Quaternary International xxx (2016) 1–10

Contents lists available at ScienceDirect

Quaternary International

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

Multiproxy study of plant remains from Cerro Casa de Piedra 7 (Patagonia, Argentina)

Laura Caruso Fermé [a, *], Nadia J. Velázquez [b], A. Cecilia Martínez Tosto [c], Cristina Yagueddú [c], L. Susana Burry [d], M. Teresa Civalero [e]

[a] IDEAus/CONICET, Puerto Madryn, Chubut, Argentina
[b] CONICET-UNMdP, Laboratorio de Palinología y Bioantropología, Facultad de Ciencias Exactas y Naturales, Argentina
[c] UNMdP, Laboratorio de Botánica, Facultad de Ciencias Exactas y Naturales, Universidad Nacional de Mar del Plata, Argentina
[d] UNMdP, Laboratorio de Palinología y Bioantropología, Facultad de Ciencias Exactas y Naturales, Universidad Nacional de Mar del Plata, Argentina
[e] InstitutoNacional de Antropología y Pensamiento Latinoamericano, Buenos Aires, Argentina

ARTICLE INFO

Article history:
Received 15 March 2016
Received in revised form
3 November 2016
Accepted 9 November 2016
Available online xxx

Keywords:
Archaeobotany
Charcoal
Wood
Coprolites
Hunter-gatherers
South patagonia

ABSTRACT

The objective of this work is to carry out an integral study of macro and microbotanical remains with the aim of providing information to the palaeoenvironmental reconstruction and understanding the different practices employed in the acquisition of woody material used by hunter-gatherer societies from the northwestern region of the Santa Cruz Province, Argentine Patagonia, during the early and middle Holocene. For this purpose, we study macrobotanical remains (carbonized and non-carbonized wood) recovered from different combustion structures and from the sediment of the three stratigraphic levels dated by ^{14}C and resulting in ages of 9640 ± 190 years BP; 8380 ± 120 years BP and 6150 ± 105 years BP, of the Cerro Casa de Piedra 7 site. Also, pollen and small plant fragments of human and camelid coprolites were studied. The analysis conducted show differences in the taxonomic resolution obtained by each one of the proxies. The marked representation of *Nothofagus pumilio* among charcoal and wood makes clear that the forest was an environment recurrently used by hunter-gatherers occupying CCP7. The study of pollen and plant fragments coming from coprolites, allowed the identification of grass species typical of the steppe environments and forest-steppe ecotonal areas. In this way, plant fragments provide higher level of taxonomic resolution and a greater diversity for paleoenvironmental reconstruction. The results obtained by means of the multi-proxy analysis allowed us not only to enlarge the reconstruction of the hunter-gatherers livable environment, but also to recognize the availability and use of the plant resources in the Early-Mid-Holocene in the region.

1. Introduction

In order to meet a variety of needs plant environments have been fully exploited through time by all types of societies. The use of plants has been crucial to their survival, leading to the implementation of subsistence strategies aiming at exploiting the resource (Aceituno and Loaiza, 2015). These strategies have been changing over history, according to the landscape characteristics and transformations, the technology changes, and also the social needs. Hence the continuous exploitation of the plant environment makes it difficult to understand its evolution, apart from the management that human groups have made over it. Both humans and environment have co-evolved for thousand of years (Barberena et al., 2015; Uzquiano, 2014). The recovered plant remains of archaeological sites are, first of all, the result of social activities, but they also relate to the natural environment where a particular group develops its activities. The explored and occupied environments form the territory of a society. Thus, the study of plant remains allows obtaining information both palaeoenvironmental and of management of plant resources by past societies.

The study of macro- and micro-plant remains found in archaeological contexts allows making inferences on where the plant formations come from, knowing the function that plant resources played within the society, and evaluating the impact that social operations had on the surroundings. However, even though the

* Corresponding author.
E-mail addresses: lcarusoferme@gmail.com (L. Caruso Fermé), nvelazquez@mdp.edu.ar (N.J. Velázquez), amtosto@mdp.edu.ar (A.C. Martínez Tosto), lburry@mdp.edu.ar (L.S. Burry), mtcivalero@gmail.com (M.T. Civalero).

http://dx.doi.org/10.1016/j.quaint.2016.11.005
1040-6182/

plant record is abundant in the archaeological sets, an integral study of the macro- and micro-plant remains is still infrequent or inexistent in archaeological researches on Patagonian hunter-gatherer societies.

The palynological studies of diverse deposits done to date in Patagonia (Bamonte and Mancini, 2011; Brook et al., 2013; Burry et al., 2006; Mancini, 2007, 2009; Mancini et al., 2002; Trivi de Mandri et al., 2006) aimed to reconstruct Late Pleistocene and Holocene palaeoenvironments, while the palynological and microhistological analyses of coprolites of different zoological origin provided information on diet, seasonality in the site use, and also contributed new taxa to the reconstruction of past vegetations (Martínez Tosto et al., 2012; Velázquez et al., 2010, 2014, 2015). On the other hand, the archaeobotanical analysis of charcoal and woods permitted obtaining information on the operation of plant resources by the Patagonian hunter-gatherer societies (Caruso Fermé, 2008, 2010, 2012, 2013, 2015; Ciampagna and Capparelli, 2012; Ortega and Marconetto, 2011; Martínez Tosto et al., 2012; etc.).

The exceptional preservation of plant material registered at Cerro Casa de Piedra 7 site (CCP7) and its long sequence of human occupation (Aschero, 1996; De Nigris, 2004; etc.) are ideal both to study the role of plant resources in the Patagonian hunter-gatherers economy and to complement the palaeoenvironmental studies already done in the region (Mancini et al., 2002; Mancini, 2007). The general objective of this work is to carry out an integral study of macro- and micro-plants with the aim of: i) providing information to the palaeoenvironmental reconstruction of the Early-Mid - Holocene of the CCP7 area, and ii) understanding the ways of acquiring wood resources in a high residential motility context.

2. The site Cerro Casa de Piedra 7

2.1. Geographical location, climate and current context

Cerro Casa de Piedra (CCP) - 47°57'S, 72°05'W- is a small elevation of volcanic origin, located south of the Perito Moreno National Park (PMNP), province of Santa Cruz, Argentina (Fig. 1). It is located at 900 m asl and at a distance approximately 500 m from the south side of the river Roble, a forest-steppe ecotonal area close to lake Burmeister. In the northern slope of CCP, a series of caves and overhangs open; the archaeological evidence of caves 5 (CCP5) and 7 (CCP7) are considered the most fruitful (Aschero et al., 2005).

Cerro Casa de Piedra 7 was initially a large overhang with an extensive living area that offered good shelter conditions, having suffered modifications through time and collapse events. The CCP7 stratigraphic sequence is composed of 19 layers radiocarbon-dated between ca. 10,690 ± 120 and 3400 years BP (Aschero, 1996; Aschero et al., 2008; Civalero and Aschero, 2003) (Fig. 2). Until now, the archaeological studies suggest that CCP7 would have been recurrently used by hunter-gatherer groups for at least the first Holocene 5000 years, and abandoned little before 3500 BP. The collapse of big blocks that divided CCP7 in two and the almost null posterior archaeological evidence suggest that this episode could have determined the cave abandonment. A recent wood charcoal dating gave 1927 ± 41 years BP δ^{13} C = −26.69 (UGA 868, corrected date) (Civalero et al., 2006–2007), which suggest an occasional and brief occupation in the late Holocene, different to that of previous times where the space use was effective and recurrent (Civalero et al., 2006–2007).

The archaeological record of CCP7 suggests a settlement-motility pattern of the residential type, evidenced by a pronounced space-structuration and a redundant site occupation (Aschero et al., 1992–93; Aschero et al., 2005).

2.2. Present-day vegetation

In the slopes of the Andes mountain ranges, between 1200 and 850 m asl, the *Nothofagus pumilio* (Poepp. & Endl.) Kkrasser and *Nothofagus antarctica* (G. Forst.) Oerst forest develops nowadays; *N. antarctica* and *Nothofagus betuloides* (Mirb.) Oerst., and shrubby, and herbaceous vegetation associated to the *Nothofagus* sp. forest, such as *Escallonia* sp., *Berberis* sp., *Fuchsia magellanica* Lam. and species belonging to the genera *Osmorrhiza* sp., *Acaena sp.* and *Perezia* sp. are also present.

