



## Zooarchaeology of flight: Avifauna resource from the Southern Argentine Puna



Silvana V. Urquiza<sup>a,\*</sup>, Ada L. Echevarria<sup>b</sup>

<sup>a</sup> CONICET, Instituto Superior de Estudios Sociales, Instituto de Arqueología y Museo, Facultad de Ciencias Naturales e IML, Universidad Nacional Tucumán, San Martín 1545 (4000), San Miguel de Tucumán, Argentina

<sup>b</sup> Fundación Miguel Lillo, Ministerio de Educación de la Nación, Miguel Lillo 251 (4000), San Miguel de Tucumán, Argentina

### ARTICLE INFO

#### Keywords:

Zooarchaeology  
Birds  
Feathers and bones  
Argentine Puna

### ABSTRACT

Birds remains recovered from archaeological contexts may or may not be the product of human activities. No matter how they reached the site, such record provides valuable information. If bird remains are product of human activities, provide information such as diet and economic, symbolic and/or ideological activities. If this record is result of a non-human process, provides also useful data such environmental conditions or seasonal abandonment of sites. On the basis of the analysis of bird remains -feathers and bones- we explore here the use of the avifaunal resource in hunter-gatherer (ca. 8480 BP), agro-pastoral (ca. 1270–220 BP) and Historical Period contexts, from a high altitude desert in the southern Puna region of Argentina. Bird remains were recovered from open-air and overhang archaeological sites. An important aspect of the zooarchaeological record is the poor representation of bird bones in relation to feathers for both types of sites. The different human groups that inhabited this area of the Puna over time used feathers (Anatidae, Phoenicopteridae, Strigidae, Passeriformes and Rheidae), for paraphernalia and manufacturing weapons. Some passerines feathers, pellets and dung of carnivores containing feathers are linked with moments of site abandonment. Birds were a reliable resource in this high desert from Archaic through Colonial times.

### 1. Introduction

Bird remains in archaeological contexts can provide a range of useful data, such as economic, ideological, taphonomic, seasonal and/or ecological information (Bishop, 2014; Bochenski et al., 1999, 2017; Cruz, 2008, 2011; Denys et al., 2017; Fiore et al., 2013; Grimm, 2010; Lefèvre, 1997, 2010; Lefèvre et al., 2003; Marciniak, 2005; Serjeantson, 1997, 1998; Tivoli, 2013; among others). Other researches combine archaeology and ethnography, as is the case of the use of feathers related to birds extinction (McGovern-Wilson, 2005).

Feathers have always been an important part of human activities. Their main use is as arrow fletching, but they are also used for other practical, decorative and ritual purposes, in particular colored feathers. This may be the reason why wing bones have been recovered in a greater percentage than other bones (Bovy, 2002).

In general sense, the small amount of bird bones found in some archaeological sites may be due to different factors such as environment, fragments passing through screen mesh sizes, differential preservation, parts being selected or discarded for eating or for use as artifacts (Gál, 2005; Gifford, 1981; Behrensmeier et al., 2003; Mameli,

2002, 2003; Stewart, 1996; Tivoli, 2013, among others). Their preservation may depend on various factors such as low temperatures delaying the action of microorganisms, acidic sedimentary contexts, drainage, feather fat and oil, and above all, microbiological activity (Mameli, 2003; Nicholson, 1996) such as that of soil bacteria that degrade feather color and integrity, particularly in moist tropical environments (Grande et al., 2004). Lefèvre and Laroulandie (2014:262) mentioned that the less pneumatized bones of diving birds being are more likely to survive that pneumatized bones of strong fliers, which explains the best representation of bird remains of coastal sites.

Moreover, hunters may have left behind parts of waterfowl on their way to their final place of use or when they carved them up at hunting sites (Bovy, 2002) such as lakes or high Andean vegas (meadows) in the Puna. In addition is useful to consider the bird bone weight (Dirrigl, 2001) and the fact that if the deposition area were temporarily flooded, bird bones could float and be re-deposited over mammal bones (Mameli, 2003:210).

Zooarchaeological research in Argentina has focused mainly on mammals, and less on birds, which have been dealt with mainly in the fields of ethnoarchaeology, economy and taphonomy of bone remains

\* Corresponding author.

E-mail address: [silvanaurquiza@csnat.unt.edu.ar](mailto:silvanaurquiza@csnat.unt.edu.ar) (S.V. Urquiza).

at archaeological sites in Patagonia, Pampa and Cuyo (Camarós et al., 2010; Cruz, 2005, 2006, 2007, 2008; Estévez et al., 2002; Fernández et al., 2009; Giardina, 2006, 2012; Lanata et al., 1992; Lefèvre, 1997, 2010; Mameli, 2002, 2003; Mameli and Estévez Escalera, 2004; Prates and Acosta Hospitaleche, 2010; Savanti, 1994; Scheinsohn et al., 1992; Scheinsohn, 2010; Tivoli, 2010, 2012, 2014; among others) and in Valle Calchaquí (Rodríguez Loredó 1997–1998). This is the same situation for the background of the Argentinean Puna. Several papers mention bird remains without including in-depth discussion, perhaps because there were fewer bird remains than Camelids remains. Some records from the northern Puna correspond to the site Inca Cueva 4 (ICC-4), were bone remains of *Nothura* sp. were identified (Mengoni 1982 in Aschero, 1984:54; Yacobaccio, 1991) in a stratigraphic level dated  $9900 \pm 200$  to  $9230 \pm 70$  BP (Aschero, 2010), and white Rheiidae feathers and red feathers of exotic birds bound together with cords (Aschero, 1979). The human remains found in ICC-4, dated 4140 to 4020 cal. BCE (Aschero, 1994) present feathers of tropical birds (Yacobaccio, 2004), and the Torres Aparicio (Jujuy) archaeological collection presents macaw feathers (Fernández Distel, 2001). Pérez de Micou (2009) mentions a diadem made of feathers at burial site No. 26 of the collection Doncellas, and Fernández Distel (1983) mentions rock art with characters wearing feathers at Coctaca.

Particularly for southern Puna, the presence of feathers in archaeological and ethno-historical references indicates their possible use as ornaments of different kinds: headdresses, headbands, necklaces, loin-cloths, garments or camouflage, among others. There is evidence of feather headdresses in Inca sanctuaries in the high Andean peaks (Dransart, 2000). The Cueva Inca Viejo site ( $860 \pm 60$  BP) has been inferred as a macroregional transit site due to the presence of exotic elements such as the feathers of *Amazona aestiva*, *Primolius auricollis*, *Buteo magnirostris* and *Phoenicopteris* sp. (López et al., 2018). In Antofagasta de la Sierra, at the site Peñas de las Trampas 1.1, two funereal structures dated ca. 8400–8210 BP were found, from which an ornament made from *Rhea pennata* feathers was recovered (Martínez, 2014). Cueva Cacao 1-A (CC1A) presents a pair of sandals, each with a *Rhea pennata* feather attached, dated  $2870 \pm 40$  BP (Olivera et al., 2003). For rock art during the Formative period, Martel (2004) mentions anthropomorphic figures with feathered headdresses at the sites Peñas Chicas 3 (PCh3), Campo de las Tobas (CT) and Curuto 5 (Cu5), and suggests they indicate hierarchy of the person depicted. No mobile bone art or rock representation of waterfowl was found in this part of the Puna. At Peñas Chicas 3 (PCh3) and Peñas Coloradas (PC2.5) some etchings of wading birds with large knee joints may represent flamingos (Á. Martel personal communication). At the site Punta de la Peña 9-I (Structure 4), a medium sized bird pelvis was recovered (Urquiza, 2013) from a funereal context ( $1388 \pm 45$  BP) (Gonzalez Baroni, 2013). Also for ca. 1200 to 600 BP at the site Punta de la Peña 9-III (Structure 2), fragments of feathers split transversally along their mid shaft associated to fletching were recorded around along with broken arrowheads and tendon ties (López Campeny, 2001). At Real Grande 9 (RG9), on the upper course of river Las Pitas, Falconidae feathers were found embedded in the sand around a basket without any contextual associations (Podestá, 1989, 1991). At the overhang site Quebrada Seca 3 (QS3), Elkin (1994) recovered part of a postcranial skeleton of a large bird and grey feathers (early Holocene); later, for ca. 6100–7200 BP, no bird is recorded, and for the late Holocene, bone remains of *Phoenicopteris andinus* (*Phoenicoparrus andinus* sensu Elkin, 1994) are identified. In northern Chile, feather diadems of pelican (*Pelecanus thagus*) were found at the Playa Miller 3 cemetery at Arica (1000–1470 CE) (Horta Tricallotis, 2000). Standen (2003) suggests intensive capture of pelicans. Pelican bones, hides and feathers are associated to blankets and head covers or “caps” made of pelican hide on naturally mummified bodies in a Chinchorro cemetery (5400–3700 BP), the exception being an artificially mummified body wrapped in the hide of a *Rhea*, a bird from the Andean highlands. For Puna de Atacama, Peña-Villalobos et al. (2015) identified the feathers and bone remains of birds at the site

Tulán-122 dated  $2740 \pm 40$  BP and  $2510 \pm 40$  BP as Passeriformes: *Sicalis* sp., and infers according to the number of down and contour feathers that these must have arrived complete to the site. And from Tulán-85 site (3000–2200 BP), with an economy based mainly on the camelid exploitation, were recovered flamingos (*P. chilensis* and *P. andinus*) bones and eggshells. These records suggest hunting events and recurrent egg collecting activities, and the lack of wings and crania is indicating a standardized butchering in order to obtain the wings (Cartajena et al., 2010). In prehispanic caravan routes that connect the Atacama desert with pacific coast were found human burials containing clothes and blankets made using seabirds (Briones et al., 2005; Torres-Rouff et al., 2012). Briones et al. (2005) analyzed transitory camp sites along these caravan routes that are associated with sites exhibiting avian seabirds geoglyphs such the Cerro Mono 2 site. These authors found in the site Cerro Mono 1 two female funerary bundles (3370–3320 BP cal 1 sigma), with bodies covered by seabird skin with feathers in outside, and in the site Campamento Soronal 3 (S-3) were found bones and feathers of seabirds (1360–1300 BP cal. 1 sigma).

Regarding this state of knowledge, this paper presents and discusses the remains of bird bones and feathers recovered from archaeological sites of the Southern Argentine Puna: Punta de la Peña 4 (PP4) and Piedra Horadada 2 (PH2) (Fig. 1). Our main goal is to assess the use of birds in these contexts, comparing bones and feathers data in order to understand information that can be missed in sites where only bones are preserved. Results are discussed using ethnographic/ethnohistoric background, approaching the ancient uses of birds. Also, taphonomic aspects are briefly revisited, remarking the good preservation of the feather structures and colors.

## 2. Geographical setting and study area

The study area is located in the ecoregion Desert Puna or Salt Puna in northwest Argentina, characterized by marked aridity and large daily temperature range. This area belongs to the southern part of the central Andes (south of 24°S) at an elevation of 3500–5000 m above sea level. Encompasses the arid highlands with snow-capped peaks, volcanoes, salt flats, lakes and high plateaus. Characterized by a dry climate, high solar radiation, with broad daily and seasonal thermal range, low atmospheric pressure, scarce precipitation 100 mm/yr, and endemic species. Predominant vegetation types are shrub-steppe, halophile, herbaceous and sammophile steppes, and high Andean vegas (wetlands) (Cabrera, 1976; Cabrera and Willink, 1980; Troll, 1958).

Sites are located in the so-called Intermediate Sector (Olivera, 1992) according to resource availability and Vega Intermedia (intermediate meadow) according to topography and plant resources (Aschero, 2006), at elevation is 3550 to 3900 m above sea level. This intermediate location is currently a route between Fondo de Cuenca (3400 to 3550 msnm) and the Vega in Quebradas de Altura (3800 to 4600 msnm) (Cohen, 2014; Olivera, 1992; Podestá, 1989).

Current autochthonous fauna in the area includes Camelidae (*Vicugna vicugna*, *Lama glama*), carnivores (*Puma concolor*, *Galictis cuja*, *Oreailurus jacobita* and *Lycalopex culpaeus andinus*, among others), Rodentia (e.g. *Chinchilla brevicaudata*) and Aves (Barquez et al., 2006; Ojeda et al., 2002; Redford and Eisenberg, 1992). Exotic fauna includes species such as Caprinae, *Equus africanus asinus*, among others. Some current autochthonous Aves are Rheiidae: *Rhea pennata* (Lesser rhea); Phoenicopteridae: *Phoenicopteris chilensis* (Chilean flamingo), *Phoenicoparrus andinus* (Andean flamingo), *Phoenicoparrus jamesi* (Puna flamingo); Anatidae: *Anas flavirostris* (Speckled teal), *Oressochen melanopterus* (Andean goose); Laridae: *Chroicocephalus serranus* (Andean gull); Strigidae: *Athene cunicularia* (Burrowing owl); Cathartidae: *Vultur gryphus* (Andean condor); Falconidae: *Phalcoboenus megalopterus* (Mountain caracara); Accipitridae: *Geranoaetus melanoleucus* (Black-chested buzzard-eagle); Columbidae: *Columbina picui* (Picui ground-dove), *Metriopelia melanoptera* (Black-winged ground-dove); and Passeriformes such as Hirundinidae: *Orochelidon andecola* (Andean

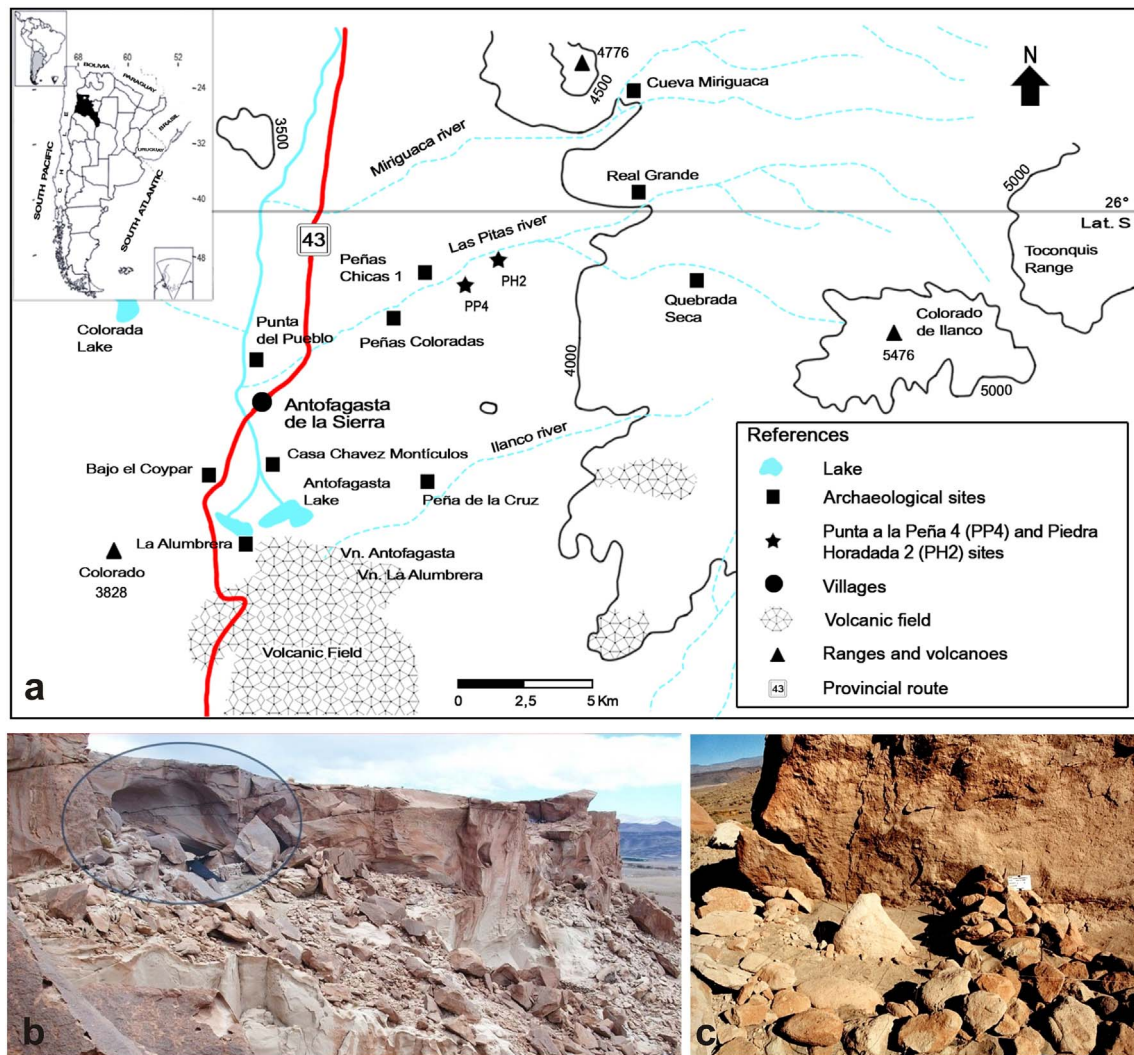


Fig. 1. a) Location and distribution map of archaeological sites in Antofagasta de la Sierra (Argentine Puna); b) outcrops view of sites Punta de la Peña 4 and c) outcrop view of site Piedra Horadada 2.

swallow); Fringillidae: *Spinus atratus* (Black siskin), *Spinus uropygialis* (Yellow-rumped siskin), Thraupidae: *Phrygilus plebejus* (Ash-breasted Sierra-Finch) among others (Van Perlo, 2015).

