

A palaeoparasitological analysis of rodent coprolites from the Cueva Huenul 1 archaeological site in Patagonia (Argentina)

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*The aim of the present study was to examine the parasite fauna present in rodent coprolites collected from Cueva Huenul 1 (CH1), northern Neuquén (Patagonia, Argentina), an archaeological site that provides stratified sequences of archaeological and palaeontological remains dating from the Late Pleistocene/Early Holocene Transition to the Late Holocene period. Twenty rodent coprolites collected from different sedimentary units from the site, with ages ranging from 13.844 ± 75-1.416 ± 37 years BP, were examined for parasites. Each coprolite was processed as a whole: rehydrated, homogenised, spontaneously sedimented and examined using light microscopy. The coprolites and the eggs of any parasites present were described, measured and photographed. In all, 158 parasite eggs were found in 10 coprolites. The faeces were positive for *Viscachataenia quadrata* Denegri, *Dopchiz*, *Elissondo* & *Beveridge* and *Monoecocestus* sp. *Beddard* (Cestoda: Anoplocephalidae) and for *Heteroxytnema* (*Cavioxyura*) *viscaciae* Sutton & Hugot (Nematoda: Oxyuridae). The coprolites examined were tentatively attributed to *Lagidium viscacia* Molina (Mammalia, Rodentia, *Caviomorpha*, *Chinchillidae*). The life cycles of these parasites are discussed.*

Key words: palaeoparasitology - Patagonia - rodent coprolites - *Viscachataenia quadrata* - *Heteroxytnema* (*Cavioxyura*) *viscaciae*

The relevance of rodents as hosts in parasite life cycles, including those of zoonotic importance, has been fully recognised (Miyazaki 1991, Perkins et al. 2005, Morand et al. 2006). During the past few years, several samples of rodent coprolites and remains of rodents found in regurgitated pellets collected from several archaeological sites in Patagonia, Argentina, were examined for parasites. These samples span the Late Quaternary period, from the Pleistocene-Holocene Transition to the Late Holocene. Positive results were obtained for the nematodes *Trichuris* sp., *Capillaria* spp, *Calodium* sp., *Eucoleus* sp., *Echinocoleus* sp., *Trichosomoides* sp., *Pterygodermatites* sp., *Paraspidodera* sp. and *Heteroxytnema* sp. and for *Monoecocestus* sp. and one taeniid (cestodes) (Fugassa 2006a, b, Fugassa & Barberena 2006, Fugassa et al. 2007, Sardella & Fugassa 2009a, b, 2011, Sardella et al. 2010, Beltrame et al. 2011).

Recently, new research was initiated at Cueva Huenul 1 (CH1) (36°56'45"S 69°47'32"W), northern Neuquén (Patagonia, Argentina) (Fig. 1), an archaeological cave that provides a stratified sedimentary sequence ranging from the Late Pleistocene to the Late Holocene and in which well-preserved coprolites were found. The excavations provided a 1.4-m sequence composed of two sets

of lithostratigraphic units. Basal units VIII-V of the sequence have a high content of organic matter. This material is composed primarily of megafauna dung remains. The radiocarbon dates of these units range between 13.844 ± 75-11.841 ± 56 years BP. In contrast, the second stratigraphic set (units IV-I) has a lower abundance of organic matter, with predominant aeolian sedimentation and is dated between 9.531 ± 39-1.416 ± 37 years BP. The site presents evidence of a very brief, but redundant use of the cave by humans (Barberena et al. 2010) during different stages of the human settlement of northern Patagonia. This paper presents the first palaeoparasitological examination of the coprolites of CH1.

The aim of the present study was to examine the parasite fauna present in rodent coprolites collected from CH1 and to identify the parasitic remains and the host origin of the faeces to assess the parasite life cycles and the importance of rodents in the area studied. In conjunction with other analyses currently in progress, this study will contribute to a palaeoecological reconstruction of Patagonian ecosystems through time.

