Composition, abundance and distribution of zooplankton in the Iraqi marine and brackish waters.

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Abstract

Zooplankton composition and abundance of marine and brackish water, Southern Iraq were studied seasonally from winter to autumn 2010. Five stations were chosen: Shatt Al-Basrah, Khor Al-Zubair, Al-Fao and Iraqi marine and coastal water. Samples were collected by plankton net (120 µm mesh size and 40 cm diameter of mouth aperture). Some physical and chemical parameters of the water were measured. Quantitative and qualitative studies of zooplankton were carried out. Sixty taxa of zooplankton were identified in the present study. 35 taxa were belonging to copepods, while 25 taxa were belonging to other zooplankton.

The more abundant copepod and other zooplankton at all stations were, Paracalanus aculeatus, Parvocalanus crassirostris, Acartia (Odontacartia) pacifica, Bestiolina arabica, Polychaets; adults and larvae, cirripeds larvae, planktonic bivalves, planktonic gastropods and fish eggs and larvae. Copepod is the major group of zooplankton in the study area, while calanoid copepod was the most dominant order followed by cyclopoid, harpacticoid and poecilostomatoid. Seven taxa of copepods were recorded for the first time in the study area. The total number of zooplankton at all stations were 194266 ind/m^3 recorded in autumn at station 1, while the lowest number was 6804 ind/ m^3 reported during winter at station 3.

1. Introduction

Mohammed, (1965, a and b) was the first who studied physical and chemical properties in Shatt Al-Arab, this is followed by several other ecological studies, such as Al-Saadi & Arndt (1973), Arndt & Al-Saadi (1975) , Saad (1978), Al-Saadi *et al*.(1975, 1979 & 1989). Maulood *et al*. (1979) and Abaychi *et al*. (1988) showed the importance of the Shatt Al-Arab River as a nutrient source to the Arabian Gulf. Moreover, Gurney (1921) was the first who identified some zooplankter and some benthic crustacean from the mouth of the Shatt Al-Arab and the city of Amara on the Tigris River.

Yamazi (1974) studied the zooplankton communities in the Arabian Gulf. Jacob *et al*. (1979) observed the plankton and related features of the Kuwait waters. Gibson *et al.* (1980) investigated the zooplankton of the Gulf waters north and south of the Striates of Hormos. Michel *et al.* (1986 a, b) investigated zooplankton diversity, distribution and abundance in the Kuwaiti waters. Furthermore, Khalaf (1988) recorded ten species of calanoid copepods from Khor Abdullah, Khor Al-Zubair and Shatt Al-Arab, also Khalaf (1991) described a new species of calanoid copepod, *Acartia (Acartiella) faoensis* from NW Arabian Gulf and Khor Al-Zubair waters of Iraq. Khalaf (1992) recorded three species of calanoid copepods for the first time in the Arabian Gulf.

Salman *et al*. (1986) investigated the monthly changes of zooplankton of Shatt Al-Arab River from 1982-1984. Abdul-Hussein *et al.*(1989) surveyed the Rotifers in the northern part of Shatt Al- Arab River, whereas Ajeel (2004) investigated the zooplankton of the Shatt Al-Basrah canal. Ajeel *et al.*

(2004) surveyed the zooplankton of Garmat-Ali River and Ajeel *et al*. (2006) studied the seasonal abundance of zooplankton in the southern Iraqi Marshes. Khalaf (2008a) made a new records of *Bestiolina arabica* (calanoid : copepod) from Khor Al-Zubair and Shatt Al-Arab River. Khalaf (2008b) described a new species of the genus *Phyllodiaptomus* viz Phyllodiaptomus *irakiensis* from the Shatt Al- Arab River.

The aims of the study are giving an overview of the dominant zooplankton, abundance and species composition, with a special focus on copepods for being the dominant group in the study area, also identifying some hydrographic aspects which may have effects on distribution and abundance of the zooplankton.

2. Materials and methods.

Zooplankton samples were seasonally collected from five, environmentally different stations during 2010 (Figure 1). Collection was made in the surface water during daytime, with respect to tide, by using a plankton net, 40 cm in diameter and 120 μm mesh-size, equipped with a flow meter and towed, by using the nautical boat medium-sized, with a medium speed. The samples were immediately preserved in 5% buffered formaldehyde sea water for further analyses. Air temperature, water temperature, salinity, pH, dissolved oxygen (DO) and total dissolved solids (TDS) were measured in the field by a digital multi meter YSI incorporated 556 MPS.

