ЮБИЛЕЙНА НАУЧНА КОНФЕРЕНЦИЯ ПО ЕКОЛОГИЯ (СБОРНИК С ДОКЛАДИ)
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DISTRIBUTION OF GOBIID SPECIES (GOBIIDAE, PISCES) IN THE YANTRA RIVER (DANUBE BASIN, BULGARIA)

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Abstract: Recently, a rapid spread of some species of family Gobiidae upstream the Danube River and its tributaries has been observed. The distribution of gobiid species in the Yantra River (Danube tributary in Bulgaria) was studied. Four gobiid species (out of six species occurring in the Danube) were recorded: *Neogobius fluviatilis, N. gymnotrachelus, N. melanostomus*, and *Proterorhinus marmoratus*. Most frequently occurred *N. melanostomus* reaching as far upstream as Petko Karavelovo. It was followed by *N. gymnotrachelus* reaching as far upstream as Polsko Kosovo, and *P. marmoratus*, upstream to Petko Karavelovo. *N. fluviatilis* was found only at the site near Krivina not far from the river estuary. Most abundant were *N. melanostomus* and *N. gymnotrachelus*. The former dominated at sites upstream of Byala, while the latter at sites close to estuary. The potential reasons for the range expansion of gobiid species upstream the Yantra River were discussed.

Key words: Invasive species, gobies, frequency of occurrence, abundance, Yantra River

INTRODUCTION

Six gobiid species with Ponto-Caspian origin have been reported in the Bulgarian-Romanian section of the Danube River: *Benthophilus stellatus*, *Neogobius fluviatilis, N. gymnotrachelus*, *N. kessleri*, *N. melanostomus* and *Proterorhinus marmoratus* (DRENSKY, 1948, 1951, BANARESCU, 1964, MARINOV, 1978, KARAPETKOVA & ZIVKOV, 1995, VASSILEV & PEHLIVANOV, 2005). In the past, most of these species occurred extremely rarely and in very low number (DRENSKY, 1948, 1951, BANARESCU, 1964, MARINOV, 1978), two of them (*B. stellatus* and *N. kessleri*) being even listed in the Red Data Book of Bulgaria (BOTEV & PESHEV, 1985). Recent studies, however, showed that *N. fluviatilis, N. kessleri* and *N. melanostomus* were among the fish species with the highest frequency of occurrence and abundance in the

migrating ichthyoplankton (VASSILEV, 1994) and in the shoreline zone of the Bulgarian section of the Danube River (POLACIK *et al.*, 2008a).

In the latest decades, the four *Neogobius* species, which are native in the Lower Danube, increased considerably their range upstream to the Middle and Upper Danube and its tributaries (AHNELT *et al*., 1998, SMEDEREVAC *et al*., 2001, ERŐS *et al*., 2005, JURAJDA *et al*., 2005, WIESNER, 2005, POLACIK *et al*., 2008b). Moreover, their densities appeared to be much higher in the non-native distribution area compared to native range (POLACIK *et al*., 2008b). *P. marmoratus* which is considered a post-glacial immigrant in the Upper Danube has also been constantly expanding its range within the Danube tributaries and Central Europe (AHNELT, 1989, AHNELT *et al*., 1998, HARKA *et al*., 2006).

In the Bulgarian Danube tributaries in the past, Drensky (1951) reported only two gobiid species *N. fluviatilis* and *N. melanostomus*. Later, KARAPETKOVA (1994) and KARAPETKOVA & ZIVKOV (1995) did not find *N. melanostomus* and reported the occurrence of *N. fluviatilis* in the lowest reaches of all Danube tributaries to the East of Tsibritsa River, *N. gymnotrachelus* in the lowest reaches of the rivers Ogosta, Vit, Yantra and Rusenski Lom, and *N. kessleri* in the rivers Vit and Yantra. The species *B. stellatus* and *P. marmoratus* were recorded only in the estuary of the Ogosta River (KARAPETKOVA, 1994). VASSILEV & PEHLIVANOV (2005) also reported the findings of the four *Neogobius* species in the lowest reaches of the Danube tributaries. Most recent studies confirmed the occurrence of 3 *Neogobius* species and *P. marmoratus* in the Danube tributaries in the North-West Bulgaria, as well as Yantra and Rusenski Lom rivers (MIHOV & KOEV, 2006, TRICHKOVA *et al*., In press). Moreover, the goby species reached quite far upstream the Danube tributaries (e.g. *N. fluviatilis* as far upstream as Pisanets in Beli Lom; *N. gymnotrachelus*, *N. melanostomus* and *P. marmoratus* as far upstream as Byla in the Yantra River (MIHOV & KOEV, 2006).

