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A Study on the Diversity of Planktons of Urban and Rural Ponds of Kokrajhar District, Assam, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Due to rapid urbanization, many aquatic habitats are now under severe eutrophication because of waste contaminated soil. Therefore, it is essential to assess the status of aquatic ecosystem surrounding us. The present study was conducted for the study of diversity of planktons which are indicator of aquatic ecosystem of two urban and two rural ponds of Kokrajhar district, Assam. The present study reveals a total of 37 species of planktons of which 23 species represents phytoplankton and 14 species represent zooplankton. The most pollution-tolerant species of *Euglena, Navicula, Nitzschia, Ankistrodesmus, Phacus,Pinnularia* and *Scenedesmus* were recorded indicating the highest degree of organic pollution. This plankton study explore that water quality has reached its threshold level and therefore, it needs some corrective measures to maintain the water quality from further deterioration in the study area.

Keywords: Plankton; eutrophic species; Kokrajhar; urban; rural.

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1. INTRODUCTION

Water is an essential requirement for the growth and existence of all living organisms on Earth. It plays a vital role in various aspects of life on our planet, including agriculture, industry, and even human survival [1]. A pond is a type of aquatic ecosystem characterized by shallow, standing water, and it is known to support a diverse range of living organisms. The term "plankton" refers to organisms that inhabit the water column and encompass both macroscopic and microscopic life forms. These organisms float freely in water and lack the ability to swim against the currents [2].

Planktons are present in both freshwater and saltwater environment and play a crucial role in aquatic ecosystems [2]. They serve as an integral and sensitive component of these ecosystems, often indicating environmental disruptions [3]. The plankton community encompasses a wide range of organisms, including tiny plants and small animals. It holds significant importance for insect larvae and specific fish species. Plankton can be categorized into two main groups: phytoplankton and zooplankton [4].

Phytoplanktons are tiny single-celled photosynthetic organisms found in aquatic environments which have multiple significant roles. They contribute to primary production, serve as a vital food source for herbivores, and act as valuable indicators of water quality in pollution studies [5]. Through the process of primary production, phytoplankton convert light energy into chemical energy, making them essential in the aquatic food web [3]. Similar to terrestrial plants, they utilize light energy and carbon dioxide to produce carbohydrates, while also releasing oxygen. These microscopic organisms are crucial to the Earth's ecosystems, generating approximately half of the atmosphere's oxygen, which is comparable to the collective oxygen production of all land plants in a given year [5]. Phytoplankton forms the basis of food chain in open water resources and also acting as an indicator of the water quality [6].

Zooplankton refers to small, heterotrophic animals that float in water and serve as a crucial food source for various aquatic organisms. They play a significant role in providing essential nutrients such as proteins, fats, carbohydrates, mineral salts, and water, which are required by fish in the right proportions [3].Zooplankton is predominantly found in the shallow regions of water bodies, and their population tends to increase in eutrophic waters. These organisms are highly sensitive to pollution, and certain species are commonly used as indicators of environmental pollution [4]. In water bodies, zooplankton plays a vital role in the food chain as consumers and significantly contributes to overall fish production [3]. Zooplankton study is helpful in evaluating the ecological status of the freshwater reservoirs as they are important in nutritive level and as well as ameliorating pollution status and thus used for determining the health of an aquatic ecosystem [7].

Due to rapid population growth, industrialization, contamination of fresh water from the factories and household effluents, water qualities in developing countries have extremely deteriorated [8]. As a result of water resources contamination from domestic and industrial effluents, numbers of Asian cities are facing increase in organic and nutrient material in drinking water [9]. The global proportion of urban population has increased from 28.3% in 1950 to 50% in 2010; an example can be seen of the largest cities in India which are urbanizing at exceptional pace [10]. Because of the same reason one of the demographic issues in the21st century in India is urbanization [11].

Due to urbanization, many aquatic habitats are now under severe eutrophication because of waste contaminated soil. Therefore, it is essential to assess the status of aquatic ecosystem surrounding us. Hence, in the present work an attempt was made to know the diversity of planktons which are indicator of aquatic ecosystem of two urban and two rural ponds of Kokrajhar district, Assam during the pre-monsoon period from March to May, 2023. The pre-monsoon is the only non flooded period in Assam, so the exact measure of aquatic ecosystem for a particular area can be assessed. Through the present investigation it will help to get an idea about the phytoplankton and zooplankton diversity present here and the status of aquatic ecosystem of Kokrajhar town and it’s surrounding.

2. METHODOLOGY

2.1 Study Area

Plankton samples were collected from four different ponds in Kokrajhar district of which two ponds from urban areas and other two from rural

areas. The urban ponds were Gaurang Park and Children Park located at Kokrajhar town. The rural ponds were Gendrabil and Khargaon located outside of Kokrajhar town.

Urban Pond 1: Gaurang Park is located on the bank of Gaurang River (Latitude 26.423845˚N, Longitude 90.263239˚E).

Urban Pond 2: Children Park Pond (Latitude 26.400086˚N, Longitude 90.263505˚E).

Rural Pond 1:Gendrabeel Pond (Latitude 26.377983˚N, Longitude 90.281521˚E). It is located 2km away from Kokrajhar town.

Rural Pond 2: Khargaon Pond (Latitude 26.414586˚N, Longitude 90.286064˚E). It is located 2.95km away from Kokrajhar town.

2.2 Sample Collection

The plankton containing water sample was collected from the study sites during pre monsoon period (March to May, 2023). The planktons were mostly collected from the site in the early morning of the day (7am to 10 am).The planktons were collected from the surface of the ponds using plankton net of mesh size 50µm. The planktons collected were transferred to the polythene bottles and then fixed with 4% formalin.

2.3 Quantitative Analysis

The samples were then brought to the laboratory, Department of Zoology, Science College Kokrajhar for identification and for quantitative analyses. The identification of planktons was done by observing under binocular light microscope (under 40 micron). Planktons were identified up to generic level with the help of standard literature [2,4,5,12]. For quantitative analysis of plankton was done by employing Sedgewick-rafter cell counting chamber. One ml. of plankton containing water sample was transferred to the counting chamber and counted using binocular microscope. The volume of 1ml. sample water put in the Sedgewick counting chambered is considered as a quadrate. Here planktons were counted from a total of 10 quadrates or 10 ml water sample.

2.4 Statistical Analysis

Statistical analysis was done by Microsoft excel and PAST software (4.0 version). Frequency, abandance and diversity indexes of Shannon, Simpson's Dominance index, Pielou's Evenness index were calculated in Microsoft excel. Cluster analysis of Bray Curtis' Dissimilarity index was also done in Microsoft Excel (Past). Graphical presentations were also analyzed with the Microsoft excel.

