

NEW DATA ON DISTRIBUTION
OF THE MONKEY GOBY, *NEOGOBIUS FLUVIATILIS*
(PALLAS, 1814) IN BOSNIA AND HERZEGOVINA
AND CROATIA WITH NOTES ON ECOLOGY AND
ASSOCIATED FISH FAUNA

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The invasive fish species *Neogobius fluviatilis* was recorded at one locality on each of the two investigated rivers, Una and Kupa. The expansion of this species in Bosnia and Herzegovina is presented, as well as the habitat characteristics of the locality on the Una River. Additionally, a list of the associated fish fauna at both localities is given: 18 and 29 additional fish species were recorded for the Una and Kupa Rivers, respectively.

Key words: *Neogobius fluviatilis*, Sava River drainage, invasive species

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Tijekom istraživanja ihtiofaune nizinskih rijeka Hrvatske, na jednom lokalitetu istraživanog područja rijeke Une i jednom lokalitetu područja rijeke Kupe zabilježena je invazivna riblja vrsta, *Neogobius fluviatilis*. Daje se osvrt na širenje te vrste u Bosni i Hercegovini i Hrvatskoj te značajke staništa na rijeci Uni na kojoj je zabilježena. Također, daje se popis utvrđenih vrsta riba na oba lokaliteta, za rijeku Unu 18, a za rijeku Kupu 29 vrsta.

Ključne riječi: *Neogobius fluviatilis*, sliv rijeke Save, invazivna vrsta

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INTRODUCTION

Several Ponto-Caspian goby species (Benthophilionae, Gobiidae, Perciformes) are considered invasive (HAERTEL *et al.*, 2012; NEILSON & STEPIEN, 2009; COPP *et al.*, 2005). They inhabit a whole range of different habitats: estuaries, brackish and freshwater lagoons and lakes, as well as small to large rivers (KOTTELAT & FREYHOF, 2007; MILLER, 2003; JANKOVIĆ *et al.*, 1987). The range of these species extends from the Black and Caspian Seas towards the east and north of Europe where they have colonized numerous lotic freshwater habitats. Thus nowadays, some of the species, like *Babka gymnotrachelus* (Kessler, 1857), *Neogobius melanostomus* (Pallas, 1814) and *Ponticola kessleri* (Günther, 1861), are globally recognized as invasive species (HAERTEL *et al.*, 2012; PIRIA *et al.*, 2011a, b; NEILSON & STEPIEN, 2009; COPP *et al.*, 2005). Also among these species is *Neogobius fluviatilis* (Pallas, 1814), first recorded in Croatia in 2005 in the Danube River (POLAČIK *et al.*, 2008) and later recorded at other several localities in Croatia (JELIĆ *et al.*, 2012; PIRIA *et al.*, 2011b, 2013). Additionally, three more expanding goby species, *P. kessleri*, *N. melanostomus* and *Neogobius gymnotrachelus* (Kessler, 1857) were added to the list of the Croatian fauna (POLAČIK *et al.*, 2008), all recorded for the first time also in 2005 in the Croatian section of the Danube River. Two species were later recorded in the inland part of the country: *P. kessleri* in the Sava and Drava Rivers (JELIĆ *et al.*, 2012; PIRIA *et al.*, 2011b; ČALETA *et al.*, 2010;), *N. melanostomus* in the Sava River (PIRIA *et al.*, 2011a). In Bosnia and Herzegovina *N. fluviatilis* and *P. kessleri* (NEDIĆ *et al.*, 2014; SOFRADŽIJA, 2009) were recorded of goby species.

The original range of *Neogobius fluviatilis* (Pallas, 1814) comprises the lagoons and rivers of the Black Sea basin (MILLER, 2003). In the Danube River basin, the limit for its distribution used to be the Djerdap Gorge (ROCHE *et al.*, 2013), which appeared to have represented a physical barrier to its further movement upstream. However, in 1965, when the Djerdap Reservoir was built and the barrier disappeared, this species was recorded more upstream (BĂNĂRESCU, 1970). In the following forty years the species expanded very rapidly through numerous European rivers: it was recorded in Hungary (AHNELT *et al.*, 1988), Serbia (e.g. DJIKANOVIĆ, 2013; SMEDEREVAC *et al.*, 2011; SIMONOVIĆ *et al.*, 1996; JANKOVIĆ *et al.*, 1987), Poland (GRABOWSKA and GRABOWSKI, 2005), Austria (WIESNER, 2005), Netherlands (van KESSEL *et al.*, 2009), Bosnia and Herzegovina (e.g. NEDIĆ *et al.*, 2014; SOFRADŽIJA 2009) and Croatia (e.g. JELIĆ *et al.*, 2012; PIRIA *et al.*, 2011b, 2013).

This study represents new records of the *N. fluviatilis* for Bosnia and Herzegovina and Croatia. Additionally, we present the expansion of this species in these areas, as well as the fish community compositions in the investigated localities inhabited with *N. fluviatilis*.

