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An Environmental Study to Compare Biodiversity and Distribution for Rotifera Community on Different Sites of the Janabi River's in the Wasit Province, Iraq

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Abstarct: The qualitative and quantitative composition of the rotifera community was studied for four seasons of 2023 at three sites.Forty-seven Rotifera taxonomic units were identified. The total density ranged from 12463.6 to 3764.3 Ind./m3, whereas S3 was recorded as the lowest number of species, and this site was considered an area for discharging sewage with river water. The relative abundance, Shannon-Wiener coefficient ranged from 2.92-1.78bit/Ind, Uniformity of species index ranged from 0.96-0.57, species richness ranged from 6.21-3.08, and Jaccard index of similarity studied ranged from 55.98% -52.58%. Site 3 recorded a clear decrease was observed of the environmental indicators due to the influence of sewage water. Thus, the results showed a clear negative impact on the diversity of the rotifera community.

Key points: Invertebrate; Janabi River; biodiversity; Rotifera; Zooplankton.

1.Introduction

Rotifera are a microscopic group of multicellular invertebrate animals that live in aquatic and semi-aquatic environments. They are also known as rotifera due to the presence of a ciliated area at the front end, hence their name according to the strokes of those cilia (15). They are considered very small animals and often have thin body wall, with adult lengths ranging from 40-2000µ. (23). Rotifera are crucial to the functioning of most freshwater ecosystems because of the role they play in the food chain. They are found in all freshwater bodies, from large permanent lakes to small temporary ponds, and in sewage ponds. (11). Zooplankton groups are impacted by abiotic and biotic factors (e.g. light, hydrology, water physicochemical characteristics, parasitism, competition, and predation). Spatial and temporal variation occurs to these factors in aquatic life (35). Rotifera were used in our current study due to their small size, short life cycle, and high sensitivity to surrounding conditions (12).

Many field local studies evaluated with quantitative and qualitative of zooplankton as well as rotifers, Cladocera, and Copepoda, assemblage including:- (1); (4); (25); (22); (6);(2); (7);(20,21).

The aim of this study is to serve as an introduction to other future studies that attempt to cover and prepare data on biodiversity indicators in all Iraqi water bodies, as these indicators are a true reflection of water quality, as their increase gives evidence of the health of these environments, and their decrease reflects the occurrence of environmental pollution.

2.METHODOLOGY

2.1 Study Area:

The study was attempted on the Janabi River, which is one of the branches of the Gharraf River. Its length is about 13,300 Km, its width is 19m, and its depth is about 230cm. It irrigates an area of 200,000 Acres, of cultivated areas (Agriculture Directorate of Hay District). The river was divided

into three sites. The first (S1) was located at 30.18.69° longitude and 44.02.80° latitude. The second site (S2) was about 5,150 Km away from the first site and was located at 30.14.34° longitude and 44.04.90° latitude. The third site (S3) was about 3,400 Km away from the second site and was located at 29.15.20° longitude and 44.04.59° latitude. The third site (S3) was the area near wastewater effluent. The total distance between the first and third sites was 8,550 Km.

