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The expansion and occurrence of the Amur sleeper (*Perccottus glenii*) in eastern Slovakia

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A b s t r a c t . The Amur sleeper, *Perccottus glenii* Dybowski, 1877, is indigenous in eastern Asia. During the second half of the 20th century, with the aid of man, it spread over the eastern part of Europe as well as in central Asia. In the course of 50 years of its dispersal in the western direction the species already reached the Vistula drainage area (the Baltic Sea basin) and the Danube drainage area (the Black Sea basin). In the latter basin, its occurrence was ascertained in the drainage area of the Tisza river in Hungary in 1997. In eastern Slovakia, the Amur sleeper was first recorded in 1998 in the Latorica drainage area. In the course of subsequent years it has become a common species in the streams in the basins of the Latorica, Bodrog and Tisza rivers. In shallow lentic waters densely grown with aquatic plants the species becomes a superdominant or even exclusive species in the local fish communities. It has no marketable value but presents a serious threat to the existence of native fish species with similar identical microhabitat requirements.

Key words: *Perccottus glenii*, exotic species, invasion, Tisza river basin

Introduction

In an absolute majority of cases, both intentional and unintentional introduction or invasion of an exotic fish species causes a risky contamination of indigenous ichthyofauna. As a rule, the presence of one or several exotic taxa exerts a permanent, direct or indirect, negative influence on the native species, as has been widely demonstrated for fishes (A l l e n d o r f 1991, R o s s 1991, E f f o r d et al. 1997, C r i v e l l i 1995, H o l č í k 1991). In most cases, the introduction of an exotic species will not remain limited to the initial hydrological area into which it had been introduced. Often the species will gradually spread uncontrolled over a large territory. Any attempt at preventing the exotic element from spreading or even removing it from the biota it had invaded has failed.

After the non-indigenous form, *Carassius auratus,* had expanded over the Danube river basin in the second part of the 20th century (H o l č í k & Ž i t ň a n 1978, L u s k et al. 1998), we are now witnessing the expansion of several species of the genus *Neogobius* (A h n e l t et al. 1998, Z w e i m ü l l e r et al. 1996, K a u t m a n 2001, S t r á ň a i & A n d r e j i 2001, H o l č í k 2002, etc.). In recent years, *Ictalurus melas* (K o š č o & K o š u t h 2002) and *Perccottus glenii* Dybowski, 1877, a species hitherto unknown in central Europe, have recently occurred and spread in eastern Slovakia (the Tisza drainage area).

Perccottus glenii is indigenous to the Russian Far East, north-eastern China, and the northern part of the Korean Peninsula (B e r g 1949, N i k o l s k y 1956, K i r p i c h n i k o v

1945, Elovenko 1981, Bogutskaya & Naseka 2002). In the course of the 20th century, two introductions into the European part of Russia were recorded. The first introduction took place in St. Petersburg in 1912. There, after having been temporarily kept in aquaria, the species was released into small ponds and occurred in free waters in their environs. Subsequently, the species gradually spread over the drainage area of the Gulf of Finland (Dmitriev 1971, Panov et al. 1999). The second introduction took place in Moscow in 1948 when the species was imported by the participants of the Amur Expedition. After having been kept in aquaria and having become popular among the aquarium keepers, the Amur sleeper was released into nature. Then it began spreading over the hydrological system of the Moscow river and the upper part of the Volga river basin (Spanovskaya et al. 1964). Apparently, this second introduction was the onset of a gradual occupation of the range in the European part of Russia and its dispersal westwards. Its further spread over both the Asian part of Russia, the Baikal area, Kazakhstan, Uzbekistan, Turkmenistan and the eastern part of Europe and, in recent years, even the White Sea and the Arctic Ocean basins is connected with transports of stocking materials of various fish species in which the Amur sleeper was an undesired admixture (Litvinov & O'Gorman 1996, Elovenko 1981, Bogutskaya & Naseka 2002). Around 1980 the European range of the Amur sleeper was limited to the environs of St. Petersburg, the drainage area of the Oka river (Moscow region) and the middle part of the Volga river basin (Elovenko 1981). At present the species is dispersed over practically the whole European part of the former Soviet Union, and it is spreading westwards. In Poland the Amur sleeper was first recorded in the Vistula river (the Baltic Sea basin) in 1993 (Antychowicz 1994). Over of subsequent years it has spread into the middle reaches of the Vistula, including its floodplains and tributaries (Terlecki & Palka 1999). Kozlov (1993) reports the species from the Don river, Bogutskaya & Naseka (2002) from the Dnieper river. Korte et al. (1999) found the Amur sleeper to be a dominant fish species in the upper reaches of the Dniester river basin in Carpathian Ukraine. The first finds of the species in the Danube river system come from the Tisza river basin in Hungary (Harka 1998), in Carpathian Ukraine from the Latorica drainage area (Moshu & Guzun 2002), and in Slovakia from the basins of the Latorica and Bodrog rivers (Košco et al. 1999, Kautman 1999, our own data).

