



The Parasites of Some North Carolina Rodents

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Source: *Ecological Monographs*, Vol. 6, No. 2 (Apr., 1936), pp. 151-232

Published by: [Ecological Society of America](#)

Stable URL: <http://www.jstor.org/stable/1943242>

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ECOLOGICAL MONOGRAPHS

Vol. 6

APRIL, 1936

No. 2

THE PARASITES OF SOME NORTH CAROLINA RODENTS

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THE PARASITES OF SOME NORTH CAROLINA RODENTS

INTRODUCTION

The parasites of rodents are of unusual interest. Probably because rodents are of small size and can be captured with comparative ease students of parasites have often examined them. Not only do many rodents carry infectious diseases but the damage they do to crops and forests results in losses of thousands of dollars annually. Rodents furnish very satisfactory material for the study of experimental parasitic infestations.

Fluctuations in the number of wild animals are of importance both in pure and applied ecology. These often result from epidemic diseases caused by animal parasites, bacteria, or fungi. Animal parasites usually are not fatal but may lessen the vitality so that infectious diseases are more serious.

PREVIOUS WORK

Wenyon (1926) has made a careful study of all protozoan parasites. Levine and Becker (1933) made a host and check list of the species of *EIMERIA* and this includes many rodent parasites.

Hall (1916) monographed the known nematodes from the orders Rodentia, Lagomorpha, and Hydracoidea. He described 34 species from North American rodents including 11 new species. Yorke and Maplestone (1926) included in their work on the "Nematode Parasites of Vertebrates" a list of all the known species of parasitic nematodes. The various trichostrongylids were treated by Nagaty (1932) who reduced the number of species found in rodents to five.

Several new species of tapeworms were reviewed by Stiles (1895). The cestode family Anoplocephalidae was reviewed thoroughly by Douthitt (1915) and Baer (1927). Meggitt (1924) monographed the cestodes of mammals and included a list of all known cestodes.

Trematodes are represented in very few species of North American rodents. The aquatic types such as the muskrat and the beaver are the only representatives which show an appreciable number of trematode species. These have been described by various authors. Barker (1915) in conjunction with various co-workers, and Price (1931) described the majority of the species from the muskrat.

The systematic classification of external parasites has been done by various specialists. Ferris has studied the Anoplura. The Acarina have been studied by Banks (1915) and Ewing (1922, 1925). The Ixodidae were monographed carefully by Nuttall, Warburton, and their associates (1908, 1911, 1915).

Baker (1904, 1905), Jordan and Rothschild have studied the fleas. Jordan (1933) reduced the numerous American species of *CERATOPHYLLUS* by creating new genera for many of the species. Rocky Mountain spotted fever has stimulated work upon the external parasites of mammals, especially in the Bitter Root Valley, Montana. The fleas of the rodents were studied by Dunn and Parker (1925) and *Dermacentor andersoni* Stiles was surveyed by Cooley (1915, 1932), and Hooker, Bishopp, and Wood (1912).

The pathological and economic significance of special groups of rodents has stimulated parasitological research on such animals. It is inadvisable to discuss the results of such work. However, a cursory summary of the major works is necessary. The helminth parasites of the rat were carefully surveyed by Oldham (1932). The intestinal protozoa of the rat were studied by Hegner (1929) and Kofoid, McNeil and Bonestell (1933). The presence of *Gongylonema neoplasticum* (Fibiger and Ditlevsen 1914) and *Apophallus donicum* (Skrjabin and Lindtrop 1919) in the rats of Washington is of significant interest (Price and Chitwood, 1932). The external parasites of the rat have been studied in various places. Fox and Sullivan (1925) have summarized the subject very well.

The genus *Citellus* has been studied intensively. The protozoans were covered very thoroughly by Becker (1926-1933) and co-authors and Henry (1932). The helminths were studied by MacLeod (1933). The genera *Lepus* and *Sylvilagus* have been studied rather intensively in various localities. A summary of rabbit parasites and diseases was compiled by Schwartz and Shook (1928, 1933). The parasites of the rabbits of Canada were surveyed by Boughton (1932). The study of rabbits in Arizona was undertaken by Vorhies and Taylor (1933) and those of Oklahoma by Ward (1934). Weimer, Hedden and Cowdery (1934) made an investigation upon the helminth parasites of rabbits in West Virginia.

MATERIALS AND METHODS

A total of 287 rodents including 41 cottontail rabbits, 53 gray squirrels, 54 white footed mice, 84 house mice and 55 brown rats were examined for parasites. The rabbits were collected from October, 1933 to August, 1934. The other rodents were examined from May, 1934 to April, 1935. All of the hosts were collected in Durham County and the majority of the forest dwellers from the Duke Forest.

The only animals obtained alive throughout the period of observation were the house mice, which were captured with box traps in various houses and buildings in Durham, North Carolina. The rabbits and squirrels were shot with a 0.12 gauge shotgun. The white-footed mice were captured with the use of snap-traps. They were collected within 9 to 14 hours after the baiting of the traps. Rats were captured alive during the summer months by

means of steel traps but these proved unsatisfactory during the fall and winter months when they were shot with a 0.22 rifle. The rats obtained during the summer months were collected from various meat and grocery establishments in Durham, N. C. Those shot were "dump" rats. When captured the animals were at once placed in tight cloth bags in order to prevent the escape of external parasites.

All of the animals with the exception of some of the squirrels, which were captured by a hired hunter, were removed to the laboratory and examined immediately for external parasites and protozoa. In some cases examination could not be completed immediately and the non-examined organs were placed in a cold room where the temperature remained at about 4° C.

In the laboratory hosts were removed from the cloth bags and combed carefully with a fine-tooth comb for external parasites. Fleas were killed with a chloroformed brush. Lice and mites were killed in hot 70 per cent alcohol. The cloth bag was then examined under a binocular microscope. All external parasites were preserved in 70 per cent alcohol and cleared in turpinol.

The host was skinned and blood and intestinal smears were made and examined for ten minutes each under high and low power objectives. Three fresh blood smears were obtained from the heart and liver. Three smears each were made from the stomach, duodenum, jejunum, ileum, caecum, colon, and rectum. The internal organs, the intercostal and diaphragm muscles were dissected under a binocular microscope and the parasites removed and washed in physiological salt solution. The muscles were also pressed between glass plates as an examination for trichina.

Protozoans were fixed in hot Bouin's fixative and stained in iron-alum haematoxylin. Nematodes were killed in 70 per cent alcohol and preserved in five parts of 70 per cent alcohol to one part of glycerin. Cestodes were allowed to die in tepid water to insure complete relaxation of the proglottids. Cestodes and trematodes were fixed and preserved in Conant's fixative of the following formula:

50 per cent alcohol.....	100.0 c.c.
Glacial acetic acid.....	2.5 c.c.
40 per cent formalin.....	6.5 c.c.

For microscopic examination and identification of the parasites cestodes were stained in Ehrlich's haematoxylin and trematodes in borax-carmin. They were mounted in damar. Nematodes were cleared in glycerin and examined.

The writer wishes to thank Dr. A. S. Pearse for the many helpful suggestions and criticisms given during the course of this work and the preparation of this manuscript. Thanks are also due to Dr. M. C. Hall for the use of the host catalogue of the Bureau of Animal Industry; to Dr. B. G. Chit-

wood, Dr. M. Skinker, Dr. H. E. Ewing and Dr. A. D. Shaftesbury for the identification of the nematodes, cestodes, mites, and lice, and fleas respectively; to Mr. Allen McIntosh for assistance in the preparation of the bibliography of parasites; to Dr. H. F. Prytherch, United States Bureau of Fisheries, Beaufort, North Carolina, for laboratory space, and to Mr. B. C. Shrapnel for assistance in the examination of some of the hosts.

HOSTS EXAMINED

After a preliminary survey of the rodents of North Carolina five were selected to study. These were species which varied in habits, size, and food and could be obtained in sufficient numbers to permit routine examinations throughout a year.

Sciurus carolinensis carolinensis Gmelin

The southern gray squirrel was selected for study as a comparatively large, arboreal mammal. The total length may be 250 cm.

Gray squirrels are active only during the day. They store up nuts, fruits, buds, seeds, and grains for times when food will be difficult to find. They do not hibernate although they may remain in the nest for long periods during inclement winter weather. They are strictly arboreal rodents and are not found away from forests.

The gray squirrel either builds a bulky nest of leaves and twigs in the crotch of a limb or else chooses a hollow in some rotted tree trunk. The young number from four to six and often two litters are raised a year.

Peromyscus leucopus leucopus (Rafinesque)

White-footed mice share with the meadow mice the distinction of being the commonest and most widely distributed of the North American small rodents. *Peromyscus leucopus leucopus* is a small rodent having a maximum length of 18 cm. with the tail less than half the total length. It frequents the cover of fallen logs, piles of rock, and other shelters such as are common in forests and brush lands. Occasionally it builds a nest in low bushes, or uses old nests made by birds. It is terrestrial, strictly nocturnal, and is active throughout the year. The food is almost strictly vegetarian. The number of young in a litter varies from three to seven but is usually four or five. There may be as many as four or five litters a year, hence young may be seen at almost any time.

Mus musculus musculus Linnaeus

This is the only species of the genus *Mus* which has established itself in North America. The maximum total length is 150 to 155 cm. While this mouse is more or less a "house" mouse it lives in open fields in many places. It is omnivorous but it is not as destructive as the rat.

Rattus norvegicus (Erxleben)

The brown, or Norway, rat has a maximum total length of 275 cm. It is perhaps the most thoroughly disliked of rodents. It frequently lives under filthy conditions, carries disease and is such a destructive creature that the hand of man has been set against it from time immemorial. The Norway rat is aggressive and so easily adapts itself to varying conditions that today it has a cosmopolitan distribution. It lives in great numbers in all large cities, on water-fronts, and is also widely spread over less inhabited districts, even frequenting fields and brushy areas where it finds favorable conditions.

Sylvilagus floridanus mallurus (Thomas)

The cottontail rabbit is a typical mammal of medium size and is widely distributed. In forested regions cottontail rabbits frequent only brushy areas among the trees, coming out to feed upon green vegetation in the late afternoon or early morning about the edges of fields or meadows. It is seldom seen in heavy stands of trees where there is no underbrush or an occasional glade. Cottontails are very prolific and in the warmer parts of their range young animals may be found during any month of the year. The production of several broods a year is general among representatives of this genus. The number of young in a litter varies from three to seven, with four as an average.

PARASITES WHICH INFESTED THE HOSTS EXAMINED

In this section the parasites found by the writer in each host are presented separately. The genus and species of the parasites, author and date of description, the average number of parasites per host, the percentage of hosts infested, and the part of the body which the parasite infests are given. Tables 1 to 5 present data by months for the various parasites.

SCIURUS CAROLINENSIS CAROLINENSIS Gmelin

CESTODA

1. Larval stage of *Taenia taeniaeformis* (Batsch 1786): 0.189, 1.89%; liver.

NEMATODA

2. *Longistriata hassalli* (Price 1925): 77.5, 92.45%; duodenum.

ARTHROPODA

ACARINA

3. *Atricholaelaps glasgowi* (Ewing 1925): 0.32, 13.2%; on skin.
4. *Ixodes hexagonus* (Leach 1815): 0.075, 5.66%; on skin.
5. *Trombicula* sp.: 6.35, 50.94%; on skin.

ANOPLURA

6. *Hoplopleura sciuricola* (Ferris 1921) : 3.81, 32.64% ; on skin.
7. *Neohaematopinus sciurinus* (Mjöberg) : 28.75, 50.94% ; on skin.

SIPHONAPTERA

8. *Orchopeas wickhami* (Baker 1895) : 3.66, 50.94% ; on skin.

PEROMYSCUS LEUCOPUS LEUCOPUS (Rafinesque)

PROTOZOA

1. *Giardia microti* (Kofoid and Christiansen 1915) : 100% ; intestine.

TREMATODA

2. *Entosiphonus thompsoni* (Sinitsin 1931) : 0.11, 3.7% ; jejunum.

NEMATODA

3. Larval nematodes : 0.11, 1.85% ; encysted in the wall of the caecum.
4. *Rictularia coloradensis* (Hall 1916) : 0.203, 16.68% ; duodenum and jejunum.
5. *Syphacia peromysci* n. sp. : 4.94, 22.22% ; caecum.

ARTHROPODA

DIPTERA

6. Larva of *Cuterebra fontinella* (Clark) : 0.037, 1.85% ; in skin.

MUS MUSCULUS MUSCULUS Linnaeus

PROTOZOA

1. *Endamoeba muris* (Grassi 1879) : 13.09% ; small intestine.
2. *Trichomonas muris* (Grassi 1879) : 30.95% ; caecum.

CESTODA

3. Larval stage of *Taenia taeniaeformis* (Batsch 1786) : 0.35, 3.57 ; liver.
4. *Hymenolepis diminuta* (Rudolphi 1819) : 0.14, 1.19% ; small intestine.

NEMATODA

5. *Heterakis spumosa* (Schneider 1866) : 0.97, 10.71% ; caecum and rectum.

ARTHROPODA

ACARINA

6. *Echinolaelaps echidninus* (Berlese) : 0.04, 1.19% ; on skin.

SIPHONAPTERA

7. *Xenopsylla cheopis* (Rothschild 1903) : 0.15, 10.51% ; on skin.

RATTUS NORVEGICUS (Erxleben)

PROTOZOA

1. *Chilomastix bettencourti* (Fonseca 1913) : 5.4% ; intestine.
2. *Endamoeba muris* (Grassi 1879) : 1.8% ; small intestine.
3. *Trichomonas muris* (Grassi 1879) : 60% ; caecum.
4. *Trypanosoma lewisi* (Kent 1880) : 1.8% ; blood.

CESTODA

5. Larval stage of *Taenia taeniaeformis* (Batsch 1786) : 0.36, 12.72% ; liver.
6. *Hymenolepis diminuta* (Rudolphi 1819) : 0.29, 7.27% ; jejunum.

NEMATODA

7. Eggs of *Capillaria hepatica* (Bancroft 1893) : 2.6% ; liver.
8. *Heterakis spumosa* (Schneider 1866) : 0.52, 14.54% ; caecum and rectum.
9. *Nippostrongylus muris* (Yokogawa 1920) : 102.76, 78.18% ; duodenum and jejunum.
10. *Trichosomoides crassicauda* (Bellingham 1845) : 1.3, 47.2% ; urinary bladder.

ARTHROPODA

ACARINA

11. *Echinolaelaps echidninus* (Berlese) : 4.14, 27.27% ; on skin.

ANOPLURA

12. *Polyplax spinulosa* (Burmeister 1839) : 1.98, 7.27% ; on skin.

SIPHONAPTERA

13. *Xenopsylla cheopis* (Rothschild 1903) : 0.018, 1.8%.

The following parasites infested seven rats examined at Beaufort, N. C.

CESTODA

1. *Hymenolepis diminuta* (Rudolphi 1819) : 5.57, 71.42% ; jejunum.
2. *Hymenolepis nana* (Siebold 1852) : 3.85, 14.28% ; jejunum.
3. Larval stage of *Taenia taeniaeformis* (Batsch 1786) : 0.14, 14.28% ; liver.

NEMATODA

4. *Heterakis spumosa* (Schneider 1866) : 16.14, 85.71% ; caecum and rectum.
5. *Nippostrongylus muris* (Yokogawa 1920) : 28, 85.71% ; duodenum and jejunum.
6. *Trichosomoides crassicauda* (Bellingham 1845) : 4, 71.42% ; urinary bladder.

ARTHROPODA

ACARINA

7. *Echinolaelaps echidninus* (Berlese) : 3.42, 57.14% ; on skin.

SIPHONAPTERA

8. *Echidnophaga gallinacea* (Westwood 1875) : 1.14, 14.28% ; on skin.
9. *Xenopsylla cheopis* (Rothschild 1903) : 3.42, 57.14% ; on skin.

SYLVILAGUS FLORIDANUS MALLURUS (Thomas)

PROTOZOA

1. *Eimeria stiedae* (Lindemann 1865) : 36.58% ; white cysts in the liver.
2. *Enteromonas intestinalis* (Fonseca 1918) : 75.6% ; caecum.

TREMATODA

3. *Hasstilesia tricolor* (Stiles and Hassall 1894) : 1903.6, 41.46% ; small intestine.

CESTODA

4. Immature *Cittotaenia pectinata* (Goeze 1782) : 7.48, 78.07% ; duodenum and jejunum.
5. Mature *Cittotaenia pectinata* (Goeze 1782) : 1.78, 78.07% ; jejunum.
6. Larval stage of *Taenia pisiformis* (Bloch 1780) : 1.8, 31.7% ; attached to peritoneum or abdominal mesenteries.

NEMATODA

7. *Obeliscoides cuniculi* (Graybill 1923) : 19.63, 70.73% ; attached to the gastric mucosa.
8. *Trichostrongylus affinis* (Graybill 1924) : 48.14, 58.53% ; caecum and colon.
9. *Trichostrongylus calcaratus* (Ransom 1911) : 207.21, 80.48% ; duodenum and jejunum.

ARTHROPODA

ACARINA

10. *Haemaphysalis leporis-palustris* (Packard 1869) : 51.02, 100% ; on skin.
Larvae : 12.9, 36.58%.
Nymphs : 10.6, 48.78%.
Adults : 27.4, 100%.

SIPHONAPTERA

11. *Cediopsylla simplex* (Baker 1895) : 7.7, 78.04% ; on skin.
12. *Odontopsyllus multispinosus* (Baker 1904) : 1.26, 17.97% ; on skin.

DIPTERA

13. Larva of *Cuterebra fontinella* (Clark) : 0.12, 7.07% ; in skin.

SUMMARY OF FINDINGS

PROTOZOA

There is a fundamental difference between protozoan infestations and helminthic infestations in that the protozoan parasites multiply in the body, resulting in a fluctuation in numbers, whereas in helminthic infestations the organisms do not multiply in the body and can be increased in number only by repeated reinfestation (Chandler, 1932).

Eight species of protozoa were found infesting the rodents examined by the writer. Squirrels were not regularly examined for protozoa but when examinations were made no protozoans were found. The white-footed mouse harbored one species; the house mouse, two species; the rat, four species; the rabbit, two species.

Giardia microti infested all of the white-footed mice examined by the writer. It was usually found in the duodenum but occasionally in the ileum and caecum.