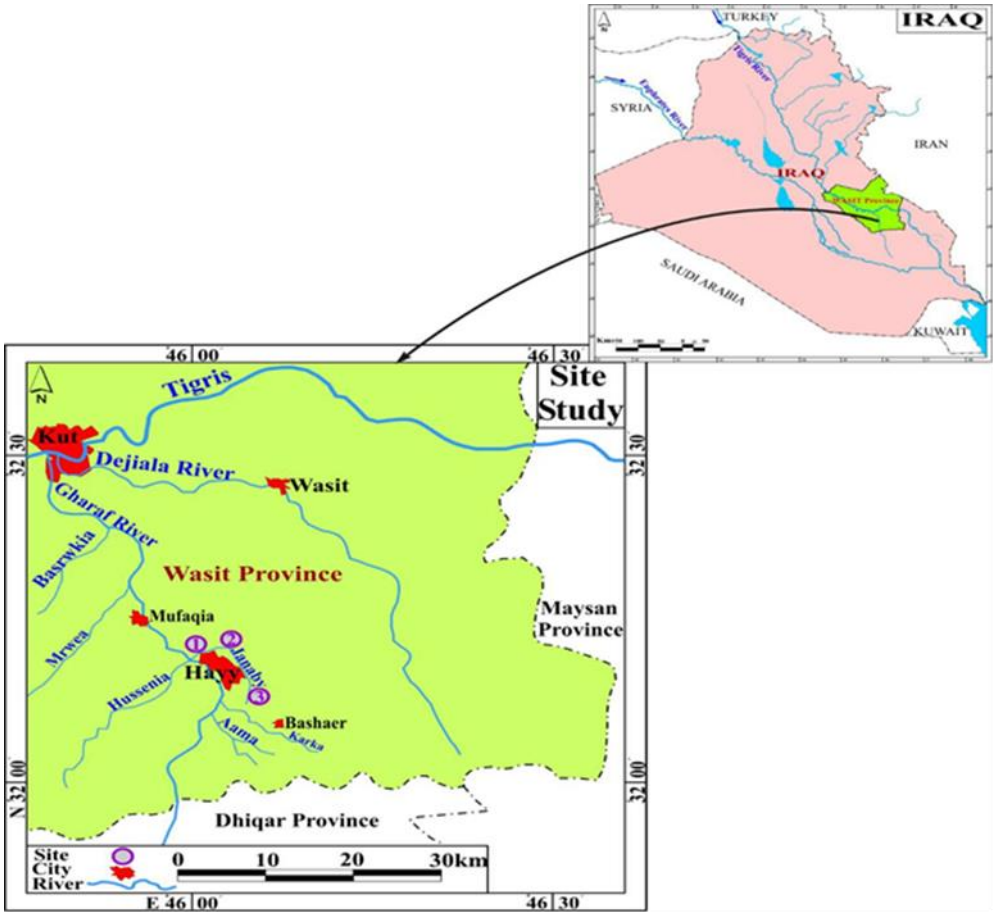

Figure 1. Map showing the studied site on the Janabi River

2.2 Sample Collection

Samples were collected seasonally during 2023. Forty-five of each site's water was filtered at 0.5-1 m depth below the surface of the water, and it was passed through a Hydro-Bios plankton net with 55µ diameter. After that, the samples were concentrated to 10 ml, and then the samples were preserved directly in special bottles by adding 4% formalin (34). Species were examined by using a compound microscope and different identification keys were adopted (10), (31), (29), (33). The results were expressed as individual/m^3.

*Measures of diversity:*The following ecological indicators have been accountable**:** Relative Abundance Index (Ra):This was determined using the formula presented by (28),Ra% = (N÷Ns)*100 where N: a number of individuals at each taxonomic unit;Ns: the total number in the sample.Species Richness Index (D) was determined monthly by using (24) formula D = (S-1)÷log N where S: species no.; N: total numbers of individuals. Jaccard presence – community**:** According to(13) formula ISj= [C÷(A+B-C)] where *A* = no. of species on site A. *B* = no. of species on site B and*C* = no. of species in both of A and B sites.Shannon–Weiner Diversity Index (H) was determined monthly by using (32) formula. H=∑(ni÷n)*Ln (ni÷n)whereni: individuals no. per taxonomic unit; n: the total summation of individuals. A bit./Ind. unit expressed the results. The Species Uniformity Index (E) was calculated using (26) formula. E = H÷LnS where LnS: the greatest theoretical value is diversity;H: Value of Shannon-Weiner; S: number of taxonomic units at each site. (30) stated that if the index value were more than 0.5, uniformity would be apparent.

3. RESULTS AND DISCUSSION

Forty-seven species of rotifera were identified at all sites throughout the study period. The highest number of species was identified belonging to the *Brachionus*, represented by seven species, while six species were identified for the *Keratella*, six species for the *Lecan*, and three species for the *Monostyla*. The interplay species among the sites were 13 species out of 47 species that were diagnosed during the study period. This result is consistent with what was recorded by (9).

