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Current Study of Physicochemical parameters and Plankton Biodiversity with respect to Fish Production in Nawargaon Lake, Th. Maregaon, Dist. Yavatmal, (M.S.). India

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ABSTRACT
Nawargaon Lake has rich number of species and biodiversity of aquatic animals. The Nawargaon Lake is principal fresh water body located within Maregaon tahsil in Yavatmal District of Maharashtra. Now a day lake is degraded by both natural and anthropogenic activities, which deteriorate their quality of lake water. Due to increased human population, industrialization, use of fertilizers and man-made activity water is highly polluted with different harmful contaminants. It is necessary that the quality of drinking water should be checked at regular time interval. Limnological parameter and plankton diversity are important criterion for determining the suitability of water for irrigation and drinking purpose. The water remained moderately alkaline (pH 7.6) while electrical conductance (0.2846ms/cm), TDS (224.5mg/l), chloride (145mg/l), hardness(137.25mg/l) and alkalinity(205.19mg/l) showed low mean values. Average dissolved oxygen levels were at 4.56mg/l while average nitrate and phosphate levels were 2.50mg/l and 3.48mg/l respectively. On the basis of water quality parameters in general, Nawargaon Lake was not found to be eutrophic. A high rate of primary production (405.044mgc/m2/hr), diversity of phytoplankton(42forms), zooplankton(98forms) and fish (15species) were also observed during the study period. Nawargaon Lake has greatest importance for humankind. The specific status of limnological characteristics and diversity of plankton in Nawargaon Lake have been studied through seasonal survey in two annual cycles(2018-19 and 2019-20) and annual survey of fishes in two annual cycles.

Keywords: *Phytoplankton. Limnological characteristics, Biodiversity, Nawargaon Lake, Eutrophic, zooplankton.*

INTRODUCTION

Plankton is the most sensitive floating community which is being the first target of water pollution, thus any undesirable change in aquatic ecosystem affects diversity as well as biomass of this community. The measurement of planktons productivity helps to understand conservation ratio at various trophic level and resources as an essential input for proper management of lake. Some notable studies on phytoplankton and zooplankton diversity have been made by Rao and Choubey, 1990[1]; Mishra et al.,2010[2].

Fishes occupy all three levels such as primary, secondary and tertiary consumer of food web in aquatic ecosystem. Man being the top carnivore in this food system as it is a very good source of protein. Fish protein is supposed to be cheapest. The production of million calories would take 15-20-man days by fishing and 56-man days by beef farming. The investigations on the Indian fresh water fishes have mainly been restricted to taxonomy[3].

Biological production in any aquatic body gives direct correlation with its physico-chemical status which can be used as trophic status and fisheries resources potential[4]. Life in aquatic environment is largely governed by physico-chemical characteristics and their stability. These characteristics have enabled biota to develop many adaptations that improve sustained productivity and regulate lake metabolism.

In the rural area of Maharashtra so far as aquatic food is concerned the fish plays an important role in the delicious food preferred by the common people for locally available fishes found in the nearby fresh water bodies for nutrition among the essential food constituents. Natural stagnant fresh water bodies provide a self-employment for poor fisherman and social, economic conditions of various places in Yavatmal district.

Various types of fishes are found in the Nawargaon lake available for the local rural poor fisherman for their fulfilment of basic needs of life by selling in the weekly market of nearby places and get money. In the Nawargaon lake found locally available fish species for weekly market easily get the common people food requirement in Maregaon Taluka, District Yavatmal.

METHODOLOGY

Study Area:Nawargaon Project and Dam's Official Designation is "Nawargaon, D-03119". Locally also known as "Nawargaon Lake". Nawargaon Dam was constructed as part of irrigation projects by Government of Maharashtra in the year 1997. It is built on and impounds Nirguda River. The dam is an Earth-fill Gravity Dam. Purpose of the dam is for irrigation. Live storage capacity is 12.475 MCM. Now a days almost all water bodies make for good picnic spots. Nawargaon lake is also a popular Tourist attraction for its scenic beauty.

