Oceanological and Hydrobiological Studies
International Journal of Oceanography and Hydrobiology
Vol. XXXV, No.1

Institute of Oceanography (23-28) University of Gdańsk
2006

Research Article

Third-stage larvae of *Anisakis simplex* (Rudolphi, 1809) in the Great Cormorant [*Phalacrocorax carbo sinensins* (Blumenbach, 1798)] from the Vistula Lagoon, Poland

GERARD KANAREK✉, LESZEK ROLBIECKI✉

University of Gdańsk, Department of Invertebrate Zoology
Al. Marsz. Piłsudskiego 46, 81-378 Gdynia, Poland
✉*kanarek@sat.ocean.univ.gda.pl*
✉*lrolbiecki@sat.ocean.univ.gda.pl*

Key words: parasite, *Anisakis simplex*, Great Cormorant, *Phalacrocorax carbo sinensins*, herring, Vistula Lagoon, Poland

Abstract

Five out of 28 Great Cormorants collected in spring 2005 from the Vistula Lagoon were found to contain a total of 19 (16 in the stomach and 3 in the intestine) stage III larvae of *Anisakis simplex*. Spring is the season when nematode-infected herring from the western Baltic, Danish straits, and the North Sea arrive in the Vistula Lagoon and transmit the infection to cormorants feeding on them. This study is the first record of *A. simplex* larvae in the Great Cormorant.

INTRODUCTION

Anisakis simplex is a cosmopolitan nematode species that occurs mainly in the colder temperate and polar waters. The definitive hosts are marine mammals (whales and pinnipeds). The first intermediate hosts are the Euphasiacea (Crustacea) which become infected with free-living stage II larvae. Planktivorous fish (mainly herring) serve as the second intermediate hosts, occasionally regarded as paratenic hosts, that support stage III larvae (Smith and Wootten 1978, Nagasawa 1990, Moravec 1994).

The Vistula Lagoon is one of the largest coastal water bodies throughout the Baltic Sea area (Łomniewski 1958). Herring from the western Baltic, Danish straits, and the North Sea arrive, mainly in spring and less frequently in autumn, to the southern Baltic (including the Vistula Lagoon) to spawn. Some of the herring are infected with the nematode *Anisakis simplex* (occasionally reported merely as *Anisakis* sp.) (Rokicki *et al*. 1997, Myjak *et al*. 1996, Rodjuk and Shukhgalter 1998, Rolbiecki and Rokicki 2002, Shukhgalter 2002). It is at that time that *A. simplex* can infect, or be transmitted to, other, frequently accidental, hosts. Their range includes terrestrial mammals, including humans which, when infected, develop a condition termed anisakiasis (Ishikura *et al*. 1992). Among the hosts are also fish and predatory/piscivorous birds. When in those hosts, the larvae usually stay at a stage identical to that supported by herring; such hosts are termed paratenic. The nematode has already been recorded in the Vistula Lagoon in the zander (Rolbiecki and Rokicki 2000, Rolbiecki 2003) and flounder (Rolbiecki and Izdebska 2005). In addition, in the nearby Gulf of Gdańsk, *A. simplex* was reported in cod (Myjak *et al*. 1994) and stickleback (Podolska and Morozińska 1994). Most probably, both the stickleback and the flounder became *A. simplex*-infected when feeding on infected viscera of herring or cod discarded by fishermen.

This study is a continuation of research commenced in 2000 on the helminth fauna of the Great Cormorant in the southern Baltic (Kanarek *et al*. 2002, 2003, Kanarek and Rokicki 2005).

The Great Cormorant, identified in this study as an *Anisakis simplex* host, extends the list of known hosts of the nematode.

MATERIAL AND METHODS

In March 2004, 28 Great Cormorants (*P. carbo sinensis*) (26 adults and 2 immature specimens) from the Vistula Lagoon were examined. The birds had been shot during the pre-breeding season by permission issued by the Minister of the Environment (DOPweg-4201-03-17/04/al.) and pursuant to decision No. 27/03 of the Local Ethical Commission on Experiments Involving Animals at

the Medical University in Gdańsk. After delivery to the laboratory, the birds were subjected to standard parasitological examination and dissection.

The nematodes collected were fixed in a 19:1 mixture of glacial acetic acid and formalin. The parasites were cleared in lactophenol to facilitate identification, measurements, and photographing.

