INTERNATIONAL JOURNAL OF RESEARCHES IN BIOSCIENCES, AGRICULTURE & TECHNOLOGY
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www.vmsindia.org

Current status of physico –chemical characteristics and biological factors of Navargaon Lake in Maregao Taluka, District-Yavatmal (M.S.). India

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ABSTRACT
Nawargaon Lake was constructed as part of irrigation projects by Government of Maharashtra in the year 1997. Nearest city to Lake is Maregaon and the Lake is situated in Maregaon Taluka of Yavatmal District of Maharashtra in India . It is built on and impounds Nirguda River. In the present study an attempt has been made on physico – chemical characteristics and plankton diversity and density of a sub urban perennial water body, located in Nawargaon in Maregaon Taluka District Yavatmal Of Maharashtra. The study was conducted during Feb. 2016 to Jan. 2017. The samples were analyzed at monthly intervals for a period of one year. Limnological parameter and plankton diversity are an important criterion for determining the suitability of water for irrigation and drinking purpose. Nawargaon Lake has greatest importance for humankind. The physico-chemical parameters are water temperature, electric conductivity, total dissolved solids, total hardness, total alkalinity, turbidity, pH, dissolved oxygen, chlorides, COD , BOD, etc. The biological factors considered were macro-zoo benthos and plankton of the lake. Lake was highly productive as presence of various class and order of benthos,zooplankton and phytoplankton although there were no sign of problem like eutrophication . Biological studies indicate that lake water was fit for aquatic organism, such as fishes because of there were plenty of food .

Introduction

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 (Jhingran et al., 1969). Life in aquatic environment is largely governed by physico-chemical characteristics and their stability. The physico-chemical as well as the biological factor of lake have vital role in aquaculture and productivity of fishes. The quality of water determines the quality of fish to be produce in it. The physical factors are water temperature, water current and turbidity of water, whereas the chemical parameter of lake comprise pH, dissolved oxygen, total alkalinity and total hardness of water. The biological factors considered were macro-zoo benthos and plankton of the lake. The seasonal changes in different physico-chemical parameters are responsible for annual variation and growth of biological factors viz.,macro-zoo benthos and plankton etc.

Tepe et al., (2005) found that the water quality attributes such as water temperature,light penetration, dissolved oxygen, total alkalinity and total hardness are the representative of the seasonal fluctuation . Ali et al., (2006) showed that the water quality of fresh water ecosystem undergoes complex changes due to all physico-chemical factors and water quality as a sequence disrupting the aquatic life. Hayat et al., (1996) and Jena et al., (1998) revealed that temperature and ecological conditions are responsible for the fluctuation of salt contents, which in turn influence the production, and growth of fish .

Materials and Methods

The sampling was carried out in Nawargaon lake at five different sites (Latitude:20.0763283N and Longitude:78.7675095E),monthly between Feb.2016 to Jan.2017 for one year. About 12 water sample were collected in each months.

The physico-chemical factors are water temperature,water current,turbidity of water pH,dissolved oxygen,total alkalinity and total hardness of water,whereas biological factors were macro-zoo benthos and plankton of the lake. Study of physico-chemical factors was carried out by using standard methods(APHA,1998). For the qualitative estimation safe water quality standards were use(Boyd and Tucker,1998;Ali et al .,2000). Macro-zoo benthos collected from 1m ^{2}area of lake at the depth of 15cm. The plankton was sampled at each spot by filtering 100liters of water. Preservation was made on the spot in 4% formalin. The quantitative analysis of plankton was made with the help of Sedgwick-Rafter counting slide as suggested by Welch(1952).

Result and Discussion

Water temperature

The average water temperature of lake was found to be varying from 14.12˚c to 21.58˚c during Feb to August respectively.Thus, water of Nawargaon lake is coldest in winter and hottest in monsoon.(Table- 1)

Water velocity

While calculating the velocity of water,we observed that the rate of water flow is fluctuated from a minimum value of 0.307m/s in Feb.to a maximum value of 0.899m/s in Aug.Thus the water current with a rate of 0.313m/s in winters to 0.849m/s in monsoon is useful for fish survive (Table 2).

