PHYTOPLANKTON AS BIOINDICATOR FOR WATER QUALITY IN RELATIONSHIP WITH FISH MORTALITY IN FISH FARMS AT NORTHEAST OF DAMIETTA - EGYPT.

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Abstract

The phycological and physico - chemical evaluation was performed in three fish farms at northeast of Damietta (Boghdady, Dorgham and Moamen) as well as their irrigation canals over the period from May 2001 to April 2002. The species number was negatively correlated with water salinity and pollution. The data revealed 32, 25 and 28 species number inside the three fish farms Boghdady, Dorgham and Moamin, respectively. Such number increased to become 96, 72 and 56 respectively at these canals. Phytoplankton biomass was relatively higher in fish farms than that in irrigation canals. Cyanophyta, Bacillariophyta and Pyrrophyta were mostly the dominant phytoplanktonic groups in the different stations. Phycological indices indicated that water was moderately polluted (β-mesosaprobic) in the irrigation canals and heavily polluted (polysaprobic) in the fish farms. There was also low net oxygen production by phytoplankton and high biological oxygen demand in fish farms. The depletion of the dissolved oxygen especially during second half of night in addition to the high concentration of ammonia might lead to fish mortality in subsurface water of fish farms.

Introduction

Human impact on water resources might result in water pollution and could kill healthy life for organisms. The resulting industrialization, urbanization and agricultural runoff have lead to many chemical and physical changes of the aquatic resources (Ormerod *et al*., 1996). Non -toxic pollutants cause eutrophication (Jenkins *et al*., 1995). The periodicity and growth of planktonic algae in fish culture pond ecosystems can be related to different physico-chemical factors (EL Otify, 1999). Cairns and Scherier (1962) showed that high concentrations of detergents in organic pollutants completely inhibit the photosynthetic activity in phytoplankton. The high nutrition status of fish farms and the sediment resuspension has a decisive effect on the water quality (Nordvarg and Johansson, 2002). The N and P inputs from animal wastes and outflow of water of these nutrients through fish production, losses through runoff water and the incorporation of these nutrients into the fish pond sediments (Watanabe *et al*., 2002).

(ISSN: 1110-8649)

Although the eutrophic water is characterized by high algal production or growth (Bell, 1991), excessive eutrophication leads to depletion of dissolved oxygen in water that ultimately results in fish death (Goldman and Horne, 1983). Dissolved oxygen is an efficient and sensitive indicator for the water quality conditions and essential for maintaining the fish fertility in fishery bonds (Kollasa, 1988). Generally, each algal species has an optimum oxygen concentration in which it grows well (Schmager, 1986). Biological assessment for water quality is preferable, rapid and accurate and has several advantages over the chemical monitoring in integrating responses to a range of pollutants occurring in water over different time scales (Herman and Adrienne, 1995). Diversity is an important index, which is affected by certain environmental conditions such as water pollution (Steed and Moring 2000). However, Ingrid *et al*. (1996) suggested that diatom communities and *Oscillatoria rubescence, Aphanizomenon flos aqua* and *Microcystis aeruginosa* can be used successfully as bioindicator for water pollution, monitoring eutrophication and assess water quality.

The major objective of the present study is to use phytoplankton as bioindicator for water quality in water systems of three fish farms (Boghdady, Dorgham and Moamin, which depend on animal wastes in their fish feeding and moreover suffer from fish mortality problem mainly during summer) in order to find essential scientific reasons of this problem and consequently to find the practical solution. The performance of such work was conducted through monthly studying the species composition, succession, biomass, productivity, and diversity of phytoplankton in the three fish farms and its irrigation canals.

Material and Methods

The study area was chosen at the northeast of Damietta. This area, as indicated in figure 1, was represented by Boghdady (on Lake Manzala), Dorgham (on the estuary of River Nile) and Moamin (on Mediterranean Sea).

Some physico - chemical parameters of water were investigated monthly according to Golterman (1969). During June, July and August 2001 (fish mortality months), two determinations were conducted in surface and subsurface water (1m depth) each two hours intervals; the first was the determination of phytoplanktonic primary productivity (as oxygen production) during the light day. The second was the dissolved oxygen over the day and night according to Winkler (1962). Biological oxygen demand (B.O.D.) was monthly determined according to APHA (1989) while sediment analyses were carried out according to Piper (1947) and Jackson (1962). The algal species were identified according to Skuja (1948), Zabelena *et al*. (1954), Hendy (1964) and Hindak *et al*. (1975) and counted using an inverted microscope, following sedimentation according to Utermohle (1936). The phytoplankton biomass was calculated according to Edler (1979). The diversity index, saprobic index and compound eutrophication were respectively performed according to Shannon and Weaver (1963), Sladecek (1973) and Round (1981).

