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Ecological Survey of Al-Gharaf Canal at Thi Qar Province, Iraq.

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Abstract

Ecological survey on some invertebrates of three stations (Al-Nasir, Al-Shatra, Al-Gharaf), in Al-Gharaf River was conducted. Some chemical and physical factors of the study area have been measured also species diversity, evenness and richness of the invertebrates has been quantified.

58 species of invertebrates were recorded comprised: 3 Annelida, 10 Mollusca, 3 Copepoda, 17 Cladocera, 20 Rotifera, 2 Ostracoda, 3 Crustacean larva. The highest density were recorded in st_2 (3201.2 ind/m^2 and 5742.22 ind/L) in comparison with st_1 (3327 ind/m^2 and 423.32 ind/L) and st_3 (2369.2 in/m^2 and 400.18 ind/L).

Mollusca had higher values of diversity in all stations (1.3, 0.9, 0.85 in st_1, st_2 and st_3 respectively), moreover st1 was higher than that in other stations in ecological indices. Evenness was found to be 0.57, 0.62 for Cladocera and Copepoda in st_1 in comparison to st_2 (0.53, 0.8) and st_3 (0.31, 0.51) respectively. Annelida had a comparable in seasonal values and low in all ecological indices among three stations.

Evenness varied inversely to the temperature. Invertebrate species diversity was positively correlated with chlorophyll a and nitrate, but negative correlated with temperature, salinity , and BOD.

1- Introduction

Al-Gharaf canal is of essential importance for domestic and agricultural uses and its water masses are essential to satisfy requirement of Basrah and Thi Qar provinces.

A search of literature revealed that there are no previous studies on the area, except

several works concerned with physical – chemical condition at this canal (Hussein and Fahad, 2008 (a, b); Hussein *et al*., 2009), also level of heavy metal accumulation within various organs of aquatic organisms were reported a previous paper (Hussein and Fahad, 2008c, 2009).

Iraqi literature on invertebrates that established on neighboring habitats as Shatt Al-Arab were that (Gurney, 1921; Ahmed, 1975; Al-Saboonchi *et al*., 1986; Al-Adhub & Hamza, 1987; Abdul-Saheb, 1989).

The aim of the present study to give some information about the quantity and quality of major group of invertebrates (Annelida, Mollusca, Zooplankton) and its relationship with chemical-physical condition and some ecological indices like species diversity, evenness and richness.

Description of The study Area

Tigris is one of the two main rivers feeding Iraq with essential quantities of freshwater. It split, after passing Kut Dam into two major branches, the former moves towards Maysan province and the other branch (Al-Gharaf canal) is penetrating Thi Qar governorate and directed towards Al-Nasir (st_1) our study area (Fig. 1) and so on. The canal is distinguished at this location with low gradient and moving current creating considerable loads of sediment.

The adjusted lands influenced by domestic sewage, waste from land cultivation and some private factories. St_1 (Al-Nasir) is situated at distance 90 km from Kut Dam, st_2 (Al-Shatra) is located at distance 12 km from st_1 and st_3 (Al-Gharaf) is situated at distance 21 km from st_2. all stations affected by disposal of Al-Gharaf district and also affected by drainage water from cultivated lands. Quite little aquatic vegetation was detected in the region including *Phragmites australis*, *Typha* sp., *Potamogeton* sp., *Ceratophyllum demersum* and *Vallisineria spiralis*.

2-Materials and Methods

Quantitative samples were taken bimonthly interval from three stations in Al-Gharaf canals from October 2010 till September 2011.

Zooplankton were collected by plankton net (mesh size 0.5µm). at each stations 100L of water were taken from the surface (ten replicates). Mollusca (Mussels and snail) were collected by wooden quadrates (30 × 30 cm) eight times and means were taken, quadrate was pressed inside clay in depth 12 cm. Annelida were collected in the same quadrate eight times also, screening with sediment sorting series (mesh size 0.2 mm) in all cases the organisms were preserved in 70% alcohol for later examination (Lind, 1979). Identification of some organisms to species, others as far as necessary according to special references for each group (Edmondson, 1959; Al-Hamed, 1966;

Brinkhurst and James, 1971; Frandsen, 1983).

The following environmental parameter were investigated: Chlorophyll a, water temperature, chlorine, comparative degree of pollution were obtained by the 5- day Biochemical Oxygen Demand test (BOD). pH meter was used to determined the hydrogen ion concentration. Dissolved oxygen, total phosphate and nitrate also measured(Lind, 1979).

Statistical Evaluation

Diversity (H) were computed by Shannon and Weaver equotient (1948).

$$H = \sum_{i=1}^{s} Pi \log pi$$

Where H= diversity, S= No. of species in sample

Pi= proportion of total sample belonging to the species

Richness index were computed by Margalefe equotient (1968)

D= S-1/ In N

Where D= Richness index, N= No. of individual

S= No. of species.

Evenness were also determined by Pielou equotient (1966)

J= H/In S

Where J= Evenness of index, H= Shannon index

S= No. of species in the sample

Correlation Coefficient (r) between these parameters were then determined (Suedecar and Cochram, 1976)

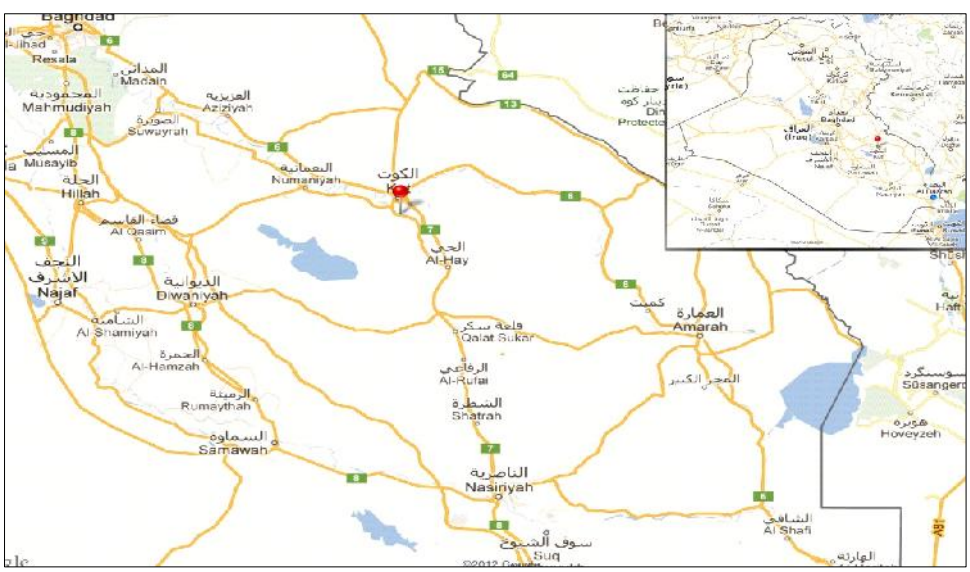


Fig (1) Location of sampling area

3-Result

Chemical Physical Condition

Condition at all stations were generally similar in temperature, dissolved oxygen biochemical oxygen demand, salinity, chlorophyll a, and phosphate except for nitrate and pH (Fig. 2, 3)

