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COMPARATIVE ROLE OF EPIBIOTA AND PLANKTON PRIMARY AND SECONDARY PRODUCERS IN EGYPTIAN DELTA LAKES.

By

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Key Words: Plankton, Epbiota, productivity, Lakes, Egypt.

ABSTRACT

A comparative study of the productivity of lasion (epiphytes) and epizoa on Potamogeton pectinatus in Egyptian brackish waters (El-khobiza fish farm, Lake Edku and Lake Menzalah) with the phytoplankton and zooplankton standing crops was carried out. The standing crop of epibiota was assessed per unit weight (gm) and unit area (cm^2) of the hydrophytes. The comparative relationship of the standing crop of the epibiota substrate on hydrophytes is much greater than the standing crop of plankton. The epibiota with the macrophytes provide an important food item for the most common Egyptian fish of inland waters, Tilapia spp.

INTRODUCTION

Macrophytes grow in abundance in Egyptian Delta lakes. Their distribution is not homogeneous and depends on salinity and on the trophic level of the environment. They are very dense in eutrophic brackish-lake zones, decreasing with increasing salinity (up to 5 gm Cl/l), (Aleem and Samaan, 1969) and with decreasing eutrophy to dispersed patches, disappearing at the lake-sea connections. The most widespread is Potamogeton pectinatus and to a lesser extent Ceratophyllum demersum and Potamogeton crispus.

Most current researches on the lake productivity were directed to the study of the plankton production. The macrophytes with their epibiota have received less attention. Their role in the ecosystem was investigated by Halim and Guerguess (1981) for Lake Menzalah.

Zaki (1960) studied the distribution and the standing crops of macrophytes in Nozha Hydrodrome. Aleem and Samaan (1969) assessed the net production of Potamogeton pectinatus with its epiphytes in Lake Maryut. Samaan (1974) studied the distribution and seasonal variation of P. pectinatus and Ceratophyllum demersum in Lake Edku. Similar estimations were performed by Samaan et al 1988 b) in Lake Burollos. Vollenwieder and Samaan (1972) used C_{14} for measuring the rate of carbon assimilation by epiphytes growing on artificial substrates Guerguess (1979) investigated the epibiota on P. pectinatus on quantitative and qualitative basis in Lake Menzalah and in El-khobiza fish farm (K.F.F) (Guerguess, 1990). Samaan and Abdallah (1981) studied the effect of pollution on the colonization of periphyton on artificial substrates in Lake Maryut. they also in 1982 measured the growth rate of periphyton on artificial substrates in Nozha Hydrodrom. Samaan et al (1988 a) dealt with the epiphytes on P. pectinatus in Lake Borullos but only qualitatively.

The importance of the epibiota growing on macrophytes as food for lake fishes was pointed to by Elster and Jensen (1960) for Tilapia spp and other fishes in Nozha Hydrodrome. El-Sarraf (1976) carried out a qualitative study on the macrophytes of Lake Edku - with their epibiota in relation to the feeding habits of Tilapia spp and Mugil spp. El Kholy and Abd El-Malek (1972) studied the feeding of Tilapia zillii in Lake Qaroun in relation to locality and Abd El-Malek (1972 a and b) studied the feeding habits of T zillii in relation to size and sex.

MATERIALS AND METHODS

The epibiota (epiphytes and epizoa) of the macrophytes Potamogeton pectinatus, Ceratophyllum demersum and the red alga Polysiphonia spp. were studied quantitatively and qualitatively in different inland waters. Plankton samples were also taken simultaneously from the surrounding water for comparative study.

Macrophyte samples of about 100 gm were collected and kept in a sample bottle with 4% formalin. In the laboratory, the macrophytes are rubbed and washed with water several times (1-2 liters) to obtain the epibiota. The water volume is measured, the macrophytes are weighed as wet weight after being partially dried on blotting paper for about half an hour.

For phytoplankton studies, 5 liters of surface water samples were preserved with 4% formalin and reduced to about 1/25 after sedimentation. A phytoplankton net was also horizontally hauled at the surface for 10 minutes (50 mesh per 1 cm). and also 100 liters were collected by means of a 10 l bucket and filtered through the same net for the zooplankton standing crop determination

Subsamples of both the epiphytes and the phytoplankton were counted in a counting cell of capacity 1 cc. the epizoa and the zooplankton in a glass tray (Rafter cell) of 5 cc.

