Ectoparasites Of Small Mammals At UNDERC

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David Amrol

213 Keenan Hall

University of Notre Dame

Dr. George B. Craig

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ABSTRACT

During the summer of 1992 a survey of small mammal ectoparasites was conducted on the UNDERC property in Gogebic Co., Michigan. One hundred and forty mammals were live captured and combed for ticks and fleas. The survey was focused on obtaining an estimate of Lyme Disease on the property; this disease is a growing health problem in the Upper Peninsula. This survey was achieved by collecting and identifying ticks in search of the vector, *Ixodes dammini*. In addition, ear biopsies were taken which were cultured for the bacterial spirochete.

From the data collected *Ixodes dammini* was not found to be prevalent; only one specimen was found. Only 65 miles away in Menominee Co. Lyme Disease is widespread. In Dr. Walker's survey 40% of the mice ear biopsies and 60% of the chipmunk biopsies were infected. Rodents had an average of 21 *I. dammini* larvae per animal with a range of 0 to 124 specimens per animal. A variety of variables could have led to this low rate of recovery in Gogebic Co.. In addition, valuable information on other ectoparasites was collected. Five species of ticks were found. One of these ticks, *Ixodes muris* is possibly a new county and UP record. Seven species of fleas were also collected. These specimens give us information on both parasite-host interaction and geographic distribution.

INTRODUCTION

The primary focus of this survey is to determine if Lyme Disease is present on the UNDERC property and if so, to what extent. Lyme Disease is a tick-borne zoonosis of humans and some domestic animals. It is caused by the bacteria spirochete *Borrelia burgdorferi* and is carried in the east and midwest by the vector *Ixodes dammini*. The tick has four life stages: egg, larva, nymph, and adult. The tick must take a blood meal from mammals in each of these stages to molt to the next stage and to reproduce. The larva and nymphs usually feed on small mammals such as mice and voles while the adults feed on larger mammals such as deer. The spirochete can be picked up during any feeding and then passed on in the next feeding, so small mammals make up the reservoir for the disease. It is these small mammals that I trapped in order to collect their ectoparasites.

Lyme disease was first diagnosed in the United States in the northeast and has been steadily spreading. Reported cases are increasing each year, and the disease is one of the nation's fastest growing health problems. A survey of the property was conducted in 1980 by Dr. Andrew Spielman of the Harvard School of Public Health and no *Ixodes dammini* were found on one hundred mice caught. In 1986 a Lyme Tick was found on the leg of Dr. William Black, the first *Ixodes dammini* found in the Upper Peninsula. In recent years Vilas County, Wisconsin, in which part of the property is located, reports 8-10 cases of Lyme disease per year. In 1990 an UNDERC Grounds Keeper, Craig Haas, came down with the disease, possibly acquired on the property.

In addition to finding the abundance of *Ixodes dammini* on the property this project aims to provide an account of all the small mammal ectoparasites. Both ticks and fleas were collected and identified. These will be used along with other surveys to create host-parasite comparisons and create a map of ectoparasite distribution in the Upper Peninsula of Michigan and Wisconsin.

MATERIALS AND METHODS

Small mammals were live-trapped using a total of 75 Sherman aluminum traps on a near daily basis from 5-23 to 7-16 in the summer of 1992. Initially single trap lines of about 40 traps spreading over a few hundred meters were set up nightly. After getting poor trapping results with this technique multiple lines of 10 traps were set in four or five different locations starting on the night of 6-22. This enabled the best locations to be found and also gave a wider geographic area trapped. In addition to these lines, separate traps, including two large Hartz Hav-a-Heart traps, were set in Killarney Point during the daytime to capture

red squirrels. The following map shows the location of the trap sites and the dates in which they were in used.

The traps were baited with peanut butter and provided with cotton to provide warmth and comfort for trapped animals. At dusk the traps were set and they were checked early the next morning to avoid undue suffering by the mammals. All animals including squirrels were handled in the same manner. The captured rodents were shaken from the traps into plastic bags which contained a large plastic centrifuge tube containing cotton soaked in Metofane, a veterinary anesthetic. The rodent was guided by hand into the tube and became anesthetized after a few minutes. Then rodent was then placed in a white dissecting dish for inspection.

The animal was inspected for ectoparasites with particular attention to the neck and ears. All visible parasites were removed with fine forceps and the animal was then combed with a fine toothed comb. These ectoparasites were placed in vials containing 70% ethanol. Next, the ears were swabbed inside and out with O-tips dipped in 95% ethanol prior to ear punching. Two biopsies were taken from each ear with a standard skin punch. These punches were placed in vials containing 30%glycerol/PBS buffer solution and placed in a jar of ice. Immediately upon returning to the lab these vials were quick frozen in liquid nitrogen. They were then shipped to Dr. Ned Walker of Michigan State for culturing of Borrelia spirochetes in BSK II media. The ear punches also served as identification of recaptured animals. The animals were returned to the same location in which they were captured and were observed until they fully recovered.

In addition to mammal trapping, dragging was utilized to a small extent. A white piece of flannel was dragged through tall grasses at a slow walk. Ticks attached to the flannel were placed in vials containing 70% ethanol. Only six good drags were made however due to poor weather.

In the lab all the ectoparasites were identified to species. The ticks were identified by Dr. Ned Walker. The fleas were mounted and identified according to Fleas of Eastern United States, by Irving Fox and An Atlas of the Fleas of the Eastern United States, by Allen Benton. Dr. Robert Lewis of Iowa State also helped in the flea identification.

Precautions were taken in the field to minimize the risk of contraction of Lyme Disease. Long light colored pants were worn and tucked into socks. Legs and ankles were then sprayed with a DEET containing repellent. Every night a thorough tick check was conducted before showering.

RESULTS

After 39 nights of trapping a total of 140 small mammals were captured and processed. Of these animals 100 were first time captures and 40 were recaptures. 66 of these animals were deer mice, *Peromyscus maniculatus*, 27 were meadow voles, *Microtus pennsylvanicus*, 15 were least chipmunks, *Eutamias minimus*, 31 were red squirrels, *Tamiasciurus*, and one was a meadow jumping mouse, *Zapus hudsonicus*. From these animals a total of 119 ticks and 219 fleas were collected. A complete list of the ectoparasites found on the UNDERC property is included in table 1.

Five specimens of ticks were collected during the survey. 56 *Dermacentor variabilis*, or the common dog tick, were identified. This species was found in the larval stage and almost entirely on the *Microtus* and *Peromyscus* species. The *Microtus* provided 43 of the 66 collected while the *Peromyscus* contained 12. 59 *Ixodes marxi* were found exclusively on the *Tamiasciurus*. Three *Ixodes muris* were found on the *Microtus* and *peromyscus*. These species may be new county records, and possibly UP records. These ticks will be held in the Michigan State Museum. One *Ixodes angustus* was found on a *Microtus*. Only one Lyme Ticks, *Ixodes dammini*, was found during the two month survey on a *Peromyscus*.

One hundred ear tissue biopsies were cultured by Dr. Ned Walker. All one hundred of these samples tested negative for the spirochete. This same analysis was used by Dr. Walker in his survey of Lyme Disease in Menominee County, Michigan. Only 65 miles from UNDERC 40% of the Peromyscus trapped contained the bacterial spirochete and 60% of the chipmunks contained the spirochete. A typical captured animal would contain 21 *I. dammini* larvae and 1 nymph. The range of *I. dammini* per rodent was 0 to 124 for larvae and 0 to 13 for nymphs.