The annual range of the water temperature in the Al-Garaf canal is about 11-35ºC at st_3 are however approximately 1-1.5ºC lower than those at st_1 and st_2. Unlike the temperature the monthly means of dissolved oxygen content are higher at st_1 (12 mg/L) in January than those of st_2 and st_3 (6.1, 7.8 mg/L) in May respectively.

The PH value was varied between (8.0 – 8.9) in April, but is lowered where mean value fluctuate (7.2 – 7.8) at June in all stations

During the warmer months chlorine (in chloride) of the canal grades from (0.3 – 0.36) mg/L in all stations. While in winter these values increased to (0.9 – 1.02) mg/L.

The comparative degree of pollution (as inferred from the BOD) at the three stations were ranged from (0.98 – 6.8), (2.57 – 8.3) and (0.83 – 8.69) mg/L at st_1, st_2 and st_3 in December and April respectively.

Monthly changes in nitrate (NO_3) concentration were showed fluctuating pattern. St_1 showed lower values than those at st_2 and st_3. The lowest values were in May counting from (3.9-6.8) mg/L and the highest were recorded in June and October (12.1-12.9) mg/L.

Monthly differences in phosphate concentration for the selection stations, were ranged from the minimum value at October (0.1-0.2) mg/L, and the maximum values however, (2.7-5.1) mg/L were measured in July.

The monthly and localized changes in chlorophyll a. The monthly means fluctuating between (0.15-9.2, 0.92-11.95, 0.71-12.85) mg/L at st_1, st_2 and st_3 respectively. Means values of dissolved oxygen and salinity showed reverse trend to temperature (r= - 0.46, -0.57) respectively.

Biotic Condition

Table (1) showed density of some invertebrates in Al-Gharaf canal. 58 species were recorded in all stations comprised. 3 Annelida, 10 Mollusca, 3 Copepoda, 17 Cladocera, 20 Rotifera, 2 Ostracoda, and 3 Crustacean larvae. The maximum density of Benthos (Annelida and Mollusca) were (989, 974, 775) ind/m^2 during autumn and spring in st_1, st_2, and st_3 respectively, while the maximum density of zooplankton (Copepoda, Cladocera, Rotifera, Ostracoda, and Crustacean larve) were (185.5, 228.7, 248.6) ind/L during winter in st_1, st_2, and st_3 respectively (fig 4). The minimum density of Benthos were (716, 620, 462.1) ind/m^2 during winter and summer in st_1, st_2, and st_3 respectively, while the minimum density of zooplankton were (7.32, 7.42, 10.78) ind/L

during autumn in st_1, st_2, and st_3 respectively (Fig. 5).

There was no significant correlation between total invertebrates and chlorophyll a ($r= 0.095$, $P> 0.05$), also such correlation found with water temperature ($r= 0.39$), while invertebrate density had negative correlation with salinity ($r= - 0.4$, $P>0.05$). Temperature had inverse relationship with dissolved oxygen and salinity ($r= - 0.17$, $- 0.36$) respectively.

The species composition of the three stations was Annelida, Mollusca, Copepoda, Cladocera, Rotifera, Ostracoda, and Crustacean larva. Mollusca group was high density in st_1 while in st_2 exhibit in a low density in comparison with st_1. Unlike to Annelida which were recorded in high number in st_1 in comparison with other stations.

Table (2) showed occurrence of species of the invertebrates in Al-Gharaf canal. Maximum number of species were recorded in st_1, 47 species including 3 Annelida, 10 Mollusca, 3 Copepoda, 17 Cladocera, 20 Rotifera, 2 Ostracoda, and 3 Crustacean larva, while in st_2 53 species were recorded including 3 Annelida, 10 Mollusca, 3 Copepoda, 12 Cladocera, 20 Rotifera, 2 Ostracoda, and 3 Crustacean larva. Similar number of species were recorded in st_3 including: 3 Annelida, 10 Mollusca, 3 Copepoda, 16 Cladocera, 16 Rotifera, 2 Ostracoda, and 3 Crustacean larva.

(Fig. 6, 7, 8) explained percentage of main group of invertebrates in selected stations. In st_1, Annelida have maximum percentage in all over the year followed by Mollusca which ranged between (25 – 37%) in summer and winter respectively. In st_2 the minimum percentage 35% in winter, while Mollusca have higher percentage (59%) in autumn. In st_3 percentage of Mollusca increased to 92% in Autumn in comparison to Annelida which was decreased to 7%. Other groups were very few and comprised (0.1-7.5%) in different season in the three stations.

The ecological indices (diversity, richness and evenness) values were low for all groups except Mollusca due to dominance of few species of Rotifera and Cladocera. The result showed high value of diversity, richness and evenness indices of Mollusca in st_1 in comparison to values in st_2 and st_3. Table (3, 4, 5) explained seasonal changes in diversity, richness and evenness in each group of the invertebrates in st_1, st_2 and st_3. generally, st_1 was higher than other stations in biological indices. Mollusca has higher values of diversity (1.3, 0.9, 0.85) in st_1, st_2 and st_3 respectively.

Evenness was found to be (0.57, 0.62) for Cladocera and Copepoda in st_1 in comparison with st_2 (o.53, 0.8) and st_3 (0.31,

0.51) respectively. While Annelida had a comparable in seasonal values and low in all ecological indices between the three stations. Species diversity were positively correlated with chlorophyll a and nitrate (r= 0.45, 0.5), but negatively correlated with temperature and salinity (r= - 0.45, - 0.52). similarly evenness had negatively relation with temperature (r= - 0.53).

