



Benthic community study and seasonal variation of zooplankton biomass in Dukan Lake Kurdistan region-Iraq

Luay A. Ali

Biology Department, College of Education-Salahaddin University, Erbil

ARTICLE INFO

Article History:

Received: 06/08/2018

Accepted: 10/09/2018

Published: 28/10/2018

Keyword: Benthic invertebrates, Zooplankton, Dukan Lake, Kurdistan, Iraq

Corresponding Author:

luay.ali@su.edu.krd

Luay06@gmail.com

ABSTRACT

A study of benthic invertebrates and seasonal variation of zooplankton biomass has been carried out at three selected sites on Dukan Lake. Monthly samples of water, benthic and zooplankton invertebrates were collected during period from July 2016 to the February 2017. Some physical and chemical properties of water were studied and the results showed that the air temperature ranged from 1 to 36.5°C, water temperature ranged from 4 to 32.5°C, hydrogen ion concentration (pH) of studied lake were ranged from 7.01 to 8.6. electrical conductivity ranged from 163.39 to 801.19 $\mu\text{s.cm}^{-1}$, turbidity level of lake during studied period were ranged from 1 to 8NTU, dissolved oxygen from 3 to 6.1 mg.l^{-1} , and BOD₅ were ranged from 1 to 26 mg.l^{-1} . Concerning to benthic invertebrates the results showed that a total of 18 species were recorded belonged to Nematoda, Annelida, Arthropoda and Mollusca. Regarding to planktonic communities, total zooplankton number was ranged from 10 to 8726 ind.l^{-1} . While, the total count of phytoplankton was ranged from 99573 to 754001 cell.l^{-1} . Positive correlation between total count of phytoplankton and total count of zooplankton was reported with $r=0.455$, $r=0.478$ and $r=0.381$ in the site1, site 2 and site 3 respectively.

INTRODUCTION

Invertebrates are a major component of the aquatic ecosystem such as ponds, pools, streams, rivers and lakes. They are good biological indicators due to their long lived in aquatic ecosystem and including species of varying degree of tolerance for different source of pollution (Klemm et. al., 2001).

Many studies on invertebrates community were conducted on different lakes in Iraq among them; (Salih et al., 1990) made a study on effects of some factors on the distribution of Chironomid larvae in Mosul dam. The effects of Samarra Impoundment

on zooplankton distribution was studied by (Sabri et al., 1993), they observed that the zooplankton community decreased during the drainage season. While, (Sabri et al., 1997a) investigated the distribution of benthic and zooplankton invertebrates community of some dams and Reservoirs water in center of Iraq. On the other hand, the effects of Himreen Impoundment on the benthic and planktonic invertebrates in Diyala river was carried out by (Saadalla, 1998).

Dukan lake is one of the important and largest lake in Iraqi Kurdistan region, and there were few research projects have been

carried out on it, in that manner, (Bilbas, 2014) made an ecosystem health assessment of Dukan lake. While, a study of the shore zooplankton community in Dukan Lake was carried out by (Dhahir, 2016). She identified 37 species belonged to three main groups; Cladocera, Copepoda and Rotifera. The present project aimed study of the benthic community and seasonal variation of zooplankton invertebrates in Dukon Lake.

MATERIALS AND METHODS

Dukan Lake is located on the Lesser Zab River, about 65km northwestern of Sulaymaniyah city. Samples for physical, chemical and biological variables in three sites from small part of Dukan Lake were collected during period extended from July 2016 to the February 2017(Fig. 1). Water samples were collected for analysis using pre-washed polyethylene bottle by water sample twice before filling. Physico-chemical measurements were conducted including: Water temperature, pH, Electrical conductivity and Turbidity by using pH meter (Alla France pH-meter-1-15), EC meter and Turbidity meter (HACH, 2100A). While, Dissolved Oxygen using Azide modification method, as well as, BOD test according to (APHA, 2012).

Benthic invertebrates samples were collected in selected sites by using Surber sampler. While, the zooplankton were collected by passing 55L of lake water through a planktonic net with 55 μ m pore size. The collected samples were fixed with 5% formalin and later preserved in ethanol alcohol 70% (A.P.H.A., 2012).

Identification of invertebrates species and counting of zooplankton was undertaken in the laboratory using a compound microscope and the following references were used: (Edmondson, 1959; Smith, 2001; Ruppert et al., 2003; Thorp and Covich, 2010 and Hammadi et al., 2012).

