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MACROPHYTES, ALGAE AND BIODIVERSITY IN AQUATIC ECOSYSTEMS (A CASE STUDY)

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INTRODUCTION

Usually, the construction of hydrotechnical developments are considered as harmful to the ecological equilibrium of river ecosystems, especially to the biodiversity of these water bodies.

The present paper aims to analyze, a specific situation – the formation and evolution of biodiversity in a man-made lake. The installing of an abundant community of algae on the surface of aquatic macrophytes determines a significant increase of general biodiversity of that ecosystem. In this case, as in other aquatic ecosystems, the macrophytes (especially in case they appear as abundant shrubs) act as freshwater reefs, representing a microbiotope populated by a lot of various organisms.

MATERIAL AND METHODS

The situation of macrophyte communities was investigated by field observations, concerning their species composition and spatial development. Parts of the water plants were cut off and, in laboratory, they were carefully washed in order to remove attached microalgae.

That obtained algal material was examined at a laboratory microscope and species were identified.

Microphytobenthos sampling was performed using a small gravitation corer.

Phytoplankton was collected using a bottle sample, usually for 1 liter of water. In laboratory, these samples were analysed following usual methods, in order to identify occurring species and to determine cell density.

All algal samples were fixed on field with 40 % formaline.

RESULTS AND DISCUSSION

Communities of vegetal organisms – either macrophytes or algae – represent important elements in the structure and function of aquatic ecosystems. On one hand, they fulfill the role of primary producers of organic matter (that including their role as the first trophic level in the ecosystem) and, on the other hand, through their specific metabolism influence some major characteristics of the aquatic environment, the life conditions for the other biocenotic components.

They produce oxygen as a consequence of photosynthesis which favors the existence and normal development of different animal populations; many species of plants have the ability to uptake from water and to store in their body diverse substances that are defining the quality of water as life environment : various noxes, pollutants, heavy metals, but nutrients too.

Through all of this aquatic macrophytes and algal communities are major factors in modeling features of aquatic biotope, having a significant impact, often direct on the biodiversity of ecosystems.

Obviously, the variety of the structure of these communities – littoral rooted vegetation, floating plants, submerged vegetation – in case of macrophytes, phytoplankton, periphyton, microphytobenthos in case of algae, but also their specific composition represent, together with the other biocenotic components, defining elements of general biodiversity in aquatic ecosystems

We must also mention the fact that, between different components of the aquatic ecosystem are established interrelations that can influence the biodiversity structure and size. Thus, between aquatic macrophytes and algae can appear competitive relations; for instance, the effect of shading the mass of water generated by excessive development of macrophytes can result in a significant alteration of life conditions for algae. There may also be some competition between micro- and macrophytes for available nutrients. These can lead to some reduction in biodiversity.

Last, but not least, the consumption, sometimes selective, of microphytes by zooplankton populations, by fish fry or by filtrating molluscs may influence the biodiversity situation.

In order to highlight the interaction between macrophytes and algae and the relationship between them and biodiversity, we will refer to the situation from an man-made ecosystem – Bâtca Doamnei water power reservoir (Neamţ, Romania).

This reservoir is part of hydrotechnical development of Bistriţa River. It was formed in 1962,

after the damming of the river at the western border of Piatra Neamț city and the building of a dyke in the major bed of the river.

The reservoir is fed mainly by the water originating in the Bicaz great water power reservoir, which first passed through the Stejaru hydroelectric power plant and then runs through smaller downstream resevoirs Pângărați and Vaduri. To this is added the flow introduced on the old river bed of Bistrița and including the water of some smaller tributaries. A direct tributary of the reservoir is Doamnei Rivulet, which flows into the lake at its right bank

The reservoir surface is 240 hectares, its length is 3.2 km, volume reaches cca. 10 millions cubic metres and maximum depth is 15 metres.

Main uses of this reservoir consist in production of electrical energy and as drinking water supply for Piatra Neamt city.

