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MACROPHYTES OF THE LAKES TRNOVAČKO JEZERO, VELIKO STABANJSKO JEZERO, AND MALO STABANJSKO JEZERO ON MT. VOLUJAK (MONTENEGRO)

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Abstract - The present paper gives results of floristic investigations of macrophytes in lakes on Mt. Volujak, the spatial distribution of the recorded species, and basic ecological characteristics of the milieu of life in the investigated biotopes.

Key words: Mountain lakes, vascular plants, charophytes, flora, ecology

UDC 581.9(479.16 Mt. Volujak)

INTRODUCTION

With its geomorphological, hydrographic, climatic, and other specific characteristics, Montenegro represents an inexhaustible challenge for naturalists to spend time frequently on its territory and study its natural assets. In that way, they discover new data, fill out existing knowledge, and follow and interpret observed changes. In the given context, the flora and vegetation of aquatic ecosystems, especially glacial lakes (of which Montenegro possesses an abundance) represent a significant field for botanical research.

From the botanical aspect, the greatest attention of investigators has in the past been focussed on the lowland Lake Skadar, which is the largest lake in Montenegro (Černjavski *et al*. 1949; Janković and Blaženčić, 1973; Janković, 1983; Blaženčić and Blaženčić, 1983a; Ristić and Vizi, 1981; Lakušić and Pavlović, 1981), while the republic's mountain lakes have been less studied. The mountain lakes have been investigated from time to time, starting in 1967 (Ivanović *et al*. 1968). More thorough floristic-faunistic investigations of these lakes were initiated in 1979 (Petković, 1984). Since that time, more intensive research has been started on the flora and vegetation of about 30 lakes in the Prokletije Range and on Mts. Bjelasica, Sinjajevina, Durmitor, and Volujak.

Most of the results obtained in these investigations have already been published (Blaženčić and Blaženčić, 1986, 1989, 1994, 1994a, 1994b, 1997; Blaženčić *et al*. 1994, 1995). The present paper gives results of floristic and ecological study of macrophytes of the lakes Trnovačko Jezero, Veliko Stabanjsko Jezero, and Malo Stabanjsko Jezero on Mt. Volujak.

MATERIAL AND METHODS

Study of the macrophytic flora in lakes of Mt. Volujak was carried out in August of 1987 (the lakes Malo Stabanjsko Jezero and Veliko Stabanjsko Jezero) and 1988 (the lake Trnovačko Jezero). Before collection of samples of plant material, air and water temperatures were measured with a mercury thermometer having a sensitivity of 0.2°C. Clarity of the water was established with the aid of a Secchi disk, while its reaction (pH) was determined with a special paper indicator (Merch 6.4-8.0). Physical features and characteristics of bottom relief were recorded on transects and transverse profiles.

Investigation of the flora and vegetation was conducted by means of observation from the shore and from a light boat by the method of transects and transverse profiles. Along each of the latter, samples were taken "dotwise," i.e., at enough points to get a full picture of the floristic diversity of vegetation and the distribution of populations of the recorded species.

Samples were collected with the aid of special rakes (Blaženčić and Blaženčić, 1991) and immedi-

ately fixed on site with 4% formaldehyde. By analyzing a large number of samples from a dense network of transects "covering" vegetation of the littoral, it is possible to ascertain its floristic composition and the spatial distribution of populations of aquatic plants, which can be precisely enough shown on bathymetric charts. The bathymetric charts used in the present work were taken from Stanković (1998).

Laboratory processing of samples was done at the Institute of Botany of the University of Belgrade's Faculty of Biology, in whose collection the material is stored.

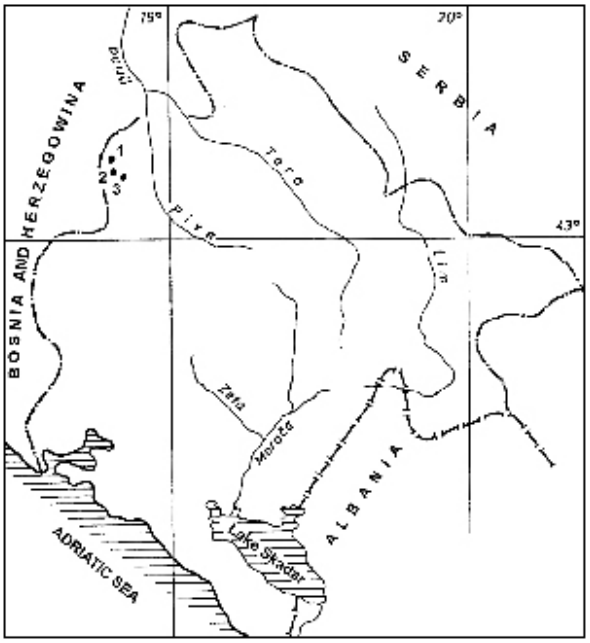

Fig.1. Geographical position of the lakes Trnovačko Jezero (1), Veliko Stabanjsko Jezero (2) and Malo Stabanjsko Jezero (3) in Montenegro.