Towards the east, at approximately 800 m asl, the *Verbena tridens* Lag., *Berberis* sp., *Mulinum spinosum* Pers. and *Chiliotrichium* sp. shrubby steppe grows; the *Nardophyllum obtusifolium* Hook. & Arn. steppe with *Festuca pallescens* (St.-Yves) Parodi, accompanied by *Stipa ibari* Philippi, *Poa ligularis* Nees ex Steud., *Carex* sp., *Cerastium arvense* Cham. & Schltdl., *Adesmia lotoides* Hook.f., *Nassauvia darwinii* (Hook. & Arn.) Dusén & Dusén, *Acaena pinnatifida* Ruiz et Pavón and *Mulinum spinosum* also develops. At 300 m asl is present the *Festuca pallescens* steppe with *Poa ligularis*, *Rytidosperma picta* (Nees et Meyen) Nicora, *Stipa* sp., *Carex* sp.,

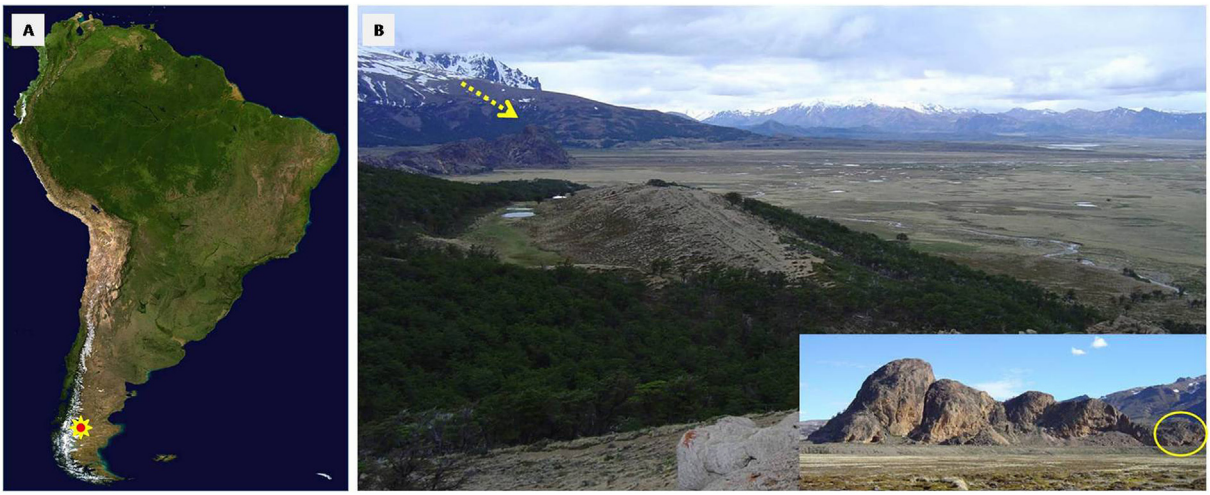

Fig. 1. a) *Location of Cerro Casa de Piedra in South America. b)* Cerro Casa de Piedra and location of Cerro Casa de Piedra 7 site (CCP7) (Caruso Fermé and Civalero, 2014).

Please cite this article in press as: Caruso Fermé, L., et al., Multiproxy study of plant remains from Cerro Casa de Piedra 7 (Patagonia, Argentina), Quaternary International (2016), http://dx.doi.org/10.1016/j.quaint.2016.11.005

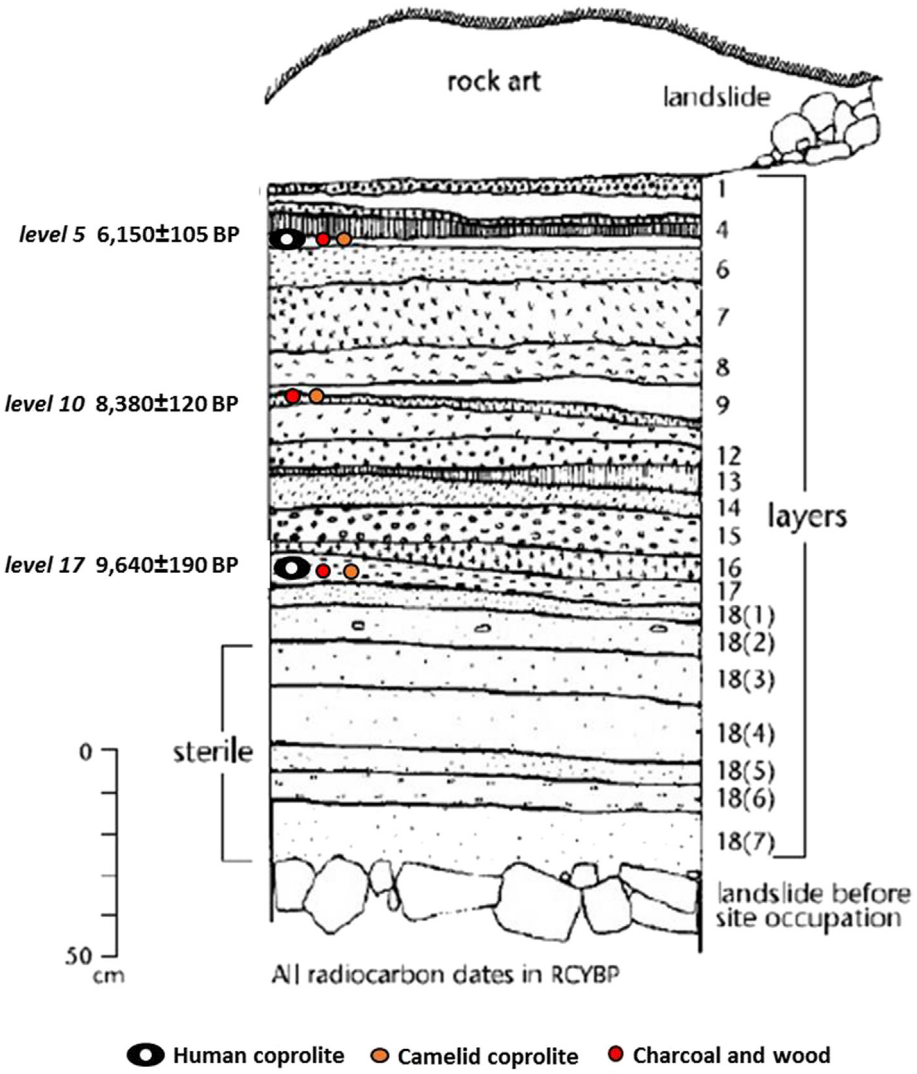

Fig. 2. *Stratigraphy and radiocarbon dating of CCP7 site* RCYBP: radiocarbon years Before Present.

Colobanthus lycopodioides Griseb., *Armeria maritima* (Mill.) Willd (Mill.) Willd., *Acaena pinnatifida*, *Polygala darwiniana* A.W. Benn, *Nassauvia darwinii*, *Perezia recurvate* (Vahl) Less. and *Mulinum microphyllum* (Cav.) Pers., exhibiting *Nardophyllum obtusifolium*, *Senecio filaginoides* DC. and *Berberis heterophylla* G. Forst shrubs.

There also is a high semi-desert, with dense patches of *Empetrum rubrum* Vahl ex Willd. in sheltered sites, and swamps with *Caltha sagittata* Cav., *Plantago barbata* G. Fors., *Acaena magellanica* (Lam.) Vahl and cyperaceans (Mancini et al., 2002; Mermoz, 1998; Movia et al., 1987) (Fig. 3).

2.3. Historical development of landscape and vegetation

The palynological study of sediments done in sites CCP5 and CCP7 evidenced changes in the vegetation development during the Holocene that suggest temperature, moisture and precipitation variations (Mancini et al., 2002; Mancini, 2007). Before 9000 years BP the vegetation of the area of Cerro Casa de Piedra was represented by a grass-steppe, which would indicate more humid conditions than today (Mancini, 2007). After *ca.* 9000 years BP, a drop in grasses and an increase of *Nothofagus* trees, shrubs and cushion plants such as *Empetrum* and *Azorella*, suggest an increase of temperature and a greater seasonality (Mancini, 2007).

