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The gastrointestinal helminth fauna of the eider duck (*Somateria mollissima* L.) in the Netherlands

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Summary

The gastrointestinal helminth fauna of 25 eider ducks (*Somateria mollissima* L.) in the Netherlands has been described and number of worms counted or estimated. For the most common species maximum worm numbers are given. Five nematode species were found: *Amidostomum acutum* (max. intensity 1500), *Paracuaria formosensis*, *Streptocara crassicauda*, *Tetrameres fissispina* and *Capillaria nyrocinarum* (max. intensity 1700). Trematodes were represented by 12 species: *Cotylurus cornutus*, *Catatropis verrucosa*, *Notocotylus attenuatus*, *Cryptocotyle concavum* (max. intensity > 10.000), *Psilotrema simillimum* (max. intensity > 10.000), *Himasthla militaris*, *Gymnophallus somateriae*, *G. rostratus*, *Lacunovermis macomae*, *Maritrema gratiosum*, *Microphallus longicaecum* and *M. somateriae*. The total number of gymnophallid and microphallid digeneans exceded 100.000 in some birds. Other digeneans, not identified at the species level, belonged to the genera *Diplostomum*, *Paramonostomum* and *Levinseniella*. Cyclophyllid cestodes (mainly Hymenolepididae) were present in high numbers (max. intensity > 4000), but mostly in the immature stage. One *Ligula intestinalis* could be identified. Acanthocephalan infections with high numbers (max. intensity 4000) of *Profilicollis botulus* were very common.

Key words: eider duck; *Somateria mollissima*; helminths; the Netherlands

Introduction

The eider duck (*Somateria mollissima*) is a common bird in the Wadden Sea in the Netherlands. In the peak month January, the population reaches 100 000 – 150 000 birds. The birds live in salt or brackish water and feed mainly on bivalve molluscs, particularly cockles (*Cardium edule*) and mussels (*Mytilus edulis*). Young animals may prefer softer food such as shore crabs (*Carcinas maenas*).

During the winters of 1999/2000, 2000/2001 and 2001/2002 many birds were found dying or dead on the beaches. There has been a lot of debate about the cause of death. Some people accused the cockle fishermen of over fishing the food of the eiders, but others claim a mass invasion of parasites as the real cause of death. Mass mortality of eider ducks due to infections with acanthocephalans has been repeatedly reported in Scandinavian countries (Christiansen, 1948; Grenquist, 1952; Persson *et al.*, 1974; Itämies *et al.*, 1980; Hario *et al.*, 1992, 1995; Hollmén *et al.*, 1996, 1999), the UK (Harrison, 1955; Thom & Garden, 1955; Garden *et al.*, 1964; Liat Lim Boo & Pike, 1980; Thompson, 1985) and the Netherlands (Swennen & Van Den Broek, 1960). Outside Europe, there are reports from the US and Canada (Clark *et al.*, 1958; Threlfall, 1968; Ching, 1989).

To investigate the role of parasites in the mass mortalities on the Dutch coast, it is necessary to have an idea about the helminth fauna of the eider duck in the Netherlands. Studies on the parasites of eider ducks in Europe are mainly directed towards the acanthocephalans and studies on the prevalence of other parasites are rare (Persson *et al.*, 1974). In the Netherlands, a detailed study has never been done before. In their general lists of wild bird parasites, Van Den Broek and Jansen (1964; 1971) mention 15 helminth species in the eider.

The aim of the present paper is to describe which parasites have been found in the Netherlands with an indication of their potential as a cause of mass mortality.

Materials and Methods

Origin of the investigated eider ducks

In total, 25 eider ducks were investigated. All ducks were found death on the coast of the North Sea or the Wadden

Sea. Thereafter they were either transported directly to the Institute and investigated for the cause of death or deep frozen, transported to the Institute and investigated at a later date.
Fifteen eider ducks were collected in the period 1976 – 1991, during which the Dutch Working Group on Mortality of Wild Birds was active. The other ten eider ducks were found dead along the Friesian Wadden Sea coast in December 1999.
Most ducks were young and gender was evenly distributed.

Method of investigation
From the ducks, collected in the period 1976 – 1991, the gastrointestinal tract or parts of it were received, sections were made and a complete examination made by the pathologists to look for possible causes of death. This meant that sometimes only a part of the intestine was received.
From five of the ducks, collected in the period 1976 – 1991, the whole gastrointestinal tract was investigated, from eight, only the intestine or parts of it; and from two only the gizzard. As a consequence, the worm numbers of these birds could only be semi-quantitatively estimated. The ten ducks from 1999 were not completely investigated. Only the gastrointestinal tract was examined and worm numbers counted.
If the gastrointestinal tract was still complete, the proventriculus and the gizzard were removed, slit open and washed with tap water in a bucket. The koilin layer of the gizzard was removed. Gizzard and koilin layer were separately investigated under a stereomicroscope (x10) for the presence of parasites. If parasites were found, they were removed and added to the contents of the bucket. These contents were poured over a sieve with screen mesh 0.074 mm. Material on the sieve was collected and worms were counted and identified.
The gastrointestinal tract was slit open with a pair of blunt scissors. The contents were washed carefully with tap water in a bucket. Worms which were adhering to the intestinal wall (acanthocephalans) were removed and added to the contents of the bucket. The same procedure was followed as for the gizzard. However, from the material on the sieve, all acanthocephalans were picked out and counted. The other material on the sieve was suspended in water. Thereafter, either all the fluid was investigated or two samples of 1/100 were taken. After sampling, the number of worms in both samples was counted and the total number of worms calculated.

