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ECOLOGY OF ROTIFERA IN WADI EL RAYAN, EGYPT

BY

SHERIF E. RAMADAN* AND GAMAL M. EL SHEBRAWY

*National Institute of Oceanography and Fisheries Kayet-Bey, Alexandria, Egypt.

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ABSTRACT

Wadi El Rayan Lake is a man-made lake located in a great depression in the arid western desert South-West of Cairo (30° 23' E. and 29° 10' N.). Thirty one Rotifera species were recorded from the area of Wadi El Rayan during the four seasons of 1989. Twenty of them, namely Anuraeopsis fissa, Asplanchna girodi, Brachionus plicatilis, B. quadridentatus, B. urceolaris, Collotheca sp., Hexarthra oxyuris, Keratella tropica, Lecane arcula, L. grandis, Lepadella ovalis, Monomonta sp., Monostyla bulla, M. closterocerca, M. hamata, Proalides sp., Synchaeta oblonga, Trichocerca cylindrica, T. longiseta and T. pusilla are regaraded as records new to the area.

Keratella quadrata and Proalides sp. dominated the rotiferan community. Winter was the flourishing season while spring was the least productive one.

The community composition, the distribution, the seasonal variation, the dominant kinds and the biological quality parameters were discussed.

INTRODUCTION

Rotifers play an important role as graziers, suspension feeders and predators within the zooplankton community. They also serve as an essential food supply for invertebrate and vertebrate predators.

According to the available literature, the rotifers of the inland waters of Egypt were included through studies carried out on Maruit Lake (El-Hawary, 1960; Samaan and Aleem, 1972; Abdel Aziz, 1987; Guerguess, 1988); in Edku Lake

(Samaan, 1976; Soliman, 1983; Guerguess, 1990); Burollus Lake (Abouel Ezz, 1984); Manzala Lake (El Maghraby et al., 1963; Guerguess, 1979; 1983; 1986 a; Anon, 1987; Lane, 1992; Ramadan and Hashem, 1993); Qarun Lake (Khalil, 1978); Naser Lake (Zaghloul, 1985; Guerguess, 1986 b; Abd El-Mageed, 1992); El Serw Fish Farm (El Shebly, 1991); Rosetta Nile Branch (Zaghloul, 1976); Damietta Nile Branch (Helal, 1981); Nile water near Cairo (Klimowiez, 1961 a,b; 1962); Nile water North of Aswan (Elster and Volenweider, 1961). More over, Guerguess (1985) published on mass production of the rotifer Brachionus urceolaris and Guerguess (1992) reported on rotifers as indicators of pollution in the Mediterranean coastal lagoons of Egypt.

Due to the isolated location of Wadi El Rayan, little is known about its Rotifera. The only previous contributions to this field are those of Boraey (1978) who just mentioned that Brachionus is an abundant genus and Keratella is a scarce one, Khalil (1984) who recorded three species and Saleh (1984-5) who listed 41 species of Rotifera in Wadi El Rayan Lake.

None of the above mentioned works was particularly interested in the ecology of the Rotifera in the area.

The present study is the second of the invertebrate results obtained from a four seasons survey completed in 1989 by a team affiliating to the National Institute of Oceanography and Fisheries aiming to investigate the ecology of Wadi El Rayan Lake. The first one was that performed by Ramadan et al., (1993) on the ecology of Cladocera in the area.

Wadi El Rayan Lake :

Wadi El Rayan Lake is a man-made lake located in a great depression in the arid western desert South West of Cairo (30° 23` E and 29° 10` N). It consists of two parts at two different elevations receiving its water from the drainage system of the neighbouring agricultural lands of El Fayoum province through El Wadi Drain. The first part of the lake covers an area of about 63 km² and is completely filled with water. The area of the second part (about 110 km²) is increasing over the years. The 2 parts are connected to each other by a shallow and densely covered with emerging macrophytes channel.

MATERIAL AND METHODS

During 1989, seasonal planktonic samples were collected from 8 localities (Fig. 1) representing different ecological conditions as summarized in Table (1). At each locality, a 20 μ mesh size standard plankton net was used to filter 150 litres of the site's water. The filtrate was preserved in 6 % formalin. The volume was standardized to 150 ml in the laboratory and triplicate subsamples (3 ml each) were removed for counting (using 100 X binocular

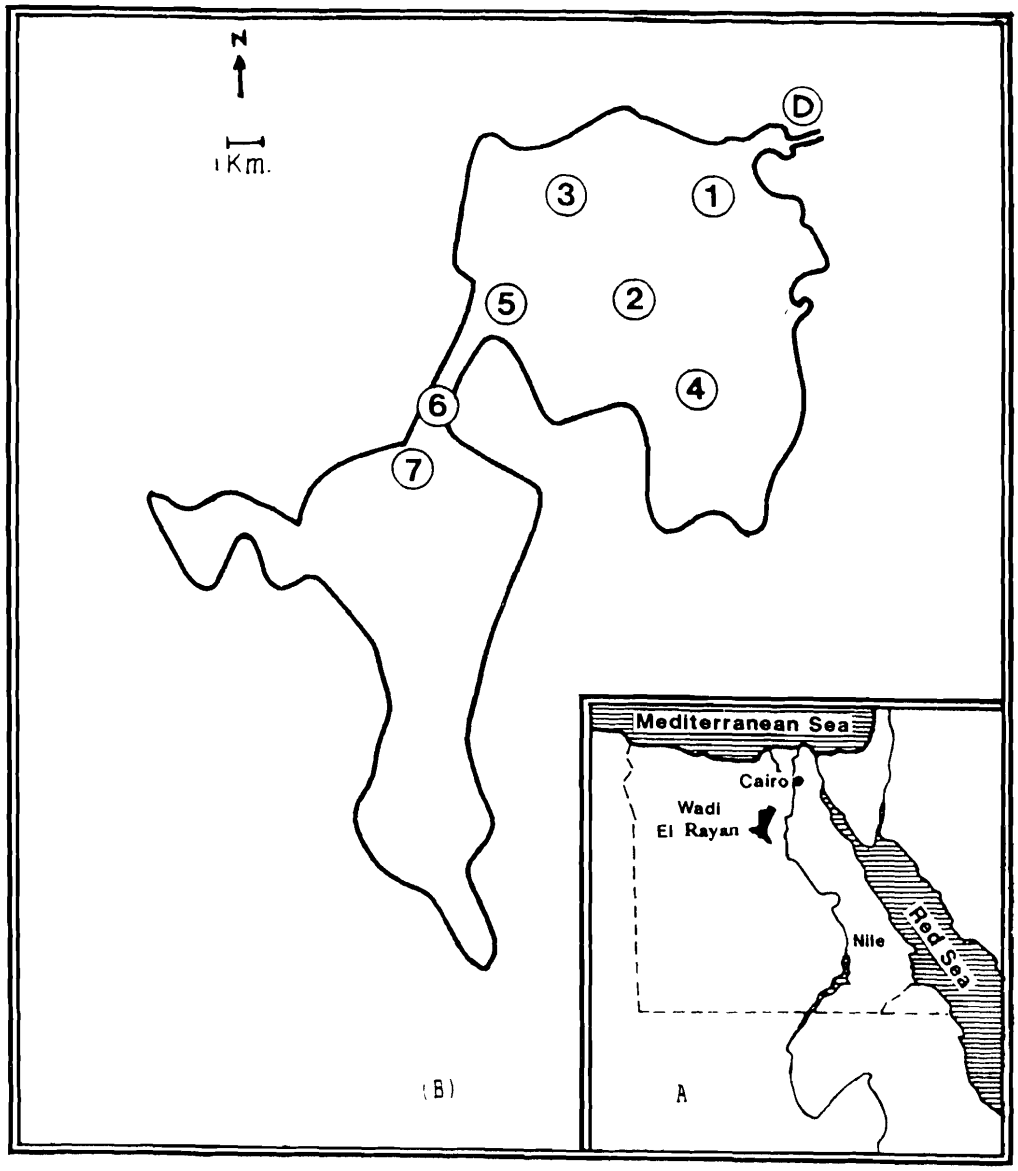


Figure 1: Sampled localities.
A. Map of Egypt showing the site of Wadi El Rayan with respect to Cairo the capital of Egypt.
B. Diagrammatic outline of the lake showing the sampled localities D and 1-7.

