Occurrence of Zooplankton in Relation to Water Quality in Kandawgyi Lake, Mandalay Region

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Abstract

The freshwater zooplankton was studied from January to August 2019. Specimens were collected once a month with the use of plankton net. A total of 19 genera and 31 species of zooplankton from both study areas comprising of 28 species from Site I (Southern part) and 29 species from Site II (Northern part) were recorded. The highest number of individuals was higher in Site I than that in Site II in Kandawgyi Lake. Among the recorded specimens, *Brachionus calyciflorus, B.angularis* and *B.caudatus* were dominated species, cladoceran, *Moina micrura* was dominant species and copepods, *Microcyclops* sp. was dominating species and the rest of the species were rare and not observed throughout the studied period. Zooplankton abundance was directly correlated with water temperature, dissolved oxygen was not correlated and industrialisation and human activities are main causes of water pollution which indirectly causes problem to aquatic ecosystem of lake.

Key words: Zooplankton, Water quality Assessment, Kandawgyi Lake

Introduction

Zooplankton is tiny animals found in all aquatic ecosystems, particularly the pelagic and littoral zones in the ocean, also in ponds, lakes, and rivers. They are classified by size and / or by developmental stage (Lynn, 2007).

The zooplankton community is composed of both primary consumers (which eat phytoplankton) and secondary consumers (which feed on the other zooplankton). They provide a direct link between primary producers and higher tropic levels such as fish. Nearly all fish depend on zooplankton for food during their larval phases, and some fish continue to eat zooplankton in their entire lives (Madin *et. al*., 2001).

Zooplankton are economically and ecologically important group of aquatic organisms. Their ecological processes influence fishery, oceanography and climate. They play an important role in food web by linking the primary producers and higher trophic level (Deivanai *et al.,* 2004).

Zooplankton are one of the most important ecological parameters in water quality assessment. The freshwater zooplankton comprises of rotifera, cladocera and copepoda. They have their own peak periods of density and are also affected by local environmental conditions prevailing at the time (Contreras *et al.,* 2009).

Kandawgyi Lake was formerly known as the Tet Thay In. It is situated in west Than Lyet Maw, Chan Mya Thazi Township. It covers 322.43 hectares. It is 3657.6 m long from north to south and 975.36m from east to west. In the olden times, the Tet Thay In was a natural pond of used water and sewage of the native people, where the Shwe Ta Chaung and the Thingaza Chaung merged.

The physico–chemical and biological characteristics of water play an important role in plankton productivity and final yield of aquaculture products. Thus, the objectives of this study were:

- to record and identify the zooplankton species

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- to examine the occurrence and composition of zooplankton in relation to physicochemical characteristics of water in Mandalay Kandawgyi Lake

Materials and Methods

Study Area

Kandawgyi Lake is about 322.43 hectares. It is 3657.6 m long from north to south and 975.36m from east to west. It is located in the south–western part of Mandalay between latitude 21°55′34.78″ N and 21°56' 42.16'' N and longitude 96°3' 20.47''E and 96°4' 22.67'' E (Fig. 1).

Site I (Southern part)

Site I is located near the outlet of water of the Southern part of Mandalay Kandawgyi Lake. It is situated between Latitudes 22° 33.5′ N and Longitude 95° 35.5′ E and the elevation above sea level is 90 m. Total area is about 0.95 km^2 .

Site II (Northern part)

Site II is located near the outlet of water of the Northern part of Mandalay Kandawgyi Lake. It is located between Latitude 22° 30.25′ N and Longitude 95° 44′ E. The elevation is about 91 m above sea level. This area is about 0.53 km^2.

Fig. 1 Map of study area and study sites

Study Period

The present study was conducted from January 2019 to August 2019.

Collection of Samples

Water samples were collected monthly from two sampling sites. The samples were collected by plankton nylon net with a mouth diameter of 12 cm and 50µm mesh size. Samples were hauled horizontally through the surface water.

Preservation and Identification of Species

Final volume of the filtered sample 150ml were preserved by adding 10% formalin for further analysis. Samples were identified under a compound microscope with a magnification of 4×, 10×, 40×. Identification was made according to Edmonson (1966), Pennak (1989) and Witty (2004). Microphotographs were recorded with cannon digital camera attached to compound microscope.

