

REVIEW OF AQUATIC VEGETATION OF THE REGIONAL PARK "STARI BEGEJ"

B. Butorac

Butorac, B. (1995): Review of aquatic vegetation of the regional park "Stari Begej". - Tiscia 29, 27-32.

Abstract. Within the Regional Park "Stari Begej" the following macrophyte associations have been recorded: *Nymphaeetum albo-luteae* Nowinski 1928, *Hydrochari-Nymphoidetum peltatae* Slavnić 1956 and *Trapetum natantis* Müller et Görs 1960. These associations were first mentioned in this area by Gigov and Gyôrfy in 1960. The authors also distinguished the *Myriophyllo-Potametum* Soó 1934 community, which is no longer present in the waters of this protected area.

Preliminary studies of aquatic vegetation showed that in this habitat the association *Wolffietum arrhizae* Myaw. et Tx. 1960 (*Lemnetea* class) developed. The following new associations were found in the region: *Salvinio-Spirodeletum polyrrhizae* Slavnić 1956, *Lemnetum trisulcae* Soó 1927, and *Lemno-Utricularietum vulgaris* Soó (1928) 1938.

Key words: aquatic community, floating vegetation, submerged vegetation.

B. Butorac, Institute of Nature Protection of the Republic of Serbia, Department in Novi Sad, Petrovaradinska tvrđava 3, Novi Sad, Yugoslavia.

Introduction

The Regional Park Stari Begej is located in Vojvodina - in the north-eastern part of Yugoslavia, at the estuary of river Begej into the river Tisza, and is a remnant of the floodplain between the two rivers. The seven parts reported in Butorac and Stojšić (1991-1992) are characterized by a mosaic-like vegetation of swamps, marshes, flooded and periodically flooded forests.

The heterogeneous flora and vegetation of this protected area are hardly known. The only data on the vegetation are from 1960 published by Gigov and Gyôrfy. They surveyed the aquatic, swamp and flooded-forest vegetation of dried-up Carska Bara, Vojtina Mlaka and Mala Bara. Therefore only certain parts of the Regional Park were investigated from floristic, phytogeographic or phytocenological point of view, and other parts were not visited. Some supplements were given to the knowledge of aquatic vegetation of this protected area by Butorac and Stojšić (1991-1992). The authors reported about the first discovery of *Wolffietum arrhizae* association, the stands of the smallest flowering plant on some parts of the protected area which are occasionally flooded by the river Begej.

In the past, when the human influence was

significantly smaller, the whole area was exposed to floods because of its low terrain (72-74 m a.s.l.), and the characteristics of the vegetation are just due to those conditions. Regulation of the riverbed at the beginning of this century reduced the flooded areas. Some twenty years ago the extended flood-prevention works resulted in even more drastic changes in the landscape. The typical habitat was changed by canalization of a part of river Begej which was cut off at the 15th km and directed to a newly excavated riverbed (i.e. canal). The old riverbed of the Begej, which is about 10 km in length, was surrounded with an embankment, and separated from the river Begej alive (Ham, 1975). Thanks to the controlled water regime, the inundation of the low terrain from the old riverbed has been reduced and less frequent, having an important influence on the recent vegetation.

Material and Methods

Phytocenological relevés were taken in the protected area in 1990, 1991 and 1992 according to the method of Braun-Blanquet (1964). Collected plants were determined after Jávorka (1925), Jávorka and Csapody (1934) and Josifović (1970-1986). Syntaxonomic status of the species was given from

Soó (1964-1980). Associations and subassociations were identified according to the first literature descriptions. Syntaxonomic status of associations and subassociations was determined from Soó (1973) and Parabućski et al. (1986).

