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NEW RECORD OF ENDANGERED RED ALGA *BANGIA ATROPURPUREA* (A. ROTH) C. AGARDH (BANGIALES, RHODOPHYTA) IN THE NIŠAVA RIVER, SERBIA

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Abstract - *Bangia atropurpurea* was found at two new localities in the Nišava River (Southern Serbia). In Serbia, this species is endangered. It has been found so far in the Trgoviški Timok River, the Gvozdovačka River and the Raška River. With the two new localities in the Nišava River, at present *Bangia* occupies four rivers (five localities). New findings are important for the protection of the biodiversity of red algal flora in the region, and provide useful information on the ecological preferences of the species in Serbia.

Key words: *Bangia*, endangered species, Nišava River, Serbia

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INTRODUCTION

The main objective of this manuscript is to report the finding of *Bangia atropurpurea* (A. Roth) C. Agardh 1824 (Agardh, 1824) at two new localities in the Nišava River (Southern Serbia). We have summarized the water characteristics of the localities, and in addition, briefly discuss the importance of new data for protecting red algae in Serbia.

Red algae (Rhodophyta) are mainly marine organisms, though about 178 species are found in freshwaters (Sheath, 1984). *Bangia atropurpurea* is an epiphytic benthic alga that occurs mostly in rivers and streams in many regions around the world (Kipp, 2008): the British Isles (John et al., 2002), Japan (Notoya *and* Iijima 2003), New Zealand (Boedeker et al. 2008), and North America (Wehr *and* Sheath, 2003). Müller et al. (2003) classifies all freshwater representatives of the genus *Bangia* as *Bangia atropurpurea* (A. Roth) C. Agardh, and all marine populations as *Bangia fuscopurpurea* (Dillwyn) Lyngb. Certain earlier studies confirm their separation (Gargiulo, 1998; Müller, 1998), but many systematic issues within the order *Bangiales* remain unclear (Müller et al., 2001).

Bangia is classified as an endangered species (EN) (Simić et al., 2007) in Serbia. So far, its presence has been established in three localities: the Trgoviški Timok River (Simić *and* Ranković 1998), the Gvozdovačka River (Obušković *and* Obušković, 1998) and the Raška River (Simić, 2008) (Fig. 1.). Even with its cosmopolitan distribution, this species is also endangered in Slovakia (Marhold *and* Hindak, 1998) and Germany (Kusber et al., 2005), while it is already extinct (EX) in Poland (Siemińska, 1992), found in one locality in Finland (Eloranta *and* Kwandrans, 2007), in five locations in Romania (Cărăuş, 2003), several locations in Ukraine (Tsarenko et al., 2006), Slovenia (Vrhovšek et al., 2006) and is common in Austria (Rot et al., 1999).

MATERIALS AND METHODS

The Nišava is 218 km long. It belongs to the Black Sea drainage basin and originates in the Stara Planina Mountains in western Bulgaria. Through Serbia, it flows generally westward, until it empties into the Južna Morava River, about 10 km from the city of Niš (Gavrilović and Dukić, 2002). The primary cause for sampling the benthic algae in the

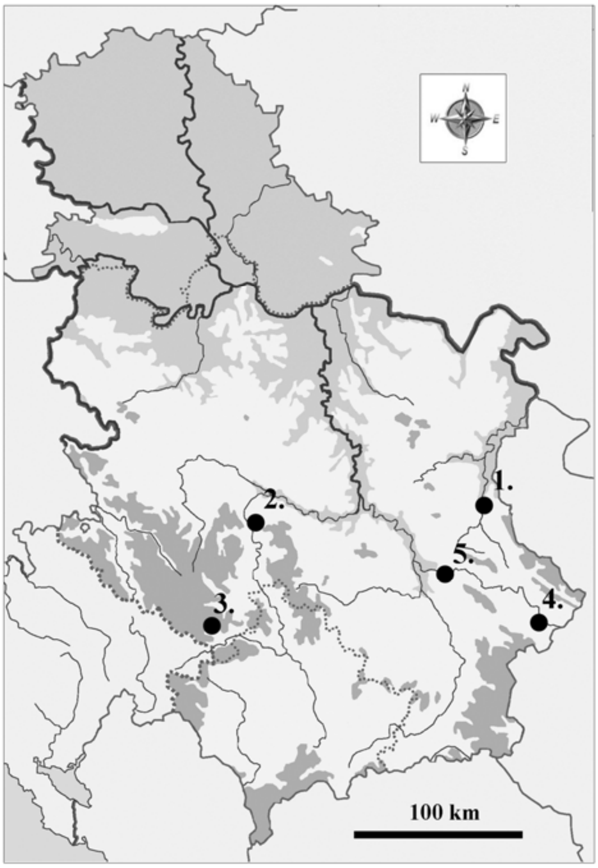

Figure 1. Map of Serbia showing localities where *Bangia atropurpurea* (A. Roth) C. Agardh is recorded. 1. Trgoviški Timok River 2. Gvozdovačka River 3. Raška River 4. Nišava River (Jerma estuary) 5. Nišava River (canyon "Sićevačka klisura").

