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SEASONAL VARIATIONS IN PHYSICO- CHEMICAL PARAMETERS OF MAMBAZHATHURAIYARU RESERVOIR AT KANYAKUMARI DISTRICT, TAMILNADU, INDIA

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Abstract

Water is the most versatile inorganic liquid on this planet occurring as universal solvent and indispensable component of nature holding both biotic and abiotic entities in a complex dynamic and delicate ecological balance by virtue of its unique capacity of existing in solid, liquid and gaseous states. The present study was undertaken to assess the quality of water by using physico-chemical parameters of Mambazhathuraiyaru reservoir of Kanyakumari district, Tamilnadu, India. The concentration of water quality parameters like temperature was ranging from 24 to 29.5°C, pH was ranging from 6.44 to 7.12, dissolved oxygen content was ranging from 2.24 to 5.32 mg/l, nitrate was ranged from 0.90 to 2.79 mg/l and calcium was ranging from 12.3 to 162.4 ppm were studied from Mambazhathuraiyaru reservoir, India from June 2017 to December 2017. The results were compared with standards prescribed by WHO and ISI (10500-91). The duration of the reservoir concentrations of nutrients and other water quality parameters potency have been controlled by the anthropogenic inputs from sources.

Keywords: Physico-chemical parameters, water, biotic, nutrients, reservoir

1. Introduction

Water is an essential compound for life on earth. It is the most widely distributed nongaseous substance in nature. Fertile river valleys with abundant water supplies are the centers for beginning civilizations. For the life, demand for water has increased dramatically and its uses have become much more varied. Water is used in agriculture, industry, recreation, and non ingested personal consumption. Water quality monitoring is of immense importance in the conservation of water resources for agriculture and life. Water supply and other activities involves the assessment of physico-chemical parameters of water bodies. Impacted changes in the quality of water are reflected in the biotic community structure. Extensive evaporation of water from the reservoir due to high temperature and low rain fall

enhances the amount of salts, heavy metals and other pollutants, which are conscientious factor for the poor quality of the reservoir ecosystem (Arain *et al.*, 2008).

Water is scare and valuble resource and it is highly essential for the survival of mankind. Water also plays an equally important role in food control. In recent years, a number of events affecting water quality have resulted in increased public concern about surface water quality Chindah (2003). Macer (2000) postulated that the presence of impurities, reduces the quality and uses to which water may be deployed as well as well serve as a major factor controlling the state of health in both cultured and wild fishes. Water must be analyzed to determine its acceptability for the intended purpose. Non availability of portable water to settlements necessitates heavy reliance on coastal waters for domestic, agricultural or recreational purposes.

Natural resources are the important wealth of our country, water is one of them. Good quality water is very necessary for good and healthy life. It is essential part of protoplasm and creates a state for metabolic activities to occur smoothly; therefore no life can exist without water. Fresh water resource is becoming day by day at the faster rate of deterioration of the water quality is now a global problem (Mahanand *et al.*, 2005). Mambazhathuraiyaru reservoir being an important ecological site, this study is aimed at providing useful inputs and necessary for the management of the environmental aspects of the many multipurpose lakes and reservoirs. Despite such an exhaustive work, up to now, there was no systematic study carried out for the physicochemical analysis and quality control assessment Mambazhathuraiyaru reservoir for a period of June 2017 to December 2017. The water from this reservoir is used only purpose and nearly for irrigation.

2. Materials and methods

The water samples were collected every month from the Mambazhathuraiyaru reservoir, the physico-chemical parameters were analyzed by appropriate standardized procedure under field and laboratory condition. For the sake of interpreting the data, a calendar year was divided into 3 main seasons viz Pre monsoon- (January – May), southwest monsoon-(June – September) and northeast monsoon-(October-December). Three stations were fixed for the present study as S-I, S-II and S-III respectively. Station-I is located near the mouth or inlet of reservoir. Station- II is located about 500 m away from the S- I. Station-III is located near the outlet of reservoir.

