

## Research Article

---

# Diversity of fresh water algae from some important habitats of district Chitral, Pakistan

Naeem Ullah<sup>1</sup>, Masrina Sartaj<sup>1</sup>, Asma Nawaz<sup>1</sup>, Fida Hussain<sup>1</sup>,  
Muzammil Shah<sup>2</sup>, Nawaz Jang<sup>3</sup>, Farooq Jan<sup>4</sup>, Ikram Muhammad<sup>5</sup>,  
Kashif Ali<sup>6</sup> and Muhammad Shuaib<sup>7\*</sup>

1. Department of Chemical and Life Sciences, Qurtuba University of Science and Information Technology, Peshawar-Pakistan

2. Department of Biological Sciences, King Abdulaziz University, Jeddah-21589-Saudi Arabia

3. School of Environmental Science and Engineering, Kunming University of Science and Technology, Chenggong Campus, Kunming, Yunnan-China

4. Department of Botany, Abdul Wali Khan University Mardan-Pakistan

5. Laboratory of Plant Metabolic Engineering, Faculty of Life Science and Technology, Kunming University of Science and Technology-PR China

6. Institute of Ecology and Geobotany, School of Ecology and Environmental Science, Yunnan University, Kunming-China

7. School of Ecology and Environmental Science, Yunnan University, Kunming-China

\*Corresponding author's email: [zeyadz44@yahoo.com](mailto:zeyadz44@yahoo.com)

### Citation

Naeem Ullah, Masrina Sartaj, Asma Nawaz, Fida Hussain, Muzammil Shah, Nawaz Jang, Farooq Jan, Ikram Muhammad, Kashif Ali and Muhammad Shuaib. Diversity of fresh water algae from some important habitats of district Chitral, Pakistan. Pure and Applied Biology. Vol. 8, Issue 3, pp1943-1949.

<http://dx.doi.org/10.19045/bspab.2019.80138>

---

Received: 15/04/2019

Revised: 22/06/2019

Accepted: 17/07/2019

Online First: 24/07/2019

---

### Abstract

In the present study, different localities of district Chitral were visited for a collection of freshwater algae. A total of 52 species belonging to 15 genera were recorded from different localities of district Chitral. Among the identified genera *Mougeotia* were dominant genus with 12 species. The contribution of *Mougeotia* was 23.07%. The 2<sup>nd</sup> most dominant genera *Spirogyra* was recorded with 8 species. The contribution of *Spirogyra* was 15.38%. The genera *Zygnema* comprised 7 species. The contribution of *Zygnema* was 13.46%. The genus *Ophiocytium* was recorded with 5 species. The contributions of *Ophiocytium* were 9.61%. The genus *Cosmarium* and *Microspora* each recorded with 3 species and the genus of *Microspora* each genus contributions were 5.76%. The other genera *Phacotus*, *Wislouchiella*, *Dinobryon*, and *Hormodium* every two species were recorded. And each species were contributed 3.84%. The other genus *Plamella*, *Radiofilum*, *Stichococcus*, *Tetraspora* and *Ulotrix* were represented by single species. Each species contributed were 1.92% recorded in this study. Further studies are recommended in the research area to report and document complete algal diversity of research area.

**Keywords:** Classification; Freshwater algae; Habitats; Chitral; Pakistan

### Introduction

Algae are a large group of photosynthetic, eukaryotic multicellular and unicellular microorganism which has thallus body. The

structure of chloroplast differs from different species. The chloroplast helps in food production by the process of photosynthesis. On earth, algae are considered to be the most

important organisms because it is one the source of food for aquatic life. The algae survive in low and high temperature. The size of algae varies from minute like pin head to large species. They also form colonies while many forms branched structures. Algae found everywhere in rivers marine water, soil, etc. [1]. Algae are a good source of food and energy, among them, many unicellular species are of prime importance. *Chlorella* is a source of nutrients. Blue-green algae are also known as nitrogen-fixing organisms. They have also a great effect on the production of rice [2]. Algae are of different kinds, among them more than 500 genera and 8000 species of green algae have been discovered and a large number is yet to be discovered [3].

