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EVALUATION OF ORGANIC POLLUTION BY PALMER'S ALGAL INDEX OF SALT LAKE, BRAILA COUNTY

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Abstract

The present study was conducted to assess the organic pollution level of Sarat Lake in the city of Braila.

A total of 14 species belonging to 12 genera of phytoplankton have been identified, among them 9 species belong to Bacillariophyceae, 2 species of Cholorophyceae and 3 species of Cyanophyceae.

The Palmer, Algal Genus and Algal Species Pollution Index were employed to study the water quality of Sarat Lake in the city of Braila. Palmer's Algal Index showed that all four stations in Sarat Lake have little organic pollution. The total scores in S1 and S4 were 11 indicating moderate pollution, in S2 and S3 were 9 indicating lack of organic pollution. The genera with tolerance to pollution were Oscillatoria, Phormidium, Synedra and Navicula. Physical-chemical analysis data has supported Palmer's organic pollution index.

Shannon Wiener index was recorded as a diversity index, it recorded the maximum value (3,311) in S4 and the minimum value (2,774) in S2. Thus, algae taxa can be considered a good bioindicator for assessing the health of lentic aquatic ecosystems.

Key words: phytoplakton, Pollution Index, diversity

INTRODUCTION

Phytoplanktons are the primary producers in pelagic food chain and they need nutrients.

Algae are involved in water pollution in a number of important ways. Due to the enrichment of inorganic phosphorous and nitrogen is responsible for the growth of algae in water bodies [1].

The algal communities not only respond to natural changes in the lakes, but they can also present variations as a result of human interventions that affecting the water body, either directly or through tourist activities in the Salt Lake.

Algae are one of the most rapid bioindicator of water quality changes due to their short life spans, quick response to pollutants and easy to determine their numbers [10], [11].

In present study Palmer, (1969) Algal Genus Pollution Index and Algal Species Pollution Index were employed to study the water quality of Salt Lake from Braila county. A list of most pollution tolerant genera and species according to Palmers index were calculated for all sampling stations. A pollution index factor was assigned to each genus and species by determining the relative number of total points scored by each alga. The pollution status of sampling stations of Salt Lake was determined based on their index. This water pollution index is used for detection and evaluation of water pollution. The purpose of this study is to know the use of algae as bioindicator to determine the quality of Salt Lake.

MATERIAL AND METHODS

Study area

The Salt Lake micro-depressionary area is located in the eastern part of Romanian Plain (Braila Plain or Northern Baragan), in a micro depressionary area, on a total area of about 300 ha which accumulates groundwaters from neighbouring higher areas, this phenomenon also being the cause of soil degradation processes by salinization and recurrent water logging [3].

Salt Lake is an old course of the Danube. High salinity formation allowed on the lake bottom, a layer of mineralized sludge with significant therapeutic qualities, thanks to which Salt Lake Resort is known both at home and abroad. The lake on the northeast

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side, on the shore on which the resort is located, is of almost circular shape, with a diameter of about 1 km and is separated by the lake on the southwest side, which has an elongated shape with a length of about 2 km and the average width of 350 m. The separation of the 2 lakes is due to the construction of an industrial railway line and a road access road that connects the national roads DN2B and DN21. The surface of the water mirrors of the two lakes, calculated for an average water level, is about 171 ha.

Collection of sample and Analysis

The present study on algal taxa was conducted in May 2013 four different stations (S1, S2, S3 and S4). The first two stations are located near Salt Lake resort balneoclimatică (S1, S2), and the next two are located around the central area sources (S3, S4) (figure 1).

Fig 1 Area study

The biological samples were fixed in the ground with Lugol solution. For the establishment of the main phytoplankton taxonomy groups, an extensive literature [2], [4], [5], [6], [7].

The different genera of planktonic algae were observant along with the physic-chemical parameters like pH, temperature, dissolved oxygen, nutrients.

Temperature, dissolved oxygen, conductivity and pH were measured with multi-parameter HQ40D. Weekly, the nitrogen compounds (N-H_4+, N-NO_3-, N-NO_2-) were determined using a Spectroquant Nova 400 spectrophotometer, compatible with Merck kits.

