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Lithic taphonomy in desert environments: Contributions from Fuego-Patagonia (Southern South America)

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ABSTRACT

This paper focuses on the contributions of taphonomic approaches to the study of lithic assemblages. Based on actualistic and archaeological case studies from Fuego-Patagonia (South America), here I summarize some of the main taphonomic issues identified for the regional lithic record which are of relevance for the archaeological research in other desert environments. Specifically, distributional patterns in lithic assemblages produced by wind are highlighted and main guidelines for pseudoartifact study are presented and discussed. Actualistic data show lithic artifacts up to 50 mm in size – or weighting ~13 g – can be moved by winds blowing at 90 km/h. Finally, a methodological exercise (Banyai's zoom) is proposed for lithic mimic recognition.

1. Introduction

> *'A refined understanding of taphonomic mechanisms which affect stone artefacts would provide better basis for interpreting archaeological assemblages.'*
>
> (Hiscock, 1985: 93)

Throughout the history of our discipline, theoretical as well as methodological advances changed the way we define, approach, and inquire into the archaeological record and its components (Trigger, 2006; Podgorny, 2008, 2009). One of these recent changes has been the incorporation of lithic artifacts into the realms of taphonomic studies (Hiscock, 1985, 2002; Dibble et al., 1997; Barton et al., 2002; Bordes, 2003; Borrazzo, 2004, 2006; Thiébaut et al., 2010; Borrero, 2011a, 2011b, 2014a, 2015; Eren et al., 2011; Domínguez-Rodrigo et al., 2011; Weitzel et al., 2014; Ugalde et al., 2015, among others). This inclusion does not imply assuming that artifact – as a subsample of rocks modified by hominins – are like organic remains but recognize that – although their undeniable higher toughness to bear the passage of time – they do suffer modifications (morphologically and/or spatially) in different patterned ways, as a response to temporal and environmental conditions (e.g. Bertran et al., 2012). Each of these modifications or alterations (at the level of the individual artifact and/or the assemblage) constitutes itself a record of archaeological interest since it provides insightful information about assemblage formation history. Furthermore, the study of such alterations may highlight taphonomic bias in the technological structure, composition, and spatial distribution of lithic assemblages which can influence our behavioral interpretations.

Within this general perspective on the stone components of the archaeological record, lithic taphonomy studies the effects of natural and cultural processes acting upon artifacts from their deposition until their recovery. This approach in lithic artifact analysis is also concerned with the identification and characterization of taphonomic processes capable of creating spatial or morphological (i.e. geofacts or pseudoartifacts) patterns similar to those produced by humans (also known as *background noise* see Borrero, 2001a, 2007, 2014a, 2015).

Due to their durability, lithic artifacts are the more frequent archaeological remains in Patagonian deserts and semi-deserts (≤400 mm annual rainfall, maximum wind speed ~150 km/h). Consequently, the reconstruction of hunter–gatherer behavior is often based primarily on the study of those materials. This situation emphasizes the need of incorporating a taphonomic perspective in lithic artifact analysis. Moreover, beyond their regional contribution, the results of the studies presented in this paper are also

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relevant to the broader realm of archaeological research in desert environments because they stress the need to search and isolate taphonomic patterns for accomplishing better interpretations of past human behavior.

In this paper I draw some of the main taphonomic trends in regional lithic assemblages from actualistic and archaeological research carried out in high-latitude Patagonian desert and semi-desert environments. The results presented here were obtained within the lithic taphonomy research program conducted in the region since 2002, which is part of the Regional Taphonomy research of Magallania Project, directed by Borrero (2001a, 2001b, 2007, 2014b) and Borrero et al. (2008). Lithic taphonomy program aims at characterizing *spatial* and *morphological* effects of taphonomic agents and processes on the regional lithic record. The former refers to changes in artifact distribution involving vertical and horizontal displacements, size selection, and changes in orientation, inclination, and position (i.e. exposed face). Morphological effects refers to postdepositional modifications introduced in artifact's formal attributes (outline, edge, surface, ridge, etc.) by physical and/or chemical weathering (breakage, abrasion, polishing, weathering rinds; Burroni et al., 2002; Goudie, 2004), and rock coating formation (salt crust, rock varnish, lichen growth; see Dorn, 2009). Within this perspective, pseudoartifacts represent an 'extreme morphological effect' of taphonomic processes operating in a particular environment.

Archaeological lithic assemblages studied in this paper were collected from sites and/or localities surveyed in Tierra del Fuego Province (Borrazzo, 2004, 2010, 2011a, 2014; Borrero et al., 2008; Borrazzo and Borrero, 2015 and references therein). Actualistic data presented result from longitudinal and short term experiments carried out in the study region as well as naturalistic observations and field collection of geofacts conducted throughout Patagonia (Borrazzo, 2010, 2011a, 2011b, 2013; Borrazzo and Borrero, 2015).

This paper assesses wind effects on surface lithic assemblages by means of actualistic data from Tierra del Fuego and explores the potential of different Patagonian environments to produce geofacts (or pseudoartifacts), i.e. rocks resembling artifacts. Main guidelines for pseudoartifact studies are presented and discussed, which include a methodological exercise of changing the scales of observation to identify lithic mimics.

2. Distributional taphonomic effects: assessing eolian transport

2.1. Regional background

The dominant strong winds from the SW – named *southern westerlies* – have a prominent role in the climate of Fuego-Patagonia (Frederiksen, 1988; Coronato, 1993; McCulloch et al., 1997) and are important taphonomic agents as well. Within northern Tierra del Fuego Province winds of 60 km/h blow more than 200 days per year, with gusts over 150 km/h (Isla et al., 1991; Vilas et al., 1999; Borrazzo, 2013). Also, we recorded 80 km/h winds during fieldwork in Chubut and Santa Cruz Provinces, where they can reach *ca.* 100 km/h (Servicio Meteorológico Nacional, 2005). Therefore, surface archaeological record in exposed-to-wind areas are subject to high energy processes (e.g. Borrazzo, 2004, 2006, 2013; Santiago and Oría, 2007).

