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RESEARCH PAPER

A Study of Zooplankton Community in Alwand River and Dam- Iraq

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A B S T R A C T:

This study was conduct on the zooplankton community from eight selected sites in the Alwand Rivers and Alwand Dam .Monthly samples of water, zooplankton and phytoplankton were collected for the period from June 2018 to February 2019 .The results of physico-chemical properties of water showed that the Air temperature ranged from 9-47 °C while water temperature ranged from 8-35.7 °C, hydrogen ion concentration in most of studied period was alkaline side above 7 , it was ranged between 7.6 -8.26, Turbidity ranged from 5.98 to 317.6 NTU, dissolved oxygen from 1.5 mg.l^{-1} to 3.13 mg.l^{-1} and electrical onductivity from 918 to 1782 µs.cm-¹. Regarding to zooplankton, 81 species belonging to Rotifera (70 species), Cladocera (6 species) and zcopopoda (4 species). Also total count of phytoplankton was ranged from 60000 to 145000 cells.l^{-1} while total count of zooplankton from 4566.758 to 32433.98 ind.m^{-3}.

KEY WORDS: Zooplankton, Alwand river, Alwand Dam, Iraq.
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INTRODUCTION

Zooplankton is the floating and microscopic animal found in all the water bodies, especially the pelagic and littoral zones in the ocean, also in ponds, lakes, and rivers, scientists have found that all of the zooplankton descent into one of two categories, the first group is called holoplankton these zooplankton spend their entire lives drifting through the epi- and meso- pelagic zones. While the second group is called meroplankton are organisms lives plankton one part of life cycle (Dede and Deshmukh, 2015).

Zooplankton communities that inhabit different water bodies in diversity and density as well as in the physicochemical properties of water. Moreover, zooplankton has been considered are one of the most important components in fresh water ecosystems, they perform several vital functions with in lake ecosystems including the transference of energy and nutrients from producers to secondary consumers, the sequestration of nutrients, and the removal of phytoplankton from the water column, also used as one of the bioindicators for accessing aquatic ecosystem health (Apaydın Yağcı,et al ,2017)
Numerous studies on Strong relation exist between phytoplankton and zooplankton in different parts of the world, Lonsdale, et al. (1996) made a study on effects of zooplankton grazing on phytoplankton communities in Lower Hudson River. However, Gołdyn et al. (2008) studied

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seasonal variability in phytoplankton formation and grazing effect on phytoplankton at the Swarzędzkie Lake in western Poland, In Greater Zab River Ali (2010) conducted a study on Seasonal variation in physico-chemical properties and zooplankton biomass. While, Dorche et al. (2018) studied the Seasonal variations of plankton structure as bioindicators in Zayandehrud Dam Lake in Iran.

The aim of this study is to survey and study the zooplankton community and its relations to phytoplankton in Alwand River and Dam-Iraq, and some physicochemical and factors of the rivers have also been measured.

MATERIALS AND METHODS

The Alwand River originates from Iranian territory, and enters Iraq Southeast of the city of Khanaqin, in 2013 the Alwand Dam was built about 7 km south-east of the Khanaqin City. The length of Alwand dam about 1342m. Then high of the dam about 24 meters, while the usual storage capacity reached to up to 37.924 million cubic meters, Khanaqin city is located on the coordinates of 34 ° 20′00 ″ N 45 ° 23′00 ″ E (Hassan, 2013; Saed ,2015).