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The surface area of 1 gm of Potamogeton pectinatus was measured using a calibrated eye piece micrometer and found to be 50.53 cm^2. The results are referred therefore to both weight (per gm) and area per cm^2. Samples were collected from the following sites (Figs 1,2 and Table 1):

1. El Khobiza fish farm (K.F.F) in the south east of Lake Edku. Three stations (1-3) were surveyed, but for the macrophytes mainly station 1.

2. Lake Edku, south western part, 3 stations (I-III) were surveyed, macrophytes were collected in the vicinity of the 3 stations as they were scarce.

3. Lake Menzalah: 4 stations, st.1 in the south eastern basin, st.2 in the north (El Gameel) basin, st.3 in the north western and st.4 in the south western basin. Sampling of only Potamogeton pectinatus (stations 1, 3, 4) was carried out from July 1990 to December 1990 and of the alga Polysiphonia spp (st 2 only in July) through the project "Environmental impact assessment in the area of Lake Menzalah". It is worthy mentioned that Lake Borullos and Wadi El Rayan depression were visited only once, therefor the results can not be considered as representative of these two lakes.

Table (1). Sampling sites, duration of sampling and number of samples

Sites	Period of Survey	Total plankton Samples	Total Macrophytes Samples
El Khobiza fish farm	July 1987 - August 1989	135	75 (1-6) times/month
Lake Edku, south of El-Boughaz	August 1989 - May 1991	198	19 (1-4) times/month
Lake Menzalah	July 1990 - December 1990		19 samples
Wadi El-Rayan	One in August 1990	4	2 samples
Lake Borullos	One in June 1991	11	2 samples

RESULTS AND DISCUSSION

Warmings (1923) and Meuche (1939) (in Hutchinson, 1966) divided haptobenthos, organisms adnate to solid surface, into "epiphyton" which forms scattered communities and "lasion" which forms a thick matted community.

The primary producers in the Egyptian Delta lakes include the phytoplankton in the pelagic subsystem and the submerged higher plants, the macrophytes with their lasion, the semibenthic subsystem (Halim and Guerguess, 1981).

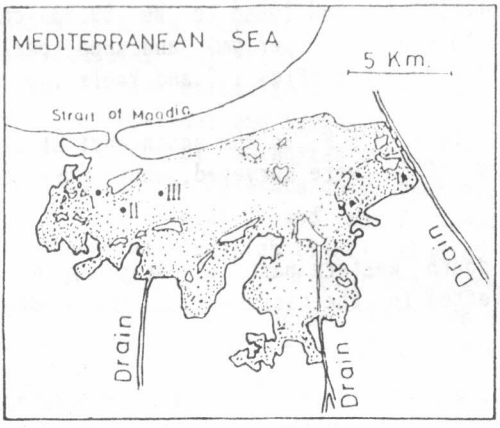

Figure 1: Lake Edku, sites of station and distribution of macrophytes.

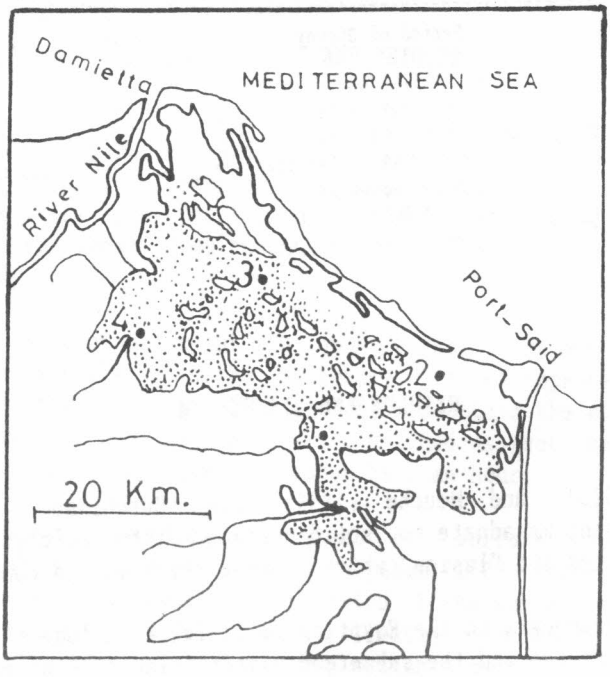

Figure 2: Lake Menzala, sites of stations and distribution of macrophytes.