Turbidity

It has been observed that the water is highly turbid during monsoon period (July-August) with a value of 92.9NTU. Thus is obvious because water becomes turbid due to the rainfall and flash flood. With an unusual variation water was found extremely less turbid during restof the seasons with the minimum of 7.9NTU in winter. (Table 3).

pH

pH fluctuation occur only within a narrow range. The pH of lake was found to be varying from 7.6 to 8.32 during July to December. Therefore, during monsoon the water is least basic and it seems more basic during winter (Table 4)

Dissolved Oxygen

In December, the oxygen content dissolved in water was found to be highest with the value of 10.72mg/l.The lake has less D. O. content in July with the value of 7.6mg/l. Thus the fish can endure water having the dissolved oxygen content from7.93mg/l (during monsoon) to 10.57mg/l (during winter). (Table 5).

Total Alkalinity

In our observation it has been observed that the lake water was alkaline and the magnitude was varying from 59.34mg/l to 100.46mg/l from Augustto February. Thus, the water of Nawargaon Lake is most alkaline during winter and then with a regular decrement is least alkaline during monsoon .(Table 6)

Total Hardness

The degree of hardness calculated in the lake water was lowest in July (78.52mg/l) and highest in February (109.26 mg/l). The study summarized that the water in winter in highly hard, while least hard during monsoon.(Table 7).

Macro-zoo benthic Density

The number of Ephemeroptera (211Units/m^2in December while 12 Unit/m^2 in July), Trichopteran (210 Unit/m^2 in December while 8Unit/m^2 in July), Dipteran (13 Units/m^2 in July while 145 Units/m^2 in February), Plecopteran nymphs (51Units/m^2in January while 1 Units/m^2 in August), Coleopteran larvae (99 Units/m^2in December while 9 Units/m^2 in July). Odonata larvae (130 Units/m^2 in December while 7 Units/m^2 in June). The average total macro-zoo benthos observed (812Units/m^2 in December while56 Units/m^2in July) and (in winter season 646.33 Units/m^2 while during monsoon 114 Units/m^2). (Table 8).

Plankton Diversity

The total phytoplanktons were Chlorophyceae, Bacillariophyceae and Cyanophyceae (2925 Units/l in January while 400 Units/l in August). The total zooplaktons were Crustaceans and Rotifers (25Units/l in August and 400 Units/l in January). The total plankton density vary (3110 Units/l in January to 425 Units/l in August.(table9).

In the present study, the water temperature of the lake was observed to be moderate throughout the year. This moderate water temperature is due to its spring-fed nature of origin. It is also supported by Odum (1971) that photoperiod was shorter in winter than summer which is directly related to temperature and hence water temperature is highest in June. The velocity of water current was observed to be fluctuated from a minimum of 0.307 m/s (February) to a maximum of 0.899 m/s (August). It is also obvious from our study that the average rate of water is highest in monsoon whereas lowest in winter.

In present study water was highly turbid during Monsoon (July-August) while very low during rest of the seasons with the minimum of 7.9 NTU in winter. These observations are also supported by Jhingran (1965) who reported that turbidity generally increased to a maximum value in monsoon due to the suspended solids in the flooded water whereas, during the post monsoon months the turbidity values were low but increased again during the summer months with the increase in tidal management and intensity .Upadhyay (1997) calculated the turbidity variation from 2 to 162NTU.

pH is gradually increased from a minimum of 7.83 during monsoon to a maximum of 8.28 during summer. Similar variations in pH of the lake Khoh were recorded by Kumar et al.(2006) in Garhwal Himalayas. They concluded that winter maxima for pH might be due to algal growth and minima in monsoon might be due to influx of organic and inorganic ions in to the lake caused by flash flood.

In our study D O highest during winter whereas lowest during,Ali(1999) reported that the dissolved oxygen variation shows inverse relationship with water temperature variation.

Bhatt et al (1984) also reported high D O and low free CO2 concentration in winter.

In present study,the water of Nawargaon lake was found to be most alkaline during winter and least during monsoon.Total hardness show minimum during monsoon to a maximum during winter.

Density of total macro-zoo benthos and total plankton populations were plenty in winter while rarely during monsoon. Detritus standing stock is the main reason for high density of benthos in winter and substratum stability too. Moderate temperature low gradient of velocity favors the growth of biotic communities. Similar study was carried out by Rautela et al.,(2006) who reported that the macro-zoo benthos had a maximum population during winter(325 Units/m^2) and the minimum (15 Units/m^2) during monsoon season.

