ECOLOGIA BALKANICA
2019, Vol. 11, Issue 1 June 2019 pp. 161-166

Macrophyte-based Assessment of Ecological Status of Aldomirovsko and Dragomansko Marshes, Bulgaria

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Abstract. The study was conducted in Dragomansko and Aldomirovsko marshes situated in west Bulgaria. During 2017 sampling was carried out between July and September within belt transects: 17 transects in Dragomansko marsh and 9 in Aldomirovsko marsh. Data of aquatic plants and abiotic habitat parameters were collected in a zigzag pattern along each transect. The applied Reference Index evaluates two aspects of macrophyte community: taxonomic composition (assigned to 1 of 3 indicator groups) and abundance (DAFOR scale: dominant, abundant, frequent, occasional and rare), which are combined into one multimetric. Sixty-three taxa were found on the territory of the marshes, twenty of which common for both marshes. Helophyte species had higher representation in Aldomirovsko marsh (51%), whereas in Dragomansko marsh their percent share was 38%. Based on the analysis of the aquatic macrophytes the assigned ecological status for both Dragomansko (RI=8.36) and Aldomirovsko (RI=0) marshes was moderate.

Key words: macrophytes, wetland vegetation, karst marshes.

Introduction

Dragomansko and Aldomirovsko marshes (Fig. 1) are shallow karst lakes, often drying up during the summer months, located in west Bulgaria, north-west from Sofia in the Znepole region (STEFANOV, 2002). Both marshes are included in the National Environmental Framework (Aldomirovsko swamp is categorized as protected area, Dragomansko as Ramsar site) and provide habitats for many plants, invertebrates and birds (SHURULINKOV, 2014). The water bodies belong to the national lake type L4: lowland or semi-mountain natural lakes and swamps in Pontic province.

The studies on the wetland flora and vegetation in both lakes started in the beginning of 20th century with the extensive research of JORDANOFF (1931) which reported as most widespread *Phragmites australis*, *Equisetum fluviatile*, *Typha angustifolia*, *Scirpus lacustris*, *Glycera maxima*, *Eleocharis palustris*, *Carex acuta*, *C. melanostachya* associations. Hygrophyte vegetation had limited distribution. Later STOYANOFF (1935) studied floristic diversity in Aldomirovsko and Dragomansko marshes, which was represented by 26 and 71 macrophyte species respectively. KOCHEV & YURUKOVA (1984) thoroughly investigated vegetation

diversity of both lakes which was presented by 16 formations and 17 associations. Vegetation and flora of Aldomirovsko marsh has been also studied by APOSTOLOVA *et al.* (2001). During 2005-2007 after the final restoration of Dragoman marsh TRAYKOV & TOSHEVA (2015) found 180 vascular plants on its territory.

The role of the macrophytes in lakes is well-known and has been studied in many researches. Macrophytes create fundamentally different environmental conditions in shallow lakes (SØNDERGAARD & MOSS, 1997). They also respond to changes in the environment and are reliable indicators of ecosystem health. With increasing of eutrophication, the species diversity of aquatic macrophytes generally declines, and the species communities are being replaced by monoculture-forming strong competitors (REJMÁNKOVÁ, 2011).

Based on the above, our study aimed to assess the aquatic macrophyte composition and ecological status of the marshes.