Results and discussion

The following syntaxa of aquatic vegetation of marshes, flooded areas and the old riverbed of Begej could be distinguished according to Soó (1973) and Parabućski et al. (1986):

Class: *Lemnetea* W. Koch et Tx. 1954
 Order: *Lemnetalia* W. Koch et Tx. 1954
 Alliance: *Lemnion minoris* W. Koch et Tx. 1954
 Ass.: *Wolffietum arrhizae* Myawaki et Tx. 1960
 Ass.: *Salvinio-Spirodeletum polyrrhizae* Slavnić 1956
 Ass.: *Lemnetum trisulcae* Soó 1927, Knapp et Stoffers 1962, Trinajstić 1964
 Alliance: *Hydrocharition* Rübél 1933
 Ass.: *Lemno-Utricularietum vulgaris* Soó (1928) 1938

Class: *Potametea* Tx. et Prsg 1942
 Order: *Potametalia* W. Koch 1926
 Alliance: *Nymphaeion* Oberd. 1956 emend. Neuhausl 1959
 Ass.: *Nymphaetum albo-luteae* Nowinski 1928 (syn.: *Myriophyllo-Nupharetum* W. Koch 1926)
 Subass.: *nymphaetosum* (Timár) Kárpáti
 Subass.: *nupharetosum* (Timár) Kárpáti
 Ass.: *Hydrochari-Nymphoidetum peltatae* Slavnić 1956
 Ass.: *Trapetum natantis* Müller et Görs 1960

In the Regional Park "Stari Begej", three associations of the alliance *Lemnion minoris* were recorded (see Table 1).

1. *Wolffietum arrhizae*

This association developed on four localities between the embankment and the old riverbed of Begej, south of Vojtina Mlaka (cf. Butorac and Stojšić, 1991-1992). This paper reported for the first time on the floating stands of the smallest macrophytes in this region. Poor floristic composition and the cenological characteristics reflected on a specific water regime of the habitat. In

Table 1. Phytosociological relevés from *Lemnion minoris* and *Hydrocharition* communities.

	1	2	3	4	5	6	7	8	9	10	11	12
Association character species and <i>Lemnion minoris</i> W. Koch et Tx. 1954 ex Oberd. 1957 and <i>Hydrocharition</i> Rübél 1933												
<i>Wolffia arrhiza</i> (L.) Wimm *	5.4	5.4	5.5	-	-	-	-	-	-	-	-	-
<i>Salvinia natans</i> (L.) All. **	-	-	-	3.2	2.2	2.2	3.2	-	+	-	-	-
<i>Spirodela polyrrhiza</i> (L.) Schleid. **	+1	1.1	+1	+1	2.1	2.2	3.1	+1	-	-	-	-
<i>Lemna trisulca</i> L. ***	4.4	4.2	4.4	1.2	-	-	-	5.5	5.5	2.2	2.1	2.1
<i>Lemna minor</i> L. ****	3.3	2.1	1.1	5.1	1.1	2.1	2.1	1.1	2.1	2.1	3.1	3.1
<i>Utricularia vulgaris</i> L. ****	-	-	-	-	-	-	-	-	-	5.5	4.4	4.4
<i>Lemnetalia</i> W. Koch et Tx. 1954 and <i>Lemnetea</i> W. Koch et Tx. 1954												
<i>Hydrocharis morsus-ranae</i> L.	-	-	-	4.2	1.1	2.1	1.1	-	+1	-	-	-
<i>Myriophyllum spicatum</i> L.	-	-	-	2.2	-	1.1	1.1	-	-	-	-	-
<i>Ceratophyllum demersum</i> L.	-	-	-	4.2	-	+	-	-	-	-	-	-
<i>Najas marina</i> L.	+1	-	+1	-	-	-	-	-	-	-	-	-
<i>Nuphar luteum</i> Sm.	-	-	-	-	-	-	1.1	-	-	-	-	-
<i>Trapa natans</i> (agg.)	-	-	-	-	-	+1	-	-	-	-	-	-
Accessory species												
<i>Phragmites communis</i> Trin.	-	-	-	+1	1.1	1.1	-	-	-	-	-	+1
<i>Typha latifolia</i> L.	-	2.1	-	-	-	-	-	+	-	-	-	-
<i>Polygonum amphibium</i> L.	-	-	-	+1	-	-	-	-	-	1.1	-	-
<i>Glyceria aquatica</i> Presl.	-	-	-	-	1.1	-	-	-	-	-	-	-

