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Assessment Of Physico-Chemical Parameters And Population Of Phytoplankton In Shalmala Lake And Unkal Lake

Ratna V Airsang, Akanksha Joglekar, B. S. Nagashree
Department Of Botany, J.S.S. Banashankari Arts Commerce And Shantikumar Gubbi Science College, Vidyagiri, Dharwad – 580004.

Abstract:
Assessment of physico-chemical parameters and population of phytoplankton in Shalmala Lake and Unkal Lake were undertaken from the month of April 2024 to June 2024. Ten physico-chemical parameters were studied. This analysis included the measurement of physical parameters like air and water temperature, pH and electrical conductivity as well as chemical parameters such as dissolved oxygen (DO), free CO_2, Biological oxygen demand (BOD), total hardness (TH), calcium, magnesium and total alkalinity (TA). Diversity of Phytoplankton species also observed during the study. Total of twenty one species of phytoplankton were recorded belonging to Chlorophyceae (7), Dinophyceae (2), Bacillariophyceae (1), Cyanophyceae (6) and Euglenophyceae (5). The investigation results revealed that the water collected from both lakes was not fit for drinking during the study period.

Key Words*: Unkal lake, Shalmala lake, physico-chemical parameters, phytoplankton, Eutrophication.*

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I. Introduction:

Fresh water ecosystem comprising of lentic and lotic water bodies, play a crucial role in ecosystems, sustaining a variety of life forms, supplying fresh water to local communities, fostering biodiversity, and offering recreational opportunities. One such life form is phytotplankton, obviously they are foundational base of the aquatic food web and constitute significantly to ecosystem functioning.

Phytoplankton are small, microscopic, free floating photosynthetic aquatic plants. They play an important role in aquatic ecosystems as they are primary producers supporting zooplankton, fishes and other consumers. Understanding phytoplankton diversity in freshwater bodies is essential as it reflects health and ecological status of these aquatic environments. Physicochemical parameters influence the phytoplankton species abundance, productivity, diversity etc. The changes in these parameters offers valuable insights assessing and monitoring the water quality. Water from Unkal lake and Shalmala Lake was collected to study physico-chemical parameters and diversity of phytoplankton on weekly basis. During rainy season, adding of more organic matter from surrounding residential areas lead the lakes towards eutrophication.

II. Review Of Literature

Chakraborty *et al*., (2014) have studied diversity of phytoplankton diversity in the coastal waters of Port Blair, South Andaman, India. Ansari *et al*., (2015) have investigated diversity of phytoplankton and water quality assessment of ONGC pond, Hazira. Airsang and Lakshman (2015) have investigated Seasonal variation and phytoplankton diversity in Shetter lake of Navalgund, Dharwad in Karnataka, India. Begum *et al*., (2016) have analysed the diversity of phytoplankton and pollution tolerant species of Navule pond, Shivamogga, Karnataka. Ansari and Singh (2017) examined the limnological characteristics and phytoplankton diversity of two ponds of semi-arid zone of Western Uttar Pradesh, India. Sharma and Tiwari (2018) assessed the relationship between phytoplankton diversity and physico-chemical parameters of Nachiketa Tal, Garhwal, Himalaya. Ujianti *et al*., (2019) have studied phytoplankton as indicator for assessing water quality in Garang watershed, Central Java, Indonesia. Sharma *et al.*, (2020) examined the correlation between water quality parameters and phytoplankton diversity in the Tehri reservoir, Garhwal, Himalayas. Hossen *et al*., (2021) assessed the physico-chemical parameters and diversity of phytoplankton in Kirtankhola river, Bangladesh. Sarasvathi and Vetrisehi (2022) investigated the seasonal variation of phytoplankton of temple ponds of Vellore district, Tamil Nadu. Samuel *et al*., (2023) have studied the physico-chemical properties and plankton diversity in five selected ponds in Makurdi, Nigeria. Rajyalaxmi and Aruna (2024) also examined the composition, density and diversity of phytoplankton in Rathi Cheruvu, Bhadradri Kothagudem, Telangana, India.

In the present study, the physico-chemical properties of the water and the phytoplankton communities were assessed in Shalmala Lake and Unkal lake over a span of two months. The study focused on variations of physico-chemical parameters and phytoplankton population.

