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Syntaxonomy, ecology and distribution of the *Potamogeton* genus in Bulgaria

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Abstract

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The research aims to provide a comprehensive review of the syntaxonomy, ecology and distribution of the *Potamogeton* communities in Bulgaria. A dataset of 171 relevés, collected across the country according to the Braun-Blanquet approach was analysed. Hierarchical clustering was performed with the PC-ORD software package using the Bray-Curtis dissimilarity and the flexible beta clustering algorithm for classification analyses. The diagnostic species were determined by calculating the Phi-coefficient and only the statistically significant values were considered.

The syntaxonomical diversity is represented by 1 class, 1 order, 2 alliances and 10 associations (*Potamogetonetum pusilli*, Potamogetonetum berchtoldii*, Potamogetonetum crispi, Potamogetonetum lucentis, Potamogetonetum natantis, Potamogetonetum nodosi, Potamogetonetum pectinati, Potamogetonetum perfoliati*, Potamogetonetum trichoidis*, Scirpo fluitantis-Potametum polygonifolii**). The most wide-spread associations are *Potamogetonetum nodosi* and *Potamogetonetum natantis*. Five associations are recorded for the first time for the territory of the country.

Keywords: ecology; macrophyte vegetation; syntaxonomy; wetlands

Introduction

The *Potamogeton* genus is a cosmopolitan genus, represented in Europe by 22 species. Fifteen of them are present on the territory of Bulgaria. A species, previously known as *Potamogeton pectinatus* nowadays has a status of a synonym to *Stuckenia pectinata* (Stoyanov et al., 2022). They form species-poor, often monodominant communities, belonging to *Potamogetonetea* class. It comprises vegetation of rooted aquatic plants, both submerged and with leaves floating on the surface (Mucina et al., 2016). According to Apostolova (2023), this class is represented in Bulgaria by 3 orders and 6 alliances.

The communities of *Potamogeton* on the territory of Bulgaria have been studied since the 50th years of the 20th century (Kochev and Yordanov, 1981; Kochev et al., 1986; Stoyanov, 1948; Tzonev, 2002, 2009; Valchev et al., 2012). The *Potamogeton* phytocoenoses were first classified according to the Dominance approach to 4 formations and 6 associations (Kochev and Yordanov, 1981). Nowadays, studies following the Braun-Blanquet approach have documented 1 class, 1 order, 2 alliances, 5 associations and 2 plant com-

munities (Kochev et al., 1986; Tzonev 2002, 2009; Valchev et al., 2012).

The aim of this research was to provide a syntaxonomy review of the communities dominated by different species of the *Potamogeton* genus on the territory of Bulgaria, to compare their preferences towards the ecological conditions, and to map their distribution.

Materials and Methods

Study area

The *Potamogeton* dominated phytocoenoses in the research focus of the present study, are located throughout several geographical units within the country, as follows: the Danubian Plain, the Thracian Valley, the valleys of Sofia, and Burgas and Struma River, the Forebalkan, the Western Balkan Range, Kraishte Region, the Western Rhodopes and Vitosha Mountain. This geographical diversity leads to geological, geomorphological, climatic, water and soil diversity. The climate is temperate to the north, mainly transitional in the central parts of the country and with Mediterranean features in the southern parts (Velev, 2010). The main rivers are Vit, Osam, Yantra, Iskar, Maritsa and Struma (Hristova, 2012). Soils are mainly Fluvisols, Cambisols, Phaeozems and Vertisols (Ninov, 2002).

Data collection & Data analysis

To study the *Potamogeton* phytocoenoses we prepared a dataset of 171 relevés (sample plots). Twenty-five of them came from digitized literature data (Kochev and Yordanov, 1981; Kochev et al., 1986; Stoyanov, 1948; Tzonev, 2002; Valchev et al., 2012), and 146 were originally collected relevés during the vegetation seasons of 2017–2023 years following the Braun-Blanquet approach (Westhoff & van der Maarel, 1978). For each relevé a full species list, cover of each species, GPS coordinates, elevation and water depth were recorded. The water depth was measured with a survey ruler. The sample plot sizes varied depending on the size of the communities, but were within the range of 4–16 m^2, as recommended by Chytrý & Otýpková (2003).

