A comparative study of rotifer community in two lotic vs. Lentic environments

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Abstract

Rotifera population was studied at two stations: the first was in the Garmat -Ali River, and the second in the fish farming ponds of the Marine Science Center at the University of Basrah. Monthly samples were collected for four months, from February to May 2023, using a 40 cm diameter plankton net with a mesh 53-µm aperture. One hundred liters of water were filtered. Some environmental parameters were measured, including water temperature, pH, salinity, and total suspended solids. The quantitative and qualitative composition of the Rotifer population was also studied using modern taxonomic references. Water temperature ranged from 19-25°C at station one, while at station two it ranged from 20-27°C. The lowest salinity value (1.75 g/l) was recorded at station one, and the highest (38.5 g/l) at station two. pH values ranged from 7.11 to 8.19, with the lowest and highest values recorded at station one. The highest total suspended solids (TSS) values were recorded at station two during April, and the lowest at station one during February. The density of Rotifer was highest at station one, reaching 4.186 individuals/L during May, and lowest at station two (1.395 individuals/l). Nine genera of Rotifer were identified, with the highest number of species recorded at station one during May and the lowest at station two during February. The aim of the study is to compare the qualitative and quantitative composition of the rotifer community between two different environments. The study showed that both environments exhibited homogeneous diversity and densities of the phylloxera community, but the river environment showed the emergence of species that disappeared in the basin environment. This is due to the diversity of food resources along the river, while the basin environment is limited and depends on fertilization seasons.

Keywords: Rotifers community, Garmat-Ali River, aquatic environments.

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Introduction

Rotifera (also called Rotatoria) are a group of relatively small, microscopic aquatic invertebrates comprising slightly more than 2000 identified species of Unsegmented animals with bilateral symmetry and a pseudocoelom (Segers, 2004). Most Rotifera inhabit littoral environments-approximately 75% are true planktonic and far removed from surface symbiosis (Pennek, 1978). The Rotifera are a small group that inhabits the aquatic environment, but they are more important and present in the freshwater environment, as they form an important link in the food web chain, as the larvae of larger animals depend on them for nutrition(Hammadi *et al*., 2012). This is due to their small size and their presence in large numbers, as their reproduction rates are fast, in fact, they are the fastest among multicellular animals (Metazoa) (Lawrence *et al*., 2012), and they often reach high-density groups.

Most Rotifera species inhabit freshwater, but some live in brackish waters such as estuaries, and a few inhabit marine environments (Fradkin, 2001). Some species have even been found in sea ice cores from the Arctic (Chengalath, 1985) and the Baltic Sea (Werner & Auel, 2004). However, they have not yet been found in Antarctica (Schnack Schiel, 2003). Furthermore, the order Seisonacea, which includes only three species, and the suborder Monogononta, which comprises about 100 species, are entirely marine. Rotifera species generally possess three main characteristics: a ciliated anterior end called the corona, jaws called trophi, and a thickened body wall called the lorica (Hammadi *et al*., 2012).

Previous Studies

Gurney (1921) was the first to study zooplankton, as well as some benthos, in certain areas of Iraqi inland waters extending from the Tigris River in Maysan Governorate to the Shatt al-Arab and the Arabian Gulf. Other studies followed, such as (Mohammed, 1965) study on the Cladocera in southern Iraq. However, no researchers addressed brachionids until the study by Al-Saboonchi *et al*. (1986), in which they identified 11 species of brachionids. Ali & Abdullah (1999) tracked changes in Rotifers biomass in relation with changes in phytoplankton biomass in the Shatt Al-Arab. Then, Ahmed *et al*. (2005) demonstrated monthly changes in nutrients and chlorophyll-a levels, on the one hand, and Rotifera density, on the other, in the northern part of the Shatt al-Arab, recording 23 species of this group.

