Summary

The term biomanipulation was originally defined as management of aquatic communities by controlling natural population of organisms aimed at water quality improvement.

This study was carried out in the River Nile at EL-Kanater EL-Khayria beside Fish research station of the National Institute of Oceanography and Fisheries (NIOF).

1. Field survey

The abiotic factors:

1- Water temperature attained the highest value of 30.10°C in summer, while the lowest value of 20.4°C was found in winter.

2- The pH values lie on the alkaline side (pH > 8). Its value ranged from 8.41 in winter to 8.10 during summer.

3- Electrical conductivity value reached the major peak of 426 µmohsCm^{-1} in summer, while the minor one of 335 µmohs Cm^{-1} was recorded during winter season.

4- Ammonium–N concentration increased from 46.50 µgL^{-1}in winter to 115.60 µgL^{-1}in summer.

5- The highest nitrite values of 13.80 µgL^{-1}was recorded during spring, while the lowest one of 1.60 µgL^{-1}was observed in summer.

6- Nitrate concentrations were much higher than the corresponding values of NH_4-N except in spring 2003 when the reverse was true. Nitrate values fluctuated between 616.80 µgL^{-1} in summer and 17.30 µgL^{-1} in spring.

7- Total organic nitrogen reached the highest values of 10.58 mg L^{-1} in spring and decreased to the lowest value of 1.07 mgL^{-1} during winter.

8- Orthophosphate values fluctuated from a minimum of 7.20 μgL^{-1} during autumn to a maximum of 55.40 μgL^{-1}in summer.

9- Total organic phosphorus values varied between a minimum of 54.70 μgL^{-1} in winter and a maximum of 329.70 μgL^{-1}in summer.

10- The general distribution pattern of silicate ranged from a minimum of 0.49 mgL^{-1} during winter to a maximum of 2.30 mgL^{-1} during summer.

The biotic factors:

Phytoplankton

The general pattern of phytoplankton crops showed two major peaks in winter (2540×10^4 cells L^{-1}) and autumn (2352×10^4 cells L^{-1}). Its numerical density was declined during the other two seasons, reaching the lowest value during spring (773×10^4 cells L^{-1}).

Green algae occupied the first predominant position (56.7% of the total phytoplankton crop). The most dominant genera of Chlorophyta were *Dictosphaerium, planktonema, Oocystis, Scenedesmus,* and *Coelastrum* .

Diatoms occupied the second predominant position (32.7% of the total phytoplankton crop). The most dominant species were *Melosira*, *Cyclotella,* and *Syndra.*

Blue-greens occupied the third predominant position (10.1% of the total phytoplankton crop). The most leading species were *Microcystis, Merismopedia, Chrococcus, Cylindrospermopsis,* and *Lyngbya.*

Chrysophyceae, Cryptophyceae, Dinophyceae, and Euglenophyceae were recorded as rare groups during the period of investigation. They contributed only 0.49 % of the total phytoplankton standing crop.

Chlorophyll *a* reached the highest value (59.49 µg*chl.a*L^{-1}) in winter, while the lowest value (26.0 µgChl.*a*L^{-1}) was found in spring. Chlorophyll *a* of the different phytoplankton component indicated that netplankton (> 20µm) constituted the major fraction of total chlorophyll *a* (24.6%) compared to nano & picoplankton (< 20µm).

Zooplankton

Zooplankton assemblages are categorized in three main groups (rotifera, cladocera, and copepoda). Rotifera were the most dominant organisms in the area of study (95.79 % of the total zooplankton). The Rotifer fauna comprised 24 species belonging to 17 rotifer genera. *Keratella, Conochillus* and *Brachionus* were the most dominant genera, representing totally 87.51 % of the total rotifer counts.

Cladocera were the second important group, constituted numerically 2.15 % of the total population. Copepoda, the third group, constituted 1.05 % of the total population.

2. In situ grazing experiments

pH values were usually increased with time and zooplankton density, its values varied between 7.91 and 8.8.

Nitrate contents were much higher during autumn and summer seasons than the corresponding values of ammonium and nitrite while it lower than ammonium concentration in spring season.

Orthophosphate, TOP and TON were usually increase at the grazed enclosures compared to the ungrazed sets or control.

On the other side, silicate concentrations were often decrease at the enclosures inoculated with zooplankton organisms compared to the control group.

NH_4-N values ranged from 24.7 to 48.8 μgL^{-1}, 29.8 to 91.3 μgL^{-1}, and 96.8 to 124.3 μgL^{-1} during autumn, spring and summer experiments respectively.

NO_2-N concentrations ranged from 3.3 to 7.6 μgL^{-1}, 8.5 to 14.5μgL^{-1}, and 1.6 to 3.5 μgL^{-1} during autumn, spring, and summer experiments respectively.

NO_3-N values ranged from 24.7 to 178.7μgL^{-1}, 12.1 to 23.8μgL^{-1}, and 570.3 to 650.6μgL^{-1} during autumn, spring and summer experiments respectively.

