Eco-phycological study of Darbandi Ranya water body\ Sulaimani

Research Project

Submitted to the department of (Biology collage of education) in partial fulfillment of the Requirements for the degree of B.A or BSc. In (Biology)

By:

Avan Aziz Babakr

Supervised by:

Sana Kayfi Najmaddent

April-2023

SUPERVISOR CERTIFICATE

This study has been written under my supervision and has been submitted for the award of the degree of BSc. in science in Biology my approval as supervisor.

Signature:

Name: Assistant Lecturer Sana K. Najmadden

Date: 6/ 4 / 2023

DECLARATION

I declare that the thesis entitled: A (Eco-phycological study of darbandi Ranya water body\ Suleimani is my own original work, and hereby certify that unless stated, all work contained within this research is my own independent research and has not been submitted for the award of any other degree at any institution, except where due acknowledgment is made in the text.

Signature:

Student Name: Avan Aziz Babakr

Date: / / 2023

DEDICATION

This thesis is dedicated to the people who have supported me throughout my Education specially my lovely parents (Aziz and Bahar) and my lovely sisters (Aran and Ziwar). Thanks for making me see this adventure through to the end.

AVAN

ACKNOWLEDGEMENT

I would like to thank Allah for his blessing virtues to implant the soul of endurance and faith in myself for completing this study. Also, I have no appropriate words that fully express the immense indebtedness and deep gratitude I owe to my worthy learned research supervisor assist **Sana Kayfi Najmadden** for her keen interest admirable guidance constructive suggestions affectionate supervision inspiring behavior and valuable knowledge which she contributed to this work in multitude ways whenever I needed she was there near me and always strayed me out from the disaster.

I would like to dedicate this work to all staff of biology department our family and our friends.

SUMMARY

This study attempted a range of physical, chemical and biological parameters of selected water bodies in Lower Zab River in Ranya/ Sulimani. The main aim of the study is to evaluate water quality of selected study sites and identified algal composition during October 2022.

About physical analysis: The mean value of water temperature, EC and TDS were 25.7 ºC, 329 µS.cm^{-1} and 164.5 mg.l^{-1} respectively. The water turbidity ranged between 1.9- 6.5 NTU. On the other hand, the results of the chemical parameters were as follow: mean value of pH, total Alkalinity and Total hardness were 8.2, 189 mgl-1 CaCO3 and 187.5 mgl^{-1} CaCO3 respectively. The mean value of PO4 was 1.3 mg.l^{-1}. dissolved oxygen and five days biochemical oxygen demand values were ranged from 6 to 6.8 mg.l^{-1} and 0.6 to 2 mg.l^{-1} respectively.

Phycologically, a total of 7 algal species belong to 4 genera, 3 families,3 orders and 1 divisions were identified.

List of content

List of figures

List of plate

Chapter One

Introduction

Water is a very important Grace for the environment, the most important to maintain life and it is required in almost all humanitarian activities. Drinking, domestic use, agriculture, industries, energy production, navigation, and entertainment. (Yadav and Sharma, 2022). Many countries are concerned with the presence, uses, security and management of water sources. The evaluation of water quality has become an important issue, especially with an awareness that freshwater will be a rare resource in the future (Kopyrina, *et al,.* 2020).

Water quality is the physical, chemical and biological characteristics of water, it is an assessment of water condition relative to the requirements of human need. (Toma *et al*., 2018).

One of the main types of microorganisms in aquatic ecosystems is algae including phytoplanktons which are microscopic photosynthetic organisms some of them extremely resistance to unsuitable environmental condition, Algae are found in unicellular, colonial, coenobic and filamentous forms (Banyasz, 2011). Alga flora is one of the most important organisms that are found in the aquatic ecosystems especially which is the main source of oxygen and food chan (Toma and Aziz, 2021).

Aim of study:

1- To study physicochemical character of Lower Zab River in Qaladze.
2- To identify algal species in selected area.