Table (1): Sampled localities and their physicochemical variables [D: Feeding drain; A.D. average depth in metres; A.pH: average pH; O_2: Average dissolved oxygen as mg/l; S ‰ average salinity; A.S.: Average secchi disc depth in meters. A.A.T. = Avg. air temp. °C; A.S.T. = Avg. surface water temp. °C; * = after Konsowa, 1991].

Station	Location	A.D.	A. pH*	O_2*	A.A.T.	S‰*	A.S.T.	A.S.
D	Pre the outlet of El Wadi Drain	2.0	8.5	7.5	23.7	1.2	21.6	0.38
1	First Elevation 200 metres in front of El Wadi drain.	5.5	9.0	8.5	24.6	1.4	22.2	1.15
2	Outlet Middle of the first elevation	14.5	9.0	8.5	23.9	1.5	22.4	1.55
3	West of the first elevation.	8.6	9.1	8.9	23.5	1.6	21.9	1.78
4	South-east of the first elevation	23.0	8.7	9.1	24.6	1.5	22.5	1.58
5	Pre-entrance of the connecting channel	2.0	9.1	8.5	24.0	1.6	21.6	1.5
6	End of the connecting channel	2.0	8.7	8.6	22.5	1.3	20.4	1.6
7	Second elevation, 200 metre off the water fall.	2.0	8.6	8.3	22.5	2.5	20.0	1.9

microscope) and identification . Identification was performed by consulting Koste (1978) and Koste and Shiel (1990) and was confirmed by Prof. H. Dumont, the director of the Institute of Animal Ecology, Ghent University, Belgium.

The individuals of each species, for each subsample, were counted and the average population density (PD) of the species, as well as the total rotifers population density (TPD) were calculated according to the equations mentioned in Ramadan et al., (1992). The Sorensen (1948) index of similarity and the Koch (1957) index of biotal dispersity were applied as mentioned in Green (1971). The Shannon-Wiener index for species diversity (H) was applied as mentioned in Weber (1973) and the equitability (E) was calculated according to Pielou's (1966) equation. The species richness index (SR) was calculated according to Margalef's (1958) equation and the community dominance index (CDI) was applied as described by McNaughton (1968).

RESULTS

By constituting about 61 % of the total zooplankton population in Wadi El Rayan, Rotifera proved to be the dominant group in the community.

Through the present investigation, thirty one species of Rotifera were identified from Wadi El Rayan (Table 2). Twenty of them, namely Anuraeopsis fissa, Asplanchna girodi, Brachionus plicatilis, B. quadridentatus, B. urceolaris, Collotheca sp., Hexarthra oxyuris, Keratella tropica, Lecane arcula, L. grandis, Lepadella ovails, Monomonta sp., Monostyla bulla, M. closterocerca, M. hamata, Proalides sp., Synchaeta oblonga, Trichocerca cylindrica, T. longiseta and T. pusilla are regarded as new records from the area.

The Rotifera community was dominated by Keratella quadrata and Proalides sp. where averages of 9694 and 3708 organisms/m3/year were respectively recorded for the whole area representing 38.49 % and 14.72 % of the total population in sequence. Only Collotheca sp., Colurella adriatica, Keratella quadrata, K. tropica, Trichocerca cylindrica and T. pusilla were able to exist in all of the sampled localities. Brachionus quadridentatus disappeared from all the stations but D and 1 where it was weakly represented (Table 2).

The standing crop of rotifera for the whole area averaged 25189 organisms/m^3/year. Two peaks of 44302 and 42463 organisms/m^3/year appeared in stations 4 and 5 respectively. The lowest value (4467 organisms/m^3/year) of rotifers production was recorded in station 6 (Table 2 and Fig. 2). The highest number of species (29), species richness (SR = 3.1466) and Diversity (H = 4.0397) were recorded in station D (El Wadi Drain), while the lowest analogous values were calculated for station 3 (Table 2). The highest and lowest equitabilities (E = 0.8540 and E = 0.3348) were recorded in stations 6 and 7 respectively. The highest and lowest community dominance indices (CDI= 80.69 %

Table 2: Species composition, distribution, Population density (P.D.) as number of organisms/m^3/year, pereantage of P.D./TPD (%), species richness (SR), Diversity index (H), Equitability (E) and Dominance % (CDI) of Rotifera in the sampled localities.