Table (1): Density of some invertebrates in the study area

Group	St_1				St_2				St_3			
	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring
Annelida ind/m	539	657	382	583	366	390	309	530	123.9	42.5	46	329
Mollusca ind/m	218	332	334	282	269.2	582	311	444	338.2	612	432	346
Copepoda ind/L	15	3	18	19	29	2.9	25.1	26	7.9	5	13.4	6.8
Cladocera ind/L	33	3.1	54	34	25	2.9	121	24.1	3.4	1.13	155	16.4
Rotifera ind/L	21.3	0.42	1.5	20.4	10.3	0.42	36.1	17.3	1.9	0.71	28.5	22
Ostracoda ind/L	14.7	0	45	14.1	46.4	0.64	19.2	32.1	5.3	0.42	23.2	19.2
Crustacean ind/L	22	0.8	67	35	62	0.56	27.3	65.9	36.7	3.5	28.5	21.2
Total ind/m^2	757	989	716	865	635.2	972	620	974	462.1	654.5	478	775
Total ind/L	108	3.32	185.5	122.5	172.7	7.42	228.7	165.4	55.2	10.78	248.6	85.6

Table (2) Occurrence of some invertebrates in the study area ((+) Present, (-) absent)

Group	St_1				St_2				St_3			
	Sum.	Aut.	Win.	Spr.	Sum.	Aut.	Win.	Spr.	Sum.	Aut.	Win.	Spr.
Annelida												
Tubifex tubifex	+	+	+	+	+	+	+	+	+	+	+	+
Branchiura sworby	+	+	+	+	+	+	+	+	+	+	+	+
Limnodrilus cluparadiana	+	+	+	+	+	+	+	+	+	+	-	+
Mollusca												
Physa acuta	-	-	+	+	+	+	+	+	+	+	+	+
Lymnaea auricularia	-	-	+	+	+	+	+	+	+	+	+	+
Melanopsis nodosa	+	+	+	+	+	+	+	+	+	+	+	+
Melanopsis costata	+	+	+	+	+	+	+	+	+	+	+	+
Corbicula fuminalis	-	+	-	+	+	+	+	+	+	+	-	+
Uno tigrids	+	+	-	+	+	+	+	+	+	+	+	+
Psudodontopsis euphratica	-	+	-	-	+	+	+	+	+	+	+	+
Theodoxus jordani	+	+	+	+	-	+	-	+	+	+	+	+
Mollusca												
Bellamya bengalensis	-	-	-	-	+	+	+	+	-	-	+	+
Melanoides tuberculata	+	-	+	+	+	+	+	+	+	+	+	+
Mollusca												
Copepoda												
Cyclops sp.	+	+	+	+	+	+	+	+	+	+	+	+
Diaptomus arapolioensis	+	+	+	+	+	-	+	+	+	-	+	+
Harpact coid	+	-	+	+	+	+	+	+	+	+	+	+
Cladocera												
Bosmina longirostris	+	-	+	+	-	+	+	+	+	+	+	-
Moina affinis	+	+	+	+	-	+	+	+	+	+	+	-
Simocephalus vetulus	+	+	+	+	-	-	+	+	-	-	-	-
Alona affinis	+	-	+	+	+	+	+	+	+	+	+	-
Chydorus sphearicus	+	-	+	+	+	+	+	+	+	+	+	-

Acroptrus sp.	+	-	+	+	+	+	+	+	+	+	+	-
Cladocera												
Camptocerus rectrostris		-				-						
Eurycera sp.	-	-	+	-	-	-	+	-	-	-	-	-
Diphanosoma brachyurum	+	+	+	+	+	-	+	+	-	-	+	-
Latoropsis fasciulata	-	-	+	-	-	-	-	-	-	-	+	-
Macrothrix spinosa	-	-	-	-	-	-	-	-	-	-	+	-
Daphnia lumholtzi	-	-	-	-	-	-	-	-	-	-	+	-
Leydigia sp..	-	-	-	-	-	-	-	-	-	-		-
Sidia sp.	-	-	-	-	-	-	-	-	-	-	+	-
Ceriodaphnia reticulate	-	-	-	-	-	-	-	-	-	-		-
Scapholebris kingi	-	-	-	-	-	-	-	-	-	-		-
Holopedium sp.	-	-	-	-	-	-	-	-	-	-		-
Biparalona sp.	-	-	-	-	-	-	-	-	-	-	-	-
Rotifera												
Asplanchna sp.	+	+	+	+	+	+	+	+	+	+	+	+
Keratella sp.		-	-				-					
Branchionum sp.		-	-			-	-					
Trichocera sp.		-		-			-					
Ascomorpha sp.	+	-	-	+	+	+	-	+	+	+	+	+
Pleosoma sp.	-	-	-	+	+	-	-	+	-	-	-	-
Platyis sp.	+	-	-	-	+	-	-	-	-	-	-	+
Synchaeta sp.	+	-	-	+	+	-	-	+	-	-	-	+
Lecane sp.		-	-			-	-		-	-	-	
Habotocha sp.	+	-	+	+	+	-	+	+	-	-	-	+
Rotaria sp.	-	-	-		-	-	-		-	-	-	
Euchlanis sp.		-				-			-	-	-	
Monostyla sp.	+	-	+	+	-	-	-	+	-	-	-	-
Epiphanies sp.	-	-	+	+		-		+	-	-	-	-
Hamingia sp.	+	-	-	-	+	-	+	-	-	-	-	-
Prompholyx sp.	-	-	-	-	+	-	+	+	-	-	-	-
Notholca sp.	-	-	-	-	-	-	+	-	-	-	-	-
Concochiloides sp.	-	-	-	-	-	-	+	+	-	-	-	-
Filira sp.	-	-	-	-	-	-	-	-	-	-	+	-
Macrotrachela sp.	-	-	-	-	-	-	-	+	-	-	+	-
Bipalpus sp.	-	-	-	-	-	-	-	-	-	-	-	-
Testudinella sp.	-	-	-	-	-	-	-	-	-	-	-	-
Ostrcoda	-	-	-	-	-	-	-	-	-	-	-	-
Species 1	-	-	-	-	-	-	-	+	+	+	-	+
Species 2	-	-	-	-	-	-	-	-	+	+	+	+
Crustacean larvae	-	-	-	-	-	-	-	+	+	+	-	+

Table (3): Seasonal diversity richness and evenness for each group of invertebrate in st_1