Table 2: Average standing crops & composition of phytoplankton and lasion (epiphytes) on Potamogen Pectinatus in different sites of Lake Edku and Lake Manzalah.

xxx common, xx frequent and x rare

Species	Phytoplankton		Lasion (epiphytes) on P. pectinatus					
Sites	K.F.F.	L.Ed	K.F.F.	L. Ed	Lake Menzalah			
					St.1	St.2	St.3	St.4
Av. No of cells l^{-1} x 10^3	195	271						
Av. No of cells on 1 gm x 10^3			3160	1785	738	287	654	213
Av. No of cells on 1 cm^2 x 10^3			63	35	15		13	4
Cyanophyta								
Aphanizomenon sp.			x	x				
Lyngbya spp.			x					
Nodularia spumigena		x						x
Nostoc sp.								xxx
Oscillatoria spp.	x	x	x	x	x	x	x	x
Spirulina spp.	x	x			x		x	
Euglenophta								
Euglena spp.	xx	x			x		x	
Bacillariophyta								
Amphora spp.		x	x		x	x	x	
Bacillaria paradoxa	x	x	x	x				
Biddulaphia sp.		x		x			x	x
Campylodiscus sp.		x		x			x	x
Cyclotella spp.	xx	xxx	x	x	xx	xx	x	x
Epithemia sorex		x		x	x		x	x
Gyrosigma sp.	x	x	x		x	x	x	
Mastogloia spp.	xxx	xx	xxx	xxx	xxx	xxx	xxx	x
Melosira moniliformis		x		x		xx		
Navicula spp.	x	x	x		x	x	x	xx
Nitzschia lanceolata	xx		x					
Nitzschia longissima	x	x	x	x	xx		x	x
Nitzschia minutissima	xx	x	xxx	xx	xx	xxx	xx	xx
Nitzschia punctata		x	x	xxx	x	x	xxx	x
Nitzschia subcohaerens	x	x	x	x	x	x		
Nitzschia spp.	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Surirella sp.	x	x			x			
Synedra barbatula	x	x		x	x	x	x	x
Thalassiosira spp.	x	x		x	x		x	
Thalassiothrix spp.	x	x		x	x		x	x
Chlorophyta								
Cosmarium sp.		x	x	x				
Dispora crucigenioides			x	x				
Pediastrum boryanum	xxx	xx	x	x	x		x	
Scenedesmus spp.	x	x			x			
Ulothrix tenerrima		x	x					

K.F.F. El-Khobiza fish farm. & L.Ed. : South west of Lake Edku.

Table 3: Average standing crops & composition of zooplankton and epizoa on Potamogen Pectinatus in differant sites of Lake Edku and Lake Manzalah.

xxx common, xx frequent and x rare

Species / Sites	Zooplankton		Epizoa on P. pectinatus					
	K.F.F.	L.Ed	K.F.F.	L. Ed	Lake Menzalah			
					St.1	St.2	St.3	St.4
Av. No of organisms L^{-1}	71	34						
Av. No of organisms on 1 gm			71	362	139	171	27	274
Av. No of organisms on 100 cm^2			140	716	275		53	542
Free living Nematoda	xx	x	xxx	xxx	xxx		xxx	xxx
Oligochaeta	x	x	xxx	xx	x			x
Rotifera								
Ascomorpha sp.					xx		x	
Brachionus angularis	x	x	x		x		x	
Brachionus calyciflorus	xx	x	x	x	x			x
Brachionus urceus	x	x			xx		x	
Brachionus sp.	x	x			x			
Horaella brehmi	x	x	x		xx		x	x
Monostyla bulla		x	x		x			x
Monostyla closterocerca	x		x		x			x
Rotaria neptunia	xx		xxx					
Cladocera								
Bosmina longirostris		x	x					
Diaphanosoma excisum		x						
Alona bukobensis	x	x						x
Moina micrura	xx	xxx	x	x				
Macrothrix laticornis	x	-						
Copepoda								
Acanthocyclops americanus	xx	xxx		x		x		
Mesocyclops leuckarti	xxx	xxx	x	x		xx	x	x
Nitocera lacustris		x		xx	x		xx	x
Ostracoda								
Nauplii & Cypris of Cirripedia		xxx		x				
Nauplii of Copepoda	xx	x	x	x			x	x
Mysis of shrimps	x	x						
Larvae of Mosquito	x	x	xx	xxx	x		x	x
Gammarus spp.		x		xx		x	x	

