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HYDRO BIOLOGICAL ASSESSMENT OF WATER BODIES FROM MIRAJ TAHSIL MAHARASHTRA: A COMPARATIVE STUDY

A. B. Sarwade [a] and N. A. Kamble [b]
a & b. Shivaji University Kolhapur, India.
***Corresponding author's Email: drknitinkumar@yahoo.in**

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Abstract: Physicochemical features of freshwater bodies were regulated by number of factors. It includes temperature, turbidity, pH, total alkalinity, carbondioxide, dissolved oxygen, biological oxygen demand, chemical oxygen demand, phosphate, chloride and hardness. Present study focused on the determination of hydrobiological parameters during different seasons in January, 2011 – December, 2013 in three lakes of Miraj tahsil. The study indicated marked variation in some of the factors as turbidity, CO_2, DO, COD, Alkalinity etc. Obtained data showed, variations in pollution status of three lakes. As per observations and analysis contamination of lakes was Bharatnagar > Mhaishal > Brahmanath lake.

Keywords: Physicochemical factor; Seasonal variation; Water quality.

Postal Address: "102, "Green Park" Apartment, Near "Hotel Lishan" Kadamwadi Road, Kolhapur – 416003.

INTRODUCTION

Aquatic organisms need a healthy environment with adequate nutrients for their growth and development. Fluctuations in level of water quality may lead to abrupt changes in the aquatic life. The interactions of physical and chemical content of water play a significant role in composition, distribution and abundance of aquatic organisms (Mustapha and Omotosho, 2005). Water quality plays a role in the distribution of fish (Welcomme, 1979). The changes in temperature, transparency, DO, COD, nitrate and phosphate has impact on the function and biodiversity of water body (Mustapha, 2008). Limnological parameters of the aquatic environment have been found to influence yields and production of lakes. Lake with its surrounding environment has unique assets and proved valuable ecosystems in nature (Kumar *et.al*, 2008). Lake has important social and economic benefits as a result of tourism and recreation and found culturally and aesthetically important for people throughout the world (An. *et.al* 2002). Along with chemical, physical parameters such as temperature, turbidity and current are also known to operate in lake-ecosystem (Schowerbel, 1972). The chemical elements found in water especially those studied in this work have found effected on biological processes such as conversion of energy, production of organic material and ultimately for production of aquatic resources found in Lake Ecosystem.

Development of human communities and increase in irresponsible use of water resources has deteriorated river and lake water qualities (Sanchez, 2007). The pollution causing factors are decreasing the utility of water day by day (Tank and Chippa, 2013). The abundance of organic compound radio nuclides toxic chemicals, nitrites and nitrates in water cause unfavorable effects on the human health especially body malfunctions and chronic illness (Ikem *et. al*, 2003). Among environmental pollutants non degradable metals and inorganic pollutants tend to accumulate in vital organs of animals and lead to long term toxic affects (Karthikeyan *et. al* 2007 and Singh *et. al*, 2008). Water quality monitoring has a high priority for the determination of current conditions and long

term trends for effective management also ensure protection of public health (WHO, 2011), since about 90% of water supply globally comes from large water bodies. The supply of safe water is today's need in order to get prevention from various chronic and infectious diseases (Lerda, 1996). The changes in the water quality and quantity, species distribution and diversity, production capacity etc. can be determined by physicochemical parameters. Present work has undertaken to observe water quality of Bharatnagar lake, Mhaishal lake and Brahmnath Lake with physicochemical parameters along with seasonal changes. The variations in the physic-chemical parameters of the lake have been studied by Joshi and Patel (2012) Hardikar and Acharya (2013) Siddhartha *et al.* (2013).

EXPERIMENTAL

1) Study area: Study area includes District Sangli, located at the western side of Maharashtra with 16.8670˚N latitude and 74.5670˚E longitude. Sangli is the district headquarters and total area is about 8,578 km² (3,312 sq m). Miraj tahsil is a important tahsil in Sangli district. The water samples were collected from different sites i.e. Bharatnagar lake, Mhaishal lake and Brahmanath lake for assessment of physicochemical parameters.

- Site A - Bharatnagar lake is at latitude 74 º. 38´ N Latitude and 16º.50´E Longitude.
- Site B – Mhaishal lake is at latitude 16º. 7500648 N and longitude 74º. 7073692 E
- Site C - Brahamanath lake is at latitude 16º.89315 N and longitude 74º.7935 E.

