International Journal of Academic Research
ISSN: 2348-7666; Vol.7, Issue-4 April, 2020
Impact Factor: 6.023; Email: drtvramana@yahoo.co.in

Study on Algal Diversity of two fresh water bodies of Hyderabad with reference to Assessment of water quality using Algal Indices

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Abstract

A study on Algal characterization of two lakes of Hyderabad viz. Safilguda Lake and Pedda Cheruvu for a period of two years was made, to find the occurrence of specific taxa that serve as indicator taxa of specific ecological conditions. The present paper highlights assessment of water quality of these two lakes using Algal pollution indices based on the algal community of these water bodies. Phytoplankton diversity of two lakes revealed the presence of 165 algal species that belong to 69 genera. Chlorophyceae was observed to be the highly diversified group, represented by 52 species belong to 30 genera and Dinophyceae was poorly represented with 6 species belonging to 3 genera. Palmer (1969) algal indices have been applied to rate water samples for high or low organic pollution. Pollution index of algal species there is 'Theoretical maximum organic pollution' in Pedda Cheruvu and 'Lack of organic pollution' in Safilguda Lake. The study conducted on Safilguda Lake was carried out after the Lake restoration, an attempt has been made to compare the present status with previous studies which were carried out before restoration to assess the lake water quality over the years.

Keywords: Phytoplankton, Algal index, Bioindicators, Pedda Cheruvu, Safilguda Lake,

1. Introduction

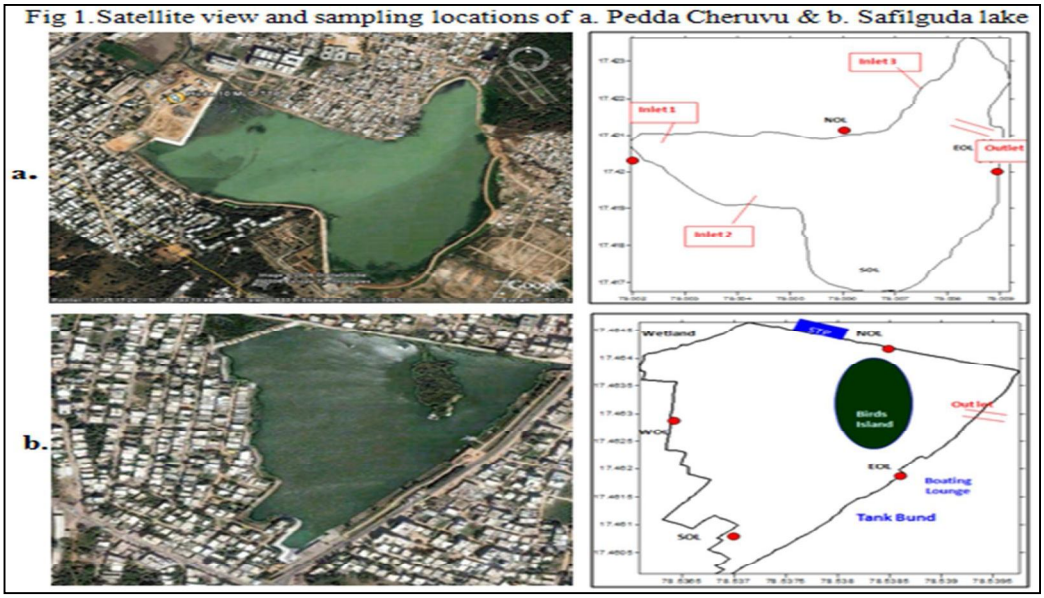
Algae, one of the most diverse groups of living organisms are distributed in different types of water habitats and play a vital role in maintaining aquatic ecosystem. The overall condition or health of aquatic ecosystems is determined by the interaction of all its physical, chemical and biological components, which make up its ecosystem. The water quality index (WQI) is an index that reflects the composite influence of different water quality parameters which is considered and taken for calculation of water quality and it acts as an important tool to determine the drinking water quality in urban, rural and industrial area. is defined index (Chaurasia, et al., 2018). Biological monitoring or bio-monitoring is the use of biological response to assess the ecological integrity of freshwater ecosystems. Bioindicators are evaluated through presence/absence, condition, relative abundance, reproductive success, community structure (i.e. composition and diversity), community function (i.e. trophic structure), or any combination

