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Original Scientific Report

New floristic and syntaxonomic data from rice fields in Bulgaria

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ABSTRACT:
The present work is a floristic and phytocoenological study of rice fields in the Thracian Lowland, South Central Bulgaria. Two species new to the Bulgarian alien flora were found as a result: *Heteranthera reniformis* (Pontederiaceae) and *Rotala ramosior* (Lythraceae). The class *Oryzetea sativae* is documented with phytocoenological relevés for the first time in Bulgaria.

Keywords:
oryzicolous flora and vegetation, weeds, *Oryzetea sativae*

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Rice fields are highly dynamic temporary aquatic ecosystems with quickly changing chemical properties and water levels. The biotic communities related to them develop rapidly and have a very specific oryzicolous flora and vegetation (Raus & Raabe 2002; Brullo & Guarino 2007). Rice is not a widespread crop in Bulgaria. Paddy fields cover an area of about 12 000 ha (Fig. 1), exclusively in the Thracian Lowland (CLC 2012; Slavova 2015). Information about the weed communities in rice fields of the country is outdated (Dimitrov 1949). However, there are some recent reports about several weeds new to Bulgaria (Cheschmedzhiev & Stoychev 2005; Vladimirov & Delcheva 2016; Vladimirov *et al.* 2017) from these habitats. A probable presence of the class *Oryzetea sativae* Miyawaki 1960 in Bulgaria was assumed by Tzonev *et al.* (2009), but without any published relevés.

Among countries neighbouring Bulgaria, Greece is the most important as a grower of rice, with rice fields distributed in the northern part of the country: in the deltas of the rivers Nestos, Axios, etc. (Ntanos 1997). Rice is also cultivated on a large area in European Turkey, especially close to the town of Edirne (Damar 2006; Uzun & Demirkan 2013).

Floristic and phytocoenological studies of the rice fields in South Central Bulgaria were carried out in 2016–2017. Methods of the floristic school of Braun-Blanquet (1964) were applied in the vegetation studies. All data analyses were performed with the SYN-TAX 2000 program package (Podani 2001). The work of Mucina *et al.* (2016) was used for determination of the synoptic scheme. Herbarium specimens are deposited in the herbarium of the Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences (SOM).

Two species new for the Bulgarian vascular flora (typical oryzicolous xenophytes) were found as a result of these studies, in addition to a new syntaxon.

***Heteranthera reniformis* Ruiz & Pav. Fl. Peruv. 1: 43. 1798** (Fig. 2)
Thracian Lowland: Rice fields ca. 2.5 km south of Graf Ignatievo village (Plovdiv district), 42.25264° N, 24.74239° E, 188 m a.s.l., 12.09.2016, leg. & det. Tsoneva S, Gussev Ch & Georgiev V (SOM 176690, SOM 176691); Thracian Lowland: Rice fields ca. 2.5 km south of Graf Ignatievo village (Plovdiv district), 42.25380° N, 24.74084° E, 190 m a.s.l., 13.09.2016, leg. & det. Tsoneva S, Gussev Ch & Georgiev V (SOM 176683, SOM 176689).

This species is an annual or facultatively perennial plant, with a native range in North, Central and South America (Horn 2002). It is distinguished easily from the other

Table 1. Diagnostic table of the association *Oryzo sativae-Echinochloetum cruris-galli*.

