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Air Sac Nematode *Monopetalonema alcedinis* in a Belted Kingfisher (*Megaceryle alcyon*) in Maryland, USA

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ABSTRACT: Sporadic and geographically widespread reports of parasites affecting the Belted Kingfisher (*Megaceryle alcyon*) have been published but few have described details of the pathology. A female, adult kingfisher was found dead in a heavily wooded area of a zoo in Maryland, USA. At necropsy, numerous sexually dimorphic, 4.4–40.5-cm adult *Monopetalonema alcedinis* nematodes were found tightly wound within the coelomic cavity between organs and completely filling the caudal thoracic and abdominal air sacs. Abundant, 30–60- μ m diameter, larvated, thick-walled ova were found in the bronchi and parabronchi, within the mesentery, and in the serosa of multiple coelomic organs. *Monopetalonema alcedinis* is a characteristic member of the superfamily Diplostriaenoidea, a group of nematodes occurring in birds and reptiles. Infective larvae within an invertebrate intermediate host are ingested and penetrate the intestine, traveling to the lungs and then into the air sacs, where the adult females release eggs. The ova are coughed up by the avian host and passed in feces. Specimens of *M. alcedinis* have been found in the Belted Kingfisher, although typically intensity of infection is low and infections remain asymptomatic. In contrast, we report the second documented case of high numbers of *M. alcedinis* resulting in pathologic changes in which parasitism contributed to host mortality.

Key words: Air sac nematode, Belted Kingfisher, diplostriaenid parasite, Diplostriaenoidea, *Megaceryle alcyon*, *Monopetalonema alcedinis*, nematode.

The Belted Kingfisher (*Megaceryle alcyon*), a member of the Coraciiformes, is found commonly throughout North America along rivers, streams, ponds, and lakes with clear water and high banks for nesting. The diet consists primarily of fishes, but aquatic and terrestrial invertebrates (crayfish, mollusks, aquatic insects,

and crickets), amphibians, and small birds also are consumed (Cornell Laboratory of Ornithology 2009). Over the past century, information about the diversity and distribution of the helminth fauna of kingfishers across North America has increased (Muzall et al. 2011), although implications of parasitism on the health status of this common avian species were not examined. We describe dramatic lesions and mortality in a Belted Kingfisher from Maryland, USA infected with *M. alcedinis*.

A female, adult, free-ranging kingfisher was found dead in an exhibit pool in a heavily wooded area at the Maryland Zoo in Baltimore, Maryland, USA in January 2009. On gross examination, the bird was in good body condition. Upon opening the coelomic cavity, multiple 1–2-mm diameter, 4.4–40.5-cm long, white nematodes were found tightly wound within the coelomic cavity between organs including around the mesentery, liver, and especially concentrated around the ventriculus. The parasites appeared to fill the caudal thoracic and abdominal air sacs completely (Fig. 1). The air sacs appeared cloudy, thickened, and tan. The serosal surface of the ventriculus was thickened, irregular, and adhered to the mesentery and intestines. The adult worms were removed from the coelomic cavity intact and placed in isopropyl alcohol. The specimens were examined, identified, and accessioned into the US National Parasite Collection (USNPC) in Beltsville, Maryland, USA (USNPC 102692). The nematodes were identified as adult *Monopetalonema alcedinis* (Rudolphi 1819) based on the

FIGURE 1. Coelomic cavity of a Belted Kingfisher (*Megascops asio*) from Maryland, USA, with several individuals of *Monopetalonema alcedinis* between and encompassing the coelomic organs and filling the majority of air sac space.

FIGURE 2. Parasitism of a Belted Kingfisher (*Megascops asio*) from Maryland, USA. Numerous larvated, thick-walled eggs of *Monopetalonema alcedinis* surrounded by mucus and predominantly lymphohistiocytic inflammation with fewer multinucleated cells and heterophils. The bronchus is lined with hypertrophic and hyperplastic respiratory epithelium with lymphohistiocytic inflammation. H&E stain; 200 $\times$ magnification.

redescription of this species from Ontario, Canada (Anderson 1959) and on comparison to voucher specimens in the USNPC.