The sites which were most tick infested are Moccasin Lake and Killarney Point. Moccasin contained most of the *D. variabilis*, 45 of 66 collected. Killarney Point contained all of the *I. marxi* found. This is because this species was host specific to the red squirrels which were only caught here.

Included in figure 1 is a map showing each site and the ticks collected there. On the following tables 2, 3, 4, and 5 are lists of the ticks identified from UNDERC by date, host, location, and parasite. Table 6 summarizes this data.

Fleas of seven different species were found on the mammals collected. The most numerous were *Megabothris vison* and *Orchopeas caeden durus*. 152 *M. vison* and 56 *O. caeden durus* were collected. All but on of these fleas were found on the *Tamiasciurus*. Five *Orchopeas leucopus* were collected from the

Peromyscus and *Microtus*. The *Eutamias* showed the most variation of species. One *Monosopsyllus vison*, one *M. Vison*, three *Megabothris acerbus*, and one *Tamiophila grandis* were found on the *Eutamias* trapped.

The most fleas were collected at Killarney Point, mainly because the *Tamiasciurus* were the only animals which hosted a large number of The *Megabothris* and *Orchopeas*, up to 40 for a single squirrel. The fish dump contained three of the species caught: *O. leucopus, M. vison* and *M. acerbus*. This diversity is due to the large number of *Eutamias* trapped there. Only two *O. leucopus* were found in the West Woods. One each of *T. grandis* and *Mo. vison* were collected at Moccasin.

Another map(figure 2) showing the flea distribution for UNDERC is included as well as tables 7, 8, 9, an 10 containing the fleas collected by date, host location, and parasite. These are once again summarized in table 11.

Discussion

Although much of the data collected is what was expected from the survey, there were some obvious surprises. Six of the species of fleas agree with the present geographic distributions and host specificity. One species *O. caeden caedens* is not abundant in Gogebic Co. Four of the species of ticks are also common in the region except for the new county record, *I. muris*. Some questions that arose during the survey include the lack of *I. dammini* found. Another expected parasite that was not collected is lice. Lice should have been as common as the fleas, but none were found.

The sites in which ticks were found all share a common geography. The sites were all dry, grassy or forested areas. The sites were each near a body of water, either a lake or creek. This water provided a suitable living habitat for the mammals which serve as hosts. Although the sites were next to water, the elevation was slightly raised so the drainage was quick. This provided a dry ground cover for the ticks even with a large amount of rainfall. Other sites were tried including lower wet lands, and areas far from water. Both of these were poor trapping areas. For parasites to thrive, they must live in a environment which is suitable for their host.

The ticks collected all experienced some degree of host specificity. The *Tamiasciurus* were found to only host the *Ixodes marxi*. Almost every squirrel caught had these ticks. These ticks were found on no other small mammal caught. The *Microtus* had by far the largest concentrations of *D. variabilis*. On 27 animals caught 43 of this species of tick were found. 12 *D. variabilis* were found on 66 *Peromyscus*, and one was found on 15 *Eutamias*. Reasons for the high

Microtus infestation could be that *Microtus* feed and bed in the areas most suitable for ticks. Also the *Microtus* might not be as efficient in cleaning ectoparasites from their fur as *Peromyscus* or *Eutamias.* The *I. muris* and *I. angustus* were caught in to few a number to conclude anything about there host interactions.

The lack of *Ixodes dammini* found on the property is the question of most interest. Menominee Co. had large numbers of *I. dammini* and spirochete infection, yet UNDERC had only one *I. dammini* and no infection. Possibly the geography of UNDERC does not suit this species. It was a cold rainy summer which may have decreased the activity of the ticks. The survey we ran could have been conducted in the wrong time of year. Perhaps if we had trapped in fall or spring we would have found the *I. dammini* we were looking for. The sole *I. dammini* was collected on the first day of trapping. So possibly the survey began just as the Lyme Tick finished it's period of activity. Also maybe different species of mammals hosted the ticks, such as larger raccoons, beaver, and skunks. This survey does not rule out the presence of Lyme Disease on the property. If it is not already on the property however, it seems inevitable that it will be there soon.

The fleas collected also exhibited some degree of host specificity. The best example of this is once again found in the *Tamiasciurus*. The red squirrels hosted all the *Orchopeas caeden* species and all but one of the *Megabothris vison*. No other fleas were collected from the squirrels. These fleas were almost always found together, so they probably feed from different parts of the squirrel's body to avoid competition. The *Peromyscus* and *Microtus* were the only animals hosting *O. leucopus*, which is expected. The *Eutamias* hosted four different species, but only two different species were found on the same chipmunk. A *T. grandis* and *Mo. vison* were found on the same host. The *T. grandis* is very unusual to find on a trapped animal because this species lives in the animal's den and seldomly leaves with the animal.

There is not much that can be told from the geographic distribution because so few fleas of species other than *Megabothris* and *Orchopeas* were found. The animals almost certainly host more fleas than were found, because presumably a lot of fleas jumped from the host after spending many hours in a trap. The two best sites were Killarney Point and the Fish Dump. Killarney contained all the squirrels trapped and the Fish Dump contained most of the chipmunks trapped. The fleas seemed to be much more abundant on these larger animals. One surprise was the *Orhopeas caeden caedens* found. This species is often found further east, but is not common in the Upper Peninsula.

In my examination of the mammals I expected to find large numbers of

lice. Human error could be a possible reason for the lack of lice. The animals were carefully inspected and combed however. If they were present, they were not obvious to an examiner. If they were absent it could be due to the geography or cold rainy summer we experienced.

This survey leads the way for further research in upcoming years. Next summer another UNDERC student will continue with the trapping. Besides small mammals he will also start trapping larger mammals such as skunks and raccoons which may host adult ticks and different ectoparasites. With more research we can learn the dispersion pattern of the Lyme tick and other parasites.

Table 1

ECTOPARASITES OF SMALL MAMMALS
GOGEBIC CO., MICH., SUMMER, 1992

David Amrol
Biology Dept., Univ. Notre Dame

KEY: TICKS:
L,N,A= Larva,Nymph,Adult; DV = *Dermacentor variabilis*;
IMX=*Ixodes marxi*; IAN=*Ixodes angustus*; IMU = *Ixodes muris*;
Ident-Dr.Ned Walker, MSU
FLEAS: OL - *Orchopeas leucopus*; OCD = *Orchopeas caeden durus*;
OCC =*Orchopeas caeden caedens*; MPV= *Monosopsyllus vison*; TG = *Tamiophila grandis*; MV = *Megabothris vision*; MA= *Megabothris acerbus*
Ident - David Amrol, UND; Dr. Robert Lewis, ISU

#	HOST	PARASITES	SITE	1992 DATE
3	Peromyscus	6 L - DV	Line 1	5-23
6	Peromyscus	9 mites	Line 2	5-27
16	Peromyscus	2 OL	Line 1	6-9
21	Microtus	beetle	Line 1	6-19
28	Red Squirrel	2 MV	Killarney	6-23
34	"	2 MV	"	6-25
35	"	3 MV	"	6-25
36	"	11 N, IMX 1 Female. IMX	"	6-25
37	"	1 Female. IMX	"	6-25
41	"	4 MV, 4 OCD	"	6-26
42	"	10 MV; 1 OCD	"	6-26
57	"	1 L, 1 N -IMX	"	6-29
56	"	3 OCD; 6 MV 1 Female IMX; 1 N IMX 7 MV; 2 OCD	"	6-29

