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Evaluation of Host Preferences by Helminths and Ectoparasites among Black-tailed Jackrabbits in Northern California

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ABSTRACT: Fifty-four black-tailed jackrabbits (*Lepus californicus*) (five juvenile males, 22 adult males, five juvenile females, and 22 adult females) from Humboldt County, California (USA) were evaluated for sex and age-specific differences in parasite prevalences and intensities, 26 February through 30 October 1996. Nematodes found included *Biogastranema leporis* in 42 hares (78% prevalence), *Rauschia triangularis* in 26 hares (48%), *Trichostrongylus calcaratus* in 14 hares (26%), and *Trichuris sylvilagi* in two hares (4%). Cestodes found included *Taenia* sp. cysticerci in five hares (9%) and *Taenia* sp. coenurus found in one hare (2%). Ectoparasites found included the ticks *Dermacentor variabilis* on 10 hares (19%) and *Ixodes spinipalpis* (=*Ixodes neotomae*) on nine hares (17%), as well as the anoplurid louse *Haemodipsus setoni* on 12 hares (22%). No significant differences in the parasite prevalences or intensities were found between male and female jackrabbits; this was for all males and females collectively, juvenile males and females only, as well as adult males and females only. Combining male and female hosts, adult jackrabbits had a significantly higher prevalence of *B. leporis* and *R. triangularis* compared to juveniles. This is the first known report of *Trichostrongylus calcaratus, Rauschia triangularis, Trichuris sylvilagi,* and *Dermacentor variabilis* among black-tailed jackrabbits and the first known report of *T. calcaratus* and *T. sylvilagi* in the western USA. This is the first published report of *I. spinipalpis,* the vector for Lyme disease in California, on black-tailed jackrabbits.

Key words: Black-tailed jackrabbits, *Lepus californicus,* nematodes, Ixodid ticks, host selection, host extension, range extension.

Studies on the parasites of black-tailed jackrabbits (*Lepus californicus*) have been conducted in New Mexico (USA) (Dikmans, 1937; Samson, 1968; Pfaffenberger and Valencia, 1988a, b), Wyoming (USA) (Bergstrom and Honess, 1982), Arizona (USA) (Lipson and Krausman, 1988), Colorado (USA) (Brittain and Voth, 1975), Kansas (Hansen et al., 1965), and California (USA) (Rohrbacher and Ehrenford, 1954; Lechleitner, 1959a; Furman and Loomis, 1984). These studies generally have involved jackrabbit populations in grasslands or desert areas. In no cases have jackrabbits associated with grasslands in coastal forests and a cool Mediterranean climate been evaluated for parasites.

There is limited work available on age and sex-specific preferences among parasites of leporids. Pfaffenberger and Valencia (1988a) found that the cestodes, *Raillietina selfi* and *Taenia serialis* were found only in female black-tailed jackrabbits and cottontails (*Sylvilagus auduboni*) in New Mexico. Keith et al. (1985) found that the nematode, *Protostrongylus boughtoni* occurred more frequently in male than female snowshoe hares (*Lepus americanus*). Because there was so little information about age or sex-specific preferences among parasites of leporids, we evaluated this topic further. We tested the null hypothesis that there were no significant differences in parasite prevalences or intensities between male and female jackrabbits, and between adult and juvenile jackrabbits in Humboldt County, California.

Between 26 February and 30 October 1996, we collected 54 black-tailed jackrabbits (five juvenile males, 22 adult males, five juvenile females, and 22 adult females) by coursing hounds under a California Department of Fish and Game (Sacramento, California) permit after acceptance of the study by the Humboldt State University (Arcata, California) Institutional Animal Care and Use Committee. All juvenile rabbits were collected between 20 June and 10 September 1996.

The study area was the 51 ha Elk River Spit (40°45′N, 124°12′W), Humboldt County, California, which comprises coastal dune (33 ha), salt marsh (7 ha), fresh water marsh (0.5 ha), and intertidal mudflats (9.5 ha). Because jackrabbits were observed using only the coastal dune habitat throughout the period of the study, no attempt was made to evaluate habitat effects on parasite abundance.

