Trampling, taphonomy, and experiments with lithic artifacts in the southeastern Baguales Range (Santa Cruz, Argentina)

Catalina Balirán

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ABSTRACT

This work assesses the impact of taphonomic processes on the surface lithic record of La Verdadera Argentina archaeological locality (Santa Cruz, Argentina). Different stages of weathering were observed on lithic artifacts’ surfaces, the edges consistently exhibiting less intense alteration, which may be the result of a reclamation process of the archaeological record or of animal trampling. At such, this project was designed to understand the potential effect of animal trampling on surface lithic artifacts. Toward this end, two experimental plots were established in La Verdadera Argentina. Results of these actualistic tests are used as a frame of reference for the taphonomic analysis of the surface artifact assemblage recovered along an archaeological survey transect (T9). Preliminary results indicate that the effects of taphonomic processes are registered very quickly. The hypothesis explaining the edge modifications observed in the local lithic record as a result of taphonomic processes cannot be discarded.

Keywords: Lithic taphonomy; Lutite; Weathering; Archaeology; Patagonia.

RESUMEN

PISOTEO, TAFONOMÍA Y EXPERIMENTOS CON ARTEFACTOS LÍTICOS EN EL SUDESTE DE LA SIERRA BAGUALES (SANTA CRUZ, ARGENTINA). Este trabajo tiene como objetivo general discutir la incidencia de los procesos tafonómicos que actúan sobre el registro lítico de superficie en la localidad arqueológica La Verdadera Argentina (Santa Cruz, Argentina). En la superficie de dichos artefactos se observan diferentes grados de meteorización, siendo siempre los filos los que exhiben menor intensidad de alteración. Se ha planteado que esta diferencia puede ser resultado tanto de prácticas de reclamación del registro arqueológico como producto del pisoteo de animales. Este trabajo busca evaluar los efectos potenciales del pisoteo sobre los artefactos líticos de superficie. Para ello se sembraron dos pistas experimentales en la localidad. La información actualística obtenida se utiliza como marco de referencia para el análisis tafonómico del conjunto artefactual de superficie recuperado en una transecta (T9). Los primeros resultados indican que los efectos derivados de los procesos tafonómicos son registrables en el corto plazo. Se concluye que la hipótesis que explica el fenómeno observado en el registro lítico como producto de procesos tafonómicos no puede ser descartada.

Palabras clave: Tafonomía lítica; Lutita; Meteorización; Arqueología; Patagonia.
INTRODUCTION

Understanding the role of taphonomic processes in the transformation of lithic archaeological records is key to their interpretation (Hiscock 1985; Schiffer 1987; Eren et al. 2010, among others). The effects of trampling have been studied extensively (Wilk and Schiffer 1979; Gifford-Gonzalez et al. 1985; Nielsen 1991; Lopinot and Ray 2007; Eren et al. 2010, among many others). This paper aims to contribute to taphonomic studies, focusing on animal trampling and its effect on surface lithic archaeological records. This work is part of a long-term, actualistic program of investigation geared towards understanding the effects of trampling on the lithic record at La Verdadera Argentia (LVA) locality (Argentine Patagonia).

BACKGROUND

Trampling taphonomy

The occurrence of artifacts produced or transformed by taphonomic processes is a topic that has been studied extensively (Hiscock 1985; Pryor 1988; Peacock 1991; Thiebaut et al. 2010b; Borrazzo 2011a). Different lines of investigation regarding features observed on these artifacts or pseudo-artifacts suggest how this kind of record is produced and how it should be studied. When artifacts are affected by geomorphological processes, attributes associated with weathering should indicate the gradual action of geomorphological processes in the form of differing degrees of surface alteration (Peacock 1991). Nonetheless, several authors advise the use of multiple attributes to assess the origin of surface characteristics (Peacock 1991; Burroni et al. 2002; Borrazzo 2011a). For some of these authors, comparison between a lithic assemblage and the region’s prehistoric technological baseline is key to detecting patterns. Such studies aim to understand how taphonomic processes alter artifacts and create pseudo-artifacts that mimic those of anthropic origin.

