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Phytoplankton Community Structure at Some Sites of Marine Origin Fish Fry collection, with special reference to Mugilidae along Mediterranean Coast, Egypt

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Received 10th January 2010, Accepted 11th March 2010

Abstract

Phytoplankton Samples were collected from six sites along Mediterranean Coast of Egypt from Alexandria to Damietta during, 2005, besides January and February, 2006 (the period of marine origin fish fry collection). A total of 209 phytoplankton taxa were recorded; 96 Bacillariophyceae, 28 Dinophyceae, 28 Cyanobacteria, 7 Euglenophyceae, 49 Chlorophyceae and one species of silicoflagellates. The main phytoplankton groups were characterized by Bacillariophyceae and Chlorophyceae (64.63% and 28.13% to the total community, respectively). Kassara (West of Damietta) ,El-Meadyia and Rosetta sites showed increase in phytoplankton abundance(848.3x10^3, 539.9x10^3 and 329.2x10^3unit.l^{-1} respectively) which associated by the increasing production of marine fish fry, particularly Mugilidae (*Mugil cephalu*s and *Mugil capito*),which reached 14.2x10^6,566x10^3 and 1.1x10^6fry.$year^{-1}$ respectively. At Kassara site, fish fry production was positively correlated with pH, ammonia and nitrate, while at El- Meadyia site fish fry of *M.cephalus* was negatively correlated with pH, and at Rosetta site, fish fry of *M.capito* was positively correlated with number of phytoplankton species and species diversity, and fish fry production *M. cephalus* was negatively correlated with salinity and total phytoplankton counts. While Soffara (east of Damietta) site showed low phytoplankton counts (98.5x103 unit.l-1) and high production of fish fry (13.4x10^6 fry.$year^{-1}$), total phytoplankton was positively correlated with pH value, and fish fry production was negatively correlated with ammonia. The lower phytoplankton counts recorded at K21 and El-Mex sites(66.7x$10^3$and 206.4 x10^3unit.1^{-1},respectively), coincided with low production of marine fish fry at K21 (485x10^3 fry.$year^{-1}$) and moderately value of fish fry production at El-Mex site (770x10^3 fry.$year^{-1}$). At K21 site fish fry of *M.capito* was negatively correlated with salinity and DO, while phytoplankton count was positively correlated with salinity during the period of *M.cephalus* fish fry collection, at El-Mex site phytoplankton count was negatively correlated with DO.

Phytoplankton species diversity ranged between 0.52 nats (El-Meadyia, January, 2006) and 3.47 nats (K21, March). The Similarity matrix showed that, all stations grouped with species similarity level (47.32 - 85.36%) during winter, (49 - 90%) during autumn and (47.43 - 87.07%) during summer.

Keywords: Phytoplankton, diversity, similarity, fish fry, mugilidae, Mediterranean Coast.

1. Introduction

The survival of fish larvae are dependent on the availability of proper planktonic feed at the right time and place (Taivo and Murray, 1981). The stripped mullet, *Mugil cephalus*, is a catadromous fish with world-wide distribution, it spawns in the sea but thrives and grows rapidly in a wide range of salinities and geographical location (El-Gharabawy and Assem 2006).The nutrition of larval stages is one of the most critical aspects in the rearing of marine fish. During the first developmental stages, massive mortalities or low growth rates may occur, usually due to an inappropriate diet (Morais *et al*., 2005). Environmental conditions were also had an important role on the spawning success and recruitment of fish larvae (Hempel, 1968). Spring-spawning herring was determined by environmental factors other than the size of spawning stock (Drageund and Nakken, 1973). Deterioration of environmental condition often occurred result in serious economic losses (Bondad-antaso *et al*., 2005) .Embryos and newly hatched larvae were found to be particularly sensitive to water quality (Jezierska *et al*., 2008). So, the appearance of fish fry along the coasts is dependant to a large extent on the suitability of the environmental conditions at these coasts. Many compounds present in phytoplankton could potentially influence digestive enzyme activity in fish larvae (Lazo *et al*., 2000). There is bioactive compounds in the algal cells have a significant role controlling fish health (El-Kassas and Khairy, 2009).The present study was conducted to trace the composition of phytoplankton community relative to the variations of some environmental conditions and their relation with fish fry of Mugilidae were collected on a commercial scale along the Mediterranean Coast of Egypt, to impact their relation between phytoplankton abundance and fish fry growth. The collected fry is the only marine species source for stocking fish farms in Egypt (Shakweer *et al*., 2008)

This paper is a part of the research plan of Aquaculture Division, National Institute of Oceanography and Fisheries. This plan deals with distribution, biological and rearing aspects of marine fish fry along Mediterranean coast of Egypt from Alexandria to Damietta.

2. Materials and methods

Samples of phytoplankton were performed at six selected sites, along the coastal water of Egypt (Figure 1) together with fish fries, from February to May, 2005 (the time of *Mugil capito* fish fry collection) and from July to December,2005 (the time of *Mugil cephalu*s fish fry collection),beside January and February,2006. Two sites are situated near Alexandria City (K21 and El-Mex), other two localities are situated at Rosetta Branch and Lake Edku-sea connection (El-Meadyia and Rosetta) and the latter sites are situated opposite to Damietta Governorate (Kassara and Soffara). Quantitative phytoplankton samples were collected from the surface water, using plastic bottles of 2 liter capacity. The samples were preserved immediately with 4% neutralized formalin solution. Estimation of the phytoplankton count was carried out by sedimentation method (American Public Health association A.P.H.A., 1995) and expressed as unit.l^{-1} (The unit comprised cells, colonies and filaments). The identification of algal taxa followed (Peragallo and Peragallo, 1897-1908; Lebour, 1925; Cupp, 1934; Heurk**,** 1962; Hendy, 1964; Sourina, 1968; Sournia, 1986; Dodge, 1982; Mizuno, 1990). Species diversity was calculated according to the equation of (Shannon and Weaver, 1963). Samples of fish fries were collected from the selected sites together with for environmental conditions analysis which was published in the (Final Project's Report , 2005-2007). The statistical design used for studying the species similarity is Multivariate Methods; species analysis (species clustering) using Primary Program which used to define species assemblages (species co-occur at sites) using Bray-Curtis similarity matrix with aim to find" Natural grouping" of the samples more similar (Cormack, 1971).Results were analyzed with the SPSS 15.0 for windows, 2006 (Statistical Package for Social Science).

The level for accepted statistical significance was $p<0.01$ and $p<0.05$.

3. Results

3.1. Environmental conditions

The measurements of Phyisco-chemical parameters to phytoplankton sampling are shown in Table (1). The lowest pH value 6.75 (Rosetta and Kassara, November, 2005) and fish fry production (*Mugil cephalus*) reached 85% and 59% respectively,to the total marine fry fish collected there, while the highest one 8.89 (El-Mex, February, 2005), where phytoplankton density decreased to reach 66.4×10^3 unit l^{-1} and fish fry production (*M. capito*) reached 67.82% to the total marine fry fish collected there, this met with high zooplankton density.

Water salinity values showed wide range at the area of investigation. The lowest value (2.86 PSU) recorded at Kassara site during September,2005 was accompanied with high phytoplankton density (2277.6×10^3unit.l^{-1}),high dissolved oxygen value (11.43 ml.l^{-1}), low fish fry production of *Mugil cephalus* (47% to the total marine fish fry collected),and low nutrient salts values, except SiO_4^{-2}(Table 1)

On the other hand, the highest water salinity value (40.89 PSU) recorded at Rosetta site during March met with high phytoplankton density (1071.5×10^3 unit.l^{-1}), higher concentrations of dissolved oxygen (11.78 ml.l^{-1})),low nutrient salts ,except $SiO_4^{-2}$and PO_4^{-3}, and fish fry production (*M. capito*)reached 70.86% to the total marine fish fry collected (Table 1).

3.2. Phytoplankton Community composition

The study sites harbored a diversified phytoplankton community (209 taxa), that included 121 fresh and brackish water forms besides 88 marine forms. Six algal groups were represented, namely; Bacillariophyceae (96 species), constituted about 64.63% to the total community, Chlorophyceae (49 species), forming 28.13%, Dinophyceae (28 species) with 1.61%, Cyanobacteria (28 species) 5.02%, Euglenophyceae (7 species) 0.6% and one silicoflagellate species (0.01%).Bacillariophyceae predominated the investigation sites, except El-Mex site, where Chlorophyceae were co-dominant with Bacillariophyceae (Figure 2).