Objectives:

- Study of physico-chemical parameters of water samples from selected freshwater bodies.
- Study of phytoplankton population in each water body.

Description of study area:

Dharwad is a moderate city situated in the northern part of Karnataka, India. It covers an area of approximately 202.3 square kilometres. Geographically the city is positioned at latitude of 15.36° N and a longitude of 75.06° E.

Unkal Lake

The unkal lake (Fig.1) stands as the largest water body in twin city Dharwad-Hubli. It was constructed by honourable engineer Sir. M. Visvesvarayya in the late 19th century as a primary source of drinking water to the residents. It is located along Hubli-Dharwad road near the NH-4 bypass (Fig.2). Unkal lake approximately covers 245 acres (Photo1) with catchment area of 35 square kilometers and depth 25 ft. It stands 750 meters above the sea level. The average rain fall received during the 2023-2024 is nearly about 1123 mm.

Fig. 1: Maps showing Unkal Lake, Dharwad-Hubballi, Karnataka, India

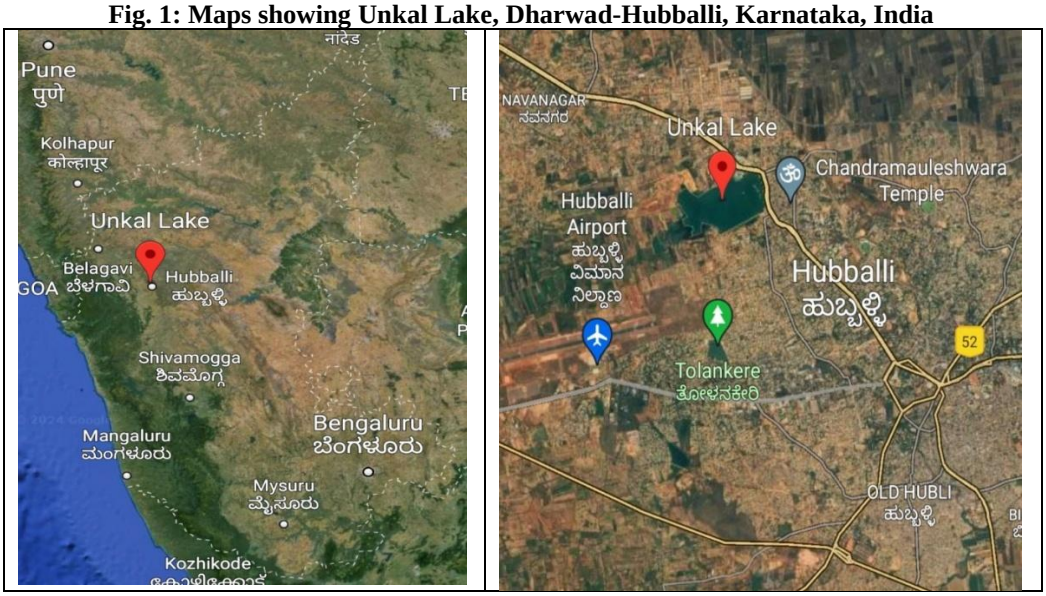


Fig 2: Satellite view of Unkal Lake	Photo1: Showing a view of Unkal Lake
	

Shalmala Lake

Shalmala lake is a significant tributary of the Malaprabha river that originates near the Someshwar temple in Dharwad and flows through Karnataka (Fig.3,4). The Shalmala River is approximately 128 kilometers long. Once it originates it collects nearby in Someshwar temple (photo 2) then flows underground hence is also called as "Guptagamini".

