

A PARASITOLOGICAL SURVEY OF THE GENUS CITELLUS
IN WESTERN CANADA.



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ABSTRACT.

The results are given of a parasitological survey of 236 ground rodents (Genus Citellus) from the province of Manitoba. The survey yielded five ectoparasites, all previously recorded. It also yielded four species of Nematodes, three of which are regarded as new to science, an Acanthocephalan and two species of Cestodes which were previously unrecorded. No Trematodes or intracellular Protozoans were found.

The importance of the Arthropod parasites as transmitters of disease is cited. The pathogenicity of the enteric parasites and the correlation between the incidence of infection and host abundance is discussed.

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Among the worst enemies of the prairie farmer in Western Canada are the various species of Citellus a type of burrowing rodent commonly referred to as the Ground Squirrel or the Gopher. These animals are most difficult to keep in check and they cause an immense amount of damage to cultivated crops. The annual loss to agriculture in the State of North Dakota, for example, has been estimated at more than one million dollars. (Reference No. 26.) In Manitoba the gopher population in ^{Certain} such areas as have been surveyed, has been estimated at 20 animals per acre. (Reference No. 20.) and the damage caused has been conservatively estimated at fifty cents per rodent each year. The loss per acre thus occasioned may mean all the difference between a comfortable profit and a heavy loss on the years crops. In addition to the direct loss inflicted by gophers upon crop growth, the mounds of earth thrown up during their tunnelling operations increase considerably the expense of working the land and gathering the harvest.

There is further the possibility of such common rodents serving as alternate hosts, or as the direct carriers of organisms pathogenic to higher animals. Citellus beechyi in California has been shown to be susceptible to Pasteurella pestis of bubonic plague, and to be capable of acting as host to murine species of Ceratophyllus through whose agency the disease is conveyed to man. Whilst the possible establishment of bubonic plague in the Canadian prairie areas would seem

to be remote, the similarity of climatic conditions in Western Canada to those in the endemic areas of bubonic plague in Manchuria and the fact that the latter disease is essentially one of ground rodents through whose ectoparasites the disease is conveyed to man, must not be overlooked.

The effect from a parasitological standpoint of the practice used by some mink ranchers, of feeding fur bearing animals upon small mammalia has not been experimentally investigated, but is another point worthy of consideration.

Now there can be little doubt that artificial methods of controlling ground rodents - trapping, poisoning, burrow fumigation - have not in the past yielded results commensurate with the immense expense involved. In Manitoba a sum of approximately \$5000.00 has been spent as a bounty upon gophers, and an approximate total of 100,000 gophers has been destroyed in one year, but there is no evidence that any serious diminution has been thereby brought about in the gopher population.

It would seem to the writer that a type of animal so destructive and so potential in destructive possibilities would well repay the trouble of a minute and thorough investigation of the natural factors in it's environment which oppose it's biotic potential either by maintaining a high degree of mortality among immature animals or by influencing the fertility of the mature animals. Such natural factors opposing it's biotic potential are temperature values outside the effective range, pathogenic bacteria and fungi, pathogenic helminths, predatory enemies, and so forth.

It is well known that ground rodents are particularly susceptible to cyclic fluctuations of population density. The

factors inducing such fluctuations are obscurely known. Climatic extremes undoubtedly play a part. Overcrowding reduces the potential fertility. Bacterial and helminth parasitism may be pathogenic. Boughton (4) has shown that in the case of the Western Canadian Snowshoe Rabbit population, endemic helminth infestation may become epidemic under conditions of overcrowding and of adverse climatic conditions, and that epidemic mortality from helminth infestation can be an important factor in bringing about local fluctuations of population density.

