

**A Study of Ectoparasites from Mammals of
Michigan's Upper Peninsula**

Biology 569 Practicum in Aquatic Biology

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ABSTRACT

Between May 21, 1994 and July 17, 1994, mammals were trapped at the University of Notre Dame's Environmental Research Center (UNDERC) in Gogebic County, Michigan. The mammals were examined for the Lyme disease vector and spirochete, *Ixodes scapularis* and *Borrelia burgdorferi* respectively. No *I. scapularis* were found. Ear biopsies from all the mammals captured proved negative for the spirochete bacterium. The only tick species to be captured were *Ixodes muris* and *Dermacentor variabilis*. The species of fleas captured consisted of *Megabothris quirini*, *Megabothris acerbus*, *Monopsyllus vison*, *Orchopeas caedens*, *Orchopeas leucopus*, and *Cediopsylla inaequalis*. The results of this study, a study by McCracken (1993), and a study by Amrol (1992) seem to indicate that neither *I. scapularis* nor *B. burgdorferi* are present on the UNDERC property in significant numbers.

INTRODUCTION

Lyme disease is a systemic disease caused by the spirochete bacterium *Borrelia burgdorferi*, and is common in North America, Europe, and Asia. It has recently become the most common arthropod-borne disease in the United States (Barbour and Fish, 1993). There is a growing concern that this disease could spread from the now concentrated areas of the Northeast and North Pacific to other areas. More than 9,600 cases of Lyme disease from 45 states were reported to the Centers for Disease Control and Prevention in 1992 (Ginsberg, 1993).

The bacterial pathogen is carried by arthropod vectors which vary depending upon the region studied. In North America, the vectors of *B. burgdorferi* are *Ixodes scapularis* in eastern North America and *Ixodes pacificus* in western North America. *Ixodes ricinus* and *Ixodes persulcatus* have been determined to be the vectors for *B. burgdorferi* in Europe and Asia respectively (Lane 1991). More than eighty percent of the Lyme disease cases in North America are caused by *I. scapularis*.

It has been shown that *I. scapularis* feeds on most mammals in the region of the northeastern United States, however, only certain species of animals are competent reservoirs for *B. burgdorferi*. The white-footed deer mouse (*Peromyscus leucopus*) is an important reservoir and one that is found in the region of this study, namely Northern Michigan. This property, owned by the University of Notre Dame, has had *I. scapularis* found on it previously. The Vector Biology Laboratory began trapping mammals on the property in 1980. No *I. scapularis* were found between 1981 and 1983. In 1984, one *I. scapularis* was found and this was the first one recorded from the upper peninsula. Lyme disease has become increasingly prevalent since then. Eight to ten cases of Lyme disease occur annually in a county in Wisconsin neighboring the study site at UNDERC. Also, in a study conducted by Ned Walker (Michigan State University) in a county sixty-five miles from this study site, forty percent of the mice and sixty percent of the chipmunks tested positive for *B. burgdorferi* (McCracken, 1993). In the past three years, only a single *I. scapularis* has been found at the UNDERC study site. It was located on a *Peromyscus* species on May 23, 1992 on the west side of the property.

This study will serve to gain more information about the property so that the progress of Lyme disease invasion can be charted. It will also serve as a general survey of the small mammals present in the area.

MATERIALS AND METHODS

From May 21, 1994 to July 17, 1994 small mammals were trapped live at the University of Notre Dame's Environmental Research Center (UNDERC) in Gogebic County, Michigan (Figure 1). The site

consisted of 2,226 hectares with several lakes scattered throughout the property. The dominant species of vegetation included the Sugar Maple (*Acer sacharum*), Eastern Hemlock (*Tsunga caradensis*), and Balsam Fir (*Abies balsamea*). The traps were distributed at a variety of sites as shown in Figure 2, including meadows, bogs, and forest (See Appendix I). The traps were generally set in lines of ten with each trap spaced about ten meters apart.

