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The helminth community of *Apodemus sylvaticus* (Rodentia, Muridae) in the Sierra de Gredos (Spain)

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Abstract

The helminth community of Apodemus sylvaticus *(Rodentia, Muridae) in the Sierra de Gredos (Spain).*— The Spanish mountain range of Gredos was included in the studies conducted on the Iberian peninsula to investigate helminth fauna of small mammals. The helminth community of the wood mouse, *Apodemus sylvaticus* (Rodentia, Muridae), was analysed. Qualitatively, 13 helminth species were detected: *Plagiorchis* sp. I and *Plagiorchis* sp. II (Trematoda); *Taenia parva larvae*, *T. martis larvae*, *T. taeniaeformis larvae*, *Rodentolepis straminea* and *R. fraterna* (Cestoda); and *Trichuris muris*, *Heligmosomoides polygyrus*, *Syphacia stroma*, *S. frederici*, *Aspiculuris tetraptera* and *Rictularia proni* (Nematoda). Quantitatively, the highest prevalence (65.0%) and the mean abundance (36.9%) of *H. polygyrus* stand out. In comparison with the other mountain ranges studied, analysis of the global results demonstrates that the helminth fauna of the host species studied is diverse despite the adverse climatic conditions. This could be related to both the particular ecological characteristics and the appropriate state of preservation of this ecosystem.

Key words: Helminths, *Apodemus sylvaticus*, Rodentia, Muridae, Sierra de Gredos, Spain.

Resumen

Comunidad helmintiana de Apodemus sylvaticus *(Rodentia, Muridae) en la Sierra de Gredos (España).*— Como parte de los estudios helmintofaunísiticos que sobre pequeños mamíferos se están llevando a cabo en la península ibérica, la sierra española de Gredos fue estudiada. La comunidad helmintiana del ratón de campo, *Apdoemus sylvaticus* (Rodentia, Muridae), fue analizada. Cualitativamente, 13 especies de helmintos fueron detectadas: *Plagiorchis* sp. I y *Plagiorchis* sp. II (Trematoda); *Taenia parva larvae*, *T. martis larvae*, *T. taeniaeformis larvae*, *Rodentolepis straminea* y *R. fraterna* (Cestoda); y *Trichuris muris*, *Heligmosomoides polygyrus*, *Syphacia stroma*, *S. frederici*, *Aspiculuris tetraptera* y *Rictularia proni* (Nematoda). Cuantitativamente, destaca la mayor prevalencia (65,0%) y abundancia media (36,9%) de *H. polygyrus*. El análisis de los resultados globales permite evidenciar, en comparación con otras sierras estudiadas, a pesar de las adversas condiciones climáticas, la existencia de una helmintofauna diversa de la especie hospedadora estudiada. Este hecho podría estar relacionado tanto con las particulares características ecológicas como con el adecuado estado de conservación de este ecosistema.

Palabras clave: Helmintos, *Apodemus sylvaticus*, Sierra de Gredos, España.

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Introduction

The helminth fauna of small mammals (insectivores and rodents) on the Iberian peninsula has been analysed in several studies in the last fifty years. However, many of these contributions offer only qualitative reports on the helminth fauna and do not take ecological aspects, such as the characterisation of the helminth communities, into account. Moreover, few of these studies referred to ecologically–limited geographic areas.

This study is part of various multidisciplinary projects which were carried out with the aim to fill the gap in our knowledge on the helminth community of the small mammals present in the peninsular ecosystems of great ecological importance. Thus, the objective of this article is to analyse the helminth community of the wood mouse, *Apodemus sylvaticus* (Rodentia, Muridae), in the Regional Park of Sierra de Gredos, a natural ecosystem located in the centre of the Iberian peninsula, considering qualitative, quantitative and ecological aspects.

Material and methods

The study area is the Sierra de Gredos, a Spanish regional park range of 3,500 km^2, situated in the southern part of the Iberian Central System, in the Province of Avila. It is located at an altitude ranging from 1,000 to 2,600 m, and has an Atlantic climate. A helminth fauna study of 40 individuals of the wood mouse, *A. sylvaticus* was undertaken in two expeditions, in June 1998 and in July 1999. The helminths were collected and identified as described by Fuentes et al. (2000).

The helminth community composition and structure was analysed and for each helminth species detected the prevalence, mean abundance, median intensity, range and total number of helminths were calculated according to Bush et al. (1997).

The helminth community components were analysed by calculating the frequency of occurrence of the number of species, abundance index and the frequency distribution of helminths. The abundance index was calculated according to Bush (1973), Pence & Eason (1980).

The frequency distribution of parasitic species of each infrapopulation was calculated by means of the Lefkovitch index (L), where L is variance/mean ranging from –1 (positive binomial or uniform distribution), 0 (Poisson or random distribution) and +1 (negative binomial or aggregated distribution).

The diversity/uniformity analysis of the helminth community was carried out using the Shannon index (Pielou, 1975; Magurran, 1988), the Simpson index (D) (Simpson, 1949) expressed as 1–D (Magurran, 1988) and the Berger–Parker index (Berger & Parker, 1970; May, 1975; Magurran, 1988).