### 3. Archaeological sites

Both sites are located 8 km northeast of the mouth of the river Las Pitas in Antofagasta de la Sierra, Catamarca Province (Argentina).

The overhang site Punta de la Peña 4 (PP4) is located at the edge of a jointed ignimbrite outcrop at 3650 m above sea level (26°1'40.26" S and 67°20'33.17" W) with a lengthy occupation sequence spanning the Early Holocene (ca. 8900 to 8300 BP), Late Holocene (ca. 4500 to 3200 BP) through 500 BP. The latest occupation being a twentieth century corral in the section under cover of the overhang (Fig. 1b). The site exhibits rock art painting and engravings of diverse chronology and styles, such as geometrical patterns (ca. 5500–1200 BP) and red points and traces (ca. 4500–4100 BP) (Urquiza and Aschero, 2014).

Site Piedra Horadada 2 (PH2) is an open-air settlement among collapsed ignimbrite blocks at an elevation of 3640 m above sea level (26° 01' 25.21" S and 67° 20' 18.41" W), and consists of circular and sub-circular architectonic structures of various sizes. Structure 1 (S1) dates back to 690 ± 60 BP and 580 ± 60 BP, and includes a large, heavy rock (monolith or "huanca") (Fig. 1c). The overall interpretation of the site regarding functionality demonstrated a ritual occupation or

pastoral transit site (Urquiza et al., 2013).

Structure 2 (S2) is a natural shelter under a collapsed block enclosed by a stone drywall, with an initial burial event of a newborn human. Carbon dating for level 3 provides a date of 1270 ± 50 BP (Urquiza et al., 2013) (Table 1).

#### 3.1. Taphonomic context, climate and occupation dynamics

In present day, the soils of the study area are lacking in vegetation and exposed to high solar radiation, high thermal amplitude and low humidity. These factors produce soil desiccation, mainly in the uppermost layers. However, these conditions were changing along the Holocene record.

For the Early Holocene, the osseous material exhibits low preservation, in association with an environmental stage of changes between humid climate conditions that change to aridity. This is because the hydrological dynamic of the PP4 overhang site that implies restrictions of downward water infiltration, as result of the proximity of the mother rock. This situation produced a high content of water in these Early Holocene layers, which exposed zooarchaeological remains to a long lapse of direct contact with fluids, which reacted as catalyzers in osseous dissolution process (Urquiza, 2016). Therefore, the low preservation degree in faunistic remains in contact with the rock floor, in the covered sector of the site, suggests some level of ponding for

**Table 1**

Radiocarbon dates from PH2 and PP4 sites.

UGA: Center for Applied Isotope Studies (CAIS), University of Georgia, EE.UU. LP: Laboratorio de Tritio y Radiocarbono (Tritium and Radiocarbon Laboratory) (LATYR), Universidad Nacional de La Plata, Argentina. Calibrated  $\pm 2$  sigmas using the program Oxcal 3.10 (PH2 site) y Oxcal 4.1 (PP4 site).

Site	Unit	Level/micro-sector	Associated elements	Dating age and corrected date (cal. 2 sigma)	Dated material	Bibliographic references
Piedra Horadada 2 (PH2)	E1 (ritual structure of monolith or <i>huanca</i> )	4/B2	Passeriformes feathers	(LP1572) 690 $\pm$ 60 y BP cal CE 1265–1371	Charcoal	López Campeny (2009, 2014)
		3/C3		(LP1620) 580 $\pm$ 60 y BP cal CE 1311–1401	Charcoal	Urquiza, Romano, & López Campeny (2013)
	E2 (funerary context)	1		(UGA15100) 220 $\pm$ 30 y BP cal CE 1654–1794	Thatch	Urquiza, Romano, & López Campeny (2013)
		3/B1	Passeriformes feathers	(UGA1887) 1270 $\pm$ 50 y BP cal CE 660–880	Charcoal	López Campeny (2009)
Punta de la Peña 4 (PP4)	C (uncovered sector)	6/K8	Anseriformes bones	(UGA15091) 8480 $\pm$ 40 y BP cal BCE 7581–7448	Charcoal	Urquiza and Aschero (2014)
		1/K8 (discard area)	Passeriformes feathers	(UGA9264) 960 $\pm$ 40 y BP cal CE 1032–1206	Charcoal	Rodríguez et al. (2003) Urquiza and Aschero (2014)
		3 to 5/K9 (funerary context)	<i>Anas flavirostris</i> feathers	(LP1870) 570 $\pm$ 80 y BP cal CE 1309–1413	Animal fiber (bundle cord tie)	López Campeny (2006–2007)
	A (covered sector)	3/Lente 3x- (working area)	Rheidae, Strigidae and Anatidae (cut feathers)	(UGA15093) 1035 $\pm$ 30 y BP cal CE 990–1149	Charcoal	Urquiza and Aschero (2014)
		3/Lente 3z- (working area)		(UGA15089) 760 $\pm$ 40 y BP cal CE 1222–1385	<i>Chenopodium quinoa</i> seeds	Rodríguez et al. (2006) Urquiza and Aschero (2014)
		3/Lente 3x (inside stove)		(UGA15088) 740 $\pm$ 50 y BP cal CE 1228–1391	<i>Zea Mays</i> grains	Urquiza and Aschero (2014)
		3/Lente 3z (sparse stove)		(UGA15089) 700 $\pm$ 40 y BP cal CE 1282–1393	<i>Chenopodium quinoa</i> seeds	Urquiza and Aschero (2014)
		3/Lente 3x (inside stove)		(UGA15090) 690 $\pm$ 50 y BP cal CE 1279–1400	<i>Chenopodium quinoa</i> seeds	Rodríguez et al. (2006) Urquiza and Aschero (2014)
		3/Lente 3x (outside stove)		(UGA15088) 560 $\pm$ 50 y BP cal CE 1316–1458	<i>Zea Mays</i> grains	Rodríguez et al. (2006) Urquiza and Aschero (2014)
		3 (stove over the top of layer 4)		(LP869) 460 $\pm$ 70 y BP cal CE 1405–1630	Charcoal	Rodríguez et al. (2003) Urquiza and Aschero (2014)
		2/L4	Anatidae and Passeriformes (cut feathers) Strigidae feathers	(UGA9263) 540 $\pm$ 40 y BP cal CE 1330–1458	Thatch	Urquiza and Aschero (2014)
1/L3d	Strigidae and Anatidae (cut feathers) Phoenicopteridae feather	(LP1601) 750 $\pm$ 60 y BP cal CE 1220–1392	Charcoal			

early occupations of the site. This implies post depositional dynamic controlled by pH, meteorization and diagenesis (Urquiza et al., 2009).

For the Late Holocene, the zooarchaeological record exhibits a better preservation that is related with a new transition between humid conditions and aridity, with an aridity maximum toward 1000 BP that continues to the Historical period.

The palaeoenvironmental framework (Tchilinguirian and Olivera, 2005; Urquiza, 2009; Tchilinguirian and Olivera, 2014) suggest cooler and humid conditions between 9900–8700 BP, in coincidence with more early human occupations in the covered sector of the site PP4 (8970  $\pm$  60 BP). Later, begins gradually a new aridization process and human occupations continued in the open-air sector of the PP4 site (8480  $\pm$  40 BP) were the recovered elements (bone fragments of wild camelids and birds, and lithics) displays gypsum in surface and a poorly preservation. Also were found concretions made up of bone splinters,

lithic fragments and charcoal from stoves, all with high content of albumin, which suggest a product of slaughtering/consumption in the open area of the site (Urquiza, 2009; Urquiza and Aschero, 2014).

There is also mineral replacement (KCl) in Camelidae bones, probably related with evaporation stages in the substrate (Urquiza, 2016). Later, the PP4 site is abandoned, which is coincident with the increasing of aridity (ca. 6300–3900 BP). At the same time-lapse were occupied a residential structure in the covered sector between ca. 4000–3800 BP (Urquiza and Aschero, 2014).

Later, the site remains unoccupied between ca. 3200–1000 BP, in coincidence with a final humid stage and a transition to an aridization process (Tchilinguirian and Olivera, 2005) that continues to present day.

Towards 1270  $\pm$  50 BP, was recorded a human burial in the PH2 (S2) site, later disturbed by a brief occupation, and then again in a

historical context of abandonment when where found feathers of Emberizidae within carnivore dung. Between ca. 700–200 BP there are sporadic occupations around a monolith in PH2 (S1) site, with a niche in a wall as a deposit of faunistic remains, fleeces and twines. All these records exhibit good preservation (López Campeny, 2009, 2014; Urquiza et al., 2013).

During the late occupation (ca. 740–460 BP) in the covered sector of PP4 site, were carried out sporadic cleanings of floors, accumulating materials from previous occupations in peripheral areas (discard areas 1 and 2) (Urquiza and Aschero, 2014).

Between ca. 500 to 1000 BP, were recovered cut feathers of Anatidae (Andean Goose and Crested Duck), Strigidae, *Rhea* and Passeriformes on a litter of straw, in an area where several activities carried out, such as projectile points replacement, instruments manufacture and fiber processing (cords and needles), among others.

In the uncovered sector of the site were found a funerary bundle (570 ± 80 BP), it was covered by garbage of Colonial-Republican occupations, when after the XVI century, the site was occupied and used as corral for autochthonous (*Lama glama*) and introduced domestic animals like sheep's and goats, whose trampling mixed different materials of layers 1 and 2 (Urquiza and Aschero, 2014).

#### 4. Methodology for analysis of the faunal sample

The study sites were divided into open-air sites (PH2-S1) and overhang sites (PH2-S2 and PP4). Bone and feather samples were collected according to excavation levels and packed separately from other kinds of materials recovered.

Preservation in both types of sites is excellent (Urquiza et al., 2013; Urquiza and Aschero, 2014). The preserved materials comprise cartilage tissue, tendons, hooves, leather, hair, feathers, wool, fleeces, articulated artiodactyl extremities, faeces, and derivated material textiles. Only in early levels of the PP4 site, faunistic remains exhibits bad preservation, suggesting water infiltration and ponding. Sediments of sites are composed mainly of sandy clay loam texture. In the open air site PH 2-S1 pH is weakly acid (5,5 to 6,5), and in the overhang site PP4 where diagenesis was more intense pH is variable between neutral to alkaline (7,5 to 10) for three sectors (Urquiza et al., 2009). This situation is congruent with the hydrodynamic of overhang sites which exposed in increasing way bones and feathers with water and body fluids, which catalized bones dissolution in Early Holocene levels (Urquiza, 2016).

Taxonomical determination of feathers was performed by comparison with the Colección Ornitológica de la Fundación Miguel Lillo (COFML, Ministerio de Educación de la Nación), with the support of bird identification guides by Canevari et al. (1991) and Narosky and Yzurieta (2010). We follow the nomenclature criteria of Narosky and Yzurieta (2010) and Remsen et al. (2017). Feathers specimens were identified taxonomically to genera and species through analysis of their specific ornamentation.

Anatomical and taxonomical identification of bones was done by comparison to modern reference bone collections and reference manuals (Bacher, 1967; Fick, 1974; Gilbert et al., 1981; Langer, 1980; Sisson and Grossman, 2005), considering the elements size and the morphological comparison of diagnostic zones (Mameli and Estévez Escalera, 2004: 64–71). Bones were measured following Cohen and Serjeantson (1996) and Von den Driesch (1976); and distinguished according to degree of bone fusion. When it was not possible to assign bones to a given taxon, they were described according to body size relative to natural life size (sensu Narosky and Yzurieta, 2010:30), for which we followed the definitions by Urquiza (2009): Small Birds (less than 25 cm); Medium Birds (30 to 50 cm), and Large Birds (over 50 cm).

To quantify bone material we used number of specimens (NSP). The minimum number of individuals (MNI) (Chaplin, 1971; White, 1953) was calculated for each element, laterality and age. For feathers, we

used Number of Feathers (NF) and when possible MNI. Besides, we followed criteria of Bochenki and Tomek (1997), Laroulandie (2005), Lyman (1994), Reitz and Wing (1999), among others, to assess taphonomic issues and processes that modified bones. We performed macroscopic observations on bones and feathers to determine presence of marks, traces and breakages caused by human and non-human action (Binford, 1981; Gifford, 1981; Lyman, 1994), as well as mineral precipitation. We also recorded the degree of fragmentation in the bone set, weathering stages (Behrensmeier, 1978) and thermal alteration (Nicholson, 1993). The traces on the bones and feathers were studied in stereoscopic trinocular loupes.

## 5. Results

### 5.1. Piedra Horadada 2 (PH2) site

For Structure 1, the overall zooarchaeological analysis (vertebrates and invertebrates) allow us to define brief occupations, alternating with abandonment stages. Invertebrate remains belong to Dermestidae, Carabidae, Anisoptera and *Danaus plexippus erippus*. Vertebrate remains are composed mainly of Camelidae (*Lama glama* and *Vicugna vicugna*), and the rest includes *Ctenomys* sp., *Liolaemus* sp., *Equus* sp. The avifaunal skeletal set constitutes 1.5% of total of the fauna bone sample at the open-air site (Structure 1). For Structure 2 were recovered Camelidae (32%), and lesser amounts of Rodentia and ovicaprids (Urquiza et al., 2013).

We identified 208 passerine feathers, 154 for the Structure 1 (MNI: 7) and 54 for the Structure 2 (MNI: 2). The feathers in the Structure 1 are made-up of 44% Furnariidae, 17% Rhinocryptidae, 10% Emberizidae and a few Fringillidae (5%), Thraupidae (5%) and Tyrannidae (2%). The remaining sample could only be determined to the level of the order Passeriformes (14%). The greatest percentage of feathers came from stratigraphic levels 3 and 2 (580 ± 60 to 220 ± 30 BP). These feathers were recognized as contour, down, contour tectrices and primary feathers. Within the family Thraupidae, we determined *Phrygilus* sp. (Sierra-finch) ventral down feathers (MNI: 1) for the Historical Period. At 220 ± 30 BP we recovered Tyrannidae feathers, as well as contour feathers and down feathers of a *Spinus* sp. (MNI: 1) male, based on color. The Rhinocryptidae contour and ventral feathers from levels 1 and 2 belong to a single individual; as do the Passeriformes feathers from levels 4 and 5 in the same microsector (B4 and 5). Moreover, for the Structure 2, mostly are feathers of Emberizidae (89%) and in a lesser percentage undetermined Passeriformes (11%).

Around the monolith or “huanca” (Fig. 2) were found fragments of diaphysis and a dentary of Passeriformes (cf. *Spinus* sp.) (MNI: 1) (220 ± 30 BP), and Medium Bird (MNI: 1) were found. The Medium Bird coracoid presents a cut mark made by a sharp instrument and two fused humerus fragments are thermally altered, associated with two hemimandibles of *Liolaemus* sp. (690 ± 60 BP) (Table 2).

Also round the monolith were recovered pellets and dungs, which contexts suggest a non-human accumulation. Emberizidae (Old world Buntings) down feathers (n: 11) were found in pellets (Historical Period) (Fig. 3). For 580 ± 60 BP we recovered a pellet containing bone remains of *Phyllotis* sp., and a Canidae (cf. *Lycalopex* sp.) dung containing generic contour feathers of Furnariidae: *Geositta* sp. (Miner) (n:30) (Urquiza et al., 2013).

Under the shelter of the overhang of Structure 2, we recovered fox (cf. *Lycalopex* sp.) dung containing two undetermined bone fragments (< 1 cm), the exoskeleton of a scorpion (Scorpiones: Bothriuridae) (Urquiza, 2009), and ventral feathers of Passeriformes: Emberizidae (NP: 48, MNI: 1) corresponding to the Historical Period. In zone outside the overhang at 1270 ± 50 BP we recorded scattered Passeriformes feathers (NP: 6) (Table 3).

