



Subsistence strategies in Argentina during the late Pleistocene and early Holocene



Gustavo Martínez, María A. Gutiérrez*, Pablo G. Messineo, Cristian A. Kaufmann, Daniel J. Rafuse

INCUAPA-CONICET: Instituto de Investigaciones Arqueológicas y Paleontológicas del Cuaternario Pampeano, Facultad de Ciencias Sociales, Universidad Nacional del Centro de la Provincia de Buenos Aires, Avenida del Valle 5737, B7400JWI, Olavarría, Buenos Aires, Argentina

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ABSTRACT

This paper highlights regional and temporal variation in the presence and exploitation of faunal resources from different regions of Argentina during the late Pleistocene and early Holocene. Specifically, the faunal analysis considered here includes the zooarchaeological remains from all sites older than 7500 ¹⁴C years BP. We include quantitative information for each reported species (genus, family, or order) and we use the number of identified specimens (NISP per taxon and the NISP_{total} by sites) as the quantitative measure of taxonomic abundance. The taxonomic richness (Ntaxa_{total} and Ntaxa_{exploited}) and the taxonomic heterogeneity or Shannon-Wiener index are estimated in order to consider dietary generalization or specialization, and ternary diagrams are used to categorize subsistence patterns of particular sites and regions. The archaeological database is composed of 78 sites which are represented by 110 stratigraphic contexts. Our results demonstrate that although some quantitative differences between regions are observed, artiodactyls (camelids and deer) were the most frequently consumed animal resource in Argentina. Early hunter-gatherers did not follow a specialized predation strategy in megamammals. A variety in subsistence systems, operating in parallel with a strong regional emphasis is shown, according to specific environmental conditions and cultural trajectories.

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1. Introduction

The archaeology from different regions of Argentina has made remarkable advances due to the increase in the number of sites investigated and the consequent generation of data that has contributed to fill preexisting spatial and chronological gaps. The economy of early hunter-gatherers has been mainly based on the zooarchaeological record. These investigations have improved the significance of subsistence studies in the last two decades. At the same time, the current zooarchaeological record of Argentina has a broad temporal and spatial distribution. This situation has encouraged a new integration of data, testing of existing models, and reformulation of the faunal exploitation tendencies formerly proposed. The aim of this paper is to present a detailed and updated database of the faunal distribution associated with archaeological sites in Argentina during the late Pleistocene and early Holocene

(ca. 12,500 to 7500 ¹⁴C years BP). This information will be discussed in order to evaluate previous subsistence patterns related to early human occupations (Borrero, 2009; Gutiérrez and Martínez, 2008; Miotti and Salemme, 1999; Quintana and Mazzanti, 2001; Salemme and Miotti, 2008; Yacobaccio, 2013). The main goal of this paper is to highlight regional and temporal variation in the human exploitation of faunal resources during the above mentioned period, as well as human-megafauna predation strategies and their degree of interaction. Issues discussed include a summary of zooarchaeological evidence (sites, location, chronology, species distribution, etc.) and the major faunal exploitation patterns at a regional scale. In this paper, we integrate faunal information from all the archaeological regions in order to build an integrated subsistence model for early human occupations of Argentina. We describe the major trends found in the regional economies and subsistence patterns. According to the particularities of each regional zooarchaeological assemblage, the conditions under which the database are built and the applied methodologies are specified. Finally, temporal and spatial trends of the regional economies are discussed.

* Corresponding author.

E-mail address: mgutierrez@soc.unicen.edu.ar (M.A. Gutiérrez).

The physical boundaries of Argentina extend between 22° and 55° S (ca. 2.8 million km²). Based on environmental characteristics, six main regions are defined from north to south: 1) Northwest, 2) Northeast, 3) Chaco, 4) Central-West, 5) Pampas, and 6) Patagonia including Tierra del Fuego (Fig. 1) (Prates et al., 2013). The Northwest region includes several subregions: the Puna or altiplano, the valleys and gorges, and the subtropical forest. The Central-West region includes the mid-altitude mountain ranges (*Sierras Centrales*), and the pre-cordillera and the eastern slope of the Andes. The Pampas region is a grassland plains with a flat to gently undulating landscape. Most of Patagonia is a dry/cold steppe plateau deeply cut by rivers, while the western sector includes the forest and the steppe-forest ecotone.

A great variety of climatic conditions affected the studied regions, but a general trend of extreme climatic changes and environmental instability is proposed for the time of human arrivals (Borrero, 2008; Martínez et al., 2013). After the retreat of the

Pleistocene glaciers in ca. 14,000 BP, a warmer trend was initiated, that was interrupted by a cold and arid pulse around 11,000 BP, although this event would have commenced earlier in southern Patagonia, where the influence of the Antarctic Cold Reversal was significant (McCulloch et al., 2005). The hostile climate eventually improved during the Early Holocene (Walker et al., 2012). Detailed paleoclimatic trends of each region will not be described here due to space constraints but can be consulted elsewhere (Bargo et al., 2010; Borrero, 2008; Fernández et al., 2012; Mancini et al., 2013; Mansilla et al., 2016; Martínez et al., 2013; Yacobaccio, 2006, 2013; among others).

2. Faunal records, models and trends in subsistence associated to early human occupations in Argentina

For the Northwest of Argentina (ca. 22° S to 27° S), almost all records of early human occupation are exclusively located in the

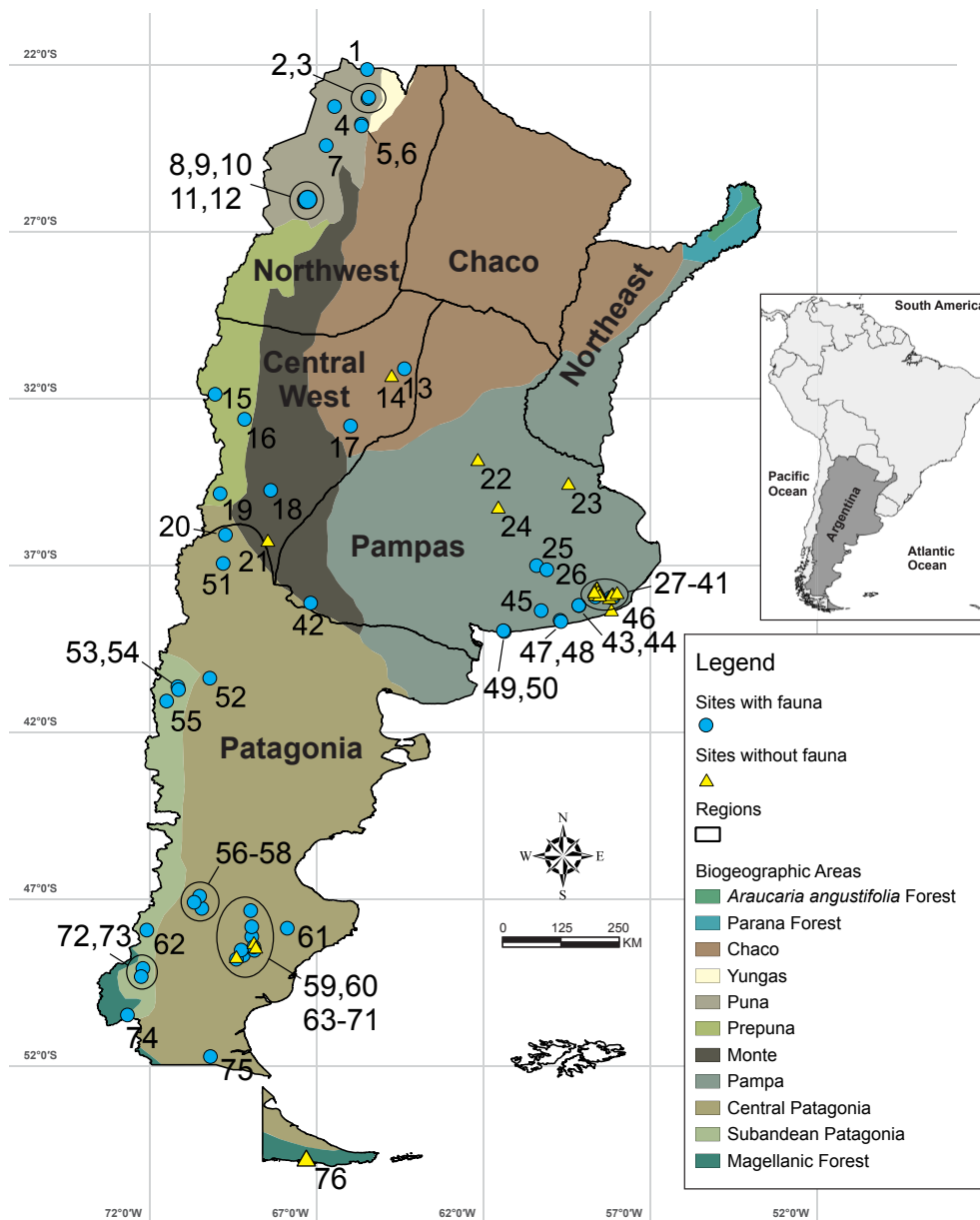


Fig. 1. Map of Argentina showing the limits of the biogeographic provinces (see Morrone, 2001), archaeological regions, and the location of sites discussed in this paper. Site identification numbers are shown in Table 1.

