

# Ectoparasites from Mammals of Michigan's Upper Peninsula

Biology 569 Practicum in Aquatic Biology

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1993

ABSTRACT Between May 15 and July 11, 1993, mammals were surveyed for the Lyme disease vector and spirochaete, *Ixodes scapularis* and *Borrelia burgdorferi*, Gogebic County in the upper peninsula of Michigan. Eighty-six mammals of twelve species were trapped and examined. No *I. scapularis* were found. Ear biopsies from one mammal, *Ondatra zibethica*, tested positive for the presence of spirochetes. At this time it is unknown whether this spirochaete is *B. burgdorferi*. Sixty-four ticks of six species and one hundred twenty-two fleas of seven species were also collected. The tick species that were collected were *Dermacentor variabilis*, *Ixodes angustus*, *Ixodes cookei*, *Ixodes marxi*, *Ixodes muris*, and *Ixodes texanus*. The one specimen of *I. texanus* collected from a *Mustela vison* may significantly extend the known range of *I. texanus*. Species of fleas that were collected were *Epidemia wenmanni*, *Megabothris acerbus*, *Megabothris quirini*, *Monopsyllus vison*, *Orchopeas caedens*, *Orchopeas leucopus*, and *Tamiophila grandis*. No ectoparasites were found on hosts that had been previously unreported. The results of this study and the study by Amrol (1992) seem to indicate that both *I. scapularis* and *B. burgdorferi* are not present on the study site in significant numbers.

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### INTRODUCTION

LYME DISEASE is a zoonosis caused by the spirochaete bacterium *Borrelia burgdorferi*. Lyme Disease occurs in North America, Europe, and Asia, and although Lyme Disease has probably occurred at low levels of incidence in the North America for centuries, it has recently become the most common arthropod-borne disease in the United States (Barbour and Fish 1993).

In North America the vectors of *B. burgdorferi* have been demonstrated to be the tick *Ixodes scapularis* in eastern North America and *Ixodes pacificus* in western North America. *I. scapularis* was formerly described as *I. dammini* in 1979 by Spielman *et al.* In 1993 Oliver *et al.* demonstrated the conspecificity of *I. dammini* and *I. scapularis*. Furthermore, sequencing results of internal transcribed spacer units of rDNA from both *I. scapularis* and *I. dammini* by Wesson *et al.* (1993) indicate that *I. scapularis* and *I. dammini* are indeed the same species. The earlier name, *I. scapularis* Say, 1821 now has priority over the name *I. dammini*. In Europe and Asia, respectively, *Ixodes ricinus* and *Ixodes persulcatus*, which are closely related to *I. scapularis* and *I. pacificus* have been demonstrated to be the vectors of *B. burgdorferi* (Lane 1991, Filippova 1991). *Borrelia burgdorferi* is maintained in nature in regions where the distribution of competent wildlife reservoirs of *B. burgdorferi* and the distribution of competent vectors coincide.

In the southern United States, *I. scapularis* primarily feeds upon lizards, which are not competent reservoirs for *B. burgdorferi* (Lane 1990); thus nymphal infection rates in the southern United States are generally less than one percent, and the number of Lyme disease cases is less than that of the northeastern United States (Kardatzke *et al.* 1992). *B. burgdorferi* infection rates in *I. pacificus*, in the western United States are generally between one and five percent (Lane and Burgdorfer 1988). Again the number of Lyme disease cases in the west are much less than the number in the northeast. In Europe and Asia, spirochete infection rates in *I. ricinus* and *I. persulcatus*, respectively, are often as high as those in *I. scapularis* in the northeastern United States, as the feeding ecology of the European and Asian vectors is similar to that of the vectors of the northeastern United States.

More than eighty percent of the Lyme disease cases in North America are caused by the northern form of *I. scapularis*. In the northeastern United States *I. scapularis* has been shown to feed on nearly all mammal species and many of the bird species present in that region (Anderson and Magnarelli 1984, Magnarelli and Stafford 1992). Some of these species are competent reservoirs of *B. burgdorferi* and others are not. The White-footed Deer Mouse (*Peromyscus leucopus*), has been demonstrated to be an especially important reservoir (Levine *et al.* 1985). Studies by Fish and Daniels (1990) and Fish and Dowler (1989) in the state of New York, indicate that larger species of mammals such as Raccoons (*Procyon lotor*), Striped Skunks (*Mephitis mephitis*), and Opossums (*Didelphis virginianus*) are important reservoirs of *B. burgdorferi* and may perhaps be actually more important in maintaining the reservoir than *P. leucopus*, as larger mammals tend to possess more ticks and range over greater distances. While rodents tend to be the primary hosts of larval and nymphal *I. scapularis*, White-tailed Deer (*Odocoileus*

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*virginianus*), have been established to be the primary host of adult *I. scapularis* in the northeastern United States.

A Lyme disease focus exists in the upper Midwest of the United States in the vicinity of the Wisconsin-Minnesota border (Barbour and Fish 1993). There is evidence that the ecology of the disease is different in the Midwest than it is in the northeast. In Illinois, Eastern Chipmunks were found to have higher mean larval densities of *I. scapularis* than White-footed Deer Mice (Mannelli *et al.* 1993). Furthermore changes in the spatial and temporal distribution of immature *I. scapularis* on *P. leucopus* indicate that animals other than *P. leucopus* may be important hosts for *I. scapularis* (Kitron *et al.* 1991).

In this study eighty six individuals of twelve species of small and medium size mammals were trapped in the upper peninsula of Michigan and examined for the presence of *I. scapularis*, *B. burgdorferi*, and other ectoparasites. The study site is a 2,226 hectare tract of land owned by the University of Notre Dame. *I. scapularis* had been previously found on the site. In 1980 the Vector Biology Laboratory began trapping small mammals on the site. No *I. scapularis* were found between 1981 and 1983. In 1984, one *I. scapularis* was found. This was the first record of *I. scapularis* from the upper peninsula. Since that date Lyme disease has become quite common in the upper peninsula. Eight to ten cases of Lyme disease occur each year in Villas County, Wisconsin which borders the study site. In a study conducted by Ned Walker in Menominee County, Wisconsin, sixty-five miles from this study site, forty percent of the mice studied and sixty percent of the chipmunks tested positive for *B. burgdorferi*, (personal communication). Between May 23 to July 16, 1992, David Amrol captured one hundred individuals of five species of mammals on the study site and examined them for ectoparasites. Five species of ticks and seven species of fleas were collected. Amrol found one *I. scapularis* on a single *Peromyscus* species on May 23 on the west side of the property. Ear tissue biopsies from the one hundred small mammals all tested negative for the presence of *B. burgdorferi*.

## METHODS

From May 15, 1993 to July 11, 1993, small and medium size mammals were live trapped at the University of Notre Dame's Environmental Research Center in Gogebic County, Michigan. Traps were distributed at approximately twenty-two different sites on the property (Appendix I). The dominant species of vegetation inhabiting the sites were second growth Sugar Maple (*Acer saccharum*), Eastern Hemlock (*Tsuga canadensis*), and Balsam fir (*Abies balsamea*). Sites that provided the most reliable small mammal trapping success were well drained and near water. Low meadows, bogs, and sites that were poorly drained did not yield good trapping success. The greatest trapping success was in the second growth hemlock groves. These groves were generally confined to areas much less than an acre. The most successful groves possessed numerous rotting stumps and fallen trees that presumably provided good rodent habitat. Boreal Red-backed Voles (*Clethrionomys gapperi*) and White-footed Deer Mice (*P. leucopus*), were caught

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almost exclusively in hemlock groves. The Prairie Deer Mouse (*Peromyscus maniculatus gracilis*), was also captured in the hemlock groves, but it was also commonly captured in deciduous, rocky, and disturbed habitats. The Least Chipmunk (*Eutamias minimus*), and the Eastern Chipmunk (*Tamias striatus*) were caught almost exclusively in deciduous and disturbed habitats. Red Squirrels (*Tamiasciurus hudsonicus*) were captured exclusively at Killarney Point. Medium size mammal traps were placed along shorelines, on game trails, and in sites where mammals or their marks had been seen.

