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Reviewed Article:

An Experimental Programme for the Collection and Use of Retouching Tools Made on Diaphyseal Bone Splinters

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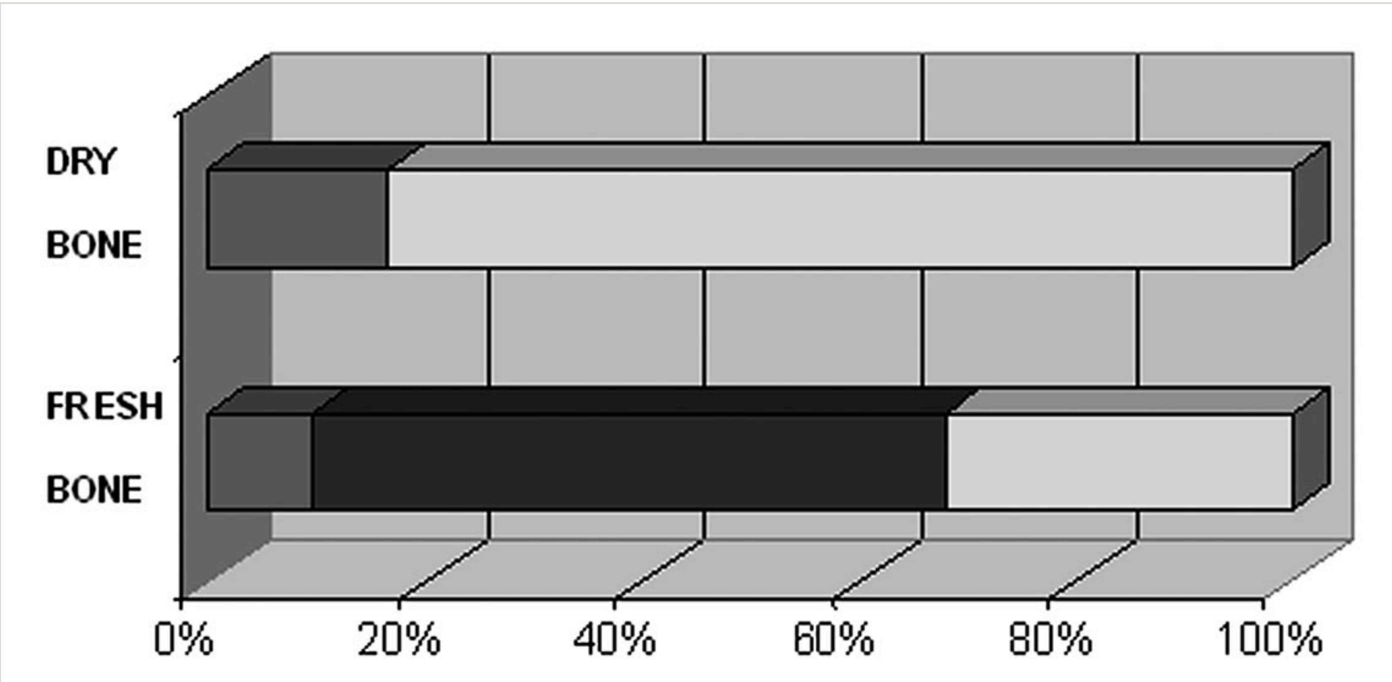

The present work presents the results of 38 experiments of bone fragmentation and blank collection, together with 177 experiments of retouch. In the first series of experiments, the fragmentation step was executed by massive percussion using macro-lithic tools. The goal was to study the fragmentation stigmas and the traits of products and by-products. In the

retouching experiments, the bone blanks were used to retouch flint and quartzite, and the goal was to study the formation and development of use traces.

> “The experimental programme results allow a series of relevant contributions to the research efforts centred on Palaeolithic retouching tools and, on a broader scope, on the Palaeolithic use of animal and lithic resources.

Previous studies

The first registered retouch experiments with bone tools were done by Siret (1925). Those experiments were part of his study of La Quina materials found by Henri-Martin (1910). Siret concluded that some diaphyseal bone splinters with imprinted marks were in fact retouching tools. He suggested that tools were used as active items for pressure-flaking retouch of lithic implements. The next milestone was the diffusion of Semenov's work in Western Europe (Semenov 1964). This soviet researcher described the use traces left on some retouching tools made of bone found on a recent Palaeolithic site. After some experimental replication, he also determined that the use traces were the product of pressure-flaking retouch.

During the sixties there was a renewed interest in bone splinters with imprinted marks. In Germany Feustel (1973) did some experimentation and once again linked different retouching tasks with this kind of traces, and Dauvois's (1974) studies pointed in the same direction. Rigaud (1977) did both pressure and percussion experiments and concluded that his sample of Magdalenian retouching tools had been used in percussion (instead of pressure-flaking) retouching tasks.

In Italy Leonardi's (1979) experiments evaluated different functional attributions of a sample of Mousterian materials: he concluded that they had been used in percussion tasks. During the next two decades, Lenoir (1973, 1986) did extensive research on Mousterian Quina assemblages and conducted a number of experiments on this issue. His studies were centred on the lithic aspect, but also laterally touched the bone tools.

In the early nineties other experimental works were added to the existing pool of scientific experiences. Boëda and Vincent (1990) definitely linked Quina retouch and bone retouching tools, and Vincent's PhD dissertation (Vincent 1993) attested to the use of bone splinters and other skeletal parts for percussion tasks. Vincent described a series of different stigmas on bone surfaces that can be related to retouching tasks. During the early 90s Chase (1990) did some replication experiments regarding La Quina bone tools. For Chase the imprints were the product of really brief retouching episodes.

Armand and Delagnes (1998) studied an assemblage of retouching tools made of bone splinters, found in Artenac site (a Charentian but non-Quina Mousterian site). Their experimental programme, as with Vincent's (1993) one, is quite exhaustive and systematic.

They also describe a series of different stigmas on bone surfaces that were associated with retouching tasks.

Some years later Bourguignon's experimental programme (Bourguignon 2001) studied the Quina-type retouch on lithic side-scrapers. In particular, she investigated the technical parameters of lithic management and included some valuable reflections on bone tools and their use at retouching tasks. She also showed the existence of an important degree of juxtaposition between the totipotentiality of use (the whole array of possibilities of use) of different tools (for example: retouching tools on limestone versustools on bone splinters).

