

QUANTITATIVE PRESENCE OF MACROPHYTES IN BASIC CHANNEL NETWORK OF HYDROSYSTEM DANUBE - TISZA - DANUBE

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Abstract. Quantitative presence of aquatic vascular plants is given at certain sections of Hydrosystem Danube - Tisza - Danube in Backa: channels Vrbas - Bezdan, Backi Petrovac - Karavukovo and Jegricka. Among submerged plants which are not rooted, species *Ceratophyllum demersum* is the most frequent in all sections. From submerged plants that are rooted, *Myriophyllum spicatum* and *Vallisneria spiralis* have the greatest quantitative presence. Floating non rooted hydrophytes are small floating flowering plants and water ferns. *Spirodela polyrrhiza*, *Lemna gibba*, *Salvinia natans* and *Azolla caroliniana* have high coverage values at certain spots. From group of floating rooted hydrophytes, most numerous are *Trapa natans*, *Nymphaea alba*, *Nuphar luteum* and *Nymphoides flava*. Due to great surface and big floating leaves, they are covering large areas of water mirror, especially in channel Vrbas - Bezdan. Among numerous emerged macrophytes giving coast zone of all channels, highest participation is of *Phragmites communis*, *Typha angustifolia* and *Glyceria maxima*. It is concluded that differences in floristic structure and quantitative presence of various life forms of aquatic plants in investigated sections of Hydrosystem Danube - Tisza - Danube are due to different age of channels (30 to 200 years), different physico-chemical conditions of aquatic environment, purpose functions of channels, pollution degree and application of different protection measures.

Keywords: *Hydrosystem Danube - Tisza - Danube, hydrophyta, floristic structure, ecological groups, quantitative presence.*

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Introduction

Hydrosystem Danube - Tisza - Danube is one of the most important hydrotechnical objects at Vojvodina area. Total length of channel network is 960 km, from which about 400 km is in Bačka. Channel network consists of new channels, radically or partially reconstructed old channels and water flows included in a new system. Hydrosystem as a whole is a complex solution of numerous watereconomy problems at Vojvodina area - drainage, water supply of irrigation and distribution systems, industry development, fishery, swamp

settlements sanitation, navigation, recreation etc.

Channel network is a specific category of artificial aquatic ecosystems, where macrophyte vegetation is important component. Namely, aquatic plants are natural phytosanators, participating in water selfcleansing process, but on the other hand, high quantitative presence of aquatic plants is of important influence to organic production - plant mass, contributing to high level of eutrophication and overgrowth of these water biotopes.

Important data on water vegetation of Basic channel network of Hydrosystem Danube - Tisza - Danube are given in papers Slavnić (1956), Čanak

et all. (1969), Vukoje (1986), Stojanović et all. (1991, 1992, 1993), Butorac et all. (1991,1992), Vučković et all. (1993), Stanković et al. (1991, 1993).

In this paper, floristic structure and quantitative presence of vascular plants is given for channels Vrbas - Bezdan, Bački Petrovac - Karavukovo and Jegrička, in purpose of better knowledge of recent condition of aquatic vegetation at Basic channel network which is not sufficiently investigated from this point of view.

Material and methods

Investigations were carried out in 1991 -1993 period.

Plant species were determined according to Flora of SR Serbia (Josifović, 1970-1986) and Iconografia Florae Partis austro-orientalis Europae Centralis (Jávorka and Csapody, 1975).

Phytocenological surveys, on the basis of which phytocenological tables were constructed and total covering value of plant species determined, were taken according to method of Braun-Blanquet (1964).

General characteristics of investigated sections of DTD hydrosystem channels

Channel Vrbas - Bezdan (Fig. 1/I) is one of the oldest sections of Basic channel network, constructed in 1793 (before 200 years). In hydrotechnical sense, it consists of two gradual basins (bjefs). Channel is main, 80.9 km in length, with water mirror width 25-30 m, and 2.2 - 3.2 m deep. Water supply is from Danube over pump station in Bezdan, and in favourable hydrological conditions also over Baja channel, which flows in at Szebes-Fok. Having in mind waste waters and concentrated pollution sources, this channel is one of the most protected objects of Hydrosystem DTD, which ensures satisfactory water quality.

Channel Bački Petrovac - Karavukovo (Fig. 1/II) belongs to group of navigable channels of Basic channel network DTD. Among other purpose functions, through this channel one-way navigation occurs (approx. 20 objects per year). This is one of more recent sections, constructed about 30 years ago (1960-1965). Total length of channel is 52 km, water mirror width is 40-50 m, with depth of 1.8 - 2.5 m. Water supply is from channel Bečej - Bogojevo at Bogojevo, or from Danube at Bezdan (through channel Odžaci - Sombor). At this section there is no important pollution source, which

