

The occurrence and status of species of the genera *Cobitis*, *Sabanejewia*, and *Misgurnus* in Slovakia

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Abstract. In Slovakia, *Cobitis elongatoides* (Bacescu et Mayer, 1969), *Sabanejewia balcanica* (Karaman, 1922), and *Misgurnus fossilis* (Linnaeus, 1758) are protected by national legislative, and localities of European importance have been delimited for these species within the Natura 2000 system. In Slovakia, the three species only occur in the Black Sea river system (the Danube and Tisza R. basin). Of them, *C. elongatoides* is the most widely distributed and most numerous both in its pure form and its hybrid, diploid-polyploid complexes (*C. elongatoides* x *C. tanaïtica*). It occurs in proper streams and in natural as well as in artificial aquatic habitats, above all, in lowland regions. Comparing data on this species from 1955–1965, no major changes have been found. *S. balcanica* occurs chiefly in the middle reaches of rivers, first of all, in the Bodrog drainage area (the Laborec, Ondava, Topľa R.) in eastern Slovakia. In the western part of Slovakia (the Danube river system) the occurrence of this species is distinctly less frequent and insular. The distribution of the species has been markedly affected by water pollution, construction of dams and reservoirs, and river bed modifications. The occurrence of *M. fossilis* is almost exclusively limited to the lowland regions of eastern Slovakia and the Danube Lowland. In those regions, the amelioration measures taken during the second part of the 20th century caused the original natural wetlands to vanish – together with the occurrence of this species. However, *M. fossilis* found a secondary suitable environment in man-made hydro-amelioration channels, earth pits, and fishponds.

Key words: Danubian spined loach, weather loach, Balcan spiny loach, occurrence, Tisza basin, Danube basin, devastating factors

Introduction

In recent years, the family Cobitidae has become the object of intense investigations, as also indicated by the fact that three species from this family were the topics of three international conferences (Brno 1999, Olsztyn 2002, and Šibenik 2006). The data obtained and the application of karyological and genetic analyses fundamentally changed the previous ideas of the taxonomy of the genera *Cobitis* and *Sabanejewia* (Bohlen & Ráb 2001, Perdices et al. 2003, Lusková et al. 2004, Bartoňová et al. 2008, Papoušek et al. 2008). The fact that most cobitid species are protected by the national legislatures of the particular countries as well as by that of the European Union has emphasized the conservation viewpoint. It appears that knowledge of the distribution and present status of populations, including the precise taxonomic identity of species of this family in concrete regions is

required both for conservation purposes and for clarifying the phylogenetic and colonisation processes. Detailed data on the distribution of cobitid species have been reported in recent years from several countries (e.g., Lusk et al. 2000, Mrakovčić et al. 2000, Pováž & Šumer 2000, 2003, Delič et al. 2003, Erős et al. 2003). No synoptic paper is available in Slovakia on the actual distribution and status of populations of the particular cobitid species. Very detailed data (dating from 1957–1964) are available on the occurrence of these species in Slovakian rivers (Kux & Weisz 1964, Kux 1964), permitting a comparison with their present status. Partial data on the distribution and taxonomic status of the cobitid populations investigated were presented by Lusk et al. (2003) and Lusková et al. (2004). Koščo et al. (2006) present actual data on the occurrence of cobitid species in a part of the Tisza River basin. In the presented paper, we present an overview of the distribution of *C. elongatoides* and its hybrid populations, *S. balcanica* and *M. fossilis* in Slovakia. The data presented here have also been utilized in selecting localities of European importance within the Natura 2000 system in Slovakia.