Fig. 3: Maps showing Shalmala Lake, Dharwad, Karnataka, India

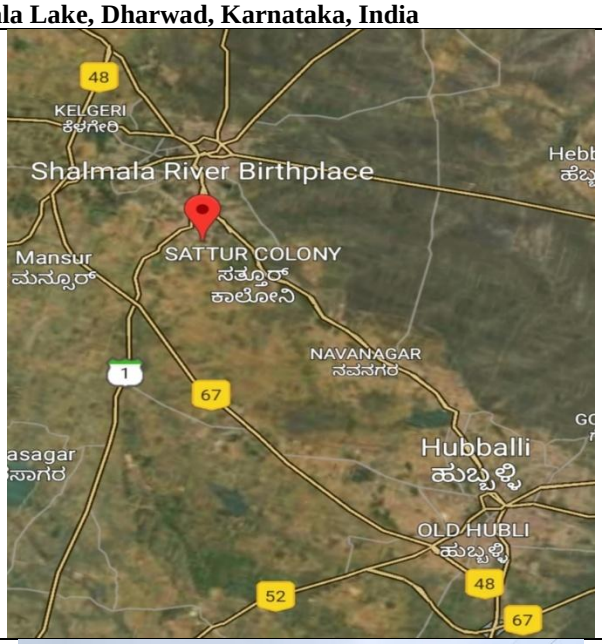


Fig 4: Showing Satellite view of Shalmala Lake

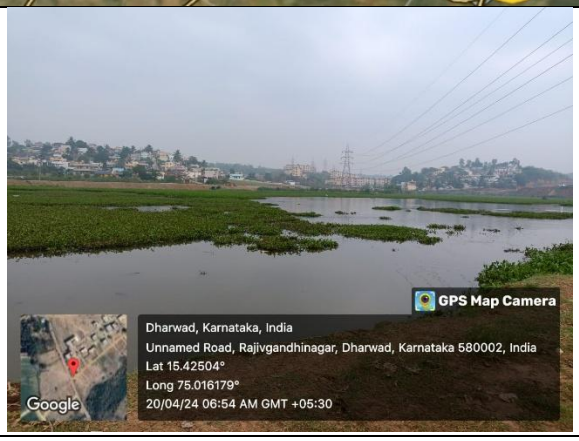


Photo 2: Showing Shalmala Lake

III. Materials And Methods:

Water samples were collected from Unkal Lake and Shalmala Lake over a period of two months from April 2024 to June 2024. Surface water samples were collected from fixed spots on specific days for four weeks. Well cleaned polyethylene cans of 1 litre capacity were used for sample collection. Air and water temperature were measured on the spot. Three litres of water samples were collected each time of which two litres each were used to measure physico-chemical parameters. The physico-chemical analysis of water was carried out as per the standard protocol of APHA (1995). Winklerization was made in separate 250 ml BOD bottles for the estimation of dissolved oxygen. The analysis included measurement of physical parameters like air temperature, water temperature, pH as well as chemical parameters such as dissolved oxygen (DO), free CO_2, Biological oxygen demand (BOD), total hardness (TH), calcium, magnesium and total alkalinity (TH).

One litre of each collected samples was preserved in 4% Formalin for three days. Supernatant were discarded and Lugol's solution was added to sediments. The phytoplankton sediment was concentrated to 30ml by centrifugation. Phytoplankton abundance was studied by Lackey's drop method.

