The complex ecologic method for evaluating and monitoring the quality of Somes hydrographic basin, MONISON, CONTRACT 610/2005

1. Introduction

Somes basin condition is complex; the biocenoza of this basin is already poorer due to the pollution with cyanide and heavy metals that has been going on for decades. Previous studies made in the Somes hydrographic basin by members of ICIA and UBB (1999, 2002, 2003) show high concentrations of heavy metals in sediments and aquatic organisms. The results obtained from the determinations made in 2003 by the collective of UBB show high concentrations of heavy metals in aquatic organisms which means that they have adapted to the local conditions and reflect the ecological effects that haven't been studied so far. This aspect is very important because the value of the determined concentrations have indicated the presents of a much higher concentration of heavy metals than the values obtain from the previous analyses, that can be explain only by the accident from the celluloses factory and paper SC Somes SA Dej (2002), that resulted with significant overflow of polluting substances in the Somes river, the factory did not confess to this accident.

The usage of live organism for bioindication and monitoring of the water quality is based on two fundamental principles: 1. the water is a complex life environment in which multiple interactions accord between environmental physical-chemical factors, the alive components of aquatic ecosystem and the effects of antropical origin; 2. the communities of aquatic organism, which together contribute to the unfolding of the biogeochemistry cycles of chemical elements in nature, are grouped from the ecological point of view in 3 interdependent categories: autotrophic organisms that produce organic biomass (cianobacterias, alga, cormofite), decomposing microorganisms and heterotrophic organisms that consume the organic biomass (animals, parasite fungus). Starting from this principles, the biological evaluation of the quality of the Somes water at the level of the station where the samples where taking for physical-chemical analyze, it is done by a simultaneous study of the 3 categories of interdependent organisms: analyze of the bacteria activity form water and sediment, evaluation of the phytoplankton, periphiton and vascular plants, also the study of different consuming organism: benthic invertebrates, aquatic and shore birds. From this categories of autotrophic, producing and consuming organisms, according to the standardize methods the biomonitoring of the aquatic environment that are applied if the quality of any type of water, the ones that are sensitive enough are chosen to indicate through custom physiological reactions of the different parameter of the water flow and the degree of degradations of the limitrophe areas of land.

Certain functional parameters of the alga cells, connected to the capacity of protection against stress factors of the ambient (egg. water pollution), present very sensible modifications depending on the alterations of the quality of the aquatic environment, they can be used with success in bioindication of the water pollution of different sectors of Somes.

The presents or absents of an organism from a hydrographic basin is closely related to local biotic and abiotic factors. The complexities of the natural relationships between land and aquatic organism and between environment factors reflect the character and the type of flowing water and the whole environment. Studying this relationship is the right method to assess the quality of the flowing water, together with data from chemical analyses of the rivers waters. The macrozoobentos organisms, namely invertebrates macroscopic organisms of they river ecosystem, especially the larves complex, plecoptere, efemeroptere, trichoptere and diptere are used for this purpose, they are ideal bioindicator organisms. On the other hand human activity affects more and more the flowing water quality, from the springs to the river mouth, changing the living conditions for most of the aquatic organisms. In these new conditions it can be observed an alteration of the initials ecological relationships establish between community members in comparison with the situation encountered in other similar ecosystems that are not affected, as references. Organisms that have survived the entropic impact can also work as bioindicators, reacting, through specific adaptation, in the new artificial conditions (Bohmer et al., 2001). These bioindicator properties of organisms from macrozoobentos need long term studies of the flowing waters and a continues comparison of old publish data with those of current studies, for a real appreciation of the evolution tendency of communities, to facilitate the restoration activities of the sectors or of the affected or destroyed by human activity habitats. In more and more countries national programs are develop for biomonitoring communities from

phytoplankton and macrozoobentos with the purpose of clarifying ecological flowing waters, to appreciate the stress level produce by different human activities on the river ecosystem and implied on the water quality (Berlin and Thiele, 2002).

Community study of ants offers other perspective on the perturbation process. The comparison of different trophic levels (egg. birds, ants, plants) makes possible the elaborations of a complex image about these processes. But these ecological studies can be based only on information and precise faunistic knowledge. So before any ecological study of this span a scientific investigation must be made on the fauna.