The traps used were 3" x 3.5" x 9" Sherman traps and about thirty to forty traps were set each night. The traps were baited with either peanut butter, oat bran, sunflower seeds, cracked corn, or a mixture of these. The traps were set in the evening and checked the following morning. When small mammals were captured, they were released into a plastic bag and then maneuvered into a plastic jar. The lid of the jar contained a towel soaked in Metofane anaesthesia. The rodents were observed continuously as the anaesthesia took effect, and when the animal was anaesthetized it was placed in a white enamel pan. Identification of the mammal was performed using William Burt's *Mammals of the Great Lakes Region* (1957) and *A Field Guide to the Mammals* (1976). The rodents were checked for ectoparasites with a pair of tweezers and any found were preserved in seventy percent ethanol (See Appendix II for complete trapping data). An ear biopsy was also taken from each animal with a stainless steel ear punch. The ear punch was cleaned with alcohol between each use. The biopsies were placed in a thirty percent glycerol/PBS cryoprotectant and frozen in liquid nitrogen. Upon completion of the procedure, the animals were placed back in the trap to revive. They were then released in the same place they were taken.

The ear biopsies were unfrozen and placed in BSK II media and allowed to incubate for two weeks. They were then examined by dark field microscopy for the presence of *B. burgdorferi*. This entire procedure was performed by Ned Walker at Michigan State University. Any ticks were also identified by Ned Walker. Any fleas were identified by the author using *Fleas of Western North America* (Hubbard, 1947), *An Atlas of the Fleas of the Eastern United States* (Benton, 1980), and *Ectoparasites of Mammals of Indiana* (Whitaker, 1982). Fleas were first bleached in 11.5 percent potassium hydroxide and then mounted on slides and observed.

A respirator, gloves, apron, and goggles were worn when near the animals to protect against possible hantavirus infection. Blood was screened for the virus by the CDC for information.

RESULTS AND DISCUSSION

Eighteen small mammals of seven species were captured in 1994 (Table 1). The most abundant species was *Peromyscus maniculatus* followed by *Peromyscus leucopus*, six individuals and four individuals respectively. Also captured were two *Tamias striatus*,

two *Tamiasciurus hudsonicus*, two *Zapus hudsonicus*, one *Procyon lotor*, and one *Castor canadensis*. Tissue biopsies were taken from sixteen animals and all tested negative for spirochete bacteria.

Ectoparasites were collected from eight of the above mentioned animals. The following is a list of ectoparasites obtained from small mammals.

ACARI COLLECTIONS

Family Ixodidae

Dermacentor variabilis: 16 adult females, 7 adult males, *Castor canadensis*, 5-21-94 UNDERC; 1 adult female, *Procyon lotor*, 7-12-94 Site A.

Ixodes muris: 2 adult females, *Tamiasciurus hudsonicus*, 7-14-94 Site A; 1 adult female, *Zapus hudsonicus*, 7-8-94 Site A.

SIPHONAPTERA COLLECTIONS

Family Ceratophyllidae

Megabothris acerbus: 1 male, *Tamias striatus*, 7-13-94 Site A.

Megabothris quirini: 1 female, *Zapus hudsonicus*, 7-17-94 Site A.

Monopsyllus vison: 1 male, 3 females, *Tamiasciurus hudsonicus*, 7-14-94 Site A; 1 male *Tamiasciurus hudsonicus*, 7-13-94 Site A.

Orchopeas caedens: 2 males, 1 female, *Tamiasciurus hudsonicus* 7-13-94 Site A; 1 female, *Tamiasciurus hudsonicus*, 7-14-94 Site A.

Orchopeas leucopus: 1 female, *Peromyscus leucopus*, 6-5-94 Site B. 1 female, *Peromyscus maniculatus*, 6-5-94 Site B.

Cediopsylla inaequalis: 1 female, *Zapus hudsonicus*, 7-8-94 Site A.

Twenty-seven ticks were collected from four species of mammals, *Z. hudsonicus*, *P. lotor*, *T. hudsonicus*, and *C. canadensis*

(See Table 4). Two species of tick were collected, *Dermacentor variabilis* T and *Ixodes muris* (Table 3). As in previous studies, *D. variabilis* was the most common species of tick on the property. One *D. variabilis* was taken from a raccoon (*P. lotor*) on July 12, 1994. Twenty-three *D. variabilis* were taken from a beaver (*C. canadensis*) trapped in a lake on the property on May 21, 1994. The only other species of tick found was *I. muris*. Three individuals were taken, one from a *Z. hudsonicus* on July 8, 1994, and two from a *T. hudsonicus* on July 14, 1994.