RESULTS

Five cormorants (2 adult females and 3 adult males) were found to host a total of 19 stage III *Anisakis simplex* larvae. The prevalence was 17.8% at a mean intensity of 3.8 specimens and intensity range of 1-8 specimens. The larvae were live, non-encysted, found in the stomachs of 4 birds (16 larvae) and in the intestine of one cormorant (3 larvae).

Description

Stage III larva of *Anisakis simplex* (n=19, Fig. 1): body length 14.370-22.493 (18.889) mm; maximum width 0.175-0.468 (0.357) mm. Length of larval (boring) tooth 0.008-0.017 (0.015) mm. Excretory pore situated 0.027-0.049 (0.033) mm away from the anterior extremity. Oesophagus length 1.404-2.174 (1.802) mm, distance of nerve ring from anterior extremity 0.168-0.304 (0.251). Ventriculus length 0.634-1.057 (0.862) mm; ventriculus width 0.136-0.257 (0.191) mm. Ventriculus obliquely connected with the intestine. Tail length 0.091-0.589 (0.328) mm; mucron length 0.016-0.027 (0.019) mm.

The nematodes collected corresponded to *A. simplex* larval morphology type I of Berland (1961) and Shiraki (1974).

DISCUSSION

The cormorant is the most abundant piscivorous bird in the Vistula Lagoon. Its population, constantly increasing in size since the mid-1980s, has become a serious factor limiting fish stocks in the Lagoon. As demonstrated by Stempniewicz (2003), the cormorant's annual fish consumption in the area is estimated at more than 750 tonnes (an average across the years 1995-1997).

The Vistula Lagoon cormorant diet includes 25 fish species representing the Ammodytidae, Anguillae, Bothidae, Clupeidae, Cyprinidae, Esocidae, Gadidae, Gasterosteidae, Gobiidae, Osmeridae, Percidae, Pleuronectidae, Salmonidae, and Zoarcidae as well as petromyzonid cyclostomates. The dominant food item (1995-1997 data) is the ruffe, *Gymnocephalus cernnus* of the Percidae (58-75.5% of the diet). The remaining species account for less than several per cent of the diet. Depending on the year, herring contributed 7.7% (in 1995), 1.2-2.2% (1996) or 0.4-1.2% (1997) to the cormorant diet (Martyniak *et al*. 2003,

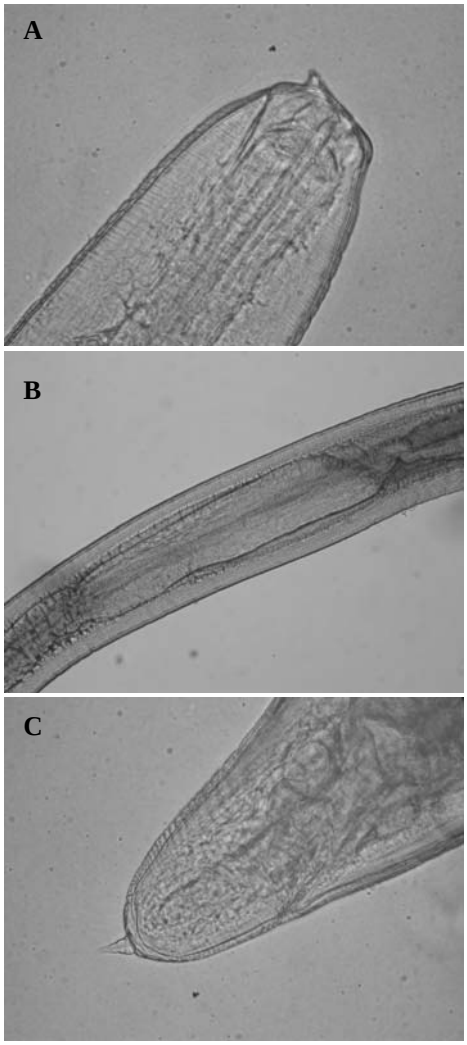

Fig. 1. Stage III larvae of *Anisakis simplex* from *Phalacrocorax carbo sinensis*. A, anterior extremity with larval tooth and excretory pore (x 400); B, ventriculus region (x 100); C, tail with mucron (x 400).

