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Rotifera of the Southern Iraqi Marshes, with a reference to the major zooplankton groups in the region.

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Abstract

Vertical hauls were collected from 25 stations scattered throughout the southern Iraqi marshes during the period 7-18 December 2012. About 56 taxa of rotifers were recorded at these 25 stations covering the 3 major southern Iraqi Marshes. The very important species of Rotifera which govern the abundance of Rotifera and zooplankton as a whole is *Synchaeta lakowitiziana* which accounts for 176.5, 79.71, 70.17 and 69.93 ind/L at stations 10, 3, 15 and 20, respectively. Bdelloidea and *Brachionus plicatilis* were ranked second and third in abundance. Protozoa and Copepoda were the second and third important groups of zooplankton after Rotifera. Water temperature, salinity, pH, turbidity, chlorophyll-*a* and dissolved oxygen were measured at each station. The results of the physical, chemical and biological parameters at all the 25 stations have been treated using two statistical programs, SPSS version 21 and The Multivariate Analysis of Ecological Data (CANOCO).

Introduction

Rotifera is a group of small animals forming an important link in the food chain at the freshwater environments, it converts energy from bacteria, phytoplankton and detritus into the next trophic level of consumers. It is also a good indicator of the quality of water, particularly waters subjected to waste water pollution (Suthers & Rissik, 2009; Agrawal & Gopal, 2013).

Rotifera of the Southern Iraqi waters has been the subject of earlier studies in the region (Gurney, 1921). Recently, Al-Saboonchi *et al*. (1986) identified some taxa of Rotifera in the Garmat-Ali marshes. The Rotifera of the southern Iraqi marshes were thoroughly investigated (Ahmed & Mohammed, 2006; Ahmed & Ghazi, 2009; and Salman *et al*. 2014). Rotifera of Shatt Al- Arab river was recently studied (Hammadi, 2010 and Hammadi and Bielańska-Grajner, 2012). This article is a report of the Rotifera species in the southern

Mesopotamian Marshes collected from 25 stations during 7-18/12/2012, which were not sampled before.

Material and Methods

Vertical hauls were collected from 25 stations scattered throughout the southern Iraqi marshes (Figure 1, Table 1) during the period 7-18 December 2012.

A plankton net with a mesh size of 53 µm and a mouth aperture of 40 cm was used for this purpose. The net was lowered to near the bottom

