

AQUATIC MACROPHYTES FROM DANUBE DELTA LAGOONS MUSURA BAY AND ZATONUL MARE

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ABSTRACT: The Romanian Danube Delta, a unique, young and continuing to grow region situated in the eastern part of Europe, is the largest continuous marshland and the second largest delta on the continent, and also a favorable place for developing a unique flora and fauna in Europe, with many rare and protected species. The predominance of the aquatic environment, led to the existence of a particular macrophytic flora. In this context, the purpose of this paper is to contribute to the study of aquatic macrophytes. The present study took place over two years, between 2013-2014, and in each year a number of expeditions were made in the two lagoons (Musura Bay and Zătonul Mare) in different seasons, in order to observe the diverse flora, because, due to seasonal variation in water quality, there might be a significantly seasonality of the vegetation also.

Keywords: macrophytic vegetation, Danube Delta, aquatic macrophytes.

INTRODUCTION:

The Danube Delta represents the youngest geographical region of Romania, a unique European space with its own characteristic features. The diverse conditions of the Danube Delta lead to the settling here of a rich and diversified vegetation.

The terrestrial vegetation occupies smaller surfaces, being well represented in the riverside coppice area, the periodically flooded lands and on the sandbanks that are never flooded. The sands shelter a characteristic psammophile vegetation while halophile plants grow on saline soils (such as marine sands) (Gâștescu et al., 2008).

However, the dominant vegetation develops on lands with permanent water (ponds, lakes, channels), where there is water vegetation, or in wetlands with palustrine vegetation.

Given the complex study of the Danube Delta biodiversity, numerous researchers have been preoccupied by the cormophyte flora, with over 300 scientific papers that refer to water plants, the palustrine vegetation, the plants in meadow, forest, riverside coppice and sandbank zones or others that represent species that are endangered, rare or protected by the law (Sanda, et al., 1973; Ciocârlan, 1994; Petrescu, 2007; Ciocârlan, 2011). Also, we must mention the papers that describe plants introduced by people, involuntarily or for economical reasons.

The synthesis papers published after 1990 mention a number of 955 species plus 64 subspecies of cormophytes (Ciocârlan, 1994), and 157 vegetal associations (Popescu et al., 1997). The analysis of the biotypes of the species described shows a large percentage of therophytes, which suggests the high degree of human influence on the area. The high degree of anthropic influence is also supported by the large percentage of cosmopolitan and adventives species determined as a result of the analysis regarding the ratio of various floral elements (geo-elements) (Ciocârlan, 1994).

Considering these aspects and the unique quality of the area also reflected by its genesis, as well as by its

physical and geographical characteristics, the study of the Danube Delta flora and vegetation represents an important component of the general study of biodiversity. On the other hand, any concern connected to protection and preservation must be based on well documented scientific studies.

MATERIALS AND METHODS:

The present study took place over two years, between 2013-2014, and in each year a number of expeditions were made in different seasons, in order to observe the flora diversity, because, due to seasonal variation in water quality, there might be a significantly seasonality of the vegetation also.

The present observations took place in two lagoons: Musura Bay and Zătonul Mare (Fig. 1. a, b).



Fig.1. The location of Musura Bay (a) and Zătonul Mare (b) in Danube Delta region

Musura Bay or Northern Bay is situated between Sulina and the southernmost arm of the Chilia Distributary, Stary Stambul. It has a length of about 12

km, is crossed by Romanian-Ukrainian border and has a very low, marshy coast.

For the Musura Bay, as result of the sedimentation of sandy sediments derived from the Sary Stambul secondary mouth and transported by the longshore current from the north, a submerged littoral bar was formed in Ukrainian waters, near the Romanian–Ukrainian border, that became a lateral spit with a length of about 3.5 km in 1985. At the beginning of the 1990s, the new island length was already sufficiently long to cross the border between the Ukraine and Romania. Subsequently, the island advanced to the south for about 3 km (Stanică et al., 2007). In its present position, the new spit (approximately 7 km in length and 80 m wide), has transformed the previous Musura Bay into a lagoon, with two inlets (north and south of the former bay).

South of the mouth of the arm of Sfântul Gheorghe is a lagoon area, Zătoane that is made, according by some authors of two aquatic ecosystems: Zătonul Mare and Zătonul Mic, separated from the sea by a narrow sand zone, but keeping the communication with Danube system.

RESULTS AND DISCUSSION:

Due to the field trips that took place in spring, summer and autumn period, between 2013 - 2014, 35 taxa were identified in the study area, as follows.