Ahmed & Mohammed (2006) studied Rotifera community in the marshes of southern Iraq, followed by Ali and Ghazi (2008) who investigated the Rotifera of the Shatt Al-Arab from Qurna to Faw and recorded 47 taxonomies. Ghazi & Ahmed (2008) also studied the abundance and diversity of Rotifera in ponds belonging to the Garmat Ali area and recorded 26 species. Furthermore, a study by Salman *et al*. (2008) identified 105 species of Rotifera in the marshes of southern Iraq. The aim of the study is to compare the qualitative and quantitative composition of the rotifer community between two different environments.

Materials And Methods

Two stations were selected for conducting the current study, one in a flowing water environment in the Garmat-Ali River and the second in a still water environment, which is the fish farming ponds belonging to the Marine Science Centre at the University of Basrah site (Figure 1).

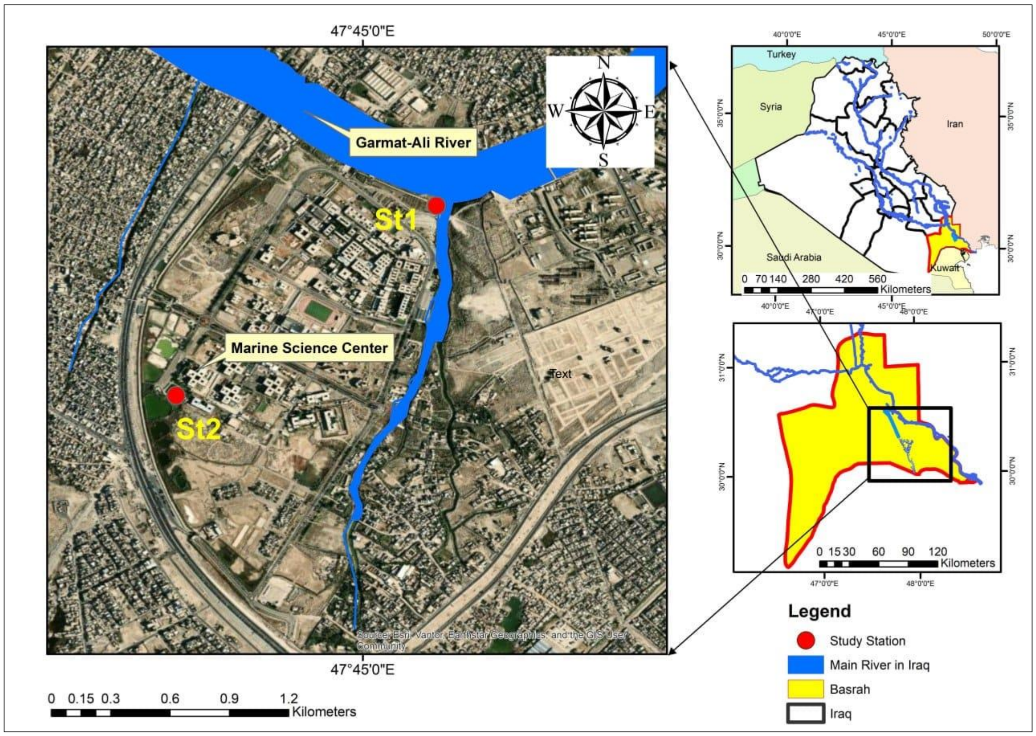

Figure (1): It shows the sample collection sites.

Water and biological samples were collected from the two selected stations through period from to February and May 2023. The rotifer samples were collected using zooplankton net with a 53-micron mesh size by hauling them horizontally for a distance of three meters. The samples were placed in plastic bottles and preserved with (4% formalin). Water temperature, salinity, and pH were measured using a YSI multi meter.

Total (TSS) were measured using the method described by the American Public Health Association (APHA, 2005), by filtering 100 cm3 of the sample through pre-dried and weighed Miliporefilter papers (0.45 μm). The paper was then transferred to an electric oven at (105) °C to ensure complete evaporation of the water. The results were expressed in mg/l. The amount of total suspended solids was determined from the following equation:

TSS (mg/l) = A - B/ (C) × 1000

•Where:

•A = Weight of filter paper and suspended solids.

