The aquatic vegetation of large Danube river branches in Romania

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Introduction

The aquatic vegetation represents a significant category of primary producers, directly and indirectly involved in the aquatic ecological systems functionality (Vădineanu et al. 1998) and it indicates the trophic status of water bodies (Sârbu, 2006). In the context of the European legal regulation (WFD) the aquatic vegetation is one of the biological elements to be assessed in the process of defining the ecological status of surface water bodies. The first evaluation of aquatic plants that followed the guidelines of European Standard EN 14184 was carried out in Romania between 2002-2004 in the frame of the international project "Macrophytes Inventory Danube – Corridor and Catchment", funded by the Austrian Federal Ministry of Education, Science and Culture. It was focused on the most significant Danube river corridors: main channel, river branches, and the secondary channels in the Danube Delta. This paper will present the inventory of aquatic vegetation for the five large branches of the Danube River in and close to the Danube Delta: Borcea, Măcin, Chilia, Sulina, Sf. Gheorghe, which cover a length of 951 km in total.

Methods

Five Danube river arms were evaluated between 2002-2004, in the periods of optimum vegetation development (July and August). Two of them are located outside the Danube Delta (Borcea, and Măcin arm, medium width: 200 – 400 m, medium depth: 2 – 16 m) and the other three are located inside the delta (Chilia, Sulina, and Sf. Gheorghe arm, medium width: 300-550 m, medium depth: 25 – 35 m). The methodology followed the European Standard EN 14184, which is recommended for assessing the aquatic macrophyte vegetation in running waters and follows the principles described by Kohler (Kohler et al. 1971, Kohler 1978, Kohler and Janauer 1995). The method is based on the assessment of the aquatic macrophytes in contiguous survey units. In all survey units the abundance per species was estimated in a 5 level descriptor scale (1 – rare, 2 – occasional, 3 – frequent, 4 – abundant, 5 – very abundant). For each species the growth form (acro-pleustophytes, submerged pleustophytes, submerged anchored, floating leaf rooted plants, amphiphytes and helophytes) was identified in the survey unit.

In all survey units the following habitat parameters were assessed: bank structure, sediment type, flow class, Secchi depth transparency, connectivity type and land use type (CORINE – systems) in the areas adjacent to the river or any other water body type. Each subdivision of these parameters is characterized by a specific number code. The numerical information in the field data sets was used for standard diagrams: distribution diagrams, relative plant mass (RPM) and average distribution of species (MMT/O/d).

Results

38 aquatic taxa were recorded: 2 genus of filamentous algae and 36 vascular plants. Two of them (*Salvinia natans* (L.) All and *Trapa natans* L. are threatened in Europe due to the Bern

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Convention–App I and one (*Vallisneria spiralis* L.) is protected in Romanina and listed as vulnerable (Romanian Red List).

In the Danube river branches outside the Danube Delta (Borcea & Măcin arms), 26 aquatic taxa were identified. Only two acropleustophytes (*Cladophora* sp., *Spirogyra* sp.), one submerged anchored aquatic plant (*Ceratophyllum demersum* L.) and one amphiphyte (*Butomus umbellatus* L.) showed significant distribution (Fig. 1). The relative plant mass values support their dominance (Fig. 2). The majority (80%) of aquatic taxa was rare (MMO < 1) or occasional (MMO < 2) and only 20% were frequent. The filamentous algae showed ubiquitous distribution (Fig. 3).

In the Danube river branches inside the Danube Delta (Chilia arm, Sulina arm and Sf. Gheorghe arm), 34 aquatic taxa were identified. Among them, four acropleustophytes (*Cladophora* sp., *Spirogyra* sp., *Spirodela polyrhiza* (L.) Schleiden, *Salvinia natans*), five submerged anchored plants (*Ceratophyllum demersum*, *Potamogeton natans* L., *P. nodosus* Poiret, *P. pectinatus* L., *Trapa natans*) and two amphiphytes (*Butomus umbellatus*, *Schoenoplectus lacustris* (L.) Palla) showed significant distribution in all the three river branches (Fig. 4). With respect to the average distribution of species 15% were rare (MMO < 1), 30% were occasional (MMO < 2) and 55% were frequent (MMO < 3). No ubiquitous taxa were recorded (Fig. 5). The relative plant mass values support the dominance of three aquatic plants: *Ceratophyllum demersum*, *Butomus umbellatus* and *Potamogeton nodosus* (Fig. 6).