MATERIALS AND METHODS

Twenty rodent coprolites obtained from different units (II, V, VI and VII) of CH1 were examined for parasites. The coprolites were inventoried and processed individually (Fugassa 2006b). The examination, consisting of the external observation of the faeces, was conducted according to Chame (2003) and Jouy-Avantin (2003). Each coprolite was fully processed by rehydration in a 0.5% aqueous tris-sodium phosphate in a glass tube for one week at 4°C, then homogenised and processed by spontaneous sedimentation (Lutz 1919, Callen & Camer-

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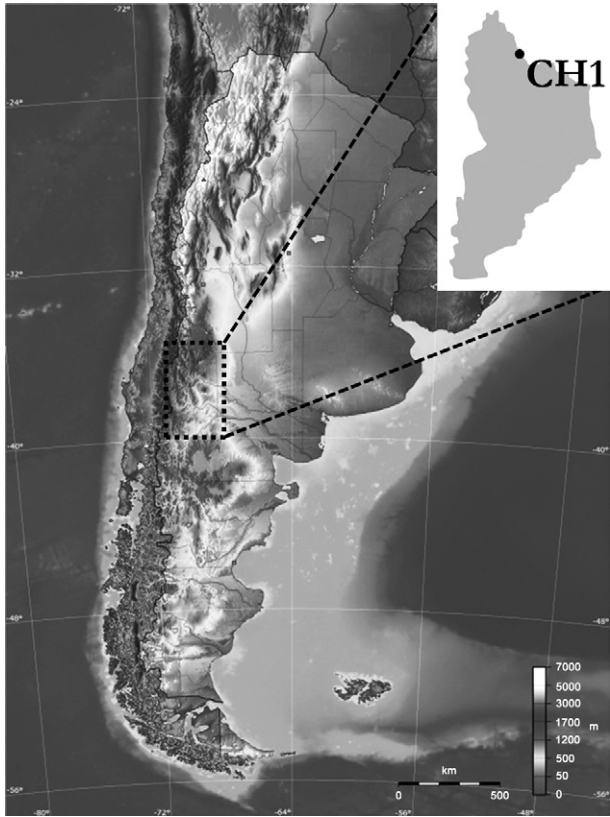


Fig. 1: geographic location of the archaeological site Cueva Huenul 1 (CH1), Northern Patagonia, Neuquén, Argentina. In detail, Neuquén Province, with the location of CH pointed.

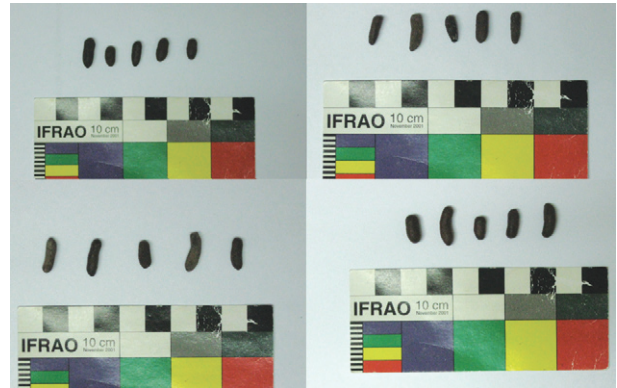


Fig. 2: macroscopic aspect of the rodent coprolites collected from the Cueva Huenul 1.



Fig. 3: egg of *Heteroxytnema (Cavioxyura) viscaciae* (Nematoda: Oxyuridae). Bar = 20 µm.

on 1960) and preserved in 70% ethanol. Ten slides were prepared from each coprolite and one drop of glycerin was added to each slide. The slides were examined with light microscopy. The eggs of the parasites were measured and photographed at 40X magnification.

RESULTS

The coprolites were dark brown and concave to conical, with a smooth surface. One extreme was dull and the other was sharp (Fig. 2). The average measurements of the faeces were 11.70 ± 1.88 mm long by 4.72 ± 0.61 mm wide; the average weight was 0.10 ± 0.03 g.

Ten coprolites contained eggs of three parasites: 118 eggs of *Heteroxytnema (Cavioxyura) viscaciae* Sutton & Hugot 1988 (Nematoda: Oxyuridae), 32 eggs of *Viscachataenia quadrata* Denegri, Dopchiz, Elissondo & Beveridge 2003 and eight eggs of *Monoecocestus* sp. Beddard 1914 (Cestoda: Anoplocephalidae).

The eggs of *H. viscaciae* (Fig. 3) were thick-walled with an operculum at 1 pole and were collected from two coprolites from unit II. The egg measurements ($n = 90$) ranged from $122.5\text{--}147.5$ (133.39 ± 4.10) µm long and $55.0\text{--}72.5$ (62.75 ± 4.48) µm wide. The eggs were oblong and asymmetrical with a convex side and a concave side, with a rounded pole and a more acute pole. An operculum was observed at the sharper pole.