Material and Methods

Most of the territory of Slovakia (96%) belongs to the Black Sea river system and only a small part (4%) in the north of the country, comprising the headwaters of the Poprad and Dunajec rivers (the Vistula R. basin), belongs to the Baltic Sea river system. The hydrological system belonging to the Black Sea can be divided into two regions, see the Tisza R. and the Danube R. basins. The occurrence and population status of the species under study was related to the particular basins of the so-called skeleton rivers (Fig. 1). In the present study, we have based on our own data obtained in the course of the past 20 years largely by electro-fishing. A 5–9 mm mesh size net was only used in deeper stagnant waters. We also utilized preliminary data on the occurrence of the species under study, recently published by other authors (Černý & Kvaszová 1998, Stráňai et al. 1999, 2001, Hajdú & Kováč 2002, Chynoradský & Kováč 2002, Holčík 2003). Literary data utilized in graphic comparisons with the past (Figs 2–4) are listed in faunal textbooks by Oliva et al. (1968) and Baruš, Oliva et al. (1995), also including citations of original papers. For comparing the present status with the one in the concrete streams 40–50 years ago, we utilized data published by Kux & Weisz (1964) and in the unpublished PhD thesis by Kux (1964)



Fig. 1. Skeleton rivers of the hydrographic network of Slovakia.

Results and Discussion

Cobitis spp.

The territory of Slovakia harbours populations belonging to *Cobitis elongatoides* (Bacescu et Maier, 1969), and populations showing a hybrid diploid-polyploid character. According to our earlier investigations (Lusk et al. 2003, Lusková et al. 2004), pure populations of *C. elongatoides* occur only in the Slaná, Bodva and Hornád river basins (in the western part of the Tisza basin). The eastern part of the Tisza basin (the Bodrog and Tisza proper) and the Danube basin are inhabited by hybrid diploid-polyploid complexes showing the basic composition *Cobitis elongatoides* x *Cobitis tanaitica*. Of the species under study, *C. elongatoides* and its hybrid complexes occupy the widest range. Their present occurrence is mainly concentrated in lowland regions in the SW and SE parts of Slovakia (Fig. 2).

In the Tisza River basin, *C. elongatoides* mainly occurs in the lowlands of SE Slovakia (the Bodrog, Latorica, and Tisza basins, Fig. 2). There it is common in small streams, hydroamelioration channels, disconnected oxbows, and earth pits, but also in the main streams as long as they contain loamy deposits. In the basin of the Ondava River (a tributary to the Bodrog R.), this species ranges far northward up to its headwaters, because of their lying low above the sea-level. The low gradient of the river almost all along its length permits the development of micro-habitats (fine sand-loamy sediments) that are necessary for the occurrence of cobitids. A similar situation is found in the lowland part of the Uh River basin. In other important streams in the Bodrog basin – the Topľa and Laborec rivers, the headwaters of the Uh R. (the Ubl'a and Ulička streams), the occurrence of *C. elongatoides* is insular and occasional.

C. elongatoides also occurs in localities considerably polluted by organic substances downstream of the outlets of waste waters from municipal treatment plants (e.g., the Ondava R. below Svidník, the Trnávka R. below Sečovce, the Topľa R. below Bardejov). In such localities, we observed high numbers and participation (up to 40 % of populations) of *C. elongatoides* in the total abundance of fish communities.

In the western part of the Tisza basin (the Hornád, Bodva, and Slaná rivers), the frequency of occurrence of *C. elongatoides* is distinctly lower than in its eastern part (Table 1). The occurrence of this species is concentrated in the lowland per southward of Košice

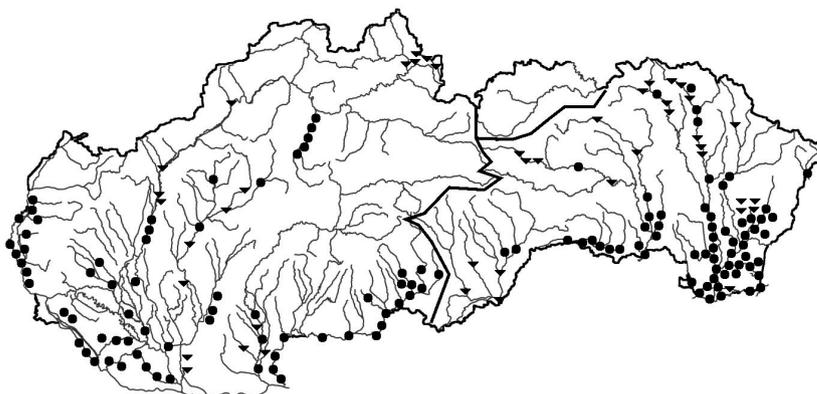


Fig. 2. Present occurrence (● 1995–2005) in historical and new localities and present absence in historical localities (▼ 1955–1964) of *Cobitis* spp. in Slovakia.