The presence of vegetation reduces such wind effects by retaining sediments and artifacts within or below it. Wet fine-grain substrate also avoid eolian removal by 'sticking' materials to its surface, preserving artifacts with sizes as small as 10 mm in surface assemblages (Borrazzo, 2013; Borrazzo and Borrero, 2015). A related phenomenon, corrasion (eolian abrasion, Breed et al., 1997; Goudie, 2004) occurs in Patagonian desert–semi desert environments affected by strong winds. Dune fields – where dried and loose sand is available for eolian transportation-offer the most abrasive contexts for lithic artifacts at the regional scale (Borrazzo, 2006; Borrazzo and Borrero, 2015; Carranza, 2015). Naturalistic studies in the field and data collected from long term experiments set in Santa Cruz and Tierra del Fuego Provinces allow us to confirm that the strongest winds available in the region (over 100 km/h) have the capacity to move, transport (by saltation and/or creeping), and (re)deposit lithic artifacts bigger than 10 mm. Also, field observations showed that being aware of maximum wind speed value is more informative and useful for our archaeological taphonomic research than annual mean wind speed. This is due to the fact that bursts – regardless their brevity – have the largest impact on surface record since they have the capacity to move larger and heavier materials and/or disrupt stable conditions thus beginning dynamic processes that may lead to the creation of a new stable state.

Overall, these observations emphasize the importance of modeling wind effects on lithic artifact through further actualistic studies to achieve a better understanding of the local surface archaeological record formation (c.f. Borrero, 2011b; Massigoge and González, 2012). Although the need to study the role of wind transport in Patagonia is clear enough, actualistic research in Fuegian steppe may be of much wider relevance for the study of spatial and morphological properties of lithic assemblage in other desert/semi-desert environments.

2.2. Methods

In order to assess and begin to gauge the impact of eolian erosion on lithic assemblages, we set a plot with 44 experimental flakes (Table 1). Unlike our previous long term experiments, this plot was designed and set in the field to be surveyed and control on a daily basis for artifact movements and wind speed throughout the experiment duration (11 days).

The plot was located in the north of San Sebastian Bay (Tierra del Fuego, Argentina), on the top of a clay dune devoid of prehistoric artifacts (Vilas et al., 1999; Favier Dubois, 2001; Borrazzo, 2013). The selected spot was smooth, dry, and free of vegetation. Visibility conditions were excellent. It was exposed to the dominant wind (SW) and exhibited a 10° SW slope. Plot included experimental artifacts (flake and debris) produced by free-hand percussion from two nodules of local silicified rocks, one of the most frequent raw materials represented in regional archaeological assemblages. Pieces selected for the experiment exhibited up to 60 mm, as they are the most common sizes recorded among artifact collections in the region (Borrazzo, 2010, 2012). Size categories were assigned by using a 5 mm interval grid (Franco, 2002). Sector A included 10 artifacts of 20–30 mm size (1.28–3.46 g weight or 1344–5152 mm^3 volume, Table 1). Sector B was composed of 11 larger pieces, with 35–55 mm size (5.18–31.90 g or 4352–24,576 mm^3 volume, Table 1). Pieces in both sectors were set following a linear design, perpendicular to major wind direction, although wind moved some of the experimental artifacts soon after their deposition on the plot (Fig. 1A and E). The position of the ruler was established perpendicular to artifact line and parallel to the slope. It was fixed to the substrate by means of two cloves to facilitate daily controls and ensure accuracy of data collected. All the artifacts were deposited with the ventral surface on the dry substrate and their main axes parallel to the row (Fig. 1).

A third group of 23 smaller artifacts (5–25 mm, $\leq$1.50 g, $\leq$1920 mm^3) were deposited on sector C of the plot. In this case, pieces were set clustered in a circular fashion, in random position and orientation, but avoiding physical contact among them.

Table 1
Description of experimental artifacts deposited in the plot and the length of displacement recorded after 11 days (Distance).

Sector	#	Length (mm)	Width (mm)	Thickness (mm)	Vol (mm^3)	Weight (g)	Size (mm)	Distance (cm)
A	1	27	23	7	4347	3.36	30	0
A	2	32	23	7	5152	3.46	30	66
A	3	24	18	5	2160	2.08	25	35
A	4	24	22	4	2112	2.62	25	52
A	5	30	14	6	2520	2.78	25	15
A	6	26	17	3	1326	1.54	25	8
A	7	21	15	3	945	1.36	20	unknown[a]
A	8	24	14	4	1344	1.28	20	unknown[a]
A	9	15	17	2	510	1.32	20	15
A	10	28	20	4	2240	2.6	25	0
B	1	40	41	11	18,040	11.6	40	0
B	2	64	32	12	24,576	31.9	50	0
B	3	25	45	12	13,500	13.16	40	20
B	4	42	25	9	9450	7.96	40	5
B	5	54	43	6	13,932	13	55	0
B	6	51	20	8	8160	9	40	15
B	7	39	22	7	6006	7.22	35	5
B	8	53	30	7.5	11,925	11.26	50	22
B	9	40	49	9	17,640	16.24	50	0
B	10	34	32	4	4352	5.18	35	110
B	11	37	28	5	5180	5.36	35	2
C	1	24	16	5	1920	1.5	25	unknown[a]
C	2	13	11	7	1001	1	15	unknown[a]
C	3	11	5	2	110	<0.1	10	unknown[a]
C	4	13	6	3	234	<0.1	10	unknown[a]
C	5	17	18	4	1224	1	20	unknown[a]
C	6	11	9	2	198	<0.1	15	unknown[a]
C	7	18	6	5	540	<0.1	15	unknown[a]
C	8	14	12	1	168	<0.1	15	unknown[a]
C	9	16	8	2	256	<0.1	15	unknown[a]
C	10	15	10	2	300	<0.1	15	unknown[a]
C	11	14	7	3	294	<0.H121	15	unknown[a]
C	12	10	5	2	100	<0.1	10	unknown[a]
C	13	6	8	1	48	<0.1	10	unknown[a]
C	14	6	5	3	90	<0.1	10	unknown[a]
C	15	6	5	2	60	<0.1	10	unknown[a]
C	16	4	3	1	12	<0.1	5	unknown[a]
C	17	4	3	1	12	<0.1	5	unknown[a]
C	18	3	3	1	9	<0.1	5	unknown[a]
C	19	5	8	2	80	<0.1	10	unknown[a]
C	20	11	9	2	198	<0.1	10	unknown[a]
C	21	9	7	2	126	<0.1	10	unknown[a]
C	22	8	5	1	40	<0.1	10	unknown[a]
C	23	10	7	2	140	<0.1	10	unknown[a]