Trichomonas muris was found infesting the caecum and occasionally the ileum of 60 per cent of the rats and in 30.95 per cent of the house mice examined by the writer. The presence of this protozoan is correlated with a pH of approximately 6.8 (Kofoid, McNeil, and Bonestell, 1933). The other protozoans found in rats were very rare. *Trypanosoma lewisi*, a blood protozoan, was found in one rat; *Chilomastix bettencourti*, in three rats; *Endamoeba muris* in one rat. The latter protozoan was more common in house mice, 13.05 per cent being infested.

Enteromonas intestinalis infested the caecum and colon of 75.6 per cent of the rabbits studied by the writer; *Eimeria stiedae* infested the liver of 36.58 per cent.

TREMATODES

Only two species of trematodes were found infesting the rodents examined by the writer. These parasites usually require a snail as an intermediate host and many species of trematodes are not expected in land animals in a region in which there is a paucity of fresh water.

Hasstilesia tricolor occasionally infested rabbits in enormous numbers at any season of the year. Seventeen (41.46 per cent) of the rabbits examined by the writer harbored this parasite, with an average of 1,903 parasites per host. The life history of this parasite is unknown but it probably encysts as the metacercaria upon vegetation. Infestation probably results from the ingestion of the encysted stage with the food. No correlation between the habitat of the host and the parasitic infestation can be made since the rabbit is a roaming animal.

Entosiphonus thompsoni, a trematode which is usually found in shrews, was found in two white-footed mice. The largest number of ENTOSIPHONUS

present in a single infestation was four. Krull (1934) also found this trematode in the same host. The life-history of this species is unknown.

CESTODES

Five species of tapeworms infested the rodents examined. No cestodes were found in *Peromyscus* and, with the exception of one instance where a host contained a larva of *Taenia taeniaeformis*, none was found in squirrels. Three species were found in rats or mice and two infested rabbits.

Hymenolepis diminuta, a common tapeworm of the rat, was encountered in only 7.27 per cent of the rats examined by the writer. This tapeworm requires an intermediate insect host and the ingestion of the latter by a rat for completion of its life cycle. Although only seven rats were examined at Beaufort, *H. diminuta* was found in five of them, with an average of 5.5 worms per host.

Hymenolepis nana, the dwarf tapeworm, was found in one rat examined at Beaufort, twenty-seven being present. This parasite infests rats and man in various parts of the world. It is unique among cestodes in that it is capable of completing its development from egg to adult in a single host.

The larval stage of *Taenia taeniaeformis*, the cat tapeworm, was found in 12.72 per cent of 35 rats and in 3.57 per cent of 84 house mice examined. The largest number of parasites in an individual infestation was seven found in a rat in February. This parasite occurred occasionally throughout the year in rats but it was never abundant (Table 4). The squirrel harbored a single

TABLE 1
Sciurus carolinensis carolinensis

Showing occurrence of parasites during the months from September to May. The upper figures in each instance indicates average number of parasites per host; the lower, the percentage of hosts infested.

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
Number of hosts examined	7	10	8	5	10	6	3	3	1
<i>Taenia taeniaeformis</i>	0 0	0 0	0 0	0 0	0 0	0.16 16.66	0 0	0 0	0 0
<i>Longistriata hassalli</i>	110.33 95.71	102.6 100	101 87.77	13 60	106.9 100	62.33 100	19.33 100	46 100	16 100
<i>Trombicula</i> sp.	7.0 42.75	14.1 60	14.75 87.5	1.8 60	1.3 50	0.33 16.66	2.0 66.66	0 0	0 0
<i>Atricholaelaps glasgowi</i>	0.57 28.57	0.1 10	0 0	0 0	0.9 30	0 0	1 30	0 0	0 0
<i>Ixodes hexagonus</i>	0.14 14.2	0.2 10	0 0	0.2 20	0 0	0 0	0 0	0 0	0 0
<i>Neohaematopinus sciurinus</i>	2.7 14.44	2.6 50.0	6.5 87.5	80.2 100	101.3 90	2.16 16.66	0 0	0 0	0 0
<i>Hoplopleura sciuricola</i>	0.7 14.44	0 0	0.25 12.5	2.2 60.0	17.8 70.0	0 0	0 0	0 0	0 0
<i>Orchopeas wickhami</i>	0.72 28.57	0.3 20.0	1.0 62.5	13.6 60.0	3.1 60.0	9.5 66.66	7.0 100	1.33 33.3	1 100

specimen. There is only one other record of this parasite infesting squirrels of the United States (Dobrovsky and Harbough, 1934).

The only adult cestode found in 41 rabbits examined was *Cittotaenia pectinata*. CITTOTAENIA is the only genus of rabbit cestodes represented both in America and the Old World. Over 90 per cent of rabbits examined harbored this parasite; 78.7 per cent were infested with the adults and 65 per cent with immature forms. Young forms occurred most frequently in large numbers from individual rabbits collected in May, June and July. The average number of worms found in these months were 50, 7.8 and 8 respectively. In February there was an infestation of two of the five rabbits examined. Mature individuals of this cestode usually occurred singly or in pairs. On nine occasions 3, 4, or 5 worms were taken from rabbits during the warmer months. Infestation by CITTOTAENIA apparently takes place at all seasons of the year, with an increase during the spring months.

The larval stages of *Taenia pisiformis*, the dog tapeworm, were encountered in 31.7 per cent of the rabbits studied by the writer, with an average of 1.8 per host. The largest number of cysticerci found in an individual rabbit was 22. There appears to be no favorable time for infestation since sporadic occurrences of cysticerci were found throughout the year (Table 5).

NEMATODES

The rodents examined by the writer were infested with eleven species of nematodes. The squirrel harbored one species; white-footed mouse, two species; rat, five species; rabbit, three species. Squirrels and rabbits were infested only with strongyloids; white-footed mice, a spiruroid and an oxyuroid; rats, a strongyloid, an oxyuroid, a spiruroid and two trichuroids;

TABLE 2
Peromyscus leucopus leucopus

Showing occurrence of parasites during the months of the year, June, 1934 to April, 1935. The upper figure in each instance indicates average number of parasites per host; the lower, the percentage of hosts infested.

	Jan.	Feb.	Mar.	June	July	Aug.	Oct.	Nov.	Dec.
Number of hosts examined	5	7	8	5	7	6	5	5	6
<i>Giardia microti</i>	100	100	100	100	100	100	100	100	100
<i>Entosiphonus thompsoni</i>	0 0	0 0	0 0	0 0	0.85 28.57	0 0	0 0	0 0	0 0
<i>Rictularia coloradensis</i>	0 0	0 0	0 0	0.6 40.0	0.42 28.57	0.33 33.33	0 0	0.4 40.0	0.16 16.6
<i>Syphacia peromysci</i>	0 0	18.85 42.85	6.12 25.0	1.2 20.0	5.28 28.57	0 0	0 0	1.0 20.0	6.0 50.0
Larval nematode (Encysted)	0 0	0 0	0 0	0 0	0 0	0 0	0 0	1.2 20.0	0 0
<i>Cuterebra fontinella</i> (larva)	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.33 16.66

TABLE 3
Mus musculus musculus

Showing occurrence of parasites during the months of the year, June, 1934 to April, 1935. The upper figure in each instance indicates average number of parasites per host; the lower the percentage of hosts infested.

	Jan.	Feb.	Mar.	June	July	Aug.	Oct.	Nov.	Dec.
Number of hosts examined	7	8	5	7	16	33	5	7	6
<i>Endamoeba muris</i>	0 0	0 0	0 0	71.4 0	18.7 0	13.04 0	0 0	0 0	0 0
<i>Trichomonas muris</i>	57.42 0	50.0 0	40 0	28.5 0	43.7 0	13.04 0	20.0 0	42.8 0	33.3 0
<i>Taenia taeniaeformis</i> (larva)	0 0	0 0	0 0	0 0	0.06 6.2	0.08 8.6	0 0	0 0	0 0
<i>Hymenolepis diminuta</i>	0 0	0 0	0 0	1.71 14.2	0 0	0 0	0 0	0 0	0 0
<i>Heterakis spumosa</i>	0 0	0 0	0 0	0 0	0 0	0.95 4.3	1.4 20.0	7.0 85.7	0.16 16.6
<i>Echinolaelaps echidninus</i>	0.57 14.28	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
<i>Xenopsylla cheopis</i>	0 0	0 0	0 0	0 0	0.43 31.2	0.26 17.3	0 0	0 0	0 0

house mice, the same oxyuroid as rats. All of the nematodes with the exception of *Trichosomoides crassicauda* infested the digestive system. The heligmosomid, *Longistriata hassalli*, was found in 92.45 per cent of the 53 squirrels examined, with an average of 77.5 per host. Table 1 shows this species to be very common throughout the period of study. No information concerning seasonal variation was obtained since no squirrels were examined during the summer months, but the worm probably is present throughout the year. The small number of parasites found in some of the hosts was influenced by the age of the host as young animals were usually not infested. Infestation by *Longistriata hassalli* is probably by skin penetration, the common method of infestation of other heligmosomids.

Rictularia coloradensis, a spiruroid, was encountered in 16.66 per cent of 54 white-footed mice examined by the writer. It usually occurred singly but occasionally two females were present. The males of RICTULARIA apparently do not remain long in the host, as none was found. Table 2 shows that no parasites were found during the first four months of the year. No examinations were made in May. The life-history of RICTULARIA is unknown.

Syphacia peromysci, n. sp., the oxyuroid of PEROMYSCUS, was found living free in the caecum. It was present in 22.22 per cent of the white-footed mice examined, with an average of 4.94 per host. It appears occasionally throughout the year (Table 2). The life-history of this species is unknown but probably simple as in other oxyuroids.

Heterakis spumosa, a rat and mouse nematode, is a non-pathogenic oxyuroid inhabiting the caecum and colon of rats and mice. It is rather

TABLE 4
Rattus norvegicus

Showing occurrence of parasites during the months of the year, May, 1934 to April, 1935. The upper figures in each instance indicates average number of parasites per host; the lower the percentage of hosts infested.

	Jan.	Feb.	Mar.	May	June	July	Aug.	Oct.	Nov.	Dec.
Number of hosts examined....	6	5	7	5	5	5	4	8	5	4
<i>Chilomastix bettencourti</i>	0 0	0 0	0 0	20 40	40 0	0 0	0 0	0 0	0 0	0 0
<i>Endamoeba muris</i>	0 0	0 0	0 0	0 20	20 0	0 0	0 0	0 0	0 0	0 0
<i>Trichomonas muris</i>	50	60	66.66	80	60	60	75	62.5	60	50
<i>Trypanosoma lewisi</i>	16.6 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
<i>Taenia taeniaeformis</i> (larva)	0 0	1.8 40.0	0.14 14.25	0.4 20.0	1 20.0	0 0	0 0	0.37 25.0	0 0	0 0
<i>Hymenolepis diminuta</i>	0.16 16.66	0 0	0 0	0 0	0 0	2.8 40.0	0.25 25.0	0 0	0 0	0 0
<i>Capillaria hepatica</i> (eggs)	0 0	0 0	14.2	0 0	0 0	0 0	0 0	0 0	0 0	20
<i>Heterakis spumosa</i>	0.16 16.0	0 0	0 0	2.8 20.0	2.4 40.0	0.4 40.0	0 0	0 0	0 0	0 0
<i>Nippostrongylus muris</i>	122.83 83.3	44.6 100.0	71.57 62.5	6.2 40.0	146.4 80.0	71.4 100.0	208.25 100.0	247.37 87.5	39.2 80.0	17.5 25.0
<i>Trichosomoides crassicauda</i>	2.16 83.33	1.0 40.0	1.57 57.14	1.8 40.0	1.2 40.0	1.0 40.0	1.0 25.0	1.62 37.5	1.0 40.0	0.75 40.0
<i>Echinolaeps echidninus</i>	7.16 50.0	1.2 60.0	7.57 28.57	9.2 40.0	0 0	0 0	0 0	0.36 12.5	12.83 33.3	0 0
<i>Polyplax spinulosa</i>	0 0	0 0	0.57 14.2	20.6 40.0	0 0	0 0	0 0	0.12 12.0	0 0	0 0
<i>Xenopsylla cheopis</i>	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0.25 25.0

common in other parts of the United States. It was rarely encountered during this survey. Eight of the 55 rats examined by the writer harbored these parasites, which were present during the summer months with the exception of a single individual found in January (Table 4). The eggs of *Heterakis spumosa* are viable for long periods of time under favorable conditions of temperature and moisture. They develop rapidly at summer temperatures. The life history is simple and the eggs become infective within fourteen days (Winfield, 1932). The mice on the other hand, harbored this parasite during the winter months (Table 3). The highest single infestation was 17 worms in a mouse examined in November when six of seven mice were infested. In general the rats of Beaufort appear to be more highly infested with this parasite than are those in Durham. Four of the seven rats examined showed comparatively high infestations—46, 29, 21 and 14 respectively.

The rat strongyloid, *Nippostrongylus muris*, was found in 78.18 per cent of the 55 rats examined by the writer. Large numbers were found in individual rats giving an average of 247.3 worms per host. The largest number

of worms found in an individual rat was 951. The infective larvae of *N. muris* enter rats by boring through the skin. When they are fed to rats only a small proportion are able to reach the intestine (Yokogawa, 1922). The infective larvae are carried to the lungs by the blood stream and pass through the respiratory system to the digestive system by way of the trachea.

The trichuroid, *Trichosomoides crassicauda*, is a parasite of the urinary tract of rats. It occurred in 47.2 per cent of the 55 rats studied by the writer, with an average of 1.3 worms per host. The parasites were present at any season of the year (Table 4). The largest number of worms present in a single infestation was 7. Infestation with this worm is by the ingestion of the eggs. The larvae are dispersed by means of the blood stream. Only those larvae which reach the urinary tract in their wanderings after having left the blood stream reach sexual maturity (Thomas, 1922).

TABLE 5
Sylvilagus floridanus mallurus

Showing occurrence of parasites during all months of the year, October, 1933 to September, 1934. The upper figures in each instance indicates average number of parasites per host; the lower, the percentage of hosts infested.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Oct.	Nov.	Dec.
No. of hosts examined	5	5	3	3	2	4	3	3	4	6	4
<i>Eimeria stiedae</i>	20 ^{····}	60 ^{····}	33.3	66.6	0 ^{····}	50 ^{····}	33.3	66.6	25.0	0 ^{····}	50.0
<i>Enteromonas intestinalis</i>	60 ^{····}	80 ^{····}	100 ^{····}	66.6	100 ^{····}	100 ^{····}	66.6	66.6	75.0	66.6	50.0
<i>Haastileria tricolor</i>	5152.2 80.0	2200.0 20.0	183.3 33.3	5696.0 66.6	0	5043.7 50.0	694.6 66.6	166.6 33.3	0	143.0 16.6	40.25 75.0
<i>Cittotaenia pectinata</i> Mature	1.2 80.0	1.4 80.0	1.0 66.6	0.66 33.3	3.0 100	3.25 75.0	1.66 66.6	1.66 66.6	3 75	1.0 83.3	1.75 100
<i>C. pectinata</i> Immature	6.4 60.0	9 40	3 66.6	3.6 100	50 100	7.8 100	8 66.6	1.33 66.6	3.0 25.0	1.16 33.3	3 75
<i>Taenia pisiformis</i> (larva)	1.6 40.0	0 0	2.66 66.6	2.33 33.3	3.5 50.0	6.25 50.0	0.33 33.3	0.33 33.3	3.75 50.0	0.5 16.6	0 0
<i>Obeliscoides cuniculi</i>	6.8 20.0	38.6 60.0	24.66 100.0	36.3 100.0	12.0 100.0	28.25 100.0	28.0 100.0	2.66 66.6	12.3 66.6	18.0 66.6	5.75 50.0
<i>Trichostrongylus affinis</i>	0 0	29.4 40.0	8.0 66.6	267.3 100.0	69.5 100.0	109.2 100.0	92.3 100.0	19.0 66.6	3.75 50.0	10.1 33.3	3.75 50.0
<i>T. calcaratus</i>	71.8 60.0	132.2 80.0	290.6 100.0	910.0 100.0	403.5 100.0	495.7 100.0	173.3 66.6	21.6 66.6	49.3 50.0	37.3 66.6	26.7 100.0
<i>Haemaphysalis leporis-palustris</i> *	4.8 80.0	2.2 40.0	4.0 100.0	15.0 100.0	0 0	0 0	10.0 66.6	4.3 33.3	54.0 75.0	26.1 66.6	9.0 100.0
nymphs	4.4 80.0	1.6 40.0	6.6 66.6	7.0 100.0	48.5 100.0	5.5 50.0	5.3 66.6	16.6 100.0	31.5 75.0	5.6 50.0	4.75 75.0
adults	20.8 100.0	9.4 100.0	30.6 100.0	68.6 100.0	113.0 100.0	53.0 100.0	18.6 100.0	60.6 100.0	42.0 100.0	3.0 100.0	6.25 100.0
<i>Cediopsylla simplex</i>	5.2 80.0	12.1 100.0	28.6 100.0	13.6 100.0	4.5 100.0	9.7 100.0	1.5 50.0	4.0 66.6	0 0	2.8 66.6	2.2 75.0
<i>Odontopsyllus multispinosus</i>	0.2 20.0	0.6 20.0	12.6 100.0	3.3 66.6	0 0	0 0	0 0	0 0	0 0	0 0	0 0
<i>Cuterebra fontinella</i> *	0.2 20.0	0 0	0 0	0 0	0 0	0.25 25.0	0 0	0 0	0.75 50.0	0 0	0 0

*Larvae

The trichuroid, *Capillaria hepatica*, was represented only by eggs in the liver of two rats. Infestation by this nematode is brought about by the ingestion of the eggs. Transmission is presumably through the eating of dead infested rats. If mature eggs are ingested hatching takes place in the small intestine and the newly liberated larvae, after penetrating the intestinal wall, reach the liver by way of the circulatory system according to Fülleborn (1924), but Nishigori (1925) and Asada (1925) believe that larvae pass through the intestinal wall into the abdominal cavity and then penetrate into the liver.

Only one specimen of the spiruroid, *Protospirura muris*, was found. This parasite requires an intermediate host such as a cockroach (Cram, 1926) during its life cycle.

The rabbit stomach worm, *Obeliscoides cuniculi*, was found in 70.73 per cent of the 41 rabbits examined by the writer, with an average of 19.6 per host. Examination of stomach walls of infested rabbits usually showed congestion of the gastric mucosa with numerous hemorrhages. The worms were usually free on the mucous membrane or embedded deep in the stomach wall. The rabbits examined by the writer show that infestation of *OBELISCOIDES* may occur throughout the year (Table 5). The largest number of worms found in an individual rabbit was 166. Infestation takes place through the mouth. There is no penetration of the skin by the infective larvae (Alicata, 1932).

