The Impact of Increasing the Salinity of Shatt Al-Arab River Waters on the Density of Phytoplankton and Zooplankton

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Abstract: ***The chlorophyll a contents and biomasses of phytoplankton, the distributions of phytoplankton and zooplankton and salinity of Shatt Al-Arab waters in [Abu Al-Khaseeb (Hamdan), Karmat Ali and Kerdland stations were monthly varied during the period of study from February till June, 2016. In Karmat Ali station, the highest levels of chlorophyll a content and biomass and they were in and Winter season, were 12.55 and 840.85 respectively, the least levels for them were in Spring season, they were 0.014 and 0.938 respectively. In Kerland station, the highest levels of chlorophyll a content and biomass were in Winter season, were 8.277 and 554.56 respectively, the least levels for them were in Summer season, they were 0.000534 and 0.036 respectively, where as in Abi Al-Khaseeb station, the highest levels of chlorophyll a content and biomass and they were in Winter season, were 34.176 and 2289.8 respectively, the least levels for them were in Summer season, they were 0.03124 and 2.1respectively. Mastorugloia braunii recorded in Karmat Ali station the highest occurrence in April and it was 187, then came next to It Cyclotella Meneghiniana Kütz, it recorded occurrences in Mrch and February, they 167 and 156 respectively, then C. striata (kütz) Grunow came, it recorded in Mrch and February 134 and 98 occurrences respectively. Kerland station showed that Cyclotella Meneghiniana Kütz recorded the highest occurrences in February March and they were 156 and 93 respectively, then C. striata (kütz) Grunow came next to it, it showed occurrences in February and March, they 134 and 82 respectively. Hamdan (Abu Al -Khaseeb ; showed that Cocconeis placentula var. euglypta (Ehr.) Cleve recorded the highest occurrences in February March and they were 98 and 65 respectively. In Karmat Ali station, Cirripedia larvae recorded the highest number in May and it was 948, next to it Cladocera came, it recorded the number 569 in June while in Kerland station, Cirripedia larvae recorded the highest number in March, it was 1588 and then Cladocera recorded the number 995 in April but Hamdan (Abu Al -Khaseeb) showed that Cyclops sp recorded the highest number in April, it was 261 and then Copepod nauplii (in April) recorded the number 237. In Karmat Ali station, the salinity increased with increasing the temperature from 1.4 at 13.8 c^{o} in February up to 1.78 at 28.3 c^{o} in May., whereas in Kerland station, Hamdan (Abu Al –Khaseeb) showed that the salinity increased with increasing the temperature from 1.79 at 13.8 c^{o} in February up to 2.1 at 16.1 c^{o} in March.***