Algae of the section Charophyta were identified using the keys of Corillion (1957, 1975), Gollerbakh and Krasavina (1983), and Krause (1997), while identification of vascular plants was performed on the basis of the following literature: Flora of the USSR, Vol. 1 (Komarov and Ilin, 1934); Flora von Mitteleuropa, Vol. 1 (Hegi, 1965); Flora of the Socialist Republic of Serbia, Nos. 1-8 (ed. by Josifović, 1977-1979); and Flora Europaea, Vol. 5 (Dandy and Valentine, 1980).

RESULTS AND DISCUSSION

The lake Trnovačko Jezero. The lake Trnovačko Jezero is located in the northwestern part of Montenegro between the mountains Volujak and Maglić on the border with Bosnia-Herzegovina (Fig. 1). The lake also goes by the name of Volujačko Jezero from Mt. Volujak. It lies at an elevation of 1517 m above sea level, and its geographic coordinates are 43° 15´ N latitude and 18° 43´ E longitude. It is located in a spacious basin in the middle of the region's highest limestone masses (Stanković, 1998).

The lake Trnovačko Jezero is kidney-shaped, about 800 m long, and approximately 700 m wide. It has a poorly indented shoreline. The lake's greatest depth is 9.0 m. The water is clean and very transparent. The bottom is clearly visible to a depth of 4.0 m, and maximal water clarity was 7.0 m.

The lake is fed water from precipitation, sublacustrian springs, and short brooks, and loses water through

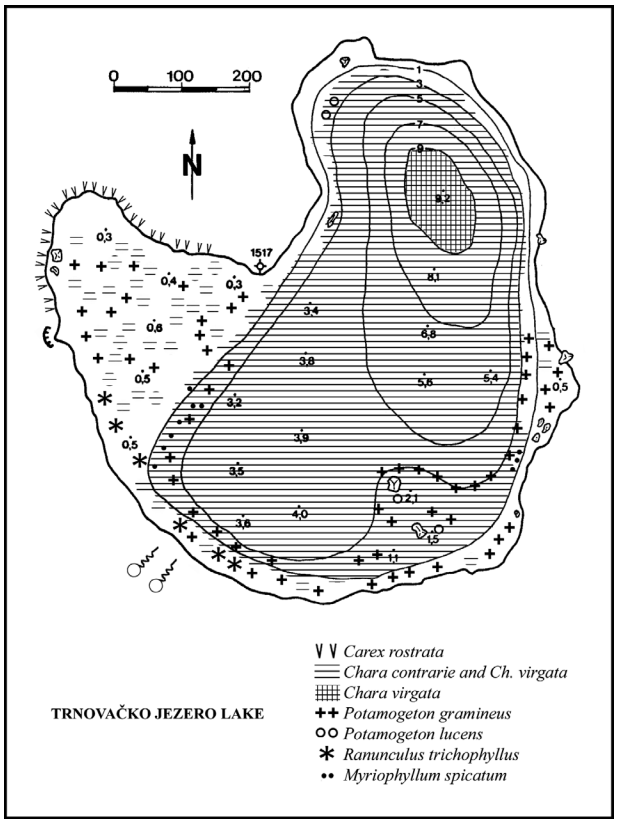

Fig. 2. The distribution of macrophytes in the lake Trnovačko Jezero.

sinkage and evaporation. The seasonal amplitude of fluctuation in the level of water is about 100 cm. Temperature of the upper layers of water on sunny summer days varies from 15 to 21°C and differs little from air temperature (12.5 to 23.8°C).

The reaction of water of the lake Trnovačko Jezero is neutral to weakly alkaline (pH from 7.0 to 7.8). On the basis of the amount of dry residue (74 mg/l) and other indices of chemical composition (S t a n k o v i ć , 1998), it can be concluded that the lake's water is characterized by high purity.

In addition to water clarity as one of the most significant factors, relief and physical properties of the bottom and the littoral zone are also important for development and spatial distribution of plants in lakes. The shoreline of the lake Trnovačko Jezero is characterized by considerable diversity. There are scree slopes, morainal deposits, and material (sediment) deposited at its mouth by a short brook originating below the Bare Spring.

The bottom of the lake Trnovačko Jezero is completely overgrown with hydrophilic vegetation (Fig. 2). Submersed plants are absolutely dominant in it, floating plants occur sporadically, and there is no zone of emersed plants (Fig. 2).

