The relationship of sex and ectoparasite infestation in the water rat
Scapteromys aquaticus (Rodentia: Cricetidae) in La Plata, Argentina

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Abstract. I studied the relationship between sex and infestation with ectoparasites in the water rat Scapteromys aquaticus from La Plata river marshland, Argentina. The Relative Density’s Index (RDI) for males was 3.90% (females 3.60%). A total of 2653 ectoparasites were collected on 33 male hosts, and 1945 on 31 females. Ectoparasite specific richness (S) and diversity (H) were S = 14, H = 1.17 on males, and S = 10, H = 1.52 on females. The similarity between male and female rodents according to their ectoparasites was 75.00%. Although no ectoparasite species showed significant mean abundance (MA) differences between host sexes (p<0.05), and only Laelaps manguinhosi prevalence was significantly higher on male hosts (N= 2.01, p<0.05) in this study, there are reasons to think that the sex of the water rat affects ectoparasite burden and specific richness. This information has epidemiological potential because the closely related Scapteromys tumidus is involved in the transmission of Rickettsia coronii, which causes Marsella fever in humans. Rev. Biol. Trop. 54(2): 673-679. Epub 2006 Jun 01.

Key words: ectoparasites, host sex, Scapteromys aquaticus, water rat, La Plata river marshland, Argentina.
Ectoparasites of S. aquaticus have been the subject of some studies in Argentina, most of them conducted on their taxonomy and morphology, as well as lists of species and localities of collection (Ronderos 1965, Castro et al. 1987, 1991, Castro and Cicchino 1987, Mauri 1965, Mauri and Mosquera 1987, Lareschi 1996, Lareschi and Sánchez López 2000). Infestation parameters and indexes of some ectoparasite species have been examined by Lareschi (1996), Lareschi and Iori (1998), Liljeström and Lareschi (2001, 2002), Nava et al. (2003), and Lareschi et al. (2003). Few investigations have been conducted on the relationship between arthropods and wild rodents of different sexes, (Lareschi and Cicchino 2002, Liljeström and Lareschi 1998, 2001, Lareschi and Liljesthröm 2000), and only one (Lareschi 2004) have considered acarine and flea species simultaneously.

Populations of S. aquaticus from Buenos Aires province localities have been previously studied, and intraspecific behavioral, physiological and morphological differences between males and females have been noticed (Massoia 1961, Cueto et al. 1995, Sánchez López 1998). The subject of the present study is to analyze the interrelationship between host sex and the infestation with ectoparasites in La Plata river marshland.

MATERIALS AND METHODS

The marginal forest at Punta Lara, situated in an ecotonal area between the Guayano-Brasileña and Patagonian zoogeographic Neotropical Subregions (Ringuelet 1962), was the selected study area. It is located 50 km from Buenos Aires city, on the costal fringe of La Plata river (34°47' S; 58°1' W) (Buenos Aires Province), where the South American subtropical humid forest reaches its southern limit as a riverine forest. However, human interventions have greatly modified the original vegetation and the resulting landscape is a mixture of native and exotic forest species (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 furs of the hosts were examined with magnifying lens in order to obtain ectoparasites. Specialists in endoparasites (CEPA VE) have collected filarioids and helminthes from the host’s cavities. Ectoparasites were preserved in 70% ethanol and mounted on permanent slides following conventional techniques for each group and identified. Representative individuals of rodents and ectoparasites were housed at the Collections of the Departments of Vertebrate Zoology and Entomology respectively, La Plata Museum, Argentina.

The following indexes and parameters were calculated for each host sex: Relative Density’s Index: RDI = \[\frac{\text{number of captured rodents}}{\text{number of traps}}\] X 100; Species Richness: S = number of species; Shannon Diversity’s Index: \[H = -\sum p_i \ln p_i\], where \(p_i\) = proportion of each species in the sample (Begon et al. 1988); C-Sorensen index (C= number of ectoparasite species in both host sexes; Sm and Sf: ectoparasite specific richness in male and female hosts respectively) (Morales and Pino 1987); Specificity index SI (SI= number of ectoparasites of a particular species in only one host sex X 100 / sum of number of ectoparasites of a particular species in total number of hosts) (Marshall 1981); Mean Abundance: MA = total number of individuals of a particular parasite species in a particular host sex / total number of hosts of that sex; Prevalence: P = (number
of hosts parasited with a particular parasite species / total number of hosts examined for that parasite species) x 100 (Bush et al. 1997). The significance of MA and P differences between host sexes were analyzed using Student’s t-test (p<0.05) (Morales and Pino 1987), and Normal Deviation (N) (p<0.05) (Snedecor and Cochran 1979) respectively.

