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The memory of the landscape: Surface archaeological distributions in the Genoa Valley (Argentinean Patagonia)

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ABSTRACT

In this paper we focus on the regional/local scale of the archaeological record of the Central-West area of Chubut (Argentinean Patagonia) through the characterization of its regional taphonomy, considered from an archaeological perspective. We focus our research in the comparison of three different landscape situations: 1) a slope leading to highlands, 2) an azonal vegetal community (wetland or *mallín*), and 3) a salt lake. Our main goal is to compare those situations, in order to determine the main taphonomic factors that regulate the archaeological material distribution in those locales. The ultimate goal is to address how past hunter–gatherers inhabited these landscapes. We depart from the assumption that distributions of artifacts are mainly explained by the action of post-depositional processes. To evaluate this assumption first we postulate a series of hypothesis and expectations for each locale, considering the main post-depositional agents present in them, and we evaluated if the patterns of material distributions can be explained by one or many of those processes. Only if explanation cannot be achieved by them, we recurred to human depositional activities. As a result we managed to explain most of the archaeological distributions in terms of post-depositional processes. Only in two cases we propose that human deposition occurred.

So I began to get an idea of bog as the memory of the landscape, or as a landscape that remembered everything that happened in and to it (Seamus Heaney, 1980, *Preoccupations*, p. 54).

1. Introduction

Deserts around the world share similar characteristics. They are subjected to similar abiotic selective pressures, mainly determined by moisture scarcity (Brown et al., 1979). Biologically, there is a limited scope of answers to deal with this constraint, so it is reasonable to expect biotic convergence. The assumption that there exist patterns operating at a large scale, emerging as system properties that cannot be dealt as the mere addition of local results is what has been termed “macroecology” (Brown and Maurer, 1989). This view has also been applied to humans. Following Burnside et al. (2012) “We define human macroecology as the study of human–environment interactions across spatial and temporal scales, linking small-scale interactions with large-scale, emergent patterns and their underlying processes”. This is the sort of effort that a “Desert Archaeology” deserves: the linking of small (local) scale interactions between humans and the desert environment with large-scale emergent patterns common to the archaeological record located at those environments. Hence, the very first step is to determine the interactions at the local scale. There exists by now a certain quantity of works around the world settled at this scale (Holdaway et al., 1998, 2005, 2008, 2010; Bailey, 2007; Holdaway and Faning, 2008; Douglass and Wandsnider, 2012; Davies, 2013) but fewer are trying this effort at a macroscale level (for example, Holdaway et al., 2015).

In this paper we will pay attention to the local scale in order to contribute to the characterization of the regional taphonomy of the Central-West area of Chubut in Argentinean Patagonia, South America (Fig. 1, up). In this region we will focus our study in the Genoa Valley, setting our spatial focus at the mesoscale (*sensu* Delcourt and Delcourt, 1991) totalizing 3542 km^2 (Fig. 1, down).

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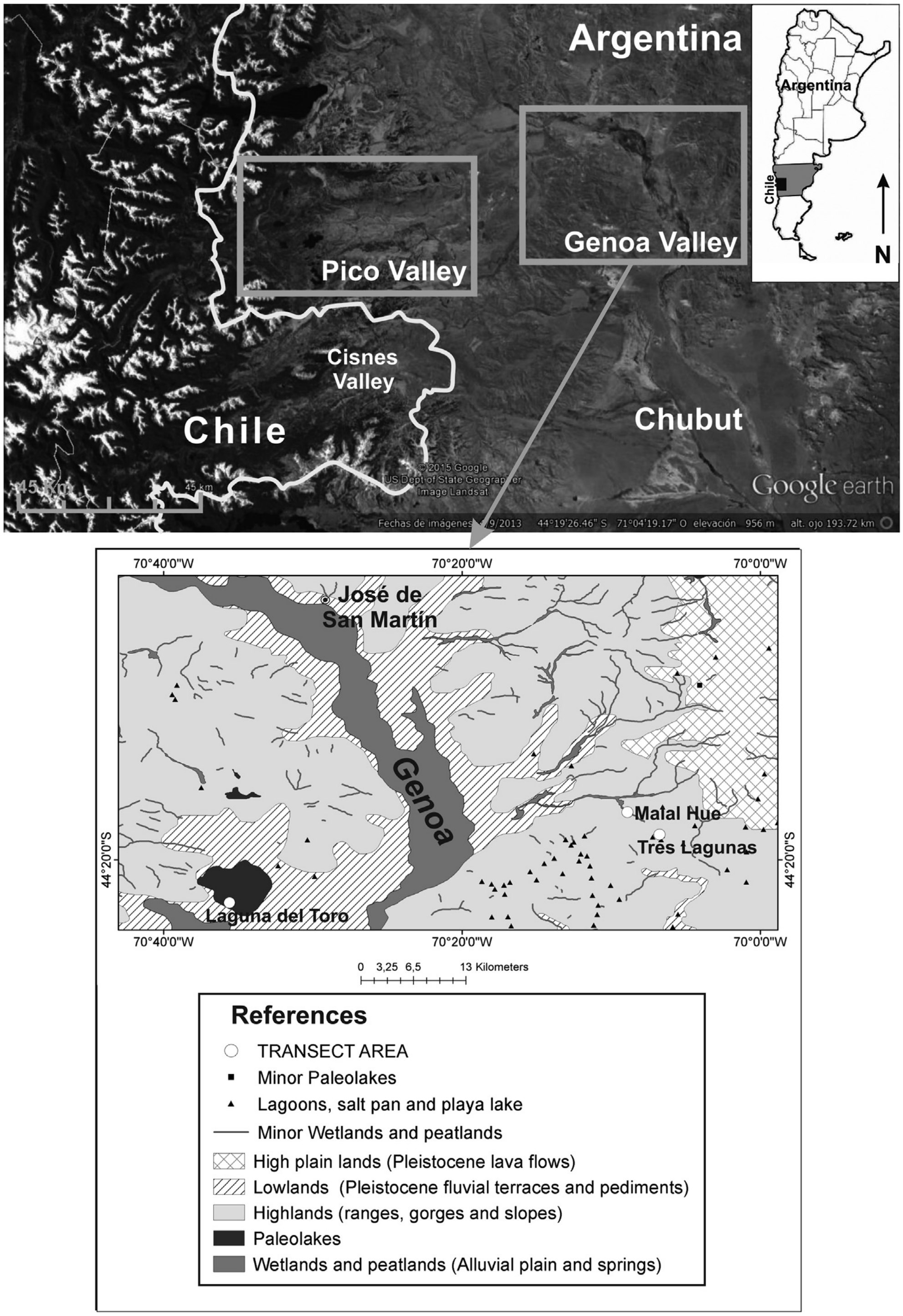

Fig. 1. Areas mentioned in the text and detail of the Genoa Valley geomorphology.

In a previous work (Rizzo et al., 2015), we compared the archaeological record of two biomes present in Central-West area of Chubut in a coarse-grained scale: the steppe, represented by Genoa Valley versus the forest represented by the Pico Valley. Both valleys are connected, situated at similar latitude and are part of our research area (Fig. 1, up). Genoa Valley, located at the Precordillera, offers a quick access to Andean forest resources to the West, and to the steppe and its lava mesa and plateaus (highlands), to the East. The Pico Valley conforms an East-West corridor (Matteucci et al., 2011), modeled by Pleistocenic glacial action, which facilitates the Cordillera de Los Andes crossing (since it is located at low altitude), leading to the Pacific and allowing access to forest resources (mostly vegetal ones as wood, cane, medicinal plants, etc.). Our results allowed us to consider that in Genoa Valley, although the predominance of aeolian and hydric erosion, there are different situations probably related with a variety of taphonomic modes (*sensu* Behrensmeyer and Hook, 1992) or landscape variations within the steppe.

