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The Arthropod Ectosymbionts of the Fox Squirrel in Coles County, Illinois

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THE ARTHROPOD ECTOSYMBIONTS OF THE FOX SQUIRREL IN COLES COUNTY, ILLINOIS

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IN COLES COUNTY, ILLINOIS

presented by

Jeanine L. Stanis

a candidate for the degree of

Master of Science

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ABSTRACT

The body surface areas of 18 squirrels (Sciurus niger) were calculated by regions, and the numbers and densities of the ectoparasite populations present on each region determined. Four species representing four genera of arthropods were recovered. The louse, Neohaematopinus antennatus was the most abundant organism with Orchopeas howardii, Haemagamasus reidi, and Dermacentor variabilis being also present. The average population density of all parasite species combined was highest on the back and decreased on the belly, tail, legs, and the head respectively. Body regions showing greatest average total population densities were different for males and females. The females were found to have a higher density of ectoparasites on the tail region. The highest ectoparasite density was found on the belly for the males.

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INTRODUCTION

In recent years the importance of the arthropod ectoparasites of sciurid rodents as vectors and reservoirs of disease has become increasingly apparent. Unlike many other animals the squirrel has adapted well to urban life thus bringing itself, and its parasites into close proximity to the human population. Also the squirrel's continuing popularity as a game animal, brings the hunter and dogs into contact with the carcass. This is reason enough to warrant a better understanding of the parasites of the animal and their potential transfer to man and his animals (Parker, 1971).

An investigation into the arthropod ectoparasites of the fox squirrel, Sciurus niger rufiventer, was conducted in Coles County, Illinois from December 29, 1974 to September 15, 1975. The primary purpose of the survey was to identify the ectoparasites and delineate their location to the specific body regions. Ectoparasite density was also determined for each region.

MATERIALS AND METHODS

Eighteen fox squirrels were trapped in Coles County, Illinois, between December 29, 1974 and September 15, 1975. Two trapping areas were used, both within a twelve mile radius of Charleston, Illinois. The squirrels were obtained by live trapping using guillotine type traps. Twenty traps were baited with corn, sunflower seeds and peanuts.

Captured squirrels were transported to the laboratory in the traps and sacrificed by placing the animal in a glass gallon jar containing cotton saturated with ether. Immediately after death the animals were removed from the jar, placed on a white enamel pan and sexed by examination of organs. The jar was inspected for ectoparasites, which were identified, labeled as body region unknown, and stored in vials containing 70% ethanol.

Animals were carefully skinned over a white enamel pan by making a circumferential cut into the anterior and posterior halves at midbody. The anterior portion was reflected over the forelimbs to the digits and over the neck and head to the tip of the nose where it was then cut away from the body. The posterior portion is treated in the same fashion by reflecting the skin toward the rear and pulling the tail out of its skin covering. These two halves were rolled together and placed in a bag, sealed and frozen for later examination. The enamel pan was washed with alcohol and the fluid examined for ectoparasites. The parasites were identified, labeled as body region unknown, and stored in vials containing 70% ethanol.

Frozen skins were thawed and sectioned into five regions: head, back, underparts, legs and tail (Fig. 1). The animals were processed in a uniform manner thus standardizing any errors produced by distortion, stretching or shrinkage of the skins. The head was designated as the area anterior to a circumferential cut 1/2 inch behind the base of the ears. The back constituted the dorsal area and sides down to the point where the buff colored hair on the chest and abdomen began. The underparts consisted of the ventral area covered by buff colored hair excluding that area on the underside of the head and legs. The skin on the legs was cut away from the other skin on a line where the legs joined the body. Skin from appendages was handled collectively as one body region. Tail skin was separated at the line where it joined the body. This host sectioning technique was obtained in part from Parker and Holliman (1972).

Skin surface area was determined by tracing its configuration on a heavy cardboard sheet. The pinnae were removed, measured separately and the area of both ear surfaces calculated. The area of each tracing was measured with a polar planimeter. The measurements for individual pieces for all squirrels were added together according to their respective regions. All regions were added to give the total body surface area for each squirrel.

