GASTRO-INTESTIMAL HELMINTHS OF KAMSAS COYOTES

by

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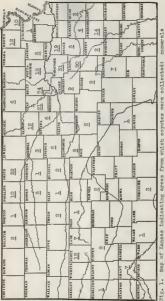
INTRODUCTION

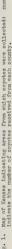
The coyote, <u>Ganis latrans</u> Say, is perhaps the most convon productor of dessetic and wild animals in the state of Kansas. The feeding habits of the coyots cause it to ingest larval parasites which an maturing may be the source of infection to both wild and decostic animals and ram.

The purpose of this investigation was to determine the nature and incidence of the gastro-intestinal helmints of the coyotes. This investigation was made in conjunction with other studies on the coyote earnied on in the scolegy laboratories of Kannas State College by Rr. D. J. Ameel, Br. H. F. Oler, and Dr. O. H. Tiessier. The coyotes examined were received from trappers and hunters from 44 counties in the state of Eansas as indicated in Fig. 1. These coyotes were received only during the cool months of the year. They were either brought to the laboratory or shipped by express. During this period 424 coyotes were received.

MATERIAL AND METHODS

The stomach, scall and large intestines were dissected from each coyote and the mesentary and manta were removed. An incluion was made with a pair of solssors from the sardsas to the pyloric ends of the stomach along the greater curvature, after which the stomach contents were searched and the worms





removed by forceps. To remove the helminits from the intestines, the flushing method of Aekart and Holf (1980) was adapted. The intestinal contents which were removed readily by fauset water under pressure were flushed into a large jar and after several decentings the residue was placed in a photographic pan. The works from the respective habitats were recovered and placed in vials containing 10 per cent formalin or 70 per cent alcohol. Following this procedure the vials were labeled with the specimen number of the coyote and the location from which the puresites were talma. The pursaines were labeled with the specphonol, identified and recorded.

INCIDENCE OF CASTRO-INTESTIMAL TELMINTIS IN THE COYOTES OF KANSAS

A total of 17,039 halminth parasites was found in the 407 coyotes examined and recorded. The parasites comprised the seconds, <u>formany smill</u> Termany, and <u>Termanestik Jeening</u> von Uinstory its stomachmours, <u>formalouters pure</u> Hall and Rigdor and <u>Promalenters presentialis</u> von Linstory its teperorus, <u>Tannia</u> <u>pisiforming</u> filedh and <u>Ricylidim</u> genirus Linstory its hosterowy. <u>Anaylostom saminum</u> Ercolani. Of the 407 coyotes, 13 wars entirely free it halminthe, Learing 504 er 505 per cent of the opyotes showing infections of one or more of the above species in the gastro-intestinal treat. The number of parasites in the individual coyotes ranged from 1 to 510, those coyotes having parasites in the stomach anabored 105, constituting free having parasites in the stomach mabered 105, constituting free

per cent of the tokal number. These showing infections of both the stownsh and intestines numbered 170 supprising 45.4 per cent of the total. These coyotes having parasites in the intestions numbered 355 or 97.8 per cent of the coyotes.

The analysis of the incidence of the belinisth paramites according to species, number, and percentage of coyotes inforted, location of paramites in the digestive tract, the number and percentage of paramites in relation to the total and the range in the number of the paramites in the individual coyotes will be considered.

The Ascarids, <u>Toxocare canis</u> and <u>Toxascaris loonina</u>

The total infections of 30 <u>functions</u> <u>statis</u> occurred in 7 or 1.7 per cent of the coyotes examined. The masker in the individual coyotes ranged from 1 to 12 and were found in the small infections.

<u>Tonnacatia localina</u>, numbering SEG, was found in 77 coyotes or 18,9 per cent of these examined. The individual infection wurled from 1 to 45. The stomachs of 0 coyotes were infected with 15 <u>Tonnacaris localina</u> ranging from 1 to 5 in the individual coyotes. This constituted 2.4 per cent of the total number of <u>Tonnacaris localina</u>.

The total infection of assarids numbered 568 or 3.1 per cent of the overall infection of helminths. Specimens of Texasceris legning constituted 94.6 per cent of the ascerid

infections.

The Hookwarm, Ancylostoma canimum

<u>Americations saning</u> occurred in 60 or 14.7 per cent of the 407 coyoles examined. The number of holizorus in each coyolo renged from 1 to 65 and totaled 576 for the 407 coyoles. The perssibes were found in the stomach and in the small intertines. The stomach of one coyole contained one holizorus. <u>Americatorus</u> canings computed 2,1 per cent of the total infection.