Water Samples Analysis

A liter of surface water sample was collected monthly from each site and packed in black plastic bag to avoid the unnecessary reaction as much as possible. Water temperature was measured with the help of an ordinary laboratory thermometer. pH of water were measured with pH test strip (6–8) at each sampling site. Dissolved oxygen (DO) was measured using a dissolved oxygen meter (Horiba Co.Ltd., Japan).

Species composition

Data were analyzed by presenting in percentage (%) after Thrusfield (1995)

$$\text{Species composition} = \frac{\text{Total no. of individuals in each species}}{\text{Total no. of individuals in observed species}} \times 100$$

Results

A total of 19 genera and 31 species of zooplankton from both study areas comprising of 28 species from Site I (Southern part) and 29 species from Site II (Northern part) were recorded. Among them 21 species of rotifers, five species of cladocerans and two genera of copepods was observed in Site I and 21 species of rotifers, six species of cladocerans and two genera of copepods was observed in Site II (Table 1–2).

Composition and occurrence of zooplankton

In Site I, the composition of zooplankton was found to be the highest in rotifers (85%), followed by Cladocera (8%) and Cyclopoida (7%) and In Site II, the composition of zooplankton was found to be the highest in rotifers (70%), followed by Cladocera (18%) and Cyclopoida (12%) (Fig. 2 & 3).

A total number of 1309 individuals, 34 species were recorded from both study sites. Among them, the total number of individuals 774 and 16 species in Site I and 535 individuals, 16 species were found in Site II.

In Study site I, the highest total number of individuals was found to be 153 individuals, 149 individuals and 16 species in May, July, August and the lowest total number of 35 individuals in January and 9 species were observed in June. The most abundant species of *Brachionus angularis, B. calyciflorus* and *B. caudatus, Moina mircrura* and *Microcyclops sp.* were recorded. The highest number of individuals *Brachionus caudatus* (76) individuals was recorded in May and *Moina mircrura* (22) individuals was observed in July and the lowest number of *Notholca accuminata was* one individual in two times during the study period. *Brachionus ruben, Nicsmirnoxius eximius, Diaphanosoma brachyurum, D. leutenbergianum* were rare species and a total of one individuals in each time was observed during the study period (Table 1).

In Study site II, the highest total number of individuals was found to be 135 individuals in March and 15 species from February to April and the lowest total number of 41 individuals in February, May and 11 species were observed in July and August. The highest number of individuals of *Brachionus angularis, Moina mircrura* and *Microcyclops sp.* were recorded. The highest number of individuals *Brachionus caudatus* (28) individuals was recorded in August and the lowest number of *Notholca accuminata was* one individuals in two times during the study period. and *Moina mircrura* (20) individuals was observed in March. *Brachionus ruben, Keratella tropica, Nicsmirnoxius eximius, Platyias quadricornis* were rare species and a total of one individuals in each time was observed during the study period (Table 2).

In comparison with site I and site II *Lecane luna, Platyias quadricornis* and *Diaphanosoma exisum* were not observed in Site I and *Brachionus forficula* and *Hexathra mira* were not observed in Site II and the lower number of individuals in two times and *Platyias quadricornis* the lowest number of one individuals in each time was observed during the study period.

Relation of zooplankton with temperature and dissolved oxygen

In Site I, the highest number of species was observed in May, July and August. In this month, water temperature ranged of (28–30^{o}C) was observed (Fig. 4). In Site II, the highest number of species was observed in January (Fig. 5). During this month, water temperature of (20^{o}C) when the highest dissolved oxygen (6.33 mg/L) was observed. The highest number of individuals was found in May. In this month, water temperature of (30^{o}C) when the dissolved oxygen (5.41 mg/L) was observed in Site I (Fig. 6). The highest individuals were observed in March. In this month, water temperature of (26^{o}C) and dissolved oxygen (4.33 mg/L) was observed in Site II (Fig. 7). The number of species and individuals with water temperature was directly correlated and dissolved oxygen was found to be not correlated.