Much experimental work has been done to link characteristics of the archaeological record in general and in lithic artifacts in particular to specific causes (Gifford-Gonzalez et al. 1985; Burroni et al. 2002; Weitzel and Colombo 2006; Lopinot and Ray 2007; Borrazzo 2008, 2011a y b; Schoville and Brown 2010; Weitzel 2010, 2012; Eren et al. 2010, 2011; Pargether 2011; Balirán 2012; Weitzel et al. 2014). Among them, trampling experiments provide a frame of reference for understanding artifact distributions (Gifford-Gonzalez et al. 1985; Pintar 1987; Nielsen 1991; Osborn and Hartley 1991; Eren et al. 2010; Borrazzo 2011b, among many others), and factors that alter artifacts or produce pseudo-artifacts (Gifford-Gonzalez et al. 1985; Burroni et al. 2002; Flegenheimer and Weitzel 2007; Lopinot and Ray 2007; Schoville and Brown 2010; Weitzel 2010, 2012; Borrazzo 2011a; Eren et al. 2011; Pargether 2011; Balirán 2012; Weitzel et al. 2014).

Study region

La Verdadera Argentina archaeological locality is located in the southeast of the Baguales Range, Santa Cruz Province, Argentina. It is a steppic environment, between 300 to 600 m asl, characterized by a mean annual rainfall of 300 mm, and mean annual temperature of 8° C. Both native and exotic fauna are present today (Borrazzo 2011b), including (native) guanaco (Lama guanicoe), grey fox (Pseudalopex griseus), choique (Rhea pennata), and puma (Puma concolor puma); and (exotic) cattle and horses. La Verdadera Argentina ranch was established in 1923 (J. P. Riquez, personal communication, 2011), from which date forward the introduction of large numbers of European cattle significantly amplified the trampling effects of the local fauna that has been present throughout the Holocene.

Several lithic sources have been recorded in the locality, occurring mainly as secondary deposits composed of several lithologies (chert, dacite, diabase, and lutite) available as boulders and/or large blocks. However, lutite is the most frequently occurring material in all LVA lithic assemblages (Borrazzo 2006, 2008; Borrero et al. 2006). The chronology for local human occupation was obtained from the stratified Cerro León 1 and 3 rock shelter sites. Humans appear to have been present in the area throughout the Holocene, between 8,856 ± 84 and 907 ± 45 14C years BP (Borrazzo 2006, 2008; Borrero et al. 2006; Borrero and Borrazzo 2011).

The southeastern extent of Baguales Range has been characterized as marginal to the home ranges of populations settled to the east (Franco and Borrero 2000; Borrazzo 2006, 2008; Borrero et al. 2006). The absence of archaeological materials in viable local rock shelters (e.g., LVA cave; Borrazzo 2008) is consistent with this interpretation.

Although the LVA archaeological locality has been occupied throughout the Holocene, the archaeological record is sparse. Open-air surface sites are the most common evidence of a human presence in the locality and these are primarily lithic scatters, probably indicating low sedimentation rates (Borrazzo 2011b). This paper addresses the formation of surface lithic assemblages in the LVA archaeological locality.

Surface lithic assemblages collected from the LVA locality contain high frequencies of lutite tools weathered to differing degrees. Retouched and flaked edges exhibit lower intensities of weathering. In a previous publication, Balirán (2012) suggested that this
phenomenon could be explained by either reclamation—reintroduction of artifacts from the archaeological contexts to systemic contexts (Schiffer 1987)—or taphonomic processes, particularly animal trampling in the current context. This led to a pilot project aimed at evaluating the impact of trampling on surface lithic artifacts.

The focus of this work is to quantify the occurrence of fractures and/or macroscopic edge damage in experimental samples and to compare these patterns to those observed during the taphonomic analysis of a local archaeological surface assemblage (T9) in order to evaluate the relevance of experimental data for interpreting the archaeological record.

**Behavioral vs. taphonomic processes: working hypotheses**

As mentioned, LVA’s surface lithic assemblages are dominated by lutite artifacts. Weathering is readily identifiable on this raw material since the color of the rock surface becomes lighter as weathering increases. A recurring pattern of varying degrees of weathering (sensu Borrazzo 2006) among lithic artifacts was recorded; artifact edges—both isolated and continuous flake scars—are less weathered than other surfaces (Figure 1).