Enumeration of phytoplankton was conducted based on a modification of the membrane filtration technique of (McNabb, 1966) and (Hinton and Maulood, 1979).

RESULTS

In this study, a number of physico-chemical parameters were studied (table 1), the results showed that the air temperature in the studied sites ranged between 1 to 36.5°C with significant monthly variation ($p < 0.05$) and non-significant differences ($p > 0.05$) between studied sites, while the water temperature showed regional and monthly variations with significant differences ($p < 0.05$) and it ranged between 4 to 32.5°C.

The results of hydrogen ion concentration showed significant differences ($p < 0.05$) between studied sites and date of sampling. The pH values of the studied lake were ranged from 7.06 to 8.6.

Electrical conductivity level of the studied lake at the selected sites were ranged between 163.39 to 801.19 μ s.cm⁻¹, and the statistical analysis showed a significant differences ($p < 0.05$) among sampling date only.

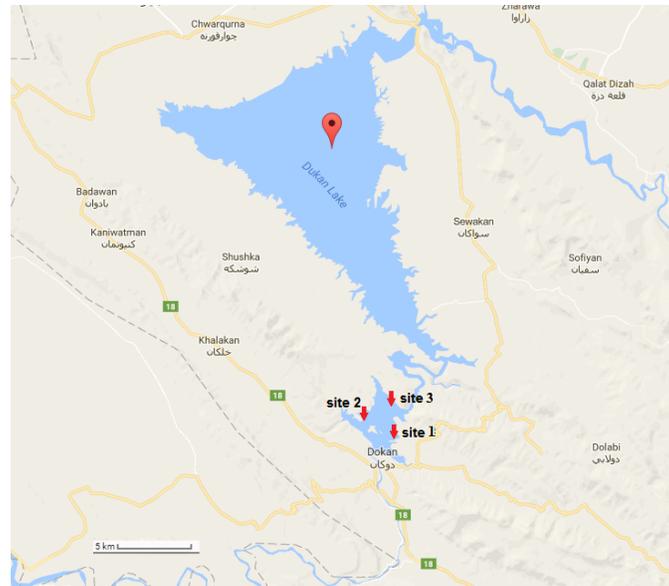


Fig. (1): Map of Iraq, inset location of sampling sites on Dukon Lake (Google Earth)

The turbidity level of the present study was ranged between 1 to 8 NTU and statistically the significant differences ($p < 0.05$) were observed between studied sites and date of sampling.

Dissolved oxygen concentrations revealed that they were a significant differences ($p < 0.05$) between studied sites and date of sampling, it was ranged between 3 to 6.1 mg.l^{-1} .

BOD_5 level fluctuated between all sites and ranged from 0.7 to 26 mg.l^{-1} and the statistical analysis showed that the regional and monthly variation with significant differences ($p < 0.05$).

Collection of benthic invertebrates were made at the studied lake for eight months,

and a total of 18 species were recorded (table 2) including 3 species of Nematoda, followed by Annelida with 4 species (3 Oligochaeta and 1 Leech), then by Arthropoda 5 species (3 insects, 1 crab and 1 shrimp), and then by Mollusca with 6 species (5 gastropoda and 1 bivalvia).