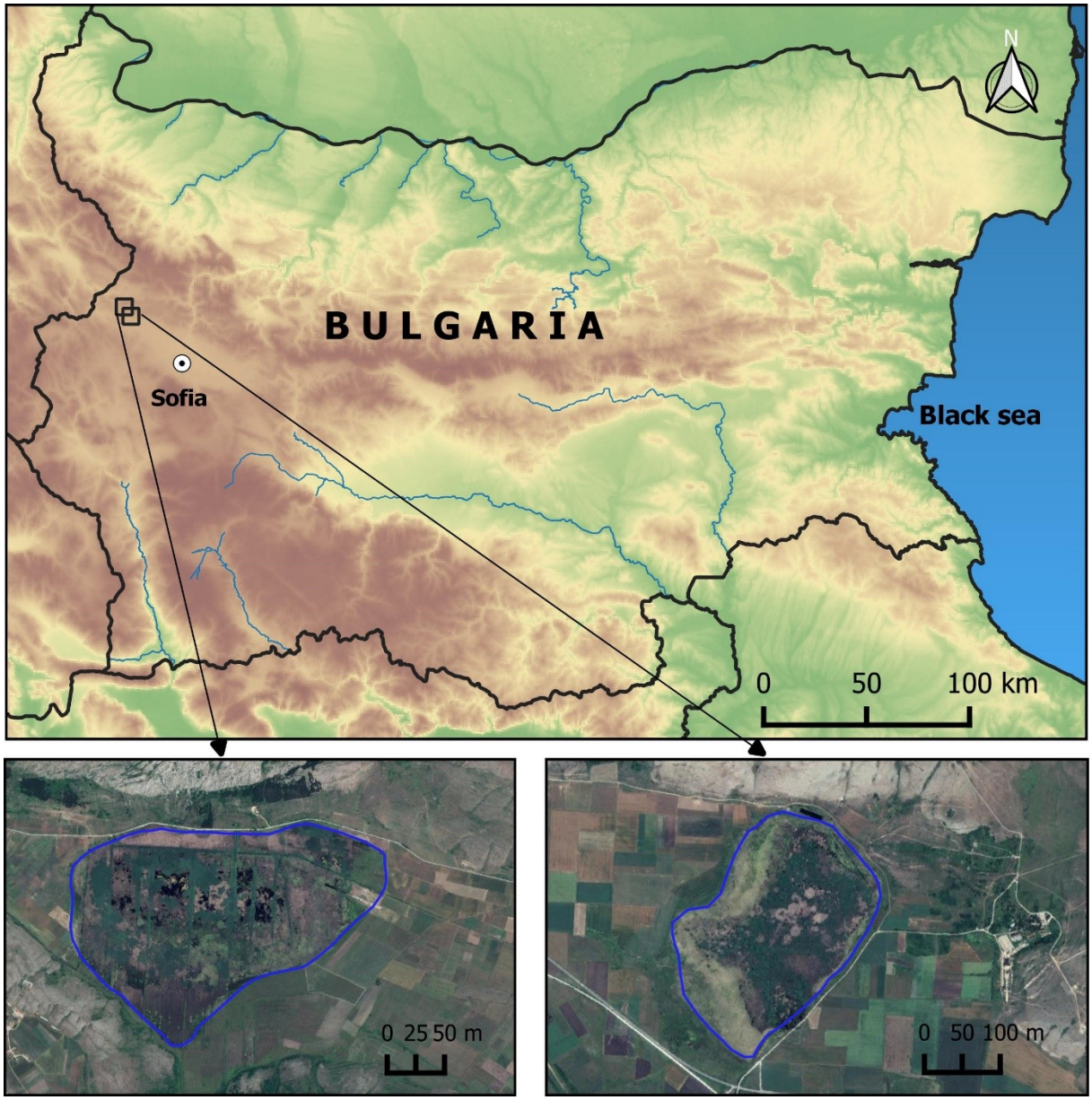

Fig. 1. Location of studied water bodies on the territory of Bulgaria.

Material and Methods

Sampling was carried out in 2017 between July and September within belt transects: 17 transects in Dragomansko marsh, respectively 9 in Aldomirovsko, covering the entire area of both marshes (331 and 129 ha). The sampling procedure included the collection of aquatic plants and the recording of abiotic habitat parameters in a zigzag pattern along each transect. The abundance of plant species was estimated on site using a five-scale system (KOHLER, 1978) similar to the commonly used DAFOR scale. The level of aquaticity that characterized the taxon's affinity to water was according CHAUVIN (after BIRK *et al.*, 2007). The nomenclature followed DELIPAVLOV *et al.* (2003).