Keywords: Phytoplankton, Zooplankton, Salinity, Shatt- Al-Arab, Plankton

1. Introduction

Most zooplankton are microscopic animals (water invertebrates) floating or drifting, inhabiting all layers of the water even to great depths. They are feed on phytoplankton and some organic materials, suspended in the water so frequently and present in surface water or near the surface. They include larval stages of most of the nektonic and benthic animals. The size ranged from 5 µm, as in some Ciliata and Protozoa, such as flagellates, to large animals such as Jellyfish, which has a diameter of up to one meter or more (Barnes, 1969).. It has an importance in the food chain of the aquatic ecosystems throughout the world, channeling energy and nutrients from primary products (phytoplankton) to consumers of economic importance (such as fish, shrimp, etc.), because they are highly productive and important in fish diets. An improved understanding of zooplankton production and growth can be applied to increase fish production in aquaculture facilities and in the wild (Herrera, and Castro, L. 2008). zooplankton in turn serves as food for larger animals Its greatest density in the upper, lighted zone and in productive waters planktonic organisms may occur in such enormous numbers that the water appears turbid (Seguin., Braconnot and Elkaim 1997.). The abundance of zooplankton in a certain area shows the presence of the prosperity of the zooplankton in that region and thus refers to the abundance of fish and crustaceans commercial (Raymont, . 1983). Zooplanktons invariably form an integral component and significantly contribute to biological productivity of freshwater communities [Sharma and Sharma, 2008].Due to their importance as food for fish; zooplanktons have been studied from various inland ecosystems of Iraq. Information on the ecology of this group of organisms in Iraqis Al-Hammar Marshes, however, is still limited (Ajeel *et al*., 2015).The rate of zooplankton production can be used as a tool to estimate the exploitable fish stock of an area [Twari and Nair1991]. In marsh environments zooplankton are good ecological indicators due to their wide physiological tolerances among species. Also, due to their place in the aquatic food chains, changes in population abundance may cascade both up and down. Furthermore, environmental perturbation [Salman *et al*., 2014]. Zooplankton research ecosystems near Basrah has a history of over 90 years, starting with Gurney [Gurney, 1921], who first identified several species of zooplankton from lower Mesopotamia, the mouth of the Shatt Al- Arab River, and the Tigris River, near the city of Amara, he found 77 taxa belonging to Rotifera, Cladocera and Copepoda. Mohammad research, [1965] followed, with collections and identifications of cladocerans from southern Iraq. This latter study included the Shatt Al-Arab from the mouth of Khour Al-Amaya to Qurna, where fifteen new species to Iraq were found and a unique species assemblage downstream observed. AL-Hammed [1966] studied the zooplankton of the inland waters of Iraq. Khalaf et al. [1976] investigated crustaceans, particularly, the Cladocera of the middle and southern region of Iraq, where twenty-three species of Cladocera were described from the marshes extending from the Qurna to Chebaish. In Shatt Al-Arab River from 1982 – 1984, Salman et al. [, 2012] studied the seasonal abundance of zooplankton, and found that Cladocera was the dominant group, with as much as 68% of species count, followed by Copepoda. Additionally, Al-Saboonchi et al. [, 1986] investigated the seasonal changes in the quality and quantity of zooplankton in Al-Hammar Marshes near Garmat-Ali River, were 21 genera belonging to three groups, Rotifera, Cladocera and Copepoda were identified. [Abdul-Hussein et al, 1989] surveyed the Rotifera in northern Shatt Al- Arab River. Ajeel *et al.* [2000] found that the peak of density of Simocephalus vetulus in a pond in (Garmat Ali) at Basrah occurred during February 1997. And Ajeel et al. [2001] recorded 23 species of Cladocera including six new records to the Shatt Al-Arab River. Whereas, AL-Zubaidi and Salman. [2001] studied the zooplankton of the southern Shatt Al-Arab River. Later Ajeel [2004] investigated the zooplankton of the North Shatt Al-Arab, Shatt Al-Basrah and Khour Al-Zubair Canal. Then Ajeel [2004] surveyed the zooplankton of Garmat-Ali River. Abbas [2010] study abundance of Cladocera and some other zooplankton and diversity in the Northern part of Shatt Al-Arab River. Ajeel and Abaas. [2013] (unpublished) studied the diversity of Cladocera of the Shatt Al-Arab River, Southern Iraq. Phytoplankton, considered as the basic component of an aquatic food chain, is the source of oxygen and the main autochthonous primary producers (Shams, . Afsharzadeh and Atici, 2012). The floristic variation in phytoplankton community depends on the availability of nutrients, temperature, light intensity and on other limnological factors (Ghosh, Barinora and Kesh, 2012). Phytoplankton is one of the major biological elements used for the assessment of the ecological status of surface water bodies, and the variation in the biotic parameters provides a good indication of energy turnover in aquatic environments, due to its sensitivity to any change in the environment [Forsberg, 1982; Reynolds, 2006]. Many authors emphasized the importance of phytoplankton as bioindictors in different aquatic systems (Aziz, Ganjo and Shekha, 2003; Bellinger and Sigee 2010).The main freshwater inflow into the northern Arabian Gulf is from the Shatt Al -Arab River. The study was carried out to identify the impact of salinity on abundance and distribution of phytoplankton and zooplankton in three stations[Abi Al-Khaseeb (Hamdan), Karmat Ali and Kerdland] that were chosen on Shatt Al-Arab River.

2. Materials and Methods

Qualitative study of phytoplankton

Samples of phytoplankton were monthly collected from three sites of study [Abi Al-Khaseeb (Hamdan), Karmat Ali and Kerdland stations], sampling period started with February till June of 2016, by using nets of µ 20 eyes. The samples were fixed by using Logal, s solution that was prepared according the method of Lind (1979).In the laboratory each of the samples was thoroughly washed with distilled water, part of it was examined to identify the non diatomic planktons, where as the diatomic planktons were treated with hydrogen peroxide (10%) in order to remove siliconic walls. Phytoplankton were identified by using the following references; Husted (1930;1985);Cleve-Euler (19511955);Hendey (1964;1970);Tayler (1976); Germain (1981); Dodge (1982); Husted (1985); Dodge (1985) ;Snoeijs (1993);Snoeijs and Vilbaste (1994) ; Snoeijs and Potapova (1995) ; Snoeijs and Kasperoveiciene (1996) ; Snoeijs and Balashova (1998) ; Botes (2001) and Perry (2003).

Quantitative study of phytoplankton

Phytoplankton was collected for quantitative study by filtering liters two hundreds of water in each station through a net of µ 20 eyes. The samples were kept in 500 ml plastic vials, were washed with distilled water, were concentrated up to ml 10 was concentrated by using the centrifuge and in 10 ml plastic vial were kept till the examination and counting by using the compound microscope. Counting of cells was done by using a transferred sectors method according to the following equations;

Number of cells in (cm3) of water sample = Number of counted cells in one by transferred sector x coefficient of conversion.

