13. ORGANIC ARTEFACTS

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13.1 BONE INDUSTRY

The following will form a preliminary account of bone tools recovered from Iberomaurusian archaeological levels at Taforalt Cave, Morocco. Materials studied include bone tools excavated from 2003 to 2016 (n = 40), as well as a number of tools from excavations undertaken in the 1950s (n = 160). These tools will be analysed as a unitary group, as all were recovered from Grey Series units and all but two are associated with Iberomaurusian burial areas.

There exists a further published record indicating that 543 additional tools were recovered during excavations during the 1950s (Roche 1963). In addition to the 200 tools currently under study, this brings the total number of bone tools known to have been excavated from the site to 743. While only a subset of these tools remains available for study, the size of this subset alone represents the largest Palaeolithic North African bone tool industry recovered to date and indicates a numerous, widespread and well developed bone tool industry within the Iberomaurusian.

The study of these tools is the focus of an ongoing research project, aimed at examining the bone tools from a *chaîne opératoire* perspective. This analytical method seeks to understand tools from initial selection and creation, through to use and function, and finally to their eventual deposition and recovery as archaeological artefacts. As a part of this larger study, a number of methods will be used together to investigate different stages along this operational chain. The first stage of the *chaîne opératoire* will continue to be assessed through the use of ZooMS (zooarchaeology by mass spectrometry), in order to identify patterning in the taxa selected for tool construction (Desmond et al. 2018). How the tools may have functioned will be assessed through a comparative examination of tool microtopography. These can then be compared to use-traces found on ethnographic tools of known function, from geographically and technologically commensurate cultures (e. g. prehistoric groups from thermo-Mediterranean biozones, semi-sedentistic groups, groups which exploit similar food resources, etc.).

The current study describes an intermediate stage in the *chaîne opératoire* and details the development of a typological framework used to analyse the tools' individual and collective attributes. In deploying such a typology, it will become possible to assess repeatedly occurring size, shape and, in some cases, wear patterns, to examine the relationship of individual tools to the assemblage overall, and to determine whether the Iberomaurusians were engaged in the repeated production of specific industrial types. When features such as overall shape and wear patterning are combined with an examination of construction patterning (e. g. taxa selected for raw material) and use-wear correspondences among types, repetition in tools with like overall features can indicate the repeated construction of tools for particular purposes through time.

As such, the typological assessment of the tools described here represents a single methodological avenue among many, situated within a diachronic, life-history approach to the study of these tools. These descriptions do not represent the catalogue as an end-goal; rather, the following typology serves merely as a descriptive record, itself a platform for continued assessment of use-trace correspondences among like tools. These categorisations will form the basis for a synthetic research program which can demonstrate most likely specific uses for individual tools and tool-types, based on ethnographic analogy, and with the potential for an experimental programme. Following this, we wish to understand how these tools functioned as constituent components within a larger cultural complex, by attempting to situate tools within the larger themes of subsistence, craftsmanship, industry, practice, ideology and meaning. For example, if a number of tools are consistent with perishable-crafting activities, we might ask what this can tell us about the relationship between increasing sedentism and the emergent creation of perishable food collection, transportation, processing and storage technologies.

Reports from the Abbé Roche excavations undertaken at Taforalt during the 1950s indicate that 543 bone tools were recovered, the present location of which remains unknown (Roche 1963). Based on reconstructions of Roche's *Niveaux* system (in particular, its interpolation with the initial stratigraphic units of A, B and C; see **Chapter 2**), 206 tools (37.9 %) were recovered from interior parts of the cave, 139 (25.6 %), from the central parts and 198 (36.5 %) from the more exterior parts. Though the subset of 200 tools currently available for study were recovered primarily from burial areas, it should be noted that over 60 % of the Roche reported collection (present whereabouts unknown) were present in the centre of the cave and near its entrance, positions to be expected from 'everyday' manufacture and use activities.

Additionally, those bone tools classed by Roche as 'points' in one form or another (e. g. *poinçons*, *alènes*, etc.) show an even greater bias towards the 'light zone' of the cave, where daylight would have made crafting and other activities practicable. Pointed tools occur in the highest frequency near the exterior of the cave (n = 108, or 47.3 %), followed by the middle of the cave (n = 64, or 27.9 %), with fewest found in the cave's interior (n = 57, or 24.9 %) (see **Chapter 2** on the spatial distribution of Roche's *Niveaux*).

Through an examination of such 'zones' of recovery, it may be possible to deduce where activities necessitating bone tools were likely to have taken place. For example, Roche recovered a total of 66 pointed bone tools from C_{av}/*Niveau C en avant*, a small area abutting the northern cave wall near the cave entrance (see **fig. 2.5c**). While the fact that these tools cluster near the cave wall may indicate a passive accumulation, the much higher frequency in occurrence here suggests that the manufacture and/or use of these tools was happening nearby, within probably the best-lit area of the cave. The presence of bone tools in great numbers outside burial areas necessarily informs the understanding of bone tools recovered within burial areas, and will be discussed further at the appropriate juncture.

Of the 200 tools currently available for study, 40 were excavated since 2003, during the current research programme. All but 2 of these (95 %) were excavated from Sector 10 (see **Chapter 15**). Two tools were also recovered from Sector 8, during the excavation of a molluscan column. In November 2016, a collection of previously unpublished tools (n = 161) was located in the Rabat Archaeological Museum, material which had been recovered during excavations at Taforalt in the 1950s. These are distinct from the collection of 543 tools reported in Roche (1963) and, like the post-2003 tools, were excavated primarily from burial areas (specifically *Nécropole I* and *Nécropole II*).

These tools were contained in 16 different boxes and, in some cases, provenience data were written on either the boxes or the tools themselves. Four of these boxes retain a written date of "1952" (boxes 4, 6, 12 and 14). Many annotations found on the outside of these boxes remain obscure, and may refer to a variety of stratigraphic references (see **Chapter 2**). Following annotations where "Sep" stands for *Sépulture*, seemingly indicating either single burial groups or wider zones within particular coarse stratigraphic units of the GS in the cemetery areas, and "N" for *Nécropole*, indicating a cemetery area, 13 of the 16 boxes containing bone tools indicate that they were recovered from such areas (boxes 7 and 8 were determined not to contain bone tools). In his writings, Roche defined two different cemetery areas; namely, N1 (or NI) in the main alcove and N2 (or NII) further west (deeper into the cave) (see **Chapter 15**). Of the 16 boxes, seven are associated with *Nécropole I* (boxes 1, 2, 3, 9, 10, 14 and 15a) and two are associated with *Nécropole II* (boxes 4 and 11). Additionally, five different boxes relate to specific burial groups, boxes 5, 9, 12 and 12a, are all associated with "Sep A" (the uppermost stratigraphic division). In total, these boxes attesting a direct relationship to burial areas account for 97 of the 161 total tools; however, this may be an underestimation, as the remaining 64 tools came from boxes which had either indeterminate or no provenience data.

Because the majority of the tool subset available for study was recovered from burial areas, it is tempting to ascribe these tools a ritual or symbolic function, and/or to presume their deliberate placement as grave goods. Distinctively modern ontological categories of 'symbolic' vs. 'utilitarian' notwithstanding, it is, at present, difficult to untangle whether those tools found in burial areas do consist of deliberately placed tools, whether they are accidental inclusions present in the burial matrix, or a combination of both. Among the 'missing' collection of 543 tools, the higher frequency in tools reported near the front of the cave in non-burial areas is suggestive. As sequential, intercutting burial episodes have been attested in Sector 10 (Humphrey et al. 2012), there is an indication that elements from previous burials were treated with care, and sometimes included in subsequent burials, placed to the side, etc. This suggests that burials were (at least initially) localised to a special, rear area of the cave, and due to the spatially delimited nature of the burial area, sometimes earlier burials were disturbed in the process of later ones. One obvious solution to this would have been to 'import' matrix from other areas of the cave; this could serve as a suspension medium for any new bodies being interred, and minimise the chances of disturbing earlier burials. That some Grey Series sediment was brought to Sector 10 for this explicit purpose is indicated by a number of other lines of evidence. For example, in the GS, Sector 10 contains no structures associated with habitation areas (hearths, etc.), yet the matrix does contain artefacts associated with living areas, workshop areas, processing areas, etc., in the form of burnt and unburnt animal bones, lithic debitage, charcoal, etc. It is extremely unlikely that these activities were taking place *in situ* in Sector 10; at the very rear of the cave, Sector 10 is the least-lit area of the cave and all such activities would have had to have taken place atop the burials. It is far more likely that some of the Sector 10 Grey Series sediment was brought in from other areas of the cave, in order to facilitate new burial episodes and minimise the disturbance of previous ones. As such, any small habitation or industrial related inclusions in the Sector 10 Grey Series must be considered 'imported'; this, of course, should include the possibility that some of the smaller bone tools came to be deposited in the same fashion. Nevertheless, preliminary ZooMS analyses have suggested the inclusion of some of these tools with specific burial episodes; for example, the placement of equid remains on the axial skeleton of Individual 1 (Desmond et al. 2018).

Furthermore, an initial analysis of the Sector 10 bone tools' spatial distribution appears to show that these do not form what we would expect from a passive accumulation, as evident, for example in "C_{av}/*Niveau C en avant*"; they do not cluster around the cave wall, but rather generally spread across the burial area. Again, this could indicate either their deliberate inclusion as grave goods, or their unintended presence in imported Grey Series matrix. What is not indicated by this pattern is that Sector 10 served as a bone tool workshop area. Research into the distribution of tools within burials in *Nécropoles I* and *II* is ongoing; until such a point, however, specific determinations about the inclusion of smaller tools as deliberate or accidental should be suspended. Further ZooMS research is currently underway, and this may shed light on a deliberate inclusion of tools created from particular taxa.

Methods and Terminology

In Palaeolithic North Africa, as elsewhere, bone tools have generally not served as diagnostic elements of technocomplexes; lithic technology has usually served to define cultural entities. Though bone tools are omnipresent in the world archaeological record, non-systematic descriptions and presuppositional, functionality-based characterisations of bone tools (e.g. 'needles' or 'arrowheads' to describe gracile pointed tools) have served to obscure their true functions, and have hindered comparability between collections, both on an inter-site and inter-industry basis. For this reason, this study uses a morphological, feature-based typology without resort to subjective categories (e.g. 'awls' or 'pins'). While a morphologically descriptive typology must be developed in order to assess tools' quantitative and qualitative attributes, this is undertaken only as a preparatory stage in order to facilitate a more broad *chaîne opératoire* understanding of tools, based on specific correspondences in construction and use-wear, rather than on general correspondences in overall size and shape.

The first step in developing a descriptive typology is to examine the tools physically, to create descriptive categories, and to use these to guide the collection of comparable quantitative and qualitative data. At present, few typological studies have been undertaken on North African bone tool technologies. One notable exception is the work of Camps-Fabrer, whose 1966 study analysed tools from a number of North African Palaeolithic sites, including Bou Zabaouine, Columnata, Afalou Bou Rhummel, Tamar Hat and a few tools from Taforalt, among others (Camps-Fabrer 1966). As had Roche (1963) originally, Camps-Fabrer assigned tools to different categories based on an assessment of functionality due to gross form, largely following the French prehistoric bone tool tradition (with categories including *tranchets*, *lissoirs*, *poinçons*, *alènes*, etc.) (Camps-Fabrer 1966, 51). Camps-Fabrer's work therefore provides a ready comparative study for interrogating typological correspondences, particularly between the European Aurignacian and Magdalenian and the North African Palaeolithic. Though some authors posit cultural and/or technological connections between the European and North African Palaeolithic, as yet no evidence has been found linking contemporary North African and French/European Palaeolithic technocomplexes (*contra* Ferembach 1962; Pallary 1909; etc.). For these reasons, we have chosen to develop an independent typological schema, rather than use Camps-Fabrer's (or Roche's) extant categorisations, which are themselves embedded in the study of the European Upper Palaeolithic.

In creating an analytical approach to tools from Taforalt, we have also chosen to eschew whole-tool typological descriptions, as most extant bone tool typologies use functional descriptors (e.g. awl, pin, polisher, etc.) as category names. These can serve to presuppose (and potentially obscure) individual tool functionality from a use-wear perspective, as tools are *de facto* presumed to have been used as members of their eponymous classes. Ethnographic and archaeological collections worldwide prove that a similarity in gross morphology often belies any similarity in use. Long thin pointed tools, classed together as 'needles', are shown to have specific applications, ranging from roof-thatching tools, to tools for threading fish, to spindles (Soffer 2004, 408). While initial typological categories must rely, to a certain extent, on overall shape and tool morphology, these typological categorisations will here serve only as a basis for assessments of tool functionality driven by use-wear criteria. It is our hope that the future application of associative statistics and/or cluster analyses to these quantitative and qualitative characteristics (such as degree of completeness, tip type, profile type, base type, size class, etc.) will eventually provide a firmer basis for apprehending correspondences and differences in use-wear patterning, and therefore functionality. This approach will also allow tools to be grouped inclusively, rather than solely by assigning each tool to one of a number of mutually exclusive type categories. This is important, as a single tool may display characteristics of more than one functional class (e.g. being both spatulate and pointed, incised and fragmentary, etc.). We use Douglas Campana's 1989 study of Natufian and Zagros Proto-Neolithic bone tools and Mark Newcomer's 1974 study of Natufian bone tools as the basis for much of the following typology. These studies have been chosen because they investigate transitional Levantine Epipalaeolithic bone tool technologies in many ways similar to the Iberomaurusian, and both studies include robust experimental components. The typological methods (and therefore results) employed here will also then be comparable with those describing many

Breakages	Category
Broken tip	Base fragment
Broken base	Point/ovoid/spatulate etc. fragment
Broken base and tip	Shaft fragment
Broken irregular/indeterminate	Broken end
With refitting breaks or without visible breakages	Relatively complete
No breakages	Complete

Tab. 13.1.1 Breakage categories.

pre-Neolithic Levantine bone tools. In the descriptions, rather than 'distal', 'medial' and 'proximal', we use the terms 'tip', 'shaft' and 'base' to refer to the ends and body of the tool (following Newcomer 1974, 141). The term 'tip' refers to the working end of the tool, the term 'base' refers to the held, hafted or otherwise articulated non-main working end, and 'shaft' refers to what otherwise might be considered the medial portion of the tool (between the base and tip).