•B = Weight of empty filter paper.

•C = Sample volume (100 ml)

The study used an Oven apparatus (Memmert type), a sensitive balance (OHAUS type), filter paper (2.5cm type), and a compound microscope (Humascope Plus type). (Taxographic sources: Fernando, 2002; Hammadi *et al.,* 2012).

Some environmental indices such as the Diversity Index and the Richness Index were used and data were statistically analyzed using Canoco software and SPSS software to determine the correlation coefficient and significant differences between the two stations.

Rotifera

Water and biological samples were collected from the two selected stations during the period from February to May 2023. A net was used to collect rotiferas, with a diameter of 40 cm and a pore size of 53 micrometers, by passing a quantity of 100 litres of water through the net. The contents of the net were then placed in a 500 ml bottle, and the samples were preserved with 4% formalin and transported to the laboratory.

Method of counting the Rotifera: Before taking the secondary sample, the sample was shaken in multiple directions, taking care not to shake in a circular motion or in a way that would cause the Rotifera to concentrate in the center area or be uneven. Then, 1 ml of the 100 ml sample was taken and placed on the counting slide, and the slide cover was gently placed on top without leaving any air bubbles. The counting slide can hold 1 ml, so after adding more, if an air bubble is found, we do not use a larger sample to remove it. Instead, we use distilled water to fill the slide. Then, the counting slide was placed in the field of examination of the compound microscope, using the smallest objective lens by placing the samples under the light focus. Then, the objective lens was replaced with a lens of higher magnification while keeping the position of the samples under the light focus. Then, the samples were counted from one corner of the slide while moving the slide in the same direction along the horizontal line that we started counting, then the adjacent sector was examined, and so on to the rest of the sectors of the slide.

The previous steps were repeated until a representative number of the quantities was obtained. The count results were then recorded in the section of the slide where the suspended particles were counted, using the unit (individuals/ml0 (Ghazi 2005). The method described by the American Public Health Association (APHA) (2005) was followed to calculate the population abundance using the following equation:

Total Number/l = C * V1 / V2 * V3

Where:

C = Number of individuals

V2 = Sample volume in litres

V2 = Secondary sample volume in millilitres

V3 = Filtered sample volume in litters

Results

Water temperature ranged from 19-25 °C at station 1 and from 20-27 °C at station 2 (Figure 2). The lowest salinity value (1.75 g/l) was recorded at station 1, and the highest (38.5 g/l) at station 2 (Figure 3). pH values ranged from 7.1 to 8.2, with the lowest values at station 2 and the highest at station 1 (Figure 4). The highest value for TSS substances was recorded at station 1 in the month of Dh, reaching 0.082, while the highest value at station 2 was recorded in the month of April, reaching 0.307. The lowest value was recorded at station 1, reaching 0.039 mg/L. (Figure 5).

The highest density of the Rotifra was recorded at station one, reaching 10.43 individuals/L. The highest density was recorded for the species *Polyarthra* sp.at 1.99

individuals/L in May, while the lowest density was recorded for the *Bdelloidea SP*, which disappeared from this station.

At station two, the total density was recorded at 8.59 individuals/L, with the highest density for the species Synchaeta at 1.99 individuals/L in March. Most species recorded minimum values of (0) throughout the study period. The species *Anuraeopsis fissa* and *Aschomorpha sp* disappeared from this station(Table1).

By observing Figure (6), which represents the strength of the correlation between the studied species and the measured environmental factors, we note that species such as *Asplanchna sp*., *Bdelloidea sp*., *Brachionus spp*., and *Synchaeta spp*. were highly affected by most environmental factors, while species *Anuraeopsis fissa*, *Aschomorpha sp*., *Polyarthra sp*., and *Keratella quadrata* were only minimally affected. The species *Lecane sp*. showed no effect whatsoever on the measured environmental factors.

