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Seasonal Variations in Physicochemical Parameters of Five Selected Perennial Lakes of Nagzira Navegaon Corridor in Gondia District of Maharashtra State, India

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ABSTRACT

The present study deals with the physicochemical parameters of five selected lakes in Nagzira Navegaon corridor in Gondia district of Maharashtra State. The wetlands are utilized for irrigation, agriculture, pisciculture and domestic purposes. The wetlands situated in the corridor fulfill the water requirement of wild animals during their movement from one protected area to another in central Indian landscape. It is an urgent need to assess the physicochemical parameters. The physicochemical parameters of five selected lakes were analyzed from October 2014 to September 2016. The results discovered that there was significant seasonal variations in some physicochemical parameters, Water Temperature ranges from 22.80 ± 0.20 at Rengepar lake during winter season to 29.89 ± 0.19 at Umarzari lake during summer, pH ranged from 7.12±0.01 to 8.08±0.04, it was minimum 7.12 during winter season from Rengepar lake and maximum 8.08 during summer season at Umarzari lake, Conductivity values were differ from 0.17 ± 0.02 during winter season at Putli lake to 0.34 ± 0.01 during summer season at Rengepar and Chulbandh lake., Transparency values fluctuates from 37.87 ± 0.55 during monsoon season at Putli lake to 75.25 ± 0.02 during summer season at Rengepar lake, Dissolved Oxygen (DO) values varied from 5.69 ± 0.03 during monsoon season at Chulbandh lake to 9.14 ± 0.09 during winter season at Putli lake, Carbon di Oxide (CO_2) values differ from 3.04 ± 0.05 during winter season at Putli lake to 4.66 ± 0.04 during summer season at Naktya lake, Biological Oxygen Demand (BOD) values differ from 6.23 ± 0.18 during winter season at Putli lake to maximum 12.83 ± 0.13 during summer season at Umarzari lake, Chemical Oxygen Demand (COD) values varied from 20.26 ± 0.03 during winter season at Umarzari lake to 35.90 ± 0.11 during summer season, Phosphate values differ from 0.34 ± 0.01 during winter season at Naktya lake to 0.90 ± 0.01 during summer season at Rengepar lake and Nitrate values varied from 0.43 ± 0.03 during winter season at Putli lake to 1.04 ± 0.03 during monsoon season. Regular monitoring of water quality parameters can help to conserve freshwater ecosystem.

Keywords- Physicochemical parameters, Nagzira-Navegaon corridor, Gondia, Lakes, Conservation

INTRODUCTION

Wildlife ecosystem is complex, fragile and integrated ecosystem not only comprising of land, forest and animals but also wetlands and its related flora and fauna. Wetlands are sources of drinking water and feeding ground for the animals living around it. Therefore, the health and productivity of these wetlands become important for a wildlife sanctuary (Vogt *et al.,* 2007).

Water bodies are frequently contaminated by different kinds of pollutants resulting from increasing human population, urbanization and industrialization. Disposal of domestic wastes in wetlands were causing undesirable changes in physico-chemical and biological characteristics of these water bodies. Organic enrichment of these water bodies results in high Oxygen demand and low Oxygen content (Sharma, 2008). Water chemistry exhibits variable physical and chemical characteristics and consequently variable planktonic composition (Fathi, 2001). These variations depend mainly on the type and nature of the area itself as well as the man-made additions or runoff minerals and chemicals from agriculture. Limnological studies on determining the different parameters such as Dissolved Oxygen, pH, Conductivity etc. play significant roles on ascertaining the water quality of such water bodies (Fathi *et al.,* 2005).

The corridor between Nagzira Wildlife Sanctuary and Navegaon National Park situated in Gondia district of Maharashtra State provides an excellent habitat for avifauna in the form of water bodies with marshy plant growth, terrestrial platforms having thick as well as scattered trees and bushy vegetation (Bahuguna *et al.,* 2010). Wild animals widely use this corridor for their movement between Nagzira and Navegaon. The wetlands situated in the corridor fulfill the water requirement of wild animals during their movement and lean season. NN corridor has number of wetlands and other pocket of water bodies distributed in the whole study area, but water bodies have been decreasing continuously in the corridor. 182.76 sq. km. area in 1990, under wetlands in the corridor was reduced to 137.62 sq. km. in 1999; and to 104.35 sq. km. in 2009 (Yadav *et al.,* 2012). perennial lakes in the corridor among which one perennial lake from each block was selected for the study.