The evidence that epidemic mortality is prevalent among gophers is by no means so complete as in the case of rabbits, field mice and lemmings. The presence of an epidemic is less easily detected among such deep burrowing forms than among non-burrowing forms since a gopher usually dies in its burrow. A continuous record of gopher abundance over the whole of Manitoba is not available, but such evidence as the writer has been able to collect from farmers and naturalists in the area suggests strongly that there exist peak years of abundance followed by a sharp decline in population density. The peaks however are not synonymous over the area but vary by one year or more between different localities. In the case of localities studied the maxima of abundance appear to be as follows.

| | |
|------------------------------|--|
| <i>C. tridecemlineatus</i> . | 1897-99. 1912. 1917. 1923. 1927. 1932. |
| <i>C. franklini</i> | 1912. 1917. 1923. 1927. 1932. |
| <i>C. richardsoni</i> . | 1912. 1917. 1923. 1927. 1932. |

The aim of the investigation reported below therefore has been that of surveying the parasitic fauna of the species

of gophers present in Manitoba with a view to ascertaining which members of that fauna have the potentiality of gopher destruction, and which members of the fauna have the potentiality of spreading from the gopher to man and higher animals. The report is based upon an examination of 236 individuals, representing three species of Citellus common in the Southern half of Manitoba, carried out during the period May to October 1932, a year which appears to be a peak year of gopher abundance.

METHODS.

Three species of Citellus were included in the survey. C. franklini is an indigenous form, comprising about 2% of the Manitoba gopher population and more abundant in the eastern area of the province where it is to be found among uncultivated shrubby land, feeding on plant foliage and seeds upon insects, upon eggs and nestlings of birds. It is popularly called the Scrub Gopher.

C. tridecemlineatus another indigenous form, represents about 8% of the gopher population and is most plentiful in the eastern and northern edge of the prairie region, being essentially an open prairie or pasture land form; it feeds chiefly upon the foliage and seeds of wild and cultivated plants and upon grasshoppers and crickets.

C. richardsoni the predominant gopher of Manitoba, is an immigrant from the southwest, entering the province about 1900. It rapidly spread over the cultivated areas but at present is located most densely in the dry agricultural southwest area of the province.

Most of the animals examined during the survey were obtained from as many scattered points as possible, but as the

total area covered was approximately 80,000 square miles, it was not possible to conduct examinations at regular intervals of time. Most of the animals were obtained alive, were etherised in the laboratory, the fur combed for ectoparasites, and a routine post-mortem examination performed.

The helminthological technique used was the standard technique recommended by other authors. Intestinal helminths were obtained by a decantation method, were washed briefly in warm water, and fixed in 70% alcohol at 75 degrees centigrade, a method found satisfactory both for nematodes and cestodes, followed by preservation in 70% alcohol plus glycerine. Nematode preparations were made by clearing in glycerine alcohol at room temperature and mounting in glycerine jelly. Cestode material was stained with Delafields haematoxylin and cleared in beechwood creosote. This latter clearing agent was found most satisfactory also for the ectoparasitic fauna.

Taxonomy.

The survey yielded five ectoparasites and seven endoparasites, which may be listed briefly as follows:-

ARTHROPODA.

| | |
|----------------|--|
| Ixodidae | <u>Dermacentor venustus</u> (Banks). |
| Dermanyssidae | <u>Liponyssus occidentalis</u> (Ewing). <u>Liponyssus montanus</u> (Ewing). |
| Pulicidae | <u>Ceratophyllus bruneri</u> (Baker). |
| Haematopinidae | <u>Linognathoides montanus</u> (Osborne). |

CESTODA.

| | |
|-----------------|--|
| Dilepididae | <u>Prochoanotaenia spermophili</u> n.sp. |
| Hymenolepididae | <u>Weinlandia citelli</u> n.sp. |

NEMATODA.

Strongylidae

Warrenius bifurcatus (Sleggs).

Spiruridae

Rictularia citelli n.sp.Spirura infundibuliformis n.sp.Physaloptera spinicauda n.sp.

ACANTHOCEPHALA.

Moniliformidae

Moniliformis spiradentatis n.sp.

The absence of Trematoda and larval Cestoda is noteworthy but it may be noted that Boughton found no Trematoda and only two larval Cestoda in Lepus americanus.

All five species of ectoparasites were common to the three species of Citellus examined. Of the helminthes, some were restricted to one Citellus species, others to two, and one occurred in all three host species. The helminthes were all parasites of the stomach or of the anterior half of the duodenum; the caecum, large intestine, liver, lungs and muscles were free from parasites. About 40% of the gophers examined showed disease of the wall of the stomach or intestine but although a considerable number of such lesions were sectioned and examined, no causative Protozoan was found. Several specimens showed splenic enlargement, but time did not permit the preparation and examination of blood smears of such individuals and the writer was unaware at the time that a trypanosone had been recorded from Citellus richardsoni.