Coefficient of conversion = Coefficient of sample concentration x number of transferred sectors in (cm3) of a concentrated sample.

Number of transferred sectors in (cm3) of a concentrated sample = Diameter area/ area of transferred sector x 20. Where (cm3)= Twenty drops of 0.05 cm3 size. Non diatomic spcies were counted by using Haemocytometer and the method of Martinez *et al* (1975). Measuring of chlorophyll and biomass of aquatic plants; Chlorophyll a and biomass were measured, by taking 5 gm of the aquatic plant and crushed by porcelain mortar with 10 ml of 90% aceton and was left in refrigerator for 24 hours after surrounding the vials with aluminum foils, the filterate was measured on 665 and 750 nanometer wavelengths, using spectrophotometer (Hitachi type, 4-1500 model)..After that two drops of 2N HCl were added to each sample, then the measurements of absorption were repeated using the same above mentioned wavelengths, according to Lorenzen, s equations (38).Plants tissues analysis for protein, fat, moisture and ash contents according to (A.O.A.C., 1981).

The method of collection of zooplankton samples;

The samples of zooplankton were monthly collected from three stations, they were the rivers of [Abi Al-Khaseeb (Hamdan), Karmat Ali and Kerdland stations], for the period from February till June of 2016, by using hand net of conical shape was carried by a hand catch (rod) was ending on the other side with a bottle of stopper for the purpose of discharging the sample to preservation bottle. After collection for known distances by drawing the net in such a way that its nozzle was horizontally submerged (sinked) below the surface of water for about three meters. The contents of this bottle will pass in to another tightly closed ml500 plastic bottle. The sample was directly fixed after collection by % 6-4 formaldehyde with environment water sample. After bringing the samples to the laboratory, all the species and numbers of zooplankton were fixed. The water that entered into the net during the above mentioned collection method was calculated according to the mathematical law of cylinder volume;

$V = r^2 \pi h$
V= the volume of filtered water in ml
r = the diameter of net 's nozzele (meter)
π = the constant ratio (3.14)
h=the highness of water column (meter) that represented the horizontally drawn distance by the net.
The numbers of individuals in a sample were divided by 0.211 to get the results in a cubic meter.
V= (0.152) (3.14) (3) V = 0.211 m^3

3. Results

Table 1: shows Physicochemical factors of Karmet Ali station

Chlorophyll a content (mg/ L)	PO4 (µg /L)	NO3 (µg/L)	DO (mg/ L)	pH	Salinity (g/ L)	Temperature (C^O)	Months
.0390	0.192	6.31	8.7	8.4	1.4	13.8	February
0.187	0.22	6.87	8.4	8.35	1.4	15.1	March
0.708	0.14	7.8	7.3	7.9	1.4	20.6	April
0.809	0.43	9.44	7.91	7.89	1.78	28.3	May
0.895	0.4	7.9	6.6	8.4	1.29	31.4	June

Table 2: shows Physicochemical factors of Kerland station

Chlorophyll a content (mg/ L)	PO4 (µg /L)	NO3 (µg/L)	DO (mg/L)	pH	Salinity (g/ L)	Temperature (C^O)	Months
0.53	0.3	18.8	8.5	7.9	1.79	13.8	February
0.419	0.33	8.66	7.8	8.1	2.1	16.1	March
0.505	0.16	8.47	7.4	8.18	1.9	20.4	April
1.676	0.45	11.2	7.68	7.61	1.9	26.2	May
1.242	0.53	7.41	6.5	7.66	1.55	28.7	June

Table (3) shows Physicochemical factors of Abu Al-Khaseeb station.

Chlorophyll a content (mg/ L)	PO4 (µg /L)	NO3 (µg/L)	DO (mg/ L)	pH	Salinity (g/ L)	Temperature (C^O)	Months
0.289	0.21	14.2	10.2	7.2	1.99	11.7	February
0.549	0.3	7.9	8.1	7.13	1.5	13.2	March
0.914	0.1	16.4	7.2	8.1	1.72	21.3	April
3.843	0.25	8.9	6.95	7.95	1.2	28.6	May
3.612	0.43	12.41	6.8	8.04	2.05	31.4	June

Table 4: shows the chlorophyll a content and biomass of phytoplankton in three different stations for Summer, Winter and Spring seasons

Station	Summer season		Winter season		Spring season	
	Chlorophyll a content	Biomass	Chlorophyll a content	Biomass	Chlorophyll a content	Biomass
Hamdan	0.03124	2.1	34.176	2289.8	0.124	8.308
Kerdland	0.000534	0.036	8.277	554.56	0.000704	0.047168
Karmat Ali	0.03124	2.1	12.55	840.85	0.014	0.938

