Results

1. Field survey

1.1. The abiotic factors

Physico-chemical parameters are shown in Table (1) and can be summarized as follows:

1.1.1. Temperature:

In general, air temperatures were slightly higher than the corresponding values of water temperature. The absolute air temperature varied between 22.2°C during winter and 35.0°C during summer, with annual amplitude of 12.8°C. With regard to the water temperature, its highest value of 30.1°C was observed in summer, while the lowest value of 20.4°C occurred in winter; with annual amplitude of 9.7°C. Their annual average values were respectively 26.05 and 23.75°C for air and water temperature.

1.1.2. pH value:

The pH values lie on the alkaline side (pH > 8). Its maximum value of 8.41 was observed in winter, while the minimum value of 8.10 occurred during summer. It was also observed that, its values varied within a narrow range during spring and summer seasons when its values were respectively 8.11& 8.10.

1.1.3. Water conductivity:

The present results revealed that, electrical conductivity values had obviously high in summer when its value reached the major peak of 426 µmohs Cm^{-1}, while the minor one of 335µmohs Cm^{-1} was recorded during winter season. The annual average conductivity value was 368.75 µmohs Cm^{-1}.

1.1.4. Nutrient salts

1.1.4.1. Ammonium–Nitrogen (NH_4 – N)

Ammonium-nitrogen showed a wide variation between the extreme values. Its concentration increased from 46.50 µgL^{-1} in winter to 115.60 µgL^{-1} in summer. On the other hand, its values were more or less similar during winter and autumn, when its values varied respectively from 46.50 to 47.50 µgL^{-1}. Its annual average value amounted to 68.13 µgL^{-1}.

1.1.4.2. Nitrite (NO_2 – N)

In general, nitrite nitrogen represents the unstable form of inorganic nitrogen in a natural aquatic ecosystem. 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. The annual average value of nitrite was 6.18 µgL^{-1}.

1.1.4.3. Nitrate (NO_3 – N)

Nitrate is the most stable form of inorganic nitrogen in natural water. It is a prime plant nutrient and rising in its concentrations might be increase the eutrophication of waters. In general, its 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; with annual average value of 221.36 µgL^{-1}.

1.1.4.4. Total organic nitrogen (TON):

Total organic nitrogen contents reached the highest values of 10.58 mgL^{-1} in spring and decreased to the lowest value of 1.07 mgL^{-1} during winter. TON annual average value amounted to 5.57 mgL^{-1}.

1.1.4.5. Orthophosphate:

No other element in natural waters has been intensively studied as phosphorus. Ecological interest in phosphorus stems from its major role in biological metabolism, and the relatively small amounts of phosphorus available in the hydrosphere. The present study revealed that, its concentration had gradually increased from autumn 2002 to summer 2003. Its values fluctuated from a minimum of 7.20 μgL^{-1} during autumn to a maximum of 55.40 μgL^{-1} in summer; with annual average value of 25.04 μgL^{-1}.

1.1.4.6. Total organic phosphorus:

The present results clarified that, TOP concentrations were significantly high during summer and spring seasons while its level showed a severe drop in winter and autumn. Its values varied between 54.70 μgL^{-1} in winter and 329.70 μgL^{-1} in summer. Its annual average value amounted to 167.74 μgL^{-1}.

1.1.4.7. Reactive silicate (SiO_2 – Si):

Silica is the element responsible for the formation of the siliceous frustules of diatoms. Silicate concentrations showed an obvious increase during summer. 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 annual average of silicate was 1.10 mgL^{-1}.

1.2. The biotic factors

1.2.1. Phytoplankton

This section is concerned mainly with the variations of phytoplankton standing crop at the studied area during the investigated period.

The results gained during this study are presented in Table (2) and can be summarized as follows:

The general pattern of phytoplankton standing crop showed two major peaks in winter (2540×10^4 cells L^{-1}) and autumn (2352×10^4 cells

L^{-1}), while it was declined during the other two seasons, reaching the lowest value in spring (773 × 10^4 cells L^{-1}). Its annual average value was 1811 × 10^4 cells L^{-1}.

Phytoplankton classes and their percentage abundance to the total standing crop are clearly noticed in Table (2) and Figures (2 and 3).

A total of 268 species belonging to 7 classes were identified during this study.