The relevés were digitized using TURBOVEG programme (Hennekens and Schaminée, 2001), and contributed

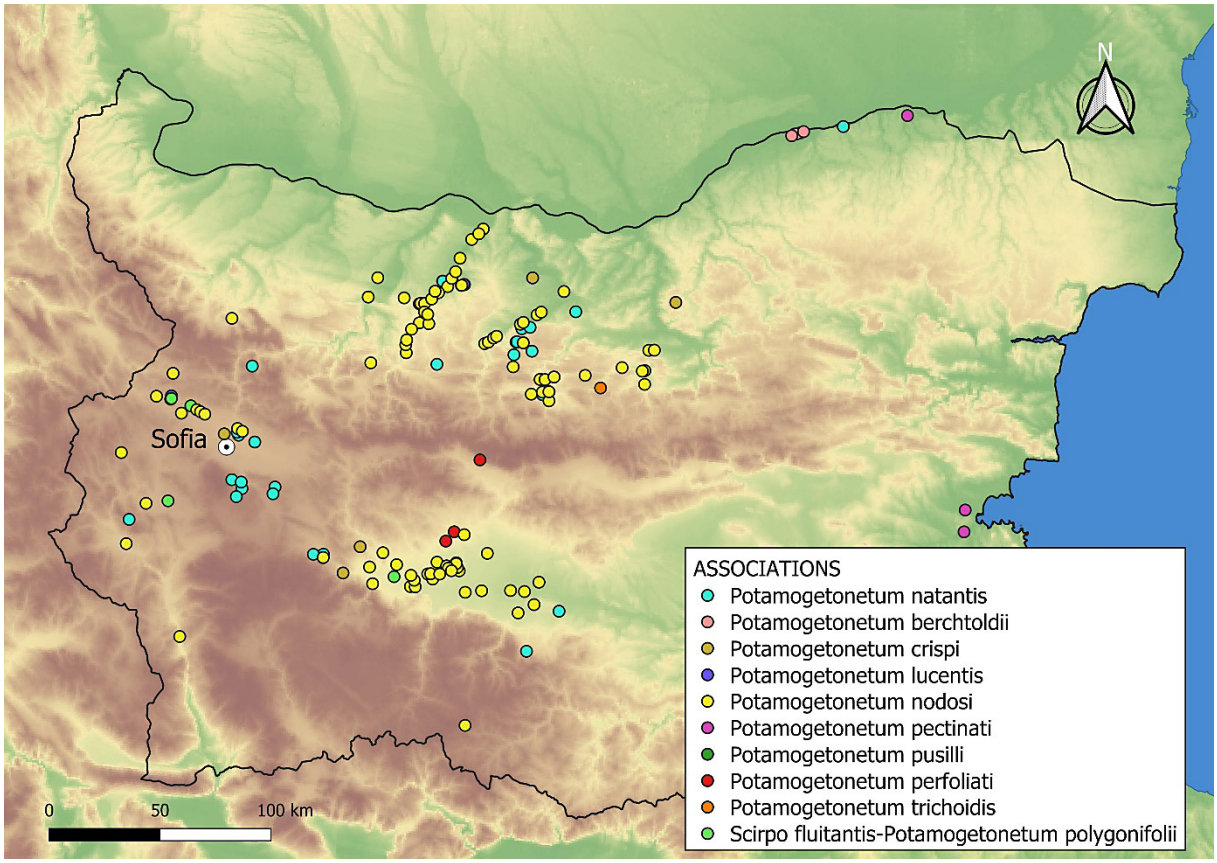

Fig. 1. Distribution of the studied associations in Bulgaria

to the Balkan vegetation database (EU-00-013) (Vassilev et al., 2020). The nomenclature of the species followed Stoyanov et al. (2022), and was subsequently standardized according to Euro+Med PlantBase (2024). The statistical analyses were performed by the PC-ORD (McCune and Mefford, 2006) software package, through the JUICE software for vegetation analyses (Tichý, 2002). Hierarchical clustering was performed using the Bray-Curtis dissimilarity and the flexible beta clustering algorithm. The diagnostic species were determined by calculating the Phi-coefficient and only the statistically significant values were considered. Species with coverage above 50% in at least in 20% of the releves in any cluster were considered as dominants, whereas constant species were those having at least 50% presence in a cluster.

