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ASSESSMENT OF THE ECOLOGICAL STATUS OF THE BUTIMANU-DÂMBOVIȚA LAKE BASED ON BIOTIC INDICES

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Abstract

A sea, a river or a lake are not just masses of water, but they must be viewed together with the creatures in them, as ecosystems. Billions of microscopic organisms are located at the bottom of lakes and rivers or found in suspension in their waters, acting on the chemical composition of the water. The anthropization of the environment has profound repercussions on aquatic ecosystems. As a result there is a change in the chemical composition of natural waters and imbalance of stability in biocenoses. Starting from these considerations the objectives pursued in carrying out the present study are: identifying the qualitative and quantitative structure of the diatomaceous flora, establishing their specific diversity, evaluating the level of saprobity, in order to evaluate the ecological status of the Butimanu-Dâmbovița lake water based on the biological diatom index (IBD).

Key words: *Biological Diatoms Index, Diversity Index, Ecological Status, Similiariate Index.*

INTRODUCTION

Aquatic ecosystems are permanently under anthropogenic pressure, and the effects on aquatic communities, which reflect the balance of the ecosystem, are a current concern in the world of science, both worldwide and in Romania. This investigates the response of different aquatic communities to stress factors such as: deforestation, dam construction, intensive agriculture, domestic and industrial pollution and others. The communities of algae, invertebrates and fish are implicitly affected by all these processes, being a fine barometer of environmental changes, having an important role in the ecological processes in the lotic and slow ecosystems (Cîmpean et al., 2018).

According to the Water Framework Directive (2000/60/EC), algae is one of the main groups used to assess water quality in continental aquatic ecosystems, whether natural or anthropogenic, with flowing or standing water.

Diatoms are some of the most common types of phytoplankton. Most of them are unicellular, although they can live in colonies, individuals stick to each other by a mucilaginous substance, secreted by the cytoplasm, which can entirely envelop the colony, in the form of a bow or filament. A special feature of the diatom cell consists in this shape of the body wrapped in a unique cell wall covered by two asymmetrical parts, impregnated with hydrated silicon dioxide, with a crack between them (Figure 1) – hence the name of the algae (Cîmpeanu, 2010).

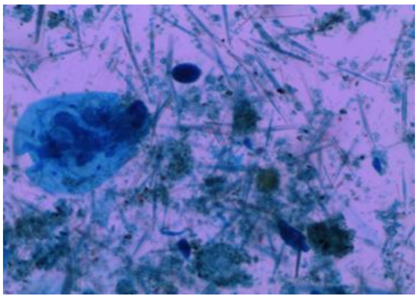


Figure 1. Different forms and types of diatoms

Due to the morphological and ecological peculiarities, diatoms represent a group that can be used efficiently for the qualitative estimation of the lotic periphytic communities, but also in the evaluation of the quality of their living environment (Rasiga et al., 1997, Battes, 2005). Diatoms are used to monitor environmental conditions and in the study of water quality. Diatoms are widely applied in assessing the ecological status of aquatic ecosystems using indices calculated from pollution sensitivity and species indicator values (Duleba et al., 2021).

The main features that give diatoms the status of good indicators of water quality are the short life cycle, the various ways of spreading and their ability to develop in all types of aquatic ecosystems. These algae constitute a frequently dominant group in aquatic ecosystems in pelagic and benthic habitats and play a significant role in biogeochemical cycling of elements, especially silicon (Burliga and Kociolek, 2016).

It has been found that each water basin is characteristic of a certain specific complex of dominant algae, but in all these basins, in the cold period of the year, diatoms develop abundantly, and in the warm time of the year – the blue algae. It is strictly necessary to monitor the current ecological status of surface waters. Aquatic algae communities are the essential indicators of water quality as the most sensitive to changing environment.

In Romania, water resources do not always correspond qualitatively and quantitatively due to poor management, pollution and the lack of a treatment infrastructure. Initially, in our country, the evaluation of water quality for the purpose of its administration, was based mainly or exclusively on the analysis of physico-chemical indicators, methods of biological evaluation, becoming fully accepted in the 70s of the last centuries (Balaban, 2008).

Starting from these considerations, the objectives pursued in carrying out the present study are: identifying the qualitative and quantitative structure of the diatomaceous flora, establishing their specific diversity, evaluating the level of saprobity, in order to evaluate the ecological status of the Butimanu-Dâmbovița lake water based on the biological diatom index (IBD).

