Mansoura Journal of Biology Vol. 35 (2) December, 2008.

PROTOZOAN DIVERSITY AT BAHR-SHEBEEN AND AL-ATF CANALS IN EL-MENOFEYIA PROVINCE

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ABSTRACT

This study was carried out to evaluate the variations in the existance and the numerical densities of different Protozoa in less polluted (Bahr Shebeen canal) and polluted (Al-Atf drainage canal) water bodies and the response of these organisms to some ecological factors.

Water samples were collected by a transparent Perspex water sampler (1.2 L) for detecting Protozoa and measuring certain physico-chemical parameters.

Protozoa were sedimented at 7°C, examined microscopically using a Carl-Zeiss Jena transmittted-light inverted microscope and identified. The densities are expressed as number of organisms x 10^2/L.

The presence of various Protozoa were found to be in the favour of ciliophoran individuals followed by phytomastigophoreans and then sarcodines. These organisms could be divided ecologically into three groups (most common, frequent and rare) depending on their monthly existance and on their numerical densities. It was found only that the most common protozoan's numerical densities were higher in the polluted water body than those of the less polluted one. The relationships between various protozoan densities and certain physico-chemical factors were examined thoroughouly via the Minitab Statistical programme. It was proved that some of these parameters were significantly effective on the protozoan availability. The instantaneous growth rates of different Protozoa showed variations in both canals and could be referred to food type, its concentrations, abundance of the feeding protozoan genus itself and the predation influence of various predators including ambush protozoans and invertebrates.

Finally, it is recommended to improve the water quality through ehancing protozoan diversity by stopping and prohibiting illegal

domestic sewage inflow in the Nile and its branches to minimize pollutants loading.

INTRODUCTION

Studying of zooplankton is of vital importance in assessing the biological activity of rivers, coastal lagoons and estuaries [**Castel (1993); Bakker (1994) and Laprise & Dodson (1994)**] as they are considered as the secondary producers in the aquatic food chain.

The Nile receives about 37 main drains discharging municipal agricultural and industrial wastewater [**Abul Ela *et al.*, (1990)**].

The population densities of some freshwater types of zooplankton including Protozoa and their response to various ecological factors in El-Menofeyia province were extensively studied by [**Galal *et al.*, (1997)**]. Protozoa are considered as important components in the aquatic ecosystems and could be used as bioindicators of the water quality [**Antipa (1977) and Henebry & Cairns (1980)**]. According to the minute size and rapid growth rates, Protozoa are more convenient tool to follow up pollution in rivers and streams; [**Bick (1973)**]. In addition, Protozoa seem to help indirectly in improving the water quality through their influence on the bacterial populations and consequently on the breakdown of different pollutants; [**Galal (1980 & 1993) and Galal & Authman (1994)**] studied the dynamics of some planktonic and benthic ciliates in the River Nile in Kalubeyia province. Protozoan diversity and the corresponding densities at various water bodies with different levels of pollution were examined in many provinces of Egypt [**Galal (1994, 1999 and 2000); Galal & Gaber (2002) and Galal *et al.*, (2005)**]. Simultaneously, [**El-Bassat (2002)**] investigated the seasonal variations of different planktonic groups particularly Protozoa in various stations at Damietta Branch of the River Nile.

Protozoan diversity in a productive fishpond at Jos Plateau in Nigeria was followed up by [**Absalom *et al.*, (2002)**] where water temperature ranged between 22 and 28°C. Trophic roles and growth rates of planktonic ciliates were studied by [**Yasindi & Taylor (2006)**]. Moreever, [**El-Bassat & Taylor (2007)**] examined the pelagic zooplankton community including Protozoa at lake abo Zaabal in Egypt.

MATERIAL AND METHODS

This study was carried out during a period extending between $August_{95}$ and $July_{96}$ in El-Menofeyia Province where samples were collectd twice monthly. Bahr Shebeen is an irrigation canal with an average depth of three meters and average width of about 30 meters, while those of Al-Atf drainage canal are 1.5 and six meters respectively. Four sampling stations were chosen, as replicates, for each water body (Al-Mathan, Al-Anssari, University bridge and Al-Kassed at Bahr Shebeen, Ratib, El-Wehda, El- Bridge and Farm stations at the other one). Water samples were collected by the help of a transparent Perspex water sampler of 1.2 liter volume for detecting the protozoan organisms and measuring the following physico-chemical parameters (water temperature, electrical conductivity, dissolved oxygen, salinity, nitrates, phosphates, organic matter and chlorophyll-a). The latter four parameters were detected by methods adopted by **[APHA (1992)]**, while the former factors were measured in situ using YSI-S-C-T meter model 33. Protozoan organisms were sedimented using Heraeus-Christ GMBH cooling centrifuge where replicates of 10 ml were centrifuged at 1500 rpm for three minutes at 7^{0}C. The volume of each replicate was concentrated to 3 ml by decanting the supernatant and the residual part was transferred into Petri dishes in order to be examined microscopically using a Carl-Zeiss Jena transmittted-light inverted microscope. Protozoan densities are expressed as number of organisms x 10^{2}/L.

Protozoan organisms were identified alive according to the method used by **[Bick (1972); Patterson & Hedely (1992)]**. The statistical analyses were carried out via the Minitab Statistical Package and the growth rates were calculated using **[Rivier *et al.*, (1985)]**.

