MONTHLY VARIATION OF GREEN ALGAE (CHLOROPHYCEAE) AND THEIR CORRELATED WITH PHYSICOCHEMICAL PARAMETERS OF SEDAWGYI DAM, MANDALAY REGION

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Abstract

Monthly variations of green algae (Chlorophyceae) and water quality of Sedawgyi Dam, Madaya Township, Mandalay Region were studied from March to December 2018. Algal specimens and water samples were collected from three stations of Sedawgyi Dam. Physicochemical parameters of water samples such as pH, temperature, alkalinity, total hardness, nitrite nitrogen, phosphate, biological oxygen demand and dissolved oxygen were also analyzed. In the present study, a total of 14 genera and 37 species of green algae (Chlorophyceae) were recorded. The green algae specimens of Sedawgyi Dam consisted of *Chlorococcum* (1 species), *Tetradon* (1 species), *Selenastrum* (1 species), *Kirchneriella* (1 species), *Coelatrum* (2 species), *Scenedesmus* (5 species), *Pediastram* (10 species), *Closterium* (4 species), *Cosmarium* (3 species), *Spondylosium* (2 species), *Arthrodesmus* (1 species), *Staurastrum* (4 species), *Stauradesmus* (1 species) and *Eurastrum* (1 species). The algal specimens were found to be more abundant in April and May and less abundant in July to September. The physio-chemical data analysed in Sedawgyi Dam indicates that the lake is at present free from pollution.

Keywords: Green algae, monthly variations, Physico-chemical parameters, Sedawgyi Dam

Introduction

Rivers, lakes, dams, canals and etc. are important resources of water for various purposes. Standing or running water is important sources of community water supply and irrigation and therefore their quality has to be monitored regularly. The quality of water can be monitored by the types of organisms present in water (Kumar *et al*. 2009).

The physical and chemical characteristics of water bodies affect the species composition, abundance, productivity and physiological conditions of aquatic organisms. These stressed systems support an extraordinarily high proportion of the world's biodiversity.The phytoplankton in a reservoir is an important indicator of the water quality. Phytoplanktons are recognized worldwide as bioindicators in the aquatic environment (Yakubu *et al*. 2000). Phytoplankton is one of the most essential characteristics of the aquatic ecosystem for maintaining its stability and a means of coping with any environmental change (Jayaraman *et al*. 2003 and Tiwari *et al*. 2004). Water maintains an ecological balance between various groups of living organisms and their environment (Kumar *et al*. 2009).

Most freshwater algae are highly sensitive to pollutants. Any physical or chemical changes in aquatic systems, naturally or by entry of pollutants, will bring about changes individual organisms, populations and communities. The most important sources of organic matters in water are the disposal of municipal sewage, industrial waste water, urban and run-off. The source of toxic pollutants to take is usually material derived human activities (Goel 2006).

According to Goel (1997), the abundance, species composition and condition of aquatic organisms remain largely dependent upon the quality of water. Any changes in water quality by pollution will affect the aquatic communities. The number and kind of microorganisms in water depended largely upon the available supply of nutrients, organic matter, presence of other organisms and the environmental conditions.

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The abundance of species composition and condition of aquatic organisms remain largely upon the available supply of nutrients, organisms matter, presence of other organisms and the environmental conditions. Some species of algae are more sensitive to change in water quality (Goel 2006).

Chlorophyceae the free living phytoplankton, is mostly limited to shallow waters and attached to the submerged plants or found in moist soil. Chlorophyta are rarely the predominating organisms in the phytoplankton of ponds and lakes, the number of species in the fresh water plankton is very large (Smith 1950). Green algae are ecologically important as major producers of biomass in freshwater systems, either as planktonic (standing water) or attached (running waters) organisms (Bellinger & Sigee 2010).

Water in dams is important source of community water supply and irrigation. Sedawgyi dam serve as source of water for irrigation, drinking and recreational purposes. Sedawgyi dam is situated in Madaya Township, Pyin Oo Lwin District, Mandalay Region. It was constructed in 1976 and built in 1987. It is situated between North Latitude 22˚19" and 22˚24", between East Longitude 96˚19" and 96˚25" at 131.37 meters above sea level.

The water in Sedawgyi dam flows into the ditches and canals along the villages, agricultural fields and fishery ponds. So the quality of water based on environmental factors such as occurrence of algae, chemical properties of water, anthropogenic activities and other sources.

The aim and objectives of this research was to reveal the green algae growing in Sedawgyi dam, to study the monthly variations of green algae occurrence and to analyze the physico-chemical parameters of water and their effects on algal population.

Materials and Methods

Sedawgyi Dam is located in Madaya Township, Pyin Oo Lwin District, Mandalay Region.Three sampling sites were chosen to examine the algal composition, the monthly variation of phytoplanktons and water analysis of Sedawgyi Dam. Sampling site I is northern part of Sedawgyi Dam, sampling site II is middle part of Sedawgyi Dam and sampling site III is southern part of Sedawgyi Dam.

