



P-ISSN: 2349-8528

E-ISSN: 2321-4902

[www.chemijournal.com](http://www.chemijournal.com)

IJCS 2020; 8(2): 2620-2624

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Received: 19-01-2020

Accepted: 21-02-2020

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## Ecological diversity of species and its measurement in lentic ecosystem in Mysuru

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DOI: <https://doi.org/10.22271/chemi.2020.v8.i2an.9146>

**Abstract**

The paper attempts to give an account of fresh water algae as an indicator of water quality. Eight lakes of Mysore have been studied. The Palmers Index IDSELS Diatom index and OMNIDA software, were used for calculated and analysed. The order of tolerance to organic pollution was calculated using the Garrett ranking techniques .According to Palmer index all the eight lakes were organically polluted. Bogadi lake was least polluted and Karanji lakes and mandakahalli lake were polluted. The present investigation compares the use of old and new techniques of detecting the water quality. It also enables us to understand whether the algae is imparting organic pollution of lake water. The species index indicated that Bogadi lake, Hadinaru lake, Karanji lake & Bilikere lake had low organic pollution. The diatom index showed that all lakes ranged between moderate and high organic pollution but the degradation levels in the water was also high. Dalvoi lake and Mandakahalli lake had the highest organic pollution. Species of *Euglena* and *Scenedesmus* were the most tolerant species found in organic polluted lakes. Algae were found to be highly resistant in Karanji lake, Dalvoi lake, Kukkarahalli lake and bilekere lake. These sites were found to be conducive for the growth of algae, while most of the other lakes had idiosyncratic species. This study uses the advanced modern tools in determining levels of organic pollution in lake ecosystem.

**Keywords:** Algae, palmer, garrett, louies-laclereq, organic pollution

**Introduction**

All major lakes are facing acute pollution problem resulting in emission of foul odour, silt deposits and choking due to excessive algal growth. The use of algae as a biological indicator, their diversity and distribution can be exploited for fish monitoring and surveillance for assessing the contaminants. Some notable work was done by Hosmani and Bharathi (1980)<sup>[9]</sup>, Hosmani and Naganandi (1998), Mahadev and Hosmani (2005) Mahadev and syed, Alchecl Ahmed (2008)<sup>[19]</sup> and Mahadev *et al.*, (2009)<sup>[20]</sup> on “Algae as indicators of organic pollution”, This study was done based on the classic work of Palmer (1969) . Hosmani (2013)<sup>[12]</sup> developed “Algal index of pollution based on the observation of 269 reports by 165 authors who reported that the algae were tolerant to organic pollution.

The pollution index was scored based on the relative number of algae. The index has been used by several research palmer (1969), Nygoard (1976)<sup>[21]</sup> Kelly (2006)<sup>[14]</sup> Hosmani (2013)<sup>[12]</sup> and Hosmani and mruthunjays (2013)<sup>[12]</sup>, A more developed by Louies-Laclereq (IDSELS) 2008<sup>[17]</sup> and Lecoite (2003) which is based on the occurrence of only donation species in any water body.

Kelly (2006)<sup>[14]</sup> used diatoms and algae as indicator of ecological status and explained the precise method of sampling and calculating the water quality. This index not only estimates the organic pollution but also determines the percentage of anthropogenic pollution in the range between low and high. It also determines the degradation level of pollutants in the water. The present study investigates algae collected from eight lakes of Mysore district and its surrounding. The sample collections were made seasonally for a period of two years from 2015 to 2017.

**Materials & Methods**

Mysore district lies between 11° 39' and 12° 50' north latitude and 75° 45' east longitude. It is situated in the southern part of Deccan peninsula and it is a southern district of Karnataka state. The district is distinctly featured by many numbers of water channels and lakes fed by

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the river Cauvery and its tributaries. These are responsible for the development of major wetlands of the district. Additionally, rain fed fresh waters is also abundant.

### Sampling Sites

Sampling for algae was done from 8 lakes which are situated at a distance of 15-22 kms in and around Mysuru. These lakes were contaminated due to various anthropogenic activities. Some of the lakes become occasionally dry but again gets inundated through channels. The water of all lakes was light green, green in colour and also aquatic plants like *Ipomea*, *Typha*, *Pistia*, *Lemna*, *Eichhornia*, *Numphea*, *Azolla* and *Potamogeton* were commonly found.

