

# *Litomosoides pardinasi* n. sp. (Nematoda, Onchocercidae) from two species of cricetid rodents in Northern Patagonia, Argentina

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**Abstract** Seventy-seven cricetid rodents, corresponding to six different species, deposited at the Mammal Collection at Centro Nacional Patagónico, Puerto Madryn, Chubut, were examined for parasites. *Litomosoides pardinasi* n. sp. is described parasitizing the pleural and abdominal cavities of *Phyllotis xanthopygus* (Phyllotini) and the abdominal cavity of *Oligoryzomys longicaudatus* (Oryzomyini) in the northern Patagonia, Argentina. The new species is included in the *carinii* group, characterized by the presence of a right spicule with a dorsal heel and a terminal cap well cuticularized; left spicule composed with a handle longer or as long as the blade, and the blade constituted by a cuticularized distal filament. *Litomosoides pardinasi* n. sp. possesses a buccal capsule tubular with an anterior enlargement, and a smooth cavity; four labial and two dorsal cephalic papillae; vulva posterior to the esophagus–intestinal junction; male tail with three to five pairs of symmetric postcloacal papillae; female tail slender; vagina globular and small. This is the first record for a filarioid in a Phyllotini rodent and the southernmost record of any filarioid species worldwide.

## Introduction

More than 30 species of *Litomosoides* Chandler 1931 were reported in the American continent from different groups of hosts, such as bats of the families Phyllostomidae and Vespertilionidae, marsupials Didelphidae, and rodents of the families Ctenomyidae, Echimyidae, Sciuridae, and

Cricetidae (Bain et al. 1989; Brant and Gardner 1997; Esslinger 1973; Guerrero et al. 2002; Notarnicola and Navone 2009; Notarnicola et al. 2010a). In the last 10 years, five new species of *Litomosoides* were described in cricetid rodents in central and northeastern Argentina, and *L. patersoni* (Mazza 1928) was found in the type host and type locality in the northwest of the country and has been redescribed (Notarnicola 2005; Notarnicola and Navone 2002; Notarnicola et al. 2000, 2002, 2010b).

It is known that filarioids worms are distributed in tropical and subtropical climates (Anderson 2000). This distribution reflects that of their vectors, mainly mosquitoes and dipterans. For *Litomosoides*, however, the life cycle involves stages in the Macronyssidae mite *Ornithonyssus bacoti* (Hirst 1913) (Bain et al. 1980, 2002). This mite dwells in nests of mice, and both nymphs and adults suck blood from the hosts (Williams 1946). The northernmost record of *Litomosoides* was given by Chandler (1931) with *L. sigmodontis* Chandler 1931, a parasite of *Sigmodon hispidus* Say and Ord 1825, in Houston (29°45'N), Texas, USA, while the southern limit of its distribution corresponds to the record *L. bonaerensis* Notarnicola et al. 2000, a parasite of *Oligoryzomys flavescens* (Waterhouse 1837) in La Balandra (34°45'S), Buenos Aires Province, Argentina (Lareschi et al. 2003; Notarnicola et al. 2000).

Here we describe a new species of *Litomosoides* from two different host species of cricetid rodents in northern Patagonia: *Phyllotis xanthopygus* (Waterhouse 1837) and *Oligoryzomys longicaudatus* (Bennett 1832), and report a new southern limit for the genus.

## Materials and methods

In 2001, researchers have captured and deposited several species of cricetid rodents from five localities of

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Neuquén Province in the Mammal Collection at Centro Nacional Patagónico (CNP) Puerto Madryn, Chubut, Argentina. Rodents were stored in 96% ethanol. The collection manager, Dr. Ulyses F. J. Pardiñas, kindly allowed us to extract the viscera and check them for parasites.

Filarioid worms were recovered from the pleural and abdominal cavities, and preserved in 96% ethanol. For the study under light microscopy, specimens were cleared in glycerin. Cross sections of a female, posterior to the vulva, were obtained by cutting sections with a razor blade and mounted in glycerin. To examine the head papillae, an *en face* view of the head was prepared (see Notarnicola et al. 2000). Microfilariae were dissected from the uterus of fixed females. Illustrations were made with the aid of a drawing tube. Measurements are given in micrometers unless otherwise stated. Mean values and standard deviations are given with ranges within parentheses.