Algae being on autotrophic considered are very important in the ecosystem. Algae help the formation of the food chain for other animals [4]. Algae seaweed is found 100 meters deep in the water, most can be found on trees, soil, and animals. They can also be found in pores of limestone as well as sandstone, being a unique organism flourish under high temperature and in polar ice [5]. They are a different size in a different habitat, microscopic algae are called phytoplankton can be found in ocean and lacks [6]. Cyanobacteria represent the early life of algae. Fossils records of above 3 billion years reported algae form the rock which was lacking oxygen algae and other green plants produce oxygen through photosynthesis, they are the first plant to appear as photosynthetic about billion years ago [7]. Algae belong to Eukaryotic group of the organism except for blue-green algae [7]. In Eukaryotic algae, there is an important organelle (chloroplast) having green pigments like chlorophyll which helps to trap light during Photosynthesis and other accessory pigments like carotenoid (yellow and brown). [8]. Algae are present in different form and shape, single and independent cell combine and

arranged them self in a colonial form. These cells attached end to end in branched form and make filaments [9].

In this study 37 species of green algae related to 6 genera of the phylum, *Volvocophycota* have been reported from various freshwater bodies of Chitral. Among them these 10 spp were found to belong to the genus *closterum*, 9 spp of each *characium* and *cosmarium* genera, 5 spp of *Chlamydomonas* genus and 2 spp each belonging to the genus *Cateria* and *Chlorella each*, were found during the study. The main objective behind the study of various algal species was to work out the taxonomic studies of unicellular green algal species, reporting their habitats, locations weather and season along with the PH value of habitat water as well [10].

#### **Materials and methods**

The present research work includes the collection, identification, classifications, and distribution of freshwater algae in different localities of district Chitral. The study includes different Genera and their species found in the designated area of district Chitral. It also includes chemical analysis of water in the study area such as Goblin gole and Kosht gole.

#### **Study area**

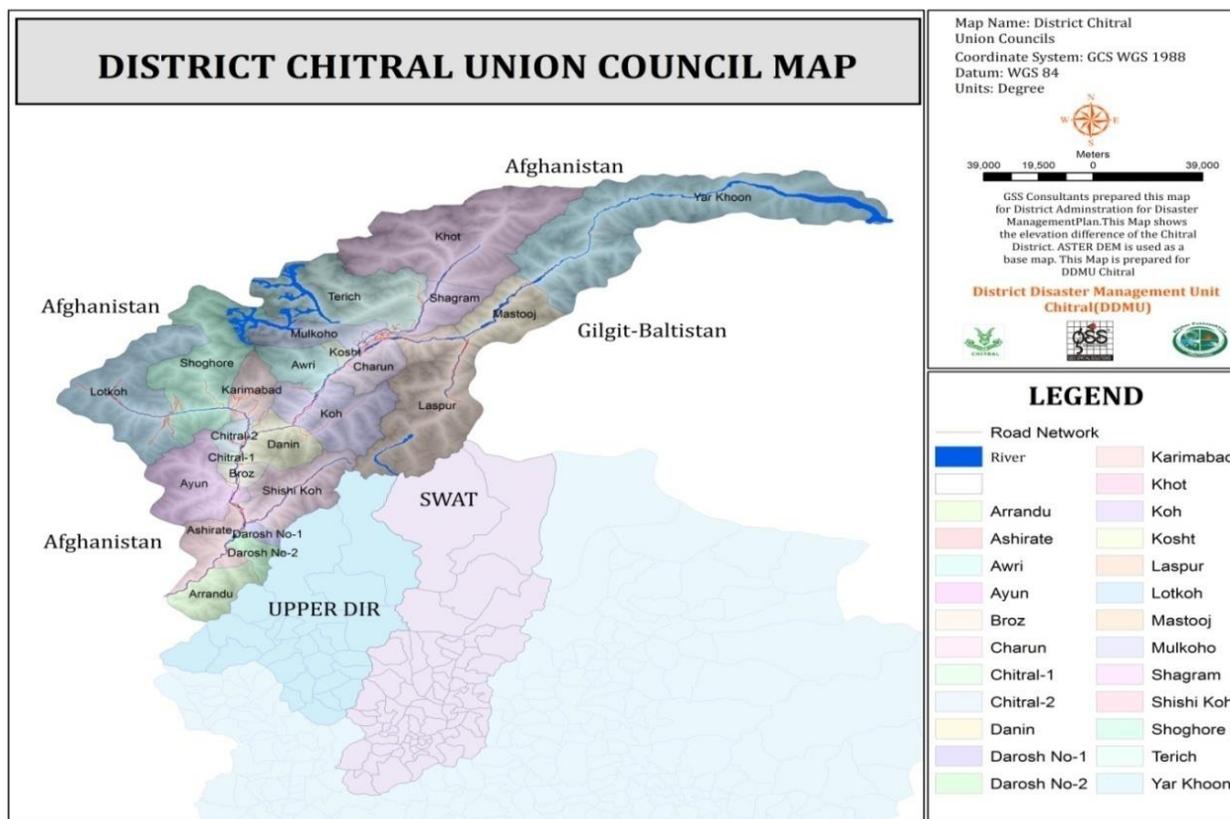
Chitral is situated at the northern area of KPK Pakistan. The local of Chitral also call it Chitral and Qashqar. The distance between Chitral and Peshawar is 322 kilometers. Threes also air route from Peshawar to Chitral. It has a unique location and potential. The district Chitral is connected to Afghanistan, Central Asian states, the northern area of Gilgit and China. The geography can prove developing Chitral to be the most progressive district in Pakistan. The district of Chitral is settled by local people but is also a small population of Pashtun people in the south. There also Kalash people are living in the most beautiful valley of subdivision Chitral like Bumbouret, Rumbur, and Birir.

