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LIFE HISTORY TRAITS OF NERETVA ROACH *Rutilus basak* (Heckel, 1843) (Pisces, Cyprinidae): BIOLOGICAL AND ECOLOGICAL CONTRIBUTION FOR BIODIVERSITY CONSERVATION OF FRESHWATER FISH

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ABSTRACT

This paper is a review of the relevant scientific literature on the present status, distribution, habitat, ecological traits, population structure and threats of Neretva roach *Rutilus basak* (Heckel, 1843). The species inhabits a restricted area of the Adriatic Sea watershed in Croatia and Bosnia and Herzegovina. The major threats are habitat loss caused by significant hydrological changes in the water regime in the area of distribution and the introduction of non-indigenous species. Still, *R. basak* is quite widespread and often abundant. Information brought together in this study will improve our knowledge about this species.

How to Cite

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INTRODUCTION

Freshwater ecosystems in the Adriatic Sea basin are especially rich in endemic species and so they are unique and of major importance for conservation (Crivelli and Maitland 1995a, b; Mrakovčić et al., 1995; Crivelli, 1996; Kottelat and Freyhof, 2007). This region has a very high ratio of rare, threatened and endemic freshwater fishes (Mrakovčić et al., 1995; Mrakovčić et al., 2006; Glamuzina et al., 2013), it is often considered a biodiversity "hot spot" (Darwall et al., 2014; Buj et al., 2015) and so it is of particular interest for conservation purposes. Despite the importance of endemic species for biodiversity conservation in Europe, many Adriatic freshwater fish species have been inadequately studied and their distribution, ecology and population trends are largely unknown. Neretva roach *Rutilus basak*, a freshwater fish species distributed in the Adriatic Sea watershed of Croatia and Bosnia and Herzegovina, is studied in this paper (Tutman and Glamuzina, 2007; Matić-Skoko et al., 2011; Tutman et al., 2012). Although it is relatively common and abundant (Matić-Skoko et al., 2011; Ćaleta et al., 2015), scientific knowledge on this species is still insufficient and partly obsolete. There are studies on general biological and ecological data (Vuković and Ivanović, 1970; Vuković and

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Ivanović, 1971; Vuković, 1977; Sofradžija, 2009) and overall faunistic records (Kosorić, 1978; Kosorić et al., 1983). There is also data on age structure (Aganović and Kapetanović, 1978). However, the characteristics useful for conservation management such as distribution data, population trends, sensitivity to the invasion of non-indigenous species, pollution, hydrological changes have not been studied systematically (Glamuzina et al., 2001; Tutman et al., 2013). Only recently, length-weight relationship (Dulčić et al., 2009), some biological and ecological characteristics and the conservation status (Tutman and Glamuzina, 2007), as well as the population structure, age and growth pattern (Matić-Skoko et al., 2011) have been analysed for the population of the Hutovo Blato wetland. Additional data, like information on the main threats, is derived from different ichthyological monitoring surveys (Glamuzina et al., 2001; Tutman et al., 2013). The purpose of this study is to give a comprehensive review of biological and ecological data, habitat preferences and conservation status of Neretva roach compiled from literature data. This review might serve as a foundation for future research aimed at better and effective management and conservation programs.

MATERIALS AND METHODS

In total, 19 literature sources were analysed, 12 presenting original data.

RESULTS

Conservation status

Rutilus basak (Fig. 1) is listed as Least Concern (LC) by the last assessment of the IUCN in the year 2006 (Crivelli, 2006). In the Red Book of Freshwater Fish of Croatia, *R. basak* is listed as Near Threatened (NT) (Mrakovčić et al., 2006), while as Endangered (EN) in the Red List of Fauna of Federation of Bosnia and Herzegovina as part of the Republic of Bosnia and Herzegovina (Škrijelj et al., 2013). Analysis of the observed category divergence in the status rank indicates a lack of harmonized methods that are used to assess species status as rational numbers are not given in the Bosnia and Herzegovina national Red List assessment. This results in an altered status rank without a clearly understandable explanation of the underlying reasons for the species status. In order to avoid an overestimation or underestimation of the regional extinction risk of a species, the Guidelines for the Application of IUCN Red List Criteria at Regional Level should be applied (IUCN, 2016).