Frequency was calculated by using the formula-

$$\text{Frequency (\%)} = \frac{\text{Total number of quadrats in which species has occured}}{\text{Total numberof quadrats studied}} \text{ x } 100$$

Abundance was calculated by using the formula-

$$\text{Abundance} = \frac{\text{Total number of individuals of the species}}{\text{Total number of quadrats in which the species has occured}}$$

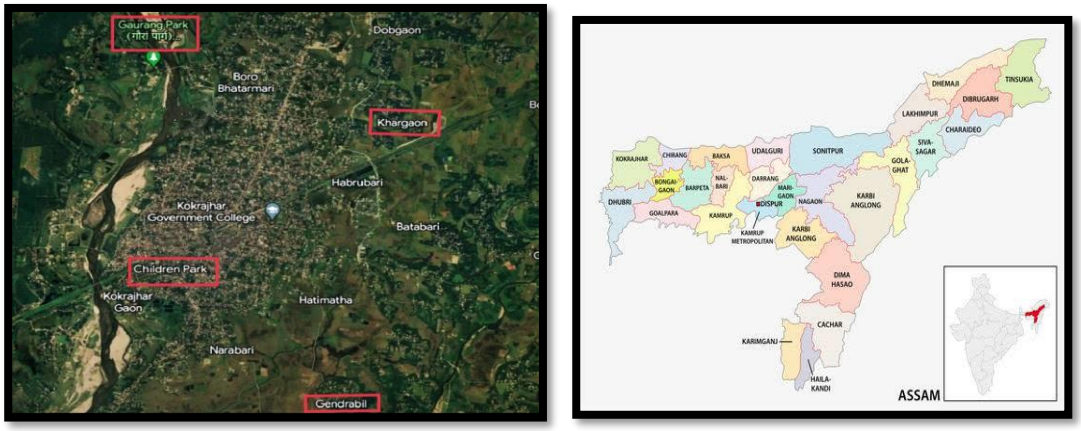


Fig.1. Map representing the study areas

Shannon diversity index was calculated using the formula [13]

$$H' = -\sum \frac{\mathrm{n}}{\mathrm{N}} Ln \frac{\mathrm{n}}{\mathrm{N}}$$

Simpson's index of dominance was calculated using the formula [14]

$$\mathrm{D} = -\sum \left(\frac{\mathrm{n}}{\mathrm{N}}\right)^2$$

Evenness index was calculated using the formula [15]

$$J = H'/Ln\mathrm{S}$$

Here, H/ for Shannon index, n for total number of individual species, N for total number of species population, J for Pielou's evenness index, S for number of species in a study site, D for Simpson's Dominance index, Ln for logarithm.

3. RESULTS

During the present study, a total of 23 species of phytoplankton were reported from the four studied ponds of Kokrajhar district, Assam representing 4 families of Bacillariophyceae, Cholophyceae, Cyanophyceae and Euglenophyceae.In the present study, Cholophyceae constituted the largest group among phytoplanktons followed by Bacillariophyceae in all the four ponds, but Cyanophyceae was recorded from only three ponds but not recorded in Gendrabil pond Table 1).

A total of 14 species of Zooplankton were reported from the studied ponds belonging to the class Copepoda, Cladocera, Rotifera and Branchiopoda.In the present study, Rotifera constituted the major group among the zooplanktons found in all the ponds. But the species diversity is less in rural ponds in compare to urban ponds (Table 1).

After Bray Curtis cluster analysis the urban ponds and the rural ponds have found some differences in phytoplankton species composition and frequencies of different species. But two ponds of urban sites have close distance with each other. Similarly two rural ponds have also close distance with each other (Fig. 2).

The total number of individual planktons in 10 quadrates of studied or in per 10ml samplei.e. quantities of each plankton species was shown in the Tables 2-5. The species which has highest frequency in Gaurang pond were *Pediastrum sp.* (100%) and *Scenedesmus sp*.(100%);in Children park pond *Navicula sp*.(100%), Scenedesmus sp. (100%), *Selenatrum sp*.(100%) and *Monoraphidium sp.* (100%); in Gendrabeel pond where *Navicula sp.* (100%), *Phacus sp.* (100%), *Euglena sp.* (100%) and in Khargaon pond *Phacus sp*.(100%) had highest frequency (Figs. 7-10). The more abundant of species in Gaurang pond were *Scenedesmmus sp* (2.8), in Children park pond *Navicula sp.* (2.2), in Gendrabeel pond *Navicula sp.* (2) and in Khargaon pond *Daphnia sp.* and *Trichocercasp*had highest abundance.

The Shannon Weiner diversity index (H′) of phytoplankton ranged from 2.33 to 2.6. i.e. rich diversity of phytoplanktons. The lowest H/ value (2.33) obtained in Gendrabil Pond and that of higher value (2.6) in Gaurang Park Pond. The H/ of zooplanktons ranged from 0.63 to 1.99 of which its minimum value(0.63) observed in Khargaon Pond and its maximum value(1.99) observed in Gaurang Park Pond.

The values of Simpson Dominance index of phytoplanktons of the three ponds, Gaurang Park pond, Children Park pond and Khargaon pond are 0.09,almost same that support rich diversity index of Shannon. On the other hand, in Gendrabil pond, the Simpson's Dominance index was found higher than as compared to other ponds i.e. 0.1, that indicates low diversity of Shannon (Table 6).

4. DISCUSSION

Plankton play key role in the productivity of an aquatic ecosystem [16]. The present study reveals a total of 37 species of planktons of which 23 species represents phytoplankton and 14 species represent zooplankton. In the present study, 23 species of phytoplanktons of 4 families belongs to Bacillariophyceae, Chlorophyceae, Cyanophyceae and Euglenophyceae were reported from four study sites (ponds) of Kokrajhar district (Figs. 3-6). Among them, Chlorophyceae constitute the major group among phytoplankton community with 13 genera where majority of contribution is from *Scenedesmus sp*. followed by *Selenastrum sp.* Bacillariophyceae represented by 5 genera where major portion of is contributed by *Navicula sp.* followed by Diatom sp. Cyanophyceae represented by 3 genera where *Anabaena sp.* is a major contributor, while in euglenophyceae , 2 genera are recorded from the studied sitewhere majority of contribution is from *Phacus sp.* followed by *Euglena sp.*