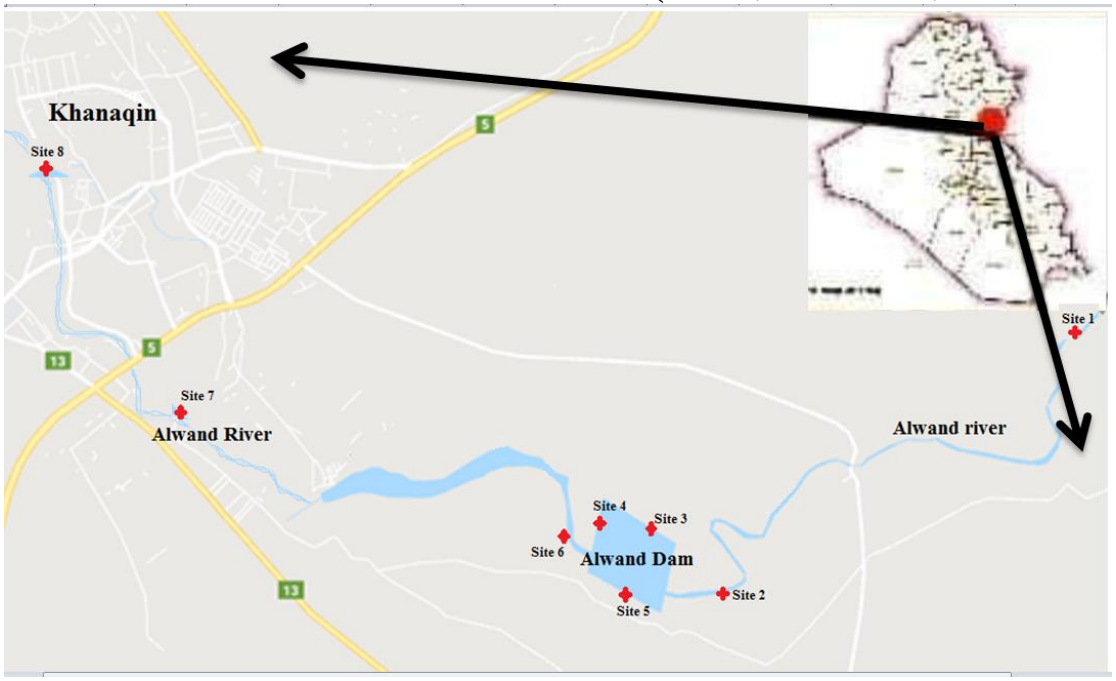

Fig. (1) Map of Iraq showing the studying sites on Alwand River and Dam-Iraq.

Water Samples for physical, chemical and biological variables in eight sites from of Alwand river and Alwand Dam were collected by using a polyethylene bottle washed them with a river sample twice before using during period from June 2018 to the February 2019 (Fig.1). The measurements of physico-chemical parameters were conducted including: Air temperature by using precise mercury thermometer, pH using pH-meter model HI 2210, Electrical conductivity by using EC-meter model (Senz µSiemen conductivity tester), and Turbidity monred by using Turbidity meter model TB, 210 IR, while Dissolved Oxygen and BOD_5 measured by Azide modification method (A.P.H.A.1998). The zooplankton samples were collected by passing 30 liters of River and Dam water using a network of plankton (55 mash pore in diameter), then concentrated samples were fixed with 5% formalin and subsequently stored in 70% ethanol (APHA 2012). As for the phytoplankton Enumeration, was conducted on the basis of modified membrane filtration technique (Hinton and Maulood, 1979).

Statistical analysis was conducted for the data using IBM spss program version 22. One way Analysis of Viriance (ANOVA) without replication to determine the effect of different sites and sampling date, the comparison between the means of studied factors data were conducted using least significant differences (LSD) value (P<0.05). Duncan was also used to determine whether the mean results of sites and date are significantly different or not.

RESULTS AND DISCUSSION

In the present study, table (1) showing the results of physical and chemical properties of the Alwand River and Dam at eight studied sites, from the table appear that the air temperature was ranged from 9 to 47 C°, the lowest value was recorded at site 7 during December 2018, while the highest value was recorded at site 6 during July 2018. The similar results were reported by (Saadalla, 1998) in Diyala River. On the other hand, the measurements of water temperature ranged from 8 to 35.7 C°. The minimum water temperature was recorded at two site (7,1) during December 2018 and January 2019 respectively. While, the maximum water temperature observed in site 4 during July 2018. The statistical analysis showed that the air and temperature value was significantly different (P< 0.05) between studied sites and date of sampling. The fluctuations in air and water temperature are close with that reported and explained by (Bello et al., 2017).

Hydrogen ion concentration in Alwand river and Dam during of most of studied period was at alkaline side above 7, the higher value was 8.26 recorded in site 2 during December 2018, while, the lower value was 7.6 recorded in site 6 during November 2018 with high significant differences (p<0.005) between date of sampling and studied sites. Such results is normal condition for Iraqi Inland water and as a result of geological formation of the area (Ganjo, 1997), also the same results were reported by (Dhahir, 2016) in Dukan Lak and (Ali, 2010) in Lesser Zab River.