These observations raise the question: Are the observed intra-artifact differences in weathering a result of human behavior or of taphonomic processes? To answer this question it is necessary to examine both possibilities and determine how each of these factors might have contributed to the formation of the archaeological record throughout the Holocene. Thus, the aim of this paper is to compare experimental trampling data and archaeological collections. Currently we know that while archaeological evidence at LVA is sparse, the locality was available to and visited by hunter-gatherers during the Holocene and, although this pattern is interpreted from stratified sites, it is assumed that surface assemblages reflect a similar level of human use.

One hypothesis to explain the observed patterns of weathering on lutite artifact surfaces is artifact reclamation (sensu Schiffer 1987). That is, if different degrees of weathering can be interpreted as different exposure times of rock surfaces, we can assume that a considerable amount of time passed between the production of an artifact and any other scar exhibiting a lesser amount of weathering. Therefore, lower weathering stages on edges would be the result of a provisioning strategy that seeks to save time and energy by resharpening abandoned tools or by selecting preexisting flakes as blanks for tool manufacture. An alternative hypothesis explains the occurrence of less-weathered fractures and/or flake scars as the effects of taphonomic processes. An assessment of local taphonomic agents and processes suggests that animal trampling is the most likely source of the pattern.

**MATERIALS AND METHODS**

Several features of the LVA locality make this latter hypothesis plausible: a low sedimentation rate, which reduces the likelihood of artifact burial; a generally hard substrate with ample gravels and sparse vegetation cover; and an abundance of native wildlife and European livestock. In this context, it is reasonable to propose that the surface lithic record is subject to animal trampling and that this has been the case for a long time. To test this hypothesis, a long-term experimental study was specifically designed to assess how taphonomic processes act on the LVA surface lithic record. In this first stage of our research, we focus on the effects of the animal trampling.

![Figure 1. Artifacts from archaeological sample T9 that exhibit different weathering stages on their surfaces. Lower stages can be observed on the edges.](image-url)
**Transect 9 (T9)**

The archaeological material discussed in this paper comes from a surface collection identified as Transect 9 (T9). This transect runs NW-SE and the surface slopes gently to the east. Visibility ranges from 50% to 100% and two surveyors collected all surface materials within an area 250 m long by 10 m wide.

The sample is composed of 305 artifacts, 87.87% (N = 268) of which are made from lutite. The remaining 12.13% (N = 37) were manufactured from other local and non-local raw materials (e.g., chert, basalt, dacite). This study considers only the lutite artifacts, since 1) this material exhibits higher degrees of macroscopic weathering as surface exposition time increases and 2) it is the most common raw material in T9 and other archaeological samples collected in the area.

Previous work in the study area called attention to taphonomic processes affecting surface lithic assemblages and suggested the need to account for such processes during techno-morphologic analyses (Borrazzo 2006, 2008). Here, we follow Hiscock (1985), who posits that lithic artifacts change between their deposition and later retrieval and that, therefore, the study of formation processes is not only useful, but necessary for proper interpretation of the archaeological record. We also follow Borrazzo’s (2004, 2006, 2010) approach to taphonomic analysis of archaeological lithic assemblages, defining the taphonomy of lithic artifacts as “an archaeological and actualistic study which describes, defines and systematizes the effects produced by natural and cultural processes and agents that acted on lithic artifact sets since their deposition and until their retrieval from the archaeological context” (Borrazzo 2004: 9).

Chemical weathering intensity is the focus of this taphonomic analysis. Borrazzo (2004, 2006) defines four stages (0, 1, 2 and 3) of abrasion (physical weathering) on different parent materials, while Hiscock (1985) describes four continuous but different stages for chemical weathering in chert, ranging from “fresh” to “heavily weathered.” Following these two authors, a qualitative scale of lutite weathering is developed here; higher degrees of weathering result in a more porous rock texture and a lighter or whiter color:

Stage 0: no weathering, or “fresh” in Hiscock’s (1985) terminology

Stage 1: the rock surface exhibits a thin, light grey coating. The texture of the rock remains similar to that in stage 0.

Stage 2: the surface turns lighter grey and becomes porous.

Stage 3: the rock texture is rough and very porous and the surface has an almost white coloration.

Techno-morphological analysis of both experimental and archaeological samples was conducted following Aschero’s (1975, 1983) protocols.