The relative abundance of the algal groups varied spatially and monthly, the phytoplankton community, nutrient salts concentrations, as well as marine origin fish fry production were discussed as follows:

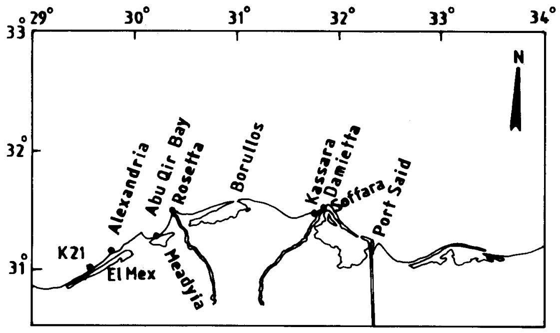

Figure 1: The area of study and sampling sites along the Egyptian Mediterranean Coast

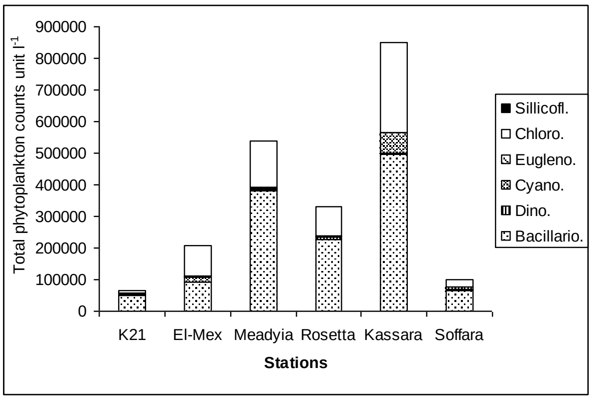

Figure 2. Distribution of Phytoplankton Classes (unit.1^{-1}) at different sites of investigated area.

3.2.1. K21 site

The phytoplankton samples were collected from February to April; from July to November, 2005; and February 2006. The phytoplankton density ranged between 30.6×10^3 unit.l^{-1} (March, 2005) and 115.2×10^3 unit.l^{-1}(February, 2006) as shown in Figure (3), with an average 66.7×10^3 unit.l^{-1}. This period included marine fish fry collection (*M. capito*) from February to May and from September to December, 2005 (*M. cephalus*) as shown in Table (1). The phytoplankton community was represented by 123 taxa; 41 were of marine forms and the others were either fresh or brackish. Bacillariophyceae were the dominant (77.7% to the total community, 64 species), while Chlorophyceae represented by 13.4% (24 species), Cyanobacteria 6.3% (20 species), Dinophyceae 2.6% (13 species) and two species of Euglenophyceae. Maximum diversity recorded in March (3.47nats, 49 species), while the lowest in July (2.57 nats, 38 species).

Zooplankton average density reached $43.0\text{x}10^3$ individual.m^{-3}, its diversity fluctuated between 1.6 and 2.6 nats, it was dominated by Rotifera and Copepoda (39.5%,36.5 to the total community respectively), Rotifera were dominated by *Ascomorpha saltans ,Brachionus plicatilis* and *Colurella adriatica* ,also Cirriped larvae, lamellibranch veligers, and spionid larvae were observed (Final Project's Report 2005-2007).

Low phytoplankton density recorded during March, was met with high zooplankton density, which leads to increase in fish fry production of *M. capito* (74.34% to the total fish fry collected). The dominant phytoplankton species were *Thalassiosira rotula* Meunier (9.6% to the total community); *Synedra ulna* (Nitzch.) Ehr. (9.6%); *Melosira varians* Agardh (5.6%); *Pleurosigma macrum* Wm. Sm. (5.3%) and *Nitzschia sigma* Wm. Sm. (5%).

The highest phytoplankton density recorded during February 2006, was represented by 43 species, they dominated by Bacillariophyceae (92.0% to the total community), *Nitzschia microcephala* Grun and *Mastogloia smithii* were the dominant (13.4% and 12.5%, respectively), and the other species were recorded as frequent or rare forms. Also high phytoplankton density observed during September (81.4×10^3 unit.l^{-1}), represented by 37 taxa and was also dominated by Bacillariophceae (74.6%), followed by Chlorophyceae (13.9%) and Cyanobacteria (11.3%). The most dominant species were *Melorsira moniliformis* (Müller) Agardh.(27.4% to the total community), *Melosira varians* Agardh. (14.4%), the Chlorophycean species *Pediastrum clathratum* (A. Braun) Lag. (7%), and the Cyanobacterian species *Oscillatoria limnetica* Lemm. (5.5%). The phytoplankton density was accompanied with moderate production of fish fry (*M. cephalus*) 62% to the total fish fry collected, and nutrient concentrations were 97.89 and 69.45µM for nitrate and silicate, respectively.

High fish fry production of *M. cephalus* (70% to the total fish fry collected) recorded during October accompanied with low zooplankton density, relatively low phytoplankton density (43.2×10^3unit.l^{-1}). Bacillariophyceae (80.4% to the total community) was the most dominant group dominated by *Melosira varians* Agardh (14.7% to the total community), *Nitzschia microcephala* Grun. (11.6%) and *Nitzschia sigma* Wm. Sm. (6.2%), followed by Cyanobacteria (12.4%), which was dominated by *Oscillatoria splendida* Grev. (5.8%) and Chlorophyceae formed (7.1%), represented by 7 species as rare forms, these were met with high nitrate and silicate concentrations (119.9, 68.4 µM respectively), relatively high dissolved oxygen value (8.39 ml.l^{-1}), and low ammonium concentration (3.9 µM).

Table 1. Physico-Chemical parameters (Final Project's Report, 2005-2007), Fish fry %, Total phytoplankton ($unit.l^{-1}x10^3$), Number of species and Species diversity (nats) at different sites of investigated area.

K21 Site:

unit			($ml.l^{-1}$)	(µM)					fish fry %	$unit.l^{-1}x10^3$		nats
parameter	pH	PSU	DO	NH_4^{+1}	NO_2^{-1}	NO_3^{-1}	SiO_4^{-2}	PO_4^{-3}	*M.capito*	T.Phy.	No.Spp	Diversity
Feb.2005	8.43	26.91	9.6	12.69	1.4	11.9	18.47	2.35	64.38	51.6	39	2.8
March	7.9	25.74	8.3	32.22	0.43	11.54	33.97	6.77	74.34	30.6	49	3.47
April	8.17	26.33	8.4	22.45	0.91	11.72	26.22	4.56	66.42	55.5	37	2.98
May	8.03	38.49	10.4	9.14	0.25	2.41	5.68	21.87	46.2	n.c.		
parameter	pH	PSU	DO	NH_4^{+1}	NO_2^{-1}	NO_3^{-1}	SiO_4^{-2}	PO_4^{-3}	*M.cephalus*	T.Phy	No.Spp	Diversity
July	8.1	8.66	4.69	5.47	1.01	99.8	68.4	0.69		84.8	38	2.57
August	8	8.4	4.9	5.3	0.9	82.4	59.3	0.41	61	89.4	37	2.98
Sep.	8.6	8.69	4.6	6.2	1.33	97.89	69.45	0.56	62	81.4	37	2.73
Oct.	7.75	6.93	8.39	3.9	1.63	119.87	68.4	0.75	70	43.2	44	3.28
Nov.	8	7.90	8.82	57.85	3.88	175.95	63.6	0.65	65	48.8	44	3.2
Dec.	7.12	7.50	6.48	45.80	2.14	110.4	59.80	0.61	55	n.c.		
Feb.2006	7.8	22.9	8.9	10.42	1.1	9.4	16.24	1.96	n.c.	115.2	43	3.23

3.2.2. El-Mex site

The phytoplankton samples were collected from February to May (the period of marine fish fry of *M. capito* collection) and from July to November, 2005 (the period of marine fish fry of *M. cephalus* collection) as shown in Table(1). The phytoplankton community was represented by 132 species (30 species of marine origin and the others of brackish and freshwater forms), with an average of 206.4×10^3 $unit.l^{-1}$. Bacillariophyceae were contributed by 70 species, while Chlorophyceae by 37 and Cyanobacteria by 15, the other forms related to Dinophyceae and Euglenophyceae. The dominancy shared by Bacillariophyceae and Chlorophyceae which were approximately contributed 45.52% and 45.88% to the total community, respectively (Figure 2).

Species diversity ranged between 1.58 nats, with 43 species in August due to the dominance of *Actinastrum gracillimum* G. M. Smith (66.5% to the total community) and 3.41 nats, with 61 species in November where the community was shared by *Cyclotella* spp. (18.4% to the total community), *Crucigenia* spp. (16.7%) and *Oscillatoria* spp. (7.6%).

Zooplankton diversity ranged between 2and 3 nats, with an average value $47.0x10^3$ $individual.m^{-3}$,dominated by Rotifera 61.4%,Copepoda 20.6%and Protozoa 14.3%(the dominant species were *Brachionus plicatilis*, *B.calyciflorus* and *Halicyclops magniceps*).The highest zooplankton density were recorded during March and April, while the lowest one was observed in September and November.