The duodenum-jejunum nematode, *Trichostrongylus calcaratus*, occurred in 80.48 per cent of the rabbits examined by the writer, with an average of 207.2 per host. *Trichostrongylus affinis*, a nematode inhabiting the caecum and colon, was found in 58.53 per cent of the hosts examined, with an average of 48.1 per cent per host. Infestation of rabbits by species of *TRICHOSTRONGYLUS* may take place either through the skin or with the food. The latter is the more common mode of infestation (Sarles, 1932).

ARTHROPODS

Thirteen species of arthropods were found infesting the rodents studied by the writer. Squirrels carried six species; house mice, two species; rats, three species; rabbits, four species. No arthropods were found on *PEROMYSCUS*, which were caught in snap traps, with the exception of two larvae of *Cuterebra fontinella* infesting one host.

Of the two mites found infesting the squirrels examined by the writer, an unidentified species of *TROMBICULA* larva, a chigger mite, was more common. It was found on 50.94 per cent of the 53 squirrels examined with an average of 6.35 per squirrel. The largest number of *TROMBICULA* found upon an individual squirrel was 103. This larval mite, the adults of which are free living, occurred during seven of the eight months of squirrel examination.

None were found in April when only three squirrels were examined for parasites. The largest average number of mites was found in October and November (Table 1). Undoubtedly these mites would prove to be more numerous during the summer months when *TROMBICULA* larvae are very numerous.

The mite, *Atricholaelaps glasgowi*, and the tick, *Ixodes hexagonus*, were uncommon, the former infesting only seven squirrels with an average of 0.32 per host; the latter, four specimens from three squirrels.

The louse, *Neohaematopinus sciurinus sciurinus*, was found upon 50.94 per cent of the squirrels, with an average of 26.7 per host. This louse was most prevalent during the month of December when an average number of 80.2 per host occurred. Lice were found whenever there was an appreciable number of hosts examined. *Hoplopleura sciuricola* showed an infestation of 22.64 per cent with an average of 3.81 per host. The largest number of *HOPLOPLEURA* found in a single infestation was 129 on a squirrel examined during January.

The flea, *Orchopeas wickhami*, occurred on 50.94 per cent of the squirrels examined, with an average of 3.66 per host. The largest number of fleas found was 57, found on a squirrel examined in December. Fleas were not prevalent during any of the months of the survey.

The rats examined by the writer harbored a mite, *Echinolaelaps echidninus*, a louse, *Polyplax spinulosa* and the tropical rat flea, *Xenopsylla cheopis*.

The mite was the most common, occurring on 27.27 per cent of the 55 rats examined, with an average of 14.14 per host. No mites were found during the summer months. The average number of parasites per monthly number of rats varied very little during the months it was present (Table 4).

The common rat louse was rarely collected (Table 4). Only 7.27 per cent of the rats were infested. The largest number of lice found was 53 in May. The average number per host was 1.98. Only one specimen of the tropical rat flea was collected. Fourteen *Xenopsylla cheopis* were collected from the 83 house mice examined. They were present only during July and August (Table 3). Low temperatures are harmful to the tropical rat flea (Bacot, 1914). The common rat flea, *Nosopsyllus fasciatus*, was not encountered during this survey. It appears that fleas are uncommon on Durham rats and mice. However at Beaufort, North Carolina, four of the six rats examined harbored fleas: *Xenopsylla cheopis* and *Echidnophaga gallinacea*, the tropical stick-tight flea. The average number of fleas per host was 3.42 for *Xenopsylla cheopis* and 1.14 for *Echidnophaga gallinacea*.

Two species of fleas and one species of tick were found infesting rabbits. *Haemaphysalis leporis-patustris*, the rabbit tick, was found upon all of the rabbits examined by the writer. This parasite requires three hosts upon which to feed in the larval, nymphal, and adult stages respectively. The

adults feed longer than the larvae or nymphs, therefore were found to be more numerous (Table 6).

Two species of fleas, *Cediopsylla simplex* and *Odontopsyllus multispinosus*. The former is the common rabbit flea of the Eastern United States and was found throughout the year. *Odontopsyllus multispinosus* is rather uncommon and was found only from February to May (Table 5). The greatest number occurred in March, an average of 12.6 per host. *Cediopsylla simplex* was more prevalent during February, March, and April (Table 5).

Four rabbits harbored the larval stages of a fly, *Cuterebra fontinella* (Table 5).

DISCUSSION

The preceding summary indicates that there is a predominance of internal parasites in the rabbits and rats, which are of larger size than the other rodents studied and therefore offer a more suitable habitat for parasites. Both are voracious feeders and thus permit greater infestation. Numerous rabbits and rats facilitate the dispersal of the parasites through faeces, thus enhancing the opportunity for infestation and reinfestation. A rat is omnivorous and has filthy habits which make infestation easy through the ingestion of eggs or larvae or by skin penetration. Pearse (1930) found that large, omnivorous, cursorial rodents usually are the most highly parasitized. The prevalence of *Hymenolepis diminuta*, which requires an intermediate host for completion of its life history, at Beaufort is probably due to the comparatively large number of fleas infesting the rats. The rats of Durham are not very heavily infested with fleas and show little infestation with this tapeworm (Table 4). Pearse (1930) states that mature tapeworms are common in mammals in open fields. The writer has observed a dominance of tapeworms in the rabbit, which lives in the field and forest.

The squirrel, although a comparatively large rodent, was infested with only one species of internal parasite, a strongyloid nematode. It is a comparatively clean arboreal animal. Its food is usually limited to fruits, nuts, seeds, buds and bark, thus apparently limiting infestation by parasites. The infestation by the single nematode undoubtedly takes place during short forays upon the ground. The squirrels showed high infestation of this nematode (Table 1) "probably because shade and moisture in forests are favorable for the development of the eggs and because when the hosts visit the ground they go again and again to situations which are favorable for infestation" (Pearse, 1930).

Small rodents such as house mice and *Peromysci* do not offer very favorable habitats for any large number of parasites. It is a recognized fact that small animals usually harbor few parasites. The parasites which occur in great numbers must necessarily be minute in size.

Squirrels carried more species of external parasites than any other rodent studied by the writer (Table 1). Squirrels have a permanent nest to which they return. They run about on the ground and may become infested in this way. However, infestation is easier in the nest which is suitable for breeding and metamorphosis of the parasites. Lice and *TROMBICULA* larvae showed specificity for squirrels and were only common on them. Lice were occasionally collected from rats. Adult mites were found on rats although they were uncommon. The rabbit apparently is an ideal host for a large number of ticks. It is of a comparatively large size and frequents shrubby areas which favors tick infestation (Pearse, 1930).

SEASONAL VARIATION

No seasonal variation was demonstrated in *SCIURUS* since no examinations of squirrels were made during the summer months. Seasonal variation is evident only in the parasites of the rats and rabbits. These were numerous and occurred throughout the year thus giving opportunity for comparison of the degrees of infestation. No seasonal variation for *Hasstilesia tricolor*, *Hymenolepis diminuta*, larval tapeworms, *Trichosomoides crassicauda* and *Heterakis spumosa* was demonstrated.

Figure 1 shows a dominance of *CITTOAENIA* during the spring and summer months. High initial infestation was followed by a decrease in numbers. In Canada rabbits are said to develop an almost complete immunity to *CITTOAENIA* with a change in diet from green vegetation to bark during the winter (Boughton, 1932). There is apparently a similar reaction in the rabbits studied by the writer. As the cestodes grow some of them are lost until only one or two adult parasites remain during the winter months.

Figures 2 and 3 indicate an increase of *Trichostrongylus affinis* and *T. calcaratus* during the spring months, with a gradual decrease in the number of worms later. The high infestation apparently is followed by a host immunity response with the discharge of worms (Stoll, 1932). As many as 2,000 *T. calcaratus* were taken from individual rabbits by the writer. In laboratory animals a lethal dose is approximately 1,000 worms (Sarles, 1932a). The results obtained by the writer indicate that there is a host immunity response similar to that found by Stoll (1932) and Sarles (1932) after experimental infestations. The decrease in the number of worms during the winter months is undoubtedly influenced by the unfavorable lower temperature for the free-living larval stages (Stoll, 1932).

Variations in temperature apparently influenced the seasonal variation of *Obeliscoides cuniculi* and *Nippostrongylus muris* (Tables 4 and 5). No evidences of immunity reactions to these parasites have been demonstrated. The immunity reactions of white rats to *Nippostrongylus muris* (Yokogawa, 1922) apparently does not hold true for the brown rat (Chandler, 1931).

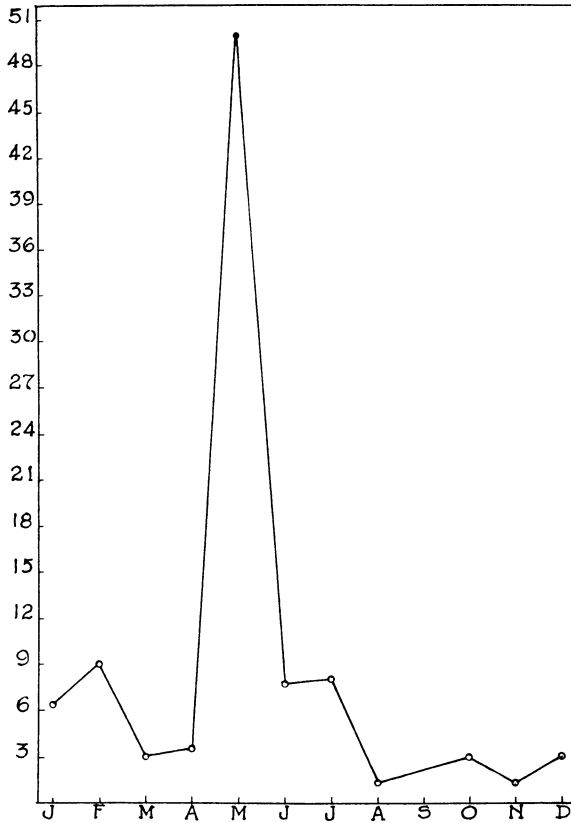


FIG. 1. Monthly variation in the average number of immature tapeworm, *Cittotaenia pectinata*, found in the cottontail rabbit, *Sylvilagus floridanus mallurus*, during a year.

Haemaphysalis leporis-palustris showed variations in the number of larvae, nymphs and adults appearing on the rabbits studied by the writer. The adults feed longer than the larvae or nymphs, therefore were found to be more numerous (Fig. 4). Hooker (1912) states from personal observation that large numbers of larvae and lesser numbers of nymphs when repleted abandon the host during the daytime. He regards this as an adaptation of the tick to the habits of their natural hosts, the hare and the rabbit. These remain during the day in their resting places and roam at night. The engorged ticks, dropping from the hosts in the resting places, undergo metamorphosis in a situation which favors their finding a host when they emerge and are ready to feed. In general the number of nymphs collected by the writer was greater than the number of larvae. The rabbits studied were collected during the day.

In Figure 4 an attempt is made to show the general succession of the

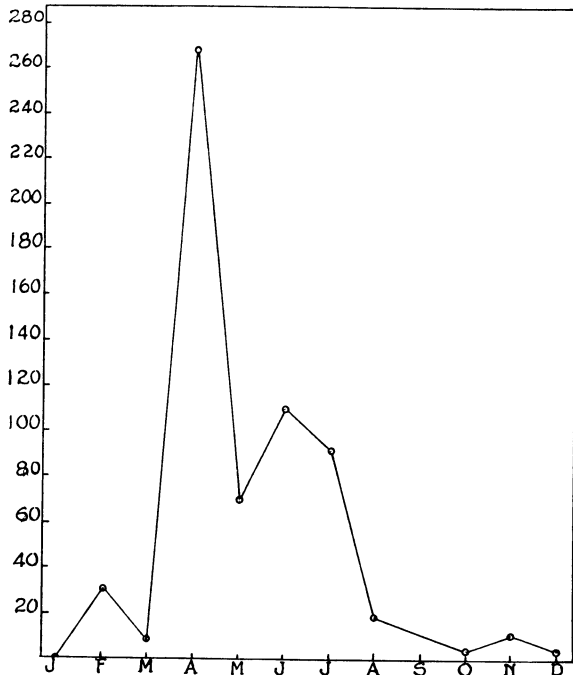


FIG. 2. Monthly variation in the average number of caecum nematode, *Trichostrongylus affinis*, found in the cottontail rabbit, *Sylvilagus floridanus mallurus*, during a year.

various stages of HAEMAPHYSALIS. The larvae are comparatively numerous during April, July and October, approximately 90 days separating each successive increase. The time required for the life-history of this tick at summer temperature is 87 days (Nuttall, Warburton, Cooper, and Robertson, 1915). The nymphs show periods of increase in numbers during May, August, and October. The periods of nymphal predominance follow those of the larvae, demonstrating a correlation between infestation and the life-history. There are also variations in the number of adults infesting the rabbits but there is no definite correlation between infestation and life-history since the feeding time for the host is greater than that of the larvae or nymphs. In general the adults are most abundant during the spring and late summer. The rate of metamorphosis is dependent upon the temperature. Figure 4 shows the correlation between monthly mean temperature and the average number of larvae, nymphs and adults. There is a decrease in the number of ticks with a decrease in temperature. A greater amount of time is necessary for metamorphosis at low temperatures and thus there are fewer parasites infesting the host. *Haemaphysalis leporis-palustris* apparently completes its life-history twice during the year.

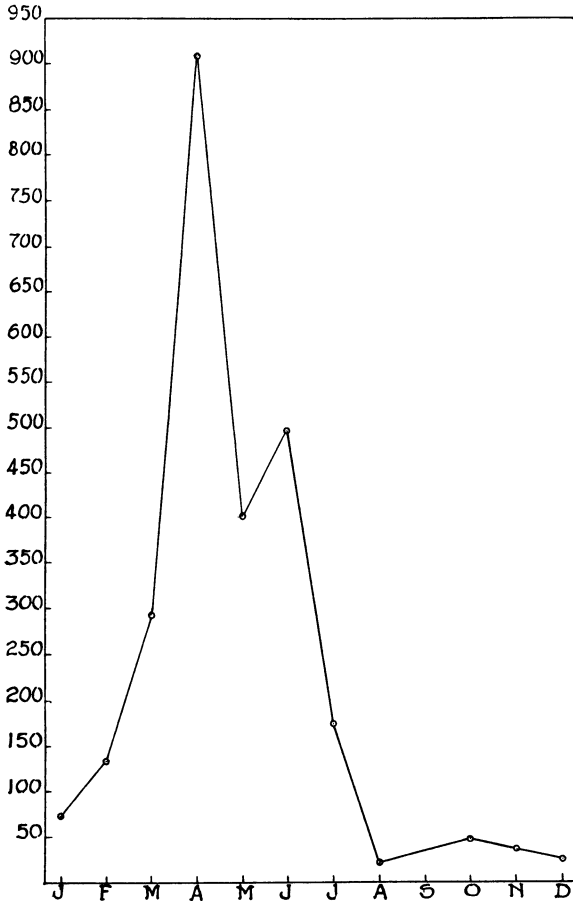


FIG. 3. Monthly variation in the average number of duodenum nematode, *Trichostrongylus calcaratus*, found in the cottontail rabbit, *Sylvilagus floridanus mallurus*, during a year.

Table 5 shows the prevalence of *Cediopsylla simplex* and *Odontopsyllus multispinosus* during February, March and April. Many fleas, e.g. *Nosopsyllus fasciatus* increase in numbers during the colder parts of the year (Bacot, 1914). This apparently holds true for *CEDIOPSYLLA* and *ODONTOPSYLLUS*. Furthermore, rabbits remain in their resting places for longer periods of time when the temperature is low, thus permitting easier infestation by fleas.

CONCLUSIONS

Nearly all evidence indicates the desirability of elimination from valuable agricultural, range, and forest areas, of such species as the prairie dog, ground squirrel, and rabbit. The pocket gopher in a citrus orchard or an alfalfa field

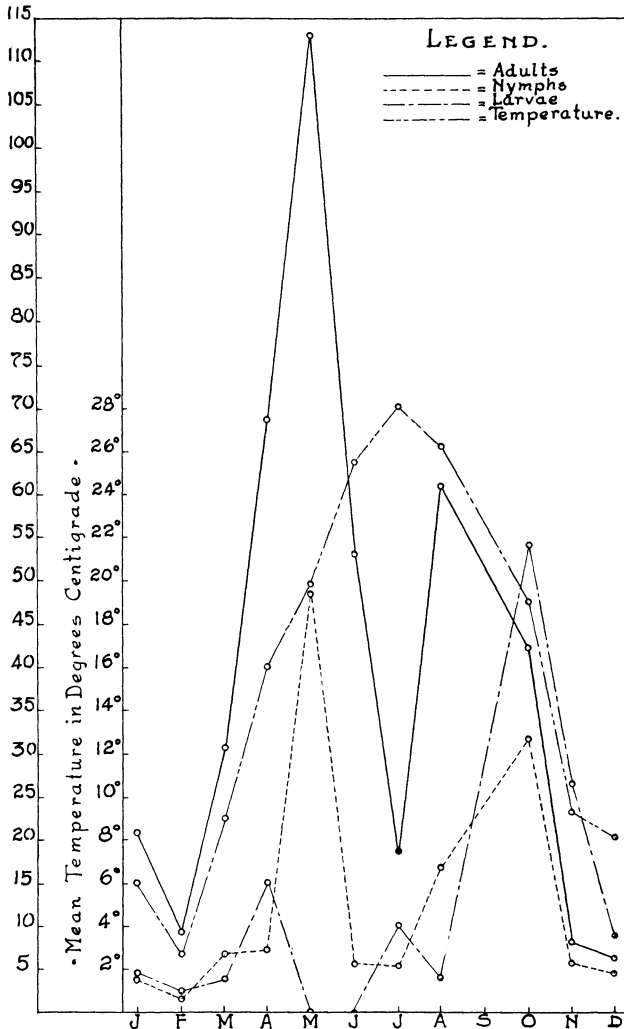


FIG. 4. Monthly variations in the average number of adults, nymphs, and larvae of the rabbit tick, *Haemaphysalis leporis-palustris*, during a year. The mean atmospheric temperature for the months in which observations were made is given.

is likewise undesirable. The California and Columbian ground squirrels must often be eliminated before profits can be made in cultivated areas. On the other hand, many rodents act as checks on insects. Some of the beneficial activities of rodents in the soil are: stirring up surface layers, increasing porosity; decreasing the size of particles; increasing aeration; increasing water percolation; helping to incorporate into the soil larger quantities of organic matter; depositing faeces and urine; depositing dead bodies. It must

be remembered that the injurious rodent effects are direct and easily observable, while beneficial rodent work is usually indirect and difficult to appreciate. The transmission of diseases by rats, ground squirrels, and rabbits is a menace to public health and control measures should be made with such rodents. The wholesale elimination of rodents has never been advocated, except for the obnoxious rat. "It is advisable to interfere with nature as much as necessary, but as little as possible" (Taylor, 1930).

