Prevalence of parasitic heartworms in swans in England

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Introduction

Round-worms of the class Nematoda are frequent internal parasites of birds. One order, the filarial worms (Filariidae), are located in the blood vascular system of the host, 18 genera of the family Onchocercidae occurring in birds. The first stage larval form, microfilaria, circulate in the blood stream and pass from one bird to another through an intermediate host, a blood-sucking arthropod.

As early as 1879 observations were made by Manson (1904) on the microfilariae of *Filaria picae* from a Chinese Crow *Corvus*. The first information on the life cycle of an avian filarioid was reported by Dutton in 1905. He recorded the presence of larvae, thought to be those of *Filaria cypseli* Annett, Dutton and Elliot (1901) in fat bodies of a biting louse of the subfamily Leiothinae which was parasitizing the House Swift *Apus affinis*. According to Dutton these ectoparasites were supplementing their feather diet with blood and lymph from their avian host. Thomas (1931) while investigating possible intermediate hosts for a filarial parasite from domestic ducks observed a microfilaria in the stomach contents of a freshly killed black fly. He was unable to recover any adult worms from the infected duck that was dissected. Gonnert (1937) failed in his attempts to elucidate the vectors of *Ornithofilaria mavis* (Leiper, 1909) which occurred in the Redwing *Turdus iliacus*. Chernin (1953) determined that white domestic Pekin ducks exposed during July and August became infected with an unknown filarioid the adults of which he was unable to find at autopsy. Robinson (1955) conducted feeding experiments with several species of mosquitoes on Common Crows *Corvus brachyrhynchos*, White-throated Sparrows *Zonotrichia albicollis*, Blue Jays *Cyanocitta cristata*, a Fish Crow *C. ossifragus* and Cardinals *Richmondena cardinalis*, harbouring microfilariae of various undetermined filarioids. Little or no development of the microfilariae took place in the mosquitoes. However, Jellison (1940) earlier found engorged Culicoides in the nests of birds from the family Corvidae and suggested that they might transmit the filarial worms found in these crows.

Anderson (1956) established the first life cycle for an avian parasite. He reported the vectors of *Splendidofilaria fallisensis* from the domestic duck in Canada to be black flies of the genus *Simulium*. Niles *et al.* (1965) reported the discovery of infective filarial larvae in wild-caught *Mansonia crassipes* from Hokkandara, Ceylon. These larvae were inoculated into experimental chickens and the adult parasites recovered from the peritoneal cavity of these birds were named *Cardiofilaria nilesi*. The natural definitive host or hosts of *C. nilesi* have not yet been found although a similar parasite has been seen in wild crows, mynah birds and barbets in Ceylon. Recently, the biting louse *Trinoton anserinum* was determined to be a natural cyclodevelopmental vector for the heartworm, *Sarconema eurycerca*, common in some species of waterfowl (Seegar *et al.* 1976).

S. eurycerca was first described by Wehr (1939) from a Whistling Swan *Cygnus columbianus columbianus*, where it was found to be parasitic in the heart muscle. Other species of swans infected are the Trumpeter Swan *C. cygnus buccinator* (Cowan 1946), the Bewick's Swan *C. columbianus bewickii* (Ryzhikov 1959), the Whooper Swan *C. cygnus cygnus* (Seegar & Sladen, uppub.) and the Mute Swan *C. olor* (Boughton 1965). Three species of geese commonly infected by this nematode are the Canada Goose *Branta canadensis* (Levine and Hanson 1953), the White-fronted Goose *Anser albifrons* (Sonin 1963) and the Bean Goose *A. fabalis* (McDonald 1969).

Quortrup and Holt (1940) reported from Utah that 9% of the Whistling Swans autopsied in 1937–38 and 23·8% in 1939 had adult worms in the myocardium. McDonald (see Holden & Sladen 1968) doing post mortem examinations in the same area during the years 1957–63 found a prevalence of 16·2%. Holden and Sladen (1967) reported all of 7 juvenile and subadult Whistling Swans autopsied from the Chesapeake Bay, Maryland, to have heartworm. From 1973 to 1976, 795 Whistling Swans were surveyed for microfilariae of *S. eurycerca* by blood test (Seegar 1979a). Prevalence of heartworm in wintering swans captured in Maryland and North Carolina was 19% in adults and 24% in juveniles. Adult swans captured on their

North Slope, Alaska, breeding grounds were found to have a prevalence of 32%.

