Marsh Bulletin 3(2)(2008) 171-191

MARSH BULLETIN

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Zooplankton of Basrah district, Southern Iraq

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Abstract

Monthly samples were collected from seven stations at Basrah city by a plankton net (0.090 mm mesh-size and 40 cm mouth aperture) from November 1995 to December 1996 at stations 3, 4, 7 (St.3 is a small pool at the university campus, Garmat-Ali ; St.4 Al-Maqal creek, a small creek connected to Shatt Al-Arab River ; St.7 Abdulyan creek in Abi-Al-Khasib, South of Basrah) and from December 1995 to May 1996 at station 5 and from June 1996 to May 1997 at stations 1, 2, 6. The population density of zooplankton ranged between 110 ind/m^3 during August 1996 at sta. 1 to 1769250 ind/m^3 during April 1996 at sta. 5. Copepoda constitute 36.8 % of the total zooplankton. The second important group was Rotifera (33.7 %), then Ostracoda (10.7 %), whereas Cladocera came fourth (8.8 %) followed by the cirripede larvae (4 %). Biomass of zooplankton estimated as wet weight, it ranged from 0.5 mg/m^3 during June 1997 at sta. 6 to 67241 mg/m^3 during March 1996 at sta. 5. The biomass in terms of dry weight, ranged from 1.028 mg/m^3 during July 1996 at sta. 4 to 21929 mg/m^3 during March 1996 at sta. 5 and in terms of displacement volume and standing crop, the biomass ranged between 0.028 ml/m^3 and 1.820 mg C/ m^3 during June 1996 at sta. 4 and 88.6 ml/ m^3 and 5757 mg C/ m^3 during April 1996 at sta. 5, respectively.

Key words: zooplankton, density, distribution, fresh water, Shatt Al-Arab River, Basrah

1- Introduction

Zooplankton are important components of food webs in aquatic ecosystems throughout the world, channeling energy and nutrients from algae and bacteria to fish. 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. Therefore, the interest has been focused here on this important group, as it has not been well documented.

However, the research on the zooplankton of Basrah extends back to Gurney (1921) who for the first time surveyed freshwater Crustacea of the lower Mesopotamia. Mohammad (1965), then identified cladoceran from the middle and south of Iraq. Khalaf and Smirnov (1976) investigated the Entomostraca, particularly, the Cladocera of the middle and south of Iraq. Furthermore, AL-Saboonchi *et al.* (1986) studied the zooplankton of the Al-Hammar Marshes (near Garmat-Ali River), qualitatively and quantitatively, between 1980 and 1981. Moreover, Salman *et al.* (1986) investigated the monthly changes of the zooplankton in a station in Shatt Al-Arab River from 1982 – 1984. Abdul-Hussein *et al.* (1989) surveyed the Rotifera in northern Shatt Al-Arab River. AL-Zubaidi and Salman (2001) studied the zooplankton of the southern Shatt Al-Arab River. Whereas Ajeel (2003) investigated the zooplankton of the Shatt Al-Basrah Canal. Later Ajeel *et al.* (2005) surveyed the zooplankton of Garmat-Ali River and Ajeel *et al.* (2006) studied the seasonal abundance of zooplankton in the southern Iraqi Marshes. However, the earliest studies of this review were mainly concerned with the taxonomy of Cladocera and to a lesser extent of Copepoda, whereas the latter articles were investigating the abundance and distribution of Cladocera and Copepoda and only few papers were concerned with rotiferan abundance. Moreover, in most of these articles a single station was sampled. Therefore, there is no thorough investigation of the various groups of zooplankton throughout different stations in Basrah and for one complete years. For this reason and for estimating the zooplankton production in various localities in Basrah, which has not been conducted before, the present study was carried out.

2- Materials and methods

Study area:

Samples were taken from three different localities. The first represented by stations 1 , 2 and 6 (Fig. 1) and include Shatt Al-Arab at Al-Hartha (St. 1), Garmat Ali River (St. 2) and Shatt Al-Arab near the city centre at Al-Ashar (St. 6). The second locality including stations 4 and 7, which are creeks opening to the main Shatt Al-Arab. Station 4 located at Al-Maqal creek and St. 7 at Abdulyan creek. The third locality including stations 3 and 5 representing small enclosed pools. St. 3 occurred at the

Garmat Ali, Basrah University Campus, and St. 5 at Al-Sabkha.

Stations 4 and 7, Al-Maqal and Abdulyan creeks. Al-Maqal creek, is a small creek connected to Shatt Al-Arab River. It is 5 – 8 m wide and about 1 – 2 m deep. It receives heavy domestic sewage effluents. Abdulyan creek is located in Abi-Al-Khassib, South of Basrah, a rural area with many date-palm trees, its width was 5 – 10 m and depth 1 – 2 m.

The small pools or ditches are represented by stations 3 and 5. Station 3 is a small, largely permanent pool (60 x 40 x 0.5m) with many aquatic plants, like *Phragmites australis* and *Panicum repens.* It lies at the University campus in Garmat-Ali. It is the richest one in zooplankton among the seven chosen stations. Station 5 is a small ditch occurred near the end of Al-Rubatt creek, of no more than 6 m in diameter and about 30 – 40 cm in depth. It contains filamentous algae.

Sample collection:

Seven sampling stations were selected in various localities in Basrah (Fig. 1). The nature of these stations is quite different from each other, therefore two sampling methods were used one hundred liters of water were taken from stations 3, 4 and 7, and passed through a 0.090 mm mesh-size plankton net with a mouth aperture of 40 cm. Sampling was done on a monthly basis for the period from November 1995 to December 1996. Station 5 was sampled from December 1995 through May 1996. However, sampling at stations 1, 2 and 6 was carried out by the same plankton net used above, but was towed behind a boat for 15 min. A flow-meter was mounted at the mouth of the net to determine the volume of water filtered by net (DeBernardi, 1984). Samples from these stations were collected from June 1996 to May 1997. Samples were preserved in 4 % formalin while those used for weight measurements, were freezed.

In the laboratory, the samples were poured into a graduated vessel, and diluted if densely populated. Then a 10 ml subsample was taken. The sample was placed in a Bogorov chamber, examined and counted under a stereomicroscope. This procedure was repeated for 3 times, then the whole sample was examined for the rare species. Because of the wide variations in numbers of the various groups of zooplankton, the data of abundance (No./m^3) were transformed into $\log_{10}$ No./m^3. Tests of significance were carried out using the SPSS packages.

Zooplankton Biomass:

The displacement volume of the zooplankton in each sample of stations 3, 4 and 5 were measured by placing the sample into 500 ml volumetric flask and the volume was raised to the final mark of 500 ml by addition of water. Then the sample was filtered into a 500 ml volumetric flask, through a net of a mesh-size less than that used for sample collection, and then water was added until the mark 500 ml by using a 10 ml cylinder. The added volume of water is equal to the displacement volume of the zooplankton. The volume of zooplankton (ml/m^3) was then obtained by dividing the volume of zooplankton by the volume of sample filtered by the net.

The standing crop of the zooplankton (mg C/m^3) was calculated using the conversion factor of 65 mg C/ml of displacement volume (Jacob *et al.*, 1979). Stations 1, 2, 6 and 7 were excluded from the estimation of biomass because the samples contain more plant remains than zooplankton.

Fresh weight and Dry weight:

Fresh weight and dry weight of the zooplankton were estimated by filtering the sample through a wet filter paper of a known weight using a vacuum pump and the wet weight was recorded by subtracting the weight of the wet filter paper without the zooplankton from that of the filter paper with the zooplankton. Then the filter paper was oven – dried at 60 ºC for 24 hours and the dry weight was recorded. A filter paper without sample was dried up at the same temperature for the same period to obtain the dry weight of the filter paper, the process was repeated for 3 times. By subtracting the dry weight of the filter paper without sample from that with sample we obtained the dry weight of the sample. Then the wet weight and dry weight were converted into mg/m^3 by dividing the weight of the sample by the volume of the filtered sample.