### Collection of water sample and analysis

Water samples and sediments were collected from 8 lakes for 2 years 2015-2017. The samples were collected in 30 ml vials and few drops of lugol's iodine and 4% formaldehyde were added, labelled and stored. Identification and enumeration of algae were done by Lackey's drop method (1938) slightly modified by Saxena (1987). Algae were identified using the monographs of Desikachary (1959) [6], Prescott (1982) [24], 3 cott and Prescott (1961) [25], Philipose (1960) [23], Gandhi (1998) [7] Taylor *et al.*, (2007) [26]. The software Ominida GB 5.3 was used to calculate the Louis-Laclereq Index (Lecointe *et al.*, 2003) [16]. The order of merit given by Palmer's algal index (1969) was converted into different ranks by using the formula Percentage position =  $10(R_j - 0.5)/N_j$  where  $R_j$ ; Rank given for the  $i$ th item,  $j$ th individual and  $N$  = number of items ranked by the  $j$ th individual. The percentage position of each rank thus obtained was converted into scores by referring to the table given by Henry G Arreett (1924) [8]. Each score of the index was added and divided by the total number of observations (number of lakes). The mean score of all the factors was arranged in the order of their ranks and interpreted.

Alternate to these indices Blanco and Blanco (2012) [3] have used the Duro Batom index using weighted average method to derive autoecological profiles of water chemistry. Idiosyncratic species in polluted lakes were determined according to the software developed by Atmar and Pallerson, 1995.

### Results and Discussion

The results of the indices for the eight lakes are given in tables. The highest organic pollution index was reported in Karanji lake, Dalvoi lake, Kukkrhalli lake, and Bilikere lake. The values ranged between a minimum of 20 to a maximum of 33. The least index was observed in Bogadi Lake. Species like *Euglena*, *Oscillatoria*, *Scenedesmus* and *Synedra* appeared in all lakes and are the most prominent indicators of organic pollution. The twenty algal species tolerant to organic pollution are shown in table 2. Among these species, *Euglena acus*, *Scenedesmus quadricauda* and *Synedra* were found to be the most tolerant species. The scores 14 to 22 were taken as probable evidence of high organic pollution. The lower values in Bogadi lake and Hadhinaru lake indicated that

the organic pollution was low. In the present study, it was observed that all the 8 lakes were organically polluted. The species index gave an indication that Bogadi and Hadhinaru lakes categorised as low organic polluted (Total score of 14) was tending to be organically polluted.

The Louis-Laclereq (2008) [17] index of pollution derived from the OMNIDA GB 5.3 is presented in table 2. The percentage indicator of organic pollution was very high in Dalvoi lake, Kukkrhalli lake and Bilikere lake. The level of organic pollution was low in Bogadi Lake and Shetty lake. The table also depicts the level of disturbance by human activity. Dalvoi lake and Karanji lake were heavily polluted due to human interference while the rest of the lakes were highly disturbed. Only two lakes Kukkrhalli and Bilikere lakes were moderately disturbed. The two lakes Bogadi and Shetty lakes were less disturbed. The index was derived mainly on the basis of the abundance and distribution of diatom species throughout the period of study. Diatom cells often remained for a long duration and hence can serve as an important indicator of organic pollution as well as anthropogenic activity (Hosmani 2010) [10].

The Garrett ranking technique (1824) is an important tool in attributing the rank. According to this technique, the ranking of each lake is presented in table 3. The highest pollution was observed in Dalvoi lake (ranking 1) followed by Karanji lake (ranking 2). The least polluted lakes were Mandakahalli and Hadhinaru lake. The rankings of remaining lakes lie between moderate values (table 4). This ranking enables researchers to select lakes for conservation strategies.

