



Contents lists available at ScienceDirect

Quaternary International

journal homepage: www.elsevier.com/locate/quaint

Dunes, hills, waterholes, and saltpeter beds: Attractors for human populations in western Pampa, Argentina



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ARTICLE INFO

Article history:

Available online 25 July 2016

Keywords:

Desert environment
Human attractors
Colonizing patterns
Western pampa
Argentina

ABSTRACT

Desert environments have generally been considered unsuitable places for the development of human communities. However, archaeological research shows that they have been intensively populated and traveled landscapes. These environments share common characteristics (scarcity of surface water, desert vegetation, high evapotranspiration, water imbalance, among others). But archaeological investigations account for the variability of both, desert settings and social trajectories of their populations.

In Western Pampa (southwest of La Pampa province, Argentina), the distribution and availability of fresh water is the main variable for spatial organization of prehispanic populations. Also the crossroads of Indian trails or *rastrilladas*, articulated and connected places that mitigated its hostility, such as dune fields, springs, hill ranges, natural pools, temporary or permanent ponds. It is around these reservoirs that prehispanic human activities are recorded. Archaeological sites are sometimes ephemeral, in other of recurrent use. Considering the significant environmental dynamics of this landscape, it is possible to discuss the differential organizational patterns recorded alongside this arid region.

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1. Introduction

Western Pampa comprises the mid-continental region in the center of Argentina. It is an arid and semiarid environment that comprehends about 100.000 km² and is included between the 600 and the 200 mm isohyets (Fig. 1).

Hunter-gatherers populations lived throughout this region during the last 9000 years, at least, although not continuously in any given sub-area (Gradín et al., 1984; Berón, 2014). These populations adopted different mobility patterns along the time, generally tethered to water supplies, used lithic stone tools, items made from organic materials like malacological and ostrich eggshell beads, worked leather and bone and had a diversified diet (Berón, 2004; Cimino, 2006; Berón et al., 2012b; Barberena et al., 2015). About 1500 years ago gradual changes began: they incorporated decorated pottery and intensified the use of different kind of ornaments, as copper mineral beads, copper earrings and adornments, mobile and rock art, use of pigments, burial in formal graves, some of them very complex. By these times temporary settlements were more frequent, located in the better watered parts, and social differentiation began to be shown through the

presence of grave goods or evidences of expertise tasks in some child's burials (Aranda, 2007; Berón et al., 2012a).

Towards the last 1000 years, population growth is archaeologically recorded, suggested by emergence of formal burial areas, the redundancy of use of domestic campsites with high density of material culture as well as an increasing record of wide social networks transposing the Andean range, and the occurrence of violence and conflict (Berón, 2004, 2014; Berón et al., 2012b; Berón et al., 2012c; Salazar Siciliano and Berón, 2013). It was surely motivated by demographic pressure and, from XVI th century, the pushing menace of European colonizers, located on east and west sides of their territories. Historical records mention several ethnic groups with defined identities and territories all around the area, reaching the Andean slopes.

By the end of XIX Century (between 1879 and 1885), this complex socio cultural system was broken up by military campaigns carried out by the central Argentine government, during the paradoxically called “Desert Campaign”. Different military divisions went into these territories, killing, impeaching and pulling the survivors towards the less favorable lands. In this way the environmental category of desert was employed as a metaphor, regarding low demographics of indian people, to whom Spanish names were imposed in order to better identify and assort, and thus justifying its occupation by colonizers. The main goal of this paper

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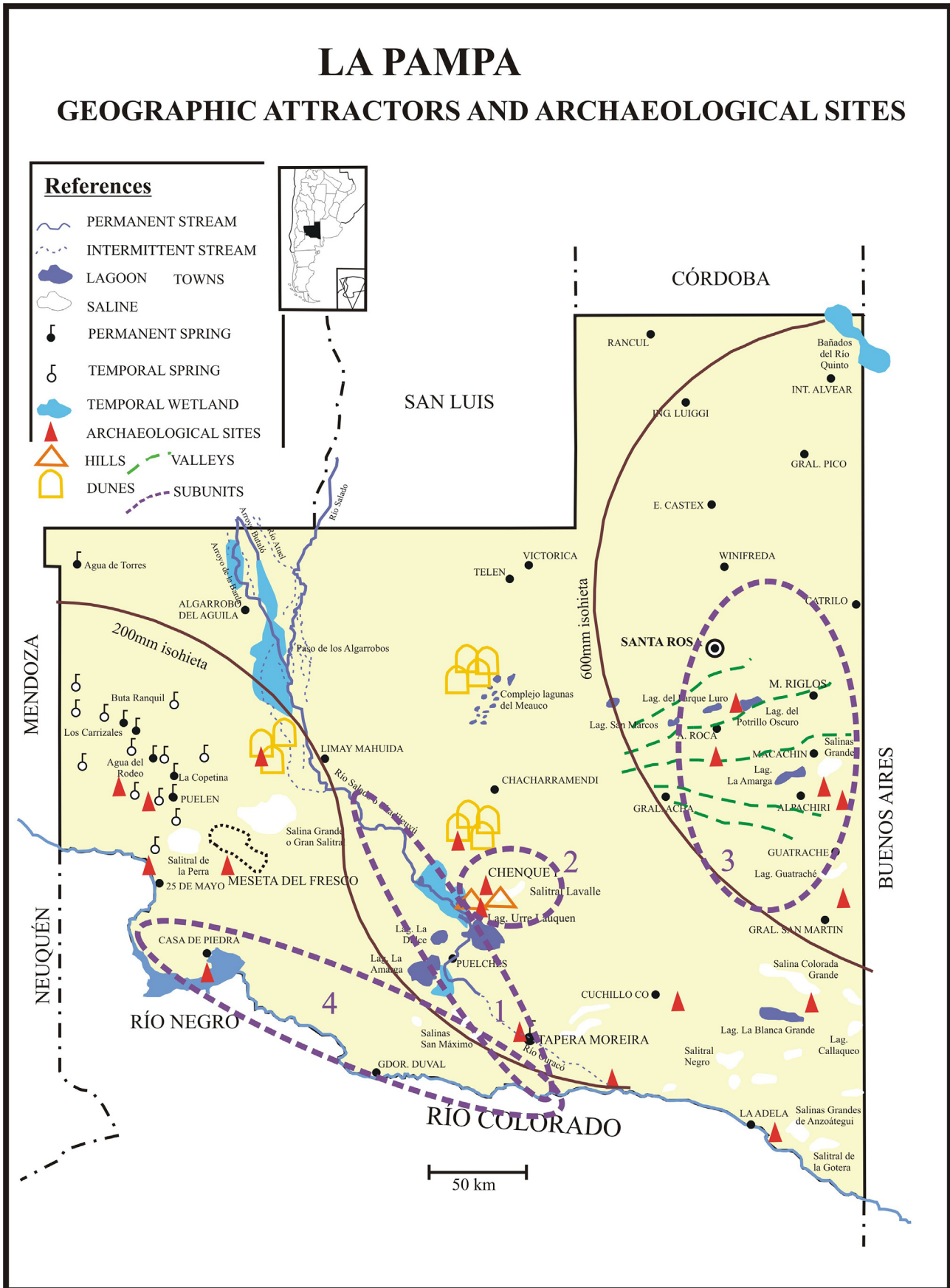