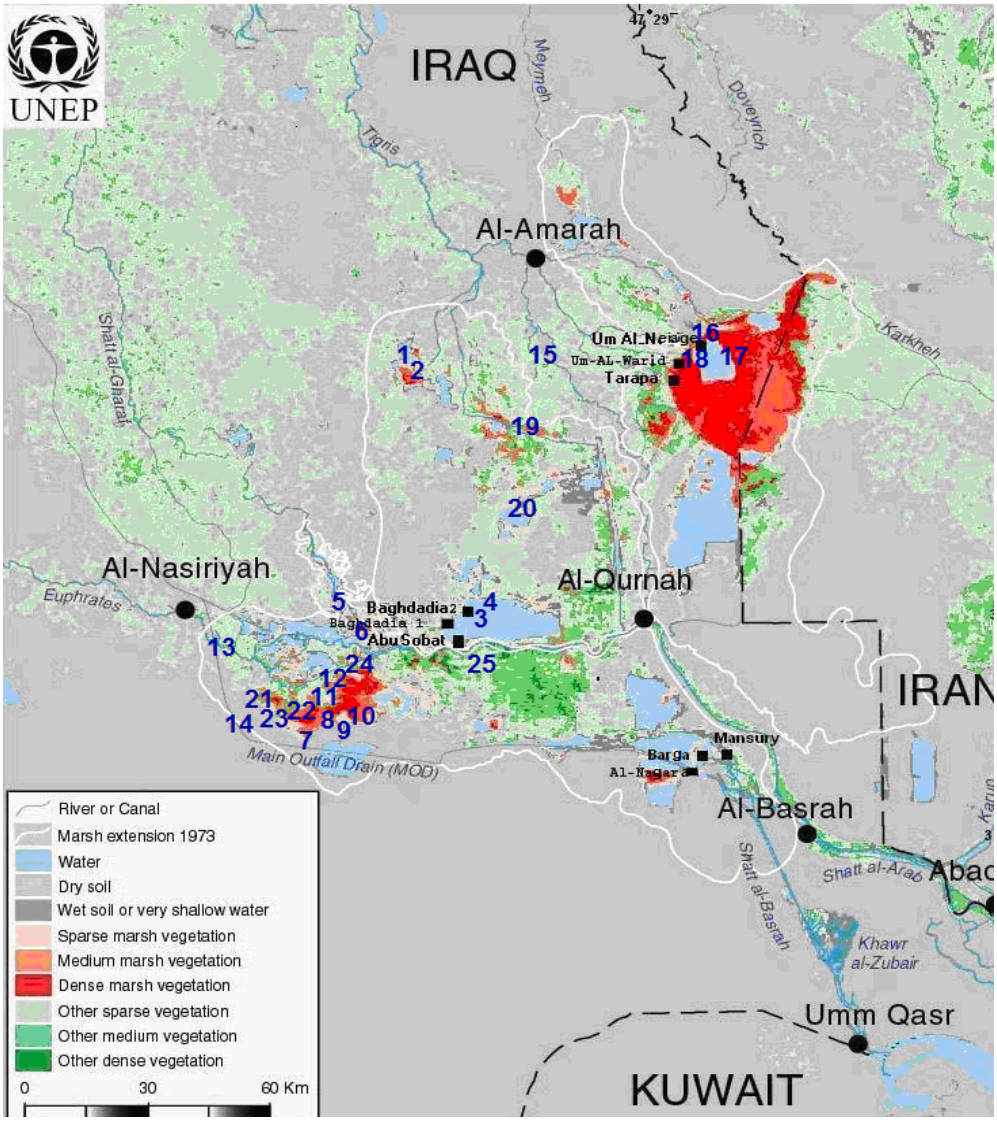

Figure 1: Map of the study area with the location of the 25 sampling stations.

and pulled gently to the surface. The samples were fixed with 4% formalin. The depth of water was recorded and the volume of water filtered by the net was calculated from the expression:

$V=r^2$ (22/7) h , where

h is the depth of water in meters, and the number of Rotifera (ind/L) was then obtained (APHA, 2005).

In the laboratory, 1 ml of the sample was taken from the concentrated plankton sample (100 mL), and poured into a sedgewick Rafter and counted. Sub-samples were taken until enough Rotifers (100 individuals or more) were enumerated and in each time the counted sub-sample was returned back to the original sample.

For identification of Rotifera, the most recent literatures were consulted (See Hammadi, 2010, for references).

Water temperature, salinity and pH, were measured at each station by a multimeter (YSI), turbidity by a HACH 2100 p Turbidimeter, chlorophyll-*a* and dissolved oxygen were determined according to Lind (1979).

The results of the physical, chemical and biological parameters at all 25 stations have been treated using two statistical programs, SPSS version 21 and The Multivariate Analysis of Ecological Data (CANOCO).

Results

Water temperature ranged from 14.0 ˚C at station 15 t0 18.2 ˚C at station 6 (Table 1). Due to the shallowness of the area only a few reading of depth were taken. Water depth changed from 1.5-3 m at stations 5, 7 and 10, respectively. The pH at station 7 was slightly acidic (6.73), and neutral (7.1) at station 8, whereas at the rest of stations, the values were on the alkaline side. Salinity changed from 0.5 ‰ to 9.7 ‰ at stations 5 and 7, respectively. Dissolved oxygen fluctuated between 2.2 mg/L at station 9 to 11.14 mg/L at station 17. Turbidity ranged from 0.0 at stations 16 and 17 to 59 FTU at station 2. Chlorophyll-*a* values fluctuated between 0.57 and 27.76 mg/m^3 at stations 10 and 8, respectively.