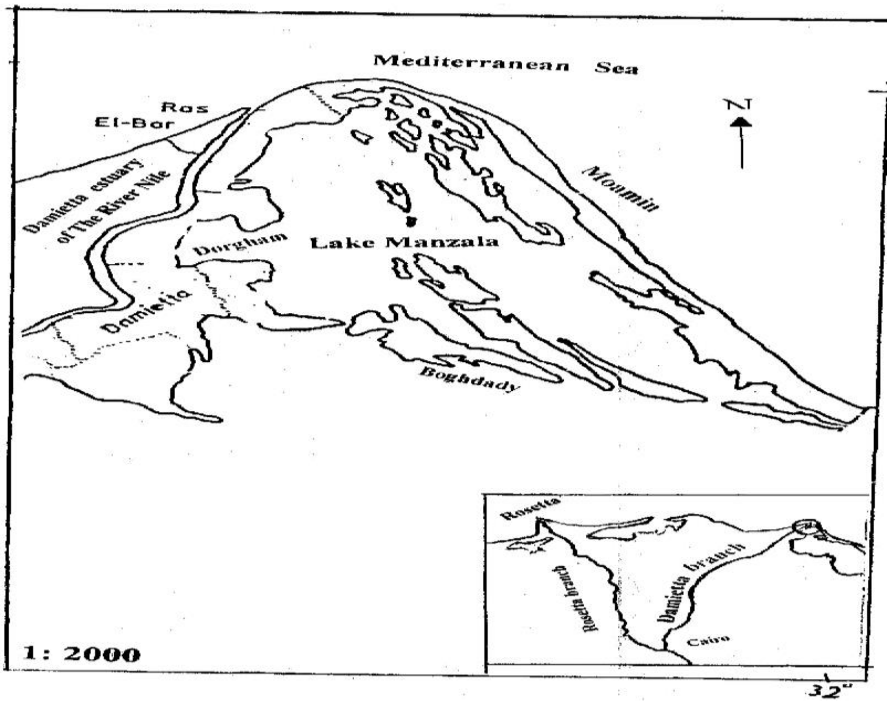

Fig. (1) A map showing the study area.

Results and Discussion

Phytoplankton and water chemical parameters commonly undergo annual and seasonal cycles (Anderson, 1995). The mean values of water temperature in the study area varied between 20°C and 23°C (Table 1). These variations of temperature are found to affect the periodicity, diversity and succession of the phytoplankton group (Behrndt, 1990). Means of pH values of the study area showed more wide range with relative high pH values during summer months recorded in fish farm. This was concomitant with the peak of phytoplanktonic biomass. These results are in agreement with El-Sabrouti (1990).

Water turbidity showed highly spectral and temporal variations ($p \leq 0.001$) with very high values at fish farms by increasing organic pollution. The mean values of dissolved oxygen varied between 4.5 to 7.7 mg/L with local variations. The low values were recorded inside fish farms seemed to be due to using of chicken wastes (organic pollutants) as fish feeds. El-Naggar *et al*. (1998) reported that organic polluted water is devoid from a measurable concentration of dissolved oxygen. The mean values of biological oxygen demand (B.O.D.) varied between (8.6 to 28 mg/L) with high value at fish farms. This was mainly due to high pollution status of water at fish farms. In this connection, Tebbutt (1977) recorded that polluted water is characterized by having B.O.D. of 12 mg /L or more in average. Variation trends of salinity, electric conductivity, total hardness, chloride, T.D.S., Sulphate, Na and K values appeared similar during the study period with high values in fish farm. This may be due to that the highly evaporation rate which would increase salinity of shallow marine and brackish waters in fish farms. Similar observations regarding increased salinity due to the high evaporation rates from shallow water were also reported by Herman and Adrienne (1995).

Table (1) Mean values of some physico-chemical parameters at the three fish farms (F.F.) and their irrigation canals (I.C.) during the period (May 2001 to April 2002).