1.2.1.1. Chlorophyceae:

Green algae occupied the first predominant position where it constituted 56.68 % of the total phytoplankton crop. Its highest numerical density of 1576 × 10^4 cells L^{-1} was recorded in winter while the lowest one of 476 × 10^4 cells L^{-1} occurred during spring. Percentage abundance of the green algal community revealed the flourishing of the green algae in winter in the event that its percentage abundance reached 62.04 % of the total crop. In addition to, the percentage abundance of Chlorophyceae had obviously decreased in autumn when its value amounted to 46.56 % of the total phytoplankton crop. The annual average value of the green algae was 1026 × 10^4 cells L^{-1}.

A total of 142 species belonging to 52 genera, 15 families, and 5 orders were identified during the course of investigation.

Dominant genera of green algae:

The most dominant genera of Chlorophyta during the period of study were *Dictosphaerium, planktonema, Oocystis, Scenedesmus,* and *Coelastrum* as clearly noticed in Table (3).

1.2.1.1.1. *Dictosphaerium* Naegeli :

Dictosphaerium was the most abundant genus in the study contributing 28.26 % of the total greens. Its population density reached a maximum of 756 × 10^4 cells L^{-1} in winter 2003, while its minimum crop was recorded in autumn (100×10^4 cells L^{-1}) and summer (86×10^4 cells L^{-1}).

Dictosphaerium was represented by four species; *D. pulchellum, D. elegans, D. subsolitarium,* and *D. ehrenbergianum.* Their seasonal variations are shown in Table (4).

***D. pulchellum* Wood:**

D. pulchellum was the main dominant species, constituting 91.72 % of the genus. With regard to the seasonality of *D. pulchellum,* it flourished at the studied area during winter and autumn but diminuted in summer. Its standing crop ranged from 32×10^4 cells L^{-1} to 756×10^4 cells L^{-1},

D. elegans, D. subsolitarium, and D. ehrenbergianum constituted totally 8.08 % of the genus. The first one represented 3.45 % of the genus. They were usually observed spring and summer seasons.

1.2.1.1.2. *Planktonema* Schmidle:

Planktonema occupied the second predominant position, forming 16.08 % of the total greens. It was represented by only one species *(P. lauterbornii)*.

P. Lauterbornii attained the maximum density of 280×10^4 cells L^{-1} in autumn 2002, followed by 216×10^4 cells L^{-1} during winter 2003, while its minimum population density (68×10^4 cells L^{-1}) was observed in spring 2003.

1.2.1.1.3. *Oocystis* (Nageli):

Oocystis contribute 12.53 % of the total greens. This genus attained the highest crop of 256×10^4 cells L^{-1} in summer 2003, while its lowest density of 16×10^4 cells L^{-1} was observed in spring 2003. *Oocystis* was represented by 8 species as shown in Table (5).

***O. parva* W.F. G.S. West:**

O. parva was the most dominated species of the genus, constituting 74.22 % of the genus and 9.50 % of the total greens. Its major peak of 220 × 10^4 cells L^{-1} was observed during summer while the minimum one of 12 × 10^4 cells L^{-1} was noticed during spring; with a seasonal average of 95 × 10^4 cells L^{-1}.

***O. borgei* Snow:**

The species formed 19.92 % of the total genus numbers. Its highest crop appeared during autumn (52 × 10^4 cells L^{-1}) while the lowest density observed in spring (2 × 10^4 cells L^{-1}). Its annual average value was 26 ×10^4 cells L^{-1}.

***O. solitaria* Witrock:**

O. solitaria constituted 4.49 % of total genus numbers. The maximum density was observed during summer (11 × 10^4 cells L^{-1}), while the minimum crop of this species was recorded during spring (2 × 10^4 cells L^{-1}). Its annual average value was 4.49×10^4 cells L^{-1}

O. elliptica W. West, *O. submarina* Lagerheim, *O. lacustris* Chodat, *O. marssonii* Lemmermann, and *O. crassa* Wittrocle were observed as rare and scattered species, they represented totally 1.2 % of the total genus crop.

1.2.1.1.4. *Scenedesmus* Meyen:

It contributed 9.57 % of the total green algae. Its crop ranged between a maximum of 158 × 10^4 cells L^{-1} in summer and a minimum of 52 × 10^4 cells L^{-1} in spring 2003. There were 21 species represented this genus as shown in Table (6).

***S. ecornis* (Ehr.) Chodat:**

S. ecornis was the most lending one, where it constituted 26.53% of the total genus. Its highest density of 44 × 10^4 cells L^{-1} was recorded during winter, but it was poorly recorded in autumn (4 × 10^4 cells L^{-1}).

S. bijugatus **(Trup.) Kutzing:**

S. bijugatus formed 25.51 % of the total genus. It appeared during summer (76 × 10^4 cells L^{-1}) and autumn (24 × 10^4 cells L^{-1}), while it disappeared in winter and spring.

