



Contents lists available at ScienceDirect

## Journal of Anthropological Archaeology

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# Consumption of animals beyond diet in the Atacama Desert, northern Chile (13,000–410 BP): Comparing rock art motifs and archaeofaunal records



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## ARTICLE INFO

## Article history:

Received 1 June 2015

Revision received 31 August 2015

## Keywords:

Consumption

Rock art

Zoomorphic motifs

Archaeofauna

Atacama Desert

## ABSTRACT

The relations between humans and animals extend into socio-cultural aspects that go beyond the mere acquisition of food, meaning that animals constitute cultural resources that fulfill diverse roles in social and cultural systems. Visual images in different media, including rock art, represent one of the ways in which these complex relationships take place. While in the New World few comparative analyses of archaeofaunal and visual data have been addressed, in the Old World these studies have been framed by a dichotomist view between drawn (thought) and consumed (eaten) understanding, both terms as separate and disconnected social realms. This view also structures an abstract, non-pragmatic, rather passive, world drawn in art, against a concrete, practical, active world of consumption. The analysis we present here, based on principles of substantive economy theory, explores the relation between humans and animals in the prehistory of the Atacama Desert (ca. 13,000–410 BP), by comparing visual images of fauna depicted in rock art (engravings and paintings) with archaeofaunal remains from domestic and funerary contexts. The dataset (comprised of 1534 archaeofaunal items and 729 rock art animal motifs from 117 sites) was standardized by calculating the percentage of ubiquity of each animal item per period of time, using Spearman's rank correlation coefficients to identify synchronic and diachronic changes in the relative importance of certain animals consumed. We observed important temporal and contextual variations in the consumption of animals drawn in rock art in the Atacama Desert, and we conclude that they reflect a selection of a wide range of ritual and utilitarian, but not mutually exclusive, functions. In particular, images of camelids emphasized the importance of providing fiber for the creation of textile artifacts and camelid use as pack animals in the caravan trade, both activities that were fundamental in the economy of local societies.

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## 1. Introduction, theoretical background and state of art

This paper presents an analysis of the relation between humans and animals in the prehistory of the Atacama Desert, in northernmost Chile (western South America) (Fig. 1). Based on principles of substantive economy theory (Polanyi, 1976 [1957]), we explore temporal and contextual variations in the consumption of animals

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<http://dx.doi.org/10.1016/j.jaa.2015.09.004>

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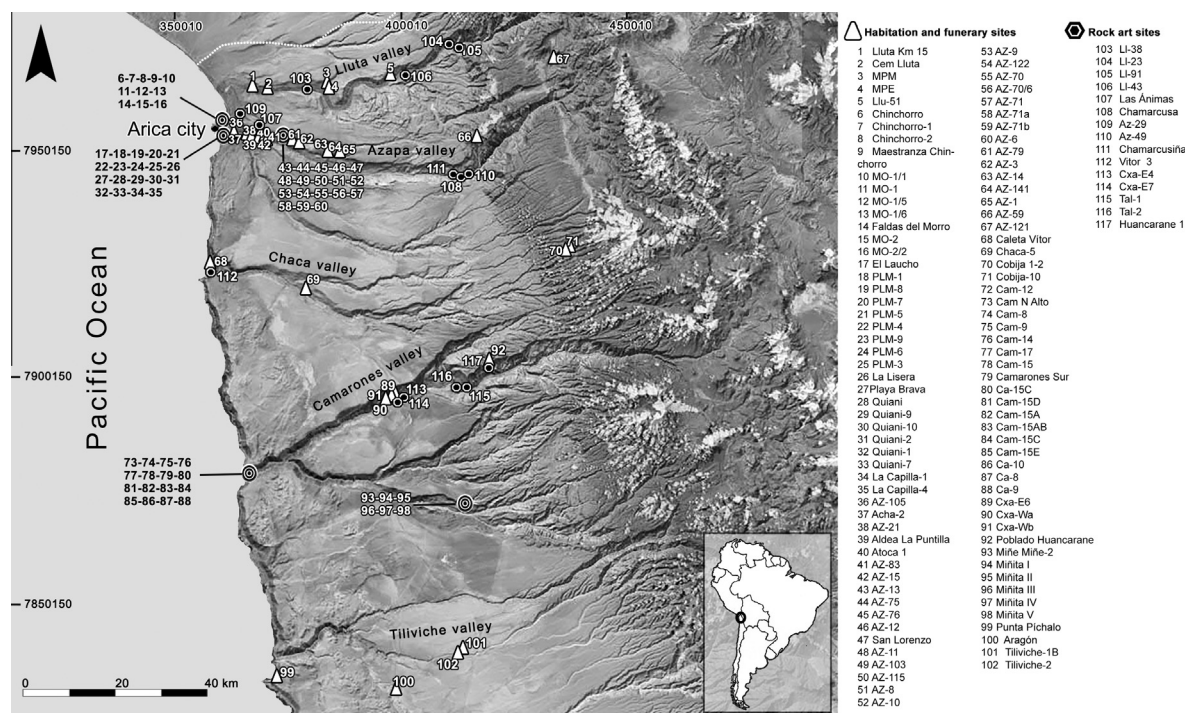


Fig. 1. Study area and location of archaeological sites analyzed.

by comparing visual images of fauna depicted in rock art (engravings and paintings) with archaeofaunal remains from domestic and funerary contexts. The analysis covers from the first human settlements (ca. 13,000 BP) to the European invasion (410 BP),<sup>1</sup> in the exoreic Western Valleys of the South Central Andean area (Lumbreras, 1981). This span of time is archaeologically characterized by diverse subsistence modes, including hunting, gathering, fishing, horticulture, and farming.

Socio-cultural aspects that go beyond the mere acquisition of food cross the relations between humans and animals. Animals are not simply sources of nourishment; they also constitute cultural resources that fulfill diverse roles in social and cultural systems (deFrance, 2009; Descola, 1996; Fiore and Zangrando, 2006; Ingold, 1994; Morphy, 1989; Russell, 2012; Ucko, 1989, 2005). Visual images in different media, including rock art, represent one of the ways in which these complex relationships take place. Comparative archaeological studies of fauna depicted versus fauna consumed have been at the heart of discussions in the anthropological interpretation of the cultural attitudes toward animals in parietal art of Europe and Africa. Most of these studies have established that there is no coincidence between the species depicted and those eaten. This opposition has been explained within different scenarios, such as shamanism (Clottes and Lewis-Williams, 2001; Lewis-Williams, 1982), religion (Leroi-Gourhan, 1958, 1984), narratives of myths (Vinnicombe, 1972), ways of thinking (Criado and Penedo, 1989) and differential hunting strategies (Mithen, 1988). Most of these propositions were developed in response to the principles of sympathetic magic used to explain Paleolithic art (Conkey, 1987, 1993; Ucko and Rosenfeld, 1967).

In the New World, the comparative analysis of archaeofaunal and visual data has been scarcely addressed. As in the Old World, it has been established that the fauna eaten do not match with the depicted animals (Fiore and Zangrando, 2006; Whitley, 1994). This has been interpreted as a product of shamanic initiation

ceremonies and male rites of passage. In both cases, however, with the support of both ethnographic and ethnohistorical accounts, the art production has been linked to subsistence needs and gendered social strategies, stressing the socially active role of art.

With some exceptions (such as Fiore and Zangrando, 2006; Lewis-Williams, 1982; Mithen, 1988; Whitley, 1994), most of the above mentioned studies faced the problematic issue of falling into the apparent dichotomy between drawn (thought) and consumed (eaten), understanding as separate and disconnected social realms: on the one hand, the world of the abstract, non-pragmatic, rather passive, drawn in art, and, on the other hand, the concrete, practical, active world of consumption. We think that this dichotomous understanding of the drawn and the consumed stems from a concept of consumption that exclusively refers to diet.

This statement assumes that the procurement of natural resources was exclusively or predominantly for food (Bird and O'Connell, 2006; Ellen, 2002; Pluciennik, 2001; Renfrew et al., 1974). Certainly, animal meat has been a fundamental source of calories and protein in human diet, and the acquisition, distribution and consumption of this and other food supplies have contributed to structure subsistence, settlement and mobility patterns. Nevertheless, animals serve a wide range of purposes other than food. A large number of animal by-products such as leather, bones, blood, and feathers, among others, were used as raw materials to manufacture artifacts that fulfill a variety of functions, such as clothing, personal ornamentation, tools, and dwellings. These by-products were also consumed for ritual purposes (Fiore, 2011; Goepfert, 2010; Marciniak, 1999, 2011; Ratto and Basile, 2013; Russell, 2012; Szpak et al., 2014). Furthermore, the ways peoples value, use and relate to animals have been mediated by particular cosmologies (Descola, 1996, 2012). As Fiore and Zangrando (2006:372) have shown, there are "ideological factors implied in the development of a human group's diet". Therefore, the wide spectrum of animal uses covers diverse spheres of biological, social and cultural life.

