Research Article

To assess the fresh water algal diversity in relation to water quality from river Panjkora, district Dir lower, Pakistan

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Abstract

Thirty-five species belong to fresh water are taxonomically identified with the quality of water bodies from the remote areas. The samples are collected from the river Panjkora different sites during February 2015 to August 2016. Algae are collected, identified and describe in the area for the first time and exploration of the local species are presented in this article. The total 35 species belongs to 16 Genera, 15 Families, 12 Orders, 9 classes and 5 Phylum's having phylum Chlorophyta includes 22 (63%) species, Charophyta 6(17%) species, Euglenophyta 4 (11%) Species, Ochrophyta 2 (6%) species and Rhodophyta 1 (3%) species. The most dominant are Genus *Euglena* 4 species (24%), Genera *Ankistrodesmus*, *Microspora*, *Spirogyra* and *Ulothrix* has 3 Species (17%), Genera *Chaetophora*, *Chlamydomonas*, *Cladophora*, *Nitella*, *Oocystis*, *Stigeoclonium* and *Volvox* has 2 species (12%), *Asterococcus*, *Batrachospermum*, *Chlorochromonas*, *Synura*, *Zygogonium* each has 1 species (6%).It is the first inclusive taxonomical study in river Panjkora and its surrounding area, the river Panjkora is rich of algal species further investigations were needed.

Keywords: Physico-chemical characteristics; Algal diversity; Freshwater; River Panjkora; Dir lower; Pakistan

Introduction

Algae are widespread in their existence found in every moist place including moist soil throughout the year. In the world lot of

taxonomic work is done to classify the algal species but the most promising work is done on freshwater algal species. Algae are the important group of the organism and affect

human life both positively and negatively and it is a source of food [1]. Algae are the unicellular or multicellular most important photosynthetic life on earth having no true roots, stems and leaves, mostly found in the fresh water and moist places [2]. Algae contribute oxygen to the environment [3]. It is the primary producers and found in all ecosystems help in the different food chains. It is a direct and indirect source of food for fish, aquatic animals, and men also. Many algae were identified from the freshwater habitats by Hussain *et al.* [4], Hussain *et al.* [5] and Leghari *et al.* [6]. From Karachi fresh water algae revealed by Aliya *et al.* [7], Leghari, [8], the taxonomic survey of freshwater algae from Multan by Ghazala *et al.* [9]. A checklist of freshwater algae from Baluchistan by Hussain *et al.* [4]. From Azad Kashmir and Panjab Taxonomic studies were done [10]. Algae are different form and shapes, some are one cell and some are combining together and live in the form of colony and these worked independently. Dir lower is rich of plant diversity [11]. The current literature reveals that there is no study done before on fresh water algal diversity from River Panjkora.

Materials and methods

Study area

District Dir lower is situated with the longitudes and Latitudes of 34° , 37° to 35° , 07° North and 71° , 31° to 72° to 14° East. District Dir is approximately 830 meters above the sea level, experiencing the annual rain falls is 1468mm. It has a boundary with district Chitral on the Northern side, With Bajour and Afghanistan on the Western side, with district Malakand on the southern side, with district Swat on the eastern side. The river Panjkora is a river in Khyber Pakhtunkhwa, Pakistan. It originates from the Kohistan Dir upper mountains passing upper and Lower Dir. River Panjkora then joins with river Swat at Sharbatti Bosoq Pull, behind the Totakan district Malakand

and then connects with River Kabul at Charsadda in the Peshawar valley.

Collections

More than 70 samples were collected from different locality of river Panjkora and its surrounding. Algal species were collected in a clean plastic bottle with a capacity of 1 liter from the different site of fresh water bodies in river Panjkora. The collected water is from the depth of 1-3 feet's below the surface waters. The species is collected through hands picking, forceps, direct put the water in bottles.

Preservations and identifications

The algal species is preserved with 4% formalin [12]. Aquatic algal species were preserved with 8%feramlin, and phytoplankton was preserved with 2%feramlin. The algal species were identified with the available literature like [13-16].

