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Assessment of Water Quality in MithiRiver: Based on Fungi and Phytoplankton Population

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Abstract: *The present investigation of Mithi river, Mumbai was performed by analyzing various physicochemical parameters and water quality index and fungal and phytoplankton diversity for the evaluation of the deterioration level. The study was carried out for one month period during January 2024. Samples were collected every sunday from six stations viz. Near ViharLake, Aarey colony Goregaon, Marol Andheri, vakola Santacruz, BKC and Mahim creek. The results obtained from differentparameters studied were Temperature (33°C-24°C), pH (9.7-6.1), EC (974-26µs/cm), TDS (91-435 ppm), Salinity (0-20.5) and DO (0-1.7). Certain species of fungi were also isolated from Mithi river from which majorly there is indication of presence of Aspergillus and Rhizopus. SWI shows the adverse effect of pollution on Mithi river. WQI of Mithi River of station 1 and 2 showed good quality of water but as the river flows through densely populated city of Mumbai the water quality of Mithi river shows deterioration.*

Abbreviations: pH- Potential of Hydrogen, DO- Dissolved Oxygen, BOD- Biochemical Oxygen Demand, EC-Electrical Conductivity, TDS-Total Dissolved Solids, SWI- Shannon Wiener Diversity Index, WQI-Water Quality Index.

Keywords: Mithi river, Water sample, Physico-chemical parameters, Fungi, Phytoplankton, Pollution

I. INTRODUCTION

Water contamination is an international issue that is not limited to the acts of a single individual or state. Water pollution ona bigger scale must be addressed since pollution and the deterioration of water quality obstruct essential and acceptable water uses. In the last 3 to 4 centuries, urbanization and industrialization have progressed affecting water bodies, which are being generally used for discharging domestic and industrial waste. River water pollution has an adverse effect on the environmental health and hygiene of people in surrounding areas of the river. *(Nagarsekar et al.,2014)*.

In many ecosystems, fungi are essential to biological processes because they break down organic materials in rivers, live onalgae as parasites or symbionts, and provide food for higher trophic animals. However, fungi are susceptible to changes in their surroundings. Changes in fungal communities provide understanding of the physicochemical assessment of river water quality and ecosystem health. As a class of primary producers that incorporate mineral compounds into the biological cycle,phytoplankton is essential to aquatic ecosystems. The microscopic, freely drifting phytoplankton is the greatest plant life found in the oceans. Despite their tiny size, phytoplankton plays a crucial role in the aquatic food chain by serving as a foodsource for a wide range of creatures, including fish and shellfish, which in turn supply food for larger animals. Furthermore, most of the oxygen we breathe comes from phytoplankton. The phytoplankton community functions in sluggish seas and only in slow-moving water environments, rivers or artificial reservoirs. Any change in the abiotic components like physico- chemical changes will be reflected by the biological organisms that are by the phytoplankton *(Varsani et al., 2021)*

Mithi river is located on Salsette island in Mumbai, India. The river rises during the monsoon season and is seasonal. The river originates from Vihar Lake and receives flow from Powai Lake. It flows for a total of 15 km before it meets the Arabian sea at Mahim creek flowing through residential and industrial complexes of Powai, Sakinaka ,Kurla, Kalina, Vakola and Bandra-Kurla complex, Dharavi and Mahim. *(Pawar et al., 2018).*

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The Mithi River was there long before the construction started. The river is being choked by solid waste, and its drainage capacity has been significantly reduced because of the river's narrowing due to concrete bank borders. Water pollution in the Mithi River in Mumbai is a pressing issue with significant environmental and public health ramifications. According to a study by Ahmed Shabbir Khan (2021), industrial discharge, untreated sewage, and improper waste management practices areprimary contributors to water pollution in Mumbai. Every day, untreated and uncontrolled amounts of waste are dumped intothe river by slums, illegitimate factories, small-scale industries, etc. that are located along its banks. The city's rapid industrialization and population growth exacerbate these problems, placing immense pressure on its water bodies.

