Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 7, No. 1, p. 61-71, 2015
http://www.innspub.net

INNSPUB
RESEARCH PAPER

OPEN ACCESS

Biodiversity of the macroinvertebrates in the Southern Iraqi Marshes, with a special reference to oligochaeta

Murtatha Yousif Al-Abbad[1*], Salman Dawood Salman[2], Imad H. Al-Qarooni[1]

[1]*Department of Biology, Col. Education, Univ. Basrah, Basrah, Iraq*

[2]*Marine science center, Univ. Basrah, Basrah, Iraq*

Article published on July 4, 2015

Key words: Macroinvertebrates, Gastropoda, Oligochaeta, Al-Swaib Marshes, Southern Iraq.

Abstract

Despite the importance of macroinvertebrates in the dynamics of aquatic ecosystems, however, a little work has been conducted on this group in Iraq. The aim of the present paper is to investigate the distribution and diversity of aquatic macroinvertebrates of the Marshes of Al-Swaib, southern Iraq. Invertebrates, occurring in the shallow water zones at two stations in the Al-Swaib Marshes, were sampled at monthly intervals during March 2012 to February 2013, in order to determine the relationship between the aquatic invertebrates (both species number and individual number) and some environmental factors such as water temperature, pH, conductivity, organic matter and texture of the mud at each station. A total of 8325 individuals of invertebrates belonging to 37 taxa was sampled. The most dominant groups were Varia, Oligochaeta and Gastropoda. Varia group comprised about 54% of the total invertebrates, followed by Oligochaeta (34%) and Gastropoda (12%). The Shannon-Weaner diversity index ranged from 0.56 to 1.11.Canonical Correspondence Analysis (CCA) revealed that the temperature and pH were the most important factors affecting some species of macroinvertebrates.

***Corresponding Author:** Murtatha Yousif Al-Abbad ✉ mymal.col2@yahoo.com

Introduction

Benthic macroinvertebrates are used for biomonitoring programs (Rosenberg and Resh, 1993). Because they are sessile or limited in their range of movement and therefore cannot avoid pollution (Gaufin, 1973). They are forming important food sources for many aquatic organisms and are mediators in nutrient cycling in aquatic systems by the breakdown and utilization of suspended or attached organic material (Beatty *et al.*, 2006). Small invertebrates are functionally important in many terrestrial and aquatic ecosystems (Wilson, 1992; Freckman *et al.*, 1997). Many of which are used as guides to the properties and the quality of water (Rosenberg and Resh, 1993) including oligochaetes (Howmiller and Beeton, 1971; Martins *et al.*, 2008). The naidid worms is one of the most important group of aquatic Oligochaeta mainly found as true benthos in fresh water (Arslan and Sahin, 2003) and comprised of 22 known genera (with the genus *Pristina*) widespread in the world(Brinkhurst and Jamieson, 1971). Tubificoids include 582 species are considered as freshwater inhabitants (Martins *et al.*, 2008). For these reasons there is a great interest in macroinvetebrates, including oligochaetes, in many countries around the world (Goodnight, 1940; Kozlovskaya, 1976; Loden and Harman, 1980; Liang and Wang, 2000; Corbi *et al.*, 2005; Alves and Gorni, 2007). None the less in Turkey, several studies on macroinvetebrates were conducted (Kazanci and Girgin, 1998; Arslan and Sahin, 2003; Yildiz and Balik 2006; Yildiz *et al.*, 2007).

In Iraq, noteworthy, studies were carried out on benthic invertebrates communities; for instance, Al-Lami *et al.* (1998) studied the benthic invertebrates of Euphrates River in Al-Qadisia dam. In Basrah (southern Iraq) three reports on sixteen species of the Naidid worms are available (Al-Abbad, 2010; Al-Abbad and Al-Mayah, 2010; Al-Abbad, 2012). Jaweir and Radhi (2013) reported some species of Naididae and Aeolosomatidae associated with aquatic plants in waters of the Tigris River in Baghdad region.

Despite the importance of Oligochaeta in the dynamics of aquatic ecosystems (Fisher and Beeton, 1975; Loteste and Marchese, 1994) as well as in the pollution studies (Milbrink, 1983; Marchese and Drago, 1999), a few work has been conducted on this group in Iraq. The aim of the present study is to investigate the distribution of aquatic macroinvertebrates, particularly oligochaetes and their diversity in relation to some physicochemical parameters at two shallow water stations in Al-Swaib Marshes in Iraq.

Materials and methods

The study area

The Marshes of Al-Swaib extend along the east side of Shatt Al-Arab River from Al-Swaib River towards Basrah city (southern Iraq).

