

***Syncuaria squamata* (Linstow, 1883) (Nematoda: Acuariidae) in the Great Cormorant [*Phalacrocorax carbo sinensis* (Blumenbach, 1798)] in northern Poland**

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Summary

Of the 105 great cormorants (*Phalacrocorax carbo sinensis*) from northern Poland (the Vistula Lagoon and Masurian Lake District), examined in 2000 – 2001, 67 proved hosts of the nematode *Syncuaria squamata* (Linstow, 1883). The prevalence, mean intensity, and intensity range amounted to 63.8 %, 36.2 specimens, and 1 – 120 specimens, respectively. The infection was heavier in the immature birds (84.6 %, 40.9 inds, and 1 – 120 inds) than in the adults (3.7 %, 1 ind.). The nematodes were dominated by gravid females (n=1846), followed by males (n=157), immature females (n=79), and L4 larvae (n=2). Measurements of the parasite are provided. *S. squamata* is a new species for the parasite fauna of Poland.

Key words: *Syncuaria squamata*; Nematoda; Great Cormorant; *Phalacrocorax carbo sinensis*; Gulf of Gdańsk; Vistula Lagoon; Mazurian Lakeland; Poland

Introduction

Since the mid-1980s, the European population of the great cormorant (*Phalacrocorax carbo sinensis* (Blumenbach, 1798)) has been observed to increase in size (Stempniewicz *et al.*, 1998). At present, Poland boasts Europe's largest great cormorant population, but, so far, data on the nematofauna composition in cormorants in Poland have been limited to two species only: *Baruscapillaria carbonis* (Dubinin et Dubinina, 1940) and *Contracaecum rudolphii* Hartwich, 1964 (Okulewicz 1989, 1997; Żuchowska 2000; Kanarek *et al.*, 2002). *Syncuaria squamata* found in this study is a new species for the fauna of Poland.

Materials and Methods

In the breeding season 2000, 52 immature great cormorants (27 nestling chicks aged 1 – 6 weeks and 25 post-nestling chicks ranging in age from birds older than 6 weeks to those

ready to leave the nest) from the breeding colony (Kąty Rybackie) located on the Vistula Spit and from the Vistula Lagoon area were examined. In 2001, 26 immature specimens (12 nestling chicks and 14 post-nestling chicks) were subjected to examination as well. The weak gonad development made sexing of those birds impossible. Some of the birds had fell out of the nests or fell down on the ground together with their nests. Live birds were put to sleep with chloroform as described by Dubinina (1971). In addition, 12 sexually mature specimens (4 ♀♀, 8 ♂♂) were examined. The adults were found dead on the Vistula Spit or in fishing nets in the Vistula Lagoon. In August 2001, additional 15 adults (6 ♀♀, 9 ♂♂) obtained as a result of culling of a population inhabiting the Lake Selment Wielki near Elk (Masurian Lake District) (Fig. 1) were also examined.

Helminthological examination was performed according to the generally adopted techniques (Dubinina, 1971). The nematodes found, isolated from the stomachs and cleaned of food remains, were fixed in 19:1 mixture of glacial acetic acid and 40 % formalin and kept in 70 % ethanol. For identification, the parasites were cleared in lactophenol or glycerol. The nematodes were measured with a measuring eyepiece of the microscope and returned to ethanol.

Results

Stomachs of 67 great cormorants were found to contain a total of 2084 *Syncuaria squamata* specimens. Nematodes were found only in the Vistula Spit cormorants, except for a single specimens (an immature female) occurring in a cormorant from the Masurian Lake District. The general extent of infection can be expressed as 63.8 % prevalence, mean intensity of 36.2 specimens, and intensity range of 1 – 120 specimens. In 2000, the infection rate was reflected by 84.6 %, 33.2 inds, and 1 – 120 inds, the respective data revealed in 2001 being 84.6 %, 19 inds, and 1 – 56 inds.

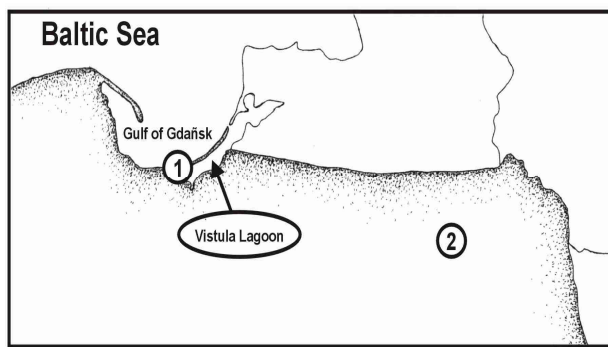


Fig. 1. Map of sampling stations, 1: Breeding colony in Kąty Rybackie, 2: Lake Selment Wielki

The immature birds proved to be much more strongly affected (84.6 %, 40.9 inds, 1 – 120 inds) than the adults (3.7 %, 1 ind.). The prevalence was similar in the nestling chicks and post-nestling chicks, but the intensity was clearly higher in the latter (Table 1). The nematodes were dominated by gravid females (n=1845), followed by males (n=157), immature females (n=79), and L4 larvae (n=2). Most of the gravid females were found in the nestling chicks (Table 2).