After sectioning and measuring, the various body regions were placed into separate labeled beakers of a 5% solution of sodium hydroxide. After 18 hours the hair was sufficiently loosened to be removed by scraping. The hair was placed in a petri dish and carefully examined under a dissecting microscope for ectoparasites. The skin was then examined under a dissecting microscope. The maceration fluid remaining in the beakers was examined. Any ectoparasites observed were labeled as to identity and

body region and then stored in vials of 70% ethanol. Those organisms requiring examination under a compound microscope were cleared in lactic acid and mounted in Hoyer's medium on micro-slides. The ectoparasites were identified by a variety of specific taxonomic keys and papers.

LITERATURE REVIEW

The literature on arthropod ectoparasites of squirrels is extensive and widely scattered. Therefore this discussion will be divided into the following sections: Order Mallophaga (chewing lice); order Anoplura (sucking lice); order Siphonaptera (fleas); order Acarina (ticks and mites); and order Diptera (flies).

Order Mallophaga

The Mallophaga, or chewing lice, are generally known as parasites of birds. No species were reported on squirrels until Parker (1968) reported Bruelia rotundata on two gray squirrel carcasses in Virginia. None have been found since.

Order Anoplura

Several species of Anoplura, or sucking lice, have been reported as parasitizing gray and fox squirrels. Graham and Uhrich (1943) found Neohaematopinus sciurinus on fox squirrels in Kansas. Harkema (1936) recovered Hoplopleura sciuricola and Neohaematopinus sciurinus from gray squirrels in North Carolina. Parker (1968) noted Neohaematopinus sciuri, Hoplopleura sciuricola and Enderleinellus longiceps from road killed gray squirrels during a gray squirrel emigration in Virginia. Dansby and Shoemaker (1971) found N. sciuri, E. longiceps and H. sciuricola on fox and gray squirrels in West Virginia. Katz (1938) also reported H. sciuricola from the fox squirrel in Ohio. Watson (1959) listed H. sciuricola and

N. sciuri as occurring on gray squirrels in Florida. He also noted that adult lice were more abundant dorsally while immatures were more common in ventral regions. Wilson (1957) reported H. sciuricola, N. sciurinus and E. longiceps from Sciurus niger in Indiana. Morlan (1952), Hopkins (1949) and Moore (1957) listed H. sciuricola, N. sciurinus and Polyplax spinulosa from the fox squirrel. Randolph and Eads (1946) noted H. sciuricola and N. sciurinus as occurring on fox and gray squirrels in Texas. Parker and Holliman (1971) listed three species of lice on gray squirrels in Virginia: N. sciuri, which was found to be present in greatest density on the back of the host; E. longiceps, which occurred in greatest density on the head; and H. sciuricola, which occurred in greatest density on legs and back.

Order Siphonaptera

Among the Siphonaptera Graham and Uhrich (1943) reported Orchopeas wickhami from the fox squirrel in Kansas as did Brown and Yeager (1945) in Illinois and Harkema (1936) in North Carolina. Bell and Chalgren (1943) and Freeman (1941) reported Orchopeas wickhami from gray squirrels. Olexik, Perry and Wilhelm (1969) recorded O. wickhami from gray and fox squirrels in Tennessee. In 1958, Dasgupta and Meedeniya reported O. wickhami from gray squirrels in England. The authors went on to note that O. wickhami acted as host to the endoparasite Hepatozoon sciuri. Katz (1938) listed Ceratophyllus fasciatus as occurring on fox squirrels in Ohio. In 1947, Hubbard showed Orchopeas wickhami to be synonomous with O. howardii, with the latter name taking presidence. Parker (1968) listed O. howardii from gray squirrels in Virginia as did Wilson (1943) in West Virginia. Morlan (1952) reported O. howardii, Ctenocephalides felis, and

Xenopsylla cheopis from gray and fox squirrels in Georgia. Allen (1942) listed O. wickhami and Conorhinopsylla stanfordi as parasitizing Sciurus niger in Michigan. Moore (1957) and Hopkins (1949) also listed O. wickhami as a parasite of gray and fox squirrels. Watson (1959) in a study of gray squirrels in Florida listed O. howardii and noted that this ectoparasite ranged over the entire body but was more numerous between the shoulders where the hind feet and teeth could not reach. Benton and Cerwonka (1960) stated, in their study of host relationships of Siphonaptera of eastern North America, that the study of host relationships in fleas is complicated because of the fleas mobility. Despite this complication the authors found O. howardii howardii to be closely affiliated with the gray squirrel. Barkalow and Shorten (1973) also stated that O. howardii is the gray squirrels "particular flea."