Stempniewicz *et al*. 2003). However, in spring, the herring - in addition to the ruffe – is the major food item (Stempniewicz and Grochowski 1997). When feeding at that time on herring, the cormorant may become infected with *Anisakis simplex*. It is worth mentioning that the present finding of live larvae as well as the fact that the stomachs of three birds were empty and two contained some food remains only (bones, otoliths, and ruffe) allows us to conclude that the cormorants digest herring, whereas *A. simplex* evidently survives.

The nematodes in question (occasionally identified to genus only) had been earlier recorded in other pisci- and omnivorous birds, *e.g*., the fulmar (*Fulmarus glacialis*) in Great Britain and Iceland (Riley 1972, Ólasdóttir *et al*. 1996), common gull (*Larus canus*) in Norway (Bakke and Baruš 1975), puffin (*Fratercula arctica*) (Ólasdóttir *et al*. 1996), and guillemot (*Uria lomvia)* in Iceland and the Barents Sea (Ólasdóttir et al. 1996, Kuklin 2001). Those birds usually yielded stage III larvae (Riley 1972, Bakke and Baruš 1975, Ólasdóttir *et al*. 1996) but also stage IV ones (Riley 1972, Ólasdóttir *et al*. 1996), adult specimens being reported in one study (Riley 1972).

In their definitive hosts, marine mammals, the *Anisakis simplex* stage III larvae moult into stage IV, and subsequently into adults capable of reproduction. As observed in numerous instances, *A. simplex* - when in birds - most often remain at a developmental

stage identical to that found in fish, stage IV larvae being found occasionally only; this is the case in humans as well.

ACKNOWLEDGEMENTS

Many thanks to Messrs Wiesław Podsiadły and Hubert Jochem of the "Żuławy" Hunters Association in Nowy Dwór Gdański for their assistance in procuring the birds for the research. The study was partly supported by the Polish State Committee for Scientific Research grant No. 2PO4C 070 27.

REFERENCES

Bakke T. A., Baruš V., 1975, *Studies of the helminth fauna of Norway XXXVI: The common gull, Larus canus L., as final host for Nematoda. I. Qualitative and quantitative data on species of Ascaridoidea (Railliet & Henry, 1915)*, Norw. J. Zool., 23, 183-191.

Berland B., 1961, *Nematodes from some Norwegian marine fishes*, Sarsia, 2, 1-50.

Ishikura H., Kikuchi K., Nagasawa K., Ooiwa T., Takamiya H., Sato N., Sugane K., 1992, *Anisakidae and Anisakidosis*, [in:] Sun T. (ed.) *Progress in Clinical Parasitology*, Vol. 3, Springer-Verlag, New York, pp. 43-102.

Kanarek G., Rolbiecki L., Sitko J., Baruš V., Rokicki J., 2002, *The occurence of Contracaecum rudolphi Hartwig, 1964 in the cormorant (Phalacrocorax carbo sinensis) in northern Poland*, Slovenské a české parazitologické dni, 28-31 May, 2002, Stará Lesná, Slovenská Republika: 22.

Kanarek G., Sitko J., Rolbiecki L., Rokicki J., 2003*, Digenean fauna of the great cormorant Phalacrocorax carbo sinensis (Blumenbach, 1798) in the brackish waters of the Vistula Lagoon and the Gulf of Gdańsk*, Wiad. Parazytol. 49, 293-299.

Kanarek G., Rokicki J., 2005, *The status of studies on the helminth fauna of the Great Cormorant (Phalacrocorax carbo sinensis) in northern Poland*, Wiad. Parazytol. 51, 165.

Kuklin VV., 2001, *On a helminth fauna of seabirds of the Archangelskaya Bay (Northern Island of Novaya Zemlya)*, Parazitologiya 35, 124-133 (In Russian)

Łomniewski K., 1958, *Vistula Lagoon*, Prace geograficzne 15 PAN, Warszawa, 106 pp. (In Polish)

Martyniak A., Wziątek B., Szymańska U., Hliwa P., Terlecki J., 2003, *Diet composition of Great Cormorants Phalacrocorax carbo sinensis at Kąty Rybackie, NE Poland, as assessed by pellets and regurgitated prey*, Vogelwelt 124, 217-225.

Moravec F., 1994, *Parasitic nematodes of freshwater fishes of Europe*, Kluver Academic Publishers, 473 pp.