Algal specimens and water samples were collected monthly intervals between March, 2018 and December, 2018. Physico-chemical parameters of water samples such as temperature, pH, total hardness, phosphate, nitrite nitrogen, biological oxygen demand and dissolved oxygen were analyzed at freshwater aquaculture research, water and soil examination laboratory, Yangon.

The number of algae belonging to different genera were determined and counted under the microscope using a haemacytometer and are calculated with the following formula used by Lavens and Sorgeloos (1996) and then calculated with relative abundance (%) by Boyd (1982).

Number of cell m-1 = $(n_1 + n_2) / (2 + 80) + 80 + 10^3 + d$

= $(n_1 + n_2) / 2 + 10^3 + d$

n_1 = number of cells counted in upper rafter

n_2 = number of cells counted in lower rafter

d = dilution factor

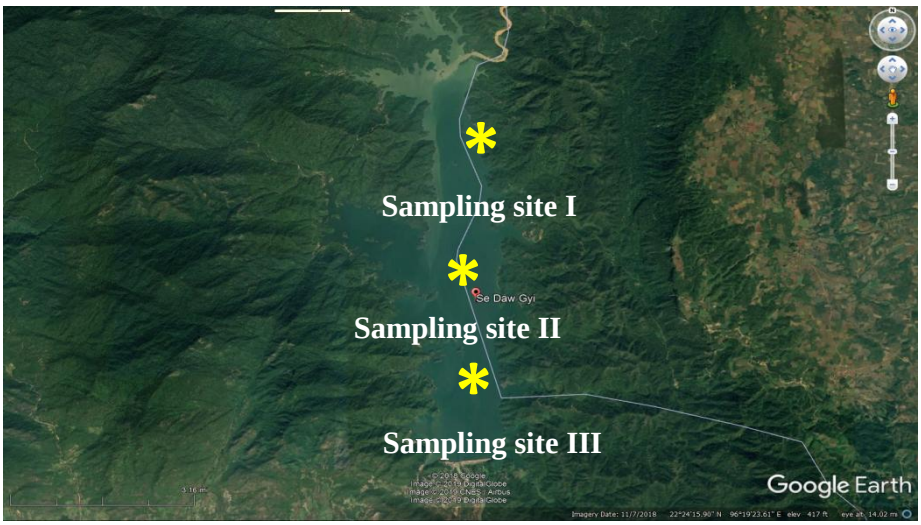

Figure 1 Location Map of Study Area

Results

Totally 37 algal species belong to 14 genera were collected and recorded from the study areas. The green algae specimens of Sedawgyi Dam consisted of *Chlorococcum* (1 species), *Tetradon* (1 species), *Selenastrum* (1 species), *Kirchneriella* (1 species), *Coelatrum* (2 species), *Scenedesmus* (5 species), *Pediastram* (10 species), *Closterium* (4 species), *Cosmarium* (3 species), *Spondylosium* (2 species), *Arthrodesmus* (1 species), *Staurastrum* (4 species), *Stauradesmus* (1 species) and *Eurastrum* (1 species). The list of the algal species was stated in Table 1. Water analysis parameter found in study area from March to December, 2018 was shown in Table (2 - 7) and Figure (6- 10).

Table 1 List of Green Algae Recorded in Sedawgyi Dam

1	*Chlorococcum humicola*	20	*Pediastrum simplex* var. *radians*
2	*Tetradron trigonum*	21	*Pediastrum simplex* var. *sturmii*
3	*Selenastrum bibraianum*	22	*Closterium intermedium*
4	*Kirchneriella lunaris*	23	*Closterium moniliferum*
5	*Coelastrum indicum*	24	*Closterium praelongum*
6	*C. microporum*	25	*Closterium pseudolunula*
7	*Scenedesmus acutus*	26	*Cosmarium contractum* var. *minutum*
8	*Scenedesmus baculiformis*	27	*Cosmarium quadrum*
9	*Scenedesmus acuminatus*	28	*Cosmarium lundelli* var. *ellipticum*
10	*Scenedesmus quandricauda*	29	*Spondylosium pulchrum* var. *constrictum*
11	*Scenedesmus quadricauda* var. *westii*	30	*Spondylosium pulchellum*
12	*Pediastrumbiradiatum* var. *langecornutum*	31	*Arthodesmus convergens*
13	*Pediastrum boryanum*	32	*Staurastrum arachne* var. *curvatum*
14	*Pediastrum boryanum* var. *langecurne*	33	*Staurastrum bibrachiatum*
15	*Pediastrum duplex* var. *clathratum*	34	*Staurastrum natator*
16	*Pediastrum duplex* var. *genuinum*	35	*Staurastrum proboscideum*
17	*Pediastrum duplex* var. *reticulatum*	36	*Stauradesmus cuspidatus*
18	*Pediastrum simplex*	37	*Eurastrum spinulosum*
19	*Pediastrum simplex* var. *duodenarium*		

