of 11%) between the largest datasets examined, the studied sample did not provide any convincing indications of site or region specific recycling behaviours. Again, with increased sample sizes inter-site or inter-regional differences may appear and we cannot, therefore, rule out their existence at this time.

Discard Patterns

As has been alluded to in previous chapters, the total length of barbed points at time of discard differs between sites and analytical zones. As can be clearly seen in Figure 8.2 below, the total length of 'intact' bilaterally barbed (Group A) points changes according to the latitude of the zone in which it was discarded (also see data in Table 8.4). The two available data points for 'intact' implements in Zone I (Isturitz) fall between 70 and 110 mm, and total implement length at discard then steadily increases through Zones II through IV (heading north from the Pyrenees), before beginning to decrease through Zones V to VII. This same pattern is observed when impact fractured mesial-proximal fragments are added to the bilaterally barbed dataset, reiterating these inter-regional differences in the discard of used and broken weaponry.

This same south to north unimodal pattern was also found for both the 'intact' unilaterally barbed point (Group A and Group B) datasets (B and C in Figure 8.2), though these latter analyses can include data only from the four southernmost zones (Zone I to IV). That this same pattern is indicated despite so few data points being available suggests that larger datasets may reinforce these regional differences and not disperse the observed pattern.

A similar regional separation of both the bi- and unilaterally barbed datasets is seen in Figure 8.3, where the basal section of the implement (the barbs-to-base section plus the proximal bulb) is graphed against the distal-mesial section. These scatter plots give a better indication of regional differences in reduction intensity for two main reasons: (1)

the proximal section of these points were found to be broadly standardised across the Magdalenian region studied, and (2) barbed points were reduced (with few exceptions) from the distal extremity only. Thus, with a stable proximal section length, the intensity of reduction before discard can be more clearly identified and compared between single implements and across sites and regions.

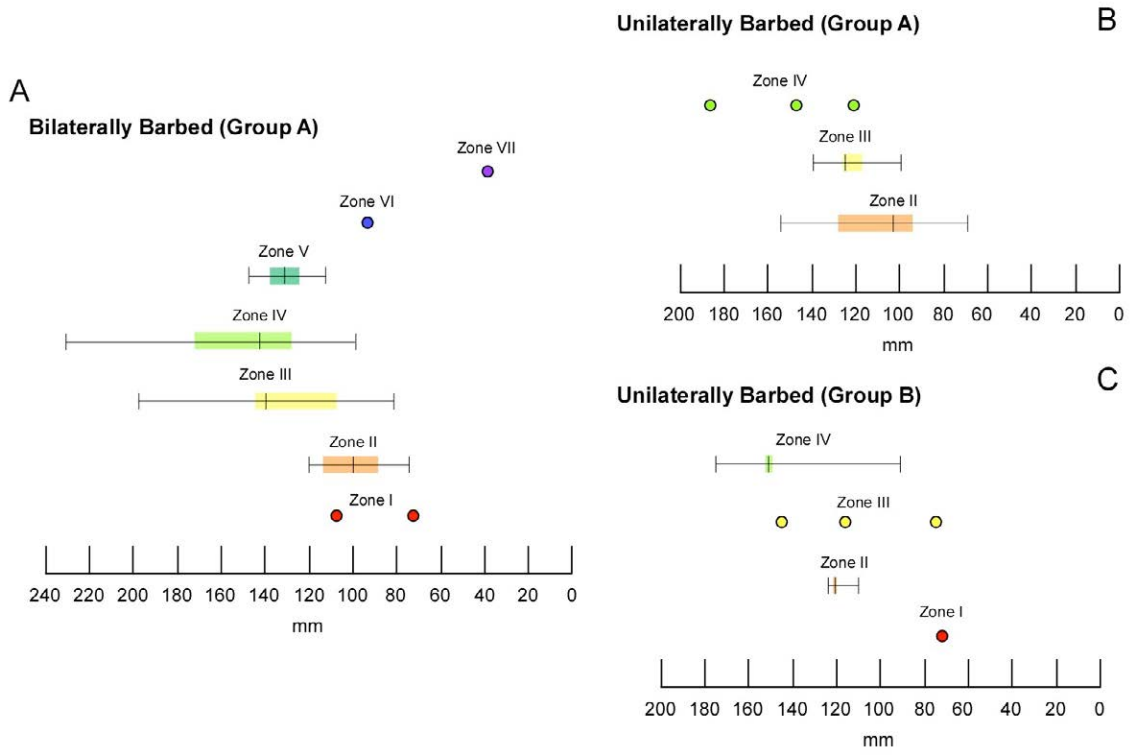


Figure 8.2: Comparison of total implement length for bi- and unilaterally barbed 'intact' implements. Dots represent single data points.

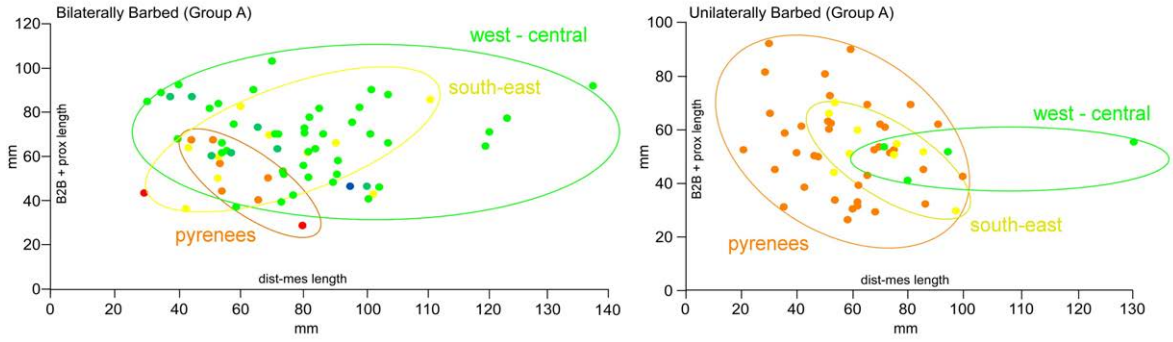


Figure 8.3: Comparison of discarded 'intact' bilaterally barbed (Group A) points: Basal section (barbs-to-base plus proximal bulb) against distal-mesial length.

Table 8.4: 'Intact' implement total length at time of discard (not including recycled, post-depostionally fractured implements) – by site and region.