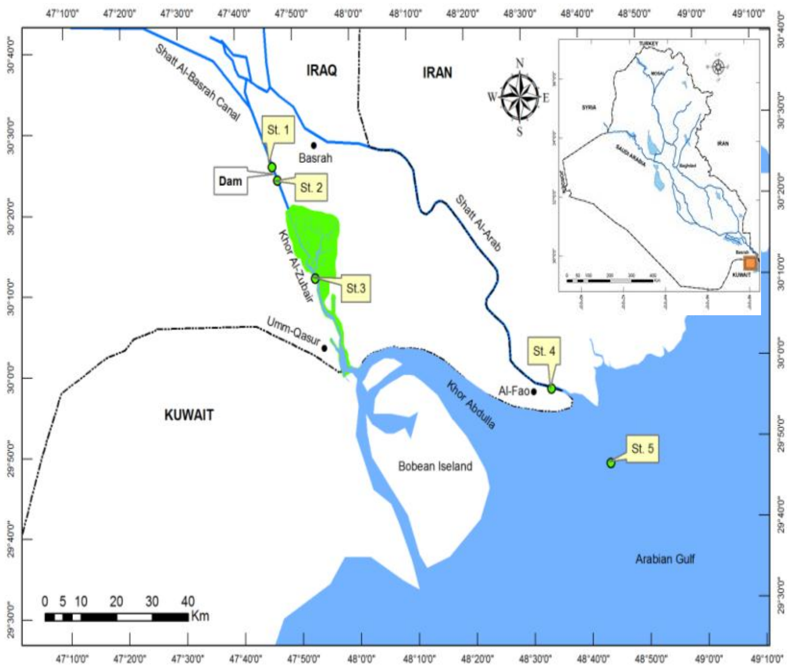

Figure 1: Location map of the study area

The geographical locations of sampling stations

Station 1; Located in Shatt al- Basrah before dam, (30°25'18.39"N 47°46'10.15"E).
Station 2: Located in Shatt al- Basrah after the dam, (30°23'39.44"N 47°46'59.57" E
Station 3: located at the port, Khor al-Zubair, (30°11'22.50"N 47°53'15.05"E)
Station 4: Located in Shatt al-Arab River at al-Fao, (29°56'44.70"N 48°33'54.82"E)
Station 5: Located in al-Masab of Shatt-al-Arab, (29°47'14.03"N 48°43'49.23"E)

Zooplankton samples were counted for larger representatives, such as decapods, salps, medusa, arrow worms and fish larvae, these larger forms were isolated, for further counting process of more dense smaller organisms as naupliar, copepodite stages and adults of copepods, protozoan, Ostracods, planktonic Gastropod, bivalves and other invertebrate's larvae, by using of Bogorov chamber. Counting, dissecting was made under a binocular dissecting microscope model (Wild) at proper magnification. The examination at a higher magnification under the compound microscope model (ZEISS, Germany), with camera Lucida, may be used to identify questionable organisms. For dense sample, dilution was made to the suitable volume to facilitate the counting; the diluted samples were sub-sampled by 5ml (a ladle). And counting was made 2 times, then the mean was taken for every sample, then the whole sample was examined for very rear species. Identification of some unidentified species was made with the aid of the following guides, keys and references: Wickstead (1965); Khalaf (1988, 1991, 1992, 2008a, b); Zheng Zhong (1989); Al-Yamani & Prusova (2003); Al-Yamani *et al.* (2011).

3. Results

3.1. Physical and Chemical parameters

Temperature

The minimum value of air temperatures was 8.5C° at station 3 in winter, while the maximum value was 48.3 C° at station 4 in summer. The minimum value of water temperatures was 10.9 C° at station 1 in winter, while the maximum value was 39.92 C° at station 5 in summer, (Figures 2 and 3).

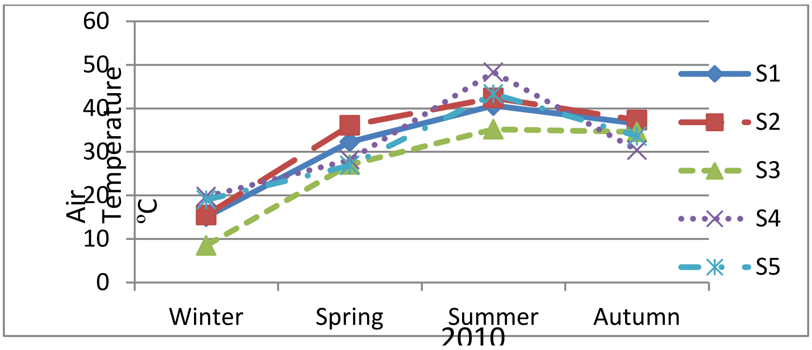

Figure 2: Seasonal variations in air temperature at five selected stations during 2010.

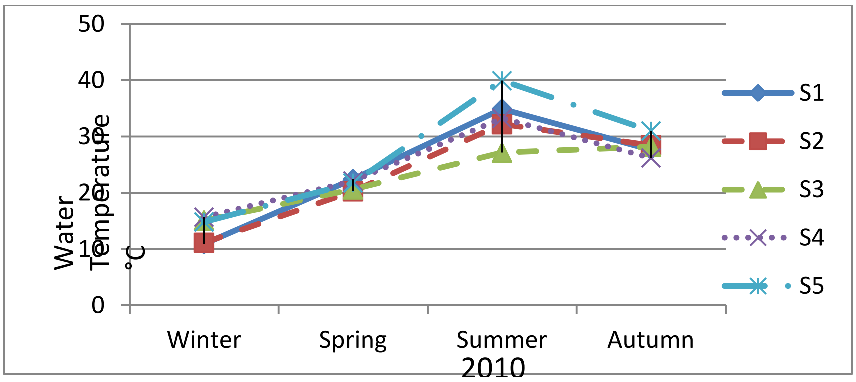

Figure 3: Seasonal variations in water temperature at five selected stations during 2010.