thereof. The presence or absence of the indicator or of an indicator species or indicator community reflects the environmental conditions of the water body under study. Phytoplankton abundance in a water body reflects the average ecological condition and, therefore, it may be considered as remarkable indicator of water quality, trophic status and pollution level (Bhatt et al. 1999, Saha et al. 2000). Algae are ideally suited for water quality assessment because they have rapid reproduction rates and very short life cycles, making them valuable indicators of short-term impacts (Omar WM, 2010). Palmer (1969) developed a pollution index to estimate the organic pollution level in freshwater aquatic bodies through most available and dominant algal species. The technique enables the investigator to place the sites under study from the most polluted to the least polluted or compare similar sites.

The most standard Plamer's algal pollution index up to date is a classic research outcome that helps to estimate the organic pollution level in freshwater aquatic bodies through most available and dominant algal species (Palmer et al. 1969).

The present investigation is aimed to find out the algal diversity of these two lakes and assess their water quality using and Palmer (1969) pollution index based on the algal community reported in these water bodies. The field work was spread over a period of two years from March 2004 to February 2006 and the samples were collected on monthly basis. Further, the study conducted on Safilguda Lake was carried out after the Lake restoration, an attempt has been made to compare the present status with previous studies which were carried out before restoration to assess the lake water quality over the years.

Fig 1.Satellite view and sampling locations of a. Pedda Cheruvu & b. Safilguda lake



2.0 Materials and Methods

2.1 Study area: Founded in 1591 on the banks of river Musi, the city of Hyderabad is located in the heart of the Deccan plateau at 1700 feet above sea level. The area exhibits undulating topography with hill ranges, manmade forests, stunningly beautiful landscapes adorned with awe inspiring prehistoric formations and natural lakes. According to Census of India, 2011, it is the 4th populous city in India and multitude of factors such as population growth, industrialization, construction activities put this city under continuous stress. Once known as 'City of Lakes' lost most of its water bodies to pollution and other human centric developmental activities. The lentic water-bodies chosen for the present study are Pedda Cheruvu and Safilguda Lake situated in Hyderabad Metropolitan area. Pedda Cheruvu is located in Nacharam municipality, lies in the coordinates of 17.2560°N, 78.3327°E and spreads over an area of 128 acres (51.8 Ha). It was an irrigation tank before but in due course of time, is totally consumed by ill effects of urbanization. Safilguda lake is located in Malkajgiri municipality, lies in the coordinates of 17.2730°N, 78.3220°E. According to the state gazette the water spread area of the lake 50 years before was FTL of 537 Mts and spread over 3.95 square miles and was a good water source of irrigation and drinking. Due to the unprecedented population growth and industrialization in the last few decades the extent of water spread is reduced to 27.5 Acres (11.13 Ha). In 2001 this the lake was restored, Demarcated, dredged and fenced under 'Lake Conservation Programme' initiated by Hyderabad Urban Development Authority (HUDA). A sewerage treatment plant (STP) of capacity 0.6 MLD, has been constructed to treat the dry weather flow of sewage and it is functional since January' 2003.

