

Parasite Community (Arthropods and Filarioids) Associated with Wild Rodents from the Marshes of La Plata River, Argentina

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ABSTRACT: We investigated the parasite community (arthropods and filarioids) associated with wild rodents from a marshy area in Buenos Aires province, Argentina. During 1995 and 1996, 105 sigmodontine rodents were trapped in The Reserva Selva Marginal de Punta Lara and in La Balandra (Argentina). Six sigmodontine species with a relative density (RDI) of 11.1% were trapped. A total of 3,371 specimens from 16 species of arthropods and 2 species of filarioids were collected. The values of parasite species richness (S) and prevalence (P) were as follows: from *Scapteromys aquaticus* S = 9; P = 96%, from *Oligoryzomys* spp. S = 8; P = 100%, from *Oxymycterus rufus* S = 8; P = 93%, and from *Akodon azarae* S = 6; P = 93%. The single *Deltamys kempfi* captured was not parasitized. Parasite communities of *S. aquaticus* and *Ox. rufus* showed the highest similarity resulting from their overlapped microhabitats, not only when presence/absence of species was considered (Sorenson's index; C_{ss} = 82%), but also when the proportion of every species was taken into account (Pianka's index; O = 26.67). The 2 species of filarioids collected were restricted to *Oligoryzomys* spp. and *Ox. rufus*. The absence of lice and filarioids from *Ox. rufus* from La Balandra suggests an isolation of this host population from the northern localities. Considering arthropod–filarioid associations, a significant affinity was observed from *Ox. rufus* from Punta Lara, between *Litomosoides oxymycteri* and the mite *Ornithonyssus bacoti*. *Scapteromys aquaticus* and *Ak. azarae* may not be susceptible to filarioids; although *Or. bacoti* were recovered from both.

KEY WORDS: ectoparasites, filarioids, parasite community, wild rodents, Sigmodontinae, arthropods, Nematoda, *Litomosoides*, marshes, Buenos Aires province, Argentina.

The Reserva Selva Marginal de Punta Lara and La Balandra are situated in the marshes of the Rio de la Plata, in the northeast of Buenos Aires province, Argentina. The area is an ecotone, with mixed communities from the subtropical humid forest and pampasic grassland, and harbors a large biodiversity of plants and animals (Barrios and Moschione, 1993). Several parasitic arthropods and helminths have been collected from sigmodontine rodents in these marshes (Mauri and Mosquera, 1987; Suriano and Navone, 1996; Lareschi and Iori, 1998; Notarnicola et al., 2000). However, only Lareschi (1996), and Lareschi et al. (2003) have analyzed the infestation parameters of the parasite community in the Reserva Selva Marginal de Punta Lara and the Reserva Natural de Hudson, respectively. One of the arthropods reported on sigmodontines from the marshes of the Rio de la Plata is the mite *Ornithonyssus bacoti* (Hirst) (Acari: Macronyssidae) (Lareschi, 1996). This species is known to transmit filarioids of the genus *Litomosoides* (Nematoda: Onchocercidae) in experimental laboratory conditions (Bain et al., 1980). However, Lareschi et al. (2003) did not find positive associations between 2 species of *Litomosoides* and *Or.*

bacoti parasitizing the wild rodents *Oxymycterus rufus* (Fisher) and *Oligoryzomys delticola* (Thomas) (Rodentia: Muridae) from Hudson locality.

As part of our ongoing research in the marshes of the Rio de la Plata, we studied the parasite community associated with wild rodents from Reserva Selva Marginal de Punta Lara and La Balandra. The aim of this study is to characterize the community of arthropods and filarioids, with the use of various infestation parameters and indices. We also analyzed the association between arthropods and filarioids, in order to identify those species that potentially could be vectors of the filarioids.

MATERIALS AND METHODS

Two localities situated at the freshwater coast of Rio de la Plata, 30 km apart, were sampled: Reserva Selva Marginal de Punta Lara (34°47'S; 58°1'W) and La Balandra (34°56'S; 57°42'W) (Fig. 1). The area belongs to La Pampa Biogeographic Province (Morrone, 2001). The landscape of both is similar, consisting of a mixture of graminoid swamps and forested wetlands, with a humid–mesothermal climate, undefined rainy season, and scarce incidence of freezing conditions (Dascanio et al., 1994).