MATERIAL AND METHODS

The fish samples were collected at one locality on the Una River (N45°13'37.4'', E16°31'48.1'', 108 m a.s.l.) (as the river determines the border between Croatia and Bosnia and Herzegovina, the samples were taken on the Croatian side of the border: on the left river bank in Hrvatska Kostajnica, as well as on the right river bank in Bosanska Kostajnica on the Bosnian side of the border) on August 25 and September 26 and 27, 2008. One locality was sampled on the Kupa River (in Brest, Croatia: N 45°27'23.1'', E 16°15'6.67'', 96 m a.s.l.) on July 9, 2006, August 25, October 25 and 31, 2008.

The Kupa River, with its length of 296 km and the Una River, 212 km long, are right tributaries of the Sava River, belonging to the Black Sea basin. Sampling localities were



Fig. 1a. *Neogobius fluviatilis*, specimen collected on the Kupa River; **1b.** Brest, locality on the Kupa River.

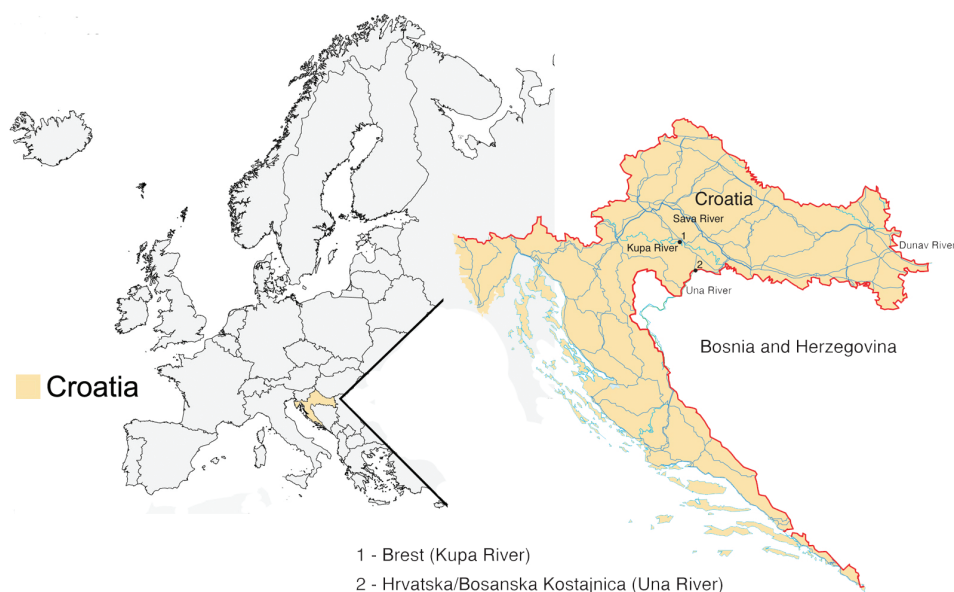


Fig. 2. Localities on the Kupa and Una Rivers where *Neogobius fluviatilis* was collected.

situated on the lower reaches of the rivers: approximately 30 km away from the Una River mouth into the Sava River in Jasenovac and 15 km away from the Kupa River mouth in the Sava River in Sisak. Sampling of the material was done by electrofishing (300/500 V; 7.38 A; 1.3 KW). After identification, collected specimens were released back into the river. *N. fluviatilis* species identification was done according to the following morphological features: first branched ray of second dorsal twice as long as penultimate ray, nape completely scaled, no black spot in first dorsal (KOTTELAT & FREYHOF, 2007). Also, for all collected *N. fluviatilis* specimens, the total body length, from the tip of the snout to the end of the caudal fin rays, was measured. Other fish specimens collected on the Una River were identified using standard literature: KOTTELAT & FREYHOF (2007), MRAKOVČIĆ *et al.* (2006), VUKOVIĆ & IVANOVIĆ (1971) and VUKOVIĆ (1977). Systematics and taxonomy followed KOTTELAT & FREYHOF (2007).

RESULTS AND DISCUSSION

The studies on the fish fauna of two rivers in Croatia, the Una and Kupa, were conducted in 2006 and 2008. On the September 26 and 27, 2008, at the locality Bosanska Kostajnica on the Una River, two specimens of the invasive fish *N. fluviatilis* were recorded. The same year, on October 31, ten more specimens of the species were collected at the locality Brest on the Kupa River. These localities represent new data concerning the distribution of *N. fluviatilis* in Bosnia and Herzegovina (locality Bosanska Kostajnica) and Croatia (locality Brest). As the Una River represents the frontier between Bosnia and Herzegovina and Croatia, the data on the new finding of the species in the river, could be considered also as new information on the species distribution in Croatia. The finding of a very small specimen (about 4 cm long) of *N. fluviatilis* on the Una River is very interesting and valuable since it indicates the real possibility of the species' successful reproduction in this area.

According to the published data and our results, *N. fluviatilis* so far inhabits seven rivers in the inland part of Croatia (the Danube, Drava, Ilova, Korana, Kupa, Kupčina and Sava) and was recorded at approximately 15 localities ((PIRIA *et al.*, 2013, 2011b; JELIĆ *et al.*, 2012; POLAČIK *et al.*, 2008). In Bosnia and Herzegovina, this species has been recorded only in the Sava River (NEDIĆ *et al.*, 2014). Thus, with combined data from the two countries, Croatia and Bosnia and Herzegovina, *N. fluviatilis* was recorded in a total of eight rivers in the area: the Danube, Drava, Sava and several rivers from the Sava drainage basin (the Ilova, Korana, Kupa, Kupčina, and Una).