Stations / Parameters	Boghdady		Dorgham		Moamin		F Ratio	Probability
	I.C	F.F	I.C	F.F	I.C.	F.F.		
Temperature ^oC	21.8	22.0	22.3	21.0	23.0	20.4	0.1	ns
pH	7.8	9.0	7.5	8.4	7.7	8.9	5.1	P < 0.01
Turbidity (NTU)	5.4	9.7	4.9	18.0	5.9	17.6	12.0	p< 0.001
$D.O_2$ (mg/L)	6.4	4.5	6.8	4.8	7.7	5.6	30.9	p < 0.001
B.O.D. mg/L	11.6	28	9.8	26.2	8.6	17.8	41.2	p < 0.001
Salinity %0	12.8	25.3	32.8	52.8	33.7	67.1	35.4	p < 0.001
Con. 10^4 (m moh)	1.8	3.4	4.8	6.1	4.3	8.2	28.5	p < 0.001
T. hardness (Meq/L)	9.3	122.7	25.4	235.5	22.9	244.8	53.4	p < 0.001
Cl-1 (mg/L)	0.9	3.9	11.2	14.3	11.9	24.8	9.9	p < 0.001
T.D.S. (g /L)	3.7	31.2	41.8	63.3	56.6	76.6	31.6	p < 0.001
SO_4^{--} x10^3 (mg/L)	3.7	3.9	3.6	4.0	3.4	3.9	13.9	p < 0.001
Na_+ (mg/L)	19.4	75.0	30.4	94.7	25.9	87.8	16.2	p < 0.001
K^+ (mg/L)	0.7	4.6	1.8	4.0	1.0	5.1	16.7	p < 0.001
ph.ph.Alk. (Meq/L)	0.2	0.4	0.2	0.1	0.2	0.4	10.3	p < 0.001
T. alk. (Meq/L)	3.7	4.2	2.4	2.8	5.4	6.6	14.4	p < 0.001
NO_2 (mg/L)	0.9	2.0	0.7	1.9	1.3	2.9	3.4	p < 0.05
NO_3 (mg/L)	0.5	3.7	0.8	1.4	0.5	2.6	5.8	p < 0.001
NH_3 (mg/L)	2.1	4.3	1.8	3.4	2.2	2.9	1.9	ns
Si (mg/L)	3.1	7.8	1.2	3.7	1.6	5.1	9.6	p < 0.001
PO_4^{--} (mg/L)	0.0	0.1	0.0	0.0	0.0	0.0	16.0	p < 0.001
T. PO_4^{--} (mg/L)	146	264	155	322.5	192.2	361.8	13.1	p < 0.001
Pb^{++} (mg/L)	0.9	5.9	1.5	5.1	0.9	4.1	17.4	p < 0.001
Cu (mg/L)	0.0	0.3	0.0	0.2	0.0	0.2	13.9	p < 0.001
Cd (mg/L)	0.1	1.1	1.1	0.8	0.3	0.2	8.0	p < 0.001
Zn (mg/L)	0.8	4.3	1.8	4.2	0.8	3.6	11.5	p < 0.001

Mean values of ph.ph. alkalinity and total alkalinity showed high variations (p<0.001) with high values at fish farm. Moss (1973), stated that total alkalinity values greater than 1.4 meq/l indicated eutrophic conditions. Inorganic -

N (nitrite, nitrate and ammonia) was present in excess with higher values in fish farms than in irrigation canals, mainly due to the fish feeding and its metabolites. Moreover, subsurface measuring the NH_3 in fish farms water records very high values (ranged from 4.9 to 9 mg/l) during summer months (data not shown). In this respect, Reid (1961) found that the concentration of ammonia in the unpolluted water is ≈ 1 mg/L while in polluted water is ≈ 12 mg/L. In the present investigation, low contents of silica were recorded in irrigation canals, where high growth of diatoms was observed. In fact, Jones *et al*. (1996) reported that diatoms result in depletion of reactive silica from water. The lower levels of PO_4 content detected in the irrigation canals than that in fish farms may be due to the difference of pollution status of water. However, Vollenweider (1971) reported that water with dissolved phosphorus exceed 0.01 mg/l indicate its eutrophic conditions. There was a high local variation of total soluble phosphorus ($p < 0.001$), with high values in shallow water fish farm. This may be attributed to the high degree of pollution (Raymont, 1980). In addition, the table shows that lead, copper, cadmium and zinc have a narrow range of variation. This could be due to run off from agricultural and from sea anti-fouling paints on boats and ships (Kurt *et al*., 1996).

As shown in figure 2, dissolved oxygen content in surface and subsurface water during 24 hours was lesser in fish farms than in the irrigation canals. The dissolved oxygen in the irrigation canals appeared to be enough for aquatic biota (4.4 - 7.2 mg /l) and nearly, if any, enough in fish farms (0.7 - 4.8 mg/L). As a whole, the dissolved oxygen seemed not enough in the subsurface water of fish farms particularly during the second half of night (2.4- 0.7 mg/L). This may be due to the high chemical and biological oxygen demand (C.O.D and B.O.D) from organic polluted water of fish farm. Consequently, fish float at the surface water of fish farm, which has relatively high dissolved oxygen content or may die at subsurface water. It was reported that the minimum concentration of the dissolved oxygen required for healthy growth of fish and all water biota is 5 mg L^{-1} (Train, 1979). Eutrophication and organic wastes would result in an oxygen deficiency and consequently mass mortality of aquatic organisms (Borum and Sand-Jensen, 1996).

Figure 3 shows the results of phytoplanktonic primary productivity during day light at surface and subsurface water of the fish farms and their irrigation canals. It is clear that oxygen production through phytoplanktonic photosynthesis in fish farms was very low (-0.3 to 0.4 mg/L) relative to that recorded in the irrigation canals (0.4 -1.2 mg/L). On the other hand, there was an inversion in the net oxygen production by phytoplankton at subsurface water of fish farms, a phenomenon that augmented with the progress of day. This inversion was mainly due to the high pollution status of water that would inhibit photosynthetic activity of phytoplankton in addition to the increased oxygen consumption by living biota in the fish farms.