The level of electrical conductivity at the studied river and Dam water was ranged from 918 to 1782 µs. cm-¹. The higher level of EC was recorded in site 4 during Octoper 2018, while the lower level of EC was recorded in site 6 during February 2019. Statistical analysis observed that the EC value was significantly different (P< 0.05) between studied sites and date of sampling. The variability may be associated with the presence of chloride ions and dissolved ions that form the main constituents of water and directly affect EC values and similar results have been reported by (Moyel and Aboud, 2015) in Shatt al-Arab River.

The level of turbidity ranged from 5.98 to 317.6 NTU. The maximum value was 317.6 recorded at Site 8 during November 2018. While, the minimum value was 5.98 recorded at site 7 during February 2019 with significant differences (P<0.005) between study sites and date of sampling. This may be due to several factors such as discharging of many contaminants or due to heighten of phytoplankton growth (Ali, 2010). These recorded results were close to that reported by (Saadalla, 1998) in Diyala River.

Dissolved oxygen concentration of studied river was ranged from 1.5 to 2.93 $mg.l^{-1}$. The higher level of dissolved oxygen was 2.93 recorded at Site 1 during January 2019. While, the minimum value was observed in site 8 during September 2018. Statistically the results showed significant differences (p< 0.05) between both study sites and dates of sample, this may be attributed to a high organic matter which escort by increase in action of anaerobic bacteria and decreasing of dissolved oxygen in water (Toma, 2011). In addition to, BOD_5 values were ranged between 0.01 to 1.43 $mg.l^{-1}$, the lower value was recorded at two sites (6,7) during June 2018, whereas the higher value was recorded at site 2 during September 2018, and statistically analysis showed significant differences (p< 0.05) between study sites and dates of sample. The fluctuation in BOD_5 value may be related to the several causes such as human activities pollution caused by throwing pollutants directly into the river and high decomposition of organic matters in the lake during summer due to high water temperature, and low water level (Ali and Dhahir, 2017).

Concerning to zooplankton community study, 80 species of zooplankton were identified (Table 2) represented by three groups; Cladocera was dominant group (68.889%). Copepoda was second ranked in order of zooplankton abundance in the study site with (41.463%). The third ranked order of zooplankton in studied river and Dam was Rotifera with (17.607%).

Regarding to Cladocera, 6 species (*Bosmina coregoni* (Baird, 1857), *Bosmina longirostris* ((Muller 1785) *Eubosmina tubicen* (Brehm, 1953), *Alona rectangular(Sars 1861), Cerodaphnia reticulate* (Jurine ,1820) and *Scapholeberis kingi* (Sars ,1903)) were recorded they belonged to four families; Bosminidae Chydoridae, and Daphinidae. The lowest value of Cladocera was observed in the winter months. The high density of Cladocera was 833.35 ind.m^{-3} recorded at site 5 during June 2018, this may be due to agreeable environmental conditions, including temperature, dissolved oxygen and the availability Bumper food in the form of bacteria, waste disposal and also abundance of food resources (aquatic plants and phytoplankton) as organic matter on this site (Salve and Hiware, 2010).

However, Copopoda represented by 4 species (*Diacyclops thomasi* (Forbes 1882), *Megacyclops viridis* (Kiefer,1927), *Orthocyclops modestus* (Herrick,1883) and *Microcyclops rubellus* (Lilljeborg, 1901)) belonged to one family (Cyclopoidea), the higher population density of it was in summer season with 566.678 ind.m^{-3} reported at site 5 during June and July 2018, while lower number of copepoda was recorded in winters seasons with significant differences ($p< 0.05$) between study sites and dates of sample. The current results are consistent with the result of (Saadalla, 1998) in Himreen impoundment and (Sontakke and Mokashe, 2014) in Dekhu reservoir in India.

Rotifera come in third ranked in this study, during the sampling date 70 species of it were observed belonged to 12 families; Philodinidae, Branchionidae, Lecanidae, Lepadellidae, Scaridiidae, Asplanchnidae, Trichotriidae, Notommatidae, Trochosphaeridae, Testudinellidae, Synchaetidae and Euchlanidae. The total recorded Rotifera in the present study was ranged between 33.334 to 11900.238 ind.m^{-3}, with significant differences ($p< 0.05$) for both study sites and dates of sample. The maximum value was recorded in site 3 during December 2018, while the minimum value were recorded in sites 1 during January 2019, and this may be due to decrease of phytoplankton number in which zooplankton grazing on it, in addition to low temperature during cold winter months. The current results were agreed with those reported by (Ali, 2010) in Greater Zab River.

