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ASSESSMENT OF TROPHIC STATE OF A RESERVOIR USING DIFFERENT ALGAL INDICES

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The present study is to assess the distribution of phytoplankton and to determine the trophic state index of the reservoir using different algal indices. The study was conducted during March 2013 to February 2014. During this study a total of 25 algal genera belonging to class cyanophyceae, chlorophyceae and bacillariophyceae were recorded. The maximum genera were represented by bacillariophyceae followed by chlorophyceae and cyanophyceae. Different trophic indices like chlorophycean index, compound index and diatom index based on algal species were calculated. The algal indices state that most of the sites analysed were within the mesotrophic state and slightly eutrophic state. Hence it is time to take adequate measures to prevent the reservoir from eutrophication.

KEY WORDS: algal indices, eutrophication, reservoir, trophic state, water analysis

Water is the universal solvent carrying the dissolved gases, elements, substances and organic compounds that determines the physical and chemical properties of the water. The physical and chemical properties of water are very important for the metabolism of aquatic organisms inhabiting the water medium. The essential life processes of all organisms depend on water. Indian sub continent is very rich in fresh water resources. A large number of fresh water bodies in the form of lakes, rivers, ponds, pools, man-made reservoirs exist in Kerala. Reservoir is basically a dynamic ecosystem which is a combination of fluviatile and lacustrine systems. Algae are a group of diverse, photosynthesizing unicellular and colonial organisms found widely in different habitats including oceans, inland waters and estuaries. More than 45% of the global primary production was carried out by these organisms. Phytoplanktons are widely diverse in aquatic environments. The present study is to assess the distribution of phytoplankton and to determine the trophic state index of the reservoir using different algal indices.

MATERIALS AND METHODS

Study area:

Aruvikkara located in Kerala, India with co-ordinates 8.5677800°N 77.018890°E is a village in Thiruvananthapuram district in the state of Kerala, India. It is located on the banks of the Karamana river 15 km from Thiruvananthapuram city. Aruvikkara dam is one of the main sources of water for distribution in the Trivandrum city. The stations selected were based on the importance of human interventions and also the undisturbed area. The distance between the stations were approximately 2 kilometers. The different sampling sites were Station 1 located at Koovakudy bridge; Station 2 located at Vembanni; Station 3 located at Mundela; Station 4 located at Kaliankuzhi; Station 5 located at Mullilavinmoodu; Station 6 located at Mailamoodu; Station 7 located at Kanchikkavila and Station 8 located at Temple side.

The samples for phytoplankton analysis were collected from all eight stations in separate clean plastic bottles. Phytoplankton were collected by filtering 20 litres of water through phytoplanktonic net made of standard silk bolting cloth no.30 and were fixed immediately using 4% formalin or Lugols iodine (Trivedy and Goel 1986). Identification of algal taxa from a particular site provides a useful indication of water quality. Phytoplanktons collected were identified using standard literatures.

Limnologists have proposed specific indices for the assessments of nutrient status of water bodies. These indices use ratios of particular groups of microalgae as a trophic index, and mostly depend on the fact that desmids are typical of low nutrient waters, colonial blue green algae, chlorococcales.

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1. Chlorophycean index (Rawson, 1956) is calculated by dividing the number of species of chlorococcales by the number of species of desmids. The chlorophycean index below 1 is considered as oligotrophic, between 1 and 2.5 as mesotrophic and above 2.5 as eutrophic.
2. The compound index of Nyggard (1949) is calculated as:

$$CI = \frac{\text{Species of Cyanophyceae+Chloroccales+Centric diatoms}}{\text{Number of desmid species}}$$

Compound index ratio	Trophic state
Compound index ratio < 1	Oligotrophic
Compound index ratio = 1 –2.5	Mesotrophic
Compound index ratio > 1	Eutrophic

3. The diatom index of Nyggard (1949): Diatom index was calculated by dividing the number of species of centric diatoms to number of species of pinnate diatoms.

diatom index	Trophic state
ratio < 1	Oligotrophic
ratio = 1 –2	Mesotrophic
ratio > 2	Eutrophic

RESULTS

Distribution of phytoplankton in the Aruvikkara reservoir was represented in table 1. 22 genera of phytoplankton representing the class Cyanophyceae, Chlorophyceae and Bacillariophyceae were observed in the water collected from eight sites of the aruvikkara reservoir. The class Bacillariophyceae forms the dominant group followed by Chlorophyceae and Cyanophyceae.