Reference Index (RI) and transformation into ecological quality ratio (EQR) were calculated after GECHEVA *et al.* (2013). For the assessment, the species were designated to three different groups: "reference taxa", "indifferent taxa" and "degradation indicators". The relative share of these different groups decides of the ecological class of the investigated transect. The ecological quality class (Table 1) of the water body results from averaging the results of the single transects.

Table 1. Class boundaries for RI and EQR, L4.

Ecological status	RI	EQR
High	100 - 66	1 – 0.83
Good	65 - 16	0.82 – 0.58
Moderate	15 - -58	0.57 – 0.21
Poor	-59 - -100	0.20 – 0
Bad		Macrophyte depopulation

Results and Discussion

Community structure of macrophytes in the studied marshes

Flat mud-dominated lake shore was character for Aldomirovsko marsh. Considerable amount of detritus and solid waste were found. The Dragomansko marsh shore had flat to medium slope and was mud-dominated.

Sixty-three taxa were found on the territory of both marshes, among them 19 were not directly connected with water or are tree species (Table 2). Twenty of the total 63 species were common for both marshes.

Thirty-three species were recorded in Aldomirovsko marsh, 17 helophytes, 5 hygrophytes and 6 hydrophytes. The most common species were *Schoenoplectus lacustris*, *Carex riparia*, *Typha latifolia*, *Phalaris arundinacea* and *Phragmites australis*.

Fifty species were registered in Dragomansko marsh, 16 helophytes, 12 hygrophytes and 3 hydrophytes. The most abundant species were *Carex riparia, Typha latifolia, Schoenoplectus lacustris, Phalaris arundinaceae* and *Phragmites australis*.

Considering the lake size and water level, there were few differences in the species abundances in the two marshes. Helophytes represented 32% of total species in Dragomansko marsh, while they had 51% share in Aldomirovsko marsh. Also in Dragomansko marsh 38% of the observed species were non-aquatic, including trees.

Hydrophytes were represented by *Ceratophyllum demersum*, *C. submersum*, *Hydrocharis morsus-ranae*, *Lemna minor*, *L. trisulca*, *Myriophyllum verticulatum* and *Potamogeton lucens*. Their assemblages should be maintained due to the impact of these plants on the dynamics of nutrients,

dissolved organic and inorganic carbon, oxygen, and pH.

Ecological status

Among the recorded species in Aldomirovsko marsh were no representatives of the "reference taxa" group instead of domination of indifferent indicators: *Schoenoplectus lacutris, Potamogeton lucens* and *Ceratophyllum submersum*.

Studied transects in Dragomansko marsh had different ecological status assessment. Most of the transects were in good status based on species composition and abundance. Reference indicator *H. morsus-ranae* was recorded in two transects, while one transect was dominated by indifferent and disturbance taxa. This could be a result of the untreated domestic wastewater discharge from Dragoman town (SHURULINKOV, 2014).

Based on the analysis of the aquatic macrophytes the assigned ecological status for both Dragomansko (RI=8.36) and Aldomirovsko (RI=0) marshes was moderate status. Thus, they may require management measures as a reduction in nutrient load in order to reach a good ecological status.

Table 2. List of species and level of aquaticity. Legend: 1-Exclusively aquatic species (or mainly aquatic in regular conditions); 2-Aquatic taxon with common terrestrial forms or truly amphibious (common aquatic forms as well as terrestrial forms); 3-Supra-aquatic bryophytes and lichens. Commonly submerged a part of the hydrological cycle; 4-Helophytes or Amphiphytes. Erected forms with basis commonly inside water; 5-Hygrophilous taxa. Possibly submerged (at least the basis) a part of the year; 6-Bank, wood, grasslands or ruderal herbaceous species. May be found in water accidentally or in conditions of high flow; 7-Woody riparian species. May be flooded temporarily; 8-Brackish water or salty marshes species.