Sampling and Analysi

Physico-chemical Analysis:

During the study, water samples were collected at seasonal interval during 2018-19 and 2019-20 using clean 1L-polyethylene bottle for analysis of water variables in the laboratory from pre-selected station of the Lake. The water quality parameters such as air and water temperature, pH, depth of visibility, alkalinity (Carbonate and bicarbonate), dissolved oxygen and primary productivity were measured in the field itself. LCD portable digital multistep thermometer of -50C to 150C range was used to measure water temperature, digital pH meter was used for measuring hydrogen ion concentration(pH), depth of visibility was measured by a standard Secchi disc of 20cm diameter, Total Dissolved Solids were estimated by digital (Hold) TDS meter and results are expressed in ppm or mg/l. However, for the electrical conductivity, nitrate nitrogen, orthophosphate, silicates and fluorides samples were brought to laboratory in bottles of 500 ml. capacity and analysed within 24 hours. There physico-chemical parameters were analysed following Standard Method[5]. Prior to this, the samples were secured in refrigerator. Conductivity was measured by 'Systronics' direct reading conductivity meter(308), ELICO ion analyser LI 126 was used for determining fluoride ions in the water. Primary productivity was estimated using light and dark bottle method. Methods stated by [5] were followed for water analysis.

Plankton Analysis:
For Plankton study, samples were collected from surface water, littoral region and bottom mud. For qualitative analysis, the plankton samples were collected by towing Hensen's standard plankton net with uniform speed. The net was made of no. 25 bolting silk. The plankton sample so collected was fixed in 70% ethyl alcohol. For quantitative estimation of the zooplankton, 50 litres of surface water was filtered through a small plankton net made up of the bolting silk number 25. Sub-samples of small quantities (10ml) were taken and counting chamber under a C.Z. Inverted microscope. Zooplankton numbers were expressed as individuals per litre. Identification of zooplankton was done after [6].

Fishes Analysis:
For the study of ichthyofauna, fishes were collected with the help of local government contractor and some illegal fishermen from the lakes and identified after [7].

RESULTS AND DISCUSSION

Results of Limnological study are summarized in **Table No.1**. Air temperature varied between 23C in winter 2018-19 to 38.9C in summer 2019-20. Water temperature was observed to be highest during summer 2019-20 (34.7C) and lowest during winter 2018-19 (19.5C). The overall average value of air and water temperature was 31.25C and 27.68C respectively. A good synchronization between temperature and dissolved oxygen was seen. Temperature showed a significant inverse relationship with dissolved oxygen. Such an inverse relationship has also been observed [8].

In the present study, average turbidity was 123.33cm with maximum of 147.7cm in summer 2018-19 and minimum 85.5cm in monsoon 2019-20. These varying trends reveal that during monsoon season water was turbid, pH fluctuated between 7.2 to 8.4. The minimum pH was recorded in monsoon 2018-19 which was mainly attributed to rain water after a long dry period, and maximum pH was recorded during summer 2019-20. Sharma noted pH range of 7.7 to 8.7 and 7.4 to 9.2 in LakePichhola and Fatehsagar respectively. Sumitra et al observed values between 8.3 to 9.3 of Lake Pichhola while noted a wide range of pH (6.4 to 9.1) in different water bodies in and around Udaipur.