Fig no.01- Map of Mithi river

Fig no.02- Mithi river flowing through Mahim creek

II. AIM AND OBJECTIVE

The main aim of this research paper presented to you is to divide the Mithi river into different sections and study its water quality as well as various biological elements like fungi and phytoplankton in a scientific manner. The Water Quality Index (WQI) helps to understand the quality of water and the level of how much it is polluted.

Comprehensively studying fungal and phytoplankton diversity in the Mithi River, Mumbai, is essential for assessing the ecological health of this urban waterway. Research indicates that fungal and phytoplankton communities serve as crucial indicators of water quality and ecosystem integrity *(Gulis & Suberkropp, 2003; Saravanan et al., 2019)*. This information is vital for guiding effective conservation efforts and implementing measures to mitigate pollution and habitat degradation, ultimately contributing to the preservation of urban waterways, Evaluate Environmental Impact, Temporal and Spatial Comparison and Water Quality Index Assessment.

III. MATERIALS AND METHODOLOGY

Area of Study:

Mithi river (17.8 km length, 7295 ha catchment area) is a seasonal river originating at an altitude of 246 m (about 807.09 ft) above sea level from spillway discharges of Vihar and Powai lakes, travelling to the Mahim Bay (*Padalkar et al, 2014)*. The Mithi River, situated in Mumbai, once emblematic of its name's sweetness in Hindi, has undergone a profound transformation,transitioning from a pristine watercourse to a heavily polluted drain.

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Collection of Samples:

Sr No.	STATIONCODE	LOCATION	LATITUDE	LONGITUDE	ADDRESS
1	MR001	Near Vihar Lake	19.140502°N	72.890191°E	Powai, Mumbai-400087
2	MR002	Goregaon, Aarey Colony	19.133058°N	72.890115°E	Goregaon (East), Mumbai-400087
3	MR003	Andheri, Marol	19.106620°N	72.884984°E	MV Road, Andheri (East) Mumbai-400059
4	MR004	Vakola, Santacruz	19.083187°N	72.847954°E	Rustamba putak road Santacruz(east) mumbai-400055
5	MR005	Bandra-Kurla complex Point	19.071207° N	72.873397° E	Madina masjid road, Kurla (west), Mumbai- 400070
6	MR006	Mahim creek	19.048144° N	72.837712° E	Swami Vivekanand Marg, Mumbai-400040

Table no.01 - Sampling stations

Water collection at these diverse locales was meticulously executed using sterilized plastic bottles, ensuring sample integrity for subsequent laboratory analysis, which was conducted following refrigeration at 4°C. Only surface water was collected for analysis.

Onsite analysis of water: Different physical-chemical parameters were selected for water analysis and were measured on the sampling sites using digital meter. Parameters such as, Ambient temperature, Temperature, pH, Electrical conductivity, Total dissolved solids and salinity were measured. Dissolved oxygen was measured by the Winkler method (titration).

Fungal isolation: The isolation and identification of fungi from water samples followed standard procedures outlined in *" Michael J. Leboffe and Burton E. Pierce."*

Isolation on Potato Dextrose Agar (PDA) Plates: The water sample underwent standard plate culturing on PDA plates. After inoculating the water sample onto PDA plates, the plates were then incubated at room temperature for2 days.

Transfer to Fresh PDA Plates: Following incubation, different fungal colonies were isolated from the initial PDA plates and transferred to fresh PDA plates to obtain pure cultures for further analysis.

Preparation of Slides for Fungal Identification: To identify the isolated fungi, slides were prepared by staining with cotton blue in lactophenol stain. A small amount of mycelium from each fungal colony was mounted on the slide using a needle within the stain to ensure even distribution. A cover slip was gently applied to the slide to eliminate air bubbles.

Microscopic Examination: The prepared slides were examined under a microscope to observe the morphological characteristics of the fungal structures, such as hyphae and spores.