Conclusion

Briefly,present study concluded that physico-chemical parameters levels indicate the moderate quality of water,lake water of the study area was not polluted in respect to physico-chemical assessment. But biological studies indicate that lake water was fit for aquatic organism,such as fishes because of there were plenty of food in the form of benthos, zooplankton and phytoplankton. Nawargaon lake water was habitable for fishes and fit for development of aquaculture. There were no sign of problems like eutrophication. It is also concluded that the higher growth of macro-zoo benthos and planktons in the lake is favoured by low water temperature, low current velocity,moderate turbidity with high D O,high alkalinity and high hardness during winters season.

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Table.1 Average monthly and seasonal variation in water temperature (°C) of Nawargaon Lake (2016-2017)

Month	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.
Spot A	12.3	14.7	15.5	17.8	20.4	21.5	21.9	20.4	19.7	17.9	14.5	12.7
Spot B	15.5	17.3	17.3	19.6	20.5	20.4	20.8	19.5	18.6	17.7	16.4	15.6
Spot C	11.2	15.6	17.2	19.7	19.5	20.7	22.4	20.6	18.8	16.9	13.4	11.6
Spot D	16.3	17.8	18.5	20.5	20.8	21.5	21.3	19.6	18.6	17.6	16.8	15.3
Spot E	16.5	17.9	18.3	20.8	20.2	20.3	21.5	19.5	18.8	17.3	16.7	15.4
Average	14.36	16.66	17.36	19.68	20.28	20.28	21.58	19.92	18.9	17.48	15.56	14.12
Season		Spring		Summer		Monsoon			Autumn		Winter	

Table.2 Average monthly and seasonal variation in water current velocity (m/s) of Nawargaon Lake.

Month	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.
Spot A	0.289	0.364	0.393	0.416	0.576	0.663	0.849	0.615	0.433	0.269	0.281	0.274
Spot B	0.304	0.337	0.393	0.428	0.438	0.864	0.957	0.813	0.522	0.391	0.324	0.314
Spot C	0.271	0.366	0.398	0.421	0.421	0.633	0.765	0.651	0.434	0.354	0.265	0.261
Spot D	0.337	0.351	0.598	0.924	0.924	0.963	0.972	0.811	0.614	0.483	0.388	0.391
Spot E	0.334	0.349	0.598	0.944	0.923	0.877	0.951	0.813	0.619	0.433	0.335	0.325
Average	0.307	0.353	0.476	0.627	0.656	0.656	0.899	0.741	0.524	0.386	0.319	0.313
Season		Spring		Summer		Monsoon			Autumn		Winter	

Table.3 Average monthly and seasonal variation in turbidity(NTU) of Nawargaon Lake.

Month	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.
Spot A	09	11	17	10	12	95	86	51	31	11	08	10
Spot B	06	05	11	09	17	91	96	64	41	18	07	10
Spot C	05	08	09	11	22	88	99	59	39	14	05	07
Spot D	07	09	06	13	21	89	94	61	31	12	11	08
Spot E	09	07	05	09	19	94	97	57	27	10	09	08
Average	7.2	8.0	9.6	10.4	18.2	91.4	94.4	58.4	33.8	13	8.0	8.6
Season		Spring		Summer		Monsoon			Autumn		Winter	

Table.4 Average monthly and seasonal variation in pH of Nawargaon Lake.

Month	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.
Spot A	8.2	8.3	8.2	8.1	8.2	7.9	7.9	8.3	8.2	8.6	8.2	8.1
Spot B	7.4	8.3	8.2	8.7	8.6	7.6	7.6	7.3	7.4	7.7	8.1	8.3
Spot C	8.1	8.6	8.2	7.9	7.9	7.2	7.8	8.2	8.3	8.1	8.7	8.4
Spot D	8.2	8.1	8.2	8.3	8.5	8.1	8.1	7.9	7.8	8.3	8.5	8.2
Spot E	8.0	8.1	8.2	8.3	8.3	8.0	8.1	7.6	7.8	8.0	8.1	8.2
Average	7.98	8.28	8.2	8.26	8.3	7.76	7.9	7.86	7.9	8.14	8.32	8.24
Season		Spring		Summer		Monsoon			Autumn		Winter	

Table.5 Average monthly and seasonal variation in dissolve oxygen(mg/l) of Nawargaon Lake.

