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TAXONOMIC DETERMINATION OF ALGAE OF SANGOTA DISTRICT SWAT, PAKISTAN

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ABSTRACT

The taxonomic study of algae of district Swat, Khyber Pakhtunkhwa Pakistan and the exploration of the local species are presented in this article. Twenty three (23) algal species were collected from different areas of Swat. The largest genus was Euglena having seven species (30.43%) which was most commonly found in the area. Next to it was the genus Dactylococcopsis containing four different species (20%), followed by genus Ankistrodesmiis with three distinct species (13.04%), and Schroederia having two species (8.69%). The rarely occurring genera were Lagerheimia, Scenedesmus, Chlorochromonas, Characiopsis, Quadrigula, Lacustris, and Tetraedron with one species each (4.34%). The available literature on the algae showed that algae are most extensively present in all damp areas of the districts. As river Swat is the main river in the district due to which majority of the areas are damp providing better environment to the algal growth. Our article presents the main algal species which harm the water table of the area.

Keywords: Cyano-bacteria, fresh water algae, green and unicellular algae.

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INTRODUCTION

Algae are very important photosynthetic organisms on this earth. Aquatic web foods are formed due to algae which help and support animals (Hussain *et al*., 2009). About hundred meters below the water it form algae seaweed but most algae grow on trees, soil & animals. Some are inside porous rocks i.e. limestone and sandstone. Algae are very unique which grow in high temperature or also grow deep within polar ice (Bellinger and Sigee, 2010). Algae have different size in large habitats. Phytoplankton swims in oceans and lakes called

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microscopic algae. Thousand of these species can be put in small pin heads (Khair *et al*., 2006). Algae are the early life forms of cyanobacteria. Three billion years ago fossils are founds in rocks that the algae are formed where no oxygen occurs. Oxygen is produced as a byproducts by the algae and other photosynthesizing plants and comes to the environment. A billion years ago it was first plants coming to the earth that photosynthesized (Khalid *et al*., 2010). Algae are eukaryotes with the exception of cyanobecteria; having a membrane in which there is mitochondria and nucleus (Hussain *et al*., 2010). Chlorophyll is the important pigment responsible for the capture of light in photosynthesis and the chloroplast is an important organelle of eukaryotic algae. Certain algae have carotenoids called secondary pigments yellow or brown. Unicellular organisms which lack membrane bounded organelles are prokaryotes called cyanobecteria. It is a similar character to bacteria (Lashari *et al*., 2009).

Algae have different forms & shapes. One celled algae combine and formed colony. These attached celled work independently. But in multicellular algae, the cells join end to ends unranked or branched making filaments. Complex algae have highly specialized cells (Nawaz and Sarim, 2004). District Swat located in the extreme North of Khyber Pakhtunkhwa 35° towards North and 72° 30′ to East present in large mountains. In the North side Chitral district in West side is district Dir in South is Mardan. This district is divided into two regions plains & mountains. In the Northern side Swat is separate by Abasin Kohistan which is a barrier between Swat, Gilgit, and Chitral. Mankial range reach to proper Swat and meet with Shangla range. These ranges separate Swat from Shangla.

MATERIALS AND METHODS

Algal specimen were collected with the help of forceps, hands picking, direct taking water in the bottle (Fig. 1), for the floating algal flora, picking by hand (Figure 2) with soil then clean with the help of tape water for preparation of microscopic slides (Figure 3). These collected algal specimens were preserved in 3% formalin. These specimens were identified following the methodology of Prescott (1951) and Tiffany and Britton (1952). For identification a drop of algal specimen was placed on slide for micro algae i.e. Cyanophyceae and diatom flora. For filamentous algae filament was separated with forceps and placed on slide and put cover slip on it for microscopic examination by comparing the figures given in literatures with the specimen as observed under microscope and by finding the structural details of the specimens.