2) Field Sampling: Water samples were collected at morning 9.00 am to 10.00 am for physicochemial analysis by monthly intervals in the period of January, 2011 to December, 2012. Physicochemical parameters such as temperature, pH, Total alkalinity, Turbidity, Chloride, Hardness, CO_2, DO, COD, BOD and Phosphate were analyzed regularly during all the three seasons by following the standard methods (APHA, 1989; Trivedi and Goel 1984).

3) Stastiscal analysis: Stastical analysis of data was made by Standard deviation and Standard Error. Finally readings were interpreted to find out water quality in relation to its pollution status.

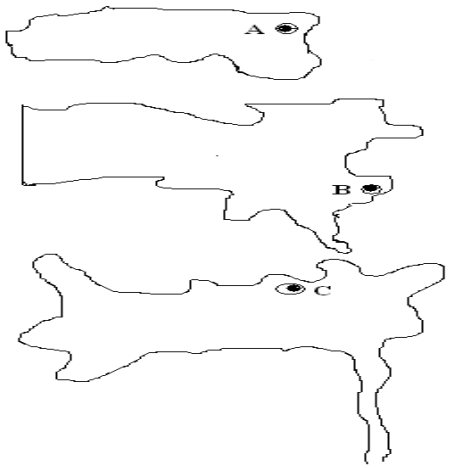


Figure 1 Map showing water collection sites from Miraj Tahsil. Site A – Bharatnagar lake, Site B – Mhaishal lake, Site C – Brahmanath lake

RESULTS AND DISCUSSION

Increased demand of water as a cosequence of population growth, agriculture, industrial development and building construction has altered chemical, physical and biological characteristics of natural water resources (Regina and Nabi 2003) (Table 1 to 3 and Figure 2 to 14).

Temperature: Water temperature is an important factor for aquatic life; many aquatic organisms are sensitive to changes in water temperature. Temperature over 30°C cause regression in plant growth and decay in plant (Kara Yasim, 2004). In the present work the overall mean temperature of three lakes was 24°C–29°C throughout the three years. Temperature rose in summer and started falling towards rainy to winter season, similar result was observed by Khare *et. al,* (2007). As water temperature rises, the rate of photosynthesis increases thereby providing adequate amounts of nutrients (Boulton, 2012).Temperature of Bharatnagar lake was 25ºC–27ºC which was slightly similar with Mhaishal lake which was 24ºC – 28ºC, comparatively Brahmanath lake showed low temperature i.e. 25ºC–26ºC. There was no significant change in the average values of three lakes. The temperature variations in the lake were normal for metabolic activities of organisms such as fish as reported by Boyd and lichtkoppler (1979).

Turbidity: Turbidity in natural water is caused by clay silt, organic matter, phytoplankton and other microscopic organism etc. In summer and rainy it was found to be high and in winter it was found to be low as in summer due to decrease in water level. In rainy season due to surface runoff and addition of suspended materials in the lake. Turbidity in Bharatnagar lake in summer was 96±2.88, in rainy 122.6±6.12 and in winter 111.87±20.45. Similarly Mhaishal lake showed less transparency with high range of turbidity i.e. 101.5±5.4 to 147.66±116.13, where as Brahmanath lake showed less turbid water ranging from 43.96±13.24 to 63.45±12.14 which indicates that this lake was less polluted as compared to remaining two lakes with more transparency. Secchi–disc transparency followed the water turbidity trend because turbidity determines light penetration hence as turbidity increases secchi disc transparency decreases. Our result coincides with observations of Wade (1988).

pH: pH range between 7–8 has been considered good for fish culture (Jhingran, 1997). Present lakes showed neutral to slight alkaline pH ranging from 7 – 9.7. Most natural water has pH values between 5 -10 with the greatest frequency of values falling between 6.5 – 9 (Boyd, 1990). The pH of natural water can provide important information about many chemical and biological processes and provides indirect correlations to a number of different impairments and was monitered for various purposes like toxicity to aquatic life. Scuthorpe (1967) reported that pH, free CO_2 and ammonia were crucial factors in the survival of aquatic plants and fishes than the oxygen supply. pH fluctuation are known to related to biochemical events in water (Wright, 1975).