The phytoplankton density ranged between 9.1×10^3 $unit.l^{-1}$ (May) and 543.1 $unit.l^{-1}$ (August) as shown in Figure (3).Phytoplankton counts reached 441.8, 543.1 and 325.3×10^3 $unit.l^{-1}$ during July, August and September, respectively (Figure 3). The most dominant group was Bacillariophyceae except in August, when Chlorophyceae was the most dominant; *Actinastrum gracillimum* G. M. Smith formed the main bulk (66.5% to the total community). In July, Bacillariophyceae formed 66.7% to the total community, *Cyclotella kutzingiana* (Thw.) Chauvin (31.3% to the total community), *Nitzschia delicatissima* Cleve (15.9%) and *Cyclotella meneghiniana* Kütz (9.9%), while Chlorophyceae (30.5%) shared by *Ankistrodesmus setigerus* (Schrod) G.S.West (9%), *Scenedesmus acuminatus* (Lege.) Chod (7.8%), and *Crucigenia rectangularis* (Nag.) Gay.(4.5%).

In September, the high phytoplankton density accompanied with low salinity (4.5 PSU) and the concentrations of nutrient salts attained; 6.25, 12.98, 43.3and 92.3µM for ammonia, nitrite, nitrate and silicate, respectively (Table 1). Bacillariophyceae was the most dominant (66.1% to the total community) followed by Chlorophyceae (29.7%). The dominant species were *Nitzschia delicatissima* Cleve (42.8%), *Crucigenia rectangularis* (Nag.) Gag. (9.5%), *Actinastrum gracillimum* G.M.Smith (8.6%), *Cyclotella meneghiniana* Kütz. (5.9%). The recorded species considered as fresh or brackish forms, while 8 species were marine forms.

Fry of marine fish represented 98.02% to the total fish fry collected during March. This was accompanied with high silicate, phosphate and ammonia concentrations (206.91, 26.21 and 171.9 µM, respectively). Phytoplankton density reached 128.9×10^3 $unit.l^{-1}$, with 37 species; Bacillariophyceae formed 38.6% to the total community, with 22 species. Chlorophyceae formed 43.5% (9 species), Cyanobacteria 8.1% (3 species) and Euglenophyceae 9.8% (3 species). The dominant species were the chlorophycean species *Closterium acutum* Breb (23.6% to the total community) and *Chlorella marina* Butcher (13.9%). Bacillariophyceae were dominated by *Cyclotella meneghiniana* Kütz and *Cyclotella kutzingiana* (Thw.) Chauvin (15.1% and 13.6%, respectively).The Cyanobacterian species *Oscillatoria limnetica* Agardh represented (6.5%) and Euglenophyta was mainly represented by *Euglena acus* Ehr. 6% to the total community.

Water salinities ranged between 2.7 PSU (December,2005) and 10.97(February,2005), NH_4^{+1} concentration fluctuated between 5.35 (October,2005) and 171.9 µM (March,2005), NO_2^{-1} ranged between 0.25 (May) and 12.98 µM (September), NO_3^{-1} varied between 0.51 (May) and 67.26 µM (November), SiO_4^{-2} ranged from 67.1(December) to 206.91 µM (March) and PO_4^{-3} 4.05 (December) and 26.21 µM (March) as shown in Table (1).

Table 1. Cont.

El-Mex site

unit			(mg.l^{-1})	(µM)					fish fry %	unit.l^{-1}x10^3		nats
parameter	pH	PSU	DO	NH_4^{+1}	NO_2^{-1}	NO_3^{-1}	SiO_4^{-2}	PO_4^{-3}	*M.capito*	T.Phy.	No.Spp	Diversity
Feb.2005	8.89	10.97	8.10	96.90	7.85	9.50	172.25	6.29	67.82	66.40	53	3.23
March	7.88	4.30	2.90	171.90	12.38	1.14	206.91	26.21	98.02	128.90	37	2.52
April	8.39	7.64	3.20	134.40	10.11	5.31	189.58	16.25	77.92	159.80	55	2.86
May	7.90	4.51	2.20	76.32	0.25	0.51	137.12	22.85	39.20	9.10	37	0.94
parameter	pH	PSU	DO	NH_4^{+1}	NO_2^{-1}	NO_3^{-1}	SiO_4^{-2}	PO_4^{-3}	*M.cephalus*	T.Phy.	No.Spp	No.Spp
July	8.46	5.00	2.80	6.01	12.33	52.03	81.70	6.19	75.00	441.80	37	2.33
August	8.40	4.60	3.20	5.90	11.98	43.20	79.21	5.97	73.00	543.10	43	1.58
Sep.	7.09	4.50	8.10	6.25	12.98	43.3	92.30	6.47	75.00	325.30	51	2.34
Oct.	7.65	4.50	8.19	5.35	12.38	52.36	188.64	5.50	85.00	43.20	52	3.16
Nov.	7.90	4.10	7.18	76.80	12.87	67.26	72.45	4.55	81.00	140.20	61	3.41
Dec.	8.10	2.70	8.65	96.32	11.45	59.30	67.10	4.05	60.00	n.c.		

3.2.3 .Meadyia site

The phytoplankton samples were collected from February, 2005 to January 2006 except of April and October (Figure 3).It was coincided with the period of fish fry collection of *M. capito* from February to May and for *M. cephalus* from September to December. The highest phytoplankton density were recorded during February and August (1337.9×10^3 and 1597×10^3 unit.l^{-1}, respectively), while the lowest density appeared during December 79.2×10^3 unit.l^{-1}. Species diversity fluctuated between 0.52 nats, with 18 species (January 2006) and 3.07 nats, with 52 species (June, 2005). The community was represented by 125 taxa belonging to six groups, Bacillariophyceae were the leader forming, 70.3% to the total community (58 species), Chlorophyceae 27% (35 species), Cyanobacteria 1.3% (16 species), Euglenophyceae 0.7% (5 species), Dinophyceae 0.64% (10 species) and Silicoflagelletes.

Zooplankton average density reached 30.0 x10^3 individual.m^{-3}, and diversity ranged between 1.1and 2.9 nats, dominated by Copepoda 39.9%, Protozoa 22.4% and Rotifera 10.51%, the dominant Copepod species was *Euterpina acutifrons* and from *Rotifera Brachionus angularis*. The highest zooplankton density was recorded during July, while the lowest one was observed in June and August.

The high density of phytoplankton recorded in February accompanied with low zooplankton counts and high fish fry production in which *M. capito* represented 88.41% to the total fish fry catch. Nutrient concentrations were 19.89, 9.23 and 2.3µM for ammonia, silicate and phosphate, respectively. Forty taxa of phytoplankton were recorded. Bacillariophyceae and Chlorophyceae were the dominant (50.7% and 47% to the total community, respectively).While Euglenophyceae and Cyanobacteria were recorded as rare forms. The most dominant species were *Cyclotella meneghiniana* Kütz.(41.9% to the total community) and *Chlorella marina* Bütcher (40.0%).

In September, fry of *M. capito* represented 82% to the total fish fries collected accompanied with high phytoplankton counts (379.2×10^3 unit.l^{-1}),and high diversity (2.7 nats, with 50 species belonging to six groups. Bacillariophyceae and Chlorophyceae were the dominant (80% and 43.3% to the total community,respectively),while Dinophyceae, Cyanobacteria, Euglenophyceae and Silicoflagellates formed the rest. The most dominant species were *Biddulphia aurita* 22.6% to the total community, *Cyclotella kutzingiana* (Thw), Chauvin (13.2%), *Cyclotella meneghiniana* Kütz. (8%) and *Cyclotella comata* (Ehr.), Kütz.(6.5%).

Phytoplankton density dropped in December to reach 79.2×10^3 unit.l^{-1}(Table 1).This was accompanied with low concentration of ammonia (9.10µM) and moderate concentration of nitrate, nitrite, and phosphate (21.06, 3.25and 2.7µM , respectively while silicate concentration reached 39.54 µM . The catch of *M. capito* fry was 60% to the total fish fry collection. The phytoplankton community was represented mainly by Bacillariophyceae (93.6%), Chlorophyceae (4.9%), while Dinophyceae and Euglenophyceae were 1.23 and 0.25%, respectively. *Biddulphia mobiliensis* Bail. Grun. (78.43% to the total community) was the most dominant species.

