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Species of the nematode genus *Amidostomum* Railliet and Henry, 1909 in aquatic birds in the Netherlands

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Summary

The presence of gizzard worms belonging to the genus *Amidostomum* was studied in birds in the Netherlands during the period 1975 – 2003. *Amidostomum acutum* was found in Anatidae: *Anas acuta*, *A. clypeata*, *A. crecca*, *A. penelope*, *A. platyrynchos*, *A. strepera*, *Aythya ferina*, *Ay. fuligula*, *Ay. marila*, *Bucephala clangula*, *Melanitta fusca*, *M. nigra*, *Tadorna tadorna*, *Somateria mollissima* and *Recurvirostra avocetta*. No *Amidostomum* species were found in the following three species of Mergini: *Mergus albellus*, *M. merganser* and *M. serrator*. *Amidostomum anseris* was seen in *Anser albifrons*, *A. fabalis*, *Branta bernicla* and *Branta leucopsis*. *Amidostomum cygni* was detected in *Cygnus bewickii* and *Cygnus olor*, while *Amidostomum fulicae* was found in *Fulica atra*. The prevalence is only given for bird species where ten or more individuals had been investigated: *Anas platyrhynchos* (n = 14): 21.4 %; *Melanitta nigra* (n = 12): 91.7 %; *Somateria mollissima* (n = 117): 100 %; *Anser albifrons* (n = 11): 100 % and *Cygnus olor* (n = 10): 60 %. Based on the present results, much more attention should be paid to the systematics, the epidemiological pattern and the pathogenicity of worms of this genus.

Key words: *Amidostomum*; birds; gizzard; the Netherlands

Introduction

It is surprising that in the Netherlands, a country with a very rich bird life of more than 300 species, relatively little is known about their helminth fauna. Van den Broek and Jansen Jr. (1964) and Van den Broek and Jansen (1971) mention the helminths of 54 bird species, of which 32 birds are typical water birds. For each bird species, they give only a few helminths and in almost half of the cases only one. The helminths of some birds, or group of birds, have been studied more extensively, such as the oystercatcher (*Haematopus ostralegus*) (Borgsteede *et al.*, 1988), Passeriformes (Borgsteede *et al.*, 2000), birds of prey (Borgsteede *et al.*, 2003) and the common eider (Borgsteede *et al.*, 2005).

Recently much attention has been paid to the gizzard worm *Amidostomum acutum* in the common eider (*Somateria mollissima*). According to Borgsteede (2005), this nematode contributed – in combination with shortage of food - to mass mortality among adult eiders in the winter 2001/ 2002. Although the pathogenic role of *A. acutum* has hardly been described in the literature, another species of the genus, *A. anseris*, is a well known pathogenic gizzard worm in geese (Cram, 1926; Herman & Wehr, 1954; Herman *et al.*, 1955; Knudsen, 1966; Tuggle & Crites, 1984). Vetési *et al.* (1976) did experimental studies with *A. anseris* in goslings, ducklings and chickens to demonstrate the histopathological changes.

Surveys of parasites in the gizzard of birds, particularly water birds, frequently mention the presence of an *Amidostomum* species in Europe (Palm, 1965; Orlandi & Colombani, 1974; Macko, 1978; Ryšavý *et al.*, 1982; Birová & Macko, 1984; Macko & Birová, 1985; Okulewicz, 1997; Straková, 1999; Betlejewska & Kalisińska, 2001; Straková, 2001; Kavetska *et al.*, 2004) and the US/Canada (Clark *et al.*, 1958; Bishop & Threlfall, 1974; Tuggle & Crites, 1984; McLaughlin & McGurk, 1987).

The interest in *A. acutum* has encouraged us to see how this species is spread among water birds in the Netherlands and which other species occur apart from *A. acutum.* Therefore, this study, based on material collected over a period of more than 25 years, describes the presence of species of the genus *Amidostomum* in birds in the Netherlands.

Materials and Methods

Investigated birds

In 1975, the Dutch Working Group on Bird Mortality started its work. Dead birds were collected by volunteers and

sent to the Central Veterinary Institute. They were investigated by a specialist pathologist in bird diseases (the late Dr. Th. Smit) for the cause of death. He distributed the material from the birds among virologists, bacteriologists, toxicologists and a parasitologist (F.B.). Apart from the birds which were suspected of parasitism being the cause of death, it was a good opportunity to collect and study whole gastrointestinal tracts or parts thereof from birds that had died from other causes. The first author received more than 1700 whole intestinal tracts or parts of it from 149 bird species of which 71 birds which can be associated with water (Gaviidae, Podicipidae, Procellariidae, Sulidae, Phalacrocoracidae, Ardeidae, Ciconiidae, Plataleidae, Anatidae, Rallidae, Haematopodidae, Charadriidae, Scolopacidae, Recurvirostridae, Stercorariidae, Laridae and Alcidae) in the period during which the Working Group was active (1975 – 1990) and thereafter till 2004.