Eighteen species of rotifera were recorded in S1, with a monthly density of 12,463.6 Ind./m^3. The greatest monthly density peaks occurred during autumn as much as 4,977.1 Ind./m3, and the lowest in summer, reaching 1,466 Ind./m3. This may be this way since the level of the Phytoplankton is high, and this is because the concentration of Diatoms in the rivers is high, this means that as the abundance of Diatoms rises, the level of Rotifera increases due to their nutritional relationship, and also due to the conditions of the rivers which are suitable for both to live in it. (16). This outcome agrees with what was observed by (5).

On a S2, the number of rotifera species, 26, was determined and the monthly density was 5952.1 Ind./m3. A peak of 2132.7 Ind. / m3 occurred in spring and a lower density of 1199.1 Ind. / m3 was registered in the summer.

The lowest monthly density among all sites was recorded on S3, with 23 species of rotifera, reaching to 3764.3 Ind./m^3. The highest value was recorded in the spring, reaching to 1899.1 Ind./m^3, and the lowest in the winter, which amounted to 844 Ind./m^3. This may be due to the site falling under the influence of wastewater and the significant amount of organic contaminants that are present that, when decomposed, lead to the depletion of dissolved oxygen (3) as shown in Figure 2.

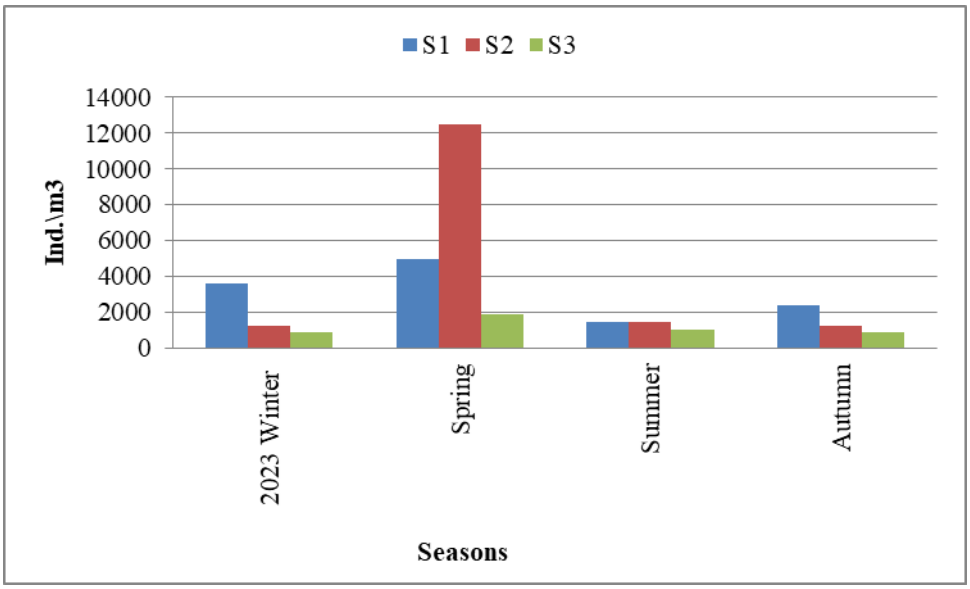

Figure 2. Seasonal variations of the rotifera total density during the period study

3.1 Environmental indicators

The current study showed that the highest values for the Shannon-Wiener index (Figure 3) were recorded in the S2 which amounted to 2.19-2.92 bit/Ind., while the lowest values were recorded in the S1 which amounted to 1.78-2.44 bit/Ind. While on S3 this index ranges from 2.16-2.57 bit/Ind. This case is consistent with what was stated by (27) that the critical conditions to which the environment is exposed are accompanied by a decrease in biodiversity, and it is possible that there will be a great opportunity to increase the number of other opportunistic organisms that were originally present in a few, and in return, other species disappear or migrate because they are unable to bear those conditions.