2.2: Collection and analysis of samples : Water samples were collected for quantitative and qualitative phycological analysis from these water bodies at monthly intervals. Surface water samples were collected in one liter sterilized clean high density polythene bottles and were kept in the sedimentation columns after adding 2-3 ml of Lugol's solution. The samples were set aside undisturbed for about 4 weeks for complete setting of the organisms and finally the sample is concentrated to 100 ml. Detailed analyses of phytoplankton populations are done by estimating the numbers in each species. The algal samples were identified under the binocular compound microscope and counting was done by Drop count method (Trivedi and Goel, 1984). Motile algae were identified from fresh samples. Qualitative identification of phytoplankton forms up to species level was done with the help of monographs (Desikachary, 1959; Suxena and Venkateswarlu, 1966; Phillipose, 1967; Coesel, 1996; Anand, 1998 and Rai, 2006). Pollution index of algal genera and Pollution index of algal species proposed by Palmer (1969) was employed to biologically assess the water quality of the lakes.

3.0 Results and Discussion:

Two years data on the seasonal studies of phytoplankton diversity of two Lakes revealed the presence of 165 algal species belong to 69 genera that belong to various algal taxonomic groups such as viz. Cyanophyceae, Chlorophyceae, Bacillariophyceae, Euglenophyceae and

Dinophyceae (Table1). Chlorophyceae was observed to be the highly diversified group that was represented by 52 sps. (30 genera) & Dinophyceae was poorly represented group with 7sps. (4 genera). Euglenophyceae is represented by 22 sps. (4 genera), Bacillariophyceae by 44 sps (16 genera) and Cyanophyceae - 41 sps. (16 genera) respectively.

With a total of 125 species the algal flora at Pedda Cheruvu fluctuated between 41,100 nos/L -1, 29,600 nos/L, the order of dominance various algal groups in the lake was Cyanophyceae> Chlorophyceae >Bacillariophyceae> Euglenophyceae> Dinophyceae.

In Safilguda Lake the algal flora fluctuated between 31,000 nos/L - 70,300 nos/L. With a total of 89 species of algae belonged to 41 genera and the order of dominance of various algal groups in the lake was

Chlorophyceae > Cyanophyceae> Bacillariophyceae> Dinophyceae> Euglenophyceae.

At both lakes under study, Chlorophyceae were chiefly represented by the species of order Volvocales, Chlorococcales and Desmids. This group was predominantly represented by unicellular genera of *Chlamydomonas, Phacotus, Chlorogonium, Gloeocystis* and *Pandorina.*

Euglenophyceae was the least represented group in Safilguda Lake that occupied a portion of 0.4% and in Pedda Cheruvu it occupied a portion of 3.92% in the total phytoplankton bulk. *Lepocincilus* (2 spp.) *and Trachelomonas* (2 spp.) were common to both lakes. *Euglena* (8 spp.), *Phacus* (6 spp.), and *Trachelomonas* (4 spp.) were reported only in Pedda Cheruvu and in this lake blooms of *Euglena acus* and *Euglena oxyuris* observed in August '2004.

Bacillariophyceae formed third dominant group in these lakes. It occupied a portion of 6.68% and 12.7% in the respective total phytoplankton bulk of Pedda Cheruvu and Safilguda Lake. *Cyclotella, Navicula*, *Gomphonema* and *Nitzschia sps* were found abundantly in waters of Pedda Cheruvu and species belong to genera *Amphora, Cymbella, Gyrosigma, Rhopalodia* are reported only at Safilguda lake.

Dinoflagellates though present in small numbers were an interesting group from ecological point of view. *Glenodinium* and *Ceratium* were common to both lakes while presence of *Peridinium* was confined to Pedda Cheruvu.

Assessment of Water Quality

On the basis of biological parameters an attempt has been made to assess the water quality and pollution in the lakes. Palmer (1969) algal indices have been applied to rate water samples for high or low organic pollution. According to the Palmer (1969) Pollution index of algal genera with an API=26 there is 'High organic pollution' in Pedda Cheruvu (API = 26) and 'Probable organic pollution' in Safilguda Lake (API = 19). According to the Palmer (1969) Pollution index of algal species there is 'Theoretical maximum organic pollution' in Pedda Cheruvu (API = 46) and 'Lack of organic pollution' in Safilguda Lake (API = 10). The results were tabulated in Table 2 and 3.

