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ECOLOGICAL STUDIES ON FISH FARMS OF EL-FAYOUM DEPRESSION (EGYPT)

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ABSTRACT

This study was carried out at the fish farms of El-Fayioum province during 2003 farming season. They extend along the eastern bank of Lake Qarun. These farms derive its water and drainage wastes into Diar El-Berka Drain. pH values at the chosen farms ranged between 7.43 and 8.91 and its values are certainly optimum for fish culture. Salinity levels at fish farms adjacent to Lake Qarun (Goda 2, 9.5‰) are generally much higher than the other fishing ponds due to seepage from the lake water. The major nutrient concentrations (N & P) at the main feeder were much higher than the corresponding values at fish farms. Nitrogen concentrations that represented by NO_2-N, NO_3-N and NH_4-N indicated the dominance of NH_4-N over NO_2-N and NO_3-N at the selected fish farms (0.026, 0.091 & 0.59 mg/L respectively). Total organic phosphorus (TOP) concentrations at the chosen farms were much higher than the corresponding values of orthophosphate. The abundance of phytoplankton reached the climax during January and March (8746, 6937 x 10^4cell/L respectively), but showed a severe drop during September and October (59, 38 x 10^4cell/L respectively) at all farms under investigation. *Oreochromis niloticus* prefers diet on *Navicula* spp. and *Cyclotella* spp. from diatoms; Prorocentrum *apora* from dinoflagellates; *Euglena* spp. and *Phacus caudatus* from euglenoids and few species of green and blue green algae. So it should decreases supplementary foods at these farms during the abundance of phytoplankton items in spring and summer seasons. Fish production of these farms depends on intensive aquaculture in which the fishes are fed with external food supply. This kind of aquaculture can be changed to extensive production during spring and summer seasons.

1. INTRODUCTION

This study was carried out at the fish farms of El-Fayioum province during 2003 farming season. They extend along the eastern bank of Lake Qarun. Nowadays, Egyptian Government has been recently embarked on programs of intensive fishing of all water sources. From the technical point of view, El-Fayioum Fish Farms (Shalkhany, Goda 1 & 2 and El-Shora) employ tilapia farming for increasing fish yield. Nile tilapia is to be considered the most important fish species in Egypt, contributes more than 70% of the Egyptian fish landing (Ishak *et al*., 1982). The carrying capacity and production of fishponds could be increased by fertilization that encourages growth of phytoplankton and in turn zooplankton that is required as natural food for fish (Crisman and Beaver, 1990). Also, Touliabah (1992) evaluated the impacts of fish production and fertilization on managing phytoplankton in Serw Fish Farm. Shehata *et al.* (1994) conducted two experiments for six months in freshwater fish farm to determine the optimum fertilizer doses (urea and super-phosphate) which increase phytoplankton and zooplankton populations for tilapia culture in addition to the artificial food. Sweilum (2001) studied culture of *Oreochromis* *niloticus* in mono-, di-, and poly-culture systems in Barrage Fish Farm. The author reported that the highest growth rate of Nile tilapia was recorded in polyculture system than the mono and di-culture. Khallaf and Aline-na-ei (1987) studied feeding ecology of *Oreochromis niloticus* & *Tilapia zillii* in a Nile canal in the Egyptian delta. They found that, *O. niloticus* are on average about 97% of food of plant origin, compared with 92 % for *T. zillii*. Exploitation of fisheries resources in Egypt, as well as elsewhere in Africa, has been carried out in the absence of adequate ecological knowledge of the fish food (Mavuti, 1990). However, most of the available information comes from experimental enclosures and much less is known about trophic interactions in large ponds (Brett and Goldman, 1996). Farming activities can cause important impacts on the environments due to the discharge of wastewater into streams, rivers and lakes (Etnier and Guterstam, 1997).

This study was performed to evaluate the phytoplankton communities and the effect of fishponds on their crops and composition.

2. MATERIALS AND METHODS

The sampling program commenced on January 2003 and extended to December 2003 monthly. Water samples were collected by Ruttner Bottles, 2-liter capacity.

Physicochemical characteristics were analyzed by Dr. Mohamed Hamdy, who is one of the research teamwork (personal communication).