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In this work, as a continuation of the mentioned above, we will focus our research in the comparison of three different taphonomic situations located at Genoa Valley: 1) an azonal vegetal community (active wetland or *mallín*) in alluvial plain with shallow and stable water tables, 2) a salt lake and 3) a slope, leading to plateau along a degraded wetland. Our main goal is to compare those situations, in order to determine their impact on archaeological material distributions, as a first step to build a baseline for the Genoa Valley taphonomy. We only consider here the spatial dimension. The temporal dimension will not be faced in this work, since we did not have yet any means to date surface distributions (unlike the case of Australia where Holdaway and its team were able to localize and date "heat-retainers hearths or earth ovens" associated with surface artifact distributions, see Holdaway et al., 2008, 2010). This is not problematic since spatial dimension allows for a coarse–-grained treatment of the time (see below the concepts of cumulative and spatial palimpsests). Our goal is to generate a way to determine, returning to the epigraph, how the landscape remembers or records what happened in and to it. The ultimate goal is to address how past hunter–gatherers inhabited these landscapes.

1.1. Patagonia: environment and archaeology

1.1.1. Environment

Patagonia is an elongated territory located between 39° S and 55° S in Southern South America. By its shape, it receives an important oceanic influence which determines the lack of subpolar conditions, tundra and permafrost (Morello, 1984), expected by its high latitude. The regional climate is determined by the westerly winds coupled with precipitation induced by the high western flanks of the Andean Cordillera (McCulloch et al., 1997) in what it was called "rainshadow effect". As a consequence, a strong East-West gradient is produced, with annual precipitation ranging from of 4000 mm on the Western slope (in Chilean territory) to 2500 mm at the Eastern slope, 900 mm at the steppe border and less of 800 mm at the steppe (Morello, 1999), achieving 200–100 mm in the driest zones. This gradient is also reflected in vegetation. To the West, Andean- Patagonian Subantarctic forests cover the Andean mountains and to the East grass steppes give way to shrub–grass steppes, and those to the semideserts and deserts (Jobbágy et al., 1996).

In the arid and semiarid zones, the steppe includes the Subandean District (Soriano, 1983), dominated by the bunchgrass *Festuca pallescens*, and the Occidental and Gulf of San Jorge Districts, characterized by *Stipa* bunchgrasses and shrubs (Adler et al., 2005). There is some variation in vegetation at a local scale that depends on water availability, as in the azonal communities associated to streams or shallow water tables that are locally known as *mallines* (Buono et al., 2010). They cover 3%–5% of Patagonia but they can be 20–30 times more productive than the surrounding steppes (Buono et al., 2010; Horne, 2010). Their vegetation have higher nutritional quality than the surrounding steppes, so their importance for grazing is greater (Raffaele, 2004; Buono et al., 2010) and warrant access to water in an area where it is scarce. In reference to the fauna, *guanaco* (*Lama guanicoe*), an indigenous Camelidae that reaches 120 kg and lives in big herds, is the biggest mammal. Other smaller mammal species present in this environment are *piche* (*Zaedyus pichiy*, a kind of armadillo), different species of carnivores like foxes and skunks and many types of rodents (Fernández, 2010). Among the avian fauna, the *ñandú* and *choique* (*Rhea americana* and *Rhea pennata*, respectively) are important given their sizes and abundance. Finally, it should be mentioned that, in historical times, European horse and cattle were introduced into this landscape (Scheinsohn, 2003).

1.1.2. Archaeology

Patagonia was inhabited by hunter–gatherers since 12,000 BP on. Since megafaunal extinction and with counted local exceptions (as in the maritime littoral) *guanaco* was the main staple during Early and Middle Holocene times. The Late Holocene (c. 5000 BP to the present) is characterized by notorious climatic and ecological changes that influenced Patagonian hunter–gatherers occupation (Borrero, 2001a). An increase in the demographic density of human populations in northern Patagonia has been argued on the basis of an increment in the quantity of archaeological sites (Borrero, 2001a; Barrientos, 2002; Scheinsohn, 2003; Barrientos and Perez, 2004, among others). This process could be related to cases of restricted residential mobility and wide exchange networks, as demonstrated by obsidian distribution and other items exchanged with non-hunter neighbors (Scheinsohn, 2003, among others). Related to this demographic density increase, it has been proposed that all the available biomes in Patagonia (steppe, forest, forest-steppe ecotone, marine coasts, etc.) were occupied by this period (Borrero, 2001a). As a consequence, an increase in circulation of diverse types of artifacts between them was recorded (Bellelli et al., 2003, 2007; Podestá et al., 2007, among others). In more recent times, hunter–gatherers had links with farmers on the Western slope of the Andean Cordillera, but cultigens on the Eastern slope were not critical for subsistence (Mena, 1997). The presence of Europeans affected hunter–gatherers in many ways, some of which show an archaeological expression, as in the case of the horse adoption (Scheinsohn, 2003). Ethnographically these inhabitants were called *Tehuelches Septentrionales* (Escalada, 1949; Casamiquela, 1965).

1.2. Theoretical framework: landscape archaeology

A landscape is "(…) a heterogeneous land area composed of a cluster of interacting ecosystems that is repeated in similar form throughout" (Forman and Godron, 1986, pp 11). So, it can be said that a landscape is less complex than a region (since this one contains a certain number of landscapes) and that an ecosystem is the more homogeneous and simpler part of a landscape. Then, the actual extension of a landscape could be variable, since it is recognized that most of the principles of landscape ecology can be applied to ecological mosaics at any scale. All landscapes have a structure (pattern) that influences its function (process). This interaction between the spatial pattern and the process defines the landscape concept. In this sense we apply a landscape taphonomy (Burger et al., 2008) or regional taphonomy approach. Regional taphonomy is "focused on the distribution of preservational pockets in the landscape, as well as the study of the mechanisms that accumulate and preserve archaeological materials" (Borrero, 2001b, pp 98) while landscape taphonomy is defined as a "taphonomy of those artifact-bearing landscapes" a taphonomic perspective that "provides the needed means of critically evaluating the ways meaning is assigned to pattern" (Burger et al., 2008, pp 206).

In the 1970s, some archaeologists began to emphasize the importance of recovering the information offered by the archaeological materials deposited on surface (Judge et al., 1975; Flannery, 1976; Baker, 1978; Tainter, 1979; Lewarch and O'Brien, 1981; O'Brien and Lewarch, 1981; Odell and Cowan, 1987; Redman, 1987; among others). Some of these early works, as Dancey (1998) noted, followed an culture-history paradigm and postulated the need to retrieve surface information as a mere reflection of what happened at subsurface level. This concern also led to review, and even to reject, the concept of the archaeological site and to analyze the surface record as valid in itself. Those works were framed in what was known as non-site archaeology (Thomas,

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1975), off-site archaeology (Foley, 1981a), siteless survey (Dunnell and Dancey, 1983) or distributional archaeology (Ebert, 1992). These frameworks argued the need to consider archaeological materials as continuously distributed in space, reflecting the spatial continuity of human behavior. From these points of view, resources were extracted at certain points of the landscape and taken to other points considered as settlements or processing areas (Foley, 1981b).

When archaeologists focus only on the sites, they lose track of a large part of human behavior that took place out of them. Thus, as Tainter (1998) suggests: "(…) Surface remains are the major element of the archaeological record, and they document parts of the past that other remains do not clearly reveal" (Tainter, 1998, pp 175–176). Now, in order to interpret surface materials, it has to be taken into account natural as long as cultural processes. Foley considers that post-depositational processes bias the possibility of recovering artifacts (Foley, 1981a), since they are affected by geomorphological and pedogenic processes of different kinds that can redistribute them, influence the degree of visibility (due to the different rates of erosion and deposition corresponding to different types of landforms), and even cause their destruction. Thus, artifact distributions could respond to the action of post-depositional processes rather than to the differential use of space by humans. Consequently, the presence of artifacts may represent, as considered Wandsnider and Camilli (1992), visibility windows rather than cultural activities.