PHYTOPLANKTON: (*S.K.Maiti)*

By using a plankton net bounded to a small plastic bottle with the help of waterproof sealing tape. Phytoplankton net was held vertical at midheight and the water was poured through the mesh. Transfer the collected samples to clean sample containers. Add an appropriate fixative, such as Lugol's iodine or formaldehyde, to the samples to preserve phytoplankton cells. Mix the samples gently to ensure thorough distribution of the fixative. Transfer a portion of the preserved sample to a centrifuge tube. Centrifuge the sample to concentrate phytoplankton cells at the bottom of the tube. Carefully remove the supernatant to avoid disturbing the concentrated phytoplankton pellet.

Microscopic Observation:

Take a small amount of the concentrated sample using a pipette and place it on a clean microscope slide. Cover the sample with a coverslip to prevent evaporation and contamination. Place the slide on the stage of a compound microscope and observe the sample at 10x magnification. Identify and count the phytoplankton species present in the sample, recording observationsas necessary for further analysis

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Fig. No.03 Collecting water sample using plankton net.

WATER QUALITY INDEX: The Water Quality Index (WQI) is a numerical expression that provides a concise and standardized representation of the overall quality of water based on the assessment of multiple physical, chemical, and biological parameters. **The Weighted Arithmetic Water Quality Index Method (WAWQI)** is used for assessing the waterquality of Mithi river. *(Valentina Andreea Calmuc et. al., 2018).*

WQI standard table – referred from Bureau of Indian Standards (BIS) is the National Standard Body of India. *Brown et al (1972), Chatterji and Raziuddin (2002)*

Range of WQI	Status
0-25	Excellent
26-50	Good
51-75	Poor
76-100	Very poor
Above 100	Unsuitable for drinking

Table no.02 - WQI standard chart

Shannon Weiner Index: This is also called Shannon-Weiner index or Shannon-Weaver index. It is a widely used indexfor measuring biological diversity, *Albuaejee (et.al. 2020).* It is represented as

(H) = Σ pi in pi

Were, Pi = proportion of the i^{th} species.

Range	Level of diversity	Impact of pollution or adverse factors
< 1	Low	Maximum
1- < 3	Moderate	Medium
≥3	High	Minimum

Table no.03 - Ranges of SWI

IV. RESULTS AND DISCUSSION

Physico-chemical parameters – Temperature of surface water collected ranged from 33°C to 24°C showing maximum and minimum values in the span of one month. PH was found in the range of 9.7 to 6.1. Electrical conductivity is minimum at station 1 (26µs/cm) and maximum at station 6 (974µs/cm) which is due to input of elements through domestic waste. The results showed that TDS is from 91ppm to 435 ppm. BOD value of station 1 shows 1.7 dissolved oxygen whereas it gets negligible on all other stations. Salinity of all stations was negligible except the station 6.

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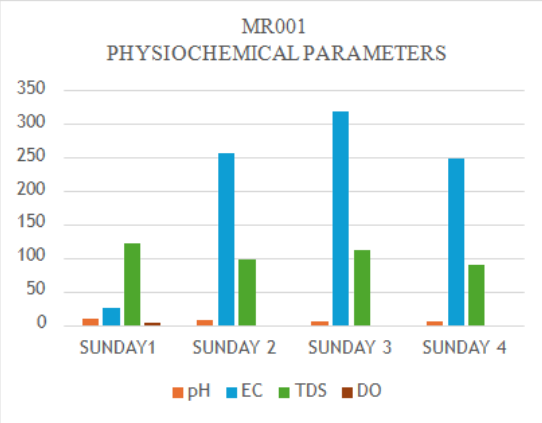