Figure 1. Specimen of Algae

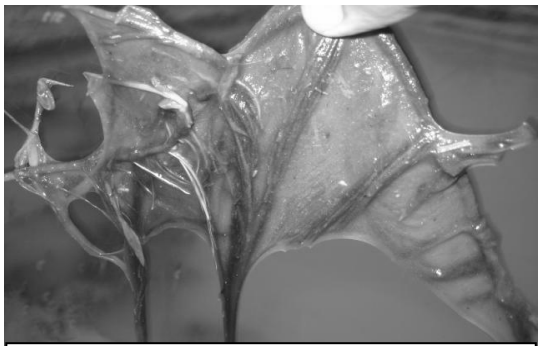

Figure 2. Collection of Algae

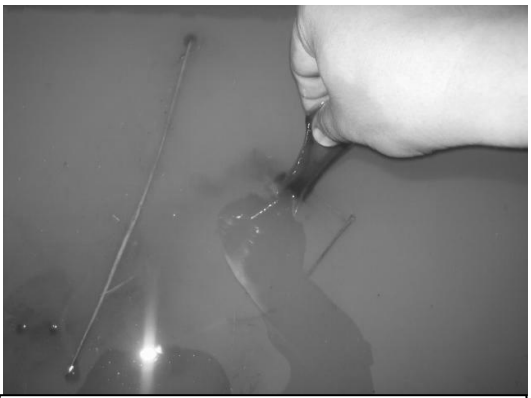

Figure 3. Specimen of Algae

RESULTS AND DISCUSSION

The present research focuses on eco-taxonomic determination of Algae of Sangota District Swat. In our collection, members of genus Euglena were recorded to be the largest. This genus was represented by 7 species in which *Acus* was the most abundant having three and *Oxyuris* having two species, while the remaining species were one in number in these twenty three (23) species of Algae, which were collected and identified from Sangota District Swat. The commonly occurring species is Euglena**,** with seven species (30.43%) of the whole algae. The other genera were *Dactylococcopsis,* 4 species (20%), *Ankistrdesmiis, 3* species (13.04*)* and *Schroederia*, 2 species (8.69%). The rarely occurring species were *Lagerheimia*, *Scenedesmus, Chlorochromonas, Characiopsis, Quadrigula, Lacustris* and *Tetraedron*, with 1 species each (4.34%). Vast areas of Pakistan are not yet studied. The occurrence of the species is shown in the

Table-1. Therefore, this study was undertaken to make a survey in Swat to record the taxonomy of algae over there.

Table-1. Occurrence of algae species in different areas of Swat.

S#	General	Mangl Awar	Banjot	Sangota	Fizagat	Margazar	Loyebanr	Jambil
1.	*Euglena gracilis*	-	-	-	-	+	-	+
2.	*Euglena oxyuris*	-	-	-	-	-	-	-
3.	*Euglena proxima*	-	-	-	-	-	-	+
4.	*Euglena acus var. Rigida*	-	-	-	-	-	-	-
5.	*Euglena acus Ehrenberg*	-	-	-	-	+	-	+
6.	*Euglena minuta*	+	-	-	-	-	-	+
7.	*Lagerheimia longiseta*	-	-	-	-	+	-	-
8.	*Ankistrodesmiis convolutes*	-	-	-	-	+	-	+
9.	*Ankistrodesmiis falcatus*	-	-	-	-	-	-	-
10.	*Ankistrodcsmus fractus*	-	-	-	+	-	-	+
11.	*Schroederia setigera*	-	-	-	-	-	-	-
12.	*Schroederia Judayi*	-	+	-	-	-	-	-
13.	*Quadrigula lacustris*	-	-	-	-	-	-	-
14.	*Tetraedron constrictum*	-	-	-	-	-	-	-
15.	*Scenedesmus quadricauda*	-	+	-	+	-	-	-
16.	*Stjnura Adamsii*	-	-	-	+	+	-	-
17.	*Dactylococcopsis acicularis*	-	-	-	+	-	-	-
18.	*Dactylococcopsis Smithii*	-	+	-	+	-	-	-
19.	*Dactylococcopsis fascicularis*	-	-	+	-	+	-	-
20.	*Dactylococcopsis rhaphidioides*	-	-	+	-	+	-	-
21.	*Euglena gracilis*	-	+	-	-	-	+	-
22.	*Chlorochromonas minuta*	-	+	+	+	-	+	-
23.	*Characiopsis lageniformis*	-	+	+	+	-	-	-

Taxonomic Description

Euglenaceae

This family includes the pigmented, halophytic euglenoids which contain a peculiar type of chlorophyll, the chemistry of which is not well known. In addition to this pigment there may be haematochrome

which appears when the organisms are subjected to intense illumination or, in a few forms, may be present at all times. The chlorophyll is localized in definitely and specifically shaped chloroplasts (chloroleucites) which may be disc-like, ribbons, or stellar plates scattered through the cell or, rarely, radiating from the center. In some forms lens-shaped pyrenoids can be discerned projecting from either surface of the chloroplast. As mentioned above, food reserve is paramylon, a carbohydrate, which may be deposited about the pyrenoid, or it may collect independently in the cytoplasm. The shape of the paramylon grains is specific, and varies greatly among the different genera and species, and is therefore of taxonomic value. The grains may be minute and numerous rods, a few large sticks, circular plates, or doughnut-shaped rings. The nucleus is Usually conspicuous and is centrally located. Most members of this family have a single thick flagellum, but a few have 2. The flagella are attached at the anterior end, arising from basal granules and emerging through a canal. Placed interiorly and laterally is a complex red pigment-spot.