Station / Species	0		1		2		3		4		5		6		7		Average	
	P.D.	%	P.D.	%	P.D.	%	P.D.	%	P.D.	%	P.D.	%	P.D.	%	P.D.	%	P.D.	%
1- Anuraeopsis fissa (Gosse, 1851)	290	3.96	97	0.57	14	0.08	--	--	250	0.56	28	0.07	236	5.28	125	0.36	130	0.52
2- Asplanchna girodi (De Guerne, 1888)	28	0.38	611	3.59	125	0.67	153	0.46	403	0.91	722	1.7	--	--	42	0.12	261	1.04
3- Brachionus calyciflorus Pallas, 1766	1125	15.37	472	2.77	1125	6.03	1722	5.23	458	1.03	1820	4.29	83	1.86	--	--	851	3.38
4- B. plicatilis (Muller, 1786)	70	0.96	--	--	--	--	--	--	--	--	28	0.07	--	--	139	0.40	30	0.12
5- B. quadridentatus (Hermann, 1783)	208	2.84	56	0.33	--	--	--	--	--	--	--	--	--	--	--	--	33	0.13
6- B. urceolaris (Muller, 1773)	361	4.93	14	0.08	--	--	--	--	--	--	--	--	42	0.94	181	0.53	75	0.30
7- Cephalodella gibba (Ehrenberg,1832)	208	2.84	91	0.53	28	0.15	56	0.17	--	--	42	0.10	77	1.72	28	0.08	66	0.26
8- Colurella sp.	84	1.15	458	2.69	403	2.16	861	2.62	70	0.16	792	1.87	14	0.31	445	1.29	391	1.55
9- Colurella adriatica (Ehrenberg,1831)	194	2.65	14	0.08	28	0.15	361	1.1	56	0.13	1626	3.83	958	21.44	236	0.69	434	1.72
10- Euclanis dilatata (Ehrenberg, 1832)	181	2.47	--	--	167	0.9	--	--	--	--	47	0.11	--	--	116	0.34	64	0.25
11- Filinia longiseta (Ehrenberg, 1834)	125	1.71	97	0.57	--	--	--	--	--	--	320	0.75	--	--	--	--	68	0.27
12- Hexarthra oxyuris Sernov, 1903.	153	2.09	181	1.06	389	2.09	625	1.89	556	1.25	250	0.59	--	--	5611	16.32	971	3.85
13- Keratella cochlearis (Gosse, 1851)	625	8.54	222	1.30	417	2.24	--	--	42	0.09	--	--	--	--	28	0.08	167	0.66
14- K. quadrata (Muller, 1786)	1068	14.59	4556	26.75	7959	42.69	20612	62.63	5403	12.2	17111	40.3	278	6.22	20569	59.83	9694	38.49
15- K. tropica (Apstein, 1907)	500	6.83	1278	7.50	70	0.38	778	2.36	722	1.63	514	1.21	167	3.74	763	2.22	599	2.38
16- Lecane arcula (Harring, 1914)	--	--	83	0.49	--	--	14	0.04	--	--	--	--	111	2.48	195	0.57	50	0.20
17- L. grandis (Murray, 1913)	28	0.38	--	--	--	--	28	0.09	--	--	2222	5.23	56	1.25	70	0.20	300	1.19
18- L. luna (Muller, 1771)	28	0.38	42	0.25	--	--	28	0.09	14	0.03	83	0.20	56	1.25	83	0.24	42	0.17
19- Lepadella patella (Muller, 1786)	70	0.96	28	0.16	14	0.08	--	--	70	0.16	111	0.26	319	7.14	236	0.69	106	0.42
20- L. ovalis (Muller, 1786)	42	0.57	28	0.16	--	--	--	--	--	--	28	0.07	278	6.22	177	0.51	69	0.27
21- Monomonta sp.	42	0.57	28	0.16	--	--	--	--	--	--	28	0.07	56	1.25	--	--	19	0.08
22- Monostyla bulla (Gosse,1886)	--	--	42	0.25	--	--	56	0.17	--	--	56	0.13	278	6.22	195	0.57	78	0.31
23- M. closterocerca (Lehmarda, 1859)	111	1.52	14	0.08	--	--	--	--	28	0.06	264	0.62	569	12.74	346	1.01	167	0.66
24- M. hamata (Stokes, 1896)	28	0.38	--	--	--	--	--	--	56	0.13	42	0.10	250	5.60	111	0.32	61	0.24
25- Mytilina ventralis (Ehrenberg,1832)	70	0.96	28	0.16	42	0.23	--	--	--	--	208	0.49	--	--	707	2.06	132	0.52
26- Polyarthra vulgaris Carlin, 1943.	278	3.8	667	3.92	--	--	--	--	181	0.41	333	0.78	83	1.86	1444	4.20	373	1.48
27- Proalides sp.	56	0.76	445	2.61	2111	11.32	1167	3.55	24583	55.49	1216	2.87	--	--	83	0.24	3708	14.72
28- Synchaeta oblonga (Ehrenberg,1831)	945	12.91	4742	27.84	1486	7.97	172	0.52	7604	17.1 6	2152	5.07	--	--	1639	4.77	2343	9.30
29- Trichocerca cylindrica (Imhof,1891)	250	3.41	417	2.45	444	2.38	139	0.42	1111	2.51	2500	5.89	56	1.25	195	0.57	639	2.5
30- T. longiseta (Schrank, 1802)	139	1.9	486	2.85	486	2.61	195	0.59	445	1.00	473	1.11	28	0.63	--	--	281	1.12
31- T. pusilla (Jennings, 1903)	14	0.19	1834	10.77	3334	17.88	5944	18.06	2250	5.08	9445	22.24	472	10.57	611	1.78	2988	11.86
Total species	29		27		18		17		19		27		21		28			
Total specimens (TPD)	7321		17031		18642		32911		44302		42463		4467		43377			
Species Richness (SR)	3.1466		2.6686		1.7288		1.5382		1.6824		2.4399		2.3797		2.3935			
Diversity index ($\bar{H}$)	4.0397		3.1735		2.6876		1.9141		2.2609		2.4587		3.7517		2.2710			
Equitability (E)	0.8314		0.6673		0.6444		0.4682		0.5321		0.5170		0.8540		0.3348			
Dominance % (CDI)	29.95		54.59		60.58		80.69		72.65		62.54		34.18		76.16			

and 29.95 %) were recorded in stations 3 and D respectively. Both the similarity index (Table 3) and the Biodispersity index (Table 4) exhibit a strong relation between stations D & 5, D & 1, D & 7and 5 & 7.

The following are the species composition and the biological quality parameters in the sampled localities.

Station D:

The Rotifera community in El Wadi Drain was composed of 29 species (Table 2). Its average total population density (TPD) during 1989 was 7321 organisms/m3/year. Brachionus calyciflorus and Keratella quadrata dominated the community (with a community dominance index CDI = 29.95) while Asplanchna girodi, Lecane grandis, L. luna and Monostyla hamata were lower in dominance (28 individuals/m3/year for each). Since Trichocerca pusilla was represented by only 14 specimens, it was the lowest representative in this station. As mentioned above, the highest species richness (SR = 3.1466) and diversity index (H^{-} = 4.0397) were recorded in this station. The equitability (E = 0.8314) was the second highest E recorded in the area. Lecane arcula and Monostyla bulla were absent from this station during the period of the work.

Station 1 :

Twenty seven species were identified in this locality. The dominants were Synchaeta oblonga (27.84 %) and Keratella quadrata (26.75 %) (Table 2). CDI = 54.59 %. Inspite of the increase of TPD to about 2.3 fold of its value in the drain, the value of SR (2.6686), H^{-} (3.1735) and E (0.6673) were respectively less than in the drain station.

Station 2:

Table 2 shows that only 18 species were hauled from this site. Of them, K. quadrata is the most dominant and Trichocerca pusilla can be considered as the next in this respect (CDI = 60.58). Anuraeopsis fissa and Lepadella patella were the least represented species (0.08 % for each). The TPD (18642 organisms/m^3/year) was high and the SR, H^{-} and E were lower than their corresponding values in station 1.

Station 3:

The least number of species, SR and H^{-} were recorded in this locality (Table 2). On the other hand, the CDI (80.69) was the highest. . The TPD was about 1.8 fold its value in station 2. The community was also dominanted by K. quadrata (62.63 %) and T. pusilla can be considered as the second (18.06 %). Lecane arcula was the least represented species (only 0.04 %).

Table (3): Similarity Index.

	D	1	2	3	4	5	6	7
D	--	89.29	76.59	62.22	79.17	92.86	76.00	87.27
1		--	75.56	72.73	78.26	85.19	79.17	83.02
2			--	74.29	81.08	75.56	56.41	72.73
3				--	72.22	72.73	68.42	69.77
4					--	78.26	70.00	75.56
5						--	79.17	86.79
6							--	76.59
7								--

Table (4): Biodispersity of Rotifera in Wadi El Rayan.

	D	1	2	3	4	5	6	7
D	--	80.6	55.2	48.4	65.5	86.7	61.3	77.4
1		--	60.7	57.1	64.3	74.2	65.5	71.0
2			--	59.1	68.2	60.7	39.3	57.1
3				--	60.9	57.1	52.0	53.6
4					--	64.3	53.8	60.7
5						--	65.5	76.7
6							--	62.1
7								

Station 4:

In this locality, 19 species were recorded, Proalides sp. was the most dominant while Synchaeta oblonga was the second in this respect (Table 2). Lecane luna and Monostyla closterocerca were the least represented species in this station. The highest TPD (44302 organisms/m^3/year) was recorded in this station (Table 2). The values of SR, $\bar{H}$ and E were higher than the corresponding values in the previous station, while that of CDI (72.65) was lower.