1. Monthly Variation of Genera in Three Sampling Sites

Relative abundant (%) of 14 genera of Chlorophyceae: *Coelastrum, Scenedesmus, Pediastrum, Closterium, Cosmarium, Arthodesmus* and *Staurastrum* found in study area were given in graphs for monthly variations in Figure (2 - 5). In sampling site I, the maximum population of *Coelastrum* observed in April and the minimum population was occurred in September. In sampling site II, the maximum growth recorded in March and the maximum growth observed in May. The population of *Coelastrum* was not occurred in July. The maximum population recorded in May and the minimum population occurred in June at sampling site III. The three sites as one unit, the maximum population recorded in April and the minimum population was in December.

The maximum growth of *Scenedesmus* recorded in April and the minimum growth was in July at sampling site I. The maximum population occurred in May at sampling site II and III and the minimum population was observed in August at sampling site II and December at sampling site III. The three sites as one unit, the maximum population occurred in May and the minimum was in August.

The *Pediastrum* population existed nearly same population throughout the study period at sampling site I. In sampling site II, the maximum population was occurred in May and the minimum population was in July. In sampling site III, the maximum population was in April to June and the other months observed nearly same population. The three sites as one unit, the maximum population was in May and the minimum was in July.

In sampling site I, the maximum population of desmids was recorded in May and November. The minimum population was observed in December. In sampling site II, the maximum growth of desmids was observed in May and the minimum growth was in August. In sampling site III, the minimum population was in July and the other months observed nearly same population. The three sites as one unit, the maximum population was in May and the minimum population was in July.

2. Physico-chemical Parameters of Water Samples of Three Sampling Sites

All the results of monthly variation in Physico-chemical parameters were showed in Table (2 - 7) and Figure (6 - 10). In this research, the temperature ranges during study period was observed from 27.5°C to 30.5°C.

The high temperature of water (30°C - 3.5°C) was observed in May at three sampling sites. The low temperature of water (27°C-27.5°C) was recorded in December at three sampling sites.

The lowest value of pH of water was (6.5 mg/L) in May at sampling site I and II. The highest value (7.5mg/L) was occurred in April and November at sampling site III.

The lowest value of total alkalinity was (30 mg/L) in September at sampling site III. The highest value of (120 mg/L) in April at sampling site I. The value of total alkalinity in summer was higher than those in other seasons.

The highest value of hardness was (140mg/L) in July at sampling site I. The smallest value of hardness was (35 mg/L) in September and (38 mg/L) in August at sampling site I.

The maximum value (0.55 mg/L) of phosphate was in May (summer) at sampling site I and the minimum value (0.001 mg/L) was in June at sampling site I. The phosphate content ranged from (0.001 mg/L – 0.55 mg/L).

The value of nitrite-nitrogen was (0 mg/L) in June at the three sampling sites. The highest and lowest value of nitrite-nitrogen concentration were 0.411 mg/L and 0.006 mg/L. The maximum value (0.411 mg/L) was observed in August (rainy season) at sampling site I and the minimum value (0.006 mg/L) was recorded in March (summer) at sampling site II.

The maximum value (3.5 mg/L) of biological oxygen demand was in May (summer) at sampling site II and the minimum value (0.2 mg/L) was in December (winter) at sampling site III.

In this research, dissolved oxygen contents in the water samples were found in the range of 1.5 mg/L-6.0mg/L. The maximum value (6.0 mg/L) of dissolved oxygen in September at sampling site I and the lowest value (1.5 mg/L) was in June at sampling site II and III.