RESULTS

The collected protozoan organisms in the present study were divided into three main categories depending on both their numerical densities and their existance throughout the different months of the year:-

a) The most common protozoan organisms which were detected throughout all the year round in considerable numbers at both canals including *Euglena, Amoeba*, Litonotus, *Cinetochilum*, *Paramecium*, *Vortiocella* and *Euplotes* sp.

b) The frequent Protozoa which were recorded in several months of the year and their numerical densities were mostly lesser than those of the most common group such as *Actinophrys*, *Coleps*, *Urotricha*, *Stentor*, *Oxytricha* and *Stylonychia* sp.
c) Rare protozoans which were obtained only within few months of the year, sometimes they could not be easily detected during sampling and therefore, their numerical densities were the lowest such as *Arcella*, *Lacrymaria*, *Frontonia*, *Ophridium*, *Trichodina*, *Spirostomum*, and *Codonella* sp.

It was proved that the most common Protozoa are more or less the same at the different sampling stations of Bahr Shebeen canal where seven protozoan organisms were detected at these sites as could be seen in figure (1). Numerical density of Euglena sp. showed two peaks: the first one during May (40 x 10^2 /L) and the other (50 x 10^2 /L) during August. *Amoeba* sp. kept their densities below 10 x 10^2 /L at different sampling stations of Bahr Shebeen throughout a period extending between October and July and slightly above 10 x 10^2 /L during August and September. The protozoan *Litonotus* sp. showed two maximal values (24 and 15 x 10^2 /L) on November and February respectively. On the other hand, *Cinetochilum* sp. represented two peaks; the first occurred during October (20 x 10^2 /L) and the second one took place during March (13 x 10^2 /L). *Paramecium* sp. was found to have a major peak during November (14 x 10^2 /L). *Vorticella* sp. and *Euplotes* sp. achieved their peaks (16 and 17 x 10^2 /L respectively) on June.

On the other hand, the most common protozoan genera detected at Al-Atf drainage canal were found to be nine in number as shown in figure (2); six of which had their peaks on August and September (116, 44, 20, 32, 46 and 18 x 10^2/L for *Euglena*, *Amoeba*, *Litonotus*, *Cinetochilum*, *Paramecium* and *Euplotes* spp. respectively), while the other three had their peaks during October, November and May (17, 15 and 56 x 10^2/L for *Oxytricha*, *Coleps* and *Vorticella* spp. respectively).

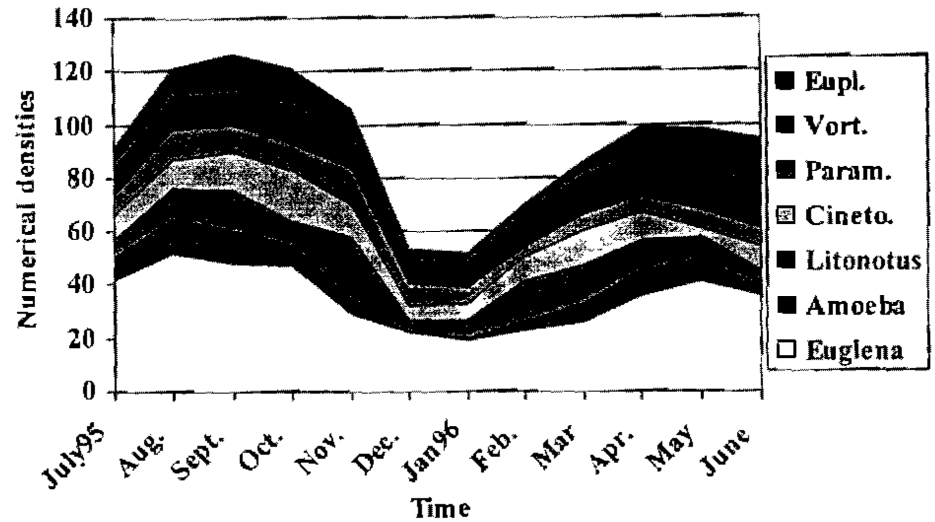

Fig (1): Average monthly abundance (x10^2 /L) of the most common protozoans at four different sampling stations at Bahr Sheben canal.

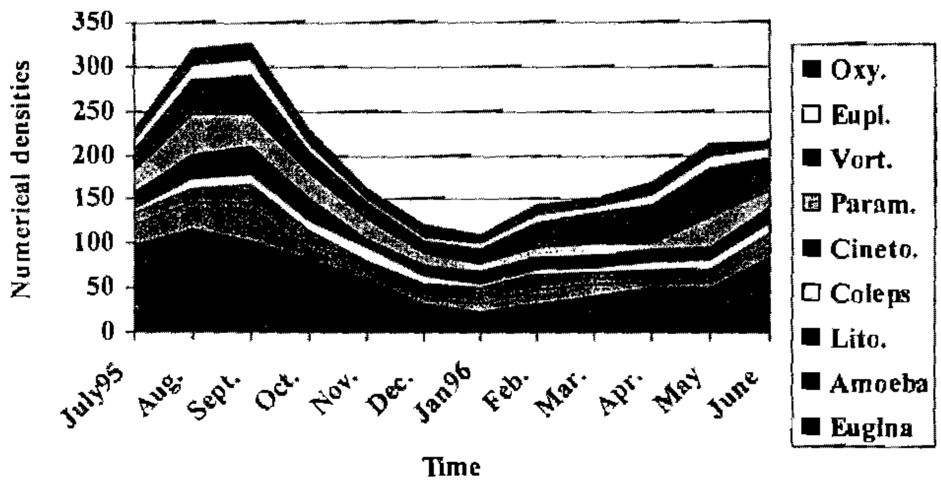

Fig (2): Average monthly abundance (x10^2 /L) of the most common protozoans at four different sampling stations at Al – Atf drainage canal.