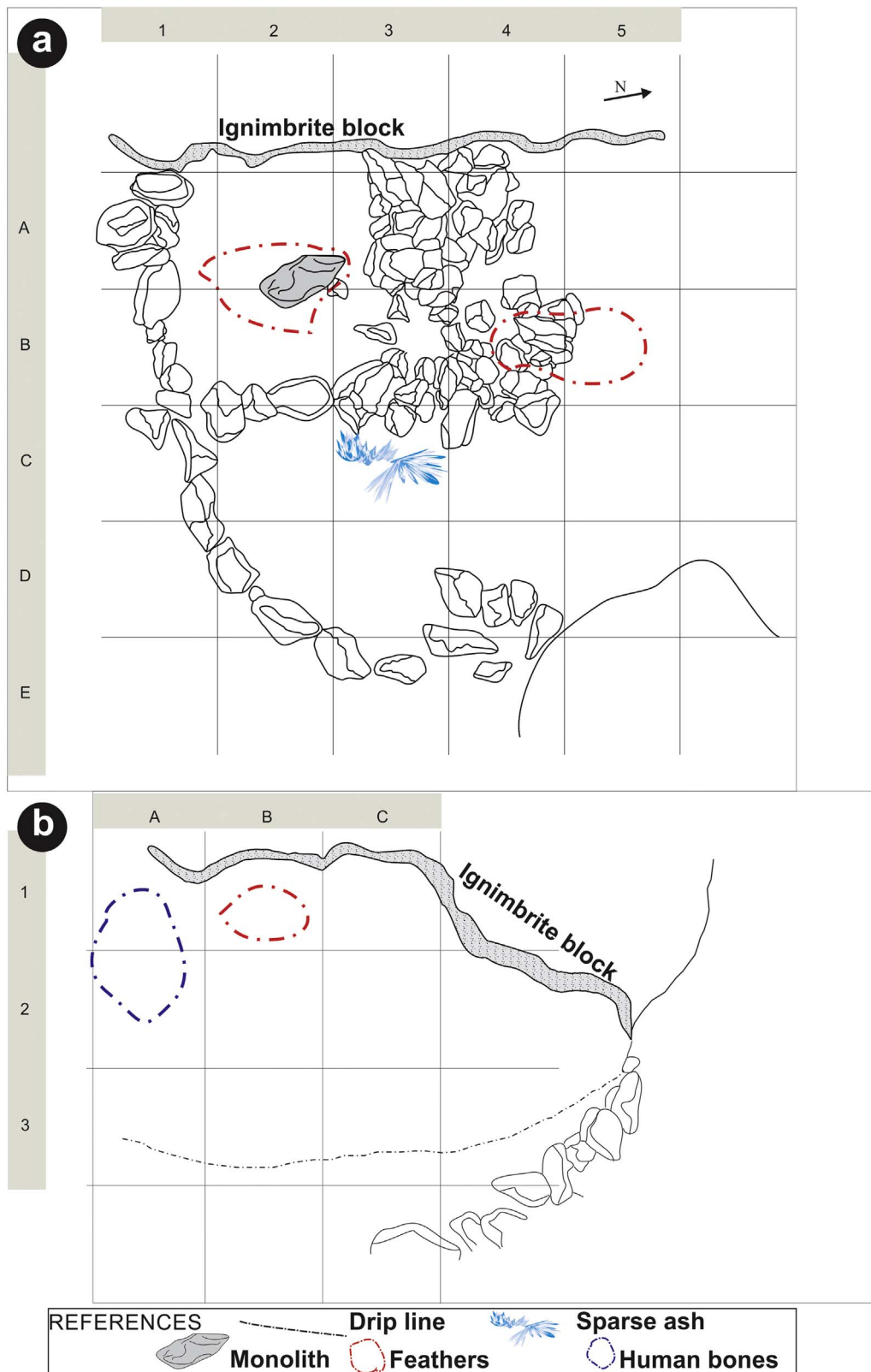


Fig. 2. Context plans of PH2. a) Structure 1: draft showing the location of the bird remains in different levels; b) Structure 2: location of bird remains in level 3. Each square is 1 × 1 m. (Modified from López Campeny, 2009)

5.2. Punta de la Peña 4 (PP4) site

The faunistic record (vertebrates and invertebrates) of the overhang site is composed of mammals (99,16%), Birds (0,80%) and Squamata

(0,04%). Within mammals camelids are dominant: Camelidae (53%) -*Lama glama*, *Vicugna vicugna* and *Lama guanicoe*-, followed by Rodentia, Dasipodidae, Cervidae and ovicaprids. Among invertebrates, we found Argasidae, Bothriuridae, Dermestidae and Calliforidae:

**Table 2**  
Feathers and bird bone remains at the open-air archaeological site Piedra Horadada 2 (Structures 1 and 2).

Site Piedra Horadada 2	Years BP (C14)/ Taxon	Feathers								Bones			
		Passeriformes indeterminate	Furnariidae	Fringillidae	Rhinocryptidae	Tyrannidae	Emberizidae	Thraupidae	NFt	Bi	Passeriformes	BM	NSPt
S1	690 ± 60	7	1	–	–	–	–	–	8	2	–	3	5
	580 ± 60	12	40	–	25	–	–	–	77	8	–	3	11
	220 ± 30	6	14	7	2	3	–	–	32	–	2	–	2
	Historical period	2	2	–	–	–	15	7	26	–	1	–	1
	SC	–	11	–	–	–	–	–	11	–	–	–	–
S2	NFt	27	68	7	27	3	15	7	154	10	3	6	19
	1270 ± 50	6	–	–	–	–	–	–	6	–	–	–	–
	Historical period	–	–	–	–	–	–	–	48	2	–	–	2
	NFt	6	–	–	–	–	48	–	54	2	–	–	2

S1: Structure 1; S2: Structure 2; SC: section cleaning; NFt: total number of feathers; Bi: indeterminate bird; BM: medium birds; NSPt: total NSP.

*Compsomyops* sp. (Urquiza and Aschero, 2014).

The birds sample includes bones and feathers. The fragmentation degree of recovered bones (NSP 22) makes difficult the taxonomic identification. The highest proportion of bones was recorded in the covered sector under the overhang at levels 1 to 3 (ca.540 to 980 BP), in association with human activities areas (Urquiza and Aschero, 2014) (Fig. 4). Towards 540 ± 40 BP (UGA 9263) (Ibid), two keel fragments (Anatidae) and one fused femur fragment with spiral fracture were recovered, in addition to long bones including one which was not fused of medium size birds. Weathering of the bones set ranged from 1 to 3 with MNI: 3. In the uncovered area of the overhang, with radiocarbon dating on charcoal 8480 ± 40 BP (UGA 15091) (Urquiza and Aschero, 2014) we identified a tibiotarsus and long bones diaphysis of Anseriformes. The bones have gypsum precipitated superficially, with weathering ranging from 3 to 4 for MNI: 2, and one thermally altered diaphysis (stage 2) (Tables 4 and 5).

In overhang PP4, feathers were only recovered for the Late period. Total number feathers was NPT: 580, including down feathers, contour feathers, semiplumes and primary feathers distributed over the three sectors of the overhang, with a larger proportion in the sheltered sector. The feathers represented 90% Passeriformes, 5,3% Anseriformes, 2,4% Strigiformes, 2% Rheiformes, 0,3% Phoenicopteriformes. Within Passeriformes we identified Thraupidae, Emberizidae and Furnariidae (Fig. 5). Anseriformes are represented by the family Anatidae with *Oressochen melanopterus* (Andean goose), *Lophonetta specularioides* (Crested duck) and *Anas flavirostris* (Speckled teal); owls are represented by the family Strigidae: *Athene cucularia* (Burrowing owl) (Fig. 6), rheas by the family Rheidae: *Rhea pennata* (Lesser rhea),

flamingos by Phoenicopteridae (Fig. 7; Table 5).

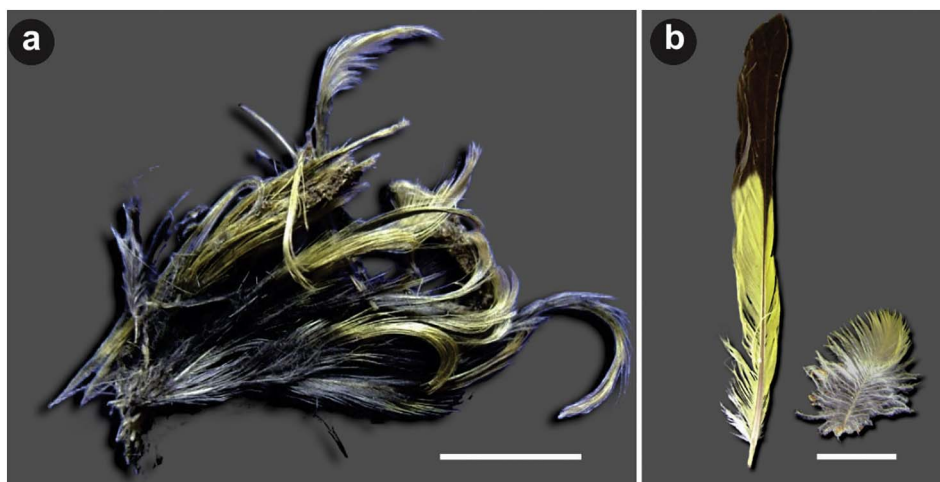
The uncovered overhang sector, inside a funerary bundle containing a naturally mummified female corpse (570 ± 80 BP - LP1870), five feathers were identified, one of which was a brown Anatidae: *Anas flavirostris* contour feather, which the only duck species lacking in cut feathers (Fig. 6b).

In regard of feathers intentionally cut (n: 53) with a sharp lithic instrument (probably a retouched cutter), colors were white, black, pink, and white with brownish hues (ca. 1000 BP to Historical Period) (Fig. 8b, c; Table 6). Three types of cuts were recognized: A) Longitudinal cuts following the hollow shaft that are found in primaries feathers of Anatidae (n: 11), and in contour feathers of Anatidae (n: 8), Rheidae (n: 4) and Strigidae (n: 2). B) Vane cuts on primaries feathers of Furnariidae (n: 19) and in contour feathers of Anatidae (n: 1) and of Phoenicopteridae (n: 1); C) Combination of A and B, only in Anatidae contour (n: 5) and in primaries feathers (n: 2) (Fig. 9).

## 6. Discussion

### 6.1. Preservation: Feathers against bones

Despite the good preservation of feathers in both types of sites, there is little number of avian bones in relation to the feathers. This may be due to that elements of medium birds (e.g. Anseriformes), such as breast (coracoides and keel), proximal wings (humerus) and leg bones (femur, tibiotarsus) being brought to the site as separate parts, or maybe birds were plucked before they were brought to the site, and the other body parts were processed elsewhere. Also, is possible that birds were not



**Fig. 3.** PH2 site. a) Passeriformes: Emberizidae within carnivore dung from Structure 2 (1270 ± 50 BP); b) Passeriformes: Fringillidae: *Spinus* sp. from Structure 1, around the monolith (220 ± 30 BP). Scale bar: 1 cm.

**Table 3**  
Details of feather types from archaeological site Piedra Horadada 2 (PH2-S1 and S2).

Chronology (years BP)	Scientific name	Common name	Feathers	
S1 690 ± 60	Passeriformes: Furnariidae	Ovenbirds/Horneros, camineras, leñateros	Indeterminate (n:1) around monolith	
	Passeriformes	Passerine/Pájaros cantores	Contour shaft (n:1) around monolith	
	Passeriformes	Passerine/Pájaros cantores	Ventral down (n:1)	
	Passeriformes	Passerine/Pájaros cantores	Down (broken) (n:1)	
	Passeriformes	Passerine/Pájaros cantores	Contour (n: 3) (2 broken)	
	Passeriformes	Passerine/Pájaros cantores	Contour (n:1)	
	580 ± 60	Passeriformes: Furnariidae	Ovenbirds/Horneros, camineras, leñateros	Contour (n:1) around monolith
		Passeriformes: Furnariidae	Ovenbirds/Horneros, camineras, leñateros	Contour (n: 2) around monolith
		Passeriformes: Furnariidae	Ovenbirds/Horneros, camineras, leñateros	Contour and down (n: 2) around monolith
		Passeriformes: Furnariidae	Ovenbirds/Horneros, camineras, leñateros	Contour (n: 5) under wall rocks
Passeriformes: Furnariidae: <i>Geositta</i> sp.		Miner/Caminera	Contour tectrices (n: 30) <b>within carnivore dung</b>	
Passeriformes: Rhinocryptidae		Tapaculos/Gallitos	Ventral down (n: 25) around monolith	
Passeriformes		Passerine/Pájaros cantores	Contour and down (n: 6) around monolith	
Passeriformes		Passerine/Pájaros cantores	Contour and down (n: 4) around monolith	
Passeriformes		Passerine/Pájaros cantores	Contour (n: 1)	
Passeriformes		Passerine/Pájaros cantores	Primary (n: 1)	
220 ± 30	Passeriformes: Fringillidae: <i>Spinus</i> sp. ♂	Siskin/Cabecita negra	Contour (n: 5)	
	Passeriformes: Fringillidae: <i>Spinus</i> sp.	Siskin/Cabecita negra	Contour and primary (n: 2) around monolith	
	Passeriformes: Furnariidae	Ovenbirds/Horneros, camineras, leñateros	Contour and down (n: 3) around monolith	
	Passeriformes: Furnariidae	Ovenbirds/Horneros, camineras, leñateros	Contour and down (n: 10)	
	Passeriformes: Furnariidae	Ovenbirds/Horneros, camineras, leñateros	Contour (n: 1)	
	Passeriformes: Rhinocryptidae	Tapaculos/Gallitos	Contour (n: 2)	
	Passeriformes: Tyrannidae	Tyrant-flycatchers/Atrapamoscas	Contours and down (n: 3)	
	Passeriformes	Passerine/Pájaros cantores	Down (n: 1)	
	Passeriformes	Passerine/Pájaros cantores	Contour and down (n: 5)	
	Historical period	Passeriformes: Furnariidae	Ovenbirds/Horneros, camineras, leñateros	Contour (n: 1)
Passeriformes: Furnariidae		Ovenbirds/Horneros, camineras, leñateros	Contour (n: 1)	
Passeriformes: Emberizidae		Old world Buntings/Semilleros	Contour and down (n: 3)	
Passeriformes: Emberizidae		Old world Buntings/Semilleros	Down (n: 1) around monolith	
Passeriformes: Emberizidae		Old world Buntings/Semilleros	Down (n:11) 0.57 cm depth around monolith/ <b>within pellet</b>	
Passeriformes: Thraupidae: <i>Phrygilus</i> sp.		Sierra-finch/Yal	Ventral down (n:7)	
Passeriformes		Passerine/Pájaros cantores	Down (n: 1)	
Passeriformes		Passerine/Pájaros cantores	Down (n: 1)	
SC		Passeriformes: Furnariidae	Ovenbirds/Horneros, camineras, leñateros	Contour (n: 3) 0.62 cm depth around monolith
		Passeriformes: Furnariidae	Ovenbirds/Horneros, camineras, leñateros	Contour and down (n: 8)
S2 1270 ± 50	Passeriformes	Passerine/Pájaros cantores	Indeterminate (n:6)	
	Historical period	Passeriformes: Emberizidae	Old world Buntings/Semilleros	Ventral feathers (n: 48) <b>within carnivore dung</b>

Bold fonts are used to highlight the non-anthropogenic origin of some of the feathers samples.

completely consumed, and some elements were discarded. However, the presence of cut traces and termic alteration suggest bird processing. This scenario is coincident with Bovy (2012) and Broughton et al. (2007) where wings and breast parts of waterbirds were found, with preservation of dense elements such as the coracoid and humerus, being probably that the other body parts were processed elsewhere. On the other hand, could be linked to that defleshed bones, have more chance to being preserved than bones buried as complete carcasses in caves (Bochenski et al., 2017).

## 6.2. Birds along time

In the sites analyzed here, we found a greater proportion of feathers than of birds bones. All bird orders identified are currently present in the area. Passeriformes, Anseriformes, Rheiformes, Strigiformes and Phoenicopteriformes are found in Punta de la Peña and the lakes of Antofagasta and La Alumbreira, supporting the idea of that if faunal distribution has remained unchanged, human action range was close to the occupation sites. Long bones diaphysis and a tibiotarsus (ca. 8480 BP) and femur (ca. 540 BP) of Anseriformes show signs of the fleshier parts (thigh) having been eaten. They were found in association to remains of Camelids, charcoal and lithic flakes and chips (Urquiza and Aschero, 2014).