The classification in the quality classes was made according to the order 161/2006 [8].

The pollution status of sampling stations of Salt Lake was determined based on Palmer, (1969) Algal Genus Pollution Index and Algal Species Pollution Index as shown in Table 1 and Table 2.

Table 1 Algal genus pollution index (Palmer, 1969)

Genus	Pollution index	Genus	Pollution index
Anacystis	1	Micractinium	1
Ankistrodesmus	2	Navicula	3
Chlamydomonas	4	Nitzschia	3
Chlorella	3	Oscillatoria	5
Closterium	1	Pandorina	1
Cyclotella	1	Phacus	2
Euglena	5	Phormidium	1
Gomphonema	1	Scenedesmus	4
Lepocinclis	1	Stigeoclonium	2
Melosira	1	Synedra	2

Table 2 Algal species pollution index (Palmer, 1969)

Algal species	Pollution Index
Ankistrodesmus falcatus	3
Arthrospira jenneri	2
Chlorella vulgaris	2
Cyclotella meneghiniana	2
Euglena gracilis	1
Euglena viridis	6
Gomphonema parvulum	1
Melosira varians	2
Navicula crptocaphala	1
Nitzschia acicularis	1
Nitzschia palea	5
Oscillatoria chlorine	2
Oscillatoria limosa	4
Oscillatoria princeps	1
Oscillatoria putrid	1
Oscillatoria tenuis	4
Pandorina morum	3
Scenedesmus quadricauda	4
Stigeoclonium tenue	3
Synedra ulna	3

Following numerical values for pollution classification of Palmer (1969), 0-10= Lack of organic pollution 11-15= Moderate pollution 16-20= Probable high organic pollution 20 or more = Confirms high organic pollution.

To study the diversity of planktonic stations established in the Salt Lake, were calculated the following indexes: Shannon - Wiener (HS), maximum diversity (Hmax) (theoretical) and Shannon equitability index (E = HR) using version 2 Biodiversity_pro program.

RESULTS AND DISCUSSION

Phytoplankton

The qualitative analysis of phytoplankton from the Salt Lake revealed the presence of three taxonomic groups: Bacillariophyta, Clorophyta and Cyanophyta.

The phytoplankton is constituted from fourteen species. This taxonomic groups are represented by:

- Bacillariophyta represented by a species *Pinnularia viridis, Cymatopleura solea, Navicula cuspidata, Synedra acus, Cymbella sp., Caloneis amphisbaena, Stephanodiscus hantzschii, Achnanthes sp. and Tabellaria flocculosa.*;
- Clorophyta with the species *Tetraedron minimum* and *Tetraedron trigonum*;
- Cyanophyta with the species *Phormidium uncinatum, Oscillatoria tenuis* and *Oscillatoria putrida*.

From the point of view of abundance the dominant group was represented by bacillariophyceae, followed by cyanophyceae and clorophyceae (figure 2).

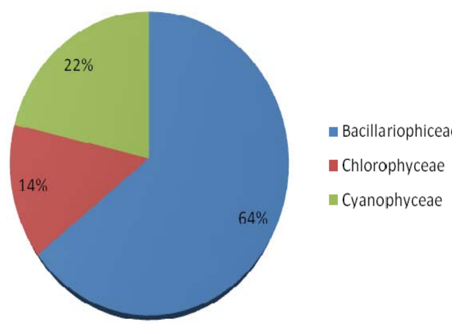

Fig 2 Abundance of phytoplankton

Physic-chemical parameters

The stage of the water quality in Salt Lake is evaluated according to the order no. 161/2006, and the obtained results are presented in the table below (Table 3).

