Distribution patterns and conservation status of the species from genus *Alburnoides* (Pisces, Cyprinidae) in Bulgaria

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Abstract

Analysis of the distribution of all three species from genus *Alburnoides* in Bulgaria is made. The model is generated on the basis of data from real locations, calculated in ArcGIS 10.2. environment and visualized on MGRS UTM 10 km grid maps. Based on the data for the distribution of each species particular conservation implications are proposed.

Keywords: Spurlins, *Alburnoides,* distribution, conservation, Bulgaria.

Introduction

The spurlins from genus *Alburnoides* Jeitteles, 1861 are small fish, which inhabit mainly the middle courses of fast flowing rivers, rich in oxygen. They are widespread in temperate Eurasian rivers and some lakes, part of the basins of North, Black and Sea of Azov as well as in Caspian Sea and middle course of Volga River, south to Kura drainage. They occur also in Amu Darya drainage, part of Aral Sea basin, as well as in the basins of Euphrates and Tigris. In the Mediterranean the distribution covers Rhone and many smaller rivers from France eastward to Genova (Italy). Spurlins could be found also in Drin River, Skadar, Prespa and Ohrid Lakes and some other rivers in Albania, as well as rivers in Eastern part of Balkan Peninsula and Western Anatol, flowing into Aegean and Marmara Seas (Berg, 1949; Bogutskaya & Naseka, 2004; Kottelat & Freyhof, 2007; Roudbar et al., 2016).

It has been considered for long time that genus *Alburnoides* in Europe and parts of Asia is represented by only one species – *Alburnoides bipunctatus*. With the advance of genetic research and modern statistical interpretation of the data, a lot of new taxa inside of the genus have been described last 10 years and nowadays, a total of 32 species are included in *Alburnoides* (Levin et al., 2016).

The spurlin has been reported for the first time in Bulgaria (as *Alburnus bipunctatus*) from the basin of Iskar River (Kovatcheff, 1905; Drensky, 1921). Later, it has been also reported as *Alburnoides bipunctatus* from Treklyanska River, tributary of Struma (Kovatcheff, 1921; 1923). According to Chichkoff (1933) this species is distributed in Iskar, Vit, Ogosta and some other rivers, flowing into Danube River in Bulgaria. The same author found also spurlins in Rezovska River and described them as a new subspecies – *A. b. tzanevi*, which he published also for the ichthyofauna of Kamchia River (Chichkoff, 1934). Later Chichkoff (1940) conducted the first detailed

morphological description of the spurlins in the country. He again listed the specimens from Kamchia River into the subspecies *A. b. tzanevi* and assumes that it occurs also in Veleka River, as well as in some other rivers in East Bulgaria. In the same paper he describes another subspecies – *A. b. strymonicus*, from Mesta and Struma Rivers and gives detailed morphological description of the spurlins from the rivers part of the Danube River basin. He presumes that the subspecies *A. b. strymonicus* should be distributed in Vardar River, where it has been earlier found by Karaman (1924).

According to Drensky (1948) the subspecies *A. b. tzanevi* is a junior synonym of the subspecies *A. b. rossicus,* but he does not provide any evidence to prove it.

Berg (1949) claims that the spurlins from Struma and Vardar Rivers are identical and they should belong to one of the already described subspecies *A. b. fasciatus* or *A. b. smyrnaeus*. According to him the spurlins from Rezovska River belong to the infrasubspecific taxa *A. b. fasciatus* natio *tzanevi*.

According to Drensky (1951) there are three subspecies of spurlins in Bulgaria: *A. b. bipunctatus* – in the upper courses of the rivers part of Danube River basin, including Ogosta, Iskar, Vit, Osam and Yantra; *A. b. fasciatus* – in the rivers, which are flowing directly into Black Sea, i. a. Kamchia, Veleka and Rezovska and *A. b. strymonicus* – in Struma and Mesta Rivers.

Paspalev & Peshev (1955) found the subspecies *A. b. bipunctatus* in Iskar River and Karapetkova (1972) reported it from Yantra River. Bulgurkov (1958) found the same subspecies in the rivers Palakaria, Vedena and Gabeshnitsa, all part of Iskar River basin and the subspecies *A. b. strymonicus* in the upper course of Struma River. The later has been also reported by Mihajlova (1965) in the Struma River drainage. Mihailova (1970) found spurlins in the rivers of Western Stara Planina Mountain without noticing their subspecies status.