Fig. 1. Western Pampa. Main geographic attractors and archeological sites.

is to show a macro-regional approach to cultural processes and social trajectories of the populations that occupied this continental desert, during the Holocene. We discuss the geomorphological setting, main resources distribution and availability, some trends on landscape use, chronology, the existence of occupational hiatuses and their relation with paleoenvironmental aspects. We consider that some of these main resources as salt deposits, ponds, waterholes, lagoons and particular outcrops, as well as outstanding landforms as hills, dunes and aeolian valleys, acted as attractors for human settlement and displacements. Finally we present the differential organizational patterns recorded alongside this particular environment.

2. Regional and social setting

Western Pampa is a semi-desert environment, generally considered as an unsuitable place for the development of human communities. However, archaeological research shows that this region has been an intensively populated and traveled landscape.

From a biogeographical point of view, diversity and productivity of drylands depend on the interaction between environmental limitations of each particular region and the complex adaptations developed by organisms and factors that allow them to maintain the water balance and thermal energy within viable limits (Villagra et al., 2011).

The Argentine Pampas have been characterized in the lore as extensive grassy plains. But this streamlining only matches to the eastern Pampas, while the western Pampas are desert to semi-desert landscapes with a highly variable geomorphology and some dominant physiographic features as the Pampas hills, transverse valleys and basalt plateau, and secondary geomorphic traits, but not least important as the dune fields, lagoons and salt marshes (Fig. 1). The main limiting variable is the scarcity of surface drinking water.

Among the processes that permanently reshape this landscape there are the high evapotranspiration records, intense sunlight and dry river beds that rarely reach its base level. A unique permanent river flows at the south end of this territory, the Colorado river. Another watershed runs through this vast region, the fluvial system formed by rivers Atuel and Salado that converge in northern La Pampa forming a single basin that takes the names Chadileuvú and Curacó till its drainage into the Colorado River in the south end of this territory (Fig. 1). But this is a downgraded river system that possibly never constituted a regular water source. All this led to the accumulation of sand transported by the wind that contributed to the formation of dunes (Centro de Investigaciones Geográficas (CIG), 1983). From the phytogeographical point of view, the area belongs to the Monte Province (Cabrera, 1976). Espinal province is also present in the Lihué Calel National Park, although marginally (Covas, 1964).

This environment was populated by social groups with a marked hunter-gatherer subsistence that would have occupied, in a persistent way, some sectors with more favorable environmental conditions, but that would have moved seasonally to exploit wild resources. While they did not have a comprehensive management of the domestication of plants or animals, from 1000 years BP approximately, they occasionally joined pets like dogs, and then domesticated plants, such as corn (Prates et al., 2010; Musaubach and Berón, 2015).

Its members were generally linked by kinship, either by marriage, by descent or through social alliances. No marked chiefdoms or major differences in status existed, although around 1000 AP male graves with differential outfits and multiple burials of young people (predominantly males) dedicated to the war, suggest some kind of social differentiation, being ascribed or acquired (Berón

et al., 2012a). Precisely, towards the last 1000 years it has been recorded the presence of interpersonal conflict, with different characteristics, manifestations and dimensions, as a social fact that permeated these social groups and had an upsurge in the last 400 years (Berón, 2014).

3. Geomorphological and climatic characterization of western Pampas

The most part of the research area is included in the Pampean Sand Sea or Central Pampean Dunefield. The rainfall pattern is 250–300 mm per year, determining a semiarid–arid environment. The Pampean plain is a heterogeneous geomorphological setting reflecting the major structural characteristics of the subsurface geology and the climatic gradient (Iriondo & Kröling, 1996; Zárate & Tripaldi, 2012).

The upper litho-stratigraphic unit in the region, consists of aeolian sands, characterized by an heterogeneous nature and regional diversity. This cover corresponds to the Meauro Formation, assigned to the Late Pleistocene–Holocene. Iriondo (1990) grouped the deposits covering the Pampean plain into the Pampean aeolian system, including western and eastern coverings. It was later subdivided, from the geomorphological point of view, as Western Pampean Sand Mantles and Dune Fields and Western Pampean Dune Fields units, (Zárate & Tripaldi, 2012). This units fall within what Bruniard (1982) delineated as the Arid Diagonal, that covers an area of 300,000 km², ranging between 32°S and 39°S. This formation originated at the end of the Late Pleistocene, during the last glacial maximum (LGM), simultaneously with a strip of loess located downwind (Tripaldi & Forman, 2007; Zárate & Tripaldi, 2012).

The sediments are composed of very fine and silty sand and originated mainly in the high mountains through snow and cryogenesis. Physical weathering products were transported by melt water southwards, along the Desaguadero and Salado fluvial system, and deflated north and northwest by southerly winds during the LGM and other cold periods. Wet interludes intercalated were characterized by pedogenesis and development of alluvial belts. The thickness of the units is between 5 and 15 m (Iriondo, 1990; Iriondo & Kröling, 1996).