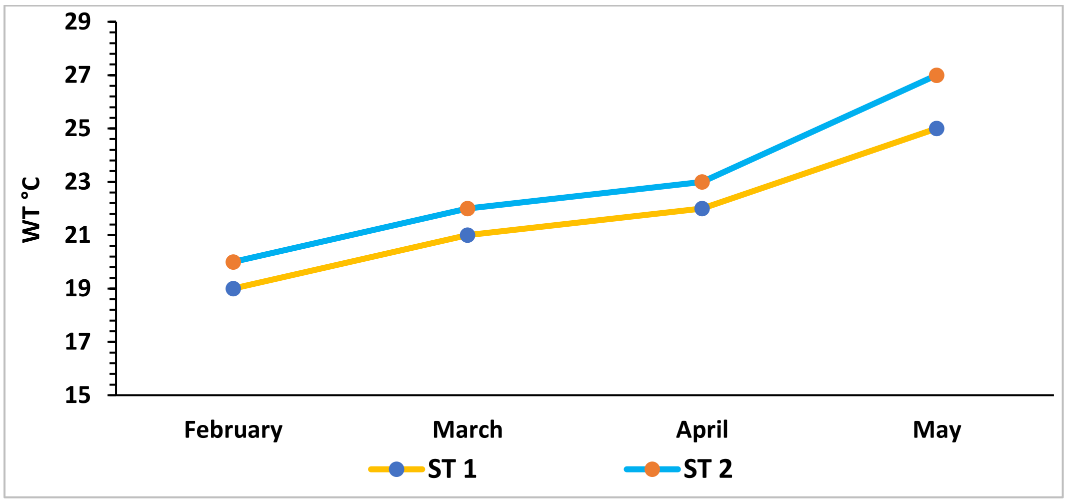

Figure (2): Monthly variation in water temperature for the study stations during 2019.

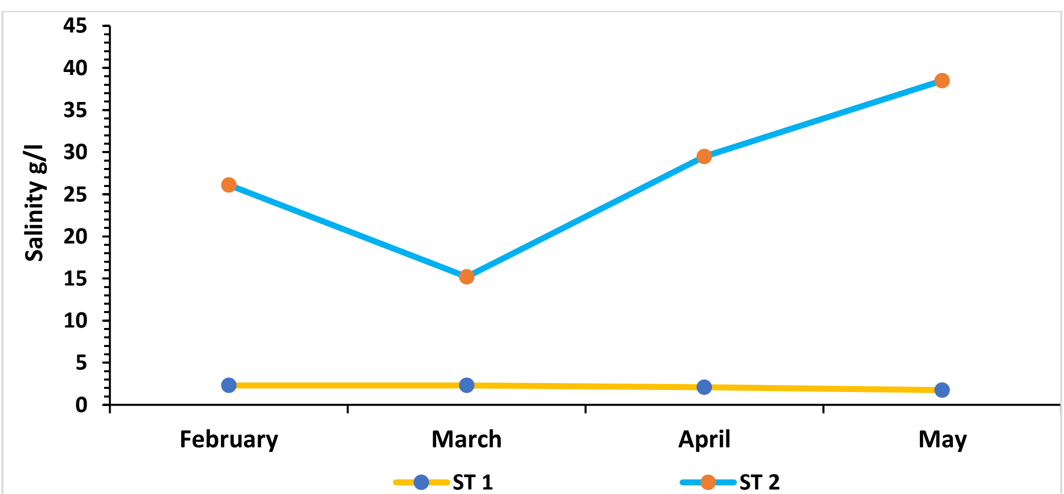

Figure (3): Monthly variation in water salinity concentrations for the study stations during 2019.

