HELMINTHOLOGIA, 42, 4: 215 – 218, 2005

The gizzard worm, *Amidostomum acutum* (Lundahl, 1848) Seurat, 1918 in common eiders (*Somateria mollissima* L.) in the Netherlands

F. H. M. BORGSTEEDE

Animal Sciences Group WUR, Division Infectious Diseases, Laboratory for Parasitic Diseases, P.O. Box 65
8200 AB Lelystad, The Netherlands, E-mail: *fred.borgsteede@wur.nl*

Summary

A study was made on the prevalence of *Amidostomum acutum* in the gizzard of the common eider (*Somateria mollissima* L.) in the Netherlands. The investigated birds were found dead along the Dutch coast in the winter of 2001/ 2002. From the dead birds collected at two localities, the North Sea coast near the Hondsbossche Zeewering and the Wadden Sea coast of the isle Texel, 50 eiders were selected. These 50 birds consisted of ten adult males, ten adult females, 15 juvenile males and 15 juvenile females. All birds were infected with *A. acutum.* The number of worms varied from four to 826. There were no significant differences in worm numbers in birds from both localities. Adult birds had significantly more worms (av. 150) than juveniles (48). Adult males had significantly more worms (av. 202) than adult females (98). These differences were found in both localities. The possible role of *A. acutum* in the mass mortality among the eiders is discussed.

Key words: common eider; *Somateria mollissima*; *Amidostomum acutum*; gizzard; the Netherlands

Introduction

The common eider (*Somateria mollissima*) is a large diving duck that mainly lives in brackish or salt water of the circumpolar region of the Northern Hemisphere. A small population has settled at the Ukrainian coast of the Black Sea (Ardamatskaya, 2001). Most eiders in the Netherlands overwinter along the coast of the Wadden Sea and the North Sea. They mainly originate from the Baltic and Danish breeding colonies, but there are also birds that breed in the Netherlands. The population between 1993 and 1997 was estimated to be between 102 000 and 173 000 (Swennen *et al.*, 1989).
In the winter of 1999/2000, mass mortality among eiders occurred and approximately 21 000 birds died (Camphuysen *et al.*, 2002). In the two following winters, again, mass mortality was observed, although on a smaller scale (resp. 5 – 7 000 and 10 – 12 000) than in the winter of 1999/2000 (Ens *et al.*, 2002).
To investigate the cause of this mass mortalities, ca. 400 eiders, adults, subadults and juveniles, collected during the three winters and stored in freezers, were dissected in March 2002. From seven possible causes: oil pollution, intoxication, a viral epidemic, an epidemic of non-viral microorganisms, parasites, chronic stress and lack of food, only two were found to be candidates: parasites and lack of sufficient food (Ens *et al.*, 2002).
Mass mortality among common eiders is a regularly reported phenomenon and most authors regard the acanthocephalan *Profilicollis botulus* as the cause of death (Clark *et al.*, 1958; Garden *et al.*, 1964; Itämies *et al.*, 1980). However, dissection of 311 eiders showed that 83.3 % of the adult birds (n=78) had less than 100 *P. botulus* in the intestine and none more than 1000, while 69.5 % of the younger birds had more than 100 *P. botulus* and 11.6 % more than 1000 (Ens *et al.*, 2002).
Although eiders have a rich helminth fauna of cestodes, trematodes, nematodes and acanthocephalans, special attention has been given to the gizzard worm *Amidostomum acutum*, that has a 100 % prevalence in the common eider (Borgsteede *et al.*, 2005). The related species *A. anseris*, is a well-known pathogen in geese (Herman *et al.*, 1955; Knudsen, 1966; Vetési *et al.*, 1976; Tuggle & Crites, 1984). It may be that the pathogenic effects of *A. acutum* in the common eider have been underestimated.
The present study examines the prevalence of *A. acutum* in common eiders collected in the winter of 2001/2002 from two localities in different age groups and its possible contribution to the mass mortality.