So, the goal of the present work was to study the species composition and distribution of gobiid fishes in one of the biggest Danube tributaries, the Yantra River.

MATERIALS AND METHODS

The Yantra River is 285 km long (the third longest Bulgarian tributary of the Danube). It ranks second in catchment area after the Iskar River reaching 7 862 km². The river rises from the northern foot of Hadzhi Dimitar Peak in Central Stara Planina Mountains at an altitude of 1 340 m a.s.l., and it flows into the Danube close to Vardim Village. In its middle and lower course, the river makes many turns forming numerous gorges. It has a high convolution coefficient 3.1 and its catchment is characterized with a small mean slope value 4.6 ‰. The mean altitude of the whole catchment is 470 m a.s.l. The biggest tributaries are Rositsa River (164 m long), Zlatarishka River, Stara Reka, etc. (MARINOV, 1957).

Sampling was carried out at totally 28 sites in the Yantra River and its tributaries as follows: 11 sites in the Yantra River; 8 sites in Rositsa River basin; 3 sites in Dryanovska River; 2 sites in Zlatarishka River; one site in Stara Reka and one in Golyama Reka rivers.

The sampling was conducted in the period 3-8 August 2007. Standard river morphometric and water physico-chemical parameters were measured (Table 1). Bottom substrate type was determined at every sampling site. The fish were collected by single pass electrofishing using electrofishing appliance with double insulation, FEG 5000 (manufactured by EFKO – Elektrofischfanggerate GmbH, Germany 2000) having an output of 150-300/300-600 V. A mean fish sampled length at site was 90 m. All goby specimens collected were fixed in alcohol and later processed at the laboratory. Standard length and weight were measured using a calliper and electronic balance to the nearest 0.1 mm and 0.1 g, respectively. Frequency of occurrence of each species and catch per unit effort (CPUE – number of fishes per 100 m electrofishing, ZALEWSKI, 1985) at every site were calculated.

Table 1. *List of sampling sites in the Yantra River, where gobiid species were caught: river morphometric and water physico-chemical characteristics.*

Site and Site No.	Distance from Danube km	River width m	Depth m	Water Velocity m/s	Water Temp. °C	Conductivity, µS/cm	pH	Bottom Substrate
1. Yantra near Krivina Village	5	30–35	0.5-0.8	0.2-0.4	26.7	590	7.5-8.0	Silt
2. Yantra near Beltsov Village	25	78	0.4 (Max.1)		27.6	578	7.5-8.0	Boulders, gravel, silt
3. Yantra downstream Byala Town	60	45	1	0.7-0.8	26.8	585	7.5-8.0	Gravel, sand
4. Yantra near Polsko Kosovo Village	70	45 (Max.48)	1.5	Approx.1	25.6	557	8.0	Gravel
5. Yantra near Petko Karavelovo Village	100	70	1.5	0.8	23.9	480	6.5	Gravel, sand

RESULTS AND DISCUSSION

Totally four gobiid species were recorded at five sampling sites in the lower reaches of the Yantra River (Tables 1 and 2, Fig. 1). The river morphometric and water physico-chemical characteristics of the sampling sites, where gobies were found are presented in Table 1. River width ranged from 30 to 78 m and depth from 0.4 to 1.5 m. Water velocity was in the range from 0.2 to 1 m/s; conductivity from 480 to 590 µS/cm and pH from 6.5 to 8.0. Gravel and sand dominated at upstream sites and silt at downstream sites (Table 1).