Typological Categories

Degree of Completeness

In considering the tools, the degree of completeness of each tool is first assessed into a binary, as being either complete or broken. Next, examination is made of where the tool shows breakage(s): e.g. to the tip, base, etc. (**tab. 13.1.1**).

By using these categorisations, relevant data can still be extracted even from incomplete tools. For example, when calculating the average tip-diameter of pointed tools, complete, relatively complete, and point fragments shall all be considered. When determining the types and degrees of smoothing evident on bases, complete, relatively complete, and base fragments will all be considered. This allows for a more inclusive appraisal of individual features, without having to discount all but complete tools.

As many tools have elements which may not have been modified even at the time of their use (e.g. tools with a broken or anatomical base), these are categorised as 'relatively complete'. This category includes tools which do not display clear recent or taphonomic alteration (e.g. different colours, sharp angles, etc., at breaks), and may have functioned as tools in their current form. This also includes tools with indeterminate levels of completeness, such as weathered tools, and tools with re-fitting breaks which can be examined as though they were whole.

Points which show breaks only at the very point tip are also considered relatively complete, as their morphology, formation strategies, use-traces, etc., can all be examined given the extant tool, and size-categorisations will not be greatly affected. In these cases, however, tip-diameter cannot be assessed.

Size Measurements

Next, all tools are measured and their maximum length, maximum width and tip diameter (for points) are recorded. These measurements are taken on all complete and relatively complete tools, and these data are plotted in order to determine size-clustering of the tools and tool types. Measurements were taken using digital callipers at the longest/widest point for each tool. For points and point fragments, tip-diameter

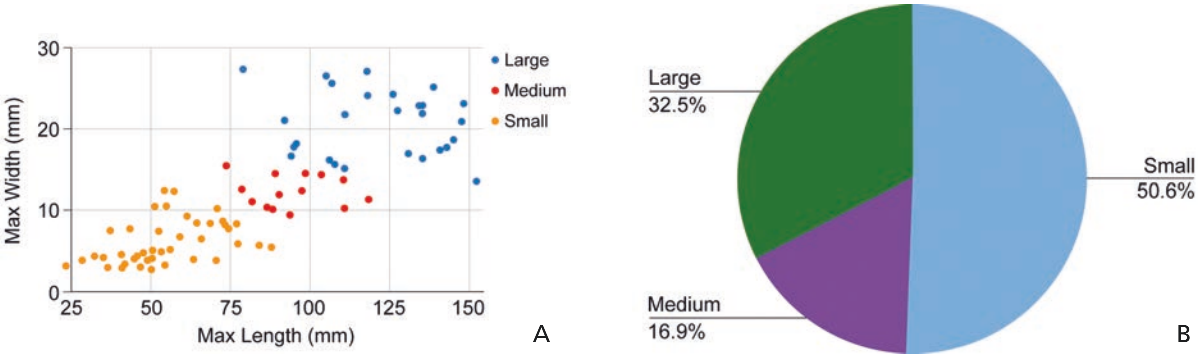


Fig. 13.1.1 **A** Complete tool size distribution plot; **B** Complete tool size-value determinations. – (After Desmond 2017).

measurements were taken in accordance with Campana's 1989 study of Natufian tools, in order that these data should be comparable between the two studies. Because of the nature of varied point-tip symmetries, shapes, etc., the tools were measured using digital callipers as close to the point-tip as possible, along the widest possible platform.

After determining the most prominent typological features among the tools, tool size can be plotted to uncover correspondences and patterning within and between different types. Here I use two different analyses: a basic length/width size plot (**fig. 13.1.1A**), and a surface-area proxy (here called 'size-value') (**fig. 13.1.1B**). Though all tools were measured, only complete or relatively complete tools are plotted for size (to the exclusion of all fragments) based on their maximum length and maximum width (**fig. 13.1.1A**). For **figure 13.1.1A**, size category determinations were constructed using the following criteria: small tools are considered as such if their length times width is 70 % or less of the average length times width, medium tools have size-values within 71 % to 129 % of this average, and large tools have size-values of 130 % or more of this average. As is evident from this chart, there exists quite a wide spread of tool-size, but most tools fall into the small size category. This is interesting, as, although larger tools are represented, their presence is not enough to pull the average size toward 'medium'. While this length times width value is a useful metric for constructing tool size categories, it does not give any idea as to the tools' surface area. For this reason, a size proxy for the surface area of each tool has also been created, using the square-root of maximum length times maximum width for each (**fig. 13.1.1B**) (following Hodgkins et al. 2016). While this size-value does not provide a mathematically exact representation of a tool's total surface area, it has the advantage of assigning each tool a single, individual size-value. This value can then be plotted and compared to the size-values of other tools and tool-types. At Taforalt, the average size-value for all 83 complete and relatively complete tools of all types is 30.99 mm. Here, surface area size-value determinations were constructed using the same criteria as size categories: small tools are considered as such if they have size-values of 70 % or less of the average (50.6 % of total); medium tools have size-values within 71 % to 129 % of the average (16.9 % of total), and large tools have size-values of 130 % or more of the average (32.5 % of total) (**fig. 13.1.1B**). Both of these analyses provide useful benchmarks in understanding the size and surface area of complete tools. When considering use-wear and functionality at a later stage, it is important to understand where an individual tool falls within a comparative size spectrum specific to that assemblage being examined. Understanding both tool size and rough surface area are crucial when attempting to understand correspondences between overall shape, formation strategy, and use-wear.

As pointed tools are the most numerous type at Taforalt, these were naturally included in the first size-distribution assessment. However, because of the great number of pointed tools (67.9 % of the total as-

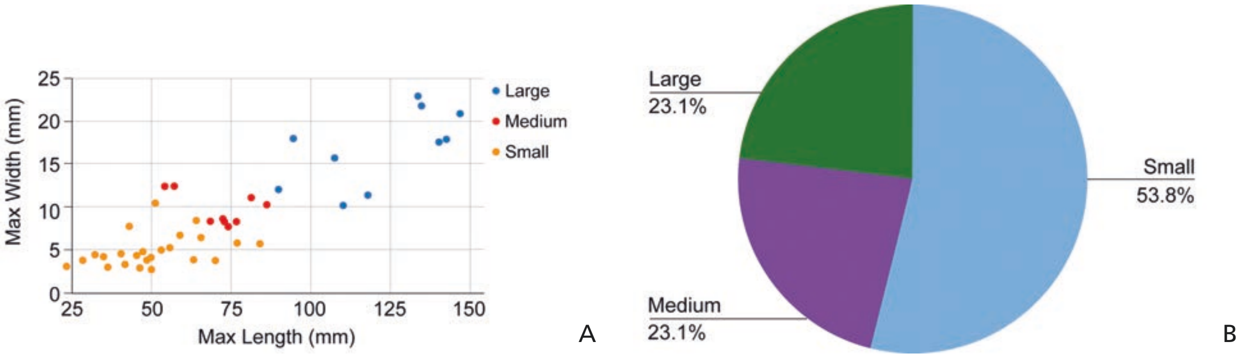


Fig. 13.1.2 **A** Complete point size distribution plot; **B** Complete point size-value determinations. – (After Desmond 2017).

semblage; see **fig. 13.1.7**), we have also established internally relative size groupings for pointed tools, to the exclusion of all non-pointed forms. As with the first size class assessment, only complete and relatively complete pointed tools have been considered. As **figure 13.1.2** illustrates, most points again cluster within the smallest size class and size-value, even when larger tool-types (e.g. spatulate pointed and metapodial pointed tools) have been included.

As in **figure 13.1.1**, these size category determinations were constructed using the following criteria: small tools are considered as such if they have size-values of 70 % or less of the average, medium tools have size-values within 71 % to 129 % of the average, and large tools have size-values of 130 % or more of the average (**fig. 13.1.2A**).

To determine an average surface area (or size-value) categorisation internal to pointed tools, size-value categories were again created using the square-root of maximum length times maximum width for each (**fig. 13.1.2B**). Small points are those tools with size-values of 70 % or less of the average (53.8 % of total pointed tools), medium points have size-values within 71 % to 129 % of the average (23.1 % of total pointed tools), and large points have size-values of 130 % or more of the average (also 23.1 % of total pointed tools). Here, it is interesting to note that, while small pointed tools are the dominant component of the assemblage, medium and large pointed tools both represent 23.1 % of total pointed tools (in contrast to large tools representing 32.5 % of the total overall assemblage; see **fig. 13.1.1B**). Future comparative use-wear studies must be based on comparison with ethnographic tools of a similarly small size. While not enough to determine specific tool uses, it is clear from size class data alone that the spectrum of possible functional categories for the smallest Taforalt points can be constrained.

Following points, the next most common tool characteristic is spatulate tools. All complete and relatively complete tools which can be classed as 'spatulate' (inclusive of spatulate ovoid, spatulate point, etc.) have been considered. This analysis was based on a total of 15 complete or relatively complete spatulate tools (15 % of total complete or relatively complete tools). Represented here are the proportions of small, medium, and large tools within the general length times width size categories (rather than surface area approximations/size-values) (**fig. 13.1.3**). Following points and spatulate tools, the next most numerous tool-categories contained less than ten elements, shown in **table 13.1.2**.

Shaft Types

All tools and tool fragments are then assigned a shaft type, consisting of one of the types shown in **table 13.1.2** and **figure 13.1.3**.

Metapodial tools (n = 7)	**• 7 large tools, 100 %**
Double-ended tools (n = 6)	• 6 small tools, 100 %
Ovoid tools (n = 5)	• 1 small tool, 20 % 4 large tools, 80 %
flat bevels (n = 5) *see **fig. 13.1.8n**	• 4 small tools, 80 % 1 large tool, 20 %

Tab. 13.1.2 Size categories for other tool types.

Parallel (fig. 13.1.4a)	**Curved (fig. 13.1.4h)**
Parallel converging (**fig. 13.1.4b**)	Angled (**fig. 13.1.4i**)
Convex (**fig. 13.1.4c**)	Asymmetric angled (**fig. 13.1.4j**)
Asymmetric Convex (**fig. 13.1.4d**)	Asymmetric peak (**fig. 13.1.4k**)
Convex tapering (**fig. 13.1.4e**)	Steep mid-shaft angle (**fig. 13.1.4l**)
Concave (**fig. 13.1.4f**)	Asymmetric steep mid-shaft angle (**fig. 13.1.4m**)
Asymmetric concave (**fig. 13.1.4g**)	Irregular (**fig. 13.1.4n**)

Tab. 13.1.3 Shaft type.

Parallel n = 8, 7.8 %	**Curved n = 8. 7.8 %**
Parallel converging n = 34, 33 %	Angled n = 1, 1.0 %
Convex n = 7, 6.8 %	Asymmetric angled n = 11, 10.7 %
Asymmetric Convex n = 6, 5.8 %	Asymmetric peak n = 2, 1.9 %
Convex tapering n = 6, 5.8 %	Steep mid-shaft angle n = 1, 1.0 %
Concave n = 2, 1.9 %	Asymmetric steep mid-shaft angle n = 6, 5.8 %
Asymmetric concave: n = 3, 2.9 %	Irregular n = 3, 2.9 %

Tab. 13.1.4 Shaft type percentages.

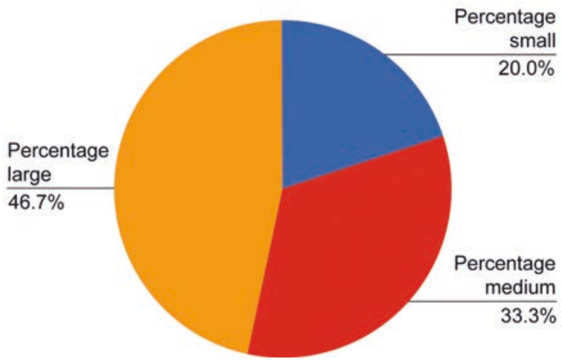


Fig. 13.1.3 Size categories for spatulate tools.

Here tools with a 'faintly x' profile have been grouped in with the general profile; for example, tools with a 'faintly concave' profile will be grouped with tools with a 'concave profile'. Though these types function as discrete categories, it is important to remember that similar or identical uses may produce different shaft types, and/or different uses may produce similar shaft types, in part based on the original morphology of the bone used and the degree of use. For example, concave (**fig. 13.1.4f**), asymmetric steep mid-shaft angle (**fig. 13.1.4m**) and asymmetric concave (**fig. 13.1.4g**) could be formed by similar kinds of use-wear, or may represent different use-wear stages for the same tool type. Since the true shape of a shaft type may not be evident in broken tools, only complete or relatively complete tools were assessed for diagnostic shaft-type (**tab. 13.1.4**).