(Fig. 2). There the species occurs in canalised lowland streams (the Turňa, Belžanský, and Sartoš streams) as well as in hydro-amelioration channels (Perinský, Komárovský, Gombošský ch.), K o š č o et al. (2004)

In the Danube basin, *C. elongatoides* is common both in its easternmost part (the Ipel' basin) and in the Danube proper. It is less frequent in the lower reaches of its tributaries, the Hron, Nitra, and Váh rivers) It is abundant in the Morava R. where its occurrence reaches up to the middle reaches of that river (L u s k et al. 2000, L u s k o v á et al. 2004). In the Danube Basin, *C. elongatoides* occurs in the major streams (provided that they contain suitable habitats) and, above all, in various waters in their floodplains and the adjacent lowlands. Historical data only are available on its occurrence in marginal localities, particularly in headwaters. In most cases, the occurrence of the species could not be confirmed.

The occurrence of *Cobitis* spp., the same as of *Sabanejewia balcanica* and *Misgurnus fossilis*, has never been documented in waters belonging to the Baltic Sea system (the Dunajec, Poprad, and additional small streams) in the north of Slovakia (K u x & W e i s z 1960, K o š č o & K o š u t h 1999).

Compared to the past, particularly the 1955–1964 period (K u x 1964), we could only observe minor changes in the distribution of *C. elongatoides*. The populations of this species vanished in parts of streams flooded by large dam basins (Domaša, Zemplínská Šírava, Ružín in the Tisza Basin; Orava in the north of the Danube basin). In lowland regions, the destruction of suitable localities, due to hydro-amelioration measures, was compensated chiefly by the dense network of amelioration channels where *C. elongatoides* could find favourable environmental conditions. In regions where fragmentary populations remained preserved (the Ondava, Váh, Hron, Hornád, and Laborec rivers), the disappearance of devastating influences (e.g., water pollution) was followed by restored occurrence of *C. elongatoides*. However, the disappearance of this species from the headwaters is permanent as a rule. L u s k et al. (2000) observed a similar situation in the Dyje and Morava basins in the Czech Republic.

Basing on our own results, we do not consider *C. elongatoides* (both poor and hybrid populations) to be endangered in the territory of Slovakia. Save for exceptions (see above), its occurrence is limited by the presence of a suitable environment. In lowland regions

Table 1. Localities investigated (N) with assumed occurrence of *Cobitis elongatoides* (*C.e.*), *Sabanejewia balcanica* (*S.b.*), and *Misgurnus fossilis* (*M.f.*), and percentages (%) of positive ones in the basins of major streams in Slovakia in 1995–2005.

Drainage area of river	Locality <i>C.e.</i> - N	Positive <i>C.e.</i> (%)	Locality <i>S.b.</i> - N	Positive <i>S.b.</i> (%)	Locality <i>M.f.</i> - N	Positive <i>M.f.</i> (%)
Bodrog	361	30.2	361	20.8	260	31.2
Hornád	134	11.9	134	6.0	32	12.5
Bodva	62	22.6	62	1.6	26	15.4
Slaná	25	28.0	25	12.0	11	18.2
Total Tisza	582	25.1	582	14.9	329	27.7
Ipel'	81	35.8	81	9.9	78	1.3
Hron	91	9.9	91	3.3	18	5.5
Nitra	79	10.1	79	5.1	79	8.9
Váh	83	18.1	83	14.5	68	13.2
Danube	99	28.3	99	14.1	57	35.1
Morava	97	23.7	97	3.1	81	22.2
Total Danube	530	21.1	530	11.8	381	14.7

that offer suitable conditions (especially in SE Slovakia), *C. elongatoides* is among the dominant components of the local ichthyocoenoses. Within the Natura 2000 system, a total of 17 localities “of European importance” were selected for *C. elongatoides*. The species is protected by national Slovakian legislation (Intimation no. 24/2003). In the Red List of Fishes of Slovakia, the species is listed as *Cobitis taenia* and is evaluated as “Near Threatened” (H e n s e l & M u ž í k 2001).