Owing to the difficulty in obtaining material from a particular area at any definite time it is impossible to give an exact comparison of the infection in all the localities from month to month.

However some generalized statements will be given later in this paper. Table 1. is a record of the incidence of infection for each species of parasite for both young and adult of all three species of hosts. The young of C. tridecemlineatus and C. franklini are found to be uninfected up to the age of eight weeks, but those of C. richardsoni are heavily infected, in some cases at an early age.

TABLE 1.

RELATIVE ABUNDANCE OF DIFFERENT PARASITES

| PARASITE | C. tridecem | | C. franklini | | C. richardsoni | |
|-------------------------------------|-------------|--------|--------------|--------|----------------|--------|
| | No exam. | % inf. | No exam. | % inf. | No exam. | % inf. |
| Rictulari citelli | 71. | 21.1 | 11. | 18.1 | 154. | |
| Spirura infun- dibulformis | 71. | 19.4 | 11. | | 154. | .6 |
| Physaloptera spinicauda | 71. | 15.4 | 11. | 18.1 | 154. | |
| Moniliformis spiradentatis | 71. | 8.4 | 11. | | 154. | |
| Warrenius bifurcatus | 71. | | 11. | | 154. | 61.9 |
| Weinlandia citelli | 71. | 14. | 11. | 9. | 154. | 2.9 |
| Prochoan- otaenia spermophili | 71. | 2.8 | 11. | | 154. | 1.9 |

Males and females are exposed to infection to a like extent and although there is a slight variation in the infection of the two sexes, as shown in Table 2. below, it is not sufficiently great to be of any particular significance. The mean and maximum number of parasites per host is however of considerable importance and will be discussed later.

TABLE 2.

THE RELATIVE INFECTION OF THE TWO SEXES AND
THE NUMBER OF PARASITES PER HOST

Citellus tridecemlineatus.

| Parasite. | No. of males examined | No. of females examined | % inf. males | % inf. females | Mean No. of worms | Max. No. of worms |
|------------------------------------|-----------------------|-------------------------|--------------|----------------|-------------------|-------------------|
| <i>Rictularia citelli</i> | 29. | 42. | 24.1 | 19. | 4. | 8. |
| <i>Spirura infundibuliformis</i> | 29. | 42. | 20.7 | 19. | 18. | 48. |
| <i>Physaloptera spinicauda</i> | 29. | 42. | 17.2 | 19. | 2. | 4. |
| <i>Moniliformis spiradentatis</i> | 29. | 42. | 10.4 | 7.1 | 7. | 19. |
| <i>Weinlandia citelli</i> | 29. | 42. | 13.7 | 14.2 | 5. | 15. |
| <i>Prochoanotaenia spermophili</i> | 29. | 42. | 6.8 | | 1. | 1. |

Citellus franklini.

| | | | | | | |
|--------------------------------|----|----|------|-----|-----|-----|
| <i>Rictularia citelli</i> | 6. | 5. | 16.6 | 20. | 3. | 4. |
| <i>Physaloptera spinicauda</i> | 6. | 5. | 16.6 | 40. | 4. | 7. |
| <i>Weinlandia citelli</i> | 6. | 5. | | 20. | 17. | 17. |

Citellus richardsoni

| | | | | | | |
|------------------------------------|-----|-----|------|-----|-----|-----|
| <i>Warrenius bifurcatus</i> | 69. | 85. | 62.6 | 60. | 24. | 83. |
| <i>Spirura infundibuliformis</i> | 69. | 85. | | 3.3 | 2. | 3. |
| <i>Weinlandia citelli</i> | 69. | 85. | | 3.5 | 8. | 20. |
| <i>Prochoanotaenia spermophili</i> | 69. | 85. | | 2.3 | 8. | 17. |

DERMACENTOR VENUSTUS. (Banks).
Dermacentor andersoni (Stiles).