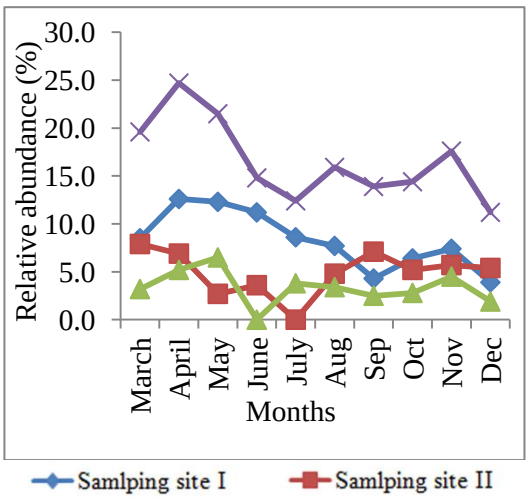

Figure 2 Monthly variation of *Coelastrum* found in individual sampling site

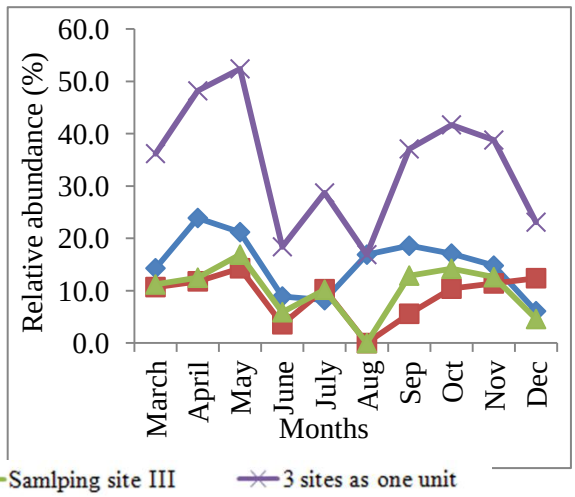

Figure 3 Monthly variation of *Scenedesmus* found in individual sampling site

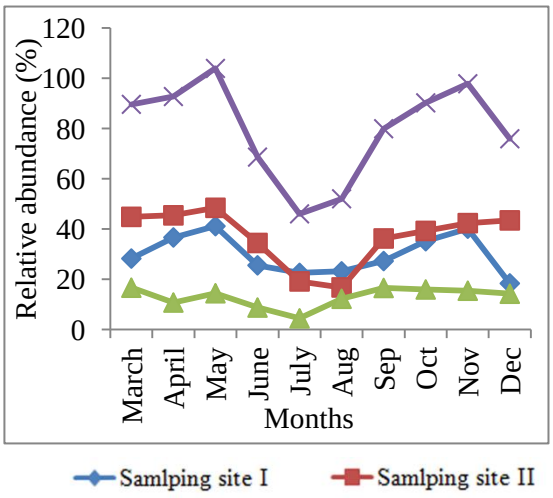

Figure 4 Monthly variation of *Pediastrum* found in individual sampling site

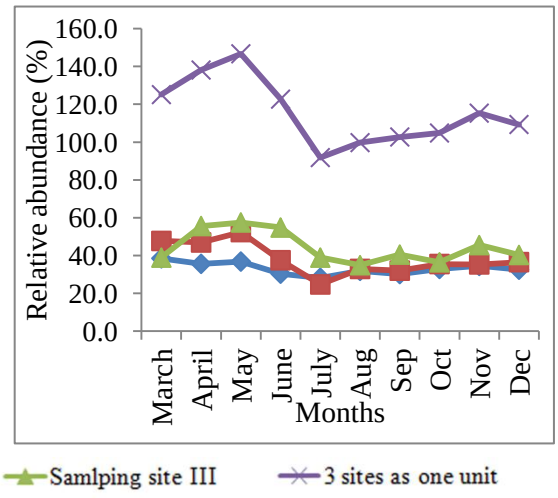

Figure 5 Monthly variation of desmids found in individual sampling site

Table 2 Monthly variation of temperature in water samples of three sampling sites (March- December, 2018)

Site No.	Temperature									
	March	April	May	June	July	August	September	October	November	December
I	29	29	30	28.9	28	29.7	29.5	29.5	28.9	27
II	29.5	29	30.5	28.7	28.2	29.7	29.5	29.5	28.9	27.5
III	29.5	29	30.2	28.5	28	29.8	28.9	29.7	28.6	27.5

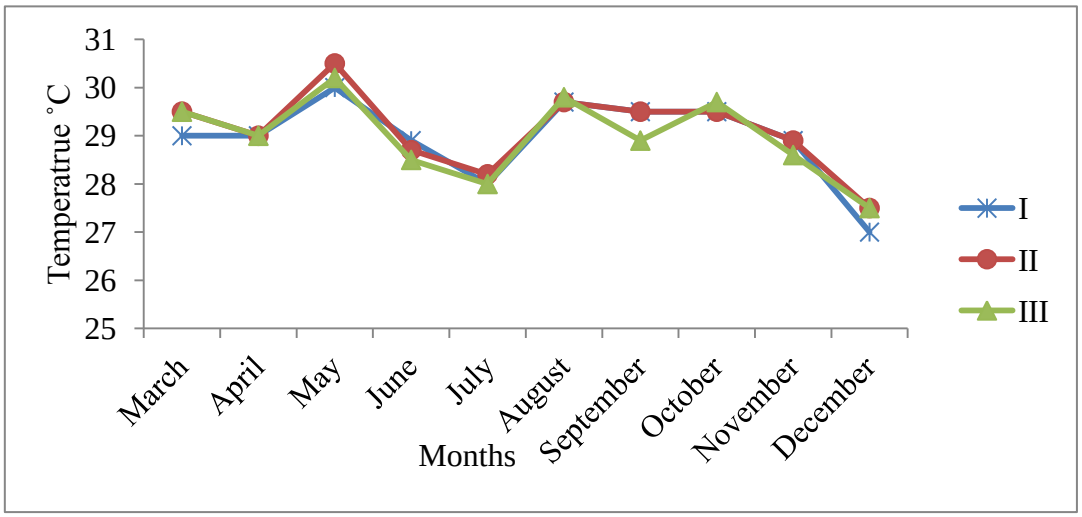

Figure 6 Monthly variation of temperature in water samples of three sampling sites (March- December, 2018)

