Notes on Two Species of *Filaroides* (Nematoda: Filaroididae) from Carnivores in Texas

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**ABSTRACT:** The pathology and host-parasite relationships of two species of the genus *Filaroides* from west Texas carnivores are discussed. These are *Filaroides milksi* Whitlock, 1956 from the lungs of the hog-nosed skunk, *Conopatus mesoleucus*, and *Filaroides osleri* (Cobbold, 1879) Skrjabin, 1933 from the trachea and bronchi of the coyote, *Canis latrans*. The lungs of the hog-nosed skunk infected with *F. milksi* were extremely congested, and there was a severe interstitial pneumonia surrounding numerous granulomatous foci containing adult and larval nematodes. This species is briefly redescribed from the hog-nosed skunk, which represents a new host record. *Filaroides mephitis* Webster, 1966 is considered a synonym of *F. milksi*. Also, the validity of *Filaroides hirthi* Georgi and Anderson, 1975 is suspect. *Filaroides osleri* in the coyote presented as a mild to severe verminous bronchitis. Infections ranged from a small pinpoint nodule at the tracheal bifurcation to many large nodular lesions extending from the proximal ⅔ of the trachea into the anterior bronchi. Cellular reactions consisting of epithelioid cells, histiocytes, and a few eosinophils surrounded the entwined nematodes. A mild interstitial pneumonia and, in one instance, small parenchymal granulomas surrounding immature worms were observed in the lungs of some infected animals.

*Studies on the helminth fauna of west Texas carnivorous mammals revealed infections in the coyote, *Canis latrans*, and hog-nosed skunk, *Conopatus mesoleucus*, with *Filaroides osleri* (Cobbold, 1879) Skrjabin, 1933 and *Filaroides milksi* Whitlock, 1956, respectively. The pathology, host-parasite relationships, and taxonomy of these species from their respective hosts are discussed.*

**Materials and Methods**

Animals were routinely necropsied; nematodes removed and fixed in glacial acetic acid, and preserved in a mixture of 70% ethyl alcohol and 5% glycerine by volume. One cm square portions of lung parenchyma and small pieces of trachea from infected hosts were fixed in 10% buffered formalin. Sections were cut at 4–6 μ and stained with hematoxylin and eosiin or Giemsa. In the following description all measurements are in microns unless otherwise indicated. Drawings were made with the aid of a Leitz drawing tube.

**Filaroides milksi** Whitlock, 1956

**NEW SYNONMY:** *Filaroides mephitis* Webster, 1966 (Can. J. Zool. 45: 145).

**DESCRIPTION** (based on fragments of numerous δδ and 99 specimens): *Filaroididae* Schultz, 1951; *Filaroides* Van Beneden, 1858: long, slender, filiform nematodes. Cuticle smooth, without striations, very delicate, often detached from hypodermis. Buccal capsule very shallow, indistinct, not sclerotized. Four large papillae in outer circle, four smaller papillae in inner circle, amphids lateral. Esophagus muscular, simple. Excretory pore slightly posterior to nerve ring. Posterior extremity of female with blunt tail, vulva close to anus without conspicuous vulvar inflation. Vagina muscular. Uteri paired, ovoviviparous, with hatched larvae. Male with very rudimentary bursa bearing two pairs large pedunculate, postanal papillae. Spicules similar, subequal, scimitar-shaped, without transverse striations, blunt-tipped (Fig. 1). Gubernaculum lightly sclerotized, ⅔ length of spicules. Eggs thin-shelled, with well-developed larvae.

**FEMALE** (based on 10 specimens): One fragmented female 10.6 mm long, remaining specimens broken, total length undetermined. 82–94 (89) wide (maximum). Esophagus 122–140 (133) long. Nerve ring and excretory pore 65–88 (74) and 94–129 (109) from anterior extremity, respectively. Vulva and anus 76–82 (77) and 20–26 (23) from posterior extremity. Larvae 234–280 (254) long.
**Remarks**

*Filaroides milksi* has been previously reported from dogs in New York (Whitlock, 1956; Judd, 1960), Iowa (Peckham et al., 1960), Connecticut (Mills and Nieldsen, 1966), and Canada (Greenway and Stockdale, 1970), and the striped skunk, *Mephitis mephitis*, from Iowa (Levine et al., 1965). *Filaroides mephitis* was described as a distinct species by Webster (1966) from *Mephitis mephitis* in eastern Canada. Dyer (1970) also reported this species from the same host in North Dakota. This species was differentiated on the basis of larger size of the male (up to 24 mm versus 3.4–4.4 mm for *F. milksi*), larger spicules (48–60 in *F. milksi* versus 85.5–89.3 in *F. mephitis*), and presence of a prominent vulvar inflation in *F. milksi*. Specimens from the hog-nosed skunk in the present study appear intermediate in size (a single broken male measuring 7.5 mm), spicules 59–78 long, and females with only a slight to no inflation in the vulvar region. Examination of the type specimens of *F. mephitis* (USNM Helm. Coll. No. 61679 and 61680) revealed no morphological differences by which these species could be distinguished. Spicules of *F. mephitis*, although larger, appeared identical to those recovered from the hog-nosed skunk (Figs. 1, 3). Therefore, *Filaroides mephitis* Webster, 1966 is considered a synonym of *F. milksi*.