Typical Ixodid or hard-shelled ticks of medium large size measuring up to 6 mm. in length in the adult. It is recorded as being the causative agent of tick paralysis as well as the transmitter of certain diseases of man and animals, such as Tularemia and Rocky Mountain Spotted Fever.

Male. Has a well developed scutum covering the entire dorsal surface of the body, which is chesnut brown with sparsely scattered white spots and unequal punctuations. Scutum bears thirteen festoons on the posteria margin. Mouth parts project forward beyond the anterior margin so as to be visible from the dorsal side. Eyes rather flat and at the sides, level with the second legs. The palps are much longer than broad and the second segment is without retrograde spur. Coxa I. with two long well developed contiguous spurs, the external being conical. Coxa II. and III. with two short spurs. Coxa IV. is much longer than broad with a spur at the antero-external angle. The spiracle is situated at the side of the body behind leg IV. and the postero-external extension of the peritreme is well developed.

Female. Scutum small and pale, being only slightly longer than broad and having a posteria border a little sinuous. The eyes as in the male, are located at the sides, about the middle of the length of the scutum opposite the second pair of legs.

The species venustus is distinguished from the closely related species occidentalis and albipictus by the shape of the spiracle and the well developed postero-external extension of the peritreme.

Localities. Montana, Wyoming, U.S.A., Manitoba, British Columbia, Can.

CERATOPHYLLUS BRUNERI. (Baker).
Ceratophyllus. (Curtis 1832).

Specific diagnosis:- Siphonaptera of medium size with the three thoracic segments not strongly constricted and their epiphyses extending over but one abdominal segment. Pronotal comb with 18 ctenidia, genal comb absent and gena without recurved process. Head bluntly rounded anteriorly. Eyes present, genal row with one bristle. Labial palpi with four pseudojoints and reach to about the distal end of the femora. Maxillary palpi shorter than the anterior coxa. Legs slender.

Female:- Third joint of the antenna nine pseudojoints distinct on the posterior side, but indistinct on the anterior. Second joint of the antenna with a row of fine hairs which extend almost to the outer end of joint III. Gena without recurved process but style present. Abdominal tergites with only two rows of bristles. Three antipygidial bristles present. Body of gravid female never swollen so as to expose extensive areas of connective membrane.

Male:- Body slightly smaller than female with the posterior end curved dorsally. Third joint of the antenna distinctly divided into nine pseudojoints. Gena without recurved process, style absent. Abdominal tergites with only two rows of bristles. Three antipygidial bristles, claspers short, smooth on the ventral margin, and bristles are in a small group of five near the upper end.

Host and locality. Citellus sp. Montana, Citellus tridecemlineatus, Citellus franklini, and Citellus richardsoni, Manitoba.

LIPONYSSUS OCCIDENTALIS. (Ewing).

Liponyssus (Kolenati).

Female:- Small with large dorsal shield. Palpi moderate; chelicera stout. Dorsal shield extending across the body at the shoulders, lateral margins behind the shoulders convex. Peritreme very long and very sinuous, reaching to the anterior coxa. Sternal plate about three times as broad as long, barely reaching to the third coxae, and with the anterior margin strongly arched; anterior setae situated on the anterior margin; middle setae situated on a line between the anterior and posterior setae, the latter being almost at the tip of the posterior angles. Anal plate egg-shaped in outline; anus small, almost circular with a uniform rim and situated in front of the middle transverse line; paired setae situated near the level of the anterior margin of anus. Posterior setae situated more than their length behind the anus; caudal area forming a lobe-like projection of the anal plate. Legs moderate. Body length 0.61 mm. Width about 0.31 mm.

Male. Unknown.

Hosts. C. richardsoni and C. tridecemlineatus.

Locality. Montana and Manitoba.

LIPONYSSUS MONTANUS. (Ewing).