Table 1. Diversity of planktons recorded from urban and rural ponds

Sl. No.	Name of Planktons/Family	Urban Pond 1(Gaurang Park)	Urban Pond 2(Children Park)	Rural Pond 1 (Gendrabil)	Rural Pond 2(Khargaon)
	Phytoplankton/ Family				
A.	**Bacillariophyceae**				
1.	*Navicula sp.*	+	+	+	+
2.	*Diatoma sp.*	+	+	+	+
3.	*Pinnularia sp.*	+	+	+	+
4.	*Aulacoseira sp.*	+	+	+	-
5.	*Calonies sp.*	-	+	-	-
B.	**Chlorophyceae**				
6.	*Closterium sp.*	+	+	+	+
7.	*Spirogyra sp.*	-	-	+	-
8.	*Pediastrum sp.*	+	+	-	+
9.	*Scenedesmus sp.*	+	+	+	+
10.	*Staurastrum sp.*	+	-	-	-
11.	*Ankistrodesmus sp.*	+	+	-	-
12.	*Treubaria sp.*	+	+	+	+
13.	*Actinastrum sp.*	+	+	-	+
14.	*Volvox sp.*	-	+	+	-
15.	*Selenastrum sp.*	+	+	+	+
16.	*Cosmarium sp.*	+	+	+	+
17.	*Monoraphidium sp.*	+	+	-	+
18.	*Tetrastrum sp.*	-	-	-	+
C.	**Cyaenophyceae**				
19.	*Rivularia sp.*	+	-	-	-
20.	*Anabaena sp.*	+	+	-	+
21.	*Arthospira sp.*	+	-	-	-
D.	**Euglenophyceae**				
22.	*Euglena sp.*	+	+	+	+
23.	*Phacus sp.*	+	+	+	+
	Name of zooplanktons/Class				
A.	**Copepoda**				
1.	*Cyclop sp.*	+	+	+	-
2.	*Nauplii sp.*	-	-	+	-
B.	**Cladocera**				
3.	*Alona sp.*	+	-	-	-
4.	*Daphnia sp.*	-	+	+	+
5.	*Ceriodaphnia sp.*	-	-	+	-
C.	**Rotifera**				
6.	*Polyarthra sp.*	+	-	-	-
7.	*Anuraeopsis sp.*	+	+	-	-
8.	*Asplancha sp.*	+	-	-	-
9.	*Trichocerca sp.*	+	+	-	+
10.	*Brachionus sp.*	-	-	+	-
11.	*Monostyla sp.*	+	-	-	-
D.	**Branchiopoda**				
12.	*Dadaya sp.*	+	-	-	-
13.	*Acroperus sp.*	+	-	-	-

(Here '+' indicates presence and '-' indicates absence)

