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NERETVA RUDD, *SCARDINIUS PLOTIZZA* HECKEL & KNER, 1858 (CYPRINIDAE), ENDEMIC FISH SPECIES OF THE ADRIATIC WATERSHED; BIOLOGICAL-ECOLOGICAL AND CONSERVATION TRAITS

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ABSTRACT

The Neretva rudd, Scardinius plotizza, *is an endemic cyprinid species restricted to the Adriatic drainage system (Neretva River basin) of Croatia and Bosnia and Herzegovina, which biological and ecological characteristics, occurrence and distribution, are yet largely unknown and is cataloged as being data deficient (DD) in the Croatian Red Book. Due to its exceptionally small distribution range, it can be considered a stenoendemic. Therefore, more information about its life cycle is essential to develop appropriate management strategies. Major threats are a very narrow distribution area, sparse information about its biology, sensitivity to organic pollution, regulation of rivers and draining of wetlands. This paper is a brief summary of taxonomy, biological-ecological status, present population trends and conservation traits. It represents an overview of the current state of knowledge of the species, with particular emphasis on the conservation challenges.*

Key words: *Scardinius plotizza,* endemic species, Neretva River basin, conservation

SCARDOLA DELLA NERETVA, *SCARDINIUS PLOTIZZA* HECKEL & KNER, 1858 (CYPRINIDAE), SPECIE ITTICA ENDEMICA DELLO SPARTIACQUE ADRIATICO; TRATTI BIOLOGICI-ECOLOGICI E DI CONSERVAZIONE

SINTESI

La scardola della Neretva, Scardinius plotizza, *è una specie endemica di ciprinidi, limitata al sistema di drenaggio dell'Adriatico (bacino del fiume Neretva) della Croazia e della Bosnia ed Erzegovina. Le caratteristiche biologiche ed ecologiche, presenza e distribuzione, sono in gran parte sconosciute e pertanto la specie è catalogata come "carenza di dati" (DD) nel Libro rosso della Croazia. Visto il suo areale eccezionalmente piccolo, può essere considerata specie steno-endemica. Nuove informazioni sul suo ciclo di vita sono pertanto essenziali al fine di sviluppare strategie di gestione adeguate. Le principali minacce sono: zona di distribuzione molto stretta, informazioni scarse sulla sua biologia, sensibilità all'inquinamento organico, regolazione dei corsi d'acqua e drenaggio delle zone umide. L'articolo è un breve riassunto di: tassonomia, stato biologico-ecologico, attuali tendenze demografiche e caratteristiche di conservazione. Esso rappresenta una panoramica dello stato attuale delle conoscenze sulla specie, con particolare enfasi sulle sfide di conservazione.*

Parole chiave: *Scardinius plotizza,* specie endemica, bacino del fiume Neretva, conservazione

INTRODUCTION

Freshwater ichthyofauna of the Adriatic watershed is characterized by a significant number of endemic species with a narrow range of distribution (Mrakovčić *et al*., 2006; Kottelat & Freyhof, 2007). These species are critical components of community structure in a sense that their endangerment can serve as an excellent indicator for monitoring the environmental perturbation on natural biodiversity of the particular area. However, one of major disadvantages is a paucity of published data relating to their essential biological and ecological characteristics, as well as distribution, vulnerability and protection (Economidis, 2002). One such valuable endemic species is cyprinid Neretva rudd *Scardinius plotizza* Heckel & Kner, 1858, locally called „peškelj" or „keljavac" (for specimens lesser than 20 cm). Attempts to develop an effective population management strategy have been obstructed by a deficiency of basic biological information (Tutman *et al*., 2012).

All information on the biology and ecology of this species are sparse and mostly scattered in the older literature. The papers available are mainly related to general biology (Vuković & Ivanišević, 1962; Vuković & Ivanović, 1971; Vuković, 1977) and distribution (Kosorić, 1978; Kosorić *et al*., 1983) issues. In recent years, the research presented the length-weight relationship (Dulčić *et al*., 2009), morphological and meristic characteristics (Prusina *et al*., 2009), morphometric analysis of pharyngeal teeth (Marčić *et al*., 2012) and some biological and ecological characteristics and conservation status of the population in the Hutovo blato wetland from Bosnia and Herzegovina (Tutman *et al*., 2012). Despite the fact that surveys of taxonomy and phylogeny of endemic and rare cyprinid lately attracted considerable interest (Ketmaier *et al*., 2003; Bianco *et al*., 2004; Freyhof *et al*., 2005), data on Neretva rudd are rather scarce (Perea *et al*., 2010). In this paper, all the data from the former literature were analyzed together with some recent data gathered by the author and his colleagues from 2012 till 2015. Finally, we propose some management guidelines that could improve the conservation of *S. plotizza*.