Preparation and examination of phytoplankton: The water samples were preserved in situ with Lugol's Iodine solution. A known volume of the samples was allowed to stand on a graded cylinder for five days until the algal species settle and the supernatant then to be siphoned off with plastic tube ended with plankton cloth of 10 mm mesh diameter. A drop method technique was applied for counting and identifying different phytoplankton species. Drop method technique applied for counting phytoplankton community according to APHA (1992)

Nutritional analysis: The feeding habits for, 75 stomachs of *Oreochromis niloticus* were examined. These specimens were sampled from three fish farms extended along the eastern, middle and western basins of Lake Qarun during 2003. The gut of each fish was removed and preserved in 4 % formalin in labeled jars for laboratory examination. The contents of alimentary canals were washed and examined in the laboratory using inverted microscope. The main references used for identification of phytoplankton organisms were Lebour & Marie (1930), Henedy (1964), Pascher (1976), Prescott (1978) and Mizuno (1990).

Statistical analysis: Correlation (person), regression analysis and analysis of variance are obtained by Minitab Program (12.1) under windows.

3. RESULTS

Physico-chemical characteristics are shown in Table (1) and can be summarized as follows: pH values at Diar El-Berka Drain (8.08) were relatively low compared to different studied fish farms (8.41 – 8.65). Carbonate alkalinity was much lower than bicarbonate at all studied areas. Carbonate values at the drain (14.2 mg/L) was commonly low and sometimes was not detected while its values at the fish farms (22 – 31 mg/L) had obviously increased.

Contrary, bicarbonate alkalinity at the drainage water (308 mg/L) was usually higher than the corresponding values at the fish farms (251 – 300 mg/L). Salinity levels recorded at the drain (3.0 ‰) were lower than that recorded at all farms. Shalkhany Fish Farm has lowest salinity (4.2 ‰) while Goda 2 farms is the highest (9.5 ‰). At the same time, calcium, magnesium, sodium and potassium contents showed similar distribution pattern of salinity where Goda 2 attained the maximum levels (Ca, 162; Mg, 671; Na, 1925; K, 84 mg/L) and Shalkhany achieved the minimum values (Ca, 103; Mg, 420; Na, 1221; K, 63). It was also observed that magnesium and sodium concentrations were strongly increased than the corresponding values of calcium and potassium.

In general, nitrogen concentrations that represented by NO_2-N, NO_3-N and NH_4-N indicated the dominance of NH_4-N over NO_2-N and NO_3-N either at the drain (NO_2, 0.13; NO_3, 0.82 & NH_4, 1.02 mg/L) or the selected farms (NO_2, 0.026; NO_3, 0.092 & NH_4, 0.60 mg/L).. As well as, its values at Diar El-Berka Drain were much higher than fish farms. NO_2-N values ranged from 0.018 at Shalkhany Farm to 0.031 mg/L at Goda 1. NO_3-N concentrations at Goda 1 & 2 (0.097 & 0.099 mg/L respectively) were distinctly increase Shalkhany and El-Shora Farms (0.081 & 0.09 mg/L respectively). NH_4-N concentrations attained minimum values of 0.42 mg/L at Shalkhany Farm while maximum concentrations of 0.71 mg/L occurred at El-Shora Farm. In contrast to nitrogen and phosphorus contents, silicate concentrations were relatively high at chosen farms (Shalkhany, 10.73; Goda 1, 13.31; Goda 2, 14.94; El-Shora, 14.82 mg/L) compared to Diar El-Berka Drain (10.46 mg/L). Orthophosphate concentrations detected at Goda 2 (0.16 mg/L) was the maximal, while its contents were more or less similar at the others. On the other hand, total organic phosphorus had obviously increase the inorganic forms and attained its maximum value of 0.76 mg/L at Shalkhany Farm while its minimum value of 0.46 mg/L occurred at Goda 2. Shalkhany Fish Farm harbored the highest phytoplankton crops followed by El-Shora Farm, while at Goda 1 & 2 was less (Table 2). In general, the abundance of phytoplankton reached the major peak during mid winter (Jan.) and early spring (March), but showed a severe drop during September and October at all sites under investigation.

Species composition of phytoplankton (Table 3) at these farms included, Bacillariophyceae, Chlorophyceae, Dinophyceae, Euglenophyceae, Cyanophyceae and Cryptophyceae.

A total of 41 species at Shalkhany Farm, 49 species at El-Shora Farm and 41 species at Goda Farms were identified.

