

3.10. WATER QUALITY OF THE GORNJE PODUNAVLJE PROTECTED AREA ESTIMATED ON THE BASIS OF BIOINDICATORS

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3.10.1. INTRODUCTION

Along the Yugoslav section of the Danube some flooded areas still exist (Brankovic *et al.* 1998), and among them, the floodplain within the Gornje Podunavlje protected area is the largest one (Budakov *et al.*, 1995). Protection of these floodplains is in accordance with the Pan-European Biological and Landscape Diversity Strategy (Strasbourg, 1995), Convention on Biological Diversity (Rio de Janeiro, 1992) and Convention on Wetlands (Ramsar, 1971), as well as with the Resolution on Biodiversity Conservation Policy in FR Yugoslavia (Beograd, 1993).

The Gornje Podunavlje is situated along the left bank, between 1347 and 1433 km of the Danube course. It is a swampy complex divided by the embankment into the two parts. The Apatinski Rit, being the part directly connected with the Danube, is under the influence of flooded waters. The part which comprises Monostorski Rit, a lot of canals and permanent and ephemeral pools is separated from the Danube by the embankment and is under the influence of underground waters.

In order to recognize quality of the Gornje Podunavlje natural values as a basis for protection and conservation, the Institute for Protection of Nature of Serbia carried out various investigations, including phytoplankton community and ichthyofauna which are very important members of aquatic biocenoses. The phytoplankton and ichthyofauna are not only good indicators of water quality and condition of all the water ecosystem, but they play an important role in self-purification of the water and maintenance of ecological balance.

3.10.2. MATERIAL AND METHODS

The phytoplankton and ichthyofauna of the Gornje Podunavlje protected area were investigated in the period of 1996-1998.

During the algological and saprobiological investigations, standard limnological methods were used (Sladecek *et al.*, 1973). Qualitative composition of the phytoplankton community was shown as a participation of the different algal groups in the total number of taxa, and quantitative composition as a participation of algal groups in the total number of algae. The density of the phytoplankton community was expressed as a number of individuals per 1 cm³ (ind/cm³).

Fish species were sampled by electrofisher and nets.

The saprobity index was calculated after Pantle & Buck (1955) on the basis of phytoplankton and fish species as bioindicators.

3.10.3. RESULTS AND DISCUSSION

Within the Gornje Podunavlje protected area, during the study period, very diverse phytoplankton community was recorded - 377 species, varieties and forms of algae (Fig. 1).

Chlorophyta was the most diverse group, making 47.5 % of all taxa. Among the green algae, the following genera were represented by the largest number of species, varieties and forms: *Scenedesmus* (23 taxa), *Cosmarium* (20), *Staurastrum* (18), *Closterium* (12), *Tetraedron* (11). The species, such as *Actinastrum hantzschii* Lagerh., *Eudorina elegans* Ehr., *Micratinium pusillum* Fresen, although the only representatives of their genera, were wide spread in the investigated waters.

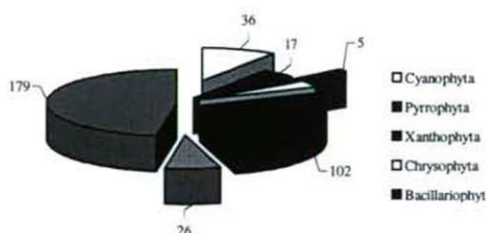


Fig. 1. Diversity of Phytoplankton Community

Among Bacillariophyta, to which belonged 27.1 % of all recorded taxa, the genera: *Navicula* (14 taxa), *Cymbella* (9), *Gomphonema* (8) and *Nitzschia* (8) were the most heterogenous ones. Although represented by a small number or only one taxa, the genera: *Stephanodiscus*, *Cyclotella*, *Melosira*, *Asterionella*, *Fragilaria*, *Diatoma*, *Amphora*, *Cocconeis*, *Anomoeneis* were characteristic representatives of the silicate algae of the investigated waters.