Rodents were trapped in April, July, and December 1995, and in May, July, and October 1996, in accordance with regulations and policies of the Dirección de Administración y Difusión Conservacionista del Ministerio de Asuntos Agrarios, Buenos Aires. The sample design was explained in

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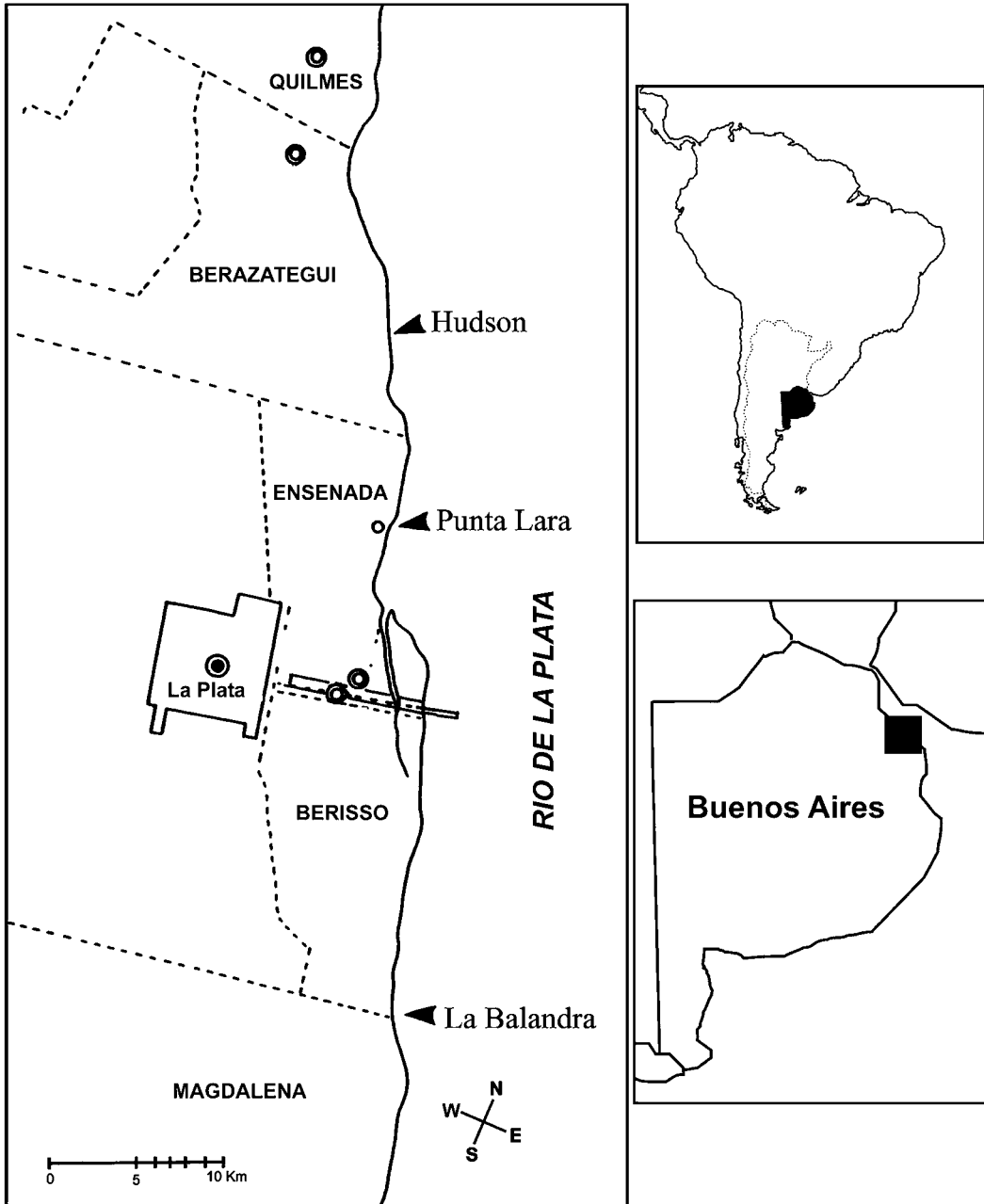


Figure 1. Maps of South America (right, top), Argentina (right, bottom), and a detail map of the marshy area bordering Rio de la Plata showing the sample localities, Punta Lara and La Balandra, and a northern nearby locality, Hudson (left).