At Shalkhany Fish Farm, green algae (*Ankistrodesmus fusiformis*) had obviously flourished in January but it was not observed during gut analysis of *Oreochromis niloticus*. On the other hand, *Navicula* spp. and *Cyclotella* spp. were strongly preferred to *Oreochromis niloticus* (Table 4), in addition to different species of euglenoids that mostly dominated, particularly during summer season.

At El-Shora Fish Farm, dinoflagellates (*Prorocentrum apora*) flourished in January, diatoms dominated in March and April, blue green algae were present in May and June while Euglenophyceae were the prevalent class during July and August. On the other hand, the green algae were sporadically occurred. *Oreochromis niloticus* inhabiting El-Shora Fish Farm consumed diatoms and Euglenoids as well as consumed on few species of green algae.

At Goda Fish Farm, the green alga (*Ankistrodesmus fusiformis*) showed an intensive blooming in January and February, the blue green algae (*Anabena blanktonena* – *Anabenobsis circularis*) were widely distributed during may, diatoms (*Nitzschia frustulum* & *N. closerium*) and dinoflagellates were rarely found. *Oreochromis niloticus* at Goda Fish Farms prefer diatoms and *Prorocentrum apora* from dinoflagellates.

Table (1): The physico-chemical parameters in Fish farms (after M.Hamdy; personal communication).

Parameters	Shalkhany		Goda 1		Goda 2		El-Shora		Drain	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean
pH	7.43 - 8.87	8.41	8.13 - 8.91	8.65	8.02 - 8.78	8.54	7.78 - 8.77	8.52	7.28 - 8.61	8.08
CO_3 mg/L	0.0 - 40	26	15 - 50	31	0 – 50	29	0.0 – 45	22	0.0 - 35	14.2
HCO_3 mg/L	192 - 400	251	133 - 350	265	265 - 360	300	250 – 400	302	235 - 450	308
S‰	1.7 - 7.2	4.2	4.1 - 10.9	8.4	5.4 – 12.8	9.5	4.5 - 8.3	6.4	1.5 - 6.4	3.0
Ca mg/L	40 - 160	103	80 - 248	146	72 - 264	162	64 – 240	138	40 - 152	97
Mg mg/L	289 - 603	420	274 - 748	476	463 - 882	671	348 – 627	474	169 - 482	309
Na mg/L	517 - 2311	1221	955 - 2836	1830	1117 - 3152	1925	960 – 2562	1531	488 - 2475	1182
K mg/L	39 - 88	63	44 - 92	76	52 - 106	84	52 – 102	78	18 - 80	40
NO_2 mg/L	0.004- 0.05	0.018	0.013 - 0.10	0.031	0.004 – 0.07	0.029	0.003 - 0.05	0.026	0.013 - 0.26	0.13
NO_3 mg/L	0.03 - 0.25	0.081	0.026 - 0.30	0.097	0.031 – 0.27	0.099	0.03 - 0.21	0.09	0.10 - 2.3	0.82
NH_4 mg/L	0.21 - 1.12	0.42	0.19 - 1.46	0.56	0.22 - 2.26	0.69	0.31 - 1.42	0.71	0.16 - 2.54	1.04
SiO_3 mg/L	4.17 - 21.14	10.73	5.2 - 24.3	13.31	8.0 - 22.78	14.94	2.22 - 29.37	14.82	1.52 - 17.75	10.46
PO_4 mg/L	0.04 - 0.29	0.12	0.04 - 0.18	0.11	0.06 - 0.29	0.16	0.04 - 0.19	0.11	0.06 - 0.37	0.20
TOP mg/L	0.24 - 1.24	0.76	0.24 - 0.80	0.57	0.18 - 0.68	0.46	0.12 - 0.91	0.57	0.42 - 1.59	0.9

Table (2): Abundance of Phytoplankton at Fish Farms Neighboring to Lake Qarun (10^4 cells /L).

Months	Shalkhany	Goda 2	Goda 1	El-Shora	El-Berka drain
Jan.	33128	540	868	450	46
Feb.	3000	1198	1368	1818	60
Mar.	2000	4900	4600	16250	48
Apr.	50	570	-----	6800	30
May	160	----	4400	720	15
June	296	204	270	94	14
July	517	9	28	342	12
Aug.	446	10	58	1339	10
Sep.	83	40	60	55	13
Oct.	39	9	90	14	4
Nov.	971	112	26	212	7
Dec.	280	139	1611	----	8
Avg.	3414	703	1216	2554	22

Table (3): Species composition of phytoplankton at the Fish Farms.