Relévе number	1	2	3	4	5
Locality	Saedinenie	Saedinenie	Trud	Dinkata	Dinkata
Date	3.10.2017	3.10.2017	3.10.2017	3.10.2017	3.10.2017
Latitude	42.2143	42.21917	42.25376	42.26149	42.26072
Longitude	24.55976	24.55711	24.74092	24.28945	24.28648
Sample area	25	9	100	25	100
Coverage	60	70	90	90	95
Diagnostic species for the association					
Oryza sativa	+	3	4	1	3
Echinochloa crus-galli	2a	2a	2a	2a	2a
Ammannia coccinea	1	1	2a		+
Diagnostic species for the class *Oryzetea sativae* Miyawaki 1960; order *Cypero difformis-Echinochloetalia oryzoidis* O. de Bolòs et Masclans 1955; and alliance *Oryzo sativae-Echinochloion oryzoidis* O. de Bolòs et Masclans 1955					
Diplachne fascicularis	2a	2a	1	4	
Cyperus difformis	3	+	1		2a
Lindernia dubia	1		+	+	+
Heteranthera rotundifolia	+	2a			
Rotala ramosior	2a			+	
Heteranthera reniformis			+		
Pycreus serotinus				+	
Other species					
Persicaria hydropiper			+		+
Schoenoplectus triqueter				+	1
Persicaria lapathifolia	+			+	
Alisma plantago-aquatica				+	
Bidens tripartita			+		
Bolboschoenus maritimus					3
Characeae		+			
Chenopodium album	+				
Cirsium arvense	+				
Cynodon dactylon	1				
Lemna minor				+	
Plantago lanceolata	+				
Polygonum aviculare	1				
Portulaca oleracea	+				
Pycreus flavescens		+			
Setaria viridis		+			
Typha angustifolia			+		

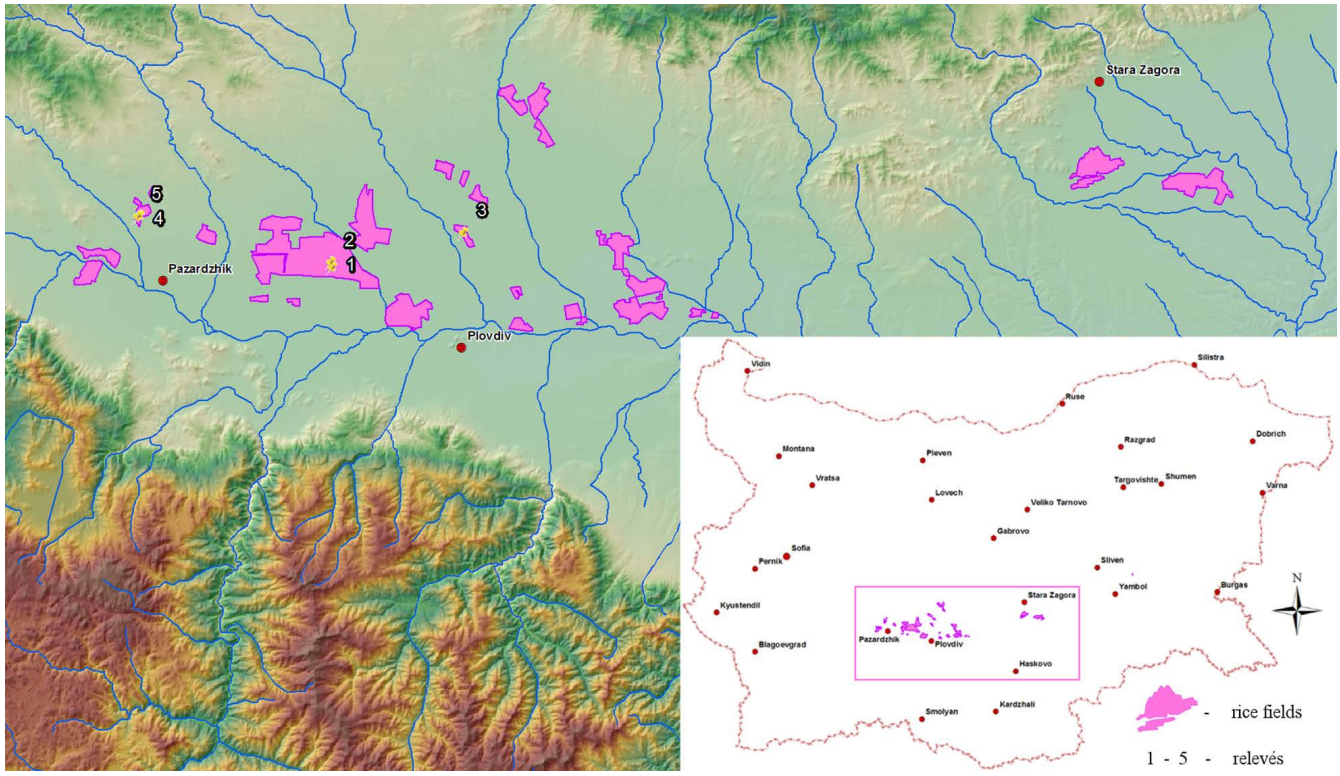

Fig. 1. Distribution of rice fields and studied vegetation in Bulgaria.