Table 1. Cont
El-Meadiya

unit			$ml.l^{-1}$	(µM)					fish fry %	$unit.l^{-1}x10^3$		nats
parameter	pH	PSU	DO	NH_4^{+1}	NO_2^{-1}	NO_3^{-1}	SiO_4^{-2}	PO_4^{-3}	*M.capito*	T.Phy.	No.Spp	Diversity
Feb.2005	8.73	11.86	8.40	19.89	4.35	3.12	9.23	2.30	88.41	1337.9	40	1.61
March	8.04	11.90	7.30	13.95	3.03	4.96	41.50	5.57	60.15	426.9	41	2.24
April	8.39	11.88	3.20	16.92	3.69	4.04	25.37	3.94	49.02	n.c.		
May	8.17	13.39	3.10	3.15	0.95	25.65	5.51	2.98	8.87	281.2	25	3.0
parameter	pH	PSU	DO	NH_4^{+1}	NO_2^{-1}	NO_3^{-1}	NO_3^{-1}	PO_4^{-3}	*M.cephalus*	$unit.l^{-1}x10^3$	No.Spp	Diversity
July	8.1	25.00	2.90	2.01	2.90	2.80	40.80	3.80	n.c.	155.4	36	1.94
Aug.	7.35	7.57	8.62	2.01	0.45	3.16	37.80	1.25	82.00	1597.0	50	2.19
Sep.	7.25	27.23	8.65	0 .66	3.16	1.15	37.80	4.05	82.00	379.2	50	2.70
Oct.	7.5	30.95	6.91	1.69	4.94	21.60	59.60	3.98	70.00	n.c.		
Nov.	7.85	38.5	10.45	18.35	9.06	49.34	76.50	4.25	75.00	729.8	44	2.85
Dec.	8.00	40.00	12.80	9.10	3.25	21.06	39.54	2.7	60.00	79.2	22	1.06
Jan.2006	7.91	32.90	9.90	10.60	2.60	12.40	20.10	2.30	n.c.	293.8	18	0.52

3.2.4. Rosetta site

The phytoplankton samples were collected from February 2005 to January 2006 except, April, May, October and November. The average phytoplankton density reached 329.2×10^3 unit.l^{-1}, and ranged between 23.7×10^3 unit.l^{-1}in June and 1101.2×unit.l^{-1} in February, 2005 (Figure 3) .

Zooplankton average density reached 77.0x10^3 organisms/m^3, its diversity ranged between 1.0 - 5.2 nats. It was dominated by Copepoda 32.0%, Rotifera 25.0% and Protozoa 19.0%. The dominant phytoplankton group was Bacillariophyceae (68.65% to the total community) with 53 species, followed by Chlorophyceae (27.48%) with 29 species. Dinophyceae (17 species), Euglenophyceae (3 species), Cyanophyceae (7 species) and Silicolfagellates (one species) constituted 2.5%, 0.87%, 0.49% and 0.01%, respectively. Species diversity ranged between 0.6 (March) with 29 species and 3.08 nats (August) with 31 species. The highest phytoplankton density recorded during February was mainly represented by Chlorophycean species *Carteria cordiformis* Butcher (59.6% to the total community) and Bacillariophycean species *Skeletonema costatum* (Grev.) Cleve (27.2%).This was coincided with high production of fish fry, where *M. capito* reached 97.85% to the total fish fry collected. Concentrations of nutrient salts were low (1.13, 0.15, 2.77, 2.06 and 3.65µM) for ammonia, nitrite, nitrate, phosphate and silicate, respectively).

Table 1. cont.

Rosetta

unit			$ml.l^{-1}$	(µM)					fish fry %	$unit.l^{-1}x10^3$		nats
parameter	pH	PSU	DO	NH_4^{+1}	NO_2^{-1}	NO_3^{-1}	SiO_4^{-2}	PO_4^{-3}	*M.capito*	T.Phy.	No.Spp	Diversity
Feb.2005	8.57	37.33	10.30	1.13	0.15	2.77	3.65	2.06	97.85	1101.2	37	1.29
March	7.95	40.89	11.78	2.03	17.9	3.29	174.76	12.09	70.86	1071.5	29	0.6
April	8.26	39.11	9.10	1.58	9.03	3.03	89.21	7.08	49.02	n.c.		
May	8.15	33.90	5.10	3.00	0.8	25	30.10	3	34.38	n.c.		
parameter	pH	PSU	DO	NH_4^{+1}	NO_2^{-1}	NO_3^{-1}	SiO_4^{-2}	PO_4^{-3}	*M.cephalus*	$unit.l^{-1}x10^3$	No.Spp	Diversity
July	7.65	17.26	11.43	1.20	1.78	12.26	35.76	0.6	n.c.	144.7	46	2.79
Aug.	8.51	9.30	1.90	2.09	1.99	11.35	38.45	1.84	72.00	33.5	31	3.08
Sep.			2.20	1.20	1.78	12.26	35.76	1.09	72.00	74.8	27	1.55
Oct.	7.95	11.23	10.30	7.95	5.15	4.45	37.44	1.65	85.00	n.c.		
Nov.	6.75	2.86	9.10	10.65	8.64	35.19	39.08	2.01	85.00	n.c.		
Dec.	7.82	2.90	11.40	22.40	12.48	64.4	39.99	5.70	75.00	120.5	43	1.55
Jan.2006	8.10	35.20	8.40	2.40	2.10	40.10	32.90	3.20	n.c.	64.0	32	2.41

3.2.5. Kassara site(West of Damietta)

Kassara site is one of several wild mullet fries (*Mugil cephalus* and *M.capito*) collecting centers along the Mediterranean coast. The phytoplankton samples were collected during March, August, September, November (2005) and February (2006) (Figure 3). Phytoplankton was represented by 89 taxa with an average density reached 848.3×10^3 unit.l^{-1}, which was the highest density that recorded along the Mediterranean Coast of Egypt coincided with the highest zooplankton average counts (428.0x10^3 Organisms.m^{-3}), its diversity ranged between 0.9-2.3 nats and dominated by Rotifera(88.3%).The highest zooplankton density was recorded in February,2006,while the lowest one in August. Fish fry production in this site attained 17769×10^3 fry/year shared by *M. Capito* 13309×10^3 fry/year and *M. cephalus* 4460×10^3 fry/year, as well as high nutrient salts concentration, dissolved oxygen concentration and pH value, while salinity value was low compared to Soffara site. The phytoplankton community shared by Bacillariophyceae (42 species) 58.36% to the total community, Chlorophyceae (26 species) 33.37% and Cyanobacteria (13 species) 7.72%, while Dinophyceae (5 species) and Euglenophyceae (3 species) (0.36% and 0.18%, respectively), appeared as rare forms. Species diversity fluctuated between 1.81 nats August (27 species) and 2.65 nats November (44 species). Bacillariophyceae and Chlorophyceae were the dominant except of August, where Cyanobacteria were the leader, due to the dominancy of *Oscillatoria limnetica* Lemm. (31.5% to the total community).

High phytoplankton counts were recorded during September (2277.6×10^3 unit.l^{-1}), 51 taxa, and mainly represented by Bacillariophyceae (21 species) 59.72% to the total community, in which *Cyclotella comata* (Ehr.) Kutz. (30.4%), *Cyclotella meneghiniana* Kutz. (14.3%), *Nitzschia microcephala* Grun.(6.1%) and *Nitzschia delicatissima* Cleve (4.8%)were the dominant. Chlorophyceae(16 species) 33.73% to the total community, represented by *Coelastrum microporum* Nag. (8.7%), *Scenedesmus accuminatus*(Lege.) Chod (5.04%), *S. Opolensis* P. Richt. (3%), *S.bijuatas*(Turpin) Lege. &Ehr (2.8%) and *Crucigenia rectangularis* (Nag.) Gay 4.5%.Dissolved oxygen concentration (11.43ml.l^{-1}), high silicate concentration (86.42 µM), ammonia (9.9 µM) and low salinity value (2.86 PSU) were recorded during this month, while fish fry production of *M. cephalus* reached 47% to the total fish fry production

Table 1. Cont.
Kassara (West of Damietta)

unit			(ml.l^{-1})	(µM)					%	unit.l^{-1}x10^3		nats
parameter	pH	PSU	DO	NH_4^{+1}	NO_2^{-1}	NO_3^{-1}	SiO_4^{-2}	PO_4^{-3}	fish fry	T.Phy.	No.Spp	Diversity
March										489.8	44	2.56
									M.cephalus			
July	7.80	2.63	8.86	8.64	1.93	8.99	49.50	1.06	44			
August	7.62	2.92	9.80	9.70	2.21	9.90	56.40	1.03	46	447.2	27	1.81
Sep.	7.45	2.86	11.43	9.90	2.25	11.4	86.42	1.70	47	2277.6	51	2.64
October	7.05	2.95	8.64	9.19	2.01	10.59	53.55	2.30	45	n.c.		
Nov.	6.75	3.01	7.18	10.08	1.61	10.30	159.7	4.40	59	944.2	44	2.65
Dec.	6.75	3.01	7.18	10.08	1.61	10.30	40.59	1.60	60	n.c.		
Feb.2006	7.67	3.01	8.10	9.61	1.40	7.63	30.90	1.40		82.4	51	2.28

