Biodiversity of Zooplanktons in Al-Razzaza Lake at Karbala Province/ Iraq

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Abstract

This study was conducted to assess the biodiversity of zooplanktons with assessing the water quality of Al-Razzaza Lake by chemical and physical analysis in addition to The Shannon – Wiener biological diversity index. The samples were collected each month from January 2013 to March 2014, from three sits. The chemical and physical analysis includes: water temperature, DO, salinity, TSS & pH. The rotifers that collected during the study period were consisting of seven species, including: *Keratellaquadrata*; *Keratellatropica*; *Branchionusquadridentata; Branchionus urceolaris*; *Cephalodellatantilliodes*; *Notholcasquamula* and *Synchaetatremula*. Arthropods recorded in the present study were Crustacea and Hexapoda (Insects). Crustacea consist of microfauna (zooplanktons) that include Copepoda (*Cyclope spp.* &*Diaptomus spp.*) and Cladocera (*Diaphanosomabrachyrum*). The Shannon – Wiener biological diversity index had the lowest value at 0.85 in winter 2013at site 3, while the highest value was 2.0 in autumn at site 1, for zooplanktons.

Key word:-Biodiversity , Zooplankton , Razzaza
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Zoology Classification QL1-355

word zoo= animal, plankton= floating) these organisms have very low ability to swim, so they drift passively by even modest currents or winds can push them around, including: bacteria, protozoa, rotifers, microcrustaceans, fish larvae, and juveniles of various macro invertebrates. These microfauna may be subdivided into categories by both size and habitat type [1]:

A. Picoplankton: body size ranges (0.2 – 2.0) µm, mostly bacteria.

Introduction:

Al-Razzaza Lake location in Karbala and Anbar. The directional information of this area is located approx (20 km) northwest of Karbala, and (50 km) southeast of Ramadi. The coordinates are: N 32’ 41” E 43’ 40” and the altitude around 30m.

The animal concept of the microbiota of lakes and ponds generally consist of two broad assemblages that in open water termed zooplanktons (from Greek

without any contact with solid surface known as (Holoplankton), or some have transitory life usually the first larval stage which known as (Meroplankton) [2]. The zooplanktons community inhabiting macrophytes stands, whether attached to stems, leaves/ fronds, sessile on the animals inhabitants, mobile over surfaces, or free swimming [3 and 4].

B. Nanoplankton: body size ranges (2 – 20) µm, mostly protozoa.

C. Microplankton: body size ranges (20 – 200) µm, protozoa, rotifers, and juveniles of microcrustacea.

D. Macroplankton: > 200 µm, large protozoa, some rotifers, and most microcrustacea.

Zooplanktons species neither spend their entire life suspended in water

Materials and Methods:

This study includes three sites for sampling water; sediments and invertebrates located in Karbala. The stations were located by using GPS to determine the N and E value in addition to latitude, as described below:

	N	E	Latitude
S 1	32.64'785''	043.87'912''	17 m
S 2	32.58'579''	043.82'956''	12 m
S 3	32.59'175''	043.81'784''	15 m

The three sites of sampling showed in the lake as represented in figure (1).

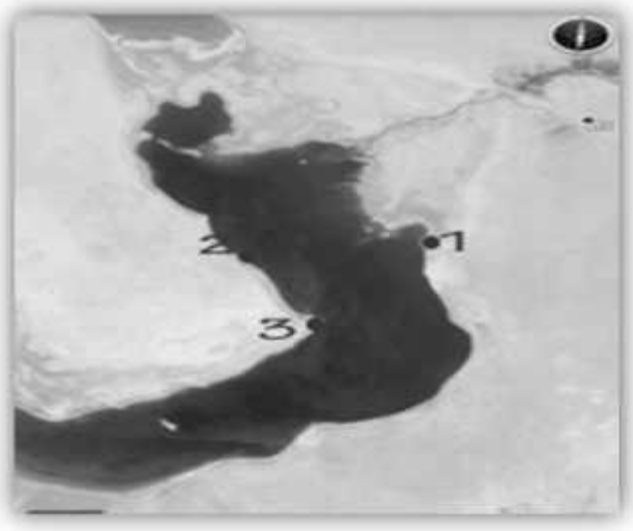


Figure 1: the sampling sites of study area in Al-Razzaza Lake

then the samples kept in polyethylene bottles and the samples preserved by

Zooplanktons samples were collecting by filtering 100 liter of the Lake water through a net of mesh size (52µm), and

The Shannon – Weaver diversity index was measured according to the equation below as described By (7).

$$H = -\Sigma \, ni / N \, Ln \, ni / N$$

n_i: Number of Species individuals in the Site

N: Number of all Species individuals in the same site

The results explained by the following:

1 < Low Diversity
(1 – 3) Moderate Diversity
3 > High Diversity

the highest value for DO was 7.3mg/l in January 2014 (Tables: 1, 2 & 3).

WFD UK [10] standards for water quality, considered that DO concentration between (4 – 6) mg/l is moderate water, while (7 – 9) mg/l considered good water quality. The CCME [11] guide line for the protection of freshwater aquatic life is between 5.5 to 6.0 mg/l, but UNESCO and WMO [12] mentioned that DO concentration of 9 mg/l is optimal, while 7-8 mg/l considered acceptable, and 3.5-6 mg/l considered poor.

Study results showed that the lowest value for TSS was 4748 mg/l in January 2013, while the highest value was 8157 mg/l in August (Tables: 1, 2 & 3).