representative of the genus in Bulgaria, *H. rotundifolia*, by its leaf blades. The leaves are reniform, usually as wide as or even wider than long; the procumbent vegetative stems readily root at the nodes (nodes rootless in *H. rotundifolia*); and the inflorescences are 3–8-flowered (one-flowered in *H. rotundifolia*) (Raus *et al.* 2002). In Europe, this species has been reported from Greece (Raus *et al.* 2002), North Macedonia (Karov *et al.* 2005) and also as naturalised in rice fields of France, Portugal and Italy (Hussner 2012; DAISIE 2017).

***Rotala ramosior* (L.) Koehne in Martius, Fl. Bras. 13(2): 194. 1877** (Fig. 3)

Thracian Lowland: Rice fields ca. 2.5 km south of Graf Ignatievo village (Plovdiv district), 42.25380° N, 24.74084° E, 190 m a.s.l., 13.09.2016, leg. & det. Tsoneva S, Gussev Ch & Georgiev V (SOM 176682).

Rotala L. is a genus new to Bulgaria. According to Blackwell (1970), it differs from *Ammannia* L. in its leaves, which are strongly attenuate at the base or narrowed to a petiole; solitary flowers in the leaf axils; and possession of a septicidal capsule with a finely striate outer-wall surface. The species is a small, hairless annual, naturally distributed in North and Central America (Camp *et al.* 2011). In Europe, it has been reported from rice fields of Greece, North Macedonia and Italy (Raabe & Raus 2002; Hussner 2012; Lansdown *et al.* 2016; DAISIE 2017).

Synoptic scheme of established syntaxa

Class *Oryzetea sativae* Miyawaki 1960

Order *Cypero difformis-Echinochloetalia oryzoidis* O. de Bolòs et Masclans 1955

Alliance *Oryzo sativae-Echinochloion oryzoidis* O. de Bolòs et Masclans 1955

Association *Oryzo sativae-Echinochloetum cruris-galli* Soó ex Ubrizsy 1948

On the basis of phytocoenological relevés (see Table 1), it can be concluded that these communities belong to the association *Oryzo sativae-Echinochloetum cruris-galli*, the only association of the class *Oryzetea sativae* present in Europe (see Bolòs & Masclans 1955; Ubrizsy 1961; Ninot *et al.* 2011; Borhidi *et al.* 2012; etc.). Typical of this association is the presence of many exotic weeds like *Ammannia coccinea* Rottb., *Lindernia dubia* (L.) Pennell, *Heteranthera rotundifolia* (Kunth) Griseb. and *H. reniformis* Ruiz & Pav., *Rotala ramosior* (L.) Koehne, *Diplachne fascicularis* (Lam.) P. Beauv., etc., and naturalised neophytes like *Cyperus difformis* L. However, there are also hygrophytes typical of the Bulgarian flora, such as *Persicaria lapathifolia* (L.) Delarbre, *Pycreus flavescens* (L.) Rchb. and *Typha angustifolia* L. More specific is the delayed development of this vegetation before rice harvesting: in late October, even November. The floristic structure of weed vegetation is highly dynamic. For example, a comparison with the species composition given by Dimitrov (1949)

Fig. 2. *Heteranthera reniformis*: a) close view, b) population in a harvested rice field.

shows that many new species of tropical origin inhabit the vegetation plots. The basin of the river Maritsa connects Bulgaria and Turkey. This river can be regarded as the main migratory route north-westwards for these species. In order to clarify all the floristic and ecological peculiarities of rice fields in Bulgaria, some new and more detailed floristic and phytocoenological investigations will be necessary.