A collective work edited by Patou-Mathis (2002) offered a list of typologies for studying retouching tools, compressing tools, percussion tools, and bones with imprints and scrapings. Malerba and Giacobini (2002, 29) used some of those typologies and studied retouching tools from La Quina, San Bernardino and Fumane. They confirmed the use of the tools for percussion tasks (on flint implements). They also found a lateralization of both the imprints and the active areas, which they related to right-handed subjects.

In recent years a study of the Middle Pleistocene Atapuerca site (Rosell *et al.* 2011), included the results of an *ad hoc* experimental programme to replicate a retouching tool made on a bone splinter. Furthermore, Mallye *et al.* (2012) did a series of 73 experiments with retouching tools made of bone splinters. They used the bone tools to work quartzite and flint implements. In this case, the authors did not find a relationship between position of the active area and dominant hand of the subjects. Finally, Jéquier, Romandini and Peresani (2012) studied two assemblages of retouching tools made from bone splinters from Fumane's Uluzzian and Mousterian layers.

Methodology and materials

Methodology

In the most general terms, this work assumes that experimentation in archaeology is a methodological tool based on actualistic and empiric principles. It allows a systematic approach to evidence that can be quantitative and inferential. Experimentation should be used to formulate and test hypotheses and to build alternative ones. Optimally, the use of experimentation will develop as a continuum of interacting reflections, data collection, analysis, testing and reformulation of hypotheses.

On the other hand, those experimental processes must be integrated in a broader context: that of the analysis and interpretation of archaeological materials. Focus should not be on the evidence, but on the final goal of building models to explain societies from the past and historical processes.

Consequently, the present work does not deal in experimental archaeology with a emulating or artisan perspective, nor delves on savoir-faire [know-how] aspects, beyond the basic skills to perform the needed actions. On the contrary, it builds a scientific programme based on three principles: (1) systematic organization of collected data; (2) quantitative, mathematic-statistical treatment of information; and (3) the aforementioned hypothetical-deductive general structure.

Therefore, the experiments presented here can be included in Callahan's (1999. 5) level III of investment (authentic and scientific). They can be also included in the group that Baena (1997, 4) denominates as "rigorous models with high variable control". Regarding the general organization of experiments, they can be categorized as "process and function", as in Reynolds (1994, 7) classification.

The experiments were designed to analyse the collection and use of a specific kind of tool: retouching tools made of bone splinters from some ungulate specific bones. Thus, I studied the process of fracturing a sample of *Bos taurus* and *Cervus elaphus* long bones and metapods. The blanks obtained from those experiments were used in a second phase: to retouch lithic tools (quartzite and flint ones). The array of possible retouching tasks and the selection of animal and lithic raw materials were based on the archaeological registry of a series of Mousterian sites in the north of Iberia (Echegaray and Freeman 1978, Mozota 2009, Navazo et al. 2005, Sanguino and Montes-Barquín 2005, Utrilla et al. 1987). All those sites delivered important ensembles of retouching tools made on ungulate diaphyseal bone splinters.

In the first series of experiments, the goal was to study the physical mechanisms of fracturing, the actual stigmas of percussion and the traits of the fragmentation products and by-products. This analysis was done following a series of controlled and independent statistical variables. I also studied the morphometry (the most relevant morphological and metric traits) of every usable blank obtained in the experiments.

In the retouching experiments, the goal was to comprehend the formation and development of different use traces and how traces related to different retouching tasks and other variables. Using the same systematic approach, the analysis followed a series of statistical independent variables. Additionally, as a specific objective, I did a search of stable and recognizable patterns of use traces (related to specific tasks) that could be identified in the archaeological record (Quina-style retouch, for example). As I said before, a total number of 177 retouching experiments were done using 134 bone blanks (some of them had a double use). The use traces were studied mostly on the base of quantitative variables (obtained from the registry, counting and measurement of stigmas); qualitative observations were also recorded during the process.

All data from the experiments were united in a database and studied using Excel, XLStat and SPSS software packages. The statistical analysis was done from a double perspective: descriptive and exploratory. I did a microscopic observation of traces using a wide range of equipment, including: (1) a metallographic conventional microscope x50-x200 (Leica DM2500), (2) a modular group of different stereomicroscopes x10-x50 (Leica MZ and EZ series), a macroscope x10-x90 (Leica Z16 APO) and a robotized stereomicroscope x12-x70 (Leica MZ16A). Observation was typically paired with the recording of digital images of the use traces. All measurements were done directly on the materials or on properly scaled images.

Materials and variables

Materials and variables from bone collection phase (including diaphyseal fragmentation and blank selection):

To study the anthropic processing of ungulate long bones and metapods, 38 of those bone elements (See Table 1) were fractured, using macro-lithic tools in different raw materials, sizes and weights (See Table 2). Fresh bones were prepared and cleaned. Flakes and retouched flakes of flint and lutite were used for this task. Cartilage, tendons, grease and flesh were removed from bone surfaces. As Table 2 shows a variety of macro-lithic tools (both hammers and anvils) were used for fracturing the bones.

As stated before, independent variables were the structural elements of data analysis. For this part of experimental programme the independent variables were the following ones:

- Taxonomic origin: domestic *Bos Taurus* or European *Cervus elaphus*
- Anatomic origin: The anatomical element used for the experiment (different long bones and metapods were selected)
- Bone freshness: I defined two broad categories for the experiments. First one was 'fresh bone'. It refers to fresh skeletal elements coming from animals that died a maximum of two weeks before experimentation. Those bones were preserved in cold environments until the actual work. Second one was 'dry bone'. Those dry bones came from open-air natural accumulations, which were at least one year old.
- General fracturing strategy: Three different strategies of bone fracturing were implemented, but the intermediate one (B) was finally considered of low interest and resolution as its intermediate character reduced the value for comparison and reference.

The aforementioned strategies were:

Strategy A	A bone fracturing strategy to obtain marrow. This strategy implies an opportunistic collection of diaphyseal splinters (to use them as blanks for bone tools). It tries to emulate a general situation in which the anthropic agent is not previewing the collection of those blanks, and this happens as a post *hoc* opportunistic exploitation. Technically, this

	strategy was characterized by: (1) strong initial hammering on the central area of the diaphysis (in order to break open the bone element); (2) after the initial breakage, a recurrent hammering with varying intensities in order to open the remaining of the diaphysis and access the marrow fat.
Strategy B	This was an intermediate strategy that combined some traits and goals from the other two (A and C). But, as mentioned before, this strategy was finally considered of low value on comparative and predictive terms.
Strategy C	A bone fracturing strategy to obtain blanks. This category implies a possible opportunistic collection of marrow fat as well, but as a secondary *post hoc* exploitation. In this case, I carefully planned and executed the bone fragmentation in order to obtain a high number of blanks with the appropriate dimensions and morphology for retouching tasks. Technically, this strategy was characterized by: (1) controlled initial hammering to break and separate both epiphyses from the diaphysis; (2) recurrent hammering along diaphysis in order to fracture this part in two longitudinal halves; (3) fragmentation of both diaphyseal halves to obtain an optimum number of retouching tools.