Tab. 1. Prevalence (%), mean intensity (ind.) and range of intensity (ind.) of *Syncuaria squamata* in the cormorant from the Vistula Lagoon and Mazurian Lakeland

	Nestling chicks	Post-nestling chicks	Adult
Vistula Lagoon	87.2/22.7/1 – 93	82/40.1/2 – 120	0
Mazurian Lakeland	-	-	6.6/1/1
Total	87.2/22.7/1 – 93	82/40.1/2 – 120	3.7/1/1

-- not examined; 0 – not found

Tab. 2. Population structure (prevalence, mean intensity, range of intensity) of *Syncuaria squamata* in the great cormorant in the Vistula Lagoon and the Mazurian Lake District

Nematode	Cormoran	Nestling chicks	Post-nestling chicks	Adult
Males (n=157)		46.9/3.7/1 – 8	65.6/4.8/1 – 25	0
Gravid females (n=1846)		100/21.2/1 – 86	100/36.4/1 – 109	0
Immature females (n= 79)		50/3/1 – 11	46.9/2.7/1 – 9	3.7/1/1
Larvae L4 (n=2)		0	3.1/2/2	0

Description (measurements in millimetres):

Male (n=17): body length 5.76 – 10.13 (mean of 7.63); maximum width 0.20 – 0.31 (0.22). Cordon length 0.77 – 1.33 (1.03). Deirid length 0.023 – 0.042 (0.032); deirid width 0.019 – 0.030 (0.025). Muscular pharynx length 0.17 – 0.29 (0.25); glandular pharynx length 0.36 – 0.48 (0.42). Nerve ring-anterior body end distance 0.16 – 0.28 (0.26). Longer spicule length 1.03 – 1.49 (1.20); shorter spicule length 0.13 – 0.20 (0.16).

Gravid females (n=26): body length 17.6 – 34.1 (27.4); maximum body width 0.55 – 0.86 (0.69). Cordon length 0.83 – 1.56 (1.23). Egg length 0.029 – 0.058 (0.040); egg

width 0.019 – 0.039 (0.027). Vulva-anus distance 0.22 – 0.39 (0.26); tail length 0.08 – 0.19 (0.11). Deirid length 0.042 – 0.065 (0.051); deirid width 0.042 – 0.065 (0.052). Muscular pharynx length 0.41 – 0.55 (0.44); glandular pharynx length 0.84 – 1.17 (1.00). Nerve ring-anterior body end distance 0.45 – 0.64 (0.58).

Immature females (n=17): body length 5.84 – 10.61 (8.17); maximum body width 0.19 – 0.34 (0.27). Cordon length 0.66 – 0.96 (0.81). Deirid length 0.023 – 0.046 (0.031); deirid width 0.026 – 0.038 (0.031). Vulva-anus distance 0.099 – 0.15 (0.13). Muscular pharynx length 0.13 – 0.24 (0.18); glandular pharynx length 0.33 – 0.49 (0.39). Nerve ring-anterior body end distance 0.17 – 0.21 (0.19).

L4 larva (female, n=1): body length 2.53; maximum body width: 0.16. Cordon length 0.31; distance between anterior body length and the characteristic bipartite deirid 0.47. Deirid length 0.0056; deirid width 0.0037. Nerve ring-anterior body end distance 0.15. Deirid-cordon distance 0.096. Muscular pharynx length 0.0103; glandular pharynx length 0.0207. Tail length 0.079.

Discussion

The nematode genus *Syncuaria* is represented by 9 valid

species occurring world-wide in birds from the families Podicipedidae, Phalacrocoracidae, and Ciconidae (Wong *et al.*, 1986). One of those species, namely *S. squamata*, is regarded as specific for the cormorants *Phalacrocorax carbo* (L., 1758), *P. auritus* (Lesson, 1831), and *P. pygmaeus* Pall., 1773 (Baruš *et al.*, 1978; Wong *et al.*, 1986; Anderson, 1992). So far, only *S. decorata* (Cram, 1927) (reported as *Decorataria decorata*) has been recorded in Poland from the little grebe (*Podiceps ruficollis*) and the great crested grebe (*P. cristatus*) (Okulewicz, 1980, 1997). *Syncuaria squamata* found in this study expands the list of nematode species known from Poland.