Table 5: shows the total number of phytoplankton X 10 4 (individual / liter) during the months of 2015-2016 for Karmat Ali station

Class : Cyanophyceae	February	March	April	May	June
Anabaena constricta (Szafer) Geitler	5	1	3	-	
Chroococcus disperses (Keissl) Lemmermann	3	-	-	-	
Gomphospheria aponina Kütz.	2	3	-	-	
Lyngbya limnetica Lemmermann	6	2	4	2	5
microcoleus acutissimus	-	-	-	-	
scytonema leplobasis	4	-	-	-	
Oscillatoria princes Vaucher	-	-	2	5	3
O. limmetica Lemmermann	6	1	4	-	7
Spirulina major Kütz.	7	3	6	-	1
Division : Chlorophyta					
Class : chlorophyceae					
Cladophora secunda Kütz.	4	-	2	2	
Cosmarium hammeri Reinsch	5	-	8	11	
Closterium kuetzingii	-	-	1	-	2
chraraciopsis spinifer	-	-	1	-	
Goniom	3	-	-	-	
Stigeoclonium curvirostrum skuja	2	-	-	-	
Scendesmus quadricauda (Trup.) deBrebisson	-	-	2	5	1
Spirogera scrobiculata	-	-	5	10	11
Ulothrix cylindricum	1	-	-	-	

Ulothrix zonata (Weber and Mohr.) Kütz.	3	-	-	-	
Tolypothrix	-	-	-	4	
Volvox sp	5	7	19	-	
Division : Bacillariophyta					
Class : Bacillariophyceae					
Centrales					
Cyclotella Meneghiniana Kütz.	156	167	1		1
C. striata (kütz) Grunow	134	98	1		1
Melosira varians			2	3	

Pennales					
Amphipora sphaero.	2				
Amphipora sp.	3				
A. ovalis Kütz.	1				
A. coffeaeformis.	1				
Bacillaria paxillifer (Muller) Hendey	1			2	11
Cocconeis placentula var. euglypta (Ehr.) Cleve	8	67	1	3	2
C. placentula var. lineata (Ehr.) Cleve	7	54	1	10	3
Cymbella aspera.	1				
Cymbella affinis Kütz.	1	2			
C. cistula (Hemb.) Grunow	1	1			
C. microcephala Grunow	1				
C. tumida (Breb.) van Heurck	1				
C. ventricosa Kütz.	15				
Calonies permagna			4	1	2
Calonies ventricosa	5		3	2	1
Diatoma tenue var. elongatum Lyngbye	1		2	3	5
D. vulgare Bory	1		93	11	18
Diploneis ovalis (Hil.) Cleve			1	2	1
E. zebra (Ehr.) Kütz.			1		
E. zerbra var. porcellus Kütz.Grunow			1		
F. pinnata Ehrenberg	1	1	1	1	1
Fragilaria sp.	3	4	9	17	11
Gomphonema sphaerophorum Hustedt	11		9		
G. augur Ehrenberg	1				
G. gracile Ehrenberg	2		2		
Gygrosigma spencerii var. nodifera Grunow	6	3		2	1
G. tenuirostrum (Grun.) Cleve	1	2		1	1
Mastogloia braunii Grunow	3		187		
M. elliptiica var. dansei (Thwa.) Cleve			1		
M. smithii var. amphicephala Grunow	4				
Navicula cryptocephala fo. minuta Boy- P.	1		1		1
Navicula cuspidata	1			1	2
Navicula sigma	9			1	1
Navicula sp	11	18	3	3	11
Navicula radiosa			4	1	14
N. rhynchocephala Kütz.		2			
Nitzschia fasciculata			3	1	1
Nitzschia cryptocephala	7			2	
Nitzschia sp	6	2	6	11	4
Nitzschia hangarica			1		1
N. apiculata (Greg.) Grunow	2				
N. filiformis (W. smith) Hustedt	3			1	1
N. longissima (Breb.) Ralfs			11	13	16
N. obtusa W. smith	2			1	1
N. sigma rigidula	1			1	1
N. sigma (Kütz.) W. smith	1			1	1
pleurosigma		1			
Rhoicosphenia curvata (Kütz.) Grunow	2	1	1	1	1
Rhopalodia gibba (Her.) O. Müller			2	1	
Rhicosolenia sp.	1		1	2	
Surirella robusta var. splendida (Ehr.) van Heurck	1				
Surirella ovalis	1				
Surirella sp.	1		1		
Synedra sp	2	3		1	1
Synedra fasciculata	4	1	1	2	1
Synedra affinis				1	3

