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Seasonal occurrence of ectoparasites associated with the water rat *Scapteromys aquaticus* (Muridae, Sigmodontinae) from Punta Lara, Argentina.

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Abstract

Seasonal variation in the infestation parameters of *Scapteromys aquaticus* ectoparasites was studied in Punta Lara, Argentina. A total of 66 hosts were parasitized with 4,598 arthropod specimens belonging to 15 species. The higher total mean abundance was shown in fall (MA=102.26), and seasonal specific richness varied from 9 to 10. Summer and fall ectoparasite communities showed the highest similarity (Css=84.61) in species composition. Only in *Laelaps manghinhosi, Hoplopluera scapteromydis* and *Eutrombicula alfreddugesi were* seasonal mean abundance and prevalence both significant. Whereas, in *Ornithonyssus bacoti*, *Androlaelaps fahrenholzi* and *Laelaps paulistanensis, only* seasonal prevalence was significant. Seasonal data presented in this study provides indentifications of the ectoparasite species that are closely associated with *S. aquaticus*, as well as those which constitute secondary associations. This information contributes to a better understanding of ectoparasite-host relationships.

Introduction

The water rat *Scapteromys aquaticus* Thomas is the only species of the genus reported from Argentina (Galliari *et al.* 1996), and has previously been treated as a subspecies of *Scapteromys tumidus* (Waterhouse, 1837) (Brum-Zorrilla *et al.* 1986 in Galliari *et al.* 1996). The water rat inhabits Chaco, Entre Ríos and Buenos Aires provinces and is very abundant in marshy and flooded areas along Rio de la Plata and Río Paraná, where lowlands with *Scirpus* spp. and *Cortaderia* spp. are dominant (Massoia 1961; Massoia and Fornes 1964). Seasonal density of *S. aquaticus* populations from localities from Buenos Aires province were studied, and no remarkable variation was noticed in relation to its high longevity (more than 24 months) which is thought to cause the overlapping of at least two generations, along with a reduction in their density variation (Massoia 1961; Massoia and Fornes 1964; Cueto *et al.* 1995; Sánchez López 1998).

More than 20 species of acari, lice and fleas are known from the water rat, and almost all of them from Buenos Aires province, Argentina. However, seasonal studies have not been carried out, except for the louse *Hoplopleura scapteromydis* Ronderos (Liljesthröm and Lareschi 1998; 2001). The aim of the present study is to report on the seasonal occurrence, mean abundance, and prevalence of the various species of acari, lice and fleas associated with S. *aquaticus* in Punta Lara, Argentina.

Materials and methods

Punta Lara locality is situated 50 km from the city of Buenos Aires, on the coastal fringe of the Río de La Plata (34° 47´S; 58° 1´W), in Buenos Aires Province. It is located in an ecotonal area between the Guayano-Brasileña and Patagónica zoogeographic Neotropical Subregions (Ringuelet 1962), characterized by marshes. The climate is temperate humid-mesothermal, with an undefined rainy season and rare incidence of freezing conditions. There is an annual precipitation of 1,062 mm and mean annual temperature of 16.1°C (Dascanio *et al.* 1994).

Samples of rodents were obtained in accordance with regulations and policies from Dirección de Administración y Difusión Conservacionista del Ministerio de Asuntos Agrarios de la Provincia de Buenos Aires. Rodents were captured from March 1990 to December 1991 in 22 trapping sessions. Captures were realized with a 7.5 cm x 15 cm x 8 cm live-trap cages using a rectangular grid with 30 trap stations (3X10), 3 m apart. Traps were baited with oiled bread and activated for one night at each trapping session. The rodents were killed with sulfuric ether and frozen in individual plastic bags. The skin and pelage of the hosts were examined with a magnifying lens in order to obtain ectoparasites, which were preserved in 70% ethanol and mounted on permanent slides following the conventional techniques for each group. To identify acari, Boero (1957), Strandtmann and Wharton (1958), Till (1963) and Furman (1972), keys and descriptions were followed; for fleas, Smit (1987) and Linardi and Guimarães (2000), and for lice Johnson (1972) and Durden and Musser (1994). Representative individuals of rodents and ectoparasites were deposited at the Colecciones de Entomología y Mastozoología, Museo de la Plata, Argentina.