Distribution

In Croatia, *R. basak* is distributed in lakes and small rivers near Imotski (Crveno, Modro, Prološko and Ričice Lakes, River Vrljika) and in the Neretva River, including its larger tributaries (Baćinska Lakes, rivers Matica, Norin and lower part of Neretva) (Mrakovčić et al., 2006, Ćaleta et al., 2015). In Bosnia and Herzegovina, *R. basak* is spotted in the lower Neretva River drainage (Neretva River and its tributaries the Tihaljina, Trebižat, Jasenica, Bregava, Buna and Hutovo Blato wetland) (Vuković, 1977; Mrakovčić et al., 2006; Sofradžija, 2009; Ćaleta et al., 2015). In the Neretva, it is spotted upriver until the inflow of the Buna River (Kosorić et al., 1983). It seems that the fast flow of the middle and upper Neretva is unfavourable for *R. basak* which prefers moderate to slow current velocities. However, the species does not occur in the reservoirs in the middle and upper Neretva. It is also recorded on the Trebišnjica Channel above the Svitavsko accumulation of the Hutovo Blato wetland (Fig. 2).

Fig 1. Neretva roach *Rutilus basak* (Heckel, 1843), 220 mm TL from the Hutovo Blato wetland, Bosnia and Herzegovina (photo by Nikola Zovko, January 2017).

Habitat and ecology

Rutilus basak is a non-migratory species inhabiting a wide range of mostly shallow habitats, such as streams and rivers with moderate to slow currents, lakes, backwaters and artificial water bodies with abundant vegetation. However, it was mostly found in calm and relatively cool (15°-17°C) slow-flowing water. *Rutilus basak* usually lives in small groups during summer, while during winter it can gather into larger shoals in lakes and in calm areas of rivers. Spawning takes place close to shore on submerged vegetation and hard substrates (Vuković, 1977; Mrakovčić et al., 2006, Tutman and Glamuzina, 2007; Ćaleta et al., 2015).

Biology

Rutilus basak can reach up to 240 mm TL (ca. 200 g) (Mrakovčić et al., 2006), but usually it grows up to 150 mm SL (30-50 g). Males range from 120-190 mm, females from 116-233 mm with a maximum observed age of 10 years and a predominance of 4-year-old individuals ranging from

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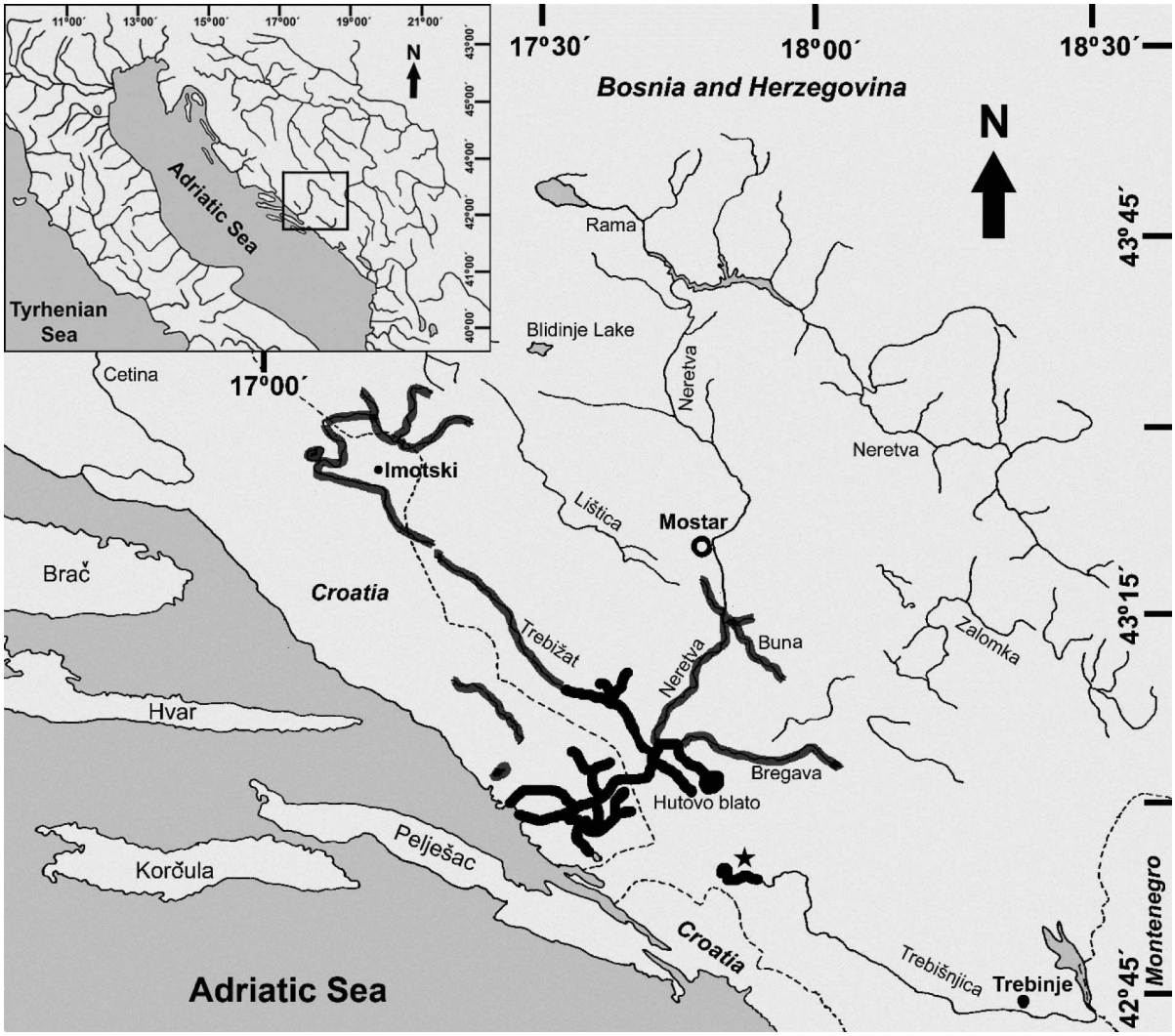

