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First paleoparasitological study of micromammal coprolites from the holocene of the Somuncurá Plateau Protected Natural Area (Patagonia Argentina)

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ABSTRACT

The Somuncurá Plateau is a Protected Natural Area located in the middle of the northern extra-Andean arid Patagonia. Inhabited by at least 20 small mammal species, is the place with the uppermost species richness in Patagonia. The aim of this study was to examine the parasite remains from micromammal coprolites collected in association with a bone sequence recovered at the east of the Somuncurá Plateau (site "Alero Las Lechuzas"). Coprolites came from the four temporal units previously defined: unit I (4790 ± 100 yrs. ^{14}C B.P.), unit II, unit III (7840 ± 120 yrs. ^{14}C B.P.) and unit IV. Each coprolite was processed, rehydrated, homogenized, processed by spontaneous sedimentation and examined using a light microscope. Coprolites and eggs were described, measured and photographed. Samples were positive for two nematode species: *Helminthoxys caudatus* Freitas, Lent & Almeida, 1937 (Oxyurida, Oxyuridae) and *Trichuris* spp. (Trichinellida: Trichuridae). This is the first paleoparasitological study developed for the Somuncurá Plateau Protected Area. Moreover, this is the first time that the genus *Helminthoxys* is reported from ancient times worldwide. Coprolites were attributed to the mountain cavy *Microcavia australis* (Rodentia, Caviidae).The presence of *H. caudatus* for the Middle Holocene of northern Patagonia contributes to the study of the history of the histricomorphs and pinworms relationships.

1. Introduction

The Somuncurá Plateau is a Protected Natural Area, a massive 25,000 km^2 volcanic plain located in the middle of the extra-Andean arid Patagonia, in the center of Chubut and Río Negro Provinces, Argentina. Few years ago, it was an unexplored area regarding the small mammals' fauna. Somuncurá harbours a number of endemic species and is an area of a great biogeographical importance for the evolution of diverse taxa [1]. In the last years, researches on the composition of the small mammals began to develop. Inhabited by at least 20 small mammal species, Somuncurá is the place with the uppermost species richness in Patagonia compared to other sites of similar area [2–6].

Paleoparasitology is the study of parasites found in archaeological or paleontological material. In a broad sense, paleoparasitologists are interested on the evolution of parasites-hosts-environment relationships, as well as in the origin and the evolution of infectious diseases within a paleoepidemiological perspective [7,8]. In recent years, some paleoparasitological studies on micromammals from Patagonia were done [9]. The aim of this study was to examine the parasite remains from micromammal coprolites collected in association with a bone sequence recovered at the east of the Somuncurá plateau ("Alero Las Lechuzas" site). This is the first paleoparasitological study from this Protected Area from the arid Patagonia.

2. Material and methods

The Somuncurá Plateau is located in Chubut and Río Negro Provinces, Argentina, between 41°–43°S and 66°–68°W (Fig. 1). The altitudinal gradient (500 to 1600 m a.s.l.) is formed by superimposed layers of successive basalt flows. The effusive core, a mountain belt called Sierra del Somuncurá (Cerro Corona, highest elevation,

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Fig. 1. Geographical location of the Somuncurá Plateau, Patagonia, Argentina.

1644 m a.s.l.) is in the center of the plateau. The climate is arid, warmer in the eastern and northern areas at lower elevations and colder in the southern and western areas at higher elevations. The vegetation follows the elevational gradient, according to León [10] classification for the extra-Andean Patagonia: Southern Monte (Monte Phytogeographical Province), Monte-Patagonian Steppe ecotone (Ecotono Rionegrino) and Patagonian Steppe (Patagonian Phytogeographical Province).

"Alero Las Lechuzas" is a bone sequence of small mammals recovered in a rockshelter at the east of the Somuncurá plateau, within the limits of the Southern Monte, near to its ecotone with the Patagonian steppe (41° 36′ 26″ S, 66° 26′ 13″ O, Río Negro province, Andrade in elaboration). The 1 × 1 m grid was defined and the sequence was excavated by four artificial layers of 10 cm thick until reaching the basement rock, at a depth of 0.56 m. Four temporal units were defined: unit I (16–26 cm, 4790 ± 100 yrs. ^{14}C B.P.), unit II (26–36 cm), unit III (36–46 cm, 7840 ± 120 yrs. ^{14}C B.P.) and unit IV (46–56 cm). Coprolites were associated with the small mammals' bones all over the sequence. There is few evidence of anthropic activity in the upper levels of the recorded excavated sample (stone tool debitage).