Chapter Tow

Literature Review

During a period extended from 1978 to 2022, many studies for water quality assessment in springs, streams, rivers, lakes, ponds and wells have been done in Kurdistan Region of Iraq including Erbil, Sulaimani and Duhok provinces.

During the last decade, many studies on phycolimnology were done by researchers include some of them Bilbas (2014) studied the ecosystem health assessment of Dukan lake and its tributaries in Sulaimani, Kurdistan region of Iraq. Within the twenty selected sites, four sites were selected as inlets of the lake, include Lower Zab River, Garfen Stream and Hizop Stream. Generally, results revealed that air temperature has a wide range of fluctuation; it was ranged from 3.5 to 42.5 ºC. Water temperature in river and stream sites was ranged from 5.5 to 36 ºC, total alkalinity and total hardness were range from 100 to 390 mg CaCO3 L^{-1} and 100 to 332 mg CaCO3 L^{-1} respectively, while turbidity ranged from 0.5 to 15 NTU, EC ranged from153 to 398 µS.cm-1. PO_4^{-3} ranged from 0.49 to 25.5 µg P-PO4.L-1, Cl- ranged from 2.98 to 46.67 mg.L-1 nitrate were ranged from 39.11 to 88 µg NNO3.L-1, potential hydrogen ion was ranged from 7.10-8.80. Phycologically, a total of 93 algal species was identified.

Toma and Aziz (2022) conducted Algal study in the springs and streams from Shaqlawa district, Erbil Province, Iraq II- Zygnematales. A total of 116 species belonging to 9 genera were identified. The most dominant genera included Spirogyra and Cosmarium (31, 30) taxa respectively. Out of them, 30 species were recorded for the first time in Iraq. Newly found genera included one species each for Cylindrocystis, Debarya, Hallasia and Staurastrum, nine species belonged to

Mougeotia, three species returned to Closterium, and fourteen genera were related to Cosmarium .Growth of Zygnemataceae and Desmids increased in the summer than during the winter season.

Sdiq *et al,* (2022) conducted limnological study in the Upstream and Downstream

Degala Basin Water Body within Erbil to determine physicochemical and biological properties EC, TDS, Chloride, total alkalinity, nitrate, and DO, pH, total hardness The statistical analysis of the data revealed that there were significant differences in physico-chemical parameters between the two sites, with high significant relationships for (EC, TDS, chloride, Na, K, Ca hardness, total alkalinity, nitrate, and DO) and low significant relationships for (pH, total hardness, Mg hardness, and Sulfate) at the ($p \leq 0.05$) for all parameters studied different algal species obtained from all sampling sites in Degala basin revealed the presence of a variety of algal species.

Chapter 3

Study Area

3.1 Lower Zab River

The Lower or Lesser Zab River has its origins in Iran, where two small streams join together to form the Kalveh stream (Chami Kalveh) in the Azarbayjani-Gharbi region. The Kalveh stream flows in a SouthSouth eastly direction about 42 km until it enters Iraq near Mawat subdistrict, where it joins with the Siwayl stream, which lies entirely in Iraq, in Penjwin area. From Mawat to Rania, the river travels about 54 km a narrow passage in a north-westerly direction, until it enters the wide basin of the Dukan Lake. In southwest of Dukan Lake, the Lower Zab River flows for 402 km through Iraq to join the Tigris River north of Bayji town (Bilbas 2014).