[a] These pieces were not localized after surveying a 10 m radius from the plot.

Experiment spanned from January 13 to 24, 2013. During that period, the direction and maximum velocity of the wind was recorded daily at the spot and/or the surrounding area. An anemometer (Skywatch Xplorer 3) was used for wind speed measurements in the field.

2.3. Experimental results

Maximum velocity of wind recorded during the experiment at the spot or the surrounding area was 52–89 km/h and always blew from SW. Table 1 shows the distance of artifact horizontal displacements in sectors A and B measured from initial (plot set up) to final (gathering) position. Artifacts from sector C could not been localized at the end of the experiment.

A chi-square test of independence was performed to examine the relation between weight/occurrence of displacement and weight/distance of displacement, which was significant in both cases (weight/displacement $X^2 = 6.8865$, 1 df, $p = 0.0253$; weight/distance $X^2 = 19.8$, 1 df, $p = 0.0001$).

Soon after their deposition, many artifacts were moved by the wind, which was blowing at 60 km/h with bursts up to 70 km/h at the moment of the plot setting. All but one case (artifact # 6, plot A) recorded a NE direction displacement (downwind) and therefore upslope. This emphasizes the prominent role of wind in the movements recorded within this short time experiment.

Each artifact from sector C (the smallest/lightest pieces in the plot) was moved promptly by the wind after its deposition and only 15 of the 23 debris remained inside experimental space C (an area of *ca.* 0.5 × 0.5 m, without material demarcation) for photographic record. Among the former, six pieces were put in contact with each other by the wind (Fig. 2). One day later (January 14, 2013), only 17 artifacts of sample C were identified in the plot and/or within a 5 m radius. After eleven days, none of the artifacts originally deposited from sector C were still on the experimental space and they were not found within a 10 m radius from the plot either. The 10 m radius can be considered a minimum distance reached by those artifacts. Nevertheless, given the small size of the pieces in sample C (5–15 mm), we cannot completely rule out that some of the smallest artifacts were deposited close to the experimental space (somewhere between 5 and 10 m radii) but remained unnoticed during the survey.

Most of the pieces in sector A and B exhibited less radical changes. As it was expected, smaller pieces on sector A (artifacts # 7 & 8) resembling metric attributes of those on sector C, presented a