Examination of type specimens of *Filaroides hirthi* Georgi and Anderson, 1975 revealed few morphological differences between specimens collected in the present study and this species. This species supposedly differed from *F. milksi* by (1) smaller size and (2) slightly stouter spicules with broader knobs for attachment of retractor muscles. Paratypes of *F. hirthi* (USNM Helm. Coll. No. 72943 and 72944) appear to be immature specimens. The spicules of the species reported as *F. hirthi* appear very similar to those observed herein from the hog-nosed skunk and those reported as *F. mephitis* by Webster (1966) (Figs. 1–3). Additionally, Hirth and Hottendorf (1973) in the original description of the pathology of this nematode stated the male was up to 6.0
mm long and 90 wide, while the female approached 10.0 mm long and 185 wide. This information was not included in the new species description of *F. hirthe* by Georgi and Anderson (1975) who described living specimens as 2.3–3.2 mm long and 35–43 wide in the male and 6.6–13.0 mm long and 58–102 wide in the female. Thus, both the spicules and range of measurements are probably within the range of intraspecific variation of *F. milksi*.

*Filaroides milksi* is differentiated from *F. martis* (Werner, 1782) Dougherty, 1943 and *F. osleri* principally by the smaller size of the spicules which are 46–89 as compared to 174–183 and 99–133 in the latter two species, respectively (Levine et al., 1976). Additionally, the spicules of *F. osleri* have prominent transverse ridges, the tail of the female is rounded and the anus and vulva are very close. *Filaroides milksi* differs from *F. canadensis* Anderson, 1963 in that the distal ends of the spicules are not split and the gubernaculum is considerably larger (Anderson, 1963).

**Filaroides osleri** (Cobbold, 1879)  
Skrjabin, 1933

**Host record:** *Canis latrans*, coyote. Twenty four animals infected of 94 examined.

**Locality:** Benjamin, Knox Co., Texas; Ross and Adams Ranches, King Co., Texas; Beggs and Pitchford Ranches, Dickens Co., Texas. Collected by the author from September 1973 to November 1976.

**Location:** Trachea and bronchi forming nodular lesions under tracheal epithelium.

**Disposition of specimens:** The Museum of Texas Tech University, Department of Medical Zoology, No. 1594–1673.

**Pathology:** Animals less than 1 year of age were rarely infected (3/24) while the majority of cases were noted in animals over 2 years of age (15/24). The extent of pathological manifestations in the 24 infected coyotes varied considerably. Usually the anterior \% of the trachea was not involved. The middle one third occasionally had a few nodules measuring 1–3 mm in diameter. In the posterior one third of the trachea at the bifurcation of the bronchi and sometimes into the bronchi themselves, the lesions became larger and more numerous. Grossly, the lesions appeared as white to pink polyloid or sessile nodules just under the mucosa, 1–12 mm in diameter (Fig. 5). Often the anterior and posterior extremities of numerous nematodes protruded from the lesion. In more severe infections the majority of the lesions were located in the tracheal bifurcation with the larger adjacent lesions sometimes becoming confluent. They were confined to the ventral and ventrolateral aspects of the trachea and were raised as much as 5 mm above the mucosal surface. In no instance were the lesions so numerous as to occlude the lumen of the trachea or bronchi.

The lungs of infected animals showed no signs of gross pathological changes.

Histologically, the size of the nodules corresponded to the number of adult nematodes present in the lesion. Smaller lesions contained only a few nematodes and in some instances only a single worm. Occasionally, the ciliated columnar epithelium of the trachea was continuous over the lesion. Often this appeared to be absent with the surface of the lesion covered by a layer of connective tissue (Fig. 6). In all lesions the host reaction was substantial. Basically, the nodule consisted of masses of entwined adult and larval nematodes surrounded by plasma cells, lymphocytes, collagen, fibroblasts, neocapillaries, eosinophils, and a few histiocytes (Fig. 7). Usually the lesions did not progress beyond the level of the perichondrium. At the base of the nodules the mucous alveoli and tracheal glands were destroyed, and occasionally a few lymphocytes, plasma cells, and eosinophils were seen in tracheal tissue adjacent to the lesions. Histologic sections of trachea and bronchi occasionally revealed first-stage larvae, and immature adults in the dilated lymphatics of the bronchial and tracheal walls (Fig. 8).