A total of 67 coprolites from the units I, II, III and IV were examined for parasites. The coprolites were described, measured and weighted. Samples were whole processed by rehydration in a 0.5% water solution of trisodium phosphate (Na_3PO_4) in a glass tube for at least 72 hs, followed by homogenization, filtered and processed by spontaneous sedimentation [11] and preserved in 70% ethanol. Twenty slides of each sample were made with the aid of a drop of sediment mixed with one drop of glycerin, and examined at 10× and 40× using a light microscopy. Measurements were taken from those well-preserved eggs. Eggs dimensions and morphologies were compared with data from the literature in order to identify the parasites at the lowest taxonomic level.

Fig. 2. Macroscopic aspect of the rodent coprolites studied from the Somuncurá Plateau (Patagonia, Argentina).

3. Results

The coprolites were brown with a smooth surface and rounded extremes, many of them with a longitudinal groove (Fig. 2). Table 1 presents measurements and parasites found in each stratigraphic unit.

Coprolites from all levels were found parasitized, 39 out of 67 coprolites examined were positive for nematode species. Microscopic observations also revealed pollen grains and vegetal fibers.

Ten coprolites contained eggs of nematodes attributed to *Helminthoxys caudatus* Freitas, Lent & Almeida, 1937 (Oxyurida: Oxyuridae). The eggs (Fig. 3) were oblong, thick-walled and operculated. Some of them were embryonated. The egg measurements are shown in Table 1.

Microscopic examination also revealed barrel-shaped eggs with smooth walls with plugs at each poles, compatible with *Trichuris* sp. Roederer, 1761 (Trichinellida: Trichuridae), collected from 38 pellets (Fig. 4). Differences found in the egg measurements were attributed to the presence of different species of trichuriids (Table 1).

4. Discussion

This is the first paleoparasitological study from this Protected Natural Area. At least 20 micromammal species were found in the Somuncurá Plateau: 15 cricetids (Cricetidae, Sigmodontinae), 2 marsupials (Didelphidae), and 3 caviomorphs (*Microcavia australis*, *Galea musteloides*) (Caviidae) and *Ctenomys* sp. (Ctenomiidae) [3,4].

The neotropical histricognath rodents (Hystricomorpha) are included in 4 superfamilies (Cavioidea, Chinchilloidea, Erethizontoidea, Octodontoidea), named caviomorphous (Caviomorpha). The Cavioidea comprises 3 families: Caviidae, Cuniculidae, and Dasyproctidae [12]. The evolutionary relationships among hystricognath rodents and the geographical origin of the Caviomorpha (endemic to the Neotropics) have generated considerable debate. Some of the arguments used for the monophyletic origin hypothesis of caviomorphs concerned the distribution of the parasite pinworms of these rodents [13].

Species of oxyurid nematodes (pinworms) are monoxenic parasites that live in the posterior third of the digestive tract of various vertebrates and arthropods [14]. The genus *Helminthoxys* includes ten nominal species, all of them parasites of caviomorphs. The type-species *Helminthoxys caudatus* has been reported from *Microcavia australis* in Argentina [15]. *Helminthoxys velizy* Parra Ormeño, 1953 is specific to the chinchillid *Lagidium peruanum* in Bolivia and Peru. *H. urichi*

Table 1
Parasites found in micromammal coprolites from "Alero Las Lechuzas", Somuncurá, Patagonia, Argentina.

	Analized coprolites	Measurements long-wide (mm)	Parasites found	Egg measurements long-wide (μm)	Positive coprolites	N° of eggs
Level I (4790 ± 100 yrs. B.P.)	10	9,12 ± 0,73–3,61 ± 0,27	*Trichuris* sp.	47.5–62.5 (58.83 ± 5.06) – 27.5–35.0 (31.47 ± 2.26)	5	29
Level II	27	9,81 ± 1,42–3,69 ± 0,40	*Helminthoxys caudatus*	95.0–120.0 (109.25 ± 6.23) – 52.5–87.5 (65.05 ± 7.62)	3	79
			Trichuris sp.	72.5–85.0 (77.69 ± 4.04) – 37.5–42.5 (40.5 ± 2.43)	2	9
			Trichuris sp.	45.5–57.5 (50.49 ± 5.14) – 27.5–32.5 (29.94 ± 2.04)	1	7
			Trichuris sp.	55.0–65.0 (58.70 ± 4.10) – 27.5–37.5 (30. 53 ± 2.98)	16	55
Level III (7840 ± 120 yrs. B.P.)	20	9,38 ± 0,40–3,70 ± 0,33	*Helminthoxys caudatus*	97.5–107.5 (105.8 ± 5.37) – 57.5–72.5 (62.18 ± 4.05)	1	12
			Trichuris sp.	47.5–62.5 (55.83 ± 4.32) – 27.5–35.0 (30.68 ± 2.98)	6	59
Level IV	10	7,54 ± 0,44–3,19 ± 0,29	*Helminthoxys caudatus*	97.5–120.0 (105.15 ± 7.18) – 52.5–72.5 (60.67 ± 5.15)	6	20
			Trichuris sp.	52.5–72.5 (65.47 ± 5.78) – 35.0–42.5 (39.88 ± 3.13)	6	24

Fig. 3. Egg of *Helminthoxys caudatus* (Nematoda: Oxyuridae) found from Somuncurá Plateau (Patagonia, Argentina). Bar = 40 μm.