Order Acarina

At least eight species of ticks are listed in the literature as being parasitic on gray and fox squirrels. Harkema (1936) reported Ixodes hexagonus in North Carolina. Graham and Uhrich (1943) found Dermacentor variabilis on squirrels in Kansas. In 1945, Bishopp and Trembly listed Amblyomma americanum, Amblyomma cajennense, Amblyomma maculatum and Cermacentor variabilis as occurring on the gray and fox squirrel. Clark (1958) found Ixodes marxi and D. variabilis on the gray squirrel. Wilson (1957) reported D. variabilis from fox squirrels in Indiana as did Morlan (1952) in Georgia. Randolph and Eads (1946) listed A. americanum and Ixodes scapularis as occurring on gray and fox squirrels in Texas. Moore (1957), in a study of fox squirrels in Florida, reported A. americanum, A. maculatum, A. tuberculatum and D. variabilis as parasitizing this host. Wilson (1961)

found that A. americanum and D. variabilis may be vectors of disease in man and domestic animals. Cooley (1944) stated that A. americanum is a transmitter of Rocky Mountain spotted fever rickettsia and may be a potential transmitter of tularemia. Ixodes marxi (McLean, 1963) has also been incriminated in the transfer of Powasson virus.

Graham and Uhrich (1943) reported the mites Atricholaelaps glasgowi and Trombicula sp. from fox squirrels in Kansas. These species were also noted by Harkema (1936) and Bell and Chalgren (1943). In 1938, Katz reported Sarcoptes scabei and Trombiculid mites from fox and gray squirrels in Ohio. The author found that squirrels harboring sarcoptid mites were more prone to disease than those not infested with the mite. Allen (1942) reported Sarcoptes scabei and Euhaemogamasus oregonensis from fox squirrels in Michigan. He suggested that squirrels infested with Sarcoptes sp., and which were in the hairless condition of mange, were rendered more susceptible to predation because of lowered vitality. Strandtmann (1949) listed Haemolaelaps glasgowi and H. megaventralis from gray and fox squirrels. Randolph and Eads (1946) reported Atricholaelaps sigmodoni in Texas and Moore (1957) listed A. megaventralis and Listrophorus sp. from fox squirrels in Florida. In 1958 Clark reported Haemolaelaps ambulans and Ornithonyssus bacoti from gray squirrels. Parker (1968) noted Haemogamasus sp., H. ambulans, Echinolaelaps sp. and Androlaelaps casalis on gray squirrels in Virginia. In 1969, Redington reported Haemogamasus reidi on gray squirrels in Maryland. Redington also noted that the mites occurred only at the tips of the tails on the squirrels examined. Parker and Holliman (1971) listed Androlaelaps glasgowi, Rostrozetes sp. and trombiculids as parasitizing gray squirrels in Virginia. It was suggested by the authors that the trombiculids may have been responsible for the red spots on the

skin of the belly and underparts of the hosts. In 1974, Whitaker and Wilson compiled a distribution list of parasitic and phoretic mites occurring on the hair of wild mammals. The following mites were listed as occurring on Sciurus niger: Androlaelaps casalis, Androlaelaps fahrenholzi, Eulaelaps stabularis, and Haemogamasus reidi. Mites occurring on Sciurus carolinensis were Cheyletus eruditus, Androlaelaps casalis, Androlaelaps fahrenholzi, Haemogamasus ambulans, Haemogamasus reidi, Laelaps nuttalli, and Ornithonyssus bacoti.

Order Diptera

The botfly or warblefly larva, Cuterebra sp., was reported by Katz (1938) from fox and gray squirrels in Ohio, by Parker (1968) on gray squirrels in Virginia and by Atkeson and Givens (1951) in Alabama. It has been suggested (Seton, 1920) that the Cuterebra may emasculate its host, but there has been no conclusive evidence found to substantiate this theory.

RESULTS

Average skin surface areas for the 18 squirrels studied are given in Table 1 according to body region and sex. The largest region was the back, 38%, followed in decreasing order by the legs, 25%; belly, 18%; head, 11%; and tail, 9%.