Legend

Lemnion minoris W. Koch et Tx. 1954 ex Oberd. 1957
 **Wolffietum arrhizae* Miyawaki et J.Tx. 1960 = 1,2,3
 ***Salvinio-Spirodeletum polyrrhizae* Slavnić 1956 = 4,5,6,7
 ****Lemnetum trisulcae* Soó 1927 = 8,9
Hydrocharition Rübél 1933
 *****Lemno-Utricularietum vulgaris* Soó 1928 = 10,11,12

Sites
 Stari Begej = 1,2,3,4,8,9
 Kanal = 5
 Carska bara = 6,10,11,12
 Perleska bara = 7

accordance with periodical drying up in the warmest months (particularly during the last few years), the ecological conditions have changed in the habitats, and became similar to those in the most shallow, warm, still waters of Vojvodina. These alterations caused a somewhat different structural appearance of *Wolffietum arrhizae*, when compared to the stands near village Bokros and other areas in Hungary (Szalma et al., 1985; Fintha, 1984). *Utricularia vulgaris* and *Stratiotes aloides* were not recorded together with *Wolffia arrhiza*, similarly to the situation on some Hungarian areas (Fintha, 1984).

2. *Salvinio-Spirodeletum polyrrhizae*

Slow or no water flow in certain periods of year, lukewarm, eutrophic water (Branković, 1992) and other changed parameters of water regime conditioned visible exuberant growth of the character species of this associations: *Salvinia natans* and *Spirodela polyrrhiza*, corresponding to the results of some other authors (Slavnić, 1956; Topić, 1989; Stojanović, 1990). Well-developed stands of *Salvinio-Spirodeletum polyrrhizae* association were found near the bank of the old riverbed of Begej, as well as in the canals that supply the surrounding pools with water. Recently they are, however, muddy and covered by vegetation. Particularly large number and coverage of the edificator species of this association was noticed at widened bends of those lateral canals, as well as near the bank of the old riverbed of Begej. At those places the speed of water decreased and the water is more shallow, but still deep enough to develop certain differences in floristic composition of the stands.

This association becomes the most apparent in August. *Salvinia natans*, *Spirodela polyrrhiza* and *Lemna minor* have a huge importance in the stands of *Salvinio-Spirodeletum polyrrhizae* association. According to the data from Slavnić (1956), Stojanović et al. (1990), Rauš et al. (1978, 1980) and Szalma (1987-1988) it is a heliophytic floating community, which forms a thick green "carpet" on the water surface. Investigations in the Regional Park "Stari Begej" showed, however, that submerged forms are also included in the floristic composition of this association, species from the genera *Myriophyllum* and *Ceratophyllum*. The total coverage is increased by dense populations of *Hydrocharis morsus-ranae*.

3. *Lemnetum trisulcae*

This association of the submerged duckweed has a relatively limited extension in the Regional Park "Stray Begej". It only developed in fragments at some places along the old riverbed of Begej, from

Vojtina Mlaka to Perleska Bara. These terrains are occasionally flooded, sometimes even up to the roots of old willow trees at the embankment, which is the western border of the Regional Park. The stands of this monoculture association develop in the shade of willow trees, and are of submerged-hydrophytic character as it was recorded by Rauš et al. (1978) and Topić (1989). The latter author points out that submerged layers are at the depth from a few cm to several dm. The dominant species of this association is the pseudofloating *Lemna trisulca*, i.e. this scyophytic species (Landolt, 1977) occurs totally submerged in the water but close to the surface, giving the impression of a floating vegetation (Janković, 1972; Janković et al., 1987, 1988). This species influences the physiological processes of the plants in the deeper water layers, reducing there the light intensity.

4. *Lemno-Utricularietum vulgaris*

This association is the only one from the alliance *Hydrocharition* (Table 1.), and located in only one part - Carska Bara. The duckweed - bladder-wort community is the final successional stage of the smallest aquatic vascular plants. It is similar to *Salvinio-Spirodeletum polyrrhizae* association, and there is no distinct ecological or spatial boundary between them.