Puna environment, with occupations being virtually absent in the valleys and the lowlands (Martínez, 2012). Zooarchaeological evidence indicates important changes in resource exploitation and consumption during the Early (11,000–8200 ¹⁴C years BP) and Middle Holocene I (8200–6200 ¹⁴C years BP) (sensu Yacobaccio, 2013), characterized by an increase in the use of camelids and a reduction of Chinchillidae Family. This change, together with other lines of evidence, suggests an economic specialization in camelid which later resulted in the domestication of these artiodactyls (Aschero and Martínez, 2001; Yacobaccio, 2006, 2013).

For the Central-West of Argentina (ca. 28° S to 36° S), the earliest evidence of human occupation is located in the *Sierras Centrales* and the pre-cordillera and eastern slopes of the Andes. In the *Sierras Centrales*, data for human occupation during the late Pleistocene and early Holocene period (ca. 11,000–9000 ¹⁴C years BP) is scarce (Rivero, 2010, 2012; Rivero and Berberían, 2008). During this time, hunter-gatherers adopted a generalized diet that included some species of megafauna and an emphasis on gregarious animals and high-rate return resources (camelids and deers). For the early Holocene, all animals recovered belong to modern species, with a focus on hunting guanaco and gathering plants (Rivero, 2010; Rivero and Berberían, 2008). In the pre-cordillera and eastern slopes of the Andes, occupation emerged during the early Holocene (ca. 9000 ¹⁴C years BP), and the zooarchaeological evidence indicates the consumption of modern fauna, especially camelids and greater rhea. Guanacos were important in the diet of human groups, accompanied by chinchillas and other small rodents (Neme and Gil, 2008). The increase in plant consumption for this moment is inferred from findings of grinding tools (Berberían and Calandra, 1984).

For the Pampas region of Argentina (ca. 31° S to 39° S), a generalized regional economy based on a wide-ranging diet and a broad spectrum of resource exploitation has been proposed for the late Pleistocene and early Holocene period (ca. 12,000–7000 ¹⁴C years BP) (Gutiérrez and Martínez, 2008; Miotti and Salemme, 1999; Politis and Messineo, 2008). Previous research by Gutiérrez and Martínez (2008) suggested that the subsistence was mainly focused on artiodactyls (guanaco and deer), followed by small mammals and birds; whereas the role of megamammals was marginal. For the late Pleistocene and early Holocene period, taxonomic diversity and richness are greater compared to the middle Holocene, which has been characterized by a specialized regional economy (Gutiérrez and Martínez, 2008).

Archaeological evidence indicates that human peopling of northern Patagonia (ca. 36° S to 44° S) took place during the Pleistocene-Holocene transition (Barberena et al., 2015; Borrero, 2009; Salemme and Miotti, 2008). With the exception of just one site dated in ca. 10,600 ¹⁴C years BP (El Trébol site), which contains bone remains of fish, birds, huemul and Mylodontinae (Lezcano et al., 2010), the remaining sites of this region are dated to the early Holocene (Arias Cabal et al., 2012; Barberena et al., 2010; Cordero, 2009, 2011; Crivelli Montero et al., 1993, 1996; Hajduk et al., 2004, 2007; Lezcano et al., 2010). Modern species characterize the faunal assemblages, including guanaco, flightless birds, fox, plains viscacha, fish, mollusk, and other small rodents. There is also evidence for the exploitation of plant resources. The bone assemblages are informative of the different environments used by the earliest humans of northern Patagonia, including the steppe, the forest, and the steppe-forest ecotone. In summary, archaeological evidence of northern Patagonia shows that the guanaco was not necessarily the main resource consumed by early human populations. Plants, foxes, and other small mammals appear as important, and suggest the existence of adaptations not simply focused on large mammals (Borrero, 2008; Cordero, 2011; Lezcano et al., 2010). For southern Patagonia (ca. 44° S to 54° S) most dates

assigned to early human occupation fall between ca. 11,000 and 10,000 ¹⁴C years BP (Prates et al., 2013; Salemme and Miotti, 2008). With the exception of the Andean foothill sites, extinct Pleistocene fauna are recorded in several sites (Borrero and Martin, 2012; Miotti and Salemme, 1999; Miotti et al., 1999; Paunero et al., 2010). Modern species are represented mainly by guanaco, flightless birds (*Rhea americana* and *Rhea pennata*), and deer. Smaller species (foxes, birds, fish, and rodents) are also recorded but in lower frequencies and are not considered as significant resources for early humans. In conclusion, hunter-gatherers from north and south Patagonia evolved as generalists during the late Pleistocene and early Holocene, and then shifted toward specialists during the middle Holocene (Miotti and Salemme, 1999; Salemme and Miotti, 2008).

3. Material and methods

The archaeological sites and their stratigraphic contexts considered in this paper are listed in Table 1 and mapped in Fig. 1. Late Pleistocene and early Holocene zooarchaeological evidence is available for the Northwest, the Central-West, the Pampas, and the Patagonia regions. The northeastern part of Argentina, Chaco and Northeast regions, and the coast of continental and insular portion of Patagonia do not contain zooarchaeological data for this time period. In order to interpret geospatial patterns, we describe sites by archaeological regions (Prates et al., 2013), biome location (Morrone, 2001), and altitude (in meters above sea level). The chronological range chosen for faunal analysis includes all sites older than 7500 ¹⁴C years BP or 8200 cal years BP, the date considered as the boundary between early and middle Holocene (see Walker et al., 2012:651–653).

All radiocarbon dates that are accepted by authors in the original contributions are incorporated into the database, and we exclude those dates which were directly rejected by these same authors (e.g., outliers, probable contamination, ambiguous evidence, etc.). In relation to the chronology, we describe the maximum, minimum, and the number of radiocarbon dates (non-calibrated) corresponding to each stratigraphic context (layer, unit, level, burial, features, etc.).

The zooarchaeological database is assembled from only published information, and for each site we report if the stratigraphic context presents faunal remains or not. For building our database, we registered the presence of all faunal remains associated with the stratigraphic context as published by the authors. We included mammals, birds, reptiles, amphibians, fish, and mollusks remains (plant vestiges were noted, however they were not quantified here). We also registered those species with evidence of human exploitation (e.g., presence of butchering marks, anthropic fractures, culturally burned bones, hearth association, and bones introduced by humans), as considered in the original contributions. Consequently, determination of which taxa were actually exploited is not easy to interpret; factors such as age of discovery, excavation and research techniques are not always comparable (Cannon and Meltzer, 2004; Lyman, 2013). One of the most problematic concerns with determining which taxa were exploited is in the evaluation of evidence or what Surovell and Waguespack (2009) call *textual taphonomy* or “the evaluation of taphonomic factors on the basis of published text and images” (Surovell and Waguespack, 2009:85). In an attempt to treat all faunal remains equally, we agree with these authors that “it is difficult to equally apply the same criteria to all sites, and as such, one is likely to introduce additional research bias into the data” (Surovell and Waguespack, 2009:92). Although our database likely includes naturally deposited bones, with this approach we avoid eliminating taxa that were actually being exploited. While other methodological approaches

Table 1
Archaeological sites from Argentina (location, chronological data, and faunal exploitation).