TON values ranged from 1.1 to 14.5 mgL^{-1}, 2.6 to 10.6 mgL^{-1}, and 1.4 to 23.3 mgL^{-1} during autumn, spring, and summer experiments respectively.

Orthophosphate concentrations ranged from 1.5 to 16.3 μgL^{-1}, 17.0 to 49.2 μgL^{-1}, and 34.9 to 106.5 μgL^{-1} during autumn, spring, and summer experiments respectively.

TOP values ranged from 11.5 to 88.1 μgL^{-1}, 87.4 to 220.8 $\mu g\ L^{-1}$, and 94.9 to 479.4 μgL^{-1} during autumn, spring and summer experiments respectively.

Silicate concentrations ranged from 0.1 to 0.9 mgL^{-1}, 0.03 to 1.55 mgL^{-1}, and 0.9 to 2.3 mgL^{-1} during autumn, spring, and summer experiments respectively.

Phytoplankton classes during the grazing experiments revealed that, the numerical density of Chlorophyceae was frequently increased

with increasing time of the experiment (except the first day in autumn experiment, when it decreased) especially with high densities of zooplankton. This is due to the increasing of some species of green algae (e.g., *Coelastrum reticulatum* during autumn and summer experiments, and *Dictosphaerium pulchellum* during spring**).**

Also, Bacillariophyceae increased gradually with time and zooplankton density with few exceptions in autumn and summer experiments. This is due to the abundance of *Melosira granulata* (Ehr.) Ralfs, *Melosira granulata var. angustissma* Muller and *Syndra ulna* (Nitzsch) Ehr.

With optimum density of zooplankton, Cyanophyceae increased with time because of the occurrence of *Microcystis aeruginosa* in autumn experiment, and *Microcystis elachista* in the spring & summer experiments. While with high density of zooplankton, blue-greens decreased significantly in the first day and increased again during the last day of the autumn and spring experiments, but in summer experiment it increased remarkably with time.

Chrysophyceae, Cryptophyceae, Dinophyceae and Euglenophyceae were recorded as rare groups during the grazing experiments.

Zooplankton was represented by three groups namely rotifera, cladocera, and copepoda. Rotifers constituted 95 % of the total zooplankton community. The main species of rotifers were *Keratella cochlearis* and *conochilus unicrinis.*

Grazing and feeding rates

Grazing rate during the autumn season indicated that green algae and diatoms, especially *Planktonema lauterbornii* Schmidle, *Dictosphaerium pulchellum* Wood, *Cyclotella operculata* Kutz, and

Syndra ulna (Nitzsch) Ehr. were the most preferable algal cells grazed by the zooplankton community. Also, these organisms grazed to a large extent on *Microcystis aeruginosa Kützing* and *Merismopedia glauca* (Ehrenberg) Nägeli. On the other side, the grazing rate during the spring and summer seasons, was obviously high on blue green algae such as *Chroococcus dispersus* (Keissler) Lemmermann followed by diatoms & green algae.

The maximum feeding rate of zooplankton on phytoplankton was recorded in autumn (1013 cells/org./h) in the first day of the experiment with optimum density of zooplankton.

3. Predation experiment (December 2003)

Water temperature varied within a narrow range in the different aquaria.

The pH values of the water in the different enclosure lie in the alkaline side throughout experiment period, the pH values during these experiment were suitable for fish life.

Water conductivity was high at the aquaria stocked by fish compared to control. Ammonium concentrations increased with time. This can be related to fish excretion.

Nitrite, nitrate, and silicate decreased with the high densities of fish, while orthophosphate concentration was obviously increased.

Green algae, diatoms and blue green algae were usually consumed during this experiment. Green algal crops decreased after 24 hours and slightly increased after 48 hours. For example, the population density of *D. pulchellum* decreased after 24 hours and began to increase after 48 hours at all aquariums, but the density of *Planktonema lauterbornii*

Schmidle was obviously decreased at the last aquarium with increasing *Oreochromis niloticus* densities.

Diatoms crop showed a significant decrease in the first and last day of the experiment at all predating aquarium compared to control. *Melosira granulata* (Ehr.) Ralfs and *Syndra* decreased severely at all aquariums in comparison with control. *Cyclotella ocellata* Pant and *Cyclotella operculata* Kutz were significantly low at the last day of experiment compared to first one.

The standing crops of blue green algae were usually much low compared to green algae and diatoms. *Microcystis aeruginosa* Kutzing decreased gradually with time in all aquariums. *Microcystis elachista* (W. & G. S. West) Starmach was numerically the most important species of the blue green algae. Its numerical density showed a significant drop at the third and fourth aquariums (high density of fish).

Chrysophyceae, Cryptophyceae and Dinophyceae were recorded as rare groups during the predation experiment.

Zooplankton was represented by rotifera, cladocera, and copepoda. Rotifera was the main dominant group during the predation experiments. It was dominated by *Keratella cochlearis*. It increased obviously with high density of *Oreochromis niloticus* (linn.) and vice versa. Cladocera and Copepoda were recorded as rare groups.