COMPARATIVE EVALUATION OF WATER BODIES OF RANCHI WITH REFERENCE TO ALGAL DIVERSITY

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Accepted Sept. 2011

ABSTRACT

Four water bodies of Ranchi (Jharkhand) viz. Ranchi lake, Line tank, West Jail road tank, and Hatania tank have been studied with a view to monitor for physico-chemical status on the monthly basis for one year. These water bodies receive mainly domestic and municipal wastes and are situated in the populated areas. Algal flora have been identified and prevalence of species diversity of characteristic algal flora is understood in relation to physico-chemical parameters. Water Quality Index is obtained in response to certain important physic-chemical factors. These analyses provided converging lines of evidences for assessment of pollution.

This has been reemphasized that biologists and planners must make serious attempts to revitalize fresh water bodies to become more usable in order to withstand the ever rising population load.

Key words :

Introduction

Ranchi , situated at longitude 85" 18' East and latitude 23" 26' and 23" 2' North, Ranchi has an area extending up to 177.19 sq kms. Tropic of cancer passes through Ranchi district. Ranchi is the most populous city of South Chhotanagpur. Due to alarming growth of population and industrialization, disposal of sewage has become a problem every-where. The water bodies selected for study are situated at densely populated areas within Ranchi municipal area and receive effluents from all the sides. These water bodies are permanent and the climatic and physiographical conditions are much conducive to the growth of algae. Algae have been used by many workers as bio-indicators of pollution (Kumar *et al.*, 1974; Rai and Kumar, 1980; Rana, 1980; Nandan and Patel, 1983; Subert, 1984; Rana and Palria, 1988; Ramakrishnan, 1990,2003; Ramakrishnan *et al.,* 2000; Ramchandra *et. al,* 2006; Guru, 2007 b, c, 2008 b, Mukherjee *et al.,* 2010).The predominance of chlorophyceae in naturally formed pools have been well established (Nandkar *et al.*, 1983) .Diversity of Species has been used to evaluate the ecological importance of water quality of some wetlands (Agarker *et al*, 1994) natural ecosystem like streams and rivers as well (Laal *et al.*, 1982, Bilgrami and Siddiqui, 1983, Mohapatra and Mohanty, 1992, Singh *et al.*, 2002;Khare and Srivastava,2009, Hota and Suresh, 2010); and ponds (Bazmi *et. al,.* 1994. Guru and Sahu, 2006, Guru, 2007 a, b, c, d, 2008 a,b, Guru and Goswami, 2011; Bandopadhyay *et al*, 2010).

In aquatic water bodies the algae are responsible for the biological production of energy which they transfer to the organisms placed on higher rung of trophic level . It is also well established that phytocommunities exhibit seasonal stability as they reflect the changes in light, temperature and status of the nutrients in their habitat However, studies

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have demonstrated that various types of aquatic pollution (Subert, 1994; Agarker *et al*, 1994; Guru and Goswami, 2011) are responsible for change in community structure. Kumar and his associates (Kumar *et al* 1974) and several other authors have studied the effect of various types of pollution on algae since they constitute a strategic component of aquatic environment and concluded that any disruption or damage of this will disturb the ecological food chain. Later, a number of workers have contributed valuable information in the field and even identified a large number of bioindicators of pollution tolerating algal genera (Ramakrishnan, 1990, 2003).

This paper summarizes our efforts on water bodies in Ranchi with reference to monitor these fresh water ecosystems for better and healthier utilizations in future.

Material and Methods

Four water bodies namely, (1) Ranchi Lake,(2) Line tank, (3) West jail road tank and (4) Hatania tank were selected. Samples of water were collected from these water bodies on a monthly basis from January to December and analyzed for physico-chemical characteristics as prescribed in the standard methods of APHA (1994).

Algal samples were collected from all the sampling stations and identified using standard texts (Prescott, 1962; Philipose, 1967; Hazen, 1902).

Result and Discussion

Physico-chemical status:

Table 1 reveals that water temperature increases from January (23.5°c) in water bodies 1,3, and 4 and from February (25°c) in water body 2, attains its peak value during June (32.5°c in water bodies 1 and 4, 30° in water body 3 and 31.5°c in water body 2) in all the four water bodies. This result is in conformity with Kumar and Singh (2000) and Chaudhary *et al*. (2001). The maximum value of conductivity was recorded in water body 2 while the lowest in water body 4. The maximum turbidity was found in water body 1 and lowest in water body 4.

