Biodiversity of Sirpur Wetland, Indore

March 2020-2021

PREFACE

Environmental Research Laboratory (ERL), EPCO was entrusted to conduct a study on Biodiversity of Sirpur Wetland vide Office Order No: 4819/EPCO/2020, Bhopal, dated 27/1/202 of Executive Director, EPCO. The study is an important component under conservation of Sirpur Wetland Project sanctioned under National Wetland Conservation Plan of Ministry of Environment, Forests & Climate Change (MoEF&CC).

Under this project various mitigative measures as proposed in the Detailed Project Report have been implemented under the supervision of Municipal Corporation, Indore with the coordination of Environmental Planning & Coordination Organization (EPCO), which is nodal agency for implementation of Sirpur Wetland Project. The basic objective was to improve the water quality of this pristine wetland through implantation of various conservation measures as envisaged in the DPR. Beside improvement of the water quality as per CPCB best uses criteria; other important objective was to focus on overall biodiversity of this wetland which inhabits innumerable flora and fauna of both terrestrial and aquatic categories including large number of residential and migratory birds.

Hence to mobilize relevant information required for preparation of the report, a technical team of ERL along with the personnel from Indore Municipal Corporation had visited the wetland on two occasions: first from 4-6th March, 2020 and 2nd from 2-5th March, 2021 for collecting various information related to sampling site, catchment structure, problems /threats of the wetland etc towards preparation of biodiversity status of the wetland vi-a-vis existing water quality of the Wetland. The team collected water and sediment samples from various 12 stations (8 from Upper Lake and 4 from Lower Lake) of the wetland to evaluate the present status of water quality as well as biodiversity of the wetland. Water samples were collected and analyzed at Environmental Research Laboratory of EPCO which is a State Laboratory of MP for Air & Water Analysis. Sampling was done twice with an interval of almost one year so as to

assess the overall biodiversity of the wetland with reference to changing anthropogenic and natural variables. Besides above information, maps pertaining to various parameters, like drainage basin, demographic structure, existing land use, contour plan, proposed area for plantation and gabion structure, map for buffer zone etc have been prepared with the help of IMC.

Photography relating to various aspects of the lake has also been done. The team had interaction with the local community and stakeholders of the wetland, officials of Indore Municipal corporations and distinguished Environmental Conservationist like Mr. Bhalu Monde, a Padmyashri recipient and internationally acclaimed bird watcher to incorporate their suggestion in preparing the report. The report prepared on the basis of data generated in two different occasions during 2020-21 is discussed below.

Contents

1. INTRODUCTION

India is one of the richest nations in terms of biological diversity. The two major factors responsible for this are wide range of climatic zones and the existence of islands with their own variety of endemic species. The conservation of biodiversity is not only essential for ecological and environmental issues but also for sustainable economic and social processes, not only at the national but also at the global level. The importance of biodiversity and its conservation is getting greater recognition all over the world, particularly in countries such as India, which strongly depend upon their agriculture and natural resources. The subject of biodiversity conservation has been engaging our attention during the past few years and there have been many attempts for *in-situ* conservation. Some species-rich areas were declared as Biosphere Reserves, National parks & Sanctuaries to give protection to their natural flora and fauna. Increasing population, industrialization, commercialization, and consumerism together has formed a highly explosive combination. Number of factors like misuse of nature, destruction and degradation of forests and habitats, contamination and destruction of natural resources is leading to the extinction of several species of organisms. India is classified as one of the world's 12 centers of mega-diversity in terms of animal and plant wealth. According to the union Ministry of Environment and Forests, the country has 6.67% of the animal species in the world and the plant species add up to a 12.53 per cent of the total number in the world. One of the basic functions of conservation of bio-diversity is to develop strategies leading to improvement and management of natural resources including lake, reservoir, wetland etc.

Wetlands are areas lying along the banks of rivers and lakes and the coastal regions. They are life-supporting systems providing fish, forest products, water, flood control, erosion buffering, a plant gene pool, wildlife, recreation, and tourism areas. Though they are endowed with a rich biodiversity, yet of late they are being greatly exploited. Many wetland species have become threatened and endangered because of their dependence on a particular type of wetland ecosystem, which has become seriously degraded or destroyed. Large areas here have been

converted to agricultural land or there has been widespread overgrazing. Removal of sand, gravel, and other material from the beds of rivers and lakes has not only caused destruction to the wetlands but has led to sedimentation, which has affected other areas. The introduction of exotic plants has had an adverse effect on these areas. The water hyacinth, a native of South America, is now a major pest in many areas forming a vast floating shield over the surface of the water and clogging up rivers and canals. A number of factors have been responsible for the depletion of wetland areas mainly the mangrove forests, along the coasts of India. Intensive aquaculture development, deforestation, pollution from tankers, domestic waste, agricultural runoff and industrial effluents are some of the factors. The Ramsar Convention for the preservation of wetlands of international importance especially as Waterfowl habitat was held in Iran in 1971.

Thereafter several initiatives have been taken by the Government for conservation of wetlands involving number of agencies from government and semi government departments.

But the fragile ecosystem of many wetlands is still under threat due to both anthropogenic and natural factors. It provides refuge to thousands of migratory birds and the balance in the ecosystem has to be maintained to ensure safe habitat for the birds.

In many parts of India, freshwater ecosystems are even more threatened than are terrestrial ecosystems. Despite this, conservation of freshwater bio-diversity has been seriously underrepresented in protected areas systems. Entire ecosystems are now at risk of being eliminated. Aquatic organisms constitute a vital link of the food chain in aquatic ecosystem and their productivity directly depends on physico-chemical features of lake. The state of Madhya Pradesh is the second largest state in India. This state is blessed with innumerable number of water resources and is rich in biodiversity, a large part of which are yet to be explored. However like other places a large number of water bodies in the state are facing multiple problems, conservation of bio-diversity being one of them. Hence knowledge on abundance,

composition and seasonal variation of aquatic communities of this part of India will help in planning, conservation and successful management of the water bodies.

2. Scope of Work

Under the scope of work following parameters were selected for analysis at an interval of one year. The first sampling was done during March 2020 and the second and final one was conducted during March 2021.

2.1 Parameters

A	Biological	B	Physico-chemical
1	Phytoplankton	1	Temperature
2	Zooplankton	2	pH
3	Protozoans	3	Turbidity
4	Macro-Floral (Macrophytes)	4	Dissolved Oxygen
5	Macro Macro-Faunal (Fish)	5	TDS
6	Benthos	6	Conductivity
		7	BOD

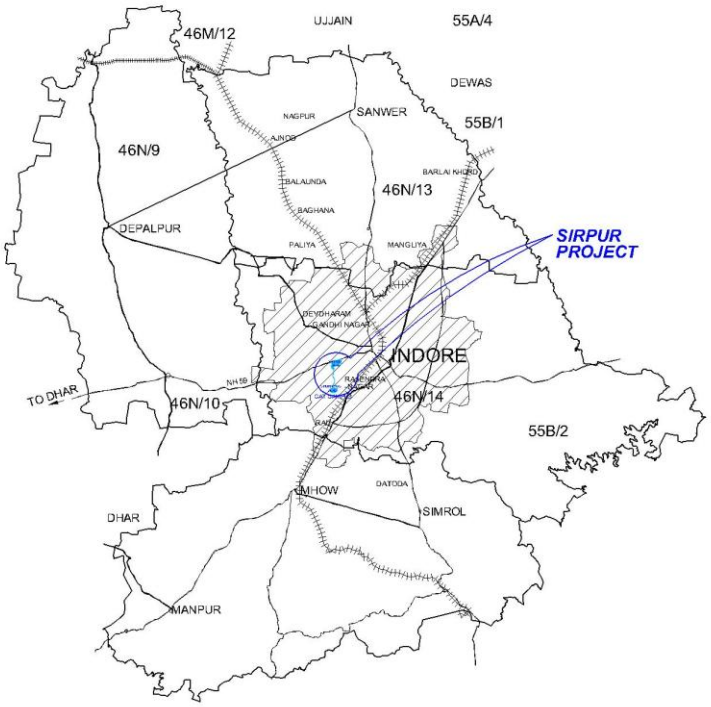
3. STUDY AREA

3.1 DESCRIPTION OF THE PROJECT SITE: INDORE CITY PROFILE

Indore is the largest city and the commercial capital of the central Indian state of Madhya Pradesh and is situated on the Malwa Plateau, just north of the Vindhya Range. It is the administrative headquarters of the District Indore and earlier served as the capital of the former princely state of Indore and used to be the summer capital of the erstwhile state of Central India. The city is located in the Narmada River valley, River Saraswati and River Khan, which are tributaries of River Kshipra, flow through Indore. The two rivulets unite at the center of the city where a small temple of Sangamnath or Indreshwar exists. The city of Indore derived its name from the deity itself. With growing population, the city is expanding rapidly and so is

its tourism industry. Indore is known for its architectural splendor. The tales of the glorious past are narrated by these splendid historical monuments add names of monuments and cast a magical spell on the visitors. Rani Ahilya Bai Holkar was a great architectural patron and spent a lot of money on the construction of many temples across the nation. The queen is taken in great regard by the people and as a tribute; her statue was built in the center of the city, near Rajwada. Indore owes its early growth to trade and commerce, which is still a dominant feature of the city. The present city is about 400 years old settlement. Till the end of 15th century its original nucleus was a riverside village, which occupied the bank of river Saraswati. This area is now known as Juni Indore.

The little village grew as an important halting place for pilgrims traveling between great religious cities, Ujjain on the bank of the Holy the River; Narmada. Later, in addition to the halting place it was also a camping place for forces of Moghuls and Marathas who frequently moved to South and North for expanding their kingdoms. The Zamindars of village Kampel (about 10 km. S.E) visualized the opportunity of flourishing trade in this settlement and settled on the banks of the River Khan. To withstand the foreign invasions, Zamindars built a castle, giving this village a character of a walled town, although the town hardly suffered the destruction of feudal wars. In 1728, the chief of the Marathas, Bajirao Peshwa, granted Holkar State to Malhar Rao. He ruled the state from 1728 to 1766. During this period development was primarily for military and commercial development was incidental. In 1818 the capital was shifted from Maheshwar to Indore, though Rani Ahilya Bai, daughter-in-law of Malhar Rao, initiated the proposal. Apart from being a historical city, it is also the commercial capital of the state of Madhya Pradesh.



3.2 Location and Linkages

Indore city is located in the center of Indore district. It is situated on fertile Malwa Plateau, located at 23° 43'N latitude, 76°42'E longitude. Indore is located at an average altitude of 550mts, above MSL with a gentle slope towards the north. The city is located 264 km away from Bhopal the capital of MP. The city is well linked by road, rail and air. Regional road pattern fans out in all directions. The National Highway 3 (Agra-Bombay road) passes through the city area. The State highway and the District highway connect the city with the State capital Bhopal, all district headquarters of the division and important towns within the district. The city is served by a broad gauge and meter gauge western railway line passing through the heart of the city. The city also serves regular air service which connects Indore city to Mumbai, Bhopal, Jabalpur and New Delhi. Indore has for a long time been a rail and road transportation hub.

3.3 SIRPUR WETLAND

Location of Sirpur Wetland

The Sirpur wetland where the present study was conducted is situated in the out skirts of Indore town. However with the extension of the township, the wetland has become a part of the Indore city. The wetland was developed by raising an embankment across the inflow channel which brings water to this lake.

4. MATERIAL AND METHODS

4.1 General

The present study was conducted during March 2020 to March 2021 to assess the water quality with respect to Biodiversity of Sirpur Wetland at different stations of the wetland.

Sampling Team of EPCO at Sirpur Wetland

Total 12 sampling stations were selected to collect water samples from both surface and bottom waters. 4- Sampling stations were selected from Chota Talab and 8- Sampling stations were selected from Bara Talab.

4.2 Sampling stations at Chota Talab

Station: L1- This station is located in small lake (Chota Talab) of the twin water bodies of Sirpur wetland near the site office of Nagar Nigam, adjacent to Hanuman Mandir. This station is also rich in macrophyte diversity. Sample from this station was collected from littoral region. This region is subjected to nutrient enrichment due to siltation/erosion

Station: L2- This station is situated near view point at Chota talab approximately 200 meters away from first station. The area being in the littoral region is also rich in macrophyte density. Accumulation of organic masses was observed in this area due to agglomeration of large quantity of aquatic weed.

Station: L3- This station is situated on eastern part of the wetland (near Prajapat Nagar). The catchment is mostly used for plantation. This area is also rich in macrophyte density. Further a large part along this region is victim of siltation and accumulation of nutrients of autocthonus origin.

Station: L4- This sampling station is situated near centre of the Chota Talab. The area of this part of the wetland falls under limnetic region. This place is comparatively poor in macrophyte diversity.

Sampling stations at Bara Talab

Station U1: This station is situated near Hanuman Chalk (U-point). The station is on Southern part of the Bara Talab and infested with emergent as well as submerged macrophyte.

Station U2: This station is situated near the entry point /view point of the Bara Talab. Samples were collected from littoral zone of the wetland.

Station U3: This station is located on eastern southern part of the water body (near the Naoghat). The area inhabitated by large number of avi fauna.

Station U4: This station is situated near the overflow point of the wetland. Samples were collected from the littoral region which is rich in macrophyte density.

Station U5 - This station is situated near the Majhar in Bara Talab (the bigger water body of the wetland). This place is rich with different varieties of macrophytes especially *Hydrilla verticillata* and *Ceratophyllum* and few submerged macrophytes.

Station U 6- This station is situated near Naoghat at Bara Talab. The area inhabits large number of residential birds.

Station: U 7- This station is situated near temple at Bara Talab**.** This is one of the major sites of anthropogenic activities. This station is also enriched with few varieties of macrophytes especially the submerged types like Hydrilla, Vallisneria, Potamogeton pectinatus etc.

Station: U 8- This sampling station is situated near centre of the Bara Talab. The area is in the littoral region and mostly occupied by birds. This station is also poor in macrophytic density.

4.3 Sampling Technique

During the period of investigation summer samples (Considering March as representative of summer season) were collected from 12 identified sampling stations. Following the standard method, water samples were collected in sterile glass bottles, plastic cans from each station. After collection of the samples the bottles were tightly capped and were immediately transported to the mobile laboratory to avoid any unpredictable changes in the physico-chemical characteristics. Suitable preservation techniques were adopted as per the standard methods (APHA, 2010).

Parameters like temperature, turbidity, conductivity, dissolved oxygen, TDS were analyzed on the field while rest of the parameters were analyzed in the Environmental Research Laboratory of EPCO following the methods described in APHA (2010) and Golterman and Clymo, (1969).

For the collection of Biological samples, the known amount of sample was filtered through plankton net and preserved by adding Lugol's iodine and formalin solution for phytoplankton and zooplankton respectively. Macrophytes were collected by quadrate method while macrobenthos were collected using Eckman Dredge mud sampler. Data for Fish mobilized from the local fisherman community.

4.4 Methods for Analyzing Physico-chemical Parameters

1. Temperature

Atmospheric temperature at the time of sampling was determined by a 0.1^0 Centigrade thermometer. Temperature of surface and bottom water was recorded by dipping the thermometer directly into the water, keeping it steady for about a minute and then noting the temperature. Temperature at two to three places at the same sampling station was recorded and means water temperature was noted. The result has been expressed as ^OC.

2. pH

During present investigation pH was measured by electrochemical method with the help of pH meter.

3. Turbidity:

Turbidity during present investigation was determined by Turbidity Tube and the result is expressed as Jackson Turbidity unit (JTU).

4. Dissolved Oxygen (DO)

Dissolved oxygen was determined by Winkler's method with Azide modification. Water samples were collected in 125 ml glass stoppered bottles without bubbling and were immediately fixed with addition of 1 ml each of Manganous sulphate and alkaline iodide azide reagent respectively. After thorough mixing of the reagents in sample, a flocculent precipitate was formed which settled down at the bottom.

For qualitative estimation, 1ml of concentrated H_2SO_4 was added to dissolve the brown precipitate. 50 ml of this solution was transferred to a conical flask and titrated against 0.025N solution of sodium thiosulphate ($Na_2S_2O_3$) titrant until the disappearance of blue colour by using starch as an indicator**.** The Dissolved Oxygen concentration was calculated using the following formula.

$$\text{Dissolved oxygen (mg/l)} = \frac{\text{vol (ml) of titrant x N x 8}}{\text{vol (ml) of sample taken}} \times 1000$$

5. Total Dissolved Solids (TDS)

TDS was measured using the electronic TDS meter (ELE) and was reported as mg/liter or parts per million (ppm).

6. Conductivity:

Conductivity was measured in mili siemens per centimeter square using a calibrated conductivity meter. The measurement was made in the field immediately after water sample has been obtained, because conductivity changes with storage time.

7. Biochemical Oxygen (BOD)

During present investigation, BOD was analyzed by subtracting the value of final concentration of DO (after 5 days of incubation at 20oC) from the initial concentration of DO. Dissolved oxygen was analyzed using Wrinklers method with azide modification as described above.

4.5 Methods for Analysis of Biological Parameters

4.5.1 Phytoplankton

For quantitative and qualitative evaluation of phytoplankton, one litre of water sample was collected and filtered through Nylo bolt plankton net of mesh size 20µ. The sample was preserved after adding 10 ml.of Lugol's iodine. For the counting, drop count method was preferred using a standard calibrated dropper. Organisms were identified under Leica Trinocular Image Analyzer System. Total number of units per drop was enumerated and results were calculated as units per litre. Identification was helped with Ward and Whipple (1959), Palmer (1980), Adoni, et.al. (1985).