With regard to weapons or traps, we found remains indicating the use of bows, arrows and cords which may have been used to hunt birds in lakes and high Andean vegas, and traces of them may have remained at the killing sites. Although long bones of legs waterfowl seem to have been introduced into overhang PP4, preservation conditions as water

seepage and pooling in Early Holocene levels (Urquiza et al., 2009) not enabled preservation of other skeletal parts or feathers on the rock floor.

At later times, cuts of meat such as breast, thigh and wing may have been taken into the covered sector of the overhang, but there is absence of feet and cranial and axial skeleton. These high yield (breast and thigh) and low yield (wing) parts may have been eaten, and the feathers used secondarily in ornaments and fletching, while bills, claws and bones may have been used in artifacts which have not been preserved in the site. Necks and feet, which are absent from the archaeological record, may have been used in broth, where the skin is eliminated by boiling or burning. Another possibility, which we are not entirely persuaded of, considering the limitations of the outdoors, is that the hunters pre-processed the kill in situ, discarding the lower-yield parts before carrying it back to Punta de la Peña. Birds may have been eaten in a greater proportion than is represented archaeologically, considering that the action of various taphonomic processes may have modified the accumulations or caused differential preservation of mammals and birds under the same depositional context, also due to the low bone density of certain bird parts such as skull, vertebrae, ribs and phalanges.

With regard to *Rhea pennata*, it is worth noting that no skeletal part was found at any of the study sites, although there are *R. pennata* feathers in the aforementioned funereal contexts and in the overhang Punta de la Peña 4 for the late period (1035 ± 30 BP to the Historical Period), where they were used for fletching.

At the open-air site Piedra Horadada 2 (PH2), feathers in Structure 1 are *Phrygilus* sp. (Sierra-finch) ventral down feathers, probably part of a



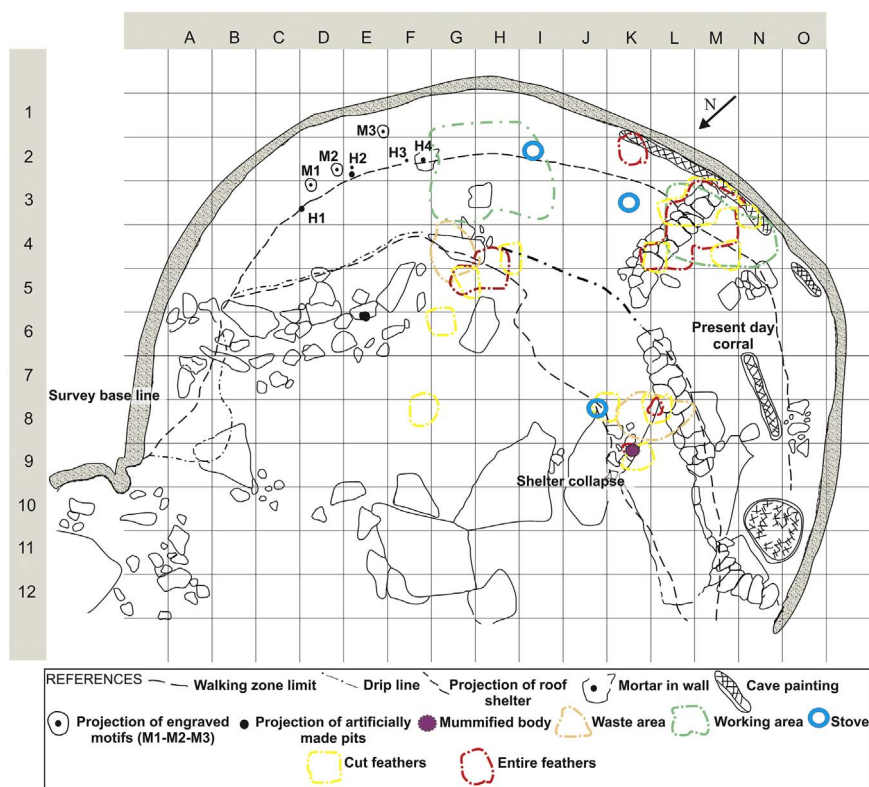


Fig. 4. Context plan of PP4 site, showing the location of bird remains for different levels in coincidence with working areas of Late Holocene. Scale 1:75. (Modified from Urquiza and Aschero, 2014)

Table 4  
Feathers and bird bone remains from archaeological site overhang Punta de La Peña 4 (PP4).

Punta de la Peña 4 Years BP/taxon	Feathers						Bones					
	Passeriformes				Anseriformes	Strigiformes	Rheiformes	Phoenicopteriformes	NFt	BM	Anseriformes	NSPt
	T	F	E	R								
SC	-	-	-	-	-	-	-	-	-	1	-	1
8480 ± 40	-	-	-	-	-	-	-	-	-	-	6	6
1035 ± 30 to 460 ± 70	-	3	-	-	6	1	2	-	12	-	-	-
990 ± 40 to 750 ± 60	4	5	2	1	15	6	1	1	35	8	-	8
570 ± 80 (Tomb)	-	-	1	-	1	3	-	-	5	-	-	-
540 ± 40	428	46	26	-	5	2	3	-	510	5	2	7
Historical Period	-	5	3	-	4	2	3	1	18	-	-	-
NPt	432	59	32	1	31	14	9	2	580	14	8	22

524

i: Passeriformes indeterminate; T:Thraupidae; F:Furnariidae; E: Emberizidae; R: Rhinocryptidae; NFt: Total number of feathers; BM: Medium birds; NSPt: total NSP; SC: Section cleaning.

nest on the ground among the rocks, to which hair, wool and plants were added during the Historical Period. In the same area, we recovered *Spinus* sp. (Siskin) and Tyrannidae (Tyrant-flycatchers) feathers (220 ± 30 BP).

Despite the good preservation of small Passeriformes feathers, it is worth noting that no Medium Bird feather was recorded in association with Medium Bird skeletal remains (580 ± 60 and 690 ± 60 BP). This may be due to only parts of medium birds, such as breast and proximal wings, being brought to the site, or to the birds having been plucked before they were brought in. Based on the evidence of human marks on the bones of these birds located in the sector around the monolith and the fireplace, we assume that they were eaten on site, contributing additional protein to the diet.

### 6.3. Birds obtaining

The palaeoenvironmental background suggests that the Early Holocene occupations (ca. 8900–8300 BP) are coincident with the regression and desiccation of palaeolakes. The geological interpretation of Las Pitas river profile would indicate a perennial basin, with resources availability and without important palaeogeographic glacial barriers or extreme dune barriers. Later, the palaeoenvironment becomes more arid (ca. 7900–6300 and 5600–4500 BP), changing about 4500–3900 BP to wetter conditions, and with the expansion of wetland expansion in several fluvial landscapes (Tchilinguirian and Olivera, 2014). In regard of this, is inferred that along time ecosystems allowed the presence of birds, mainly waterbirds, as been observed.

The lake of Antofagasta located 9.5 km away from Punta de la Peña provides a highly appropriate micro-environment for Aves. Currently, different species such as ducks, gulls, coots, flamingos *Phoenicopiterus*

**Table 5**  
Details of types of feathers at the site Punta de la Peña 4 overhang (PP4).

Level	Chronology (years BP) and sector	Scientific name	Common name	Parts present		
0 (Historical Period)	Covered sector (Republican Period)	L4b	Strigiformes Strigidae: <i>Athene cucularia</i>	Burrowing Owl/ Lechucita vizcachera	Contour (n:2)	
		L4a,b,c	Passeriformes: Emberizidae	Old world Buntings/ Semilleros	Contour (n:3)	
			Passeriformes: Furnariidae	Ovenbirds/Horneros, camineras	Primary (n:2) Contour (n:2)	
	Drip line (Colonial Period)	H5a	Phoenicopteriformes: Phoenicopteridae	Flamingo/Flamenco, parina	Contour <b>vane cut transversally</b> (n:1)	
			Rheiformes Rheidae: <i>Rhea pennata</i>	Lesser Rhea/Choique	Contour (n:2) Contour <b>cut along the shaft</b> (n:1)	
		G5b	Anseriformes Anatidae: <i>Oressochen melanopterus</i>	Andean Goose/Guayata	Primaries <b>cut along the shaft</b> (n:4)	
			Passeriformes: Furnariidae	Ovenbirds/Horneros, camineras	Primary (n:1)	
	1	Covered sector (750 ± 60)	H4c K4d M2c M3a	Anseriformes Anatidae: <i>Oressochen melanopterus</i>	Andean Goose/Guayata	Down (n:1) Primary <b>cut along the shaft</b> (n:1) Contour <b>cut along the shaft</b> (n:3)
				Anseriformes Anatidae: <i>Lophonetta specularioides</i>	Crested Duck/Pato crestón	Speculum feather <b>cut along the shaft</b> (n:1) Contour <b>vane cut</b> (n:1) Contour <b>cut along the shaft</b> (n:2) Contour <b>vane cut and cut along the shaft</b> (n:3) Primaries <b>cut along the shaft</b> (n:2) Down (n:1)
				Phoenicopteriformes: Phoenicopteridae	Flamingo/Flamenco	Contour (n:1)
K4d			Strigiformes	Burrowing Owl/ Lechucita vizcachera	Contour (n:6)	
L3d			Strigidae: <i>Athene cucularia</i>			
M2c						
K4d			Passeriformes:	Sierra-finch/Yal	Contour (n:4)	
L3b			Thraupidae: <i>Phrygilus</i> sp.			
M2c			Passeriformes: Furnariidae	Ovenbirds/Horneros, camineras	Contour (n:3) Primary (n:1) Primary <b>vane cut</b> (n:1)	
Uncovered sector (990 ± 40)			K8b,d	Passeriformes: Emberizidae	Old world Buntings/ Semilleros	Contour (n:2)
		Passeriformes: Rhinocryptidae		Tapaculos/Gallitos	Contour (n:1)	
		F8b	Rheiformes: Rheidae: <i>Rhea pennata</i>	Lesser Rhea/Choique	Primary (n:1) (fill of level 1 in a pit of level 2)	
		Covered sector (540 ± 40)	L4a	Strigiformes Strigidae: <i>Athene cucularia</i>	Burrowing Owl/ Lechucita vizcachera	Contour (n:1)
			L4a	Rheiformes Rheidae: <i>Rhea pennata</i>	Lesser Rhea/Choique	Contour and primary remige <b>cut along shaft</b> (n:3)
			L4a,c	Anseriformes	Andean Goose/Guayata	Primary <b>cut along the shaft and vane</b> (n:1)
M3A			Anatidae: <i>Oressochen melanopterus</i>		Contour <b>cut along the shaft and vane</b> (n:1) Contour <b>cut along the shaft</b> (n:1)	
Uncovered sector	L3c,d L4 a,c,d M4c	Passeriformes: Furnariidae	Ovenbirds/Horneros, camineras	Contour (n: 13) Primary (n:9) Primaries <b>vane cut</b> (n:6) A section of right wing <b>cut vane</b> (n:13 primaries)		
		Passeriformes: Thraupidae: <i>Phrygilus</i> sp.	Sierra-finch/Yal	Contour (n: 427) Primary (n:1)		
		Passeriformes: Emberizidae	Old world Buntings/ Semilleros	Contour (n: 26)		
	G5a	Anseriformes Anatidae: <i>Oressochen melanopterus</i>	Andean Goose/Guayata	Primary <b>cut along shaft</b> (n:2)		
	J8b	Passeriformes: Furnariidae	Ovenbirds/Horneros, camineras	Primary (n:5) in combustion structure		
	K8d	Strigiformes: Strigidae: <i>Athene cucularia</i>	Burrowing Owl/ Lechucita vizcachera	Filoplume <b>cut along the shaft</b> (n:1)		

(continued on next page)

Table 5 (continued)

Level	Chronology (years BP) and sector	Scientific name	Common name	Parts present	
3	Covered sector (460 ± 70–1035 ± 30)	L3b,d	Strigiformes: Strigidae: <i>Athene</i>	Burrowing Owl/ Lechucita vizcachera	Contour <b>cut along the shaft</b> (n:1)
		M3a,c	<i>cunicularia</i>		
		M4c	Anseriformes	Andean Goose/Guayata	Contour <b>cut along the shaft and vane cut</b> (n:1)
			Anatidae: <i>Oressochen melanopterus</i>		Contour <b>cut along the shaft</b> (n:1) Primary <b>cut along the shaft</b> (n:3) Primary <b>cut along the shaft and vane cut</b> (n:1) Contour (n:2)
		Rheiformes	Lesser Rhea/Choique		
		Rheidae: <i>Rhea pennata</i>			
		Passeriformes: Furnariidae	Ovenbirds/Horneros, camineras	Contour (n:3)	
3 to 5	Tomb (570 ± 80)	K9	Strigiformes: Strigidae: <i>Athene</i>	Burrowing Owl/ Lechucita vizcachera	Contour (n:1) Primary (n:2)
			Anseriformes: Anatidae: <i>Anas</i>	Speckled teal/Pato	Contour (n:1)
			<i>flavirostris</i>	barcino	
			Passeriformes: Emberizidae	Old world Buntings/ Semilleros	Contour (n:1)

Bold fonts are used to highlight the types of intentional cuts in feathers.

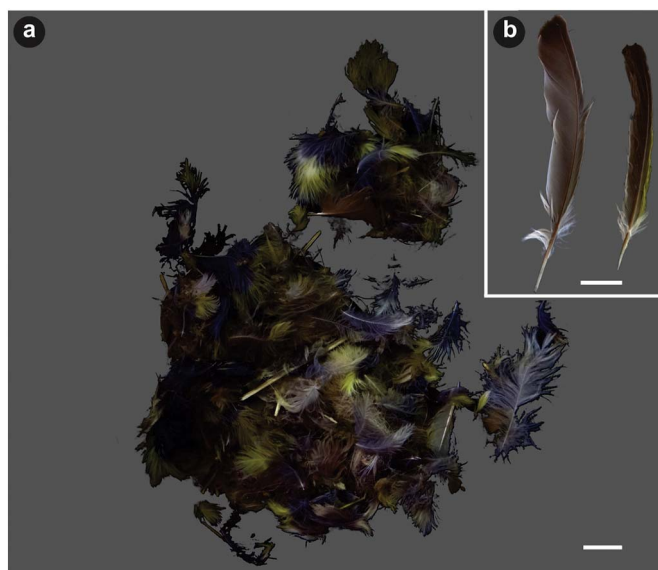


Fig. 5. PP4 site. a) Passeriformes: Thraupidae: *Phrygilus* sp. and Passeriformes: Furnariidae (L4c-540 ± 40 BP); b) Passeriformes: Furnariidae (L4c-Republican Period). Scale bar: 1 cm.

*chilensis* (Chilean flamingo), *Phoenicoparrus andinus* (Andean flamingo) and *Oressochen melanopterus* (Andean goose) among others, nest there in the warm months and migrate seasonally, moving down to the lower valley wetlands when the winter weather begins in May and June (Canevari et al., 1991). We therefore suggest summer seasonality for occupations of the Punta de la Peña 4 overhang at Historical Period and 540 ± 40 BP, where there is a greater percentage of Andean geese and flamingo feathers. The bones of these flamingo species were found in Late Holocene of Quebrada Seca 3 (Elkin, 1996) close to the sites analyzed here, and from Salar de Atacama in Chile (Cartajena et al., 2010 and Berenguer and Acevedo, 2015), and also there are records of feathers in the Puna of Salta (López et al., 2018) (Table 7). In the same sense, Tyrannidae (Tyrant-flycatchers) migrate from the Puna to lower elevations in winter, so the stratigraphic level dated in 220 ± 30 BP, at the open-air site Piedra Horadada 2 (PH2-S1), can be tentatively assigned to temperate/warm months.

During the molting season (spring-fall), Andean geese lose their primary feathers and are unable to fly, so they gather in flocks for protection. Therefore, the feathers can be obtained without killing the

animal, by collecting them near nests on the shores of the lakes. However, feathers used for fletching need to be clean and in good condition, which is not usually the case for feathers collected from the ground.