Fig 2. Distribution map of Neretva roach *Rutilus basak* (Heckel, 1843) (bold black lines) in the Adriatic drainage basin. The star indicates a new record in the Trebišnjica Channel above the Svitavsko accumulation of the Hutovo Blato wetland (Bosnia and Herzegovina).

147 to 157 mm TL (22.1%), within ages ranging from 0 to 10 years in the sample (Tutman and Glamuzina, 2007; Matić-Skoko et al., 2011). The male : female ratio for all fish combined was 0.34 : 1.00 but changed across length classes. Females were dominant in all classes; however, this dominance was less expressed at the beginning of the spawning season (M : F = 0.39 : 1.00) as it seems that females are more exposed to catch in this period. First mature individuals occurred in the 120 mm length class, and all specimens above 150 mm TL were fully mature. Total lengths at 50% maturity (Lm50) were 140 mm for both males and females. At an estimated age of 2 years, 40.4% of males and 30.8% females were mature, while in the third year all individuals were fully sexually mature (Matić-Skoko et al., 2011). The spawning period extended from the end of February until the middle of April, with a peak in the first half of March at temperatures between 12°-17°C. They start to spawn at a water temperature of 13°C, with females laying up to 100.000 sticky eggs (Tutman and Glamuzina, 2007; Matić-Skoko et al., 2011). Gonad development commenced again in October and continued through January and February. The gonadosomatic index (GSI) reached its minimum values in August and September. There was a high correlation between the GSI and the percentage of ripe and running males and females (Matić-Skoko et al., 2011). The parameters of the allometric length-weight relationship estimated by Dulčić et al. (2009) are a=0.0053 (0.0037 – 0.0067), b=3.31 (3.19 – 3.43) and the correlation coefficient r^2=0.8971. During the spawning period, nuptial tubercules appear on the head (Vuković, 1977; Sofradžija, 2009). There are only general notes in the published literature on the feeding behaviour and diet of this species, which consists of

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algae, planktonic organisms and small aquatic invertebrates (Vuković, 1977; Mrakovčić et al., 2006; Sofradžija, 2009; Glamuzina et al., 2013).

Population status

Although common and abundant in the distribution area, no precise data about population trends is available in the literature. The population of this species in the Neretva drainage is estimated to be stable (Mrakovčić et al., 2006; Tutman and Glamuzina, 2007). It can be locally numerous, especially in lakes, like in the Hutovo Blato wetland (Bosnia and Herzegovina) where it represented 15% of the total fish catches (Kosorić, 1978; Tutman and Glamuzina, 2007). It does not seem to be very common in the Neretva River (Vuković, 1977; Mrakovčić et al., 2006; Tutman and Glamuzina, 2007; Ćaleta et al., 2015). There is no published data for other parts of the distribution area.

