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Helminths of Sympatric Black-tailed Jack Rabbits (*Lepus californicus*) and Desert Cottontails (*Sylvilagus audubonii*) from the High Plains of Eastern New Mexico

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ABSTRACT: Thirty-five desert cottontails (*Sylvilagus audubonii*) and 35 black-tailed jack rabbits (*Lepus californicus*), occurring sympatrically near the Clovis-Portales area of eastern New Mexico were infected with four species of Eucestoda (adults of *Raillietina salmoni* and *Raillietina selfi*, larvae of *Taenia pisiformis* and *Taenia serialis*). *Raillietina salmoni* and *T. pisiformis* more commonly infected *S. audubonii*. *Raillietina selfi* was found in near equal prevalence in both host species. *Taenia serialis* was recovered only from *L. californicus*. Thus, three of the four helminth species were shared by both lagomorphs (Jaccard's coefficient = 75). Female hosts were most heavily infected with *R. selfi* and *Taenia serialis*.

Key words: Black-tailed jack rabbit, *Lepus californicus*, desert cottontail, *Sylvilagus audubonii*, cestodes, sympatric hosts, survey.

The first study on the helminths of black-tailed jack rabbits (*Lepus californicus*) in New Mexico was by Dikmans (1937) who described the nematode *Nematodirus neomexicanus*. De Bruin and Pfaffenberger (1984) recovered both adult and larval cestodes (*Raillietina retractilis* and *Taenia pisiformis*, respectively) and nematodes (*Dermatoxys veligera*) from the desert cottontail (*Sylvilagus audubonii*). Samson (1968) reported two species of cestodes (*Mosqovoyia pectinata* and *Raillietina retractilis*) and six species of nematodes (*Dermatoxys veligera, Micipsella brevicauda, N. neomexicanus, Nematodirus* sp., *Passalurus nonanulatus*, and *Trichostrongylus colubriformis*) from *L. californicus* from New Mexico. None of these studies attempted to examined helminths of both host species where they occur sympatrically. The present study attempts to (1) describe the helminth fauna, (2) examine host and host sex preference in the respective species of helminths, and (3) determine the extent of overlap of species of helminths between black-tailed jack rabbits and desert cottontails in a sympatric population.

Thirty-five *S. audubonii* and 35 *L. californicus* were collected in a radius of 18.6 km of Clovis, Curry County, New Mexico (34°14′N, 103°13′W) from May to November 1985. Lagomorphs were collected by a 22-caliber rifle shot in the head. Immediately after shooting all hosts were frozen until necropsy. During examination, visual and tactile inspection of the abdominal cavity was made before dissection in order to remove any cysts and to collect cysticerci. The stomach, small intestine and large intestine were examined separately. Contents within each of these organs were flushed onto a series of sieving screens (850, 420, and 210 μm). Cestodes were collected from the screens with the aid of a stereomicroscope. Each section of the gastrointestinal tract was then incised and examined with a stereomicroscope. Other visceral organs, skeletal muscle, remaining splanchnia, and brain and spinal cord also were examined grossly for coenuri or cysticerci.

Cestodes were treated according to standard procedures (de Bruin and Pfaffenberger, 1984), stained with Celestine blue B and mounted in Canada balsam. Parasites were accessioned in the Eastern New Mexico University medical zoology collection (Eastern New Mexico University, Portales, New Mexico 88130, USA; accession numbers 1516–1707) and the U.S. National Parasite Collection (Beltsville, Maryland 20705, USA; accession numbers 79825–

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79831). Use of the terms prevalence, intensity and anatomical site were according to Margolis et al. (1982). Chi-square analysis and Jaccard's index of species overlap (Leong and Holmes, 1981) were used to examine host-parasite associations.

At the time this paper was written the original collection data were not available for analysis of overdispersion. Therefore, because intensity and abundance data could only be subjectively evaluated, the following analyses will be presented only in terms of frequency data.

A total of 1,342 representing 420 (31%) larvae and 922 (69%) adult cestodes were collected from 35 desert cottontails and 35 black-tailed jack rabbits. Large numbers of sexually immature intestinal cestodes were observed in cottontails (323 of 922, 35%) when compared to black-tailed jack rabbits (six of 922, <1%). Because strobilization was not sufficiently developed to distinguish these immature forms they were excluded in the statistical analyses.

Sylvilagus audubonii and *L. californicus* were the definitive hosts of *R. salmoni* and *R. selfi* and intermediate hosts of *T. pisiformis*. Coenuri of *Taenia serialis* were found only in *L. californicus*.