SITE	Bilaterally Barbed Group A (mm)	Unilaterally Barbed Group A (mm)	Unilaterally Barbed Group B (mm)
La Vache	95.98 – 120.13	64.61 – 154.01	110.29 – 124.21
Isturitz	72.61 – 107.94	NA	72.45
Courbet	81.78 - 197.91	111.99 –134.48	75.45 – 145.69
Grotte du Bois-Ragot	112.18 - 146.76	NA	NA
La Madeleine	106.83 – 205.2	NA	91.91 – 175.5
Laugerie-Basse	98.34 – 230.3	121.89 – 147.72	149.75 – 152.62
Aurensan	74.22 – 92.9	NA	NA
Montastruc	172.09	NA	NA
Gourdan	91.44	NA	NA
Andernach-Martinsberg	38.67	NA	NA
Hohle Fels	93.1	NA	NA
La Tuiliere	113.42	NA	NA
Mas d'Azil	126.62	NA	NA
REGION	**Bilaterally Barbed Group A (mm)**	**Unilaterally Barbed Group A (mm)**	**Unilaterally Barbed Group B (mm)**
Zone I	72.61 – 107.94	NA	72.45
Zone II	74.22 – 120.13	69.75 – 154.01	110.29 – 124.21
Zone III	81.78 – 197.91	111.99 – 134.48	75.45 – 145.69
Zone IV	98.34 – 230.3	121.89 – 147.72	91.91 – 175.5
Zone V	112.18 – 146.76	NA	NA
Zone VI	93.1	NA	NA
Zone VII	38.67	NA	NA

As was found for the total implement length box-and-whisker plots above, the southern most (Pyrenean) bilaterally barbed data points (those from sites located in Zones I and II) cluster together at the lower part of the spectrum. Those points recorded for the mid-altitude Zones IV and V cluster together at the higher end of the spectrum, and those points from Zone III (Courbet) overlap the mid-range of these two regionally separated areas.

For the unilaterally barbed points, this same separation of the Pyrenean (Zones I and II) data from the west-central data (Zones IV and V), with the south-eastern (Zone III) data

falling in between the former two is also found (Figure 8.3: Right). Thus, these analyses also suggest a decrease in point reduction intensity moving from the Pyrenees, north into central France.

These patterns found within both the uni- and bilaterally barbed point datasets appear to correspond with the availability of antler raw material. Several hypotheses for the movement of reindeer and the interaction of Magdalenian hunters with these animals (and the antler raw material which comes with them) have been proposed. The first of these hypotheses suggests a north-south movement of reindeer and the Magdalenians who may have followed these herds. In this first scenario Gironde, Périgord and Lot (Quercy) are suggested to have been occupied by both reindeer and humans alike during the winter, with the Pyrenees occupied during the summer and autumn months (e.g. Lacoore 1956; Sturdy 1975; Bahn 1977; Gordon 1988a, 1988b, 1990). The second hypothesis suggests a smaller scale migration orientated on an east-west axis. In this hypothesis, herds are argued to have moved between the Massif Central and the Gironde, spending a significant portion of the year in the middle altitude areas of the Périgord (Delpech 1983, 1987; White 1980). Finally, others have proposed largely sedentary behaviour of the reindeer who occupied the Périgord during the Magdalenian (Bouchud 1954; Bouchud *et al*. 1953; Cheynier *et al*. 1952; Fontana 2000; see Kuntz and Constamango [2011] for discussion of these hypotheses).

In each of these scenarios, the middle altitudes of the Périgord, Dordogne, Quercy (etc.), which correlate with Zone IV in this analysis, are seen as a central area for reindeer occupation for *at least* a season each year and potentially much longer. With a strong reindeer presence suggested for Zone IV, antler (if not always of the shed adult male variety), may have been more readily available to those Magdalenian peoples occupying this area - or - *when* the Magdalenian groups occupied this area. With an abundance of antler, the early discard of antler weaponry in this region may be explained in terms of raw material availability as well as cultural ideals concerning form and efficiency dictating the discard of points at an early stage in their reduction.

Unbarbed Points

In lieu of well dated sites (perhaps currently the largest problem in Magdalenian archaeology), one of the only ways left to us to chronologically examine changes in intensity of point reduction across geographical regions is to compare single bevel based points with double bevel based. This approach is justified owing to the widely recognized shift from the single to the double bevel basal form at the beginning of the Late Magdalenian, and one which has been used in the past (after Pétillon 2008).

Maintenance Activity

Like the barbed weaponry discussed above, the unbarbed and bevel based points examined were found to have been rejuvenated using the same suite of methods and range of workmanship across the entire corpus. There was, however, a single difference in maintenance techniques identified. These differences were found in comparison of the La Vache (Zone II) and La Madeleine (Zone IV) assemblages.

Within both the La Vache and La Madeleine assemblages, single and double bevel based projectile points were found to have had poorly remade bases worked onto their proximal extremities. However, while those identified in the La Vache collection were carved using longitudinal scraping and there is some evidence for limited grinding or polishing of the material to create a smooth surface (see Figures 5.39 and 5.43 in Chapter 5), those identified in the La Madeleine collection were roughly 'hacked' out from the distal end towards the proximal edge (see Figure 7.24: F - I). These methods are intrinsically different to each other, result in recognisably different stigmata, though achieve the same result (a newly formed bevel base).

While these base reconstruction methods were the only clearly identified distinction in maintenance techniques identified in the studied corpus, it does indicate that differences in osseous projectile point maintenance practices *did exist* during the Middle to Late Magdalenian. That additional differences in maintenance techniques were not identified is likely owing to the small sample sizes available from the additional 23 sites. Extensive examination of additional assemblages is therefore required before we can

rule out the existence of any further differences in maintenance techniques having been practiced at these sites.

Table 8.5: Number of unbarbed points with evidence for maintenance.

Site	Single Bevel	Double Bevel	Dist-Mes; Mes Fragments	Total
La Vache	N = 33/72; 45.8% rejuvenated	N = 59/433; 13.6% rejuvenated	N = 218/598; 36.4% rejuvenated	N = 310/1103; 28.1% rejuvenated
Isturitz	N = 21/166; 12.6% rejuvenated	N = 58/202; 28.7% rejuvenated	N = 139/538; 25.8% rejuvenated	N = 218/906; 24% rejuvenated
La Madeleine	N = 13/30; 43.3% rejuvenated	N = 19/107; 17.75% rejuvenated	N = 19/182; 10.4% rejuvenated	N = 41/319; 12.8% rejuvenated

Rates of rejuvenation for these unbarbed projectile points are broadly similar for the two case study assemblages (La Vache: 28.1%; Isturitz: 24%; Table 8.5), while that found for the La Madeleine sub-sample (as the largest supplementary dataset) reaches only 12.8%. This latter result appears to be driven by the low proportion of distal-mesial/ mesial fragments in the examined collection, and thus, can be explained by the incomplete nature of the studied La Madeleine assemblage. A larger sample from this site must, therefore, be examined before any regional difference in maintenance method or frequency can be invoked.

Interestingly, despite the smaller sample size for La Madeleine, the proportion of rejuvenated implements identified for both single and double bevel based points is consistent with that of the complete La Vache assemblage (Table 8.5). The Isturitz collection, on the other hand, has a significantly lower rate of identified rejuvenated single bevel based points (four times less, in fact), but a higher rate for the double bevel based points (almost double) than the former two collections. The close correlation between the La Vache and La Madeleine values may indicate that despite the small sample size of the latter, these two locations had similar rates of unbarbed point rejuvenation, while those points discarded at Isturitz were discarded at an entirely different rate. These results might alternatively indicate that the osseous projectile

weaponry at Isturitz was repaired and reworked with such care that that it is impossible for the analyst to identified this behaviour in the assemblage, and consequently, the rate of rejuvenation is underestimated.