Shaft types in themselves can reveal some information as to the nature of a tool's function. For example, tools with a marked shaft asymmetry can provide clues as to the direction-of-movement of the tool, if, for example, one side or edge is worn down more than another (assuming an initial symmetry in shaping). This can be borne out by an investigation of polish along the affected areas (with higher polish indicating more extensive use/handling), and/or the presence of lithic striations or undulations (discussed below). Considering the overall shape of a tool shaft is a crucial step in finding best-fit matches among ethnographic tool

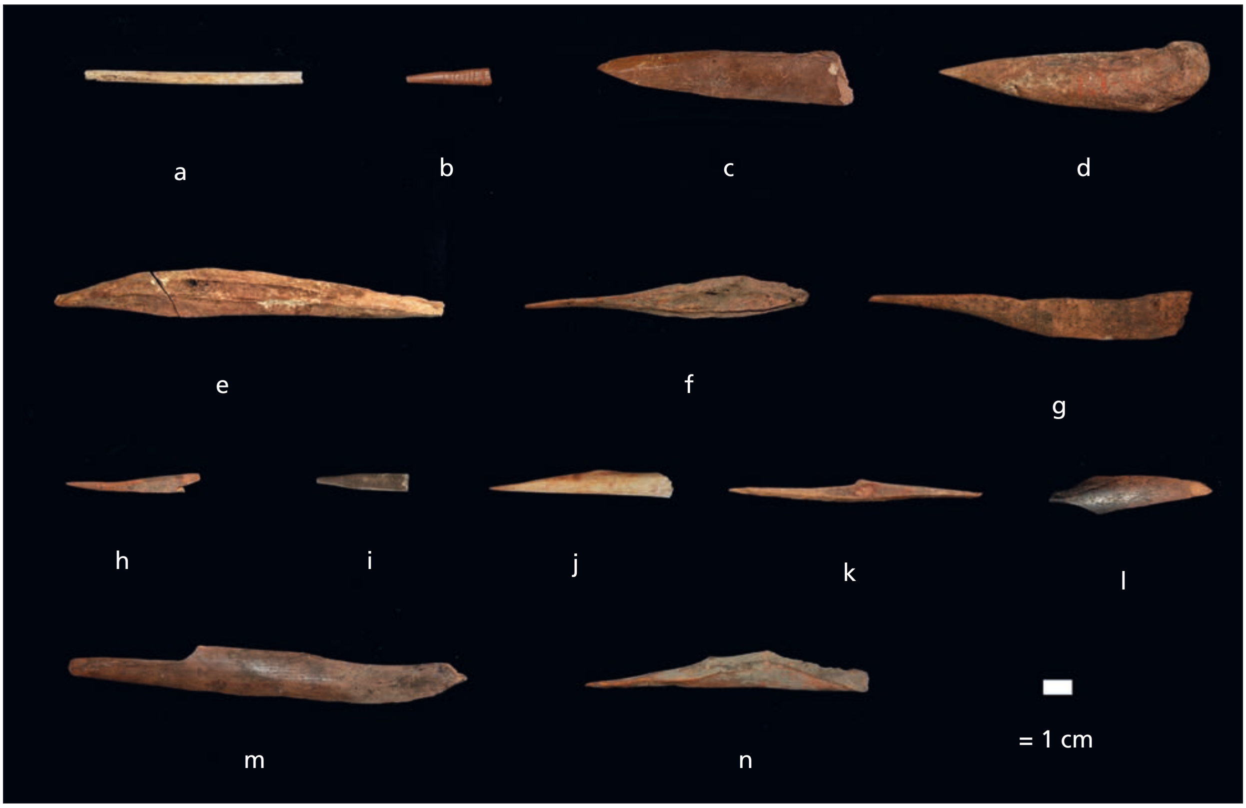


Fig. 13.1.4 Shaft type. – (After Desmond 2017).

Straight/non-undulating (fig. 13.1.5a)	Undulating (one side) (fig. 13.1.5c)
Faintly undulating (**fig. 13.1.5b**)	Undulating (**fig. 13.1.5d-e**)

Tab. 13.1.5 Shaft profile.

Fig. 13.1.5 Shaft profile. – (After Desmond 2017).

collections, as the location and degree of wear (e. g. polish to the tip end only or along the whole tool) affect the entire shaft profile, and can demonstrate concentrated and/or diffuse use foci along the tool's shaft.

Shaft Profile

Following shaft type, all tools are assessed for their shaft profile, and grouped into one of the categories shown in **table 13.1.5** and **figure 13.1.5**.

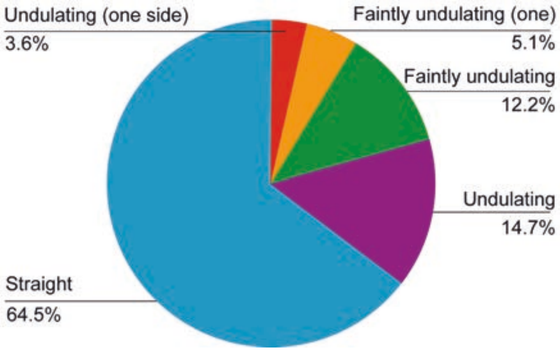


Fig. 13.1.6 Shaft profile percentages for all types, complete and fragmentary.

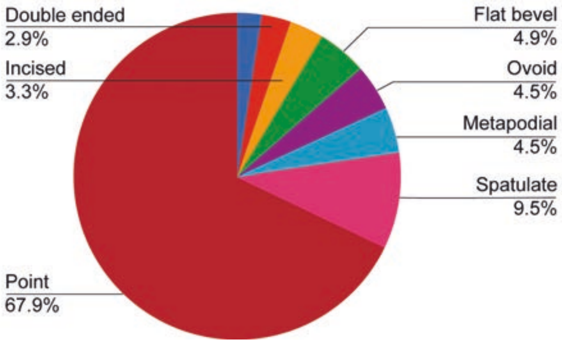


Fig. 13.1.7 Inclusive types.

The profile of the tool shaft (straight/undulating) may also offer clues as to the tool's degree, stage and manner of use. Undulating profiles occur when a tool's natural morphology or breakages have been smoothed over, rounded and/or obliterated, indicating lithic shaping or long-term repeated use. Manner-of-use categories in tools with undulating profiles can also be inferred, because, in order to gain this profile, they must be continuously abraded against a material softer than bone (e.g. repeatedly passed through a softer yielding material), held in the hand, etc. Undulating profiles can also be a product of lithic (re-)sharpening (Newcomer 1974; Campana 1989). In cases where the tool was deliberately shaped or reshaped, longitudinal lithic striations will be visible; if lithic striations are obliterated/not present, the tool can be inferred to have long-term repeated articulations with a material softer than bone (Campana 1989). At Taforalt, 35.3 % of tools exhibit some degree of undulation, ranging from faint to strong undulation (**fig. 13.1.6**).

While the lack of an undulating profile does not preclude re-sharpening and re-use of tools, the presence of undulations is an excellent indicator that a tool has been smoothed through repeated use, lithic re-sharpening or a combination of both. For example, a bone tool which was shaped from a splinter with irregular edges will, through repeated contact with material softer than bone, display smoothing and rounding of these irregular edges consistent with an undulating profile. Undulation then is a useful criterion in determining the stage of a particular tool's use, as it implies long-term and repeated articulations with a material softer than bone (e.g. hand-held uses) and/or, in the case of lithic re-sharpening, the deliberate curation of tools. There is an observable difference between initial shaping and resharpening of used bone tools: for example, the presence of polish and/or use wear obliterating and/or overlying lithic scraping striations (e.g. striations seeming to 'fade' into polish) indicate that the tool has been used since it was initially shaped.

When imparted as a result of longitudinal lithic scraping, undulating profiles can appear in the form of chattermarks. These are visually distinctive and, according to Newcomer (1974, 149):

> […] chattermarks seem to be caused by the stone tool bouncing over uneven parts of the bone surface and thus failing to maintain contact with the bone throughout its sweep. An analogous situation occurs on unmetalled roads, which inevitably develop ruts, and corrugations perpendicular to these ruts through the failure of passing vehicles wheels to maintain constant contact with the road's surface.

Discrete and Inclusive Types

Once measurements, degree of completeness, shaft type and shaft profile have been assessed, the gross form of the tool will be typed as a member of one of the discrete categories listed below. These categories, however, do not preclude inclusive analyses of individual features, wherein all tools exhibiting a certain charac-

Point	Point: n = 64, 32 % Point fragment: n = 37, 18.5 %
Incised	Incised: n = 2 Incised point: n = 2, 1 % Incised hollow: n = 4, 2 % Incised irregular: n = 1, 0.5 % Incised shaft fragment: n = 1, 0.5 %
Flat bevel (those tools with a flattened platform at tip)	Flat bevel: n = 5, 2.5 % Flat bevel fragment: n = 4, 2 %
Ovoid	Ovoid: n = 5, 2.5 %
Metapodial	Metapodial point: 4, 2 % Metapodial flat bevel: n = 1, 0.5 % Metapodial fragment: n = 6, 3 %
Spatulate	Spatulate: n = 3, 1.5 % Spatulate point: n = 7, 3.5 % Spatulate flat bevel: n = 1,0.5 % Spatulate point fragment: n = 3, 1.5 % Spatulate ovoid: n = 5, 2.5 % Spatulate ovoid fragment: n = 1, 0.5 % Spatulate shaft fragment: n = 3, 1.5 %
Double ended	Double ended: two points: n = 2, 1 % Double ended: one point one flat bevel: n = 1, 0.5 %
Irregular	Irregular: n = 2, 1 % Irregular point: n = 1, 0.5 % Irregular fragment: n = 1, 0.5 % Irregular: tooth: n = 1, 0.5 %
Indeterminate	Point or double ended: n = 2, 1 % Point/double ended fragment: n = 2, 1 % Base/shaft fragment: n = 1, 0.5 % Flat bevel/shaft fragment: n = 1,0.5 %
Shaft fragment	Shaft fragment: n = 18, 9 %
Base fragment	Base fragment: n = 11, 5.5 %

Tab. 13.1.6 Percentages of discrete types.

teristic (e. g. 'pointed tools') are considered together (e. g. spatulate pointed, point fragment, irregular point, etc.). Though there exists a wider spread of potential categories (e. g. ovoid fragment), only those categories represented within the Taforalt data-set are included. Here tools are assigned to either the 'parent' category (e. g. 'spatulate') or to a relevant descriptive sub-category (e. g. 'spatulate flat bevel') (**tab. 13.1.6**).

From these data, it is clear that most of the discrete types only contain a few elements, with points, point fragments, shaft fragments and base fragments accounting for nearly 65 % of total tools. While types containing only one element may have the potential to be diagnostic (for example, were we to find a harpoon, this would be fairly clear), those represented here are not, and as such the study of categories with few elements (one or two) will be left until later.

Within this discrete categorisation, we separate tools which possess more than one diagnostic feature (e. g. spatulate points), and group them in a qualitative way as members of the category which describes their most 'prominent' feature (e. g. metapodial flat bevels are classed as metapodial tools, rather than as flat bevels). This necessarily prevents tools being considered as members of more than one category. For this reason, an inclusive attribute typology has also been created, wherein a single tool may be counted in multiple attribute categories at once. For example, in this inclusive attribute typology, a spatulate point would be

Category	Subtypes
Symmetrical	Symmetrical pointed (**fig. 13.1.8a**) Symmetrical rounded (**fig. 13.1.8b**) Symmetrical gouged (**fig. 13.1.8c**) Symmetrical rounded gouged (**fig. 13.1.8d**) Symmetrical irregular (**fig. 13.1.8e**)
Acute	Acute pointed (**fig. 13.1.8f**) Acute rounded (**fig. 13.1.8g**) Acute rounded gouged (**fig. 13.1.8h**) Acute irregular (**fig. 13.1.8i**)
Obtuse	Obtuse pointed (**fig. 13.1.8j**) Obtuse asymmetric (**fig. 13.1.8k**) Obtuse rounded (**fig. 13.1.8l**) Obtuse gouged (**fig. 13.1.8m**)
Flat bevel	Snapped (**fig. 13.1.8n**)
Spatulate	Convex spatulate (**fig. 13.1.8o**)

Tab. 13.1.7 Point types.

Triangular n = 12 (**fig. 13.1.10a**)	Minimally modified n = 43 (**fig. 13.1.10f**)
Angular n = 10 (**fig. 13.1.10b**)	Intact anatomical n = 14 (**fig. 13.1.10g**)
Ovoid n = 12 (**fig. 13.1.10c. d**)	Flattened n = 6 (**fig. 13.1.10h**)
Irregular n = 8 (**fig. 13.1.10e**)	

Tab. 13.1.8 Base type counts.

grouped with both 'spatulate' and 'point'. Though some tools will be counted more than once, this allows for more robust comparisons to be made among tools with like features (**fig. 13.1.7**).
This kind of analysis allows trends across otherwise discrete types to become much more clear. From most to least common, the most prominent features of tools from Taforalt are: pointed, spatulate, metapodial, ovoid, flat bevel, incised, double-ended, and irregular.