RESULTS

Sixty-four individuals of S. aquaticus were captured. The relative density was RDI = 3.90% for males and RDI = 3.60% for females. A total of 4,598 ectoparasites were collected. The species of arthropods were the following: Acari, Laelapidae: Androlaelaps fahrenholzi (Berlese, 1911), Androlaelaps rotundus (Fonseca, 1935), Gigantolaelaps woffshi (Oudemans, 1910), Laelaps echidninus Berlese, 1887, Laelaps manguinhosi Fonseca, 1935, Laelaps paulistanensis Fonseca, 1935; Macronyssidae: Ornithonyssus bacoti (Hirst, 1913); Ixodidae: Ixodes loricatus Neumann, 1899; Trombiculidae: Eutrombicula alfrededegesi (Oudemans, 1910). Insecta, Phthiraptera, Hoplopleuridae: Hoplopleura scapteromysis Ronderos, 1965; Siphonaptera, Rhopalopsyllidae: Polygenis (Neopolygenis) atopus (Jordan & Rothschild, 1922), Polygenis (Neopolygenis) massoiai Del Ponte, Polygenis (Polygenis) axius axius (Jordan & Rothschild), Polygenis (Polygenis) bohlsi bohlsi (Wagner, 1937), Polygenis (Polygenis) platensis platensis (Jordan & Rothschild, 1908).

Values of ectoparasite specific richness and diversity were S = 14, H = 1.17 on male hosts, and S = 10, H = 1.52 on females. The similarity between male and female rodents according to their ectoparasites was Css = 75.00%. The number of ectoparasites, MA, P and SI from every ectoparasite species are detailed on Table 1 for each host sex. No ectoparasite species showed significant MA differences between host sexes, and only L. manguinhosi prevalence was significantly higher on male hosts.

### Table 1

| Ectoparasites | Males (N=33) | | | | | Females (N=31) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N° | MA | P (%) | SI | | N° | MA | P (%) | SI | | | | | |
| Androlaelaps fahrenholzi | 115 | 3.48 (0-35) | 72.72 | 110.13 | | 87 | 2.80 (0-17) | 1.3 | 70.96 | 0.16 | 88.61 |
| Androlaelaps rotundus | 1 | 0.03 (1) | 3.23 | 192.31 | | 0 | 0.00 | 0.00 | 0.00 | 1.46 | - |
| Gigantolaelaps woffshi (Oudemans, 1910) | 1 | 0.03 (1) | 3.03 | 60.00 | | 2 | 0.06 (0-1) | 0.05 | 6.45 | 0.64 | 120.00 |
| Laelaps echidninus Berlese, 1887 | 1 | 0.02 (0-01) | 3.03 | 192.31 | | 0 | 0.00 | 0.00 | 0.00 | 1.46 | - |
| Laelaps manguinhosi Fonseca, 1935 | 1413 | 42.82 (0-427) | 90.90 | 134.61 | | 623 | 20.09 (0-91) | 1.49 | 67.74 | 2.37* | 63.15 |
| Laelaps paulistanensis Fonseca, 1935 | 5 | 0.15 (0-2) | 12.12 | 136.36 | | 2 | 0.06 (0-1) | 0.09 | 6.45 | 0.32 | 54.55 |
| Ornithonyssus bacoti (Hirst, 1913) | 51 | 1.64 (0-11) | 45.45 | 31.78 | | 270 | 9.00 (0-175) | 1.35 | 51.61 | 0.49 | 174.42 |
| Ixodes loricatus Neumann, 1899 | 19 | 0.67 (0-4) | 42.42 | 115.52 | | 18 | 0.68 (0-10) | 0.35 | 25.80 | 1.43 | 117.24 |
| Eutrombicula alfrededegesi (Oudemans, 1910) | 125 | 3.78 (0-26) | 39.39 | 68.72 | | 227 | 7.52 (0-90) | 1.05 | 58.06 | 1.52 | 133.09 |
| Hoplopleura scapteromysis Ronderos, 1965 | 888 | 26.91 (0-366) | 48.48 | 109.84 | | 680 | 21.93 (0-147) | 0.33 | 45.16 | 0.26 | 89.51 |
| Polygenis (Neopolygenis) atopus Jordan & Rothschild, 1922 | 31 | 0.94 (0-6) | 39.39 | 105.62 | | 26 | 0.84 (0-17) | 0.54 | 22.58 | 1.07 | 94.38 |
| Polygenis (Neopolygenis) massoiai Del Ponte | 1 | 0.03 (1) | 3.03 | 192.31 | | 0 | 0.00 | 0.00 | 0.00 | 0.00 | - |
| Polygenis (Polygenis) axius axius Jordan & Rothschild | 0 | 0.00 | 0.00 | - | | 1 | 0.03 (0-1) | 0.00 | 3.23 | 0.00 | 192.31 |
| Polygenis (Polygenis) bohlsi bohlsi (Wagner, 1937) | 1 | 0.03 (0-1) | 3.03 | 192.31 | | 0 | 0.00 | 0.00 | 0.00 | 0.00 | - |
| Polygenis (Polygenis) platensis platensis (Jordan & Rothschild, 1908) | 1 | 0.03 (0-1) | 3.03 | 192.31 | | 0 | 0.00 | 0.00 | 0.00 | 0.00 | - |