Lareschi et al. (2003). Rodents were killed with sulfuric ether, frozen in individual plastic bags, and identified to species. For the purpose of calculating infection parameters and indices, we grouped *Oligoryzomys flavescens* and *Oligoryzomys delticola*, because of the small sample size of each, and report values as *Oligoryzomys* spp.

Host fur and thoracic and abdominal cavities were examined for parasites. Arthropods recovered from the fur were fixed in 70% ethanol, mounted on permanent slides, and identified following conventional techniques and bibliography. Filarioids from the thoracic and abdominal cavities were fixed in 10% formalin, transferred to 70% ethanol, and

Table 1. Number of specimens of every species and their totals collected on the four representative rodents captured in Punta Lara and La Balandra.

Parasites	Host species							
	<i>Scapteromys aquaticus</i>		<i>Oxymycterus rufus</i>		<i>Oligoryzomys</i> spp.		<i>Akodon azarae</i>	
	Punta Lara (n = 8)	La Balandra (n = 38)	Punta Lara (n = 16)	La Balandra (n = 14)	Punta Lara (n = 8)	La Balandra (n = 7)	Punta Lara (n = 6)	La Balandra (n = 8)
<i>Androlaelaps fahrenheitzi</i>	14	17	58	27	1	1	3	1
<i>Androlaelaps rotundus</i>	—	—	—	—	—	—	16	32
<i>Gigantolaelaps wolffsohni</i>	—	—	—	—	14	7	—	—
<i>Laelaps manguinhosii</i>	146	696	—	—	2	1	—	—
<i>Laelaps paulistanensis</i>	—	—	—	—	6	11	—	—
<i>Mysolaelaps microspinosus</i>	—	—	—	—	20	5	—	—
<i>Ornithonyssus bacoti</i>	19	27	87	67	—	—	—	—
<i>Ixodes loricatus</i>	1	2	2	1	—	—	2	2
<i>Eutrombicula alfreddugesi</i>	9	248	536	321	—	—	2	3
<i>Hoplopleura aitkeni</i>	—	—	—	—	—	—	10	9
<i>Hoplopleura scapteromydis</i>	254	181	—	—	—	—	—	—
<i>Hoplopleura travassosi</i>	—	—	—	—	165	140	—	—
<i>Polygenis (Neopolygenis) atopus</i>	9	33	—	—	1	5	—	—
<i>Polygenis (Polygenis) axis axis</i>	—	—	8	1	—	—	—	—
<i>Polygenis (Neopolygenis) massoi</i>	1	—	—	—	—	—	—	—
<i>Polygenis</i> sp.	—	—	—	—	—	—	1	—
<i>Litomosoides bonaerensis</i>	—	—	—	—	11	56	—	—
<i>Litomosoides oxymycteri</i>	—	—	44	—	—	—	—	—
Total	453	1,204	735	417	220	226	34	47

cleared in lactophenol for identification. Rodents were deposited in the Colección de Mastozoología from Museo de La Plata (CMMLP), Buenos Aires, Argentina. Voucher specimens of arthropods and filarioids were deposited in the Colección de Entomología (CEMLP), and Colección de Helmintología (CHMLP) respectively, at Museo de La Plata, Buenos Aires, Argentina. The following indices and parameters were calculated following Lareschi et al. (2003): species richness (S); relative density index (RDI = [number of trapped rodents/number night trap] × 100; [Begon et al., 1988]). Mean abundance (MA) and prevalence (P) were calculated following Bush et al. (1997). The total values of these indices were calculated taking into account the total number of rodents of each sampled species.

Parasite communities associated with individual host species were compared with Sorensen's (C_{ss}) and Pianka's (O) indices.

$$C_{ss} = 2C/Sa + Sb,$$

where C = number of shared species, and Sa and Sb = species richness of the communities of hosts a and b respectively (Morales and Pino, 1987).

$$O = \sum p_j p_k / \sqrt{\sum p_j^2 \sum p_k^2}$$

where p_j and p_k are proportions of parasite species in the hosts j and k respectively. This index is expressed as a percentage (Pianka, 1973).