Care was taken to note any cysts or lumps in the skin or body cavity before dissection. Sex was determined by internal characteristics. Adults (>11-mo-old) were identified by complete closure of the epiphyseal line on the humerus (Lechleitner, 1959b). The stomach, small intestine, and large intestine, along with the diaphragm, reproductive organs, lungs, heart, bladder, head, and any abnormal tissues were immediately stored at −10 C until future analysis. The skin was inspected for lesions, cysts, and ectoparasites. Each pelt was combed with a fine-toothed comb having a space of approximately 0.03 mm between teeth; all ectoparasites found were stored in 70% ethyl alcohol. The liver, reproductive organs, bladder, kidneys, diaphragm, lungs, heart, eyes, nares, and nasal cavity were evaluated for parasites and abnormalities. Later, the stomach, small intestine, and large intestine were thawed and evaluated separately by first flushing their contents through a screen with mesh size of 1.9 mm to remove larger debris and then through a mesh size of 150 μm to catch nematodes. The intestinal tract lining also was opened lengthwise and carefully checked for parasites with a 30×-dissecting microscope. All worms and cysts were stored in 70% ethyl alcohol.

Helminths were deposited into the U.S. National Parasite Collection (Beltsville, Maryland, USA) (Accession numbers USNPC 88242 through 88245). Ticks and lice were deposited into the U.S. National Tick Collection (Georgia Southern University, Statesboro, Georgia, USA) (Accession numbers RML 122561 and 122562).

Terminology follows that outlined in Margolis et al. (1982) as modified by Bush et al. (1997). Ninety-five percent confidence intervals (CI) around the prevalences were calculated based on the F distribution (Ostle and Malone, 1988). Differences in prevalence by sex and age of host were determined with a chi-square test (Langley, 1970). The null hypothesis of no difference in intensity was evaluated with a two-sample *t*-test for unequal variances (Microsoft Excel 5.0, Microsoft Corporation, Redmond, Washington, USA). Values of $P < 0.05$ were considered statistically significant.

Four nematode species, two metacestodes, two tick species, and one anoplurid louse species were found (Table 1). The nematode *Biogastranema leporis* was found both in the stomach and cecum. *Rauschia triangularis* occurred in the small intestine with a few worms observed in the cecum. *Trichostrongylus calcaratus* was found in the cecum with a few worms in the stomach. *Trichuris sylvilagi* was found only in the cecum. The *Taenia* sp. cysticerci were found in the abdominal cavity attached to muscle adjacent to the kidneys. The one *Taenia* sp. coenurus was observed in the abdominal cavity attached to the muscle adjacent to the vagina of a female jackrabbit.

In no cases were there any significant differences in the prevalences or intensities of parasite between male and female jackrabbits; this was for all males and females collectively, juvenile males and females only, as well as adult males and females only. Thus, our null hypothesis of no preferences by these parasites for male or female hosts could not be rejected. We then combined male and female hosts. Based on a chi-square test, adult jackrabbits had significantly higher prevalences of *B. leporis* ($P < 0.0001$) and *R. triangularis* ($P < 0.01$) compared to juveniles. *Biogastranema leporis* was found in two of 10 juveniles and 40 of 44 adults; *Rauschia triangularis* was found in none of 10 juveniles but occurred in 26 of 44 adults. These differences between adults and ju-

TABLE 1. Prevalence and intensity of parasites in 54 black-tailed jackrabbits (*Lepus californicus*) on the Elk River Spit (Humboldt County, California), February to October 1996.