All of the squirrels examined harbored ectoparasites, though no severe pathological conditions were observed. The total number on the 18 squirrels was 366 parasites with an average of 18.2. Parasite numbers varied from host to host. Totals ranged from 2 to 49 on individual squirrels. Ten males yielded a total of 229 ectoparasites (average 20.4), and the eight females yielded a total of 137 ectoparasites (average 15.5).

The distribution of the combined species of ectoparasites on the body of the host was determined from total counts on each body region. The data show that 48.9% or 179 ectoparasites were on the back, 21.1% (77) on the belly, 2.7% (10) on the head, 6.8% (25) on the legs, and 5.0% (18) were on the tail. Fifty-seven ectoparasites (15.5%) were of uncertain location.

Population densities, determined by dividing the number of ectoparasites on each body region into the calculated area for each region, are shown in Table 2. The greatest average population density on the 18 squirrels occurred on the back. Decreasing average densities occurred on the belly, tail, legs, and head, respectively.

Body regions showing greatest average population densities were different for males and females. The average densities of the males

conformed with the above overall average population densities. The females, however, differed in that the second most dense region was the tail, followed in decreasing average density by the legs, head, and belly.

The back, belly, leg, and tail regions all were found to have a greater average density of ectoparasites for the males than for the females. The calculations for the head region showed no such difference. When body regions of all squirrels were compared, the back had a significantly greater average density than any other region with the belly ranking second in this respect.

Four species of ectoparasites (Table 3) were identified from 18 squirrels: Neohaematopinus antennatus; Orchopeas howardii; Haemogamasus reidi; and Dermacentor variabilis. The louse Neohaematopinus antennatus was the most numerous of the four species. The greatest average population density for this species occurred on the back and belly, with decreasing average densities on the legs, head, and tail (Table 4). Juvenile specimens of N. antennatus constituted the major portion of parasites collected on all regions. Adult lice were more prevalent on the back region than on any other.

The flea, Orchopeas howardii, was found on 13 of the 18 squirrels examined. The greatest average population density occurred on the back region with decreasing densities on the belly, tail, legs and head.

Haemogamasus reidi parasitized 11 of the 18 squirrels examined. Though 51 mites were recovered from the squirrels, no one area harbored a significantly greater average density.

Dermacentor variabilis was present on only two of the 18 squirrels. Of the five ticks recovered, four were found on the ears of the host animals.

Other incidental organisms not considered to be parasites were observed in the pelage of the squirrels. Immature spiders of the family Lycosidae, lepidopteran larvae, sap beetles of the family Nitidulidae and an ash-gray leaf bug of the family Piesmatidae were found. Three of the four ectoparasites found are illustrated in Figure 2.

Table 1. Average skin surface area of the various body regions of 10 male and 8 female fox squirrels.

Body Region	Males		Females		Total	
	Surface (cm^2)	%	Surface (cm^2)	%	Surface (cm^2)	%
Back	221.2	39.6	198.0	37.0	209.6	38.0
Belly	102.1	18.3	95.0	18.0	98.6	18.0
Head	60.4	10.8	58.5	11.0	59.5	11.0
Legs	126.9	22.7	129.3	24.0	128.1	24.0
Tail	48.5	8.6	50.7	10.0	49.6	9.0
Entire Body	559.1	100.0	531.5	100.0	545.4	100.0

Table 2. Ectoparasite densities on the various body regions of 10 male and 8 female fox squirrels.

Sex and Body Region	Ectoparasites Recovered: Total Avg. No.	Standard Deviation	Range	Avg./cm^2
Males				
Back	10.30	3.89	0-49	0.46
Belly	4.30	2.40	0-18	0.42
Head	0.40	0.63	0-04	0.06
Legs	0.70	0.76	0-03	0.05
Tail	0.40	0.61	0-02	0.08
Unknown location	4.30			
Total	20.40			1.08
Females				
Back	8.13	2.90	0-22	0.32
Belly	1.00	1.19	0-04	0.08
Head	0.75	1.13	0-04	0.10
Legs	2.25	1.71	0-06	0.14
Tail	1.63	1.25	0-04	0.26
Unknown location	1.75			
Total	15.51			0.90
Males and Females				
Back	9.33	3.35	0-49	0.80
Belly	2.83	1.93	0-18	0.51
Head	0.56	0.98	0-04	0.16
Legs	1.39	1.35	0-06	0.20
Tail	0.94	1.11	0-04	0.34
Unknown location	3.17			
Total	18.22			2.01

Table 3. Arthropod ectoparasites recovered from 18 fox squirrels in Coles County, Illinois.