We recorded the occurrence of less-weathered fractures and micro-flaking on the edges of artifacts recovered from surface contexts. To build a framework for systematic analysis of the origin of these features, we designed a trampling experiment. The author established two experimental plots (see below) based on previous experimental work in the area (Borrazzo 2011b) as well as more general experimental research on formation processes (Schiffer 1987; Borrero 1991; Kligmann 2009) and trampling in particular (see Pryor 1988; McBrearty et al. 1998; Eren et al. 2010; Weitzel 2010; Thiébaut et al. 2010b).

Trampling experiments aim to link particular effects with their potential causes; this information is then used to interpret the archaeological record (e.g., Nielsen 1991; Flegenheimer and Weitzel 2007; Eren et al. 2010; Weitzel 2010). In this particular case, special attention was paid to average thickness of fracture sections since it has been demonstrated that this attribute is a good indicator of flake breakage by trampling (Merenzon 1988; Borrazzo 2010; Weitzel 2010; Jennings 2011; Weitzel et al. 2014): the thinner the flake, the more likely it is to be broken during trampling (Borrazzo 2010). The proposed maximum thickness for trampling fractures is 7 mm (Flegenheimer and Weitzel 2007; Weitzel 2010, 2012; Weitzel et al. 2014).

**Experimental plots**

In 2011, two plots were established in LVA. This longitudinal study includes annual survey for each of 10 years (the time it took another local experimental plot to stabilize; Borrazzo 2011b), or until no changes to the experimental assemblage are recorded during three consecutive surveys (i.e., the plot stabilizes), whichever occurs soonest. The experiment consisted of three stages:

- sample preparation
- plot set up
- survey

The first stage included manufacture of a sample of lutite artifact replicas (N = 100) using a hard hammer and free hand percussion, the most frequent technique recorded in LVA lithic assemblages. Each piece was labeled, measured, and photographed, and a drawing of its outline was produced. This information was recorded to aid detection of any changes in the sample through time. Subsequently, each piece was painted with white diluted acrylic to increase the visibility of changes (fractures, flaking, micro-flaking) to dark gray lutite surfaces. Subsequently, the sample was divided randomly into two subsamples: A (n = 54) and B (n = 46).
The second stage involved placement of the experimental assemblage on two active livestock tracks and recording of each artifact's exposed surface. The experimental plots were measured, georeferenced and photographed (Figure 2). Survey began one year following plot establishment. Each survey, the following observations are recorded:

- fractures and/or alterations to each pieces
- placement of the exposed face, changes in which provide evidence of trampling even when no other changes are detected
- frequency of burial (recorded as 0%; 25%; 50%; 75% of artifact surface)
- length of experimental artifact distribution

This experiment was designed to control for several variables in order to improve its comparability with the archaeological record. However, we must acknowledge that there are factors related to both the timescale of the processes involved and the scope and goals of our research that are beyond the control of this experiment. It is important to bear these limitations in mind throughout the experiment, as the results are directly dependent on both controlled and uncontrolled variables. Here, the controlled variables are raw material, substrate and local fauna; the archaeological and the experimental samples are both made on lutite, the substrate is the same due to the fact that both tracks were plotted near T9 and, for this reason, the available fauna is expected to be the same. Uncontrolled variables include the animal that generated each fracture, the action of other taphonomic agents such as water, wind, gravity or snow, and the accumulated effects of these agents over long periods of time.

RESULTS

Experimental observations

The first survey was conducted one year after the plots were established, at which time it was clear that the animal tracks were still active. All observations were made in the field and the experimental sample left in place for future surveys. The information collected during this first survey shows that:

- 32% of the specimens had a new surface exposed (Plot A = 13; Plot B = 19). This is a minimum value since exposed faces may have changed multiple times but only those with the opposite face showing at the time of survey can be recorded as having changed;
- 11% of the sample exhibited fractures involving the entire artifact and/or its edge (Plot A = 11);
- 9% became partially buried (between 25 and 75% of their surface; Plot A = 4; Plot B = 5);
- 9% of the sample could not be relocated (Plot A = 7; Plot B = 2);
- the plot's length increased (horizontal distribution of the sample, parallel to track margins; additional length: Plot A = 12 cm, Plot B = 15 cm);
- one piece was found 276 cm away from its original location in Plot A;

Figure 2. Experimental plots on animal tracks. Plot A (Left) and Plot B (Right).
Seven percent of the sample exhibited micro-flaking. Edges with continuous micro-flaking did not exceed 12 mm in length, although a few pieces presented more than one fracture and/or micro-flaking. This suggests that such edge damage can be generated in the short term and that its presence—and therefore flake scar continuity—could be expected to increase over the long run.