In this paper, we make use of the concept of consumption as derived from substantivist economic anthropology: consumption

<sup>1</sup> All the dates presented are expressed in calibrated years BP.

**Table 1**  
Dimensions and categories of animal consumption used in this study.

Dimension of consumption	Category of consumption	Archaeological evidence for categories of consumption
<i>Productive consumption</i> : goods and services are utilized to produce other goods and services	Raw material	Artifacts made of animal by-products
<i>Personal consumption</i> : individual or collective utilization of goods and services for the preservation and reproduction of human social life	Food	Remains with signs of having been consumed as part of the diet Complete creatures or parts of them that are part of offerings in domestic and mortuary rituals Animal images in rock paintings and engravings
	Ritual	
	Visual	

refers to the end phase in the economic process that involves the use of goods and services and that contributes to social reproduction (García-Canclini, 1995; Godelier, 1970; Narotzky, 2004; Polanyi, 1976 [1957]). More precisely, consumption is “the meaningful use people make of the objects that are associated with them. The use can be mental or material; the objects can be things, ideas or relationships; the association can range from ownership to contemplation” (Carrier, 2002: 193). In this perspective, consumption refers not only to basic needs, but also to non-basic requirements and desires, which contribute to social reproduction. Social reproduction is understood as the renewal of the socio-economic order through processes that involve labor, technology, alliance, exchange, ideology, and social relations, among other aspects, through which a concrete historical social reality sets up the conditions for its continuity and contains transformations within the limits of a dominant logic (Barnard and Spencer, 2002: 929; Narotzky, 2004: 225). Not only does it include the production of the means of production and the means of consumption, but it also involves the social production of consciousness and of ideologies, all of which are necessary to maintain and to reproduce social life (Laslett and Brenner, 1989: 382–383; Narotzky, 2004: 240).

In contrast, the formalist notion of consumption is defined as “merely the acquisition of goods on the basis of their utility value – i.e. the provision of basic human needs, and the consumer as the ‘rational man’, making ‘rational’ decisions on the basis of these given needs” (Buchli and Lucas, 2001: 21). Even those needs that have a biological basis (such as eating) are socially and culturally created and reproduced (Fiore and Zangrando, 2006). Thus, the act of consumption is inherently a social and cultural phenomenon (Appadurai, 1986; Baudrillard, 2009; Bourdieu, 1987, 1998[1979]; Buchli and Lucas, 2001; deFrance, 2009; Miller, 1987).

According to the substantive approach, consumption can be analytically separated into two dimensions: productive and personal consumption. Productive consumption, or “use for”, means that goods and services are utilized to produce other goods and services. Personal consumption refers to the individual or collective utilization of goods and services for the preservation and reproduction of human social life (Buchli and Lucas, 2001; Godelier, 1970; Narotzky, 2004). Therefore, the perspective adopted here implies that the visual use of images by people constitutes a kind of personal consumption, since art is a cultural artifact used by people for different social and cultural ends at the service of social reproduction and given their close connection with the ideological sphere.<sup>2</sup> For example, Fiore and Zangrando (2006:382) suggested that ceremonies of body painting of animal images were “of crucial importance for the reproduction of the Yamana social structure, because it generated and justified the existence of age and gender divisions” (see also Lewis-Williams, 1982; Mithen, 1988; Whitley, 1994, among others).

<sup>2</sup> Following Fiore and Zangrando (2006:372) we employ the term ‘ideological’ “as the set of concepts and values (both rational and affective) present in the thoughts, perceptions and practices of a human group. [...] This broad definition of the term is not restricted to the [marxist] notion of ‘false consciousness’ [...] although it includes it”.

In this paper, within the two dimensions of consumption defined above, we analyzed four categories of animal consumption. In productive consumption we include raw material, whereas personal consumption comprises food, ritual, and visual categories (Table 1). The two dimensions of consumption (productive and personal) and the four categories of animal consumption (raw material, food, ritual, visual) are analytic classifications. However, these practices of consumption were inextricably integrated into social life (a particular animal item could have simultaneously participated in different social scenarios). Moreover, our classificatory categories do not exhaust the whole potential range of animal consumption in prehistory because they are based on the nature of the archaeological data provided by the literature.

**Raw material** category includes artifacts manufacture made of animal by-products such as clothing (e.g., shirt, loincloth, sandal), personal ornaments (e.g., hat, headdress, necklace, earring), musical instruments (whistle, drum), tools for craft manufacture (e.g., spindle, spindle whorl, needle, weft beater known as *wichuña*), tools for terrestrial and marine exploitation (e.g., fishhook, harpoon barb, barb of composite hooks, awl, weight, harpoon tip, prying tool, knife, sling, bow and arrow), and artifacts for containers and/or transport (e.g., bag, cordage). **Food** comprises remains with signs of having been consumed as part of the diet (e.g., remains of shells in shell middens, bones with cut marks or signs of combustion). **Ritual** consumption involves complete creatures (e.g., monkey, guinea pig, dog) or parts of them (e.g., camelid ear and hoof) that are part of offerings in domestic (e.g., buried in the habitation floors) and mortuary (e.g., funerary goods) rituals (Fig. 2). **Visual** consumption includes animal images in rock paintings and engravings, such as camelids, birds, serpents, lizards and canids.

We aim to contribute to the understanding of human/animal interactions over time, considering that art played a key role in these complex relationships. Three main questions guide this study: (1) What animals were used and what were the social contexts of their consumption over time? (2) Were there synchronic and diachronic variations in the preferences in animal consumption? (3) Were the animals depicted in rock art also consumed in other social contexts? Because of the extraordinary preservation of organic remains, something very unusual elsewhere, which allows the identification of a wide range of materials derived from animals, the Atacama Desert of northern Chile provides an advantageous scenario to examine our objectives and research questions. Additionally, a long-standing tradition in rock art and geoglyph studies in the region (e.g., Briones, 2006; Muñoz and Briones, 1996; Niemeyer, 1968–1969; Núñez, 1976; Schaedel, 1957) has resulted in the inventory of hundreds of sites with explicit fauna motifs (Valenzuela et al., 2014).

## 2. Study area

The study area corresponds to the exoreic Western Valleys of northern Chile (18°–19°S), in the South Central Andes. It extends from the Pacific Ocean (0 masl) to the foot of the Andes (1500 m) about 60 km away from the coast. This territory covers more than 5300 km<sup>2</sup>, and is dissected by deep canyons fed by perennial rivers



**Fig. 2.** Artifacts and ecofacts made from animal by-products. **Interval 1:** (a) child mummy with loincloth of camelid wool; (b) fishhooks made of mollusk valve; (c) loincloth of camelid wool; (d) bone harpoon tip whipped with camelid fiber and barrel-knots; (e) bone squid-jigging hook with wool barrel knots. **Interval 2:** (f) camelid hooves; (g) dog cranium; (h) twisted camelid fiber strands attached to a feather bundle; (i) *capacho* (carrying basket) of camelid wool and plant fiber; (j) woven camelid wool bag; (k) camelid fiber slingshot; (l) shaft whipped with camelid leather strap. **Interval 3:** (m) trumpet whipped with wool cord; (n) leather moccasins with wool ornamentation; (o) feather headdress; (p) *qhipu* (mnemonic device made of knotted strings of wool); (q) pendant of *Spondylus* (spiny oyster); (r) wool fez-type hat. Photographs: a, b, c, d, e, i, m, n, o, p, q, and r by Fernando Maldonado; f, g, h, j, k, and l by Manuel Alarcón.

(Fig. 1). These rivers, which rise in the Andes, cross the Atacama Desert, and finally discharge into the sea, acted as geographic and cultural connectors that facilitated the mobility of people, things and ideas between coast and inland. Favorable habitats for human settlement were constrained to the valleys and the coast, which together defined a single eco-cultural unit (Schiappacasse et al., 1989).

The extreme arid conditions of the Atacama Desert have remained stable for millions of years (Evenstar et al., 2009; Rech et al., 2006). Prehistoric human life was possible thanks to two main factors: (a) the upwelling of cold nutrient-rich waters from the Humboldt Current, which supports one of the most diverse and productive marine ecosystems on the planet (Ledesma et al., 2007); and (b) the occurrence of summer precipitation in the Andean foothills, which sustains perennial stream discharge and oases with riparian vegetation along deep valleys (Houston, 2006; Marquet et al., 1998), as well as coastal wetlands hosting

discrete patches of vegetation with endemic and migratory avifauna (Peredo and Miranda, 2001; Sielfeld et al., 2012). Marine fauna include a great diversity of birds, fish, mollusks, crustaceans and mammals (CONAMA, 2008; Craig, 1982; Quintanilla, 1983). Terrestrial fauna are comparatively scarcer and less diverse, including a few species of birds, rodents, reptiles, bats, insects, freshwater crustaceans, foxes, felines, and guanacos (*Lama guanicoe*) (Quintanilla, 1983; Sielfeld et al., 2012). Domestic camelids (llama or *Lama glama* and alpaca or *Vicugna pacos*), guinea pig (*Cavia* sp.) and domestic dogs (*Canis familiaris*) appear in the archaeological record from 4000 years ago. Despite this wide array of wildlife, people were very selective regarding the animals consumed in different social environments and at different time periods.