As present study conducted on Safilguda Lake was carried out after the restoration, an attempt has been made to compare the present status with previous studies which were carried out before restoration to assess the lake water

quality over the years. The lake was previously dominated by Cyanophyceaen flora was now dominated by Chlorophyceae. The Palmer (1969) Pollution index of algal genera reveals that the lake was 'Highly organically polluted' before restoration and after restoration it has 'Probable organic pollution'.

The study concludes that the conventional water bodies in the study sites are in potential danger of being polluted by anthropogenic activity. Repair, restoration and protection of these urban water bodies will not only improve their health but also provide livelihood opportunities to a large number of people.

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International Journal of Academic Research
ISSN: 2348-7666; Vol.7, Issue-4 April, 2020
Impact Factor: 6.023; Email: drtvramana@yahoo.co.in

Table 1. List of Algal species recorded in Pedda Cheruvu (A) & Safilguda Lake (B)

S.No	Name of the Algal Species	A	B
	Cyanophyceae		
1	*Anacystis rupestris*	+	-
2	*Rhabdoderma irregulare*	+	-
3	*Aphanocapsa grevillei*	-	+
4	*Coelosphaerium kuetzingianum*	+	+
5	*Coelosphaerium rubrum*	+	-
6	*Merismopedia glauca*	+	+
7	*Merismopedia minima*	+	-
8	*Merismopedia punctata*	+	+
9	*Merismopedia tangarvikae*	+	-
10	*Merismopedia tenuissima*	+	+
11	*Gloeocapsa conactina*	-	+
12	*Microcystis aeruginosa*	+	+
13	*Microcystis irregularis*	+	-
14	*Microcystis robusta*	+	-
15	*Microcystis flos- aquae*	+	+
16	*Chroococcus elegans*	+	+
17	*Chroococcus minimus*	+	+
18	*Chroococcus minutus*	+	+
19	*Chroococcus rufescens*	+	-
20	*Chroococcus turgidus*	+	+
21	*Spirulina nordstedtii*	+	-
22	*Arthrospira jenneri*	+	-
23	*Arthrospora platensis var. tenuis*	+	-
24	*Phormidium gracile*	+	-
25	*Lyngbya spiralis*	+	+
26	*Oscillatoria agardhii*	+	-
27	*Oscillatoria angusta*	+	-
28	*Oscillatoria chalybea*	+	-
29	*Oscillatoria curviceps*	+	+
30	*Oscillatoria formosa*	+	+
31	*Oscillatoria irrigua*	+	-
32	*Oscillatoria limnetica*	+	+
33	*Oscillatoria limosa*	+	-
34	*Oscillatoria miniata*	+	-
35	*Oscillatoria princeps*	+	+
36	*Oscillatoria tenius*	+	-
37	*Anabaena circinalis*	+	-
38	*Anabaena reciboskii*	+	-
39	*Anabaena spiroides*	+	-
40	*Aphanizomenon flos-aquae*	+	-
41	*Nostoc verrucosum*	+	+
	Total	39	18