During the Holocene different erosion processes acted in this region, whose geomorphology is characterized by the action of water and wind on the Salado and Chadileuvú basins. In addition, almost all of the territory is under the predominant control of mechanical morphogenetic processes, carried out mainly by geomorphic agents such as temperature (heat, frost action) salts, aeolian deposition and deflation, and sporadic water runoff eroding landforms in slopes: canyons and gullies (Calmels, 1996). Particularly during the Late Holocene, important climate changes occurred. Between 3500 and 1000 years BP in the Chaco-Pampean plain, semiarid climate was established. Widespread deflation of the surface sediments and new deposition shaped a mantle of silt and sand, with some associated dune fields (Iriondo, 1990; Iriondo & García, 1993; Tripaldi & Forman, 2007; Zárate & Tripaldi, 2012). From other paleo-environmental proxies including pollen studies and reconstruction of paleo-precipitation, Schabitz (2003) noted an increase in aridity over the past 3–4 ka, also indicated by dune formation and remobilization of sand. Similar changes have been recorded and analyzed through different paleoindicators in central southern Patagonia and south of Mendoza, where a dry period is recorded from 2200 BP onwards, with a greater intensification of aridity around 900 BP (Gil et al., 2005; Gil & Neme, 2010; Garvey, 2008; Stine & Stine, 1990; Stine, 1994, 2000). The most obvious consequence of this was a drastic reduction of the amount and distribution of surface water with the resulting involvement of

ecosystem productivity during prolonged drought periods (Jones et al., 1999; Stine, 2000; Tonni et al., 2001).

The southwest of the province has been one of the areas most affected by deflation, and is characterized by the small thickness of sand left on surface; the wind eroded and transported sediments, revealing consolidated underlying material (calcareous crusts, volcanic boulders, basalt rock outcrops). It is mainly the intense wind action that affects the status of archaeological evidence in the area, which mostly appears on the surface of the ground because they were either exposed or never underwent burial processes. There are few stratified sites, only two with extensive cultural chronological sequences. Consequently, in these semi-arid environments, significant environmental dynamics have produced a fragmentary archaeological record.

4. Microregional settings and environmental attractors

As in most desert landscapes, the distribution and availability of fresh water is the main variable for spatial organization of pre-hispanic populations. The arid and semi-arid characteristics presented by La Pampa province do not offer conditions for a native hydrographic network arises. In consequence substitute water resources, as dune fields, temporary lagoons, ponds, and springs were utilized and concentrated human activities.

Four main geomorphological units and several subunits or landscapes can be differentiated in the study area: 1- Alluvial strip of Atuel – Salado – Chadileuvú – Curacó Basins, 2- Southern Pampean Hill Range, 3- Transversal Valleys system and 4- Mid Colorado River Basin (Fig. 1). General geomorphological characteristics of each unit can be seen in Berón (2015). Each of these units has a remarkable variability among them as well as biotic and geomorphic particular traits that constituted attractors for human populations. The principal attractors are introduced, explaining their importance for human subsistence in this Western Pampa desert.

4.1. Dune fields

Extensive active dune fields span the center of La Pampa province all along the Chadileuvú and Curaco rivers basins and the north bank of the Colorado river (Fig. 1). Many archaeological sites have been detected in these areas, and they are covered alternately by active dunes with important taphonomic biases, already studied in similar contexts (Borrazzo, 2006). That is why the vast majority of archaeological sites in this unit are shallow but very frequent and with a high density of cultural remains. Dunes were the most suitable places for settlement, retaining heat in cold times and offering refuge and natural water reservoirs. The dune shapes, due to their lithological condition, are favorable areas for infiltration and storage of water of low salinity. Precisely the most interesting units in relation to the direct use of underground water, or as means of transfer to deeper water are the dunes. In the dunes fields freshwater lenses are associated. The dunes favor infiltration and vertical down transfer and in them, in the upper section of the underlying unity, freshwater lenses are formed, being the only sources of water supply. Due to the loose and well selected sand that comprise them, this gives dunes high absorption capacity of rain water, even in those places where they have been fixed with artificial greenery. While active dunes are those with higher permeability and effective porosity, the set, including the oldest, constitute an area of preferential infiltration or recharge to the underground system. Generally they have a moderate to low tenor salt water, but in some cases, this greatly exceeds potability standard. Recharging derives from the infiltration of rain and, depending on the absorption

capacity is higher in living than in the semi and fixed dunes. The water in this unit is often used for domestic supplies (Auge, 2004).

4.2. Saline and saltpeter beds

The province of La Pampa has numerous saline and saltpeter beds of varying size, quality, composition and production types, that concentrated extraction activities and population in pre and post Hispanic times. Regarding the edible salt, La Pampa is the main producer. Among the numerous salt bodies, two of them stand out. La Colorada Grande can be considered the most important, as it is the Argentina's largest salt reserve, and Hidalgo also known as Salinas Grandes, is an excellent reservoir located in a pit filled by wind transport (Mogni, 1991, Fig. 1).

Salinas Grandes de Hidalgo has been a significant place in the history of Argentina, as in the first decades of the nineteenth century was the place of supply of salt consumed by the “saladeros” of the city of Buenos Aires, for leather tannery (García, 1974 [1810]). It was the settlement area of the Boroganos and later of Calfucurá chieftain (Bechis, 2002; Ratto, 2005; Nacuzzi, 2013). This salt marsh is currently still in commercial operation by the company Dos Anclas SA. Control in obtaining such a precious element like salt, with a high exchange value, played a major role in the formalization of inter-ethnic relations and territories, as access control guaranteed a privileged position for negotiation. Thus, Salinas Grandes became an area of unquestionable strategic value, confluence of Indian trade routes and became an obligatory way for approaching Buenos Aires border (Ratto, 2005, Fig. 2). At the beginning of the 1850s the Salinas Grandes were under the control of the chiefdom *Cura* (Stone in *Mapuzungun* language) or “Lordship of Salinas Grandes”, with a population consisting of 10,000 to 12,000 people. By then the Confederation of Salinas Grandes had already extended its direct or indirect political power to virtually all the Pampas of southern Argentina, controlling not only the salt mines but also the Indian pathways and a considerable part of the trade of cattle to Chile through Andean mountain passes (Hux, 2007; León Solís, 1982; Mandrini, 1991; Marini de Díaz Zorita, 1979; Pinto Rodríguez, 1996; Villalobos, 1989, Figs. 2 and 3).