4.5.2 Zooplankton

Zooplanktons were collected by using a small meshed plankton net mode of bolting silk of 20µ, fitted with a demarcated collecting test tube of plastic. One liter of water was filtered and the collected plankton form was preserved in 5% formalin. For the counting, drop count method was preferred using a standard calibrated dropper. Identification was done using Leica Trinocular Image Analyzer System following standard literature such as Pennak (1989), Needham and Needham (1962), Michael (1973) etc. the result were expressed as organisms per litre.

4.6 Collection of Macrophytes

To enumerate the types and number of species of macrophytes of Sirpur wetland, samples were collected from the identified sampling spots. The collected samples of macrophytes were sorted out species wise from the wetland. The samples were washed thoroughly to make them free from animals and debris attached with them. Sorted species were brought to the laboratory in high-density polythene bags. Identification of the species was done with the help of different standards texts and monographs of Ward and Whipple, (1959) and Needham and Needham (1962).

4.7 Collection of Macro-benthos

For macrobenthic analysis, soil samples from bottom layer of Sirpur Wetland of different stations were collected using Eckman Dredge mud sampler. The collected samples were transferred in high density polythene bags and carried to laboratory for further investigation. Identification of different categories of macrobenthic organisms were done with the help of keys and monographs (Adoni, 1995).

4.8 Fishes

Data on fish catches were gathered through the information available from local fisherman as fishing in the wetland has been prohibited since last couple of years.

5. Result

5.1a Physico-chemical Parameters

Variation indifferent physico-chemical parameters during March 2020 is depicted in Table-1

Table-1 Variation in Physico-chemical parameters in Surface and Bottom waters of various Stations of Sirpur Wetland during March 2020

		Parameter							
Station	**Depth**	Air Temperature ^{0}C	Water Temperature ^{0}C	pH	Turbidity (JTU)	DO (mg/l)	TDS (mg/l)	Conductivity (µMos/cm2)	BOD (mg/l)
L1	S	27.1	25	8.3	70	7.6	503.25	0.825	1.2
	B		23	7.6	60	2	520.33	0.853	3.6
L2	S	27.3	25.2	8.5	80	12	498.98	0.818	0.4
	B		23.1	7.9	60	6.4	506.91	0.831	0.8
L3	S	27.4	25.3	8.8	90	9.6	492.27	0.807	0
	B		23.3	8.2	58	6	505.08	0.828	1.2
L4	S	27.5	25.4	8.2	80	8.8	505.08	0.828	0
	B		23.3	8	75	6.4	504.47	0.827	0.8
U1	S	27.6	25.5	8.4	10	7.2	308.05	0.505	0.8
	B		23.4	7.6	30	4.4	304.39	0.499	1.6
U2	S	27.7	25.6	8.6	10	8	304.39	0.499	0
	B		23.4	8	35	7.2	302.56	0.496	0.4
U3	S	27.8	25.7	8.4	10	8	306.22	0.502	0
	B		23.5	7.6	52	6	301.34	0.494	0.4
U4	S	27.9	25.6	8.5	15	8	309.88	0.508	0
	B		23.3	7.8	35	7.2	302.56	0.496	0.4
U5	S	28	25.7	8.3	10	8.4	347.7	0.57	0
	B		23.4	7.9	40	5.6	303.78	0.498	2
U6	S	28.1	25.8	8.4	20	8	309.27	0.507	0
	B		23.6	7.8	55	5.2	300.73	0.493	1.2
U7	S	28.2	25.7	8.5	10	8.8	308.66	0.506	0
	B		23.5	7.7	30	6.4	301.34	0.494	0.8
U8	S	28.3	25.8	8.6	15	9.2	309.88	0.508	0
	B		23.5	7.6	38	6	304.39	0.499	0.8

S: Surface Water, B: Bottom water

5.1b Physico-chemical Parameters

Variation indifferent physico-chemical parameters during March 2021 is depicted in Table-2

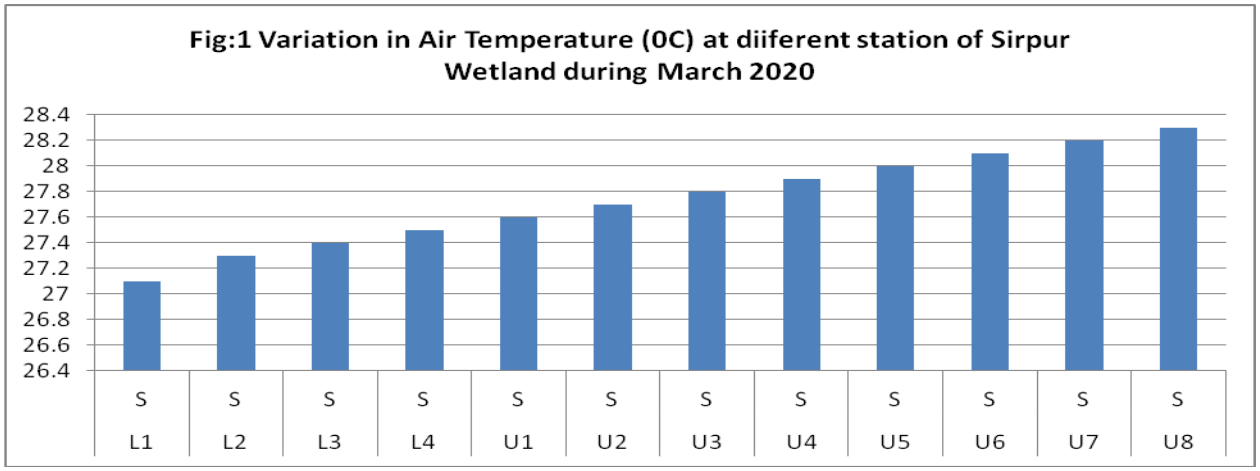
Table-2 Variation in Physico-chemical parameters in Surface and Bottom waters of various Stations of Sirpur Wetland during March 2021

		Parameter							
Station	**Depth**	Air Temperature ^{0}C	Water Temperature ^{0}C	pH	Turbidity (JTU)	DO (mg/l)	TDS (mg/l)	Conductivity (µMos/cm2)	BOD (mg/l)
L1	S	30.0	28.0	8.6	25	8.8	957	1.569	Not Done
	B		27.6	8.3	30	8.0	967	1.585	
L2	S	32.2	28.0	8.7	40	8.0	963	1.579	
	B		27.6	8.4	38	6.4	957	1.569	
L3	S	30.2	28.1	8.8	30	8.0	958	1.570	
	B		27.7	8.4	35	6.4	961	1.575	
L4	S	30.4	28.7	8.3	31	7.6	960	1.574	
	B		28.6	8.0	36	6.4	962	1.577	
U1	S	32.0	28.8	8.8	08	7.6	520	0.852	
	B		28.7	8.4	12	6.4	486	0.797	
U2	S	32.2	28.8	8.6	<5	6.8	481	0.789	
	B		28.7	8.4	10	6.0	479	0.785	
U3	S	32.4	28.9	8.5	<5	6.8	483	0.792	
	B		28.8	8.2	15	6.4	478	0.784	
U4	S	32.6	29.0	8.7	<5	8.4	482	0.790	
	B		28.8	8.6	15	7.2	479	0.785	
U5	S	32.8	29.0	8.5	8	7.6	482	0.790	
	B		28.8	8.6	10	6.4	476	0.780	
U6	S	31.9	29.9	8.6	<5	8.1	488	0.800	
	B		29.2	8.5	14	7.6	475	0.779	
U7	S	32.9	29.3	8.5	<5	8.0	489	0.802	
	B		29.2	8.8	10	7.6	476	0.780	
U8	S	32.9	29.3	8.5	8	8.8	476	0.780	
	B		29.2	8.6	14	7.6	482	0.790	

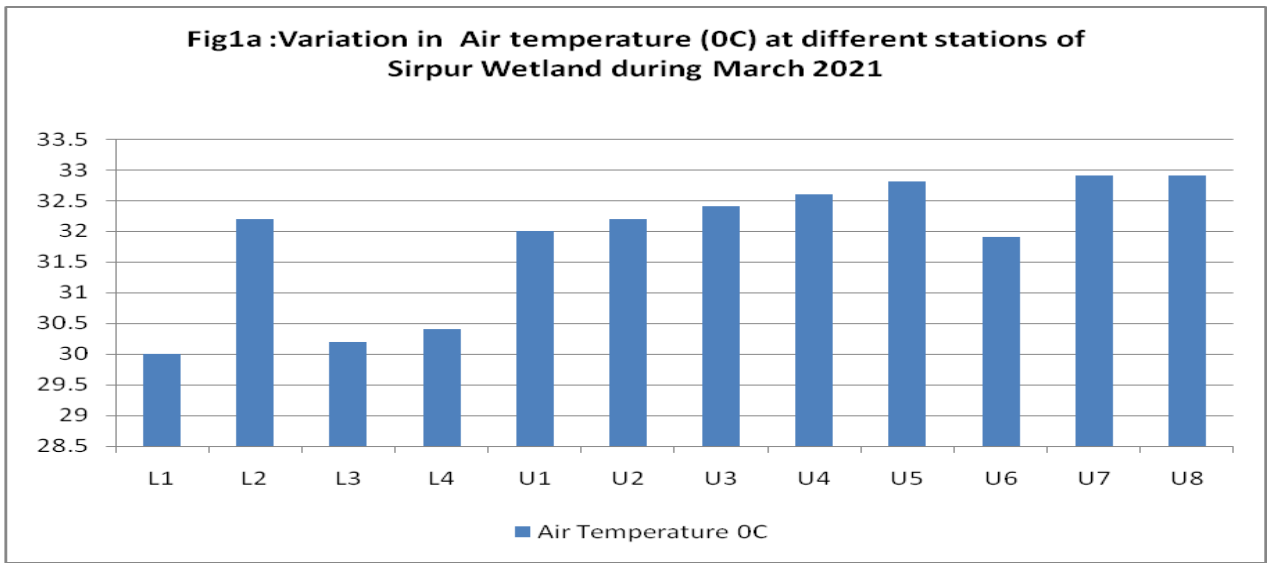
S: Surface Water B: Bottom water

1. Atmospheric Temperature

Variation in Atmospheric Temperature during the period of investigation is depicted in Figure1&1a. Minimum value of Atmospheric Temperature (27.1^{0}C) during March 2020 was recorded at Station-L1 while the maximum value (28.3^{0}C) during this period was observed at Station- U8.

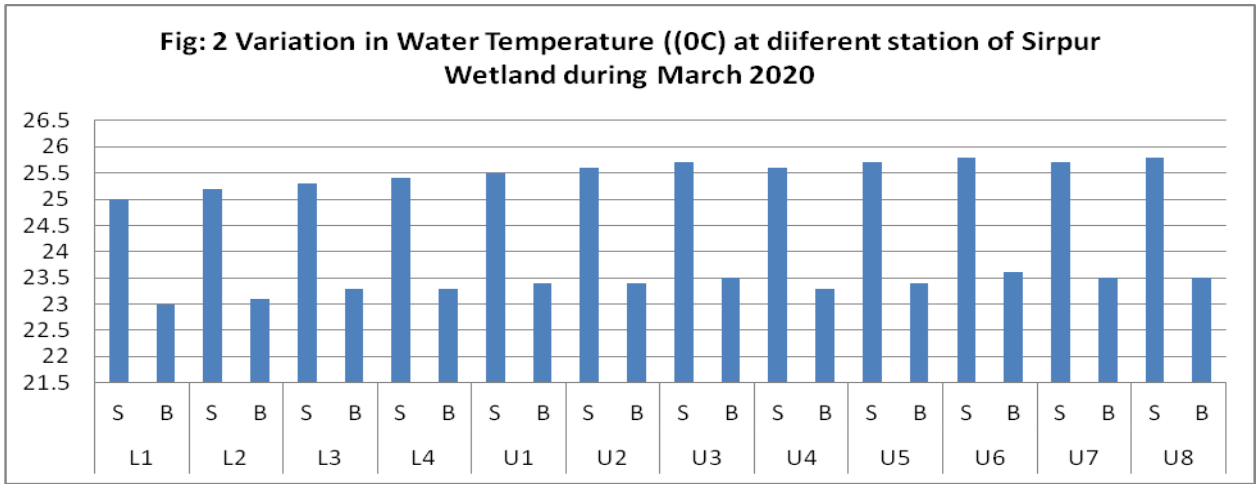


In subsequent year i.e. March 2021, Minimum value (30.0 ^{0}C) of Atmospheric Temperature was recorded at Station-L1, while the maximum value (32.9 ^{0}C) during this period was observed at Station- U7&U8.

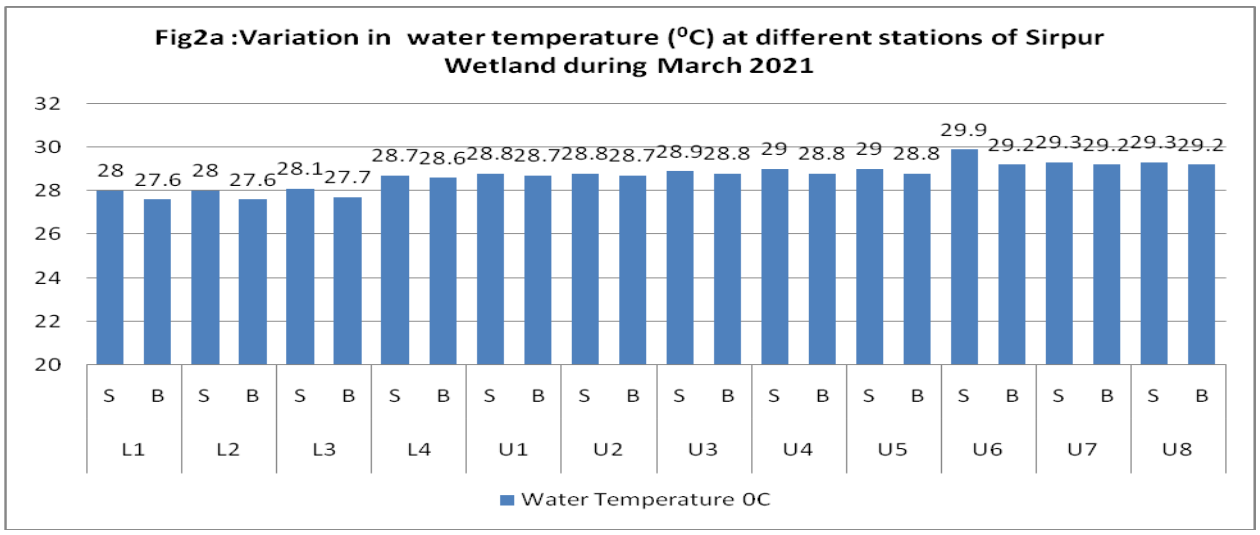


2. Water Temperature

Variation in Water temperature during the period of investigation is depicted in Figure-2&2a. Minimum value of Water temperature (23^{0}C) during March 2020 was recorded at Station- L1, B while the maximum value (25.8^{0}C) during this period was observed in surface water at Station- U6S, U8S.

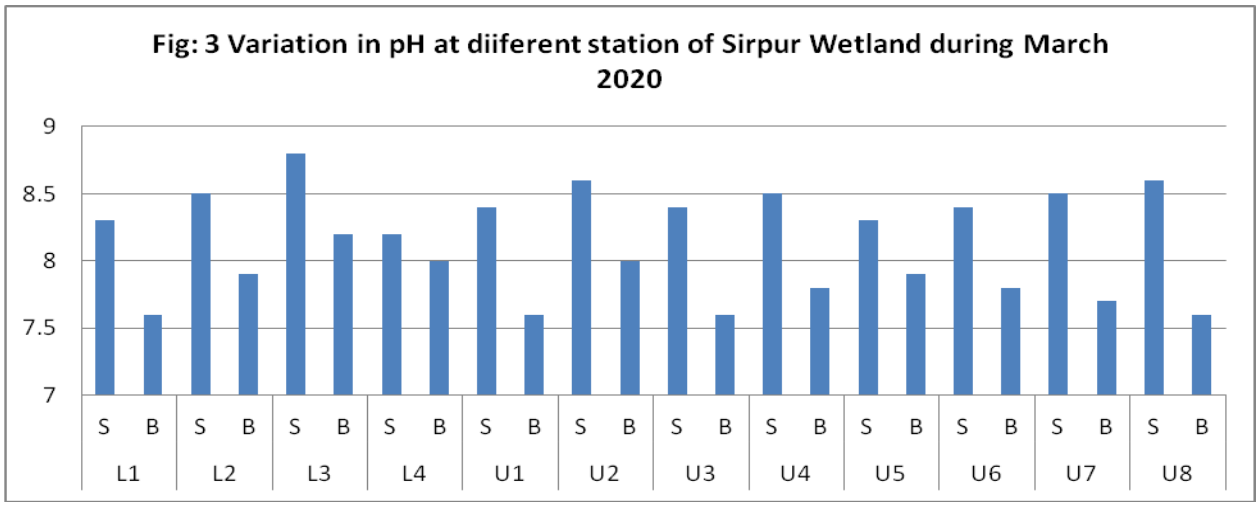


In subsequent year i.e. March 2021, minimum value of Water Temperature (27.6 ^{0}C) was recorded at Station-L1B&L2B, while the maximum value (29.9^{0}C) during this period was observed in at Station- U6S.