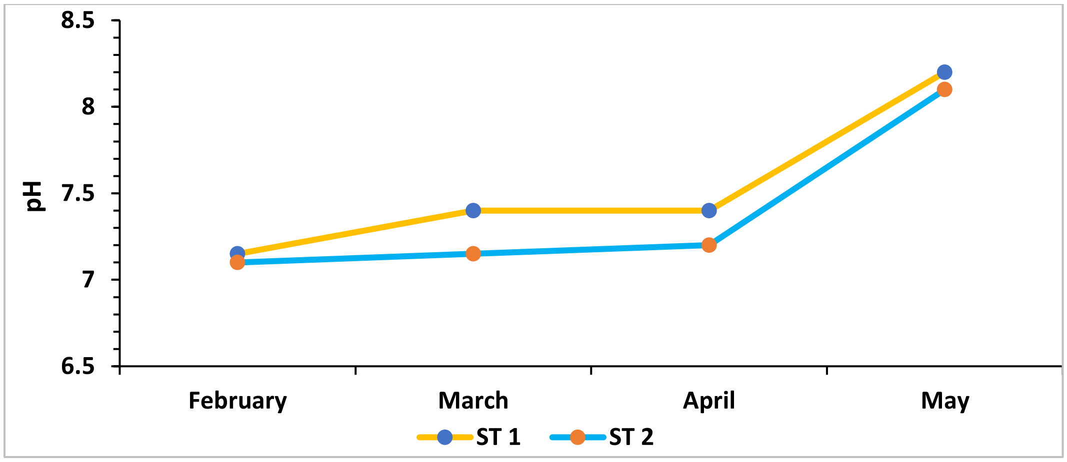

Figure (4): Monthly variation in pH values for study stations during 2019.

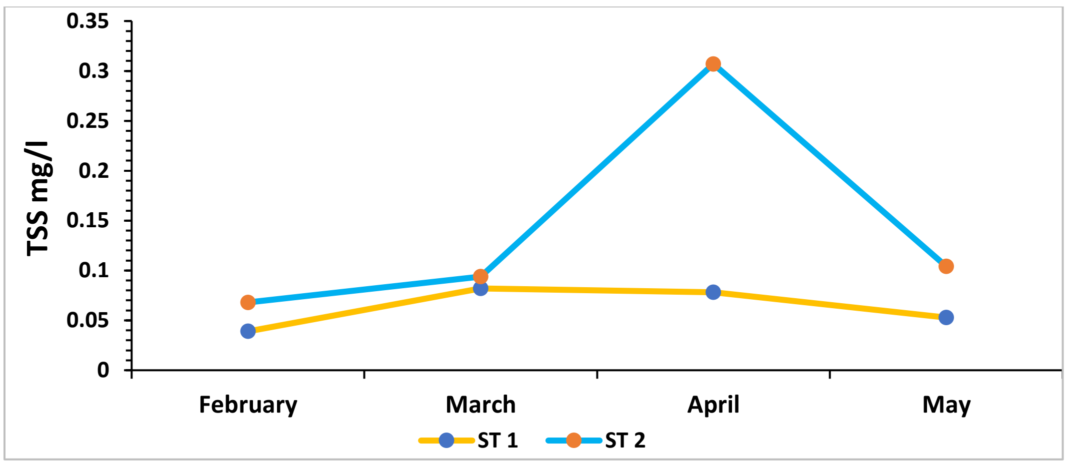

Figure (5): Monthly variation in total suspended solids values for the study stations during 2019.