An overall revision of genus *Alburnoides* in Bulgaria has been made by Marinov (1973). Using statistical processing of the data from morphological survey he studied the spurlins from all three river catchments in the country – Danube River, Black Sea and Aegean Sea. He made the following conclusions:

- The subspecies *A. b. tzanevi* and *A. b. strymonicus* are morphologically identical with the nominant subspecies;
- There are no evidence that *A. b. tzanevi* is junior synonym of *A. b. fasciatus*;
- *A. b. fasciatus* does not occur in Bulgaria;
- The only subspecies, distributed in all rivers of the country is *A. b. bipunctatus.*

Wherefore, after Marinov's revision only the subspecies *A. b. bipunctatus* exists in the Bulgarian ichthyological literature.

Johal (1977) surveyed the morphology and growth rate of the spurlins from Ogosta River and compared the data with those received by Kabisch (1974) for Oslava River in Czech Republic. He concluded that both populations belong to the nominant subspecies *A. b. bipunctatus*, although the specimens from Bulgaria are slightly different.

The recent study by Stierandová et al. (2016) gives new light about the taxonomy and distribution of spurlins in Europe. It is based on detailed comparative sequencing analysis of mitochondrial and nuclear markers of all European spurlins. Molecular analysis revealed 17 Eurasian lineages divided into two main clades, termed the Ponto-Caspian and European in accordance with the lineages distribution. The paper confirmed that the species richness in the genus *Alburnoides* in Europe is much underestimated. According to the authors the genetic analysis

support the validity of 11 morphologically accepted species and four more phylogenetic lineages, which required descriptions as separate species. It is interesting that the distribution of the nominotypical species *A. bipunctatus* sensu stricto is redefined and it covers only small part of Western Europe. Thus, this species does not occur in Bulgaria, but as a part of the European clade, another three species should be considered for the country. They are as follows:

Alburnoides sp. 2. This is a lineage from the so called Midwest European group, which inhabits the Lower Danube River basin in Croatia, Serbia, Bosnia and Herzegovina, Romania and Bulgaria. It differs genetically from the other lineages in Danube River basin as well as from *A. bipunctatus* sensu stricto. It is designated as *Alburnoides* sp. 2, because there is no available name in the literature for these representatives.

Alburnoides tzanevi. This is the only lineage, which represented the so called South Bulgarian group. There is strong genetic support for the validity of this species, and it stays well separated in the phylogenetic tree of the genus (see in Stierandová et al., 2016).

Alburnoides strymonicus. This is a lineage from the so called Aegean group, which inhabits the rivers Struma and Mesta in Bulgaria and Greece. All genetic data, demonstrated by Stierandová et al. (2016) establish its status as a separate species.

The main goal of the present paper is to define the exact distribution of all three species of spurlins in Bulgaria and based on that to propose particular conservation implications.

Information about the distribution of genus Alburnoides in Bulgaria could be find in the following publications: Karapetkova (1974) and Karapetkova (1976) – in Kamchia River; Karapetkova (1975), Karapetkova (1976), Dikov & Živkov (2004) and Vassilev et al. (2005) – in Veleka River; Karapetkova & Dikov (1986) and Pehlivanov et al. (2014) – in Vit River; Dikov et al. (1988) – in Palakaria River, tributary of Iskar River; Karapetkova & Undzian (1988) – in Roussenski Lom River; Stefanov (2001) and Vassilev & Pehlivanov (2002) – in Struma River; Economidis et al. (2009), Penczak et al. (1985), Apostolou (2005) and Apostolou et al. (2010) – in Mesta River; Raikova-Petrova et al. (2011) – in Iskar River. Under the name *A. bipunctatus* it exists in the review papers by Karapetkova & Živkov (1995), Zivkov et al. (2005), Karapetkova et al. (1998), Stefanov (2007) and Vassilev & Pehlivanov (2005).

Material and Methods

The material for the present paper has been collected in the period 2005 – 2017 mainly by electrofishing, following the CEN standard (EUROPEAN STANDARD – WATER QUALITY – SAMPLING OF FISH WITH ELECTRICITY/2003) with backpack electrofisher Hans Grassl IG 200-2.

A total of 634 localities all around the country have been visited and in 341 of them spurlins have been found.

All the available information, published in the ichthyological literature has been used for drawing up the distribution maps as well. For this purpose, we have used only the localities, mentioned in the literature, which we were able to georeference – a total of 157 localities. All other data are just analyzed and commented in the text.

All together, the localities are situated in 187 UTM squares around the country, which are visualized on MGRS UTM 10 km grid.