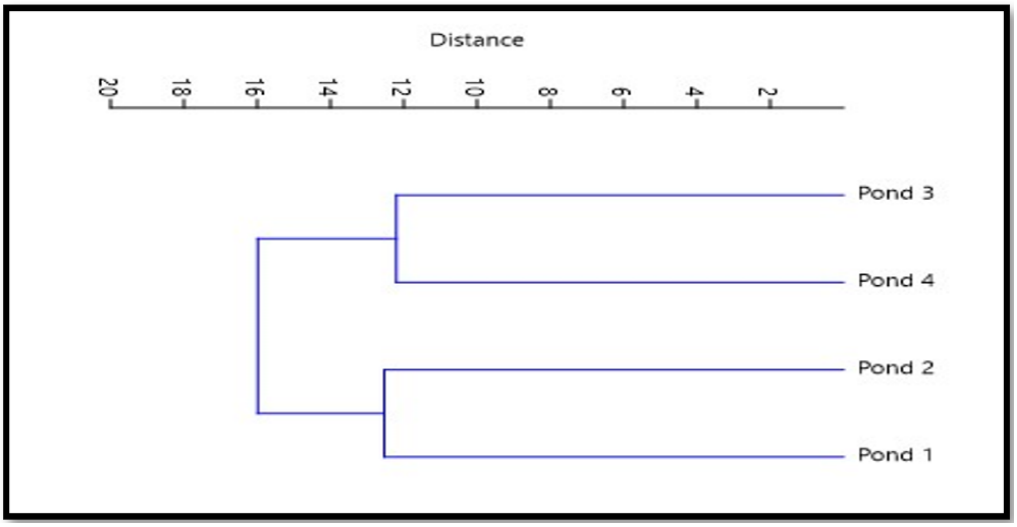


Fig. 2. Dissimilarity index of phytoplanktons after Bray Curtis of four ponds

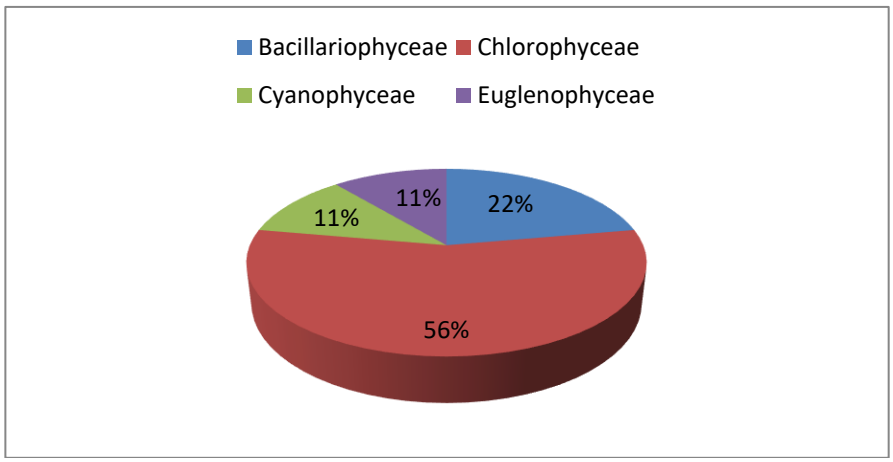


Fig. 3. Composition of phytoplanktons in Gaurang Park Pond

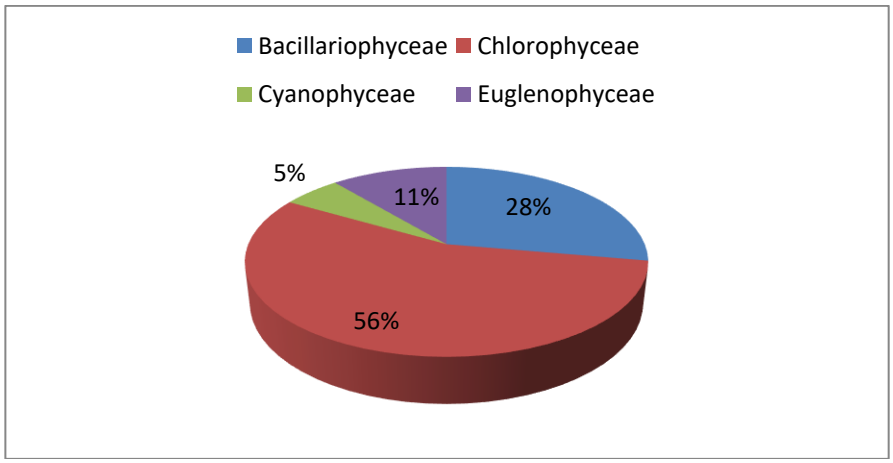


Fig. 4. Composition of Phytoplanktons in Children Park Pond

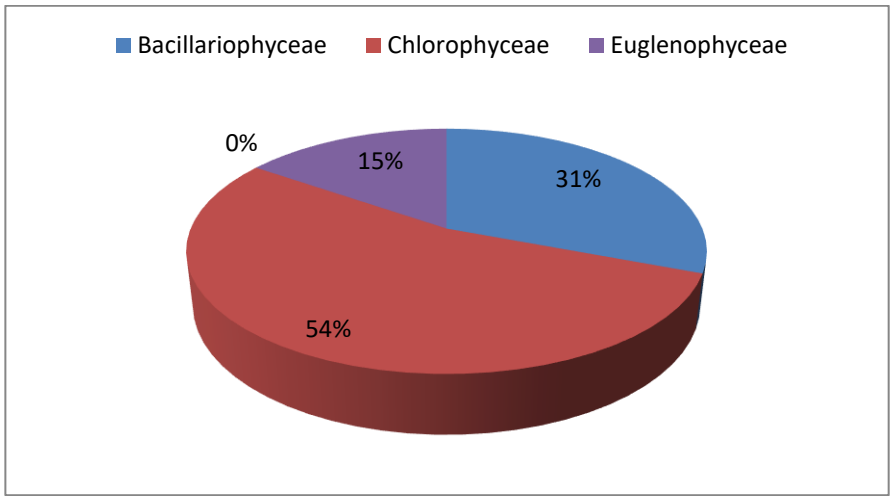


Fig. 5. Composition of Phytoplanktons in Gendrabil Pond

Table 2. Frequency and Abundance of Phytoplanktons and Zooplanktons in Gaurang Park Pond

Sl No.	Name of Phytoplanktons	Total no. of Planktons per 10ml (10 quadrate)	Total no. of quadrate studied	Total no. of quadrates of occurence	Frequency (%)	Abundance
1	*Navicula sp.*	3	5	2	40	1.5
2	*Closterium sp.*	1	5	1	20	1
3	*Diatom sp.*	5	5	4	80	1.25
4	*Pediastrum sp.*	6	5	5	100	1.2
5	*Pinnularia sp.*	2	5	2	40	1
6	*Treubaria sp.*	2	5	1	20	2
7	*Scenedesmus sp.*	14	5	5	100	2.8
8	*Aulacoseir sp.*	4	5	3	60	1.333
9	*Staurastum sp.*	1	5	1	20	1
10	*Ankistrodesmus sp.*	3	5	2	40	1.5
11	*Actinastrum sp.*	3	5	3	60	1
12	*Rivulariasp.*	1	5	1	20	1
13	*Euglena sp.*	2	5	1	20	2
14	*Phacus sp.*	1	5	1	20	1
15	*Selenastrum sp.*	6	5	4	80	1.5
16	*Cosmarium sp.*	2	5	1	20	2
17	*Monoraphidium sp.*	8	5	4	80	2
18	*Arthrospira sp.*	3	5	2	40	1.5
	Zooplanktons					
1	*Alona sp.*	3	5	3	60	1
2	*Polyarthra sp.*	3	5	2	40	1.5
3	*Anuraeopsis sp.*	3	5	3	60	1
4	*Asplancha sp.*	2	5	1	20	2
5	*Trichocerca sp.*	6	5	4	80	1.5
6	*Dadaya sp.*	1	5	1	20	1
7	*Acroperus sp.*	1	5	1	20	1
8	*Oxyurella sp.*	1	5	1	20	1
9	*Monostyla sp.*	1	5	1	20	1

Table 3. Frequency and Abundance of PhytoplanktonsinChildren Park Pond

Sl No.	Name of Phytoplankton	Total no. of Planktons per 10ml (10 quadrate)	Total no. of quadrate studied	Total no. of quadrats occurence	Frequency (%)	Abandance
1	*Naviculla sp.*	11	5	5	100	2.2
2	*Diatom sp.*	4	5	3	60	1.3333
3	*Pinnularia sp.*	3	5	2	40	1.5
4	*Aulacoseira sp.*	1	5	1	20	1
5	*Closterium sp.*	1	5	1	20	1
6	*Pediastrum sp.*	3	5	3	60	1
7	*Scenedesmus sp.*	10	5	5	100	2
8	*Calories sp.*	1	5	1	20	1
9	*Selenastrum sp.*	6	5	5	100	1.2
10	*Cosmarium sp.*	1	5	1	20	1
11	*Monoraphidium sp.*	9	5	5	100	1.8
12	*Ankistrodesmus sp.*	1	5	1	20	1
13	*Treubaria sp.*	2	5	2	40	1
14	*Actinastrum sp.*	3	5	2	40	1.5
15	*Volvox sp.*	2	5	2	40	1
16	*Anabaena sp.*	5	5	4	80	1.25
17	*Euglena sp.*	5	5	3	60	1.6666
18	*Phacus sp.*	2	5	2	40	1
	Zooplanktons					
1	*Cyclop sp.*	1	5	1	20	1
2	*Daphnia sp.*	5	5	3	60	1.6666
3	*Anuraeopsis sp.*	1	5	1	20	1
4	*Trichocerca sp*	2	5	2	40	1

Table 4. Frequency and abundance of Phytoplanktons in Gendrabeel Pond

Sl No.	Name of Phytoplankton	Total no. of Planktons per 10ml (10 quadrate)	Total no. of quadrate studied	Total no. of quadrats of occurence	Frequency (%)	Abandance
1	*Naviculla sp.*	10	5	5	100	2
2	*Diatom sp.*	4	5	3	60	1.3333
3	*Pinnularia sp.*	3	5	2	40	1.5
4	*Closterium sp.*	2	5	2	40	1
5	*Spirogyra sp.*	1	5	1	20	1
6	*Scenedesmus sp.*	6	5	4	80	1.5
7	*Volvox sp.*	2	5	2	40	1
8	*Phacus sp.*	8	5	5	100	1.6
9	*Euglena sp.*	7	5	5	100	1.4
10	*Aulacoseir sp.*	2	5	1	20	2
11	*Treubaria sp.*	3	5	2	40	1.5
12	*Selenastrum sp.*	9	5	5	100	1.8
13	*Cosmarium sp.*	1	5	1	20	1
	Zooplanktons					
1	*Cyclop sp.*	3	5	3	60	1
2	*Daphnia sp.*	3	5	3	60	1
3	*Ceriodaphnia sp.*	1	5	2	40	0.5
4	*Brachionus sp.*	2	5	2	40	1
5	*Nauplius sp.*	2	5	2	40	1

