

4.1. SURVEY INTO THE AQUATIC MACROPHYTES OF THE ZASAVICA NATURAL RESERVATION (YUGOSLAVIA)

Vukov, D., Igic, R., Boza, P., Anackov, G. and Butorac, B.

4.1.1. INTRODUCTION

The Natural Reservation Zasavica extending over an 671ha. area covers southern Voivodina and northern Macva regions (Yugoslavia). Due to legislative measures in 1991 it became a Special Reservation while in 1992 following IUCN classification their habitats and wildlife were preserved.

A very important role within this Special Natural Reservation plays the river Zasavica with its high diversity and richness of plant and animal world. The two streams Prekopac and Jovaca joins together making 33.1km long Zasavica river flowing southwest-northeast and emptying into the Sava river near Macvanska Mitrovica. Numerous depression springs supply it with water during the whole year. The Banovo Polje locality rich in springs imposing specific ecological conditions extends over about 700m river stream. Water temperature during summer is between 16° and 21° C, pH between 8 and 9. Its ecological characteristics make the Banovo Polje locality a valuable and attractive habitat of aquatic plants.

4.1.2. MATERIAL AND METHODS

The field investigations were performed in 1998 - 1999 period. Plant material was collected and preserved in Herbarium of the Institute of Biology, Novi Sad. Plant determination was done after Flora Europaea (Tutin et al., 1964; Tutin et al., 1968-1980), Hungarian flora (Soó, 1964-1973), and Hínár határozó (Felföldy, 1990). Nomenclature of plants was adjusted to Flora Europaea. Floral elements were given after Soó (1964-1973).

The Banovo Polje locality covering about 700m stream of the Zasavica was divided into the seven sections (100m each). Within each section water temperature and pH were measured, plant material was collected, and biomass of each recorded plant species using a five degree scale was estimated (Kohler, 1978). Data were processed after Pall et al. (1996) while the results presented graphically. Plant life forms were also analyzed (Luther, 1949; Pall et al., 1996).

4.1.3. RESULTS AND DISCUSSION

The depression springs have a great impact upon the ecological conditions of the river, water temperature and pH in particular. In summer, temperature and pH values were measured (Table 1). Rather balanced pH ranged from 8 to 9, whereas oscillating water temperature relied upon stream proximity. The lowest temperature of 16° C was recorded in study section VII, whereas the highest of 21° C in section V.

Table 1. Temperature and pH values recorded at Banovo Polje locality

No. of section	t (°C)	pH
1	18	9
2	20	8.5
3	19	9
4	19	8.5
5	21	8
6	18	9
7	16	8.5

The floristic data related to the region of the Zasavica river and its surrounding are poor. Only a few data may be found in Flora SR Srbije (Josifovic, 1970-1976; Saric, 1980) and Flora Srbije I (Saric, 1992). Our survey in the period 1998-1999 revealed 22 aquatic plants at the Banovo Polje locality (Table 2).

Table 2. List of aquatic macrophytes, life forms, and floral elements

Species	abbreviation	Growth form	Floral elements
<i>Ceratophyllum submersum</i> L.	Cer sub	Bp	Eurasian (-mediterranean)
<i>Ceratophyllum demersum</i> L.	Cer dem	Bp	circumpolar
<i>Hottonia palustris</i> L.	Hot pal	Bp	Evropska
<i>Hydrocharis morsus-ranae</i> L.	Hyd mor	Ap	Eurasian
<i>Hippuris vulgaris</i> L.	Hyp vul	H	circumpolar (-cosmopolitan)
<i>Lemna minor</i> L.	Lem min	Ap	cosmopolitan
<i>Lemna trisulca</i> L.	Lem tri	Mp	cosmopolitan
<i>Myriophyllum spicatum</i> L.	Myr spi	Bp	circumpolar
<i>Myriophyllum verticillatum</i> L.	Myr ver	Bp	circumpolar
<i>Nuphar lutea</i> (L.) Sibth. & Sm.	Nup lut	F	Eurasian (-mediterranean)
<i>Nymphaea alba</i> L.	Nym alb	F	Eurasian (-mediterranean)
<i>Phragmites australis</i> (Cav.) Trin. Ex Steudei	Phr aus	H	cosmopolitan
<i>Potamogeton pectinatus</i> L.	Pot pec	Bp	cosmopolitan
<i>Potamogeton lucens</i> L.	Pot luc	Bp	Eurasian (-mediterranean)
<i>Sagittaria sagittifolia</i> L.	Sag sag	H	Eurasian (-mediterranean)
<i>Salvinia natans</i> (L.) All.	Sal nat	Ap	Eurasian, European and submediterranean characters
<i>Scirpus lacustris</i> L.	Sci lac	H	Eurasian
<i>Sparganium emersum</i> Rehm.	Spa ere	H	Eurasian
<i>Spirodela polyrrhiza</i> (L.) Schleid.	Spi pol	Ap	circumpolar
<i>Stratiotes aloides</i> L.	Str alo	F	Eurasian (Eurosiberian)
<i>Typha angustifolia</i> L.	Typ ang	H	cosmopolitan
<i>Typha latifolia</i> (L.) Hoffm.	Typ lat	H	circumpolar-african

Floristic analysis shows that the majority of plants belongs to the eurichorn species group with wide area range (circumpolar, Eurasian, cosmopolitan), some are the remnants of Tertiary flora of north and central Europe (Meusel, 1968) while their relict character in the Pannonian Plains was also reported (Budak et al., 1992). The two ornamental floating species, *Nymphaea alba* and *Nuphar luteum* otherwise known by their European (Mediterranean) and Eurasian (Mediterranean) distribution deserve a mention (Soó, 1964-1973). Another Tertiary relict of aquatic and marsh vegetation of central and southeastern Europe is Eurasian (Eurosiberian) species (Soó, 1964-1973) *Stratiotes aloides* restricted to the plains of the Pannonian region. All the plants cited above are protected by legislative measures as Natural rarities. The two plants, *Hottonia palustris* and *Hippuris vulgaris* are under the risk of

extinction therefore included in the Red Book of the Serbian Flora (Butorac, 1999; Vuckovic and Panjkovic, 1999).