A study of the writer's "List of Parasites of Rodents" makes one doubt the conception that a particular parasite is limited to a single host species and a single host may harbor but one species of a particular general group. Becker (1933) maintains that a particular parasite will develop in any host which provides satisfactory environmental conditions and mode of entrance and further that, "host-specificity becomes interpretable in terms of known physiological phenomena, and does not require any special interpretation involving a peculiar quality which species (host or parasite) possess that is separate and apart from what is observable in individuals."

Trematodes are uncommon in land rodents but in such aquatic types as the muskrat and beaver they are common. Trematodes are usually present in those rodents whose habitat are either in or near bodies of water. It is significant to note that the rodents of North Carolina, examined by the writer, showed only two species of trematodes and only one of these in any abundance.

It is a pertinent fact that the cestodes of the family Anoplocephalidae are well represented among herbivorous mammals. *Cittotaenia pectinata*, only adult cestode found in rabbits, is a member of this family. The life histories of the members of this family are unknown. Douthitt (1915) maintains that the type of soil determines infestation by anoplocephalids.

Omnivorous or insectivorous rodents usually harbor species of tapeworms belonging to families other than Anoplocephalidae. *HYMENOLEPIS* is a parasite of rodents and birds. These hosts are insect eaters and the birds more so than the rodents. There is a greater representation of Hymenolepididae in birds than in rodents.

Susceptibility, food, size and habits of the host, soil, and temperature undoubtedly influence the type of parasite and the degree of infestation. Seasonal periodicity may be influenced to some extent by the age of the host. Within the past 10 years there has been a widespread interest in observations or experiments dealing with the subject of resistance and susceptibility of helminthic infestations. Resistance to infestation or reinfestation by internal parasites has been shown to be correlated to some extent with the physiological status of the host. Rabbits show a tendency to lose their worms after initial infestation. Some of them show positive resistance to certain nematodes and show no infestation with them (Stoll, 1932). Furthermore, the

tendency to lose parasites may be associated with parasitic over-crowding, in the case of large tapeworms. The intestinal flora, and pH, undoubtedly influence the appearance and disappearance of internal parasites. Rabbits tend to lose their parasites in the winter months when food is scarce and the hosts resort to a bark diet (Boughton, 1932). An arboreal animal with a restricted herbivorous diet, for example, the squirrel, shows fewer internal parasites than a terrestrial animal which is omnivorous or has a non-restricted herbivorous diet, for example, rat and rabbit. In general the number of species of parasites is directly proportional to the size of the host. Temperature probably to some degree controls the infestation of hosts by fleas and ticks. It may influence the varying degrees of internal parasites during the various seasons, low temperatures being unfavorable to the free-living larvae.

SUMMARY

1. Scientific rodent control is advisable.
2. Two hundred eighty-seven rodents were examined for parasites: 53 gray squirrels, 54 white-footed mice, 84 house mice, 55 brown rats and 41 cottontail rabbits.
3. Eight species of protozoa were found infesting the rodents examined: white-footed mouse, 1; house mouse, 2; rat, 4; rabbit, 2.
4. Trematodes were uncommon in the rodents studied. One species was found in the white-footed mouse and one in the rabbit.
5. The rat, house mouse and rabbit were the only rodents found to harbor adult cestodes.
6. Eleven species of nematodes were found: squirrel, 1; white-footed mouse, 2; rat and house mouse, 5; rabbit, 3.
7. Seventeen species of arthropods infested the rodents examined: squirrel, 6; white-footed mouse, 1; rat, 4; house mouse, 2; rabbit, 4.
8. Smaller rodents harbor fewer parasites than do larger hosts.
9. Rodents having permanent nests are parasitized with more species of external parasites than are other rodents.
10. Arboreal habit lessens the possibility of internal parasites.
11. The type of food influences the character and degree of parasitism. Insectivorous rodents harbor cestodes requiring an insect as intermediate host. Herbivorous rodents harbor species of Anoplocephalidae, the life-histories of which are unknown.
12. Seasonal periodicity of parasites is influenced by temperature and change of diet. Susceptibility of hosts and immunity responses probably influence periodicity of infestation.
13. A list of parasites of North American rodents is presented in Appendix I.

14. The description of a new species of nematode from the white-footed mouse is presented in Appendix II.

APPENDIX I

A LIST OF PARASITES OF RODENTS

Here are listed the parasites reported from North American Rodentia and Lagomorpha. The parasites are arranged alphabetically under appropriate systematic groups and the hosts are listed in alphabetical order under them. Localities and bibliographic references for hosts are given whenever possible.

PROTOZOA

Babesia citelli Becker and Roudabush 1934

Citellus tridecimlineatus t.; Iowa; Becker and Roudabush 1934, 524.

Balantidium sp.

Dasyprocta aguti; Strong, Shattuk and Wheeler 1926, 130.

Rattus norvegicus; Atchley 1935, 183.

Chilomastix bettencourti (Fonseca 1915)

Rattus norvegicus; United States; Kofoid, McNeil and Bonestell 1933, 187.

C. magna Becker 1926

Citellus tridecimlineatus texensis; Iowa; Becker 1926, 288.

Councilmania decumani Kofoid, Swezey and Kessel 1923

Rattus norvegicus; Cosmopolitan; Kofoid, McNeil and Bonestell 1933, 187.

Eimeria beecheyi Henry 1932

Otospermophilus grammurus g.; California; Henry 1932, 280.

E. bilamellata Henry 1932

Callospermophilus chrysodeirus c.; California; Henry 1932, 282.

E. callospermophili Henry 1932

Callospermophilus chrysodeirus c.; California; Henry 1932, 287.

E. citelli Kartchner and Becker 1930

Citellus tridecimlineatus t.; Iowa; Kartchner and Becker 1930, 20.

E. cuniculi (Revolta 1878)

Oryctolagus cuniculus domesticus; Levine and Becker 1933, 86.

E. cynomysis Andrews 1928

Cynomys ludovicianus l.; Levine and Becker 1933, 86.

E. eubeckeri Hall and Knipling 1935

Citellus franklinii; Iowa; Hall and Knipling 1935, 129.

E. falciformis (Eimer 1870)

Mus musculus; Levine and Becker 1933, 86.

- E. franklinii* Hall and Knipling 1936
Citellus franklinii; Iowa; Hall and Knipling 1935, 129.
- E. geomydis* Skidmore 1928
Geomys bursarius; Nebraska; Skidmore 1929, 183.
- E. irresidua* Kessel and Jankiewicz 1931
Oryctolagus cuniculus domesticus; Baltimore; Kessel and Jankiewicz 1931, 309
- E. magna* Pearard 1925
Lepus californicus c.; California; Levine and Becker 1933, 88, 97.
Oryctolagus cuniculus domesticus; Iowa; Becker 1933, 232, 234.
Sylvilagus floridanus mearnsi; Iowa; Becker 1933, 232, 234.
- E. media* Kessel and Jankiewicz 1931
Lepus californicus c.; Levine and Becker 1933, 88, 97.
Oryctolagus cuniculus domesticus; Levine and Becker 1933, 88, 97.
- E. miyairii* Becker and Hall 1931
Rattus norvegicus; Iowa; Becker and Hall 1931, 115.
- E. monacis* Fish 1930
Marmota monax monax; District of Columbia; Fish 1930, 99.
- E. neotomae* Henry 1932
Neotoma fuscipes f.; California; Henry 1932, 284.
- E. nieschulzi* Dieben 1924
Rattus norvegicus; Levine and Becker 1933, 89.
R. rattus rattus; Ibid.
- E. ondatrae-zibethicae* Martin 1930
Ondatra zibethica z.; Nebraska; Martin 1930, 273.
- E. os* Crouch and Becker 1931
Marmota monax m.; Iowa; Crouch and Becker 1931, 128.
- E. perforans* (Leuckart 1879).
Lepus americanus a.; Canada; Boughton 1932, 535.
L. californicus c.; Levine and Becker 1933, 88, 97.
Oryctolagus cuniculus domesticus; Levine and Becker 1933, 88, 97.
- E. perforoides* Crouch and Becker 1931
Marmota monax m.; Iowa; Crouch and Becker 1931, 128.
- E. princeps* (Labbe 1894)
Oryctolagus cuniculus domesticus; Levine and Becker, 1933, 88, 97.
- E. residua* Henry 1932
Neotoma fuscipes f.; California; Henry 1932, 285.
- E. schubergi* (Labbe 1896)
Mus musculus; Levine and Becker 1933, 97.
- E. sciurorum* Galli-Valerio 1922
Sciurus niger rufiventer; Iowa; Knipling and Becker 1935, 418.

- E. separata* Becker and Hall 1931
Rattus norvegicus; Iowa; Becker and Hall 1931, 131.
- E. sprehni* Yakimov 1934
Castor canadensis c.; Canada; Yakimov 1934, 294.
- E. stiedae* (Lindemann 1865)
Lepus americanus a.; Canada; Boughton 1932, 535.
L. californicus c.; Levine and Becker 1933, 88, 97.
Ondatra zibethica z.; Canada; Law and Kennedy 1932, 30.
Oryctolagus cuniculus domesticus; Cosmopolitan; Schwartz and Shook 1933, 12.
Sylvilagus floridanus alacer; Oklahoma; Ward 1934, 84.
S. f. mallurus; North Carolina; this paper.
- E. sp.*
Oryctolagus cuniculus domesticus; Canada; Boughton 1932, 524.
Sciurus griseus g.; Levine and Becker 1933, 92.
Sciurus sp.; Ibid.
- Endamoeba citelli* Becker 1926
Citellus tridecimlineatus texensis; Iowa; Becker 1926, 444.
- E. cuniculi* Brug 1918
Lepus californicus c.; Oklahoma; Ward 1934, 84.
Oryctolagus cuniculus domesticus; Wenyon 1926, 229.
Sylvilagus floridanus alacer; Oklahoma; Ward 1934, 84.
- E. hystolytica* (Schaudinn 1903)
Rattus norvegicus; South Carolina; Lynch 1915, 32.
- E. muris* (Grassi 1879).
Mus musculus; North Carolina; Harkema, this paper.
- Enteromonas intestinalis* Fonseca 1918
Lepus californicus c.; Oklahoma; Ward 1934, 84.
Oryctolagus cuniculus domesticus; Wenyon 1926, 307.
Sylvilagus floridanus alacer; Oklahoma; Ward 1934, 84.
S. f. mallurus; North Carolina; Harkema, this paper.
- Giardia beckeri* Hegner 1926
Citellus tridecimlineatus texensis; Iowa; Hegner 1926, 203.
- G. duodenalis* Davaine 1875
Lepus californicus c.; Oklahoma; Ward 1934, 84.
Oryctolagus cuniculus domesticus; Stiles and Boeck 1923, 180.
Sylvilagus aquaticus a.; Oklahoma; Ward 1934, 84.
Sylvilagus floridanus alacer; Oklahoma; Ward 1934, 84.
- G. lamblia* Stiles 1916
Rattus norvegicus; California; Kofoid, McNeil and Bonestell 1933, 187.

- G. microti* Kofoid and Christenson 1915
Microtus californicus c.; California; Kofoid and Christenson 1915, 31.
Peromyscus leucopus leucopus; North Carolina; Harkema, this paper.
Peromyscus maniculatus gambeli; California; Kofoid and Christenson 1915, 31.
- G. muris* Grassi 1879
Mus musculus; California; Kofoid and Christenson 1915, 31.
Peromyscus maniculatus gambeli; California; Ibid.
P. m. maniculatus; California; Stiles and Boeck 1923, 180.
Rattus norvegicus; Missouri; Tsuchiya and Rector 1935, 426.
- Haemogregarina citellicola* (Wellman and Wherry 1910)
Otospermophilus grammurus beecheyi; United States; Brumpt 1913, 101.
- Hepatozoon muris* (Balfour 1905)
Rattus norvegicus; District of Columbia; Price and Chitwood 1931, 55.
R. rattus rattus; United States; Brumpt 1913, 100.
- Hexamitus marmotae* Crouch 1934
Marmota monax m.; Iowa; Crouch 1934, 513.
- H. muris* (Grassi 1881)
Rattus norvegicus; California; Kofoid, McNeil and Bonestell 1933, 187.
- H. pulcher* Becker 1926
Citellus tridecimlineatus texensis; Iowa; Becker 1926, 295.
- Sarcocystis leporum* Crawley 1914
Sylvilagus floridanus mallurus; Maryland; Crawley 1914, 214.
- S. muris* Negri 1910
Rattus norvegicus; District of Columbia; Price and Chitwood 1931, 55;
 Missouri; Tsuchiya and Rector 1935, 426.
- Tetratrichomastix citelli* Becker 1926
Citellus tridecimlineatus texensis; Iowa; Becker 1926, 294.
- Trichomonas cryptonucleata* Crouch 1933
Marmota monax m.; Iowa; Crouch 1933, 297.
- T. digranula* Crouch 1933
Marmota monax m.; Iowa; Kentucky; Crouch 1933, 296.
- T. intestinalis* (Leuckart 1879)
Rattus norvegicus; South Carolina; Lynch 1915, 22, 32.
- T. marmotae* Crouch 1933
Marmota monax m.; Iowa; Kentucky; Crouch 1933, 296.
- T. muris* (Grassi 1879)
Citellus tridecimlineatus texensis; Iowa; Becker 1926, 294.
Mus musculus; United States; Stiles and Boeck 1923, 180.
Peromyscus maniculatus gambeli; California; Kofoid and Christenson 1915, 31.

- P. leucopus leucopus*; Wenrich 1921, 120.
Rattus norvegicus; California; Kofoid, McNeil and Bonestell 1933, 187;
 Missouri; Tsuchiya and Rector 1935, 427.
- T. wenrichi* Crouch 1933
Marmota monax m.; Kentucky; Crouch 1933, 296.
- T. sp.*
Citellus tridecimlineatus texensis; Iowa; Becker 1926, 296.
- Trypanosoma brucei* Plimmer and Bradford 1899 (experimental)
Peromyscus californicus c.; Michigan; Packanian 1934, 139.
P. eremicus anthonyii; Ibid.
P. e. eremicus; Ibid.
P. maniculatus artemisiae; Ibid.
P. m. bairdii; Ibid.
P. m. gambeli; Ibid.
P. m. osgoodi; Ibid.
P. m. ribidus; Ibid.
P. m. sonorensis; Ibid.
P. polionotus p.; Ibid.
P. truei gilberti; Ibid.
- T. citelli* Watson 1912
Citellus richardsonii; Canada; Watson and Hadwen 1912, 24.
- T. cruzi* Chagas 1909 (experimental)
Neotoma fuscipes annectens; California; Kofoid and Donat 1933, 258.
N. f. macrotus; California; Wood 1934, 497.
P. californicus c.; California; Kofoid and Donat 1933, 258.
P. cremicus fraterculus; California; Kofoid and Donat 1933, 258.
P. maniculatus gambeli; California; Wood 1934, 497.
P. truei giloerti; California; Wood 1934, 497.
Rattus norvegicus; California; Kofoid and Donat 1933, 258.
- T. evotomys* Hadwen 1912
Evotomys gapperi saturatus; Canada; Watson and Hadwen 1912, 25.
- T. hippicum* Darling 1910 (experimental)
Coendou laenatum; Panama; Clark and Dunn 1933, 275.
Dasyprocta punctata dariensis; Ibid.
- T. hixsoni* Becker and Roudabush 1934
Citellus franklini; Iowa; Becker and Roudabush 1934, 529.
- T. iowensis* Becker and Roudabush 1934
Citellus tridecimlineatus t.; Iowa; Becker and Roudabush 1934, 527.
- T. leporis-sylvaticus* Watson 1912
Sylvilagus floridanus mallurus; Canada; Watson and Hadwen 1912, 22.
- T. lewisi* (Kent 1882)
Neotoma fuscipes macrotus; California; Wood 1934, 497.

- Rattus norvegicus*; Cosmopolitan; Watson and Hadwen 1912, 24.
Rattus rattus r.; Wenyon 1926, 463.
- T. microti* Laveran and Pettit 1909
Microtus californicus c.; California; Wood 1934, 499.
M. pennsylvanicus; Nebraska; Coatney 1935, 456.
- T. otospermophili* Wellman and Wherry 1910
Otospermophilus grammurus beecheyi; California; Wellman and Wherry, 1910, 419.
- T. peromysci* Watson 1912
Peromyscus maniculatus m.; Canada; Watson and Hadwen 1912, 22.
P. m. nebracensis; Ibid.
- T. sp.*
Lepus californicus c.; Oklahoma; Ward 1934, 84.
Sylvilagus aquaticus a.; Ibid.
Sciurus sp.; Canada; Watson and Hadwen 1912, 24.

TREMATODA

- Agomodistomum norvegicum* Loewen 1934
Rattus norvegicus; Kansas; Loewen 1934, 250.
- Alariae mustelae* Bosma 1931
Ondatra zibethica z.; Canada; Law and Kennedy 1932, 30.
Peromyscus leucopus noveboracensis; Michigan; Bosma 1934, 117.
- Amphimerus speciosus* (Stiles and Hassall 1898)
Rattus norvegicus; District of Columbia; Cram 1928, 72.
- Apophallus donicum* (Skrjabin and Lindtrop 1919)
Rattus norvegicus; District of Columbia; Price and Chitwood 1931, 55.
- Ascotyle diminuta* Stunkard and Haviland 1924
Rattus norvegicus; New York; Stunkard and Haviland 1924, 4.
- Catatropis filamentis* Barker 1915
Ondatra zibethica z.; Canada; Law and Kennedy 1932, 30; Nebraska;
 Harrah 1922, 55.
- Cladorchis subtriquetrus* Rudolphi 1814
Castor canadensis c.; Canada; Swales; 1933, 474, 476.
- Echinochasmus schwartzi* Price 1931
Ondatra zibethica z.; Maryland; Price 1931, 4.
- Echinoparyphium contigerum* Barker and Bastron 1915
Ondatra zibethica z.; Canada; Law and Kennedy 1932, 30.
- Echinostomum armigerum* Barker and Irvine 1915
Ondatra zibethica z.; Canada; Ibid.
- E. callawayensis* Barker and Noll 1915
Ondatra zibethica z.; Canada; Ibid.

