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SPECIES OF EIMERIA FROM THE THIRTEEN-LINED GROUND SQUIRREL, SPERMOPHILUS TRIDECEMLINEATUS, FROM WYOMING

Robert S. Seville1,2, Diane M. Thomas1, Russell Pickering1, and Nancy L. Stanton1

Abstract.—Five species of the coccidian genus Eimeria (E. boecheri [prevalence = 17.9%], E. callomorphilumurinensis [28.6%], E. laramensis [16.1%], and E. bilamellata [3.6%]) were recovered from 56, 13-lined ground squirrels (Spermophilus tridecemlineatus) collected from two sites in eastern Wyoming. Two squirrels from one site were also passing an unidentified polyposporocystic coccidian. Infected squirrels were found to harbor from one to three species simultaneously. Previously these same eimerian species were found infecting sympatric populations of Wyoming ground squirrels (Spermophilus elegans) and white-tailed prairie dogs (Cynomys leucurus) at one of the sites; it is suggested that the exchange of these generalist parasite species among co-occurring sciurid hosts contributes to the consistent prevalence levels reported in Wyoming ground squirrels.

Key words: Eimeria, Spermophilus tridecemlineatus, prevalence, polyposporocystic coccidia.

Shults et al. (1990) reported the occurrence of six species of eimerian parasites (Protozoa: Apicomplexa) in sympatric populations of Wyoming ground squirrels (Spermophilus elegans elegans Kennicott, 1863) and white-tailed prairie dogs (Cynomys leucurus Merriam, 1890) from Wyoming. Stanton et al. (1992) conducted a study of eimerian species in four Wyoming ground squirrel populations and found that most infected ground squirrels harbored two or more species and that the eimerian assemblage was present across populations and over years.

Toft (1986) recognized two classes of parasites: micro- and macroparasites. Macroparasites (e.g., helminths) tend to produce long-lasting infections and are endemic in host populations, while microparasites (protozoa, bacteria, viruses) produce short-lived infections and long-lasting immunity, resulting in oscillations of infection frequency (epidemics) within the host population. The stability for intestinal protozoans reported by Stanton et al. (1992) does not support Toft’s prediction regarding microparasites. While there have been no mechanisms proposed for maintaining stability in microparasite communities, Stock and Holmes (1987) proposed that species richness of intestinal helminth communities of grebes was enhanced by reduced host specificity which allowed parasite exchange among related hosts. One important factor in maintaining the stability of eimerian assemblages is exchange of parasite species among closely related sympatric host species.

The purpose of this study was to determine which eimerian species are present in wild populations of 13-lined ground squirrels (Spermophilus tridecemlineatus Mitchill, 1821) and to assess the role these hosts play in maintenance of the stable eimerian guild observed in Wyoming ground squirrels.

Methods

In 1991 we sampled 13-lined ground squirrels from two locations: (1) a native short-grass prairie/hayfield 10 km south of Laramie, Wyoming (41°12′ N, 105°33′ W), and (2) a native short-grass prairie/hayfield 18 km south of Gillette, Wyoming (44°17′ N, 106°31′ W).

At the Laramie site squirrels were live-trapped using National live-traps once a month from July to September. Over the four-day trapping period squirrels were trapped using three 60 × 42-m trapping grids with traps set every 6 m (162 total traps). Traps were set at 2000 hr and checked each morning by 0800 hr.

At the Gillette site, six 400-m transects and

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Table 1. Total percent infected and prevalences (hosts infected with given species/hosts examined) of eimerian species in ground-dwelling sciurid hosts at Laramie and Gillette collection sites in Wyoming (% inf = total percent infected with Eimeria; Eibe = E. beecheyi; Eibi = E. bilamellata; Eica-mo = E. callospermophili-morainensis; Eila = E. larimerensis; and Eisp = E. spermophilii).

<table>
<thead>
<tr>
<th>Sciurid host</th>
<th>% inf</th>
<th>Eibe</th>
<th>Eibi</th>
<th>Eica-mo</th>
<th>Eila</th>
<th>Eisp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spermophilus tridecemlineatus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laramie (n = 41)</td>
<td>43.9</td>
<td>7.3</td>
<td>2.4</td>
<td>9.6</td>
<td>14.6</td>
<td>0</td>
</tr>
<tr>
<td>Gillette (n = 15)</td>
<td>85.7</td>
<td>46.7</td>
<td>6.7</td>
<td>80.0</td>
<td>20.0</td>
<td>0</td>
</tr>
<tr>
<td>Total (n = 56)</td>
<td>51.8</td>
<td>17.9</td>
<td>8.6</td>
<td>28.6</td>
<td>16.1</td>
<td>0</td>
</tr>
<tr>
<td>S. elegans</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laramie (n = 1007)</td>
<td>68.0</td>
<td>34.0</td>
<td>11.0</td>
<td>43.0</td>
<td>17.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Cynomys leucurus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laramie (n = 18)</td>
<td>94.0</td>
<td>83.0</td>
<td>17.0</td>
<td>22.0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Results