Although the size of the nematodes found was similar to that reported by Baruš *et al.* (1978), Moravec (1990), Wong *et al.* (1986), and Wong and Anderson (1987), the ranges of both length and width were wider, which could have resulted from a higher number of the parasites measured in this study.

The level of infection observed (63.8 %, 36.2 inds, 1 – 120 inds) should be considered high. For example, 3 out of the 10 Bohemian cormorants studied by Moravec (1990) proved infected and yielded a total of 12 nematodes. Dezfuli *et al.* (2002), who studied cormorants in Italy, reported infection at the level of 21 %, 2.3 inds, and 1 – 10 inds. The 5-week-old Canadian double-crested cormorants (*Phalacrocorax auritus auritus*) examined by Wong and Anderson (1987) showed the extent of infection to amount to 93 %, 17 inds, and 2 – 46 inds.

It is worth mentioning that the high infection parameters found in the great cormorant of the Kąty Rybackie breeding colony may be indicative of intensive reproduction of the parasite in the adjacent brackish waters of the Vistula Lagoon and Gulf of Gdańsk of salinities averaging 2.4 and 7.5 PSU, respectively (Łomniewski, 1958; Majewski, 1990). As reported by numerous authors (e.g., Stempniewicz & Grochowski, 1997; Bzoma *et al.*, 2003), the colony members feed in the Lagoon and in the Gulf; moreover, there are no major freshwater reservoirs in the colony's vicinity.

A relationship between the presence of *Syncyaria squamata* and the cormorant age may provide interesting insights. Apart from a single nematode found in an adult bird, all the parasites were removed from immature cormorants. It is, however, difficult to assess the data provided by other authors who seldom, if at all, reported age categories of the birds they examined or based their studies on artificial infection. When trying to identify causes of the higher infection rate in the immature birds, one has to first rule out a possibility that the parents (adults) of the birds "avoid" infected fish or are not exposed to them due to different food preferences. It is worth mentioning that, like adults, immature cormorants are typical piscivores, fed fish by the parents from their first day out of an egg. As opposed to some birds (e.g., the seagulls), the cormorants do not experience an ontogenetic dietary switch, therefore the food composition is virtually identical in the immature and adult birds. For this reason, both the young and the adult cormorants are exposed to identical invasive forms of parasites occurring in their food. Consequently, the presence of most *S. squamata* in the immature birds is most likely a result of a much higher food uptake (related to high energy demand) by the immature birds during growth (Sitko, 1993) or the deficiency of their incompletely developed immunological system (Ros *et al.*, 1997; Sol *et al.*, 2003), or a combination of the two factors. However, effects of other environmental variables cannot be excluded. Moreover, a high density of the great cormorants at their breeding sites may play a role as well by rapidly increasing the abundance of larval stages of the parasite, supported by intermediate (ostracods) and paratenic hosts (fish), as discussed by, i.a.,

Jensen *et al.* (1994) and Mitgaard *et al.* (2003). It has to be added that during the period of study, in 2000, the Vistula Spit breeding colony consisted of 7995 breeding pairs; there were 8670 pairs in 2001 and as many as 11495 pairs in 2004, making the colony the Europe's largest (Goc *et al.*, 2005).

The structure of the great cormorant-supported *S. squamata* population is an additional question. Among the four developmental studies found, gravid females were dominant. They dominated both in the nestling chicks and in the post-nestling chicks. Wong and Anderson (1987), who examined much fewer birds, found the naturally infected double-crested cormorants to support mostly mature males, followed by immature females, gravid females, and the L4 larvae. From the age of 8 weeks on, the birds supported primarily males, the younger birds being affected mostly by immature females; those birds older than 15 weeks were usually hosting males only. The artificially infected double-crested cormorants examined in week 12.5 – 22.4 showed a slight domination of gravid females. With respect to the data obtained, it is worth stressing that the great prevalence of nematode females, particularly the gravid ones, is advantageous from the standpoint of the species' persistence in the ecosystem.

Acknowledgements

The authors wish to extend their sincere thanks to Prof. V. Baruš of the Institute of Vertebrate Biology, CAS, Brno (Czech Republic) for his help in nematode identification. The research was supported in part by the Polish Scientific Research Committee grant No. 2PO4C 070 27.

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RECEIVED JULY 4, 2005

ACCEPTED OCTOBER 31, 2005