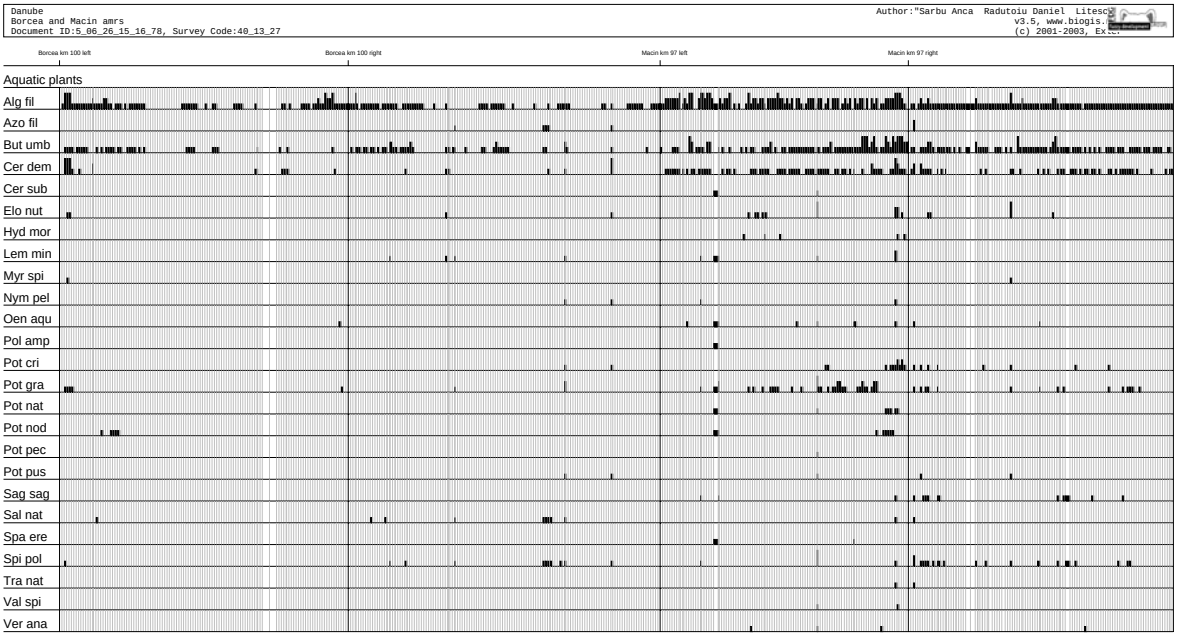

Figure 1. Distribution diagram – Danube river branches located outside the Danube Delta (Borcea arm & Măcin arm).

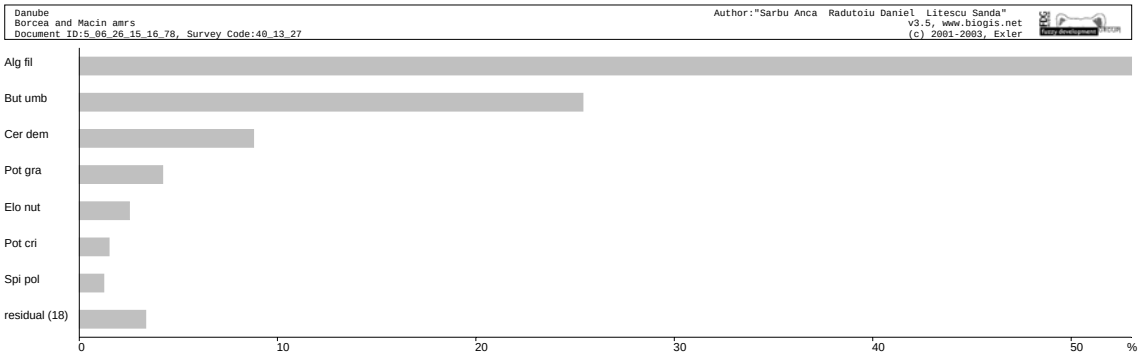

Figure 2. Relative Plant Mass – Danube river branches located outside the Danube Delta (Borcea arm & Măcin arm)