Sabanejewia balcanica

In their study, P e r d i c e s et al. (2003) included most populations, occurring in the Danube basin, in the Danubian-Balcanian complex of *Sabanejewia*. Phylogenetic analyses, based on the variability of cytochrome *b* gene in samples taken from 6 populations in Slovakian rivers, have shown that the individuals examined belong to sublines III and IV of the complex mentioned. On the basis of analytical results, the populations under study have been evaluated as members of *Sabanejewia balcanica* (B a r t o ň o v á et al. 2008). This species is the rarest as regards its occurrence in Slovakia. Its occurrence (i.e. the extent and number of positive localities) shows an unambiguous increasing trend from the west (the Danube basin) to the east (the Tisza basin) (Fig. 3). Compared to *C. elongatoides*, *S. balcanica* is distinctly more sensitive to organic pollution.

In the eastern part of the Tisza basin, *S. balcanica* occurs only in streams, producing stable and locally even very numerous populations in suitable localities. In the headwaters of the Uh R. (the tributaries Ublianka, Ulička and Zbojský brook), lying in the territory of Slovakia, *S. balcanica* accounts for over 10 % of the total numbers in the local ichthyocoenoses (K o š č o 1998). In the Uh basin south of the Vihorlat Mts, *S. balcanica* occurs in the Okna tributary. In the Uh River proper, the frequency of occurrence of this species was very low, in only 20 % of the 10 localities investigated due to the heavy pollution of this stream in its Ukrainian part.

S. balcanica is most widely distributed in streams and basin of the Laborec, Ondava, and Topľ'a rivers (Fig. 3). The overall frequency of occurrence in the localities investigated in the Laborec basin is 39.5 %, being absent from the lowland zone, polluted for the time being. Concretely, this pertains to the stream section below Humenné, and from Michalovce

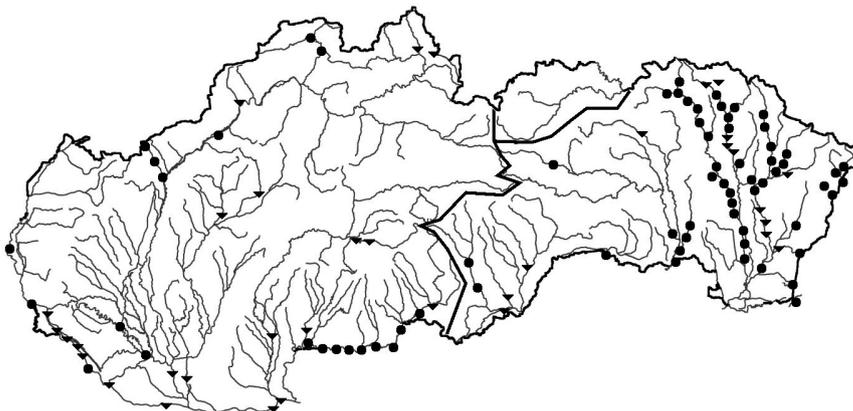


Fig. 3. Present occurrence (● 1995–2005) in historical and new localities and present absence in historical localities (▼ 1955–1964) of *Sabanejewia balcanica* in Slovakia.

down to the mouth. *S. balcanica* is numerous in some localities (over 20 %) both in the main stream and in its tributaries, the Cirocha and Udava streams. A similar situation is found in the Ondava basin. The species is numerous in the submontane region up to 340 m a.s.l. It is absent from sections polluted by waste waters from major town agglomerations (Stropkov, Svidník, Vranov nad Topľou). The occurrence of *S. balcanica* is renewing below the mouth of an unpolluted tributary to the Topľa even though the stream of the Ondava R. already lies in the lowland (110 m a.s.l.). In some localities with suitable substrate, *S. balcanica* accounts for 17 – 19 % of the total abundance of the local ichthyocoenosis. The occurrence of this species was ascertained in a large percentage (62.5 %) of localities investigated on the Ondava River. A comparison of historical data (1955–1965) with the present status indicates that in the Ondava R. the initial distribution of *S. balcanica* has remained unchanged, whereas the percentage of localities showing a positive occurrence of this species has distinctly decreased in the Laborec and Topľa R. (Table 2). In the lowland region of SE Slovakia, *S. balcanica* occurs in the Latorica R. only near the Slovakian-Ukrainian boundary, and it has also been ascertained in the boundary section of the Tisza River (Fig. 3). The species is absent from the Bodrog River.