Threats

Despite their distributional area and relative abundance, it is evident that a great deal of general knowledge concerning threats still remains largely unknown. Many threats seem not to impact *R. basak* as the population status is estimated to be stable and the species seems not to be declining. Some of the major threats to aquatic biodiversity are partially defined only for small parts of distribution area – the Neretva River delta in Croatia (Mrakovčić et al., 2006) and the Hutovo Blato wetland in Bosnia and Herzegovina (Tutman and Glamuzina, 2007; Matić-Skoko et al., 2011). At present, the only known situation is for the Hutovo Blato wetland where a long-term trend of loss of environmental quality caused by significant hydrological changes in the water regime is noted. Reduced supply of water from underground sources as well as from the Neretva leads to a general reduction of water levels in the Hutovo Blato, leading to the loss of aquatic habitats (Glamuzina et al., 2001; Tutman and Glamuzina, 2007; Tutman et al., 2013). Another problem arising in the Neretva River drainage is the introduction of non-indigenous species, particularly *Lepomis gibbosus*, *Gymnocephalus cernua* and *Carassius auratus* (Dulčić et al., 2005; Glamuzina et al., 2017). Some of the specific threats that have been identified for populations of *R. basak* in the Hutovo Blato wetland area are loss of spawning and nursery areas due to water capacity lowering which in some areas results in reduction of depth due to siltation (Glamuzina et al., 2001; Tutman et al., 2013). Those populations are also threatened by restricted movements that prevent linkage of local populations to nearby habitats (Matić-Skoko et al., 2011). This phenomenon has led to fluctuations in population strength of *R. basak* in some areas of the wetland (Glamuzina et al., 2001; Tutman et al., 2013). However, it seems that none of these threats have been shown to significantly affect *R. basak*.

Use and trade

Little information is available on utilization of the species as it has no market value and is of very limited economical interest. Non-targeted species are occasionally caught by artisanal fishers in the Hutovo Blato wetland area. If used at all, *R. basak* is consumed raw and smoked by the local population (Tutman and Glamuzina, 2007).

Conservation actions

Although, according to the Ordinance on proclaiming wild taxa protected and strictly protected (Law of Nature Protection No. 70/05 and 139/08), *R. basak* is strictly protected in Croatia, no conservation actions have ever been implemented, while in Bosnia and Herzegovina, it is unprotected. The mouth of the Neretva River in Croatia was declared an ornithological and ichthyological reserve, whereas the Hutovo Blato wetland in Bosnia and Herzegovina was given the status of a Nature Park in 1995, and a Ramsar Site in 2001. But likewise, conservation actions have not been performed.

DISCUSSION

Despite Neretva roach being a relatively abundant fish species (Mrakovčić et al., 2006; Ćaleta et al., 2015), the original data on the ecological traits of the species is mostly derived from older studies (Vuković and Ivanović, 1970; Vuković and Ivanović, 1971; Vuković, 1977; Aganović and Kapetanović, 1978; Kosorić, 1978; Kosorić et al., 1983) with very little new information (Tutman and Glamuzina, 2007; Matić-Skoko et al., 2011). Overall, this study compiled major life-cycle traits of *R. basak*, which can be selected as an indicator to monitor habitat quality and the short, medium and long-term biodiversity management (Tutman et al., 2016). The information obtained suggests that many basic characteristics of this species are still lacking for the comparable analysis of the entire population. Further research should thus be directed to the inventory studies and characterization of the species across its respective ranges. Such information will improve the biological and ecological knowledge of this species and will also allow introduction and adjustment of future management strategies and conservation measures.

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SAŽETAK

ŽIVOTNE ODREDNICE NERETVANSKE PLOTICE (BASAK) *Rutilus basak* (Heckel, 1843) (Pisces, Cyprinidae): BIOLOŠKO-EKOLOŠKI DOPRINOS OČUVANJU BIODIVERZITETA SLATKOVODNIH RIBA

U radu je dan pregled relevantne znanstvene literature o trenutnom statusu, distribuciji, staništu, ekološkim svojstvima, strukturi populacije i prijetnjama neretvanskoj plotici (Basak) *Rutilus basak* (Heckel, 1843). Navedena vrsta nastanjuje ograničeno područje jadranskog riječnog sliva u Republici Hrvatskoj i Bosni i Hercegovini. Najveće prijetnje vrsti su gubitci staništa uzrokovani značajnim hidrološkim promjenama vodnog režima na njenom distributivnom području te introdukcija alohtonih ribljih vrsta. Ipak, *R. basak* je prilično rasprostranjena vrsta koju se često nalazi u izobilju. Informacije objedinjene u radu bi mogle unaprijediti znanja o navedenoj vrsti.

Ključne riječi: Jadranski riječni sliv, status, distribucija, prijetnja, očuvanje

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