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The racer goby, *Babka gymnotrachelus* (Kessler, 1857) invades the Evros river: evidence of recent establishment in Greece

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Abstract – The discovery of the racer goby *Babka gymnotrachelus* in the transboundary Evros river basin, collected on September 10th 2018 at two locations very close to the Greek-Bulgarian and Greek-Turkish borderlines, is reported. This is a new addition to the non-native ichthyofauna of Greece and the Aegean Sea drainages, and it is the second non-native Ponto-Caspian goby to enter this river. Boat-based electrofishing sampling, following the EU Water Framework Directive monitoring program, provides first evidence of what is presumed to be a recently established population; most of the 13 collected specimens are juveniles and the species has not yet been located in the river's tributaries. Further study and international cooperation in monitoring and management of this and other alien species in the Evros are proposed.

Keywords: *Babka gymnotrachelus* / Evros river / alien species / transboundary river / Balkans

Résumé – Le gobie coureur, *Babka gymnotrachelus* (Kessler, 1857) envahit la rivière Evros : preuve d'une implantation récente en Grèce. La présence du gobie coureur *Babka gymnotrachelus* dans le bassin transfrontalier du fleuve Evros, prélevé le 10 septembre 2018 à deux endroits très proches des frontières gréco-bulgare et gréco-turque, est signalée. Il s'agit d'un nouvel ajout à la faune ichtyenne non indigène de la Grèce et aux bassins versants de la mer Égée, et c'est le deuxième gobie Ponto-Caspien non indigène à entrer dans cette rivière. L'échantillonnage de la pêche à l'électricité par bateau, conformément au programme de surveillance de la Directive-cadre sur l'eau de l'UE, fournit les premières preuves de ce qui est présumé être une population récemment établie ; la plupart des 13 spécimens prélevés sont des juvéniles et l'espèce n'a pas encore été trouvée dans les affluents de la rivière. Il est proposé de poursuivre l'étude, et la coopération internationale en matière de surveillance, et de gestion de cette espèce et d'autres espèces exotiques dans la région d'Evros.

Mots clés : *Babka gymnotrachelus* / rivière Evros / espèce exotique / rivière transfrontalière / Balkans

The racer goby *Babka gymnotrachelus* (Kessler, 1857) is native to the river catchments of the Black, Marmara and Caspian seas (Miller & Vasil'eva, 2003). Since the mid 1990s, this goby has invaded several central European rivers although it has not been recorded in Balkan rivers that enter the Mediterranean (Piria *et al.*, 2017a; Koutsikos *et al.*, 2019). Here we report on the recent discovery of *B. gymnotrachelus* in the transboundary Evros-Maritza-Meriç basin (hereafter Evros, the classical name), the largest river in the Balkans after the Danube. The Evros has been called an "open-door" for invading alien species (Ozulug *et al.*, 2018); that is, human-assisted species dispersal which drift downstream of Bulgarian entry points. This dispersal pathway concerns species introduced from Bulgaria's Danubian and Black Sea basin freshwater fauna. In recent years another non-native Ponto-Caspian goby, the Pontian monkey goby *Neogobius fluviatilis* (Pallas, 1814) was documented in Bulgarian (Stefanov *et al.*, 2008) and Greek parts of the Evros basin (Zogaris and Apostolou, 2011) but despite several sampling visits, the population in Greek waters was not re-located (Economou *et al.*, 2016; Zogaris *et al.*, 2018) and no new non-native gobies were recorded in this river until now.

During September 10th 2018, 13 specimens of *B. gymnotrachelus* were collected on routine EU Water Framework Directive (EU WFD) fish monitoring within Greek territory in the Evros. Electrofishing surveys are undertaken with a five-meter aluminum boat that holds a generator-powered direct-current electrofisher (EFKO, 8 kW, 150–300/300–600 V) with a hand-held netted ring anode of 40 cm diameter (effective electric field of about 2.5 m diameter). This method catches fishes along the banks and at depths of down to

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Fig. 1. Cropped photograph of *Babka gymnotrachelus* from Evros_MD site (93.5 mm TL). Photographed alive on-site in a field aquarium after application of clove-oil anesthetic.

about 1.7 m. At least 400 m of river stretch within Greek territory was sampled at each survey site; however, benthic habitats in deeper waters were out of reach. All stunned fish were collected by the netted anode and by a second operator using a separate dip-net. After measurement and identification nearly all specimens were released alive back to the river. In this survey, non-native gobies were collected, photographed in a field aquarium, anaesthetized (using clove oil), humanly euthanized and fixed in a 98% ethanol solution for lab study (Fig. 1).