Results

A total of 37 (92.5%) of the individuals analysed were parasited by thirteen species: two trematodes (40.0%), five cestodes (25.0%) and six nematodes (77.5%). The helminth population with the greatest prevalence (65.0%) and abundance (36.9) was *Heligmosomoides polygyrus* (table 1).

Eight of the helminth species found have an indirect biological cycle and five have a direct biological cycle. Moreover, 29 (72.5%) of the individuals analysed presented helminths with a direct cycle and 26 (65.0%) presented helminths with an indirect cycle, but this difference was not statistically significant.

The frequency of occurrence of the helminth species indicated a clear tendency towards an infracommunity of one (32.5%), two (20.0%) or three (27.5%) species, with only one infracommunity consisting of as many as seven different species.

Table 1. Helminth community composition and structure of *Apodemus sylvaticus* in the Sierra de Gredos: P. Prevalence (n. Number of parasitised hosts; % Percentage; 95% CI. 95% Confidence interval); Ma. Mean abundance (SE. Standard error); Mi. Mean intensity; T. Total number of individuals; A. Abundance index; L. Lefkovitch index.
Tabla 1. Composición y estructura de la comunidad helmintiana de Apodemus sylvaticus *en la Sierra de Gredos: P. Prevalencia (n. Número de hospedadores analizados; %. Porcentaje; 95% CI. Intervalo de confianza del 95%); Ma. Abundancia media (SE. Error estándar); Mi. Intensidad mediana; T. Número total de individuos; A. Índice de abundancia; L. Índice de Lefkovitch.*

	P			Ma		Mi				
Helminth species	**n**	**%**	**95% CI**	**SE**		**Range**		**T**	**A**	**L**
Plagiorchis sp. I	13	33	22–53	28.2	15.4	14	1–516	1,128	28.20	1.00
Plagiorchis sp. II	8	20	11–38	1.3	0.6	6	1–15	51	1.28	0.87
Taenia parva larvae	1	3	0–14	0.03	0.03	1	1	1	0	0
Taenia martis larvae	3	8	2–22	0.1	0.1	1	1–2	4	0	0.23
Taenia taeniaeformis larvae	1	3	0–14	0.03	0.03	1	1	1	0	0
Rodentolepis straminea	2	5	1–18	0.1	0.1	2	1–2	3	0.08	0.30
Rodentolepis fraterna	6	15	7–32	18.8	16.7	11	1–668	752	18.80	1.00
Trichuris muris	3	8	2–22	0.3	0.2	3	1–9	13	0.33	0.82
Heligmosomoides polygyrus	26	65	50–80	36.9	10.0	31	1–276	1,475	36.88	0.99
Syphacia stroma	4	10	4–25	4.0	3.4	10	1–137	158	3.95	0.99
Syphacia frederici	11	28	23–40	6.8	3.9	7	1–143	271	6.78	0.99
Aspiculuris tetraptera	1	3	0–14	0.9	0.9	35	35	35	0.88	0.96
Rictularia proni	6	15	7–32	0.7	0.4	2	1–15	26	0.65	0.87

The diversity/uniformity index values of the helminth community were: 1.5 for the Shannon index, 0.7 for the Simpson index and 0.6 for the Berger–Parker index.

Analysis of the abundance index values (table 1) established the following helminth community structure: *H. polygyrus*, *Plagiorchis* sp. I, *Rodentolepis fraterna*, *Syphacia frederici*, *S. stroma*, and *Plagiorchis* sp. II as dominant species; *Aspiculuris tetraptera*, *Rictularia proni* and *Trichuris muris* as co–dominant species; *R. straminea* as successful immigrant species; and *Taenia parva larvae*, *T. martis larvae* and *T. taeniaeformis larvae* as unsuccessful immigrant species.

Distribution frequency analysis of helminth populations (table 1) showed that all dominant and co–dominant species have a negative binomial distribution.

Discussion

The helminth community in the present study is composed of 13 species only, but the detection of Plagiorchiidae trematodes with an aquatic cycle, as well as Hymenolepididae cestodes and Rictulariidae nematodes stands out. These helminth species characterise the helminth fauna of the wood mouse in this ecosystem within the peninsular context.

In contrast with the infracommunity composition, the high percentage of global parasitation largely consists of only 1 to 3 helminth species. This correlates with the low or medium

values of the Shannon, Simpson and Berger–Parker indices which show a moderate richness or diversity.

As expected, the helminth community structure of *A. sylvaticus* in Sierra de Gredos is made up of helminths which are tipically dominant, more prevalent and abundant in the Iberian peninsula as a whole. Moreover, the helminth community has a low destabilising capacity on the wood mouse population as the component species present a clearly negative binomial distribution.

In comparison with other mountain ranges studied (Feliu et al, 1987, 1997; Fuentes et al., 2000, 2003, 2004; Portoles et al., 2000; Torres et al., 2003), the analysis of the global results demonstrates a diverse helminthfauna of *A. sylvaticus* in spite of the adverse climatic conditions. This could be related to both the particular ecological characteristics and the appropriate state of preservation of this ecosystem. However, when comparing the helminth fauna of this host in the Sierra de Gredos with its global helminth fauna and also with other mountain ranges (Eastern part of the Spanish Pyrenees, Serra Calderona mountains/Valencian Country and Sierra Espuña/Murcia), the absence —to date— of any Catenotenid tapeworm and Capillarid nematode stands out.

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