The association between filarioids and arthropods was calculated with the use of the Fager affinity index (I_{ab})

$$I_{ab} = 2J/Na + Nb$$

where J = number of hosts parasitized by species a and b simultaneously; Na and Nb = number of hosts parasitized

by species a or b, respectively. The significance of this index was analyzed with the use of the Student's t-test (α = 0.05) (Morales and Pino, 1987).

RESULTS

A total of 105 rodents were trapped: host species richness (S) was 5, and total relative density (RDI) was 11.1%. Rodent species (Muridae: Sigmodontinae) collected and their relative density indexes were: *Scapteromys aquaticus* Thomas (RDI = 3.9%), *Oxymycterus rufus* (RDI = 2.6%), *Oligoryzomys* spp. (RDI = 1.3%), *Akodon azarae* (Fischer) (RDI = 1.2%), and *Deltamys kempi* Thomas (RDI = 0.09%).

A total of 3,371 parasites (3,260 arthropods and 111 filarioids) were collected. Eighteen species of parasites (16 arthropods and 2 filarioids) were identified as follows: Acari, Laelapidae: *Androlaelaps fahrenheitzi* (Berlese), *Androlaelaps rotundus* (Fonseca), *Gigantolaelaps wolffsohni* (Oudemans), *Laelaps manguinhosii* Fonseca, *Laelaps paulistanensis* Fonseca, and *Mysolaelaps microspinosus* Fonseca; Macronyssidae: *Ornithonyssus bacoti*; Ixodidae: *Ixodes loricatus* Neumann; Trombiculidae: *Eutrombicula alfreddugesi* (Oudemans); Phthiraptera, Hoplopleuridae: *Hoplopleura aitkeni* Johnson, *Hoplopleura scapteromydis* Ronderos, and *Hoplopleura travassosi* Werneck; Siphonaptera, Rhopalopsyllidae: *Polygenis (Neopolygenis) atopus* (Jordan and Rothschild), *Polygenis (Neopolygenis) massoi* Del Ponte, *Polygenis (Polygenis) axis axis*

Table 2. Number of specimens collected (N), prevalence (P), and mean abundance (MA) followed by the maximum burden of the arthropods and filarioids collected on the four representative rodents from marshes of Río de la Plata, Argentina.

Parasites	Host species											
	<i>Scapteromys aquaticus</i> (n = 46)			<i>Oxymycterus rufus</i> (n = 30)			<i>Oligoryzomys</i> spp. (n = 15)			<i>Akodon azarae</i> (n = 14)		
	N	P (%)	MA (max)	N	P (%)	MA (max)	N	P (%)	MA (max)	N	P (%)	MA (max)
<i>Androlaelaps fahrenheitsi</i>	31	26	0.7 (6)	85	50	2.8 (18)	2	13	0.1 (1)	4	14	0.3 (3)
<i>Androlaelaps rotundus</i>	—	—	—	—	—	—	—	—	—	48	50	3.4 (23)
<i>Gigantolaelaps wolffsohni</i>	—	—	—	—	—	—	21	73	1.4 (5)	—	—	—
<i>Laelaps manguinhosi</i>	842	76	18 (122)	—	—	—	3	20	0.2 (1)	—	—	—
<i>Laelaps paulistanensis</i>	—	—	—	—	—	—	17	27	1.1 (6)	—	—	—
<i>Mysolaelaps microspinosus</i>	—	—	—	—	—	—	25	56	1.7 (6)	—	—	—
<i>Ornithomyssus bacoti</i>	46	22	1 (13)	154	53	5.1 (50)	—	—	—	—	—	—
<i>Ixodes loricatus</i>	3	7	0.1 (1)	3	7	0.1 (2)	—	—	—	4	21	0.3 (2)
<i>Eutrombicula alfreddugesi</i>	257	33	5.6 (80)	857	33	28.6 (486)	—	—	—	5	21	0.3 (3)
<i>Hoplopleura aitkeni</i>	—	—	—	—	—	—	—	—	—	19	50	1.3 (8)
<i>Hoplopleura scapteromydis</i>	435	24	9.5 (187)	—	—	—	—	—	—	—	—	—
<i>Hoplopleura travassosi</i>	—	—	—	—	—	—	305	47	20 (123)	—	—	—
<i>Polygenis (Neopolygenis) atopus</i>	42	41	0.9 (4)	4	7	0.1 (3)	6	33	0.4 (2)	—	—	—
<i>Polygenis (Polygenis) axius axius</i>	3	7	0.1 (1)	9	13	0.3 (4)	—	—	—	—	—	—
<i>Polygenis (Neopolygenis) massoi</i>	1	2	0.02 (1)	28	23	0.9 (9)	—	—	—	—	—	—
<i>Polygenis</i> sp.	—	—	—	—	—	—	—	—	—	1	7	0.1 (1)
<i>Litomosoides bonaerensis</i>	—	—	—	—	—	—	67	40	4.5 (31)	—	—	—
<i>Litomosoides oxymycteri</i>	—	—	—	44	40	1.5 (20)	—	—	—	—	—	—
Total	1,660	96	35.92	1,184	93	39.31	446	100	29.4	81	93	5.7