Even though there is no zone of emersed plants, of plants belonging to this zone, specimens of *Carex rostrata* Stokes in With are found at certain places in offshore shallows. As for the zone of floating plants, it occurs in the form of a single discontinuous "concealed" belt at a depth of between 0.5 and 2.5 m. The only floating plant on the given lake is *Potamogeton gramineus* L. This species is characterized by the existence of submersed and floating leaves. Most of the plants of this species at the time of our investigations exhibited development of only submersed leaves, and floating leaves were developed solely on certain plants in shallow parts of the lake. Inasmuch as individuals of this species are found at depths of from 0.5 to 2.5 m, there is little probability that examples from greater depths will "throw out" floating leaves before the end of the vegetation season at these elevations. Thus, even though there are plants with floating leaves that could in view of their distribution in the lake build a floating belt, such a belt is nevertheless not formed because floating leaves of most of the plants of this species do not rise to the water's surface.

The bottom of the aquatic basin of the lake Trnovačko Jezero is completely covered by submersed plants. In this vegetation belt and throughout the entire lake, the species *Chara contraria* A.Br. and *Chara virgata* Kutz are absolutely dominant. This characteristic is so typical of the given lake that it can be designated a "lake of the *Chara* type" (Fig. 2). Down to a depth of 3.0 m, populations of the two mentioned species occur mosaically in mixed associations with vascular plants of the species *Potamogeton gramineus*, *Ranunculus trichophyllus*, *Myriophyllum spicatum*, and *Potammogeton lucens* (Fig. 2, Table 1). At lesser depths (1 to 2 m), *Chara contraria* and *Chara virgata* are either equally represented, or else *Chara contraria* is more abundant. The abundance ratio changes with increase of depth, *Chara virgata* becoming increasingly abundant and in many places covering the bottom in the form of pure populations. Morphological characteristics of the thallus also change with increase of depth, especially in individuals of the species *Chara contraria*, in which characteristics of the form *capillacea* Mig. become more and more pronounced. Charophytes are in the phase of fructification.

On plants from shallow parts of the lake (to a depth of 2.0 m), there is a well-developed coating composed mainly of algae, while numerous larvae of aquatic animals are present in the rhizoidal part. The plants are also very incrusted with calcium carbonate ($CaCO_3$). Calcification decreases with depth, so that plants from the greatest depths are almost completely without a calcified wrapping around their thalli. Numerous "packets" of snail eggs are also present on the thalli of these algae.

The temperature of water in the surface layers (20.6°C) differed insignificantly from air temperature (23.8°C). The temperature of water in vegetation declined with depth, but did so very slowly, with the result that the difference between temperature in the surface layer and temperature at a depth of 4 m (17.5°C) comprised 3.1°C.

The Stabanjska Jezera Lakes (*Veliko Stabanjsko Jezero* and *Malo Stabanjsko Jezero*). These lakes are found in the western part of Montenegro on the Bioče mountain massif, which makes up the eastern part of Mt. Volujak (Fig. 1). The lake Veliko Stabanjsko Jezero lies at an elevation of 1319 m above sea level, while the lake Malo Stabanjsko Jezero is at 1194 m. The geographic coordinates of the former are 43° 11' 40" N latitude and 18° 43' 35" E longitude, while those of the latter are 43° 11' 10" N latitude and 18° 43' 40" E longitude (S t a n k o v i ć , 1998). Like the lake Trnovačko Jezero, the Stabanjska Jezera Lakes are glacial in origin. They lie on limestone and receive water from precipitation, while the lake Veliko Stabanjsko Jezero has two temporary tributaries as well. Water is lost from the lakes through evaporation and filtration. Both lakes are characterized by great seasonal

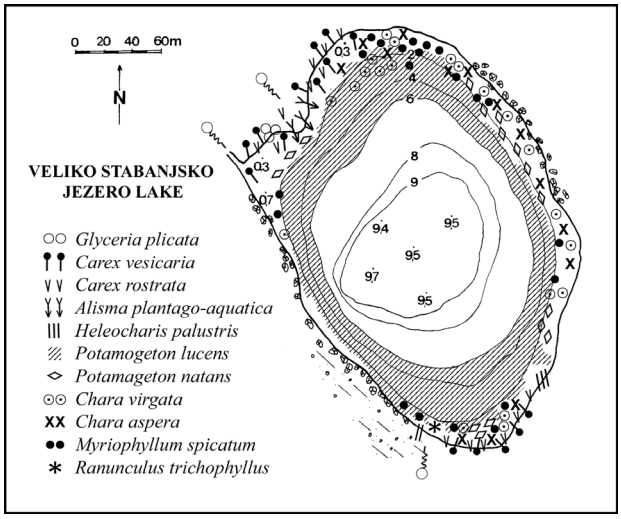

Fig. 3. The distribution of macrophytes in the lake Veliko Stabanjsko Jezero.