MATERIALS AND METHOD

The sampling of diatoms was carried out according to the norms for the collection of algal material from the phytoplankton of surface waters. Phytoplankton samples were collected by filtration using planktonic fillets with variable mesh sizes between 20 and 40 μm (Figure 2). The preservation of the samples of algae from periphyton or plankton is done at the time of sampling with: - Lugol's solution: add 0,3 ml of Lugol's solution to 100 ml of the sample and keep it in the dark,- formol: add 40 ml formol to 1l of the sample, immediately after collection, and for samples in which diatoms predominate, the fixation is made in 10 % solution - ethylic alcohol 95 %.

Figure 2. Plankton fillet

The determination of algae from most systematic groups is made, based on morpho-structural characters, under the optical microscope with the help of wet preparations made between the blade and the slide, using objectives of 10x, 20x, 40x, 60x and with 100x immersion.

The counting of diatomaceous individuals (number of individuals/species) from the samples is done by dragging the sample under a zigzag microscope, so as to avoid returning several times to the same microscopic field.

Biological Diatomical Index (IBD)

In order to apply the Biological Diatom Index, it is necessary to identify taxonomically up to the species level and to count at least 400 individuals/sample. After the numerators are made, the percentage abundance for each taxon is calculated (A‰), and the species that do not have an abundance higher than the threshold value established for each one according to the IBD Methodological Guide are excluded. The following is estimated the probability of presence of a taxon representative of each of the water quality classes, according to the formula: where: Ax = abundance of taxon x (‰); Px(i) =

probability of presence of taxon x for the quality class; Vx = the ecological value of the taxon.
The annexes of the Methodological Guide also provide the values for Px(i) and Vx. Thus, 7 values F(i) are calculated, which lead to the finding of parameter B, according to which the final value of IBD is obtained, after the following transformation:

B	[0;2]	[2;6]	[6;7]
IBD	1	(4.75B)-8.5	20

The Biological Diatomical Index makes it possible to assess river water quality in 5 classes (Table 1), according to the Water Framework Directive 2000/60/EC:

Table 1. Surface water quality classes by IBD values

IBD	IBD ≥17.0	17.0>IBD ≥13.0	13.0>IBD ≥9.0	9.0>IBD ≥5.0	IBD <5.0
Quality class	Excellent (I)	Good (II)	Acceptable (III)	Mediocre (IV)	Lower (V)
Color coding	Blue	Green	Yellow	Orange	Red

The presentation of the results for the surface water categories, according to the Water Framework Directive, is made by illustrating the ecological situation coded on colors as follows: class I, very good ecological status – blue, class II, good ecological status – green, class III, moderate ecological status – yellow, class IV, poor ecological status – orange, class V – bad ecological status – red.

Diversity indices

Diversity indices use the principle that species diversity decreases as negative impacts on the environment increase. Diversity indices relate the number of species (taxa) observed to the number of individuals – their abundance. Some diversity indices provide additional information by also calculating the uniformity of the distribution of the number of individuals in a given taxon relative to the total number of individuals in the sample. The reason why diversity indices have a wide applicability in assessing ecological status is because they are simple to calculate, they can be applied to all types of water bodies, they can be used in comparative analyses.

The most commonly used diversity index is *Shannon-Wiener* (H') which is based on the number of species and their abundance:

H' = - ∑ (P x ln (Pi)i

where: H = number of species;

pi = number of individuals of species i in relation to the total number of individuals in the sample;

P = is the proportion of the species; i represents fairness, with the limit to be between 0 and 1.

Similarity index

Similarity indices provide information about the similarity of two or more samples (small quantity taken from a sample to examine the type, quality or value of the sample). The *Jaccard* similarity coefficient is calculated to compare the diversity between two communities of organisms, according to the formula:

Cj= c/(a+b)

where:

a = number of species present only in culture A;

b = number of species present in culture B only;

c = the number of species present in both cultures.