Part of the collected specimens are stored in the ichthyological collections of National Museum of Natural History, Sofia and National Museum in Prague.

Results and Discussion

Spurlins have been found by us in 341 different localities in the country. Another 157 localities have been taken from the scientific literature, which makes a total of 498 localities of all three species visualized on the map (Fig. 1).

All the species from genus *Alburnoides* in Bulgaria have alopatric distribution, inhabiting different and well separated geographic regions, as follows: *Alburnoides* sp. 2 – tributaries of Danube River in North Bulgaria and Kamchia River, flowing into Black Sea in East Bulgaria; *Alburnoides tzanevi* – the rivers, flowing directly into Black Sea in the southeasternmost part of the country; *Alburnoides strymonicus* – the rivers, flowing into Aegean Sea in Southwest Bulgaria (Fig. 1).

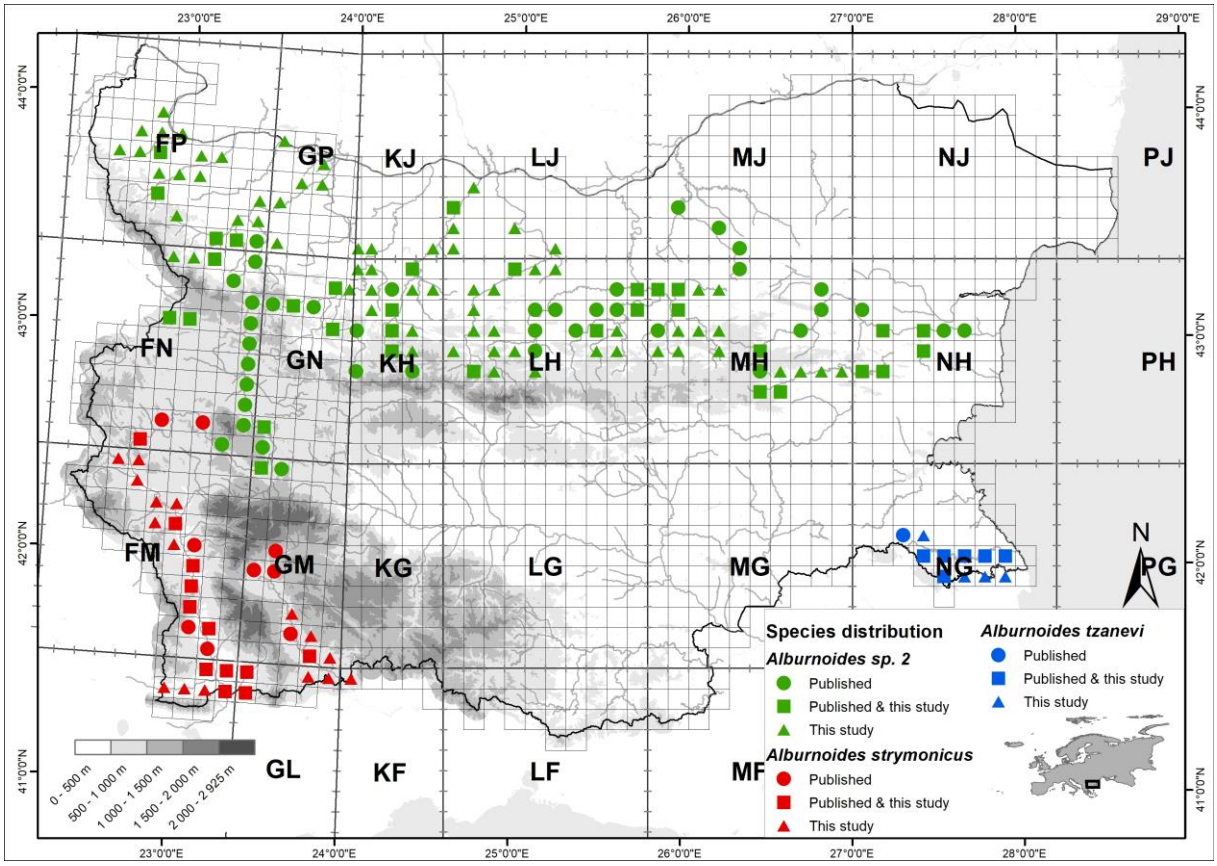

Figure 1. Distribution of the species from genus *Alburnoides* in Bulgaria.

