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EVOLUTION OF AN AQUATIC ECOSYSTEM (THE SUCEAVA RIVER) FOR A 3-YEAR PERIOD IN TERMS OF ECOLOGICAL DYNAMICS

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Abstract. The paper presents the ecological diversity dynamics of an emissary (the Suceava river) in 25 control sections along a 3-year sampling period. The preliminary results of analysis for the biotic communities determined from all 25 locations demonstrated the following aspects: in the upstream and downstream control sections, in terms of phytoplanktonic, zooplanktonic and benthic macroinvertebrates components, the Suceava river and its tributaries water is framed in 'very good' and 'good' ecological status according to the Romanian Norm (Order MMGA No 161/2006); in the upstream control sections, the phytoplankton is better represented than in the downstream control sections for numerical density and remanent biomass. Also, dominant species in phytoplankton and zooplankton – for numerical density and remanent biomass – are oligo-betamesosaprobic species; concerning the benthic macroinvertebrates there is a quite high diversity, represented by Ephemeroptera, Trichoptera, Diptera species, and association of the Oligocheta together with Chironomidae organisms. The project goal was estimating the value of the trophic basis, in all control sections of the emissary, because the main actions that must be achieved in these areas in order to accomplish a sustainable management are represented by: the reduction of the nutrient charge in the Suceava river, especially its tributaries inputs, this being the only way to prove the capacity to support the productivity of the entire system.

Keywords: water quality, the Suceava river, phytoplankton, zooplankton, benthic macroinvertebrates.

AIMS AND BACKGROUND

The rivers play a major role in shaping the ecological status of the areas they cover and control the global water cycle and the hydrological cycle, being the most dynamic transport factors[1]. The monitoring program started in 2007 by creating a conceptual framework for investigation by the methods that evaluate the dynamic characteristics of aquatic ecosystems. To reveal the changes of quality indicators had been selected 25 control sections covering the entire emissary – the Suceava river including a number of representative tributaries (Pozen, Solonet and Salcea streams), taking into account the influence of some economical agents, urban

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waste storage areas (Suceava landfill) and, also,the urban and rural settlements[2]. The paper presents the biological results in order to highlight ecological dynamics of natural emissary – the Suceava river by an integrated monitoring program that contributes to a sustainable management of water resources enabling environmental risk situations.

EXPERIMENTAL

The Suceava river is part of the Siret basin, springs from the the northern country of Obcina Mestecanis of the Lucina Massif (1588 m) and after crossing the 170 km, flows into the Siret river in Liteni town at a distance of 21 km south-east of the Suceava city[3]. The geographical position of control sections performed by the Global Positioning System (GPS) technique can be seen in Fig. 1.

Fig. 1. The Suceava river basin

The information about geographical position of all 25 control sections is presented in Table 1.

The hydrobiological investigation for all sampling campaigns was performed in accordance with standard methods and methodologies[4–8]. To achieve the objectives were sampled momentary storage compartments – water and sediment – from the sampling sites in drawing 4 seasons: February 2008–January 2010 in order to study the most representative biotic communities of the aquatic ecosystems (phytoplankton, zooplankton, benthonic macroinvertebrates) and to evaluate the contaminated sites by the distribution of pollutant substances in terms of biotic communities. This was chosen for capturing important stages of life cycles and fluctuation fields of the main factors that influencing the control structure and functions of biotic populations. Depending on the biological sample type was

used special and adequate sampling equipment and the samples for analysis were preserved in 4% formaldehyde solution in order to assess the water quality status for February 2008 – January 2010 period time.