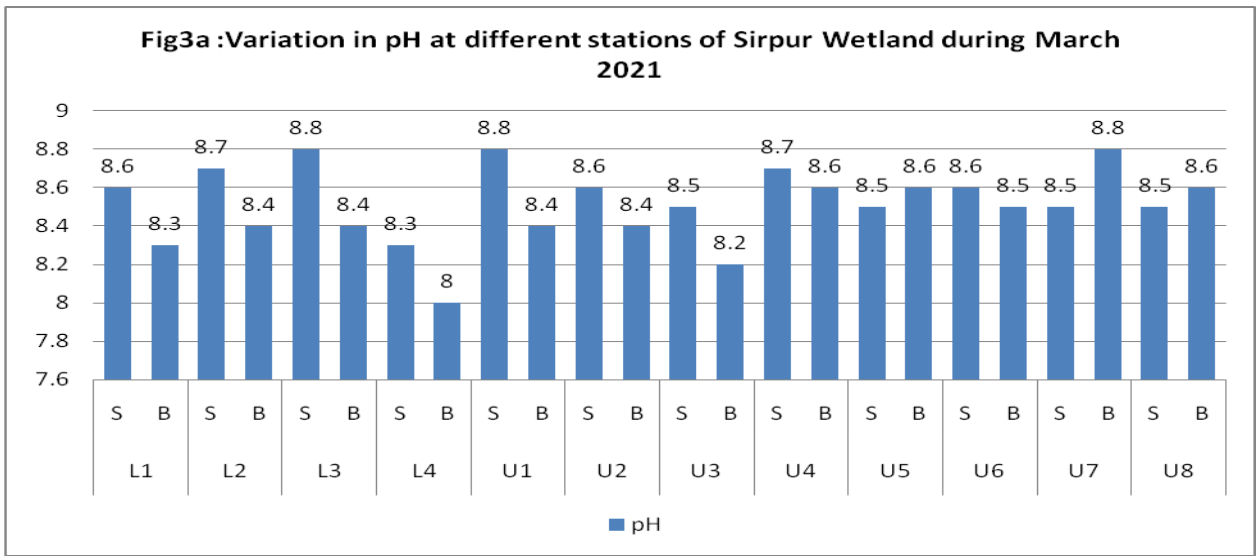


3. pH

Variation in pH during the period of investigation is depicted in Figure-3&3a. Minimum value of pH(7.6) during March 2020 was recorded at Station- L1,B; U1B;U3,B;U8,B; while the maximum value (8.8) was observed at Station- L3,S .

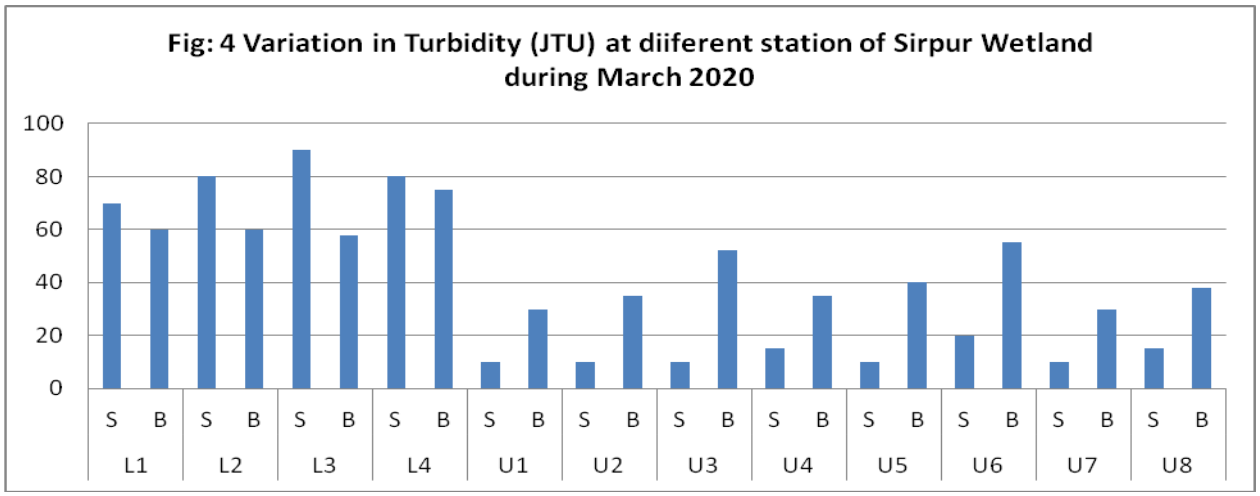


In subsequent year i.e. March 2021, minimum value of pH (8.0) was recorded at Station-L4B while the maximum value (8.8) during this period was observed at several Stations- L3S.U1S & U7B.

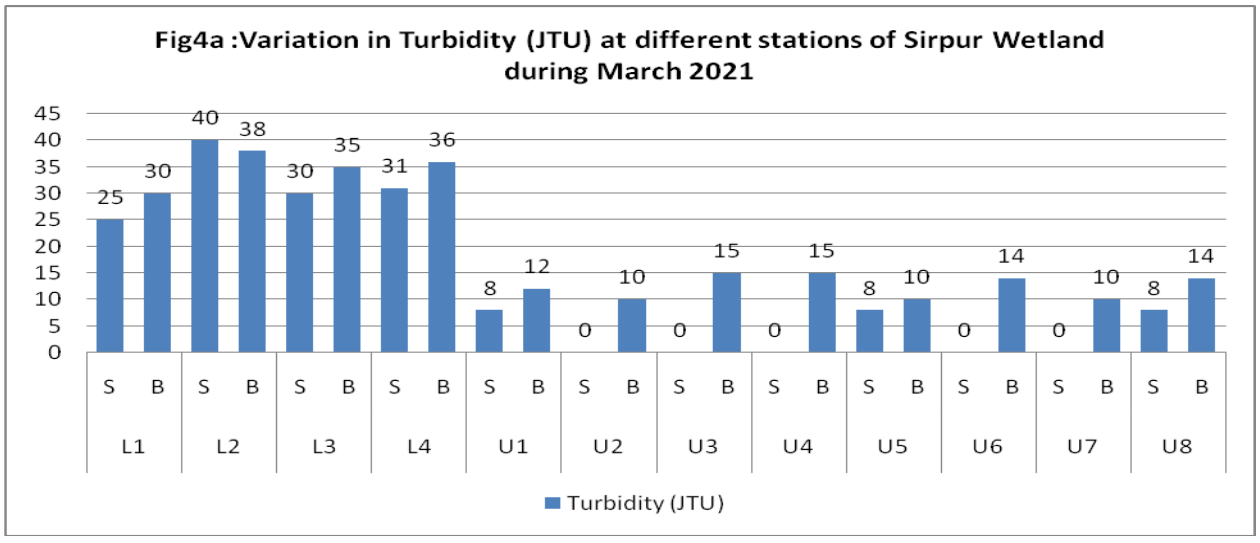


4. Turbidity

Variation in turbidity during the period of investigation is depicted in Figure-4&4a. Minimum value of turbidity (10 JTU) during March 2020 was recorded at several Stations viz. U1S, U2S, U3S, U5S, and U7S; while the maximum value (90JTU) was observed at Station-L3S.

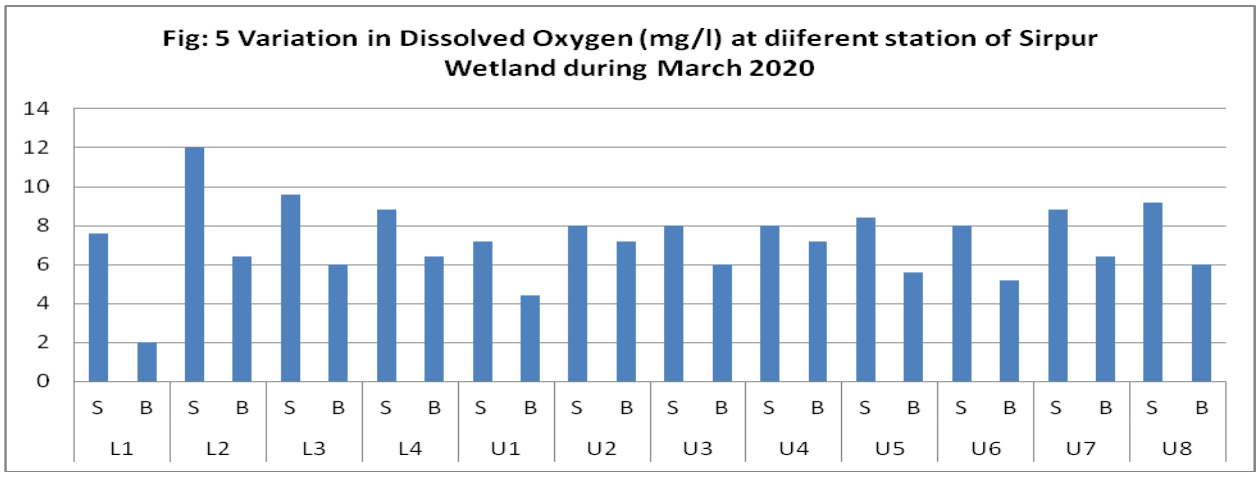


In subsequent year i.e. March 2021, minimum value of Turbidity (<5 JTU) was recorded at several stations viz. Station-U2S,U3S,U4S,U6S,U7S while the maximum value (40 JTU) during this period was observed at Station- L2S.

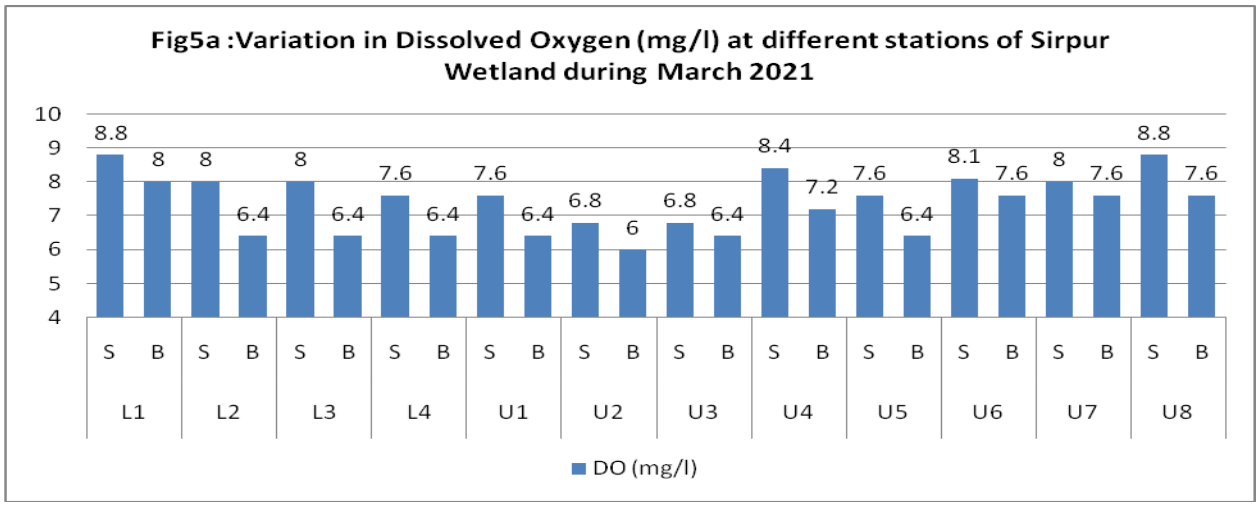


5. Dissolved Oxygen

Variation in Dissolved Oxygen during the period of investigation is depicted in Figure-5&5b. Minimum value of Dissolved Oxygen (2mg/l) during March 2020 was recorded at Station- L1B while the maximum value (12mg/l) was observed at Station- L2S.

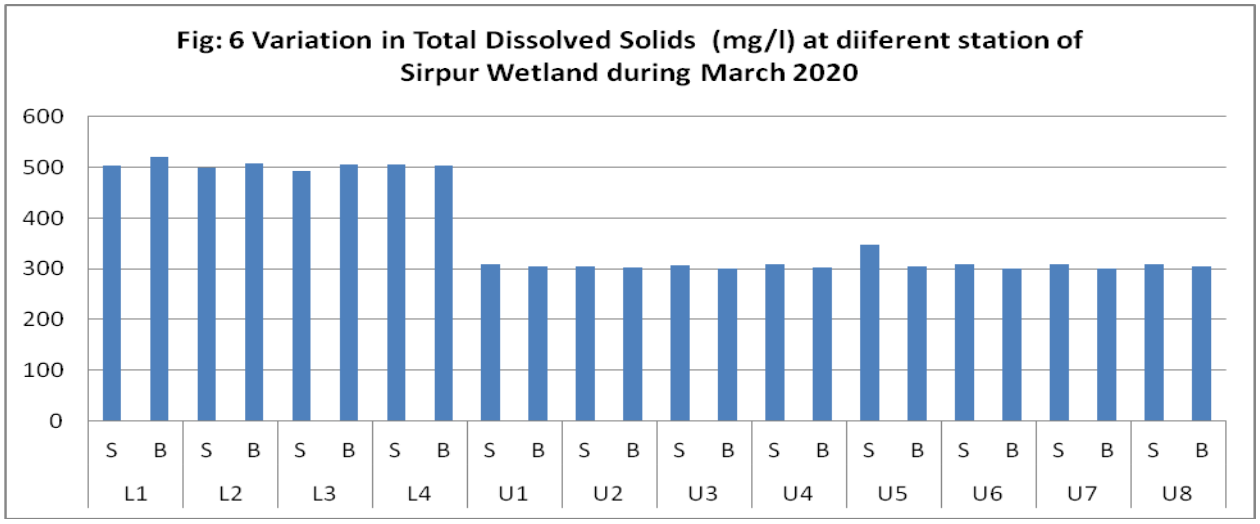


In subsequent year i.e. March 2021, minimum value of Dissolved Oxygen (6.0mg/l) was recorded at Station-U2B, while the maximum value (8.8mg/l) during this period was observed at Station- L1S &U8S.

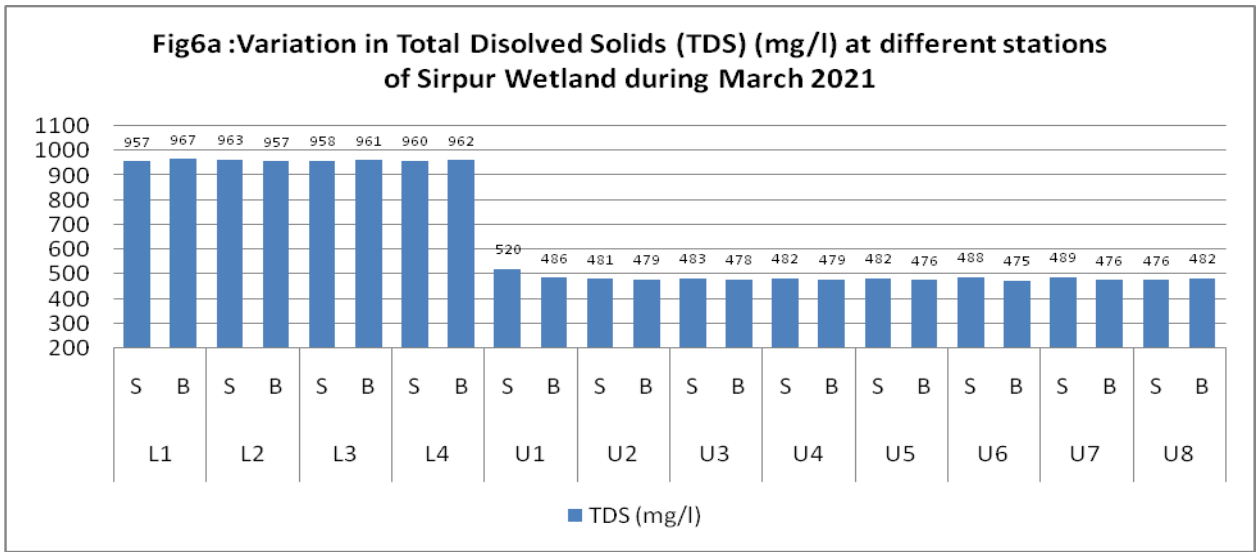


6. Total Dissolved Solids

Variation in Total Dissolved Solids during the period of investigation is depicted in Figure-6&6a. Minimum value of Total Dissolved Solids (300.73 mg/l) was recorded at Station-U6B; while the maximum value (520.33 mg/l) was observed at Station-L1B.

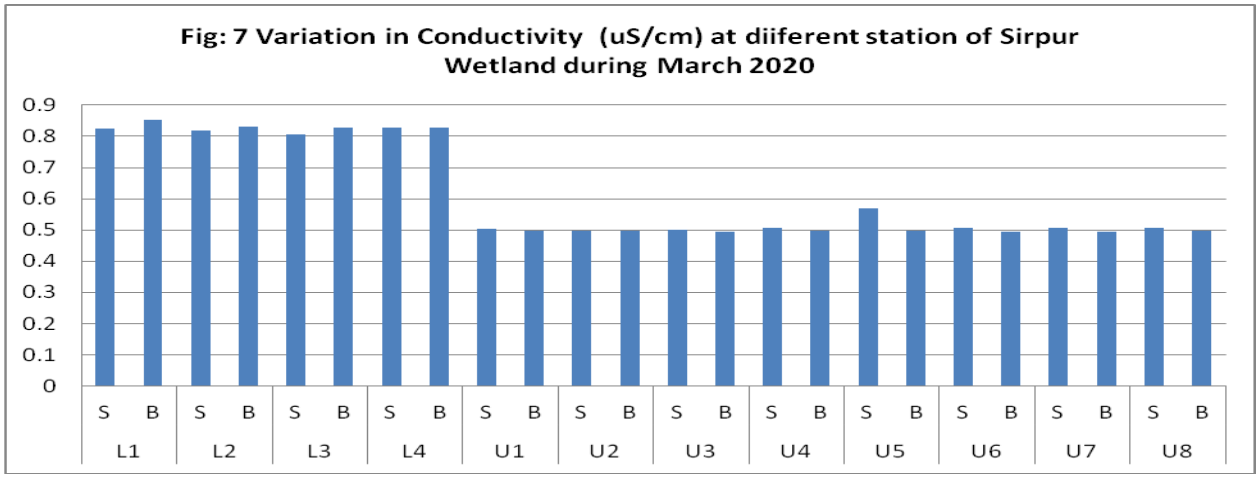


In subsequent year i.e. March 2021, minimum value of Total Dissolved Solids (475.0 mg/l) was recorded at Station- U6B, while the maximum value (967.0 mg/l) during this period was observed at Station- L1B.