K.F.F. El-Khobiza fish farm. & L.Ed. : South west of Lake Edku.

COMPARATIVE ROLE OF EPIBIOTA AND PLANKTON.

The role played in the ecosystem of lake water by the macrophytes was assessed in relation to the phytoplankton standing crops. The results show that the submerged macrophytes with their associated flora and detrital material are the basis of the major food chain in the Egyptian Delta lakes and other inland waters. This association consists mostly of Bacillariophyceae, Cyanophyta and Chlorophyta. The primary browsers and herbivores that graze and feed on them comprise mainly free living Nematods, some Copepoda, Rotifera, Cladocera, Amphipoda, Gastropoda and Mosquito larvae. This of an edible and luxuriant mixture provides inviting table of lasion and epizoa which attracts fish grazers.

In Lake Edku two localities (Fig 1) were investigated comparatively, one in the south western lake and the other in the south eastern lake (El-Khobiza fish farm, K.F.F). An inverse relationship was found between the increased density of the macrophytes with their associated standing crop of epiphytes and a lowered phytoplankton standing crop in K.F.F. and vice verse (table 2 and 3 and Figs 3 and 4). A similar inverse relationship exists between epiphytes and epizoa in S.W. Lake and between phytoplankton and zooplankton (Figs 5 and 6).

In K.F.F the macrophytes were present in dense patches especially to the east of the farm where the water chlorosity is low (0.28- 1.49 g l^{-1}). These macrophytes include Potamogeton pectinatus and to a lesser extent of Ceratophyllum demersum. At the same time, the average lasion standing crop is also much greater in K.F.F. (3.16 x 10^6 cells on 1 gm) than in the south western Lake Edku (1.78 x 10^6 cells on 1 gm of Potamogeton pectinatus).

In the south western Lake Edku (S.W. Edku), the macrophytes occur in dispersed patches due to wide fluctuations in chlorosity, (0.9 - 23.4 g l^{-1}. The quantitative relation between macrophytes with their growing epiphytes and phytoplankton is opposite to that in the K.F.F. Aleem and Samaan (1969) observed that the phytoplankton production in Lake Maryut displays an inverse relationship with the density of macrophytes due to competition for nutrient salts. The phytoplankton standing crops are higher in SW Edku due to the scarcity of macrophytes and lower lasion production.

An inverse trend was also observed between zooplankton and epizoa. The average zooplankton standing crop was higher in K.F.F (71 x 10^3 organisms m-3) than in SW Edku (34 x 10^3 organisms m-3), while the average epizoa standing crop was greater in SW Edku (362 organisms on 1 gm) than in K.F.F (71 organisms on 1 gm of P. pectinatus).

In Lake Menzalah (Fig. 2), in the south eastern basin (st.1), the most eutrophied part of the lake, nutrient salts are not a limiting factor and chlorosity is low (Halim and Guerguess, 1981), Plankton and macrophytes are present in dense patches with a heavy growth of lasion. The average lasion standing crop reached 738 x 10^3 cells on 1 gm of P. pectinatus, while the epizoa were slightly lower (139 organisms on 1 gm) than recorded in the south western Lake Menzalah (st.4). In the north of the lake (st.2) near the lake-sea

