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IMPACT OF ENVIRONMENTAL PARAMETERS ON BENTHIC INVERTEBRATES AND ZOOPLANKTON BIODIVERSITY OF THE EASTERN REGION OF DELTA COAST AT DAMIETTA, EGYPT

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ABSTRACT

Environmental parameters as well as heavy metals (cadmium, lead, copper and zinc) in water and sediment have been studied in the eastern section of Delta coast-Mediterranean Sea. This research has been done during four seasons from summer 2002 to spring 2003. Both zooplankton and benthic invertebrates abundance in sediment have been estimated in Damietta coast. Most of environmental parameters showed higher concentrations during summer and autumn 2002 than that values recorded in winter and spring 2003. Dissolved oxygen concentration was decreased to reach (0 mg/l) at New Damietta drain. while BOD concentration increased at the same site. due to the increased quantity of industrial drainage water which adversally affected the biodiversity. Lead values in water showed high concentration (0.08 mg/l) at sites 4 & 2 during 2002 & 2003 respectively. This increase may be due to the activity of maritime ports for both commercial transport and fishing at Ezbet el-Borg. Heavy metals were magnified 100-1000 times in sediment more than that recorded in water. The concentrations of heavy metals in water and sediment were in the order of Zn> Cu> Pb>Cd. Sites 4 & 3 showed higher abundance of invertebrate species than other sites. Biodiversity of invertebrates in sediment was higher at sites 1 and 3. and that may be attributed to the high concentration of DO in water and TOC in sediment. Twenty two species of zooplankton of 6 phyla were identified. The biodiversity of zooplankton during spring 2003 was higher than that recorded during summer 2002.

Analysis of variance (ANOVA) for the environmental parameters in water. sediment and biodiversity (one-way and two-way) showed a strong significant difference for both one- way (years and site) and two-way (site x years). P <0.05. The obtained results will be useful for the monitoring of pollution status at the study area. in particular the sensitivity of aquatic invertebrates to changes of environmental characteristics. Therefore. monitoring programs should continue to control and maintain the environmental quality of Mediterranean Sea.

INTRODUCTION

The Mediterranean Sea is subject to pollution (including chemical and bacterial contamination and the spread of pathogenic micro-organisms) and eutrophication, mainly from inputs from rivers. especially along the African shores. the southern coasts of France and the North Adriatic. The problems are mainly in semi-enclosed bays. some of which still receive large amounts of untreated sewage. Discharge of nitrogen and phosphorus is probably the cause of the phytoplankton blooms; the 'red tides' that are now frequent in certain parts of Mediterranean waters. The rapid growth of tourism is a major threat to the environment and biodiversity in vast of the coastal area. The Mediterranean Sea has the highest species diversity among the European seas, but some fishing species are being overexploited, while others are thought to be within safe biological limits (UNEP/FAO, 1986).

The increasing of heavy metals in natural waters is a serious problem, where the most important sources are industrial and domestic wastes as well as agricultural runoff. Toxic metals which are some of the most dangerous pollutants can move from aquatic ecosystems by various processes and through biological chain, then accumulate by human beings (Mance, 1987). The analysis of the concentration inside the organisms is an important approach to assess the bioavailability of substances and to evaluate their behaviour in the environment. A toxicokinetic approach with accumulation and elimination studies gives an indication about parameters like turnover, persistence, biotransformation etc. of pollutants and enables a better understanding of the mechanisms of chemicals in the invertebrates biodiversity. These heavy metals have harmful effects on the environment (Walsh *et al.*, 1996). Moreover, pollution by heavy metals has also the adverse effect on the aquatic life that in turn affects the human health through food chain (El-Deek *et al.*, 1994 ; Zyadah & Serag, 2001).

The aim of the present study was to investigate the distribution of heavy metals and physico-chemical characteristics of both water and sediment in the eastern part of Mediterranean Sea coast at Damietta, to detect their effect on the biodiversity of benthic invertebrates in sediment and zooplankton in the water and to evaluate their possible risk to fish and human health.

MATERIALS AND METHODS

The sampling sites were accurately chosen along the eastern section of Mediterranean Sea coast at Damietta, and the study has been conducted during 2002 (summer and autumn) to 2003 (winter and spring). Site 1: Mothalath inlet ; site 2: Ezbet el-Borg; site 3: Navigation canal in east of Damietta Port; site 4: New Damietta; site 5: New Damietta drain; site 6: East of Gamassa and site 7: Gamassa drain (Figure 1). The selection of sites were chosen to cover all the variety of water quality. Water and sediment were collected and analyzed for both physical and chemical characteristics, also heavy metal (Cd, Pb, Cu and Zn) were determined according to Moore & Chapman (1986) and APHA – Standard Methods (1992).

