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Water pollution

SPATIO-TEMPORAL EVOLUTION OF THE BIOTIC COMPONENTS IN THE AQUATIC ECOSYSTEMS FROM DANUBE DELTA BIOSPHERE

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Abstract. The paper presents data from the comparative biological analysis of the aquatic ecosystems of the Danube delta in two sampling sites: Uzlina and Murighiol for the sampling period (April 2005-October 2006). The results on the biotic communities determined from Uzlina and Murighiol locations demonstrated the following aspects: in the Murighiol and Uzlina control sections from the point of view of phytoplanktonic, zooplanktonic and benthic macroinvertebrates components, in the period 2004-2006, similarly to the year 2003, the Danube water is an eutrophic system equilibrated for class IInd according to the Norm concerning the reference objectives for the surface water quality classification (Order No 161/2006); the phytoplanktonic and zooplanktonic biocenosis represents the trophic basis necessary for ichthiofauna development in the aquatic ecosystems in the control sections: Murighiol and Uzlina; in the Murighiol control section, the phytoplankton is better represented than in the Uzlina control section for numerical density and remanent biomass; dominant species from phytoplankton and zooplankton – for numerical density and remanent biomass – are oligo-betamesosaprobic species. The researches will be continued in order to assess the seasonal variations, the final results will estimate the value of the trophic basis in the two control sections in the framework of the Danube delta biosphere, because the main actions that must be achieved in this areas in order to accomplish a sustainable management are represented by: the reduction of the nutrient charge in the Danube, especially the Danube delta inputs, controlling the punctiform and diffuse pollution sources; the prevention of a wetlands' loss through the pressure reduction on them; the restoration of wetlands, being the only way to prove the capacity to support and productivity of the entire Danubian system.

Keywords: aquatic ecosystems, the Danube delta, biotic components-phytoplankton, zooplankton, benthic macroinvertebrates.

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AIMS AND BACKGROUND

The aquatic ecosystems are dynamic systems that keep their stability in the conditions of permanent fluctuations of biotic and nonbiotic parameters. The dynamic equilibrium of the aquatic ecosystems is accomplished due to the connections between the species and the environmental conditions and also to the mutual connections between the existing populations[1–3]. From this point of view, the *study of biotic/population – phytoplankton, zooplankton and/or benthonic components* – from the position of the systemic method and conception, in order to characterise the dynamics and role within the integrated aquatic ecosystems represents a proprietary problem of the research in ecology.

Our researches are important because:

• in August 1990, the Danube delta was declared by UNESCO reservation of the biosphere. It is made up of the delta, the complex of lagoons Razim–Sinoe and Valea Dunarii upstream until it gets to Cotul Pisicii, measuring a surface of 591 200 ha. This represents 2.5% of the Romania's territory.

• in 1994, the Danubian countries signed in Sofia the Convention of Cooperation on the Protection and Sustainable Use of the Danube river, as an instrument of bilateral and multilateral cooperation between the riverain countries, intended to permanently improve the water protection system in the Danube river basin[4,5].

In this area, the vegetal associations comprise over 1150 species of plants grouped as follows:

– aquatic plants – hydrophilic submersibles or natante, nenuphars, yellow water lilies, club mosses, sword flags, etc.;

– the floating reed islet, 19.5 km^2 – floating island, thick of 0.60-2 m, made up of roots and reed rhizomes;

– the riverside coppices of willow trees, poplar trees, red and white sea buckthorns;

– exotic forests on Letea and Caraorman narrow reefs made up of autumnal and pedunculate thick oak trees, black and white poplar, alder trees, elm trees, etc., shrubs like the hawthorn, the cornel tree, the privet, the Mediterranean vegetation, ivy and Virginia creeper, and also lianas *Clematis vitalba*, *Humulus rupulus*, *Periploca graeca*;

– 60% of the world's population of cormorants;

– the largest cormorant population in Europe;

– almost half of the world's population with red neck (they spend the winter here);

– besides these ones, we can also notice the winter and summer swan, wild ducks and geese, white, grey, yellow and red herons, cranes, egrets, spoon bills, eastern flossy ibis, bald coots, white tailed eagle, the Dobrudjan hawks, storks, flamingo birds;

– ichthiofauna comprises over 1500 fish species, among which we can mention: the sturgeons – the beluga, the Black sea sturgeon, the sterlet and the sevruga;

– the bearers of black roes: the mackerels, the anchovies, the carp, the sheat fish, the pike perch, the pike, etc[6.7].

