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Short communication

THE NEMATODE PARASITE, *ANGUILLICOLA CRASSUS* KUWAHARA, NIIMI ET ITAGAKI, AND THE MONOGENEAN GILL PARASITE, *PSEUDODACTYLOGYRUS ANGUILLAE* (YIN ET SPROSTON), IN EEL, *ANGUILLA ANGUILLA* (L.), FRY

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ABSTRACT. The aim of the study was to determine the prevalence and intensity of infection of European eel, *Anguilla anguilla* (L.), with nematode and monogenean gill parasites. Fifty individuals obtained from Vistula Lagoon stocking material were examined in August and October 2006. The prevalence of infection with *Pseudodactylogyrus anguillae* (Yin et Sproston) in August was 52.4%, and in October 17.2%, while the mean intensity of infection in the same periods was 4.0 and 1.2 individuals, respectively. The prevalence of infection with *Anguillicola crassus* Kuwahara, Niimi et Itagaki was 4.8 (August) and 20.7% (October), while the mean intensity was 1.0 and 2.5 individuals. Releasing parasite-infected stocking material is harmful from the perspective of fisheries management and simultaneously increases the area of occurrence of the parasites.

Key words: *ANGUILLA ANGUILLA*, STOCKING, *ANGUILLICOLA CRASSUS*, *PSEUDODACTYLOGYRUS ANGUILLAE*, VISTULA LAGOON, POLAND

Anguillicola crassus Kuwahara, Niimi et Itagaki is a swim bladder parasite while *Pseudodactylogyrus anguillae* (Yin et Sproston) infects the gills of eel, *Anguilla* spp. In the early 1980s, *A. crassus* was introduced from Asia to Europe, where, in a very short time, it became a new parasite in European eel, *Anguilla anguilla* (L.) (Køie 1991). During the *A. crassus* life cycle, there are typically intermediary hosts, usually copepods (Moravec 1994) and the so-called paratenic host, mainly small fish (Rolbiecki 2002). Eel (the final host) is exposed to these parasites by preying on invertebrates and small

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fish, which are infected with stage III larvae. The paratenic hosts are especially significant for large eel, which, due to their size, prey on fish more frequently.

The origin of *P. anguillae* in European eel is not clear (Buchmann et. al. 1987). The first reports of the occurrence of monogenean gill parasite of the genus *Pseudodactylogyrus* in European eel come from Russia, where the most likely vector was the introduced Japanese eel, *Anguilla japonica* Temminck et Schlegel (Buchmann et al. 1987). Perhaps the gill parasites then expanded to other European regions. Initially, they occurred only in *A. japonica* in Japan, China, and Taiwan and in *Anguilla reinhardtii* (Steindachner) in Australia (Buchmann et al. 1987, Køie 1991). However, there are indications that *P. anguillae* is an endemic species in Europe and North America (Cone and Marcogliese 1995).

The aim of the current study was to determine the prevalence and intensity of infection of the European eel used in Vistula Lagoon stocking programs. The current work presents the first data from Polish regions regarding the occurrence of the *A. crassus* and *P. anguillae* parasites in eel used for stocking programs.

In August and October 2006, 51000 and 37400 of European eel fry reared at a hatchery were released into the Vistula Lagoon. Fifty eel chosen at random from the stocking material were examined (21 individuals in August and 29 in October). Their total length range was 153-241 mm and body weight was 7.1-23.1 g. Full helminthological dissection was performed in accordance with generally accepted principles. The parasites collected were fixed in hot 70% ethanol. For identification, the parasites were cleared in lactophenol, and glyceringelatine preparations were made from some of the individuals. To describe the occurrence of the parasites in the fish, the following were determined: prevalence of infection (percentage of infected individuals), mean intensity of infection (mean number of parasites per infected host), and range of intensity (limits determined by the least and most parasites in the examined infrapopulation).

The overall prevalence of infection of the eel (for all parasites and examination periods) was 40.0%, at a mean intensity of 3.4 individuals and at a range of intensity of 1 to 8 individuals. The extent of *P. anguillae* infection in August was 52.4% and in October it was 17.2%, while the mean intensity of infection in the same periods was 4.0 and 1.2 individuals, respectively (Table 1). The extent of *A. crassus* infection was 4.8 (August) and 20.7% (October), and the mean intensity of infection was 1.0 and 2.5 individuals.

The following stagesat *A. crassus* were identified: one stage III larva in the intestine wall; four stage IV larvae in the swim bladder lumen (2 females and 2 males); 13 adult nematodes (9 females and 4 males). The co-occurrence of *P. anguillae* and *A. crassus* was noted in three eel individuals.