Throughout the summer a maximum of seventy 3" x 3.5" x 9" Sherman, two 10" x 12" x 32" Tomahawk, seven 7" x 7" x 30", and two 4" x 4" x 15" Havahart live traps were operated. The total number of trap nights was 695 Sherman trap nights and 427 Tomahawk and Havahart trap nights (Appendix III). The average number of traps in operation each night was nineteen. Traps were baited and set in the evening and checked at dawn. Sherman traps were baited with a mixture of peanut butter and rolled oats. Fish were used to bait the nine medium size mammal traps. Fish were wrapped in hardware cloth to prevent loss due to rodents, and suspended by wire from the top of the trap to aid in attracting the mammals. Cracked corn and bird seed were used to bait traps for Red Squirrels and chipmunks at Killarney Point.

When small mammals were captured they were released into a bag and maneuvered into a small plastic transparent jar that had been modified to possess a lid that contained cotton soaked in Metofane anaesthesia. Rodents were observed through the sides of the jar as the anaesthesia took effect. When the animal was anesthetized it was taken out of the jar and placed in a white enamel pan. Identification was aided with William Burt's *Mammals of the Great Lakes Region* (1957). The sex of each animal was determined and recorded. Measurements of total length, tail length, and ear length, measured to the notch, were then recorded (Table 4). A small stainless steel punch was used to take one to three tissue biopsies from the ear. The stainless steel punch was dipped in alcohol and flamed between ear biopsies on successive animals. The animals were examined with a comb and forceps for ticks, fleas, and other ectoparasites. Ectoparasites were removed and preserved in eighty percent alcohol. Upon completion of the procedure, animals were placed back in the trap to revive; they were subsequently released.

Care was taken to approach medium size mammals in traps so as to disturb the animal as little as possible. Animals were anesthetized by injection from a syringe at the end of a two foot pole. Before injection the animal was pushed to the rear of the trap and held immobilized by an assistant with the aid of a plunger, designed to slip into the opening and fit the trap. A mixture of Ketamine and Xylazine was then injected at a dosage of one milliliter per kilogram body weight (Appendix IV). The trap was then closed and covered with a cloth until the anaesthesia took effect. Animals were removed, identified, measured, and examined for ectoparasites. One or two tissue biopsies were taken from the ears of the animals. After the procedure was finished, the animals were then placed back into the trap with the door closed. A dark cloth was placed over the trap until the

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animals had completely revived. On one occasion a 0.10 milliliter injection of Yohimbine was used to revive a muskrat. The animals were released from the trap after it had been ascertained that they were in good condition.

Ear tissue biopsies were placed in a thirty percent glycerol/ PBS cryoprotectant and frozen in liquid nitrogen. Ear tissue biopsies were unfrozen and placed in BSK II media and allowed to incubate for two weeks. Biopsies were examined by dark field microscopy for the presence of *B. burgdorferi* by Ned Walker at Michigan State University. Ticks were also identified by Ned Walker. Ticks remain in the possession of Ned Walker. Fleas and other ectoparasites were identified by the author. Fleas were bleached in ten percent potassium hydroxide and mounted on slides for examination. Identification was according to the *Fleas of the Eastern United States* by Irving Fox (1968). Fleas and other ectoparasites remain in the possession of the author.

## RESULTS AND DISCUSSION

One hundred-ten small and medium sized mammals of twelve species were captured (Table 1). The most abundant species of mammal captured was *P. m. gracilis*. Twenty individual *P. m. gracilis* were examined. Fourteen each of *P. leucopus*, *C. gapperi*, and *T. hudsonicus* were also examined. The only other two mammals captured in significant numbers were the Eastern Chipmunk and Least Chipmunk. Ten *T. striatus* and seven *E. minimus* were captured. Two muskrats (*Ondatra zibethica*) and one each of *Martes pennanti*, *Mustela vison*, *Mephitis mephitis*, and *Marmota monax* were examined.

Tissue biopsies were taken from eighty-six animals. All but one tissue biopsy tested negative for the presence of spirochaete bacteria. Spirochetes were isolated from a single muskrat captured near the outlet of Plum Lake on July 3. It is unknown at this time whether this spirochaete is *B. burgdorferi* or another spirochaete species. Spirochetes of the genus *Leptospira* are known to occur in Muskrats. Further tests by Ned Walker will be conducted to identify the spirochaete in question.

Ectoparasites were collected from forty-two of the above mentioned animals. The following is a list of ectoparasites obtained from small and medium size mammals.

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### ACARI COLLECTIONS

#### Family Ixodidae

*Dermacentor variabilis* (Say): 1 adult female, *Canis familiaris*, 5-22-93 UNDERC; 1 adult female, 1 adult male, *Martes pennanti*, 5-29-93 AE; 1 nymph, 1 adult male, *Canis familiaris*, 6-5-93 Land O' Lakes, WI; 1 nymph, *Peromyscus maniculatus gracilis*, 6-26-93 3Q; 10 adult females, 6 adult males, *Erethizon dorsatum*, 6-30-93 Land O' Lakes, WI.

*Ixodes angustus* (Neumann): 3 adult females, *Clethrionomys gapperi*, 6-19-93 57M; 1 larva, 1 nymph, *Clethrionomys gapperi*, 6-26-93 57P; 1 nymph, *Peromyscus maniculatus gracilis*, 7-5-93 13R.

*Ixodes cookei* (Packard): 13 nymphs, 5 adult females, *Marmota monax*, 7-5-93 C.

*Ixodes marxi* (Banks): 1 adult female, *Tamiascurus hudsonicus*, 6-6-93 45K; 4 nymphs, 1 larva, *Tamiascurus hudsonicus*, 6-15-93 K.Pt.; 1 adult female, *Tamiascurus hudsonicus*, 6-17-93 K.Pt.; 1 nymph, *Tamiascurus hudsonicus*, 6-18-93 K.Pt.; 3 larvae, 1 nymph, *Tamiascurus hudsonicus*, 6-23-93 K.Pt.1; 2 larvae, *Tamiascurus hudsonicus*, 6-23-93, K.Pt.2; 2 adult females, *Tamiascurus hudsonicus*, 7-7-93 K.Pt.1.

*Ixodes muris* (Bishopp and Smith): 1 larva, *Clethrionomys gapperi*, 5-29-93 28H.

*Ixodes texanus* (Banks): 1 adult female, *Mustela vison*, 5-17-93 FC.

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### SIPHONAPTERA COLLECTIONS

#### Family Hystrihopsyllidae

*Epitedia wenmanni* (Rothschild): 1 female, *Peromyscus maniculatus gracilis*, 5-27-93 35I.

#### Family Ceratophyllidae

*Megabothris acerbus* (Jordan): 2 males, *Peromyscus maniculatus gracilis*, 5-21-93 34A; 1 female, *Tamias striatus*, 6-15-93 45; 1 female, *Tamias striatus*, 7-5-93 1Q; 1 female, *Tamias striatus*, 7-11-93 12U.

*Megabothris quirini* (Rothschild): 1 female, *Clethrionomys gapperi*, 5-24-93 59E, 1 female, *Peromyscus leucopus*, 5-27-93 28H, 1 female, *Peromyscus maniculatus gracilis*, 5-27-93 35I; 1 female, *Clethrionomys gapperi*, 6-26-93 57P; 1 male, *Clethrionomys gapperi*, 7-5-93 58P.

*Monopsyllus vison* (Baker): 3 males, *Tamiascurus hudsonicus*, 6-6-93 45K; 1 male, *Tamiascurus hudsonicus*, 6-15-93; 2 males, *Tamiascurus hudsonicus*, 6-17-93 K.Pt.; 4 females, *Tamiascurus hudsonicus*, 6-18-93 K.Pt.; 6 females, 4 males, *Tamiascurus hudsonicus*, 6-21-93 K.Pt.; 1 female, *Tamiascurus hudsonicus*, 6-22-93 K.Pt.1; 10 females, 3 males, *Tamiascurus hudsonicus*, 6-23-93 K.Pt.1; 6 females, 4 males, *Tamiascurus hudsonicus*, 6-23-93 K.Pt.2; 1 female, *Tamiascurus hudsonicus*, 6-25-93 K.Pt.1; 6 females, 1 male, *Tamiascurus hudsonicus*, 7-3-93 K.Pt.1; 2 females, 1 male, *Tamias striatus*, 7-5-93 1Q; 6 females, 2 males, *Tamiascurus hudsonicus*, 7-7-93 K.Pt.1; 2 females, 3 males, *Tamiascurus hudsonicus*, 7-11-93 15U.

