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Study of the relative abundance for zooplankton community in the Euphrates River within the city of Samawah/ Iraq

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***Abstract*---**This study, the first of its kind, was conducted on the Euphrates River in the city of Samawah. To identify and diagnose the environment of the diversity of zooplankton in the Euphrates River. This study was conducted from December of the year 2021 until February 2022. Three sites were chosen: The first site (enters The Euphrates River in the city of Samawah) The second site (city centre) and the third site (the exit of the river from the city) are 11 km away from each other. The study included a diagnosis of zooplankton, the study of total density and evidence of relative abundance. The study identified 50 zooplankton taxonomic units, 31 units belonged to Rotifera, 10 units belonged to Cladcera, and 9 units belonged to Copepoda. The Rotifera predominate in the Euphrates river, both quantitatively and qualitatively. The total density of zooplankton recorded values ranging from 260 - 3110 ind/m^3 recorded for Rotifera, the Rotifera recorded the highest density, which ranged between 220 - 2990 ind / m^3, and the Cladcera recorded the lowest density in this study, which ranged between no-appearance - 160 ind / m^3 The density of the Copepoda ranged between 10 - 370 ind /m^3. The results of the relative abundance index showed that the species *R. neptunia, Aspelta bidentatea, Syncheta oblonga* of the Rotifera. the species *Lmmatur Cladocerai*, from Cladocera group of Copepoda, species Cyclops , this is it species which are the most abundant zooplankton units in the of the Euphrates River.

***Keywords*---**Euphrates River, zooplankton, biodiversity, relative abundance.

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Introduction

Zooplankton is defined as very minute aquatic animals that drift in the water column from the ocean, seas or fresh water bodies to move over a great distance. It usually travels in the sunlit area where food resources are abundant and is also found in deep ocean waters. They are heterotrophs in nature (sometimes consuming fires) and are the preferred food for many marine animals. Zooplankton plays a very important role in the aquatic ecosystem as a basic link between primary products (phytoplankton) and large organisms of economic importance such as fish and others, so they are considered among the organisms Important in the food chain is the aquatic environment, which feeds on primary products and organic residues, and thus plays an important role in the integration of the energy balance of the water ecosystem, (Anene, 2003). It can also be considered as important indicators of the safety of fisheries as a food source for organisms at different levels Higher food (Davies et al., 2009). Zooplankton is an important food source for aquatic organisms, especially fish, and some of their larval stages feed on them throughout their life (Madin et al, 2001).

Materials and Methods

Samples collected

Samples were collected from the study sites at a rate of once per month from the Euphrates River in Samawah during the winter season, at a rate of once per month for the period from December 2021 until February 2022, at a depth of about 30 cm below the surface of the water. Samples were collected with three replicates for each. Site of the study Three samples were drawn from different places from the center and from both sides of the river. In collecting samples from the river water, a net of plankton with holes diameter of 55 microns was used. Samples were collected with 60 liters of water from the station and passed into the network of zooplankton, diameter 55 micro, the sample was concentrated to 100 ml. The samples were kept in special bottles. After adding Furmalin 2 ml.

A map showing the study sites on the Euphrates River in the city of Samawa
Biological Tests

Zooplankton Identification

For the purpose of diagnosing and enumerating the types of zooplankton, a special slide (Sedgewick-Rafter Chamber) was used, which accommodates one ml of the concentrated sample size. Several sources were relied upon in diagnosing zooplankton groups, the most important of these sources (Edmondson, 1959; Pennak, 1978; Pontin, 1978 Smith, 2001; Thorp and Covich) and expressed the results as (3m/in).