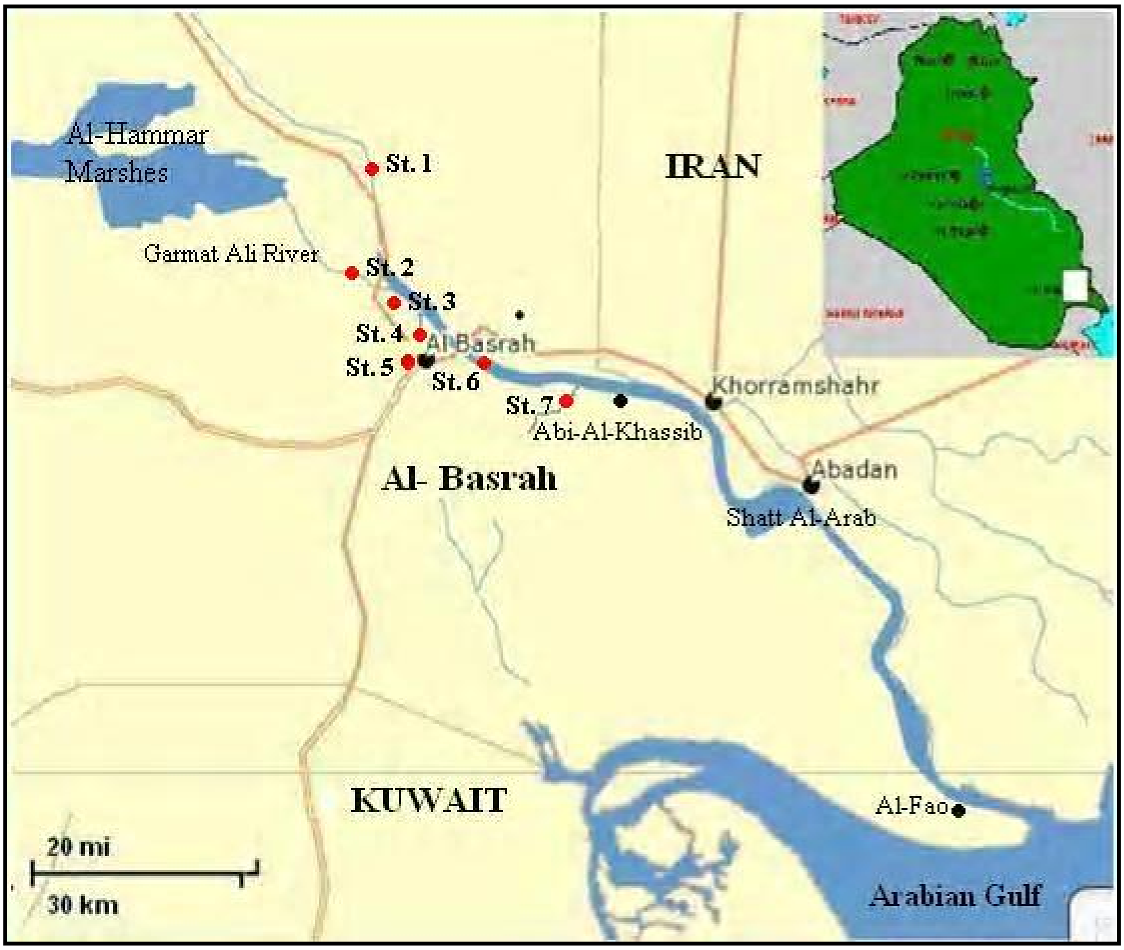

Fig. 1: Map of lower Mesopotamia showing the sampling stations.

3- Results

Hydrography of the area:

Water temperatures at stations 1, 2 and 6 are very close to each other, it ranged between 14° C (in February 1997) and 34° C (in July 1996). Salinity changed from 0.90 ‰ (in December 1996) to 1.38 ‰ (in July of the same year). The pH varied from 7.3 – 8.5 and the dissolved oxygen from 4.5 mg/l (in July 1996) to 8.2 mg/l (in February 1997).

At stations 4 and 7 water temperature fluctuated between 15.1° C in (February 1996) to 33° C (in July of the same year). Salinity changed from 1.00 ‰ (in February) - 2.1 ‰ (in July). pH ranged from 7.2 (in November 1995) – 8.3 (in July 1996). The dissolved oxygen varied from 4.5 mg/l (in July) – 7.9 mg/l (in February).

At stations 3 and 5 water temperatures fluctuate between 15.1° C (in January 1996) and 33 °C in May. Salinity at station 3 ranged from 1.12 – 2.28 ‰ and recorded in November 1995 and September 1996. Salinity at station 5 ranged from 4.0 – 6.8 ‰ in January and May 1996. The pH changed from 7.6 (in December 1996) to 8.4 in April 1996. The Dissolved oxygen at station 3 varied from 5.1 – 8.3 mg/l (in July and January 1996) and at station 5 from 6.5 – 8.2 mg/l (in May and January 1996).

Zooplankton:

Among Copepoda, Calanoida was the rare group in all stations. Cyclopoida, Harpacticoida and nauplii of Copepoda were the dominant in most stations. Cladocera, Rotifera, Ostracoda and cirripede larvae are discussed in detail and the rest of group like Mysidacea, Nematoda, larvae of Mollusca, insect larvae, Polychaete larvae and the like are grouped into "others".

Station 1:

Located in the Shatt Al-Arab River, before the union of the Shatt Al-Arab with Garmat Ali canal (the Euphrates River after coming out of the Al-Hammar Marshes). It has the same features of Shatt Al-Arab River.

The density of zooplankton ranged from 110 ind./m^3 in August 1996 to 1610 ind./m^3 in April 1997 (Table 1). The average monthly density was 419 ind./m^3. The highest peak was recorded in April (1610 ind./m^3 ; temp. 22.5 ºC). The relationship (r^2) between the temperature and the density of zooplankton was 0.09, which is not significant ($P> 0.05$).

Total Copepoda (Fig. 2), the highest peak (1223 ind./m^3) was reached in April 1996. Cyclopoida peaked (341 ind./m^3) in April 1997 (Table 3). Harpacticoida showed a maximum density in April 1997 (123 ind./m^3), (Table 3). Nauplii of Copepoda exhibited the highest peak is reached in April (758 ind./m^3), (Table 3).

Cladocera (Fig. 3) exhibited a rise in June 1996 (205 ind./m^3) and another peak was observed in May 1997 (229 ind./m^3).

Rotifera (Fig. 4) generally showed a very low density as the net used for sampling is quite large (90 µ) for this group. However, the peak was attained in May (245 ind./m^3).

Cirripede larvae (Fig. 5) were present in very low numbers due to the large mesh size of the net. The highest numbers (99 ind./m^3) was recorded in April 1997.

Ostracoda is rarely occurred in this station. Among the "others" (Fig. 6) the insects; although rare, attended high numbers in February and May 1997 (32 & 24 ind. /m^3, respectively).

Station 2:

Garmat-Ali River, representing the Euphrates River after passing through the Al-Hammar Marshes. It should have a combined feature of Shatt Al-Arab River and Al-Hammar Marshes. It is subjected to the tidal rhythm of the Shatt Al-Arab River and the Arabian Gulf.

Total zooplankton abundance ranged from 447 ind./m^3 in June 1996 (temp. 33 ºC) to 45291 ind./m^3 in March 1997 (temp. 17 °C), (Table 1), with an average of 13537 ind./m^3.

The relationship between temperature and zooplankton abundance (r^2) was 0.3542 which is highly significant ($P < 0.05$).