*Orchopeas caedens* (Jordan): 2 males, *Tamiascurus hudsonicus*, 6-21-93 K.Pt.1; 2 females, 1 male, *Tamiascurus hudsonicus*, 6-23-93 K.Pt.1.

*Orchopeas leucopus* (Baker): 3 females, 3 males, *Peromyscus maniculatus gracilis*, 5-21-93 7A; 1 female, *Peromyscus maniculatus gracilis*, 6-4-93 53E; 1 male, *Peromyscus maniculatus gracilis*, 6-4-93 65J; 6 females, *Peromyscus maniculatus gracilis*, 6-6-93 25H; 1 female, *Peromyscus leucopus*, 6-10-93 9N; 1 female, *Peromyscus leucopus*, 6-24-93 TLab; 2 females, 1 male, *Peromyscus maniculatus gracilis*, 6-26-93 3Q; 1 female, 1 male, *Peromyscus maniculatus gracilis*, 6-26-93 8Q; 5 females, 4 males, *Peromyscus maniculatus gracilis*, 6-26-93 10Q; 3 females, *Peromyscus maniculatus gracilis*, 7-5-93 13R; 1 male, *Peromyscus leucopus*, 7-5-93 17R; 1 female, *Peromyscus leucopus*, 7-5-93 6Q.

*Tamiophila grandis* (Rothschild): 1 female, 2 males, *Tamias striatus*, 6-6-93 69J.



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Sixty-four ticks were collected from eight species of small and medium size mammals, *M. pennanti*, *M. vison*, *M. monax*, *T. hudsonicus*, *P. m. gracilis*, *C. gapperi*, and *E. dorsatum*. Six species of ticks were collected, *D. variabilis*, *I. angustus*, *I. cookei*, *I. marxi*, *I. muris*, and *I. texanus* (Table 2).

As in the 1992 study by Amrol, *D. variabilis* was one of the most abundant species of tick. Twenty-two *D. variabilis* were collected from mammals. Only adults and nymphs were collected. Sixteen *D. variabilis* were collected from a Porcupine that was taken in Land O' Lakes, Wisconsin. A nymph and an adult female were also taken from a stray dog, *C. familiaris* in Land O' Lakes. One adult female was taken from a dog on the field station property. Two adult *D. variabilis* were collected from a Fisher (*M. pennanti*), on May 29. The remaining single *D. variabilis* was a nymph taken from a *P. m. gracilis* in a Hemlock grove on the northeast shore of Tenderfoot Lake. Lawrence (1965) reports *D. variabilis* from a number of hosts in northern Michigan, including *P. maniculatus* and *E. dorsatum*.

The next most abundant tick collected was *I. marxi*. Sixteen *I. marxi* were collected from seven *T. hudsonicus* at Killarney Point. Larvae, nymphs, and adults were collected. As in the 1992 study by Amrol *I. marxi* was the only species of tick found on *T. hudsonicus*. According to Cooley and Kohls (1945), Lawrence (1965), and Wilson and Johnson (1971), *I. marxi* is rarely found on species other than *T. hudsonicus*.

Sixteen nymphal and adult female *I. cookei* were taken from a single *M. monax* captured at the faculty cabin on July 5. The type specimen of *I. cookei* originally collected by Packard was taken from *M. monax* (Cooley and Kohls 1945). *I. cookei* is known to parasitize other medium size mammals in northern Michigan, including, *M. vison*, *M. mephitis*, and *E. dorsatum* (Lawrence 1965).

Six *I. angustus* were collected from two *C. gapperi* and one *P. m. gracilis*. There are numerous records of collections of *I. angustus* from *P. leucopus* and *C. gapperi* as well as other hosts in Michigan.

One *I. muris* was collected from a single *C. gapperi* on May 29 on the southeast side of Plum Lake. In the 1992 study by Amrol, three *I. muris* were collected from *Peromyscus* and *Microtus pennsylvanicus*. According to Amrol these collections were new Gogebic County and upper peninsula records. However, Lawrence (1965) reports *I. muris* from Iron County, Michigan which borders Gogebic County.

One adult female *I. texanus* was collected from a *M. vison* on May 17. According to Cooley and Kohls (1945), the distribution of *I. texanus* is generally western and southern, having been first found by Banks in Texas on a Raccoon. Cooley and Kohls also report it collected from numerous *Mustela* species, but not *M. vison*. Clifford *et al.* (1961) reports *I. texanus* from *M. monax*, *P. lotor*, and *Sylvilagus floridanus* in the eastern United States. Lawrence (1965) makes no reference to *I. texanus* in Michigan. This specimen may significantly extend the known range of *I. texanus*.

One hundred twenty-two fleas were collected from five species of small mammals, *T. striatus*, *T. hudsonicus*, *P. m. gracilis*, *P. leucopus*, and *C. gapperi*.

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Seven species of fleas were collected, *E. wenmanni*, *M. acerbus*, *M. quirini*, *M. vison*, *O. caedens*, *O. leucopus*, and *T. grandis* (Table 3).

As in the 1992 study by Amrol, the most abundant flea found was *M. vison*. Sixty-five *M. vison* were found exclusively on the Red Squirrels captured at Killarney Point. An additional three *M. vison* were found on a single Eastern Chipmunk captured in a Hemlock grove on the northeast shore of Tenderfoot Lake. *M. vison* has been found on a number of hosts including *T. hudsonicus*, *T. striatus*, *Glaucomys volans*, and predators of the genus *Mustela* (Benton 1980). Among these, *T. hudsonicus* is the only species listed as a true host by Benton. Both Wilson and Johnson (1971) and Scharf *et al.* (1990) also report collections of *M. vison* from *T. hudsonicus* in northern Michigan. Scharf *et al.* (1990) also found *M. vison* to reside on *T. striatus*.

Another flea found in association with *T. hudsonicus* was *O. caedens*. Five *O. caedens* were found on two Red Squirrels captured at Killarney Point. Both these Red Squirrels also possessed numerous *M. vison*. In the 1992 study by Amrol a much larger number of *O. caedens* were found on *T. hudsonicus*. Benton and Cerwonka (1960) list *O. caedens* as being a class I flea, that is associated with only one host species, *T. hudsonicus*, and rarely found on predators or ecological associates of *T. hudsonicus*.

The second most abundant species of flea collected in the study was *O. leucopus*. *O. leucopus* were collected exclusively from the *Peromyscus*. Thirty-one were collected from *P. m. gracilis*, and four were collected from *P. leucopus*. Benton (1980) lists *O. leucopus* as one of our most abundant fleas" infesting nearly every species of *Peromyscus*. Literature from studies in northern Michigan confirm Benton's observations. Wilson and Johnson (1971) found *O. leucopus* exclusively on *P. maniculatus* on Isle Royale. Additionally Lawrence (1965) and Scharf and Stewart (1980) list *O. leucopus* as being present on *P. maniculatus* and *C. gapperi*. This could be expected as *C. gapperi* was found to be in close association with *P. m. gracilis* and *P. leucopus* in this study.

No other fleas were found in abundant numbers. A single *E. wenmanni* was found on a *P. m. gracilis* trapped in a deciduous forest near the shore of Tenderfoot Lake on May 27. *E. wenmanni* is listed as having a fall or winter population maximum by Benton (1980). Lawrence (1965), Wilson and Stewart (1971), Benton (1980), and Scharf and Stewart (1980), list *E. wenmanni* as residing on *Peromyscus* species, as well as other species such as, *C. gapperi*, *M. pennsylvanicus*, *Sorex cinereus*, *T. hudsonicus*, and *Mustela erminea*.

Five *M. acerbus* were found on two species of mammals, three *T. striatus* and one *P. m. gracilis*. Benton and Cerwonka (1960) list *M. acerbus* as a class I flea primarily parasitizing *T. striatus* and occasionally, *E. minimus* and other ecological associates. Lawrence (1965), Wilson and Johnson (1971), Scharf and Stewart (1980), and Scharf *et al.* (1990) list no species other than *T. striatus* or *E. minimus* as hosts for *M. acerbus* in northern Michigan.

Five *M. quirini* were found on three *C. gapperi* and one *P. leucopus*. Benton (1980) lists both *C. gapperi* and *M. pennsylvanicus* as true hosts of *M. quirini*. Lawrence (1965) lists a large number of hosts of *M. quirini* in northern

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Michigan. Scharf and Stewart (1980) and Scharf *et al.* (1990) list *P. m. gracilis* and *Zapus hudsonicus* as hosts for *M. quirini*.