Results and Discussion

Based on the hierarchical clustering performed, and the specialized literature on syntaxonomy we distinguished 1 class, 1 order, 3 alliances and 10 associations (Sanda et al., 2008, Šumberová, 2011, ,Landucci et al. 2015, Felzines, 2016, Hrivnák et al., 2019, Cvijanović et al., 2018, Zervas et al. 2020). All new associations for Bulgarian vegetation were marked with [*]. We propose the following syntaxonomical scheme:

Cl. *Potamogetonetea* Klika in Klika et Novák 1941
- Ord. *Potamogetonetalia* Koch 1926
  - All. *Potamogetonion* Libbert 1931
    - Ass. *Potamogetonetum denso-nodosi* de Bolós 1957
    - Ass. *Potamogetonetum pectinati* Carstensen 1955
    - Ass. *Potamogetonetum trichoidis* Freit et al. 1956*
    - Ass. *Potamogetonetum crispi* Soó 1927
    - Ass. *Potamogetonetum pusilli* von Soó 1927*
    - Ass. *Potamogetonetum lucentis* Hueck 1931
    - Ass. *Potamogetonetum berchtoldii* Wijsman ex P. Schipper, B. Lanj. & Schaminée *in* Schaminée, Weeda & V. Westh. 1995*
    - Ass. *Potamogetonetum perfoliati* Koch 1926 em. Passarge 1964*
    - Ass. *Potamogetonetum polygonifolii* Segal 1965*
  - All. *Nymphaeion albae* Oberd. 1957
    - Ass. *Potamogetonetum natantis* Soó 1927

Syntaxa descriptions

Ass. *Potamogetonetum natantis* Soó 1927 (Table 1, cluster 1-PA)

Constant species: *Potamogeton natans* (100), **Dominant species:** *Potamogeton natans* (90).

This was a widespread association located mainly in lowlands reaching up to an elevation of 1198 m a.s.l. (Fig. 1). It was found in slow-moving rivers, water reservoirs, and channels. The average water depth was 0.4 m. These phytocoenoses can be found at higher elevations than the other syntaxa.

The communities were species poor with an average of 2 species per relevé. Other species found in the floristic composition were *Ceratophyllum demersum, Myriophyllum spicatum, Elodea canadensis, Alisma plantago-aquatica, Typha laxmanii.*

This association was recorded for the first time in Bulgaria by Tzonev (2002). It is a widespread association in Europe and is well-documented for the Czech Republic (Šumberová, 2011, Landucci et al., 2015), Slovakia (Hrivnák et al., 2019), and Romania (Sanda et al., 2008).

Ass. *Potamogetonetum pusilli* von Soó 1927* (Table 1, cluster 2-PP).

Constant species: *Potamogeton pussilus* (100), Schoenoplectus spp. (100), **Dominant species:** *Potamogeton pusillus* (100).

This association is represented by 1 relevé only, and it was located in the Thracian lowland, in a water drainage channel near Saedinenie town (Fig. 1). It was a monodominant community of *Potamogeton pusillus* with a total cover of 90%.

This is a newly recorded association for the territory of Bulgaria. The species composition and vegetation structure are similar to such phytocoenoses in other European countries like the Czech Republic (Šumberová, 2011, Landucci et al., 2015), Slovakia (Hrivnák et al., 2019), and Romania (Sanda et al., 2008).

Ass. *Potamogetonetum lucentis* Hueck 1931 (Table 1, cluster 3-PL).

Constant species: *Potamogeton lucens* (100) **Dominant species:** *Potamogeton lucens* (75).

This association was locally distributed in the country in the Danubian plain and Sofia lowland (Fig. 1). The average depth of the water in the stands was 0.77 m. The phytocoenoses had a semi-open horizontal structure with an average total cover of 72%, the lowest among all established associations.

The phytocoenoses were dominated by *Potamogeton lucens*. It was among the syntaxa with a larger number of species, varying in the range 4–6. Other species found were *Sparganium erectum, Persicaria amphibia, Ceratophyllum submersum, Bidens tripartita*.