Paleoclimatic reconstructions for the Atacama Desert suggest that both the availability of wildlife and the capacity to sustain domesticated fauna in the area have remained relatively similar

until the present day. Fluctuations in the productivity of marine and terrestrial ecosystems, however, have been detected over the last 14,000 years in response to changes in ENSO (El Niño Southern Oscillation) activity. Oceanographic records, for example, show increased marine productivity between 12,200 and 6840 BP (Carré et al., 2012; Kaiser et al., 2005; Makou et al., 2010; Ortlieb et al., 2011). Productivity decreased between 5180 and 1160 BP (Carré et al., 2012; Ortlieb et al., 2011). Marine productivity rose again between 1200 and 610 BP along the Chilean–Peruvian coast (Makou et al., 2010). Terrestrial paleoclimate records document past changes in bioproductivity due to variations in the discharge of fresh water tied to fluctuations in the intensity and frequency of rainfall at higher elevations of the Andes (Gayo et al., 2012a,b; Nester et al., 2007). It has been shown that, associated with a widespread wet phase detected regionally across the adjacent highlands, water availability and ecosystem productivity increased between 13,800 and 11,400 BP throughout the inland valleys (<2000 masl) located further south (21°S). On the other hand, pronounced arid conditions in the Andes by 9500–8400 BP (Latorre et al., 2006; Moreno et al., 2007; Quade et al., 2008; Rech et al., 2001, 2002) might have caused a drop in water availability and productivity across deep canyons in the Atacama Desert. Opposite conditions would be expected between 8000 and 3050 BP as a result of increased precipitation in the Andes (Holmgren et al., 2001; Latorre et al., 2006, 2002; Moreno et al., 2007; Placzek et al., 2001). By 1050–680 BP, augmented bioproductivity brought about by regional positive hydrological budgets took place during the so called Medieval Climatic Anomaly (Gayo et al., 2012b).

The current state of archaeological knowledge does not reveal a direct correlation between such fluctuations in productivity and changes in prehistoric culture patterns (Santoro et al., 2015). The increase in ocean water temperature provoked by ENSO, which cause a decrease in Humboldt Current endemic fauna, could have been compensated for by the use of migratory tropical adapted species of fish and birds. Indeed, the archaeological and bioanthropological records show that people never faced depletion of marine resources, which, on the contrary, were the regular staple food throughout the whole prehistory in this area (Roberts et al., 2013a; Santoro et al., 2015).

### 3. Material and methods

We studied archaeofaunal items and rock art animal motifs from three broad temporal intervals: Interval 1 Specialized Hunter–Gatherers and Fisherfolk (SHGF) ca. 13,000–3600 BP, Interval 2 Incipient Farmers and Fisherfolk (IFF) ca. 3600–1000 BP, and Interval 3 Advanced Farmers and Fisherfolk (AFF) ca. 1000–410 BP. These intervals are correlated to subsistence mode and level of cultural development, and they match the relative chronology of rock art as verified by our ongoing research (Valenzuela et al., 2014). By using this approach we avoided a mechanical use of the traditional cultural periodification defined for the prehistory of the exoreic Western Valleys (Archaic, Formative, Middle Horizon, Late Intermediate and Inka Horizon), which has been established based on the changes in ceramic styles, and which do not correlate with the rate of changes in rock art.<sup>3</sup>

<sup>3</sup> We did not analyze the data considering the spatial variable, as our study does not consider the factors or causes that affect the consumption of animals. Prehistoric people integrated the complementary resources of the coast and the lower valleys of this section of the Atacama Desert as a single habitat, within a range of less than a day's walking distance. The restricted ecological conditions of the valleys constrained the development of separated cultural groups. Conversely, a geographic segregation of the data would have created an artificial construct. Additionally, although the location of sites (e.g., proximity to the coast) could have affected the availability of certain animals, this variable is not meaningful for our study questions.

Interval 1 SHGF covers the Archaic period and corresponds to the first human settlements and the consequent development of the Chinchorro Culture. The Chinchorro were specialized coastal hunter–gatherers and fishers who employed complex processes for the artificial mummification of their dead (Arriaza et al., 2008; Santoro et al., 2012). Interval 2 IFF, which includes the Formative period and Middle Horizon, is characterized by village life supported by a mixed agro-maritime subsistence and the introduction of domestic animals, the production of pottery and textiles (camelid wool), and long distance traffic of goods by means of llama caravans (Chacama, 2004; Muñoz, 2004). Interval 3 AFF comprises the Late Intermediate period and the Inka Horizon. This is a period of time during which the local societies of the lowland Arica Culture flourished, characterized by a standardized pottery and textile industry. The subsistence was based on intensive farming and marine resources exploitation, coupled with a specialization of caravan traffic, among other elements. The Inka political and economic administration and reorganization (550 BP) altered the ways of life of the local populations, although the identity of their material culture remained relatively intact until just after European invasion (410 BP) (Santoro et al., 2004, 2010b; Uribe, 2000).

#### 3.1. Motifs of animals in rock art

Several researchers have pointed out the difficulties involved in the identification of animals in prehistoric art (Bednarik, 2013; Berenguer, 1996; Clegg, 1991; Clottes, 1989; González-Morales, 1997; Ingold, 1994; Lorblanchet, 1989; Morphy, 1989; Rosenfeld, 1984). In northern Chile, this difficulty is reflected in the limited attempts to identify species, which have focused on distinguishing domesticated from wild camelids (Berenguer, 1996; Gallardo and Yacobaccio, 2005). In our study, animals were identified according to their iconicity (Morphy, 1989), which refers to formal properties that resemble those of the existing fauna in the region, in such a way that they were unmistakably recognized as animals and not as something else, regardless of their semantic signification (Ingold, 2000). Because the studied art is schematic and synthetic, portrayed as highly conventional images without analytical resolutions (Leroi-Gourhan, 1982), for the identification of animal taxa in rock art we looked for both intrinsic and extrinsic attributes:

- (1) Intrinsic attributes are “distinctive features of their shape and posture from which we form our mental images of them” (Clottes, 1989: 38). These involve key formal attributes including general morphology, emphasis of certain species-specific anatomical attributes, and behavior.
- (2) Extrinsic attributes are features external to the depictions themselves (Clottes, 1989: 40). These comprise other motifs associated with animals in composed scenes (e.g., herder figures associated with camelids indicate domestic species, i.e., llama or alpaca), extra-somatic elements of the figures (e.g., camelids with loads on their backs and noses attached to ropes express typical portrayals of llama caravans), and the composition or arrangement of motifs (e.g., camelids in lines suggest a caravan, which is another ethological feature exclusive to llamas).

The 729 identified motifs of animals come from a total of 2285 figures that include, among others, anthropomorphic, artifact and non-figurative motifs, which were recorded by us through intensive fieldwork. The animal motifs come from 15 sites distributed between the Lluta (22%), Azapa (46%), Chaca (2%) and Camarones (29%) valleys (Fig. 1). The rock art motifs were assigned to a specific temporal interval combining various methods, which provided maximum and minimum age estimates (sensu Morwood, 2002): spatial association (rock art assemblages regularly occur adjacent

to stratigraphic archaeological deposits that were dated by AMS and/or diagnostic materials), superimposition and differential weathering (certain motifs were superimposed systematically and differential weathering was observed among different styles of the superimposed motifs), stratified art (art covered by archaeological deposits that were dated by AMS), and depiction of subjects of well-known chronology (Valenzuela et al., 2014).

### 3.2. Archaeofaunal items

Archaeofaunal items consist of all the artifacts and ecofacts of animal origin. Artifacts are objects made of bone, teeth, shell, leather, feathers, and wool. Ecofacts include bones, antlers, desiccated soft tissue, shells, and feathers.

The sample is composed by 1534 archaeofaunal items from 102 archaeological sites (62 funerary, 29 domestic and 11 funerary/domestic sites) collected from a selection of 73 reports published between 1917 and 2012 (Table 2). We selected these reports because they included complete inventories and exhaustive lists, descriptions, and photographs of the recovered faunal materials. These reports were generated by scholars following the archaeological tradition of detailed descriptions of materials. Moreover, the environmental conditions of the Atacama Desert facilitated the exceptional preservation of organic remains, which helped us to verify the identification of the reported items. We directly derived the information from the publications and classified each animal record using a series of categories. As the available quantitative and qualitative information was generated by different procedures for data recovery and recording, we only considered the information that could be unequivocally assigned into specific

variables, and in consequence, any ambiguous records were omitted from our database and subsequent statistical analyses.