B. gymnotrachelus was found at sampling sites "Evros_MD" near Nea Vissa village and at "Evros_UP" near Ormenio village (Fig. 2). Additionally, at "Evros_MD" and at the southernmost site, "Lykofos", *N.* fluviatilis was re-located; this species was first discovered in Greek territory 24 river kilometers downstream of "Lykofos" in 2011 (Zogaris and Apostolou, 2011). A tributary site, "Erythro_DW" had no gobies; although native gobies have been found in many other tributaries (Dimitriou *et al.*, 2012). *B. gymnotrachelus* specimens were collected in a variety of habitats, including muddy backwaters and deeper water near rocky groynes. The fish community in the sampled areas was rich (13–20 species per site) and the native western tubenose goby *Proterorhinus semilunaris* (Heckel, 1837) was by far the most abundant goby (Tab. 1).

B. gymnotrachelus specimens were identified (based on: Miller and Vasil'eva, 2003; Kottelat and Freyhof, 2007; Vassilev *et al.*, 2012) by the following characteristics:

- the lack of a black spot on the posterior part of the first dorsal fin *versus* a visible black spot in *Neogobius melanostomus* (not present in this river);
- the first branched ray of the second dorsal fin is about as long as the penultimate ray *versus* the second dorsal branched fin ray, being twice as long as the penultimate ray in *N. fluviatilis*;
- a more roundish head *versus* a more flat and broader head in *Ponticola kessleri* (not present in this river) and *versus* the narrower pointed head of *N. fluviatilis*, and;

Fig. 2. EU WFD boat-based fish monitoring sites on the Evros river.

- areas without scales on the nape (this area feels very smooth when touched as compared with *N. fluviatilis,* where nape scaling gives a relatively rough texture).

In addition, the sides of *B. gymnotrachelus* often show a characteristic but variable slanting striped pattern. Since sexual maturity occurs after the second year of life, at an approximate total length (TL) greater than 5.8 cm (Grabowska, 2005; Cocan *et al.*, 2016) only specimens from "Evros_MD" had reached reproductive sizes (Tab. 2). The 8 specimens from "Evros_UP" includes young-of-the-year juveniles, providing first evidence that the species probably reproduces and is therefore established in the area. The possibility of young-of-the-year fishes being recently introduced by humans at this location is highly unlikely, and this is corroborated by the older individuals collected at Evros_MD, which is 46 river kilometers downstream. All collected specimens were stored in the HCMR Fish Museum at Anavissos, Greece.

B. gymnotrachelus and other related Ponto-Caspian goby species have been assessed as "invasive" in the Balkan countries (Simonović *et al.*, 2013), however this species' invasion progress has been poorly recorded (Roche *et al.*, 2013; Jakšić *et al.*, 2016; Piria *et al.*, 2017b). Caution is needed in tracking, identification and invasiveness assessments of Ponto-Caspian gobies since even hybridization among invaders is a possibility, although probably extremely rare (Haertl *et al.*, 2012; Lindner *et al.*, 2013). In our case, hybridization with sympatric gobies is highly unlikely but genetic analyses and further study is recommended in order to research the provenance and mode of entry into the Evros river

Table 1. Total number and size classes of gobid fishes caught at four surveyed sites.