Total Copepoda (Fig. 2) likewise exhibited several peaks the highest of which (6145 ind./m^3) was in March 1997.

Cyclopoida showed great fluctuations in density with the highest peak was attended in March 1997 (2095 ind./m^3), (Table 3).

Harpacticoida peaked in October 1996 (231 ind./m^3), (Table 3).

Copepod nauplii showed several peaks, one in September 1996 (2338 ind./m^3), the highest in November (4104 ind./m^3) and a slightly less pronounced peak (4050 ind./m^3) in March 1997, (Table 3).

Cladocera (Fig. 3) exhibited the highest number (7207 ind./m^3) in April 1997.

Rotifera (Fig. 4) represented here in appreciable numbers with slight rises in density in July and September 1996 (3192 and 3769 ind./m^3, respectively), a great rise (26211 ind./m^3) occurred in November and still the highest density reached in February (38224 ind./m^3) and March 1997 (37016 ind. /m^3).

Cirripede larvae (Fig. 5) exhibited the highest figure in November 1996 (3264 ind./m^3).

Ostracoda was very rare.

Among the "others" the larvae of molluscs reached their peak in February 1997 (853 ind./m^3) (Fig. 6).

Station 3:

The abundance of zooplankton varied from 16330 ind./m^3 in February 1996 (temp. 18 ºC) to 432085 ind./m^3 in May of the same year (temp. 23 ºC) (Table 2), with the average of 199562 ind./m^3. The relationship (r^2) between density and temperature was 0.0827, which is not significant ($P>0.05$).

Total Copepoda (Fig. 7) exhibited the highest peak (287500 ind./m^3) in June 1996 and another peak (261000 ind./m^3) in November of the same year.

Calanoida was recorded on five occasions only with the highest numbers in November 1995 (1500 ind./m^3), (Table 4).

Cyclopoida reached highest numbers in October (112500 ind./m^3), (Table 4).

Harpacticoida exhibited the highest peak (14000 ind./m^3) in March 1996, (Table 4).

Copepod nauplii peaked (200000 ind./m^3) in June and a further greater rise (217500 ind/m^3) occurred in November of the same year (Table 4).

Cladocera (Fig. 8) peaked in November 1995 (48500 ind./m^3), January 1996 (43000 ind./m^3).

Rotifera (Fig. 9) appeared in high numbers (120800 ind./m^3) in January 1996, with the highest rise (290000 ind./m^3) in May 1996 and another slight rise in December of the same year (80000 ind./m^3).

Ostracoda (Fig. 10) attended a highest rise (34000 ind./m^3) in March 1996 and slightly less pronounced peak (14375 ind./m^3) exhibited in May and still another higher rise (20000 ind./m^3) recorded in December of the same year.

Of the "others", Molluscan larvae appeared in high numbers in May and November 1996 (625 and 1500 ind./m^3, respectively), (Fig. 11). Nematode peaked in October 1996 (7500 ind./m^3).

The insects shoed the highest peak (15200 ind/m^3) in October, (Fig. 12).

Station 4:

Total zooplankton fluctuated between 1175 ind/m^3 in July 1996 (temp. 33 °C) and 65320 ind/m^3 in April of the same year (temp. 25 °C) (Table 2), with average of 15443 ind/m^3. The relationship (r^2) between zooplankton abundance and temperature was 0.0124, which is not significant ($P > 0.05$).

Total Copepoda, attended their pronounce increase (60875 ind/m^3) in April 1996 and a less pronounced peak (13250 ind/m^3) in October of the same year (Fig. 7).

Cyclopoida, exhibited their highest peak (11250 ind/m^3) in April 1996 (Table 4).

Harpacticoida, attended high numbers in October (2500 ind/m^3) and November of the same year (2450 ind/m^3) (Table 4).

Nauplii of Copepoda, reached their highest numbers (47500 ind/m^3) in April 1996 and peaked again (9750 ind/m^3) in October of the same year (Table 4).

Cladocera, attended their maximum numbers in March / April (2560 / 2510 ind/m^3) (Fig. 8).

Rotifera, showed their highest peak in May (29100 ind/m^3) and another minor rise (17850 ind/m^3) in November of the same year (Fig. 9).

Ostracoda, showed the greatest rise in May 1996 (2250 ind/m^3) and another slight increase in November 1996 (350 ind/m^3) (Fig. 10).

Among the "others" Nematoda attended a high peak in November 1996 (3500 ind/m^3) (Fig. 11), and the insects peaked in March of the same year (1620 ind/m^3) (Fig. 12).

Cirripede larvae, were rare in this river (Fig. 13).

Station 5:

This temporary pool and sampled from December 1995 to May 1996. It contains no Calanoida and no Harpacticoida.

The zooplankton abundance varied from 5196 ind./m^3 in December 1995 (temp. 17 °C) to 1769250 ind./m^3 in April 1996 (temp. 25 °C) (Table 2), with the average of 522544 ind./m^3. The relationship (r^2) with temperature was 0.0405, which is not significant ($P > 0.05$).

Total Copepoda, attended two peaks, one in February 1996 (176950 ind/m^3) and the other in May (69500 ind/m^3) (Fig. 7).

Cyclopoida, reached their highest peak in March 1996 (40000 ind/m^3) (Table 4).

Copepod nauplii, exhibited a fairly high peak in February 1996 (161700 ind/m^3) (Table 4).

Cladocera, showed a single pronounce peak in March 1996 (249300 ind/m^3) (Fig. 8).

Rotifera, appeared in high density in May 1996 (9500 ind/m^3) (Fig. 9).

Ostracoda, attended a pronounce peak ever recorded in all the stations in April 1996 (1590000 ind/m^3) (Fig. 10).

Larvae of Mollusca, included within the "others" was represented here in very low number in April 1996 (Fig. 11). The insects were present in high numbers in March 1996 (12000 ind/m^3) (Fig. 12).

Station 6:

The abundance of zooplankton ranged between 112 ind./m^3 in June 1996 (temp. 29 °C) and 2047 ind./m^3 (temp. 22 °C), in April 1997 (Table 1), with the average of 635 ind./m^3. The relationship (r^2) of abundance of zooplankton with temperature was 0.0145 which is not significant ($P > 0.05$).

Total Copepoda, exhibited high numbers (413 ind/m^3) in September 1996 (temp. 28 ºC), with the highest peak (1322 ind/m^3) in April 1997, (Fig 2).

Calanoida, were very rare.

Cyclopoida, appeared in slightly high numbers in September 1996 (135 ind/m^3) (Table 3).

Harpacticoida, attained a rise in February 1997 (40 ind/m^3) (Table 3).

Nauplii of Copepoda, attended their pronounce peak occurred in April 1997 (1202 ind/m^3) (Table 3).

Cladocera, rare, but reaching a slight rise in April 1997 (145 ind/m^3), (Fig. 3).

Rotifera, showed a high rise in November (712 ind./m^3) (Fig. 4).

Cirripede larvae, reached 187 ind./m^3 in April 1997 (Fig. 5).

Among the "others" the larvae of Mollusca peaked in February 1997 (609 ind./m^3), and polychaete larvae peaked in September 1996 (677 ind./m^3) (Fig. 6).

Station 7:

It has been sampled from November 1995 to December 1996. The zooplankton abundance varied between 660 ind./m^3 in December 1995 and 11290 ind./m^3 in May 1996 (temp. 30 ºC) (Table 2), with the average of 4814 ind./m^3. The relationship with temperature was 0.2746 which is highly significant ($P < 0.05$).

Total Copepoda, attained their highest numbers in September 1996 (9120 ind/m^3) (Fig. 7).

Calanoida, only appeared on one occasion. Cyclopoida, exhibited their highest rise in September 1996 (1250 ind/m^3) (Table 4).

Harpacticoida, attended their highest numbers, in February 1996 (990, ind/m^3) (Table 4).