In what it is called landscape archaeology, the archaeological record is defined as the record of overlapping distributions of discarded materials for extended periods. Then, archaeological distributions are considered in a space theoretically qualified as landscape (Rossignol and Wandsnider, 1992; Wandsnider and Camilli, 1992) taking into account simultaneously both time and space dimensions (Crumley, 2000, pp 8). When we study archaeological surface distributions, hence, we expect to find a cumulative palimpsest, defined as "(…) one in which the successive episodes of deposition, or layers of activity, remain superimposed one upon the other without loss of evidence, but are so re-worked and mixed together that it is difficult or impossible to separate them out into their original constituents" (Bailey, 2007, pp 204). In our case we could even deal with a spatial palimpsest "a variant of the cumulative palimpsest but distinct from it and defined as a mixture of episodes that are spatially segregated but whose temporal relationships had become blurred and difficult to disentangle" (Bailey, 2007, pp 207). It is interesting to notice that these concepts are generally employed as if palimpsests were negatives and they present a distorted image of what really happened. In this sense, we agree that "palimpsests are universal, an inherent feature of the material world we inhabit. They are no some distorted or degraded version of a message that needs to be restored to its original state before it can be interpreted. To a large state they *are* the message" (Bailey, 2007, pp 209, italics on the original). Palimpsests are the common way in which the archeological record is presented to us. The absence of palimpsest is only possible in a systemic context (*sensu* Schiffer, 1972) not in an archaeological scale (unless exceptional situations). The memory of the landscape is usually expressed as a palimpsest.

We have to state that in Argentina distributional studies have had a wide development, particularly in Patagonia where they thrived from the 90's on (Borrero, 1987; Borrero et al., 1992; Belardi, 1992, 2004; Bellelli et al., 2000; Castro et al., 2003; Zubimendi, 2010 among others) but they were also performed in the Northwest Argentina (Nazar, 1996; Ratto and García, 1996; Manzi, 2000, 2006) as long as in the Pampean region (Franco, 1991, 1994; Madrid et al., 2002). We rely on this background in order to incorporate Genoa Valley to the distributional discussion.

Given what is said above, in this work we will depart from the assumption that artifact distributions are mainly explained by the action of post-depositional processes rather than to differential use of space by humans. There are many factors that could intervene in material distributions and their visibility, but for each sampled location in the area we will postulate a main process that explains artifact distributions. If this process cannot explain artifact distribution we will appeal to alternative expected processes acting in that locale. Only if explanation cannot be achieved by any of the expected post-depositional processes, we will recur to human depositional activities as a cause.

2. Material and methods

2.1. Research area and sampled locations

Genoa Valley conforms one of the biggest wetlands or *mallín* in Patagonia (Horne, 2010). Being located between the Cordillera de los Andes and the Precordillera hills it is surrounded by highlands. The presence of minor wetlands and peatlands at the alluvial plain and adjacent tributary streams, springs and water bodies (Fig. 1, down) warrant the presence of *guanaco* herds looking for high quality pastures. With the exception of Gradin's work in Cerro Shequen (Gradin, 1978), in the Southern part of the area, the rest of the valley was archaeologically unknown until our team began a research project in 2012 at José de San Martín locality (Northern part, Fig. 1).

As said above, in this work we will compare three different locales, considering them as different landscape situations that could present particular characteristics in terms of their taphonomic processes. These locales will act as strata for sampling. They are 1) a slope leading to the plateau 2) an azonal vegetal community (wetland or *mallín*) and 3) a salt lake (see Fig. 2):

1) Malal-Hue: located on the edge of an ephemeral water course, which in the past was a *mallín*, at 60 km south of the José de San Martín town (Figs. 1 and 2a). It presents aeolian sand mounds and pediment cover with blowouts. The transected sector extends from the mouth of this ephemeral water course, when it flows into a larger one, up to its source in a hilly area. The slope of this ephemeral water course facilitates the access to the plateau (*meseta*), and could have been an important sector for human circulation. In fact, archaeological materials are continuously distributed, which makes it difficult to determine "sites". It presents sandy soils and scattered shrubs, which warrant good visibility, and is disposed in a 5 km long gentle slope which goes from 796 masl to approximately 900 masl at the summit of the hill.

Given this situation, our hypothesis is that the main process affecting archaeological material distribution here is gravity (Rick, 1976; Borrazzo, 2008; Herzlinger, 2012). In the literature, gravity will manifest as reptation due to freeze–thaw cycles of the ground and rain-induced runoff (Gardner, 1979; Matsuoka, 1998; Bertran et al., 2015). Downslope movements increase with slope gradient. In gentle slopes, diffusion (*sensu* Bertran et al., 2015) dominates although the presence of vegetation limits artifact diffusion. Therefore we expect that the lower the altitude, the most material accumulated (Rick, 1976) and that the bulk of the materials recorded should be downslope.

On this slope there is a gravel lane (Fig. 2a) which connects different farms. Since it presents archaeological materials, we consider that it functions as a gully that collects artifacts, as long as the rest of sedimentary particles, from the lateral slopes and transport them downslope. So, in addition to study the effects of gravitational action and water runoff downslope, we hypothesize that the road will function as an attractor of archaeological materials and that the passing vehicles will have effects on them. Gravel

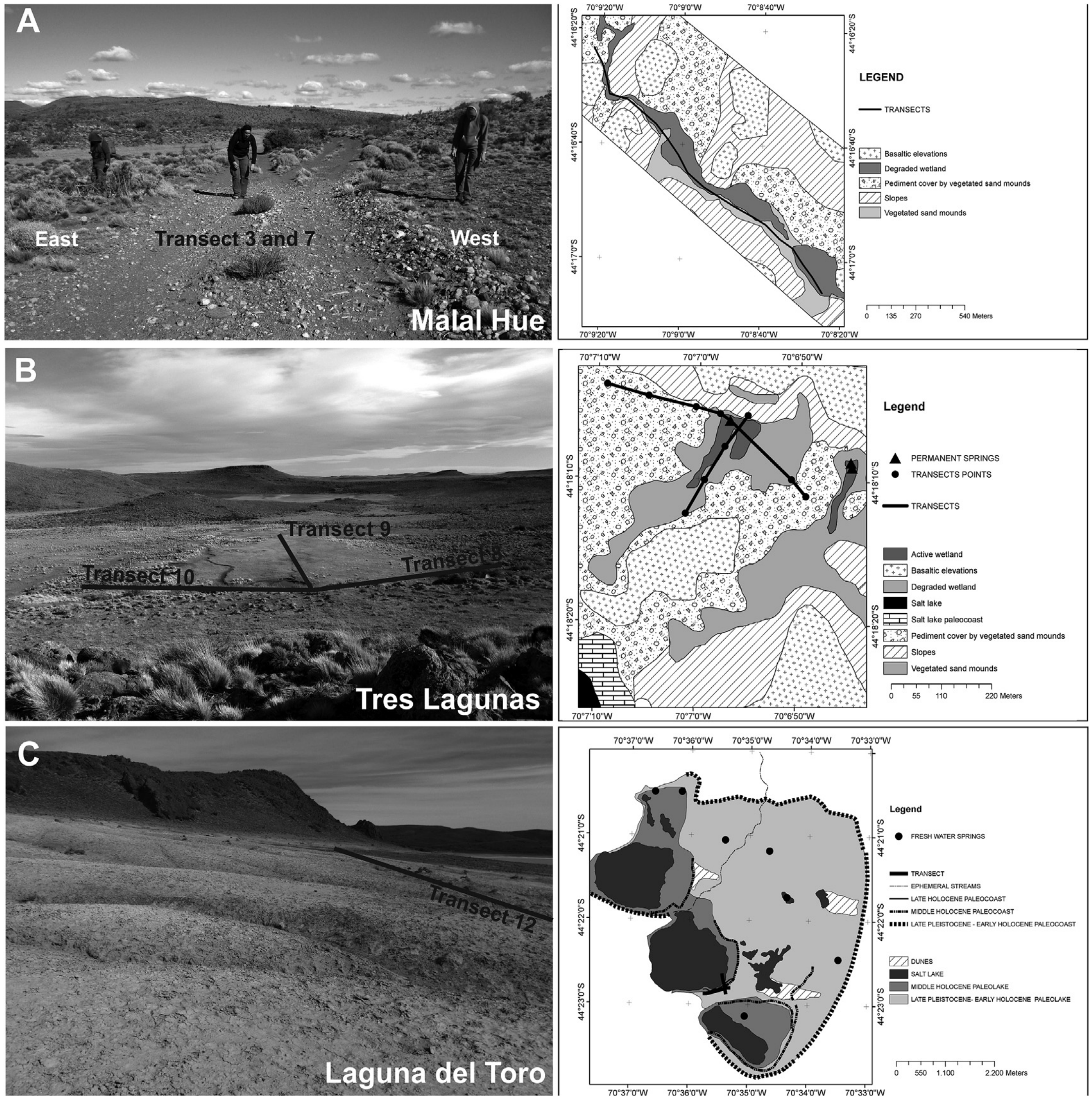

Fig. 2. Left – Landscapes transected in a) Malal-Hue, b) Tres Lagunas, c) Laguna del Toro; Right – geomorphology of each one.