Fig. 4. Egg of *Trichuris* sp. (Nematoda: Trichuridae) found from Somuncurá Plateau (Patagonia, Argentina). Bar = 20 μm.

Cameron & Reesal, 1951 occurs in *Dasyprocta aguti*, a member of the Dasyproctidae in Trinidad and French Guyana [16]. Five species are specific to members of the Octodontoidea, including *H. abrocomae* from *Abrocoma cinerea* in Bolivia [17], *H. freitasi* Quentin, 1969 from *Trichomys aperoides* in Brazil, *H. gigantea* Quentin, Courtin & Fontecilla, 1975 from *Octodon degus* in Chile and *Octodon bridgesi* in Argentina [18], *H. quentini* Barus, 1972 from *Capromys pilorides* and *H. tiflophila* [19] from *Mysateles prehensilis,* the last two in Cuba. Two additional species, *H. pujoli* Quentin, 1973, a parasite of the Bolivian caviid *Microcavia niata* and *H. effilatus* Schuurmans-Stekhoven, 1951, from *Lagidium viscacia* in Argentina, were synonymized with *H. pujoli* and *H. velizi,* respectively [15]. Hugot [13] verified the specificity of all the species of *Helminthoxys* and showed that the host range of this genus seems to be strictly restricted to the Hystricognath. *H. caudatus* is restricted to Caviidae and was found only in *M. australis*. The specificity of *H. caudatus* and the morphology of the studied coprolites allowed to identified them as belonging to the southern mountain cavy *M. australis* (Geoffroy and d'Orbigny) (Rodentia: Caviidae). The southern mountain cavy is a hystricognath rodent that inhabits arid and semiarid lowlands and valleys. It is one of the smallest caviomorph rodents (250 g.) [20], exhibits diurnal habits, and lives in social groups [21]. In the Monte desert of Mendoza province, southern cavies prefer to locate their colonies under plants with low branches, and preferably *Condalia Microphylla* [20]. It is also able to live in the absence of ground vegetation cover [22]. This is the first time that the genus *Helminthoxys* is reported from ancient times and its presence in the Middle Holocene from the Somuncurá Plateau contribute to the study of the history of the histricomorphs and pinworms relationships.

Species of *Trichuris* Roederer, 1761 (Nematoda: Trichuridae) have a cosmopolitan distribution and include intestinal parasites of the caecum and colon of mammals, mainly humans, primates, pigs, ovines, goats, cervids, rodents, lagomorphs, African antelopes, marsupials, felids and canids. They hatch in the small intestine of the definitive host and larvae migrate to the large intestine, where they penetrate the intestinal mucosa and develop through four molts before reaching the adult stage [14]. Species of *Trichuris* are included among the geohelminths; their eggs are deposited from host feces to the soil and the infective larvae develop within the egg. A total of 24 species of *Trichuris* have been described from 10 families of rodents in America. Eight of these species have been reported from Argentina, including *T. dolichotis, T. myocastoris, T. laevitestis, T. bursacaudata, T. pampeana, T. pardinasi, T. navonae, T. thrichomysi*, and also four additional species, not identified to specific level [23]. There are previous paleoparasitological findings of *Trichuris* from rodent coprolites and raptor pellets with rodent remains from archaeological sites of Patagonia [9,24]. This is the first time that *Trichuris* is found in *M. australis*. Once again from Patagonia, the extent of hosts and the plasticity which exhibits the *Trichuris* genus, found in a broad range of rodent species examined at present, have been confirmed for *M. australis.*

Microcavia australis was consumed by human populations in northern Patagonia at least since the Late Holocene [25,26]. However, the species of nematodes found in the studied samples are not known as zoonotic species.

5. Conclusion

This is the first paleoparasitological study developed for the Somuncurá Plateau Protected Area. Moreover, this is the first time that the genus *Helminthoxys* is reported from ancient times. Due to the specificity of *H. caudatus* and the morphological characteristic of coprolites examined, they were attributed to the mountain cavy *M. australis*. The results display, once again, that the paleoparasitology is a

tool to know the zoological origin of coprolites.

The paleoparasitology contributes to improve the knowledge about the history of the host-parasite relationship. In this case, the presence of *H. caudatus* for the Middle Holocene of northern Patagonia contributes to the study of the history of the histricomorphs and pinworms relationships.

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