	Summer			Autumn			Winter			Spring			Total		
	Div.	Rich.	Even.	Div.	Rich.	Even.	Div.	Rich.	Even.	Div.	Rich.	Even.	Div.	Rich.	Even.
Annelida	0,2	0,32	0,1	0,5	0,31	0,45	0,4	0,34	0,36	0,4	0,32	0,36	0,38	0,34	0,31
Mollusca	0.43	0.74	0.58	1.6	1.03	0.53	1.5	1.2	0.53	1.2	1.25	0.4	1.3	1.05	0.51
Copepoda	0,98	0,7	0,89	0,31	1,03	0,44	0,45	0,69	0,41	0,8	0,68	0,73	0,63	0,8	0,62
Cladocera	0.94	1.7	0.48	0.67	1.16	0.97	1.05	1.76	0.46	1.5	2.27	0.37	1.04	1.72	0.57
Rotifera	0,78	3,93	0,3	0,41	1,16	0	0,5	9,3	0,31	0,82	3,6	0,33	0,63	4,4	0,31
Ostracoda	0.31	0.37	0.44	0.2	0	0.29	0.3	0.27	0.43	0.12	0.38	0.17	0.23	0.34	0.33

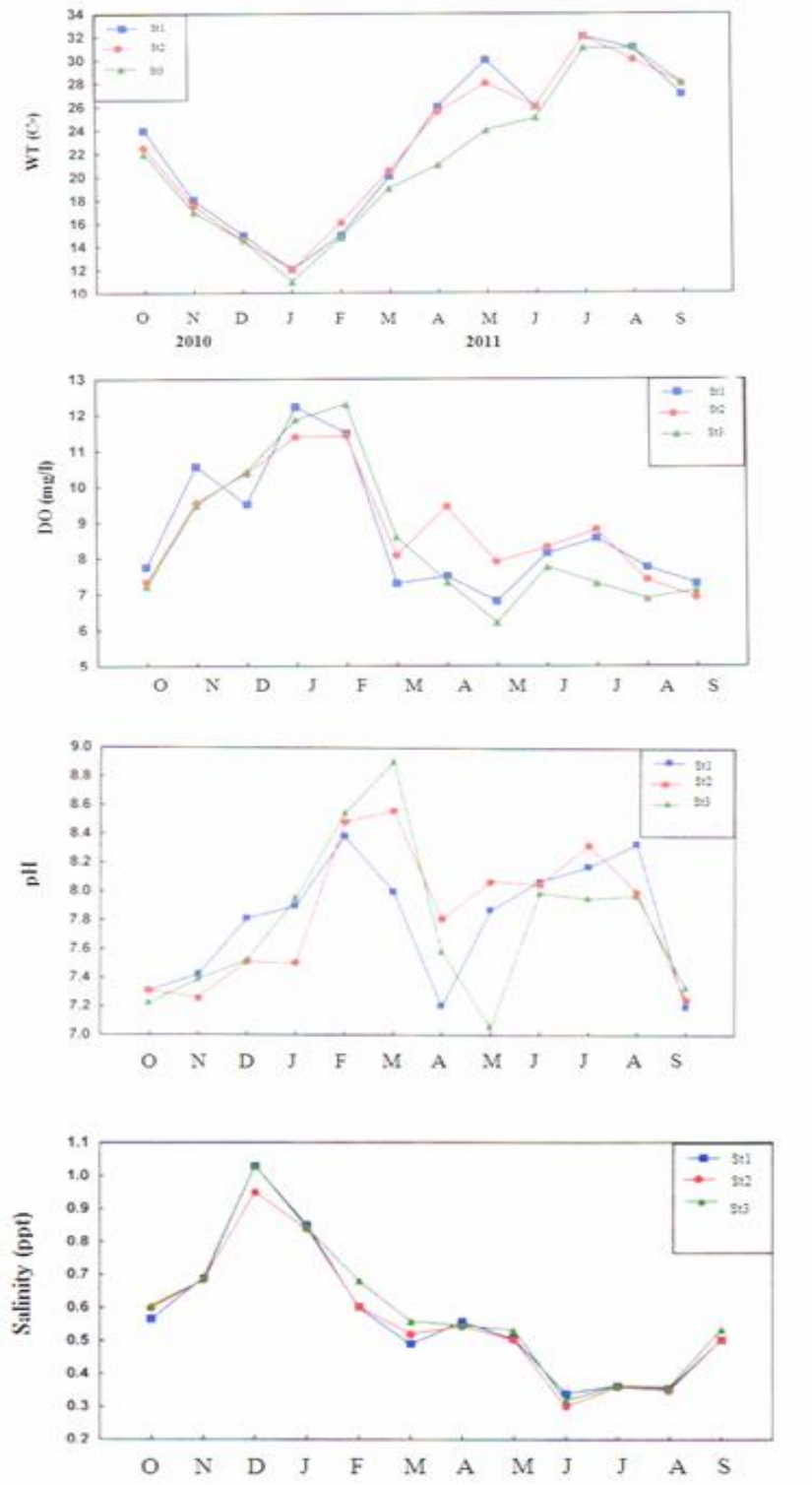
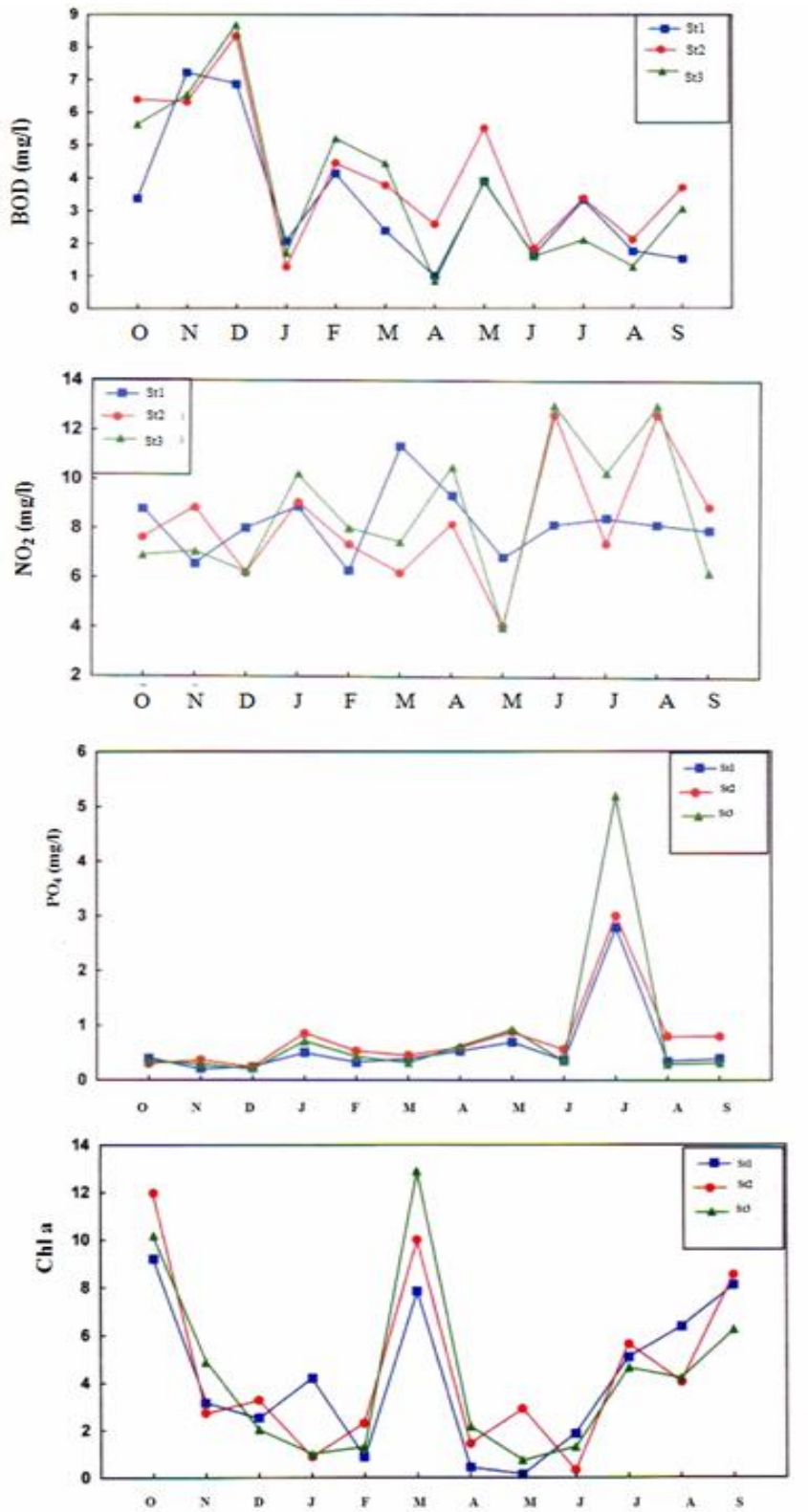