Since 6500 years BP, the rise of shrubby taxa -Asteraceae subf. Asteroideae, Solanaceae, *Berberis*, *Mulinum*-as well as of *Nothofagus* poses a summer temperature increase associated to a more hydric availability. The pollen association during this lapse would reflect the development of a forest-shrub steppe ecotone that nowadays develops towards zones closer to the Andes mountain ranges (Mancini et al., 2002). The *Nothofagus* pollen percentage values were greater at *ca.* 3480 years BP. After *ca.* 3000 years BP the increase of *Nothofagus* and the decrease of shrubby taxa (Asteraceae subf. Asteroideae, *Mulinum, Empetrum*, *Berberis*) indicate an episodic increase of precipitation and a decrease of temperature, although not so significant as to enable the continuous establishment of the forest. Since 2700 years BP, the greater development of the discontinuous forest suggest greater humidity conditions than today and greater micro-environmental heterogeneity with possible forest fluctuations (Mancini, 2007; Mancini et al., 2002).

In the northern sector of the Perito Moreno National Park ranging from 1200–250 years BP, the Alero Destacamento Guardaparque and Alero Dirección Obligatoria pollen sequences evidence the expansion of the shrubby steppe, suggesting a temperature increase comparable to current records (Mancini et al., 2002).

Please cite this article in press as: Caruso Fermé, L., et al., Multiproxy study of plant remains from Cerro Casa de Piedra 7 (Patagonia, Argentina), Quaternary International (2016), http://dx.doi.org/10.1016/j.quaint.2016.11.005

3. Materials and methods

3.1. Archaeological excavation

The archaeological excavations began in the western sector of the site CCP7 (area 1) (Aschero et al., 1992–1993). Later, a prospection in central sector of the cave was performed (area 2). From 1990 systematic excavations were realized during different campaigns. The excavation of area 1 was expanded to a total of 14 m^2 so that the material studied in this work correspond to this area.

3.2. Sampling

Plant remains were recovered through the dry sieving of all the sediment from excavation. The mesh size of the sieves used was 2 mm. This sampling strategy was performed systematically and rigorously to all excavated levels in CCP7 (Caruso Fermé, 2012).

Numerous coprolites were collected from sediments of the three levels from archaeological excavation of site CCP7. Collection was performed through sediment sieving using a 2 mm mesh. For this study, eleven coprolites were randomly selected to palynological and microhistological analysis. The cave condition, the extreme aridity and the type of sampling allowed the recovery of abundant quantities of wood, wood charcoal, leaves, seeds, camelid coprolites and two wooden artifacts from levels 17 and 6 (Caruso Fermé, 2015).

The archaeobotanical study comprised the analysis of four proxy types: a) charcoal, b) wood, c) pollen and d) plant fragments. Plant macro-remains (charcoal and wood) come from different combustion structures and from the sediment of the excavation. Microrests (pollen) and small plant fragments were included in human and camelid coprolites. All the studied plant fragments (micro and macro) come from three stratigraphic levels: level 17–9640 ± 190 years ^{14}C BP–, level 10–8380 ± 120 years ^{14}C- BP and level 5–6150 ± 105 years ^{14}C BP- (Aschero, 1996; Aschero et al., 2008; Civalero and Aschero, 2003; De Nigris, 2004; etc.) (Table 1).

3.3. Analysis of woody material

The plant remains were recovered through sediment sieving using a 2 mm mesh. Random sampling of microsectors from levels 5, 10 and 17 of site CCP7 was performed due to abundance of macro-remains (carbonized and uncarbonized) (Caruso Fermé, 2012, 2015).

The study of woody material consisted in the taxonomic determination of charcoal and wood fragments dispersed within sediments of the excavation, derived from the different combustion structures recorded at every stratigraphic level.

Wood identification was carried out through the visualization of the three anatomical wood planes (transversal, longitudinal-longitudinal radials and tangential). Samples were prepared by hand-breaking every piece of charcoal and wood due to the extreme dryness of the latter. The samples were analyzed by optic microscope (Olympus BX51) and compared with modern wood reference samples and bibliography (Caruso Fermé, 2013, 2015).

3.4. Analysis of human and camelid coprolites

Camelid and human coprolites were stored in dry conditions. Eleven samples were studied: a) 2 human coprolites and b) 9 camelid fossil pellets. One gram of each was used from human coprolites; all pellets of approximately 0.3 g were used from camelids. Samples were hydrated wit 0.5% trisodic phosphate at 4 °C during five days. Then they were filtered through 260 μm pore aperture meshes to separate coarse from fine fractions. The following analyses were done:

3.4.1. Microhistological analysis of plant fragments

Coarse fractions were used, bleached with 50% sodium hypochlorite, washed with distilled water and then mounted on glycerine jelly-treated slides. A hundred fields were observed with the microscope at 100× magnification. The determination was done at the genus level and to species when feasible, by comparing with reference histological preparations of different plant organs

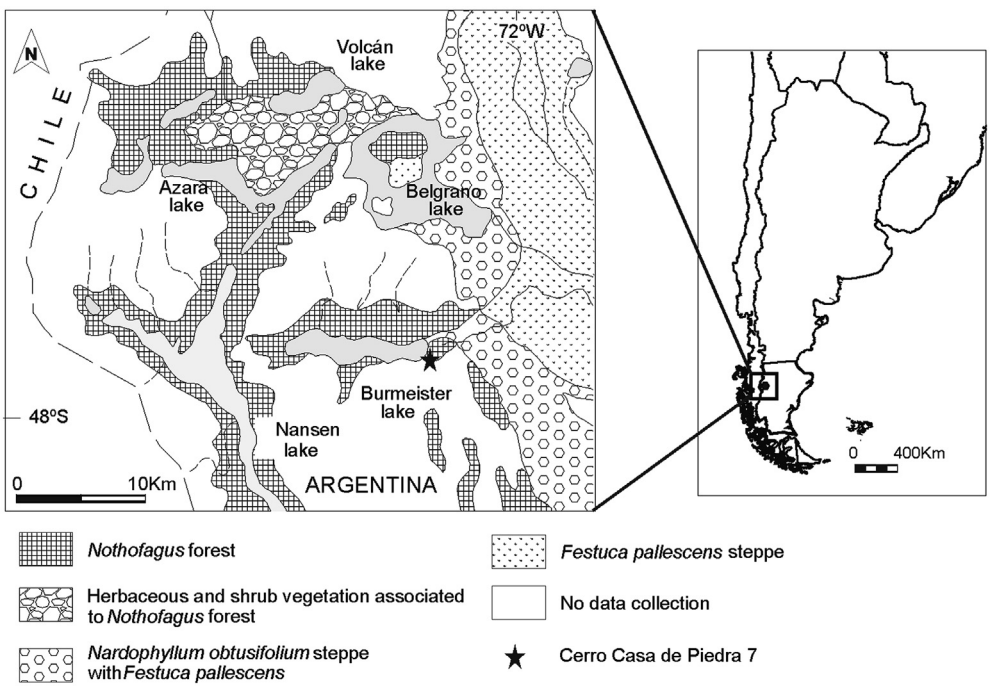

Fig. 3. Map of Perito Moreno National Park (PMNP), Santa Cruz province, showing the areas of the vegetation units (modified from Movia et al., 1987) (after Velázquez et al., 2014).

Please cite this article in press as: Caruso Fermé, L., et al., Multiproxy study of plant remains from Cerro Casa de Piedra 7 (Patagonia, Argentina), Quaternary International (2016), http://dx.doi.org/10.1016/j.quaint.2016.11.005

growing in the study area (Yagueddú and Arriaga, 2010).

Plant fragments percentages of human and camelids coprolites were calculated.