Again, full examination of the La Madeleine assemblage is required before concrete decisions can be made concerning these initial results.

Recycling Activity

As the original bevel based form on the studied unbarbed weaponry requires no alteration for reuse as wedges, these points may be considered particularly useful for this kind of recycling. Consequently, it is not surprising to find that bevel based points recycled as wedges were widely identified in the studied dataset: examples identified in the La Vache, Isturitz, La Madeleine, Grotte du Bois-Ragot, Gönnesdorf, and La Placard collections.

Table 8.6: Number of unbarbed point fragments with evidence for recycling.

Site	Single Bevel	Double Bevel	Dist - Mes; Mes Fragments	Total
La Vache	N = 1/72; 1.38% recycled	N = 6/433; 1.3% recycled	N = 3/598; 0.5% recycled	N = 10/1103; 0.9% recycled
Isturitz	N = 27/166; 16.2% recycled	N = 18/202; 8.9% recycled	N = 48/538; 8.9% recycled	N = 93/906; 10.2% recycled
La Madeleine	N = 4/30; 13.3% recycled	N = 18/107; 16.82% recycled	N = 8/182; 4.3% recycled	N = 30/319; 9.4% recycled

Table 8.7: Frequency of decoration on bevel based points recycled as wedges.

Site	Single Bevel	Double Bevel	Dist - Mes; Mes Frags	Total
La Vache	N = 1/1; 100% decorated	N = 2/5; 20% decorated	N = 0/1; 0% decorated	N = 3/7; 42% decorated
Isturitz	N = 7/18; 38% decorated	N =9/17; 52% decorated	N = 28/45; 62% decorated	N = 44/80; 55% decorated
La Madeleine	N = 1/1; 100% decorated	N = 8/17; 47% decorated	N = 6/6; 100% decorated	N = 15/24; 62% decorated

An aspect of these recycled points which was shared across all datasets, was the preferential selection of decorated projectile points for reuse (Table 8.7). It was determined that 17.7% of the double bevel and 36.7% of the single bevel based points from La Vache were decorated, while 17.9% of the double bevel and 29.5% of the single bevel based points from Isturitz displayed decoration. When these figures are compared to the proportion of recycled (wedge) implements which exhibit decoration (Table 8.7), this selection behaviour is reflected by the 42% minimum proportion (La Vache) identified.

In comparing how bevel based points were recycled at the studied sites, it was found that while these technologies were recycled only as wedges at La Vache and La Placard, at Isturitz, single bevelled points were also recycled into pendants. More variety in bevel based point reuse was identified in the La Madeleine collection where implements were recycled as chisels, spatulas/spoons, and awls/pressure flakers (or similar). Those bevel based points recovered from Grotte du Bois-Ragot were also most frequently recycled as wedges, though a single example was found to have been reworked into a possible foreshaft for another weapon.

Discard Patterns

When comparing the penetration length (implement length minus the base section) of single bevel based points across the analytical zones, a similar pattern to that identified for the uni- and bilaterally barbed total implement distributions is found. Weapon tips in the Pyrenees (Zones I and II) were more intensely reduced before discard than those points discarded in the mid-altitude areas of Zones IV and V (Figure 8.4; also see Table 8.8). Examination of the Gönnesdorf assemblage located in Zone VII found that while the range of point length was similar to those of the southern sites, these implements were discarded in a similar range to those recovered from Zone IV.

Analysis of the double bevel based points, on the other hand, found that both the total and common discard range were similar between the three sites from which adequate sample sizes were available (Figure 8.4: C). Furthermore, when compared to the

corresponding single bevelled data, only the La Madeleine (Zone IV) dataset differs in any significant way. Here, the single bevelled points fall within a shorter range of each other and were most commonly discarded between 42.9 and 95.7 mm. while the double bevel dataset reaches almost twice of the range of the former group and has a lower set common discard range (between 87.6mm and 30.7mm).

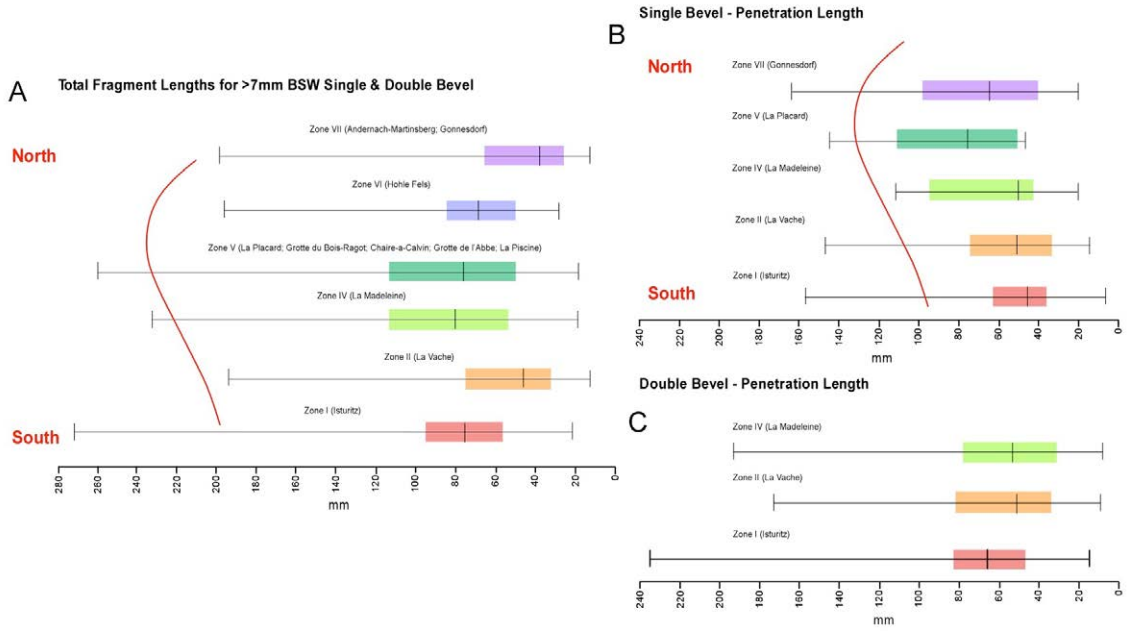


Figure 8.4: Box-and-whisker plots for the single and double bevel based regional assemblages: (A) Total (impact fractured) fragment (distal-mesial, mesial, mesial-proximal and proximal) length for >7mm BSW single and double bevel based points; (B) Penetration length (distal tip to base shoulder) for single bevel (>7mm BSW) points; (C) Penetration length (distal tip to base shoulder) for double bevel (>7mm BSW) points.

If the single bevelled points are taken to represent the Middle Magdalenian and the double bevelled the Late Magdalenian, it might be proposed that the above presented results suggest a temporal change in regional perceptions (which can reflect raw material availability) as to when an unbarbed point was exhausted. However, as only the La Vache and Isturitz assemblages were examined in sufficient quantity to be representative of their sites, and because La Vache was not occupied during the Middle Magdalenian, this suggestion of a temporal change cannot be supported.