Environment temperature and surface water temperature were measured using a digital centigrade thermometer. Water pH -Negative logarithm of hydrogen ion concentration

has been recorded in the field itself using an pH meter. Dissolved oxygen was estimated by modified Winkler's method. For the analysis of nutrients, surface water samples were collected in clean polythene bottles and kept immediately in an icebox and transported to the laboratory. The water samples were than clean by a millipore filtering system and analyzed for nitrate and nitrite by adopting standard procedure of (APHA *et al.*, 1998).

Mambazhathuraiyaru reservoir is situated in Kalkulam Taluk of Kanyakumari district, Tamilnadu, India. The field studies involved collection of the surface and bottom water samples from 5 stations at an interval of 0.5 Km. The present study was carried out over a period of different seasons (June 2017 to December 2017). Water samples were collected from the mouth of the reservoir at three different stations in the early morning and they were transported to the laboratory in plastic standardised containers maintained at about 5º C and analyzed for the physicochemical parameters. Concentration of water parameters like temperature, pH, turbidity, dissolved oxygen(DO), nitrite (No_2^-), nitrate (No_3^-), calcium(Ca^{++}) and magnesium(Mg^{++}) was determined by adopting the standard method (APHA,1992). The analysed data were compared with standard values recommended by WHO (1993) and ISI(10500-91).

3. Result

The monthly fluctuation and average in rainfall (mm) recorded at the Mambazhathuraiyaru reservoir during June 2017 to December 2017 are depicted Fig.1. The water temperature (^{0}C) recorded in S-I ranged from 26 (^{0}C) in June to 28 (^{0}C) in September with an average value of 26.75 ± 1.37 ^{o}C. The seasonwise variations in water temperature values were also studied (Table.1 & 2). During southwest monsoon period, the minimum water temperature of 25.5 ± 1.29^{o}C was recorded in S-II against the maximum of 26.75 ± 1.37^{o}C in S.I. In the northeast monsoon period, the minimum temperature of 26.5 ± 1.32^{o}C was recorded in S-II against the maximum of 27.66 ± 1.75^{o}C was recorded in the S-I (Fig.2a). The seasonwise variations in pH values were also studied (Table. 1 & 2). During southwest period, the minimum pH of 6.91 ± 0.16^{o}C was recorded in S-II against the maximum of 6.98 ± 0.14 in S.I. In the northeast monsoon period, the minimum pH of 6.66 ± 0.24 was recorded in S-II against the maximum of 6.73 ± 0.25 was recorded in the S-III (Fig.2b).

The monthly fluctuation and average in dissolved oxygen (ml/l) content estimated in the sampling stations during the study period are shown in Fig.2c. During southwest monsoon period, the minimum dissolved oxygen (ml/l) of 3.16 ± 1.02 ml/l was recorded in S-II against

the maximum of 4.46 ± 0.49 ml/l in S.I. In the northeast monsoon period, the minimum dissolved oxygen (ml/l) of 3.08 ± 0.28 ml/l was recorded in S-II against the maximum of 5.32 ± 0.28 ml/l was recorded in the S-I.

Fig.2d depicts the monthly average and fluctuation in nitrite recorded in the sampling stations during the period from during June 2017 to December 2017. During southwest monsoon period, the minimum nitrite (µg/l) of 1.10± 0.33 (µg/l) was recorded in S-I against the maximum of 1.49 ± 0.52 (µg/l) in S-II. In the northeast monsoon period, the minimum nitrite 1.30 ± 0.31 (µg/l) was recorded in S-I against the maximum of 2.19± 0.62 (µg/l) was recorded in the S-II. The season wise average and fluctuation on nitrate (µg/l) values recorded at the sampling stations are shown in Fig.2e. During southwest monsoon period, the minimum nitrate (µg/l) of 19.98 ± 3.41 (µg/l) was recorded in S-I against the maximum of 26.27 ± 4.22 (µg/l) in S-II. In the northeast monsoon period, the minimum nitrate (µg/l) of 22.84 ± 3.24 (µg/l) was recorded in S-I against the maximum of 30.55 ± 2.32 (µg/l) was recorded in the S-II.

