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Gastrointestinal Parasites of Cougars (*Felis concolor*) in Washington and the First Report of *Ollulanus tricuspis* in a Sylvatic Felid from North America

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ABSTRACT: Gastrointestinal helminths including two species of cestodes (*Taenia omissa* and *T. ovis krabbei*) and three species of nematodes (*Toxocara cati*, *Cylicospirura subequalis* and *Ollulanus tricuspis*) are reported from two free-ranging cougars (*Felis concolor*) in Washington (USA). *Ollulanus tricuspis* is reported for the first time from cougars and represents the first occurrence of this parasite in a sylvatic felid from North America.

Key words: Cougar, *Felis concolor*, parasites, *Ollulanus tricuspis*, *Cylicospirura subequalis*, survey.

Although numerous species of helminths have been recorded from the cougar (*Felis concolor*) (see Anderson, 1983; Rausch et al., 1983; Forrester et al., 1985; Waid and Pence, 1988) only one parasite (*Taenia omissa*) is considered to comprise the core species across the host's range (Waid and Pence, 1988). Based on this concept and the presence of *T. omissa* in a single cougar examined in Washington (Skagit County) (Rausch et al., 1983) its presence in other populations in Washington would not be unexpected. We recently had the opportunity to examine this when two dead cougars from King County in western Washington (47°30'N, 121°30'W) were presented to us by the Washington Department of Wildlife for necropsy.

The first cougar was a 10-to-12-yr-old female that had been radio-collared for 6 yr as part of an ongoing study of cougar population dynamics. The second cougar was a 12-mo-old male which had been radio-collared 6 mo previously. Both animals had been found dead and were frozen until necropsy. At necropsy, serum from clotted blood present in the heart was collected and submitted to the Washington Animal Disease Diagnostic Laboratory (Pullman,

Washington 99164, USA) for evaluation for feline leukemia viral (FeLV) antigens with an ELISA method (CITE®, Feline Leukemia Virus Test Kit, IDEXX Corporation, Portland, Maine 04101, USA), and for antibodies to feline immunodeficiency virus (FIV) with an ELISA method (CITE®, IDEXX Corporation, Portland, Maine 04101, USA) and feline infectious peritonitis (FIP) virus (McKeirnan et al., 1987). Although autolyzed, the heart, liver, lung and kidneys were examined macroscopically. The stomach, small intestine and large intestine were opened separately in water, their contents removed and linings scraped. After removing large helminths, the residue was examined with the aid of a dissecting microscope for smaller specimens. All helminths were preserved in 10% neutral buffered formalin. Nematodes other than *O. tricuspis* were transferred to 70% ethanol with 5% glycerine by volume, and examined in glycerine mounts after alcohol evaporation. *Ollulanus tricuspis* were studied without prior clearing and mounted in tap water. Cestodes were stained in acetic carmine, processed by standard methods and mounted permanently. Each rostellum was mounted separately with application of enough pressure to cause the hooks to lie flat. Many cestodes were unidentifiable because of the poor condition of the specimens.

Representative specimens have been deposited in the U.S. National Museum Parasite Collection (Beltsville, Maryland 20705, USA) as follows: *Taenia omissa*, Number 81889; *Taenia ovis krabbei*, 81890; *Toxocara cati*, 81887; *Cylicospirura subequalis*, 81888; and *Ollulanus tricuspis*, 81891.

TABLE 1. Numbers of gastrointestinal helminths of two cougars (*Felis concolor*) from western Washington.

Parasite (location)	Male juvenile cougar	Female adult cougar
<i>Toxocara cati</i> (stomach, small intestine)	5	62
<i>Cylicospirura subequalis</i> (stomach)	2	111
<i>Ollulanus tricuspis</i> (stomach)	10,650	0
<i>Taenia omissa</i> (small intestine)	0	21
<i>Taenia ovis krabbei</i> (small intestine)	25	0
<i>Taenia</i> spp. unidentifiable (small intestine)	28	50

Both cougars were serologically positive for FeLV antigen. Only the adult female cougar was weakly positive for FIV. Neither animal exhibited a titer for FIP. The role of these viral infections in the cougars could not be determined.

Five species of helminths were recorded from these two cougars (Table 1) including the nematode *Ollulanus tricuspis* (Figs. 1 and 2). This is only the second report of this parasite in a free-ranging felid and the first report from North America.