Table 2 Physical-chemical parameter values and water quality class

Parameters	pH	DO (mg/l)	T°C	$N\text{-}H_4^+$ (mg N/l)	$N\text{-}NO_3^-$ (mg N/l)	$N\text{-}NO_2^-$ (mg N/l)
S1	8.44	7.85	23	0.52	1.53	0.08
S2	8.50	7.65	22.9	0.55	0.64	0.04
S3	8.47	7.60	23	0.59	0.87	0.06
S4	8.50	7.75	23	0.47	1.22	0.14
Water quality class	6.5-8.5	II	It is not standardized	I	I	III

Palmer's pollution index

The total scores in S1 and S4 were 11 indicating moderate pollution, in S2 and S3 were 9 indicating lack of organic pollution

according to Palmer (Tables 3 and 4), Oscillatoria was found to be the most active participant in all stations which may be the good indicator of contaminated water the similar observation recorded by Palmer [9], Navicula, Synedra and Phormidium were recorded repeatedly and consider as indicators of pollution in view of the results of Palmer pollution index. The most dominant species was *Oscillatoria tenuis*.

Table 3 Pollution index of Algal genera according to Palmer, (1969) at four stations of Salt Lake

Name of algal Genera	Group	Pollution Index (Palmer1969)	S1	S2	S2	S4
Navicula	D	3	+(3)	+(3)	+(3)	+(3)
Synedra	D	2	+(2)	-	-	+(2)
Phormidium	B	1	+ (1)	+(1)	+(1)	+(1)
Oscillatoria	B	4	+(5)	+(5)	+(5)	+(5)
Total Score		11	11	9	9	11

D= Diatoms; G=Gren; B= Blue greens

Table 4 Pollution index of Algal species according to Palmer, (1969) at four stations of Salt Lake

Name of algal Species	Group	Pollution Index (Palmer1969)	S1	S2	S2	S4
Pinnularia viridis Ehrenberg 1843	D	-	+	+	+	+
Cymatopleura solea Smith 1851	D	-	+	+	+	+
Navicula cuspidate Kützing 1844	D	-	+	+	+	+
Synedra acus Kützing 1844	D	-	+	-	-	+
Cymbella cistula Kirchner 1878	D	-	-	-	+	+
Caloneis amphisbaena (Bory) Cleve 1894	D	-	+	+	+	+
Stephanodiscus hantzschii Grunow in Cleve & Grunow 1880	D	-	+	+	+	+
Achnanthes sp. Bory, 1822	D	-	+	+	+	+
Tabellaria flocculosa (Roth) Kützing 1844	D	-	+	+	-	-
Tetraedron minimum (A.Braun) Hansgirg 1888	G	-	-	+	+	+
Tetraedron trigonum (Nägeli) Hansgirg 1888	G	-	-	-	+	+
Phormidium uncinatus Gomont ex Gomont 1892	B	-	+	+	+	+
Oscillatoria tenuis C.Agardh ex Gomont 1892	B	4	+(4)	+(4)	+(4)	+(4)
Oscillatoria putrid Schmidle 1901	B	1	-	+(1)	+(1)	+(1)
Total Score		**5**	**4**	**5**	**5**	**5**

D= Diatoms; G=Gren; B= Blue greens

Shannon Wiener index

Wilhm and Dorris [12] set diversity index <1 for highly polluted, 1-3 for moderately polluted and >4 for unpolluted water bodies.

Analyzing algal species biodiversity measured by the Shannon-Wienerindex (H' S), it is observed that the highest value is found in S4 (3.311), followed by S3 (3.046) and the lowest biodiversity is found in S1 (2.959) and S2 (2.774) (Table 5). Therefore, this water body comes in diversity index (1-3) means moderately polluted.

Table 5 Dynamics diversity index Shannon – Wiener

Index	S1	S2	S3	S4
H'S	2.959	2.774	3.046	3.311
HSmax	3.322	3.459	3.585	3.7
HR	0.891	0.802	0.85	0.895

H'S- real diversity; HSmax- maximum diversity; HR=E- relative diversity (equitability)

CONCLUSIONS

Through the qualitative processing of the biological samples were highlighted three taxonomic groups of algae (Bacillariophyceae, Cyanophyceae, and Chlorophyceae).

Over all pollution indexes was showed that all stations of the Salt lake water showed confirms moderate organic pollution and Palmer (1969) suggested that algae are reliable indicators of water pollution as it was justify in present study.

Physical-chemical analysis data has supported Palmer's organic pollution index.

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