Materials and variables from blank using phase (retouching of flint and quartzite implements):

I did 177 retouching experiments using a total number of 134 bone blanks (some of them had a double use). The use phase was studied on the base of independent variables (pre-determined) and dependent quantitative variables (obtained from registry). It included the counting and measurement of different categories of stigmas. As before, qualitative observations were also recorded during the whole process.

Independent Variables: For this part of the experimental programme, the independent variables were the following ones:

- Bone freshness: fresh or dry bone, as in the first part of experimental programme
- Retouching task: percussion retouch (Quina or simple), or pressure retouch
- Lithic raw material: flint or quartzite
- Intensity of use: measured both in working time and number of percussions

The dependent variables were separated in two broad groups. On one hand, I recorded the morphometry and position of the active areas (for example, those zones showing marks of use). On the other hand, individual stigmas of use were identified, counted and measured.

Categories of stigmas: Three categories of stigmas, or use traces, were defined through three specific criteria: identifiability (meaning the quality of being identifiable), repetition and univocity. In other words, the criteria were that the stigmas (1) could be recognized and differentiated, (2) without any degree of juxtaposition or continuity, and (3) that they were frequently present on the used blanks (and on every sample or sub-sample of those blanks).

Therefore, the identified stigmas were:

Linear impressions	Elongated marks, narrow and deep (See Figures 2.1 and 2.3). They have a v-shaped profile. Its delineation on the bone surface is straight or slightly curved on its length. Those impressions are produced by a lithic edge impacting the bone surface. For this study, the linear impressions were counted and measured on their length. Also, its angle of orientation (related to the blank longitudinal axis) was recorded. Those impressions are the most common and abundant of the use traces studied here. Their detailed morphology can quite variable, depending on numerous variables (force applied, percussion trajectory, working angle, lithic edge configuration, blank shape, et cetera). When considering these numerous variables in relation to the final detailed morphology of the impressions, they showed a high degree of juxtaposition and equifinality. This is why no sub-categories of linear impression were created, despite its variable morphology.
Trihedral impressions	Deep impressions that present a negative trihedral shape. They are produced by the impact of an apex of the lithic edge on the bone blank (See Figure 2.2).
Striations	Straight or slightly curved, elongated lines. They are directly associated to linear impressions, and they are typically perpendicular or sub-perpendicular to those traces (See Figures 2.3 and 2.4). Sometimes, when striations appear on important concentrations, they can be mistaken for scrapping marks related to activities such as butchery or blank preparation activities. Striations are usually produced when the lithic apexes scrape against the bone surface during a percussion or pressure movement, before the lithic edge 'bites' the blank producing a linear or trihedral impression.

In addition to those three stigmas, another type of more general use-wear was documented: It is what I called 'widespread chipping'. It can be defined as important alterations of cortical bone surface (due to use), located on the active areas of the blank. These alterations are produced by the concentration of impacts on a limited area.

Results

Effects of independent variables on bone fragmentation and blanks:

Bone Freshness

The dry bone sample is characterized by frequent transverse initial fractures, combined with a small percentage of longitudinal fractures (See Figure 1). No oblique fracturing was detected. The edges of dry bone fractures are scaly and irregular, and the fracture line can easily run across the epiphysis. Blanks obtained from dry bone processing are quite flat. They are also of a bigger size than the fresh bone blanks (See Table 3). Dry bone fracturing produces a high number of non-usable small splinters (See Table 4).

Fresh bone fragmentation is characterized by abundant oblique initial fractures, some transversal ones and a small percentage of longitudinal fractures (See Figure 1). The edges of fresh bone fractures are smooth, slightly curved and they present acute angles. The fracture line rarely crosses the epiphysis. Blanks obtained from fresh bone fragmentation are somewhat more curved than dry ones, and they are also typically smaller (See Table 3).

Taxonomic and anatomic origin

Compared to the *B. taurus* sample, *C. elaphus* bones produced an absolute lower number of blanks (See Table 4), but this relates to its smaller size. In the deer long bone sample, the more frequent initial fracture is the transverse one. This predominance determines the resulting blanks and results in a higher number of tubular of semi-tubular blanks. Deer metapods, however, favour oblique and longitudinal fractures. This fact results in a higher presence of elongated, rectangular and regular blanks. *B. Taurus* blanks are of a bigger size that *C. elaphus* ones, particularly in its width and thickness (See Table 3).

General fracturing strategy

Only the A and C strategies were considered for the final reprisal of results. It became clear that strategy A produces more non-usable bone splinters, and strategy C produces a slight higher number of usable blanks. Additionally, the blanks from strategy C are much more homogeneous on their size (See Table 5).

Effects of independent variables on active areas and use marks (stigmas)

Lateralization

For the active areas, the most prominent result was a clear pattern of lateralization. This pattern appears only in the percussion sub-sample of experiments and relates to the fact that the experimenter was right-handed. The pattern makes itself evident when considering the position of such active areas on the blanks: In some blanks, active area reached both sides of its width, so no lateralization could be measured. If these blanks are excluded, 66 out of 102 active areas were lateralized to the right side of the blank, in contrast with the 36 that showed left-side lateralization.

For the pressure experiments, no clear lateralization pattern was detected: Excluding the eight non-lateralized active areas (the ones reaching both sides of blank), eight out of 15 were lateralized to the left side, and seven were lateralized to the right side. Even as it is a quite small sample, results suggest that pressure retouching does not necessarily produce a stable lateralization pattern.

Use traces

The study of use traces or stigmas shed light on other aspects considered, including some of the independent variables: bone freshness, retouching task and lithic raw material.