The water bodies were alkaline throughout the period of study. pH of the water ranged from 8.4 to 9.26. The minimum value was noticed during November 2009 in all the water bodies and maximum during April and May 2010 for the water bodies 1, 3, 2 & 4 respectively. The increased pH value during April and May was due to increased concentration of bicarbonate alkalinity. The

TABLE 1— DISTRIBUTION OF GREEN ALGAE IN WATER AT VARIOUS WATER BODIES (CONTAINING SEWAGE AND MUNICIPAL WASTE)

S.N	NAME OF THE TAXA	RL	LT	J T	HT	COMMON
1	*Sphaerella lacustris* (Girod) Wittr	+	+	+	+	*
2	*Tetraspora gelatinosa* (Vaucher) Desvouk	+	+	+	+	*
3	*Chlorococcum infusionum* (Schrank) Meneghini	-	+	+	+	#
4	*C. vitiosum* Printz		-	+	+	+
5	*C. humicola* (Naegeli) Rabenhorst	+	+	+	+	*
6	*Nautococcus pyriformis* Korsh	-	-	-	+	
7	*Phyllobium dimorphum* Klebs	+	-	-	+	
8	*Pediastrum borryanum* (Turpin) Meneghini	+	-	-	-	#
9	*P. tetras* (Ehr) Ralfs		+	+	-	+
10	*Hydrodictyon reticulatum* (Linn) Lagerheim	+	-	-	-	
11	*Tetraedron minimum* (A.Braun) Hansgirg	+		+	+	*
12	*Chlorella vulgaris* Beijerink	+	+	+	+	#
13	*Oocystis eclipta* W. West	-	+	-	+	#
14	*Nephrocytium obesum* W. et . G.S. West	+	+	+	+	*

15	*Botriococcus braunii* Kuetzing	+	+	+	+	*
16	*Ankistrodesmus falcatus* (Corda) Ralfs	+	+	+	+	#
17	*A. convolutus corda*	+	-	-	+	
18	*Actinastrum hantzschi* Lagerheim	-	-	-	+	#
19	*Selenastrum gracil*e Reinsch	+	+	-	+	
20	*Kirchneriella obesa* (W. West) Schmiddle	+	+	+	+	*
21	*Coelastrum micriporum* Naegeli	+	+	+	+	#
22	*Cru cigenia triangularis* (Chodat) Schmidle	+	+	+	+	#
23	*C. tetrapedia* (Kirchner) W et G.S. West	+	+	+	+	*
24	*C. quadrata morren*	+	+	+	+	*
25	*Scenedesmus oblicus* (Turpine) Kuetzing	+	+	-	+	#
26	*S. dimorphus (*turpin*e)* Kuitzing	+	+	+	+	*
27	*S. bernardi* G.M. Smith	+	-	-	+	
28	*S. bijugatus (Turpine) Kuetzing*	+	+	+	+	*
29	*S. bijugatus* (Turpin) f. irregularis Wille	+	+	+	+	*
30	*S. bijugatus* (Turpin) Kuetzing var. bicellularis (Chodat) Smith	+	+	+	+	*
31	*S. bijugatus* (Turpin) Kuetzing var. alternance (reinsch) Hansgirg f. parvus (G.M.Smith) Philipose	-	-	-	+	
32	*S. arcuatus* (Lemmermann) Lemmermann	-	+	+	+	
33	*S. arcuatus* (Lemmermann) Lemmermann var. capitatus G.M. Smith	-	+	+	+	
34	*S. quadricauda* (Turpin) Brebisson	+	+	+	+	*
35	*S. quadricauda* (turpin) Brebisson var. bicaudatus Hansgirg	+		+	+	*
36	*S. quadricauda* (Turpin) Brebisson var. quadrispina (Chodat) Smith	+	+	+	+	*
37	*S. quadricauda* (Turpin) Brebisson var. eualternance Praschk	+	+	+	+	*
38	*S. quadricauda* (Turpin) Brebisson var. Westii G.M.Smith	+	+	-	+	
39	*Ulothrix tennerima* Kuetzing	+	+	+	+	#
40	*U. tenussima* Kuetzing	-	+	+	+	
41	*U. zonata* (Weber et mohr) Kuetzing	+	+	+	+	*
42	*Cldophora glomerata* (L) Kuetzing	-	-	-	+	#
43	*Stigeoclonium ten*ue Kuetzing	+	+	+	+	#
44	*S. lub*ricum Kuetzing	+	+	+	+	*
45	*S. aestivale* Hazen	+	+	-	+	
46	*Oedogonium calliandrum* Hoff	+	+	+	+	*
47	*O. capillare* [(L) Kuet] Hirn f. madagascariense Gauth-Liev	+	+	+	+	*
48	*O. capilliforme*(Kuet, Wittr) Hirn var. capilliforme f. capilliforme	-	+	+	-	
49	*O. dacchense* Isl. Sharma	-	+	+	-	
50	*O. khannae* Skuja f. khannae	-	-	+	-	
51	*O. l*autumniarum Wittr	+	-	-	+	
52	*O. plagiostomum* (Wittr) Hirn f. minuta	+	+	+	+	*
53	*O. singulare* Kam.		+	-	-	+
54	*O. sociale* (Wittr) Hirn f. sociale	+	+	+	+	*
55	*Bulbochaete mo*nile Wittrock et Lundell Sec. Hirn	-	+	-	-	
56	*B. rectangularis* Wittrock	-	+	-	-	
57	*Spirogyra communis* (Hassal) Kuetzing	+	-	-	-	#
58	*S. condensate* (Vaucher) Kuetzing	+	-	-	-	
59	*S. formosa* (Transcau) Czurda	+	-	-	-	
60	*Closterium abruptum* G.S. West	+	+	-	+	#
61	*C. ac*erosum (Schrank) Ehr	+	+	-	+	
62	*C. intermedium* Ralfs	+	+	-	+	
63	*C. parvulum* Naegeli	-	-	+	-	
64	*C. setaceum* Ehr	+	+	-	+	
65	*C. tumidum* Johnson	+	+	-	+	
66	*C. venus* Kuetz	+	+	+	+	*
67	*Cosmarium subcostatum* Nordsterdt	+	+	+	+	#
68	*C. punctulatum* Brebisson	+	+	+	+	*
69	*C. bioculatum* Brebisson	+	+	+	+	*
70	*C. crenatum* Hantzch	+	+	+	+	*