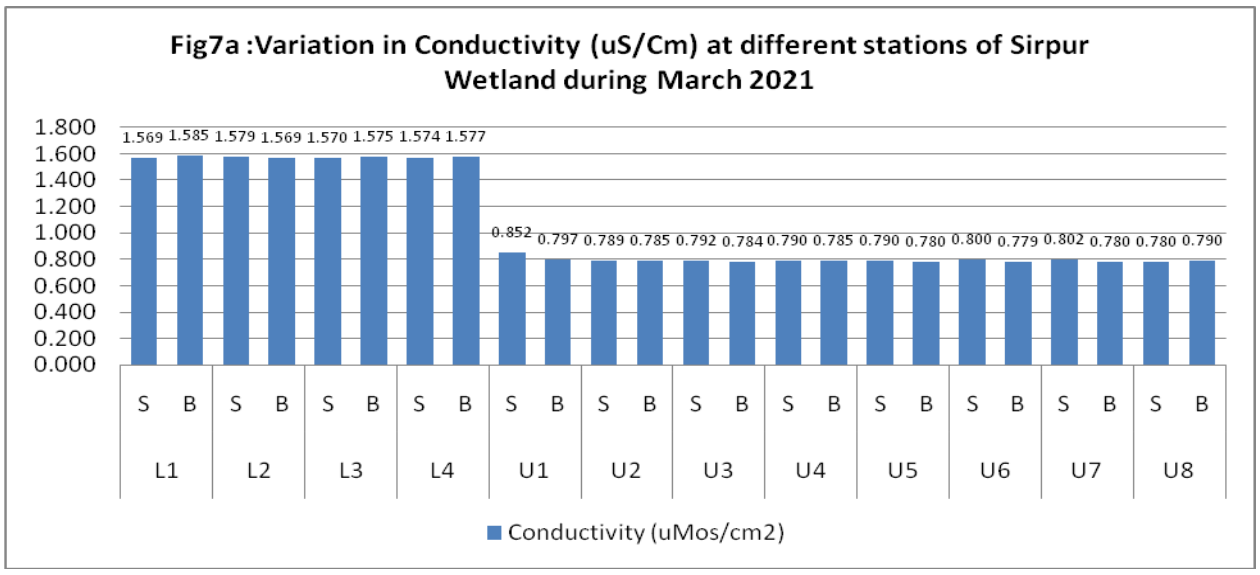


7. Conductivity

Variation in Conductivity during the period of investigation is depicted in Figure-7&7a. Minimum value of Conductivity (0.493 µS/cm) was recorded at Station- U6B; while the maximum value (0.853 µS) was observed at Station- L1B.

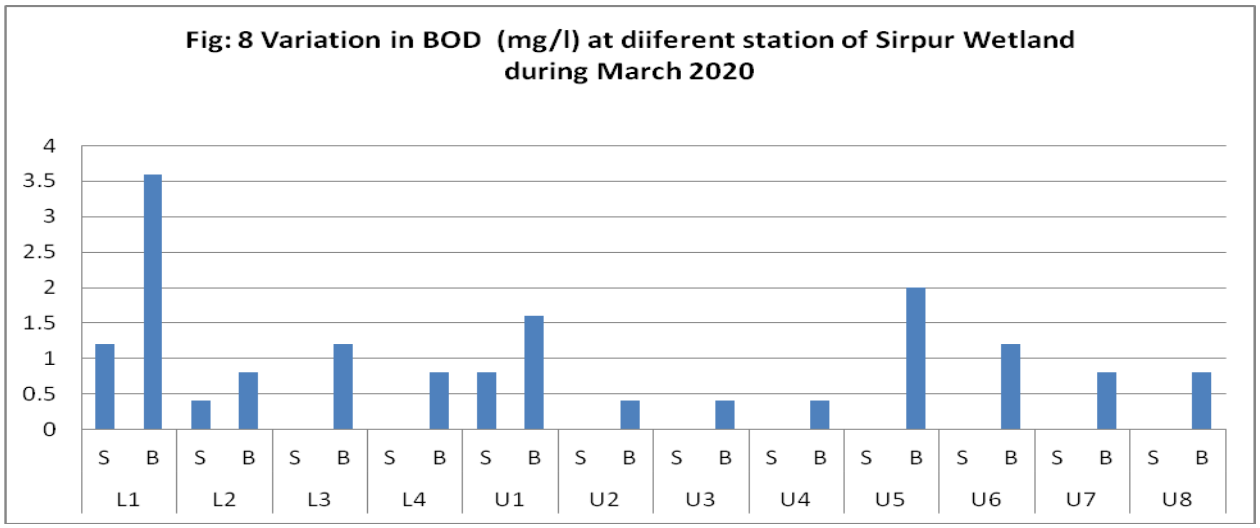


In subsequent year i.e. March 2021, minimum value of Conductivity (0.779µS/Cm) was recorded at Station- U6B, while the maximum value (1.585µs/cm) during this period was observed at Station- L1B.



8. Biochemical Oxygen Demand

Variation in Biochemical Oxygen Demand during the period of investigation is depicted in Figure-8. Minimum value (NIL) of Biochemical Oxygen Demand was recorded at many places while the maximum value (3.6 mg/l) was observed at Station-L1B.



BOD could not be done during 2021 during technical problems.

5.2 Biological Parameters

5.2.1 Phytoplankton

Biotic components are totally dependent on abiotic components. Phytoplankton is ecologically significant, as they trap the radiant energy of sunlight to convert chemical energy i.e. organic materials. Many herbivores graze upon Phytoplankton food organisms and thus these organisms may become the basis of food in the aquatic ecosystem and zooplanktons are dependent on it. Small fishes are also dependent on both of these planktons.

Phytoplankton constitutes the first trophic level of an aquatic ecosystem. Being the primary producers in the food web and through the process of photosynthesis, phytoplankton provides food and oxygen to other organisms. The species composition and abundance of Phytoplankton in a biotope may be altered by any change in the prevailing environmental conditions. Therefore to assess the changes in the biological characteristics in relation to changes of various environmental parameters, phytoplankton was analyzed for different stations of Sirpur Wetland during the period March 2020 and March 2021.

During the period of investigation (March 2020&21) total 36 species of phytoplankton belonging to four different classes were recorded at surface water of various stations of Sirpur Wetland. The total number of Chlorophyceae species was 19, Bacillariophyceae was 11, and Cyanophyceae and Euglenophyceae was 5 and 1 respectively.

Table 3: Phytoplankton density (1X10^{3}organism /liter) in surface water at different stations of Sirpur Wetland during March 2020

Group	L1	L2	L3	L4	U1	U2	U3	U4	U5	U6	U7	U8
Chlorophyceae												
1. *Ankistrodesmus falcatus*	4	1	8	2	3	7	7	1	2	1	3	1
2. *Chlorella sp*	2	4	4	6	2	2	4	0	0	2	0	1
3. *Chlorococcum humicola*	4	2	2	2	6	6	1	4	1	0	0	1
4. *Closterium sp*	5	7	6	2	4	4	2	4	1	0	0	4
5. *Coelastrum sp*	2	2	4	6	5	5	8	4	0	0	1	0
6. *Cosmarium sp*	6	4	8	4	6	6	2	8	1	4	0	4

7. Crucigenia sp	4	4	6	2	8	8	10	12	0	1	0	2
8. Elkatothrix sp	2	6	4	4	10	2	8	4	3	4	2	0
9. Euastrum sp	6	4	12	6	10	2	6	1	1	1	2	0
10. Eudorina elegans	6	6	14	2	8	5	4	8	1	3	0	2
11. Kirchnerilla sp	4	2	4	10	4	4	6	8	0	1	2	0
12. Pleodorina sp	6	6	5	8	4	2	10	8	1	0	0	1
13. Scenedesmus armata	7	18	0	3	10	3	14	0	2	4	2	2
14. Scenedesmus bijugatus	3	6	0	4	14	4	10	4	0	2	1	0
15. Spirogyra sp	4	6	2	10	4	10	8	10	0	4	4	0
16. Stauratrum sp	10	14	2	6	8	4	10	4	0	2	2	2
17. Tetradon sp	6	4	2	10	18	12	2	4	0	0	1	0
18. Ulothrix sp	6	8	10	2	4	4	6	8	2	1	2	0
19. Volvox sp	10	2	8	6	10	8	4	8	1	6	0	1
Bacillariophyceae												
1. Amphora sp	2	0	2	1	2	8	8	0	2	0	0	1
2. Asteronella sp	0	2	4	0	0	1	1	4	0	2	2	2
3. Cyclotella sp	4	6	8	10	12	12	4	8	0	0	2	1
4. Cymbella sp	6	4	8	4	2	2	0	6	3	3	0	2
5. Denticulla sp	4	2	1	8	2	2	4	0	1	2	1	0
6. Epithemia turgida	8	8	8	14	6	11	12	0	12	0	1	1
7. Fragillaria sp	2	0	6	8	6	2	10	0	10	2	2	2
8. Frustula sp	4	0	4	10	10	12	2	2	2	1	0	2
9. Gomphonema sp	4	6	0	6	12	2	6	4	6	3	0	4
10. Pinnularia sp	4	4	10	6	10	0	6	12	6	6	2	2
11. Tabellaria sp	12	10	18	10	12	6	4	2	4	1	2	2
Cyanophyceae												
1. Anabaena sp	4	2	3	8	0	4	4	2	4	4	2	1
2. Lyngbya majuscula	8	4	6	14	6	6	8	9	8	2	2	2
3. Merismopedia pseudofilamentasa	10	0	10	12	7	8	10	2	10	1	4	1
4. Rivularia aquatica	8	4	2	4	12	7	18	3	18	0	2	1
5. Spirulina major	8	6	2	4	10	8	12	4	12	0	2	0
Euglenophyceae												
1. Euglena acus	4	2	10	4	8	6	8	6	8	0	1	0

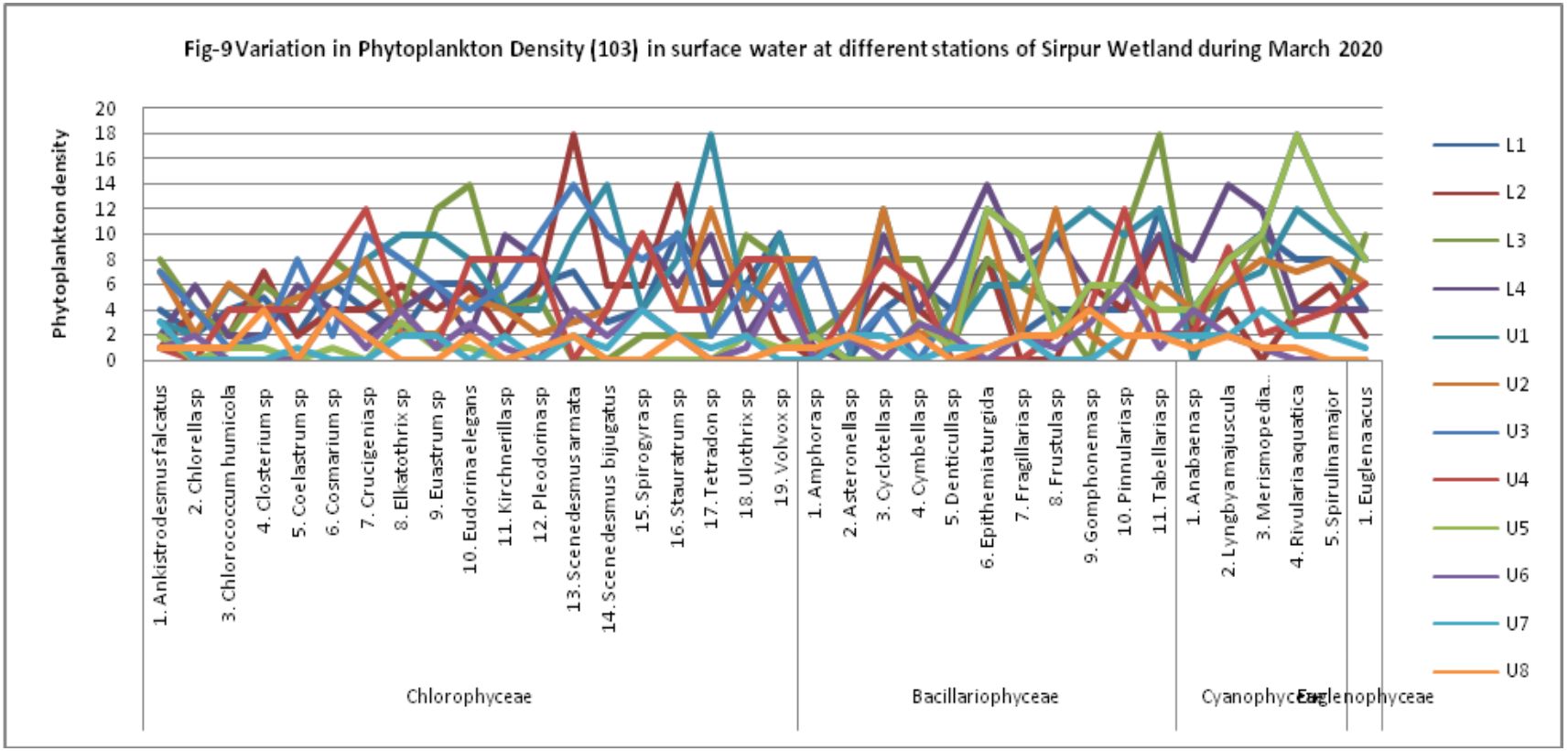


Fig-9 Variation in Phytoplankton Density (103) in surface water at different stations of Sirpur Wetland during March 2020
Phytoplankton density
20
18
16
14
12
10
8
6
4
2
0
1. Ankistrodesmusfalcatus
2. Chlorella sp
3. Chlorococcum humicola
4. Closterium sp
5. Coelastrum sp
6. Cosmarium sp
7. Crucigenia sp
8. Elkatothrix sp
9. Euastrum sp
10. Eudorina elegans
11. Kirchnerilla sp
12. Pleodorina sp
13. Scenedesmus armata
14. Scenedesmus bijugatus
15. Spirogyra sp
16. Stauratrum sp
17. Tetradon sp
18. Ulothrix sp
19. Volvox sp
1. Amphora sp
2. Asteronella sp
3. Cyclotella sp
4. Cymbella sp
5. Denticulla sp
6. Epithemiaturgida
7. Fragillaria sp
8. Frustula sp
9. Gomphonema sp
10. Pinnularia sp
11. Tabellaria sp
1. Anabaena sp
2. Lyngbya majuscula
3. Merismopedia...
4. Rivularia aquatica
5. Spirulina major
1. Euglena acus
Chlorophyceae
Bacillariophyceae
Cyanophyceae
Euglenophyceae
L1
L2
L3
L4
U1
U2
U3
U4
U5
U6
U7
U8

Table 4: Phytoplankton density (1X10^{3}organism /liter) in surface water at different stations of Sirpur Wetland during March 2021

Group	L1	L2	L3	L4	U1	U2	U3	U4	U5	U6	U7	U8
Chlorophyceae												
1. *Ankistrodesmus falcatus*	2	0	4	0	6	8	4	7	0	2	2	0
2. *Chlorella sp*	0	3	0	0	4	2	0	0	0	2	0	0
3. *Chlorococcum humicola*	2	4	2	0	2	2	0	4	2	2	0	2
4. *Closterium sp*	0	2	0	0	8	0	0	0	0	2	0	0
5. *Coelastrum sp*	0	0	0	4	0	3	2	0	0	0	2	0
6. *Cosmarium sp*	2	0	1	0	0	0	0	2	0	0	0	2
7. *Crucigenia sp*	0	0	0	0	0	0	0	0	0	0	0	0
8. *Elkatothrix sp*	0	2	0	0	0	4	0	0	0	2	0	0
9. *Euastrum sp*	0	0	0	0	2	4	0	2	2	2	0	0
10. *Eudorina elegans*	0	0	0	0	0	0	0	0	0	0	0	0
11. *Kirchnerilla sp*	0	0	4	2	0	0	0	0	0	0	0	0
12. *Pleodorina sp*	0	2	3	4	5	6	0	0	3	2	0	2
13. *Scenedesmus armata*	0	0	0	0	0	0	0	0	0	0	0	0
14. *Scenedesmus bijugatus*	0	0	0	0	0	0	0	0	0	0	0	0
15. *Spirogyra sp*	8	2	0	0	2	0	0	0	0	02	4	0
16. *Stauratrum sp*	2	3	0	1	0	0	3	2	2	2	0	0
17. *Tetradon sp*	0	0	0	0	0	2	4	0	2	0	2	2
18. *Ulothrix sp*	0	2	7	3	0	3	4	2	3	8	0	7
19. *Volvox sp*	8	6	4	3	2	0	3	4	0	2	2	6
Bacillariophyceae												
1. *Amphora sp*	4	6	2	2	0	4	0	2	6	0	1	0
2. *Asteronella sp*	4	2	0	4	2	0	0	0	2	4	2	3
3. *Cyclotella sp*	11	7	0	4	2	4	0	2	0	2	2	0
4. *Cymbella sp*	2	1	0	0	0	3	1	0	6	0	1	2
5. *Denticulla sp*	3	2	6	2	1	7	1	0	0	3	2	0
6. *Epithemia turgida*	0	0	0	0	0	0	0	0	0	0	0	0
7. *Fragillaria sp*	1	3										
8. *Frustula sp*	0	2	2	0	0	0	0	01	3	0	0	1
9. *Gomphonema sp*	0	2	3	0	0	0	0	0	0	0	1	0
10. *Pinnularia sp*	0	2	1	1	1	0	0	0	2	1	2	0
11. *Tabellaria sp*	1	1	2	1	2	0	0	2	0	1	0	0
Cyanophyceae												
1. *Anabaena sp*	1	2	3	8	4	6	3	2	1	1	0	0
2. *Lyngbya majuscula*	0	0	0	0	0	0	0	0	0	0	0	0

3. *Merismopedia pseudofilamentasa*	0	0	0	0	0	0	0	0	0	0	0	0
4. *Rivularia aquatica*	0	0	0	0	0	0	0	0	0	0	0	0
5. *Spirulina major*	0	0	0	0	0	0	0	0	0	0	0	0
Euglenophyceae												
1. *Euglena acus*	0	0	0	1	2	3	0	0	0	0	0	0

However a variation in availability of different species at different stations during this period was observed. I significant fluctuations in density of number of species was observed at all the stations (Fig-9&10). In general Cholophyceae was the dominant species in both the years.