Fourteen fleas were collected from five species of small mammals, *Z. hudsonicus*, *P. maniculatus*, *P. leucopus*, *T. striatus*, and *T. hudsonicus* (Table 5). Six species of fleas were collected, *Megabothris quirini*, *Megabothris acerbus*, *Monopsyllus vison*, *Orchopeas caedens*, *Orchopeas leucopus*, and *Cediopsylla inaequalis* (Table 2). The most abundant species of flea was *M. vison*. Five individuals were found, all on *T. hudsonicus*. For the past three years, *M. vison* has been the most abundant flea (McCracken 1993, Amrol 1992).

Four *O. caedens* were found on *T. hudsonicus*. Most of the *T. hudsonicus* were trapped at Kilarney Point (See Figure 2) and so this is where the *O. caedens* and *M. vison* were found. *O. caedens* is a species of flea that is associated with only one host species, that being *T. hudsonicus* (Benton and Cerwonka, 1960).

Two *O. leucopus* were collected, one from a *P. leucopus* and one from a *P. maniculatus*. Almost every species of *Peromyscus* has *O. leucopus* as one of its most abundant ectoparasites (Benton, 1980).

One *M. quirini* was found on a *Z. hudsonicus*. The meadow jumping mouse is listed as a host for *M. quirini* by Scarf et. al. (1990). One *M. acerbus* was found on a *T. striatus*. *M. acerbus* is another species of flea that parasitizes one host primarily, *T. striatus* (Benton and Cerwonka, 1960). One *C. inaequalis* was found on a *Z. hudsonicus*.

The number of mammal captures was relatively low compared with the past two years, and thus flea and tick counts were also low. A possible explanation might be the many rainy nights. In all there were fifteen nights when rain prevented successful trapping. The mice are active at night, but not in the rain. Also, since the bait was rain soaked, it did not give off as much odor for the mice to follow. Five traps were smashed by bears, mostly at site J near Moccasin Lake. This prevented trapping to continue in this area.

There were no *I. scapularis* found in 1994. Since 1980, only two *I. scapularis* have been found on the property (McCracken, 1993) suggesting that this ectoparasite is not present in significant numbers. Since several cases of Lyme disease are reported in surrounding areas each year, it could be that *I. scapularis* is present but difficult to find. It is also possible that these cases of Lyme disease are acquired elsewhere in the country and only diagnosed in the surrounding area. More research is needed to be sure.

Table 1. Number and Species of Mammals Trapped.

<u>Species</u>	<u>Number</u>
<i>P. leucopus</i>	4
<i>P. maniculatus</i>	6
<i>T. hudsonicus</i>	2
<i>T. striatus</i>	2
<i>P. lotor</i>	1
<i>Z. hudsonicus</i>	2
<u><i>C. canadensis</i></u>	<u>1</u>
total	18

Table 2. Number and Species of Fleas Collected.

<u>Species</u>	<u>sex</u>		<u>total</u>
	<u>male</u>	<u>female</u>	
<i>M. vison</i>	2	3	5
<i>M. quirini</i>	0	1	1
<i>M. acerbus</i>	1	0	0
<i>O. caedens</i>	2	2	4
<i>O. leucopus</i>	0	2	2
<i>C. inaequalis</i>	1	0	1
total	6	8	14

Table 3. Number and Species of Ticks Collected.

<u>Species</u>	<u>Number</u>
<i>D. variabilis</i>	24
<u><i>I. muris</i></u>	<u>3</u>
total	27

Table 4. Number of Ticks per Host Species.

	<u><i>D. variabilis</i></u>	<u><i>I. muris</i></u>
<i>T. hudsonicus</i>	0	2
<i>C. canadensis</i>	23	0
<i>P. lotor</i>	1	0
<i>Z. hudsonicus</i>	0	1

Table 5. Number of Fleas per Host Species.