Point Type

Points, flat bevels (tools with a flattened platform at the point tip; see **fig. 13.1.7n**), and spatulate points (and fragments thereof) are then further classed by point type, based on their point-tip profile. This category considers only the very tip of the point, as the tool itself may have concave, convex or irregular sides, faces or edges (accounted for in the shaft profile). Though other point-type combinations are possible, only those categories represented within the Taforalt data-set are listed in **table 13.1.7** and **figure 13.1.8**.
As with shaft type, these categories may represent different stages of use within the same manner of use, or differences may be due to repurposing, sharpening, etc. There may be correspondences across types as well; for example, 'acute pointed' (**fig. 13.1.8f**) and 'obtuse pointed' (**fig. 13.1.8j**) may have effectively served the same purpose, and similarly 'symmetrical rounded' (**fig. 13.1.8b**) and 'acute rounded' (**fig. 13.1.8g**).
The notion that tools served a singular purpose within their life must also be avoided; along with re-purposing, it is possible that an individual tool could have served many different functions, both synchronically

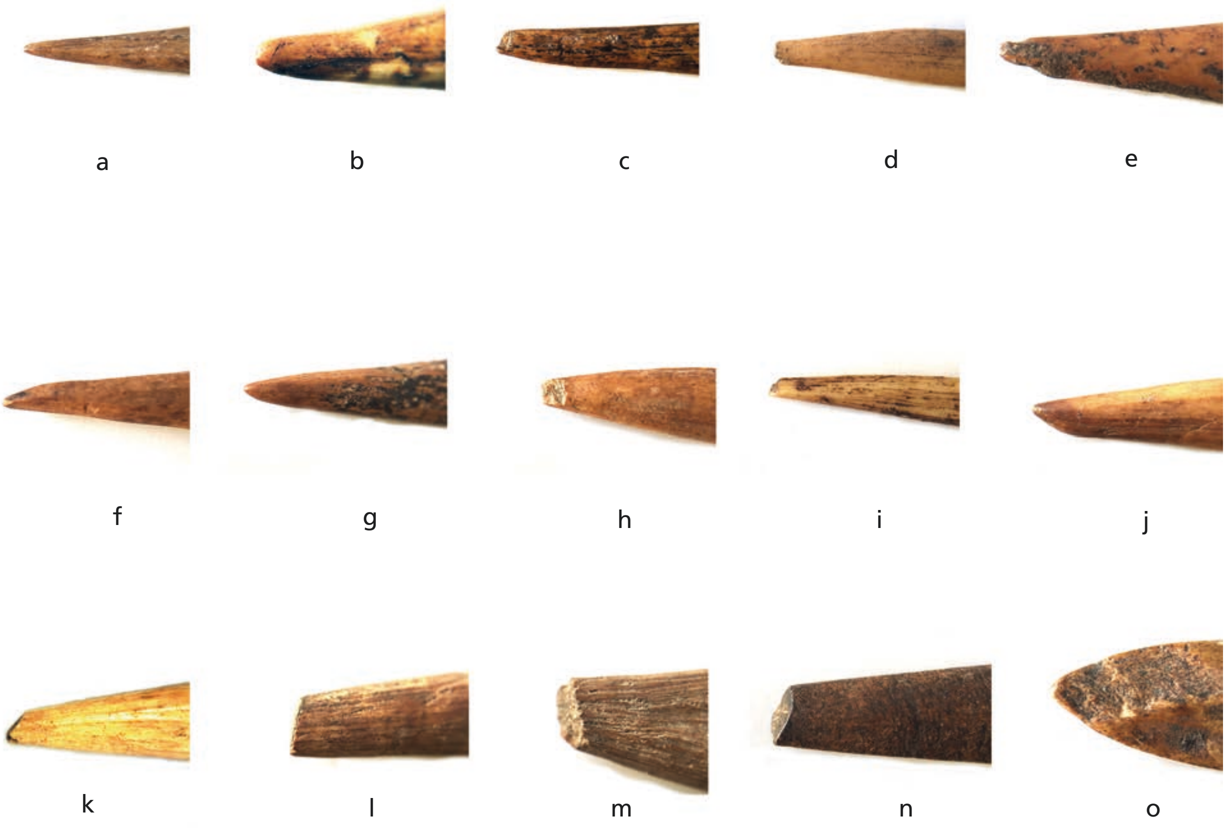


Fig. 13.1.8 Point types. – (After Desmond 2017).

(e. g. using a thin tool as a convenient toothpick) and diachronically (a tool used for one purpose becomes better suited for another purpose as it is used). However, using these data to track correspondences between tip-type and other tool features may allow for an understanding of congruences between different forms, morphologies and kinds of use wear, and, as such, is considered a useful typological metric. Since in most cases the working-end (or tip) of the tool manifests the bulk of the information relating to use, these categories have been expanded to include more types rather than less, in order to get a higher resolution picture of correspondences between tip-type and other tool features. The results of this analysis are as follows (**tab. 13.1.8**, with cross-references to the photographs in **fig. 13.1.8**).

For pointed tools, the most common tip-type is 'symmetrical pointed', normally considered a true point. Not all symmetrically pointed tips however are perfectly sharp; the tip-diameter and roundedness of the point tip should be viewed on a continuum and as potentially representative of different stages of use (e. g. Campana 1989, 69).

Though different tip-types could represent tools of a similar utility in different stages of use, tip-type is still a useful descriptive category, in that it can be combined with other evidence of long-term, repeated use (e. g. an undulating shaft profile, a high degree of polish, a very smoothed base, etc.) to provide evidence for tool creation, curation and use patterns. Diagnostic tip-wear patterns, such as the 'rounded gouge' considered later, may also be indicative of specific functions and we can search for similar distinctive trace markers among ethnographic tools.

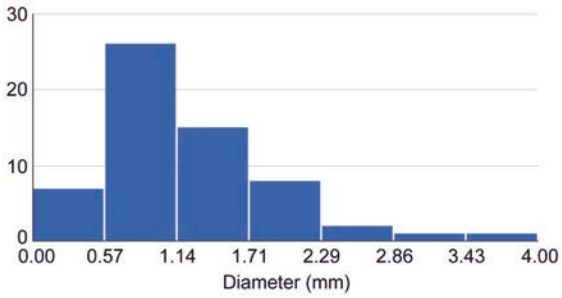


Fig. 13.1.9 Point tip diameter counts.

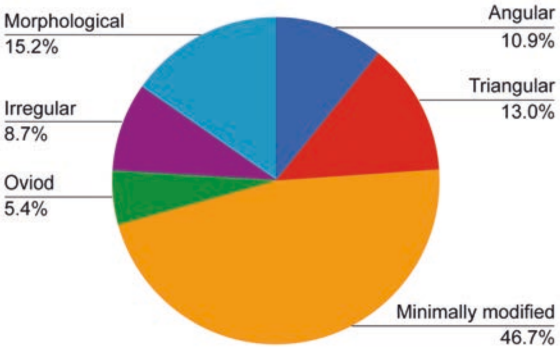


Fig. 13.1.11 Base type percentages.

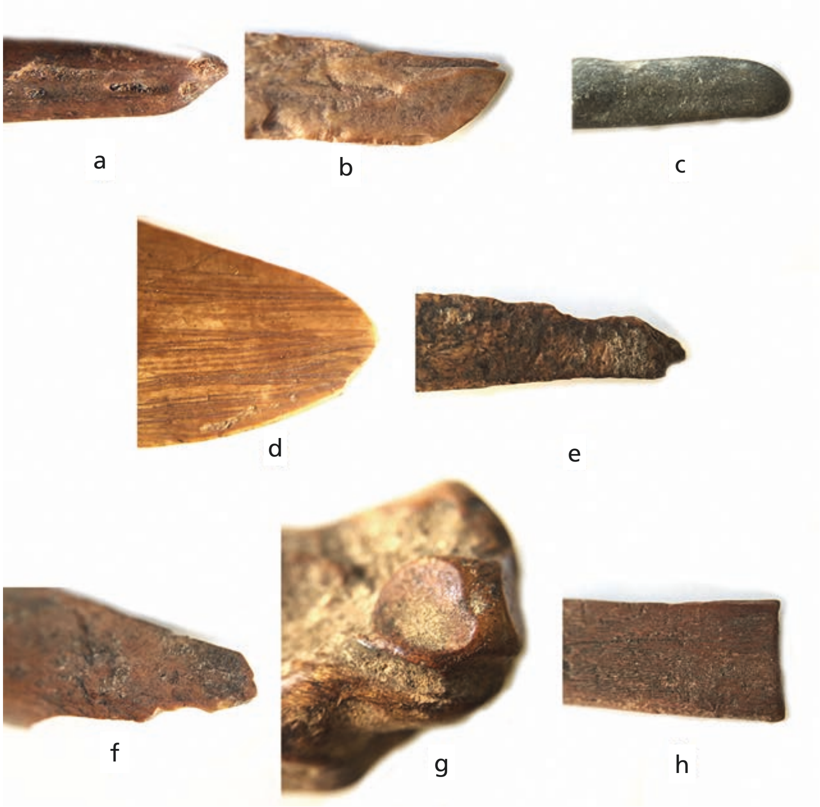


Fig. 13.1.10 Base types. – (After Desmond 2017).

Tip Diameter

Another useful tool for understanding potential uses of pointed implements is to measure the tip diameter. Experimental studies have shown that among pointed bone tools, different tip diameters are suited to different practices; for example, point-diameters above 2 mm are not effective in the penetration of leather (Campana 1989, 57). Tip diameters were measured on a sample of 60 implements with intact points; the average tip diameter is 1.26 mm, with the distribution of tip diameters as shown in **figure 13.1.9**.

As this chart shows, the most common tip-diameter range is between 0.5 mm and 2 mm, which account for just over 88 % of all tools measured. These data underline the trend in small features, size-classes, etc., among points, indicating that these gracile bone points generally had very small tips as well. Clues as to function are further indicated through use-wear present on the tools' tips, discussed at a later stage, which suggests that these were not sharpened to a fine point and then abandoned before use. In order to address the potential for equifinality, however, the only way to investigate particular functionalities is through an examination of use-wear. Though a small point tip size is suggestive, it is the presence of wear to the tip which will suggest specific functions, whether in crafting, weaving, hideworking, projectile use, or otherwise. Tip-diameter data taken together with forthcoming microscopy and micro-topographic analyses may help to uncover specific size-class, point type, point-diameter and use-wear patterning, revealing the presence of repeated industrial types with similar use-wear through time.

Base Type

Next, complete tools, relatively complete tools anf base fragments are categorized by base-type. Along with a tool's working end/point, shaft, and shaft profile, this allows for the presumed 'base', or non-main working end of the tool, to be analysed. This category describes the shape of the base when (if applicable) the tool is lying on its widest side (**tab. 13.1.8** and **fig. 13.1.10**). This represents solely a categorisation based on overall shape, and yielded the results shown in **table 13.1.8** and **figure 13.1.11**.

That the most numerous category among base types is 'minimally modified' is perhaps no surprise; it is this feature, in large part, that allows us to identify the (opposed) working end of the tool. However, correspondences between base type and point type, or base type and shaft type, may be revealed under a more thorough examination of use-wear. For example, tools with an unmodified base and an irregular shaft are less likely to show use-wear on the base end, indicating that the working portion of the tool was highly concentrated at the tip, or in some cases extending no more than halfway down the shaft. Tools which were only used at the tip eliminate a number of potential uses, and, when combined with an examination of use-wear patterning, may suggest specific uses.

Base Smoothing

After the shape of the base has been assessed, we then categorise tools by the degree of smoothing or polish present on the base. Smoothing at the base is a meaningful feature of tools, as it may indicate the stage of use (e. g. from faintly smoothed/less used to very smoothed/highly used). Smoothing and/or polish specifically were not assessed for the tips of the tools; as the tips are the 'working end' of the tool, it is to be expected that they will exhibit use wear here. Smoothing/polish on the base, however, may provide clues as to how the tool was engaged during use, with significant smoothing indicating repeated abrasive contact with a material softer than bone, and can be a good indication of hand-held uses (Campana 1989, 68). We have chosen to examine for 'smoothing' rather than 'polish', as tools which exhibit very smoothed bases may not exhibit polish due to the nature of the bone (e. g. cancellous or spongy), weathering, differential cleaning techniques or the base being obscured by matrix/concretions. In order to assess this, tools have been classed into three categories based on base-smoothing (**fig. 13.1.12**).

- Faintly smoothed (**fig. 13.1.12b**)
- Moderately smoothed (**fig. 13.1.12c**)
- Well smoothed (**fig. 13.1.12d**)

Tools with a well-smoothed base may in some cases have been double-ended tools, although, unless an equal amount of diagnostic use-wear is present at the base of the tool, it will not be typed as such. As a

Fig. 13.1.12 Base smoothing. – (After Desmond 2017).

result, the number of double-ended tools may be an underestimation. Degrees of smoothing may also indicate different stages and/or degrees of use, and as such, tools with different degrees of smoothing on the base should not necessarily be considered to have been used in different ways. For example, tools with well-smoothed and faintly-smoothed bases may have been used the same way, and exemplify different stages of wear imparted by the same function, rather than different uses.

In order for tools to have been classed as possessing 'faintly smoothed' bases, these tools must display more roundedness and/or polish on the base than do tools examined as unmodified taphonomic control samples (e.g. **fig. 13.1.12a**). Photos of these control samples show the degree of rounding that one might expect to occur on unmodified animal bone excavated from the same or neighbouring archaeological contexts. Since some unmodified faunal controls show incipient rounding (assumed to be post-depositional), a slightly more advanced (yet still 'faint') degree of rounding has been taken as the threshold for recognition as an artefactual effect here. The degree of smoothing on base types is shown in **figure 13.1.12**.

As this chart shows, the degree of smoothing when all tool bases are considered together is almost equally distributed between the three categories. We can further examine degrees of base smoothing by tool-type, to see if this internal ratio holds true among different tool-classes, particularly points (**fig. 13.1.13B**). Among points, a different patterning of abrasion to the tools' bases emerges. Here, faint smoothing is present on 39.4 % of tool bases, moderate smoothing on 18.2 %, and well smoothed bases are evident on 42.4 %. Clearly there is a visibly higher percentage of well-smoothed and faintly smoothed bases among pointed types, and this may be an indication of different curation of pointed tools (e.g. used for longer durations) and/or an emphasis on hand-held uses among tools with these attributes.