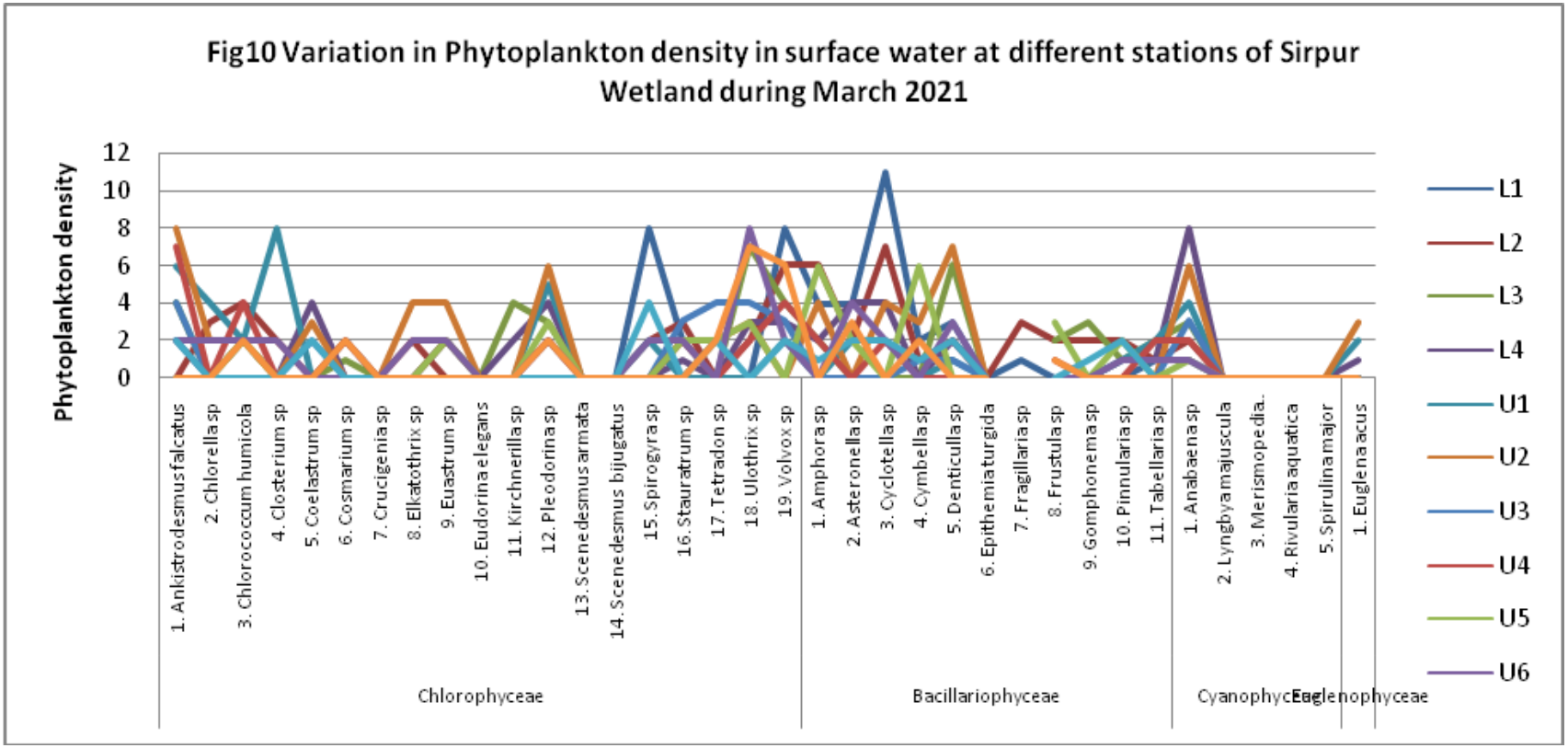


Fig10 Variation in Phytoplankton density in surface water at different stations of Sirpur Wetland during March 2021
Phytoplankton density
12
10
8
6
4
2
0
1. Ankistrodesmusfalcatus
2. Chlorella sp
3. Chlorococcum humicola
4. Closterium sp
5. Coelastrum sp
6. Cosmarium sp
7. Crucigenia sp
8. Elkatothrix sp
9. Euastrum sp
10. Eudorina elegans
11. Kirchnerilla sp
12. Pleodorina sp
13. Scenedesmus armata
14. Scenedesmus bijugatus
15. Spirogyra sp
16. Stauratrum sp
17. Tetradon sp
18. Ulothrix sp
19. Volvox sp
1. Amphora sp
2. Asteronella sp
3. Cyclotella sp
4. Cymbella sp
5. Denticulla sp
6. Epithemiaturgida
7. Fragillaria sp
8. Frustula sp
9. Gomphonema sp
10. Pinnularia sp
11. Tabellaria sp
1. Anabaena sp
2. Lyngbya majuscula
3. Merismopedia.
4. Rivularia aquatica
5. Spirulina major
1. Euglena acus
Chlorophyceae
Bacillariophyceae
Cyanophyceae
Euglenophyceae
L1
L2
L3
L4
U1
U2
U3
U4
U5
U6

While in bottom water during March 2020, total 38 species of phytoplankton belonging to four different classes were recorded at various stations of Sirpur Wetland. The total number of Chlorophyceae species was 20, Bacillariophyceae was 11, and Cyanophyceae and Euglenophyceae was 4 and 3 respectively.

Table 5: Phytoplankton density (1X10^{3}organism /liter) in Bottom water at different stations of Sirpur Wetland during March 2020

Group	L1	L2	L3	L4	U1	U2	U3	U4	U5	U6	U7	U8
Chlorophyceae												
1. *Ankistrodesmus sp*	0	0	0	2	3	8	8	4	2	1	0	1
2. *Chlorella sp*	2	4	4	6	2	2	4	0	2	2	0	0
3. *Chlorococcum humicola*	4	2	2	2	6	6	1	4	0	3	4	0
4. *Closteriopsis sp*	2	2	4	4	4	4	6	2	1	1	1	6
5. *Closterium sp*	5	7	6	2	4	4	2	4	0	2	0	0
6. *Coelastrum microporum*	4	4	6	8	2	2	4	6	0	0	1	2
7. *Coelastrum sp*	2	2	4	6	5	5	8	4	2	7	2	0
8. *Cosmarium sp*	6	4	8	4	6	6	2	8	0	2	0	4
9. *Crucigenia sp*	4	4	6	2	8	8	10	12	0	4	2	0
10. *Elkatothrix sp*	2	6	4	4	10	2	8	4	2	4	1	0
11. *Euastrum sp*	6	4	12	6	10	2	6	1	1	0	3	0
12. *Eudorina elegans*	6	6	14	2	8	5	4	8	0	2	0	3
13. *Kirchnerilla sp*	4	2	4	10	4	4	6	8	2	1	0	0
14. *Pleodorina sp*	6	6	5	8	4	2	10	8	2	0	1	1
15. *Scenedesmus bijugatus*	3	6	0	4	14	4	10	4	6	3	1	2
16. *Scenedesmus alterans*	11	4	2	8	12	10	10	0	0	4	2	1
17. *Spirogyra sp*	4	6	2	10	4	10	8	10	6	2	1	2
18. *Tetradon sp*	6	4	2	10	18	12	2	4	6	3	0	2
19. *Ulothrix sp*	6	8	10	2	4	4	6	8	2	5	3	6
20. *Volvox sp*	10	2	8	6	10	8	4	8	4	3	1	7
Bacillariophyceae												
1. *Amphora sp*	2	0	2	1	2	8	8	0	0	2	2	2
2. *Asteronella sp*	0	2	4	0	0	1	1	4	2	3	2	1
3. *Cyclotella sp*	4	6	8	10	12	12	4	8	6	6	0	0
4. *Cymbella sp*	6	4	8	4	2	2	0	6	0	2	2	2
5. *Denticulla sp*	4	2	1	8	2	2	4	0	1	1	2	1
6. *Epithemia sp*	0	2	2	20	4	4	6	2	3	0	3	2
7. *Fragillaria sp*	2	0	6	8	6	2	10	0	4	2	2	1

8. Frustula sp	4	0	4	10	10	12	2	2	6	0	2	1
9. Gomphonema sp	4	6	0	6	12	2	6	4	2	0	0	2
10. Pinnularia sp	4	4	10	6	10	0	6	12	2	2	2	2
11. Tabellaria sp	12	10	18	10	12	6	4	2	8	3	0	5
Cyanophyceae												
1. Anabaena sp	4	2	3	8	0	4	4	2	2	2	2	2
2. Lyngbya majuscula	8	4	6	14	6	6	8	9	1	4	2	0
3. Rivularia aquatica	8	4	2	4	12	7	18	3	5	4	5	1
4. Spirulina major	8	6	2	4	10	8	12	4	6	2	8	2
Euglenophyceae												
1. Euglena acus	4	2	10	4	8	6	8	6	4	2	4	2
2. Euglena oxyuris	1	8	8	6	10	8	8	4	6	1	6	2
3. Trachelomonus sp	0	8	5	6	2	10	1	0	2	3	2	0

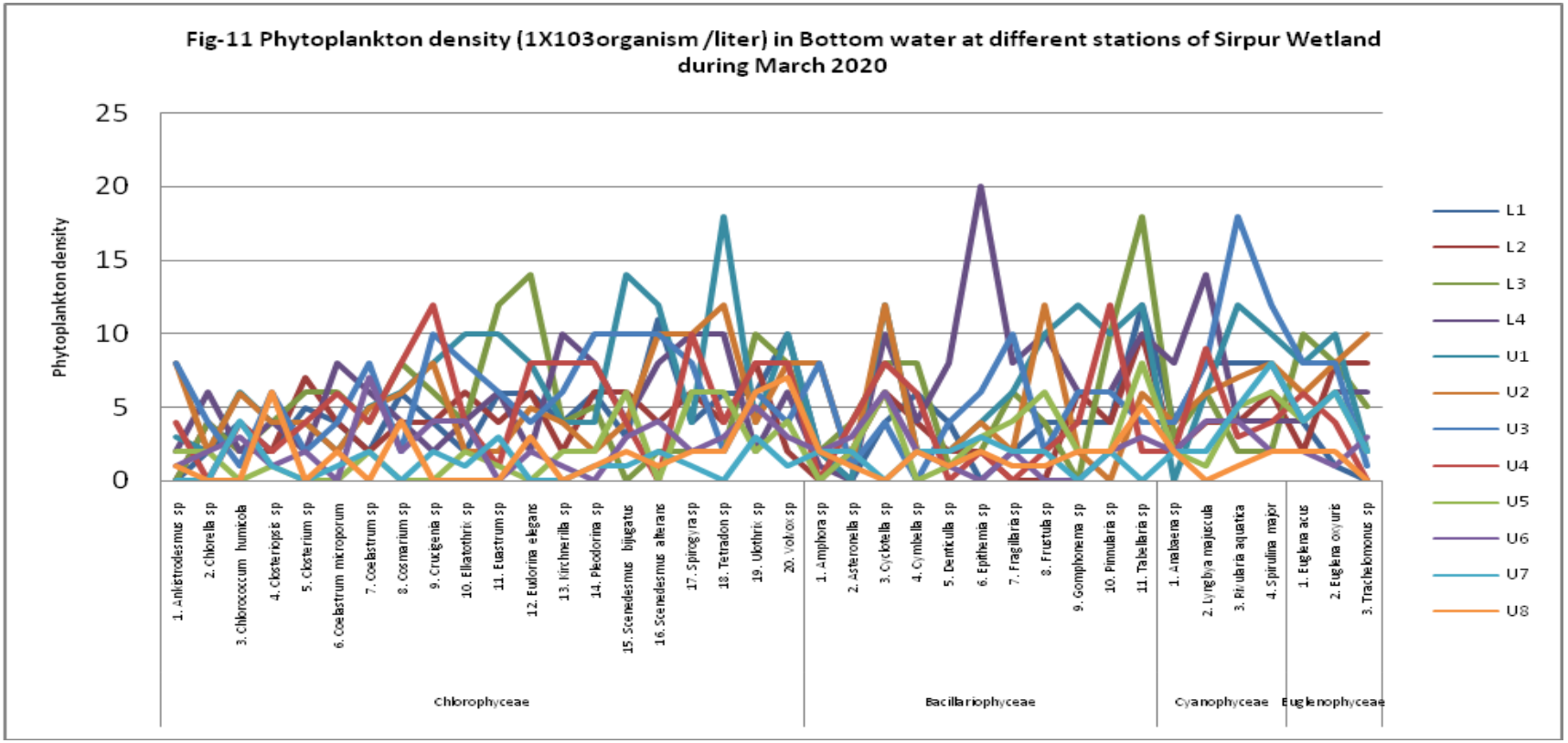


Fig-11 Phytoplankton density (1X103organism /liter) in Bottom water at different stations of Sirpur Wetland during March 2020
Phytoplankton density
25
20
15
10
5
0
1. Anklistrodesmus sp
2. Chlorella sp
3. Chlorococcum humicola
4. Closteriopsis sp
5. Closterium sp
6. Coelastrum microporum
7. Coelastrum sp
8. Cosmarium sp
9. Crucigenia sp
10. Ellatothrix sp
11. Eustrum sp
12. Eudorina elegans
13. Kirchnerilla sp
14. Pleodorina sp
15. Scenedesmus bijugatus
16. Scenedesmus alterans
17. Spirogyra sp
18. Tetradon sp
19. Ulothrix sp
20. Volvox sp
1. Amphora sp
2. Asteronella sp
3. Cyclotella sp
4. Cymbella sp
5. Denticula sp
6. Epithemia sp
7. Fragilaria sp
8. Fructula sp
9. Gomphonema sp
10. Pinnularia sp
11. Tabellaria sp
1. Anabaena sp
2. Lyngbya majuscula
3. Rivularia aquatica
4. Spirulina major
1. Euglena acus
2. Euglena oxyuris
3. Trachelomonus sp
Chlorophyceae
Bacillariophyceae
Cyanophyceae
Euglenophyceae
L1
L2
L3
L4
U1
U2
U3
U4
U5
U6
U7
U8

Table 6: Phytoplankton density (1X10^{3}organism /liter) in Bottom water at different stations of Sirpur Wetland during March 2021

Group	L1	L2	L3	L4	U1	U2	U3	U4	U5	U6	U7	U8
Chlorophyceae												
1. *Ankistrodesmus sp*	2	2	1	4	1	0	0	2	0	2	2	4
2. *Chlorella sp*	4	2	8	2	2	6	0	4	2	0	0	4
3. *Chlorococcum humicola*	0	0	2	4	0	0	2	4	2	1	0	0
4. *Closteriopsis sp*	0	0	0	2	0	0	1	0	0	2	0	3
5. *Closterium sp*	0	2	0	0	0	0	4	0	6	0	0	0
6. *Coelastrum sp*	2	8	0	0	6	7	1	3	0	2	7	2
7. *Cosmarium sp*	4	2	3	9	6	2	1	0	0	8	0	1
8. *Crucigenia sp*	4	5	0	0	6	7	2	3	7	0	8	1
9. *Elkatothrix sp*	2	0	0	0	5	1	0	3	8	0	4	5
10. *Euastrum sp*	2	5	0	7	0	6	3	4	0	5	0	7
11. *Eudorina elegans*	3	6	0	2	5	0	0	7	3	9	2	1
12. *Kirchnerilla sp*	2	1	7	3	6	9	1	0	0	7	8	1
13. *Pleodorina sp*	4	2	9	3	7	5	2	3	6	0	4	7
14. *Scenedesmus bijugatus*	6	9	2	8	3	6	7	5	4	2	8	2
15. *Tetradon sp*	8	9	2	3	6	5	4	8	9	3	1	2
Bacillariophyceae												
1. *Asteronella sp*	4	2	6	1	3	3	9	5	7	6	3	1
2. *Cyclotella sp*	2	8	9	1	4	3	6	7	8	9	1	0
3. *Denticulla sp*	0	2	3	8	4	5	6	6	5	3	2	4
4. *Fragillaria sp*	0	5	6	8	9	1	3	9	8	2	3	6
5. *Frustula sp*	1	2	8	6	7	6	5	3	2	7	3	0
6. *Pinnularia sp*	1	3	6	8	9	1	2	3	7	8	9	8
Cyanophyceae												
1. *Anabaena sp*	6	3	7	8	9	1	2	6	8	4	6	2
2. *Lyngbya majuscula*	5	6	2	3	4	5	6	2	7	4	2	3
3. *Rivularia aquatica*	2	3	4	6	4	6	8	2	7	5	2	1
Euglenophyceae												
1. *Euglena acus*	1	2	4	3	6	7	1	2	3	4	2	2
2. *Trachelomonus sp*	2	1	3	6	2	5	7	2	3	4	2	1