Bone freshness	In the bone freshness variable, dry bone (See Figure 3.1) showed a smaller number of linear impressions compared to fresh bone (See Figure 3.2). This is due to the relative resistance of dry versus fresh bone against the cutting edge of the lithic tool. The qualitative appearance of impressions on dry bone is also very different from the ones made on fresh bones. On the other categories of stigmas, only small and relative differences were documented when comparing dry and fresh bone.
Retouching task	When studying the features of stigmas in relation to different tasks, first and foremost differences arise between pressure and percussion retouching tasks. Considering fresh bone retouch on flint only, percussion (See Figure 3.3) is characterized by longer linear impressions, a relatively low presence of widespread chipping on active areas and a relatively high presence of trihedral impressions ((See Table 6). Consequently, pressure retouch (See Figure 3.4) is characterized by shorter linear impressions, a higher presence of widespread chipping and a lower presence of trihedral impressions (See Table 6). Within the percussion tasks, Quina and simple retouching tasks also showed relevant differences. When they are compared within the sub-sample of fresh bone retouch on flint, Quina type (See Figure 4.1) is characterized by longer and more abundant linear impressions, a scarcity of striations and a high incidence of trihedral impressions and widespread chipping (See Table 6). Therefore, simple retouch (See Figure 4.2) shows opposite traits, including a higher number of striations per active area (See Table 6).
Lithic raw material	When looking at fresh bone percussion on flint (See Figure 4.3) and comparing it with the same task on quartzite (See Figure 4.4) two main differences can be identified: retouching tasks on flint produce longer linear impressions, and a smaller number of striations per active area (See Table 6).

An example of application

The present work is centred on the experimental programme and its results, but it is also possible to offer a brief preview of the applications of my research to archaeological assemblages. The subsequent case is presented as an example of the inferential possibilities and hypothetical applications of my experimental programme.

The Figure 5 illustrates a comparison between some assemblages of archaeological tools and the experimental results. The archaeological assemblages came from recent excavations at Axlor's site (Dima, Bizkaia) (Gonzalez Urquijo *et al.* 2005, Mozota 2009). They are separated by archaeological layers. Their alphabetic denomination follows a chronologic order, so levels B, C, D, F, M and N run from the most recent to the oldest. When considering retouched lithic tools, flint was the predominant raw material in all these layers. The more recent archaeological levels (B, C and D) were characterized by a prevalence of Quina retouch and Quina-style side-scrappers. Older levels (F, M and N) showed a low presence of Quina retouch or Quina-style side-scrappers and a relative abundance of flat and small side-scrappers, points and retouched flakes (Rios-Garaizar 2008). Extended information on those assemblages can be found in Mozota (2012).

The graphical depiction of significant traces on experimental and archaeological bone tools (See Figure 5) shows a relevant correlation of data. Specially, when considering linear impression length and percentage of widespread chipping variables. It can be observed that the positions of experimental percussion tasks are part of the same distribution as the archaeological samples from Axlor. In parallel, the experimental pressure task position shows a quite distant position from the distribution. The graph also illustrates how the experimental samples of Quina and simple retouch are not just grouped, but aligned with archaeological samples on a direct correlation function. The correlation coefficient for percussion tasks and Axlor layers is 0,9 with a R2 of 0,8. That proves a direct, very strong correlation within that group of values. From the interpretation point of view, these data allow us to conclude that Axlor bone tools were used for percussion tasks, and not for pressure tasks.

On a second level of interpretation, the data also suggest that some of the Axlor levels (B, C and D) are much closer to the Quina retouch experimental sample, while the other ones (F, M and N) seem to group with the simple retouch sample. As stated before, the lithic samples of the Axlor levels seem to corroborate the results from the comparison; younger levels show abundance of Quina industries, while older ones show a scarcity of those materials and a higher presence of simple retouch.

Conclusions

The experimental programme results allow a series of relevant contributions to the research efforts centred on Palaeolithic retouching tools and, on a broader scope, on the Palaeolithic use of animal and lithic resources. All my contributions must be understood as part of a collective process of many researchers that begun in the first decade of the twentieth century. It started with the qualitative description of the stigmas, which was followed by the analytical classification of traces and, finally in more recent times, the fully functional understanding of their formation and development.

Considering the experiments of blank collection, this is not the first work that directly addresses the fragmentation of ungulates bones, but it is the first that places its focus on the splinters that will be used as retouching tools. Given the growing importance of this type of tool (especially for Middle Palaeolithic sites) this aspect can be considered of particular importance. Moreover, the emphasis on understanding the collection of blanks allows cross connections between areas often addressed separately (such as lithic technology/management versus hunting/management of animal carcasses).

With regard to the retouch experiments, the contributions have been significant in quantitative and qualitative ways. In absolute terms, this is the most comprehensive work published to date (177 experiments). From the qualitative point of view, it is also the most complete work, given the number of variables considered and recorded and the importance of the experimental subsets. It was possible, through experimentation, to define different trends and some characteristic patterns of use (specially on variables such as worked lithic raw material or type of retouch). A specific contribution of this work is the definition of some categories of stigmas or use traces, which are based on a number of criteria previously established (identifiability, repetition and univocity).

Finally, this programme is also a tool with great potential for inference, as showed with the Axlor's brief example.

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Attachment(s)

Table 1. Bone processing experiments. (21.78 KB)
Table 2. Macro-lithic tools. (10.22 KB)
Table 3. Blank size and morphometry. (10.16 KB)
Table 4. Blanks & non-usable splinters. Number of items per processed bone. (9.94 KB)
Table 5. Strategies A and C blank sizes (variables are standardized for an easier comparison). (8.03 KB)
Table 6. Use traces or stigmas on retouching tools. (7.94 KB)

Keywords bone
use wear analysis
experimental archaeology

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Bibliography

ARMAND, D. and DELAGNES, A., 1998. Les retouchoirs en os d'Artenac (couche 6c): perspectives archéozoologiques, taphonomiques et expérimentales. In J.-P. Brugal, L. Meignen and M.-H. Pathou-Mathis, eds. 1998. *Actes des XVIIIe Rencontres internacionales d'archéologie et d'histoire d'Antibes, 1997; Économie préhistorique: les comportements de subsistance au Paléolithique*. Antibes: Sophia Antipolis-APDCA, pp. 205-214.

BAENA, J., 1997. Arqueología experimental, algo más que un juego. *BAEX*, 1, pp. 2-5.

BOËDA, E. and VINCENT, A., 1990. Rôle plausible de l'os dans la chaîne de production lithique à La Quina: données expérimentales. In CNRS (Centre national de la recherche scientifique) 1990, *Les Moustériens charentiens, pré-actes du Colloque de Brive, 26-29 août 1990*, pp. 51-52.

BOURGUIGNON, L., 2001. Apports de l’experimentation et de l’analyse techno-morfo fonctionelle à la reconnaisance de processus d’amenagement de la retouche Quina. *Prehistoire et approche expérimentale; Prehistoire,* 5, pp. 35-66.

CALLAHAN, E., 1999. What is Experimental Archeology. In D. Wescott, ed. 1999. *Primitive technology: a book of earth skills*. Layton: Gibb Smith, pp. 4-6.