## Results

Seventy-seven cricetid rodents from the Tribe Phyllotini, Akodontini, and Oryzomyini were examined. Localities of this sample are shown in Table 1. The new species of *Litomosoides* was found parasitizing 11 *P. xanthopygus* and one *O. longicaudatus*.

**Table 1** List of host species examined by locality in Neuquén Province

Locality	Tribe	Host species parasitized
Estancia Yuncón, Piedra del Aguila	Phyllotini	0/4 <i>Eligmodontia</i> sp.
	Phyllotini	3/7 <i>Phyllotis xanthopygus</i>
Estancia Collón Curá, Cerrito Piñón	Akodontini	0/5 <i>Akodon iniscatus</i>
	Phyllotini	7/29 <i>Phyllotis xanthopygus</i>
	Phyllotini	0/1 <i>Eligmodontia</i> sp.
Las Coloradas	Phyllotini	1/3 <i>Phyllotis xanthopygus</i>
Estancia La Porteña, Sierra de Cuchillo Curá, Las Lajas	Phyllotini	0/5 <i>Phyllotis xanthopygus</i>
	Phyllotini	0/3 <i>Eligmodontia</i> sp.
	Akodontini	0/2 <i>Akodon</i> sp.
Route 40 and Río Neuquén, 300 m downstream, Chos Malal	Akodontini	0/12 <i>Akodon molinae</i>
	Orizomyini	1/3 <i>Oligoryzomys longicaudatus</i>
	Phyllotini	0/3 <i>Graomys griseoflavus</i>

Numbers indicate the hosts parasitized over samples

## *Litomosoides pardinasi* n. sp.

### Description

*General (based on ten males and 17 females)* Males 3.7 times smaller than females in length. Cephalic extremity rounded. In apical view, two dorsal cephalic papillae near the amphids, four small labial papillae (Fig. 1b). Buccal capsule tubular, provided with an anterior segment transparent and a posterior segment well cuticularized, with an anterior enlargement; buccal cavity smooth. Esophagus of moderate length comprises an anterior muscular and a slightly differentiated posterior glandular portion. Anterior extremity of female robust. Vulva posterior to the esophagus–intestinal junction.