Sampling, isolation and examination

Samples of macroinvertebrates were collected monthly from March 2012 to February 2013 at two shallow water stations (depth 5-25 cm) in Al-Swaib Marshes (Fig. 1). Three replicates were taken from each station. Samples were collected using corer tube with an internal diameter of 11.52 cm. The samples were performed at each station by plunging the corer tube to a depth of more than 5 cm in the sediment. The samples were brought to the laboratory in plastic containers. Live invertebrates were isolated from the sediments by a 75 µm mesh size sieves. Samples were examined under a dissecting microscope and sorted into three groups, Oligochaeta, Gastropoda, and Varia. Some of the Oligochaeta (the genus *Dero*) were examined alive under a compound microscope in a drop of water, while the rest of species of Oligochaeta, Gastropoda and Varia were killed in 4% formalin and preserved in 70% ethanol.

The specimens of Oligochaeta were temporarly mounted with a few drops of glycerin, or Amman's lactophenol (Brinkhurst, 1971) and identified with the aid of the keys of Brinkhurst (1971), Brinkhurst and Jamieson (1971) and Timm (2009). The measurements of the body and chaetae were made from temporary mount. Drawings were made using a camera lucida fixed to the microscope. The gastropods were identified to species according to

Clench (1959) and Ahmed (1975). Nevertheless no attempts were made to identify Copepoda, Cladocera, Ostracoda, Nematoda and Chironomidae to species.

parameters measuring

Physical and chemical parameters such as temperature, salinity, and pH of the water; and texture, Total Organic Carbon (TOC) and pH of the mud were measured monthly at each station.

Community structure analyses

Community structure analyses of oligochaetes were carried out using the following indices:

(a) Dominance (D %): D = na / n ×100, where na is the number of individuals of species a, and n represents the total number of individuals in sample.

(b) Frequency (C %): C = Na / N × 100, where Na is the number of samples in which species a occurred, and N represents the total number of samples.

(C) The Shannon-Weaner index (Shannon and Weaver, 1949)

The test of significance analyses for the various physical parameters over the stations were done by t-test.

Statistical analysis

The relationships between species assemblages and environmental variables were analyzed by Canonical Correspondence Analysis (CCA, CANOCA). The analysis was applied to 12 sampling times, 37 taxa, three quantitative variables (pH, temperature and conductivity) and four seasons (spring, summer, autumn and winter). While the significance of variation among the relation between the species and ecological parameters were evaluated using Monte Carlo permutation tests.

Results

Environmental factors

The results of measurements of the physical and chemical parameters of both mud and water samples of the two stations are presented in Table 1. The statistical analysis showed no significant differences in the measured parameters between the two stations. It is apparent that the 2 stations are very similar to each other in many respects simply because they are close to each other, however the clay and the silt contents of the mud are slightly different, as station 1 had slightly higher clay (53%) and less silt (41%) in regards to station 2 (48% clay and 46% silt). Moreover, station 2 is slightly more saline (3.87%) than station 1 (3.15%) (Table 1).

Table 1. Mean values and standard deviation (±) of some of the physical and chemical parameters of the mud and water from near the bottom at the two stations of Al-Swaib Marshes during March 2012-February 2013.

Station	Mud bottom						Water		
	Texture %			TOC %	pH	Sal (ppt)	Temp	pH	Sal (ppt)
	Clay	silt	sand						
1	53 ±1.0	41 ±1.0	6 ±2.0	4.724 ±0.021	7.06 ±0.045	3.145 ±1.17	21.2 ±4.84	8.15 ±0.75	1.05 ±0.18
2	48 ±1.5	46 ±2.5	6 ±1.0	4.338 ±0.307	7.6 ±0.39	3.868 ±0.73	21.9 ±4.73	8.22 ±0.51	1.08 ±0.17

Macroinvertebrates densities

Generally, station 1 had more macroinvertebrates (5167 ind./ m^2) than station 2 (3170 ind./ m^2) (Table 2). A total of 37 taxa of macroinvertebrates were encountered at the two stations of Al-Swaib Marshes. Varia was the most important group (54%; 2410 ind., at st. 1 and 2073 ind., at st. 2 ; Table 2), followed by Oligochaeta (34%; 2211 and 616 ind., at the 2 stations, respectively.) Whereas, the Gastropoda ranked third (12%; 546 and 481 ind., at stations 1 and 2 respectively). Nematodes was the most important group (32.3%) of the Varia followed by chironomids, copepods, ostracods and cladocera (Table 2).