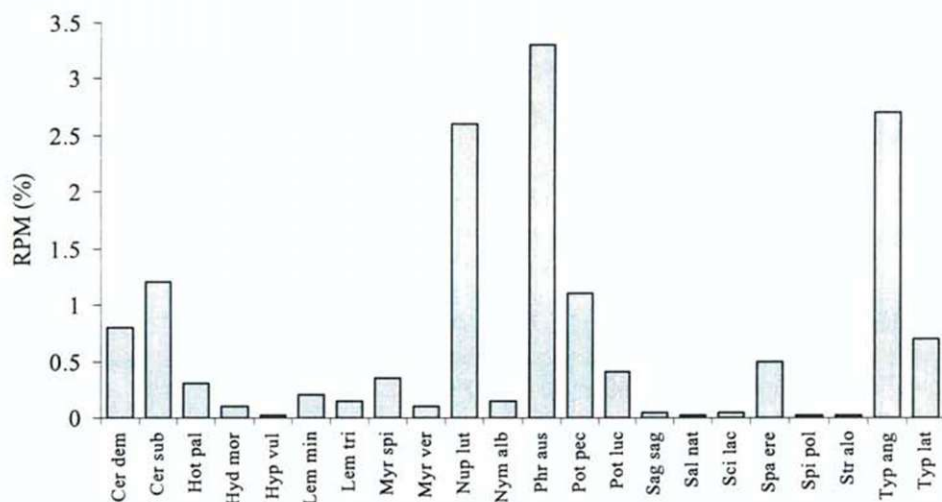


Fig. 1. Distribution of percentage relative biomass (RPM (%)) of aquatic plant species.

Our survey of the area shows that the highest percentages were found with *Phragmites australis* (3.35%), then *Typha angustifolia* (2.66%), *Nuphar luteum* (2.11%), *Ceratophyllum submersum* (1.16%), and finally *Potamogeton pectinatus* (1.08%), whereas the remaining species were recorded with the values less than 1%.

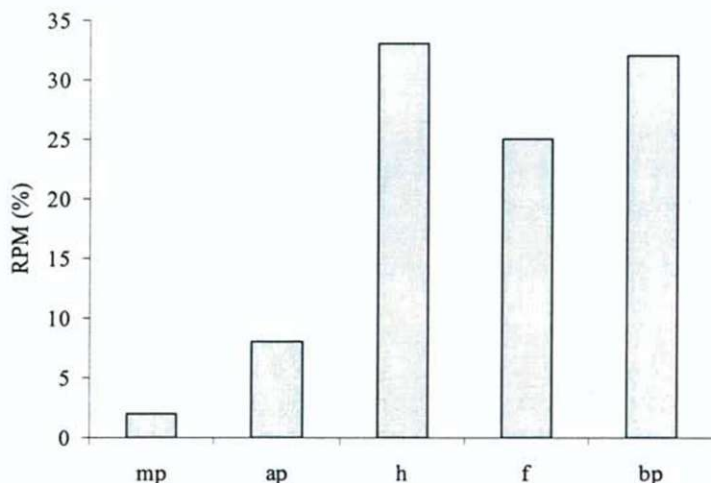


Fig. 2. Relative percentage biomass of different life forms of aquatic plants

Life form analyses (Fig. 2) show the dominance of helophytes (h-33.42%), then benthopleustophytes (bp-31.50), and floating aquatics (f-25.60%) while acroleustophytes and mesopleustophytes were far less frequent (ap-7.50 and mp-1.98%, respectively).

4.1.4. CONCLUSIONS

The method after Kohler was employed to study aquatic macrophytes of the Banovo Polje locality (Zasavica Natural Reservation). Most of 22 aquatics are widespread while the Tertiary relicts of water and marsh vegetation like *Nymphaea alba*, *Nuphar lutea*, and *Stratiotes aloides* conserved due to legislative measures are also present. Among the species being at risk of extinction are *Hottonia palustris* and *Hippuris vulgaris* included in the Red Book of endangered species. The highest RPM values were found with *Phragmites australis*, *Typha angustifolia*, *Nuphar luteum*, *Ceratophyllum submersum*, and *Potamogeton pectinatus* while the remaining aquatics were less present (less than 1%). Life form analyses show the dominance of helophytes, then benthopleustophytes, floating aquatics, and acroleustophytes, whereas only one species of the mesopleustophyte group was observed.

4.1.5. SUMMARY

Using the method after Kohler the aquatic macrophytes of the Special Natural Reservation Zasavica (Yugoslavia) were assessed. Of 22 recorded aquatics most interesting are the Tertiary relicts of water and marsh vegetation like *Nymphaea alba*, *Nuphar luteum*, and *Stratiotes aloides*, as well as species at a high risk of total extinction like *Hottonia palustris* and *Hippuris vulgaris* included in the Red Book of the Serbian flora. According to the RPM values the highest percentages were obtained with *Phragmites australis*, then *Typha angustifolia*, *Nuphar luteum*, *Ceratophyllum submersum*, and *Potamogeton pectinatus*. The analysis of life forms shows the dominance of helophytes, then benthopleustophytes, floating aquatics, and acroleustophytes, whereas only a species of mesopleustophyte group was recorded.

4.1.6. REFERENCES

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