Identification of the helminths
Nematodes and acanthocephalans were identified under the stereomicroscope (10x) and then the light microscope (x100), after clearance in chlorallactophenol. Digeneans were stained with borax-carmine and identified at 100x. Identification of cestodes to the species level was impossible due to the condition of the worms. Most cestodes collected from the eider ducks that died in 1999 could be identified at the family level. For the identification of the helminths the following references were used: Bartoli (1965, 1974, 1983), Baruš & Sergejeva (1989), Bowers & James (1967), Cable (1953), Ching (1965, 1972, 1973, 1982, 1995), James (1964), Khokhlova (1974), Pekkarinen & Ching (1994) and Stunkard & Uzmann (1958).

Results

The results from the eider ducks collected in the period 1976 – 1991, from which not all organs were completely investigated, are summarised in Table 1.
Table 2 gives the complete results of the whole gastrointestinal tract of ten eider ducks collected in 1999.
When the results of the two groups of birds were combined, it became obvious that the following infections are very common in the eider duck: gizzard: *Amidostomum acutum* (100 %); intestine: *Capillaria nyrocinarum* (69.6 %); Gymnophallidae/Microphallidae (100 %); *Psilotrema simillimum* (100 %); *Cryptocotyle concavum* (100 %); Cestodes, mainly immature Hymenolepididae, (100 %); *Profilicollis botulus* (100 %); caecum: *Catatropis verrucosa* (65.2 %).
Less common species were: gizzard and proventriculus:

Table 1. Gastrointestinal helminth species found in 15 eider ducks from the Dutch North Sea and Wadden Sea coast, found in the period 1976 – 1991

Species/Family	Site of location	Number investigated	Number positive (% positive)
Amidostomum acutum (N)	gizzard	7	7 (100)
Paracuaria formosensis (N)	gizzard	7	2 (28.6)
Tetrameres fissispina (N)	proventriculus	5	1 (20)
Streptocara crassicauda (N)	gizzard	7	1 (14.3)
Capillaria nyrocinarum (N)	intestine	13	10 (76.9)
Gymnophallidae/Microphallidae (T)	intestine	13	13 (100)
Psilotrema simillimum (T)	intestine	13	13 (100)
Cryptocotyle concavum (T)	intestine	13	13 (100)
Cotylurus cornutus (T)	intestine	13	1 (7.7)
Catatropis verrucosa (T)	caecum	13	8 (61.5)
Cestodes (mainly Hymenolepididae)	intestine	13	10 (76.9)
Profilicollis botulus (A)	intestine	13	10 (76.9)

N = Nematoda; T = Trematoda; A = Acanthocephala

Table 2. Gastrointestinal helminth species in ten eider ducks (*Somateria mollissima*) found death on the Friesian Coast of the Wadden Sea, the Netherlands in December 1999

Species	Location	No. ducks positive	Range of intensity (min-max)
Amidostomum acutum (N)	gizzard	10	20 – 1500
Capillaria nyrocinarum (N)	intestine	9	10 – 1700
Capillaria spp. (N)	intestine	1	10
Diplostomum spp. (T)	intestine	2	20 – 40
Cotylurus cornutus (T)	intestine	2	10 – 40
Catatropis verrucosa (T)	caecum	7	10 – 100
Notocotylus attenuatus (T)	caecum	1	2
Paramonostomum spp. (T)	caecum	1	3
Gymnophallus somateriae (T)	intestine	8	10 – >10 000
Gymnophallus rostratus (T)	intestine	6	10 – >10 000
Gymnophallus spp. (T)	intestine	2	10 – 1000
Lacunovermis macomae (T)	intestine	8	10 – >10 000
Cryptocotyle concavum (T)	intestine	10	100 – >10 000
Maritrema gratiosum (T)	intestine	5	10 – 300
Maritrema spp. (T)	intestine	1	100
Levinseniella spp. (T)	intestine	5	10 – 400
Microphallus longicaecum (T)	intestine	4	10 – 100
Microphallus somateriae (T)	intestine	7	10 – 100
Microphallus spp. (T)	intestine	1	20
Psilotrema simillimum (T)	intestine	10	10 – >10 000
Himasthla militaris (T)	intestine	6	10 – 200
Ligula intestinalis (C)	intestine	1	1
Cestodes (mainly immature Hymenolepididae) (C)	intestine	10	100 – >4 000
Profilicollis botulus (A)	intestine	9	10 – 4000

N = Nematoda; T = Trematoda; C = Cestoda; A = Acanthocephala

Paracuaria formosensis (28.6 %); *Tetrameres fissispina* (6.7 %); *Streptocara crassicauda* (5.9%); intestine: *Cotylurus cornutus* (13 %); *Himasthla militaris* (26.1 %); caecum: *Notocotylus attenuatus* (4.3%); *Paramonostomum* spp. (4.3 %).