Synedra acus Kütz.		5			1
Synedra ulna balatonis	2	2		1	2
Synedra ulna	2	7	5	2	1
Synedra ulna biceps		1			
S. pulchella Kütz.				2	1
S. ulna (Nitzsche) Ehrenberg	1				1

Table 6: shows the total number of phytoplankton X 10 4 (individual / liter) during the months of 2015-2016 for Kerdland station

Class : *Cyanophyceae*	February	March	April	May	June
Anabaena constricta (Szafer) Geitler	11	2	3	-	
Gomphospheria aponina Kütz.	-	1	-	-	
Lyngbya limnetica Lemmermann	-	-	2	4	3
Merismopedia elegans A. Br.	-	-	1	-	
Nostoc verrucosum Vaucher	-	-	1	-	
Oscillatoria princes Vaucher	1	-	4	5	2
O. limmetica Lemmermann	-	3	4	2	
Spirulina major Kütz.	-	3	2	-	
Division : *Chlorophyta*					
Class : *Chlorophyceae*					
Cladophora secunda Kütz.	8	5	2	2	
Cosmarium hammeri Reinsch	-	11	5	11	2
Closterium kuetzingii	-		-	1	
Chraraciopsis spinifer	-	-	1	-	
Oedogonium rufescens *Wittrock*	6	4	5	5	3
Goniom	-	-	-	-	1
Stigeoclonium curvirostrum Skuja	2	1	-	-	
Scendesmus quadricauda (Trup.) deBrebisson	-	4	-	5	1
Spirogera scrobiculata	-	10	7	10	1
Ulothrix cylindricum	7	7	-	-	
Ulothrix zonata (Weber and Mohr.) Kütz.	-	1	-	-	
Tolypothrix	-	-	-	4	
volvox sp	3	8	2	-	1
Division : *Bacillariophyta*					
Class : *Bacillariophyceae*					
Centrales					
Cyclotella meneghiniana Kütz.	156	93			
C. striata (kütz) Grunow	134	82			
Melosira varians		3	1		
Pennales					
Amphipora sphaero.	2	1			
Amphipora alata Kütz.	1	1			
Amphipora sp.	3				
A. coffeaeformis.	2				
Bacillaria paxillifer (Muller) Hendey	5	3	1	2	3
Cocconeis placentula var. euglypta (Ehr.) Cleve	80	51			2
C. placentula var. lineata (Ehr.) Cleve	101	33	2		3
Cymbella aspera.	3				
Cymbella affinis Kütz.	2				
C. cistula (Hemb.) Grunow	1		1		
C. microcephala Grunow	2				
C. tumida (Breb.) van Heurck	1				
C. ventricosa Kütz.	4		1		
Calonies permagna	49	1		2	2
Calonies ventricosa	1	2		1	2
Diatoma tenue var. elongatum Lyngbye	3	1	4	3	
D. vulgare Bory	1		1		3
Diploneis ovalis (Hil.) Cleve	1		1		
Epithemia sorex Kütz.	1				
Fragilaria brevistriata var. inflate (Pant.) Hustedt		1		1	
F. pinnata Ehrenberg	3	10	7	3	8
Fragilaria sp.	1	21	2	6	17
Gomphonema lanceolatum	1				
G. augur Ehrenberg	1				
G. constrictum var. capitata (Her.) Cleve	2				

G. gracile Ehrenberg	2		1		
Gygrosigma spencerii var. nodifera Grunow	1	4	1	4	
Hanttzschia amphioxys	2				
G. tenuirostrum (Grun.) Cleve		1			
Mastogloia braunii Grunow	4	1		1	1
M. elliptiica var. dansei (Thwa.) Cleve				1	
M. smithii var. amphicephala Grunow	8			5	
Navicula cryptocephala fo. minuta Boy- P.		2	1	1	
Navicula cuspidata					1
Navicula sigma	18	7	1	1	
Navicula sp	2	11		13	23
Navicula radiosa		16	4	11	1
N. pseudotuscula Hustedt	4				
N. viridula var. rostellata (Kütz) Cleve		1			3
Nitzschia amphibia Grunow	7				
Nitzschia fasciculata		1	1	1	2
Nitzschia cryptocephala	9		1		
Nitzschia sp	2	9	4	1	5
Nitzschia hangarica	1	2			
N. apiculata (Greg.) Grunow	2		1		
N. filiformis (W. smith) Hustedt	4		1		
N. longissima (Breb.) Ralfs		3		18	23
N. obtusa W. smith				1	1
N. palea (Kütz.) W. smith	4				
N. scalaris (Ehr.) W. smith	3				
N. sigmarigidula	5	1		7	1
N. sigma (Kütz.) W. smith	2	1		2	1
pleurosigma			1		1
Rhoicosphenia curvata (Kütz.) Grunow	1	3		1	1
Rhopalodia gibba (Her.) O. Müller	1			2	
Rhicosolenia sp.	2	1	1		
Surirella robusta var. splendida (Ehr.) van Heurck	1				
Surirella ovalis	8				
***Surirel**la* sp.	2				
Surirella capronii	5				
Synedra sp	4	4			
Synedra fasciculata	3				1
Synedra affinis	2	2			4
Synedra acus Kütz.	1				1
Synedra ulnabalatonis	1				4
Synedra ulna	2	5	1	1	12
Synedra ulna biceps	1	1			2
S. pulchella Kütz.	8	1			
Thalssionema franen	2				
S. ulna (Nitzsche) Ehrenberg	5	4		1	