Three *T. grandis* were taken from an eastern Chipmunk on June 6 near the shore of Tenderfoot Lake. Benton and Cerwonka (1960) list *T. grandis* as a class I flea, parasitizing *T. striatus* almost exclusively. Benton (1980) says that it is quite certainly a nest flea.

Two additional ectoparasites were collected from an Eastern Chipmunk at Killarney Point on June 19. One Collembola, family Poduridae, and one mite suborder, Orbatida were collected.

No *I. scapularis* were found in the study. Since 1980, only two *I. scapularis* have been found at the study site. There are two possible explanations. The first is that *I. scapularis* is not on the property in significant numbers. The second possibility is that *I. scapularis* is present and, researchers have not been able to find the ticks. The existence of eight to ten cases of Lyme disease each year in neighboring counties seems to indicate that *I. scapularis* is present in some numbers. This may however be misleading. It is possible that those cases are acquired elsewhere and only diagnosed in the region of the study site. Epidemiological studies of the travel habits of those with Lyme disease in the region could determine if this is true.

The fact that one hundred-eighty-five tissue biopsies, collected at the study site, have tested negative for *B. burgdorferi* seems to suggest that the incidence of both *B. burgdorferi* and *I. scapularis*, in association with the mammals trapped, is quite low. If *I. scapularis* and *B. burgdorferi* are present in high numbers, mammals other than those trapped, or birds, may be responsible for the transmission of the disease. More extensive small and medium mammal trapping and mist netting of birds could possibly determine if this is true. Studies of the ectoparasites of White-tailed Deer could determine whether adult *I. scapularis* are present in abundant numbers. This could be determined by capturing and examining deer, or perhaps more easily by examination of deer killed by hunters. Precautions would have to be taken however, to examine deer within a few hours after they are killed, as ectoparasites drop off quite quickly once their host is killed. One thing is certain, however, *B. burgdorferi* and *I. scapularis* do not seem to be as abundant as they are in the eastern United States, where Deer Mice are commonly found infested with dozens of *I. scapularis* infected with *B. burgdorferi*.

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Table 1. Number and Species Composition of Mammals Trapped

Species	Total Captures	Unique Captures			Total
		Female	Male	Unknown	
<i>M. pennanti</i>	1	1	0	0	1
<i>M. vison</i>	1	0	1	0	1
<i>M. mephitis</i>	1	1	0	0	1
<i>M. monax</i>	1	1	0	0	1
<i>E. minimus</i>	11	3	2	2	7
<i>T. striatus</i>	13	3	5	2	10
<i>T. hudsonicus</i>	16	8	6	0	14
<i>P. m. gracilis</i>	27	6	13	1	20
<i>P. leucopus</i>	21	9	4	1	14
<i>C. gapperi</i>	15	4	9	1	14
<i>O. zibethica</i>	2	1	1	0	2
<i>E. dorsatum</i>	1	1	0	0	1

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Table 2. Number of Ticks per Host Species

	<u><i>D. variabilis</i></u>	<u><i>I. angustus</i></u>	<u><i>I. cookei</i></u>	<u><i>I. marxi</i></u>	<u><i>I. muris</i></u>	<u><i>I. texanus</i></u>
<i>M. pennanti</i>	2	0	0	0	0	0
<i>M. vison</i>	0	0	0	0	0	1
<i>M. monax</i>	0	0	18	0	0	0
<i>T. hudsonicus</i>	0	0	0	16	0	0
<i>P. m. gracilis</i>	1	1	0	0	0	0
<i>C. gapperi</i>	0	5	0	0	1	0
<i>E. dorsatum</i>	16	0	0	0	0	0

## ECTOPARASITES OF MICHIGAN'S UPPER PENINSULA

Table 3. Number of Fleas per Host Species

	<u><i>T. striatus</i></u>	<u><i>T. hudsonicus</i></u>	<u><i>P. m. gracilis</i></u>	<u><i>P. leucopus</i></u>	<u><i>C. gapperi</i></u>
<i>E. wenmanni</i>	0	0	1	0	0
<i>M. acerbus</i>	3	0	2	0	0
<i>M. quirini</i>	0	0	1	1	3
<i>M. vison</i>	3	65	0	0	0
<i>O. caedens</i>	0	5	0	0	0
<i>O. leucopus</i>	0	0	31	4	0
<i>T. grandis</i>	3	0	0	0	0

ECTOPARASITES OF MICHIGAN'S UPPER PENINSULA

Table 4. Average Total Length, Tail Length, and Ear Length of Mammals Trapped

Species	Sex	Total Length	Tail Length	Ear Length
<i>M. pennanti</i>	f	no measure	no measure	no measure
<i>M. vison</i>	m	570 mm (n=1)	no measure	no measure
<i>M. mephitis</i>	f	660 mm (n=1)	303 mm (n=1)	29 mm (n=1)
<i>M. monax</i>	f	520 mm (n=1)	124 mm (n=1)	no measure
<i>E. minimus</i>	f	224 mm (n=2)	118 mm (n=2)	16 mm (n=1)
	m	183 mm (n=2)	65 mm (n=1)	18 mm (n=1)
	u	208 mm (n=3)	102 mm (n=3)	17 mm (n=1)
	t	205 mm (n=7)	100 mm (n=6)	17 mm (n=3)
		160-225 mm	65-115 mm	17-18 mm
<i>T. striatus</i>	f	261 mm (n=3)	112 mm (n=3)	18 mm (n=1)
	m	248 mm (n=5)	111 mm (n=5)	19 mm (n=4)
	u	258 mm (n=2)	108 mm (n=2)	17 mm (n=2)
	t	254 mm (n=10)	111 mm (n=10)	18 mm (n=7)
		224-280 mm	105-125 mm	15-20 mm
<i>T. hudsonicus</i>	f	319 mm (n=8)	145 mm (n=8)	21 mm (n=8)
	m	315 mm (n=6)	140 mm (n=6)	21 mm (n=6)
	t	317 mm (n=14)	143 mm (n=14)	21 mm (n=14)
		275-379 mm	130-170 mm	18-25 mm

## ECTOPARASITES OF MICHIGAN'S UPPER PENINSULA

Table 4. Average Total Length, Tail Length, and Ear Length of Mammals Trapped

Species	Sex	Total Length	Tail Length	Ear Length
<i>P. m. gracilis</i>	f	176 mm (n=6)	83 mm (n=6)	21 mm (n=4)
	m	178 mm (n=12)	91 mm (n=12)	20 mm (n=9)
	u	143 mm (n=1)	77 mm (n=1)	19 mm (n=1)
	t	175 mm (n=19)	88 mm (n=19)	20 mm (n=14)
		142-192 mm	50-102 mm	19-22 mm
<i>P. leucopus</i>	f	176 mm (n=9)	91 mm (n=9)	20 mm (n=3)
	m	166 mm (n=4)	83 mm (n=4)	19 mm (n=4)
	u	176 mm (n=1)	86 mm (n=1)	no measure
	t	173 mm (n=14)	88 mm (n=14)	19 mm (n=7)
		155-187 mm	73-109 mm	18-20 mm
<i>C. gapperi</i>	f	127 mm (n=1)	40 mm (n=4)	15 mm (n=3)
	m	126 mm (n=9)	42 mm (n=9)	16 mm (n=6)
	u	127 mm (n=1)	37 mm (n=1)	14 mm (n=1)
	t	173 mm (n=14)	88 mm (n=14)	19 mm (n=7)
<i>O. zibethica</i>	f	587 mm (n=1)	260 mm (n=1)	no measure
	m	555 mm (n=1)	215 mm (n=1)	no measure
<i>E. dorsatum</i>	f	585 mm (n=1)	260 mm (n=1)	no measure



