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Short communication

Non-indigenous benthic fishes as new hosts for *Bucephalus polymorphus* Baer, 1827 (Digenea: Bucephalidae) in the Vistula River basin, Poland

Y. Kvach[1], K. Mierzejewska[2]

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ABSTRACT

Key-words: *non-indigenous species, non-indigenous species, Vistula River, gobiidae, Chinese sleeper,* Bucephalus polymorphus

Two Ponto-Caspian gobiid species, the racer goby, *Babka gymnotrachelus*, and the monkey goby, *Neogobius fluviatilis*, the introduced fishes in the Vistula River, Poland, were found being infected with metacercariae of *Bucephalus polymorphus*. The encysted larvae were located in muscles and fins of these fish. The adult specimens occurred in the gut of another non-indigenous species, the Chinese sleeper *Perccottus glenii*. The life cycle of *B. polymorphus* in the Vistula River drainage includes three non-indigenous components: 1) the zebra mussel *Dreissena polymorpha*, the source of cercariae; 2) gobiids (the racer and monkey gobies), which are new in this water drainage but could play more important role in the life cycle than habitual cyprinids, thanks to their small size (favorable in transmission through the food-web); 3) the Chinese sleeper, a new accidental definitive host. The presence of these non-indigenous components in the life cycle maintains the distribution and further spread of *B. polymorphus* in the colonized area.

RÉSUMÉ

Espèces de poissons non-indigènes, nouveaux hôtes de *Bucephalus polymorphus* Baer, 1827 (Digenea : Bucephalidae) dans le bassin de la Vistule, Pologne

Mots-clés : *espèces non-indigènes, rivière Vistule, gobiidé, « dormeur chinois »,* Bucephalus polymorphus

Deux espèces de gobiidés Ponto-Caspiennes, le gobie coureur *Babka gymnotrachelus* et le gobie fluviatile *Neogobius fluviatilis*, poissons introduits dans la rivière Vistule, Pologne, ont été trouvées infectées par des métacercaires de *Bucephalus polymorphus*. Les larves enkystées étaient localisées dans les muscles et les nageoires de ces poissons. Des spécimens adultes se trouvaient dans l'intestin d'une autre espèce non-indigène, le « dormeur chinois », *Perccottus glenii.* Le cycle de vie de *B. polymorphus* dans le bassin de la Vistule comprend trois composantes non-indigènes : 1) la moule zébrée *Dreissena polymorpha*, source des cercaires ; 2) des gobiidés (gobie fluviatile et coureur) qui sont nouveaux dans ce bassin versant mais pourraient avoir un rôle plus important dans le cycle de vie que les cyprinidés habituels, en raison de leur petite taille (favorable à la transmission dans le réseau trophique) ; 3) le « dormeur chinois », un nouvel hôte final accidentel. La présence de ces composantes non-indigènes dans le cycle de vie maintient la distribution et amplifie la propagation de *B. polymorphus* dans l'aire colonisée.

(1) Odessa Branch of the Institute of Biology of the Southern Seas of NAS of Ukraine, Pushkinska 37, 65-125 Odessa, Ukraine, yuriy.kvach@gmail.com
(2) Department of Fish Biology and Pisciculture, Warmia and Mazury University in Olsztyn, Oczapowskiego 2, 10-719 Olsztyn, Poland

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INTRODUCTION

Bucephalus polymorphus Baer, 1827 (Digenea: Bucephalidae) is a digenean parasite originally described as cercaria from the unionid mussels (Overstreet and Curran, 2002). Mature specimens are located in the intestine of predatory fish, mainly pike-perch *Sander lucioperca* (L., 1758), perch *Perca fluviatilis* L., 1758, sometimes pike *Esox lucius* L., 1758, and many others (Niewiadomska, 2003). The second intermediate hosts are various freshwater fishes, mainly cyprinids. The area of origin of this parasite is Eastern Europe (drainages of the Baltic, Black, and Caspian Seas) and Western Siberia (basins of Ob and Irtish Rivers) (Bauer, 1987). This species also occurred in Western Europe, especially in France, where it was reported from the invasive Ponto-Caspian zebra mussel *Dreissena polymorpha* (Pallas, 1771) (Wallet *et al*., 1985; Molloy *et al*., 1997). The presence of the parasite in the invasive mussels has an importance with respect to the view of further distribution of the parasite.

In the Black Sea basin, *B. polymorphus* usually uses gobiids as intermediate hosts. Naidenova (1974) noticed this parasite in the muscles of tadpole gobies *Benthophilus* spp. in the desalinated Sea of Azov. She also noted that tadpole gobies could also host mature individuals of this digenean. In the Dniester Estuary, the metacercariae were mentioned in the round goby *Neogobius melanostomus* (Pallas, 1814) and the ratan goby *Ponticola ratan* (Nordmann, 1840) (Kvach, 2004). In the Turkish Lake Egirdir, the metacercariae occurred in muscles of the Caucasus goby *Knipowitschia caucasica* (Berg, 1916) (Diler and Yıldırım, 2003).