Along the time, the formation of biocoenoses in this aquatic biotope was determined by the following main sources:

- Entering the new biotope of different organisms originating from Bicaz reservoir and the two smaller reservoirs situated upstream;
- Biological intake from the old course of Bistrița River and from the right bank tributary (Doamnei Rivulet);
- Survival, under the new environment conditions, of some organisms which lived in pre-existent water bodies within flooded area.

Due to the functioning of these population ways for 56 years, in present time Bâtca Doamnei reservoir has several various biocoenoses: phytoplankton, microphytobenthos, aquatic macrophytes, zoobenthos, fish communities (populations of perch, common rudd, pike), etc.

We will now refer to the main primary producers in this ecosystem : aquatic macrophytes and algae.

Chronologically, the first to have entered here were the planktonic algae, transported by water masses from Bicaz power reservoir, Afterwards several populations of macrophytes have gradually been installed in this water body.

To date have been identified :

Emergent macrophytes:

Phragmites communis (reed), *Typha latifolia* (common bulrush), *Alisma plantago- aquatica* (common water plantain), *Butomus umbellatus* (flowering rush), *Stratiotes aloides* (water soldier); *Sparganium erectum* (branched bur-reed).

Submerged macrophytes:

Elodea canadensis (Canadian waterweed); *Myriophyllum spicatum* (spiked water-milfoil); *Vallisneria spiralis* (eel grass); *Potamogeton crispus* (curled pondweed); *Potamogeton perfoliatus* (redhead grass); *Potamogeton pectinatus* (sago pondweed); *Potamogeton natans* (broad-leaved pondweed)

Free floating macrophytes:

Lemna minor (duckweed); *Lemna trisulca* (star duckweed); *Spirodela polyrhiza* {greater duckweed}

We have to specify that, because of reservoir's features (volume of water mass, the size of water flow and the relatively reduced storage time), the phytoplankton had not favorable development conditions; this resulting in usually low cell densities – in the order of individuals/ml. Its qualitative composition, based mainly on algal populations being in transit – was limited to about 22 euplanktonic species (see Annex). This indicates a reduced diversity of this biocenotic element.

In its turn, the microphyto-benthos – the algal community living on the sediments covering the basin's bottom – showed a moderate development. This situation was due, on one hand, to frequent water transparency drops determined by suspended particulate matter introduced by major rains, floods, and, on other hand, by turbulence of water masses and sediment disturbing produced by intense winds and waves. During our investigations, a total number of 49 species were identified in respective algal samples; the diatoms were dominant (Annex).

The observations made on the macrophyte communities have highlighted an interesting phenomenon concerning the general biodiversity in this water ecosystem. On leaf surface, on the petiole of the leaves and on the plant stems have been installed algal communities which formed a very abundant and rich periphyton. Along the time, there were recorded 146 algal species and varieties (Annex); these entities were found only in attached communities living on macrophytes. Other species (32) were found both in periphyton and in microphytobenthos composition.

These data show a significant increase of ecosystem global biodiversity, determined by the fixation of various algal populations on aquatic macrophytes in this ecosystem.

In fact, the relationship biodiversity – aquatic macrophytes is not limited to the important number of algal species. In these epibioses appeared a lot of other organisms which, once more, contribute to the increasing biodiversity of the whole ecosystem. There were observed many protozoans (as amoebas, *Vorticella*), rotifers (*Brachionus*, *Lecane*), amphipods, worms (especially Nematods, leeches), insect larvae (dragonflies - Odonata, caddisflies - Trichoptera), as well as some mollusks (*Lymnaea*, *Planorbis*). In fact, it is a very complex, varied living world, which shows very interesting seasonal changes.

This way, the aquatic macrophytes from this water reservoir (as well as those from other freshwater ecosystems) represent a special micro-biotope that favors the installing and development of an abundant and varied epibiose, which has a significant contribution to the increase of general ecosystem biodiversity.

Macrophyte communities work as a kind of reef, where a lot of living organisms find optimal environmental conditions, including food, shelter. Thus, the premises for the significant increase of the biodiversity in the aquatic ecosystem are ensured.

CONCLUSIONS

Under the specific limnologic conditions of Bâtca Doamnei reservoir, influenced by its position within the hydrotechnical development system of Bistrița River and by its operation regime, along the time important aquatic macrophyte communities developed there.