Myjak P., Szostakowska B., Wojciechowski J., Pietkiewicz H., Rokicki J., 1994, *Anisakid larvae in cod from the southren Baltic Sea*, Arch. Fish. Mar. Res. 42, 149-161.

Myjak P., Szostakowska B., Pietkiewicz H., Wyszyński M., Grawiński E., Dąbrowski J., Potajałło U., 1996, *Occurence of anisakid larvae (Nematoda) in marine fish caught in the Gulf of Gdańsk and the Vistula Lagoon*, Crangon 1, 57-64.

Nagasawa K., 1990, *The life cycle of Anisakis simplex: a review*, [in:] Ishikura H., Kikuchi K., (eds). *Intestinal anisakiasis in Japan*, Springer-Verlag, Tokyo, pp. 31-40.

Ólasdóttir D., Lilliendahl K., Sólmundsson J., 1996, *Nematode infections in icelandic seabirds*, Bull. Scan. Soc. Parasitol. 6, 124-125.

Podolska M., Morozińska J., 1994, *Anisakis simplex (larva III-stage) in stickleback Gasterosteus aculeatus from Southren Baltic*, Wiad. Parazytol. 40, 305-309. (In Polish)

Riley J., 1972, *The pathology of Anisakis nematode infections of the Fulmar Fulmarus glacialis*, Ibis 114, 102-104.

Rodjuk G., Shuhgalter O., 1998, *Parasitofauna of the Baltic herring in the South-Eastern Baltic Sea and the Vistula Lagoon*, Proceedings of Symposium on Freshwater fish and the herring populations in the coastal lagoons – Environment and Fisheries, 5-6 May, 1998, Gdynia, Poland, 196-201.

Rokicki J., Podolska M., Wyszyński M., 1997, *Infection of Baltic Herring and Sprat with Anisakis sp. 1995-1996,* Studia Mat. Seria B 69, 160-180. (In Polish)

Rolbiecki L., 2003, *Diversity of the parasite fauna of cyprinid (Cyprinidae) and percid (Percidae) fishes in the Vistula Lagoon, Poland*, Wiad. Parazytol. 49, 125-164.

Rolbiecki L., Rokicki J., 2000, *The occurence of the nematodes Anisakis simplex pathogenic to man in pike-perch from the Vistula Lagoon, Poland*, Wiad. Parazytol. 46, 397-402.

Rolbiecki L,. Rokicki J., 2002, *III-stage Anisakis simplex (Rudolphi, 1809) (Nematoda; Anisakidae) larvae in herring caught in autumn from the polish part of the Vistula Lagoon*, Acta Scient. Pol., Piscaria 1, 105-110.

Rolbiecki L., Izdebska JN., 2005, *Stage III larvae of Anisakis simplex (Rudolphi, 1809) in the flounder, Platichthys flesus (L.), in the Polish zone of the Vistula Lagoon as an important veterinary-medical problem*, The Second Conference on Travel Medicine, 12-14 May, Białystok, Poland, 139.(In Polish)

Shiraki T., 1974, *Larval nematodes of family Anisakidae (Nematoda) in the northern Sea of Japan – as a causative agent of eosinophilitic phlegmon or granuloma in the human gastro-intestinal tract*, Acta Med. Biol. 22, 57-98.

Shukhgalter O., 2002, *Anisakis simplex (Rud., 1809) (Nematoda: Anisakidae): growth and morphometry of larvae from spring spawing herring (Clupea harengus membrans L.) in the Vistula Lagoon and adjacent areas of the Baltic Sea*, Oceanol. Stud. 31, 67-73.

Smith JW., Wootten R., 1978, *Anisakis and anisakiasis*, Adv. Parasitol. 16, 93-163.

Stempniewicz L., Grochowski A., 1997, *Diet composition of Cormorants in the breeding colony of Kąty Rybackie, NE Poland (regurgitated preys, 1992-94)*, Suppl. Ric. Biol. Selvaggina 26, 537-544.

Stempniewicz L., Martyniak A., Borowski W., Goc M., 2003, *Fish stocks, commercial fishing and cormorant predation in the Vistula Lagoon, Poland*, [in:] Cowx IG., (ed.) *Interactions between fish and birds: implications for menagemnet*, Blackwell Publishing, Ltd., pp. 51-64.