Fig (2) Environmental factors of study area



Fig(3)Environmental factors of the study area

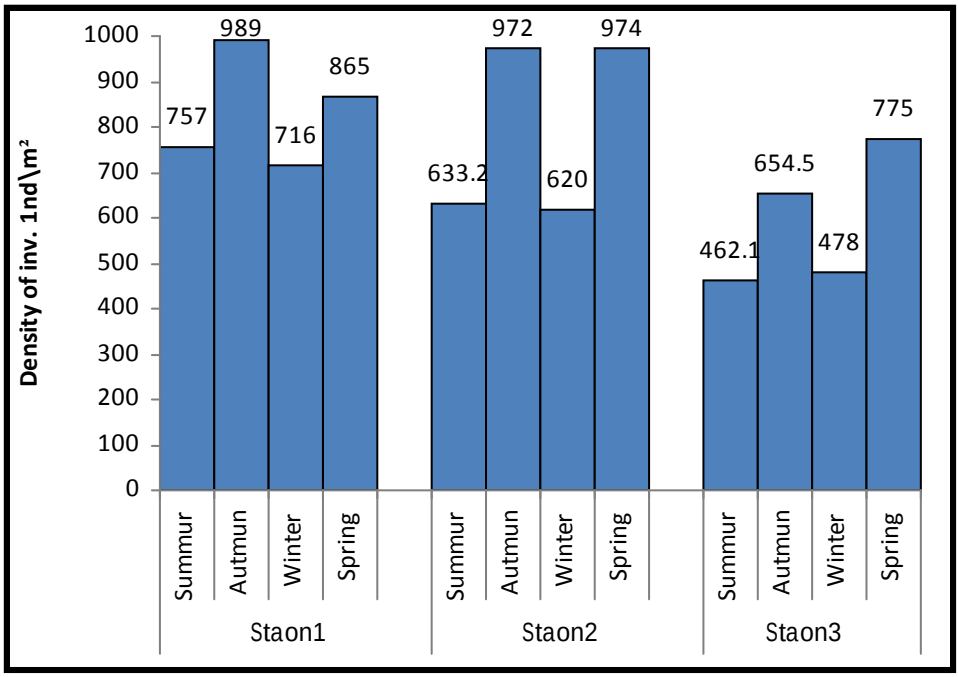


Fig (4) Density of invertebrates (Annelides& Mollusca) in three stations

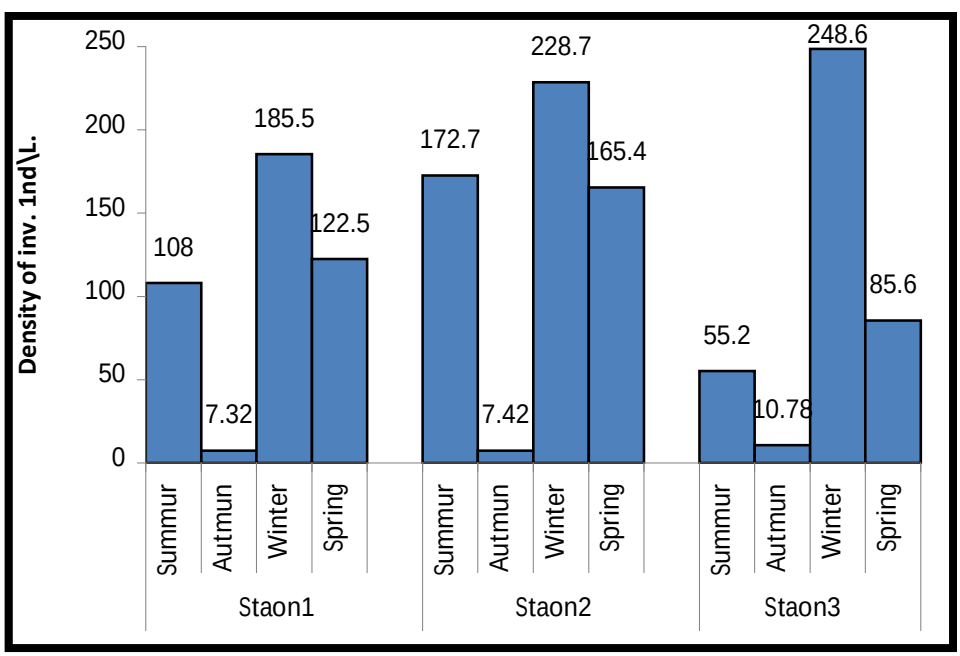


Fig (5) Density of invertebrates (Zooplankton) in three stations

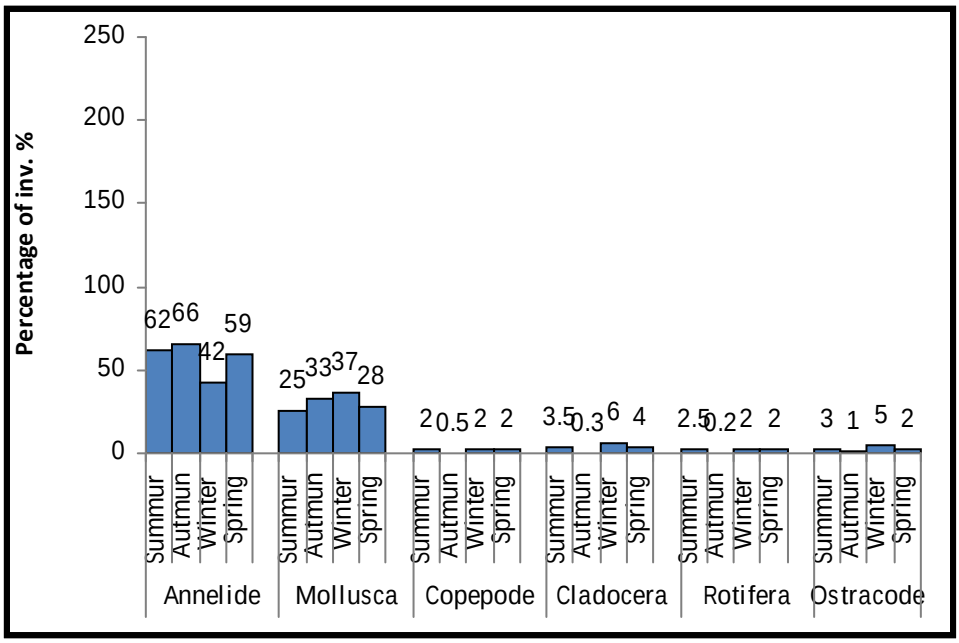


Fig (6) percentage of invertebrates in station 1

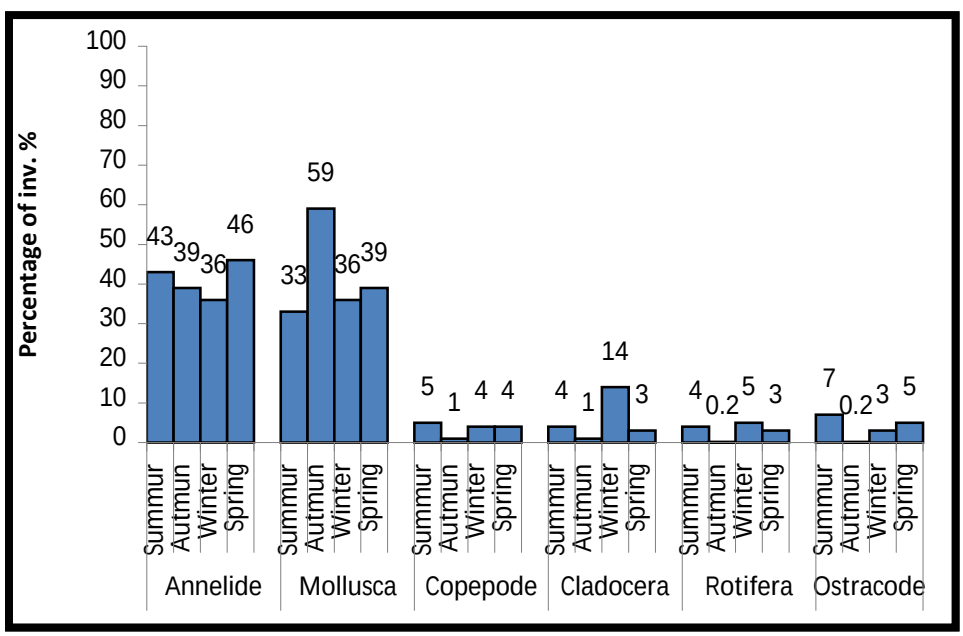