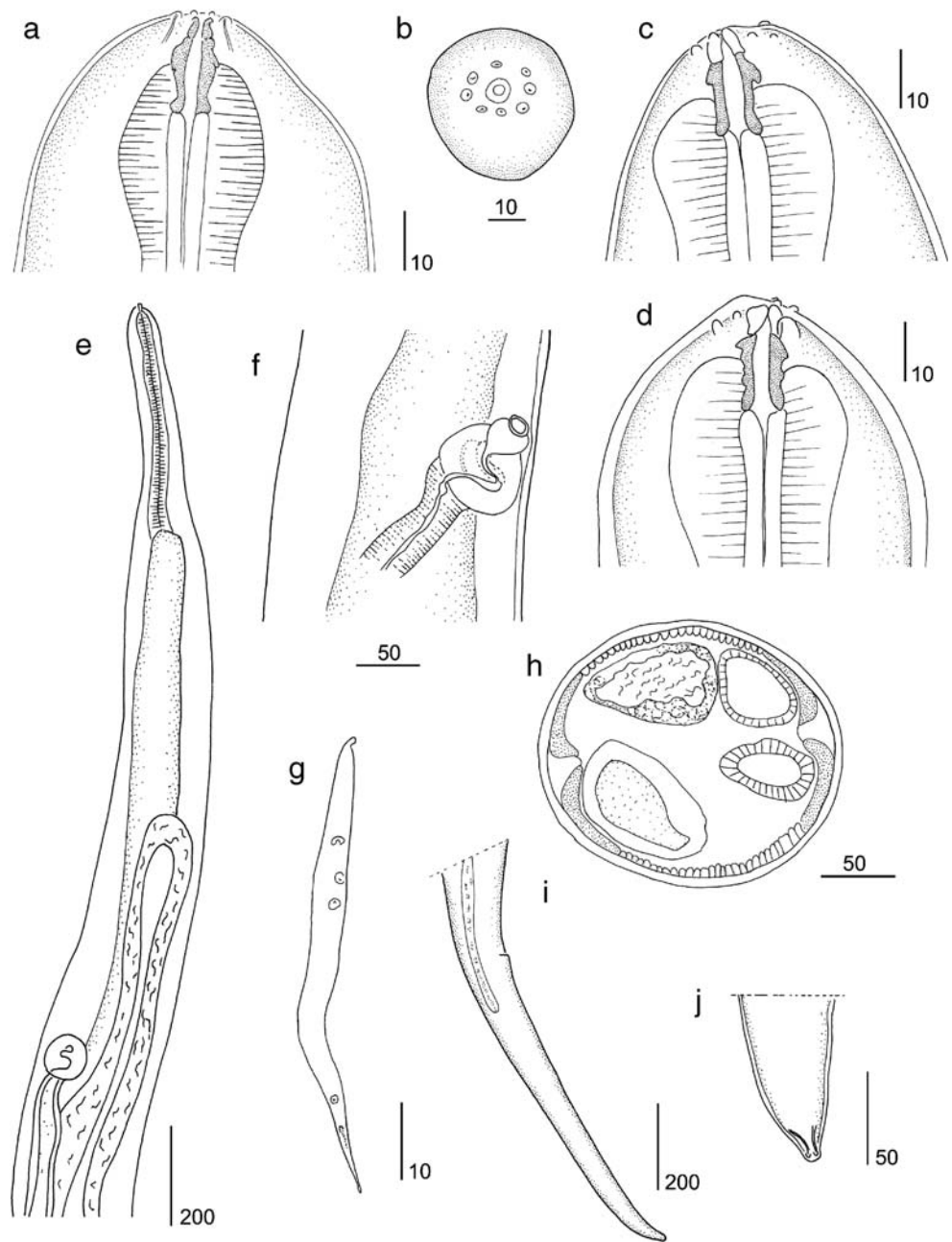
*Males* Posterior region coiled with three to four loops. Left spicule with handle longer than blade; blade consisting of a filament. Right spicule well cuticularized, with prominent dorsal heel and terminal cap. Tail attenuated with three to six pairs of symmetric postcloacal papillae; some specimens with unpaired disposition of the papillae (Figs. 2e, h and 3d). Area rugosa begins anterior to cloaca, consisting of transverse ridges made of small longitudinal crests; ridges are extended on the ventral surface and are close one from another. Testicle is visible at the level of the esophagus.

*Holotype* Body length, 16.335 mm; width at mid-body, 140; buccal capsule 18 long, external diameter 7; buccal cavity, 3 wide; esophagus, 350 long; nerve ring from anterior extremity, 300; tail 160 long; left spicule 220 long, handle 120 long; right spicule 105 long. Spicular ratio 1:2.09. Area rugosa 1,200 long, from 500 to 1,700 anterior from tail end; crest about 2 in height, spaced 5–6. Measurements from paratypes and voucher specimens are given in Table 2.

*Female* Vulva located far posterior to the esophagus–intestinal junction. Vagina globular and small (Fig. 1e, f). Ovijector muscular directed posteriad, some specimens coiled and visible anterior to the vagina. Vagina difficult to observe when uterus is filled with microfilariae. Tail slender, with divergent phasmids. In transverse section, lateral hypodermic chord thick; internal cuticular ridge dome-shaped (Fig. 1h).

*Allotype* Body length, 57.42 mm; width, 220; width at level of vulva, 200; buccal capsule 17 long and external diameter 8, buccal cavity 3; nerve ring not visible; esophagus, 450 long; vulva from apex, 1,300; vulva located 850 from esophagus–intestinal junction; tail, 520 long. Measurements from paratypes and voucher specimens are given in Table 3.

**Fig. 1** Females of *Litomosoides pardinasi* n. sp. from *Phyllotis xanthopygus*. **a** Anterior extremity from allotype, median view. **b**, **c**, and **d** Anterior extremity from paratypes, apical, median, and lateral views. **e** Anterior region, ventral view. **f** Vulva. **g** Uterine microfilaria. **h** Cross section posterior to the vulva. **i** Tail, lateral view. **j** Tail extremity showing phasmids



*Microfilaria* ( $n=10$ ) Sheath present, stuck to the body and visible at anterior extremity. Body fusiform with cephalic hook. Tail attenuated, thin and without nuclei at tip of the tail. Measurement based on uterine microfilariae from two different host specimens of *P. xanthopygus*: body length  $73.1 \pm 13.9$  (54–93), width  $3.55 \pm 0.6$  (3–5).