Pteridophyta: *Salvinia natans* (L.) All. (floating fern), T, Euras., Angiospermatophyta: Dicotyledonatae, Ranunculales, Nymphaeaceae: *Nuphar lutea* Sm. (yellow water lily), Hd, Euras. (Fig.2), *Nymphaea alba* L. (white water lily), Hd, Eur.; (Fig.3), Ceratophyllaceae: *Ceratophyllum demersum* L. (hornwort), Hd, Cosm., *Ceratophyllum submersum* L. (hornwort), Hd, Eur.; Polygonales, Polygonaceae: *Rumex hydrolapathum* Huds. (great water dock), H, Eur.; Myrthales, Trapaceae: *Trapa natans* L. (water caltrop), T, Euras. Cont. (submedit.), Lythraceae: *Lythrum salicaria* L. (purple loosestrife), H, Circ; Haloragaceae: *Myriophyllum spicatum* L. (spiked



Fig. 2. *Nuphar lutea*

Out of the total of 35 taxa identified, a number of 14 belong to **aquatic vegetation** (emersed, attached or not attached to a substrate). The flora that makes up this vegetation develops along the channels with calm

water-milfoil), H, Circ., *Myriophyllum verticillatum* L. (whorled water milfoil), H, Circ.; Umbelliflorales, Umbelliferae: *Cicuta virosa* L. (cowbane), H, Euras., *Oenanthe aquatica* (L.) Poir. (water dropworts), T, Euras.; Labiatae, Lamiaceae: *Mentha aquatica* L. (water mint), H, Eur., Lentibulariaceae: *Utricularia vulgaris* L. (greater bladderwort), Hd, Circ.; Boraginales, Boraginaceae: *Myosotis scorpioides* L., (water forget me not), H, Euras.; Gentianales, Menyanthaceae: *Nymphoides peltata* (S.G.Gmel.) Kuntze, (fringed water-lily) Hd, Euras.; Monocotyledonatae: Alismatales, Alismataceae: *Alisma plantago-aquatica* L. (common water plantain), Hd, Circ., *Sagittaria sagitifolia* L. (arrowhead), Hd, Euras., Butomaceae: *Butomus umbellatus* L., (flowering rush), Hd, Euras.; Hydrocharitales, Hydrocharitaceae: *Hydrocharis morsus-ranae* L., (common frogbit), H, Euras., *Stratiotes aloides* L. (water soldier), Hd, Euras., *Elodea canadensis* Michx. (pondweed), H, Adv.; Najadales, Potamogetonaceae: *Potamogeton crispus* L., (curled pondweed), Hd, Cosm., *Potamogeton natans* L., (floating pondweed), Hd, Circ., *Potamogeton pectinatus* L. (syn *Stukenia pectinata* L. Boerner) (sago pondweed), Hd, Cosm., *Potamogeton perfoliatus* L., (perfoliate pondweed), Hd, Cosm., Najadaceae; *Najas marina* L. (spiny water nymph), T, Subcosm.; Cyperales, Cyperaceae: *Schoenoplectus lacustris* (L.) Palla. (lakeshore bulrush), G, Cosm., *Carex riparia* Curtis, (greater pond sedge), G, Euras.; Typhales, Sparganiaceae: *Sparganium erectum* L. (simplestem bur reed), G, Euras., Typhaceae: *Typha angustifolia* L., (narrowleaf cattail), G, Circ., *Typha latifolia* L. (broadleaf cattail), G, Cosm.; Poales, Poaceae: *Phragmites australis* (Cav.) Trin. ex Steud., (common reed), G, Cosm.; Arales, Lemnaceae: *Lemna minor* L. (common duckweed), Hd, Cosm., *Lemna trisulca* L. (star duckweed), Hd, Cosm.



Fig. 3. *Nymphaea alba*

waters or at the surface of still waters. In this category, we remark the *Potamogeton* species that are widely distributed in the Danube Delta, and we have to point that the great occurrence of *Potamogeton crispus*

indicates a stronger anthropogenic influence, which leads to an oxygen deficit and accumulation of organic materials in the respective pools. On the other hand, we noticed the presence of two species being listed in the “Romanian Red List of Vascular Plants. One is *Trapa natans* that even if is practically ever-present in the Danube Delta aquatic basins, it was observed that mainly the draining of certain lakes and marshes along the Danube, and secondly the presence of toxic substances, led to the strong reduction of the populations of *Trapa natans*, so the species is listed as “vulnerable” (VU) in the “Romanian Red List of Vascular Plants” (1994), according to the IUCN categories. The other species is the mixotrophic *Utricularia vulgaris* which develops in shallow waters; its status in the “Romanian Red List of Vascular Plants” (1994) is “rare” (R), according also to the IUCN categories.