Copepod nauplii, peaked in September 1996 (7870 ind/m^3) (Table 4).

Cladocera, exhibited a peak in January 1996 (1190 ind/m^3), (Fig. 8).

Rotifera, peaked (6500 ind/m^3) in June. (Fig. 9).

Ostracoda, peaked in May 1996 (2250 ind/m^3) (Fig. 10).

Among the "other" Nematoda present here in relatively high numbers 670 ind/m^3 (in January 1996), and peaked in October (2550 ind/m^3) (Fig. 11).

Insects, also exhibited an increase in numbers in March 1996 (1500 ind/m^3) (Fig. 12).

Cirripede larvae, not continuously present, but occurred in relatively high numbers in May 1996 (3750 ind/m^3) (Fig. 13).

Biomass of zooplankton:

Due to the presence of plant fragments in the samples of stations 1, 2, 6 and 7, therefore, these samples were excluded from the discussion here.

Average biomass of zooplankton at station 3 varied from 201 – 1189 mg WM (wet mass)/m^3 during December 1995 – May 1996, with monthly average of 722 mg WM /m^3. In terms of dry mass, the biomass varied from 20 – 422 mg DM/ m^3, with monthly average biomass of 149 mg DM/ m^3, whereas the displacement volume and the standing crop fluctuated between 0.6 and 6.8 ml/ m^3 and 36.0 and 443.0 mg C/ m^3 during December 1995 / February and May 1996, the average monthly displacement volume was 3.5 ml/ m^3 and the average standing crop was 228.0 mg C/ m^3 (Table 5).

The average biomass in terms of wet mass at station 4 was ranging from 5.1 – 420.1 mg/ m^3 and recorded during June and April 1996. The average monthly value was 103.9 mg WM/ m^3. Whereas in terms of dry mass, the values in the same station were ranging from 1.0 – 89.7 mg/ m^3 and recorded in July and April 1996, with the average of 22.6 mg/ m^3. The displacement volume and the standing crop were 0.03 – 2.1 ml/ m^3 and 1.8 – 133.7 mg C/ m^3 and obtained in June and April 1996, with the monthly average values of 0.5 ml/ m^3 and 31.3 mg C/ m^3 (Table 6).

In station 5, the biomass ranged from 481.2 – 67240.6 mg WM/ m^3 and recorded in May and March 1996, with the monthly average value of 25933.9 mg/ m^3. The biomass in terms of dry mass was ranging from 128.1 – 21929.3 mg/ m^3 and obtained in May and March 1996, with the monthly average value of 8302.4 mg/ m^3. Whereas, the biomass in terms of displacement volume and standing crop were 0.4 – 88.6 ml/ m^3 and 23.9 – 5756.9 mg C/ m^3, respectively and recorded in December 1995 and April 1996, with the average displacement volume of 28.4 ml/ m^3 and standing crop of 1849.2 mg C/ m^3 (Table 7).

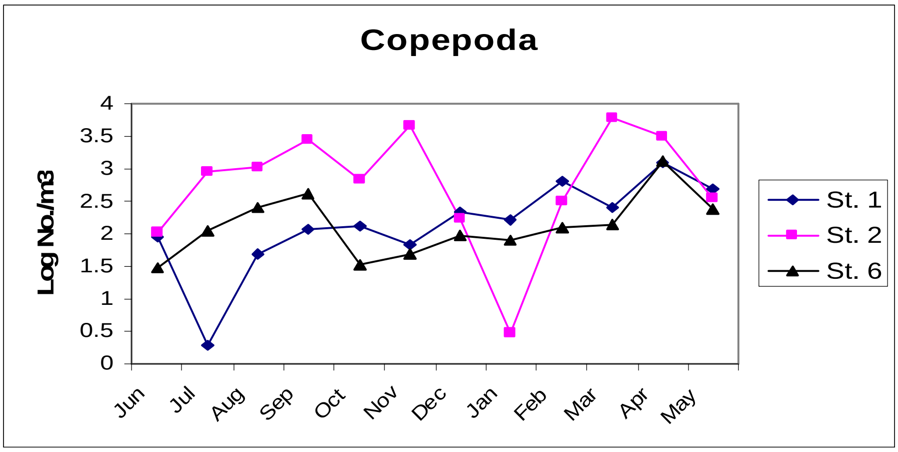

Fig. 2: Total Copepoda (log No/m^3) at stations 1, 2 and 6, sampled between June 1996 and May 1997.

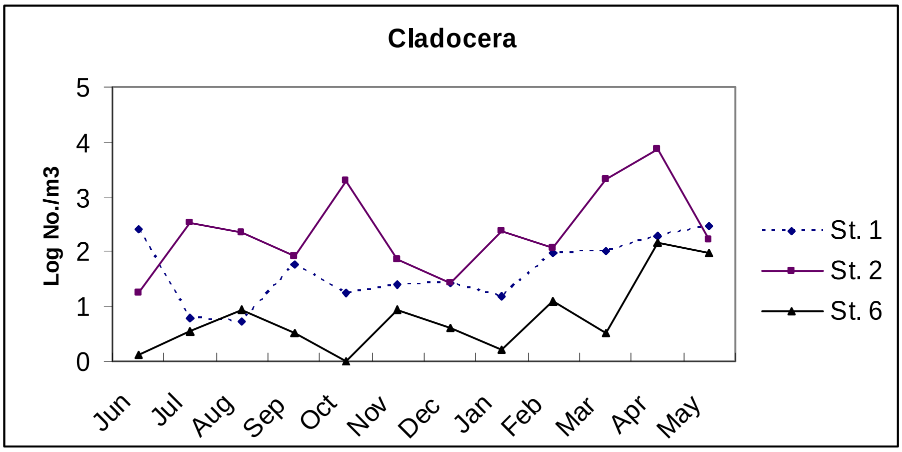

Fig. 3: Total number of Cladocera (log No/m^3) at stations 1,2 and 6, sampled from June 1996-May 1997.

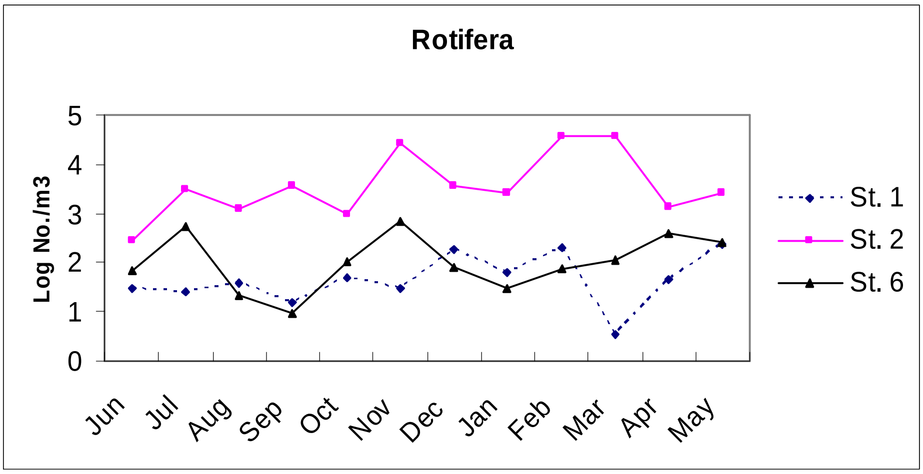

Fig. 4: Total number of Rotifera (log No/m^3) at stations 1, 2 and 6, sampled from June 1996 – May 1997.