Suspended Particulate Matter is defined as the dry weight of all particulate matter in a sample, including clay, silt, sand, mineral particles; phytoplankton, heterotrophic plankton (bacteria), and particulate organic detritus. It absorbs heat from sunlight and increases water temperature [13]. Therefore, phytoplankton and the heterotrophic community it supports contribute to what is measured by SPM [14].

adding formaldehyde (5%) to be classified later.

Invertebrate's identification and estimation for zooplanktons were done by taken 1ml of the concentrated sample in the counted slide and examined under compound microscope, then the species belong to Rotifers; Copepods and Cladocerans identified by using (5); (3) and (6), the results were expressed by Individual/m^3.

Results and Discussion:

Study results showed that the minimum values of water temperature was 15°C were recorded in January 2013. While the maximum value of water temperatures were 31°C recorded in August 2013. As showed in Tables (1, 2 & 3).

In previous study on Al-Razzaza Lake, Hassan [8] measured the water temperature of the lake finding that it's ranges between (11.9 – 34) ^{0}C.

The present study results showed that the lowest pH value was (5.11) in May which acidic, while the highest value of pH was (8.7) in June which considered slightly alkaline, the other months of study period were around neutral pH (Tables: 1, 2 & 3).

The obtained data showed that the lowest value for salinity was 1.982ppt in January 2013, while the highest value was in August was 2.528ppt. (Tables: 1, 2 & 3).

Salinity is affected primarily by the geology of the area through which the water flows and the presence of naturally occurring salts [9].

Present study findings revealed that the lowest value was 4.05mg/l in August, while

Table 1: Mean ± Standard deviation of water samples collected from site1 of Al-Razzaza Lake during study

period (2013 – 2014).

Water Parameters	Mean ± standard deviation				
	Site 1				
	Winter2013	Spring 2013	Summer2013	Autumn2013	Winter2014
Water Temperature (^{0}C)	17.0±1.6	22.33±2.49	30.0±1.8	26.0±2.92	17.0±1.41
DO (mg/L)	7.13±0.03	7.98±0.655	5.537±1.00	6.479±0.341	6.8±0.74
pH	7.6 ±0.17	8.0±0.0	8.43±0.104	7.77±0.386	7.2±0.18
Salinity (ppt.)	2.115±0.004	2.379±0.06	2.251±0.287	2.583±0.431	2.06±0.058
TSS (mg/L)	4354.5±495.21	6362.33±188.42	6789.0±579.32	7194.0±384.794	7332.0±469.93

Table 2: Mean ± Standard deviation of water samples collected from site 2 of Al-Razzaza Lake during study period (2013 – 2014).

Water Parameters	Mean ± standard deviation				
	Site 2				
	Winter 2013	Spring 2013	Summer 2013	Autumn 2013	Winter2014
Water Temperature (^{0}C)	16.5±0.408	21.67±2.625	29.33±1.70	25.33±1.7	16.33±1.247
DO (mg/L)	7.255±0.184	7.426±0.280	5.941±1.233	6.502±0.4	6.607±0.722
pH	7.4±0.88	7.9±0.216	8.47±0.06	7.9±0.374	7.23±0.08
Salinity (ppt.)	2.062±0.064	2.372±0.072	2.205±0.229	2.34±0.058	2.146±0.114
TSS (mg/L)	5817.0±108.594	6039.3±369.37	7119.0±734.86	7464.3±450.64	7264.0±367.36

Table 3: Mean ± Standard deviation of water samples collected from site 3 of Al-Razzaza Lake during study period (2013 – 2014).

Water Parameters	Mean ± standard deviation				
	Raz'za 3				
	Winter 2013	Spring 2013	Summer 2013	Autumn 2013	Winter 2014
Water Temperature (^{0}C)	16.5±0.408	21.67±2.625	29.33±1.699	25.67±2.054	16.33±1.247
DO (mg/L)	7.195±0.075	7.911±0.336	5.538±1.06	5.688±1.172	6.416±0.619
pH	7.4±0.1	7.867±0.189	8.2±0.141	7.87±0.33	7.27±0.05
Salinity (ppt.)	1.9965±0.0445	2.257±0.066	2.286±0.198	2.292±0.084	2.100±0.038
TSS (mg/L)	5720.0±73.84	6360.3±233.687	7255.3±616.9	7354.3±361.63	7046.7±335.24

The rotifers that collected included seven species, these seven species were: *Keratellaquadrata*; *Keratellatropica*; *Branchionusquadridentata; Branchionus urceolaris*; *Cephalodellatantilliodes*; *Notholcasquamula* and

Zooplanktons community of Al-Razzaza Lake:

Arthropods that recorded in present study were Crustacea and Hexapoda (Insects). Crustacea consist of microfauna (zooplanktons) that include Copepoda (*Cyclope spp*. &*Diaptomus spp.*)and Cladocera (*Diaphanosomabrachyrum*).

In the present study, the only recorded species of Cladocera was *Diaphanosomabrachyrum.* Likewise the study on Habbanyiah Lake found that the two genera *Diaphanosoma* and *Bosmina* were recorded by Al – Lami *et al.* [18]. Rautio & Vincent [21]found the species *Diaphanosoma brachyrum* beside twenty – four genera of cladocera in Ramsey Lake/ Canada, in addition to copepods including *Cyclope spp*. and thirteen other species. *Diaphanosoma* previously reported by Al – Nimrawii [22] in both Iraqi rivers, Tigris and Euphrates.

