Study on Some Aquatic Micro and Macro Algae from Dagon University Campus

Khin Khin Phyu[1], Myat Myat Moe[2]

Abstract

In order to determine some aquatic algae of the Dagon University Campus, were observed in the taken from different habitats planktonic (Euplanktonic, Tychoplanktonic) and benthic (epipelic, epiphytic, epilitic). These samples took from 5 sites from September to December 2017. In the investigation, a total of 34 taxa were identified by Smith (1950), Prescott (1962), Dillard (1989-2008) and John *et al* (2008). Among them, 20 species belong to division Chlorophyta, 5 species belong to division Chrysophyta, 4 species belong to division Euglenophyta, 5 species belong to Cyanophyta. The result of this study gives information about the habitat of existing alga species of Dagon University Campus and their microscopical characters. The general uses of some collected algae were also indicated.

Keywords: Benthic, Plantonic, Chlorophyta, Freshwater, Dagon University.

Introduction

Dagon University is located 20km north from Yangon City Center of Myanmar at latitude16° 50' N and longitude 96° 12' E.. It is one of the largest national universities in Myanmar. The total area of the University Campus is 6.40 km^2.

In the freshwater environment, light energy conversion and related synthetic of carbon compounds are carried by three major groups of organisms; primary producers, higher plants and algae. Algae are the main microorganisms involved in this process and may be defined as simple plants (lacking roots, stems, and leaves) that have chlorophyll as their primary photosynthetic pigment and lack a sterile covering of cells around the reproductive cells.

Among the various species of algae, vegetative propagation may result from the division and separation of cells, from the breaking of filaments, from specialized thick-walled dormant cells or from motile spores that develop directly from vegetative cells but Cyanobacteria has no sexual reproduction occur (Pooja 2011).

There are two main forms of algae, micro and macroalgae. Microalgae are divided into two general groups: phytoplankton and periphyton.Periphyton live attached to rocks, sediments, plant stems and aquatic organisms. (Addy& Green 1996).

Macroalgae come in many colors including green, red, brown and blue, as well as in a variety of forms-some growing tall, with others growing as mats. Filamentous algae are usually considered as "macrophytes" since they often form floating masses that can be easily harvested, although many consists of microscopic, individual filaments of algal cells. (Mohammad & Rina 2009).

On the basic of their habitat, aquatic algae can be categorized as: planktonic, benthic, marine, freshwater, lentic and lotic.

Planktonic algae are microscopic plants that live in every drop of pond water. They are important because they produce oxygen and food for the animals that live in the pond. These tiny plants get their nutrients directly from the water, so their growth and reproduction are dependent on the number of nutrients (i.e. fertilizer) in the water.

Benthic algae are present in the bottom sediments of almost all aquatic systems, where they require adequate light to carry out photosynthesis and growth.

[1] Demonstrator, Department of Botany, Dagon University
[2] Professor, Department of Botany, Dagon University

Particular taxonomic groups, such as filamentous green algae and pennate diatoms are typical of benthic conditions, while Volvocales and centric diatoms are characteristic of the pelagic environment (Sigee 2004).

The aims and objectives of this study were to give the knowledge of some algae flora found in Dagon University Campus and to study the microscopical characters of algae and their habitat in water bodies.

Materials and Methods

Collection

The collection period was taken from September to December 2017 so as to include the rainy and winter season. All together 5 stations were selected for a random sample collection from campus.

Samples were collected from stagnant water bodies and stones, aquatic plants that have in the bottom of the ponds and sediments from the shore of the ponds.

Identification

After collection macro and microalgae samples were done using an electronic microscope, photographs and measurement as discussed by John *et al.* (2008) and Prescott (1962).

Taxonomical analysis of both micro and macro algae was done with the help of cited literature and monographs of Prescott (1962, 1964), John *et al.* (2008), Dillard (1989-2008) and Smith (1950).

Figure (1) Location map of Dagon University Campus

Figure (2) Study sites

Results and Discussion

Thealgae were collected randomly from five sites in Dagon University Campus from September to December 2018. Totally 34 species were collected. Among them, 25 species were found as microalgae and 9 species were found as macroalgae, showed in Table 1.Table 2-5 showed the classification of algae collected from Dagon University Campus. According to habitat, the collected algae were distinguished as planktonic and benthic. (Table 6).