The Ponto-Caspian gobiids are invasive species in different regions of Europe and North America (Copp *et al*., 2005; Košuthová *et al*., 2009). Mühlegger *et al*. (2009, 2010) detected the metacercariae of *B. polymorphus* in fins of the invasive round goby in the Middle Danube River in Austria. So, in the life cycle of *B. polymorphus*, two invasive components could act as intermediate hosts: 1) the invasive zebra mussel, 2) the invasive round goby.

In the Vistula River, four non-indigenous species of Ponto-Caspian gobiids were found: the monkey goby *Neogobius fluviatilis* (Pallas, 1814), the round goby *N. melanostomus*, the racer goby *Babka gymnotrachelus* (Kessler, 1875), and the western (or freshwater) tubenose goby *Proterorhinus semilunaris* (Heckel, 1837) (Kostrzewa and Grabowski, 2001, 2002; Grabowska *et al*., 2008). Another non-indigenous bottom-dwelling fish in the Vistula River is the Chinese sleeper *Perccottus glenii* Dybowski, 1877 (Antychowicz, 1994).

The aim of the presented study was to analyse the role of the newly introduced fishes in the life cycle of *B. polymorphus* in the Włocławek Reservoir of the Vistula River.

MATERIAL AND METHODS

The fishes were sampled using electrofishing, fishing nets, and deep-nets on two sampling sites in the Włocławek Reservoir on the lower Vistula River in Poland (Figure 1). Racer goby and monkey goby were caught predominantly in central part of the reservoir close to Dobiegniewo locality (sampling site S1; Figure 1). The Chinese sleeper and freshwater tubenose goby were almost exclusively caught in the upper part of the reservoir in a shallow bay on the left bank near Wola Brwileńska locality (sampling site S2; Figure 1). The fish were kept alive in the bucket with aerated water and dissected within two days. In total, 391 individuals of fishes were examined for parasites: 132 individuals of the racer goby *Babka gymnotrachelus*, 63 ind. of the monkey goby *Neogobius fluviatilis*, 37 ind. of the western tubenose goby *Proterorhinus semilunaris*, and 159 ind. of the Chinese sleeper *Perccottus glenii*. The pieces of muscles and dissected guts of the fishes were pressed between two slides and examined under a stereomicroscope. The fins were examined without pressing.

The metacercariae were isolated from the cysts by pepsin digestion. All digeneans (larvae and adults) were fixed in hot formalin and stored in tubes. Such preserved samples were transported to the laboratory, washed in 3% hydrogen peroxide, in 70% alcohol, and subsequently stained with the iron acetocarmine (Georgiev *et al*., 1986). The flukes previously dehydrated in the graded series of alcohol and cleared in eugenol were finally mounted in Canada balsam.

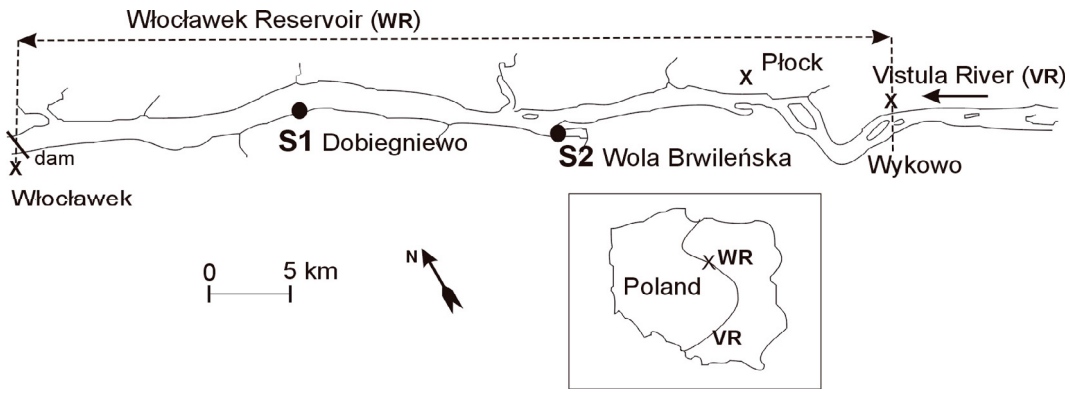

Figure 1
The sampling sites of non-indigenous fish in the Włocławek Reservoir. S1 – sampling site of racer and monkey gobies, S2 – sampling site of Chinese sleeper and western tubenose goby.