Oligochaetes, however, composed of 23 naidids (50.7% of the Oligochaeta) and 3 tubificids (49.3% of the Oligochaeta). *Limnodrilus hoffmeisteri*, ranked on top of the list of Oligochaeta (47%) at the 2 stations combined, followed by *Nais communis*, *Dero nivea*, Naidinae *sp.* and *Allonais gwaliorensis*. Whereas, the Gastropoda was dominated by *Lymnaea auricularia*, *Melanoides tuberculata*, *Physa acuta and Bellamya bengalensis*.

Table 2. A list of species and number of individuals of macroinvertebrates from the two sampling stations of Al-Swaib Marshes collected from March 2012-February 2013.

Invertebrates taxa	No. of individuals			
	Station 1	**Station 2**	**DIG**	**DIT**
Slavina appendiculata d'Udekem, 1855	84	6	3.2	1.1
Nais variabilis Piguet, 1906	55	12	2.4	0.8
Nais communis Piguet, 1906	209	67	9.8	3.3
Nais pardalis Piguet, 1906	98	0	3.5	1.2
Dero obtusa d'Udekem, 1855	8	1	0.3	0.1
Dero sawayai Marcus, 1943	1	0	0	0
Dero nivea Aiyer, 1929	161	36	7	2.4
Dero digitata (Müller, 1773)	57	2	2.1	0.7
Dero cooperi Stephenson, 1932	14	2	0.6	0.2
Aulophorus furcatus (Müller, 1773)	24	0	0.9	0.3
Stylaria fossularis Leidy, 1852	2	0	0.1	0
Chaetogaster diastrophus(Gruithuisen, 1828)	12	2	0.5	0.2
Stephensoniana trivandrana (Aiyer, 1926)	0	15	0.5	0.2
Allonais gwaliorensis (Stephenson, 1920)	126	27	5	1.7
Allonais pectinata (Stephenson, 1910)	16	1	0.6	0.2
Pristinella sima (Marcus, 1944)	20	1	0.7	0.3
Pristinella osborni (Walton, 1906)	42	2	1.6	0.5
Pristinella idrensis (Sperber, 1948)	1	0	0	0
Pristinella notopora (Cernosvitov, 1937)	1	0	0	0
Pristina proboscidea Baddard, 1896	32	1	1.2	0.4
Pristina longiseta Ehrenberg, 1828	70	58	4.5	1.5
Pristina aequiseta Bourne, 1891	12	9	0.7	0.3
Naidinae *sp.*	144	11	5.5	1.9
Tubifex tubifex (Muller, 1774)	8	34	1.5	0.5
Limnodrilus hoffmeisteri Claparède, 1862	993	327	47	16
Limnodrilus claparedianus Ratzel, 1868	21	2	0.8	0.3
OLIGOCHAETA	**2211**	**616**	**100**	**34**
Number of taxa of Oligochaeta	24	20		
Shannon Weaner index	0.91	0.75		
Lymnaea auricularia (Linnaeus, 1758)	189	198	37.7	4.6
Physa acuta (Draparnaud, 1805)	103	30	13	1.5
Melanopsis nodosa (Ferussac, 1823)	3	17	1.9	0.2
Melanoides tuberculata (Müller, 1774)	122	199	31.2	3.8
Bellamya bengalensis (Lamark, 1882)	121	6	12.4	1.5
Theodoxus jordani (Sowerby, 1836)	8	31	3.8	0.4
GASTROPODA	**546**	**481**	**100**	**12**
Number of Gastropoda taxa	6	6		

Table 2. Continued

INVERTEBRATES Taxa	No. of individuals			
	STATION 1	STATION 2	DIG	DIT
Copepoda	501	444	21.1	11.4
Cladocera	189	198	8.6	4.7
Ostracoda	239	355	13.3	7.2
Chironomidae	313	795	24.7	13.3
Nematoda	1168	281	32.3	17.4
VARIA	**2410**	**2073**	**100**	**54**
Number of taxa of Varia	5	5		
Shannon Weaner index H′	1.15	1.03		
Total Taxa	**35**	**31**		

DIG: %Domination in group; DIT: %Domination in total

In terms of dominance and frequency of Oligochaeta, *L. hoffmeisteri*, at station 1 exhibited the highest dominance (45%) and frequency (100%), whereas, at station 2 it constituted 53% in terms of dominance and 42% in frequency (Table 3).

The mean density of Oligochaeta was 2763 ind. / m² and 821 ind. / m² at stations 1 and 2, respectively, that of Gastropoda was 701 ind. / m² at station 1 and 652 ind. / m² at station 2; and of Varia was 3182 ind. / m²and 2610 ind. / m² at the two stations, respectively.

The highest average monthly density of the oligochaetes at the two stations combined was recorded in July (4600 / m²) while those of the Gastropoda and Varia were recorded in November (1480 / m², 7512 / m², respectively). The highest number of Taxa (25) was reported in September and December; and the lowest (11) was recorded in August (Table 4).

