

**NEW FIND OF THE RARE AND ENDANGERED SPECIES
BANGIA ATROPURPUREA (ROTH) C. AGARDH (RHODOPHYTA) IN SERBIA**

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Abstract — Data about distribution of *Bangia atropurpurea* (Roth) C. Agardh indicate that this species was found on relatively small number of localities in freshwaters in Europe and world. In Red List of Algae, in some countries, this species is defined as a extinct (Ex) (Poland) or as endangered (En) (Slovakia). In this study, morphological and ecological characteristics of rare and endangered species *B. atropurpurea* that was found on three localities in Serbia: in Trgoviški Timok River (East Serbia), Gvozdačka Reka River (West Serbia) and Raška River (South-western Serbia). The Raška River is new find of the species *B. atropurpurea*.

Key words: Rhodophyta, *Bangia atropurpurea*, Serbia

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INTRODUCTION

Freshwater red algae (Rhodophyta) appear to be an endangered algal group in many countries. These algae can characterize their environments in many ways owing to their different preferences for physical, chemical, and biological variables (Eloranta and Kwadrans, 2004). Data on the distribution of *Bangia atropurpurea* (Roth) C. Agardh indicate that this species has been found at a relatively small number of localities in freshwaters in Europe and elsewhere (Kumano, 2002). Requiring specific ecological conditions, the species *B. atropurpurea* is included in red lists of algae in some countries, where it is defined as extinct (Ex) (Poland) (Sieminska, 1992) or endangered (En) (Slovakia) (Marhold and Hindak, 1998).

In Serbia, the genus *Bangia* (species *B. atropurpurea*) was recorded for the first time in the Trgoviški Timok River, at the locality Gornja Kamenica (Eastern Serbia) (Simić, 1995; Simić and Ranković, 1998) (Fig. 1) and after that at localities in rivers of Western Serbia (the Gvozdačka Reka River) (Obušković and Obušković, 1998) (Fig. 1). The find at the Gornja Kamenica locality

was confirmed in 2003 and 2005 (Simić et al., 2007) (Fig. 1).

MATERIAL AND METHODES

The species *B. atropurpurea* was recorded on 9 September 2006 in the Raška River (Southwest Serbia), in the immediate vicinity of Sopoćani Monastery (N-43° 06' 928", E 020° 22' 473") (Fig 1). Algological samples were taken by standard methods and immediately fixed in 4% formalin. The fixed algological material is stored in the collection of the Institute of Biology in Kragujevac, Serbia. The following water parameters were measured at the sampling sites: (°C), velocity (m/s), pH, BOD₅ (mg/l) and conductivity at a temperature of 25°C (measured with a digital conductometer of the HANA EP-3 type and expressed in µS/cm). Chemical analyses were performed by standard methods (APHA, 1985).

RESULTS AND DISCUSSION

A new find of the species *Bangia atropurpurea* was recorded in the Raška River at an altitude of 695 m in fast cold water that was aerated and had a temperature of 12.4°C. Electroconductivity of the water was 380µS/cm, while its pH value was 7.98. The thalli *B.*