Collection of parasites

The gizzards were opened and the contents washed with tap water. The washings were collected in a bucket. Thereafter, the koilin layer of the gizzard was removed and the gizzard was washed again and scraped off with a blunt knife. All material was collected in the same bucket. The koilin layer was examined under a stereomicroscope (magn. 6 x) for the presence of worms. The contents of the bucket were poured over a sieve (screen mesh 0.074 mm). The material on the sieve was suspended in buffered 4 % formaldehyde solution and stored for later examination. All collected worms were identified at the species level (Czaplinski, 1962; Baruš *et al.*, 1978; Ryšavý *et al.*, 1982).

Results

Table 1 lists the bird species in which an *Amidostomum* species was found. Within the Anatidae, results from 25 bird species were available, of which 22 were positive for *Amidostomum*. No *Amidostomum* species were seen in the fish eating ducks: *Mergus albellus* (n = 21), *M. merganser* (n = 1) and *M. serrator* (n = 26). In the ducks, *A. acutum* was the only species, in geese *A. anseris* and in swans *A. cygni*.

Because the number of birds per species is generally low, it is not reliable to give a percentage of prevalence. If we regard a number of birds per species of ten or more as a minimum for a realistic assessment of the prevalence, then we see the following prevalences: *Anas platyrhynchos* (n = 14) 21.4 %; *Melanitta nigra* (n = 12) 91.7 %; *Somateria mollissima* (n = 117) 100 %; *Anser albifrons* (n = 11) 100 % and *Cygnus olor* (n = 10): 60 %.

Outside the Anatidae, we found *A. fulicae* in *Fulica atra* and *A. acutum* in *Recurvirostra avocetta*.

Discussion

The study clearly shows that the genus *Amidostomum* is well represented in the Anatidae in the Netherlands. This is in agreement with others who studied helminths of water

Table 1. List of the bird species in which an *Amidostomum* species was found

Family	Subfamily	Tribe	Species	No. gizzards	*A. acutum*	*A. anseris*	*A. cygni*	*A. fulicae*
Anatidae	Anatinae	Anatini	*Anas platyrhynchos*	14	3			
			Anas crecca	3	2			
			Anas penelope	5	1			
			Anas strepera	1	1			
			Anas acuta	2	1			
			Anas clypeata	1	1			
Anatidae	Anatinae	Aythyini	*Aythya marila*	8	7			
			Aythya fuligula	4	3			
			Aythya ferina	5	2			
			Bucephala clangula	3	1			
Anatidae	Anatinae	Mergini	*Melanitta fusca*	2	2			
			Melanitta nigra	12	11			
			Mergus serrator	26				
			Mergus merganser	1				
			Mergus albellus	21				
			Somateria mollissima	117	117			
Anatidae	Tadornidae		*Tadorna tadorna*	9	4			
Anatidae	Anserinae		*Anser albifrons*	11		11		
			Anser fabalis	1		1		
			Branta bernicla	6		3		
			Branta leucopsis	1		1		
			Cygnus olor	10			6	
			Cygnus bewickii	1			1	
Rallidae			*Fulica atra*	6				2
Recurvirostridae			*Recurvirostra avocetta*	6	4			

fowl in Europe. In Czechoslovakia, *A. acutum* was observed in *Anas platyrhynchos*, *A. querquedula*, *A. crecca*, *A. penelope*, *A. clypeata*, *A. acuta*, *Aythya nyroca*, *Ay. fuligula*, *Ay. ferina* and *Anser anser*. *Amidostomum anseris* was found in *Anser anser* and *A. fabalis*. In *Anser fabalis*, also *Amidostomum spatulatum* was present (Macko, 1978; Birová & Macko, 1984; Macko & Birová, 1985; Straková, 1999; Straková, 2001). The finding of *A. acutum* in *Anser anser* is remarkable, as this species is mainly found in Anatini. Conversely, the presence of a typical 'geese' *Amidostomum* in Anatini is repeatedly mentioned. Christiansen (1948) and Persson *et al.* (1974) mention the presence of *A. anseris* in the common eider. This is probably an incorrect identification, because all others who have studied the parasite fauna of common eiders found exclusively *A. acutum.* A survey of stomach worms of wild ducks in Poland showed the presence of *A. acutum* in several Anatini, Aythyini and Mergini (Betlejewska & Kalisińska, 2001). The results of these authors confirm our finding, that *Amidostomum* was absent in birds of the genus *Mergus*. It is likely that this is related to their source of food (mainly fish). As far as the authors know, there is no record of *Amidostomum* species from ducks of the genus *Mergus*.