Table 7: Shows the total number of phytoplankton X 10 4 (individual /liter) during the months of 2015-2016 for Abu Al-Khaseeb station

Class : *Cyanophyceae*	February	March	April	May	June
Anabaena constricta (Szafer) Geitler	5	-	7	-	
Chroococcus dispersus (Keissl) Lemmermann	-	-	3	-	
Gomphospheria aponina Kütz.	-	-	3	-	
Lyngbya limnetica Lemmermann	1	1	4	5	
Merismopedia elegans A. Br.	-	-	4	-	
Microcoleus acutissimus	-	-	1	-	
Scytonema leplobasis	1	-		-	
Nostoc verrucosum Vaucher	7	2	3	-	
Oscillatoria princes Vaucher	3	1	5	11	
O. limmetica Lemmermann	-	-	6	-	
Spirulina major Kütz.	-	-	1	-	
Division : *Chlorophyta*					
Class : *Chlorophyceae*					
Cladophora secunda Kütz.	6	4	3	3	
Cosmarium hammeri Reinsch	-	2	1	-	
Closterium kuetzingii	-	-	7	16	
chraraciopsis spinifer	-	-	1	-	
Oedogonium rufescens Wittrock	7	3	6	5	

Goniom pectorale	3	-	-	-	

spirogera scrobiculata		-	3 5	12
Ulothrix cylindricum	1	-	-	-
Ulothrix zonata (Weber and Mohr.) Kütz.	3	-	-	-
volvox sp	5	7	4	17
Division : Bacillariophyta				
Class : *Bacillariophyceae*				
Centrales				
Cyclotella Meneghiniana Kütz.	13	27	65	16
C. striata (kütz) Grunow	32	33	48	3
Melosira varians	-	3	3	2
Pennales				
Achnanthes lanceolata var. rostrata Hustedt	-	-	1	-
Achnanthes brevipes	-	-	2	-
Amphipora sphaero.	-	-	-	-
Amphipora alata Kütz.	-	-	-	-
Amphipora sp.	-	-	1	-
A. ovalis Kütz.	-	-	-	-
Bacillaria paxillifer (Muller) Hendey	5	-	1	1
Cocconeis placentula var. euglypta (Ehr.) Cleve	98	65	11	45
C. placentula var. lineata (Ehr.) Cleve	45	43	23	14
Cymbella aspera.	-	-	-	1

Table 8: shows the total number of zooplankton X 10 ^{4} (individual l/ liter) during the months of 2015-2016 for Karmet Ali station

Zooplankton	February	March	April	May	June
Copepod nauplii	9	95			
Copepodite stages	19	47			
Egg sacs of *Copepoda*		33			
Foraminifera		-			
Tintinnida		24			
Hydrozoa		42			
Jellyfish & medusa		-			
Nematode	9	57			
Sagitta sp.		-			
Rotifera		-			
.sgge *arefitoR*		-			
Polychaeta adult &larvae.		52			47
Ostracoda		-			
Shrimp, larvae.		-		9	
Mysis larvae &adult		-		24	5
Isopoda		-			
Cladocera		-	57	166	569
Amphipoda		-		14	
Megalopa larvae		-			
Cirripedia larvae		213	114	948	
Aplacophor		-			
Planktonic bivalves		14		19	
Planktonic Gastropoda		9		19	
Apapendiculari (Oikopleura sp.)		-			
Fish eggs& larvae		9		47	

Zooplankton	February	March	April	May	June
Acrocalanus gibber	47	-			
Paracalanus aculeatus	9	-			
Parvocalanus crassirostris		-			
Clausocalanus minor		-			
Euchaeta concinna		-			
Centropages tenuiremis		-			
Pseudodiaptumus arabicus		-			
Pseudodiaptumus ardjuna					
Temora turbinata		-			
Labidocera minuta		-			
Acartia (Odontacartia) ohtsukai		-			
Acartia (Acartiella) faoensis		-			