This feature favored the installation of abundant epiphytic algal communities. This way, to the 69 algal species already identified in phytoplankton and micro- phytobenthos were added other 146 species (varieties included), attached to the surface of aquatic macrophytes; so the number of algal species was doubled due to the epiphytic populations. More, that macrophytes constituted a reef-like microbiotope populated by a lot of invertebrates.

It may be seen that the biodiversity increase in this water body contributes to a higher biodiversity of the whole hydrographic basin of Bistrița River.

ABSTRACT

In this paper the author presents the results of the research carried out over several years on the composition of main primary producers of a dam reservoir on Bistrița River. As a consequence of the developing of a rich and various aquatic macrophyte community, a lot of periphytic algae populated this microbiotope. This resulted in a significant increase of biodiversity in this man-made lake.

REFERENCES

1. CĂRĂUŞ I., 1970 – Cercetări asupra fitoplanctonului din lacurile de baraj Pângărati, Vaduri, Bâtca Doamnei, Reconstrucția (valea Bistriței), *Lucr.Stat.Cercet."Stejarul",* 3: 239-245;
2. PRALEA FĂNICA *,* 2006 – Elemente privind structura şi dinamica fitoplanctonului din lacul Bâtca Doamnei (Județul Neamț), *Stud.Cerc.Muz.St.Natur. Piatra Neamt*, X : 85-94.

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ANNEX

Algae identified in Bâtca Doamnei Reservoir.
Notice. In square brackets, after each species, there is mentioned the type of community where that entity was found :Ph = phytoplankton; Mi = micro-phytobenthos; Pe = Periphyton

Cyanobacteria

Arthrospira jenneri Stizenberger ex Gomont [PE]
Beggiatoa alba (Vaucher) Trevisan [MI]
Chamaesiphon incrustans Grunow [PE]
Chroococcus limneticus Lemmermann [PH]
Chroococcus minutus (Kützing) Nägeli [PE]
Geitlerinema amphibium (C.Agardh ex Gomont) Anagnostidis [PE]
Leptolyngbya tenuis (Gomont) Anagnostidis et Komárek [PE]
Nostoc commune Vaucher ex Bornet et Flahault [MI] [PE]
Oscillatoria amoena (Kützing) Gomont [PE]
Oscillatoria limosa C.Agardh ex Gomont [MI] [PE]
Oscillatoria tenuis C.Agardh ex Gomont [MI]
Oscillatoria sp. [PE]
Phormidium sp. [PE]
Rhabdoderma lineare Schmidle et Lauterborn [PE]
Spirulina major Kützing [PE]
Stigonema ocellatum (Dillwyn) Thuret ex Bornet et Flahault [MI] [PE]
Tolypothrix tenuis Kützing ex Bornet et Flahault [PE]

Bacillariophyta

Achnanthes bioretii Germain [PE]
Achnanthes brevipes C.Agardh [PH] [MI] [PE]
Achnanthes brevipes C.Agardh var. *intermedia* (Kützing) Cleve [MI] [PE]
Achnanthes coarctata (Brébisson) Grunow var. *rhomboidea* Tarnavschi et Jitariu [PE]
Achnanthes lanceolata (Brébisson ex Kützing) Grunow [PE]
Achnanthes lanceolata (Brébisson ex Kützing) Grunow var. *rostrata* (Østrup) Hustedt [PE]
Achnanthes sp. [PE]
Achnanthidium affine (Grunow) Czarnecki [PE]
Achnanthidium exiguum (Grunow) Czarnecki [MI] [PE]
Achnanthidium exile (Kützing) Heiberg [PE]
Achnanthidium minutissimum (Kützing) Czarnecki [PE]
Adlafia minuscula (Grunow) Lange-Bertalot [PE]
Amphipleura pellucida Kützing [PE]
Amphora coffeaformis (C.Agardh) Kützing [PE]
Amphora inariensis Krammer [PE]
Amphora lybica Ehrenberg [MI]
Amphora ovalis (Kützing) Kützing [MI] [PE]
Amphora ovalis (Kützing) Kützing var. *gracilis* (Ehrenberg) v. Heurck [PE]
Amphora pediculus (Kützing) Grunow ex A.Schmidt [PE]