(Jordan and Rothschild), and *Polygenis* sp.; Nematoda, Ochocercidae: *Litomosoides bonaerensis* Notarnicola, Bain, and Navone, and *Litomosoides oxymycteri* Notarnicola, Bain, and Navone.

Parasite species richness was as follows: *S. aquaticus* S = 9, *Oligoryzomys* spp. S = 8, *Ox. rufus* S = 8; and *Ak. azarae* S = 6. The single specimen of *D. kemp*i was not parasitized.

Table 1 summarizes the number of parasites collected from each host species and locality and Table 2 provides the values of P, MA, and the maximum burden (max) for each parasite species.

Only one arthropod species, *An. fahrenheitsi*, was collected from all 4 host species. The 2 filarioid species, most of the laelapid mites, and all of the lice found were collected from only one host species each. The remaining arthropods were shared by 2 or 3 host species (*La. manguinhosi*, *Or. bacoti*, *P. (P.) a. axius*, *P. (N.) massoi*; and *I. loricatus*, *E. alfreddugesi*, *P. (N.) atopus*, respectively). The single

specimen of *Polygenis* sp. collected from *Ak. azarae* was not able to be identified to species.

Only 2 species of rodents were parasitized by filarioids. *Litomosoides bonaerensis* parasitized the abdominal cavity of *Oligoryzomys* spp. from both collection localities, and *L. oxymycteri* parasitized the thoracic and abdominal cavities of *Ox. rufus* from the Punta Lara (Tables 1 and 2).

All of the *Oligoryzomys* spp. (100%) were parasitized, followed by *S. aquaticus* (P = 96%), *Ox. rufus* (93%), and *Ak. azarae* (P = 93%). *Scapteromys aquaticus* and *Ox. rufus* had the highest mean abundance (36.1 and 39.5, respectively, Table 2).

There was a high similarity between the presence/absence of the parasite species, and their proportion in the hosts, in *S. aquaticus* and *Ox. rufus* (Tables 3 and 4).

In the population of *Oligoryzomys* spp., the Fager association indices between the different species of arthropods and the filarioid *Li. bonaerensis* were not significant, even considering the Punta Lara and La

Table 3. Sorensen’s index of similarity (C_{ss}) among host species from the marshes of the Río de la Plata, Argentina.

	<i>Scapteromys aquaticus</i>	<i>Oligoryzomys</i> spp.	<i>Akodon azarae</i>
<i>Oxymycterus rufus</i>	82%	25%	43%
<i>Scapteromys aquaticus</i>		35 %	40%
<i>Oligoryzomys</i> spp.			14%

Table 4. Pianka’s index of similarity (O) among host species from the marshes of the Río de la Plata, Argentina.

	<i>Scapteromys aquaticus</i>	<i>Oligoryzomys</i> spp.	<i>Akodon azarae</i>
<i>Oxymycterus rufus</i>	26.7	0.1	10.1
<i>Scapteromys aquaticus</i>		0.1	2.8
<i>Oligoryzomys</i> spp.			0.1

Balandra host populations independently (Table 5). Similarly, from *Ox. rufus* the association between *Li. oxymycteri* and the arthropods were also not significant. However, when the population of *Ox. rufus* from Punta Lara was considered independently, the index between *Li. oxymycteri* and the mite *Or. bacoti* ($lab = 0.70$; $P < 0.05$) was significant (Table 5).