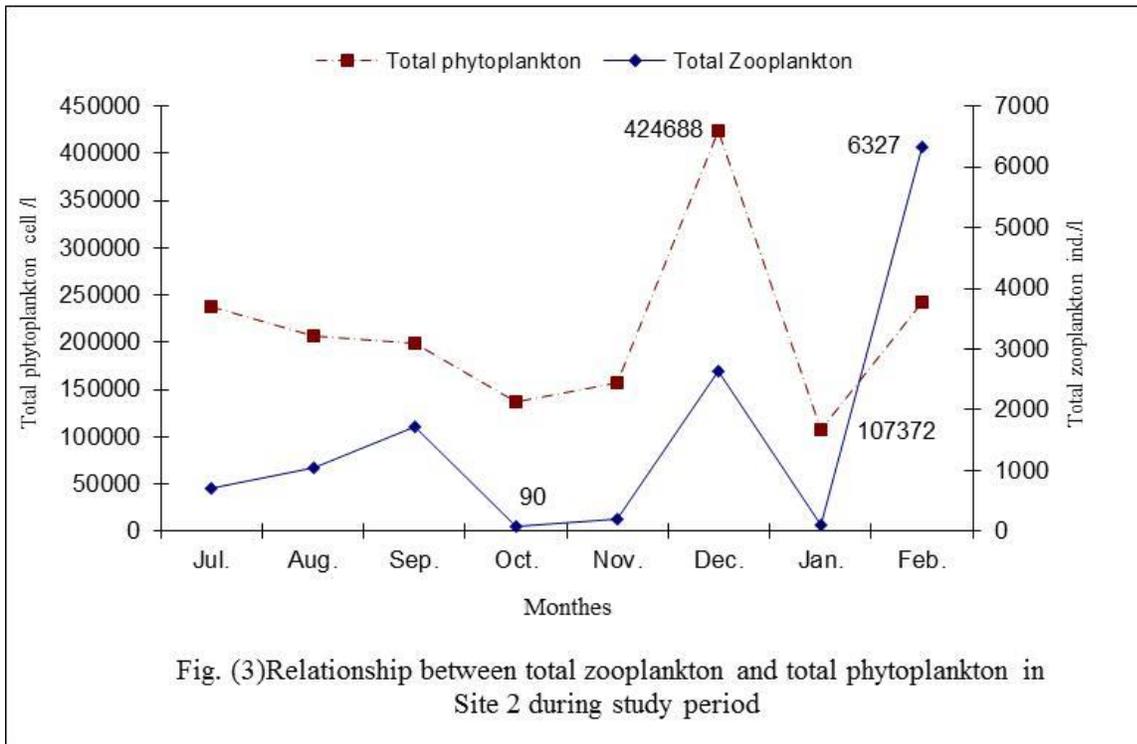
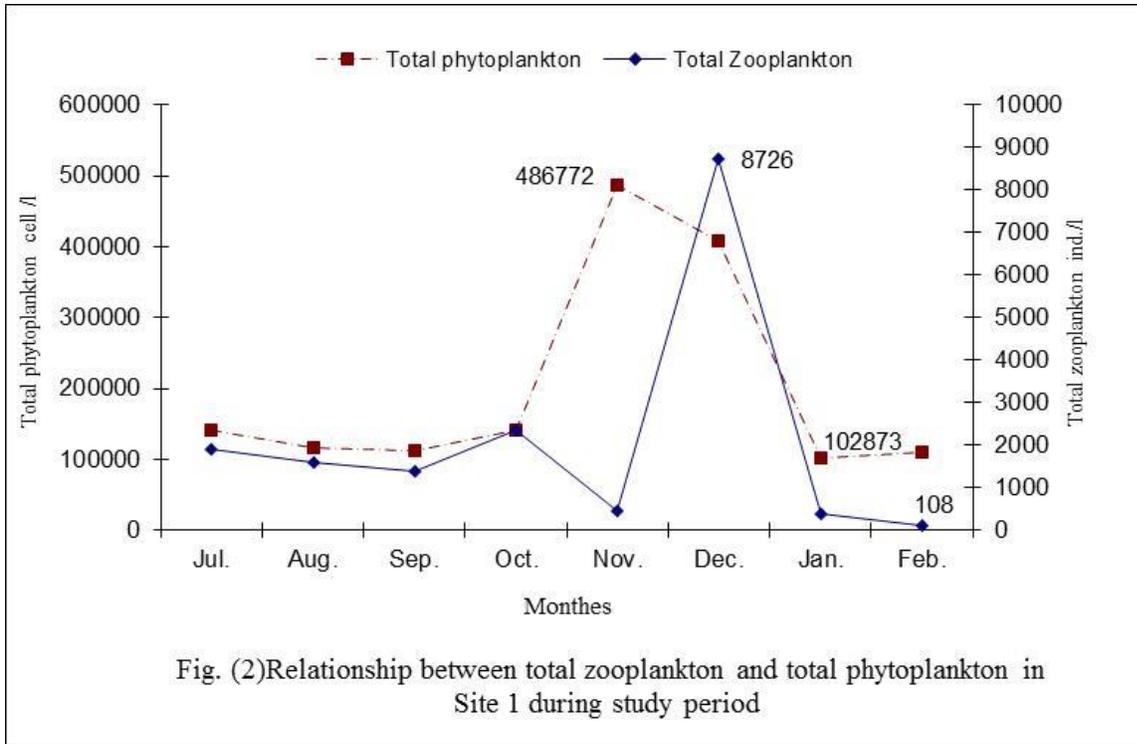
Concerning to the total count of zooplankton, the results showed it was ranged from 10 to 8726 ind.l^{-1} . While, the total count of phytoplankton was ranged from 99573 to 754001 cell.l^{-1} . The results statistical analysis revealed that there are a positive correlation between total count of phytoplankton and total count of zooplankton with $r = 0.455$, $r = 0.478$ and $r = 0.381$ in the site1, site 2 and site 3 respectively (Fig. 2,3 and 4).