UNDERC Ectoparasites

55	Peromyscus	1 OL	Fish dump	6-28
53	Red Squirrel	2 Female IMX	Kilarney	6-28
52	"	3 MV; 2 OCD	"	6-28
51	"	2 Female IMX 1 MV; 1 OCD	"	6-28
49	Peromyscus	2 L DV	Moccasin	6-27
50	"	1 N DV	Gravel Pit	6-27
48	Red Squirrel	16 MV, 3 OCD, 1OCC	Killarney	6-27
44	Peromyscus	2 L, 6 N, 1 Fem. IMX 1 L DV	Gravel pit	6-26
83	Microtus	10 L DV	Moccasin	7-3
80	Peromyscus	2 N IMU	Fish Dump	7-3
76	Microtus	1 OL; 1 N IAN	Roach	7-3
71	Chipmunk	1 MA	Fish Dump	6-30
67	Microtus	1 L - DV	Moccasin	6-30
65	Red Squirrel	4 N, 1 Female	Killarney	6-30
64	"	11 MV, 3 OCD 4 Females IMX	"	6-30
62	Chipmunk	1 MA	Fish Dump	6-30
60	Microtus	2 L DV	Moccasin	6-29
58	Red Squirrel	4 MV, 1 OCD	Killarney	6-29
103	Microtus	1 L DV	Moccasin	7-9
102	Microtus	2 L DV	"	7-9
100	Red Squirrel	11 OCD; 34 MV	Killarney	7-92
99	Microtus	Mites	Roach	7-8

UNDERC Ectoparasites

96	Chipmunk	1 MV 1 L DV	Fish Dump	7-8
92	Red Squirrel	1 female IMX 4 OCD, 1 MV	Killarney	7-8
90	"	4 MV	"	7-8
89	Peromyscus	1 L DV	Fish Dump	7-7
88	Microtus	4 L DV	Moccasin	7-3
84	"	17 L DV	"	7-3
129	"	1 Female IMU	Roach	7-14
	Probable new record for UP & County, possibly for MICH.			
126	"	2 L DV	Moccasin	7-14
119	Red Squirrel	2 L IMX 1 tick unidentifiable	Killarney	7-13
117	"	4 N IMX	"	7-13
116	"	12 MV, 4 OCD	"	7-13
115	"	2 MV	"	7-13
114	Microtus	mites	Moccasin	7-12
109	Peromyscus	1 OL	Fish Dump	7-10
107	Microtus	1 N DV	Moccasin	7-10
106	Microtus	3 L DV mites ?	"	7-10
140	Red Squirrel	10 MV, 2 OCD	Killarney	7-19
139	"	15 MV. 12 OCD	"	7-19
137	Microtus	Mites?	Moccasin	7-16
136	Chipmunk	1 MPV, 1TG	"	7-16
135	Red Squirrel	1 Female IMX 4 MV, 3 OCD	Killarney	7-16
133	Chipmunk	1 MA	Fish Dump	7-15

UNDERC Ectoparasites

0	Tick drag	Derm.variabilis	Inkpot	6-8
0	"	2 D.v.	Line 1	6-11
0	"	7 D.v.	Morris	5-28
0	"	4 D.v.	Line 3	6-10
0	"	8 D.v.	Moccasin	6-1

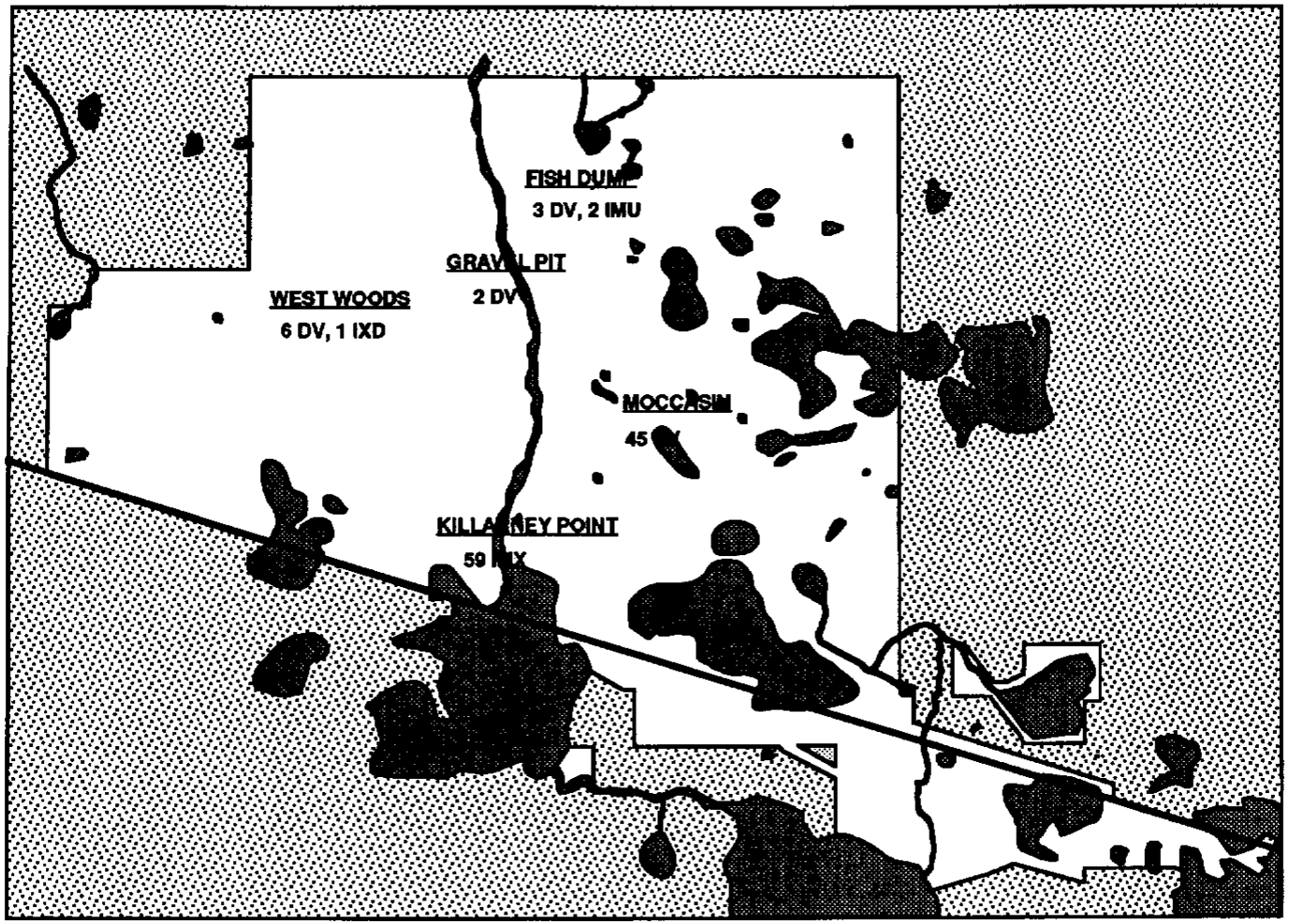

FIGURE 1

TICKS PER SITE AT UNDERC 1992

TABLE 2
TICKS OF SMALL MAMMALS
GOGEBIC CO., MICH., SUMMER, 1992
DAVID AMROL
BIOLOGY DEPT.,UNIV. NOTRE DAME

KEY: DV=Dermacentor variabilis; IMX=Ixodes marxi; IAN=Ixodes angustus
IMU=Ixodes muris; IXD=Ixodes dammini; L,N,A=Larva, Nymph, Adult
Identified by Dr. Ned Walker, MSU