The paper provides data on the aquatic ecosystems of the Danube delta in two sampling sites: Uzlina and Murighiol for the samplings period (April 2005-October 2006) based on comparative biological analysis.

It is recommended the researches to be carried out also for other control sections in the framework of the Danube delta biosphere[8,9], because the main actions that must be achieved in the Danube and Danube delta areas in order to accomplish a sustainable management are represented by:

– the reduction of the nutrient charge in the Danube, especially the Danube delta inputs, controlling the punctiform and diffuse pollution sources[10,11];

– the prevention of wetlands' loss through the pressure reduction on them;

– the restoration of wetlands, being the only way to prove the capacity to support and productivity of the entire Danubian system[12–16].

Thus, the optimisation of the nutrients' retention capacity implies a whole approach of the management techniques based on ecological reconstruction tests of the wetlands which suffered an anthropic impact, but also a reduction of the nutrients quantity which go into a different ecosystems through the control of punctiform and diffuse sources.

In order to decrease the nutrients' excess in the punctiform and diffuse sources, a solution could be the fitting out of an artificial wetlands, which are capable by the vegetable structure (herbal and/or arboriculture vegetation) to keep big quantities of nutrients.

EXPERIMENTAL

The main objectives proposed for the characterisation of the aquatic systems under study include:

• qualitative and quantitative analysis of the aquatic ecosystems (from water and sediment) through month determination of the characteristics for phytoplankton, zooplankton and benthonic macroinvertebrates;

• evaluation of the present state of the organisation stage of the biotic compounds and their dominating populations.

The main proposed activities for their realisation are:

(i) carrying of the development of a sampling program and the samples processing, properly dimensioned:

• at spatial stage: in order to allow the estimation of the structural parameters of the biotic communities starting from the level of the searched ecosystem complexes,

• at the temporal stage: to capture the proportion and sense in which the ecosystems evolution perform;

(ii) the knowledge of the temporal and spatial dynamics of the internal and external controlling factors influencing the structure of the biotic communities – phytoplankton, zooplankton and benthonic macroinvertebrates and the specific activity of their populations;

(iii) identification in the biotic community structure of some possible bioindicators important for the integrated system monitoring (due to the raised sensitivity of this compartment at the modification of the trophic state of the ecosystems) through saprobic/biodiversity indices.

During our investigations were drawn momentary samples from the two stock compartments – water and sediment – from the sampling sites Uzlina and Murighiol in drawing campaigns period April 2005-October 2006 in order to study the most representatives biotic communities of the aquatic ecosystems (phytoplankton, zooplankton, benthonic macroinvertebrates).

The samples (drawn according to national norms for water quality – methods of biological sampling and also to methodological guides on studying the evolution of water quality by biological tests) for biological tests were preserved in 4% formaldehyde solution and the used sampling techniques were according to the above mentioned norms, as follows:

• to analyse the phytoplankton, 1 l of sample was drawn directly from the water;

• to analyse the zooplankton, the sample was concentrated by filtering a volume of water of 50 dm^3;

• the benthic macroinvertebrates were drawn using special drawing equipment for aquatic sediments.

RESULTS AND DISCUSSION

The analyses of the biotic communities in the sampling sites Uzlina and Murighiol were focused on the quantitative (numerical density, biomass, abundance after numerical density and biomass) and qualitative component (dominant species, indicator species).