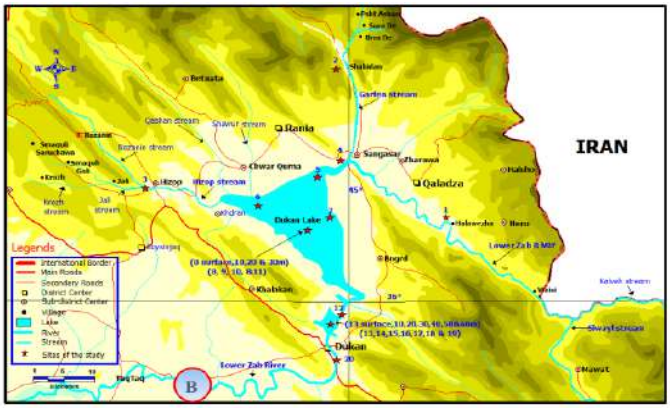
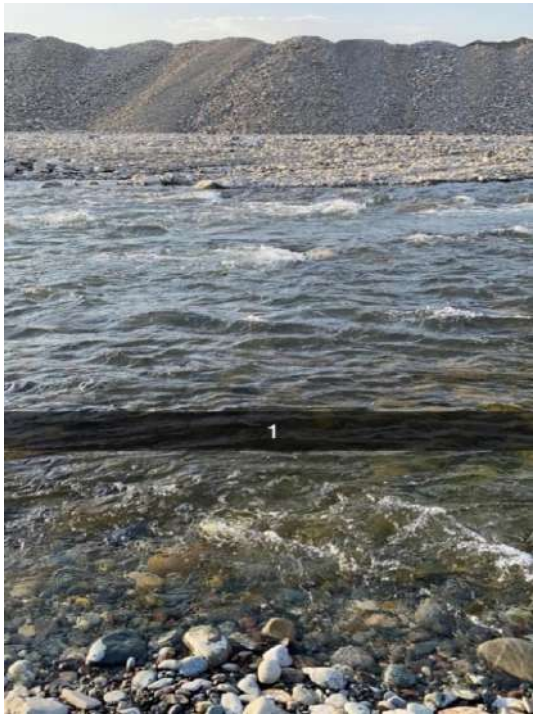
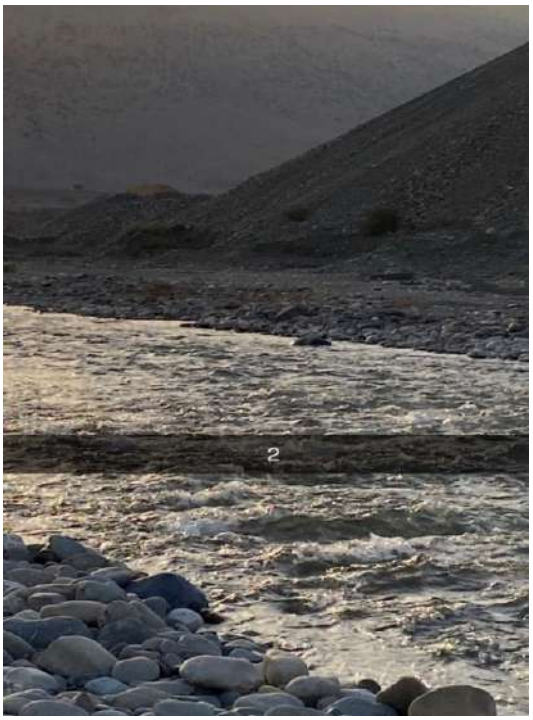