Female. Large, the body length being about 1.02 mm. and the width about .60 mm. Palpi large; chelicera shearlike but the hooked tips of both arms rather blunt. Dorsal shield medium, lateral margins behind the shoulders very slightly convex. Peritreme long and sinuous and extending to opposite coxa 1. Sternal plate with posterior corners broadly rounded and not extended. Anal plate very

large, broadly rounded in front and somewhat truncate behind, anus subcircular with a uniform rim, and situated almost centrally; paired setae situated far forward, being at the level of the anterior margin of the anus; median setae situated about its length behind the anus; caudal area crescentic, scobiate. Legs long; anterior pair longer than the second pair and about equal to the third pair. Last pair reaching to about the tip of the abdomen.

Male. Unknown.

Host. C. richardsoni and C. tridecemlineatus.

Locality. Montana and Manitoba.

LINOGNATHOIDES MONTANUS (Osborne 1912).

Lingognathoides (Cummings).

Specific diagnosis. First pair of legs smaller than either the second or third pairs. Abdomen with only slight rudiments of pleural plates on its segments. Six pairs of abdominal spiracles present which open on the flat body surface and not on tubercles. Abdomen clothed in normal setae with never more than a single transverse row on a typical segment. Antennae five segmented, the second being the longest and the last two being quite distinct. Temples more or less swollen but without postero-lateral angles.

Male. Body about .84 mm. long by about .4 mm. in greatest body width. Head large, about the size of the thorax; temples slightly swollen; clypeal region pointed; forehead knoblike. Legs stout with well developed single claws on the tarsi of the first pair. Abdomen broad with a single transverse row

of short setae on each segment. Posterior end broadly rounded. Color, light brown.

Female. Body length about 1.15 mm. by about .4 mm. in greatest body width. Head, antennae and legs similar in size and shape to those of the male. Abdomen large and rectangular, ending bluntly, and bearing on each segment a single transverse row of long coarse setae. Body color, dark brown.

Host. Species of Citellus.

Locality. Practically all over the North American Continent.

WARRENIUS BIFURCATUS. (Hall 1916). (Sleggs 1925).

Generic diagnosis. Warrenius. Head simple, no lips evident, bursa is deeply incised dorsally to form two large lateral lobes and a small dorsal lobe. The dorsal lateral and ventral ray systems are well defined and separated from one another, the rays of each system being more closely related to one another than to the rays of the other systems. The dorsal lobe is supported by the dorsal ray which branches dicotomously. The external dorsal rays are slender wavy rays lying in the lateral lobes, the tip of which are some distance from the bursal margin. The recurved tip turns toward the dorsal ray and is closer to this than to the postero-lateral. The postero-lateral and medio-lateral rays originate in a common stem. The latero-lateral and ventro-lateral rays originate as branches of a common stem and diverge from their origin to their termination near the bursal margin. They are usually large for ventral rays. The spicules are well developed; uteri divergent;

vulva in the posterior half of the body. Ovijector well developed.

Specific diagnosis. bifurcatus.

The worms are whitish in color after fixation but the intestine is red when the worm is alive. The male is considerably shorter and not so stout as the female and may exhibit two or three flat coils or may be coiled in a flat spiral. The female is very strongly coiled in a flat spiral, the extremities of the body being frequently hidden within the ends of the coil. The posterior end of the female bears a minute curved cuticular spine. Cuticle is finely striated transversely and presents also about 24 longitudinal striae running the full length of the body. No buccal capsule is present. Diameter of head in female exclusive of cuticular inflation, about 48 μ . Diameter of head in male exclusive of cuticular inflation, about 36 μ . Length of cesophagus in female about 75 μ . Length of cesophagus in male about 600 μ . The nerve ring is situated about one-third of the way along the cesophagus from the anterior end of the body. The cesophagus is dilated posteriorly and separated from the mesenteron by a constriction. The excretory pore is about two-thirds of the way along the cesophagus.

Male. Length 7-12 mm. Greatest body width 215 μ . Right spicule bifurcates in a horizontal plane, left in a vertical. Right lateral lobe of the bursa is about one and one-half times as long as the left.

Female. Length 15-18 mm. Greatest body width 315-335 μ . Distance of anus from posterior end ranges from 88-120 μ . Vulva is a transverse crescentic slit about 2.6 mm. from the posterior end.

Eggs. Very numerous in a gravid female; 12-16 segmented and enclosed in a thin shell.

Host. Citellus richardsoni, in stomach and duodenum.