	<u>T. huds.</u>	<u>P. leuc.</u>	<u>T. stri.</u>	<u>P. mani.</u>	<u>Z. huds.</u>
<i>M. quirini</i>	0	0	0	0	1
<i>M. acerbus</i>	0	0	1	0	0
<i>M. vison</i>	5	0	0	0	0
<i>O. caedens</i>	4	0	0	0	0
<i>O. leucopus</i>	0	1	0	1	0
<i>C. inaequalis</i>	0	0	0	0	1

Appendix I. Trap Site Locations. See Figure 2
for map.

<u>Location</u>	<u>Community Type</u>	<u>Map Code</u>
Kilarney Point	Hemlock, Disturbed	A
Plum Lake N	Deciduous	B
Plum Lake E	Deciduous	C
North Meadow	Deciduous/Meadow	D
Student Residences	Deciduous/Meadow, Disturbed	E
Roach Lake	Hemlock	F
West Meadow	Deciduous/Meadow	G
Vernal Pond	Deciduous	H
Bog Pot	Deciduous	I
Moccasin Lake	Deciduous	J
Roach Lake Rd. N	Deciduous	K
Roach Lake Rd. S	Deciduous/Meadow	L

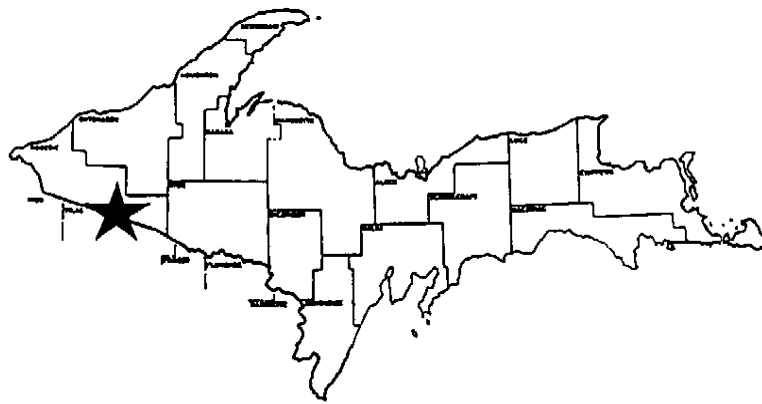


Figure 1. Upper peninsula of Michigan. Location of the University of Notre Dame Environmental Research Center, Gogebic County Michigan.