Table 8.8: Common discard range for projectile point types examined.

	La Vache	Isturitz	La Madeleine
Double Bevel (<7mm BSW)	68.46 - 115.64 mm	81.25 - 110.9 mm	NA
Double Bevel (>7mm BSW)	76.33 - 117.9 mm	74.29 - 109.97 mm	61.21 - 124.49 mm
Single Bevel (<7mm BSW)		72.44 - 87.7 mm	NA
Single Bevel (>7mm BSW)	68.4 - 103 mm	65.34 - 98 mm	61.51 - 131.04 mm
Lussac - Angles	NA	56.52 - 77.6 mm	NA

If all 'intact' and impact fractured fragments from both single and double bevel based points are graphed according to analytical zone (Figure 8.4: A), the same unimodal pattern of artefact discard can be identified. As all point fragments likely to have been intentionally discarded in retooling activities are included (see Chapters 1 and 4 for discussion), this analysis can be argued to give us the best indication of the impact raw material availability has had on tool reduction intensity. With the greatest quantity of lengthy fragments found to be discarded (once again) in the possibly raw material rich mid-altitude zones (Zones IV and V), we might fairly confidently suggested that raw material availability played a central role in these regional patterns of antler projectile point reduction and discard.

Assessing how much of an impact cultural ideals had on time of implement discard can also be considered from these results. A number of authors have discussed the notion that culturally defined preferences often take precedence over more functional considerations (e.g. Knecht 1997a; Nelson 1997; Shott and Sillitoe 2005). As discussed previously, tool form does include culturally defined dimensions and values which may not only influence its original manufacture but also dictate when a projectile point is considered no longer usable. A point may be considered unusable by its owner even when it may technically be rejuvenated - if the implement cannot be reworked into a form considered culturally 'correct'.

Shott and Sillitoe (2005) have proposed the use of the terms 'maximum utility' and 'realised utility' in discussing the intensity of tool reduction through use (and rejuvenation). They explain that 'maximum utility' describes the amount of reduction possible between first use and final discard, while 'realised utility' describes the amount of reduction each implement underwent before discard. These terms allow the researcher to identify and discuss the gap between when a tool has been absolutely exhausted and no longer functions and the point at which the tool was discarded. Actual discard may be significantly earlier than its functional exhaustion, and if so, can indicate the influence of a number of economic and social processes.

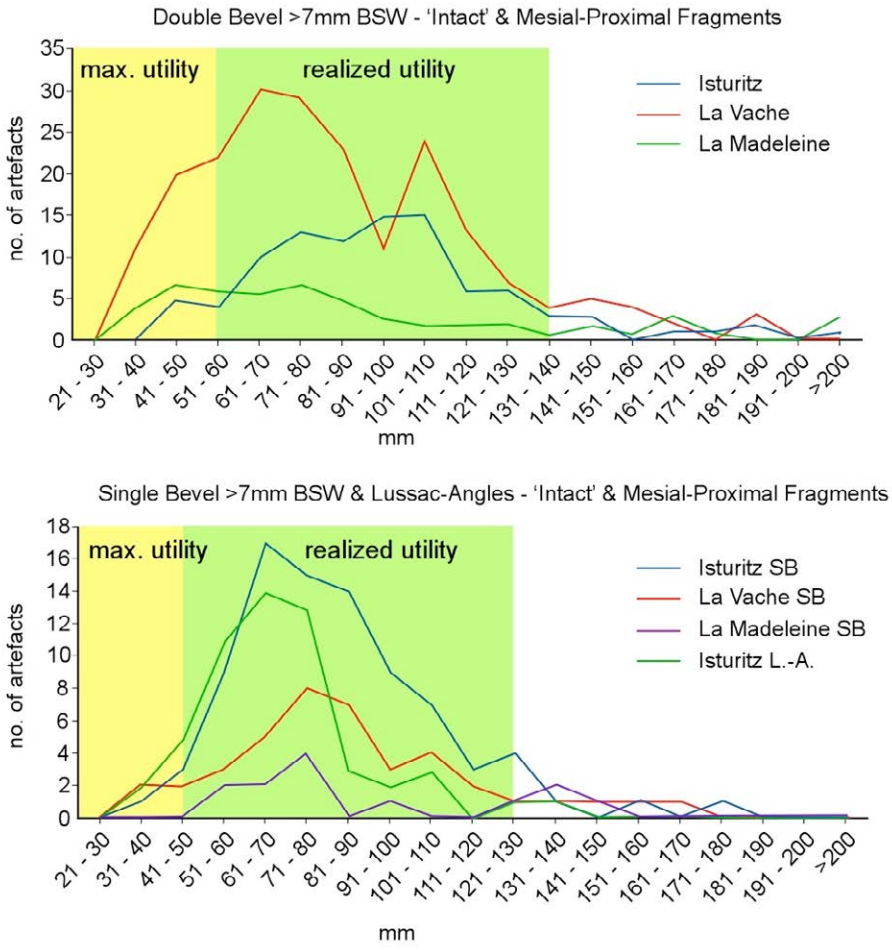


Figure 8.5: Exploring maximum utility as against realized utility for Magdalenian bevel based points. Total implement length for 'intact' and mesial-proximal impact fractured single and double (>7mm BSW) bevel based points graphed in 10mm units.

Shown in Figure 8.5 is the distribution (by 10 mm units) of 'intact' and mesial-proximal (impact fractured) fragments for both single and double bevel based points from Isturitz, La Vache and La Madeleine. If we take the data points falling within the common discard range (discussed above) as the realised utility range for these technologies, the artefacts which fall below this range, but must also have remained functional (though perhaps with less efficiency) to have continued in use might then be argued to represent the upper end of their maximum utility.

As was shown above, raw material availability appears to have influenced the early discard of weapon in Zones IV and V when compared to the surrounding regions; however, comparison of the Isturitz, La Vache and La Madeleine data also suggests that there is a sharp drop in implement discard after c.60 mm total implement length for double bevel based points. This drop occurs between c.50 and 80 mm for the single bevel based points depending on the site (Figure 8.5). Such a sudden drop in discard rate related to implement length might suggest that either; (A) functional efficiency drops once weapon tips reach these lengths; or (B) the maximum range for culturally determined implement form has been reached. That some weapons were reduced beyond this point indicates that further use life was available for these weapon types, and therefore, that purely functional reasons may not explain the common discard ranges identified.

That points discarded at Isturitz were found to be on average around 20 mm longer than those discarded at La Vache, while those discarded at La Madeleine were discarded around 20 mm longer than those at Isturitz suggest that ideals for total implement length may have been differed between sites. While these differences may be driven by raw material availability, cultural ideals cannot be ruled out entirely.

Experiments are required in order to positively identify the maximum utility of these bevel based points (as well as the barbed points discussed above); however, from these archaeologically based results it might reasonably be suggested that the common discard ranges were at least partially influenced by cultural ideas regarding implement form and these ideas may differ between sites and/or regions.