***Commomn species. # Listed in Palmer's Index (most tolerant genera)**

Table 2 —

SN	Parameter	UNIT	Ranchi Lake			Line Tank			Jail Road Tan			kHatania Talab		
			Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg
1	**Temperature**	0°C	32.5	19.5	26.5	31.5	18	26.5	32	19	26.8	32.5	18.5	26.9
2	**Conductivity**	μ mhos/ cm	968	617	799	1182	726	989	822	637	736.5	608	432	476.5
3	**Turbidity**	NTU	160	56	85.2.	45	5	22.5	84	06	39.3	44	10	26.7
4	**pH**		9.92	8.77	9.26	8.68	7.86	8.22	8.90	8.13	8.49	8.80	8.18	8.4
5	**Alkalinity**	$CaCO_3$ mg/l	325	210	246.9	460	240	331.6	220	140	164.5	268	165	211.9
6	**BOD at 200C**	mg/l	72	14	40	38	18	27.1	45	17	33.7	46	15	21.6
7	**TDS**	mg/l	625	408	526	1750	468	646	556	430	451.8	394	276	339.1
8	**TSS**	mg/l	227	32.1	133.9	85	18	49.3	150	12.1	63.1	82	17.7	49.7
9	**Hardness**	$CaCO_3$ mg/l	242	144	185	332	182	271.23	190	144	1706	170	140	151
10	**Chloride**	Cl mg/l	189.9	129.9	152.5	176.2	142.1	159.1	182.9	119.9	144.6	159.9	75.	103.7
11	**Sulphate**	SO_4 mg/l	43	19.9	17.9	39.0	23.8	31.5	14.5	2.3	6.9	1.8	2.5	4.6
12	**Nitrate**	NO_3 mg/l	1.90	0.10	0.63	2.92	0.27	1.46	2.61	0.68	1.40	2.72	0.55	1.56
13	**Phosphate**	PO_3 mg/l	1.75	0.45	1.21	5.52	0.75	1.89	1.15	0.25	0.67	1.20	0.32	0.61
14	**Silica**	SiO_3 mg/l	29.2	6.4	16.1	49.0	16.8	28.6	28.9	13.9	21.9	35.1	16.3	24.2
15	**Calcium**	Ca mg/l	75.4	36.1	49.8	72.1	36.9	57.9	46.5	28.1	34.5	49.7	30.5	37.2
16	**Magnessium**	Mg mg/l	21.9	6.8	14.7	38.5	21.9	31.5	24.8	9.1	20.5	17.5	3.9	13.9
17	**Sodium**	Na mg/l	9.52	56.4	69.8	89.4	55.3	66.9	61.0	42.2	52.3	112.5	46.0	77.7
18	**Potassium**	K mg/l	46.5	19.9	32	31.4	18.9	26.3	28.8	15.4	22.9	63.1	20.3	36.2
19	**Iron**	Fe mg/l	0.48	0.10	0.29	1.52	0.33	0.73	0.64	0.17	0.42	1.23	0.35	0.63
20	**Mangnise**	Mn mg/l	0.03	BDL	0.01	0.73	0.03	0.32	0.34	BDL	0.04	0.11	BDL	0.04
21	**Zink**	Zn mg/l	0.09	BDL	0.01	0.09	0.01	0.01	0.11	0.02	0.05	0.09	0.01	0.04