Figure (3.1): A. Map of Lower Zap river

B. Map of Qaladze showing Lower Zab and Khas region





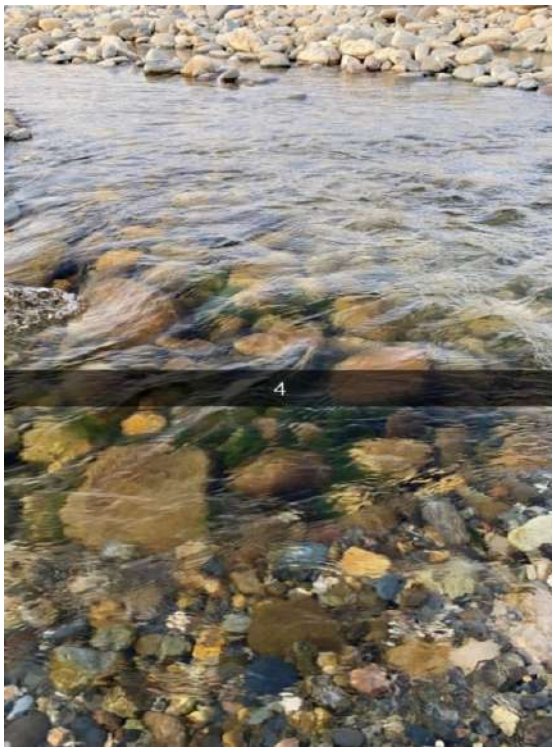


Figure (3.2): Images from the study sites Lower Zab

Chapter four

Material Method

4.1. Water sampling

Water samples were collected from 4 different sites of lower zap river in Ranya district analyzing physico chemical properties and phycological study. Winklar and Amber bottles were used for DO and BOD5 respectively. These bottles were placed under the surface of water, filled and stoppered to eliminate air bubbles formation. Later, Winkler's reagents (MnSO4 and Alkali iodide azide) were added to the Winklar's bottle immediately then cons. H2SO4 was added in situ. All water samples were delivered immediately to the laboratory as soon as possible, in a cool and dark condition (APHA, 2017)

4.2. Physicochemical parameters:

4.2.1. pH, Ec, TDS and water temperature were measured in the field directly by using a portable pH/EC/TDS (Hanna instrument HI9811-5). The instrument was calibrated before each sampling with standard solution

4.2.2. Turbidity: The turbidity was measured by Nephelometric method using HACH turbidity-meter model (2100A, U.S.A).

4.2.3. Total Alkalinity:

Total alkalinity was determined in the laboratory by titration method using standard sulfuric acid titrant (0.02N) as described by APHA (2017).

Alkalinity as mg CaCO3/L = A x B x 50000/ml of sample.

Where: A= ml of standard acid used.

B= normality of standard acid.

4.2.4. Total Hardness

Total Hardness was determined by EDTA Titrimetric method as described by APHA (2017), using Eriochrome Black T indicator and buffer solution of pH10.

Hardness as mg CaCO3/L = A x B x1000/ml of sample… … … … 4-3

Where: A= ml titration of sample

B= mg CaCO3 equivalent to 1ml EDTA titrant

4.2.5. Phosphorus (PO_4^{-3}):

It was measured by spectrophotometer in wave length 690 nm. Stanious chloride method used for the determination as described by APHA ,2017.

4.2.6. Dissolved Oxygen (DO):

Dissolved oxygen was determined by Azide Modification Method of the classical Winkler procedure (1888) using manganous sulfate solution, alkaliiodide-azide

reagent, sulfuric acid and sodium thiosulfate as titrant as described by APHA (2017). The results were expressed in mg/L. For titration of 200 ml sample, 1ml of sodium thiosulfate titrant =1mg DO/L.

4.2.7 Biochemical Oxygen Demand for Five-Days (BOD_5):

Biochemical Oxygen Demand of water samples in dark bottles was calculated after five-day incubation in 20 ºC according to APHA (2017). The following equation was used: BOD5 in mg/L = DO before incubation – DO after 5 days incubation

4.3. Biological Studies

4.3.1. Algal Studies:

4.3.1.1. Algal Collection and Preservation:

For collection of non-diatom algae, epilithic algae scraped from surface site by spatula, The collected sample at each site was added to clean, sterilized, non-reactive plastic bottles of 50 ml capacity. preserved with 0.35 ml Lugol's solution Bold and Whyne, 1985 and APHA, 2017).

4.3.1.2. Identification of Algae:

Non-diatom algal forms were identified using the following references: Prescott (1978), and John *et al*, (2011).

Chapter 5

Result and discussion

5.1 Water physico chemical properties:

Water Temperature: is recognized increasingly by scientist's environment managers and regulators as an important and highly sensitive "master" variable of water quality, Temperature directly influences distribution interactions, survival, growth rates, timing of life history events and metabolism of aquatic organisms in river system. (Hannah and Garner,2015). In the present study the mean value of water temperature was 25.7 C^0 during sampling collection.

EC: The electrical conductivity (EC) of water is a measurement of the ability of water to conduct an electric current, the greater the content of ions in the water the more current the water can carry (Blakely et al., 2012). In the present study the mean value of EC was 329 µS/cm which was accordance with WHO recommended standard for drinking.