3.2.6. Soffara site (East of Damietta)

Phytoplankton samples collected during February, August, November, 2005 and February, 2006 (Figure 3) met with the period of fish fry collection for *M. capito* during February 2005 and *M. cephalus* during November. Soffara site recorded low zooplankton counts 28.0x10^3organsims.m^{-3}, dominated by Copepoda 50.7%, and Rotifera 33.9%. Phytoplankton density attained 98.5×10^3 unit.l^{-1}, 83 taxa were recorded and dominated by Bacillariophyceae (45 species) 67.28% to the total community, Chlorophyceae (18 species) 21.62%, Cyanobacteria (6 species) 7.08%, Dinophyceae (12 species) 3.5% and Euglenophyceae (0.51%) which represented only by two species. Species diversity ranged between 1.66 nats in February, 2005 (26 species) and 2.62 nats in November (22 species). Bacillariophyceae was the most dominant group during all months, except February 2005, where Cyanobacteria (2 species) was the most dominant group (51.36% to the total community), which mainly represented by *Phormidium tenues* (Menegh) 51.11% to the total community, followed by Bacillariophyceae (14 species) 35.14% which were dominated by *Cocconeis placentula* Ehr.(25.6% to the total community), Chlorophyceae (4 species) 11.27% and Dinophyceae (6 species) 2.23% to the total community. During this month fish fry production of *M. capito* reached 64.84% to the total fish fry collected. These results were accompanied with low concentration of nutrient salts (1.13, 0.15, 2.7, 3.65 µM for ammonia, nitrite, nitrate and silicate respectively). High salinity value was recorded (37.3 PSU).

The highest phytoplankton density was recorded during February, 2006 (320.4×10^3 unit.l^{-1}). 53 Phytoplankton taxa were recorded, Bacillariophyceae (26 species) contributed 69.79% to the total community dominated by *Nitzschia closterium* W. Smith (48.06% to the total community), *Cyclotella kutzingiana* (Thw.) Chauvin and *Cyclotella meneghiniana* Kutz (7.49% and 5.93% respectively) Chlorophyceae (14 species) shared by 23.91% to the total community, represented mainly by *Chlorella marina* Butcher, *Crucigenia rectangularis* (Nag.) Gay, *Ankistrodesmus falcatus* V. *marable* and *Scenedesmus bijuatus* (Turp.) Kutz.(7.18%, 4%, 3.8% and 2.9% to the total community, respectively).

Table (1). Cont.
Soffara (East of Damietta)

unit			(ml.l^{-1})	(µM)					fish fry	unit.l^{-1}x10^{3}		nats
parameter	pH	PSU	DO	NH_4^{+1}	NO_2^{-1}	NO_3^{-1}	SiO_4^{-2}	PO_4^{-3}	*M.capito*	T.Phy.	No.Spp	Diversity
									%			
Feb.2005	8.6	37.33	8.1	1.13	0.15	2.7	3.65	2.1	64.85	37.2	26	1.66
									69.6			
									35.22			
			DO						*M.cephalus*			
July	7.55	33.24	11.78	9.30	1.4	28.27	46.42	1.70	40			
August.	7.61	32.13	9.87	6.90	1.20	24.30	34.30	0.90	39	17.4	21	2.51
Sep	7.22	33.11	10.65	7.23	0.96	25.90	39.54	1.30	41			
October	7.29	33.49	9.18	1.02	0.59	4.25	3.55	1.50	45			
Nov.	7.45	31.39	10.12	0.78	0.30	5.28	3.48	0.33	58	19.0	22	2.62
Dec.	7.9	37.67	7.67	1.90	2.50	38.27	17.0	2.25	65	n.c.		
Feb.2006	8.1	37.2	7.9	1.01	0.28	4.9	8.90	1.35		320.4	23	1.98

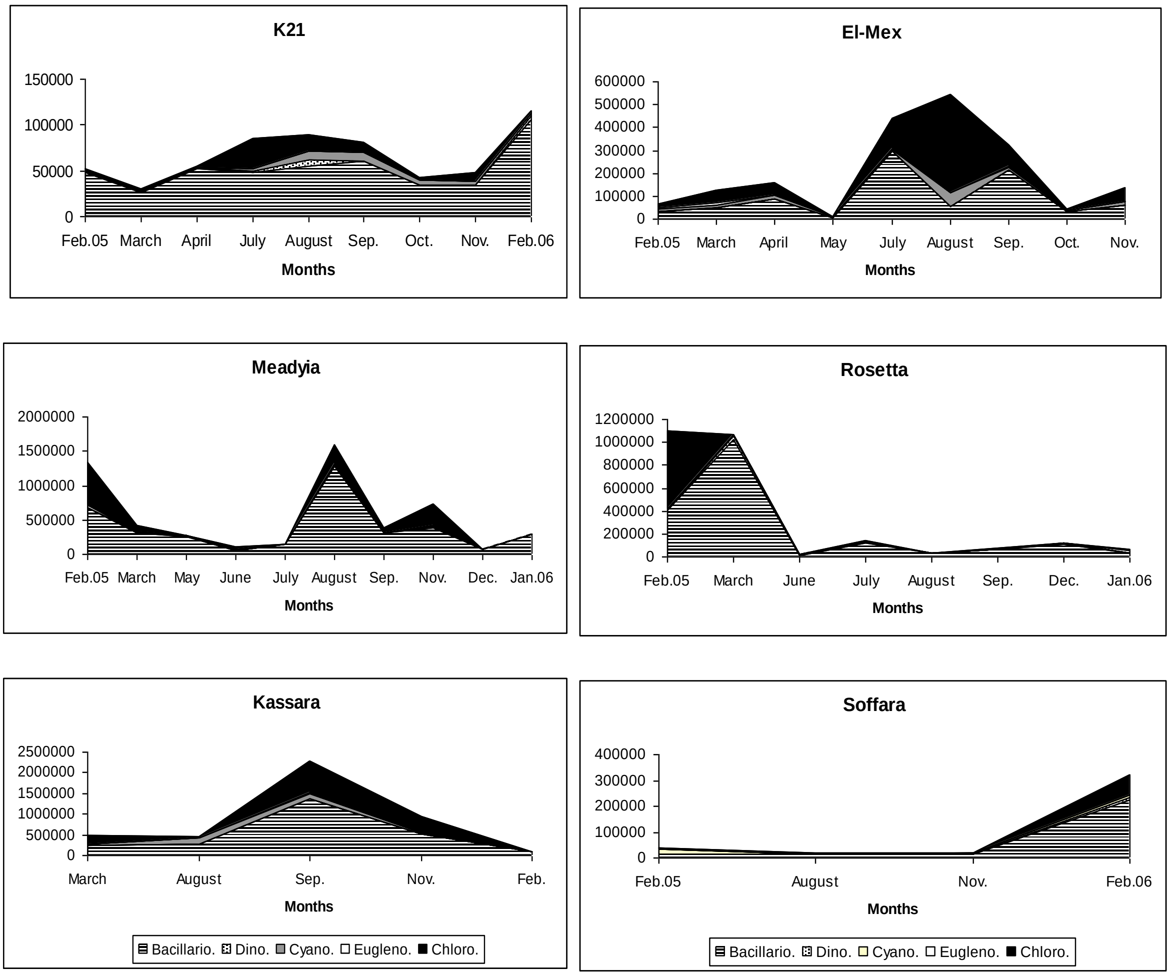

Figure 3. Phytoplankton counts (unit.l^{-1}) at six sites of the studied area during 2005-2006.

4. Discussion

Hydrogen ion concentration (pH) considered as one of the most important factors affecting fish in the marine environment. Alkaline or neutral water seems more productive than acid water for fish living (Swingle, 1957 and Huet, 1972). This result was agreed with the present study where, fish fry was successfully collected when the pH of water lies in the slightly alkaline side. Higher values of pH were recorded during autumn at most localities in comparison with those recorded in summer. This may be due to phytoplankton blooming where CO_2 is consumed during photosynthesis (Shakweer *et al*., 2008). The changes in pH is a result of photosynthesis that involves the uptake of free carbon dioxide from the water and the precipitation of calcium carbonate (Haroon and Daboor, 2009).