Table 3 Monthly variation of pH in water samples of three sampling sites (March- December, 2018)

Site No.	pH									
	March	April	May	June	July	August	September	October	November	December
I	6.8	6.9	6.5	6.9	6.9	6.7	6.6	6.9	7.2	7.1
II	7.2	7.4	6.5	6.9	7.3	7.4	7.2	7.3	7.3	7.1
III	7.2	7.5	6.7	7.2	7.2	7.2	7.1	7.2	7.5	7.2

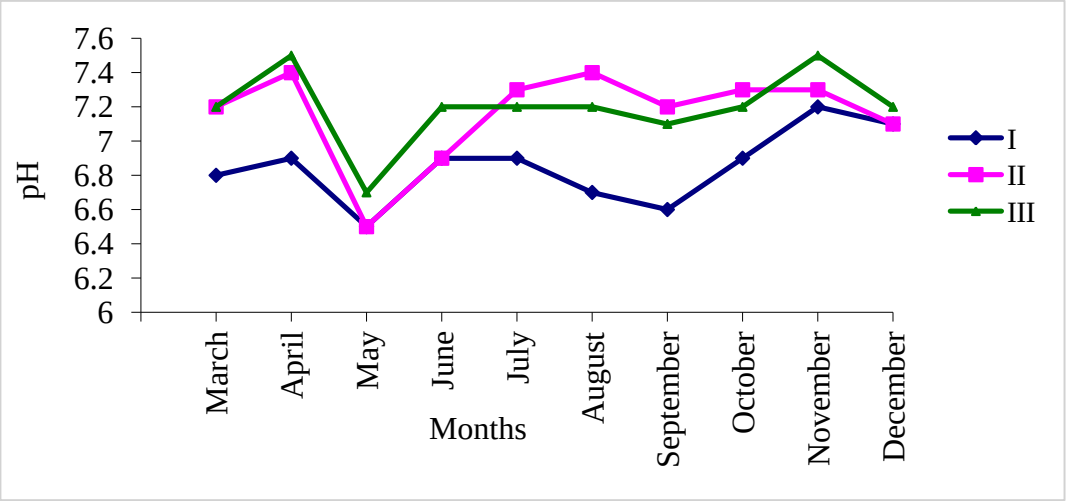

Figure 7 Monthly variation of pH in water samples of three sampling sites (March- December, 2018)

Table 4 Monthly variation of Alkalinity in water samples of three sampling sites (March- December, 2018)

	Alkalinity									
Site No.	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
I	100	120	80	50	50	80	75	85	100	90
II	80	100	90	50	70	60	55	78	90	80
III	60	80	100	60	80	40	30	55	70	60

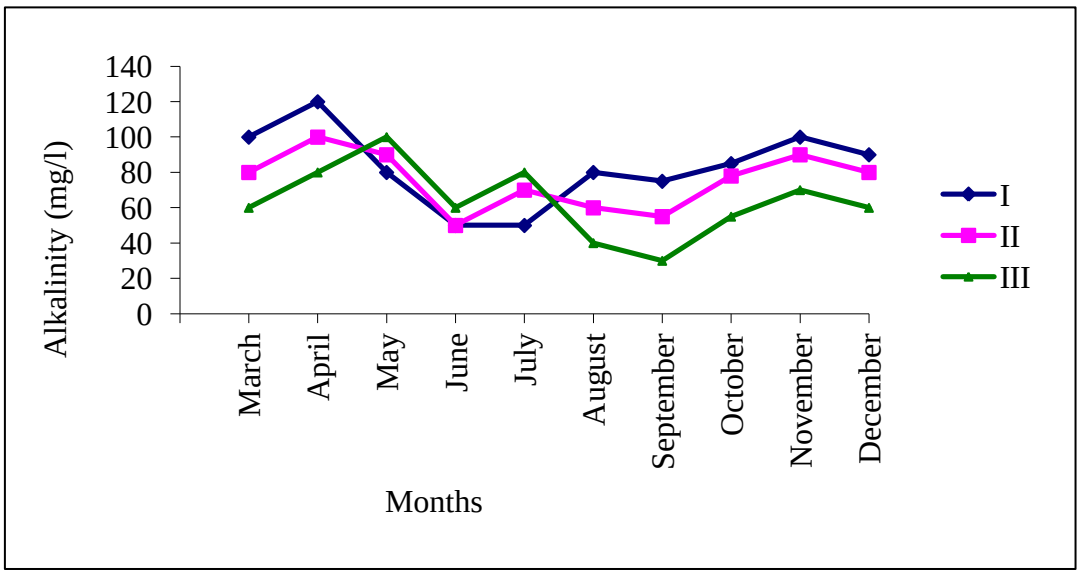

Figure 8 Monthly variation of Alkalinity in water samples of three sampling sites (March- December, 2018)