In most cases birds are n the upper part of the trofic chain of the rivers. For these reason any change that affects the riveran habitat structure or the quality has an effect on birds distribution and abundance. We must a mention here, that some times it is hard to make a difference between different factors that might have an impact on birds effective – especially in the case of migrating birds. In these cases influences suffered on the migrating routs and in the wintry places make an unknown variable almost in all the nesting population studied.

To evaluate the influence of the natural factors and entropic on the water birds, we've chosen 2 birds species, that have a bioindicator value in the river case. These species are: the Common Kingfisher or the European Kingfisher (*Alcedo atthis*) and the Common Sandpiper, (*Actitis hypoleucos)*. These 2 species populate all the Somes river.

2. Results

Within these project samples were taken and physical-chemical and biological characteristics were determined from the water of the Somes hydrographic basin with the purpose of elaborating a original idea of biomonitoring the quality of the river.

For sample prelevation 5 stations were point, considering of the river characteristics, the influence of the affluents and the sources of pollution (table number 1).

Table 1 prelevation stations

Nr.	Sample code	Placement of the prelevation point
1	S.I.	upstream from Cluj-Napoca city
2	S.II.	downstream from Cluj-Napoca city at the level of Someseni locality and downstream from all the industrial discharge and the purification station
3	S.III.	downstream from Dej locality, at the level of Casei commune
4	S.IV.	downstream from Ticau defile and upstream from Lapus river spilling at the level of Buzesti locality
5	S.V.	downstream from Lapus river spilling, a that level of Pomi

The results obtained are as follows:

- Salts of heavy metals, that are present in water and sediment, constitute a type of very serious pollution for surface waters due to there toxicity and stability, producing perturbations in the biological equilibrium with negative consequences on the selfpurifying system, on the fishing economy and different usages of water.
- The impurity contents from the surface and phreatic waters is influence by the physical-chemical structure of the soil, the source of air pollution, the spilling of residue, the atmospheric precipitation debit and the sedimenting dust deposit.
- In general, the determined concentration are in the allowable limits, higher values are register in V station after the Lapus confluence possible determine by the mining exploitations along Lapus valley.
- The concentration values of heavy metals are higher in the stations situated downstream from Somes confluence with Lapus that comes with a pollution charge. We can say that this rising appears to be a result of pollution accumulations.

- The abundance variety of the main groups from macrozoobentos reflects the degree of impurity of different area of Somes.
- After the results the number of Oligochete from station I (Gilau) is rising until station III, due to large quantities of organic matter spilled downstream of Cluj and Dej. Considering the natural purification of these impurities and the toxic effect exerted by the heavy metals, the number of Oligochete is significantly dropping in station IV and V.
- The number of Chironomide shows a similar variety with the Oligochete, but they are more sensitive organisms, due to polluted waters especially with copper downstream from Dej locality, station III., there number is significantly dropping.
- The maxim abundance of Efemeropter is in station I. Due to the presence of some characteristic species and clean water downstream from Cluj locality, Beginning from station II it can be observed a significantly dropping due to atrophic influences, followed by the rising in abundance in station IV., thanks to the phenomenon of natural purification in the inferior defile of Somes. Polluted water derived after Lapus spilling (station V.) determine a very low abundance.
- Plecopterele are very abundance upstream from Cluj, after that they appear only in station II, in a very small number and disappear in station III., IV., and V. This phenomenal can be explain through the fact that these organisms are very sensitive to water charge with organic substances and the lack of oxygen.
- Trichopter abundance reflects in a truthful way the atrophic pressure and the water charge of organic substances at the lavel of station II. and III., reestablishing o similar density to the one in station I at the level of station IV., where water purifies naturally, to disappear almost completely after the Lapus spilling at the level of station V. under the influence of polluted waters with organic substances and heavy metals.
- The group of organisms from the "other" category represent a big diversity an the level of station I., being represented by lavas of diptere and mollusk, especially *Ancylus fluviatilis*, organisms present only in the mountain and submountain areas of the rivers. Other wise the abundance variety of these species reflect the anthropological pressure as in the groups interpreted above.