S.No	Name of the Algal Species	A	B
	Chlorophyceae		
42	*Chlamydomonas angulosa*	+	-
43	*Phacotus lenticularis*	+	-
44	*Pandorina morum*	+	+
45	*Eudorina elegans*	+	-
46	*Chlorogonium elongatum*	-	+
47	*Gloeocystis gigas*	-	+
48	*Tetraspora gelatinosa*	+	-
49	*Ulothrix subtilissima*	-	+
50	*Stigeoclonium tenui*	+	-
51	*Cladophora glomerata*	+	-
52	*Chlorococcum humicola*	+	+
53	*Micractinium pusillum*	+	-
54	*Characium falcatum*	-	+
55	*Pediastrum boryanum*	-	+
56	*Pediastrum duplex*	+	+
57	*Pediastrum ovatum*	-	+
58	*Pediastrum simplex*	+	+
59	*Pediastrum tetras*	-	+
60	*Coelastrum microporum*	+	-
61	*Ankistrodesmus falcatus*	+	+
62	*Chlorella vulgaris*	+	-
63	*Dictyosphaerium ehrenbergianum*	-	+
64	*Kirchneriella lunaris*	-	+
65	*Oocystis crassa*	+	-
66	*Schroederia setigera*	-	+
67	*Selenastrum bibraianum*	+	-
68	*Tetraedron caudatum*	+	+
69	*Tetraedron hastatum*	-	+
70	*Tetraedron incus*	+	+
71	*Tetraedron limneticum*	+	+
72	*Tetraedron minimum*	-	+
73	*Tetraedron muticum*	-	+
74	*Tetraedron trigonum*	-	+
75	*Tetraedron tumidulum*	+	+
76	*Actinastrum hantzschii*	+	-
77	*Crucigenia irregularis*	+	+
78	*Crucigenia rectangularis*	+	+
79	*Crucigenia tetrapedia*	+	-
80	*Scenedesmus acuminatus*	+	+
81	*Scenedesmus armatus*	+	-
82	*Scenedesmus bijuga*	+	+
83	*Scenedesmus dimorphus*	+	+
84	*Scenedesmus obliquus*	+	-

S.No	Name of the Algal Species	A	B
85	*Scenedesmus quadricauda*	+	-
86	*Closterium lanceolatum*	+	-
87	*Cosmarium contractum*	+	+
88	*Cosmarium lundelli*	-	+
89	*Cosmarium tumidum*	+	+
90	*Staurastrum javanicum*	-	+
91	*Staurastrum paradoxum*	-	+
92	*Staurastrum tetracerum*	-	+
93	*Euastrum didelta*	-	+
	Total	33	35
	Euglenophyceae		
94	*Euglena acus*	+	-
95	*Euglena maxima*	+	-
96	*Euglena minuta*	+	-
97	*Euglena oxyuris var. minor*	+	-
98	*Euglena piciformis*	+	-
99	*Euglena polymorpha*	+	-
100	*Euglena rostrata*	+	-
101	*Euglena viridis*	+	-
102	*Lepocinclis ovum*	+	+
103	*Lepocinclis sphagnicola*	+	+
104	*Phacus acuminata*	+	-
105	*Phacus circumflexus*	+	-
106	*Phacus curvicauda*	+	-
107	*Phacus longicauda*	+	-
108	*Phacus orbicularis var. caudatus*	+	-
109	*Phacus pleuronectus*	+	-
110	*Trachelomonas armata*	+	+
111	*Trachelomonas hispida*	+	-
112	*Trachelomonas horrida*	+	-
113	*Trachelomonas planktonica*	+	-
114	*Trachelomonas superba*	+	-
115	*Trachelomonas volvocina*	+	+
	Total	22	4
	Bacillariophyceae		
116	*Cyclotella meneghiniana*	+	-
117	*Melosira granulata*	+	-
118	*Fragilaria vaucheriae*	-	+
119	*Synedra tabulata*	+	-
120	*Synedra ulna*	+	-
121	*Cocconeis placentula*	-	+
122	*Achnanthes exigua*	+	+
123	*Achnanthes inflata*	-	+
124	*Achnanthes microcephala*	-	+