Annual Mean Value of Different

present result had in conformity with the results of earlier workers (Ramakrishnan, 1990, 1991, 2003; Ramakrishnan *et al*, 2000). Alkalinity is important for aquatic life in freshwater system because it equilibrated pH changes that occur naturally as a result of photosynthetic activity of chlorophyll bearing vegetation, the carbonate & bicarbonate forms the components of alkalinity (Trainor, 1984). The range of total alkalinity in Indian waters may be found from 40 mg/l to over 1000 mg/l (Jhingran, 1992). The total alkalinity of water was predominantly high in all the four experimental water bodies ranging from 210 mg/l to 325 mg/l, 240 mg/l to 460 mg/l, 140 mg/l to 220 mg/l and 165 mg/l to 268 mg/l for the water bodies 1, 2, 3, & 4 respectively. High values of BOD (14 mg/l to 72 mg/l in water body 1, 18 mg/l to 38 mg/l in water body 2, 17 mg/l to 45 mg/l in water body 3 & 15 mg/l to 46 mg/l in water body 4) were recorded in all the four experimental water bodies and thus indicating that untreated domestic sewage are being dumped into the water bodies, resulting in accumulation of large amount of organic matter in water bodies.Total dissolved solids (TDS) ranges from 408 mg/l to 625 mg/l, 468 mg/l to 1750 mg/l, 430 mg/l to556 mg/l, & 76 mg/l to 394 mg/l and TSS 32.1 mg/l to 227 mg/l, 18 mg/l to 851 mg/l, 12.1 mg/l to 150 mg/l, & 40.1 mg/l to 100.8 mg/l in water bodies 1, 2, 3, & 4 respectively. The hardness of surface water varied from 144 mg/l to 242 mg/l, 182 mg/l to 32 mg/l, 144 mg/l to 190 mg/l respectively, the value fluctuating positively in accordance with total alkalinity of water (210 to 325 mg/l, 240 to 460 mg/l, 140 to 220 mg/l and 165 to 268 mg/l respectively. The magnesium content of water in all the four stations varied from 6.8 to 21.9 mg/l, 21.9 to 38.5 mg/l, 9.1 to 24.8 mg/l, and 3.9 to 17.5 mg/l respectively with an irregular pattern. Magnesium remains low in comparison to calcium. It may be possible due to the uptake of magnesium by macrophytes and algae in the formation of chlorophyll magnesium porphyrin-metal complex and enzymatic transformations (Wetzel, 2001). Concentrations of Phosphorous and nitrogen remained generally low in the reservoir water. The higher value of Phosphate was recorded in winters. Nitrate compared to phosphate and silicate concentration was relatively high in all the four water bodies. The range of variation during the study period was from 6.4 to 29.2 mg/l, 16.8 to 49.0 mg/l, 13.9 to 29.8 mg/l and 16.3 to 35.1 mg/l respectively. Concentration of chloride, calcium, total hardness and the values of electrical conductivity were found to be lower during July-August (monsoon) and higher during May-June (summer). Nitrate, sulphate and phosphate showed considerable rise from May to August. The result of the present investigation is in conformity with the findings of Gonzalves & Joshi, (1946) ; Sriniwasan , (1972), Jindal & Vasisth, (1985) & Jindal and Kumar, (1993). Ramakrishnan (2003) also reported the maximum values during the rainy months and minimum value during summer months showing negative correlation with phytoplankton population. The maximum Sodium (77.7 mg/l) and potassium (36.2) were recorded at water body 4 and minimum (Na - 22.9 mg/l & K- mg/l - 52.3) at water body 3 (West Jail road tank). The concentration of potassium is usually lower in natural waters than sodium. The chemical properties of both sodium and potassium are similar as both are alkaline group metals (Ramachandra *et al*., 2006).