According to the study, Nawargaon Lake characterized by low levels of dissolved oxygen with average value of 5.65mg/l. The highest oxygen value of 7.2mg/l was observed in winter season of 2018-19 and lowest value of 4.4mg/l was observed in summer 2019-20. The peak value during winter was also observed [8-10]. Dissolved oxygen shows a significant negative relation with temperature, alkalinity, total hardness, electrical conductance, nitrate, phosphate, chloride, silicate and turbidity. The observed high value of dissolved oxygen in winter due to the high solubility at low temperature and less degradation of organic matter. During the study, the highest value of total alkalinity was in summer 2018-19 (239mg/l) and lowest value was observed in winter 2019-20 (149mg/l). Total alkalinity shows a positive relationship with temperature, turbidity, pH, total hardness, TDS, conductivity, chloride, nitrate, phosphate, silicate and humidity. The average value of total hardness during the study was 170.16mg/l with lowest value of 138mg/l during monsoon 2018-20 and highest value of 221mg/l during summer 2019-20. This increase in total hardness during summer period is due to higher photosynthetic activity, free carbon dioxide is utilized and bicarbonates are converted into carbonates and precipitated as calcium salts thus increasing hardness[11].

Electrical conductance was high during summer season, whereas winter and monsoon season didn't show much variation. The summer season of 2018-19 showed highest value of 0.47mS/cm of conductance and lowest value of 0.34mS/cm was observed in winter 2019-20. Seasonal variations in the conductivity may be due to the increase concentration of salt because of discharge effluent and organic matter. In the present study, Total Dissolved Solid (TDS) ranged between 209mg/l to 275mg/l with lowest during winter 2019-20 and highest during summer 2018-19 respectively. Higher concentration of TDS also due to the discharge sewage and organic matter by the interference of human.

Chloride concentration varied between 129mg/l noted during monsoon 2018-19 to 215mg/l during summer 2019-20. Higher chloride concentration during the summer because high temperature and consequent evaporation. In rainy season, lower concentration of this factor due to dilution. According to the study, rich contents of nitrates were observed, with maximum of 3.95mg/l during summer 2018-19 and minimum of 2.66mg/l during monsoon2019-20. This can be attributed to high evaporation which increases the concentration during summers. Nitrate showed positive relation with temperature, pH, alkalinity, total hardness, TDS, electrical conductivity, chloride, phosphate, silicate, fluoride and productivity, and negative relation with dissolved oxygen. Present study observed maximum orthophosphate content of 3.55mg/l during summer 2019-20 and minimum of 2.05mg/l during monsoon 2018-19. Higher values of phosphate during summer months were also reported [8]. Higher phosphate content during summer because of high temperature can evaporate water and increases concentration. The value of silicate ranged between 0.05 to 0.122mg/l with maximum during summer 2018-19 and minimum during monsoon 2019-20. Silicate showed negative correlation with dissolved oxygen and fluoride. Domestic sewage, human activity, industrial effluent and rock weathering and add to phosphate content in water.

In the present study, the values of fluoride varied between 1.5 to 3.47mg/l, with maximum value during summer 2019-20 and minimum during monsoon 2019-20. According to WHO [12], permissible limit for fluoride in drinking water is 1.0 mg/l. Fluoride showed positive correlation with turbidity, pH, dissolved oxygen, hardness, nitrate, phosphate. Trophic status of an ecosystem depends upon rate of energy flow which may be assessed by estimating primary production. Nawargaon Lake had a minimum value of humidity as 76mgc/m2/hr in monsoon 2019-20 and maximum value of 227mgc/m2/hr in summer 2018-19. Sharma[8] also recorded high winter productivity in their studies on tropical freshwater bodies in comparison to summer.

The phytoplankters constitutes bulk of primary producers and are the base of food chain in any water body. The phytoplanktonic community of water body during the present study was represented by six groups namely Chlorophyceae, Bacillariophyceae, Desmidiaceae, Xanthophyceae, Myxophyceae and Dinophyceae. Total 58 forms were identified and out of these 28 belonged to Chlorophyceae, 11 to Bacillariophyceae, 9 to Myxophyceae, 4 to Dinophyceae, 3 to Desmidiaceae and 3 to Xanthophyceae in the water of Nawargaon Lake.The most prominent phytoplankters during the study were *Oedogonium sp*., *Volvox sp*., *Ulothrix sp*. and *Pediastrum sp*. from group Chlorophyceae. While *Microsystis sp*. and *Coccochlaris sp*. dominated Myxophyceae. The present results may be reasoned as the lake was filled with new water after a long dryness. Baghela observed the dominance of Chlorophyceae in Oligotrophic Lake Jawai Dam. The total phytoplankton diversity represented in form of Menhinick's index was observed to be 0.71**(Table 2 and 4).**