Forty-one 13-lined ground squirrels were sampled at the Laramie site and 15 at the Gillette site. Five species of Eimeria were found infecting squirrels in both populations. Overall, 51.8% of all squirrels examined were infected with at least one species of Eimeria. The total percent infected was significantly higher at the Gillette (86.7%) than at the Laramie site (43.9%; P ≤ .05). Infected squirrels at Gillette also had higher parasite species richness (1.77 species/infected squirrel) than at Laramie (1.17). Total percent infected and prevalences by species at each site are presented in Table 1.

Overall, the Eimeria callospermophili-morainensis complex was the most prevalent species found, infecting 28.6% of the 56 hosts examined. Significantly more hosts were
infected with this species complex at the Gillette site than the Laramie site (80% vs. 9.6%; \( P \leq .05 \)).

*Eimeria beecheyi* Henry, 1932 was the second most prevalent species found, infecting 17.9% of the hosts examined. Significantly more hosts were infected at the Gillette site (46.7% vs. 7.3%; \( P \leq .05 \)).

*Eimeria larimerensis* Vetterling, 1964 was found infecting 16.1% of the squirrels examined. Prevalence was higher at the Gillette site (20% vs. 14.6%), but the difference was not significant (\( P \leq .05 \)).

*Eimeria bilamellata* was the least common species found during the study (3.6%). Again, prevalence was higher at the Gillette site (6.7% vs. 2.4%), but the difference was not significant (\( P \leq .05 \)).

Two squirrels at the Laramie site were also infected with a subspherical polysporocystic coccidian (Fig. 1) with 10–12 sporozoites. The number of sporozoites could not be determined due to the large amount of residuum present in the sporocysts. Mean size for 15 measured oocysts was 38.62 \( \times \) 30.20 \( \mu \) m. Sporozoites were spherical and measured 10.65 \( \times \) 10.65 \( \mu \) m (\( n = 15 \)) and had no steida body. Both oocysts and sporocysts contained numerous residual bodies. Attempts to infect two captive Wyoming ground squirrels (*Spermophilus elegans*) were unsuccessful.

**DISCUSSION**

The occurrence of *E. beecheyi*, *E. bilamellata*, and *E. morainensis* in 13-lined ground squirrels constitutes new host records for these species in this host. Polysporocystic oocysts have not been previously reported from sciurid rodents. Levine et al. (1955) identified two polysporocystic species, *Klossia perplexens* from deer mice (*Peromyscus maniculatus*) and *K. variabilis* from the western big eared bat (*Corynorhinus rafinesquii*) collected at the Grand Canyon, Arizona. Because all species of *Klossia* previously described were found in invertebrates, Levine et al. (1955) postulated that the two species were parasites of invertebrates eaten by the deer mouse and bat. Dorney (1965) reported finding two polysporocystic oocysts in feces from a woodchuck (*Marmota monax*) from Pennsylvania that resembled the descriptions of the two species in the genus *Klossia* reported by Levine et al. (1955). Dorney speculated that the two oocysts might represent spurious infections of invertebrate origin. Based on these reports, it is likely that the polysporocystic coccidian observed in 13-lined squirrels is a member of the genus *Klossia* and possibly of invertebrate origin. However, identification to species requires further work, including the identification of the primary host.

The results of this study indicate that while the eimerian fauna of 13-lined ground squirrels is very similar to that of Wyoming ground squirrels and white-tailed prairie dogs, at the Laramie site there were some differences in the prevalences of the different parasites. Of the five species found infecting 13-lined squirrels, all have been reported previously from sympatric ground squirrels (Shults et al. 1990, Stanton et al. 1992), and all have been reported from white-tailed prairie dogs in Wyoming (Todd and Hammond 1968a, 1968b, Todd et al. 1968, Shults et al. 1990). However, at the Laramie site 13-lined squirrels were not as frequently infected and had lower prevalences than Wyoming ground squirrels for all species and lower prevalences than white-tailed prairie dogs for *E. beecheyi*, *E. callospermphili-morainensis*, and *E. bilamellata*. Values for 13-lined squirrels at the Gillette site (where no other species of sciurids were present) were more similar to those for Wyoming ground squirrels at the Laramie site (Table 1). Additionally, Wyoming ground squirrels had greater species richness than 13-lined squirrels (Stanton et al. 1992). Species richness for prairie dogs has not been reported.

Results indicate that related sympatric hosts can be infected by the same species of *Eimeria*, which may contribute to the stability of the eimerian guild.

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**LITERATURE CITED**


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