Chlorophyceae

Chlorophyceae was represented in the study by 9 genera. It accounts for 41% of the algal composition in the reservoir. They were *Spirogyra* sp, *Ankistrodemus* sp, *Cosmarium* sp, *Closterium* sp, *Micrasterias* sp, *Oedogonium* sp, *Pediastrum* sp, *Scenedesmus* sp, *Staurastrum* sp of which *Cosmarium* sp was the dominant followed by *Spirogyra* sp.

Bacillariophyceae

Bacillariophyceae was represented by 10 genera. It accounts for 45% of the algal composition in the reservoir. The main representatives include *Gyrosigma* sp, *Melosira* sp, *Navicula* sp, *Nitzschia* sp and *Pinnularia* sp.

Cyanophyceae

Cyanophyceae was represented by 3 genera, which were *Oscillatoria* sp, *Spirulina* sp and *Anabena* sp.

DISCUSSION AND CONCLUSION

The maximum algal presence was observed during the summer and post monsoon periods and it may be due to the ideal conditions for the algal growth. The ideal conditions include the temperature, water current, nutrient availability, etc. Minimum algal presence was observed during the monsoon. Increase in the water current, increased turbidity and the influx of water causes the decrease in phytoplankton number during monsoon.

In this study Chlorophycean index calculated revealed that the station 1, 3 and 6 are slightly eutrophic having chlorophycean index values greater than 1. Data on chlorophycean index was presented in the table 2. The present study revealed that the numbers of species of chorococcales observed in the reservoir were slightly higher or equal to the number of species of desmids i.e. in agreement with the findings of Rawson (1956) as in eutrophic water bodies, the number of chlorococcales is likely to exceed the number of species of desmidiaceae while in oligotrophic water bodies the condition is reversed. According to Rawson (1956) Eutrophic condition of a water body is characterized by the presence of blue-green algae. The present study also comes across the presence of the blue green algae viz *Oscillatoria* sp, *Spirulina* sp and *Anabaena* sp.

Nyggard (1949) reported compound index as one of the reliable indicators of trophic status.

Figure 1: Figure showing the algal composition of Aruvikkara reservoir

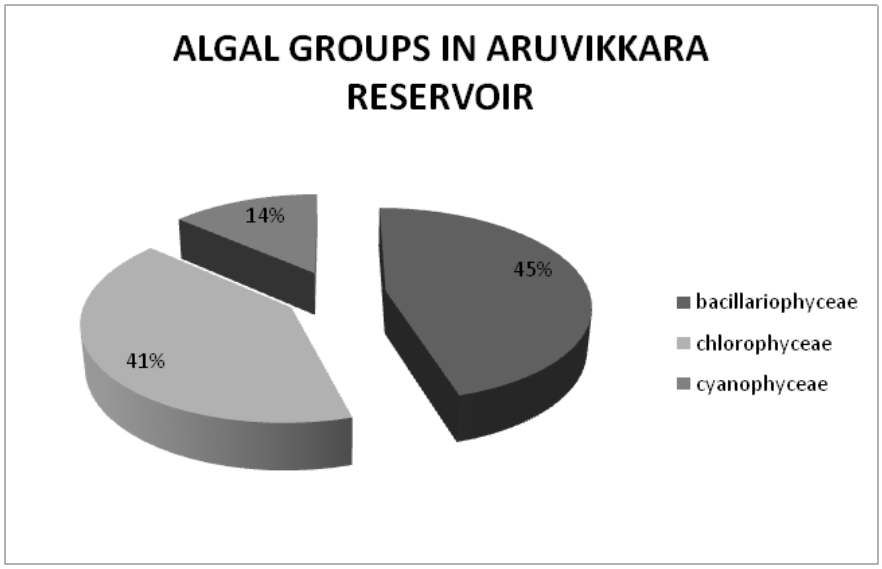

Table 1. Diversity of Phytoplankton recorded during the present study at different sites