Results and discussion

The present's research work is focusing on the exploring of algal species from the river Panjkora district Dir Lower, KPK, Pakistan. The algal diversity in the River Panjkora and its surrounding lakes and streams are rich. The algal species were collected, identified in the river Panjkora for the first time. In our collection, the most dominant Phylum Chlorophyta includes 22 (63%) species, Charophyta 6 (17%) species, Euglenophyta 4 (11%) Species, Ochrophyta 2 (6%) species and Rhodophyta 1 (3%) species shown in the (Figure 1). While the Genus Euglena 4(24%), Genera Ankistrodesmus, Microspora, Spirogyra and Ulothrix has 3 Species (17%), Genera Chaetophora, Chlamydomonas, Cladophora, Nitella, Oocystis, Stigeoclonium, and Volvox has 2 species (12%), Asterococcus, Batrachospermum, Chlorochromonas, Synura, Zygonium each has 1 species (6%) Shown in the (Figure 2) the same results from the various freshwater habitats algal species is taxonomically identified and

explored from various parts of Pakistan by Hussain *et al.* [5], Leghari *et al.* [6] and Hussain *et al.* [4]. The same results from Karachi in fresh water fresh water algae habitats revealed by Aliya *et al* [7], Leghari [8], the taxonomic survey of freshwater algae from Multan by Ghazala *et al.* [9]. A total of 68 blue green algal species belonging to 29 genera documented from various habitats like rivers, streams, ponds, stagnant water and waste water documented from district Malakand KPK, Pakistan by Hussain *et al.* [17]. The same results from

Baluchistan a checklist of freshwater algae documented and identified by Hussain *et al.* [4]. The pH of different water bodies from various freshwater algal habitats, stagnant and running water and waste water bodies explain by Hussain *et al.* [18]. The algal diversity observed in wastewater bodies which is dominated in algal blooms during summer seasons by Hussain and Shah [19]. Freshwater algal species belong to 6 genera from the various site of Peshawar valley documented by Hussain *et al.* [20].

Figure 1. It shows us the Phylum percentages, number of species in the river Panjkora KPK, Pakistan

Figure 2. It shows us the number of Genus and its percentages in river Panjkora KPK, Pakistan

Hajiabad

The total algae species in record Hajiabad near river Panjkora are *Nitella flexilis*, *Spirogyra aequinoctialis*, *Spirogyra scrobiculata*, *Zygogonium ericetorum*, *Ankistrodesmus fractus*, *Ankistrodesmus falcatus*, *Asterococcus limneticus*, *Chlamydomonas angulosa*, *Chlamydomonas glohosa*, *Cladophora glomerata*, *Microspora floccose*, *Microspora loefgrenii*, *Oocystis elliptica*, *Stigeoclonium flagelliferum*, *Stigeoclonium lubrium*, *Ulothrix zonata*, *Volvox globator*, *Euglena*

acus, *Euglena oxyuris*, *Euglena proxima* and *Batrachospermum moniliforme* shown in (Table1). The pH 7.90, conductivity 700.00 μ S/cm, Total solids (TS) 890mg/L, Total dissolved solids (TDS) 900mg/L, Total suspended solids (TSS) 4mg/L, Total hardness (TH) 220mg/L, Calcium as CaCO₃ 164.50mg/L, Magnesium as CaCO₃ 156mg/L, M-alkalinity as CaCO₃ nil mg/L, Sulphate as SO₄⁻² 305mg/L, Potassium as K⁺ 21.3mg/L, Chlorides as Cl⁻¹ 3.50mg/L, Sodium as Na⁺ 120mg/L and Nitrates as NO₂⁻¹ 1.8mg/L Show in the (Table 2).

