

Nematodes of the genus *Amidostomum* (Railliet et Henry, 1909) in wild ducks (Anatinae) of north-western Poland

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Summary

The study was aimed to quantify infections with nematodes of the genus *Amidostomum* in wild ducks of north-western Poland. The birds examined (282 individuals representing 16 species) belonged to three, ecologically different, tribes: the Anatini, Aythyini and Mergini. The 923 individuals of *Amidostomum* found (*A. acutum*, *A. orientale*, and *Amidostomum* sp.) accounted for 29.1 % of all the nematodes identified in the ducks and occurred in 57.8 % of the birds at an average intensity of 5.7 per infested duck. Of all the duck groups examined, the heaviest exposure was found in the adult male Mergini (an average infestation intensity of 15.1 and 12.3 parasites per infested duck and examined duck, respectively).

Key words: *Amidostomum*; wild ducks; Anatinae; Poland

Introduction

In waterfowl, nematodes of the genus *Amidostomum* Railliet et Henry, 1909 cause one of the most dangerous gizzard diseases called amidostomosis. The condition may result in mass mortality in eider ducks (Borgsteede, 2001) and domestic anseriforms (Czapliński, 1960). As shown by Betlejewska and Kalisińska (2001) and by Kavetska *et al.* (2004), amidostomosis is at present one of the most frequent parasitic diseases in Polish wild ducks.

At the latitude of Poland, duck amidostomosis is most often caused – both in wild and domestic ducks – by *Amidostomum acutum* (Lundahl, 1848). According to numerous authors, the remaining congeners, i.e., *A. anseris* (Zeder, 1800), *A. fulicae* (Rudolphi, 1819), and *A. spatulum* Baylis, 1932, are relatively rare in ducks. Their pathogenicity being poorly known so far (Czapliński, 1960, 1961, 1962; Ryzhikov, 1967; Baruš *et al.*, 1978; Ryšavý *et al.*, 1982; Anderson, 2000).

The amidostomatid life cycle is simple. It involves no intermediate host (Anderson 2000). Although *Amidostomum*

is a cosmopolitan genus (Czapliński, 1960, 1962; Baruš *et al.*, 1978; Anderson, 2000), it seems that the temperate climate offers the optimal conditions for their development. In the Palaearctic region, the parasites (particularly *A. acutum*) are commonly present in the domestic duck (*Anas platyrhynchos* f. dom.) and in wild ducks of the genera *Anas*, *Aythya*, and in the Mergini tribe (Czapliński, 1961, 1962, 1973; Ryzhikov, 1967; Baruš *et al.*, 1978; Ryšavý *et al.*, 1982; Kavetska *et al.*, 2004).

The Anatinae are a very important component of aquatic ecosystems, both marine and freshwater. The diets and feeding modes of those ducks are very diverse. While some of the Anatinae, e.g., the mallard, are common in Poland and are a popular hunting target, other species are very rare and protected by law; many of the latter are considered threatened by extinction. The avian fauna of north-western Poland is very peculiar. The area lies at the intersection of migration routes of numerous rare wild anseriformes, many of which overwinter exclusively on the southern Baltic. Due to the high pathogenicity of *Amidostomum* and because the Anatinae have a potential of being a major source of the parasites in the coastal zone (Czapliński, 1973; Kavetska *et al.*, 2004), this study was made to quantify the *Amidostomum* infestation in wild ducks of north-western Poland.

Material and Methods

The study involved examination of the alimentary tracts of 282 wild ducks from north-western Poland, collected in 1998 – 2003 (Table 1). Representatives of game species (175) were supplied by hunters, the remaining birds (107) being obtained from fishermen; when diving for food, the ducks (occasionally in large numbers) get frequently entangled in fishing nets and die. The dissected birds represent 16 species of three tribes: the Anatini (173 individuals), Aythyini (52), and Mergini (57). Classification of

the investigated birds according to age and gender is presented in Table 2.