Eggs of *V. quadrata* (Fig. 4) were collected from units VII, VI, V and II. These eggs were thick-shelled and four-lobed in shape. The oncosphere was not measured and was surrounded by an elongate pyriform apparatus ($n = 3$) 39.17 µm long by 26.67 µm wide. The size ranges (means) of the 13 eggs that were measured were $75\text{--}90$ (82.69 ± 5.44) µm long by $75\text{--}100$ (91.73 ± 8.74) µm wide.

A total of eight Cestoda eggs belonging to family Anoplocephalidae and with characteristics attributable to *Monoecocestus* sp. were collected from unit II (Fig. 5). The size ranges (means) of the four eggs that were measured were $54.5\text{--}60$ (59.15 ± 1.3) µm long by $52.5\text{--}62.5$ (56.7 ± 1.5) µm wide.

The coprolites were tentatively assigned to *Lagidium viscacia* Molina 1782 (Caviomorpha: Chinchillidae), the chinchillón or vizcacha serrana.

DISCUSSION

Based on the characteristics of the eggs of the parasites found in this study and on knowledge regarding the parasite fauna of modern viscachas, the faeces were ten-

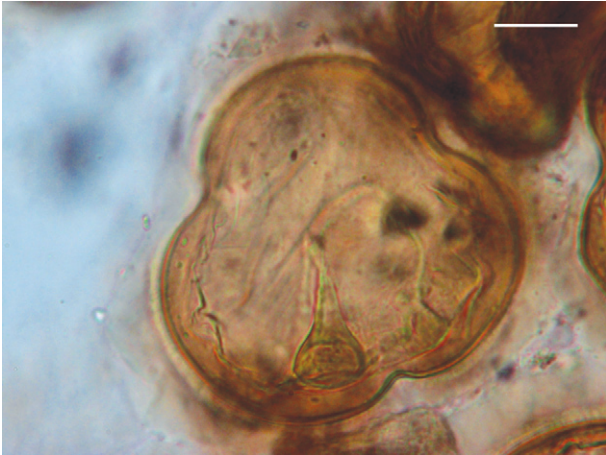


Fig. 4: egg of *Viscachataenia quadrata* (Cestoda: Anoplocephalidae). Bar = 20 μ m.



Fig. 5: egg of *Monoecocestus* sp. (Cestoda: Anoplocephalidae). Bar = 20 μ m.

tatively attributed to *L. viscacia* (Caviomorpha: Chinchillidae) (Hugot & Sutton 1989, Denegri et al. 2003).

The family Chinchillidae contains chinchillas, viscachas and their fossil relatives. The family is restricted to southern and western South America. Cabrera (1961) recognised three species of *Lagidium*, *Lagidium peruanum*, *L. viscacia* and *Lagidium wolffsohni*. The southern viscacha (*L. viscacia*) is found in Argentina, Bolivia, Chile and Peru. Reig (1986) stated that chinchillids predominate (60%) among the living fauna of Andean localities and that *Lagidium* and *Chinchilla* are Andean endemics that became adapted to arid Andean valleys by the Miocene. He also reported that a foundational immigrant stock is known. The first representatives of this stock are well documented for the early Oligocene of Patagonia. These species originally occupied low lands and forested areas and secondarily invaded Andean zones. Viscacha bones were recovered in the archaeological faunal assemblage of CH1 in low frequencies. These animals may have been

brought to the cave as food by humans occupying the site, but the bones do not show cuts that would verify this use. Viscachas may also have occupied the cave (their occurrence was recorded during the field work).

The anoplocephaline cestodes (Cyclophyllidea: Anoplocephalidae) represent a diverse group of parasites infecting both terrestrial mammals (placentals and marsupials) and birds. Based on the number of genera present in these hosts, the most important radiation of anoplocephalines has been in rodents and lagomorphs (Beveridge 1994, Wickström et al. 2005). The intermediate hosts of these cestodes are oribatid mites, which are ingested by their herbivorous definitive hosts (Beveridge 1994). Anoplocephalids are parasites of zoonotic importance for animals and humans (Denegri et al. 1998, Taylor et al. 2001).

