Research Article

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A Weight-length Relationship of the Amur Sleeper (*Perccottus glenii* Dybowski, 1877) (Odontobutidae) in the Danube River Drainage Canal, Serbia

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Abstract: The Amur sleeper (*Perccottus glenii*), an indigenous species to the Russian Far East, northern China and the northern part of the Korean Peninsula, is an invasive alien species to European waters. It may have negative impact on eggs and larvae of native fish species, aquatic macroinvertebrate and larval amphibians. There were few findings of the Amur sleeper specimens in Serbia during 2001-2003, while the first record of established population was in the Danube River flood plain (1139 river km) in 2005. Our study included 85 specimens from the Danube River canal near Veliko Gradište, Serbia, caught in two consecutive years (November 2015 and October 2016), with the aim to assess the weight-length relationship of this population. Body length of specimens ranged from 35.78 mm to 140.68 mm, while body weight ranged from 0.5 g to 40 g. The age of specimens was 0+, 1+ and 2+. Length-weight analysis did not show differences between regression slopes of samples from the two years, with *b* values of 3.317 and 3.113 for 2015 and 2016, respectively.

Key words: Introduced species, *Perccottus glenii*, Danube River, weight-length relationship, age structure

Introduction

One of the main threats to biodiversity are invasive species (Clavero & García-Berthou 2005, García-Berthou 2007), so there is an increasing interest in data, which can attribute to their control and management (Nehring & Steinhof 2015). The Amur sleeper (*Perccottus glenii* Dybowski, 1877) is a species indigenous to the Russian Far East, north-eastern China and the northern part of the Korean Peninsula (Koščo et al. 1999). Numerous authors provide information on the species introduction and current distribution in waters of central and eastern Europe (Harka 1998, Koščo et al. 1999, Gergely & Tucakov 2004, Jurajda et al. 2006, Ćaleta et al. 2011). For the fisrt time the Amur sleeper was recorded in Serbia in 2001, from the Jazovo fish pound (Gergely & Tucakov 2004). Catch of single specimens was reported at two localities in the Danube River, near Vinci (Šipoš et al. 2004) and Vajuga (Simonović et al. 2006), at 1047 and 903 river km, respectively. However, the first record on establishment of a local population in the Danube River flood plain (near Ivanovo, 1139 river km) was by Hegediš et al. (2007). The lack of precise information about the occurrence and abundance of the Amur sleeper is probably due to the difficulty of conducting field research in small water bodies heavily overgrown with vegetation, where the species most often occurs (Rechulicz et al. 2015). However, some probabilistic models provide preliminary, rapid assessment of its range (Jarić et al. 2012), while models based on large-scale bioclimatic variables (Reshetnikov & Ficetola 2011) effectively predict the invasion of this species.

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Since the Amur sleeper is not a strong swimmer and it occurs in water bodies that either have a weak current or are stagnant with well-developed vegetation (Bogutskaya & Naseka 2002), its population establishment in flood zones may have negative impact on eggs and larvae of economically important fish species that spawn in these types of habitats (Hegediš et al. 2007). Complete elimination of the eggs, larvae and juveniles of crucian carp (*Carassius carassius*) (Bogutskaya & Naseka 2002) and considerable decrease in species richness of aquatic macroinvertebrates and larval amphibians (Reshetnikov 2003), are side effects of the Amur sleeper presence. Additionally, it prefers to consume pike (*Esox lucius*), crucian carp, perch (*Perca fluviatilis*) and wild carp (*Cyprinus carpio*) among other fish species in fish culture ponds (Bogutskaya & Naseka 2002).

One of the useful tools that helps in the calculation of the standing crop biomass and prediction of weight required in yield assessment is the weight-length relationship (WLR) (Morey et al. 2003). Additionally, the WLR allows fish condition factor to be determined and used for between-regions life-history comparison and ontogenetic changes (Safran 1992, Petrakis & Stergiou 1995). The WLR of individuals in a fish population is regarded as a basic tool used in fisheries science and management for assessing natural populations (Tsoumani et al. 2006, Britton & Davies 2007). Its values can give us information about a specific population, irrespective of individual variation, and thus gives an idea of condition and fitness of population (Verreycken et al. 2011).

The aim of the present study was to assess the weight-length relationship of an Amur sleeper population from the Danube River canal in Serbia. These data can be further used to compare with other populations of the Amur sleeper within the species native and invasive range.

Materials and Methods

During a 2015-2016 survey, 85 specimens of the Amur sleeper were caught by electrofishing (220V, 8.5A) in the Danube River canal (N 44°45′03.26″; E 21°28′53.40″) near Veliko Gradište (1060 river km). Two samples, from November 2015 (n=35) and October 2016 (n=50), were caught in the densely overgrown with submerged vegetation canal at 1.3 m depth, after a total fishing time of 90 minutes on catching surface of about 200 m^2. The specimens were stored in 95% ethanol until examination.