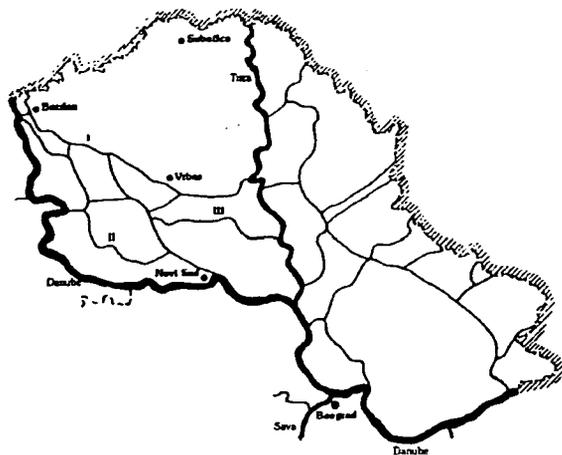


Fig. 1. The Basic channel network of Hydrosystem Danube - Tisza - Danube. Numbers are marking investigated channels: I - Vrbas - Bezdan; II - Bački Petrovac - Karavukovo; III - Jegrička.

ensures good water quality.

Channel Jegrička (Fig. 1/III) used to be natural water flow and recipient for drainage from southern Backa region. By regulatory undertake, mostly done until 1960, Jegrička is today mostly regulated, multipurpose water flow with conductory water regime. Specificity of this channel are hydrotechnical and hydromorphological characteristics, on the basis of artificial and natural specifications of river bed. Jegrička water flow is divided into three gradual basins, with specific water regime. Upper basin (from Despotovo to Zmajevu) is totally regulated, lower basin (near Žabalj) is natural depression transformed into fish pond, and middle basin is partly regulated, and partly consists of natural depression with non-regulated river bed. The total length of Jegrička is 65 km. Water mirror width and depth are different in every basin. Waste waters used to flow in Jegrička from hemp processing plant in Zmajevu, which caused worsening of water quality and destruction of life forms. After closing of this plant (in 1982), aquatic life begun to restore and "normalize", following increase of water quality.

In investigated sections of Hydrosystem DTD, water quality is continuously controlled by physical, chemical and biological analyzes. According to values of most important parameters, waters from all three channels are within limits for II water class. According to results of biological analyzes, these are waters with beta-mesosaprobic features.

Results and discussion

By investigations of macrophyte water vegetation in sections of the Basic channel network of Hydrosystem DTD (channels Vrbas-Bezdan, Bački Petrovac-Karavukovo and Jegrička), different ecological groups of aquatic plants were determined, among which some are to be emphasized because of significant quantitative presence.

From comparative review of floristic structure and covering values of individual plant species (Table 1), it could be seen that there are differences

between sections investigated. Channel Vrbas-Bezdan is the richest in floristic sense, and also most interesting. Total of 40 species of aquatic and emerged plants was found.

Among submerged plants which are not rooted, in all channel sections most abundant was *Ceratophyllum demersum* (I - 7678; II - 1559; III - 3075), which occurs in central, deepest parts of channels. Due to dense population, easy multiplication, dispersion, and important organic production, this species represents a serious problem in most of channels of Hydrosystem DTD. From other species in this group of life forms,

Table 1. Covering value of hydrophytes in Hydrosystem Danube-Tisza-Danube sections