The archaeological record indicates that settlements and encampments of the different indigenous groups that controlled the salt in historical times and previously (Boroganos, Ranqueles, Salineros) were placed at strategic points in the vicinity of these salt marshes, with availability of critical resources such as drinking water (Laguna Chillhué, Médanos de Alduncin, Médanos de Costilla, Bajo de Atrouco) and safeguarding of competitors or enemies (Berón et al., 2015a).

In a previous work three archaeological sites were surveyed, around Chillhué lagoon (Berón, 2004). In one of them (site 3 Laguna de Chillhué) incomplete human remains of an adult female person were recovered. The skull has intentional erect tabular cranial deformation type (planolambdoid variety). It was dated at 1930 ± 30 years BP (UGA 02009). This type of deformation is the most frequent and of wider areal dispersion in the Pampas and north patagonian areas (Berón & Luna, 2009). It became the oldest skull with this kind of intentional deformation in the region, which continued to be used till ca. 300 years BP. Other sites around the saline show evidences of permanent or re-used campsites (Berón et al., 2015a, Fig. 1).

4.3. Pampean Hills system and landscape outstanding places

Pampean Hills system (Lihué Calel, Sierras Chicas and Sierra Chata hills) offer alternative concentration of temporary or permanent water supplies (Fig. 1). In Southern Pampean Hill Range the

INDIAN TRAILS OR RASTRILLADAS BY XIX TH CENTURY

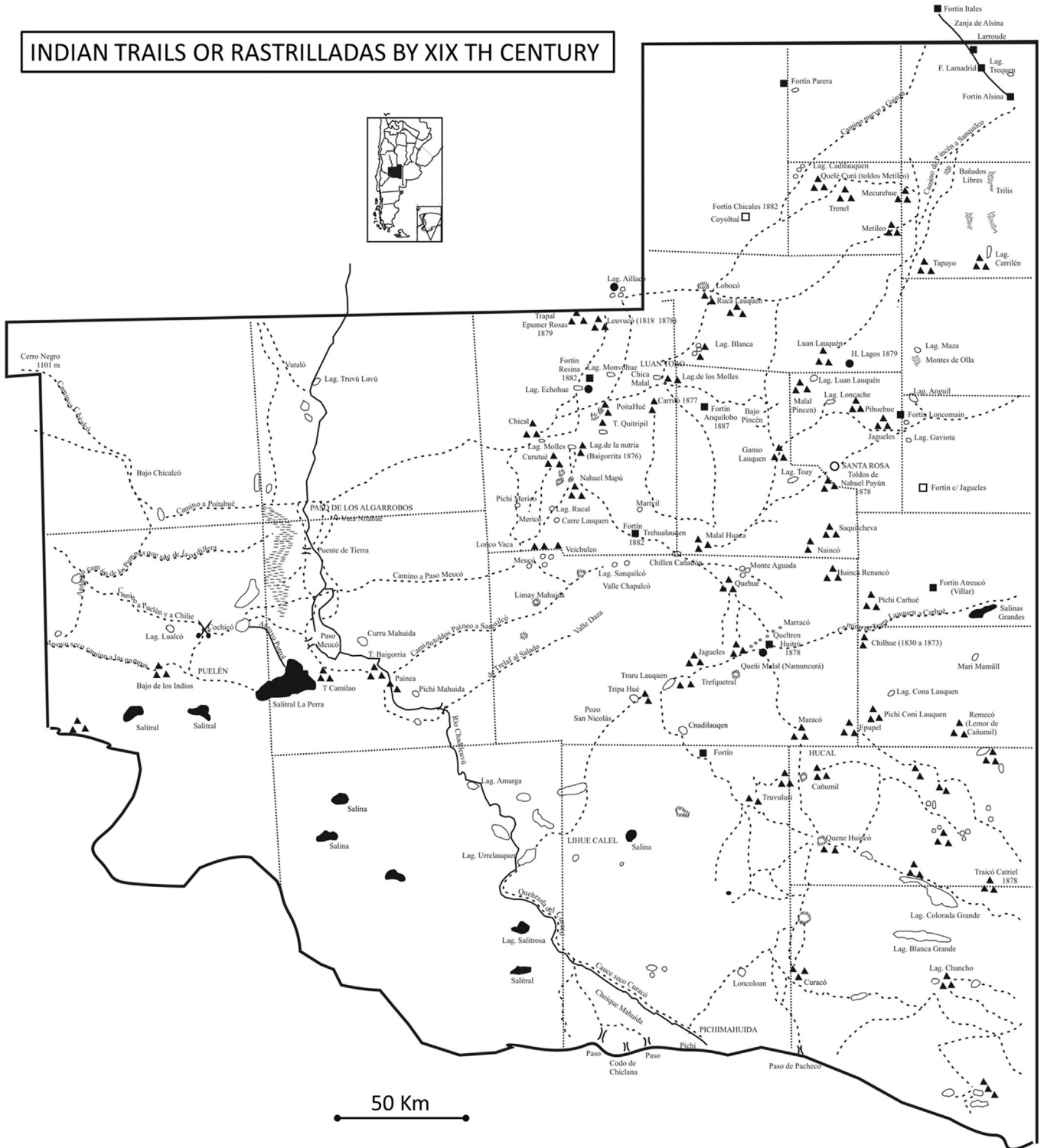


Fig. 2. Indian trails or rastrilladas, by XIX th century. Taken and modified from Marini de Diaz Zorita 1982.

landscape is governed by the structural control imposed by the Lihue Calel and Sierra Chica hill ranges. The maximum elevation is Cerro Sociedad, 589 m asl. Its geomorphology indicates the establishment of a more favorable and moist microclimate than the semiarid adjacent areas. The mountain relief helps to retain water from the scarce rainfall and moderate summer temperatures, leading to the existence of numerous waterholes, some of them

standing permanently in the area. This makes possible the existence of a varied flora and fauna [Inventario Integrado de los Recursos Naturales de la Provincial de La Pampa (IIRN), 1980].