The total body length (TL) was measured with an electronic digital caliper (0.1 mm) and body weight was measured using a digital scale (0.1 g). The samples were grouped in 10 mm interval length classes and their percentage distribution was analysed. The scales for age analysis were taken from the left flank at the level of the second dorsal fin. They were read under a dissecting stereomicroscope with reflected light by three operators. Additionally, the catch per unit effort (CPUE) was calculated as fish individuals per 1 square m (ind. m^{-2}).

The relationship between the length (L) and weight (W) of a fish was expressed by the equation $W = aL^b$, which was converted into its logarithmic expression $\log W = \log a + b \log L$. The parameters a and b were calculated using the least-square regression, as was the coefficient of determination (r^2). Additionally, the difference between the two regression slopes was tested by a t-test at the 0.05 significance level.

Results and Discussion

The total body length of the studied specimens ranged from 35.78 mm to 140.68 mm, while the body weight ranged from 0.5 g to 40 g. The length values are in concordance with the values (30-145 mm) reported by Nehring & Steinhof (2015) for the Amur sleeper populations in the Upper Danube River. However, they differ from those of the Amur sleeper in its native range (72-106 mm and 33-116 mm) reported by Liu et al. (2013) and Huang et al. (2014), respectively. In our study, the average values of the total body length and weight were 76.6±22.9 mm and 6.7±6.9 g, respectively. The average total body length and weight in November 2015 were 75.7±26.6 mm and 7.2±9.7 g, respectively, whereas, in October 2016, they were 77.2±20 mm and 6.4±4 g, respectively.

The analysis of the percentage distribution of length classes was based on 10 mm interval classes, starting with 30.1-40.0 mm up to 140.1-150.0 mm. The highest percentage of specimens (37%) caught in November 2015 was in the length class of 50.1-60.0 mm. It was followed by the length classes of 60.1-70.0 mm (14%), 70.1-80.0 mm and 80.1-90.0 mm (11% each), 110.1-120.0 mm (9%), 110.1-120.0 mm (6%), and 40.1-50.0 mm, 90.1-100.0 mm, 100.1-110.0 mm and 140.1-150.0 mm (3% each). The highest percentage of specimens (26%) caught in October 2016 was in the 80.1-90.0 mm length class. It was followed by the length classes of 70.1-80.0 mm (22%), 90.1-100.0 mm and 100.1-110.0 mm (12%), 30.1-40.0 mm and 50.1-60.0 mm (8%), 40.1-50.0 mm (6%), 60.1-70.0 mm (4%) and 110.1-120.0 mm (2%).

Table 1. Percentage distribution of age classes in the Amur sleeper (*Perccottus glenii*) from the Danube River canal, Serbia, caught in November 2015 and October 2016. The number of analysed specimens is 23

Length classes	November 2015			October 2016			Both years		
	Age classes								
	0+	1+	2+	0+	1+	2+	0+	1+	2+
30.1-40 mm				22.2%			8.7%		
40.1-50 mm	7.1%			11.1%			8.7%		
50.1-60 mm	21.6%						13%		
60.1-70 mm	14.3%						8.7%		
70.1-80 mm		7.1%						4.4%	
80.1-90 mm		14.3%			22.2%			17.3%	
90.1-100 mm					22.2%			8.7%	
100.1-110 mm			7.1%			11.1%			8.7%
110.1-120 mm			14.3%			11.1%			13%
120.1-130 mm			7.1%						4.4%
130.1-140 mm									
140.1-150 mm			7.1%						4.4%

The scale analysis of 23 individuals showed that nine specimens were 0+, seven were 1+ and seven 2+. The length distribution of different age classes is given in Table 1.

The data show that the samples, which were 0+ were distributed in the length classes below 70 mm, while 1+ samples were in the length classes between 70 mm and 100 mm, and 2+ samples were above 100 mm (Table 1). Therefore, we can assume that 54% of all specimens from November 2015 were predominantly 0+, 25% of the specimens were 1+ and 21% of them were 2+. In the samples from October 2016, 26% of all specimens were 0+, 60% of them were 1+ and 26% were 2+. According to Zhigileva & Kulikova (2016), the specimens of 2+ age class have a TL of 140-150 mm and weight of 50-55 g. Our data showed that 2+ specimens had a TL of 103-140 mm and weight of 11.8-40 g, which is more in line with the 2+ specimens (TL 101.6 mm) as reported by Simonović et al. (2006).