Taking the monthly percentages of the most common protozoan genera relative to the total collected Protozoa in these two water bodies (Table 1) in our consideration, it revealed that, at Bahr-Shebeen, the lowest and the highest percentages are 21.5 and 37.8% for *Euglena* during February and July; 1.4 and 8.2% for *Amoeba* on Jannuary and August; 5.4 and 18.1% for *Litonotus* on June and November; 2.3 and 11.5% for *Cinetochilum* on May and October; 3.7 and 11.0% for *Paramecium* on February and December; 6.7 and 14.3% for *Vorticella* on September and June; 2.8 and 15.2% for *Euplotes* during February and June respectively. On the other hand, the minimal and maximal percentages at, Al-Atf canal, achieved 18.6 and 41.7% for *Euglena* on Jannuary and July; 4.7 and 12.3% for *Amoeba* during November and September; 4.1 and 15.3% for *Litonotus* on June and Jannuary; 1.7 and 7.9% for *Coleps* on July and November; 5.8 and 11.0% for *Cinetochilum* on November and Jannuary; 3.8 and 14.6% for *Paramecium* on April and May; 8.7 and 24.8% for *Vorticella* on October and May; 2.6 and 6.2% for *Euplotes* on November and May; 4.1 and 9.6% for *Oxytricha* on June and December respectively.

Figure (3) presented the average monyhly numerical densities for frequent Protozoa at Bahr-Shebeen and their peaks ranged between 7 and 10 x 10^2/L, while those of rare protozoans varied between 0.0 and 3 x 10^2/L as could be seen in figure (5). On the other hand, average monthly densities of frequent and rare Protozoa at Al-Atf canal were presented at figures (4) and (6) respectively. Those of frequent genera ranged from 0.0 to 12 x 10^2/L, while those of rare Protozoa varied between 0.0 and 2 x 10^2/L, but zero values of the latter are more frequent than the former genera.

The combined effect of the studied ecological factors upon the most common protozoa proved that certain combinations of these factors were statistically significant as could be seen in Table (2). At Bahr Shebeen, *Euglena* was found to be highly significantly influenced by various probabilities of only five examined parameters (temperature, electrical conductivity, oxygen, nitrates and total plankton) followed by *Euplotes*. The effect of four factors influence significantlly *Euglena*, *Euplotes*, *Amoeba* and *Paramecium*, while that of three factors affect significantlly *Euglena*, *Euplotes*, *Amoeba*, *Cinetochilum*, *Paramecium* and *Vorticella*. The influence of only two factors proved significant levels for *Euglena*, *Amoeba*, *Euplotes*, *Cinetochilum* and *Paramecium*.
At Al-Atf drainage canal, *Euglena* behaves similarly with various

probabilities against only four factors (temperature, oxygen, phosphates and plankton) followed by *Amoeba*, *Cinetochilum*, *Paramecium*, *Euplotes*, *Oxytricha*, *Colep*, *Vorticella* and *Litonotus*. The influence of both three and two factors affect significantly all the most common protozoan genera except *Litonotus*.

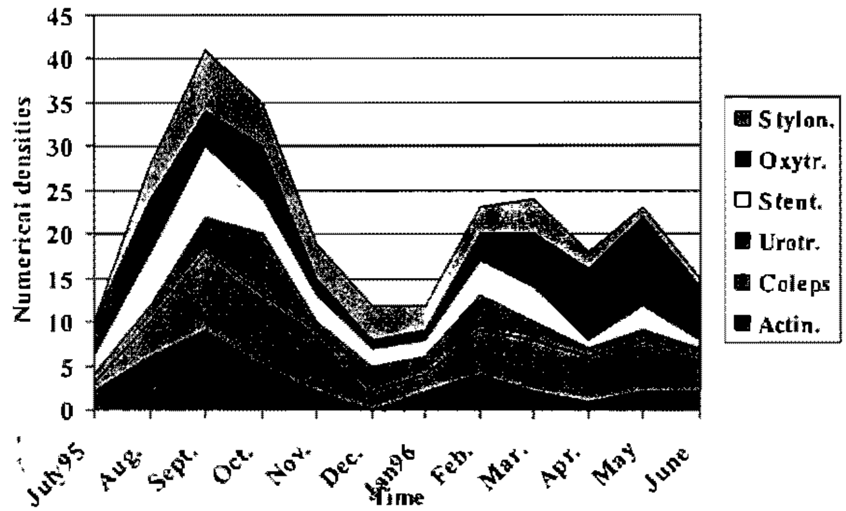

Fig (3): Average monthly abundance (X 10^2/L) of the frequent protozoans at four various sampling stations at Bahr Shebeen canal.

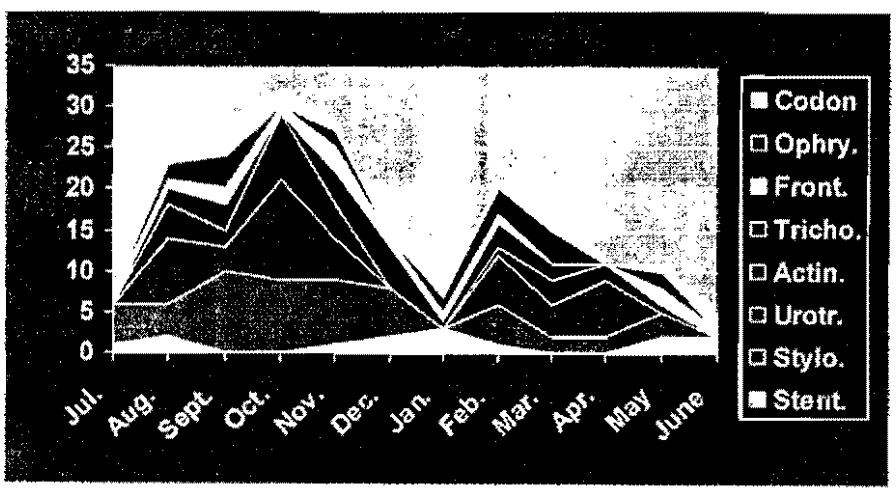

Fig (4): Average monthly abundance (X 10^2/L) of the frequent protozoans at four various sampling stations at Al-Atf drainage canal.