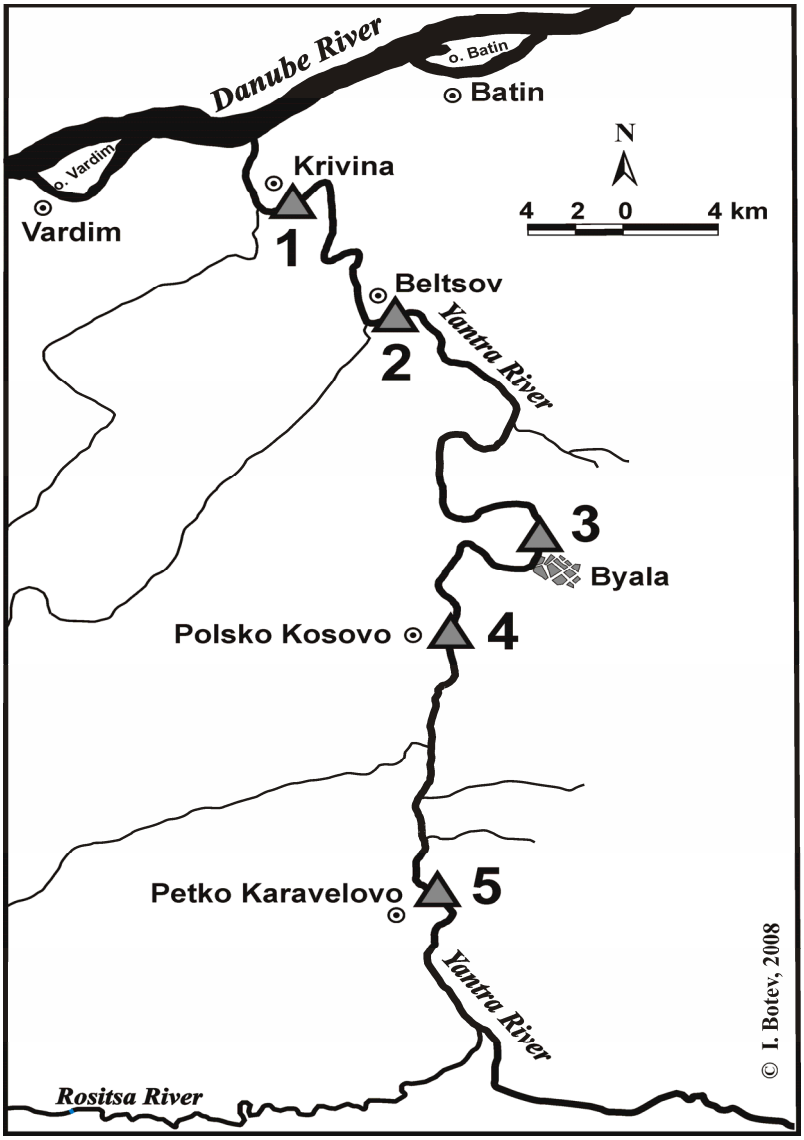

Fig. 1. *Scheme of sampling sites in the Yantra River, where gobiid species were caught.*

Table 2. *Gobiid species recorded in the Yantra River in August 2007 with ranges of their standard lengths and weights.*

Species Code	Species	Standard Length, mm	Weight, g
Nf	Monkey goby *Neogobius fluviatilis* (Pallas, 1811)	22.9–76.4	0.1–5.1
Ng	Racer goby *Neogobius gymnotrachelus* (Kessler, 1857)	25.6–53.6	0.2–2.4
Nm	Round goby *Neogobius melanostomus* (Pallas, 1814)	28.6–104.6	0.3–25.0
Pm	Tubenose goby *Proterorhinus marmoratus* (Pallas, 1814)	27.0–39.2	0.2–1.0

The three *Neogobius* species and *P. marmoratus* caught were represented by juvenile as well as by adult individuals. The ranges of their standard lengths and weights are given in Table 2. Most frequently found gobiid species was *N. melanostomus* which occurred at 17.86% of all 28 sites sampled (Fig. 2). It was followed by *N. gymnotrachelus* (at 14.29% of sites) and *P. marmoratus* (at 10.71% of sampled sites). The rarest was *N. fluviatilis* which was found only at one site (3.57%) (Fig. 2). The accompanying fish fauna was dominated by *Alburnus alburnus, Romanogobio albipinnatus* and *Leuciscus idus* in the Yantra near Krivina and by *Barbus petenyi, Squalius cephalus* and *Rhodeus amarus* at upstream sites.