Table (1) Collected Micro and Macro algae

Microalgae	Macroalgae
1. *Palmella mucosa*	1. *Ulothrix tenerrima*
2. *Sphaerocystis schroeteri*	2. *Protoderm aviride*
3. *Characium angustum*	3. *Cladophora glomerata*
4. *Characium obtusum*	4. *Oedogonium crassiusculum*
5. *Pediastrum tetras*	5. *Spirogya stictica*
6. *Ankistrodesmus facatus*	6. *Oscillatoria princeps*
7. *Ankistrodesmus fusiformis*	7. *Oscillatoria subbrevis*
8. *Selenastrum gracile*	8. *Anabaena cylindrica*
9. *Selenastrum westii*	9 *Calothrix confervicola*
10. *Tetraedron lobalatum var polyfurcatum*	
11. *Scenedesmusacutiformis*	
12. *Scenedesmus desiformis*	
13. *Scenedesmus obliquus*	
14. *Closterium moniliferum*	
15. *Cosmarium blyttii*	
16. *Characiopsis longipus*	
17. *Navicula gregaria*	
18. *Pinnularia virideformis*	
19. *Gomphonema constrictum var capitatum*	
20. *Nitzschia sp.*	
21. *Euglena mutabilis*	
22. *Phacus orbicularis*	
23. *Trachelomonas armata*	
24. *Trachelomonas armata var lonispina*	
25. *Chroococcus turgitus*	

Table (2) Classification of Chlorophyta

Class	Order	Family	Genus	Species
Chlorophyceae	Tetrasporales	Palmellaceae	*Palmella*	*P. mucosa*
			Sphaerocystis	*S. schroeteri*
	Ulotrichales	Ulotrichaceae	*Ulothrix*	*U. tenerrima*
	Chaetophorales	Chaetophoraceae	*Protoderma*	*P. viride*
	Cladophorales	Cladophoraceae	*Cladophora*	*C. glomerata*
	Oedogoniales	Oedogoniaceae	*Oedogonium*	*O. crassiusculum*
	Chlorococcales	Characiaceae	*Characium*	*C. angustum*
				C. obtusum
		Hydrodictyaceae	*Pediastrum*	*P. tetras*
		Oocystaceae	*Ankistrodesmus*	*A. falcatus*
				A.fusiformis
			Selenastrum	*S. gracile*
				S.westii
			Tetraedron	*T. lobulatum var. polyfurcatum*
		Scenedesmaceae	*Scenedesmus*	*S. acutiformis*
				S.disciformis
				S.obliquus
	Zygnematales	Zygnemataceae	*Spirogyra*	*S. stictica*
		Desmidiaceae	*Closterium*	*C. moniliferum*
			Cosmarium	*C. blyttii*

Palmella mucosa Kuetzing, 1843

Plant mass densely green, forming gelatinous expansions on the substrate; individual cell sheaths evident at first but becoming indistinct. Chloroplast parietal, covering nearly the entire wall. Cells 5 µ in diameter.

Sphaerocystis schroeteri Chodat, 1897

A free-floating spherical colony of spherical cells, which including both undivided and recently divided cells. Chloroplast cup-shaped and covering most of the wall. Cell 5 µ in diameter; colony 87.5 µ in diameter.

Ulothrix tenerrima Kuetzing, 1843

Filaments free-floating or attached, long, cylindrical, slightly constrictions at the cross walls. Chloroplast folded parietal plate, about ½ the length of the cell, with 1 pyrenoid. Cells 10 µ in diameter, 15 µ long.

Protoderma viride Kuetzing ,1894

Thallus an attached disc, irregular in outline, made up of branched filaments that are compact and parenchymatous internally but semi-radiate and spreading at the margin; terminal cells slightly narrowed; chloroplast a parietal disc with 1 pyrenoid. Cells 6.25 µ in diameter, 10 µ long.

Cladophora glomerata (L.) Kuetzing, 1845

Thallus composed of attached, dark green, fluffy; filaments successively and regularly branched; cell very slightly attenuated toward the apices of the branches, which are bluntly pointed. Main axis 70 µ in diameter, 10 times the diameter in length. Cells in the branches 50 µ in diameter, 10 times the diameter in length.