Table 1. Relative distribution of algal species in among the different sites of river Panjkora

S.No	Algal species	Hajiabad	Daab	Kandaroo	Tarai	ShagoKaas
1	<i>Nitella flexilis</i>	+	+	-	-	-
2	<i>Nitella tenuissima</i>	-	+	+	+	-
3	<i>Spirogyra aequinoctialis</i>	+	+	+	+	+
4	<i>Spirogyra scrobiculata</i>	+	+	-	+	+
5	<i>Spirogyra weberi</i>	-	+	+	-	+
6	<i>Zygogonium ericetorum</i>	+	-	-	-	-
7	<i>Ankistrodesmus fractus</i>	+	-	-	+	+
8	<i>Ankistrodesmus convolutes</i> Corda	-	-	+	+	-
9	<i>Ankistrodesmus falcatus</i>	+	+	+	-	-
10	<i>Asterococcus limneticus</i> G.M. Smith	+	-	-	+	+
11	<i>Chaetophora attenuate</i> Hazen	-	+	+	-	-
12	<i>Chaetophora elegans</i> F. Schrunk, 1783	-	+	+	-	-
13	<i>Chlamydomonas angulosa</i>	+	+	-	+	+
14	<i>Chlamydomonas glohosa</i>	+	-	-	+	+
15	<i>Cladophora fracta</i>	-	+	+	+	-
16	<i>Cladophora glomerata</i>	+	-	+	-	-
17	<i>Microspora crassior</i>	-	+	-	-	+
18	<i>Microspora floccose</i>	+	+	+	+	-
19	<i>Microspora loefgrenii</i>	+	-	-	-	+
20	<i>Oocystis crassa</i>	-	-	+	+	-
21	<i>Oocystis elliptica</i>	+	+	-	-	+
22	<i>Stigeoclonium flagelliferum</i>	+	-	-	+	-
23	<i>Stigeoclonium lubricum</i>	+	-	-	+	+
24	<i>Ulothrix equalis</i>	-	+	+	-	+
25	<i>Ulothrix cylindricum</i>	-	+	-	+	-
26	<i>Ulothrix zonata</i>	+	-	+	+	-
27	<i>Volvox aureus</i>	-	-	+	-	+

28	<i>Volvox globator</i>	+	+	-	+	-
29	<i>Euglena acus</i>	+	-	+	+	+
30	<i>Euglena gracilis</i>	-	+	-	-	+
31	<i>Euglena oxyuris</i>	+	-	+	-	+
32	<i>Euglena proxima</i>	+	+	-	+	-
33	<i>Chlorochromonas minuta</i>	-	-	+	+	+
34	<i>Synura vella</i>	-	+	-	-	+
35	<i>Batrachospermum moniliforme</i>	+	+	-	-	-

Table 2. Physico-chemical analysis of water samples taken from various algal water bodies in river Panjkora various sites Dir Lower, Pakistan

Parameters	Collection sites					WHO Suggested limit
	Hajiabad	Daab	Kandaro	Tarai	Shago Kaas	
pH	7.90	8.02	7.21	7.39	8.50	6.5-9.2
Conductivity $\mu\text{S}/\text{cm}$	700.00	680.00	690.00	691.00	695.00	1000
Total solids (TS)mg/L	890	1250	910	1025.1	975	1000
Total dissolved solids (TDS)mg/L	900	720	800	2010	1098.64	1000
Total suspended solids (TSS)mg/L	4	5	5.636	4.362	14.232	5
Total hardness (TH) mg/L	220	338.6	615	517	425	500
Calcium as CaCO_3 mg/L	164.50	192	184	172	179	248.00
Magnesium as CaCO_3 mg/L	156	164	172	133	156	150
M-alkalinity as CaCO_3 mg/L	302.25	308.50	335.50	320.50	323	500
P-alkalinity as CaCO_3 mg/L	-	-	-	-	-	30
Sulphates as SO_4^{-2} mg/L	305	95.5	280	200	312	250
Potassium as K^{+1} mg/L	21.3	6.293	7.273	20.00	13.7	75
Chlorides as Cl^{-1} mg/L	73.50	72	26	45	36.75	250
Sodium as Na^{+1} mg/L	120	250	166.5	180	230	200
Nitrates as NO_2^{-1} mg/L	1.8	0.5	2.0	1.6	0.8	.5