The character species distinguishing this associations from those mentioned above are *Utricularia vulgaris* and the species of the genus *Lemna*. *Utricularia vulgaris* is an insectivorous species, and since withdraws from the aquatic habitats of Vojvodina, it is on the list of "Red Data Book of Serbia".

Water depth, eutrophicity, light and temperature regime are the most important background factors in development and survival of its floristic composition and cenological structure.

5. *Nymphaeetum albo-luteae*

It is an important association of the Strict Nature Reserve "Carska Bara", and its another locality was found in the old riverbed of Begej, close to village Perlez. This association is the main character of aquatic vegetation of Perleska Bara. Waterlily community is the association of the largest aquatic macrophytes, occurring in the Carska Bara as a more or less wide belt, and is in direct contact with the stands of hydro-helophytic vegetation at the bank zone. The main structural and physiognomic characteristics of this species poor association are given by white and yellow water-lilies, *Nymphaea alba* and *Nuphar luteum*. They contribute to the beauty of the scenery, and are protected

representatives of the pool-swamp ecosystems. These are differential species of the subassociations: *nymphaetosum* and *nupharetosum*. Third species of this community is the water chestnut, *Trapa natans* agg. (i.e. *Trapa longicarpa* M. Jank. 1954 ssp. *perlongicornis* M. Jank. 1986 var. *cornata* (Nath.) Glck. 1936), but its density and dispersion are low. The water layers below these floating forms are filled with dense populations of only one species, *Ceratophyllum demersum*.

Restricted stands of this association have somewhat more complex structure in the old riverbed of Begej, with an important contribution of *Hydrocharis morsus-ranae*, *Salvinia natans*, and the presence of *Myriophyllum spicatum* was also established (Table 2).

Ecology of *Nymphaetum albo-luteae* association is greatly influenced by two character species characterized by strong and often very long rhizomes (trunks), laid horizontally on the bottom, by which these hydrophytes spread quickly and smoothly. They occupy the water surface by large floating leaves, and the bottom is largely muddied by their dead parts.

6. *Hydrochari-Nymphoidetum peltatae*

The stands of frogbit-fringed water-lily association are adapted to very shallow, well-illuminated, slow, warm waters, such as Vojtina Mlaka is. They were found in the vegetation of Carska Bara in certain years only, when water level was extremely low, with high temperature and illumination. This association can not be developed in deeper, cooler water of the old riverbed of Begej with at least occasional waterflow.

The habitats suitable for its optimum development are also characterized by high organic production, with enormous layer of mud on the bottom. These conditions indicate a very strong eutrophication. In the last years, high emergent plants such as reed (*Phragmites communis*), bulrush (*Typha latifolia* and *Typha angustifolia*), sweet-grass (*Glyceria maxima*), bur-reed (*Sparganium ramosum*) have been expanding closer and closer to the center of the water of Carska Bara.

The basic aspect of *Hydrochari-Nymphoidetum peltatae* is given by the character species of the association: *Nymphoides flava* (syn: *Nymphoides peltata*). *Hydrocharis morsus-ranae* and some other floating macrophytes, which are the character species of the alliance, order and class, play an important role in floristic composition and physiognomy.

Table 2. Phytosociological relevés from *Nymphaeion* and *Potametalia* communities.