The birds were examined for the presence of parasites. The entire gastrointestinal tracts were removed and frozen at -18°C . After thawing at room temperature, the tracts were divided into 9 sections (oesophagus, proventriculus, gizzard, duodenum, jejunum, ileum, colic caeca, large intestine, and cloaca). The nematodes, which were found using the method developed by Skrjabin (1928) and Czapliński (1960), were fixed in 75 % ethyl alcohol with 5 % glycerine and cleared in glycerine. Subsequently, after hydration and incubation in 30 % acetic acid, they were mounted as permanent slides by embedding in polyvinylpyrrolidone (PVP). The nematodes were identified with the aid of keys published by Czapliński (1962); Ryzhikov (1967); Smogorzewska (1976); Baruš *et al.* (1978) and Ryšavý *et al.* (1982).

The infestation with *Amidostomum* was quantified by calculating the following parameters, as recommended by Pojmańska (1993) and Bush *et al.* (1997):

- (a) prevalence (extensity): the percentage of birds infested with *Amidostomum*;
- (b) intensity (mean and range): the average number of *Amidostomum* in a single host;
- (c) relative density: the abundance of *Amidostomum* in host

assemblage (the total number of parasites divided by the number of ducks examined, both infested and parasite-free).

Male-female and immature-adult comparisons were made using the parameters calculated as described above. Ducks in their first year of life were regarded as immature. The comparisons involved all the ducks taken together as well as individual tribes. Significance of differences between the sexes and between age categories in all the ducks was tested using the χ^2 and Fisher's tests (for prevalence) and Student's *t*-test or its non-parametric equivalent (for mean intensity and relative density); the between-tribes differences were tested for significance using the analysis of variance.

In addition, an attempt was made to determine the extent of *Amidostomum* dominance in the ducks examined in the light of data supplied by various authors (Pojmańska, 1993).

Results and Discussion

As late as in 1960, Czapliński (1960) emphasised the rarity and poor knowledge of *A. acutum* pathogenicity of Anatinae in Poland. However, subsequent studies (Czapliński, 1961, 1962, 1973; Betlejewska and Kalisińska, 2001) de-

Table 1. Species composition and numbers of ducks examined

Species	Common name	No. of birds examined
Anatini		173
<i>Anas penelope</i> L., 1758	Wigeon	1
<i>Anas strepera</i> L., 1758	Gadwall	1
<i>Anas crecca</i> L., 1758	Teal	4
<i>Anas platyrhynchos</i> L., 1758	Mallard	161
<i>Anas querquedula</i> L., 1758	Garganey	1
<i>Anas clypeata</i> L., 1758	Shoveler	5
Aythya		52
<i>Aythya ferina</i> (L., 1758)	Pochard	6
<i>Aythya fuligula</i> (L., 1758)	Tufted duck	4
<i>Aythya marila</i> (L., 1761)	Scaup	42
Mergini		57
<i>Somateria mollissima</i> (L., 1758)	Eider	1
<i>Clangula hyemalis</i> (L., 1758)	Long-tailed duck	24
<i>Melanitta fusca</i> (L., 1758)	Velvet scoter	4
<i>Melanitta nigra</i> (L., 1758)	Common scoter	8
<i>Bucephala clangula</i> (L., 1758)	Goldeneye	13
<i>Mergellus albellus</i> (L., 1758)	Smew	1
<i>Mergus merganser</i> L., 1758	Goosander	6
Total		282

Table 2. Classification of the investigated birds according to age and gender

Tribe	Males (n=157)		Females (n=125)	
	immature	adult	immature	adult
Anatini (n=173)	49	45	50	29
Aythya (n=52)	4	28	8	12
Mergini (n=57)	15	16	17	9

monstrated that the birds present on the Baltic coast constitute a poorly known and underestimated source of the parasites. The most recent research (Betlejewska and Kalisińska, 2001; Kavetska *et al.*, 2003, 2004) shows amidostomosis to be one of the most frequent parasitic diseases of wild ducks; depending on the species, 28 – 75 % of a population are affected.

The examined gastrointestinal tracts of the ducks were found to house a total of 28.857 parasites, including 3.170 nematodes (11.0 %). The 923 *Amidostomum* nematodes (*A. acutum*, *Amidostomum orientale* Ryzhikov et Pavlov, 1959 and *Amidostomum* sp.) accounted for 29.1 % of all the nematodes found (Fig. 1). Those parasites were located exclusively in the gizzard, more specifically in a loosened-up area beneath the koilin layer and the area where the gizzard opens into the duodenum.