N°= Number of ectoparasites, MA= Mean Abundance (burden range), t= Student’s t-test, P= prevalence, N= Normal Deviation and SI= Specific Index. * p<0.05.
DISCUSSION

The results obtained showed higher ectoparasite burden on male rodents in agreement with previous studies from Tiradentes and Belo Horizonte (Botelho 1990), Minas Gerais State, Brazil. Besides, male hosts showed higher ectoparasite specific richness. Larger size of males (Massoia 1961) might benefit them with higher burden and specific richness of ectoparasites. However, males showed lower ectoparasite diversity than females. Out of the 15 ectoparasite species collected, two mite and four flea species infested only one host sex; however, all of them showed low values of P and MA that suggest secondary ectoparasite-host associations. In comparison with other wild rodent species which inhabit in Punta Lara marshland, the highest MA, P, diversity and specific richness of ectoparasites showed by S. aquaticus suggest that it is usually an alternative host for those ectoparasites generally associated with other host species in the same locality (Lareschi 1996, 2000). A. rotundus, mostly associated with Akodon azarae in Punta Lara (Lareschi 1996), and L. echidinus, usually associated with Rattus species (Strandtmann and Wharton 1958), infested exclusively male individuals of the water rat. P. (N.) massoiai, P. (P.) b. bohlsi and P. (P.) p. platensis, also infested only male hosts. Studies from Buenos Aires province localities, show that male individuals of S. aquaticus have larger average movements, and home range size, with a greater chance of contact with individuals of the same and other species, than females do (Cueto et al. 1995, Sánchez López 1998). Hence, these behavioral characteristics of males may give them better possibilities of being colonized by ectoparasites.

