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# STUDIES REGARDING THE EUTROPHICATION OF THE NEGRENI RESERVOIR IN BOTOSANI COUNTY

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***Abstract***

*The deterioration through eutrophication of the waters from natural and/or artificial reservoirs represents one of the most important problems for administrators and customers of water resources systems. This work presents some studies performed at the Negreni reservoir in Botosani County, situated on The Baseu River. It can not be used as drinkable water anymore, due to the uncontrolled development of vegetation. The causes of this phenomenon are complex. Anthropological activities are mainly responsible for disturbing the fragile ecological balance. Cleaning may be a valid solution, but it is always better to preserve and prevent, than to repair.*

***Keywords****: water resources, eutrophication, water quality deterioration, cleaning*

## Introduction

The term "eutrophication" is derived from two Latin words meaning "good" and "food". In studies of freshwater ecosystems, the term is used to refer to the process by which lakes, ponds, and streams become enriched with inorganic plant nutrients, especially phosphorus and nitrogen. This process happens naturally over a long period of time as dead organic matter accumulates, and it is one step in the normal succession of the freshwater ecosystem. However, when the nutrient enrichment occurs due to the activities of humans – fertilizer runoff from agriculture or private homes, for example – the rate of this natural process is greatly intensified. Human-induced eutrophication is sometimes referred to as "cultural eutrophication."

In freshwater systems, phosphorus and nitrogen serve as the limiting nutrients – the levels of these two nutrients determine the biological productivity of the lake, pond, or stream. A sharp increase in one or both of these elements can result in an "algal bloom" – a sudden population explosion of algae. There are several direct and indirect costs associated with algal blooms. As the algae population proliferates, waters become increasingly more turbid. This turbidity is due, in part, to the single-celled algal organisms present in the water and in part, to dead and decaying organic material. The turbidity coupled with the appearance of algal mats, which can sometimes stretch from shore to shore, render eutrophic masses of water unappealing to swimmers and boaters.

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An algal bloom can also set off a chain of events whose effect is more far-reaching and serious than the aesthetic aspects. As the algae begin to die, bacterial populations move in to decompose the organic matter. These aerobic microbes can cause significant and sudden drops in the level of dissolved oxygen. During the daylight hours, there is a great deal of photosynthetic (oxygen-generating) activity in an eutrophic mass of water, so that effects may not be noticeable. At night, when photosynthesis ceases (but plants and animals continue breathing), the resulting net drop in dissolved oxygen can be devastating, sometimes leading to massive fish deaths.

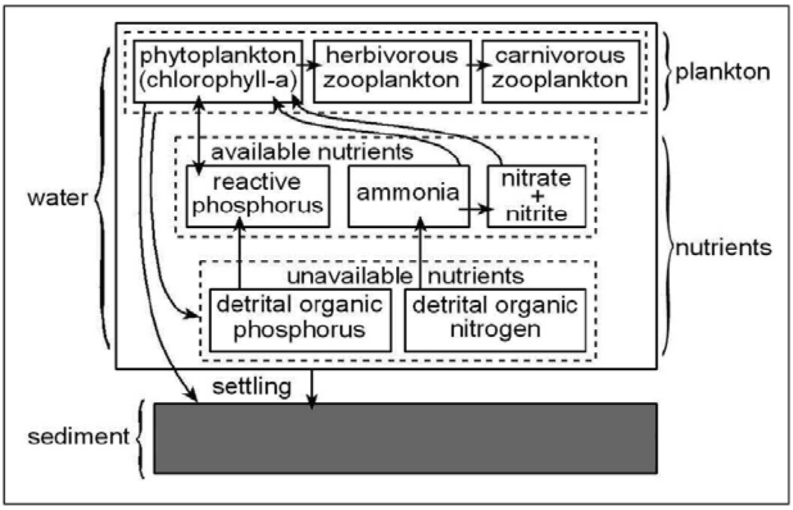


**Fig. 1.** Eutrophication scheme for the water of a lake.

Eutrophication models have traditionally been used to examine the relationship of phytoplankton production and standing crop with nutrients such as phosphorus, nitrogen, and silica [1, 2]. These models have been typically applied to the Great Lakes to evaluate the impact of existing and proposed phosphorus control measures on lake productivity and nutrient concentrations. The modeling has advanced from early studies that correlated phytoplankton (chlorophyll-a) concentrations with nutrient loadings and concentrations [3], to present day sophisticated three-dimensional multi-segment models which are driven by mechanistically derived hydrodynamic and sediment transport models that can simulate multiple types of phytoplankton and zooplankton as well as important carbon and nutrient forms [4-7].