Salinity

Seasonal variations in salinity values ranged from 7.97 ‰ at station1 in winter, to 52.76‰ at station 3 in autumn (Figure 4).

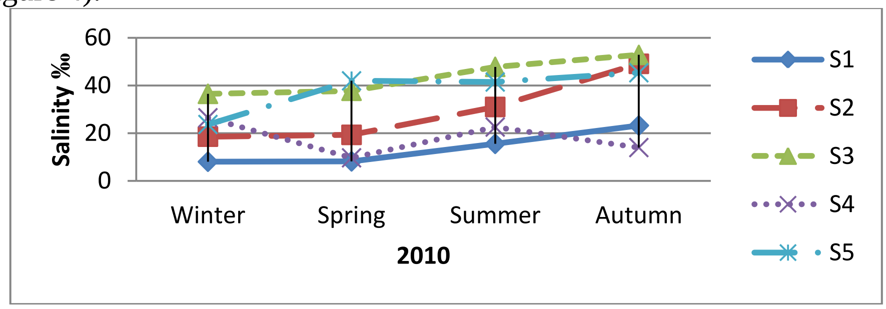

Figure 4: Seasonal variations in salinity at five selected stations during 2010.

Hydrogen Ion Concentration (pH).

Slight seasonal changes in the pH values of the investigated area were noted where it ranged between 7.62 at station 2 in summer and 8.46 at station 1 in spring (Figure 5).

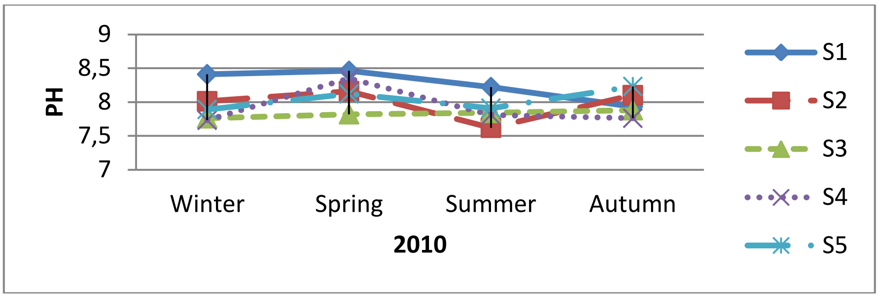

Figure 5: Seasonal variations in hydrogen ions concentration (pH) at five selected stations during 2010.

Dissolved oxygen (DO).

The highest value of dissolved oxygen (DO) was 11.86 mg/L at station 1 in spring, while lowest one was 5.55 mg/L at station 3 in autumn (Figure 6).

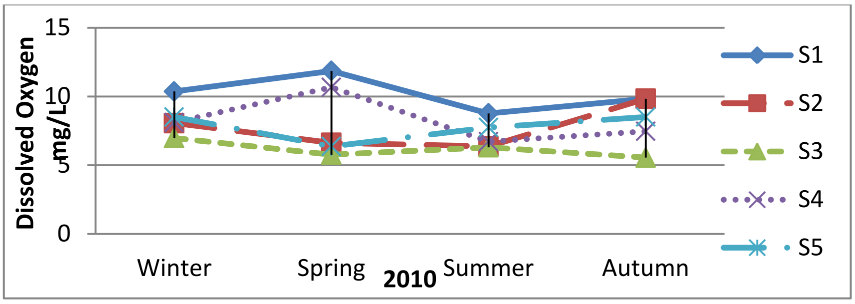

Figure 6: Seasonal variations in dissolved oxygen (DO) at five selected stations during 2010.

Total dissolved solids (TDS).

Seasonal changes in the total dissolved solid values were ranging from 8.9 g/L at station 1 in winter, to 49.55 g/L at station 3 in autumn ((Figure 7).

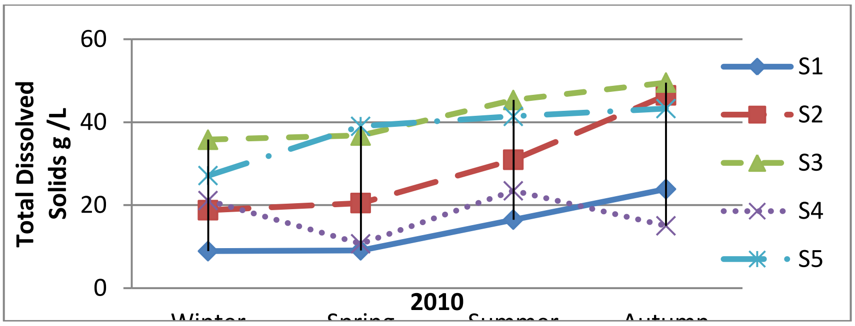

Figure 7: Seasonal variations in total dissolved solids (TDS) at five selected stations during 2010.