Site	ID	Biomes	Altitude msnm	Stratigraphic context*	N° ¹⁴ C	Maximum	Minimum	Faunal	References	
Northwest										
La Cueva de Yavi	1	Puna	3412	–	7	10,450 ± 55	8320 ± 260	WPI	Grosjean et al., 2007	
Pintoscayoc 1	2	Puna	3800	Layer 6 base	2	10,720 ± 150	10,340 ± 70	Yes	Rosenfeld, 2002	
				Layer 6 top	2	9190 ± 110	9180 ± 230	Yes		
				Burial structure	1		9080 ± 50	No		
				Layer 5 base	1		7850 ± 110	Yes		
Inca Cueva 4	3	Puna	3650	Layer 2 and 1b	5	10,620 ± 140	9230 ± 70	Yes	Yacobaccio and Morales, 2011	
Hornillos 2	4	Puna	4020	Level 6	3	9710 ± 270	9150 ± 50	Yes	Yacobaccio et al., 2013	
				Level 4	1		8280 ± 100	Yes		
				Level 3	2	7760 ± 160	7430 ± 80	Yes		
León Huasi 1	5	Puna	3800	–	1		10,550 ± 300	WPI	Fernández Distel, 1989	
Huachichocana III	6	Puna	3400	Layer E3	4	10,200 ± 420	8620 ± 130	Yes	Yacobaccio and Morales, 2011	
Alero Cuevas	7	Puna	4400	F4	3	9650 ± 100	8504 ± 52	Yes	López, 2008	
Cueva Salamanca 1	8	Puna	3650	Level 10	1		8100 ± 50	WPI	Martínez et al., 2010;	
				Level 7	1		7620 ± 60	WPI		
				Level 5	1		7550 ± 60	WPI		
				Level 4	1		7500 ± 60	WPI		
Punta de la Peña 4	9	Puna	3543	Layer 7	1		8970 ± 60	Yes	Rodríguez et al., 2003	
Quebrada Seca 3	10	Puna	4050	Layer 2b25–2b19	4	9790 ± 50	9050 ± 90	Yes	Elkín, 1996	
				Layer 2b18–2b15	3	8660 ± 80	8330 ± 110	Yes		
				Layer 2b14–2b11	4	8670 ± 350	7150 ± 110	Yes		
Peña de las Trampas 1.1	11	Puna	3582	Unit 3E	2	10,190 ± 190	10,030 ± 100	WPI	Martínez, 2012	
				Burial structure 1	4		8440 ± 40	8140 ± 30	No	
				Burial structure 2	3		8210 ± 30	8000 ± 30	No	
Peñas de la Cruz 1.1	12	Puna	3665	Level 3	1		7910 ± 100	WPI	Martínez, 2005	
Central-west										
Gruta de Candonga	13	Chaco	900	Layer G base	1		10,450 ± 50	Yes**	Cornejo et al., 2014	
El Alto 3	14	Chaco	1650	Component 1A	2	10,010 ± 80	9790 ± 80	No	Rivero, 2012	
Colorada de la Fortuna	15	Prepuna	3340	–	1		8160 ± 160	WPI	García, 2009	
Agua de la Cueva	16	Prepuna	2900	Unit 2 Layer 2b	2	10,950 ± 190	9210 ± 70	Yes	García, 1998, 2003a	
Intihuasi	17	Chaco	1535	Unit IV	2	8068 ± 95	7970 ± 100	Yes**	González, 1960	
Gruta del Indio	18	Monte	660	Unit Atuel IV	27	10,950 ± 60	7430 ± 90	Yes	Gil and Neme, 2010	
				Unit Pre-Atuel III	1		7860 ± 90	No		
Arroyo Malo 3	19	Prepuna	2000	Unit C	5	8900 ± 60	7650 ± 50	Yes	Neme, 2007	
El Chancho 1	20	Monte	760	Layer 1	2	11,750	10,450	No	Neme et al., 2009	
Cueva Delerma	21	Monte	1187	Unit D/F	1		7650 ± 70	No	Gil, 2006	
Pampas										
Laguna El Doce	22	Pampa	120	Burial	1		8274 ± 68	No	Ávila, 2011	
Arroyo de Frías	23	Pampa	30	Burial	2	10,300 ± 60	9520 ± 75	No	Politis and Bonomo, 2011	
Laguna de los Pampas	24	Pampa	84	Burial 1	2	8971 ± 77	8835 ± 83	No	Politis et al., 2012	
Campo Laborde	25	Pampa	170	Archaeological deposit	4	8090 ± 190	7750 ± 250	Yes	Politis and Messineo, 2008; Scheifler et al., 2015	
La Moderna	26	Pampa	203	Lower levels	5	8356 ± 65	7448 ± 109	Yes	Politis and Gutiérrez, 1998	
Cerro El Sombrero abrigo 1	27	Pampa	398	Unit 1	4	10,725 ± 90	10,270 ± 85	No	Mazzia, 2011	
Cueva Zoro	28	Pampa	404	Lower levels (1° occupation)	2	10,153 ± 61	10,094 ± 62	No	Mazzia, 2011	
				Ephemeral occupation	1		8859 ± 64	No		
El Ajarafe	29	Pampa	350	Early occupation	2	8787 ± 41	8574 ± 42	No	Mazzia, 2011	
Los Helechos	30	Pampa	350	–	1		9640 ± 40	No	Mazzia, 2011	
Cueva La Brava	31	Pampa	180	Unit 3	1		9670 ± 120	No	Mazzanti, 1999	
Alero El Mirador	32	Pampa	195	Unit 4	1		8920 ± 37	No	Mazzanti et al., 2013	
Abrigo Los Pinos	33	Pampa	180	Unit 3	4	10,465 ± 65	8750 ± 160	No	Mazzanti et al., 2013	
Cerro La China 1	34	Pampa	158	Unit 3	5	10,804 ± 75	10,525 ± 74	Yes	Mazzia, 2011	
Cerro La China 2	35	Pampa	165	Unit 3	2	11,150 ± 135	10,560 ± 75	No		
Cerro La China 3	36	Pampa	178	Unit 3	1		10,610 ± 180	No		
Cueva Burucuyá	37	Pampa	180	Unit 3	1		10,000 ± 120	No	Mazzanti et al., 2013	
Cueva Tixi	38	Pampa	200	Layer E base	2	10,375 ± 90	10,045 ± 95	Yes	Mazzanti and Quintana, 2001;	
Cueva El Abra	39	Pampa	170	Lower component	1		9834 ± 65	Yes	Quintana et al., 2003	
Lobería sitio 1	40	Pampa	155	Unit 6b	1		9787 ± 81	No	Mazzanti et al., 2010	
				Unit 6a	2	7921 ± 44	7888 ± 54	No		
				Transition Unit 4–3	1		10,425 ± 75	No		
Amalia sitio 2	41	Pampa	93	Unit 3 middle	1		7700 ± 65	No	Martínez and Osterrieth, 2003	
Casa de Piedra 1	42	Monte	250	Lower occupations	2	8620 ± 190	7560 ± 230	Yes	Gradín, 1984	
Paso Otero 5	43	Pampa	83	Unit CgB6-AC6-Ab6	3	10,440 ± 100	9560 ± 50	Yes	Martínez and Gutiérrez, 2011	
Paso Otero 4	44	Pampa	81	Lower levels	5	9283 ± 83	7314 ± 73	Yes	Alvarez et al., 2013	
Arroyo Seco 2	45	Pampa	110	Unit Y/S	11	12,240 ± 110	11,190 ± 110	Yes	Politis et al., 2014	
				Unit S	3	11,320 ± 110	11,000 ± 100	Yes		
				Unit Z	10	8390 ± 410	7043 ± 82	Yes		
				Unit S/Z	1		7388 ± 74	Yes		

Table 1 (continued)

Site	ID	Biomes	Altitude msnm	Stratigraphic context*	N° ¹⁴ C	Maximum	Minimum	Faunal	References
Meseta de Chocorí	46	Pampa	5	Unit Y	2	8461 ± 74	7540 ± 80		
El Guanaco 1	47	Pampa	25	Burial 1	1	7623 ± 78		No	Politis and Bonomo, 2011
El Guanaco 2	48	Pampa	28	Unit 2	2	9250 ± 40	7494 ± 74	Yes	Frontini, 2012
Monte Hermoso 1	49	Pampa	1	—	6	9140 ± 120	8123 ± 82	Yes	Frontini, 2012
La Olla 1	50	Pampa	0	Burial	1	7866 ± 75		No	Bayón et al., 2011
				Archaeological deposit	4	7920 ± 90	7315 ± 55	WPI	Bayón and Politis, 1996
Patagonia									
Cueva Huenul	51	Central Patagonia	789	Unit IV	5	10,155 ± 98	9261 ± 66	Yes	Barberena et al., 2015; Fernández et al., 2012
Cueva Epullán Grande	52	Central Patagonia	760	Period 1 (strata 7)	3	9970 ± 100	7550 ± 70	Yes	Cordero, 2011
Cueva Trafal 1	53	Subandina Patagonia	760	Initial occupation (layer 18)	2	9430 ± 230	9285 ± 105	Yes	
				Component 1 (layer 13)	3	9285 ± 330	7308 ± 285	Yes	
Cuyín Manzano	54	Subandina Patagonia	700	Cultural Fase 3	1	9320 ± 240		Yes	
El Trébol	55	Subandina Patagonia	780	Lower levels (5–7)	2	10,600 ± 100	10,570 ± 130	Yes	Lezcano et al., 2010
Cueva Grande de Arroyo Feo	56	Central Patagonia	600	Layer 11 base	2	9410 ± 70	9330 ± 80	Yes	Silveira, 1979
Cueva de las Manos	57	Central Patagonia	480	Layer 11 media	2	8610 ± 70	8410 ± 70	Yes	
				Layer 6	2	9320 ± 90	9300 ± 90	Yes	Mengoni Goñalons and Silveira, 1976
Alero Cárdenas	58	Central Patagonia	750	Layer 7	2	7750 ± 125	7300 ± 200	WPI	Gradín et al., 1987
Los Toldos 3	59	Central Patagonia	520	Level 11	1	12,600 ± 650		Yes	Cardich et al., 1973
				Level 9	1	8750 ± 480		Yes	
Cueva Maripe	60	Central Patagonia	572	All levels	5	9518 ± 64	7703 ± 43	Yes	Miotti et al., 2007
Piedra Museo (AEP1)	61	Central Patagonia	98	Unit 6 and transition 5/6	8	12,890 ± 90	10,470 ± 60	Yes	Miotti et al., 1999; Marchionni et al., 2010
				Unit 5 and transition 4/5	6	10,470 ± 65	9230 ± 105	Yes	
				Level 2	2	7670 ± 100	7470 ± 140	Yes	
Cerro Casa de Piedra 7	62	Subandina Patagonia	888	Layer 18–19	2	10,690 ± 72	10,530 ± 620	Yes	De Nigris, 2004
				Layer 17	4	9640 ± 190	8362 ± 68	Yes	
				Layer 16	1	8920 ± 200		Yes	
				Layer 15	2	9730 ± 100	9041 ± 64	Yes	
				Layer 12/13	2	8300 ± 115	7920 ± 130	Yes	
				Layer 10	1	8380 ± 120		Yes	
				Layer 9 (MSD)	1	8138 ± 52		Yes	
Cerro Tres Tetras 1	63	Central Patagonia	460	Unit 5 lower	8	10,560 ± 140	10,260 ± 110	Yes	Paunero, 2003
Cueva de la Mesada	64	Central Patagonia	200	Unit 8	1	9090 ± 40		No	Paunero et al., 2007
Cueva Tunel	65	Central Patagonia	200	Lower component	4	10,510 ± 100	10,400 ± 100	Yes	Paunero et al., 2010; Valiza Davis et al., 2013
Cueva de la Ventana	66	Central Patagonia	270	Unit 6	2	7970 ± 40	7665 ± 75	No	Paunero et al., 2005
La Martita 4	67	Central Patagonia	455	Lower component	2	8050 ± 90	7940 ± 260	Yes	Aguerre, 2003
Casa del Minero 1	68	Central Patagonia	189	Unit 4	2	10,999 ± 55	10,967 ± 55	Yes	Paunero et al., 2007
				Unit 3c	1	10,250 ± 110		Yes	
Alero El Verano 1	69	Central Patagonia	199	Unit 4b	2	8960 ± 140	7500 ± 250	Yes	Durán et al., 2003
La Gruta 1	70	Central Patagonia	289	Unit 1	6	10,845 ± 61	8090 ± 30	No	Mancini et al., 2013
La Gruta 2	71	Central Patagonia	289	—	1	7560 ± 30		Yes	Mancini et al., 2013
Cueva del Paisano Desconocido	72	Subandina Patagonia	427	—	1	8000 ± 40		Yes	Espinosa et al., 2013
Campos de Bloques 1 Oquedad	73	Subandina Patagonia	354	—	1	9663 ± 56		Yes	Belardi et al., 2010
Chorrillo Malo 2	74	Magellanic Forest	273	Layer IIIb	2	9740 ± 50	9690 ± 80	Yes	Franco and Borrero, 2003
Las Buitreras	75	Central Patagonia	74	Layer 5	1	7670 ± 70		Yes	Borrero and Martín, 2008
Imiwaia 1	76	Magellanic Forest	4.5	Layer S	1	7842 ± 53		No	Piana et al., 2012
Gruta del Manzano	77	Central Patagonia	1350	Conjoin D	7	8141 ± 44	7070 ± 130	Yes	Neme et al., 2011
Cerro Corral II	78	Subandina-Central Patagonia	925	Layer IV	1	10,020 ± 96		WPI	Arias et al., 2012