The lowest diversity rate was recorded on S1 in the spring, while the highest value was recorded on S2 in the summer. This could be due to the nature of the water quality and the environmental

suitability conditions, including good ventilation, intensity of lighting, and vegetation density, which helps in the presence and abundance of rotifera (17).

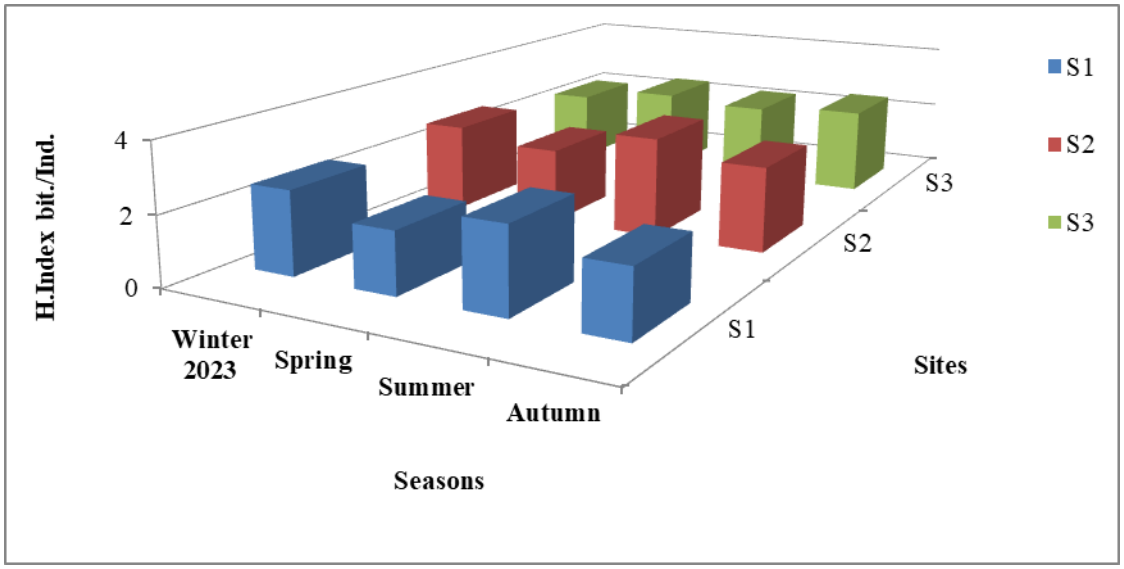

Figure 3. Seasonal variations of the rotifera species Shannon-Weiner Index (H) in the Janabi River during the study period

As for the values of the species richness index, it is clear from Figure (4) that they are the best indicator of change in the ecosystem, as increasing the richness index value of taxonomic units, including the number of different species, is linked to an increase in the nature of the biological community and the place in which it lives (8). The lowest species richness (D) value was registered on S3, which reached 3.08 in autumn, and the highest species richness (D) value was registered on S2, which reached 6.21 during spring. The increase in the Rotifera richness species may be due to several reasons, including the presence of vegetation cover, which provides a suitable environment for the presence of coastal species attached to plants, as well as the abundance of food along the river course contributed to the distribution of the Rotifera community based on the principle of benefiting from transported food (18).