## ECTOPARASITES OF MICHIGAN'S UPPER PENINSULA

### Appendix I. Trap Site Locations

<u>Location</u>	<u>Community Type</u>	<u>Code</u>
Gravel Pit	Rock Pile, Shoreline	A
Generator Bldg.	Disturbed, Deciduous/Meadow	B
Research Lab	Rocky Shoreline	C
Gravel Pit	Low Meadow	D
Vernal Pond 4	Hemlock	E
Bergner Lake	Pine	F
Roach Lake	Hemlock	G
Plum Lake SE	Hemlock	H
Faculty Cabin	Deciduous	I
Research Lab	Rocky Shoreline	J
Killarney Point	Hemlock, Disturbed	K
Residence	Disturbed, Deciduous/Meadow	L
Plum Lake S	Shoreline, Hemlock, Balsam Fir	M
Main Road	Deciduous	N
Plum Lake N	Deciduous	O
Forest Service Bog	Hemlock	P
Tenderfoot Lake	Hemlock, Shoreline	Q
Crampton Lake	Hemlock	R
Brown Lake Road	Deciduous	S
Brown Lake	Deciduous	T
Killarney Point W	Deciduous	U
Cranberry Lake Road	Deciduous	V

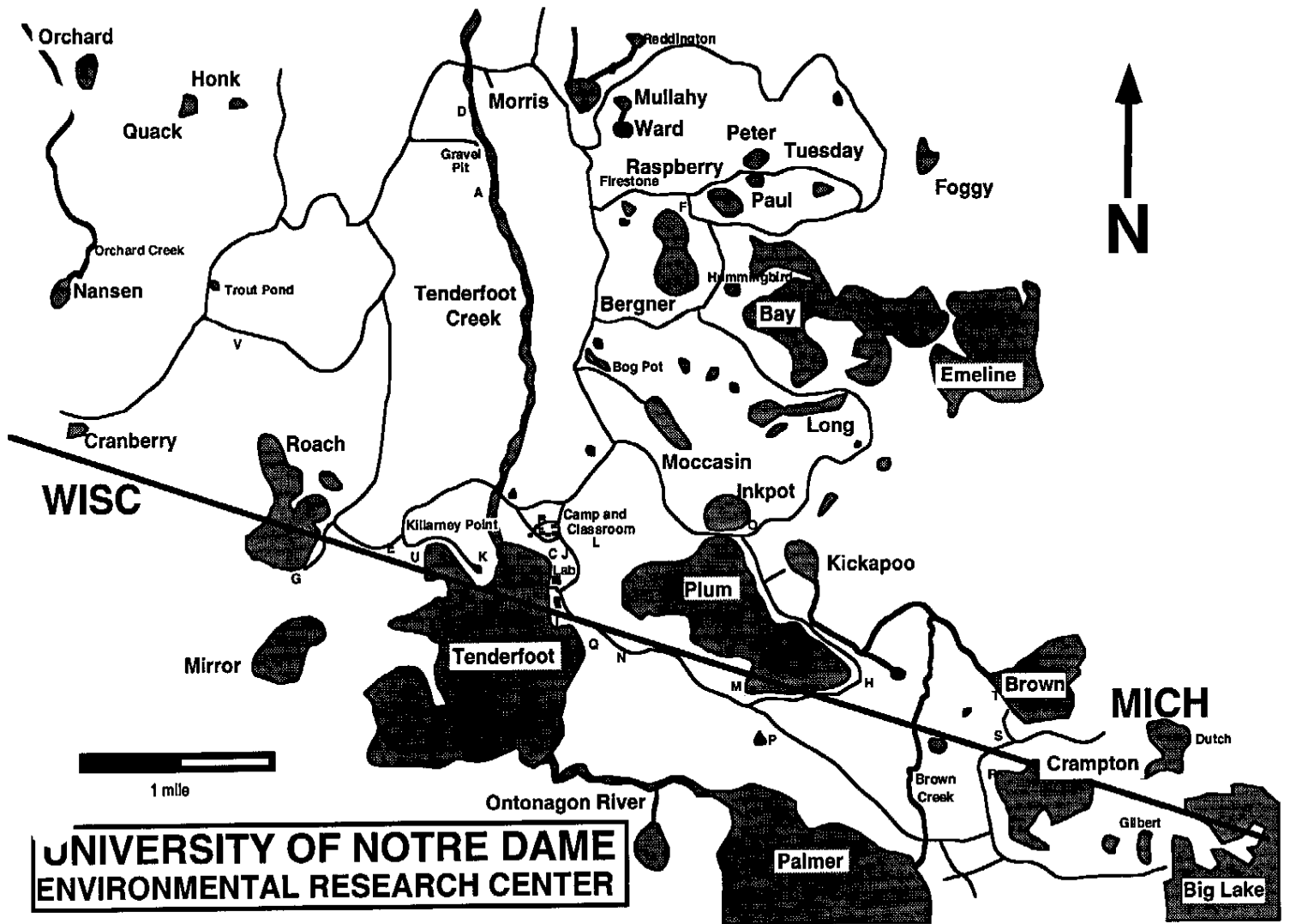


Figure 1. Trap Site Locations

## ECTOPARASITES OF MICHIGAN'S UPPER PENINSULA

### Appendix II. Complete Trapping and Collection Data

<u>Date</u>	<u>Trap No/Site</u>	<u>Species</u>
5-15-93	4A	<i>Peromyscus maniculatus gracilis</i> male, no measurements 2 ear biopsies no ectoparasites
5-16-93	6A	<i>Peromyscus maniculatus gracilis</i> recaptured, not examined
5-17-93	5A	<i>Eutamias minimus</i> male, length=160 mm, tail=short 2 ear biopsies 1 flea collected
5-17-93	GB	<i>Tamias striatus</i> froze to death metal band on ear #636
5-17-93	FC	<i>Mustella vison</i> male, length=570 mm 2 ear biopsies 1 adult female <i>Ixodes texanus</i>
5-21-93	26D	<i>Eutamias minimus</i> length=220 mm, tail=112 mm 2 ear biopsies no ectoparasites
5-21-93	7A	<i>Peromyscus maniculatus gracilis</i> male, length= 177 mm, tail=90 mm 2 ear biopsies 3 female <i>Orchopeas leucopus</i> 3 male <i>Orchopeas leucopus</i>
5-21-93	31A	<i>Eutamias minimus</i> recaptured, not examined
5-21-93	34A	<i>Peromyscus maniculatus gracilis</i> male, length=180 mm, tail=87 mm 2 ear biopsies 2 male <i>Megabothris acerbus</i>

## ECTOPARASITES OF MICHIGAN'S UPPER PENINSULA

### Appendix II. Complete Trapping and Collection Data

<u>Date</u>	<u>Trap No/Site</u>	<u>Species</u>
5-22-93	UNDERC	<i>Canis familiaris</i> 2 adult female <i>Dermacentor variabilis</i>
5-22-93	10D	<i>Eutamias minimus</i> recaptured, not examined
5-22-93	35A	<i>Peromyscus maniculatus gracilis</i> recaptured, not examined
5-22-93	6A	<i>Eutamias minimus</i> recaptured, not examined
5-22-93	5A	<i>Eutamias minimus</i> female, length=223 mm, tail=115 mm 2 ear biopsies no ectoparasites
5-24-93	59E	<i>Clethrionomys gapperi</i> male, length=131 mm, tail=46 mm 2 ear biopsies 1 female <i>Megabothris quirini</i>
5-24-93	57E	<i>Clethrionomys gapperi</i> male, length=124 mm, tail=42 mm 2 ear biopsies no ectoparasites
5-24-93	61E	<i>Peromyscus leucopus</i> female, length=173 mm, tail=92 mm 2 ear biopsies no ectoparasites
5-24-93	60E	<i>Peromyscus leucopus</i> female, length=187 mm, tail=91 mm 2 ear biopsies no ectoparasites
5-24-93	4A	<i>Peromyscus maniculatus gracilis</i> recaptured, not examined

## ECTOPARASITES OF MICHIGAN'S UPPER PENINSULA

### Appendix II. Complete Trapping and Collection Data

<u>Date</u>	<u>Trap No/Site</u>	<u>Species</u>
5-24-93	32A	<i>Peromyscus maniculatus gracilis</i> recaptured, not examined
5-24-93	58E	<i>Peromyscus leucopus</i> escaped
5-24-93	14F	<i>Eutamias minimus</i> female, length=215 mm, tail=110 mm 2 ear biopsies no ectoparasites
5-27-93	1G	<i>Peromyscus maniculatus gracilis</i> male, length=182 mm, tail=88 mm 3 ear biopsies no ectoparasites
5-27-93	24H	<i>Peromyscus leucopus</i> female, length=184 mm, tail=109 mm previously punched 3x in right ear 2 ear biopsies 1 flea found- not captured
5-27-93	28H	<i>Peromyscus leucopus</i> length=176 mm, tail=86 mm previously punched 3x in left ear 2 ear biopsies 1 female <i>Megabothris quirini</i>
5-27-93	35I	<i>Peromyscus maniculatus gracilis</i> female, length=192 mm, tail=93 mm 2 ear biopsies 1 female <i>Megabothris quirini</i> 1 female <i>Epitedia wenmanni</i>
5-29-93	AE	<i>Martes pennanti</i> female, no measurements 2 ear biopsies 1 adult female <i>Dermacentor variabilis</i> 2 adult male <i>Dermacentor variabilis</i>