have been proposed (see for example Cannon and Meltzer, 2004), we consider that the selected methodology is the most adequate for the objectives of this paper.

Five body-size categories were established for the database: Category 1 (very-small mammal <5 kg); Category 2 (small mammal between 5 and 25 kg); Category 3 (middle-sized mammal between 25 and 100 kg); Category 4 (large mammal between 100 and 1000 kg); and Category 5 (megamammal >1000 kg). All body class values from extinct mammals larger than 10 kg were derived from Prevosti and Vizcaino (2006).

For all the sites we report quantitative information for each species, including genus, family, or order (only when detailed information was available). Throughout, we use the number of identified specimens (NISP per taxon and the NISP_{total} by sites) as the quantitative measure of taxonomic abundance because it has advantages over other units (e.g., derived measures such as MNI). For instance, NISP can be tallied as identifications are completed (additive) and the analyst does not have to recalculate this measure every time a new specimen is identified (Lyman, 1994, 2008). To consider dietary generalization or specialization, we calculated two variables: the taxonomic richness (Ntaxa_{total} and Ntaxa_{exploited}) and the taxonomic heterogeneity or Shannon-Wiener index (Lyman, 2008). The taxonomic richness recorded in the sites are not always directly linked to the diversity of species exploited by human groups, but it can be influenced by other factors such as the sample size, the functionality assigned to sites, the taphonomic processes identified, and the degree of detail that the archaeofauna were analyzed. To infer whether the sample size influenced the taxonomic richness and heterogeneity, we calculated the correlation between Ntaxa_{total} and log of NISP_{total}, and Heterogeneity and log of NISP_{total} of faunal assemblages considering the total number of sites and sites by region (Lyman, 2008).

To calculate the taxonomic diversity (archaeological abundance) within each body size class by region (see dataset appendixes), we counted the number of occurrences (presence) of species, genus, or family for each taxonomic body size category. In cases where the taxonomic determination was realized to a specific level (e.g., *Abracomia cinerea*) we did not quantify the higher taxonomic categories, such as genus (*Abracomia* sp.) and family (Chinchillidae). However, when no specific taxonomic determination was made, we considered these higher categories in the quantification. In order to standardize abundance and diversity we divided the total number of occurrences by the number of species, genus, or family represented within each body size class. This is necessary to avoid the over or underestimation of some body size categories (see applications in Surovell and Waguespack, 2009).

Following Lyman (2013), to facilitate categorization of subsistence patterns for particular sites and regions, we used ternary diagrams. According to this author, in specialized economies the zooarchaeological record is dominated by remains of one or a few closely related resource types (narrow niche), whereas generalized economies include a large variety of resources in more or less equal abundances (wide niche). Specialization and generalization are

considered here as a tool to explore the breadth of the resource representativeness in sites and/or regions. It is not our intention to use these concepts in terms of other socio-economic variables (see Yacobaccio, 2006; Zangrando, 2009 and citations therein).

For building ternary diagrams, our previous five body size categories were grouped into three: small-bodied taxa (Categories 1 and 2 < 25 kg), medium-bodied taxa (Category 3 –from 25 kg to 100 kg–), and large-bodied taxa (Categories 4 and 5 > 100 kg). To construct these ternary diagrams, the NISP of the taxa with indications of human utilization per size category were estimated. Ternary diagrams allow us to compare simultaneously multiple assemblages in terms of prey body size and thus capture the variability of the empirical record by region. Subsequently, we performed a ternary graph that identifies trends in the faunal exploitation at the regional scale and over time, taking into account two time periods: Pleistocene-Holocene transition (ca. 12,500–9500 ¹⁴C years BP) and early Holocene (ca. 9500–7500 ¹⁴C years BP). To obtain the average by region and time period we added the NISP of each size category of all the sites. These values were then expressed in the ternary graph through the %NISP. The Central-West region was not considered in this study due to the scarcity of sites (only two sites with detailed faunal records does not report which of all identified species have been exploited). Lastly, the Arroyo Seco 2 site was not included in the ternary diagrams because faunal species identified in the stratigraphic context belong to a clear palimpsest (Politis et al., 2014) which chronologies exceed both time periods considered in this paper. Thus, it was not possible to diagram faunal assemblages of this particular site because there is no way to effectively separate the pre-9500 ¹⁴C years BP taxa from the 9500–7500 ¹⁴C years BP taxa.

4. Results

The archaeological database is composed of 78 sites which are represented by 110 stratigraphic contexts (Table 1, Fig. 1). In the Northwest region, there are 12 archaeological sites (all in the Puna Biogeographic area), and these are represented by 24 stratigraphic contexts; 21 (87.5%) contain faunal remains but only 12 with detailed faunal information (Table 1, Appendix A). In the Central-West region, there are nine sites (three in Chaco, three in Monte, and three in Prepuna Biogeographic areas). These sites are represented by 10 stratigraphic contexts; only 6 (60%) have faunal remains, and 2 have detailed quantification data (Table 1, Appendix B). In the Pampean region, there are 29 sites (28 in the Pampas and one in the Monte Biogeographic areas) which are represented by 36 stratigraphic contexts. From these, only 12 (37.5%) have faunal remains, three of which do not have sufficient quantification data (Table 1, Appendix C). In Patagonia, there are 28 archaeological sites (19 in Central Patagonia, 6 in Subandean Patagonia, 2 in Magellanic Forest, and 1 in Subandina-Central Patagonia Ecotone Biogeographic areas) which are represented by 40 stratigraphic contexts; 36 (90%) have faunal remains, and 34 have detailed quantification information (Table 1, Appendix D).

Table 2
Number of occurrences of species standardized to taxonomic diversity by body class by geographic region.

Body size	Northwest			Pampas			Central-West			Patagonia		
	Occ	FGS	Occ/FGS	Occ	FGS	Occ/FGS	Occ	FGS	Occ/FGS	Occ	FGS	Occ/FGS
5	–	–	–	14	6	2.33	2	2	1	5	3	1.66
4	–	–	–	20	10	2	2	2	1	6	2	3
3	21	3	7	19	4	4.75	7	4	1.75	49	4	12.25
2	2	1	2	25	5	5	3	1	3	32	6	5.33
1	32	15	2.13	60	27	2.22	4	3	1.33	77	24	3.2

References: Occ (occurrences) and FGS (Family/Genus/Specie).