Species	Aquaticity
Aldomirovsko	
Hydrophytes	
Ceratophyllum demersum	1
Ceratophyllum submersum	1
Lemna minor	1
Myriophyllum verticullatum	1
Potamogeton lucens	1
Potamogeton polygonifolius	1
Hygrophytes	
Bidens tripartita	5
Epilobium hirsutum	5
Epilobium palustre	5
Ranunculus repens	6
Ranunculus sceleratus	n.a.
Helophytes	
Agrostis stolonifera	4
Alisma plantago-aquatica	4
Butomus umbellatus	4
Carex riparia	n.a.
Eleocharis palustris	4
Iris pseudacorus	4
Juncus inflexus	4
Lysimachia nummularia	5
Lysimachia vulgaris	5
Lythrum salicaria	5
Persicaria amphibia	2
Phalaris arundinacea	4
Phragmites australis	4
Scirpus lacustris	1
Sparganium erectum	4
Typha angustifolia	4
Typha latifolia	4
Cirsium arvense	n.a.
Dipsacus laciniatus	n.a.
Galium aparine	n.a.
Salix alba	n.a.
Dragomansko	
Hydrophytes	

Ceratophyllum submersum	1
Hydrocharis morsus-ranae	1
Lemna trisulca	1
Hygrophytes	
Bidens tripartita	5
Epilobium hirsutum	5
Epilobium roseum	n.a.
Holcus lanatus	6
Lamium sp.	n.a.
Mentha spicata	6
Persicaria lapathifolia	6
Ranunculus repens	6
Rumex conglomeratus	n.a.
Scrophularia umbrosa	n.a.
Solanum dulcamara	5
Urtica dioica	6
Helophytes	
Agrostis stolonifera	4
Carex riparia	n.a.
Juncus inflexus	4
Juncus effusus	4
Lycopus europaeus	4
Lysimachia nummularia	5
Lysimachia vulgaris	5
Lythrum salicaria	5
Persicaria hydropiper	4
Phalaris arundinacea	4
Phragmites australis	4
Potentilla reptans	n.a.
Scirpus lacustris	1
Sparganium erectum	4
Typha angustifolia	4
Typha latifolia	4
Other	
Calamagrostis arundinaceae	n.a.
Chamomilla recutita	n.a.
Clematis vitalba	n.a.
Conyza canadensis	n.a.
Cirsium arvense	n.a.
Dipsacus laciniatus	n.a.
Elymus repens	n.a.
Erigeron annuus	n.a.
Galium aparine	n.a.
Latyrus tuberosus	n.a.
Populus alba	n.a.
Prunus cerasifera	n.a.
Rubus caesius	n.a.
Sambucus ebulus	n.a.
Scutellaria hastifolia	n.a.
Sonchus asper	n.a.
Salix sp.	n.a.
Salix alba	n.a.
Salix purpurea	n.a.

Conclusions

Most common species in both marshes were helophytes *Schoenoplectus lacutris, Potamogeton lucens and Ceratophyllum submersum*, with dominance of *C. riparia*. Helophytes dominated in Aldomirovsko marsh, while hydro- and hygrophytes had similar percent share with helophytes in Dragomansko marsh.

Both marshes support rich macrophyte communities, with total of 63 species observed. Nineteen of the species listed for the area were not considered aquatic or are tree species. Their presence suggests a naturally occurring process of drought in both marshes, concentrated mainly in the peripheral areas.

Both marshes were assessed in moderate ecological status and management measures should be implemented to reach a good status, e.g. providing a flow regime which ensures the current extent of wetland communities and a reduction in nutrient load.

Considering the lack of previous researches on the ecological status of these water bodies, this study presents a basis for specific conditions within the lake type for future researches regarding the ecosystem potential, services and sustainable development of protected wetlands in Bulgaria.

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Received: 30.01.2019
Accepted: 15.04.2019