The Stome worns, <u>Physelopters</u> rara and <u>Physelopters</u> preputialis

<u>Firmalopters pars</u>, totaling 1,000, cosured in 554 of the 407 coyotes; they comprised infections of 68,4 per cent. The number of parasites ranged from 1 to 55. They were found in the stouach and small intestinos, however they occurred more frequently in its stouact.

Coyotos showing balminth infections of the stamach mushered 195. This constituted 47.4 per cent of the coyotes exminned. Of the 1,909 <u>Translaptors year</u> found in the digestive tract, 1,448 were taken from the stamach. These comprised 75.5 per cent of the total musher of <u>Hypelopters pers</u>.

Twolve specimens, tentatively identified as <u>Fivealepters</u> <u>measurbialis</u> were found with <u>Firselepters</u> pure in the stamechs of three covotes. These infections in the three covotes constituted 0.7 per cent of the 407 coyotes examined. Of the total number of Physelopters, 1,021, 0.5 per cent was <u>Physelopters</u> presentialis.

> The Tapeworms, Taenia pisifornia and Dipylidius caninus

The total infection of tapewords numbered 14,008 comprising 64 per cash of the total hainingh infection. The total infection of <u>Taenis pisiformin</u> numbered 14,000, ranging from 1 to 519 in the individual coyotes. <u>Taenis pisiformin</u> comprised 90.0 per cash of the total number of tapewords present. All of the 14,000 tapewords were found in the small intestine.

Two <u>Divilidium canimum</u> were found in the small intestine of one coyote, comprising 0.01 per cent of the total infection of tapeworms.

Table 1 shows the number and distribution of the internal parasites found in each of the 484 coyotes examined.

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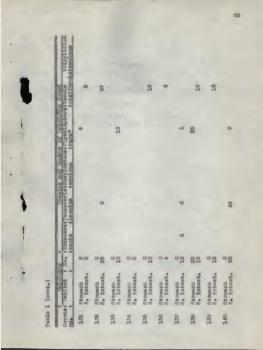
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DISCUSSION

The foregoing data beer out the fact that the seven species of heldnith perssites, <u>Towneers canis</u>, <u>Towneeris lecting</u>, <u>Anaviertems canimus</u>, <u>Envelopters pers</u>, <u>Envelopters meanuticlis</u>, <u>Taonis pisiformils</u>, and <u>Dirulidius canimus</u> are capable of infecting the gastero-intestinal treat of coyotes.

Coyotes 1 to 100 were received from January 31, 1948, to April 11, 1949; those numbering 107 to 424 were received from December 15, 1949, to April 20, 1949. A higher incidence of the hostworm, <u>Anariantum commun</u>, was noted in the group received from January 31, 1949, to April 11, 1949.

The commonset and most numerous parasite was the dog tapeworm, <u>Taonia piciformis</u>; the next most prevalent parasite was the stommatmorm, <u>Provalortare rere</u>.

According to Horgan (1046) two different species of <u>Physelopters</u> have never been reported from the same minal at the same time. This study indicated the courrence of two species of <u>Physelopters</u> in the stomachs of three coyotes. Three coyotes contained specimums of <u>Physelopters pars</u> and other specimum tentifying identified as <u>Physelopters presoutialie</u>.

Comparison of <u>Toxocara canis</u> (Werner, 1782) and <u>Toxascaris Loonins</u> (Linstow, 1902)

Investigations indicate that three species of ascarids belonging to two genera occur in carnivores. In the genus

Towneers, Toronary canis is found in dogs and fourse and Towneers anti is found in cats and fourse. In the other genus <u>Towneeris</u>, <u>Towneeris</u> <u>heating</u> occurs in dogs, cats, fourse, and several wild follows.

These ascarids are not readily differentiated, especially as preserved spectrums. Clearing or dissoction of the body wall to expose the base of the coscylagues is required to determine whether the escophague terminates postorically in a ventriculum or histologically distinct ovoid bulb (Fig. 2) characteristic of the genus <u>Tomocurs</u>, or whether such a bulb is lacking (Fig. 3) as in the comus. <u>Tomocurs</u>.