It is worth to mention that the total number of phytoplankton was ranged from 60000 to 145000 cells.l^{-1}. Maximum number of phytoplankton was observed at site 3 during September 2018, while a minimum number was recorded at Site 2 during November 2018. The lower densities of phytoplankton was recorded in cold months and this may be related to low temperatures in addition to other factors such as light, nutrients and primary consumers that acts as growth limit. Concerning to zooplanktonic communities the results showed that the total zooplankton number was ranged from 4566.758 to 32433.98 ind.m^{-3}, the maximum and minimum number were observed in December and July 2018 respectively. The variations in the population densities may be due to many factors such as water temperature, dissolved oxygen, hydrogen ion concentration and electrical conductivity. From the statistical analysis appear that there are positive correlations between each of Rotifera and Copepoda and phytoplankton with r=0.101 and 0.022 respectively, while a negative correlation was observed between Cladocera and phytoplankton with r=-0.002. These results are close with the results reported by Haque (2015) in Tidal Sangue River in Bangladesh. Generally, decrease of the number of zooplankton during November 2018 may be due to decrease of phytoplankton number in which zooplankton grazing on it, in addition to

low temperature during cold winter months. These results are consistent with those reported by Saadalla (1998) in Diyala River and El-Sherbiny, et al (2011) in Timsah Lake in Egypt.

Table (1) Physico-chemical properties of ALwand River and Dam, data represented as minimum and maximum value from June 2018 to February 2019

Physico-chemical Parameters	Site1	Site2	Site3	Site4	Site5	Site 6	Site7	Site8
Air temperature(˚C)	15-43	15-42	20-43	20-44.33	15-45	13-47	9-41	12-42
Water temperature(˚C)	8-32.33	12.33-33.33	13-33.33	12-35.7	14-31	12-31.7	8-30.7	11-32.33
Hydrogen ion con. (pH)	7.8-8.12	7.59-8.26	7.80-8.19	7.72-8.21	7.65-8.24	7.6-8.16	7.73-8.22	7.52-8.21
Electrical conductivity (EC) (µs.cm-¹)	921-1685	932-1701	944-1759	937-1782	941-1702	918-1691	971-1699	962-1708
Turbidity (NTU)	18.66-113	13.6-79.4	9.03-36.03	7-29.1	6.48-23.7	9.85-39.7	5.98-42.43	10.74-317.6
Dissolved oxygen (mg $.l^{-1}$)	1.47-2.93	1.98-2.37	1.33-2.67	1.7-3.1	1.6-3.13	1.8-3.13	2.1-2.73	1.5-3
Biochemical oxygen demand (BOD_5) (mg $.l^{-1}$)	0.04-1.13	0.03-1.43	0.03-1.3	0.05-1.16	0.04-1.13	0.01-1.1	0.01-1.1	0.03-0.83

Table (2) list of Zooplankton recorded during studied period in ALwand River and ALwand Dam.

ZOOPLANKTON	**Site1**	**Site2**	**Site3**	**Site4**	**Site5**	**Site6**	**Site7**	**Site8**
Phylum: Rotifera (17.607%)								
Class: Bdelloidea								
Order: Bdelloidae								
Family: Philodinidae								
Bdelloidae sp (Ehrenberg)	+	+	+	+	+	+	+	+
Bdelloidae sp (Ehrenberg)		+	+		+			
Class: Monogonata								
Order: Ploima								
Family: Branchionidae								
Anuraeopsis fissa (Gosse 1851)	+	+	+					
Anuraeopsis ovalis (Bergendal)					+			

Keratella tecta (Gosse,1851)	+	+	+	+		+	+	+
Keratella tropica (Apstein 1907)	+	+	+	+	+	+	+	+
Keratella Cochalaris (Gosse,1851)	+	+	+	+	+	+	+	+
Brachionus forficula (Wierzejski,1891)	+	+	+	+	+	+	+	+
Brachionus falcatus (Zacharias ,1898*)*	+	+	+	+	+	+	+	+
Brachionus angularis (Gosse,1851)	+	+	+	+	+	+	+	+
Brachionus rotundiformis (Tschugunoff,1921)	+	+	+	+	+	+	+	+
Brachionus dimidiatus (Bryce,1931)		+	+	+		+	+	+
Brachionus calyciflorus (Pallas,1766)		+	+	+	+	+	+	+
Brachionus quadridentatus (Hermann1783)		+			+	+	+	+
Brachionus Plicatilis (Muller,1786)			+	+	+	+	+	+
Brachionus Rubens (Ehrenberg,1838)				+				
Brachionus variabilis (Hempel,1896)			+	+	+		+	
Brachionus Diversicornis (Daday,1883)		+					+	
Platyias quadricornis (Ehrenberg,1832)		+	+					
Notholca acuminate (Ehrenberg, 1832)			+	+	+			+
Notholca Squamula (Muller 1786)					+	+	+	+
Family: Scaridiidae								
Scaridium longicaudum (Muller 1786)			+					
Family:*Asplanchnidae*								