Precisely in the Lihue Calel and Sierra Chata Hills there are numerous and varied archaeological sites, of diverse functionality. One of the most relevant is Chenque I cemetery, a formal funerary structure used by different populations of hunter – gatherers

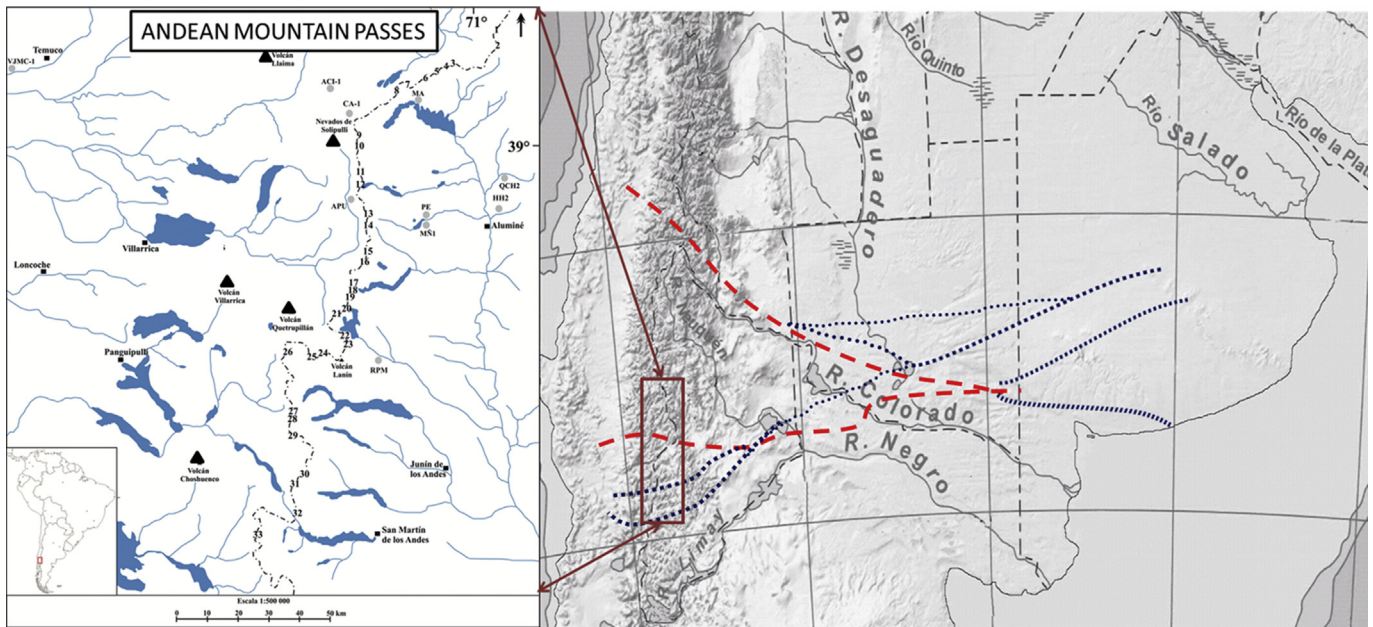


Fig. 3. Andean mountain passes and interaction corridor, 32° to 40° S. Taken and modified from Salazar Siciliano and Berón (2013). Main sites mentioned in the map: VJMC-1: Villa JMC-1. ACI-1: Alero Cabeza de Indio-1. CA-1: Carilafquen-1. APU: Aleros de Purranque 1, 2, 3. MA: Montículo Angostura. PE: Peutué. MN1: Mariñanco 1. QCH2: Quilachanquil 2. HH2: Huiñ-Huiñ 2. RPM: Recintos pircados del río Malleo. Mountain passes numbered on the map, between 38° 45' and 40° 30' S: 1-Paso Internacional de Pino Hachado, 2- Paso de Mallín chileno, 3- Paso del Arco Norte, 4-Paso del Arco, 5- Portezuelo Sin Nombre, 6- Paso Batea Mahuida, 7- Paso Mallín de Icalma (o de Coipocahué), 8- Paso Internacional de Icalma, 9- Paso de Llaima (o de Los Cruceros o de Santa María), 10- Paso de Nellocahuí, 11- Hito IX-18b, 12- Paso de Reigolil, 13- Portezuelo de Coloco, 14- Paso de Malalco, 15- Paso Rilul I, 16- Paso Rilul II, 17- Paso de Huirindil, 18- Anihuerahui I, 19- Anihuerahui II, 20- Paso Tromen I, 21- Paso Tromen II, 22- Portezuelo de Quillehué, 23- Paso Internacional Mamuil Malal (o Tromen o Villarrica), 24- Paso de Paimún, 25- Paso Carilafquen, 26- Paso de Quetru, 27- Paso Internacional de Carrirñe (o Liquiñe), 28- Paso de Oconi, 29- Paso de Lipinza, 30- Paso de Quelguenco, 31- Paso Pirehueico, 32- Paso Internacional Hua-Hum (o Riñihue o Choshuenco), 33- Paso de Ilpela (o de los Contrabandistas o Rancho).

during 700 hundred years (between 1050 and 290 years BP) (Berón, 2004; Berón and Luna, 2007; Luna, 2008; among others).

West and eastward of the Chadilevú riverbed, this depressed portion of the regions is spotted with isolated hills to a maximum height of 1000 m asl: Torres, Centinela, Colon, Pichi Choique Mahuida and Cerro Negro Hills, among others, as well as high rock formations as Carapacha Grande (319 m asl) and Carapacha Chica (287 m asl) Hills. They constitute outstanding places in the landscape, important for good visibility and as rock quarries. An example is the Pichi Choique Mahuida hill, constituted by riodacita, a good quality rock employed locally for manufacturing artifacts. But the most important quarry in the region is Meseta del Fresco, a chert source that was recurrently recorded in the archaeological assemblages of different sites and widely used by hunter – gatherer groups from the Pampas as a source of raw material (Berón, 2006a; Carrera Aizpitarte et al., 2015).