Parasite species	Number infected (n = 54)	Percent prevalence (95% C.I.)	Intensity (Mean ± SD)	Intensity Range
Helminths				
Biogastranema leporis	42	78 (64–88)	690 ± 1,054	1–4,263
Rauschia triangularis	26	48 (34–62)	81.0 ± 109	1–449
Trichostrongylus calcaratus	14	26 (15–40)	21.7 ± 23.1	1–64
Trichuris sylvilagi	2	4 (0–13)	1.0 ± 0.0	1
Taenia sp. (cysticerci)	5	9 (3–20)	1.0 ± 0.0	1
Taenia sp. (coenurus)	1	2 (0–10)	1.0	1
Arthropods				
Dermacentor variabilis	10	19 (9–31)	3.6 ± 2.3	1–24
Ixodes spinipalpis	9	17 (8–29)	1.2 ± 0.4	1–2
Haemodipsus setoni	12	22 (12–36)	3.2 ± 2.4	1–8

venile jackrabbits may not be so great if the 150 um mesh size screen used to trap nematodes allowed some of the small larval nematodes that might be infecting juvenile animals to pass through.

Rauschia triangularis, Trichostrongylus calcaratus, Trichuris sylvilagi, and *Dermacentor variabilis* in black-tailed jackrabbits all appear to be new host records for these parasites; this also is the first known report for *T. sylvilagi* from the genus *Lepus. Biogastranema leporis, Taenia* spp., and *Haemodipsus setoni* previously has been observed in black-tailed jackrabbits of northern California (Rohrbacher and Ehrenford, 1954; Lechleitner, 1959a).

Skrjabin et al. (1960) lists *Trichostrongylus calcaratus* from a "*Lepus sylvaticus,*" and as having a North American distribution. There also are several unpublished records in the U.S. National Parasite Collection of *T. calcaratus* from *Lepus* spp., but none are reported from sites that fall within the known North American distribution of black-tailed jackrabbits. Samson (1968) reported *Trichostrongylus colubriformis* among black-tailed jackrabbits in New Mexico. Thus, while there are other reports of *Trichostrongylus* spp., including *T. calcaratus,* from leporids, our findings still appear to be the first report of *Trichostrongylus calcaratus* from black-tailed jackrabbits.

Boughton (1932) first reported *Nematodirus triangularis* from snowshoe hares (*Lepus americanus*) collected in Manitoba. In reevaluating the genus *Nematodirus,* Durette-Desset (1979) used parasites collected in Oregon and renamed them *Rauschia triangularis*; she did not identify the hosts from which these parasites were collected. There is, however, one unpublished record in the U.S. National Parasite Collection of *Nematodirus triangularis* from a snowshoe hare in Oregon (USNPC 058796.00). Thus, our study is the first known published report of *R. triangularis* from the western United States and first known report from black-tailed jackrabbits.

Although there are no previously known published accounts of *Ixodes spinipalpis* in black-tailed jackrabbits, the U.S. National Tick Collection has three unpublished records of *I. spinipalpis* parasitizing black-tailed jackrabbits in Oregon: two females from Benton County (RML 64774), one female from Grant County (RML 64775), and one male and two females from Deschutes County (RML 64776), respectively. *Ixodes spinipalpis* plays an important role in the maintenance of *Borrelia burgdorferi,* causative agent of Lyme disease, in the western USA (Brown and Lane, 1992). Both *I. spinipalpis* and *D. variabilis* have been reported previously in Humboldt

County (Furman and Loomis, 1984); however, this is the first known report of *D. variabilis* from black-tailed jackrabbits.

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LITERATURE CITED

BERGSTROM, R. C., AND R. F. HONESS. 1982. Ectoparasites. *In* Diseases of wildlife in Wyoming, E. T. Thorne, H. Kinston, W. R. Jolley, and R. C. Bergstrom (eds.). Wyoming Game and Fish Department, Laramie, Wyoming, pp. 231–260.

BOUGHTON, R. V. 1932. The influence of helminth parasitism on the abundance of the snowshoe rabbit in western Canada. Canadian Journal of Research 7: 524–547.

BRITTAIN, P. C., AND D. R. VOTH. 1975. Parasites of the black-tailed jackrabbit in north central Colorado. Journal of Wildlife Diseases 11: 269–271.