Month	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.
Spot A	9.8	8.9	8.4	8.6	7.8	7.2	8.1	8.5	9.3	9.8	10.5	10.3
Spot B	11.3	8.9	7.8	7.2	7.4	7.4	7.1	8.6	9.3	10.1	10.4	10.8
Spot C	9.8	8.9	9.5	8.3	7.9	8.2	8.7	8.7	9.4	9.2	10.9	10.1
Spot D	10.4	9.3	8.7	7.4	7.4	8.2	8.3	9.3	9.9	10.5	11.1	10.9
Spot E	10.4	9.3	8.6	7.9	7.5	7.9	8.2	9.5	9.8	10.5	10.7	11.2
Average	10.34	9.06	8.6	7.88	7.6	7.78	8.08	8.92	9.54	10.02	10.72	10.66
Season		Spring		Summer		Monsoon			Autumn		Winter	

Table.6 Average monthly and seasonal variation in total alkalinity(mg/l) of Nawargaon Lake.

Month	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.
Spot A	91.9	80.1	76.2	71.0	64.2	62.4	60.8	64.4	73.5	85.9	89.9	92.4
Spot B	96.2	87.1	80.8	74.1	63	61.7	61.8	62.5	79.8	89.1	99.2	101
Spot C	99.6	83.4	78.5	74.7	62.7	65.4	59.9	67.8	77.6	81.1	101.5	99.2
Spot D	103.3	97.1	79.7	70.2	71.1	60.1	57.6	70.4	91.1	95.3	98.2	99.8
Spot E	111.3	97.1	81.7	73.2	73.1	62.8	56.6	71.1	87.1	91.3	91.9	108.2
Average	100.46	88.96	79.38	72.64	66.82	62.48	59.34	67.24	81.82	88.54	96.14	100.16
Season		Spring		Summer		Monsoon			Autumn		Winter	

Table.7 Average monthly and seasonal variation in total hardness (mg/L) of Nawargaon lake.

Month	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.
Spot A	101.2	93.7	91.2	89.1	75.4	77.5	78.2	77.2	82.5	90.6	92.3	97.5
Spot B	109.3	98.8	85.9	78.2	77.1	75.9	74.9	78.2	82.1	89.2	96.7	101.2
Spot C	104.3	98.5	99.8	92	90	84.4	81.7	84.9	89.6	98.4	99.6	103.1
Spot D	112.4	96.5	94.7	87.5	85.1	74.9	82.4	88.2	91.5	101.4	106.1	109.2
Spot E	119.1	107.4	96.2	86.3	84.6	79.9	84.3	86.9	87.5	98.2	106.3	108.5
Average	109.26	98.98	93.56	86.62	82.44	78.52	80.3	83.08	86.64	95.56	100.2	103.9
Season		Spring		Summer		Monsoon			Autumn		Winter	

Table 8. Average monthly and seasonal variations in Macro-zoo benthic density (Units/m^2)

Macrobenthic groups (Units/m^2)	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.
Ephemeroptera	149	73	52	24	21	12	35	64	110	144	211	155
Trichoptera	140	77	35	21	10	08	35	64	110	144	210	150
Deptera	145	116	63	43	34	13	29	62	88	139	142	110
Plecoptera	48	39	43	40	21	02	01	14	03	14	20	51
Coleoptera	46	61	22	38	11	09	22	22	94	88	99	39
Odonata	42	76	39	29	07	12	50	52	92	110	130	52
Total Macro-zoo benthos (Unit/m^2)	570	442	254	195	104	56	172	278	497	639	812	557
Season		Spring		Summer		Monsoon		Autumn			Winter	

Table 9. Average monthly and seasonal variations of Plankton density (Units/L)

Plankton group (Units/L)	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.
Chlorophyceae	375	725	325	510	135	275	Nil	230	475	650	500	600
Cyanophyceae	225	175	Nil	200	125	125	Nil	125	75	150	200	250
Total phytoplankton	2175	1725	1550	1420	950	802	400	1080	2850	2629	2550	2925
Crustaceans	175	100	50	175	25	75	25	75	100	225	155	125
Rotifers	Nil	100	200	220	75	Nil	Nil	25	25	175	100	60
Total Zooplankton	175	200	250	395	100	75	25	100	125	400	215	185
Total Plankton (Units/L)	2350	1925	1800	1815	1050	877	425	1180	2975	3029	2850	3110
Season		Spring		Summer		Monsoon			Autumn		Winter	

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