The highest counts of zooplankton was reported at station 10, at Hor Al-Sinaff, left of the dike (Al-Hammar marsh), as the count was 219.1 ind/L (Table 2). Station 3 Hor Al-Saffat (Al-Kasrah of Al-Chibayish marshes), comes second in abundance of zooplankton (101.2 ind/L) followed by station 20 (Al-Izz river, at the end of canal) when the abundance was 79.8 ind/L, station 15 at Um-Al-Naaj of Al-Huwaiza marshes had 77.76 ind/L. These zooplankton

counts are, certainly, a reflection of the abundance of Rotifera, as the sampling means (the mesh size of the net) is mainly for collecting Rotifera. Therefore, station 10 had the highest rotifer counts (188.1 ind/L), followed by station 3 (82.58 ind/L), station 20 (72.4 ind/L) and station 15 (72.3 ind/L) (Table 2).

About 56 taxa of rotifers were recorded at these 25 stations covering the 3 major southern Iraqi Marshes (Table 2). The very important species of Rotifera which govern the abundance of Rotifera and zooplankton as a whole is *Synchaeta lakowitiziana* which accounts for 176.5, 79.71, 70.17 and 69.93 ind/L at stations 10, 3, 15 and 20, respectively (Table 2). Bdelloidea ranked second in abundance, but very much less than the previous species. They constitute 4.0 ind/L at station 7, at the entrance of Hor Al-Sinaff of Al-Hammar marsh and 2.84 ind/L at station 8, at the centre of Hor Al-Sinaff and 2.13 ind/L at station 10, 1.52 ind/L at station 1 the feeder of Hor Oda at Al-Chibayish marsh (Table 2).

Brachionus plicatilis ranked third in abundance, it was represented by 11.7 ind/L at station 25, the Conjuction Canal between Al-Chibayish marsh close to Al-Hammar marsh and only 1.62 ind/L at station 1 and 1.43 ind/L at station 7. *Polyarthra dolichoptera* is the forth in abundance, represented by 6.1 ind/L at station 25, 3.65 ind/L at station 10 and 2.79 at station 4, at Hor Al-Baghdadia of Al-Chibayish marsh (Table 2).

Protozoa is the second important group after Rotifera, constituting 60.3 ind/L at station 11 at the end of Hor Al-Kermashia of Al-Chibayish marsh, and 12.2 ind/L at station 5 at the feeder of Hor Abu-Zurig of Al-Chibayish marsh,8.8 ind/L at station 3, 7.76 ind/L at station 24 at Garmat-Bani-Seed, 7.5 ind/L at stations 9 & 18 and 7.2 ind/L at station 17.

The third important group of zooplankton is the Copepoda nauplii, which reached 39.2 ind/L at station 25, 25.3 ind/L at station 10, 8.9 ind/L at station 4, 6.87 ind/L at station 7 and 6.21 ind/L at station 3.

Analysis of the correlation coefficient between some species of Rotifera, other groups of zooplankton and the environmental parameters using (CCA) canonical correlation analysis (CANOCO). CCA – ordination showed that positive significant relationships were found between water temperature and *B. calyciflorus* (r=0.401), *Brachionus* spp. (r=0.476), and *C. adriatica* (r=0.490). Negative significant relationships between pH and bdeloidea (r=-0.671), *B. calyciflorus* (r=-0.453) and Nematoda (r=-0.400) (Figure 2).