Chitral district is located between 35 - 130 and 36 55 north latitude and 71 120 and 73 53 east longitudes. Afghanistan is situated to the northwest, the district of upper Dir and province of Afghanistan to the south, Gizar district of northern areas and Swat district to the east of district Chitral.

**Physical features and topography**

Chitral valley is nearly 320 km away from Peshawar city. It has three of the highest ranges in the world. There are villages and cultivable lands among these mountains. This

range is Hindukush range to the west bordering of Afghanistan, Hinduraj range to the east. There are lots of peaks and Terichmir is the highest with a height of 25263 feet (7700) meters, most part of the district is mountainous. The district Chitral of composed of several valleys. Most valleys are most important and the largest one. It starts from Broghil to Arandu on the southern tip of Afghan border. Another valley is Terich, Owir, Lotkoh, Mulkoh, Torkoh, Shishi and Ashurat (Figure 1).



**Figure 1. Local area district Chitral, Pakistan**

**Collection of samples**

The water and algal samples were collected from the selected areas in District Chitral. The species collection was done with squeezers, directly putting in a bottle. These collected samples were then brought in 1-liter plastic bottles and polythene bags.

**Preservation of sample**

The sample was brought in the laboratory of Qurtuba University in a plastic bottle and was added four percent formaldehyde solutions so that decomposer eliminated. The sample of freshwater algae is preserved in Herbarium, Department Life and Chemical Sciences Qurtuba University Peshawar.

### Slide preparation and species identifications

The slide was prepared from one drop of each sample. The drop of water samples was put on the slide with the help of forceps and micropipette from the bottle and put the dropping water on the slide and covered with coverslip. Identification was carried by led compound microscope using object 10<sub>x</sub> 20<sub>x</sub> 40. Identification was carried out from the book [11].

### Chemical analysis of water

The water samples were also collected for chemical analysis from the study area where collected fresh water brought to PCSIR laboratory Peshawar.

### Results

#### Chemical analysis of water from the study area

##### Chemical analysis of golian gole

The water samples from the selected stream were:

- Total hardness as CaCO<sub>3</sub> was 995.00mg/L (standard drinking water upto500)
- Total dissolved solids (TDS) was 1050mg/ (standard drinking water upto1000)
- Chloride as CL was 38.26 mg/L (standard drinking water up to 500)
- Sulphate as SO<sub>4</sub> was 653.82 mg/L (standard drinking water up to 400)
- pH was 7.08 mg/L (standard drinking water up to 6.50-8.50)
- Sodium as Na was 29.90mg/L (standard drinking water up to 200)
- Nitrite as NO<sub>2</sub> was Nil mg/L (standard drinking water upto50.00)
- Calcium as CaCO<sub>3</sub> was 193.03mg/L (standard drinking water upto200)
- Magnesium as CaCO<sub>3</sub> was 801.97 mg/l(standard drinking water up to 100)
- Potassium as K 6.60 mg/L
- Conductivity 1630.00 mg/L
- Total alkalinity as CaCo<sub>3</sub>00mg/L