Total Alkalinity: Alkalinity of water may result due to water discharge, microbial decomposition with organic matter in the water body (Kumar *et. al*, 2008). In the present work alkalinity varied from 237 – 509.8 mg/l which was maximum in rainy season and minimum in summer season. Among the three lakes under study, Bharatnagar lake was found to be more alkaline with maximum value of 509.833±73.71mg/l, and Mhaishal lake was found be less alkaline among three with minimum alkalinity of 237±30.315mg/l. According to Durnani (1993) withdrawal of CO_2 from the bicarbonates for photosynthesis by algae may increase total alkalinity, which indicated presence of algal growth in Bharatnagar and Brahmanath lake.

CO_2: CO_2 is soluble in water and the amount of CO_2 that will dissolve in the water will be a function for temperature and concentration of CO_2 in the air. Value of free CO_2 ranged from 5.13± 3.36 in winter in Brahmanath lake and maximum in Bharatnagar lake i.e. 40.66±58.858. High CO_2 content of water indicated high pollution level (Kaur et.al; 2000). Hence as Bharatnagar lake showed high CO_2 indicated more pollution as compared to other two lakes.

DO: DO is essential to all living organisms. Water body receives the supplies of oxygen mainly from atmosphere and during the process of photosynthetic activity of chlorophyll bearing plants. Low DO concentration (< 3 mg/lit.) in fresh water aquatic system indicated higher pollution causing negative effects on aquatic ecosystem (Raut *et. al*, 2011). Present lakes showed value of DO highest in winter at Brahmanath lake i.e. 31.216±4.05 and minimum in rainy season in Mhaishal lake. DO increases in winter due to result of runoff accounted for by winter rains. (Tepe and Mutlu, 2004). High Concentration of DO indicated good water quality of Brahmanath lake.

BOD: BOD is the amount of DO needed by aerobic biological organisms in a body of water to breakdown organic material present in given water sample at certain temperature over a specific time period considered as an important water quality indicator. Higher BOD values was recorded at Bharatnagar lake as 43.91±3.165 in summer season as compared to Mhaishal Lake and Brahmanath Lake, which showed high percentage of organic loading on the lake. Minimum BOD value was recorded at Brahmanath lake as 11.37± 1.11 mg/l indicating less organic pollution. BOD values increase with the increase in ready metabolic organics present in the water (Syeda *et.al*; 2003).

COD: Both organic and inorganic component was analyzed by COD method**.** All the lakes showed the COD values within the range of 36.58mg/l to 135.41mg/l. Maximum average value was observed in Bharatnagar lake in

summer season and minimum was observed in Brahmanath lake in winter season. High Chemical Oxygen Demand was linked with pollution (Tepe *et.al,* 2005).

Phosphate: High or low deposition of phosphate in the lakes showed high or low deposition of minerals and organic content. Phosphate level in the present lakes showed increase in postmansoon and was decreased in mansoon and premansoon with in the range of 0.4 - 2.0 mg/l which found higher in Brahmanath lake and lower in Mhaishal lake and moderate in Bharatnagar lake as

Table 1. Summer, Rainy and Winter seasonal changes in the physicochemical parameters in Brahmanath lake, Miraj Tahsil, Maharashtra (Feb 2011 – Jan 2014)

S.No	Physicochemical Parameters (mg/l)	Summer (Feb - May)	Rainy (June - Sep)	Winter (Oct - Jan)
1	Temperature (˚C)	26.96± 0.46	26.5 ± 1.08	25.66 ± 0.144
2	Turbidity	145.03 ±4.193	63.45 ± 12.145	43.96 ± 13.24
3	pH	7.213 ± 0.51	7.6 ± 0.076	7.28 ± 0.275
4	Total Alkalinity	342 ±21.07	313.5 ± 85.41	327.66±15.82
5	CO_2	17.6 ± 0.0	15.97 ± 6.183	5.13 ±3.36
6	DO	11.35 ± 7.66	11.83 ± 4.45	31.216 ±4.05
7	BOD	43.91 ± 3.319	22.33 ± 5.93	11.37±1.11
8	COD	146.91 ±26.65	49.66 ± 18.07	36.58 ± 1.626
9	Phosphate	0.63 ± 0.31	0.158 ± 0.062	2.02 ±2.98
10	Chloride	41.40 ± 14.24	88.49 ± 35.878	62.80 ± 12.28
11	Hardness	241.33 ± 13.86	142.74 ± 64.935	224.6±14.047
12	TS	337.16 ± 8.632	301.25 ± 55.96	249.16±13.71
13	TDS	308.66 ± 3.21	301.75±57.35	233.41±14.46