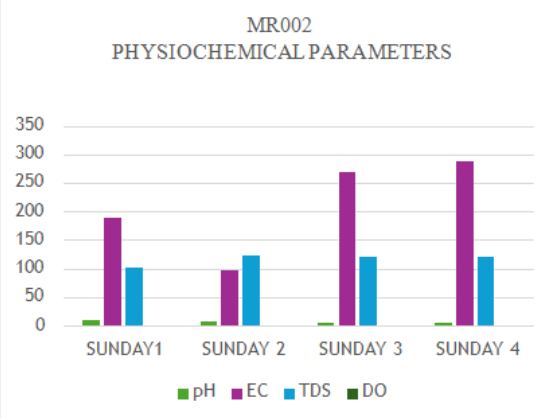

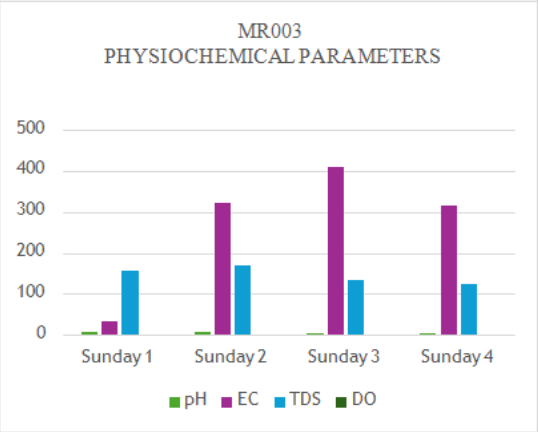

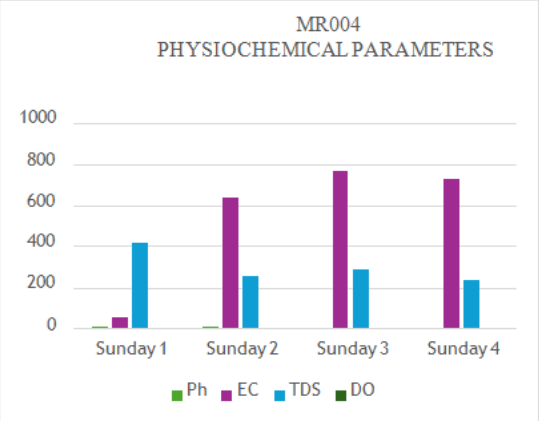

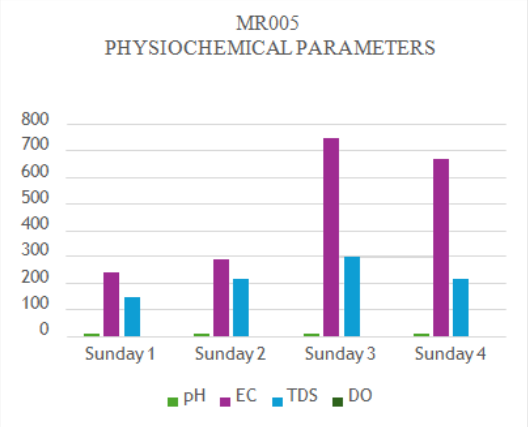

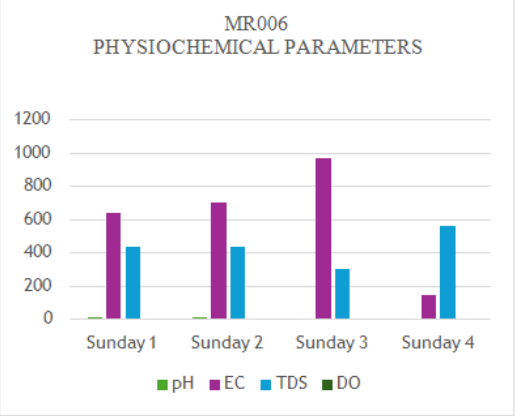

Water Quality Index -

Sr. no.	Station code	WQI	Status
1	MR001	19.58	Excellent
2	MR002	30.44	Good
3	MR003	136.14	Unsuitable for drinking

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4	MR004	156.5	Unsuitable for drinking
5	MR005	76.95	Very poor
6	MR006	84.08	Very poor

Table no.04 - WQI of Mithi river

WQI of present Mithi river is recognized from various Physico-chemical parameters. The graph represents the variations of water quality on six sampling stations. Station 3 and 4 showed the higher WQI indicating that water is much more polluted than other stations, as these stations are dumped with domestic waste due to densely populated area.