The species diversity index was 1.15 and 1.03 at stations 1 and 2, respectively (Tables 2 and 4).

Table 3. Dominance and frequency of Oligochaeta at Al-Swaib Marshes.

OLIGOCHAETA	STATION 1		STATION 2	
	D	f	D	f
NAIDID SPECIES				
Slavina appendiculata d'Udekem, 1855	3.8	42	1	8
Nais variabilis Piguet, 1906	2.5	53	2	8
Nais communis Piguet, 1906	9.5	64	10.9	42
Nais pardalis Piguet, 1906	4.5	39	0	0
Dero obtusa d'Udekem, 1855	0.4	22	0.2	3
Dero sawayai Marcus, 1943	0.1	3	0	0
Dero nivea Aiyer, 1929	7.3	42	5.8	33
Dero digitata (Müller, 1773)	2.6	50	0.3	6
Dero cooperi Stephenson, 1932	0.6	8	0.3	6
Aulophorus furcatus (Müller, 1773)	1.1	42	0	0
Stylaria fossularis Leidy, 1852	0.1	6	0	0
Chaetogaster diastrophus (Gruithuisen, 1828)	0	0	0.3	6
Stephensoniana trivandrana (Aiyer, 1926)	0	0	2.4	8
Allonais gwaliorensis (Stephenson, 1920)	5.7	58	4.4	17
Allonais pectinata (Stephenson, 1910)	0.7	28	0.2	3
Pristinella sima (Marcus, 1944)	0.9	33	0.2	3
Pristinella osborni (Walton, 1906)	1.9	44	0.3	6
Pristinella idrensis (Sperber, 1948)	0.1	3	0	0
Pristinella notopora (Cernosvitov, 1937)	0.1	3	0	0
Pristina proboscidea Baddard, 1896	1.5	31	0.2	3
Pristina longiseta Ehrenberg, 1828	3.2	33	9.4	31
Pristina aequiseta Bourne, 1891	0.5	25	1.5	8
Naidinae sp.	*6.5*	*58*	*1.8*	*16*
TUBIFICID SPECIES				
Tubifex tubifex (Müller, 1774)	0.4	8	5.5	8
Limnodrilus hoffmeisteri Claparède, 1862	45	100	53	42
Limnodrilus claparedianus Ratzel, 1868	1	14	0.3	6
Number of species	24		20	
Number of specimens	2211		616	

%Dominance and %frequency

Table 4. Average monthly densities (per m²) of the macroinvertebrates at the two stations (combined) of Al-Swaib Marshes during March 2012-February 2013.

Taxa	Mar 2011	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan 2012	Feb
Slavina	80	48	0	0	0	0	0	0	120	0	272	20
Nais variabilis	16	48	0	0	40	0	16	0	120	48	152	96
Nais communis	168	24	0	64	0	0	96	16	864	272	352	352
Nais pardalis	48	0	0	0	0	0	0	0	432	16	192	96
Dero obtusa	0	16	8	0	0	8	24	0	0	16	0	0
Dero sawayai	0	0	0	0	0	8	0	0	0	0	0	0
Dero nivea	0	0	24	240	696	64	8	0	0	464	80	0
Dero digitata	0	0	0	40	120	0	88	0	64	80	80	0
Dero cooperi	0	0	0	0	0	0	0	0	0	128	0	0
Aulophorus furcatus	8	0	40	16	40	64	8	0	0	16	0	0
Stylaria fossularis	0	16	0	0	0	0	0	0	0	0	0	0
Chaetogaster	96	16	0	0	0	0	0	0	0	0	0	0
Stephensoniana	0	0	0	0	0	0	0	0	120	0	0	0
Allonais gwaliorensis	0	0	0	0	0	0	272	160	248	128	152	168
Allonais pectinata	0	0	0	8	0	16	16	32	64	0	0	0
Pristinella sima	0	0	8	16	0	40	8	32	0	64	0	0
Pristinella osborni	8	0	0	0	0	0	48	80	120	48	0	48
Pristinella idrensis	0	0	0	0	0	0	8	0	0	0	0	0
Pristinella notopora	0	0	0	0	0	0	8	0	0	0	0	0
Pristina proboscidea	8	0	0	0	0	8	8	144	64	32	0	0
Pristina longiseta	0	0	0	16	24	56	24	288	552	64	0	0
Pristina aequiseta	16	0	0	0	72	0	16	16	0	0	0	48
Naidinae *sp.*	160	0	0	0	120	32	72	0	0	240	320	296
Tubifex tubifex	0	336	0	0	0	0	0	0	0	0	0	0
Limnodrilus	480	792	648	720	3488	640	560	152	432	1344	1096	208
Limnodrilus	0	0	0	0	0	16	0	0	0	16	152	0
Oligochaeta	**108**	**1296**	**728**	**1120**	**4600**	**952**	**1280**	**920**	**3200**	**2976**	**2848**	**151**
Oligo. Taxa at months	11	8	5	8	8	11	17	9	12	16	10	9