Species	Squirrels Infested		Parasites Recovered	
	No.	%	No.	%
Anoplura				
Neohaematopinus antennatus	13	72.2	264	72.1
Siphonaptera				
Orchopeas howardii	13	72.2	46	12.6
Acari				
Haemogamasus reidi	11	61.1	51	13.9
Dermacenter variabilis	2	11.1	5	1.4
Total			366	100.0

Table 4. Densities of four ectoparasite species found on 18 fox squirrels in Coles County, Illinois.

Host Body Region	*Neohaematopinus antennatus*		*Orchopeas howardii*		*Haemogamasus reidi*		*Dermacentor variabilis*	
	Total Number	Avg./cm^2	Total Number	Avg./cm^2	Total Number	Avg./cm^2	Total Number	Avg./cm^2
Back	149	.040	29	.007	--	--	1	.0003
Belly	70	.040	4	.002	3	.002	--	--
Head	6	.006	--	--	--	--	4	.0040
Legs	15	.007	3	.001	7	.003	--	--
Tail	5	.006	2	.002	11	.010	--	--
Unknown	19	--	8	--	30	--	--	--
Entire Body	264	.080	46	.012	51	.015	5	.0043

DISCUSSION

Neohaematopinus antennatus was the most abundant parasite, comprising 72.1% of all the specimens recovered. The density determinations for this species were highest on the back and belly regions, with decreasing densities on the legs, head, and tail. The high incidence of juvenile lice on the belly as opposed to the back may be attributed to their small size as compared to the adults. While grooming, a squirrel is more likely to dislodge a more easily grasped larger louse than a small one. Thus the larger adults may seek a region, such as the back, that is less accessible to the squirrels teeth and claws. Watson (1959) noted numerous louse eggs on the backs of the squirrels he was studying. So many, in fact, that the back seemed to have a silver tinge. Since this region of the animal is less easily groomed it may also be advantageous for adult lice to get to this area for reproductive purposes.

Parker and Holliman (1971) reported red spots on the skin of the belly and underparts of the hosts. They suggested it may have been caused by trombiculids. These red spots were also noted in this study but here they were caused by clusters of lice burrowing into the skin and raising small red welts on the afflicted area.

The density determinations for Orchopeas howardii were highest on the back region, with decreasing densities on the belly, legs, tail, and head. Other studies (Parker, 1971, and Parker and Holliman, 1971) have indicated that O. howardii occurred most frequently on the tail. This parasite is one which readily abandons its host after death. In

both of the above studies squirrels were obtained by hunting with a gun thus causing the animal to fall to the ground and dislodge ectoparasites. The high incidence of fleas reported on the tail may have stemmed from the fact that they were trapped in the long, dense hair of the tail. In this study there was a minimum of disturbance thus resulting in a more accurate regional census.

The density study for Haemogamasus reidi showed a slightly greater density of mites occurring on the tail region, with decreasing densities on the legs and belly. No mites were found on the back or head regions. Redington, 1969, and Parker and Holliman, 1971, also reported that H. reidi demonstrated a definite preference for the tail region. However, the data for this study were not considered conclusive as no single region had a significantly higher population. Also the mites exhibited a marked tendency for becoming separated from the host during handling manipulations, in which more than half of the total collected could not with certainty, be assigned to a body region. The above studies done by Redington, and Parker and Holliman were conducted on gray squirrels and in a different climatic environment. These conditions may possibly be factors in determining the preferred areas of the mite.

Dermacentor variabilis was found on only 11.1% of the hosts. The density study yielded decreasing densities from head to tail. Most of the ticks were recovered from the lightly haired region of the pinnae where the tick could more easily attach itself. These results could not be considered conclusive since only one host harbored the majority of ticks recovered.

Male and female hosts differed as to degree of average ectoparasite population density for the different body regions. On the males

the density was highest on the back with decreasing densities on the belly, tail, legs, and head respectively. The females, however, varied from this in that the second most dense region was the tail rather than the belly. This difference may be attributed to the fact that the females suckle the young on the belly region thus making it less desirable for the parasites to remain in this area of high disturbance. The tail of the female may have gathered more ectoparasites because of its large contact area with the leaf nest or box and the young squirrels.

