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Parasites Associated with Thirteen-lined Ground Squirrels (*Spermophilus tridecemlineatus* Mitchell) from Ames, Iowa

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A total of 19, thirteen-lined ground squirrels (*Spermophilus tridecemlineatus*) were examined for parasites from two locations in Ames, Iowa. Parasites found and their respective prevalence included *Androlaelaps fabrenholzi* (47.4%), an unidentified non-parasitic mesostigmatic mite (21.1%), *Ixodes sculptus* (52.6%), *Opisocrostis bruneri* (26.3%), a skin bot believed to be *Cuterebra* sp. (5.3%), *Monocystis* sp. (18.8%), *Eimeria citelli*, (81.3%) and *E. bilamellata* (18.8%). Helminths were not found, nor were antibodies to *Toxoplasma gondii*.
INDEX DESCRIPTORS: *Spermophilus tridecemlineatus*, parasites, Iowa.

Spermophilus tridecemlineatus (Mitchill), the thirteen-lined ground squirrel is common throughout much of the United States. Although parasitological studies have been conducted elsewhere on this species, data for central Iowa ground squirrels is limited. Therefore, the goal of this study was to determine which parasites were associated with thirteen-lined ground squirrels from Ames, Story county, Iowa and to what degree the squirrels were parasitized.

MATERIALS AND METHODS

Nineteen thirteen-lined ground squirrels were either snap or live trapped between 14 June and 30 July, 1985. All squirrels were collected from two sites on or adjacent to the Iowa State University campus at Ames. Site (1) was Veenker Memorial Golf Course which is approximately one Km north of the campus, while site (2) was located at the north end of the Veterinary Medicine complex, near a small woodlot.

All squirrels were returned to the laboratory for necropsy. Blood samples were taken from 13 animals and the serum frozen for indirect hemagglutination (IHA) titer analysis to *Toxoplasma gondii*.

Ectoparasites were preserved in 70% ethanol. Mites and larval ticks were dehydrated in ethanol, cleared in xylene and mounted on glass slides with Canada balsam. Fleas were cleared in 15% potassium hydroxide prior to the above procedure. Unmounted ectoparasites were stored in 70% ethanol.

Following the collection of ectoparasites, all squirrels were eviscerated and their body cavities examined for cysts. The entire gastrointestinal tract was cut longitudinally and examined for helminths. Material from the rectum of 16 ground squirrels was subjected to fecal flotation using Sheather's sugar solution. Intestinal contents and mucosal scrapings from three infected squirrels were aerated in 4% potassium dichromate in order to sporulate the oocysts.

RESULTS AND DISCUSSION

The eight species of parasites found during this study included 1 tick, 2 mites, 1 flea, 1 skin bot and 3 protozoans. No helminths were recovered. The prevalence of these parasites is shown in Table 1.

Androlaelaps fabrenholzi (Berlese) has a wide distribution and has been collected from many mammalian hosts including 13-lined ground squirrels (Whitaker and Wilson, 1974). The mites were collected from just behind the eyes to the tail on the dorsal surface. *Androlaelaps fabrenholzi* was collected from nine ground squirrels and from both study areas, however, squirrels from site 2 were the most heavily infested. Since squirrels from site 1 were live trapped and those from site 2 were snap trapped, the lesser infestation rate observed from site 1 is possibly not due to mites leaving the host.

The second mite collected was a non-parasitic mesostigmatic mite

that could not be identified due to insufficient clearing. A total of four ground squirrels from site 2 were infested with this mite.

Ixodes sculptus (Neumann) was recovered from 10 ground squirrels, and only from collection site 2. The 92 specimens, including 6 females, 57 nymphs and 20 larvae were all removed from the dorsal surface of the body. All attached ticks were collected from the right front leg in the area of the cephalic vein. *Ixodes sculptus* males were not found. This is to be expected since they are not considered to be parasitic and their usual place of habitation is the litter of the ground squirrel burrows (Hixson, 1932).

In other Iowa studies, *I. sculptus* has been collected from badgers (*Taxidea taxus*) in Dickinson county by Wittrock and Wilson (1974) and from thirteen-lined ground squirrels on the Tama Indian Reservation, Tama county (Eddy and Joyce, 1942). Eddy and Joyce (1942) also reported on specimens from four other counties. Hixson (1932) also collected ticks from thirteen-lined ground squirrels in the Ames area where he worked out the life history of *I. sculptus*.

The common ground squirrel flea *Opisocrostis bruneri* (Baker), was associated with five (26.3%) of the squirrels collected. A total of 10 males and one female were found on squirrels from site 2. Although primarily a ground squirrel flea, *O. bruneri* has also been collected from predators of ground squirrels (Wittrock and Wilson, 1974) and accidental hosts such as lagomorphs (Haas and Dicke, 1959). *Opisocrostis bruneri* is of much interest since other members of this subgenus are efficient vectors of plague (*Yersinia pestis*).