The wide range of water salinity values at the area of investigation indicated that, the water salinity is not the limited factor of attractive marine fish fry due to its ability to live at the coastal area regardless its salinity (El-Gharabawy and Assem 2006 and Shakweer *et al*., 2008). This was due to the fact that marine fish especially grey mullet accommodating in water bodies at wide range of salinity. At K21 site fish fry of *M.capito* was negatively correlated with salinity ($r = -0.956$, $p<0.05$), while phytoplankton count was positively correlated with salinity during the period of *M.cephalus* fish fry collection ($r = 0.761$, $p<0.05$).At Rosetta site fish fry of *M.cephalus* was negatively correlated with salinity and phytoplankton counts ($r = -0.768$ and -0.742, $p<0.05$, respectively)

Concentrations of dissolved oxygen at the various sites indicate that, these sites are well aerated and favorable for the existence of fish fry. The development of fish eggs, survival of larvae and recruitment are all dependent on oxygen content of water (Taivo and Murray, 1981). At K21 site fish fry of *M.capito* was negatively correlated with DO($r = -0.906$, $p<0.05$), and at El-Mex site phytoplankton count was negatively correlated with DO during the period of *M.cephalus* fish fry collection ($r = -0.860$, $p<0.05$).

Nutrient salts concentration showed wide range of spatial and seasonal variations. El-Mex site receives a heavy load of wastewater discharged from El-Ummum Drain (2.4×10^9 m^3/year) and El-Nubaria Canal (0.1×10^6 m^3/day) (El-Gindy *et al.*,1986). The highest ammonia concentrations existed during September and November as a result of agriculture wastewater discharged. The use of fertilizer containing ammonia is a source of ammonium ion in water (Vanloon, and Duffy, 2000). At El-Mex site fish fry of *M.capito* was positively correlated with ammonia and silicate ($r=0.956$ and 0.995, $p<0.05$, respectively), while during the period of *M.cephalus* fish fry collection, phytoplankton counts were positively correlated with phosphate ($r=0.759$, $p<0.05$) and fish fry positively correlated with number of phytoplankton species and species diversity($r=0.913$ and 0.968, $p<0.05$, respectively). Nitrate is the most stable form of inorganic nitrogen compound in marine environment (Grasshoff *et al*., 1976). So, nitrate was well positively correlated with fish fry and diversity ($r=0.83$, 0.675, $p<0.01$, respectively) and with total phytoplankton counts and number of species respectively. Higher concentration of silicate was found at El-Mex site in comparison with the other sites of fry collection along the coastal areas of Egypt. The spring blooming of phytoplankton cause a rapid decrease in the concentration of silicon (Riley and Chester, 1971). Silicate was correlated with species diversity ($r=0.594$, $p<0.05$) The highest phytoplankton density recorded during September coincided with high percentage of marine fish fry production (*M. cephalus*) which reached 75% to the total fish fry collected there. This result may explain the decrease of dissolved oxygen concentration at El-Mex site may be due to consumption of oxygen in the oxidation process of dissolved organic matter (Shakweer *et al*., 2008). The presence of Cyanobacterian species as well as Euglenophycean species emphasizes the presence of pollution at El-Mex site. The assemblages of Cyanobacteria have ability to grow under wide range of chemical variability (Holmes and Whitton, 1981) and Euglenoides often occur in deoxygenated water (Round, 1981).

The moderate phytoplankton density recorded during October at K21 site are net producers of dissolved oxygen and they assimilate ammonia as a nitrogen source for growth there by reducing the accumulation of un-ionized ammonia, which can be toxic to aquatic animals at relatively low concentration (Smith, 1991).At K21 site, fish fry production was positively correlated with pH, dissolved oxygen, diversity and number of species ($r= 0.636$, 0.689, 0.624 and 0.579, $p<0.05$ respectively).Total phytoplankton counts were positively correlated with pH, silicate concentration ,diversity and number of species ($r= 0.561$, 0.780, 0.687 and 0.669, $p<0.05$ respectively),and negatively correlated with phosphate concentration ($r=-0.565$, $p<0.05$).

At El- Meadyia site, the community was typically brackish water, which usually comprises fresh, brackish and marine forms with different contributions, only 43 species of phytoplankton were of marine forms. This agrees with the results of Gharib and Dorgham (2000) demonstrated at the same area. The abundance of *C. meneghiniana* in the area during February is an indicator of pollution and low water salinity (2.86 PSU) coincided with Gharib and Dorgham (2000) and Hussein (2008). During December Bacillariophyceae was dominant over Chlorophyceae, this may be due to the competition for phosphate which leads to flourish of large number of diatoms over the green species (El-Sherif, 1993 and Sommer *et al*., 1986). Fish fry of *M.capito* was positively correlated with ammonia and nitrite ($r=0.932$, $p<0.05$, respectively).At Rosetta site low nutrient salts concentrations recorded during February may be due to their consumption by phytoplankton, these results were accompanied with an increase in pH value (8.7) and moderately salinity value (11.5 PSU), this due to the fact that marine fish especially grey mullet can withstand and accommodate in water bodies at wide range of salinity (Shakweer *et al*., 2008). During February, the phytoplankton community mainly represented by Chlorophycean species *Carteria cordiformis* (59.6% to the total community), which considered as indicator species of pollution (El-Sherif, 1993). Chlorophyta which represents the major component of the community is a wide spread class in eutrophic area (Kolay and Sahin.2007). Total phytoplankton counts were positively correlated with salinity ($r=0.524$, $p<0.05$), Fish fry of *M.capito* was positively correlated with number of phytoplankton species and species diversity($r=0.946$ and 0.975, $p<0.05$, respectively), while fish fry production *M. cephalus* was negatively correlated with salinity and total phytoplankton counts ($r=-0.768$ and -0.742, $p<0.05$, respectively).

At Kassara site, fish fry production was positively correlated with pH value, ammonia and nitrate($r=0.841$, 0.745 and 0.838, $p<0.05$), while at Soffara site total phytoplankton was positively correlated with pH value ($r=0.712$, $p<0.05$), and fish fry production was negatively correlated with ammonia ($r=- 0.743$, $p<0.05$).

4.1.Multivariate Methods (Species Similarity)

Attention appears to have turned to similarity (Arhonditsis *et al*., 2003), as they are good for detecting suitable changes in community structure.

The dendrograms showing classification of six sites based on mean the mean root-root transformed abundance of 209 taxa of phytoplankton were estimated at different sites using the Bray-Curtis measure of similarity and groups average sorting through six months which were further grouped into three seasons(Figure 4).

4.1.1. Winter (February -March, 2005)

As shown in Figure 4, sites affinities with similarity level 48.0% delineated three groups. The first comprised two sites; K_{21} and Damietta (E) with similarity level 57.1 %. The second group with similarity level 69.9 % comprised El-Mex site, El-Meadyia and Boughaz El- Meadyia with high similarity level 85.4 % at Meadyia and Boughaz El-Meadyia.The third similarity group showed the least similarity at 48% level and represented at Rosetta site. During March two main groups namely; K21 with similarity level 47.3% and the second has similarity level of 47.4 % at Rosetta site. This group is further divided into three homogenous sub-groups namely; El-Meadyia and west of Damietta (Kassara) site with the highest similarity level 82.55% followed by El-Mex site at 70.0% level. The third subgroup comprised Boughaz El-Meadyia at the level of 47.5%, due to the dominancy of Bacillariophyceae and Chlorophyceae at these sites.

4.1.2. Summer (July- August, 2005)

The similarity level of 52.7 % comprised four sites (Figure 4).They delineated two groups. The first is the minimum one and comprised K_{21} site (52.7 %). The second is at Rosetta site with similarity level 68.5 %.This group was divided into two subgroups namely; El-Mex and Meadyia sites (87.1 %). The dendrogram with complete linkage correlation coefficient distance during August (Figure 4) comprised the six sites and delineated two major groups. The first with similarity level 47.4% and comprised El-Mex site. The second group with similarity level 50.9% is divided into two sub-groups. The first with similarity level 65.0% and comprised El-K21 and Rosetta sites. The second subgroup comprised three sites namely; El- Meadyia and Damietta (W) with similarity level 68.5%. The third one has similarity level 57.9 % and represented by Damietta (E).

4.1.3. Autumn (September-November, 2005)

The dendrogram classification in September, 2005(Figure 4) showing similarity of 49% delineates three groups. The first group comprised K_{21} with minimum similarity (49%).Group two represented El-Mex site with similarity level about 50%. The third group comprised El- Meadyia site with similarity level 60% and it was divided into one homogeneous sub-group reached in similarity level to 90% and comprised Rosetta and Damietta (W) (Kassara). Bacillariophyceae achieved the highest percentage. The dendrogram classification in November, 2005(Figure 4) showed similarity level of 53.53% delineates two main groups. The first group contributed K_{21} and Damietta (E) Soffara at similarity level 64.58%. The second group reached 60.15% similarity level and it was divided into two sub-groups, the first is at Damietta (w) and the second is a homogenous subgroup with similarity level 81.52%, comprised El-Mex and El- Meadiya sites, which represented the highest similarity.