ECTOPARASITES OF MICHIGAN'S UPPER PENINSULA

Appendix II. Complete Trapping and Collection Data

<u>Date</u>	<u>Trap No/Site</u>	<u>Species</u>
5-29-93	26H	<i>Peromyscus leucopus</i> recaptured, not examined
5-29-93	28H	<i>Clethrionomys gapperi</i> male, length=131 mm, tail=44 mm previously ear punched 2 ear biopsies 1 <i>Ixodes muris</i> larva
5-29-93	66H	<i>Peromyscus</i> not examined
5-29-93	29I	<i>Peromyscus maniculatus gracilis</i> recaptured, not examined
5-29-93	34I	<i>Tamias striatus</i> female, length=244 mm, tail=110 mm 1 ear biopsy no ectoparasites
6-1-93	52E	<i>Peromyscus leucopus</i> recaptured, not examined
6-1-93	54E	<i>Peromyscus leucopus</i> recaptured, not examined
6-1-93	57E	<i>Peromyscus maniculatus gracilis</i> male, length=183 mm, t=100 mm, e=19 mm 2 ear biopsies no ectoparasites
6-4-93	53E	<i>Peromyscus maniculatus gracilis</i> female, length=187 mm, t=95 mm, e=21 mm 2 ear biopsies 1 female <i>Orchopeas leucopus</i>
6-4-93	58E	<i>Peromyscus</i> recaptured, not examined

## ECTOPARASITES OF MICHIGAN'S UPPER PENINSULA

### Appendix II. Complete Trapping and Collection Data

<u>Date</u>	<u>Trap No/Site</u>	<u>Species</u>
6-4-93	65J	<i>Peromyscus maniculatus gracilis</i> male, length=190 mm, t=102 mm, e=19 mm 2 ear biopsies 1 male <i>Orchopeas leucopus</i>
6-5-93	Land O'Lks.	<i>Canis familiaris</i> 1 adult male <i>Dermacentor variabilis</i> 1 <i>Dermacentor variabilis</i> nymph
6-6-93	51E	<i>Peromyscus</i> recaptured, not examined
6-6-93	58E	<i>Peromyscus</i> recaptured, not examined
6-6-93	61E	<i>Peromyscus</i> recaptured, not examined
6-6-93	45K	<i>Tamiascurus hudsonicus</i> male, length=379 mm, t=155 mm, e=19 mm previously ear punched 2 ear biopsies 1 adult female <i>Ixodes marxi</i> 3 male <i>Monopsyllus vison</i>
6-6-93	11F	<i>Eutamias minimus</i> recaptured, not examined
6-6-93	25H	<i>Peromyscus maniculatus gracilis</i> male, length=180 mm, t=99 mm, ear=21 mm previously ear punched 2 ear biopsies 1 unidentified parasite 6 female <i>Orchopeas leucopus</i>
6-6-93	28H	<i>Clethrionomys gapperi</i> male, length=114 mm, t=37 mm, ear=14 mm previously ear punched 2 ear biopsies no ectoparasites

## ECTOPARASITES OF MICHIGAN'S UPPER PENINSULA

### Appendix II. Complete Trapping and Collection Data

<u>Date</u>	<u>Trap No/Site</u>	<u>Species</u>
6-6-93	IH	<i>Ondatra zibethica</i> male, length= 555 mm, tail=215 mm 2 ear biopsies no ectoparasites
6-6-93	31I	<i>Peromyscus maniculatus gracilis</i> recaptured, not examined
6-6-93	69J	<i>Tamias striatus</i> male, length=270 mm, t=115 mm, e=18 mm 2 ear biopsies 1 female <i>Tamiophila grandis</i> 2 male <i>Tamiophila grandis</i>
6-6-93	16L	<i>Tamias striatus</i> male, length=224 mm, tail=110 mm previously ear punched 1 ear biopsy no ectoparasites
6-6-93	17L	<i>Tamias striatus</i> female, length=280 mm, tail=115 mm 2 ear biopsies no ectoparasites
6-8-93	GL	<i>Tamias striatus</i> recaptured, not examined
6-10-93	52M	<i>Clethrionomys gapperi</i> female, length=117 mm, tail=40 mm 2 ear biopsies no ectoparasites
6-10-93	54M	<i>Peromyscus maniculatus gracilis</i> female, length=170 mm, tail=85 mm 2 ear biopsies no ectoparasites



## ECTOPARASITES OF MICHIGAN'S UPPER PENINSULA

### Appendix II. Complete Trapping and Collection Data

<u>Date</u>	<u>Trap No/Site</u>	<u>Species</u>
6-10-93	2N	<i>Peromyscus leucopus</i> female, length=180 mm, tail=88 mm 2 ear biopsies no ectoparasites
6-10-93	9N	<i>Peromyscus leucopus</i> female, length=186 mm, tail=92 mm 2 ear biopsies 1 female <i>Orchopeas leucopus</i>
6-10-93	10N	<i>Peromyscus leucopus</i> female, length=171 mm, tail=90 mm 2 ear biopsies no ectoparasites
6-15-93	7N	<i>Peromyscus leucopus</i> recaptured, not examined
6-15-93	4N	<i>Peromyscus leucopus</i> recaptured, not examined
6-15-93	1N	<i>Peromyscus leucopus</i> recaptured, not examined
6-15-93	54M	<i>Peromyscus maniculatus gracilis</i> recaptured, not examined
6-15-93	K.Pt.	<i>Tamiascurus hudsonicus</i> female, l=340 mm, t=155 mm, e=21 mm 2 ear biopsies 1 <i>Ixodes marxi</i> larva 4 <i>Ixodes marxi</i> nymphs
6-15-93	K.Pt.	<i>Tamiascurus hudsonicus</i> female, l=345 mm, t=160 mm, e=25 mm previously ear punched 2 ear biopsies 1 male <i>Monopsyllus vison</i>

## ECTOPARASITES OF MICHIGAN'S UPPER PENINSULA

### Appendix II. Complete Trapping and Collection Data

<u>Date</u>	<u>Trap No/Site</u>	<u>Species</u>
6-15-93	45	<i>Tamias striatus</i> male, length=265 mm, t=125 mm, e=19 mm 2 ear biopsies 1 female <i>Megabothris acerbus</i>
6-17-93	K.Pt.	<i>Tamias striatus</i> male, length=225 mm, t=105 mm, e=17 mm 2 ear biopsies no ectoparasites
6-17-93	K.Pt.	<i>Tamiascurus hudsonicus</i> male, length=295 mm, t=130 mm, e=19 mm released at Roach Lake 2 ear biopsies 1 adult female <i>Ixodes marxi</i> 2 male <i>Monopsyllus vison</i>
6-17-93	K.Pt.	<i>Tamiascurus hudsonicus</i> female recaptured, not examined
6-18-93	K.Pt.	<i>Tamiascurus hudsonicus</i> male, length=305 mm, t=130 mm, e=22 mm died 2 ear biopsies 1 <i>Ixodes marxi</i> nymph 4 female <i>Monopsyllus vison</i>
6-18-93	K.Pt.	<i>Tamiascurus hudsonicus</i> escaped at teaching lab
6-18-93	50K.Pt.	<i>Eutamias minimus</i> male, length=205 mm, t=65 mm, e=18 mm 2 ear biopsies no ectoparasites
6-18-93	48K.Pt.	<i>Eutamias minimus</i> female, l=225 mm, t=110 mm, e=16 mm 2 ear biopsies no ectoparasites