The comparative analysis of the phytoplankton, zooplankton and benthos characteristics within the aquatic ecosystems integrated in the Danube delta, in the Uzlina and Murighiol control sections for the period of the study (2005-2006) included:

(i) research of the biotic associations from illustrative aquatic ecosystems of both control points – Uzlina and Murighiol – was achieved from the point of view of conception and systemic analysis, with supposition that these associations are considered subsystems of respective aquatic ecosystems biocenosis;

(ii) are characterised by homogeneous family of algae with representatives of the divisions – Bacillariophyta, Chlorophyta; at the Murighiol location was present the algae from Euglenophyta division;

(iii) characterisation of the numerical density and biomass on the biotic components in aquatic ecosystems structure, in campaign sampling (2005-2006):

• phytoplankton associations are constant and dominant components in aquatic ecosystems structure for numerical density and biomass – oligo-betamesosaprobic diatoms, betamesosaprobic chlorophyte;

• at the all moment of sampling, from a qualitative and quantitative point of view, the dominant groups are the Bacillariophyceae, and Chlorophyceae are sub-dominant;

• population density and biomass at the Uzlina location present in general elder value in comparison with the Murighiol location. In Figs 1-4 is presented the spatio-temporal evolution for numerical density and biomass phytoplanktonic in the Uzlina or Murighiol locations in the period of the study (2005-2006);

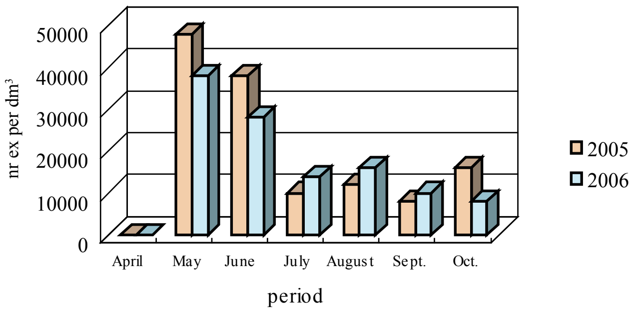

Fig. 1. Numerical density for phytoplankton in the Uzlina location – April-October 2005-2006

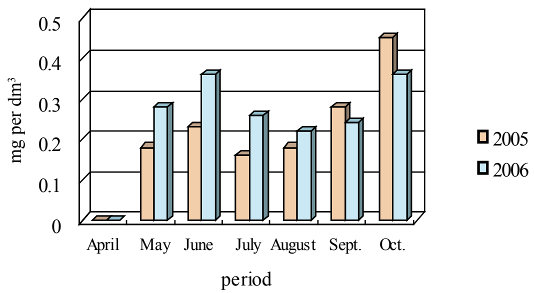

Fig. 2. Biomass for phytoplankton in the Uzlina location – April-October 2005-2006

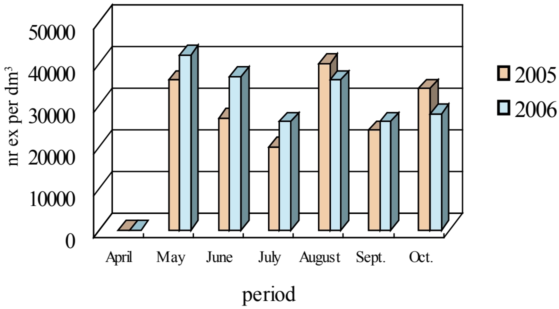

Fig. 3. Numerical density for phytoplankton in the Murighiol location – April-October 2005-2006

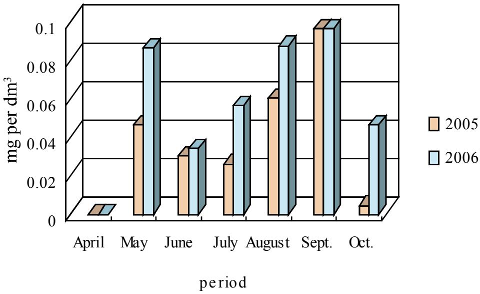

Fig. 4. Biomass for phytoplankton in the Murighiol location – April-October 2005-2006