Shalkhany	Goda 1 & 2	El-Shora
Bacillariophyceae	**Bacillariophyceae**	**Bacillariophyceae**
Nitzschia fusiformis Ehr.	*Nitzschia vitrea* Norman	*Nitzschia frustulum* (Kuetz.) Grun
Nitzschia sublinearis Hust.	*Nitzschia palea* (Kutz) W. Smith	*Nitzschia longissima* (Breb.)Ralfs
Nitzschia acicularis W. Smith	*Nitzschia frustulum* (Kuetz.) Grun	*Nitzschia acicularis* W. Smith
Nitzschia palea (Kutz) W. Smith	*Nitzschia acicularis* W. Smith	*Nitzschia closterium* (Ehr.)
Nitzschia amphibia Grunow	*Nitzschia closterium* (Ehr.)	*Nitzschia palea* (Kutz) W. Smith
Nitzschia thermalis Kuetz.	*Nitzschia amphibia* Grunow	*Nitzschia sublinearis* Hust.
Nitzschia closterium (Ehr.)	*Nitzschia sigma* W. Smith	Nitzschia lorenziana Grunow
Nitzschia hungarica Grun	*Nitzschia frustulum var.subsalina*	*Nitzschia vitrea* Norman
Nitzschia limnophila W.Smith	*Nitzschia thermalis* Kutz	*Nitzschia hungarica* Grun
Nitzschia longissima (Breb.)Ralfs	*Melosiera granulata* (Ehr.) Ralfs	*Amphiprora paludosa* W. Smith
Nitzschia ignorata Krasske	*Pleurosigma sp.*	*Stephanodiscus sp.*
Nitzschia obtuse W.Smith	*Synedra ulna* (Nitzchia) Her	*Melosiera granulata* (Ehr.) Ralfs
Nitzschia frustulum var. subsalina Kuetz.	*Cyclotella glomerata* Bach.	*Cyclotella glomerata* Bach.
Nitzschia vitrea Norman	*Cyclotella menghiniana* Kuetz	*Cyclotella menghiniana* Kuetz
Epithemia zebra Ehr.	*Navicula sp.*	*Cyclotella operculata* (Ag.)Kutz
Navicula apiculata Gregory	*Amphiprora paludosa* W. Smith	*Pleurosigma sp.*
Navicula sp.	**Chlorophyceae**	*Synedra ulna*
Amphiprora paludosa W. Smith	*Ankistrodesmus fusiformis* Corda	*Navicula sp.*
Melosiera granulata (Ehr.) Ralfs	*Ankistrodesmus falcatus var spirilliformis*	**Chlorophyceae**
Pleurosigma sp.	*Ankistrodesmus falcatus* (Corda) Ralfs	*Ankistrodesmus fusiformis* Corda
Cyclotella glomerata Bach.	*Ankistrodesmus convoulatus* Corda	*Ankistrodesmus convulatus* Corda
Cyclotella operculata (Ag.)Kutz	*Kirchnerella obesa* (W.west)Schmidle	*Crucigenia quadrata* Morreu
Cyclotella menghiniana Kuetz	*Cosmarium sp.*	*Crucigenia tetrapedia West*
Cymbella sp.	*Scenedesmus apiculatus* Chodat	*Elakatothrix gelatinosa* Wille
Chaetocerous sp.	*Scenedesmus bijuga* (Turp) Lager	*Kirchnerella obesa* (W.west)Schmidle
Chlorophyceae	*Scenedesmus intermedius* Chodat	*Coelastrum sp.*
Ankistrodesmus falcatus (Corda) Ralfs	*Oocystis sp.*	*Scenedesmus quadricauda* (Turpin) Breb.
Kirchnerella sp.	*Crucigenia quadrata* Morreu	*Scenedesmus bijuga* (Turp.) Lager.
Scenedesmus dimorphus (Turpin) Kuetz.	*Crucigenia tetrapedia* West	**Dinophyceae**
Oocystis sp.	*Clostium sp.*	*Prorocentrum apora* Schiller
Ankistrodesmus fusiformis Corda	*Selenastrum sp.*	*Prorocentrum micans* Ehr.
Dinophyceae	*Planktonema sp.*	*Protoperidinium sp.*
Prorocentrum micans Ehr.	**Dinophyceae**	**Euglenophyceae**
Prorocentrum apora Schiller	*Prorocentrun apora* Schiller	*Euglena acus* Ehr.
Protoperidinium sp.	*Protoperidinium sp.*	*Phacus sp.*
Euglenophyceae	**Euglenophyceae**	*Euglena viridis* Ehr.
Euglena sp.	*Euglena sp.*	*Euglena geniculata* Duj.
Phacus sp.	*Phacus sp.*	*Euglena gracilis* Klebs
Phacus ploeuronectes Dujardin	**Cyanophyceae**	*Euglena caudata* Hubner
Cyanophyceae	*Anabaena sp.*	*Euglena variabilis* Klebs.
Anapena sp.	*Anapenopsis circularis* (W.&G.S.West)	*Euglena limnophila* Klebs
Lyngbya limnetica Lemm.	*chrococcus sp*	*Euglena proxima* Swir.
Oscillatoria sp.	*Lyngbya limnetica* Lemm.	*Euglena tripteris* (Dujardin)
Anapenopsis circularis (W.&.West) V.Miller	*Phormidium sp.*	*phacus curvicauda* Swir.
Cryptophyceae	**Cryptophyceae**	*Phacus ploeuronectes* Dujardin
Chromonas sp.	*Cryptomonas ovata* Prescott	*Phacus caudatus* Huoner
		Cyanophyceae
		chrococcus sp
		Lyngbya limnetica Lemm.
		Phormidium sp.
		Cryptophyceae
		Chromonas sp.
		Cryptomonas ovata Prescott