In the present study two genera of Copepods were found and identified as *Cyclopes pp.* and *Diaptoms spp.,* these results agrees with that reported by Sabtie [23] in his study on benthic community in three marshes of southern Iraq (Al – Hawizah; Al – Chibaysh and Al – Hammar) in addition to Garma River, he record two species of *Diaptoms.* Al – Lami *et al.* [18] found the genera *Diaptoms* in Habanyiah Lake. In both Iraqi rivers, Al – Nimrawee [19] recorded the two genera *Cyclopes pp.* and *Diaptoms spp.* represented in rotifers; copepods and cladocera.

Rotifers (Wheel – Animalcules) shown the highest densities among all collected *Synchaetatremula*.Rotifers are microfauna found in rivers; streams; lakes and ponds [3].

Rotifers are the most abundant metazoan in inland waters; these rotifers belong to the littoral microfauna and are not commonly found in open water [15]. Most of the rotifers littoral approximately 75%, including 100 species of zooplanktons and they live away from Neuston [16].

Lakes of Mysore city (Kamana; Mandakally and Devanoor), Padmanabha [17] recoded sixteen species of rotifers including: *Keratellaquadrata*; *Keratellatropica*; *Branchionusquadridentata* and *Branchionus urceolaris*.

Al – Lami *et al.* [18] recorded four genera of rotifers from Al-Habbaniya Lake, which were (*Keratella*; *Branchionus; Cephalodella* and *Trichocerea*). The presence of similar species between the two lakes Al-Habbaniya and Al-Razzaza Lake, maybe due to the fact that they had the same water source input come from Euphrates River.

Al – Nimrawee [19] in his study on zooplanktons and benthos community of Tigris and Euphrates rivers in central Iraq, he identified rotifers (*Keratella* and *Branchionus*) in both rivers. Abd Al – Rezzaq [20] recorded nineteen genera of rotifers in Al – Hilla River including the two genera *Keratella* and *Branchionus.*

Zooplanktons densities and seasonal variations:

Zooplanktons are microfauna, in this study the collected zooplanktons

The species *C. tantelliodes* had the highest density in winter 2013 at 32,000 Ind./m^3, while lowest density in summer at 1427 Ind./m^3. For *N. squamula* the highest density in winter 2013 at 4400 Ind./m^3, and disappeared from collected samples in summer. The *S. tremula* showed a highest density in winter 2013 at 900Ind/m^3, while the lowest density spring at 53 Ind./m^3.

Rotifers are the most abundant species through zooplankton, and have their peak in density when the water temperature ranges from (18 – 22) ^{0}C, in both eutrophic and mesotrophic lakes [26]. This fact agrees with study results findings, when the highest density for all rotifers densities were in winter season, which had water temperature around 17 ^{0}C.

The copepods had two species, *Cyclopes pp.* had the highest density in winter 2013 at 24,100 Ind./m^3 and the lowest density in autumn at 2817 Ind./m^3.

The species *Diaptomas spp*. found to have a highest density in summer at 11,233Ind/m^3, while the lowest density in winter 2013 at 533Ind/m^3.

Nauplii the immature stage of copepods, had the highest density in summer at 11,733 Ind./m^3, while the lowest density was in winter 2013 at 2100 Ind./m^3.

Decapods live in warm - water and the maximum temperature for their reproductive is 30^{0}C [27].

Cladocera had one species in this study, *D. brachyrum* had the highest density in summer at 1887Ind/m^3 and the lowest density in autumn at 100 Ind./m^3.

The zooplanktons density in lake Nanha, found to be distributed among them as the following, rotifers mean density 1615 zooplanktons. Table (4; 5 & 6) showed the mean ± SD density of zooplanktons in each study site.

In the present study findings showed that the species of zooplanktons were differing from each other in their densities through the study period.

The species *K. quadrata* had the highest density in winter 2013 at 239.000 Ind./m^3, while the lowest density was in summer 2013 at 1087 Ind./m^3. While for *K. tropica* also had the highest density in winter 2013 at 5100 Ind./m^3 and disappeared from samples that collected in summer and autumn.

Keratella spp. prefers water temperature range from (15 – 18)^{0}C for growth and reproduction [24]. In the present study results found that the water temperature was (16 – 17)^{0}C in winter months, which is the perfect temperature for their growth, so that the genera *Keratella spp.* had the highest densities in winter during the study period.

The species *B. quadredentatus* had the highest density during winter 2013 at 14,900 Ind./m^3, while the lowest density during summer at 1413Ind/m^3. While the other species *B. urceolaris* had the highest density during summer at 17,667 Ind./m^3 and the lowest density was during spring at 320 Ind./m^3.

Brachionus spp. found in high densities brackish water estuaries [25]. This agrees with the present study that found the *Brachionus spp*. species had high densities in Al-Razzaza Lake especially during summer when the water salinity was slightly brackish.

(185 – 425) Ind./m^3. While in other study, the rotifers range from (356 - 720) Ind./m^3, and the *Keratella* was the dominant species through all zooplanktons [17].

Ind./L; for copepods were 98.0 Ind./L and for the cladocera were 17.0 Ind./L [28].

In a study on lake Skomielno, Paleolog [29] found the rotifers density ranges from

Table 4: Mean ± Standard deviation of total number of zooplankton species found in water samples collected from site 1 of Al-Razzaza Lake during study period.