Tables 2 and 3 show the measurements of the filarioids recovered from one *O. longicaudatus*. Measurements of microfilariae obtained from one mature female parasitizing this host: Body length 92–98–85 by 3 wide.

**Type host** *P. xanthopygus* (Waterhouse 1837) (Rodentia: Cricetidae) female, collected January 2001 by U.F.J.

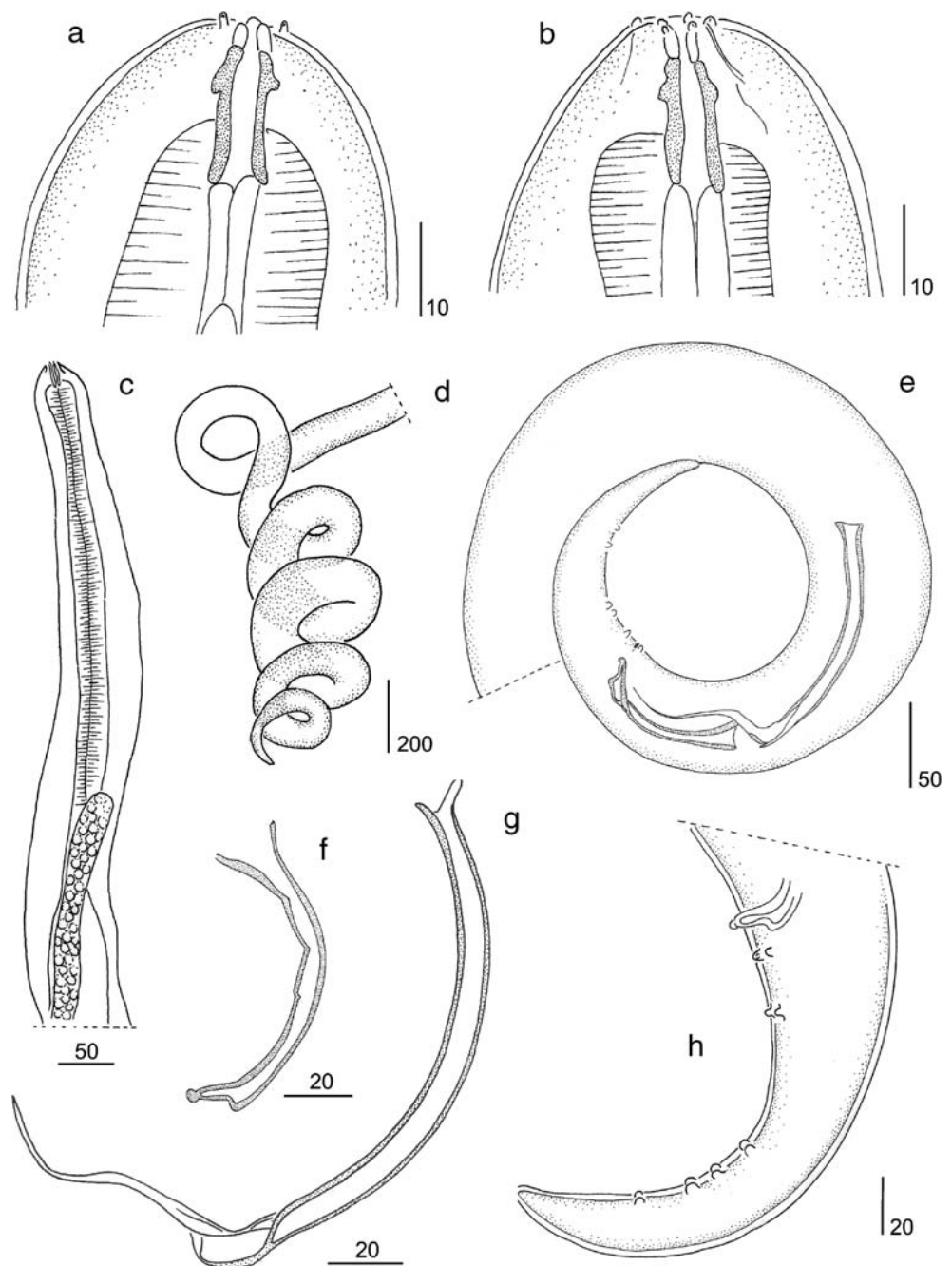
Pardiñas, S. Cirignoli, and D. Podestá, deposited at Colección de Mamíferos del Centro Nacional Patagónico CNP 1951 (UP425).