Table 1 Monthly occurrence of Zooplankton in Site I during January to August 2019

Sr. No.	Scientific name	Jan	Feb	Mar	April	May	June	July	August	Total
1	*Asplanchna priodonta*	2	2	4	2	10	0	1	3	24
2	*Brachionus angularis*	1	36	26	0	2	35	2	8	110
3	*B. calyciflorus*	4	18	10	1	1	13	25	3	75
4	*B. caudatus*	0	27	17	11	76	5	59	26	221
5	*B. diversicornis*	0	2	1	0	8	0	1	4	16
6	*B. falcatus*	0	0	0	1	20	6	6	1	34
7	*B. quadridentata*	0	0	4	13	1	0	0	1	19
8	*B. ruben*	0	0	0	0	0	0	0	1	1
9	*B.bidentata*	0	0	0	0	2	0	1	0	3
10	*B. forficula*	0	0	0	8	4	0	0	0	12
11	*B. plicatilis*	0	0	0	5	0	0	0	0	5
12	*Keratella tropica*	0	0	0	4	0	0	0	0	4
13	*Notholca acuminata*	0	0	1	0	0	1	0	0	2
14	*Anuraeopsis fissa*	1	0	0	0	0	3	0	0	4
15	*Monostyla bulla*	0	1	5	1	1	4	5	2	19
16	*Trichocerca pusilla*	3	0	0	0	1	0	5	2	11
17	*Nicsmirnoxius eximius*	1	0	0	0	0	0	0	0	1
18	*Hexathra mira*	0	0	0	0	1	0	3	0	4
19	*Polyarthra vulgaris*	17	10	6	4	0	7	5	1	50
20	*Filinia longiseta*	2	2	4	0	0	0	0	5	13
21	*Horaella brehmi*	0	0	0	3	13	7	4	0	27
22	*Diaphanosoma brachyurum*	0	0	0	0	0	0	0	1	1
23	*D. leutenbergianum*	0	1	0	0	0	0	0	0	1
24	*Moina micrura*	0	7	7	0	6	0	22	2	44
25	*M. brachiata*	0	4	2	0	0	0	3	0	9
26	*Alona retangula*	0	3	2	0	0	0	0	0	5
27	*Microcyclops sp.*	2	10	10	7	4	0	5	1	39
28	*Mesocyclops leckurti*	2	5	5	2	3	0	2	1	20
	Total no. of individuals	35	128	104	62	153	81	149	62	774
	Total no. of species	10	14	15	13	16	9	16	16	

Table 2 Monthly occurrence of Zooplankton in Site II during January to August 2019

Sr. No.	Scientific name	Jan	Feb	Mar	April	May	June	July	August	Total
1	*Asplanchna priodonta*	3	8	6	1	3	4	1	13	39

2	*Brachionus angularis*	14	10	26	2	1	7	4	28	92
3	*B. calyciflorus*	8	0	14	1	0	2	6	7	38
4	*B. caudatus*	1	1	12	0	4	6	4	19	47
5	*B. diversicornis*	5	1	2	0	4	1	8	0	21
6	*B. falcatus*	0	0	0	0	4	1	1	2	8
7	*B. quadridentata*	1	0	0	1	1	0	0	0	3
8	*B. ruben*	0	0	0	0	2	0	0	3	5
9	*B.bidentata*	1	0	0	0	0	0	0	0	1
10	*B. plicatilis*	0	2	6	1	4	1	15	0	29
11	*Keratella tropica*	0	0	0	1	0	0	0	0	1
12	*Notholca acuminata*	1	1	0	0	0	0	0	0	2
13	*Anuraeopsis fissa*	1	0	0	0	0	0	0	4	5
14	*Lecane luna*	0	0	0	3	0	0	0	1	4
15	*Monostyla bulla*	0	1	1	3	0	0	0	0	5
16	*Trichocerca pusilla*	3	2	0	0	0	6	7	11	29
17	*Nicsmirnoxius eximius*	0	1	0	0	0	0	0	0	1
18	*Polyarthra vulgaris*	11	4	1	1	0	4	0	3	24
19	*Filinia longiseta*	0	0	0	0	0	0	0	3	3
20	*Horaella brehmi*	0	0	0	0	7	5	4	0	16
21	*Platyias quadricornis*	0	0	0	1	0	0	0	0	1
22	*Diaphanosoma brachyurum*	0	1	6	0	0	2	0	0	9
23	*D. leutenbergianum*	0	0	1	0	4	0	0	0	5
24	*D.exisum*	5	0	0	0	0	0	0	0	5
25	*Moina micrura*	7	1	20	1	1	2	8	0	40
26	*M. brachiata*	2	1	19	1	1	1	3	0	28
27	*Alona retangula*	0	5	1	2	0	0	0	0	8
28	*Microcyclops sp.*	6	0	15	20	3	0	0	0	44
29	*Mesocyclops leckurti*	3	2	5	10	2	0	0	0	22
	Total no.of individuals	72	41	135	49	41	42	61	94	535
	Total no.of species	16	15	15	15	14	13	11	11	