lanes are made and, once in a while, maintained by road machinery. This machines should act over the materials breaking and tossing away them to the sides. These same accumulations are used to filling the holes produced in the lane. So roads will collect but also redistribute materials along it. The effect of vehicles will be broken materials but also materials "splashed" to the sides. Hence our expectation, in this respect, is to find more materials, and more broken, at the road than on its laterals.

Another hypothesis is related with the "collector effect" (Rizzo et al., 2015). Archaeological artifact collection is a hobby for many local people in Patagonia. Even in our study area, where low density population makes think that their action should have less impact, there are people who are known for their lithic artifacts collections. Since the gravel lane we transected is utilized by local people, we suppose that on their way, they could pick up the archaeological pieces that catch their attention. This behavior will be studied in detail in a future work but, here our expectation is that we won't find much formal tools in this area since collectors we will prefer those them.

2) Tres Lagunas: following the gravel lane referred above, after overstepping the hilltop and descending to the Northern slope (Figs. 1 and 2b), there is a wetland or *mallín* situated at 840 masl, nourished by springs. In an eroded profile of this *mallín* we found buried bones of *guanaco* and lithic scatters located at the bottom of the eroded profile (Rizzo et al., 2015). Below the bones of guanaco, it was located an organic paleosoil covered by sands and humic paleosoil, dated on 2490 ± 80 (LP-2902, δ^{13}: −24 ± 2‰). This context indicates organic sedimentation, pedogenesis in shallow water table area, wetland desiccation and erosion processes. Hence we expect here an alternation between moments of aridity and humidity with advances (organic sedimentation and pedogenesis) and retractions (erosion or aeolian sedimentation) of the *mallín* influencing materials distribution and their burial associated with humidity.

As *guanaco*, horse and sheep are present in this locale our hypothesis is to find trampling effects (see Douglass and Wandsnider, 2012). Hence we expect to find high fragmentation in archaeological materials. Also both humidity and trampling will favor burying of archaeological materials and since this is a flat surface, reptation it is not expected. Finally, we hypothesize that although "collector effect" should be present its impact will be low since only neighboring farmers and their employees circulate in this place.

3) Laguna del Toro: It is a closed basin conformed by three shallow salt lakes located at 600 masl (Fig. 2c). This area could be important for human populations since although saline, animals feed there. There are many levels of ancient shores (Fig. 2c) between 600 and 630 masl. When the 611 masl paleocoast was active, the three salt lakes were united and occupied a surface of 9 km^2. Between the paleocoast and the salt lake there is a flat and salt lacustrine terrace. Water action is evidenced by gullies located in the lacustrine landforms and an alluvial cone in the toe of the gullies (Fig. 2c photo). Differential erosion takes sand and clay away, leaving behind heavy and coarse fraction as clasts and archaeological artifacts. In an NW–SE line there is a series of freshwater springs (see in Fig. 2c) that also could be important for humans and animals. Hence, in this area our hypothesis is that artifacts are associated to gullies dynamic so we expect more materials in the zone where gullies are present.

Although there is sheep farming in this sector (and probably there is also *guanaco*), we hypothesize that although we will find fragmentation related with trampling effects, it would be low, since there is no direct relation between intensity of trampling and fragmentation (although substrate penetration introduces variability see Douglass and Wandsnider, 2012) and sheep, is a light animal. Also we hypothesize a low incidence of “collector effect”, since although the salt lake is at the side of a gravel lane, it is inside a private property that, at least for the last ten years, has been closed to the public.

2.2. Methods

In order to test our hypothesis we decided to perform transects in each strata or locale in order to compare them. Although the transects represent a small sample of the total area covered by Genoa Valley, for the purposes of this work these are useful to compare different landscape situations in the steppe. We selected the transects no randomly and with the following characteristics: 1) surface archaeological materials presence, and 2) a minimum area of 900 m^2–1000 m^2 by locale, to facilitate comparisons between them. Our sampling unit is each complete transect although in order to verify what expectations predicted, we divided them into 100 m lineal units.

All artifacts recovered along transects were collected. Artifacts were analyzed considering the following variables: 1) frequency of materials collected, 2) density of materials (calculated in artifacts/m^2), 3) types of artifacts, 4) broken and complete artifacts percentages and 5) raw materials. These variables will be utilized to evaluate expectations devised for each locale and to compare the different landscape situations studied. Although size could be considered as an important measure to evaluate post-depositional process, since this work constitute a first baseline in the area, we decided to consider fragmentation in a coarse-grained way and not to include size. In a future work we intend to deepen the study of this variable, reviewing fragmentation variable in a finer-grained way (as in Douglass and Wandsnider, 2012) and including size.

Apart from the evaluation of the different expectations we also compared the results obtained in each of the three locales. In doing so we have averaging the transects obtained in each locale. Below the locales and the transects performed are presented:

1) Malal-Hue: we performed two transects of 1000 m long and 10 m wide (T3 and T7), following the road, up the ephemeral stream (Figs. 2a and 3). Four operators walked the transects separated 2.5 m from each one, recording all the archaeological materials on the road (two central operators) and one operator at each side of the road (one at the East and the other at the West, Fig. 2a). So, each transect covered a surface of 10,000 m^2. Both transects were subdivided in 10 units, each one of 100 m long (covering 1000 m^2 each unit, Fig. 3). We also have performed two other transects, T1 and T2 in a perpendicular sense to T3 (and crossing the little valley formed by the ephemeral creek) but since they covered a twentieth century midden and they were not long enough to be compared with the others (see above) we decided not to include them in this work. T4 and T5 were performed near the owner's house and a creek and no materials were recorded there.
2) Tres Lagunas: we devised three transects (T8, T9 and T10), disposed as a fan from a point 0. Two of them crossed the *mallín* (Figs. 2b and 4). They were walked by four operators located at 2.5 m from each other. These transects have 300 m long and 10 m wide (totalizing 3000 m^2 each one) and were composed by three units of 100 m. This decision was taken because in T8 at 300 m, is cut by a gravel lane, affecting the distribution of materials, so we preferred not to continue that transect in order to avoid “noise” to the sample. In order to keep constant the units sampled, we decided to maintain the same sampled units for T9 and T10, especially taking into account that, from Pleistocene to Holocene, there was a continuous desiccation of the *mallín*, with fluctuations attributed to humid periods. Hence, it is possible that T9 and T10 could be located on a sector that in certain moments of the year presented water, according to the seasonal and annual fluctuations (Figs. 2b and 4).

At three kilometers to the SE, we performed another transect, T6, near the outpost which produced no materials at surface.

3) Laguna del Toro: here we devised two transects, T11 and T12, walked by four operators, located at 2.5 m from each other. Transect 11 was set perpendicular to the ancient coast line. The three first units are set in the Middle to Late Holocene paleoshores (Figs. 5 and 2c). At 600 m is located the current shore of the lake, so we only walked six units of 100 m (totalizing 6000 m^2). This shore fluctuates seasonally so in Fig. 5, since the photo corresponds to spring, the last two units seems to be inside the salt lake but as we transected that area in summer, water level was low. Between 350 m and 500 m there is a flat terrain where the deposition of sediments transported by gullies occurs (see below).