Aneumastus tuscula (Ehrenberg) Mann et Stickle [PE]
Anomoeoneis sphaerophora Pfitzer [MI] [PE]
Asterionella formosa Hassall [PH]
Aulacoseira distans (Ehrenberg) Simonsen [PH]
Aulacoseira granulata (Ehrenberg) Simonsen var. *angustissima* (Müller) Simonsen [PH]
Aulacoseira italica (Ehrenberg) Simonsen [PH]
Caloneis amphisbaena (Bory) Cleve [MI] [PE]
Caloneis bacillum (Grunow) Cleve [PE]
Caloneis permagna (Bailey) Cleve [PE]
Caloneis silicula (Ehrenberg) Cleve [MI]
Campylodiscus hibernicus Ehrenberg [PE]
Cocconeis neodiminuta Krammer [PE]
Cocconeis pediculus Ehrenberg [MI] [PE]
Cocconeis placentula Ehrenberg [MI] [PE]
Cocconeis placentula Ehrenberg var. *euglypta* (Ehrenberg) Grunow [PE]
Cocconeis placentula Ehrenberg var. *lineata* (Ehrenberg) v. Heurck [PE]
Craticula accomoda (Hustedt) Mann [PE]
Craticula ambigua (Ehrenberg) Mann [PE]
Craticula cuspidata (Kützing) Mann [MI] [PE]
Cyclotella comta (Ehrenberg) Kützing [PH] [PE]
Cyclotella meneghiniana Kützing [PH]
Cyclotella stelligera Cleve et Grunow [PH]
Cymatopleura elliptica (Brébisson) W.Smith [MI] [PE]
Cymatopleura solea (Brébisson) W.Smith [PE]
Cymatopleura solea (Brébisson) W.Smith var.*apiculata* (W.Smith) Ralfs [PE]
Cymbella affinis Kützing [MI] [PE]
Cymbella aspera (Ehrenberg) Cleve [PE]
Cymbella bistritzae Oltean et Zanoschi [MI] [PE]
Cymbella cistula (Hemprich et Ehrenberg) Kirchner [PE]
Cymbella cistula (Hemprich et Ehrenberg) Kirchner var. *maculata* (Kützing) v. Heurck [PE]
Cymbella cymbiformis C.Agardh [MI]
Cymbella helvetica Kützing [PE]
Cymbella helvetica Kützing var. *curta* Cleve [PE]
Cymbella hustedtii Krasske [PE]
Cymbella laevis Nägeli [MI]
Cymbella lanceolata (Ehrenberg) v. Heurck [PE]
Cymbella naviculiformis (Auerswald ex Heiberg) Cleve [PE]
Cymbella subcapitata Péterfi et Róbert [PE]
Cymbella tumida (Brébisson in Kützing) v. Heurck [PE]
Cymbella turgida Gregory [PE]
Cymbella ventricosa Kützing [MI] [PE]
Cymbella sp. [MI] [PE]
Cymbopleura cuspidata (Kützing) Krammer [PE]
Denticula kuetzingii Grunow [MI]
Diatoma elongatum (Lyngbye) C.Agardh [PE]
Diatoma elongatum (Lyngbye) C.Agardh var. *actinastroides* Krieger [PE]
Diatoma hyemale (Lyngbye) Heiberg var. *mesodon* (Ehrenberg) *G*runow [PE]
Diatoma mesodon (Ehrenberg) Kützing [MI]
Diatoma tenue Kützing [MI] [PE]
Diatoma vulgare Bory [MI] [PE]
Diatoma vulgare Bory var. *ehrenbergii* (Kützing) Grunow [PE]
Didymosphenia geminata (Lyngbye) M.Schmidt [PE]
Diploneis elliptica (Kützing) Cleve [PE]
Diploneis ovalis (Hilse) Cleve [PE]
Encyonema caespitosum Kützing [MI]
Encyonema gracile Rabenhorst [PE]
Encyonema minutum (Hilse) Mann [PE]
Encyonema prostratum (Berkeley) Kützing [PE]
Encyonema silesiacum (Bleisch) Mann [PE]
Entomoneis paludosa (W.Smith) Reimer [PE]
Epithemia adnata (Kützing) Brébisson var. *porcellus* (Kützing) Patrick [PE]
Epithemia argus (Ehrenberg) Kützing [MI] [PE]
Epithemia sorex Kützing [PE]
Epithemia turgida (Ehrenberg) Kützing [PE]
Epithemia zebra (Ehrenberg) Kützing [PE]
Eucocconeis flexella (Kützing) Meister [PE]
Eunotia bilunaris (Ehrenberg) Schaarschmidt [PE]
Eunotia exigua (Brébisson ex Kützing) Rabenhorst var. *bidens* Hustedt [PE]
Eunotia lunaris (Ehrenberg) Grunow [PE]
Eunotia pectinalis (Kützing) Rabenhorst var. *minor* (Kützing) Rabenhorst [PE]
Eunotia praerupta Ehrenberg [PE]
Eunotia tenella (Grunow) Hustedt [MI] [PE]
Fallacia pygmaea (Kützing) Stickle et Mann [PE]
Fragilaria capucina Desmazières var. *mesolepta* (Rabenhorst) Rabenhorst [PE]
Fragilaria crotonensis Kitton [PH]
Fragilaria intermedia Grunow [PE]
Fragilaria leptostauron (Ehrenberg) Hustedt [PE]
Fragilaria pinnata Ehrenberg [PE]
Fragilaria pinnata Ehrenberg var. *lancettula* (Schumann) Hustedt [PE]
Fragilaria virescens Ralfs [PE]
Frustulia saxonica Rabenhorst [MI] [PE]
Frustulia vulgaris (Thwaites) de Toni [PE]
Geissleria decussis (Østrup) Lange-Bertalot et Metzeltin [PE]
Gomphonema acuminatum Ehrenberg [PE]
Gomphonema acuminatum Ehrenberg var. *brebissonii* (Kützing) Cleve [PE]
Gomphonema augur Ehrenberg [PE]
Gomphonema clavatum Ehrenberg [PE]
Gomphonema constrictum Ehrenberg ex Kützing var. *capitatum* (Ehrenberg) Grunow [MI] [PE]
Gomphonema intricatum Kützing var. *pumilum* Grunow [PE]
Gomphonema longiceps Ehrenberg var. *subclavatum* Grunow [PE]
Gomphonema olivaceum (Lyngbye) Kützing [MI] [PE]
Gomphonema olivaceum (Lyngbye) Kützing var. *calcareum* (Cleve) v. Heurck [PE]