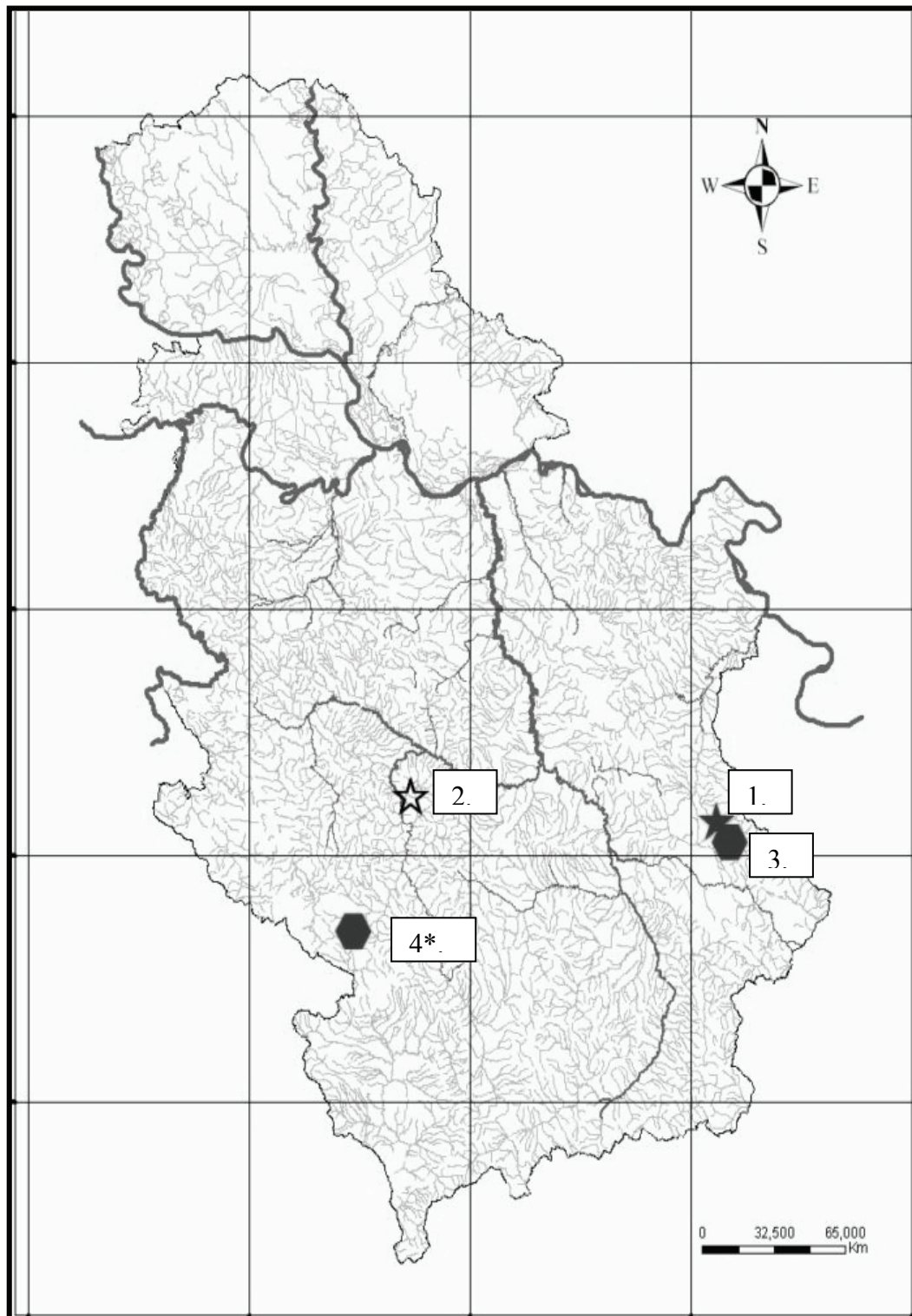


Fig. 1. Sites of finding *B. atropurpurea* of on the territory of Serbia. 1 – Trgoviški Timok River (Simić 1995); 2 – Gvozdačka Reka River (Obušković and Obušković 1998); 3 – Trgoviški Timok River (Simić et al., 2007); 4 – Raška River (*new find).

Table 1. Biometric characteristics of the alga *Bangia atropurpurea*.

Biometric characteristics	Raška River (*new find)	Trgoviški Timok River Gornja Kamenica (Simić and Ranković 1998)	Kumano (2002)
Color of filaments	dark purple tinged with brown	dark purple tinged with brown	dark purple tinged with brown
Hight of plants (cm)	2-4 30-100	2-9 19-100	2-4.5 20-60 (98)
Diameter of plants (µm)	sterile plants 30-50 mature talus 35-63 monosporangial plants 70-100	sterile plants 19-40 mature thallus 35-50 monosporangial plants 50-100	sterile plants 18-20 mature thallus 35-50 monosporangial plants 50-98
Length of cells (µm)	sterile plants 8-20 mature plants 10-16	sterile plants 15-23 mature plants 18-23	sterile plants 8-20 mature plants 5-15
Diameter of cells (µm)	6-8 -	5	6-8
Length of rhizoids (µm)	20	19-99	8-20

Table 2. Values of morphometric, abiotic, and biotic parameters at investigated sites.

Rivers/ Values	Trgoviški Timok River (Simić, 1995; Simić et al., 2007)			Gvozdačka Reka River (Obušković and Obušković 1998)	Raška River (*new find)
GIS data	N 43° 33' 58.9" E 20° 39' 40.2"			N 43° 33' 29" E 20° 41' 50.5"	N 43° 06' 92.8" E 20° 22' 47.3"
Altitude (m)	340				695
Habitat	river			river/microacumulacion	river
Max. bed width (m)	10-12				10
Max. depth (m)	0.2-0.6				0.5-1.0
Substrate	rock/limestone			rock	rock/limestone
Years	1991			2003, 2005	2006
Month	VII	X	XI	VII	IX
Coverage (%)	1	5	10	+	10
Water velocity (m/s)	0.66	0.43	0.72		0.7
Waters temperature(°C)	14.0	12.8	5.6		12.4
BOD ₅ (mg/l)	1.10	0.73	0.2	-	
pH	8.14	8.15	8.20	-	7.98
Conductivity (µS/cm)	-	-	-	-	380
Macroalgae at sites	<i>Cladophora</i> sp. <i>Vaucheria</i> sp.			<i>Cladophora</i> sp. <i>Vaucheria</i> sp.	<i>Cladophora</i> sp.
Threat / Protection	yes/no			yes/no	yes/no

atropurpurea were visible to the naked eye. Coverage was less than 5% . In the community of macroalgae at the same locality, thalli of the species *Vaucheria* sp. and *Cladophora* sp. were also recorded on the locality's limestone substrate (Table 1).