The occurrence of *S. balcanica* is considerably more limited in the western part of the Tisza basin. In the Hornád sub-basin it occurs in the Olšava tributary, a stream relatively little affected by stream modification (K o š č o & K o š u t h 2002). In the Hornád River itself it only occurs below its confluence with the Torysa River. We were unable to confirm its occurrence in the Torysa R. On the whole, the occurrence of *S. balcanica* is low (6 % from investigated localities), Table 1. In the Slaná basin it only occurs in short sections of minor streams, viz., in the Bodva R. below the mouth of the Ida R., and in the Rimava stream (Fig. 3).

In the western part of Slovakia, belonging to the Danube basin, *S. balcanica* occurs in the Danube itself (Fig. 3). We recorded a more frequent occurrence of this species in the easternmost tributary to the Danube, the Ipeľ River basin. It is distributed both in the submontane region and in the lowland part where the Ipeľ R. forms the boundary with Hungary. There the species occurred in 9.9 % of the localities investigated. Occasional earlier literary data report the occurrence of *S. balcanica* in other tributaries to the Danube – in the Hron and Nitra basins. More data on the actual occurrence of *S. balcanica* are available on the Váh basin where it has been ascertained both in the Váh R. proper (Dubnica nad Váhom) and in its tributaries (the Vlára and Kysuca rivers). The occurrence of *S. balcanica* in the Slovakian part of the Danube basin is insular and its populations are unstable, the cause

Table 2. Changes in the occurrence of *C. elongatoides* and *S. balcanica* in the eastern part of the Tisza basin in 1955–1965 and 1995–2005. N, number of localities investigated; +%, percentage of localities showing positive occurrence of the species.

River	<i>C. elongatoides</i>	<i>C. elongatoides</i>	<i>S. balcanica</i>	<i>S. balcanica</i>
	1955–65 N - +%	1995–2005 N - +%	1955–1965 N - +%	1995–2005 N - +%
Uh	37 – 35.1	38 – 36.8	37 – 5.4	38 – 18.4
Laborec	10 – 0	18 – 27.8	10 – 70.0	18 – 33.3
Ondava	20 – 40.0	16 – 43.7	20 – 63.6	16 – 62.5
Topľa	19 – 15.8	23 – 8.7	19 – 68.4	23 – 39.1
Latorica	8 – 50.0	82 – 32.9	8 – 12.5	82 – 2.4
Bodrog	3 – 66.7	41 – 17.1	3 – 0	41 – 0
Tisza	3 – 66.7	6 – 33.3	3 – 0	6 – 16.7

of which is the fact that this is the western limit of the range of this species. In the past, *S. balcanica* occurred in the Czech Republic only in the Bečva R. basin, a part of the Morava R. basin. That was the westernmost occurrence of the species in the left-hand part of the Danube basin. At present, however, the species occurs there no longer (L u s k et al. 2000).

In the course of the past 50 years, the occurrence of *S. balcanica* suffered the greatest amount of negative changes. The species vanished from a number of minor streams and localities, and even its numbers decreased in comparison with the past ones. In the first place, it was the heavy and extensive water pollution (W e i s z & K u x 1959, 1962, K u x & W e i s z 1964) that caused the species to vanish from many river sections. Thus, for instance, in the eastern part of Slovakia (the Bodrog and Tisza basins), *S. balcanica* occurred in 36.3 % of localities investigated in 1960, as against a mere 15.7 % at present. The representation of this species in the overall abundance of fish communities has markedly decreased as well. For instance, in the Topľa basin, where the species commonly occurs, its representation in identical localities has decreased (K u x 1964) against the present one (from 5.2 to 2.1 %, 11.0 to 0.1 %, 5.0 to 1.7 %, 3.0 to 0.3 %, 4.0 to 9.9 %). The extent of the occurrence of *S. balcanica* has also been decreased by the flooding of river sections by dam reservoirs (Domaša reservoir on the Ondava R., Orava res. on the Orava R.). A distinctly destructive effect is observed of the permanent intensive exploitation of gravel and sand directly in the beds of some of the rivers (Laborec, Topľa).