Total dissolved solid (TDS): refers to the total amount of dissolved inorganic solids and small number of organic matters in a given volume of water (Spellman, 2008). In this study the mean value of TDS was164 mg. l^{-1}

pH is one of the most common analyses in soil and water testing, is the standard measure of how acidic or alkaline a solution is. Aquatic organisms need the pH of their water body to be within a certain range for optimal growth and survival. Although each organism has an ideal pH, most aquatic organisms prefer pH of 6.5 – 8.0. Outside of this range, organisms become physiologically stressed. (Addy et al., 2004) in all studied sites pH of water grater than 8 which is characteristic of

Kurdistan water which is mostly contain $CaCO_3$. This is acceptable by WHO slandered for drinking, and it is accordance with Billbas,2014, Toma and Aziz, 2022.

Turbidity: is the amount of cloudiness in the water. Drinking water should have turbidity of 5 NTU or less. In present study site turbidity in site 2 was 6.5 NTU which is higher than the value that recommended by WHO. High level of turbidity may be attributed to silt, clay, total suspended solids, number of algal cells especially diatoms APHA, 2012.

Total Alkalinity: Alkalinity is the buffering capacity of a water body. It measures the ability of water bodies to neutralize acids and bases thereby maintaining a fairly stable pH. Water that is a good buffer contains compounds, such as bicarbonates, carbonates, and hydroxides, which combine with H+ ions from the water thereby raising the pH (more basic) of the water. Without this buffering capacity, any acid added to a lake would immediately change its pH. (Kelly Addy, Linda Green, and Elizabeth Herron, 2004). Furthermore, total alkalinity is mainly produced by carbonate ($CO3^{=}$), bicarbonate (HCO3) and hydroxyl (OH^{-}) anions (Driscoll, 2002). In this study mean value of total alkalinity was 189 $mg.l^{-1}$ as CaCO3. Total alkalinity in most of the studied sites considered bicarbonate alkalinity with pH lower than 8.3.

Total Hardness: Total hardness is the ability of water to precipitate soap. The presence of calcium and magnesium along with carbonate, bicarbonate, sulphate and chloride causes the hardness in water (Bashkin, 2003). In this study, total hardness values showed 187.7 $mg.l^{-1}$ as CaCO3 which is accordance with WHO standard for drinking.

Phosphorus ($PO4^{-3}$): is a measure of the inorganic oxidized form soluble phosphorus (Langmuir, 1997). The value of PO4 in all studied site was higher than the value that recommended by WHO. Natural phosphorus comes from weathering

of phosphorus-bearing rocks and decomposition of organic material. The other sources of elevated phosphorus level in surface water is anthropogenic activities, soil particles and fertilizer run-off (Rump and Krist, 1999).

The determination of DO concentrations is usually involved in water quality assessment because DO is used by aquatic organisms, therefore, involved in both chemical and biological processes within water bodies (APHA, 2017). In present study the mean value of DO was lower than the recommended value by WHO is 6.4 $mg.l^{-1}$. The biochemical oxygen demand BOD_5 is the measure of the amount of oxygen needed by the aerobic micro-organisms for the biological degradation of organic substances in water. The values of DO presented in Table (5.1) showed between 0.6-2 $mg.l^{-1}$. High level of BOD_5 in site 4 may be due to increase metabolic rate and decomposition in this site (MPCA, 2009).