CHASE, P. G., 1990. Tool-making tools and middle Paleolithic behavior. *Current Anthropology*, 31, pp. 443-447.

GONZÁLEZ ECHEGARAY, J. and Freeman, L. G., 1978. *Vida y muerte en Cueva Morín*. Santander: Institución Cultural de Cantabria.

DAUVOIS, M., 1974. Industrie osseuse préhistorique et expérimentation. In H. Camps-Fabrer, ed. 1977. *1er Colloque sur l’industrie de l’os dans la Préhistorire*, Paris: Editions Ophrys, pp. 73-88.

GONZÁLEZ-URQUIJO, J., IBÁÑEZ-ESTÉVEZ, J. J., RIOS-GARAIZAR, J., BOURGUIGNON, L., CASTAÑOS-UGARTE, P. and TARRIÑO, A., 2005. Excavaciones recientes en Axlor. Movilidad y planificación de actividades en grupos de Neandertales. In R. Montes-Barquín and J. A. Lasheras, eds. 2005. *Neandertales Cantábricos. Estado de la cuestión*. Madrid: Museo de Altamira, pp. 527-539.

FEUSTEL, R., 1973. *Technik der Steinzeit. Archäolithikum-Mesolithikum. Veröffentlichungen des Museums für Ur- und Frühgeschichte Thüringens 4*. Weimar: Böhlau.

HENRI-MARTIN, L., 1910. *Recherches sur l'évolution du Moustérien dans le gisement de la Quina (Charente) T. 1: industrie osseuse*. Paris: Schleicher frères.

NAVAZO, M., DÍEZ-FERNÁNDEZ LOMANA, C., TORRES, T., COLINA, A. and ORTIZ, J. E., 2005. La cueva de Prado Vargas. Un yacimiento del Paleolítico Medio en el sur de la cordillera cantábrica. In R. Montes-Barquín and J. A. Lasheras, eds. 2005. *Neandertales Cantábricos. Estado de la cuestión*. Madrid: Museo de Altamira, pp. 152-166.

JEQUIER, C.A., ROMANDINI, M. and PERESANI, M. 2012. A comparison between Latest Mousterian and Uluzzian bone retouching tools. *Comptes rendus - Palevol,*11(4), pp. 283-292.

LEONARDI, P. (1979): Una serie di ritoccatoi prevalentemente musteriani del Riparo Tagliente in Valpantena presso Verona. *Prehistoria alpina*, 15, pp. 7-15.

LENOIR, M., 1973. Obtention experimentale de la retouche de type Quina. *Bulletin de la Société Préhistorique Française*, 70(1), pp. 10-11.

LENOIR, M., 1986. Un mode de retouche “Quina” dans le Moustérien de Combe-Grenal (Domme. Dordogne). *Bulletin de la Société Anthropologique du Sud-Ouest*, 21 (3), pp. 153-160.

MALERBA, G. and GIACOBINI, G., 2002, Fiche éclats diaphysaires avec marques transversales d’utilisation. In M. Patou-Mathis, ed., 2002. *Fiches typologiques de l’industrie osseuse préhistorique. Cahier X: Retouchoirs, compresseurs, percuteurs. Os à impressions et à eraillures*. Paris: Editions Société préhistorique français, pp. 29-37.

MALLYE, J. B., THIÉNAUT, C., MOURRE, V., COSTAMAGNO, S., CLAUD, E., and WEISBECKE, P., 2012. The Mousterian bone retouchers of Noisetier Cave: experimentation and identification of marks. *Journal of Archaeological Science,* 39(1), pp. 1131-1142.

MOZOTA, M., 2009. El utillaje óseo musteriense del nivel “D” de Axlor (Dima, Vizcaya): análisis de la cadena operativa. *Trabajos de Prehistoria*, 66(1), pp. 27-46.

MOZOTA, M., 2012. *El hueso como materia prima: El utillaje óseo del final del Musteriense en el sector central del norte de la Península Ibérica.* Ph. D. Universidad de Cantabria.

PATOU-MATHIS, M. ed., 2002. *Fiches typologiques de l’industrie osseuse préhistorique. Cahier X: Retouchoirs, compresseurs, percuteurs. Os à impressions et à eraillures*. Paris: Editions Société préhistorique français.

REYNOLDS, P. J., 1994. *Experimental archaeology. A perspective for the future*. The Reuvens Lecture 5, Stichting voor de Nederlandse Archeologie, 1994.

RIGAUD, A., 1977. Analyses typologiques et technologique des grattoirs magdaléniens de la Garenne à Saint-Marcel (Indre). *Gallia Préhistoire,* 20(1), pp. 1-43.

RIOS GARAIZAR, J., 2008. Variabilidad tecnológica en el Paleolítico Medio de los Pirineos Occidentales: una expresión de las dinámicas históricas de las sociedades neandertales. *Treballs de Arqueologia*, 14, pp. 171-194.

ROSELL, J., BLASCO, R., CAMPENY, G., DÍEZ, J. C., ALONSO ALCALDE, R., MENÉNDEZ, L., ARSUAGA, J. L., BERMÚDEZ DE CASTRO, J. M. and CARBONELL, E., 2011. Bone as a technological raw material at the Gran Dolina site (Sierra de Atapuerca, Burgos, Spain). *Journal of Human Evolution*, 61(1), pp.125-131.

SANGUINO, J. and MONTES-BARQUÍN, R., 2005. Nuevos datos para el conocimiento del Paleolítico Medio en el centro de la Región Cantábrica: La Cueva de Covalejos. In R. Montes-Barquín and J. A. Lasheras, eds. 2005. *Neandertales Cantábricos. Estado de la cuestión*. Madrid: Museo de Altamira, pp. 489-538.

SEMENOV, S. A., 1964. *Prehistoric Technology: An Experimental Study of the Oldest Tools and Artefacts from Traces of Manufacture and Wear*. London: Cory, Adams & Mackay.

SIRET, L., 1925. L'emploi de l'os dans la retouche des sílex moustériens. *Bulletin de la Société Préhistorique Française*, 22, pp. 208-210.

UTRILLA, P., VILCHEZ, J., MONTES, L., BARANDIARÁN, I., ALTUNA, J., GIL, E. and LÓPEZ, P., 1987.*La cueva de Peña Miel. Nieva de Cameros, La Rioja*. Madrid: Ministerio de Cultura.

VINCENT, A., 1993. *L'outillage osseux au Paléolithique moyen: une nouvelle aproche*. Ph. D. Université de Paris-X.