Table 5 Monthly variation of Hardness in water samples of three sampling sites (March- December 2018)

	Hardness									
Site No.	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
I	80	85	70	80	140	38	35	50	60	61
II	65	74	60	90	120	62	60	80	70	74
III	60	80	40	100	110	64	62	82	80	75

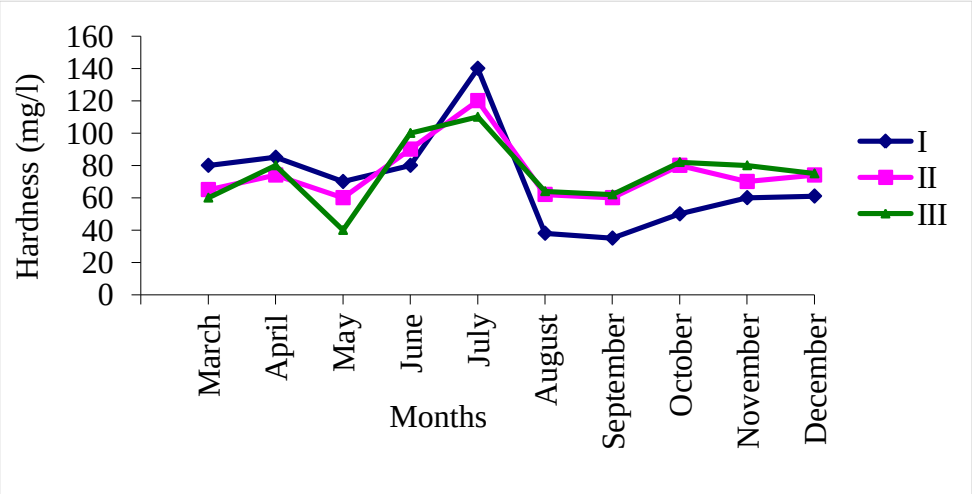

Figure 9 Monthly variation of Hardness in water samples of three sampling sites (March- December, 2018)

Table 6 Monthly variation of DO, BOD, Phosphate and Nitrite nitrogen in water samples of three sampling sites (March- July, 2018)

	March			April			May			June			July		
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
DO (mg/L)	2.5	3.5	4	1.5	2.5	3	3.5	4	4	2	1.5	1.5	3	3.5	4
BOD (mg/L)	1	1.5	1.5	2	2.5	2.5	2	3.5	3	0.5	0.5	0.5	0.5	0.5	0.5
Phosphate	0.06	0.05	0.06	0.07	0.05	0.07	0.55	0.5	0.5	0	0.02	0.04	0	0.01	0.02
Nitrite nitrogen	0.072	0.01	0.03	0.12	0.1	0.11	0.11	0.06	0.14	0	0	0	0.17	0.1	0.09

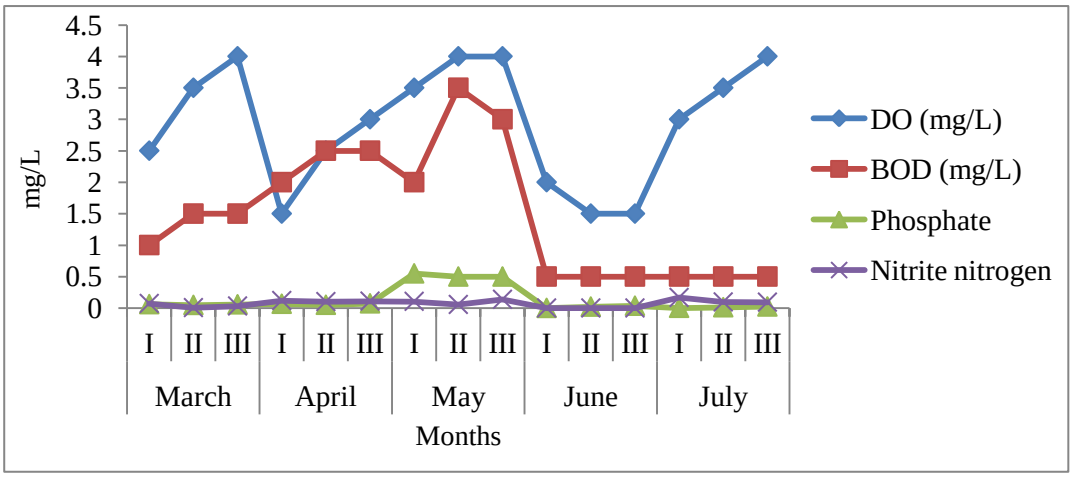

Figure 10 Monthly variation of DO, BOD, Phosphate and Nitrite nitrogen in water samples of three sampling sites (March-July, 2018)