Zooplankton in water was collected during summer 2002 and winter 2003 by zooplankton net (mesh-size 150 micrometer), using a plastic container of ten-liter capacity from 5 sites, except the two drains at sites 5 & 7. The collected samples were preserved directly with 4% neutral formaline solution. The zooplankton species were identified using a research binocular microscope. The density of zooplankton organisms was expressed in DAFOR (D: Dominant; A: Abundant; F: Frequent; O: Occasional and R: Rare) according to Bordic (1985). Sediment was collected from 7 sites by grab and was separated to two parts: one part for physico-chemical parameters analysis and the second part was washed using different mesh-sizes sieves, to separate the invertebrates fauna. The invertebrates in the sediment were identified and the density was estimated in number of individual per kg of sediment. Invertebrate samples were collected from the qudrate ($1m^2$) to describe the biodiversity within the quadrate according to Ashby (1973). Quadrate was used in the coast randomly (3-5 times) at each site to estimate the density of invertebrates species and expressed in No/ m^2. Analysis of invertebrates data obtained from the quadrate is shown according to Kershaw & Looney (1985). Coastal collection was done to estimate all species occurred at each coastal site, and the analysis of data obtained from the quadrate was run.

Statistical analyses were run using the Statistical Package for the Social Science (SPSS). Moreover, one and two ways ANOVA were employed to find the significant differences of environmental parameters between water, sediment and the biodiversity, also, means ± standard errors ($x^{-} \pm SE$) were derived for all data.

RESULTS AND DISSCUSSION

The mean variations of physico-chemical characteristics in water of eastern region of Med. Sea (Damietta coast) during 2002 – 2003 are shown in Table (1). Most of environmental parameters showed higher concentrations during 2002 than that values recorded in 2003. The values of hydrogen–ion concentration (pH) showed high concentration (8.8) at sites 5 & 7 during summer 2002. Similar results of pH concentrations were recorded in Medit. Sea, in Turkey Aysen *et al.*, (1988); at Alexandria, Egypt (Abul-Kassim & Dowidar, 1990); in Greece (Pangos *et al.*, 1992). The increased and decresed of pH values may be due to the mixed drainage water at these sites (Zyadah & Serag, 2001). Total dissolved solids (TDS), sulfate and calcium hardness values were higher at sites 1, 3, 4 & 6 than other sites, while sites 5 & 7 showed the lowest values of those parameters, due to the wastewater of drains discharged into Medit. Sea coast. The average values of TDS in the present results were lowered than other reported data ; Aysen *et al.* (1988) in Turkey; Said & Karam (1990) in Egypt.

The values of dissolved oxygen (DO) concentrations were peaked at sites 3, 4 & 6 (7.4-9 mg/l), while it decreased at sites 5 & 7 to reach 0 mg/l at site 5 during 2003 (Table 1), otherwise, the biochemical oxygen demand (BOD) concentration recorded the lowest values at the same sites. This is due to increase quantity of industrial drainage water from the industrial zone at New Damietta city, but BOD concentrations were optimized at the same sites. There is indirect relationship between DO and BOD concentrations (Sawyer & McCarty, 1978). Similar data were obtained in the River Nile (Zyadah, 1996 a & b); in River Nile-Damietta estuary (Zyadah, 1997). Generally the concentrations of DO were higher in 2003 than

2002. The decrease of DO value in summer was logic, where the relationship between temperature and DO is reversed (APHA, 1992).

The highest values of ammonia, nitrate, phosphate and orthophosphate were recorded at sites 5 &7 (Table 1), while the lowest values were at sites 3 & 4. High concentration of phosphorus is related to the pollutants and other nutrient elements at these sites. Elevated phosphorus concentrations cause eutrophication problems, while phosphorus deficiency may be in most cases a limiting factor for biological production (Abdel-Moati *et al.*, 1992). Nitrate is important salt because it is considered the principal source of fixed nitrogen in marine environment. The concentration of nitrate-nitrogen in seawater may vary from 0.001 to 0.5 mg/l (Mario, 1974). Other reported data showed that total phosphorus and orthophosphate increased at Ezbet-El-Borg, navigation channel, Gamassa drain and Gamassa; while seasonal variations revealed the highest values in winter and summer (Zyadah *et al.*, 2002 c).