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Gallery Image

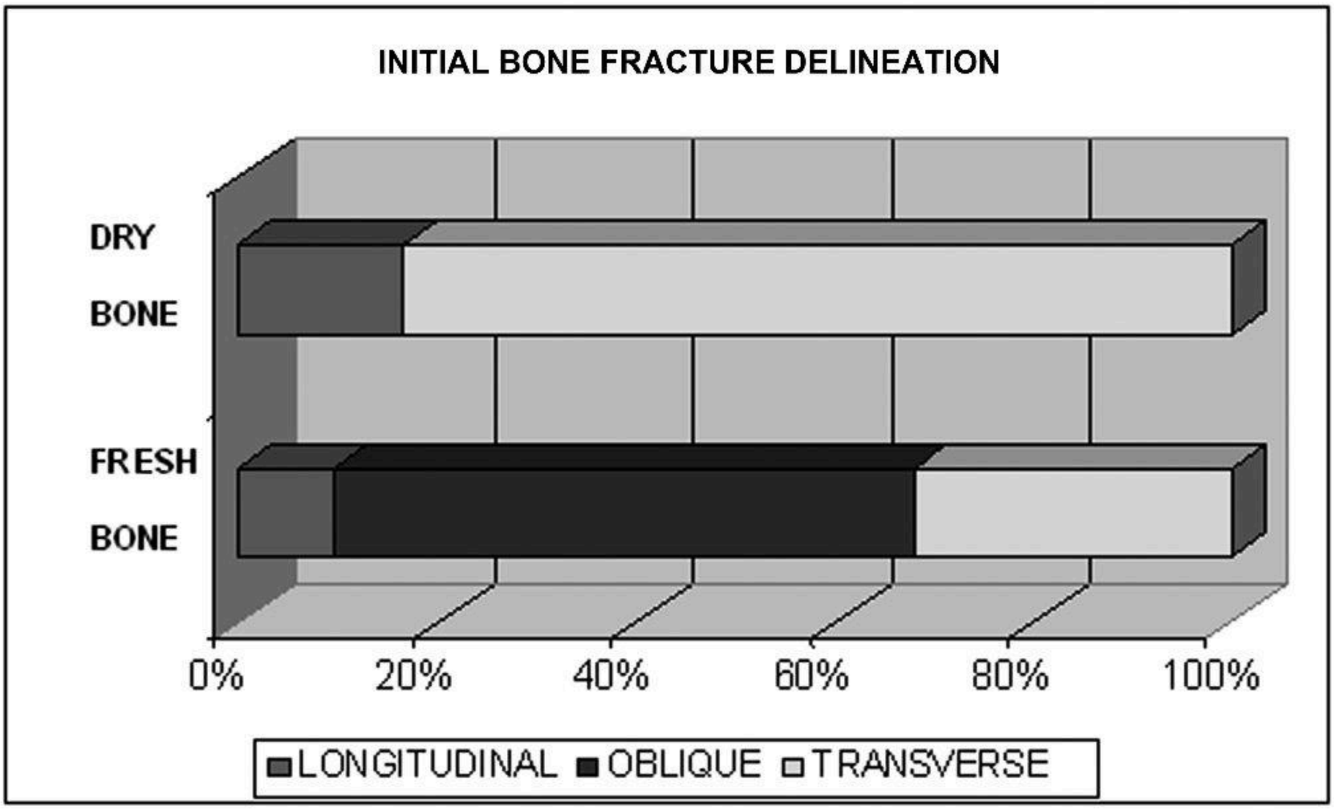

FIG 1. INITIAL FRACTURE DELINEATION GRAPH (BLANK OBTAINING EXPERIMENTAL PHASE).