The seasonwise variations in calcium (ppm) values were also studied (Table.1&2). During southwest monsoon period, the minimum calcium value of 21.07 ± 3.80 (ppm) was recorded in S-III against the maximum of 131.9 ± 33.12 (ppm) in S-I. In the northeast monsoon period, the minimum calcium value 19.76 ± 7.05 (ppm) was recorded in S-II against the maximum of 90.76 ± 14.20 (ppm) was recorded in the S-I (Fig.2f). The monthly fluctuation and average in magnesium (ppm) at the sampling stations are shown in Table 1 & 2 and Fig. 2g. During southwest -monsoon period, the minimum magnesium value of 100.17 ± 26.37 (ppm) was recorded in S-III against the maximum of 703.6 ± 51.32 (ppm) in S-I. In the southwest monsoon period, the minimum magnesium value of 59.83 ± 12.63 (ppm) was recorded in S-III against the maximum of 693.33 ± 127.46 (ppm) was recorded in the S-I.

4. Discussion

The physico-chemical parameters fluctuated much in the selected sampling stations of the experimental reservoir. Water temperature depends on incoming solar radiation. In the present study December 2017 reported low temperature. During the northeast monsoon period, the water temperature was low when compared with southwest monsoon period. This was due to the cooling of the atmosphere. The highest values observed during the month of January were due to summer. There was an increase in water temperature during Pre monsoon season and was due to less rainfall when compared with northeast monsoon

season. It is stated that in most of the Indian reservoirs the difference between highest and lowest temperature never exceeds 8°C to 10°C. The water temperature during December was low because of strong land breezes, fresh water influx and precipitation. High value during summer (January and February) could be attributed to high solar radiation (Govindasamy *et al*., 2000).

pH is a fundamental biogeochemical parameter, which plays a major role in most natural processes and has a quite universal importance in ecosystem. The pH of the water is critical to the survival of most aquatic plants and animals. Many species cannot survive if pH drops under 5.0 or rises above 9.0. Changes in pH can alter the water chemistry, usually to the disadvantage of native species (Smith 1992). During the present investigation a low pH was observed at S-II through out the study period. Season wise data showed maximum pH during the northeast monsoon season and minimum during non monsoon season. Monsoon influenced pH variation was reported by Subramanian (1982) in Krishna river.

Dissolved oxygen is obviously essential for the metabolism of all aquatic organisms that process aerobic respiratory bio-chemistry (Wetzel, 1975). The concentration of dissolved oxygen showed a wide range of variations throughout the study period. In the present study maximum dissolved oxygen values recorded (5.34 ml/l) in stations I are due to low turbidity. Similar trend was observed earlier in Vellar estuary by Jegatheesan (1974). A minimum dissolved oxygen level was observed at S-II during the course and study. The low dissolved oxygen indicates survivals are not suitable for many aquatic organisms. The minimum level dissolved oxygen due to low transparency was reported by Sreenivasan (1976). In the present study high values of dissolved oxygen were recorded during the northeast monsoon period due to the intrusion of fresh dissolved oxygen rich water in the reservoir and resultant circulation and mixing of water. Low values of dissolved oxygen were also due to high temperature in the summer as well as due to microbial demand for oxygen in decomposition of suspended and dissolved organic matter (Umayorubhagan *et al*., 1998).