Gomphonema parvulum (Kützing) Kützing [PE]
Gyrosigma acuminatum (Kützing) Rabenhorst [PE]
Gyrosigma acuminatum (Kützing) Rabenhorst var. *lacustre* (W.Smith) F.Meister [PE]
Gyrosigma scalproides (Rabenhorst) Cleve [PE]
Gyrosigma spenceri (Bailey ex Queckett) Griffith et Henfrey [PE]
Hannaea arcus (Ehrenberg) Patrick [PE]
Hantschia amphioxys (Ehrenberg) Grunow [PE]
Hantzschia amphioxys (Ehrenberg) Grunow var. *capitata* Müller [PE]
Hippodonta capitata (Ehrenberg) Lange-Bertalot, Metzeltin et Witkowski [PE]
Lemnicola hungarica (A.Grunow) Round et Basson [PE]
Luticola mutica (Kützing) Mann [MI] [PE]
Melosira varians C.Agardh [MI]
Meridion circulare (Greville) C.Agardh [MI]
Meridion circulare (Greville) C.Agardh var. *constrictum* (Ralfs) v.Heurck [PE]
Navicula anglica Ralfs [MI]
Navicula capitatoradiata Germain [PE]
Navicula cincta (Ehrenberg) Ralfs [PE]
Navicula cryptocephala Kützing [MI] [PE]
Navicula dicephala Ehrenberg [PE]
Navicula erifuga Lange-Bertalot [PE]
Navicula exigua Gregory [PE]
Navicula gastrum Ehrenberg [PE]
Navicula gregaria Donkin [PE]
Navicula hungarica Grunow [MI] [PE]
Navicula hungarica Grunow var. *capitata* (Ehrenberg) Cleve [PE]
Navicula lanceolata (C.Agardh) Ehrenberg [MI] [PE]
Navicula menisculus Schumann [PE]
Navicula minima Grunow [PE]
Navicula oblonga Kützing [PE]
Navicula radiosa Kützing [MI]
Navicula rhynchocephala Kützing [PE]
Navicula veneta Kützing [PE]
Navicula viridula (Kützing) Ehrenberg [PE]
Navicula sp. [MI] [PE]
Neidium affine (Ehrenberg) Pfitzer [PE]
Neidium dubium (Ehrenberg) Cleve [PE]
Nitzschia acicularis W.Smith [PH] [PE]
Nitzschia dissipata (Kützing) Grunow [PE]
Nitzschia intermedia Hantzsch ex Cleve et Grunow [PE]
Nitzschia linearis (C.Agardh) W.Smith [PE]
Nitzschia palea (Kützing) W.Smith [PE]
Nitzschia paleacea Grunow [PE]
Nitzschia sinuata W.Smith [PE]
Nitzschia tryblionella Hantzsch [MI] [PE]
Nitzschia sp. [PE]
Pinnularia borealis Ehrenberg [PE]
Pinnularia microstauron (Ehrenberg) Cleve [PE]
Planothidium lanceolatum (Brébisson ex Kützing) Lange -Bertalot [PE]
Reimeria sinuata (Gregory) Kociolek et Stoermer [PE]
Rhoicosphenia abbreviata (C.Agardh) Lange-Bertalot [MI]
Rhopalodia gibba (Ehrenberg) Müller var. *ventricosa* (Kützing) H.Peragallo et M.Peragallo [PE]
Sellaphora bacillum (Ehrenberg) Mann [PE]
Sellaphora pupula (Kützing) Mereshkowsky [PE]
Stauroneis anceps Ehrenberg [MI]
Stauroneis phoenicenteron Ehrenberg [PE]
Stephanodiscus hantzschii Grunow in Cleve et Grunow [PE]
Surirella angustata Kützing [MI] [PE]
Surirella linearis W.Smith [PE]
Surirella ovata Kützing [MI]
Surirella ovata Kützing var. *pinnata* (W.Smith) Hustedt [PE]
Synedra vaucheriae Kützing [PE]
Tabellaria fenestrata (Lyngbye) Kützing [PE]
Tryblionella hungarica (Grunow) Frenguelli [PE]
Ulnaria ulna (Nitzsch) Compère [MI] [PE]