• in zooplanktonic organisms (after numerical density) for all campaign of the sampling are present betamesosaprobic rotifers and rhizopoda, betamesosaprobic species of the cladocers and oligo-betamesosaprobic copepoda;

• density and biomass for zooplankton components in the Uzlina location were small in comparison with the Murighiol location. In Figs 5-8 is presented the spatio-temporal evolution for numerical density and biomass zooplanktonic in the Uzlina or Murighiol locations in the same period of the study (2005-2006);

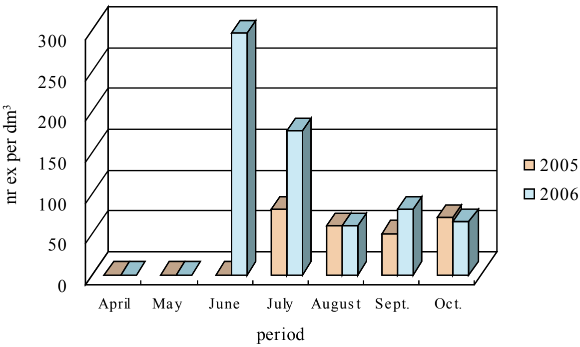

Fig. 5. Numerical density for zooplankton in the Uzlina location – April-October 2005-2006

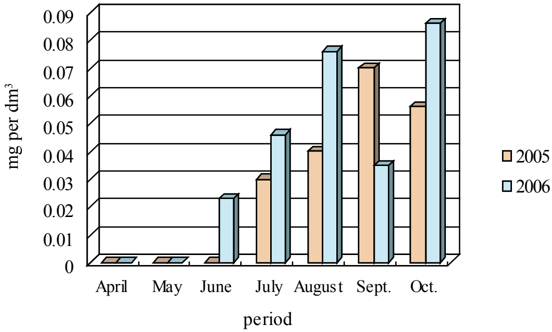

Fig. 6. Biomass for zooplankton in the Uzlina location – April-October 2005-2006

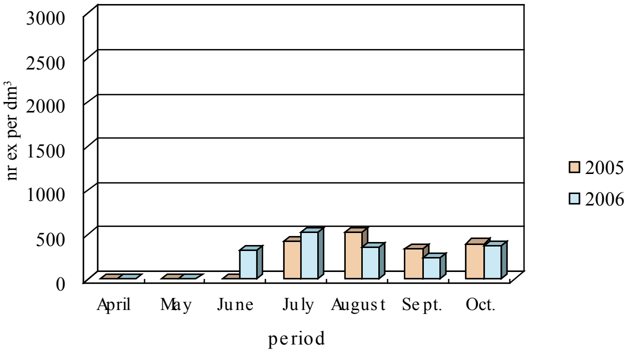

Fig. 7. Numerical density for zooplankton in the Murighiol location – April-October 2005-2006

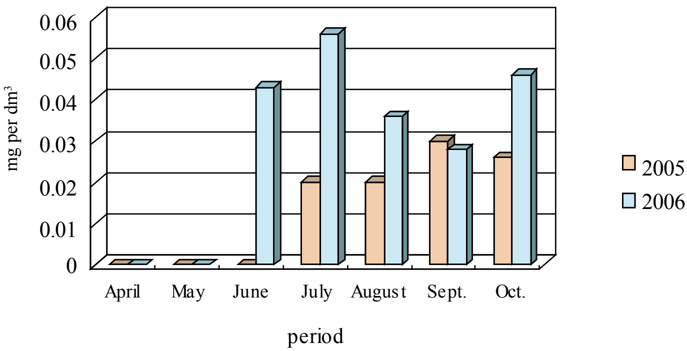

Fig. 8. Biomass for zooplankton in the Murighiol location – April-October 2005-2006

• during the investigation of the numerical density, the most frequent macroinvertebrates groups in the Uzlina and Murighiol locations were Gasteropoda and Lamelibranhiates;

• spatio-temporal distribution of the numerical density and biomass for macrozoobenthos in each of the sampling locations – Uzlina and Murighiol during the study is represented in Figs 9-12.