Table 5. Frequency and Abundance of Phytoplankton in Khargaon Pond

Sl No.	Name of Phytoplanktons	Total no. of Planktons per 10ml (10 quadrate)	Total no. of quadrate studied	Total no. of quadrats of occurence	Frequency (%)	Abandance
1	*Naviculla sp.*	7	5	4	80	1.75
2	*Diatom sp.*	3	5	3	60	1
3	*Pinnularia sp.*	2	5	2	40	1
4	*Closterium sp.*	1	5	1	20	1
5	*Pediastrum sp.*	2	5	2	40	1
6	*Scenedesmus sp.*	4	5	3	60	1.3333
7	*Treubaria sp.*	1	5	1	20	1
8	*Actinastrum sp.*	2	5	2	40	1
9	*Anabaena sp.*	1	5	1	20	1
10	*Euglena sp.*	3	5	3	60	1
11	*Phacus sp.*	9	5	5	100	1.8
12	*Selenastrum sp.*	2	5	2	40	1
13	*Tetrastrum sp.*	5	5	4	80	1.25
14	*Cosmarium sp.*	3	5	3	60	1
15	*Monoraphidium sp.*	4	5	3	60	1.3333
	Zooplanktons					
1	*Daphnia sp.*	2	5	2	40	1
2	*Trichocerca sp.*	1	5	1	20	1

Table 6. Diversity indeces of planktons of urban and rural ponds

Diversity indeces/ Planktons	Urban Pond 1 (Gaurang Park)	Urban Pond 2 (Children Park)	Rural Pond 1 (Gendrabil)	Rural Pond 2 (Khargaon)
Phytoplanktons				
Shannon Diversity index(H)	2.6016	2.5968	2.3345	2.4744
Simpsons Domonance index(D)	0.0948	0.0914	0.1123	0.0932
Pielou Evenness index(J)	0.9001	0.8984	0.9101	0.8924
Zooplanktons				
Shannon Diversity index(H)	1.9957	1.1490	1.5465	0.6365
Simpsons Domonance index(D)	0.1609	0.3827	0.2231	0.5555
Pielou Evenness index(J)	0.9082	0.8288	0.9609	0.9183