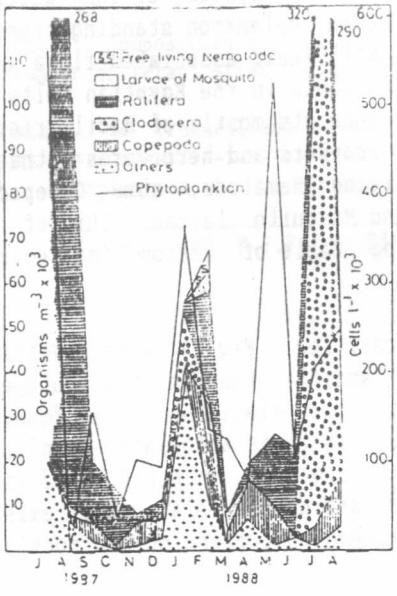

Figure 3: Monthly variations of phytoplankton standing crops and zooplankton standing crops and composition (El-Khobiza fish farm).

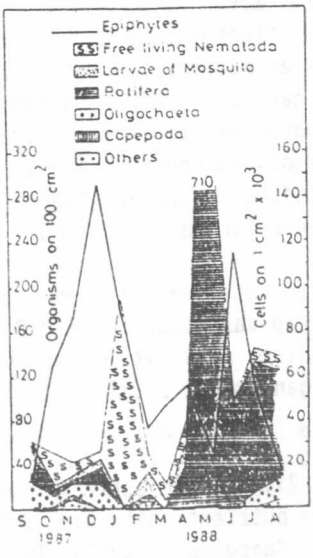

Figure 4: Monthly variation of lasion standing crops and epizoa standing crops and composition of Potamogeton poctinatus in El-Khobiza fish farm.

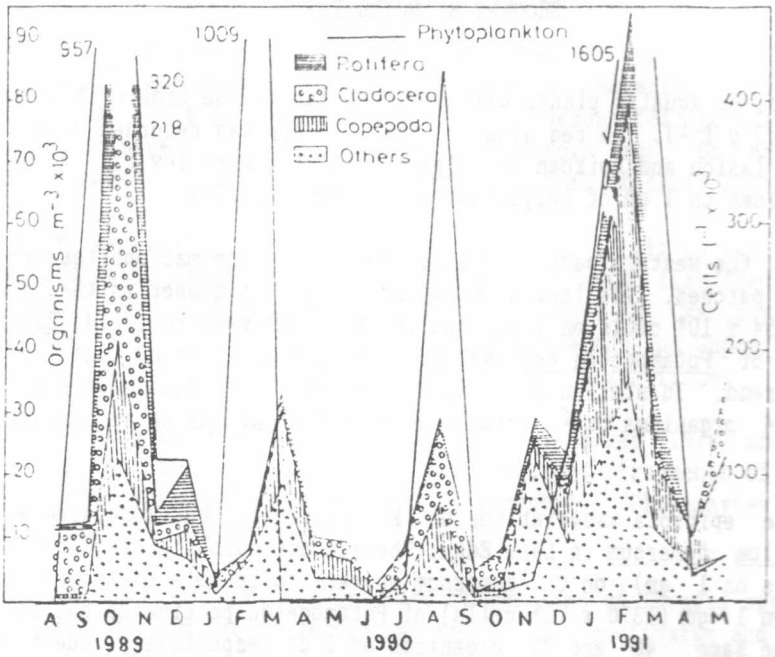

Figure 5: Monthly variations of phytoplankton standing crops and zooplankton standing crops and composition in south western region of Lake Edku.

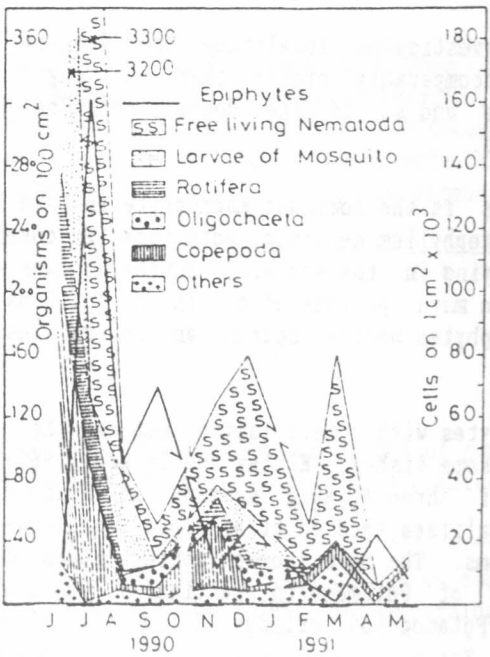

Figure 6: Monthly variations of lasion standing crops and epizoa standing crops & composition of Potamogeton pectinatus in south western region of Lake Edku.

connection, no aquatic plants were recorded due to the higher chlorosity values (1.06 - 7.2 g l^{-1}). The red alga Polysiphonia spp was recorded once in July, 1990. The lasion and epizoan on Polysiphonia spp. were low (287 x 10^3 cells and 171 organisms on 1 gm of Polysiphonia sp. respectively).