NUMBER	HOST	PARASITE	SITE	DATE'92
1	PEROMYSCUS	IXD:N 1	WEST WOODS	5-23
3	PEROMYSCUS	DV:L 6	WEST WOODS	5-23
27	TAMIASCIURUS	IMX:N 1	KILLARNEY POINT	6-23
29	PEROMYSCUS	DV:N 1	FISH DUMP	6-24
35	TAMIASCIURUS	IMX:N 11	KILLARNEY POINT	6-25
35	TAMIASCIURUS	IMX:N 11	KILLARNEY POINT	6-25
36	TAMIASCIURUS	IMX:A 1	KILLARNEY POINT	6-25
37	TAMIASCIURUS	IMX:A 1	KILLARNEY POINT	6-25
44	PEROMYSCUS	DV:L 1	GRAVEL PIT	6-26
48	TAMIASCIURUS	IMX:L 2,N 6, A 1	KILLARNEY POINT	6-27
49	PEROMYSCUS	DV:L 2	MOCCASIN	6-27
50	PEROMYSCUS	DV:N 1	GRAVEL PIT	6-27
51	TAMIASCIURUS	IMX:A 2	KILLARNEY POINT	6-28
53	TAMIASCIURUS	IMX:A 2	KILLARNEY POINT	6-28
56	TAMIASCIURUS	IMX:A 1,N 1	KILLARNEY POINT	6-29
57	TAMIASCIURUS	IMX:L 1, N1	KILLARNEY POINT	6-29
60	MICROTUS	DV:L 2	MOCCASIN	6-29
64	TAMIASCIURUS	IMX:A 4	KILLARNEY POINT	6-30
65	TAMIASCIURUS	IMX:N 4, A 1	KILLARNEY POINT	6-30
67	MICROTUS	DV:L 1	MOCCASIN	6-30
76	MICROTUS	IAN:N 1	ROACH	7-3
80	PEROMYSCUS	IMU:N 2	FISH DUMP	7-3
83	MICROTUS	DV:L 10	MOCCASIN	7-3
84	MICROTUS	DV:L 17	MOCCASIN	7-3
88	MICROTUS	DV:L 4	MOCCASIN	7-3
89	PEROMYSCUS	DV:L 1	FISH DUMP	7-7
92	TAMIASCIURUS	IMX:A 1	KILLARNEY POINT	7-8
96	EUTAMIAS	DV:L 1	FISH DUMP	7-8
102	MICROTUS	DV:L2	MOCCASIN	7-9
103	MICROTUS	DV:L 1	MOCCASIN	7-9
106	MICROTUS	DV:L 3	MOCCASIN	7-10
107	MICROTUS	DV:N 1	MOCCASIN	7-10
117	TAMIASCIURUS	IMX:N 4	KILLARNEY POINT	7-13
119	TAMIASCIURUS	IMX:L 2	KILLARNEY POINT	7-13
126	MICROTUS	DV:L 2	MOCCASIN	7-14
129	MICROTUS	IMU:A 1	ROACH	7-14
135	TAMIASCIURUS	IMX:A 1	KILLARNEY POINT	7-16

TABLE 3
TICKS OF SMALL MAMMALS BY HOST
GOGEBIC CO., MICH., SUMMER, 1992
DAVID AMROL
BIOLOGY DEPT.,UNIV. NOTRE DAME

KEY: DV=Dermacentor variabilis; IMX=Ixodes marxi; IAN=Ixodes angustus IMU=Ixodes muris; IXD=Ixodes dammini; L,N,A=Larva, Nymph, Adult Identified by Dr. Ned Walker, MSU

NUMBER	HOST	PARASITE	SITE	DATE'92
96	EUTAMIAS	DV:L 1	FISH DUMP	7-8
60	MICROTUS	DV:L 2	MOCCASIN	6-29
102	MICROTUS	DV:L2	MOCCASIN	7-9
106	MICROTUS	DV:L 3	MOCCASIN	7-10
103	MICROTUS	DV:L 1	MOCCASIN	7-9
84	MICROTUS	DV:L 17	MOCCASIN	7-3
88	MICROTUS	DV:L 4	MOCCASIN	7-3
83	MICROTUS	DV:L 10	MOCCASIN	7-3
67	MICROTUS	DV:L 1	MOCCASIN	6-30
76	MICROTUS	IAN:N 1	ROACH	7-3
129	MICROTUS	IMU:A 1	ROACH	7-14
126	MICROTUS	DV:L 2	MOCCASIN	7-14
107	MICROTUS	DV:N 1	MOCCASIN	7-10
80	PEROMYSCUS	IMU:N 2	FISH DUMP	7-3
89	PEROMYSCUS	DV:L 1	FISH DUMP	7-7
29	PEROMYSCUS	DV:N 1	FISH DUMP	6-24
44	PEROMYSCUS	DV:L 1	GRAVEL PIT	6-26
50	PEROMYSCUS	DV:N 1	GRAVEL PIT	6-27
49	PEROMYSCUS	DV:L 2	MOCCASIN	6-27
3	PEROMYSCUS	DV:L 6	WEST WOODS	5-23
1	PEROMYSCUS	IXD:N 1	WEST WOODS	5-23
135	TAMIASCIURUS	IMX:A 1	KILLARNEY POINT	7-16
117	TAMIASCIURUS	IMX:N 4	KILLARNEY POINT	7-13
119	TAMIASCIURUS	IMX:L 2	KILLARNEY POINT	7-13
92	TAMIASCIURUS	IMX:A 1	KILLARNEY POINT	7-8
36	TAMIASCIURUS	IMX:A 1	KILLARNEY POINT	6-25
37	TAMIASCIURUS	IMX:A 1	KILLARNEY POINT	6-25
48	TAMIASCIURUS	IMX:L 2,N 6, A 1	KILLARNEY POINT	6-27
27	TAMIASCIURUS	IMX:N 1	KILLARNEY POINT	6-23
35	TAMIASCIURUS	IMX:N 11	KILLARNEY POINT	6-25
35	TAMIASCIURUS	IMX:N 11	KILLARNEY POINT	6-25
57	TAMIASCIURUS	IMX:L 1, N1	KILLARNEY POINT	6-29
64	TAMIASCIURUS	IMX:A 4	KILLARNEY POINT	6-30
65	TAMIASCIURUS	IMX:N 4, A 1	KILLARNEY POINT	6-30
51	TAMIASCIURUS	IMX:A 2	KILLARNEY POINT	6-28
53	TAMIASCIURUS	IMX:A 2	KILLARNEY POINT	6-28
56	TAMIASCIURUS	IMX:A 1,N 1	KILLARNEY POINT	6-29

TABLE 4
TICKS OF SMALL MAMMALS BY SITE
GOGEBIC CO., MICH., SUMMER, 1992
DAVID AMROL
BIOLOGY DEPT., UNIV. NOTRE DAME

KEY: DV=Dermacentor variabilis; IMX=Ixodes marxi; IAN=Ixodes angustus IMU=Ixodes muris; IXD=Ixodes dammini; L,N,A=Larva, Nymph, Adult Identified by Dr. Ned Walker, MSU