Transect 12 is located in the southern part of the salt lake at 613 to 615 masl, meaning next to Middle Holocene paleoshore and following it. It has 1000 m long × 10 m wide, totalizing 10,000 m^2 (subdivided in 10 units of 1000 m^2 each one). In the first three and the last three units there is high salinization while in the intermediate units salinization is lower (see Fig. 5). In this sector there are a series of gullies carved by water erosion with northern runoff that should affect archaeological material distribution, since many of the artifacts we found are located inside the gullies (see Fig. 2c).

3. Results

3.1. Malal-Hue

In transect 7 we recorded 49 artifacts (road plus both laterals) while in transect 3 we recorded 173. When considering both transects, T3 has more artifacts (78% of both transects) than T7 (22% of both transects). This is coherent with our expectation of finding more materials downslope (T3).

3.1.1. Gravity

In statistical terms, we should expect a negative correlation between altitude and frequency of artifacts: that is, the higher the

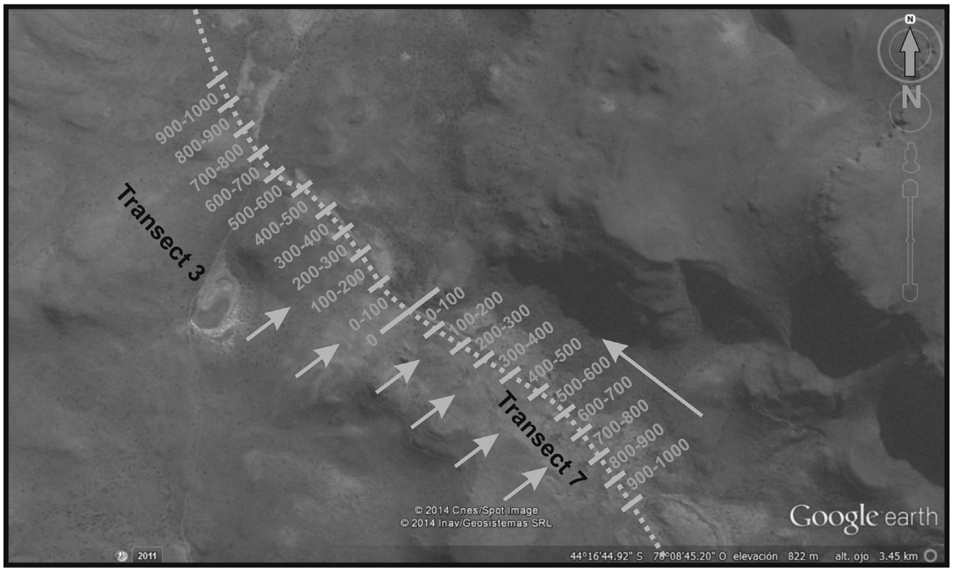

Fig. 3. Detail of the transects 3 and 7 in Malal-Hue.

altitude the less the frequency and the opposite. In Fig. 6 we present archaeological materials distribution in transects T3 and T7 units (labeled by the altitude above the sea of each unit). The figure shows that, in general terms, this expectation is accomplished but there are frequency peaks and valleys that do not fit. From those, the most noteworthy is the peak (more materials than expected) located at 798.5 masl at T3 unit 300–400 (see Fig. 3). This is clear in Fig. 7 where we present the linear fit of these values. Pearson's correlation coefficient in this case gets a low value of $r^2 = 0.3$ but when this peak are removed a better fit is obtained ($r^2 = 0.59$). In reference to this peak, we could not explain the higher than expected frequency of materials by mere gravity action. Therefore we have to appeal to other process. Our hypothesis will be that here we have a point of primary deposition of archaeological materials, so this concentration of artifacts could be attributed to a human occupation. This situation is reinforced by the presence of a nearby blowout in the degraded *mallín* (in reference to the relationship between human occupation and blowouts, see below). Also T3 unit 300–400 (at 798.5 masl) is the only one where materials at the sides of the road are more abundant than on the road itself, reinforcing this interpretation (the materials are no present there only because the road is collecting them). In reference to the unit at 790 masl, (T3 unit 900–1000) where we would have expected the bulk of the materials, since is the lower unit, it is interesting to notice that the 6 artifacts recorded there appear at the laterals and not on the gravel lane. This could be explained by the fact that this part of the road, close to an active *mallín*, would be waterlogged during winter–spring and hence, burying of materials could be more pronounced than in the rest of the gravel lane.

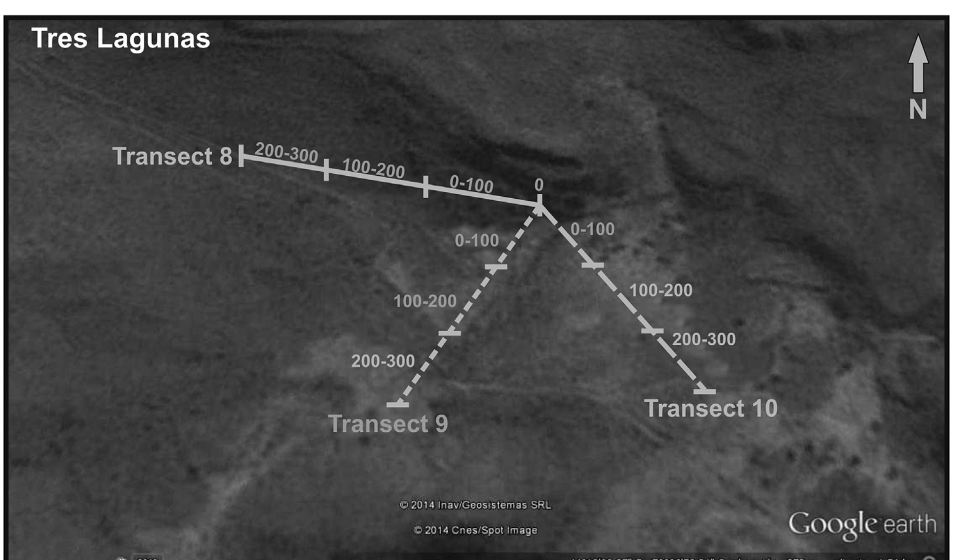

Fig. 4. Detail of the transects 8, 9 and 10 in Tres Lagunas.

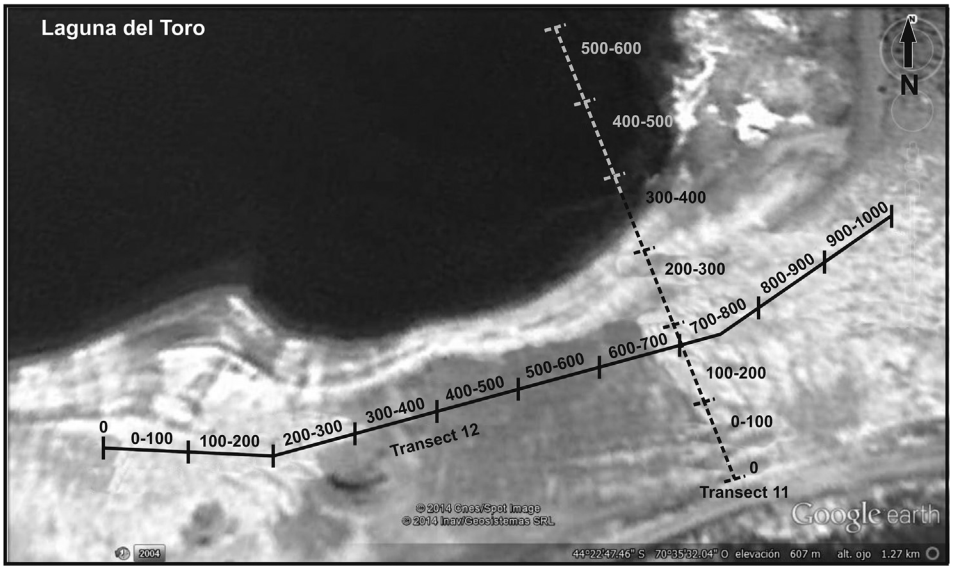

Fig. 5. Detail of the transects 11 and 12 in Laguna del Toro.