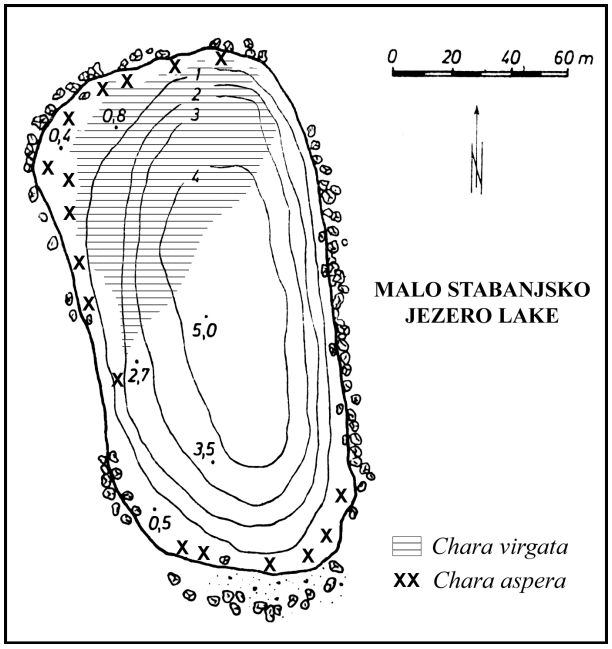

Fig. 4. The distribution of macrophytes in the lake Malo Stabanjsko Jezero.

fluctuations of the water level. The water level throughout the year varies 4 to 5 m in the lake Veliko Stabanjsko Jezero and as much as 17 to 18 m (!) in the lake Malo Stabanjsko Jezero. According to S t a n k o v i ć (1998), the chemical composition of water in these two lakes is similar. The reaction is neutral (pH = 7.3), and nitrate, nitrite, ammonia, iron, and manganese are lacking. The lakes are characterized by somewhat elevated content of sulphate (17.3 and 16 mg/l, respectively), which comes from schists. Total hardness (5.6 °pH for Veliko and 6.7 °pH for Malo) points to significant representation of limestones in the watersheds, as is also indicated by the recorded quantity of calcium (36.0 mg/l for Veliko Jezero and 50.4 mg/l for Malo Jezero).

The Lake Veliko Stabanjsko Jezero is oval-shaped, with the long axis oriented in a northwesterly direction. It is about 300 m long and around 200 m wide. The shoreline is weakly indented. Boulders are found around the lake, and the shore is formed by sediment at places where periodic streams flow into it. Maximal depth of the lake is 9.5 m. Water clarity is 6.5 m. The water is clear and dark-green in color. The bottom in the southeast and northwest parts of the lake is gently sloping, and hydrophilic vegetation in these places is significantly better developed and more diverse than in parts of the lake characterized by a steep and rocky bottom (Fig. 3).

Three zones of aquatic plants are distinguishible in vegetation of the lake Veliko Stabanjsko Jezero. Along the shore is a narrow and discontinuous belt of semi-aquatic plants. This zone is replaced and sometimes broken up by a zone of floating plants, while the widest zone in the lake is formed by submersed plants. They are also present in the two preceding zones, but in somewhat deeper water build underwater plant communities by themselves.

The emersed zone in shallows near the lake's banks from the shoreline to a depth of 0.5 m is built of the following species: *Carex vesicaria* L., C. *rostrata*, *Heleocharis palustris* (L.) R.Br., *Glyceria plicata* Fr., and *Alisma plantago-aquatica* L. Also recorded in this zone are the submersed species *Ranunculus trichophyllus*, *Chara virgata*, and *Chara aspera* Willd., which occur there mosaically to build mixed plant communities with semi-aquatic plants. Moving deeper (from 0.5 to 2.5 m), such vegetation is replaced by a discontinuous belt of floating plants. Only one floating species—*Potamogeton natans* L.—is found in this zone, and the following submersed species are also present in it in varying floristic and quantitative ratios: *Potamogeton lucens*, *Myriophyllum spicatum*, *Chara virgata,* and *Chara aspera*. With increase of depth and depending on relief of the bottom, there is an increase in the abundance and coverage of submersed species. Gentle bottom slopes to a depth of 2.0 m are overgrown by populations of charophytes in the form of underwater carpets among which are found examples of the species *Myriophyllum spicatum*. Between 2.0 and 3.0 m of depth, the dominant species in vegetation is *Potamogeton lucens*, which at greater depths (3.0 to 6.0 m) builds the monospe-

cific subassociation *Potamogetonetosum lucentis* J. and Ž. Blaž. subass. n. (Fig. 3).