NUMBER	HOST	PARASITE	SITE	DATE'92
96	EUTAMIAS	DV:L 1	FISH DUMP	7-8
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80	PEROMYSCUS	IMU:N 2	FISH DUMP	7-3
29	PEROMYSCUS	DV:N 1	FISH DUMP	6-24
44	PEROMYSCUS	DV:L 1	GRAVEL PIT	6-26
50	PEROMYSCUS	DV:N 1	GRAVEL PIT	6-27
117	TAMIASCIURUS	IMX:N 4	KILLARNEY POINT	7-13
64	TAMIASCIURUS	IMX:A 4	KILLARNEY POINT	6-30
56	TAMIASCIURUS	IMX:A 1,N 1	KILLARNEY POINT	6-29
57	TAMIASCIURUS	IMX:L 1, N1	KILLARNEY POINT	6-29
135	TAMIASCIURUS	IMX:A 1	KILLARNEY POINT	7-16
119	TAMIASCIURUS	IMX:L 2	KILLARNEY POINT	7-13
65	TAMIASCIURUS	IMX:N 4, A 1	KILLARNEY POINT	6-30
92	TAMIASCIURUS	IMX:A 1	KILLARNEY POINT	7-8
36	TAMIASCIURUS	IMX:A 1	KILLARNEY POINT	6-25
37	TAMIASCIURUS	IMX:A 1	KILLARNEY POINT	6-25
35	TAMIASCIURUS	IMX:N 11	KILLARNEY POINT	6-25
27	TAMIASCIURUS	IMX:N 1	KILLARNEY POINT	6-23
35	TAMIASCIURUS	IMX:N 11	KILLARNEY POINT	6-25
51	TAMIASCIURUS	IMX:A 2	KILLARNEY POINT	6-28
53	TAMIASCIURUS	IMX:A 2	KILLARNEY POINT	6-28
48	TAMIASCIURUS	IMX:L 2,N 6, A 1	KILLARNEY POINT	6-27
106	MICROTUS	DV:L 3	MOCCASIN	7-10
103	MICROTUS	DV:L 1	MOCCASIN	7-9
102	MICROTUS	DV:L2	MOCCASIN	7-9
126	MICROTUS	DV:L 2	MOCCASIN	7-14
67	MICROTUS	DV:L 1	MOCCASIN	6-30
107	MICROTUS	DV:N 1	MOCCASIN	7-10
88	MICROTUS	DV:L 4	MOCCASIN	7-3
84	MICROTUS	DV:L 17	MOCCASIN	7-3
83	MICROTUS	DV:L 10	MOCCASIN	7-3
60	MICROTUS	DV:L 2	MOCCASIN	6-29
49	PEROMYSCUS	DV:L 2	MOCCASIN	6-27
76	MICROTUS	IAN:N 1	ROACH	7-3
129	MICROTUS	IMU:A 1	ROACH	7-14
1	PEROMYSCUS	IXD:N 1	WEST WOODS	5-23
3	PEROMYSCUS	DV:L 6	WEST WOODS	5-23

TABLE 5
TICKS OF SMALL MAMMALS BY PARASITE
GOGEBIC CO., MICH., SUMMER, 1992
DAVID AMROL
BIOLOGY DEPT., UNIV. NOTRE DAME

KEY: DV=Dermacentor variabilis; IMX=Ixodes marxi; IAN=Ixodes angustus
IMU=Ixodes muris; IXD=Ixodes dammini; L,N,A=Larva, Nymph, Adult
Identified by Dr. Ned Walker, MSU

NUMBER	HOST	PARASITE	SITE	DATE'92
103	MICROTUS	DV:L 1	MOCCASIN	7-9
44	PEROMYSCUS	DV:L 1	GRAVEL PIT	6-26
67	MICROTUS	DV:L 1	MOCCASIN	6-30
89	PEROMYSCUS	DV:L 1	FISH DUMP	7-7
96	EUTAMIAS	DV:L 1	FISH DUMP	7-8
83	MICROTUS	DV:L 10	MOCCASIN	7-3
84	MICROTUS	DV:L 17	MOCCASIN	7-3
126	MICROTUS	DV:L 2	MOCCASIN	7-14
49	PEROMYSCUS	DV:L 2	MOCCASIN	6-27
60	MICROTUS	DV:L 2	MOCCASIN	6-29
106	MICROTUS	DV:L 3	MOCCASIN	7-10
88	MICROTUS	DV:L 4	MOCCASIN	7-3
3	PEROMYSCUS	DV:L 6	WEST WOODS	5-23
102	MICROTUS	DV:L 2	MOCCASIN	7-9
107	MICROTUS	DV:N 1	MOCCASIN	7-10
29	PEROMYSCUS	DV:N 1	FISH DUMP	6-24
50	PEROMYSCUS	DV:N 1	GRAVEL PIT	6-27
76	MICROTUS	IAN:N 1	ROACH	7-3
129	MICROTUS	IMU:A 1	ROACH	7-14
80	PEROMYSCUS	IMU:N 2	FISH DUMP	7-3
135	TAMIASCIURUS	IMX:A 1	KILLARNEY POINT	7-16
36	TAMIASCIURUS	IMX:A 1	KILLARNEY POINT	6-25
37	TAMIASCIURUS	IMX:A 1	KILLARNEY POINT	6-25
92	TAMIASCIURUS	IMX:A 1	KILLARNEY POINT	7-8
56	TAMIASCIURUS	IMX:A 1,N 1	KILLARNEY POINT	6-29
51	TAMIASCIURUS	IMX:A 2	KILLARNEY POINT	6-28
53	TAMIASCIURUS	IMX:A 2	KILLARNEY POINT	6-28
64	TAMIASCIURUS	IMX:A 4	KILLARNEY POINT	6-30
57	TAMIASCIURUS	IMX:L 1, N1	KILLARNEY POINT	6-29
119	TAMIASCIURUS	IMX:L 2	KILLARNEY POINT	7-13
48	TAMIASCIURUS	IMX:L 2,N 6, A 1	KILLARNEY POINT	6-27
27	TAMIASCIURUS	IMX:N 1	KILLARNEY POINT	6-23
35	TAMIASCIURUS	IMX:N 11	KILLARNEY POINT	6-25
35	TAMIASCIURUS	IMX:N 11	KILLARNEY POINT	6-25
117	TAMIASCIURUS	IMX:N 4	KILLARNEY POINT	7-13
65	TAMIASCIURUS	IMX:N 4, A 1	KILLARNEY POINT	6-30
1	PEROMYSCUS	IXD:N 1	WEST WOODS	5-23

TABLE 6
TICKS OF SMALL MAMMALS PER SITE

	DV	IAN	IMU	IMX	IXD
FISH DUMP	3	0	2	0	0
GRAVEL PIT	2	0	0	0	0
KILLARNEY POINT	0	0	0	59	0
MOCCASIN	45	0	0	0	0
ROACH LAKE	0	1	1	0	0
WESTWOODS	6	0	0	0	1