Station 5:

Twenty seven species were recorded in this locality. As in stations 2 and 3, K. quadrata and T. pusilla were leading the community in this site. TPD (42463 organisms/m^3/year) was the next highest value in the whole area (Table 2). SR and E were slightly lower while $\bar{H}$ was slightly higher than their corresponding values in the previous station. The value of CDI (62.54) was within the range of that recorded for the three preceeding stations.

Station 6:

This locality was the poorest in rotifers. It harboured 4467 organisms/m^3/year (Table 2), representing 21 species. Colurella adriatica and Monostyla closterocerca were the dominants, while Collotheca sp. was the weakest represented species (14 organisms/m^3/year). The calculated CDI for this station was slightly higher than that calculated for station D. At the same time, its value was far from those calculated for all the other stations. The SR (2.3797) was slightly lower than in the previous station, while $\bar{H}$ (3.7517) was the highest one after that calculated in station D. The value of E (0.854) was the highest recorded in all the sampled localities (Table 2).

Station 7:

Of the 26 species recorded in this locality K. quadrata has a PD (20569 organisms/m^3/year) nearly equal to that of station 3 and it represents (like in stations 2,3 and 5) the most dominant rotifer. Hexarthra oxyuris (5611 organisms/m^3/year) can be considered the second dominant, while Cephalodella gibba and K. cochlearis represented the fewest existence (28 organisms/m^3/year for each). The value of E = 0.3348 was the lowest in the sampled localities and H = 2.271 was lower than that recorded in any of the previous stations except 3 and 4. The value of SR was slightly higher than that recorded in station 6 and the value of CDI = 26.16 was the second highest one in the area.

Seasonal variation

Figure 3 exhibits that winter was the flourishing season of rotifers in Wadi El Rayan and a drastic decline occurred in the production during spring when the TPD only attained about 1/3 of its winter value (Table 5). During summer

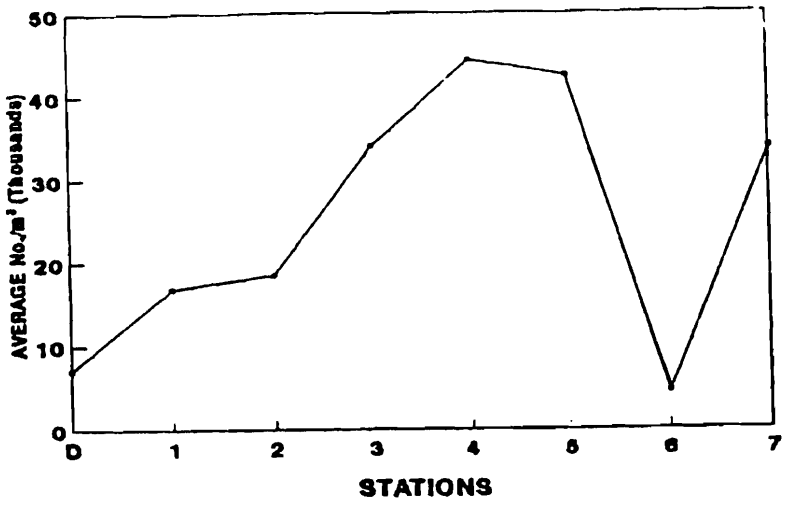


Figure 2: Frequency of total Rotifera in the sampled localities during 1989.

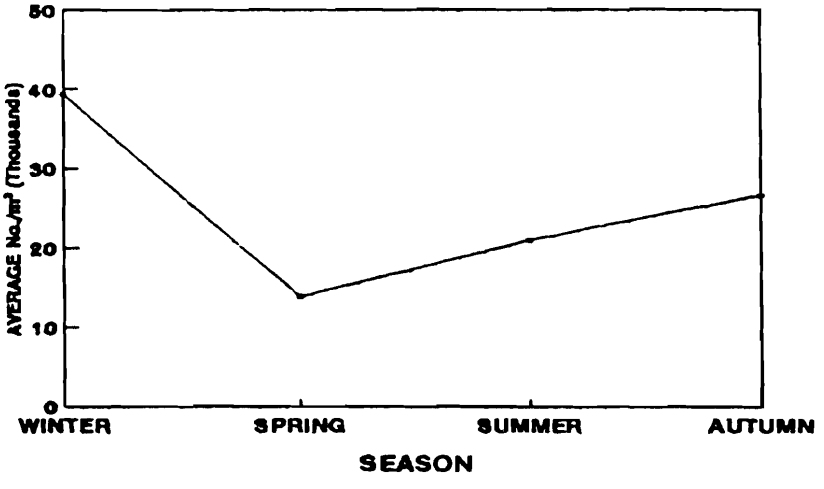


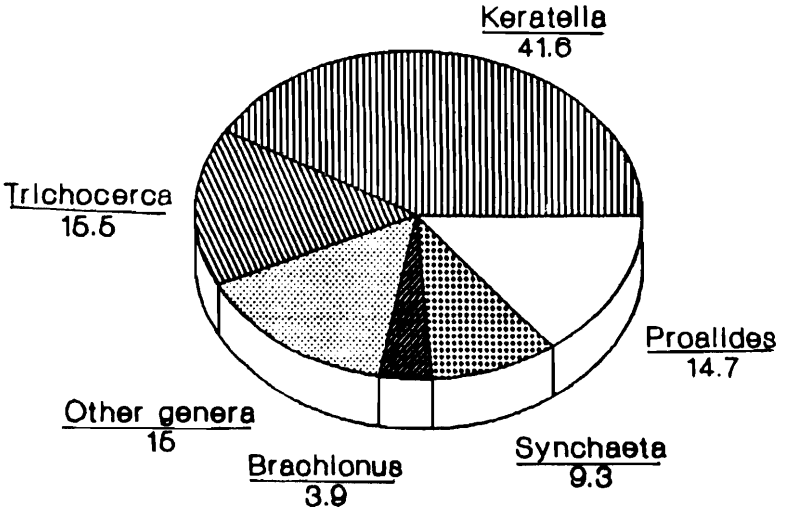
Figure 3: Seasonal variations of total Rotifera during 1989.

Table 51 Frequency (F.) as organsims/m3 and their percentage, species richness (SR), diversity index (H) equitability (E) and community dominance index (CDI) of rotifers in Wadi El Rayan during the four seasons of 1989.