This association has been recorded for Bulgaria for the first time by Kochev et al. (1986). It is well documented for the Czech Republic (Šumberová, 2011, Landucci et al., 2015), Slovakia (Hrivnák et al., 2019), and Romania (Sanda et al., 2008).

Table 1. Shortened synoptic table for Potamogeton syntaxa in Bulgaria

Number of cluster	1		2		3		4		5		6		7		8		9		10	
Syntaxa	PA		PP		PL		PT		PE		PO		PC		SP		PB		PN	
Number of relevés	31		1		4		3		3		6		9		6		2		106	
Phi/PF	Phi/PF		Phi/PF		Phi/PF		Phi/PF		Phi/PF		Phi/PF		Phi/PF		Phi/PF		Phi/PF		Phi/PF	
Diagnostic species for ass. *Potamogetonetum natantis*																				
Potamogeton natans[2]	79	100	---	0	---	0	---	0	---	0	---	0	---	0	---	50	---	0	---	0
Diagnostic species for ass. *Potamogetonetum pusilli*																				
Potamogeton pusillus[2]	---	---	99	100	---	0	---	0	---	0	---	0	---	0	---	0	---	0	---	2
Diagnostic species for ass. *Potamogetonetum lucentis*																				
Potamogeton lucens	---	0	---	0	63	100	---	0	---	0	---	0	---	0	36	67	---	50	---	0
Diagnostic species for ass. *Potamogetonetum trichoidis*																				
Potamogeton trichoides	---	0	---	0	---	0	100	100	---	0	---	0	---	0	---	0	---	0	---	1
Diagnostic species for ass. *Potamogetonetum perfoliati*																				
Potamogeton perfoliatus	---	0	---	0	---	0	---	0	92	100	---	0	---	0	---	17	---	0	---	0
Diagnostic species for ass. *Potamogetonetum polygonifolii*																				
Potamogeton polygonifolius	---	0	---	0	---	0	---	0	---	0	100	100	---	0	---	0	---	0	---	0
Diagnostic species for ass. *Potamogetonetum crispi*																				
Potamogeton crispus[2]	---	0	---	0	---	0	---	0	---	0	---	0	69	100	55	83	---	0	---	2
Diagnostic species for ass. *Potamogetonetum pectinati*																				
Stuckenia pectinata[2]	---	3	---	0	---	25	---	0	---	0	---	0	---	0	88	100	---	0	---	0
Diagnostic species for ass. *Potamogetonetum berchtoldii*																				
Potamogeton berchtoldii	---	0	---	0	---	25	---	0	---	0	---	0	---	0	---	17	82	100	---	0
Diagnostic species for ass. *Potamogetonetum nodosi*																				
Potamogeton nodosus	---	0	---	0	---	0	---	0	---	0	---	0	---	0	---	17	---	0	92	100
Diagnostic species for ord. *Potamogetonetalia* & cl. *Potamogetonetea*																				
Utricularia vulgaris	---	0	---	0	50	50	---	0	---	0	---	0	---	0	30	33	---	0	---	1
Nymphaea alba[1]	---	0	---	0	48	25	---	0	---	0	---	0	---	0	---	0	---	0	---	0
Ceratophyllum submersum	---	0	---	0	48	25	---	0	---	0	---	0	---	0	---	0	---	0	---	0
Trapa natans	---	0	---	0	---	0	---	0	47	33	---	0	---	11	---	0	---	0	---	0
Zannichellia palustris	---	0	---	0	---	0	---	0	---	0	---	0	---	0	67	50	---	0	---	2
Myriophyllum verticillatum	---	0	---	0	---	0	---	0	---	0	---	17	---	0	56	50	---	0	---	1
Nuphar lutea[1]	---	3	---	0	---	0	---	0	---	0	---	0	---	0	56	33	---	0	---	0
Ranunculus aquatilis	---	0	---	0	---	0	---	0	---	0	---	0	---	0	56	33	---	0	---	0
Najas minor	---	0	---	0	---	0	---	0	---	0	---	0	---	0	69	50	---	0	---	0
Ceratophyllum demersum	---	0	---	0	---	0	---	0	---	0	---	17	---	22	42	83	---	100	---	21
Myriophyllum spicatum	---	29	---	0	---	25	---	67	---	0	---	33	---	11	37	83	---	50	---	31
Ranunculus trichophyllus	---	16	---	0	---	0	---	0	---	0	---	0	---	0	19	33	84	100	---	0
Diagnostic species for cl. *Phragmito-Magnocaricetea*																				
Sparganium erectum	---	3	---	0	57	50	---	0	---	0	---	0	---	11	---	0	---	0	---	5
Oenanthe aquatica	---	3	---	0	58	50	---	0	---	0	---	0	---	0	---	17	---	0	---	0
Schoenoplectus lacustris	---	0	---	0	---	0	---	0	---	0	53	33	---	0	---	0	---	0	---	0
Phalaroides arundinacea	---	3	---	0	---	0	---	0	---	0	39	17	---	0	---	0	---	0	---	0
Carex riparia	---	0	---	0	---	0	---	0	---	0	39	17	---	0	---	0	---	0	---	0
Mentha aquatica	---	0	---	0	---	0	---	0	---	0	39	17	---	0	---	0	---	0	---	0