Daab (College Khawar)

The total algal species recorded in Daab are *Nitella flexilis*, *Nitella tenuissima*, *Spirogyra aequinoctialis*, *Spirogyra scrobiculata*, *Spirogyra weberi*, *Ankistrodesmus falcatus*, *Chaetophora attenuate*, *Chaetophora elegans*, *Chlamydomonas angulosa*, *Cladophora fracta*, *Microspora crassior*, *Microspora floccose*, *Oocystis elliptica*, *Ulothrix equalis*, *Ulothrix cylindricum*, *Volvox globator*, *Euglena gracilis*, *Euglena proxima*, *Synura vella* and *Batrachospermum moniliforme* shown in (Table 1). The pH 8.02, conductivity 680 $\mu\text{S}/\text{cm}$, Total Solids (TS) 1250mg/L, Total dissolved solids (TDS) 720mg/L, Total

suspended Solids (TDS) 5mg/L, Total Hardness (TH) 338.6mg/L, Calcium as CaCO_3 192mg/L, Magnesium as CaCO_3 164mg/L, M-alkalinity as CaCO_3 308.50mg/L, P-alkalinity as CaCO_3 nil mg/L, Sulphate as SO_4^{-2} 95.5mg/L, Potassium as K^{+1} 6.293mg/L, Chlorides as Cl^{-1} 72mg/L, Sodium as Na^{+1} 250mg/L and Nitrates as NO_2^{-1} 0.5mg/L shown in (Table 2).

Kandaroo

The algal species recorded in Kandaroo on the side of river Panjkora are *Nitella tenuissima*, *Spirogyra aequinoctialis*, *Spirogyra weberi*, *Ankistrodesmus convolutes*, *Ankistrodesmus falcatus*,

Chaetophora attenuate, *Chaetophora elegans*, *Cladophora fracta*, *Cladophora glomerata*, *Microspora floccose*, *Oocystis crassa*, *Ulothrix equalis*, *Ulothrix zonata*, *Volvox aureus*, *Euglena acus*, *Euglena oxyuris* and *Chlorochromonas minuta* Shown in (Table 1). The pH 7.21, Conductivity 680.00 μ S/cm, Total solids (TS) 910mg/L, Total dissolved solids (TDS) 800mg/L, Total suspended solids (TSS) 5.636mg/L, Total hardness (TH) 615mg/L, Calcium as CaCO₃ 184mg/L, Magnesium as CaCO₃ 172mg/L, M-alkalinity as CaCO₃ 335.50mg/L, P-alkalinity as CaCO₃ nil mg/L, Sulphate as SO₄⁻² 280mg/L, Potassium as K⁺ 7.273mg/L, Chlorides as Cl⁻¹ 26mg/L, Sodium as Na⁺ 166.5mg/L and Nitrates NO₂⁻¹ 2.0mg/L Shown in the (Table 2).

Tarai

The total algal species recorded in the Tarai in the side of River Panjkora are *Nitella tenuissima*, *Spirogyra aequinoctialis*, *Spirogyra scrobiculata*, *Ankistrodesmus fractus*, *Ankistrodesmus convolutes*, *Asterococcus limneticus*, *Chlamydomonas angulosa*, *Chlamydomonas glohosa*, *Cladophora fracta*, *Microspora floccose*, *Oocystis crassa*, *Stigeoclonium flagelliferum*, *Stigeoclonium lubricum*, *Ulothrix cylindricum*, *Ulothrix zonata*, *Volvox globator*, *Euglena acus*, *Euglena proxima* and *Chlorochromonas minuta* Shown in (Table 1). The pH 7.39, Conductivity 691.00 μ S/cm, Total solids (TS) 1025.1mg/L, Total dissolved solids (TDS) 2010mg/L, Total suspended solids (TSS) 4.362mg/L, Total hardness (TH) 51mg/L, Calcium as CaCO₃ 172mg/L, Magnesium as CaCO₃ 133mg/L, M-alkalinity as CaCO₃ 320.50mg/L, P-alkalinity as CaCO₃ nil mg/L, Sulphates as SO₄⁻² 200mg/L, Potassium as K⁺ 20.00mg/L, Chlorides as Cl⁻¹ 45mg/L, Sodium as Na⁺ 180mg/L and Nitrates as NO₂⁻¹ 1.6mg/L Shown in the (Table 2).