Table 1. The Suceava river and its tributaires control sections

No	Control sections name	Placement
1	SV5	Suceava river – Brodina village
2	SV6	Pozen tributaire upstream – Radauti city
3	SV7	Pozen tributaire downstream – Radauti city
4	SV8	Suceava river upstream – Dornesti village
5	SV9	Suceava River downstream – Dornesti village
6	SV11	Suceava river – Milisauti town
7	SV21	Suceava river upstream from the confluence with Solonet stream
8	SV22	Suceava river downstream from the confluence with Solonet stream
9	SV23	Solonet upstream from the confluence with Suceava river
10	SV10	Solonet downstream – Cacica village
11	SV26	Solonet – Partestii de Jos
12	SV26+500 m	
13	SV26+1000 m	
14	SV14	Suceava river – Mihoveni dam
15	SV15	Suceava river – Itcani quarter
16	SV3	Suceava river upstream wastewater discharge of sewage of town with Castle stream
17	SV4	Suceava river downstream from the discharge of sewage effluent and upstream of municipal landfill site
18	SV1	Suceava river in front of municipal landfill
19	SV2	Suceava river downstream of the drainage discharge leachate
20	SV2+500 m	from municipal landfill
21	SV2+1000 m	
22	SV16	Suceava river – Tisauti village
23	SV19	Salcea stream
24	SV18	Suceava river – Veresti village
25	SV17	Suceava river – Liteni village

The study of the biotic associations that were been investigated was performed using the methods and techniques like: sampling, processing and analysis of samples, field and laboratory experimental methods, quantitative data processing and interpretation. The biological assessment methods – essential tools used to characterise aquatic biota were represented by: the saprobic system designed by Kolkwitz and Marson[9] which listed the vegetal and animal organisms according

to their sensitivity or tolerance to chemical compounds against decomposition of organic substances, naming them indicator pollution organisms, methods that focus on the presence/absence of benthic macroinvertebrates indicators of aquatic communities.

The phytoplankton community represents the bulk that bring into the ecosystems the energy, determine existing food chains in an aquatic ecosystem and also constitutes the trophic structure of many aquatic ecosystems[10]. The zooplanktonic organisms are particularly sensitive to pollution, so a lot of these bodies are used as bioindicators. Aquatic benthic community consists of integrated population biocenosis that lives on the river bottom or attached to rocks or other submerged objects.

RESULTS AND DISCUSSION

The Romanian norm 161/2006 (transposed from Directive 2000/60/EC) introduced a classification of the quality factors that describe the ecological condition of surface water.

This classification consists of 5 classes for surface water: very good (I), good (II), moderate (III), poor (IV) and bad (V). The analysis of the biotic communities in the all sampling site focused on the quantitative (numerical density, biomass, abundance after numerical density and biomass) and qualitative component (dominant species, indicator species).

From the list of specified quality indicators were presented, in a graphic form, the evolution of biological quality indicators from surface water (Figs 2–5) and, also, the macroinvertebrates organisms from sediment (Figs 6 and 7). Concerning phytoplankton community, the all 25 control sections, were represented by microscopic unicellular algae, colonial or filamentous mass flowing water and because of the short life cycles, respond quickly to changes in the aquatic environment. The evolution of saprobic index for the entire emissary – the Suceava river – revealed uniform distribution of phytoplankton community with high values of the index recorded in the municipal landfill control sections. The most representative taxonomical groups in terms of phytoplanktonic comunity were species from Bacillariophyta, Chlorophyta associations and desultory Cyanophyta, Chrysophyta, Dinophyta, Euglenophyta associations. The saprobic index values induced for analysed control sections an ecological state ‘good’ and ‘very good’, except of those control sections which were located in the area of municipal landfill. The highest numerical density value of phytoplankton was recorded in SV11 (the Suceava river in the Milisauti town) control section on March 2008 and May 2009 (639.000 ex./dmc), decreasing it in the SV4, SV1, SV3, SV2 sampling sites (Fig. 2).