A positive significant relationship was found between salinity and bdelloidea (r=0.519), but a negative significant relationship with *L. bulla* (r=-0.408) (Figure 2). A positive significant relationship was obtained between dissolved oxygen and *L. bulla* (r=0.497), whereas negative significant relationships were noticed with *B. angularis* (r=-0.397), *B. calyciflorus* (r=-0.493), *P. dolychoptera* (r=-0.540), Copepoda (r=-0.452) and total zooplankton (r=-0.410) (Figure 2). Positive significant relationships were detected between Nematoda and turbidity (r=0.606) and chlorophyll-*a* (r=0.469) (Figure 2).

Discussion

Al though, the Rotifra is an important link in the food chain of the freshwater habitat, yet their overwhelming diversity, indicate organic pollution (Sladecek, 1983). In the present investigation only 56 taxa were recognized in the 25 stations representing most of the southern Mesopotamia marshes. Unfortunately, the time of sampling is confined to the most coldest times in the year, yet it is expected that only the cold tolerant species of Rotifera can be encountered in this period. However, previous study , emphasize the presence of about 105 taxa of Rotifera in a quite limited areas of the marshes, but sampled over a period of 15 months (Salman *et al*., 2014).

The present study indicates that the Protozoa (ciliated and amoeboid protozoans) is forming the next important group of zooplankton. Previous records, apparently, overlooked this important group of zooplankton, although plankton nets as fine as 53 µm was also used, but the main concern in that investigation was the Rotifera (Salman *et al*., 2014).

CANOCO test showed that *B. angularis*, *B. plicatilis*, *C. gibba* and *S. lakowitziana* were positively correlated with water temperature (Figure 2). *Brachionus* spp. and Nematoda exhibited positive correlation with turbidity, pH, DO and chlorophyll-*a*. However, total zooplankton, Copepoda, total Rotifera displayed negative correlation with salinity. Whereas Protozoa, Ostracoda and other species of Rotifera showed negative correlation with DO, chlorophyll-*a*, and turbidity (Figure 2). It is recommended here that such extensive sampling should be repeated, at least, on seasonal basis, so that a firm conclusion can be reached.

Table 1: Locations of sampling sites at the Iraqi Southern Marshes and some environmental factors measured during the sampling period 7-18 Dec., 2012

