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SEASONAL VARIATIONS OF ZOOPLANKTON SPECIES AT THE KANTHARYAR LAKE OF HLAWGA WILDLIFE PARK, MINGALARDON TOWNSHIP, YANGON REGION

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Abstract

Seasonal variations of zooplankton species at the Kantharyar Lake of Hlawga Wildlife Park, Mingalardon Township, Yangon Regionwas conducted during June, 2017 to January,2019. A total of 52 zooplankton species of two phyla, four classes, seven orders, 23 families and 36 genera were collected from the study site. The rotifers and copepods were dominant species in the lake. The abundance of zooplankton was highest in the wet season and the lowest in the cold season. Among the species, *Brachionus falcatus* was the most abundant and *Calanoides carinatus* was least abundance in study sites. During the study period the maximum number of zooplanktons were recorded in July and the minimum number of zooplankton in January.

Keywords: zooplankton, seasonal distribution, weather parameter, correlation

Introduction

Freshwater is the most essential requirement for life and yet comprises only < 1% of the Earth's surface water. Water is the key substance for the survival of all organisms in this globe (Bera *et al.*, 2014). Zooplankton is drifting microorganisms movement by the water current that are importance in the fresh water and marine water ecosystems of biosphere. Plankton is a part of aquatic life, which is composed of tiny organisms, living and drifting in the direction of water current. It is the main source of food for most fauna of lotic and lentic water ecosystem. Freshwater zooplankton is an important biological component in aquatic ecosystem, whose main function is to act as a primary and secondary links in the food chain (Sebastian *et al.*, 2014). Zooplankton play a vital group of organisms that transfer energy from the nutrient cycle, the algae, to the higher trophic levels such as fish. Zooplankton constitute important food item of many omnivorous and carnivorous fish fry and prawn fry because it supply the necessary amount of proteins required for rapid growth and development of different organs of fish (Mozumder and Naser, 2009).

They eats step by step to become the higher energy flow from aquatic ecosystem. Three kinds of namely rotifers (Phylum Rotifera), copepods and cladocerans, (Phylum Arthropoda)are the members of zooplanktons. Three major zooplankton groups dominate freshwater ecosystems (rotifer, copepoda and cladocerans). Rotifers have widely been used as biological indicators in studies due to their sensitivity to different levels of water quality parameters (Radix *et al.,* 2002). Copepods are used as biological indicators for certain ecosystem (AItaff and Chandran, 1995; Aman and AItaff, 2004). Copepods unlike other zooplanktons have a much wider adaptation to unfavorable climate (Reid and Williamson, 2010) and are also reported to be the most abundant members of the zooplankton population.They are food sources of aquatic organisms in the water ecosystem (Gannon and Stemberger, 1978; Gajbhiye and Desai 1981).

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The zooplankton which play a role of converting phytoplankton into food, suitable for fish and aquatic animals have acquired importance in fishery research. The plankton can also play an important role in indicating the presence or absence of certain species of fishes on in determining the population densities (Jayabhaya, 2009).

Zooplanktons are affected by environmental conditions and can rapidly respond to environmental change. They are good indicator of water quality because they are strongly affected by environmental conditions and due to their short life cycle, these communities often respond quickly to environmental change and water quality. Zooplanktons play an important role in indicating the eutrophication status and productivity of a freshwater body. Planktons not only increases fish production but also helps in bioremediation of heavy metals and other toxic material. Plankton can also as biomarker for water quality assessment for fish production (Pradhan *et al*., 2008). Distribution of zooplankton community depends on complex factor (change of climatic condition, physical and chemical parameter and vegetation cover) (Mikschi,1989). Diversity and abundance of zooplanktons are also indicators of the water ecosystem. Hlawga wildlife park is one of the important high diversity area in Myanmar. No or little investigation of the zooplankton diversity of freshwater ecosystem of Hlawga wildlife is conducted yet. Thus, the present study was conducted to know the zooplankton population in different sites of Hlawga wildlife park including seasonal aspects by the following aims and objectives;

- to record the occurrence of zooplankton species in the studied area
- to analyze the correlation of the distribution of zooplankton and weather parameters
- to assess the seasonal variation of zooplankton species

Materials and Methods

Study area and Study period

The lake of Hlawga Wildlife Park, Mingaladon Township, Yangon Regionwas chosen as study area. Hlawga Wildlife park was constituted in 1982 and is located between Longitude 96° 05' E to 96° 08' E and Latitude 17° 17' N to 17° 42' N, Approximately 35kmand are span over (1540 acres) north of Yangon. It is situated in the north of Mingaladon – Insein area, to the west of the Yangon- Pyay road and adjacent to the township of Taukkyan. Six study sites were chosen to assess the population structures. The study period lasted from June 2017 to Jan, 2019(Fig.1 and Plate 1).