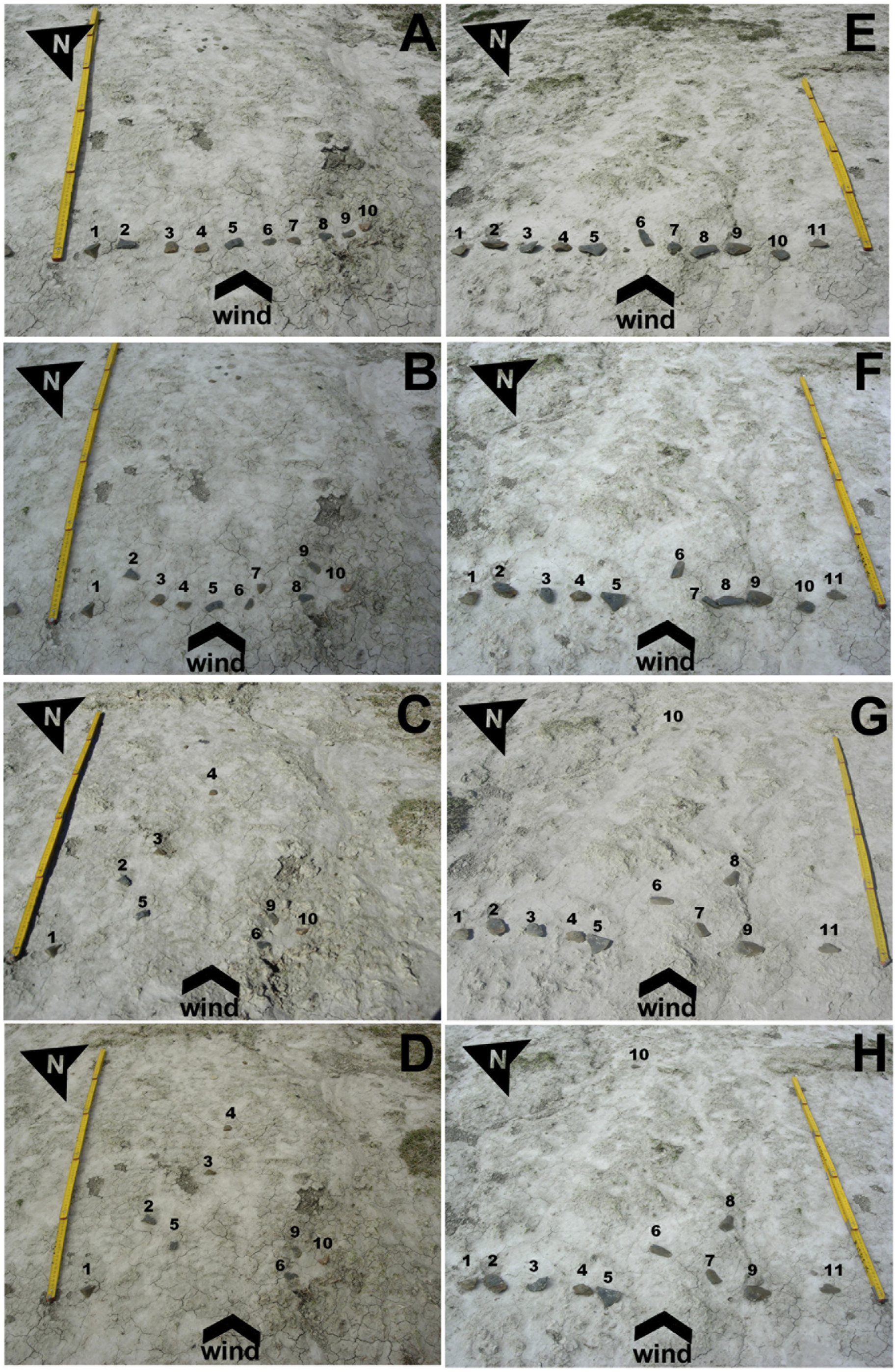

Fig. 1. Horizontal displacements produced by ≤89 km/h winds on sectors A and B of the plot (through day 1–4). A–D: sector A (medium-size pieces); E–H: sector B (large pieces). Ruler on the picture is 1 m long.

similar trend: after recording movements toward NE, they could not be identified within the 10 m radius (Table 1). But two pieces of sector A (artifacts # 6 & 9, Table 1) with similar metric properties behaved differently. On the one hand, three days after its deposition, artifact #6 (1.54 g; 1326 mm^3) was located 8 cm to the NE (and up in the slope) from its position the day before (Fig. 1B and C). Maximum wind speed records for day two and three were 60 and 73 km/h, blowing from the SW. From day three until to the end of the experiment, this small piece did not record further movements. Furthermore, although the largest piece on sample A (artifact # 2, Table 1) moved 66 cm NE from its original position, some smaller artifacts (# 1 & 10) were not displaced during the eleven days that the experiment lasted. A thorough examination of the surface of sector A showed that some irregularities –resulting from a small accumulation of clay pellets- offered shelter from the SW wind to pieces # 6, 9, and 10 (Fig. 3). Therefore, small-scale 'wind shadow effect' is the more feasible mechanism to explain the stability recorded on artifacts # 6, 9 & 10 in sector A. This small scale phenomenon was previously recorded during other experiments in the region (Borrazzo and Borrero, 2015).

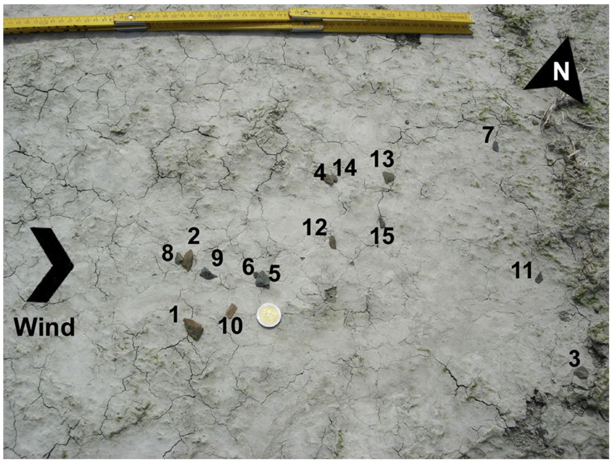

Fig. 2. Remaining artifacts in Sector C (smallest pieces of the experiment) soon after setting the plot (coin in the picture is 2.2 mm in diameter).

Finally, artifact #6 on sector B (9 g, 8,160 mm^3) moved slowly upward in the slope while swaying but without rolling soon after its deposition (Fig. 1E).

2.4. Discussion

This experiment showed that regional winds of *ca*. 90 km/h have the capacity to move artifacts of up to 50 mm in size and up to 13.16 g of weight, though major distances were recorded by pieces exhibiting sizes of ≤40 mm or weighting ≤5.18. These results indicate that wind transport and redeposition of artifacts may indeed explain the granulometric composition of surface assemblages in the area, such as Las Mandíbulas 2 (sample 1, 2005) a dense scatter with lithic materials that exhibit 35 mm as the maximum size (Borrazzo, 2013). Therefore, our study stresses the role of the wind in the formation of new 'sites' (or pseudo-sites), incorporating disturbed cultural material (c.f. Cameron et al., 1990).

Within the size range of experimental artifact, microtopographic phenomena (elevations, depressions, etc.) were important factors preventing and/or limiting the eolian transport of pieces, even when the latter were very small. As it was mentioned above, saturated fine grain substrates also inhibit artifact removal by wind (Borrazzo, 2010, 2013). It remains to inquire into the role of curved sections in artifact shapes as an enabler for wind removal, an attribute not explored here but suggested by our asystematic observations as an important trait affecting flake transportability. Finally, back and forth movements were not recorded in this or previous experiments (Borrazzo, 2013), probably due to strong southern westerlies in the region. However, they may be a prominent process introducing variation in spatial patterns within desert–semi desert regions.