S No.	Station Name and Location	Station Sitation	WT ° C	pH	Sal. ‰	DO mg/L	Tur. FTU	Chlorophyll-*a* mg/m^3	Depth m
1	Hor Oda feeder (Al-Chibayish)	31° 36' 01.5" N, 46° 50' 33.0" E	16.4	8.2	0.8	8.2	15.22	6.36	
2	Hor Oda (Al-Chibayish)	31° 35' 19.9" N, 46° 50' 52.7" E	16.7	7.9	1.6	7.1	59	24.86	
3	Hor Al-Saffatt (Kasrah-Al-Chibayish)	31° 00' 15.6" N, 47° 00' 48.0" E	16.5	7.9	2.8	6.8	31.95	13.88	2.8
4	Hor Al-Baghdadia (Al-Chibayish)	31° 01' 57.0" N, 47° 02' 08.3" E	16.5	7.8	3.4	3.8	4.18	6.94	2
5	Hor Abu Zarig feeder (Abu Jary Dam, Al-Chibayish)	31° 02' 31.7" N, 46° 39' 06.7" E	16.5	8.1	0.5	9.85	2.38	8.67	1.5
6	Hor Al-Fuhood jetty (Al-Chibayish)	30° 59' 04.4" N, 46° 42' 5.14" E	18.2	8.2	0.9	7.6	12.48	14.45	
7	Hor Al-Sanaff entrance (Al-Hammar)	30° 48' 22.2" N, 46° 35' 20.9" E	16	6.7	9.7	3.5	3.23	8.09	3
8	Mid Hor Al-Sanaff (Al-Hammar)	30° 48' 42.1" N, 46° 35' 52.0" E	16.2	7.1	9.7	2.8	2.4	27.76	2
9	Hor Al-Sanaff, the Dike-right (Al-Hammar)	30° 48' 34.6" N, 46° 36' 14.8" E	17.1	7.7	5.5	2.2	1.27	7.51	2
10	Hor Al-Sanaff, the Dike-left (Al-Hammar)	30° 48' 44.8" N, 46° 36' 24.9" E	17	7.9	5.2	2.25	2.55	0.57	3
11	End of Hor Al-Kermashia Drainage (Al-Chibayish)	30° 49' 53.6" N, 46° 34' 14.9" E	15.6	8.2	2.4	7.5	6.3	2.89	
12	Hor Al-Kermashia, enterance (Al-Chibayish)	30° 51' 58.3" N, 46° 33' 26.6" E	16.8	8.5	2.5	8	4.16	5.78	
13	Siphon (Al-Fadheela River), Third River	30° 57' 57.5" N, 46° 19' 51.3" E	15.4	8.3	4.9	7	9.24	2.31	
14	Al-Khameesia Canal, enterance (K140) (Al-Chibayish)	30° 47' 27.8" N, 46° 23' 29.1" E	15.8	8.6	5.2	7.2	14.77	1.73	
15	Al-Huwaiza Marsh (Um Al-Naaj) WH3	31° 37' 18.6" N, 47° 76' 36.7" E	14	8.8	0.6	8	0.39	8.67	
16	Al-Huwaiza Marsh (Um Al-Naaj) Abu Athba Marsh	31° 38' 17.5" N, 47° 36' 36.3" E	14.2	8.8	0.7	9.5	0	9.83	
17	Al-Huwaiza Marsh (Um Al-Naaj) WH4	31° 37' 18.1" N, 47° 38' 38.5" E	14.1	8.8	0.6	11.2	0	8.92	
18	Al-Huwaiza Marsh (Um Al-Naaj) Al-Mastara	31° 36' 59.5" N, 47° 34' 40.2" E	14.2	8.3	0.7	8.1	19.41	4.41	
19	Al-Izz River, left, close of the Dam	31° 27' 23.7" N, 47° 05' 39.0" E	14.4	8.5	0.8	7.4	11.76	3.98	
20	Al-Izz River, (End of Canal 4)	31° 19' 48.0" N, 47° 02' 26.5" E	16	8.1	1.5	5	9.04	6.2	
21	Al-Khameesia Bridge (Al-Chibayish)	30° 49' 59.9" N, 46° 26' 06.3" E	15	8.4	5.4	7.7	15.26	6.12	
22	Near Al-Kermashia railway station (Al-Chibayish)	30° 48' 48.5" N, 46° 33' 54.0" E	16.4	7.9	5.4	6	6.36	4.12	
23	Um Al-Wadda (Al-Chibayish)	30° 48' 26.5" N, 46° 31' 28.6" E	15.7	8.3	4.2	6.35	10.46	7.95	
24	Garmat Beni-Saeed (Dam)	30° 52' 51.9" N, 46° 34' 22.5" E	16.3	8.3	1.6	7.95	8.7	5.7	
25	Conjuction Canal between Al-Hammar and Al-Chibayish	30° 54' 59.3" N, 46° 00' 21.9" E	15.7	8.3	3.7	3	13.37	2.51	

Table 2: List of total density (ind./L) of the zooplankton groups and rotiferan taxa at twenty five stations of the Iraqi Southern Marshes in December 2012