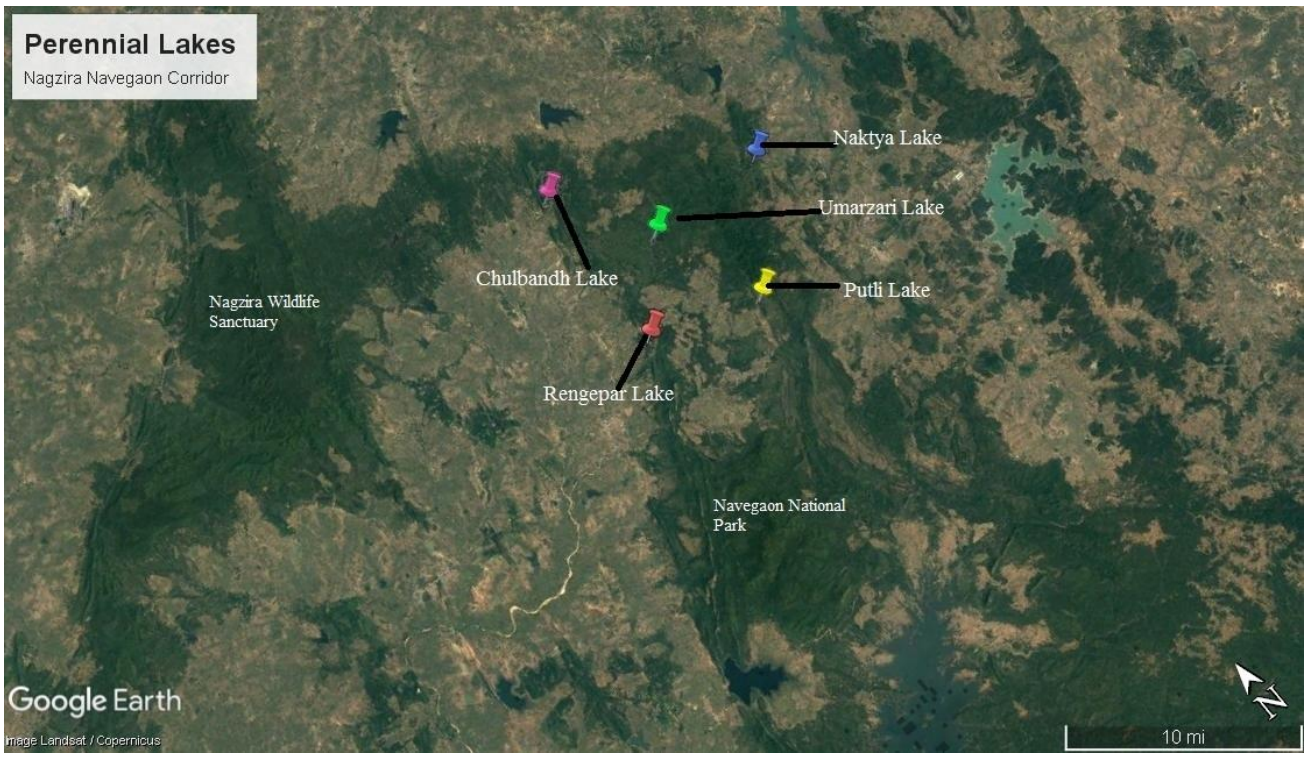

Figure 1- Google map of selected perennial lakes in Nagzira Navegaon corridor

Lakes viz. Putli (N 21.093127^0 and E 80.284214^0), Naktya (N 21.162392^0 and E 80.339668^0), Umarzari (N 21.171802^0 and E 80.255765^0), Rengepar (N 21.117159^0 and E 80.209932^0) and Chulbandh lake (N 21.223740^0 and E 80.214837^0) ranging from the Mundipar Murdoli to Navegaon block between Nagzira WLS and Navegaon NP were selected for the present investigation. Therefore the present study was carried out to monitor some major wetlands in Nagzira Navegaon corridor with special references to water quality parameters. There are 71 non- perennial and 7 In the present work the attempt was made to analyze the physicochemical properties (Temperature, pH, Conductivity, Transparency, Dissolved Oxygen, Carbon di Oxide, Biological Oxygen Demand, Chemical Oxygen Demand, Phosphate and Nitrate) from five different perennial lakes in Nagzira Navegaon corridor of Gondia district of Maharashtra.