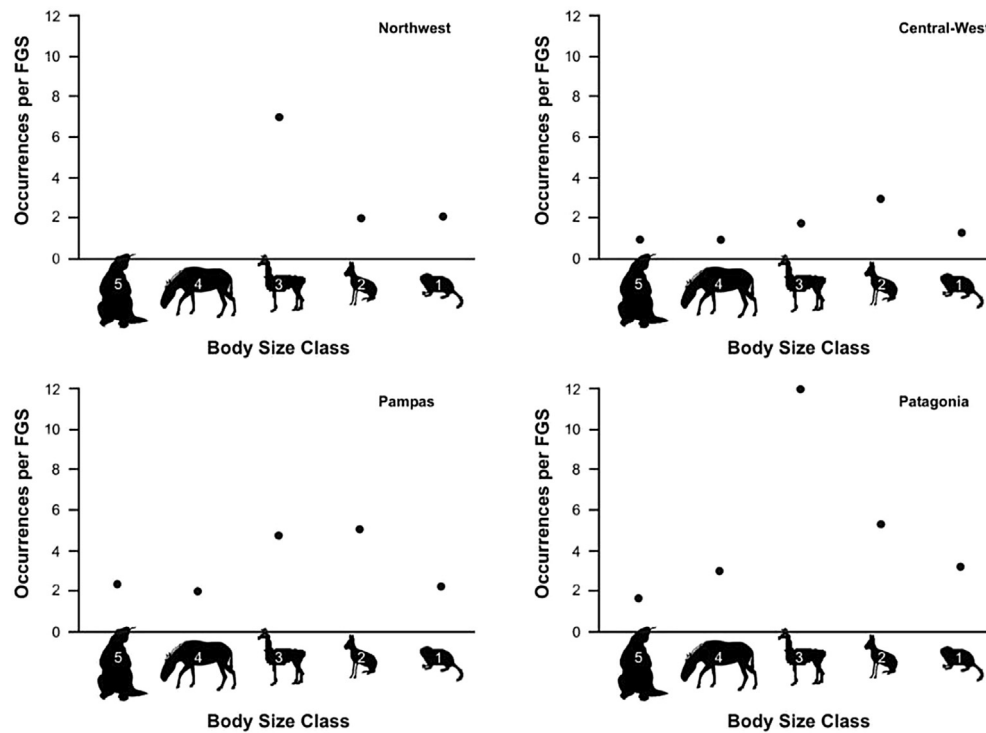


Fig. 2. Taxonomic diversity by body class by geographic region (FGS = Family/Genus/Specie).

To calculate the diversity of each body size class we include all the faunal information with or without evidence of exploitation. In the Northwest, the predominance of Category 3 (mainly camelids) in most of the archaeological sites ($\text{Occ}/\text{FGS} = 7$) is highlighted. Categories 1 and 2, which include rodents such as chinchillas and small carnivores, are less significant. In the Pampas and the Central-West, a more homogeneous distribution for different size groups is recorded, although there is a slight predominance of taxa sizes 2 and 3 (guanaco, deer, carnivores, Patagonian mara, plains viscacha, greater rhea, and coypu). The Pampas region has the highest occurrence of Category 5 (megamammals), while in the other regions, representation of this category is low or absent (e.g., Northwest). Finally, Patagonia registered a predominance of Category 3, represented mainly by guanaco (Table 2; Fig. 2). In summary, the size categories are diverse by region, showing a similar pattern of representation in all size categories in the central regions of the country, and a more focused trend in Category 3 which mainly corresponds to camelids in the Northwest and Patagonia.

As mentioned above, sample size can influence the taxonomic richness (or N_{taxa}). For this reason, to evaluate if the taxonomic richness was influenced by the size of the sample we made the correlation between the log of $N_{\text{ISP}}_{\text{total}}$ and $N_{\text{taxa}}_{\text{total}}$ for all sites (Appendixes A, B, C, and D). As a result, the correlation was positive (Spearman's $\rho = 0.391$) and significant at the 0.01 level (2-tailed; Fig. 3A). Taking into consideration the correlation between log of $N_{\text{ISP}}_{\text{total}}$ and $N_{\text{taxa}}_{\text{total}}$ by region, we find a more positive and stronger correlation in the Pampas ($\rho = 0.676$, $p < 0.05$) and Patagonia ($\rho = 0.555$, $p < 0.01$) regions. For the Northwest region, the correlation is positive but not significant ($\rho = 0.407$, $p = 0.19$). No correlation was estimated for the Central-West region due to the scarcity of assemblages. Moreover, heterogeneity is a function of taxonomic richness and it is possible that this will also be a function of sample size (Lyman, 2008). For this reason, we made the correlation between Heterogeneity and log of $N_{\text{ISP}}_{\text{total}}$ for all sites (Appendixes A, C, and D). As a result, the correlation was positive

(Spearman's $\rho = 0.479$) and significant at the 0.01 level (Fig. 3B). Taking into consideration the correlation between log of $N_{\text{ISP}}_{\text{total}}$ and Heterogeneity by region, we can observe a positive and non significant correlation in the Northwest ($\rho = 0.309$, $p = 0.32$) and Pampas ($\rho = 0.359$, $p = 0.38$), but in Patagonia a positive and significant correlation ($\rho = 0.469$, $p < 0.05$) was observed. Although these results indicate that variation in taxonomic richness and heterogeneity may be a result of variation in sample size across the compared assemblages, we consider this index useful for exploring and comparing the multiple assemblages.

The highest taxonomic richness_{exploited} in the Northwest region is represented in the top of layer 6 at the Pintoscayoc 1 site ($N_{\text{taxa}} = 9$), followed by the base of layer 6 and 5 at this same site ($N_{\text{taxa}} = 8$ and 7, respectively). The remaining sites present $N_{\text{taxa}}_{\text{exploited}}$ lower than 3 (see Appendix A). The Pintoscayoc 1 site also presents the highest taxonomic heterogeneity at the base of layer 6 (1.379), followed by Hornillos 2, level 3, and Pintoscayoc 1, base of layer 5 (0.781 and 0.715, respectively), Pintoscayoc 1, top of layer 6 (0.661), Inca Cueva 4 (0.583), and Punta de la Peña 4 (0.547). The rest of the archaeological contexts present a low heterogeneity.

In the Central-West region only the taxonomic richness_{exploited} could be calculated for the Intihuasi site ($N_{\text{taxa}} = 3$; Appendix B). In the Pampas the taxonomic richness_{exploited} is higher in Paso Otero 4 ($N_{\text{taxa}} = 11$), followed by Cueva Tixi ($N_{\text{taxa}} = 9$), Arroyo Seco 2 ($N_{\text{taxa}} = 6$), El Abra, and El Guanaco 2 ($N_{\text{taxa}} = 5$ each). The rest of the archaeological sites have an $N_{\text{taxa}}_{\text{exploited}}$ of 1 or 2 (Appendix C). With the taxonomic heterogeneity we can observe the same tendency; the highest values are associated with the sites that have a high N_{taxa} such as Paso Otero 4 (1.822), Cueva Tixi (1.595), El Guanaco 2 (0.900), Arroyo Seco 2 (0.813), and El Abra (0.636).

In Patagonia, the Cueva Epuyán Grande site has the highest taxonomic richness_{exploited} ($N_{\text{taxa}} = 9$), followed by El Trébol ($N_{\text{taxa}} = 8$), Cueva Traful 1, layer 18 ($N_{\text{taxa}} = 5$), Alero El Puesto 1, layer 6 and 4/5, and Cueva Traful 1, layer 13 ($N_{\text{taxa}} = 4$ each). The rest of the archaeological contexts have a low $N_{\text{taxa}}_{\text{exploited}}$

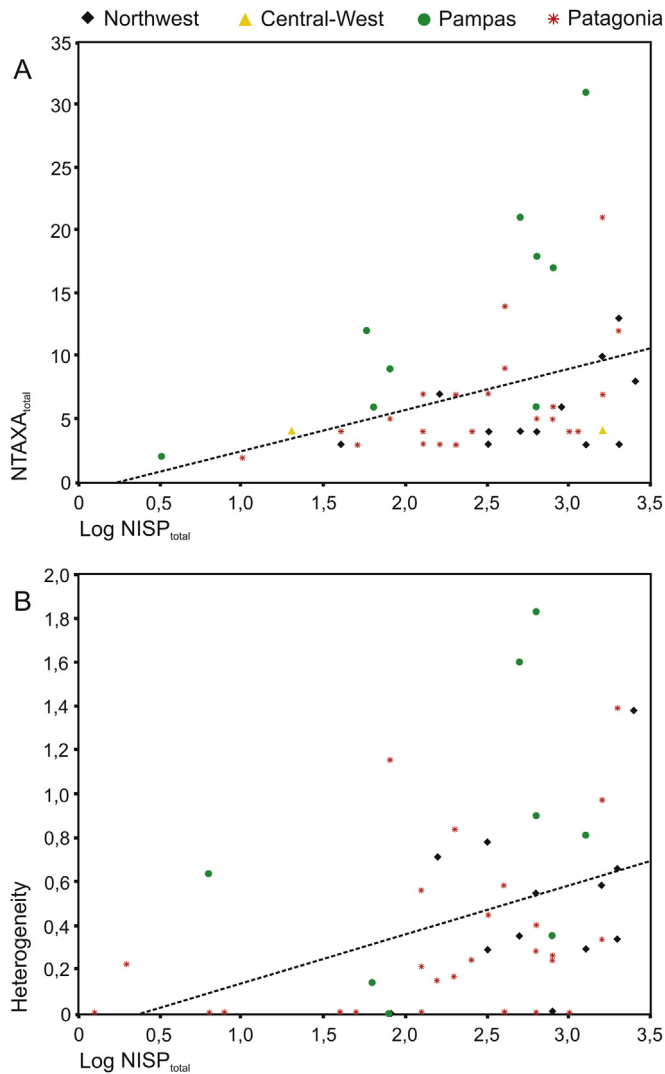


Fig. 3. A: Correlation between sample size (log of NISP_{total}) and taxonomic richness (NTAXA_{total}); B: Correlation between sample size (log of NISP_{total}) and heterogeneity.