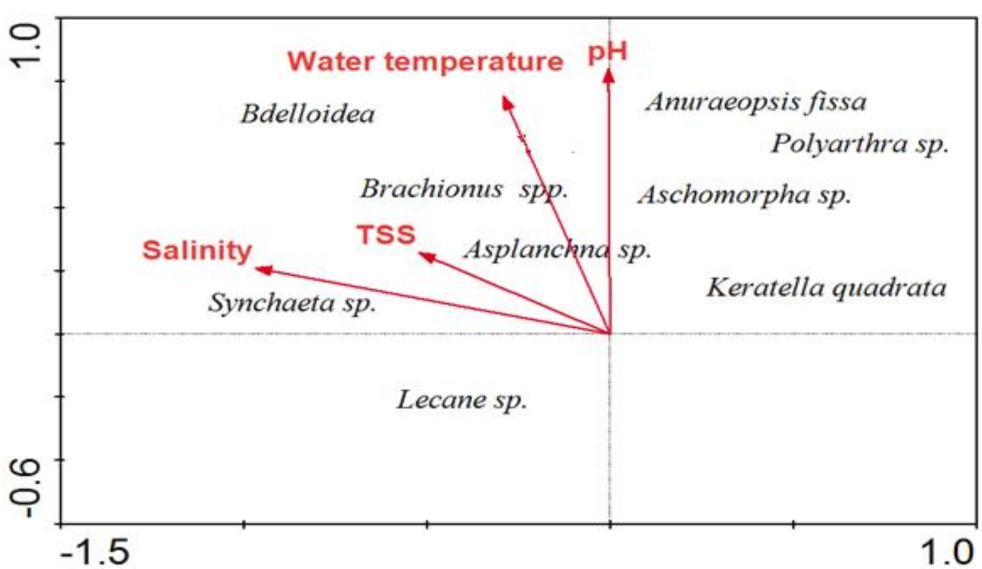

Figure (6): CCA analysis using the Canoco program for the correlation coefficient values between Rotifera species and environmental factors at two stations over four months during 2023.

Table 1: Density of Rotifera (ind./l) at the two stations for the period from February to May 2023.

species	staion 1				station 2			
	February	March	April	May	February	March	April	May
Anuraeopsis fissa	0	0	0	0.19	0	0	0	0
Aschomorpha sp	0	0	0	0.79	0	0	0	0
Asplanchna sp	0	0	0.39	0	0	0	0.59	0.39
Brachionus spp	0.19	0	0.19	0.39	0	0	0	0.19
Bdelloidea	0	0	0	0	0	0	0.59	0.39
Keratella quadrata	0	0.19	0.19	0.19	0.19	0	0	0
Lecane sp	0.79	1.39	0	0	0	1.69	0	0.99
Polyarthra spp	0	0	0.19	1.99	0	0	0.19	0
Synchaeta spp	0.99	0.79	0.99	0.59	1.39	1.99	0	0

Discussion

Water temperature is one of the most important environmental factors, as it is closely linked to the abundance of aquatic life (Li, *et al.*, 1989), It is one of the most important factors affecting the presence, density, and distribution of organisms, as well as their biological and physiological activities (Kinnesh, 1986), in the current study showed a slight difference in temperatures between the two stations, ranging from one to two degrees, the temperature was lower at the first station than at the second, this may be due to the first station having more open, flowing water than the second station, which was relatively small in area as it consisted of fish farming ponds, this is consistent with the findings of previous studies (Andrei-Emil *et. al.*, 2020; Piccolroaz, *et. al.*, 2024). This aligns with the conclusions of many researchers, such as (Al-Suwaij, 1999; Hussein & Attee, 2000).

Reid (1961) classified water according to salinity values: fresh (less than 0.5 ppt), brackish (more than 0.5 mg/l and less than 30 mg/l), and saline (more than 35 g/l). Based on this classification, the water from the first station was brackish, while the water from the second station was saline. As (Andrei-Emil, *et. al.*, 2020 and Piccolroaz, *et. al.*, 2024). The TSS values were consistent with the salinity values. Indicated in their study, the various uses of water, along with the rising groundwater levels in central and southern Iraq, the saltwater intrusion from the Arabian Gulf via the Shatt al-Arab waterway affecting Basra, and the reduced freshwater flow from the Tigris River, all contribute to increased salinity levels, especially during periods of drought and low rainfall. This was clearly evident in the second station during May in this study, while rainfall affected salinity levels, leading to a decrease during March.

Alkaline characteristic is the dominant characteristic of Iraqi waters due to the abundance of bicarbonate and carbonate ions (Al-Rubaie, 1997). On the one hand, and on the other hand, many factors affect the pH values, including the decrease or increase in the concentration of dissolved carbon dioxide due to photosynthesis processes that lead to the consumption of carbon dioxide and then a decrease in pH values (Sabri *et al*., 1989), pH values recorded in many rivers around the world have ranged within a narrow range similar to the current study, including the James River (7.5-8) in the United States (Marshall & Nesius, 1993) and the Nile River (8-9.1) in Africa (Whitton, 1975).