Tortanus forcipatus		-			
Bestiolina arabica		-			
Arctodiantomus (Rhabdodintomus)salinus		-			
Calanopia elliptica					
Cyclops sp.	**14**	**71**	**43**	**47**	**118**
Halicyclops sp.		-			
Oithona attenuata		-			
Oithona sp.		**14**			
Microsetella sp.	**14**	**90**	**47**	**19**	
Macrosetella gracilis		-			
Euterpina acutifrons		-			
Clytemnestra scutellata		-			
Aegisthus sp.		-			
Oncaea clevei					
Harpacticoida	**19**	**81**			

Table 9: shows the total number of zooplankton X 10^4 (individual l/ liter) during the months of 2015-2016 for Kerdland station

Zooplankton	February	March	April	May	June
Copepod nauplii	**118**	**95**	**47**	**19**	
Copepodite stages	47	47	14	104	
Egg sacs of *Copepoda*	14	33			
Foraminifera		-			
Tintinnida		-			
Hydrozoa		-			
Jellyfish & medusa		-			
Nematode		24	19	98	
Sagitta sp.	14	-			
Rotifera	52	-		24	
Rotifera eggs		-			
Polychaeta adult &larvae	9	-	14		38
Ostracoda		-			
Shrimp larvae	5	-			
Mysis larvae&*Mysis* adult		-	100		
Isopoda		-			
Cladocera		-	995		
Amphipoda		-			
Megalopa larvae		-			
Cirripedia larvae	57	1588		109	
Aplacophor		-			
Planktonic bivalves	14	-	28		47
Planktonic Gastropoda		57	38		
Apapendiculari (Oikopleura sp.)		-			
Fish eggs& larvae	14	19	85	95	114

Zooplankton	February	March	April	May	June
Acrocalanus gibber	9	-			
Paracalanus aculeatus	14	-			
Parvocalanus crassirostris		-			
Clausocalanus minor	5	-			
Euchaeta concinna		-			
Centropages tenuiremis		-			
Pseudodiaptumus arabicus		-			
Pseudodiaptumus ardjuna					
Temora turbinata		-			
Labidocera minuta		-			
Acartia (Odontacartia) ohtsukai		-	24		
Acartia (Acartiella) faoensis		-			
Tortanus forcipatus		-			
Bestiolina arabica		-			
Arctodiantomus (Rhabdodintomus)salinus		-			
Calanopia elliptica					
Cyclops sp.	14	47		90	
Halicyclops sp.		-			
Oithona attenuata		-			

Oithona sp.	14	-			
Microsetella sp.	24	-			
Macrosetella gracilis		-			
Euterpina acutifrons		-			
Clytemnestra scutellata		-			
Aegisthus sp.		-			
Oncaea clevei					
Harpacticoida 1	33	95			
Zooplankton	February	March	April	May	June
Copepod nauplii	62	152	237	52	24
Copepodite stages	47	-	104	114	24
Egg sacs of *Copepoda*	28	-			14
Foraminifera		-			
Tintinnida		71			
Hydrozoa		28			
Jellyfish & medusa		-			
Nematode		43		28	9
Sagitta sp.		-			
Rotifera		-	142	38	
Rotifera eggs		-		118	
Polychaeta adult &larvae		-			5
Ostracoda		-			
Shrimp larvae	9	-			
Mysis larvae		-			
Isopoda		-			
Cladocera		-			57
Amphipoda		-			
Megalopa larvae		-			
Cirripedia larvae		128	166	119	
Aplacophor		-			
Planktonic bivalves		-			
Pl*anktonic Gastropoda*		19			
Apapendiculari (*Oikopleura* sp.)		-		24	
Fish eggs& larvae		9	90	52	114

Table 10: continue shows the total number of zooplankton X 10 ^{4} (individual l/ liter) For (Hamdan) Abu Al-Khaseeb station during the months of 2015-2016

Zooplankton	February	March	April	May	June
Acrocalanus gibber		-			
Paracalanus aculeatus		-			
Parvocalanus crassirostris		-			
Clausocalanus minor		-			
Euchaeta concinna		-			
Centropages tenuiremis		-			
Pseudodiaptumus arabicus		-			
Pseudodiaptumus ardjuna					
Temora turbinata		-			
Labidocera minuta		-			
Acartia (Odontacartia) ohtsukai		-			
Acartia (Acartiella) faoensis		-			
Tortanus forcipatus		-			
Bestiolina arabica		-			
Arctodiantomus (Rhabdodintomus)salinus		-			
Calanopia elliptica					
Cyclops sp.	14	190	261	71	156
Halicyclops sp.		-			
Oithona attenuata		-			
Oithona sp.		-			
Microsetella sp.		118	47	38	
Macrosetella gracilis		-			
Euterpina acutifrons		33			
Clytemnestra scutellata		-			
Aegisthus sp.		-			
Oncaea clevei					
Harpacticoida 1		71			

4. Discussion

1) Chlorophyll a content biomass;

Table (4) showed the values of chlorophyll a contents and biomasses of the three studied [(Karmat Ali, Kerland and Hamdan (Abu Al - Khaseeb)] stations.