Table (4): Fish Behavior at Fish Farms neighboring to Lake Qarun

Shalkhany	Goda 1 & 2	El-Shora
Oreochromis niloticus	Oreochromis niloticus	Oreochromis niloticus
Bacillariophyceae	**Bacillariophyceae**	**Bacillariophyceae**
Cyclotella bodanica Eulenst	*Cyclotella glomerata* Bach.	*Cyclotella menghiniana* Kuetz
Cyclotella striata (Kutz.) Grun.	*Cyclotella menghiniana* Kuetz	*Cyclotella glomerata* Bach.
Cyclotella glomerata Bach.	*Nitzschia hungarica* Grun	*Cyclotella bodanica* Eulenst
Cyclotella menghiniana Kuetz	*Amphiprora paludosa* W. Smith	*Cyclotella striata* (Kutz.) Grun.
Nitzschia longissima W.Smith	**Euglenophyceae**	*Nitzschia lorenziana Grunow*
Nitzschia frustulum var.subsalina	*Euglena limnophila* Klebs	*Nitzschia longissima* W.Smith
Nitzschia lorenziana Grunow	*Euglena proima* Ehr.	*Nitzschia frustulum var. subsalina* (Kuetz.) Grun
Navicula minima (Grun.)	*Euglena geniculata* Duj.	*Navicula placenta* Ehr.
Navicula rotaeana (Rabh.)Grun.	*phacus curvicauda* Swir.	*Navicula conforvaceae* Kutz.
Navicula conforvaceae Kutz.	*Phacus caudatus* Huoner	*Navicula minima* Grun.
Navicula placenta Ehr.	*Euglena sp.*	*Navicula rotaeana* (Rabh.)Grun.
Navicula jentzschii Kutz.	**Dinophyceae**	*Navicula jentzschii* Kutz.
Gyrosigma kutzingii (Grun.) Cleve	*Prorocentrum micans* Ehr.	*Gyrosigma kutzingii* (Grun.) Cleve
Caloneis amphisbaena (Bory) Cleve	*Prorocentrum apora* Schiller	*Caloneis amphisbaena* (Bory) Cleve
Euglenophyceae		**Euglenophyceae**
Euglena limnophila Klebs		*Euglena geniculata* Duj.
Euglena proima Ehr.		*Euglena limnophila* Klebs
Euglena geniculata Duj.		*Euglena proima* Ehr.
Euglena caudata Hubner		*Euglena acus* Ehr.
Chlorophyceae		*Euglena viridis* Ehr.
Ankistrodesmus convoulatus Corda		*Euglena gracilis* Klebs
Scenedesmus quadricauda (Turpin)Breb.		*Euglena caudata* Hubner
Cyanophyceae		*Euglena variabilis* Klebs.
Anapenopsis circularis (W.&G.S.West) V.Miller		*phacus curvicauda* Swir.
Oscillatoria sp.		*Phacus caudatus* Huoner
		Chlorophyceae
		Ankistrodesmus convulatus Corda
		Scenedesmus quadricauda (Turpin) Breb.
		Cyanophyceae
		Anapenopsis circularis (W.&G.S.West) V.Miller
		Oscillatoria sp.