Shannon Weiner Index -

Station code	Sampling day	SWI	Range	Level of Diversity	Impact of pollution or adverse factors
MR001	Sample day 1	2.483	1≤ 3	Moderate	Medium
	Sample day 2	2.504	1≤ 3	ModerateModerate	Medium
	Sample day 3	2.355	1≤ 3	Moderate	Medium
	Sample day 4	2.759	1≤ 3		Medium
MR002	Sample day 1	1.616	1≤ 3	Moderate	Medium
	Sample day 2	1.4	1≤ 3	Moderate	Medium
	Sample day 3	1.52	1≤ 3	Moderate	Medium
	Sample day 4	1.351	1≤ 3	Moderate	Medium
MR003	Sample day 1	5.535	1≥3	High Moderate	Minimum
	Sample day 2	2.895	1≤ 3	Moderate	Medium
	Sample day 3	2.903	1≤ 3	Moderate	Medium
	Sample day 4	2.929	1≤ 3		Medium
MR004	Sample day 1	2.937	1≤ 3	Moderate	Medium
	Sample day 2	3.0283	≥3	High	Minimum
	Sample day 3	3.0229	≥3	High	Minimum
	Sample day 4	3.0240	≥3	High	Minimum
MR005	Sample day 1	3.0	≥3 1≤ 3	High	Minimum
	Sample day 2	2.824	≥3	Moderate	Medium
	Sample day 3	3.0	1≤ 3	High	Minimum
	Sample day 4	2.93		Moderate	Medium
MR006	Sample day 1	2.669	1≤ 3	Moderate	Medium
	Sample day 2	2.751	1≤ 3	Moderate	Medium
	Sample day 3	3.197	≥3	High	Minimum
	Sample day 4	3.219	≥3	High	Minimum

Table no.05 - SWI of Mithi river

SWI is used to calculate the population of phytoplankton which is contributing to pollution in Mithi river. The phytoplankton under microscope were identified by "*APHA"* Standard book. The major species of phytoplankton discovered in this study were *Asterionella, Scytosiphon, Ulothrix, Hildenbrandia, Synedra, Aphanizomenon*, etc. are present in the Mithi river, belonging to the algae family which indicates the pollution of river. (shashank et at., 2022). The major diversity of phytoplankton is followed by *cyanophyceae* and *fragilariophyceae* and very minor population is of *chlorococcaceae* and *florideophyceae.*

Fungal isolates – Around 12 fungal isolates consisting of genera: *Aspergillus, Fusarium, Trichoderma and Penicillium* were obtained in this study with *Aspergillus* as the predominant genus. The table shows the cultural features in terms of their color, surface characteristics, edge and reverse colony color.

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Color	Surface Characteristics	Edge	Reverse color	Identity of isolates
Dark green	Cottony	White, circular	Cream	*Aspergillus sydowii*
Greyish black	Granular	White, irregular	Cream	*Aspergillus niger*
Greenish blue	Smooth	White, irregular	White Pale yellow	*Aspergillus fumigatus*
Greenish grey	Velvet type	White	Cream Pale yellow	*Penicillium expansum*
Black	Granular	Black, irregular	Cream	*Aspergillus niger*
White	Smooth	White, circular	Cream	*Fusarium incarnatum*
Whitish green	Granular	Circular	White	*Trichoderma crinaceum*
Mint green	Powder type	White, circular	Cream	*Aspergillus flavus*
White	Mycelial	White, irregular	Cream	*Aspergillus japonicus*

Table no.06 - Cultural characteristics of fungal isolates from Mithi river

Correlation -

MR001	pH	EC	TDS	DO	Temperature	Ambient Temperature	SWI
pH	1						
EC	-0.84328	1					
TDS	0.597986	-0.60486	1				
DO	0.812466	-0.9692	0.776571	1			
Temperature	0.905476	-0.82628	0.881307	0.89776	1		
Ambient Temperature	0.814024	-0.96979	0.775484	0.999995	0.898089	1	
SWI	-0.248	-0.03944	-0.72515	-0.16657	-0.51794	-0.16565	1

Table no.07 - Pearson's correlation matrix for physicochemical parameters and phytoplankton of station 1