Season	Winter		Spring		Summer		Autumn		Average	
Species	F	%	F	%	F	%	F	%	F	%
1- Anuraeopsis fissa (Gosse, 1851)	--	--	132	0.97	277	1.3	111	0.43	130	0.52
2- Asplanchna girodi (De Guerne, 1888)	542	1.36	472	3.45	--	--	28	0.11	261	1.04
3- Brachionus calyciflorus Pallas, 1766	396	0.99	493	3.60	14	0.07	2500	9.62	851	3.38
4- B. plicatilis (Muller, 1786)	--	--	7	0.05	28	0.13	83	0.32	30	0.12
5- B. quadridentatus (Hermann, 1783)	118	0.3	14	0.10	--	--	--	--	33	0.13
6- B. urceolaris (Muller, 1773)	201	0.50	14	0.10	56	0.26	28	0.11	75	0.30
7- Cephalodella gibba (Ehrenberg,1832)	77	0.19	77	0.56	83	0.39	28	0.11	66	0.26
8- Collotheca sp.	597	1.50	63	0.46	195	0.92	708	2.72	391	1.55
9- Colurella adriatica (Ehrenberg, 1831)	153	0.38	938	6.86	604	2.84	42	0.16	434	1.72
10- Euclanis dilatata (Ehrenberg, 1832)	120	0.30	70	0.51	23	0.11	42	0.16	64	0.25
11- Filinia longiseta (Ehrenberg, 1834)	146	0.37	125	0.91	--	--	---	--	68	0.27
12- Hexarthra oxyuris Sernov, 1903	97	0.24	104	0.76	2361	11.11	1319	5.08	970	3.85
13- Keratella cochlearis (Gosse, 1851)	208	0.52	139	1.02	--	--	320	1.23	167	0.66
14- K. quadrata (Muller, 1786)	32875	82.53	1556	11.38	14	0.07	4333	16.67	9694	38.49
15- K. tropica (Apstein, 1907)	556	1.40	285	2.88	69	0.32	1486	5.72	599	2.38
16- Lecane arcula (Harring, 1914)	7	0.02	--	--	42	0.20	153	0.59	50	0.20
17- L. grandis (Murray, 1913)	1146	2.88	--	--	---	--	56	3.85	300	1.19
18- L. luna (Muller, 1771)	69	0.17	70	0.51	28	0.13	--	--	42	0.17
19- Lepadella patella (Muller, 1786)	43	0.11	104	0.67	28	0.13	250	0.96	106	0.42
20- L. ovalis (Muller, 1786)	86	0.22	93	0.68	69	0.32	28	0.11	69	0.27
21- Monomonta sp.	7	0.02	14	0.10	28	0.13	28	0.11	19	0.08
22- Monostyla bulla (Gosse, 1886)	7	0.02	--	--	181	0.85	125	0.48	78	0.31
23- M. closterocerca (Lehmarda, 1859)	201	0.50	215	1.57	97	0.46	153	0.59	167	0.66
24- M. hamata (Stokes, 1896)	42	0.11	7	0.05	97	0.46	97	0.37	61	0.24
25- Mytilina ventralis (Ehrenberg, 1832)	492	1.24	34	0.25	--	--	--	--	132	0.52
26- Polyarthra vulgaris Carlin, 1943.	160	0.40	375	2.74	291	1.37	667	2.57	373	1.48
27- Proalides sp.	14	0.04	28	0.20	14706	69.20	83	0.32	3708	14.72
28- Synchaeta oblonga (Ehrenberg, 1831)	1461	3.67	78957	57.72	14	0.07	--	--	2343	9.30
29- Trichocerca cylindrica (Imhof, 1891)	--	--	153	1.12	528	2.48	1875	7.21	639	2.54
30- T. longiseta (Schrank, 1802)	14	0.04	97	0.71	236	1.11	778	2.99	281	1.12
31- T. pusilla (Jennings, 1903)	--	--	104	0.76	1181	5.56	10667	41.05	2988	11.86
Total species	27		28		25		26		27	
Total specimens (TPD)	39835		13678		21250		25988		25188	
Species Richness (SR)	2.4546		2.8351		2.4086		2.4593		2.5394	
Diversity index (H)	1.3252		2.5376		1.8677		2.7821		2.12815	
Equitability (E)	0.27886		0.5276		0.4021		0.5533		0.4404	
Dominance % (CDI)	86.20		69.1		80.32		57.72		53.21	

Table (6): Seasonal variation of total Rotifera (organsims/m^3) in Wadi El Rayan during 1989.

Station	Winter	Spring	Summer	Autumn
D	15107	12277	1882	--
1	21532	24693	5332	16555
2	27111	8612	12389	26445
3	82278	4135	9276	35888
4	25823	30430	111611	9331
5	81017	19281	7871	61666
6	2141	2444	6722	6551
7	63601	7544	14908	51444



followed by autumn, a gradual increase in TPD was observed when 21250 and 25988 organisms/m^3/year were respectively estimated (Table 5). During spring, the highest number of species (28) appeared and consiquently the highest SR (2.8351) was calculated. Oppositely, during summer the lowest number of species (25) and SR (2.4086) were observed. The highest $\bar{H}$ and lowest CDI appeared during autumn, while the lowest $\bar{H}$ and highest CDI appeared during winter (Table 5). The highest and lowest E were calculated for autumn and winter respectively. From the 31 rotifran species recorded through the present investigation, 17 proved a perennial behaviour. During winter, K. quadrata was the dominant species (82.53 %) and Synchaeta oblonga was the second dominant one (only 3.67 %), while in spring, S. oblonga was the dominant (57.72 %) and K. quadrata was the second dominant (11.38 %). During summer, Proalides sp. and H. oxyuris were the dominant and second dominant species (69.2 and 11.11 % respectively). During autumn, T. pusilla and K. quadrata were the dominant and second dominant species (41.05 and 16.67 % respectively). Table 6 shows that stations 3 and 5 were the most productive sites during winter, while station 6 was the least productive one. In spring, the production peak appeared in station 4 and the least production was hauled from station 6. During summer and for the whole period of investigation, stations 4 and D represented respectively the most fertility and least in the whole area. During autumn, the rotifers totally disappeared from station D (El Wadi Drain) and showed the least and highest production in stations 6 and 5 respectively (Table 6).

Dominant Kinds

As shown in figure 4, the rotiferan community was dominated by the genera, Keratella, Trichocerca, Proalides, Synchaeta and Brachionus. The following deals in detail the seasonal variation and abundance of these genera:

Genus Keratella

By contributing about 41.6 % to the total rotifers (Fig. 4), this genus dominated the rotiferan community in Wadi El Rayan. The representatives of genus Keratella in the area were three species:

1. Keratella quadrata :

Owing to its continuous high population in the whole sampled localities, this species was the most important rotifer in the area. It was represented by two forms K. quadrata quadrata and K. quadrata dispersa.

K. quadrata quadrata contributed about 27% to the total rotifers in the area with an average standing crop of 6804 organisms/m3/year (Table 7). Station 3 was the most flourishing site for this variety, especially during winter when a peak of 79000 individuals/m^3 was recorded (Table 7), while stations D, 6 and 7 were the least productive sites (Fig. 5). A big difference in the seasonal production of this variety was observed when a peak of 26035 organisms/m^3

appeared during winter (Table 7), followed by a drastic drop during spring. This was followed by a totally disappearance during summer and a weak reappearance during autumn, (Fig. 6).

K. quadrata dispersa was less frequent (2891 organisms/m^3/year, Table 7). Station 7 was the flourishing site for this form (20320 organisms/m^3/year) especially during winter when 49111 organisms/m^3 were estimated (Table 7), while stations 1, 5 and 6 were the least productive sites. In spite of this low frequence, K. quadrata dispersa had virtually the same seasonal variation of K. quadrata quadrata (Fig. 6).

2. Keratella tropica :

Inspite of the low average PD of this species (599 organisms/m^3/year, Table 8), its flourishment in station 1 (1278 individuals/m^3/year) was noticeable. That was due to the high population (4556 organisms/m^3) hauled from this site during autumn. Regarding its seasonal variation, a gradual decrease in its production from winter through summer followed by a sharp increase to its peak during autumn was observed (Fig. 7).