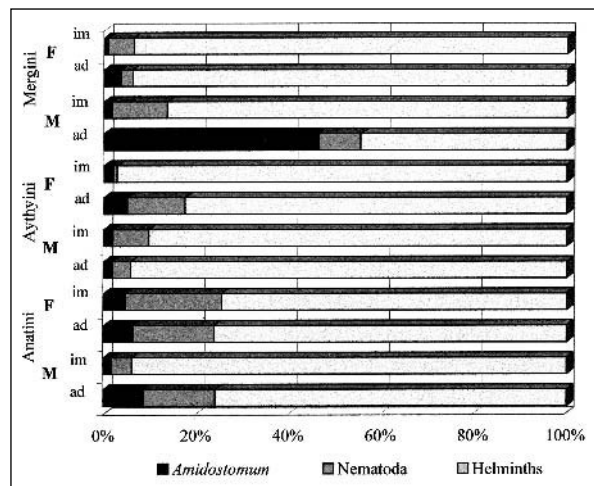


Fig. 1. The frequency of *Amidostomum* in the total number of nematodes and helminths

A. acutum was the dominating species (85.5 %), *A. orientale* being less numerous (13.3 %); few worms could not be identified at the species level, they were regarded as *Amidostomum* sp. (1.2 %). A comparison of host preferences (Mergini and Aythyini only) as well as the infestation prevalences and intensities allows to tentatively assign most of the *Amidostomum* sp. to *A. orientale*. The presence of that species among the helminth fauna of the ducks examined is its first documented record in Poland (Okulewicz, 1997).

The *Amidostomum* prevalence in the wild Anatinae examined was relatively high (57.8 % ± 5.7). Although the Mergini showed the lowest prevalence (52.6 % ± 12.9), the mean infestation intensity and its range as well as the relative density were at their highest in those birds (Table 3). Prevalence of *Amidostomum* in the examined birds averaged 58 % (confidence interval from 52 to 64 %). Adults were much more commonly infested (63 %) than the immature birds (53 %); more males carried the parasites (60 %), than females (55 %). Males showed the largest differences in prevalence: while 70 % of adults were infested, the infestation prevalence among immature males was only 47 % ($p \leq 0.05$). Differences in prevalence between adult males (70 %) and adult females (50 %) proved statistically significant as well.

Fig. 2 summarises the *Amidostomum* infestation prevalence

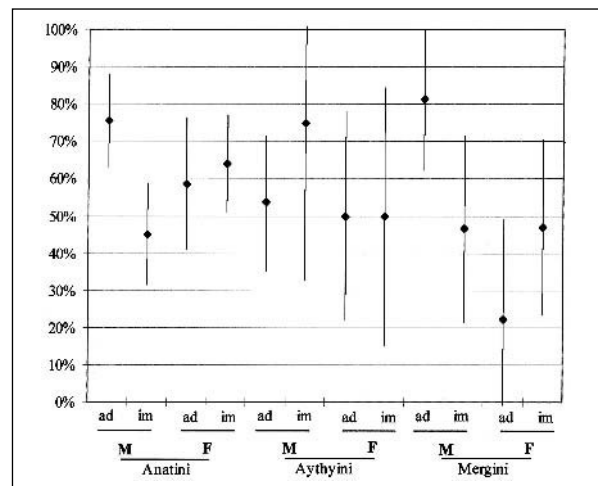


Fig. 2. The *Amidostomum* infestation prevalence among the ducks examined

among wild ducks in north-western Poland. The lowest incidence of the nematodes (22 %) was recorded among adult female Mergini, the highest (81 %) being typical among adult males of the tribe, particularly in *Clangula hyemalis*. The infestation incidence among immature Mergini, regardless of sex, averaged 47 %.