The Lake Malo Stabanjsko Jezero is located in a beech grove at the bottom of a deep funnel-shaped doline. The banks, especially the east and west banks, are very steep and rocky. The bottom of the lake, particularly near the shore, is muddy. Although it is small and shallow in summer, the lake Malo Stabanjsko Jezero becomes several times larger in spring or at times of heavy precipitation. On the basis of tracks visible on shore, we were able to establish that the boundary of the highest water level is located 17 to 18 m above the water level at the time of our investigations. The water is yellowish-green in color and transparent to a depth of 3.0 m. The greatest measured depth was 5.0 m.

The lake's macrophytic flora is represented by only two species of charophytes: *Chara virgata* and *Chara aspera*. A dense population of *Chara virgata* overgrows the muddy bottom in the north and northwest parts of the lake at depths of from 0.5 to 4.5 m (Fig. 4). Mixed populations of the species *Ch. virgata* and *Ch. aspera* appear in shallower parts of the lake in places where the muddy bottom passes over into a rocky bottom, while only sparse and low bushes of *Ch. aspera* are present next to the shore itself (0.1-0.2 m), where they develop on detritus between rocks and boulders.

There are no vascular macrophytes in the lake Malo Stabanjsko Jezero. The main factor preventing the development of vascular plants in this lake is the exceptionally great seasonal amplitude of fluctuation in the water level (17-18 m!). As a result of this fluctuation, the lake is a suitable habitat for survival of only submersed macrophytes adapted both to deep water (which is present at times of high water levels) and to shallow water (present when the water level is low), and *Chara virgata* and *Chara aspera* are precisely such species.

In the western and central parts of the Balkan Peninsula, both *Chara virgata* and *Chara aspera* are widely disseminated species (Blaženčić and Blaženčić, 2003). They are found in aquatic ecosystems on a limestone geological substrate in water with a neutral to basic reaction (pH 7.2 to 8.0) in mixed or pure populations (Blaženčić and Blaženčić, 1994c; Blaženčić *et al.* 1990; Bruisma *et al.* 2000). Analysis of vertical distribution at many localities in this region makes it clear that: a) both species can be found to depths of 6.0 m; b) populations of *Chara virgata* are found at considerably greater depths (to 12 m); c) populations of *Chara aspera* are most abundant in off-shore fresh or brackish waters (0.2 to 1.5 m); and d) *Chara virgata* is dominant in deeper water (around 5.0 m and deeper). The regularities recorded in the course of earlier investigations are confirmed by analysis of the vertical distribution of charophytes in lakes on Mt. Volujak. Survival of the species *Chara aspera* in shallow waters of mountain lakes in regions with a moderately continental climate or in maritime bogs (Zavodnik, 1968) is probably promoted by the tubers formed by this species in the rhizoidal part, which enable the plants to withstand unfavorable conditions and allow for relatively rapid vegetative reproduction.

In cases of aquatic ecosystems characterized by great amplitudes of fluctuation in the water level, charophytes are also reliable indicators of minimal water levels. To be specific, the outer boundaries of their populations are most often also the boundaries of the lowest water levels in a given habitat. Thus, it is possible on their basis to judge indirectly the minimal annual water level, just as it is possible on the basis of indicators on shoreline rocks to draw indirect conclusions about the highest water levels.

Located at a short distance apart from each other, the lakes Veliko Stabanjsko Jezero and Malo Stabanjsko Jezero are also a good example illustrating the fact that the appearance, development, and survival of aquatic macrophytes are in the presence of the same climatic conditions, geological characteristics of the substrate, and physico-chemical characteristics of the water—decisively influenced by the dynamics of hydrological phenomena, physical properties and morphometry of bottom relief, and adaptive characteristics of the species.

Floristic Survey of Species in Lakes on Mt. Volujak and Their Dissemination in Montenegro

Carex rostrata Stokes in With. (bottle sedge). The species has been previously recorded at 14 localities around lakes, beside brooks, and on boggy terrains at elevations ranging from 6 to 1678 m above sea level (Rohlena, 1942; Blaženčić and Blaženčić, 1996, 2005; Blaženčić *et al.* 1993/94; Muravev, 1935; Lakušić and Jovanović, 1997; Birks and Walters, 1972/73). The lakes Trnovačko Jezero, Veliko Stabanjsko Jezero, and Malo Stabanjsko Jezero are newly recorded habitats for this species.

Carex vesicaria L. (bladder sedge). This species has been recorded before at eight localities beside and around lakes on Mt. Durmitor at elevations of from 1319 to 1773 m above sea level (Pančić, 1874; Rohlena, 1942; Birks and Walters, 1972/73; Blaženčić and Blaženčić, 2005; Blaženčić *et al.* 1993/94). The lake Veliko Stabanjsko Jezero is a newly recorded habitat for this species.