S.No	Name of the Algal Species	A	B
125	*Achnanthes minutissima*	-	+
126	*Mastogloia smithii*	+	-
127	*Navicula cryptocephala*	+	+
128	*Navicula cuspidata*	+	+
129	*Navicula mutica*	+	
130	*Navicula pupula*	+	+
131	*Navicula rhusteditii*	-	+
132	*Navicula rhynchocephala*	+	+
133	*Navicula subtilissima*	+	-
134	*Pinnularia biceps*	+	-
135	*Gyrosigma kuzingii*	-	+
136	*Gomphonema acuminatum*	-	+
137	*Gomphonema gracile*	+	+
138	*Gomphonema lanceolatum*	+	-
139	*Gomphonema montanum*	+	-
140	*Gomphonema parvulum*	+	-
141	*Gomphonema sphaeroporum*	+	-
142	*Amphora ovalis*	-	+
143	*Amphora veneta*	-	+
144	*Cymbella affinis*	-	+
145	*Cymbella aspera*	-	+
146	*Cymbella cuspidata*	+	+
147	*Cymbella cymbiformis*	+	+
148	*Cymbella tumida*	-	+
149	*Cymbella turgida*	-	+
150	*Rhopalodia gibba*	-	+
151	*Nitzchizia acicularis*	+	+
152	*Nitzchizia acuminata*	-	+
153	*Nitzchizia bilobata*	+	-
154	*Nitzchizia hungarica*	+	-
155	*Nitzchizia palea*	+	-
156	*Nitzchizia sublinearis*	+	-
157	*Nitzchizia sigmoidea*	+	-
158	*Nitzchizia obtusa*	+	+
159	*Hantzschia amphioxys*	-	+
	Total	27	27
	Dinophyceae		
160	*Glenodinium gymnodinium*	+	+
161	*Glenodinium palustre*	-	+
162	*Glenodinium cinctum*	-	+
163	*Peridinium bipes*	+	-
164	*Peridinium pusillum*	+	-
165	*Ceratium hirundinella*	-	+
	Total	3	4
	Grand Total	124	88

Table 2. Pollution Index of Algal genera (API) of Pedda Cheruvu (A) and Safilguda Lake (B)

S.No	Genus	API	A	B
1	*Anacystis*	1	1	-
2	*Ankistrodesmus*	2	2	2
3	*Chlamydomonas*	4	4	-
4	*Chlorella*	3	3	-
5	*Closterium*	1	1	-
6	*Cyclotella*	1	1	-
7	*Euglena*	5	5	-
8	*Gomphonema*	1	1	-
9	*Lepocinclis*	1	1	1
10	*Spirogyra*	1	-	-
11	*Melosira*	1	1	-
12	*Micractinium*	1	1	-
13	*Navicula*	3	3	3
14	*Nitzschia*	3	3	3
15	*Oscillatoria*	5	5	5
16	*Pandorina*	1	1	1
17	*Phacus*	2	2	-
18	*Phormidium*	1	1	-
19	*Scenedesmus*	4	4	4
20	*Stigeoclonium*	2	2	-
21	*Arthrospira*	1	1	-
22	*Synedra*	2	2	-
	Total		**45**	**19**

Score Description:
<14 Low organic pollution;
15-19 Probable organic pollution and
=>20 High organic pollution

Table 3. Pollution Index of Algal species (API) of Pedda Cheruvu (A) and Safilguda Lake (B)

S.No	Algal Species	API	A	B
1	*Ankistrodesmus falcatus*	3	3	3
2	*Arthrospira jenneri*	3	3	-
3	*Chlorella vulgaris*	2	2	-
4	*Cyclotella meneghiniana*	2	2	2
5	*Euglena viridis*	1	1	-
6	*Euglena acus*	6	6	-
7	*Gomphonema parvulum*	1	1	-
8	*Navicula cryptocephala*	1	1	1
9	*Nitzschia palea*	5	5	-
10	*Oscillatoria limosa*	4	4	-
11	*Oscillatoria princeps*	1	1	1
12	*Oscillatoria tenuis*	4	4	-
13	*Pandorina morum*	3	3	3
14	*Scenedesmus quadricauda*	4	4	-
15	*Stigeoclonium tenue*	3	3	-
16	*Synedra ulna*	3	3	-
	Total		**46**	**10**

Score Description:
0-10 suggests lack of organic pollution;
11-15 indicates moderate pollution;
16-20 indicates probable high organic pollution;
21 or more confirmed high organic pollution;
44-Theoretical maximum