## Experimental

The Negreni reservoir was built between 1972 and 1976 on The Baseu River, and occupies a surface of 312 ha. The dam of the lake is situated S-W of the Negreni village, the Stiubieni commune. The hydrographic Baseu River basin is characterized by a non-uniform flow, with a minimum at the end of summer and a maximum usually during spring, due to snow melt or after heavy rains.

The deepest point of the reservoir is 10m, but during dry periods it can drop to 8.5 m. The average annual flow of the Baseu River through the Negreni section is 0.492 $m^3/s$ with a historic maximum of 114 $m^3/s$.

The water of the Negreni reservoir has a pH which varies between 7 and 8.5, this variation being caused by organic substances decomposition, $CO_2$ emissions, precipitations and the nature of the substrate.

**Fig. 2.** General view of the Negreni reservoir, Botosani County.

The level of saturated dissolved oxygen does not decrease under 67.1% with a minimum concentration of 6.7 mg/dm$^3$, caused by photosynthesis during the hot season, when dissolved oxygen has higher saturation values. Moreover, during summer, the water has a higher alkalinity due to phytoplankton development.

During 2008 some analyses were performed on the quality of some samples of water from the Negreni reservoir. Because samples could only be preserved refrigerated for 10-12 hours, they used 1 ml of Lugol solution for each 100 ml phytoplankton sample. Before examining the samples, they were concentrated through decantation using a graded cylinder, and stored for 2-3 days in a dark place. During this time all suspended particles, including algae, descended on the bottom of the cylinder.

In order to count phytoplankton organisms they used a Burker-Turk type slide, which has a network of 9 mm$^2$ squares, with a height of 0.1 mm [8]. The liquid in excess which covers the network is kept in some lateral channels on the slide. All the organisms in a square are counted, and a formula is used to calculate the number of units per volume:

$$x = \frac{1000 \cdot a \cdot n}{N} \qquad \text{(STAS 6329/90)}$$

where:

***x*** = number of organisms in 1 ml of initial sample of water;
***a*** = number of organisms counted on the slide;
***n*** = number of ml of sample after concentration;
***N*** = number of ml of the initial sample.

Some of the organisms discovered in the lake are presented in figures 3-10 [9-11].

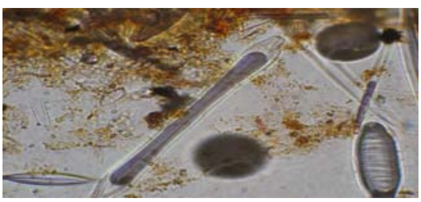

**Fig. 3.** Synedra acus.

**Fig. 4.** Scenedesmus quadricauda.

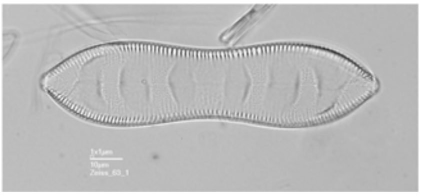

**Fig. 5.** Cymatopleura solea.

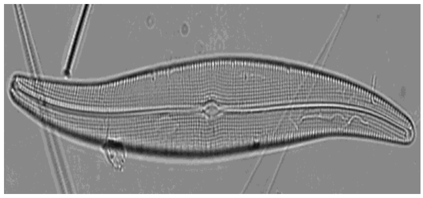

**Fig. 6.** Gyrosigma acuminatum.

**Fig. 7.** Phacus pleuronectes.

**Fig. 8.**Euglena acus.

**Fig. 9.** Anabaena spiroides.

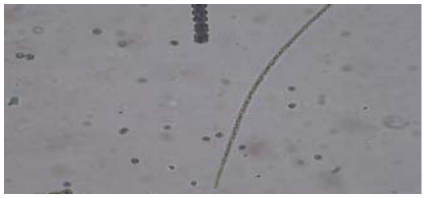

**Fig. 10.** Oscillatoria limosa.

## Results and Discussions

The results of the experiment are centralized in table 1, where one can see a variation in the number of organisms during different seasons and depending on the place where the samples were taken from. During summer an increase of the biomass was observed.