Table 2. Summer, Rainy and winter seasonal changes in the physicochemical parameters in Bharatnagar lake, Miraj Tahsil, Maharashtra (Feb 2011 – Jan 2013)

S.No	Physicochemical Parameters (mg/l)	Summer (Feb - May)	Rainy (June - Sep)	Winter (Oct - Jan)
1	Temperature (˚C)	27.916 ± 0.2887	26.5 ± 0.5	25.5 ± 0.25
2	Turbidity	96 ± 2.8831	122.61 ±6.120	111.87 ± 20.45
3	pH	8.96 ± 0.057	9.366 ± 0.635	9.731 ±0.296
4	Total Alkalinity	503.66 ±15.308	509.83 ±73.716	405.66 ± 58.858
5	CO_2	20.346 ± 4.65	16.7±2.506	18.9 ±8.245
6	DO	17.2±6.366	16.65 ± 7.676	12.35 ±1.171
7	BOD	33.416 ± 3.165	17.433 ± 1.5003	16.25±1.089
8	COD	135.4167±9.319	65.33 ± 14.979	41.±2.410
9	Phosphate	0.5716±0.0894	1.066 ± 0.638	0.533 ±0.062
10	Chloride	311.63 ±49.0232	252.55 ± 12.719	392.31±33.605
11	Hardness	348±11.532	472.83±10.610	489.49±24.547
12	TS	916.25±45.535	890.833±2.466	983.66±28.567
13	TDS	910.416±17.692	899.916±7.375	1015.66±34.78

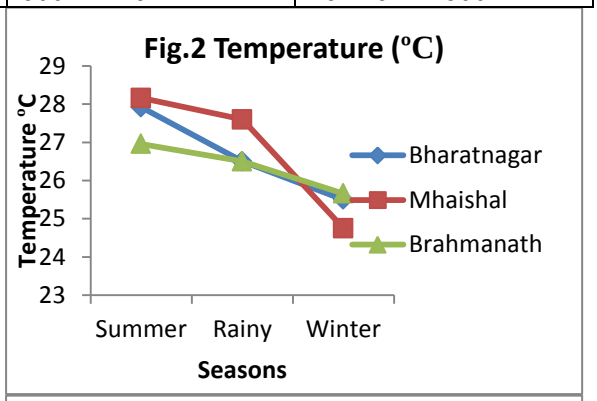
Table 3. Summer, Rainy and Winter seasonal changes in the physicochemical parameters in Mhaishal lake, Miraj Tahsil, Maharashtra (Feb 2011 – Jan 2014)

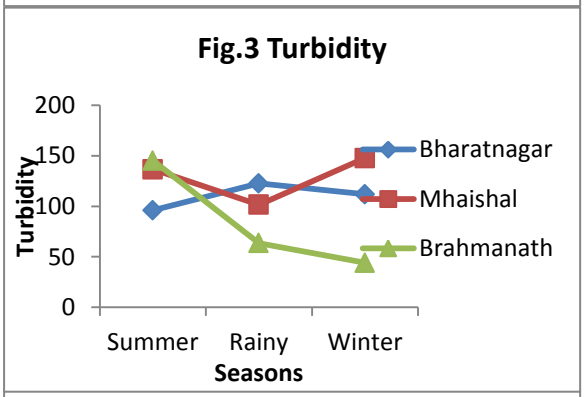
S.No	Physicochemical Parameters (mg/l)	Summer (Feb - May)	Rainy (June - Sep)	Winter (Oct - Jan)
1	Temperature (˚C)	28.166 ± 1.154	27.66 ± 0.629	24.75 ± 0.901
2	Turbidity	136.49 ± 5.958	101.5 ± 5.448	147.66 ±116.13
3	pH	7.53 ± 0.057	8.35 ± 1.730	9.36 ±0.472
4	Total Alkalinity	237 ±30.315	280.6 ± 0.577	286.83 ± 63.49
5	CO_2	22 ± 11.614	20.533±4.164	34.13 ±8.623
6	DO	14.6±3.983	9.233 ± 1.650	9.916 ±0.900
7	BOD	19.75 ± 6.628	16.416 ±3.923	13.66 ±3.105
8	COD	49 ±25.607	60.833 ±16.825	38.75 ± 4.769
9	Phosphate	0.408±0.028	0.731 ± 0.412	0.17 ±0.04
10	Chloride	124.44 ± 5.063	140.32 ±0.524	216.19 ± 113.16
11	Hardness	342.66±21.38	502 ± 91	337.66 ± 9.073
12	TS	513±29.043	515.5±52.575	446.41±22.282
13	TDS	469.5±32.271	506±47.137	437.75±14.506