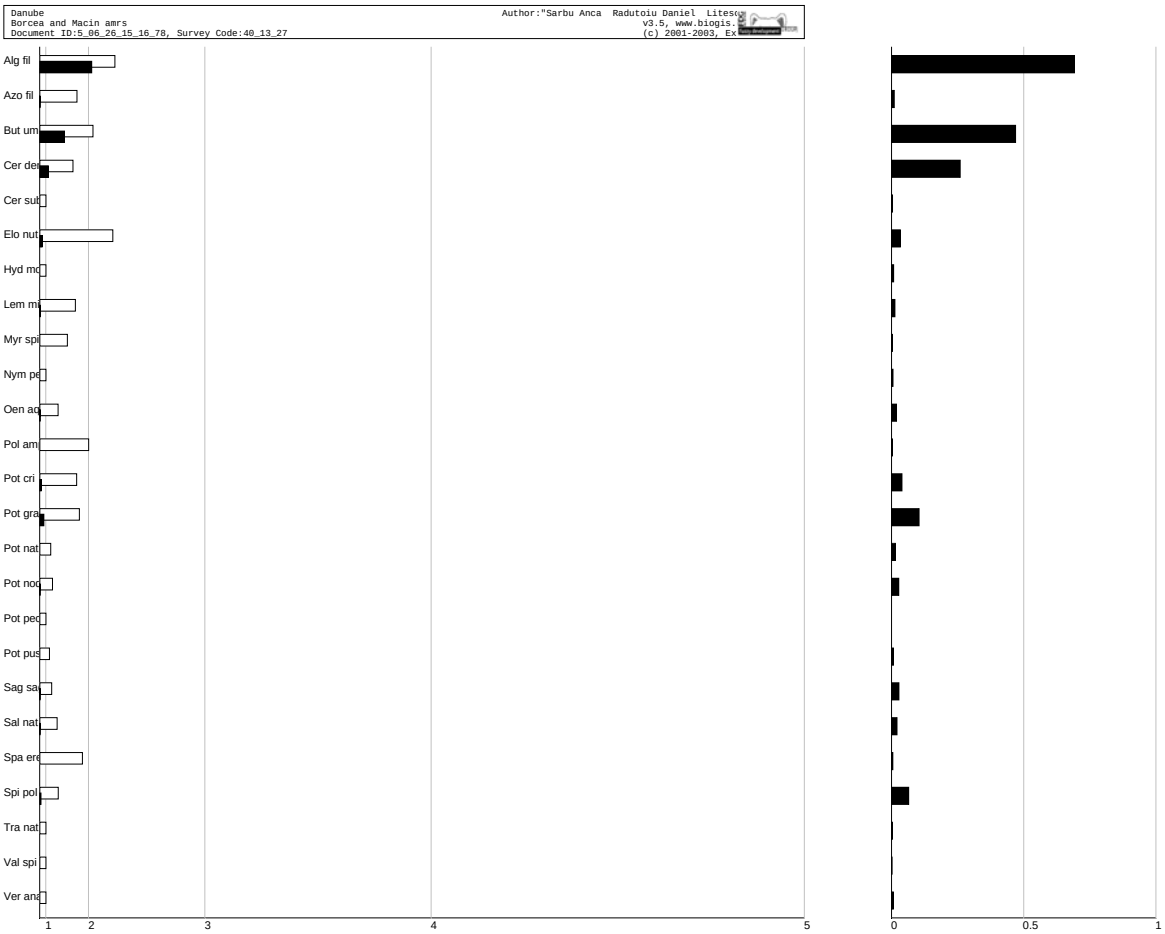

Figure 3. Average distribution of species (MMT/O/d) – Danube river branches (Borcea arm & Măcin arm located outside the Danube Delta)