Environmental indicators

Index of relative abundance

This indicator was calculated by the abundance ratio based on the following equation explained by (Odum 1971).
Ra = $N*100$/Ns
So: N = the number of returning individuals for each taxonomic unit
Ns = total number of organisms in the sample
The results were expressed using percentage:
Dominant Species : > 70%
70-40% :Abundant Species
40-10% :Less abundant Species
10%:>Rare Species

Results and Discussion

Total Density of Zooplankton

Total density is defined as the total number of people present in a unit of area or volume (Rabee, 2008, El-Shabrawy and Khalifa, 2002;). Differences in zooplankton density depend directly or indirectly on the interaction or overlap between physical and chemical factors and biotic factors such as predation, competition, and phytoplankton density (Salve et al., 2013). The total population density of zooplankton in the current study varied, with the highest values reaching 3110 ind/m^3 in the second site during December 2021, while the lowest values were 260 ind/m^3 in the third site during January 2022 (Figure 1)

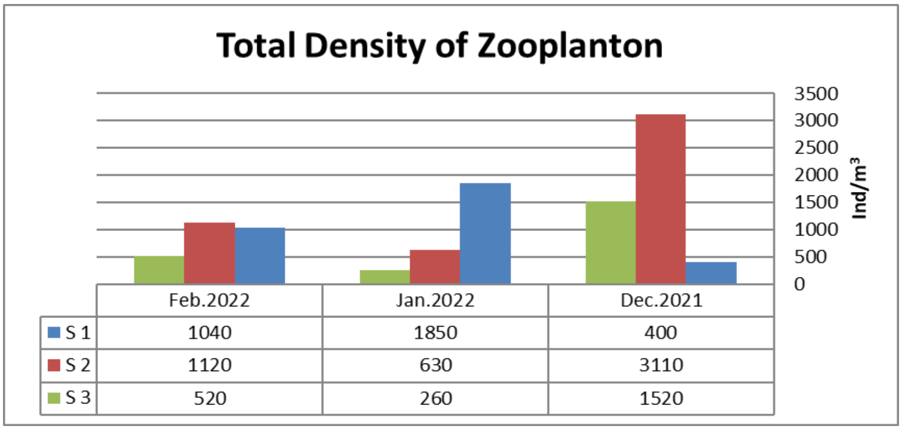


Figure (1): Monthly changes of the total densities of zooplankton per Ind/m^3 in the study sites of the Euphrates River waters in Samawah during the period December 2021 to December 2022

The increase in the total density of zooplankton in winter may be due to the decrease in turbidity in these months, December, January and February. It is known that the negative effect of turbidity, which determines the growth of zooplankton (Deksne, 2011), and that the availability of nutrients is a result of primary productivity and nutrients as a result of moderate degree Heat (Shara and Kotwal, 2011)) The decrease in these months is due to the predation factor by adult fish or their larval stages as well as other aquatic invertebrate predators that feed on each other causing a decrease in their numbers (Jack and Thorp, 2002).

As for the local changes, site 3 (exit of the river from the city) recorded the lowest values. This may be due to the high values of the vital oxygen requirement, and its negative and limiting effect on the growth of zooplankton is known, and this is supported by Deksne (2011). While the highest density of zooplankton was recorded in site 2 (city center), the reason may be due to the nature of physical and chemical factors that mainly control the biodiversity and abundance of species and population density of zooplankton (Koli and Muley, 2012). The flow and abundance of aquatic plants are ideal conditions for zooplankton to thrive .

The results of the current study also show that most of the increases in the total density of zooplankton were during the month of December, consistent with what was mentioned by(Saron and Meitei 2013) . Among the local studies that recorded the highest intensity in the months of December, January and February are the Nimrawi (2005) study in the Tigris and Euphrates rivers, the Ali (2010) study in the Great Zab River, the Nashaat (2010) study on the Tigris River, the Akbar (2013) study on the Gharraf River, and the Al-Karaawi study (2014) in the Kufa River and Salman (2015) study on the Gharraf River and Al-Azawii (2015) study in the Tigris River.

It also agreed with the results of several international studies recorded by Junior et al. (2008) recorded the highest density of zooplankton during winter in Itajai-Acu River in Brazil, while Ramesha and Solphina (2013) recorded the highest density of zooplankton during the blooming period of algae as it increases dissolved oxygen and decreases levels of toxic ammonia in Seeta River in India. These variations in the growth and flourishing density of zooplankton compared with the current study may be due to the suitability of the surrounding environmental conditions that differ from one river to another and from one country to another.

Total Density and Relative Abundance Index (Ra) of Rotifera

The total density of Rotifera in the current study ranged between the highest density of Rotifera 2990 ind/ m^3 during the month of December 2021 in location 2 (the city center), while the lowest values were 220 ind/ m^3 recorded during the month of January in location 3 (exit of the river from the city) (Figure2).