- E. coalitum* Barker and Beaver 1915
Ondatra zibethica z.; Canada; Ibid; Maryland; Krull 1935, 76.
- E. revolutum* (Froelich)
Ondatra zibethica z.; Canada; Swales 1933, 474.
- E. sp.*
Ondatra zibethica z.; Canada; Swales 1933, 480.
- Entosiphonus thompsoni* Sinitzin 1931
Peromyscus leucopus leucopus; North Carolina; Harkema, this paper.
P. l. noveboracensis; Maryland; Krull 1933, 49.
- Fasciola hepatica* Linnaeus
Castor canadensis c.; Stiles 1895, 280.
Oryctolagus cuniculus domesticus; Schwartz and Shook 1933.
Peromyscus leucopus noveboracensis; Maryland, Krull 1933, 98.
Sylvilagus floridanus alacer; Louisiana; Dikmans 1930, 162.
S. f. mallurus; Maryland; Krull 1933, 50.
- Hasstilesia texensis* Chandler 1929
Lepus californicus texianus; Texas; Chandler 1929, 3.
Sylvilagus floridanus alacer; Texas; Chandler 1929, 3.
- H. tricolor* (Stiles and Hassall 1891)
Lepus americanus a.; Stiles and Hassall 1891, 160, 161.
Oryctolagus cuniculus domesticus; Schwartz and Shook 1933.
Sylvilagus floridanus mallurus; Stiles and Hassall 1894, 160, 161.
Sylvilagus sp.; Alabama; Noble and Smith 1932, 216.
- Hemistomum craterum* Barker and Noll 1915
Ondatra zibethica z.; Canada; Law and Kennedy 1932, 30.
- Heterochinostomum magnovatum* Stunkard and Haviland 1924
Rattus norvegicus; New York; Stunkard and Haviland 1924, 7.
- Monostomum sp.*
Microtus pennsylvanicus p.; Stiles and Hassall 1894, 253.
- Notocotyle hassalli* McIntosh and McIntosh 1934
Microtus pennsylvanicus p.; Maryland; McIntosh and McIntosh 1934, 36.
- N. quinqueseriale* Barker and Laughlin 1915
Microtus pennsylvanicus p.; Maryland; Harrah 1922, 54.
Ondatra zibethica z.; Canada; Law and Kennedy 1932, 30; Washington;
Harrah 1922, 54.
- N. urbanensis* (Cort 1914)
Ondatra zibethica z.; Maryland; Harrah 1922, 51.
- Nudacotyle novicia* Barker 1916
Ondatra zibethica z.; Canada; Law and Kennedy 1932, 30.
- Paragonimus sp.*
Ondatra zibethica z.; Michigan; Ameal 1932, 382.

- Paramonostomum echinum* Harrah 1922.
Ondatra zibethica z.; Colorado; Harrah 1922, 56.
- P. pseudalveatum* Price 1931
Ondatra zibethica z.; Price 1931, 10.
- Plagiorchis proximus* Barker 1915
Ondatra zibethica z.; Canada; Law and Kennedy 1932, 30.
- Postharmostomum laruei* McIntosh 1934
Tamias striatus lysteri; Michigan; McIntosh 1934, 3.
- Psilostomum ondatrae* Price 1931
Ondatra zibethica z.; Canada; Law and Kennedy 1932, 30.
- Renifer ellipticum* Pratt 1903
Castor canadensis c.; Philadelphia; Canavan 1934, 117.
- Scaphiostomum pancreaticum* McIntosh 1934
Peromyscus gossypinus g.; Georgia; McIntosh 1935, 80.
Tamias striatus lysteri; Michigan; McIntosh, 3.
- Schistosomatium douthitti* Price 1931
Microtus pennsylvanicus p.; Price 1931, 691.
Mus musculus; Price 1931, 691.
Peromyscus maniculatus; Price 1931, 690.
- S. pathlopticum* Tanabe 1923
Rattus norvegicus; Massachusetts; Tanabe 1923, 197.
- Stephanoproraoides larvi* Price 1934
Castor canadensis c.; Canada; Price 1934, 1.
- Urotrema schillingeri* Price 1931
Ondatra zibethica z.; Maryland; Price 1931, 8.
- Wardius zibethicus* Barker and East 1915
Ondatra zibethica z.; Law and Kennedy 1932, 30.

CESTODA

- Andrya cuniculi* (Blanchard 1891)
Oryctolagus cuniculus domesticus; United States; Meggitt 1924, 206.
- A. macrocephala* Douthitt 1915
Geomys bursarius; Minnesota; Douthitt 1915, 10.
- A. primordialis* Douthitt 1915
Eutamias gapperi galei; United States; Baer 1927, 211.
E. g. gapperi; United States; Baer 1927, 211.
Microtus pennsylvanicus, p.; United States; Meggitt 1924, 19.
Sciurus hudsonicus h.; Minnesota; Douthitt 1915, 5.
- Anomataenia telescopica* Barker 1915
Ondatra zibethica z.; United States; Meggitt 1924, 56.

- Catenotaenia pusilla* (Goeze 1782)
Rattus norvegicus; United States; Oldham 1931, 65.
R. rattus rattus; United States; Oldham 1931, 65.
- Cittotaenia ctenoides* (Railliet 1890)
Lepus californicus c.; Oklahoma; Ward 1934, 34.
L. sp.; West Virginia; Weimer, Hedden and Cowdery 1934, 55.
Sylvilagus aquaticus a.; Oklahoma; Ward 1934, 84.
S. floridanus alacer; Oklahoma; Ward 1932, 84.
S. f. mallurus; Pennsylvania; Smith 1908, 264.
- C. pectinata* (Goeze 1782)
Erethizon dorsatum d.; United States; Baer 1927, 211.
Lepus americanus a.; Canada; Boughton 1932.
L. californicus c.; United States; Meggitt 1924, 26.
L. c. melanotis; Nebraska; Douthitt 1915, 47.
Oryctolagus cuniculus domesticus; Baer 1927, 213.
Sylvilagus floridanus mallurus; North Carolina; Harkema, this paper.
S. nuttalli nuttalli; United States; Meggitt 1924, 26.
S. n. pinetis; United States; Baer 1927, 213.
S. palustris p.; United States; Meggitt 1924, 29.
- C. praecoquis* Stiles 1895
Geomys bursarius; United States; Baer 1927, 212.
- C. sp.*
Geomys bursarius; Minnesota; Douthitt 1915, 62.
- Cladotaenia sp.*
Cynomys bursarius; Scott 1931, 49.
- Davainea sp.*
Geomys breviceps b.; Oklahoma; Douthitt 1915, 62.
- Diandrya composita* Darrah 1930
Marmota flaviventris nosophora; Wyoming; Darrah 1930, 252.
- Echinococcus granulosus* (Batsch 1786)
Oryctolagus cuniculus domesticus; Hall 1919.
- Hymenolepis diminuta* (Rudolphi 1819)
Mus musculus; North Carolina; Harkema, this paper.
Rattus norvegicus; District of Columbia; Stiles and Hassall 1894; California; McCoy 1909, 1370.
R. rattus rattus; United States; Oldham 1930, 62.
Sigmodon hispidus h.; United States; Meggitt 1924, 70.
S. h. texianus; Smith 1908, 264.
- H. evaginata* Barker and Andrews 1915
Ondatra zibethica z.; Canada; Law and Kennedy 1932, 30.

- H. fraterna* (Stiles 1906)
Mus musculus; Maryland; Shorb 1933, 91
Rattus norvegicus; Maryland; Shorb 1933, 91.
- H. nana* (Siebold 1852)
Rattus norvegicus; District of Columbia; Price and Chitwood 1931, 55;
 Missouri; Tsuchiya and Rector 1935, 427.
- H. sp.*
Geomys breviceps b.; Oklahoma; Douthitt 1915, 62.
G. bursarius; Illinois; Minnesota; Dakota; Douthitt 1915, 62.
G. personatus fallax; Texas; Douthitt 1915, 62.
Ondatra zibethica z.; Canada; Swales 1933, 480.
- “Larval Tapeworm”
Cynomys leucurus; Wyoming; Scott 1930, 115.
Sciurus carolinensis c.; Maryland; Virginia; Schwartz 1928, 67.
- Mesocestoides lineatus* (Goeze 1782)
Mus musculus; Hall 1919, 61.
Rattus norvegicus; United States; Oldham 1931, 64.
- Multiceps multiceps* (Leske 1780) (larva)
Lepus americanus a.; Canada; Boughton 1932, 213.
Lepus sp.; United States; Meggitt 1924, 154.
Oryctolagus cuniculus domesticus; United States; Meggitt 1924, 154.
- M. packi* Christenson 1929 (larva)
Lepus americanus a.; Minnesota; Christenson 1929, 49.
L. californicus c.; Oklahoma; Ward 1934, 84.
L. californicus c.; Oklahoma; Ward 1934, 84.
L. campestris c.; United States; Schulz 1931, 205.
Sylvilagus floridanus mearnsi; United States; Schulz 1931, 206.
- M. serialis* (Gervais 1847) (larva)
Lepus americanus a.; Canada; Boughton 1932, 213.
L. californicus c.; United States; Hall 1919, 81
L. c. deserticola; Ibid.
L. c. texianus; Ibid.
L. c. wallawalla; Ibid.
L. callotis; Mexico; Meggitt 1924, 155.
L. campestris c.; Meggitt 1924, 155.
Oryctolagus cuniculus domesticus; Hall 1919, 81.
Rattus norvegicus; United States; Oldham 1931, 65.
Sciurus carolinensis c.; United States; Hall 1919, 81.
S. niger neglectus; Ibid.
S. n. niger; United States; Meggitt 1924, 155.
S. n. rufiventer; Nebraska; Martin 1930, 804.

- Sylvilagus floridanus mearnsi*; United States; Bonnal, Joyeux and Bosch 1933, 1068.
S. palustris palustris; United States; Bonnal, Joyeux and Bosch 1933, 1068.
- Oochoristica* sp.
Geomys bursarius; Minnesota; Douthitt 1915, 62.
- Paroniella retractilis* (Stiles 1895)
Sylvilagus auduboni arizonae; Stiles 1895, 343.
- Paranoplocephala infrequens* (Douthitt 1915)
Evotomys sp.; North Dakota; Baer 1927, 212.
Geomys bursarius; Canada; Baer 1927, 212.
Microtus sp.; United States; Baer 1927, 212.
- Prochoanotaenia spermophili* MacLeod 1933
Citellus richardsonii; Canada; MacLeod 1933, 124.
C. tridecimlineatus t.; Canada; MacLeod 1933, 124.
- Rallietina (Johnstonia) salmonis* (Stiles 1895)
Lepus californicus melanotis; United States; Meggitt 1924, 49.
Sylvilagus floridanus mallurus; United States; Schulz 1931, 184, 185.
- R.* sp.
Geomys breviceps b.; Oklahoma; Meggitt 1924, 51.
Lepus alleni a.; Arizona; Vorhies and Taylor 1933, 551.
- Schizotaenia americana* (Stiles 1895)
Erethizon dorsatum d.; United States; Baer 1927, 212.
E. epixanthum e., Ibid.
- S. anoplocephalooides* Douthitt 1915
Geomys breviceps b.; Oklahoma; Douthitt 1915, 35.
- S. erethizontis* (Beddard 1914)
Erethizon dorsatum d.; New York; Douthitt 1915, 33.
E. epixanthum e.; Alaska; Baer 1927, 116.
- S. sigmodontis* Chandler and Suttles 1922
Sigmodon hispidus h.; United State; Baer 1927, 211.
Sigmodon h. texianus; Texas; Chandler and Suttles 1922, 123.
- Taenia hydatigena* (Pallas 1766) (larva)
Mus musculus; District of Columbia; Stiles and Hassall 1894, 353.
Rattus norvegicus; United States; Oldham 1931, 66.
R. rattus rattus; United States; Ibid.
Sciurus niger neglectus; Hall 1919, 81.
S. n. niger; Meggitt 1924, 160.
- T. pisiformis* (Bloch 1780) (larva)
Lepus americanus a.; Canada; Boughton 1932, 213.
L. californicus c.; Oklahoma; Ward 1934, 84.
L. c. wallawalla; California; Hall 1919, 81.

- L. sp.*; West Virginia; Weimer, Hedden and Cowdery 1934, 55.
Mus musculus; Hall 1919, 81.
Oryctolagus cuniculus domesticus; Hall 1919, 81.
Rattus rattus r.; United States; Oldham 1931, 66.
Sylvilagus auduboni baileyi; Meggitt 1924, 164.
S. floridanus alacer; Oklahoma; Ward 1934, 84.
S. f. mallurus; Hall 1919, 82.
S. f. mearnsi; Hall 1919, 82.
S. nuttalli, n.; Meggitt 1924, 164.
S. n. pinetis; Hall 1919, 82.
S. palustris palustris; Hall 1919, 82.
T. portolae (Wellman and Wherry 1910) (larva)
Otospermophilus grammurus g.; California; Meggitt 1924, 164.
Taenia taeniaeformis (Batsch 1786) (larva)
Mus musculus; California; McCoy 1909, 1370; United States; Hall 1919, 81.
Ondatra zibethica z.; Canada; Law and Kennedy 1932, 30.
Rattus norvegicus; United States; Hall 1919, 81.
Sciurus carolinensis c.; North Carolina; Harkema, this paper.
S. n. rufiventer; Kansas; Dobrovsky and Harbough 1934, 67; Nebraska; Martin 1930, 804.
T. twitchelli Schwartz 1924 (larva)
Erethizon epixanthum e.; Alaska; Schwartz 1924, 2.
T. sp.
Erethizon dorsatum d.; District of Columbia; Stiles and Hassall 1894, 334.
Sylvilagus floridanus mallurus; Ibid.
S. palustris p.; Ibid.
Weinlandia citelli MacLeod 1933
Citellus franklinii; Canada; MacLeod 1933, 122.
C. richardsonii; Ibid.
C. tridecimlineatus t.; Ibid.

NEMATODA

- Ascaris laevis* Leidy 1856
Marmota monax m.; United States; Hall 1916, 41.
Capillaria gastrica (Baylis 1926)
Rattus norvegicus; District of Columbia; Alicata and Lucker 1932, 311.
C. hepatica (Bancroft 1893)
Castor canadensis c.; District of Columbia; Chitwood 1934, 10.
Geomys bursarius; Philadelphia; Weidman 1917, 37.
Ondatra zibethica z.; Canada; Swales 1933, 475.
Rattus norvegicus; Hall 1916, 32.

- R. rattus alexandrinus*; Hall 1916, 32.
Sylvilagus floridanus alacer; Oklahoma; Ward 1934, 84.
Thomomys fessor; Wyoming; Dikmans 1932, 84.
- C. ransomia* Barker and Noyes 1915
Ondatra zibethica s.; Nebraska; Hall 1916, 34.
- C. sp.*
Cynomys leucurus ludovicianus; Ratcliffe 1931, 37.
- Castorstrongylus castoris*; Chapin 1925
Castor canadensis c.; District of Columbia; Chapin 1925, 681; Philadelphia; Canavan 1931, 199.
- Citellina marmotae* Manter 1930
Marmota monax canadensis; Maine; Manter 1930, 29.
M. m. monax; New York; McClure 1934, 49, 51, 55.
- Citellinema bifurcatum* Hall 1916
Citellus elegans; Colorado; Hall 1916, 142.
- C. mcnaicis* Manter 1930
Marmota monax canadensis; Maine; Manter 1930, 29.
- C. quadrivittati* (Hall 1916)
Eutamias quadrivittatus q.; Colorado; Schulz 1933, 77.
- C. sleggsi* Manter 1930
Citellus richardonii; Canada; Schulz 1933, 77.
- Dermatoxys veligera* (Rudolphi 1819)
Lepus alleni a.; Arizona; Vorhies and Taylor, 1933, 551.
L. californicus melanotis; United States; Hall 1916, 102.
Sylvilagus auduboni baileyi; United States; Hall 1916, 102.
S. nuttalli pinetis; Ibid.
- Dipetalonema diacantha* (Molin 1858)
Erethizon dorsatum d.; Minnesota; Jellison 1933, 43, 45.
- Dirofilaria repens* Railliet and Henry 1911
Erethizon dorsatum d.; Philadelphia; Canavan 1931, 223.
- D. scapiceps* (Leidy 1886)
Lepus campestris c.; United States; Schulz 1931, 136-137.
Sylvilagus floridanus alacer; United States; Ibid.
S. floridanus mallurus; United States; Hall 1916, 166.
S. palustris palustris; United States; Schulz 1931, 136-137.
- D. spinosa* Canavan 1929
Erethizon dorsatum d.; Minnesota; Jellison 1933, 43, 45.
- D. subcutanea* (Linstow 1899)
Erethizon dorsatum d.; Philadelphia; Canavan 1931, 221; Canada; Boulenger 1920, 492.
- Filaria* sp.
Castor canadensis c.; Michigan; Hall 1916, 188.

- Filaria obtusa* (Froelich 1791) *Protospirura muris* (Gmelin 1791)
Rattus norvegicus; District of Columbia; Stiles and Hassall 1894, 339.
- Gongylonema neoplasticum* (Fibiger and Ditlevsen 1914)
Rattus norvegicus; District of Columbia; Lucker 1931, 55.
- Gongylonema* sp.
Castor canadensis c.; Michigan; Hall 1916, 198.
- Graphidium strigosus* (Dujardin 1845)
Oryctolagus cuniculus domesticus; Schwartz and Shook 1933.
Sylvilagus aquaticus a.; Oklahoma; Ward 1934, 84.
Sylvilagus floridanus alacer; Oklahoma; Ward 1934, 84.
- Heligmosomum vexillatum* Hall 1916
Rattus norvegicus; Colorado; Hall 1916, 157.
Thomomys fessor; Colorado; Hall 1916, 157.
- Heterakis spumosa* Schneider 1866
Mus musculus m.; Maryland; Winfield 1933, 177.
Rattus norvegicus; United States; Hall 1916, 47.
R. rattus rattus; Ibid.
- Heteroxytnema cucullatum* Hall 1916
Eutamias minimus oparius; Colorado; Hall 1916, 60.
- Litosomoides carinii* Vaz 1934
Sigmodon hispidus h.; Mexico, Texas; Vaz 1934, 146.
- L. patersoni* Sandground 1934
Sigmodon sp.; Sandground 1934, 596.
- L. sigmodontis* Chandler 1931
Sigmodon hispidus h.; Texas; Chandler 1931, 6.
- Longistriata adunca* Chandler 1932
Sigmodon hispidus h.; Texas; Chandler 1932, 25, 27.
- L. carolinensis* Dikmans 1935
Peromyscus maniculatus nebracensis; Indiana; Dikmans 1935, 72-81.
- L. dalrympei* Dikmans 1935
Ondatra zibethica z.; New Jersey, Indiana, Mississippi; Dikmans 1935, 72-81.
Microtus pennsylvanicus p.; Ibid.
- L. hassalli* (Price 1928)
Sciurus carolinensis c.; Maryland; Price 1928, 4.
- L. musculi* Dikmans 1935
Mus musculus; Louisiana; Dikmans 1935, 72-81.
- L. norvegicus* Dikmans 1935
Rattus sp.; Louisiana; Dikmans 1935, 72-81.
- L. noviberiae* Dikmans 1935
Sylvilagus aquaticus littoralis; Louisiana; Dikmans 1935, 78.
S. floridanus alacer; Louisiana; Ibid.