The presence of algae indicated whether they were indigenous to each of the lakes or were accidentally introduced whenever there were rains or by human activity which survived only for few months (allocthonous). The autocathonous algae usually (origin within the lake itself) completed their life cycles in the lakes. Some algae resulted as blooms during certain seasons. In the present study, Dalvoi lake, Karanji lake and Kukkrhalli lake were judged to be the most hospitable sites. While the lakes Shetty, Hadhinaru and Bogadi did not support the growth and distribution of the algae. The genera *Euglena* and *Synedra* had similar niche requirements and were found to be more common and prevalent in these lakes. These were most resistant to extinction and replaced the species of the genera *Gomphonema* and *Oscillatoria*. However species of the genera *Ankistrodesmus*, *Cyclotella* and *Chlorella* were highly sensitive to environmental conditions and therefore appear occasionally. The species of *Euglena*, *Scenedesmus lepoeinclis* and *Synedra* were highly resistant and were autocathonous in origin and appear regularly in almost all lakes. The lakes can be reorganized in descending order (Atmar and Patterson, 1995) (Table 5). Many of the genera selected as indicator of organic pollution by Palmer index (1969) are those which were idiosyncratic (or) those that appeared occasionally when the environmental conditions were favourable. Probably they were predominant during all seasons and each author has reported based on their presence. Therefore it is essential that the selected organisms that are always present at high level organic pollution.

**Table 1:** Algal index of the genera

Algal Genera	Dalvoi lake	Karanji lake	Kukkrahalli lake	Mandakahalli lake	Shettykere lake	Hadhinaru lake	Bogadi lake	Billikere lake	P
<i>Ankistrodesmus</i>	1	2	-	2	-	-	-	-	2
<i>Chlamydomonas</i>	-	4	-	-	4	-	4	-	4
<i>Chlorella</i>	3	-	-	-	-	-	-	-	3
<i>Closterium</i>	1	1	1	1	1	-	1	1	1
<i>Cyclotella</i>	1	-	-	1	-	-	-	1	1
<i>Euglena</i>	5	5	5	5	5	5	-	5	5
<i>Gomphonema</i>	1	1	1	-	-	-	1	1	1
<i>Lepocinclis</i>	1	1	1	1	-	-	1	1	1
<i>Melosira</i>	-	-	-	-	-	-	-	-	1
<i>Micracythis</i>	1	1	-	1	-	1	-	-	1
<i>Micra etinium</i>	1	1	-	-	-	3	-	-	1
<i>Navicula</i>	3	3	4	-	-	3	3	3	3
<i>Nitzschia</i>	3	3	3	3	-	3	3	3	3
<i>Oscillatoria</i>	-	4	4	4	-	4	-	4	4
<i>Pondorina</i>	1	-	1	1	1	1	-	-	1
<i>Phacus</i>	2	2	2	2	2	2	-	2	2
<i>Phormidium</i>	1	1	-	-	1	-	1	1	1
<i>Scenedesmus</i>	4	4	4	4	4	4	4	4	4
<i>Stegioclonium</i>	-	-	-	-	2	-	-	-	2
<i>Synedra</i>	2	2	2	2	2	2	2	2	2
Total Score	31	33	28	27	23	25	20	28	

**Table 2:** Species Index (Palmer, 1969)

Algal Genera	Dalvoi lake	Karanji lake	Kukkrahalli lake	Mandakahalli lake	Shettykere lake	Hadhinaru lake	Bogadi lake	Billikere lake	P
<i>Ankistrodesmus falcatus</i>	3	3	3	3	-	-	-	-	3
<i>Arthrospira jennari</i>	2	-	2	-	2	-	2	-	2
<i>Chlorella vulgaris</i>	-	-	2	-	-	-	-	-	2
<i>Cyclotella meneghiniana</i>	2	-	-	2	-	-	-	2	2
<i>Euglena viridis</i>	-	-	-	-	-	-	-	1	1
<i>Euglena acus</i>	6	6	6	6	6	6	-	6	6
<i>Gomphonema parachus</i>	1	-	-	-	-	-	1	1	1
<i>Melosira islandica</i>	-	-	-	-	-	-	2	-	2
<i>Navicula cryptocephala</i>	1	-	1	-	1	1	1	-	1
<i>Nitzschia cryptocephala</i>	-	-	-	-	1	-	1	-	1
<i>Nitzschia palea</i>	5	5	-	-	-	-	-	5	5
<i>Oscillatoria chlorine</i>	-	-	2	2	2	-	-	-	2
<i>Oscillatoria limoso</i>	-	-	-	-	-	-	-	-	4
<i>Oscillatoria princeps</i>	1	1	-	-	1	-	-	-	1
<i>Oscillatoria puntrido</i>	1	-	-	-	-	-	-	-	1
<i>Oscillatoria tenuis</i>	-	-	-	-	4	-	-	-	4
<i>Pondorina morum</i>	-	-	-	3	-	-	-	-	3
<i>Scenedesmus quadricands</i>	-	4	4	4	4	4	4	4	4
<i>Stegioclonium tenne</i>	-	-	-	-	-	-	-	-	3
<i>Synedra ulna</i>	3	3	3	3	3	3	3	3	3
Total	25	22	23	23	24	14	14	22	