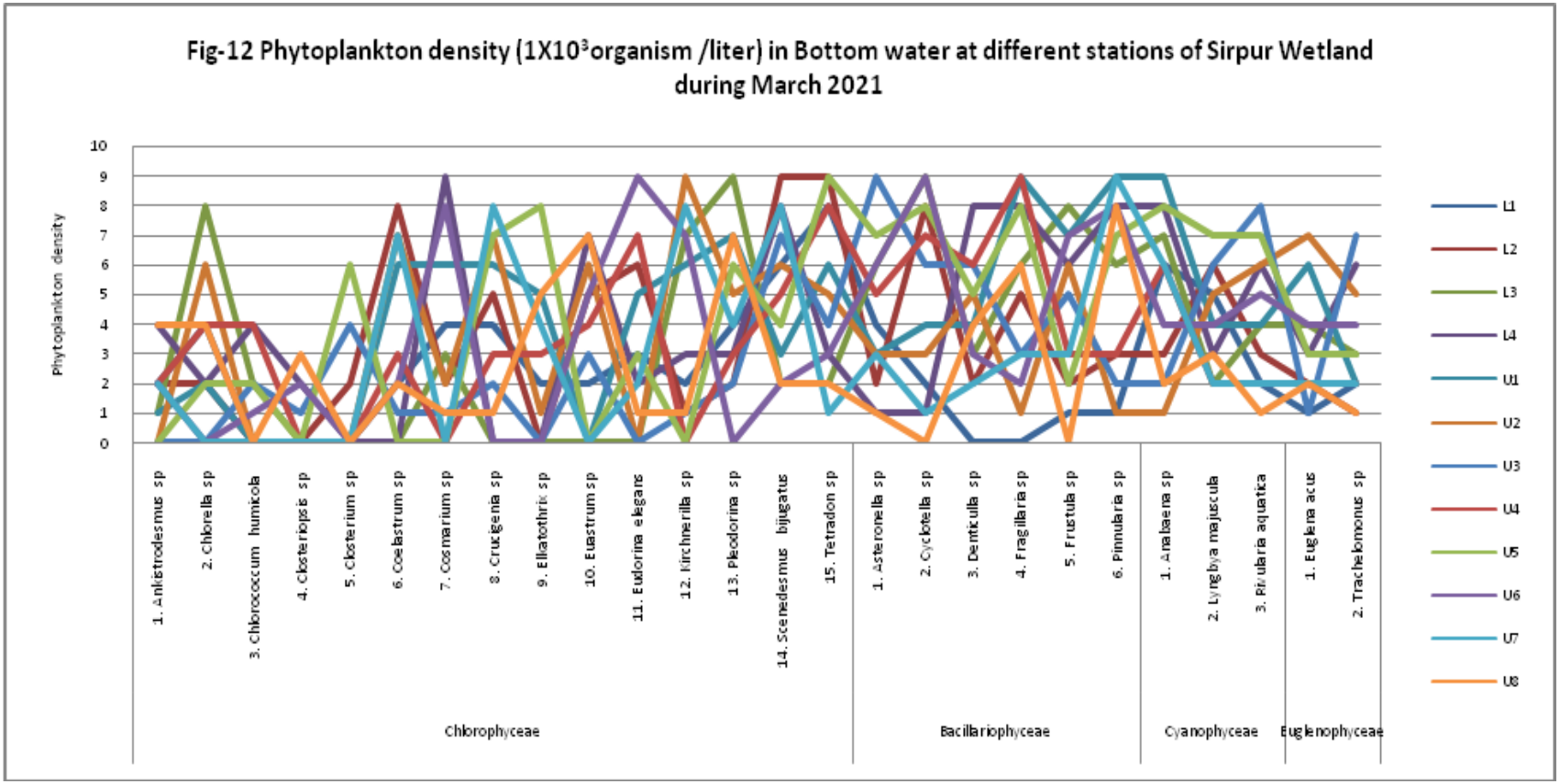


Fig-12 Phytoplankton density (1X10³organism /liter) in Bottom water at different stations of Sirpur Wetland during March 2021
Phytoplankton density
10
9
8
7
6
5
4
3
2
1
0
1. Ankistrodesmus sp
2. Chlorella sp
3. Chlorococcum humicola
4. Closteriopsis sp
5. Closterium sp
6. Coelastrum sp
7. Cosmarium sp
8. Crutigenia sp
9. Ellatothrix sp
10. Euastrum sp
11. Eudorina elegans
12. Kirchnerilla sp
13. Pleodorina sp
14. Scenedesmus bijugatus
15. Tetradon sp
1. Asteronella sp
2. Cyclotella sp
3. Denticulla sp
4. Fragillaria sp
5. Frustula sp
6. Pinnularia sp
1. Anabaena sp
2. Lyngbya majuscula
3. Rivularia aquatica
1. Euglena acus
2. Trachelomonus sp
Chlorophyceae
Bacillariophyceae
Cyanophyceae
Euglenophyceae
L1
L2
L3
L4
U1
U2
U3
U4
U5
U6
U7
U8

During March 2021, in bottom water total 26 species of phytoplankton belonging to four different classes were recorded at various stations of Sirpur Wetland. The total number of Chlorophyceae species was 15, Bacillariophyceae was 6, and Cyanophyceae and Euglenophyceae was 3 and 2 respectively.

Phytoplankton assemblages respond rapidly to changes in their environment with concomitant changes in overall abundance, growth rates, and species composition, changes in physical and chemical water quality (nutrient concentrations, loading, salinity, temperature, and turbidity) can thus have a rapidly changed species composition. Phytoplankton growth is mainly due to nutrient loading especially with phosphorus and nitrogen coming from surface runoff which leads to the eutrophication Stevens, (2005).Thus the most common, obvious and persistent water quality problem is called eutrophication (Vyas, 2007). Excessive loading of phosphorus and nitrogen may result high algal blooms (Jana et.al. 1995). Goel,et.al. (1995) also found similar results of dominancy of Chlorophyceae and Bacillariophyceae groups of phytoplanktons and observed about 25 species of each group.

5.2.2 Zooplankton

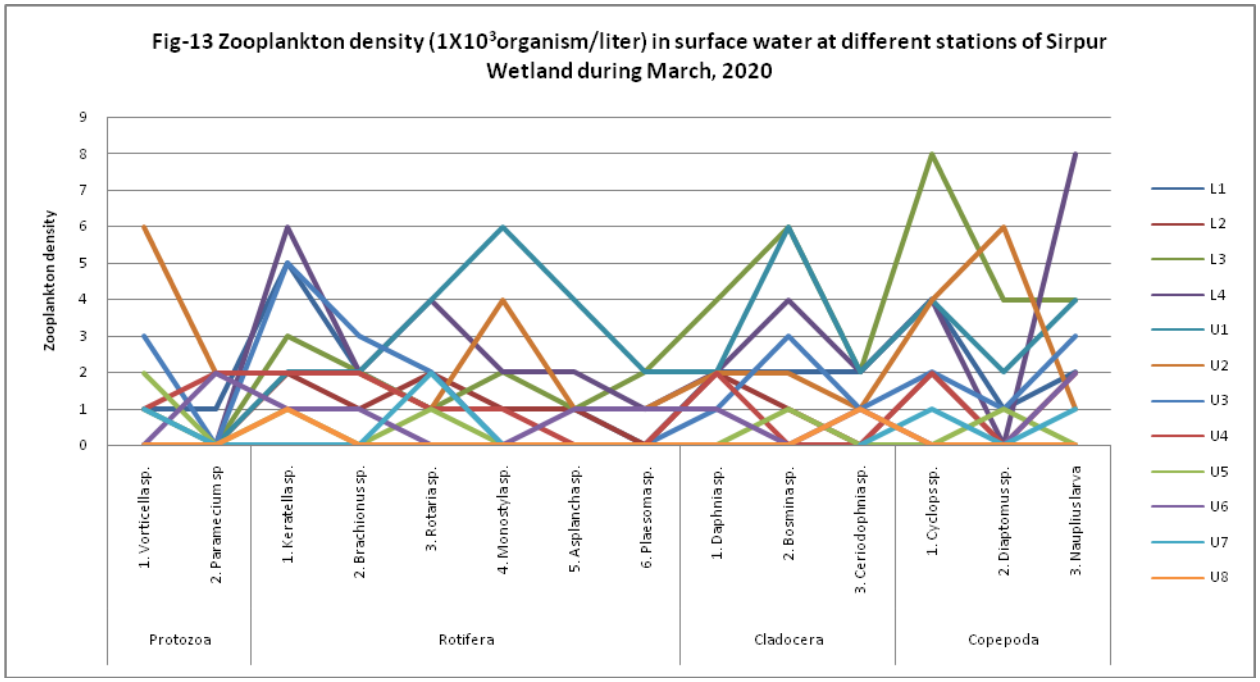
The animal components of fresh water constitute an extremely diverse assemblage of organisms represented by nearly all phyla. Analyses of their functional roles within aquatic system are necessary for understanding the reasonable balance exists between the general modes and limiting of growth and reproduction in relation to food availability and utilization. Evolution of the population dynamics and certain important adaptive behavioral characteristic that influences these dynamics are fundamentals for formulation of productivity of individual species, populations and of their entire communities. The planktonic communities of freshwater include animals as well as plants. Many of animals (zooplankton) are herbivores, feeding directly upon algae and bacteria inhabiting the same water masses in which they live, inevitably, their activities deplete the standing stock of phytoplankton and hence, may have a significant effect upon their dynamics and population ecology. Interaction between

zooplankton and algae has long interested Limnologist as well as Oceanographers, and considerable theory has been developed. Grazing may also influence the succession of phytoplankton species.

Zooplankton population observed in surface water of Sirpur wetland during the period of March 2020, is shown in Table-7. During the period of investigation total 14 species of zooplankton belonging to four different classes were recorded at surface water of various stations of Sirpur Wetland. The total number of Protozoa species was 2, Rotifera was 6, and Cladocera and Copepoda were represented by 3 species each.

Table-7 Zooplankton density (1X10^{3}organism/liter) in surface water at different stations of Sirpur Wetland during March, 2020

Group	L1	L2	L3	L4	U1	U2	U3	U4	U5	U6	U7	U8
Protozoa												
1. *Vorticella sp.*	1	0	1	0	0	6	3	1	2	0	1	0
2. *Paramecium sp*	1	0	0	0	0	2	0	2	0	2	0	0
Rotifera												
1. *Keratella sp.*	5	2	3	6	2	2	5	2	1	1	0	1
2. *Brachionus sp.*	2	1	2	2	2	2	3	2	0	1	0	0
3. *Rotaria sp.*	1	2	1	4	4	1	2	1	1	0	2	0
4. *Monostyla sp.*	1	1	2	2	6	4	0	1	0	0	0	0
5. *Asplancha sp.*	1	1	1	2	4	1	0	0	0	1	0	0
6. *Plaesoma sp.*	0	0	2	1	2	1	0	0	0	1	0	0
Cladocera												
1. *Daphnia sp.*	2	2	4	2	2	2	1	2	0	1	0	0
2. *Bosmina sp.*	2	1	6	4	6	2	3	0	1	0		0
3. *Ceriodophnia sp.*	2	0	2	2	2	1	1	0	0	1	0	1
Copepoda	3	2	3	3	3	3	3	1	0	1	0	0
1. *Cyclops sp.*	4	2	8	4	4	4	2	2	0	0	1	0
2. *Diaptomus sp.*	1	0	4	0	2	6	1	0	1	0	0	0
3. *Nauplius larva*	2	0	4	8	4	1	3	2	0	2	1	0

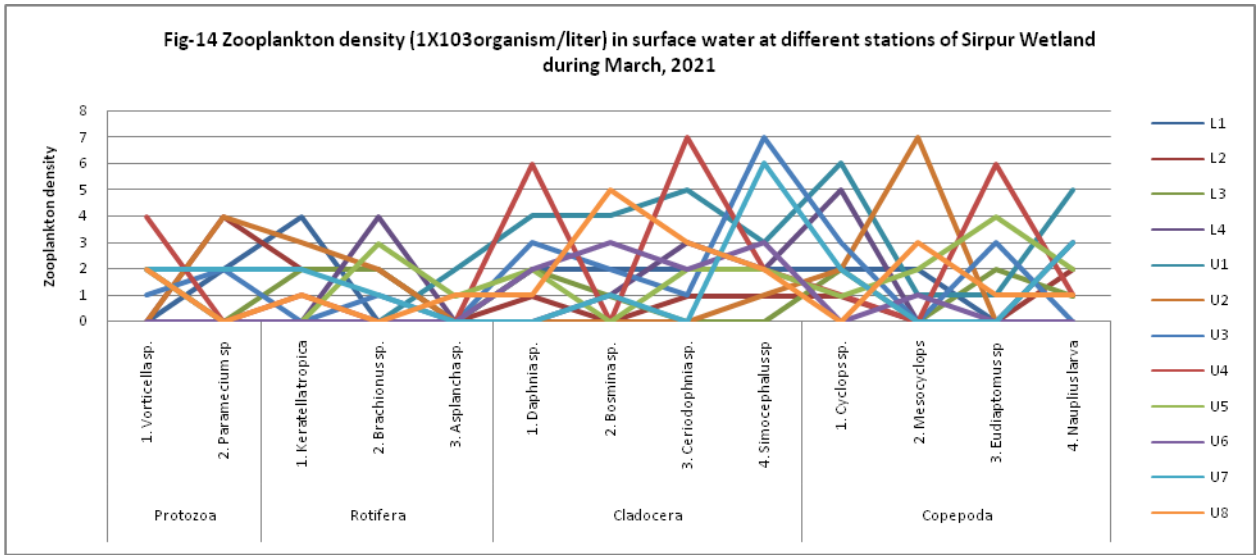


While in March 2021 total 13 species of zooplankton belonging to four different classes were recorded at various stations of Sirpur Wetland in surface water. The total number of Protozoa species was 2, Rotifera was 3, and Cladocera and Copepoda were again represented by 4 species each.

Table-8 Zooplankton density (1X10^{3}organism/liter) in surface water at different stations of Sirpur Wetland during March, 2021

Group	L1	L2	L3	L4	U1	U2	U3	U4	U5	U6	U7	U8
Protozoa												
1. *Vorticella sp.*	0	0	0	2	0	0	1	4	2	0	2	2
2. *Paramecium sp*	2	4	0	0	0	4	2	0	0	0	2	0
Rotifera												
1. *Keratella tropica*	4	2	2	0	0	3	0	1	0	0	2	1
2. *Brachionus sp.*	0	2	2	4	0	2	1	0	3	0	1	0
3. *Asplancha sp.*	0	0	0	0	2	0	0	0	1	0	0	1
Cladocera												
1. *Daphnia sp.*	2	1	2	0	4	0	3	6	2	2	0	1
2. *Bosmina sp.*	2	0	1	1	4	0	2	0	0	3	1	5

3. Ceriodophnia sp.	2	1	0	3	5	0	1	7	2	2	0	3
4. Simocephalus sp	2	1	0	2	3	1	7	2	2	3	6	2
Copepoda												
1. Cyclops sp.	2	1	2	5	6	2	3	1	1	0	2	0
2. Mesocyclops	2	0	0	0	1	7	0	0	2	1	0	3
3. Eudiaptomus sp	0	0	2	0	1	0	3	6	4	0	0	1
4. Nauplius larva	0	2	1	3	5	0	0	1	2	0	3	1



While in bottom water of March 2020 total 11 species of zooplankton belonging to four different classes were recorded at various stations of Sirpur Wetland. The total number of Protozoa species was 1, Rotifera was 4, and Cladocera and Copepoda were again represented by 3 species each (Table-9, Fig-15).