Species	Seasons				
	Winter 2013	Spring 2013	Summer 2013	Autumn 2013	Winter 2014
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
K. quadrata	176100.0± 6123.7	65500.0± 75479.6	1346.7± 552.41	1186.7± 356.4	35866.7± 8173..9
K. tropica	3050.0±449.1	200.0± 182.84	0.0±0.0	0.0±0.0	266.7± 77.12
B. quadridentatus	10200.0± 489.9	9486.7± 6250.3	1413.3± 221.71	7166.7± 3996.9	5566.7± 3993.6
B. urceolaris	4100.0± 81.65	370.0± 129.4	16800.0± 5192.3	9783.3± 1443.6	3100.0± 713.75
C. tantilloides	23150.0± 2163.7	7266.7± 4196.7	3720.0± 398.95	1433.3± 418.99	4500.0± 1444.5
N. squamula	4400.0± 400.0	100.0± 81.7	0.0±0.0	366.7± 129.62	333.3± 71.404
S. tremula	600.0± 0.0	53.3± 41.09	300.0± 244.95	366.7± 149.72	333.3± 71.404
Cyclopes pp.	24100.0± 2857.7	7666.7± 3015.54	13333.3± 3879.3	3466.7± 316.98	4333.3± 981.94
Nauplii	5700.0± 244.9	3133.3± 2028.7	11066.7± 3938.1	4353.3± 403.13	4666.7± 2452.7
D. brachyarum	450.0± 150.0	600± 173.0	1566.7± 853.9	100.0± 91.42	166.7± 124.7
Diaptomus spp.	6700.0± 500.0	5133.3± 736.4	8483.3± 1741.8	2200.0± 1757.8	533.3± 960.41
Total	258550	98910	58030	30423.4	59666.7

Table 5: Mean ± Standard deviation of total number of zooplankton species found in water samples collected from site 2 of Al-Razzaza Lake during study period.

Species	Seasons				
	Winter 2013	Spring 2013	Summer 2013	Autumn 2013	Winter 2014
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
K. quadrata	20200.0± 489.9	68833.3± 7947.26	1466.7± 618.24	1203.3± 460.8	35266.7± 6840..9
K. tropica	5100.0± 1224.7	200.0± 82.84	0.0±0.0	0.0±0.0	216.7± 49.36
B. quadridentatus	14900.0± 2531.1	9733.3± 653.83	1466.7± 339.9	7166.7± 873.2	7333.3± 593.82
B. urceolaris	3550.0± 50.0	330.0± 69.44	17333.3± 5247.0	9366.7± 1898.0	3066.7± 641.6
C. tantilloides	32000.0± 100.0	8600.0± 647.09	1533.3± 524.9	1700.0± 216.02	3866.7± 643.84
N. squamula	600.0± 0.0	133.3± 124.72	0.0±0.0	366.7± 98.29	400.0± 68.56
S. tremula	900.0± 300.0	70.0± 61.644	400.0± 282.8	566.7± 71.82	600.0± 88.85
Cyclopes pp.	23600.0± 1306.4	6400.0± 796.08	13533.3± 5149.3	2816.7± 308.078	5700.0± 433.59
Nauplii	15600.0± 3000.0	3600.0± 3115.6	11733.3± 4722.5	4333.3± 937.68	5433.3± 1312.3
D. brachyarum	150.0± 50.0	720.0± 85.3	1886.7± 639.1	116.7± 64.99	200.0± 141.4
Diaptomus spp.	8300.0± 2041.2	7733.3± 1329.99	11233.3± 3517.9	3233.3± 250.7	1100.0± 198.48
Total	124900	105633.2	60586.6	30780.1	63123.4

Table 6: Mean ± Standard deviation of total number of zooplankton species found in water samples collected from site 3 of Al-Razzaza Lake during study period.

Species	Seasons				
	Winter 2013	Spring 2013	Summer 2013	Autumn 2013	Winter 2014
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
K. quadrata	239000± 25311.4	71433.3± 3283.7	1520.0± 674.9	1220.0± 459.9	33200.0± 5499.8
K. tropica	2800.0± 400.0	200.0± 82.92	0.0±0.0	0.0±0.0	200.0± 82.48
B. quadridentatus	6500.0± 500.0	9800.0± 566.4	1506.7± 367.5	7083.3± 776.8	6066.7± 4196.3
B. urceolaris	3250.0± 250.0	320.0± 269.81	17666.7± 567.1	9750.0± 2089.3	3100.0± 743.73
C. tantilloides	28000.0± 3265.9	9466.7± 6824.1	1426.7± 457.6	1900.0± 294.39	3800.0± 1557.8
N. squamula	2100.0± 1224.7	133.3± 24.72	0.0±0.0	366.7± 98.92	400.0± 86.54
S. tremula	700.0± 81.649	70.0± 61.64	400.0± 282.8	533.3± 84.75	600.0± 98.69
Cyclopes pp.	19800.0± 816.5	7233.3± 615.9	12566.7± 3975.2	2833.3± 361.26	7533.3± 753.45
Nauplii	2100.0± 734.9	2966.7± 2145.3	11600.0± 5187.2	3866.7± 882.13	5466.7± 1359.7
D. brachyarum	150.0± 122.47	730.0± 133.22	1800.0± 557.77	100.0± 41.42	400.0± 282.84
Diaptomus spp.	1950.0± 122.5	6800.0± 711.81	10966.7± 2735.4	3000.0± 449.48	1400.0± 574.8
Total	306350	108423.3	59453.5	30653.3	62166.7

K. quadrata had the highest density in this season. Shiel [3] found that the family Brachionidae, the genus *Keratella* is common and an abundance in wide range of habitats. The species *K. quadrata* prefers freshwater ponds and bay water. The optimal water temperature for their survives is 150C and its distribution limited by the temperature and pH [31]. In the present study statistical analysis findings, *K. quadrata* had a strong inverse correlation with water temperature (r= - 0.967), as well as the correlation with pH (r= - 0.947).