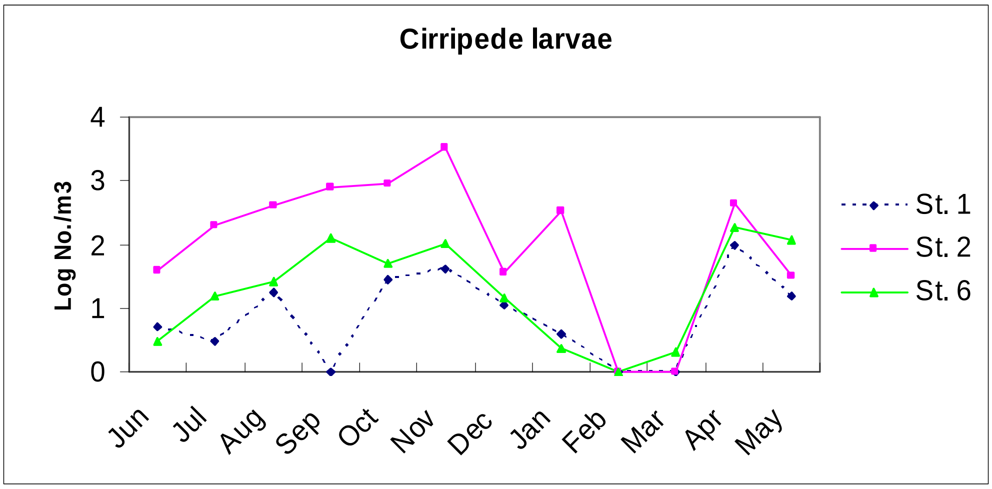

Fig. 5: Total number of Cirripede larvae (log No/m^3) at stations 1, 2 and 6, sampled between June 1996 and May 1997.

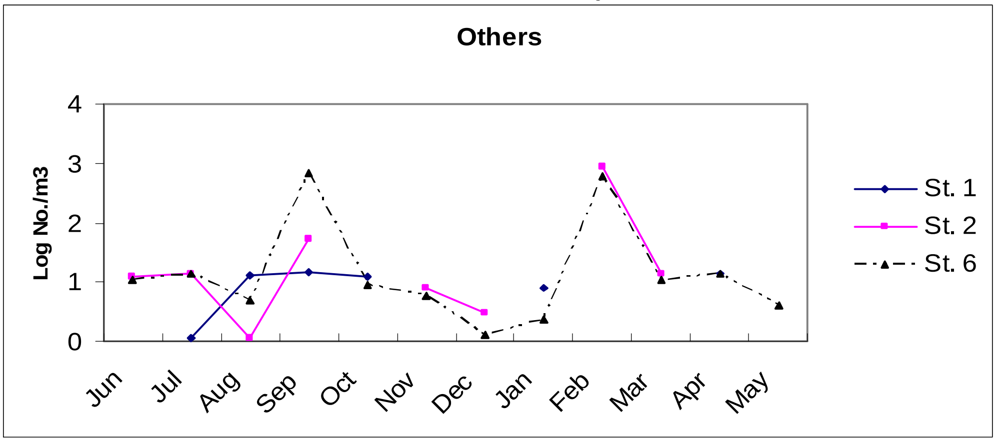

Fig. 6: Total number of "others" (log No/m^3) at stations 1, 2 and 6, sampled from June 1996 – May 1997.

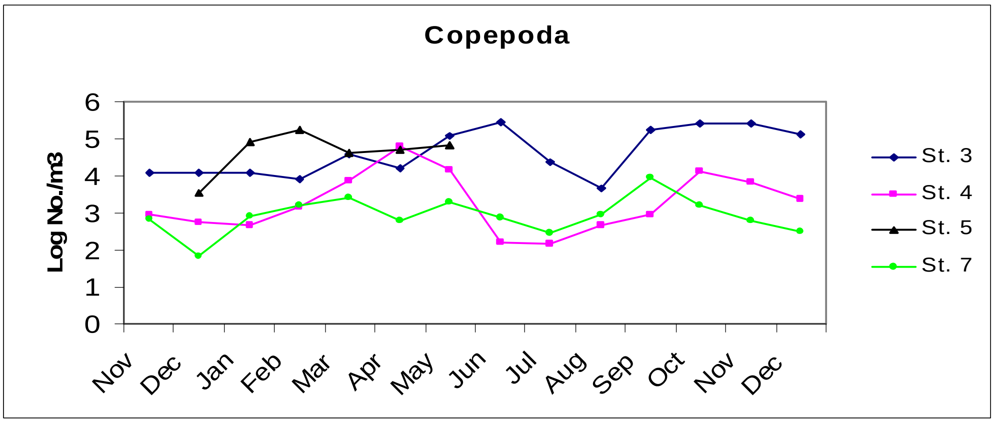

Fig. 7: Total Copepoda (log No/m^3) at stations 3, 4, 5 and 7, sampled from November 1995 – December 1996

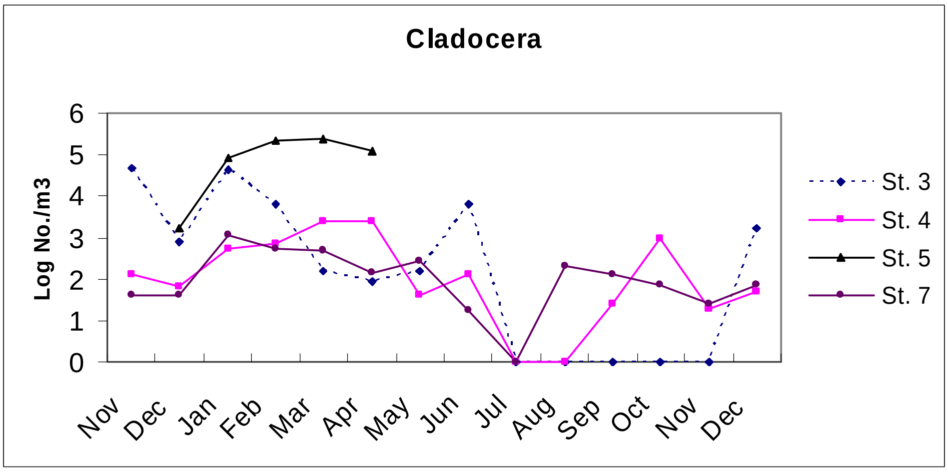

Fig. 8: Total number of Cladocera (log No/m^3) at stations 3, 4, 5 and 7, sampled from November 1995 – December1996.

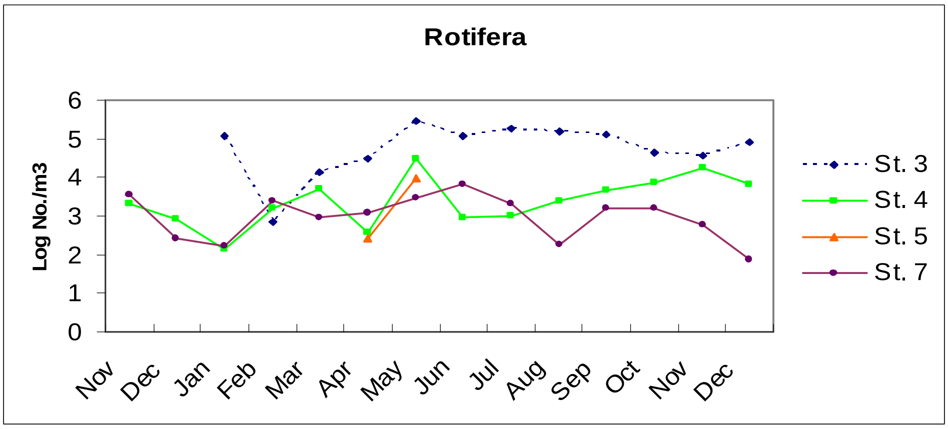

Fig. 9: Total number of Rotifera (log No/m^3) at stations 3, 4, 5 and 7, sampled from November 1995 – December1996.

