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FIRST RECORD OF COMMON BREAM, *ABRAMIS BRAMA* (LINNAEUS, 1758), INTRODUCED TO THE VARDAR RIVER BASIN, REPUBLIC OF MACEDONIA

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This is the first record of the common bream, *Abramis brama* (Linnaeus, 1758), introduced into the Tikvesh Reservoir, Crna Reka river, as a part of the Vardar river basin in the Republic of Macedonia. Twenty-two specimens of this cyprinid fish species were captured in the Tikvesh Reservoir on October 2014. Two of them were immediately frozen for further analysis in the laboratory at the Institute of Animal Science – Fishery Department. The distinguishing morphometric and meristic features – fin ray formulae (D III/10, A III/26, P I/15, V II/8), lateral lines with 53 scales, a deep body, and a small head and eyes – are in accordance with those reported for the species *Abramis brama*. The two fish were aged 5+. Their further spread in Republic of Macedonia is to be expected.

Key words: *Abramis brama,* non-native, Tikvesh Reservoir, Crna Reka river

ПРВ НАОД НА ДЕВЕРИКА, *ABRAMIS BRAMA* (LINNAEUS, 1758), ИНТРОДУЦИРАНА ВО СЛИВОТ НА РЕКАТА ВАРДАР, РЕПУБЛИКА МАКЕДОНИЈА

Ова е прв наод на обична деверика – *Abramis brama* (Linnaneus, 1758), интродуцирана во акумулацијата Тиквеш, Во Црна Река, како и во дел од вардарскиот слив во Репиблика Македонија. Дваесет и два примерока од од овој цириниден вид се изловени од акумулацијата Тиквеш во октомври 2014 година. Два од нив веднаш се замрзнати за понатамошни анализи во лабораторијата на Институтот за сточарство – Одделение за рибарство. Морфометриските и меристичките податоци се дадени преку формулата на перкини зраци (D III/10, A III/26, P I/15, V II/8), латералната линија со 53 крлушки, длабокото тело и малите глава и очи – што соодветствува на наодите објавени за видот *Abramis brama*. За двата примерока е одредена возраст од 5+. Се очекува нејзино понатамошно распространување во Република Македонија.

Клучни зборови: *Abramis brama;* ненативен; акумулација Тиквеш; Црна Река

INTRODUCTION

The awareness of threats to biodiversity posed by the introduction of non-native species has increased considerably in recent decades. Although there is legislation in many countries to control or prohibit non-native fish introductions, inceptions still occur, mostly supported by fisheries and the aquaculture industry (Copp et al., 2005; Vitule et al., 2009). Regardless of the nature of the introduction (intentional or accidental), these actions modify local ecological conditions by altering the reproduction, growth and development of native species; introductions can also influence hybridization and present diseases and parasites (Blanc, 2001; Gozlan et al., 2006). Particular scientific concern surrounds the intentional release of non-native species into reservoirs, and the subsequent impact on the ecosystem (Semlitsch and Bodie, 1998; Önsoy et al., 2011). Stocking reservoirs with translocated or alien fish species for recreational fishing has long been a pervasive human activity

(Allan and Flecker, 1993), and these introductions have also affected surrounding streams and rivers below dams (Moyle and Light, 1996).

The common bream, *Abramis brama* (Linnaeus, 1758), is a cyprinid fish, native to most of Europe and western Asia. According to Freinhof and Kottelat (2008), in the Balkan Peninsula, *A. brama* is a native of Slovenia, Croatia, Bosnia, Herzegovina, Montenegro, Serbia, Bulgaria, Greece and the Republic of Macedonia. Conversely, previous studies (Karaman, 1924; Dimovski and Grupče, 1971; Grupče and Dimovski, 1973; Economidis, 1991; Economidis and Banaresku, 1991; Naumovski, 1995; Georgiev, 1998; 2000; 2004; Nastova-Gjorgjioska and Kostov, 2000; Kostov, 2008a, 2008b; Kostov and Van der Knaap, 2009; Kostov et al., 2001, 2010, 2011a, 2011b; Economou et al., 2007; Smith and Darwall, 2006; Skoulikidis et al., 2009; Ristovska et al., 2011; Simonović et al., 2013) show that *A. brama* have never been present in the waters of R. Macedonia, including the Vardar river basin, until now.