Seasonal data were grouped into fall (March, April and May 1990/91), winter (June, July and August 1990/91), spring (September, October and November 1990/91) and summer (December 1990/91, January and February 1991). Ectoparasite species richness (S= number of species), mean abundance (MA = total number of individuals of a particular ectoparasite species in a sample of hosts captured in a certain season / the total number of sampled hosts in that season, including both infected and non-infected hosts) and prevalence [P = (number of hosts captured in a certain season infected with individuals of a particular ectoparasite species / the number of examined hosts captured in that season) x 100] were calculated (Begon *et al.* 1987; Bush *et al.* 1997). Seasonal abundance was analyzed using Kruskal-Wallis'test (H) (Siegel 1991) and prevalence, pairing the data, by using Normal Deviation (N) (Snedecor and Cochran 1979). Similarity between seasonal ectoparasite communities, considering presence /absence, was calculated by using Css Sorensen index (Css= 2C / S1 + S2) (Morales and Pino 1987).

Results and discussion

Sixty-four individuals of *S. aquaticus* were captured during the year. Although this rodent showed a slight increase in summer (N=23) and fall (N=30), its seasonal abundance did not vary statistically (H=3,88; n.s) (Table I). All the hosts were infested with ectoparasites throughout the entire year. A total of 4,598 specimens belonging to 15 species were collected. The highest ectoparasite specific richness (S=10) and total mean abundance (MA= 102.26) occurred in fall, while the lowest MA (31.47) occurred in summer (Table I). Considering ectoparasite presence / absence, seasonal ectoparasite communities were the most similar between fall and summer (Css= 84.21%) and the least similar between summer and winter (Css= 66.66%). The similarity between spring and fall was Css= 80.00% and the comparison between the remaining seasons was overall Css= 73.68%.

The following species of ectoparasites were collected (see Table I):

Acari, Laelapidae, Laelapinae
Androlaelaps fahrenholzi (Berlese, 1911)

This mite parasitized *S. aquaticus* throughout the year. The mean abundance peaked in winter (MA=7.90) and fall (MA=3.26) (H=7.28; n.s.). The highest prevalence was shown in winter (P= 100%), and the difference between this season and the remaining ones was significant (vs fall: N= 2.90; $p<0.05$; vs spring: N= 3.13; $p<0.05$; vs summer: N= 3.17; $p<0.05$).

Comments: *Androlaelaps fahrenholzi* is a cosmopolitan species which was reported infesting a great number of mammals worldwide (Standtmann and

Table I. Seasonal mean abundance (MA) (minimun-maximun burden) and prevalence (P) of *Scapteromys aquaticus* ectoparasites in Punta Lara, Argentina. (March 1990-December 1991).

	Seasons of the year							
N° of hosts	*fall*		*winter*		*spring*		*summer*	
	23		*10*		*16*		*15*	
Ectoparasites	MA (max-min)	P (%)	MA (max-min)	P (%)	MA (max-min)	P (%)	MA (max-min)	P (%)
Androlaelaps fahrenholzi	3.26 (0-17)	73.91	7.90 (0-35)	100.00	1.69 (0-7)	62.50	1.40 (0-5)	60.00
Androlaelaps rotundus	0.00	0.00	0.10 (0-1)	10.00	0.00	0.00	0.00	0.00
Gigantolaelaps wolffsohni	0.09 (0-1)	8.70	0.00	0.00	0.00	0.00	0.07 (0-1)	6.67
Laelaps echidninus	0.00	0.00	0.10 (0-1)	10.00	0.00	0.00	0.00	0.00
Laelaps manguinhosi	42.52 (0-192)	95.65	68.30 (7-747)	100.00	16.50 (0-60)	56.25	7.40 (0-37)	66.67
Laelaps paulistanensis	0.17 (0-1)	17.39	0.10 (0-1)	10.00	0.13 (0-2)	6.25	0.00	0.00
Ornithonyssus bacoti	12.48 (0-175)	65.22	1.10 (0-6)	50.00	1.13 (0-60)	37.50	0.93 (0-5)	33.33
Ixodes loricatus	0.26 (0-1)	26.09	0.40 (0-1)	50.00	1.38 (0-10)	43.75	0.33 (0-2)	26.67
Eutrombicula alfreddugesi	4.52 (0-49)	52.17	0.00	0.00	1.62 (0-11)	37.50	14.80 (0-90)	86.67
Hoplopleura scapteromydis	38.43 (0-366)	52.17	3.70 (0-360)	20.00	35.63 (0-150)	68.75	5.13 (0-57)	26.67
Polygenis (Neopolygenis) atopus	0.48 (0-3)	30.43	1.70 (0-6)	50.00	0.56 (0-4)	31.25	1.33 (0-17)	20.00
Polygenis (Neopolygenis) massoiai	0.00	0.00	0.00	0.00	0.00	0.00	0.07 (0-1)	6.67
Polygenis (Polygenis) axius axius	0.04 (0-1)	4.35	0.00	0.00	0.00	0.00	0.00	0.00
Polygenis (Polygenis) bohlsi bohlsi	0.00	0.00	0.00	0.00	0.06 (0-1)	6.25	0.00	0.00
Polygenis (Polygenis) platensis	0.00	0.00	0.00	0.00	0.06 (0-1)	6.25	0.00	0.00
Total	102.26 (13-385)	100	83.40 (1-443)	100	58.75 (1-192)	100	31.47 (2-100)	100