Material and Methods

In 1999–2002 years the occurrence of the Amur sleeper was studied by means of electrofishing, using a gear producing pulsating electrical current, 170–250 V, 0.5–3.5 A. The fish caught in the localities under study were determined down to species and released. For later examinations, samples of fish were preserved in 5 % formaldehyde (food, growth), 80 % ethyl alcohol (growth, biometrics), frozen (genetic analyses) or kept live (karyology analysis). The species diversity index (H') was calculated according Shannon & Weaver (1949) using binary logarithms. The documentary material is deposited in the collections of the Department of Ecology, Prešov University, Slovakia.

Results and Discussion

In Slovakia the Amur sleeper was first found for in August 1998 in a pool near Kamenná Moľva in the floodplain of the Latorica river (Košco et al. 1999). Kautman (1999)

found the species in April 1999 in the floodplain of the Latorica river, viz., in the Vel'ké plytčiny and Brestovisko channels near the village of Boťany, and in the Leleský channel near the village of Leles. In July 1999, we caught the Amur sleeper in several places in the floodplain of the Latorica river. During our subsequent investigations carried out in August 1999, we found the species even in the dead river branches of the Bodrog river.

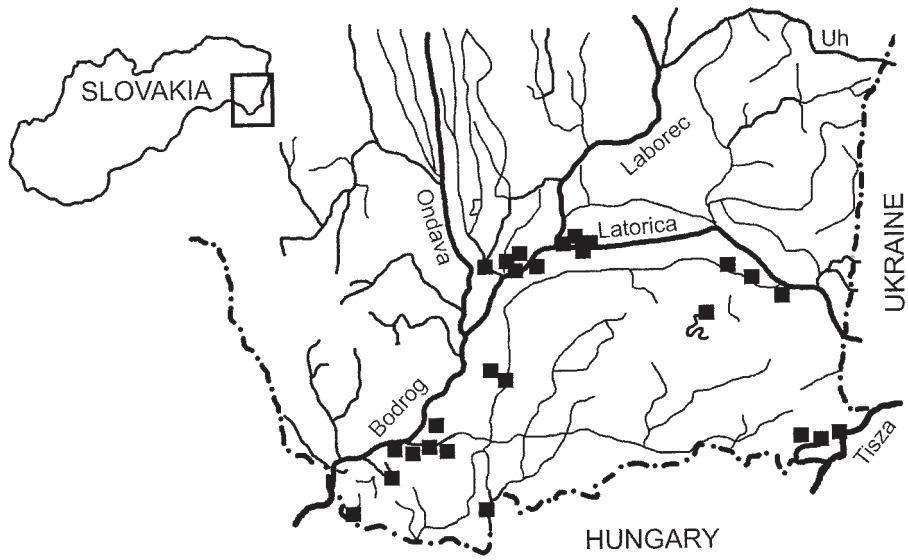

Fig. 1. Localities of evidenced occurrence (■) of *Perccottus glenii* in the Latorica, Bodrog and Tisza drainage areas, eastern Slovakia.

Intense investigations implemented in 2001 and 2002 in the Bodrog, Latorica and Tisza drainage areas, eastern Slovakia, have shown that the Amur sleeper had become a common species in the hydrological systems of those rivers (Fig. 1). In shallow lentic waters of various habitats (gravel pits, channels, backwaters), densely grown with aquatic vegetation (*Stratiotes aloides, Myriophyllum spicatum, Ceratophyllum demersum, Elodea canadensis, Nuphar luteum, Typha latifolia),* the species was dominant in the local fish communities in a number of places. Such microhabitat types harbour minimum numbers of fish species *(Esox lucius, Perca fluviatilis)* reported as important predators of the Amur sleeper (B o g u t s k a y a & N a s e k a 2002). This is fully confirmed by our own observations: in localities with the greatest abundance of the Amur sleeper we would usually find only occasional individuals of *E. lucius*, less than 150 mm in standard length. The share of the Amur sleeper in samples of fish taken in the localities under study increases significantly with increasing surface of the habitat grown with aquatic vegetation. Habitats with high dominance of the Amur sleeper show rather low species richness and low species diversity (H') of the fish community (Table 1). The representation of the Amur sleeper in the fish community in a locality is significantly dependent upon the degree to which it is grown with aquatic vegetation ($R=0.97$, $F=177.7$, $p<0$). Likewise, the number of fish species present decreases significantly with increasing grown-up area ($R=0.86$, $F=34.5$, $p < 8^{-5}$), the same as their species diversity H' ($R=0.87$, $F= 36.2$, $p< 6^{-5}$). The number of fish species in the locality examined decreases with increasing share of the Amur sleeper ($R=0.81$, $F=22.1$, $p<51^{-4}$).