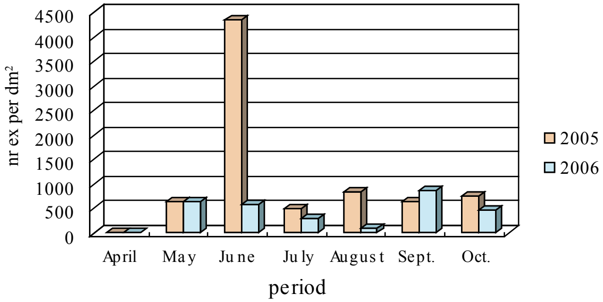

Fig. 9. Numerical density for benthic macroinvertebrates in the Uzlina location – April-October 2005-2006

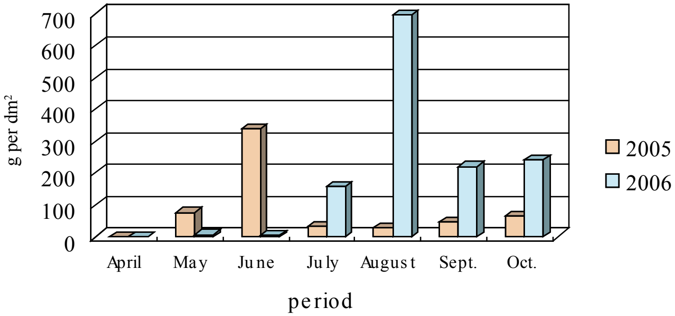

Fig. 10. Biomass for benthic macroinvertebrates in the Uzlina location – April-October 2005-2006

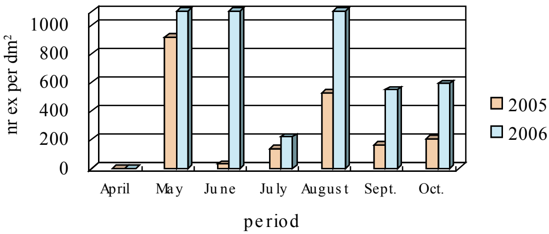

Fig. 11. Numerical density for benthic macroinvertebrates in the Murighiol location – April-October 2005-2006

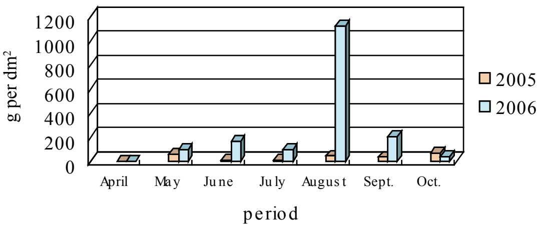

Fig. 12. Biomass for benthic macroinvertebrates in the Murighiol location – April-October 2005-2006

CONCLUSIONS

The results obtained through comparative biological analysis for each sampling site: Uzlina and Murighiol for the samplings period (2005-2006) are:

– in the Murighiol and Uzlina control sections from the point of view of phytoplanktonic, zooplanktonic and benthic macroinvertebrates components, in the period 2005-2006, the Danube water is an eutrophic system equilibrated as class II according to the Norm concerning the reference objectives for the surface water quality classification (Order No 161/2006);

– the phytoplanktonic and zooplanktonic biocenosis represent the trophic basis necessary for ichthiofauna development in the aquatic ecosystems in the control sections: Murighiol and Uzlina;

– in the Uzlina control section, the phytoplankton is better represented than in the Murighiol control section for numerical density and remanent biomass;

– dominant species from phytoplankton and zooplankton – for numerical density and remanent biomass – are oligo-betamesosaprobic species.

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