The resulting dataset is a matrix of nominal values, in which columns are variables and rows are individual observations of archaeofaunal items. Variables include: site, context (e.g., funerary, domestic), chronology, animal category (e.g., camelids, sea birds, canids, etc.), type of artifact (e.g., headdress, fishhook, harpoon, bag, shirt, necklace, spoon, cordage, hat, slingshot, sandal, spindle whorl, etc.) or ecofact (e.g., soft or hard tissue, dried animal, etc.), function (e.g., container, terrestrial or marine exploitation tools, dress, crafts manufacturing tools, etc.), faunal material (e.g., leather, bone, fiber, shell, teeth, feather, etc.), and taxonomic classification. Each row corresponds to observations, derived from the literature, and classified according to the different qualitative values defined for each variable. The constructed matrix records the presence for all categories per site and chronological interval, regardless of the number of cases for each category reported in the reviewed literature.

### 3.3. Data integration and comparative analysis

Our dataset is composed of 2263 animal items distributed between 1534 archaeofaunal items and 729 rock art animal motifs (engravings and paintings) originated from 117 funerary, domestic, funerary/domestic, and rock art archaeological sites (Table 3, Fig. 1).

Rock art animal motifs and archaeofaunal items were classified according to the most specific taxonomic category possible (varying from Phylum such as Mollusca, to species such as *C. familiaris*), and then grouped into broad non-overlapping animal

**Table 2**

Amount of bibliographic sources consulted, organized by year of publication. The amount of archaeological sites is indicated along with the types of contexts and the types of archaeological elements reported.

Range of year of publication	Number of papers consulted	Number of archaeological sites reported	Number of items by type of archaeological context		Number of items by type of archaeological material	
			Domestic context	Funerary context	Ecofact	Artifact
1917–1936	2	1	0	11	5	6
1937–1955	1	2	6	4	0	10
1956–1974	13	21	4	183	28	159
1975–1993	33	39	286	590	338	538
1994–2012	24	62	189	261	186	264

**Table 3**

Archaeofaunal items and animal motifs in rock art organized by consumption categories in different temporal intervals.

Type of evidence	Consumption categories/type of site	Interval 1		Interval 2		Interval 3		Total	
		Count	Sites	Count	Sites	Count	Sites	Count	Sites
Archaeofaunal items	Food	184	18	100	19	141	12	425	46
	Funerary	75	6	43	7	4	2	122	15
	Domestic	74	9	21	9	113	8	208	23
	Funerary/domestic	35	3	36	3	24	2	95	8
	Raw material	254	28	378	39	276	28	908	84
	Funerary	161	13	227	32	201	19	589	54
	Domestic	45	11	14	4	61	7	120	21
	Funerary/domestic	48	4	137	3	14	2	199	9
	Ritual	101	18	33	10	67	21	201	46
	Funerary	74	9	15	8	46	16	135	31
Domestic	4	4	7	1	11	3	22	7	
Funerary/domestic	23	5	11	1	10	2	44	8	
Rock Art	Visual	15	1	122	4	592	11	729	15
	Rock art	15	1	122	4	592	11	729	15
	Total <sup>a</sup>	554	35	633	52	1076	44	2263	117

<sup>a</sup> Site numbers do not add up because a number of sites contain more than one category.

categories (e.g., mollusks, canids, lizards, monkeys, rodents, etc.) to facilitate their comparison (Tables 4 and 5). Additionally, each item was classified into raw material, food, ritual and visual categories of consumption.

Because of the nature of our dataset and to facilitate comparisons, we standardized our data by calculating the percentage of ubiquity of each animal category per consumption category and interval of time. The percentages of ubiquity were calculated as

the number of sites that included a given animal taxa per category and interval, independently of how many occurrences of a given taxa were documented in each category and interval. Our aim was to identify the largest variety of consumption categories, and therefore, our dataset provides a good measure of richness (number of taxa used for each consumption category and interval) and ubiquity (representation of these categories between sites) but not of abundance. As a result, and given some uncertainties

**Table 4**  
Animal frequencies represented in rock art motifs.

Animal categories	Interval 1 (13,000–3600 cal. AP)	Interval 2 (3600–1000 cal. AP)	Interval 3 (1000–410 cal. AP)	Total
Marine fauna		12	3	15
Birds (sea, terrestrial freshwater)		5		5
Birds (sea)		2		2
Cetaceans			3	3
Fish (marine)		5		5
Inland fauna	15	109	588	712
Anurans		1	2	3
Bird (terrestrial freshwater)		2	4	6
Bird (terrestrial/air)	7	14	73	94
Camelids	8	78	486	572
Canids		5	14	19
Cervids			1	1
Crustaceans (freshwater)		1	2	3
Dragonfly			1	1
Felines		1	1	2
Lizards		3	3	6
Snakes		4	1	5
Tropical forest fauna		1	1	2
Monkeys		1	1	2
Total	15	122	592	729

**Table 5**  
Percentage of ubiquity (proportion of sites with the represented animal category for each temporal interval) of animal categories represented by archaeofaunal items and rock art motifs.

Animal categories	Interval 1 (n = 35)				Interval 2 (n = 52)				Interval 3 (n = 44)			
	Food	Raw material	Ritual	Rock art	Food	Raw material	Ritual	Rock art	Food	Raw material	Ritual	Rock art
Marine fauna	48.6	62.9	34.3	0.0	25.0	25.0	9.6	3.8	25.0	25.0	25.0	4.5
Cetaceans	8.6	5.7	0.0	0.0	0.0	0.0	0.0	0.0	2.3	4.5	2.3	4.5
Pinnipeds	28.6	25.7	11.4	0.0	0.0	9.6	3.8	0.0	2.3	15.9	2.3	0.0
Birds (sea)	8.6	17.1	28.6	0.0	0.0	1.9	1.9	2.3	9.1	11.4	0.0	0.0
Birds (sea, terrestrial freshwater)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.0	0.0	2.3	0.0
Fish (marine)	31.4	11.4	0.0	0.0	19.2	7.7	0.0	3.8	18.2	0.0	2.3	0.0
Mollusks (marine)	45.7	54.3	2.9	0.0	23.1	21.2	3.8	0.0	20.5	18.2	15.9	0.0
Crustaceans (marine)	11.4	0.0	0.0	0.0	3.8	0.0	0.0	0.0	4.5	0.0	0.0	0.0
Echinoderms	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.0
Inland fauna	28.6	57.1	37.1	2.9	34.6	75.0	15.4	7.7	22.7	61.4	40.9	25.0
Camelids	22.9	54.3	28.6	2.9	26.9	75.0	11.5	7.7	22.7	61.4	29.5	25.0
Cervids	2.9	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3
Canids	2.9	2.9	2.9	0.0	3.8	13.5	7.7	3.8	2.3	4.5	18.2	15.9
Felines	0.0	0.0	0.0	0.0	5.8	0.0	3.8	1.9	0.0	0.0	0.0	2.3
Rodents	14.3	0.0	0.0	0.0	15.4	1.9	3.8	0.0	13.6	4.5	15.9	0.0
Bird (terrestrial freshwater)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	2.3	0.0	6.8
Bird (terrestrial birds/birds of flight)	0.0	0.0	2.9	2.9	1.9	0.0	0.0	5.8	0.0	2.3	9.1	13.6
Snakes	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.8	0.0	0.0	0.0	2.3
Lizards	0.0	0.0	2.9	0.0	0.0	0.0	0.0	3.8	0.0	0.0	0.0	4.5
Anurans	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	4.5
Crustaceans (freshwater)	14.3	0.0	0.0	0.0	7.7	0.0	0.0	1.9	6.8	0.0	0.0	4.5
Dragonfly	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3
Tropical forest fauna	0.0	0.0	0.0	0.0	0.0	3.8	0.0	1.9	0.0	0.0	4.5	2.3
Monkeys	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	4.5	2.3
Birds (tropical forest)	0.0	0.0	0.0	0.0	0.0	3.8	0.0	0.0	0.0	0.0	0.0	0.0
Total	51.4	80.0	51.4	2.9	36.5	75.0	19.2	7.7	27.3	63.6	47.7	25.0

associated with our identifications, we produced a conservative compilation of the minimum representation and use of animals within the settlements and rock art of the study area.

We used the percentage of ubiquity to calculate Spearman's rank correlation coefficients with added measures of probability to identify synchronic and diachronic change in the relative importance of certain animals consumed. To calculate the correlations we recorded the absence of data as zero. This decision has a mild effect on the calculation of the correlation values but we believe it is well justified, as we are certain that, given the currently available information, in most cases these animals or their depictions were not present in a given site. As we identified and tallied the rock art motifs individually, we occasionally use frequencies of these motifs to make some specific comparisons (Table 4). Nevertheless, we only use percentage of ubiquity to compare art with archaeofaunal remains.

#### 4. Results

We present the percentage of ubiquity of the archaeofaunal and rock art animal items identified according to time interval and

consumption category in Table 5. We include the Spearman's correlation coefficients for the comparisons among different periods of time as well as between uses in Table 6. Our results show that the animals with the highest values of ubiquity, regardless of consumption category or temporal interval, are camelids and marine mollusks. A second tier of animals includes canids, pinnipeds, inland birds and marine fish, which are also fairly ubiquitous, particularly when compared with the rest of the animals. We present the percentage of ubiquity of camelid and mollusk raw material items in Table 7.