The zooplanktons seasonal variation studied for five seasons (fifteen months) in three sites. The seasonal variation affected by the physical and chemical water conditions. Water factors that influence zooplankton density and distribution are, (water temperature, water action, DO, pH, and salinity) [30].

In winter 2013 the zooplanktons varies among species, *K. quadrata* had the highest density percentage among all other species at all study sites, as shown in fig. (7).

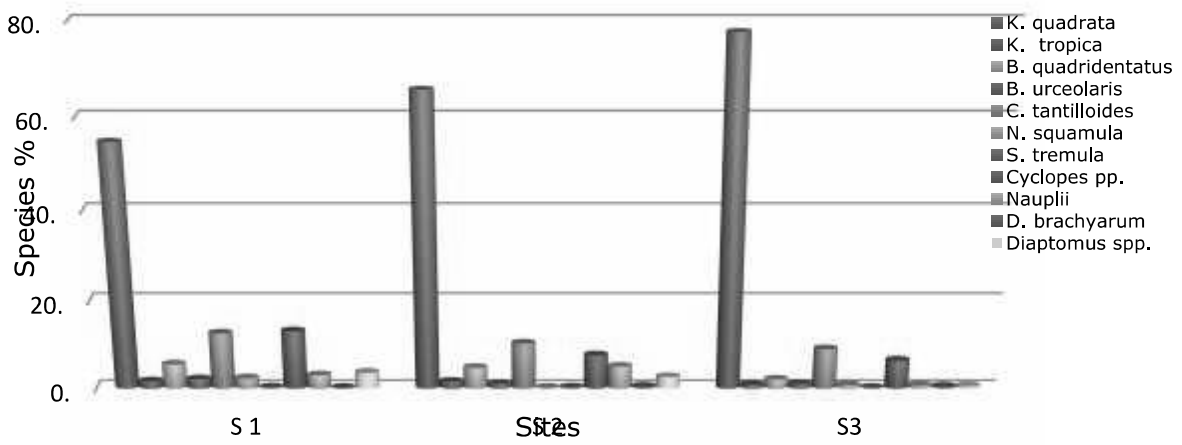
species *N. squamula* and *S. tremula* had the lowest densities among all rotifers.

The copepods species showed the *Cyclope spp.* had a higher density than *Diaptomus spp.* The *Cyclope spp*. live along the plant – covered banks of stagnant and slow – flowing bodies of water, live in warm waters [32]. The species showed an inverse correlation with water temperature (r= - 0.567).

C. tatilliodes showed the second density among rotifers, the correlation with water temperature similar to genus *Keratella* that was inverse strong correlation at (r= - 0.892).

For the other rotifers *B. quadridentatus* showed the third position in density through rotifers in this season, while in other seasons the genus showed a reverse density as well be revealed later. The other

Fig. 7: Zooplankton species (%) during winter 2013 in Al-Razzaza Lake

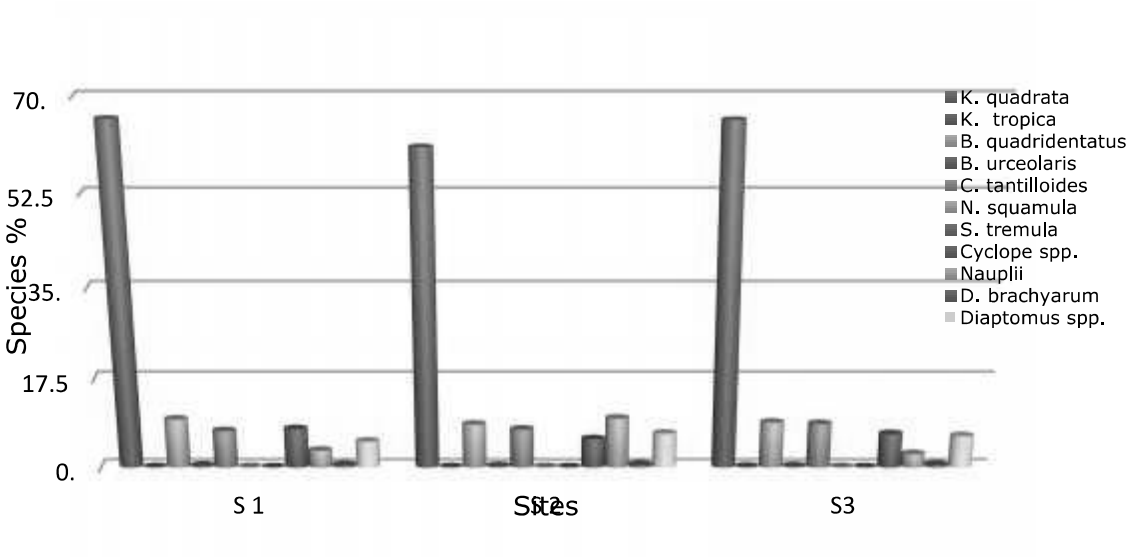


food item because its small, slow swimming speed, habit of staying suspended in water and high reproductive rate, they are good source of amino acids and high digestibility [33]. The nauplii increased in density, while in comprising with the adult *Cyclpe spp.* which decreased in density, maybe because they are prey for fishes, especially carp fish [32]. This found in the field observations as a fish content of Al-Razzaza Lake.