Barbed Versus Unbarbed Point in Single Site Assemblages

The importance of negative evidence has been pointed out by Binford (1973), who argued that items which were curated (carefully maintained, and therefore, had longer use lives) would be discarded less frequently than more expedient (shorter use life) items, and consequently, would be less likely to be recovered from the archaeological record.

Using this argument, the significantly lower proportion of barbed points (in comparison to unbarbed points) in each of the studied assemblages - as well as the Magdalenian archaeological record in general - may indicate that this type of weaponry was more carefully curated than their unbarbed counterparts. The increased level of skill and time required for their initial manufacture and continued maintenance certainly supports this notion, as does the greater potential barbed weaponry has for carrying and transmitting social messages (discussed below).

Thus, while the same range of maintenance techniques were applied to both the barbed and unbarbed projectile points studied, and broadly similar discard ranges were identified, the fewer number of barbed points recovered from the archaeological record (only 1,500 to 2,000 in total!) may indicate a significant difference in how these weapon tips were curated during the Middle to Late Magdalenian.

Additionally, the slightly higher rate of barbed point recycling (between 10% and 12.8% against the unbarbed point assemblages: 0.9% to 10.2%) in the La Vache, Isturitz and La Madeleine collections may indicate more than simple reuse of points in an effort to save time, effort and material. As will be discussed in the following sections, barbed points may, in fact, have had increased social significance in Magdalenian communities, and thus, the extension of their use life beyond use as a projectile tip may reflect a multi-layered aspect in barbed point technology.

Social Aspects: Networks, Interaction and Social Signalling

As was outlined in Chapter 1, because of their high visibility to both those intimate with the carrier as well as those persons socially distant, projectile weapons are a prime

material culture candidate for transmitting social information. This idea has been taken up in the archaeological literature addressing Magdalenian osseous weaponry, where the distribution of stylised weaponry across the Magdalenian region has resulted in the envisioning of extensive social networks. The apparent proliferation of both parietal and portable art, along with the extensive decoration of carried weaponry, has also been argued to reflect an increase in social tensions and a considerable amount of social competition (e.g. Bahn 1982; Conkey 1985; Geist 1978; Jochim *et al*. 1999).

Two aspects of the studied osseous projectile points, in particular, were considered to be potentially informative for investigating Magdalenian social interaction and organisation: the design and decoration of bevel based point proximal extremities and the design similarities of regionally dispersed bilaterally barbed points. Each of these two aspects will be considered below with reference to how maintenance and discard behaviours may impact on our understanding of these social aspects.

Design and Decoration of Bevel Based Points

As was shown in Chapters 5 and 6, a number of distinctly different bevel edge designs were identified in both the La Vache and Isturitz assemblages. In addition, a range of bevel striation designs - particularly at Isturitz - were also identified.

Despite Leroi-Gourhan (1968) having concluded that during the Early Magdalenian the striations found on bevel based points "have an ornamental character" (1968:58), before they became merely functional (i.e. to facilitate hafting) during the Middle Magdalenian, the range of designs identified in this study suggests that a stylistic component to point base design was not completely abandoned in the subsequent Magdalenian periods.

At Isturitz, three 'types' of basal edges were identified (Figure 6.21): the 'arrow' (which was also found on several whale bone implements with a slightly difference character and which one might classify as a separate type), the 'curved', and the 'round' based bevel edge. While the 'arrow' and 'curved' bevel base design were found on both single and double bevel based points, the 'round' edge form was only identified on single

bevel based points. The La Vache assemblage, on the other hand produced four 'types' of basal edges (Figure 5.38): the 'arrow', the 'square', the 'curved' and the 'pointed' edge type.

'Arrow' and 'curved' base edge forms are common to both La Vache and Isturitz, while the 'round' type was unique to Isturitz, and both the 'pointed' and 'square' types were only found in the La Vache assemblage. The absence of the 'round' type at La Vache may be simply explained by the fact that this site was not occupied during the Middle Magdalenian (as Isturitz was), the single bevel based points being dominant during this earlier phase. The complete absence of both the 'square' and 'pointed' basal types at Isturitz, on the other hand, is more perplexing.

As outlined at the beginning of Chapter 6, Isturitz is commonly agreed to have been an aggregation site - a location at which regionally dispersed groups would gather periodically to engage in economic and social activities. That weaponry displaying different morphologies and/or decoration was used and deposited at Isturitz is, therefore, to be expected (see Conkey [1980] for discussion of Spanish Magdalenian weaponry in this light). Similarly, the wider range of bevel base forms represented in the La Vache assemblage might be explained if one accepts that this site was also a location where usually regionally dispersed peoples congregated for a period (see arguments for this idea at the beginning of Chapter 5).

Ethnographically, individually distinctive weaponry has been shown to be a useful and geographically wide ranging phenomenon. For example, ownership marks were observed to have been incised on a range of objects including whale, walrus, and seal harpoons, arrow heads for hunting land mammals, and fishing gear amongst Alaskan Eskimos (Boas 1899; Reynolds 1989). Observation of the !Kung has given an example of where the identification of individual weapons is required when hunting in groups. Marshall (1961) reports that a captured animal is owned by the person whose arrow was first to penetrate deeply enough into the animal that the poison coating the point is effective, "each man makes arrows for himself, shaping the points... with some slight distinction so that he will known them from the arrows of other men" (Marshall

1961:238). Similar examples of distinctive arrows being important for meat distribution are given by Biesele (1975) and Deacon (1992).

In Australia, the variety of intricately carved hardwood spear designs are believed to have more to do with socio-ideological factors, such as demonstrating manufacturing skill or to indicate the identity of the maker/owner, rather than different technical functions (Cundy 1989). In discussing these same artefacts, Allen (2011:75) has argued that "while the overall spear could be manufactured to conform with performance criteria, beyond this there is considerable scope for inventive barbing designs". The construction alone has also been cited as enough for a hunter to identify his own arrow in the Alaskan context (Reynolds 1989), and have been traded among groups as part of the delayed reciprocal exchange system known as Hxaro in Southern Africa (Brooks *et al*. 2006; Lee 1979; Mitchell 2003; Wiessner 1983; Wadley 1987).

Reynolds (1989) noted that ownership marks (and we can include overall weapon design) can refer to various levels of ownership, such as: the individual, household, family, task group, settlement, or society, and that marks can be inherited. Weissner (1983:265), however, cautions that decorations on arrows may not always carry information, as in her ethnographic work with the !Kung San some of the decorations around arrow shafts were reported to be included on the implement because "the maker thought that it was beautiful, lucky, or when he was entertaining others who were watching him make arrows".