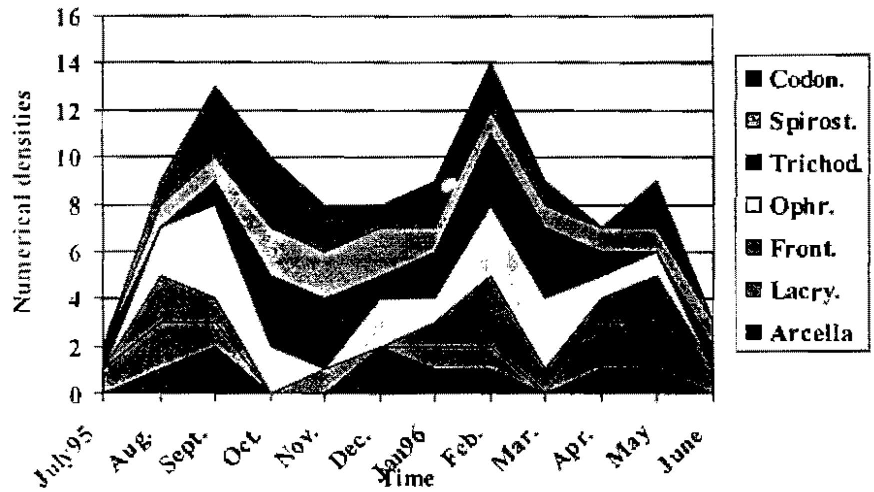

Fig (5): Average monthly abundance (x 10^2/L) of the rare protozoans at four various sampling stations at Bahr Shebeen canal.

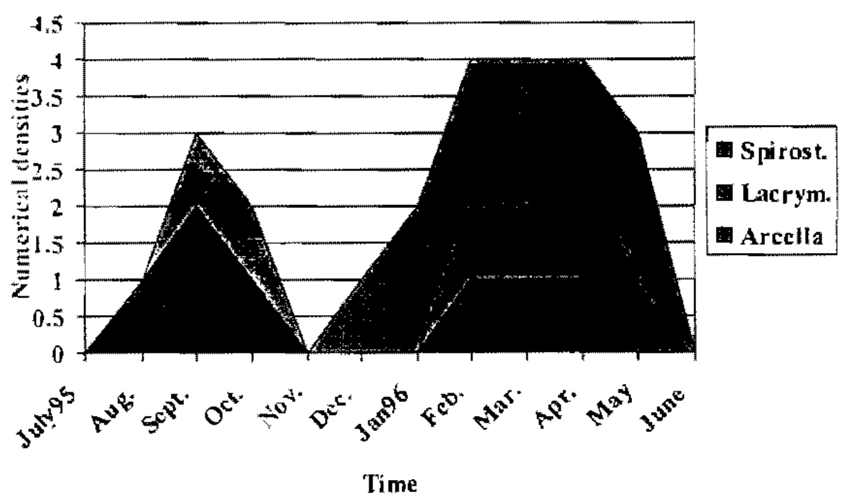

Fig (6): Average monthly abundance (x 10^2/L) of the rare protozoans at four various sampling stations at Al-Atf drainage canal.

Table (1): Monthly percentages of the most common protozoan genera relative to the total collected Protozoa at Bahr Shebeen and Al-Atf canals.

Month	*Euglena*	*Amoeba*	*Litonotus*	*Cinetochilum*	*Paramecium*	*Vorticella*	*Euplotes*	*Coleps*	*Oxytricha*
July B	37.8	7.2	6.3	8.1	7.2	9.0	6.3	---	---
A	41.7	9.8	6.4	7.7	10.6	10.2	4.3	1.7	4.7
Aug. B	32.9	8.2	7.0	7.0	7.0	7.6	7.9	---	---
A	33.7	9.0	4.4	8.1	13.4	11.3	4.7	3.5	4.9
Sept. B	26.7	6.7	8.3	8.3	5.6	6.7	7.8	---	---
A	28.5	12.3	5.6	8.9	10.3	11.7	5.0	3.6	5.6
Oct. B	28.3	4.8	5.5	11.5	6.0	8.4	8.4	---	---
A	31.6	6.8	5.3	9.5	11.4	8.7	3.0	4.2	6.5
Nov. B	21.8	3.8	18.1	9.0	10.5	8.3	8.3	---	---
A	30.9	4.7	6.3	5.8	11.0	9.9	2.6	7.9	6.3
Dec. B	30.1	0.0	6.9	6.9	11.0	12.3	5.5	---	---
A	23.5	5.9	11.8	9.6	9.6	10.3	3.7	5.2	9.6
Jan. B	26.0	1.4	9.6	8.2	8.2	12.3	5.5	---	---
A	18.6	9.3	15.3	11.0	7.6	13.6	5.1	4.2	7.6
Feb. B	21.5	2.8	14.0	8.4	3.7	12.2	2.8	---	---
A	18.9	10.1	10.1	7.7	7.7	16.0	4.7	3.0	7.1
Mar. B	21.9	5.9	11.8	10.9	5.0	12.6	4.2	---	---
A	23.7	8.1	6.9	8.1	6.9	20.2	3.7	4.0	6.4
Apr. B	29.0	7.3	8.9	8.9	4.8	12.9	8.1	---	---
A	27.6	3.8	6.5	7.6	3.8	24.3	6.0	4.9	7.6
May B	31.5	6.2	6.9	2.3	5.4	11.5	11.5	---	---
A	22.1	3.5	5.8	6.2	14.6	24.8	6.2	5.3	5.3
June B	32.1	2.7	5.4	8.0	6.3	14.3	15.2	---	---
A	37.8	8.1	4.1	8.1	8.6	16.7	5.0	5.4	4.1