In the present study, nitrite concentration was lower than the nitrate, since nitrite is in unstable form, its oxidation in to nitrite can be considered as the main reason for the low nitrite. The maximum nitrite content was recorded during northeast monsoon season and minimum values were obtained during nonmonsoon season. During the monsoon season the nutrients (both nitrogen and phosphorus) were added mainly from the irrigation run off, river discharge rainfall conditions (Ashok Prabu *et al*., 2008). Sukumaran *et al*., (2013)

reported that an increase in nitrite concentration could attribute the bacterial decomposition of planktonic detritus by the activity of nitrifying bacteria and air-sea interaction of exchange of chemical elements. Minimum values of nitrite in non monsoon and may be due to reduction of river flow and utilization by phytoplankton as reported by Subramanian and Mahadevan, (1999). Nitrate is released in the water by biological oxidation of nitrogenous compounds. Maximum nitrate values were recorded in the northeast monsoon season and minimum nitrate values in southwest season. High concentration of nitrate registered during monsoon season might be due to heavy rainfall, resultant river- runoff, land drainage and input of fertilizers from the adjacent agricultural fields and oxidation of ammonia. Prema (2000) reported that the higher concentration of nitrate may be due to higher rate of nitrate regeneration from organic materials.

Calcium and magnesium values showed maximum value at S-I, which is a marine station. The calcium and magnesium determine the hardness of water and considered as micronutrients that influence the growth and distribution of plant and animals (Wetzel, 1975). In the present study high value of calcium and magnesium was observed during monsoon season. Both calcium and magnesium concentration increased towards the freshwater zone of the reservoir is in agreement with present observation.

The results reveal that the all water quality parameters are within the permissible limits. The sampling sites S-II and S - III showed physico-chemical parameters within the water quality standards and the quality of water is good and it is fit for drinking purpose. Reservoir is not polluted. The water is useful for drinking, irrigation, fishing and hydro electric generation activities. Based on the results of the present study it can be stated that, the water quality of the Mambazhathuraiyaru reservoir can be improved, if the physicochemical parameters of the water body are maintained at required levels.

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Table-1: Average results of the Physico-chemical parameters of Mambazhathuraiyaru reservoir in southwest monsoon.

Sl.No	Parameter	WHO	ISI (10500-91)	Sampling stations of Mambazhathuraiyaru reservoir		
				S1 (ml/l)	S2 (ml/l)	S3 (ml/l)
1.	Temperature	-	-	26.75	25.5	26.75
2.	pH	6.5-8.5	6.5-8.5	6.9875	6.9125	6.9625
3.	Turbidity	1	5	0	1	0
4.	DO mg/l	-	-	4.46	3.16	4.3275
5.	Nitrite (mg/l)	0.3	0.3	0.1105	0.14925	0.13175
6.	Nitrate (mg/l)	1 - 9	4 - 9	1.99875	2.627	2.297
7.	Ca^{++} mg/l	75	200	131.9	28.675	21.075
8.	Mg^{2+} mg/l	30	100	703.6	320.75	100.175

Table-2: Average results of the Physico-chemical parameters of Mambazhathuraiyaru reservoir in northeast monsoon.

Sl.No	Parameter	WHO	ISI (10500-91)	Sampling stations of Mambazhathuraiyaru reservoir		
				S1 (ml/l)	S2 (ml/l)	S3 (ml/l)
1.	Temperature	-	-	27.66667	26.5	27.5
2.	pH	6.5-8.5	6.5-8.5	6.69	6.66	6.73
3.	Turbidity	1	5	1	2	0
4.	DO mg/l	-	-	5.32	3.08	5.04
5.	Nitrite (mg/l)	0.3	0.3	0.130	0.219	0.165
6.	Nitrate (mg/l)	1 - 9	4 - 9	2.283	3.055	2.653
7.	Ca^{++} mg/l	75	200	90.76667	19.76667	20.1
8.	Mg^{2+} mg/l	30	100	693.9333	183.6333	59.83333

Figure 1. Shows rainfall (mm) level in Mambazhathuraiyaru reservoir during the study period June to December 2017.