Data collection

Water samples were monthly collected from six study sites of in the lake of Hlawga Wildlife Park. The collection was done between 8-10 am in the morning. Water sample from site III was taken first at 9:30 am. Then site IV, site I, site V, site II, site VI with the interval of 30 minutes. Plankton net with the mesh size of 100 μm was used to collect with the zooplankton. The mouth diameter of the net was 26 cm with 40 cm handle. The plankton samples were collected by filtering 60 liters of water through the plankton net. After collection, the plankton samples were filtered into the plastic bottles. A standard volume of 480ml were mixed and preserved in 4% formalin. The preserved plankton specimens were examined in under stereomicroscope. The water sample brought to the laboratory of Zoology Department, University of Yangon for further identification (Plate2).

Identification

Identification of the zooplankton species was made according to Davis (1955), Edmondson (1959)and Shiel (1995).

- ❖ “Lac Keys” dropping method (1935) , the following formula;

$$\text{Zooplankton / Liter} = \frac{N \times C}{Y} \times 10$$

N = Number of zooplankton counted in 0.1 ml. concentrate

C = Total volume of concentrate in ml

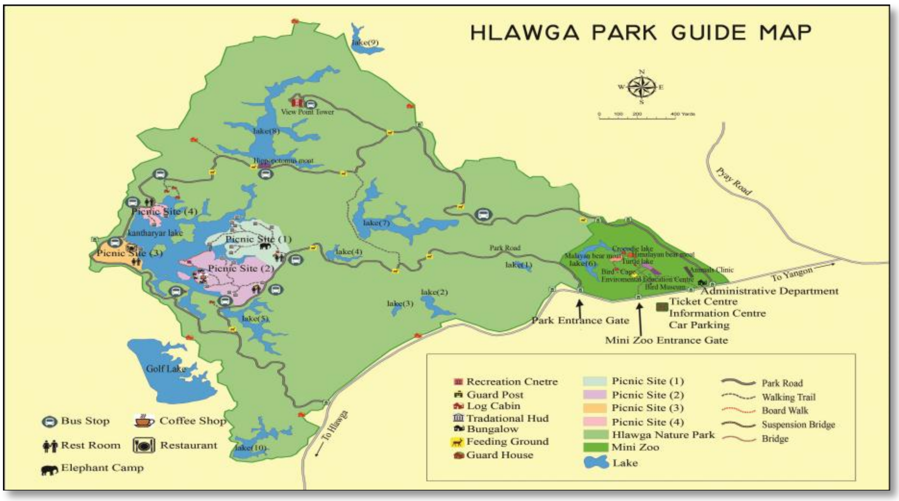
Y = Total volume of water filtered for sample in liters

Weather parameters

Monthly weather data of rainfall and humidity during the study period (2017-2018) were obtained from the Department of Meteorlogy and Hydrology, Mayangone Township in Yangon Region.

Data analysis

Pearson correlation coefficient was computed to analyze the relationship between abundance of the species and weather parameters and statistical analyses was made by Analysis of Variance (ANOVA) to determine significances of the species compositions. All analyses of data were conducted using Statistical Package for Social Science (SPSS) version 16 while graphics were performed by Excel program.