Nawargaon Lake harbour diverse taxonomic groups of zooplankton representing Protozoa, Rotifera, Cladocera, Copepoda and Ostracoda. During present investigation, 9 forms of protozoans belonging to 8 genera and 9 species were reported. Rotifers were represented by 20 genera and 40 species. Along with these, 29 species of Cladocerans belonging to 12 genera, and 10 genera and 11 species belonging to Copepoda are enlisted. Besides these, 5 species of Ostracoda were also recorded. After including occasional zooplankters like insects and their larvae, crustacean larvae, spiders and mites total 104 forms of zooplankters were recorded. According to the Menhinick's index of diversity, Rotifers indicated highest diversity throughout the study period followed by Cladocerans, Protozoans, Copepods, Ostracods, Insects and others **(Table 3 and 4, Fig. 1,2,3 &4).**

In the present investigation, 15 species of fishes belonging to 6 family and 13 genera were reported from Nawargaon Lake. (Table 5)

Table 1. Physiological Parameters of Nawargaon Lake during (2018-2020)

Parameters	Year 2018-2019			Year 2019-2020		
	Winter	Summer	Monsoon	Winter	Summer	Monsoon
Air Temp.(°C)	25.3	37.4	29.9	23	38.9	33
Water Temp.(°C)	19.5	33.1	28.9	20.2	34.7	29.7
Turbidity (NTU)	142.5	97	147.7	132.3	85.5	156
Humidity (mgc/m2/hr)	165	121	223	188.4	76	227
pH	7.4	7.9	7.2	7.6	8.4	7.9
D.O.(mg/l)	7.2	5.2	5.7	6.2	4.4	5.2
Alkalinity(mg/l)	149	139	189	208	210	191
Hardness(mg/l)	155	179	159	169	221	138
TDS (mg/l)	209	275	219	235	247	212
Conductivity (mg/l)	0.34	0.47	0.37	0.39	0.41	0.36
Chlorides (mg/l)	157	215	129	143	198	177
Nitrates(mg/l)	2.79	3.95	2.66	3.54	3.44	2.69
Phosphates(mg/l)	2.67	3.33	2.15	2.54	3.55	2.05
Silicates(mg/l)	0.07	0.122	0.05	0.049	0.08	0.059
Fluorides(mg/l)	3.44	1.5	2.05	3.45	3.47	2.41
Phytoplankton density (no./l)	908	804	798	821	761	891
Zooplankton density (no./l)	73	77	66	85	58	77

Table 2: Biological Diversity of Phytoplanktonic Groups Based on Menhinick's Index in the Nawargaon Lake

Phytoplanktons	Year 2018-2019			Year 2019-2020		
	Winter	Summer	Monsoon	Winter	Summer	Monsoon
Chlorophyceae	0.48	0.57	0.33	0.51	0.52	0.56
Desmidiaceae	0.19	-	0.21	0.27	0.21	0.16
Xanthophyceae	-	-	-	0.26	-	0.34
Myxophyceae	0.26	0.37	0.08	0.41	0.30	0.53
Dinophyceae	0.38	0.24	-	0.15	-	-
Bacillariophyceae	0.22	0.31	0.30	0.32	0.24	0.51

Table 3: Biological Diversity of Zooplanktonic Groups and Based on Menhinick's Index in the Nawargaon Lake