5. Conclusions

The phytoplankton abundance of some coastal areas located along the Mediterranean Coast of Egypt were carried out parallel to collection of fish fry of marine origin, as well as prevailing environmental conditions to conclude that, West of Damietta (Kassara) showed the highest phytoplankton abundance associated with the highest production of fish fry of marine origin, particularly grey mullet due to increase in nutrient salts and dissolved oxygen concentrations which create favorable conditions to survive these fries compared to East of Damietta site (Soffara), which showed low phytoplankton density. El-Meadyia and Rosetta sites showed gradual decrease in phytoplankton abundance.

While the phytoplankton density of Rosetta site was lower than El-Meadyia, the production of fish fry in Rosetta was higher than El-Meadyia, due to increase in nutrient salts (phosphate, silicate and nitrate), as well as increasing in dissolved oxygen concentration. The phytoplankton density of El-Mex and K_{21} sites were lower than other sites, accompanied with low fish fry production due to decrease in salinity value at El-Mex site than K_{21} as a result of water discharged from El-Ummum Drain, decreasing in dissolved oxygen, and phosphate concentration in K_{21} than El-Mex.

These results presented a good example of some statistical analysis that can be applied to the biological data as shown in the clustering of Bray-curtis similarities.

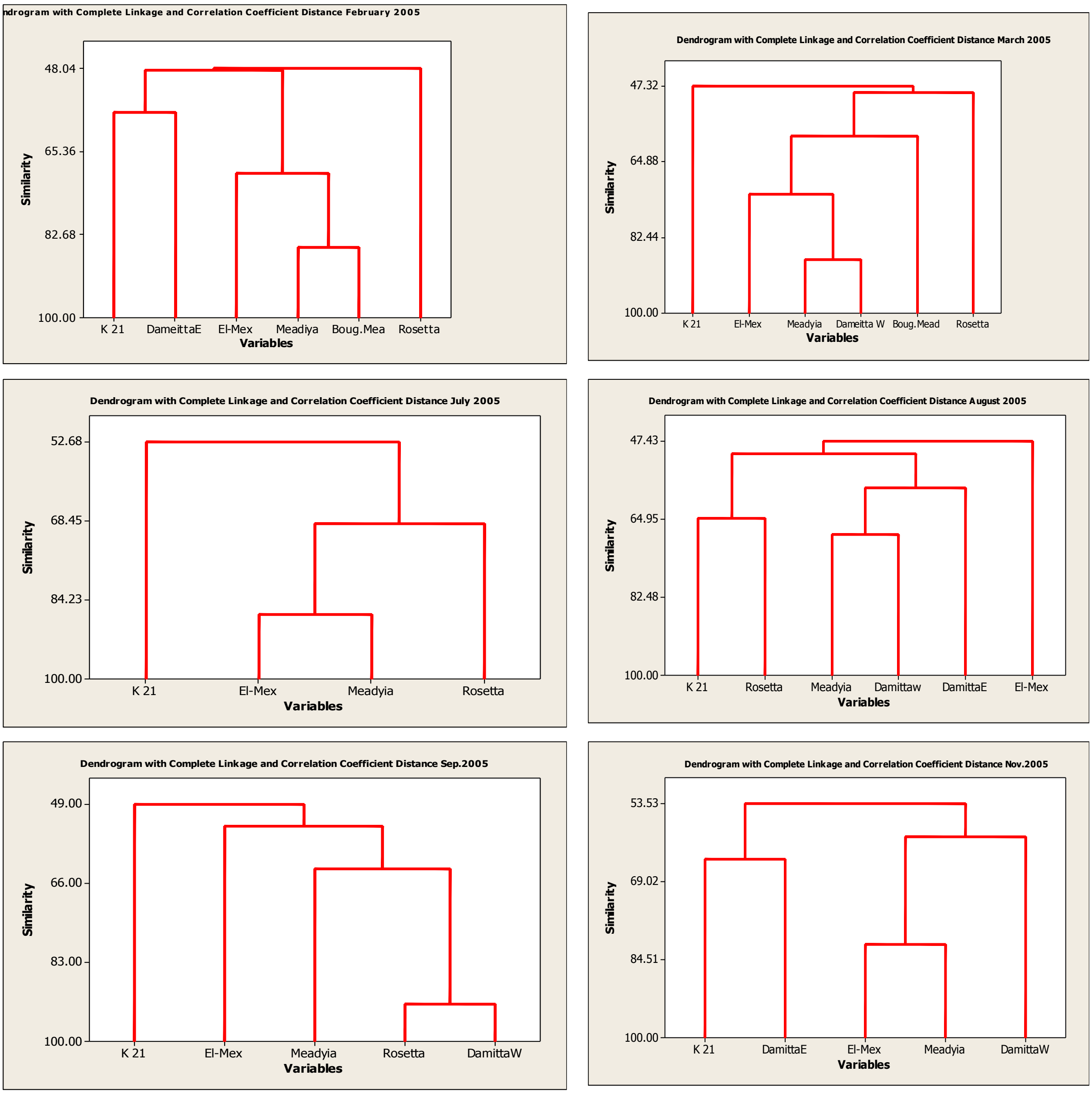

Figure 4. Dendrogram for group-average clustering of Bray-curtis similarities for species from 6 sites during 6 months.

Acknowledgement

Authors are deeply grateful to Prof. Dr. Mohammed Abd El-Razek Principal investigator of this research plan for providing facilities of the phytoplankton samples as well as the final report of the distribution, biological and rearing aspects of Marine fish fry from Mediterranean Sea plan between Alexandria and Damietta Governorate.

References

American Public Health association (A.P.H.A.):1995,' Standard Methods for the Examinations of Water and Wastewater'. 19 Edition , American Public Health association, AWWA and WPCF.

Arhonditsis G.; Karydis M. and Tsirtsis G.:2003, Analysis of Phytoplankton community structure using similarity indices: anew methodology for discriminating among eutrophication levels in coastal marine ecosystems. *Environment Mangement* 31:619-632.

Bondad-antaso, M.; Subasinghe, R.P.; Arthur, J.R.; Ogawa, K.; Chinabut, S.; Adlard, R.; Tan, Z. and Shariff, M.: 2005,Disease and health management in Asiana *aquaculture Vet.Parasitology*,132:249-272.

Cormack, R.M.: 1971, A review of classification .J.R. *Statist. Soc.Ser.A.*, 134:321-367.

Cupp, E.E.: 1934, Marin plankton diatoms of the West Coast of North America. *Bull. Scripps Inst.Oceanogr.*, 5(1): 1-238.

Dodge, J.D.: 1982, Marin dinoflagellates of the British Isles.*Her Majesty's Stationary Office,London,*303.PP.

Drageund, O. and O.Nakken, 1973.Relationship of parent stock size and year-class strength in Norwegian Spring Spawning herring.*Rapp.P.V.Reun*, 164:2-29.

El-Gharabawy, M.M., and Assem, S.S.: 2006, Spawning induction in the Mediterranean grey mullet *Mugil cephalus* and larval developmental stages. *African Journal of Biotechnology* vol. 5(19)1836-1845.

El-Gindy, A.A.; Aboul-Dahab, O. and Halim, y.: 1986, Preliminary estimations of water and trace metals balances in El-Mex Bay West of Alexandria, Egypt. *Rapp. Comm. Int. Mer. Medit*., 30(2):P.127.

El-Kassas, H.Y. and Khairy, H.M.: 2009, A trial for biological control of a pathogenic fungus (*Fusarium solni*) by some marine micro-organisms. *An.Euras.J.Agric. &Environ.Sci*., 5(3):434-440.

El-Sherif, Z.M.: 1993, Evolution of the standing crop phytoplankton in some polluted coasts of Alexandria, Egypt. *The Bulletin of the H.I.P.H*. Alex.XXIII (3):711-729.

Final Project's Report: 2005-2007, Distribution, Biological and Rearing Aspects of Marin fish fry from Mediterranean Sea between Alexandria and Damietta Governorate NIOF, Alexandria Egypt.

Gharib, S.M. and Dorgham, M.M.: 2000,Weekly Structure and Abundance of Phytoplankton in Boughaz El-Meadyia, Egypt. *Journal Aquat. Biol. &Fish.*,Vol.4: No.2:183-210.

Grasshoff, K. with contribution by T. Almgreen; Dawson, R.; Ehrhardt, M.; Fonselins, S.; Joseffson, B.; Koroleff, F. and kremling, K.: 1976. *Methods of Sea water analysis.* New York. PP297. 607

Haroon, A.M. and Daboor, S.M.: 2009, The role of different Macrophytes groups in water quality sediment chemistry and Microbial flora of both irrigation and drainage canals. *World Applied Science Journal*, 6 (9):1221-1230.

Hempel, G.: 1968, Synopsis of the symposium on North Sea Fish Stocks-recent changes and their causes. *Rapp. P.V. Reun. I C E S*, 172: 445-449.