Wharton 1958). In central and northern Argentina this mite has been recorded from species of the orders Rodentia, Didelphimorpha, Microbiotheria, Xenarthra and Chiroptera (Lareschi and Mauri 1998). In localities situated near the Rio de la Plata, this mite was mainly associated with *S. aquaticus* (Lareschi 1996; 2000; Lareschi *et al.* in press). However, mites identified as *A. fahrenholzi* are often highly variable morphologically, and it is unclear whether this mite species is truly polyxenous, or is a composite of species with narrower host ranges.

Androlaelaps rotundus (Fonseca, 1936)

Only one specimen of this mite was collected, in winter.

Comments: *Androlaelaps rotundus* has a neotropical distribution and is associated with a number of akodontine rodents (Gettinger and Owen 2000). In the study area, this mite parasitized *Akodon azarae* (Fischer) throughout the year, but its abundance was higher in winter (Lareschi 2000). A single specimen of *A. rotundus* was collected from *S. aquaticus* in that season, but this association may be considered secondary, or accidental.

Gigantolaelaps wolffsohni (Oudemans, 1910)

Two specimens were collected in fall and summer respectively.

Comments: This mite has a neotropical distribution and is primarily associated with *Oryzomys* and *Oligoryzomys* species. In the study area, this mite was mainly associated with *Oligoryzomys* spp. (Lareschi 2000), while its association with *S. aquaticus* is secondary, or accidental.

Laelaps manguinhosi Fonseca, 1936

This mite parasitized *S. aquaticus* during the entire year. Its seasonal abundance was significantly different ($H= 17.31$, $p<0.0005$) with peaks in fall ($MA= 42.52$) and winter ($MA= 68.30$). The highest maximum burden was shown in winter (747), and this was the only record where minimum burden was different from zero (it was 7). *Laelaps manguinhosi* infested all host individuals in winter and 95.65% of them in fall, but the prevalence of infestation in the remaining seasons was lower than 67.00%. The differences between prevalences of the following seasons were significant: fall vs spring ($N= 3.03$;

$p<0.05$), fall vs summer ($N= 2.23$; $p<0.05$), winter vs spring ($N= 3.53$; $p<0.05$) and winter vs summer ($N= 2.78$; $p<0.05$).

Comments: *Laelaps manguinhosi* mainly parasitizes sigmodontine species of the genera *Holochilus*, *Nectomys* (Furman 1972) and *Scapteromys* (Lareschi 1996), and all of these rodents are associated with freshwater marshlands (Massoia 1961). In the Argentinean marshes of Rio de la Plata this mite was mainly associated with *S. aquaticus,* but it was also reported from *Oligoryzomys* spp., which overlaps in microhabitat use with all the above-mentioned rodents (Lareschi 1996; 2000; Lareschi *et al.* in press). However, since the morphological variation of *L. manguinhosi* was observed related with every host species, it is unclear whether it is polyxenous, or a composite of several host specific mite species.

Laelaps paulistanensis Fonseca, 1936

With the exception of the summer, this mite was collected in the remaining seasons. The values of the mean abundance were lower than 0.2 in every season. The highest prevalence was shown in fall (17.39%), and this value significantly differed from that in summer ($P=0\%$; $N= 2.20$; $p<0.05$).