**Other host** *O. longicaudatus* (Bennett 1832) (Rodentia: Cricetidae) male CNP 1952 (UP450), January 2001. See Appendix for detail on number of collection.

**Site of infection** Abdominal and pleural cavities in *P. xanthopygus*; abdominal cavity in *O. longicaudatus*.

**Type locality** Las Coloradas (39°33'18"S; 70°34'47"W), Neuquén, Argentina.

**Fig. 2** Males of *Litomosoides pardinasi* n. sp. **a–g** from *Phyllotis xanthopygus*. **h** From *Oligoryzomys longicaudatus*. **a, b** Anterior extremity from holotype, lateral and median views. **c** Anterior region. **d** Posterior region. **e** Tail with spicules from holotype, lateral view. **f** and **g** Right and left spicules, lateral views. **h** Tail, lateral view



**Other localities** Estancia Yuncón (40°20'42"S; 70°07'52"W), Piedra del Águila; Estancia Collón Curá (40°14'57"S; 70°37'54"W), Cerrito Piñón; Route 40 and Río Neuquén (37°24'50"S; 70°13'41"W) right margin 300 m downstream from the bridge, Chos Malal, Neuquén, Argentina.

**Specimens deposited** Holotype (male) CHMLP 6067, allotype (female) CHMLP 6068, paratypes from abdominal cavity CHMLP 6069, and from thoracic cavity CHMLP 6070 from *P. xanthopygus*; vouchers CHMLP 6082 from *O. longicaudatus* deposited at the Colección Helmintológica

Museo de La Plata, Argentina. See [Appendix](#) for details on collection numbers.

**Prevalence and mean intensity** Eleven of 36 *P. xanthopygus* (30.5%), and one of three *O. longicaudatus*; 7.1 (1–16) worms per hosts.

**Etymology** The species is named after Dr. Ulyses Pardiñas, a paleontologist who contributes to the knowledge of the Sigmodontinae rodents in Argentina and also a friend.



**Table 2** Measurement data from male paratypes and voucher specimens of *Litomosoides pardinasi* n. sp. from *Phyllotis xanthopygus* and *Oligoryzomys longicaudatus* examined in Neuquén Province

Measurements	Specimens (n=9) from <i>P. xanthopygus</i>	M1 from <i>O. longicaudatus</i>
Body length	15.75±2 (13.68–19.47) mm*	19.01 mm
Maximum width	131.1±28.8 (85–180)	215
Buccal capsule (L × W)	17 ± 1.6 (15 – 20) × 7 ± 0.5(6 – 8)	21 × 9
Esophagus length	358.7±39.4 (290–400)	460
Nerve ring	250±92.5 (100–380)	330
Tail length	168.3±15 (150–200)	185
Left spicule	235±17.3 (210–270)	235
Handle	148.3±7 (140–160)	160
Right spicule	108.4±5.1 (100–115)	100
Area rugosa length	1,706.2±654.8 (700–2400)	1,590
Area rugosa from to tip tail	601±171.1 (360–850) to 2,307.5±737.5 (1,250–3,000)	570 to 2,160

## Remarks

Based on the morphological characteristics of the spicules, *L. pardinasi* n. sp. belongs to the *carinii* group (Bain et al. 1989, 2003; Notarnicola et al. 2000). The right spicule possesses a well-cuticularized dorsal heel and a terminal cap; the left spicule has a handle longer than or as long as the blade, and the blade possesses a cuticularized distal filament. These features make *L. pardinasi* n. sp. substantially different from those in the *sigmodontis* group.