Abramis brama is distributed in most European drainages, from Adour, France to Pechora, the White Sea basin (Kottelat and Freyhof, 2007). It is abundant in standing waters throughout Europe, typifying the last of the four longitudinal zones of most European rivers (Billard, 1997; Bruslé and Quignard, 2001; Benejam et al., 2005). Into the Aegean Sea basin is native for Greece – Lake Volvi, Struma and Maritza drainages (Economou et al., 2007), and for Bulgaria – Struma, Mesta and Maritza rivers basins (Karapetkova and Zivkov, 2006). Naturally, it is absent from the Iberian Peninsula (Doadrio, 2002), the Adriatic basin, Italy, Scotland, Scandinavia north of Bergen (Norway) and Finland (Kottelat and Freyhof, 2007). Locally, it has been introduced in Ireland, Spain (Lluís et al., 2005), Italy, Asia the Marmara basin (Turkey), eastward to the Aral basin, the Baikal Lake and the upper Ob and Yenisei drainages (Kottelat and Freyhof, 2007).

Abramis brama inhabit lower parts of large to medium sized slow-flowing rivers, brackish estuaries and warm and shallow lakes (Kottelat and Freyhof, 2007). Adults are usually found in still and slow-running waters where they travel in large shoals (Vostradovsky, 1973). Adults feed on insects, particularly chironomids, small crustaceans, molluscs and plants. Larger specimens may feed on small fish. Juveniles feed on zooplankton (Povz and Sket, 1990; Billard, 1997; Simonović, 2001; Karapetkova and Zivkov, 2006).

DESCRIPTION OF TIKVEŠ RESERVOIR

The Tikveš Reservoir is one of the oldest reservoirs in R. Macedonia. It is located on the Crna Reka river, the largest right tributary of the Vardar river, 12 km southwest of Kavadarci and 3 km from the village of Vozarci. The Vardar river drains the second largest catchment in the Balkans after the Evros, including an area occupying more than two thirds of Macedonia, as well as small portions of Greece and Serbia. It has a mean catchment elevation of 747 m, and a mean annual discharge of 3.62 km^3/year. Its main tributaries include the Crna Reka river, a right bank tributary, and Bregalnica, its largest left tributary. The lake was built in 1968 by redirecting river water and building a 104 m high dam. It has a surface area of approximately 14 km^2, a length of nearly 30 km, and width of 500 m. Its maximum depth is 150 m, and the total volume is approximately 475 m^3.

Although constructed mainly for hydropower generation and irrigation, important aquaculture and recreational fisheries have also been developed. From 20 fish species that belong to the Tikvesh Reservoir ichthyofauna, the following seven are non-native: *Carassius gibelio*, *Acipenser gueldenstaedtii, Acipenser ruthenus, Lepomis gibbosus, Ameiurus nebulosus, Gimnocephalus cernua, Pseudorasbora parva* (Kostov et al., 1998; Kostov et al., 2011a). The last investigation showed that *A. nebulosus* became dominant in the lake, as did the introduced *G. cernuua.* However, it seems that illegal introductions of non-native species still continue. This paper reports on the appearance of the common bream, *Abramis brama* (Linnaeus, 1758), in the Tikveš Reservoir (Crna Reka river) as a part of the Vardar river basin.

FISH SAMPLING

The bream specimens in this study were caught on the 28th of October in 2014, in the upper part of the Tikveš Reservoir (N41º18’25’’, E21º57’88’’) (Fig. 1) using a standing gill net with a mesh size of 20–60 mm. From 22 registered specimens, two were frozen at –20ºC for determination and further analyses in the laboratory at the Institute of Animal Science – Fishery Department. The identification was performed based on the morphological characteristics according to the determination key used by Vuković and Ivanovic (1971), Simonnović (2001), Karapetkova and Zivkov (2006), and Kottelat and Freyhof (2007).

Morphometric measurements follow methods by Kotelat and Freyhoff (2007). Standard length was measured from the tip of the snout to the last scale covering the caudal fin. Scale count includes scales on the caudal fin. All standard measurements were obtained with digital callipers to the nearest 0.1 mm. Age was determined from scales taken from the left flank at the level of the dorsal fin using a digital microscope (Olympus).