Phycological Status:

Initial survey revealed that that Ranchi Lake is characterized by blooms of blue green algae*, Microcystis* spp; Line tank had to face recurrent growth of water hyacinth, *Eichhornia crassipes*. The other two water bodies were devoid of any macrovegetation, but all the four are recipients of domestic sewage. A profuse growth of algae was observed in all these polluted water bodies. Water dries up here during May and June and remains more or less sufficient for rest of the year. The collection was scanty during the months of May, June, July and August, moderate in September while in the rest of the month it was in abundance. During February and March it was more abundant. Total Number of algal species found in Ranchi Lake, Line tank, Jail tank And Hatania tank were 54, 52, 43 And 59 respectively. In all, 73 different algal species were recorded from the four sampling stations, out of which 34 being common (Table 2).

Taxa common in all the four water bodies were *Sphaerella lacustris, Tetraspora gelatinodsa, chlorococcum humicola, Tetraedron minimum, chlorella vulgaris, Nephrocytium obesum, Botryococcus braunii, Ankistrodesmus falcatus, Kirchneriella obesa, coelastrum microporum, Crucigenia triangularis,C. tetrapedia, C. quadrata. Scenedesmus dimorphous, S. bijugatus, S.*

TABLE 2 — WATER QUALITY INDEX(W.Q.I.) IN RESPECT TO CERTAIN PARAMETERS

W. B.	SL NO	PARAMETERS	UNIT	STANDARD VALUE si	UNIT WEIGHT VALUE wi	MEAN OBSERVED VALUE WITH SEM vi	WATER QUALITY INDEX qiwi
W.	1.	Conductivity	µ mhos/cm	40.0	0.0390	799.66 ±36.86	77.96
B.	2.	pH		7.0-8.50	0.1837	9.26 ± 0.12	27.76
1.	3.	Alkalinity	$CaCo_3$mg/l	120.0	0.0130	246.91 ± 9.27	2.67
	4 .	TDS	mg/l	500.0	0.0031	526.16 ± 25.50	0.32
	5.	BOD at 20°C	mg/l	5.0	0.3124	40.16 ± 5.28	252.00
						qiwi	360.71
W.	1.	Conductivity	µ mhos/cm	40.0	0.0390	989.33 ±40.32	96.46
B.	2.	pH		7.0-8.50	0.1837	8.26 ± 0.06	14.95
2.	3.	Alkalinity		120.0	0.0130	331.66 ± 19.83	3.59
	4.	TDS	mg/l	500.0	0.0031	646.00 ± 24.96	0.40
	5.	BOD at 20°C	mg/l	5.0	0.3124	27.16 ± 1.80	169.73
					qiwi	285.13	
W	1.	Conductivity	µ mhos/cm	40.0	0.0390	736.58 ±15.91	71.81
B.	2.	pH		7.0-8.50	0.1837	8.49 ± 0.07	18.25
3.	3.	Alkalinity	$CaCo_3$ mg/l	120.0	0.0130	164.58 ± 16.11	1.78
	4.	TDS	mg/l	500.0	0.0031	491.83 ± 13.25	0.30
	5.	BOD at 20°C	mg/l	5.0	0.3124	33.15 ± 2.32	210.87
						qiwi	201.85
W.	1.	Conductivity	µ mhos/cm	40.0	0.0390	476.65 ±44.88	46.47
B.	2.	pH		7.0-8.50	0.1837	8.43 ± 0.05	17.51
4.	3.	Alkalinity	$CaCo_3$ mg/l	120.0	0.0130	211.91 ± 11.38	2.29
	4.	TDS	mg/l	500.0	0.0031	339.66 ± 10.47	0.21
	5.	BOD at 20°C	mg/l	5.0	0.3124	21.66 ± 3.28	135.37
						qiwi	201.85

bijugatus f. irregularis, S. bijugatus var. bicellularis, S. quadricauda, S. quadricauda var. bicaudatus, S. quadriccauda var. qudrispina, S. quadricauda var. eualternance, Ulotheix tennerima, U. zonata, Stigeoclonium tenue, S. lubricum, Oedogonium calliandrum, O. capillare, O. plageostomum, O. sociale, Closterium venus, Cosmarium subcostatum, C. punctiolatum, C, biculatum, and C. crenatum.

A similar algal flora in rivers and ponds polluted by domestic and organic wastes has been reported by many Indian workers (Singh *et al.*, 1969; Rana, 1980; Verma *et al.*, 1978; Parmasivam and Srenivasan, 1981; Nandkar *et al.*, 1983 and Palria and Rana, 1988).Palmer's pollution index (Palmer, 1980) for rating the pollution status was applied to evaluate phycological status. Out of 20 most pollution tolerant genera rated by Palmer (Palmer, 1969), five genera were observed at all the four sampling stations.