DISCUSSION

In the present study, the parasite species richness varied between $S = 6-9$. The list of parasite–host associations reported here agree with previous studies (Lareschi, 1996; Lareschi and Iori, 1998; Notarnicola et al., 2000). The specific host–parasite associations (e.g. *An. rotundus*–*Ak. azarae*, *H. travassosi*–*Oligoryzomys* spp., *Li. oxymycteri*–*Ox. rufus*), as well as high P and MA values in a given species (e.g., *La. manginhosi*–*S. aquaticus*) are constant along the geographic distribution of the hosts (Lareschi et al., 2003; Lareschi, 2006; Notarnicola, 2004: unpublished thesis, Universidad Nacional de la Plata, Argentina). Thus, parasites can be considered useful tools in identifying their host species.

The values of total P and MA from *S. aquaticus* and *Oligoryzomys* spp. obtained here were similar to those of the Hudson and Punta Lara studies (Lareschi, 1996; Lareschi et al., 2003). However, *Ox. rufus* showed a higher P and MA than in the localities mentioned above (Hudson: 76% and 10; Punta Lara: 89% and 23.3 vs. present study: 93% and 39.5), and the MA of *Ak. azarae* was lower (9 and 31, respectively, vs. 5.8) (Lareschi, 1996; Lareschi et al., 2003). Further studies on the component populations of the arthropods and filarioids in the area will contribute to a better understanding of the meaning of the differences in the values of those indices.

The dominance of *S. aquaticus* and *Ox. rufus* in this study is consistent with other studies from freshwater marshes along the La Plata and Paraná rivers (Massoia, 1961; Kravetz, 1972; Cueto et al., 1995; Sánchez López, 1998: unpublished thesis, Universidad Nacional de Buenos Aires, Buenos Aires, Argentina). Moreover, these rodent species showed the highest similarity in

their parasite communities, both when considering presence/absence of the species ($C_{ss} = 82\%$) and when proportions of every species are taken into account ($O = 26.7$). This suggests that *S. aquaticus* and *Ox. rufus* may overlap in their use of microhabitats. *Scapteromys aquaticus* is a semiaquatic rodent, well suited for swimming, and prefers flooded areas (Massoia, 1961; Massoia and Fornes, 1964; Kravetz, 1972), whereas *Ox. rufus* is mainly associated with patches of grassland near streams, marshes, or lagoons, but does not occur in flooded areas (Kravetz, 1972; Cueto et al., 1995; Sánchez López, 1998). However, these rodents share microhabitat when foraging for their main food source: arthropods and oligochaetes (Massoia, 1961; Massoia and Fornes, 1964; Kravetz, 1972). Our results support the hypothesis that hosts with microhabitat overlap increase the probability of sharing their parasites, especially the possibility of being colonized by ectoparasites that spend part of their life cycle on the soil, such as fleas and some acarines (Lundqvist, 1985: unpublished thesis, University of Lund, Sweden).

Both Sorensen (C_{ss}) and Pianka (O) indices gave similar results (Tables 3 and 4). Although C_{ss} values were higher than O , the former index only takes into account the presence/absence of the parasite species, whereas the O index also considers the relative frequency of these parasites. In the pair *S. aquaticus*–*Ox. rufus*, 7 of 10 parasites were shared; however, the proportions were different. On *S. aquaticus*, *La. manginhosi*, and *H. scapteromydis* were the dominant species, but were not shared with *Ox. rufus*; *E. alfreddugesi* and *Or. bacoti* were the dominant species on *Ox. rufus* and were also shared with *S. aquaticus* (see Table 2).

The absence of lice on *Ox. rufus* is consistent with previous studies in the area (Lareschi, 1996; Liljeström and Lareschi, 2002). In Punta Lara, no lice were observed parasitizing this rodent, except during floods (Lareschi, 1996). A low P and MA for the sucking louse *Hoplopleura fonsecai* Werneck was been reported in Hudson (Lareschi et al., 2003). In contrast, in Otamendi (34°09’S; 58°57’W), a northern locality near Punta Lara, specimens of *H. fonsecai* in every

Table 5. Fager's index (*Iab*) of association between arthropods and filarioids from *Oxymycterus rufus* and *Oligoryzomys* spp. from the marshes of the Río de la Plata, Argentina.