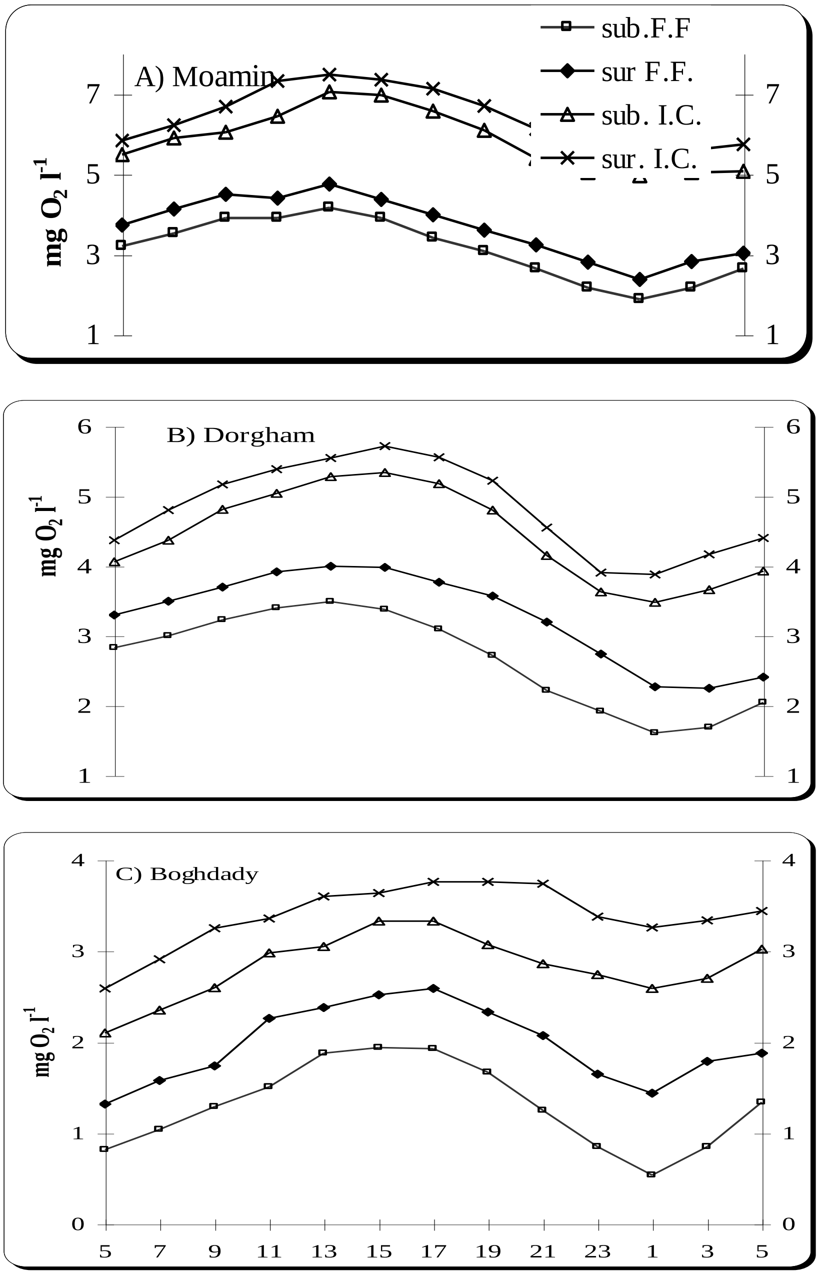

Fig. (2) Mean values of the dissolved oxygen in water during 24 hrs at surface and at (1.0 m depth) of the three fish farms (F.F.) and its irrigation canals (I.C.).