Alburnoides sp. 2

This is the most widespread species of spurlin in the country. It is distributed in the basins of thirteen Danube River tributaries – Nishava, Voynishka River, Vidbol, Archar, Lom, Tsibritsa, Ogosta, Iskar, Vit, Osam, Yantra and Roussenski Lom, as well as in Kamchia River, flowing into Black Sea. It is found recently in a total of 241 different localities. Another 104 localities in the country are published in the ichthyological literature. All the localities are situated on 139 UTM squares (Fig. 1). For 39 of them

there is only published information for the existence of the species, till in another 33, the species is both published and found recently. In 67 UTM squares the species is reported for the first time in this study.

This species occurs in the middle courses of the rivers with fast flowing water and gravel to stone bottom. We found it on the altitude between 20 to 860 m a. s. l. There are some localities published in the old literature, situated above this limits up to 1000 m a. s. l. (Chichkoff, 1939; Bulgurkov, 1958). The species has never been found in Danube River, as well as in the upper parts of the rivers above 1000 m a. s. l. *Alburnoides* sp. 2 is nowadays extirpated from Roussenski Lom River, where it was found by Karapetkova & Undzian (1988), due to heavy pollution of the river.

Alburnoides tzanevi

An endemic species, which occurs only in some rivers, flowing into the Southwestern part of Black Sea on the territory of Bulgaria and European part of Turkey. This is the most rear species of spurlin in Bulgaria, found only in the basins of two rivers – Veleka and Rezovska.

It is found recently in a total of 33 different localities. Another 17 localities of the species are published in the ichthyological literature. All the localities are situated on 11 UTM squares (Fig. 1). For one of them there is only published information for the existence of the species, till in another six, the species is both published and found recently. In 4 UTM squares the species is reported for the first time in this study.

The species occurs in fast flowing parts of the rivers on the altitude between 8 to 256 m a. s. l. It has never been found in the upper courses of the rivers above this altitude. This makes it the lowermost species of spurlin in Bulgaria, restricted to very limited range in the country.

Alburnoides strymonicus

This is an endemic species, which occurs only in the basins of Struma and Mesta Rivers in Bulgaria and Greece. It is found recently in a total of 67 different localities. Another 36 localities of the species are published in the ichthyological literature. All the localities are situated on 37 UTM squares (Fig. 1). For 9 of them there is only published information for the existence of the species, till in another 12, the species is both published and found recently. In 16 UTM squares the species is reported for the first time in this study.

A. strymonicus occurs in the main courses of Struma and Mesta rivers as well as in some of their tributaries. It prefers stretches with fast flowing water and gravel to stone bottom. It could be found from the border with Greece upstream to the altitude of 670 m a. s. l. According to the information published in the literature, this species used to occur on the altitude up to 870 m a. s. l. (Chichkoff, 1940; Bulgurkov, 1958; Mihajlova, 1965; Penczak et al., 1985), but it seems that it got extinct from the higher part of its distribution in the country.

Conservation implications

It has been previously shown that the Balkan populations of spurlins are often restricted to different ecoregions, well separated to each other (Stierandová et al., 2016). The same pattern could be observed among the Bulgarian species as well. All three species are well separated geographically and do not co-occur in the country. There are even some big disjunctions in their distribution. Thus, there is a big gap between the areas of *A. strymonycus* and *A. tzanevi* because none spurlin

species inhabit the basin of Maritza River. The same picture could be observed between the distribution patterns of *A. tzanevi* and *Alburnoides* sp. 2, where spurlins do not occur in the Black Sea Rivers between Kamchia on North and Veleka on South.

For a long period of time all populations of spurlins in the country have been considered to be part of one species named *A. bipunctatus*. Under the same name it is included in the Red Data Book of Bulgaria in the category Data Deficient (DD). After its recent splitting into three separated species in the country, a new revision of the conservation status of spurlins in Bulgaria is required. Following the same criteria used in the Red Book, we propose new categorization for them. According to us, *A. tzanevi* should have higher conservation status due to its restricted range (less than 5000 km^2), wherefore we listed it in the category **Endangered (EN)**. For the other two species we propose the category **Vulnerable (VU)**, because there are clear evidence that their extent of occurrence decline recently. Both of them became extinct in the higher parts of their ranges, mostly because of barraging of the rivers and construction of Small Hydropower Plants. Moreover, *Alburnoides* sp. 2 has been extirpated from one of the river basins, which it used to inhabit – Roussenski Lom, due to heavy pollution of the water. *A. strymonicus* has also got quite limited distribution, restricted only to the basins of Struma and Mesta Rivers.

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