Heleocharis palustris (L.) R.Br. The given species has been recorded at a greater number of localities (around 30) in ditches, swamps, bogs, and marshes from low-lying to mountainous regions at elevations ranging from 6 to 1678 m above sea level (Pančić, 1874; Adamović, 1913; Rohlena, 1942; Černjavski *et al.* 1949; Birks and Walters, 1972/73; Lakušić and Pavlović, 1976; Blaženčić and Blaženčić, 1983a, 1992/93, 1994a, 1996, 2005; Blaženčić *et al.* 1993/94). The lake Veliko Stabanjsko Jezero is a newly recorded locality for this species.

Glyceria plicata Fr. (plicate sweet-grass). The species has been recorded at four localities in ditches, beside brooks, around springs, and on the shores of lakes on the Zoljevica near Andrijevica, in the vicinity of Berane, on Mt. Durmitor, and in the dale Crtov Do below Mt. Ledenica at elevations of 690 to 1600 m above sea level (Rohlena, 1942). The lake Veliko Stabanjsko Jezero is a newly recorded locality for this species.

Alisma plantago-aquatica L. (water plantain). This species is widely disseminated in Montenegro. It grows in swamps, in ditches, and on the banks of rivers, canals, and lakes at elevations ranging from 1.0 to 1311 m above sea level. It has been recorded at a greater number of localities (Adamović, 1913; Rohlena, 1942; Smarda, 1968; Lakušić, 1983; Černjavski *et al.* 1949; Lakušić and Pavlović, 1973, 1976; Blaženčić and Blaženčić, 1983a, 1989, 2004; Blaženčić and Cvijan, 1980). The lake Veliko Stabanjsko Jezero is a newly recorded locality for this species.

Potamogeton natans L. The given species has been recorded at a greater number of localities (around 20), most often in standing waters (lakes, fish farms, stagnant tributaries, bogs, canals). It is distributed from low-lying to mountainous regions at elevations of from 6 to 1780 m above sea level (Pančić, 1874; Stanković, 1934; Rohlena, 1942; Lakušić and Pavlović, 1976; Covich and Knežević, 1981; Petković, 1981; Lakušić, 1983; Petković and Petković, 1986; Blaženčić and Blaženčić, 1989, 1992/93, 1993/94, 1994a, 1996, 1997, 2005; Blaženčić *et al.* 1993/94). The lake Veliko Stabanjsko Jezero is a newly recorded locality for this species.

Myriophyllum spicatum L. This species is distributed in standing and slowly flowing waters, in bogs, and on the banks of rivers, brooks, and lakes. In Montenegro, it has been recorded in many places ranging from lowlands (Lake Skadar) to mountain localities such as lakes on Mt. Durmitor and other high mountains. It is distributed at elevations ranging from 6 to 1517 m above sea level (Pančić, 1874; Adamović, 1913; Ristić and Vizi, 1981; Lakušić, 1969, 1983; Lakušić and Pavlović, 1976, 1981; Blaženčić and Blaženčić, 1983a, 1986, 1992/93, 1996, 1997; Janković *et al.* 1980; Blaženčić and Cvijan, 1980; Blaženčić *et al.* 1993/94; Čuturilo and Ratković, 1983; Rakočević, 2000). The lakes Trnovačko Jezero and Veliko Stabanjsko Jezero are newly recorded habitats for this species.

Locality Species	VS	T	MS
Glyceria plicata	0 - 0,5	-	-
Carex vesicaria	0 - 0,5	-	-
Carex rostrata	0 - 0,5	0 - 0,5	-
Alisma plantago-aquatica	0 - 0,5	-	-
Heleocharis palustris	0 – 0,2	-	-
Potamogeton natans	0,5 – 2,5	-	-
Potamogeton gramineus	-	0,5 – 2,5	-
Potamogeton lucens	0,5 – 6,0	2,0 – 2,5	-
Ranunculus trichophyllus	0,5 – 1,0	0,5 – 1,0	-
Myriophyllum spicatum	0,5 – 3,0	1,0 – 2,0	-
Chara aspera	0,1 – 2,0	-	0,1 – 2,0
Chara contraria	-	0,5 – 8,0	-
Chara virgata	0,2 – 2,0	0,5 – 9,0	0,5 – 4,5

Table 1. The macrophytes in the lakes Veliko Stabanjsko jezero (VS), Trnovačko jezero(T) and Malo Stabanjsko jezero. (The number in the table show depth in metres).