Site	Coordinates	River (km)	Date	Species	Total number	Size class (cm)		
						< 5	6–10	11–15
Evros_UP	41°44'14.70"N2 6°14'7.24"E	202	10/9/2018	*Babka gymnotrachelus*	8	8	0	0
				Proterorhinus semilunaris	27	13	11	3
				Neogobius fluviatilis	0	0	0	0
Evros_MD	41°34'17.08"N 26°35'12.99"E	156	10/9/2018	*Babka gymnotrachelus*	5	2	3	0
				Proterorhinus semilunaris	9	6	3	0
				Neogobius fluviatilis	7	6	1	0
Erythro_DW	41°20'41.08"N 26°29'38.50"E	117	11/9/2018	*Babka gymnotrachelus*	0	0	0	0
				Proterorhinus semilunaris	0	0	0	0
				Neogobius fluviatilis	0	0	0	0
Lykofos	41°6'41.48"N 26°18'12.43"E	75	12/9/2018	*Babka gymnotrachelus*	0	0	0	0
				Proterorhinus semilunaris	76	70	6	0
				Neogobius fluviatilis	3	2	1	0

Table 2. *Babka gynotrachelus* total length (mm), sex and location (MD = Evros_MD, UP = Evros_UP).

No	1	2	3	4	5	6	7	8	9	10	11	12	13
TL (mm)	61.97	92.3	93.46	36.72	23.99	29.13	37.9	35.39	37.85	31.14	40.3	35.98	43.82
SEX	female	female	female	female	female	female	female	female	female	male	male	male	male
Station	MD	MD	MD	MD	MD	UP	UP	UP	UP	UP	UP	UP	UP

basin (*e.g.* Ohayon and Stepien, 2007; Grabowski *et al.*, 2016). In our opinion natural dispersion into the Evros by *B. gymnotrachelus* is inconceivable, despite the fact that this river is geographically close and historically related to the Black/Marmara Sea catchments that host native populations of this and other Ponto-Caspian gobies. We hypothesize that the probable vector for invasion is the accidental transfer through fish stocking practices from the Danubian/Black Sea catchments to the Evros's Bulgarian artificial dam reservoirs. Fish stocking and unintentional angler-associated translocations are frequent in the Bulgarian part of the basin and several freshwater organisms have entered Greece and Turkey through this transboundary river (İnnal and Erk'akan, 2006; Barbieri *et al.*, 2015; Ozulug *et al.*, 2018). The Bulgarian part of the Evros basin has several large reservoirs, including hydroelectric dams and it is well-known that these attract amateur fishing activity were fish introductions are poorly regulated (Stefanov *et al.*, 2008). Large numbers of young-of-the-year fishes, including alien gobiids, are known to pass through hydroelectric dam turbines and overflows (Janáč *et al.*, 2013). Reservoir development with stocking and amateur fishing are a primary route of entry of many invasive species of fish in the Mediterranean: river basins (Clavero and Hermoso, 2011; Koutsikos *et al.*, 2019) and elsewhere (Johnson *et al.*, 2008).

The Evros's *B. gymnotrachelus* record is especially important because it provides: i) first evidence of what we presume to be an early stage invasion process; ii) preliminary data that the native *P. semilunaris* is still the most abundant goby relative to the other two non-native Ponto-Caspian gobies (at least in the shallower waters and river banks sampled); and, iii) possible indication of a downstream dispersal from Bulgaria of *B. gymnotrachelus* (the juvenile specimens at "Evros_UP" were collected literally c. 20 m. from Bulgarian territorial waters). However, this report also shows the inadequate degree of ichthyological monitoring by the three countries sharing the Evros river. Additionally, boat-based electrofishing on its own may not be adequate for quantitative surveys of benthic gobies and other methods should also be employed (Szalóky *et al.*, 2015; Lenhardt *et al.*, 2017). Moreover, it is noteworthy that *B. gymnotrachelus* has been overlooked and its establishment status was undefined until recently even in several Danube tributaries (Roche *et al.*, 2013; Piria *et al.*, 2017b); the species is probably overlooked in the Bulgarian and Turkish stretches of the Evros also. This species should obviously be present in the Bulgarian part of the Evros but there are no published records to our knowledge (Vassilev *et al.*, 2012; Yankova, 2016). Biological pollution problems such as the expansion of non-native Ponto-Caspian gobies, which are a potential pressure on biotic communities (Roche *et al.*, 2013), is also a reason for international cooperation in monitoring and management of this important transboundary river (Dimitriou *et al.*, 2012; Trebitz *et al.*, 2017).

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