4.4. Transversal valleys

A remarkable geomorphological feature is the occurrence of a series of large depressions with a general NE–SW directedness, on the central eastern limit of La Pampa province. They are known as Transversal Valleys, of probable aeolian origin, that cut across the structural plain and have been carved into late Miocene deposits (Malagnino, 1989; Calmels, 1996, Fig. 1). They are major geoforms, 60–100 km long and 80–100 m deep, surrounded by vegetated dune fields, and organized in very large dune complexes, 10–24 km long, about 2 km wide and up to 40 m high (Zárate & Tripaldi, 2012). Transverse Pampean Valleys system has a dry subhumid water regime, with an average annual rainfall of 450–600 mm. The characteristic vegetation is an open forest of *Prosopis caldenia*, *sammofilo* grasslands, and *halofilo* scrubs, offering a wide range of biotic resources.

From a cultural perspective, we have proposed that the valleys would have worked as corridors of social communication between populations of two subregions of the Pampas, eastern and western, as well as major physiographic features in the delimitation of territories (Berón, 2004; Berón et al., 2006; Berón et al., 2015a). This assertion is based on the differential composition of archaeological contexts in this area, principally dominated by ortoquartzite end and side scrapers, proper of Humid Pampa, as well as drag and jab decorated pottery. A total of 15 archeological sites share these characteristics and most are associated with permanent or temporary sources of drinking water. Four chronological dates have been obtained, ranging from 600 to 1900 years BP (Berón et al., 2015a).

4.5. Surface water resources

As stated above, in addition to rivers with insufficient or no drainage, there are other water bodies of lesser magnitude, such as ponds, streams, springs, salt flats and salt marshes. A quick view of them allows us to observe the wide variations existent as to size, durability, features and so on. In the case of lagoons, salt marshes and salt flats, transition can exist from one form to another depending to the extent of rainfall (Fig. 1).

Lagoons can be fed by rainfall, springs, streams and rivers, and have a variable extension, going from 10,000 ha the largest lagoon called La Amarga, located in vicinity of Puelches, to the smallest and ephemeral that arise after rain that is stored in low or depressed areas. The total amount is over half a mile, although this amount varies depending on annual rainfall. In drought conditions many of them disappear, and reappear again when the rainfall regime increase. The major presence occurs in eastern and center of the provincial territory, although the largest group of lakes is situated in the center-south area. In general, the basins are characterized by

a shortage of flow, with evaporation and infiltration primarily responsible for the loss of surface flows.

In the west of the study area, in the region of the basalt plateau, there are more than fifty springs like Puelén, La Copelina, Buta Ranquil, Chos Malal, Agua de Torres and Los Carrizales (Bisceglia, 1977). The first is permanent and very abundant. Actually feeds a pipeline extending from Puelén to La Reforma and Chacharramendi, with a branch to Puelches. In dune fields areas, “water-holes” or small springs are found, that feed from the discharge of dune areas, while in the valleys and depressions tend to arise at the foot of cliffs or slopes of the terraces. One of the most important pond is that associated to Tapera Moreira Locality (38° 33′ S y 65° 33′ O), a group of six archaeological sites with different characteristics and functionalities. The Site 1 is a campment of diversified activities and recurrent use along the Holocene that span ca. 5000 to 300 years BP. Although they are located on the Curacó river bank, of irregular regime and salty water, undoubtedly it is the presence of a permanent spring which ensured the water supply (Fig. 1).

Regarding the presence of streams, land conditions and prevailing rainfall patterns make the amount of these resources be quite reduced. In the East the streams are mostly fed by springs, rarely exceeding 10 km long, so its volume is minimal, except in case of exceptional rainfall. The most prominent are Traicó Chico which contributes to saline Colorada Grande, and the ones feeding the salines Blanca Grande, Salinas Grandes and Guatraché lagoon. In the transverse valleys there are little channels that carry water only on the occasion of rainfall, highlighting the stream Netrafó which originates near Quehué and reaches the Luro Park lagoon.

In the mountains of Lihue Calel, the Namuncurá and Sierra streams collect water from rainfall. In the northwest, the Atuel River Delta generates streams, as in the case of Arroyo de la Barda, the only channel through which the waters flow, sporadically arriving in La Pampa. Also worth mentioning the Potrol stream, fed by water infiltrating from the Atuel River flows into the Grand Salitral.

In recent years, as a result of the declaration of wetlands as one of the protected ecosystems by international conservation programs (RAMSAR Convention), the Provincial Reserve Nochilei Co, was created in April 25, 2013, in order to protect the wetlands area which are preserved in the north end of La Pampa, around the runway of Atuel river (Mariani et al., 2013).

4.6. Indian trails or *rastrilladas*

All this complex and variable system of resources, dwellings, stopping points, springs, waterholes, permanent or temporary ponds, pools, salines, dune fields, hill ranges, quarries, associated to human settlements, cemeteries, funerary places, campsites and hunting and special tasks areas, were linked by a system of ancient Indians tracks or “*rastrilladas*”, (*rupü* in Mapuzungun), that constituted a true network that stretched from the Atlantic Ocean to the Andes (Fig. 2). There were main roads as Camino de los Chilenos, Camino de la Travesía, Rastrillada de las Pulgas, Rastrillada de las Víboras, Camino de la Derechura; and secondary roads linking each other and forming a real road network that sustained different types of social interaction. The main *rastrillada* or indigenous path, known as the “road of Chileans” (Camino de los Chilenos), was structured from east to west, following the landform of the Argentine Valley and connecting various strategic sites located from Buenos Aires fields to Chile, through the mountain passes, including the Salinas Grandes in its way (Barba, 1956; Marini de Diaz Zorita, 1979; Berón & Migale, 1991; Berón et al., 2006; Curtoni, 2007; Mollo & Della Mattia, 2009).

5. Discussion and conclusions

Archaeological investigations in Western Pampas account for the development of human communities from early times in the Holocene. During Early Holocene only exploratory incursions were recorded but by the end of the Middle Holocene (from ca. 5000 BP), there are records of continued colonization and recurrent use of an encampment, and eventual forays or special uses of diversified landscapes until the end of the Late Holocene (ca. 300 BP) (Berón, 2015). The availability of water sources and other attractors as salines, quarries or temporal lagoons gave rise to these situations.