Table (5-1) Limnological results of the studied water bodies in October 2022

P Sites	Water T. C^0	EC µS/cm	TDS $mg.l^{-1}$	pH	Turbidity NTU	PO_4 $mg.l^{-1}$	T. Alkalinity mgl^{-1} CaCO3	T. Hardness mgl^{-1} CaCO3	DO mgl^{-1}	BOD_5 mgl^{-1}
S1	26	333	167	8.25	1.9	1.28	200	192	6.4	1.4
S2	25	328	164	8.15	6.5	1.32	180	184	6.4	1.2
S3	26	327	163	8.21	3.1	1.29	178	181	6	0.6
S4	26	328	164	8.26	2.2	1.33	200	194	6.8	2
Mean	25.7	329	164.5	8.2	3.4	1.3	189	187.7	6.4	1.35
WHO Standard		100-500	100-500	6.5-8.5	5	0.1-1	150-200	100-300	6.5-8	0

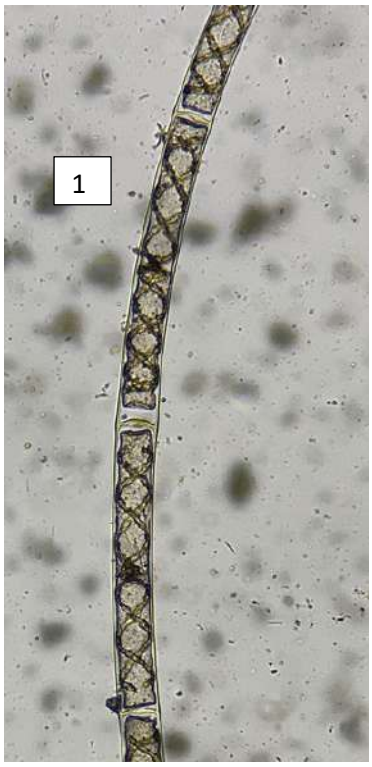
5.2 Algal study:

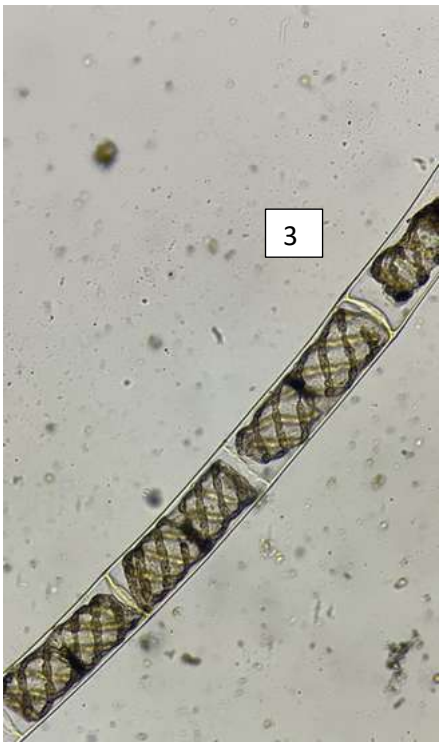
In the present study, as demonstrated in table (5.2), the non-diatom algal taxa represented by one division which was Chlorophyta, 1 class, 3 orders, 3 families, 4 genera and 7 species. Order Zygnematales was the dominant in species composition. Spirogyra were the most popular genera of Chlorophyta which is including 4 different species and there were identified in almost studied sites followed by Zygnema which included 2 species. Furthermore, both genera Ulothrix and Cladophora represented by one species for each of them.

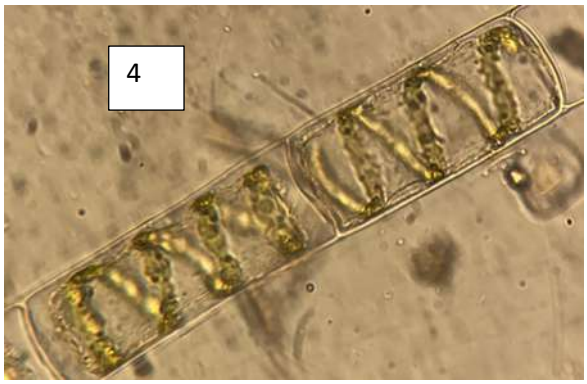
In general, filamentous green algae divided in to two groups: non-branched filament such as Spirogyra, Zygnema and Ulothrix. And branched filament such as Chladophora. The result of the study accordance with Toma, 2022 and Abdulwahid, 2008. Filamentous green algae were predominant group among other algal groups in Lower zab river khas region.