In searching the literature, it was noted that other researchers found a higher incidence of ectoparasites per host than was recovered in this study. I believe that this low yield of parasites may be attributed to the fact that collecting was done in periods of low parasite productivity (January through September). Parker (1971) noted definite correlations between abundance of parasites and seasonal conditions. Harkema (1936) reported that the population of Orchopeas howardii and Neohaematopinus scirui reach their peak in late fall and early winter. Watson (1959) substantiated these data with peaks noted for O. howardii and N. sciuri occurring in November and December. Sharp drops in abundance occurred in January and February.

The rise and fall in ectoparasite abundance can be linked to weather conditions. It is known that flea development is inhibited by temperatures of above 90 degrees Fahrenheit and by heavy, driving rains. Strickland (1914) also reported that the pupal stage of fleas may last for long periods in cold weather and that the imago may completely form in the pupal case but will remain there until the weather becomes favorable. This same variation in abundance due to weather occurs in lice (Katz, 1938). Other factors such as molting of host pelage may also be factors in determining ectoparasite abundance.

Though all squirrels were infested by ectoparasites, no severe pathological conditions were apparent. Several authors (Katz, 1938; Brown and Yeager, 1945; Chapman, 1938; and Allen, 1942) reported scabies mange in fox and gray squirrels. These infestations can rapidly eliminate the host from the population as they may reduce the hosts resistance to disease and inclement weather conditions.

Cuterebra or botfly larvae have been reported by Katz, 1938; Atkeson and Givens, 1951; and Parker, 1968. Their pathology is still unclear, but their large size would most certainly make them an undesirable irritant. Neither botfly larvae nor scabies was observed in this study. The absence of botfly larvae was probably due to the collecting period as the larvae occur during early fall and my collecting ended at this time.

Incidental organisms, not considered to be parasites, found in the pelage of the squirrels were probably inadvertently caught in the fur of the host as their activities brought them in contact with one another.

APPENDIX

Species Accounts

Neohaematopinus antennatus (Osborn)

Morphology

Neohaematopinus antennatus was placed in the genus *Neohaematopinus* on the basis of the following morphological characteristics (Kellogg and Ferris, 1915). Antennae five-segmented, set very close to the anterior margin of the head. Basal segment with distal post-axial angle less produced and bearing a stout spine. The head is broad, narrower than the thorax. Anterior pair of legs small, with slender claw; middle and posterior pairs subequal, larger than the first pair, and with stout claws.

Abdomen without distinctly sclerotized tergal and sternal plates, although in some specimens these are present as narrow bands immediately in front of transverse rows of hairs. Usually with the second to seventh tergites and second to sixth sternites with two rows of spines, the remainder with one. Pleural plates present on the first to seventh segments.

Distribution

This parasite is found in North America, Europe, Asia and Central America.

Host List

N. antennatus is restricted to the genus *Sciurus*.

Orchopeas howardii (Baker)

Morphology

This species was placed in the genus *Orchopeas* on the basis of the following morphological characteristics. The pronotal ctenidium consists of nine or ten spines on a side and the fifth tarsal segment of each leg is armed with four pairs of lateral plantar bristles plus a basal and an apical submedian pair. The moveable finger of the male genitalia is ham-shaped and much narrower basally than distally where it is armed with a row of four to seven heavily pigmented spiniforms. The head of the receptaculum seminis of the female is barrel-shaped. Males have two stout antepygidial bristles and one minute bristle on a side; females have three stout antepygidial bristles, the middle one the longest on each side (Fox, 1940).

Distribution

This flea ranges from Florida to Canada in the eastern United States.

Host List

The host list for *O. howardii* is quite long and consists of mammals from the orders Rodentia, Carnivora, Marsupialia, Insectivora, Lagomorpha, and Primata.

Haemogamasus reidi (Redington)

Morphology

The mite, *Haemogamasus reidi*, was identified on the basis of the following characteristics. Fixed digit bidentate, the teeth followed by a ridge. Dorsal seta long, stout, slightly curved upwards extending

to base of the pilus dentilis. Dorsal and lateral lyriform fissure distinct. Four pairs of barbed gnathosomal setae. Deutosternum with eleven transverse rows of denticles, two to five per row. Pedipalp with trochantal setae barbed. Dorsal shield wide, and densely covered with setae. Surface of shield sculptured anteriorly.