Karmat Ali station; The highest levels of chlorophyll a content and biomass and they were in Winter season, were 1 12.55 and 840.85 respectively, the least levels for them were in Spring season, they were 0.014 and 0.938 respectively.

Kerland station; The highest levels of chlorophyll a content and biomass and they were in Witer season, were 8.277 and 554.56 respectively, the least levels for them were in Summer season, they were 0.000534 and 0.036 respectively.

Abi Al-Khaseeb station; The highest levels of chlorophyll a content and biomass and they were in Winter season, were 34.176 and 2289.8 respectively, the least levels for them were in Summer season, they were 0.03124 and 2.1respectively.

2) Phytoplankton distribution;
The distribution of phytoplankton in the three studied [(Karmat Ali, Kerland and Hamdan (Abu Al -Khaseeb)] stations were mentioned in 5, 6 and 7 tables

Karmat Ali station;
Table (5) showed that *Mastorugloia braunii* recorded the highest occurrence in April and it was 187, then came next to It *Cyclotella Meneghiniana* Kütz, it recorded occurrences in Mrch and February, they 167 and 156 respectively, then *C. striata* (kütz) Grunow came, it recorded in Mrch and February 134 and 98 occurrences respectively.

Kerland station;
Table (6) showed that *Cyclotella Meneghiniana* Kütz recorded the highest occurrences in February March and they were 156 and 93 respectively, then *C. striata* (kütz) Grunow came next to it, it showed occurrences in February and March, they 134 and 82 respectively.

Hamdan (Abu Al -Khaseeb;
Table (7) showed that Cocconeis placentula var. euglypta (Ehr.) Cleve recorded the highest occurrences in February and March and they were 98 and 65 respectively. 3-The distribution of zooplankton.

Table (8) showed the zooplankton distribution in Karmat Ali station;

Cirripedia larvae recorded the highest number in May and it was 948, next to it *Cladocera* came, it recorded the number 569 in June.

Table (9) showed the zooplankton distribution in Kerland station; *Cirripedia* larvae recorded the highest number in March, it was 1588 and then *Cladocera* recorded the number 995 in April.

Table (10) showed the zooplankton of Hamdan (Abu Al - Khaseeb);
Cyclops sp recorded the highest number in April, it was 261 and then *Copepod nauplii (*in April) recorded the number 237.

The tables (1, 2 and 3) illustrate the physicochemical factors of the water for three stations (Karmat Ali, Kerland and Hamdan (Abu Al -Khaseeb) on Shatt Al- Arab River.

Karmat Ali station; Table (1) showed the chlorophyll a content increased with increasing water temperature from 0.0390 at 13.8 c^o in February to 0.895 at 31.4 in June and this means an increase in the activity of phytoplankton. Phosphate ion concentration **i**ncreased with increasing the temperature, it increased from the level of 0.192 at 13.8 c^o in February up the level of 0.43 at 28.3 c^o in May. Nitrate ion concentration increased with increasing the temperature, it increased from 6.31 at 13.8 c^o in February up to 9.44 at 28.3 c^o in May. The salinity increased with increasing the temperature from 1.4 at 13.8 c^o in February up to 1.78 at 28.3 c^o in May.

Kerland station; Table (2) showed the chlorophyll a content (0.53) and phosphate ion concentration (o.3) increased with increasing the temperature at 13.8 c^o in February, they reached the highest levels to them at 26.2 c^o in May, they were 1.676 and 0.45 respectively. Nitrate ion concentration decreased with increasing the temperature, it decreased from 18.8 at 13.8 c^o in February to 7.9 at 28.7c^o in June. The salinity increased with increasing the temperature from 1.79 at 13.8 c^o in February up to 2.1 at 16.1 c^o in March.

Hamdan (Abu Al -Khaseeb; Table (3) showed chlorophyll a content increased with increasing water temperature from 0.289 at 11.7 c^o in February up to 3.843 at 28.6 in May.Phosphate ion concentration **i**ncreased with increasing the temperature, it increased from the level of 0.21 at 11.7 c^o in February up to the level of 0.43 at 31.4 c^o in June. Nitrate ion concentration increased with increasing the temperature, it increased from 14.2 at 11.7c^o in February up to 16.4 at 21.3 c^o in April. The salinity increased with increasing the temperature from 1.99 at 11.7 c^o in February up to 2.05 at 31.4 c^o in June.

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