Fig (7) percentage of invertebrates in station 2

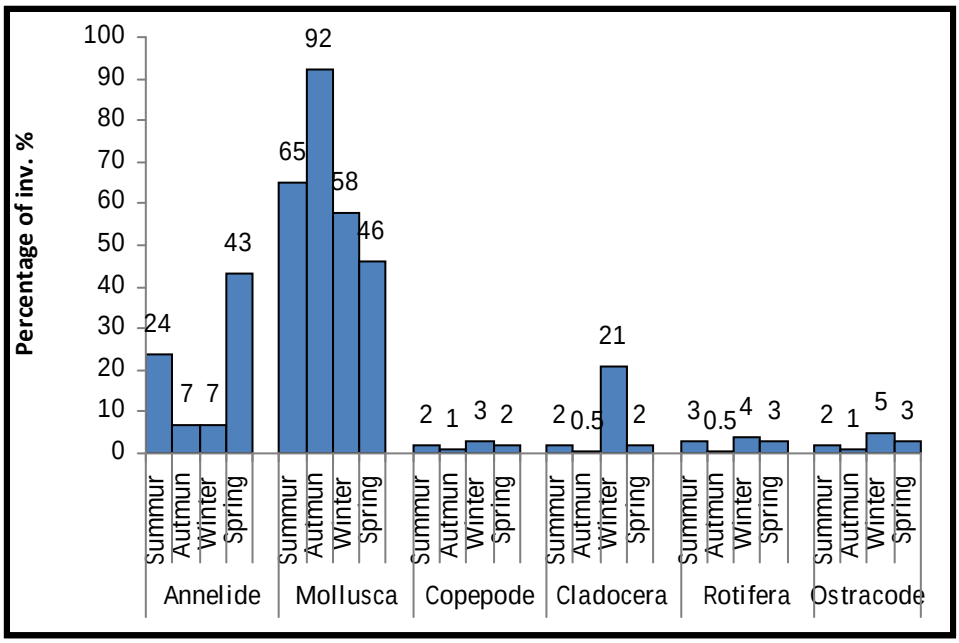


Fig (8) percentage of invertebrates in station 3

4-Discussion:-

The highest number of invertebrates were recorded in st_2 (3201.2 ind/m^2 and 5742.22 ind/L) in comparison with st_1 (3327 ind/m^2 and 423.32 ind/L) and st_3 (2369.8 ind/m^2 and 400.18 ind/L) that could be related to physicochemical characters of water substratum and water region.