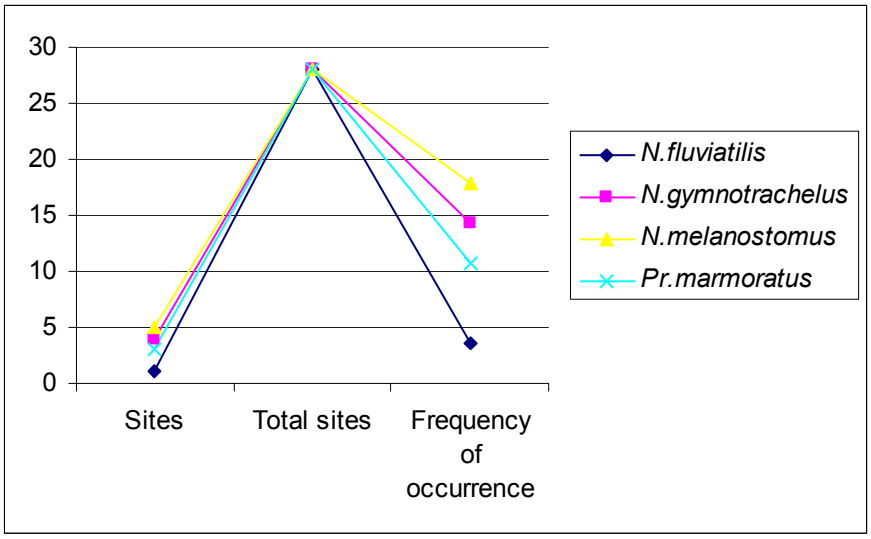

Fig. 2. *Frequency of occurrence of gobiid species in the Yantra River.*

The occurrence of *N. fluviatilis* in the Yantra River was reported already by DRENSKY (1951). In the 1960s, KARAPETKOVA (1972, 1994) found a few specimens of *N. fluviatilis* and *N. kessleri* in the estuary of the Yantra River at about 300 m from the confluence with the Danube. KARAPETKOVA & ZIVKOV (1995) reported on the occurrence of *N. fluviatilis, N. gymnotrachelus* and *N. kessleri* in the lowest reaches of the Yantra River. First records of *N. melanostomus* and *P. marmoratus* in the river were reported by MIHOV & KOEV (2006). They found four gobiid species: *N. fluviatilis* reaching as far upstream as Tsenovo (about 30 km far from the Danube), and *N. gymnotrachelus*, *N. melanostomus* and *P. marmoratus* as far upstream as Byala (about 60 km from the Danube) (MIHOV & KOEV, 2006). One year later, our results confirmed the occurrence of these species: *N. fluviatilis* occurred in the river lowest reaches (near Krivina, about 5 km from the Danube), *N. gymnotrachelus* as far upstream as Polsko Kosovo (about 70 km), while *N. melanostomus* and *P. marmoratus* reached as far upstream as Petko Karavelovo (about 100 km). Although *P. marmoratus* reached quite far upstream, it was not recorded at the two most downstream sites near Krivina and Beltsov. So compared to previous studies in the Yantra River, in recent years, only small advancement of *N. fluviatilis* upstream occurred; *N. kessleri* was not found; and two new gobiid species appeared *N.*

melanostomus and *P. marmoratus,* which together with *N. gymnotrachelus* expanded their range 70-100 km upstream from the confluence with the Danube.

Most abundant in the Yantra near Krivina was *N. fluviatilis* followed by *N. gymnotrachelus* (Table 3). The latter had very high relative abundance at Beltsov as well, but its number decreased considerably at upstream sites. The species *N. melanostomus* was very abundant at the site near Byala and the most abundant compared to other gobies at the upstream sites (Table 3). *P. marmoratus* had comparatively low number at all sites, with highest abundance at Petko Karavelovo. The highest relative abundance for the whole river was shown by *N. melanostomus*. In September 2006, MIHOV & KOEV (2006) reported *N. gymnotrachelus* as most frequently occurring and most numerous species, especially in the Yantra near Byala. It was followed by *N. melanostomus*. Most likely, these differences are determined by the natural fluctuations of species abundance within different seasons and years.

Table 3. *Catch per unit effort (CPUE, number of gobiid species per 100 m electrofishing) at different sampling sites.*

Site No	Site length m	CPUE			
		Nf	Ng	Nm	Pm
1	115	9.65	6.96	2.61	0
2	50	0	32	16	0
3	93	0	1.08	38.71	1.08
4	87	0	2.30	4.60	1.15
5	128	0	0	7.03	4.69