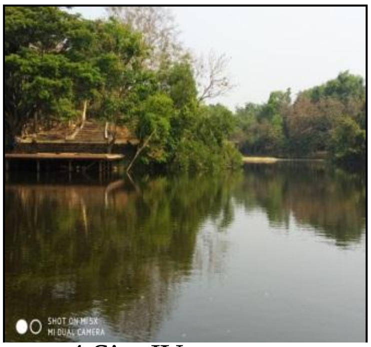
(**Source:** Trustee Office, Hlawga Wildlife park, 2017)

Figure 1 Map of Hlawga wildlife park showing study area

1.Site - I
Between east and north)

2. Site -II
(Between east and south)

3. Site-III
(Between south and west)



4.Site IV
(Between west and north)

5. Site V
(Between south and north)

6. Site VI
(Between south and north)

Plate1. Selected sampling sites of the study area

1.Boat used for water sample

2. Drifting water through plankton net

3. Plankton net

4. Equipment and apparatuses

5. Stereomicroscope

Plate2. Equipment and apparatuses used for collection and identification of the specimens

Results

A total numbers of 52 species of zooplanktons, under 23 families, seven orders, belonging four classes and two phylum of zooplanktonwere collected from the six different sites in the lake of Hlawga Wildlife park. Among them Phylum Rotifera comprised of Class-Monogononta and Digononta. Class-Monogononta was belonging to 30 species, 21 genera, 16 families of three orders. Class Digononta was belonging to three species, three genera, two families of only one order. And also Phylum Arthropoda comprised of class Branchiopoda (Cladocerans) and Maxillopoda (Copepods).Class Branchiopoda was belonging to eight species, five genera, three families of one order anf class Maxillopoda with 11 species, seven genera, two families of two orders (Table 1 and Plate 3,4 and 5).

In the study period, Class Monogononta covered58 % of the total harvest indicating the highest recorded and followed by Class Maxillopoda with21 % Class Branchiopoda with 15% and the lowest Class Digononta with 6% were recorded respectively (Fig.2).

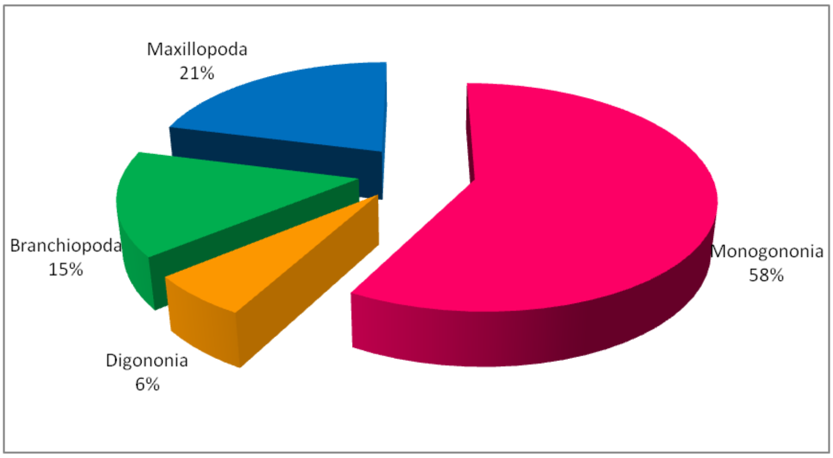


Figure2 Percentage of species occurrence among the class of recorded zooplanktons group in the study area

Table 1 Occurrence of zooplanktons in the study area

No	Phylum	Class	Order	Family	Species name
I	Rotifera	Monogononta	Collothecacea	Collothecidae	1.*Collotheca mutabilis* (Hudson, 1885)
			Flosculariaceae	Conochilidae	2. *Conochilus coenobasis* (Sudzuki, 1964)
				Filiniidae	3. *Filinia longiseta* (Ehrenber,1834)
					4. *Filinia terminalis* (Aacharias,1898)
				Flosculariidae	5. *Ptygura longicornis* (Davis, 1867)
					6. *Sinantheria socialis* (Linne,1758)
				Hexartharidae	7. *Hexarthra propinqua* (Bartos, 1947)
				Testudinellidae	8. *Pompolyx sulcata* (Pejler,1957c)
			Ploima	Asplanchnidae	9.*Asplanchna priodonta* (Gosse,1850)
				Brachionidae	10.*Anuraeopsis fissa* (Gosse, 1851)
					11.*Brachionus angularis* (Gosse, 1851)