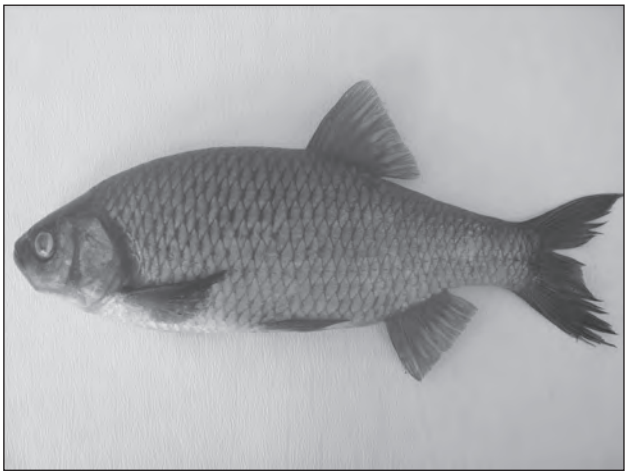

Fig. 1: The Neretva rudd, *Scardinius plotizza****, 23 cm TL (photo by P. Tutman, October 2008).***
Sl.. 1: Krapovec vrste *Scardinius plotizza* ***iz reke Neretve, dolžina 23 cm. (Foto: P. Tutman, oktobra 2008).***

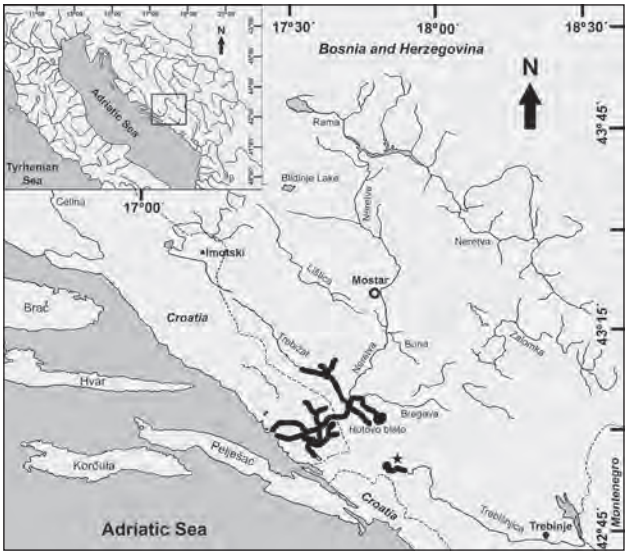

Fig. 2: The distribution map of the Neretva rudd, *Scardinius plotizza* ***(bold black lines). The star indicates a new record in the Trebišnjica channel above the Svitavsko accumulation of the Hutovo blato wetland (Bosnia and Herzegovina).***
Sl.. 2: Zemljevid območja razširjenosti krapovca vrste *Scardinius plotizza* ***(krepke črne črte). Zvezdica označuje nov podatek o pojavljanju vrste iz kanala Trebišnjice nad akumulacijo Svitavsko v mokrišču Hutovo blato (Bosna in Hercegovina).***

REVIEW OF AVAILABLE LITERATURE

Distribution

The Neretva rudd (Fig. 1), in the older literature mentioned as *Scardinius erythrophthalmus scardafa* (Bonaparte, 1837), is an endemic species of limited distribution, geographically restricted to the rivers and lakes of the Adriatic watershed area (lower Neretva River drainage) in Croatia and Bosnia and Herzegovina. In Croatia it is restricted to the rivers Neretva, Norin and Matica drainage near Vrgorac, and lakes Baćina, Kuti, and Desne, while in Bosnia and Herzegovina in the river Neretva and their tributaries Tihaljina, Krupa and Hutovo blato wetland (Mrakovčić *et al*. 2006; Kottelat & Freyhof, 2007) (Fig. 2). It is also recorded on the Trebišnjica channel above the Svitavsko accumulation

of the Hutovo blato wetland (eastern Herzegovina, Bosnia and Herzegovina; 42°55'37.68" N, 17°50'36.83" E; 224 m a.s.l (Hamzić, A., *pers. comm.*). The total range (EOO) of the species is estimated to be less than 2000 km^2, with the estimated area of occupancy (AOO) less than 500 km^2.