3.2. Zooplankton composition

Sixty taxa of zooplankton were identified in the present study. Thirty five taxa were belonging to copepods, while twenty five taxa were belonging to other zooplankton (Table 1). The more abundant copepods and other zooplankton at all stations were, *Paracalanus aculeatus*, *Parvocalanus crassirostris* , *Acartia (Odontacartia) pacifica*, *Bestiolina arabica*, nauplii and copepodite stages, polychaets adults and larvae, Cirripeds larvae, planktonic bivalves, planktonic Gastropods and fish eggs and larvae (Table 2). *Parvocalanus crassirostris*, *Acartia (Odontacartia) pacifia*, *Acartia (Acartiella) faoensis*, *Bestiolina arabica* , *Microsetella rosea*, copepod nauplii, copepodite stages, rotifers, ostracoda, shrimp and cirripede larvae were the more abundant at station 1, while *Paracalanus aculeatus*, *Parvocalanus crassirostris*, *Acartia (Odontacartia) pacifia*, *Acartia (Acartiella) faoensis*, *Bestiolina arabica*, *Oncaea clevei*, copepod nauplii, copepodite stages, rotifers, polychaet adult and larvae, ostracods, cirripeds larvae, planktonic bivalves, planktonic gastropods were the more abundant at station 2 .

Table 1: Occurrence and distribution of zooplankton at five selected stations during 2012 .

ZOOPLANKTON	WINTER					SPRING					SUMMER					AUTUMN				
	S 1	S 2	S 3	S 4	S 5	S 1	S 2	S 3	S 4	S 5	S 1	S 2	S 3	S 4	S 5	S 1	S 2	S 3	S 4	S 5
Acrocalanus gibber	-	+	-	+	-	+	-	-	-	+	+	-	+	+	+	+	+	+	-	+
Paracalanus aculeatus	-	+	+	+	+	+	+	-	-	+	+	+	+	+	+	+	+	+	+	+
Parvocalanus crassirostris	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Subeucalanus subcrassus	-	+	-	+	-	-	+	-	-	-	-	+	+	-	+	-	-	-	-	-
Clausocalanus minor	-	-	-	+	+	-	-	-	-	-	+	+	+	-	-	+	-	-	-	-
Euchaeta concinna	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Centropages tenuiremis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Pseudodiaptomus marinus	+	-	-	+	+	-	-	-	+	+	-	+	+	+	-	-	-	-	+	+
Temora turbinata	-	-	-	+	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	+
Labidocera minuta *	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-
Acartia(Odontacartia) pacifica	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Acartia (Acartiella) faoensis	+	+	+	-	-	+	+	+	-	-	+	+	+	-	-	+	+	+	-	-
Tortanus forcipatus *	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Bestiolina arabica	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Arctodiaptomus(Rhabdodiptomus) salinus	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-
Cyclops sp.	+	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Halicyclops sp.	+	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-
Oithona attenuata	-	-	+	+	+	-	-	+	+	+	-	-	+	+	+	-	+	+	+	+
Oithona sp.	-	-	-	-	+	-	-	+	+	+	-	-	+	+	+	-	-	+	+	+
Microsetella sp.	+	+	+	-	-	+	+	+	+	-	+	-	+	+	+	+	-	-	+	-
Macrosetella gracilis	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Euterpina acutifrons	-	-	+	+	+	-	-	-	+	+	-	-	+	+	+	-	-	+	+	+
Clytemnestra scutellata *	-	-	-	-	-	-	+	-	-	+	-	+	-	-	-	-	-	-	+	-
Aegisthus sp. *	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-	+
Ectinosoma (*Halectinosoma*) sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
Harpecticoid 1 *	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
Harpecticoid 2 *	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
Oncaea clevei	-	+	-	-	+	-	+	+	-	+	-	+	+	+	+	+	+	+	+	+
Sapphirina sp. *	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
Corycaeus(Dithrichocorycaeus) dahli	-	-	-	-	-	-	-	-	-	+	-	-	-	+	+	-	-	-	+	+
Corycaeus(Dithrichocorycaeus) lubbocki	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	+
Corycaeus(Dithrichocorycaeus) andrewsi	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+

(*) = Species reported for the first time in the investigated area.