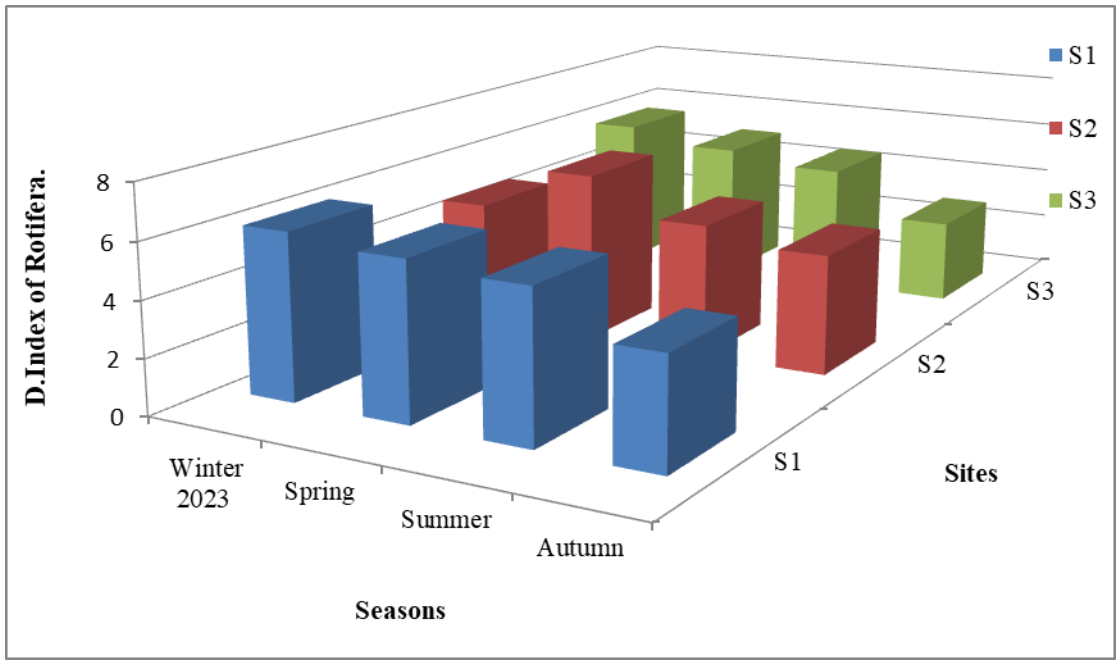

Figure 4. Seasonal variations of the rotifera species richness index in the Janabi River during the study period

While the results of the species uniformity index showed that the highest value was in the summer which reached to 0.96 on the S2, and the lowest value was in the spring which reached to 0.57 on

the S1(Figure 5). An absence of environmental pressure, as shown by the high species uniformity index values in this study, creates a favourable environment for rotifera stability (19).

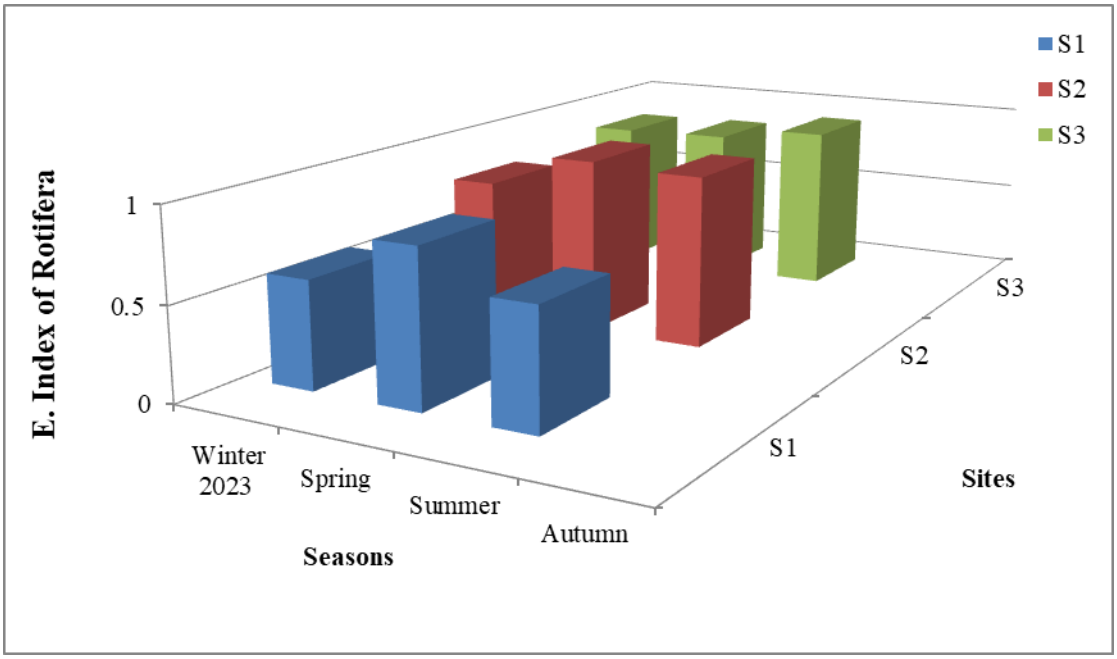

Figure 5. The Seasonal variations of the rotifera species uniformity index (E) in the Janabi River during the period study