3.1.2. *Gravel lane as an attractor for archaeological materials*

We have postulated that on the gravel lane we should expect more materials and more fragmentation in the gravel lane than in its laterals (operators W and E). Results are presented in Table 1.

Table 1
Artifact frequency in transects 3 and 7 (road vs laterals).

	Complete artifacts	Broken artifacts	Total
T3 lateral E	14	24	38
T3 road	29	59	88
T3 lateral W	21	26	47
T7 lateral E	5	5	10
T7 road	16	11	27
T7 lateral W	8	4	12

As it can be appreciated there are slightly more materials in the road than in the sum of both laterals but it is not a relevant difference. In Fig. 8 we compare fragmentation by road versus laterals in the two transects (T3 and T7).

In T3 (downslope) there is more fragmented materials than in T7 (upslope). In the former fragmentation frequencies are somewhat higher in the road than in the laterals. Correlatively there are more complete artifacts in the laterals. In T7, roughly, there are more complete materials with higher frequencies at the Western lateral. Noteworthy, although it was expected to find more materials on T3, there is no reason for them to be more fragmented than in T7.

3.1.3. *Collector effect*

We will evaluate this effect by considering formal tools vs. flakes and cores and raw materials frequencies. If we compare the proportions of formal tools vs. flakes and cores recovered in these transects, in T3 formal tools represent 7.5% ($n = 13$) vs. 92.5% ($n = 160$) for flakes and cores, while in T7 is 8.2% ($n = 4$) and 91.8% ($n = 45$) respectively. These proportions, interestingly, are quite alike. This figures could be explained by the “collector effect” since it could be expected that collectors action should be biased to formal tools and to be homogeneous all along the transect. In T3 end scrapers predominates with 53.85% while side scrapers are in second place 38.5%, and in third place, informal tools with 7.69%. In T7 only end scrapers where recovered as formal tools.

3.2. *Tres Lagunas*

In T8 we collected 153 artifacts, while in T9 there are only 6 and in T10, there are also 6. In T9 materials were recorded only in the first unit (Fig. 4, unit 0–100). In T10 they were detected only in the second and third units (Fig. 4, units 100–200 and 200–300). In T8 there are materials in all units but the highest frequency is reached in unit 100–200 (Fig. 4) with $n = 129$. This is interesting since this transect is located in an area that probably was at the edge of the Holocene *mallín* and never was flooded because is higher than the rest. So, it could be suggested as an original point of deposition. Since T9 and T10 could be flooded seasonally (in times of greater environmental humidity), presence of artifacts

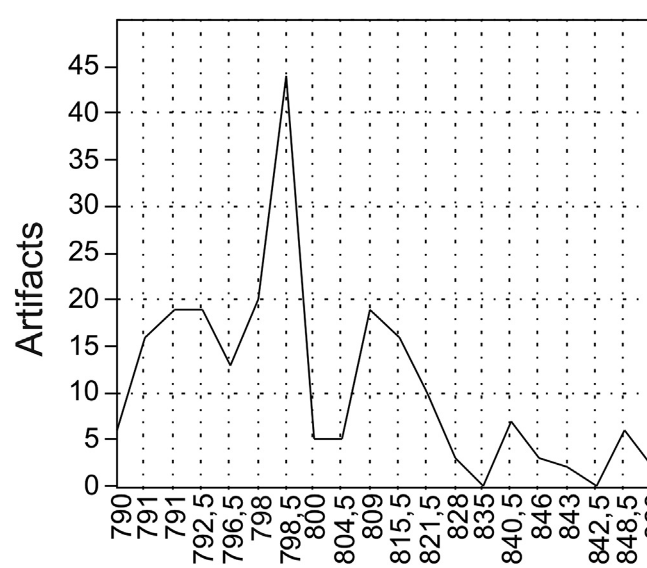

Fig. 6. Transects 3 and 7 artifact frequencies by meters above sea level.

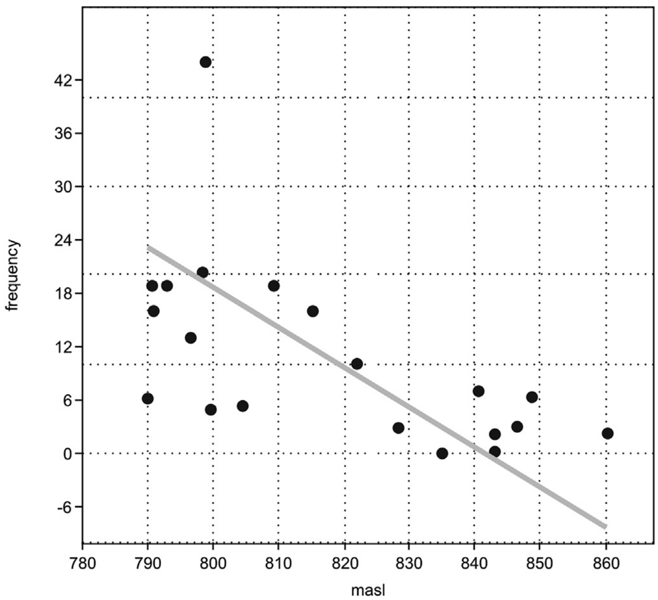

Fig. 7. Linear fit for transects 3 and 7 artifact frequencies.

there could be attributed to dry moments or seasons, when the *mallin* shrinks.

3.2.1. Trampling

We will evaluate trampling by considering fragmented artifacts frequencies. In Fig. 9 percentages of complete and broken artifacts for each transect are presented. In T8 complete artifacts predominate although there is an important percentage of broken ones. In the rest of the transects there is the same quantity of materials in both categories but the sample is too small (n = 6 for both).

3.2.2. Collector effect

The proportions of formal tools vs. flakes and cores in T8 is 11% (n = 17) vs. 89% (n = 136) while T9 is 50% (n = 3) vs. 50% (n = 3) and T10 is 16.7% (n = 1) vs. 83.3% (n = 5) respectively.

Among the lithic tools in T8 predominate end scrapers with 64.7% (n = 11) followed by projectile points and bifacial tools 17.6% (n = 3), side scrapers (11.7%, n = 2) and informal tools (5.9%, n = 1). In the two remaining transects, although the small sample, projectile points and bifacial tools predominate with 66.7% (n = 2) followed by end scrapers 33.3% (n = 1) in T9, while end scrapers is the only tool recorded in T10 (n = 1).

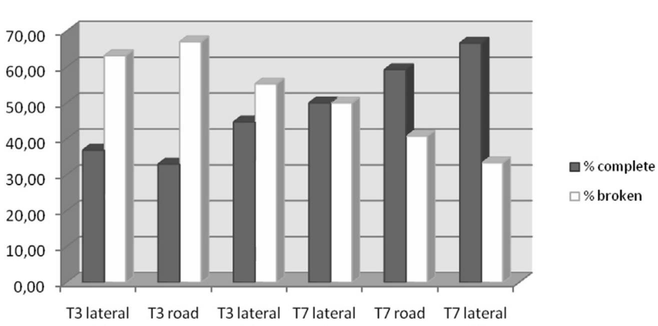

Fig. 8. Complete vs. broken artifacts percentages in Malal-Hue.

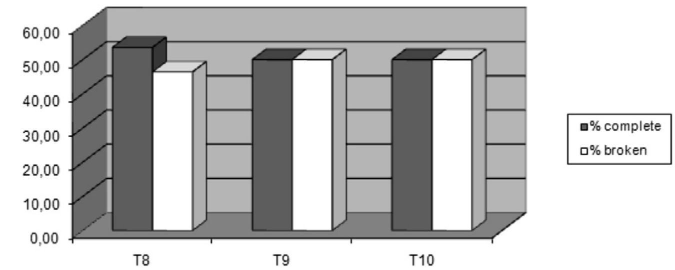

Fig. 9. Complete vs. broken artifacts percentages in Tres Lagunas.