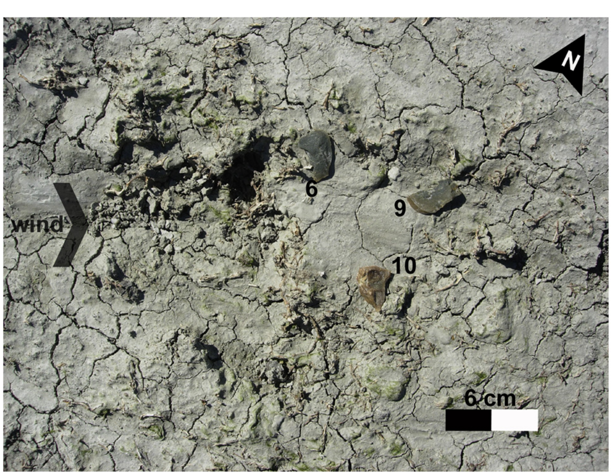

Fig. 3. Artifacts from sector A sheltered by a small accumulation of clay pellets.

Next, the results obtained in the experiment will be used as a frame of reference to estimate the distributional impact of winds on the regional archaeological record. Thus, size composition of lithic artifact assemblages collected by Magallania Project at 29 archaeological sites of northern Tierra del Fuego is considered (Borrazzo, 2010). Samples include surface (N = 3646 pieces) and stratigraphic (N = 1347 pieces) proveniences. Table 2 shows the size composition of assemblages split by artifact condition (whole/fragmented).

As it can be observed on Table 2, 93.6% of the artifacts recovered through excavation exhibit ≤40 mm in size and that is also the case of 65.8% of the surface sample. Based on the experimental results presented above, 65–93% of the regional lithic record displays the physical properties to be transported by local winds (89.3 and 51%, respectively if we exclude fragmented artifacts from this assessment). Moreover, maximum wind speed records (i.e. 150 km/h) indicate that these frequencies are actually *minimum* values for the size of artifacts that can in fact undergo eolian transport in the region.

Table 2
Size composition of regional archaeological artifact assemblages from northern Tierra del Fuego.

Size (mm)	Stratigraphy			Surface			Total
	Whole	Frag.	Total	Whole	Frag.	Total	
5	19	40	59	2	23	25	84
10	133	276	409	48	210	258	667
15	130	191	321	99	326	425	746
20	78	113	191	135	349	484	675
25	71	59	130	146	238	384	514
30	34	38	72	133	182	315	387
35	18	24	42	133	135	268	310
40	16	21	37	126	115	241	278
45	14	12	26	116	97	213	239
50	7	5	12	121	90	211	223
55	6	5	11	108	66	174	185
60	12	2	14	66	62	128	142
65	6	1	7	73	41	114	121
70	4	–	4	82	38	120	124
75	1	1	2	65	25	90	92
80	3	–	3	36	9	45	48
85	–	–	–	24	8	32	32
90	4	–	4	17	4	21	25
95	–	–	–	12	3	15	15
100	–	–	–	18	3	21	21
105	1	–	1	11	2	13	14
110	–	–	–	8	1	9	9
115	1	–	1	10	4	14	15
120	1	–	1	4	1	5	6
125	–	–	–	7	–	7	7
130	–	–	–	6	–	6	6
135	–	–	–	1	2	3	3
140	–	–	–	1	–	1	1
145	–	–	–	1	–	1	1
150	–	–	–	1	–	1	1
160	–	–	–	1	–	1	1
250	–	–	–	1	–	1	1
Total	559	788	1347	1612	2034	3646	4993

Similar assessment can be made for other lithic assemblages (Cameron et al., 1990). For instance, Bertran et al. (2012) summarize the size distribution of lithic assemblages experimentally produced by several reduction techniques (on anvil, discoid, laminar, Levallois, and biface) in order to characterize the general size distribution of knapping products, a frame of reference for taphonomic sorting analysis. Based on the size frequencies informed by the authors in the paper (Table 3), over the 90% of the experimental artifacts would be moved by wind if they were exposed to a ~90 km/h wind.

Table 3
Mean particle size distribution of experimental Palaeolithic debitage (>2 mm) (after Bertran et al., 2012: Fig. 3).

Size class	2–5 mm	5–10 mm	10–20 mm	20–31.5 mm	31.5–50 mm	>50 mm
Freq (%min–max)	62–85%	10–20%	2–11%	0–16%	0–5%	0–2%

3. Morphological taphonomic effects: the production of pseudoartifacts

Desert and semi-desert landscapes of Patagonia offer adequate conditions for mechanical (i.e. impact and/or pressure) fragmentation of rocks producing the most difficult geofacts to distinguish from man-made artifact. Among the processes involving these actions are rockfalls, runoff during the snowmelt period, marine and fluvial transport and deposition of gravels, trampling of large mammals on desert pavements and/or gravel-rich substrates. As it was posed at the beginning of this paper, pseudoartifacts can be considered the extreme outcome of morphological taphonomic effects.