While the chroniclers and travelers considered this region as one of the most hostile crossings of Pampean environment (called *La Travesía* or “The crossing”), the crossroads of Indian trails or *rastrilladas* pointed, articulated and connected places that mitigated its hostility, such as dune fields, springs, hill ranges, natural pools, temporary or permanent ponds. It is around these reservoirs where archaeological evidence of prehispanic human activity is recorded, sometimes ephemeral, in other of recurrent use, in the way of “stopping points” (Schlanger, 1992).

The intensive environmental dynamics in La Pampa province, dominated by wind erosion, have produced a fragmentary archaeological record. Anyway it is possible to discuss the mobility and social organizational patterns recorded alongside this particular scenery.

The middle basin of Colorado River, the only permanent fluvial resource, has the oldest record of human colonization (ca. 8600 years BP), but a discontinuity of chronological records between Middle and Late Holocene. In Lihue Calel and Sierra Chica hill ranges i.e., the geomorphology enables the establishment of a more favorable and moist microclimate than the semiarid adjacent areas, leading to the existence of numerous waterholes, some standing permanently in the area. Concordant with this, there is a variable archaeological record that includes long use and occasional campsites, cemeteries, rock art manifestations, rock structures, quarries and so on. In other cases, as in the Curacó Basin, the availability of an abundant and permanent water spring gave rise to a continuous or recurrent occupation from the end of Middle to Late Holocene (5000–300 years BP). Eastern La Pampa province concentrates small permanent or temporary pools, surrounded by dunes, where signs of human settlement are abundant for Late Holocene (Berón, 2015; Berón et al., 2015a). Furthermore there are several areas covered by edible salt deposits, which were a major pull factor for human groups from different origin and in different chronologies.

The chronological distribution of radiocarbon dates indicates an early colonization of the southern end of this large territory (ca 8600 yr BP), a gap of information between ca. 6500 and 5500 yr BP (ca. 6000–5000 according to radiocarbon ages), and a re-colonization from 5000 yr BP onwards (Berón, 2004, 2015). At macro-regional scale, there is a hiatus of information for the mid-Holocene in neighboring regions: south-central Mendoza (ca. 7500–4000 BP, Gil & Neme, 2010), Western Pampa (ca.6000–5000 BP; Berón, 2004), and subtropical Andes (Mendez Melgar et al., 2015). This gap in southern Andean region has been attributed by some authors to the effects of volcanism, that could have produced significant areal disasters (Durán, 1997; Durán & Mikkani, 2009), while others believe that the main motivation was the alternating periods of increased aridity, which caused the absence of archaeological records as a result of a change in human strategies, in response to changing conditions in the regional structure of resources (Durán, 2002; Gil et al., 2005; Garvey, 2008; Gil & Neme, 2010). At the Tapera Moreira locality, the lowest levels are enriched with volcanic ash of all sizes which is correlated with a total absence of evidence. Therefore, it represents the period when

Tapera Moreira Site 1 was first used consistently. Probably this gap of information during mid-Holocene is a phenomenon linked to the south Andean region and the surrounding area. While it had been stated that there was a gap of information in the middle Holocene in Southeastern Pampa (Barrientos, 2001; Barrientos & Pérez, 2002), recent research contradicts this assumption and several archaeological sites dated in this period have been located and published during the last years, pointing a continuous archaeological signal of human occupation in southeastern Pampas (Politis, 2014; Martínez et al., 2015; Mazzanti et al., 2015).

Borrero (2005), analyzing the case of the deserts of northwest Patagonia, at the same latitude of western Pampas, with similar environmental conditions and early Holocene ephemeral occupations, points that the costs of colonizing these deserts could be higher, compared with earlier examples of colonization, as were far less inviting environments for human occupation. And proposes that during drier periods there was probably a strong pressure on resources located close to the basin (Borrero, 2005: 151). This may be the case of western Pampas in Early Holocene as well as in a period of increasing aridity during Late Holocene, as we detail below, where chronological hiatuses exist.

During the Early Holocene and beginning of Middle Holocene the only occupation dated in Western Pampa is the Site 1 of Casa de Piedra Area, in the middle valley of the Colorado River (Fig. 1). The 14C dispersion curves obtained on this site indicate an early stage of colonization of this space which is continued in the early middle Holocene. At the base of the Lower Occupations, two 14C dates, which yielded ages of 8620 BP and 7560 BP, were obtained. At the top of the Intermediate Occupations, a third 14C date of 6080 BP was obtained. Unfortunately, the upper part of the stratigraphic sequence at Site 1 was not dated (Gradín et al., 1984).

The Medium Holocene frame corresponds to the Curacó River Basin, where most of the archaeological sites are superficial, but there is an extensive chronological and cultural sequence in the Tapera Moreira Locality, ranging from 5000 BP until the end of the Late Holocene (ca. 300 BP). So the Curacó area seems to be the only area of the subregion with records of continued colonization and recurrent use of an encampment due to the availability of an abundant and permanent pond (Berón, 2015).

During final Late Holocene Casa de Piedra repopulates, continues the occupation of the Curacó area and new spaces are colonized such as mountainous area of Lihué Calel. Paleo-environmental records of southeastern La Pampa and southern Mendoza indicate that during the last 1000 years occurs alternating warmer and dry cycles, some more severe than others (Villalba, 1994; Schabitz, 1994, 2003). That is probably the time of occupation of other areas such as the Chadileuvú lower basin (Berón, 1998) and most sites recorded in the West Pampa Basaltic Plateau (Aguerre, 2002), which still have no radiocarbon dates.

Late Holocene is better represented in all microareas, but the best records have been obtained in two sites, the upper component of Tapera Moreira site 1 and a funerary structure called Chenque I. We choose the last one to make a state of knowledge.

Chenque I is situated in Lihué Calel hill range, where the geomorphology enables the establishment of a more favorable and moist microclimate than the arid adjacent areas, leading to the existence of numerous waterholes, some standing permanently in the area. Chenque I site is a prehispanic cemetery of hunter-gatherers in which 25 radiocarbon dates are available as well as about 73 isotopic values ($\delta^{13}\text{C}_{\text{col}}$ n = 28; $\delta^{13}\text{C}_{\text{AP}}$ n = 16; $\delta^{15}\text{N}$ n = 19; $\delta^{18}\text{O}$ n = 10; Berón et al., 2009, 2013). It began to be used exclusively as cemetery ca. 1000 years BP and continued with the same functionality up to ca. 300 years BP. However, a gap in use between 700 and 435 years BP was identified in Chenque I site, that coincides with a period of intensification of aridity, which

could be correlated with an abandonment of that territory by the people who used this cemetery, perhaps moving to other areas (Fig. 1).