Reynolds (1989:89) has also pointed out that "the majority of property marks found archaeologically and depicted in the literature are on arrowheads and harpoons", and that their lack of identification in the archaeological record may be owing to the possibility that these marks were either painted onto tools or having been located on the (perishable) shaft of the weapon. However, Conkey (1981:41) has argued that ownership marks "are easily distinguished from decoration or 'art' because they are isolated from more all-encompassing motifs", and thus, such marks might be able to be cautiously identified. For example, the range of engraved marks on the base of bevel based points are clearly removed from any decorated engraving and/or painted on the

shaft of the weapon, and furthermore, would only be visible when not hafted. Thus, these marks along with the bevel edge forms, would only be useful in identifying particular points when not in use, and therefore, might be useful for settling disputes over hunting successes (for example), though these weapons would be indistinguishable when hafted if no other decoration was included.

The fact the bevel edge forms can play no role in overt social signalling (when the projectile is in use), supports the notion that they may rather reflect different communities of practice which existed during the Middle to Late Magdalenian in the study region. Certainly, each bevel edge type appears to have been carefully crafted and are numerous enough in each of the two studied assemblages to represent communities rather than single individuals.

As was shown in Chapters 5 and 6, it was important to identify the bevel edge types so the analyst could also identify the types and intensity of use wear which had accumulated on the proximal edge. In most cases, fair to extreme amounts of wear had accumulated on the proximal edge of the base preventing the identification of the original base form. Thus, the researcher must keep in mind the changing morphology of base forms as they accumulate wear in use and how this change can influence both the identification of specific weapons in the past (by their owners/makers) as well as the modern analyst. Clearly, further examination of archaeological assemblages is required to investigate these ideas.

Similarities in Form and Decoration in Bilaterally Barbed Points

The widespread similarity in the form and decoration of bilaterally barbed points has been a widely discussed topic in the past (e.g. Bahn 1982; Lefebvre 2011; Julien 1982; Gonzalez Sainz 1989; Straus 1992). In terms of how these similarities were maintained over a distance of some 1000 km (south to north) throughout the Magdalenian region, Jochim *et al*. (1999:134) has suggested that "active visiting and exchange, and an ongoing emphasis of cultural ties, may have been used to counteract the effects of distance". It is also argued that similarities found not only in projectile weaponry, but also in portable artworks "suggests just these sorts of intense processes of social

interaction and the active use of style to mediate interaction across this wide area" (1999:134).

Where the morphological differences between unbarbed point types are only visually obvious in an unhafted state, and thus when not in use, barbed points exhibit a range of physical features (such as barb form, decoration, basal form, etc.) which might be considered capable of holding and transmitting information both in and out of active use. This increased scope for storing and transmitting social information, and their potentially more careful curation (as suggested by their infrequency in the archaeological records) suggests that these items may have had a role in Magdalenian social interactions.

A useful framework in which to consider Magdalenian barbed weaponry is Hayden's (1998) 'practical' verses 'prestige' technologies. While 'practical' technologies describes those items which "solve practical problems of survival and basic comfort" 'prestige' technologies do not aim to perform a specific practical task, but instead act to display wealth, success, and power. Their purpose is to solve social problems or accomplish a social task such as attracting mates, labour or allies, bonding members of social groups together via displays of success, or creating debt and reciprocal obligations (see also Costin 1991; Earle 1978; Hayden 1993; Hodder 1986; Olausson 1983; Peebles and Kus 1977; Perlès 1992).

A wide variety of barbed weapon forms were technically available to the Magdalenian artisans who created the bilaterally barbed points; however, a restricted range of morphological forms (in terms of barb shape, shaft section, point dimensions, etc.) and decoration techniques and motifs were selected. Remarkably simpler barbed point forms might be argued to have functioned just as (or even more) effectively in hunting either terrestrial or aquatic game (depending on what these weapons were used against), with experiments demonstrating that even the unbarbed or self-barbed points which take significantly shorter time periods and less effort and skill to produce were extremely effective weapon tip forms. With more time and energy efficient projectile point forms available to the Magdalenians, why were such carefully crafted items produced, perhaps

these items could be considered as prestige technologies? Points which functioned to either solve social problems or accomplish a social task?

It might be suggested that these bilaterally barbed points were capable of containing both emblemic style (through overall morphology of barb, shaft, base and raw material used) as well as assertive style (through individual motifs, etc.) (see Chapter 1 for a discussion on theories of style). In this sense, the strong morphological and decorative similarities would act to tie regionally dispersed groups together and allow interactions taking place while out on the landscape to be less stressful. Ethnographically, this process has been described as signalling to the observer that the unknown group likely shares similar values and practices and can therefore be somewhat predictable in their behaviour (Weissner 1983). Alternatively, and for these same reasons, these weapon tips may have functioned as weapons of war, their presence signalling to viewers the hostile intentions of the carrier/s. Barbed spears and arrows have been recorded ethnographically to have been used in warfare in a number of ethnographic contexts, for example, by the Beothuk, Thule, and Ingalik peoples of North America (Marshall 1996; McGhee 1977; Osgood 1940), as well as in Australia where they are reportedly used for both individual combat and war (including a specific type known as 'death spears') (Davidson 1934). In a number of these contexts, the weapons are stated to have been deliberately discarded (and sometimes burnt) once they had killed an individual, providing an alternative reason for their discard into the archaeological record than breakage and/or exhaustion of the implement.

Interestingly, Langlais (2009, 2011) has found that there is considerable regional variability in the form of microliths produced during the Middle Magdalenian. During this period, microlith technology becomes more diversified from what it was during the Early Magdalenian, as well as more distinct from domestic technologies. In particular, these lithic elements were hafted laterally or apically, with scalene bladelets being the dominant type in southwest France, pointed backed bladelets in the Pyrenees, and large pointed backed bladelets with a truncated base in the Poitou region (Langlais 2011).

This change in pattern is suggested to coincide with an increase in territoriality and/or spatial organisation of groups as suggested by the increase in portable art and decorated osseous weaponry (e.g. Bahn 1982; Buisson *et al*. 1996; Conkey 1985; Jochim *et al*. 1999). Thus, it might be suggested that while the different forms of microlith carried within antler shafts (i.e. lithic/antler composite weapon tips) held and transmitted information regarding different regional identities, the osseous bilaterally barbed points may have been intentionally standardised in order to tie these same groups together under an overarching common 'Magdalenian' identity.

If this use of microlith barbs and osseous bilaterally barbed points was indeed the case, how intensively each individual point was reduced before discard may have been influenced not purely by its ability to effectively penetrate and hold game, but by their ability to transmit these social messages. In other words, these implements were discarded once their form became too far removed from the commonly recognised form and thus were considered unacceptable for further use.

These suggestions for the use of barbed weaponry in Magdalenian social signalling might also be supported by the form of associated spearthrowers. While ethnographic examples of spearthrowers found in various geographical contexts are often shown to have been multi-purpose tools (e.g. in Australia; Gould [1980]), as far as we can tell from the recovered Magdalenian examples, they functioned purely as projectile launching devices. These Palaeolithic artefacts are also exquisitely carved and decorated, with several apparent versions of the same theme (commonly known as 'the ibex and bird') found in several geographically dispersed sites (Arudy, Enlène, Mas d'Azil, Bédeilhac, Isturitz, Bruniquel). Such effort put into these weapons which would have also been highly visible on the landscape, therefore, may also suggest that projectile weaponry played a role in Magdalenian social interaction.