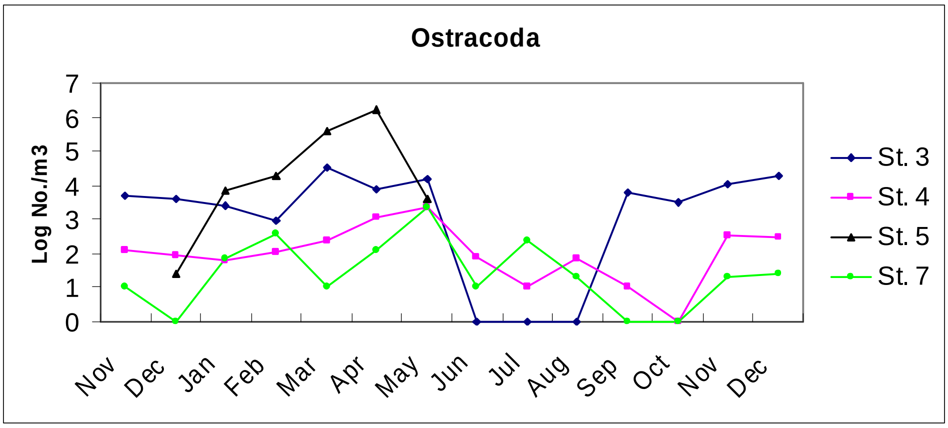

Fig. 10: Total number of Ostracoda (log No/m^3) collected at stations 3, 4, 5 and 7, from November 1995 – December1996.

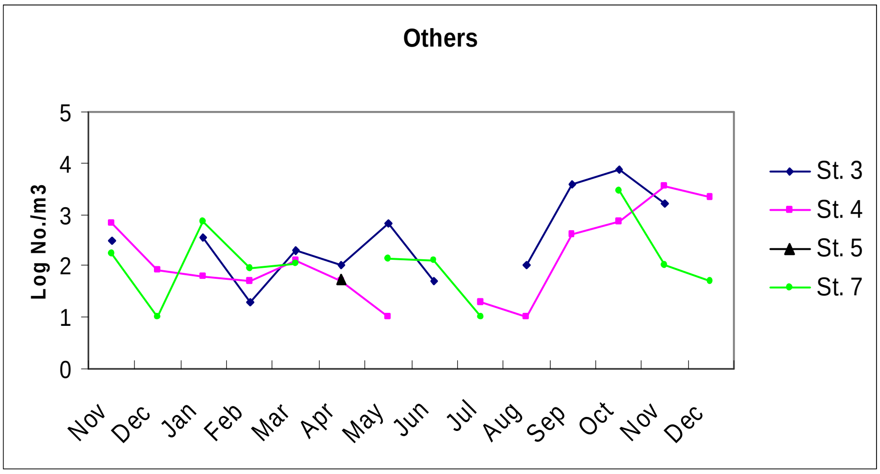

Fig. 11: Total number of "others" (log No/m^3) at stations 3, 4, 5 and 7, sampled from November 1995 – December1996.

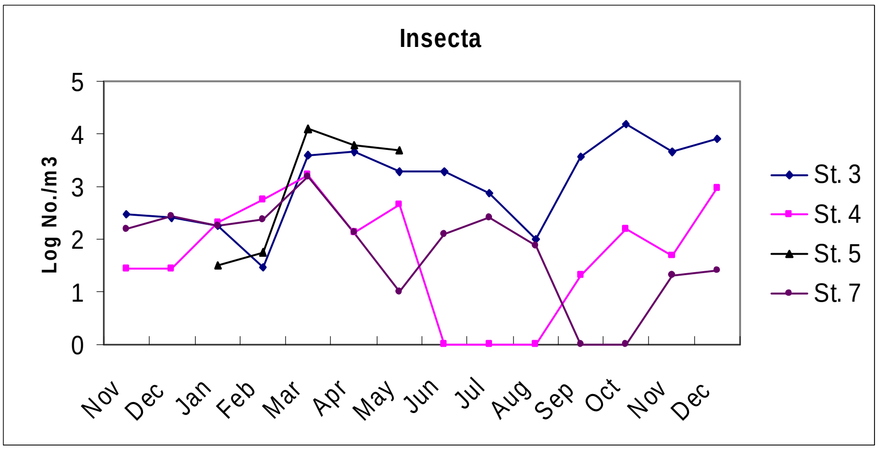

Fig. 12: Total number of Insecta (log No/m^3) collected at stations 3, 4, 5 and 7, from November 1995 – December1996.

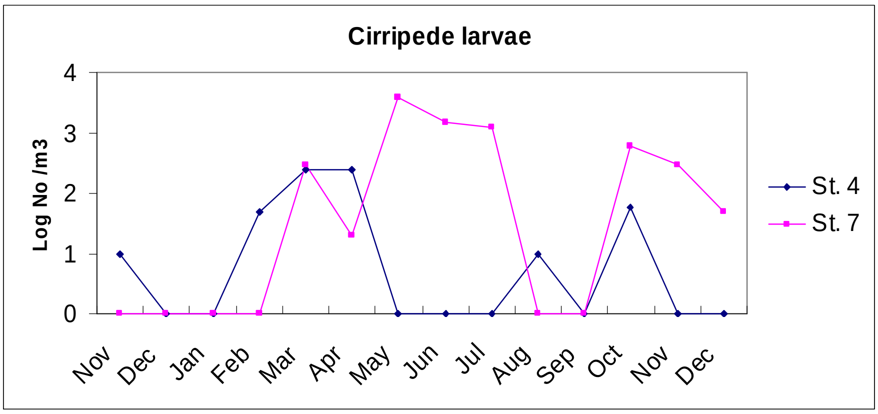

Fig. 13: Total number of Cirripede larvae (log No/m^3) at stations 4 and 7, collected from November 1995 – December1996.

Table (1): Total numbers (No. /m^3) of zooplankton at stations 1, 2 and 6 collected from June 1996 – May 1997.

Stations	Jun. 1996	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan. 1997	Feb.	Mar.	Apr.	May
St. 1	329	130	110	211	255	166	441	270	964	413	1610	995
St. 2	447	4655	2877	7583	4462	34206	3928	4138	39530	45291	12184	3140
St. 6	112	672	311	1226	202	879	202	125	831	277	2047	730

Table (2): Total numbers (No./m^3) of zooplankton at stations 3, 4, 5 and 7 collected from November 1995 – December 1996.

Stations	Nov. 1995	Dec.	Jan. 1996	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct	Nov.	Dec.
St. 3	66100	17150	170030	16350	89900	60530	432075	408175	189260	154800	307550	321200	313150	237650
St. 4	4300	1640	1480	4455	17050	65320	46730	1295	1175	3068	5855	22710	28770	12356
St. 5		5196	177289	407527	992300	1769250	88000							
St. 7	4530	660	3160	5400	6010	2310	11250	9027	4035	1370	10745	6525	1705	623

Table (3): Total numbers (No./m^3) of Calanoida, Cyclopoida, Harpacticoida and copepod nauplii at stations 1, 2 and 6 collected from June 1996 – May 1997.

Stations	Copepoda	Jun. 1996	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan. 1997	Feb.	Mar.	Apr.	May
	Calanoida	1	3	8	11	–	–	0.6	4	20	3.5	0.7	-
St. 1	Cyclopoida	32	35	15	36	19	10	121	66	83	21	341	155
	Harbacticoida	10	18	7	7	86	31	16	12	43	88	123	8
	Nauplii	45	39	18	66	28	26	82	85	490	172	758	318
	Calanoida	–	5	–	0.1	–	–	-	-	0.5	-	–	–
St. 2	Cyclopoida	54	378	226	488	85	511	97	714	305	2095	485	142
	Harbacticoida	10	1	34	69	231	33	4	–	1	0.2	80	–
	Nauplii	41	524	792	2338	369	110	72	285	10.5	1050	2631	205
	Calanoida	–	–	9	0.1	0.	0.3	–	0.3	0.1	2	–	–
St. 6	Cyclopoida	11	35	87	135	9	15	57	11	25.7	35	67	114
	Harbacticoida	2	5.7	28.5	7	4.1	3	8	8.5	40.1	12	53	21
	Nauplii	17.2	72	124	271	20	32	32	62	59	92	1202	110

Table (4): Total numbers (No./m^3) of Calanoida, Cyclopoida, Harpacticoida and copepod nauplii at stations 3, 4, 5 and 7 collected from November 1995 – December 1996.