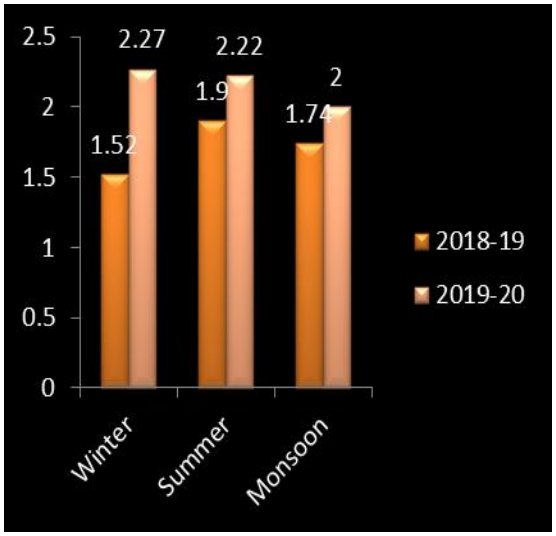
Zooplanktons	Year 2018-2019			Year 2019-2020		
	Winter	Summer	Monsoon	Winter	Summer	Monsoon
Protozoans	1.52	1.90	1.74	2.27	2.22	2.00
Rotifers	2.67	3.54	3.94	3.22	2.94	3.61
Cladocerans	2.60	2.69	2.78	2.41	3.24	2.67
Copepods	2.13	1.77	1.35	1.51	2.31	2.00
Ostracods	-	1.42	1.00	0.71	1.16	1.00

Table 4: Total Diversity of Phytoplanktonic and Zooplanktonic Groups Based on Menhinick's Index in the Nawargaon Lake during (2018-2020)

Planktons	Year 2018-2019			Year 2019-2020			Average
	Winter	Summer	Monsoon	Winter	Summer	Monsoon	
Phytoplanktons	0.68	0.73	0.47	0.78	0.64	0.93	0.71
Zooplanktons	4.59	5.34	3.3	4.64	5.59	5.17	4.72

Table 5: List of Fishes Occurred in Nawargaon Lake during (2018-2020)

No.	Fishes	2018-19	2019-20
1	*Catla catla*	+	+
2	*Notopterus notopterus*(Pallas)	+	+
3	*Cirrhinus cirrhinus* (Bloch)	+	+
4	*Ctenopharyngodonidella* (Val.)	+	+
5	*Labeo gonius* (Ham-Buch)	+	+
6	*Labeo rohita* (Ham-Buch)	+	+
7	*Puntius sarana* (Ham-Buch)	+	+
8	*Puntius ticto* (Ham-Buch)	+	+
9	*Chela cachius* (Ham-Buch)	-	+
10	*Garragotyla* (Gray)	-	+
11	*Aorichthys seenghala* (Sykes)	+	+
12	*Mystus cavasius* (Ham-Buch)	+	+
13	*Heteropneustes fossilis* (Bloch)	+	+
14	*Xenentodon cancila* (Ham-Buch)	+	+
15	*Gambusia affinis* (Baird and Girard)	+	+



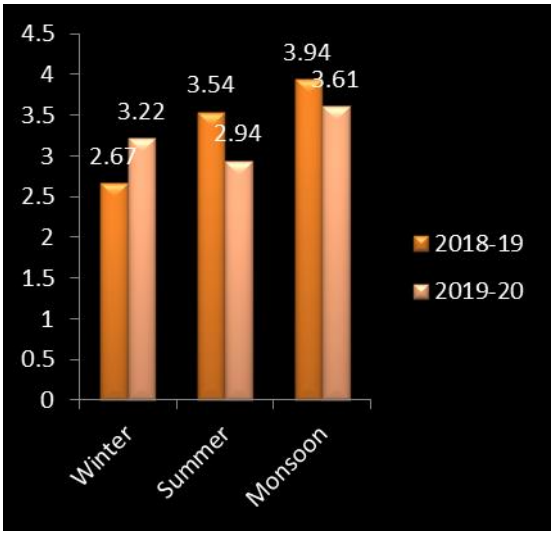


Figure 1 : Diversity Of Protozoan at Nawargaon Lake**. Figure 2**: Diversity of Rotifers at Nawargaon lake