Materials and Methods

Dead eiders were collected during the winter 2001/2002 from the beaches and coast of two localities, the Hondsbossche Zeewering (HBZ)(North Sea Coast, 52’ 45” N,

04' 39" E) and the Wadden Sea coast of the island of Texel (TX) during a daily surveillance by volunteers. After collection, birds were classified according to the state of the corpse (very fresh, fresh, old, very old, complete or desintegrated), kept in tagged plastic bags and deep-frozen, generally within 24 hours after collection. For the present study, 50 very fresh or fresh eiders were selected from both localities. Data of the investigated birds are given in table 1.

Table 1. Origin, stage of development and gender of the 100 investigated common eiders

	females		males	
Locality	juveniles	adults	juveniles	adults
Hondsbossche Zeewering	15[1]	10[2]	15[3]	10[4]
Wadden Sea coast Texel	15[3]	10[1]	15[3]	10[3]

[1] Collected in the period Dec 2001 – Jan 2002; [2] Eight birds (from which two immatures) collected in the period Dec 2001 – Jan 2002, two birds in; resp. Feb and Mar 2002; [3] Collected in the period Dec 2001 – Feb 2002; [4] Collected in the period Dec 2001 – Feb 2002 (from which three immatures)

The deep frozen eiders were thawed and dissected in April 2002. After dissection, the gizzard and proventriculus were separated from the intestine. They were opened, the contents washed with tap water and the washings collected in a bucket. Thereafter, the koilin layer of the gizzard was removed and the gizzard was washed again and proventriculus and gizzard were scraped off with a blunt knife. All collected material was concentrated in the same bucket. The koilin layer was examined under a stereomicroscope (magn. 6 x) for the presence of worms. Worms which were found in the koilin layer were removed, counted and identified at the species level (Czaplinski, 1962). 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 % formalin solution and stored for later examination. From the stored material, worms were also collected, counted and identified. The sum of the results of the washings and the koilin layer together represented the number of worms per common eider.

Results

All investigated common eiders had worms in the gizzard and all birds had *Amidostomum acutum* present. This confirms earlier findings of Borgsteede *et al.* (2005). Twenty five birds also had other nematodes in the gizzard or proventriculus, generally in low numbers (<5).The following species, *Streptocara crassicauda*, *Paracuaria formosensis*, *Tetrameres fissispina* (in the proventriculus) and *Echinuria uncinata* (in the proventriculus) were found in respectively 13, 9, 4 and 3 common eiders. Remarkably, 23 of these 25 birds were juveniles. The results of the counts of *A. acutum* are presented in Table 2.

These results were analysed for differences between localities (HBZ versus TX), age (adult versus juvenile/immature) and gender (male versus female). No significant differrences were found between the number of worms in all eiders from HBZ and TX. However, if the 20 adults from these localities were compared, then eiders from TX had significantly more worms ($P < 0.05$). This significance was not noted when the adults of both sexes were examined separately. Another significant difference ($P < 0.05$) was found between juvenile males. Here, birds from HBZ had higher counts than those of TX.

With regard to age, there was an obvious difference between the adults and the younger birds. Adults (mean 150 worms) were more heavily infected than juveniles/imamtures (mean 48 worms) ($P < 0.05$). Only when the worm burden of the juvenile females (mean 45 worms) and adult females (mean 62 worms) from HBZ were compared, this difference could not be demonstrated.

With regard to gender, there was a significant difference between adult males (mean 202 worms) and adult females (mean 98 worms) ($P < 0.05$). This significant difference was also present when this analysis was made for the two localities separately. Differences between males and females had not developed in the younger birds.

Table 2. Numbers of *Amidostomum acutum* in the gizzard of the investigated common eiders

	females (n=50)		males (n=50)	
Locality	juveniles (n=30)	adults (n=20)	juveniles (n=30)	adults (n=20)
Hondsbossche Zeewering (n=50)	n=15 mean: 45 worms range: 6 – 167	n=10 mean: 62 worms range: 6 – 127	n=15 mean: 65 worms range: 11 – 156	n=10 mean: 110 worms range: 65 – 166
Wadden Sea coast Texel (n=50)	n=15 mean: 50 worms range: 4 – 141	n=10 mean: 134 worms range: 19 – 381	n=15 mean: 34 worms range: 13 – 111	n=10 mean: 295 worms range: 127 – 826

Discussion

The results of this study clearly demonstrated that *Amidostomum acutum* is a very frequently occurring parasite in the common eider in the Netherlands. All investigated birds were infected and the worm burden varied from 4 – 826. The number of worms found is either a correct number, or an underestimation, since birds may have lost

worms in the period between the start of the starvation and their death.