The greatest damage of the canal is done by domestic and agricultural wastes discharged to the river, and because of that's waste, the hydrogen ion concentration goes towards alkaline side

Annelida was the dominant group in all studies stations followed by Mollusca the Cladocera. Variation was found in other group which presence in low density and it's very important as food item for fish and other aquatic organism. Most species of invertebrates in selected stations were previously recorded in Iraqi rivers and lakes (Hamzah, 1980; Frandson, 1983; Rasheed, 1985; Daoud *et al*., 1986; Al-Hamed, 1966; Saood, 1987; Al-Adhub and Hamzah, 1987; Abdul-Saheb, 1989; Al-Qarooni, 2005, 2011).

According to the little data available about density and abundance of invertebrates in Al-Gharaf canal so there were many investigations performed on surrounding area such as Al-Qarooni (2005) was recorded only four species of snail (*Lymnaea auricularia*, *Physa acuta*, *Bellamya bengalenis* and *Gyrulus* sp.) in three southern marshes, but the recent study was recorded 10 species of Mollusca. Also

Alsoodani *et al*. (2007) identified 87 species of Zooplankton in marshes including: 53 species of Rotifera, 24 species of Cladocera, 4 species of Copepoda and 6 species belong to insect, Ostracoda and Nematode, while our study were recorded 58 species in Al-Gharaf canal including: 3 species of Annelida, 10 species of Mollusca, 3 species of Copepoda, 17 species of Cladocera, 20 species of Rotifera, 2 species of Ostracoda, 3 species of crustacean larva.

Few specific articles were deal with Zooplankton of marshes such as (Al-Saboonchi *et al*., 1986; Al-Qarooni, 2005; Al-Soodani, 2007).

We deduced that highest density of individual of invertebrates recorded in spring in all studied stations which conceded with increase of phytoplankton and zooplankton, while the lowest density of invertebrates were recorded in summer. Similar results were reported in previous studies (Mohammad, 1965, 1986; Winner *et al*., 1980; Mangalo and Akbar, 1986, 1988).

Diversity indices of invertebrates varied inversely as the degree of the organic pollution (as inferred from BOD). This was an evident of higher value of Ecological indices in st_1 in comparison to st_2 and st_3 because of the lowest value of BOD. The observation accords well those of (Hynes, 1960; Mohammed, 1980; Al-Gizany, 2005; Abaa, 2010). In the Annelida however, species diversity with the increase of organic matter (Mohammed, 1980; Akbar, 1999).

Within the invertebrates species richness and evenness were equal important in predicting species diversity at all stations. This indicates that the increase in the diversity index could be result from an increase on both component's evenness and richness.

5-Conclusions

1. In a 12 months ecological survey of Al-Gharaf canal. Selected physical – chemical features were measured and the diversity richness and evenness of the invertebrates were quantified.

2. The fauna of the canal composed 58 species include: 3 Annelida, 10 Mollusca, 3 Copepoda, 17 Cladocera, 20 Rotifera, 2 Ostracoda, 3 Crustacean larva.

3. The density of invertebrates were recorded in st_2 (3201.2 ind/m^2 and 5742.22 ind/L) in comparison with st_1 (3327 ind/m^2 and 423.32 ind/L) and st_3 (2369.8 ind/m^2 and 400.18 ind/L)

4. Mollusca had the highest values in ecological indices in all stations. Unlike to Annelida which had the lowest values in ecological indices.

6-References

Abass, M. F. (2010). Abundance of Cladocera and some other zooplankton

and diversity in the northern part of Shatt Al-Arab river. M. Sc. Thesis, Basrah Univ. 119 pp.

Abdul-Saheb, I. M. (1989). Life history and productivity of two species of freshwater mussels *Corbicula fluminalis* and *C. fluminaea* in Shatt Al-Arab river. M. Sc. Thesis, Basrah Univ. 92 pp.

Ahmed, M. M. (1975). Systematic study on Mollusca from Arabian Gulf and Shatt Al-Arab, Iraq. Bull. Basrah Nat. Hist. Mus., (3): 89 – 94.

Ajeel, S. G. (1998). Population dynamics and bioenergetics of two species of Cladocera *Simocephalus vetulus* (Muller) and *Daphnia magna* (Straus) in Basrah with a reference to zooplankton. Ph.D. Dissertation, Basrah Univ., 154 pp.

Akbar, M. M. (1999). Experimental and field study of the population dynamics of *Tubifex tubifex* (Annelida: Oligochaeta). Ph.D. Dissertation, Babylon Univ., 103 pp.

Al-Adhub, A. H. Y. and Hamzah, H. A. (1987). Caridina *Babaulti basrensis* sub sp. Nov. from the Shatt Al-Arab region, Iraq. Crustacea, 52 (3): 225 – 228.

Al-Gizany, H. R. (2005). Organic pollution and its effect in diversity and abundance of plankton in Shatt Al-Arab, Ashar and Rubat canal. M. Sc. Thesis, Basrah Univ. 82 pp.

Al-Hamed, M. I. (1966). Limnological studies on inland water of Iraq. Bull. Iraq Nat. Hist. Mus. 3: 1- 22.

Al-Qarooni, E. H. M. (2005). Study of seasonal abundance of aquatic invertebrates in southern Iraqi marshes. M. Sc. Thesis, Basrah Univ. 97 pp.

Al-Qarooni, E.H.M. (2011). Estimation of some heavy metals concentration, sediment and bioaccumulation in some invertebrates of Shatt Al-Arab river and Shatt Al-Basrah canal, southern Iraq. Ph.D. Dissertation, Basrah Univ., 243pp.

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.

Al-Sodani, H.M.; Abed, J.M.; Al-Essa, S.A.K. and Hammadi, N.S. (2007). Quantitative and qualitative study on zooplankton in restored southern Iraqi marshes. Marsh Bull., 2 (1): 43–63.

Brinkhurst, R.O. and James, B.C. (1971). Aquatic Oligochaeta of the world. University of Toronto Press, Toronto.

Daoud, Y.T.; Shihab, A.F. and Hassan, K. S.(1986). Preliminary survey of invertebrates in the Shatt Al-Arab river, Iraq. Bull. Basrah Nat. Hist., 6: 87 – 93.