Oedogonium crassiusculum Wittrock, 1871

Nannandrous. Vegetative cells cylindrical, 25 µ in diameter, 100 µ long. Oogonia 1, subglobose; opening by a superior pore; 55 µ long. Oospores ellipsoid-globose, wall smooth, thick; 52 µ in diameter, 52 µ long. Antheridia 17.5 µ in diameter, 25 µ long.

Characium angustum A. Braun, 1855

Cells solitary, symmetrical, narrowly lance-shaped, narrowed to a sharp point; stipe short, without an attaching disc; chloroplast parietal. Cells 5 µ in diameter, 75 µ long.

Characium obtusum A. Braun, 1855

Cells solitary, elongated-ovoid, stipe short, basally with a well-developed sole-like attachment portion and apically rounded with a ring-like wall thickening; chloroplast parietal. Cells 10 µ in diameter, 30 µ long.

Pediastrum tetras (Ehrenb.) Ralfs, 1844

Colony entire; inner cells with 8 straight sides but with one margin deeply incised; peripheral cells crenate with a deep incision in the outer free margin, their lateral margins adjoined along ⅔ of their length. Cells 7.5 µ in diameter.

Ankistrodesmus falcatus (Corda) Ralfs, 1848

Cells needle-like to spindle-shaped, solitary or in the cluster of 4 individuals, not inclosed in a colonial sheath; chloroplast parietal plate without pyrenoids. Cells 2 µ in diameter, 25 µ long.

Ankistrodesmus fusiformis Corda ex Korshikov, 1953

Colonies of 4 cells, with cells crosswise (often at right angles to one another) and connected by mucilage or enclosed within a mucilaginous envelope; almost cylindrical in the centre and gradually narrowing to acute apices, fusiform. Cells 3.75 µ in diameter, 42.5 µ long.

Selenastrum gracile Reinsch, 1867

Colonies of 8-64 sickled-shaped cells in the irregular arrangement, but with the convex surfaces opposed; apices of the cells sharply pointed; chloroplast a parietal plate along the convex wall, without a pyrenoid. Cells 3 µ in diameter, 12.5 µ between apices.

Selenastrum westii G.M Smith, 1920

Colony small, composed of 2-8 slender, lunate or arcuate cells, arranged with their convex walls opposed; chloroplasat a parietal plate lying along the convex wall; pyrenoid lacking. Cells 2.5 µ in diameter, 18 µ long between apices.

Tetraedron lobulatum var. polyfurcatum G.M. Smith, 1916

Cells tetragonal, flattened, the angles extended into processes that are dichotomously divided 2 times; the lobules ending in 2 spines; margin of the cell concave between processes. Cells 10 µ in diameter without processes, 22.5 µ in diameter including processes.

Scenedesmus acutiformis Schroeder, 1897

Colony composed of 8 cells arranged in a single series; fusiform-elliptic with poles sharply pointed; inner cells with a single facial longitudinal ridge. Cells 2.5 µ in diameter, 12.5 µ long.

Scenedesmus disciformis (Chodat) Fott&Komarek, 1960

Colony composed of 4-8 ovate cells arranged in alternating series, tightly packed cells, inner space absent; wall smooth. Cells 7.5 µ in diameter, 12.5 µ long.

Scenedesmus obliquus (Turp.) Kuetzing, 1833b

Colony composed of 2-8 fusiform cells linear or alternately arranged; apices of cells apiculate; wall smooth. Cells 7.5 µ in diameter, 25 µ long.

Spirogyra stictica (Engl. Bot.) Wille, 1884

Filaments long, with plane end walls; chloroplasts 4, making ½ turn, conjugation by geniculate bending of the filaments; connecting tubes not formed; the fertile cells becoming slightly swollen. Vegetative cells 55 µ in diameter, 212.5 µ long.

Closterium moniliferum (Bory) Ehrenberg ex Ralfs, 1848

Cells robust; inner margin usually tumid in mid region, slightly concave, tapering to rounded apices; chloroplasts with 4 longitudinal ridges visible and containing an axile series of 4-6 pyrenoids; wall smooth, colourless; spherical terminal vacuoles within broad cell ends. Cells 30 µ in diameter, 150 µ long.