The final arthropod collected was a single bot fly larva believed to be of the genus *Cuterebra*. The second stage larva was removed from the right inguinal area of a squirrel trapped from site 2. Although the second stage cuterebrid larva could not be identified, the specimen may be a species that normally parasitizes cottontail rabbits, since rabbits were abundant at the study site (E.P. Catts, Personal Communication). This association is accidental.

Indirect hemagglutination (IHA) titers were seronegative (dilution 1:16) for *Toxoplasma gondii* in the 13 squirrels for which serum was collected. The squirrels may have had cysts and trophozoites of *T. gondii* in the tissues, however, microscopic examinations were not performed.

There were three coccidian species noted in the fecal flotations that were performed. They were *Eimeria citelli* (Kartchner and Becker), *E. bilamellata* (Henry) and a species resembling the gregarine *Monocystis* sp.

Monocystis sp. was the most unusual host-parasite association found in the ground squirrels, since it is primarily found in the seminal vesicles of terrestrial oligochaete worms of the genus *Lumbricus* (McMahan, 1975). Although the bipolar oocysts were not measured, they strongly resembled those found in the American woodcock (*Philobela minor*) by McGhee and Pursglove (1977). Only three ground squirrels, one from site 1 and two from site 2 were found to possess *Monocystis* sp. The presence of oocysts in the fecal contents was probably due to the squirrels feeding on earthworms, much like the previously mentioned woodcock.

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Table 1. Prevalence of parasites of thirteen-lined ground squirrels from Ames, Iowa, June-July, 1985.

Parasite ^a	Site 1			Site 2			Combined		
	No. Exam.	No. Pos.	Prev. (%)	No. Exam.	No. Pos.	Prev. (%)	No. Exam.	No. Pos.	Prev. (%)
Acarina									
<i>Ixodes sculptus</i>	5	0	0	14	10	71.4	19	10	52.6
<i>Androlaelaps fabrenholzi</i>	5	2	40.0	14	7	50.0	19	9	47.4
Unidentified mesostigmatic mite	5	0	0	14	4	28.6	19	4	21.1
Siphonaptera									
<i>Opisocrostitis bruneri</i>	5	0	0	14	5	35.7	19	5	26.3
Diptera									
<i>Cuterebra</i> sp.	5	0	0	14	1	7.1	19	1	5.3
Protozoa									
<i>Monocystis</i> sp.	2	1	50.0	14	2	14.3	16	3	18.8
<i>Eimeria bilamellata</i>	2	0	0	14	3	21.4	16	3	18.8
<i>Eimeria citelli</i>	2	0	0	14	13	92.9	16	13	81.3

^aAll parasites are in the author's personal collection except for several ticks which are in the collection of Dr. Nixon Wilson, Department of Biology, University of Northern Iowa, Cedar Falls, Iowa USA.

Oocysts of *Eimeria citelli* were found in 81.3% of the ground squirrels that were examined for coccidians. Squirrels from site 2 were the only ones infected. The oocysts measured 16-21µm by 15-18µm (mean 19.1 by 16.5µm), with the three layered walls being between 0.65µm and 0.70µm. There was no micropyle present. It was of interest that Kartchner and Becker (1930), also working in Iowa, found this species in 16 of 78 (20.5%) thirteen-lined ground squirrels. The difference in prevalence between the two studies may be due to the number and ages of the squirrels examined in each study. In this study it appears that all of the squirrels except one were young of the year based on their weights. Kartchner and Becker (1930) may have examined more adult squirrels which may have been immune to *E. citelli*. Henry (1932) also found *E. citelli* in a species of *Spermophilus* from California.

In addition to infections with *E. citelli*, three ground squirrels from site 2 were found to be infected with *E. bilamellata*. The egg-shaped oocysts were 33-37µm by 25-29µm (mean 34.7 by 27.5µm) and had a thick, two-layered wall that was brown and rugose. There was also a distinct micropyle. *Eimeria bilamellata* is a parasite of several species of *Spermophilus*, but it is interesting to note that Kartchner and Becker (1930) and Todd et al. (1968) did not find *E. bilamellata* in thirteen-lined ground squirrels. In Iowa, *E. bilamellata* has been reported from *S. franklinii* (Hall and Knippling, 1935).

The thirteen-lined ground squirrels examined in this study were hosts to several parasites, with arthropods being the majority of those found. Ground squirrels from collection site 2 were more heavily parasitized than those from site 1. The reason for this discrepancy is unknown. All parasites found in this study have been reported previously from Iowa, however this appears to be the first report of *E. bilamellata* from thirteen-lined ground squirrels in the state. This appears to be the first report of cuterebrid larvae being associated with thirteen-lined ground squirrels.

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