3.4.2. Pollen analysis

Fine fractions were used for the analysis of human and camelid coprolites. They were dried, weighed and resuspended in distilled water. One tablet of a foreign marker, *Lycopodium clavatum*, (Batch N° 124961, media = 12,542 spores/tablet) was added to each sample (Stockmarr, 1971). Acetolysis, a process that breaks up the sample cellulose remains was done (Faegri and Iversen, 1989). The identification and the pollen and spores recount was done with an optic microscope at 400× and 1000× magnifications. The pollen reference collection of the Laboratory of Palynology (Universidad Nacional de Mar del Plata) and specialized bibliography were used (Velázquez et al., 2010, 2014).

4. Result

The samples consisted of 809 fragments (level 17: wood samples 79 and charcoal samples 176; levels 10: wood samples 126 and charcoal samples 115; level 5: wood samples 172 and charcoal samples 171) and 11 coprolites (Levels 17 and 5: two human coprolites; levels 5, 10 and 17: nine camelids coprolites) (Table 1). The level of determination has been mainly at the species level for taxonomic analysis of the macroremains, however in some cases the slight variability among species of some genera made it impossible to identify them. Classifications of Taxa A, B, C and D were used to refer to certain fragments whose analysis does not allow their identification as any type, family or species represented archaeologically or present in the reference collection and/or bibliographic material consulted. Nevertheless, their variable microscopic anatomical characteristics do not allow them to be lumped together in an 'Indeterminate' category.

The taxonomic analysis of the plant macro- and micro-remains evidenced the presence of tree, shrub and herbaceous taxa among the samples from levels 17, 10 and 5, site CCP7. From the different studied proxy (wood, charcoal, small plant fragments and pollen in coprolites), the identified taxa coincide with elements characteristic of the archaeological site's current vegetation (Movia et al., 1987; Mermoz, 1998; Roig, 1998). The present analysis allowed the identification of a total of 58 taxa: 14 among charcoal and wood fragments; 14 among plant fragments recovered from camelid and human coprolites; and 33 corresponding to the camelid and human coprolites pollen spectrum. Four taxa were shared between some of the proxies. (Figs. 4–6).

4.1. The stratigraphic level 17 (9640 ± 190 years BP)

Taxonomic analysis of macroremains was performed based on 225 fragments, 176 charcoals and 49 wood fragments. Charcoal sample consist of 75 fragments from combustion hearth and 101 charcoals from excavation sediments. Wood sample is composed of 49 fragments collected from excavation sediment.

Coprolite analysis carried out based on one human probably coprolite and four camelids pellets.

The analysis of plant macro- and micro-remains belonging to the stratigraphic level 17 allowed determining the presence of 42 taxa. Four of them were trees; 16 shrubs, and 22 herbs. The tree taxa are represented by *Nothofagus* sp., *N. pumilio* (Poepp. & Endl.) Krasser, *N. antarctica* and *Podocarpus* sp.; the shrub taxa by *Anarthrophyllum rigidum* (Gillies ex Hook. & Arn.) Hieron., *Escallonia rubra* (Ruiz et Pav.) Pers., *Empetrum rubrum*, *Perezia recurvata* (Vahl) Less., *Azorella monantha*, *Berberis* sp., *Azorella* sp. Empetraceae/Ericaceae, Asteraceae, Asteraceae subfam. Asteroideae, *Nassauvia* sp., Apiaceae, Rhamnaceae and Fabaceae; and among the herb plants, Poaceae represented by two genera and 7 species, Caryophyllaceae, Brassicaceae, Lamiaceae, Rosaceae, *Acaena* sp., *Armeria* sp., *Valeriana* sp., Chenopodiaceae, Rubiaceae/Lamiaceae, *Loasa* sp., Monocotyledons and the pteridophyte *Polypodium* sp. Taxa A and B were identified among the charred dispersed material.

Only two out of the 42 taxa identified are shared between samples of: a) macro-remains (wood and charcoal), b) coprolites macro-remains (plant fragments) and C) coprolites micro-rests (pollen). Such is the case of *Empetrum rubrum*, which is present among the charcoal scattered in the sediment of the excavation, in pollen of camelid coprolites and among plant fragments of human and camelid coprolites. This species has not been registered neither between the wood scattered in the sediment nor between the combustion structures. *Nothofagus* sp. is also a common taxon among the studied proxies and, although its tissue fragments were not found in coprolites, it was registered among the woody material and pollen samples of camelid coprolites. It is worth noting that the taxonomic analysis of charcoal and woods allowed the determination of two species of *Nothofagus*: *Nothofagus pumilio* and *Nothofagus antarctica*. The former is present both in charcoal and woods, and the latter, just among charcoal. Another shared taxon, in this case only among the woody material, is *Berberis* sp., present among charcoal and woods scattered in the sediment of the excavation.

As for the pollen and small fragments recovered from coprolites, some shrubby and herbaceous taxa were also documented. Among the shrubs, stand out *Azorella monantha* and the family Asteraceae, represented by *Perezia recurvata*, both species having been determined by micro-histological analysis. The most common herbs in these two proxies are Poaceae and Caryophyllaceae. In the case of

Table 1
Studied proxy types from the stratigraphic levels 17, 10 and 5, site CCP7 (area 1).

Level 17 (9640 ± 190 yr. BP)		Level 10 (8380 ± 120 yr. BP)		Level 5 (6150 ± 105 yr. BP)	
Materials	Microsector	Materials	Microsector	Materials	Microsector
Charcoal (sediment and hearth 1)	E9D, E10C F10A, C10B, D10B D11A, B11B; (hearth 1: C11B, C11C C11D)	Charcoal (sediment and hearths 1–2)	G11A, E11D; (hearth 1: F11C), (hearth 2: B11C, C11A)	Charcoal (sediment and hearths 1–2)	E10B, E10D; (hearth 1:F11A, F11C, G11A, F11D), (hearth 2: F8A)
Wood (sediment)	E9B, E9D, E10A F10A, C10B C10D,D10B, D10DD11A,C11D, D11B, E11D, F11B	Wood (sediment and hearth 1)	D9D, E10A D10D,E11B, E11D G11A, G11B; (hearth 1: F11A, F11B)	Wood (sediment and hearth 3)	F9A, F9B, E10A, D10D, E10B, E10D, F10B, C11B; (hearth 3:D11D)
Pollen (human and camelid coprolites)	C11A (camelid coprolites); E9D (human coprolites)	Pollen (camelid coprolites)	D10D	Pollen (human and camelid coprolites)	E10C (camelid coprolites); D11C (human coprolites)
Plant Remains (human and camelid coprolites)	C11A (camelid coprolites); E9D (human coprolites)		–	Plant Remains (human coprolites)	D11C (human coprolites)

Please cite this article in press as: Caruso Fermé, L., et al., Multiproxy study of plant remains from Cerro Casa de Piedra 7 (Patagonia, Argentina), Quaternary International (2016), http://dx.doi.org/10.1016/j.quaint.2016.11.005

the family Poaceae, the microhistological analysis permitted the determination of the genera *Festuca* sp. and *Rytidiosperma* sp, and the species *Poa ligularis, Stipa tenuis* (Phil.) Barkworth, *S. speciosa* (Trin. & Rupr.) Romasch, *Deschampsia antarctica* E. Desv, *Festuca argentina* (Speg.) Parodi, *F. magellanica* and *F. pallescens*.

4.2. The stratigraphic level 10 (8380 ± 120 years BP)

Macroremains taxonomic analysis was performed based on 241 fragments (115 charcoals and 126 wood non-carbonized). Sample of dispersed material on sediments consist of 47 charcoals and 82 wood fragments. Samples from combustion hearth 1 consist of 47 charcoals and 44 wood fragments and samples from combustion hearth 2 correspond to only 21 charcoals. Sample of coprolites consist of two camelids pellets.

The analysis of samples from level 10 allowed the identification of 17 taxa: 3 arboreal, 7 shrubby and 7 herbaceous. The arboreal stratum is represented by *Nothofagus pumilio, Nothofagus antarctica* and *Nothofagus* sp.; the shrubby stratum is represented by *Ribes magellanicum*, *Empetrum rubrum*, *Berberis* sp., *Nassauvia* sp., Asteraceae subf. Asteroideae, Fabaceae and Apiaceae, and the herbaceous stratum is represented by Poaceae, Caryophyllaceae, Lamiaceae, Rosaceae, *Armeria* sp., *Valeriana* sp. and Brassicaceae. Taxa C was identified among the scattered carbonized material.