A. acutum is also a common parasite of fresh water ducks in Europe. In Slovakia, Macko (1978) found low numbers (<6) of *A. acutum* in *Anas crecca* and Birová and Macko (1984) found 5 out of 23 *Anas platyrhynchos* infected with 1 – 24 (mean 12) worms. In Poland, Betlejewska and Kalisińska (2001) found 40 % of 126 *Anas platyrhynchos* positive for *A. acutum* (range 1 – 18, mean 4), while Kavetska *et al.* (2004) described the prevalence of *A. acutum* in Anatini (n = 116, 65.5 % positive with range 1 – 24, mean 4.7), Aythyini (n = 6, 83.3 % positive with range 1 – 6, mean 2.6) and Mergini (n = 21, 66.7 % positive with range 1 – 58, mean 15.1). Outside Europe, all six common eiders investigated by Clark *et al.* (1958) were positive for *A. acutum*. Bishop and Threlfall (1974) found 1 – 80 (mean 6) *A. acutum in* 44 % of 110 common eiders in Newfoundland and Labrador and McLaughlin and McGurk (1987) found *A. acutum* in 53.3 % of 1196 gizzards of 13 different species of fall migrant ducks in Canada.

The coastal area in which the mass mortality occurred has an extremely rich fauna, with hundreds of bird species belonging to the Gaviidae, Podicipitidae, Procellariidae, Phalacrocoracidae, Ardeidae, Plataleidae, Charadriidae, Scolopacidae, Anatidae, Haematopodidae, Recurvirostrae, Rallidae, Laridae and Alcidae. Particularly, many of the Anatidae are known to be the host of *A. acutum*. Detailed information about the presence of *A. acutum* in other birds in the Netherlands will be presented at a later date.

The following conclusions can be drawn: compared with other studies that mention worm numbers, the numbers in our study were exceptionally high, particularly in adult birds. There were no differences in worm burdens between the two localities; adult birds having significantly more worms than younger birds and adult males having signifycant more worms than adult females. It has been found that in general, younger animals are more heavily parasitised than older ones. This difference in parasite load has also been noticed by Persson *et al.* (1974). However, Persson *et al.* (1974) mentioned *A. anseris* as the species involved. It is probable that this identification should have been *A. acutum.* The same identification error has probably been made by Christiansen (1948). Generally, older animals acquire some immunity to helminth infections, the extent of this can vary considerably from weak to almost complete. This seems not be the case for *A. acutum* in the common eider. It may be that a bird is less able to develop immunity against a gizzard worm, comparable with the situation in ruminants, where immunity against abomasal worms develops much more slowly than against intestinal worms. However, the difference between adults and juveniles, additionally, may be related to different behavioural and feeding habits. Adults consume more food than juveniles and in contrast with juveniles, adults breed on land. Thus, the question of where the infection is picked up. *A. acutum* is found in many species of ducks, living in a fresh water habitat. This makes it probable that the infection is picked up on land with food or while drinking. The worm numbers of adult males and females were also significantly different. Persson *et al.* (1974) did not mention differences in worm numbers between males and females, but they found 45 of 54 males (83.3 %) and 32 of 49 females (49.2 %) positive. This difference was significant. The difference in behaviour between males and females on land is mainly that females stay on the nest during breeding, while the males walk around and maybe have more opportunities to pick up infection. More studies on the epidemiological pattern of *A. acutum* are needed. Leiby and Olsen (1965) have studied the life histories of *A. raillieti*, *A. skrjabini* (regarded as a synonym of *A. acutum* by Czaplinski, 1962) and *Epomidiostomum anatinum*. However, in their experimental studies with eggs from female worms, they just give the development time for the different stages, without indicating how the life cycle in nature takes place.