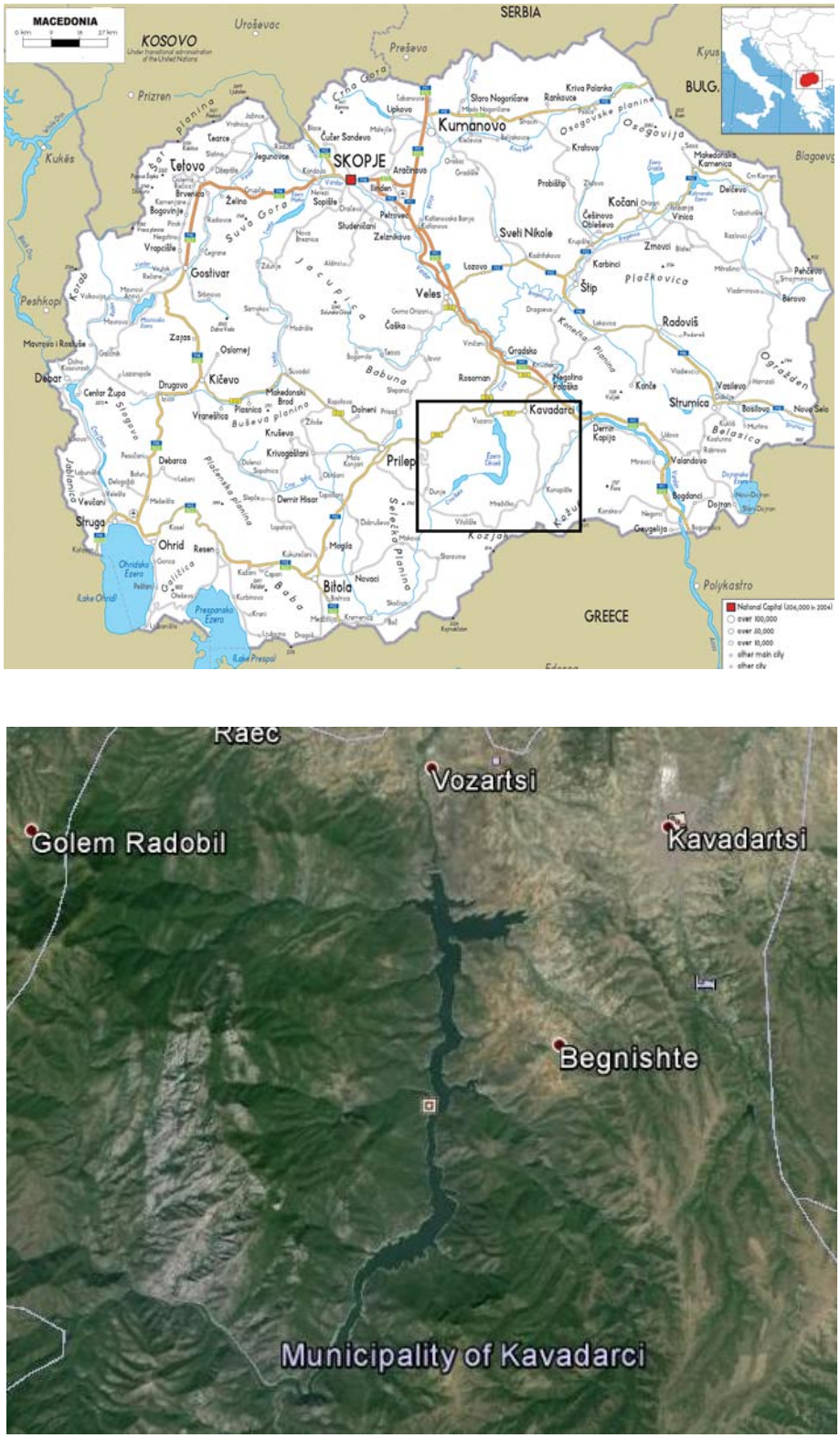

Fig. 1. Map of Tikveš Reservoir in Republic of Macedonia

DESCRIPTION OF TIKVEŠ RESERVOIR SPECIMEN

Meristic formula: D III/10, A III/26, P I/15, V II/8. Pharyngeal teeth 5:5, the teeth were long and compressed. The body was covered with small scales, and the age was determined to be 5+. Along the lateral line, 53 scales were counted. Scale count above the lateral line was 13; below the lateral line (to the midline of the belly), scale count was eight. Anal fin origin was beneath the rear end of the dorsal fin. The base of the anal fin was long, while the outline of its branched rays was strongly concave. The body was deep, with its maximum height 38.54% of SL. The length of the head was small, at 20.94% of SL. The eyes were small, at 24.12% of head length (HL), and 80.58% of snout length (Lpc). The mouth was subinferior extending into a tube. The coloration of the body was dark brown-green on the back, while the flattened sides were silver-brown. The fins were grey to light brown. The analysed specimen's body weight was 839 g (Fig. 2). Morphometric measurements and ratios are presented in Table 1.