MATERIAL AND METHODS

Sampling Methods for Physico-chemical Parameters

In the present study sampling programme was done from October 2014 to September 2016. Sampling was done in the morning hours from 7.30 to 9.30 am. Water sample were collected from three sites of each lake in fresh unsullied plastic bottles and brought to the laboratory for analysis of physico-chemical parameters by standard methods. The parameters like temperature, pH and conductivity were measured on the spot during the study with the help of water analysis kit Systronics model-371 at the sampling sites. For the dissolved oxygen, the water sample was taken in 300 ml. capacity of BOD bottle and fixed the DO on the spot. Measurement of transparency was done by Secchi disc. The results were calculated as per the standard formulas and methods suggested by APHA (1985), NEERI (1986; 2012), Kodarkar (1992) and Khanna (1993).

RESULTS

The main objective of the seasonal variations in physico-chemical analysis of water was to determine its biological status. Since the water contains dissolved and suspended constituents in varying proportions, it has different chemical and physical properties along with biological variations. The quality of water may be affected in various ways by pollution. The physicochemical characteristics properties are summarized in the table 1.

Water Temperature:

The average water temperature of different lakes during winter season ranges from 22.80 ± 0.20 at Rengepar lake to 24.16 ± 0.42 at Umarzari lake whereas during summer season it was 28.77 ± 0.40 at Naktya lake to 29.89 ± 0.19 at Umarzari lake and during monsoon season it was 26.28 ± 0.45 at Putli lake to 27.47 ± 0.03 at Chulbandh lake during the study period. Similar observations were reported by Dipak (2011) in 6 wetlands of Kaziranga National Park, Assam. The temperature fluctuations are dependent on seasons, geographic locations as well as the temperature of effluent poured into the lakes. Pawar *et al.,* (2006) observed the water temperature of Sadatpur lake was varied from 21ºC to 30ºC being minimum 21ºC in winter and maximum 30ºC in summer. Pawale (2014) observed the highest temperature 30ºC in summer and lowest temperature 23.5ºC during winter season at Vishnupuri reservoir Nanded. Punam (2017) reported lowest water temperature 24.66±1.23 during winter season and highest water temperature was 30.99±3.75 during summer in Chandpur lake of district Bhandara, Maharashtra. The low water temperature during winter may be due to high water level and low solar radiation and higher temperature in summer might be due to low water level, greater solar radiation and clear atmosphere.

pH:

In the present investigation pH values of all lakes ranged from 7.12±0.01 to 8.08±0.04, it was minimum 7.12 during winter season from Rengepar lake and maximum 8.08 during summer season at Umarzari lake. Acharjee *et al.,* (1999) recorded pH in the range of 6.6 to 7.2 in Dighali lake of Assam. Seasonally, in all the sites minimum pH was recorded during monsoon season. Lower value of pH during the monsoon season may be due to carrying heavy load of runoff and diluting water as collection sites do not seem to be polluted any appreciable source of pollution. The site at Putli Lake used by villagers to clean the cloths therefore shows higher pH in winter season. When the comparison was made between the lakes of West Bengal and NN corridor, the pH 7.6 to 8 was found similar (Pathak, 1990). Sharma *et al*., (2011) recorded the pH range in between 6.9 to 8.3, the minimum 6.9

was in monsoon and maximum 8.3 was in summer at Pichola lake, Udaipur, Rajasthan. Dhere *et al*., (2006) recorded minimum pH value 7.1 in winter and the maximum pH value 9.0 during monsoon at Karpara reservoir, Parbhani district, Maharashtra. Pawar *et al.,* (2006) observed the pH range in between 8.01 to 9.95 indicating alkaline nature of water at Sadadpur lake near Pravaranagar, Ahmadanagar district, Maharashtra. Bhaskar (2013) reported minimum pH value 7.10±0.88 during winter season and maximum 7.84±0.43 during summer season in Shionibandh lake of district Bahndara, Maharashtra.