IV. Results And Discussion:

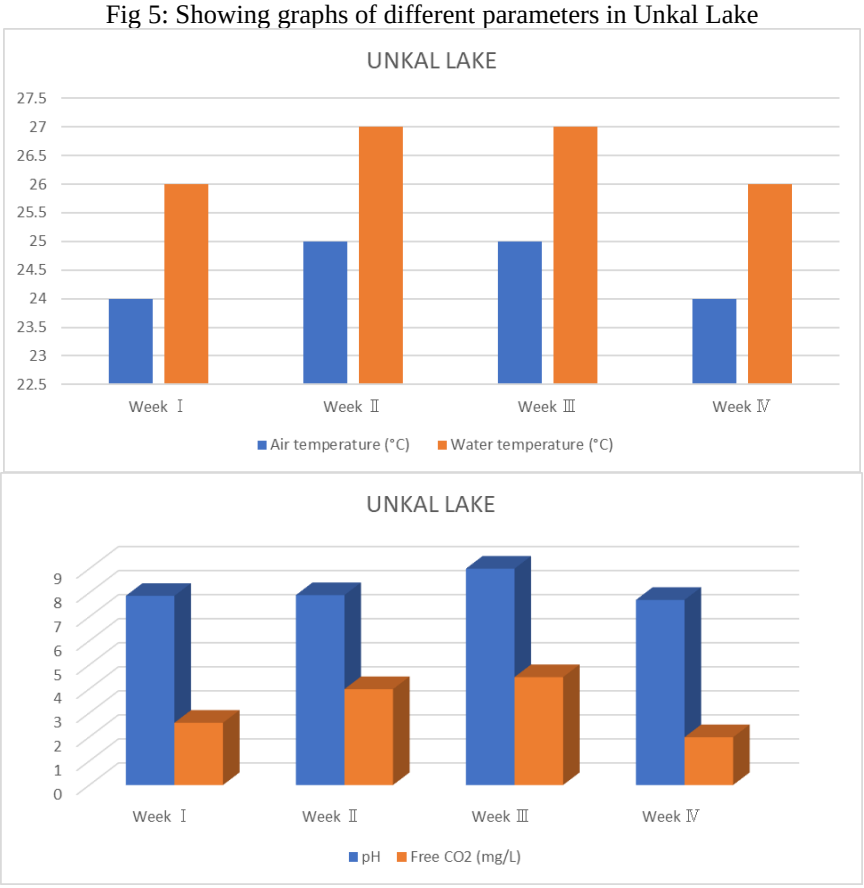
In the present investigation, the air and water temperature of Unkal ranged from 24°C to 25°C and while that of Shalmala ranged from 24°C to 26°C. pH of Unkal lake varied between 7.7 and 9. In Shalmala, pH values are relatively stable, ranging from 7.96 to 8.3. Similar readings were reported by Adhoni *et al*., (2015). Moderate changes in free CO_2 concentration can be seen in Unkal lake ranging from 1.99 to 4.49 mg/L. Shalmala exhibited a wider range of free CO_2 from 2.99 to 5.99 mg/L. Dissolved oxygen levels showed significant fluctuations. DO of Unkal Lake varied between 0.4 to 3.52 mg/L while Shalmala varied from 0.8 to 2.12mg/L. Rise in biological oxygen demand levels from -0.4 to 3.6 mg/L was recorded in Unkal and -0.68 to 2.68 mg/L in Shalmala. Total alkalinity of Unkal lake ranged from 22.4 to 32.6 mg/L and of Shalmala was ranged from 12 to 18.8 mg/L. Water of Unkal Lake is moderately hard while that of Shalmala is very hard which makes it unsuitable for consumption and domestic use.

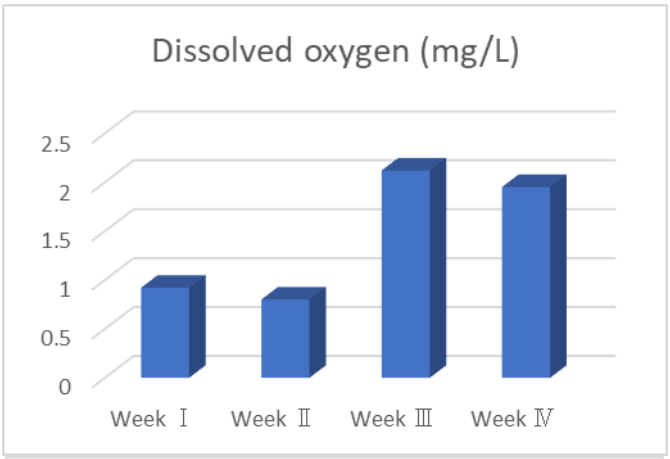
Total of twentyone species of phytoplankton were recorded belonging to 5 classes *Chlorophyceae* (7), *Dinophyceae* (2), *Bacillariophyceae* (1), *Cyanophyceae* (6), and *Euglenophyceae* (5).

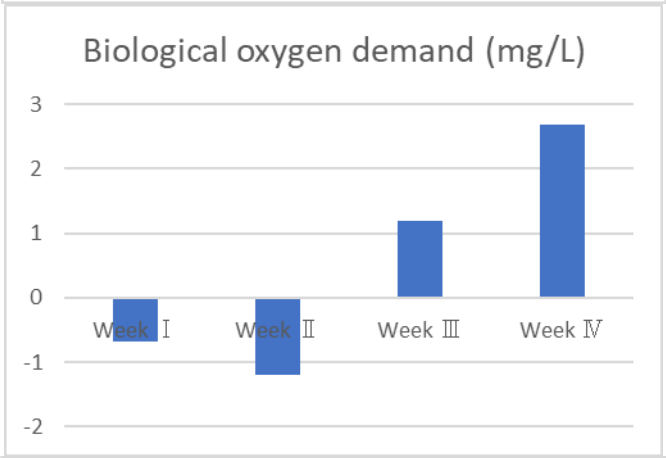
Table 1: Showing weekly variations of physico-chemical parameters of Unkal Lake.