B = Bahr-Shebeen A = Al-Atf drainage canal

Table (2) Summary of the significant relationships between most common protozoan genera and certain ecological factors through multiple and step-wise regression analyses.

i] Bahr-Shebeen

Parameters	*Euglena*	*Amoeba*	*Cinetochilum*	*Paramecium*	*Vorticella*	*Euplotes*
$C_{2,3,4,7,12}$	0.002					0.009
$C_{2,3,4,7}$	0.002	0.041				0.019
$C_{3,4,7,12}$	0.001	0.011				0.005
$C_{2,4,7,12}$	<0.001	0.007				0.007
$C_{2,3,7,12}$	0.001	0.020				0.02
$C_{2,3,4,12}$	<0.001	0.002		0.035		0.030
$C_{2,3,4}$	<0.001	0.014	0.040	0.046		0.043
$C_{3,4,7}$	0.001		0.040			0.004
$C_{4,7,12}$	<0.001	0.003			0.048	0.002
$C_{2,4,7}$	<0.001	0.018	0.020			0.014
$C_{2,4,12}$	<0.001	0.003	0.040			0.021
$C_{2,3,12}$	<0.001	0.010		0.040		0.049
$C_{2,3,7}$	0.001		0.050			0.014
$C_{3,4,12}$	<0.001	0.010	0.050	0.040		0.032
$C_{3,7,12}$	<0.001	0.007	0.050	0.040		
$C_{2,7,12}$	<0.001	0.006				0.006
$C_{2,3}$	<0.001	0.020	0.025	0.039		0.049
$C_{2,4}$	<0.001	0.004	0.012			
$C_{2,12}$	<0.001	0.003				0.016
$C_{3,7}$	0.001	0.017	0.016			
$C_{3,12}$	<0.001	0.003				0.024
$C_{4,12}$	0<.001	0.003				0.009
$C_{7,12}$	0.001	0.001			0.023	0.023

ii] At Al-Atf drainage canal

Parameter	*Euglen*	*Amoeb*	*Litonot*	*Coleps*	*Cinetochilum*	*Parameciu*	*Vorticell*	*Euplote*	*Oxytrich*
$C_{2,4,8,12}$	<0.001	0.008	0.050	0.030	<0.001	0.009	0.010	0.026	0.009
$C_{2,4,8}$	<0.001	0.013		0.030	0.002	0.024	0.008	0.036	
$C_{2,4,12}$	<0.001	0.007			<0.001	0.005	0.009	0.008	0.002
$C_{2,4,8,12}$	<0.001	0.002		0.010	<0.001	0.004		0.016	0.004
$C_{2,8,12}$	0.001	0.003		0.010	<0.001	0.002	0.008	0.008	0.035
$C_{4,8,12}$	<0.001	0.008			0.001	0.011	0.004	0.011	
$C_{2,4}$	<0.001	0.003		0.009	<0.001	0.007		0.033	
$C_{2,4,8,12}$	<0.001	0.002			<0.001	0.001		0.005	0.001
$C_{4,8}$	0.013	0.010			0.004				
$C_{4,12}$	<0.001	0.002			<0.001	0.001	0.003	0.002	0.012
$C_{8,12}$	<0.001	0.001		0.004	<0.001	0.001		0.002	0.010

Where

C_1 = time, C_2= Water temp., C_3= Electrical conduc., C_4= Dissolved oxygen

C_5= Salinity, C_6= P^H, C_7= Nitrates, C_8= Phoshates

C_9= Organic matter, C_{10}= Chlorophyll-a, C_{11}= Total protozoa, C_{12}= Plankton.

Table (3): Seasonal growth rates of the various protozoan genera at Bahr Shebeen and Al-Atf drainage canals.