3. Keratella cochlearis:

This species sporadically appeared in the area investigated. Autumn was the flourishing season (320 organisms/m^3 in average) showing a peak of 1667 organisms/m^3 in station 2 (Table 8). While the absence of this species was recorded during summer, its autumn production attained 1.5 and 2.3 its winter and spring production respectively.

Genus Trichocerca

Owing to its dense population in the majority of the stations during autumn (Table 9), genus Trichocerca can be regarded as a typical autumn plankter. It was represented in the area by three species:

1. Trichocerca pusilla:

Beside being the third dominant rotifer species in the area (2988 organisms/m^3/year, Table 2), T. pusilla dominated the species of its genus. Table 5 shows that it was absent during winter, starting to appear during spring, but flourishing (1181 organisms/m^3) during summer and attaining its production peak (10667 organisms/m^3) during autumn. This species disappeared from the drain (Station D) during the whole year except spring when few specimens were recorded. As well, it disappeared from station 6 during the whole year except autumn (Table 9).

Table (7): Frequency of Keratella quadrata quadrata (K.q.q) and K. quadrata dispersa (K.q.d) as (organisms/m³) in the sampled localities during the seasons of 1989.

Season / Station	Winter		Spring		Summer		Autumn		Average	
	K.q.q.	K.q.d	K.q.q	K.q.d	K.q.q	K.q.d	K.q.q	K.q.d	K.q.q	K.q.d
0	222	3661	222	167	0	0	0	0	111	957
1	17111	0	556	0	0	111	333	111	4500	36
2	24889	1111	2167	0	0	0	889	3778	6936	972
3	73000	56	2667	56	0	0	0	667	20417	195
4	18722	1778	667	0	0	0	222	222	4903	500
5	66944	0	111	56	0	0	0	333	17014	97
6	611	0	389	0	0	0	0	111	250	28
7	778	49111	222	4167	0	0	0	20000	250	20320
Average	26035	6840	1030	556	0	24	181	4153	6804	2891

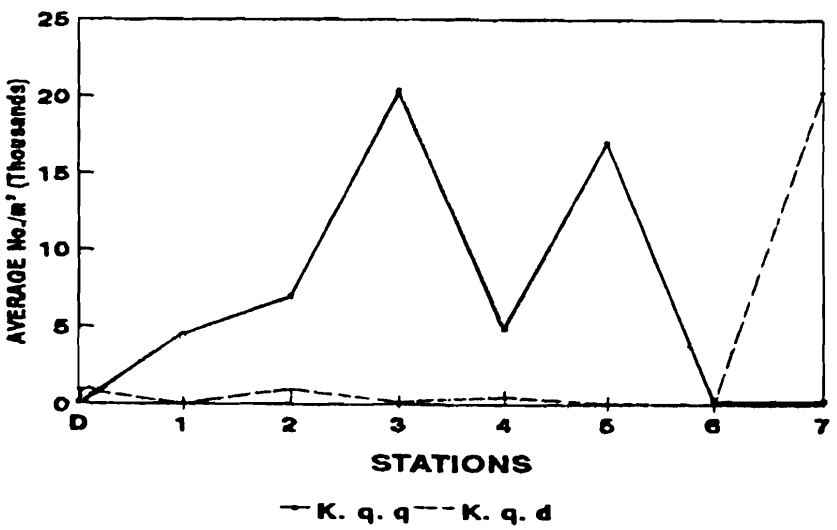


Figure 5: Frequency of Keratella quadrata quadrtata (K.q.q.) and K. q. dispersa K.q.d.) in the sampled localities.

Table (8): Frequency and seasonal variation of Keratella tropica (K.t) and K. cochlearis (K.c) as organisms/m³ in Wadi El-Rayan Depression during 1989.

Station	Winter	Spring	Summer	Autumn	Average
D	333	1444	222	0	500
1	333	111	111	4556	1278
2	167	111	0	0	70
3	167	56	0	2889	778
4	500	167	111	2111	722
5	0	56	0	2000	514
6	0	222	111	333	167
7	2944	111	0	0	764
Average	556	285	69	1486	599

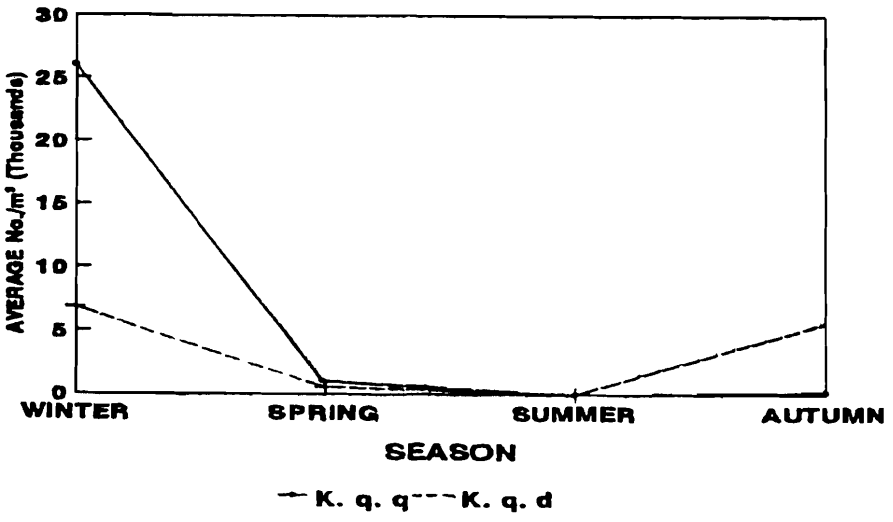


Figure 6: Seasonal variation of Keratella quadrata quadrata (K.q.q.) and K. q. dispersa (K.q.d.) in Wadi El Rayan during 1989.

Table (9): Frequency and seasonal variation of Trichocerca (organisms/m³) in Wadi El Rayan Depression during 1989, (T.c. = Trichocerca cylindrica, T.l.= Trichocerca longiseta, T.p.= Trichocerca).

Stastion	Winter			Spring			Summer			Autumn			Average		
	T.c.	T.l	T.p	T.c.	T.l	T.p	T.c.	T.l	T.p	T.c.	T.l	T.p	T.c.	T.l	T.p
D	0	56	0	1000	500	56	0	0	0	0	0	0	250	139	14
1	0	0	0	222	56	778	111	111	889	1333	1778	5667	416	486	1834
2	0	0	0	0	56	0	333	111	1778	1444	1778	11556	444	486	3334
3	0	0	0	0	0	0	111	111	333	444	667	23444	139	194	5944
4	0	0	0	0	0	0	3111	1556	6111	1333	222	2889	1111	444	2250
5	0	56	0	0	56	0	222	0	111	9778	1778	37667	2500	472	9444
6	0	0	0	0	111	0	111	0	0	111	0	1889	56	28	472
7	0	0	0	0	0	0	222	0	222	556	0	2222	194	0	611
Average	0	14	0	153	97	104	528	236	1181	1875	778	10667	639	281	2988