Heavy metal values in water fluctuated within sites during 2002/2003. Copper concentration showed highest values at sites 4-7 (Table 1), due to the effect of wastewater drainge. Lead values in water showed high concentration (0.08 mg/l) at sites 4 & 2 during 2002 & 2003, respectively, because these sites are maritime ports for both Damietta commercial transport and fishing at Ezbet el-Borg. The highest concentrations of Zn were recorded at sites 5-7, where drainage water at those sites are mixed with agricultural drainge that may lead to the increase of Zn concentration. No regular pattern of Cd concentration at both sites and seasons was found, while Cd values were high (0.022-0.026 mg/l) at sites 3 & 6. There is a sewage treatment plant at site 3 (Ras El-Bar city) and partial treated drainge water from Gamassa drain at site 6 (Zyadah *et al.*, 2002c).

The concentration of pH in sediment showed variation at sites 4-7 (Table 2). Sites 2, 5 & 7 recorded low concentration of TDS values which is related to pH and TDS values in water. Ammonia, nitrate, phosphate and TOC values in sediment increased at sites 1, 6 & 7 as shown in Table (2). This increase of the previous parameters is related to different sources of pollutants from Damietta estuary and other drains that led to increase of ammonia, nitrate and phosphorus. Zyadah *et al.*, (2002 b & c) and Zyadah *et al.* (2003) showed that total organic carbon (TOC) and total phosphorus values in water increased at both Damietta Port platforms and Ezbet El-Borg. This may be attributed to the excess effluents of shipyards, petroleum effluents and sewage discharges (Zyadah, 1997). In addition to the rotten dead freshwater plants that sink and decay in Med. Coast at Damietta; which increase TOC, nitrogen and phosphorus (Ramzy, 1994). This data agreed with other reported data (Pongos *et al.*, 1992; Fornos *et al.*, 1992 at Greece coast ; Ramzy, 1994 at Alexandria coast, Egypt). It is found that 5% of the phosphorus in Medit. Sea correlated with organic detritus and 0.05% of phosphorus in Medit. Sea correlated with carbonate materials (Fornos *et al.* 1992).

Lead concentration in sediment peaked at site 2, that is may be attributed to the highest value of Pb in water at the same site. It is found that seeping from ships painting, in addition to agriculture, sewage and industrial waste effluents lead to high concentration of Pb at this region (Zyadah *et al.*, 2002 b & c). Other reported data of Pb values were lower than present values (Scoullos *et al.*, 1992 of Greece coast (0.0001-0.0003 mg/l); Abdel-Moneim *et al.*, 1994 in Alexandria, Egypt (0.003-0.004 mg/l), while other reported data of Pb values were higher than the present results (Pangos *et al.*, 1992 in Greece coastal water (0.018-0.91 mg/l) ; Abdel-Baky & Zyadah, 1998 in Lake Manzalah-Med. Coast, Egypt (0.343-1.185 mg/l). Cadmium values in sediment increased at sites 5-7, as a result of high concentrations of Cd at the same sites in water also. Heavy metals were magnified in sediment than that recorded in water, where the concentration of heavy metals in sediment was multiplied 100-1000 times more than that recorded in water. Generally, sites 2 and 3 recorded the highest values of Cu, Pb, Cd & Zn than other sites (Table 2).. It is found that there is a relationship between heavy metal concentrations in water and sediment, where the concentration of heavy metals in sediment were higher than that recorded in water.

Table (3) showed the biodiversity of benthic invertebrates collected from sediment and within quadrate at different sites during 2002-2003. Site 4 recorded the highest biodiversity of invertebrates (14 species), while site 2 recorded the lowest one (5 species) than other sites. Invertebrates in sediment was higher in density (*Ceratostoderma glacum* : 54-300 individual/kg of sediment; *Mytilopsis leucophaeata*: 75-100 individual /kg) at site 1 than other sites ; that may be attributed to the high concentration of DO, high values of TOC and low concentration of BOD at this site. Sites 3 & 4 showed high biodiversity of the invertebrates (14 &11 species), where the water current between Damietta Port (near to site 4) and estuary of Damietta Branch across the navigation channel (site 3) play an important role for the biota biodiversity and abundance

(Zyadah, 1997). However, sites 3, 4 & 6 have suitable environmental parameters like low concentration of both ammonia and BOD, in addition to high concentration of DO, nitrate and phosphate that represent a favourable media for living organisms. It is shown that the average abundance of invertebrates biodiversity during winter and spring during 2003 was more abundant than that estimated in summer and autumn during 2002. This data is in agreement with the present results of physico-chemical parameters in water and sediment, where their concentrations increased during 2002 than 2003, that affected the biodiversity of invertebrates (Tables 1, 2 & 3).