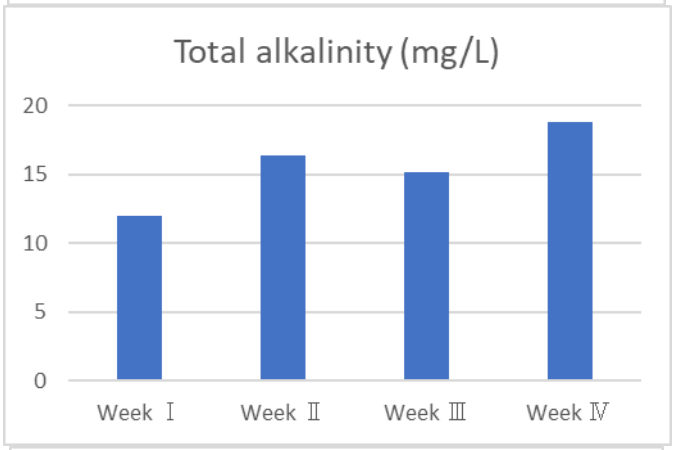
Parameters	UNKAL LAKE			
	Week I	**Week II**	**Week III**	**Week IV**
Air temperature (°C)	24	25	25	24
Water temperature (°C)	26	27	27	26
pH	7.87	7.9	9	7.7
Free CO_2 (mg/L)	2.59	3.99	4.49	1.99
Dissolved oxygen (mg/L)	2	0.4	3.52	0.92
Biological oxygen demand (mg/L)	-0.4	-0.4	1.68	3.6
Total alkalinity (mg/L)	24.6	28.6	32.6	22.4
Total hardness (mg/L)	154	190	208.1	150.3
Calcium (mg/L)	149.2	175.2	187.6	139.7
Magnesium (mg/L)	1.16	3.59	4.98	2.57

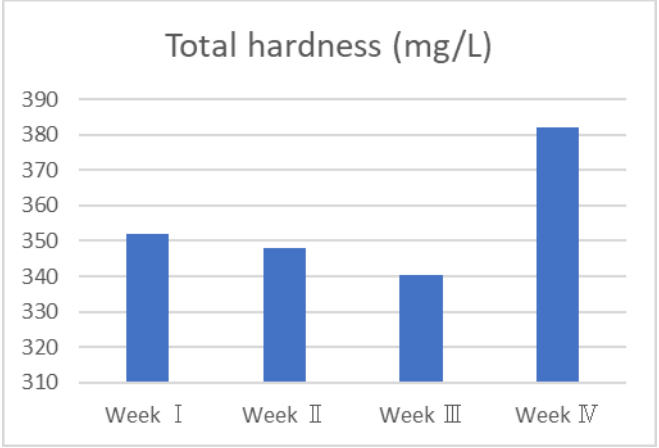
Fig 5: Showing graphs of different parameters in Unkal Lake