In spring 2013, showed a variation in density among species, but still closed to the variations in earlier season. Fig. (8).

The *K. quadrata* still had the highest density among all rotifers, but the two species *Keratella* and *Brachionus* were decreased in density than winter season, maybe that related to the fact they are food for fish larvae which began to swamp and hatching in spring. They are excellent as

Fig. 8:Zooplankton species (%) during Spring 2013 in Al-Razzaza Lake



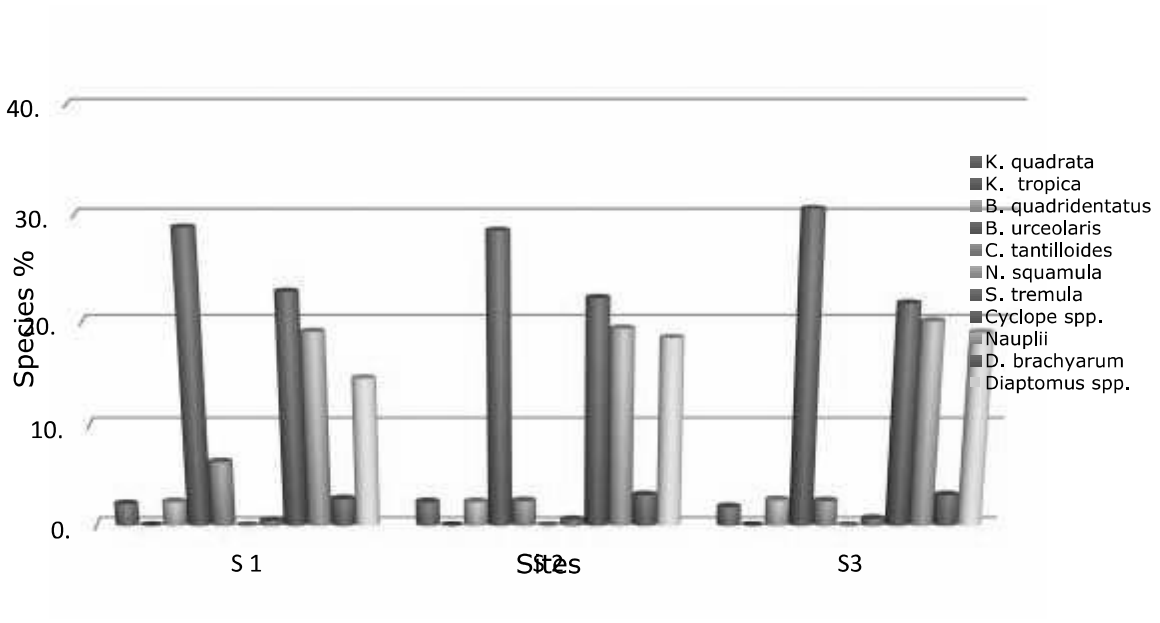
they recorded the highest density in summer was for *Brachionus spp.* while in winter the highest density was recorded for *Synchaeta spp.* as well as the study on Brazil estuary, the genus *Brachionus* dominance of all other rotifers individuals at 80% [25]. *Brachionus* predominantly feeders on bacteria, phytoplankton, and coarse particles [35]. *Brachionus* is a strong pollution – tolerance genus [25]. Maybe this explains the increase in the species density during summer season despite the increase in TSS; TDS; salinity and temperature. The *B. urceolaris* showed direct correlation with water temperature; TSS and salinity at (r= 0.938; r= 0.32 and r= 0.97) respectively. Copepods species showed density closed to each other, while cladocera much lower in density.

In summer 2013, the lowest density for all rotifers species were recorded except the species *B. ureceolaris;* nauplii; *Diaptomus* and *D. brachyrum.* Fig. (9).

The *K. quadrata* had the lowest density conversely to the winter season, due to the increase in water temperature and decrease in DO concentration, which showed direct correlation with species at (r= 0.946). The *K. tropica* and *B. quadridentatus* both are decreased in density too.

The *B. urceolaris* showed the highest density among all zooplanktons, which agrees with the findings of Õzcalkae & Temel [34] on their study of the rotifers community in lake Kűcűkcekmece/ Turkey,