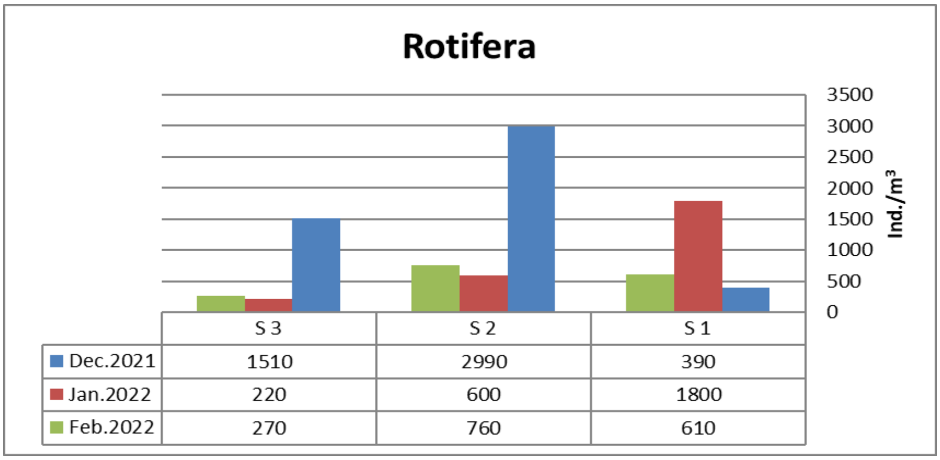


Figure (2): Monthly changes of the total densities of tanks per Ind/m^3 in the study sites for the waters of the Euphrates River in Samawah during the period December 2021 to February 2022.

The highest density of Rotifera was recorded during the month of December and this may be due to the increase in the density of phytoplankton, as the abundance of diatoms in the rivers leads to an increase in the density of Rotifera food relations between them as well as the environmental conditions of the rivers that are suitable for both (Sharma et al., 2010). Locally, Site 2 (city center) recorded the highest density of Rotifera due to environmental factors in an area that determine the presence of many Rotifera genera in that area and not the area itself (Edmondso , 1959).

As for the low density of Rotifera in Site 3 (the river leaving the city), it may be due to the reality of the area and the accompanying high percentage of organic pollutants that, when decomposing, deplete dissolved oxygen (Ahmad et al., 2011). By comparing the results of the total Rotifera densities in the current study with some local studies, Abdul Razzaq (2014) and Merhoon et al.(2017) recorded the highest Rotifera density during December in the Hilla River and AL-Diwaniyah River . The Relative Abundance Index represents the number of individuals returning to one taxonomic unit compared to the total population of individuals (Barbour et al., 1995), and it prepares information about the biome and the extent of the relative contribution of each population within the neighborhoods in the sample, and it can show the extent of the contribution of individuals in the total population and that the increased abundance levels of the organisms resistant to pollution are evidence of the lack of biodiversity (Al-Saadi, 2013).

Table(1) It was clear from the evidence of the relative abundance of the Rotifera (3) recording the percentage of emergence of the species during the study period and for each of the study sites, in Site 1 the type *Aspelta bidentata* was recorded. The highest percentage compared to the total density of other species in this station was 8.6%, followed by *R.neplunia Ehreberg* with 8.2%. As for the type, *Syncheta oblonga* Ehrenberg it reached 4.8%and *Keratella cochlearis* made up 3% of each .

As for station 2, *R. neptunia* recorded the highest percentage compared to the total density of other species in the station, with a percentage of 15%, followed by *Aspelta bidentata* with 12%, *Syncheta oblonga* Ehrenberg with 5 %, and *Brachionus urceolaris* with 3%. As for site 3, *Aspelta bidentata* recorded the highest percentage compared to the total density of other species in this site, at 7.5%, followed by *R. neptunia* with 7.2%, followed by Syncheta oblongas with 2%, while *K.quadrata (logn spin*) recorded. The percentage was 1.8%, and the species *Euchlanis delatata* was 1% Figur(3).