No	Phylum	Class	Order	Family	Species name
					12.*Brachionus calyciflorus* (Pallas, 1766)
					13.*Brachinous caudatus* (Barrois & Daday,1894)
					14.*Brachionus falcatus* (Zacharias, 1898)
					15.*Brachionus plicatilis* (Muller, 1786)
					16.*Keratella cochlearis* (Carlin, 1943)
					17. *Keratella valga* (Ehrenberg, 1834)
					18. *Plationus patulus* (Ahlstrom, 1940)
				Colurellidae	19. *Colurella obtusa* (Gosse, 1886)
				Epiphanidae	20.*Mikrocodides chlaena* (Gosse, 1886)
					21.*Proalides tentaculatus* (Barrios & Daday,1894)
				Gastropodidae	22. Ascomorpha ovalis (Carlin, 1943)
				Lecanidae	23. *Lecane mira* (Myers, 1926)
				Mytilinidae	24. *Mytilina mucronata* (O.F.Muller,1773)
				Synchaetidae	25. *Polyarthra vulgaris* (Carlin, 1943)
			Ploima	Trichocercidae	26. *Trichocerca elongate* (Gosse,1886:E)
					27. *Trichocerca cylindrical* (Imhaf,1891)
					28. *Trichocerca similis* (Wierzejski,1893)
					29. *Trichocerca dixon nuttalli* (Carlin,1939)
				Trichotriidae	30. *Wolga spinifera* (Western, 1894)
		Digononta	Bdelloida	Adinetidae	31. *Embata hamate* (Pallas, 1736)
					32. *Adineta vaga* (Bartos, 1951)
				Philodinidae	33. *Rotaria neptunia* (Ehrenberg, 1832)
	Arthropoda	Branchiopoda	Cladocera	Daphnidae	34. *Daphnia pulex* (Richard,1896)
					35. *Ceriodaphnia cornuta* (G.O. Sars, 1885)
				Moinidae	36. *Moina brachiate* (Jurine,1820)
					37. *Moina macrocopa* (*Straus,1820*)
				Bosminidae	38. *Bosmina longirostris cornuta* (G.O. Sars, 1862)
					39. *Bosmina longirostris pellucida* (Stingelin, 1895)
					40. *Bosmina longirostris brevicornis* (Hellich, 1877)

No	Phylum	Class	Order	Family	Species name
					41. *Bosminopsis deitersi* (Richard, 1895)
	Arthropoda	Maxillopoda	Cyclopoida	Cyclopidae	42. *Cyclops bicolor* (Sars,1863)
					43. *Cyclops strennus* (Fischer,1851)
					44. *Cyclopoid nauplius* (Forbes,1882)
					45. *Eucyclops prionophorus* (Kiefer,1931)
					46. *Mesocyclops edax* (S.A.Forbes,1891)
					47. *Mesocyclops tenuis* (Marsh,1909)
					48. *Mesocyclops leuckarti* (Claus,1857)
			Calanoida	Diaptomidae	49. *Diaptomus sp*. (Westwood, 1836)
					50. *Neodiaptomus yangtsekiangensis* (Mashiko, 1951)
					51. *Calanoides acutus* (Giesbrecht,1902)
					52.*Calanoides carinatus* (kroyer,1849)
Total	2	4	7	23	52