Biodiversity of zooplankton at Damietta coast is shown in Table 4.Twenty two species of zooplankton of 6 phyla were recorded. Crustacea (especially Copepoda) and Protozoa (Tintinmidae) have more abundant species than other phyla or classes. Other reported data in Lake Borollus, Egypt, showed that zooplankton was mostly composed of crustacean groups which formed (71%) by the number of zooplankton population , followed by Rotifera (15%) and Protozoa (11%) Abul Ezz (1995). The biodiversity of zooplankton at sites 1, 2 and 3 also was ranged between dominant (D), abundant (A) and frequent (F). This is may be referred to the organic carbon and nutrients at the previous sites than the other sites. These sites are related to River Nile Damietta estuary which has an eutrophic water, that may affect the productivity at this region than other regions. The density of zooplankton during spring was more abundant than that recorded during summer, that is may be attributed to the effect of either nutrient increase or season of the plankton flourish. El- Serehy and Abdel- Rahman (1999) showed that the peak of zooplankton abundance in Gulf of Suez, Egypt was recorded in winter and the lowest density during autumn.

There are two drains at sites 5 & 7 (New Damietta and Gamassa drains) that affect the quality of water and sediment especially at sites 4 & 6, respectively. Damietta estuary at site 2 affects both water and sediment quality at site 1 toward the dominant current water direction and during the tide time. This sensitive aquatic environment is suffering of pollution that lead to imbalance of plankton productivity (phytoplankton or zooplankton) (El- Adl, 2000) and affects both quantity and quality of benthic invertebrate biodiversity. However, overall previous environmental parameters will affect both fish production and public health.

Analysis of variance (ANOVA) for the biodiversity in water, sediment and biodiversity (one-way and two-ways) showed a strong significant difference for both one- way (years and site) and two-ways (site x years). $P < 0.05$.

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Table (1): Seasonal variations of physico-chemical charachteristics in water of eastern region of Med. Sea during 2002-2003.

Year Site / Paramerter (mg/l)	1	2	3	4	5	6	7
2002 pH	7.8±0.2	8.1±0.1	8.3±0.1	8.4±0.2	8.8±0.5	8.4±0.2	8.8±0.3
TDS	31450	19000	31550	31950	1100	34550	961
Sulfate	2174±94	1363±76	2748±95	2068±78	723±11	3107±77	262±39
Calcium hardness	1010±45	805±21	1075±99	1260±98	361±94	946±70	299±30
D O	6.5±0.5	4.6±1.7	7.4±1.1	7.9±2	2.3±0.5	7.6±2.2	3.6±0.1
BOD	1.2±0.1	2.3±0.3	0.5±0.05	0.1±0.1	5.8±0.4	0.05	3.7±0.4
Ammonia	10.6±3.8	8.6±1	8.3±0.2	8.1±1.7	15.6±0.8	10.2±0.2	12.3±1.3
Nitrate	4.4±3.4	4.1±3.3	2.3±1.1	2.6±1.3	1.3±0.3	2.6±1.7	4.1±3.1
Phosphate	131±25	99±55	90±8	195±52	343±91	178±94	308±100
Ortho-Phosphate µ/l	62.2±21	66±32	40.8±8.5	53.7±23	309±185	48±12.6	89.3±43
Cu	0.007	0.009	0.003	0.01	0.003	0.021	0.031
Pb	0.001	0.004	0.004	0.008	0.001	0.004	0.004
Cd	0.017	0.009	0.026	0.013	0.001	0.022	0.017
Zn	0.17±0.1	0.07	0.06	0.57±0.1	5.7±2.1	20±11	21.4±1.5
2003 pH	7.7±0.1	7.7±0.2	7.9	7.8±0.1	7.3±0.2	7.6±0.3	7.1±0.1
TDS	29200	26000	29700	30400	789	34500	935
Sulfate	2055	1080	2115	2130	537	2127	275
Ca hardness	810±15	730±52	856±63	400±19	105±12	830±81	295±24
DO	5.5±0.2	7.3±0.3	8.5±0.5	8.3	0	9±1.1	3.7±0.2
BOD	1.8±0.3	0.7±0.1	0.9±0.4	0.5	10.5±0.5	0.4±0.3	7.2±0.7
Ammonia	2.2±1.1	7.1±0.1	6.9±0.4	7.4±0.3	10.3±2.7	9.6±0.3	9.7±1.1
Nitrate	1.6±1.3	1.4±1.2	0.8±0.7	0.9±0.8	1.9±0.2	0.9±0.8	1.8±1.2
Phosphate	108±96	77±34	76±59	122±11	353±23	62±10	167±27
Ortho-Phosphate µ/l	83±7	74±42	37±1.1	80±65	152±18	56±15	88±24
Cu	0.01	0.01	0.014	0.021	0.017	0.019	0.013
Pb	0.001	0.008	0.002	0.004	0.004	0.001	0.004
Cd	0.001	0.004	0.001	0.002	0.013	0.009	0.004
Zn	0.7±0.1	0.01	1.3±0.5	1±0.2	1.26±0.5	1.2±0.6	5.6±2