Chlorophyta
Cladophora glomerata (Linné) Kützing [PE]
Closterium moniliferum Ehrenberg ex Ralfs [PE]
Cosmarium botrytis Meneghini ex Ralfs [PH]
Crucigenia rectangularis (C.Nägeli) J.Komárek [PH]
Microspora amoena (Kützing) Rabenhorst [PE]
Mougeotia genuflexa (Dillwyn) C.Agardh [PE]
Spirogyra crassa (Kützing) Kützing [PE]
Ulothrix zonata (Weber et Mohr) Kützing [PE]

Chrysophyta
Chrysococcus rufescens Klebs [PH]
Dinobryon divergens Imhof [PH]
Dinobryon sertularia Ehrenberg [PH]

Dinophyta
Glenodinium sp.[PH]
Peridinium cinctum (Müller) Ehrenberg [PH]

Cryptophyta
Chroomonas nordstedtii Hansgirg [PH]
Cryptomonas ovata Ehrenberg [PH]

Euglenophyta
Euglena acus (Müller) Ehrenberg [PH]
Euglena pisciformis Klebs [PE]
Lepocinclis ovum (Ehrenberg) Lemmermann [PE]
Petalomonas polytaphrena Skuja [PH]

Xanthophyceae
Tribonema viride Pascher [PE]
Vaucheria sessilis (Vaucher) de Candolle [PE]