Of a total of 17 identified taxa, only *Nothofagus* sp. is common among the macro-remains (charcoal and wood) and among the micro-rests (pollen) recovered from camelid coprolites. As in level 17, the analysis of woody material led to the determination at the level of species of this genus. Among the charcoal and wood samples scattered in the sediments, and coming from hearths, fragments of *N. pumilio* were identified; *N. antarctica* was only found in the spread wood.

4.3. The stratigraphic level 5 (6150 ± 105 years BP)

In the case of the stratigraphic level 5, the sample consist of 248 wood and charcoal fragments. The material dispersed is conformed for 61 charcoals and 35 woods and the material of hearth combustion consist of 45 charcoals and 107 woods. Coprolites samples consist of one human coprolite and two camelids pellets.

The analysis of samples from level 5 recorded 28 taxa. Three of them are arboreal; 14 are shrubby; 10 are herbaceous and *Misodendrum* sp. (hemiparasitic plant that grows on *Nothofagus* trees). The arboreal taxa are *Nothofagus pumilio, Nothofagus* sp., and *Podocarpus* sp. The shrubby taxa are *Empetrum rubrum, Gaultheria mucronata* (L.f.) Hook. et Arn, *Berberis* sp., *Nassauvia* sp., *Perezia* sp., Apiaceae and *Azorella* sp., Empetraceae/Ericaceae and Asteraceae subfam. Asteroideae. The herbaceous taxa are represented by *Armeria* sp., *Cerastium* sp., Poaceae (two identified species), Caryophyllaceae, Brassicaceae, Lamiaceae, Asteraceae subfam. Cichoroideae and Rosaceae.

Of the 28 taxa identified in this level, only one is present among the different analyzed proxies. Once again, *Nothofagus* sp. is common among charcoal and woods, and among pollen samples of both types of coprolites. As in the previous taxonomic analyses the woody material allowed a determination at the level of species. *Nothofagus pumilio* is present between the scattered material and the one coming from the three structures of combustion of this level.

With reference to coprolites samples the presence of *Empetrum rubrum* plant fragments can be seen in human coprolites and pollen grains within camelid coprolites. Poaceae is also represented in more than one proxy: pollen and plant fragments. The analysis of plant fragments from coprolites evidenced the presence of *Poa ligularis* and *Stipa tenuis*. This results evidenced a higher taxonomic resolution achieved.

5. Discussion

The plant remains diversity registered at site CCP7 demonstrates that the relationship between human groups and the environment is complex and exceeds beyond the mere food consumption. The plant landscape, apart from providing food and raw materials, was the framework where complex relations developed between hunter-gatherer groups and the natural environment. The exceptional conservation of the archaeobotanical remains of site CCP7 allowed grasping part of the relationship of man and its environment. The study of micro and macro-remains carried out in the site allowed discussing from an integrated perspective the existence and the use of the forest by hunter-gatherers of the Early-Mid-Holocene and the surroundings where these groups moved.

5.1. Landscape and intake areas of wood resources

The taxonomic analysis of macro-remains (charcoal and wood) shows qualitative differences between levels 17, 10 and 5 of site CCP7. Our results evidence for the earliest occupation of the cave -level 17 (9640 ± 190 years BP)- a diversity of wood species, which is lacking at levels 10 and 5 (Caruso Fermé, 2012, 2015). On the other hand, this analysis reveals a heterogeneous use of woody material by the cave inhabitants. It is important to stress that for this occupation moments an incipient development of the forest is posed (Mancini, 2007).

The strong representation of *Nothofagus pumilio* in all samples of Level 17 and the presence of shrubs like *Empetrum rubrum* (hearth 2 and charcoal in sediments) and *Berberis* sp. (charcoal and wood from sediments) indicate the presence of forest near CCP7 area. *Empetrum rubrum* and *Berberis* sp. grow in forest and ecotone forest-shrub steppe (Barthelemy et al., 2008).

Nevertheless, apart from the record of species typical of the forest zone (*N. pumilio* and *N. antarctica*), the presence of *Anarthrophyllum rigidum* and *Empetrum rubrum* indicate the existence of environments characteristic of the shrub-steppe. Also, the founding of wood of *Berberis* sp., which develops in the shrub-steppe and in the forest shows the presence of these two environments in the surroundings of the cave. Moreover, the presence of *Empetrum rubrum* in pollen and plant fragments from human and camelid coprolites is just another evidence of the existence of this species in the environment at an early cave occupation. This specie grows nowadays in the closed-canopy forest as well as in the grass-steppe.

In turn, the study of pollen and plant fragments coming from coprolites, allowed the identification of herbaceous elements and grass species of the genera *Poa, Stipa, Deschampsia, Festuca* and *Rhytidiosperma*, typical of the steppe environments and forest-steppe ecotonal areas (León et al., 1998). The presence of these taxa upholds the hypothesis of Mancini (2007) about the forest incipient development and the presence of the shrub-grass steppe in the area.

In the stratigraphic level 10 (8380 ± 120 years BP), as opposed to level 17, the samples from the two hearths and the dispersed charcoal suggest a monospecific use of the woody material, being *Nothofagus pumilio* the only represented species. However, if compared with the homogeneity of the carbonized material, a great taxonomic diversity is evidenced among the scattered samples of wood in the sediment. On the one hand, the results obtained show the procurement and selection of *Nothofagus* wood, and on the other, the possible recurrent interaction with forest-type spaces where *Ribes magellanicum* and *Berberis* sp. could have been part of the shrub stratum (Roig, 1998).

According to the palynological analysis of sediments, the

Please cite this article in press as: Caruso Fermé, L., et al., Multiproxy study of plant remains from Cerro Casa de Piedra 7 (Patagonia, Argentina), Quaternary International (2016), http://dx.doi.org/10.1016/j.quaint.2016.11.005

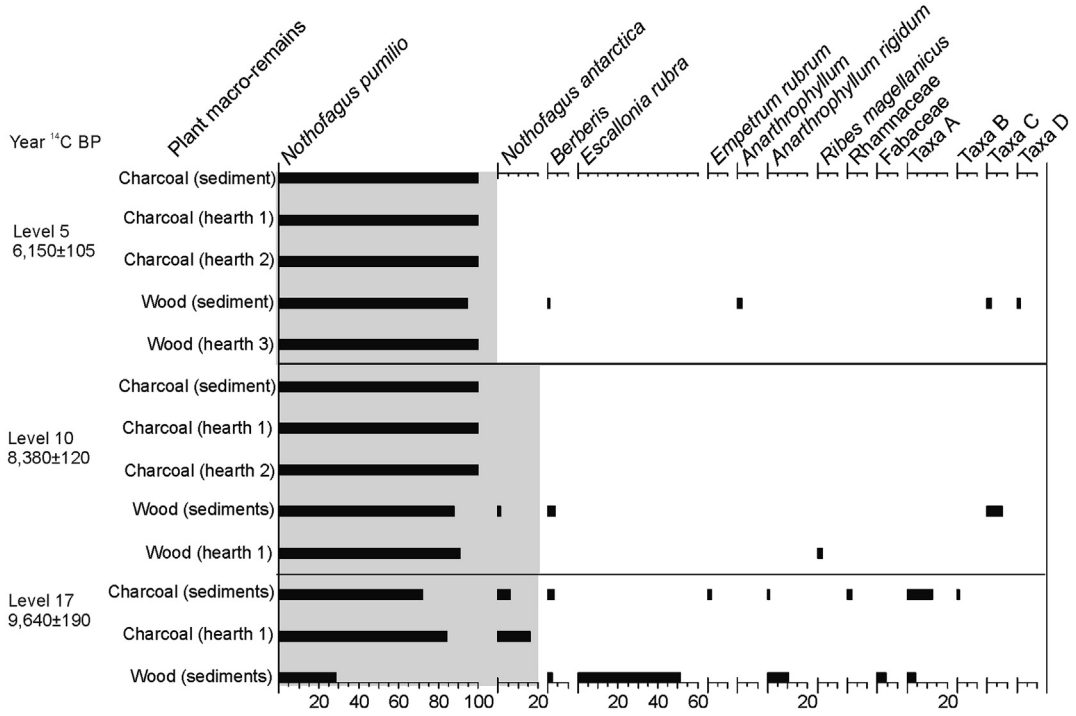

Fig. 4. Percentage anthracology diagram (charcoal and wood) -Cerro Casa de Piedra 7 site, level 17, 10, 5.