In the western part of Lake Menzalah, the macrophytes are present in dispersed patches. The lasion standing crop was higher in the north western (st.3), 654 x 10^3 cells on 1 gm than in the south western (st.4) 213 x 10^3 cells on 1 gm of Potamogeton pectinatus. The epizoan standing crop also shows the reverse trend. In station 3, it is the lowest, 27 organisms gm^{-1} and highest in st.4, 274 organisms gm^{-1} which is higher than at the other 3 stations in Lake Menzalah

The epibiota associations on P. pectinatus were compared with those on Ceratophllum demersum in Lake Edku. The average epiphyte standing crops (1982 x 10^3 cells on 1 gm) on C. demersum appears to be relatively greater than that present on 1 gm (1370 x 10^3 cells) of Potamogeton pectinatus but the epizoa was nearly the same, 40 and 38 organisms on 1 gm respectively. Due to the greater surface area per gm of Ceratophyllum demersum than of Potamogeton pectinatus, the composition was also slightly varied. Nitzschia punctata and Gammarus spp appeared relatively more abundant on Ceratophyllum demersum, while the diatom Mastogloia spp, the Oligochaete worms and the Mosquito larvae are relatively more abundant on Potamogeton pectinatus.

In the investigated localities the density of the lasion on the macrophytes is incomparably higher than the phytoplankton biomass in the surrounding waters and so is the density of the epizoa compared to the zooplankton biomass.

P. pectinatus is the dominant macrophyte in Lake Edku beside the frequent occurrence of Ceratophyllum demersum, both together cover about 50% of the total area of the lake lying in the eastern, southern, western parts and around the islands, with two main periods of growth in April-May and in August. During winter the macrophytes become scarce and covers less than 5% of the lake (Samaan, 1974).

These macrophytes with their lasion mat and the associated browsers are grazed upon by some fishes. Elster and Jensen (1960) on their study of the feeding habits of three Tilapia species in Nozha Hydrodrome found that T. nilotica and T. galilaea feed on filamentous algae covered with abundant growth of epiphitic diatoms. The main stomach content items of Tilapia zillii included small fresh pieces of Potamogeton pectinatus, Najas armata, filamentous algae and in some cases Potamogeton crispus. These water plants had abundant cover of epiphitic diatoms. The amphipod Gammarus was found in some cases.

El-Kholy and Abd El-Malek (1972) found that T. zillii in Lake Qaroun feeding vegetable and animal materials. The plant material include diatoms, cyanophytes, the red alga Palysiphonia sp., Pheaophytes, Ectocarpus sp. and higher plant tissues. Animal organisms as Nereis spp, Ostracoda, Acartia latisetosa, Gammarus spp and Gastropods were also part of their diet.

Abd El-Malek (1972 a) found that the diet of T. zillii in Lake Qaroun that varies according to variations in size. The small sized fish feed on limited number of food items, Polysiphonia sp. and Ectocarpus sp, Cyanophyta, diatoms, plant detritus and the animal food including Ostracoda and Gammarus sp. were recorded but in lower percentages than in the larger sized fishes.

On the feeding of Tilapia spp. in Lake Edku El-Sarraf (1976) indicated that the food items included diatoms, higher plant tissues (fragments of Potamogeton pectinatus and Ceratophyllum demersum), Cyanophyta, Pheaophytes, Rotifers, Polychaet larvae and Cladocera.

In El-Khobiza fish farm; transplanted fingerlings of Tilapia spp. and Mugil spp. feed naturally on the condensed patches of P. pectinatus and C. demersum with dense mat of epibiota.

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