In regard to its morphological traits, the thallus of the alga was close to traits of the given species described in the literature (Kumano, 2002). The plant of *B. atropurpurea* recorded in the Raška River was erect, filamentous, unbranched, caespitose, dark-purple tinged with brown, 2-5 cm high,

and 30-63 (100) µm in diameter. Its cells were 8-20 µm long and 30-50 µm in diameter in sterile plants; 10-16 µm long and 35-63 µm in diameter in mature plants; and 70-100 µm in diameter in monosporangial plants. It was fastened to the substrate by means of rhizoids growing downwards from the lower cell through the common outer wall. Filaments initially consist of a single row of cylindrical cells that are 6 µm in diameter, and 8 µm long when young. Later, the cells are disk-shaped, 6 µm in diameter, and 20 µm long (Table 1).

Starmach (1977) reports that the filament of *B. atropurpurea* can be up to 15 cm long and from 13 to 60 μm wide. The strand found in the Trgoviški Timok had a maximal length of up to 9 cm and width of 60-100 μm in the uppermost part (Simić and Ranković, 1998) (Table 1).

Bangia atropurpurea is a freshwater alga (Kumano, 2002) that can be found in brackish water (Eloranta and Kwadrans, 2004). It has also been found in streams and rivers, mostly as an epilithic alga. It lives on limestone substrates, travertine barriers, and large rocks, but avoids easily movable substrate (Čado, 1958, 1977; Matoničkin and Pavletić, 1960; Starmach, 1977; Sabater et al., 1989; Simić and Ranković, 1998; Simić, 2002). In the past, thalli of this species were found mostly in places exposed to lapping of water: in the littoral part of lakes, (Čado, 1958, 1977; Obušković and Obušković, 1998), on waterfalls, and on mill-wheels (Vouk, 1953). Thalli can also be found among threads of the species *Cladophora glomerata* as an epiphytic (metaphytic) alga (Matoničkin and Pavletić, 1960; Petrovska 1966; Simić and Ranković, 1998).

The species prefers water with low temperature (below 14°C) (Čado, 1958, 1977; Petković, 1980; Sabater et al., 1989; Simić and Ranković, 1998). For the most part, it is alkalophilic, dwelling in water where measured pH is up to 8.3 (Sabater et al., 1989). It is characteristic of water with low conductivity: from 198 to 288 $\mu\text{S}/\text{cm}$ (Sabater et al. 1989) and from 220-500 $\mu\text{S}/\text{cm}$ (Rott et al., 1999), respectively. Sladeček (1973) defines this species as an indicator of oligosaprobic water, while Sabater et al. (1989) classify it as euryvalent in relation to the concentration of organic matter. Finds in rivers of Serbia confirm that this species inhabits clear oligosaprobic and oligo-beta-mesosaprobic waters (Simić, 2002).

The stenovalence in relation to substrate, water temperature, current velocity, and water quality is the reason for the small number of habitats housing this species in Serbia, other parts of Europe, and elsewhere. Owing to this, any human influences, direct or indirect, that lead to changes in physical

or chemical parameters or to deterioration of water quality in the habitat and its immediate vicinity are potentially unfavorable.

To ensure protection of this species, more detailed research needs to be carried out on existing populations and habitats. Also, new legal measures should be formulated by authorities in the Serbian Ministry of Environmental Protection. Finally, the list of plants protected as natural rarities of Serbia ("Službeni glasnik RS", 50/93 and 93/93) should be extended to include algae, among them the red alga *B. atropurpurea*.

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НОВ НАЛАЗ РЕТКЕ И УГРОЖЕНЕ ВРСТЕ *BANGIA ATROPURPUREA* (ROTH) C. AGARDH (RHODOPHYTA) У СРБИЈИ

СНЕЖАНА СИМИЋ

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Подаци о дистрибуцији *Bangia atropurpurea* (Roth) C. Agardh показују да је ова врста налажена на малом броју локалитета у слатким водама Европе и света. У Црвеним листама алги неких земаља ова врста је дефинисана као ишчезла (Ex) (Пољска) или као угрожена (En) (Словачка). У овом раду су

приказани подаци о морфологији и екологији ове ретке и угрожене врсте, која је забележена на само три локалитета у Србији: у реци Трговишки Тимок (источна Србија), Гвоздачкој реци (западна Србија) и у реци Рашкој (југозападна Србија). Река Рашка је ново налазиште за врсту *B. atropurpurea*.