Table 1. Continued

Myosotis scorpioides	---	0	---	0	---	0	---	0	---	0	---	0	---	0	39	17	---	0	---	0
Veronica anagallis-aquatica	---	0	---	0	---	0	---	0	---	0	---	0	---	0	39	17	---	0	---	0
Lycopus europaeus	---	0	---	0	---	0	---	0	---	0	---	0	---	0	39	17	---	0	---	0
Alisma gramineum	---	0	---	0	---	0	---	0	---	0	---	0	---	0	39	17	---	0	---	0
Glyceria maxima	---	0	---	0	---	0	---	0	---	0	---	0	---	0	39	17	---	0	---	0
Sagittaria sagittifolia	---	0	---	0	---	0	---	0	---	0	---	0	---	0	39	17	---	0	---	0
Alisma plantago-aquatica	---	0	---	0	---	25	---	0	---	0	---	0	---	0	36	33	---	0	---	1
Diagnostic species for cl. *Bidentetea*																				
Persicaria amphibia[1]	---	6	---	0	48	25	---	0	---	0	---	0	---	0	---	0	---	0	---	0
Alopecurus aequalis	---	0	---	0	---	0	---	0	---	0	---	0	---	0	39	17	---	0	---	0
Rumex palustris	---	0	---	0	---	0	---	0	---	0	---	0	---	0	39	17	---	0	---	0
Diagnostic species for cl. *Lemnetea*																				
Lemna trisulca	---	0	---	0	---	0	---	0	---	0	---	0	---	0	80	67	---	0	---	0
Spirodela polyrhiza	---	0	---	0	---	0	---	33	---	0	---	0	---	11	---	17	74	100	---	6
Lemna minor	---	3	---	0	---	0	---	33	---	0	---	0	---	33	41	83	53	100	---	24
Diagnostic species for cl. *Juncetea maritimi*																				
Bolboschoenus maritimus	---	6	---	0	---	0	---	0	---	0	---	0	---	0	68	50	---	0	---	1
Diagnostic species for cl. *Zosteretea*																				
Zostera noltii	---	0	---	0	---	0	---	0	---	0	---	0	---	0	56	33	---	0	---	0
Zostera marina	---	0	---	0	---	0	---	0	---	0	---	0	---	0	56	33	---	0	---	0
Diagnostic species for cl. *Charetea intermediae*																				
Chara vulgaris	---	0	---	0	---	0	---	0	---	0	---	0	---	0	39	17	---	0	---	0
Diagnostic species for cl. *Molinio-Arrhenatheretea*																				
Agrostis stolonifera	---	0	---	0	---	0	---	0	---	0	---	0	---	0	39	17	---	0	---	0
Other species																				
Cladophora fracta	---	0	---	0	---	0	---	0	---	0	---	0	---	0	39	17	---	0	---	0
Rhizoclonium hieroglyphicum	---	0	---	0	---	0	---	0	---	0	---	0	---	0	39	17	---	0	---	0
Enteromorpha intestinalis	---	0	---	0	---	0	---	0	---	0	---	0	---	0	39	17	---	0	---	0

In the table Fidelity is given as Phi, whereas Percentage frequency is given as PF. Were used following abbreviations for syntaxa: PA - ass. Potamogetonetum natantis; PP - ass. Potametum pusilli; PL - ass. Potametum lucentis; PT - ass. Potamogetonetum trichoidis; PE - ass. Potamogetonetum perfoliati; PO - ass. Potamogetonetum polygonifolii; PC - ass. Potamogetonetum crispi; SP - ass. Potamogetonetum pectinati; PB - ass. Potametum berchtoldii; PN - ass. Potamogetonetum nodosi. Legend: 1 - Diagnostic species for all. Nymphaeion albae; 2 - Diagnostic species for all. Potamogetonion.