The importance of recognizing human from natural chipped-stone materials is primarily noted for old archaeological contexts assigned to initial human occupations in a region or the early stone tool use by hominins (Barnes, 1939; Breuil and Lantier, 1965; Haynes, 1973; Patterson, 1983; Simpson et al., 1986; Donner, 2007; Kinnunen, 2007; Shulz, 2007; Demeter et al., 2010; Andrefsky, 2013; Boëda et al., 2014; Fariña et al. 2014; Suárez et al. 2014; Wiśniewski et al., 2014; Borrero, 2015 among others; for cognitive and contextual approaches to 'Eolith problem' see also de Bont, 2003; Ellen and Muthana, 2010, 2013 and references therein). However, several works showed that this is an issue of relevance for the study of younger lithic assemblages as well (e.g. Nash, 1993; Dibble et al., 1997, 2006; Manninen, 2007; Thiébaut, 2010; Borrazzo, 2011a; McPherron et al., 2012). Here I claim that natural flaked stones produced both by percussion and/or pressure, are a very common component of lithic assemblages from stone-rich environments (e.g. Pereda et al., 1991; Macgregor et al., 2008) which have been widely underestimated or simply ignored. Moreover, whenever rocks fall, or they are trampled by large animals or transported and redeposited by water, ice, or moved down slope by gravity, fractures by percussion/pressure can occurred. High energy environments are without any doubt the contexts more prone to fracture. However, the absence of taphonomic flaking within a region should not be assumed but assessed in every context.

Studies focused on pseudoartifact recognition have hitherto emphasized morphological analysis (e.g. Barnes, 1939; Schulz, 2007; Andrefsky, 2013; Macgregor and Mackay, 2013; Lubinski et al., 2014). In particular, they attempted to establish what defines and/or differentiates a pseudoartifact from lithic artifacts by establishing threshold values for key morphological attributes and/or their frequencies in lithic assemblages. For instance, human retouch is defined as "*patterned flake removal scars that are contiguous and/or overlapping and are invasive (>2 mm).*" (Andrefsky, 2013: 417). Although this may be the case, pseudoartifacts exhibiting similar patterns are not rare (Balirán, 2014; Fig. 4).

The presence of pseudoartifacts is not a problem when dealing with formal elaborated tools, as well as debitage, cores, or artifacts deposited in a setting naturally devoid of lithic raw materials (e.g. Borrazzo, 2012). Nevertheless, special attention is always required when addressing the so called 'simple' lithic technologies because we may identify, describe, and isolate as 'diagnostic' traits or

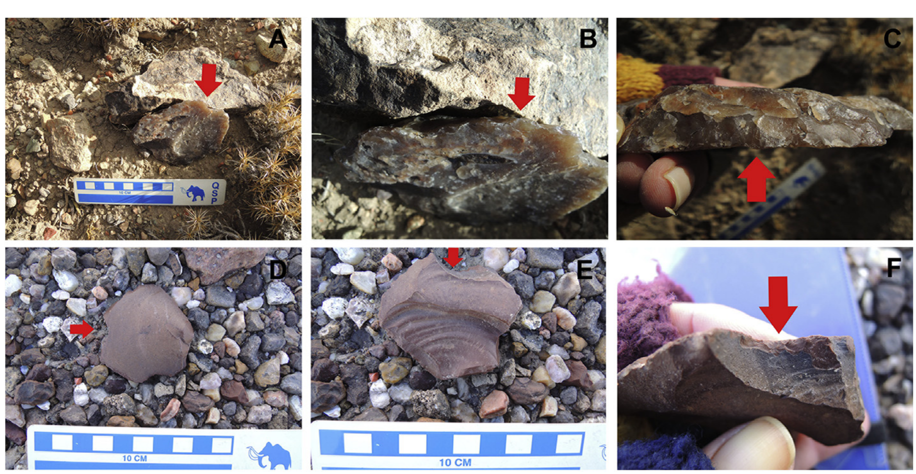

Fig. 4. Examples of (pseudo) retouch produced by trampling on desert pavement and gravel-dominated substrate (Chubut Province, Argentina). A–C) On a pseudoflake. D–F) On an archaeological flake. Arrows indicate the same spot on the edge throughout the pictures. A & D) Position of discovery; B) Detail of pseudoflake edge in contact with a nodule; E) Dorsal face of flake in pictures D–F which was found in contact with substrate. C & F) Detail of (pseudo) retouched edges on both specimens.

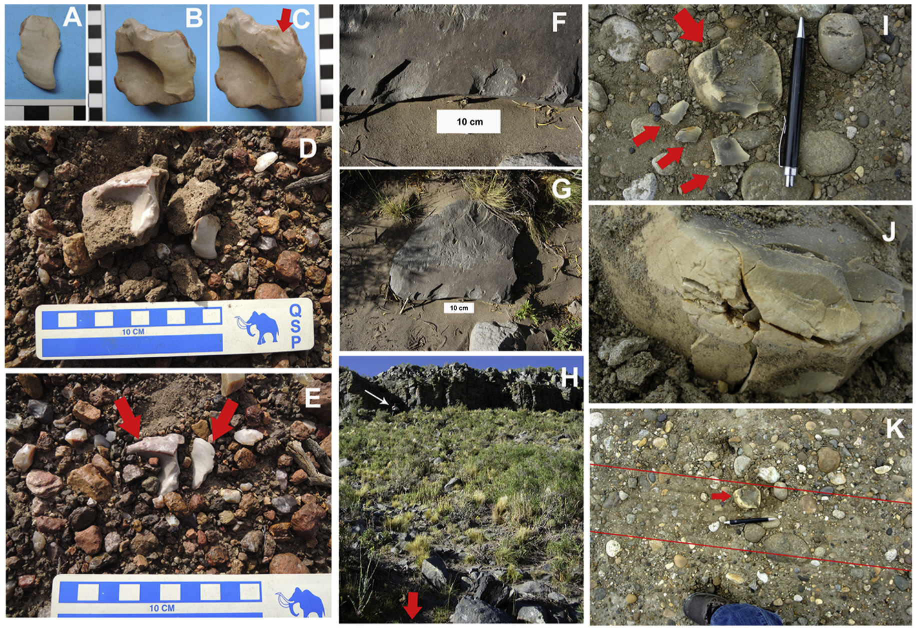

Fig. 5. Pseudoartifacts in context. A–E) Pseudocore and flake from desert pavement (Chubut, Argentina); F–H) Pseudonodular flake with flake scars produced by rockfalls, located at the base of an outcrop talus (Castillos de Pincheira, Mendoza, Argentina); I–K) Pseudocore and flakes detached by car tire on a road of Monte Leon National Park (Santa Cruz, Argentina). Arrows show pseudoartifact location; white arrow indicates human scale in H; lines describe tire mark on the road in K.