Although *S. eurycerca* has been reported in waterfowl from Britain (Scott *et al.* 1972; Boughton 1965) the prevalence in wild populations has not been examined.

Materials and methods

In July and August of 1977, 426 Mute Swans were captured by hand at three locations in England. A total of 104 Mute Swans were sampled from Abbotsbury, 156 from Christchurch and 165 from the Birmingham area. In November and December two samples of 81 and 133 Bewick's Swans were captured at the Wildfowl Trust at Slimbridge. In the second sample were 50 swans retrapped from the first catch. In November, 148 Barnacle Geese *Branta leucopsis* were captured by rocket net at the Wildfowl Trust Refuge at Caerlaverock, Scotland.

Blood samples were collected from the tarsal vein in 3 ml heparinized syringes and kept for at most 24 hours at ambient temperatures (7–12 °C) before blood tests were performed. Blood sampling techniques employed for the detection and study of *S. eurycerca* microfilariae in swans were the wet mount test (Seegar 1979b) and the thin blood smear.

Results

Two species of microfilariae were encountered during this study. The microfilariae of *S. eurycerca* is sheathed and measures 270–340 μ in length and 4·5–6·5 μ in width. This species of microfilariae was originally described from the blood of a Canada Goose (Hanson *et al.* 1965). The long sheathed larvae from Mute and Bewick's Swans was positively identified as *S. eurycerca* by comparison of morphologic measurements of microfilariae in the blood to those reported elsewhere (Seegar *et al.* 1976).

A second species of microfilariae was recovered from a juvenile Bewick's Swan. No adult specimens were available for specific identification. The microfilariae recovered measured between 60–70 μ in length and 4–6 μ in width.

The results of the blood survey for heartworm microfilariae in Mute Swans and Bewick's Swans are presented in Tables I and II. During the blood survey of Barnacle Geese no microfilariae were encountered in any of the birds sampled. The number of microfilariae/0·1 ml tarsal venous blood (the microfilaremia) for 73 parasitized Mute Swans ranged between 1 and 50 with an average of 7 larvae. For the five Bewick's Swans the microfilaremia ranged between 1 and 52 with an average of 16 larvae. The juvenile Bewick's Swan found parasitized by the short larvae had a microfilaremia of 10.

Table 1. The prevalence of microfilariae of *Sarconema eurycerca* in Mute Swan captured at three locations in southern England.

Location	Total Sample	No. Parasitized	(%)
Abbotsbury	104	10	9·6
Christchurch	156	35	22·4
Birmingham	166	28	17·0
Total	426	73	17·1

Table 2. Prevalence of microfilariae of *Sarconema eurycerca* in Bewick's Swans, captured during winter at the Wildfowl Trust, Slimbridge, England, 1977.

Date of capture	Total sample	No. Parasitized	(%)
November	81	3	3·7
December	133*	5	3·7
Total	164**	6**	3·6

* Includes 50 swans recaptured from the first sample in November.
** Total different individual swans sampled.

Discussion

In choosing a blood sampling technique as the principle tool for diagnosing heartworm infections consideration must be given to the limitations of these methods. Failure to detect microfilariae by blood survey in parasitized birds may result when, (i) the sample is too small, (ii) the worms present are in a prepatent stage of development, (iii) the worms are only of one sex, or (iv) the number of microfilariae are below the sensitivity of the test employed. Any of these situations will result in a false negative. Therefore, the prevalence will be lower than the actual infection rate in the sample.