Taxa	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20	S21	S22	S23	S24	S25
Anuraeopsis fissa																0.95									
Aschomorpha sp.																						0.16			
Asplanchna sp.										0.30															
Bdelloidea	1.52	0.43	0.95	0.28	1.30	1.16	4.01	2.84		2.13	0.50			0.88		1.26	0.43		1.16	0.12		0.93		0.85	0.41
Brachionus angularis			0.48							0.91										0.12					3.40
B. calyciflorus						0.29	0.29	0.20		0.61										0.12					
B. calyciflorus f. *amphiceros*										0.30															
B. calyciflorus f. *calyciflorus*																						1.24			
B. calyciflorus f. *dorcas*								0.20																	
B. calyciflorus f. *spinosus*								0.20												0.12					
B. lydigi																								0.08	
B. plicatilis	1.62		0.24				1.43		0.37							0.32				0.12	0.38	0.31			11.70
B. quadridentata (long posterior spines)										0.30															
B. quadridentata (short posterior spines)	0.30									0.30															
Brachionus spp.	0.20	0.21		0.28	0.43	0.29														0.12		0.31			
Cephalodella gibba			0.24							0.30	0.13									0.12					
Cephalodella spp.	0.10			0.28									0.30	0.88									0.98		
Colurella adriatica			0.24	0.28		0.58	0.29															0.16	0.12		
Colurella sp.								0.20			0.13				0.14		0.14							0.08	
Euchlanis dilatata					0.87			0.20		0.91	0.13														
E. lyra															0.29										
Euchlanis sp.															0.29	0.32									
Hexarthra mira																				0.12					
Keratella quadrata (short posterior spines form)							0.29									1.26	0.14							0.16	
K. tropica (with left posterior spine)																0.95									
K. tropica (without left posterior spine)							0.29																		
K. volga f. *asymmetrica*																									0.14
K. volga f. *monospina*																								0.08	1.22
Keratella sp.													0.30												
Lecane bulla					0.43										0.29	0.32	0.14								
L. closterocerca	0.30		0.24	0.28			0.29	0.20		0.91		0.11			0.14	0.63		0.17				1.86			
L. lunaris																0.32									

Table 2 (cont.)

Taxa	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20	S21	S22	S23	S24	S25
L. scutata																						0.16			
L. thalera										0.30						0.32				0.60					
L. ungulata										0.00										0.12		0.16			
Lecane spp.			0.24		0.43	0.29	0.29	0.20	0.37	0.30						0.63			0.29					0.31	
Lepadella (*L.*) *patella*					1.30					0.30	0.13									0.12					
Lepadella (*L.*) *patella persimilis*															0.14										
Lepadella (*L.*) sp.				0.56	0.43											0.32	0.14								
Lophocharis sp.			0.24																						
Macrochaetus subquadratus																0.32									
Mytilina sp.					1.30															0.12					
Notholca acuminata							0.29																		
N. squamula							1.15	0.20																0.08	
Notholca sp.					0.43																				
Polyarthra dolichoptera	0.10			2.79			0.29			3.65			0.30			0.32				0.48		0.31			6.12
Pompholyx sp.							0.29																		
Synchaeta lakowitziana	9.84	17.18	79.71	41.89	7.82	0.58	5.44	0.81		176.5	0.25	0.11	19.78	11.69	70.17	23.72	6.73	0.17	0.87	69.93	3.82	7.60		2.56	0.54
S. oblonga	0.30														0.57	0.32									
Testudinella patina		0.64																						0.08	
Trichocerca sp.																	0.14								
Trichotria pocillum																	0.29								
T. tetractis																		0.17		0.12					
T. truncata															0.14										
Trichotria sp.															0.14										
Total of Rotifera	**14.30**	**18.47**	**82.58**	**46.63**	**14.78**	**3.20**	**14.61**	**5.27**	**0.74**	**188.1**	**1.25**	**0.21**	**20.69**	**13.45**	**72.32**	**32.26**	**8.16**	**0.50**	**2.32**	**72.43**	**4.20**	**13.19**	**1.11**	**4.27**	**23.53**
Cirripedia												0.11												0.16	
Cladocera			0.48							0.30										0.12					
Copepoda	0.10		2.39	1.68		0.58	0.57		0.37	1.22	0.25	0.11	0.30			0.63			0.29	1.67		0.31	2.34		4.76
Copepoda nauplii	0.61	0.43	6.21	8.94	0.87	0.29	6.87	1.62	3.72	25.26	0.75	0.11	0.91		2.58	3.16	0.43	1.50	1.45	4.53		3.88	2.34	0.54	39.18
Copepoda eggs									8.56																
Ostracoda					1.30				0.37									0.67					0.49		
Nematoda	0.10	0.43	0.72			0.29	0.29	0.20		0.30	0.13	0.11						0.17			0.19			0.08	
Polychaeta larva	0.10	0.21																						0.08	
Protozoa	3.35	2.15	8.83	1.40	12.17	0.87	1.43	6.49	7.45	3.96	60.27	5.05	0.61	0.88	2.86	1.90	7.16	7.52	3.48	1.07	2.29	5.12	2.95	7.76	0.68
flatworm larva									0.37														0.12		
Rotifera eggs	0.20	1.50	20.76															20.21							12.92
Total Zooplankton	**18.56**	**21.69**	**101.2**	**58.64**	**29.13**	**5.24**	**23.77**	**13.59**	**21.59**	**219.1**	**62.65**	**5.69**	**22.52**	**14.33**	**77.76**	**37.95**	**15.75**	**10.36**	**7.54**	**79.83**	**6.68**	**22.49**	**9.34**	**12.88**	**68.16**