During **Interval 1 SHGF**, the animals most used for food were marine animals. Dietary animals were predominantly mollusks, which have 45.7% ubiquity, followed by marine fish and pinnipeds. Some terrestrial resources, particularly camelids, were also used during this period.

Spearman's correlation coefficient indicates that animals consumed as food and as raw materials are strongly and significantly correlated ( $r_s = 0.7$ ;  $P \leq 0.01$ ). In particular, this includes artifacts manufactured from marine mollusks, such as body ornaments (e.g., beads, pendants) and tools (fishing hooks), which are present in over half of the reviewed sites (Fig. 2b). A similar portion

**Table 6**  
Spearman's rank correlation coefficient matrix.

		Interval 1				Interval 2				Interval 3			
		Food	Raw material	Ritual	Rock art	Food	Raw material	Ritual	Rock art	Food	Raw material	Ritual	Rock art
Interval 1	Food	1	.704**	.322	.039	.610**	.633**	.468*	-.257	.937**	.527*	.453*	-.316
	Raw material		1	.622**	.196	.373	.794**	.629**	.052	.637**	.772**	.673**	-.056
	Ritual			1	.452*	.140	.542**	.569**	.216	.216	.659**	.534*	.188
	Rock art				1	.364	.188	.212	.510*	.134	.378	.428*	.495*
Interval 2	Food					1	.514*	.542**	.195	.718**	.332	.474*	.065
	Raw material						1	.745**	.030	.620**	.679**	.684**	-.172
	Ritual							1	.056	.486*	.737**	.667**	.027
	Rock art								1	-.127	-.001	.249	.529*
Interval 3	Food									1	.508*	.505*	-.216
	Raw material										1	.774**	.138
	Ritual											1	.059
	Rock art												1

Note: Significant correlations are flagged with an (\*) if lower than 0.05 and (\*\*) if lower than 0.01. Values in lower half of matrix are for comparisons based on item counts.

**Table 7**  
Camelid and mollusk raw material items, ubiquity, and percentage of ubiquity.

Taxa Raw material	Interval 1			Interval 2			Interval 3		
	Count	Sites	Ubiquity	Count	Sites	Ubiquity	Count	Sites	Ubiquity
<i>Camelids</i>									
Ornaments	0	0	0	2	2	5.1	1	1	3.7
Body ornaments	2	2	10.5	7	6	15.4	2	2	7.4
Footwear	1	1	5.3	4	2	5.1	12	7	25.9
Container/Transport	8	5	26.3	36	11	28.2	41	14	51.9
Ritual stuff	0	0	0.0	14	5	12.8	10	4	14.8
Tools	50	11	57.9	50	13	33.3	36	15	55.6
Rough raw material	4	1	5.3	20	9	23.1	21	10	37.0
Uid-object	9	6	31.6	20	12	30.8	14	8	29.6
Other	1	1	5.3	2	2	5.1	11	5	18.5
Clothes	58	9	47.4	95	27	69.2	62	22	81.5
Headdress	24	6	31.6	55	15	38.5	17	12	44.4
Total	157	19	100	305	39	100	227	27	100
<i>Mollusks (marine)</i>									
Ornaments	4	4	21.1	2	2	18.2	3	3	37.5
Body ornaments	22	11	57.9	11	7	63.6	4	4	50.0
Container/Transport	1	1	5.3	7	2	18.2	8	3	37.5
Ritual stuff	0	0	0.0	0	0	0.0	1	1	12.5
Tools	23	11	57.9	5	4	36.4	2	1	12.5
Uid-objects	2	2	10.5	0	0	0.0	0	0	0.0
Total	52	19	100	25	11	100	18	8	100



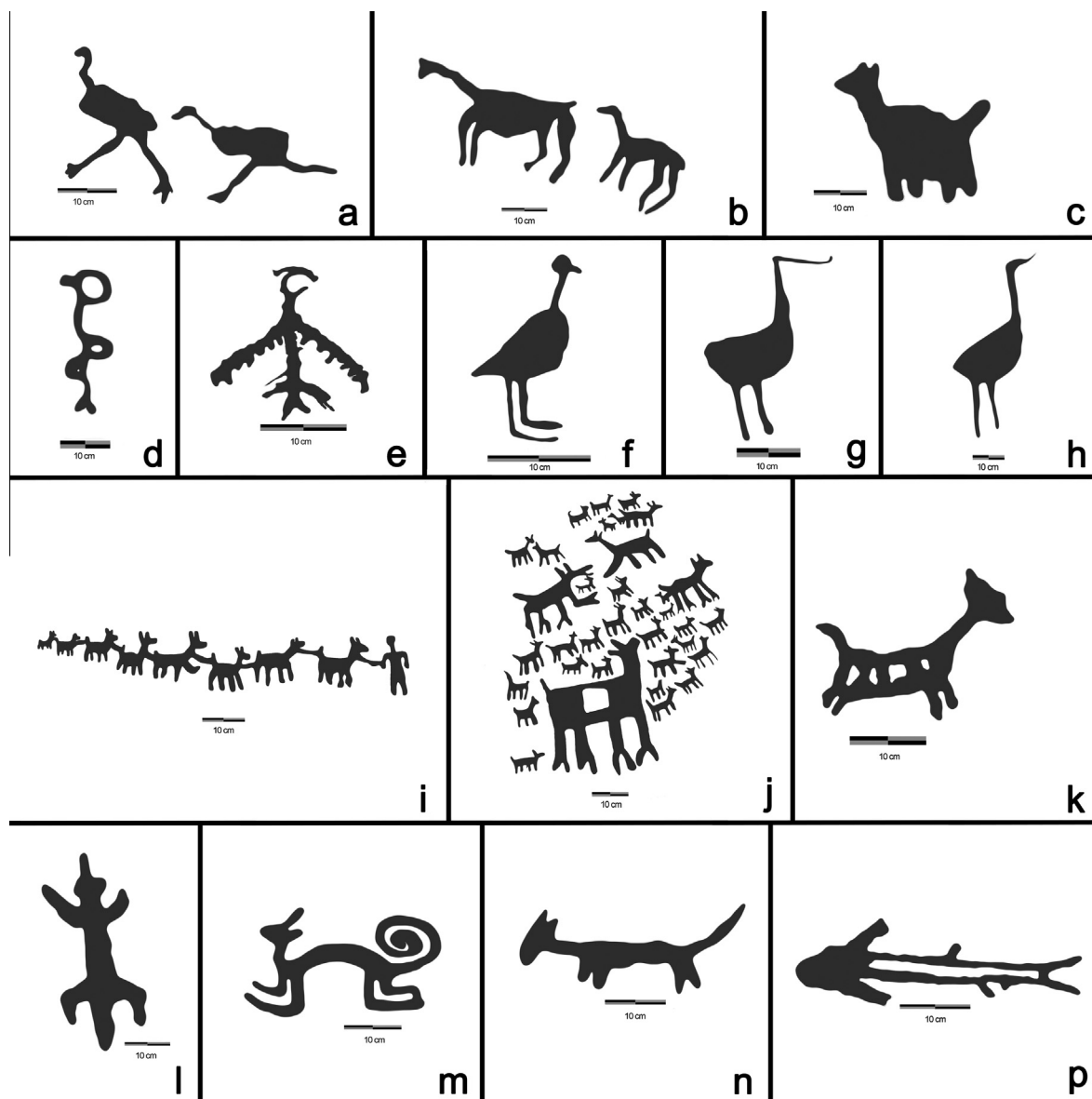
contains artifacts derived from camelids, mainly tools (e.g., ropes), clothes (skirts) and headdresses (Fig. 2a–c). Artifacts derived from pinnipeds are third and include cord and bone tools (e.g., prying tools and fishhooks) (Fig. 2e).

A high correlation coefficient ( $r_s = 0.62$ ;  $P \leq 0.01$ ) characterizes the relationship between animals used in rituals and those used for raw materials, particularly camelids, pinnipeds, mollusks, marine birds, and canids. In sites with ritual contexts, camelids and marine birds have the highest ubiquity, and in both cases, their skins and feathers are often used to cover bodies and/or as funerary offerings.

Only one site with rock art was identified associated with this period. This site includes naturalistic and dynamic figures of eight camelids and seven birds (Fig. 3a and b). These motifs have formal similarities with Archaic period rock art in the Arica highlands (Sepúlveda et al., 2013). We have identified the birds as *suri* (*Rhea tarapacensis*), whose habitat is located in the Andean highlands,

3500–4500 masl. The loose but significant correlation ( $r_s = 0.452$ ;  $P \leq 0.05$ ) observed between animals used in rock art and in rituals is probably a consequence of the small sample size associated with these categories.