The results of the study showed differences in the distribution of types of zooplankton. This difference may be due to the difference in the values of environmental factors and conditions Li *et al*. (2024). This is consistent with what was concluded by (Ajeel *et al*., 2001; Hammadi *et al*., 2012). Also, the size of the net plays a major role in determining the type and quantity of zooplankton (Ajeel, 1998). Dissemination can occur through various means: such as wind and rain, via epizoochory animals, on skin, feathers and fur, or within animals (endozoochory) in the digestive tracts of arthropods and vertebrates (Dumont, 1980).

There is ample evidence for the spread of rotifers over both short and long distances (Iakovenko *et al*., 2026). It is common knowledge that newly constructed ponds and other artificial bodies of water sometimes develop their own rotifer populations within a few days or weeks of being first filled. For example, Pontin (1989) observed that *Keratella valga* and some microscopic crustaceans used a horse paw-washing pond within two weeks of it being re-excavated and refilled after being left to dry for approximately 40 days.

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مقارنة لمجتمع الدولابيات بين بيئتين ساكنة ومتحركة

صبا عباس كاظم

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المستخلص

دُرِسَتْ مجموعة الدولابيات في محطتين الأولى في منطقة كرمة علي، والثانية في احواض تربية الأسماك التابعة لمركز علوم البحار في جامعة البصرة. جُمِعَتْ عينات شهرية لمدة اربعة أشهر، وذلك للفترة من شباط لغاية آيار 2023 تباعا بواسطة شبكة العوالق قطر فوهتها 40 سم وحجم فتحاتها 53 مايكرومتر وذلك عن طريق ترشيح 100 لتر ماء خلال الشبكة. قيستْ بعض العوامل البيئية والتي تضمنت درجة حرارة الماء والأس الهيدروجيني والملوحة و المواد الصلبة العالقة الكلية ، كما دُرِسَ التكوين الكمي والنوعي للدولابيات من خلال الاستعانة بمصادر تصنيفية حديثة. تراوحت درجة حرارة الماء بين (19-25) °م في المحطة الأولى أما المحطة الثانية فسجلت قيما ما بين (20–27) °م، وكانت أدنى قيمة للملوحة (1.75) غم/لتر في المحطة الأولى وأعلاها في المحطة الثانية (38.5) غم /لتر. تراوحت قيم الأس الهيدروجيني بين (7.11–8.19) إذ سجل أدناها وأعلاها في المحطة الأولى، بينما سجلت اعلى قيم للمواد الصلبة العالقة TSS في المحطة الثانية خلال شهر نيسان وادناها في المحطة الاولى خلال شهر شباط. بينت قيم كثافة الدولابيات ارتفاعا في المحطة الاولى إذ بلغت (4.186) فرد /لتر خلال شهر آيار وكانت ادناها في المحطة الثانية (1.395) فرد/ لتر. شخصت 9 اجناس من الدولابيات اذ بلغ اعلى عدد للأنواع خلال شهر ايار في المحطة الاولى وادناه في شهر شباط في المحطة الثانية. تهدف الدراسة الحالية الى اجراء دراسة تصنيفية وبيئية عن الدولابيات في بيئتين مختلفتين، وأظهرت بيئتي الدراسة تنوع وكثافات متجانسة لمجتمع الدولابيات لكن أظهرت بيئة النهر ظهور لأنواع اختفت في بيئة الأحواض ويعود ذلك إلى تنوع الموارد الغذائية على امتداد النهر بينما بيئة الأحواض محدودة وتعتمد على مواسم التسميد.

الكلمات المفتاحية: مجتمع الروتيفيرا، نهر كرمة علي، بيئات ساكنة.