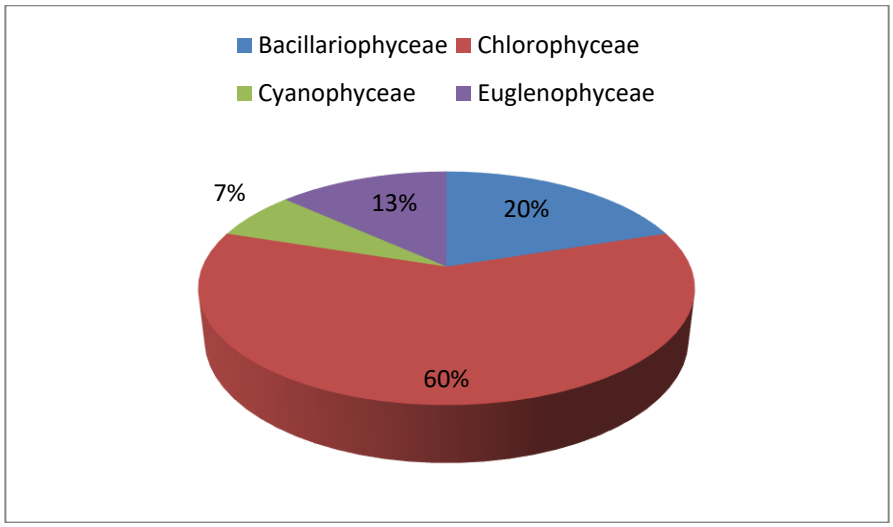


Fig. 6. Composition of Phytoplanktons in KhargaonPond

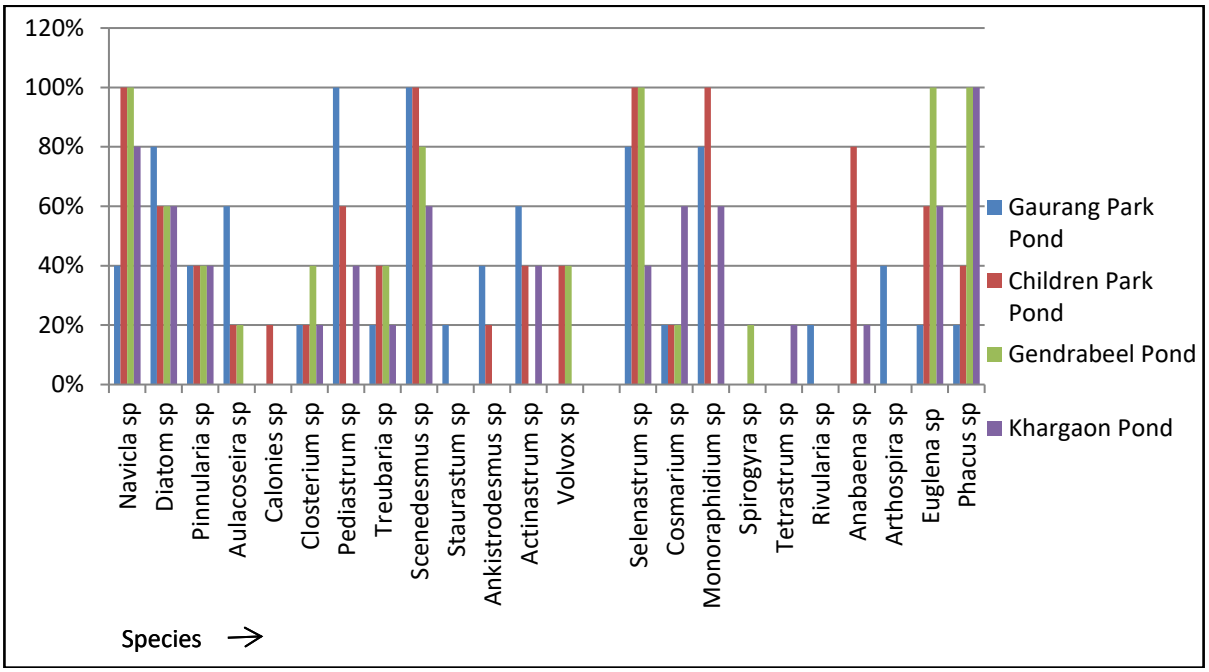


Fig. 7. Graphical representation of frequency of Phytoplanktons

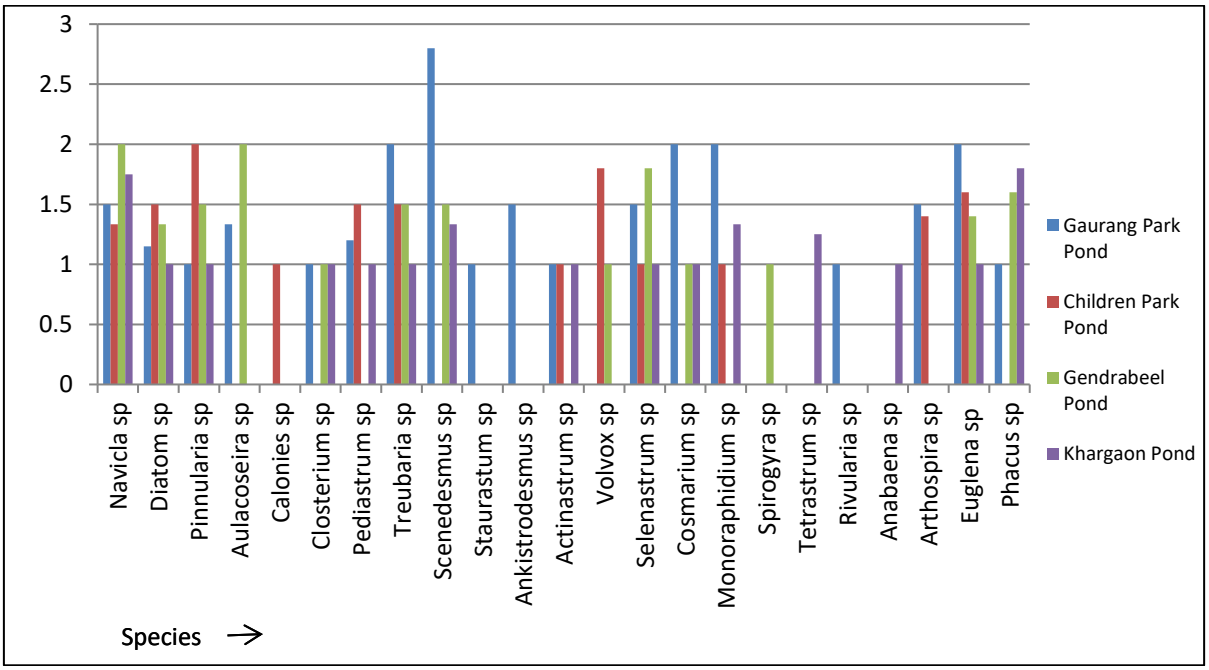


Fig. 8. Graphical representation of abundance of Phytoplanktons

Among zooplankton, a total of 14 species were reported during the study period of which belongs to Copepoda, Cladocera, Rotifera, Branchiopoda. Among the classes of zooplanktons, Rotifera constitute the major group with 6 genera where largest number was *Trichocerca sp.* Copepoda represented by 2 genera of which *Cyclop sp*. was the most frequently recorded. In cladocera, 3 genera is reported from the studied ponds where *Daphnia sp.* plays as a key contributor, while in brachiopoda, 3 genera are found to present in the studied sites where single species of *Dadaya, Acroperus*and*Oxyurella*were recorded from the studied sites.