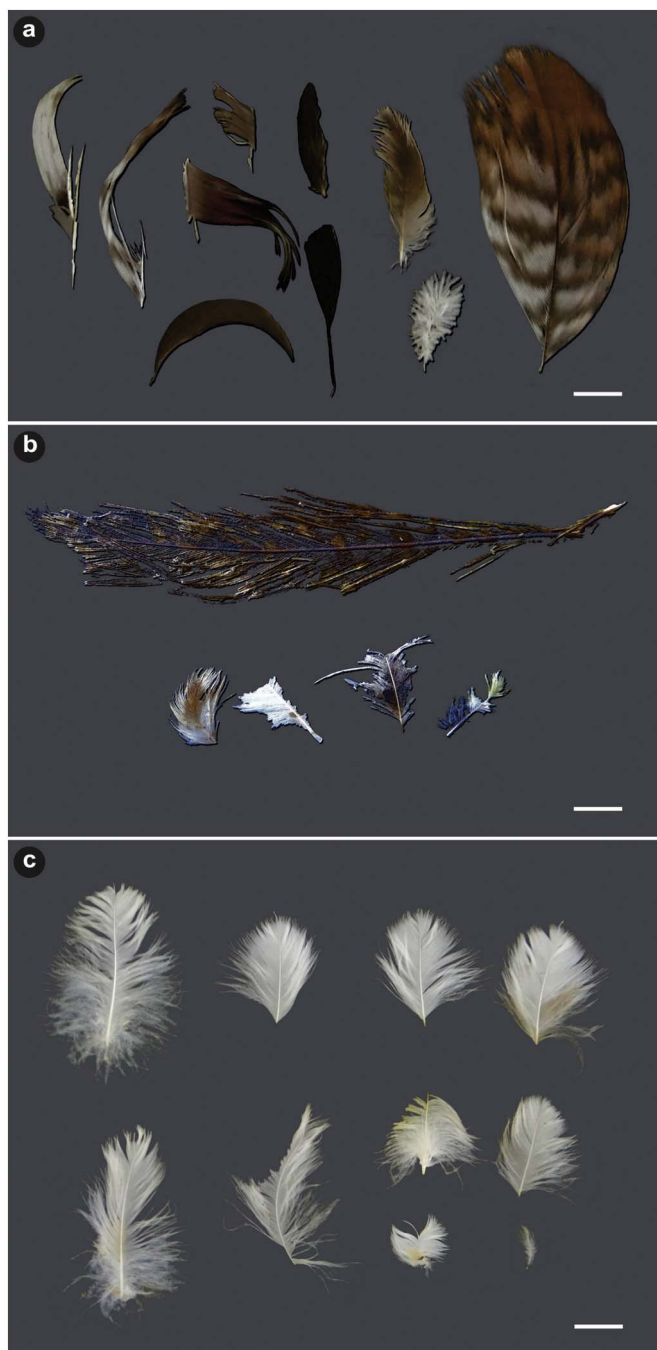
Birds are a predictable resource in nearby high Andean vegas and lakes, requiring low mobility and minimal energy expenditure for obtaining and processing, particularly during the warm season. The fact that we did not find eggshells remains does not mean that eggs were not eaten.

In regard of some ethno-historical references, the owner of the land where the study sites are located, Mr. Vicente Morales (1918–2014), in a personal communication, told us that his grandparents and parents did not hunt condors, but did hunt *Rhea pennata* and also ate their eggs. They consumed ducks and duck eggs from the lakes in Antofagasta and La Alumbreira. Their hunting technique consisted of hitting the center of the duck's body with a rock or shooting with a firearm. On this, Grebe (1984) published a paper on Andean ethnozoology which reports that livestock herders in northern Chile collect eggs of wild ducks, choiques (Rheiformes) or Passeriformes when the livestock does not require watching. Also, Guamán Poma de Ayala (1987[1615]) mentions that in the Andean highlands, livestock herders aged 12 to 18 years used adhesive and cords to hunt geese, partridge and duck, and kept the feathers for the Inkas and captains. About Passeriformes, locals use name of "pioja" and they comment that these birds living in abandoned caves of "ocultos" (*Ctenomys* sp.) (Urquiza, 2009), an analogous behavior to some Passeriformes (Tyrannidae, Thraupidae, Emberizidae, Rhinocryptidae and Furnariidae) and Strigiformes (*Athene cunicularia*) (Canevari et al., 1991).

#### 6.4. Birds as resource

Bird remains recovered from archaeological contexts are not always the product of human activities. They may be the result of animal activity such as nesting or hunting. No matter how they reached the site, bird remains provide information on former human inhabitants, such as diet and economic, symbolic and ideological activities. For instance, in an archaeological site, bird nesting can be indicative of seasonal abandonment. Moreover, birds that migrate seasonally may provide information on human groups mobility and organization or on former environmental conditions (Brothwell et al., 1981; Chapman, 1988; Daugnora et al., 2002; Marneli, 2003; Savanti, 1994; Serjeantson, 1998; Simmons and Nadel, 1998; Standen, 2003; among others).

Birds are excellent economic resources for humans, who may use their fat, blood, innards, bones, hide, feathers, eggs and sometimes bills



**Fig. 6.** PP4 site. a) Anseriformes: Anatidae: *Lophonetta specularioides* (M3a-750 ± 60BP); b) Anseriformes: Anatidae: *Anas flavirostris*, Strigiformes: Strigidae: *Athene cunicularia* and Passeriformes: Emberizidae (Tomb-570 ± 80BP); c) Strigiformes: Strigidae: *Athene cunicularia* (K4d, L3d, M2c-750 ± 60BP). Scale bar: 1 cm.

and claws. Even when birds are not hunted, their eggs and eggshells provide a good source of protein. Moreover, eggshells may be used as containers or ground for various uses such as pottery temper or paint. The flavor and toughness of birds' flesh varies according to their food and locomotion type, and fats and acids vary among species, influencing human choice of prey (Savanti, 1994). Human choice of which birds to hunt for food also depends on specimen size and weight. The parts that provide the best yield are breast (related to sternum, furcula, coracoid, scapula and humerus) and thighs (pelvis, sacrum, femur, tibiotarsus and fibula), with less flesh provided by wings (radius and ulna), cranium and neck (cervical and thoracic vertebrae), and still less by wingtips and feet (carpometacarpus, tarsometatarsus, phalanges and

caudal vertebrae) (Serjeantson, 2009). Bird fat, bones and excrement can be employed as fuel source. Fat can be used for oil, insulation and preparing pigments. Blood is edible and can be added as a paint constituent. Hide and internal viscera can be used to make thongs, headwear, clothing and food containers, while bones, bills, claws and tendons provide raw materials for artifacts and ornaments (Mameli, 2003). Birds were also used as a therapeutic resource in Pre-Hispanic and Colonial times. Although any soft parts used, such as entrails and body fluids, would have left no material evidence, there are records of use of feathers, bones and gastroliths. Gastroliths from Anatidae, Strigidae and Passeriformes were used in medications of unrecorded prescription (Corona Martínez, 2008). Regarding the use of birds bones, Berenguer and Acevedo (2015) analyzed tubes as shamanic implements from the Atacama desert, corresponding to tibiotarsus and ulna probably belonging to *Ardea* sp. and *Phoenicoparrus* sp. of the Late Intermediate Period (11th–15th centuries) from the Antofagasta archaeological collection (Table 7). In addition, bones may have been selected for making utensils, e.g. duck wing bones used as weaving pins (see DePuydt, 1994 and Bovy, 2002). Rolandi De Perrot and Jiménez de Puparelli (1983–85) have documented the weaving process in the Argentinean Puna, and mention the use of long spinning pins or “mishma”. Martínez (2012) determined for the site Peñas Coloradas 3-cumbre (PC3-c), in Antofagasta de la Sierra, that this type of spinning using “mishma” used only non-dyed animal fiber. We believe it is likely that bird bones were used for this purpose and as sewing needles.

## 6.5. Use of feathers

### 6.5.1. Feathers in ritual contexts

Bird feathers have been found in various funereal contexts in northern and western Argentina, e.g. spiral baskets decorated with feathers (Michielli, 1979; Pérez de Micou, 1997; Pérez de Micou and Ancíbor, 1994; Renard, 1997; among others), and *Rhea* sp. or “ñandú” feathers rolled and tied with a cord in the late Pre-Inca period of San Juan (Michielli, 2000). Feathers have also been found in offerings at high altitudes, such as the Inca burial of a girl on Nevado de Chuscha, accompanied by a necklace made of *Spondylus* and macaw feathers from the eastern jungles (Lema and Capparelli, 2007). A burial in Mount El Mercedario included two statuettes made of silver and *Spondylus* with a wool “chuspa” (pouch) covered in white feathers and containing coca (Michielli, 1990). Bouysse-Cassagne (1997) reports that Incas used feathers to mark territories. Lema and Capparelli (2007) mention a historical event from 1585 CE when the city of Santiago del Estero was isolated and could not receive supplies, the Spanish conquerors dressed in Rheidae (which they called “avestruz” [ostrich]) feathers, similar to the clothing of local aborigines. In the Valles Calchaquíes, the seventeenth century Jesuit “Cartas Anuas” refer to sacred places such as the rocks used as aboriginal adoration sites known as “huancas” (called “mochaderos” by the Spaniards), which were ornamented with feathers (González, 1983:235). Another reference is the use of feathers of different colors in the ornamentation of the bodies of ancestors in Quebrada de Humahuaca, Jujuy (López, 2011).

Andean feather art is mainly represented by Rheidae (*Rhea pennata*) and the three species of Phoenicopteridae. For example, *Phoenicoparrus jamesi* (Puna flamingo) contour feathers (neck, back and wing) were used in Aymara hats (Bolivia) worn at men's dances during sowing and harvest festivals (August and December), in association with the symbolic capture of vicuña calves to predict good harvests (Sigl and Mendoza, 2012 in Jaimes Betancourt, 2015). Aymaras and Quechuas used *Rhea pennata* feather headdresses in rituals for rain; youths in the area of river Pilcomayo wore *Rhea* feathered diadems in dances; and Simba-Guaraní had anthropomorphic masks with a grey feather with a white tip inserted at the top middle, possibly associated to warriors and/or ancestors (Jaimes Betancourt, 2015).

In this study case, five feathers, one of which is a dark brown Anatidae (*Anas flavirostris*) contour feather (570 ± 80 BP) were found

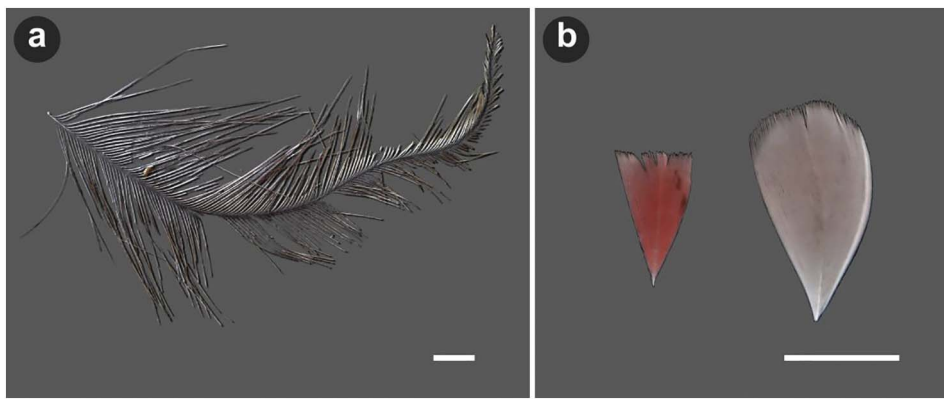


Fig. 7. PP4 site. a) Rheiformes: Rheidae: *Rhea pennata* (F8- 990 ± 40BP); b) Phoenicopteriformes: Phoenicopteridae (H5a - Colonial Period). Scale bar: 1 cm.

in association to a female mummified body. The feathers may have been part of the grave goods. In the study area, other contexts with ritual characteristics with evidence of use of feathers are the agropastoral site Real Grande 9 (RG9) with a basket surrounded by Falconidae feathers, Cueva Cacao 1-A (CC1A) with a pair of sandals

with *Rhea pennata* feathers at the heel (2870 ± 40 BP) (Olivera et al., 2003), and Peñas de las Trampas 1.1 (PT1.1) with a *Rhea pennata* feather adornment (loincloth/diadem) in an archaic funereal context (ca. 8440-8000 BP) (Martínez, 2014). Although these dates are very wide-ranging, we simply intend to note the use of feathers in ritual

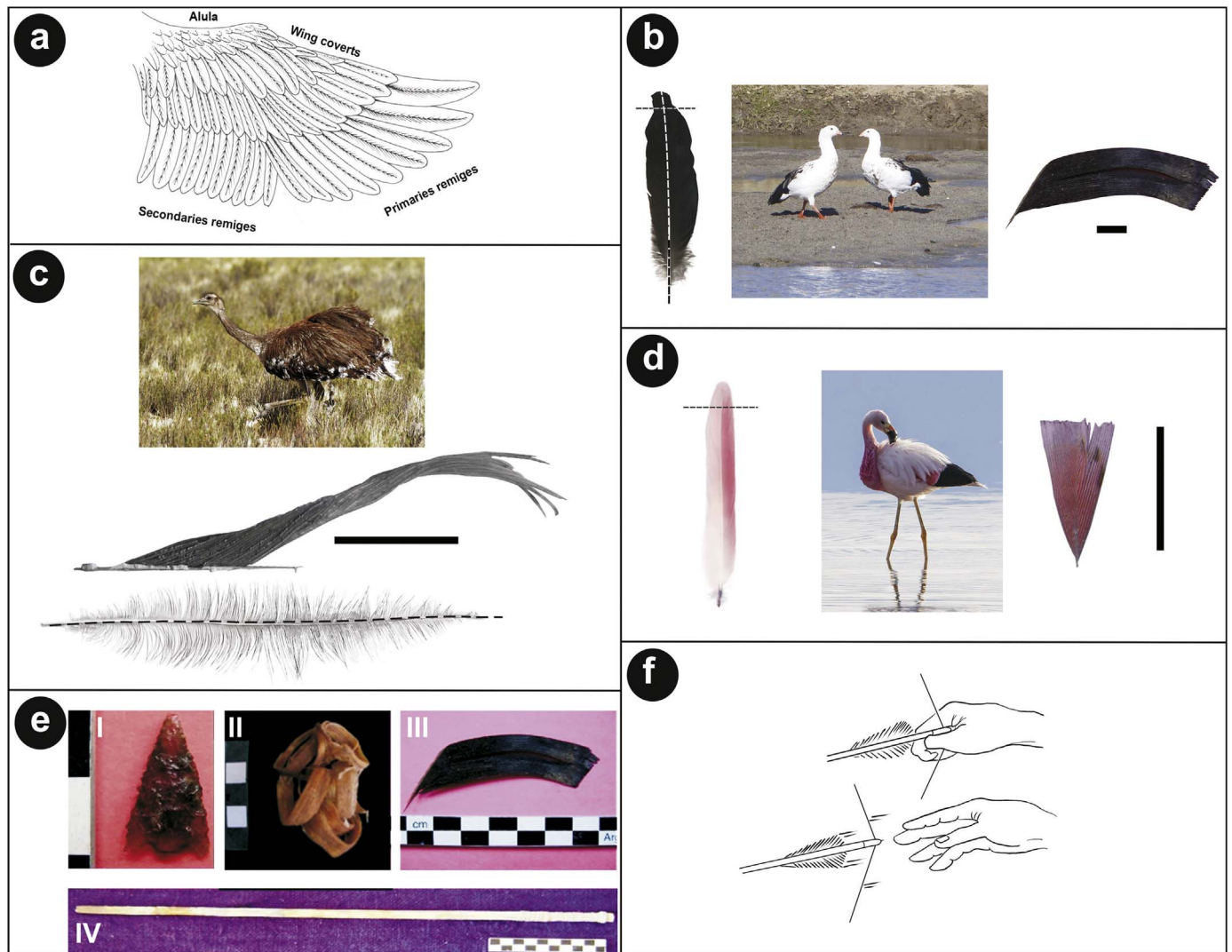


Fig. 8. Field views and feathers of Anatidae, Phoenicopteridae y Rheidae. a) Kinds of wing feathers. b) Section cut along raquis of a primary remige of Rheidae (*Rhea pennata*). c) Cut along the raquis and transversal on vexilla in a primary feather of Anatidae (*Oressochen melanopterus*). d) Transversal cut on vexilla in a covert feather of Phoenicopteridae. e) feather flething: I- arrow point, II- roll of tendons, and III- shaft with mastic rest made using *Chusquea lorentziana* (cane) and tendons bandages (540 ± 40 BP-UGA 9263) (Urquiza and Aschero, 2014). f) Diagram of an arrow shoot. Scale bar: 1 cm.

**Table 6**  
Cutted feathers from Punta de la Peña site.

Level	Nft	Taxa					
		Passeriformes: Furnariidae	Anatidae: <i>Oressochen melanopterus</i>	Anatidae: <i>Lophonetta specularioides</i>	Strigidae: <i>Athene cunicularia</i>	Phoenicopteridae	Rheidae: <i>Rhea pennata</i>
0	18		4			1	1
1	35	1	4	6			
2	510	19	5		1		3
3	9		6		1		
Nft	572	20	19	6	2	1	4



**Fig. 9.** Some cut feathers from PP4 site.

A) Cut along the shaft: 1 and 2) Strigidae: *Athene cunicularia*; 17 to 19, 25, 27 and 29) Anatidae: *Oressochen melanopterus*; 4, 5, 8, 9, 23, 25 and 26) Anatidae: *Lophonetta specularioides*. B) Vane cut: 10 to 16) Passeriformes: Furnariidae; 30) Phoenicopteriformes: Phoenicopteridae; 31 y 32) Anatidae: *Oressochen melanopterus*. C) Combination of A y B: 20 to 22, and 29) Anatidae: *Oressochen melanopterus*, 3, 6, 7) Anatidae: *Lophonetta specularioides*.

contexts, suggesting that they must have held considerable symbolic significance for ancient inhabitants of the Puna.