	Bahr-Shebeen canal				Al-Atf drainage canal			
Protozoan genera	Summer	Autumn	Winter	Spring	Summer	Autumn	Winter	Spring
Most common genera								
Euglena	$4.09\ e^{-3}$	$-5.6\ e^{-3}$	$4.94\ e^{-4}$	$5.06\ e^{-3}$	$3.6\ e^{-3}$	$-6.1\ e^{-3}$	---	$2.2\ e^{-3}$
Amoeba	$1.63\ e^{-3}$	$-9.7\ e^{-3}$	$1.22\ e^{-2}$	$1.48\ e^{-3}$	$6.0\ e^{-3}$	$-1.8\ e^{-2}$	$8.4\ e^{-3}$	$-6.2\ e^{-4}$
Litonotus	$6.74\ e^{-3}$	$5.2\ e^{-3}$	$1.22\ e^{-2}$	$-4.91\ e^{-3}$	$5.7\ e^{-3}$	$-5.7\ e^{-3}$	$6.7\ e^{-4}$	---
Cinetochilum	$2.23\ e^{-3}$	$-2.5\ e^{-3}$	$6.53\ e^{-3}$	$-1.63\ e^{-2}$	$4.9\ e^{-3}$	$-1.2\ e^{-2}$	---	---
Paramecium	$5.02\ e^{-3}$	$3.7\ e^{-3}$	$-7.7\ e^{-3}$	$1.71\ e^{-3}$	$9.8\ e^{-3}$	$-6.3\ e^{-3}$	---	$1.1\ e^{-3}$
Vorticella	$-3.2\ e^{-3}$	$-9.7\ e^{-4}$	$4.1\ e^{-3}$	---	$5.8\ e^{-4}$	$-8.8\ e^{-3}$	$7.3\ e^{-3}$	$5.2\ e^{-3}$
Euplotes	$-4.8\ e^{-3}$	$-2.7\ e^{-3}$	$-3.2\ e^{-3}$	$1.2\ e^{-2}$	$4.2\ e^{-3}$	$-1.4\ e^{-2}$	$5.2\ e^{-3}$	$9.4\ e^{-3}$
Coleps	---	---	---	---	---	$1.6\ e^{-3}$	$-3.7\ e^{-3}$	$6.0\ e^{-3}$
Oxytricha	---	---	---	---	$-7.1\ e^{-3}$	$-5.7\ e^{-3}$	$-8.9\ e^{-4}$	$9.7\ e^{-4}$
Frequent genera								
Actinophrys	$1.2\ e^{-2}$	$-1.7\ e^{-2}$	$1.5\ e^{-2}$	---				
Colpidium	---	$-2.8\ e^{-3}$	$1.0\ e^{-2}$	---				
Urotricha	$7.7\ e^{-3}$	$-2.2\ e^{-2}$	$3.2\ e^{-3}$	$-7.7\ e^{-3}$				
Stentor	$2.0\ e^{-2}$	$-1.1\ e^{-2}$	$7.7\ e^{-3}$	$-3.2\ e^{-3}$				
Oxytricha	---	$-7.7\ e^{-3}$	$1.2\ e^{-2}$	$5.7\ e^{-3}$				
Stylonychia'	$1.5\ e^{-2}$	$-6.2\ e^{-3}$	$-3.2\ e^{-3}$	$-1.5\ e^{-2}$				
Rare genera								
Trichodina	---	$1.2\ e^{-2}$	$1.2\ e^{-2}$	---				
Spirostomum	---	$7.7\ e^{-3}$	$-7.7\ e^{-3}$	---				
Codonella	---	$-4.5\ e^{-3}$	$7.7\ e^{-3}$	$7.7\ e^{-3}$				
Ophrydium	---	---	$4.5\ e^{-3}$	$-1.2\ e^{-2}$				

$e^{-n} = 10^{-n}$

The positive growth rates indicated an increase in the individual cell size and the numerical densities which in turn exhibited increasing reproductive rates, while the negative ones proved an opposite behaviour and might be termed as declination rates.

Having a glance to table (3), it was obvious that most of the growth rates were negative on autumn at both water bodies, those belonging to winter and spring showed more positive growth rates as compared with the negative values at both canals. The summer protozoan samples at Al-Atf drainage canal had negative values, while those belonging to Bahr Shebeen were mostly positive (*Vorticella* and *Euplotes* spp.). At Bahr Shebeen, growth rates exibited that *Stentor* sp. had the highest positive value (2.0×10^{-2}) during summer and *Euglena* sp recrded the lowest record (4.94×10^{-4}), while those of Al-Atf canal were 1.1×10^{-2} and 5.8×10^{-4} for *Paramecium* and *Vorticella* spp. during spring and autumn repectively. On the other hand, the highest and lowest declination at Bahr Shebeen rates were -1.1×10^{-2} and -9.7×10^{-4} in case of *Stentor* and *Vorticella* spp respectively during autumn for both, while those belonging to Al-Atf canal were -1.2×10^{-2} and -8.9×10^{-4} for *Cinetochilum* and *Oxytricha* spp. on autumn and winter respectively.

DISCUSSION

As mentioned previously, the aim of the present study was to evaluate both the protozoan diversity and its response to certain ecological factors.

The high densities of *Euglena* in both water canals throughout the various months of the year could be referred mainly to the presence of the sun light for long exposure time during the day and consequently more photosynthetic activity leading to increase the numerical densities of various heterotrophic protozoan genra.

The accumulation of the organic matter resulting from the previously mentioned photosynthetic activity, the agricultural activity and/or the illegal discharge of certain pollutants provide suitable conditions for growing and survival of the bacterial-feeding protozoan organisms such as *Cinetochilum*, *Paramecium* and *Vorticella*. Accordingly, high numerical densities of algivorous and carnivorous protozoan genera such as *Oxytricha*, *Euplotes*, *Stylonychia*, *Litonotus*, *Amoeba*, *Coleps*, *Urotricha* and *Spirostomum* found enough nutritive material and consequently, more protozoan diversity could be obtained.

Some of these protozoan genera were finally consumed by aquatic insect's and other arthropod's larvae, cladocerans and fish larvae where the food chain is completed. This predation effect might be responsible for the fluctuation and/or declination of the various protozoa at the different seasons.

Regarding the growth rates of the most common protozoan individuals , it was proved that the values of certain protozoan genera, at Bahr Shebeen, are higher than those of the same individuals belonging to Al-Atf canal except those of *Paramecium*, and **Vorticella.** The instantaneous growth rates ranged from 4.94 10^{-4} /day minimally in case of ***Euglena*** to 1.22 10^{-2} /day maximally in Litonotus during Winter at the former water body, while those of the latter one varied between a minimum of 5.8 10^{-4}/ day in case of *Vorticella* on summer and a maximum of 1.1 10^{-2}/day in *Paramecium* on spring.