Table 1. Occurrence of the Amur sleeper in various localities of eastern Slovakia in 2001–2002.

Locality (year)	Habitat type	Grown-up surface (%)	Species richness	No. fish captured (n)	Share of *P. glenii* (%)	H'	E
Svätá Mária (2002)	channel backwater	80 %	5	469	95.3	0.35	0.06
Karča-V. Kamenec (2001)	river arm	0.5%	17	363	4.1	3.18	0.78
Karča-V. Kamenec (2002)	river arm	0.5%	16	484	0.6	2.96	0.74
Hranice-Streda n.B. (2001)	channel	35%	12	363	19,0	2.63	0.73
Hranice-Streda n.B. (2002)	channel	40%	11	153	39.2	2.55	0.74
Somotor (2001)	channel	15 %	10	229	0.9	2.27	0.68
Somotor (2002)	channel	15 %	17	284	2.5	3.52	0.86
Kamenná Moľva (2002)	channel	70 %	9	74	71.6	1.60	0.505
Kamenná Moľva (2002)	3 gravel pits	5 %	17	677	0.9	2.36	0.59
Tisa-M.Trakany (2001)	lakes	10 %	14	197	2.5	2.74	0.68
Tice – Leles (2002)	old backwater	95%	2	205	82.9	0.66	0.66
Kapoňa (2001)	backwater	10 %	9	93	2.1	2.35	0.74
Kapoňa (2001)	gravel pit	45 %	10	147	51,0	2.15	0.65
N.Vieska-Somotor (2001)	old backwater	40%	9	295	33.9	2.03	0.64

The highly probable source of the Amur sleeper in eastern Slovakia is the upper part of the Latorica drainage area, lying in the territory of Ukraine. The occurrence of this species in the Latorica basin near the town of Chop, Carpathian Ukraine, is reported in an editorial attached to the article by Moshu & Guzun (2002) as well as by Litvinchuk & Borkin (2002). Likewise, Kautman (1999) refers to oral information on the occurrence of the Amur sleeper in the same region. Considering the ecological characteristics of this species, which is not a good swimmer, it may be expected that it will spread mainly from localities lying upstream to those lying in lower parts of the river basin. Usually, the occurrence of a new species will be observed with some time delay from its first penetration into the drainage area, the species having already reproduced and occurring in greater numbers. The rather abundant occurrence of this species which, moreover, shows a widespread occurrence in the Latorica and Bodrog drainage areas, as demonstrated in 1999 and 2000, would suggest that it had invaded the Latorica drainage area prior to 1998. One may assume that it was the 1998 floods that contributed to the rapid occupation of the

wide areas of the Latorica and Bodrog drainage areas. In that way the species got even to the original floodplain lying behind the levees. Its rapid spread over the Latorica, Bodrog and Tisza floodplains was also facilitated by the local amelioration channel system. General observations on a rapid spread of this species over the Vistula drainage area have been reported by Terlecki & Palka (1999), and over the Volga and Don by Bogutskaya & Naseka (2002). The later spread of the species over the Tisza river basin shows an identical course, the common occurrence of which has also been reported from Serbia, besides that in Hungary (Gergely 2002, Harka & Farkas 2001). The occupation of a river basin is significantly accelerated by high water levels and the connected floods, as also reported by Elovenko (1981) and as was the case of the Bodrog and Tisza drainage areas in eastern Slovakia.

According to our observations, the Amur sleeper in the Tisza riverine system, eastern Slovakia, is currently confined, to the Latorica, Bodrog and Tisza drainage areas, including their floodplains and the connected amelioration channel systems (Fig. 1). So far, we have not ascertained the presence of this species in the lower reaches of the Ondava and Laborec rivers (tributaries to the Bodrog river). This fact also tends to support the hypothesis that the species will spread chiefly in a downstream direction within a river drainage area. With regard to the amelioration channel network in the original floodplains along the lower reaches of the Laborec and Ondava rivers, one may expect that the Amur sleeper may penetrate even those areas in the next few years.