TICKS PER MAMMAL SPECIES

	DV	IAN	IMU	IMX	IXD
EUTAMIAS	1	0	0	0	0
MICROTUS	43	1	1	0	0
PEROMYSCUS	12	0	2	0	1
TAMIASCIURUS	0	0	0	59	0

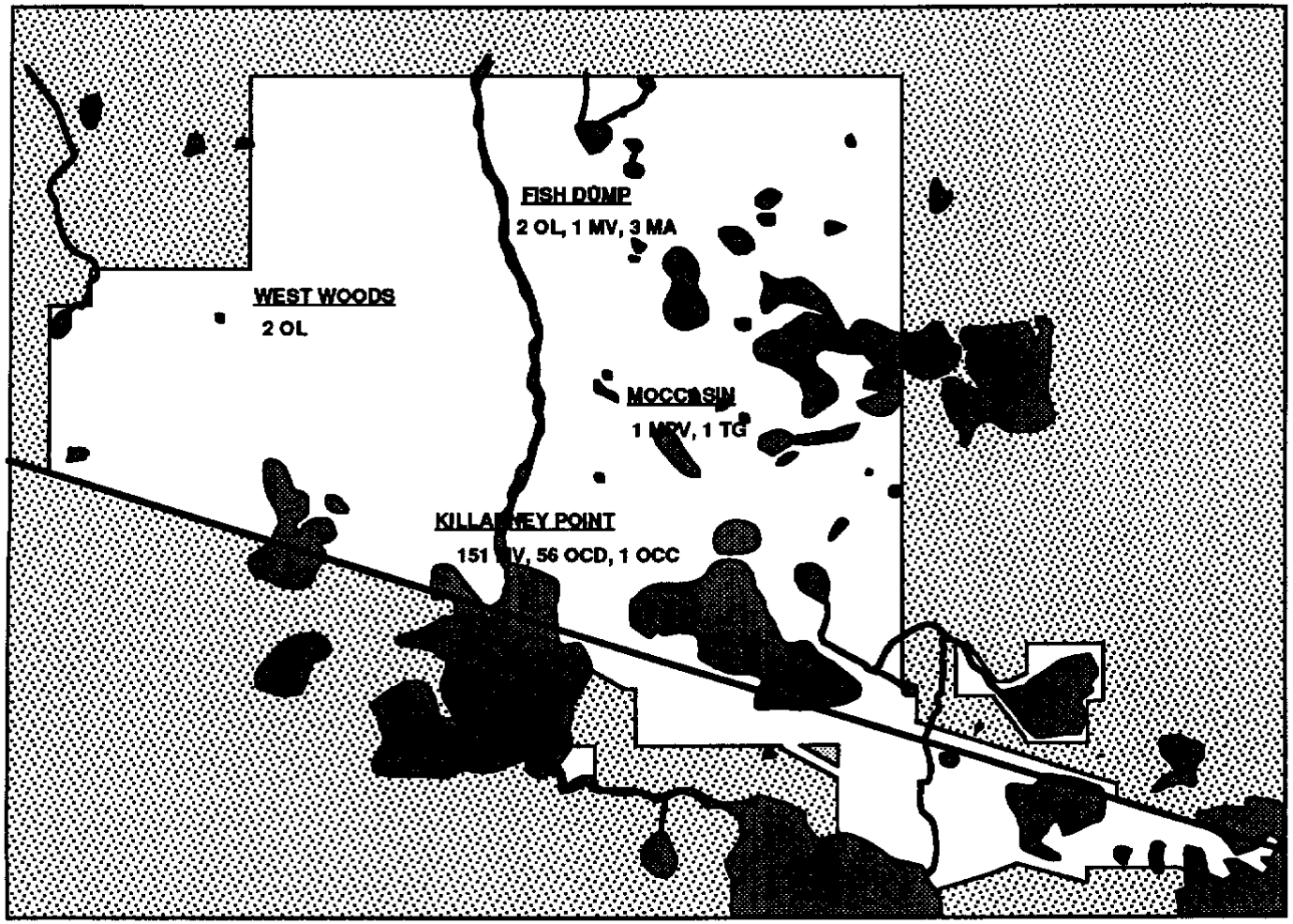

FIGURE 2
FLEAS OF SMALL MAMMALS AT UNDERC 1992

TABLE 7
FLEAS OF SMALL MAMMALS
GOGEBIC CO., MICH., SUMMER, 1992

David Amrol
Biology Dept., Univ. of Notre Dame

KEY: OL- Orchopeas leucopus; OCD- Orchopeas caeden durus
OCC- Orchopeas caeden caedens; MPV- Monosopsyllus vison
TG- Tamiophila grandis; MV- Megabothris vison
MA- Megabothris acerbus
Ident- David Amrol, UND; Dr. Robert Lewis, ISU

NUMBER	HOST	PARASIT	SITE	DATE'92
16	PEROMYSCUS	OL: 2	WEST WOODS	6-9
28	TAMIASCIURUS	MV: 2	KILLARNEY POINT	6-23
34	TAMIASCIURUS	MV: 2	KILLARNEY POINT	6-25
35	TAMIASCIURUS	MV: 3	KILLARNEY POINT	6-25
41	TAMIASCIURUS	OCD: 4	KILLARNEY POINT	6-26
41	TAMIASCIURUS	MV:4	KILLARNEY POINT	6-25
42	TAMIASCIURUS	MV: 10	KILLARNEY POINT	6-26
42	TAMIASCIURUS	OCD: 1	KILLARNEY POINT	6-26
48	TAMIASCIURUS	MV: 16	KILLARNEY POINT	6-27
48	TAMIASCIURUS	OCD: 3	KILLARNEY POINT	6-27
48	TAMIASCIURUS	OCC: 1	KILLARNEY POINT	6-27
51	TAMIASCIURUS	MV:1	KILLARNEY POINT	6-28
51	TAMIASCIURUS	OCD: 1	KILLARNEY POINT	6-28
52	TAMIASCIURUS	OCD: 2	KILLARNEY POINT	6-28
52	TAMIASCIURUS	MV: 3	KILLARNEY POINT	6-28
55	PEROMYSCUS	OL: 1	FISH DUMP	6-28
56	TAMIASCIURUS	OCD: 2	KILLARNEY POINT	6-29

UNDERC Ectoparasites

56	TAMIASCIURUS	MV: 7	KILLARNEY POINT	6-29
57	TAMIASCIURUS	OCD: 3	KILLARNEY POINT	6-29
57	TAMIASCIURUS	MV: 6	KILLARNEY POINT	6-29
58	TAMIASCIURUS	MV: 4	KILLARNEY POINT	6-29
58	TAMIASCIURUS	OCD: 1	KILLARNEY POINT	6-29
62	EUTAMIAS	MA: 1	FISH DUMP	6-29
65	TAMIASCIURUS	OCD: 3	KILLARNEY POINT	6-30
65	TAMIASCIURUS	MV: 11	KILLARNEY POINT	6-30
71	EUTAMIAS	MA: 1	FISH DUMP	6-30
76	MICROTUS	OL: 1	ROACH	7-3
90	TAMIASCIURUS	MV: 4	KILLARNEY POINT	7-8
92	TAMIASCIURUS	OCD: 4	KILLARNEY POINT	7-8
92	TAMIASCIURUS	MV: 1	KILLARNEY POINT	7-8
96	EUTAMIAS	MV: 1	FISH DUMP	7-8
100	TAMIASCIURUS	OCD: 11	KILLARNEY POINT	7-9
100	TAMIASCIURUS	MV: 34	KILLARNEY POINT	7-9
109	PEROMYSCUS	OL: 1	FISH DUMP	7-10
115	TAMIASCIURUS	MV: 2	KILLARNEY POINT	7-13
116	TAMIASCIURUS	MV: 12	KILLARNEY POINT	7-13
116	TAMIASCIURUS	OCD: 4	KILLARNEY POINT	7-13
133	EUTAMIAS	MA: 1	FISH DUMP	7-15
135	TAMIASCIURUS	OCD: 3	KILLARNEY POINT	7-16
135	TAMIASCIURUS	MV:4	KILLARNEY POINT	7-16
136	EUTAMIAS	MPV: 1	MOCCASIN	7-16
136	EUTAMIAS	TG: 1	MOCCASIN	7-16
139	TAMIASCIURUS	MV: 15	KILLARNEY POINT	7-19
139	TAMIASCIURUS	OCD: 12	KILLARNEY POINT	7-19
140	TAMIASCIURUS	MV: 10	KILLARNEY POINT	7-19
140	TAMIASCIURUS	OCD: 2	KILLARNEY POINT	7-19