The life cycle of *A. anseris* has been studied by many authors (Enigk *et al.*, 1975; Stradowski, 1974, 1975, 1977). Leiby and Olsen (1965) investigated the life cycle of *A. raillieti* and *A. skrjabini* (according to Czaplinski, 1962, resp. *A. fulicae* and *A. acutum*). The life cycle of *Amidostomum* species is a direct life cycle type, in which third stage larvae hatch from the egg and are ingested by the final host. It is not known if infection of birds can take place by skin penetration of the infective larvae as described for *A. anseris* (Enigk & Dey-Hazra, 1968). However, little is known about the epidemiological pattern in nature, or where the birds pick up their infection. Typically, it is unknown where 'sea' ducks, such as *Somateria mollissima* and *Melanitta nigra* become infected, whether it is during their period on land and infective larvae are present in fresh water ponds or if infection is also possible in brackish water or salt water.

The pathogenic role of members of the genus is well described for *A. anseris* in geese (Cram, 1926; Herman & Wehr, 1954; Herman *et al.*, 1955; Knudsen, 1966; Tuggle & Crites, 1984). Borgsteede (2005) suggested that in periods of food shortage, infections with *A. acutum* in common eiders may be fatal. There are hardly any other records of the pathogenicity of *A. acutum*. Persson *et al.* (1974) described some severe cases of amidostomosis in the common eider and Clark *et al.* (1958) reported an epizootic among eiders, which they ascribe to an acanthocephalan infection, but they also mention that all six investigated ducks were infected with *Amidostomum*. The only record of possible pathogenicity of *A. cygni* can be found in the description of parasitism in a flock of mute swans in Scotland (Pennycott, 1998). One immature out of 14 swans, had a severe *Amidostomum* (probably *A. cygni*) infection. The koilin layer was soft, easily disrupted and discoloured black/brown. The pathogenicity of *A. spatulatum*, *A. fulicae* and *A. henryi* has not been described.

Much can be said about the systematics of the genus *Amidostomum*. Czaplinski (1962) revised the genus and brought the number of species back to six: *A. acutum*, *A. anseris*, *A. cygni*, *A. fulicae*, *A. henryi* and *A. spatulatum*. Petrova (1987) subdivided the genus into two subgenere: *Amidostomum* and *Amidostomoides*. The main difference between the two generera is the presence of only one tooth in the buccal capsule in *Amidostomoides*. Lomakin (1993) made another revision. He promoted the subgenus *Amidostomoides* of Petrova (1987) to the genus *Amidostomoides* with 6 species: *Amidostomoides acutum* from Anseriformes: *Anas acuta*, *A clypeata*, *A. formosa*, *A. platyrhynchos*, *A. poecilorhyncha*, *A. strepera*, *A. crecca*, *A. querquedula*, *Aythya ferina*, *Ay. fuligula*, *Netta rufina*, *Bucephala clangula*, *Clangula hiemalis*, *Somateria mollissima*, *Melanitta nigra*, *M. fusca* and *Anser albifrons*; Ralliformes: *Fulica atra*; Charadriiformes: *Himantopus himantopus*; Galliformes: *Tetrastes bonasia*, *Tetrao urogallus*, *Lagopus lagopus* and *L. mutus*. *Amidostomoides auriculatum* in *Anas crecca* and *A. querquedula*. *Amidostomoides henryi* in *Vanellus vanellus* and *Anas crecca*. *Amidostomoides monodon* in *Melanitta nigra*, *M. fusca*, *M. deglandii*, *Somateria mollissima*, *S. fischeri* and *S. spectabilis*. *Amidostomoides petrovi* in *Clangula hiemalis*, *Bucephala clangula*, *Somateria spectabilis*, *Aythya baeri*, *Ay. marila*, *Ay. nyroca*, *Ay. fuligula*, *Melanitta nigra*, *C. Gallinago* and *Recurvirostra avocetta*. Finally, *Amidostomoides* tribonix in *Tribonix ventralis*.

Anderson (2000), in his book on the development and transmission of nematode parasites of vertebrates does not follow the systematics of Lomakin (1993). Although there are clearly anatomical differences within the species *A. acutum*, it is questionable whether these are really species specific characteristics or host related differences. Although it is tempting to split *Amidostomum acutum* into different species according to the systematic divison of the ducks: *Amidostomoides acutum* mainly occurring in Anatini (dabbling ducks), *Amidostomoides petrovi* mainly in Aythyini (diving ducks) and *Amidostomoides monodon* mainly in Mergini ('sea' ducks), experimental infections in parasite free birds of the several species could clarify the situation. However, these experiments are almost impossible to carry out in practice. The answer could be found in a molecular biological analysis of the genome of the worms from different hosts and establish their relationship.

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