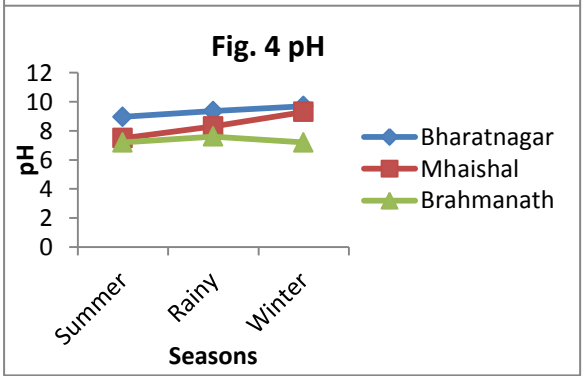
Brahmanath lake was surrounded by agricultural fields. Phosphate content in a lake may be due to release of agriculture runoff with release of domestic and industrial discharges which help in growth of phytoplankton and weeds in the lake (Dhembare, 2011)

Chloride: Chloride does not affect more to plant and algal growth and remained non toxic to aquatic organisms (Tepe *et. al,* 2005). Chloride content was found to be highest in Bharatnagar lake as 392.31±33.60 mg/l and lowest in Brahmanath lake as 41.40±14.24mg/l and moderate in Mhaishal lake 140.32±0.524mg/l.

Hardness: Hardness indicates water quality (Parasher *et.al,* 2008). Water containing concentrations up to 60 mg/l are called 'soft' and those 120–180mg/l as hard water. Total hardness range in present study was 142.74 – 502mg/l. Maximum Hardness was observed in Mhaishal lake and minimum hardness was recorded in Brahmanath lake. As hardness found related to presence of calcium and magnesium ions hence as per observations Mhaishal lake showed comparatively rich in these ions.







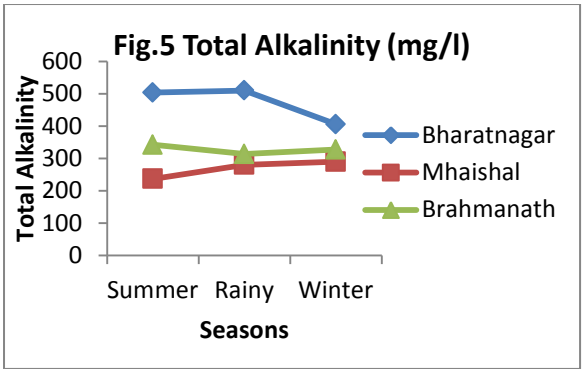


Fig.5 Total Alkalinity (mg/l)
Total Alkalinity
600
500
400
300
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100
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Summer
Rainy
Winter
Seasons
Bharatnagar
Mhaishal
Brahmanath

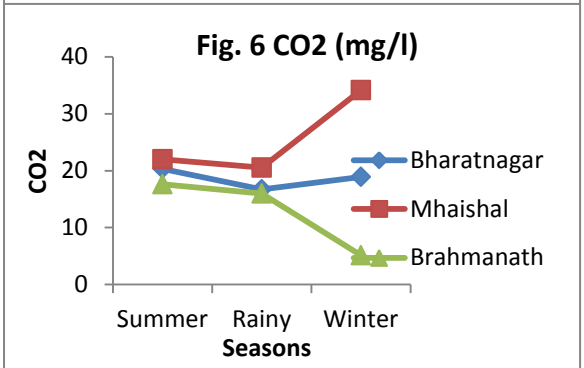
Fig. 6 CO2 (mg/l)
CO2
40
30
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10
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Summer
Rainy
Winter
Seasons
Bharatnagar
Mhaishal
Brahmanath