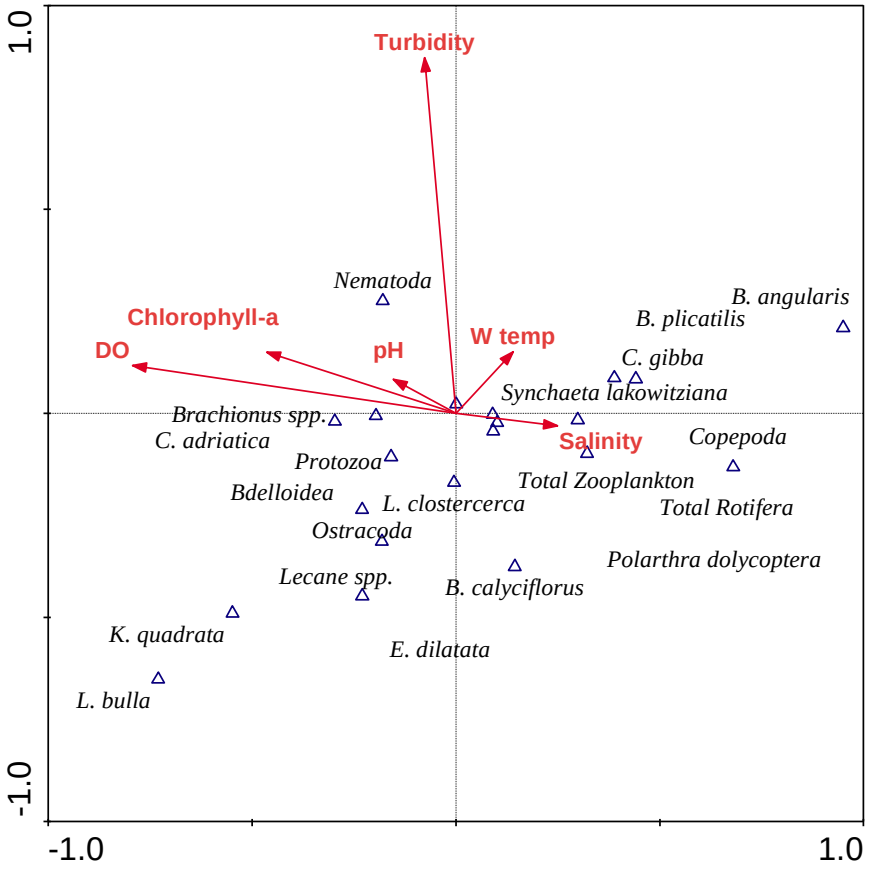

Figure 2: CCA analysis of the correlation coefficients between some species of Rotifera , other groups of zooplankton and some environmental factors during the period 7-18 December 2012 from 25 stations in the southern Iraqi marshes.