It is clear from the relative abundance index that there are five species that were the less abundant in all sites including *Brachinousurceolaris*, *Keratellacochlearis*, *K.quadrata* (long spin), *K.valga* and *R.neptunia*. As for the rest of the species, they were rare (Table 1).

Table 1. Relative abundance index (Ra Index) = R = rare species (<10% and La = less abundant species (40%-10%) and A = Abundant species) (70%-40 % and D = Dominant species (>70%). in the samples in the studied sites at the Janabi River.

	Site / Taxa	Ra		
		1	2	3
	ROTIFERA			
1	***Anuroaeopsisfissa* Gosse, 1851**	-	-	-
2	***Aspeltabidentata* (Wulfert, 1961)**	R	R	R
3	***Asplanecnapriodonta* Gosse, 1850**	R	R	R
4	***Brachionusangularis* Gosse, 1851**	-	R	R
5	***B.calcyfloruscalcyflorus* Pallas, 1766**	R	R	-
6	***B.calcyflorusamphecerus*(long spin) Pallas, 1766**	-	-	R
7	***B.calcyflorusamphecerus*(short spin) Pallas, 1766**	-	R	R
8	***B.quadridentatus*Hermann,1783**	R	R	-
9	***B.plicatlus* Muller,1786**	-	R	-
10	***Brachionusurceolaris* Muller, 1773**	-	R	La
11	***Cephalodellaaureculata* (Wulfert, 1938)**	-	-	-
12	***Cephalodellagibba* Ehrenberg,1830**	-	-	R
13	***Colurellaadriatica* Ehrenberg, 1831**	-	R	R
14	***Euchlanisdelatata* Ehrenberg, 1832**	R	R	R
15	***Fillinalongiseteа*Ehrenberg, 1834**	R	-	-
16	***Hexarethramera* Hudson,1871**	-	-	-
17	***Keratellacochlearis* Gosse, 1851**	La	La	R
18	***K.tropica*(Apstein, 1907)**	R	R	R

19	***K.quadrata*Muller, 1786**	R	-	-
20	***K.quadratalogn spin* Muller, 1781**	La	R	-
21	***K.quadratashortspin* Muller,1781**	-	-	-
22	***K. valga* Ehrenberg, 1834**	La	R	R
23	***Lecancrepida*Myers, 1926**	R	-	-
24	***L.elasma* (Hauer, 1931)**	-	R	-
25	***L. luna*Muller, 1776**	-	-	-
26	***Lecanthienimeni* (Hauer, 1938)**	-	-	-
27	***L.ohioensis*Myers, 1926**	-	-	-
28	***Lepadellasalpina* Donner, 1943**	-	R	-
29	***Manfridum.eudactylotum*Remane, 1929**	-	-	R
30	***Monostyla bulla* (Hauer, 1952)**	-	R	-
31	***M. closterocerca* (Edmondson, 1935)**	-	R	-
32	***M.hamata Ehrenberg, 1930***	-	-	-
33	**Notholca acuminate (Ehrenberg, 1832)**	-	-	R
34	**N. squamula (Muller, 1786)**	R	R	R
35	***Philodinaroseola* (Hickernell, 1917)**	R	-	-
36	***Polyarthradolicoptera*Idelson, 1925**	R	R	R
37	***Pomopholyxsulcata* Gosse, 1851**	-	R	-
38	***P.vulgaris* (Carlin, 1943)**	-	-	-
39	***Rotariacitrinus* (Weber, 1923)**	-	-	-
40	***R.neptunia* Ehreberg,1830**	R	R	La
41	***Stephanocerosfimbriatus*(Larva) Berzins, 1951**	-	-	R
42	***Synchetaoblonga* Ehrenberg,1831**	R	R	R
43	***Synchetapectiraeta* Ehrenberg, 1832**	-	R	-
44	***Trichocercabicristata* (Wulfert, 1956)**	R	R	R
45	***Trichotriatetractis* (Ehrenberg, 1830)**	-	-	R
46	***Testudinella patina* (Hermann, 1783)**	-	R	R
47	***T.rousseleti (Voigt, 1901)***	-	-	-