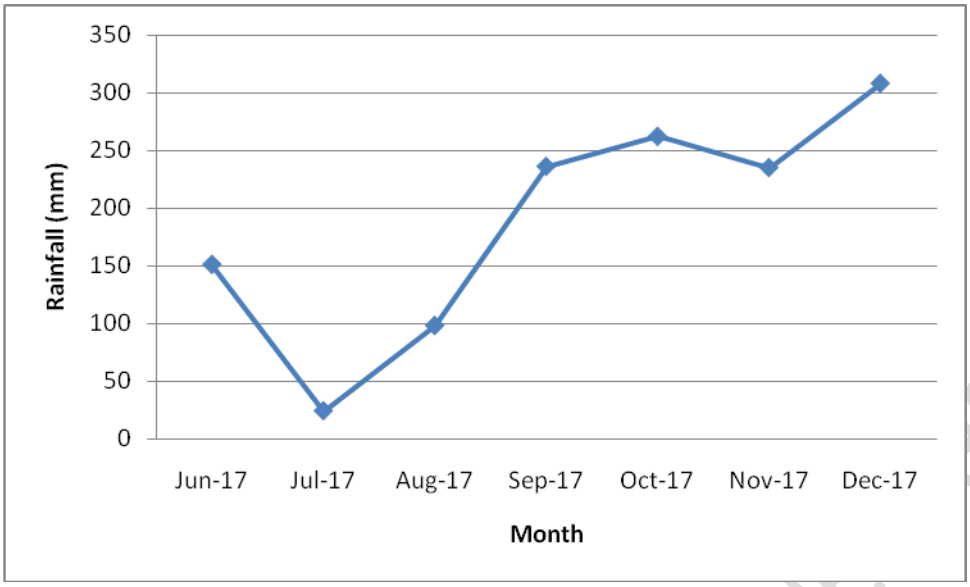
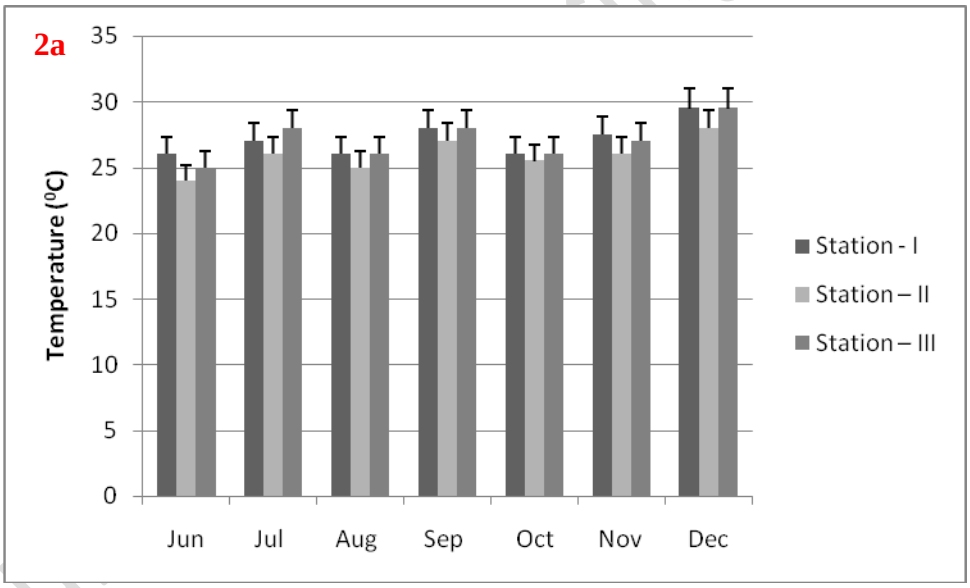
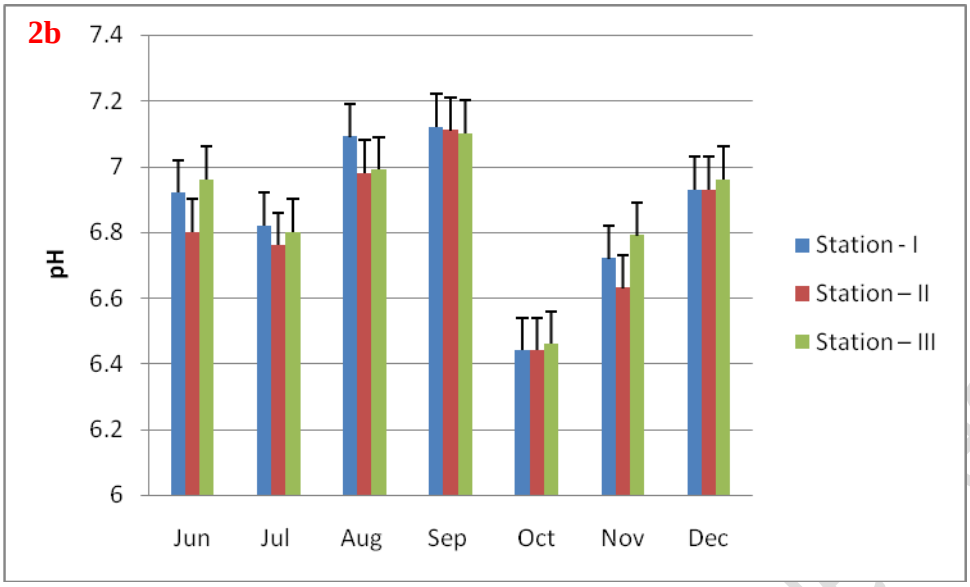