BROWN, R. N., AND R. S. LANE. 1992. Lyme Disease in California: A novel enzootic transmission cycle of *Borrelia burgdorferi*. Science 256: 1439–1442.

BUSH, A. O., K. D. LAFFERTY, J. M. LOTZ, AND A. W. SHOSTAK. 1997. Parasitology meets ecology on its own terms: Margolis et al. revisited. The Journal of Parasitology 83: 575–583.

DIKMANS, G. 1937. Two new species of the nematode genus *Nematodirus* (Trichostrongylidae) from rabbits. Proceedings of the Helminthological Society of Washington 4: 65–67.

DURRETTE-DESSET, M.-C. 1979. Les Nematodirinae (Nematoda) chez les ruminants et chez les lagomorphes. Annales de Parasitologie (Paris) 54: 313–329.

FURMAN, D. P., AND E. C. LOOMIS. 1984. The ticks of California (Acari: Ixodida). Bulletin of the California Insect Survey, Vol. 25. University of California Press, Berkeley, California, 239 pp.

HANSEN, M. F., M. H. BARTEL, E. T. LYON, AND B. M. EL-RAWI. 1965. Part II. Helminth and arthropod parasites. *In* The black-tailed jackrabbit in Kansas. Kansas Agricultural Experiment Station Technical Bulletin 140, Kansas State University, Manhattan, Kansas, pp. 41–64.

KEITH, L. B., J. R. CARY, T. M. YUILL, AND I. M. KEITH. 1985. Prevalence of helminths in a cyclic snowshoe hare population. Journal of Wildlife Diseases 21: 233–253.

LANGLEY, R. 1970. Practical statistics simply explained. Dover Publications, Inc., New York, New York, 399 pp.

LECHLEITNER, R. R. 1959a. Some parasites and infectious diseases in a black-tailed jackrabbit population in the Sacramento Valley, California. California Fish and Game 45: 83–91.

———. 1959b. Sex ratio, age classes and reproduction of the black-tailed jackrabbit. Journal of Mammalogy 40: 63–81.

LIPSON, M. P., AND P. R. KRAUSMAN. 1988. Parasites of desert leporids in the Picacho Mountains, Arizona. The Southwestern Naturalist 33: 487–488.

MARGOLIS, L., G. W. ESCH, J. C. HOLMES, A. N. KURIS, AND G. A. SCHAD. 1982. The use of ecological terms in parasitology (report of an ad hoc committee of the American Society of Parasitologists). The Journal of Parasitology 68: 131–133.

OSTLE, B., AND C. MALONE. 1988. Statistics in research, 4th Edition. Iowa State University Press, Ames, Iowa, 664 pp.

PFAFFENBERGER, G. S., AND V. B. VALENCIA. 1988a. Helminths of sympatric black-tailed jack rabbits (*Lepus californicus*) and desert cottontails (*Sylvilagus audubonii*) from the high plains of eastern New Mexico. Journal of Wildlife Diseases 24: 375–377.

———, AND ———. 1988b. Ectoparasites of sympatric cottontails (*Sylvilagus audubonii nelsoni*) and jackrabbits (*Lepus californicus mearnsi*) from the high plains of eastern New Mexico. The Journal of Parasitology 74: 842–846.

ROHRBACHER, G. H., JR., AND F. A. EHRENFORD. 1954. *Biogastranema* new genus (Nematoda: Trichostrongylidae) from the California jackrabbit, *Lepus californicus californicus* Gray (Mammalia: Leporidae). Proceedings of the Helminthological Society of Washington 21: 63–67.

SAMSON, K. S. 1968. Helminths of black-tailed jackrabbits in New Mexico. Bulletin of the Wildlife Disease Association 4: 130.

SKRJABIN, K. I., N. P. SHIKHOBALOVA, AND R. S. SHUL'LTS. 1960. Essentials of Nematodology, Vol. III. Trichostrongylids of animals and man. The Academy of Sciences of the USSR, Moscow, USSR. 890 pp. (Translated by the Israel Program for Scientific Translations.)

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