Hendy, N.I.:1964, An introduction account of the smaller algae of British coastal waters. Part v: Bacillariophyceae (Diatoms) .*Her Majesty's stationary office*, London, pp 317.

Heurk, V.H.: 1962, Atreatise on the Diatanaceae wheldon and wesly, Ltd and Verlag. G. Gramer, Berlin, 558 pp.

Holmes, N.T.H. and Whitton, B.A.; 1981, Phytobenthos of the river trees and its tributaries. *Fresh Water Biol*.: 11:139.

Huet, M.: 1972, Text book of fish culture. Breeding and cultivation of fish fishing News Books Ltd . Fishing News Books Ltd. Farnham. England.

Hussein, N.R.: 2008, Phytoplankton community structure and diversity index in Mediterranean Sea lagoon, Lake Manzalah , Egypt. *Egyptian Journal of Aquatic Research*, 34(1): 69-85.

Jezierska, B.; Lugowska, K. and Witeska, M.:2008, The effects of heavy metals on embryonic development of fish (a review). *Fish Physiology and Biochemistry*, 33:1-13.

Kolay, S. and Bulent Sahin: 2007, Ataxonomic study on the phytoplankton in the littoral zone of Karagol Lake (Borcka-Artvin/Turkish*). J.Fish. Aquatic Sci.*, 7: 171-175.

Lazo, J.P.; Dinis, M.T.; Holt, G.J.; Faulk, C. and Arnold, C.R.: 2000, Co-Feeding microparticulate diets with algae: toward eliminating the need of zooplankton at first feeding in larval red drum (*Sciaenops Ocellatus*). *Aquaculture* 188: 339-351.

Lebour, M.V.: 1925, The dinoflagellates of Northern Seas. Marine Biological Association of the United Kingdom, Plymouth, UK, pp250.

Mizuno, T.: 1990, Illustration of the fresh water plankton of Japan 9th printing, Hokush publishing Co., Lt., Japan, 353pp.

Morais. , S.; Narciso, L.; Dores, E. and Pousa's-Ferreira, P.: 2005, Investigation of fresh and freeze-Dried sea bream *Sparus aurata* L.Eggs as a fatty acid source in the enrichment of *Brachionus* sp. potential use of a waste product. *Journal of the World Aquaculture Society*. Vol. 36 : 3:202-210.

Peragallo, M. and peragallo, M.M.H.: 1897-1908, Diatomee's Marines de France et des Districts Maritimes Voisions, 236pp.

Riley, J. P. and R. Chester: 1971, Introduction to marine chemistry, Academic press London, New York.465pp.

Round, F.A.:1981, The ecology of algae. Cambridge Univ. Press C B 21 RP.pp.653.

Shakweer, L., Hemaida, H and Al-Sayes, A.: 2008, Some water quality parameter at Fish fry collection sites along the Mediterranean Coast of Egypt. *Egyptian Journal of Aquatic Research* .Vol.34 No.4: 237-246.

Shannon, C. E. and Weaver, w.: 1963, The mathematical theory of communication University of Illinois Press, Urbana, pp125.

Smith, D.W.: 1991, Mechanistic simulation modeling of phytoplankton-oxygen dynamics in aquaculture ponds.pp.436-459.In:D.Brune and J. Tomasso, editors.Aquaculture and water quality. *The world Aquaculture society*. Baton Rouge. Louisina, U S A.

Sommer, U., Gliwicz, M., Lampert, W.and Duncan, A.: 1986, The PEG-model of seasonal succession of planktonic events in fresh waters .*Arch. Hydrobiol*., 144(4):429-438.

Sourina, A.: 1968, Diatomee's planctoniques du canal de Mozambique et de Lille Maurica, ORSTOM Mein, 31:120pp.

Sournia, A.; 1986, Atlas du phytoplankton Marine, volume 1: Introduction, Cyanophycee's, Dinophycee's et Radiophycee's,216pp.

SPSS (Statistical Package for Social Science) 15.0 for window: 2006, Licend for Hi-Tec. (www SPSS.com).

Swingle, H.S.: 1957, Relationship of pH pond water to suitability for fish Cult.9th Proc. Sci. Congr.Bangkok.Thailan.

Taivo, L. and L. H. Murray: 1981, Fishery, Oceanography and Ecology. Pub. Fish. News Book Ltd. Farnham, Sur.England.pp.197.

Vanloon, J. D.H. and S. J. Duffy: 2000, Environment Chemistery. A. Glo.Perspective Oxford, New York.

الهائمات النباتية فى بعض مناطق تواجد زريعة الأسماك البحرية وخاصة العائلة البورية على طول الساحل المصرى للبحر المتوسط

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تعتبر تجمعات زريعة الأسماك البحرية وخاصة العائلة البورية (Mugilidae) التى شملت (*M.capito* *M ugil cephalus*) المصدر الرئيسى لإمداد المزارع السمكية فى جمهورية مصر العربية بالزريعة لتربيتها حتى تنمو وتبلغ الاحجام التسويقية. ويرجع الإعتماد على المصادر الطبيعية فى الحصول على هذه الزريعة إلى عدم القدرة على تفريخ مثل هذه الأنواع فى أى من المفرخات المتواجدة فى نطاق الأراضى المصرية. ويعزى انجذاب زريعة الأسماك وتجمعها فى مناطق تواجدها على طول الساحل المصرى إلى وفرة العناصر الغذائية اللازمة للزريعة وخاصة الهائمات النباتية التى تزدهر فى مناطق تواجد الزريعة نتيجة للتركيزات العالية للأملاح المغذية نتيجة صب المياه العذبة المحملة بالأملاح وكذلك ملائمة العوامل البيئية و الكيميائية لمعيشة هذه الزريعة الى جانب تميزها بالهدوء النسبى مقارنة بالظروف السائدة فى المناطق العميقة من الساحل.

تم جمع عينات الهائمات النباتية من ستة مواقع للساحل المصرى من اسكندرية إلى دمياط خلال 2005-2006 فى مواسم جمع زريعة الأسماك البحرية.

تم تسجيل 209 نوعا من الهائمات النباتية (96 من الدياتومات و 28 من الطحالب الثنائية السوط و 28 من الطحالب الزرقاء المخضرة و 7 من الإيوجلينات و 49 من الطحالب الخضراء و نوع واحد من السيلكوفلاجليت. كانت السيادة لمجموعتى الدياتومات و الطحالب الخضراء (64.63% و28.13%) على التوالى.

حققت مواقع الكسارة (غرب دمياط) والمعدية و رشيد أعلى كثافة عددية للهائمات النباتية ($848.3X10^3$ وحدة/لتر و $539.9X10^3$ وحدة/لتر و $329.2X10^3$ وحدة/لتر) على التوالى. ووافق ذلك زيادة فى اعداد الزريعة المجموعة وخاصة العائلة البورية ($14.2X10^6$ و$566X10^3$ و$1.1X10^6$ زريعة/سنة) على التوالى.

فى موقع الكسارة ظهرت علاقة إيجابية بين زريعة العائلة البورية (Mugilidae) والاس الهيدوجينى والنترات والامونيا. اما فى المعدية فكانت العلاقة عكسية بين زريعة البورى (*Mugil cephalus*)والاس الهيدروجينى.

و فى موقع رشيد فكانت العلاقة ايجابية بين زريعة الطوبارة (*M.capito*) وعدد انواع الهائمات النباتية و درجة تنوعها وعكسية بين زريعة البورى (*Mugil cephalus*) والملوحة و الهائمات النباتية,ومن المعروف أن زريعة العائلة البورية (Mugilidae) يمكن لها ان تتواجد فى مدى واسع من الملوحة.

بينما سجلت مواقع الكيلو 21 والمكس أقل كثافة عددية للهائمات النباتية ($66.7X10^3$ و$206.4X10^3$ وحدة/لتر) على التوالى. ووافق ذلك قلة فى اعداد الزريعة فى الكيلو 21 ومتوسطة فى المكس ($485X10^3$ و$770X10^3$ زريعة/سنة) على التوالى.وذلك نتيجة قلة الملوحة فى المكس عن الكيلو 21 وذلك لوجود المياة المنصرفة من مصرف العموم وأثبت ذلك وجود علاقة عكسية بين الأكسجين الذائب واعداد الهائمات النباتية.

اما موقع صفارة (شرق دمياط) سجل أقل كثافة عددية للهائمات النباتية ($98.5X10^3$ وحدة/لتر) ووافق ذلك زيادة فى اعداد زريعة العائلة البورية (Mugilidae) حيث بلغ ($13.4X10^6$ زريعة/سنة) وحققت علاقة عكسية مع الامونيا.

أوضحت الدراسة الارتباط الوثيق بين الخواص البيئية والبيولوجية للوسط المائى وتواجد و معيشة زريعة الأسماك البحرية على طول الساحل المصرى.