**Table 1.** Results of the biological analyzes performed for Negreni reservoir in 2008

| | | | **PHYTOPLANKTON** | | **ZOOPLANKTON** | | **MACRO ZOOBENTOS** | |
|---|---|---|---|---|---|---|---|---|
| **Lake** | **Section** | **Date** | **Density** | **Biomass** | **Density** | **Biomass** | **Density** | **Index saprob** |
| | | | (cel/l) | (mg/l) | (ex/l) | (mg/l) | (indiv/m²) | (Pantle-Buck ) |
| Negreni | dam-0m | 16.03. 2008 | 774.930 | 2,310 | 6 | 2,5001 | - | - |
| | dam-3m | | 293.420 | 1,246 | 3 | 1,500 | - | - |
| | middle-0m | | 341.640 | 1,591 | 4 | 2,000 | - | - |
| | middle-3m | | 405.000 | 2,590 | 7,2 | 15002 | - | - |
| | line | | 378.000 | 1,551 | 9,8 | 2,0003 | - | - |
| Negreni | dam-0 m | 27.05. 2008 | 1.366.706 | 3,492 | 4 | 2,001 | - | - |
| | dam-3m | | 1.836.729 | 4,340 | 3 | 0.013 | - | - |
| | middle-0m | | 1.744.975 | 6,597 | 5 | 2,000 | - | - |
| | middle-3m | | 1.450.000 | 7,021 | 7,2 | 2,630 | - | - |
| | line | | 4.199.884 | 7,953 | 6 | 2,003 | - | - |
| Negreni | dam-0m | 15.07. 2008 | 788.520 | 5,078 | 7 | 1,280 | 916 | 2,66 |
| | dam-3m | | 1.658.914 | 6,77 | 4 | 1,64 | - | - |
| | middle-0m | | 1.200.000 | 7,957 | 13 | 1,74 | 1166 | 2,08 |
| | middle-3 m | | 1.475.880 | 7,435 | 8 | 1,211 | - | - |
| | line | | 1.914.132 | 8,909 | 11 | 1,515 | 1055 | 2,04 |
| Negreni | dam-0m | 13.10. 2008 | 1.515.000 | 7,705 | 4 | 1,001 | - | - |
| | dam-3m | | 1.729.364 | 6,855 | 3 | 15,001 | - | - |
| | middle-0m | | 1.869.230 | 3,768 | 10 | 0,0013 | - | - |
| | middle-3 m | | 723.426 | 3,616 | 5 | 0,5001 | - | - |
| | line | | 984.408 | 6,485 | 9 | 0,0403 | - | - |

The solutions proposed for the limitation of the eutrophication process involve diminishing the nitrogen and phosphorus flow by [12-14]:

- reducing the use of fertilizers in the surrounding area;
- the decontamination of waste waters;
- closed channels around lakes to reduce the in-flow to zero;
- direct sedimentation and precipitation of nutritive substances in the effluent;
- removing phosphates from detergents;
- reforestation and reduction of the intensive animal breading technology.

Another type of solutions involves the physical manipulation of water, as follows:

- hypolimnion aeration (compressed air injection on the bottom of the lake, sometimes for entire years);
- de-stratification (mixing of surface water with deep water);
- elimination of the hypolimnion water (pumping out water from the bottom of the lake);
- modification of the flow rate.

In regard to the chemical methods one should note:

- in situ precipitation of the nutrients;
- cleaning of the anoxic mud.

The biological manipulation methods are:

- mechanical extraction of the macrophyte vegetation, of algae and even of fish;
- applying toxic substances, algaecides and pesticides;
- direct manipulation of the ecological balance by introduction of alochtone species.

## Conclusions

The Negreni reservoir has an increased eutrophication level of its water, due to abundant vegetation growth. Thus, it can not be used as a source of drinkable water. Biologically, an increase in the concentration of nutrients, especially during summer, converges with an explosive increase of phytoplankton biomass, and thus, with increased eutrophication. The composition and color of water is modified, and quality is seriously affected.

All the prevention and control methods point out the negative role of human activities because they accelerate the eutrophication process.

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