Table (5.2): Classification list of species of Chlorophyta recorded during October 2022 in Lower Zab water.

Division: Chlorophyta
Class: Chlorophyceae
Order: Cladophorales
Family: Cladophoraceae
Cladophora Kuetz., 1843.
Cladophora glomerata
Order: Zygnematales
Family: Zygnemataceae
Spirogyra Link 1820**.**
Spirogyra reteculata
Spirogyra communis
S setiformis
Zygnema C.A.Agardh 1824
Zygnema sp
Order: Ulotrichales
Family: Ulotrichaceae
Ulothrix Kuetz., 1836
U. tenuissima Kuetz







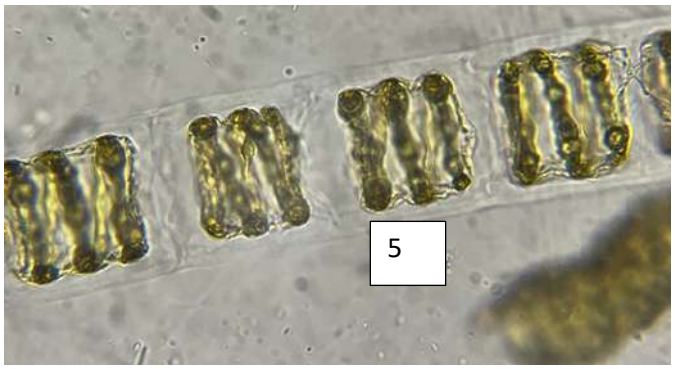
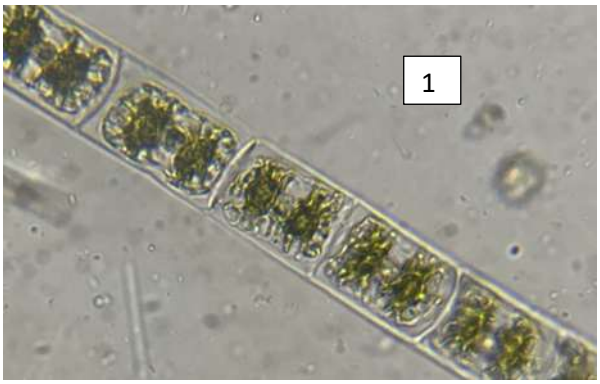


Plate (5-1): 1- Spirogyra reteculata with two chloroplasts 2- S reteculata with three chloroplast s
3- Spirogyra communis 4- S setiformis 5- Spirogyra sp.



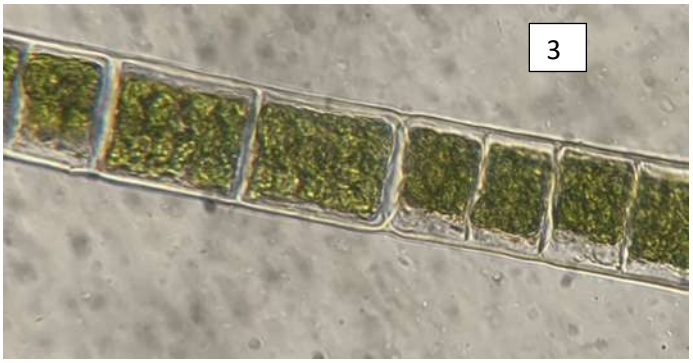


Plate (5-2): 1 and 2 *Zygnema* sp. 3- *Ulothrix tenuissima*
4- *Cladophora glomerata*

Conclusion

1- The pH values of all water bodies in this study were above 7 and at alkaline site of neutrality.

2- The total alkalinity was mainly composed of bicarbonate.

3- All studied physicochemical parameters are accepted by WHO standard for drinking excepted PO4, Turbidity, DO and BOD_5.

4- Only filamentous green algae were identified in the present study.

5- Spirogyra was predominant species among identified algae species.