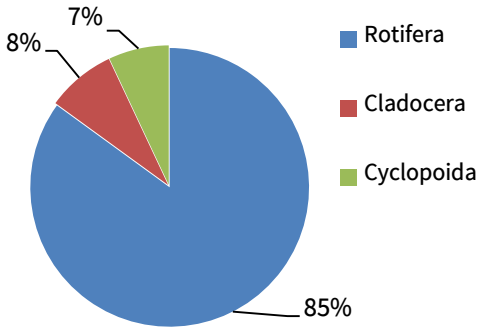

Fig.2 Percentage composition of Zooplankton individuals in different Order in Site I

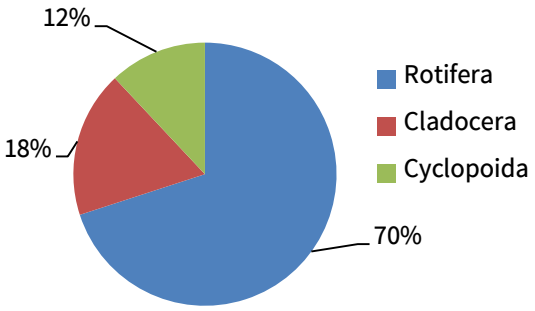

Fig. 3 Percentage composition of Zooplankton individuals in different Order in Site II

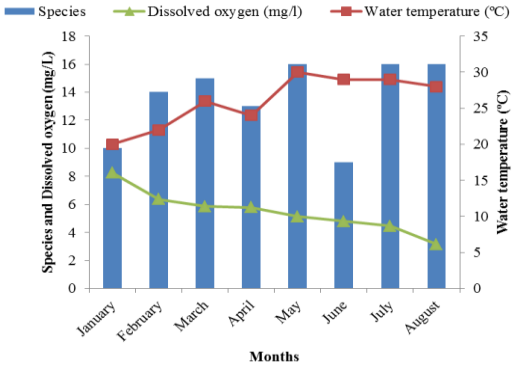

Fig.4 Relationship between total number of Zooplankton species, water temperature and dissolved oxygen in Site I

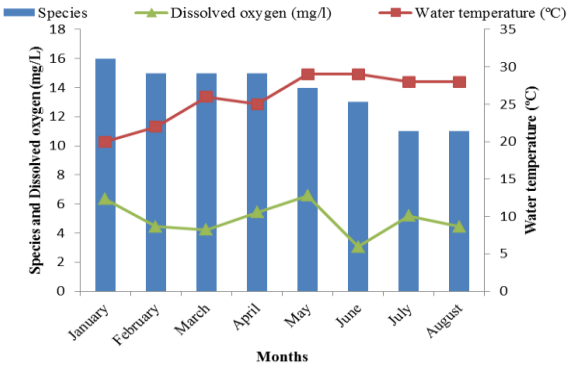

Fig.5 Relationship between total number of Zooplankton species, water temperature and dissolved oxygen in Site II

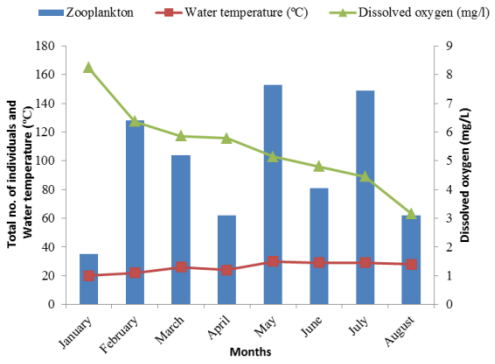

Fig.6 Relationship between total number of Zooplankton individuals, water temperature and dissolved oxygen in Site I