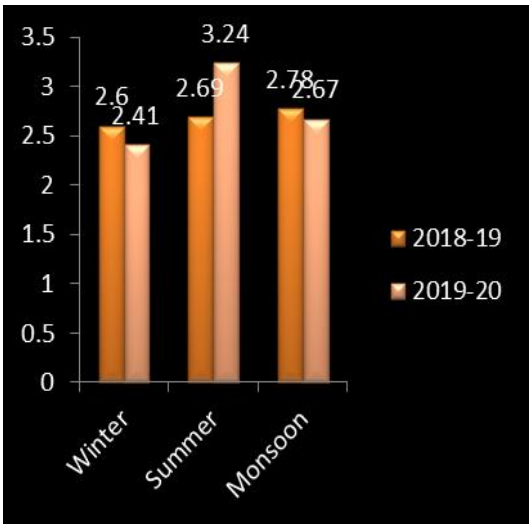


Figure 3: Diversity of Cladocerans at Nawargaon Lake.

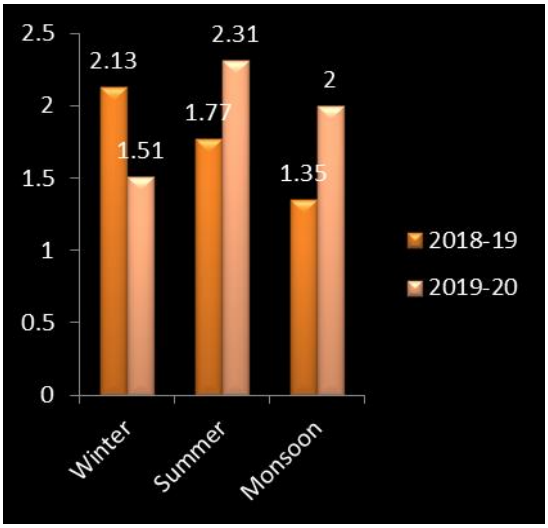


Figure 4: Diversity of Copepods at Nawargaon Lake.

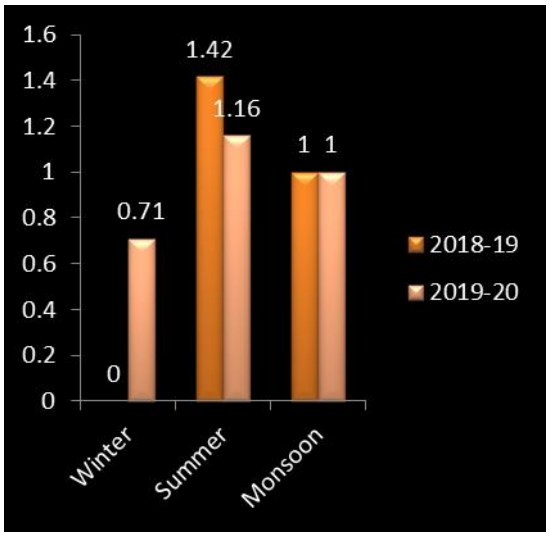


Figure 5: Diversity of Ostrcods at Nawargaon Lake.

CONCLUSION

From the present study, it may be concluded that all the physico-chemical parameters are at nearly permissible limit at all stations. The overall lake is not considered to be more polluted. The lake having rich diversity of flora and fauna. The lake is precious to all aquatic life. Therefore, it is suggested that the immediate measures are necessary to be initiated to avoid further contamination of lake due to anthropological activities. At present the lake water is suitable for fish culturing and irrigation purpose.

Conflicts of interest: The authors stated that no conflicts of interest.

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