Recommendations

1. Further study of other living organisms in Lower Zab such as invertebrate, bacteria and Fungi.
2. Further studies about algal productivity and toxicity could be necessary.
3. Further chemical test is necessary such as evaluation of heavy metals.

References

ABDULWAHID, S. J. (2008). A phycolimnological study on some springs within harir sub-district. Hawler-kurdistan. M.Sc. Thesis, Univ. of Salahaddin – Erbil, Kurdistan Region, Iraq.

AGBOGIDI, O.M., MICHAEL, O.E., EGBODUKU, O.W. and STEPHEN, O.F., (2018). Relevance of Algae as Biological Indicators of Pollution Management Studies. *Choubisa, SL*.

AMERICAN PUBLIC HEALTH ASSOCIATION (A.P.H.A.) (2012). *Standard methods for examination of water and wastewater*. 22nd Ed. Washington: 1360

A.P.H.A., (2017). Standard methods for the examination of water and wastewater. Washington, D.C.: American Public Health Association.

BLAKELY, TANYA & HARDING, JON & DIDHAM, RAPHAEL. (2012). Distinctive aquatic assemblages in water-filled tree holes: A novel component of freshwater biodiversity in New Zealand temperate rainforests. *Insect Conservation and Diversity.* 5. 10.1111/j.1752-4598.2011.00155.x.

BILBAS, A. H. A. (2014). *Ecosystem Health Assessment of Dukan Lake, Sulaimani, Kurdistan Region of Iraq*. Ph.D. Thesis, Salahaddin University, Erbil, Iraq

BOLD, H. C. and WYNNE, M. J. (1985). *Introduction to the algae*. 2nd ed. Englewood Cliffs, N.J.: Prentice-Hall.

DRISCOLL, D. G. (2002). *Hydrology of the Black Hills area, South Dakota*. Rapid City, SD (1608 Mt. View Rd., Rapid City 57702): U.S. Dept. of the Interior, U.S. Geological Survey.

HAJONG, P. and RAMANUJAM, P., (). *Algal community structure and primary productivity of stream ecosystem of west Garo hills*. Meghalaya; India.

JOHN, D. A., WHITTON, B. A. & BROOK, A. J. (2011). *The freshwater algal flora of the British Isles: an identification guide to freshwater and terrestrial algae.* 2nd Edition.Published in the United Stated of America by Cambridage University Press, New York

KOPYRINA, L., PSHENNIKOVA, E. and BARINOVA, S., (2020). Diversity and ecological characteristic of algae and cyanobacteria of thermokarst lakes in Yakutia

(northeastern Russia). *Oceanological and Hydrobiological Studies*, *49*(2), pp.99-122.

MPCA, (2008). *Sources, Types, Impact on Water Quality-A General Overview*. 1st ed. Minnesota Pollution Control Agency.

PRESCOTT, G. W. (1970). *Algae of the Western Great Lakes Area*. 6th Edition William C Brown CO Publishers. Dubuque, Lowa

RUMP, H. and KRIST, H. (1999). Laboratory manual for the examination of water, waste water, and soil. 3rd ed. Weinheim: Wiley VCH SPELLMAN, F. R. (2008). The science of water. Boca Raton: CRC Press

TOMA, J. J. & AZIZ, F. H. (2021). New Records of Algae in Shaqlawa District, Erbil, Kurdistan Region of Iraq.Al-Nahrain Journal of Science, 24(3), 55-62

TOMA, J. J. & AZIZ, F. H. (2022). Response of Algal Distribution to Environmental Condition of Shaqlawa District and their Antibiotic Activities PhD. thesis, Univ. of Salahaddin – Erbil

TOMA, J.J., SHEKHA, Y.A. and AL-BARZINGY, Y.O.M., (2018). An Ecological Assessment for Water Quality of Some Water Bodies in Koysenjaq-Erbil, Iraq. *Al-Nahrain Journal of Science*, *21*(2), pp.119-129.

YADAV, V.K. and SHARMA, S. (2022). Algae as bioindicators: a study in the pond of district Jalaun, up India. *Plant Archives*, *22*(1), pp.126-129