*L. pardinasi* n. sp. is larger, has longer spicules, and different arrangement of the caudal papillae compared to *L. guiterasi* Pérez Viguera 1934, *L. hamletti* Sandground 1934, *L. chandleri* Esslinger 1973, *L. molossi* Esslinger 1973, and *L. salazari* Notarnicola et al. 2010a, all belonging in the *carini* group and parasitic of bats (Esslinger 1973; Guerrero et al. 2002; Notarnicola et al. 2010a; Pérez Viguera 1934). Moreover, in *L. guiterasi* and *L. hamletti*, the vulva opens at the level of the esophagus, while in *L. chandleri* and *L. salazari* a little posterior to the esophagus–intestinal junction. In *L. molossi* the buccal capsule is shorter and the caudal papillae are absent (Esslinger 1973). *L. pardinasi* n. sp. also differs from *L. brasiliensis* Lins de Almeida 1936 in having a right spicule

with a simply shaped heel, and caudal papillae not arranged along the median ventral line (Guerrero et al. 2002; Notarnicola et al. 2010a).

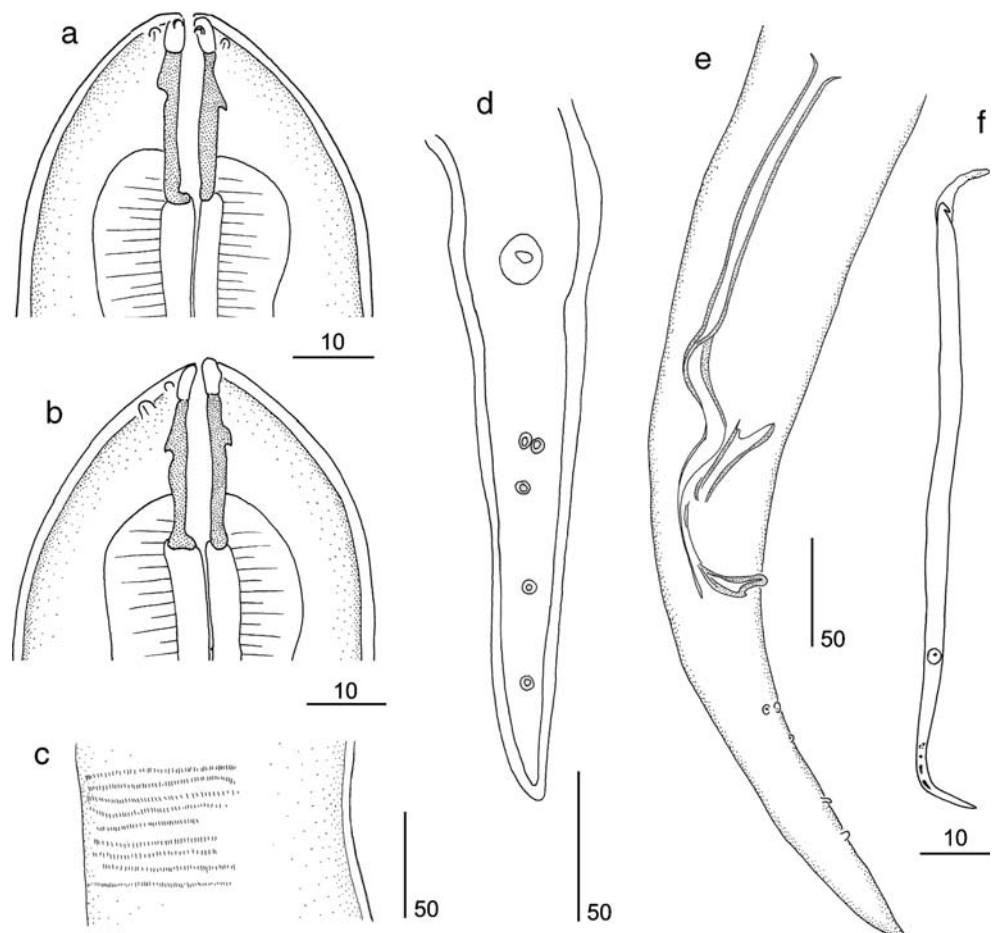
There are three *Litomosoides* species infecting bats known only by the description of the females, which can be distinguished from the new species. *L. pardinasi* differs from *L. artibeii* Esslinger 1973 in having a buccal capsule shorter, with wider and irregular walls, and lateral chords thinner (Esslinger 1973); from *L. chitwoodi* Bain et al. 2003 in being a larger species, and having a different shape of the buccal capsule (Bain et al. 2003); and from *L. solari* Guerrero et al. 2002 in having the vulva posterior to the esophagus–intestine junction, and a longer microfilaria (mean of 73.1 versus 53.7 μm) (Guerrero et al. 2002). An additional two species of *Litomosoides* were described based on the microfilaria and also are different from the new species in the current study. Microfilaria of *L. pardinasi* n. sp. differs from *L. caliensis* Esslinger 1973 and *L. colombiensis* Esslinger 1973 by the length (73.1 μm versus 60 and 115 μm, respectively) and by the shape of terminal nucleus (Esslinger 1973).