During **Interval 2 IFF**, the terrestrial fauna, particularly camelids, become more important than marine fauna. The latter, however, continue to be well represented by mollusks and fish, particularly as dietary items. Animals consumed as food and as raw materials are strongly and significantly correlated ( $r_s = 0.463$ ;  $P \leq 0.05$ ). Interestingly enough, the use of camelids as raw materials show the highest ubiquity in the entire assemblage (75%). Camelid by-products were used in the manufacture of clothing (e.g., shirts, capes), headdresses, bone tools (e.g., awls, needles, harpoon tips, *wichuñas*, spindles, spindle whorls), and woolen items for different purposes (e.g., ornaments, carrying baskets known as *capachos*, woolen bags, and slings, Fig. 2h–k), all of which are fairly common in the sites corresponding to this period in the study



**Fig. 3.** Animal motifs in rock art. **Interval 1:** (a) *Rhea pennata*, Huancarane-1, Camarones Valley; (b) camelids, Huancarane-1, Camarones Valley. **Interval 2:** (c) camelid, Cxa-E7, Camarones valley, (d) uid-bird, Las Ánimas, Azapa Valley; (e) Andean condor (*Vultur gryphus*), Cerro Chuño, Azapa Valley. **Interval 3:** (f) Peruvian Thick-knee (*Burhinus superciliaris*), Taltape-2, Camarones Valley; (g) and (h) Andean Avocet (*Recuivirostra andina*), Cruces de Molinos, Lluta Valley; (i) and (j) camelids, Cruces de Molinos, Lluta Valley; (k) camelid, Las Ánimas, Azapa Valley. **Animals less frequently depicted in rock art of the study area:** (l) lizard from Huancarane-1, Camarones Valley; (m) monkey and (n) canid from Taltape-1, Camarones Valley; (p) Speckled Smoothhound (*Mustelus mento*), Las Ánimas, Azapa Valley.

area. As in the previous period, body ornaments manufactured from mollusk shells continue to be fairly representative. During this period, canids were used in the manufacture of headdresses and bags, whereas pinniped bones were used for making prying tools and spatulas. Some marine fish bones and teeth were used to manufacture hooks, knives, and awls.

The animals consumed in rituals are correlated with those consumed as food ( $r_s = 0.54$ ;  $P \leq 0.01$ ) as well as with those used as raw material ( $r_s = 0.7$ ;  $P \leq 0.01$ ). Once again, camelids have the highest food and ritual ubiquity. Ritual items and sites have somewhat lesser relative importance than in the previous period, where ritual, and especially funerary sites, dominate the sample. Camelid skins were used for funerary coverings and some camelid body parts (specifically heads, ears, and hooves) were used as offerings in funerary and domestic contexts (Fig. 2f–g). During this period, some exotic animals, particularly parrots from the tropical forest, were identified. More specifically, tropical parrot feathers were used in some of the most elaborate headdresses.

Regarding visual consumption, camelids and inland birds have the highest ubiquity in rock art sites. Snakes, canids, and fish are also present but much less frequently. Camelids are depicted schematically and in few scenes (Fig. 3c). Birds are depicted quietly, usually frontally or in profile. More than half of the displayed birds correspond to highland taxa, and include motifs of Andean condor (*Vultur gryphus*), the Speckled Teal (*Anas flavirostris*), and Andean Goose (*Cloephaga melanoptera*) (Fig. 3d–e). The local marine birds include Black-crowned Night-Heron (*Nycticorax nycticorax*), among others. The depiction of tropical forest monkeys is also noteworthy.

Comparing the first and second intervals, positive and significant correlations were observed among animals used as food ( $r_s = 0.610$ ;  $P \leq 0.01$ ), as raw materials ( $r_s = 0.754$ ;  $P \leq 0.01$ ), in rituals ( $r_s = 0.569$ ;  $P \leq 0.01$ ), and in rock art ( $r_s = 0.510$ ;  $P \leq 0.05$ ). However, in the latter case, given that only one site included rock art during Interval 1, this result has to be taken with caution.

During **Interval 3 AFF**, the food consumption of marine fauna (mainly represented by mollusks and fish) reaches higher ubiquity than terrestrial fauna. Camelids, however, retain relatively high percentages of ubiquity. The animals consumed as food are correlated with those utilized as raw materials for a variety of objects (Spearman's  $r_s = 0.508$ ;  $P \leq 0.05$ ), which once again are headed by camelids and mollusks followed by pinnipeds and birds. Camelid use as raw material undergoes a wide range of uses mostly represented in fiber by-products (shirts, hats, belts, shoes, slingshot) and, to a lesser extent, skins (used among other things for manufacturing sandals and other footwear), and bones (harpoon barb, prying tool, *wichuñas*), among others (Fig. 2m, n, p, and r). Mollusks continued to be used for ornaments as well as for spatulas and some containers (Fig. 2q). Marine birds were used for featherwork in artifacts such as headdresses (Fig. 2o).

Animals consumed in rituals are correlated with those consumed as food ( $r_s = 0.505$ ;  $P \leq 0.05$ ) and raw materials ( $r_s = 0.774$ ;  $P \leq 0.01$ ). Besides the dominating camelids and marine mollusks, other taxa such as canids or rodents (e.g., guinea pigs mostly used as food and offerings) are also present, but with less frequency. Camelid skins and body parts continue to be used in funerary and domestic rituals.

Rock art images are dominated by camelids, canids, and inland birds (Fig. 3f–k). In particular, stylized scenes of llama caravans become increasingly frequent. Inland birds are predominantly portrayed in profile and correspond to highland taxa including suris, condors, avocets (*Recurvirostra andina*), and flamingos (*Phoenicopteridae*). Schematic images of canids are usually associated in scenes that also include camelids and humans. Some exotic animals are also displayed, such as deer and monkeys.

Comparing the second and third intervals, we note positive significantly strong correlations in food ( $r_s = 0.718$ ;  $P \leq 0.01$ ), raw materials ( $r_s = 0.624$ ;  $P \leq 0.01$ ), and rituals ( $r_s = 0.667$ ;  $P \leq 0.01$ ), in addition to a weaker but equally significant correlation regarding animal depictions in rock art ( $r_s = 0.529$ ;  $P \leq 0.05$ ).

## 5. Discussion

### 5.1. Social contexts of consumption of fauna over time

The animals were exhaustively and intensively consumed by the ancient inhabitants of the study area in two dimensions of consumption and its respective categories of consumption analyzed: productive (raw materials) and personal (food, ritual and visual). Not only were there preferences regarding the animals chosen to be consumed, but also regarding the types of consumption to which certain animals were destined. Camelids and mollusks were the most relevant (greater ubiquity) during the three periods. Whereas camelids stand out in each one of the different categories of consumption (i.e., raw materials, food, ritual and visual), mollusks were more important in food consumption and, to a lesser extent, as raw materials and in rituals, and they are not visually depicted in rock art.

Within **raw materials consumption**, a wide range of elements of animal origin (fiber, leather/hide/hair, bone, shell, feather, *guano* [dung], viscera, teeth, etc.) was used as raw materials in the manufacture of a variety of artifacts: clothing and personal ornaments (e.g., belts, shirts, hatbands, knit hats – some decorated with feathers, hide/leather loin cloths, leather sandals, bone and shell beaded necklaces, and feather headbands); containers (e.g., wool and leather bags, mollusk valves); marine exploitation instruments (e.g., bone barbs for hooks and harpoon tips, bone prying tools, leather for harpoons and rafts, and shell knives); craft manufacture instruments (spindles, spindle-whorls, *wichuña*, sewing boxes, bone needles and awls); terrestrial exploitation instruments (leather or wool binding for hafts, feathers decorating the hafts, wool slingshots, and woolen cords for multiple purposes); and musical instruments (bone whistles, drums made of cetacean vertebrae, and wool and /or leather binding of musical instruments). **Food** sources came mainly from the sea, supplemented with camelids (meat and *ch'arqui* or dehydrated meat) and, to a lesser extent, with rodents and freshwater crustaceans. This category of consumption, however, could be underrepresented in the sample, given that a great number of cases come from cemeteries (Table 2). Another possibly influencing factor concerns the fact that artifacts made from animal remains, such as leather or bones, can mask eating, as their use as raw material or as ritual elements required the death of the animal whose meat could have also served as food. Despite this, our results are in line with bioanthropological studies of paleodiet which point to the importance of marine resources through all of the prehistoric intervals (Aufderheide and Allison, 1992; Aufderheide, 1993; Aufderheide et al., 1994; Aufderheide and Santoro, 1999; Moseley, 1974; Poulson et al., 2013; Roberts et al., 2013b).

In the category **ritual consumption**, animals were offered in domestic and funerary rituals. Offerings include camelids (ears, hooves, leather and hide), monkeys, guinea pigs, parrots, dogs (heads), sea lions, pelicans, and foxes, among others. Camelids continue being important during all intervals, although with different percentages of ubiquity. Less important animals in other categories of consumption played a relevant role in ritual consumption, especially sea birds and canids. Also, there are less frequent (lizards and felines) or exotic (cervids, monkeys) animals, which are also depicted in art rock, albeit in lower frequency and ubiquity.