***Euglena gracilis* Klebs**

Cells metabolic, short-fusiform to ovoid; chloroplasts many, disc shaped bodies evenly distributed throughout the cell, with pyrenoids; paramylon bodies not observed; cell 8-15-(22) µ in diameter,37-50µ long. In Sphagnum bogs and in ponds where there is a high concentration of nitrogenous matter; usually found with other species of Euglena.

Key to species: Chloroplasts not so numerous; broadest at or above the mid region; 37-50µ long.

***Euglena oxyuris* Schmarda var. minor** (Plate 1, Fig. 2)

Cells slightly metabolic, mostly keeping a constant shape in movement; elongate-cylindric and twisted; tapering posteriorly rather abruptly to form a short tail-piece. Chloroplasts are numerous and disc-like in shape.

Key to species: Paramylon bodies in the form of 2 large, oblong rings; cells large, up to 500µ long.

***Euglena proxima* Dangeard** (Plate 1, Fig. 4)

Cells metabolic, fusiform, narrowed posterior to a blunt tip; periplast spirally striated; chloroplasts numerous, irregularly shaped discs; paramylon bodies numerous small rods scattered throughout the cell; cells 14.5-19- (21) µ in diameter, (50)-70-85-(95)µ long.

Key to species: Chloroplasts numerous, as many as 50; cells broadest below the mid region; 50-70- (95) µ long.

Euglena acus var. rigida

Cell rigid, swimming slowly and continuously in one direction, spindle-shaped but narrow and elongate, tapering abruptly posteriorly into a sharply pointed tail-piece; paramylon bodies in the form of 2

long rods (rarely more numerous small rods) ; chloroplasts numerous, plate-like and ovoid bodies, sometimes showing a spiral arrangement within the cell; 5.5-10μ in diameter, 118-12μ long.
Key to species: Cells elongate-fusiform, shaped posteriorly into a extended, well, narrowing position; 140-1 8O/μ long.

Euglena acus Ehrenberg (Plate 1, Fig. 1)

Cells very slightly metabolic, lengthen spindle-shaped, shaped posteriorly into a extended, fine tapering point, conical and shorten at the forward end; membrane indistinctly spirally striated; chloroplasts numerous, disc-like; paramylon bodies 2 to several long rods; 10-1μ, in diameter, 140-180μ long.
Key to species: Cells elongate-fusiform, 40-1 8Oμ long.

Euglena gracilis (Plate 1, Fig. 3)

Cells metabolic, short-fusiform to ovoid; chloroplasts many, disc shaped bodies evenly distributed throughout the cell, with pyrenoids; paramylon bodies not observed; cell 8-15-(22); μ in diameter, 37-50μ long. In Sphagnum bogs and in ponds where there is a high concentration of nitrogenous matter; usually found with other species of Euglena.
Key to species: Vegetative cells 16-24m in diameter.

Chroococcaceae

Unicellular or colonial, free-floating or attached to submerged or aerial substrates. There are no pseudo filamentous arrangements or expanses produced as in the Entophysalidaceae, another family in this order, which is not represented in our region.

Dactylococcopsis acicularis (Plate 1, Fig. 6)

A free-floating colony of few (rarely solitary) acicular or straight cells with extremely finely pointed poles, enclosed by a wide gelatinous envelope; cells 2-3μ in diameter, 45-60- (80), long.
Key to species: Cells straight, needle-hke, sharply pointed at the apic.

Dactylococcopsis smithii (Plate 1, Fig. 8)

Colony ovate or broadly fusiform, containing 4-8-16μ fusiform cells which are nearly straight or slightly arcuate, sometimes paired and lying end to end with one pole pointed and the other bluntly rounded; cells 3.μ in diameter, 11-15μ long. This species (listed as D. rhaphidioides Hansg. by Smith, 1920, p. 47) was more frequently found in the region than any other species of the genus. Common in the euplankton of lakes and ponds; also in rich mixtures of algae in acid bogs and small lakes.
Key to species: Cells stout, not more than 5 times their diameter in length.