Table (1) continued

ZOOPLANKTON	WINTER					SPRING					SUMMER					AUTUMN				
	S1	S2	S3	S4	S5	S1	S2	S3	S4	S5	S1	S2	S3	S4	S5	S1	S2	S3	S4	S5
Corycaeus(Dithrichocorycaeus) sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-
Copepod nauplii	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Copepodite Stages	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Egg sacs of copepoda	-	-	-	-	-	-	-	-	+	+	-	-	-	+	-	-	-	-	-	-
Foraminifera	-	-	-	-	-	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-
Tintinnida	+	+	+	-	+	-	+	-	-	+	-	-	+	+	+	-	-	+	+	-
Ceratium sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
Protoporidinium sp.	-	-	-	-	-	-	-	-	-	+	-	-	-	+	+	-	-	-	-	-
Dinoflagellate	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
Hydrozoa	-	-	-	-	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-
Jellyfish and medusa	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	+
Nematode	-	-	-	-	-	+	-	-	-	-	+	-	-	-	-	+	-	-	-	-
Sagitta sp.	-	-	-	+	+	+	+	-	-	+	-	-	+	+	+	+	-	+	-	+
Keratella quadrata	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rotifera	+	+	+	-	+	+	+	-	+	+	+	+	-	+	-	+	+	-	-	-
Rotifera eggs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-
Polychaeta adults and larvae	+	+	+	+	+	+	+	+	-	+	-	+	+	-	+	+	+	+	+	+
Ostracoda	+	+	-	+	-	+	+	+	+	+	+	+	-	+	+	+	+	-	-	+
Shrimp larvae	+	-	-	-	-	+	-	-	-	-	+	-	+	+	+	+	-	-	+	+
Mysis larvae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Isopoda	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-
Aplacophora	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Amphipoda	-	-	-	-	-	-	-	-	-	-	+	-	-	-	+	-	-	-	-	-
Cladocera	-	-	-	-	-	-	-	-	+	-	-	-	+	-	-	-	-	-	+	-
Megalopa larvae	-	-	+	+	+	-	-	+	+	-	-	+	+	+	+	-	+	+	+	+
Cirripedia larvae	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+
Planktonic bivalves	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Planktonic gastropoda	-	+	+	+	-	+	+	+	+	+	-	+	+	+	+	-	+	+	+	+
Appendicularia(*Oikopleura sp.*	-	-	-	-	-	-	-	+	-	+	-	-	+	+	+	-	-	+	-	+
Fish eggs and larvae	-	-	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+

S1: Shatt Al-Basrah, before the dam ;S2: Shatt Al-Basrah, after the dam; S3: Khor Al-Zubair; S4: Shatt Al-Arab, Al- Fao; S5: NW Arabian Gulf.

The very common zooplakton at station 3, were *Parvocalanus crassirostris*, *Acartia* (*Odontacartia) pacifica*, *Acartia (Acartiella) faoensis*, *Bestiolina arabica*, *Oithona attenuata* , copepod nauplii, copepodite stages, megalopa, cirripede larvae, planktonic bivalves, planktonic gastropoda, and fish eggs and larvae. *Parvocalanus crassirostris* , *Pesudodiaptomus marinus*, *Acartia (Odontacartia))* *pacifica* , *Bestiolina arabica* , *Oithona attenuata*, *Euterpina acutifrons*, copepod nauplii, copepodite stages, megalopa, cirripeds larvae, planktonic bivalves, planktonic gastropoda, and fish eggs and larvae were more abundant at station 4, while at station 5 the more abundant, were *Paracalanus aculeatus*, *parvocalanus crassirostris*, *Acartia (Odontacartia) pacifica*, *Bestolina arabica*, *Oithona attanuata*, *Oithona* sp., *Euterpina acutifrons*, *Oncaea clevei*, copepod nauplii, copepodite stages, *Sagitta* sp., polychaete adult and larvae, planktonic bivalves, and fish eggs and larvae (Table 3).

Table 2: Percentage of occurrence of the zooplankton in the study area.

ZOOPLANKTON	%	Occurrence
Acrocalanus gibber	60	Common
Paracalanus aculeatus	85	Very Common
Parvocalanus crassirostris	100	Very Common
Subeucalanus subcrassus	30	Rare
Clausocalanus minor	30	Rare
Euchaeta concinna	5	Very Rare
Centropages tenuiremis	5	Very Rare
Pseudodiaptomus marinus	60	Common
Temora turbinata	20	Very Rare
Labidocera minuta	10	Very Rare
Acartia(Odontacartia) pacifica	100	Very Common
Acartia (Acartiella) faoensis	60	Common
Tortanus forcipatus	5	Very Rare
Bestiolina arabica	100	Very Common
Arctodiaptomus(Rhabdodiptomus) salinus	15	Very Rare
Cyclops sp.	15	Very Rare
Halicyclops sp.	15	Very Rare
Oithona attenuta	65	Common
Oithona sp.	50	Rare
Microsetella sp.	65	Common
Macrosetella gracilis	5	Very Rare
Euterpina acutifrons	55	Common
Clytemnestra scutellata	20	Very Rare
Aegisthus sp.	20	Very Rare
Ectinosoma (*Halectinosoma*) sp.	5	Very Rare
Harpacticoida 1	5	Very Rare
Harpacticoida 2	5	Very Rare
Oncaea clevei	60	Common
Sapphirina sp.	5	Very Rare