3.1. Statistical analysis

The present results revealed that, phytoplankton crops were negative significantly correlated with salinity levels (r= - 0.36, p=0.01, n=48) and hydrogen ion concentration (r=- 0.45, p=0.002, n=48). However, NO_3-N, NH_4-N and PO_4-P values at Goda Fish Farms were high compared to the other farms but they were not significantly correlated with the total phytoplankton crops. Also, the regression analysis revealed that, the square of correlation coefficient (R^2) equal 0.27. This value means that, salinity and pH are responsible for 27 % of variation in total phytoplankton crop.

4. DISCUSSION

Water quality is still an abstract concept for fish farmers; the criteria behind it have never been adequately described. Hydrogen ion concentrations (pH) recorded at Daier El-Berka Drain was relatively low compared with the chosen fish farms. This is due to the wide variation of phytoplankton between the feeder/drain and fish farms where, pH changes in surface water result from the interaction of various biotic and abiotic processes. pH values at these farms ranged from 7.43 to 8.91 and they are optimum for fish culture (Delince, 1992). Alkalinity reached the highest values at Goda 2 Fish Farm (characterized by high salinity) while the lowest alkalinity was recorded at Shalkany Farm. Salinity contents at Goda 2 were generally higher than other fishing ponds due to seepage from Lake Qarun as it is the nearest pond to the hyper saline water. On the other hand, Shalkany Fish Farm was the lowest, since it is the only farm that receives some water from freshwater canal. Sodium, potassium, calcium and magnesium were generally following the same trend as alkalinity, high at Goda 2 and low at Shalkany Fish Farms. Major nutrient concentrations (N & P) at Dier EL-Berka Drain were much higher than the corresponding values at fish farms. Such increase is probably due to discharging lot amounts of waste water loaded with fertilizers from different farms into this drain. In general, nitrogen concentrations represented by NO_2-N, NO_3-N and NH_4-N indicated the dominance of NH_4-N over NO_2-N and NO_3-N either at the drain or the fish farms. This phenomenon can be related to natural degeneration of nitrogenous organic material of microorganisms yielding ammonia. Fish excretion and decomposition of excess un-consumed feed represented another ammonium sources in ponds (Meade, 1985). It is well known that, fish releases various waste products, such as carbon dioxide, ammonium and organic materials containing nutrients, while they remove oxygen and particulate organic material (plankton and bacterioplankton) from the system. Ammonium ions exist at lower pH values while the more toxic ammonia is present in more alkaline (pH>9) conditions. Total organic phosphorus (TOP) concentrations were much higher than the corresponding values of orthophosphate, where fish release sizeable amounts of organic phosphorus to the water. Ammonium and TOP concentrations could be correlated with the amount of stocked fish population and supplementary food added to the fish ponds. Therefore, using of food at a rate above the fish need resulted in a decline in fish production that was probably associated with accumulation of metabolism which could be alleviated by the use of an aerator to compensate dissolved oxygen consumption.

In general, the abundance of phytoplankton at the chosen fish farms reached up during mid winter (Jan.) and beginning of spring season (March), but showed a severe drop in October. This phenomenon was observed not only at these farms but also at Qarun and Wadi El-Rayian Lakes of El-Fayioum province (Konsowa and

Abd Ellah, 2002). Moderate water temperature of El-Fayoum depression in winter (17°C) could be appropriate for stimulating phytoplankton growth at this province where it is an arid region. In addition to the flourishing of *Ankistrodesmus fusiformis* which is un edible alga for the endemic fishes of these farms during cold season but they feeding efficiently on most algal community (diatoms and euglenoids) in spring and summer seasons. The algal blooms of *Ankistrodesmus fusiformis* in January could decrease dissolved oxygen and increase ammonium ions after its decay which can lead to massive loss of fish.