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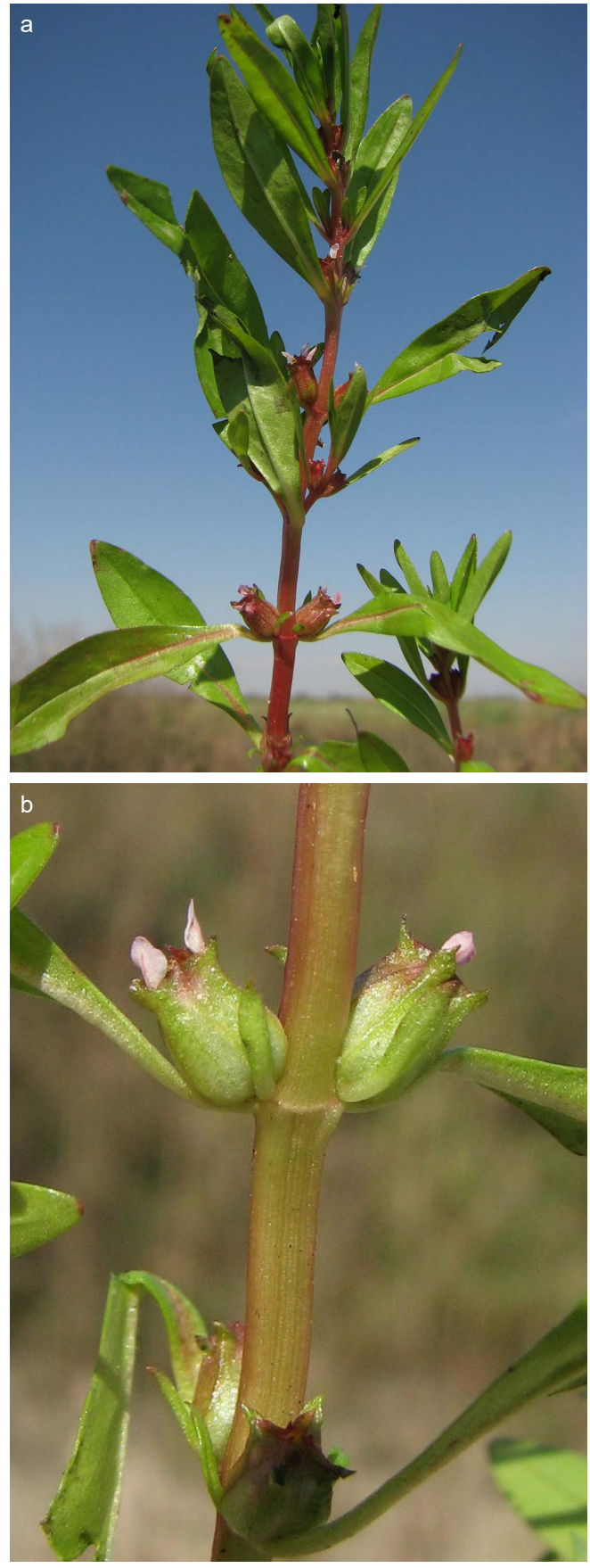

Fig. 3. *Rotala ramosior*: a) general view, b) close-up of the plant.

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REZIME

Botanica SERBICA

Novi floristički i fitocenološki podaci sa pirinčanih polja u Bugarskoj

Chavdar Gussev, Valeri Georgiev, Sonya Tsoneva i Rossen Tzonev

Rad predstavlja florističku i fitocenološku studiju pirinčanih polja u Trakijskoj niziji centralne južne Bugarske. Kao rezultat konstatovane su dve nove alohtone vrste: *Heteranthera reniformis* (Pontederiaceae) i *Rotala ramosior* (Lythraceae). Klasa *Oryzetea sativae* je, takođe, prvi put zabeležena u Bugarskoj i predstavljena je fitocenološkim snimcima.

Ključne reči: pirinčana flora i vegetacija, korovi, *Oryzetea sativae*.