Fig. 9: Zooplankton species % during Summer 2013 in Al-Razzaza Lake



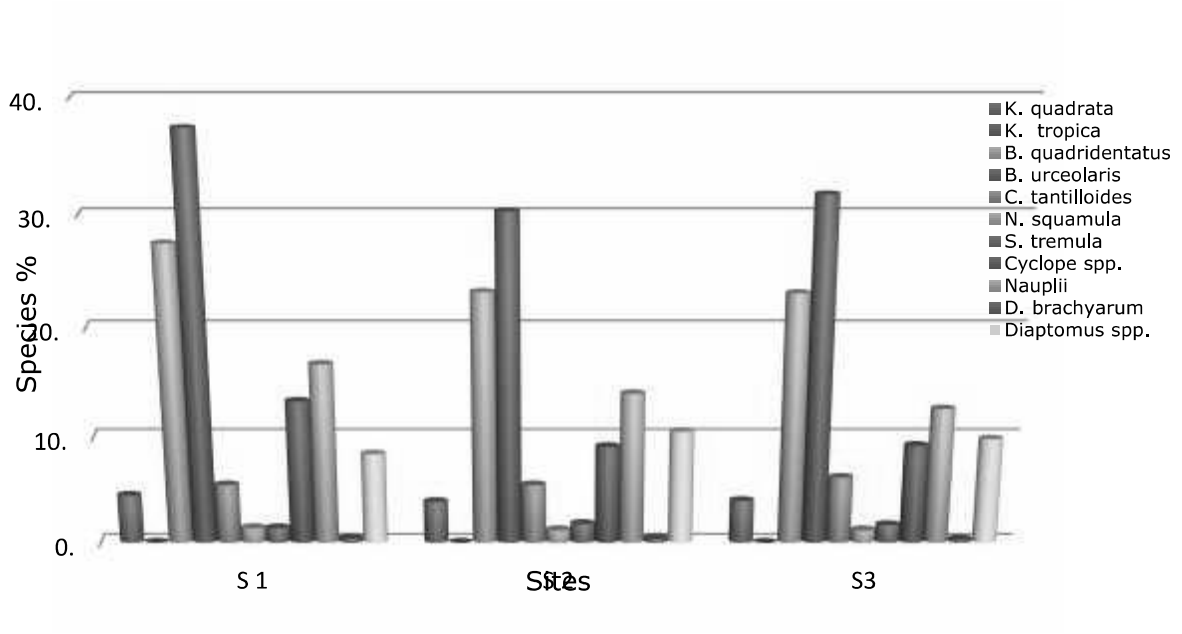
copepods and cladocera decreased in their densities.

The increase in some species affected with the increase in DO concentration beside the decrease in water temperature at 25 ^{0}C, which is good for growth and reproductive rate for many species. Beside the decrease in salinity and turbidity values.

Autumn 2013 also showed differences in zooplanktons densities. Some species increased in number, while others were not. Fig. (10).

The *K. quadrata* and *B. quadridentatus* wasrose up in density, with continuation in *K. tropica* absence. The *B. urceolaris* still the highest density among all species. *N. squamula* and *S. tremula* had slightly increased in their density. While the

Fig. 10: Zooplankton species (%) during autumn 2013 in Al-Razzaza Lake

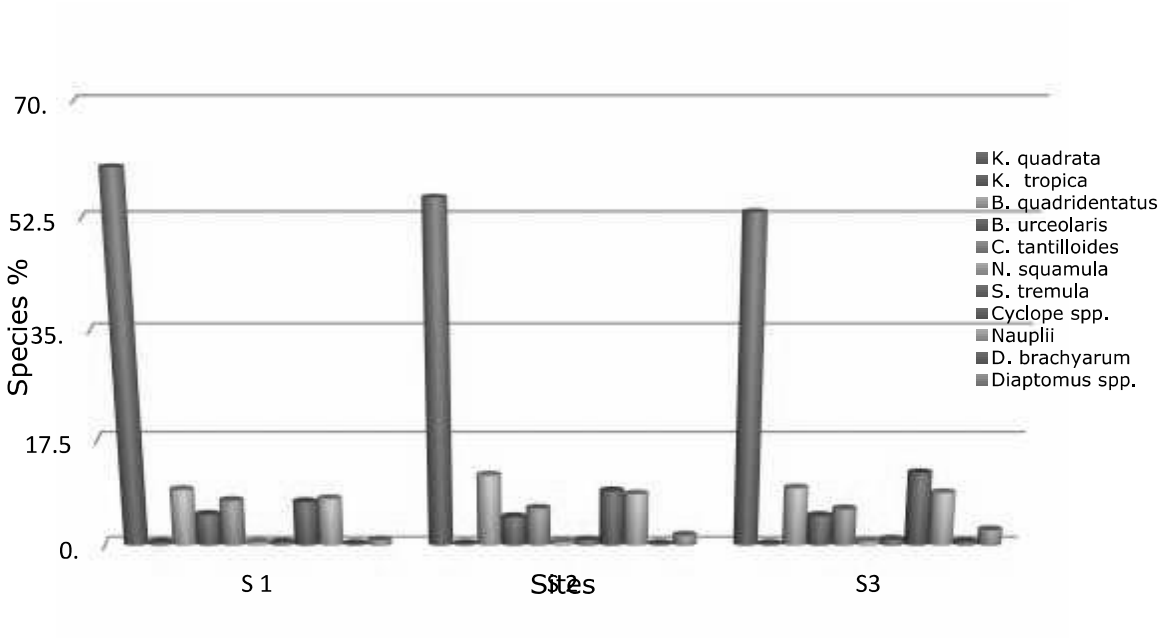


In some studies on lakes around the world found the zooplanktons community changed through seasons in dramatically way [36]. Other study in Philippines, Papa *et al.* [37] studied zooplanktons density in the Paoay Lake and recorded twenty – seven species (45% rotifers; 29% cladocera and 26% copepods), the genus *Keratella* found to be dominant in the lake at 34% of rotifers, while *Brachionus* represent 7% and *Diaphanosoma* 4%.

Winter 2014 the latest studied season, this season is so much similar to the density variation in winter 2013. Fig. (11).

This season in general had lower densities than winter 2013. The *K. quadrata* back to the top density among all zooplanktons, as well as the increase in *B. quadridentatus* density more than the density of *B. urceolaris* which decreased in density than the previous season. The *Cyclope spp.* increased in density to become higher than nauplii.