The physico-chemical data of site 1 (Ranchi lake) indicates that water has comparatively low values of phosphate, nitrate, sulphate with highly alkaline water and high BOD value. Phycological condition of this water body revealed more diverse algal forms, which included both fresh water and polluted water forms like *Spirogyra, Hydrodictyon, Oedogonium, Cladophors, Ulothrix* etc. However, majority of algal forms were common fresh water species. water body 2, (Line tank) on the other hand, showed high value of total alkalinity, total dissolved solids (TDS.), Biological Oxygen Demand (BOD) values, conductivity and pH & low values of phosphate, nitrate, calcium, magneshium etc.

The presence *of Actinastrum hantzchi, Pediastrum boryanum, Closterium acerosum, Scenedesmus oblicus, Chlorella vulgaris, Ankistrodesmus falcatus*, *Stigeoclonium tenue* and *Scenedesmus quadricauda* which are reportedly pollution tolerant, coupled with the absence of many common fresh water forms substantiate its highly polluted nature (Singh *et al*., 1969; Venkateshwarlu, 1976). The water body 4 (Hatania tank) located near Rajbhawan largely receives drainage and laundry wastes which contributed to high values of TDS, TSS and total alkalinity. The sample water was characterized by presence of low value of phosphates, nitrates, sulphates, calcium and magneshium. This pond contained algae characteristics of organic wastes and was represented by large number of *Actinastrum hantzschi*, *Actinastrum falcatus, Stigeoclonium tenue, Scenedesmus qudricauda,* and *Closterium acerosum.*

Finally, in all the waterbodies under study rest of the parameters especially the nutrients comprised of chloride, sulphate, phosphate, nitrate, calcium and magneshium were found to be much lower than the maximum permissible value (Table 2). This indicates that the surface water is somewhat deficient in nutrient content. The parameters namely conductivity, pH, alkalinity, TDS, and BOD were found to be above permissible limit as prescribed by ICMR and therefore be termed as pollutants. Physico-chemical characters together with biological monitoring and indices providing converging lines of evidences for evaluation of polluted habitats in this case as in some other studies (Carns and Dickson, 1971; James and Evison, 1979, Rana and Palria, 1988).

Conclusion:

The above background has been emphatically mentioned for a purpose to emphasize the importance of such a massive attempt to be made on every water body which feeds water to a fraction of any population. This will be a matter of investigating a water body at every place (Guru and Goswami, 2011) by both physico-chemical and biological assessment protocols encompassing all possible parameters as exemplified by earlier work. Based on even better planned, multidisciplinary studies remedial efforts have to be urgently taken up to recover quality and quantity of water and conserve water body, its aquatic biodiversity and interdependent fauna (amphibians/ reptiles/ mollusks and birds etc). This Herculean task has to have automatic consent of enlightened masses and relevant administrative channel. Such an attempt has obviously become of paramount importance, whether a lake or the water body is oligotrophic or eutrophic. Fresh water bodies have to be made more usable to withstand rising population load, any ways.

Acknowledgement

The author is grateful to U.G.C. (New Delhi/ State UGC Jharkhand) for granting financial assistance for this project in the form of minor Research Project.

REFERENCES

Agarker, M.S., Goswami H.K., Kaushik,S., Mishra, S.M., Bajpai, A.K. & Sharma, U.S. (1994). Biology, Conservation and Management of Bhojwetland. I. Upper Lake Ecosystems in Bhopal **(*Bionature*)** Monograph **:** Pp 1-119.

A.P.H.A., (1994). Standard for Estimation of Water Quality and Waste Waters (18th Edn.) American Public Health Association, Washington.

Bandopadhyay, R. and Gorai, A.C. 2010. Physico-chemical analysis of Pond Ecosystem of Dhanbad. Biospectra.vol. 5 (1).pp.57-60.

Bazmi, S. H., Siddiqui, E. N., Ahmad, M. S. and Ahmad, S. S., 1994. Biomonitoring of freshwater ponds at Darbhanga, North bihar, India. In *Proceedings of the SAARK countries conference on Environment management.*

A. K. Sinha (Ed.). Gyanodya Prakashan, Nainital. **2:** 57-63.

Bilgrami, K. S. and Siddiqui, E. N. 1983. Biomonitoring of River Ganga in Mokama-Barauni Industrial Belt. *Biol. Bull. India*. **5 (3):** 278-281.

Carns, J. Jr. and Dickson, K. L. 1971. A simple method for the Biological assessment of the effects of waste discharges on aquatic bottom dwelling organisms. *J. Water Poll. Control Fed.* **43:** 755-772.

Chaudhari, U.S., Seema Johri and P. R. Chaudhari, 2001. Trophic status of Chatri lake in the vicinity of Amrawati city. Indian J. Environ.Hlth. vol. 43 (3) p. 135-137.