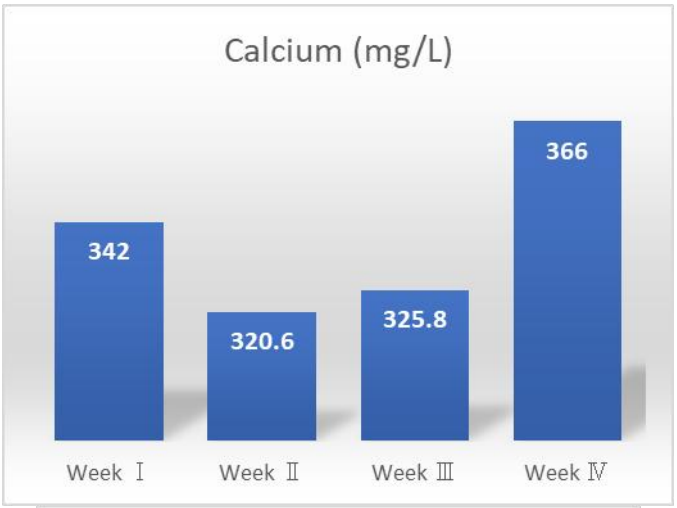



Dissolved oxygen (mg/L)
2.5
2
1.5
1
0.5
0
Week Ⅰ
Week Ⅱ
Week Ⅲ
Week Ⅳ


Biological oxygen demand (mg/L)
3
2
1
0
-1
-2
Week Ⅰ
Week Ⅱ
Week Ⅲ
Week Ⅳ


Total alkalinity (mg/L)
20
15
10
5
0
Week Ⅰ
Week Ⅱ
Week Ⅲ
Week Ⅳ


Total hardness (mg/L)
390
380
370
360
350
340
330
320
310
Week Ⅰ
Week Ⅱ
Week Ⅲ
Week Ⅳ



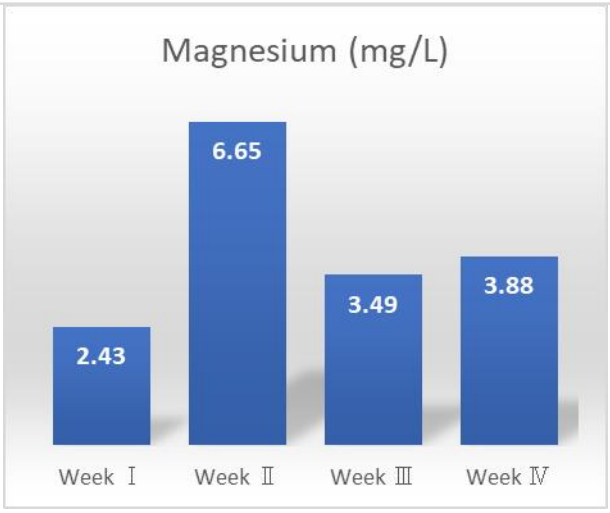


Table 2: Showing weekly variations of physico-chemical parameters of Shalmala Lake.

Parameters	SHALMALA LAKE			
	Week I	**Week II**	**Week III**	**Week IV**
Air temperature (°C)	26	25	24	24
Water temperature (°C)	24	24	24	23
pH	7.96	8.1	8	8.3
Free CO_2 (mg/L)	5.99	3.99	4.99	2.99
Dissolved oxygen (mg/L)	0.92	0.8	2.12	1.95
Biological oxygen demand (mg/L)	-0.68	-1.2	1.2	2.68
Total alkalinity (mg/L)	12	16.4	15.2	18.8
Total hardness (mg/L)	352	348	340.2	382
Calcium (mg/L)	342	320.6	325.8	366
Magnesium (mg/L)	2.43	6.65	3.49	3.88