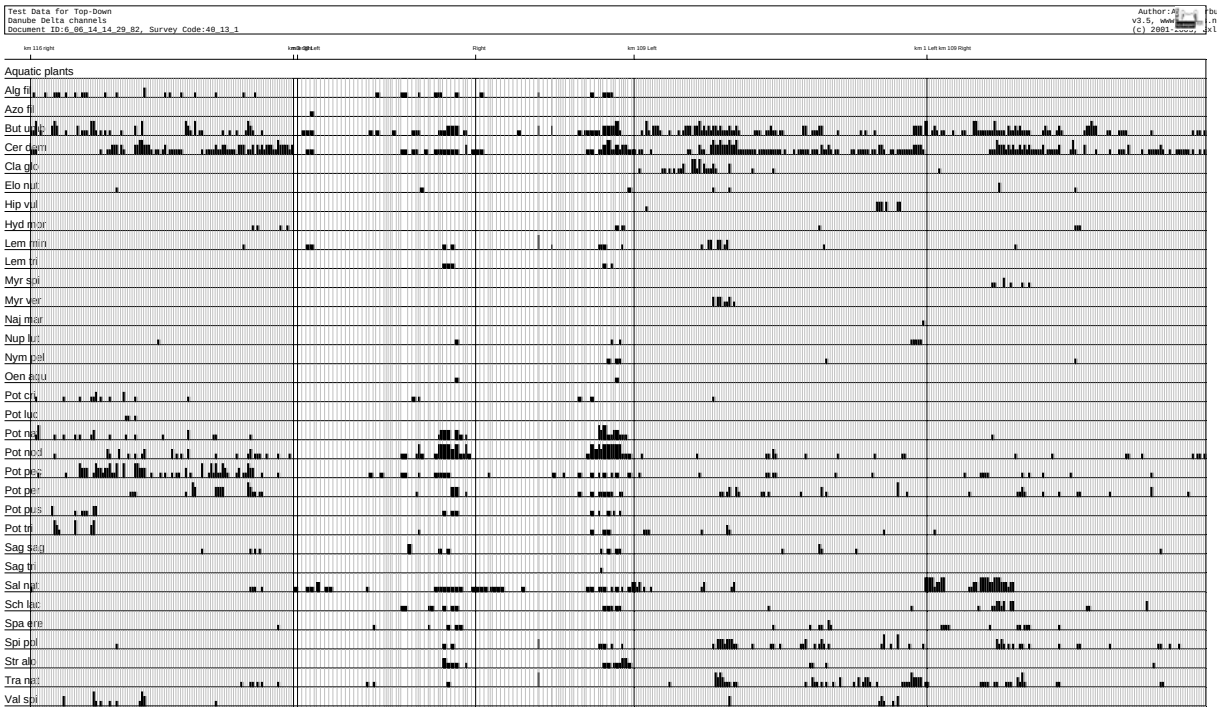

Figure 4. Distribution diagram – Danube river branches located inside the Danube Delta (Chilia, Sulina & Sf. Gheorghe arm)

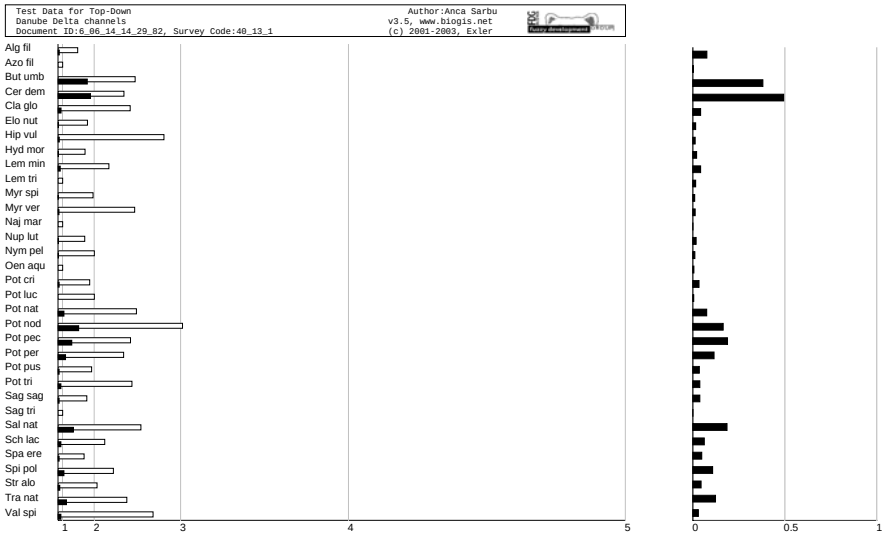

Figure 5. Average distribution of species (MMT/O/d) – river arms inside the Danube Delta