The absence of a ventriculus in a speakern collected from a coyote in this study establishes the disposite as <u>- localing</u>. The presence of a ventriculus indicates the genus <u>Temperature</u>. The species is then determined by considering the mature of the cervical also. If the latter are relatively long and marrow and tapor gendually from the region of their greatest breath to the point of their posterior termination, so that the cervical region has a lanceolate appearance, the specime is <u>1</u>, <u>caning</u> (Figs. 8). If the also are relatively short and vide and decrement anoughly in width from the region of their broatest extents to the point of their posterior termination, so that the cervical region when visced ventrally, or develop, appears heart-simpdy or has the shape of a stone Indian arrow-head, the worm is <u>7 estib</u>.

Other useful recognition characters aret The nature of the

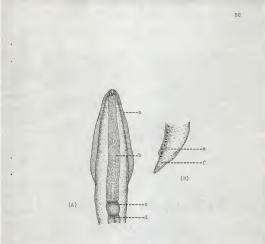
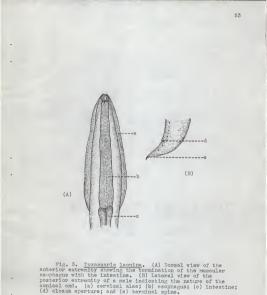


Fig. 2. <u>Toxogara canis</u>. (A) Doreal view of the anterior extensive shoring the formulation of the magniture cosponages with a distinct bulbous wontriculus. (B) Lateral view of the posterior extensive of a male indicating the nature of the "growning" end, (a) cervical alasy (b) cosponagues (c) bulbous probular expendance.



outer layer of the egg shall in gravid females and the shape of the Sail in males. Eggs of <u>Toxyonry</u> have pitted surfaces winneas those of <u>Toxyonry</u> have smooth ones. In males of the latter genus, the tail is conical in shape (Figs 5); in males of <u>Toxyonry</u>, the tail diminishes abruptly in dismeter a short distance behind the closes and therefore has been described as "probular".

These helminths, according to Monnig (1947), inhabit the upper portion of the small intestine. The adult female ascarid after copulation with the male, lays thousands of single celled once which are then passed to the exterior in the feces of the host. Under suitable conditions, the eggs segment and develop into the coiled embryo or infective stare in three to five days. The embryos moult once in the egg shell, and after incestion by the next host, hatch in the intestine and burrow into the mucosa of the intestine. They may enter the liver through the peritoneal cavity, but the usual mode of migration to this organ is by the blood stream. From the liver the larvas migrate to the lungs via the cardio-vascular system, enter the alveoli, develop and moult. After two or three woeks the larvae migrate to the respiratory passages thence to the pharyng and are passed down the oesophagus to the small intestine, where, in the normal host such as the coyote, they develop into adults in eight to nine weeks.

According to Wright (1985), in his experiments carried out with albino rate, mice, guinea pigs, and dogs, the larvae of

<u>Towassaria losnina</u> do not regularly migrate throughout the body of the host. The likewided larges penstrate the wall of the small intestine, especially that of the lower part of the ducdarum, and each to rest in the arguts of Lieberthin in the sub-succes and in the diroular much of the wall. The larges undargo considerable growth while in the intestinal wall and begin to easarys about the 9th or 10th day after infection. Following their re-entrance into the luman of the small infection undergo two edgress into the shult form,

The migratory habits of the ascarid larvae of <u>formears</u> canis and <u>formears</u> locains in the body of an accidental hest may give rise to pathological conditions.

The eggs of <u>Taxonum shale</u> and <u>Taxonum is housing</u> containing the coiled or infective lawnes may be accidentally smalleeed by man. Upon reaching the intesting, the eggs hatch and the lawnese begin a harmful migration in the body of the accidental host. Although the development of the secarid lawnes in the accidental host is very rure, it has been substantiated by exportants of Danheim (1985) who recovered a number of est ascarid lawnes from the livers of rute after infecting them with eggs containing coiled enhayce. Howerel cases of the est escerid infections in the human host have been recorded in Europe and Horth America (chotor, 1907).

The pathological conditions caused by the larvas include minute lesions accompanied by petechial hemorrhages and possible

infection by intestinal backeris. These legions are rarely severe enough to produce elinical symptoms. The large in heavy infections upon reaching the lungs may set up a versinous passmonia characterised by chronic focal alvoolar emphysems, stelectasis, ecclymotic hemorphages, local eccinophilis and marked exadetion,

Description and Pathogenesis of Ancylostoma canimum

The distribution of the dog hodewares, <u>Anovlosion contemps</u> in the canine species throughout the United States and the disease, anoylestominais, associated with the infection makes it a problem not only for the small animal practitions but also the public health official since it is capable of infecting the human. Landsberg (1939) reporting on a survey made by Himman in 1936 indicates that of 1,515 dogs examined in Hes Geleans, 41.5 per cent of the mature animals and 44.4 per cent of the immuture once were infected. This gives an idea of the incidence of this paramite in at least one section of this country.