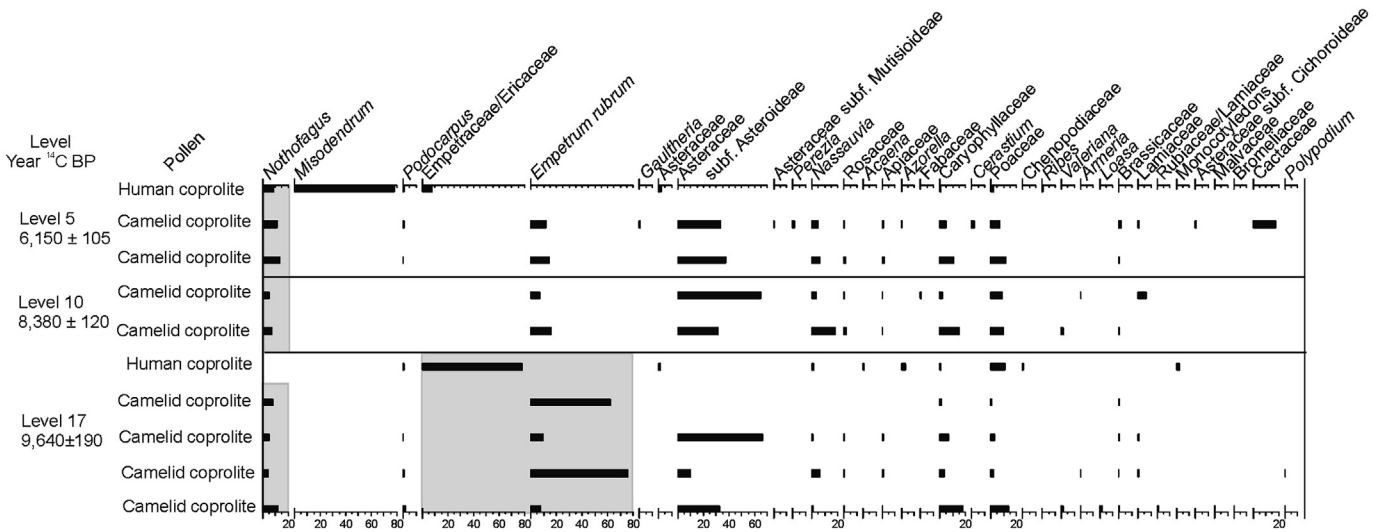

Fig. 5. Percentage pollen diagram (human and camelid coprolites) -Cerro Casa de Piedra 7, level 17,10, 5.

occupation time of this level is characterized by an increase of *Nothofagus* trees and shrubs like *Empetrum rubrum* (Mancini, 2007). Similarly, the coprolites pollen record under study evidenced elements both from the forest and the steppe, represented by shrubby and herbaceous taxa.

In the stratigraphic level 5 (6150 ± 105 years BP) the taxonomic analysis of charcoal and wood suggest a heterogeneous use of woody material. The samples of the three combustion structures, in turn, evidence a homogeneous use of woody material intended to use for combustion. It is important to bear in mind that every hearth reflects the last combustion. Nevertheless, the global analysis of the anthracological results allows confirming that among the scattered material as well as among the three hearths, *Nothofagus pumilio* is the plant species either with the highest representation or just the only taxon present.

The human coprolite pollen study permitted the identification of pollen grains of *Misodendrum*. This taxon is a *Nothofagus* hemiparasite, and according to Mancini (2007) for these chronologies forest had already developed. The absence of plant fragments in coprolites could indicate that this plant was not ingested by man, and that the grains, being anemophilous, had been incorporated to the coprolite with food or infusions. Another alternative could be that the plant had indeed been ingested and its tissues digested, so that non identifiable fragments had been left.

The analysis conducted show differences in the taxonomic resolution obtained by each one of the proxies. A clear example of that

Please cite this article in press as: Caruso Fermé, L., et al., Multiproxy study of plant remains from Cerro Casa de Piedra 7 (Patagonia, Argentina), Quaternary International (2016), http://dx.doi.org/10.1016/j.quaint.2016.11.005

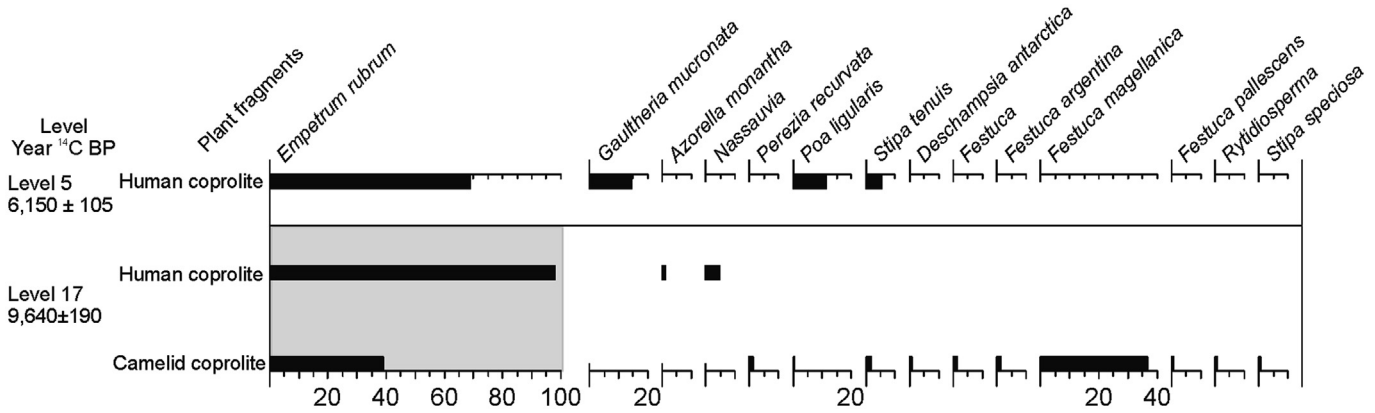

Fig. 6. Percentage plant fragments diagram (human and camelid coprolites) -Cerro Casa de Piedra 7, level 17,10, 5.

are the determinations reached at a genus and/or species level, particularly in the macro-remains analysis (wood, charcoal and plant fragments). The taxonomic analysis of charcoal and wood from levels 17, 10 and 5 allowed determinations at the species level: *Nothofagus pumilio* and *N. antarctica*, while by means of pollen analysis the determination attained the genus level: *Nothofagus* sp. Furthermore, when analyzing coprolites, the plant fragments let determine many grasses at a specific level, while through pollen analysis they were determined at family level: Poaceae. On the other hand, the results obtained evidence the presence of the same taxon in the different proxies analyzed. Such are the cases of *Empetrum rubrum* and *Nothofagus* sp. At level 17 *Empetrum rubrum* was recorded in charcoal, pollen of camelid coprolites and plant fragments of human and camelid coprolites, while in level 5 it was found among the plant remains of human coprolites and in pollen of camelid coprolites.

According to the taxonomic resolution attained, either *Nothofagus* sp. or *Nothofagus pumilio*, is common among the different proxies analyzed. At levels 17, 10 and 5 wood and charcoal of *Nothofagus pumilio* were recorded, while in levels 10 and 5 pollen of *Nothofagus* sp. was also found within camelid and human coprolites, respectively.

The presence of pollen of *Nothofagus* and the absence of *Nothofagus* plant fragments in human and camelid coprolites could be interpreted in two ways. On the one hand, as a result of the grain deposition from the pollen rain over leaves and fruits of other consumed plants (Velázquez et al., 2010). On the other hand, as a consequence of inhaling air or because of water ingest, thus entering into the digestive tract. In the case of macro-remains, the marked representation of *Nothofagus pumilio* among charcoal and wood from levels 17, 10 and 5 makes clear that the forest was an environment recurrently used by hunter-gatherers occupying CCP7, and that the use of shrubs in order to satisfy their fuel need was less intense than the advantage out of tree species. Moreover, works of different nature (Gusinde, 1937; Ratto, 2003; Piqué, 2006; Caruso Fermé, 2008; Caruso Fermé et al., 2011; among others) point out the use of *Nothofagus* wood as raw material for making bows, which could be an explanation to the presence of *Nothofagus* wood remains.