For the PH2 (S1) site, the sporadic occupations and the periods during which the structure was unoccupied support the idea that the monolith or “huanca” was associated to Andean pastoral ritual practices of fertility or for increasing agricultural and/or livestock productivity after Spanish-Indigenous contact. In this interpretative context, is remarkable the record of fragments of a neonate *Equus* sp. mandible, fleeces and twines in a niche at the wall, in front of the monolith, and the presence of beads and copper minerals of non-local provenance.

Data suggest also a transit site, being probably product of pastoral ritual practices (Urquiza et al., 2013).

Intentional cuts with a sharp instrument across the vane of a flamingo (Phoenicopteriformes) contour feather suggest that this kind of feather was used as some form of adornment (e.g. headdress, headbands, necklaces or clothing) during the Historical Period for overhang PP4 (Fig. 8d). In the Andes, flamingo feathers are used in various rituals associated to rain, the earth and curing diseases (Castro and Romo, 2006).

In association with the primary contour feathers of *Oressochen* sp.

**Table 7**  
Some archaeological records of birds from Argentine Puna and northern Chile.

	Site/archaeological collection	Chronology	Material	Taxon	Reference
Argentina	Northern Puna				
	Inca Cueva 4 (ICC-4) site	9900 ± 200 BP 9230 ± 70 BP	Bones	<i>Nothura</i> sp.	Mengoni Gohalons (1982)
	Coctaca site		White and red feathers bound together with cords	Rheidae and exotic birds	Aschero (1979)
	Collection Doncellas - Burial site No. 26	4140–4020 cal. BCE	Feathers	Tropical birds	Aschero (1994)
	Collection Torres Aparicio		Rock art with characters wearing feathers		Fernández Distel (1983)
	Peñas de las Trampas 1.1 (PT1.1) funerary structures		Diadem made of feathers		Pérez de Micou (2009)
	Peñas de las Trampas 1.1 (PT1.1) funerary structures		Feathers		Fernández Distel (2001)
	Peñas de las Trampas 1.1 (PT1.1) funerary structures		Ornament made of feathers	<i>Rhea pennata</i>	Martínez (2014)
	Southern Puna				
	Cueva Cacao 1-A (CC1A) site	ca. 8400–8210 BP			
Peñas Chicas 3 (PCh3), Campo de las Tobas (CT) and Currito 5 (Cu5) sites	2870 ± 40 BP Formative period	Sandals with a feather attached	<i>Rhea pennata</i>	Olivera et al. (2003)	
Punta de la Peña 9.I (PP9.I.) site, funerary structure 4	1388 ± 45 BP	Rock art with anthropomorphic figures with feathered headresses		Martel (2004)	
Punta de la Peña 9.III (PP9.III) site, structure 2		Pelvis	cf. Anatidae	Urquiza (2013)	
Real Grande 9 (RG9) site	ca. 1200–600 BP	Feathers split transversally		López Campeny (2001)	
Quebrada Secca 3 (QS3) overhang site	Early Holocene Late Holocene	Feathers embedded in the sand around a basket	Falconidae	Podestrá (1989, 1991)	
Cueva Inca Viejo overhang site	860 ± 60 BP	Postcranial skeleton of a large bird and grey feathers		Elkin (1994)	
		Bones	<i>Phoenicoparrus andinus</i>		
		Feathers	<i>Amazona aestiva</i>	López et al. (2018)	
			<i>Primolius auricollis</i>		
			<i>Buteo magnirostris</i>		
			<i>Phoenicopterus</i> sp.		
			Pelican ( <i>Pelecanus thagus</i> )		
			Pelican		
Chile	Atacama Desert				
	Playa Miller 3 cemetery at Arica	1000–1470 BC	Feather diadems		Horta Tricallotis (2000)
	Chinchorro cemetery	5400–3700 BP	Bones, hides and feathers (blankets and head covers or "caps") on naturally mummified bodies		Standen (2003)
			Hide (wrapped artificially mummified body)		
	Tulán-85 site	3000–2200 BP	Bones	<i>Rhea</i> sp.	Carratjena et al. (2010)
	Tulán-122 site	2740 ± 40 BP	Feathers and bone	<i>Phoenicoparrus andinus</i> and <i>Phoenicopterus chilensis</i>	
	Cerro Mono 1 (CM-1) site	2510 ± 40 BP		Passeriformes: <i>Sicalis</i> sp.	Peña-Villalobos et al. (2015)
	Campamento Soronal 3 (S-3) funerary context	3370–3320 cal. BP	Skin and feathers	Sea birds	Briones et al. (2005)
	Cerro Pintados 3 (CP-3) site	1360–1300 cal. BP	Feathers and bones	<i>Ara chloropterus</i>	
	Cerro Mono 2 (CM-2) site	970 ± 50 BP	Feathers	Sea birds	
Collection of Antofagasta Region	Late Intermediate Period	Birds geoglyphs			
		Bones tubes	<i>Ardea</i> sp.	Berenguer and Acevedo (2015)	
			<i>Phoenicoparrus</i> sp.		

and *Rhea pennata*, which were white, black, and white with brownish hues (1035 ± 30 BP to Colonial Period) and had been cut, we recovered arrow heads, shafts and rolled up tendons, suggesting a specific technological sequence of improved manufacture (Urquiza and Aschero, 2014), probably related to an effort to optimize hunting (Fig. 8e, f). These data are in agreement with the use of *Oressochen* sp. feathers for fletching arrow shafts in the steppe of Tierra del Fuego (Gusinde, 1982), although the type of feather used there is not mentioned. In the base of the data is inferred that most probably use of cut feathers was the fletching. In Andean symbolism, birds with black and white feathers are considered to be a sign of good luck (Cereceda, 1990; Elizaga Coulombié, 2009); like the condor or “mallku” (*Vultur gryphus*, Andean condor) is associated with the cult to mountains and ancestors (Van Kessel, 1996a, 1996b; Cereceda, 1990), success in commercial transactions (Grebe, 1984), while condor flesh and feathers are believed to have medicinal properties (Castro and Romo, 2006).

In addition to their use for fletching and ornaments, light, insulating down feathers and contour feathers recovered from overhang PP4 may have been used for clothing and/or sleeping places under the overhang, although some authors claim they may disintegrate rapidly in contact with soil bacteria (Grande et al., 2004; Finlayson et al., 2012).

PP4 site is inferred as a residential base of multiple activities, in long term occupations. In Punta de la Peña 4 site, archaic hunter-gatherer groups specialized in hunting wild Camelids (*Lama guanicoe* and *Vicugna vicugna*), and occasionally Andean geese and rodents. Hunting continued during agro-pastoral periods, when people raised *Lama glama* and hunted *V. vicugna*, and used transitory sites like Piedra Horadada 2, maybe in *L. glama* caravans. Finally, during time lapses of Historical Period, livestock herders used the overhang PP4 as a seasonal corral, these herders ate ovicaprids and Andean geese (Urquiza and Aschero, 2014). Some ethnographic relations have been determined between birds and Camelids in the Andes (Martínez 1976 and Ortega 2002 in Elizaga Coulombié, 2009), where certain birds such as the aquatic silvery grebes or “chullumpis” (*Podiceps occipitalis*, Silvery grebe) are considered to be the souls of Camelids. There is also mention of use of mountain caracara (*Phalco boenus megalopterus*, Mountain caracara) feathers for marking alpacas (*Vicugna pacos*) (Elizaga Coulombié, 2009).

### 6.5.2. Fletching

In the Puna were used several artifacts and techniques to hunting (Aschero and Martínez, 2001), one of which is the bow and arrow. An arrow consists of a shaft with a sharp arrowhead made of stone, bone or wood at the front end, and a nock and fletching at the back end (Salazar, 1997). The feather fletching is fastened to the shaft using plant adhesive or nerves and tendons. Usually three or more feathers are used to provide stability and flight direction, reducing any tendency for the arrow to move out of line and enabling it to travel farther (Charquero, 2008). The smoothness of the feathers enables them to grip the airflow and pull the arrow back into line if it deviates, and their negligible weight helps preserve stability (Salazar, 1997). Since fletching feathers must have strong shafts and vanes to enable them to be reused for several shots, primary flight feathers, which are the strongest, are used. Anatidae (Anseriformes) feathers, which are rigid and withstand moisture, are a good choice for fletching. And we have checked the rigidity of the archaeological feathers of *Rhea pennata*, *Athene cunicularia* and even of some Passeriformes. A sharp tool is used to cut the shaft in half along the hollow axis, from the calamus (hollow shaft) towards the vane (López-Albors et al., 1999). In this case, we believe that a lithic retouched cutter was used along hollow shafts and vanes of the feathers.

### 6.6. No human deposits

Passerines were found in coprolites and pellets, while in other cases, their feathers may have originated from nesting. It should be

highlighted that we observed that Passerine feathers digested by carnivores have broken shafts, in contrast to feathers found loose or in pellets.

The Medium Bird skeletal set has not been affected by carnivores, but Passeriformes and Strigiformes at the three sites analyzed are associated to periods of human abandonment.

Around the monolith of PH2 (S1), we found Emberizidae feathers with signs of having been contained in a pellet, and Furnariidae feathers (580 ± 60 BP up to the Historical Period), so their presence is probably due to the activities of Strigidae and/or carnivores during the short times in which the sites were abandoned during the cold months of the year. This inference is reinforced by the fact that a pellet and a carnivore dung containing remains of Passeriformes feathers were found in the same sector. In addition to the pellets, dung and remains of Passeriformes, evidence of abandonment is strengthened by the record of non-human marks on Artiodactyla bones and their weathering stages, Rodentia bone and fiber remains, and Carabidae and Dermestidae exoskeletons associated to remains of animal waste exposed to the elements (Urquiza et al., 2013). This is in agreement with previous inferences on the site's occupational dynamics, indicating short periods of occupation associated to the fireplace during summer at levels 1 and 3 (Historical Period and 580 ± 60 BP) and events when the site was abandoned, associated to levels 2 and 4 (220 ± 30 BP and 690 ± 60 BP) (Urquiza et al., 2013).

For the small overhang PH2, Structure 2, evidence points to abandonment or lack of occupancy during the Historical Period and ca. 1270 BP with Emberizidae ventral feathers in carnivore dung. Supporting this idea are the bone remains of Rodentia, ovicaprids and *Vicugna vicugna* with signs of prolonged weathering prior to final interment (Urquiza et al., 2013), and the fact that the shelter under the overhang provides an ideal hiding place for foxes.

## 7. Concluding remarks

In this study case, feathers and bones provided data on the association between birds and ancient inhabitants of the Argentinean Puna. Particularly the advantage of feathers analysis in archaeological contexts is that it allows taxonomical identification to genus or species levels. Birds were a reliable resource in this high desert from archaic through colonial times. The different human groups that inhabited this area of the Puna over time used feathers waterfowl (Anatidae and Phoenicopteridae), Strigidae, Rheidae and Passeriformes for paraphernalia, manufacturing weapons, and also as nutritional complement.

## Acknowledgments

This research was supported by grants FONCyT-PICT 1160 (S. Urquiza), CIUNT G26-404 Universidad Nacional de Tucumán (C. Aschero) and PIP-CONICET 6398 (C. Aschero). We are grateful to Rebeca Lobo for her collaboration. Also thanks to Pablo Pereyra and Analía Dupuy of Fundación Miguel Lillo for their outstanding help in the drawings of feathers; to Paula and Michael Webster who provided pictures of modern *Phoenicoparrus andinus* and to Freddy Burgos who provided pictures of modern *Rhea pennata*. The authors thank the editor Chris Hunt and two anonymous reviewers for their constructively critical reviews. In memoriam of Chiquitrulli (*Myiopsitta monachus calita*).

## References

- Aschero, C.A., 1979. Aportes al estudio del arte rupestre de Inca Cueva-1 (Departamento Humahuaca, Jujuy). In: Actas de las Jornadas de Arqueología del Noroeste argentino, Antiquitas 2. Instituto de Arqueología. Universidad del Salvador, Buenos Aires, pp. 419–459.
- Aschero, C.A., 1984. El sitio ICC-4: Un asentamiento precerámico en la quebrada de Inca Cueva (Jujuy, Argentina). Estudios Atacameños 7. pp. 53–60.
- Aschero, C.A., 1994. Reflexiones desde el Arcaico Tardío (6000-3000 AP). Rumitacana. Rev. Antropol. 1, 13–17.