Tritosternum with base barbed. Presternal area with many small spines. Sternal shield with three pairs of setae; no accessory setae; three pairs of lyriform pores. A pair of genital setae situated anteriorly and accessory setae distributed on the posterior two thirds of the shield. Anal shield pear-shaped with three anal setae; no accessory setae.

Distribution

This mite ranges through North America, Europe and the Orient.

Host List

In North America H. reidi has been reported from the genera Tamiasciurus, Sciurus, Glaucomys, Neotoma, Microtis, Clethrionomys, and Thomomys.

Dermacentor variabilis (Say)

Morphology

Dermacentor variabilis was identified according to the following characteristics. Anal groove curved about the anus. Body ornately patterned. Second segment of palpi not projecting laterally beyond base capituli. Eyes present. Basis capituli not hexagonal dorsally. Male without adanal and accessory shields. Palpi short, second segment not twice as long as wide. Basis capituli rectangular dorsally. Spiracular plate with broad dorsal prolongation; goblets very small and numerous.

Distribution

The American dog tick is the most widely distributed species in the United States. It has been recorded from 39 states in the eastern United States.

Host List

The host list for this species is numerous and includes mammals from the orders Carnivora, Lagomorpha, Marsupilia, and Rodentia. Some birds have also been found to harbor this parasite (Lancaster, 1972).