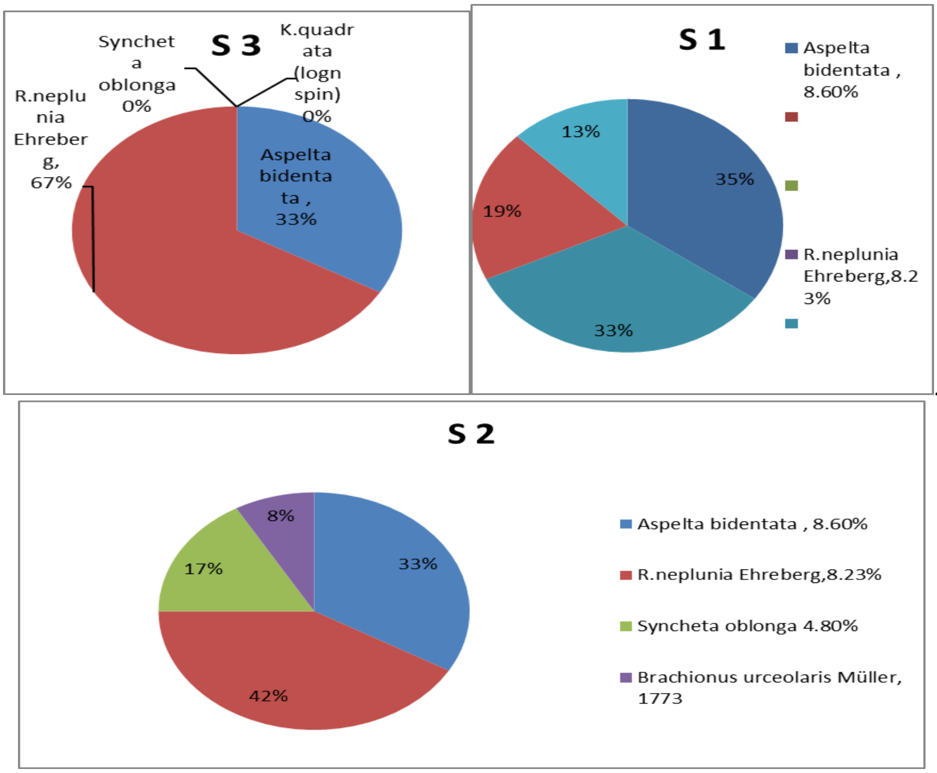


Figure (3): The relative abundance of the predominant Rotifera species in the study sites for the waters of the Euphrates River in the city of Samawah during the period from December 2021 to February 2022.

Total Density and Relative Abundance Index (Ra) of Cladocera

The density of Cladocera recorded during the months of the study in the Euphrates River, values that ranged from non-appearance to 160 Ind/m^3, as the highest values were during December 2021, while its density did not appear in different months of the year (Figure 4).