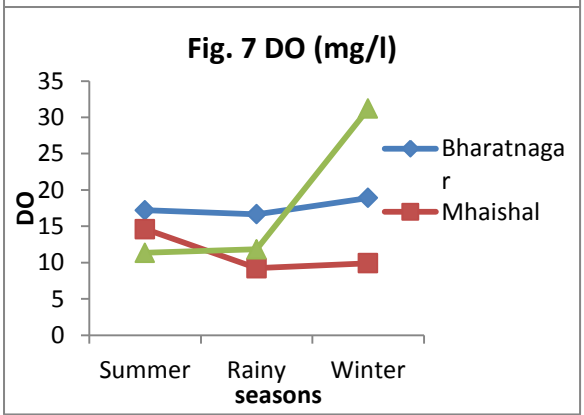
Fig. 7 DO (mg/l)
DO
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Summer
Rainy
Winter
seasons
Bharatnaga
r
Mhaishal

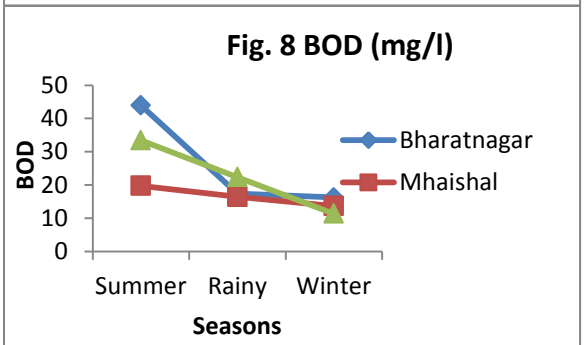
Fig. 8 BOD (mg/l)
BOD
50
40
30
20
10
0
Summer
Rainy
Winter
Seasons
Bharatnagar
Mhaishal

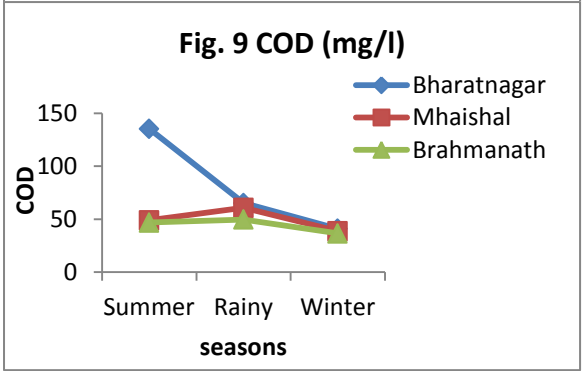
Fig. 9 COD (mg/l)
COD
150
100
50
0
Summer
Rainy
Winter
seasons
Bharatnagar
Mhaishal
Brahmanath

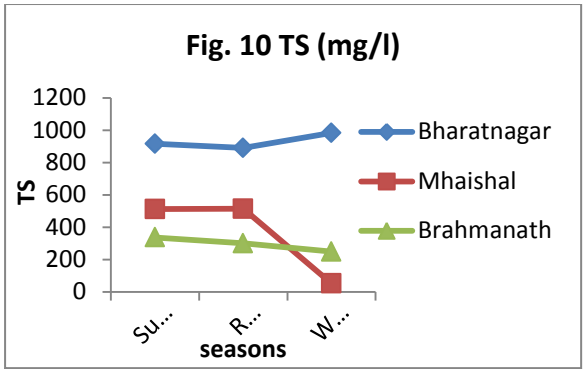
Fig. 10 TS (mg/l)
TS
1200
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seasons
Bharatnagar
Mhaishal
Brahmanath

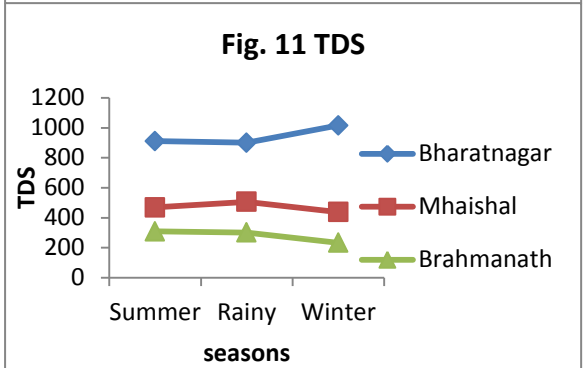
Fig. 11 TDS
TDS
1200
1000
800
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400
200
0
Summer
Rainy
Winter
seasons
Bharatnagar
Mhaishal
Brahmanath