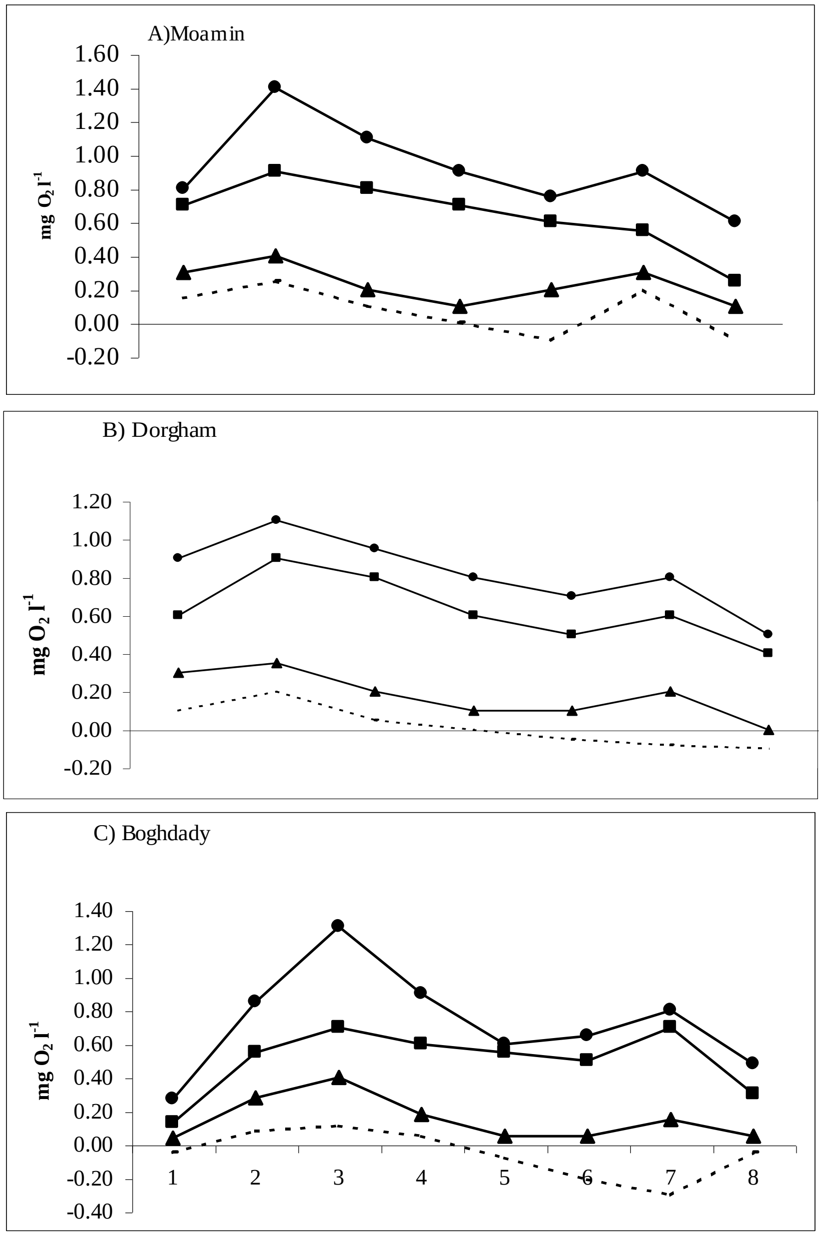

Fig. (3) Mean net phytoplanktonic primary productivity - mg O_2 /L during light day at surface and at (1.0 m depth) of the three fish farms (F.F.) and its irrigation canals (I.C.).

Sediment Analysis

As revealed in table 2, seasonal variations of pH values occur in very narrow range (7.4-7.7). On the contrary, there was a wide range of changes in the sedimentary salinity, chlorisity, and electric conductivity values. This could explain the cycles of elements that transfer from sediment to water and vice versa in the saline region. The sedimentary carbonate values were low throughout study the period. In addition, calcium carbonate and sulphate showed the same local variation of salinity because they represent the main part of salt compositions.

Table (2): The mean values of physico-chemical parameters of the sediments in the three fish farms (F.F.) and their irrigation canals (I.C).

Station / Species	Boghdady		Dorgham		Moamin		F ratio	Probability
	F.F	I. C.	F.F	I. C.	F.F	I. C.		
pH	7.4	7.5	7.4	7.6	7.7	7.7	0.8	ns
Salinity % o	30.0	19.0	41.1	21.0	45.0	34.0	59.6	p < 0.001
Conductivity m moh	55.0	41.2	73.2	54.9	83.1	62.3	79.3	p < 0.001
Chloride mg/Kg	11.2	8.4	8.8	6.6	12.3	9.2	1.2	ns
T.hardness mg/kg	276.0	207.0	200.0	150.0	256.0	192.0	51.3	p< 0.001
Carbonate mg/kg	0.2	0.1	0.2	0.1	0.1	0.0	0.8	ns
Bicarbonate mg/kg	0.5	0.4	0.9	0.7	0.6	0.5	1.8	ns
Calcium carbonate %	85.5	76.0	87.6	85.6	84.0	76.9	2.0	ns
Sulphate mg/kg	0.9	0.7	0.7	0.5	0.7	0.5	1.3	ns

Phytoplankton Distribution

Phytoplankton studies are much needed for water resources management and to predict the evaluation of aquatic ecosystem (Walater *et al*., 1996). A total of 119 phytoplankton taxa were recorded in the present study area; the most predominat species are presented in table 3. The high species number was recorded at the irrigation canals; 96 species at Boghdady (27 Cyanophyta, 41 Bacillariophyta, 11 Chlorophyta, 11 Pyrrophyta and 6 Euglenophyta), 72 species at Dorgham (15 Cyanophyta, 34 Bacillariophyta, 6 Chlorophyta, 12 Pyrrophyta and 5 Euglenophyta) and 56 species at Moamen (16 Cyanophyta, 25 Bacillariophyta, 4 Chlorophyta, 10 Pyrrophyta and 1 Euglenophyta). In contradiction, low species number was recorded inside the three fish farms; 32 species at Boghdady (10 Cyanophyta, 18 Bacillariophyta,3 Pyrrophyta and 1 Euglenophyta), 25 species at Dorgham (8 Cyanophyta, 12 Bacillariophyta, 2 Pyrrophyta and 3 Euglenophyta) and 28 species at Moamen (7 Cyanophyta, 18 Bacillariophyta, 1 Pyrrophyta and 2 Euglenophyta). This may be attributed to salinity and pollutions in the fish farms. However, it is known that the number of phytoplankton species decreases with the increase in salinity and pollutions. (Remane and Schliper, 1971).