Summary

This chapter has explored the similarities and differences of antler projectile point maintenance, recycling and discard behaviour across the study region. It was found that while the methods used to rejuvenate both the barbed and unbarbed (bevel based) points

were similar (with one exception), regional differences in the stage that an implement was discard could be identified. These regional differences were found to likely be the result of raw material availability as well as cultural notions as to projectile point usability and exhaustion.

Conclusions and Future Research Potential

"A wealth of information remains to be recovered from the study of bone [osseous] technology" (LeMoine 1994:317)

The research presented in the preceding chapters has provided an indication of the wealth of information still to be extracted from the study of Pleistocene osseous projectile technology. While debitage resulting from the maintenance of antler projectile points may not survive the destructive processes of the archaeological record, examination of the discarded weaponry allows for detailed analysis of past maintenance and discard behaviours. Furthermore, it is hoped that the ideas presented in the preceding chapters have illustrated that the consideration of technological data in the light of non-technological concepts such as 'communities of practice' and 'social signalling' can also provide interesting avenues for future research.

To conclude this thesis, the following sections will summarise the key findings of the research and discuss what has been learnt concerning the curation of Middle to Late Magdalenian antler projectile points. The limitations of the presented research will then be described and suggestions for future research outlined.

Key Findings

The examination of 4,751 fragments of uni- and bilaterally barbed points as well as single- and double bevel based unbarbed points resulted in a number of central findings relating to the maintenance, recycling and discard of these Magdalenian antler weapons technologies. Each of these findings will be now be outlined.

Maintenance Activity

Methods of projectile point rejuvenation were found to be largely consistent across all of the barbed and unbarbed point types. The distal tip of each of the five broad

projectile point types (bilaterally barbed, unilaterally barbed, double bevel based, single bevel based, and Lussac-Angles) were resharpened using either a lithic tool which was scraped across the material surface or the point was ground against a grindstone. A combination of these two methods also appears possible. This resharpening process resulted in the production of striations, facets, and uneven sections on the artefact, all of which were used to identify rejuvenated implements.

It was found that unbarbed points which had accrued significant damage to the distal tip in use often had a portion of this section (usually between 40 and 60 mm in length) removed through the use of either the BFW or UFW technique. While this technique was also found to have been used on barbed points, it appears to have been a rare occurrence at the studied sites.

Barbs were often partially or completely removed from both uni- and bilaterally barbed points. The evidence suggests that these barbs were fractured in use and then ground down to a smooth surface as part of the weapon maintenance activities. It was suggested that this type of maintenance was essential to the continued successful use of the point, as such damage may have resulted in the failure of the weapon (as has been shown to be case for the distal tip of osseous points in experiments).

The proximal section or bases of these projectile points were also shown to have received maintenance during their use life. In the case of the barbed points, one or both basal protuberances (depending on the point type) were occasionally ground away presumably because they were damaged in use. Rarely was a completely new base constructed on an existing barbed weapon. In those few cases where the base had been remade, a conical form base was crafted. One identified case had notches carved into the left and right sides of the proximal shaft (an example from La Tulière: Figure 7.19: A). These notches suggest that a feature which may be argued to have acted to hold a line between the projectile point and the shaft were an important part of (at least some) Magdalenian barbed points. This particular artefact, therefore, supports Weniger's (1992, 2000) argument that some of the Magdalenian barbed weaponry functioned as

true mobile harpoons. Such weapons may have been used against either terrestrial (deer) or aquatic (salmon) prey.

Bevel based and unbarbed points, on the other hand, have been shown in experiments to often slip in their haft and fracture at or below the level of the haft. This artefact behaviour was reflected in the archaeological assemblages - particularly in the case of La Vache - in which significant proportions of the collection were made up of proximal or short mesial-proximal fragments. Several implements were found to terminate in poorly remade bases, further supporting the notion that the maintenance of this weapon type included the complete reconstruction of the base. This finding led to the observation that while barbed points were reduced *only from their distal tip* towards the mesial section, bevel based points were reduced from *both their distal tip and proximal edge* towards their mid-section. This determination of reduction direction is essential to a detailed understanding of the changing morphology of these items through use and maintenance cycles.

It was estimated that around 50% to 60% of the original bevel based point length was removed through use and maintenance cycles, while barbed points were reduced by around 30% to 40% on average before discard. Differences in reduction intensity were found to be influenced by both raw material availability and cultural ideals concerning point form and/or usability.

The existence of inter-site and perhaps inter-regional differences in maintenance techniques was indicated by the identification of different methods of bevel base reconstruction at La Vache and La Madeleine. While this example was the only clear difference identified in the dataset, the small sub-samples examined from the 23 additional sites likely minimised the identification of site specific maintenance methods. Further examination of these and other assemblages are required in order to determine if additional inter-site variations on point maintenance methods were practiced during the Middle to Late Magdalenian.

The *quality* of the maintenance executed on the repaired points appears to have been a product of several different processes including: the skill and/or preference (patience?) of the individual undertaking the work, the time available for the execution of the maintenance (i.e. in the field versus at a base camp), and the stage at which the implement was in its projectile use life (hastier work being more common at the end of a points use life). Examination of rejuvenated projectile points recovered from identified hunting camps (away from base camps occupied for longer periods) may provide an avenue for exploring the signatures of these different processes on maintenance quality.

Finally, it was found that poorly maintained weapons resulted in the fracture of longer portions of the implement (longer fragments) in use, as indicated by a comparison of fragment length against repair quality. Thus, the archaeological assemblages were found to the support the observations made in experiments concerning the catastrophic failure of osseous weaponry when not kept in optimum condition.

Recycling Activity

Both barbed and unbarbed projectile points were found to have been recycled into a variety of domestic and tool making tools. These secondary use lives included reuse as wedges, spatulas or spoons, awls or pressure flakers (or similar such pressure inducing tool), projectile foreshafts, and pendants.

With the exception of the barbed points from La Vache (which were recycled at a rate of 0.9%), the projectile points recovered from Isturitz, La Vache, and La Madeleine were all recycled at a similar rate (between 10% and 12%). That three sites located in three different regions of south-west France recycled their osseous weaponry at a similar rate is intriguing, especially since it was shown that raw material availability (at least partially) influenced the discard of weaponry. As both Isturitz and La Madeleine are considered to have been Magdalenian aggregation sites, and this thesis has suggested that La Vache may also have been such a location (though on a much smaller scale and with a particular focus), these similarities may thus be explained as the product of similar site functions. However, if La Vache was not a ‘micro aggregation’ site, then

such similarities in recycling rate become even more of an interesting result as different circumstances have resulted in similar behaviours. Clearly, examination of a wider range of Magdalenian site assemblages is required to further elucidate this aspect of Magdalenian projectile point use and discard.