Two species parasitizing marsupials also are different from *L. pardinasi* n. sp. *Litomosoides petteri* Bain et al. 1980 from *Micoureus demerarae* (Thomas 1905) in that they possess a complete set of head papillae, vulva at the level of the esophagus instead of posterior as in *L. pardinasi*, and a preclonal papilla that is absent in the new species. Both males and female of *L. wilsoni* Guerrero et al. 2002, a parasite of *Monodelphis emiliae* (Thomas 1912), possess a longer tail, different shape of buccal capsule, and a shorter microfilaria (61.8 versus 73.1 μm) (Bain et al. 1980; Guerrero et al. 2002).

In comparison with six species in the *carinii* group that occur in rodents, *L. pardinasi* n. sp. differs from *L. andersoni* Brant and Gardner 1997, a parasite of *Ctenomys opimus* Wagner 1986 from Bolivia, in having a tubular buccal capsule instead of triangular, in the presence of the head papillae, absent in *L. andersoni*, and in the length of the blade of the left spicule—shorter in *L. pardinasi* (Brant and Gardner 1997); from *L. carinii*, a parasite of *Sciurus* sp. from Brazil, in having a buccal cavity thinner, and numerous cloacal papillae—not visible in *L. carinii* (Bain et al. 1989).

*L. pardinasi* n. sp. differs from the four species that occur in cricetids. From *L. scotti* Forrester and Kinsella 1973 it differs in possessing a longer buccal capsule without a notorious ring, and inconspicuous amphids (Forrester and Kinsella 1973); from *L. silvai* Padilha and Faria 1977 in having a buccal cavity with smooth walls, a rounded tail tip in females, and different arrangements of the caudal papillae (Moraes Neto et al. 1996; Notarnicola et al. 2000); from *L. bonaerensis*, a parasite of *Oligoryzomys nigripes* Olfers 1818 (originally mentioned as *O. delticola*)

**Fig. 3** *Litomosoides pardinasi* n. sp. **a, b** and **f** from *Oligoryzomys longicaudatus*. **c–e** from *Phyllotis xanthopygus*. **a** and **b** Anterior extremity from male, median and lateral views. **c** Area rugosa. **d** and **e** Male tail, ventral and lateral views. **f** Uterine microfilaria



**Table 3** Measurement data from female paratypes and voucher specimens of *L. pardinasi* n. sp. from *Phyllotis xanthopygus* and *Oligoryzomys longicaudatus* examined in Neuquén Province

Measurements	Specimens ( $n=12$ ) from <i>P. xanthopygus</i>	Specimens ( $n=5$ ) from <i>O.</i> <i>longicaudatus</i>
Body length	59.409±6.2 (53.44–58.94) mm	58.44 mm <sup>a</sup>
Maximum width	274.1±33.7 (190–300)	220±53 (141–249)
Width at vulva	192.8±48.8 (150–290)	181±32.4 (125–200)
Buccal capsule ( $L \times W$ )	19.9±2.6 (16–26) × 8.8± 1.1(6.5–10)	20.4±0.8 (20–22) × 9
Esophagus length	470.9±40.8 (400–540)	535±65 (450–600)
Nerve ring to apex	331.1±87.3 (200–520)	327±53 (270–390)
Tail length	502.8±57.9 (420–600)	800 <sup>a</sup>
Vulva to apex	1,403.6±275.5 (1,000–1,900)	1,230±335 (840–1,750)
Vulva to e–i junction <sup>b</sup>	911.3±266 (500–1,390)	660±311 (300–1,150)

<sup>a</sup> From one entire specimen

<sup>b</sup> Distance of the vulva to the esophagus–intestinal junction

from Buenos Aires, Argentina, is different because the buccal capsule has irregular walls instead of an annular thickening, and by the absence of a precloacal papilla (Notarnicola et al. 2000). *L. pardinasi* n. sp. resembles *L. odilae* Notarnicola and Navone 2002, a parasite of *O. nigripes* from Misiones, in having a small vagina, an area rugosa with tight ridges, and similar shape of the buccal capsule. Females of the new species, however, lack the lappets at the tail tip, males do not have a protruding cloaca, and the sheath of the uterine microfilaria is not visible (Notarnicola and Navone 2002).