Recent studies showed that compared to other Danube tributaries in Bulgaria, the highest number of gobiid species (four) has been recorded in the Yantra River. For example, three species were reported in the North-West Bulgarian tributaries Vidbol, Archar, Lom and Ogosta (TRICHKOVA *et al*., In press). Most frequently found in these rivers was *P. marmoratus*, followed by *N. fluviatilis* occurring mainly in the river lowest reaches and *N. melanostomus* found in the lowest reaches of Archar and Ogosta. In September 2005, *N. fluviatilis* was found in the Vit River (near Riben) and Osam River (near Muselievo) (unpublished data). In the easternmost tributary Rusenski Lom, again only *N. fluviatilis* was recorded but reaching as far upstream as Ivanovo (about 35 km from the Danube) and up to Pisanets in the Beli Lom River (MIHOV & KOEV, 2006). The comparative results showed that *N. fluviatilis* was the most frequently encountered gobiid species in the Bulgarian Danube tributaries but its distribution is restricted to the river lowest reaches, except in the Rusenski Lom River. The other gobiid species also occurred in the lowest reaches of Danube tributaries with the exception of the Yantra River, where *N. gymnotrachelus, N. melanostomus* and *P. marmoratus* expanded their range 70-100 km upstream from the confluence with the Danube.

Different factors were discussed to facilitate the range expansion of the gobiid species in the Danube basin: the general change in character of the Danube as a result

of river regulation, gradual increase in the mean annual and seasonal water temperatures as well as ballast water transport (COPP *et al*., 2005, JURAIDA *et al*., 2005, WIESNER, 2005). Our recent study supported the hypothesis of disjunct spreading of *Neogobius* species in the Danube attributed to the transport of population-founding individuals via ships moving upstream (POLACIK *et al*., 2008b). Most likely, the spread and increase in number and range of gobiid species in the Yantra River was also facilitated by human activities, such as: river regulation, sand and gravel excavation works, activities of fishermen, etc. As benthic fish species, the occurrence and abundance of gobies are to a great extent dependant on the type of substrate. For example, in the Danube, *N. fluviatilis* was more abundant in area with beaches covered by a fine substrate both in native and non-native range, while *N. gymnotrachelus* and *N. melanostomus* appeared to occur at higher relative densities along shelter-providing shorelines in native range and among rocks and rip-rap habitats in non-native range (ERŐS *et al*., 2005, JURAIDA *et al*., 2005, POLACIK *et al*., 2008b). At the same time, *P. marmoratus* demonstrated high plasticity in meso-habitat use (ERŐS *et al*., 2005). These substrate preferences can partly explain the occurrence of *N. fluviatilis* in the lowest reaches of the Yantra River near Krivina where the bottom substrate was silt, and this of *N. gymnotrachelus, N. melanostomus* and *P. marmoratus* at upstream sites dominated by gravel and sand (Table 1). Some species-specific traits such as reproductive and food patterns, low parasite loads relative to native species, aggressive behaviour, especially of *N. melanostomus*, etc. (SIMONOVIC *et al*., 2001, CORKUM *et al*., 2004, GRABOWSKA, 2005, KAKAREKO *et al*., 2005, ONDRACKOVA *et al*., 2005, ADAMEK *et al*., 2007) might have also contributed to the invasion success of the gobiid species in the Yantra River. Further studies on distribution and invasive biology of gobiid species with respect to the potential impact on the native ichthyofauna in the Yantra River and other Danube tributaries in Bulgaria are necessary.

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РАЗПРОСТРАНЕНИЕ НА ВИДОВЕТЕ РИБИ ОТ СЕМ. GOBIIDAE В Р. ЯНТРА (ДУНАВСКИ БАСЕЙН, БЪЛГАРИЯ)

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(Резюме)

През последните години се наблюдава широко разпространение на видовете риби от сем. Gobiidae нагоре по течението на р. Дунав и притоците ѝ. Поради това е изследвано разпространението на попчетата в един от дунавските притоци р. Янтра. От общо 6 вида срещащи се в р. Дунав, в р. Янтра са установени 4: *Neogobius fluviatilis, N. gymnotrachelus, N. melanostomus* и *Proterorhinus marmoratus*. Най-често срещан е *N. melanostomus*, който достига нагоре по течението до Петко Каравелово, следван от *N. gymnotrachelus,* срещащ се до Полско Косово и *P. marmoratus* до Петко Каравелово. *N. fluviatilis* е намерен само до Кривина в най-долното течение на реката. С най-голяма численост са *N. melanostomus* и *N. gymnotrachelus*. Първият доминира на местата нагоре от Бяла, а вторият в близост до устието. Дискутирани са вероятните причини за разширяване на ареала на попчетата нагоре по течението на р. Янтра.