Table (2) continued

ZOOPLANKTON	%	Occurrence
Corycaeus(Dithrichocorycaeus) dahli	25	Very Rare
Corycaeus(Dithrichocorycaeus) lubbocki	10	Very Rare
Corycaeus(Dithrichocorycaeus) andrewsi	10	Very Rare

Corycaeus(Dithrichocorycaeus) sp.	10	Very Rare
Copepod nauplii	100	Very Common
Copepodite stages	100	Very Common
Egg sacs of copepoda	15	Very Rare
Foraminifera	10	Very Rare
Tintinnida	55	Common
Ceratium sp.	5	Very Rare
Protoporidinium sp.	15	Very Rare
Dinoflagellate	10	Very Rare
Hydrozoa	10	Very Rare
Jellyfish and medusa	10	Very Rare
Nematode	15	Very Rare
Sagitta sp.	55	Common
Keratella quadrata	5	Very Rare
Rotifera	65	Common
Eggs of rotifera	10	Very Rare
Polychaeta adults and larvae	85	Very Common
Ostracoda	75	Common
Shrimp larvae	45	Rare
Mysis larvae	5	Very Rare
Isopoda	10	Very Rare
Aplacophora	5	Very Rare
Amphipoda	10	Very Rare
Cladocera	15	Very Rare
Megalopa	65	Common
Cirripedia larvae	95	Very Common
Planktonic bivalves	95	Very Common
Planktonic gastropoda	80	Very Common
Appendicularia *(Oikopleura* sp.)	35	Rare
Fish eggs and larvae	85	Very Common

Table 3: Abundance and distribution of the zooplankton at five stations in the study area.

ZOOPLANKTON	Occurrence				
	S1	S2	S3	S4	S5
COPEPODS					
Acrocalanus gibber	C	R	R	R	C
Paracalanus aculeatus	C	V.C	C	C	V.C
Parvocalanus crassirostris	V.C	V.C	V.C	V.C	V.C
Subeucalanus subcrassus	A	C	V.R	A	V.R
Clausocalanus minor	R	V.R	V.R	V.R	V.R
Euchaeta concinna	A	A	A	A	V.R
Centropages tenuiremis	A	A	A	A	V.R
Pseudodiaptomus marinus	C	V.R	V.R	V.C	C
Temora turbinata	A	A	A	V.R	C
Labidocera minuta	A	A	A	V.R	V.R
Acartia(Odontacartia) pacifica	V.C	V.C	V.C	V.C	V.C
Acartia (Acartiella) faoensis	V.C	V.C	V.C	A	A
Tortanus forcipatus	A	A	A	A	V.R
Bestiolina arabica	V.C	V.C	V.C	V.C	V.C

Arctodiaptomus(Rhabdodiptomus) salinus	C	A	A	A	A
Cyclops sp.	R	V.R	A	A	A
Halicyclops sp.	R	A	A	V.R	A
Oithona attenuata	A	V.R	V.C	V.C	V.C
Oithona sp.	A	A	C	C	V.C
Microsetella sp.	V.C	R	C	C	V.R
Macrosetella gracilis	A	A	V.R	A	A
Euterpina acutifrons	A	A	C	V.C	V.C
Clytemnestra scutellata	A	R	A	V.R	V.R
Aegisthus sp.	A	A	V.R	V.R	R
Ectinosoma (*Halectinosoma*) sp.	A	A	A	V.R	A
Harpacticoida 1	A	V.R	A	A	A
Harpacticoida 2	A	A	A	V.R	A
Oncaea clevei	V.R	V.C	C	R	V.C
Sapphirina sp.	A	V.R	A	A	A
Corycaeus(Dithrichocorycaeus) dahli	A	A	A	R	C
Corycaeus(Dithrichocorycaeus) lubbocki	A	A	A	A	R
Corycaeus(Dithrichocorycaeus) andrewsi	A	A	A	V.R	V.R
Corycaeus(Dithrichocorycaeus) sp.	A	A	A	V.R	V.R
Copepod nauplii	V.C	V.C	V.C	V.C	V.C
Copepodite stages	V.C	V.C	V.C	V.C	V.C
Egg sacs of copepod	A	A	A	R	V.R

OTHER ZOOPLANKTON	Occurrence				
	S1	S2	S3	S4	S5
Foraminifera	A	R	A	A	A
Tintinnida	V.R	R	C	R	C
Ceratium sp.	A	A	A	V.R	A
Protoporidinium sp.	A	A	A	V.R	R
Dinoflagellate	A	A	V.R	A	V.R
Hydrozoa	R	A	A	A	A
Jellyfish and medusa	A	A	A	A	R
Nematode	C	A	A	A	A
Sagitta sp.	R	V.R	R	R	V.C
Keratella quadrata	V.R	A	A	A	A
Rotifera	V.C	V.C	V.R	R	R
Eggs of rotifera	V.R	V.R	A	A	A
Polychaeta adults and larvae	C	V.C	V.C	R	V.C
Ostracoda	V.C	V.C	V.R	C	C
Shrimp larvae	V.C	A	V.R	R	R
Mysis larvae	A	A	A	A	V.R
Isopoda	A	A	V.R	A	V.R