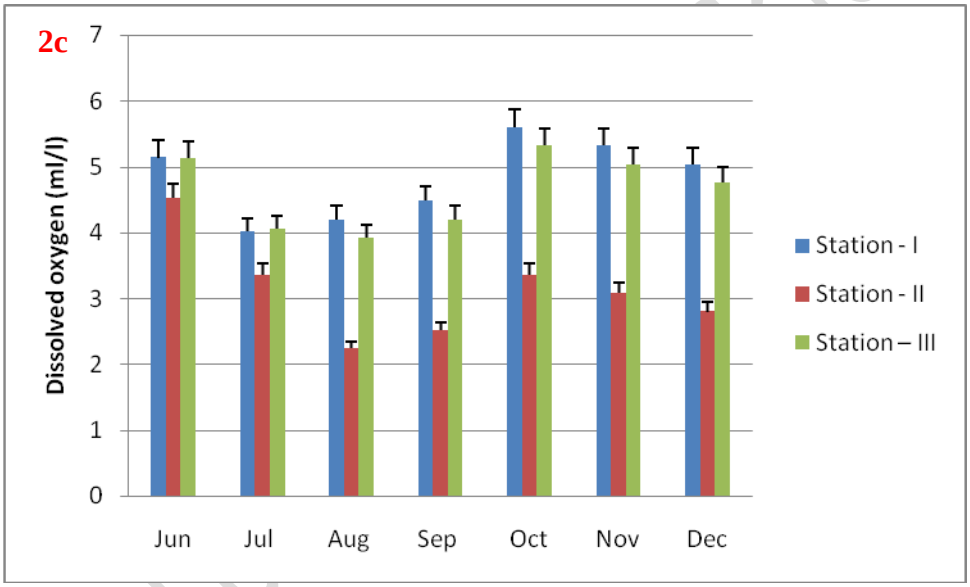
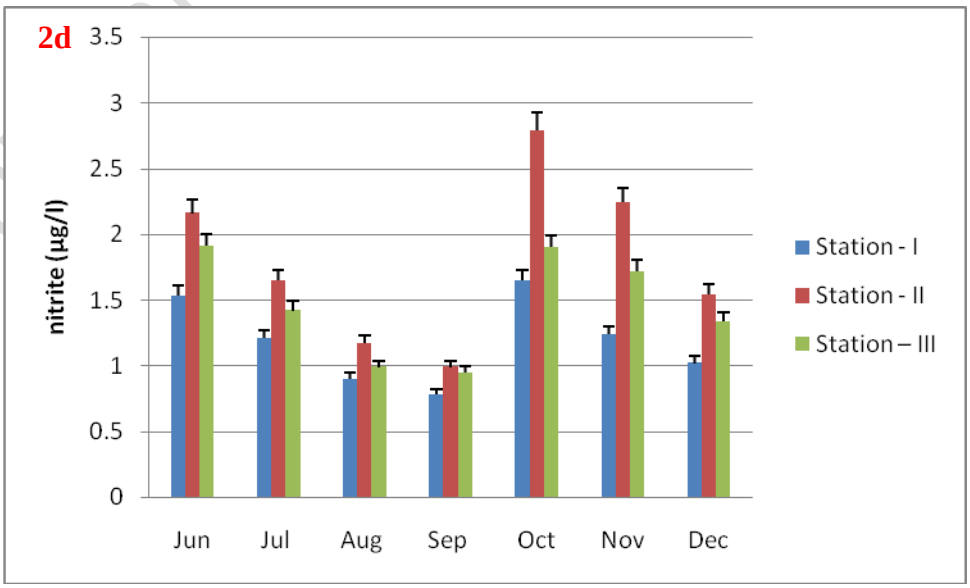