Potamogeton lucens L. The given species is distributed in rivers and lakes, as well as on fish farms. In Montenegro, it has been recorded at many places, from lowlands (Lake Skadar, 6 m above sea level) to mountain localities up to 1440 m above sea level (such as lakes on Mt. Durmitor and in the Prokletije Mountains) (Pančić, 1874; Rohlena, 1942; Černjavski *et al.* 1949; Smarda, 1968; Blaženčić and Cvijan, 1980; Janković *et al.* 1980; Covich and Knežević, 1981; Blaženčić and Blaženčić, 1983, 1983a, 1986, 1989, 1996; Blaženčić *et al.* 1993/94; Lakušić, 1983; Lakušić and Pavlović, 1976; Rakočević, 2000). This is the first time that the lakes

Trnovačko Jezero and Veliko Stabanjsko Jezero have been recorded as localities at which this species is found.

Ranunculus trichophyllus Chaix. This species is widely distributed in calm and slowly flowing waters in low-lying to subalpine regions at elevations ranging from 6 to 1773 m above sea level (Adamović, 1913; Rohlena, 1942; Černjavski *et al.* 1949; Nedeljković, 1959; Smarda, 1968; Ristić and Vizi, 1981; Blaženčić and Blaženčić, 1986, 1992/93, 1994, 1994a, 1996, 1997, 2005; Blaženčić *et al.* 1993/94; Rakočević, 2000). This is the first time that the lake Veliko Stabanjsko Jezero has been recorded as a locality at which the given species is found.

Potamogeton gramineus L. The given species has been recorded at 10 localities in standing and slowly flowing waters on Mt. Durmitor (Pančić, 1874; Blaženčić and Blaženčić, 1996; Blaženčić *et al.,* 1993/94), on Mt. Sinjajevina (Blaženčić and Blaženčić, 1996), and in the Prokletije Mountains (Blaženčić and Blaženčić, 1986). The habitats of this species are found at elevations of 1411 to 1500 m above sea level. The species *Potamogeton gramineus* is known from the lake Trnovačko (Volujačko) Jezero through specimens in the herbarium of the Institute of Botany and Jevremovac Botanical Garden (University of Belgrade) collected by K. Maly on 8 August 1925.

Chara aspera Detharding ex Willdenow. This species has been recorded in bogs and lakes of Montenegro at 10 localities ranging from low regions (Ulcinj, Lake Skadar) to mountain lakes on Mt. Durmitor and in the Prokletije Mountains. It is found in habitats at elevations of from 1.0 to 1700 m above sea level (Blaženčić and Blaženčić, 1986, 1989, 1992/93, 1994, 1996, 1997a, 2002, 2003; Blaženčić *et al.* 1992/93). The lakes Veliko Stabanjsko Jezero and Malo Stabanjsko Jezero are new localities for this species in Montenegro.

Chara contraria A.Br. ex Kutzing. The given species is widely distributed in calm or slowly flowing waters of rivers, lakes, and bogs in low-lying to mountainous regions. It has been recorded at 16 localities at elevations ranging from 1.0 to 1773 m above sea level (Vilhelm, 1912; Filarszky, 1931; Blaženčić and Blaženčić, 1986, 1989, 1992/93, 1994, 1996, 1997a, 2002, 2003, 2004, 2005; Blaženčić *et al.* 1993/94). The lake Trnovačko Jezero is a new locality for this species in Montenegro.

Chara virgata Kutz. The given species is distributed in calm or slowly flowing waters of natural and artificial lakes in hilly and mountainous regions at elevations ranging from 620 to 1850 m above sea level (Blaženčić and Blaženčić, 1986, 1992/93, 1994, 1996, 1997, 1997a, 2002, 2003, 2004, 2005; Blaženčić *et al.* 1993/94). The lakes Trnovačko Jezero, Veliko Stabanjsko Jezero, and Malo Stabanjsko Jezero are new localities for this species in Montenegro.

CONCLUSION

The lakes Trnovačko Jezero, Veliko Stabanjsko Jezero, and Malo Stabanjsko Jezero are glacial in origin. They lie on a limestone geological foundation. The lakes are characterized by clean and transparent water and by a neutral to weakly alkaline reaction (pH 7.3-7.8). Due to the great amplitude of fluctuation in the water level, especially in the latter two lakes (from 5 to 18 m), a typical zone of emersed plants is lacking in their vegetation. Floating plants are developed here and there, and submersed plants completely or in large measure overgrow their bottoms (Figs. 2-4). With respect to abundance and coverage, charophytes are dominant in vegetation of the lake Trnovačko Jezero, while they are the only recorded macroscopic plants in the lake Malo Stabanjsko Jezero. It can therefore be asserted that these lakes belong to the so-called *Chara type of lakes*. The lake Veliko Stabanjsko Jezero is floristically the richest (Table 1) and differs from the other two in terms of vegetation. Between 2.0 and 3.0 m of depth, the vegetation is dominated by the species *Potamogeton lucens*, which at greater depths (3.0 to 6.0 m) builds the monospecific subassociation *Potamogetonetosum lucentis* J. and Ž. Blaž. subass. n. (Fig. 3).