MR002	pH	EC	TDS	DO	Temperature	Ambient Temperature	SWI
pH	1						
EC	-0.70316	1					
TDS	-0.70096	-0.01401	1				
DO	-0.42447	0.587287	0.024525	1			
Temperature	-0.38202	-0.11379	0.635816	-0.66446	1		
Ambient Temperature	0.259376	0.503497	-0.87047	0.243622	-0.5825	1	
SWI	0.608172	-0.0492	-0.81781	-0.51852	-0.076	0.698907	1

Table no.08 - Pearson's correlation matrix for physicochemical parameters and phytoplankton of station 2

MR003	pH	EC	TDS	DO	Temperature	Ambient Temperature	SWI
pH	1						
EC	-0.64481	1					
TDS	0.941164	-0.35283	1				
DO	-0.59742	0.185822	-0.69536	1			
Temperature	0.936482	-0.86256	0.774505	-0.54084	1		

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Ambient Temperature	-0.79035	0.363669	-0.77171	0.08055	-0.62203	1	
SWI	0.570688	-0.96676	0.291797	-0.32329	0.82221	-0.15811	1

Table no.09 - Pearson's correlation matrix for physicochemical parameters and phytoplankton of station 3

MR004	pH	EC	TDS	Temperature	Ambient Temperature	SWI
pH	1					
EC	-0.62717	1				
TDS	0.467549	-0.94133	1			
Temperature	0.431068	-0.43218	0.636425	1		
Ambient Temperature	0.04559	0.690026	-0.86067	-0.50833	1	
SWI	-0.45302	0.976571	-0.97134	-0.43819	0.824981	1

Table no.10 - Pearson's correlation matrix for physicochemical parameters and phytoplankton of station 4

MR005	pH	EC	TDS	DO	Temperature	Ambient Temperature	SWI
pH	1						
EC	-0.9323	1					
TDS	-0.55634	0.799565	1				
DO	-0.55556	0.674136	0.85447	1			
Temperature	0.883434	-0.98694	-0.87914	-0.7747	1		
Ambient Temperature	-0.63028	0.346551	-0.04924	0.345285	-0.30571	1	
SWI	0.330671	-0.62796	-0.77256	-0.33028	0.649805	0.512395	1

Table no.11 - Pearson's correlation matrix for physicochemical parameters and phytoplankton of station 5

MR006	pH	EC	TDS	Temperature	Ambient Temperature	SWI
pH	1					
EC	0.234512	1				
TDS	-0.02044	-0.97491	1			
Temperature	0.892548	-0.18378	0.397407	1		
Ambient Temperature	-0.90025	-0.63429	0.453246	-0.62608	1	
SWI	-0.9832	-0.20693	0.006803	-0.85129	0.875831	1

Table no.11 - Pearson's correlation matrix for physicochemical parameters and phytoplankton of station 6

The diversity of phytoplankton plays a crucial role in evaluating the quality of water in river. This diversity was seen to be influenced by physicochemical parameters in this study. A thorough analysis indicates that distribution of phytoplankton in the river is uneven, showing a high level of pollution. Taking into consideration both the physico chemical parameters and phytoplankton diversity, the Mithi river water is unsuitable for consumption purposes.

V. CONCLUSION

In the present study of Mithi river, most of the physicochemical parameters were not within the standards limits of BIS. The WQI indicates pollution in all stations except for station 1 and 2. The SWI shows the diversity of phytoplankton's especially cyanophycean algae which indicates pollution of water. The correlation shows a perfect positive relation of dissolved oxygen and salinity with phytoplankton which means that Mithi river is polluted.

Efforts should be made by local authorities and environmental organizations to address the issues affecting the Mithi River, including cleanup drives, sewage treatment initiatives, and awareness campaigns. However, the restoration of the

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river's health and ecosystem is an ongoing challenge that requires sustained efforts and cooperation from all those who are involved. Spreading awareness about water pollution and encouraging people to act is crucial for safeguarding the ecosystem of rivers. It is important to understand the impact and engage locals to spread awareness for maintaining the health of Mithi river.

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