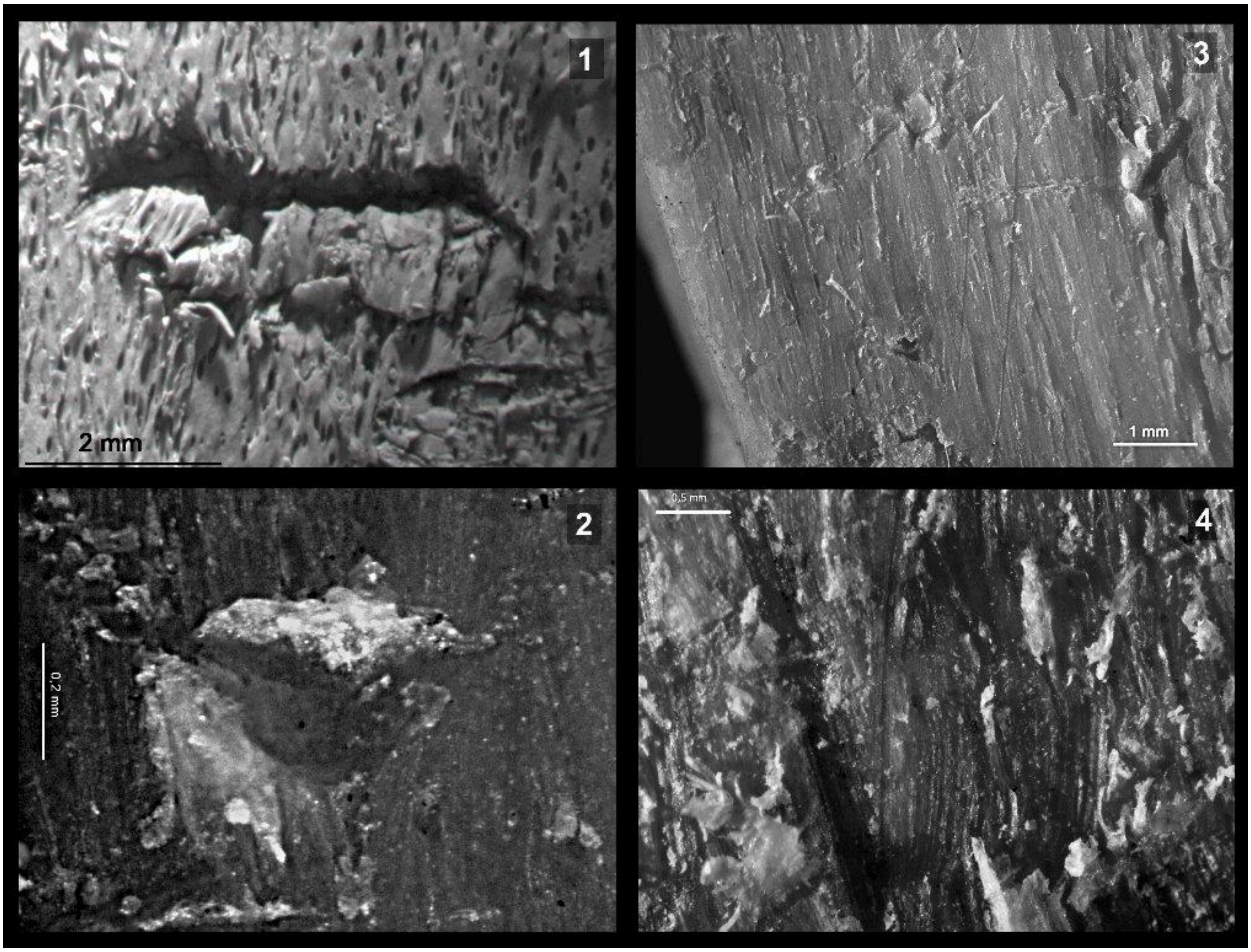

FIG 2. STIGMA CATEGORIES FOR EXPERIMENTAL BONE TOOLS.

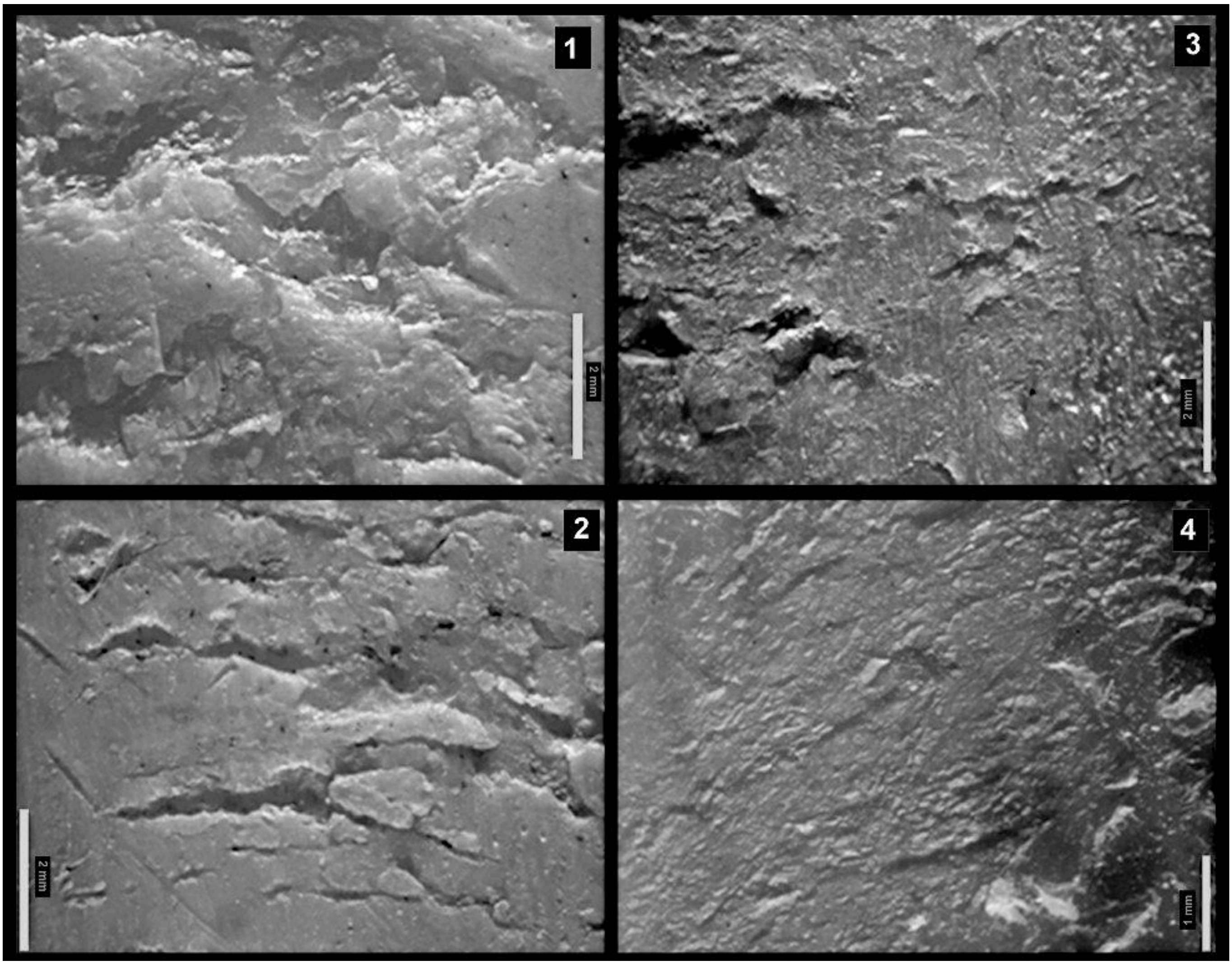

FIG 3. STIGMAS AND USE AREAS: BONE FRESHNESS; PERCUSSION VERSUS PRESSURE RETOUCH.