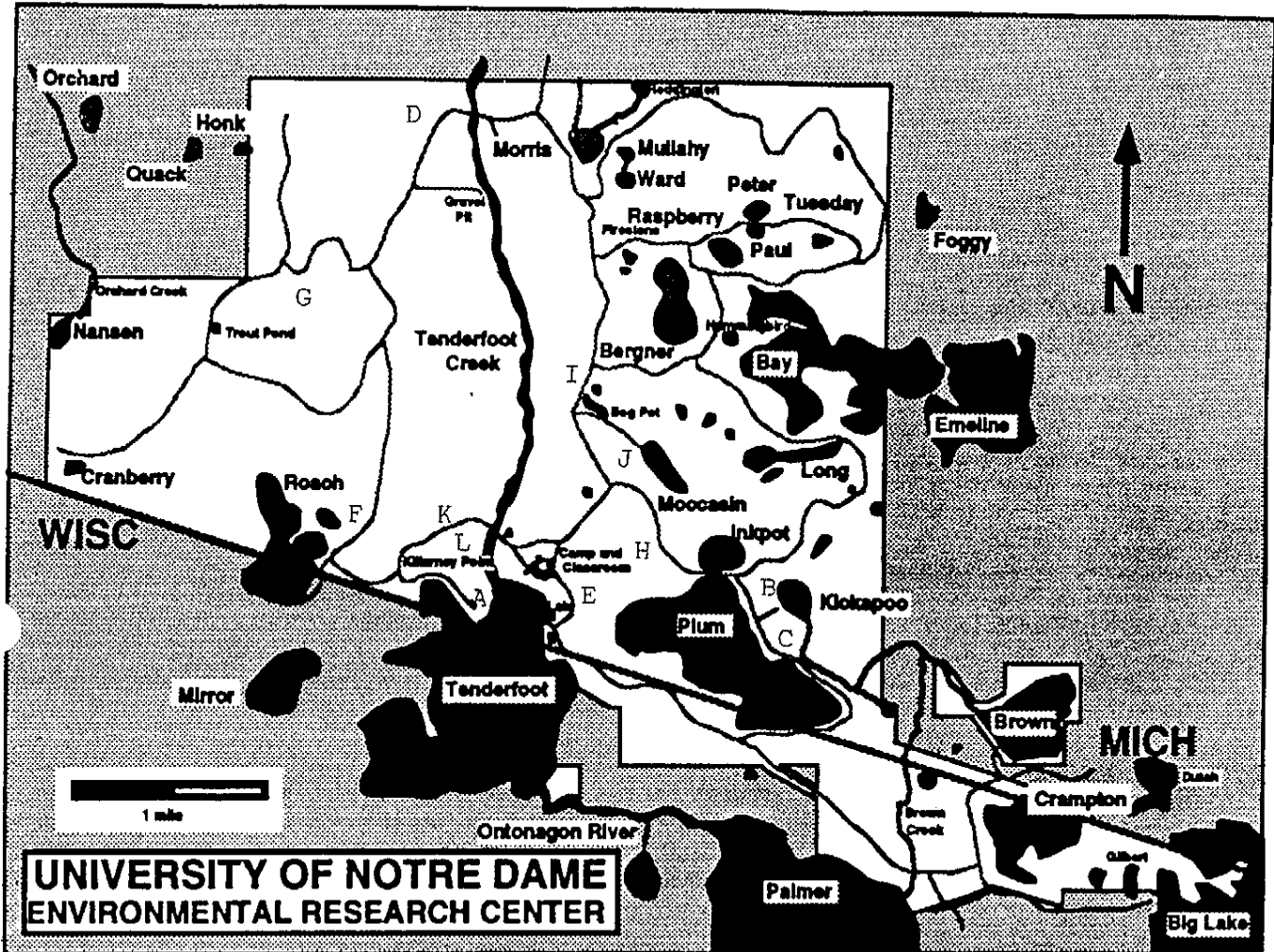


Figure 2. University of Notre Dame Environmental Research Center. Location of trap sites.

Appendix II. Complete Trapping and Collection Data

<u>Date</u>	<u>Trap Site</u>	<u>Species</u>
5-21-94	UNDERC	<i>Castor canadensis</i> , 16 female <i>Dermacentor variabilis</i> , 7 male <i>D. variabilis</i> .
5-21-94	K	<i>Peromyscus leucopus</i> , no ectoparasites.
5-23-94	K	<i>Peromyscus leucopus</i> , recaptured, no ectoparasites.
5-23-94	K	<i>Peromyscus leucopus</i> , no ectoparasites.
6-5-94	B	<i>Peromyscus leucopus</i> , 1 female <i>Orchopeas leucopus</i>
6-5-94	B	<i>Peromyscus maniculatus</i> , 1 female <i>Orchopeas leucopus</i> .
6-7-94	B	<i>Peromyscus maniculatus</i> , no ectoparasites.
6-15-94	E	<i>Peromyscus maniculatus</i> , no ectoparasites.
6-25-94	E	<i>Tamias striatus</i> , no ectoparasites.
7-8-94	A	<i>Zapus hudsonicus</i> , 1 <i>Ixodes muris</i> , 1 female <i>Cediopsylla inaequalis</i> .
7-9-94	A	<i>Peromyscus maniculatus</i> , no ectoparasites.
7-12-94	A	<i>Procyon lotor</i> , 1 female <i>Dermacentor variabilis</i> .

7-12-94	K	<i>Peromyscus maniculatus</i> , no ectoparasites.
7-13-94	L	<i>Tamias striatus</i> , 1 male <i>Megabothris acerbus</i> .
7-13-94	A	<i>Tamiasciurus hudsonicus</i> 2 male, 1 female <i>Orchopeas caedens</i> , 1 male <i>Monopsyllus vison</i> .
7-14-94	A	<i>Tamiasciurus hudsonicus</i> 3 female, 1 male <i>Monopsyllus vison</i> , 1 female <i>Orchopeas</i> <i>caedens</i> , 2 <i>Ixodes</i> <i>muris</i> .
7-16-94	A	<i>Peromyscus maniculatus</i> , no ectoparasites.
7-17-94	A	<i>Zapus hudsonicus</i> , 1 female <i>Megabothris</i> <i>quirini</i> .

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