This dog hoolstorn has been reported frequently in cats and in other carnivores. Ackert's findings in 1941 indicated the stomach as a new habitat for Anevlostors, gaminus in the cat.

The hookworns belong to the family Strongylidas and are characterised by the presence of a burea copulatrix on the posterior end of the male. It has a cream-colored cylindrical body with a finely stricted chilinous cuticle. The works have a wide baccal expetile provided with three tooth on each fide of the aperture. The makes range from 10 to 12 mm in length and 0.4 mm in width while the females range from 14 to 16 mm or more in length and 0.6 mm in width. The bures which is large and flaring is supported by long alender rays.

The call positive widence of an infection in an animal is the presence of the eggs in the feces. The size of the eggs according to Mannig (1947) measures 58-56 by 37-45 microns and contain an embryo of should click when laid.

The embryomated egg requires a favorable environment for further development. It develops best in a wet, light, andy loam soil shided with decaying vogetable matter. Under outdoor temperature variations, its eggs usually hatch in 24-64 hours. The larvae, feeding upon living bacteria, grow to almost twice their original length within 75 hours. They then undergo eedysis shadding their outclude covering and enter the second or infective stage of larval development. Growth continues for about four or five days at which the the larvae are shout 0.55 to 0.7 m in length (Landsberg, 1950). The infective larvae are unable to feed in the soil and depend upon their entrunes into the final host to continue their development. This larval steps is known as the filterifour or infective taxes.

This filariform larvae under suitable conditions of temperature and moisture remain on the surface or upper layers of the soil. They are capable of climbing upon any protruding objects

such as leaves, sticks, or soll particles, extending their bodies and commonly waving book and forth. As long as a moist atmosphere prevails the larges remain on the surface of the soll. As drynose annues, they migrate book into the soil.

The larvae are attracted by heat and exhibit thigmotropism. They may live in the soil about six weeks.

Infection of the final host, the dog or related carnivores, may occur in three ways. The larvae may penetrate the skin, may be ingested with food and water, or prematal infection may occur. Mouth infection is probably the most common means of infection in the dox because of their food labits.

During skin penetration the enticular shouth is lost if it has not already been lost in the soil (Gort, Augusting, Ackert, Fayne and Fayne, 1928) and the larves find their way into the blood capillaries from where they are carried by the wonous circulation to the right side of the heart and out through the pulmonary arteries into the lungs. From the lung capillaries, they buryow their way out into the alveoli, and mignets into the bronchidles, up the traches, more down the occophagus and finally become localized in the small intestine. During this stage of mignetion they unlarge a third codysis with allows the worms to attach themselves to the gut mucces.

When the infection occurs by mouth, the larvae do not undergo lung migration but develop directly in the intestine.

The most likely route of the larvae in prenatel infection is transportation from the maternal circulation to the fetus.

Poster (1932) pointed out that the development of the larvae is not initiated until the birth of the pupples and that the larvae remain in the organs until parturition.

The ponstration of the skin produces a local reaction. Landsberg (1939) observed that young dogs showed no more than a transitory inflammation after largel ponstration while in old animals a marked edems and inflammation occurred immediately and persisted for at locat a week, with pronounced azmidation and mersesis at the center of the legion.

Petechial hemorrhages are found in the lungs as a result of the migratory journey of the larvas from the pulmonary capillaries into the air sacs.

The most extensive and serious morbidity from As <u>earling</u> is produced by the stachment of the parasites to the mesons of the intestine and the associated ansmis. The worms maintain themselves in the intestine by grasping a portion of the macous membrane with their powerful mouth parts. A portion of the macous membrane with their powerful mouth parts. A portion of the macous is drawn into the buckel cavity and is torn away as the worms signate from place to place in the intestine to feed ("ealls, 1603). With the macoas removed there remain small blowding mecroits areas which may become fool of secondary bacterial infections.