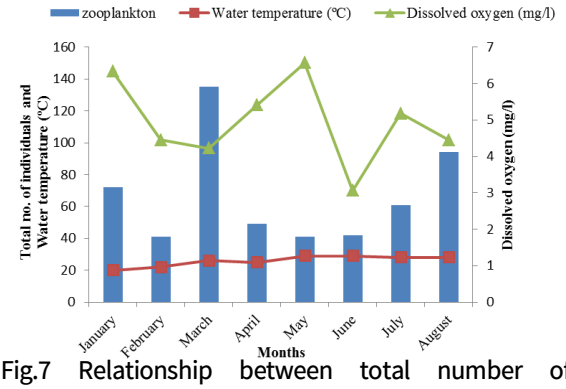

Fig.7 Relationship between total number of Zooplankton individuals, water temperature and dissolved oxygen in Site II

Discussion

A total of 19 genera and 34 species of zooplankton from both study areas comprising of 28 species from Site I (Southern part) and 29 species from Site II (Northern part) were recorded. Among them 21 species of rotifers, five species of cladocerans and two genera of copepods was observed in Site I and 21 species of rotifers, six species of cladocerans and two genera of copepods was observed in Site II.

In compared with the record of rotifer 16 species (Kay Thi Oo, 2005) and (Thandar Oo, 2005) were the same with the present study. Cho Mar Lwin and Thandar Saw, 2005 studied that cladocerans from southern and northern part of Kandawgyi Lake. Six species of Cladocera were observed the same as the rest of cladocerans species different from the present study. This may be due to the increase in the anthropogenic activities and urbanized catchment area and agricultural runoff are major cause for eutrophication in these lakes.

In study site I, the highest total number of individuals was found to be 153 individuals, 149 individuals and 16 species in May, July, August and the lowest total number of 35 individuals in January and 9 species were observed in June.

In study site II, the highest total number of individuals was found to be 135 individuals in March and 15 species in February to April and the lowest total number of 41 individuals in February, May and 11 species were observed in July and August.

The number of individuals was observed more in Site I than that in site II. In site I, water temperature ranged (20–30^{o}C), Do concentration (4.45– 8.24 mg/L) and site II, water temperature (20^{o}C), Do concentration (4.45–6.57 mg/L). The value of pH ranged (5–8) was recorded in both sites. It may be concluded that the environmental factors influenced on such fluctuation.

In the present study, water temperature showed ranged between 20^{o}C– 30^{o}C. Depending on the water temperature maximum abundance of zooplankton was found at the same time. Temperature is one of the essential and changeable environmental factors, since it influences the growth and distribution of flora and fauna. Water temperature ranging between 13.5 and 32^{o}C is reported to be suitable for the development of the planktonic organisms (Gaikwad *et al.*, 2008).

Dissolved oxygen concentration (DO) values were recorded ranged from 4.45 mg/L to 8.24 mg/L in Site I and 4.45 mg/L to 6.57 mg/L in Site II during the present study. The higher value of (DO) was observed during January to May than that the value declined from June to August in the present study. The DO is one of the most important parameters that reflect the physical and biological processes prevailed in water. The DO level in natural water depends upon the atmospheric air pressure, photosynthetic activity, temperature, salinity and turbulence. The solubility of oxygen increases with the decrease in temperature. The minimum DO recorded in summer was due to its utilization for decomposition of organic matter and respiration of organisms including zooplankton (Dhanasekaran *et.al.*, 2017)

The highest number of individuals was higher in Site I (southern part) than that in Site II (northern part) of Kandawgyi Lake. In Site II, the polluted water consists of decomposition of human wastes and industrial wastes of Thingazar chaung flowed into the northern part of Kandawgyi Lake. Therefore the nutrients conditions of the deposition were important source for the zooplankton population. Some species of culture fishes were introduced. Those planktivorous fishes are important in regulating the abundance and structure of zooplankton populations. However, planktivorous fishes select larger zooplankters and eliminate large cladocerans from the lake.

The abundance of zooplankton is directly correlated with water temperature, dissolved oxygen was not correlated and industrialisation and human activities are main causes of water pollution which indirectly causes problem to aquatic ecosystem of lake.

Acknowledgements

We would like to express my profound thankfulness to Prorectors Dr Si Si Khin and Dr Tin Moe Thuzar, Yadanabon University for their interest and encouragement on our research work. We are indebted thanks to Professor Dr Khin May Nyo, Head of Department and Professor Dr Thet Thet, Department of Zoology for their providing departmental facilities and invaluable advices on my topic.

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