Asplanchna priodonta (Gosse,1850)		+	+	+	+	+	+	+
Asplanchna Herriki (Guerne ,1888)			+	+		+	+	+
Family: Synchaetidae								
Synchaeta sp (Ehrenberg,1832)	+	+	+	+	+	+	+	+
Polyarthra vulgaris (Carlin 1956)			+		+	+	+	+
Polyarthra dolichoptera(Idelson,1925)		+	+		+	+		+
Family:trichotriidae Harring (1913)								
Trichotria tetractis (Ehrenberg.1830)	+	+	+	+	+	+		
Trichotria Pocillum (O.F.M. ,1776)			+	+	+			
Trichocerca porcellus (Gosse,1886)						+		
Trichocerca pusilla (Jennings, 1903)								+
Family: Notommatidae								
Cephalodella gibba (Ehrenberg 1830)	+	+	+	+	+	+	+	+
Cephalodella remanni(Donner, 1950)		+	+	+	+			+
Cephalodella Tantilloides (Hauer,1935)		+			+			
Cephalodella spp					+	+		
Cephalodella hoodia (Gosse ,1886)	+	+	+		+			+
Family: Lecanidae								
Lecane bulla (Gosse, 1851)	+	+	+	+	+	+	+	+
Lecane elasma (Harring & Myers, 1926)	+	+	+		+		+	+
Lecane thienemanni (Hauer,1938)	+							

Lecane stenroosi (Meissner,1908)	+				+	+	+	+
Lecane undulate(Hauer ,1938)		+			+			+
Lecane crepida (Harring,1914)		+	+		+			+
Lecane luna (Muller,1776)		+	+	+	+		+	+
Lecane hornemanni (Ehrenberg,1833)		+		+			+	
Lecane lunaris (Ehrenberg,1832)		+	+	+	+		+	+
Lecane tenuiseta (Harring ,1914)		+			+			
Lecane hamate (Stokes,1896)					+			+
Lecane scutata(Harring &Myers1926)					+			
Lecane punctate (Murray,1913)		+	+	+				
Lecane cornuta (Muller,1786)		+						
Lecane Donneri (Chengalath &Mulamoottil ,1974)							+	
Lecane Pyriforms (Daday,1905)		+						
Family: Lepadellidae								
Lepadella ovalis (Muller, 1896)		+	+	+	+			
Lepadella patella (Muller ,1773)	+			+	+			
Lapadella salpina (Ehrenberg, 1834)	+	+	+		+			+
Squatinella longispinata (Tatem,1867)		+			+			
Colurella obtuse (Gosse ,1886)	+	+	+	+	+		+	+
Colurella uncinata (Muller,1773)		+						
Colurella colurus (Ehrenberg ,1830)		+	+		+			
Colurella Adriatica(Ehrenberg ,1831)	+			+				
Family: Euchlanidae								
Euchlanis lyra (Hudson,1886)		+	+	+				

Euchlanis dilatate (Ehrenberg 1832)			+		+		+	+
Euchlanis triquetra (Ehrenberg 1838)	+	+	+	+	+		+	
Euchlanis tetractis (Ehrenberg)					+			
Euchlanis sp								+
Dipleuchlanis propatula (Gosse,1886)						+		
Order:Flosculariaceae								
Family:Trochosphaeridae								
Filinia longiseta (Ehrenberg,1834)							+	+
Family:Testudinellidae								
Testudenila patina (Hermann,1783)		+						
Phylum: Arthropoda								
Subphylum: Maxillopoda								
Class: Crustacea								
Order: Copepoda (41.463%)								
Family: Cyclopida								
Diacyclops thomasi (Forbes 1882)		+		+	+	+		
Megacyclops viridis (Kiefer,1927)					+			
Orthocyclops modestus (Herrick,1883)					+	+		
Microcyclops rubellus (Lilljeborg, 1901)		+	+	+	+	+	+	+
Class: Branchiopoda								
Order: Cladocera (68.889%)								
Family: Bosminidae								
Bosmina coregoni (Baird, 1857)	+	+		+	+	+	+	