Features on the edges of specimens in the experimental collection appear in some cases as isolated micro-flaking and in others as continuous flaking with up to six scars (Figure 3). Micro-flaking is usually longer along the edges of pieces (1 to 3 mm) than on their surfaces (1 to 2 mm). Continuous micro-flaking occurs along edges in lengths between 6 and 12 mm and intrudes artifacts' surfaces 2 mm or less. It is worth mentioning that they always occur as a series of individual flake scars and appear randomly on both sides of specimens.

The presence of cattle and horses was recorded near T9 area during fieldwork. This suggests that fauna walked over places where archaeological materials were collected, increasing the chances of lithic artifact trampling. It is also important to note that fresh animal footprints, excrement, and sheep wool were observed on the tracks where the experimental material was placed—very near T9—and that vegetation was absent from the tracks. All of these characteristics are proxies for recent animal circulation on these tracks, which in turns increases the chances that the experimental sample was trampled.

These preliminary results indicate that a single year was enough time for the sample to register changes. These observations highlight the presence of high-energy conditions to which LVA's surface archaeological record is currently exposed. One year after the plots were established, 6% of the sample exhibited edge damage or fracture. Maximum fracture thickness recorded was 6 mm. We used this measure as a minimum reference value when analyzing T9 archaeological sample. Conservatively, we proposed that all the fractures present in the archaeological record equal to or less than 6 mm thick could be the result of either taphonomic or anthropic processes.

**Archaeological sample**

Using the experimental data as a reference collection, techno-morphological (Aschero 1975, 1983) and taphonomic aspects of the T9 archaeological sample were analyzed. The following attributes are of particular importance to this study:

- **Fractures** (excluding edge damage): 64.18% (n = 172) of the pieces are complete and 35.82% (n = 96) are fractured, including longitudinal split fractures, which are considered of technological origin (Hiscock 2002). Artifacts with split fractures were excluded for further analysis since their anthropic origin is clear (Figure 4). Excluding split fractures (N = 10), 33.33% of lutite artifacts were broken.

- **Average thickness of broken artifacts**: we compared the thickness distributions of split and non-split fractured artifacts. While the distribution of maximum thicknesses in the former is relatively homogeneous, the non-split sample is quite different: 68.60% of the fragmented pieces (N = 59) are up to 6 mm thick (Figure 5). In order to assess the potential of breakage by trampling (Borrazzo 2010; Weitzel 2010; Weitzel et al. 2014), we measured the thickness of the fracture section in pieces with maximum thicknesses greater than 6 mm. The calibrated result is that 76.74% of the sample contains fractures with thicknesses up to 6 mm (excluding split fractures).

Considering the experimental data presented above, the occurrence of fractures and thicknesses of fractured sections in the T9 archaeological sample does not appear to be random. Fracture frequency increases as specimen thickness decreases. Considering the experimental results, 76.74% of the fractures could be explained by taphonomic processes (specifically trampling) because those pieces exhibit fractures thickness equal to or below 6 mm.
Trampling, taphonomy, and experiments with lithic artifacts in the southeastern Baguales Range (Santa Cruz, Argentina)

91

That is, the taphonomic hypothesis cannot be rejected for these artifacts. Although we cannot completely exclude the possibility that reclamation also affected the surface archaeological record, the experiment provides evidence that the effects of non-anthropic processes on artifact fragmentation—in this case the animal trampling—cannot be rejected either.

Micro-flaking (edge damage) and intensity of weathering: the presence of micro-flaking and differences in weathering intensity were analyzed. In all cases, the weathering stage observed on micro-flaking scars was lower than those on the rest of the artifact surface (Figure 1). Of the lutite artifacts (N = 268), 55.60% (N = 149) had flaking and/or micro-flaking on their edges. Among these, recorded weathering stages ranged between 1, 2 or 3 on artifacts surfaces, but 93.96% of the pieces have no weathering on their edges (stage 0) and the remaining 6.04% are minimally weathered (stage 1; Figure 6).