Oreochromis niloticus prefers diet on *Navicula* spp. and *Cyclotella* spp. from diatoms; Prorocentrum *apora* from dinoflagellates; *Euglena* spp. and *Phacus caudatus* from euglenoids and few species of green and blue green algae. In this respect, Elhigazi *et al.*, (1995) recorded that, Bacillariophyceae dominated in the fishless ponds, while in the presence of the Nile tilapia, green algae overgrown diatoms. Sondergaard *et al.*, (1990) found that, the removal of about 50% of planktivorous fish was found to be altering the plankton community towards an increase in large-sized diatoms in Lake Sobygird (Denmark). Also, Sabae (2006) stated that *Oreochromis niloticus* prey heavily on the large size diatoms compared with the corresponding density at control aquariums. So it should be decreases supplementary foods at these farms during the abundance of these items in spring and summer seasons. To achieve a good fish yield in pond production based only on natural food, one needs a good understanding of the processes of plankton production and the relative limnetic conditions of these type of plankton. With regard to Shalkhany Fish Farm, it harbored the highest phytoplankton crops followed by El-Shora Farm, while Goda 1 & 2 attained the lowest densities. The low level of salinity (1.7‰) together with low water temperature in January at Shalkhany Fish Farm may be induced phytoplankton blooming at this farm. This view is confirmed by the lowest crops of phytoplankton at Goda 2 fishpond that attained the highest salinity during the studied period. As well as, the algal species inhabiting these farms are mainly freshwater forms and increasing salinity may be inhibiting their proliferation.

Phytoplankton composition at these farms included Bacillariophyceae, Euglenophyceae, Chlorophyceae, Cyanophyceae, Dinophyceae and Cryptophyceae. The last three classes were rarely occurred at all chosen farms. Phytoplankton composition changes in the course of season and time, adapting to changes in the trophic state of the water body of the different farms. Also, the stocking density of fish at the chosen fish farms is chiefly playing an important role in phytoplankton abundance where planktivorous fish are filter feeding and tilapias are essentially pumping filter feeders (Lazarro, 1987). On the other hand, zooplankton assemblage can be plays a passive impact on phytoplankton distribution especially at the stagnant water of fish farms (El-Shabrawy *et al.*, 2006).

4.1. Statistical analysis

The present study revealed that, phytoplankton crops were negative significantly correlated with salinity levels (r= - 0.36, p=0.01, n=48) and hydrogen ion concentration (r=- 0.45, p=0.002, n=48). The multiple regression equation is

$$\textit{Phytoplankton density} = 660.06 - 0.56S‰ - 0.15\text{pH}$$

The regression analysis revealed that, the square of correlation coefficient (R^2) equal 0.27. Therefore, salinity and pH decrease phytoplankton density and responsible for 27 % of their variations. The lowest phytoplankton crops in Goda 1 & 2 confirmed this view due to increase both of salinity and pH values. On the other hand, NO_3-N, NH_4-N and PO_4-P concentrations at Goda Fish Farms were occasionally high compared to the other farms but these three items were not significantly correlated with the total phytoplankton crops. In this connection, El-Shabrawy *et al*., (2006) stated that the highest fish production and zooplankton abundance was recorded in Shalkhany Fish Farm which receives fresh irrigation water beside drainage water that improved its water quality.

Generally, Planktivorous fish and herbivorous zooplankton, recycling of nutrients within the environment and the artificial feed cast into the fish ponds during different seasons in turn regulates the level of phytoplankton in water body of any fish farms.

RECOMMENDATION

El-Fayoum Fish Farms derive their water from Daier El-Berka Drain and also drainage wastes at the same canal. So, it can be recommended that wastewater should be passing through aquatic plant channel associated with food crops before discharging again into fish ponds. This approach reduce water pollution from organic matter and nutrients contained in the wastewater. Fish production in these farms depends on intensive aquaculture in which the fishes are fed with external food supply. This kind of aqualture can be changed to extensive production during spring and summer seasons in which the fishes based on the natural phytoplankton production. This study also recommended ongoing studies on limiting nutrient and the stimulatory effect of these substances on the production of natural live fish food. So, it is necessary to use the best available method and manipulated techniques for monitoring fish farms in Egypt.

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