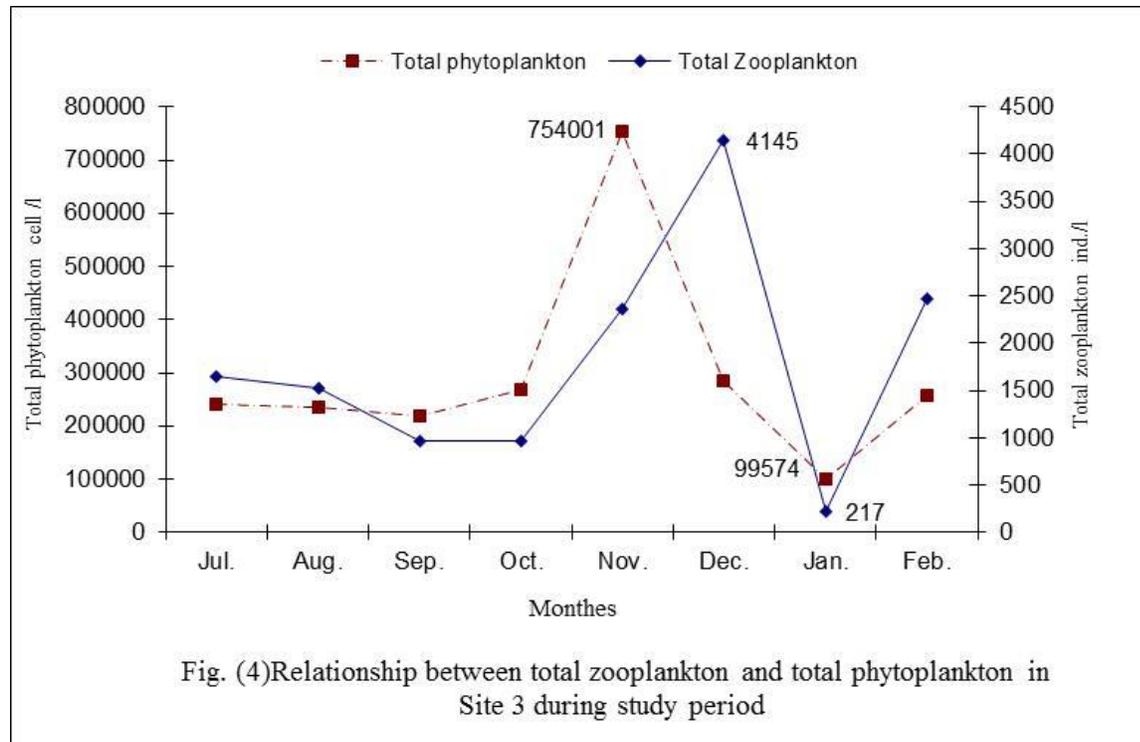
Table 1: minimum and maximum value of studied parameters during study period

Physico-chemical Parameters	Site 1	Site 2	Site 3
Air temperature	1-36 °C	1-36.5 °C	1-34 °C
Water temperature	4-31°C	5-32.5 °C	4-32 °C
Hydrogen ion concentration (pH)	7.1-8.6	7.2-8.5	7.06-8.5
Electrical conductivity (EC)	163.39 -710.1 μ s.cm ⁻¹	215-720 μ s.cm ⁻¹	189.16-801.2 μ s.cm ⁻¹
Turbidity	2.5-8 NTU	1.5-6.6 NTU	1-8 NTU
Dissolved oxygen	3.9-6 mg.l ⁻¹	4.1-6.1 mg .l ⁻¹	3-6 mg .l ⁻¹
Biochemical oxygen demand (BOD ₅)	4-26 mg .l ⁻¹	1-2.5 mg.l ⁻¹	0.7-2 mg .l ⁻¹

Table 2: list of benthic invertebrates recorded during studied period in Dukan lake