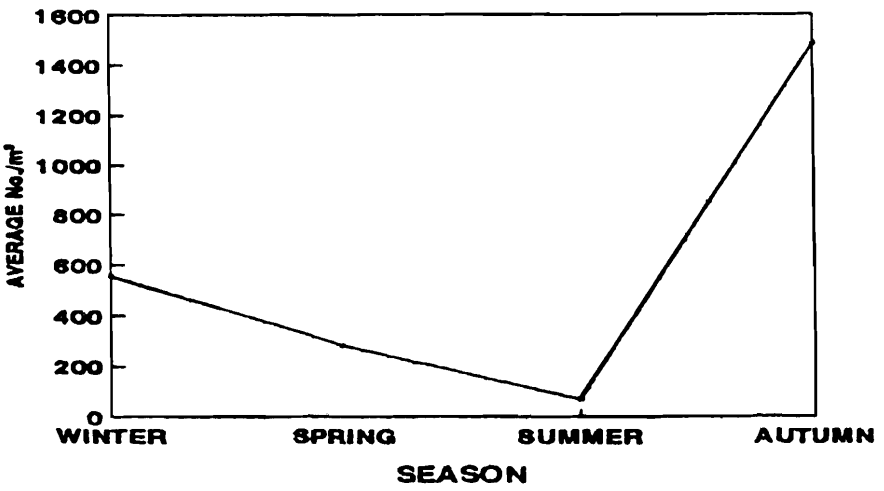


Figure . Seasonal variation of Keratella tropica in Wadi El Rayan during 1989.

2. Trichocerca cylindrica:

This species contributed 2.54 % to the total Rotifera (Table 5). Except being less abundant and being recorded in station 6 during summer, T. cylindrica had virtually the same seasonal and spatial distribution of T. pusilla (Table 9).

3. Trichocerca longiseta:

Few individuals of this species (14/m³) monopolized the winter community of genus Trichocerca in the area. While the species was totally absent from station 7 and weakly represented in station 6 (average of 28 individuals/m³/year, Table 9), its production showed 4 peaks (> 400 individuals/m³/year) in stations 1,2,4 and 5. The first two were the highest. As the time elapsed from winter through autumn the population density increased gradually (Table 9).

Genus Proalides

An odd unidentified species represented this genus in the area. It constituted 14.72 % to the total rotifers (Table 2). During winter, spring and autumn of 1989, this genus was absent from the whole area except stations D,3,4 and 7, but each during a definite season (Table 10). More than 99% of this rotifer (14706 organisms/m³) were hauled during summer (Table 10), so it can be considered a typical summer plankter. While the absence of this genus was recorded in station 6, its maximum production (24583 organisms/m³/year) was detected in station 4 (Table 10).

Genus Synchaeta

Synchaeta oblonga was the only representative of this genus in the area. It contributed 9.3% to the Rotifera community (Table 2). It was totally absent from the plankton of station 6 and weakly represented (172 organisms/m³/year) in station 3. It attained its maximum flourishment in stations 4 and 1 where 7604 and 4742 organisms/m³/year were respectively estimated (Table 11).

Spring was the flourishing season of S. oblonga when 7895 organisms/m³ (i.e. about 5.4 fold the winter production) were the average production from the whole area (Table 11). During this season the species was hauled from the whole area except station 6. Two peaks of 27485 and 18467 organisms/m³ were calculated during spring in stations 4 and 1 respectively while the paucity of this species (111 organisms/m³) was recorded in the drain (Table 11).

During winter, S. oblonga disappeared from 50 % of the sampled localities. During summer it disappeared from the whole area except station 7 where it was weakly represented. During autumn, the species totally disappeared from the zooplankton of the whole sites (Table 11).

Table (10): Frequency and seasonal variation of Proalides sp. (organisms/m³) in Wadi El Rayan Depression during 1989.

Station	Winter	Spring	Summer	Autumn	Average
D	0	222	0	0	56
1	0	0	1778	0	445
2	0	0	8444	0	2111
3	111	0	4555	0	1167
4	0	0	98000	333	24583
5	0	0	4872	0	1218
6	0	0	0	0	0
7	0	0	0	333	83
Average	14	28	14706	83	3708

Table (11): Frequency and seasonal variation of Synchaeta oblonga (organisms/m³) in Wadi El Rayan Depression during 1989.

Station	Winter	Spring	Summer	Autumn	Average
D	3667	111	0	0	945
1	500	18467	0	0	4742
2	0	5944	0	0	1486
3	0	689	0	0	172
4	2932	27485	0	0	7604
5	0	8609	0	0	2152
6	0	0	0	0	0
7	4588	1856	111	0	1639
Average	1461	7895	14	0	2343

Genus Brachionus

This genus contributed about 4% to the total rotifera in the area (Fig. 4). It was represented by four species (Table 2). The most abundant of them was B. calyciflorus. This species contributed about 86 % to the genus population and 3.38 % of the total rotifers in the area. It was one of the most dominant species in the Drain.

Table 12 and Figs 8 and 9 show that while B. calyciflorus was a perennial species in station 1, it totally disappeared from station 7. Autumn was the flourishing season while summer was the least productive one. The most productive sites were stations 5 and 3. where 1819 and 1722 organisms/m^3/year were respectively produced (Table 12).

In addition to the above mentioned species, the following three are of importance.

1. Hexarthra oxyuris was regarded as an aestival species (Table 5). In addition of being the second dominant species of the summer community of rotifers in the whole area, it was the second dominant one in station 7 during the whole period of investigation (Table 2).

While it was totally absent all the year around from station 6 (Table 13), H. oxyuris showed a perennial behaviour in stations 4 and 7.

2. Colurella adriatica was dominant in station 6 (21.44 %, Table 2), It was widely distributed in the area during winter and spring, while spring and summer were its flourishing seasons (Table 5).

3. Monostyla closterocerca was the second dominant species in station 6 (12.74 %, Table 2), perennial in stations 6 and 7, but totally absent from stations 2 and 3 (Table 2). Spring and winter were the flourishing seasons for this species, while summer was the least productive one (Table 5).

DISCUSSION

The flourishment of Rotifera in the alkaline medium (PH = 8.5-9.1) with high oxygen level (O_2 = 7.5-9.1 mg/l) (Table 1) of Wadi El Rayan, agrees with Michael (1964) and with Arora (1966). The former claimed that rotifera in general prefer more alkaline water and the latter advocated that an increase in dissolved oxygen concentration may have a beneficial effect on rotifers. The advocation of Arora (1966) is confirmed by the high Rotifera population in surface water of station 4 where the highest dissolved O2 was measured.

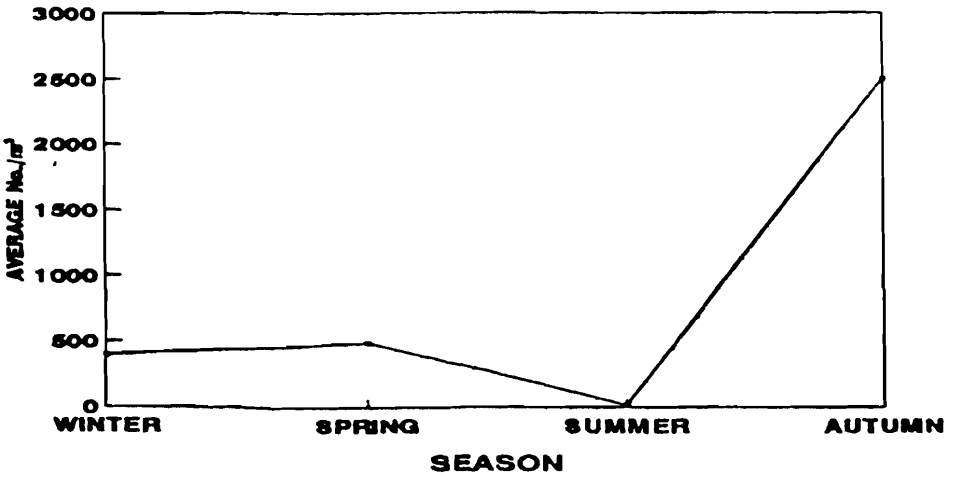


Figure 8: Seasonal variation of Brachionus Calyciflorus in Wadi El Rayan during 1989.