Table 1- Seasonal Mean Variation of Physicochemical Properties of Selected Lakes in Nagzira Navegaon Corridor from October 2014 to September, 2016.

S. N.	Parameters	Season	Lakes				
			Putli	Naktya	Umarzari	Rengepar	Chulbandh
1	Temperature	Winter	23.38±0.25	22.87±0.11	24.16±0.42	22.80±0.20	23.96±0.62
		Summer	29.48±0.05	28.77±0.40	29.89±0.19	28.83±0.24	29.85±0.06
		Monsoon	26.28±0.45	26.51±0.47	27.36±0.15	27.15±0.06	27.47±0.03
2	pH	Winter	7.23±0.02	7.29±0.02	7.43±0.02	7.12±0.01	7.43±0.05
		Summer	8.07±0.03	8.06±0.04	8.08±0.04	7.60±0.01	8.02±0.01
		Monsoon	8.00±0.03	8.00±0.05	8.01±0.13	7.78±0.01	8.00±0.09
3	Conductivity	Winter	0.17±0.02	0.19±0.01	0.22±0.03	0.20±0.01	0.21±0.02
		Summer	0.31±0.02	0.31±0.01	0.30±0.03	0.34±0.01	0.34±0.01
		Monsoon	0.22±0.01	0.23±0.01	0.24±0.02	0.24±0.00	0.23±0.03
4	Transparency	Winter	44.03±2.10	41.48±4.11	42.43±0.40	53.99±0.01	43.30±0.38
		Summer	69.45±0.43	68.62±1.87	74.34±0.63	75.25±0.02	73.97±0.22
		Monsoon	37.87±0.55	38.30±0.45	38.26±0.26	40.82±0.02	38.46±0.14
5	Dissolved Oxygen (DO)	Winter	9.14±0.09	8.38±0.03	9.09±0.25	8.88±0.12	9.10±0.15
		Summer	7.87±0.06	6.22±0.02	7.11±0.16	6.71±0.18	6.71±0.25
		Monsoon	6.20±0.00	5.95±0.07	5.74±0.04	5.87±0.21	5.69±0.03
6	Carbon Di Oxide (CO_2)	Winter	3.04±0.05	3.36±0.09	3.14±0.01	3.13±0.02	3.10±0.08
		Summer	4.60±0.01	4.66±0.04	4.07±0.08	3.89±0.03	4.03±0.03
		Monsoon	4.00±0.06	4.31±0.04	3.43±0.37	3.06±0.03	3.32±0.01
7	Biological Oxygen Demand (BOD)	Winter	6.23±0.18	8.33±0.25	8.88±0.53	8.30±0.07	8.97±0.39
		Summer	12.38±0.03	12.32±0.17	12.83±0.13	12.78±0.05	12.51±0.07
		Monsoon	9.48±0.06	9.53±0.46	9.42±0.26	9.30±0.01	8.67±0.14
8	Chemical Oxygen Demand (COD)	Winter	22.71±0.07	22.32±0.74	20.26±0.03	21.39±0.24	21.72±0.49
		Summer	35.20±0.52	35.43±0.43	35.90±0.11	35.31±0.42	35.05±0.24
		Monsoon	28.10±0.29	26.04±1.10	24.63±0.24	24.67±0.49	24.45±0.54
9	Phosphate	Winter	0.38±0.03	0.34±0.01	0.34±0.02	0.37±0.01	0.39±0.02
		Summer	0.89±0.00	0.80±0.01	0.88±0.00	0.90±0.01	0.88±0.02
		Monsoon	0.53±0.02	0.51±0.02	0.52±0.02	0.51±0.02	0.53±0.05
10	Nitrate	Winter	0.43±0.03	0.52±0.01	0.65±0.03	0.59±0.03	0.65±0.01
		Summer	0.73±0.00	0.82±0.00	0.76±0.01	0.77±0.01	0.79±0.02
		Monsoon	1.04±0.03	0.95±0.01	0.98±0.02	0.98±0.02	1.01±0.01

Fig 2- Putli Lake

Fig 3- Chulbandh Lake

Fig 4- Rengepar Lake

Fig 5- Naktya Lake

Fig 6- Umarzari Lake

Fig 7- Water quality test underway at Umarzari Lake, Fig 8- Water quality test underway at Putli Lake

Conductivity:

During the present study the conductivity values were differ from 0.17 ± 0.02 during winter season at Putli lake to 0.34 ± 0.01 during summer season at Rengepar and Chulbandh lake. Acharjee *et al*., (1999) also observed the similar observations in Dighali Lake of Assam. In the present investigation higher value of electrical conductivity (EC) might be due to increased amount of inflow of ions from the washing of weathered materials from the catchment area. Bhaskar (2013) reported 0.19±0.01 during winter season and 0.31±0.04 during summer season in Shionibandh reservoir of district Bhandara, Maharashtra. Low level of EC during winter season observed in the present study could be due to mixing of catchment floodwater which was low in ion content and opportunistic rain during winter period.

Transparency:

In the present investigation minimum transparency was observed during monsoon season however maximum transparency was recorded during summer season at all sites. Average transparency values fluctuates from 37.87 ± 0.55 during monsoon season at Putli lake to 75.25 ± 0.02 during summer season at Rengepar lake. Similar results were reported by Shivayogimath *et al.,* (2012). They stated that during monsoon season turbidity value increases as the

consequence of flow of rainwater carrying silt, clay and other suspended particles. In the winter season settlement of silt and clay contribute to low turbidity. Similar results were reported by Adebisi (1981). He reported that minimum of Secchi disc transparency occurs between August and October and water was most transparent in February and reported that fine silt held in the suspension when the water was lotic, was probably responsible for extremely low transparency in August and December, as soon as water turn lentic in January, it becomes relatively clearer. Dutta *et al*., (1988) pointed out that high amount of sand and silt carried by the floods during rainy season results with consequent decrease in transparency. In the present investigation in all the lakes minimum transparency recorded during monsoon was due to large amount of silt being carried along with runoff, the maximum transparency during summer due to low depth and shallow bed at the collection site.

Dissolved Oxygen (DO):

Oxygen being one of the most important parameters of aquatic life for their survival was studied here. In the present investigation the lower values of DO were recorded during the monsoon season at all sites whereas the higher values of DO were recorded during winter seasons. During the study period average DO values varied from 5.69 ± 0.03 during monsoon season at Chulbandh lake to 9.14 ± 0.09 during winter season at Putli lake. Dutta *et al.,* (2007) recorded the lowest DO level in Dighali and Kachadhara lake of Nagaon district to the level of 5 mg/l in the month monsoon. Raut *et al.*, (2011) observed the dissolved Oxygen value ranged 2.5 to 5.8 mg/lit. The minimum value of dissolved Oxygen was 2.5 mg/lit in summer and maximum was 5.6 mg/lit. in winter season. According to Biswas *et al*., (1975) large quantity of water in lakes dilute the organic matter, the organic matter from surface runoff, domestic activities and flooded water lowers the level of dissolved oxygen in the monsoon season. In the present investigation the lower value were recorded during monsoon which might be due to organic load carrying with runoff and with their consequent decomposition. Whereas higher value of DO in winter may be due to increased solubility of DO with fall in temperature and also due to increased photosynthetic activity of phytoplankton and macrophytes. The high level of Oxygen content in all lakes during winter season was also might be due to wideness of the lakes and low temperature prevailing during winter.

Free CO_2:

During the study period the minimum mean values of free Carbon dioxide (CO_2) differ from 3.04 ± 0.05 during winter season at Putli lake to 4.66 ± 0.04 during summer season at Naktya lake. Koli *et al.,* (2014) observed the CO_2 ranged in between 1.89 to 5.98 mg/lit. The minimum CO_2 observed in monsoon and maximum was during summer season in Tulashi tank, Kolhapur district. Patel *et al.,* (2015) observed the CO_2 ranges in between 11.6 – 13.5 mg/lit., it was minimum in monsoon 11.6 mg/lit at Borpada lake, Bhiwandi, Thane district. The minimum free CO_2 was 11.6 mg/lit., it was recorded during winter season which might be due to low biodegradable material at the bottom where as its higher value during summer may be due to organic load from summer crop agricultural runoff and domestic wastes. Sarang *et al.,* (2015) observed the CO_2 ranges between 19.8 to 24.2 mg/lit, it was minimum in monsoon and maximum in winter at Temple pond, Titwala, Maharashtra. Khekare (2018) reported free CO_2 content was 5±0.35 during winter season and 6.55±0.74 during summer season.