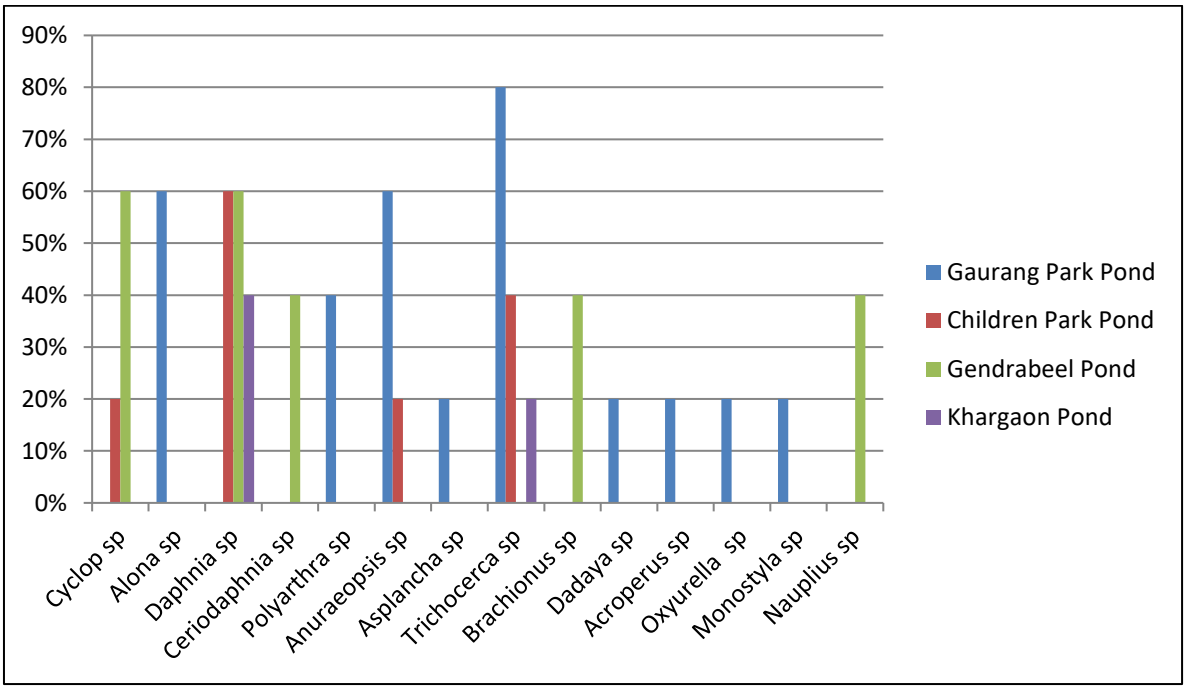


Fig. 9. Graphical representation of frequency of Zooplanktons

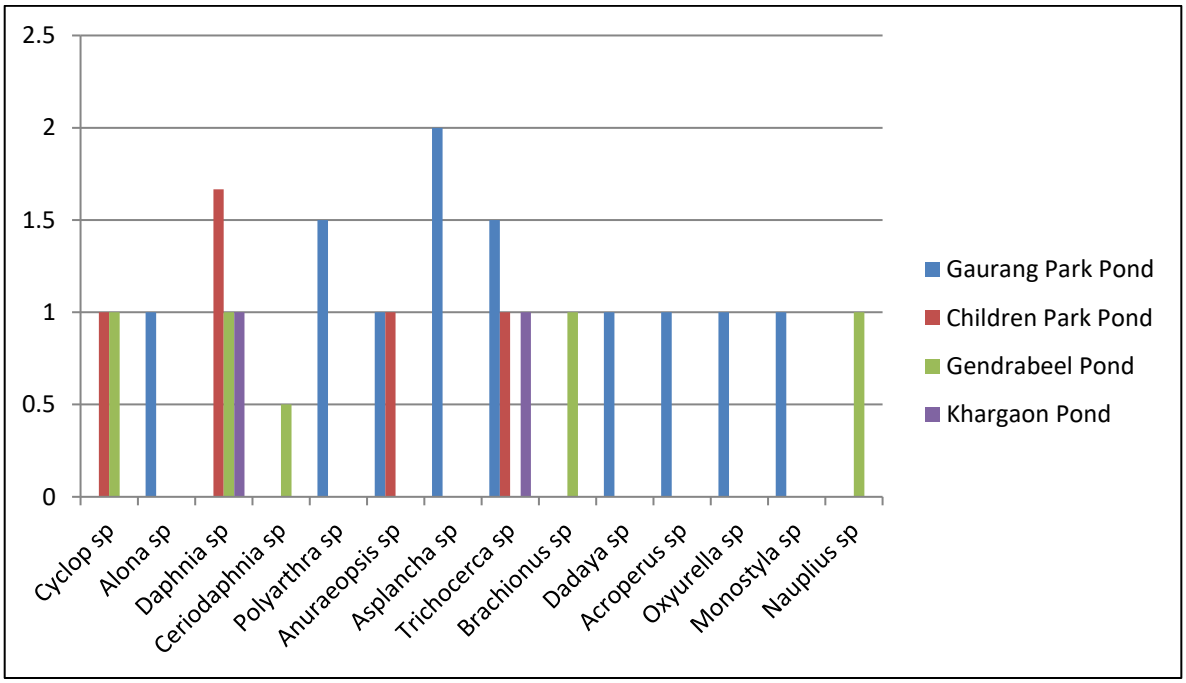
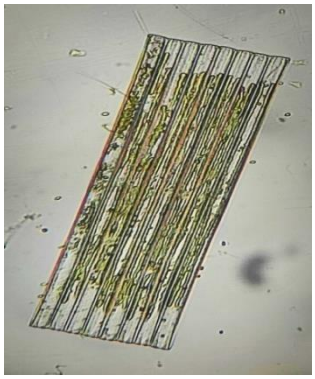


Fig. 10. Graphical representation of Abundance of Zooplanktons

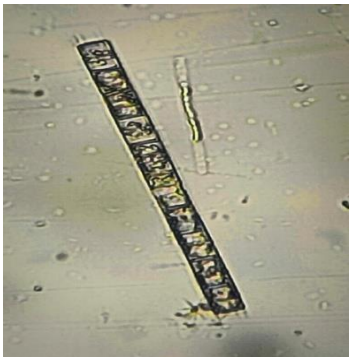
In the present study, it is found that two unban ponds- Children park pond and Gaurang park pond have some distance with each other in species composition (after Bray Curtis cluster analysis). Similarly two rural ponds- Gendrabeel and Khargaon pond have close similarity distance with each other. But there is large distance in similarity between the urban ponds and the rural ponds.They have large dissimilarity in species composition and frequency (Fig. 2).

(A) *Navicula sp*



(B) *Diatoma sp.*

(C) *Pinnulariasp*

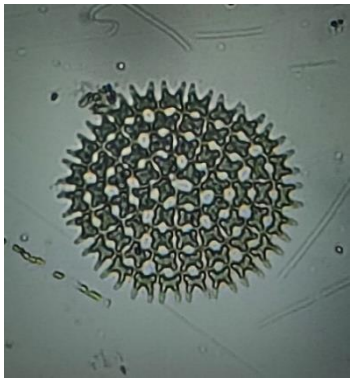


(D) *Aulacoseira sp.*

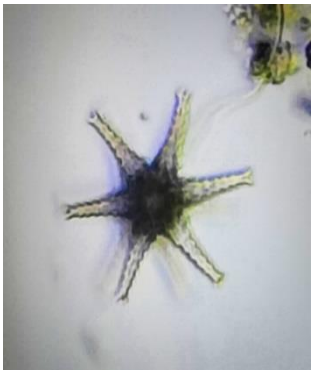
(E) *Calonies sp.*

(F) *Closterium sp.*

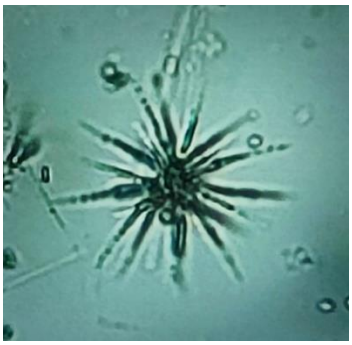
(G) *Scenedesmus sp.*



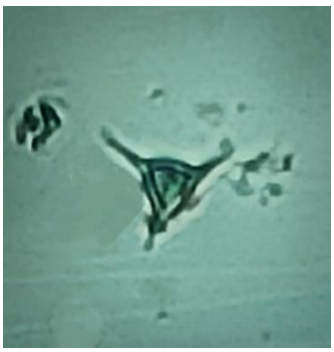
(H) *Pediastrum sp.*



(I) *Staurastrum sp.*

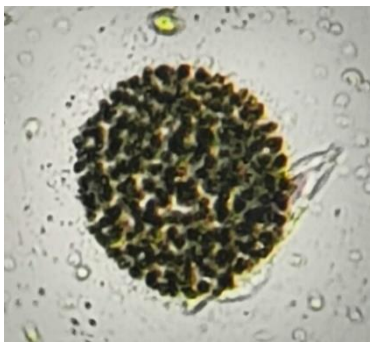


(J) *Ankistodesmus sp.*



(K) *Treubaria sp.*

(L) *Actinastrum sp.*

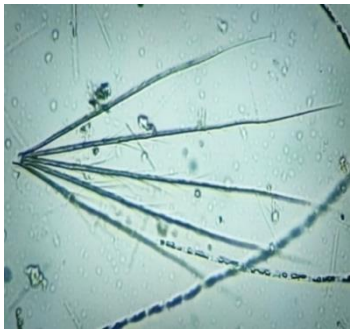


(M) *Volvox sp.*

(N) *Selenastrum sp.*

(O) *Cosmarium sp.*

(P) *Spirogyra sp.*

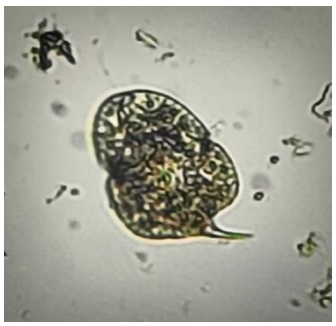


(Q) *Rivularia sp.*

(R) *Anabaena sp.*

(S) *Arthospira sp.*

(T) *Euglena sp.*



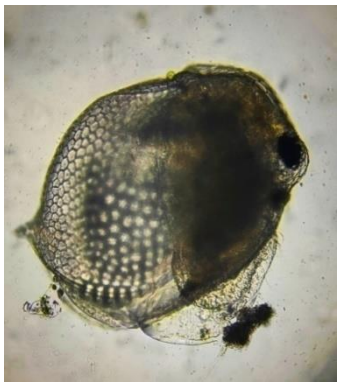
(U) *Phacus sp.*

Image 1. Different Phytoplanktons recorded from the study sites

(A) *Cyclop sp*.