Most of the species identified in the present study belong to the category of palustrine vegetation (15 species) which is understandable, taking in consideration that palustrine vegetation is the most distributed in the Danube Delta, the characteristic vegetal formation being the reed association.

Submerged vegetation is represented by few species, but here we have to remark the pondweed (*Elodea canadensis*) as an adventive plant, original from North America and introduced into Central and Western Europe in the 20th century, in our country, being first mentioned in the Danube Delta. Even if initially it had an intense development, now it is not widely distributed, the populations are not numerous, and even disappeared from certain places.

Analysis of the biological forms

Analyzing the spectrum of the biological forms we discover that hydrophytes dominate, being 16 species from the species identified. These are followed by hemicryptophytes, 9 species, geophytes, 6 species, the fewest being the therophytes, only 4 species (Fig.4).

Analysis of the floristic elements

The analysis of the floristic elements mark out the dominant Eurasian elements, which together with European ones sum up 17, forming half the floral elements. The Cosmopolitan species are also remarkable, represented by 10 species, the circumpolar elements are represented by 7 species, and we also notice the presence of one adventive plant (Fig.5).

Plant identification and flora analysis was made using specific scientific literature (Sanda et al.; 1983; Sârbu et al., 2013).

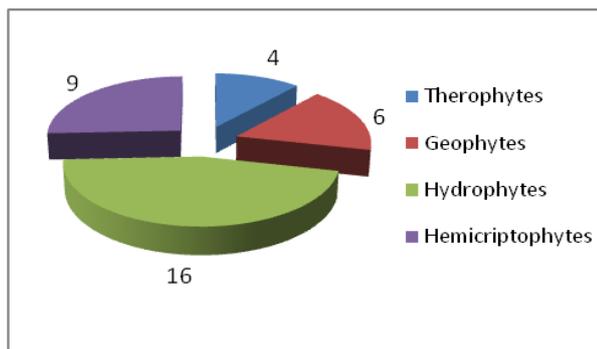


Fig.4. Analysis of biological forms

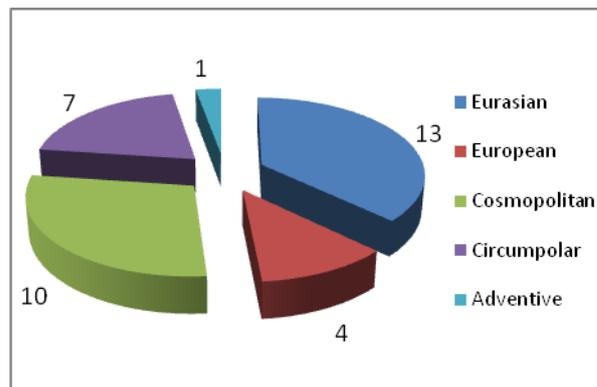


Fig.5. Analysis of floristic elements

CONCLUSIONS:

This recent study of the aquatic macrophytes of the Musura Bay and Zătonul Mare, shows a notable diversity.

The biological form analysis showed, as expected, the predominance of hydrophytes, because our study was directed towards wetlands. The presence of hemicryptophytes (25,71 %), is indicating the presence of the herbal evergreen species, adaptable to the edapho-climatic conditions in the area. Different published studies show the high percentage of therophytes, which indicates the high degree of human influence, but in our study only 11,42% of identified species are in this category, this can be explained by the fact that only a certain part of flora was studied (aquatic macrophytes).

Besides the studies of the flora from different habitats, an analysis of the floristic elements (geoelements) was made, that shows the predominance of Eurasian and European elements (48,57%), which is in the line with the fact that Eurasian and European elements are the best represented category of the Romanian flora, largely because the temperate continental climate of our country. The floristic spectrum shows a percentage of Cosmopolitan elements of 28, 57%, that shows the high level of anthropic influence, sustained also by the presence of the adventives species. The Circumpolar species represent 20% of analyzed flora.

The study of the flora and vegetation of the Danube Delta represents an important component in the study of the biodiversity of the area in general and also a very important part of the issue regarding environmental protection.

Studies are to be done in the future to analyze the interesting and diverse flora of the region.

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