The presence of different degrees of base smoothing demonstrates that the tools at Taforalt likely represent different 'life' stages of tools with similar uses. Among tools with hand-held uses, faint smoothing at the base of the tool can be an indication of earlier stage uses, where the abrasive, repeated contact of the hand in using the tool has only begun to wear-down the tool's base. This logically exists on a continuum with later-stage tools, which would themselves display heavily smoothed bases; these tools may also display other signs of heavy use and/or curation in the form of an undulating profile, high all-over tool polish, a rounded or re-sharpened tip, etc. While this analytical stage merely represents an assessment of particular attributes extant among Iberomaurusian bone tools from Taforalt, it is still possible to detect a number of use-stages among tools which likely served similar functions. The next research stage will be to identify ethnographic tools with like morphologies, which may have had analogous functions. The specific use-wear imparted as micro-typography through performing specific tasks (e.g. in piercing hides, crafting basketry, etc.) can then be identified, and an assessment of similar functionality can be further constrained through the comparison of archaeological and ethnographic tools with similar overall morphological attributes. Even in this initial comparison of size-class, shape, tip-type, base-type, base smoothing and undulating profiles, there are clear indications of long-term, repeated technological traditions present in the bone tool assemblage.

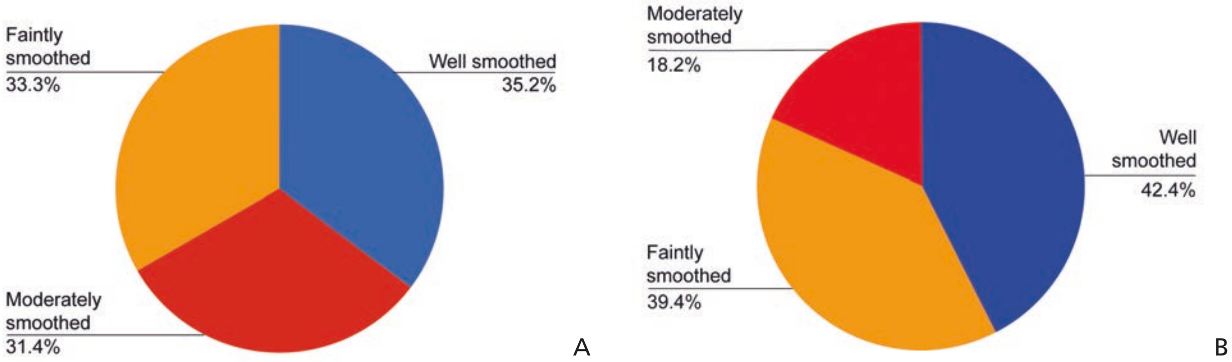
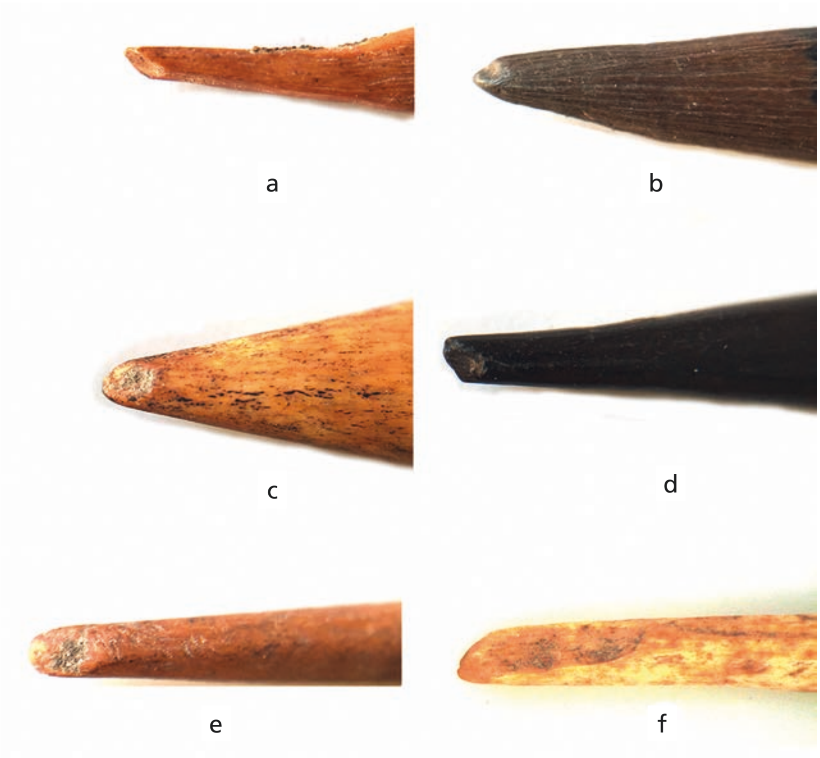


Fig. 13.1.13 Base smoothing percentages: **A** all types; **B** points.

Fig. 13.1.14 Rounded gouges.



Emergent Typological Categories

One of the benefits of using an assessment of individual tool attributes rather than an eponymous functional-based typology (with categories such as 'pins', '*lissoirs*', etc.) is that unique features of the collection can be described as they emerge. In this way, features which would not be accounted for under prefabricated typological schema can be considered, classed, and used to direct later stage use-wear investigations. At Taforalt, a number of pointed tools retain distinctive use-wear to the point-tip in the form of a rounded gouge or divot (**fig. 13.1.14**). This repeatedly occurring use-wear element is evident as a smoothed-over hollow, appearing at one side of a point-tip. While it remains possible that these represent slightly broken points which have subsequently been worn (because the overall point was still functional), or a concavity attributable to the interplay between stresses and bone structure, they may also represent a specific, repeated manner/gesture of use associated with a particular function.

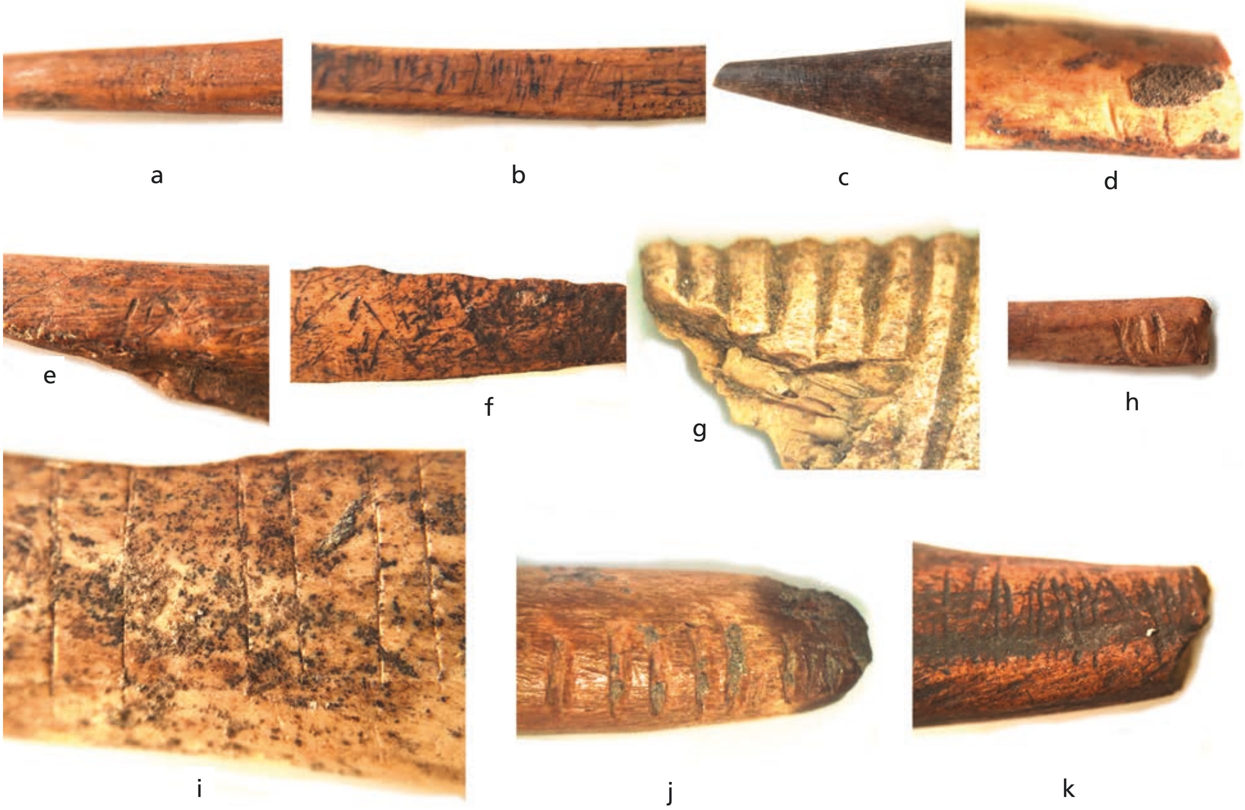


Fig. 13.1.15 Incisions and transverse use-wear: **d. g-k** incisions; **a-c. e-f** transverse use-traces.

Rounded gouges appear on 13 complete, relatively complete or point fragment tools. While the origin of this hollow is as yet obscure, this pattern may be identified on ethnographic tools of a known function, and determined to be likely a product of broken tip wear, natural mechanical stressors, or a specific and repeated bone tool functionality in place at Taforalt during the Iberomaurusian.

Furthermore, a number of tools at Taforalt have distinctive macroscopic transverse striations, either in the form of use-wear visible to the naked eye (**fig. 13.1.15a-c. e-f**) or intentional decorative/functional notching (**fig. 13.1.15d. g-k**) to the tools' shafts. In these cases, transverse use-wear occurs in the form of scratches, incisions, scoring, etc., perpendicular to the tool's main axis. Transverse use-wear is particularly useful, as it can indicate a working direction-of-movement inconsistent with longitudinal uses (e.g. a piercing-motion), and can serve as evidence for more complex articulations with other materials (e.g. crafting). In some cases, such macroscopically visible transverse wear may represent a later use-stage, where a tool has been abraded long enough to produce deep, visible striations. It is important therefore also to look for smaller, micro-topographical transverse scratches, which may be indicative of an earlier use-stage. Incised tools also provide important data relating to use and/or function. In future use-wear analyses, an attempt will be made to distinguish decorative incisions from notching related to functional uses (e.g. hafting), based on high magnification microscopy, comparative assessment with ethnographic bone tools and, potentially, an experimental programme.

Preliminary naked-eye and low magnification microscopic assessments revealed this kind of use-wear on a total of 27 tools from the categories shown in **figure 13.1.15**.

It is interesting to note that transverse use-wear appears on almost every tool type evident at Taforalt, from points to ovoid tools to spatulate tools. This is crucial in the understanding of each of these types' uses, as use-wear may only be evident on tools at a later 'life' stage (e.g. more heavily used), may be obliterated by the nature of the worked surface (e.g. polish may obscure fainter use-trace evidence) or in curation of the tools (e.g. lithic resharpening). The specific location, angle, and degree (e.g. diffuse, clustered) and nature of this use-wear also provide a much stronger platform for comparison with ethnographic tools.

Discussion and Conclusions

As a typological description of the Iberomaurusian bone tools from Taforalt cave, this study aims merely to provide a preliminary description of the 200 tools currently available for analysis. This was done in order to develop a record of the patterning of specific tool attributes and features, so that these can inform future taxa selection and use-wear investigations. These data can provide a basis for assessing typological use-wear patterning, which will then be compared with ethnographic wooden and bone tools (after Soffer 2004). As such, the goal in collecting and extracting patterning from these data is not merely to type the tools but also to allow for coherent comparisons of inter- and intra-assemblage use-wear patterns (such as whether transverse use-wear occurs only on tools of a certain size class, whether tools from geographically proximate sites show the same repeated types, etc.). While individual data-sets (like size-class) cannot enumerate specific functions, they do eliminate certain functional possibilities, and constrain comparative analyses to ethnographic tools exhibiting like features. Patterning in size-class does reveal a concerted technological strategy at Taforalt; the repeated construction and use of implements with a specific shape and size suggests a well developed bone tool industry, rather than an opportunistic and haphazard use of bones as tools. It also suggests use-based, repeated articulations through time and space; whatever process(es) imbued tools with the specific macro-wear patterning seen here, it can be said that these processes are industrial, repeated undertakings rather than one-time extemporaneous occurrences. This is bolstered by data gleaned from ZooMS testing, which suggests that specific and less-common taxa are repeatedly selected for the construction of particular tool types (Desmond et al. 2018).

Points are the most numerous type evident within the Taforalt tools. A basic trend in size-patterning shows us that points are overwhelmingly 'small' when compared to other elements of the bone tool assemblage (**fig. 13.1.2**); however, size and shape are not enough to suggest functionality among these tools. Based on size and shape alone, the point assemblage from Taforalt matches the dimensions of South African bone arrowheads, as well as bone awls from Prehistoric Missouri (Bradfield/Lombard 2011, 69; Chomko 1975, 34). For this reason, it is necessary to look for indications of use on the tool itself. The presence of polish on the base (indicative of long-term repeated handling and/or use; see Campana 1989, 131), tip-ends displaying rounding, and the absence of diagnostic impact fracturing (e.g. Letourneux/Pétillon 2008; Bradfield/Lombard 2012; etc.) suggest that this was likely not a projectile-focused industry. Future micro-topographic analyses will further bolster the understanding of these types by examining minute use-wear traces, and either refute or substantiate particular functional uses (e.g. as projectile-points), based on comparisons with ethnographic collections exhibiting like features (e.g. tools with similar size-ratios, profiles, bases and tips, tip points, polish, etc.).

Points and point fragments also, therefore, comprise the most common type represented in exclusive categorisations, wherein each tool is counted as a member of a single class. Points and point fragments account for 101 out of 200 total elements, or 50.5 % of the total assemblage. The next most common types are shaft and base fragments, which account for 29 out of 200 total elements, or 14.5 % of the total assemblage. However, because base and shaft fragments lack a diagnostic tip end, points could in fact represent up to 65 % of the total assemblage (if all base/shaft fragments were originally pointed tools).