3.3. Laguna del Toro

3.3.1. Gullies activity

In T11 we recovered a total of 42 artifacts while in T12 54 were retrieved. In T11 the greatest concentration is in unit 0–100 (Fig. 5) with 33 artifacts which can be explained by the fact that from unit 200–300 the shore of the salt lake is subjected to level fluctuations. From the geomorphologic analysis (see 2.1) the accumulation of sediments, given gullies activity, should be occurring at unit 200–300 m. So we expected that most of the materials are accumulated here. But most of the materials actually accumulated at 0–100 unit. Hence, we can hypothesize that the original deposition of archaeological materials occurred at this unit or even at the gravel lane located near it to the East.

The even distribution (with the exception of the last two units with no materials at all) and less quantities of materials (between 1 and 11 artifacts by unit) found in T12, crossed by many gullies, could be explained by gullies activity, dragging the material to the lower part of the slope.

3.3.2. Trampling

In Fig. 10 a high frequency of complete artifacts in both transects is observed, which is consistent with the expectation of lower incidence of trampling in the area.

3.3.3. Collector effect

The proportions of formal tools vs. flakes and cores is T11 of 14.3% (n = 6) vs. 85.7% (n = 36) and in T12 is 3.7% (n = 2) vs. 96.3% (n = 52). Formal tools in T11 are represented by 3 end scrapers and 3 side scrapers while in T12 one end scraper and one projectile point were recovered.

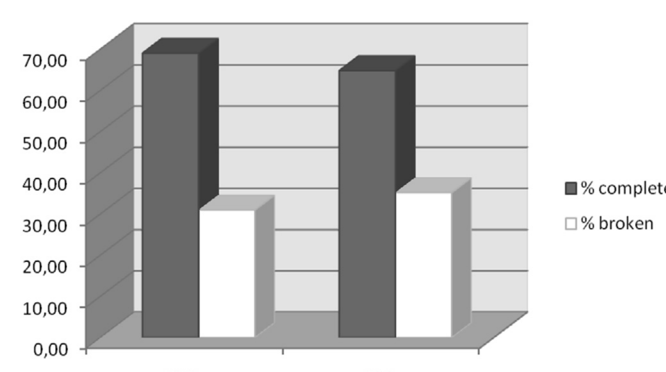

Fig. 10. Complete vs. broken artifacts percentages in Laguna del Toro.

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3.4. Comparison between areas

In this section we will compare results obtained in the three different locales. For this we will average the results by locale and compare them.

3.4.1. Densities

The highest density is recorded in Tres Lagunas. Taken into account that T9 and T10 have very few artifacts, most of the materials were recorded in T8, at the shore of the *mallín*. This adds to the idea of locating one of the points of origin of material in T8 unit 100–200 (Table 2 and Fig. 4).

Table 2
Density of archaeological materials recorded in the three locales.

Area	Total units	Surface	Total artifacts	Density (mean artif./m^2)
Malal-Hue (T3,T7)	20	20,000 m^2	222	0.011
Tres Lagunas (T8,T9,T10)	9	9000 m^2	165	0.018
Laguna del Toro (T11,T12)	16	16,000 m^2	96	0.006

The lowest density of materials is recorded in Laguna del Toro while Malal-Hue presents a middle situation (Table 2). In Laguna del Toro the low density of material could probably be explained because the points of origin of the recovered materials could be near the sources of fresh water located on higher zones (in the Middle Holocene paleoshore). Against this possibility, we found two *molinos* (grinding stones) located outside the transected area but near it, which could indicate site equipment.

The middle density in Malal-Hue could be explained considering it as a transit area between the *mallines*, located downslope, and Tres Lagunas.

3.4.2. Trampling

Highest fragmentation is recorded in Malal-Hue, as can be seen in Fig. 11. This could be explained by the fact that most of the material was located in or near the gravel lane. Nevertheless, Tres Lagunas also presents high fragmentation and, in this case, we can only attribute it to cattle and *guanaco* trampling. Also, Malal-Hue is located near a degraded *mallín* while Tres Lagunas is still active, attracting animals until today. Hence, trampling could be an important factor for fragmentation of materials, especially in the last case. The higher frequencies of complete artifacts are located in Laguna del Toro where we expected a low incidence of trampling.

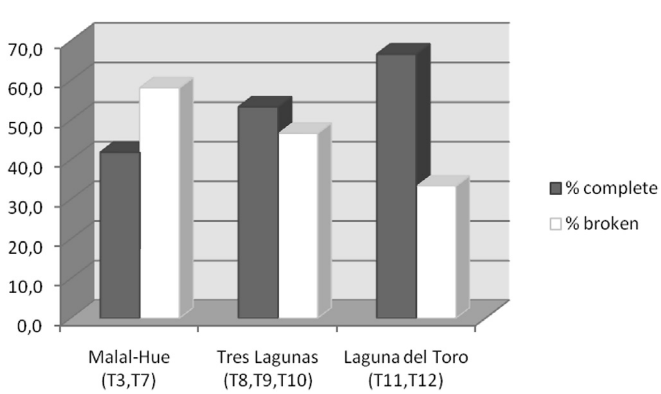

Fig. 11. Complete vs. broken artifacts percentages among the areas.

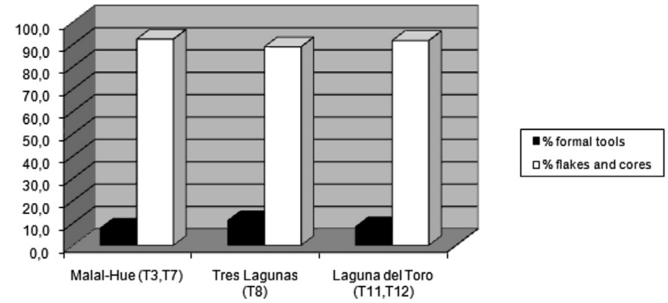

Fig. 12. Comparison of formal tools vs. flakes and cores percentages among the areas.

3.4.3. Collector effect

In all three locales the proportions of formal tools versus flakes and cores are quite low (Fig. 12). These figures could be explained by the fact that flakes always exceed tools in a knapping systemic context. But also variability in formal tools frequency could be attributed to collector effect. If consider only T8 (since the small sample from T9 and T10 will bias the results) Tres Lagunas has the highest frequency of formal tools (11%) and hence the lower incidence in collector effect which match our expectations.

Fig. 13 shows that end scrapers are dominant in the three areas. Side scrapers are present in the three areas but they are ranked in second place in Malal-Hue and Laguna del Toro while in Tres Lagunas they are ranked in third place. Projectile points and bifacial tools are present in Tres Lagunas and Laguna del Toro while they are totally absent in Malal-Hue (this could be attributed to the collector effect). Although scarce, informal tools are present in Malal-Hue and Tres Lagunas.

3.4.4. Raw material

Respect to raw materials, it can be said that chalcedony is predominant in the three locales (between 57 and 70%) while in second place are siliceous rocks with similar percentages (22 and 25%). It is noteworthy the absence of obsidian only present in very low percentages (1.4%) in Malal-Hue (Fig. 14). Also Laguna del Toro is noteworthy by the presence of siltstones (not recorded in Tres Lagunas and recorded in low frequencies in Malal-Hue) and basalt/andesite figures (higher than in the rest of the locales).

4. Discussion

In Malal-Hue we expected a negative correlation between material frequency and altitude, so the higher the altitude the less the frequency and the opposite. Given that this expectation was met, it can be said that our results are reflecting downslope movement

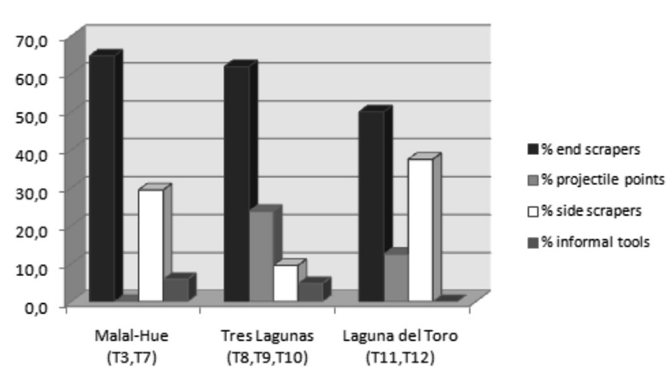

Fig. 13. Comparison of tools types percentages among the areas.