Aplacophora	A	A	A	A	V.R
Amphipoda	V.R	A	A	A	V.R
Cladocera	A	A	V.R	R	A
Megalopa	A	R	V.C	V.C	C
Cirripedia larvae	V.C	V.C	V.C	V.C	C
Planktonic bivalves	C	V.C	V.C	V.C	V.C
Planktonic gastropoda	V.R	V.C	V.C	V.C	C
Appendicularia *(Oikopleura* sp.)	A	A	C	V.R	C
Fish eggs and larvae	R	C	V.C	V.C	V.C

1-25% (very rare: V.R);26-50% (rare: R);51-75% (common: C); 76-100 % (very common: V.C) ; 0 % (absent: A).

Total number of Copepoda:

The total number of Copepoda was increased during autumn at station 1 reaching to 135590 ind/m^3, while the lowest number was recorded at station 3 reaching 3479 ind/m³ during winter (Figure 8).

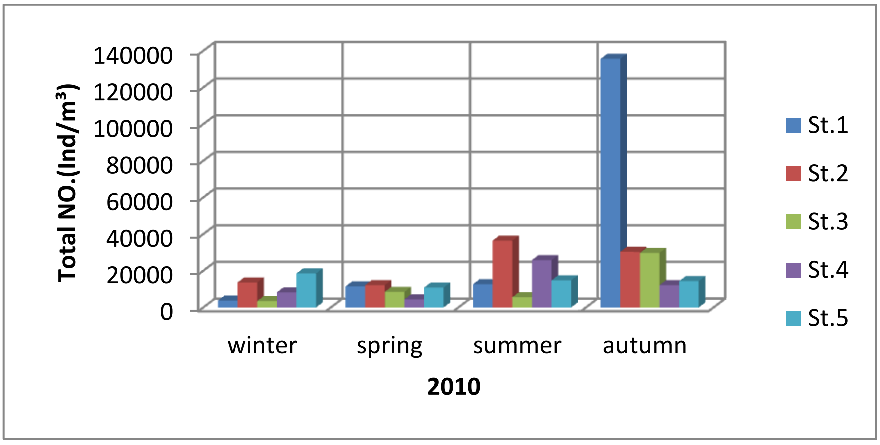

Figure 8: Seasonal variation in total numbers of copepods at five stations, during 2010

Total number of other zooplankton.

Figure 9 illustrates the season and the localized variation in other zooplankton recorded at five selected stations, during the study period. The highest number was counted at station 1 (58655) ind/m^3 in autumn, while the lowest values were recorded in autumn at station 5 reaching to 172 ind/m^3.

Total number of all Zooplankton. The total number of all zooplankton at five stations was 194266 ind/m^3 in autumn at station 1, while the lowest number was 6804 ind/ m^3 during winter at station 3 (Figure 10).

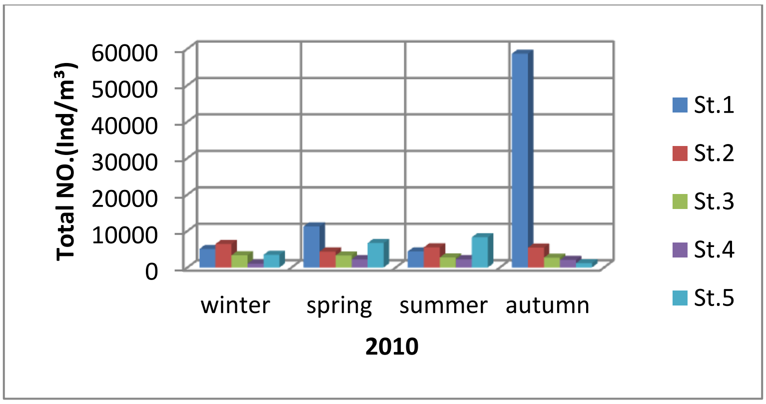

Figure 9: Seasonal variation in total numbers of other zooplankton at five stations, during 2010

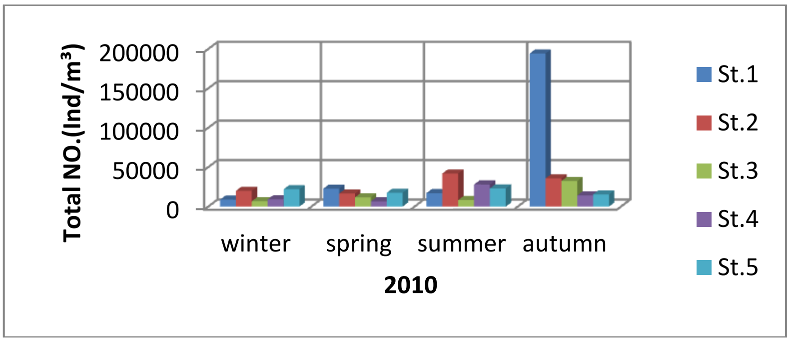

Figure 10: Seasonal variation in total numbers of all zooplankton at five stations, during 2010