**Table 3:** Ecological indices of pollution (OMNIDA software) based on the appearance of diatoms (Louis Laclereq (IDSE/5))

Name of the lake	0% indices of organic pollution	Rating	% indices of inorganic pollution	Rating	Degradation led inside the lake
Dalvoi lake	72.73	Very high	27.27	Moderate	High
Karanji Lake	62.50	High	37.50	Moderate	High
Kukkrahalli Lake	66.67	High	33.33	Moderate	High
Mandakahalli Lake	50.00	High	50.00	High	High
Shettykere Lake	20.00	Low	60.00	High	Moderate
Hadhinaru Lake	20.00	Low	60.00	High	Moderate
Bogadi Lake	40.00	Moderate	60.00	High	High
Billkere lake	72.73	Very high	27.27	Moderate	High

**Table 4:** Ranking of lakes according to heavy Garrett based on Palmer algal index values

Name of the lake	R1 (5)	R1 × 65	R2 (4)	R2 × 69	R3 (3)	R3 × 73	R4 × (2)	R4 × 18	R5 × (1)	R5 × 88	Total score	Average score	Rank
Dalvoi lake	1	65	1	69	3	219	3	234	7	616	1203	60.12	1
Karanji Lake	1	65	3	207	2	146	3	234	6	528	1180	59.00	2
Kukkrhalii Lake	1	65	2	138	3	219	3	234	4	352	1008	50.40	3
Mandakahalli Lake	1	65	2	138	1	73	2	156	2	176	608	30.40	8
Shettykere Lake	1	65	2	138	0	00	3	234	4	352	789	39.45	5
Hadhinaru Lake	1	65	2	138	2	146	2	156	2	176	622	31.10	7
Bogadi Lake	0	0	2	138	2	146	1	78	4	352	714	35.70	6
Billkere lake	1	65	2	138	2	146	2	156	5	440	805	40.25	4

## Conclusions

Palmer's algal indices of all the lakes were categorized as organically polluted. One of the well developed techniques for detection of organic pollution is the OMNIDA GB 5.3 software. This software detects only diatoms which indicate level of organic pollution. It also gives the information on the level of contamination of water bodies as well identifies which diatoms are autochthonous and which are allochthonous. Diatoms remain at benthic region in the epiphytic forms and can serve as good indicators of organic pollution. It is very important to determine the quality of any water with the help of well developed software that can give precise results. The result can be used for the measurement of heavily polluted lakes in future studies. The algae that are autochthonous and idiosyncratic species that appear or disappear suddenly in the lakes can be marked and used for longer duration. The WQI of Dalvoi lake, Karanj lake and kukkrhalii lake were highly organically polluted and species of euglena, scenedesmus, lepicinlis and synedra are the top indicators of the water quality. The ranking techniques are also another important aspect which enables researcher to place the sites under study from most polluted to the least polluted and compare similar sites conservation strategies. The combination of all newer techniques can be useful in conservation strategy of Lake Ecosystem. The present study indicated that the 8 lakes were organically polluted but the degree of pollution varied to a greater extent. These techniques helps in improving water quality in all the lakes.

## Acknowledgement

I deeply express sincere thanks to my guide Professor Late S.P. Hosmani for his guidance to research. Authors are thankful UAS (B) Bangalore and Dean (Agri.), CoA, VC Farm, Mandya and University of Mysore and also UGC for financial assistance.

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