Comments: *Laelaps paulistanensis* has a neotropical distribution, associated primarily with oryzomyine rodents. However, occasionally it has been reported parasitizing non-oryzomyines from Argentina (Lareschi 1996; Lareschi *et al.* 2003). The association with *S. aquaticus* reported in the present study is secondary. In the study area this rodent overlaps its microhabitat with *Oligoryzomys* spp.

Laelaps echidninus Berlese, 1887

Only one specimen of this mite was collected in winter.

Comments: *Laelap echidninus* is a cosmopolitan ectoparasite, primary associated with synanthropic murid rodents of the genus *Rattus* (Furman 1972). This record constitutes an accidental association due to the occurrence of *Rattus* sp. in the study area (Lareschi 2000).

Macronyssidae
Ornithonyssus bacoti (Hirst, 1913)

This mite was collected during the entire year and peaked in fall ($MA= 12.48$) ($H=7.28$; n.s.). *Ornithonyssus bacoti* prevalence varied between $P= 65.22\%$ in fall and $P= 37.59\%$ in summer, and the difference between the above mentioned seasons was significant ($N= 2.03$; $p<0.05$).

Comments: *Ornithonyssus bacoti* has a cosmopolitan distribution, and is associated with a variety of domestic and wild mammals, as well as with some birds (Strandtmann and Wharton 1958). In the marshes of Rio de la Plata, this mite is mainly associated with *S. aquaticus* and *Oxymycterus rufus* (Fisher) (Lareschi *et al.* 2003), and it may be involved in the transmition of the filaroid *Litomosoides oxymycteri* Notarnicola, Bain and Navone (Nematoda, Onchocercidae) (Lareschi *et al.* in press).

Ixodidae (ticks)
Ixodes loricatus Neumann, 1899

Immature stages of this tick parasitized *S. aquaticus* throughout the year. The MA was over one ectoparasite per host in spring, and the prevalence varied between 26.09% in fall and 50.00% in winter.

Comments: Adults of I. *loricatus* are specific to marsupial species, while immature stages parasitize sigmodontine rodents, mainly *Akodon* spp. (Lareschi 1996; Nava *et al.* 2004). However, the host preference of *I. loricatus* is mainly determined by factors such as habitat type and host density (Beldoménico *et al.* 2005). Since the association reported here with *S. aquaticus* takes place throughout the year, and the prevalence was higher than 25% in every season, this rodent may be an alternative host. Further studies are necessary in order to a better understand this ectoparasite-host association.

Trombiculidae (chiggers)
Eutrombicula alfreddugesi (Oudemans, 1920)

With the exception of the winter, *E. alfreddugesi* parasitized *S. aquaticus* during all the year. Seasonal abundance was significantly different ($H= 21.10$; $p<0.002$), and the highest mean abundance was observed in summer

(MA=14.80). Prevalence was significantly different between summer (P=86.67%) and winter (P=0.00%) (N= 9.88; $p<0.05$). Besides, these differences in prevalence were also significant between the latter season and every remaining one (vs fall: N= 5.02; $p<0.05$; vs spring: N= 3.13; $p<0.05$), and between fall and summer (N= 2.52; $p<0.05$).

Comments: This chigger has been reported throughout the New World from southern Canada to Argentina, and Caribbean Islands (Daniel and Stekol´nikov 2004). Larval stages are known to parasitize many species of reptiles, mammals, birds, amphibians and also humans (Roveda and Boero 1960). However, in the Argentinean marshes of Rio de la Plata *E. alfreddugesi* was mainly associated with *S. aquaticus* and *O. rufus* (Lareschi 1996; 2000; Lareschi *et al.* 2003; in press).

Insecta, Phthiraptera (lice)
Hoplopleura scapteromydis Ronderos, 1965

This sucking louse was collected during the entire year. Seasonal abundance was significantly different (H= 10.34; $p<0.02$) and its mean abundance peaked in fall (MA= 38.43; SI= 156.86) and spring (MA=35.63; SI= 145.43), but the maximum ectoparasite burden was highly variable (366 in fall and 150 in spring). *Hoplopleura scapteromydis* showed the highest prevalence in spring (P= 68.75%) and fall (P= 52.17%); prevalences between the latter season and winter (P= 1.96; $p<0.05$), and also between spring and the remaining two seasons (vs winter: N= 2.40; $p<0.05$; vs summer: N=2.61; $p<0.05$) were significantly different.