Biological Oxygen Demand (BOD):

During the study period, the minimum mean values of BOD differ from 6.23 ± 0.18 during winter season at Putli lake to maximum 12.83 ± 0.13 during summer season at Umarzari lake. Higher BOD values in summer may be due to organic load and reduced water flow. The lower value during winter season may be due to flow of water which dilutes the organic pollutants and decreasing microbial activity due to low temperature. Pal *et al.,* (2013) observed the BOD value ranges in between 2.8- 4.2 mg/lit, in Keerat Sagar in Mahoba district of Bundelkhand region, Uttar Pradesh. Udayashankara *et al*., (2013) observed the BOD of Lingambudhi lake, ranged in between 5.9 to 25.9 mg/lit. Mehta *et al.*, (2016) observed the BOD value fluctuates in between 2 to 7 mg/lit.

Chemical Oxygen Demand (COD):

During the study period the mean values of COD varied from 20.26 ± 0.03 during winter season at Umarzari lake to 35.90 ± 0.11 during summer season in the same lake. Sawant *et al.,* (2012) observed the COD value ranges from 25.6 to 89.9 mg/lit, at Dhamapur lake, it was minimum 25.6 mg/lit in monsoon season and maximum 89.9 mg/lit in summer season at Malwan, Sindhudurga district, Maharashtra. Puri *et al.,* (2010) observed the COD value of Gorewada lake of Nagpur city, Maharashtra varies in between 26 to 78 mg/lit. In

the present investigation the maximum value of COD was recorded during the summer season from Umarzari lake, it might be due to the domestic and agricultural discharge from nearby areas. The minimum values recorded during winter season which might be due to dilution effect as this site has been comparatively deeper containing more water in the winter.

Phosphate:

During the study period the mean values of Phosphate was differ from 0.34 ± 0.01 during winter season at Naktya lake to 0.90 ± 0.01 during summer season at Rengepar lake. Gupte *et al.,* (2013) observed the Phosphate ranged from 1.46 to 3.6 mg/lit the minimum 1.46 mg/lit was in winter and maximum 3.6 mg/lit in summer season from Shelar lake, Bhiwandi, Thane, Maharashtra. Sharma *et al.,* (2011) observed the Phosphate value ranged in between 2.08 to 3.51 mg/lit, the minimum Phosphate content 2.08 mg/lit recorded in monsoon and maximum 3.51 mg/lit in summer at Pichola lake, Udaipur Rajasthan. In the present investigation the lower value were recorded during winter season might be due to rapid utilization by aquatic plants and also due to assimilation by phytoplankton while summer maximum may be due to low water level and inflow of agricultural runoff from summer paddy cultivation in some patches at the catchment area.

Nitrate:

In the present investigation the lower values of Nitrates were recorded during the winter season at all lakes whereas the higher values of Nitrates were recorded during monsoon seasons. During study period the mean values of Nitrate were varied from 0.43 ± 0.03 during winter season at Putli lake to 1.04 ± 0.03 during monsoon season at the same lake. Belkhode *et al.,* (2016) observed the Nitrate value ranged in between 0.09 to 0.30 mg/lit, it was maximum 0.30 mg/lit in summer and minimum 0.09 mg/lit in winter at Kurual lake, Alibagh district, Raigad, Maharashtra. Jadhav *et al.,* (2013) observed the Nitrate value fluctuates in between 0.02 to 0.12 mg/lit, it was maximum 0.12 mg/lit, in summer at Nirmal lake, Vasai, Thane, Maharashtra. In the present investigation highest value during monsoon season may be attributed to heavy rainfall, land runoff, weathering of rocks and oxidation of ammonia form of nitrogen to nitrite and consequently to nitrate. However the summer maxima at all sites may be due to low water level and other anthropogenic activities..

CONCLUSION

All physico-chemical parameters were recorded under permissible limit during the study period. Lower water temperature during winter might be due to high water level and low solar radiation and higher temperature in summer might be due to low water level, greater solar radiation and clear atmosphere. The values of physicochemical characteristics such as Temperature, BOD, COD, DO etc. in all the lakes more or less similar ecological status. Transparency of the Naktya lake is lower as compared to the other lakes may be due to the less number of aquatic plants recorded in the lake during the study period.

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