Floristic analysis of samples from lakes on Mt. Volujak revealed the presence of 13 species of emersed, floating, and submersed plants (Table 1). All of the identified species are here recorded for the first time at the investigated localities, with the exceptions of the species *Potamogeton gramineus*, which was collected at the lake Trnovačko Jezero in 1925 (K. Maly, herbarium of the Institute of Botany and Jevremac Botanical Garden, University of Belgrade), and *Ranunculus trichophyllus*, which was recorded by Rohlena (1942) for the lake Trnovačko Jezero.

The species *Alisma plantago-aquatica*, *Myriophyllum spicatum, Carex rostrata, Heleocharis palustris, Potamogeton natans*, *P. lucens, Ranunculus trichophyllus,*

Chara contraria, and *Ch. aspera* are known from a greater number of localities (10 to 30) in Montenegro and have a wide range of vertical distribution: from 1.0 to 1780 m above sea level. The species *Chara virgata* has also been recorded at a considerable number of localities (19), but it is found in habitats lying at elevations of from 620 to 1850 m above sea level. The species *Glyceria plicata* has a similar range of vertical distribution (690-1600 m above sea level). However, it is considerably rarer in the flora of Montenegro and has been recorded in only five places. In lakes on the highest mountains, the species *Carex vesicaria* has been recorded at eight localities (1319-1773 m above sea level), while the species *Potamogeton gramineus* has been recorded at 10 localities (1411-1500 m above sea level).

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МАКРОФИТЕ ТРНОВАЧКОГ, ВЕЛИКОГ И МАЛОГ СТАБАЊСКОГ ЈЕЗЕРА НА ПЛАНИНИ ВОЛУЈАК (ЦРНА ГОРА)

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У склопу комплексних хидробиолошких истраживања глацијалних језера Црне Горе, флористичко-вегетацијска и еколошка проучавања обављена су и у језерима: Трновачко, Велико и Мало Стабањско. Ова језера налазе се у СЗ делу Црне Горе на планини Волујак (Сл. 1). Леже на кречњачкој геолошкој подлози. Одликују се чистом и транспарентном водом, неутралне до слабо алкалне реакције (pH= 7,3-7,8). Због велике амплитуде колебања нивоа воде, нарочито у Стабањским језерима (од 5 до 18 m) у вегетацији одсуствује типична зона емерзних биљака, флотантне биљке су развијене местимично, а субмерзне потпуно или у великој мери обрастају дно ових језера (Сл. 2-4). У вегетацији Трновачког језера по бројности и покоровности, доминирају харофите а у Малом Стабањском језеру су једине констатоване макроскопске биљке. Зато ова језера припадају ткз. хара типу језера са доминацијом биљне заједнице *Chara virgata* + *Chara contraria*. Велико Стабањско језеро је флористички најбогатије (Таб. 1), а и вегетацијски се разликује од претходна два. Између 2,0 и 3,0 m дубине у вегетацији доминира врста *Potamogeton lucens* која на већим дубинама (3,0 до 6,0 m) гради моноспецијску субасоцијацију *Potamogetonetosum lucentis* J.& Ž. Blaž. subass. n. (Сл.3).

Флористичком анализом узорака из језера на планини Волујак констатовано је присуство 13 врста емерзних, флотантних и субмерзних биљака (Таб. 1). Све констатоване врсте први пут су забележене на истраживаним локалитетима, изузев врста *Potamogeton gramineus* која је на Трновачком језеру сакупљена 1925. године (K. Maly) и *Ranuncullus trichophyllus* коју за Трновачко језеро бележи R o h l e n a (1942).

Врсте *Alisma plantago-aquatica, Myriophyllum spicatum, Carex rostrata, Heleocharis palustris, Potamogeton natans, P. lucens, Ranunculus trichophyllus, Chara contraria* и *Ch. aspera* познате су са већег броја локалитета (10 до 30) у Црној Гори и имају широк дијапазон вертикалног распрострањења од 1,0 до 1780 мнв. На знатном броју локалитета (19) забележена је и врста *Chara virgata*, али се она налази на стаништима која леже на надморским висинама од 620 до 1850 м. Сличан дијапазон вертикалне дистрибуције има врста *Glyceria plicata* (690-1600 мнв), али је знатно ређа у флори Црне Горе. Забележена је на само пет места. У језерима највиших планинских предела констатована је врста *Carex vesicaria* (1319-1773 mnv) на осам локалитета, и врста *Potamogeton gramineus* (1411-1500 мнв) на десет локалитета.