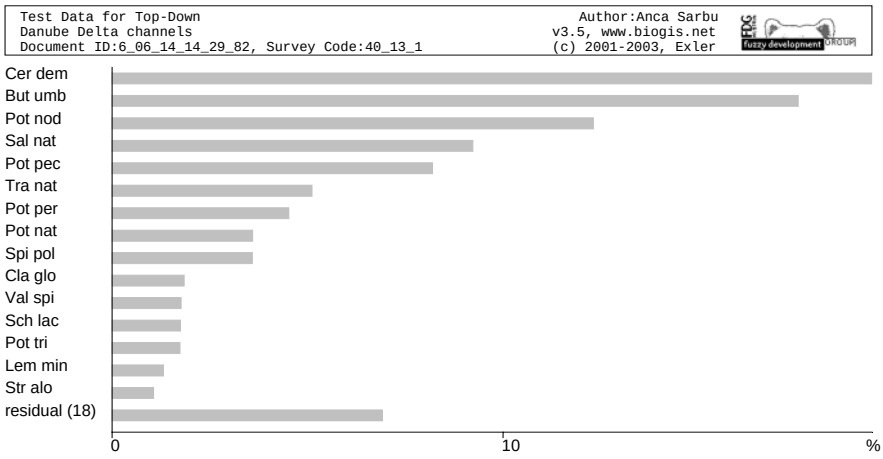

Figure 6. Relative Plant Mass – Danube river branches inside the Danube Delta

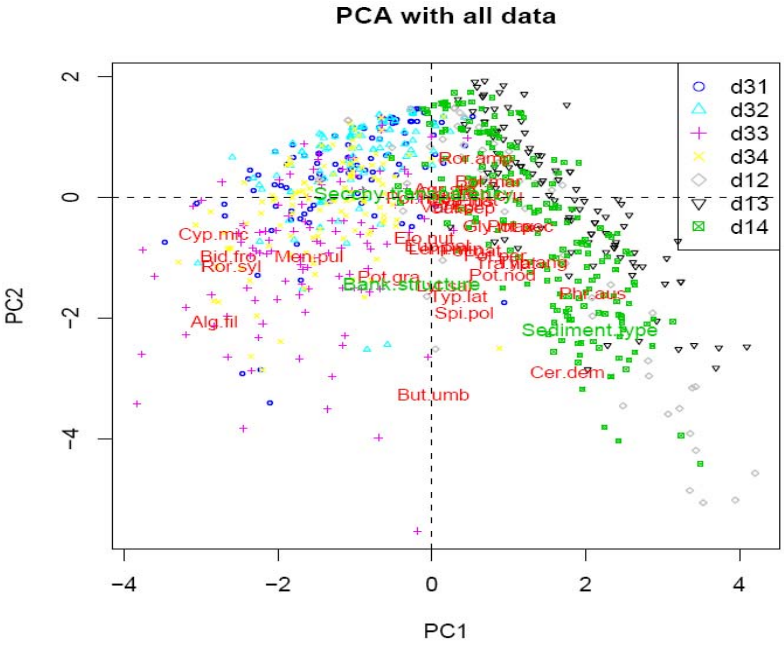

Figure 7: PCA (transformation: Kendall's correlation)

The side arms outside the Danube Delta (left half of diagram, d31-34) are clearly differentiated from the Delta Arms (d12-14). Sediment type is the most important environmental parameter characterising Delta habitats.

Discussion

The two groups of the Danube river branches are clearly differentiated by multivariate statistical analysis (Fig 7, PCA, Kendall correlation; d31-34: outside Delta; d12-14: inside Delta) not only by macrophyte abundance, but also by their composition. In this respect, species like *Hippuris vulgaris* L., *Myriophyllum verticillatum* L., *Najas marina* L., *Nuphar lutea* (L.) Sibth. & Sm., *Potamogeton lucens* L., *P. trichoides* Cham. & Schlecht., *Sagittaria trifolia* L., *Stratiotes aloides* L. were found only in the Danube Delta branches. There, the aquatic vegetation was better represented regarding diversity, distribution and relative plant mass. Among corresponding environmental parameters sediment type is most important (fine inorganic sediment is dominant in the Delta), but higher values of Secchi transparency (mean value = 0,7m) and slower water flow (both not included in the statistical analysis) may play an important role as well.

Only two macrophytes reach the dominant state in all the five Danube river arms: *Ceratophyllum demersum*, a submerged anchored macrophyte tolerant to eutrophic conditions and *Butomus umbellatus* with a significant plasticity of growth forms (submerged plant, helophyte, amphiphyte).

Summary

The aquatic vegetation is one of the biological elements to be assessed in the process of defining the ecological status of surface water bodies. Regarding this the goal of this study in five Danube river branches was a realistic picture of diversity and abundance of aquatic plants in relation to main environmental parameters and based on a standardized methodological approach.

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