De Lang E.(1994). *Mannual of simple water quality analysis*. International Water Tribunal (IWT) Foundation, Amesterdam.

Gonzalves, E. A. and joshi, D. A., 1946. Freshwater algae near Bombay 1. The seasonal succession of the algae in a tank near Bandra. J. Bombay Nat. Hist. Soc. **46:** 14-176.

Guru, S. D. and Sahu R., (2006), Morphological variations in Stigeoclonium (Chlorophyceae) in polluted water in water. *Bionature*, **26 (2):** 55-59.

Guru, Sushma, D.& Goswami, H.K. (2011) Aquatic Biodiversity Assessment should Trigger Freshwater Body Monitoring and Conservation. Chapter 46, In , Microbial Biotechnology and Ecology (EDts: Deepak Vyas et al: Pp: 773-779). Daya Publishing House New Delhi

Guru, S. D. (2007a), Effect of Xenobiotic pollution on the algal (Chlorophyceae) population of some freshwater lakes of Jharkhand. *Biospectra,* **2 (1):** 143-147.

Guru, S. D., (2007 b). A comparative study of the species richness and diversity of chlorophycean assemblage of two city based polluted tanks of Ranchi. *Biospectra*, **2 (2):** 343-345.

Guru, S. D., (2007 c). Prospect of Biomonitoring of Pollution in aquatic system by Algal (Chlorophyceae) Assessment. *Indian J. Environ. & Ecoplan.* **14 (3):** 651-654.

Guru, S. D., (2007 d), Distribution and biodiversity of desmids in a freshwater lake of Ranchi. *Vegetos*, **20 (2):** 81-85.

Guru, S. D., (2008 a). Species Richness of Scenedesmus (Chlorophyceae) in some sewage fed water bodies of Ranchi. *Bionature*, **28 (1):** 1-4.

Guru, S. D. (2008 b). Distribution and Biodiversity of Chlorococclean Flora in the Phytoseston of a Freshwater lake. *Journal of Phytological Research*, **21(1):**149-150.

Hazen, T. E., 1902. The Ulotricaceae and Chaetophoraceae of the United States. *Tory Botanical Club*. Vol. X1. No. 2.

Hota, S. S. and Gauri S., 2010. Physico-Chemical properties of River Kharkai at Domuhani, Jamshedpur in relation to water pollution. Biospectra: vol. 5 (2): 351-354.

James, A. and Evison, l. 1979. Biological Indicators of Water quality. *John Willey and Sons, New York*. Grr

Jindal, R. and R. Kumar, 1993. Limnology of a freshwater pond of nalagarh (Himachal Pradesh, India0. In Advances in Limnology, (ed.. H. R. Singh). P. 107-112.

Jindal, R. and Vasishth, H. S., 1985. Ecology of a freshwater pond at Nabha (Punjab,India). 106-113.

Jhingran V.G., 1992. *Fish and Fisheries of India*. Narendra Publishing House, New Delhi. 168p

Khare, P.K. and Srivastava, P. 2009.Seasonal variation in density, abundance and composition of periphyton community of river Ganga at Allahabad,U.P.Proc. Nat. Acad Sci. India.Sect. B, Vol. 79,Pt. IV :366-383.

Kumar, A and N. K. Singh, 2000. Phytoplanktors of a pond at Deoghar, India lb. phytoplankton standing crop in relation to abiotic factors. Phykos 39 (1&2) 21-33.

Kumar, H. D., Bisaria, G. P., Bhandari, L. M., Rana, B. C. and Sharma, V. 1974. Ecological studies on algae isolated from the effluents of an oil refinery, a fertilizer factory and a brewery, *Indian J. Environ. Hlth.* **16:** 247-255.

Laal, A. K., Sarkar, S. K., and Shah, K. L., 1982. Species diversity of periphyton as an index of pollution of River Ganga. J. Inland Fish Soc. India, **14 (1):** 44-51.

Mohapatra, P. K., and Mohanty, R. C. 1992. Determination of water quality of the water bodies using algal bioassay method. Phycos **31 (1& 2) :** 77-84.

Mukherjee P., Chakraborty A. and Radhakrishnan, 2010. An Ecological study of the b. S. College pond at Asansol (W.B.).Biospectra vol. **5 (1):** 57-60.

Nandan, S. N. and Patel, R. J., 1983. Study of algal communities in River Vishwamitri, Baroda as indicators of organic pollution. Indian. Ecol. Indian J. Ecol, , 10: 11-15.