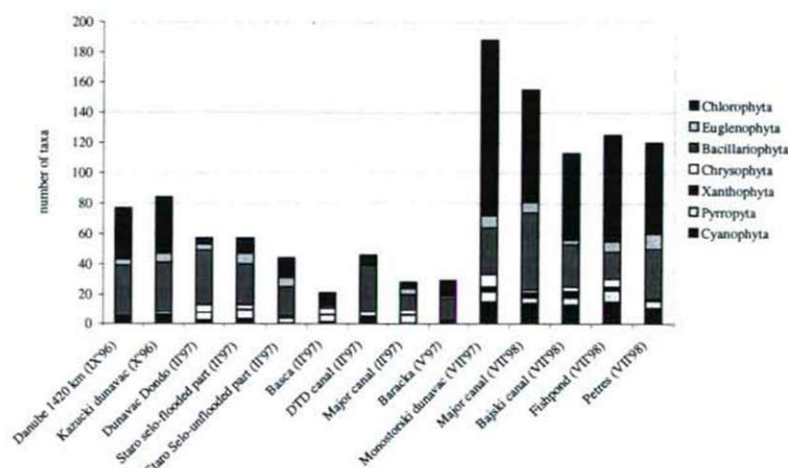


Fig. 2. Qualitative Composition of Phytoplankton Community

Cyanophyta-with 9.5 % of all taxa, Euglenophyta-with 6.9 %, Pyrrophyta-with 4.5 %, Chrysophyta with-3.1 % and Xanthophyta-with 1.3 % were represented by a significantly smaller number of taxa. Among Cyanophyta, the *Oscillatoria* genus, with 7 taxa, was the most divers one but, the species: *Aphanisonenon flos-aquae* (L.) Ralfs and *Microcystis aeruginosa* Kutz. were present in almost all the samples. *Trachelomonas*, with 11 taxa, was the most diverse genus within the Euglenophyta group, and within the Pyrrophyta group, the *Peridinium* genus, with 7 taxa.

The diversity and qualitative composition of phytoplankton community (Fig. 2) varied, depending on the sampling time and locality. But, variation was dependent, to a greater extent, on the sampling time than on the locality. The diversity of phytoplankton community was the highest during the summer, and the lowest during the winter and spring. The Chlorophyta group was characterized by the most apparent variation. During the summer, a large number of taxa, from 57 to 116, of the Chlorophyta group were recorded, while in the samples collected during the winter their number rarely exceeded 10.

The diversity of Cyanophyta was, to a certain extent, dependent on the sampling time, as well. The representatives of this group were recorded in all the samples collected during the summer, and their number varied between 11 and 15. In the winter, Cyanophyta appeared sporadically, with no more than 4 taxa. The members of Xantophyta group were recorded only in the samples collected during the summer. The diversity of the other algal groups was rather similar during all the study period.

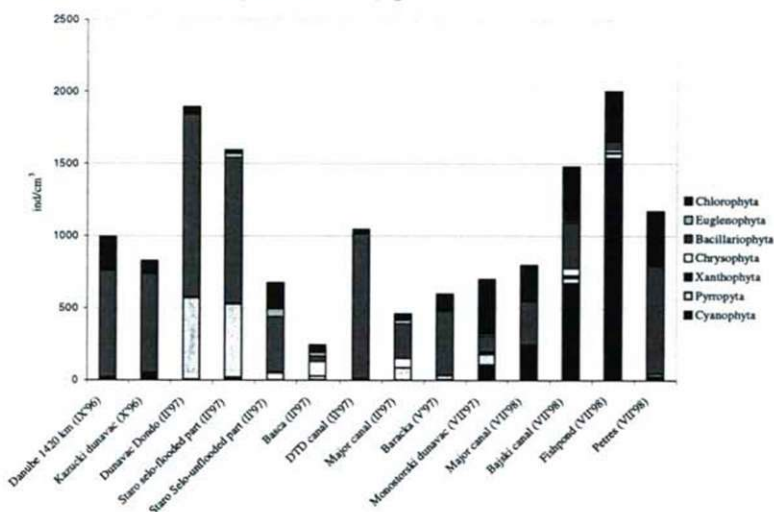


Fig.3. Quantitative Composition of Phytoplankton Community

The density of phytoplankton community varied from 247 to 2000 ind/cm³ (Fig. 4).

A common characteristic of the phytoplankton community was prevalent quantitative domination of Bacillariophyta (Fig. 3). But, the following samples were exception: Basca (II'97) with Chrysophyta domination, Monostorski Dunavac (VII'97) in which the Chlorophyta group was the dominant, and Bajski canal (VII'98) and Fishpond (VII'98), within the Bajski canal, which were characterized by Cyanophyta domination. In the

localities which were under direct influence of the flooded waters of the Danube (Dunavac Dondo and Staro Selo), significant participation of Pyrrophyta was recorded.

Stephanodiscus hantzschii Grun., *Cyclotella meneghiniana* Kutz., *Melosira granulata* (Ehr.) Ralfs, *Asterionella formosa* Hassal, were the most abundant representatives of Bacillariophyta, and among Chlorophyta, the species of the genera: *Scenedesmus*, *Ankistrodesmus*, *Pediastrum*, *Crucigenia*, *Chlamydomonas*, *Cosmarium* were the most abundant. Among Cyanophyta, participation of *Aphanisomenon flos-aquae* (L.) Ralfs, as well as participation of the species of the genera *Anabaena* and *Oscillatoria* were significant. The Pyrrophyta group was characterized by significant participation of the genera: *Cryptomonas* and *Peridinium*, while the Chrysophyta group was characterized by significant participation of the *Dinobryon* genus. Generally, participation of the Euglenophyta group was low, and the *Trachelomonas* genus was the most abundant.