3. **Conclusions**

- 3 new methods were elaborated: a method of biomonitoring of the hydrographic basin, one method for monitoring for the evaluations of the nesting populations of the species having bioindicator value and a method of generic monitoring for the evaluation of commune bird species.
- Analyzing the obtained results in the determinations that were made on the samples of water we can say that, in general, the water quality doesn't present an alarming situation, there are areas of water flows with critical values that don't impose immediately measure to remediate. Water quality of Lapus river is strongly influence by used waters insufficient purified or unpurified evacuated by the extractive unites and those that process ore that doesn't contain iron from Maramures county. Due to that fact that in 2006 there where no accidents with an ecological impact explain the fact that the water quality is in general in the parameters pointed in the standards.
- We can notice an important rising in the concentration of heavy metals from waters and sediments of Somes river after it's confluence with Lapus river. The water quality of Somes and Lapus is influence by the industrial activity and the unpurified water discharges or insufficient purified from unties that process iron free ore or those that process iron free metallurgy EM Baia mare, EM Herja, EM Nistru, EM Baiut, Cavnic, SC PHOENIX, SC ROMPLUMB SA, EM Sasar.

- The conclusion is that closeting the mines and the entrance in conservation and the ecological makeover must be supervise and monitories. By the speed of these activities (but especially of the quality) of ecological reconstruction depends a lot the reducing of pollution in the Somes basin and there for o diminutions of the mining pollutants impact on the biodiversity of the monitories aerial.
- The method DGT sown that not the whole metal concentration existent in water is bioavailable, and the percent in which the concentration are different from one metal to the other. The method DGT is an excellent way of diffracting *in situ* of metals from the water sample. The test that where done in the laboratory, in which the purpose was to determine the repeatability of the method and the recovery degree, have sown that DGT method is viable, and the results can be trusted.
- The water charge of salts of heavy metals that come from mining exploitations and from spellings in Somes at the point of confluence with Lapus river that has as results the raising of phosphatase activity at the level of the sampling station.
- The intensification of the phosphatase activity is the consequence of higher quantities accumulations of organic substances and of heavy metals, representing a detoxification mechanism of many microorganisms. Microorganisms from polluted aquatic environments are characterize by synthesis and strong acid phosphatase activity, that results in the making of phosphates, used for precipitations of cellular heavy metals as metallic phosphates.
- The rapport between of reduce or oxidized ascorbic acid, rising enzymatic activity of ascoprbat-peroxidase and the dynamic of superoxid-dismutase from plankton alga and peripheral functional parameters that ca be introduce with success in bioindications of water quality in different sectors of Somes, representing sensible variables depending the pollution degree.
- Molar rapport between the reduce formula and the oxidized formula of ascorbic acid is an indicator much more sensitive to the stress degree induced to the alga by the polluted water more then the absolute quantities of ascorbic acid.
- From the enzymes that are involved in the protection of alga against oxidation, ascorbat-peroxidase presented the most increased activity in the presence of chemical pollutants of water. Variation in superoxid-dismutase activity, although more moderate in intensity, are also proportional to the degree in which the alga are affected by water pollution.
- The composition and biodiversity of prifitol reflect the degree of perturbation broth about by the drop in water quality of Somes water as a living environment in the community of aquatic primary producers: water charge in inorganic compounds that are used in mineral nutrition of alga trigger an abundance spread of so species of diatomee with rapid cellular division and induces the emergence of alga specie that are distinguish for mezzo- or eutrofe waters, and presents of pollutants xenobiotici of atrophic origin reduces the number of perifiton species (by the despairing of those that are little tolerant) and favored the spread of a small number of resistance or tolerant species.
- Through macrozoobentos organisms we notice that the upper area of Somes upstream from Cluj (station I. Gilau) has a exceptional quality with a important biodiversity, also marked through the presence of extremely sensitive organisms.
- Downstream from Cluj (station II) we registered an accentuated pollution, especially with organic substances that determine the vanishing of sensitive creatures and the aperients in great numbers of Chironomide. This pollution phenomenal is intensified at the level of station III. downstream from Dej through large quantities of organic substances from the spilling from Gherla and Dej, and also through pollution of Somesul Mare. The atropic pressure is amplified at this level also due to the spilling of waters with a high concentration of heavy metals that result from the processing of base metal carried by Somesul Mare.