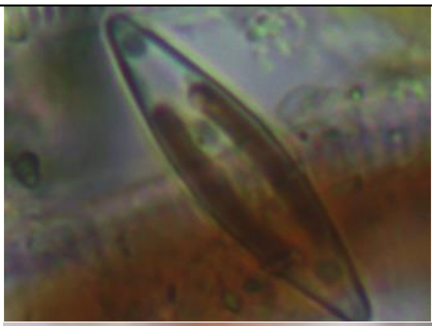
RESULTS AND DISCUSSIONS

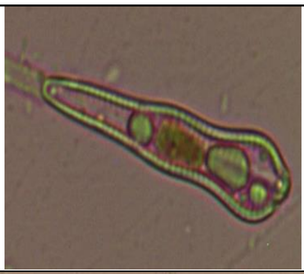
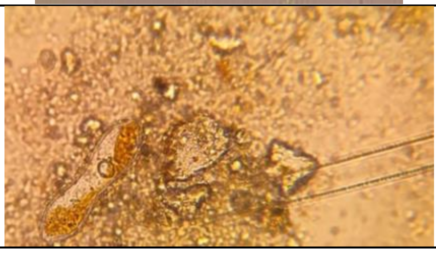
After compiling the list of species, the data contained in it can be processed according to a series of mathematical procedures that can provide, intrinsically or comparatively, information about the quality of the water resource analyzed and about the recent evolution of this indicator.

Regardless of the taxonomic level approached, it is assumed that a richer community (in species, genera, divisions, or all three at once) exhibits better water quality than a less rich one. However, the results of this indicator must be carefully addressed, as it does not differentiate between the ecological characteristics of the identified species, nor between the proportions in which they appear in the samples.

In the planktonic associations identified in lake Butimanu were determined 10 species, the best represented genus is *Navicula*, with 17 specific and intraspecific taxa, the following genera, in descending order of the number of taxa being: *Nitzschia* (12) and *Gyrosigma* (10), (Table 2). Diatomaceous species were identified using the optical microscope, and photo captures were made using the Olympus camera.

Table 2. Diatomaceous species identified

Species identified	Microscopic image capture	Quality class
Navicula sp.	 	II
Navicula sp.	 	II-III
Nitzschia sp.		II
Gyrosigma sp.	 	II

Gomphonema acuminatum		II
Vulgar diatoma		II-III
Synedra sp.		II-III

According to the values of the Biological Diatoms Index (IBD), the water of the studied lake belongs to 2 quality classes: acceptable with IBD = 11.7 (in 46.87% of the processed samples) and mediocre with IBD = 7.8 (in 53.13% of the samples). As a result of the results obtained in the determinations of the biotic indices (Figure 3), it was found that the diversity index relates to the number of identified species (taxa) and to the number of individuals – their abundance through the similarity index.

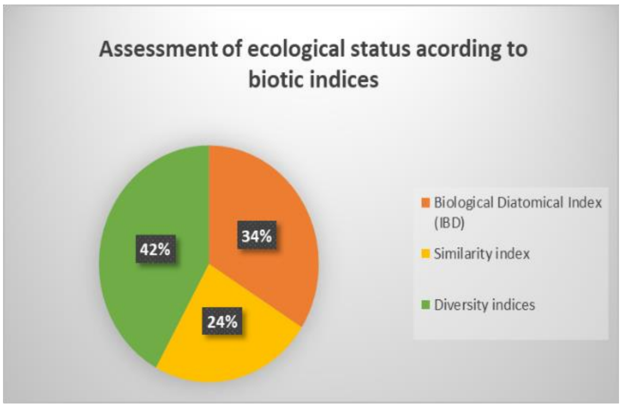


Figure 3. Correlation between determined biotic indices

CONCLUSION

The value of these indices as bioindicators is also complemented by their predominance as an algal group in most water bodies, especially on the upper and middle courses, the rapid multiplication, the prompt reaction to both short-term and long-term changes, for different types of impact, the numerous forms by which they ensure their survival (resistance spores, squeaks, zygotes, etc.) and the various ways of spreading, having as vectors water, wind, animals, man, etc. (Momeu and Péterfi, 2007).

The basic composition of phytoplankton was represented by diatomaceous algae, cyanophytes, greens and euglenophytes, which indicated a water quality that was within the limits of class III, i.e. moderately polluted. Following the results obtained, the evaluation of the quality of the studied surface water, Butimanu - Dâmbovița lake, from the point of view of the Biological Diatoms Index, is its classification in a mediocre class.

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