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References

Agrawal, A. & Gopal, K. (2013). Biomonitoring of water and waste water. Springer New Delhi, Heidelberg, New York, Dordrecht, London. 175 pp.

Ahmed, H. K. and Ghazi, A. H. 2009. A taxonomical and environmental study of the genus *Brachionus* (Rotifera: Monogononta) (Pallas, 1776) in Al-Hammer marsh, south of Iraq. *Iraqi J. Aqua.,* 6(2): 105-112.

Ahmed, H. K. and Mohammed, H. H. 2006. The Rotifera community in the South Marshes of Iraq. *Marsh Bulletin*, 1(1): 54-58.

Al-Saboonchi, A. A., Barak, N. A. and Mohamed, A. M. 1986. Zooplankton of Garma Marshes, Iraq. *J. Biol. Sci. Res.*, 17(1): 33-40.

APHA (American Public Health Association). 2005. Standard methods for the examination of water and wastewater. 21st edition. Washington, DC. 1400 pp.

Gurney, R. 1921. Freshwater crustacean collected by Dr. P. A. Buxton in Mesopotamica and Persia. *J. Bombay Nat. Hist. Soc.*, 27(4): 835-844.

Hammadi, N. S. 2010. An ecological study of Rotifera of the Shatt Al-Arab Region. PhD. Thesis, Basrah University. 356 pp.

Hammadi, N. S. & Bielańska-Grajner, I. 2012. Rotifera from the Shatt Al-Arab Region, Southern Iraq. Basrah J. Agric. Sci., 25 (Special Issue): 81-92.

Lind, O. I. 1979. Handbook of common methods in Limnology. C. V. Mosby Co. St. Louis, 199 pp.

Salman, D. S., Abbas, M. F., Ghazi, A. H., Ahmed, H. A., Akash, A. N., Douabul, A. A., Warner, B. G. and Asada, T. 2014. Seasonal changes in zooplankton communities in the re-flooded Mesopotamian wetlands, Iraq. Journal of Freshwater Ecology, 29(3): 397-412.

Suthers, I. M. & Rissik, D. (2009). Plankton, A guide to their ecology and monitoring for water quality. CSIRO PUBLISHING. 273pp.

Sladecek, V. (1983). Rotifers as indicators of water quality. Hydrbiologia, 100: 169-201.

دولابيات أهوار جنوب العراق، مع الإشارة إلى المجاميع الرئيسة للهائمات الحيوانية

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المستخلص

جمعت العينات بسحبات عمودية من 25 محطة منتشرة في جميع أنحاء اهوار جنوب العراق خلال الفترة 7 - 18 كانون الثاني 2012. وسجلت نحو 56 مرتبة تصنيفية من الدولابيات. أكثر أنواع الدولابيات وفرةً كان النوع *Synchaeta lakowitiziana* وبلغت كثافاته 176.5 ، 79.71 ، 70.17 و 69.93 فرد/لتر في المحطات 10 ، 3 و 15 و 20 على التوالي . Bdelloidea و *Brachionus plicatilis* جاءتا في المرتبتين الثانية والثالثة وفرةً. الأبتدائيات ومجذافية الأقدام هما المجموعتان الهامتان الثانية والثالثة من العوالق الحيوانية بعد الدولابيات. تم قياس درجة حرارة المياه والملوحة ودرجة الأس الهيدروجيني والعكارة وكلوروفيل-أ والأوكسجين المذاب في كل محطة. حللت النتائج الفيزيائية والكيميائية والبيولوجية باستخدام اثنين من البرامج الإحصائية SPSS الإصدار 21 والتحليل متعدد المتغيرات البيئية (CANOCO).

MARSH BULLETIN

مجلـــة الأهـــوار

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