Dactylococcopsis fascicularis (Plate 1, Fig. 5)

Colonies fusiform, composed of 4-8 elongate, arcuate or spirally sigmoid cells tapering to fine points at the poles, rather compactly

twisted and inclosed by a thin, mucilaginous envelope; cells 1.5-2μ in diameter, 19.5μ long.

Key to species: Cells are twisted concerning one another to form fascicles or bundles.

Oocystaceae

This is a large family in which there is a wide range in cell shape and arrangement. The cells may be spherical, ovate, pyramidal, or polygonal. Some forms are unicellular, others colonial. The chief characteristic which unites the 30 or more genera is the autospore method of reproduction; ordinary cell division and zoospore formation are not known. The autospores are small replicas of the mother cell and are usually cut out in a definite number from the parent protoplast. Upon escape they may remain together to form a colony, as in the Coelastraceae, or may separate. Unlike the Coelastraceae and the Scenedesmaceae, however, the colonies are not composed of definitely arranged cells. In most cases the cells are not adjoined but are held together by a gelatinous investment or by the enlarged and persistent mother cell wall, or gelatinized portions of the old wall. In the majority of forms there is a single, laminate chloroplast, but a few species have several to many disc like bodies, each with a pyrenoid. Multinucleate cells are rare.

Ankistrodesmiis convolutes (Plate 2, Fig. 1)

Solitary or in groups of 2-4 cells, fusiform in shape, twisted and sigmoid; apices sharply pointed and often twisted in opposite directions; cells 3-4.5μ, in diameter, 15-25μ long. Common in the tychoplankton.

Key to species: Cells straight, in fascicles or irregular clusters, sometimes twisted about one another.

Ankistrodesmiis fractus var. tumidiis (Plate 2, Fig. 2)

Cells needle-like to somewhat spindle-shaped, solitary or in clusters of 2-32 individuals, not enclosed in a colonial sheath; chloroplast 1, parietal plate without pyrenoids; cells 2-6μ in diameter, 25-100μ, long, sometimes longer. Ubiquitous; intermingled with other algae and most commonly found in acid water habitats of high temperatures where there is a dense conglomeration of unicellular and colonial algae.

Schroederia setigera (Plate 2, Fig. 4)

Cells fusiform, mostly acicular, the cells 3-μ, in diameter, 60-85long including the setae, which are 13-17μ, long.

Key to species: Oogonia 56-65μ long.

Schroederia judayi (Plate 2, Fig. 3)

Cells fusiform, straight or arcuate, the poles narrowed and extended into long setae, one of which terminates in short

bifurcations; 1 chloroplast, with a single pyrenoid; cells 2.5-6a in diameter, 45-63/μ long, including the setae, which are 10-μ long.
Key to species: This species resembles an unattached Characium and should be compared with some of the species of that genus. Fascicles of branches narrow in outline, opposite or whorled, arising from near the mid region of the cell in the main filament.

Tetraedron constrictum (Plate 3, Fig. 1)

Cells quadrangular in outline, tetragonal, 2 sides sub-parallel, the other 2 deeply concave as seen in front view, the angles extended into slightly tapering processes which are dichotomously branched and tipped with a short spine; in side view fusiform, the processes at the superimposed poles of the cell not quite in the same plane but slightly turned at different angles; cells 5-8μ in diameter, without processes, 8μ thick, 18-25μ;a in their longest dimension.
Key to species: Cells definitely 4-lobed, the lobes forming an H-shaped figure.

Scenedesmus quadricauda (Plate 2, Fig. 6)

A variety differing from the typical by the greater length of the spines; cells 3.5-5 μ in diameter, S-l μ long; spines 7.5-10μ, long.
Key to species: Cells cylindrical or ovate, adjoined along their entire lateral walls.

Stjnura adamsii

A free-swimming, globose colony of rather loosely arranged, elongate-pyriform or club-shaped cells, much narrowed to subacute at the posterior end; anterior end broadly rounded and furnished with a few small sharp spines; chromatophores 2 lateral, plate-like bodies, one on either side of the cell; 2 flagella of equal length; cells 8-10μ in diameter, 40-45μ long. This species appears to be synonymous with S. uvella var. longipes.
Key to species: Cells elongate-pyriform (club-shaped), not compactly arranged but rather loosely disposed in a radiating fashion in spherical or obovoid colonies.