ShagoKaas

The total species recorded in ShagoKaas near river Panjkora are *Spirogyra aequinoctialis*, *Spirogyra scrobiculata*, *Spirogyra weberi*, *Ankistrodesmus fractus*, *Asterococcus limneticus*, *Chlamydomonas angulosa*, *Chlamydomonas glohosa*, *Microspora crassior*, *Microspora loefgrenii*, *Oocystis elliptica*, *Stigeoclonium lubricum*, *Ulothrix equalis*, *Volvox aureus*, *Euglena acus*, *Euglena gracilis*, *Euglena oxyuris*, *Chlorochromonas minuta* and *Synura vella* shown in (Table 1). The pH 9.50, Conductivity 695 μ S/cm, Total Solids (TS) 975mg/L, Total dissolved Solids (TDS) 1098.64 mg/L, Total suspended Solids (TSS) 14.232mg/L, Total Hardness (TH) 425mg/L, Calcium as CaCO₃ 179mg/L, Magnesium as CaCO₃ 156mg/L, M-alkalinity as CaCO₃ 323mg/L, P-alkalinity as CaCO₃ nil mg/L, Sulphates as SO₄⁻² 312mg/L, Potassium as K⁺ 13.7mg/L, Chlorides as Cl⁻¹ 36.75mg/L, sodium as Na⁺ 230mg/L and Nitrates as NO₂⁻¹ 0.8mg/L as shown in the (Table 2).

Taxonomic description of algal species

Phylum Rhodophyta

Batrachospermum moniliforme (Figure-3, Plate-1)

It is a freshwater alga species and found in cold running water. It is soft thick and chains like Floridian starch are present. Cell size maximums 10-17 μ in diameter and 11-16 μ long.

Phylum Ochrophyta

Synura vella (Figure-3, Plate-2)

The cell is cylindrical, thallus is small and elongated. Cell size maximums 7-8 μ in diameter and 6-7 μ long.

Chlorochromonas minuta (Figure-3, Plate-3)

It is fresh water algae found in cold running water. It is soft thick and chains like Floridian starch are present. Cell size maximums 10-17 μ in diameter and 11-16 μ long.

Phylum Euglenophyta

Euglena acus (Figure-3, Plate-4)

The cell is green having chloroplast. Cell size maximums 13-17 μ in diameter and 11-16 μ long.

Euglena gracilis (Figure-3, Plate-5)

The thallus is green and forms a large ball like structure. Cell size maximums 14-17 μ in diameter and 12-16 μ long.

Euglena oxyuris (Figure-3, Plate-6)

The cell is green and forms a large ball like structure. Cell size maximums 13-17 μ in diameter and 11-16 μ long.

Euglena proxima (Figure-3, Plate-7)

The body is green and forms a large ball like structure. Cell size maximums 14-17 μ in diameter and 14-19 μ long.

Figure 3. It include species 1) *Batrachospermum moniliforme* 2) *Chlorochromonas minuta* 3) *Euglena acus* 4) *Euglena gracilis* 5) *Euglena oxyuris* 6) *Euglena proxima* 7) *Synura uvella* maximums 3-5 μ in diameter and 15-30 μ long

Phylum Chlorophyta

Ankistrodesmiis fractus (West and G. S. West) Collins 1912 (Figure 4, Plate-8)

This species has needle like cells, rather spindle shaped, sometime clusters of 2-32 individual or solitary. It has no colonial sheath chloroplast, a parietal plate without pyrenoids, the cell is 2-6 μ in diameter and 25-100 μ long, sometimes more than this. Ubiquitous; intermingled with other temperatures, where there is a dense collection of unicellular and colonial algae.