- At the level of IV station, downstream from Ticau defile, at a distance of almost 100 km of Dej it can be notice a intense natural purification, due to chemical processes (water with a rapid flow and very good oxygenated) and biological processes, phenomenal that reflects through the appearance of bivalve mollusks and in general sensitive organisms.
- The most drastic pollution can be notice at the level of station V. downstream from Lapus spilling (which leads to residual waters and mine waters from the area of Baia Mare), which determines a drop unseen along Somes of the number of species and exemplars of all types of macrozoobentos.
- On the base of the spreading and abundance of species of invasive plants we can say, that habitats from Somes bed, with the exception of Somesul Cald and other areas superior to Somesul Mare, are badly affected by antropic activities. Especially lower areas (Somesul Mic, the inferior part of Somesul Mare), habitates from the rivers shore are badly affected with invasive species, from which abundance and spreading of *Helianthus tuberosus, Echinocystis lobata* and *Xanthium italicum* is big, in same palaces even very big, causing the appearance of vegetative types with out character, where species diversity is very low.
- *Helianthus tuberosus* species is spread all the research areas, in many places reaching abundance higher than 50%. These species were cultivated as ornamental and culinary species neutralize in all the Europe territory, in our days it causes great problems for nature preservation. It is the most abundant and characteristic invasive specie along Somes river. It was found in almost all types of alluvial habituates, where antropic activities exist, especially in the areas used as agriculture terrene. Antropic activities depredate natural habitats, creating access routs and potential spreading allohtone species.
- Different types of habitats, are best conserved, with a good natural state (values 4, 5) are S-E carpatic forests of Grey or Speckled Alder (*Alnus incana*), and the vegetation from the side of waters *Petasites hybridus, Cirsium oleraceum, Telekia speciosa* and *Filipendula ulmaria,*and the danubian-pontic forests of black poplar (*Populus nigra*) with osier, daco-getic forests of hilly meadows of Black Alder, European Alder or Common Alder (*Alnus glutinosa*) with Almond Willow and Purple Willow (*Salix triandra, Salix purpurea)* are the most degraded. The degree of degradation of these habitats is closely connected with antropic activities in the rivers meadow.
- In all 48 species of ants where found in Somes valley, this number is pretty high considering the fact that the number of species of ants known in Romania is around 104. In a surprising way the biggest number of species was registered in Cluj-Napoca (39), followed by Arduzel (14), Vetis (9), Somes Odothei (7), Letca (6) and Cheile Ticaului (5), Additional we have data on a specie from Maguri Racatau, upstream from Cluj-Napoca (Pogorevici 1947). The most frequent species are: *Tetramorium caespitum*, *Formica rufibarbis*, *F. cunicularia*, *F. pratensis* and *Lasius niger*. All these species are common an are present especially in habitats with open vegetation, with a perturbations degree moderated or even higher. A long side the species *F. cinerea* is common especially on the river shore, because it tolerates very well seasonal perturbations caused by antropic activities or river flooding.
- The fact that the number of species of ants is higher in the urban habitat of Cluj-Napoca it seams very absurd, all though ant are well known for there adaptability in antropic habitats (Agosti et al. 2000). With all the severe antropic perturbations there are limiting factors parks, the "urban forest" offer the enough possibility for colonization. So in the case of Cluj-Napoca city open hills of Cetatuie host rare sub-mediterranean species in Transilvania as *Messor structor* or *Tetramorium moravicum*.On the other hand annual fooling of the river influence more severely the composition of mirmecofaunei, because only some species can handle such perturbations with catastrophically results.

- From the species found *Myrmica salina* and *Prenolepis nitens* are rare in the Romanian fauna are especially in Transylvania, both need to be mention for protection.
- The application of the elaborated methods will have an economical effect because they help to optimize and objective the process of picking, stoking and processing data of pollution of surface waters.