Bosmina longirostris (Muller 1785)	+	+		+	+	+	+	+
Eubosmina tubicen (Brehm, 1953)	+	+		+	+	+		
Family: Chydoridae								
Alona rectangular (Sars 1861)			+					+
Family: Daphniidae								
Cerodaphnia reticulate (Jurine ,1820)		+						
Scapholeberis kingi (Sars ,1903)			+					

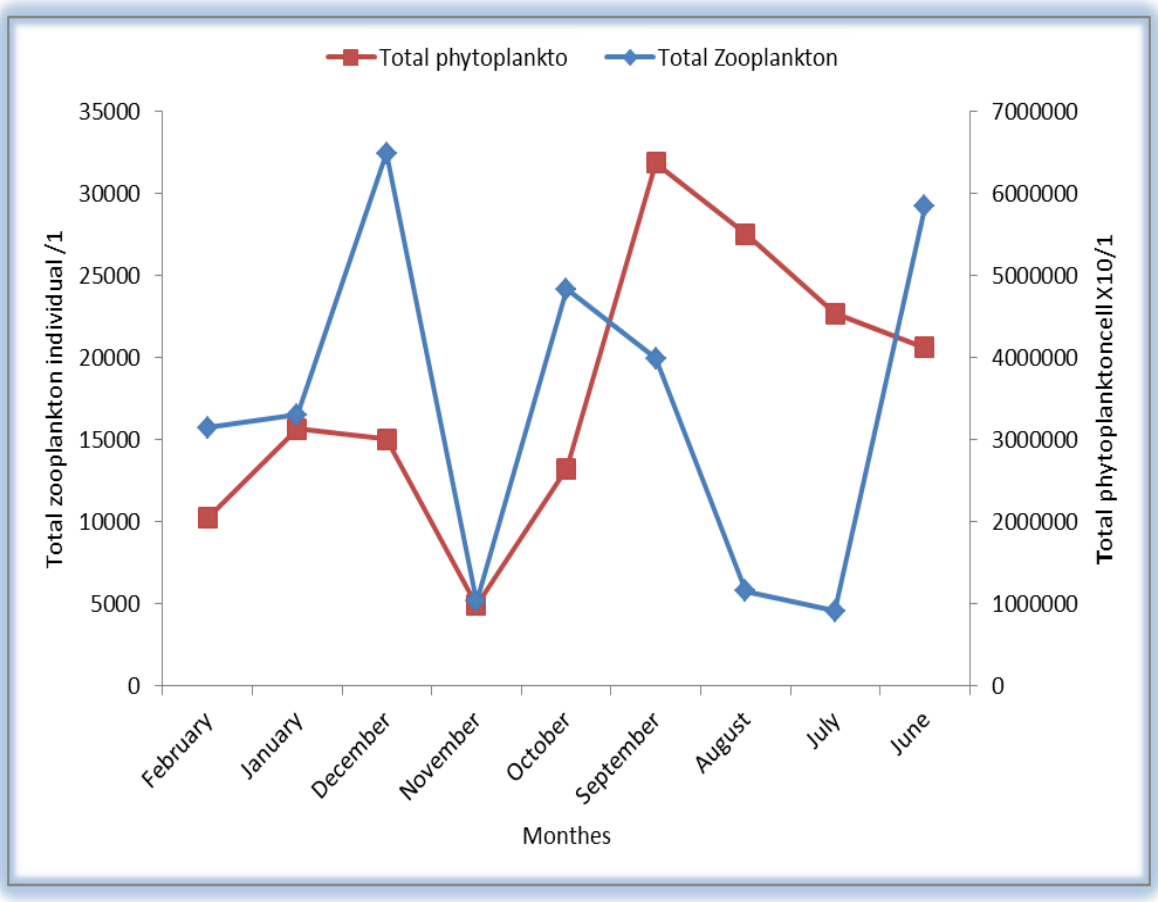

Fig. (2) Relationship between total zooplankton and total phytoplankton in ALwand river and Dam.

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