Invertebrates		Site1	Site 2	Site 3	
Nematoda	Adenophorea	<i>Mylonchulus</i> sp.	+		
		<i>Plectus</i> sp.	+		
		<i>Rhabdolaimus</i> sp.	+		
Annelida	Oligochaeta	<i>Chaetogaster diaphanus</i>	+		
		<i>Chaetogaster</i> sp.	+		
		<i>Aelosoma</i> sp.	+	+	
	Hirudinea	<i>Dina</i> sp.		+	
Arthropoda	Insecta	<i>Ablabesmyia</i> sp.	+	+	
		<i>Caenis moesta</i>	+	+	
		<i>Tendipes</i> sp.			+
	Malacostraca	<i>Potamon magnum</i>	+		
		<i>Gammarus fasciatus</i>	+	+	
Mollusca	Gastropoda	<i>Lymnaea auricularia</i>	+	+	
		<i>Physa gyrina</i>	+	+	
		<i>Physa</i> sp.	+	+	+
		<i>Promenetus exacuouus</i>	+	+	
		<i>Lymnaea auricularia</i>	+	+	
	Bivalvia	<i>Unio pictorum</i>		+	





DISCUSSION

In this study, the results of limnological parameter showed that the higher air and water temperature were 36.5°C and 32.5°C recorded at site 2 during July 2016. While, the lower air was 1°C recorded in all studied sites and the lower water temperature was 4°C was recorded in sites 1 and 3 during January 2016. The results of air temperature indicate that the studied area is characterized by cold winter and autumn, moderate spring, and warm summer and this come in accordance with (Guest, 1966). Also the variation of water temperature may be due to change in air temperature in addition to the other factors as solar radiation and turbidity (Dance and Hyness, 1980). Similar results were reported by (Bilbas, 2014) and (Dhahir, 2016).

Hydrogen ion concentration of studied lake were more than 7 and reached up to 8 many times during studied period and this is a normal condition for Iraqi inland water, which reflecting the geological formations of the area. In the present study the maximum pH value was 8.6 recorded in site 1 during August and the minimum value was 7.06 recorded in site 3 during November 2016. This result was agreed with the results reported by (Bilbas, 2014) and (Dhahir, 2016).

In the present study, electrical conductivity level was lower in summer and higher in winter season. The EC level of studied lake at the studied sites was ranged from 163.39 to 801.19 $\mu\text{s}.\text{cm}^{-1}$. Lower level of EC was recorded in site 1 during July, while the higher level of EC was recorded in site 3 during January 2016. The fluctuation of EC

may be linked to the presence of chloride and dissolved ions that are the main constituents in water and directly affect the Ec value. The present results are close to the results reported by (Al-Ghafily and Al-Tamimi, 2009) in Habbaniya lake, and higher than that reported by (Toma, 2011) and (Bilbas, 2014) in the Dukan lake. On the other hand, the minimum value of turbidity (1 NTU) was recorded at site 3 during September 2016, while the maximum value (8 NTU) was recorded at site 1 during August 2016. The high level of turbidity in site 1 and 3 may be attributed to many reasons among them the activities of fisherman, tourists and discharge of pollutants from residential surrounding area.

Dissolved oxygen concentration of studied lake was ranged from 3 mg.l⁻¹ to 6.1 mg.l⁻¹ observed in site 3 during October and site 2 during December 2016 respectively. However, BOD₅ values were ranged between 0.7 to 26 mg.l⁻¹, the lower value of BOD₅ was recorded at site 3 during July, whereas the higher value was recorded at site 1 during August 2016. The results of present study come in accordance to the findings given by (Toma, 2013) and (Bilbas, 2014) in Dukan Lake.

Concerning to the benthic invertebrates study, 18 species were recorded belonged to 4 phylum and 7 classes with dominancy of insects in all studied sites during studied period and this results come in accordance with that reported by (Saadalla, 1998) in Himreen impoundment. However, Nematoda, Oligochaeta, Gastropoda and crab were observed mostly in site 1, while

leech, shrimp and Bivalvia were recorded only in site 3 during the sampling period.

On the other hand, the results of total count of zooplankton and phytoplankton showed a clear peaks of growth in November and December and they revealed that there are a direct grazing relationships with $r = 0.455$, $r = 0.478$ and $r = 0.381$ in the site1, site 2 and site 3 respectively.

The seasonal variations of zooplankton population in studied lake suggest that the most favourable period for growth is from October to the December, and this may be due to increase of phytoplankton population. The similar phenomenon was reported by (Ali, 2010).

Finally, from the results appear that the more study should be conducted on seasonal variation of zooplankton and phytoplankton in Dukan Lake especially in the other remaining months.

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