Table 4. Continued

Taxa	Mar 2011	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan 2012	Feb
Lymnaea auricularia	240	184	264	176	216	0	120	80	856	368	312	280
Physa acuta	104	176	0	56	72	0	0	0	64	336	112	144
Melanopsis nodosa	32	16	8	0	0	0	40	0	0	0	16	48
Melanoides tuberculata	56	72	0	80	608	0	360	592	248	272	232	48
Bellamya bengalensis	0	24	0	0	120	0	344	400	0	128	0	0
Theodoxus jordani	0	0	0	0	0	0	0	0	312	0	0	0
GASTROPODA	**432**	**472**	**272**	**312**	**1016**	**0**	**864**	**1072**	**1480**	**1104**	**672**	**520**

Taxa	Mar 2011	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan 2012	Feb
Taxa of Gasrtropoda	4	5	2	3	4	0	4	3	4	4	4	4
Copepoda	440	560	376	328	200	0	256	192	3392	1168	216	432
Cladocera	120	72	136	0	48	0	144	256	1048	1024	152	96
Ostracoda	880	456	240	24	64	0	0	0	552	800	224	1352
Chironomidae	816	696	240	1064	2040	0	80	64	1104	352	1120	1288
Nematoda	960	624	752	336	488	0	288	80	1416	2960	1808	1880
VARIA	**3216**	**2408**	**1744**	**1752**	**2840**	**0**	**768**	**592**	**7512**	**6304**	**3520**	**5048**
Taxa of Varia	5	5	5	4	5	0	4	4	5	5	5	5
Diversity index	1.00	0.98	0.83	0.85	0.80	0.56	1.11	1.03	1.07	1.05	1.05	0.97
Total taxa	20	18	12	15	17	11	25	16	21	25	19	18

Statistical analysis

Canonical Corresponding Analysis based on species data and environmental variables shows the position of species in the ordination space of the first and second axes. The long arrows representing some variables, such as temperature, pH and salinity, emphasizing their impact on the community structure of the Oligochaeta (Fig. 2) and other macroinvertebrates (Fig. 3).

It is apparent the *L. hoffmeisteri*, *P. aequiseta*, *A. furcatus* and *D. nivea* were positively correlated with salinity. However, *L. claparedianus*, *D. cooperi*, *D. digitata* and *P. sima* were positively correlated with temperature. While *P. longiseta*, *A. pectinata*, *P. proboscidea*, *A. gwaliorensis*, *N. pardalis* and *P. osborni* were negatively correlated with pH (Fig. 2).

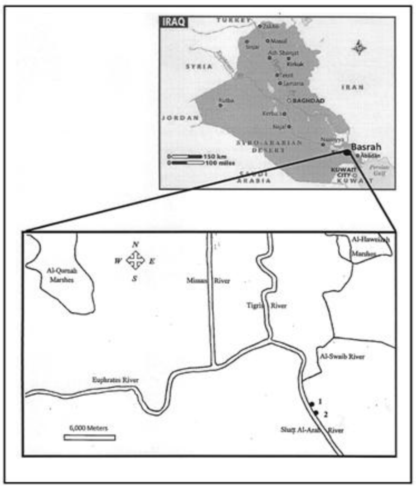

Fig. 1. Map of Iraq showing the location of Al-Swaib Marshes and the sampling stations.

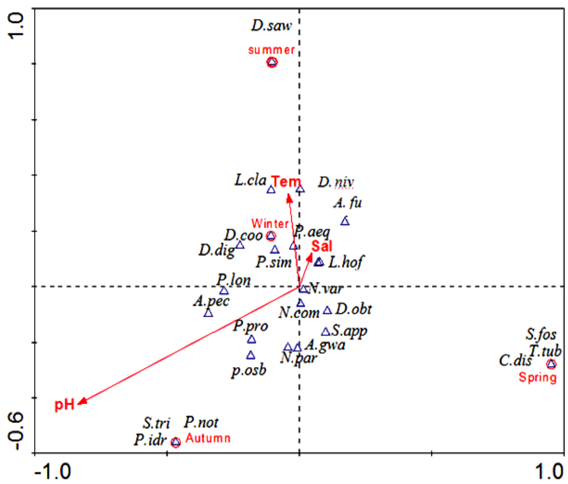

Fig. 2. Canonical Correspondence Analysis (CCA) ordination diagram based on numbers of oligochaete species and environmental factors and season at Al-Swaib Marshes.