The filariform larves are infective to man. The pathogenic condition erought from infection of <u>A</u>. <u>entime</u> is commonly called creeping emptions. The infective larves penetrate the epidemic and cause charactoristic sich locies which are

eridenced by advancing tracks of bildwared skin secompanied by prartics. Transiont derestitis and papular skin lesions have been found to be due to the infection of the filariform larves (lowe, 1030).

The Prevalence of the Tapeworm, Taonia pisiformis

The extremely large number of <u>Teenis pisiformis</u> found in the 407 coyotes examined can be assounded for by considering the food habits of this host. An examination of the stemeth contents disclosed a considerable ensuit of rabbit remains.

The life cycle of <u>Teaning pictures</u> yequires the wabbit as an intermediate host. Haves and rabbits are infected by smallowing the ages or entire procletisfs from the foces of dogs, foces, or previously infected coyotes. In the duodoms the shall is dissolved and the concepteres prostruct the intestinal wall, from where they are carried with the blood to the liver (Christenson and Rob, 1940). In the liver, the constantly growing larvae marker shout, until they emerge into the peritoneal cavity, and three to four weeks after the infection they form, on the examine or the measurery, the typical pes-staed oysticarel, which are enclosed by a fibrous example developed by the host entant.

The coyotes become inflotted with tapewores by consuming the meanly organs from haves and rabbits. The cysticerci passing the entrance of the bile duct invariants and the scolex attaches itself to the intestinal wall and undergoes sexual maturity.

SUBBLARY

A study of the digestive tract of 407 coyotes was made to determine the incidence of helminth peresites in <u>Ganis Latrans</u>. The coyotes were obtained from hunters and trapport in 44 counties of Tanass.

The storach, small and large intestine were removed in their entirety frem the abdominal cavity. The mesentery and oments were disposed of and an incluin was made along the greater curvature of the storach to expose the paramites.

The parenties found in the stonach and the intestinal tract of each individual coyote were placed in separate containers according to their location. These were then bothled in vials marked with the respective specimen number and habitat. The parenties were preserved in either 10 per cent formalin or 70 per cent alcohol and later cleared and identified.

A total of 17,850 parasites were found in the 407 coyotes examined. Of this mamber 30 were identified as <u>forecare earlies</u> 580, as <u>formscenis isonins</u> 370, as <u>Anorlestons earlings</u> 1,000, as <u>Firmschoters press</u>; 12, as <u>Firmschoters prespitabile</u>; 2, as <u>Hordidius</u> centrum and 44,000, as <u>fessis pisticatio</u>; 2.

The average total infection per coyote numbered 43.5 peresites. Of this number 3.6 occurred in the stomach; and 39.9 in the small intestines. The average incidence for the six species in each coyote was as follows: <u>Topposes</u> canis, 0.07; <u>Topposers</u> leoning, 1.5; <u>Anovices canirus</u> 0.0; <u>Physiciters</u> <u>raws</u>, 4.6; <u>Tamin philowis</u>, 30.0; <u>Physicitus canirus</u>, 2 (consured in one coyote).

Of the 407 coyotes examined 394, or 96.8 per cent ware infected with one or more of the six species mentioned. The number of parasites in each coyote ranged from 1 to 519.

Coyotes with an infection of A. <u>centums</u> numbered 60. The appearance of one <u>A</u>, <u>earling</u> in the stomach of one coyote was believed to be due to the wondering of the worw into the stomach from the intestine after the death of the hosts.

<u>P. mark</u> countred in 254 coyotes, with 75.3 per cent of these parenties countring in the standship of 155 coyotes. The high incidence of this nematode indicates that it is a regular permatic occurring in the digastive tract of coyotes.

Twelve specimens tentatively identified as <u>Physalcotera</u> <u>praeputialis</u> occurred in the stomaches of three coyotes.

This incidence of the genus <u>Flynchopters</u> was the highest of any of the four nematode genera found.

Taenia pisiformis was found in 361 coyotes. The aggregate of 14,990 tapeworms occurred in the small intestines.

Two specimens of <u>Dipylidium canings</u> occurred in the small intestine of one coyote.

Toxocara canis occurred in 7 coyotes. Toxaccaris lecning was found in 77 coyotes. The occurrence of <u>Anovloatowa canimus, Physaloptera</u> rara.

Fursalorizera prescutialis, Toxosera canis, Toxascaris loonins, Taonia pisifornis, and <u>Dipulidium caninum</u> in the gestrointestinal treat of coyotes serves as a possible source of larval infection in docostic and wild animals as well as man. None of the minule examined evidenced undue injury caused by the helminth purestes.

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