Cyanophyta, Bacillariophyta and Pyrrophyta are the main algal groups during the period of investigation at all stations. Chlorophyta, and Euglenophyta formed a considerable part of phytoplankton composition. The relative high values of total phytoplankton biomass were recorded at Boghdady followed by Dorgham and Moamin. This was mainly correlated with salinity and trophic status of water. It is reported that the increase in salinity level could cause a reduction in size of algal cell as well as biomass of phytoplankton (Remane and Schliper, 1971). Moreover, Romo and Miracle (1994) reported that there was a relationship between pollution and high population density of phytoplankton.

It is clear from figure 4 that there was a peak of total phytoplankton biomass in fish farms and also in their irrigation canals during months of August, September and October, due to the high growth of Cyanophyta as a result of growth of *Anabaena variabilis* and *Synechocystis salina*. Another relative increase in total biomass was also observed during month of April as result of the considerable growth of Bacillariophyta and Pyrrophyta especially *Fragillaria intermedia, Nitzschia acicularis, Diatoma vulgare* and *Nitzschia longissima v. parva, Exuivaella compressa, Peridinium trochoideum.* In this context, El - Otify (1999) reported that blue - green algae sustained relatively higher percentage compositions of the fish ponds, but dinoflagellates, euglenoid sustained always low percentage composition.

Correlations between the abundance of different phytoplankton groups and environmental variables are shown in figure 5. A high correlation is expressed by relatively long vector roughly pointed into the same direction, whereas arrow pointing into opposite direction indicates low correlation. Thus, Bacillariophyta, Chlorophyta, Cyanophyta and Conjugatophyta were highly correlated with ammonia, nitrite, conductivity and total alkalinity, and were less correlated with nitrate, pH, total phosphorus, chloride, turbidity, ph.ph alkalinity dissolved oxygen, temperature, total hardness Ba, Na, K and Ca. Also, Pyrrophyta was positively correlated with the previous physico- chemical parameters. These situations were mainly due to the eutrophic status of water.

In this study, the phytoplankton indices revealed that the Eutrophication is very high trophic concept of the water body in the three fish farms and moderate trophic concept of their irrigation canals (table 4A). This might be due to that fish farms usually receive organic pollutants (chicken wastes) and inorganic wastes (fertilizers) as fish feedings.

The values of species diversity index in fish farms ranged from 0.48 to 0.9 (table 4B). This may tend to indicate that water of the three fish farms was heavily polluted. On the other hand the relative high value of species diversity in the irrigation canals could suggest that water of these canals were moderately polluted. These predictions are in accordance with Wu and Suen (1985) who concluded that the decrease in community diversity was usually associated with high level of pollutants in the water body. The saprobic quotient signifies water qualities between a moderate pollution (α-β-mesosaprobic) in the irrigation canals to heavy pollution (polysaprobic) in the three fish farms (table 4C). Indeed, Hellawell (1986) suggested that pollution would greatly affect the phytoplankton growth and diversity.

Table (3): The most predominant species of algal groups at the three fish farms (F.F.) and their irrigation canals (I.C.).

Species \ Station	Boghdady		Dorgham		Moamin	
	F.F	**I.C.**	**F.F**	**I.C.**	**F.F**	**I.C.**
Cyanophyta						
Anabaena flos-aquae (Lyngb.) Breb.					+	
Anabaena variabilis		+		+		+
Gloeocapsa minuta		+				
Oscillatoria formosa Bory.	+		+		+	
Pleurochloris polychloris				+		
Synchocystis salina wisl		+		+		+
Euglenophyta						
Euglena caudata Hubner	+		+			
Euglena velata Klebs			+			
Euglena proxima Dang.			+			
Dinophyta						
Exuviaella blatica				+		+
Exuviaella compressa				+		+
Bacillariophyta						
Cyclotella meneghiniana Kutz.	+		+		+	
Navicula pygmaea Kutz.			+			
Fragillaria intermedia		+				
Nitzschia acicularis W.Sm.	+		+		+	
Nitzschia hungarica Grun.	+		+			
Nitzschia palea Kutz.	+		+			
Nitzschia longissima v. parva				+		+
Nitzschia intermedia Grun.						+
Navicula distance		+				