Fig. 6: Showing graphs of different parameters of Shalmala Lake

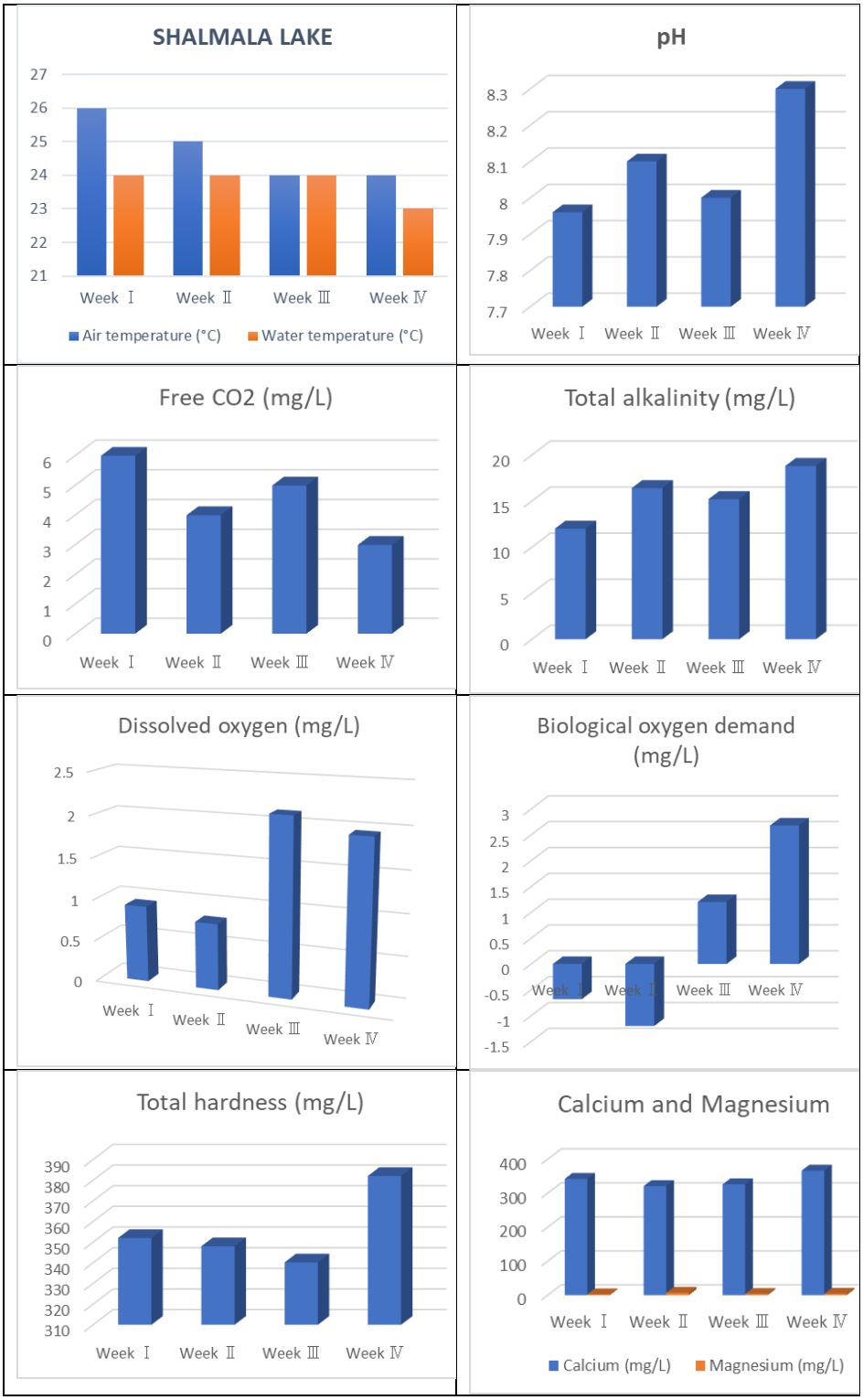


Table 3: Showing the list of species of phytoplankton found in Unkal Lake and Shalmala Lake.

SL No.	ORGANISM	UNKAL LAKE	SHALMALA LAKE
	CHLOROPHYCEAE		
1	*Crucigenia fenestrata*	-	+
2	*Crucigenia tetrapedia*	-	+
3	*Chlorella sp.*	+	+
4	*Closterium gracile*	-	+
5	*Scenedesmus arcuatus*	+	+
6	*Chlorococcum*	+	+
7	*Pandorina sp.*	-	+

DINOPHYCEAE			
8	*Peridinium minutum*	+	+
9	*Peridinium willei*	+	+
BACILLARIOPHYCEAE			
10	*Nitzschia sp.*	+	+
CYANOPHYCEAE			
11	*Oscillatoria brevis*	+	-
12	*Nostoc sp.*	-	+
13	*Microcystis sp.*	+	+
14	*Anabaena catenula*	-	+
15	*Merismopedia sp.*	-	+
16	*Chroococcus sp.*	+	+
EUGLENOPHYCEAE			
17	*Strombomonas acuminata*	+	+
18	*Euglena acus*	+	+
19	*Euglena sanguinea*	+	+
20	*Phacus caudatus*	+	+
21	*Strombomonas gibberosa*	+	+

V. Conclusion:

In this study, temperature and pH of the water bodies played a vital role. During the course of this investigation, phytoplankton observed varied generically. Increased levels of BOD in the third and fourth week suggested the abundance of organic matter. Phytoplankton belonging to all five classes were commonly found in both lentic water bodies. Chlorophyceae, Euglenophyceae and Cyanophyceae species were majorly observed. Euglenophyceae members found efficiently during the study period, indicated that water quality dropped very much due to high level of organic matter. Selected waterbodies are lead towards Eutrophication. The investigation showed increased hardness levels and varied level of other physicochemical parameters suggesting that the water from both sources is not fit for drinking, (WHO, 2022) may be used for domestic purposes, agriculture and garden.

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