Taxonomical status

This species was firstly described as *Scardinius plotizza* from type localities Jessero Grande (Matica River in Jezero valley) near Vrgorac and near Imotski, Dalmatia (Croatia) and Livno (Bosnia and Herzegovina) (Heckel & Kner, 1858). A recent study on the phylogenetic relationships and biogeographical patterns of the Circum-Mediterranean subfamily Leuciscinae inferred from both mitochondrial and nuclear data (Perea *et al*., 2010) confirms the generic status as an independent and highly supported clade.

Description

Scardinius plotizza is a moderately large fish (up to 40 cm TL), with a quite high body, slightly laterally flattened, mouth terminal, facing up; in adult specimens all the fins are dark grey with a yellow-white base, the back dark greyish flanks can be silvery-yellow to grey, silvery-white on the abdomen (Vuković, 1977; Mrakovčić *et al*., 2006; Ćaleta *et al*., 2015). From other known European *Scardinius* it is distinguished by the following diagnostic characteristics: dorsal head profile straight, snout pointing forward, tip above level of middle eye; back not humped behind nape; eye not close to dorsal head profile when viewed laterally; articulation of lower jaw below or in front of anterior margin of eye; ventral head profile with a conspicuous angle at articulation of lower jaw; all fins dark grey in adults (Kottelat & Freyhof, 2007). In addition to these characteristics, *S. plotizza* is also characterized by a specific combination of meristic and certain morphometric characters: dorsal fin (D) encountered III unbranched and 8-9 branched rays; anal fin (A) III unbranched and 9-11 branched rays; pectoral fin (P) I unbranched and 13 branched rays; ventral fin (V) with I unbranched and 8 branched rays; caudal fin (C) with 16-17 rays. Scales are relatively small (about 4.5% SL), on lateral line the scale number is (37)38-40(43), the number of gill rakers on the first gill arch vary from 11-14(18), pharyngeal teeth formulae 3.5-5.3 (Vuković, 1977; Prusina *et al*., 2009; Marčić *et al*., 2012).

The percentual relation between some plastic characteristics and standard length are: head length 26.60%, depth of head at occiput 19.98%, anterodorsal distance 57.38%, postdorsal distance 32.37%, body depth 29.88%, the smallest body depth 10.78%, length of caudal peduncle 17.96%; in relation to the head length the following was determined: eye diameter 22.23%, antieye distance 31.90%; and posteye distance 51,08%. The differences between the mean values of the measured morphometric characteristics in the males and females were not statistically significant. Modes were identical in males and females for most analyzed morphometric relationships. There were no differences in meristic characters, overall shape, coloration pattern between sexes, thus the male and female Neretva rudd population is homogeneous (Prusina *et al*., 2009).

Habitat and Ecology

Scardinius plotizza is a benthopelagic species, non-migratory, which prefers well-vegetated areas with a slow current like river backwaters, floodplain zones, oxbows, ponds and lakes in karstic areas, with a temperature between 13° – 22°C. Juveniles in schools inhabit shallow water areas rich with submerged vegetation; adults individually or in smaller schools live in the open and deeper waters (Tutman *et al*., 2012). Neretva rudd can tolerate low oxygen concentration and high water temperatures (up to 28°C during summer); in the lower parts of the River Neretva it enters in the euryhaline zone (Mrakovčić *et al*., 2006).

Biology

The maximum size of *S. plotizza* is up to 40 cm (*cca* 1000 g), but it is usually 15 – 20 cm (200 – 500 g); females ranging from 10.4 – 39 cm and males 9.9 – 34.5 cm. (Prusina *et al*., 2009). Maximum observed age is 10 years (Tutman *et al*., 2012). The parameters of the allometric length-weight relationship as estimated by Dulčić *et al*. (2009) are a = 0.0051 (0.0037 – 0.0067), b = 3.31 (3.20 – 3.42) and the correlation coefficient r^2=0.9888. It spawns from March to June with a peak in May, depending on weather conditions. Fecundity varies from 100.000 to 200.000 eggs with the relative fecundity of 214.7±33.5 (Tutman *et al*., 2012). Eggs of 1.5 mm in diameter females attach to underwater plants. This is an omnivorous species which mostly feeds on submersed herbal material and benthic invertebrate fauna (Mrakovčić *et al*., 2006).