In **visual consumption** through rock art, camelids were the most widely depicted animals in all three intervals, followed distantly by birds and canids. One of the most interesting features of rock art is that marine fauna were rarely depicted.

### 5.2. Synchronic and diachronic variations in the preferences of animal consumption

The results showed changes and continuities in the preferences in animal consumption, both in personal and productive consumption.

During **Interval 1 SHFG** the diet was predominantly marine-based. Resources from land hunting, especially camelids and, to a lesser extent, rodents, were supplementary. Such camelids may have been wild species (guanacos and/or vicuñas), given that domestic camelids (llama and alpaca) were incorporated into the local economic systems by the end of Interval 1. The most important raw materials for the manufacture of artifacts such as harpoons, hooks, ropes, skirts and necklace beads were those derived from camelids, mollusks, pinnipeds and sea birds. This is the only interval in which the productive consumption of sea fauna is comparable to that of land fauna, as in later times land fauna took precedence as a source of raw materials. In the ritual domain, the animals offered included camelids and sea birds, followed by pinnipeds. In sum, the importance held by marine fauna in the different contexts of consumption agrees with an economic formation of populations that were highly specialized in marine hunting, fishing and gathering, with a settlement pattern restricted to the coastal strip (Núñez and Santoro, 2011; Standen et al., 2004), but which gradually, by the end of the interval, incorporated resources both from the interior and from the highlands through mobility and exchange (Schiappacasse, 1995; Sepúlveda et al., 2013).

During **Interval 2 IFF** there is a significant change as the consumption of terrestrial fauna reaches the highest levels of ubiquity in all the consumption contexts. Within diet, camelids slightly surpass marine fauna, but it is in consumption as raw material where camelids reach their highest importance, mainly expressed in the production of wool textiles. Camelids were also important in ritual offerings, while other terrestrial fauna such as dogs, foxes, felines, and guinea pigs appear in ritual contexts. Marine fauna in general, however, have very low ubiquity in ritual contexts. In rock art, terrestrial fauna images take precedence over marine fauna images. The most important animals are camelids, terrestrial birds/birds of flight and snakes. Noteworthy is the inclusion of coastal fauna (sea birds and fish), which are not depicted in the following interval. Another interesting aspect is that most of the birds depicted are native to the highlands, and the images of condors stand out.

This outlook in which terrestrial resources are highly ubiquitous in Interval 2 IFF is coincident with a decrease in the occupation of the coastal strip compared to the previous and following intervals. Further, the archaeological record points to the occurrence of intense social and technological transformations in this period, such as the incorporation of domestic camelids and other non-animal terrestrial resources such as cultivated plants into the local social systems. It is likely that the camelids and/or their by-products entered the communities in the region through exchange, given the increase verified in the interaction links with Altiplanic groups (Santoro et al., 2009). Because llamas and alpacas have their most suitable habitat in the high Andes, then these camelids could have come from the highlands to the exoreic Western Valleys (Núñez and Dillehay, 1995[1978]; Valenzuela et al., 2011). This connection would also explain the highland Andean birds depicted in rock art.

During **Interval 3 AFF**, the marine-based diet continues to be important, while terrestrial fauna (camelids and rodents) decrease in relation to the previous period. Camelids are still highly relevant

in the productive consumption of raw materials, especially in the elaboration of wool textiles, as was the case in the previous period. The textile industry of this period becomes highly developed and complex, which is expressed in the use of a variety of techniques that allow a wide range of ornamental motifs (Ulloa, 1981). An increase in spinning is associated with the end of this interval, possibly as a consequence of the establishment of the textile *mit'a* as a result of the Inka administration (Santoro et al., 2010b). Additionally, marine fauna (sea birds and mollusks) resumed being used in ritual contexts, as in Interval 1, but with a greater variety of taxa. Also, canids and rodents (guinea pigs) increase in these ritual contexts. In rock art, the ubiquity and frequency of animal motifs increases, particularly camelids, canids and birds. Nearly all of the birds are from the highlands.

During Interval 3 AFF there was an intensive re-occupation of the coast and the adjacent valleys by the local communities who maintained a mixed subsistence based on the specialized exploitation of marine resources complemented with agriculture (Santoro et al., 2010a). The intensive occupation of the littoral was accompanied by an increase of marine fauna consumed in ritual contexts, although their importance in other contexts of consumption remain similar to Interval 2. Simultaneously, llama caravan traffic reaches unprecedented levels, becoming more specialized and complex, and the long-distance relations between the coast, highlands and the western Andean slope intensify (Berenguer, 2004; Núñez and Dillehay, 1995[1978]; Schiappacasse et al., 1989; Valenzuela et al., 2011). This situation could explain not only the development of camelid fiber textile weaving but also the increase of images of these animals and of explicit scenes of caravan traffic in rock art.

### 5.3. Non-visual consumption of the animals depicted in rock art

The analysis of animal consumption through archaeofaunal remains and animal motifs depicted in rock art has shown that the latter were also consumed in all the other consumption domains: food, raw material, and ritual. Camelid motifs, followed by those of terrestrial birds/birds of flight and canids, were the most important through the whole sequence of regional rock art. Only camelids occur with a high ubiquity in the other contexts of consumption.

Conversely, not everything that was consumed in other contexts was depicted in rock art, which points to subject selectivity in the contexts of visual consumption. What was drawn was a selection of what was consumed in different social contexts. Thus, we agree with Morphy (1989: 16) in that “animals in art do not provide a window to the world but a selection from the world”. Particularly interesting is the fact that, despite the sustained relevance of marine fauna as a food resource for the whole temporal sequence, it was not included in the visual rock art repertoire. One possible explanation for this absence could lie in the fact that “our ability to document marine referencing is limited by the identification of figurative marine motifs” (McNiven and Brady, 2012: 81). However, southward along the Atacama Desert coast, there is a rock art tradition of figurative motifs of marine animals (Berenguer, 2009; Contreras et al., 2008; Gallardo et al., 2012; Mostny and Niemeyer, 1984), which may be explained by the fact that this coast was not directly geographically connected to pastoral environments and communities as is the study area. Therefore, their relative absence in the study area appears to reflect rather a cultural decision, since the importance of the marine world was symbolically manifested in other components of the material culture. This included fishhooks and miniatures of boats made of non-animal materials and used as offerings in graves, and depictions in rock art of people on rafts.

Regarding the non-visual consumption of the rock art animals with greater ubiquity (canids, terrestrial birds/birds of flight, and camelids), we have identified some interesting variations. Canids, for example, occasionally depicted in rock art, were used in other contexts as ritual offerings, mainly from Interval 2 IFF and through Interval 3 AFF. These include the ritual burial of domestic dogs and *Lycalopex* spp. in dwelling floors and graves, and the use of fur (Canidae) to manufacture containers and turbans. Terrestrial birds/birds of flight, on the other hand, were used more variably through time in the non-visual contexts analyzed. Feathers and skin were mainly used in funerary bundles of Chinchorro mummies in Interval 1, whereas use as food stands out in Interval 2. During Interval 3, feathers were used in the manufacture of head-dresses, and bodies and feathers were offered in funerary rituals. Finally, camelids were used in all the consumption contexts but their ubiquity was particularly noticeable in the productive consumption of their fiber in the manufacture of textiles in all the intervals. The variations occur in the objects manufactured: in Interval 1: cords, short skirts and headdresses, among others; in Interval 2: shirts, turbans, bags and blankets; and in Interval 3 shirts, bags, ropes/cords, hats, blankets and *inkuñas* (ritual cloth). Concerning ritual consumption, the use of leather as part of the bundles in Chinchorro mummified bodies in Interval 1 stands out. In Intervals 2 and 3, the use of leather in the bundles of the bodies is maintained, but with the addition of offerings of complete bodies, heads, ears and hooves, both in house floors and in graves, particularly since Interval 3.

The hierarchical order of ubiquity of animals consumed as food, raw material and ritual maintains significant correlations between the different consumption domains and through different intervals; the same did not happen with visual consumption in rock art. This is because, even though camelids are the most important animals in all consumption contexts, including rock art, in the latter context additional fauna were included which are less frequent in the other contexts of consumption, such as terrestrial birds/birds of flight and canids, and to a lesser extent, snakes, lizards, felines, anurans, and monkeys, among others (Fig. 3l–p).

If the animals in rock art implied a selective visual consumption of what was being consumed in other contexts, camelids were the favorite subject of such choice. The insistence on depicting camelids visually must be understood within broader social consumption contexts, where they played an important role. The depiction of camelids in art became gradually significant from 3600 BP at the beginning of Interval 2, which agrees with the value these animals acquired within the socioeconomic and symbolic practices of the prehispanic populations in the exoreic Western Valleys. Rock art images of camelids appear to emphasize their relevance in two contexts of consumption: the provision of fiber for the manufacture of textiles and their use as beasts of burden and transport in caravans. These qualities were possibly selected during the domestication process about 6000–4000 years ago (Mengoni Goñalons, 2008; Mengoni Goñalons and Yacobaccio, 2006; Wheeler, 2012).