(B) *Alona sp.*

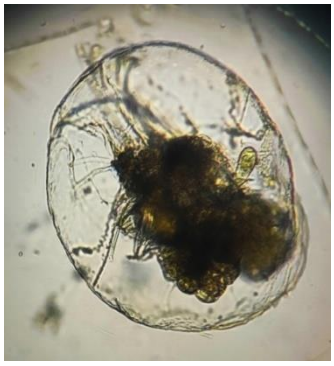
(C) *Daphnia sp.*



(D) *Ceriodaphnia sp.*

(E) *Polyarthra sp.*

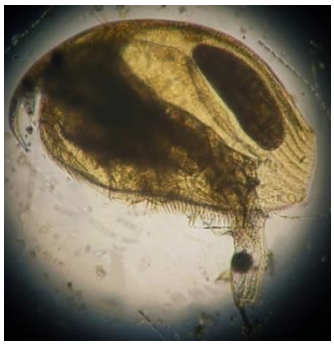
(F) *Anuraeopsis sp.*



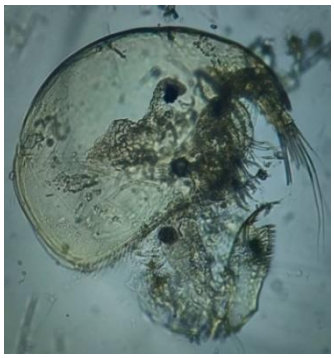
(G) *Asplancha sp.*

(H) *Trichocerca sp.*

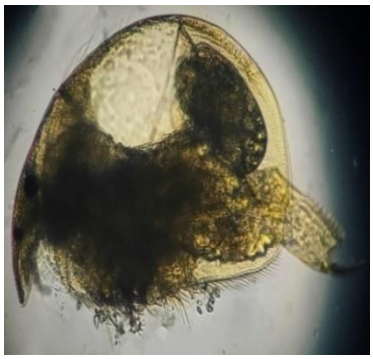
(I) *Brachionus sp.*



(J) *Dadaya sp.*



(K) *Acroperus sp.*



(L) *Oxyurella sp.*

(M) *Monostyla sp.*

(N) *Nauplius sp.*

Image 2. Different Zooplanktons recorded from the study sites

Many phytoplankton are organic pollution indicators, they indicate eutrophication of aquatic habitat [6,17,18,19]. In this study, many eutrophic tolerant species are recorded. According to Patrick [20], the species of Euglena are most tolerant to highly polluted water and significant indicator of eutrophication. Palmer [21] has shown that genera like *Scenedesmus, Euglena, Nitschia*and *Navicula* are generally found in organically polluted waters. Species of *Euglena, Scenedesmus, Lepocinclis*and *Synedra* are the top indicators of the water quality as supported by Hosmani [22].

In urban pond: In the present study, 9 eutrophic tolerant species (*Navicula sp., Closterium sp., Pediastrum sp., Pinnularia sp., Scenedesmus sp., Ankistrodesmus sp., Euglena sp., Phacus sp. and Selanastrum sp.*) were recorded in Gaurang park pond. Similarly in Children park pond also 9 eutrophic species (*Navicula sp.,Closterium sp.,Pediastrum sp.,Pinnularia sp.,Scenedesmus sp., Ankistrodesmussp., Euglena sp.,Phacus sp. and Selanastrum sp*.) were recorded.

In rural pond: In Gendrabeel pond 7 eutrophic species (*Naviculasp, Closterium sp.,Pediastrum sp., Pinnularia sp., Scenedesmus sp., Euglena sp.,Phacus sp. and Selanastrum sp*.) and 8 eutrophic species (*Navicula sp.,Closterium sp.,Pediastrum sp., Pinnularia sp.,Scenedesmus sp., Euglena sp., Phacus sp. and Selanastrum sp*.) were recorded.

All these Eutrophic tolerant species have highest frequency and abundance in all the ponds (Tables 3-5). The species which has highest frequency in Gaurang pond were*Pediastrum sp.* (100%) and *Scenedesmus sp*.(100%);in Children park pond *Navicula sp*.(100%), Scenedesmus sp. (100%), *Selenatrum sp*.(100%) and *Monoraphidium sp.* (100%) ; in Gendrabeel pond where *Navicula sp.* (100%), *Phacus sp.* (100%), *Euglena sp.* (100%) and in Khargaon pond *Phacus sp*.(100%) had highest frequency (Figs. 7-10). The more abundant of species in Gaurang pond were *Scenedesmmussp* (2.8), in Children park pond *Navicula sp.* (2.2), in Gendrabeel pond *Navicula sp.* (2) and in Khargaon pond *Daphnia sp.* and *Trichocercasp*had highest abundance.

In the present study in all the ponds, Shannon diversity index was found comparatively high (Table 6). But in all the ponds more euphrophic tolerant species were recorded. The high values of Shannon Weiner Diversity index and high frequency of eutrophic species in all the ponds explore the fact that they have been exposed to various sources of organic pollution.

5. CONCLUSION

The current study was held during the pre-monsoon period from March to May, 2023.The study though has been conducted in some selected ponds of Kokrajhar district, Assam, this will help to get an idea about the phytoplankton and zooplankton diversity present here and the aquatic status of Kokrajhar town and its surrounding.The present study reveals the existence of about 37 species of planktons within the study period. During study, some differences were observed in urban and rural ponds on phytoplankton species composition and frequency. But it was found that all the ponds have eutrophic tolerant species with high frequencies and abundance and have high Shannon diversity index. The most pollution-tolerant genus were *Euglena, Navicula, Nitzschia, Ankistrodesmus, Phacus,Pinnularia* and S*cenedesmus* were recorded to be maximum indicating the highest degree of organic pollution. Plankton study thus showed that water quality has reached its threshold level and therefore, it needs some corrective measures to maintain the water quality from further deterioration in both the urban and rural ponds.It is very essential that local people must be aware that ecosystem deterioration in Kokrajhar town and surrounding rural area that is pollution surrounds everywhere.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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