The possible role of *A. acutum* in the mass mortality of common eiders must be considered. As previously noted, the worm numbers in this study are exceptionally high. Little is known about the pathogenic effect of *A. acutum.* Pathogenicity of *A. acutum* in the common eider has been suggested by Christiansen (1948) and Persson *et al.* (1974). Persson *et al.* (1974) found *A. anseris* (susp. *A. acutum*!*)* in 77 out of 119 gizzards without giving worm numbers. They describe the degree of invasion as slight to moderate for 44.5 % of the eiders and as profuse-massive for 19.3 %.

The related species, *A. anseris,* is a well known pathogenic gizzard worm in geese, it has been described by Herman and Wehr (1954), Herman *et al.*, (1955), Knudsen (1966) and Tuggle and Crites (1984). Vetési *et al.* (1976) did experimental studies with *A. anseris* in goslings, ducklings and chickens to demonstrate the histopathological changes.

If *A. acutum* were to be considered as a pathogen in common eiders, they could cause the following effects.

- Less nutritients available for the host due to the parasite's need for nutritients. Therefore, the host needs a higher food consumption.
- Presence of *A. acutum* may influence the host appetite with anorexia as an ultimate consequence. This may be caused by metabolic products of the parasite which influence the appetite, or by damaging the gizzard, so that crushing of shells of mussels and cockles becomes painful or even impossible. A pain reaction may cause a change to other, more easily digestible food with less nutritional value.
- *A. acutum* may cause a negative food conversion in the intestine.
- *A. acutum* may suck blood or they may damage tissues that causes loss of blood and valuable proteins. This needs compensation by the host, thus higher food uptake which may be impaired, as suggested before, by the presence of the parasites.

If these processes coincide with a situation in which less food it available, it is reasonable to suggest that the combination of parasitic worm burden, particularly *A. acutum* in adult birds, with shortage of food may be one of the causes of the mass mortality among the common eiders. In

younger animals, with lower burdens of *A. acutum*, but much higher numbers of the acanthocephalan *Profilicollis botulus* (Ens *et al.*, 2002), the latter parasite may have been responsible for the pathogenic combination of food shortage and parasite presence.

Acknowledgements

The author wishes to acknowledge Mardik Leopold, Romke Kats and all others who were involved in the dissection of the eiders in April 2002. Kasia Kavetska is thanked for her help with the references, particularly those from Middle and Eastern Europe. The comments of Dermot O'Brien and his corrections of the English text are greatly acknowledged.

References

ARDAMATSKAYA, T. B. (2001): The expansion of the common eider *Somateria mollissima* at Ukrainian coast of the Black Sea. *Acta ornithol.*, 36: 53 – 54

BETLEJEWSKA, K.M., KALISIŃSKA, E. (2001): *Amidostomum acutum* (Nematoda) in mallards *Anas platyrhynchos* L. of Northwest Poland. *Animal Prod. Review, Appl. Sci Rep.* 57:*Poultry Prod. And Breed., XIII Int. Symp. of young poultry scientists, Cracow 2002*: 69 – 75

BISHOP, C.A., THRELFALL, W. (1974): Helminth parasites of the common eider duck, *Somateria mollissima* (L.), in Newfoundland and Labrador. *Proc. Helminthol. Soc. Wash.*, 41: 25 – 35

BIROVÁ, V., MACKO, J. K. (1984): Helminths of *Anas platyrhynchos* L. before and after water system regulations on the East Slovakian lowland. *Biologia (Bratislava)*, 39: 911 – 947

BORGSTEEDE, F. H. M., OKULEWITZ, A., ZOUN, P. E. F., OKULEWITZ, J. (2005). The gastrointestinal helminth fauna of the eider duck (*Somateria mollissima* L.) in the Netherlands. *Helminthologia*, 42: 83 – 87

CAMPHUYSEN, CJ., BERREVOETS, C. M., CREMERS, H. W. J. M., DEKINGA, A., DEKKER, R., ENS, B. J., VAN DER HAVE, T. M., KATS, R. K. H., KUIKEN, T., LEOPOLD, M. F., VAN DER MEER, J., PIERSMA, T. (2002): Mass mortality of common eiders (*Somateria mollissima*) in the Dutch Wadden Sea, winter 1999/2000: starvation in a commercially exploited wetland of international importance. *Biol. Conservation*, 106: 303 – 317