It was found that decorated points were preferentially selected for reuse at both La Vache and Isturitz, and that the data available from the additional 23 sites suggested that this behaviour was widespread in its employment. Similarly, it was suggested that bilaterally barbed points may have been transformed into tools with an expected longer use life than the tool making tools (such as wedges) that most unbarbed points were recycled into. This observation supports the tentative suggestion that bilaterally barbed points may have functioned in the social arena as well as the hunting arena.

Discard Patterns

Comparison of the total implement and impact fractured fragment length data identified regional differences in both the barbed and unbarbed point datasets. It was found that those zones located in the mid-altitude areas of south-west France (Périgord, Dordogne, Charentes-Vienne, etc.) discarded their antler weaponry earlier in their use live than those zones located to both the south (Pyrenees) and the north (southern Germany). It was suggested that this difference in discard behaviour may relate to the movement of Magdalenian reindeer herds, which are suggested to have spent a significant portion of the year in the mid-altitude region, and thus, antler raw material may have been more abundant in these areas.

It was also shown, following Shott and Sillitoe (2005), that the realised utility, of bevel based points differs from their maximum utility suggesting that cultural ideas regarding ideal point form and/or efficiency may have existed during the Middle to Late Magdalenian. That these cultural ideals may have differed across the Magdalenian territory was also suggested by the 20 mm differences between La Vache and Isturitz, and Isturitz and La Madeleine. Thus, though further analysis is required to explore these presented ideas, it appears that both raw material availability and cultural ideals for

point form and/or efficiency may have influenced the discard of antler barbed and unbarbed points during the Middle to Late Magdalenian.

Maintenance and Discard of Antler Projectile Points in the Middle – Late Magdalenian

While the analysis presented in this thesis is only a starting point for the investigation of Magdalenian osseous point maintenance and discard patterns, it has nevertheless provided an indication of the wealth of information which may be extracted from these assemblages with further intensive study.

It was learned that it is possible to identify inter-site and inter-regional differences in maintenance methods and discard patterns for these organic technologies, and that such information can be related to raw material availability - just as in the case of their lithic counterparts. The consideration of these data in the light of communities of practice and social interaction also led to several interesting observations which require further consideration: the possibility of La Vache being a 'micro aggregation site', bevel edge forms reflecting different communities of practice, and the possible use of bilaterally barbed points in social signalling.

In all, this thesis has demonstrated the great potential such research has for expanding our knowledge not only of Magdalenian projectile technology, but also social organisation and interaction during this late period of the European Palaeolithic.

Limitations of the Current Research

Throughout this thesis a number of limitations of the presented research were mentioned, and these problems will be outlined here in order to once again bring them to the attention of the reader.

Principally, despite attempts to gather the largest dataset available, sample size remained a central issue for the identification of inter-site or inter-regional differences in maintenance, recycling and discard practices. It is believed that the sample size effect is largely responsible for the identification of only a single example of inter-site

difference in maintenance methods, and further expansive study of assemblages will provide additional regional differences in rejuvenation techniques.

Additionally, the impact preservation, excavation quality, and museum curation has on the survival of intact archaeological assemblages dictates our ability to accurately identify rejuvenation stigmata, rates of maintenance and recycling, and the reconstruction of discard behaviour in the past. As this situation is also an issue for lithic studies (though preservation is less of a concern), such problems should not be considered a deterrent to continued research.

Finally, this project originally intended to include a series of experiments whose primary aim was to identify the 'absolute use life' (maximum utility) of both barbed and unbarbed bevel based Magdalenian points. This experiment would also have attempted to replicate the rejuvenation techniques observed in the archaeological sample and explore what impact these methods have on point efficiency. Unfortunately, the time and space requirements of this thesis – especially in the light of the extensive archaeological data which was collected and examined – did not allow for these experiments to be included.

Future Directions: Experimental Archaeology

As just stated, a series of experiments designed to determine the maximum utility of Magdalenian barbed and bevel based points were initially planned to be included in this thesis. During the course of data collection and analysis, it became clear that other experiments in addition are required in order to advance our understanding of antler projectile weaponry in general and Middle to Late Magdalenian projectile technology in particular. Together these would include:

1. A series of experiments to replicate the observed rejuvenation stigmata on the archaeological specimens. In particular, these experiments would aim to determine and differentiate (if possible) the use of a lithic blade, grindstones of various physical make up (inclusions, etc.), the use of abrasives (such as pigment, sand, etc.).

2. A series of experiments to explore the accidental fracture of antler projectile points during the process of repair and tries to replicate the few suggested examples of this phenomenon identified in the archaeological sample studied here.

Future Directions: Museum Collections and Archaeological Data

As stated above, further intensive examination and analysis of archaeological data are required to expand our understanding of Magdalenian antler projectile technologies and their role in Magdalenian communities. Suggested future museum studies include:

1. Further examination of the archaeological assemblages studied in this project at a micro scale in order to study and describe the rejuvenation stigmata identified in this thesis. These data can then be compared with that collected by the experiment proposed above (no. 1).
2. Further examination of archaeological collections from Middle to Late Magdalenian sites for evidence of maintenance and recycling, along with the identification of discard behaviour at these studied sites.
3. Examination of archaeological assemblages from other Upper Palaeolithic and late Pleistocene contexts located in Africa, Asia, America and Australasia in order to identify if maintenance and discard patterns in osseous projectile weaponry differs significantly between different late Pleistocene cultures.
4. The integration of osseous projectile weaponry maintenance and discard pattern data into a wider cultural context, including faunal data, lithic technology, environmental data, and social (parietal art, non-utilitarian artefacts such as personal ornamentation, regional stylistic trends, etc.) aspects in order to construct a more comprehensive understanding of the prehistoric communities under study.
5. Examination of tools possibly associated with the repair of osseous projectile points (such as grindstones, *bâton percé*, bladelets, burins, etc.) for use wear and for residues, and to determine their geographical and temporal distribution.

6. Use of morphometrics to explore point reduction with the next level of repeatability, objectivity, rigour, and statistical analytical potential possible to the researcher.

Conclusion

Osseous projectile weaponry was a significant component of the Pleistocene hunter-gatherers' toolkit, and this situation was particularly the case for Magdalenian hunters. Having once been described as 'impossible to evaluate', investigation of maintenance and discard patterns for osseous projectile point assemblages has been severely neglected in the archaeological literature, though recent studies by Pétillon and colleagues have taken the first steps in remedying this situation.

The research presented in this thesis has attempted to address this imbalance through providing the beginnings of a robust methodology for investigating the maintenance, recycling, and discard of osseous projectile points. By employing a multi-faceted approach which integrated traditional morphometric analysis, use wear analysis, the consideration of contemporaneous depictions of the studied weaponry, and statistics, inter-site and inter-regional differences in maintenance and discard behaviour were identified. It was shown that this line of research has the potential to provide archaeologists with ample information regarding Magdalenian technology, subsistence and social organisation, all with no more difficulties than those encountered by lithic analysts.

Now that this methodology has been successfully applied to the most robust Palaeolithic dataset available, it can be built upon and applied to more challenging assemblages. These new data will then complement the already extensive studied lithic assemblages and allow for more comprehensive interpretations of Pleistocene lifeways to be constructed.

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