Ass. *Potamogetonetum trichoidis* Freit et al. 1956* (Table 1, cluster 4-PT).

Constant species: *Myriophyllum spicatum* (67) **Dominant species:** *Potamogeton trichoides* (67).

The phytocoenoses of the association were found along river Yantra and a drainage channel in the Thracian lowland (Fig. 1). The average elevation of stands was 239 m a.s.l., and water depth between 2 cm and 80 cm.

Potamogeton trichoides, which is a species included in Appendix 3 of the Biodiversity Law in Bulgaria, was monodominant in the phytocoenoses. The number of species was between 2 and 4. Other common species found in the communities were *Elodea canadensis* and *Butomus umbellatus*.

This was one of the newly-established associations in the country. It is distributed in Romania (Sanda et al., 2008), Slovakia (Hrivnák et al., 2019), the Czech Republic (Šumberová, 2011, Landucci et al., 2015) and Greece (Zervas et al. 2020).

Ass. *Potamogetonetum perfoliati* Koch 1926 em. Passarge 1964* (Table 1, cluster 5-PE)

Constant species: *Potamogeton perfoliatus* (100), **Dominant species:** *Potamogeton perfoliatus* (100).

These communities prefer relatively deep water bodies with an average depth of 80 cm. The average elevation was

493 m a.s.l., which was the second highest after ass. *Potamogetonetum natantis*. The phytocoenoses of this association were very species-poor, and dominated by *Potamogeton perfoliatus*. In one locality *Trapa natans* was recorded. The communities had an average total cover of 89%.

This was the first record of this association for Bulgaria. The association is documented for the Czech Republic (Šumberová, 2011, Landucci et al., 2015), Slovakia (Hrivnák et al., 2019), Romania (Sanda et al., 2008), Greece (Zervas et al. 2020) and France (Felzines, 2016).

Ass. *Potamogetonetum polygonifolii* Segal 1965* (Table 1, cluster 6-PO).

Constant species: *Potamogeton polygonifolius* (100) **Dominant species:** *Potamogeton polygonifolius* (100).

This association was found in a fishpond in the Thracian lowlands (Blato River), and close Sofia lowland (near Aldomirovsko Lake) (Fig. 1). The communities were mainly located above 200 m a.s.l., and can reach up to 660 m a.s.l. of elevation. Compared to the other associations, this one preferred more acidic water. The phytocoenoses had an average total cover of 82%. They were species-poor with up to 4 species. The dominant species was *Potamogeton polygonifolius*. Other common species were *Myriophyllum spicatum, Trapa natans, Ceratophyllum demersum*.

It was a relatively rare vegetation and a newly recorded association for the country. It is also known for the Czech Republic (Šumberová, 2011, Landucci et al., 2015).

Assoc. *Potamogetonetum crispi* von Soó 1927 (Table 1, cluster 7-PC).

Constant species: *Potamogeton crispus* (100) **Dominant species:** *Potamogeton crispus* (100).

Before the current study, this association was described for Bulgaria with only 1 relevé (Tsonev, 2009). It generally inhabits both moving rivers (Yantra River, Vidima River, Kakach River), and reservoirs (Zarnovets Reservoir). The communities were found at elevations in the range of 45–521 m.

The stands had between 1–4 species, and the average total cover was 90%. *Potamogeton crispus* was the dominant species. Other common species with a low cover were *Lemna minor, Ceratophyllum demersum,* and *Myriophyllum spicatum*. It is widely spread in the Czech republic (Šumberová, 2011, Landucci et al., 2015), Slovakia (Hrivnák et al., 2019), Romania (Sanda et al., 2008), Greece (Zervas et al. 2020) and France (Felzines, 2016).

Ass. *Potamogetonetum pectinati* Carstensen 1955 (Table 1, cluster 8-SP).