Lagerheimia longiseta (Plate 2, Fig. 8)

Cells ovate or ellipsoid, with very long setae (more than twice the length of the cell) arranged in a whorl of 4-10 close to the poles; parietal chloroplast without a pyrenoid; cells 5-8μ in diameter, 9-13μ long without setae; setae 40-55μ long.
Key to species: Setae more than twice the length of the cell.

Synura uvella

A free-swimming colony of 64-128 short pyriform cells which have several short, sharp spines in the anterior region of the wall; cells 8-11 μ in diameter, 20-30-(35)μ long. Not infrequently this species becomes superabundant and produces the equivalent of a water bloom. In lakes and reservoirs this organism may become obnoxious

because of the strong oily taste it imparts to drinking water. Occur in habitats where there is a high concentration of organic matter.
Key to species: Cells pyriform, densely arranged in ovoidor spherical colonies.

Chloromoebaceae

Cells pyriform or cordate, with 2 flagella of unequal length attached at the broad anterior end, which is slightly concave; cell wall lacking; protoplast containing 2 elongate-ovate and somewhat curved chromatophores; food reserve in the form of oil droplets and a basal globule of leucosin; cells capable of becoming amoeboid, attached by a posterior pseudopodium-like extension; pigment-spot lacking.

Chlorochromonas minuta (Plate 2, Fig. 7)

Characteristics as described for the genus; cells 4.5-9.5;u, long.
Key to species: Suffultory cell without division.

Characiopsis lageniformis

Cells solitary or in small groups, fusiform, broad below and then rather abruptly narrowed to a rounded, cone-shaped apex; narrowed below to a short stipe which has a flattened attaching disc; chromatophores 2 parietal bands; cells l-ll µ in diameter, 20-23µ long. Epiphytic on Trihonema filaments.
Key to species: Cells broadly ovoid in the lower portion, abruptly narrowed interiorly and then extended to form a produced apex.

CONCLUSION

Algae in fresh waters have numerous environmental functions and are based upon the recycling of nutrients. Urbanization has led to the pollution of surface water bodies resulting in decline/extinction of some species. On the other hand, some species have increased enormously making water unfit for drinking and recreation. This study only comprises the taxonomic position of algae. It is proposed that a combined i.e. taxonomical and limnological study should be done to understand the biodiversity of alga in District Swat.

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Plate 1

Figure 1. *Euglena acus* Ehrenberg

Figure 2. *Euglena oxyuris*

Figure 3. *Euglena gracilis*

Figure 4. *Euglena proxima*

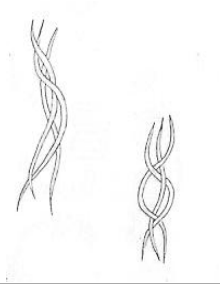

Figure 5. *Dactylococcopsis fascicularis*

Figure 6. *D. acicularis*

Figure 7. *Dactylococcopsis phidioides*

Figure 8. *Dactylococcopsis smithii*

Plat 2

Figure 1. *Ankistrodesmiis convolutes*

Figure 3. *Schroederia judayi*

Figure 2. *Ankistrodesmiis fractus*

Figure 4. *Schroederia setigera*

Figure 5. *Scenedesmus longus*

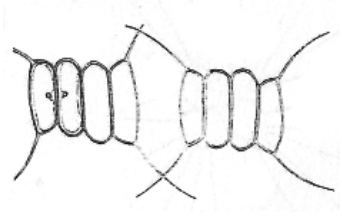

Figure 6. *Scenedesmus quadricauda*

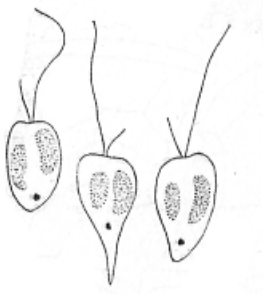

Figure 7. *Chlorochromonas minuta*

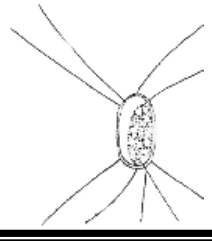

Figure 8. *Lagerheimia longiseta*

Plate 3

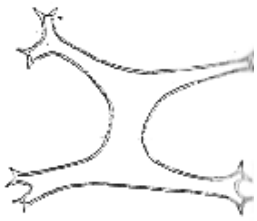

Figure 1. *Tetraedron constrictum*

Figure 2. *Quadrigula lacustris*

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