The causes why the Amur sleeper is spreading beyond its range are unambiguously connected with man's activities. At first, there were intentional introductions of this interesting species (St. Petersburg 1912, Moscow 1948). Some of the introductions were connected with utilising the Amur sleeper as a predator of mosquito larvae. A considerable number of introductions were unintentional, the Amur sleeper being introduced together with stocking materials of other fish species as their undesired admixture. This consideration even includes the transport and release of this species by amateur fishermen, and one cannot overlook even the probable releases of this species from aquarium cultures. At any rate, the fact that the species has overcome the barriers between river basins is connected with man's activities (Harka & Sallai 1999). For a review of literature on the various aspects of dispersal of the Amur sleeper, see Bogutskaya & Naseka (2002).

What will be the further occurrence of this species in Slovakia? It may be supposed that through natural migration the Amur sleeper will gradually invade the drainage areas of the lower reaches of the Ondava and Laborec rivers. Its further spread to additional streams in the Tisza river basin (the Slaná and Hornád rivers) and further on, eventually to the Danube basin (western Slovakia) through natural migration, is problematical. A much greater probability is seen in the species spreading through unintentional introduction with the stocking material of other fish species, as was the case in the past, e.g. with the dispersal of *Carassius auratus* or *Pseudorasbora parva.* Nor can a transfer by intentional activity of fishermen be ruled out (bait fish). The Amur sleeper is also suitable for aquarium culture (Machlin 1957, Schenke & Grambow 1965) and therefore one cannot exclude the possibility of the species being released into nature from aquarium cultures. The rapid colonization of the Latorica, Bodrog and Tisza river basins in the territory of Slovakia by the Amur Sleeper in the course of the past 4–5 years was invasive in character. The Amur Sleeper shows several biological and ecological properties that are typical of the so-called invasive fish species. Its reproduction capacity is high (portional spawning, the male

guarding the spawned eggs), it is resistant to high water eutrophication, including lack of oxygen. It is even capable of surviving when frozen in ice, or near drying up. It ingests animal food of all kinds, including smaller fish and amphibian larvae (Kirpichnikov 1945, Sokolov 2001, Bogutskaya & Naseka 2002).

Amur sleeper is of no positive economic importance. It attains a maximum of 250 mm in total length and up to 250 g in weight but the vast majority of populations consists of individuals less than 120 mm in total length (Berg 1949, Reshetnikov 2000). In some places it is the object of sport angling (Dmitriev 1971, Verin 1978, Shlyapkin & Tikhonov 2001, Naumenko 2002). The initial intention to utilise this species in the control of mosquitoes did not bring any significant results (Kirpichnikov 1945). The Amur sleeper presents a serious threat to the existence of a number of native fish species that show identical microhabitat requirements (stagnant waters densely grown with aquatic plants). As regards food, the Amur sleeper is characterised as a potential predator (Spanovskaya et al. 1964). The diet of the Amur sleeper consists of aquatic invertebrates of all sizes, besides larvae and smaller-sized fish and even amphibians. The predation of the Amur sleeper on other fish species, including individuals of its own species as well as fish eggs, is described on a general level by a number of authors (Kirpichnikov 1945, Nikolsky 1956). Shlyapkin & Tikhonov (2001) reported on a total disappearance of *Leucaspius delineatus* by this species in smaller reservoirs. Likewise, introduced into reservoirs harbouring a single-species fish stock of *Carassius carassius,* the Amur sleeper liquidated all individuals smaller than 40 mm in size (Reshetnikov 2000). In the diet of Amur sleepers older than one year, living in the Baikal Lake basin as well as in the Volgograd Dam Lake, fish eggs and small-sized fish formed a significant share (Litvinov & O'Gorman 1996, Naumenko 2002). Likewise, the trophic competition of the Amur sleeper, considering its voraciousness and capability to produce very numerous populations, is a negative aspect in relation to native fish species (Litvinov & O'Gorman 1996). Here it is necessary to point out that a diet composition similar to that of the Amur sleeper is also found in *Umbra krameri* (Libosvárský & Kux 1998). For this species showing similar microhabitat requirements, the Amur sleeper is a deadly threat even as a predator. The devastation action of the Amur sleeper has been demonstrated even against amphibian larvae and adults (Manteifel & Bastakov 1986, Reshetnikov 2000, 2001, Kautman 1999). We have observed that being captured, individual Amur sleepers regurgitated swallowed individuals of their own species up to 40 mm in size. In aquarium environment, individual Amur sleepers 70–90 mm in total length were observed to prey on goldfish up to 45 mm in total length.

For some fish species native to central Europe (*Umbra krameri, Leucaspius delineatus, Carassius carassius, Rhodeus amarus* and the larvae of other species), the Amur sleeper presents a real threat both as regards trophic competition and as a predator. Pains should be taken to prevent incidental transport of the Amur sleeper with stocking materials of other fish species to further river basins.

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