### Chemical analysis of golian gole

The studied water sample result is as follow:

- Total hardness as CaCO<sub>3</sub>was 75.85mg/L (standard drinking water upto500)
- Total dissolved solids(TDS) was 540.00mg/L(standard drinking water upto1000)
- Chloride as CL was 29.15mg/L (standard drinking water up to 500)
- Sulphate as SO<sub>4</sub> was 19.73mg/L (standard drinking water up to 400)
- pH was 6.84mg/L (standard drinking water up to 6.50-8.50)
- Sodium as Na was 157mg/L (standard drinking water up to 200)
- Nitrite as NO<sub>2</sub> was Nil mg/L (standard drinking water upto50.00)
- Calcium as CaCO<sub>3</sub>was 60.29mg/L (standard drinking water upto200)
- Magnesium as CaCO<sub>3</sub> was15.56mg/L(standard drinking water up to 100)
- Potassium as K 7.00mg/L
- Conductivity 850.00mg/L
- Total alkalinity as CaCO<sub>3</sub>126.84mg/L

### Discussion

In the present study, different localities of District Chitral were visited and collections of freshwater green algae were carried out. A total of 51 species belonging to 15 genera were recorded from different localities of District Chitral. Among our identified genera *Mougeotia* was dominant genus with 12 species. The species belonging to *Mougeotia* were *M. quadrangulata*, *M. gracillima*, *M. elegantula*, *M. virids*, *M. boodle*, *M. rabusta*, *M. genuflexa*, *M. sphaerocarpa*, *M. calcarea*, *M. scalaris*, *M. quadrangulata* and *M. genuflexa*. The contribution of *Mougeotia* was 23.07 % of the total identified species. The 2<sup>nd</sup> most dominant recorded genus was *Spirogyra* were with 8 species. The species belonging to *Spirogyra* were *S. narcissiana*, *S. parvuta*, *S. protocalis*, *S. lagerheimill*, *S.*

*narcissiana*, *S. crassoidea*, *S. juglis*, *S. deluta*. The contribution of *Spirogyra* was 15.38% of the total collected species. The genus *Zygnema* comprised of 7 species. These species were *Z. adpectinatum*, *Z. decussatum*, *Z. subtile*, *Z. neopectintum*, *Z. liospermum*, *Z. excarrsium*, *Z. neopectintum*. The contributions of *Zygnema* were 13.46% of the total recorded species. The genus *Ophiocytium* was recorded with 5 species. The species are *O. majus*, *O. cochleare*, *O. gracilips*, *O. majus*, and *O. gracilips*. The representation of *Ophiocytium* species was 9.61% of the total identified species. Similarly, the genus *Cosmarium* and *Microspora* each recorded with 3 species, *C. pachyderma*, *C. nitidulam*, *C. moniliforme* and *Microspora* species were *M. williana*, *M. stagnorum*, *M. pachyderma*, each genus contributions were 5.76% of the total collected species. The other genera *Phacotus*, *Wislouchiella*, *Dinobryon*, and *Hormodium* each had two species recorded. Among them, the identified species included *W.*

*planctonica*, *H. subtile*, *H. flaccidiu*, *P. lenticularis*, *P. lenticularis*, *D. sociale* and *D. sertularia*. These contributed 3.84% of the total recorded species. And other genus *Plamella*, *Radiofilum*, *Stichococcus*, *Tetraspora*, and *Ulotrix*, were represented by single species each. These species were *S. bacillaris*, *P. Miniato leiblein*, *R. irreguare*, *T. lubrica* and *U. Variabilis*, each contributing 1.92% recorded in the present study. It has been reported that 22 species belonging to 4 genera were recorded from the Kosht goal district Chitral. The genus *Mougeotia* with 12 species represented by *M. quadrangulata*, *M. gracillima*, *M. elegantula*, *M. Virids*, *M. boodle*, *M. Rabusta*, *M. genuflexa*, *M. sphaerocarpa*, *M. calcarea*, *M. scalaris*, *M. quadrangulata* and *M. genuflexa*, the genus *Zygnema* has 7 species, *Z. Adpectinatum*, *Z. decussatum*, *Z. subtile*, *Z. neopectintum*, *Z. liospermum*, *Z. excarrsium*, *Z. neopectintum*, *Hormodium*, has 2 species *H. subtile*, *H. Flaccidium* and *Ulotrix* has only one species *U. Variabilis* (Table 1).