Taenia omissa was present in one of the two cougars examined. As suggested by Waid and Pence (1988) it is likely that this parasite can be found in most populations of cougars in North America. *Taenia ovis krabbei* was first reported in cougars in Oregon (Rausch et al., 1983). However, the specimens present were undeveloped with the longest measuring 228 mm with about 220 segments. Our specimens were gravid with the longest measuring 510 mm with about 276 segments.

Toxocara cati is a parasite of many felid hosts as reflected by its occurrence in cougars (Forrester et al., 1985; present study), bobcats (*Felus rufus*) (Stone and Pence, 1978; Watson et al., 1981), and lynx (*Felis lynx*) (Van Zyll De Jong, 1966) across North America. Although the broad host range precludes its inclusion in the core helminth community of cougars, it is expected to be of regular occurrence in this mammal.

Only two species of *Cylicospirura* are found in sylvatic felids in North America: *C. felineus* and *C. subequalis*. Pence et al. (1978) reported *C. felineus* as occurring in bobcats and lynx and considered pre-

vious reports of *C. subequalis* from these hosts in North America as suspect. Later, *C. subequalis* was reported from cougars (Waid and Pence, 1988). Both species produce granulomatous lesions; however, lesions due to *C. felineus* were found exclusively in the stomach while those due to *C. subequalis* were primarily located in the proximal portion of the duodenum. In the present study, a single, large (3 cm), cystic granuloma was in the pyloric region



FIGURE 1. Adult male *Ollulanus tricuspis*. Scale bar = 100 μ m.



FIGURE 2. Caudal portion of fourth stage larva, male *Ollulanus tricuspis*. The nematode has separated from the external sheath allowing visualization of two of the five cusps present on larval male *O. tricuspis* not present on the adult male. Scale bar = 10 μ m.

of the stomach of the female. Lesions were not present in the duodenum. The mucosal surface was normal except for a small opening extending from the cyst into the lumen of the stomach. The serosal surface was intact with little evidence of the cyst. Excision of the granuloma revealed a central necrotic cavity filled with debris and adult and immature nematodes. Microscopic evaluation of the debris revealed numerous eggs. No cyst was found in the infected male; however, only two nematodes were present. This is the second report of *C. subequalis* from cougars in North America and the first from the northwestern Pacific coast of the United States.

Ollulanus tricuspis is a minute nematode occurring in the stomach of felids worldwide (see Hasslinger, 1984). The domestic cat (*Felis catus*) is the most com-

mon host for this parasite. In most surveys, intensity was not recorded; however, in one survey the mean intensity was approximately 1,500 with a maximum of 11,028 (Hasslinger and Trah, 1981). Although generally considered to be non-pathogenic, *O. tricuspis* has been associated with anorexia, vomiting and chronic gastritis in its domestic host (Hänichen and Hasslinger, 1977; Hargis et al., 1982, 1983). Other felid hosts from which this nematode has been reported include the lion (*Panthera leo*) (Chauvier and Chabaud, 1964; see Hasslinger et al., 1982), tiger (*Panthera tigris*) (see Hasslinger, 1984), cheetah (*Acynonyx jubatus*) (Hasslinger, 1982; Hasslinger et al., 1982) and wildcat (*Felis silvestris*) (Brglez and Zeleznik, 1976). Of these, *O. tricuspis* has been implicated in the debilitation or death of a lion, tiger and cheetah, all from zoos (Hasslinger, 1982; see Hasslinger, 1984).

Reports of *O. tricuspis* in North America have been sporadic and it has been confirmed only recently as occurring in domestic cats in the USA (Hargis et al., 1981; Greve, 1981). In Washington state, approximately 13% of 201 cats surveyed harbored *O. tricuspis* (Hargis et al., 1982). The discovery of *O. tricuspis* in a sylvatic felid in a state where the nematode is known to exist may not be surprising. However, compared to limited information from domestic cats (Hasslinger and Trah, 1981), the 10,650 nematodes found in the cougar was high. It was unfortunate that the condition of the stomach precluded histopathologic examination; consequently, the impact of this number of nematodes in the infected male cougar could not be assessed completely. The significance of this nematode in sylvatic felids is currently unknown, but vomiting and chronic gastritis would be likely signs of infection.

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