Microfilaria sp.

Oryctolagus cuniculus domesticus; Canada; Harkin 1927, 113.

M. rosenawi McCoy 1911

Otospermophilus grammurus becheyi; California; Hall 1916, 189.

Micropleura sigmodoni Ochoterna and Caballero

Sigmodon hispidus h.; Mexico; Ochoterna and Caballero 1932, 123-125.

Monodontus floridanus McIntosh 1935

Sigmodon hispidus h.; Florida; McIntosh 1935, 29.

Nematode sp.

Lepus californicus c.; Oklahoma; Ward 1934, 84.

Nematodirus leporis Chandler 1924

Oryctolagus cuniculus domesticus; Texas; Chandler 1924, 2.

N. neotoma Hall 1916

Neotoma cinerea rupicola; Colorado; Hall 1916, 138.

N. desertorum; Colorado; Ibid.

N. floridanus baileyi; United States; Travassos 1921, 30, 70, 115.

N. mexicana fallax; United States; Hall 1916, 138.

N. sp.; Hall 1916, 138.

N. triangularis Boughton 1932

Lepus americanus a.; Canada; Boughton 1932, 532.

N. sp.

L. alleni alleni; Arizona; Vorhies and Taylor 1933, 551.

Nematospira turgida Walton 1923

Microtus pennsylvanicus p.; Illinois; Walton 1923, 61.

Nippostrongylus muris (Yokogawa 1920)

Rattus norvegicus; Maryland; Yokogawa 1920, 29.

R. rattus alexandrinus; Maryland; Graham 1934, 352.

Obeliscoides cuniculi (Graybill 1923)

Lepus californicus c.; Oklahoma; Ward 1934, 84.

L. c. melanotis; New York; McClure 1932, 7, 14.

L. sp.; West Virginia; Weimer, Hedden and Cowdery 1934, 55.

Oryctolagus cuniculus domesticus; Graybill 1923, 340.

Sylvilagus aquaticus a.; Oklahoma; Ward 1934, 84.

S. floridanus alacer; Ibid.

S. f. mallurus; Graybill 1924, 1.

Ollulanus tricuspis Leuckart 1865 (larva)

Mus musculus; Hall 1916, 177.

Oxyuris tetraptera (Nitzsch 1821)

Mus musculus; United States; Hall 1916, 89.

O. triradiata Hall 1916

Ammospermophilus leucurus l.; United States; Hall 1916, 89

Callospermophilus lateralis cinerascens; United States; Hall 1916, 89.

O. sp.

Microtus pennsylvanicus p.; United States; Stiles and Hassall 1894, 342.

Pitymys pinetorum p.; Maryland; Stiles and Hassall 1894, 342.

Passalurus ambigua (Rudolphi 1829)

Lepus arcticus; Hall 1916, 70.

L. californicus c.; Oklahoma; Ward 1934, 84.

L. sp.; West Virginia; Weimer, Hedden and Cowdery 1934, 55.

Marmota monax m.; New York; Baker 1934, 48.

Oryctolagus cuniculus domesticus; United States; Hall 1916, 70.

Sylvilagus floridanus alacer; Oklahoma; Ward 1934, 84.

S. f. mallurus; Hall 1916, 70.

P. nonannulatus Skinker 1931

Lepus americanus a.; Canada; Skinker 1931, 5.

Sylvilagus floridanus mallurus; United States; Skinker 1931, 5.

Physaloptera spinicauda MacLeod 1933

Citellus franklinii; Canada; MacLeod 1933, 122.

C. tridecimlineatus t.; Canada; MacLeod 1933, 122.

Protospirura ascaroidea Hall 1916

Geomys breviceps b.; Oklahoma; Hall 1916, 120.

Sigmodon hispidus texianus; Oklahoma; Chandler and Suttles 1922, 123.

P. columbiana Cram 1926

Rattus norvegicus; District of Columbia; Cram 1926, 3.

P. muris (Gmelin 1790)

Microtus pennsylvanicus p.; Illinois; Walton 1924, 204.

Mus musculus m.; Hall 1916, 206; Illinois; Kudo 1924, 160.

Rattus norvegicus; United States; Hall 1916, 206.

R. rattus alexandrinus; United States; Hall 1916, 206.

R. r. rattus; United States; Hall 1916, 206.

Protostrongylus rufescens

Sylvilagus nuttalli grangeri; Scott & Honess 1932, 60.

Ransomus rodentorum Hall 1916

Thomomys fossor; Colorado; Hall 1916, 118.

Rictularia citelli MacLeod 1933

Citellus franklinii; Canada; MacLeod 1933, 122.

C. tridecimlineatus t.; Ibid.

R. coloradensis Hall 1916

Eutamias quadrivittatus c.; Colorado; Hall 1916, 175.

Peromyscus leucopus l.; North Carolina; Harkema, this paper.

Sincosta aberrans Roe 1929

"Wild Mouse"; New Jersey; Roe 1929, 3.

Spirura infundibuliformis MacLeod 1933

Citellus richardsonii; Canada; MacLeod 1933, 117.

C. tridecimlineatus t.; Canada; Ibid.

- Strongyloides papillosus* (Wedl 1856)
Lepus americanus a.; Canada; Boughton 1932, 530.
Oryctolagus cuniculus domesticus; United States; Ransom 1911, 105.
Rattus norvegicus; United States; Hall 1916, 8; Canada; Boughton 1932, 530.
- S. ratti* Sandground 1925
Rattus norvegicus; Maryland; Sandground 1925, 71; Missouri; Tsuchiya and Rector 1935, 427.
- Strongylus* sp.
Castor canadensis c.; United States; Hall 1916, 109.
- Synthetocaulus commutatus* (Diesing 1851)
Oryctolagus cuniculus domesticus; Schwartz and Shook 1933, 22.
- S. leporis* Boughton 1932
Lepus americanus a.; Canada; Boughton 1932, 533-534.
- S. rufescens* (Leuckart 1865)
Oryctolagus cuniculus domesticus; Schwartz and Shook 1933.
- Syphacia obvelata* (Rudolphi 1802)
Evotomys gapperi g.; United States; Hall 1916, 82.
Mus musculus m.; Ibid.
Neotoma mexicana fallax; Ibid.
Onychomys leucogaster l.; Ibid.
Peromyscus nasutus; Ibid.
Rattus norvegicus; Ibid.
R. rattus rattus; Ibid.
- Syphacia peromysci* n. sp.
Peromyscus leucopus leucopus; North Carolina; Harkema, this paper.
- S. thompsoni* Price 1928
Glaucomyx volans v.; Virginia; Price 1928, 2.
- Travassosius americana* Chapin 1925
Castor canadensis c.; District of Columbia; Chapin 1925, 679.
- Trichinella spiralis* (Owen 1835)
Oryctolagus cuniculus domesticus; United States; Stiles and Hassall 1894, 349.
Rattus norvegicus; United States; Hall 1916, 10.
R. rattus rattus; United States; Hall 1916, 10.
- Trichosomoides crassicauda* (Bellingham 1845)
Rattus norvegicus; United States; Oldham 1931, 78.
R. rattus rattus; United States; Oldham 1931, 78.
- Trichostrongylus affinis* Graybill 1924
Sylvilagus floridanus mallurus; Graybill 1924, 1.
- T. calcaratus* Ransom 1911
Oryctolagus cuniculus domesticus; Graybill 1924, 1.

- Sylvilagus floridanus alacer*; Oklahoma; Ward 1934, 84.
S. f. mallurus; Maryland; Ransom 1911, 367.
- T. colubriformis* (Giles 1892)
Lepus californicus melanotis; Nebraska; Skidmore 1932, 800.
Sciurus aberti aberti; United States; Hall 1916.
Sciurus a. mimus; United States; Nagaty 1932, 470.
- T. fiberius* Barker and Noyes 1915
Ondatra zibethica z.; Nebraska; Hall 1916, 129.
- T. retortaeformis* (Zeder 1800)
Oryctolagus cuniculus domesticus; United States; Travassos 1921, 15, 41, 115.
- T. sp.*
Marmota monax m.; New York; McClure 1934, 49.
- Trichuris fossor* Hall 1916
Thomomys fossor; Colorado; Hall 1916, 23.
- T. leporis* (Froelich 1789)
Oryctolagus cuniculus domesticus; United States; Hall 1916, 25.
Lepus americanus a.; Canada; Boughton 1932, 539.
Lepus sp.; West Virginia; Weimer, Hedden and Cowdery 1934, 55.
Sylvilagus aquaticus a.; Oklahoma; Ward 1934, 84.
S. floridanus f.; United States; Hall 1916, 25.
S. f. mallurus; United States; Hall 1916, 25.
- T. opaca* Barker and Noyes 1915
Ondatra zibethica z.; Nebraska; Hall 1916, 28.
- Vestibulosetaria patersoni* (Mazza 1923)
Sigmodon hispidus h.; Mexico; Vogel and Gabaldon 1932, 124.
- Warrenius bifurcatus* Hall 1916
Citellus richardonii; Canada; MacLeod 1933, 144.
- W. quadrivittati* Hall 1916
Eutamias quadrivittatus c.; Colorado; Hall 1916, 144.
- Wellcomia evoluta* (Linstow 1899)
Erethizon dorsatum d.; Philadelphia; Canavan 1931, 208.
E. epixanthum c.; Minnesota; Jellison 1933, 44.
Sylvilagus floridanus mearnsi; Kansas; Danheim 1924, 124.

ACANTHOCEPHALA

Acanthocephalid

- Lepus americanus*; Manitoba; Boughton 1932, 527, 539.
- Moniliformis moniliformis* (Bremser 1811)
Rattus norvegicus; Chandler 1921, 179.
R. rattus r.; Ibid.
Sciurus niger n.; Stiles and Hassall 1894e, 352.

M. spiradentatus MacLeod 1933

Citellus tridecemlineatus t.; Canada; MacLeod 1933, 121.

M. sp.

Neotoma sp.; Florida; Stiles 1932, 90.

Sciurus niger n.; Texas; Chandler 1921, 179.

PENTASTOMIDA

Linguatula serrata (Froelich 1789)

Oryctolagus cuniculus domesticus; Schwartz and Schook 1933.

Porocephalus sp.

Erethizon dorsatum d.; Stiles and Hassall 1894, 354.

PARASITIC MITES

Atricholaelaps glasgowi (Ewing 1925)

Sciurus carolinensis c.; North Carolina; Harkema, this paper.

Bdella cardinalis Banks

Rattus norvegicus; New York; Fox and Sullivan 1925, 17.

Cyclolaelaps circularis Ewing 1932

Peromyscus truei t.; Utah; Ewing 1933, 6.

Cytolaelaps banksi Wellman and Wherry 1910

Otospermophilus grammurus beecheyi; California; Wherry and Wellman 1910, 421.

C. penrosei Weidman 1916

Cynomys ludovicianus l.; Philadelphia; Weidman 1916, 82.

Dermanyssus evotomydis Ewing 1933

Evotomys sp.; New York; Ewing 1933, 11, 13.

Echinolaelaps echidninus Berlese

Mus musculus; Cosmopolitan; Banks 1910, 84.

Rattus norvegicus; Ibid.

R. rattus rattus; Ibid.

Euhaemogamasus americanus (Banks 1906)

Peromyscus eremicus e.; Arizona; Banks 1906, 137.

E. microti Ewing 1925

Microtus pennsylvanicus p.; New York; Ewing 1925, 142.

E. onychomydis Ewing 1933

Onychomys sp.; Arizona; Ewing 1933, 4.

E. oregonensis Ewing 1933

Dicrostonyx hudsonicus; Oregon; Ewing 1933, 5.

Phenacomys albipes; Oregon; Ibid.

E. sanguineus (Ewing and Stover 1915)

Rattus rattus rattus; Iowa; Ewing and Stover 1915, 111.

E. twitchelli (Ewing 1925)

Evotomys dawsoni d.; Alaska; Ewing 1925, 143.

- E. utahensis* Ewing 1933
Neotoma lepida l.; Utah; Ewing 1933, 41.
- E. alaskensis* (Ewing 1925)
Microtus sp.; Alaska; Ewing 1925, 138.
- Hannemania hirsuta* Ewing 1931
Perognathus californicus c.; California; Ewing 1931, 18.
- Ichoronyssus carnifex* (Koch)
Mus sp.; Oregon; Ewing 1923, 15.
- I. isabellensis* (Oudemans)
Mus sp.; District of Columbia; Ewing 1923, 16.
- I. sternalis* Ewing 1923
Marmota monax m.; Plimmers Island; Ewing 1923, 14.
- Laelaps hawaiiensis* Ewing
Rattus rattus r.; New York, New Orleans; Fox and Sullivan 1925, 1909.
- L. hollisteri* Ewing 1925
Peromyscus californicus c.; California; Ewing 1925, 2.
- L. multispinosus* Banks
Ondatra zibethica z.; Banks 1915, 84.
- L. proheticus* Banks
Marmota monax m.; Banks 1915, 84.
- Liponyssus bacoti* (Hirst)
Rattus norvegicus; District of Columbia, New York, Missouri, Texas;
Ewing 1922, 19.
- L. montanus* Ewing 1922
Citellus richardsoni; Montana, Canada; MacLeod 1933, 112.
C. tridecimlineatus t.; Ibid.
- L. occidentalis* Ewing 1922
Citellus richardsoni; Montana, Canada; MacLeod 1933, 112.
C. tridecimlineatus t.; Ibid.
- Listrophorus validus* Banks
Ondatra zibethica z.; Banks 1915, 127.
- Myobia musculi* Shrank
Mus musculus m.; United States; Banks 1910, 84.
- M. ratti* Skidmore 1932
Rattus norvegicus; Nebraska; Skidmore 1932, 172.
- Neoschongastia brevipes* Ewing 1931
Peromyscus leucopus noveboracensis; Maryland; Ewing 1931, 16.
- N. californicus* (Ewing 1925)
"Ground Squirrel"; California; Ewing 1931, 5.
- N. peromysci* (Ewing 1929)
Peromyscus leucopus noveboracensis; Massachusetts; Ewing 1931, 5.
- N. sciuricola* (Ewing 1925)
Sciurus hudsonicus richardsoni; Montana; Ewing 1931, 5.

Notoedres notoedres (Megnin)*Rattus norvegicus*; United States; Ewing 1929, 54.*R. rattus rattus*; United States; Ibid.*N.* sp.*Sciurus griseus g.*; California; Bryand 1921, 128.*Psoroptes communis cuniculi* (Delafond)*Oryctolagus cuniculus domesticus*; Schwartz and Shook 1933, 3.*Lepus californicus c.*; Oklahoma; Ward 1934, 83.*Sylvilagus aquaticus a.*; Oklahoma; Ward 1934, 83.*S. floridanus alacer*; Oklahoma; Ibid.*Sarcoptes scabiei* De Geer*Rattus norvegicus*; California; McCoy 1909, 1371.*Schizocarpus mingaudi* Trouessart 1896*Castor canadensis c.*; Banks 1915, 127.*Tetragonyssus microti* Ewing 1933*Microtus californicus c.*; California; Ewing 1933, 10.*M.* sp.; California; Ibid.*T. spiniger* (Ewing and Stover 1915)*Ondatra rivalicia*; Louisiana; Svihla 1930, 287.*O. zibethica z.*; United States; Ewing 1923, 11.*Trombicula bisignalia* Ewing 1929*Microtus pennsylvanicus p.*; Maine; Ewing 1929, 295.*Peromyscus maniculatus abietorum*; Maine; Ibid.*T. dentata* Ewing 1925*Sigmodon hispidus chiriquensis*; Panama; Ewing 1925, 260.*T. dunni* Ewing 1931*Dasyprocta punctata nuchalis*; Panama; Ewing 1931, 112.*T. harperi* Ewing 1928*Evotomys gapperi g.*; New York; Ewing 1928, 79.*Napaeozapus insignis i.*; New York; Ibid.*Sciurus hudsonicus h.*; New York; Ibid.*T. irritans* (Riley)*Lepus californicus c.*; Oklahoma; Ward 1934, 83.*Sylvilagus aquaticus a.*; Oklahoma; Ibid.*S. floridanus alacer*; Oklahoma; Ibid.*T. microti* Ewing 1928*Microtus pennsylvanicus modestus*; Colorado; Ewing 1928, 80.*M. richardsoni macropus*; Wyoming; Ibid.*T. panamensis* Ewing 1925*Sigmodon hispidus chiriquensis*; Panama; Ewing 1925, 260.*Trombicula* sp.*Sciurus carolinensis c.*; North Carolina; Harkema, this paper.

IXODOIDEA

Amblyomma longirostre Koch*Coendou rothschildi*; Panama; Dunn 1923, 98.*A. maculatum* Koch 1844*Lepus californicus merriami*; Texas; Bishopp 1912, 37.*A. parvus* Aragao 1908*Sigmodon hispidus chiriquensis*; Panama; Dunn 1923, 99.*Dermacentor albipictus* Packard*Oryctolagus cuniculus domesticus*; Bishopp and Wood 1913, 163.*D. andersoni* Stiles (*D. VENUSTUS* Banks)*Callospermophilus chrysodeirus c.*; United States; Brumpt 1922, 758.*C. lateralis cinerascens*; Western United States; Hooker, Bishopp and Wood 1912, 166.*Citellus columbianus c.*; Montana; Cooley 1932, 47, 50.*C. franklini*; MacLeod 1933, 111.*C. richardsonii*; Canada, Montana; Ibid.*C. tridecimlineatus t.*; Canada; Ibid.*Erethizon epixanthum e.*; Jellison 1933, 43.*Eutamias amoenus lutriiventris*; Montana; Cooley 1932, 32.*E. umbrinus*; Montana; Ibid.*Lepus bairdii b.*; Western United States; Hooker, Bishopp and Wood 1912, 166.*L. campestris townsendi*; United States; Brumpt 1922, 758.*Marmota flaviventris f.*; Western United States; Hooker, Bishopp and Wood 1912, 166.*M. monax m.*; Western United States; Ibid.*Microtus pennsylvanicus modestus*; Western United States; Ibid.*M. nanus canescens*; Western United States; Ibid.*Neotoma cinerea c.*; Western United States; Ibid.*Ochotona princeps p.*; Western United States; Ibid..*Sciurus hudsonicus richardsoni*; Western United States; Ibid.*Sylvilagus nuttalli n.*; Western United States; Ibid.*Thomomys fuscus f.*; Western United States; Ibid.*D. electus* Linnaeus*Lepus callotis*; Neumann 1901b, 365.*L. sp.*; Ibid.*D. occidentalis* Neumann 1899*Otospermophilus grammurus beecheyi*; Wherry and Wellman 1909, 376.*D. perumapertus marginatus* Banks*Lepus alleni a.*; Arizona; Vorhies and Taylor 1933, 550.*L. californicus*; Arizona; Ibid.*L. c. deserticola*; Utah; Stanford 1934, 247.*L. c. melanotis*; Colorado; McCampbell 1926, 12.