Fig. 11: Zooplankton species (%) during winter 2014 in Al-Razzaza Lake



In Iraq, Al-Nimrawee [19] recorded the zooplanktons diversity were in lowest value at 0.9 in April 2005 and the highest value was 1.88 in March 2004 at Tigris river, while Euphrates lowest diversity was 0.7 in April 2005 and the highest value was 2.4 in May 2004.

The reduction in TSS beside elevation of water temperature and DO allow zooplanktons to grow and increase in reproduction leading to increase density [40].

The highest diversity value was recorded in March at some Brazilian lakes [41]. While Bielańska – Grajner & Cudak [42] studied the diversity of rotifers in anthropogenic lakes and found the diversity index values ranges from (0.77 – 2.3).

The low density of rotifers species recorded in this study could be attributed to the increasing in salinity and TDS values, which agrees with the present study

Shannon – Wiener Diversity Index (H):

Shannon – Wiener index referred to the proportion count of each taxon in the total number [38]. The diversity index refers to the number of species in a sample and the distribution of the individuals among these species [39].

The lowest value for diversity index was 0.85 in winter 2013 at site 3, while the highest value was 2.0 in autumn at site 1. Table (7) showed the differences in H values in each site.

The increase in diversity values from winter to autumn through spring and summer seasons is related to the increase in density and species richness in the relative seasons, when the water temperature is suitable for growth and reproduces as well as the presence of other nutrients.

In Philippines, Aquino *et al.*[44] studied the Paoay Lake diversity for zooplanktons and finding the H values ranges from (0.8 – 2.5) in their study period from April to September of 2006.

statistical analysis by founding an inverse correlation between most rotifers and salinity. Increase in turbidity is the main factor influence the diversity of lakes [43]. This agrees with the present study findings that the TSS had high values in Al-Razzaza Lake, which affect the biodiversity in the lake.

Table 7: Shannon – Whiner Diversity Index (H) for zooplankton species of Al-Razzaza Lake during study period

	S 1	S 2	S 3
Winter 2013	1.42	1.11	0.85
Spring 2013	1.39	1.40	1.3
Summer 2013	1.77	1.74	1.74
Autumn 2013	2.0	1.74	1.85
Winter 2014	1.40	1.51	1.57

4. The zooplanktons species varied in their density from species to species, as well as from season to season. The *K. quadrata* and *B. quadridentata* had the highest density in winter and spring seasons, while *B. ureceolaris* had the highest density in summer season. The other species with copepods and cladocera are closed to each other.

5. The *K. quadrata; B. quadridentata* and *B. ureceolaris* the most abundant species among zooplanktons. While the *M. tuberculata; H. ventrosa* and *M.costata* the most abundant species among benthos.

6. Al-Razzaza Lake had a moderate diversity according to Shannon – wiener diversity index.

7. Increase the amount and sources of input waters to the lake, to improve the water quality of Al-Razzaza Lake.

Conclusion:

1. The only source of water input to the lake is Karbala trocar.

2. The water of Al-Razzaza Lake during the study period was cool to warm water. The pH is slightly acidic to slightly alkali. The lake water salinity is slightly brackish water. The dissolved oxygen content in acceptable limits. And the lake water is very hard.

3. The zooplanktons community included: Rotifers which represented by (The seven species which were: *Keratellaquadrata*; *Keratellatropica*; *Branchionusquadridentata; Branchionus urceolaris*; *Cephalodellatantilliodes*; *Notholcasquamula* and *Synchaetatremula*); Copepods (*Cyclope spp*. &*Diaptomus spp.*)and Cladocera (*Diaphanosomabrachyrum*).

beside other vertebrate's that inhabiting the lake.

2) Make a manual containing all types of living organisms that inhabit the lake dominantly and temporary.

Recommendations:

1) Create a monitoring program for Al-Razzaza Lake, to continuous the evaluation of water quality and invertebrates content of the lake,

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التنوع البايلوجي للهائمات الحيوانية في بحيرة الرزازة في محافظة كربلاء / العراق

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الخلاصة

وقد أجريت هذه الدراسة لتقييم التنوع البيولوجي من العوالق الحيوانية مع تقييم نوعية المياه من قناة الرزازة بحيرة عن طريق التحليل الكيميائي والفيزيائي بالإضافة إلى شانون - مؤشر التنوع البيولوجي وينر. تم جمع العينات كل شهر خلال الفترة من يناير 2013 إلى مارس 2014، من ثلاثة يجلس. الكيميائية والتحليل الفيزيائي وتشمل: درجة حرارة الماء، DO، والملوحة، ودرجة الحموضة TSS. والدوارات التي تم جمعها خلال فترة الدراسة والتي تتكون من سبعة أنواع، بما في ذلك: Keratellaquadrata. Keratellatropica. Branchionusquadridentata. urceolaris Branchionus. Cephalodellatantilliodes. Notholcasquamula وSynchaetatremula. كانت المفصليات المسجلة في الدراسة قشريات وسداسيات الأرجل (الحشرات). تتكون القشريات من الحيوانات الدقيقة (العوالق الحيوانية) التي تشمل كوبيبودا (سايكلوب النيابة. والغادفة النيابة.) ومتفرعات القرون (Diaphanosomabrachyrum). وكان مؤشر التنوع البيولوجي وينر أقل قيمة على مستوى 0.85 في فصل الشتاء at2013 الموقع 3، في حين كانت أعلى قيمة 2.0 في الخريف في موقع 1، لالعوالق الحيوانية - شانون.

الكلمات المفتاحية : التنوع الحيوي , الهائمات الحيوانية , الرزازة

*مستل من رسالة ماجستير للباحث الثاني.