**Table 1. List of genera showing relative distribution among different region of district Chitral**

S. No.	Genus	Species	Kosht Goal	Barumkagh	Drason	Golain Goal
1	<i>Mougeotia</i>	12	+	-	+	-
2	<i>Spirogyra</i>	8	-	-	-	+
3	<i>Zygnema</i>	7	+	-	+	-
4	<i>Ophiocytium</i>	5	-	-	-	+
5	<i>Microspora</i>	3	+	-	+	-
6	<i>Cosmarium</i>	3		+		
7	<i>Phacotus</i>	2	+	+	-	-
8	<i>Hormdium</i>	2	+	-	-	-
9	<i>Wislouchiella</i>	2	-	-	+	-
10	<i>Dinobryon</i>	2	+	+	-	
11	<i>Plamella</i>	1	-	-	-	+
12	<i>Radiofilum</i>	1	-	-	-	+
13	<i>Sstichooccus</i>	1	-	+	-	-
14	<i>Ulotrix</i>	1	+	-	+	-
15	<i>Tetraspora</i>	1	-	+	+	-

Similar outcomes from the different new water living spaces algal species are systematically identified and investigated from different parts of Pakistan by [12-16]. Similar outcomes from

Karachi in crisp water new water green growth environments uncovered [15] the ordered overview of new water green growth from various part of Pakistan [17-19]. An aggregate of

68 blue-green algal species having a place with 29 genera reported from different living space like waterways, streams, lakes, stale water and wastewater archived from area Malakand KPK, Pakistan by [19]. The algal differences were seen in wastewater bodies which are commanded in algal sprouts amid summer seasons by [20-22]. Similar outcomes from Dir lower river Panjkora by [22], explain the various algal species in relations to water qualities in water bodies. The pH of various water bodies from different crisp water algal natural surroundings, dormant and running water and wastewater bodies clarify.

### Conclusion

In the present study, different localities of District Chitral were visited for collection of fresh water algae. The 2<sup>nd</sup> most dominant genera *Spirogyra* was recorded with 8 specie. The genus *zygnema* comprised of 7 species. The genus *Ophiocytium* was recorded with 5 species. The genus *Cosmarium* and *microspora* each recorded with 3 species. The other genera *phacotus*, *wislouchiella*, *dinobryon*, and *hormodium* were recorded with two species each. The other genera *Plamella*, *Radiofilum*, *Stichococcus*, *Tetraspora*, and *Ulotrix* were represented by single species recorded in this study. From the current investigation, it has been concluded that District Chitral is an ideal habitat for the growth of freshwater algae. It is suggested that there are many aquatic sites in District Chitral which are yet to be explored for freshwater algae.

### Authors' contributions

Conceived and designed the experiments: N Ullah, M Sartaj & A Nawaz, Performed the fields work and experiments: F Hussain, M Shah & N Jang, Analyzed the data: F Jan & I Muhammad, contributed reagents/ materials/ analysis tools: K Ali, M Shuaib, Wrote the paper: M Shuaib, F Jan & F Hussain.