Ankistrodesmiis convolutes (Figure-4, Plate-9)

It may be solitary or group of cells 2-4 cells, fusiform in shape, warped and sigmoid. The tips is sharply pointed and sometimes twisted in opposite directions. Cell size

Key to species

Cell may be straight, irregular in clusters, somewhat twisted about one another.

Ankistrodesmus falcatus (Figure 4, Plate-10)

The thallus of this species is elongated and little bit fusiform. Cell size maximums 2-4 μ in diameter and 4-10 μ long.

Asterococcus limneticus G.M. Smith (Figure 4, Plate-11)

The cell is cylindrical the cell wall of this species is cellulosic, Cell size maximums 3-4 μ in diameter and 6-10 μ long.

Chaetophora attenuate Hazen (Figure 4, Plate-12)

Wall of the main axial cell is 5-6 μ in diameter and 6-8 μ long. Branching very irregular with long and tapering as well short, Arbuscular or rhizoidal branch produced throughout the length of the main axis.

***Chaetophora elegans* F. Schrank, 1783 (Figure 4, Plate-13)**

Thallus pseudoparenchyma, stouter cell. Wall of main axial cell is 3-6 μ in diameter and 5-8 μ long.

***Chlamydomonas angulosa* (Figure 4, Plate-14)**

Cell have flagella, chloroplast is present in form of cup-shaped. Cell size maximums 4-8 μ in diameter and 8-10 μ long.

Figure 4. It include the species 8) *Ankistrodesmus fractus*, 9) *Ankistrodesmus convolutus* 10) *Ankistrodesmus falcatus* 11) *Asterococcus limneticus* 12) *Chaetophora attenuate* 13) *Chaetophora elegans* 14) *Chlamydomonas angulosa*

***Chlamydomonas glohosa* (Figure 5, Plate-15)**

Cell have flagella, chloroplast is present. Cell size maximums 2-6 μ in diameter and 5-10 μ long.

***Cladophora fracta* (Figure 5, Plate-16)**

The thallus is green due to presences of chlorophyll. The cell is cylindrical there is great variability in this species and have many species and forms. Cell size maximums 5-6 μ in diameter and 7-10 μ long.

***Cladophora glomerata* (Figure 5, Plate-17)**

Chlorophyll is present, thallus is cylindrical. Cell size maximums 5-8 μ in diameter and 5-8 μ long.

***Microspora crassior.* (Figure 5, Plate-18)**

The thallus is small while the cells are rounded in outline. The majority of species

have chlorophyll. The cell is cylindrical there is great variability in this species and have many species and forms. Cell size maximums 7-8 μ in diameter and 3-7 μ long.

***Microspora floccose* (Figure 5, Plate-19)**

The cell is cylindrical, chlorophyll is present. Cell size maximums 6-8 μ in diameter and 5-7 μ long.

***Microspora loefgrenii* (Figure 5, Plate-20)**

The cell is cylindrical, thallus is small and green. Cell size maximums 7-8 μ in diameter and 5-7 μ long.

***Oocystis crassa* (Figure 5, Plate-21)**

It is a freshwater alga found in cold running water, It is soft thick and chains like Floridian starch are present. Cell size maximums 10-17 μ in diameter and 11-16 μ long.

Figure 5. It includes the species 15) *Chlamydomonas glohosa* 16) *Cladopora fracta* 17) *Cladopora glomerata* 18) *Microspora crassior* 19) *Microspora floccose* 20) *Microspora loefgrenii* 21) *Oocystis crassa*

***Oocystis elliptica* (Figure 6, Plate-22)**

Oocystis elliptica is a freshwater green algae species. The cell is slightly swollen and almost spherical; size is 6.8-16.5 μm wide and 11-25 μm long, oval to sub-cylindrical apices broadly rounded and without polar wall thickenings. The chloroplast is a large 10-20 per cell, without pyrenoids, auto-spore 4-8 per sporangium, each have several chloroplasts.