S.app: *Slavina appendiculata, N.var*: *Nais variabilis, N.com*: *N. communis, N.par*: *N. pardalis, D.obt*: *Dero obtuse, D.saw*: *D. sawayai, D.niv*: *D. nivea, D.dig*: *D. digitata, D.coo*: *D. cooperi, A.fu*: *Aulophorus furcatus, S.fos*: *Stylaria fossularis, C.dis*: *Chaetogaster diastrophus, S.tri*: *Stephensoniana trivandrana, A.gwa*: *Allonais gwaliorensis, A.pec*: *A. pectinata, P.sim*: *Pristinella sima, P.osb*: *P. osborni, P.idr*: *P. idrensis, P.not*: *P. notopora, P.pro*: *Pristina proboscidea, P.lon*: *P. longiseta, P. aeq*: *P. aequiseta, T.tub*: *Tubifex tubifex, L.hof*: *Limnodrilus hoffmeisteri and L.cla*: *L. claparedianus.*

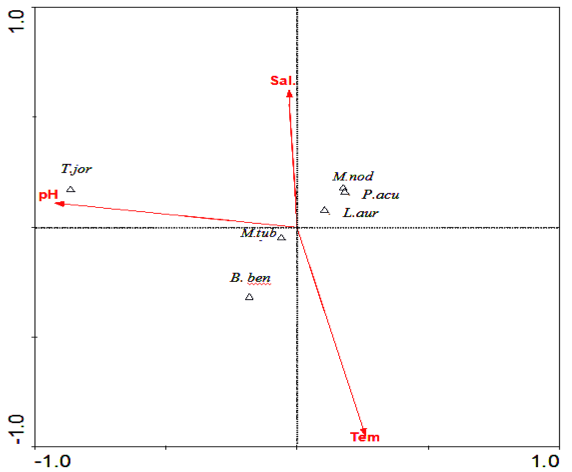

Fig. 3. Canonical Correspondence Analysis (CCA) ordination diagram based on numbers of macroinvertebrate species and environmental factors by month.

L.aur: *Lymnaea auricularia, P.acu*: *Physa acuta, M.nod*: *Melanopsis nodosa, M.tub*: *Melanoides tuberculata, B.ben*: *Bellamya bengalensis, T.jor*: *Theodoxus jordani.*

Discussion

In Iraq there are a few studies concerning the diversity and seasonal variation of aquatic macroinvertebrates, in general and the oligochaetes in particular. Perhaps, the study of Jaweir *et al.* (2012) on aquatic oligochaetes is pioneering in this context, indicating that the density of oligochaetes is ranging from 5111 ind. / m^2 at Al-Chibayish and Al-Hammar Marshes to 16800 ind. / m^2 at Al-Haweizah Marsh. These values are very much higher than those reported in the present study (920 ind. / m^2 and 4600 ind. / m^2 recorded in October and July, respectively), whereas, the number of oligochaete species recorded in the present study (26) is higher than that recorded by Jaweir *et al.* (2012) (19). These are, mostly likely, locality differences.

The present results indicate that the benthic fauna of Al-swaib Marsh was dominated by naidid oligochaetes, which is typical of many freshwater habitats (Svensson *et al.*, 1999). However, the tubificid *L. hoffmeisteri* was commonly and continuously occurring at the sampling stations, indicating an organic pollution (Yildiz and Balik, 2006) resulting from remnants of buffalo and cows grazing in these areas. This is accompanied by areduction in the water currents.It is known that *L. hoffmeisteri* can withstand diverse environmental conditions and adapts to a wide range of conditions (Brinkhurst and Jamieson, 1971), this is supported by the present results. As part of the benthic fauna, the occurrence and distribution of oligochaetes in aquatic systems, depend mainly on the type of substrate and the physical and chemical properties, biological interactions and food availability in the region (Verdonschot, 1996).

The density of benthic invertebrates was higher at station 1 than at station 2, this is largely due to the presence of different aquatic plants and filamentous algae at station 1, which act as a food source and shelter, whereas, station 2 is devoid of vegetation, except for a few algae. In this context, Hemminga and Duarte (2000) reported that macro-algae provide food, oxygen and shelter to organisms living in the area. Moreover, Botts and Cowell (1993) suggested the importance of algae in the distribution of oligochaete species on the macrophyte surface. The present results showed the domination of the tubificid species at station 1 on the naidid species, whereas the opposite is true at station 2. This is consistent with the results of Yildiz and Balik (2006) who reported that the lack of vegetation causes an increase of tubificid individuals than the naidid individuals. A major food source for the naidids is probably the microorganisms associated with the plant and detritus (Brinkhurst and Jamieson, 1971). In the present study the Oligochaeta were represented mainly by the naidid worms. Wetzel *et al.* (2000) reported that most of naidid species are cosmopolitan, and are adapted to a wide range of environmental variables (Brinkhurst and Jamieson, 1971).