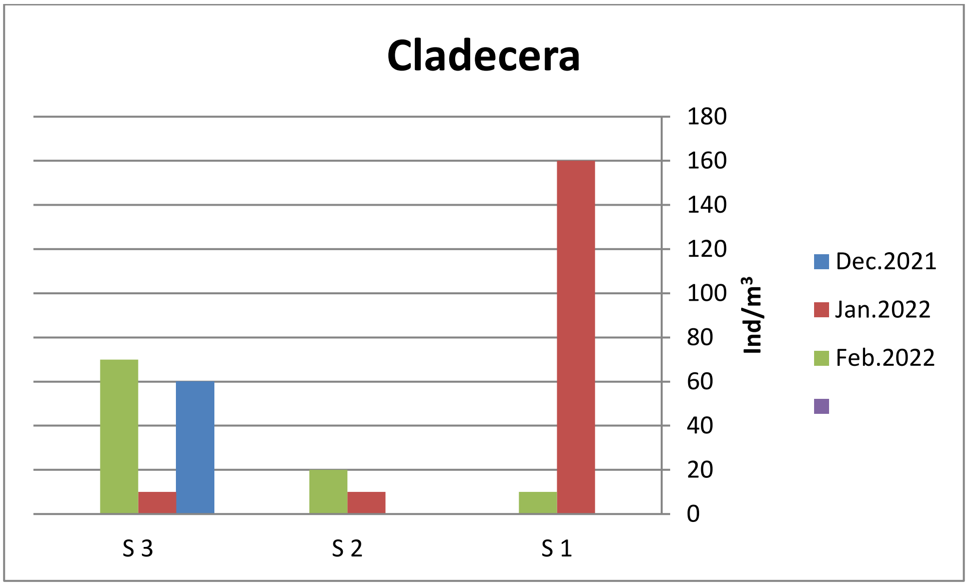


Figure (4): Monthly changes of cladecera total densities per Ind/m^3 in the study sites of the Euphrates River waters in the city of Samawah during the period December 2021 until February 2022

With regard to the monthly changes of Cladecera, few to no densities were recorded during the study months, December, January and February. This may be due to the low density of algae as well as the low temperatures in these months (Honggang et al., 2012), or it may be due to the production of static eggs. Especially in winter under unfavorable environmental conditions (Edmondson, 1959).

As for the local changes, the absence of a group has been observed in some Cladecera stations. This may be due to the sensitivity of some types of crustaceans to various pollutants, or they prefer to exist in waters with little turbidity in which there are aquatic plants, as these plants provide a suitable environment for the living of these wandering animals (Abbas and Al-Lami , 2001), or it may be due to their large sizes compared to other zooplankton groups, which makes them vulnerable to predation, as well as it may be due to their being fast moving animals in water (Ahmad et al., 2011).

Table (1)As for the relative abundance index, the Relative Abundance Index, as it appears that the species did not appear in site 1 of the study, it appeared with very few counters in the first site, the appearance of three species by the same rate of 3% .*Alona gutata* , *A. rectangula Sars* , *Bosmina longirostris*.

In Station 2, Immatur Cladocerai recorded the highest percentage compared to the percentage of other species found in this station, with a percentage of 27%, followed by Comptocercus rectiostris Schqdler,s with a percentage of 15%, followed by 6% *S.vetulus*, followed by *Alona costata*, 5.8%, then species *Chydorus pigra*, with a percentage of 5.8% . As for station 3, only two species appeared, with a percentage of 5.8%: *A.rectangula* and *S.vetulus*. Figure(5).