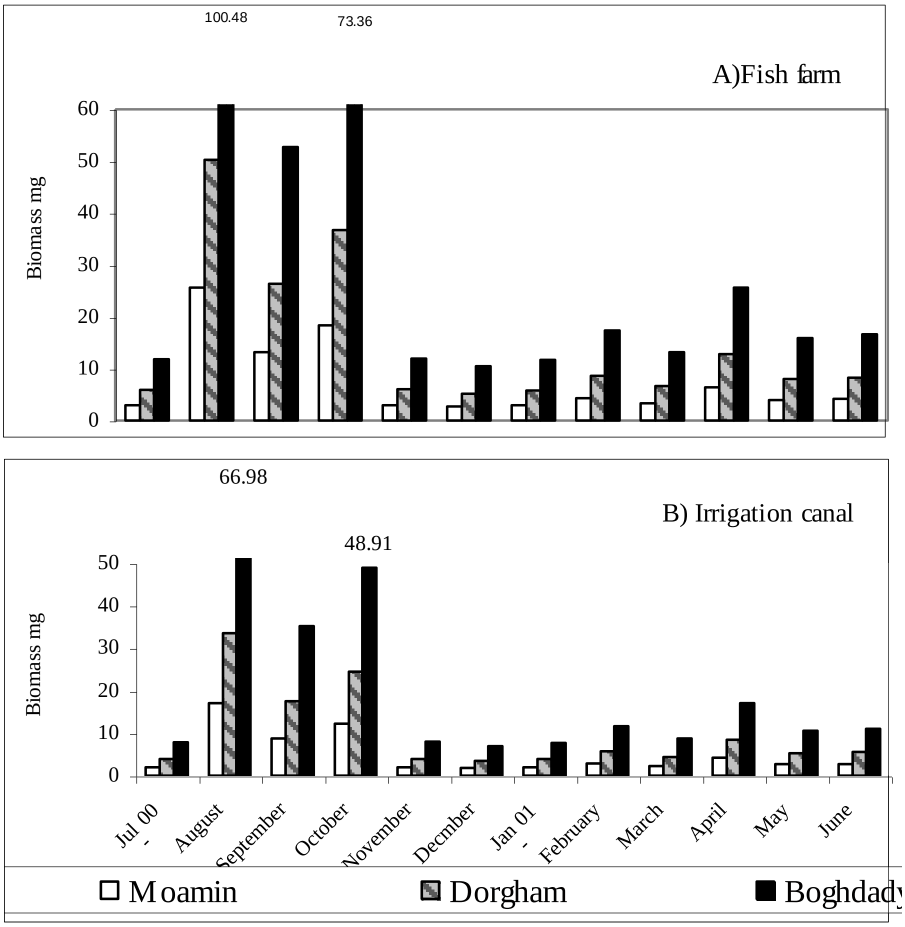

Fig. (4): The total biomass of phytoplankton at the three fish farms and their irrigation canals.

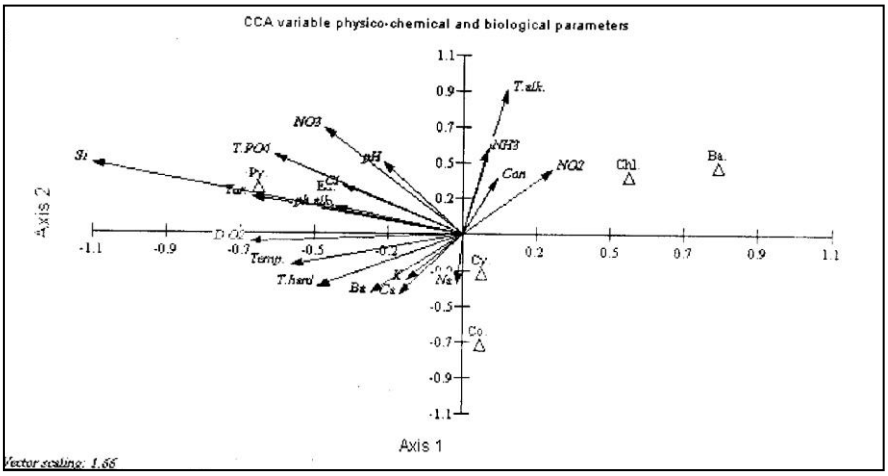

Fig. (5) Canoco analysis plot of Physico-chemical and Biological parameters. Cy = Cyanophyta, Chl = Chlorophyta, Py = Pyrrophyta, Ba= Bacillariophyta, Co = Conjugatophyta, Eu = Euglenophyta. Temp = Temperature, Sal = Salinity, ph. alk. = ph. ph alkalinity, T.alk. = Total alkalinity, Tur. = Turbidity, T.hard = Total hardness, $D.O_2$ = dissolved oxygen, con = conductivity. Si = Silica, T. PO_4 = Total phosphorus, PO_4 = Orthophosphate.

Conclusion

The present study indicates that the fish farm water is eutrophic and heavily polluted, a situation that would result in low diversity of phytoplankton. Consequently net dissolved oxygen production decreased in subsurface water of fish farms with a simultaneous increase in biological and chemical oxygen demands especially during the second half of the night. These conditions would subsequently lead to a depletion of dissolved oxygen from subsurface water of fish farms with a decrease in its values from surface water. Moreover, there were very high values of ammonia recorded in subsurface of the fish farms during summer. Such conditions might diminish fish productivity and could enhance fish mortality. Therefore, to conserve the optimal crop in the fish farms for avoidance of fish mortality, fish feeds must be chosen on scientific bases taking into consideration the concomitant importance of daily refreshment of water in the fish farms in order to improve water quality, fish quality and productivity.

Table (4) Indexes of Eutrophication, Diversity and Saprobity at the three fish farms (F.F.) and their irrigation canals (I.C.).