ECTOPARASITES OF MICHIGAN'S UPPER PENINSULA

Appendix II. Complete Trapping and Collection Data

<u>Date</u>	<u>Trap No/Site</u>	<u>Species</u>
6-19-93	54M	<i>Peromyscus</i> recaptured, not examined
6-19-93	4N	<i>Peromyscus</i> recaptured, not examined
6-19-93	8N	<i>Peromyscus</i> recaptured, not examined
6-19-93	57M	<i>Clethrionomys gapperi</i> male, length=115 mm, t=38 mm, e=19mm previously ear punched 2 ear biopsies 3 adult female <i>Ixodes angustus</i>
6-19-93	K.Pt.1	<i>Tamias striatus</i> length=245 mm, tail=105 mm, ear=15 mm previously ear punched 2 ear biopsies 1 Collembola, family Poduridae 1 Acariformes, suborder Orbatida
6-19-93	K.Pt.	<i>Tamiascurus hudsonicus</i> female, l=330 mm, t=150 mm, e=22 mm previously ear punched 2 ear biopsies no ectoparasites
6-21-93	K.Pt.1	<i>Tamiascurus hudsonicus</i> female, l=305 mm, t=135 mm, e=21 mm 2 ear biopsies 6 female <i>Monopsyllus vison</i> 4 male <i>Monopsyllus vison</i> 2 male <i>Orchopeas caedens</i>
6-22-93	K.Pt.1	<i>Tamiascurus hudsonicus</i> female, l=355 mm, t=170 mm, e=24 mm 1 ear biopsy 1 female <i>Monopsyllus vison</i>

ECTOPARASITES OF MICHIGAN'S UPPER PENINSULA

Appendix II. Complete Trapping and Collection Data

<u>Date</u>	<u>Trap No/Site</u>	<u>Species</u>
6-22-93	K.Pt.	<i>Tamias striatus</i> recaptured, not examined
6-22-93	K.Pt.	<i>Tamias striatus</i> length=270 mm, tail=110 mm, e=19 mm 2 ear biopsies no ectoparasites
6-23-93	K.Pt.1	<i>Tamiascirus hudsonicus</i> female, l=275 mm, t=130 mm, e=20 mm 2 ear biopsies 3 <i>Ixodes marxi</i> larvae 1 <i>Ixodes marxi</i> nymph 10 female <i>Monopsyllus vison</i> 3 male <i>Monopsyllus vison</i> 2 female <i>Orchopeas caedens</i> 1 male <i>Orchopeas caedens</i>
6-23-93	K.Pt.2	<i>Tamiascirus hudsonicus</i> female, l=300 mm, t=130 mm, e=18 mm 2 ear biopsies 2 <i>Ixodes marxi</i> larvae 6 female <i>Monopsyllus vison</i> 4 male <i>Monopsyllus vison</i>
6-24-93	TLab	<i>Peromyscus leucopus</i> male, length=155 mm, t=74 mm, e=18 mm 2 ear biopsies 1 female <i>Orchopeas leucopus</i>
6-25-93	K.Pt.1	<i>Tamiascirus hudsonicus</i> male, length=310 mm, t=150 mm, e=23 mm 2 ear biopsies 1 male <i>Monopsyllus vison</i>
6-26-93	640	<i>Peromyscus maniculatus gracilis</i> male, length=180 mm, t=100 mm, e=20 mm 2 ear biopsies no ectoparasites

ECTOPARASITES OF MICHIGAN'S UPPER PENINSULA

Appendix II. Complete Trapping and Collection Data

<u>Date</u>	<u>Trap No/Site</u>	<u>Species</u>
6-26-93	29H	<i>Clethrionomys gapperi</i> recaptured, not checked
6-26-93	57P	<i>Clethrionomys gapperi</i> male, length=130 mm, t=38 mm, e=17 mm 2 ear biopsies 1 <i>Ixodes angustus</i> larva 1 <i>Ixodes angustus</i> nymph 1 female <i>Megabothris quirini</i>
6-26-93	3Q	<i>Peromyscus maniculatus gracilis</i> female, l=142 mm, t=50 mm, ear=19 mm 2 ear biopsies 1 <i>Dermacentor variabilis</i> nymph 2 female <i>Orchopeas leucopus</i> 1 male <i>Orchopeas leucopus</i>
6-26-93	5Q	<i>Clethrionomys gapperi</i> male, length=124 mm, t=45 mm, e=13 mm 2 ear biopsies 1 flea collected
6-26-93	8Q	<i>Peromyscus maniculatus gracilis</i> male, length=185 mm, t=100 mm, e=21 mm 2 ear biopsies 1 female <i>Orchopeas leucopus</i> 1 male <i>Orchopeas leucopus</i>
6-26-93	9Q	<i>Peromyscus maniculatus gracilis</i> male, length=145 mm, t=75 mm, e=20 mm 2 ear biopsies no ectoparasites
6-26-93	10Q	<i>Peromyscus maniculatus gracilis</i> length=143 mm, tail=77 mm, e=19 mm 2 ear biopsies 5 female <i>Orchopeas leucopus</i> 4 male <i>Orchopeas leucopus</i>

## ECTOPARASITES OF MICHIGAN'S UPPER PENINSULA

### Appendix II. Complete Trapping and Collection Data

<u>Date</u>	<u>Trap No/Site</u>	<u>Species</u>
6-30-93	Mac	<i>Erethizon dorsatum</i> female, length=585 mm, tail=260 mm 6-29-93, Land O'Lakes, WI 1 ear biopsy 10 adult female <i>Dermacentor variabilis</i> 6 adult male <i>Dermacentor variabilis</i>
7-3-93	E	<i>Ondatra zibethica</i> female, length=587 mm, tail=260 mm 1 ear biopsy no ectoparasites
7-3-93	K.Pt.1	<i>Tamiascurus hudsonicus</i> female, l=300 mm, t=130 mm, e=20 mm 3 ear biopsies 6 female <i>Monopsyllus vison</i> 1 male <i>Monopsyllus vison</i>
7-5-93	C	<i>Marmota monax</i> female, length=520 mm, tail=124 mm released at Brown Lake 1 ear biopsy 13 <i>Ixodes cookei</i> nymphs 5 adult female <i>Ixodes cookei</i>
7-5-93	12R	<i>Peromyscus leucopus</i> male, length=176 mm, t=92 mm, e=18 mm previously ear punched 2 ear biopsies no ectoparasites
7-5-93	13R	<i>Peromyscus maniculatus gracilis</i> male, length=180 mm, t=90 mm, e=19 mm 2 ear biopsies 1 <i>Ixodes angustus</i> nymph 3 female <i>Orchopeas leucopus</i>

## ECTOPARASITES OF MICHIGAN'S UPPER PENINSULA

### Appendix II. Complete Trapping and Collection Data

<u>Date</u>	<u>Trap No/Site</u>	<u>Species</u>
7-5-93	17R	<i>Peromyscus leucopus</i> male, length=184 mm, t=87 mm, e=20 mm previously ear punched 2 ear biopsies 1 male <i>Orchopeas leucopus</i>
7-5-93	53P	<i>Peromyscus maniculatus gracilis</i> female, length=180 mm, t=86 mm, e=22 mm previously ear punched 2 ear biopsies no ectoparasites
7-5-93	54P	<i>Clethrionomys gapperi</i> female, l=127 mm, t=40 mm, ear=17 mm previously ear punched 2 ear biopsies no ectoparasites
7-5-93	58P	<i>Clethrionomys gapperi</i> male, length=129 mm, t=45 mm, e=15 mm 2 ear biopsies 1 male <i>Megabothris quirini</i>
7-5-93	7Q	<i>Peromyscus</i> recaptured, not examined
7-5-93	1Q	<i>Tamias striatus</i> female, l=260 mm, t=110 mm, e=18 mm 2 ear biopsies 1 female <i>Megabothris acerbus</i> 2 female <i>Monopsyllus vison</i> 1 male <i>Monopsyllus vison</i>
7-5-93	4Q	<i>Clethrionomys gapperi</i> length=127 mm, tail=37 mm, ear=14 mm 2 ear biopsies no ectoparasites