Serial No	Genera	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
	Myxophyceae								
1	*Oscillatoria* sps	+	+	+	+	+	+	+	+
2	*Spirulina* sps	+	–	+	+	+	–	–	–
3	*Nostoc* sps	–	+	+	+	+	–	+	–
	Chlorophyceae								
4	*Ankistrodesmus* sps	+	–	+	+	–	+	–	+
5	*Oedogonium* sps	+	+	+	+	+	+	+	+
6	*Pediastrum* sps	+	–	+	–	–	–	+	–
7	*Scenedesmus* sps	+	+	+	+	+	+	+	–
8	*Spirogyra* sps	+	–	+	+	+	+	–	–
	Desmids								
9	*Closterium* sps	+	+	+	+	+	+	+	+
10	*Cosmarium* sps	+	+	+	+	+	+	+	+
11	*Micrasterias* sps	–	–	+	+	–	–	–	–
12	*Stautrastrum* sps	+	–	+	+	+	–	+	–
	Bacillariophyceae								
13	*Fragillaria* sps	–	–	+	+	–	+	–	–
14	*Gyrosigma* sps	+	+	–	+	+	–	+	–
15	*Navicula* sps	+	+	+	+	+	+	+	+
16	*Nitzschia* sps	+	+	+	+	+	+	+	+
17	*Pinnularia* sps	+	+	+	+	+	+	+	+
18	*Cymbella* sps	+	–	–	–	+	–	+	–
19	*Gomphonema* sps	–	–	–	–	+	–	–	–
20	*Melosira* sps	–	+	+	+	–	–	+	–
21	*Hyalodiscus* sps	–	+	+	+	+	–	+	+
22	*Cyclotella* sps	+	–	–	–	+	+	–	–

Table 2. Chlorophycean index of Aruvikkara reservoir

Stations	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7	Station 8
Chlorophycean index	1.6	1.0	2.5	1.0	1.0	2.0	1.0	1.0
Trophic state	eutrophic	oilgotrophic	eutrophic	oligotrophic	oligotrophic	oligotrophic	eutrophic	oligotrophic

Table 3. Compound index of Aruvikkara reservoir

Stations	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7	Station 8
Compound index	2.6	3.0	2.5	2.2	2.6	3.0	2.3	2.0
Trophic state	eutrophic	eutrophic	mesotrophic	mesotrophic	mesotrophic	eutrophic	mesotrophic	mesotrophic

Table 4. Diatom index of Aruvikkara reservoir

Stations	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7	Station 8
Diatom index	0.2	0.5	0.5	0.4	0.3	0.3	0.4	0.3
Trophic state	Oligotrophic	Oligotrophic	Oligotrophic	Oligotrophic	Oligotrophic	Oligotrophic	Oligotrophic	Oligotrophic

The compound index calculated has been presented in the table 3. In this study the compound index value of all the studies are reported to be greater than1 and below 5. This indicates that the all the stations in the reservoir are slightly eutrophic. Nyggards findings are also agreed with our findings.

In this study all the stations has a diatom index of less than 1. The diatom index is presented in the table 4. The number of species of pennate diatoms observed in the reservoir was higher than the number of species of centric diatoms as stated by Stockner (1967) that the diatom composition of mesotrophic-eutrophic waters was mainly represented by pennate diatoms and centric diatoms achieve greater diversity in oligotrophic water bodies.

From this study, the trophic state of the reservoir can be stated with the help of different algal indices and it is clear that all the stations were in the mesotrophic or slightly eutrophic state. The eutrophic condition of the reservoir may be due to the excessive nutrient concentration of the reservoir and the nutrients released out by the death and decay of the aquatic plants. The luxuriant growth of the aquatic macrophytes may also contribute to the eutrophic nature of the reservoir. The nutrients may reach the reservoir by leaching out from the surrounding areas including the agricultural fields and plantations. Hence it is time to take adequate measures to prevent the reservoir from eutrophication. Eutrophication can prevent by avoiding unscientific agricultural practices and encroachment in the periphery of dam.

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