Table 1

Morphometric characteristics (mm) and ratios of Abramis brama from the Tikveš Reservoir

Morphometrics	mm	ratio		Morphometrics	mm	ratio	
Total length (TL)	391						
Fork lenght (FL)	354			Ventral fin lenght	60.98	SL/V	5.40
Standard lenght (SL)	329			Prepelvic lenght (Dpv)	135.59	SL/Dpv	2.43
Dorsal fin lenght (D)	84.9	SL/D	3.88	Preanal lenght (Dpa)	210.23	SL/Dpa	1.56
Dorsal base fin lenght (D1)	48.8	SL/D1	6.74	Prepectoral lenght (Dpp)	61.33	SL/Dpp	5.36
Anal fin lenght (A)	60.71	SL/A	5.42	Dist. PV	74.41	SL/PV	4.42
Anal base fin lenght (A1)	92.32	SL/A1	3.56	Dist.VA	77.34	SL/VA	4.25
Caudal fin upper lobe lenght	78.65	SL/C1	4.18	Anterior dorsal lenght (aD)	183.3	SL/aD	1.79
Caudal fin lower lobe lenght	87.17	SL/C2	3.77	Postdorsal lenght (pD)	114.13	Sl/pD	2.88
Maximum body depth (H)	126.81	SL/H	2.59	Snout lenght (Lpc)	16.53	HL/Lpc	4.17
Caudal peduncle depth (h)	36.57	SL/h	9.00	Postorbital lenght (Lpo)	36.27	HL/Lpo	1.90
Head lenght (HL)	68.89	SL/HL	4.78	Eye diameter (E)	13.32	HL/E	5.17
Pectoral fin lenght (P)	67.63	SL/P	4.86	Head depth at occiput (Hd)	55.21	HL/Hd	1.25

Fig. 2. Lateral view of *Abramis brama* from the Tikveš Reservoir

THE TIME AND ROUTE OF INTRODUCTION

Considering the weak monitoring efforts in R. Macedonia in the past, the exact time of arrival and establishment of *Abramis brama* cannot be dated. However, as we did not detect this species in a previous survey carried out from August–October of 2006 (Kostov et al., 2011a), it is possible that this fish was introduced after this data was collected. One of the possible scenarios is that the bream could have been introduced from Macedonian neighbours, Bulgaria or Serbia, where the bream is native (Drenski, 1951; Taler, 1954; Simonović and Nikolić, 1996; Simonović, 2001; Apostolos, 2005; Karapetkova and Zivkov, 2006; Zorić et al., 2014). From Bulgaria, it could have been imported accidentally, with the offspring intended for breeding in cage farms from 2006–2008 (the period when no regulations or laws to control non-native fish species existed). The other possible mode of introduction could have been via transfer from Serbia, again with offspring intended for the stocking of lakes and rivers in Macedonia for sport and recreation fishing in 2008. With this imported fish, without quarantine and control, Crna, Bregalnica, Vardar rivers and several reservoirs may have been stocked (unpublished data from records of the Macedonian Fishing Federation and State Inspectorate for Agriculture).

CONSEQUENCES

The main sources of non-native fish introductions in the country have been ascribed to aquaculture, mainly target reservoirs. The successful establishment of *A. brama* in the Tikveš Reservoir could be confirmed through records of 22 specimens, possibly all adults (age 5+), based on the described samples. The successful establishment of the bream in the Boadella Reservoir (Iberian Peninsula) was registered only after a few years of its introduction (Benejam et al., 2005). Knowing that there are successful hybrid specimens of bream and roach registered for the Rybinsk Reservoir (Russia) (Stolbunov, 2003; Kodukhova, 2011), a possible hybridization between *Rutiluss rutillus* and *A. brama* from the Tikveš Reservoir could also occur. This will complicate the predictions of ecological consequences. It is not excluded that, in the future, we will find populations of bream in more waters in R. Macedonia. The impact of *A. brama* on native fish populations and ecosystems in R. Macedonia is still speculative and needs further analysis. Prevention measures should be taken by the administration to avoid the spreading of non-native fish to other reservoirs and river basins.

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