Raillietina salmoni was the most abundant cestode (657 of 1,342, 49%) and had a higher prevalence in desert cottontails (655 of 657, 99%). The other two specimens were recovered from one female black-tailed jack rabbit. The 655 *R. salmoni*, recovered from 25 of 35 (71%) *S. audubonii* represented a broad range (2–95 individuals per host) of infection. Chi-square analysis ($\chi^2 = 649.03$, $P < 0.005$) indicated that *R. salmoni* occurred significantly more frequently in desert cottontails than in black-tailed jack rabbits.

Prevalence of *R. selfi* also was greater in desert cottontails (225 of 265, 85%) than in black-tailed jack rabbits. The range of infection was greater in cottontails (one to 64 individuals per host) than in jack rabbits (one to 12). In the latter host, the range of infection was somewhat deceiving because 13 of 15 (87%) *L. californicus* actually were infected with one to three cestodes per host. From 20 (57%) *S. audubonii*, 225 *R. selfi* were collected, compared to only 40 specimens of *R. selfi* collected from 15 (43%) black-tailed jack rabbits. Chi-square analysis indicated that the prevalence of *R. selfi* was independent ($\chi^2 = 0.57$, $P = 0.45$) of either host.

Desert cottontails also had a higher prevalence and intensity of larval *T. pisiformis*. Maximum numbers of cysticerci varied greatly between cottontails ($n = 52$) and jack rabbits ($n = 2$). In the latter host, four of 377 (<2%) cysticerci were recovered from the mesenteries of three of 35 (9%) black-tailed jack rabbits. Alternatively, 373 of 377 (99%) cysticerci were collected from 20 of 35 (57%) desert cottontails. Chi-square analysis indicated that the prevalence ($\chi^2 = 18.71$, $P < 0.0005$) of larval *T. pisiformis* was host-related, but not host sex related. Cysticerci of *T. pisiformis* were removed from numerous sites in *S. audubonii*. In decreasing order of occurrence the number of cysticerci (in parentheses) are indicated with anatomical location in host. Cysticerci appeared in the perirectal region (221), mesenteries (95), liver hilum (20), lesser omentum (12), mediastinum (11), liver stroma (10), lung parenchyma (two) and hilum of the lungs (two).

Taenia serialis coenuri were found only in *L. californicus*. Forty-three coenuri were collected from 16 of 35 (46%) hosts. Coenuri of *T. serialis* (number in parentheses following anatomical site) were recovered from skeletal muscle (34), abdominal cavity (two), retroperitoneal (six) and mediastinal (one) areas. Detailed information regarding characteristics, sites and dimensions of coenuri are presented by Valencia (1987).

In contrast to previous studies on helminths of lagomorphs in New Mexico (Dikmans, 1937; Samson, 1968; de Bruin and Pfaffenberger, 1984) nematodes were not found in the present study. This may be reflective of geographical, topographical or annual climatic differences which

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may cause the semi-arid high plains of east-central New Mexico (present study) to be less conducive to the survival of nematode egg and larval stages than the central and southern areas of the state bordering the Rio Grande River (Dikmans, 1937) and also in the Jicarilla Mountains of south central New Mexico (Samson, 1968). Samson (1968) recovered *D. veligera* from 15 of 25 (60%) black-tailed jack rabbits compared to a low of 29% (four of 14) prevalence observed by de Bruin and Pfaffenberger (1984) in east-central New Mexico.

In contrast to the above observations on nematodes, cestodes have been reported from both host species by Samson (1968) and de Bruin and Pfaffenberger (1984). *Raillietina retractilis*, a congener of two species in this study, and *Mosgovoyia pectinata* have been recorded only once from black-tailed jack rabbits in New Mexico (Samson, 1968). Samson (1968) collected *R. retractilis* from 14 of 25 (56%) and *M. pectinata* from four of 25 (16%) black-tailed jack rabbits. By comparison, de Bruin and Pfaffenberger (1984) reported *R. retractilis* and larval *T. pisiformis* from 43% (six of 14) and 21% (three of 14) of desert cottontail hosts.

We calculated a Jaccard's coefficient of species overlap of 75 for the collective helminth faunas of these two sympatric lagomorph species. Despite this, our data indicated that the desert cottontail had higher prevalences and intensities of *R. salmoni*, *R. selfi* and *T. pisiformis* than the black-tailed jack rabbit. This may be reflective of behavioral and ecological differences in these two lagomorph species. Such differences have been reported previously in other species of sympatric hosts (Custer and Pence, 1981; Pfaffenberger and de Bruin, 1986). Host sex preference was only demonstrated by *R. selfi* and *Taenia serialis* toward females of *S. audubonii* and *L. californicus*, respectively. Differences in prevalences of helminth species across host sexes are occasionally reported, but less frequently than across host age or seasonal variables. Unfortunately, data were not available to examine the influence of the latter two factors on helminth prevalences in this population.

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