Stations	Copepoda	Nov. 1995	Dec.	Jan. 1996	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
	Calanoida	1500	850	250	50	-	200	-	-	-	-	-	-	-	-
St. 3	Cyclopoida	6500	5800	9760	2180	1000	100	38125	87500	5200	100	47500	112500	40000	60000
	Harbacticoida	1500	750	20	520	11000	6000	1375	350	810	750	1250	6000	1500	350
	Nauplii	500	6250	3580	5080	75000	1500	85000	250000	7500	3250	31250	150000	237500	68000
	Calanoida	120	50				135	30							
St. 4	Cyclopoida	680	520	200	570	1870	11250	1800	75	10	75	300	1000	1050	1200
	Harbacticoida		20	60	110	350	2000	450	0	35	15	300	7500	7450	500
	Nauplii	120	170	210	775	5120	47500	9800	75	10	375	300	9750	3500	900
	Calanoida	-	-	-	-	-	-	-	-	-	-	-	-	-	-
St. 5	Cyclopoida	-	85	1230	5250	40000	31500	19000	-	-	-	-	-	-	-
	Harbacticoida														
	Nauplii	-	3750	85120	191700	3000	18000	56500	-	-	-	-	-	-	-
	Calanoida			70											
St. 7	Cyclopoida	650	70	420	90	750	125	250		25	75	1250	500	600	250
	Harbacticoida	10	-	170	390	750	10	625	125	-	-	-	900	20	-
	Nauplii			70	900	1300	500	1000	625	250	835	7820	450	30	75

Table (5): Biomass of zooplankton in terms of wet mass, dry mass (mg/m^3), displacement volume (ml/m^3) and standing crop (mg C/m^3) at station 3 (permanent pool at the University Campus in Garmat-Ali) sampled from November 1995 – December 1996.

Months	Wet Mass	Dry Mass	Displacement volume	Standing crop
November 1995	710.235	142.681	5.047	328.055
December	201.123	19.652	0.571	37.115
January 1996	1081.621	422.171	1.521	98.865
February	273.215	96.221	0.554	36.014
March	898.677	130.402	2.577	167.505
April	205.517	40.514	2.118	137.670
May	1189.214	219.528	6.815	442.975
June	985.519	142.013	6.151	399.815
July	621.202	149.455	2.812	182.780
August	608.434	156.324	2.652	172.380
September	851.782	140.513	5.511	358.215
October	970.551	125.219	5.212	338.783
November	891.841	172.514	4.665	303.225
December	621.966	134.025	2.899	188.435
Average	722.206	149.387	3.507	227.988

Table (6):Biomass of zooplankton in terms of wet mass, dry mass (mg/m^3), displacement volume (ml/m^3) and standing crop (mg C/m^3) at station 4 (Al-Maqal creek) sampled from November 1995 – December 1996.

Months	Wet Mass	Dry Mass	Displacement volume	Standing crop
November 1995	35.295	8.163	0.091	5.915
December	12.571	2.648	0.033	2.145
January 1996	17.224	5.315	0.052	3.380
February	32.917	7.810	0.121	7.865
March	139.582	25.209	0.410	26.650
April	420.065	89.653	2.057	133.700
May	295.884	53.425	1.855	120.570
June	5.118	1.672	0.028	1.820
July	5.309	1.028	0.030	1.950
August	22.517	7.912	0.058	3.770
September	53.821	18.324	0.159	10.335
October	150.328	45.233	0.610	39.65
November	158.201	25.296	0.881	57.26
December	105.603	24.672	0.353	22.945
Average	103.888	22.597	0.481	31.282

Table (7): Biomass of zooplankton in terms of wet mass, dry mass (mg/m^3), displacement volume (ml/m^3) and standing crop (mg C/m^3) at station 5 (temporary pool at the end of Al-Rubatt creek) sampled from December 1995 – May 1996.

Months	Wet Mass	Dry Mass	Displacement volume	Standing crop
December 1995	678.664	225.321	0.368	23.920
January 1996	22225.765	7419.225	16.781	1090.760
February	55182.108	18885.362	25.211	1638.710
March	67240.571	21929.281	35.868	2331.420
April	9795.209	1227.117	88.567	5756.855
May	481.227	128.114	3.898	253.370
Average	25933.92	8302.403	28.448	1849.172

4- Discussion

The zooplankton distribution varies both spatially and temporally according to the environmental conditions prevailing in the region. Differences may also arise due to the nature of distribution of the plankton, namely patchiness which may be the cause of the great variations in the catches of the nets (Raymont, 1983). Moreover, the mesh-size of the net is an important factor controlling the quality and quantity of the catch.

The present results indicate that there were great differences in the abundance of zooplankton among the seven stations sampled. Moreover, stations 3 and 5 apparently are the richest, among all, in zooplankton abundance. This is probably due to the fact that these two stations are shallow, isolated and have dense population of aquatic plants, and fishes or shrimps are absent. It is obvious that the highest density of zooplankton recorded during the spring as the peak density (1769250 ind./m^3) was reported in April 1996 at station 5 which is a small pool in Basrah city. Among the main rivers, Al-Hartha (St. 1) is the poorest, then Shatt Al-Arab at Al-Ashar (St. 6), whereas Garmat-Ali (St. 2), is having relatively high zooplankton density. Although, higher densities were recorded in November (St. 2), September (St. 6), but the highest densities were reported in April (St. 1 & 6) and March (St. 2) and these are in accordance with the rise in abundance of phytoplankton in Spring and Autumn and it's decline in Winter and Summer (AL-Zubaidi, 1985). At Al-Maqal creek (St. 4), higher abundance were recorded in March – May, October and November. Similarly peaks of abundance in Abdulyan (St. 7) were in May and September. In the ditch at the University Campus (St. 3), the density of zooplankton were pronouncedly higher than that of the rest of stations, except St. 5. These higher densities were in January 1996 and extend from May – December 1997. This is due to the fact that it is a permanent water body receiving a substantial nutrients from a nearby source. The temporary ditch (St. 5) peaked from January – April.

However, the figures of zooplankton density in the main Rivers (Shatt Al-Arab and Garmat-Ali) are very much higher than those reported by Salman *et al*. (1986) in a station further downstream at Mhajran near the city center, as they recorded a density of 21 – 642 ind./m^3 during May – December and January 1982 / 83. This controversy is, perhaps, largely due to the difference in mesh-size of the net used, as the net used by the latter authors was 0.2 mm. However, further downstream, at Al-Seba the density of zooplankton varied from 97 – 13438 ind./m^3, and two peaks of zooplankton abundance were found, one during summer and the other at the end of winter (AL-Zubaidi and Salman, 2001). These figures are compared with those reported by other authors in various parts of inland waters of Iraq, Mangalo and Akbar (1986) found that the density of zooplankton in Diyala River, further to the north of Basrah, was 861 in February 1984 and only 0.4 ind./m^3 during November 1984. Whereas Mangalo and Akbar (1988), reported density of 3843 in January 1986 and 0.5 ind./m^3 in October 1985 in Diyala River and 3 – 172 ind./m^3 in July 1986 and March 1986, respectively in the Tigris River at Baghdad.