Populations

Although no population trends estimates are available in the literature for *S. plotizza*, as this species is not specialized in its habitat requirements and is ecologically adaptable, the population is estimated as stable (Mrakovčić *et al*., 2006; Tutman *et al*., 2012). Notwithstanding, negative effects of anthropogenic activities are highly expressed (water capacity lowering, habitat loss) (Tutman *et al*., 2012). Within its distribution area it can be sporadically numerous, especially in lakes, like in Hutovo blato wetland, Bosnia and Herzegovina were represented 3.5% of the total fish abundance (Tutman *et al*., 2012).

Threats

Despite the general attention that has been given to the karstic freshwater ecosystems, it is apparent that a great deal of general knowledge concerning *S. plotizza*, although it is endemic, is still lacking. Major threats are its very limited distributional area, loss of environmental quality by hydrological changes in the Neretva River regime, fragmentation and loss of habitat. *S. plotizza* is very sensitive to organic pollution, river regulation and draining of wetland areas (Mrakovčić *et al*., 2006). Additionally, the Neretva River basin is faced with more potential changes in the hydrological regime, expected from the planned development of hydropower facilities in their upper stream area (second phase of Integral Hydro system Trebišnjica, so-called Upper Horizons). As part of their basin, Hutovo blato wetland is faced with water capacity lowering which in some areas results in a reduction of depth due to siltation. This phenomenon has led to a declining trend in their number in some wetland areas (Tutman *et al*., 2012).

Use and trade

Little information is available on the utilization of the species as *S. plotizza* has no market value and is of very limited economic interest. Only in the area of the Hutovo blato wetland, larger specimens were occasionally fishing for subsistence (Tutman *et al*., 2012).

Conservation Actions

According to the status in IUCN Red List is listed as of Least Concern (LC) (Freyhof & Kottelat, 2008). However, in the Red Book of freshwater fish of Croatia it is listed as Data Deficient (DD) (Mrakovčić *et al*., 2006), and until now there has been no data for Bosnia and Herzegovina. Although strictly protected in Croatia, no conservation actions were ever implemented; on the other side it is unprotected in Bosnia and Herzegovina.

Conservation recommendations

The effects of conservation management on population dynamics depend on the environmental and biological characteristics of *S. plotizza*. Therefore, improved knowledge about its life-history strategies to establish the distributional range and phylogenetic status, following habitat protection, water pollution control and restriction of introductions and control of non-indigenous fish species are strongly recommended. Although precise assessments of the species status often suffer from a lack of comprehensive study, population genetic studies are still lacking. Finally, a long-term monitoring of populations and changes in the hydrological regime are to be carried out.

In conclusion, this paper identified major life-cycle traits of this endemic species which can be selected as an indicator to monitor habitat quality and biodiversity management in the short, medium and long term. Endemic species are essential in balancing ecological processes and if are not adequately preserved, the entire ecosystem becomes vulnerable. The combination of biological information and population vulnerability can be a useful tool for indicating threats in the ecosystem, and also for suggesting effective actions in the conservation management.

NERETVANSKA VRSTA KRAPOVCA *SCARDINIUS PLOTIZZA* HECKEL & KNER, 1858 (CYPRINIDAE), ENDEMIČNE RIBJE VRSTE IZ JADRANSKEGA POVODJA; BIOLOŠKO-EKOLOŠKE IN NARAVOVARSTVENE ZNAČILNOSTI

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POVZETEK

Krapovec vrste Scardinius plotizza *je endemična ciprinidna vrsta, ki jo najdemo v jadranskem povodju (bazen reke Neretve) na Hrvaškem in v Bosni in Hercegovini. O bioloških in ekoloških značilnostih, pojavljanju in razširjenosti te vrste je le malo znanega, zato je v hrvaški Rdeči knjigi ovrednotena s statusom pomanjkljivo poznane vrste ("data deficient" DD). Zaradi zelo ozkega območja razširjenosti je opredeljena kot stenoendemična vrsta. Na podlagi napisanega je potrebno zbrati več podatkov o življenjskem ciklu te vrste za pripravo primernih strategij za njeno ohranitev. Najbolj jo ogrožajo zelo ozko območje razširjenosti, pomanjkljivo poznavanje o njeni biologiji, občutljivost na organsko onesnaževanje in regulacija rek ter izsuševanje mokrišč. V prispevku avtorji poročajo o taksonomiji, biološko-ekološkem statusu vrste, recentnih populacijskih trendih in značilnostih, potrebnih za ohranjanje. Prispevek predstavlja pregled trenutnega védenja o vrsti s posebnim poudarkom na izzivih za njeno ohranitev.*

Ključne besede: *Scardinius plotizza,* endemična vrsta, reka Neretva

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