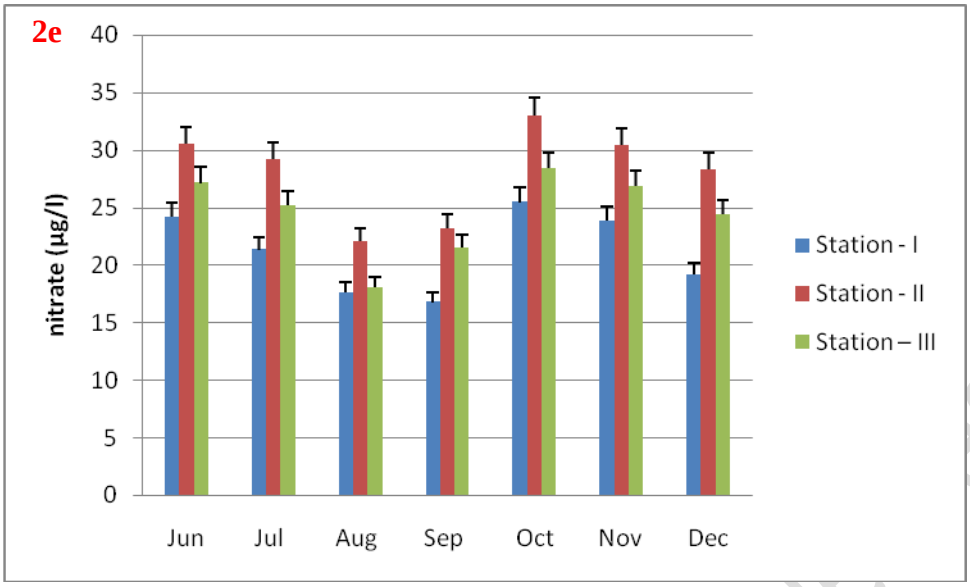
Figure 2 (2a-2g). Shows monthly variation in water Physico-chemical parameters during the study period June to December 2017