Locality. Manitoba and Saskatchewan, Canada.

RICTULARIA CITELLI n.sp. (Figures 1. and 11.)

Rictularia. (Froelich 1802).

Specific diagnosis. Buccal capsule well developed and narrow with it's aperture more or less distinctly dorsal and with it's base armed with teeth and spines. Along practically the entire ventral surface on each side, there is a row of cuticular combs or spines. Vulva anterior, near the posterior end of the oesophagus. Oviparous, the eggs containing a well developed embryo when oviposited.

Female. Rather stout worms, measuring from 30 to 60 mm. in length; of a pinkish color when alive but turning almost white on fixation. The following body measurements were found to be constant for gravid females measuring 44 mm in length. The head including cuticle is 235 μ in diameter and the body increases in thickness gradually until a point one fifth of it's length from the posterior end it is 910 μ in diameter. This diameter is held or only slightly reduced to a point a short distance from the caudal end where attenuation takes place sharply, the body ending in a fine point. Cuticle about 12 μ thick in the head region and is definitely annulated along the neck. There is a pair of stout lateral cervical papillae about 630 μ from the anterior end. The first cuticular spine in each row is situated

posterior and slightly ventral to the mouth, there being 28 spines in each row from the head region to the vulva. Spines are finely striated and rather indistinct in mounted specimens, only a few being visible posterior to the vulva. Mouth is somewhat reniform in shape and is bounded by two subequal lips. The posterior lip bears a short conical tooth on each side of its apex while the anterior one is smooth, semicircular and forms the helmet-like termination of the body. The cesophagus is simple, slightly dilated in the middle region and ends posteriorly in a hemispherical projection into the intestine. The vulva is a short transverse slit near the posterior end of the cesophagus and is bounded by prominent lips formed of cuticle overlying finger-like projections of the body wall. The body is slightly expanded on each side of the vulva. The vagina is long and bifurcates in the posterior region to form two convergent uteri which terminate in filiform ovaries.

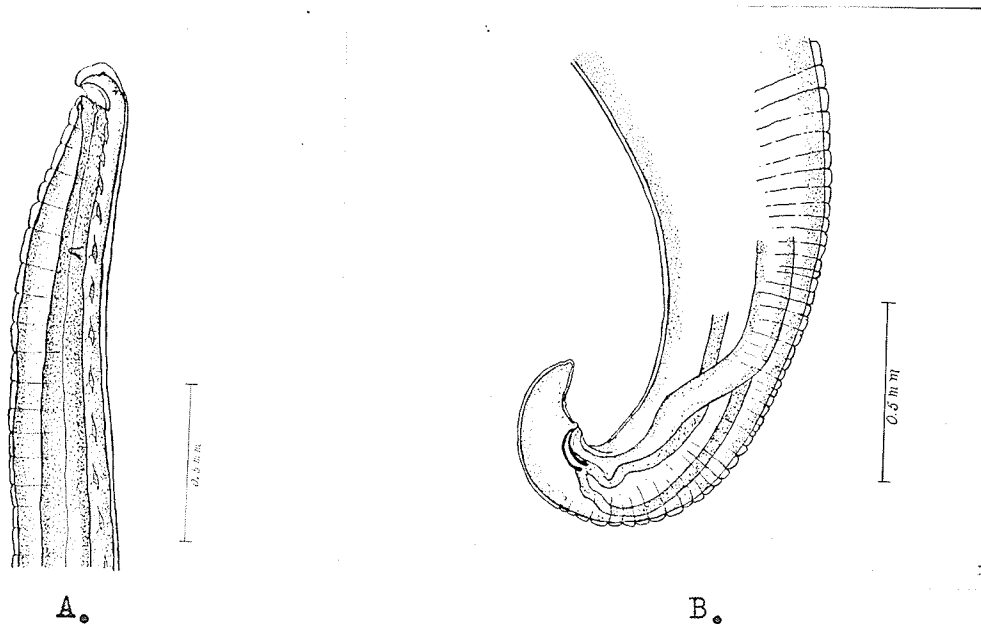


Fig. 1. Rictularia citelli. A. Anterior extremity, lateral view. B. Male posterior extremity lateral view.