Constant species: *Myriophyllum spicatum* (83), *Lemna minor* (83), **Dominant species:** *Stuckenia pectinata.*

The phytocoenoses of *Stuckenia pectinata* were located along the Danube River, Vidima River, Bourgas Lake, and Mandra Reservoir (Fig. 1). *Stuckenia pectinata* stands have higher levels of salinity than the other *Potamogeton* associations in Bulgaria. This was the association inhabiting more shallow water bodies with an average depth of 0.27 m.

The communities had open horizontal structures with an average total cover of 73%. They were the most species-rich among the described associations with up to 19 species in a sample plot. *Stuckenia pectinata* was the dominant species. Other species in the floristic composition were *Zostera marina, Najas minor, Myriophyllum spicatum, M. verticillatum, Potamogeton crispus, P. lucens, Zannichelia palustris, Lemna trisulca, L. minor, Ceratophyllum demersum*.

This association was recorded for Bulgaria at first by Kochev et al. (1986), as a plant community and Tzonev et al. (2009), assigned it to an association level. It is widely spread in the Czech republic (Šumberová, 2011, Landucci et al., 2015), France (Felzines, 2016), Slovakia (Hrivnák et al., 2019), Greece (Zervas et al. 2020) and Romania (Sanda et al., 2008).

Assoc. *Potamogetonetum berchtoldii* Wijsman ex P. Schipper, B. Lanj. & Schaminée in Schaminée, Weeda & V. Westh. 1995* (Table 1, cluster 9-PB).

Constant species: *Lemna minor* (100), **Dominant species:** *Potamogeton berchtoldii* (67).

This vegetation type was found along the Danube River, close to Nova Cherna village at elevation between 15-17 m. a.s.l. (Fig. 1), and represented by 2 relevés. Kochev et al. (1986) assigned its phytocoenoses as a plant community type.

Phytocoenoses had a moderately species-poor species composition including 5–7 species. *Potamogeton berchtoldii* was the dominant species. In the species composition *Ceratophyllum demersum, Spirodela polyrhiza, Ranunculus trichoides,* and *Lemna minor* were recorded also.

Based on the numerical analyses, we classified phytocoenoses of *Potamogeton berchtoldii* to *Potamogetonetum berchtoldii* association which is a new one for the Bulgarian vegetation. It has been recorded for France (Felzines, 2016), and Slovakia (Oťaheľová, 2011).

Ass. *Potamogetonetum denso-nodosi* (Soó 1960) Segal 1964 (Table 1, cluster 10-PN).

Constant species: *Potamogeton natans* (100), **Dominant species:** *Potamogeton nodosus* (98)

Potamogetonetum nodosi was the most widespread association in the study area with 107 relevés. Most of them are located in the Thracian lowlands, Danubian plain, Forebalkan, and Sofia lowlands (Fig. 1). The average water depth of the stands was 0.31 m. They were found at elevations be-

tween 22 and 1322 m a.s.l., but generally preferred the lower end of the range with an average elevation of 233 m a.s.l.

The phytocoenoses had an average total cover of 85% and were dominated by *Potamogeton nodosus.* The communities were species-poor with 1–7 species. Common species were *Ceratophyllum demersum, Myriophyllum spicatum, Elodea canadensis, Lemna minor, Spirodela polyrhiza, Sparganium erectum.*

It has been recorded for the Czech Republic (Šumberová, 2011, Landucci et al., 2015), Slovakia (Hrivnák et al., 2019), Greece (Zervas et al. 2020), Serbia (Cvijanović et al., 2018) and Romania (Sanda et al., 2008).

Conclusion

This research expanded our knowledge of the *Potamogeton* communities in Bulgaria. A total of 10 associations dominated by *Potamogeton* were studied, and 5 associations were established for the first time on the territory of Bulgaria (*Potamogetonetum polygonifolii, Potamogetonetum berchtoldii, Potametum pusilli*, *Potamogetonetum trichoidis*, *Potamogetonetum perfoliati*). The distribution of all 10 associations has been mapped and the most widespread were *Potamogetonetum denso-nodosi* and *Potamogetonetum natantis.* The biggest species diversity was found in *Potamogetonetum pectinati.*

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