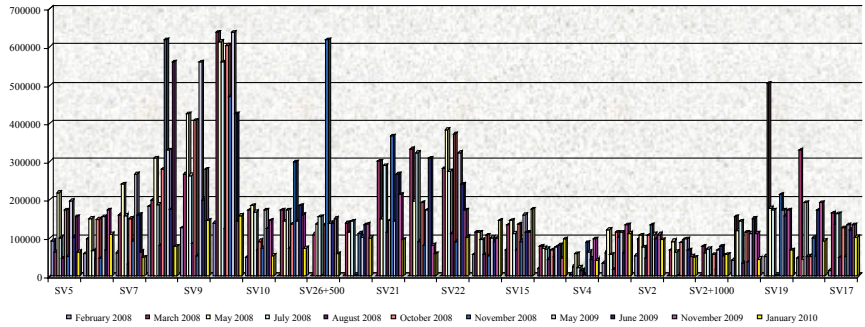

Fig. 2. Numerical density of phytoplankton community in the Suceava river

The lowest value was recorded in SV4 (the Suceava river downstream from the discharge of sewage effluent and upstream of municipal landfill site) on February 2008 (5000 ex./dmc). Concerning numerical abundance, in all sampling seasons the betamesosaprobic diatoms were the dominated species. The maximum value of remnent biomass was recorded on January 2010 (5,11 mg/dmc) in SV21 (the Suceava river upstream from the confluence with Solonet stream) (Fig. 3).

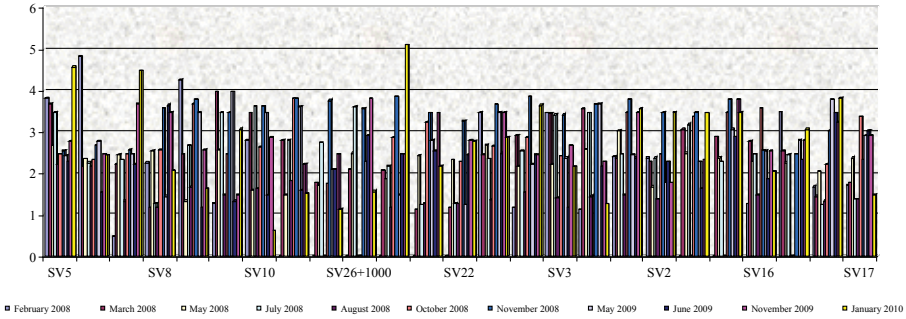

Fig. 3. Phytoplankton biomass in the Suceava river

After abundance expressed as a percentage of biomass, in all sampling campaigns the oligo-betamesosaprobic diatom species – *Navicula gracilis* or betamesosaprobic chlorophyte – *Pediastrum boryanum* dominated[11]. The zooplankton community consisting of various level consumers which populate the entire mass of water was very well represented by the betamesosaprobic rotifers, betamesosaprobic species of the cladocers and oligo-betamesosaprobic copepoda. The highest numerical density value of zooplankton organisms (520 ex./dmc) was recorded in SV23 (Solonet upstream from the confluence with the Suceava river) on May 2009 and in SV8 (the Suceava river upstream the Dornesti village) on May 2008. It was observed the absence of the zooplankton species in SV2+500, SV2+1000 (the Suceava river downstream of the drainage discharge leachate from municipal landfill), SV16 (the Suceava river in the Tisauti village), SV19 (the Salcea stream)

control sections on August 2008 (Figs 4 and 5); there were strong changes of the investigated water body due to floods.