The CPUE in the samples from November 2015 and October 2016 were 0.175 and 0.250, respectively. These values are lower than the CPUE value (0.38) for the Amur sleeper in the Vistula River oxbow, while they are similar to those (0.12) reported for the Wieprz River oxbow (Rechulicz et al. 2015). An increasing trend (43%) in the abundance between the two consecutive years in the Danube River canal in Serbia is evident. Additionally, the samples of the Amur sleeper from November 2015 were accompanied by four pikes, three rudds (*Scardinius erythrophthalmus*), seven roaches (*Rutilus rutilus*), six tenches (*Tinca tinca*), five goldfish (*Carassius auratus*), seven bleaks (*Alburnus alburnus*), and four pumpkinseeds (*Lepomis gibbosus*). With the same fishing effort, the samples of the Amur sleeper from October 2016 were accompanied by three pikes, two rudds, four roaches, seven tenches, five goldfish, five bleaks, and three pumpkinseeds. The CPUE for November 2015 and October 2016 fish community (excluding the Amur sleeper) were 0.180 and 0.145, respectively. Since the Amur sleeper can have a dramatic impact on freshwater communities (Reshetnikov 2003), the decrease in the abundance of the fish community at the sampling site may be attributed to the increase in the abundance of the Amur sleeper, however, it may be due to many other factors.

In the samples from November 2015 and October 2016, the WLR parameters *a* and *b*, the standard error of the slope and the coefficient of determination, r^2 were determined. Both regressions were highly significant ($P<0.05$). The *b* values for November 2015 and October 2016 samples were 3.317 and 3.113, respectively. The recorded *b* values fall within the range of 2.5-3.5, which is considered to be common (Froese 2006). Our results were higher than the values reported for the Amur sleeper in its native range (2.6-3.08) (Liu et al. 2013, Huang et al. 2014) and those for populations in European waters (2.94-3.08) (Grabowska et al. 2011, Nyeste et al. 2017).

The *a* values in the samples from November 2015 and October 2016 were 0.000000265 and

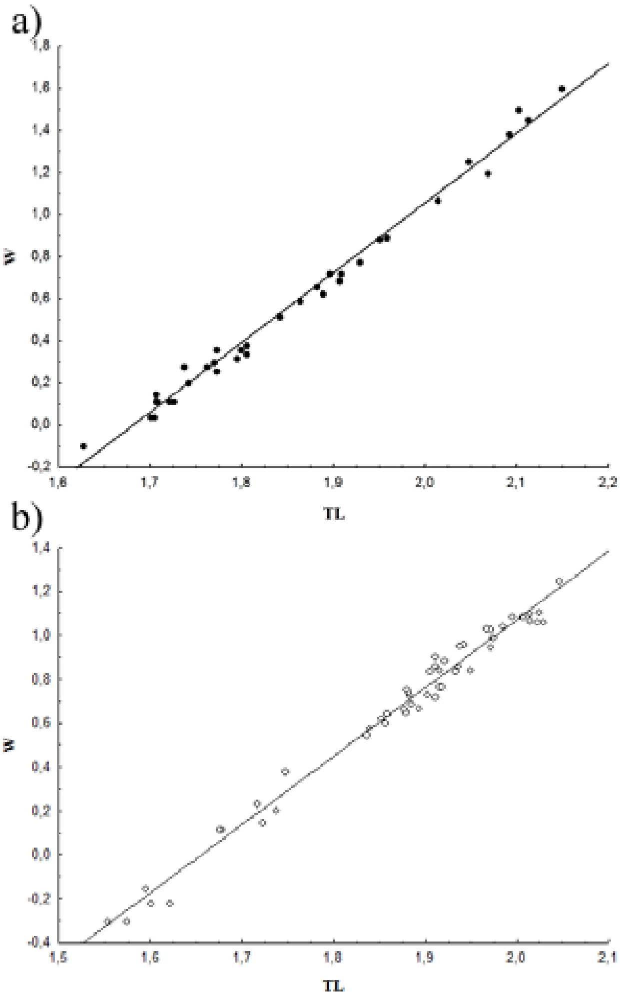

Fig. 1. Scatter plot of the weight-length relationship in the Amur sleeper (*Perccottus glenii*) from the Danube River canal, Serbia. a) November 2015, b) October 2016; W – weight; TL – total length

0.000000701, respectively, while r^2 values were 0.99 and 0.984, respectively (Fig. 1). The *t*-test (0.461) showed that there was no significant difference in the slopes of the two regression lines. Although there was no significant difference between *b* values for the two consecutive years, a certain decline in *b* (0.2) was recorded in October 2016. According to Ricker (1975), differences between different years for the same population could be associated with their nutritional condition. The observed decline in *b* could be attributed to a higher level of competition for food resources indicated by the increased population density of the Amur sleeper. The same age structure for two consecutive years and the increase in the abundance of the Amur sleeper, suggested that this was a recently established population.

This research provides useful information for strategies aimed to stop and manage the Amur sleeper dispersal in newly occupied water bodies. Also, it showed the dynamics in recently established populations of this species, which could be useful for the prevention of the invasion of this species. Additionally, as Nehring & Steinhof (2015) suggest, eradication or control of the Amur sleeper populations may be possible in small isolated systems (ponds and oxbows) if actions are taken soon after detection of the species. However, there is a need for future monitoring and research of this invasive alien species, which is still in the process of non-native range expansion in Serbia.

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