4. Discussion

Copepods are the most important group of zooplankton in the Iraqi marine costal and estuarine brackish water, both in species number and abundance. It also formed the bulk of the zooplankton in other areas such as the Arabian Gulf, Arabian Sea, the Red Sea (Kimor, 1973), and along the coast of Pakistan (Haq *et al*., 1973). Within the last half century, many brackish and coastal copepods were introduced by the ballast water into habitats, beyond their natural contemporary range (Bollens *et al*. 2002). A total of 34 species of copepod belonging to 28 genera were recorded in the present study. The dominance of copepod species were more for calanoids, then cyclopoids, harpacticoids and finally for poecilostomatoids. The vast majority of calanoids and poecilostomatoids are marine species, and in particular the former ones are outstandingly holoplanktonic (Bowman and Abele, 1982; Raymont, 1983). The cyclopoids and harpacticoids have far fewer marine planktonic species and are mainly benthic (littoral) inhabitants in inland waters (Raymont, 1983).

In the present study the very common copepod calanoids species were *Paracalanus aculeatus, Parvocalanus crassirostris, Acartia (Odontacartia) pacifica, Bestiolina arabica*, while the very rare ones were *Euchaeta concinna*, *Centropages tenuiremis*, , *Temora turbinata*, *Labidocera minuta*, *Tortanus forcipatus.* This result is agreed with that of Al-Yamani and Prusova (2003), they mentioned that *Parvocalanus crassirostris* was the most dominant copepod species in Kuwaiti waters and in Khor Al-Sabiyah. The dominance alternated between *Parvocalanus crassirostris* and *Acartia (Odontacartia) pacifica*. *Oithona attenuta*, was common in present study, while *Cyclops* sp., and *Halicyclops* sp. were very rare. In Kuwait's waters *Oithona attenuta* and *Euterpina acutifrons* were the common species (Al-Yamani and Prusova 2003). *Microsetella* sp., *Euterpina acutifrons*, were common, while the very rare ones were *Macrosetella gracilis*, *Clytemnestra scutellata*, *Aegisthus* sp., *Ectinosoma* (*Halectinosoma*) sp., harpacticoida 1, harpacticoida 2. And *Oncaea clevei*, were common, whereas *Sapphirina* sp., *Corycaeus (Dithrichocorycaeus) dahli*, *Corycaeus (Dithrichocorycaeus) lubbocki*, *Corycaeus (Dithrichocorycaeus) andrewsi*, *Corycaeus (Dithrichocorycaeus)* sp. were very rare.

From the result it is apparent that the Iraqi marine waters may resemble Kuwaiti waters in terms of the occurrence and dominant species and the level of salinity, especially, after the recent changes taking place in the changing course of the Karun River this led to the emergence of species not previously recorded in the Iraqi waters.

A total of 25 taxa non-copepod zooplankton groups were recorded in the study area. The dominance groups were cirriped larvae, planktonic bivalves, and planktonic gastropods and finally fish eggs and larvae. A similar situation was reported in northern Khor Al-Zubair by Ajeel (1990); he found that cirriped larvae were the second important group of zooplankton in this area. Cirriped larvae were the second dominated group in North-West Arabian Gulf (Ajeel, 1994). Moreover cirriped larvae were dominated in Shatt Al-Arab River (Ajeel, 2004). The genus *Acartia Dana*, 1846 is predominant and widespread in estuarine and coastal waters worldwide, but the spatiotemporal distribution of each species is very restricted (Bradford , 1976). *Acartia(Odontacartia) pacifica* is broadly distributed in coastal waters in the tropical / subtropical Indo-West Pacific regions (Moon *et al*., 2008).

The present study showed that the increasing of *A.(O.) pacifica* numbers were more in autumn at station 4, that might be due to the blooming in diatoms (Al-Handal 2009). Diatoms are the favorite diet to *A. (O.)Pacifica* (Ajeel 1990). The highest value of *Acartia (Acartiella) faoensis* at station 2 and station 3 during spring and the lowest value during summer, that might be due to the peak production period of *A.(A.) faoensis*, from mid February to the end of March (Ajeel and Khalaf, 1995), or might be due to the salinity, which plays an important role in the occurrence and distribution of this species which inhabit Khor Al-Zubiar lagoon, *A.(A.)faoensis* is considered as an indigenous species, and its creation region which considered as a hot spot (Khalaf *et al.*,2011).

The fluctuation in the quantity of *A.(A.) faoensis* in the study area might be attributed to the instability of the environmental factors such as temperature and salinity. *A.(A.)faoensis*, considered now as threatened species in the study area. The abundance of *A. (A). faoensis* in Khor Al-Zubair waters ranged between 2 and 866 ind/m3 during February and April 1990, respectively, and these figures decreased toward Khor Abdulla (Ajeel, and Khalaf, 1995).

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