Edmondson, W. T. (1959). A field guide to freshwater snail in countries of the WHO eastern Mediterranean region. Danish Bilharziasis Laboratory, 45pp.

Frandson, F. (1983). A field guide to freshwater snail in countries of the WHO eastern Mediterranean region. Danish Bilharziasis laboratory, 45 pp.

Gurney, R. (1921). Freshwater Crustacean collected by Dr. P. A. Buxton in Mesopotamia and (Persia). J. Bombay Natural History Society, 27(4): 835–844.

Hamzah, H.A. (1980). Study of some biological and ecological aspect of freshwater shrimp *Caridina basrensis* Al-Adub and Hamzah, 1979 in Shatt Al-Arab. M. Sc. Thesis, Basrah Univ. 57 pp.

Hussein, S.K. and Fahad, K.K. (2008, a). Seasonal variation in a biotic ecological condition in Al-Garaf canal one of the main branches of Tigris river at Thi-Qar province, Iraq. Basrah J. Sci., (B): 26 (1): 38 – 47.

Hussein, S.K. and Fahad, K.K. (2008, b). Seasonal variation in nutrient and chlorophyll concentration in Al-Gharaf canal one of the main branches of Euphrates southern Iraq. Basrah J. Agri. Sci., 21.

Hussein, S. K. and Fahad, K. K. (2008, c). Monthly variation in concentration of trace element of water from Al-Gharaf, one of the main branches of Tigris river. Proc. Of 4th Sci. Conf. of UK.

Hussein, S.K.; Shawi, I. J. and Abdullah, A. M. (2009). Impact of Al-Najebiya thermal energy power plant on aquatic ecosystem of Garmet Ali canal. III monthly difference in nutrient Budget and TDS. J. Thi Qar Sci., 4: 51–59.

Hussein, S.K. and Fahad, K. K. (2009). Seasonal variation in levels of heavy metals in muscles of crab *Seasarma boulengeri* collected from Al-Garaf canal at Thi-Qar Province, Iraq. J. Thi-Qar sci., 4: 42-50.

Hynes, H.B.N. (1960). The biology of polluted water. Liverpool Univ. Press. Liverpool, 202p.

Lind, O.T. (1979). Handbook of common method in limnology. 2nd ed. London, 199pp.

Margalefe, R. (1968). Perspectives in ecology theory. University of Chicago Press, Chicago. 111 pp.. Cited by Nash, R.D.M. and Gibson, R. N. 1982.

Mangalo, H.H. and Akbar, M. M. (1986). Seasonal variation in pollution density of zooplankton in the lower reaches of Diyala river, Baghdad. Iraq J. of Biol. Sci. Res., 17(3): 99–114.

Mangalo, H.H. and Akbar, M. M. (1988). Comparative study of two population of Cladoceras in the Tigris and Diyala rivers at Baghdad. J. Biol. Sci. Res., 19 (1): 117–128.

Mohammed, M. B. (1965). A faunal study of the Cladocera of Iraq. Bull. of the Biol. Res. Cen., 1: 1–11.

Mohammed, M.B. (1980). A hydrobiological survey of polluted canal. Hydrobiology, 74: 179 – 186.

Mohammed, M.B. (1986). Association of invertebrates in the Euphrates and Tigris rivers at Falluja and Baghdad, Iraq. Fur. Hydrobiology, 106 (3): 337 – 350.

Pielou, E.C. (1966). Shannons formula as measure of specific diversity: its use and misuse. Am. Nat., 100: 463 – 465.

Rasheed, K.A. (1985). Study of some biological aspect of freshwater shrimp *Ataephyra demarestii orientalis* Bouvier, 1913, in Shatt Al-Arab, Iraq. M. Sc. Thesis, College of Science, Basrah Univ.

Saood, K.D. (1987). Population dynamics secondary production and swimming behavior of *Sphaeroma annandalei annandalei* sttebing , 1911. M. Sc. Thesis, Basrah Univ. 134 pp.

Shannon, C. E. and Weaver, W. (1948). The mathematical theory of communication, Uinv. Illinosis Press, Urbana. 1, 11.117p. cited by Fausch, K.D.; Lyons, J.D.; Karr, J.R. and Angermeier, P. L. (1990).

Snedecor, G.W. and Cochran, W.G. (1976). Statistical methods. Iowa state Univ. Press. XIV, 593 pp.

Winner, J. M.; Patrick, P.H. and Wallen, D. G. (1980). Zooplankton species diversity in lake st. Clair, Ontario, Canada. Hydrobiology, 75:57–63.

دراسة بيئية لنهر الغراف، ذي قار، العراق

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الخلاصة

يتضمن البحث دراسة هيدروبايولوجية لبعض أنواع اللافقريات من ثلاث محطات (النصر، الشطرة و الغراف) في نهر الغراف. قيست بعض العوامل الفيزيائية الكيميائية فضلاً عن حساب التنوع و التكافؤ و الغنى للافقريات.

سجل 58 نوعاً من اللافقريات تضمنت 3 ديدان حلقية، 10 نواعم، 3 مجذافية الأقدام، 17 متفرعة اللوامس، 20 دولابيات، 2 درعيات و 3 يرقات القشريات. تراوحت الكثافة السكانية للافقريات (863 – 994.25)، (807 – 1139.4)، (517.5 – 750.6) فرد/لتر في المحطات الأولى و الثانية و الثالثة على التوالي.

دليل التنوع للنواعم كان مرتفعاً في جميع المحطات (1.3، 0.9، 0.85) في المحطة الأولى و الثانية و الثالثة على التوالي. فضلاً عن أن المحطة الأولى كانت أعلى في جميع قيم الأدلة البيئية.

قيم التكافؤ لمتفرعة اللوامس و مجذافية الأقدام كانت (0.57 و 0.62) و (0.53 و 0.8) و (0.31 و 0.51) في المحطة الأولى و الثانية و الثالثة على التوالي. كما أظهرت الديدان الحلقية قيم منخفضة في الأدلة البيئية لجميع المحطات.

إرتبطت كثافة اللافقريات بعلاقة طردية مع الكلوروفيل و درجة الحرارة و بعلاقة عكسية مع الملوحة، أما التنوع فقد إرتبط طردياً مع الكلوروفيل a و النترات عكسياً مع درجة الحرارة و الملوحة و الـ BOD، أما التكافؤ فقد إرتبط عكسياً مع درجة الحرارة.