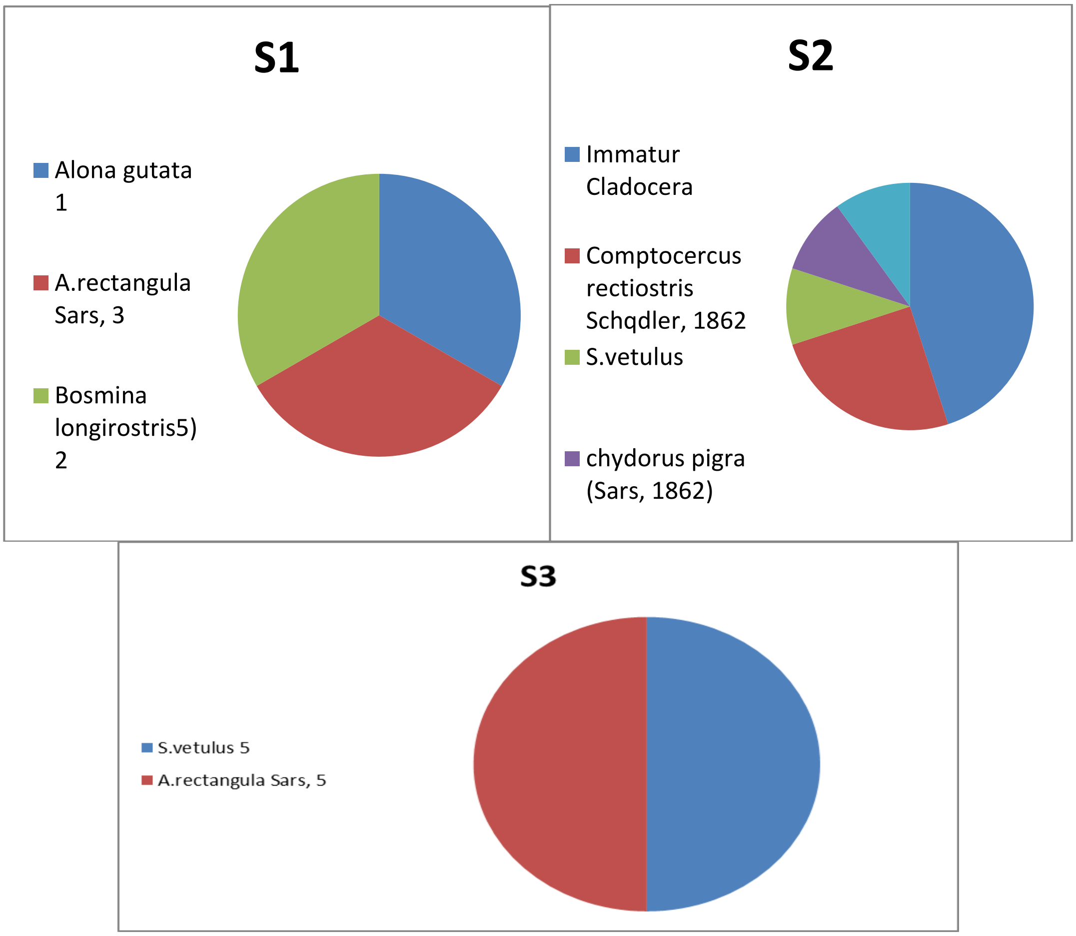
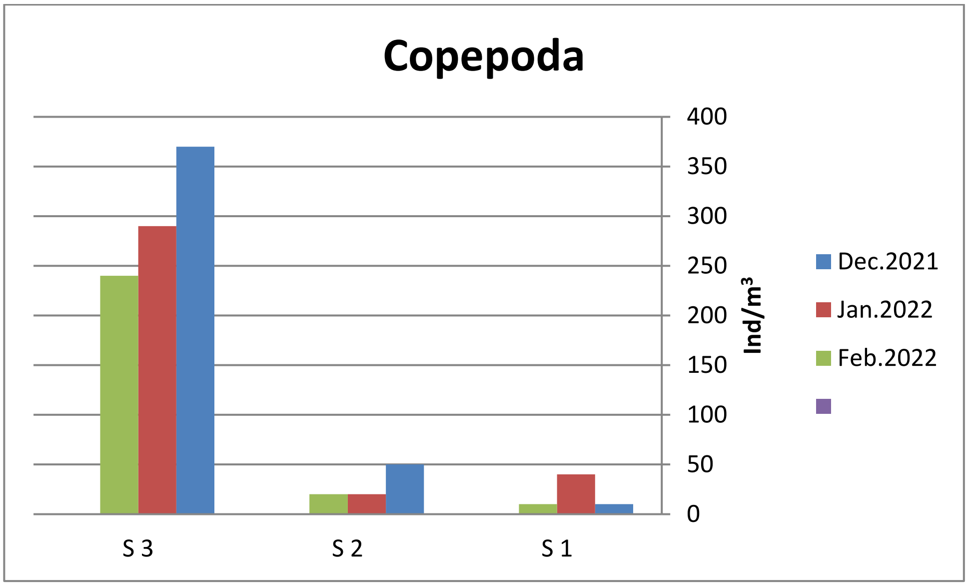


Figure (5): The relative abundance of the predominant Cladcerea species in the study sites for the waters of the Euphrates River in the city of Samawah during the period from December 2021 to February 2022.

Total Density and Relative Abundance Index (Ra) of Copepoda

The Copepoda density in the current study ranged between 10-370 Ind/m^3, where the lowest values were recorded during December 2021 at Station 1, while the highest values were recorded during February 2016 at Station 3 Figure (6).



Figure(6): Monthly changes of Copepoda total densities per Ind/m^3 in the study sites of the Euphrates River waters in the city of Samawah during the period December 2021 until February 2022

The study showed an increase in the total densities of the copepod group during the month of February, and this may be due to the stability of the environmental conditions, which become suitable for its growth (Sharma et al., 2010), as well as the availability of dissolved oxygen concentrations suitable for its growth (Ramesha and Solphina, 2013). Temperature increases the activity of microorganisms that increase the processes of decomposition and thus increase the nutrients, especially those necessary for algal blooms that are followed by the blooming of zooplankton (Amar et al., 2012).