The mean intensity of the *Amidostomum* infestation in the ducks examined was 5.7 nematodes per infested duck. No significant differences between males (6.1) and females (5.1) were found, nor were the differences between juve-

Table 3. Prevalence (± CI), intensity (range and mean, ± CI), and relative density (± CI) of *Amidostomum* spp. found in the Anatinae from north-western Poland

Nematode species	Prevalence		Intensity		Relative density
	No. of infected birds	%	Range	Mean	
Anatini n=173	105	60.7 ± 7.2	1 – 24	4.7 ± 0.9	2.8 ± 0.6
Aythyini n=52	28	53.8 ± 13.5	1 – 25	5.3 ± 2.2	2.8 ± 1.3
Mergini n=57	30	52.6 ± 12.9	1 – 58	9.5 ± 4.5	5.0 ± 2.6
Total n=282	163	57.8 ± 5.7	1 – 58	5.7 ± 1.1	3.3 ± 0.7

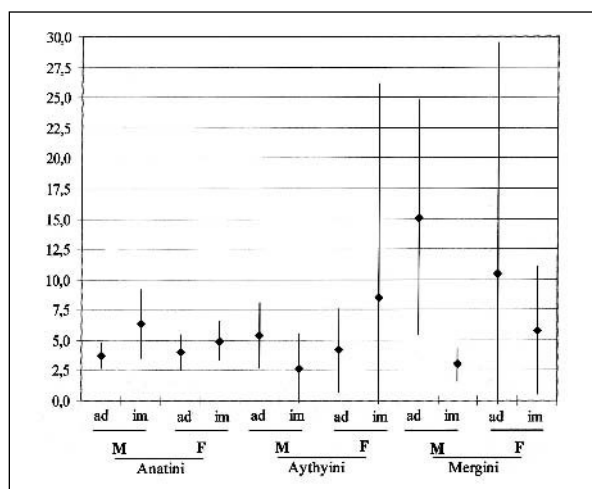


Fig. 3. Mean intensity of *Amidostomum* infestation in the ducks examined

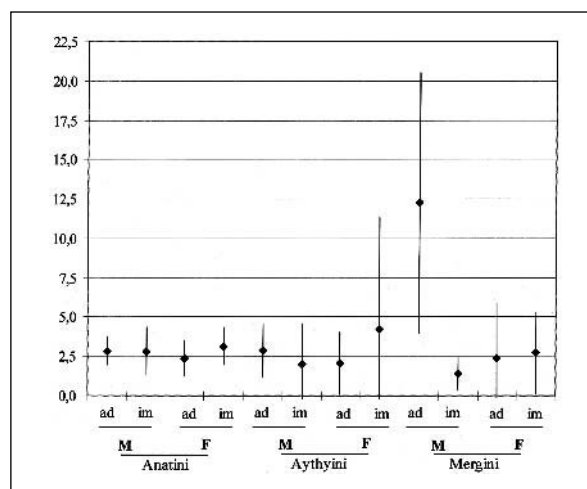


Fig. 4. Mean relative density of *Amidostomum* in the ducks examined

niles (5.3) and adults (5.9) significant. Although adult birds are commonly regarded as acquiring active immunity after recovery from some parasitic diseases (Czapliński, 1960), this proved not to be the case with amidostomosis, as shown by both the present study and earlier research (Betlejewska and Kalisińska, 2001). On the other hand, statistically significant differences in mean invasion intensity were detected between the duck tribes: the clearly highest intensity was typical of the predatory marine ducks (an average of 9.5 *Amidostomum* nematodes per infested bird). Similarly to the prevalence, the differences resulted from a significantly higher mean infestation intensity in the adult male Mergini (15.1 nematodes per an infested duck) (Fig. 3).

The mean relative density of *Amidostomum* was 3.3 per duck, so it was much lower than the mean infestation in-

tensity. However, as in the intensity, no significant differences between males (3.6) and females (2.8) and between adults (3.7) and juveniles (2.8) were detected. Here, too, the clearly highest density of the nematodes (12.3) was typical of the adult male Mergini, the lowest density (1.4 only) being typical of juvenile males of the tribe. The relative *Amidostomum* density in the remaining groups ranged from 2.0 (in the juvenile male Aythyini) to 4.3 (in the juvenile female Aythyini) (Fig. 4).