### References

1. Salah -Ud-DIN. K, Shuaib M & Husain F (2017). Documentation of micro algal species from selected region of Peshawar Valley Khyber Pakhtunkhawa (KPK) Pakistan. *Pure Appl Bio* 6(2): 561-57.
2. Husain F & Shah S. Z (2014). Direct effect of phosphate concentration on the microalgal growth in Malakand Pakistan. *Pak. j. weed sci. Res* 20 (2):199-206.
3. Kashif A, Bakhtiar G, Husain F, Shahid A & Khwja J (2015). The study of algae; the non-vascular aquatic weeds from various fresh water bodies of Peshawar Pakistan. *Pak J Weed Sci Res* 21(1): 111-112.
4. Husain F, Leghari MK, Ahmad H, Rehman K, Iqbal A, Salem M & Leghari MY (2009). Taxonomic study of fresh water unicellular green algal species from Peshawar valley Pakistan. *Inter J Physocl Phycochem* 7(1): 9-22.
5. Bellinger EG & Sigeo DC (2010). Freshwater algae identification and use as bioindicators. John Wiley and Sons, Ltd, The Atrium, Southern Gate, Cichester, West Susses, Po19 8SQ, U.K 271.
6. Sher K & Hazrat. A (2012). Taxonomic study of green algae of lower river swat KPK, Pakistan. *Fuuast J Biol* 2(1): 125-130.
7. Hussain F, Anjum G & Zaman A (2010). Some species of genus Nostoc, from soil of Khyber Pakhtunkha, Pakistan. *Pak J plant Sci* 16:65-77.
8. Husain, Laghari MK, & Munir M (2008). Qualitative and quantities distribution of algal species from paddy fields Sharaqpur and Kamalia, Punjab. *Inter J Phycol Phycochem* 4(2): 149-158.
9. Nawaz A & Sarim FM (2004). The fresh water of Swat river. *Putu J* 10: 181-183.
10. Hussain F, Leghari MK, Ahmad H, Iqbal A, Saleem M & Leghari MY (2011). Taxonomic study of unicellular green algal species from Peshawar valley. *Inter J Phycol Phycochem* 7 (1): 9-22.
11. Tiffany LH & Britton ME (1991). The algae of Illions. Chicago University Chicago press. USA.
12. Leghari SM (2001). Some fresh water

- green filamentous algae (Chlorophyta) and Dinoborocylindrica (Chrysophyta) from Lakes and Rivers in Ponds of Sindh, Pakistan. *Online J Biol Sci* 1: 145-9.
13. Imtiaz H, Afridi MS, Hussain Z, Shah M, Shuaib M & Hussain F (2018). Community assembly and ecology of microalgae of Peshawar Khyber Pakhtunkhwa Pakistan. *Pak J of Weed Sci Res* 1: 24(3).
  14. Khan H, Fiaz M, Khan S, Hussain F, Shah SZ, Shah M, Shuaib M, Saeed M, Raza F & Laghari MK. (2017). Taxonomic study of freshwater Green Algae in relation to water quality of Tehsil Landikotal, Khyber Agency, Pakistan. *Pure and Appl Biol* 6(4): 1328-1334.
  15. Aliya R, Zarina A & Shameel M (2009). Survey of freshwater algae from Karachi, Pakistan. *Pak J Bot* 41(2): 861-870.
  16. Ghazal B, Hena L, Zarina A & Mustafa A. (2005). Photochemistry and Bioactivity of some freshwater green algae from Pakistan. *Pharmaceutical Biol* 43(4): 358-369.
  17. Ghazala B, Hena. I, Zarian A & Shameel M (2009). Taxonomic survey of fresh water algae at the campus of BZ University of Multan, Pakistan. *Inter J of Phycol and Phycochem* 5(1): 77-92.
  18. Jang N, Shah ZS, Jan S, Junaid A, Khan K & Hussain F (2014). Local screening for algal Diversity in relation to water quality of district Swabi. *J of Biodiversity and Environ Sci* 5(3): 9-13.
  19. Husain F, Shah ZS & Husain Z (2016). Indexing the cyanobacterial communities of different ecological habitat of Malakand Pakistan. *Pak J Weed Sci Res* 22 (1): 37-47.
  20. Sajjida Javaria, Jan S, Ur-Rhman K & Hussain F (2013). Eco-taxonomic study of algal flora from Kurram Rivers Parachinar. *Inter J Phycol Phycochem* 9(1): 63-68.
  21. Zarina A, Naz F & Shameel F (2014). Taxonomic studies on the genus *Cosmarium corda (desmidophyceae)* from North-Eastern areas of Pakistan. *Pak J Bot* 46(4): 1501-1506.
  22. Shuaib M, Ali K, Zeb U, Ahmed S, Ali S, Khan I & Hussain F (2017). To assess the fresh water algal diversity in relation to water quality from river Panjkora, district Dir lower, Pakistan. *Pure Appl Biol* 6(2): 645-656.