Figure 1
Les sites d'échantillonnage des poissons non-indigènes dans le réservoir Włocławek S1 – site d'échantillonnage des gobies fluviatile et coureur, S2 – site d'échantillonnage du « dormeur chinois » et du gobie à narine tubulaire.

The prevalence (*P*), intensity of infection (*I*), mean intensity (*MI*), and abundance (*A*) were calculated according to Bush *et al*. (1997).

RESULTS AND DISCUSSION

Two individuals of the racer goby (*P* = 1.5%, *I* = 3 and 10 specimens, *MI* = 6.5 ± 4.9, *A* = 0.1) and one specimen of the monkey goby (*P* = 1.6%, *I* = 2, *A* = 0.03) were infected with metacercariae of *B*. *polymorphus*. The encysted larvae were located in muscles and fins of fish. The adults occurred in the gut of the Chinese sleeper (*P* = 0.6%, *I* = 5, *A* = 0.03). This species of digenean has never been detected in the Chinese sleeper before. The studied specimens of western tubenose goby were not infected with *B*. *polymorphus*.

B. *polymorphus* is a common parasite of native fish species in Poland. Adults of this parasite have already been found in the pike-perch *S*. *lucioperca*, European perch *P. fluviatilis*, asp *Aspius aspius* (L., 1758), burbot *Lota lota* (L., 1758), Wels catfish *Silurus glanis* (L., 1758), and the northern pike *E*. *lucius*. The metacercariae have been detected in the pike-perch, European perch, northern pike, furthermore in the ruff *Gymnocephalus cernua* (L., 1758) and many cyprinids like roach *Rutilus rutilus* (L., 1758), zope *Ballerus ballerus* (L., 1758), chub *Squalius cephalus* (L., 1758), orfe *Leuciscus idus* (L., 1758), bleak *Alburnus alburnus* (L., 1758), white bream *Blicca bjoerkna* (L., 1758), freshwater bream *Abramis brama* (L., 1758), tench *Tinca tinca* (L., 1758), bitterling *Rhodeus amarus* (Bloch, 1782), rudd *Scardinius erythrophthalmus* (L., 1758), gudgeon *Gobio gobio* (L., 1758), crucian carp *Carassius carassius* (L., 1758), goldfish *C. auratus* (L., 1758), and the barbel *Barbus barbus* (L., 1758) (Niewiadomska, 2003). In the Vistula River basin, mature individuals of *B*. *polymorphus* were detected in pike-perch and perch from the Włocławek Reservoir and the Vistula Lagoon (Waluga and Własow, 1988; Rolbiecki, 2003), but the metacercariae were found on gills and fins of cyprinids, like the roach, rudd, freshwater bream, white bream, bleak, tench, gudgeon, and Prussian carp *Carassius gibelio* (Bloch, 1782), as well as in the pike-perch from the Vistula River near Warsaw, in the Włocławek Reservoir, Vistula Lagoon, and the Konin Lakes in Central Poland (Baturo, 1978; Reda, 1987; Waluga and Własow, 1988; Rolbiecki, 2003). The life cycle of *B*. *polymorphus* in Poland is quite similar to the one in the Ponto-Caspian region. The main definitive host is the pike-perch, and the second intermediate hosts are various species of cyprinids. In the Ponto-Caspian region, the important role in the life cycle also is played by gobiids, which are an important dietary item of pike-perch (Smirnov, 1986). The introduction

of the Ponto-Caspain gobiids to the Baltic Sea basin makes the life cycle of *B. polymorphus* in the Vistula drainage similar to that in the Ponto-Caspian region. On the other hand, due to the presence of *B*. *polymorphus* in the Vistula River, the alien gobiids start playing the same role in this ecosystem, as in their native habitats.

Another important new component of the life cycle of *B*. *polymorphus* is the Chinese sleeper, a freshwater pray fish originally native to the Far East, thus unique in European waters. The Chinese sleeper is involved in the life cycle of this trematode as an accidental definitive host. Consequently, the life cycle of *B*. *polymorphus* in the Vistula River drainage includes three non-indigenous components. The first is the zebra mussel *D*. *polymorpha*, which is the source of cercariae (Baturo, 1978). The second are the gobiids (*B*. *gymnotrachelus* and *N*. *fluviatilis*), the newly appearing fish species in the river drainage that could play more important role in the life cycle than the commonly occurring cyprinids; their small sizes might be favorable for transmission through the food-web. The last component of the life cycle of *B*. *polymorphus* is the Chinese sleeper, which is a new accidental definitive host of this parasite.

The presence of these non-indigenous components in the life cycle maintains the further spread of *B*. *polymorphus* in the colonized area.

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