Stations		May (2001)	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan. (2002)	Feb.	Mar.	Apr.	Mean
A- Eutrophication index														
Boghdady	I.C.	1.2	1.2	1.4	1.3	1.6	1.6	1.5	1.6	3.2	1.2	1.2	3.2	1.7
	F.F.	3.8	3.8	3.0	3.9	3.9	4.9	3.8	4.4	4.6	4.8	3.8	4.8	4.5
Dorgham	I.C.	1.9	2.1	2.9	1.6	3.2	2.4	2.3	3.4	1.2	1.3	2.1	2.2	2.8
	F.F.	2.9	3.1	4.5	2.9	4.8	3.5	3.4	4.6	3.8	2.0	3.2	3.8	3.8
Moamen	I.C.	2.1	2.2	2.9	2.4	2.3	2.6	2.5	2.7	1.8	1.8	3.0	2.1	2.3
	F.F.	3.2	3.2	4.4	3.5	3.5	3.9	3.8	3.1	2.7	2.7	4.5	3.2	3.6
B- Diversity index														
Boghdady	I.C.	1.1	1.2	1.5	1.1	1.1	1.5	1.6	1.4	0.7	0.9	1.1	1.3	1.2
	F.F.	0.7	0.8	0.6	0.7	0.7	0.9	0.8	0.8	0.6	0.6	0.7	0.6	0.8
Dorgham	I.C.	1.4	1.1	0.9	1.5	1.9	1.1	1.3	1.4	0.99	0.9	1.2	1.0	1.2
	F.F.	0.9	0.7	0.6	0.9	0.7	0.7	0.8	0.6	0.6	0.6	0.7	0.6	0.7
Moamen	I.C.	0.9	1.6	1.4	1.0	0.7	0.9	1.5	0.9	1.1	1.3	1.5	1.4	1.2
	F.F.	0.6	0.9	0.9	0.6	0.5	0.6	0.9	0.6	0.7	0.8	0.9	0.9	0.8
C- Saprobic index														
Boghdady	I.C.	1.3	1.3	1.4	1.3	1.3	1.3	0.5	1.6	3.2	1.3	1.3	3.2	1.6
	F.F.	3.8	3.8	4.9	3.8	4.8	3.8	3.7	4.3	4.7	3.8	4.8	4.7	4.3
Dorgham	I.C.	1.9	2.1	2.9	1.3	3.2	2.3	2.0	3.2	1.3	1.4	2.2	2.3	2.2
	F.F.	2.8	3.9	4.3	3.8	4.7	3.4	3.9	4.7	1.8	2.9	3.1	3.9	3.1
Moamen	I.C.	2.2	2.2	2.9	2.3	2.3	2.6	2.3	2.1	1.8	1.8	3.1	2.2	2.3
	F.F.	3.1	3.1	4.3	3.4	3.4	3.8	3.3	2.9	2.6	2.63	4.4	3.1	3.3

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الهائمات الطحلبية كدليل لجودة المياه وعلاقتها بموت الأسماك في المزارع السمكية بشمال شرق دمياط

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شملت الدراسة تقدير الخواص الفيزيائية والكيميائية والمحتوى الطحلبى للمياه في ثلاث مزارع سمكية شمال شرق دمياط (البغدادي ، درغام ، مؤمن) وكذا قنوات الري لها وذلك بصفة شهرية على مدار عام كامل من مايو 2001 حتى أبريل 2002 . تم دراسة الهائمات الطحلبية من حيث الكم - والنوع والتعاقب - وإنتاجية الأكسيجين من خلال عملية البناء الضوئي - والكتلة الحية وأيضا تم استخدام بعض الأدلة مثل:- Diversity index- soprobic index - compound eutrophication لقياس جودة المياه أو درجة تلوثها في المنطقة قيد البحث . كما تم قياس تركيز الأكسجين الذائب في المياه السطحية وعمق متر كل ساعتين على مدار 24 ساعة (خلال يونيو ويوليو وأغسطس) وفى نفس التوقيت وبنفس الكيفية تم قياس الإنتاج الصافي للأكسجين من عملية البناء الضوئي للهائمات الطحلبية باستخدام تجربة حقلية كل ساعتين على مدار 24 ساعة . وأوضحت النتائج زيادة فى أنواع الهائمات الطحلبية بمياه قنوات الرى عن تلك الموجودة بمياه المزارع مما يوحى بزيادة كبيرة لدرجة التلوث فى الثانية عن الأولى. كما وضح أن استخدام مخلفات الدواجن كأعلاف للأسماك أدى إلى زيادة كبيرة في درجة عكارة المياه ونقص في إنتاج الهائمات الطحلبية للأكسجين عن طريق البناء الضوئي وزيادة كبيرة في الاستهلاك البيولوجي للأكسجين الذائب. ونتيجة لذلك انخفض تركيز الأكسجين الذائب في المياه ووصل إلى اقل تركيز في النصف الثاني من الليل عند 1 متر عمق, علاوة علي الزيادة الكبيرة في الآمونيا عند نفس العمق في المزارع السمكية الآمر الذي أدى إلى موت الأسماك في مزرعتين - ووجود الأسماك في الطبقة السطحية للمزرعة الثالثة - وحلا لهذا الآمر نوصى بعدم استخدام المخلفات الحيوانية كأعلاف - واستخدام الأعلاف المتعارف عليها علميا مع ضرورة دوام تغير مياه المزارع بشكل يومي .