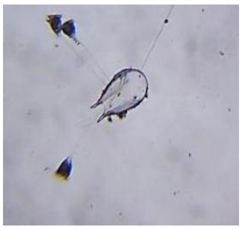
1. *Collotheca mutabilis*

2.*Conochilus coenobasis*

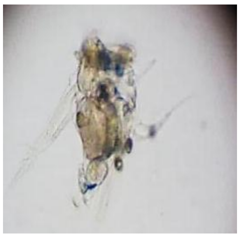
3.*Filinia Longiseta*

4.*Filinia terminalis*

5.*Ptygura longicornis*



6.*Sinantherina socialis*



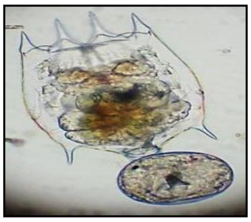
7.*Hexarthra propinqua*

8.*Pompolyx sulcata*

9. *Asplanchna priodonta*

10.*Anuraeopsis fissa*

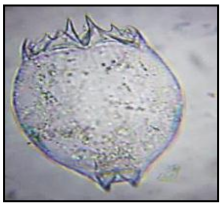
11.*Brachionus angularis*

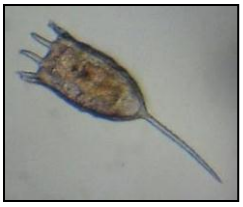


12. *Brachionus calyciflorus*


13.*Brachionus caudatus*


14. *Brachionus falcatus*


15. *Brachionus plicatilis*


16.*Keratella cochlearis*


17. *Keratella valga*


18.*Plationus patulus*


19. *Colurella obtuse*


20.*Mikrocodides chlaena*


21.*Proalides tentaculatus*


22.*Ascomorpha ovalis*


23. *Lecane mira*


24.*Mytilina mucronata*


25. *Polyarthra vulgaris*


26. *Trichocerca dixon nuttalli*


27.*Trichocerca elongate*


28.*Trichocerca cylindrica*


29.*Trichocerca similis*


30.*Wolga spinifera*


31.*Embata hamate*


32. *Adineta vaga*


33.*Rotaria neptunia*

Plate 3. Recorded rotifer species from the study area (x 40µm)

1.*Daphnia pulex* 2.*Ceriodaphnia cornuta* 3. *Moina brachiata* 4.*Moina macrocopa*

5. *Bosmina longirostris cornuta* 6.*Bosmina longirostris pellucida* 7. *Bosmina longirostris brevicornis* 8.*Bosminopsis deitersi*

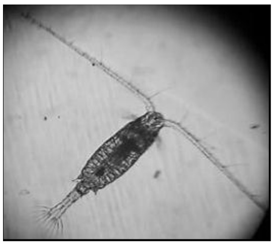
Plate 4. Recorded cladoceran species from the study area (x 40µm)

1.*Cyclops bicolor* 2.*Cyclops strennus* 3. *Cyclopoid nauplius* 4.*Eucyclops prionophorus*

5.*Mesocyclops edax* 6. *Mesocyclops leuckarti* 7. *Mesocyclops tenuis* 8. *Diaptomus sp*

9.*Neodiaptomus yangtskiangensis* 10.*Calanoides acutus* 11.*Calanoides carinatus*

Plate 5. Recorded copepod species from the study area (x 40µm)

Population status of zooplankton

Maximmun population of rotifer was recorded in July 2017(n=1775) followed by June (n=1621) and minimum population in January 2018 (n=451) in the study period. Highest number of population of copepod was recorded in June 2017 (n=412) and lowest number of species in December 2017 (n=256) respectively. As well as, highest number of population of the cladoceran in January 2018 (n=329)and lowest number in May 2018(n=154) recorded respectively (Fig. 3).

Abundance of zooplankton species as related to weather parameters

No significant correlation was recorded between the abundance of all species and temperature. Positive correlation was recorded between the abundance of rotifer and humidity (r=0.591, p>0.05) and highly significant positive correlation with rainfall (r=0.9331, p>0.01). Positive correlation no significant was recorded between the abundance of Copepods with humidity (r=0.130, p >0.05) and rainfall (r=0.312, p>0.05). However, no significant negative correlation was recorded between the abundance of cladoceran with humidity (r=-0.073, p<0.05) and rainfall (r=-0.224, p<0.05) (Table 2and Fig. 4,5 and 6).

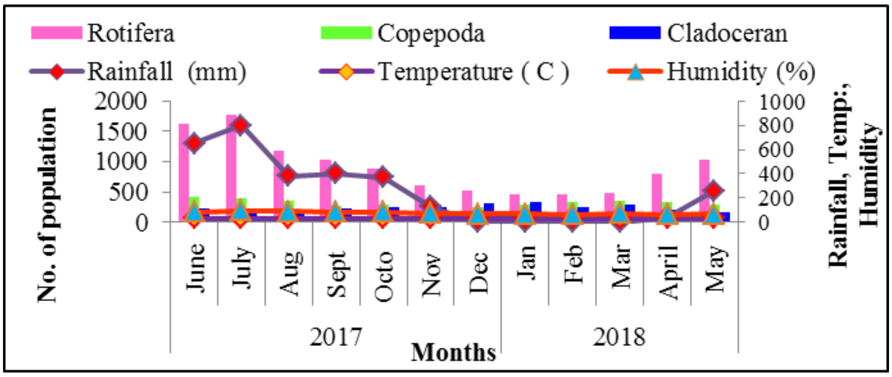


Figure 3 The relation of zooplankton population and weather parameters in all study sites