(Appendix D). It is noteworthy that the stratigraphic contexts with a greater amount of exploited species are found in those sites located in the Forest or ecotonal environments, with the exception of the Alero El Puesto 1 site. The highest taxonomic heterogeneity is observed in El Trébol (1.386) and Alero El Puesto 1, layer 6 (1.147), followed by Cueva Epuyán Grande (0.989), Cueva Trafal 1, layer 18 (0.843), Cueva Túnel, lower component (0.586), and Cueva Grande de Arroyo Feo, layer 11 (0.562).

With the aim to capture the variability in human utilization of each prey body size, we built ternary diagrams considering multiple assemblages by region and time periods. Three site distributions can be observed in the Northwest ternary graph (Fig. 4). First, several faunal assemblages ($n = 7$) indicate a focus on medium-sized game (between 25 and 100 kg body weight) such as camelids and cervids. Second, three assemblages indicate a focus on small-sized game (<25 kg body weight) (Chinchillidae). Third, two sites have intermediate values, suggesting a strategy based on the exploitation of medium and small-sized species (Fig. 4). Subsistence categories such as large-sized specialist and generalist are not represented within the Northwest faunal assemblages. Beyond the presence of some large-sized taxa in the region during the initial human occupation (Yacobaccio and Morales, 2011), it cannot be

ruled out that much of the megamammals (except horses) became extinct prior to human occupation in the Northwest (Martínez et al., 2007). The observed differences in the representation of exploited species does not appear to be closely linked with altitude, although as Yacobaccio and Morales (2011) point out the sites situated in the Puna (altitudes greater than 4000 m) were occupied later than those located on the perimeter, near to the meso-thermal valleys. Comparing taxonomic abundances through time, the oldest sites (except for Huachichocana III) have a subsistence strategy oriented towards small animals (<25 kg body weight), while sites between 9500 and 7500 ¹⁴C years BP are mainly focused on medium-sized species such as artiodactyls (>25 kg body weight).

In the Pampas region, two archaeological sites in the Tandilia mountain range show a tendency orientated towards two size classes. The Cueva El Abra site shows the exploitation of small taxa (plains viscacha, armadillo and birds), while Cueva Tixi has a high proportion of medium-small sized species. On the ternary diagram, two assemblages (Paso Otero 5 and Campo Laborde) (Fig. 5) fall in the large-game specialist corner, with 95 percent or more being big-game faunal remains. These contexts have been defined as a secondary processing site (PO5) and as a kill site (CL). Two other sites (El Guanaco 1 and 2) show a focus on medium-sized species (guanaco and deer), while Paso Otero 4 registers a high proportion of medium and small sized species (Fig. 5). In general, faunal data for the seven largest assemblages plotted on the ternary diagram suggest that hunter-gatherer groups focused on a variety of animal size categories. This information is consistent with the greater homogeneity observed with the occurrences of faunal size groups by region (Fig. 2). Although the results could be influenced by site functionality, a strong temporal trend regarding specific sized-prey exploitation is not observed.

Archaeological sites within Patagonia were analyzed considering their biogeographical areas (Central Patagonia and Subandina-Magellanic Forest). The results indicate a prevalence of sites with an emphasis on medium-sized species (mainly guanaco) in both areas (Figs. 6 and 7). In some of the earliest sites (pre 9500 ¹⁴C years BP) from Central Patagonia, low percentages of large animals are recorded. This situation suggests the exploitation of large sized and megamammals such as *Hippidium* and *Hemiauchenia* as complementary resources (see Miotti et al., 1999, Paunero et al., 2007, 2010). An interesting aspect in Central Patagonia is that two multicomponent archaeological sites (Cueva del Minero 1 and Alero El Puesto 1) present a notable difference in the taxonomic heterogeneity through time, being higher during the initial occupations of the sites (presence of extinct fauna) and then decreasing subsequently (Fig. 6; Appendix D). Meanwhile, similar size exploited species are observed in the Subandina biozone between the two time periods (Fig. 7), except for one 9500–7500 ¹⁴C years BP site (Cueva Trafal, layer 18) that shows a focus on small animals, particularly the exploitation of small carnivores, plains viscacha and *Artiodactyla* (Cordero, 2011). However, as with Central Patagonia, the exploitation of medium-sized species (guanaco) is distinguished in early Holocene multicomponent sites (Cerro Casa de Piedra 7 and Cueva Trafal 1, layer 13).

5. Discussion on trends in the regional fauna exploitation

The main goal of this paper is to underline regional and temporal variation in the occurrence and utilization of faunal resources during the late Pleistocene and early Holocene from different regions of Argentina. We standardized a significant body of faunal data, which allowed us to identify trends in hunter-gatherer subsistence patterns from diverse archaeological contexts as well as suggest modes of megamammal-human interactions. The database shows the presence of a wide variety of species available in the

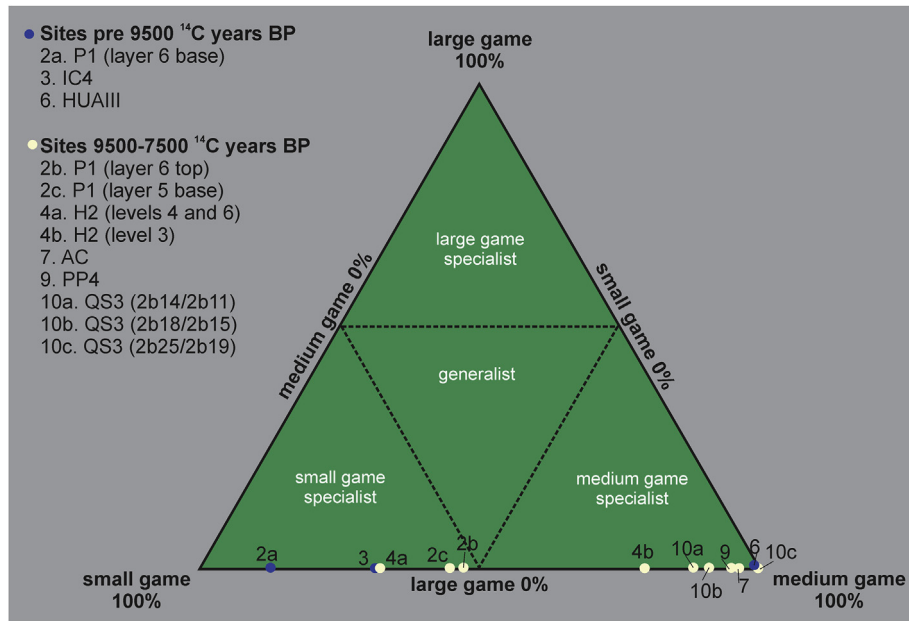


Fig. 4. Model of dietary variability based on body size of faunal prey assemblages from Northwest region (data from Appendix 1). P1 (Pintoscaoyoc 1), IC4 (Inca Cueva 4), HUAIII (Huachichocana III), H2 (Hornillos 2), AC (Alero Cuevas), PP4 (Punta de la Peña 4), and QS3 (Quebrada Seca 3).

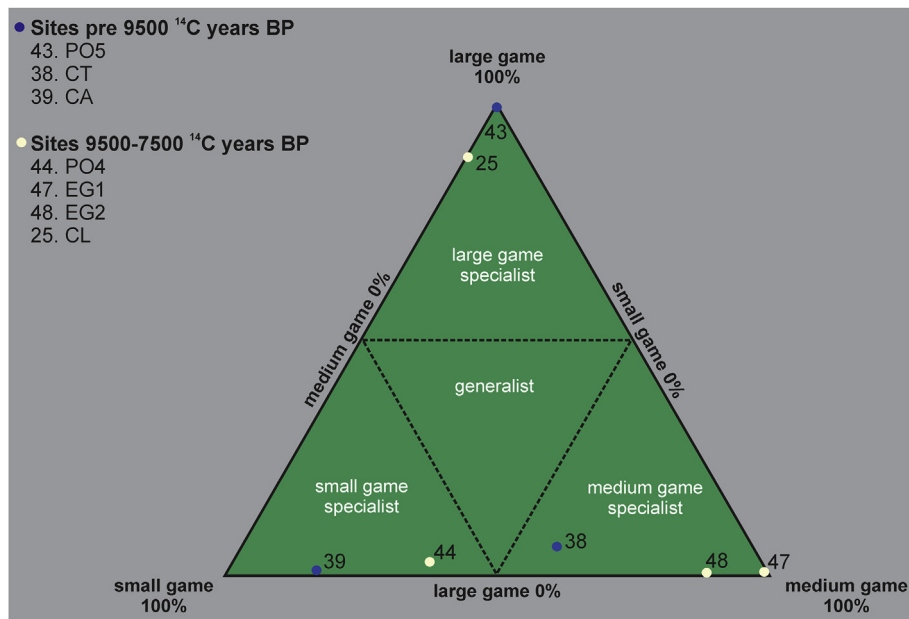


Fig. 5. Model of dietary variability based on body size of faunal prey assemblages from Pampean region (data from Appendix 3). PO5 (Paso Otero 5), CT (Cueva Tixi), CA (Cueva El Abra), PO4 (Paso Otero 4), EG1 (El Guanaco 1), EG2 (El Guanaco 2), and CL (Campo Laborde).