| Life form | | Plant species | Vrbas- Bezdan 200 years I | B. Petrovac- Karavukovo 30 years II | Jegrička 30 years III |
|---|---------------------------------|--|------------------------------|---|--------------------------|
| S U B M E R G E D | NON- ROOTED | <i>Ceratophyllum demersum</i> L. | 7678 | 1559 | 3075 |
| | | <i>Ceratophyllum submersum</i> L. | 100 | 353 | |
| | | <i>Utricularia vulgaris</i> L. | | | 10 |
| | ROOTED | <i>Myriophyllum spicatum</i> L. | 8928 | 885 | 610 |
| | | <i>Potamogeton crispus</i> L. | 2535 | | |
| | | <i>Vallisneria spiralis</i> L. | 2200 | 21 00 | |
| | | <i>Ranunculus circinatus</i> Sibth. | 1392 | | |
| | | <i>Najas marina</i> L. | 1062 | | |
| | | <i>Potamogeton perfoliatus</i> L. | 982 | 1 32 | |
| | | <i>Zanichellia palustris</i> L. | 785 | | |
| <i>Potamogeton pusillus</i> L. | | 525 | | | |
| <i>Myriophyllum verticillatum</i> L. | 225 | | | | |
| <i>Potamogeton lucens</i> L. | 5 | | | | |
| <i>Ranunculus trichophylos</i> Chax. | 5 | | | | |
| F L O A T I N G | NON- ROOTED | <i>Spirodela polyrrhiza</i> (L.) Schl. | 2110 | 1985 | 175 |
| | | <i>Hydrocharis morsus-ranae</i> L. | 1392 | 915 | 50 |
| | | <i>Lemna rminor</i> L. | 50 | 353 | |
| | | <i>Lemna gibba</i> L. | | 2153 | |
| | | <i>Salvinia natans</i> (L.) All. | 5250 | 897 | 50 |
| | <i>Azolla caroliniana</i> Wild. | | 1970 | | |
| | NON- ROOTED | <i>Nymphaoides flava</i> Hill. | 8125 | | |
| | | <i>Trapa natans</i> L. | 6607 | 459 | 50 |
| | | <i>Nuphar luteum</i> Sm. | 3400 | | |
| | | <i>Nymphaea alba</i> L. | 2335 | | 2155 |
| <i>Potamogeton fluitans</i> Roth. | | 78 | 59 | | |
| <i>Potamogeton gramineus</i> L. | 5 | 353 | | | |
| <i>Polygonum amphibium</i> L. | 5 | | | | |
| <i>Stratiotes aloides</i> L. | | 32 | | | |
| E M E R G E D | | <i>Glyceria maxima</i> (Hartm) Holmbg. | 5972 | 367 | |
| | | <i>Phragmites communis</i> Trin. | 5275 | 103 | 975 |
| | | <i>Typha angustifolia</i> L. | 1925 | 367 | 625 |
| | | <i>Sparganium ramosum</i> Huds. | 1116 | | 50 |
| | | <i>Typha latifolia</i> L. | 1100 | | 175 |
| | | <i>Iris pseudoacorus</i> L. | 475 | | |
| | | <i>Leersia oryzoides</i> (L.) Sw. | 200 | | |
| | | <i>Rumex hydrolapathum</i> Huds. | 175 | | 180 |
| | | <i>Butomus umbellatus</i> L. | 111 | | |
| | | <i>Acorus calamus</i> L. | 110 | | |
| | | <i>Heleocharis palustris</i> (L.) R.Br. | 100 | | |
| | | <i>Sium latifolium</i> L. | 100 | | |
| | | <i>Sagittaria sagittifolia</i> L. | 100 | | |
| | | <i>Oenanthe aquatica</i> (L.) Poir. | 30 | | |
| | | <i>Bolboschoenus maritimus</i> (L.) Pal. | 28 | | |
| | <i>Carex pseudocyperus</i> L. | 16 | | | |
| | <i>Scirpus lacuster</i> L. | | | 1625 | |

Ceratophyllum demersum and carnivorous *Utricularia vulgaris* were present, but with significantly less covering values. Species *Utricularia vulgaris* is present in channel Jegrička only, being differential in comparison to other two investigated sections of channel.

Submerged and rooted macrophytes are more numerous. High quantitative participation is of species *Myriophyllum spicatum* (I - 8928; II - 885; III - 610) and *Vallisneria spiralis* (I - 2200; II - 2100) in first two channels only. Most of other species from this group are differential in comparison to other investigated channels: species from genus *Potamogeton* (*P. crispus*, *P. lucens*, *P. pusillus*), *Ranunculus circinatus*, *Najas marina*, *Zanichelia palustris* etc.

Floating non rooted hydrophytes are mostly presented by small floating flowering plants, from which *Spirodela polyrrhiza* is most frequent, and with considerable covering value (I - 2110; II - 1985; III - 175). In channel Bački Petrovac - Karavukovo higher participation is of species *Lemna gibba* (II - 2153). Water fern, *Salvinia natans* is abundantly present in channel Vrbas - Bezdán (I - 5250), and *Azolla caroliniana* in channel Bački Petrovac - Karavukovo (II - 1970).

From group of floating rooted plants, by quantitative participation are emphasized *Trapa natans* (I - 6607; II - 459; III - 50) and *Nymphaea alba* (I - 2335; III - 2155). At certain spots, *Nymphoides flava* and *Nuphar luteum* are vastly present, especially in channel Vrbas - Bezdán. These plants, with numerous specimens and large floating leaves, someplace are covering large surfaces of water mirror. It is important to emphasize that water lilies are not present at all in channel Bački Petrovac - Karavukovo, and in channel Jegrička only populations of white water lily (*Nymphaea alba*) are present.

From other floating rooted hydrophytes, *Potamogeton gramineus*, *Potamogeton fluitans*, *Polygonum amphibium* and *Stratiotes aloides* are occurring, mostly with insignificant covering value (in channels Vrbas - Bezdán and Bački Petrovac - Karavukovo).

More consideration, from nature protection point of view, deserves *Stratiotes aloides*, being rare and protected species in Vojvodina area. To this category also are belonging *Nymphaea alba*, *Nuphar luteum* and *Nymphoides flava*.

Among high, emerged macrophytes that narrow coast band consists from, highest participation is of *Phragmites communis* (I - 5275; II - 103; III - 975), *Typha angustifolia* (I - 1925; II - 367; III - 625) and *Glyceria maxima* (I - 5972; II - 367). Dense

population of these plants are not allowing numerous development of other species, therefore they are present with lower covering values.

Differences in floristic structure and quantitative presence of certain life forms of aquatic plants in investigated sections of Hydrosystem Danube - Tisza - Danube are resulting from different age of channels (30 to 200 years), different physico-chemical conditions of water environment, purpose functions of channels, level of pollution and application of different protection measures.

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