As for the decrease in the total densities of the copepoda group in December in by fish larvae (Shiel et al., 2006). Particular, it may be due to its being affected by predation by vertebrates and aquatic invertebrates, which may be selective for certain sizes. The Cyclopida group is the group most exposed to predation As for the local changes, station 1 recorded the lowest total copepoda density, which appeared in agreement with the study of Dahms et al. (2006) on the Langang River in Taiwan, recorded a decrease in abundance at the top of the river compared to the bottom, while at Station 3, which has abundant aquatic plants on its banks and passes through agricultural lands, as well as calm water, which provided a good environment for the growth and reproduction of this group of organisms and reaching their peak During the study period, this agrees with Mangalo and Akbar (1986) that the presence of appropriate food and aquatic plants and the appropriate role they provide in the reproduction and growth of these organisms.

By comparing the results of the current study with some local and international studies, as the results of the current study did not agree with the study of Al-Lami and his group (2005) .Table (1) As for the evidence of the relative abundance of Copepoda in the study sites, the percentage of Halicyclops sp. It reached 10%, followed by Cyclops (♂) with 9%, and Immatur Cyclop by 9%, while Paracyclops fimbriatus Fischer, 1853 recorded 7%, while the second site recorded the same species in the first site with the highest percentage of Halicyclops sp. 12 % followed by Paracyclops fimbriatus with a percentage of 4%, followed by Immatur Cyclop and Cyclops (♂) with 3% each Figure (7).