Table 2 Correlation of zooplankton variation and weather parameter in the study

Species	Temperature(°C)		Humidity (%)		Rainfall (mm)	
	Mean	r value	Mean	r value	Mean	r value
Rotifer	30.7500	.144	76.5000	.591(*)	252.6667	.933(**)
Copepod	30.7500	.043	76.5000	.130	252.6667	.312
Cladoceran	30.7500	.013	76.5000	-.073	252.6667	-224

*Correlation is significant at the 0.05 level (2- tailed)

**Correlation is significant at the 0.01 level (2- tailed)

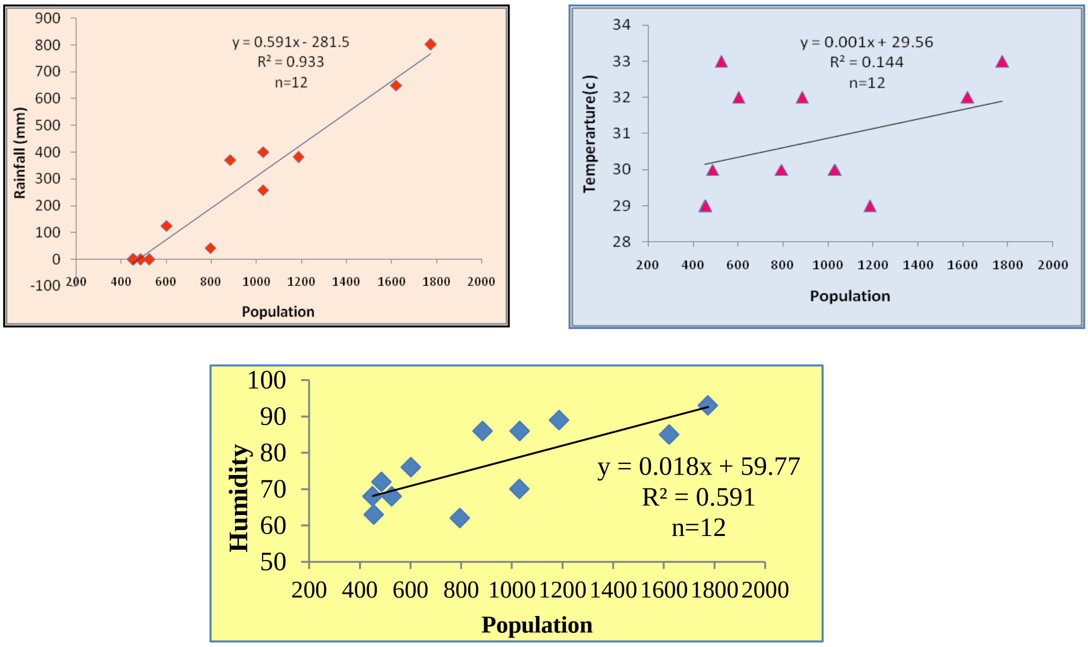


Figure 4 Correlation of rotifer population and weather parameters in study area

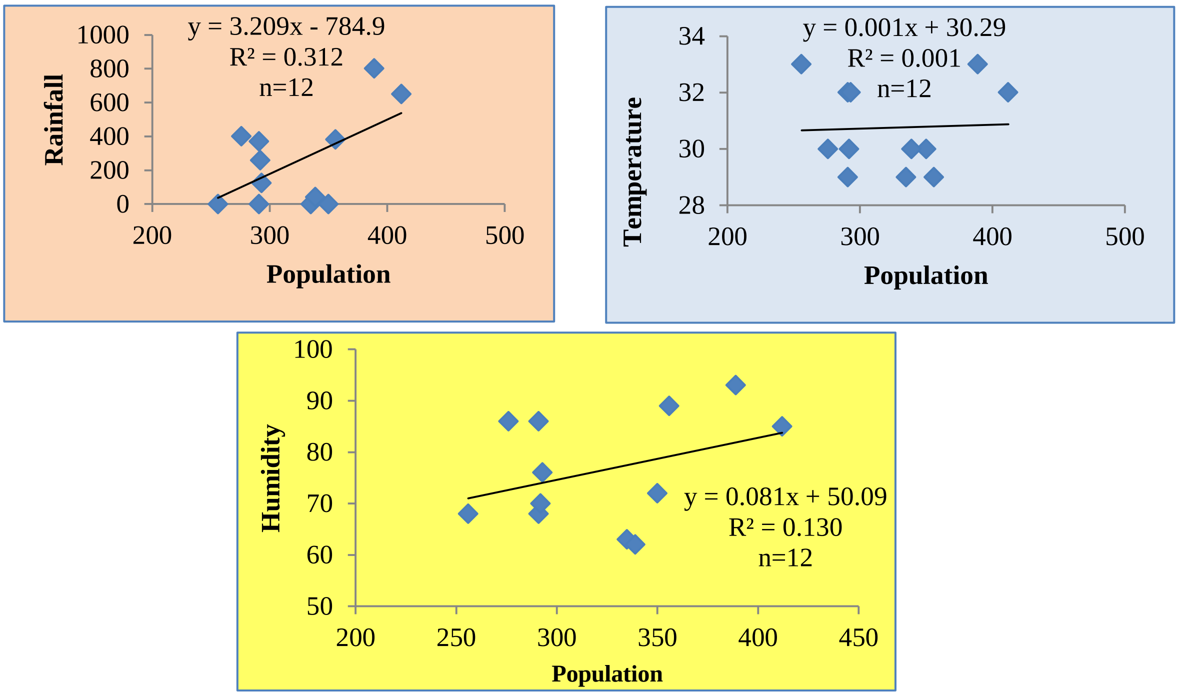


Figure 5 Correlation of copepod population and weather parameters in study area

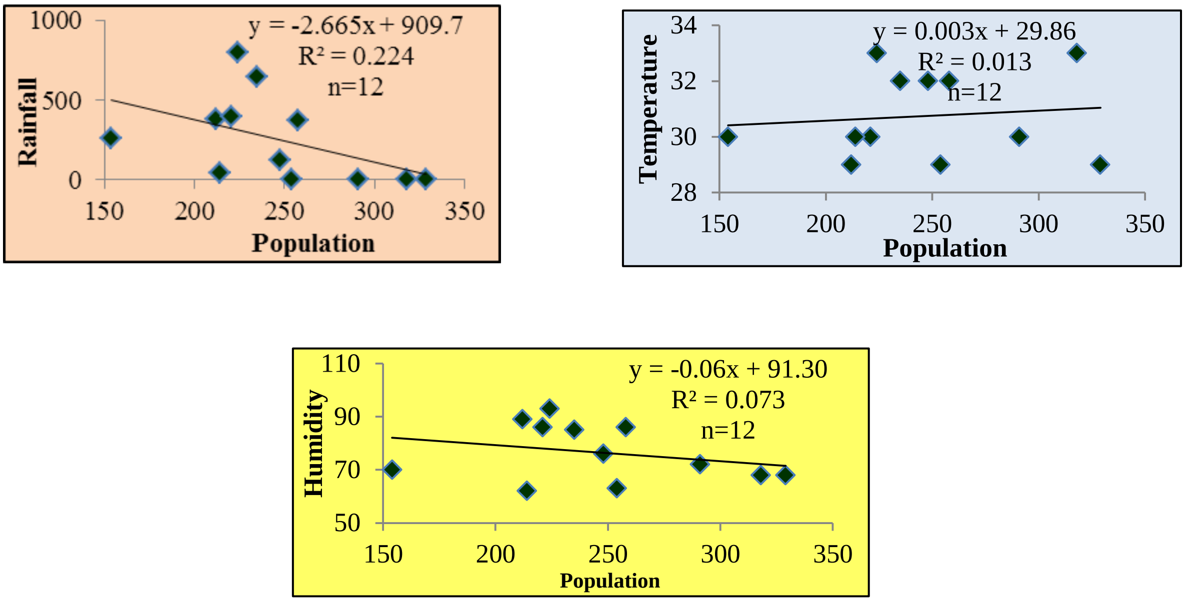


Figure 6 Correlation of cladoceran population and weather parameters in study area