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These were sometimes surrounded by lymphocytes, plasma cells, and a few eosinophils. Occasionally, there was a mild hyperplasia of lymph nodes adjacent to these lesions.

The lung parenchyma of infected animals in most instances was normal. Several of the animals had a mild interstitial pneumonia, probably unrelated to the *F. osleri* infection. In the most severe case of *F. osleri* observed in the coyote, there was a moderate degree of interstitial pneumonia with congestion and edema most severe near the hilus of the lung. A few granulomatous lesions were scattered throughout the parenchyma. These contained larval nematodes, presumably *F. osleri*, usually surrounded by an intense reaction of lymphocytes, plasma cells, eosinophils, and a few histiocytes.

### Remarks

Specimens from the coyote collected in this study conform in all respects to previous descriptions of *F. osleri* infections in dogs, coyotes, and wolves. *Filaroides pararostratus* described from nodules in the trachea of the dog in Mexico City by Flores-Barroeta (1955) is probably a synonym of *F. osleri*. Spicules of this species were only 88 long compared to 99–113 for *F. osleri*, as reported by Olsen and Bracken (1959). Specimens collected from the coyote in the present study had spicules measuring 91–115 (mean 94; 30 specimens; 10 worms from 3 animals, respectively). The prominent transverse ridges on the blade of the spicules as noted by Olsen and Bracken (1959) should serve to differentiate this species from others of the genus. Clarification of the status of *F. pararostratus* must await careful comparison with *F. osleri*.

### Discussion

The taxonomy, host–parasite relationships, and distribution of the genus *Filaroides* in North American carnivores are poorly understood. Their small size, location, and few good
taxonomic characteristics for species differentiation adds to the confusion. Additionally, both the species reported herein demonstrate considerable meristic variability in key characters used in differentiation. Thus, *F. mephitis* Webster is regarded as a synonym of *F. milksi*, while the validity of *F. hirthi* Georgi and Anderson and *F. pararostratus* Flores-Barroeta is in question.

*Filaroides milksi* is reported from dogs in several areas of southern Canada and the eastern United States; *Mephitis mephitis* in southern Canada, Iowa, and North Dakota; and *Conepatus mesoleucus* in west Texas. Examination of numerous specimens of other skunks from the same locality, including *Spilogale gracilis*, *Mephitis mephitis*, and *Mephitis macoura*, in west Texas failed to reveal infections with this nematode. Additionally, numerous other carnivores examined from the same area were not infected.

*Filaroides osleri* is apparently cosmopolitan in the dog (Levine, 1968). Coyotes and wolves are reported infected with this species in Alberta (Holmes and Podesta, 1970) and Minnesota (Erickson, 1944). Thornton et al. (1974) previously reported this species from south Texas coyotes.

The lesions produced by *F. milksi* in the hog-nosed skunk appeared similar to those described by Levine et al. (1965) in the eastern striped skunk and by Judd (1960), Peckham et al. (1960), Mills and Nielsen (1966), Greenway and Stockdale (1970), and Hirth and Hottendorf (1973) from the dog. The differences were less granulomatous response surrounding the worms, more severe peribronchiolar infiltration and hyperplasia of smooth muscle, and a more severe interstitial pneumonia with congestion and edema in the parenchyma. Although Babero (1960) noted that *Filaroides* sp. in Louisiana skunks was highly pathogenic, he failed to describe the lesions. Likewise, lesions attributable to *F. mephitis* (= *F. milksi*) were not described by Webster (1966) or Dyer (1970). Judging
from the severe reactions and heavy infections in the hog-nosed skunk in Texas and the case described from the striped skunk in Iowa by Levine et al. (1966), this nematode is highly pathogenic to skunks. The effect of this species on wild skunk populations remains to be determined.

Apparently *F. osleri* is not highly pathogenic to coyotes. Although the lesions are similar to those reported in the dog (Mills and Nielsen, 1966; Mills, 1967; Dorrington, 1968) and dingo (Dunsmore and Burt, 1972), the infection apparently does not reach the intensity nor produce the severe effects as reported in the latter species. In no instance was an infection in the coyote noted in this study or by Thornton et al. (1974) in which there were sufficient nodular lesions to block the trachea or bronchi, thus suffocating the animal. Although a mild interstitial pneumonia was noted in several coyotes, in only one instance was this probably attributable to *F. osleri* infection in the trachea. Histologically, the only difference in lesions from the coyote as compared to those in the dog was the abundance of eosinophils. The effects of this species on the morbidity and mortality of coyote populations is apparently insignificant.

**Acknowledgments**

The authors express sincere appreciation to Messrs. Larry Conner, Wyman Meinzer, and Mark Baird, who provided many of the coyotes and skunks examined in this study.

**Literature Cited**