The archaeological lithic collection can be divided into two groups: tools and artifacts with flaked edges. While the tools are clearly of anthropic origin, the artifacts with flaked edges could be the product of taphonomic processes (Figure 1). Flaked edges appear as both isolated and continuous micro-flaking and flaking. The longest flaked edge in the sample is 64 mm. Scar width varies from 3 to 10 mm, and length from 2 to 12 mm. These features always appear as a series of individual flaking scars, and the relation between length and width seems to be random. All of the tools have marginal unifacially flaked edges. The length of these edges ranges from 8 to 82 mm, and flake scars are up to 10 mm long. In some cases, tools exhibit two- and three-flake-scar series as well as evidence of edge resharpening. However,
resharpened tool edges present the same weathering stage as the rest of artifact surface (Figure 7).

DISCUSSION

As mentioned, observed patterns differ when we consider only the weathering stages on artifacts’ edges relative to artifact bodies. If reclamation for economic purposes did occur, we would expect different (lower) weathering stages (0 to 2) on artifact edges. This is not the case for the T9 archaeological sample, since 93.96% of the pieces have weathering stage 0 on their edges while the remaining 6.04% presents weathering stage 1. In this regard, and returning to the concept of weathering as an indicator of length of exposure, the traces on artifact edges show a relative synchronicity. Furthermore, as their weathering stages suggest, they would have been produced recently. It was also observed that among archaeological artifacts with retouched edges, some instruments show a different pattern (more-than-one-scar series). This difference requires further study since it may help us better understand the processes involved in the formation of the edges.

While the results obtained to date do not definitively exclude the possibility of intentional human modification of the archaeological record, they do strengthen arguments in favor of trampling—the intensity of which surely increased during the last hundred years since the introduction of European livestock—as the primary process responsible for the observed pattern among surface lithic assemblages. That is, although we cannot exclude human agency (i.e., reclamation) as a contributor to the weathering patterns described here, the introduction of large herds of cattle during the last hundred years and the relative synchronicity recorded by low weathering stages on flaked edges of T9 stone tools support the taphonomic hypothesis. Furthermore, the average thickness observed among fractured sections in the experimental sample also suggests that a large proportion of those fractures could have been produced by animal trampling.

CONCLUSIONS AND PERSPECTIVES

This work began with an archaeological question prompted by a case of equifinality in the LVA archaeological record: Are the patterns we observe in the surface lithic archaeological record the product of anthropic or taphonomic agents? This question guided the development of a research protocol designed to achieve a better understanding of the surface lithic record. In this instance, experimentation has proven fruitful in terms of generating frames of reference for interpreting the LVA surface lithic record.

Based on the experimental and archaeological data presented here, the taphonomic hypothesis cannot be rejected. The phenomena observed in the experimental sample were also recorded in the archaeological sample from T9, and comparison of the two samples is appropriate given that we were able to control for several key variables (raw material, substrate, animals presence). Although the results presented here are preliminary, the changes recorded on the experimental collection in a single year suggest that future surveys will yield still more information that will improve our understanding of the potential effects of local taphonomic processes, and clarify whether damage to experimental collections eventually stabilizes (Borrero 1991).

Although the results reported here were obtained from only the first survey, our findings have already proven relevant for determining parameters for analysis and stimulating new lines of inquiry. Specifically, the experimental research led to a hypothesis regarding the origin of patterns observed in the LVA surface lithic assemblages. In accord with other authors (Flegenheimer and Weitzel 2007; Borrazzo 2010; Weitzel 2010; Weitzel et al. 2014), we consider that the thickness of fractures is a sensitive variable in the identification of animal trampling. However, it is important to