Table 7 Monthly variation of DO, BOD, Phosphate and Nitrite nitrogen in water samples of three sampling sites (August- December, 2018)

	August			**September**			**October**			**November**			**December**		
	I	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**	**I**	**II**	**III**
DO (mg/L)	5	4	4.5	6	5	5.5	5	4	4.5	5	5.5	5.5	4.5	5	4.5
BOD (mg/L)	1	0.5	0.5	0.5	1	1	1	1.5	1	0.5	0.5	0.5	0.3	0.3	0.2
Phosphate	0.2	0.24	0.29	0.33	0.39	0.31	0.4	0.32	0.39	0.02	0.01	0.02	0.01	0.01	0.02
Nitrite nitrogen	0.4	0.231	0.204	0.276	0.1	0.102	0.1	0.09	0.1	0.05	0.009	0.086	0.04	0.005	0.082

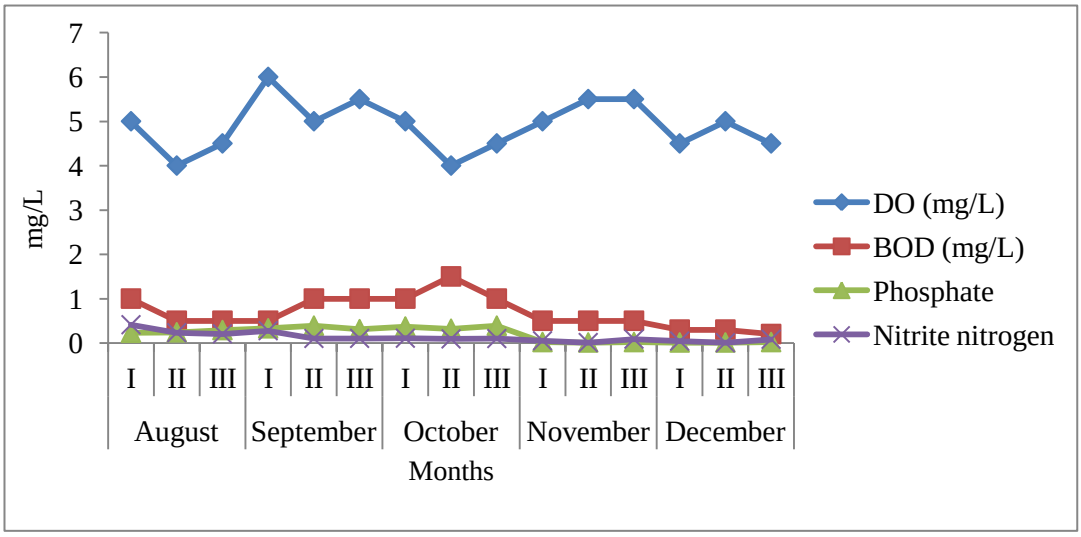

Figure 11 Monthly variation of DO, BOD, Phosphate and Nitrite nitrogen in water samples of three sampling sites (August- December, 2018**)**

Discussion and Conclusion

In this research, the physico-chemical parameters of water and the monthly variations of green algae found in Sedawgyi Dam, Madaya Township, Pyin Oo Lwin District, Mandalay Region were studied from March, 2018 to December, 2018. A total of 14 genera and 37 species of algae were recorded from three sampling sites. In Sedawgyi Dam, 32 species in sampling site I, 35 species in sampling site II and 37 species in sampling site III were collected from study period. Chlorophyceae was dominated by species of *Pediastrum, Cosmarium, Closterium, Scenedesmus* and *Staurastrum* and it was found in three sampling sites during the study period (Figure 2- 5). The species of *Chlorococcum humicola, Tetradon trigonum, Selenastrum bibraianum, Kirchneriella lunaris, Spondylosium pulchrum, Arthrodesmus archne, Stauradesmus cuspidatus* and *Eurastrum spinulosum* were less abundant in study period. It was found that there are fluctuations both in the total algal population and in the relative abundance of different genera from month to month, and from site to site, though they were not far from each other.

Monthly variations in members of Chlorophyceae showed maxima in April and May (summer) and minima in July, August and September (rainy season) at all the sampling sites. In the present investication, it was observed that high temperature and pH are favourable for rapid development of Chlorophyceae. This observations agreed with Misra *et al*. (2001) stated that High Chlorophycean count registered during summer months may be due to low DO and bicarbonate level prevailing during these periods, which favors its quick growth. The minimum population of Chlorophyceae recorded in July to September (rainy season) at all sampling sites. This findings agreed with Krishnan *et al*. (1999) stated that groups the minimum density of chlorophyceae in monsoon may be attributed to the dilution effect due to the rains as well as drifting of algae along with the water.