Collado and Schmelz (2001) emphasized that the Oligochaeta are strongly affected by seasonality. This is supported by the present results, as the multicriterial analysis (CCA) showed clear influence of water temperature on the seasonal changes in the community structure. Moreover, the present study reports more species in winter than in spring and autumn.This is perhaps due to blooming of some floating plants (such as *Salvinia natatus*) only during this period. The effect of water temperature on the community structure has also been reported by Schenkova and Kroca (2007).

Conclusions

The present data emphasized a sharp decline in the number of macroinvertebrate species in the area, and this perhaps is due to irregularities in the water budget entering the Marshes, as for sometimes there were shortage in the waters causing drying in the banks of the small channels in the Marshes which ultimately leads to decrease in number and density of the species.

References

Ahmed MM. 1975. Systematic study on Mollusca from Arabian Gulf and Shatt Al-Arab, Iraq. Basrah, Iraq: Basrah Univ., Center for Arab Gulf studies.

Al-Abbad MYM, Al-Mayah SH. 2010. New record of two species *Pristina longiseta* and *P. macrochaeta* (Oligochaeta: Naididae) from Iraq with notes on the characteristics and reproduction. Mesopot. J. Mar. Sci **25(2),** 57-66.

Al-Abbad MYM. 2010. New records of *Pristina proboscidea* and *P. aequiseta* (Oligochaeta: Naididae) from Iraq. Marsh Bulletin **5 (2)**, 132-140.

Al-Abbad MYM. 2012. New Records of twelve species of Oligochaeta (Naididae and Aeolosomatidae) from the Southern Iraqi Marshes, Iraq. JJBS **5 (1),** 31-36.

Al-Lami AA, Jaweir HJ, Nashaat MR. 1998. Benthic invertebrates community of the River Euphrates upstream and downstream sectors of Al-Qadisia dam, Iraq. River Research and Applications **14,** 383-390.

Alves RG, Gorni GR. 2007. Naididae species (Oligochaeta) associated with submersed aquatic macrophytes in two reservoir (Säo Paulo , Brazil). Acta Limnol. Bras **19 (4),** 407-413.

Arslan P, Sahin Y. 2003. Nine new Naididae (Oligochaeta) species for Sakarya River, Turkey. Turk. J. Zool **27**, 27-38.

Beatty JM, Mc Donald LE, Westcott FM, Perrin CJ. 2006**.** Guidelines for sampling benthic invertebrates in British Columbia streams. Ministry of Environment.

Botts PS, Cowell BC. 1993. Temporal patterns of abundance of epiphytic invertebrates on *Typha* Shoots in a subtropical lake. J. North America, Benthological Society **12,** 27-39.

Brinkhurst RO, Jamieson BGM. 1971. Aquatic Oligochaeta of the World. Toronto: University of Toronto Press.

Brinkhurst RO. 1971. A Guide for the identification of British aquatic Oligochaeta. Freshwater Biological Association, Scientific publication **22,** 55p.

Clench WJ. 1959. Mollusca. In: fresh water biology (Ed. W.T. Edmondson).. John Wiley and Sons, Inc. U.S.A 1117-1160.

Collado R, Schmelz RM. 2001. Oligochaeta distribution Patterns in two German Hard water lake of different trophic state. Limnologica **31,** 317-328.

Corbi JJ, Trivinho–Strixino S, Alves RG. 2005. Records of Oligochaetes in fresh water sponges, on bryozoarians and on colonial hydrozoans from Brazil. Braz. J. of Biol **65 (1),** 187-188.

Fisher JA, Beeton AM. 1975. The effect of dissolved oxygen on the burrowing behavior of *Limnodrilus hoffmeisteri* (Oligochaeta). Hydrobiologia **42,** 273-290.

Freckman DW, Blackburn TH, Brussaard L, Hutchings P, Palmer MA, Snelgrove PVR. 1997. Linking biodiversity and ecosystem functioning of soils and sediments. Ambio, Royal Swedish Academy Sciences **26 (8),** 556–562.

Gaufin AR. 1973. Use of aquatic invertebrates in the assessment of water quality. Biological Methods for the Assessment of Water Quality, ASTM STP 528, American Society for Testing and Materials 96-116.