'typical' artifacts of certain 'industries' nothing but the local epitome of natural rock fragmentation (i.e. *background noise*). As Borrero (2015:7) put it: "*la caracterización del ruido de fondo lítico es una buena forma de evaluar el grado de artificialidad de un conjunto lítico*".[1]

From this perspective, the regional identification and the study of natural/taphonomic agents and processes capable of mimicking anthropic effects on rocks arises as an important task for archaeological research.

3.1. Methodology

This section summarizes the research strategies and methods we apply for identifying and assessing the contribution of pseudoartifact component in Fuego-Patagonia case studies. Naturalistic observation (Marean, 1995) is a central element within this actualistic research. It requires searching for spots where rocks are fragmented by different natural processes (rockfall, down slope movements, marine transport, thermal stress, etc.) and recording their spatial and morphological variation in order to build patterns of local and regional natural rock fragmentation. A reference collection is built by gathering natural pieces maximizing the representation of the range of variation in natural phenomena (in this case, fracture patterns), by sampling within different settings and selecting several lithic raw materials with special attention to collect those cases where natural specimens resemble lithic artifacts. Context of recovery is carefully described and recorded, as well as the position of the findings (exposed face, sediment coverage, orientation, substrate characteristics, etc.). In addition, every piece needs to fulfill at least several requirements to confirm its unambiguous taphonomic origin before incorporating it to the reference collection. First, lithic raw material has to be naturally available at the setting. Second, most – if not all- lithic fragments completing the nodule/block need to be present at the spot; the collection of cases exhibiting 'anatomical integrity' – e.g. Figs. 4B and 5E, J – are specially favored. Third, other nodules should exhibit similar fragmentation patterns at the same spot or geomorphic unit.

Subsequently, based on naturalistic data and applying geomorphological models pertinent to the regional dynamic, longitudinal experiments are designed and set within specific spots selected in the field, which are primarily subject to yearly controls (Borrazzo, 2010, 2011b, 2013; Balirán, 2014; Borrazzo and Borrero, 2015). The application of geomorphological models available for specific taphonomic process (e.g. see Dorren, 2003 for rockfall models) allow the stratification of the landscape under study by defining spatial units where pseudoartifact are expected naturally to occur and where they are not (e.g. Castro Esnal and Borrazzo, 2015). In sum, naturalistic studies set the agenda and the subsequent experiments refine our knowledge (Marean, 1995).

Simultaneously, complementary technological research is undertaken mainly focused in the comparison of natural vs regional technological trend. This exercise may detect rich-pseudoartifact assemblages – or even pseudosites – if their technological profile (i.e. frequency of artifact types, techniques, etc.) differs strongly from the regional technological background (Dibble et al., 1997; Borrazzo, 2011a; Andrefsky, 2013; Borrazzo and Borrero, 2015).

Morphology by itself may be a limited line of work if used in the absence of other markers. And that is the case in our study region where some of the most common pseudoartifacts (flakes, retouched flakes, flake fragments, core with a few blows) do not exhibit (or miss) any diagnostic trait, so they are virtually indistinguishable from man-made lithic material. That is why blind tests are not currently included in our taphonomic research. However, a variable that certainly proved to be sensitive in pseudoartifact recognition is spatial distribution and density of materials. Mimics spread in a stone-rich landscape within the range of the processes that generated them and/or where subsidiary process/es could

[1] The characterization of lithic background noise is a good way for assessing the degree of artificiality of a lithic assemblage.

transport them. This fact limits the range of situations where pseudoartifacts can naturally occur within every landscape. On the contrary, humans do not need stones to be immediately available for manufacturing artifacts and exhibit ranges and modes that significantly differ from taphonomic processes. Also, density of findings was a variable that resulted useful for our research in El Páramo Spit (Tierra del Fuego, Argentina) where all the lithic sample resulted to be naturally flaked (Borrazzo, 2011a). Besides recording high refitting rates (pseudo)artifacts frequency remained low and constant within a 1 km long transect on gravel ridges at the head of the spit, depicting the spatial scale of relative homogeneous environmental conditions (i.e. taphonomic mode; Borrazzo and Borrero, 2015). Also, technological and taphonomic traits recorded at El Páramo collection (frequency of certain tool types, thick weathering rinds, etc., Borrazzo, 2011a) differed significantly from regional archaeological pattern. In this case, the complimentary line of evidence provided by technological analysis (and the comparison with technological regional profile) supported the non-anthropic character of the lithic assemblage.

El Páramo case study also emphasized a central aspect in pseudoartifact dilemma: the role of the archaeologist as a ‘lithic collection’ builder (Borrazzo, 2011a; Ellen and Muthana, 2013; Suárez et al., 2014). Artifact assemblages are collections of lithic pieces. As such, they involve a collector. Archaeologists as collectors are the last taphonomic agents of selection affecting lithic materials. We decide what to collect and what to leave behind in the field, what to recover from an excavation and what to leave aside in the sediment sieve pile.