Table- 9 Zooplankton density (1X10^{3}organism/liter) in Bottom water at different stations of Sirpur Wetland during March, 2020

Group	L1	L2	L3	L4	U1	U2	U3	U4	U5	U6	U7	U8
Protozoa												
1. Vorticella sp.	1	0	1	0	0	6	3	1	0	0	0	0
Rotifera												
1. Keratella sp.	5	2	3	6	2	2	5	2	1	2	1	2
2. Rotaria sp.	1	2	1	4	4	1	2	1	1	2	1	2
3. Monostyla sp.	1	1	2	2	6	4	0	1	0	0	1	0
4. Asplancha sp.	1	1	1	2	4	1	0	0	0	1	0	2

Cladocera												
1. Daphnia sp.	2	2	4	2	2	2	1	2	1	0	2	0
2. Bosmina sp.	2	1	6	4	6	2	3	0	2	1	1	1
3. Ceriodophnia sp.	2	0	2	2	2	1	1	0	1	0	2	4
Copepoda												
1. Cyclops sp.	4	2	8	4	4	4	2	2	0	2	0	2
2. Diaptomus sp.	1	0	4	0	2	6	1	0	2	1	2	1
3. Nauplius larva	2	0	4	8	4	1	3	2	1	4	1	2

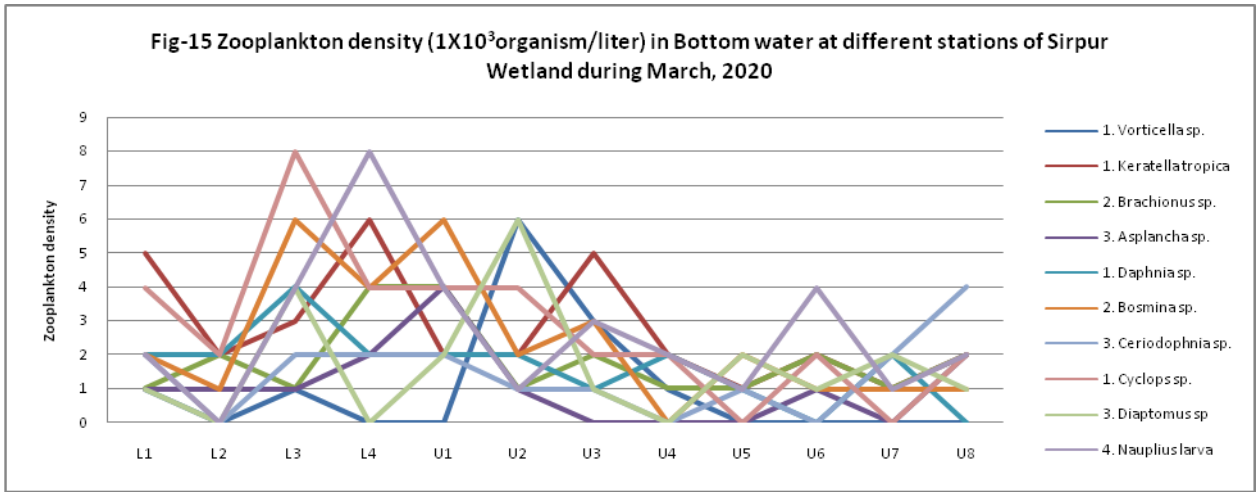
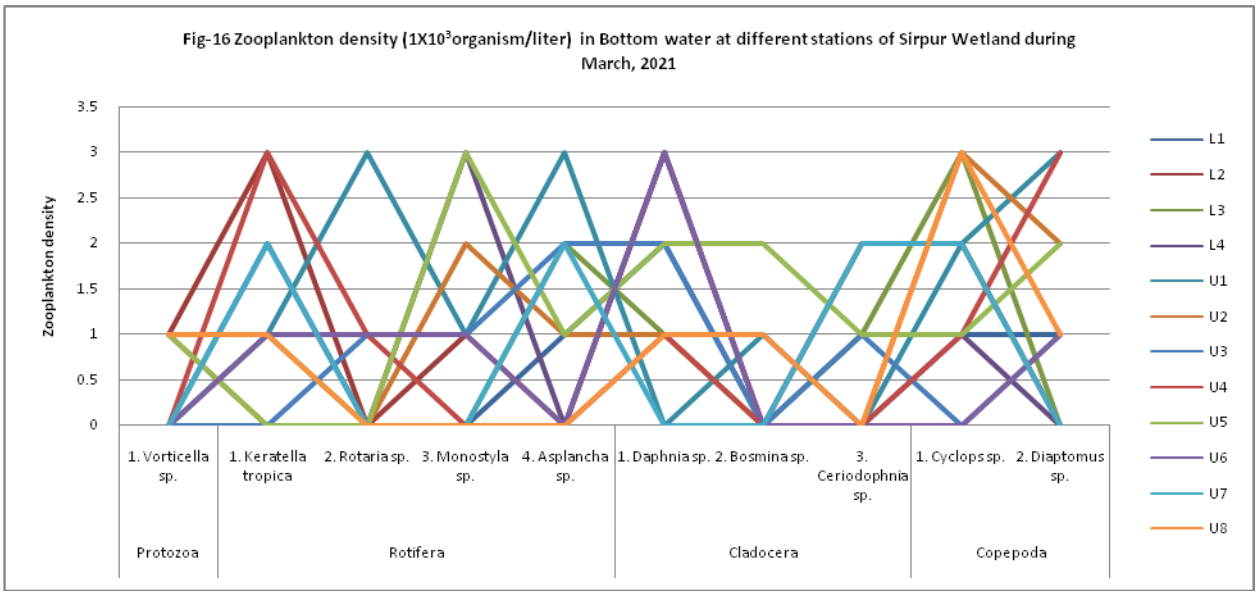


Table- 10 Zooplankton density (1X10^{3}organism/liter) in Bottom water at different stations of Sirpur Wetland during March, 2021

Group	L1	L2	L3	L4	U1	U2	U3	U4	U5	U6	U7	U8
Protozoa												
1. Vorticella sp.	0	1	0	0	0	1	0	0	1	0	0	1
Rotifera												
1. Keratella tropica	2	3	1	0	1	0	0	3	0	1	2	1
2. Rotaria sp.	0	0	0	0	3	0	1	1	0	1	0	0
3. Monostyla sp.	0	1	0	3	1	2	1	0	3	1	0	0
4. Asplancha sp.	1	0	2	0	3	1	2	0	1	0	2	0
Cladocera												
1. Daphnia sp.	2	3	1	3	0	1	2	1	2	3	0	1
2. Bosmina sp.	0	0	0	0	1	0	0	0	2	0	0	1

3. Ceriodophnia sp.	1	2	1	0	0	0	1	0	1	0	2	0
Copepoda												
1. Cyclops sp.	1	2	3	1	2	3	0	1	1	0	2	3
2. Diaptomus sp.	1	0	0	0	3	2	1	3	2	1	0	1



Zooplankton may have indirect effects on algae via excretion (Roth and Horne, 1981 and Onde and Gulati, 1988) or through removal of smallest colonies by grazing De Bernardi et. al (1981). For herbivorous zooplankton, the filtration rates determine their ability to effect phytoplankton Goldman and Horne, (1983). Progress of planktons has been dogged by insufficient basic information on the biology of many of the animals inhabiting the plankton and by the inadequacies of techniques designed to measure feeding upon natural foods in the laboratory**.** The preponderance of herbivores over primary producers therefore generates tremendous interest in the feeding of zooplankton as zooplankton consumes food, not only affect the material income of the consumer but also sets a measure to reduce the excessive primary productivity of the system. Pani et. al. (2007) studied that large sized cladocerans due to their high filtering rate can ingest wide spectrum of partials and thus have an impact on availability

of phytoplankton in the wetland. Information of Ramsagar wetland (2002) observed similar results as Rotifera was the dominant group of zooplanktons and found 7 species of Rotifers.

5.3 Macrophyte

The macrophytic vegetation is an important component of food webs of the aquatic ecosystem. They provide supports, shelter and oxygen to other organisms and play an important role in biological production. These communities accumulate large aquatic inorganic nutrients early in their growth season and thereby compete with phytoplankton for nutrient requirements. Aquatic weeds are particularly problematic as they reduce water storage capacity and also water flow. Thus over abundance of aquatic weed is not only results in serious problems for the development of fisheries, but also to other uses of water and to public health.

The important Macrophyte species observed in Sirpur wetland is shown in the Table-6. During the entire period of investigation total 12 species of macrophyte were observed. Maximum diversity of macrophytic community was observed at Station-U1 followed by Station-L1 and Station-L3. In general maximum number of macrophytic species belong to submerged community e.g. *Hydrilla, Myriophyllum, Ottelia alismides* etc.

Table- 11 Macrophytes observed at different stations of Sirpur Wetland during March, 2020

	Sampling Station							
Macro phytes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Free Floating	Lemna minor	Lemna minor,	-	-	-	-	-	-
	-	-	-	-	Spirodella sp.,	Spirodella sp.,	-	Spirodella sp.,
	Sylvania molestata,	Sylvania molestata,	-	Sylvania molestata,	-	-	Sylvania molestata,	-
Emergent	Polygonum	-	-	-	-	Polygonum	-	Polygonum
	Jussia rupens	-	-	-	Jussia rupens	-	-	-
	Potamogeton nodosus	Potamogeton nodosus	-	Potamogeton nodosus	-	Potamogeton nodosus	Potamogeton nodosus	-
Submerged	Vallisneria spiralis,	Vallisneria spiralis,	Myriophyllum spathulatum,	Vallisneria	Vallisneria	Vallisneria	Vallisneria	-
	Hydrilla verticillata,	Hydrilla verticillata,	Hydrilla verticillata, ,	Hydrilla verticillata	Hydrilla verticillata, -	-	Hydrilla verticillata,	Hydrilla verticillata,
	-	-	-	Myriophyllum spathulatum,	Myriophyllum spathulatum,	Myriophyllum spathulatum,	Myriophyllum spathulatum,	-
	Ottelia alismoides	-	-	-	-	-	-	Ottelia alismoides

Table- Macrophytes at different stations of Sirpur Wetland during March 2020

	Stations							
Type	1	2	3	4	5	6	7	8
Free Floating	2	2	0	1	1	1	1	1
Emergent	3	1	0	1	1	2	1	1
Submerged	3	2	2	3	3	1	2	2
Total	**8**	**5**	**2**	**4**	**5**	**4**	**4**	**4**

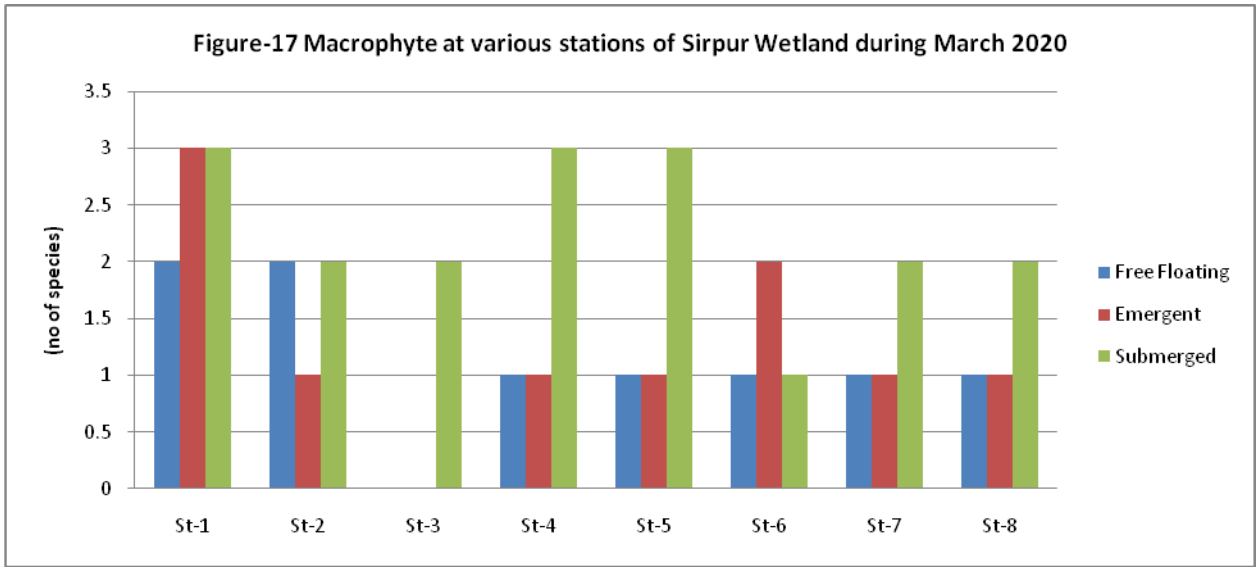


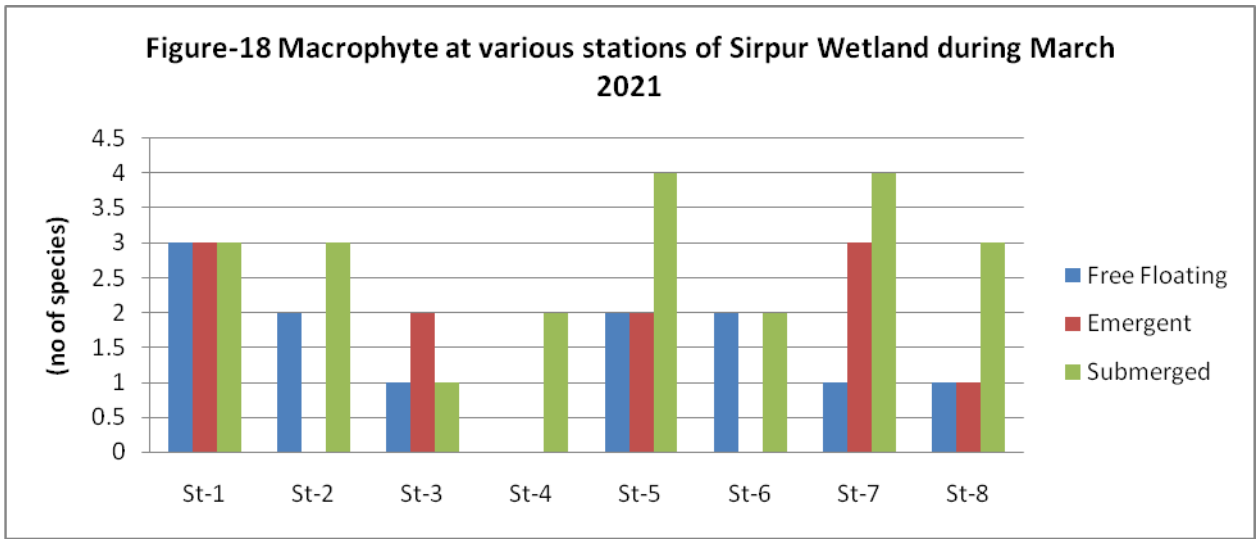
Table- 12 Macrophytes observed at different stations of Sirpur Wetland during March, 2021

	Sampling Station							
Macrophytes	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Free Floating	Lemna minor	Lemna minor,	Lemna minor,	-	-	Lemna minor,	-	Lemna minor,
	Spirodella sp.,	Spirodella sp.,	-	-	Spirodella sp.,	Spirodella sp.,	Spirodella sp.,	
	Sylvania molestata,			,	Sylvania molestata,	-		-
Emergent	Polygonum	-	-	-	Polygonum		Polygonum	Polygonum
	Jussia rupens	-	Jussia rupens	-	Jussia rupens	-	Jussia rupens	-
	Potamogeton nodosus		Potamogeton nodosus	-	-		Potamogeton nodosus	-
Submerged	Vallisneria spiralis,	Vallisneria spiralis,	-	-	Vallisneria	Vallisneria	Vallisneria	Vallisneria
	Hydrilla	Hydrilla		Hydrilla	Hydrilla	-	Hydrilla	Hydrilla

	verticillata,	verticillata,		verticillata	verticillata,		verticillata,	verticillata,
	Myriophyllum spathulatum,	Myriophyllum spathulatum,	-	Myriophyllum spathulatum,	Myriophyllum spathulatum,	Myriophyllum spathulatum,	Myriophyllum spathulatum,	-
	-	-	Ottelia alismoides	-	Ottelia alismoides	-	Ottelia alismoides	Ottelia alismoides

Table- Macrophytes at different stations of Sirpur Wetland during March 2021

	Stations							
Type	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Free Floating	3	2	1	0	2	2	1	1
Emergent	3	0	2	0	2	0	3	1
Submerged	3	3	1	2	4	2	4	3
Total	**9**	**5**	**4**	**2**	**8**	**4**	**8**	**5**



Biological attributes of a waterway can be important indicators of water quality. Biological attributes refer to the number and types of organisms that inhabit a waterway. The macrophytic vegetation is an important component of primary production in aquatic

ecosystem. They provide support, shelter and oxygen to other organisms and play an important role in productivity. The growth density and diversity of macrophytes act as an indicator for the trophic status of various water bodies. The growth of macrophytes is directly related with the nutrient level of the water body. Sirpur wetland in general is a rich habitat of various types of macrophytes including, emergent, free floating, and submerged one.

5.4 Macrobenthos

During the period of investigation total 64 species belonging to different groups were identified. Among this, Mollusca is represented by 21 species, Arthropoda contributed 36 species and Annelida is represented by 7 species.