According to the data on *N. fluviatilis* distribution in Croatia (JELIĆ *et al.* 2012; PIRIA *et al.*, 2011b, 2013), it could be suggested that the species is expanding its range in two main directions from the Danube River: via two inland rivers in the inland part of Croatia, the Drava River in the north (JELIĆ *et al.*, 2012) and the Sava River in the south (PIRIA *et al.*, 2013, 2011b). The species has probably expanded its distribution to the Una River from the Sava River. Apart from indicating the successful reproduction of *N. fluviatilis* in the researched area, the finding of the juvenile specimen in the Una River also implies the possibilities of the further expansion of the species' distribution in Bosnia and Herzegovina and Croatia. This was already noticed in several other studies (NEDIĆ *et al.*, 2014; PIRIA *et al.*, 2013, 2011b; JELIĆ *et al.*, 2012).

Records on the Una River are the southernmost in this part of the Balkan Peninsula. The most westerly locality of the Balkan Peninsula distribution is located in Croatia on the Korana River (PIRIA *et al.*, 2013).

The specimens of *N. fluviatilis* captured in the Una River were collected from habitats with combined muddy and sandy bottoms with abundant aquatic macrophytes with *Ceratophyllum* sp. domination and slower water current. Sandy or muddy bottom habitats are known to be typical for the species (e.g. PIRIA *et al.*, 2011b; KOTELLAT & FREYHOF, 2007), while some other species of the genus *Neogobius* (e.g. *N. kessleri*, *N. melanostomus*) prefer habitats with rocky bottoms and well developed vegetation (KOTELLAT & FREYHOF, 2007). Habitat conditions of the *N. fluviatilis* in the Kupa River at Brest were similar to those in the Una River: muddy bottom with aquatic macrophytes with *Polygonum* sp. Domination and slower water current. At both sampled localities on the Una and Kupa Rivers, water depth did not exceed 1 m.

During the fish sampling on the Una, apart from *N. fluviatilis*, 18 other fish species were recorded: *Alburnoides bipunctatus* (Bloch, 1782), *Alburnus alburnus* (Linnaeus, 1758), *Barbus balcanicus* Kotlík, Tsigenopoulos, Ráb & Berrebi, 2002, *Barbus barbus* (Linnaeus, 1758), *Chondrostoma nasus* (Linnaeus, 1758), *Cyprinus carpio* Linnaeus, 1758, *Phoxinus phoxinus* (Linnaeus, 1758), *Rhodeus amarus* (Bloch, 1782), *Rutilus rutilus* (Linnaeus, 1758),

Rutilus virgo (Heckel, 1852), *Squalius cephalus* (Linnaeus, 1758) (family Cyprinidae); *Cobitis elongata* Heckel & Kner, 1858, *Cobitis elongatoides* Băcescu & Maier, 1969, *Sabanejewia balcanica* (Karaman, 1922) (family Cobitidae); *Silurus glanis* Linnaeus, 1758 (family Siluridae); *Esox lucius* Linnaeus, 1758 (family Esocidae); *Thymallus thymallus* (Linnaeus, 1758) (family Thymallidae); *Lota lota* (Linnaeus, 1758) (family Lotidae).

During our research into the Kupa River (at the locality Brest) (BUČAR *et al.*, 2010; DELIĆ *et al.*, 2003, 2009, 2014; personal communication: M. Bučar), the following 29 fish species were recorded: *Abramis brama* (Linnaeus, 1758), *A. alburnus*, *A. bipunctatus*, *Aspius aspius* (Linnaeus, 1758), *B. balcanicus*, *B. barbatus*, *Carassius gibelio* (Bloch, 1782), *C. nasus*, *C. carpio*, *Gobio obtusirostris* Valenciennes, 1842, *Leuciscus idus* (Linnaeus, 1758), *Pseudorasbora parva* (Temminck & Schlegel, 1846), *R. amarus*, *Romanogobio vladykovi* (Fang, 1843), *R. rutilus*, *R. virgo*, *S. cephalus*, *Tinca tinca* (Linnaeus, 1758), *Vimba vimba* (Linnaeus, 1758) (family Cyprinidae); *C. elongata*, *C. elongatoides*, *S. balcanica* (family Cobitidae); *S. glanis* (family Siluridae); *E. lucius* (family Esocidae); *Lepomis gibbosus* (Linnaeus, 1758) (family Centrarchidae); *Gymnocephalus cernua* (Linnaeus, 1758), *Perca fluviatilis* Linnaeus, 1758, *Sander lucioperca* (Linnaeus, 1758), *Zingel streber* (Siebold, 1863) (family Percidae). Species *P. parva* and *L. gibbosus* are not native to European waters, and most probably the population of *C. gibelio* neither (see KALOUS *et al.*, 2012; RYLKOVÁ *et al.*, 2013).

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