Goodnight CJ. 1940. The Branchiobdellidae (Oligochaeta) of North American Crayfishes. Ilionois Biol. Monographs **17 (3),** 1-75.

Hemminga MA, Duarte CM. 2000. Seagrass Ecology. Cambridge University Press **65 (1-4),** 298p.

Howmiller RP, Beeton AM. 1971. Biological evaluation of environmental quality, Green Bay, Lake Michigan. J. Water pollut **42 (3),** 123-133.

Jaweir HJ, Radhi MM. 2013. Naididae (Clitellata: Oligochaeta) and Aeolosomatidae (Polychaeta : Aphano-neura) species associated withaquatic plants in Tigris River/ Baghdad/ Iraq. Baghdad J. of Sciences **10 (1),** 116-125.

Jaweir HJ, Sebtie HA, Al-Mukhtar EA. 2012. Aquatic oligochaetes of Marshes of souther Iraq. Baghdad J. of Sciences **9 (3),** 472-480.

Kazanci N, Girgin S. 1998. Distribution of Oligochaeta species as bioindicators of organic pollution in Ankara stream and their use in biomonitoring. Turk. J. Zool **22,** 83-87.

Kozlovskaya LS. 1976. Rol. bespozvono cnych v transformacii organiceskogo vescestva bolotnych pocv. Leningrad: Nauka Publishers.

Liang YL, Wang HZ. 2000. Annelida, Oligochaeta, Microdrile Oligochaetes. Pictorial Keys to soil Animals of China. Beijing: Science Press.

Loden MS, Harman WJ. 1980. Ecophenotypic variation in setae of Naididae (Oligochaeta). In: Brinkhurst, RO, Cook, DG editors. Aquatic Oligochaete Biology. New York and London: Plenum Press 33 - 39.

Loteste A, Marchese M. 1994. Ammonium excretion by Paranadrilus descolei Avrilov, 1955 and Limnodrilus hoffmeisteri Claparéde, 1862 (Oligochaeta: Tubificidae) and their role in nitrogen delivery from sediment. Polskie Archiwum Hydrobiologii **41 (2),** 189-194.

Marchese M, Drago IE. 1999. Use of benthic macroinvertebrates as organic pollution indicators in lotic environments of the Paraná River drainage basin. Polskie Archiwum Hydrobiologii **46 (3-4),** 233-255.

Martins RT, Stephan NNC, Alves RG. 2008. Tubificidae (Annelida: Oligochaeta) as an indicator of water quality in an Urban stream in southeast Brazil. Acta Limnol. Bras **20 (3),** 221-226.

Milbrink G. 1983. An improved environmental index based on the relative abundance of Oligochaeta species. Hydrobiologia **102,** 89-97.

Rosenberg DM, Resh VH. 1993. Fresh water Biomonitoring and Benthic Macroinvertebrates. 1st ed.New York: Chapman and Hall.

Schenkova J, Kroca J. 2007. Seasonal Changes of an Oligochaetous Clitellata (Annelida) Community in a Mountain Stream. Acta Universitatis Carolinae Environmentalica **21,** 143-150.

Shannon CE, Weaver W. 1949. The mathematical theory of communication, Univ. Illinois press.

Svensson J, Bergman E, Andersson G. 1999. Impact of cyprinid reduction on the benthic macroin-vertebrate community and implications for increased nitrogen retention. Hydrobiologia **404,** 99-112.

Timm T. 2009. A guide to the freshwater Oligochaeta and Polychaeta of Northern and Central Europe. Lauterbornia **66,** 1-235.

Verdonschot PFM. 1996. Oligochaetes and eutrophication; an experiment over four years in outdoor mesocosms. Hydrobiologia **334 (1-3),** 169-183.

Wetzel MJ, Kathman RD, Fend S, Coates KA. 2000. Taxonomy, Systematic and Ecology of fresh water Oligochaeta. Work book prepared for North America Benthological Society Technical information workshop, 48th Annual Meeting Keystone Resort.

Wilson EO. 1992. The Diversity of Life. New York: W.W. Norton. The burrowing behavior of Limnodrilus hoffmeisteri (Oligochaeta). Hydrobiologia **42,** 273-290.

Yildiz S, Balik S. 2006. The Oligochaeta (Annelida) fauna of Topcam Dam–Lake (Aydin, Turkey). Turk.J. Zool **30,** 83–89.

Yildiz S, Ustaoglu MR, Balik S. 2007. The Oligochaeta (Annelida) Fauna of Yuvarlak stream (Koycegiz – Turkey). Turk. J. of Fisheries and Aquatic Sciences **7,** 1-6.