In the present study, the dominance of Chlorophyceae in April and May (summer season) and November and December (winter season) were recorded in three sampling sites. The range of temperature was 30˚C-30.5˚C in May (summer). Shukla *et al.* (2013) stated that the dominance of Chlorophyceae in the summer season which indicates that the temperature of these months played an important role in increasing the population of Chlorophyceae and bright sunlight have been reported favourable factors for Chlorophyceae. Minimum population in rainy season due to the minimum transparency, cloudy weather and heavy flood decline the phytoplankton density. This findings agreed with Shukla *et al.* (2013). Aktar *et al.* (2007) stated that abundance of Chlorophyceae indicate absence of pollution. Therefore, it may be suggestd that the water in Sedawgyi Dam indicate absence of water pollution.

The species composition of Chlorophyceae with total 37 species and 14 genera of Sedawgyi Dam. These genera were *Chlorococcum, Tetradon, Selenastrum, Kirchneriella, Coelastrum, Scenedesmus, Pediastrum, Closterium, Cosmarium, Spondylosium, Arthodesmus, Staurastrum, Staurasdesmus* and *Eurastrum.* Of these *Closterium, Staurastrum* and *Cosmerium* are considered as desmids which indicate good quality of water and absence of desmids is an indication of heavy pollution of water Hosmani *et al.* (2002). According to Hutchinson (1967) desmids (e.g. *Cosmarium)* are associated with oligotrophic freshwater and in these, they may form an important food source for herbivore fish. The food chain relations of endemic and endangered species of fishes may include specific phytoplankton species. Moreover, the dominance of Desmids over Chlorococcales (e.g. *Pediastrum*) a group indicative of eutrophication. According to Munawar (1974), the species of *Coelastrum, Oocystis, Scendesmus,*

Zygnema, *Chlamydomonas*, *Chlorella*, *Spirogyra*, *Tribonema* and *Closterium* are found in polluted waters. Of these only *Coelastrum, Scendesmus* and *Closterium* were found in study area of Sedawgyi Dam in low density.

During the study period desmid population was declined during rainy season and the lowest values. This is an agreement with Sukumaran and Das (2001). In Sedawgyi Dam, the maximum population of desmids was recorded in May and December. The higher concentration of phosphate 0.50-0.55 mg/L was in May. This findings agreed with Venkateswarlu (1986) stated that the higher concentration of phosphate favour the abundance of desmids. The pH value above 7 was in April, November and December. This findings generally agreed with Gonzalves and Joshi (1946) who stated that pH was above 7 which contained fairly good number of desmids indicating that the alkaline water supports the desmid population.

The pH of water is important to the chemical reactions that take place within water, and pH values that are too high or low can inhibit the growth of microorganisms. Most natural water has a pH range of 6-8 (Goel 2006). In this research, water in Sedawgyi Dam has a pH range of 6.5-7.5. This finding agreed with Umavathi *et al.* (2007) who stated that pH in ranged of 5-8.5 is the best for plankton growth but harmful when more than 8.8.

The pH value ranged between 6.5 mg/L to 7.5 mg/L. Maximum value 7.5 mg/L was observed in April to November and minimum value 6.5 mg/L occurred in May. The pH values of water in Sedawgyi Dam water were within the acceptable limit of WHO (2000) standard which was 6.5-9.5 mg/L.

The range of alkalinity of water in Sedawgyi Dam was between 30 mg/L and 120 mg/L. The highest total alkalinity in April in sampling sites II and III and the lowest value in June in all sampling sites. This findings were greater than WHO standard which was < 25 mg/L.

Hardness of the water is due to presence of calcium and magnesium. Shilpa *et al.* (2011) stated that the hardness concentrations up to 60 mg/L are called soft water and those containing 120-180 mg/L as hard water. In this study, the range of hardness of water in Sedawgyi Dam was between 35 mg/L and 120 mg/L. According to Shilpa *et al.* (2011), the water in Sedawgyi dam may be soft water.

The concentration of phosphate ranged from between 0.001mg/L and 0.55mg/L. The highest phosphate value was obtained in May. The lowest value was found in June, July, November and December. This value was not acceptable limit for WHO (2000).

Biological oxygen demand is used as a measurement of pollutants in natural water. Biological oxygen demand is an indicator of organic load of water. BOD values ranged between 0.2 mg/L and 3.5 mg/L. The highest BOD value was occurred in April and May. The value BOD in the water of Sedawgyi Dam was lesser than WHO level (<6.0 mg/L).

In Sedawgyi Dam, 37 species and 14 genera of Chlorophyceae were recorded. The maximum growth of Chlorophyceae were recorded in April and May (Summer) and the minimum growth was in July to September (rainy season). These genera of *Scenedesmus, Pediastrum, Closterium, Cosmarium and Staurastrum* were dominant in study period. Of these *Closterium, Staurastrum* and *Cosmerium* are considered as desmids which indicate good quality of water and absence of desmids is an indication of heavy pollution of water. The physio-chemical data analysed in Sedawgyi Dam indicates that the lake is at present free from pollution.

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