Discussion

The majority of papers on parasites of eider ducks refer to mass mortality caused by *Polymorphus* spp. or *Profilicollis botulus* (see references in the Introduction). In Finland, the causative acanthocephalan is mainly *Pol. minutus* with gammarids as intermediate hosts. In Sweden, the UK and the Netherlands *Pro. botulus* prevails which uses the shore crab as intermediate host.

Only a few articles describe the other parasites of the eider duck. The most extensive study was done by Persson *et al.* (1974) in Sweden. They found four nematode species in the gizzard with *A. anseris* as the most prevalent one (64.7 %). Cestodes (82.9 %) and *Pro. botulus* (80 %) were frequently observed in the intestine. In total, Persson *et al.* (1974) found 16 helminth species with close agreement (12 species) with our study. We presume that the identification of *A. anseris* by Persson *et al.* (1974) should be *A. acutum*, because no other study on eider duck parasites mentions this species which normally occurs in geese. Van den Broek and Jansen (1964, 1971) mention 15 species for the Netherlands. Agreement with our results was in only three species. All species of Gymnophallidae and Microphallidae found by Van den Broek and Jansen (1971) differ from our identification. Species in these families are far from easy to identify and it may depend on the reference keys that were used. The same can be said for the identification of cestodes. In our study, we are sure that the majority of the cestodes belonged to the Hymenolepididae, but further classification is uncertain. In Finland, Lampio (1946) mentions *Pol. boschadis* as the most important helminth, but he also found cestodes, Strigeida, *Tetrameres* spp. and *Capillaria* spp. without giving percentages of infected birds or worm numbers.

Outside Europe, Threlfall (1968) and Bishop and Threlfall (1974) described the helminth fauna from the eider ducks in Newfoundland and Labrador. In fact, there were not great differences in the species composition compared with our results. In the gizzard, *A. acutum* was found in 44 % of the 110 investigated birds. *Tetrameres somateriae* was found in 40 %. In the intestine, *Pro. botulus* was the most common helminth (92 %), but also Microphallidae/Gymnophallidae, *Notocotylus attenuatus* and cestodes were found in the majority of the birds. Dau (1978) found cestodes and acanthocephalans in the spectacled eider (*Somateria fischeri*) from Alaska. Surprisingly, no *Polymorphus* or *Profilicollis* species were described, nor any parasite species from the gizzard. This raises the question whether

this study is complete or not.

The parasitic fauna of the eider duck fits well with the food they consume. It is remarkable that some helminths, such as *Catatropis* and *Notocotylus* use intermediate hosts that live in fresh water, while helminths, such as gymnophallids and microphallids, use intermediate hosts that live in brackish or salt water. This indicates that eider ducks pick up their parasites both on land and on sea. They stay only on land during nesting and moulting-time. It is interesting to know where the eiders pick up the parasites that have (probably) a direct life cycle such as *A. acutum*. The biology of *C. nyrocinarum* is not known. Further studies on the ecology of these species are required.

As said earlier, mass mortality of eider ducks is mainly attributed to the pathogenic effects of the acanthocephalans. Certainly, this will be true for some of the cases described in the literature. However, some authors are not sure about the role of the acanthocephalans. The number of worms can vary in birds which are found dead. Itämies *et al.* (1980) found 2200 and 3500 worms in two out of six juvenile dead birds, while the other four had less than 50. Hario *et al.* (1992) concluded that parasitic infection did not seem to be the cause of overall reduction in fecundity, in terms of clutch size and female body weight. Hario *et al.* (1995) could not find a correlation between outbreaks of eider mortality and parasite intensity. Several authors conclude that acanthocephalan numbers in ducklings are much higher than in adult birds (Liat Lim Boo & Pike, 1980; Thompson, 1985 and Hollmén *et al.*, 1996).

The conclusion is that there are still questions about the cause of the regularly observed mass mortality among eider ducks. We strongly support the statement of Hollmén *et al.* (1999) that parasites may enhance the degree of malnutrition in eiders in years and areas of limited food resources.

But there is another question. Because acanthocephalans are easily observed in the opened gastrointestinal tract, one can easily conclude that they are responsible for the death of the bird. This fast conclusion prevents people from looking at other parasites and indeed other causes. It is well known from the literature that *A. anseris* has sometimes been found in high numbers (> 100) and is pathogenic for geese (Knudsen, 1966; Vetési *et al.*, 1976). It is therefore justified to investigate in detail the role of *A. acutum* in the mass mortality of eider ducks.

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