Moreover, other tools with a pointed tip (such as metapodial and spatulate pointed tools) were not classed as ‘points’ within the exclusive type categorisations, indicating a further potential for underrepresentation. The third most numerous tool category (spatulate points) accounts for only 7 elements out of 200 (or 3.5 % of the total assemblage). The fourth most common exclusive type (metapodial fragments) accounts for 6 elements, comprising 3 % of the total assemblage. Each of the remaining exclusive type categories have less than 5 elements each, and individually represent less than 3 % of the total assemblage. Exclusive tool categories are useful in determining the overall industrial focus of a given assemblage; at Taforalt, this clearly seems to have been the production of pointed tools. However, classifying the tools within an inclusive typology is also useful. Within an inclusive typology, a single tool may be counted multiple times; however, this analysis effectively circumvents the over- or underrepresentation of specific tool features that arise as a result of assigning individual tools to exclusive categories. Here again, tools with a pointed element dominate the assemblage, representing 67.9 % of inclusive tool types. The next most commonly recognised feature is tools which are spatulate, representing 9.5 % of inclusive tool types. Even within an inclusive appraisal of features, all other types each represent less than 5 % of the total assemblage. This underlines the results from exclusive typologies; namely, that pointed tools overwhelmingly dominate the Taforalt assemblage.

In addition to individual features (e. g. pointedness, shaft shape, etc.) represented on a given tool, size plays an important role in constraining the potential uses of the bone tools considered here. In an assessment of all complete or relatively complete tools of all types, the average length is 83.4 mm, and the average width of a tool is 11.9 mm. These provide an average ‘size-value’ of 31.5 mm. This average size-value can be used to plot the relationship of an individual tool or group of tools to the assemblage overall. For example, it is clear that pointed tools have smaller overall size-values than the average of all types; pointed tools have a smaller average length (71.6 mm) and an average width (8.65 mm).

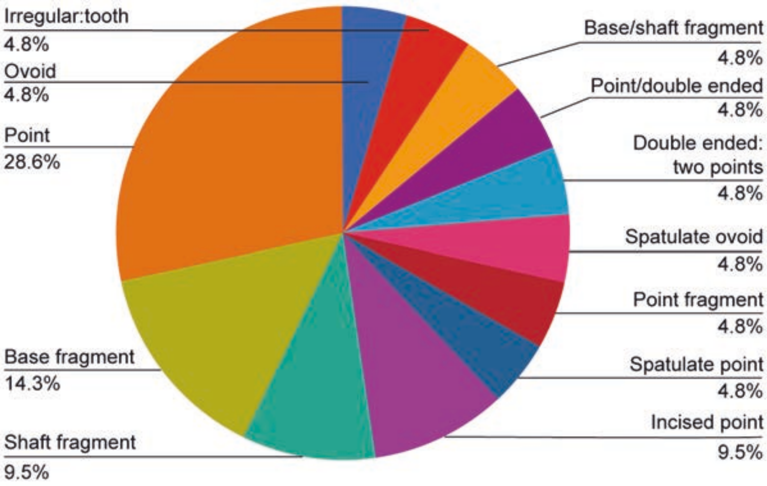
Furthermore, this categorisation includes the potentially larger pointed metapodial tools and pointed spatulate tools, indicating an industrial emphasis on the creation of small, gracile pointed tools.

It is therefore prudent to examine what exactly constitutes a ‘point’. The most obvious way to assess this is by looking at the point-tip itself, and attempting to characterise differences which appear here (**fig. 13.1.8**). Among pointed tools, the most common point types are as follows:

- Symmetrical pointed: 28 %
- Symmetrical rounded: 19.5 %
- Gouged: 11.9 %
- Acute rounded: 11.9 %
- Snapped (flat bevel): 10.2 %
- Acute pointed: 5.1 %

Other point types do exist, but each accounts for less than 5 % of the total. As discussed previously, diverse point types may be the result of similar to identical uses, merely representing different stages of use or idiosyncratic use (e. g. individual handedness, technique, etc.). For this reason, it is also informative to collapse these refined categories into broader ones. One example of this is points which display a degree of smoothing / roundedness; this in turn indicates repeated abrasive articulation with materials softer than bone. Such point types include symmetrical rounded, acute rounded, obtuse rounded, snapped, and convex spatulate points, which together account for 46 % of pointed tools. As smoothing and roundedness only develop at a sufficiently advanced stage of use, some of the remaining tools may have been used for similar or identical functions but were simply lost / deposited at an earlier stage of use. Furthermore, tools may have been re-sharpened to re-establish an effective point; this would have obliterated any rounding or polish which had previously accrued through use.

Fig. 13.1.16 Transverse use-wear by type.



The diameter of individual point-tips can be useful in exploring what functions these tools could have effectively served. For example, point tips with diameters greater than 2 mm have been experimentally shown to be ineffective in the penetration of leather (Campana 1989, 57). At Taforalt, tools with tip diameters between 0 and 2 mm account for 88.3 % of pointed tools, tools with tip diameters greater than 2 mm account for 11.7 %, and the average tip diameter of pointed tools overall is 1.26 mm. So far, we see that most tools are small, pointed, and have point-tip diameters of around 1.26 mm. These data suggest that a likely utilisation in refined mechanical tasks which would necessitate such gracile tools, and eliminate other functional purposes, such as functions involving torsion or forceful impacts (e. g. as tools used as chisels, prises, etc.), which would certainly have left an archaeological signature in the form of repeatedly broken point-tips without smoothing or rounding.

Another consideration which can provide clues as to tool function is the presence of features on the tools' bases. When all tools which have intact bases are considered, the degree of smoothing evident on each falls into three roughly equal categories. Tools with faint base smoothing account for 33.3 % of this subset, moderate base smoothing 31.4 % and well smoothed bases 35.2 %. Clearly, tools with moderately and well smoothed bases comprise the majority of the assemblage, and it would be reasonable to infer that these differential degrees of smoothing may be linked with different stages of use. Tools with well smoothed bases are commensurate with hand-held uses, where they articulate with the user's hand and become smoothed-over through time. However, alternative causes for this must also be explored. Hafted tools, for example, generally do not display significant smoothing of bases, but it will be important to examine the kinds of wear produced by different hafting techniques in a comparative assessment.

Interestingly, when only points (as the dominant component of the assemblage) are considered, a different pattern of base smoothing emerges. Among pointed tools with intact bases, faint smoothing accounts for 39.4 %, moderate smoothing 18.2 % and well smoothed bases 42.4 %. Among pointed tools, there is thus a higher percentage of well-smoothed and faintly smoothed bases, differing from the more regular continuum seen when considering all tools with intact bases. This may be an indication of different use-stage or curation patterns evident among pointed tools, and may further indicate their use in effecting tasks in which they were held in the hand.

Considering a tool's shaft can likewise provide insight into tool construction and use patterning. For example, tools with a marked asymmetry to their shaft may indicate functional gestures necessitating preferential use or abrasion to one 'side' of the tool. Tools which retain anatomical shafts or have ancient breaks (present during use) indicate that in these cases, the shaft was not heavily shaped or worked. As such, the method of use in these cases did not put the tool's shaft into repeated contact with abrasive material. This knowledge can be used to constrain further the potential functions. Among all complete and relatively complete bone tools at Taforalt, the most common shaft types are:

- Parallel converging: 28.4 %
- Asymmetric angled: 12.3 %
- Parallel: 7.4 %
- Asymmetric convex: 7.4 %
- Asymmetric steep mid-shaft angle: 7.4 %
- Convex tapering: 6.2 %
- Irregular: 6.2 %
- Convex: 6.2 %

All other shaft types present within the assemblage each represent less than 5 % of the total. Through assessing the shape of tools' shafts, patterns indicating or precluding specific functions already begin to emerge. For example, tools with asymmetrical shafts would normally preclude an effective use as projectile tips (Henshilwood et al. 2001; Bradfield 2016). We see that symmetrical shaft types account for 46.9 % of the assemblage and asymmetrical shaft types account for 53 %. While a tool's having a straight shaft is not enough to suggest projectile use (based on this feature alone), having an asymmetrical shaft usually makes use as a projectile implausible. As over half of the total tools within the Taforalt assemblage could not have been effectively used as projectiles (based on shaft asymmetry), this, along with other data (such as smoothing present on bases, roundedness and polish to point tips, etc.), suggests that production of bone points as projectiles at Taforalt was not the primary industrial objective. The 46.9 % of tools with symmetrical shafts should be assessed for other features which may give clues as to their function, projectile or otherwise.

In addition to the overall shape of a tool's shaft (described in 'shaft type'), tools' shafts may also display different degrees of undulation. Undulation occurs when the topographic irregularities present on a tool's shaft (e. g. breaks, original bone morphology, etc.) have been smoothed over. This can occur as a result of repeated abrasion during use or through intentional lithic scraping, and gives the tool a 'wavy' profile. Here, 64.1 % of tools have a straight (or non-undulating) profile, and 35.3 % of tools exhibit some degree of undulation. Like shaft-type, if shaft undulation is asymmetrically distributed, this may give clues as to the working portion of the tool (e. g. with one side or edge more smoothed over). Undulation may also provide evidence for a given tool's stage and manner of use; for example, heavily undulating tools which do not retain clear lithic striations indicate that this is the result of an advanced degree of use-wear, during which the tool was repeatedly abraded against another material, resulting in smoothing to elevated shaft surfaces.

Repeating suites of features present within the assemblage suggests the repeated production of specific industrial types (presumably with related industrial functions). This hypothesis has been bolstered by ZooMS analyses, showing that gazelle and hartebeest were being preferentially selected for the construction of long, thin, gracile points (Desmond et al. 2018). Examinations of bone tools in the ethnographic present have shown that particular taxa were selected for tool construction based on favourable histological properties (Dominy et al. 2018), and Palaeolithic peoples would have been familiar with the mechanical properties of different animals' bones (Bradfield 2018; Newcomer 1974). Bone tools considered here come from all levels of the cemetery including those dating from shortly after the onset of Grey Series sedimentation to potentially later levels (such as the "Sep A" stratigraphic level in *Nécropole 1*).

At this analytical stage, it is necessary to situate the emergent bone tool trends and features discussed above within their larger cultural and archaeological contexts. Bone tools do not constitute a natural ontological

Fig. 13.1.17 Modern Esparto crafting in Tafoughalt. – (Photo courtesy of Jacob Morales).

category as 'artefacts', but are rather constituent components of a wider cultural and technological complex, based on materials engaged in human practice through time. As such, results gained from complementary lines of archaeological inquiry can serve to illuminate bone tool patterning in suggestive ways. At Taforalt, the Grey Series levels in which these bone tools were found show an intensification in three main food resources; *Quercus* sp. (acorns) and *Pinus pinaster* (pine nuts), and five dominant species of edible mollusc (Taylor et al. 2011). As evidenced in both the skeletons (in the form of dental caries; see Humphrey et al. 2014) and in macro-botanical analyses, this intensification in acorns, pine nuts, and edible molluscs as food resources would have necessitated advanced collection, transport, processing, cooking, and/or storage techniques and technologies. The ubiquitous presence of *Stipa tenacissima* (Esparto grass) rhizomes throughout the Grey Series deposits suggests that the Iberomaurusians were using this as a material for the production of vegetal crafts. It is clear that the grasses were carried to the site whole with roots intact: Esparto rhizomes (root portions) were discarded and burned, and the stalks were likely used as a crafting material (e.g., for baskets, cordage, netting matting, etc.) (Humphrey et al. 2014). Esparto crafting persists into the ethnographic present, particularly in Morocco and southern Spain; in the region surrounding Taforalt, modern artisans still practice Esparto weaving with use of a long, thin, pointed tool (**fig. 13.1.17**). Grey Series faunal remains are dominated by *Ammotragus lervia* (Barbary sheep) (Desmond et al. 2018; **Chapter 9.1**); animal skins, fur/wool, etc. could also have served as raw material for the construction of food collecting, processing, and storage technologies, as well as other uses (such as clothing, bedding, etc.). Though hides, baskets, and other perishable crafted forms are not prone to archaeological survival, the technology used to produce such forms may still be in evidence; namely, in the bone tools used to produce these items. The above feature-based analyses of the Taforalt tools indicate that 53 % have markedly asymmetrical shafts, making their use as projectiles implausible (Henshilwood et al. 2001; Bradfield 2016). While pointed forms overwhelmingly dominate the Taforalt assemblage, most pointed forms also show base-wear commensurate with hand-held uses (Campana 1989). Among those pointed forms with anthropogenic smoothing on the base (i.e. greater smoothing/rounding than that which would be expected to occur postdepositionally), 39.4 % exhibited faint smoothing, 18.2 % moderate smoothing, and 42.4 %

had well-smoothed bases, indicative of tools at different stages of use and/or curation. Further, 46 % of pointed tools displayed visible rounding and polish at the point-tip; this may be an underrepresentation, as such wear-patterning only develops at a significantly advanced stage of use, and may be obliterated by subsequent re-sharpening. Within the Taforalt assemblage, 88.3 % of pointed tools had tip diameters between 0 and 2 mm, and experimental studies have shown that bone point-tips over 2 mm in diameter are ineffective in penetrating leather (Campana 1989, 57). Furthermore, no tools display diagnostic impact fracturing, here taken to be spin-off fractures of greater than 6 mm (Bradfield/Brand 2013). While none of these features are individually conclusive, they are collectively suggestive. In order to substantiate archaeological indications of craft activities (implied both by bone tool features and corresponding lines of archaeological evidence), it is necessary to examine the tools for use-traces which are diagnostic of craft activities. Through an examination of use-traces, bone tools used in craft activities can offer insights into constructed technological forms used in food collection, preparation, and storage (e.g. the use of baskets or hides), clothing, bedding, and other seemingly 'invisible' life-ways. Use-trace analyses performed on bone tools from other Palaeolithic contexts have shown that it is possible to diagnose and distinguish industrial activities such as leather/hide working (Akhmetgaleeva 2017; Buc 2011; Campana 1989; etc.), textile weaving (Campana 1989; Soffer 2004) and vegetal crafting (Buc 2011; Campana 1989; Stone 2015; etc.), based on an examination of microtopography. Taken together, these disparate lines of evidence may form robust inductive proxies for the use of perishable materials, and exponentially enhance our understanding of how the Iberomaurusian transition towards sedentism was facilitated technologically.