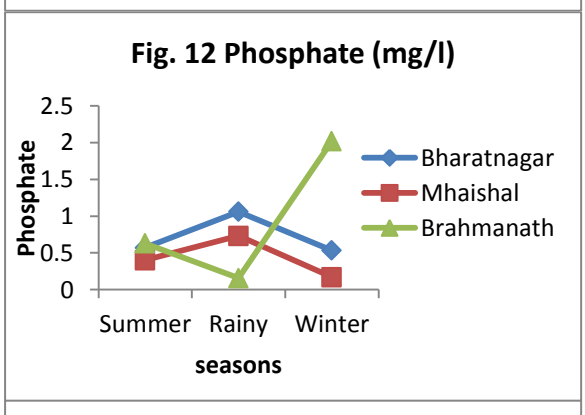
Fig. 12 Phosphate (mg/l)
Phosphate
2.5
2
1.5
1
0.5
0
Summer
Rainy
Winter
seasons
Bharatnagar
Mhaishal
Brahmanath

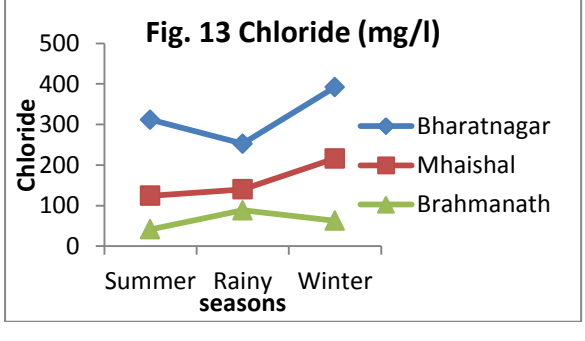
Fig. 13 Chloride (mg/l)
Chloride
500
400
300
200
100
0
Summer
Rainy
Winter
seasons
Bharatnagar
Mhaishal
Brahmanath

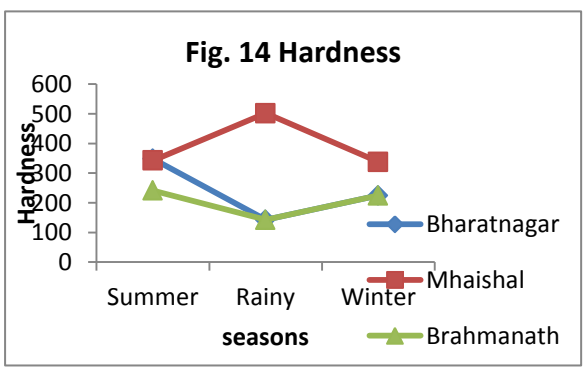
Fig. 14 Hardness
Hardness
600
500
400
300
200
100
0
Summer
Rainy
Winter
seasons
Bharatnagar
Mhaishal
Brahmanath

CONCLUSION

Dissolved constituents of water bodies are often determined as a major component for baseline limnological studies. The main objective of study was to observe the physicochemical and biological charcterisitics of lakes from Miraj tahsil. Based on the present study, it can be concluded that variations in the physicochemical parameters were observed in all these lakes. The obtained results of physicochemical parameters from Bharatnagar lake, showed that the lake was highly polluted and showed altered pH, Alkalinity, CO_2 and low O_2 due to direct discharge of sewage in to the lake. Another reason was washing of the cattles, dumping of waste baggage directly, also flowing of waste water from the slum area which surrounds the lake. Fishes were found floating on the surface of the water in dead condition which indicates water is unsafe for aquatic life and also for other use. Mhaishal lake found moderately polluted as compared to Bharatnagar lake. Inspite of cattle washing, use of water for washing of large vehicles, clothes etc. by local people lake was found to be moderately polluted because basic reason is that flow of water from Krishna river in the lake which renew the water quality. Brahmnath lake showed results within limits and the water still remained non polluted or pure and has not affected growth and development of number of aquatic life as plankton, fishes, macrophytes etc. other use like for agriculture, fisheries, domestic etc. as the lake is not more exposed to human locality. In conclusion pollution of lake can be dependent on its geographical location, type of discharge and interference for to contaminate the aquatic bodies.

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