The saprobity index values, calculated on the basis of phytoplankton species as bioindicators, varied from 1.9 to 2.8 (Fig. 4), indicating β mesosaprob, β - α mesosaprob, and α mesosaprob degree - eutrophic waters.

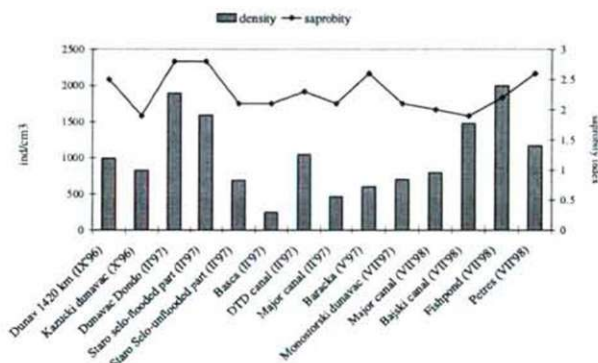


Fig.4. Relationship Between Density of Phytoplankton Community and saprobity

The saprobity index values were usually in the correlation with the density of phytoplankton community (Fig.4) that was expected knowing that algae respond to the increase of nutrients accelerating development.

In the water ecosystems of the Gornje Podunavlje protected area 55 fish species were recorded. Among them, the indicators of oligosaprob degree, such as *Alburnoides bipunctatus* Bloch, *Cottus gobio* L., indicators of oligo- β mesosaprob degree, such as *Lota lota* L., *Sander lucioperca* L., indicators of β mesosaprob degree, such as *Esox lucius* L., *Rutilus rutilus* Vladikov, *Leuciscus leuciscus* L., *L.cephalus* L., *Scardinius erythrophthalmus* L., *Alburnus alburnus* L., *Blicca bjoerkna* L., *Abramis brama* Pavlov, *Chondrostoma nasus* L., *Rhodeus sericeus amarus* Holcik, *Gobio gobio* L., *Barbus barbus* L., *Cyprinus carpio* L., *Orthrius barbatulus* L., *Silurus glanis* L., *Anguilla anguilla* L., *Perca fluviatilis* L., *Gymnocephalus cernua* L., indicators of β - α mesosaprob degree, such as *Tinca tinca* L., *Carassius carassius* L., indicators of α mesosaprob degree, such as *Carassius auratus gibelio* Bloch, *Lepomis gibbosus* L. were recorded.

The saprobity index value, calculated on the basis of the fish indicator species, was 2.0, indicating β mesosaprob degree. That is in correlation with the results obtained on the basis of the phytoplankton.

On the basis of the presented results and literature data (Brankovic *et al.*, 1997; Budakov *et al.*, 1997; Budakov and Brankovic 1999; Djukic *et al.*, 1997; Gayin *et al.*, 1998; Jankovic *et al.*, in Jankovic and Jovicic 1994, 1994; Maletin *et al.*, 1997; Obuskovic in Jankovic & Jovicic, 1994; Pujin *et al.*, 1997) it could be concluded that the waters of the Gornje Podunavlje protected area are more or less eutrophic ones, with the phytoplankton and ichthyofauna which are characteristic for the lowland water ecosystems of this region.

3.10.4. SUMMARY

The Gornje Podunavlje is situated along the left bank, between 1347 and 1433 km of the Danube course. It is a swampy complex divided by the embankment into the two parts.

The phytoplankton and ichthyofauna of the Gornje Podunavlje protected area have been investigated in the period from 1996 to 1998.

During the study period, very diverse phytoplankton community was recorded, 377 species, varieties and forms, and Chlorophyta was the most diverse group. A common characteristic of the phytoplankton community was prevalent quantitative domination of Bacillariophyta.

In the water ecosystems of the Gornje Podunavlje protected area, 55 fish species were recorded.

The saprobity index values, calculated on the basis of phytoplankton and fish species as bioindicators, varied from 1.9 to 2.8, indicating β mesosaprob, β - α mesosaprob, and α mesosaprob degree - eutrophic waters.

On the basis of the presented results and literature data it could be concluded that the waters of the Gornje Podunavlje protected area are more or less eutrophic ones, with the phytoplankton and ichthyofauna which are characteristic for the lowland water ecosystems of this region.

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