S. balcanica is protected by the national legislative of Slovakia as an endangered species. In all, 16 localities of European importance, harbouring populations of *S. balcanica*, have been proposed within the Natura 2000 system. In the Red List of Slovakia, the species is listed as “Endangered” (H e n s e l & M u ž í k 2001).

Misgurnus fossilis

Due to the specific environmental requirements of *M. fossilis* (stagnant waters, muddy bottom, stands of aquatic vegetation, high resistance to critical oxygen values), the occurrence of this species is largely limited to the East Slovakian Lowland (the Tisza and Bodrog basins) and to the Danube and Záhorie lowlands (the Danube and Morava basins), Fig. 4. There the species occurs in habitats showing alluvial character in the floodplains of major streams. In eastern Slovakia it is very abundant in the Bodrog and Latorica basins, the lower part of the Ondava R. (13 localities) and the Laborec R. (8 localities) (Fig. 4). However, we have never found it directly in the stream proper. In the regions mentioned, *M. fossilis* occurs in disconnected river branches, channel systems in floodplains, earth pits and, incidentally, fishponds. The largest representation (up to 20 % total abundance) was recorded in hydro-amelioration channels grown with dense aquatic vegetation. Likewise, in the Tisza basin its occurrence is tied with stagnant or slowly running waters with muddy bottom and aquatic vegetation.

In the western part of the Tisza basin, fragmentary populations of *M. fossilis* occur in the lowland region south of Košice, predominantly in hydro-amelioration channels (the Bodva basin) and in fishponds. Also, it occurs in the tributaries to the Hornád R. in its lower reaches flowing through the lowland. The isolated locality of *M. fossilis* in the Slaná R. was destroyed by stream modifications (Fig. 4).

Compared to the past occurrence of *M. fossilis* in the Danube basin, the numbers of this species decreased in, or vanished from, a number of localities. This was the result of water management modifications, above all, in the lowland regions in the basins of major tributaries to the Danube (the Ipeľ, Hron, Nitra, and Váh R.), due to which most natural wetlands dried

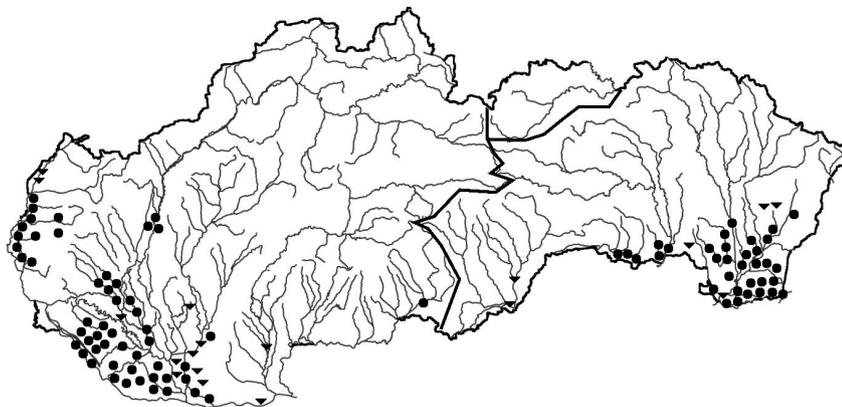


Fig. 4. Present occurrence (● 1995–2005) in historical and new localities and present absence in historical localities (▼ 1955–1964) of *Misgurnus fossilis* in Slovakia.

up. *M. fossilis* found alternative environments in artificial habitats such as channels and earth pits, yet its numbers there are considerably lower than in its original natural habitats whose hydrological regime was mostly affected by floods. A rather large number of localities of this species are found in Žitný ostrov and in the alluvial region of the Morava River (Fig. 4). Within the Natura 2000 system, 23 localities of European importance have been selected for *M. fossilis* in Slovakia. The species is protected by Slovakia's national legislation and in the Red List it is evaluated as "Critically Endangered" (H e n s e l & M u ž í k 2001).

A c k n o w l e d g e m e n t s

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