***Stigeoclonium flagelliferum* (Figure 6, Plate-23)**

Has erected which is densely branched at the base while a branch of the upper portion is irregular. Cell size maximums 6-7 μm in diameter and 4-7 μm long.

***Stigeoclonium lubricum* (Figure 6, Plate-24)**

The thallus is elongated, having branch also on the apex. Cell size maximums 2-7 μm in diameter and 4-9 μm long.

***Ulothrix equalis* (Figure 6, Plate-25)**

It may be solitary, fusiform in shape, the tips is sharply pointed and sometimes twisted in opposite directions. Cell size maximums 4-5 μm in diameter and 5-30 μm long.

***Ulothrix cylindricum* (Figure 6, Plate-26)**

This is filamentous algae, having flagella. They form colonies which are surrounded by a sheath. Cell size maximums 12-17 μm in diameter and 14-16 μm long.

***Ulothrix zonata* (Figure 6, Plate-27)**

Filamentous algae, having flagella, Cell is surrounded by a sheath. Cell size maximums 12-17 μm in diameter and 14-16 μm long.

***Volvox aureus* (Figure 6, Plate-28)**

Green filamentous algae, having flagella, they form colonies which are surrounded by sheath. Cell size maximums 12-17 μm in diameter and 14-16 μm long.

***Volvox globator* (Figure 6, Plate-29)**

The thallus is green and forms a large ball like structure. Cell size maximums 14-17 μm in diameter and 12-16 μm long.

Figure 6. It includes the species 22) *Oocystis elliptica* 23) *Stigeoclonium flagelliferum* 24) *Stigeoclonium luhricum* 25) *Ulothrix aequalis* 26) *Ulothrix cylindricum* 27) *Ulothrix zonata* 28) *Volvox aureus* 29) *Volvox globator*

***Nitella flexilis* (Figure 7, Plate-30)**

It is Smooth stonewort in fresh water. It grows in a meter long and 1mm wide. Cell size of this species maximums 12-18 μ in diameter and 11-17 μ in long.

***Nitella tenuissima* (Figure 7, Plate-31)**

This is algae having filaments; they form colonies which are surrounded by a sheath. Cell size maximums 13-17 μ in diameter and 10-16 μ long.

***Spirogyra aequinoctialis* (Figure 7, Plate-32)**

This species has a cylindrical cell, chloroplast sometime many sometimes in the group which makes 5-6 turn. The cell wall of this species is scrobiculate, spindle shape having a diameter of 3-7 μ in diameter.

***Spirogyra scrobiculata* (Figure 7, Plate-33)**

The thallus of this is cylindrical, many chloroplasts are present which make 15-17 turn. The cell wall of this species is scrobiculate, spindle shape having diameter of 3-4 μ in diameter.

***Spirogyra weberi* (Figure 7, Plate-34)**

This species sometime present in groups and sometime in groups, Thallus is elongated have 2-4 μ in diameter. Pyrenoids are located at their sides.

***Zygonium ericetorum* (Figure 7, Plate-35)**

The cell of this algae is elongated, it form sometime group. The cell is 3-6 μ in diameter and 15-41 μ long.

Figure 7. It includes the species 30) *Nitella flexilis* 31) *Nitella tenuissima* 32) *Spirogyra aequinotialis* 33) *Spirogyra scrobiculata* 34) *Spirogyra weberi* 35) *Zygonium ericetorum*

Conclusion

District Dir lower has river, lakes, streams and other fresh water bodies where algae are in abundance and district Dir lower is the most ignored area of aquatic botany. The current investigations is done is river Panjkora different sites and found 35 species belong to 5 phylum, 9 classes, 12 order, 15 families and 16 genera. The area is rich of algal flora and further study is needed under this record.

Authors' contributions

Conceived and designed the experiments: M Shuaib, Performed the Fields work and experiments: M Shuaib & K Ali, Analyzed the data: U Zeb, S Ahmed & S Ali, Contributed reagents/ materials/ analysis tools: S Ali, I Khan & F Hussain, Wrote the paper: M Shuaib & F Hussain.

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