## Discussion

There are differences between some of the measurements of the specimens found in *P. xanthopygus* and *O. longicaudatus*, such as the length of the female tail or the length of the esophagus. However there are landmarks that clearly make the filarioid species identifiable, as the shape of the buccal capsule, the shape of the anterior region in females, the small vagina, or the tight area rugosa. Several authors have reported that variations in the measurements of *Litomosoides* spp. could be associated with geographic

distribution or host-induced variations, however the landmarks remain stable (Bain et al. 1989; Esslinger 1973; Guerrero et al. 2002; Notarnicola 2005; Notarnicola et al. 2010a).

The host rodents were recovered from desert and semi-desert areas akin to the Patagonian steppe (Cabrera and Willink 1973). *P. xanthopygus* was captured in rocky areas, with xeric vegetation, while *O. longicaudatus* was trapped in low brush along the waterways of Río Neuquén (Pardiñas, personal communication). Several species of ectoparasites were reported on *P. xanthopygus* and *O. longicaudatus* for the Argentinean Patagonia; mainly fleas, but also ticks and lice. The mite vector *Ornithonyssus*, however, has not been recorded in the area (Autino and Lareschi 1998; Goff and Gettinger 1995; Kramer et al. 1999; Lareschi and Mauri 1998).

Both species of rodents are sympatric in the area our sample comes from, making the exchange of ectoparasites a plausible possibility, as mentioned by Navone et al. (2009) for other cricetid rodents in Central Argentina. The finding of one species of filarioid parasitizing two taxonomically unrelated host species in the area suggests a capture process, a phenomenon reported for other *Litomosoides* species (Bain et al. 1991; Notarnicola 2005).

In addition, species of *Litomosoides* parasitizing bats seems to have lower host specificity and wider geographic distribution than the species parasitizing marsupials and rodents, which seems to be more host-specific and with a reduced geographic distribution (Notarnicola 2004). Therefore, if more biodiversity studies would be carried out, we will be able to enlarge the diversity of the genus *Litomosoides*, as well as the geographic distribution of the known species.

This is the first record for a filarioid in a Phyllotini rodent and the southernmost record of any filarioid species worldwide.

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## Appendix

List of the host species parasitized with *L. pardinasi* n. sp., localities, and number of collection.

*P. xanthopygus* CNP 1941 male (UP 389), vouchers parasites CHMLP 6071; CNP 1942 female (UP 390), vouchers parasites CHMLP 6072 and CHMLP 6073; CNP 1943 male (UP 392), vouchers parasites CHMLP

6074 from Estancia Yuncón, Piedra del Aguila, Neuquén, Argentina (40°20'42"S; 70°07'52"W). *P. xanthopygus* CNP 1944 female (UP 400), vouchers parasites CHMLP 6075; CNP 1945 female (UP 408), vouchers parasites CHMLP 6076; CNP 1946 female (UP 409), vouchers parasites CHMLP 6077; CNP 1947 male (UP 416), vouchers parasites CHMLP 6078; CNP 1948 female (UP 417), vouchers parasites CHMLP 6079; CNP 1949 male (UP 422), vouchers parasites CHMLP 6080; CNP 1950 female (UP 424), vouchers parasites CHMLP 6081 from Cerrito Piñón, Estancia Collón Curá, Neuquén, Argentina (40°14'57"S; 70°37'54"W). *P. xanthopygus* CNP 1951 female (UP 425), CHMLP 6067 to 6070 from Las Coloradas, Neuquén, Argentina (39°33'18"S; 70°34'47"W).

*O. longicaudatus* CNP 1952 male (UP 450), voucher parasites CHMLP 6082, Route 40 and Río Neuquén right margin 300 m downstream from the bridge, Chos Malal, Neuquén, Argentina (37°24'50"S; 70°13'41"W).

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