

## Heartworm in Zoo & Aquarium Animals

Similar to other disease processes in the zoological medicine field, there is still much unknown about heartworm disease in the many different species housed under professional care at zoos and aquariums.

*Dirofilaria immitis* infections have been reported in ferrets, river otters, muskrats, harbor seals, sea lions, red pandas, Japanese raccoon dogs, wild cats, black-footed cats, golden cats, bobcats, ocelots, clouded leopards, snow leopards, tigers, African lions, American black bears, polar bears, rabbits, and horses. Wild canid species such as coyotes, jackals, foxes, wolves, and possibly Eurasian otters are considered definitive hosts; wolverine, coyotes, deer, bears, and raccoons appear to be wildlife reservoirs.

It is, therefore, not surprising that morbidity and mortality have been recorded in animal species housed in zoological and aquatic facilities. As in dogs and cats, infections are most commonly associated with the cardiopulmonary system, but aberrant worm migrations have been recorded. To complicate matters more, dirofilariasis is not limited to *Dirofilaria immitis* in zoological collections. Other species such as *D. repens* in raccoons, *D. subdermata* in North American porcupines, and *D. ursi* in bears have been reported.

Similar to dogs and cats, dirofilariasis is more prevalent in facilities in warmer areas where transmission by vectors is sustained for most of the year. Although mosquitos are common vectors for most species, black flies are the known vector for *D. ursi* and the seal louse *Echinophthirius horridus* is responsible for transmission of the heartworm *Acanthocheilonema odendhali* in seals. A major component of a proactive preventative program in zoological facilities focuses on vector control and mitigation. Vector control and mitigation is most effective when considered during habitat design and construction, but other simple preventative techniques such as mosquito cloth installment and fan placement can drastically reduce exposure.

Prevention in endemic areas has been successful with a variety of different prophylactic medications.

Although there is marked variation between institutes, most veterinarians in the zoological field focus on prophylactic medication use in members of the mustelid, procyonid, canid, felid, and otariid families if they decide to treat. The most common prophylactic medication utilized in zoos and aquariums are ivermectin, milbemycin oxime and selamectin. It is important to note that the need for prophylactic treatment of heartworm is not universally accepted by all zoo practitioners.

Diagnosis of dirofilariasis in zoological species is complicated due to cross-reactivity and poor sensitivity with commercial products to various microfilariae. Diagnosis in exotic canid species relies on antigen testing after 5-7 months post-infection while both antigen and antibody tests are preferred in felid species. Review of blood films with additional tests such as echocardiography can be helpful.

Infected animals are most commonly treated with arsenical (melarsomine) adulticidal therapy or a macrolide (levamisole) and doxycycline. However, it is critical to remark that species sensitivities to certain medications have been recorded, most noticeably river otters, ferrets and red pandas receiving melarsomine.

Dirofilariasis is a serious and complicated disease found throughout the world. The impact the disease can have on a zoological collection, even if only one animal is affected, can be profound due to the high value associated with working with endangered species. For this reason, the approach to prophylactic therapy, diagnosis, and treatment are often influenced by zoo leadership teams through risk assessment. Regardless of an institute's approach to prophylactic therapy choices, it is important that veterinarians are a part of habitat design and construction to provide vector control and mitigation strategies.