CHRISTIANSEN, M. (1948): Epidemiagtigt s*ygdomsutbrud* blandt ederfugle (*Somateria mollissima* L.) ved Bornholm, foraarsaget af dyriske Snyltere. *Dansk Ornithol. Foren. Tidsskr.*, 42: 41 – 47

CLARK, G. M., O'MEARA, D., VAN WEELDEN, J. W. (1958): An epizootic among eider ducks involving an acanthocephalid worm. *J. Wildlife Management*, 22: 204 – 205

CZAPLINSKI, B. (1962): Nematodes and acanthocephalans of domestic and wild Anseriformes in Poland. I. Revision of the genus *Amidostomum* Railliet and Henry, 1909. *Acta Parasitol. Pol.*, 10: 125 – 164

ENS, B. J., BORGSTEEDE, F. H. M., CAMPHUYSEN, C. J., DORRESTEIN, G. M., KATS, R. K. H., LEOPOLD, M. F. (2002): Eidereendensterfte in de winter 2001/2002. Alterra-rapport 521, 114 pag, ISSN 1566 – 7197 (in Dutch)

GARDEN, E. A., RAYSKI, C., THOM, V. M. (1964): A parasitic disease in eider ducks. *Bird Study*, 11: 280 – 287

HERMAN, C. M., WEHR, E. E. (1954): The occurrence of gizzard worms in Canada geese. *J. Wildl. Managem.*, 18: 509 – 513

HERMAN, C. M., STEENIS, J. H., WEHR, E. E. (1955): Causes of winter losses among Canada geese. *Trans. N. Amer. Wildlife Conf.*, 20: 161 – 165

ITÄMIES, J., TELLERVO VALTONEN, E., FAGER-HOLM, H.-P. (1980): *Polymorphus minutus* (Acanthocephala) infestation in eiders and its role as a possible cause of death. *Ann. Zool. Fenn.*, 17: 285 – 289

KAVETSKA, K. M., KALISIŃSKA, E., KORNYUSHIN, V. V., KUZMIN, Y. (2004): Stomach nematodes of wild ducks (subfamily Anatidae) from Northwestern Poland. *Acta Parasitol.*, 49: 162 – 167

KNUDSEN, E. (1966): Amidostomiasis og acuariasis hos svømmefugle. *Nord. Veterinaer-Med.*, 18: 38 – 43

LEIBY, P.D., OLSEN, O.W. (1965): Life history studies on nematodes of the genera *Amidostomum* (Strongyloidea) and *Epomidiostomum* (Tricostrongyloidea) occurring in the gizzards of waterfowl. *Proc. Helminthol. Soc. Wash.*, 32: 32 – 49

MACKO, J. K. (1978): On the nematodes of *Anas crecca* L. in the spring seasons of 1954 – 1970. *Zborník Východoslov. Múzea v Košiciach* 19AB: 61 – 65

MCLAUGHLIN, J. D., MCGURK, B. P. (1987): An analysis of gizzard worm infections in fall migrant ducks at Delta, Manitoba, Canada. *Canad. J. Zool.*, 65: 1470 – 1477

PERSSON, L., BORG, K., FÄLT, H. (1974): On the occurrence of endoparasites in eider ducks in Sweden. *Viltrevy-Stockholm*, 9: 1 – 24

SWENNEN, C., NEHLS, G., LAURSEN, K. (1989): Numbers and distribution of eiders *Somateria mollissima* in the Wadden Sea. *Neth. J. Sea Research*, 24: 83 – 92

TUGGLE, B. N., CRITES, J. L. (1984): The prevalence and pathogenicity of gizzard nematodes of the genus *Amidostomum* and *Epomidiostomum* (Trichostrongylidae) in the lesser snow goose (*Chen caerulescens caerulescens*). *Canad. J. Zool.*, 62: 1849 – 1852

VETÉSI, F., PHUC, D.V., VARGA, I. (1976): Histopathological changes in the gizzard of goslings, ducklings and chickens experimentally infected with *Amidostomum anseris*. *Acta Vet. Acad. Sci. Hung.*, 26: 113 – 128

RECEIVED JANUARY 21, 2005

ACCEPTED OCTOBER 27, 2005