Seasonal population of zooplankton

In the seasonal variation of rotifer, a highly variation was observed. The mean number of highly in the wet season was 1300 ±382 (50.43%) followed by hot season 770.3±272.83 (29.87%) and the lowest in cold season 508.5±71.22 (19.7%) in the study period. The population abundance of this species was significant among the seasons ($F=7.058, p<0.05$).Similar trend was observed in copepod, a highest in wet season 344.8±59.62 (35.68%) followed by hot season 327±30.80 (33.9%) and the lowest in cold season 293.8±32.32 (30.39 %) was observed. While, The population abundance of this species was no significant among the season ($F=2.058$, $p>0.05$).Seasonal population abundance of cladoceran recording as the highest in cold season 287.3±42.16 (38.99%), followed by 230±17.67 (31.25%) in wet season and the lowest 219.7±68.67 (29.76%) in hot seasons respectively. However, the population abundance of this species was no significant among the seasons ($F=2.016, p>0.5$) (Table.3 and Fig.7).

Table 3 Seasonal population of zooplankton in study area (Mean ± SD)

Species	Wet (Mean ±SD)	Cool (Mean ±SD)	Hot (Mean ±SD)
Rotifer	1300 ±382.58	508.5±71.22	770.3±272.83
Copepod	344.8±59.62	293.8±32.32	327±30.80
Cladoceran	230±17.67	287.3±42.16	219.7±68.67

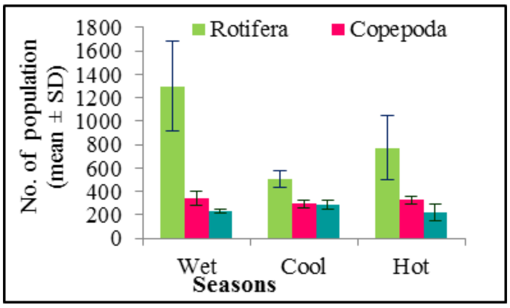


Figure7 Seasonal population of zooplankton in the study areas

Discussion

Zooplankton community structure in the lake of Hlawga Wildlife Park, Yangon Region was studied by monthly surveys in the study period. A total number of 52 species of zooplankton, 36 genera, 23 families, seven orders, four classes under two phyla were recently recorded. Especially, the family Brachionidae were recorded nine species formed the dominant and diversified genus among the rotifers in the study sites throughout the studied period.

Aung Kyaw Zaw (2012) also recorded that Brachionidae was the most diverse genus comprises nine species. The present recorded rotifers are more species rich and abundant, especially *Brachionus caudatus* are highest population density than the other recorded species. Lower species was *Collotheca mutabilis* from the rotifer group. Abundance of rotifer population was increased due to the low water temperature, flooding (causes high nutrients condition, food availability and hatching of egg) and the presence of diatoms (cyanobacteria blooms) (Gilbert, 1988).

Population of rotifer in Site V and VI were more abundant than other site. This may be due to the directly sunlight affect in quantitative changes of zooplankton. Highly significant positive correlation was recorded between the abundance of rotifer and rainfall while positive correlation, no significant was recorded in copepod. Negative correlation was recorded between the abundance of cladoceran and rainfall and humidity. The changes of weather parameter were affected positively; sometime negatively the abundance of zooplankton so this suggests that the zooplankton may be good indicator of the variation in the water quality of these lotic ecosystem. Seasonal abundance the highest numbers of rotifer population were observed in wet season followed by hot season. It may be due to environmental factors and habitats were suitable for rotifers to increase in wet season.

Rotifers population are very useful in indicating water quality particularly in pollution studies and then is less specialized feeding habits and high rate fecundity in wet season (Shadeck, 1983). During all season, cladoceran and copepods accounted of 15.38 % and 21.15 % of total abundance, respectively. According to (Karus, 2014) both groups are larger size and compared to rotifers which are smaller than 250µm. The large size of cladoceran and copepoda will decrease their abundance due to the fish predation. Therefore, the low composition of larger zooplankton size resulted in higher smaller species particularly rotifers.

Conclusion

The results of this present study revealed species occurrence and seasonal variation of zooplankton. A total number of 52 species of zooplankton, 36 genera, 23 families, seven order belonging to four class of zooplankton were recorded. Seasonal variation is highest in wet season and lowest in cold season. Peak in the family Branchionidae were recorded during in wet season. The largest number individuals were found in July and the lowest number in January. It could be concluded that availability of nutrients habitats and environmental condition of Hlawga wildlife lake is still in favourable for zooplankton species. More study will be needed to understand the structure and ecology of the zooplankton community in Hlawga lake.

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