D. variabilis (Say)

Microtus pennsylvanicus p.; Massachusetts; Parker, Philip and Jellison 1933, 349.

Peromyscus leucopus; Montana; Cooley 1932, 15; Massachusetts; Parker, Philip and Jellison 1933, 349.

Sciurus niger n.; Western United States; Hooker, Bishopp and Wood 1912, 191.

Sylvilagus aquaticus a.; Western United States; Ibid.

Haemaphysalis concinna Koch 1844

Marmota monax m.; Neumann 1901, 365.

H. flava Neumann 1897

Lepus sp.; Neumann 1901, 365.

H. leporis-palustris (Packard 1869)

Lepus americanus a.; Canada; Hewitt 1915, 230.

L. californicus c.; Oklahoma; Ward 1934, 83.

L. c. melanotis; Colorado; McCampbell 1926, 12.

L. sp.; United States; Neumann 1901, 365.

Oryctolagus cuniculus domesticus; United States; Schwartz and Shook 1933, 27.

Sylvilagus aquaticus a.; Oklahoma; Ward 1934, 83.

S. floridanus alacer; Oklahoma; Ibid.

S. f. mallurus; North Carolina; this paper.

S. palustris p.; United States; Neumann 1901, 364.

Ixodes aequalis Banks 1909

Otospermophilus grammurus beecheyi; California; Wherry and Wellman 1909, 376.

I. angustus Neumann 1901

Lepus americanus a.; Canada; Hewitt 1915, 226.

Neotoma cinerea occidentalis; United States; Neumann 1901, 365.

Sciurus douglasii d.; Canada; Hadwen 1911, 37.

S. d. vancouverensis; Canada; Ibid.

I. a. woodi Bishopp 1911

Neotoma micropus m.; Texas; Nuttall 1916, 336.

I. banksi Bishopp 1911

Ondatra zibethica z.; Arkansas; Nuttall 1916, 337.

I. dentatus Marx 1899

Oryctolagus cuniculus domesticus; Neumann 1901, 324.

I. d. spinipalpis Hadwen and Nuttall 1915

Lepus americanus a.; Canada; Nuttall 1916, 304.

Sciurus douglasii; Canada; Ibid.

I. diversifossus Neumann 1899

Sylvilagus nuttalli n.; Montana; Bishopp 1912, 30.

S. n. grangeri; Utah; Stanford 1934, 247.

- I. hexagonus* Leach 1815
Sylvilagus floridanus; Neumann 1901, 365.
- I. hexagonus cookei* (Packard 1869)
Callospermophilus chrysodeirus; San Francisco; Nuttall 1916, 328.
- I. hexagonus inchoatus* Neumann 1901
Sciurus sp.; Neumann 1901, 365.
- I. hexagonus* (Leach) *longispinosus* Neumann 1901
Marmota sp.; Neumann 1901, 365.
- I. holocyclous* Neumann 1899
Sciurus sp.; Neumann 1901, 365.
- I. kingi* Bishopp 1911
Citellus columbianus c.; Hooker, Bishopp, and Wood 1912, 82.
Cynomys gunnisoni g.; Colorado; Burnett and McCampbell 1926, 7.
Dipodomys ordii richardsoni; Hooker, Bishopp, and Wood 1912, 82.
Sciurus hudsonicus richardsoni; Ibid.
Thomomys talpoides clusius; Ibid.
Ochotona princeps p.; Ibid.
- I. loricatus* Neumann 1899
Neotoma cinerea occidentalis; Idaho; Neumann 1901, 172.
- I. marxi* Banks 1908
Lepus californicus; Oklahoma; Ward 1934, 32.
- I. pratti* Banks 1908
Thomomys sp.; California; Banks 1908, 28.
- I. ricinus* (Linnaeus)
Lepus cuniculus; Neumann 1901, 364.
Rattus norvegicus; Neumann 1901, 364.
Sylvilagus floridanus mallurus; Neumann 1901, 365.
- I. sculptus* Neumann 1904
Citellus tridecemlineatus t.; Iowa, Wyoming; Hixson 1932, 36, 42.
Cynomys gunnisoni g.; Colorado; Burnett and McCampbell 1926, 7.
- I. texanus* Banks 1909
Sciurus hudsonicus richardsoni; Bishopp 1912, 32.
- I. sp.*
Lepus californicus deserticola; Utah; Stanford 1934, 247.
Sciurus hudsonicus richardsoni; Montana; Birdseye 1912, 12.
- Margaropus annulatus* (Say)
Rattus norvegicus; United States; Banks 1910.
- Ornithodoros talaji* Guern
Rattus norvegicus; Dunn 1933, 477, 498.
R. rattus; Ibid.

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- Eutrichophilus coendu* Stobbe 1913
Coendou mexicanum mexicanum; Mexico; Harrison 1916, 73.

E. setosus (Giebel)*Erethizon dorsatum d.*; Minnesota; Fenstermacher and Jellison 1932, 294.*Trichodectes geomydis* Osborn*Dipodomys merriami m.*; Arizona; Kellogg and Ferris 1915, 73.*Geomys bursarius*; Ibid.*C. cumberlandius*; Ferris 1916, 99.*Thomomys bottae b.*; Kellogg and Ferris 1915, 73.*T. bulbivorus*; California; Paine 1912, 437.*T. monticola m.*; California; Ferris 1916, 99.*T. sp.*; California; Kellogg and Ferris 1915, 73.

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Enderleinellus extremus Ferris 1919*Sciurus colliae c.*; Mexico; Ferris 1919.*S. deppei d.*; Mexico; Ibid.*S. griseoflavus chiapensis*; Mexico; Ibid.*S. negligens*; Mexico; Ibid.*S. nelsoni*; Mexico; Ibid.*S. poleopsis p.*; Mexico; Ibid.*E. kelloggi* Ferris 1916*Sciurus goldmani*; Mexico; Ferris 1919, 22.*S. griscus nigripes*; California; Ibid.*S. griseus g.*; California; Ibid.*E. longiceps* Kellogg and Ferris 1915*Sciurus aberti ferreus*; Nebraska; Ferris 1919, 19.*S. apache*; Mexico; Ibid.*S. arizonensis huachua*; Ferris 1916, 148, 191.*S. carolinensis c.*; Mississippi; Ferris 1919, 19.*S. kaibabensis*; Arizona; Ibid.*S. niger n.*; Nebraska, Indiana; Ibid.*S. n. rufiventer*; Nebraska; Ibid.*S. oculatus*; Mexico; Ibid.*E. marmotae* Ferris 1919*Marmota monax rufescens*; South Dakota; Ferris 1919, 47.*E. nitzschi* Fahrenholz 1916*Sciurus douglasii abolimbatus*; California; Ferris 1919, 10.*S. d. mollipilosus*; California; Ibid.*S. fremonti f.*; Colorado; Ibid.*S. hudsonicus petulans*; Alaska; Ferris 1919, 9.*S. h. vancouverensis*; Alaska; Ferris 1919, 10.*S. sp.*; Ferris 1919, 10.*E. osborni* Kellogg and Ferris 1915*Citellus beldingi*; Texas; Ferris 1919, 46.

- Otospermophilus grammurus beecheyi*; California; Kellogg and Ferris 1915, 71.
- O. g. douglasii*; California; Ferris 1919, 46.
- O. g. fisheri*; California; Ibid.
- O. g. grammurus*; Arizona; Ibid.
- E. suturalis* (Osborn 1891)
- Ammospermophilus leucurus l.*; Colorado; Ferris 1919, 43.
- A. nelsoni nelsoni*; California; Ibid.
- Callospermophilus chrysodeirus c.*; California; Ibid.
- C. lateralis castanurus*; Utah; Ibid.
- Citellus beldingi*; California; Ibid.
- C. elegans*; Colorado; Ibid.
- C. franklinii*; Iowa, North Dakota; Ibid.
- C. mollis mollis*; Nevada; Ibid.
- C. oregonus*; Nevada; Ferris 1916, 149, 187.
- C. osgoodi*; Alaska; Ferris 1919, 43.
- C. townsendii*; Washington; Ibid.
- C. tridecimineatus pallidus*; Kansas; Ibid.
- C. t. texensis*; Oklahoma; Ibid.
- C. t. tridecimlineatus*; Iowa; Ibid.
- Cynomys gunnisoni g.*; Colorado; Ibid.
- C. leucurus*; Colorado, Wyoming; Ibid.
- Otospermophilus grammurus g.*; Arizona; Ibid.
- Fahrenholzia microcephala* Ferris 1922
- Heteromys goldmani*; Mexico; Ferris 1922, 161.
- Liomys irroratus canus*; Mexico; Ibid.
- L. i. texensis*; Mexico; Ibid.
- L. pictus obscurus*; Mexico; Ibid.
- F. pinnata* Kellogg and Ferris 1915
- Dipodomys deserti d.*; California; Kellogg and Ferris 1915, 73.
- D. herrmanni californicus*; California; Ibid.
- D. merriami m.*; California; Ferris 1916, 150.
- D. ordii richardsoni*; Oklahoma; Ibid.
- D. ornatus*; Mexico; Ferris 1922, 160.
- D. philippsii*; Mexico; Ibid.
- D. sp.*; Ferris 1916, 150, 193.
- Perognathus parvus olivaceus*; Nevada; Ferris 1922, 160.
- F. tribulosa* Ferris 1916
- Perognathus californicus c.*; California; Ferris 1916, 102, 1922, 163.
- P. formosus*; California; Ibid.
- F. t. reducta* Ferris 1922
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P. leucopus l.; Iowa; Ibid.
P. maniculatus gambeli; Utah, California; Ibid.
P. m. maniculatus; Iowa; Ibid.
P. m. rubidus; California; Ibid.
- H. hirsuta* Ferris 1916
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S. h. hispidus; North Carolina; Ibid.
S. h. texianus; Texas; Ibid.
S. ocrognathus; Mexico; Ibid.
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- H. nesoryzomydis* Ferris 1921
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- H. quadridentata* (Neumann 1904)
Oryzomys fulvescens f.; Mexico; Ferris 1921, 88.
O. rostratus r.; Mexico; Ibid.
- H. sciuricola* Ferris 1921
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S. carolinensis c.; Florida, Mississippi; Ibid.
S. douglasii albolimbatus; California; Ibid.
S. d. douglasii; California; Ibid.
S. d. mollipilosus; California; Ibid.
S. griseus g.; California; Ibid.
S. hudsonicus h.; Alaska; Ibid.
S. h. vancouverensis; Alaska; Ibid.
S. kaibabensis; Arizona; Ibid.
S. sp.; Ibid.
- H. trispinosa* Kellogg and Ferris 1915
Glaucomys sabrinus lascivus; Oregon; Ferris 1921, 115.
G. volans volans; Maryland; Ibid.
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- Linognathoides inornatus* Kellogg and Ferris 1915
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- Linognathoides montanus* (Osborn)
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C. beldingi; California; Ferris 1916, 99.
C. columbianus c.; Washington; Ferris 1916, 159.
C. mexicanus m.; Mexico; Ibid.
C. mollis m.; Utah; Stanford 1934, 247.
C. oregonus; Nevada; Ferris 1916, 99.
C. parryii kennicotti; Alaska; Ferris 1916, 159.

- C. plesius ablusus*; Alaska; Ferris 1916, 100.
C. sp.; Colorado; Ferris 1916, 159.
Cynomys leucurus l.; Colorado; Ferris 1916, 99.
Marmota flaviventris engelhardti; Utah; Stanford 1934, 24.
M. f. sierrae; Colorado, California; Ferris 1916, 159.
M. sp.; Oregon; Kellogg and Ferris 1915, 72.
Otospermophilus grammurus beecheyi; California; Ibid.
O. g. douglasii; California; Ferris 1916, 159.
O. g. grammurus; Arizona; Ferris 1916, 100; Utah; Stanford 1934, 247.
Sciurus niger neglectus; Ferris 1916, 100.
- Linognathus piliferus* (Burmeister)
- Lepus washingtoni w.*; California; Ewing 1924, 548.
- Microphthirus uncinata* (Ferris 1916)
- Glaucomys sabrinus lascivus*; California; Ferris 1919, 49.
- Neohaematopinus inornatus* (Kellogg and Ferris 1915)
- Neotoma cinerea occidentalis*; Ferris 1923, 252.
- N. laeviusculus* (Grube)
- Callospermophilus lateralis castanurus*; Utah; Ferris 1923, 264-265.
- Citellus beldingi*; California; Ibid.
- C. columbianus c.*; Washington; Ibid.
- C. elegans*; Colorado; Ibid.
- C. mexicanus m.*; Mexico; Ibid.
- C. oregonus*; Oregon; Ibid.
- C. osgoodi*; Alaska; Ibid.
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- C. plesius ablusus*; Alaska; Ibid.
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- Marmota flaviventris f.*; Oregon; Ibid.
- Otospermophilus grammurus beecheyi*; Ibid.
- O. g. beecheyi*; California; Ibid.
- O. g. grammurus*; Arizona; Ibid.
- N. marmotae* Ferris 1923
- Marmota flaviventris f.*; California; Ferris 1923, 267.
- M. sp.*; Montana; Ibid.
- N. pacificus*; Kellogg and Ferris 1915
- Eutamias alpinus*; California; Ferris 1923, 249.
- E. merriami pricei*; California; Ibid.
- E. speciosus frater*; California; Ibid.
- E. townsendii alleni*; California; Ibid.
- E. t. ocrogenys*; California; Ibid.
- E. t. sonomae*; Ibid.

- N. sciurinus sciurinus* (Mjöberg)
Hodomys alleni; Mexico; Ferris 1923, 244.
Neotoma fuscipes streator; California; Ibid.
Sciurus aberti ferreus; Colorado; Ibid.
S. apache; Mexico; Ibid.
S. carolinensis c.; Mississippi; Ibid; North Carolina; Harkema, this paper.
S. colliaei c.; Mexico; Ferris 1923, 244.
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S. douglasii albolimbatus; California; Ibid.
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S. d. mollipilosus; California; Ibid.
S. griseus g.; California; Ibid.
S. g. nigripes; California; Ibid.
S. hudsonicus richardsoni; Montana; Ibid.
S. nelsoni n.; Mexico; Ibid.
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S. n. rufiventer; Iowa, Indiana, Nebraska; Ibid.
S. oculatus c.; Mexico; Ibid.
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- N. sciurinus griseicolus* Ferris 1923
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- N. sciuropteri* Ferris 1916
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G. volans v.; Iowa; Ibid.
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- Philandesia foxi* Ewing
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- Polyplax alaskensis* Ewing 1927
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- P. auricularis* Kellog and Ferris 1915
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- P. auricularis* Kellog and Ferris 1915
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- C. pseudagyrtis* Baker 1904
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- Ctenopsyllus alpinus* (Baker 1895)
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- C. catatina* Jordan 1928
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- C. mexicanus* (Baker 1896)
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- C. ravalliensis* Dunn and Parker 1923
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- C. segnis* (Schonherr 1816)
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- C. selensis* (Rothschild 1908)
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- Dactylopsylla comis* Jordan 1929
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- Diamanus montanus* (Baker 1895)
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- Dolichopsylla stylosus* (Baker 1903)
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- Rattus norvegicus*; North Carolina; Shaftesbury 1934, 243.
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- Foxella ignotus apachensis* (Baker 1895)
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- Hoplopsyllus affinis* Baker 1905.
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- H. anomalus* Baker 1903
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- H. foxi* Ewing 1924
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- H. gigas* (Baker 1904)
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- H. gigas tahuvuana* Jordan 1929
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Citellus columbianus c.; Montana; Dunn and Parker 1923, 2775.

- Evotomys gapperi saturatus*; Canada; Rothschild 1915, 32, 44.
Lepus bairdii b.; Montana; Dunn and Parker 1923, 2775.
Marmota flaviventris f.; Montana; Dunn and Parker 1923, 2775.
- N. similis*
Peromyscus maniculatus rufinus; New Mexico; Chapin 1919, 59.
- N. texanus* Stewart 1930
Rattus norvegicus; Texas; Stewart 1930, 180.
- N. wenmanni* (Rothschild 1904)
Neotoma cinerea c.; Canada; Baker 1905, 154.
Peromyscus leucopus; Massachusetts; Jordan 1928, 186.
P. leucopus l.; Tennessee; Shaftesbury 1934, 257.
P. l. noveboracensis; New York; Jordan 1933, 65.
Sciurus hudsonicus richardsoni; Montana; Dunn and Parker 1923, 2775.
- Nosopsyllus fasciatus* (Bosc 1801)
Mus musculus; California; Fox 1909, 1371.
Microtus californicus c.; California; Baker 1904, 440.
Neotoma pennsylvanica p.; Jordan 1928, 183.
Peromyscus leucopus l.; Boston; Jordan 1928, 183.
Rattus norvegicus; North Carolina; Shaftesbury 1934, 255. California;
 Fox 1908, 1371.
Rattus rattus alexandrinus; Cosmopolitan; Banks 1910, 75.
R. rattus rattus; Ibid.
Thomomys bottae b.; Fox 1909, 10.
- Nosopsyllus londiniensis* (Rothschild 1903)
Rattus norvegicus; California; Baker 1906, 161.
R. rattus rattus; California; Banks 1910, 75.
- Odontopsyllus charlottensis* (Baker 1898)
Evotomys gapperi saturatus; Canada; Baker 1905, 145.
Microtus californicus c.; California; Fox 1909, 11.
Neotoma cinerea c.; Canada; Baker 1905, 162.
Lepus bairdii b.; Arizona; Dunn and Parker 1925, 2775.
Peromyscus maniculatus arcticus; Canada; Baker 1905, 162.
P. leucopus l.; Canada; Ibid.
- O. multispinosus* (Baker 1898)
Lepus californicus c.; Oklahoma; Ward 1934, 32.
Sylvilagus floridanus mallurus; North Carolina; Shaftesbury 1934, 254.
- O. spenceri*; Dunn and Parker 1923
Lepus bairdii; Montana; Dunn and Parker 1923, 2775.
Sylvilagus nuttalli n.; Dunn and Parker 1923, 2775.
- O. telegoni*; Rothschild
Evotomys gapperi g.; Baker 1905, 146.
Microtus drummondi; Canada; Tiraboschi 1907, 617.