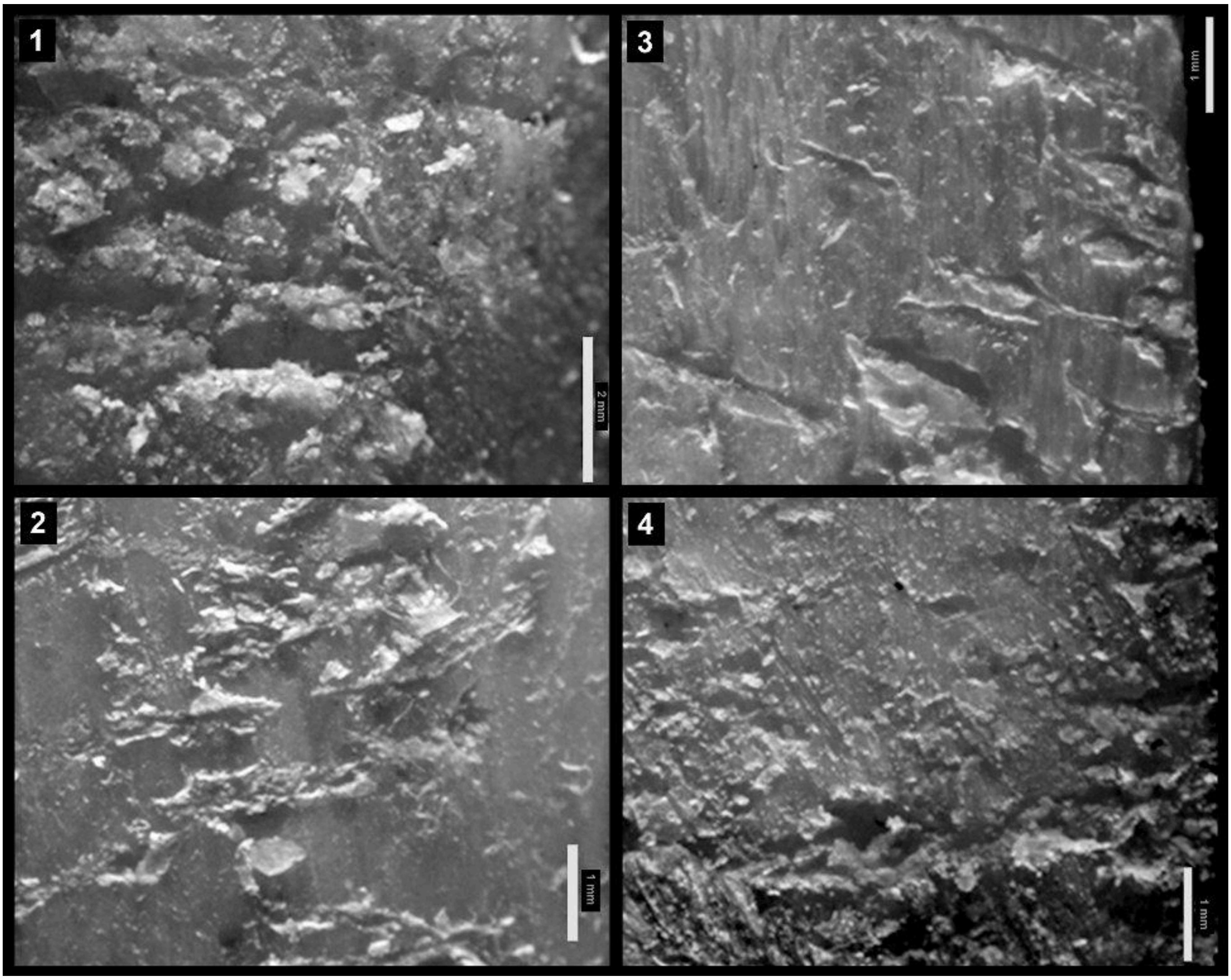

FIG 4. STIGMAS AND USE AREAS: QUINA VERSUS SIMPLE RETOUCH; LITHIC RAW MATERIAL.

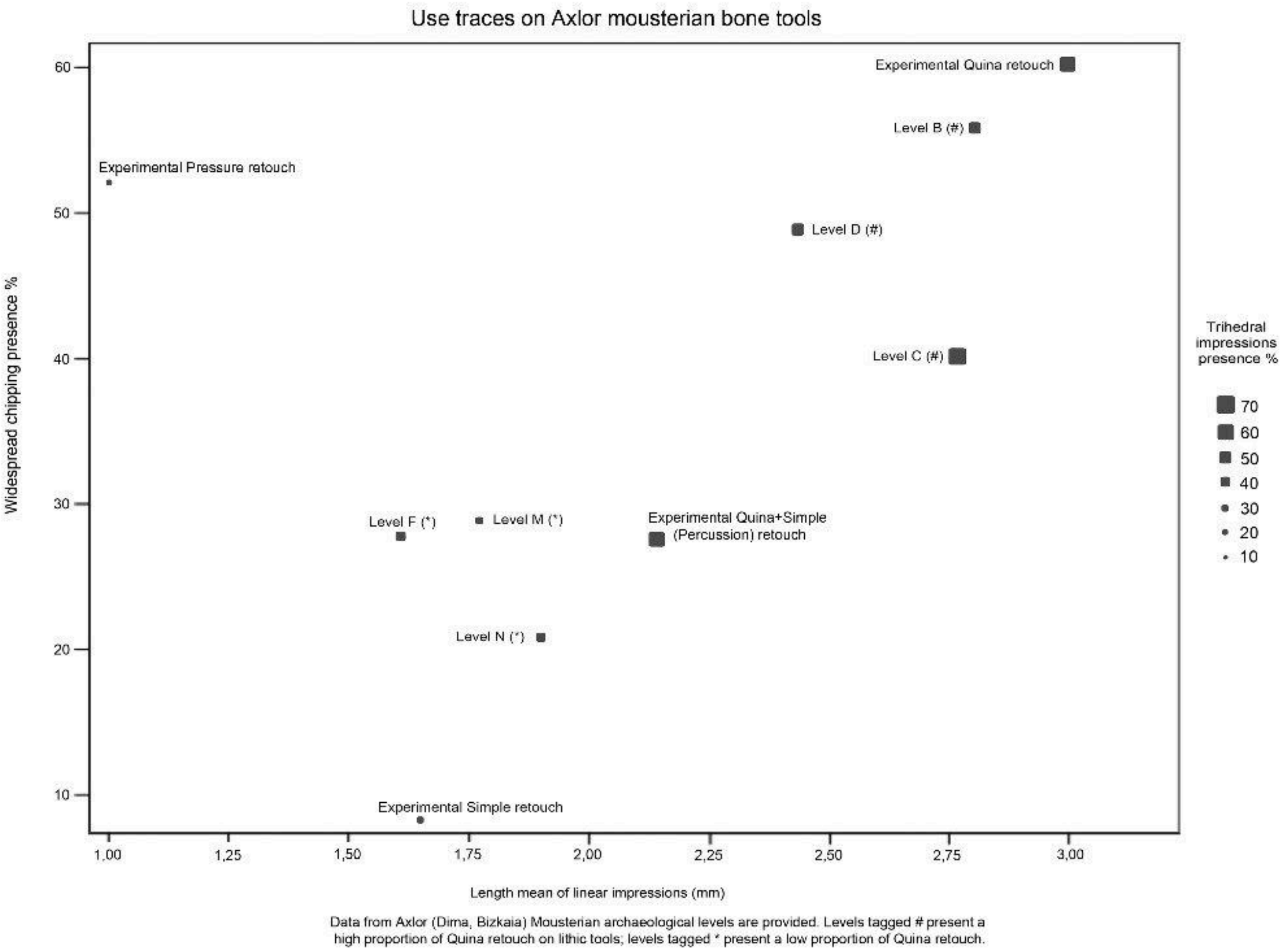

FIG 5. AN EXAMPLE OF APPLICATION ON ARCHAEOLOGICAL ASSEMBLAGES.