(where X : Mean & SE: Standard error).

Table (2): Average variations of environmental parameters in sediment of eastern region of Med. Sea during 2002-2003.

Year Site Paramerter (mg/kg dry wt.)	1	2	3	4	5	6	7
2002 pH	8.4±0.2	8.8±0.3	8.2±0.5	7.4±1	9.2±0.1	6.7±1.4	7.4±1.2
TDS	629±91	620±80	754±101	690±18	545±255	186±87	250±16
Ammonia	0.89±0.1	0.74±0.1	1±0.39	0.29±0.3	0.74±0.1	7.6±2.1	21.5±2.5
Nitrate	0.41±0.1	0.39	0.16	2.6±0.3	3.5±0.5	11.6±2.1	31.5±5
Phosphate (µg/kg)	580±80	513±33	474±10	788±262	570±192	458±122	556±156
TOC (%)	2.1±2	1.3±0.6	2.7±1.7	0.8±0.2	0.9±0.3	0.7±0.5	1.1±0.5
Cu	7.3±2.8	6.6±1.2	11.3±1.9	9.3±5.1	7.7±1.8	3.3±0.2	11.8±1.5
Pb	2.1±0.2	20.1±11	6.2±2.2	6±1	0.1±0.1	0.2±0.1	0.95±0.2
Cd	0.5±0.1	0.1	0.05	0.5±0.2	5±1.3	0.04	3.8±1.1
Zn	20±8.3	57±12	33±2.8	11±2.3	26±12.1	12±3.1	24±11
2003 pH	8.3±0.17	8.2±0.05	8.3±0.3	7.1±0.2	8.2±0.2	7.3±1	7.6±0.3
TDS	704±18	552±94	690±222	438±105	414±89	773±23	403±36
Ammonia	1.3±0.3	0.48±0.2	0.38±0.3	0.56±0.2	0.39±0.2	0.98±0.8	0.9±0.3
Nitrate	0.27±0.1	0.3±0.1	0.43±0.3	0.98±0.6	3.1±1.2	3.1±2.9	4.2±0.6
Phosphate (µg/kg)	378±26	265±142	356±58	126±21	218±18	486±33	466±5
TOC (%)	3.5±0.7	1.1±0.9	0.3	0.35±0.1	1.7±0.5	1.5	2.2±1.5
Cu	14.1±2	6.8±11	7.5±1.1	3.3±0.5	1.7±1.1	1.6±0.2	5.8±1.5
Pb	3.6±1.1	28.5±10	8.9±2.9	3.6±1.2	3.5±1.4	1.8±0.8	1.9±0.7
Cd	2.4±0.8	5.6±1.5	0.05	0.8±0.2	2.4±0.6	4±0.5	4.1±1.5
Zn	11±3.2	64±15	65±17	1.4±0.6	18.6±3.9	7.1±2.8	3.8±1.3

(where X' : Mean & SE: Standard error).

Table (3): Biodiversity of benthic invertebrates collected from eastern coastal region of Mediterranean Sea .