TABLE 8
FLEAS OF SMALL MAMMALS BY SITE
GOGEBIC CO., MICH., SUMMER, 1992
David Amrol
Biology Dept., Univ. of Notre Dame

KEY: OL- Orchopeas leucopus; OCD- Orchopeas caeden durus
OCC- Orchopeas caeden caedens; MPV- Monosopsyllus vison
TG- Tamiophila grandis; MV- Megabothris vison
MA- Megabothris acerbus
Ident- David Amrol, UND; Dr. Robert Lewis, ISU

NUMBER	HOST	PARASIT	SITE	DATE'92
109	PEROMYSCUS	OL: 1	FISH DUMP	7-10
96	EUTAMIAS	MV: 1	FISH DUMP	7-8
55	PEROMYSCUS	OL: 1	FISH DUMP	6-28
71	EUTAMIAS	MA: 1	FISH DUMP	6-30
133	EUTAMIAS	MA: 1	FISH DUMP	7-15
62	EUTAMIAS	MA: 1	FISH DUMP	6-29
100	TAMIASCIURUS	OCD: 11	KILLARNEY POINT	7-9
42	TAMIASCIURUS	OCD: 1	KILLARNEY POINT	6-26
52	TAMIASCIURUS	OCD: 2	KILLARNEY POINT	6-28
139	TAMIASCIURUS	OCD: 12	KILLARNEY POINT	7-19
48	TAMIASCIURUS	OCC: 1	KILLARNEY POINT	6-27
135	TAMIASCIURUS	MV:4	KILLARNEY POINT	7-16
51	TAMIASCIURUS	OCD: 1	KILLARNEY POINT	6-28
58	TAMIASCIURUS	OCD: 1	KILLARNEY POINT	6-29
140	TAMIASCIURUS	OCD: 2	KILLARNEY POINT	7-19
116	TAMIASCIURUS	OCD: 4	KILLARNEY POINT	7-13
57	TAMIASCIURUS	OCD: 3	KILLARNEY POINT	6-29
92	TAMIASCIURUS	OCD: 4	KILLARNEY POINT	7-8

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41	TAMIASCIURUS	OCD: 4	KILLARNEY POINT	6-26
135	TAMIASCIURUS	OCD: 3	KILLARNEY POINT	7-16
56	TAMIASCIURUS	OCD: 2	KILLARNEY POINT	6-29
65	TAMIASCIURUS	OCD: 3	KILLARNEY POINT	6-30
48	TAMIASCIURUS	OCD: 3	KILLARNEY POINT	6-27
41	TAMIASCIURUS	MV:4	KILLARNEY POINT	6-25
48	TAMIASCIURUS	MV: 16	KILLARNEY POINT	6-27
139	TAMIASCIURUS	MV: 15	KILLARNEY POINT	7-19
28	TAMIASCIURUS	MV: 2	KILLARNEY POINT	6-23
115	TAMIASCIURUS	MV: 2	KILLARNEY POINT	7-13
116	TAMIASCIURUS	MV: 12	KILLARNEY POINT	7-13
42	TAMIASCIURUS	MV: 10	KILLARNEY POINT	6-26
92	TAMIASCIURUS	MV: 1	KILLARNEY POINT	7-8
65	TAMIASCIURUS	MV: 11	KILLARNEY POINT	6-30
140	TAMIASCIURUS	MV: 10	KILLARNEY POINT	7-19
57	TAMIASCIURUS	MV: 6	KILLARNEY POINT	6-29
58	TAMIASCIURUS	MV: 4	KILLARNEY POINT	6-29
51	TAMIASCIURUS	MV:1	KILLARNEY POINT	6-28
56	TAMIASCIURUS	MV: 7	KILLARNEY POINT	6-29
90	TAMIASCIURUS	MV: 4	KILLARNEY POINT	7-8
35	TAMIASCIURUS	MV: 3	KILLARNEY POINT	6-25
34	TAMIASCIURUS	MV: 2	KILLARNEY POINT	6-25
100	TAMIASCIURUS	MV: 34	KILLARNEY POINT	7-9
52	TAMIASCIURUS	MV: 3	KILLARNEY POINT	6-28
136	EUTAMIAS	TG: 1	MOCCASIN	7-16
136	EUTAMIAS	MPV: 1	MOCCASIN	7-16
76	MICROTUS	OL: 1	ROACH	7-3
16	PEROMYSCUS	OL: 2	WEST WOODS	6-9

TABLE 9
FLEAS OF SMALL MAMMALS BY PARASITE
GOGEBIC CO., MICH., SUMMER, 1992
David Amrol
Biology Dept., Univ. of Notre Dame

KEY: OL- Orchopeas leucopus; OCD- Orchopeas caeden durus
OCC- Orchopeas caeden caedens; MPV- Monosopsyllus vison
TG- Tamiophila grandis; MV- Megabothris vison
MA- Megabothris acerbus
Ident- David Amrol, UND; Dr. Robert Lewis, ISU

NUMBER	HOST	PARASIT	SITE	DATE'92
71	EUTAMIAS	MA: 1	FISH DUMP	6-30
133	EUTAMIAS	MA: 1	FISH DUMP	7-15
62	EUTAMIAS	MA: 1	FISH DUMP	6-29
136	EUTAMIAS	MPV: 1	MOCCASIN	7-16
96	EUTAMIAS	MV: 1	FISH DUMP	7-8
92	TAMIASCIURUS	MV: 1	KILLARNEY POINT	7-8
42	TAMIASCIURUS	MV: 10	KILLARNEY POINT	6-26
140	TAMIASCIURUS	MV: 10	KILLARNEY POINT	7-19
65	TAMIASCIURUS	MV: 11	KILLARNEY POINT	6-30
116	TAMIASCIURUS	MV: 12	KILLARNEY POINT	7-13
139	TAMIASCIURUS	MV: 15	KILLARNEY POINT	7-19
48	TAMIASCIURUS	MV: 16	KILLARNEY POINT	6-27
115	TAMIASCIURUS	MV: 2	KILLARNEY POINT	7-13
28	TAMIASCIURUS	MV: 2	KILLARNEY POINT	6-23
34	TAMIASCIURUS	MV: 2	KILLARNEY POINT	6-25
35	TAMIASCIURUS	MV: 3	KILLARNEY POINT	6-25
52	TAMIASCIURUS	MV: 3	KILLARNEY POINT	6-28
100	TAMIASCIURUS	MV: 34	KILLARNEY POINT	7-9