It is worth mentioning that it is not only that brittle rocks may fracture naturally in a similar way to human flaking but the role we, archaeologist, as field collectors play in ‘artifact recognition’ (i.e. sample selection) and assemblage (sample) formation. Raw material brittleness is not a sufficient condition for a pseudoartifact to capture collector's attention in the field: the potential of fracture scars and/or detached fragments to “look like” a human-made artifact actually is (e.g. exhibiting conchoidal fracture, made on raw materials represented in regional assemblages, etc.). The other side of the coin is that low flaking quality in lithic raw material hinders the recognition of human artifacts. Thus a fraction of what may be discarded in the field can be man-made, so archaeological recovery may trigger the underrepresentation of some true artifacts in lithic assemblages. This is not a complaint or critique to archaeologists work; on the contrary, it is a review of our own practice aimed at understanding the potential sources of variation for the lithic record and the importance of incorporating a taphonomic perspective in its analysis. The preservation/collection of all intended artifacts and naturefacts allow the possibility of further taphonomic studies such as artifact/naturefact size and distribution to assess formation processes and context type (Dibble et al., 1997, 2006; Bertran et al., 2012; McPherron et al., 2012).

In sum, several issues arise as key elements in a taphonomic research focused in lithic mimics: 1) defining spatial scale of observation (micro vs macro/regional); 2) understanding landscape history and dynamic; 3) identifying current and past agents and processes; 4) establishing levels of energy involved, and 5) characterizing lithic raw material availability.

3.1.1. Banyai's zoom: an observational exercise for pseudoartifact recognition

We can approach to the study of morphological changes in lithics resulting from taphonomic processes – and pseudoartifacts in particular- by applying the scalar exercise proposed by the Hungarian artist Istvan Banyai in his wordless picture book called *Zoom* (Banyai, 1995). The concept of this book is that of a zoom out that reveals a different reality as scale of observation enlarges. A similar scalar concept underlies much of the modern archaeological research: the meaning and/or interpretation of micro vs. site vs. regional scale patterns. Here I claim that a comparable exercise can be undertaken in the field and that it contributes substantially to pseudoartifact identification.

Many pseudoartifacts are undoubtedly interpreted as artifacts when analyzed at the specimen-level. The same morphological traits can also support a technological interpretation (e.g. ‘expedient behavior’, ‘rough/coarse/simple industry’, etc.) when a pseudoartifact assemblage is techno-typologically analyzed. However, if we ‘zoom out’ our sight during field recovery and examine the ‘scene’ taphonomically (lithic itself: shape, raw material, position, orientation, etc.; the setting: raw material availability, substrate, slope, vegetation, etc.), a more parsimonious explanation may emerge as an alternative. Fig. 4 presents two examples to illustrate the exercise proposed here. As we zoom out from C to A or from F to D, we can see that pieces that we would classify as stone tools (a sidescraper in C and a notch in F) are actually pseudoartifacts. In the first case (pictures 4C–A), a natural thin fragment of chalcedony partially buried was resting at an angle on a rock. Trampling on the edge of the exposed face of the piece produced small and almost continuous flaking that mimics human-made retouch on the opposite face. In the second case (pictures 4F–D), a chert flake – of anthropic origin- exhibits a concave continuous retouched edge. Edge flaking on the ‘notch’ – as well as isolated small flake scars on other portions of the edge- exhibit lighter weathering than the rest of the piece surface, depicting they derive in average from a more recent event. The piece was deposited on a pavement-like layer of gravels within the margin of a dry temporary lagoon. ‘Pseudo’ retouch of edges may have resulted by trampling on the hard, compact substrate.

Some of the primary taphonomic questions we need to ask to the scene of lithic findings include: 1) is the raw material of the intended artifacts naturally available at the locus? Do taphonomic agents and processes observed and/or recorded in the landform depict a high energy context? Are there high frequencies of refitting? Was any of the intended artifact found close to or in ‘anatomical position’ with the piece from which it was detached? If the answer to several of these questions is positive, we may need further actualistic research into taphonomic causes before posing cultural and/or technological claims on the lithic assemblage under analysis. The application of this exercise to case studies from Fuego-Patagonia shed light on pseudoartifact issues (Fig. 5, see also Fig. 4).

In sum, Banyai's zoom challenges the scope and definitive character of conclusions (i.e. technological/anthropic origin proposed from piece and assemblage study in vacuum). It highlights the role of scale and perspective in pattern observation and recognition.

4. Summary and conclusions

Taphonomic agents and processes have a prominent role in the formation of Fuego-Patagonia lithic record. We briefly revised and explored wind effects on distributional patterns of surface lithic assemblages by mean of experimental research on artifact size and eolian transport. Then, we compared the results obtained with the granulometric data of regional archaeological assemblages from Northern Tierra del Fuego. The comparison indicates that 93 to 65% of those materials could be transported by local winds. Furthermore, some loci can be exclusively product of eolian redeposition processes (e.g. sample 1 of Las Mandíbulas 2).

Background noise is a frequent component of lithic raw material-rich environments of Fuego-Patagonia. Different processes break stones (e.g. thermal stress/shock, freeze–thaw cycles, salt crystallization, rockfall, large animal trampling; e.g. Hall, 1999;

Nash, 1993; Lopinot and Ray, 2007) but only some of them produce fractures that exhibit properties resembling human flaking activities. Archaeologists need to look for the imprint of background noise at their study areas in order to isolate and assess its contribution to the archaeological record. This fact poses the actualistic challenge for lithic analysts of moving our focus from the study of 'cultural' to 'natural' phenomena and back, thus incorporating a taphonomic perspective in lithic assemblage analyses. Background noise or pseudoartifact study is informative about environmental dynamics and the energy locally available. Its incorporation to archaeological research on a regular basis may transform technological trend in several study regions. Finally, several case studies from Fuego-Patagonia emphasize the relevance of Banyai's zoom approach to the study of exceptional or anomalous – in terms of regional or larger scale patterns- lithic records worldwide. Also, further systematic morphological research on pseudoartifacts from different environments and regions is needed. Both contextual and morphological approaches will enhance our archaeological ability to distinguish mimics from artifacts.

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