	Filaroid species					
	<i>Litomosoides oxymycteri</i>		<i>Litomosoides bonaerensis</i>			
			Locality			
	Punta Lara		La Balandra		Punta Lara	
	FI	<i>T</i>	FI	<i>T</i>	FI	<i>T</i>
Arthropods						
<i>Androlaelaps fahrenheitsi</i>	0.6	-2.1	—	—	—	—
<i>Gigantolaelaps wolffsohni</i>	—	—	0.7	0.35	0.5	0
<i>Laelaps manguinhosi</i>	—	—	0	—	0	—
<i>Laelaps paulistanensis</i>	—	—	0.3	1.4	—	—
<i>Mysolaelaps microspinus</i>	—	—	0.3	1.4	0.5	0
<i>Ornithonyssus bacoti</i>	0.7	1.5*	—	—	—	—
<i>Ixodes loricatus</i>	0.15	-1.6	—	—	—	—
<i>Eutrombicula alfreddugesi</i>	0.4	0.15	—	—	—	—
<i>Hoplopleura travassosi</i>	—	—	—	—	0.3	-1.4
<i>Polygenis</i> sp.	—	—	—	—	0.7	-0.4
<i>Polygenis</i> (<i>P.</i>) <i>axius axius</i>	0.25	-1.9	—	—	—	—
<i>Polygenis</i> (<i>N.</i>) <i>massoiaii</i>	0.5	0.1	—	—	—	—
<i>Polygenis</i> (<i>N.</i>) <i>atopus</i>	—	—	0.75	0.7	—	—

* Denotes significant association.

developmental stage were collected from about 40% of the individuals of *Ox. rufus* (Lareschi and Sánchez López, 2000). Because Otamendi is separated from the southern localities (Hudson, Punta Lara, and La Balandra) by natural and mainly antropic barriers (see Fig. 1), a migratory flow of *Ox. rufus* and other animals was observed from the Paraná River towards the Río de la Plata (Barrios and Moschione, 1993). This phenomenon is important from an ecological point of view and characterizes this biome.

Filarioids were not associated with *S. aquaticus* or *Ak. azarae*. Considering a 40% prevalence of *Litomosoides* spp. in the area, the probability of trapping 46 specimens of *S. aquaticus* and 14 of *Ak. azarae* without any of them being parasitized by filarioids seems very low. Thus, we believe that neither *S. aquaticus* nor *Ak. azarae* are susceptible to filarioids; although the mite *Or. bacoti*, which transmits filarioids, was recovered from both species. The 2 filarioid species collected in this study, *Li. bonaerensis* and *Li. oxymycteri*, were restricted to *Oligoryzomys* spp. and *Ox. rufus*, respectively. These associations were previously reported from Otamendi, Hudson, and Punta Lara (Notarnicola et al., 2000; Lareschi et al., 2003; Notarnicola, 2004; unpublished thesis, Universidad Nacional de la Plata, Argentina). *Litomosoides oxymycteri* was only collected from Punta Lara. The absence of this filarioid in La Balandra is remarkable, because the sample size of *Ox. rufus* was relatively large (present study $n = 14$, plus $n = 28$

unpublished data of JN). This observation, plus that of the lice, suggests the isolation of the populations of *Ox. rufus* from La Balandra. The association between the filarioids and the arthropods (Fager index) was not significant, except for *Or. bacoti* and *Li. oxymycteri* ($Iab = 0.70$) from Punta Lara. In Hudson, this association was significant for *Li. bonaerensis* and *H. travassosi*, and *La. paulistanensis* and *G. wolffsohni* as stated in Lareschi et al. (2003). Further studies, both in the laboratory and under natural conditions, will clarify which arthropods are susceptible to filarioid infection, and whether *Or. bacoti* is the natural vector of *Li. oxymycteri*, taking into account that Bain et al. (1980) used this mite for experimental infection.

ACKNOWLEDGMENTS

We thank María Cristina Estivariz of CEPAVE for drawing Figure 1. We also thank Carlos Galliari from CEPAVE, and Ulyses Pardiñas from Centro Nacional Patagónico, Puerto Madryn, for rodent identification. This study was supported by grants from Consejo Nacional de Investigaciones Científicas y Técnicas PIP 3000 and Universidad Nacional de La Plata, N520 Argentina.

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