In neighboring areas but on the margins of permanent water resources were located other burial structures during this period, such as Paso Alsina 1 (500–450 years BP), La Petrona (ca. 800–250 years AP), (Martínez et al., 2006; Flensburg et al., 2011), and Médano Petroquímica (Mendonça et al., 2010) over the Colorado River; Añelo cemetery (actually named as Loma de La Lata site) in the north of Neuquén (740 ± 40 y 600 ± 60 years BP, Biset, 1989, Pérez et al., 2009) and Laguna Los Chilenos 1 in southern Buenos Aires (476 ± 80 AP, Barrientos et al., 1997) which partially cover the gap chronologies recorded in Chenque I site. After this hiatus, the chronological distribution of events in the Chenque I site re-focuses between 400 and 290 years BP, the latest period of use of the cemetery. So far there have been no other burials during this period in south-central Pampas, so the entombment of individuals would have concentrated on this single locus (as a reference cemetery), prior to contact with European colonizers (Berón et al., 2015b).

Moreover, there is abundant evidence suggesting extensive networks towards the Pacific side and the Atlantic coast, crossing the Andean mountain passes (Fig. 3). For example two simple burial in Chenque I cemetery, N° 17 and 19, have $\delta^{18}\text{O}$ values corresponding to high altitude like Andean region (Berón et al., 2013). One of them has a copper earring of the same features and chronology as several ones found in a cemetery called Villa JCM-1, near Temuco in Chile (Mera et al., 2015). It has signals of interpersonal violence as projectile points insert in bones. Other features of this burial suggest it was transferred from long distances in leather packages (Berón et al., 2012b).

Another evidence of long distance interaction is pottery. Two main types of decorated vessels are related to the western slope of the Andes. One type is painted, red on white, and very frequent in funerary contexts in Araucanía. The presence of fragments belonging to this bichrome ceramic tradition in contexts of Western pampas, has been interpreted as a significant cultural diacritic of intermountain social interactions (Adán et al., 2005; Berón, 2006b, 2007; Musaubach & Berón, 2012). The second type are pots for domestic use, called *challas*, in which organic residues have been analyzed, and contain corn starch grains, a domesticated plant not cultivated locally. They have also been found in Buenos Aires province, in a horse complex context (Mazzanti, 2007). We think these pots were destined to prepare “muday”, a beverage made of fermented corn or other component (wheat, apple), which is drunk and offered to people during ceremonies. The “muday” is very popular among Mapuche people, so in the past as nowadays, as referred in this testimony from Guevara (1908):

de la noche a la mañana varias jóvenes araucanas tenían frente a mi casa grandes fogatas. En cada una de estas había enormes ollas. ¿Qué tienes en esa olla? Pregunté a una mapuchita. –Es trigo para el mudai ... – (...) Llevan después sus challá, ollas, cerca de la piedra, se hincan i principian a moler al compás de un cantito (...). Al mismo tiempo que muelen van mascando sin tragar y ese producto semilíquido lo depositan en su cantarito. (...) Una vez que se ha molido todo el trigo, se coloca nuevamente la olla al fuego, i cuando ha dado el primer hervor tanto lo molido como masticado se depositan en la challa (Guevara, 1908: 114).

From the night to the morning several young Araucanian women had big fires outside my house. In each of these there were huge pots. What do you have in the pot? I asked to a *mapuchita*. It's wheat for the *mudai* ... -. (...) They later take their *challa*, pots, near the stone, they kneel and begin to

grind to the beat of a little song (...). At the same time that they grind, they begin chewing without swallowing and the semi-liquid product is deposited in their little pot. (...) Once that the whole wheat has been ground, the pots are again placed on the fire, and when the first boil is ready so much the ground as the chewed product is deposited in the cholla (Guevara, 1908: 114).

Also some rocks of good quality, characterized as chert siliceo, used to manufacture lithic artifacts, whose massive outcrop, Meseta del Fresco, is located in the west of this area, show a wide geographic distribution (Carrera Aizpitarte et al., 2015). Other rocks that appear frequently in the lithic assemblages of different micro-areas, come from long distances as 500–600 km, for example obsidian from the Andean border and orthoquartzite from Tandilia (Berón, 2006a; Giesso et al., 2008; Berón et al., 2015a). These examples account for a marked social dynamics in a large spatial scale, along beaten paths and territorial behaviors.

5.1. Conclusion

Based on the results of archaeological research conducted on both sides of the Andes, it has been proposed the existence of a dynamic interaction corridor between 32° to 39° south latitude, indicating that the Andean range is a permeable border and the mountain passes were and are important pathways of mobility since at least 1200 years ago (Berón et al., 2012c; Salazar Siciliano & Berón, 2013, Fig. 3). As Thackeray (2005) proposed: “There is indeed an increasing awareness that people make choices for personal, social, and historical reasons as much as for the need to feed themselves, and that they did not necessarily opt for what a twenty-first century archaeologist would consider the most advantageous. Nevertheless, archaeologists still tend to write about the ‘limits’ imposed by the environment and how people ‘coped’, rather than focusing on the possibilities and the choices made” (Thackeray, 2005: 174).

Archaeological record in Western Pampa account for the variability of this environment, the variety of some resources, against the randomness of other and the high mobility and social networks developed by the populations. Many similar examples suggest that a way to deal with aridity is to increase mobility. Particularly during the last 1000 years a high population dynamics was developed along an east-west bi-oceanic corridor, following the direction of the biggest fluvial basins in the region.

Acknowledgments

This research was possible by means of fundings obtained from Conicet (grant PIP-CONICET 0834), University of Buenos Aires (grant UBACYT F-540) and ANPCYT (grant PICT 0437). Also Universidad del Centro de la Provincia de Buenos Aires and Subsecretaría de Cultura de La Pampa province contributed to this research.

Many people as students, young researchers and people of the communities around the study area, were and continue to be compromised with the understanding of this desert environment.

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