Site	Coastal collection Species	2002 Sediment (No/kg)	2002 Quadrate (No/m$^{2)}$	2003 Sediment (No/kg)	2003 Quadrate (No/m$^{2)}$
1	*Mytilopsis leucophaeata*	100±9	101±14	75±15	77±11
	Scapharca inaequivalvis	-	-	25±6	-
	Ceratostoderma glacum	54±15	177±44	300±60	185±16
	Balanus	-	-	20±3	70±9
	Hydroides sp.	-	-	-	4±2
	Crabs	-	1	-	1
2	*Mytilopsis leucophaeata*	11±5	9±4	20±4	13±3
	Scapharca inaequivalvis	-	2±1	6±2	-
	Ceratostoderma glacum	-	11±2	-	18±5
	Hydroides sp.	-	-	-	1
	Crabs	1	2	3±1	3±2
3	*Donax variabilis*	-	2	-	5±1
	Mytilopsis leucophaeata	8±23	11±5	11±5	12±4
	Scapharca inaequivalvis	12±6	20±21	20±7	2
	Tympanotonus fuscatus	8±2	27±10	27±13	1
	Ceratostoderma glacum	1	26±11	-	32±11
	Buccinum undatum	-	-	2	-
	Balanus sp.	11±4	3±1	3	15±8
	Hydroides sp.	1	-	-	3±1
	Crabs	-	-	-	2±1
	Anomia simplex	-	-	-	4±3
	Tapes aures	-	-	-	1
4	*Donax variabilis*	122±51	91±12	35±11	66±19
	Mytilopsis leucophaeata	-	-	1	-
	Scapharca inaequivalvis	-	-	1	25±11
	Tympanotonus fuscatus	2	-	2±1	7±3
	Ceratostoderma glacum	-	-	1±1	96±33
	Macoma melo	-	2±1	-	279±105
	Buccinum undatum	-	-	-	6±1
	Murex sp.	-	-	-	46±15
	Naticarius hebraeus	-	-	-	79±17
	Babylonia formosae	-	-	-	12±3
	Baccinulum corneum	-	-	-	6±2
	Balanus sp.	-	-	-	7±2
	Hydroides sp.	-	-	-	5±1
	Crabs	-	-	-	3

(where X : Mean & SE: Standard error).

Table (4): Biodiversity of zooplankton at Damietta coast.

Site Phylum Class Species	1	2	3 2002	4	6	1	2	3 2003	4	6
Protozoa - Tintinnidia										
Lepxtintinnus nordigusti	4	3	3	1	3	4	3	3	1	3
Tintinnopsis benidea	4	1	1	1	2	3	3	2	2	1
Tintinnopsis companula	4	1	1	1	1	4	2	2	1	1
Tintinnopsis cylindrice	4	1	3	2	3	5	2	3	3	2
Tintinnopsis tocantensis	4	1	1	1	3	4	1	2	2	3
Favella ehrenborgii	3	3	1	1	1	3	3	2	1	1
Rotifera Monogononta										
Synchaetae akaii	2	1	1	1	1	2	2	2	1	1
Brachinous Sp.	3	2	1	1	1	3	3	2	1	1
Annelida Polychaeta										
Polychaetes larvae	3	2	1	2	1	3	3	2	2	1
Arthropda Crustacea Copepoda										
Euterpina acutifrons	4	3	3	2	1	4	3	3	2	2
Microstella rosea	2	3	1	1	1	3	4	2	2	2
Paracalanus parvus	1	4	1	1	1	2	3	2	2	1
Acartia clausi	1	3	1	1	1	2	3	2	1	1
Acartia latistosa	1	3	1	1	1	1	3	2	2	1
Acartia grani	1	3	1	1	1	2	2	2	2	1
Acartia sp.	1	1	1	1	1	1	1	1	1	2
Oithana nana	3	3	3	2	3	4	3	3	2	2
Larvae of Crustacea										
Nauplius larvae	4	3	2	2	1	5	4	3	3	2
Cirriped larvae	5	2	3	2	2	5	3	4	2	3
Copepodite stage	3	1	3	2	2	4	2	4	3	3
Mollusca Bivalvia										
Lamellaebranch veliger	3	2	3	2	1	3	2	3	2	2
Urochordata Appendicularia										
Appendicularia sicula	1	2	1	1	1	2	2	2	2	1

(5:Dominant 4:Abundant 3:Frequent 2: Occasional and 1: Rare(Brodic, 1985).