Nineteen adults were found: Six males with a mean length of 6.4 cm (4.4–7.3 cm) and 13 females with a mean length of 26.2 cm (11.0–40.5 cm). On histologic examination, numerous 30–60- μ m diameter larvated nematode ova with a 1–2- μ m thick, double-contour, refractile wall were found in the bronchi and parabronchi, mesentery, air sacs, the serosa of the pancreas, proventriculus, ventriculus, small intestine, ovary, and within the capsules of the spleen and liver (Fig. 2). In the lung, abundant basophilic mucus along with eosinophilic cellular debris and variable lymphocytes, plasma cells, foamy macrophages, multinucleated cells, and lesser numbers of heterophils surrounded basophilic ova containing coiled larvae.

The bronchi and parabronchi were lined with hyperplastic and hypertrophic respiratory epithelium, and the mucosa occasionally was disorganized with increased numbers of mucous cells. The air sac epithelium was thickened and lined by prominent cuboidal cells occasionally arranged in short papillary projections. Similarly, the coelomic serosa was lined by plump serosal hyperplastic epithelium and variably thickened by lymphohistiocytic inflammation, most prominently surrounding the blood vessels. The air sacs and mesentery contained a few mineralized larvae. Diffuse, moderate to severe, pulmonary and meningeal hemorrhage was present. In addition, a cross-section of a nematode consistent with *Capillaria* sp. was present within the mucosa of the ventriculus. The proximal cause of death was attributed to acute, severe trauma with pulmonary and meningeal hemorrhage. The extensive parasitism and marked coelomic tissue reaction were considered contributory. Based on the lack of other parasites besides the one *Capillaria* nematode not associated with inflammation, the pathologic changes

throughout the coelom not attributed to acute trauma appeared to be caused solely by *M. alcedinis*.

Monopetalonema alcedinis is in the nematode superfamily Diplostriaenoidea, a group of parasites distinct from but often misclassified as Filarioidea (Anderson 2000; Sterner and Cole 2008) due to similar morphology of the long, thin adults and sexual dimorphism. In contrast to filarioids, diplostriaenoids do not have a microfilarid stage, and lack hematophagous insects such as black flies or mosquitoes as vectors, but instead have fully differentiated first-stage larvae (L1) that develop within an insect intermediate host. All diplostriaenids parasitize birds and reptiles and are characterized by thick-shelled, larvated eggs passed through the intestinal system. Some members of the superfamily are more commonly encountered in air sacs, including *Diplostriaena* and *Serratospiculum*, and all possess an arthropod intermediate host and involve transmission via foraging of the definitive avian host. Thus, the suggestion by Boyd and Fry (1971) that simuliids or other biting flies are involved in the transmission of *M. alcedinis* is incorrect (Anderson 2000). Larvated diplostriaenids eggs are released into the environment via the feces of the avian host, and L1s are subsequently ingested by an invertebrate host. In the insect, the larvae develop into second- and then third-stage larvae (L3) before being consumed by birds which feed on infected intermediate hosts. The L3 penetrate the intestine of the bird and migrate along the hepatic portal system to the vena cava, the heart, and finally via the pulmonary arteries to the lungs and then air sacs. Here the adults develop and can survive for several years. Ova are deposited into the air sacs, then move into the lungs via movement of air and mucus, and finally are coughed up and swallowed (Sterner and Cole 2008).

In this case numerous, large, adult nematodes were associated with chronic inflammation and fibrosis of the air sacs

and mild lymphocytic pneumonia. Hetero-granulomatous inflammation surrounded ova and larvae of *M. alcedinis* in the lungs and other organs with increased mucus in the airways. Adults are reported to puncture the air sacs and advance into the coelomic cavity, causing inflammation and extensive adhesions between the coelomic organs, as was demonstrated in this case, most notably around the ventriculus.