The productive consumption of fiber is supported by the high percentages of ubiquity in the data analyzed, and domestic and wild camelids might have been used. Their use as beasts of burden, in turn, necessarily required a unique species, the llama, and this use was not evident in the archaeofaunal data analyzed, insofar as it is not very visible in the mobiliary archaeological record, but it is evident in parietal art. It is interesting that both types of consumption required the animal alive and standing.

Textiles were a conspicuous good in the Andes and were defined as a major art form (Murra, 1975; Murra et al., 1989). Ethnohistorical references suggest that before the European invasion, the social functions of textiles in the Andes were beyond clothing and ornamentation; woven garments had cultural, social,

economic, military, political and religious roles, and were consequently highly valued (Murra, 1975). This cross-cutting importance of textiles was particularly noteworthy in northern Chile, where a local and superb industry was developed (Agüero and Cases, 2004; Ulloa, 1981).<sup>4</sup> During Interval 1, textile production developed from plant and wild camelid fiber (Agüero, 2002; Standen, 2003). From Interval 2 this industry became technologically complex and gradually incorporated camelid fiber as the prevailing raw material (Agüero and Cases, 2004; Horta, 2004). During Interval 3, textile production became highly skillful and technically and iconographically sophisticated, reaching a remarkable development (Agüero, 2000; Espouey et al., 1995; Horta, 2005). Textiles had a special place in the funerary rites of all the periods, which is why we infer that they remained as a prestige good, the precise meaning of which changed through time. However, textile representations are scarce in the rock art figures of the study area.<sup>5</sup>

Caravans consist in the specialized activity of long-distance transport of goods through the use of beasts of burden, typical of the Andean area and particularly relevant in the political economy of the South Central Andes (Berenguer, 2004; Nielsen, 1997: 340, 2009; Núñez, 1976: 148; Núñez and Dillehay, 1995[1978]). The capability of the llama to be a means of transport (it can carry on average between 20 and 40 kg depending on the distance, and it can cross a variety of environments without food or water for 3–5 days (Berenguer, 2004; Clarkson and Briones, 2001)) led to the development of a specialized long distance system of traffic of goods via llama caravan. It is probable that caravan traffic might have been in operation since Interval 2 (Briones et al., 2005; Núñez and Nielsen, 2011), but it is during Interval 3 that it became especially relevant in the societies of the South Central Andes. Caravaners must have been high Andean herders, but the marine- and agrarian-based local populations of the lowlands played an active role in the articulation of the traffic and in the supply of goods within the circulation of products, a system in which rock art worked as part of the caravan complex, as were *paskanas* (temporary shelters for caravaners), ropes, bells and hooks (Clarkson and Briones, 2001; Núñez, 1976; Núñez and Nielsen, 2011: 25; Valenzuela et al., 2011). In the rock art of the area under study, around a third of the camelid motifs appear in explicit configurations of caravan scenes<sup>6</sup> and llama caravans are a dominant subject in the rock art of northern Chile (Briones et al., 2005; Clarkson and Briones, 2001; Núñez, 1976; Sepúlveda et al., 2005; Valenzuela et al., 2011).

Ethnographic, ethnohistorical and archaeological evidence indicates that herders rarely utilized camelids just for food, but they have played important ceremonial (e.g., sacrifices, offerings, feasts), socio-political (e.g., prestige and exchange goods) and economic (e.g., caravan traffic, *ch'arki* meat, wool) roles (Aschero, 2000; Berenguer, 1995; Berenguer and Martínez, 1989; Broughton, 2010; Cartajena and Núñez, 2006; Castro, 1986; Dransart, 1999; Flores Ochoa, 1974, 1977; Gallardo, 2009; Gladwell, 2009; Goepfert, 2010, 2012; Grebe, 1984; Isbell, 1974; Lecoq and Fidel, 2003; Mariscotti, 1978; Martel, 2010; Murra, 1975; Nielsen, 2001; Tomoeda, 1993; Valenzuela, 2013; Van Kessel, 1976; Yacobaccio and Vilá, 2013; Zuidema and Urton, 1976). We think that the camelids in the rock art studied were a means to ideologically materialize and reinforce the importance

<sup>4</sup> The origin and local development of the textile production of hunter, gatherer, fisher and agricultural societies of the study zone, despite external influences, is widely supported in the technological traditions as well as in the presence of objects related to textile manufacture such as yarns, fleece, balls of yarn, sewing boxes, spindles, whorls and *wichuñas*.

<sup>5</sup> We have recorded 6 anthropomorphic figures with textiles of a total of 243 anthropomorphic motifs inventoried.

<sup>6</sup> We have recorded 172 figures of camelids in caravans of a total of 572 camelid motifs inventoried. The number of caravan compositions is 42.

of these animals in several domains of human life, especially in caravan journeys and textile production. These, in turn, were linked to the ritual world through a series of objects and elements manufactured with raw material from camelids. This preference for camelids on the part of societies whose subsistence base was not reliant on stock-breeding, is meaningful and expresses a type of human/animal relation that emphasizes the economic role of animals in domains other than just food.

## 6. Conclusions

This study sought to understand the visual images of fauna in rock art within a broader social sphere incorporating diverse contexts of consumption (provided by the archaeofaunal record) in which the animals depicted also participated. Despite of the variety of the animal remains well-preserved in the Atacama Desert, the role played by animals in prehistoric societies has been scarcely addressed. The results contribute to the discussion about animal consumption in the archaeology of the South Central Andes, through concepts informed by substantive approaches. We have shown that the animals depicted in rock art were intensely consumed in other contexts of personal and productive consumption. The animals drawn not only represented an immaterial, abstract world, but, on the contrary, were also embodied in the concrete, practical, material world that was connected with daily and non-daily consumption activities.

This first long-term inventory and quantification of animals depicted in rock art showed a great selection of animals previously unknown. Consequently, we have shown that assessing the importance of animals in the prehistory solely on the basis of their role in the diet leads to distorted interpretations, as the animals were used differentially in the four contexts of consumption analyzed corresponding to different contexts of social production through time (13,000–410 BP). The contexts in domestic, funerary and rock art sites showed that animals were not only used as food, but they were also sources of raw materials and displayed an important role as offerings in funerary and domestic rituals. Marine fauna maintained their importance as a food source during the complete temporal sequence, and were used as raw material. However, marine fauna were not integrated into the visual rock art repertoire. Conversely, the conspicuous importance of camelids in rock art at all epochs was revealed, despite the fact that its consumption as food was marginal.

The consumed/depicted dichotomy is not only inapplicable to rock art in the Atacama Desert, but it is also reductionist as it oversimplifies the complexities in the human/animal relationships. The phrase “good to think” that has become a platitude in the literature on the subject, only reflects the symbolic dimension of the use of animals, and presupposes a rather passive role of animals in art. Our data show that the animals depicted in rock art were “good to think” (Leroi-Gourhan, 1965; Levi-Strauss, 1965), good to eat, good to make rituals, and good to extract derivatives to manufacture all kinds of objects. The importance of some animals in given contexts of consumption, however, did not directly entail their depiction in art. A significant portion of the animals visually depicted were also consumed in other social contexts. In sum, the visual world was not only of thought, rather it was an active agent in social reproduction (Fiore and Zangrando, 2006), because it ideologically materialized certain aspects of the material world such as camelids. This selection of the consumed world reflects cultural decisions that did not separate it from the material world.

Based on a gross level of chronological resolution, we established that there were important changes and continuities in the preferences of animal consumption through time. Continuities were principally reflected in the food consumption of marine

fauna, the visual consumption of camelids and the consumption of raw materials derived from both types of animals. As far as discontinuities, the variations identified through time were largely associated with defining socioeconomic processes for each period or interval, such as the introduction of domestic camelids and the intensification of caravan traffic in the local economic social systems. Finally, another discontinuity is detected in the ritual context, which is more variable regarding the type of animals used.

## Acknowledgments

Funding was provided by FONDECYT projects 1111063 and 1151046. We also acknowledge the additional support of: CONICYT-PIA/ANILLO SOC 1405, ECOS-CONICYT C13H02, *Convenio de Desempeño* Universidad de Tarapacá-MINEDUC, FONDECYT projects 3130668 and 3140008, and FONDAP Program 1511009 to CR2. The Museo Arqueológico Universidad de Tarapacá San Miguel de Azapa authorized us to review and photograph their archaeological collections. We thank Susana Monsalve, Soledad Marcos, Manuel Alarcón, Ariadna Cifuentes, Teresa Cañipa, Anita Barrera, Soledad Fernández, Dánisa Catalán, Adrián Oyaneder and Paola Salgado for their collaboration; Marco Espinoza for the English translation; and Persis B. Clarkson for her comments and English editing. Two anonymous referees helped us to significantly improve this manuscript.

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