5.2. Management of woody plant resources

The results of the taxonomic analysis of plant macro-remains evidence qualitative differences between different levels in terms of charcoal and wood samples. The results achieved in the three studied levels evidence a drastic reduction of taxa used for fuel.

The study of charcoal revealed, for the earliest cave occupation —level 17- a diversity of wood species, and a full absence in levels 10 and 5. Nevertheless, only two wood species, *Nothofagus pumilio* and *N. antarctica* were registered in combustion structures of three levels studied. This result evidenced a selective utilization of wood species used for combustion.

In level 17 a minimum number of 8 wood species was identified, while in levels 10 and 5 a homogeneous representation of a single plant species, *Nothofagus pumilio*, was observed.

The results about non-carbonized wood offer a completely different view from that of charcoal. In spite of the *Nothofagus pumilio* marked representation at levels 17, 10 and 5, a great taxonomic diversity is seen. The taxonomic diversity registered among woods of the three levels could also be due to the great motility and forest and steppe exploration by the hunter-gatherers that inhabited Cerro Casa de Piedra 7 (Caruso Fermé and Civalero, 2014).

Highest percentage of *Nothofagus pumilio* between charcoal remains and wood uncarbonized suggest use of forest resources by the Patagonian hunter-gatherer societies of site CCP7. Moreover, zooarchaeological remains recovered in site CCP7 of animals that inhabit forest as *Hippocamelus bisulcus* and *Anatidea* evidenced use of forest resources (De Nigris, 2004).

Given the chronological difference between the levels studied, approximations with plant formations are only valid for certain levels. As could be shown, between the three analyzed levels a change in the species consumed that could be related to palaeoenvironmental variables is evidenced (Caruso Fermé, 2012, 2015; Caruso Fermé and Civalero, 2014). Therefore, in spite of the continuity of the exploited environments, it is important to point out the taxonomic diversity difference between charcoal and wood in the three studied levels. The results reveal a sharp heterogeneity between woods and an almost complete homogeneity between charcoals. The observed taxonomic difference may be the result of different causes: the charcoal remains come from a single activity (combustion), while woods might be related both to combustion or another type of activities, such as the making of instruments. That is why the registered taxonomic diversity between charcoal and wood might be a consequence of different activities carried out in the cave. In summary, the multi-proxy analysis carried out over the CCP7 cave allowed both the determination of new plant taxa for the region and the widening of the resolution level for the identification of the taxa present.

The results obtained by means of the multi-proxy analysis allowed us not only to enlarge the reconstruction of the hunter-gatherers livable environment, but also to recognize the availability and use of the plant resources in the Early-Mid - Holocene in the region.

Please cite this article in press as: Caruso Fermé, L., et al., Multiproxy study of plant remains from Cerro Casa de Piedra 7 (Patagonia, Argentina), Quaternary International (2016), http://dx.doi.org/10.1016/j.quaint.2016.11.005

6. Conclusion

The study of micro- and macro-plant remains of the stratigraphic levels 17, 10 and 5 of the archaeological site CCP7 evidenced the potential of the integral analysis for the enrichment of the palaeoenvironmental reconstruction and for the study of the management of wood resources by the hunter-gatherer groups that inhabited the cave. The joint analysis of the different archaeobotanical records: charcoal, wood, pollen and plant fragments within coprolites, allowed to widen the taxonomic information obtained until now through anthracological and palynological studies in the area.

The analysis of recovered macro-remains (charcoal and wood) evidenced the presence of certain plant species that had not been documented among samples coming from coprolites, examples of which are B*erberis* sp., *Anarthropyllum rigidum*, *Escallonia rubra* and *Ribes magellanicum*. Yet, the pollen and plant fragments from coprolites contributed information of shrub and herb elements belonging to the ecotone forest-steppe and steppe, such as *Perezia recurvata* and the various identified species of Poaceae. The results obtained enable, on the one hand, the formulation of new discussions on the supplying mode and use of wood resources by the Patagonian hunter-gatherer societies that inhabited the National Park Perito Moreno, and on the other, the progress in palaeoenvironmental reconstructions and the knowledge in the use of plant resources by hunter-gatherer groups.

Acknowledgements

The authors acknowledge the comments made by the anonymous referees, which have improved our original text. To 1) Consejo Nacional de Investigaciones Científicas y Técnicas; 2) Universidad Nacional de Mar del Plata and 3) Matilde Trivi de Mandri for helping in the writing.

References

Aceituno, F.J., Loaiza, N., 2015. The role of plants in the early human settlement of Northwest South America. Quat. Int. 363, 20–27.

Aschero, C.A., 1996. El área Río Belgrano-Lago Posadas (Santa Cruz): problemas y estado de problemas. In: Gómez Otero, Julieta (Ed.), Arqueología, Sólo Patagonia. CENPAT–CONICET, pp. 17–26.

Aschero, C.A., Belleli, C., Goñi, R.A., 1992–1993. Avances en las investigaciones arqueológicas del Parque Nacional Perito Moreno (Provincia de Santa Cruz, Patagonia Argentina). Cuadernos del Instituto Nacional de Antropología y Pensamiento Latinoamericano 14, 143–170.

Aschero, C.A., Goni, R.A., Civalero, M.T., Molinari, R., Espinosa, S.L., Guraieb, A.G., Bellelli, C.T., 2005. Holocenic Park: arqueología del Parque Nacional Perito Moreno. An. Parques Nac. 17, 71–119.

Aschero, C.A., Bozzuto, D., Civalero, M.T., De Nigris, M., Di Vruno, A., Dolce, V., Fernández, N., González, L., Sacchi, M., 2008. Nuevas evidencias sobre las ocupaciones tempranas de Cerro Casa de Piedra 7. In: Morello, F., Prieto, A., Martinic, M., Bahamondes, G. (Eds.), Arqueología de Fuego-Patagonia. Levantando piedras, desenterrando huesos… y develando arcanos. Centro de Estudios del Cuaternario Antártico (CEQUA), Punta Arenas, Chile, pp. 569–576.

Bamonte, F.P., Mancini, M.V., 2011. Palaeoenvironmental changes since Pleistocene-Holocene transition: pollen analysis from a wetland in southwestern Patagonia (Argentina). Rev. Palaeobot. Palynol. 165, 103–110.

Barberena, R., Prates, L., De Porras, M.E., 2015. The human occupation of northwestern Patagonia (Argentina): paleoecological and chronological trends. Quat. Int. 356, 111–126.

Barthelemy, D., Brion, C., Puntieri, J., 2008. Plantas de la Patagonia. Buenos Aires. 1a ed, p. 240.

Brook, G.A., Mancini, M.V., Franco, N.V., Bamonte, F., Ambrústolo, P., 2013. An examination of possible relationships between paleoenvironmental conditions during the Pleistocene-Holocene transition and human occupation of southern Patagonia (Argentina) east of the Andes, between 46° and 52°S. Quat. Int. 305, 104–118.

Burry, L.S., Trivi de Mandri, M.E., D'Antoni, H., 2006. Paleocomunidades vegetales del centro de Tierra del Fuego durante el Holoceno Temprano y Tardío. Rev. del Mus. Argent. Cienc. Nat. 8 (2), 127–133.

Caruso Fermé, L., 2008. Los usos de la madera entre los cazadores recolectores Sel'knam de Tierra del Fuego (Argentina). Treball de recerca-Doctorat d'Arquelogía Prehistòrica. Universitat Autónoma de Barcelona.

Caruso Fermé, L., 2010. Ethnographie, archéobotanique et expérimentation sur le site d'Ewan I (Tierra del Fuego, Argentine). Anthropobotanica N° 1.5, pp. 3–17. ISSN: 1775-3791. Muséum National d'Histoire naturelle, Paris. France.