- Aschero, C.A., 2006. De cazadores y pastores el arte rupestre de la modalidad Río Punilla en Antofagasta de la Sierra y la cuestión de la complejidad en la Puna meridional argentina. In: Fiore, D., Podestá, M. (Eds.), *Tramas en la Piedra: Producción y usos del arte rupestre*, pp. 103–140 Buenos Aires, Argentina.
- Aschero, C.A., 2010. Arqueologías de Puna y Patagonia centromeridional: comentarios generales y aporte al estudio de los cazadores-recolectores puneños en los proyectos dirigidos desde el IAM (1991–2009). In: EDUNT, *Rastros en el camino... Trayectos e Identidades de una Institución*. Instituto de Arqueología y Museo, homenaje a sus 80 años y más, pp. 257–293 Tucumán, Argentina.
- Aschero, C.A., Martínez, J.G., 2001. Técnicas de Caza en Antofagasta de la Sierra, Puna Meridional Argentina. *Relaciones XXVI. Sociedad Argentina de Antropología*, Buenos Aires, pp. 215–241.
- Bacher, A., 1967. Vergleichend morphologische Untersuchungen an Einzelknochen des postkranialen Skeletts in Mitteleuropa vorkommender Schwäne und Gänse. Tierärztlichen Fakultät. Ludwig-Maximilians Universität, München.
- Barquez R.M., M.M. Díaz, Ojeda R.A. (editores), 2006. *Mamíferos de Argentina, sistemática y distribución*. Sociedad Argentina para el Estudio de los Mamíferos. Tucumán. (359 pp.).
- Behrensmeier, A.K., 1978. Taphonomic and ecological information from bone weathering. *Paleobiology* 4, 150–162.
- Behrensmeier, A.K., Stayton, C.T., Chapman, R.E., 2003. Taphonomy and ecology of modern avifaunal remains from Amboseli Park, Kenya. *Paleobiology* 29 (1), 52–70.
- Berenguer, J., Acevedo, N., 2015. Tubos de hueso de ave como implementos chamánicos en el Desierto de Atacama, Siglos XI y XV. *Bol. Mus. Chil. Arte Precolombino* 20 (1), 51–72.
- Binford, L., 1981. *Bones: Ancient Men and Modern Myths*. Nueva York. Academic Press.
- Bishop, K.J., 2014. *Food, Feathers, and Offerings: Early Formative Period Bird Exploitation at Paso de la Amada, Mexico*. Master of Arts in Anthropology. University of California, Los Angeles.
- Bochenski, Z.M., Tomek, T., 1997. Preservation of bird bones: erosion versus digestion by owls. *Int. J. Osteoarchaeol.* 7 (4), 372–387.
- Bochenski, Z.M., Huhtala, K., Sulkaba, S., Tornberg, R., 1999. Fragmentation and preservation of bird bones in food remains of the golden eagle *Aquila chrysaetos*. *Archaeofauna* 8, 31–39.
- Bochenski, Z.M., Wertz, K., Tomek, T., 2017. What happens to dead birds left in a cave and its vicinity for a quarter of a century? A taphonomic experiment. *Hist. Biol.* <http://dx.doi.org/10.1080/08912963.2017.1335721>.
- Bouysse-Cassagne, T., 1997. Plumas: signos de identidad, signos de poder entre los incas. In: Varón, R. y J. Flores, *Arqueología, Antropología e Historia en los Andes. Homenaje a María Rostworowski*, pp. 545–565. Instituto de Estudios Peruanos-Banco Central de Reserva del Perú, Lima.
- Bovy, K.M., 2002. Differential avian skeletal part distribution: explaining the abundance of wings. *J. Archaeol. Sci.* 29 (9), 965–978.
- Bovy, K.M., 2012. Why so many wings? A re-examination of avian skeletal part representation in the south-central Northwest Coast, USA. *J. Archaeol. Sci.* 39 (7), 2049–2059. <http://dx.doi.org/10.1016/j.jas.2012.02.028>.
- Briones, L., Núñez, L., Standen, V., 2005. Geoglifos y tráfico prehispánico de caravanas de llamas en el desierto de Atacama (Norte de Chile). *Chungara. Rev. Antropol. Chil.* 37, 195–223.
- Brothwell, D., Bramwell, D., Cowles, G., 1981. The relevance of birds from coastal and island sites. In: Brothwell, D., Dimpleby, G. (Eds.), *Environmental Aspects of Coasts and Islands*. BAR, Oxford, pp. 195–206.
- Broughton, J.M., Mullins, D., Ekker, T., 2007. Avian resource depression or inter-taxonomic variation in bone density? A test with San Francisco Bay avifaunas. *J. Archaeol. Sci.* 34 (3), 374–391.
- Cabrera, A.L., 1976. Regiones Fitogeográficas Argentinas. *Enciclopedia argentina de agricultura y jardinería*. Tomo II. ACME, Buenos Aires, pp. 1–85.
- Cabrera, A.L., Willink, A., 1980. *Biogeografía de América Latina*. In: *Monografía 13. Serie de Biología*. Secretaría General de la Organización de los Estados Americanos. Washington DC. EEUU, 2ª edición corregida. (120 pp.).
- Camarós, E., Parmigiani, V., Verdún, E., 2010. Differential faunal resources management in ritual and domestic spaces in Selknam society (Argentina, Tierra del Fuego). In: Hardy, K. (Ed.), *Archaeological Invisibility and Forgotten Knowledge*. British Archaeological Reports, International Series, BAR S2183, Oxford, pp. 192–201.
- Canevari, M., Canevari, P., Carrizo, G., Harris, G., Rodríguez Mata, J., Straneck, R., 1991. *Aves Argentinas*. Tomo II Fundación Acindar. Editorial ERSA, Buenos Aires, Argentina.
- Cartajena, I., Núñez, M., Núñez, L., 2010. Phoenicopteridae exploitation in the Salar de Atacama Basin (3000–2200 BP), Northern Chile. In: Prummel, W., Zeiler, J.T., Brinkhuizen, D.C. (Eds.), *Birds in Archaeology*. Groningen Archaeological Studies. 12. Barkhuis Publisher, Groningen, pp. 103–116.
- Castro, V., Romo, M., 2006. Tradiciones culturales y biodiversidad. In: *Biodiversidad de Chile. Patrimonio y Desafíos*. Comisión Nacional del Medio Ambiente, Santiago, Chile, pp. 468–493.
- Cereceda, V., 1990. A partir de los colores de un pájaro... *Boletín del Museo de Arte Precolombino N°4*. Santiago de Chile, pp. 57–104.
- Chaplin, R.E., 1971. *The Study of Animal Bones from Archaeological Sites*. Academic Press, New York.
- Chapman, A., 1988. *Los Selknam*. EMECE editores, Buenos Aires.
- Charquero, J.M., 2008. *El Tiro con Arco. Un deporte de Tradición*. Federación Andaluza de Tiro con Arco. [www.fedandarco.es](http://www.fedandarco.es). <http://www.lograrco.es/pdf/manualfendarco.pdf>.
- Cohen, M.L., 2014. Miradas desde y hacia los lugares de poder. *Antofagasta de la Sierra entre 1000 y 1500 años D.C.* *Arqueología* 20 (1), 47–72.
- Cohen, A., Serjeantson, D.A., 1996. *Manual for the Identification of Bird Bones From Archaeological Sites*. Archetype Press, London.
- Corona Martínez, E., 2008. Las Aves como Recurso Curativo en el México Antiguo y sus posibles evidencias en la Arqueozoología. *Rev. Bioarqueol. Arqueobios*. 2, 11–18 (Perú).
- Cruz, I., 2005. La representación de partes esqueléticas de aves. *Patrones naturales e interpretación arqueológica*. *Archaeofauna Int. J. Archaeozool.* 14, 69–81 (Madrid, Spain).
- Cruz, I., 2006. Los huesos de pingüinos (Spheniscidae) de los sitios de Cabo Blanco (Santa Cruz, Patagonia Argentina). *Análisis tafonómico y perspectivas arqueológicas*. *Intersec. Antropol.* 7, 15–26 Buenos Aires, Argentina.
- Cruz, I., 2007. Avian Taphonomy: observations at two Magellanic penguin (*Spheniscus magellanicus*) breeding colonies and their implications for the fossil record. *J. Archaeol. Sci.* 34, 1252–1261.
- Cruz, I., 2008. Avian and mammalian bone Taphonomy in southern continental Patagonia. A comparative approach. *Quat. Int.* 180, 30–37.
- Cruz, I., 2011. *Tafonomía de huesos de aves. Estado de la cuestión y perspectivas desde el sur del Neotrópico*. *Antipoda*. 13, pp. 147–174.
- Daugnora, L., Bilskienė, R., Hufthammer, A.K., 2002. Bird remains from Neolithic and Bronze Age settlements in Lithuania. In: *Proceedings of the 4th Meeting of the ICAZ Bird Working Group Kraków, Poland*. *Acta Zoologica Cracoviensia*. 45, pp. 233–238 (special issue).
- Denys, C., Stoetzel, E., Andrews, P., Bailon, S., Rihane, A., Huchet, J.B., Fernandez-Jalvo, Y., Laroulandie, V., 2017. Taphonomy of small predators multi-taxa accumulations: palaeoecological implications. *Hist. Biol.* <http://dx.doi.org/10.1080/08912963.2017.1347647>.
- DePuydt, R.T., 1994. Cultural implications of avifaunal remains from the Ozette Site. In: Samuels, S.R. (Ed.), *Ozette Archaeological Project Research Reports*. Vol. II. Department of Anthropology, Washington State University, Pullman, and National Park Service, Pacific Northwest Regional Office, Seattle, pp. 199–263 (Fauna, Reports of Investigation 66).
- Dirrigl Jr., F.J., 2001. Bone mineral density of Wild Turkey (*Meleagris gallopavo*) skeletal elements and its effect on differential survivorship. *J. Archaeol. Sci.* 28, 817–832.
- Dransart, P., 2000. Clothed metal and the iconography of human form among the Incas. In: McEwan, C. (Ed.), *Pre-Columbian Gold. Technology, Style and Iconography*. British Museum Press, London, pp. 76–91.
- Elizaga Coulombié, J., 2009. *Uywa ñan, runa ñan: caminos de rebaños, caminos de personas. Una aproximación a los modos de conocer en un contexto de pastores de altura en los Andes meridionales* (Doctoral thesis). Universidad de Tarapacá, Arica, Chile.
- Elkin, D.C., 1994. *Arqueozoología de Quebrada Seca 3: indicadores de subsistencia humana temprana en la Puna Meridional Argentina* (Doctoral thesis). Facultad de Filosofía y Letras. Universidad de Buenos Aires.
- Estévez, J., Vila, A., Terradas, X., 2002. The “Island Factor”: insularity as a variable in the archaeological study of the social dynamics of hunter-gatherers. In: Waldren, W.H., Ensenyat, J.A. (Eds.), *World Islands in Prehistory*. B.A.R. International Series. 1095, Oxford, pp. 107–116.
- Fernández Distel, A., 1983. *Pictografías de Coctaca (Quebrada de Humahuaca, Jujuy, Argentina)*. Indiana. 8, pp. 279–294 (Berlín).
- Fernández Distel, A., 2001. *Calzado de los cazadores-recolectores del noroeste argentino en la colección arqueológica Torres Aparicio (Jujuy)*. In: *Relaciones de la Sociedad Argentina de Antropología*. XXVI, pp. 403–414 (Buenos Aires).
- Fernández, F.J., Moreira, G.J., Ballejo, F., De Santis, L.J., 2009. *Novedosos registros de aves exhumadas del sitio arqueológico “Laguna El Sosneado (LS-3)” para el Holoceno tardío en el sur de Mendoza: aspectos tafonómicos*. *Intersec. Antropol.* 10, 327–342.
- Fick, O.K.W., 1974. *Untersuchungen an Einzelknochen europäischer Taubenarten* (Unpublished doctoral dissertation). Ludwig-Maximilians-Universität, München.
- Finlayson, C., Brown, K., Blasco, R., Rosell, J., Negro, J., Bortolotti, G., Finlayson, G., Sánchez Marco, A., Giles Pacheco, F., Rodríguez Vidal, J., Carrión, J.S., Fa, D.A., Rodríguez Llanes, J., 2012. Correction: birds of a feather: Neanderthal exploitation of raptors and corvids. *PLoS One* 7 (10). <http://dx.doi.org/10.1371/annotation/5160ffc6-ec2d-49e6-a05b-25b41391c3d1>.
- Fiore, D., Tivoli, A.M., Zangrando, A.F., 2013. Is the “environment” good to eat or good to paint? Faunal consumption and avoidance among hunter-gatherer-fishers in the Beagle Channel Region (Tierra del Fuego, Southern South America). In: Davies, M., Nkirete M’Mbogori, F. (Eds.), *Humans and the Environment: New Archaeological Perspectives for the Twenty-First Century*. Oxford University Press, Oxford, pp. 77–96.
- Gál, E., 2005. New data on bird bone artefacts from Hungary and Romania. In: *From Hooves to Horns, From Molluscs to Mammoth*, pp. 325–338.
- Giardina, M., 2006. *Anatomía económica de Rheidae*. In: *Intersecciones en Antropología*. 7. Universidad Nacional del Centro de la Provincia de Buenos Aires, Argentina, pp. 263–276.
- Giardina, M., 2012. *Intensificación en el sur de Mendoza: un enfoque avifaunístico*. *Archaeofauna Int. J. Archaeozool.* 21, 219–234 (Madrid, Spain).
- Gifford, D.P., 1981. Taphonomy and paleoecology: a critical review of archaeology’s sister disciplines. In: Schiffer (Ed.), *Advances in Archaeological Method and Theory*. 4, pp. 365–438.
- Gilbert, B.M., Martin, L.D., Savage, H.G., 1981. *Avian Osteology*. B. Miles Gilbert, Publisher, [709 Kearney, Laramie, WY 82070].
- González, A.R., 1983. *Nota sobre religión y culto en el Noroeste argentino prehispánico*. In: *Baessler Archiv Neue Folge*. XXXI, pp. 219–282 (Berlín).
- González Baroni, L.G., 2013. *Contextos funerarios y vida cotidiana en Antofagasta de la Sierra, Catamarca. Un enfoque desde la Bioantropología, el emplazamiento y la dinámica de los enterríos (ca.1500–1000 AP)* Thesis. Universidad Nacional de Tucumán, Argentina.
- Grande, J.M., Negro, J.J., Torres, M.J., 2004. The evolution of bird plumage colouration: a role for feather-degrading bacteria? *Ardeola* 51 (2), 375–383.