- O. wymani* Fox 1909
Microtus californicus c.; California; Fox 1909, 241.
- Opisocrostitis bruneri* (Baker 1895)
Citellus columbianus c.; Colorado, Idaho, Nebraska; Baker 1904, 440.
C. franklini; Idaho; Nebraska; MacLeod 1933, 112.
C. richardsoni; Canada; MacLeod 1933, 112.
C. tridecimlineatus t.; Canada; MacLeod 1933, 112.
Citellus sp.; Montana; MacLeod 1933, 112.
- O. hirsutus* (Baker 1895)
Cynomys ludovicianus l.; Colorado; Baker 1904, 443.
- O. saundersi* Jordan 1933
Citellus richardsonii; Canada; Whitehead 1933, 751.
- O. tuberculatus* (Baker 1904)
Citellus columbianus c.; Idaho; Baker 1904, 393; Montana; Dunn and Parker 1923, 2775.
Marmota flaviventris f.; Montana; Dunn and Parker 1923, 2775.
Sciurus hudsonicus richardsonii; Montana; Ibid.
- Opisodasys keeni* (Baker 1896)
Peromyscus maniculatus keeni; Queen Charlotte Islands; Baker 1904, 444.
- O. pseudarctomys* (Baker 1904)
Glaucomys sabrinus alpinus; Montana; Dunn and Parker 1923, 2775.
Marmota monax m.; New York; Baker 1904, 446.
- O. pseudarctomys acasti* (Baker 1905)
Glaucomys sabrinus s.; Canada; Baer 1905, 150.
- O. robustus* (Jordan 1925)
Sciurus aberti a.; Jordan 1925, 105.
- O. vesperalis* (Jordan 1929)
Glaucomys sabrinus alpinus; Canada; Jordan 1929, 26.
- Orchopeas caedens durus* (Jordan 1925)
Sciurus hudsonicus h.; Canada; Jordan 1929, 29.
S. h. richardsoni; Canada; Jordan 1929, 29.
- O. leucopus* (Baker 1904)
Peromyscus leucopus l.; New York; Baker 1904, 445.
P. l. noveboracensis; Jordan 1933, 62.
- O. sexdentatus agilis* (Roths 1905)
Lepus bairdii b.; Montana; Dunn and Parker 1923, 2775.
Neotoma cinerea c.; Canada; Jordan 1929, 30.
Ochotona princeps; Montana; Dunn and Parker, 1923, 2775.
Sciurus hudsonicus richardsoni; Montana; Dunn and Parker 1923, 2775.
S. h. baileyi; Canada; Baker 1906, 162.
Sylvilagus nuttalli n.; Dunn and Parker 1923, 2775.

- O. s. pennsylvanicus* (Jordan 1928)
Neotoma pennsylvanica p.; Pennsylvania, Maryland, Virginia; Jordan 1928, 184.
- O. s. schisentus* (Jordan 1929)
Neotoma sp.; Arizona; Jordan 1929, 31.
- O. wickhami* (Baker 1895)
Erethizon epixanthum e.; Minnesota; Jellison 1933, 43.
Eutamias luteiventris; Montana; Dunn and Parker 1923, 2775.
Evotomys gapperi saturatus; Baker 1905, 150.
Glaucomys volans v.; North Carolina; Shaftesbury 1934, 252.
Marmota monax m.; Pennsylvania; Jordan 1928, 183.
Sciurus carolinensis c.; Arizona, Georgia, Iowa, Nebraska, Michigan, New York; Baker 1904, 448.
S. fremonti f.; Baker 1904, 448.
S. hudsonicus h.; United States; Baker 1904, 448.
Sciurus h. richardsoni; Montana; Dunn and Parker, 2775.
Sylvilagus floridanus alacer; Oklahoma; Ward 1934, 83.
Peromyscus maniculatus arcticus; Baker 1906, 162.
- Oropsylla alaskensis* (Baker 1904)
Citellus parryii kennicotti; Alaska; Baker 1904, 394, 440.
- O. arctomys* (Baker 1904)
Marmota monax; New York; Baker 1904, 440.
M. m. rufescens; New York; Jordan 1933a, 62.
- O. idahoensis* (Baker 1904)
Callospermophilus lateralis cinerascens; Montana; Dunn and Parker 1923, 2775.
Citellus columbianus c.; Idaho; Baker 1904, 413.
C. nebulicola; Alaska; Fox 1927, 212.
Lepus bairdii b.; Montana; Dunn and Parker 1923, 2775.
Marmota flaviventris; Montana; Dunn and Parker 1923, 2775.
Neotoma cinerea c.; Montana; Dunn and Parker 1923, 2775.
Sciurus aberti a.; Arizona, Alberta; Baker 1905, 150.
Sciurus hudsonicus richardsoni; Montana; Dunn and Parker 1923, 2775.
Sylvilagus nuttalli n.; Montana; Dunn and Parker 1923, 2775.
- O. rupestris* (Jordan 1929)
Citellus richardsoni; Canada; Jordan 1929, 32.
Thomomys sp.; Canada; Jordan 1929, 32.
- Phalacroscylla arachis* Jordan 1929
Dipodomys merriami m.; Arizona; Jordan 1929, 38.
- P. paradisea*; Jordan and Rothschild 1915
Mus sp.; Rothschild 1916, 33.
Rattus sp.; Arizona; Fox 1925, 217.

- P. shannoni* Jordan 1929
Perognathus sp.; Washington; Jordan 1929, 39.
- Pulex sp.*
Lepus californicus melanotis; Colorado; MacCampbell 1926, 12.
- P. dugesii* Baker 1899
Lepus californicus c.; Oklahoma; Ward 1934, 83.
Sylvilagus floridanus alacer; Oklahoma; Ward 1934, 32.
- P. irritans* Linnaeus 1758
Lepus sp.; North Carolina; Shaftesbury 1934, 250.
Oryctolagus cuniculus domesticus; Ibid.
Rattus norvegicus; California; Fox 1908, 1371.
R. rattus r.; California; Fox 1908, 1371.
Sciurus carolinensis c.; North Carolina; Shaftesbury 1934, 350.
Sylvilagus floridanus mallurus; North Carolina; Shaftesbury 1934, 250.
- Rhadinopsylla sectilis* Jordan and Rothschild 1923
Mus sp.; Canada; Jordan and Rothschild 1923, 315.
- Rhopalopsyllus dunni* Jordan and Rothschild 1922.
Sigmodon hispidus chiriquensis; Panama; Jordan and Rothschild 1923a, 337.
- R. qwyni* Fox 1914
Rattus norvegicus; Georgia; Fox 1914, 11.
- R. sigmodoni* Stewart 1930
Rattus norvegicus; Texas; Stewart 1930, 177.
Sigmodon hispidus h.; Texas; Stewart 1930, 177..
- Stenoponia wetmorei* Chapin 1922
Peromyscus leucopus l.; Virginia; Shaftesbury 1934, 248.
P. l. noveboracensis; Canada; Chapin 1922, 54.
- Tarsopsylla coloradensis* (Baker 1895)
Sciurus fremonti f.; Colorado; Baker 1904, 441.
- Thrassis acamantis* (Rothschild 1905)
Marmota flaviventris f.; Montana; Dunn and Parker 1923, 2775.
Marmota f. avara; Montana; Dunn and Parker 1923, 2775.
- T. arizonensis* (Baker 1898)
Neotoma albigula a.; Arizona; Baker 1904, 440.
Citellus sp.; Arizona; Baker 1904, 412, 446.
- T. arizonensis littoris* (Jordan 1929)
Citellus tridecimlineatus t.; California; Jordan 1929, 31.
- T. bacchi* (Rothschild 1905)
Citellus tridecimlineatus texianus; Baker 1906, 162.
- T. fatus* (Jordan 1925)
Citellus tridecimlineatus t.; Colorado; Stewart 1930, 152.
- T. francisi* (Fox 1924)
Citellus mollis mollis; Utah; Fox 1927, 211.

T. gladiolis (Jordan 1925)*Ammospermophilus leucurus cinnamoneus*; Utah; Jordan 1930, 269.*Citellus tridecimlineatus t.*; California; Jordan 1925, 108.*Perognathus sp.*; California; Jordan 1925, 108.*T. gladiolis caducus* (Jordan 1930)*Ammospermophilus leucurus cinnamoneus*; Utah; Jordan 1930, 269.*T. howelli**Marmota flaviventris sierrae*.*T. pansus* (Jordan 1925)*Citellus sp.*; Arizona; Jordan 1925, 109.*Xenopsylla cheopis* (Rothschild 1903)*Mus musculus m.*; North Carolina; Shaftesbury 1934, 250.*Rattus norvegicus*; Cosmopolitan; Shaftesbury 1934, 250.*Rattus rattus*; Cosmopolitan; Fox 1908, 1371.*Sigmodon hispidus h.*; North Carolina; Shaftesbury 1934, 249.

HEMIPTERA

Triatoma protracta (Uhler 1894)*Neotoma fuscipes streatorum*; Utah; Brumpt 1922, 811.

HYMENOPTERA

Brachymeria fonscolombi (Dufour)*Lepus californicus texianus*; Texas; Roberts 1933, 158.

DIPTERA LARVAE

*Bogeria buccata**Mus musculus*; Ohio; Miller 1928, 13.*B. ruficus* Austen 1933*Lepus sp.*; Arizona, Colorado, New Mexico, Oregon; Austen 1933, 713.*Cochliomyia macellaria* Fab.*Lepus californicus texianus*; Texas; Roberts 1933, 157.*Cuterebra aldrichi* Austen 1933*Neotoma fuscipes f.*; California; Austen 1933, 705.*C. americana* Townsend*Lepus alleni a.*; Arizona; Vorhies and Taylor 1933, 550.*L. californicus c.*; Arizona; Ibid.*C. cuniculi* Townsend*Oryctolagus cuniculus domesticus*; United States; Schwartz and Shook 1933.*C. emasculator* Fitsch 1859*Sciurus hudsonicus petulans*; Seguy 1924, 365.*S. h. hudsonius*; Bau 1906, 25.*S. carolinensis leucotis*; Seguy 1924, 355.*Tamias striatus lysteri*; Canada; Cameron 1926, 430.

- C. fontinella* Clark
Peromyscus leucopus l.; North Carolina; Harkema, this paper.
P. l. noveboracensis; Boston; Johnson 1930, 283.
Sylvilagus floridanus mallurus; Smith 1908, 270.
S. nuttalli n.; New Mexico; Seguy 1924, 366.
- C. grisea* Coquilliet
Mus musculus; Canada; Cameron 1926, 431.
- C. lepusculi* Townsend 1897
Sylvilagus nuttalli n.; New Mexico; Seguy 1924, 366.
- C. princeps*
Lepus alleni a.; Arizona; Vorhies and Taylor 1933, 550.
L. californicus c.; Arizona; Ibid.
L. callotis; Bau 1906, 27.
- C. scudderi* Townsend
Lepus californicus texianus; Texas; Roberts 1933, 157.
- C. tenebrosa* Coquilliet
Cynomys ludovicianus l.; Montana; Parker and Wells 1919, 101.
Neotoma cinerea c.; Montana; Parker and Wells 1919, 100.
Onychomys leucogaster arcticeps; Montana; Ibid.
- C. sp.*
Lepus artemisia; New Mexico; Townsend 1892, 299.
Neotoma fuscipes macrotis; California; Gander 1929, 57.
Oryctolagus cuniculus domesticus; United States; Schwartz and Shook 1933.
Rattus norvegicus; Canada; Cameron 1926, 432.
Sylvilagus floridanus alacer; Oklahoma; Leonard 1933, 270.
S. nuttalli n.; New Mexico; Townsend 1892, 299.
S. palustris p.; Brauer 1803, 224-228.
- Dermatobia* sp.
Lepus callotis; New Mexico; Townsend 1892, 299.
- D. cyaniventris* Macquart 1849
Lepus callotis; Seguy 1924, 366.
- D. hominis* (Linnaeus)
Dasyprocta punctata dariensis; Panama; Dunn 1934, 225.
D. p. isthmica; Panama; Ibid.
- Sarcophaga plinthopyga* Wied.
Lepus californicus texianus; Texas; Roberts 1933, 157.
- S. sulcata* Aldrich
Lepus californicus texianus; Texas; Roberts 1933, 158.
- Wohlfahrtia vigil* (Walker)
Sylvilagus floridanus mallurus; Johannsen 1926, 156.

APPENDIX II

DESCRIPTION OF A NEW SPECIES OF NEMATODE FROM THE WHITE-FOOTED MOUSE

A nematode is described in this section. This parasite belongs to the family Oxyuridae Cobbold 1864, subfamily Syphaciinae Railliet 1916, and genus SYPHACIA Seurat 1916. For this species the name *Syphacia peromysci* is proposed. Dr. B. G. Chitwood of the Bureau of Animal Industry, United States Department of Agriculture, kindly examined the specimens and diagnosed them as a new species of SYPHACIA.

Syphacia peromysci nov. sp.

Members of the genus SYPHACIA are slender, milk white forms. The male is much smaller than the female and the tail of both sexes is long and slender. The cuticle is coarsely striated transversely. The mouth is provided with

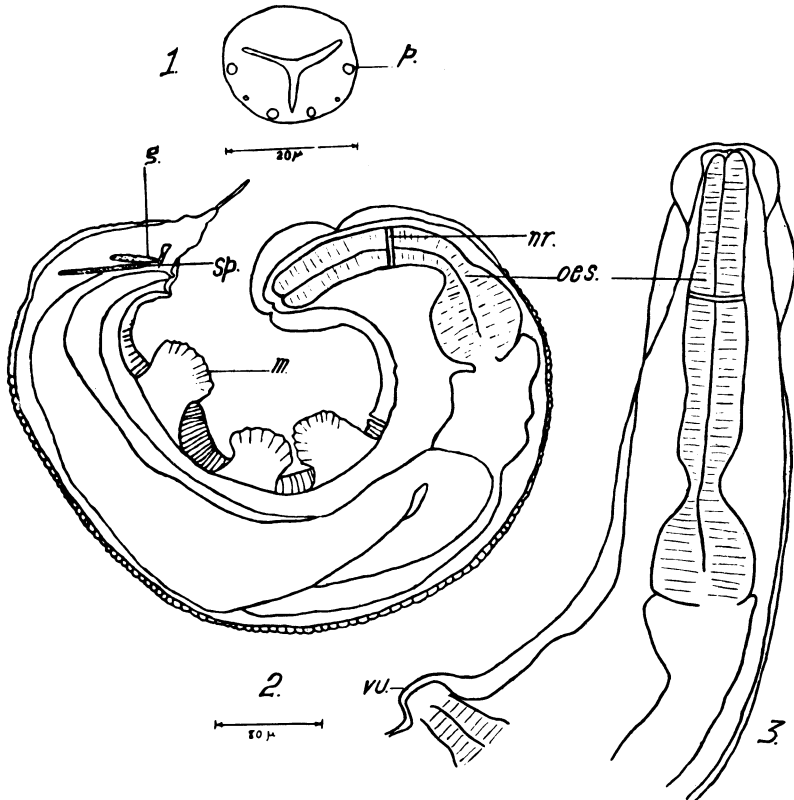


FIG. 5. *Syphacia peromysci* nov. sp.; 1. Head, end face view; 2. Adult male, entire; 3. Adult female, anterior end.

- | | | |
|------------------|------------------|--------------|
| g — gubernaculum | nr — nerve ring | sp — spicule |
| m — mamelon | oes — oesophagus | yu — vulva |
| | p — papilla | |

three lips of about equal size. The circumoral papillae are situated laterally in two groups consisting of a large papilla situated on each side of a smaller submedian one (Fig. 5, 1).

The male is 913 micra to 1.3 mm. long and 120-124 micra wide. The cuticle of the anterior end is inflated and extends to the cervical papillae. The oesophagus is typically oxyuroid, 140 to 150 micra long by 30 micra wide. The oesophageal bulb is spherical, 66 to 80 micra in diameter and is joined to the oesophagus by a slender constriction. The nerve ring surrounds the oesophagus approximately 90 micra from the anterior end of the oesophagus. The excretory pore opens ventrally approximately 172 micra from the anterior end of the body. The cervical papillae are situated approximately 60 micra from the head. Lateral alae are present beginning at the cervical papillae. There are two small symmetrical bursal alae and three pairs of caudal papillae. The spicule is simple, 70 micra long and 3 to 4 micra wide. The gubernaculum is 37 micra long by 5 micra wide and the accessory piece is 20 micra long. The ventral surface of the body bears three striated mamelons, which extend approximately 27 micra beyond the cuticle. They are approximately 50 micra long (Fig. 5, 2).

The female is 2 to 2.5 mm. long with a maximum width of 0.172 mm. The oesophagus including the bulb is 353 micra long by 46 micra wide at the widest point. The oesophageal bulb is 80 micra in diameter. The nerve ring is 97 micra from the anterior end of the oesophagus. The anus is situated 525 to 700 micra from the tip of the tail. The vulva is situated on a cuticular prominence 507 to 534 micra from the anterior end (Fig. 5, 3). The eggs are oval 80 to 81 micra long by 24 micra wide.

Host: *Peromyscus leucopus leucopus*.

Location: Caecum.

Locality: Duke Forest, Durham, North Carolina.

Syphacia peromysci resembles *Syphacia obvelata* (Rudolphi 1802), the type species of the genus, in body form and the number of mamelons in the male. It differs in that the former species is smaller than the latter in many respects. The mamelons extend beyond the cuticle to a greater distance than do those of *S. obvelata*. The eggs are much larger in the type species being 100 to 142 micra long by 30 to 40 micra wide. *Syphacia peromysci* can be separated from *S. thompsoni* Price 1928 by its smaller size. The species is readily distinguished from *S. pallargi* (Seurat 1915) and *S. pearsei* Baylis 1928 by the number of ventral mamelons, there being but two in these species.

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