	1	2	3	4	5	6	7	8	9	10	11	12
Association character species and Nymphaeion Oberd. 1956 emend Neuhausl 1959												
<i>Nymphaea alba</i> L. *	4.1	4.4	4.4	4.4	-	-	-	-	-	-	-	-
<i>Nuphar luteum</i> Sm. *	-	-	1.1	2.2	3.3	3.5	-	-	-	-	-	-
<i>Nymphoides flava</i> Hill.	-	-	-	-	-	-	5.5	5.5	4.4	-	-	-
<i>Hydrocharis morsus-ranae</i> L. **	1.2	2.2	1.1	1.1	1.1	1.2	2.2	2.2	3.2	1.2	3.1	-
<i>Trapa natans</i> (agg.) ***	1.1	-	1.1	-	+1	2.2	1.1	1.1	1.2	3.2	3.4	4.2
Potametalia W. Koch 1926 and Potametea Tx. et Prsg. 1942												
<i>Ceratophyllum demersum</i> L.	3.2	-	3.2	2.2	-	-	1.1	1.1	2.2	3.3	3.3	4.5
<i>Myriophyllum spicatum</i> L.	-	1.1	3.2	1.1	-	3.1	-	-	-	3.3	-	+1
<i>Najas marina</i> L.	-	-	-	-	-	1.1	-	-	-	-	2.1	2.2
<i>Potamogeton crispus</i> L.	+1	+1	-	1.1	-	-	-	+1	-	-	-	-
<i>Ranunculus circinatus</i> Sibth.	-	-	-	+1	-	-	-	1.1	-	-	-	-
Accessory species												
<i>Salvinia natans</i> (L.) All.	2.2	2.1	-	1.1	-	2.2	+	-	-	1.2	3.2	-
<i>Spirodela polyrrhiza</i> (L.) Sch.	1.1	-	-	1.1	-	1.1	-	-	-	1.1	-	-
<i>Lemna minor</i> L.	+1	-	-	-	-	1.1	-	+1	-	+1	-	-
<i>Lemna trisulca</i> L.	-	-	-	-	-	2.2	-	-	-	-	-	2.2
<i>Rorippa amphibia</i> (L.) Bess.	-	-	-	-	-	-	-	1.1	-	-	-	-

Legend:

- * *Nymphaeetum albo-luteae* Nowinski 1928 = 1,2,3,4,5,6
- ** *Hydrochari-Nymphoidetum peltatae* Slavnić 1956 = 7,8,9
- *** *Trapetum natantis* Müller et Görs 1960 = 10,11,12

Sites

- Carska Bara = 1,3,6,12
- Stari Begej = 2,10,11
- Perleska bara = 4,5
- Vojtina Mlaka = 7,8,9

7. *Trapa natantis*

This association is the dominant floating community in Carska Bara. Its edifier and often the only species is the water chestnut (*Trapa natans*), the species aggregate. On the basis of fruit morphology, we can state that this taxon is *Trapa longicarpa* M. Jank. 1954 ssp. *perlongicornis* M. Jank. 1986 var. *cornata* (Nath.) Glck. 1936 (Janković in Josifović, 1986) which is often present in the water-lily community.

The monotonous and compact stands cover entirely the area of Carska Bara so that often one can not see open water surface. The shallow water, thick mud layer and densely interlaced rhizomes, submerged leaves make boat passage impossible. Lack of waves and moves of already shallow water, with decomposition of organic remnants, contribute to the increase of water temperature, which also favours sprouting and spreading of water chestnut. Here it should be emphasized that, according to the literature, the fruits of the relict and protected genus *Trapa* are resistant to low temperature, so it can survive for some time even in frozen state.

The monotonous scenery is brightened up by the stands of water-lily at fringes and the autumn aspect, when floating rosettes of the water chestnut appear like a spotted carpet on the water surface. Under this layer, dense submerged mass of the horn wort (*Ceratophyllum demersum*) appears, which decrease the possibilities of shipping.

Stands of *Trapa natantis* association were found in the slow water of river Stari Begej. Their structure is different, and have lower number and coverage of the basic edifier species. From the floating coenobionts, the participation of *Salvinia natans* and *Hydrocharis morsus-ranae* is significant, and sometimes *Spirodela polyrrhiza* occurs. Because of deeper and cooler water, the scyphylic *Ceratophyllum demersum*, important by its coverage, and *Najas marina*, on an open sandy bottom, were found in the old riverbed of the Begej. Presence of latter species was not fully expected, because the stands of this association are typical for shallow and warm water with muddy bottom.

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