Nandkar, P. B., Kusum, Marathe. V., 1983. Algae in sewage containing pools and oxidation, Phykos, **22:** 37-45. A.P.H.A., 1994. Standered methods for the examination of water and waste water, 18th. Amer. Publ. Health. Assoc., New Yard, 874.

Palmer, C. M., 1969. A composing rating of algae tolerating organic pollution. J. Phycol. **5:** 78-82.

Palmer, C. M., 1980. Algae and water pollution. *Castle House Publication Ltd.* U.S.A.

Patten, B.C., 1985. Energy cycling in the Ecosystem. Ecol. Model. 28:1 - 71

Paramsivam, M. and Sreenivasan, A. 1981. Changes in algal flora due to pollution in Cauveri River. *Indian j. Environ. Hlth.* **23:** 222-238.

Philipose, M.T. 1967. Chlorococcales. I.C.M.R... Monograph, New Delhi. pp. 365.

Presscott, G. *W.1962.* Algae of The Western Great Lakes Area.

Ramakrishnan, N., 1990.Water quality assessment of two drinking water ponds using algae as indicators at Tiruvannamalai, town, Tamilnad. In Nat. Symp on Biomonitoring indicators in an aquat. Ecosystem, Erode oct 24-26. Abstract no : 07.

Ramakrishnan, N., 1991. Primary production of two man-made freshwater reservoirs at Annamalai Nagar, Tamilnadu, International on land – water Interaction (8-13 December) NIE, New Delhi. Abstract. P.61.

Ramakrishnan,, N. Ganeshan, N. C. and Thevanathan, R., 2000.Distribution of planktonic algae in three different water bodies of Tiruvannamalai, Tiruvannamalai district, Tamilnadu, Nat. Symp. On phycology in the New Millenium org. in CAS, Univ. of Madras, Chennai (March 1-3 Abstract book. PP.45).

Ramakrishnan, N., 2003."Biomonitoring Approaches for Water Quality Assessment in two water bodies at Tiruvannamalai, Tamilnadu India" in Martin J. Bunch,V. Madha Suresh and T. vasantha Kumaran, eds. Proceedings of the third International Conference on Environment and health, Chennai, India, 15-17 December, 2003.Chennai:Department of Geography, Univ. of Madras and Faculty of Env. Studies, York University. Pp. 374-385.

Ramchandra, N, T. V., Rishiram, R and Karthik., 2006. Zooplankton as Bio-indicators: Hydro-biological sciences, Indian Institute of Science, Banglore.pp.53,56-57,60.

Rai, L. C. and Kumar, H. D., 1980. Algae and the problem of water pollution. In: *Biology of Micro-organisms* (Part 1*)* (Eds) Bilgrami, K. S. and Vyas, K. M.: 127-140.

Rana, B. C., 1980. Pollution monitoring by algae. In: Proc. Nat. Work. Algal system (Eds. Seshadri, C. V., Thomas, S. and Jeeji Bai, N.) *Indian Society of Biotechnology*, I. I. T. New Delhi.

Rana, B. C., and Palria, S. 1988. Phycological and Physico-chemical evaluation of the River Ayad, Udaipur. Phykos, **27:** 211-217.

Singh, V. P., Saxena, P. N., Tiwari, A., Lausane, B. K., Khan, M. A. and Arora, I. 1969. Algal flora of sewage of U.P. in relation to physico- chemical variables. *Indian J. Environ. Hlth.* **11:** 208-219.

Singh, B. K., Srivastava, K. and Panwar, R. S., 2002. Periphytic structure of river Ghaghra with special reference to its impact on river ganga. J. Inland Fish Soc. India 2002. **34 (1) :** 39-41.

Subert, L.E.1994. (Ed) Algae as Ecological Indicators. *Academic Press, London.* pp. 434.

Sriniwasan, A. *1972. Ecology of Blue-green algae in Tropical Inland Waters. In Taxonomy and Biology of blue green algae (ed. T. V. Desikachary). Madras Univ., India; 461-469.*

Trainor, F.R, 1984 Indicator Algal Assay Laboratory and fields approaches. In *"Algae as Ecological Indicators.* Ed. Shubert, Academic press London. Pp 3 – 14.

Verma, S. R., Tyagi, A. K. and Dalela, R. C. 1978. Physico-chemical and biological characters of Kadarabad in U.P. *Indian J. Environ. Hlth.* **20:** 1-13.

Venkateshwarlu, V. 1976. Taxonomy and ecology of algae in the river Moosi, Hyderabad Nora Hedwigia. **27:** 661-676.

Wetzel, R. G., 2001. Limnology, lakes and River Ecosystem, Academic press, USA.