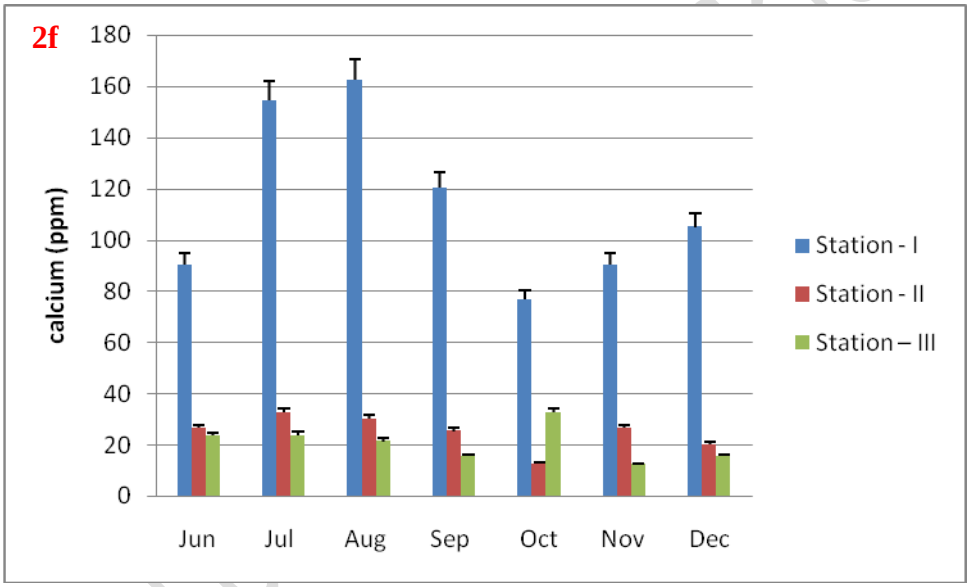


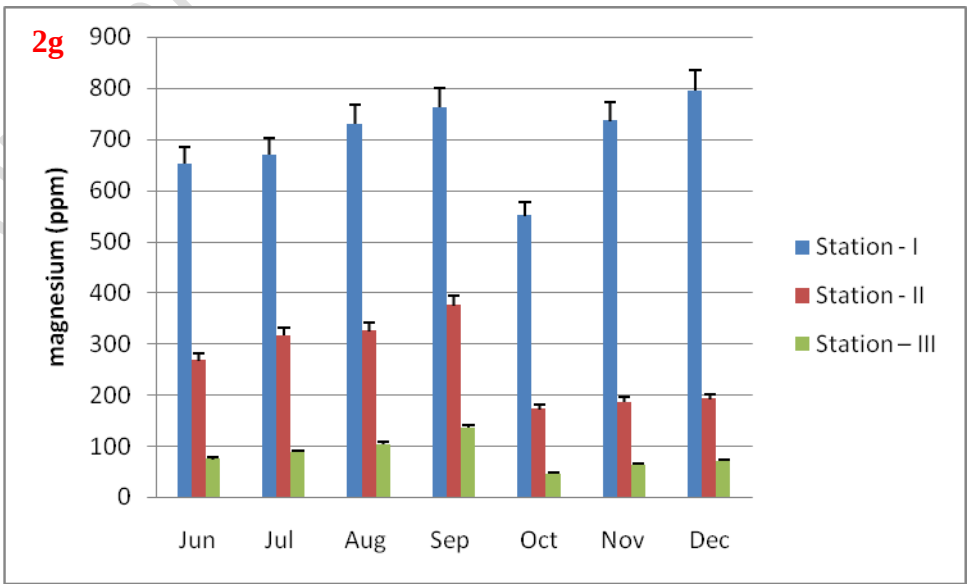

2b
pH
7.4
7.2
7
6.8
6.6
6.4
6.2
6
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Station - I
Station – II
Station – III


2c
Dissolved oxygen (ml/l)
7
6
5
4
3
2
1
0
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Station - I
Station - II
Station – III


2d
nitrite (µg/l)
3.5
3
2.5
2
1.5
1
0.5
0
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Station - I
Station - II
Station – III


2e
nitrate (µg/l)
40
35
30
25
20
15
10
5
0
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Station - I
Station - II
Station – III


2f
calcium (ppm)
180
160
140
120
100
80
60
40
20
0
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Station - I
Station - II
Station – III


2g
magnesium (ppm)
900
800
700
600
500
400
300
200
100
0
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Station - I
Station - II
Station – III