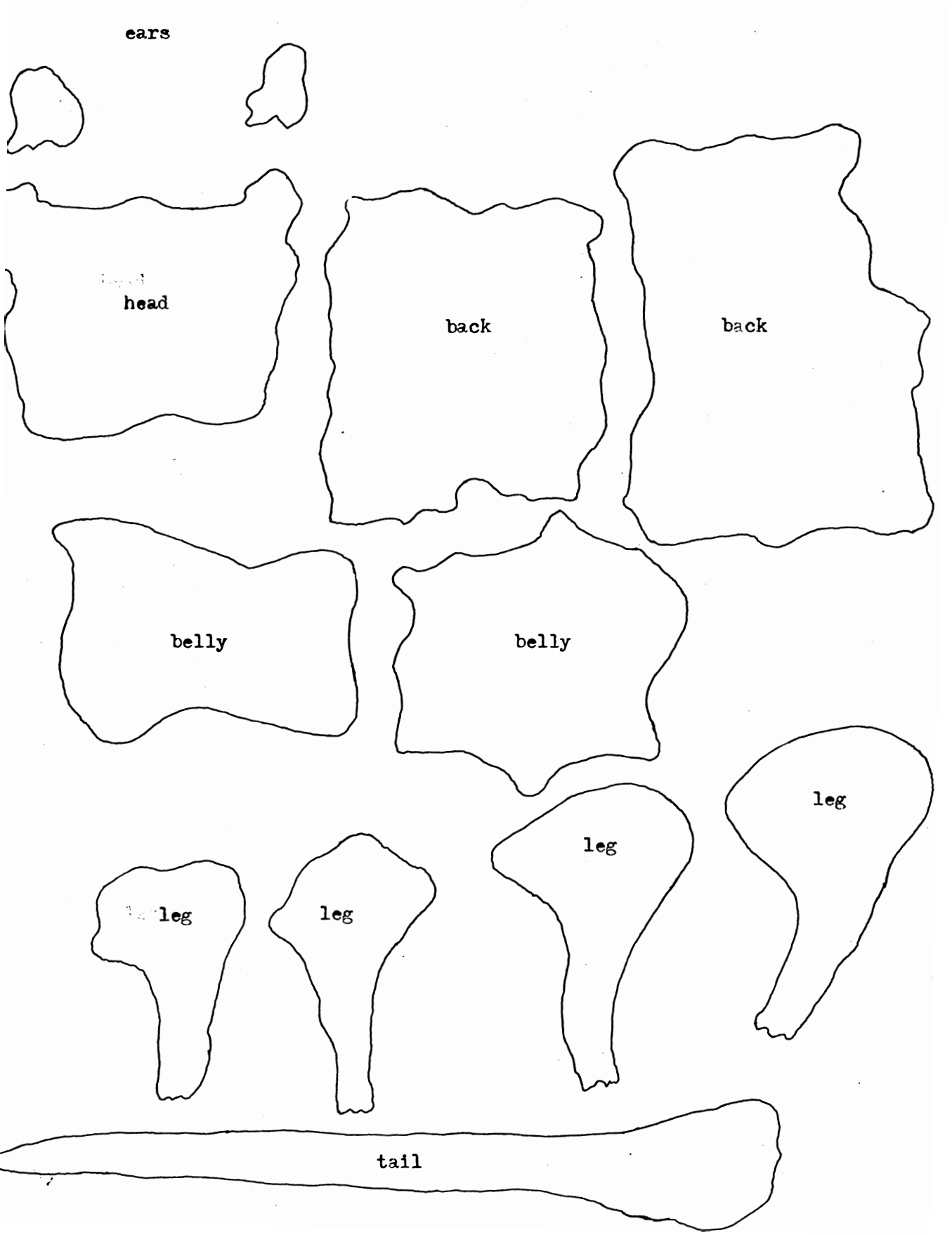
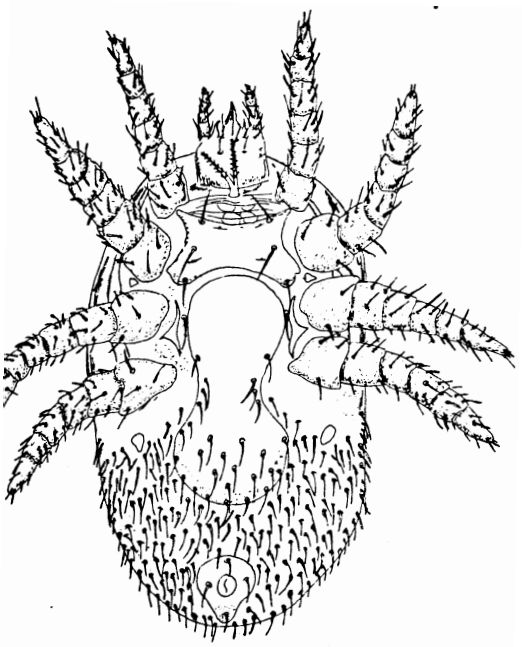
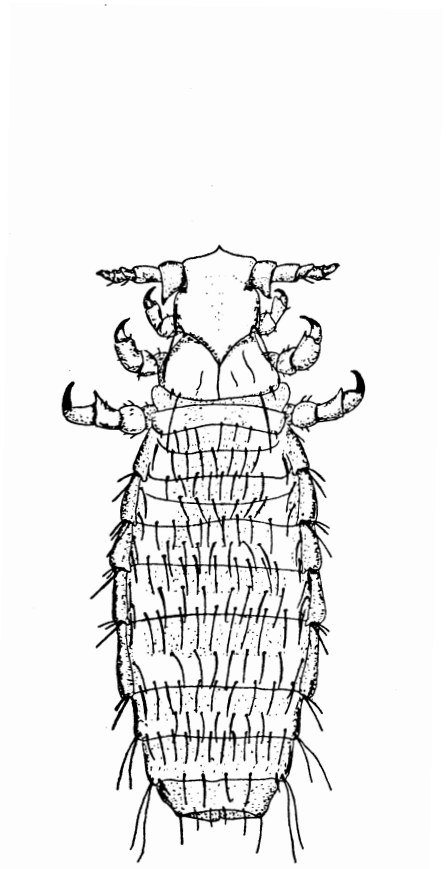


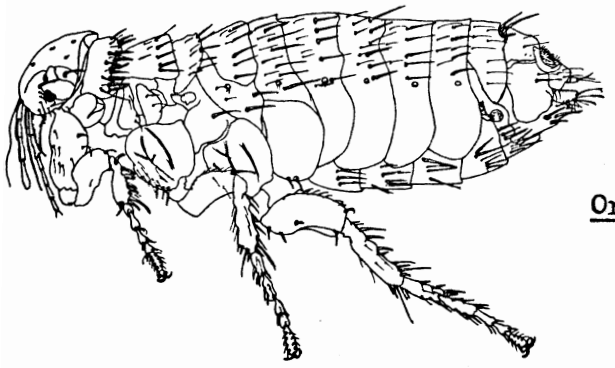
Fig. 1. Tracings of the various skin surface regions of fox squirrels.



Haemogamasus reidi



Neohaematopinus antennatus



Orchopeas howardii

Fig. 2. Three ectoparasite species found on fox squirrels in Coles County, Illinois.

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