different studied environments for the selected time periods. The distribution of species with evidence of human exploitation also shows diversity. Although some quantitative differences between regions are observed, the data suggests that artiodactyls (camelids and deer) were the most frequently consumed animal resource in Argentina. However, the methodological tools used for the zooarchaeological analyses (NISP) likely mask the importance of other species in the diet of human groups. Skeletal part frequencies of species such as fox, rodents, and other small mammals are in general always lower than those of guanaco and deer. The degree of fragmentation in these medium-sized taxa bone assemblages

influences the sample size (NISP) and consequently the representativeness of these species in the analyses conducted in this paper. Other aspects linked to human processing, transportation decisions, and differential preservation factors also influence the sample size. These issues, although important, are difficult to control for researchers, especially in review and synthesis studies like the one presented here.

Considering each time period studied, we built a ternary diagram (Fig. 8) where samples from all archaeological contexts were averaged and plotted by region (%NISP). This ternary graph attempts to explore the regional subsistence trends and variability. A

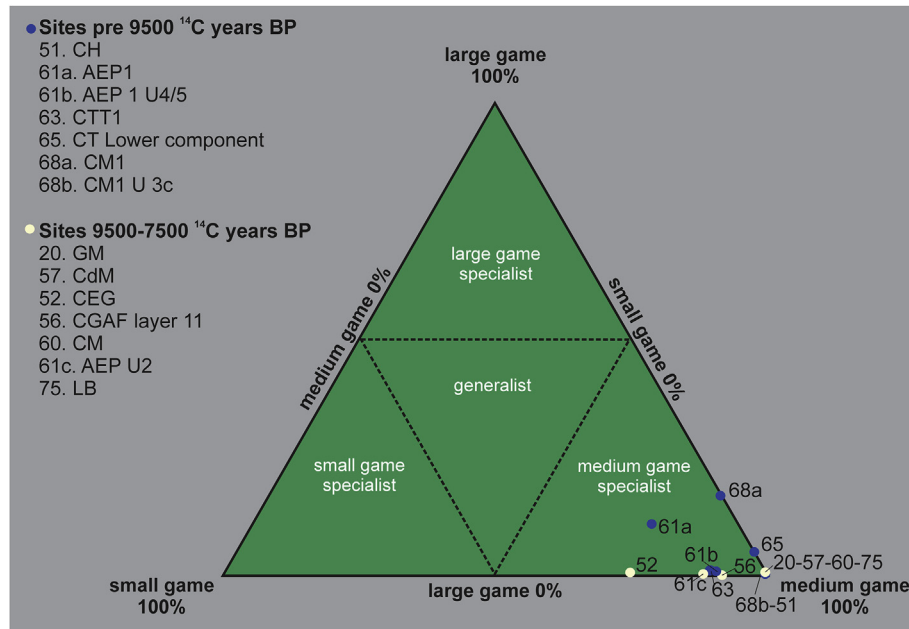


Fig. 6. Model of dietary variability based on body size of faunal prey assemblages from Central Patagonia sub-region (data from Appendix 4). CH (Cueva Huenul), AEP1 (Alero El Puesto 1), CTT1 (Cerro Tres Tetras 1), CT (Cueva Tunel), CM1 (Cueva del Minero 1), GM (Gruta del Manzano), CdM (Cueva de las Manos), CEG (Cueva Epuyán Grande), CGAF (Cueva Grande de Arroyo Feo), CM (Cueva Maripe), and LB (Las Buitreras).

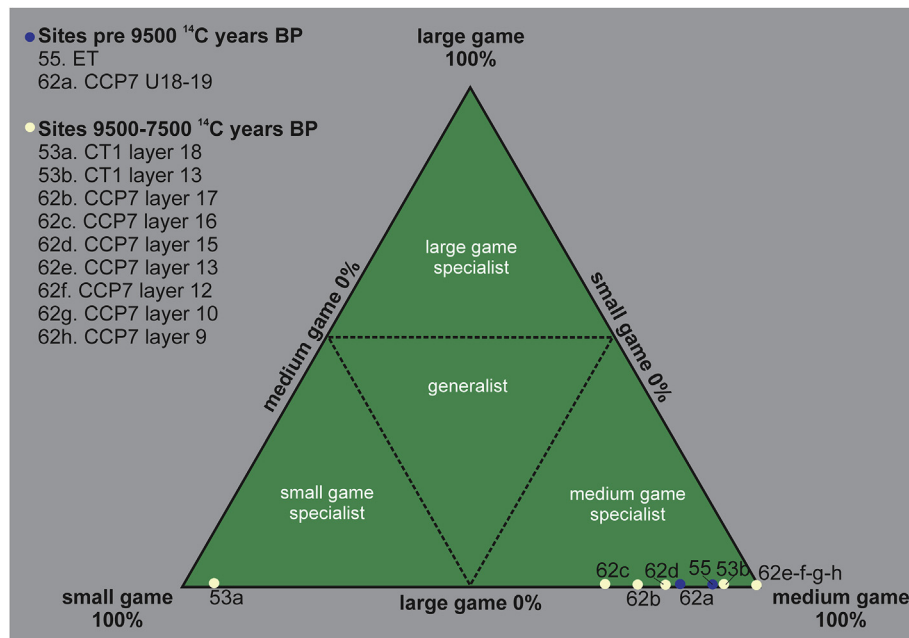


Fig. 7. Model of dietary variability based on body size of faunal prey assemblages from Subandean Patagonia sub-region (data from Appendix 4). ET (El Trébol), CCP7 (Cerro Casa de Piedra 7), and CT1 (Cueva Traful 1).

proportional exploitation of small and medium sized animals is observed in the Northwest during the two analyzed time periods (Fig. 8A,B). The results of individual contexts from this region indicates that during the earliest time (pre 9500 ^{14}C years BP) there is an emphasis on the use of small animals such as rodents (mainly plains viscacha) and in minor proportion camelids and deer (Fig. 4). Meanwhile, a decrease in the proportion of rodents and a significant increase of contexts dominated by camelids is consistent with previously suggested models for early Holocene sites (Yacobaccio,

2013). However, the results at the regional scale for this time period show almost the same subsistence tendency as the preceding period, meaning economic specialization of camelids is still not evident.

In the Pampas region, early assemblages (Pleistocene-Holocene transition) point to a broad, generalist diet, whereas early Holocene assemblages (9500–7500 ^{14}C years BP) show a tendency toward medium size game (guanaco), although very close to a generalist strategy (Fig. 8C,D). As was already stated, it was not possible to

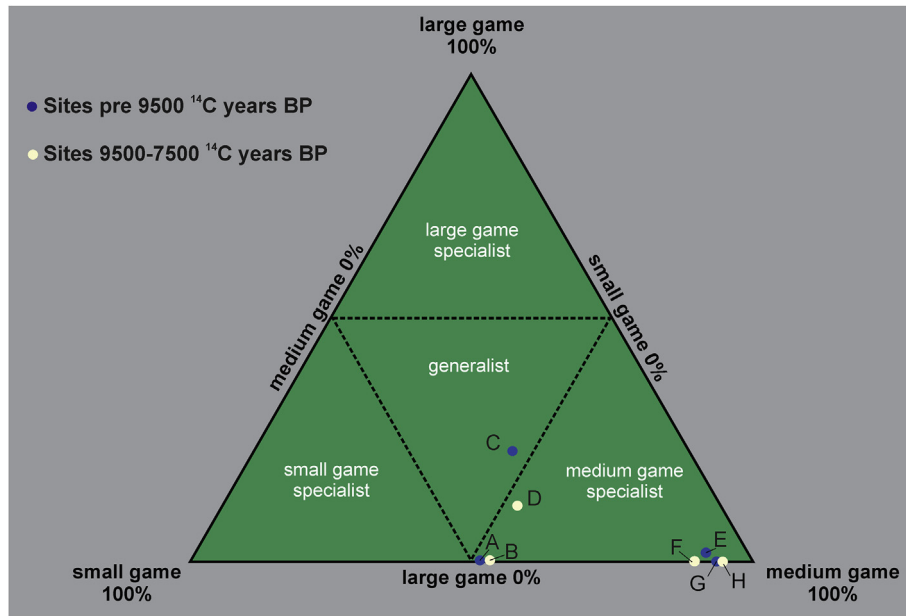


Fig. 8. Average faunal assemblages for each region considering the Pleistocene-Holocene transition (pre 9500 ^{14}C years BP) and the early Holocene (9500–7500 ^{14}C years BP) plotted on the model of dietary variability. A-B (Northwest region), C-D (Pampa region), E-F (Central Patagonia sub-region), and G-H (Subandean Patagonia sub-region).