Monopetalonema alcedinis appears to be a relatively common nematode that is not well documented in the literature in Belted Kingfishers across North America (Muzzall et al. 2011). Parasite voucher specimens in the USNPC collected over the past century document the occurrence of these nematodes in Belted Kingfishers from North Carolina (USNPC 17418), Texas (43886), Maine (45407), Indiana (56031), and Arizona (84373). Most published reports emanated from eastern regions of the continent, and often provide incidental observations based on few hosts, or were summarized in studies of other helminth parasites in Belted Kingfishers (Muzzall et al. 2011). These diplostriaenids have a broad geographic distribution, with several species of *Monopetalonema* occurring as typical parasites in various species of kingfisher from North America, South America, Africa, and probably Eurasia (Anderson 1959); only *M. alcedinis* is documented in North America.

Monopetalonema alcedinis was first documented as causing severe disease in a Belted Kingfisher with numerous adult parasites involving multiple organs and filling the coelomic cavity of the host (Swanson 1933). In contrast, low intensity was otherwise reported for this diplostriaenid, and infections were subclinical and asymptomatic. A survey of the arthropod and helminth parasites of 50 Belted Kingfishers from Ontario, Canada and Massachusetts, USA revealed *M. alcedinis* in 18% of birds (Boyd and Fry 1971). There were 1–8 adult nematodes found in each host with an average of three per bird. The longest nematode was 38 cm

long. Another survey of the helminths in birds from Florida, USA revealed *M. alcedinis* in four of seven Belted Kingfishers, with 2–6 adults per host (Forrester and Spalding 2003). Despite the fact that this parasite is generally considered to not impact the host, larger numbers of adults within the air sacs and coelomic cavity can displace organs, cause inflammation, disrupt effective breathing, and cause morbidity and mortality in rare cases. We suggest in the present case that parasitism contributed to the cause of death, resulting in weakness and debilitation prior to the trauma (i.e., striking a window or exhibit wall), which caused fatal hemorrhage. The bird was found in a pool but lacked evidence of drowning, suggesting that the bird likely died before falling into the water.

We report the first detailed histopathologic observations associated with this parasite, which typically is associated with low worm intensity and subclinical disease. Further studies are needed to identify the intermediate host(s) and document patterns of transmission in North America.

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LITERATURE CITED

- Anderson RC. 1959. The morphology of *Monopetalonema alcedinis* (Rudolphi, 1819) (Nematoda: Filarioidea) including its first-stage larva. *Can J Zool* 37:609–614.
- Anderson RC. 2000. The Superfamily Diplostriaenoidea. In: *Nematode parasites of vertebrates: Their development and transmission*. 2nd Ed. CABI Publishing, Wallingford, UK, pp. 535–539.
- Boyd EM, Fry AE. 1971. Metazoan parasites of the Eastern Belted Kingfisher (*Megaceryle alcyon alcyon*). *J Parasit* 57:150–156.
- Cornell Laboratory of Ornithology. 2009. *Belted Kingfisher (Megaceryle alcyon)*; *The birds of North America online*. <http://bna.birds.cornell.edu/bna/species/084>. Accessed January 2014.
- Forrester DJ, Spalding JG. 2003. Miscellaneous birds. In: *Parasites and diseases of wild birds in Florida*. University Press of Florida, Gainesville, Florida, pp. 979–1000.
- Muzzall PM, Cook V, Sweet DJ. 2011. Helminths of Belted Kingfishers, *Megaceryle alcyon* Linnaeus, 1758, from a fish hatchery in Ohio, U.S.A. *Comp Parasitol* 78:367–372.
- Sterner MC III, Cole RA. 2008. *Diplostriaena*, *Serratospiculum*, and *Serratospiculoides*. In: *Parasitic diseases of wild birds*, Atkinson CT, Thomas NJ, Hunter DB, editors. John Wiley and Sons, Inc., Ames, Iowa, pp. 434–438.
- Swanson G. 1933. A heavy case of internal parasitism of the Belted Kingfisher. *Wilson Bull* 40:80–82.

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