It is crucial to deploy such a framework at an early analytical stage, in order to avoid the pitfalls of 'received wisdom' in bone tool categorisations. Studies based on use-wear and experimentation have revealed a world-wide bias in the Palaeolithic bone tool interpretive record, wherein many bone tools are presuppositionally (mis-)characterised as weapons. An in-depth analysis of morphology and use-traces among Natufian and Zagros bone tool assemblages has shown that from a total of 312 Natufian bone objects, only 17 had use-wear consistent with hunting/projectile weaponry (Campana 1989). Use-trace analyses instead indicate that craft-related activities (such as net-making, basketry, hide-working, weaving, and other textile arts) account for the majority of the assemblage, formerly assumed to be weapons-dominated (Campana 1989). This is not an isolated case; rather, mischaracterisations of bone tools seem to occur widely and consistently. Bone tools from a number of Upper Palaeolithic European sites (from France, Germany, Czechoslovakia and Russia) were shown to retain clear weaving use-wear. These, however, were catalogued primarily as weapons, tools for animal-processing, or as enigmatic objects (Soffer 2004). Original categorisations of these tools include spear-tips, *pointes de sagaie*, *lissoirs* and *polissoirs*, *bâtons de commandement*, *lochstabe*, *baguettes demi-rondes*, spatules, etc. (Soffer 2004). Studies of Magdalenian bone tools showed that these too displayed hitherto unrecognised use-traces commensurate with perishable crafting (Stone 2011; 2015). In southern Africa, a study of putative MSA and LSA 'arrowheads' revealed similar inconsistencies (Bradfield 2016). Many tools initially classed as weapons were shown to retain use-traces consistent with hide-working and woodworking (Bradfield 2016).

Taken together, these studies indicate that simplistic and/or presuppositional appraisals of bone tools' function are both insufficient and inaccurate. World-wide, bone tool assemblages have been shown to contain a great internal functional diversity, and historical frameworks for categorising bone tools have effectively obscured this variety in use. Such potential under-recognition probably extends beyond miscategorisation, as many tools used in the creation of textiles will display wear only on the tool's shaft (e.g. battens), and it is disconcerting to consider the number of weaving/crafting tools which might not have been identified as tools at all, due to their lack of diagnostic 'ends' (e.g. Soffer 2004). This is likely due, in part, to preservational vagaries inherent at sites dating to the Palaeolithic. For example, if the organic products of craft activities have not survived burial for tens of thousands of years, these products (and the technological know-how used to make them) are unlikely to be accounted for in the development of bone tool typo-functional frameworks. Insights into this 'missing' technocomplex can be glimpsed through a comparative assessment with recent prehistoric sites with favourable preservation. In many dry cave sites, fibre artefacts outnumber stone artefacts by a factor of 20, and in waterlogged sites, wood and fibre artefacts often account for more than 95 % of recovered materials (Taylor 1966; Croes 1997, as referenced in Soffer et al. 2000). While organic and crafted products in the Palaeolithic may have been less elaborate and / or less numerous than more modern examples, even conservative estimations of their archaeological underrepresentation are high. One suggestion places the Old World archaeological recovery-rate at a mere 15 % of the cultural materials actually in-use, and many believe even this to be a modest estimation of cultural-product loss (Clarke 1968; Soffer et al. 2000).

These considerations underline the need for a robust *chaîne opératoire* approach to bone tools. The formulation of an in-depth descriptive catalogue serves here not as an end-goal of the study but, rather, as a platform from which to approach different stages in the bone tool *chaîne opératoire*. The use of an individual feature-based typology allows emergent features of the collection to direct archaeological investigations; in other words, the tools 'describe' themselves. In a feature-based schema, typological categories (shape, size-class, etc.) emerge from a consideration of the tools at hand. This method does not rely on the *ex post facto* application of pre-conceived typological tool categories (e. g. '*lissoirs*', 'awls', etc.). When the results of each feature assessment are considered together, patterns in construction and use clearly begin to emerge. Perhaps most importantly, this typology provides a firm and scientific basis for selecting like comparative material from ethnographic and experimental tool collections. Ethnographic tools with similar typological features to those recovered from Taforalt can be assessed for use-traces, and these traces can be compared to the traces evident on the bone tools from Taforalt. When there exists a good match between overall feature patterning and microwear patterning, it will become possible to create best-fit use scenarios for the Taforalt tools, and to build an evidence-based understanding of how these tools may have actually been used. Following the forthcoming comparative microscopy and micro-topographic analyses, and when paired with ZooMS analyses, it will become possible to determine robust best-fit scenarios for both individual tool and tool-class functionalities based on biological taxa (the source bones) and ethnographic use-wear congruences (e. g. Soffer 2004; Stone 2011; Desmond et al. 2018). After bringing together data regarding the taxa from which the tool was created, ethnographically and / or experimentally consistent use-wear patterning, it will be possible to tailor experimental studies in order to substantiate specific tool-uses and life-history narratives. The applications of this method are potentially quite profound, as understanding bone tool functionality in early sedentistic LSA contexts (like those evident at Taforalt) is a vital step in understanding how cultural transitions (and concomitant new lifeways) were orchestrated technologically, without having to rely solely on the lithic record.

Once the life history of a tool has been tightly defined, it will become possible to subject tools to more qualitative analyses, aimed at understanding the associated meanings and larger cultural contexts within which tools were used. For example, do certain types of bone tool (or bone tool taxa) occur repeatedly within burial contexts (see Desmond et al. 2018)? Are tools notched for functional purposes (e. g. to aid in hafting) or as exemplars of aids to memory and / or notation (e. g. tally sticks)? Do pigment-bearing tools indicate a superficial post-depositional transfer, or is pigment found within use-traces, indicating use-based contact with pigmented materials? Are bone tools or bone tool types associated with other artefacts (e. g. lithic cores, ochre, etc.) in a statistically meaningful way? It is our hope that the application of diverse and multi-scalar methods to bone tools will elicit a coherent scientific narrative, encompassing and bridging this critical cultural and technological phase.

A. FREYNE

13.2 SHELL ORNAMENTS

The recent excavations of the Late Stone Age (LSA) levels from Sector 8 and Sector 10 have produced several marine and freshwater shells, some of which show evidence of human modification, that have been interpreted as ornaments or special items.

Methods

All of the shells were collected in the course of excavation and sieving and identified using field identification guides.

Sector 8

The Sector 8 shells were excavated from two vertical sections, around 20 cm wide and about 3 m apart, running to a depth of about 4-5 m, excavated from 2003-2010 (Barton et al. 2013; Taylor et al. 2011; **Chapter 8**).

Find no.	Year	Sector	Unit	Identification			Length mm	Width mm	Perfora-tion Y/N	Ochre Y/N
Gastropods				Family	Genus	Species				
<1279>	2004	8	Y2	Littorinidae	*Littorina*	*obtusata*	13	10	Y	N?
<1297>	2004	8	Y2	Littorinidae?			6	4	Y?	N
<9226>	2010	8	L16	Turritella			27	11	Y	N
<10127>	2010	10	S10 GS	Nassariidae			20	12	N	N
Bivalves										
<2993>	2005	10	S10 GS	Unknown			41	46	N	Y?
<6088>	2008	10	S10 GS	Cuspidariiae	*Cuspidaria*		26	24	N	Y
<8016>	2009	8	L5	Unknown			28	15	N	N
<12025>	2013	10	S10 GS	Glycymerididae	*Glycymeris*	*nummaria*	46	46	Y	N
<15086>	2016	10	S10 BL	Ostreidae	*Ostrea*	*edulis?*	81	59	N	Y
Scaphopods										
<1436>	2004	8	L10	Dentaliidae	*Dentalium*		8	5	N/A	N
<2590>	2005	10	S10 GS	Dentaliidae	*Dentalium*		11	4	N/A	Y
<3511>	2005	10	S10 GS	Dentaliidae	*Dentalium*		17	5	N/A	Y
<4214>	2006	10	S10 GS	Dentaliidae	*Dentalium*		17	5	N/A	Y
<5848>	2008	10	S10 GS	Dentaliidae	*Dentalium*		14	5	N/A	Y?
<12532>	2015	10	S10 GS	Dentaliidae	*Dentalium*		12	4	N/A	Y
<13791>	2015	10	S10 GS	Dentaliidae	*Dentalium*		32	7	N/A	N
<14415>	2016	10	S10 GS	Dentaliidae	*Dentalium*		30	5	N/A	N
<14622>	2016	10	S10 GS	Dentaliidae	*Dentalium*		21	5	N/A	N

Tab. 13.2.1 Sector 8 and Sector 10 shell ornaments, with year, stratigraphy, identification, dimensions and modifications.

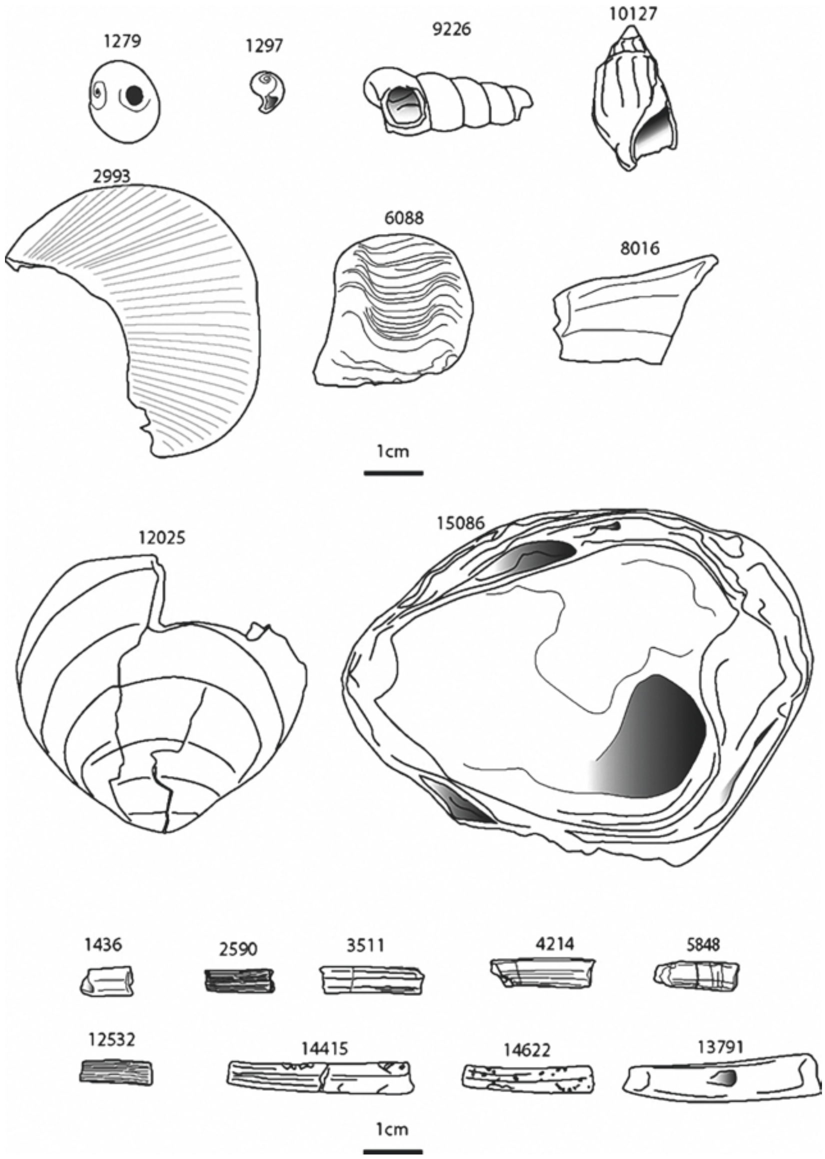


Fig. 13.2.1 Drawing of Sector 8 and Sector 10 shell ornaments (recent excavations).

Sector 10

One shell from Sector 10 comes from the ‘Brown Layer’ (BL, equivalent to Roche *Niveau IX*) and the rest are all from the overlying ashy facies of the Grey Series (GS).

The shells are grouped below by sector and then by taxon, with a summary of the information in a table (**tab. 13.2.1**). Family, genus and species are identified where possible, using identification guides which are referenced in the shell description. All shells are drawn in **figure 13.2.1** (with photographic illustrations in **fig. 13.2.2**).

Fig. 13.2.2 Photographs of Sector 8 and Sector 10 shell ornaments (recent excavations): **a** *Littorina obtusata* showing round perforation; **b** *Littorina* sp.(?) with notch; **c** *Turritella* sp. with perforation; **d** *Melanopsis* sp.; **e** Bivalve, species unknown; **f** *Cuspidaria* sp.; **g** *Glycymeris nummaria* with perforation at the umbo. Worn smooth by use or by wave action; **h** Bivalve, species unknown; **i** *Ostrea edulis*; **j** *Dentalium* sp.; **k** *Dentalium* sp.; **l** *Dentalium* sp.; **m** *Dentalium* sp.; **n** *Dentalium* sp.; **o** *Dentalium* sp.; **p** *Dentalium* sp.; **q** *Dentalium* sp.; **r** *Dentalium* sp. – Scale 2 cm; details scale 1 cm.

Results

Sector 8 Gastropods

<1279> *Littorina obtusata,* flat periwinkle – Unit Y2

This is a marine gastropod which lives in the littoral or sublittoral zone and is found in many regions, including the western Mediterranean (Robin 2008, 117; de Kluijver/Ingalsuo/de Bruyne 2016).