Although differences between prevalence and mean abundance from every ectoparasite species for each host sex, as well as the total of these parameters (except L. manguinhosi, whose P was significantly higher on males) were not significant, a tendency towards host sex effect is observed. Few specimens of fleas of every species collected, do not permit to make further analysis of the data, but they were mostly collected on males. Some previous studies support that male hosts are more heavily infested by fleas (Marshall 1981), while others indicate that females are (Soliman et al. 2001, Botelho 1990). Concerning acarines, not only A. rotundus and L. echidinus were collected exclusively on male hosts, but L. manguinhosi, A. fahrenholzi and L. paulistanensis also show higher values of their infestation parameters on that host sex. These results are in agreement with studies on lelapid mites from other host species and localities (Botelho 1990, Soliman et al. 2001). In contrast with the above mentioned species, the values of MA, P and SI of G. wolffsohni, O. bactoti, and E. alfreddugesi were higher on female hosts. Both G. wolffsohni, and O. bactoti are mostly recovered from the nests of their hosts (Strandtmann and Wharton 1958), and E. alfreddugesi spends its non-parasitic biological stages on the soil. In Buenos Aires localities, females of S. aquaticus show shorter dispersal movements than males, as well as longer stay in the nests taking care of the offsprings (Cueto et al. 1995, Sánchez López 1998). Then, these characteristics may allow them to encounter the above mentioned ectoparasites. Only I. loricatus P was higher on male hosts, while the values of MA and SI were similar between both host sexes. In the present study, H. scapteromydis infestation parameters were not significantly different between both host sexes. Some reports on Hoplopleura species show similarities on female and male hosts, while others support that males have greater populations in relation to larger body size of individuals of this sex of certain species (Marshall 1981). Studies on population dynamics of H. scapteromydis show that it is not significantly different between both host sexes, and the spatial distribution of its eggs on the host body is also similar. However, the proportion of eggs layed on every site is significantly different between male and female rodents (Liljeström and Lareschi 1998, Lareschi and Liljeström 2000). In addition to the above mentioned ecological and behavioral characteristics related to each host sex, morphological features
such as relative size and differences in the skin and its covering, as well as physiological factors such as difference in blood hormonal levels due to stress or reproductive condition, also cause variation in ectoparasite infestation parameters and indexes (Marshall 1981). Although they are not analyzed in the present study, they should not be discarded.

The results obtained in the present research support that the sex of the water rat affect principally its ectoparasite burden and specific richness. Besides, a tendency towards host sex effect on the prevalence and abundance of some species is also observed. This information, which contributes to a better knowledge of the interrelationship between ectoparasites and $S$. aquaticus from La Plata river marshland, is important to understand the role of ectoparasite vectors and mammalian reservoirs in the maintenance of diseases in the study area, and the possibilities of dissemination of pathogens.

In Uruguay, the closely related species $S$. tumidus is involved in the transmission of Rickettsia coronii, which cause Marsella fever in humans, and whose vector is the tick Amblyomma triste (Conti Diaz 2001). Although at the moment the above mentioned rickettsiae has not been reported from Argentina, the results obtained in the present study are important from an epidemiological point of view, and will contribute to further studies.

RESUMEN

Se estudió la interrelación entre el sexo de la rata de agua Scapteromys aquaticus y su infestación por ectoparásitos en la ribera del Río de la Plata, Argentina. El índice de densidad relativa de los machos fue 3.90 % y el de las hembras 3.60%. Se recolectó 2653 ectoparásitos de 33 machos y 1945 de 31 hembras. La riqueza ($S$) y diversidad específicas ($H$) de los ectoparásitos fueron $S = 14$, $H = 1.17$ en los machos y $S = 10$, $H = 1.52$ en las hembras. La similitud entre sexos fue del 75.00%. Si bien ningún ectoparásito en este estudio mostró diferencias significativas en su abundancia media entre los hospedadores de diferente sexo ($p<0.05$) y sólo la prevalencia de Laelaps manguinhosi fue significativamente mayor en los machos ($N = 2.01$, $p<0.05$), otros datos sugieren que sí existe un patrón de diferencias sexuales.

Key words: ectoparásitos, hospedero, Scapteromys aquaticus, rata de agua, río La Plata, humedal, Argentina.

ACKNOWLEDGMENTS

This study is part of my Doctoral Thesis at La Plata National University, Argentina. I express my gratitude to the dissertation committee: G. Liljesthröm (CEPAVE, Argentina), D.C. Castro (MLP, Argentina), R. Ojeda (CRICYT, Argentina) and C. de Villalobos (MLP, Argentina). I am also gratitude to U. Pardiñas (CENPAT, Argentina) and C. Galliari (Zoológico de La Plata, Argentina) for the identification of the rodents, and to A. Iori (Università La Sapienza, Italy) for her help in the identification of most of the fleas.

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