The monthly average zooplankton densities reported in the present study were 491 and 522594 ind./m^3, at stations 1 and 5, respectively, and this is in accordance with the conclusion of Brooks (1959) that the zooplankton are more abundant in the shallow enclosed areas than in the rivers. However, the monthly average zooplankton density in the Shatt Al-Arab River was 118 ind./m^3 (Salman et al., 1986) and 3676 and 2399 ind./m^3 in the Shatt Al-Arab at Al-Fao and Al-Seba (AL-Zubaidi, 1998), and 5743 ind./m^3 in the Tigris River, north of Baghdad, and 5295 ind./m^3 in the Euphrates River, east of Falluja (Mohammad, 1986). Obviously these differences are entirely due to differences in the environmental conditions prevailing in these localities and to the mesh size of nets used.

Copepoda was the main constituents of zooplankton at stations 1, 3, 4 and 6 and this is contrary to the findings of Salman *et al.* (1986) who found that Cladocera was the dominant group in the Shatt Al-Arab River, followed by Copepoda. Whereas at stations 2 and 7, the Rotifera was dominating the zooplankton and this is in agreement with the results of AL-Saboonchi *et al*. (1986) in the Garmat-Ali Marshes. Moreover, AL-Zubaidi and Salman (2001) found that at Shatt Al-Arab at Al-Fao, Copepoda was the dominant (54 %) while at Al-Seba (further to the north of Al-Fao) the Cladocera was the dominant group (58 %), followed by Copepoda (27 %), and this coincides with the above conclusion of Salman *et al.* (op. cit.). These records indicate that within the main Shatt Al-Arab there are apparently changes in the zooplankton constituents from a place to the place.

The biomass of the zooplankton was high in the spring and lower in the winter and summer, and the highest values were recorded again at stations 3 and 5, and the lowest values were reported at stations 1 and 6, these differences are likely locality variations.

5- References

Abdul-Hussein, M. M. AL-Saboonchi, A. A. and Ghani, A. A. (1989) Brachionid rotifers from Shatt AL-Arab River, Iraq. Mar. Mesop. 4(1): 1-17.

Ajeel, S. G. (1990) Ecological and biological study of some important species of marine copepods in the NW Arabian Gulf. MSc. Thesis. University of Basrah, Marine Science Center. 149 p. (in Arabic).

Ajeel, S. G. (2003) Abundance and distribution of zooplankton in some waters in southern region of Iraq. Mar. Mesop. 19(1): 95–115. (in Arabic)

Ajeel, S. G. Abdulla, S. B. and Mohammad, H. H. (2005) Abundance and distribution of the zooplankton in the Garmat-Ali River. Basrah J. of Agricultural Science. 17(1): 167-178.

Ajeel, S. G. Khalaf, T. A. Mohammad, H. H. and Abbas, M. F. (2006) Distribution of zooplankton in the Al-Hawizah, Al-Hammar marshes and Al-Izze river south of Iraq. Marsh Bulletin. 1(2): 140–153.

AL-Saboonchi, A. A. Barak, N. A. and Mohamed, A. M. (1986) Zooplankton of Garma marshes , Iraq. J. Biol. Sci. Rrs. 17(1): 33-40.

Al-Zubaidi, A. M. H. (1985) Ecological study on the phytoplankton in some marsh areas near Al-Qurna city south Iraq. MSc, thesis. University of Basrah. (in Arabic).

AL-Zubaidi, A. M. H. (1998) Distribution and abundance of the zooplankton in the Shatt AL-Arab estuary and North West Arabian Gulf. Ph. D. thesis, University of Basrah. 125 p

AL-Zubaidi, A. M. H. and Salman, S. D. (2001) Distribution and abundance of zooplankton in the Shatt AL-Arab estuary, North West Arabian Gulf, Mar. Mesop. 16(2): 187–199.

Brooks, J.L. (1959) Cladocera. In: Edmondson, W.T.(eds.). Fresh-water biology. Second edition. 27: 587–656.

DeBernardi, R. (1984) Methods for the estimation of Zooplankton abundance . In: A manual on methods for the assessment of secondary Productivity in Fresh Waters. (eds., J. A. Downing and F. H. RigIer), BP Hand book No. 17 Blakwell, Oxford. Pp. 55-86.

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

Jacob, p. G. Zarba, M. A. and Anderlini, V. (1979) Hydrography, Chlorophyll and plankton of the Kuwait coastal waters. Ind. J. Mar. Sci. 8: 150-154.

Khalaf, A. N. and Smirnov, M. N. (1976) On littoral Cladocera of Iraq. Hydrobiologia. 51(1): 91-94.

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

Mangalo, H. H., and Akbar, M. M. (1988) Comparative study of two populations of cladocerans in the Tigris and Diyala Rivers at Baghdad. J. Biol. Sci. Res. 19(1): 117-128.

Mohammad, M. B. (1965) A faunal study of the Cladocera of Iraq .Bull. Biol. Res. Center. 1: 1-11.

Mohammad, M. B. (1986) Associations of invertebrates in the Euphrates and Tigris Rivers at Falluja and Baghdad, Iraq. Archiv Fur Hydrobiologia. 106(3): 337–350.

Raymont, J. E. G. (1983) Plankton and productivity in the Ocean .П. Zooplankton Pergamon Press, 824 p.

Salman, S. D. Marina, B. A. Ali, M. H. and Oshana, V. K. (1986) Zoolpankton studies. In: Final report: The 18-month marine pollution monitoring and research programme in Iraq. Marine Science Center of Basrah University, Basrah-Iraq. pp. 136-166.

الهائمات الحيوانية في البصرة جنوب العراق

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الملخص

جمعت عينات الهائمات الحيوانية شهريا من سبعة بيئات مختلفة في مدينة البصرة بواسطة شبكة الهائمات الحيوانية (حجم فتحاتها 0.090 mm وقطر فمها 40 سم). للمدة من تشرين الثاني 1995 لغاية كانون الأول 1996 من المحطات 3 (مستنقع في جامعة البصرة)، 4 (نهر المعقل)،7 (نهر عبدليان) ومن كانون الأول 1995 لغاية مايس 1996 من المحطة 5 (بركة بالقرب من نهاية نهر الرباط)، ومن حزيران 1996 لغاية مايس 1997 من المحطات 1 (شط العرب في منطقة الهارثة)، 2 (نهر كرمة علي)، 6 (شط العرب في منطقة العشار). تراوحت الكثافة السكانية للهائمات الحيوانية بين 110 فرد/م^3 خلال آب 1996 في محطة 1 إلى 1769250 فرد/م^3 خلال نيسان 1996 في محطة 5. ولوحظ أن مجموعة مجذافية الأقدام (Copepoda) تتصدر بقية المجاميع (36.8 %) وتأتي بعدها الدولابيات (Rotifera) (33.7 %) ثم الدرعيات (Ostracoda) (10.7 %) ، أما مجموعة متفرعة اللوامس (Cladocera) جاءت بالمرتبة الرابعة (8.8 %) وبعدها يرقات ذوؤابية الأقدام (Cirripede larvae) (4 %). تراوحت الكتلة الحية للهائمات الحيوانية بدلالة الوزن الرطب بين 0.5 ملغم/م^3 خلال كانون الثاني 1997 في محطة 6 إلى 67241 ملغم/م^3 خلال آذار 1996 في المحطة الخامسة. وبدلالة الوزن الجاف تراوحت بين 0.15 ملغم/م^3 خلال حزيران 1996 في المحطة السادسة إلى 21929 ملغم/م^3 خلال آذار 1996 في المحطة الخامسة وبدلالة حجم الإزاحة والمخزون القائم تراوحت الكتلة الحية بين 0.001 مل/ م^3 و 0.1 ملغم كاربون/ م^3 خلال حزيران 1996 في المحطة السادسة إلى 88.6 مل/م^3 و 5757 ملغم كاربون/م^3 خلال نيسان 1996 في المحطة الخامسة.