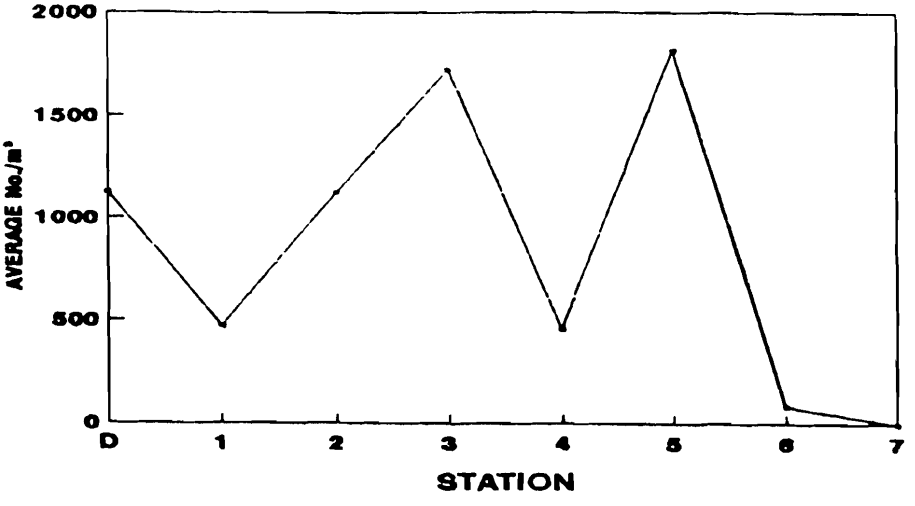


Figure 9: Frequency of Brachionus calyciflorus in the sampled localities during 1989.

Table (12): Frequency and seasonal variation of *Brachionus calyciflorus* (organisms/m³) in the sampled localities during 1989.

Station	Winter	Spring	Summer	Autumn	Average
D	889	3611	0	0	1125
1	278	56	111	1444	472
2	444	56	0	4000	1125
3	556	0	0	6333	1722
4	611	0	0	1222	458
5	389	0	0	6889	1819
6	0	222	0	111	83
7	0	0	0	0	0
Average	396	493	14	2500	851

Table (13): Frequency and seasonal variation of *Hexarthra oxyuris* (organisms/m3) in Wadi El-Rayan Depression during 1989.

Station	Winter	Spring	Summer	Autumn	Average
D	111	167	333	0	153
1	0	56	667	0	181
2	0	0	1445	111	389
3	56	0	2444	0	625
4	56	278	1667	222	556
5	0	0	778	222	250
6	0	0	0	0	0
7	556	333	11556	10000	5611
Average	97	104	2361	1319	970

The present results may lead to the conclusion that temperature boosts the abundance of some rotifer species in the area, and the decline or even disappearance of others. The evidences are:

1. The flourishment of rotifers during winter and autumn.

2. The disappearance of 20 % of the rotiferan species from the area.

3. The sharp decline in other important species such as Keratella quadrata, Brachionus calyciflorus and Synchaeta oblonga during summer,
4. The flourishment of other species such as Proalides sp. and Hexarthra oxyuris during summer.

The disappearance of some species from the area during summer was previously noticed by Ramadan et al., (1992) who recorded the absence of the whole cladoceran species except Diaphanosoma mongolianum. That may agree with the statement of Fernando (1980) and Tait (1982) that uniform high temperature of habitat are probably responsible for the lack of species diversity.

Since the availability of food increases the growth rate and fertility of the females (Comita & Anderson 1959, Anderson & Cuminin, 1979), the food together with the temperature may also be important in restricting zooplankton species diversity (Fernando, 1980). The seasonal variation of rotifer's production in Wadi El Rayan has a positive correlation with the seasonal production of total phytoplankton recorded by Konsowa (1991) except that the autumn production of phytoplankton was the highest.

In the tropics, since many species both consume zooplankton and compete with them for algal and sestonic food, fish play a key role in zooplankton density. Dumont et al., (1981) stated that the presence of small species of zooplankton is indicative of heavy predation. The dominance of the smallest rotifers during the present investigation may have resulted from heavy predation by fishes.

The present results of Rotifera dominance in Wadi El Rayan agree with those of Damietta Nile Branch (Helal, 1981), Mariut Lake (Abdel Aziz, 1987), Edku Lake (Soliman, 1988) and El-Serw Fish Farm (El-Shebly, 1991). At the same time they disagree with the results of Guerguess (1979) and Khalil (1984) who respectively recorded that Cladocera was the dominant group in Manzala Lake and Wadi El Rayan Lake. As well as, they disagree with Aboul Ezz (1984), Zaghlool (1985) and Abd El-Mageed (1992) who respectively recorded the dominance of Copepoda in Burollus Lake, Nasser Lake and Khor El Ramla (Nasser Lake).

Arora (1966) claimed that Rotifera are indicator of the trophic nature of the environment and Pejler (1957) mentioned that the presence of Brachionus sp., Keratella cochlearis and Filina longiseta (which is the case in Wadi El-Rayan) in any lake is an indicator of eutrophy.

The most dominant rotiferan species in the area was K. quadrata. It was represented by two varieties K. q. quadrata and K. q. dispersa. The latter is characterized by a short spine length. Amren (1966) considered that the temporal variation of the spine length of K. quadrata is mainly an interplay between internal and external factors. He believed that the food and temperature affect the rate of spine development. It can be concluded that beside food and temperature, salinity affects spine length of K. quadrata. This is evidenced by the dominance of K. q. dispersa in the Rotifera community of station 7 (the highest saline locality in the area).

Carlin (1943) classified genus Trichocerca as an important summer plankter in Motala River (India). That agrees with Helal (1981) working on Damietta Nile branch (Egypt). In Wadi El Rayan, as the present work shows, the peak of Trichocerca flourishment postponded its appearance to autumn.

Hexarthra oxyuris was a perennial species with a summer peak, especially in station 7. That agrees with the behaviour of Hexarthra spp. in other areas (Hutchinson 1967, Herzing & Koste 1989).

The dense sporadic appearance of Proalides sp. and Synchaeta oblonga in Wadi El Rayan during summer and spring respectively and their absolute absence or weak representation during the other seasons agree with the statement of Allan (1976). This author revealed that many rotifers are fugitive species and occur sporadically for a short period of time.

The differences between the present results and these of Khalil (1984) may by attributed to the unstability of the ecosystem of Wadi El-Rayan Lake. These differences may mostly found in the number of recorded rotifers, species composition, seasonal variation of the species and the number of the newly recorded species.

The weak representation of Lecane arcula and Monostyla bulla in the lake, in spite of their absence from the drain community, may suggest the water used for fish fry transport or/and the wintering birds as ways for the penetration of these species to the lake.

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