*Cosmarium blyttii*Wille, 1880

Semicells semicircular-trapeziform with truncate; lateral margins 3-crenate; sinus deenarrow. Cells 17.5 in µ diameter, 22.5 µ long.

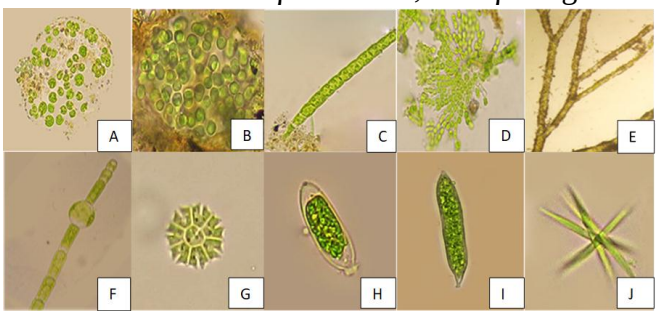

Plate 1 (A) Chlorophyta: A *Palmella mucosa*, B. *Sphaerocystis schroeteri*, C. *Ulothrix ternerrima*, D. *Proterma viride*, E. *Cladophora glomerata*, F.*Oedogonium crassiuculum*, G. *Pediastrum tetras*, H. *Characium angustum*, I. *Characium obtusum*, J. *Anskistrodesmus falcatus*.

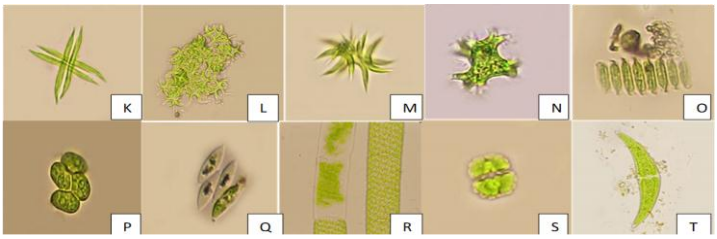

Plate 1 (B) Chlorophyta: K. *Ankistrodesmus fuciformis*, L. *Selenastrum gracile*, M. *Selenastrum westii*, N. *Tetraedron lobalatum* var. *polyfurcatum*, O. *Scenedesmus acutiformis*, P. *Scenedesmus disciformis*, Q. *Scenedesmus obliquus*, R. *Spirogya stictica*, S. *Cosmarium blyttii*, T. *Closterium moniliferum*,

Table 3 Classification of Chrysophyta

Class	Order	Family	Genus	Species
Xanthophyceae	Heterococcales	Characiopsidaceae	*Characiopsis*	*C. longipes*
Bacillariophyceae	Pennales	Naviculaceae	*Navicula*	*N. gregaria*
			Pinnularia	*P. viridiformis*
		Gomphonemataceae	*Gomphonema*	*G. constrictumvarcapitatum*
		Nitzschiaceae	*Nitzschia*	*N. sp*

Characiopsis longipes (Rab.) Borzi, 1894

Cells fusiform, straight or curved, apiculate, tapering posteriorly into a long, slender stipe, with a basal attaching disc. Cells 5 µ in diameter, 50 µ long.

Navicula gregaria Donkin, 1861

Cells solitary, naviculoid-shaped, with protracted ends; raphe distinct, axial, straight; central area very variable in size. Cells 17.5 µ in diameter, 82.5 µ long.

Pinnularia viridiformis Krammer, 1992

Cells solitary, valves linear in shape, symmetrical, slightly inflated in middle; raphe with a line; striae transverse. Cells 17.5 µ in diameter, 87.5 µ long.

Gomphonema constrictum var.*capitatum* (Ehrenberg) Grunow, 1880

Cells solitary, free-floating; valves typically clavate, rounded apical end, with attenuated base, axial area narrow, central area broad; raphe present. Cells 12.5 µ in diameter, 40 µ long

Nitzschia sp. Hassall, 1845

Cells solitary, straight, linear to elliptical, with middle constriction and with acute, attenuated apices; raphe with a uniseriate row. Cells 7.5 µ in diameter and 37.5 µ long.