Figure 7. Two tools from T9 archaeological assemblage. Above, a tool with two retouched edges (1: an end-scraper; 2: a side-scraper). Below, a side-scraper and a detail of its retouched edge.
note that 23.26% of the sample exhibits fractures with an average thickness greater than 6 mm. Fractures of these thicknesses have not been observed in the experimental sample to date, so they may indicate interaction of several different processes on the LVA surface record. These observations and results suggest new avenues of analysis for understanding the LVA record, such as fracture type analysis, which would allow us to identify the origin of fractures on archaeological artifacts (Miller 2006; Weitzel and Colombo 2006; Jennings 2011; Weitzel 2012). Moreover, it is necessary to assess whether there is a direct relationship between edge angles and the occurrence of trampling damage. Also, a more thorough analysis of the edge flaking measurements and morphologies is required to determine whether there are clear morphological patterns useful for distinguishing anthropically from taphonomically flaked edges. Finally, this paper illustrates the utility of actualistic studies to improve our interpretations of the archaeological record. As have other studies (Nielsen 1991; Lopinot and Ray 2007; Eren et al. 2010, 2011; Thiebaut et al. 2010a; Borrazzo 2011a, 2011b; Weitzel et al. 2014), we hope this paper offers a case study in which experimentation generated new data and questions about the formation of the archaeological record, contributing to trampling taphonomic studies and, in particular to the understanding of LVA’s surface lithic assemblages.

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REFERENCES

Aschero, C. 1975 Ensayo para una clasificación morfológica de artefactos líticos aplicada a estudios tipológicos comparativos. CONICET, Buenos Aires. MS.

1983 Ensayo para una clasificación morfológica de artefactos líticos aplicada a estudios tipológicos comparativos. Apéndices A-C. Revisión. Cátedra de Ergología y Tecnología, Facultad de Filosofía y Letras, Universidad de Buenos Aires, Buenos Aires. MS.


2006 Tecnología lítica del alero Cerro León 3 (Santa Cruz, Argentina). Magallania 34 (2): 63-74.


2010 Experimental examination of animal trampling effects on artifact movement in dry and water saturated substrates: a test case from South India. *Journal of Archaeological Science* 37: 3010-3021.

Eren, M., A. Boehm, B. Morgan, R. Anderson and B. Andrews

Flegenheimer, N. and C. Weitzel

Franco, N. V. and L. A. Borrero


Hiscock, P.
1985 The need for a taphonomic perspective in stone artefact analysis. *Queensland Archaeological Research* 2: 82-95.

Jennings, T. A.

Kligmann, D. M.

Lopinot, N. and J. Ray

McBrearty, S., L. Bishop, T. Plummer, R. Dewar and N. Conard

Merenzon, J.

Miller, M. J.

Nielsen, A. E.

Osborn, A. J., and R. J. Hartley

Pargeter, J.
2011 Human and cattle trampling experiments in Malawi to understand macrofracture formation on Stone Age hunting weaponry. *Antiquity* 85 (327).

Peacock, E.

Pintar, E.

Pryor, J.

Schiffer, M.

Schoville, B. J. and K. S. Brown

Thiébaut, C., M-P. Coumont and A. Averbouh
Thiébaut, C., M. P. Coumont and A. Averbouh
2010b Approche expérimentale des conséquences
du piétinement des grands herbivores sur les
vestiges lithiques et osseux. In Mise en commun des
approches en taphonomie. Actes du workshop n°
16-XVe Congress International de l’UISPP, edited by
C. Thiébaut, M. P. Coumont, and A. Averbouh, pp.
109-129. Société des Amis du Musée National de
Préhistoire et de la recherche archéologique, Les
Eyzies-de-Tayac-Sireuil.

Weitzel, C.
2010 El estudio de los artefactos formatizados
fracturados. Contribución a la comprensión del
registro arqueológico y las actividades humanas. PhD
dissertation. Facultad de Filosofía y Letras, Universidad
de Buenos Aires, Buenos Aires.

2012 Cuentan los fragmentos. Clasificación y causas
de fractura de artefactos formatizados por talla.

Weitzel, C., K. Borrazzo, A. Ceraso and C. Balirán
2014 Trampling fragmentation potential of lithic
artifacts: an experimental approach.In this volume, pp.
97-110.

NOTES
1.- Date on bone, (AA98670, dC13 -20.7).
2.- Although artifacts from plot A showed no fractures or
damage on their edges in this first survey, in a subsequent
survey, conducted in January 2014, broken pieces were re-
corded in that plot (Fractured N = 2; edge damage N = 6).
3.- Longitudinal split fractures are those that “split the flake
into left and right along the percussion axis. Each fragment
retains a portion of the platform (often with a portion of the
ringcrack in hertzian initiations), and usually a portion of the
termination and one lateral margin” (Hiscock 2002: 252).