- Grebe, M.E., 1984. Etnozoología andina: Concepciones e interacciones del hombre andino con la fauna altiplánica. *Estud. Atacameños* 7, 335–347 (Chile).
- Grimm, J.M., 2010. A bird for all occasions. The use of birds at the Romano-British sanctuary of Springhead, Kent, UK. In: Prummel, W., Zeiler, J.T., Brinkhuizen, D.C. (Eds.), *Birds in Archaeology* (Groningen Archaeological Studies 12), Groningen: GIA, pp. 187–195.
- Guamán Poma de Ayala, F., 1987. In: Murra, J.V., Adorno, R., Urioste, J.L. (Eds.), *Nueva crónica y buen gobierno*. México DF, Siglo XXI [1615].
- Gusinde, M., 1982. Los Indios de Tierra del Fuego. Los Selk'nam. Centro Argentino de Etnología Americana y Consejo Nacional de Investigaciones Científicas y Técnicas. Tomo 1. vol. 1 (Buenos Aires).
- Horta Tricallotis, H., 2000. Diademas de Plumas en Entierros de la Costa del Norte de Chile: ¿Evidencias de la Vestimenta de una Posible Parcialidad Pescadora? *Chungara. Rev. Antropol. Chil.* 32 (2), 235–243 (Universidad de Tarapacá, Arica, Chile).
- Jaimes Betancourt, C., 2015. El poder de las plumas. In: Colección de arte plumario del Museo Nacional de Etnografía y Folklore, según la cadena de producción. Catálogo del Museo Nacional de Etnografía y Folklore, La Paz, Bolivia.
- Lanata, J., Weissel, M., Caracotche, S., Belardi, J., Muñoz, S., Savanti, F., 1992. 20000 huesos de viaje submarino: análisis faunísticos del sitio Bahía Crossley. Isla de los Estados. *Palimpsesto*. 1. pp. 9–24.
- Langer, G., 1980. Vergleichend morphologische Untersuchungen an Einzelknochen in Mitteleuropa vorkommender mittelgroßer Eulenarten. Inaugural Dissertation der Tierärztlichen Fakultät der Ludwig Maximilians-Universität München.
- Laroulandie, V., 2005. Anthropogenic versus non-anthropogenic bird bone assemblages: new criteria for their distinction. In: O'Connor, T. (Ed.), *Biosphere to Lithosphere. New Studies in Vertebrate Taphonomy*. Oxbow Books, Oxford, pp. 25–30.
- Lefèvre, C., 1997. Sea bird fowling in southern Patagonia: a contribution to understanding the nomadic round of the Canoeers Indians. *Int. J. Osteoarchaeol.* 7, 260–270.
- Lefèvre, C., 2010. Birds in maritime hunter-gatherers subsistence: case studies from Southern Patagonia and the Aleutian Islands. In: Prummel, W., Zeiler, J.T., Brinkhuizen, D.C. (Eds.), *Birds in Archaeology*. Groningen Archaeological Studies 10, Barkhuis Publisher, Groningen, pp. 117–130.
- Lefèvre, C., Laroulandie, V., 2014. Avian skeletal part representation: a case study from Offing 2, a hunter-gatherer-fisher site in the Strait of Magellan (Chile). *Int. J. Osteoarchaeol.* 24 (3 - Special Issue on Birds and Archaeology: New Research), 256–264.
- Lefèvre, C., Lepetz, S., Legoupil, D., 2003. Chasseurs terrestres, chasseurs marins? L'exploitation des ressources animales dans le locus 1. In: Legoupil, D. (Ed.), *Les chasseurs-cueilleurs de Ponsobny (Patagonie australe) et leur environnement du VIème au IIIème mill. av. J.-C. Chile, Punta Arenas, 2003*. 31. Universidad de Magallanes, pp. 63–116.
- Lema, V., Capparelli, A., 2007. El algodón (*Gossypium* sp.) en el registro arqueológico del NOA: su presencia pre y post hispánica. In: Marconetto, B., Babot, P., Oliszewski, N. (Eds.), *Paleoetnobotánica del Cono Sur: estudios de casos y propuestas metodológicas*. Córdoba, Argentina, pp. 69–78.
- López, M.A., 2011. Chuchos o Cutis y Chacpas. El culto a los cadáveres de infantes y adultos dentro de ollas según los extirpadores de idolatrías andinas Andes. vol. 22 Universidad Nacional de Salta Argentina.
- López Campeny, S.M.L., 2001. Actividades Domésticas y Organización del Espacio Intrasisito. El Sitio Punta de la Peña 9 (Antofagasta de la Sierra, Prov. de Catamarca). Universidad Nacional de Tucumán, Argentina Degree thesis.
- López Campeny, S.M.L., 2006–2007. El poder de torcer, anudar y trenzar a través de los siglos. Textiles y ritual funerario en la Puna Meridional Argentina. *Cuadernos del INAPL*. 21. pp. 143–155.
- López Campeny, S.M.L., 2009. Asentamiento, Redes Sociales, Memoria e Identidad. Primer milenio de la era. Antofagasta de la Sierra, Catamarca ((Unpublished doctoral dissertation). Doctoral thesis. Universidad Nacional de Tucumán, Argentina.
- López Campeny, S.M.L., 2014. The agency of textile technology in some archaeological ritual contexts of Northwest Argentina. *J. Anthropol. Archaeol.* 2 (2), 39–75. <http://dx.doi.org/10.15640/jaa.v2n2a3>.
- López-Albors, O., Gil, F., Vázquez, J.M., Latorre, R., Ramírez-Zarzosa, G., Orenes, M., Moreno, F., 1999. Revisión: Nomenclatura e iconografía de las partes de la pluma y sus diferentes tipos. *Anales de Veterinaria (Murcia)*. 15. pp. 3–16 (España).
- López, G.E.J., Coloca, F.I., Rosenbusch, M., Solá, P., 2018. Mining, macro-regional interaction and ritual practices in the South-central Andes: the first evidence for turquoise exploitation from the Late Prehispanic and Inca periods in North-western Argentina (Cueva Inca Viejo, Puna de Salta). *J. Archaeol. Sci. Rep.* 17, 81–92. <http://dx.doi.org/10.1016/j.jasrep.2017.09.036>.
- Lyman, R., 1994. *Vertebrate Taphonomy*. Cambridge Manuals in Archaeology. Cambridge University Press, Cambridge.
- Mameli, L., 2002. Bird management in America's extreme south during the 19th century. *Acta Zool. Cracov.* 45 (special issue), 151–165.
- Mameli, L., 2003. La gestión del recurso avifaunístico por las poblaciones canoeras del archipiélago fueguino (Doctoral thesis). Universidad Autónoma de Barcelona.
- Mameli, L., Estévez Escalera, J., 2004. Etnoarqueoología de aves: el ejemplo del extremo sur americano. In: *Treballs d'Etnoarqueoología 5*. Universidad Autónoma de Barcelona. Consejo Superior de Investigaciones Científicas, Madrid.
- Marciniak, A., 2005. Placing Animals in the Neolithic. *Social Zooarchaeology of Prehistoric Farming Communities*. UCL Press, London.
- Martel, A.R., 2004. Cacao 3 (Cc3) Arte rupestre del Formativo Temprano en Antofagasta de la Sierra, Catamarca, Argentina. *Rev. Andes* 15, 185–212 Salta, Argentina.
- Martínez, M.S., 2012. Prácticas Textiles significadas en Contextos de Transformaciones en Antofagasta de la Sierra (Provincia de Catamarca-Argentina). Integrando materialidad del pasado y la oralidad del presente (Thesis). Universidad Nacional de Tucumán, Argentina.
- Martínez, J.G., 2014. Contributions to the knowledge of natural history and archaeology of hunter-gatherers of Antofagasta de la Sierra (Southern Argentinian Puna): the case of Peñas de las Trampas 1.1. In: *Hunter-gatherers From a High-altitude Desert. People of the Salt Puna (northwest Argentina)* British Archaeological Reports (BAR), International Series, pp. 71–93 (Oxford).
- McGovern-Wilson, R., 2005. Feathers flying in paradise: the taking of birds for their feathers in prehistoric Polynesia. In: Grupe, Gisela, Peters, Joris (Eds.), *Feathers, Grit, and Symbolism: Birds and Humans in the Ancient Old and New Worlds*. Verlag Marie Leidorf GmbH, Rahden, Germany, pp. 207–221.
- Mengoni Goñalons, G.L., 1982. Notas zooarqueológicas I: fracturas en hueso. VII Congreso Nacional de Arqueología, Montevideo, Montevideo, pp. 87–91.
- Michielli, C.T., 1979. Relaciones entre las técnicas textiles de la Región de Cuyo, Norte de Chile y Costa Peruana. *Antiquitas* 2, 1–14.
- Michielli, C.T., 1990. *Textilería incaica en la provincia de San Juan: Los ajuares de los cerros Mercedario, Toro y Tambillos*. Instituto de Investigaciones Arqueológicas y Museo UNSJ, San Juan, Argentina.
- Michielli, C.T., 2000. Telas rectangulares decoradas: Piezas de vestimenta del Período Tardío Preincaico (San Juan, Argentina). *Estudios Atacameños*. 20. pp. 77–90 (Chile).
- Narosky, T., Yzurieta, D., 2010. Guía para la identificación de las Aves de Argentina y Uruguay. Vázquez Manzini Editores, Buenos Aires (345 pp.).
- Nicholson, R., 1993. A morphological investigation of burnt animal bone and an evaluation of its utility in archaeology. *J. Archaeol. Sci.* 20, 411–428.
- Nicholson, R., 1996. Bone degradation, burial medium and species representation: debunking the myths, an experiment-based approach. *J. Archaeol. Sci.* 23 (4), 513–533.
- Ojeda, R. A., C. E. Borghi, Roig V. G., 2002. Mamíferos de Argentina. Pp. 23-63, *Diversidad y Conservación de los Mamíferos Neotropicales* (G. Ceballos y J.A. Simonetti). Universidad Nacional Autónoma de México y la Comisión Nacional para el conocimiento y uso de la Biodiversidad (CONABIO), (586 pp.).
- Olivera, D.E., 1992. *Tecnología y Estrategias de Adaptación en el Formativo (Agroalfarero Temprano) de la Puna Meridional Argentina. Un Caso de Estudio: Antofagasta de la Sierra (Pcia. de Catamarca, R.A.)* (Doctoral thesis). UNLP, La Plata.
- Olivera, D.E., Vidal, A.S., Grana, L.G., 2003. El Sitio Cueva Cacao 1A: Hallazgos, espacio y proceso de complejidad en la Puna meridional (ca. 3000 años AP). *Relac. Soc. Argent. Antropol.* 28, 257–270.
- Peña-Villalobos, I., Fibla, P., Sallaberry, M., Cartajena, I., Opazo, C., 2015. Discriminación de Taxones de Aves a Través del Análisis Comparativo de la Microestructura de Plumas: Una Aplicación en el Sitio Tulán 122, Puna de Atacama, Chile. *Rev. Chil. Antropol.* 30, 30–35.
- Pérez de Micou, C., 1997. Cestería. Caracterización y Aplicación de una Tecnología Prehistórica. Ficha de Cátedra. Buenos Aires: Cátedra de Ergología y Tecnología, Facultad de Filosofía y Letras, Universidad de Buenos Aires, Argentina.
- Pérez de Micou, C., 2009. Indicios arcaicos en la Colección Doncellas, Jujuy (República Argentina). El yacimiento 26 a la luz de un fechado radiocarbónico (4811 ± 39 AP). *Bull. Inst. Français Etudes Andines* 38 (1), 75–85.
- Pérez de Micou, C., Ancíbor, E., 1994. Manufactura cestería en sitios arqueológicos de Antofagasta de la Sierra, Catamarca. *J. Soc. Am.* 80, 207–216.
- Podestá, M.M., 1989. Punta del Pueblo: expresiones del arte rupestre agroalfarero en la Puna argentina. *Bol. SIAR* 3, 38–47.
- Podestá, M.M., 1991. Cazadores y pastores de la Puna: apuntes sobre sus manifestaciones de arte rupestre. *Shincal* 3, 12–16.
- Prates, L., Acosta Hospitaleche, C., 2010. Las aves de sitios arqueológicos del Holoceno tardío de Norpatagonia, Argentina. Los sitios Negro Muerto y Angostura 1 (Río Negro). *Archeofauna* 19, 7–18.
- Redford, K.H., Eisenberg, J.F., 1992. *Mammals of the Neotropics. The Southern Cone. Chile, Argentina, Uruguay, Paraguay*. Vol. 2 (ed. por Chicago).
- Reitz, E.J., Wing, E.S., 1999. *Zooarchaeology*. Cambridge Manuals in Archaeology. Cambridge University Press, Cambridge.
- Remsen, J.V., Areta, J.I., Cadena, C.D., Claramunt, S., Jaramillo, A., Pacheco, J.F., Pérez-Eman, J., Robbins, M.B., Stiles, F.G., Stotz, D.F., Zimmer, K.J., 28 April 2017. A Classification of the Bird Species of South America. *American Ornithologists' Union*. <http://www.museum.lsu.edu/~Remsen/SACCBaseline.htm>.
- Renard, S., 1997. Objetos textiles, pasos y caminantes trasandinos. Piezas similares y rasgos comunes entre textiles arqueológicos de Argentina y Chile. *Estud. Atacameños* 14, 291–305.
- Rodríguez Loredo, C., 1997–1998. Estudio Arqueozoológico del Sitio Inca Potrero Chaquiago, Barrios La Solana y Retambay Andalgalá, Provincia de Catamarca (Argentina). *Relaciones de la Sociedad Argentina de Antropología XXII-XXIII*. pp. 203–245 (Buenos Aires).
- Rodríguez, M.F., Rúgolo de Agrasar, Z.E., Aschero, C., 2003. El género Deyeuxia (Poaceae, Agrostidae) en sitios arqueológicos de la Puna meridional argentina. Provincia de Catamarca. *Chungara. Rev. Antropol. Chil.* 35, 51–72.
- Rodríguez, M.F., Rúgolo de Agrasar, Z.E., Aschero, C., 2006. El uso de las plantas en unidades domésticas del sitio arqueológico Punta de la Peña 4, Puna Meridional Argentina. *Chungara. Rev. Antropol. Chil.* 38 (2), 257–271.
- Roland De Perrot, D., Jiménez de Puparelli, D., 1983–85. La tejeduría tradicional en la Puna Argentina. *Cuadernos del Instituto Nacional de Antropología*. 10. pp. 205–290.
- Salazar, J.M., 1997. *Iniciación al tiro con arco*. Editorial y Librerías Deportivas E. Sanz. España.
- Savanti, F., 1994. Las aves en la dieta de los cazadores recolectores terrestres de la costa fueguina. *Temas de Arqueología*. CONICET, programa de estudios prehistóricos. Argentina.
- Scheinsohn, V., 2010. *Hearts and Bones. Bone Raw Material Exploitation in Tierra del Fuego*. BAR International Series 2094. Archaeopress, Oxford.
- Scheinsohn, V., Di Baja, A., Lanza, M., Tramaglino, L., 1992. El aprovechamiento de la avifauna como fuente de materia prima ósea en la Isla Grande de Tierra del Fuego: Lancha Packewaia, Shamakush I y Túnel I. *Arqueología* 2, 135–148.

- Serjeantson, D.A., 1997. Subsistence and symbol: the interpretation of bird remains in archaeology. *Int. J. Osteoarchaeol.* 7, 255–259.
- Serjeantson, D.A., 1998. Birds: a seasonal resource. *Environ. Archaeol.* 3, 23–33.
- Serjeantson, D., 2009. *Birds*. Cambridge Manuals in Archaeology. Cambridge University Press, Cambridge.
- Sigl, E., Mendoza, D., 2012. No se baila así no más... Danzas autóctonas y folklóricas de Bolivia. Tomo II. Primera edición. La Paz, Bolivia.
- Simmons, T., Nadel, D., 1998. The Avifauna of the Early Epipalaeolithic site of Ohalo II (19 400 years BP), Israel: Species Diversity, Habitat and Seasonality International Journal of Osteoarchaeology. 8. John Wiley & Sons, Ltd, pp. 79–96.
- Sisson, S., Grossman, S., 2005. *Anatomía de los Animales Domésticos*. Tomo I. Salvat Editores.
- Standen, V.G., 2003. Bienes Funerarios del Cementerio Chinchorro Morro 1: Descripción, Análisis e Interpretación. *Chungará (Arica)* 35 (2), 175–207. <http://dx.doi.org/10.4067/S0717-73562003000200002>.
- Stewart, H., 1996. *Stone, Bone, Antler and Shell: Artifacts of the North-west Coast*. Vancouver, BC: Douglas & McIntyre. University of Washington Press, Seattle.
- Tchilinguirian, P., Olivera, D.E., 2005. Evolución paleoambiental e implicancias arqueológicas en Laguna Colorada, Puna Catamarqueña. Paper presented in XVI Congreso Geológico Argentino. Actas IV. pp. 261–268 La Plata. Buenos Aires.
- Tchilinguirian, P., Olivera, D., 2014. Late Quaternary paleoenvironments, South Andean Puna (25°–27° S), Argentina. In: Pintar, E. (Ed.), *Hunter-gatherers From a High-elevation Desert: People of the Salt Puna (Northwest Argentina)*. BAR International Series, Archaeopress, Oxford, pp. 43–69.
- Tivoli, A.M., 2010. Temporal trends in avifaunal resource management by prehistoric sea nomads of the Beagle Channel region (southern South America). In: Prummel, W., Zeiler, J.T., Brinkhuizen, D.C. (Eds.), *Birds in Archaeology*. Groningen Archaeological Studies 12. Barkhuis Publisher, Groningen, pp. 131–140.
- Tivoli, A.M., 2012. Intensificación? en el aprovechamiento de aves entre los cazadores-recolectores-pescadores de la región del canal Beagle. *Archaeofauna* 21, 121–137 (España).
- Tivoli, A.M., 2013. Aprovechamiento de materias primas óseas de aves para la confección de punzones huecos en la región del canal Beagle. In: *Intersecciones en Antropología*. 14. Facultad de Ciencias Sociales – UNCPBA, Argentina, pp. 251–262.
- Tivoli, A.M., 2014. Processing activities and differentiation of bird utilization during the Late Holocene in the Beagle Channel region (Southern South America). *Int. J. Osteoarchaeol.* 24, 397–406.
- Torres-Rouff, C., Pimentel, G., Ugarte, M., 2012. ¿Quiénes viajaban? Investigando la muerte de viajeros prehispánicos en el desierto de Atacama (ca. 800 AC–1536 DC). *Estud. Atacameños* 43, 167–186.
- Troll, C., 1958. Las culturas superiores andinas y el medio geográfico. *Rev. Inst. Geogr.* 5, 3–55.
- Urquiza, S.V., 2009. Arqueofaunas del Alero Punta de la Peña 4: Implicaciones para el Manejo del Recurso Camelidae en Antofagasta de la Sierra, Puna Meridional, Catamarca (Doctoral thesis). Universidad Nacional de Tucumán, Argentina.
- Urquiza, S.V., 2013. La fauna de contextos funerarios agropastoriles del primer milenio D.C. Puna austral argentina. III Congreso Nacional de Zooloología Argentina. Instituto Interdisciplinario de Tilcara, Universidad de Buenos Aires, Argentina, pp. 39.
- Urquiza, S.V., 2016. Control Tafonómico y Geoquímico del registro Camelidae en base a Difractometría de RX (DRX). Puna Austral Argentina (Holoceno Temprano y Tardío). *Serie Correlación Geológica* 32, 101–117 Argentina.
- Urquiza, S.V., Aschero, C.A., 2014. Economía animal a lo largo del Holoceno en la Puna Austral Argentina: Alero Punta de la Peña 4. Cuadernos del Instituto Nacional de Antropología y Pensamiento Latinoamericano. Series Especiales 2 (1). pp. 86–112 (Buenos Aires).
- Urquiza, S.V., Cuenya, P., Aschero, C.A., 2009. Química del Suelo: Un Aporte a la Tafonomía en Antofagasta de la Sierra. In: Palacios, O., Vázquez, C., Palacios, T., Cabanillas, E. (Eds.), *Arqueometría latinoamericana*. 1. Comisión Nacional de Energía Atómica, Buenos Aires, pp. 209–214.
- Urquiza, S.V., Romano, A.S., López Campeny, S.M.L., 2013. Historia Ocupacional y Prácticas Sociales: un análisis arqueofaunístico contextual. Sitio Piedra Horadada 2, Antofagasta de la Sierra, Catamarca, Argentina. In: Izeta, A., Mengoni Goñalons, G. (Eds.), *De la Puna a las Sierras: Avances y Perspectivas en Zooloología del Norte de la República Argentina*. South American Archaeology Series de British Archaeological Reports (International Series), SAMAR 19 John & Erica Hedges, Ltd, Oxford, UK, pp. 121–144.
- Van Kessel, J., 1996a. La cosmovisión aymara. In: Hidalgo, F., Schiappacasse, H., Niemeyer, C. Aldunate, Mege, P. (Eds.), *Etnografía: Sociedades Indígenas Contemporáneas y su Ideología*. Editorial Andre's Bello, Santiago, Chile, pp. 169–198.
- Van Kessel, J., 1996b. Los Aymaras contemporáneos de Chile. In: Hidalgo, J., Schiappacasse, F., Niemeyer, H., Aldunate, C., Mege, P. (Eds.), *Etnografía: Sociedades indígenas contemporáneas y su ideología*. Editorial Andre's Bello, Santiago, Chile, pp. 47–67.
- Van Perlo, B., 2015. *Birds of South America: Passerines (Collins Field Guide)*. Princeton University Press, Princeton and Oxford.
- Von den Driesch, A., 1976. A guide to the measurement of animal bones from archaeological sites. In: *Bulletin of the Peabody Museum of Archaeology and Ethnology* No. 1. Harvard University.
- White, T.E., 1953. A method of calculating the dietary percentage of various food animals utilized by aboriginal peoples. *Am. Antiq.* 18, 396–398.
- Yacobaccio, H.D., 1991. *Sistemas de Asentamiento de los cazadores - recolectores tempranos de los Andes Centro - Sur (Doctoral thesis)*. Facultad de Filosofía y Letras. Universidad de Buenos Aires.
- Yacobaccio, H.D., 2004. Social dimensions of camelid domestication in the southern Andes. *Anthropozoologica* 39 (1), 237–247.