Table- 13 Variation macrobenthic fauna at various sites of Sirpur Wetland during March 2020

S.NO.		TAXA/Station	L1	L2	L3	L4	U1	U2	U3	U4	U5	U6	U7	U8
A	**Phylum**	**MOLLUSCA**												
	Class	**Gastropoda**												
	Order	**Mesogastropoda**												
	Family	**Viviparidae**												
	1	*Bellamya bengalensis*	2	1	0	1	2	1	0	1	0	1	0	1
	2	*Bithynia Pulchella*	0	1	0	0	0	3	0	0	0	1	1	0
	3	*Bellamya dissmilis*	0	1	0	0	0	1	0	0	0	0	0	0
	Family	**Thiardae**												
	1	*Thiara tuberculata*	0	0	1	0	0	0	1	0	0	0	0	0
	Order	**Caenogastropoda**												
	Family	**Paludomidae**												
	1	*Paludomus sulcatus*	1	1	0	0	1	1	0	0	0	1	0	0
	Family	**Pleuroceridae**												
	1	*Pleurocera sps.*	0	0	1	0	0	0	0	0	0	0	0	0
	Order	**Architaenioglossa**												
	Family	**Ampullariidae**												
	1	*Pila globosa*	1	1	0	2	4	4	0	2	1	2	6	4
	2	*Pila virens*	0	1	1	0	1	0	1	0	0	1	0	2
	Family	**Viviparidae**												
	1	*Viviparus viviparus*	2	1	1	4	0	4	0	1	0	2	0	2
	Order	**Hygrophila**												

	Family	**Planorbidae**												
	1	*Indoplanrobis exustus*	1	0	0	0	1	0	0	0	0	0	0	1
	2	*Gyraulus convexiusculus*	0	0	2	2	0	0	1	3	0	2	1	0
	Order	**Sorbeoconcha**												
	Family	**Turritellidae**												
	1	*Turritella communis*	0	0	0	0	1	0	0	0	1	0	0	0
	Order	**Neotaenioglossa**												
	Family	**Pleuroceridae**												
	1	*Goniobasis sp*	1	0	0	0	0	1	0	0	0	0	0	1
	Order	**Basommatophore**												
	Family	**Lymnaeidae**												
	1	*Lymnaea auricularia*	4	1	0	3	1	1	0	1	0	1	0	1
	2	*lymnaea acuminata*	0	0	1	1	0	0	1	1	0	0	1	1
	Order	**Littorinimorpha**												
	Family	**Bithyniidae**												
	1	*Bithynia tenticulata*	0	1	0	0	0	1	0	0	0	1	0	1
	Class	**Bivalvia**												
	Family	**Amblemidae**												
	1	*Parreysia occata*	0	0	0	1	0	0	0	0	1	0	1	0
	Order	**Unionoida**												
	Family	**Unionidae**												
	1	*Lamellidens consorbinus*	0	0	1	0	0	0	2	0	2		1	1
B	**Phylum**	**ARTHROPODA**												
	Class	**Crustacea**												
	Order	**Decapoda**												
	Family	**Palaemonidae**												
	1	*Palaemonetes sps.*	2	0	0	2	4	0	0	4	0	5	2	2
	Order	**Mysida**												
	Family	**Mysidae**												
	1	*Mysis sps.*	0	0	0	0	0	0	0	1	0	0	0	0
	Family	**Atyidae**												
	1	*Syncaris sps.*	1	0	0	3	0	1	0	0	0	1	0	1
	Class	**Insecta**												
	Order	**Diptera**												
	Family	**Chironomidae**												
	1	*Chironomous sps.*	2	1	0	1	1	0	0	1	0	0	1	1
	Family	**Tipulidae**												
	1	*Tipula abdominalis*	1	0	0	0	1	0	0	0	1	1	0	0

	Family	**Culicidae**												
	1	*Culex sps.*	6	4	4	0	0	0	1	0	1	1	1	1
	Order	**Odonata**												
	Family	**Gomphidae**												
	1	*Gomphus sps.*	4	0	2	0	1	0	1	0	0	1	1	0
	2	*Hegenius sps.*												
	Family	**Calopteryidae**												
	1	*Calopteryx sps.*	0	1	0	0	0	1	0	0	1	0	0	1
	Family	**Aeshinidae**												
	1	*Anax junix*	0	1	0	0	0	1	0	0	0	0	0	0
	Family	**lestidae**												
	1	Lestes sps.	0	1	0	0	0	1	0	0	0	0	0	0
	Family	**Coenagrionidae**												
	1	*Argia sps.*	0	0	1	0	0	0	2	0	0	0	1	0
	2	*Coenagrion sps.*	1	0	0	0	0	1	0	0	0	0	0	1
	Order	**Araneae**												
	Family	**Pisauridae**												
	1	*Dolomedes sps.*	1	0	0	0	0	0	0	0	0	1	0	0
	Order	**Emphemeroptera**												
	Family	**Emphemerillidae**												
	1	*Emphemerlla sps.*	1	0	0	0	1	0	0	0	0	0	1	0
	Family	**Cordulegasteridae**												
	1	*Cordulegaster sps.*												
	Family	**Caenidae**	0	0	0	0	1	0	0	0	0	0	0	0
	1	*Caenis sps.*												
	Order	**Coleoptera**												
	Family	**Hydrophilidae**												
	1	*Berosus sps.*	1	1	0	0	1	0	0	0	2	0	0	1
	Family	*Gyrinidae sps.*	0		1	0	0	0	1	0	0	1	0	0
	1	*Dineutus sps.*	0	0	1	1	0	0	2	1	0	2	0	1
	Family	**Curculionoidae**												
	1	*Camptocerus sps*	1	0	0	0	0	2	0	0	1	0	0	0
	Order	**Hemiptera**												
	Family	**Gerridae**												
	1	*Gerris sps.*	1	0	2	0	1	0	1	0	0	0	0	1
	2	*Aquaris remigis*	2	1	0	0	1	0	0	3	0	3	0	0
	Family	**Notonectidae**												
	1	*Notonecta sps.*	1	0	0	0	1	0	0	0	0	0	0	0

	Family	**Corixidae**												
	1	*Micronecta sps.*	1	0	0	0	0	0	0	0	1	0	0	1
	2	*Sigara sps.*	0	3	0	0	0	1	0	0	0	1	2	0
	Family	**Belostomatidae**												
	1	*Abedus herberti*	0	0	1	0	0	1	0	0	3	0	4	0
	2	*Lethocerus sps.*	0	2	0	0	1	0	0	1	0	1	0	1
	Family	**Naucoridae**												
	1	*Pelcoris sps.*	0	0	1	1	0	0	1	1	0	0	1	0
	Family	**Nepidae**												
	1	*Nepa sps.*	2	1	0	1	0	1	0	0	0	1	0	1
	2	*Ranatra sps.*	0	0	1	0	0	0	1	0	0	0	0	0
C	**Phylum**	**ANNELIDA**												
	Class	**Oligocheata**												
	Order	**Haplotaxida**												
	Family	**Tubificidae**	2	1	1	1	0	3	2	1	0	1	4	2
	1	*Tubifix sps.*	0	1	0	1	0	1	0	2	0	0	1	0
	2	*Limnodrilus sps.*	0	2	0	1	0	1	0	1	0	0	0	
	3	*Branchura sps.*	0	2	0	2	0	1	0	1	0	0	0	0
	4	*Stylaria lacustris*	0	1	0	1	1	0	0	0	3	0	0	0
	Family	**Megascolecidae**												
	1	*Pheretima sps.*	0	0	0	0	1	0	0	0	1	0	0	0
	Order	**Rhynchobdellida**												
	Family	**Glossiphoniidae**												
	1	*Glossiphonia sps.*	1	0	2	0	0	0	1	0	1	0	1	0
	Class	**Clitellata**												
	Order	**Rhynchobdellida**												
	1	*Hirudinea sps.*	2	1	1	0	2	1	1	0	0	0	0	0

Table- 14 Variation macrobenthic fauna at various sites of Sirpur Wetland during March 2021

S.NO.		TAXA/Station	L1	L2	L3	L4	U1	U2	U3	U4	U5	U6	U7	U8
A	**Phylum**	**MOLLUSCA**												
	Class	**Gastropoda**												
	Order	**Mesogastropoda**												
	Family	**Viviparidae**												
	1	*Viviparus viviparus*	2	0	1	0	0	0	0	2	0	0	1	0
	2	*Bellamya dissmilis*	2	1	0	0	0	0	0	1	0	0	1	0
	Order	**Architaenioglossa**												
	Family	**Ampullariidae**												
	1	*Pila globosa*	4	0	1	0	1	0	0	0	1	0	0	1
	Order	**Hygrophila**												
	Family	**Planorbidae**												
	1	*Gyraulus convexiusculus*	1	0	0	1	0	1	2	0	0	1	0	1
	Order	**Neotaenioglossa**												
	Order	**Basommatophore**												
	Family	**Lymnaeidae**												
	1	*lymnaea acuminata*	2	0	1	0	0	0	0	0	1	0	1	0
	Class	**Bivalvia**												
	Family	**Amblemidae**												
	1	*Parreysia occata*	0	0	0	0	1	0	0	0	1	0	0	0
	Order	**Unionoida**												
	Family	**Unionidae**												
	1	*Lamellidens consorbinus*	2	1	1	0	0	1	0	1	1	0	0	0
B	**Phylum**	**ARTHROPODA**												
	Class	**Crustacea**												
	Order	**Decapoda**												
	Family	**Palaemonidae**												
	1	*Palaemonetes sps.*	4	2	0	1	0	6	0	1	0	0	2	0
	Order	**Mysida**												
	Family	**Mysidae**												
	1	*Mysis sps.*	0	0	0	2	0	1	0	1	0	0	1	0
	Class	**Insecta**												
	Order	**Diptera**												
	Family	**Chironomidae**												
	1	*Chironomous sps.*	4	2	1	1	0	0	0	4	0	1	0	0
	Family	**Tipulidae**												

	1	*Tipula abdominalis*	1	0	0	3	0	1	0	0	1	0	0	1
	Family	**Culicidae**												
	1	*Culex sps.*	4	2	0	0	1	0	1	0	2	0	0	0
	Order	**Odonata**												
	Family	**Gomphidae**												
	1	*Gomphus sps.*	1	2	0	0	1	0	1	0	1	0	2	1
	2	*Hegenius sps.*												
	Order	**Emphemeroptera**												
	Family	**Emphemerillidae**												
	1	*Emphemerlla sps.*	2	1	2	0	1	0	1	0	1	0	0	1
	Family	**Caenidae**												
	1	*Caenis sps.*	1	0	1	0	2	1	0	0	0	0	1	0
	Order	**Coleoptera**												
	Family	**Hydrophilidae**												
	1	*Berosus sps.*	1	0	0	0	0	1	0	0	0	1	0	0
	Family	*Gyrinidae sps.*												
	1	*Dineutus sps.*	1	0	0	0	0	1	0	0	0	0	0	0
	Order	**Hemiptera**												
	Family	**Gerridae**												
	1	*Gerris sps.*	0	0	0	0	1	0	0	1	0	0	1	0
	Family	**Notonectidae**												
	1	*Notonecta sps.*	0	1	0	1	0	0	0	2	1	0	1	0
	Family	**Corixidae**												
	1	*Micronecta sps.*	1	0	1	0	1	1	0	0	0	0	0	0
	Family	**Belostomatidae**												
	1	*Abedus herberti*	0	0	0	1	0	0	0	0	0	0	1	0
	Family	**Nepidae**												
	1	*Nepa sps.*	0	1	0	0	3	1	1	0	0	0	0	0
	2	*Ranatra sps.*	2	0	0	1	0	1	0	1	0	1	0	0
C	**Phylum**	**ANNELIDA**												
	Class	**Oligocheata**												
	Order	**Haplotaxida**												
	Family	**Tubificidae**												
	1	*Tubifix sps.*	2	0	0	0	1	0	0	1	0	0	1	0
	2	*Limnodrilus sps.*	1	0	1	1	1	0	0	0	1	0	1	0
	Family	**Megascolecidae**												
	1	*Pheretima sps.*	2	1	1	1	0	0	0	0	1	0	1	3
	Order	**Rhynchobdellida**												

	Family	**Glossiphoniidae**												
	1	*Glossiphonia sps.*	0	1	2	3	0	1	1	0	0	1	0	0
	Class	**Clitellata**												
	Order	**Rhynchobdellida**												
	1	*Hirudinea sps.*	0	0	2	0	1	0	2	0	1	0	1	0

In Sirpur wetland most of the macrobenthic fauna in general were found in three major groups viz. Mollusca, Arthropoda and Annelida.

5.5 Fish Fauna

Fishes are the integral components of river systems and represent a visible measure of stream ecosystem structure and function. As various life stages and species of fish require different kinds of physical habitats in lotic ecosystems, **Schlosser, (1991)**. Freshwater fishes are the most diverse group of India's vertebrates with a minimum of 600 species **Talwar and Jhingran, (1991).** Since fish catch in the wetland has been prohibited from last couple of years therefore local fisherman were consulted to have an idea about type of fishes available, which is given below.

Table-15 Fish Fauna of Sirpur Wetland (As reported by local fisherman) during March 2020-2021

S. No.	Name of Fish	S. No	Name of Fish
1	*Catla catla*	10	*Mystus seenghala*
2	*Cirrhinus mrigala*	11	*Rita rita*
3	*Cyprinus carpio*	12	*Notopterus notopterus*
4	*Labeo calbasu*	13	*Notopterus chitala*
5	*Labeo rohita*	14	*Heteropneustes fossilis*
6	*Chela laubuca*	15	*Clarias batrachus*
7	*Rasbora daniconius*	16	*Channa marulius(Ophiocephalus marulius)*
8	*Punctius ticto*	17	*Chanda nama*
9	*Barbus tor*		

- **Harvesting fishes from Sirpur Wetland has been banned; hence list depicted above is based on the information gathered from local communities/fisherman.**

5.6 Avifauna

Investigation on avifauna could not be conducted during the course of investigation; therefore work done by Shri Bhalu Monde of Nature's Volunteer is referred here. As per available information total 92 species of birds have been reported from the wetland Table- .

Table- 16 List of Birds in Sirpur Lake, Indore (M.P.)

1	*Little Cormorant*	*47*	*Indian Nightjar*
2	*Little Egret*	*48*	*Spotted owlet*
3	*Cattle Egret*	*49*	*House swift*
4	*Grey Heron*	*50*	*Hoopoe*
5	*Paddy Bird*	*51*	*Plam Shift*
6	*White necked stork*	*52*	*Blossomheaded parakeet*
7	*Open billed stork*	*53*	*Roller or blue jay*
8	*Cotton teal*	*54*	*Small green bee eater*
9	*Bar headed goose*	*55*	*Pied Kingfisher*
10	*Nakta -comb duck*	*56*	*White breasted kingfisher*
11	*Dabchick (little grebe)*	*57*	*Small blue kinfisher*
12	*Spotbill*	*58*	*Grey hornbill*
13	*Common teal*	*59*	*Goldenbacked woodpecker*
14	*Pintailed duck*	*60*	*Indian skylark*
15	*Wigeon*	*61*	*Crested skylark*
16	*White backed vulture*	*62*	*Wiretailed swallow*

17	*White Scavenger vulture*
18	*Black Winged Kite*
19	*Pariah Kite*
20	*White eyed Buzzard*
21	*Tawany Eagle*
22	*Grey onail*
23	*Sarus Crane*
24	*Common Penfowl (Peacock)*
25	*Indian Mozriren*
26	*Purple Mosshen*
27	*White Breasted Waterhen*
28	*Pheasant tailed Jacana*
29	*Bronze Winged Jacana*
30	*Coot*
31	*Painted Snipe*
32	*Red Wattled lapwing*
33	*River Feru*
34	*Black Winged Stilt*
35	*Sandpiper*
36	*Little stint*
37	*Fantail snipe*
38	*Shikra*
39	*Blue Rock Pigen*
40	*Ring done*
41	*Little brown dove*
42	*Spotted dove*

63	*Common swallow*
64	*Grey shrike*
65	*Rufousbacked shrike*
66	*Black dronggo*
67	*Ashy swallow shrike*
68	*Jungle crow*
69	*Golden oriole*
70	*Black headed orile*
71	*Brahminy myna*
72	*Common Indian myna*
73	*Tree pie*
74	*Small minivet*
75	*Red vented bulbul*
76	*Jungle babbler*
77	*Common babbler*
78	*Ashy wren warbler*
79	*Indian wren warbler*
80	*Tailor bird*
81	*Magpie robin*
82	*Indian robin*
83	*Grey wagail*
84	*Pied wagtail*
85	*Redstart*
86	*Tickells fiowerepecker*
87	*Purple sunbird*
88	*Baya weaver bird*

43	*Rose Ringed Parakeet*	*89*	*White throated munia*
44	*Koet*	*90*	*Thickbilled flowerpeacker*
45	*Crow Pheasant (Coucal)*	*91*	*Purple heron*
46	*Coppersmith (Crimson br. Barbet)*	*92*	*Pochard*

6. Discussion

The period of investigation in Sirpur Wetland was conducted at two different intervals at an interval of one year. The basic objective of the study was to understand the existing water quality of this pristine wetland with particular reference to biodiversity. The wetland is an important habitat of large number of aquatic as well as terrestrial flora and fauna. During present investigation slight variation in different physico-chemical and biological parameters were observed with respect to hydrogeological variations viz. catchments structure, topographical characteristics and consequence anthropogenic activities.

The present investigation also reaffirm that the wetland is an important resource of various flora and fauna including phytoplankton, zooplankton, macrobenthos and macrophytic communities. A slight variation in various physico-chemical and biological parameters at few places may be due to accumulation of nutrients from the adjoining agricultural fields along with other anthropogenic activities.

7. Conclusion

The main observations of based on the identified limnological parameters during the period of study can be concluded as follows:

- Higher values of Total dissolved solids were recorded due to joining of suspended and dissolved matter through surface runoff.
- The water quality of Upper lake is observed to be better in comparison to Lower lake, as this one is more prone to nutrient enrichment due to authocthonus organic masses. The center of the wetland which is comparatively free from any human activities and has better quality of water .

The biological characteristics of the Sirpur wetland depicted variation in both flora and fauna at different stations. Significant variations in biological diversity at different stretches of the

wetland were observed during this period of investigation. The status of biotic community of Sirpur wetland is highlighted below:

- The algal community was observed to be primarily dominated by the Chlophyceae, Bacillariophyceae group.
- The zooplankton community on the other hand was mostly represented by Rotifera, cladocerans and copepoda group while the presence of protozaon group was meager during the period of investigation.
- Variation in number of species and total number of individuals of phytoplankton and zooplankton may be due to the predation nature of organism or the members of higher class. Number of species in general was slightly less in March 2021.
- The macrophytic vegetation was observed to be fairly developed in most of the places. However they are mostly confined at few places. The macrophyte community remained confined to the limnetic region of the wetland. Macrophytic vegetation included almost all the groups viz. Free Floating, Submerged and Emergent species however, submerged category remain predominant.
- During present investigation total 17 fish species has been recorded although in Sirpur wetland. Depletion of fish diversity in the wetland may have been influenced by cluster of variables like disturbances in the habitat, anthropogenic activities, flooding etc. However in this wetland it is difficult to arrive at any conclusion in absence of authentic information. Moreover no data could be garnered regarding release of fish seed in the wetland.

In general the study conducted during the period March 2020 to March, 2021 depicts that most of the parameters were well within permissible limits of class – B of Central Pollution Control Board, New Delhi, under designated best uses of water for drinking water after conventional treatment however accumulation of organic matter at few places has been witnessed. In

future if the inflow of sewage/ effluents and agricultural waste and accumulation of organic mass continues, the quality of water may deteriorate. However the wetland is still an important site for biodiversity conservation and presence of large number of flora and fauna designates it as a potentially rich biological resource and may well qualify for consideration as a Ramsar Wetland. Hence further mitigative efforts as required could be adopted for sustainability of the biodiversity of this pristine wetland.

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