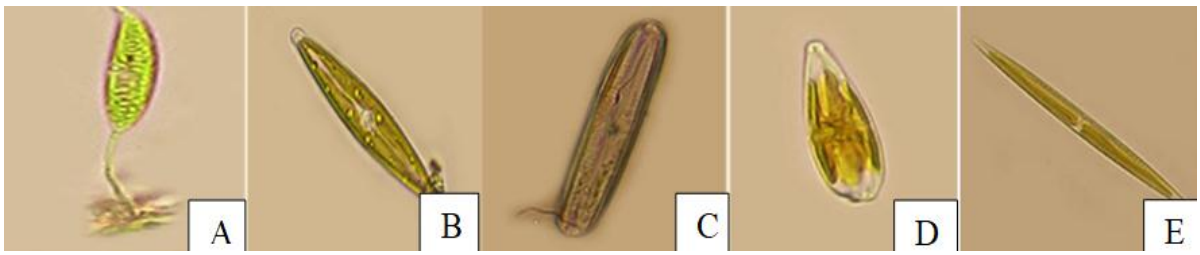

Plate 2 Chrysophyta: A. *Characiopsis longipes*, B. *Navicula gregaria*, C. *Pinnularia viridiforms*, D. *Gomphonema constrictum* var. *capitatum*, E. *Nitzschia* sp.

Table 4 Classification of Euglenophyta

Class	Order	Family	Genus	Species
Euglenophyceae	Euglenales	Euglenaceae	*Euglena*	*E.mutabilis*
			Phacus	*P. orbicularis*
			Trachelomonas	*T.armata*
				T.armata var. *longispina*

Euglena mutabilis F. Schmitz 1884

Cells narrowly cylindrical, elongate spindle-shaped, anterior end tapering and bluntly truncate, posterior end extending to form an almost cylindrical and bluntly tip; periplast with spiral striations; chloroplasts 2-8; paramylon bodies short, rectangular. Cells 10 µ in diameter, 87.5 µ long.

Phacus orbicularis Huebner, 1886

Cell orbicular in outline, posterior end broadly rounded with a short curved tail-piece; periplast longitudinally striated; paramylon bodies 1 disc-shaped plate. Cells 37.5 µ in diameter, 55 µ long.

Trachelomonas armata(Ehrenb) Stein, 1883

Test broadly ovate; flagellum aperture in a collar; wall with long backwardly directed spines in the posterior part. Test 22 µ in diameter, 30 µ long including spines.

Trachelomonas armata var. *longispina* (Playf.) Deflandre, 1926

Test broadly ovate; flagellum aperture without a collar; but with a circle of erect spines at the margin, the anterior region with short spines, the posterior portion with stout spines, both short and long. Test 36 µ in diameter, 37.5 µ long.

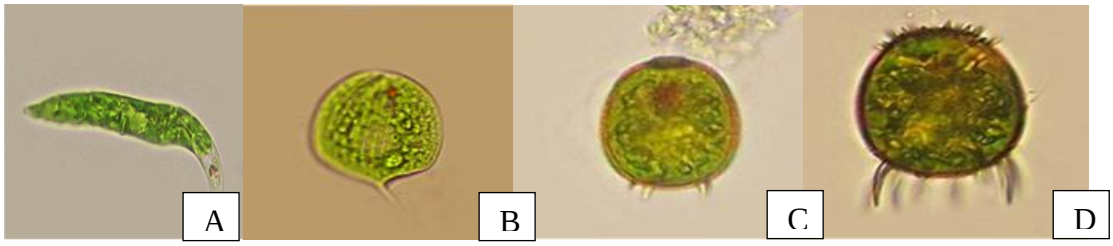

Plate 3 Euglenophyta: A. *Euglena mutabilis*, B. *Phacus orbicularis*, C. *Trachelomonas armata*, D. *Trachelomonas armata* var. *longispina*

Table 5 Classification of Cyanophyta

Class	Order	Family	Genus	Species
Myxophyceae	Chroococcales	Chroococcaceae	*Chroococcus*	*C. turgidus*
	Hormogonales	Oscillatorceae	*Oscillatoria*	*O. princeps*
				O. subbrevis
		Nostocaceae	*Anabaena*	*A.cylindrica*
		Rivulariaceae	*Calothrix*	*C. confervicola*

Chroococcus turgidus (Kuetz) Naegeli, 1849

Free-floating colony of 4 ovoid or hemispherical cells inclosed by a very wide hyaline and lamellate colonial sheath; cells bright blue green, contents coarsely granular, inclosed by individual sheaths. Cells 10 µ in diameter, 12.5 µ long; colony of cells 20 µ in diameter, 32.5 µ long.