diagram the faunal data from the Arroyo Seco 2 site; however, considering the faunal dates from this site, the subsistence trend indicates the use of megamammals and large mammals in pre 9500 ^{14}C years BP, followed by the use of medium sized game (i.e., guanaco) in 9500–7500 ^{14}C years BP (Politis et al., 2014; Salemme, 2014). Thus, the faunal assemblage from the Arroyo Seco 2 site supports the subsistence trends inferred for the Pampas. Also, the data obtained in this study agrees in general terms with previously suggested models of a generalized regional economy based on a wide-ranging diet during the late Pleistocene and early Holocene period (12,000–7000 ^{14}C years BP) (Gutiérrez and Martínez, 2008; Miotti and Salemme, 1999; Politis and Messineo, 2008). However, as proposed in Álvarez et al. (2013), the temporal scale used for building these models was covering a large time period and did not present subsistence variability in the critical stage of the Pleistocene-Holocene transition. Our results support this idea, suggesting that for the earliest time (pre 9500 ^{14}C years BP) the subsistence was generalist but the emphasis on artiodactyls is not clear. Evidently, the role of guanaco and deer for early Pampean hunter-gatherer groups needs to be explored in more detail. While the subsistence changed from a generalist to specialist during the Holocene, focusing on medium-sized animals, evidence suggests the consumption of a wide variety of species in the Pampas.

In Patagonia, averages in both areas for the two time periods show a subsistence trend towards exploiting medium sized animals like guanaco, complemented with other medium sized species such as *Hippocamelus bisulcus* and *Lama gracilis*, as well as small sized species (carnivores, birds, armadillos and rodents). This data contrasts, in general terms, with previously proposed models of a generalized regional economy based on a wide-ranging diet during the late Pleistocene and early Holocene period. These former models advocate that subsistence patterns changed to a specialized strategy during the middle Holocene (Miotti and Salemme, 1999; Salemme and Miotti, 2008), where the guanaco constitutes the main hunted prey. Our results indicate that both Central and Subandean Patagonia do not show obvious changes in subsistence along the ca. 4000 year time span considered in this paper (Fig. 8E–H). The focus on artiodactyls would be linked to greater

availability of these animals in the Patagonian environments. In previous studies, qualitative data in Northern Patagonia suggests that the guanaco was not the species most frequently exploited by hunter-gatherers, but rather various animals, including foxes, rodents, and plants were important resources in the diet (Borrero, 2008; Cordero, 2011; Lezcano et al., 2010). The richness indexes shown here indicate that parts of these contexts are those with greater species diversity, which is coherent with what has been previously postulated; however, the averaged %NISP in the ternary graphs (Fig. 8G,H) shows that the exploitation of fauna was oriented towards medium sized game.

In dealing with megamammals-human interaction, the results on the distribution of animal size categories (occurrences) show dissimilar patterns of representation by region (Fig. 2). The low incidence or complete absence of megamammals in some regions would indicate that these species were in an advanced process of extinction during the first arrival of humans to these regions (Borrero, 2009; Cione et al., 2009; Neme and Gil, 2008; Yacobaccio and Morales, 2011). In contrast, in other parts of the country, megamammals had interacted with early hunter-gatherers for several millennia before their extinction (Gutiérrez et al., 2010; Politis and Messineo, 2008).

In the Northwest region, it is interesting to note the absence of specimens (with and without evidence of exploitation) assigned to extinct megamammals in early archaeological contexts, which makes it difficult to evaluate the degree of interaction (see Yacobaccio and Morales, 2011). Even paleontological sites with evidence of Pleistocene megamammals are scarce, such as the Barro Negro site (province of Jujuy) and the lower levels of the Peña de las Trampas 1.1 site (Province of Catamarca). In Barro Negro, remains of at least five individuals of *Hippidion* (Owen, 1869), dated to ca. 12,500 and 9000 ^{14}C years BP have been recovered (Fernández et al., 1991; Yacobaccio and Morales, 2011). Furthermore, the paleontological evidence from the area of Antofagasta de la Sierra includes feces of *Hippidion*, *Mylodontidae*, and *Megatheriinae*, dated between ca. 19,600 and 12,500 ^{14}C years BP (Martínez et al., 2010). In brief, although the presence of megamammals were scarce during human peopling, the current archaeological record

indicates that they were not exploited by early hunter-gatherers, possibly because these animals would have been near extinction, and thus the regional availability of some taxa (i.e., extinct horses and giant ground sloths) would have been occasional.

In the *Sierras Centrales* and the pre-cordillera and eastern slope of the Andes, megamammals would have been available during Pleistocene–Holocene transition (Neme and Gil, 2008; Rivero, 2010, 2012; Rivero and Berberian, 2008); however, no clear evidence of bone processing has been recorded at the moment. The only exceptions might be the Gruta del Indio and Gruta de Candonga sites; although stronger evidence of interaction is still needed (Bargo et al., 2010; Castellanos, 1943; Cornero et al., 2014; García, 2003a, 2003b; Gil and Neme, 2010; Lagiglia, 2002; Long et al., 1998; Tauber and Goya, 2006). In spite of this, recent analysis suggests minimal relations between megafauna and human populations, either because they were not present at the time of the first occupations or simply because they were not consumed (García, 2003a; Neme et al., 2011).

For the Pampas, the role of megafauna and large mammals appears to have greater importance in comparison with other regions (Figs. 2 and 5). There is significant evidence of megamammal bone utilization recorded in the various archaeological contexts. Examples include *Megatherium americanum* at the Paso Otero 5 site used as fuel (Martínez and Gutiérrez, 2011); *Megatherium americanum* at the Campo Laborde site used as raw material for bone tools (Messineo and Pal, 2011); and *Megatherium americanum*, *Equus* sp., *Hippidium* sp., *Doedicurus clavicaudatus*, *Hemiauchenia* sp., and *Eutatus seguini* used for human consumption in other archaeological sites (see Appendix C). It is clear that the degree of interaction between the extinct fauna and humans in the Pampas region is strong and covers other aspects that are not exclusively linked to consumption. The open grassland environments likely favored the survival of some Pleistocene fauna into the Holocene (see discussion in Cione et al., 2009). The archaeological record for this region indicates the continued existence of mega and large mammals until ca. 7500 ¹⁴C years BP (i.e., La Moderna, Campo Laborde, Paso Otero 4, and Arroyo Seco 2), which at the moment is exclusively represented by xenarthrans (Gutiérrez et al., 2010). Results from different lines of evidence (e.g., studies on locomotory, masticatory apparatuses, and stable isotope analysis) suggest that xenarthrans, especially glyptodonts and ground sloths, consumed and exploited a wide variety of plant resources and habitats which may have given them an adaptive advantage over other extinct species (e.g., horses). Perhaps the long lasting interaction between megafauna and hunter-gatherers encouraged a generalist subsistence strategy in the onset of the early Holocene.

Current data indicates that megamammals and humans coexisted in many regions of Patagonia but they had a moderate degree of interaction, and were probably a complementary resource (Borrero, 2009; Borrero and Martin, 2012). The faunal evidence for north Patagonia suggests that Pleistocene mammals already became extinct by the time human populations arrived to the region (Borrero, 2008). The only exception is the El Trébol site, dated in ca. 10,600 ¹⁴C years BP, which contains dermal bone remains of Mylodontinae with anthropic modification (Lezcano et al., 2010). The faunal records of south Patagonia indicate that extinct Pleistocene fauna were present, and were probably consumed. The most frequent extinct species documented are extinct horse (*Hippidium saldiasi*), extinct camelid (*Hemiauchenia paradoxa*), and giant ground sloths (Milodontidae). Evidence of human processing in extinct fauna such as cut marks are scarce. Our results support previous models which suggest that megamammals seem to have been only marginally used during the initial occupations (12,500–9500 ¹⁴C years BP; Fig. 8E).

6. Conclusions

The results obtained here should be interpreted as trends considering the different spatial (regions) and temporal (late Pleistocene and early Holocene) scales as well as the application of methodological tools that take into account either individual sites or averages of the entire archaeological contexts by regions. In this sense, the information presented here provides an up to date review in subsistence strategies considering different scales. Our results demonstrate that although some quantitative differences between regions are observed, artiodactyls (camelids and deer) were the most frequently consumed animal resource in Argentina. Early hunter-gatherers did not follow a specialized predation strategy in megamammal hunting and the data established in this paper suggest a differential degree of interaction by region. The minimal or absent interactions in some regions such as the Northwest and Central-West would indicate that megamammals were in an advanced process of extinction during the initial human colonization. In contrast, in Patagonia the results suggest a moderate role in hunter-gatherer subsistence, while in the Pampas, human and megamammals had greater degree of interaction. In summary, our results indicate a high variability in subsistence systems in the different regions of Argentina operating in parallel, with a strong regional emphasis according to specific environmental conditions which offered different resources and particular cultural trajectories.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.quascirev.2016.05.014>.

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