TABLE 1

Prevalence and intensity of *Anguillicola crassus* and *Pseudodactylogyrus anguillae* in eel stocked to the Vistula Lagoon

	August		October	
Parasite	Prevalence (%)	Mean (range) intensity (individuals)	Prevalence (%)	Mean (range) intensity (individuals)
Pseudodactylogyrus anguillae	54.2	4.0 (2-8)	17.2	1.2 (1-2)
Anguillicola crassus	4.8	1.0 (1)	20.7	2.5 (1-3)
Total	52.4	4.3 (2-8)	31.0	2.3 (1-5)

The nematode parasite *A. crassus* and the monogenean gill parasite *Pseudodactylogyrus* spp. are currently the most dangerous helminth parasites infecting European eel. *A. crassus* has occurred to be more dangerous for the European eel than for the Japanese variety (its typical host). In Japan, this nematode occurs in 10 to 40% of eel, and although it lives in the swim bladder and feeds on blood, it does not do significant damage to its host. As reported by Egusa (1979), the Japanese eel has evolved to become more tolerant of the harmful impact of this parasite. However, in European eel the extent of infection can be as high as 100% at a intensity that reaches several tens of nematodes in a single fish. This cannot but have a negative impact on fish condition. The symptoms of *A. crassus* infection include severe and chronic infections and swelling, and the expansion and fibrosis of the swim bladder wall that often results in swim bladder shrinkage and decreased volume (Würtz and Taraschewski 2000). In the presence of additional stressors, such infections can even lead to death (Molnár et al. 1991). Eel infected with the gill parasite *Pseudodactylogyrus* spp. excrete excessive mucous and have damaged gills (Chan and Wu 1984). *P. anguillae* induces histopathological symptoms including hemorrhaging and acute cell growth in the gill epithelium.

A. crassus was first noted in eel inhabiting the Vistula Lagoon in Poland in 1988 (Grawiński 1994, Rolbiecki et al. 1996). In the same year, this parasite was also noted in eel imported from Sweden and Germany (Własow et al. 1991). Most of the data regarding the occurrence of *A. crassus* in eel from Poland come from northern Poland

(southern Baltic coast, southern Baltic lake region, Mazurian Great Lakes region) and the southern Baltic (Własow et al. 1997, Pilecka-Rapacz and Sobecka 2004, Bystydzieńska et al. 2005, Rolbiecki and Rokicki 2006).

The level of infection of the nematode *A. crassus* in the eel (stocking material) examined for the current study was lower (14.0%, 2.6 individuals) in comparison with previously examined fish from the Vistula Lagoon. Grawiński (1994) confirmed *A. crassus* in 75% of eel while Rolbiecki et. al. (1996) noted it in 63.3%, at a intensity of 1-25 individuals. Własow et al. (1997) noted *A. crassus* in 100% of fish at a intensity of 8.3 individuals (10 fish were analyzed) in 1996, while in 1997 the extent of infection ranged from 91.7 to 94.4% and intensity from 4.3 to 10.3 individuals (three groups of fish numbering 12, 14, and 18 individuals were examined). In the 2001-2002 period, 75.0% of the eel in the Vistula Lagoon were infected at a mean intensity of 10.0 individuals (Bystydzieńska et al. 2005), while Rolbiecki and Rokicki (2006) determined the extent of infection at 67.8% at a mean intensity of 4.2 individuals in 2005.

To date, *P. anguillae* and also *P. bini* were confirmed in Poland in 1995 in Lake Strażyn near Toruń (Dzika et al. 1995) and in the 1999-2003 period in rivers of western Pomerania (Radew, Rega, Wieprza) (Sobecka and Pilecka-Rapacz 2003). Single gill parasites were also noted in 2003 in the Vistula Lagoon (Rolbiecki, in preparation); furthermore, *P. anguillae* was confirmed in eel in 2002 on the Russian side of the Vistula Lagoon (Rodjuk and Shelenkova 2006).

The unintentional, thoughtless introduction of parasites to other geographical regions leads to serious biological and economic consequences. Since *A. crassus* and *Pseudodactylogyrus* spp. have already been introduced to Europe, ways of limiting their infection of endemic eel populations must be considered. Fighting parasites under natural conditions is very difficult. An important element of limiting the occurrence of parasites should be preventative measures. All stocking material must be analyzed to detect parasite infection prior to release; in eel this refers to *A. crassus* and the gill parasites of the genus Pseudodactylogyrus. Infected fish should either be treated or destroyed. Additionally, waters in which infected fish are transported should not be emptied into clean basins since they might carry invasive parasite eggs or larvae.

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STRESZCZENIE

PASOŻYTNICZY NICIEŃ *ANGUILLICOLA CRASSUS* KUWAHARA, NIIMI ET ITAGAKI I SKRZELOWIEC *PSEUDODACTYLOGYRUS ANGUILLAE* (YIN ET SPROSTON) U NARYBKU WĘGORZA *ANGUILLA ANGUILLA*

Celem badań było określenie ekstensywności i intensywności zarażenia węgorza europejskiego, *Anguilla anguilla* (L.) pasożytniczymi nicieniami i skrzelowcami. W sierpniu i październiku 2006 roku zbadano 50 osobników narybku węgorzy pochodzących z partii materiału do zarybienia Zalewu Wiślanego. Ekstensywność zarażenia *Pseudodactylogyrus anguillae* w sierpniu wynosiła 52,4%, a w październiku 17,2%, natomiast średnia intensywność w porównywanych okresach wynosiła odpowiednio 4,0 i 1,2 osobn. (tab. 1). Ekstensywność zarażenia *Anguillicola crassus* wynosiła 4,8 (sierpień) i 20,7% (październik), a średnia intensywność 1,0 oraz 2,5 osobn. Wykorzystywanie zarażonych węgorzy jako materiału zarybieniowego jest szkodliwe z punktu widzenia gospodarki rybackiej oraz powiększania areału występowania pasożytów.