ECTOPARASITES OF MICHIGAN'S UPPER PENINSULA

Appendix II. Complete Trapping and Collection Data

<u>Date</u>	<u>Trap No/Site</u>	<u>Species</u>
7-5-93	6Q	<i>Peromyscus leucopus</i> male, length=150 mm, t=80 mm, e=20 mm 2 ear biopsies 1 female <i>Orchopeas leucopus</i>
7-5-93	9Q	<i>Peromyscus maniculatus gracilis</i> female, l=182 mm, t=90 mm, ear=21 mm 1 ear biopsy 1 flea collected
7-6-93	13S	<i>Peromyscus maniculatus gracilis</i> male, length=160 mm, t=80 mm, e=19 mm 2 ear biopsies no ectoparasites
7-7-93	K.Pt.1	<i>Tamiascurus hudsonicus</i> male, length=310 mm, t=140 mm, e=22 mm 1 ear biopsy 2 adult female <i>Ixodes marxi</i> 6 female <i>Monopsyllus vison</i> 2 male <i>Monopsyllus vison</i>
7-8-93	13T	<i>Peromyscus</i> recaptured, not examined
7-8-93	16T	<i>Clethrionomys gapperi</i> male, length=137 mm, t=44 mm, e=15 mm 2 ear biopsies no ectoparasites
7-8-93	17T	<i>Peromyscus leucopus</i> female, length=173 mm, t=90 mm, e=19 mm 2 ear biopsies no ectoparasites
7-8-93	20T	<i>Clethrionomys gapperi</i> female, length=129 mm, t=38 mm, e=13 mm 2 ear biopsies no ectoparasites



## ECTOPARASITES OF MICHIGAN'S UPPER PENINSULA

### Appendix II. Complete Trapping and Collection Data

<u>Date</u>	<u>Trap No/Site</u>	<u>Species</u>
7-8-93	22P	<i>Peromyscus leucopus</i> female, length=157 mm, t=73 mm, e=20 mm 2 ear biopsies no ectoparasites
7-8-93	24P	<i>Clethrionomys gapperi</i> female, length=135 mm, t=40 mm, e=15 mm 1 ear biopsy no ectoparasites
7-8-93	4Q	<i>Peromyscus</i> recaptured, not examined
7-10-93	K.Pt.	<i>Eutamias minimus</i> length=190 mm, t=85 mm, ear=17 mm 1 ear biopsy no ectoparasites
7-11-93	T. Ck.	<i>Mephitis mephitis</i> female, l=660 mm, t=303 mm, e=29 mm 1 ear biopsy no ectoparasites
7-11-93	12U	<i>Tamias striatus</i> male, length=255 mm, t=100 mm, e=20 mm 2 ear biopsies 1 female <i>Megabothris acerbus</i>
7-11-93	13U	<i>Peromyscus leucopus</i> female, length=172 mm, t=90 mm, e=20 mm 2 ear biopsies no ectoparasites
7-11-93	15U	<i>Tamiascurus hudsonicus</i> male, length=290 mm, t=135 mm, e=20 mm 2 ear biopsies 2 female <i>Monopsyllus vison</i> 3 male <i>Monopsyllus vison</i>

## ECTOPARASITES OF MICHIGAN'S UPPER PENINSULA

### Appendix II. Complete Trapping and Collection Data

<u>Date</u>	<u>Trap No/Site</u>	<u>Species</u>
7-11-93	V	<i>Peromyscus maniculatus gracilis</i> male, length=190 mm, t=85 mm, e=20 mm 2 ear biopsies no ectoparasites

ECTOPARASITES OF MICHIGAN'S UPPER PENINSULA

Appendix III. Number of Traps in Operation

<u>Date</u>	<u>Sherman Traps</u>	<u>Large Traps</u>	<u>Total</u>
5-15-93	1-20	ABCDEFGHI	29
5-16-93	1-20	ABCDEFGHI	29
5-17-93	1-20	ABCDEFGHI	29
5-18-93			0
5-19-93		ABCDE GHI	8
5-20-93		ABCDE GHI	8
5-21-93	1-56	ABCDE GHI	64
5-22-93	1-56	ABCDE GHI	64
5-23-93		ABCDE GH	7
5-24-93	1-17, 21-42, 57-61	AB DE G	49
5-25-93		ABCDEFGHI	9
5-26-93	1-40	ABCDEFGHI	49
5-27-93		ABCDEFGHI	9
5-28-93		ABCDEFGHI	9
5-29-93	1-40	ABCDEFGHI	49
5-30-93		CDEFGHI	7
5-31-93			0
6-1-93	41-55, 57-61	A CDEFGHI	28
6-2-93		A CDEFGHI	8
6-3-93		A CDEFGHI	8
6-4-93	41-55, 57-71	A CDEFGHI	38
6-5-93		A CDEFGHI	8
6-6-93	1-55, 57-71	A CDEFGHI	78
6-7-93		A CDEFGH	7
6-8-93		A CDEFGH	7
6-9-93		A CDEF H	6
6-10-93	1-20, 41-57-71	A CDEF H	55
6-11-93		A CDEF H	6
6-12-93		A CDEF H	6
6-13-93		A CDEF H	6
6-14-93		A CDEF H	6
6-15-93	1, 3-10, 51-54, 57-61	A CDEF H	24
6-16-93	31-50, 62-71	A CDEF H	36
6-17-93		A CDEF H	6

ECTOPARASITES OF MICHIGAN'S UPPER PENINSULA

Appendix III. Number of Traps in Operation

<u>Date</u>	<u>Sherman Traps</u>	<u>Large Traps</u>	<u>Total</u>
6-18-93		ABCDEF H	7
6-19-93	1, 3-10, 31-40, 51-54, 57-71	ABCDEF H	45
6-20-93		ABCDEF H	7
6-21-93		ABCDEF H	7
6-22-93	10-20	ABCDEF H	18
6-23-93		ABCDEF H	7
6-24-93		ABCDEF H	7
6-25-93		ABCDEF H	7
6-26-93	1, 3-10, 21-24, 27-30, 51-54, 57-71	ABCDEF H	43
6-27-93		ABCDEF H	7
6-28-93		ABCDEFGHI	9
6-29-93		ABCDEFGHI	9
6-30-93		ABCDEFGHI	
7-1-93		ABCDEFGHI	9
7-2-93		ABCDEFGHI	9
7-3-93		ABCDEFGHI	9
7-4-93		ABCDEFGHI	9
7-5-93	1, 3-20, 52-54, 57-58	ABCDEFGHI	33
7-6-93	11-20, 8 traps	ABCDEFGHI	27
7-7-93		ABCDEFGHI	9
7-8-93	1, 3-24, 27-30	ABCDEFGHI	36
7-9-93		ABCDEFGHI	9
7-10-93		ABCDEFGHI	9
7-11-93	1, 3-20, 31-36, 38-40	ABCDEFGHI	37
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	695 trap nights	427 trap nights	1122
Trap 1-71	3" x 3.5" x 9" Sherman Trap		
Trap A, B	10" x 12" x 32" Tomahawk Live Trap		
Trap C-I	7" x 7" x 30" Havahart Live Traps		

## ECTOPARASITES OF MICHIGAN'S UPPER PENINSULA

### Appendix IV. Injection Data for Large Mammals

<u>Date</u>	<u>Species</u>	<u>Dosage</u>	<u>Anaesthesia</u>
5-17-93	<i>Mustella vison</i>	0.12 cc	Ketamine/Xylazine
5-29-93	<i>Martes pennanti</i>	0.15 cc 0.10 cc	Ketamine/Xylazine Ketamine
6-6-93	<i>Ondatra zibethica</i>	0.10 cc 0.10 cc	Ketamine/Xylazine Yohimbine
7-3-93	<i>Ondatra zibethica</i>	not recorded	Ketamine/Xylazine
7-5-93	<i>Marmota monax</i>	not recorded	Ketamine/Xylazine
7-11-93	<i>Mephitis mephitis</i>	0.80 cc	Ketamine/Xylazine

(Ketamine/Xylazine= 10 cc-100mg/cc Ketamine + 1 cc-20mg/cc Xylazine)

## ECTOPARASITES OF MICHIGAN'S UPPER PENINSULA

### ACKNOWLEDGEMENTS

I thank George B. Craig, Jr. for his support in this project. I also thank Ned Walker (Department of Entomology, Michigan State University) for identification of the ticks and spirochaete testing. Thanks also to Robert Beebe, Robert G. McClean (Center for Disease Control, Fort Collins, Colorado), Bob Spence, Kay Stewart, and the staff of the Freimann Life Science Center, for the assistance and advice they provided about anaesthetizing and trapping techniques. Field assistance was provided by members of the 1993 Practicum in Aquatic Biology and the employees of the University of Notre Dame Environmental Research Center. Special thanks to Marty B. Berg. Supplies were purchased with funds from the Clark Professor Chair. Living allowances and tuition were provided by the Bernard J. Hank Family Endowment.

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