Caruso Fermé, L., 2012. Modalidades de adquisición y usos del material leñoso entre grupos cazadores-recolectores patagónicos (Argentina). Métodos y técnicas de estudio del material leñoso arqueológico. Universitat Autònoma de Barcelona, España, 150 p.

Caruso Fermé, L., 2013. Los recursos vegetales en arqueología: estrategias de muestreo y estudio del material leñoso. Dunken. Buenos Aires, Argentina. ISBN: 978-987-02-6738-6.

Caruso Fermé, L., 2015. Modalidades de adquisición y usos de la madera en sociedades cazadoras-recolectoras patagónicas: métodos y técnicas de estudio. Treballs d'Etnoarqueologia 10. Consejo Superior de Investigaciones Científicas, Madrid, España.

Caruso Fermé, L., Civalero, M.T., 2014. Holocene landscape changes and wood use at Patagonia. Plant macro-remains from Cerro Casa de Piedra 7. Holocene 24 (2), 188–197. ISSN: 0959-6836.

Caruso Fermé, L., Álvarez, M., Vázquez, M., 2011. Análisis arqueobotánico de piezas de madera del extremo austral americano. Magallania, Chile 39 (1), 221–240.

Civalero, M.T., Aschero, C.A., 2003. Early Occupations at Cerro Casa de Piedra 7. In: Cruz Province, Santa, Argentina En, Patagonia, Miotti, L., Salemme, M., Flegenheimer, N. (Eds.), Ancient Evidence for Paleo South Americans: from where the South Winds Blow. Center for the studies of the first American (CSFA) and A&M University Press, Texas, pp. 141–147.

Ciampagna, M.L., Capparelli, A., 2012. Historia del uso de las plantas por parte de las poblaciones que habitaron la Patagonia Continental Argentina. Cazadores-recolectores del Cono Sur. Rev. Arqueol. 6, 45–75. Eudem, (Mar del Plata. Argentina).

Civalero, M.T., Bozzuto, D.L., Di Vruno, A., De Nigris, M.E., 2006-2007. Cerro Casa de Piedra 7, una fecha reciente. Cuad. del Inst. Nac. Antropol. Pensam. Latinoam. 21, 259–261.

De Nigris, M.E., 2004. El consumo en grupos cazadores recolectores: un ejemplo zooarqueológico de Patagonia Meridional., 1 ed. Sociedad Argentina de Antropología, Buenos Aires.

Faegri, K., Iversen, J., 1989. In: Faegri, K., Kaland, P.E., Krzywinski, K. (Eds.), Textbook of Pollen Analysis 4th Edition. John Wiley and Sons, Chichester, p. 328.

Gusinde, M., 1937. In: Los indios de Tierra del Fuego. Tomo 1: Los Selk'nam. 2 vols. Centro Argentino de Etnología Americana, Buenos Aires.

León, R.J.C., Bran, D., Collantes, M., Paruelo, J.M., Soriano, A., 1998. Grandes unidades de vegetación de la Patagonia extra andina. Ecología Austral 8, 125–144.

Mancini, M.V., 2007. Cambios paleoambientales en el ecotono bosque-estepa: análisis polínico del sitio Cerro Casa de Piedra 7, Santa Cruz (Argentina). In: Morello, F., Martinic, M., Prieto, A., Bahamonde, G. (Eds.), Arqueología de Fuego Patagonia. Levantando piedras, desenterrando huesos y develando arcanos. Ediciones CEQUA, Punta Arenas, Chile, pp. 89–94.

Mancini, M.V., 2009. Holocene vegetation and climate changes from a peat pollen record of the forest-steppe ecotone, Southwest of Patagonia (Argentina). Quat. Sci. Rev. 28, 1490–1497.

Mancini, M.V., Paez, M.M., Prieto, A.R., 2002. Cambios paleoambientales durante los últimos 7000 14C años en el ecotono bosque-estepa, 47-48° S, Santa Cruz, Argentina. Ameghiniana 39, 151–162.

Martínez Tosto, A.C., Burry, L.S., Civalero, M.T., 2012. Aportes paleobotánicos en la reconstrucción de paleodietas. Análisis de coprolitos del Cerro Casa de Piedra, Santa Cruz. Rev. del Mus. Antropol. vol. 5, 163–170.

Mermoz, M., 1998. Mapa preliminar de vegetación Parque Nacional Perito Moreno, Dirección Nacional de Conservación de Áreas protegidas. Delegación Regional Patagonia, Bariloche.

Movia, C., Soriano, A., León, R., 1987. La vegetación de la Cuenca del Río Santa Cruz (provincia de Santa Cruz, Argentina). Darwiniana 28, 9–78.

Ortega, F.V., Marconetto, M.B., 2011. La explotación de los recursos combustibles: su uso y representación en la costa rionegrina a través de los restos antracológicos. In: Dunken (Ed.), Arqueología de Pescadores y Marisqueadores en Nordpatagonia. Descifrando un registro de más de 6000 años, pp. 111–127. Buenos Aires.

Piqué, R., 2006. L'uso del legnonelle società fuegine: manufatti dalle collezioni del Museo Pigorini. In: Salerno, A., Taglaiacozzo, A. (Eds.), Finis Térrea. Viaggiatori, esploratori Mmissionari italiani nella Terra del Fuoco. Museo Nazionale Prehistórico Etnografico "Luigi Pigorini". Ministero per iBeni e le attivitá culturali, Roma, pp. 182–192.

Ratto, N., 2003. Estrategias de caza y propiedades del registro en la Puna de Chaschuil (Depto Tinogasta, Catamarca, Argentina). Tesis Doctoral. Universidad de Filosofía y Letras, Buenos Aires.

Roig, F.A., 1998. La vegetación de la Patagonia. In: Correa M (compaginador), Flora Patagónica. Colección Científica INTA. Tomo VIII, (1), pp. 48–174.

Stockmarr, J., 1971. Tablets with spores used in absolute pollen analysis. Pollen Spores 13, 615–621.

Trivi de Mandri, M.E., Burry, L.S., D'Antoni, H.L., 2006. Dispersión-depositación del polen actual en Tierra del Fuego, Argentina. Rev. Mex. Biodivers. 77 (1), 89–95.

Uzquiano, P., 2014. Wood resource exploitation by Cantabrian Late Upper Palaeolithic groups (N Spain) regarding MIS 2 vegetation dynamics. Quat. Int. 337, 154–162.

Velázquez, N.J., Burry, L.S., Mancini, M.V., Fugassa, M.H., 2010. Coprolitos de camélidos del Holoceno como indicadores paleoambientales. Magallania 38, 213–229.

Velázquez, N.J., Burry, L.S., Fugassa, M.H., Civalero, M.T., Aschero, C.A., 2014.

Please cite this article in press as: Caruso Fermé, L., et al., Multiproxy study of plant remains from Cerro Casa de Piedra 7 (Patagonia, Argentina), Quaternary International (2016), http://dx.doi.org/10.1016/j.quaint.2016.11.005

Palynological analysis of camelid coprolites: seasonality in the use of thesite Cerro Casa de Piedra 7 (Santa Cruz, Argentina). Quat. Sci. Rev. 83, 143–156.
Velázquez, N.J., Burry, L.S., Fugassa, M.H., 2015. Palynological analysis of extinct herbivore dung from Patagonia, Argentina. Quat. Int. 377 (7), 140–147. Elsevier, ISSN: 1040-6182.
Yagueddú, C., Arriaga, M.O., 2010. Paleodietas de camélidos del Cerro Casa de Piedra (Parque Nacional Perito Moreno, Santa Cruz, Argentina). In: De Nigris, M., Fernández, P.M., Giardina, M., Gil, A., Gutiérrez, M.A., Izeta, A., Neme, G., Yacobaccio, H. (Eds.), Zooarqueología a principios del siglo XXI. Aportes teóricos, metodológicos y casos de estudio. Ediciones Libros del Espinillo, Mendoza, Argentina, pp. 87–94.

Please cite this article in press as: Caruso Fermé, L., et al., Multiproxy study of plant remains from Cerro Casa de Piedra 7 (Patagonia, Argentina), Quaternary International (2016), http://dx.doi.org/10.1016/j.quaint.2016.11.005