The dominance indices showed *Amidostomum*, primarily *A. acutum*, to dominate the parasitic fauna of the wild Anatinae. The dominant (core) species occur in a community frequently and in high abundance (Pojmańska, 1993; Bush *et al.*, 1997). The dominants show a high dominance index. The index is defined differently by various authors. Basically, the indices can be based upon prevalence (Trojan,

Table 4. The *Amidostomum* spp. dominance index, as determined by various authors

Duck group			Prevalence	Dominance index according to				
				Kisielewska (1970)	Trojan (1975)	Aho (1990)	Pojmańska <i>et al.</i> (1980)	Holmes (1990)
Anatini	M	ad	75.6	D 2.1	D	B	D	B
		im	44.9	D 1.3	D	S	P	S
	F	ad	58.6	D 1.4	D	B	D	S
		im	64.0	D 2.0	D	B	D	B
Aythyini	M	ad	53.6	D 1.6	D	B	D	S
		im	75.0	D 1.5	D	B	D	B
	F	ad	50.0	D 1.0	D	S	P	S
		im	50.0	D 2.1	D	S	P	S
Mergini	M	ad	81.3	D 9.9	D	B	D	B
		im	46.7	I 0.6	D	S	P	S
	F	ad	22.2	I 0.5	D	S	P	S
		im	47.1	D 1.3	D	S	P	S

B – basic species; D – dominant (core) species; I – influential species; P – common species; S – satellite species

Table 5. Significance of differences in quantitative parameters of the nematode infestation between selected duck groups (M – males, F – females)

Duck groups compared	Prevalence	Mean intensity	Relative density
Mergini: Anatini	-	0.0006	0.0172
Mergini: Aythyini	-	0.0176	-
M ad: F ad	0.0215	-	-
M ad: M im	0.0042	-	-
Mergini im: Mergini ad	-	0.0000	0.0000
Mergini ad: Aythyini ad	-	0.0000	0.0000
Mergini ad: Anatini ad	-	0.0000	0.0000
Mergini M: Mergini F	0.0497	-	0.0045
Mergini M: Anatini F	0.0357	-	-
Mergini M: Anatini M	-	0.0006	0.0006
Mergini M: Aythyini M	-	0.0069	0.0042
Anatini M ad: Anatini M im	0.0025	-	-
Mergini M ad: Mergini F ad	0.0065	-	-
Mergini M ad: Aythyini M ad	-	0.0001	0.0000
Aythyini M ad: Aythyini M im	-	0.0001	0.0000
Aythyini M ad: Anatini M ad	-	0.0000	0.0000

1975; Pojmańska *et al.*, 1980; Holmes, 1990; Aho, 1990) or jointly upon prevalence and infestation intensity (Kisielewska, 1970). Using the indices developed by Aho (1990) and Holmes (1990) in whose systems the threshold for the basic species was 50.0 and 60.0 %, respectively, *Amidostomum* in this study should be regarded as satellite species. As, however, parasitic communities are not as species-rich as free-living assemblages (Pojmańska, 1993; Bush *et al.* 1997), the diversity of parasitic fauna should be assessed using the system developed by Kisielewska (1970). That system is based jointly on prevalence and infestation intensity (Table 4).

Table 5 summarises comparisons between the selected groups of ducks that showed significant differences in the parameters analysed (prevalence, mean intensity and relative density). As already noted, highly significant differences ($p \leq 0.001$) were detected between those groups in which the adult male Mergini featured prominently; those differences were revealed in the parameters involving mean parasite numbers, i.e., infestation intensity and density.

It is difficult to provide an unambiguous explanation of such wide differences between the adult male Mergini and the remaining duck groups studied. Most likely, the cause of those differences should be sought in the biology of those two-habitat ducks in which nesting and brood protection is the role of the females. They may not feed at that time or if they do feed, the food differs from that ingested by the free-ranging males which are therefore more exposed to be the invasive form of the parasite (L3). It may be contended that, similarly to grazing geese, the ganders become infested with *Amidostomum* mainly on land, by ingesting small invertebrates dwelling on the grass or on wet stones supporting large quantities of the invasive L3. Perhaps, however, the diet of the adult females, nesting or caring for their brood, contains a factor that combats the

parasite or increases immunity to it. This aspect requires more detailed ecological and behavioural studies.

Conclusions and summing up

1. The 923 individuals of *Amidostomum* found (*A. acutum*, *A. orientale*, and *Amidostomum* sp.) accounted for 29.1 % of all the nematodes identified in the ducks and occurred in 57.8 % of the birds at an average intensity of 5.7 per infested duck.

2. Of all the duck groups examined, the heaviest exposure was found in the adult male Mergini (an average infestation intensity of 15.1 and 12.3 parasites per infested duck and examined duck, respectively).

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