Two species of anoplocephalid cestodes have previously been described in viscachas belonging to *Lagidium* Meyen (Rodentia: Chinchillidae) from South America. These anoplocephalid species are *Cittotaenia quadrata* von Linstow, 1904 and *Cittotaenia pectinata* Goeze, 1782, parasites of *Lagidium peruanum* and *L. viscacia*, respectively. *V. quadrata* Denegri, Dopchiz, Elissondo & Beveridge, 2003 was subsequently proposed to accommodate *C. quadrata* (Denegri et al. 2003). Tantaleán et al. (2009) stated that in addition to the specimens of *C. quadrata* von Linstow 1904, the parasites of *L. peruanum* must also be recognised as *V. quadrata*. Denegri et al. (2003) hypothesised that the biogeographical relationships of the genus *Viscachataenia* suggest that it is derived from *Monoecocestus*, a genus that primarily parasitises South American rodents by duplication of the genitalia.

The eggs of *V. quadrata*, as found in CH1, were previously recorded in living *L. viscaciae* collected in Argentina and Peru (Denegri et al. 2003, Tantaleán et al. 2009).

Palaeoparasitological occurrences of anoplocephalid cestodes were previously reported for different archaeological sites in Patagonia. Eggs of *Monoecocestus* sp. were found in rodent coprolites from Alero Mazquirán (Sardella & Fugassa 2009a) and from Alero Destacamento Guardaparque (Sardella et al. 2010). The eggs of *Monoecocestus* sp. observed in CH1 resemble those previously found in Holocene samples from Patagonia. The presence of eggs attributable to *V. quadrata* and *Monoecocestus* sp. adds the CH1 cave, located northwest of the locations of previous findings, to the record of anoplocephalids in Patagonia.

The oxyurid nematodes include monoxenic parasites that live in the posterior third of the digestive tract of various vertebrates and arthropods (Anderson 2000). The family Heteroxyematidae includes nematodes that evolved in sciuriform, caviomorph and myomorph mammals. In addition, this family includes the primitive *Heteroxyema* sp. suggested by Hall (1916) for *Heteroxyema cucullatum*, a parasite of the rodent *Eutamias amoenus operarius* from North America. This nematode genus was subsequently divided into three subgenera, with *Cavioxyura* spp. as parasites of Neotropical Caviomorpha (Petter & Quentin 1976).

In Argentina, Teixeira de Freitas and Lins de Almeida (1936) reported the presence of *Heteroxyema werneckii* in the intestine of the caviid *Galea leucoblephara* from the northern area of Jujuy Province. *H. (C.) visca-*

ciae was described by Sutton and Hugot (1989) from *L. viscaciae* collected from Chubut Province. Foster et al. (2002) and Ferreira et al. (2007) confirmed the presence of this parasite in wild viscacha *Lagostomus maximus* from La Pampa and Chaco Provinces.

Heteroxyxynema sp. was recently found in rodent coprolites collected from Cerro Casa de Piedra, Santa Cruz Province, Argentina (Sardella & Fugassa 2011). Based on the morphological characteristics and measurements of both the coprolites and the eggs found in CHI, the oxyurids found at the CHI and Cerro Casa de Piedra archaeological sites, separated by ca. 1.500 km, were attributed to two different species, *Heteroxyxynema* sp. and *H. viscaciae*, respectively. Hugot and Sutton (1989) stated that the species related most closely to *H. viscaciae* is *Heteroxyxynema (Cavioxyura) chiliensis* Quentin, 1975, a parasite of *Octodon degus* (Molina) from Chile.

Perkins et al. (2005) stated that rodents represent one of the most important sources of zoonoses for mammals and that increases in the population densities of rodents resulted in the dispersal of zoonoses and brought them into closer contact with humans. The oxyurid nematodes found in this study are not presently considered zoonotic. However, anoplocephalids can cause human disease if people eat mites found in the soil (Denegri et al. 1998). It is probable that humans living in CHI were exposed to *V. quadrata* and/or to *Monoecocestus* sp. during the time period considered because the earliest human presence in CHI is considered to have occurred after approximately 10.000 years BP. The anoplocephalids are known to be accidental causative agents of human illness (Denegri et al. 1998, Taylor et al. 2001). Despite the brevity of the human use of the cave (Barberena et al. 2010), hunter-gatherers and animals could have been exposed to parasitic zoonoses and anthroponoses.

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