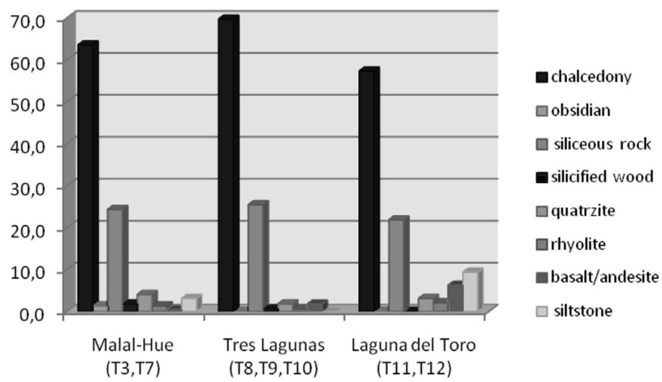

Fig. 14. Comparison of raw materials percentages among the areas.

(either due to gravity-related processes or others) rather than human occupational patterns. Materials recorded in the transects should be originally deposited elsewhere (with the exception of T3 unit 300–400 discussed below). They could be upslope, but the transects we performed achieved only to 860 masl. We do not know what happen at higher altitudes although climatic conditions (notably wind exposure) make it difficult to assume settlement there. Also, original points of deposition could be located on the slopes of the ephemeral stream the gravel lane runs. To cover these situations, transects perpendicular to T3 and T7 should be performed in future fieldwork. Nevertheless the high frequency peak found at T3 unit 300–400, could be considered as one of those original points of deposition, meaning that a human occupation occurred at that point of the landscape. This peak is situated on a blowout. There is a general pattern in Patagonian archaeology which relates blowouts with archaeological material. The most frequent explanation is that this relation is given by blowouts allowing archaeological visibility (Martínez, 2004; Martínez et al., 2010 among others). But blowouts could be originated by human occupation (see Scheinsohn, 2004). Blow outs forms when a patch of protective vegetation is lost and strong winds blow and forms depressions. Human settlement in a certain spot (with trampling and other processes) could affect the vegetation layer, triggering the processes that led to blowouts. Hence this association between blowouts and artifacts, in certain cases could be considered something more than a window of visibility (Wandsnider and Camilli, 1992).

Also we expected more materials at the road than in the laterals and higher fragmentation in the road opposed to the laterals. In reference to the first although road materials frequencies were slightly higher than the laterals this difference is not relevant. Regarding fragmentation, our expectation was only matched in T3 but upslope (T7) most of the artifacts were found complete (in the road and lateral W). Hence we can postulate that there is a differential effect: fragmentation is more pronounced downslope that upslope. May be, as Borrazzo (2011) had concluded in her experiment, this could be due to the size of fragments since the little ones (volume less than 5000 mm^3) tend to move greater distances. Therefore, it is expected that, since fragmented pieces are smaller, they were transported also downslope. An alternative explanation could be that the highest quantity of artifacts in T3 had facilitated the fragmentation by trampling. Anyway this result deserves an experimental program itself focused on the size issue, not considered here.

The results obtained in Tres Lagunas support the proposal that the advances and retractions of the *mallín* over time influenced materials distribution, their burial and exposition by erosion, since the only transect located in the area not affected by this process (T8), is the one where most of materials were recovered. Materials are concentrated in unit 2 (100–200) and this is not explained by the presence of slopes or water runoff that might be favoring accumulation in this point. So, this accumulation could be interpreted as another point of original deposition generated by human occupation. Finally, in the case of Laguna del Toro we expected that the action of the gullies could be influencing the distribution and concentration of archaeological materials at particular points in space and this situation was verified in our analysis.

Regarding trampling, in Tres Lagunas and Laguna del Toro we expected a low incidence of materials fragmentation. This was confirmed in Laguna del Toro since broken artifacts percentage is low. However, there is an unexpected proportion of artifact fragmentation in Tres Lagunas which is relatively similar to those recorded in Malal-Hue. Hence, animal trampling should be considered as an important factor in artifact breakage as vehicular trampling. This was also corroborated in Borrazzo (2011) for Sierra Baguales (Santa Cruz, Argentina). Also human trampling should be considered and, in this case, it could work as an indicator of redundancy in the use of an area. This could be reinforced in Laguna del Toro by the fact that here we recorded some equipment so redundancy is expected. But at this point is hard to differentiate the effects of human from animal trampling in this area. In relation with collector effect, our expectations were that in Malal-Hue and Tres Lagunas its incidence was higher than in Laguna del Toro since these two locales are more exposed to access of local people. Our results showed that although collector effect is present in the three locales, the highest incidence is in Malal-Hue while the lower is both in Tres Lagunas and Laguna del Toro. In fact, lithic analysis showed that although in most of the locales flakes and cores predominate, higher formal tools percentages are recorded in Tres Lagunas (dominated by end scrapers and projectile points) and in Laguna del Toro (with end scrapers, side scrapers and projectile points).

In reference to raw materials, chalcedony and siliceous rock dominate the sample, as they are locally available in the area. Instead, obsidian is notably scarce in all the locales. This is noteworthy in face of its high quality and nearness of known sources (no more of 400 km from Pampa del Asador). Particularly both to the west (in río Cisnes basin, located at Chile) and to the southeast (in El Chalía, Argentina) of Genoa Valley, obsidian from Pampa del Asador is recorded from Early Holocene times (Stern et al., 2013). We have recorded only three obsidian flakes in T3 but not sourcing was determined yet. This situation raises the question if the low frequencies of obsidian artifacts could also be attributed to collector effect or to other reasons.

5. Conclusion

In a research area with no previous information, these results allow us to have a baseline from which to begin discussing the past human occupation in Genoa Valley. This baseline was built departing from the comparison between different landscapes situations inside the steppe, in order to determine their influence over material distributions. We managed to explain most of the archaeological distributions in terms of post-depositional processes. There are two cases that remained unexplained by those processes: one is an artifact frequency peak in T3 (Malal-Hue) and the other an artifact frequency peak in T8 (Tres Lagunas). We have postulated that these two peaks could be explained as originated by human deposition. This is an issue we should test in the future but the presence of blowouts in this sector, when interpreted as originated by human occupation (see 2.1), reinforces our interpretation that a human depositional event took place there.

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Also we managed to prove that the gravel lane works as a macro-gully, collecting and transporting materials. This allows us to posit that roads could function as visibility windows (Wandsnider and Camilli, 1992) since they generate a local sample of the area. Hence, instead of rejecting its survey, given the high fragmentation expected, they should be profited as a sampling of the landscape.

Also we could detect unexpected burying processes, especially in Tres Lagunas area in which a natural buried *guanaco* was detected and excavated (Rizzo et al., 2015). This factor could explain the lack of materials en T3 at the 790 masl unit. As said in 2.1, *mallines* and water bodies are of great importance in an arid landscape. To know the distribution of *mallines* and water holes in the steppe is essential to circulate in the desert. Therefore, we should expect there most of archaeological materials concentrations. But in *mallines* is where we have detected the most potential for burying and, hence, more visibility problems. This deserves further analysis since we have only explored superficial scatters. Burying patterns should be analyzed by subsuperficial testings (Scheinsohn, 2004). There are still patterns that deserve some exploring. First, we have to increase the sample in these locales and in other places with other landscapes situations. Second, in this work we did not consider artifact size as a variable. An experimental design is needed in terms to detect size-related patterns in archaeological material distribution (Rick, 1976). Third, it is also needed to evaluate animal trampling, as it is a process that, as shown by our results, could be more important than first thought (see also Borrazzo, 2011). Fourth, a full lithic taphonomy analysis (Borrazzo, 2010) could contribute to discern processes other than the ones considered here, that could act on the materials. Finally, the continuation of these studies, will allow the comparison between the Genoa Valley with other desert areas, inside and outside Patagonia. In any, case this work was a first step in order start to recover the memory of the landscape.

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