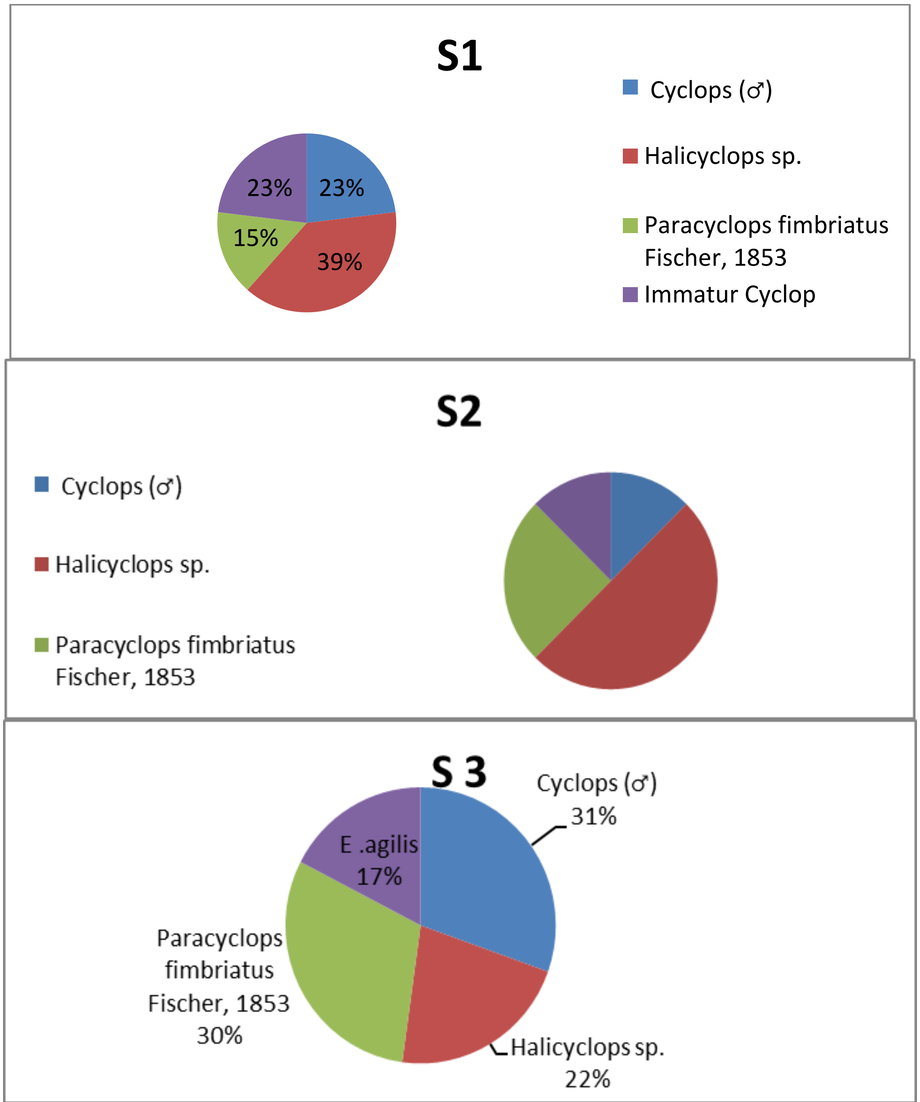


Figure (7): The relative abundance of the predominant Copepoda species in the study sites for the waters of the Euphrates River in the city of Samawah during the period from December 2021 to February 2022

Table (1): Taxonomic units recorded for zooplankton in the Euphrates River in the city of Samawah and their relative abundance according to the Relative Abundance Index, as: R = rare species. Less than (10%) and La = Less abundant (40% -10%) and A = Abundant species (70%-40% and D = Dominant species more than (70%)

taxa	Station		
	S1	S2	S3
ROTIFERA	R	R	R
Argonothlca foliacea	R	LA	R
Anuroaeopsis fissa Gosse, 1851	R	R	0
Aspelta bidentata (Wulfert, 1961)	R	0	0
Asplanecna priodonta Gosse, 1850	R	R	0
Brachionus budapestensis Daday, 1885	0	R	0
B.calcyflorus calcyflorus Pallas, 1766	0	R	R
B.forficula Pallas, 1766	0	R	R
B.quadridentatus (short spin) Hermann,1783	R	0	0
B.rubens Ehrenberg, 1838	R	R	R
B.plicatlus Müller,1786	R	0	R
Dipleuchlanis propalula (Gosse, 1886)	R	0	0
C.exigua (Wulfert, 1938)	0	R	R
Cephalodella gibba (Ehrenberg,1830)	R	R	R
Colurella adriatica (Ehrenberg, 1831)	R	0	0
Euchlanis delatata Ehrenberg, 1832	R	0	0
F. opliensis	0	R	0
Hexarethra mera Hudson,1871	R	R	R
Keratella cochlearis (Gosse, 1851)	R	R	R
K.quadrata (Müller, 1786)	R	R	R
K.quadrata (logn spin) Müller, 1781	R	R	R
K.quadrata (short spin) Müller,1781	0	0	R
Lepadella salpina Donner, 1943	0	R	0
Manfridum.eudactylotum Remane, 1929	0	R	0
Mytilina mucronata Wulfert, 1939	R	R	R
Notomata pochyura (Remane, 1933)	0	0	R
Platyias quadricornis (Ehrenberg, 1832)	R	R	0
P. patulus (Müller, 1786)	R	R	R
Rotaria citrinus (Weber, 1923)	R	R	0
R.neplunia Ehreberg,1830	R	R	R
Stephanoceros fimbriatus (Larva) Berzins,	0	R	0
Testudinella patina (Hermann, 1783)	0	R	0
Cladocera			
Alona costata Sars, 1862	R	0	0
Alona gutata	R	R	R
A.rectangula Sars, 1861	R	R	0
Bosmina longirostris (Müller 1785)	0	LA	0
Comptocercus rectiostris Schqdler, 1862	0	R	R
Chydorus spherecus (Müller, 1785)	0	R	0
Dunhervedia crassa King, 1853	0	R	0

Immatur Cladocera	R	LA	0
S.vetulus	R	R	R
Immatur Cladocera	R	R	0
COPEPODA			
Cyclops vernalis Fisher, 1853	R	R	R
Cyclops (♂)	0	R	R
Ectocyclops phaleratus (Koch, 1838)	R	R	R
E .agilis	0	0	R
Ectocyclops sp .	LA	LA	R
Mesocyclops leukarti	R	0	R
Pentaceraster affinis Sars, 1863	R	0	R
Paracyclops fimbriatus Fischer, 1853	R	R	R
Immatur Cyclop	LA	R	R

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