This specimen is a small (13 mm × 10 mm), globular beige-coloured shell, which bears a 3 mm wide perforation on the body whorl, opposite to the aperture. This appears to have been randomly placed, as it is not located conveniently in relation to the aperture for stringing, and is very round with a bevelled edge on the outer surface. The shape and location distinguish this perforation as having most likely been made by a predator rather than by a human (Stiner 1999, 740-741). Although the shell was not manufactured into a bead, it may have been used as one, and may indeed have been collected due to its potential to be strung using this perforation.

This, and potentially <1297> (see below), are the only *L. obtusata* found at Taforalt during the current round of excavations since 2004; Roche does not report any from his excavations.

<1297> *Littorina* sp? Juvenile – Unit Y2

This shell has been tentatively identified as a juvenile *Littorina sp.* (de Kluijver/Ingalsuo/de Bruyne 2016), as it looks very similar to <1279> in colour and shape, but is far smaller, measuring only 6 mm × 4 mm. This specimen is also a beige-coloured globular sea snail. It is broken next to the aperture, and this may have been due to the presence of a perforation used to string it, as the edges of the break look smoothed. However, its very small size calls into question how practical it would have been to string.

<9226> *Turritella* sp. (de Kluijver/Ingalsuo/de Bruyne 2016) – Unit L16

This shell is that of a turriculate, elongated sea snail. It measures 27 mm × 11 mm. It is beige in colour and very lustrous. Five whorls are preserved but the end is broken, perhaps purposely, and the shell probably had at least one more. There is a large, irregularly shaped perforation (6.5 mm wide) opposite the aperture on the largest whorl. This may have been intentionally made in order to string the shell as a bead. The second perforation at the narrow end is not where human-made perforations would be expected if the purpose is to create a bead, but this does have smooth, worn edges. This could have been the result of taphonomic processes before collection, i. e. sand abrasion.

Roche found several examples of perforated *Turritella* shells during his campaigns at Taforalt (Roche 1963).

Sector 8 Bivalves

<8016> Bivalve, species unknown – Unit L5

Dark grey-brown in colour, this is a fragment of fossilised shell. It is quite large, measuring 28 mm × 15 mm, yet is also quite flat, which may indicate that the complete shell may have been considerably larger. The more convex surface is shiny and well preserved, showing growth lines, and scratches and pit marks from use. The concave surface is more damaged, having exfoliated in places, though growth lines are still visible in patches.

Sector 8 Scaphopods

<1436> *Dentalium* sp. (Jones/Baxter 1987) – Unit L10
This is a small fragment of a Scaphopod, or tusk shell, measuring 8 mm × 5 mm. This is off-white in colour and has an angled, tubular form, giving it a polygonal outline in section. The outer surface is quite polished, either by wave action or by use wear.

Sector 10 Gastropods

<10127> *Melanopsis* sp. (Welter Schultes 2012b)
This is a freshwater gastropod native to North Africa (and other parts of the Mediterranean) and has a ribbed, ovate shell, which is dark grey-brown colour, and measures 20 mm × 12 mm. There are 4 whorls, and it is damaged along the lower border of the aperture. The surface is worn and shiny, particularly the lower half of the body whorl. This appears to have been a fossil shell when collected.
The specimen was recovered from around the burial area of Individual 13.

Sector 10 Bivalves

<2993> Bivalve, unknown genus and species
This shell is broken and the umbo is not preserved. The surviving piece measures 41 mm × 46 mm. It is somewhat similar in size and shape to <12025>, which has been identified as *Glycymeris nummaria* (see below). <2993> has a chalky textured surface, with a mottled yellow colour with some pink straining. The shell bears frequent very faint white radiating striae, and the concentric lines are hard to discern. The staining is most likely from ochre, either from use with the pigment or from incidental contact from the surrounding sediments.

<6088> *Cuspidaria* sp.
This is a bivalve found in many areas including the Mediterranean, usually in deeper water (Allen/Morgan 1981).
This is a broken fragment of what would have been a much larger shell, and measures 26 mm × 24 mm, and is 8.5 mm thick. The preserved fragment is from the beaked portion of the shell, and is roughly thumb-shaped. This shell is highly calcified, thick with many layers. The internal, concave surface is somewhat stained brownish-red, possibly by the surrounding sediment or by contact with ochre.
This is the only example from this family of mollusc at the site.

<12025> *Glycymeris nummaria* (de Kluijver/Ingalsuo/de Bruyne 2016)
This bivalve is off-white, with faintly visible brown concentric rings. It measures 46 mm × 46 mm. There is an oval-shaped perforation at the umbo, with smooth, worn edges, suggesting it was strung as a pendant. This kind of pendant, made using a clam valve, is seen relatively frequently at Grotte des Pigeons. Overall Roche reported 83 complete or fragmented examples of this species, the Bittersweet clam, which he called *Pectunculus violacescens* (Roche 1963).

This shell was found associated with the burial of Individual 14, and was probably used as a pendant. The polished edges of the valve and of the perforation suggest that the shell was worn for some time before it was included in the grave of this individual.

<15086> *Ostrea edulis* (de Kluijver / Ingalsuo / de Bruyne 2016)
This is the only oyster shell recovered during the recent excavations at Taforalt, and was found towards the rear of the cave under the typical ashy facies of the Grey Series in the basal 'Brown Layer'. At 81 mm × 59 mm and 38.5 mm thick, it is the largest marine shell we have collected. The shell is white, and highly calcified, with many layers. It is in a rather brittle state, with layers separating and exfoliating easily. There is a flat impression on one side of the shell where it was adhered to another shell or to the substrate. It is ochre-stained all over, with more dense patches inside the valve, which suggests it may have been used as a container or palette for the pigment.
Roche reported just one example of an oyster, found in *Niveau VI* in the exterior part of the cave (Roche 1963).

Sector 10 Scaphopods

<2590> *Dentalium* sp. (Jones / Baxter 1987)
This fragment, broken at both ends, is an off-white coloured shell, 11 mm long and 4 mm at the wider end. It bears marked longitudinal ridges, which in some *Dentalium* species are more marked on the apical end of juvenile animals (Jones / Baxter 1987, 100). There is clear ochre staining in the furrows, giving the surface a striped appearance. The shell appears worn, and this polish must have taken place after the application of ochre as the colour is worn off the peaks of the ridges.

<3511> *Dentalium* sp. (Jones / Baxter 1987)
This is also off-white coloured, and broken at both ends. It measures 17 mm long and 5 mm at the wide end. Clear longitudinal ridges are present, though not as closely spaced as those of <2590>, suggesting that this too may be the shell of a juvenile animal. The surface is worn, and there are faint traces of ochre.
This was collected from the surface of the Grey Series deposit in Sector 10, found amongst a scatter of bones of a human infant (Individual 12). Given the level of disturbance in this area, the apparent association between this shell and the infant burial is not certain.

<4214> *Dentalium* sp. (Jones / Baxter 1987)
This off-white shell is broken at both ends, and measures 17 mm × 5 mm. It bears faint longitudinal ridges, and is worn to a high shine, with faint ochre staining visible.

<5848> *Dentalium* sp. (Jones / Baxter 1987)
An off-white coloured shell, broken at both ends. It measures 14 mm × 5 mm. This specimen is poorly preserved, and has a chalky texture. The surface is pitted and exfoliating at the narrow end of the shell. The surfaces at the wider, better preserved, end of the shell are a somewhat pink / orange colour which may be due to ochre staining.

<12532> *Dentalium* sp. (Jones/Baxter 1987)
This small shell is off-white in colour, and shows marked longitudinal ridges. It measures 12 mm × 4 mm and is worn and polished in patches towards the foot end, and is substantially ochre stained. The ochre has worn off the tops of the ridges and remained in the furrows giving it a striped appearance seen frequently in the *Dentalia* at Grotte des Pigeons. It is not clear whether this appearance was achieved by the purposeful application of pigment, or whether it was stained from contact with the substrate and eroded from the ridges over time in the ground.

<13791> *Dentalium* sp. (Jones/Baxter 1987)
This is one of the largest *Dentalia* in the assemblage, measuring 32 mm × 7 mm. It is stained a light brown by surrounding sediment, a creamy colour underneath. The surface of this shell is quite smooth and worn, showing some pitting and also scratches, potentially from use.

<14415> *Dentalium* sp. (Jones/Baxter 1987)
Off-white coloured shell, measuring 30 mm × 5 mm. Longitudinal ridges are clearly visible towards the apical/narrow end of the shell, and these become less marked as the shell widens, which suggests this was the shell of a juvenile. This shell is quite pitted and etched around its circumference, most likely caused by the marine environment, pre-collection. No ochre staining was observed. This specimen was recovered in 2016 close to two elements from the arm of Individual 6 and is thought therefore to be linked to this burial.

<14622> *Dentalium* sp. (Jones/Baxter 1987)
This is an off-white coloured shell, measuring 21 mm × 5 mm, with a slightly polygonal outline in cross-section. The surface is substantially worn and pitted. No ochre staining was observed.

Discussion

The overall number of shell ornaments recovered from the LSA layers in Sector 8 and Sector 10 in recent excavations is relatively low: 18 shells in total, from at least 7 different species. These are all from marine environments (see **tab. 13.2.1**), apart from one *Melanopsis* sp., a freshwater gastropod. Roche also encountered marine shell at Grotte des Pigeons, reporting 384 examples (Roche 1963), as well as additional freshwater/brackish specimens (including *Melanopsis* from all parts of the cave). Considering these marine specimens from the earlier campaign, especially the apparently two most well-represented taxa (*Dentalium*, representing over 75 % of the total count, and *Glycymeris* "*Pectunculus*"), and using Roche's original stratigraphic units in the Grey Series (cf. **Chapter 2**), there would seem to have been a strong presence towards the front of the cave, showing a consistent increase in numbers through time, although there was another marked peak in *Dentalium* towards the back (perhaps adjacent to the burial areas). Overall, the relatively low number of marine shells at the site suggests that they were special items, rather than a routine source of food, in contrast to the land molluscs, shells of which are abundant (see **Chapter 8**) throughout the Grey Series. This is supported by the fact that many of the marine shells bear modifications such as perforations, potential string wear and pigment staining.
All the marine shells found at Grotte des Pigeons could have come from the nearest coastal areas. Many marine shell taxa from the western Mediterranean are quite generalised in their preferred environments (Claassen1998, 212), and therefore do not offer precise information on their source.

Change in species representation of, and in modifications to, shell ornaments from Sector 8 and Sector 10 through time cannot be reconstructed from the assemblage due to the small sample. The spatial distribution of species however may be informative: Scaphopods are the most frequent taxon (all identified as *Dentalium* sp. at Grotte des Pigeons), and appear througout Sector 10, but only 1 was found amongst the 5 shells from Sector 8 described here (although two extra fragments of *Dentalium*, one from the GS (MMC81, mid-height stony GS) and one from the YS (MMC118, lower Y2), were recoved amongst the shell material reported in **Chapter 8**). Out of 9 *Dentalia* in total, 8 came from Sector 10 in close proximity to burials. *Dentalia* made up approximately 78 % of Roche's marine shell finds (approximately, as some went uncounted), with most of those found in the interior of the cave. They may have had a role in the funerary behaviour of the caves' inhabitants, and as a result become concentrated close to the burials at the deepest recess of the cave, becoming less frequent towards cave entrance and exterior (Roche 1963).

Out of the 9 gastropod and bivalve specimens recovered, 4 were probably or definitely perforated. This was most likely done by marine predators, though it is possible some were purposely perforated by humans in order to string them as pendants or otherwise make them suitable for ornamentation. Predator and human-made perforations on gastropods may be differentiated from one another by the shape of the hole, and its position on the shell. Predatory snails tend to make very round, bevelled holes in the shells of their prey, which are placed anywhere on the shell. Human-made perforations are often irregularly shaped and generally positioned close to the aperture for ease of stringing (Stiner 1999, 740-741). Shells perforated by predators may still have been favoured for collection when encountered, as ready-made beads, which appears to have been the case with <1279>, *Littorina obtusata*. Further study of the perforations using a microscope would be useful so wear patterns can be more closely studied. The one freshwater species, *Melanopsis* (<12027>) did not appear to have been perforated, though it was broken along the outer border of the aperture which may have been as a result of intentional human action. Scaphopods (tusk shells), the most represented genus type, are made suitable for stringing easily by their tubular morphology. They can simply be snapped at one or both ends to make a bead (Stiner 1999, 741).

Marine and freshwater shells found at Grotte des Pigeon were clearly valued as unusual or special items when encountered, either to be collected during expeditions the coast, or traded between groups. This collection or trade in shells does not appear to have been undertaken intensively as a large part of the economy of the cave's inhabitants, though these items were likely prized as for either personal or group collections and incorporated into body or clothing decoration, potentially used as vessels for pigments, and incorporated into burials as adornments worn by the deceased, or perhaps as grave goods in their own right. Research into the sources of raw materials for lithic production at Taforalt indicates that most could have come from the local area, not more than about 25 km away (see **Chapter 12**), and this is consistent with the idea that the inhabitants may have been quite sedentary and did not undertake long distance expeditions frequently. Iberomaurusian sites from across North Africa show similar evidence of shell bead use and manufacture, generally using *Dentalia, Glycymeris* and *Turitella* (Camps 1974, 99; Campmas/Chakroun/Merzoug 2016, 96). The shell ornament evidence from the recent excavations at Taforalt is consistent with that reported by Roche for Grotte des Pigeons, who also saw mainly perforated clams and *Dentalia*, occasionally *Turritella*, with other species represented more rarely (Roche 1963). It is worth mentioning that the use of shell ornaments has a deep history at the site, from which 82,000 year old *Nassarius gibbosulus* beads have been found, amongst the earliest shell beads known anywhere in the world (Bouzouggar et al. 2007).