*Oscillatoria princeps*Vaucher, 1803

Trichomes solitary or loosely entangled to form small floating plant masses, which are black-green in colour, slightly and briefly tapering at the apex; apical cell not capitate, the outer membrane broadly convex and smooth; not constricted at the

cross-walls, which are not granular; cell contents densely granular. Cells 30 µ in diameter, 5 µ long.

Oscillatoria subbrevis Schmidle, 1813

Trichomes solitary; straight and not tapering toward the apices; apical cell rounded, not capitate and without a calyptra; with frequent necridia in evidence; cross walls not granular; cell contents pale gray-green. Cell 7.5 µ in diameter, 2.5 µ long.

Anabaena cylindrical Lemmermann 1896

Trichomes straight, aggregated to form a blue-green colony. Mucilage sheath thin and colorless. Cells subspherical,4 µ in diameter, 6 µ long. Heterocyst 4.5 µ in diameter, 5.5 µ long.

Calothrix confervicola [(Roth, 1806) C.A. Agardh, 1824] Bornet et Flahault, 1886

Filaments solitary or in clusters of 3-4, sheath thin, colourless, not lamellated, tapering to a blunt apical cell. Heterocyst basal, spherical 22.5 µ in diameter. Vegetative cells 12.5 µ in diameter at the base.

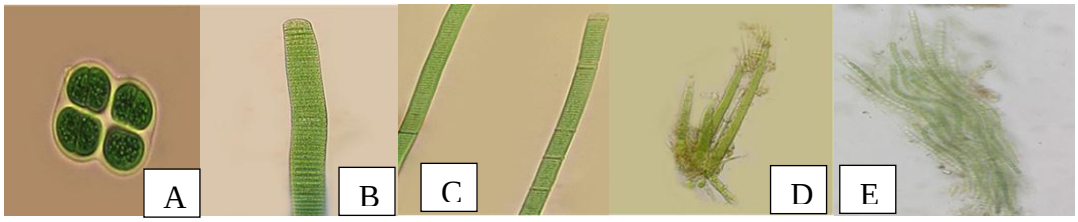

Plate 4 Cyanophyta: A. *Chroococcus turgitus*, B. *Oscillatoria princeps*, C. *Oscillatoria subbrevis*, D. *Anabaena cylindrica*, E. *Calothrix confervicola*

Table 6- Habitat of collected algae

Scientific Name	Planktonic		Benthic		
	Eu	Tycho	Ef	Ep	El
Palmella mucosa	✔				
Sphaerocysti sschroeteri			✔		
Ulothrix tenerrima				✔	
Protoderma viride					✔
Cladophora glomerata					✔
Oedogonium crassiusculum					✔
Characium angustum				✔	
Characium obtusum				✔	
Pediastrum tetras	✔			✔	
Ankistrodesmus falcatus			✔		
Ankistrodesmus fusiformis			✔		
Selenastrum gracile	✔				
Selenastrum westill	✔				
Tetraedron lobalatum var. *polyfurcatum*	✔				
Scenedesmus acutiformis			✔	✔	
Scenedesmus disciformis			✔	✔	
Scenedesmus obliquus	✔			✔	
Spirogyra stictica	✔				
Closterium moniliferum		✔			
Cosmarium blytti	✔				
Characiopsis longipes				✔	
Navicula gregaria	✔	✔			

Pinnularia viridiformis	✔	✔			
Gomphonema constrictum var.*capitatum*	✔				
Nitzchia sp.	✔	✔			
Euglena mutabilis		✔			
Phacus orbicularis	✔				
Trachelomonas armata		✔			
Trachelomonas armata var. *longispina*		✔			
Oscillatoria princeps		✔	✔	✔	
Oscillatoria subbrevis		✔	✔	✔	
Chroococcus turgidus	✔				
Anabaena cylindrica			✔		
Calothrix confervicola			✔	✔	✔

Eu = Euplanktonic, Tycho = Tychoplanktonic,Ef = Epipelic, Ep = Epiphytic, El =Epilitic

These habitats of collected algae were accordance with Prescott (1964) and John *et al* (2008). In this study, the members of Chlorophyta were highest.