On the other hand. the growth rates of frequent and rare protozoan genera at Bahr Shebeen varied between 7.7 10^{-3} /day and 2.0 10^{-2} /day in case of *Urotricha* and *Stentor* as frequent genera and ranged from 4.5 10^{-3} /day to 1.2 10^{-2} /day in *Ophridium* and ***Trichodina*** as rare individuals respectively.

On the contrary, the growth rates of frequent and rare protozoan genera belonging to Al-Atf canal could not be calculated due to the irregularity of the data and the presence of more zero values. It is worthy to mention that all the different protozoan genera have negative growth rates during autumn at both water bodies apart from *Coleps* as a carnivor at Al-Atf canal, *Litonotus* as ambush predator, *Paramecium*, *Trichodina* and *Spirostomum* as bacterial feeding protozoans at Bahr Shebeen. During winter and spring, growth rates of most of the various protozoan genera were proved to be more positive with few negative values. On the other hand, the growth rates during summer were more or less completely positive in both polluted and unpolluted water bodies. The negative growth rates during various seasons could be interpreted mostly as a result of the presence of certain carnivorous organisms including ciliated protozoans such as *Amoeba*, *Litonotus*, *Stentor*, *Lacrymaria* and *Stylonychia*.

The difference in growth rates of the same protozoan organisms in the examined two water bodies during the same season could be possible referred to food type, food concentrations and abundance of the feeding protozoan genus itself beside the predation influence of the other organisms. This is parallel to the results obtained by **[Kimball *et al.*,**

(1959); Laybourn & Stewart (1975); Baldock & Baker (1980); Baldock *et al.*, (1980) and Laybourn (1984)]. Simultaneously, The minimal growth rate of *Euglena* sp. During Winter, as compared with those of the other seasons, at Bahr Shebeen and Al-Atf canals could be mostly attributed to the low incident solar radiation as compared to the other seasons.

It was not so easy to detect any significant single relationship between one of the examined ecological factors against any of the various protozoan genera apart from water temperature and the planktonic density in both water canals. The significant relations may provide an indication about the importance of these two factors in influencing the predominance of some protozoan genera.

According to **[Hamilton & Preslan (1970) and Laybourn (1984)]**, the growth rates and consequently the reproduction rates are controlled by a complex range of environmental and biological factors particularly temperature and food supply.

Finally, the combined effects of certain measured ecological parameters were examined statistically through applying both multiple and step-wise regression analyses and consequently some significant combined relationships were achieved. This may give a good indication for the annual protozoan yield and consequently make it possible, together with those of the other planktonic groups, to predict the availability of good qualitative and quantitative food for certain types of fishes. It is worthy to mention that the results of these analyses were supported by those belonging to **[Laybourn (1976); Rogerson (1981); Galal (2000) and Galal & Gaber (2002)]**.

It was proved that both nitrates and phosphates' concentrations are much fluctuated at Al-Atf canal than those belonging to Bahr Shebeen which could be referred to one or more of these reasons; the illegal discharge of some pollutants such as fertilizers particularly those of nitrate and phosphate origin, the illegal sewage drainage especially at Al-Atf canal and the release of organophosphates and ammonia – free amino acids as excretory products by various planktonic groups mainly Protozooplankton individuals; **[Laybourn (1984)]**. Accordingly, it is recommended to improve the water quality through ehancing protozoan diversity by stopping and prohibiting illegal domestic sewage inflow in the river and its tributaries to minimize pollutants loading.

REFERENCES

Absalom, K.V., Musa, S.O., Akpa, L.E. and Oyindshola, A. (2002): Protozoan diversity in a reproductive fishpond of a tropical plateau. J. Aqu. Sci., 17 (2): 109-112.

Abul Ela, T.A., Fayed, S.E. and Ghazy, M.M. (1990): Zooplankton as parameter of pollution of the Nile water in Egypt. Proc. Zool. Soc. A.R. Egypt, 21: 203-217.

Antipa, G.A. (1977): Use of commensal protozoa as biological indicator of water quality and pollution. Trans. Amer. Micros. Soc., 96: 482 – 489.

APHA (1992): (American Public Health Association), Standard methods for the examination of water and wastewater. 18th ed., Green berg, A.E; Clesceri, L.S. and Eatan, A.D. (editors) APHA, WFF and AWWA, Washington D.C.

Bakker, C. (1994): Zooplankton species composition in the Oosterschelde (S.W Netherland) before, during and after the construction of a storm-surge barrier. Hydrobiologia, 283: 117-126.

Baldock, B. and Baker, J.H. (1980): The occurrence and growth rates of Polychaos fasciculatum, a rediscovered Amoeba. Prototistoligica, 16: 79 – 84.

Baldock, B., Baker, J.H. and Sleigh, M.A. (1980): Laboratory growth rates of six species of freshwater Gymnamoeba. Oecologia (Berlin), 47: 156 – 159.

Bick, H. (1972): Ciliated Protozoa "An illustrated guide to the species used as biological indicator in freshwater biology. W.H.O. Geneva, Switzerland.

Bick, H (1973): Population dynamics of protozoa associated with the decay of organic materials in freshwater. Amer.Zool.,13: 149-160.

Castel, J. (1993): Long-term distribution of zooplankton in the Gironde Estuary and its relation with river flow and suspended matter. Cah. Biol.Mar., 34: 145-163.

El-Bassat, R. (2002): Ecological studies on zoplankton communities with particular refernce to free-living Protozoa at Damietta Branch. Ph.D Thesis, Ain-Shams Univ.