The highest values of the rotifer similarity index were among S2 and 3, which reached 55.98% (Fig. 6 and Table 2) then it was followed by S1 and S2, with a similarity percentage value was 52.58%. This may be due to its effect on sewage and detergent effluents, or it may be due to the absence of some species that may be present when appropriate conditions are available. Thus, it differs from other sites, as the Jaccard similarity index indicates the extent of similarity between communities based on the composition of the communities. This guide is used to compare between communities as well as to compare changes in the composition of the community over time (14).

Table 2. Jaccard's presence coefficient matrix between sites for Rotifer

Step	Clusters	Distance	Similarity	Joined 1
1	2	44.01013	55.98987	2
2	1	47.41552	52.58448	1
Similarity Matrix				
	S 1	S 2	S 3	
S 1	*	52.5845	30.243	
S 2	*	*	55.9899	
S 3	*	*	*	

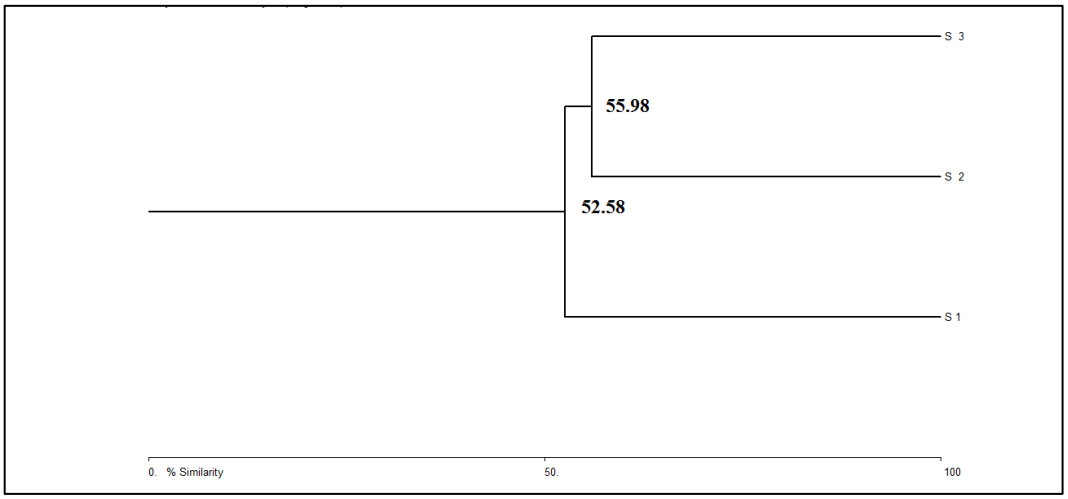

Figure 6. Dendrogram of Jaccard Index percentages of rotifer

4.CONCLUSIONS

The lowest values of the Shannon-Wiener index were recorded in the S1, accompanied by a decrease in biodiversity, and it is possible that there will be a great opportunity to increase the number of other opportunistic organisms that were originally present in a few, and in return, other species that are unable to withstand these conditions will disappear or migrate. The values of the species uniformity index indicate the absence of environmental pressure, which provides a suitable environment for the stability of rotifera.

It is clear from the relative abundance index that there were five species that were the least abundant in all stations: *Brachinousurceolaris*, *Keratellacochlearis*, *K.quadrata* (long spin), *K.valga*, and *R.neptunia*, and the rest of the species were rare and few.

The qualitative similarity between the stations was calculated using the Jaccard similarity index. The highest percentage of similarity was 55.98% found among S2 and 3, followed by S1 and 2, with a similarity percentage was 52.58%.

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