Algae has long been used as indicators of water quality. Diatoms are found in every aquatic habitat and the group of algae most commonly used in water quality analysis. Some species are tolerant pollution such as *Navicula*, *Gomphonema*. (APHA 1985). *Cladophora* sp is indicators of eutrohphic (high nutrient) conditions *Pinnularia* occurs in some pond with pH 6.6-6.8 (Round 1956).*Navicula* and *Gomphonema* were commonly found in some water with pH 7.1-7.6. *Euglena* and *Phacus* have been identified as tracers of high organic wastes. Brady (1979) and Nygard (1949) stated that pennate diatoms and desmids are commonly found in non-polluted conditions. Schmidt (1987) reported that Desmids are more common on digotrophic (low nutrient) and dystrophic (high color) lakes and ponds but some species can occur in eutrophic (high nutrient) water bodies. The genus *Pediastrum* is an indicator of moderately polluted waters and *Ulothrix* is the examples of scarily polluted water.

Algae are economically important both directly and indirectly. For example, fertilizers, soil conditioner and livestock feed. (Wehr*et al* ,2015).The richest source of diatoms fossils are deposits of their skeletons known as diatomite or diatomaceous earth which give many useful products. (Pooja, 2011). The genus *Oscillatoria*, and *Anabaena* have useful compounds. Algae use as food, for the production of useful compounds, as biofilters to remove pollutants from waste water, to environmental change, in space technology and as laboratory research systems.

Conclusion

This research was a preliminary study. Therefore, it is also hoped that the present information can give little basic information for further researchers.

Acknowledgements

We would like to express our deepest thanks to Professor Dr. MyatMyat Moe, Head of Botany Department, Dagon University, for her permission and support in the department

References

Addy, K. & L. Green. (1996). Algae in Aquatic Ecosystems. Department of Natural Resources Science, University of Rhodo Island.

APHA., 1985.Standard Methods for the Examination of Waste Water Treatment,12th Ed, American Public Health Association, New York.

Brady, H.T.1979.The Diatoms flora of Australia Report .1. Freshwater diatoms of North Territory, Especially in the Magela Creek System. School of Biological Sciences Macquarie University.

Dillard, G. E., 1989-2000. Freshwater Algae of the Southeastern United States (Part 1to 7). GebruderBorntrager, Berlin.

John, David M; Whitton, Brian A and Brook, Alan J, 2008. The Freshwater Algal Flora of the British Isles. Cambridge University Press, UK.

Nygard, G.1949.Hydrobiological Studies of some Danish ponds and lakes. The quotient hypothesis and some new or little known phytoplankton organisms, K. Danske, Viedersk. Skr.,

Pooja, 2011. Understanding Lower Plants. Discovery Publishing house PVT. LTD. Darya Ganj, New Delhi.

Prescott, G.W., 1962. Algae of the Western Great Lakes Area. W.M.C. Brown Co. Inc., Dubuque, Iowa, U.S.A.

Prescott, G.W., 1964. How to know the fresh-water Algae? W.M.C. Brown Co. Inc., Dubuque, Iowa, U.S.A. 1-293.

Round F.E, 1956. The Phytoplankton of Three water reservoirs in Central Wales. Arch. F.Hydrobiol.

Schmidt, J.C.1987.Howto Identified and Control Water Weeds and Algae. fourth ed. Applied biochemist, Inc.

Sigee,D.C., 2004. Freshwater Microbiology. John Wily & Sons Ltd, The Atrium, Southern Gate, Chi Chester, West Sussex PO19 8SQ, England.

Smith, Gilbert. M., 1950.The Fresh Water Algae of the United States, Inc., McGraw-Hill Book Company, New York, London.

Wehr, J. D., R. G. Sheath and J. P. Kociolek, 2015. Freshwater Algae of North America.San Diego: Academic Press, Elsevier Inc. U.S.A.

Mohammad R.H & Rina., 2009.Uses of algae and aquatic macrophytes as feed in small scale aquaculture.FOA. VialedelleTerme di Caralla, Rome, Italy.