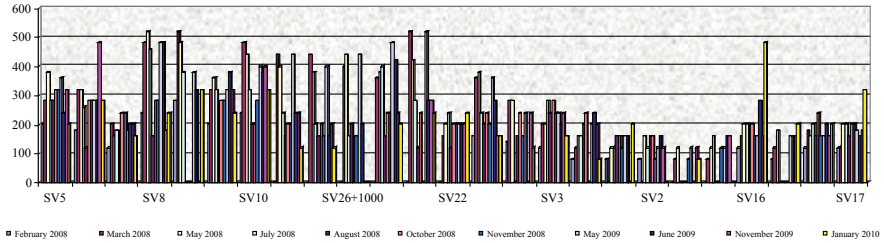

Fig. 4. Numerical density of zooplankton community in the Suceava river

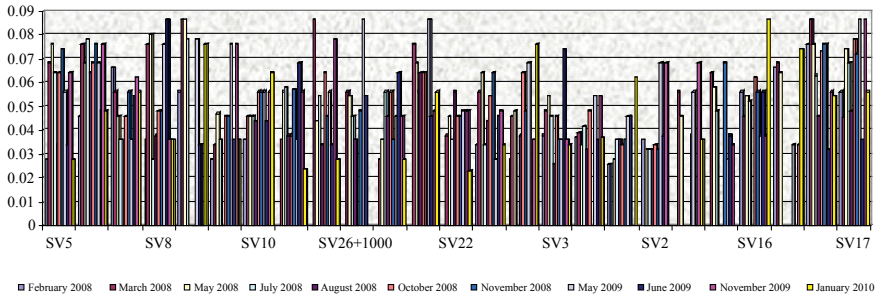

Fig. 5. Zooplankton biomass in the Suceava river

The maximum value of remnent biomass was recorded on January 2010 (0.086 mg/dmc) in SV16 (the Suceava river in the Tisauti village). In terms of numerical abundance and biomass throughout the sampling period predominated in upstream control sections oligo-betamesosaprobic cladocers species – *Bosmina longirostris*[11] and in downstream control sections betamesosaprobic rotifers (*Keratella quadrata frenzeli*)[11] and ciliates species. The sediment samples were collected for all control sections, except SV14 (the Suceava river on the Mihoveni dam) location, where sampling was not possible because of the dam area. The highest value of numerical density was recorded on November 2009 in SV22 (the Suceava river downstream from the confluence with the Solonet stream) – 16.420 ex./mp, Ephemeroptera and Diptera species were dominated. Spatial-temporal distribution of the numerical density and biomass for macroinvertebrates in each of the sampling locations for entire period is represented in Figs 6 and 7.

In sediment, there was a noticeable heterogeneity of Trichoptera, Ephemeroptera, Amphipoda and Plecoptera species on upstream the Suceava river control sections, better than downstream of the Suceava river and its tributaries control sections, where representative were Oligochaeta and Chironomidae associations as an important bioindicators in the integrated system monitoring (due to the

raised sensitivity of this compartment at the modification of the trophic state of the ecosystems)[12].

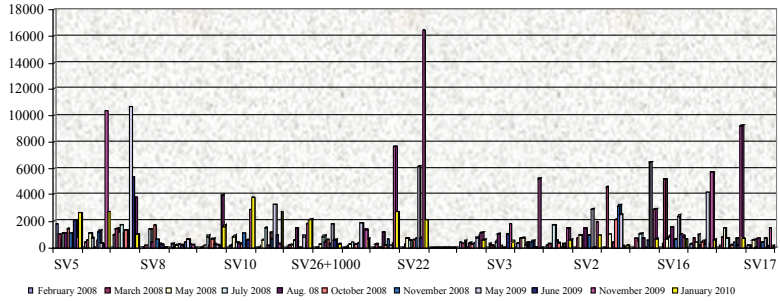

Fig. 6. Numerical density of benthic macroinvertebrates organisms in the Suceava river

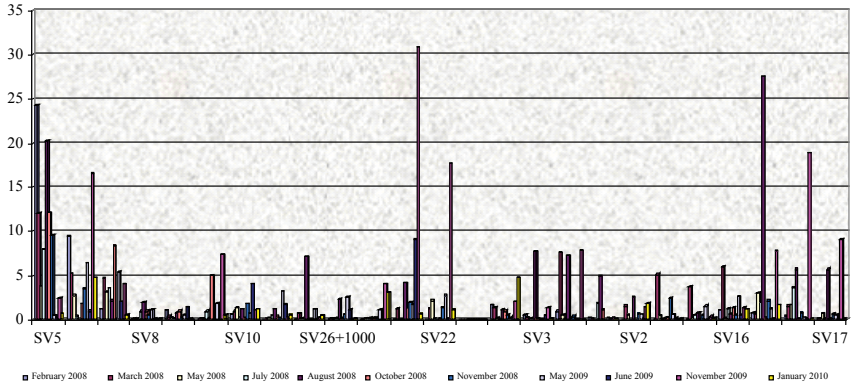

Fig. 7. Benthic macroinvertebrates biomass in the Suceava river

CONCLUSIONS

The project goal was the estimating the value of the trophic basis, in all control sections of the emissary, 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 Suceava river, especially in its tributaries inputs, this being the only way to prove the capacity to support productivity of the entire system. The integrated monitoring system designed to highlight the dynamics of ecological and biological diversity of the Suceava river and its main tributaries in all season periods will be useful to train and develop a database that will allow mathematical modelling of dispersion of the pollutants in surface water and also, in resource management water.

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