El-Bassat, R. and Taylor, W. (2007): The zooplankton community of Lake Abo Zaabal, a newly-formed mining lake in Cairo, Egypt. African J. Aq. Sc., 32(2): 185-192.

Galal, M. (1989): Ecological studies on the ciliate and bacterial populations of slow sand filters. Ph. D. Thesis, Univ. of London.

Galal, M. (1993): A study of protozoan diversity, in the River Nil;e at Benha, Kalubeyia, Egypt with particular reference to ciliates. J.Egypt. Ger. Soc. Zool., 20 (D): 27 – 42.

Galal, M. (1994): The protozoan diversity in clean- and waste-water bodiesin Kalubeyia Governorate, Egypt. J. Egypt. Ger. Soc. Zool., 13 (D): 197 – 206.

Galal, M. (1999): Ciliate protozoan's diversity in Damietta branch of the River Nile between Kalubeyia and Dakahleyia provinces. Egypt. J. Aquat. Biol. And Fish., 3 (4): 197 – 213.

Galal, M. (2000): population densities, growth and filtering rates of certain bacteria feeding hymenostome ciliates at three different water bodies. Egypt. J. Aquat. Biol. And Fish., 4 (3):251 – 270.

Galal, M. and Authman, M.N (1994): The population densities and the growth rates of the most common Holotrichs and Spirotrichs in the River Nile at Benha, Kalubeyia, Egypt. J. Egypt. Ger. Soc. Zool., 13 (D): 207 – 218.

Galal, M. and Gaber, N. (2002): Population densities of protozooplankton and their response to certain factors in the River Nile in El-Menofeyia province, Egypt. J. Egypt. Ger. Soc. Zool., 38 (D): 1 - 14.

Galal, M., Khallaf, E. and Authman, M. (1997): Population densities of some freshwater types of zooplanktopn and their response to various ecological factors in two drainage canals in El Menoufiya Province, Egypt. J. Union, Arab. Biol., Cairo, vol. 8(A): 253 – 277.

Galal, M., Khallaf, E and El-Sehemy, M. (2005): Ecological studies on protozoo- plankton in two different water bodies in Shebeen El-Koum,

El-Menofeyia province, Egypt. Proc. Of El-Minia First International Conference, (15-17, April 2005).
TOWARDS A SAFE AND CLEAN ENVIRONMENT (C-5).

Hamilton, R.D. and Preslan, J.E. (1970): Observation on the continuous culture of a planktonic phagotrophic protozoa. J. Exper. Mar. Biol. And Ecol., 5: 94 – 104.

Henebry, M.S. and cairns, J. (1980): Monitoring of stream pollution using protozoan communities on artificial substrates. Trans. Am. Micro. Soc., 99: 151 – 160.

Kimball, R.F., Caspersson, T.O., Svensson, G. and Carlson, L. (1959): Quantitative cytological studies on *Paramecium Aurelia*. Exp. Cell Res., 17: 160 – 172.

Laprise, R. and Dodson, J.J. (1994): Environmental variability as a factor controlling spatial patterns in distribution and species diversity of zooplankton in the St. Lawernce Estuary. Mar. Ecol. Prog. Ser., 107: 67-81.

Laybourn, J. (1976): Energy budgets for *Stentor coerulus* Ehrenberg. Oecologia (Berlin), 22: 431 – 437.

Laybourn, J. (1984): A functional biology of free-living Protozoa. Croom Helm (London and Sydney).

Laybourn, J. and Stewart, J.M. (1975): Studies on consumption and growth in the ciliate Colpidium campylum Stokes. J. Anim. Ecol., 44: 165 – 174.

Patterson, D.J. and Hedely, S. (1992):Free-Living freshwater Protozoa. A colour guide. Wolfe publishing Ltd. England.

Rivier, A.; Brownlee, D.C.; Sheldon, R.W. and Rassoulzadegan, F. (1985): Growth of microzooplankton: a comparative study of bactivorous zooflagellates and ciliates. Mar. Microbiol Food webs, paris, 1: 51-60.

Rogerson, A. (1981): The ecological energetics of *Amoëba proteus* (Leidy) as influenced by temperature and food concentration. Can. J. Zool., 56: 543 – 548.

Yasindi, A.W. and Taylor, W. (2006): The trophic position of planktonic ciliate populations on the food webs of some East African lakes. African J. Aqu. Sci., 31 (1): 53-62.

تنوع الأوليات فى بحر شبين ومصرف العطف بمحافظة المنوفية

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أجريت هذه الدراسة كجزء من رسالة دكتوراة بجامعة المنوفية ، وهى تهتم بتنوع الكائنات الأولية خاصة الهدبية منها ، حيث تتميز هذه المخلوقات بدقة الحجم وسرعة التكاثر وارتفاع معدلات الأيض مما يمكننا من استخدامها ككواشف حيوية لأنواع مختلفة من التلوث. ولقد وجد إختلاف فى التنوع البيئى ومعدلات النمو لتلك الكائنات فى كلتا القناتين ، وذلك لإختلاف بعض العوامل البيئية فيهما ومن بينها التلوث خاصة العضوى منه. كما أنه يمكن الربط فيما بعد بين الكثافة العددية لتلك الكائنات وتوافر الأسماك أكلة الهائمات المائية ، وبالتالى كثير من الأسماك الأخرى ، مما يمكننا من تقدير حجم الثروة السمكية تقريباً لأى جسم مائى. وبناءاً على ذلك تمت التوصية بضرورة تجريم ومعاقبة القاء مخلفات الصرف الصحى والزراعى والحيوانى فى نهر النيل وروافده.