Laboratory controlled studies on the microfilarial infection of *S. eurycerca* in the Whistling Swan indicate that this nematode has a nocturnal periodicity. The larvae are

found to concentrate in the peripheral circulation of the definitive host between 0100 hrs and 0400 hrs (Seegar 1977). If a similar periodicity of the larvae occurs in the Mute and Bewick's Swans this would result in a lower microfilaremia during field sampling in the day time and increase the number of false negative results.

The blood survey of Mute and Bewick's Swans indicated that the number of microfilariae/0·1 ml blood was low when compared to the infection in Whistling Swans. The average microfilaremia of *S. eurycerca* for 138 parasitized Whistling Swans was 33/0·1 ml blood (Seegar 1977). The average microfilaremias of the Mute and Bewick's Swans was 7 and 16/0·1 ml, respectively. The microfilaremias of three Bewick's Swans retrapped in the second catch had all decreased. One bird tested negative for the infection on the second examination but was determined to have a very low microfilaremia after a persistant search of the blood sample. Therefore, it is likely that some swans which tested negative for heartworm had a very low microfilaremia not detected by the wet mount test.

The 17% prevalence of *S. eurycerca* in 426 Mute Swans closely approximates the 20% prevalence found in 795 Whistling Swans (Seegar 1979a). Mute Swans introduced to the Chesapeake Bay, Maryland, have been routinely surveyed for filariasis and 2 swans of 140 birds sampled by our parasitology laboratory, Johns Hopkins University, were parasitized by *S. eurycerca*. Two of five Mute Swans captured on the Black Sea, USSR, were found to be infested with the louse *T. anserinum*, which were infected with developmental stages of *S. eurycerca* (Seegar *et al.* 1976).

The prevalence of heartworm in Bewick's Swans examined at Slimbridge was determined to be 3·7%. Rizhikov (1959) reported 4 of 6 swans from the Yakutsk area, USSR, infected with *S. eurycerca*.

The short microfilariae recovered from a juvenile Bewick's Swan is very similar in morphology to *Splendidofilaria fallisensis* (Anderson 1954). Adult specimens of this species have been recovered from Bewick's Swans autopsied at the Wildfowl Trust (Scott *et al.* 1972). Similar microfilariae have been recovered from 7 juvenile Whistling Swans although no adult nematodes were available from these birds for specific identification (Seegar 1977). The prevalence of this short microfilariae in both Whistling and Bewick's Swan was 0·8% (7/795) and 0·6% (1/164), respectively.

Although there does not seem to be a high mortality associated with the infection in Whistling Swans some morbidity may occur. Whistling Swans found parasitized by heartworm were significantly lighter in body weight than nonparasitized birds of the same sex and age group (Seegar 1977). The results of the heartworm survey on Mute Swans in southern England indicate that *S. eurycerca* is a common parasite in this host. Excellent opportunities now exist to examine the affects of heartworm on morbidity and mortality in these local populations of Mute Swans, many of which are presently under close observation by ornithologists.

Acknowledgements

I would like to acknowledge the general support of the project afforded by Sir Peter Scott and Professor G. V. T. Matthews. I am grateful to Malcolm Ogilvie, Myrfyn Owen, Colin Campbell, Karl Lane, Philip Bacon, John Fair and Bert Coleman for the capture of swans and geese; to Mary Evans for information on Bewick's Swans histories and weights; to Martin Brown, Philip Bacon and Donna Seegar for helping in taking samples. Special thanks are given to the entire staff of the Wildfowl Trust for the very warm friendship extended to the author and his family during tenure of a North Atlantic Treaty Organisation post-doctoral Fellowship at Slimbridge.

Summary

During the year, 1977, 426 Mute Swans *Cygnus olor* and 164 Bewick's Swans *C. columbianus bewickii*, were surveyed for microfilariae by blood test. Mute Swans were captured by hand from three locations in England and 73 (17%) had the heartworm *Sarconema eurycerca*. Six Bewick's Swans (3·6%) caught at the Wildfowl Trust, Slimbridge, were determined to have heartworm and one juvenile swan was infected with a short microfilaria. No microfilariae were found in 148 Barnacle Geese *Branta leucopsis* rocket-netted at the Wildfowl Trust, Caerlaverock, Scotland.

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