Nišava River was the assessment of the water quality using diatoms as bioindicators (Kelly, 1998).

Sampling on the Nišava River was done monthly from May 2008 to March 2009. Conductivity, pH and water temperature were measured with a Lovibond Multimeter WTW 340i at each sampling site. Ammonium ions, nitrates, nitrites, phosphates, silicates and total hardness were measured using a Lovibond photometer PC Multidirect. Algological samples were collected and fixed in 4% formaldehyde. Microscopic examination and identification of the *Bangia* filaments was done using a Zeiss Axio-Imager M1 microscope.

RESULTS AND DISCUSSION

Bangia was collected at two of the thirteen sampling localities in the Nišava River. Thalli were first found 400 m downstream from the confluence of the Nišava and Jerma rivers (collected in May 2008) and after that at the "Sićevačka klisura" canyon (collected in December 2008), located 14 km from the city of Niš. All the characteristics of *Bangia* (color of filament, dimensions, number of cell rows, cell dimensions) from both localities correspond to the species description in Kumano (2002). Individuals of *Bangia* were filamentous, non-branched, cylindrical, developed in mass and mainly attached to large stones (boulders, > 250 mm). Up to six thalli grew from a single base.

The water characteristics for both localities are summarized in Table 1.

Researchers have reported the presence of two red algae taxa in the Nišava River: *Chantransia pygmea* and *Paralemanea* sp. (Branković et al., 2007). *Bangia atropurpurea*, in addition to the two new localities in the Nišava River, is currently found in four rivers (five localities). Our measurements of the water characteristics from two localities show low nutrient levels, slightly alkaline pH and a somewhat elevated conductivity (Table 1). Our results are similar to the water characteristics from the localities in Serbia where *Bangia* is found (particularly the Trgoviški Timok River (Simić, 1995) and the Raška River (Simić 2008)) and to published data from other countries (Sheath, 1984; Sheath and Sherwood, 2002; Eloranata and Kwandrans, 2002). For example, *Bangia* filaments are found within a certain temperature range, similar to that of the Trgoviški Timok River (5.6 – 14.0^{0}C) (Simić, 2008) and the Nišava River (3.5 – 14.2^{0}C), indicating a stenovalence in relation to water temperature. Studies show that the seasonality of *Bangia* is influenced greatly by changes in the light regime (Sheath, 1984), as well as temperature (Sheath and Hambrook, 1990). Gargiulo et al. (1996) conclude that the temperature and photoperiod appear to be critical ecological factors acting together as a seasonal trigger, though they emphasized a stronger effect of temperature.

Table 1. Water characteristics for the Nišava River at the Jerma estuary and "Sićevačka klisura" canyon.

Locality	Month/ Year	Water temperature (^{0}C)	pH	Total hardness	Conductivity (µS/cm)	Ammonium ion (mg/L)	Nitrates (mg/L)	Nitrites (mg/L)	Phosphates (mg/L)
Jerma estuary	5/08	14.2	6.69	40	388	0.18	< 1	< 0.01	1.00
"Sićevačka klisura" canyon	12/08	3.5	6.37	9	291	0.17	< 1	< 0.01	0.10

While there are 11 red algal species found in Serbia, some occupy only a few localities (Cvijan et al., 2003). Evaluating the ecological preferences of many freshwater red algae taxa is difficult due the scarcity of records (Eloranta *and* Kwandrans, 2004) and finding these taxa at new localities in Serbia is therefore very important for assessing their ecological preferences. If any kind of protection measurement is to be implemented in the future, additional data should then be used for reevaluating the biodiversity of red algae in this area, as well as determining the treating factors. In Serbia, even though the majority of red algae species are within the boundaries of protected areas, they are threatened by various human activities (e.g. deforestation, erosion, pollution) (Simić et al., 2010). It is speculated that man's activities, which lead to eutrophication and the damming of rivers and streams, are the reason for the lower diversity and abundance of freshwater red algae in central and southern Europe in comparison to Nordic countries (Kwandrans and Eloranta, 2010).

It is important to protect not only the endangered species, but the heterogeneity of the benthic algae assemblages, because they are the basic energy source of any lotic system, transformers in food webs (transforming inorganic chemicals into organic forms) and nutrient cycles in streams, and provide a habitat for a diversity of organisms (Stevenson et al., 1997).

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