UNDERC Ectoparasites

90	TAMIASCIURUS	MV: 4	KILLARNEY POINT	7-8
58	TAMIASCIURUS	MV: 4	KILLARNEY POINT	6-29
57	TAMIASCIURUS	MV: 6	KILLARNEY POINT	6-29
56	TAMIASCIURUS	MV: 7	KILLARNEY POINT	6-29
51	TAMIASCIURUS	MV:1	KILLARNEY POINT	6-28
41	TAMIASCIURUS	MV:4	KILLARNEY POINT	6-25
135	TAMIASCIURUS	MV:4	KILLARNEY POINT	7-16
48	TAMIASCIURUS	OCC: 1	KILLARNEY POINT	6-27
58	TAMIASCIURUS	OCD: 1	KILLARNEY POINT	6-29
51	TAMIASCIURUS	OCD: 1	KILLARNEY POINT	6-28
42	TAMIASCIURUS	OCD: 1	KILLARNEY POINT	6-26
100	TAMIASCIURUS	OCD: 11	KILLARNEY POINT	7-9
139	TAMIASCIURUS	OCD: 12	KILLARNEY POINT	7-19
52	TAMIASCIURUS	OCD: 2	KILLARNEY POINT	6-28
140	TAMIASCIURUS	OCD: 2	KILLARNEY POINT	7-19
56	TAMIASCIURUS	OCD: 2	KILLARNEY POINT	6-29
135	TAMIASCIURUS	OCD: 3	KILLARNEY POINT	7-16
48	TAMIASCIURUS	OCD: 3	KILLARNEY POINT	6-27
65	TAMIASCIURUS	OCD: 3	KILLARNEY POINT	6-30
57	TAMIASCIURUS	OCD: 3	KILLARNEY POINT	6-29
116	TAMIASCIURUS	OCD: 4	KILLARNEY POINT	7-13
41	TAMIASCIURUS	OCD: 4	KILLARNEY POINT	6-26
92	TAMIASCIURUS	OCD: 4	KILLARNEY POINT	7-8
55	PEROMYSCUS	OL: 1	FISH DUMP	6-28
109	PEROMYSCUS	OL: 1	FISH DUMP	7-10
76	MICROTUS	OL: 1	ROACH	7-3
16	PEROMYSCUS	OL: 2	WEST WOODS	6-9
136	EUTAMIAS	TG: 1	MOCCASIN	7-16

TABLE 10
FLEAS OF SMALL MAMMALS BY HOST
GOGEBIC CO., MICH., SUMMER, 1992

David Amrol
Biology Dept., Univ. of Notre Dame

KEY: OL- Orchopeas leucopus; OCD- Orchopeas caeden durus
OCC- Orchopeas caeden caedens; MPV- Monosopsyllus vison
TG- Tamiophila grandis; MV- Megabothris vison
MA- Megabothris acerbus
Ident- David Amrol, UND; Dr. Robert Lewis, ISU

NUMBER	HOST	PARASIT	SITE	DATE'92
96	EUTAMIAS	MV: 1	FISH DUMP	7-8
71	EUTAMIAS	MA: 1	FISH DUMP	6-30
62	EUTAMIAS	MA: 1	FISH DUMP	6-29
136	EUTAMIAS	TG: 1	MOCCASIN	7-16
136	EUTAMIAS	MPV: 1	MOCCASIN	7-16
133	EUTAMIAS	MA: 1	FISH DUMP	7-15
76	MICROTUS	OL: 1	ROACH	7-3
109	PEROMYSCUS	OL: 1	FISH DUMP	7-10
16	PEROMYSCUS	OL: 2	WEST WOODS	6-9
55	PEROMYSCUS	OL: 1	FISH DUMP	6-28
100	TAMIASCIURUS	MV: 34	KILLARNEY POINT	7-9
115	TAMIASCIURUS	MV: 2	KILLARNEY POINT	7-13
100	TAMIASCIURUS	OCD: 11	KILLARNEY POINT	7-9
92	TAMIASCIURUS	OCD: 4	KILLARNEY POINT	7-8
90	TAMIASCIURUS	MV: 4	KILLARNEY POINT	7-8
35	TAMIASCIURUS	MV: 3	KILLARNEY POINT	6-25
92	TAMIASCIURUS	MV: 1	KILLARNEY POINT	7-8
116	TAMIASCIURUS	MV: 12	KILLARNEY POINT	7-13

UNDERC Ectoparasites

139	TAMIASCIURUS	OCD: 12	KILLARNEY POINT	7-19
139	TAMIASCIURUS	MV: 15	KILLARNEY POINT	7-19
140	TAMIASCIURUS	OCD: 2	KILLARNEY POINT	7-19
140	TAMIASCIURUS	MV: 10	KILLARNEY POINT	7-19
28	TAMIASCIURUS	MV: 2	KILLARNEY POINT	6-23
34	TAMIASCIURUS	MV: 2	KILLARNEY POINT	6-25
116	TAMIASCIURUS	OCD: 4	KILLARNEY POINT	7-13
135	TAMIASCIURUS	MV:4	KILLARNEY POINT	7-16
135	TAMIASCIURUS	OCD: 3	KILLARNEY POINT	7-16
51	TAMIASCIURUS	OCD: 1	KILLARNEY POINT	6-28
51	TAMIASCIURUS	MV:1	KILLARNEY POINT	6-28
52	TAMIASCIURUS	MV: 3	KILLARNEY POINT	6-28
52	TAMIASCIURUS	OCD: 2	KILLARNEY POINT	6-28
48	TAMIASCIURUS	OCC: 1	KILLARNEY POINT	6-27
42	TAMIASCIURUS	OCD: 1	KILLARNEY POINT	6-26
42	TAMIASCIURUS	MV: 10	KILLARNEY POINT	6-26
48	TAMIASCIURUS	OCD: 3	KILLARNEY POINT	6-27
48	TAMIASCIURUS	MV: 16	KILLARNEY POINT	6-27
56	TAMIASCIURUS	OCD: 2	KILLARNEY POINT	6-29
65	TAMIASCIURUS	OCD: 3	KILLARNEY POINT	6-30
41	TAMIASCIURUS	MV:4	KILLARNEY POINT	6-25
41	TAMIASCIURUS	OCD: 4	KILLARNEY POINT	6-26
65	TAMIASCIURUS	MV: 11	KILLARNEY POINT	6-30
58	TAMIASCIURUS	OCD: 1	KILLARNEY POINT	6-29
57	TAMIASCIURUS	OCD: 3	KILLARNEY POINT	6-29
56	TAMIASCIURUS	MV: 7	KILLARNEY POINT	6-29
58	TAMIASCIURUS	MV: 4	KILLARNEY POINT	6-29
57	TAMIASCIURUS	MV: 6	KILLARNEY POINT	6-29

TABLE 11
FLEAS OF SMALL MAMMALS PER SITE

	OL	OCC	OCD	MPV	MV	MA	TG
FISH DUMP	2	0	0	0	1	3	0
GRAVEL PIT	0	0	0	0	0	0	0
KILLARNEY POINT	0	1	56	0	151	0	0
MOCCASIN	0	0	0	1	0	0	1
ROACH LAKE	1	0	0	0	0	0	0
WESTWOODS	2	0	0	0	0	0	0

TICKS PER MAMMAL SPECIES

	OL	OCC	OCD	MPV	MV	MA	TG
EUTAMIAS	0	0	0	1	1	3	1
MICROTUS	1	0	0	0	0	0	0
PEROMYSCUS	4	0	0	0	0	0	0
TAMIASCIURUS	0	1	56	0	151	0	0

Acknowledgements

I would first like to thank the Hank Family for their endowment which made this course possible. I also thank Dr. Craig, my advisor, for all his help and guidance, Dr. Cynthia Lord for her help with trapping, Dr. Robert Lewis for his help in flea identification, and Dr. Ned Walker for his tick identifications and ear punch analysis. I also appreciate the help and support from the entire 1992 UNDERC class and teaching assistants, especially Dr. Martin Berg, the Assistant Director who had to live with us all summer.

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