Comments: *Hoplopleura scapteromydis* is a permanent and specific ectoparasite of *S. aquaticus*. In Punta Lara, this louse has a continuous reproduction during all the year with overlapping generations (Liljesthröm and Lareschi 1998; 2001).

Siphonaptera: Rhopalopsyllidae, Rhopalopsyllinae (fleas)
Polygenis (Neopolygenis) atopus (Jordan & Rothschild, 1922)

This flea parasitized *S. aquaticus* during the entire year. The mean abundance was over 1.5 only in winter, and the prevalence varied between 20% in summer and 50% in winter.

Comments: *Polygenis (N.) atopus* has been mentioned mainly in association with marsupials (Machado-Allison, 1962) and oryzomyne rodents (Linardi 1985). However, in localities near the Rio de la Plata and Rio Paraná in Argentina, *P. (N.) atopus* is very abundant, and has been reported in association with *A. azarae*, *O. rufus* and *S. aquaticus*, with a remarkable preference towards the last mentioned host species (Lareschi and Iori 1998; Lareschi *et al.* 2003; in press; Nava *et al.* 2003). The association of *P. (N.) atopus* with *S. aquaticus* throughout the year is consistent with previous findings.

Polygenis (Neopolygenis) massoiai Del Ponte, 1967

Only one specimen was collected in summer.

Comments: *Polygenis (Neopolygenis) massoiai* was recorded only from eastern Argentina (Smit 1987; Autino and Lareschi 1998) and Uruguay (Lareschi *et al.* 2006), and it is primarily associated with *Oxymycterus* spp. (Lareschi and Iori 1998; Lareschi *et al.* 2003), which is very abundant in areas next to the Río de la Plata.

Polygenis (Polygenis) axius axius (Jordan and Rothschild, 1923)

Only one specimen was collected in fall.

Comments: *Polygenis (P.) a. axius* was reported parasitizing marsupials and rodents in Brazil and Argentina (Linardi and Guimarães 2000). The only specimen collected in this study suggest that this flea may be secondarily associated with *S. aquaticus*.

Polygenis (Polygenis) bohlsi bohlsi (Wagner, 1901)

Only one specimen was collected in spring.

Comments: *Polygenis (Polygenis) bohlsi bohlsi* has been recorded in central and South American countries parasitizing marsupials and rodents (Linardi and Guimarães 2000). The association with *S. aquaticus* may be secondary

Polygenis (Polygenis) platensis (Jordan & Rothschild, 1908)

Only one specimen was collected in spring.

Comments: *Polygenis (Polygenis) platensis* was reported parasitizing rodents from Argentina, Uruguay and southern Brazil (Autino and Lareschi 1998; Lareschi *et al.* 2006; Linardi *et al.* 2005). Although two subspecies were previously established, recent studies suggest that there is not enough evidence to differentiate subspecies of *P. (P.) platensis* (Lareschi and Linardi 2005; Linardi *et al.* 2005). This flea is mainly associated with *Ctenomys* and *Akodon* species (Autino and Lareschi 1998). Thus, the association with *S. aquaticus* may be secondary.

Although all ectoparasite-host associations reported in the present study have been previously reported in the literature, most of these records come from species and distributional lists (Autino and Lareschi 1998; Castro and Cicchino 1998; Lareschi and Mauri 1998). In the last ten years infestation parameters and ecological aspects of some *S. aquaticus* ectoparasites have been studied (Lareschi 1996; 2006; Liljesthröm and Lareschi 1998; 2001; Lareschi and Liljesthröm 2000; Lareschi *et al.* 2003; in press), but seasonal variation of most of the species are unknown. The host skin and pelage constitutes the physical setting where ectoparasites live, and it may be a moderately constant environment for the ectoparasite, but it may still vary with different parameters like seasonal temperature and humidity. Besides, when not on the host, ectoparasites are in the host nest or in the nearby microhabitat, where seasonal change also takes place (Marshall 1981). The seasonal data presented in this study provides identifications of those ectoparasite species that are closely associated with *S. aquaticus*, and clarified those which constitute secondary associations. This information is important, since it contributes to a better understanding of ectoparasite-host relationships.

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