S. protuberans **Fritsch:**

It constituted 12.76 % of the genus number and its maximum crop was recorded in summer (32 × 10^4 cells L^{-1}), while it disappeared in spring.

S. quadricauda **(Turpin) Brebisson:**

S. quadricauda contributed 11.73 % of the total genus number, and 1 % of the total greens. This species was recorded during all seasons and attained its maximum population density during winter (24 × 10^4 cells L^{-1}) while the minimum value was recorded during spring (2 × 10^4 cells L^{-1}).

S. quadricauda var. longispina **(Chod.) G.M. Smith:**

It constituted 5.10 % of the total genus number. It was completely disappeared during autumn and its maximum density was recorded in winter (16 × 10^4 cells L^{-1}).

S. intrmedius **Chodat** :

It contributed 4.59 % of the total genus crop. It was not recorded in autumn 2002 and attained its maximum density in winter (14 × 10^4 cells L^{-1}).

S. opoliensis **P. Richer:**

This species formed 4.08 % of the total genus crop. It was recorded in spring (1 × 10^4 cells L^{-1}) and autumn (15 × 10^4 cell L^{-1}) and disappeared during the other seasons.

S. bicudatus **Dedusenko:**

S. bicudatus contributed 3.57 % of the total genus crop. Its numerical density ranged from 2×10^4 cells L^{-1} to 8 ×10^4 cells L^{-1}.

The other species of *Scenedesmus* (Table 6) were observed as rare forms. They represent 6.38 % of the genus crop.

1.2.1.1.5. *Coelastrum* Nageli :

It represented 9.50 % of the total green algal crop. Its maximum crop of 184 × 10^4 cells L^{-1} was observed in autumn 2002, while the minimum density of 16 × 10^4 cells L^{-1} was noticed in spring 2003. Its average number amounted to 98 × 10^4 cells L^{-1}. This genus was represented by *C. reticulatum, C. cambricum, C. sphaericum, C. astroideum,* and *C.microporum* as shown in Table (7).

***C. reticulatun* (Dang Eard) Senn:**

It formed 97.44 % of the genus *Coelastrum*. Its population density ranged between 176 × 10^4 cells L^{-1} during autumn 2002, and 16 × 10^4 cells L^{-1} during spring 2003.

The last four species; *C. cambricum* Archer, *C. sphericum* Nageli, *C. astroideum* De Notaris, and *C.microporum* Nageli were noticed as rare forms and constituted about 3 % of the total genus crop.

1.2.1.1.6. Other genera of Chlorophyceae :

There were 47 rare genera of Chlorophyceae represented totally about 24 % of total green algae.

The leading species of Chlorophyceae:

Generally, as in Table (8), two species; *Dictosphaerium pulchellum* wood and *planktonema lauterbornii* Schmidle were the most dominant species in Chlorophyceae at all (25.92 % and 16.27 % of total Chlorophyceae respectively), while *Oocystis parva* W& G. *S.* West, *Coelastrum reticulatum* (Dang) Senn, *Scenedesmus ecornis* (Ehr.)

Chodat. and *Oocystis borgei* Snow were recorded as common species in the class represented totally 23.53 % of the class.

The systematic position of these species is given as follows:-

Phylum: Chlorophyta

Subphylum: Chlorophyceae

Order: Chlorococcales

Family: Scenedesmaceae

Genus: *Actinastrum Lagerheim*

A. hanzschii Lagerheim

A.hanzschii var. *subtile*Wolos Zynska

A. sp

Genus: *Coelastrum* Naegeli

C. cambricum Archer

C. microporum Naegeli

C. reticulatum (Dangeard) Senn.

C. sphaericum Naegeli

C. astroideum De Notaris

Genus: *Crucigenia* Morren

C. crucifera (Wolle) Komarek

C. quadrata Morren

C. rectangularis (A. Braun) Gray

C. tetrapedia (Kircher) W. & G. S.West

Genus: *Scenedesmus* Meyen

S. acuminatus (Legerh) Chodat

S. acuminatus var. minor

S. acutus Meyen

S. bicaudatus (Hansgirg) Chodat

S. bicangatus (Trup.) Kutzing

S. denticulatus Lagerh

S. dimorphus (Turpin) Kutz

S. disciformis (Chodat) Fott

S. ecornis (Ehrenberg) Chodat

S. intermedius Chodat

S. obliquas (Turpin) Kutzing

S. obtusus Meyen

S. opoliensis P. Richter

S. ovallernus Chodat

S. protuberans Fritsch

S. quadricauda (Turp.) de Brebisson

S. quadricauda var. *longispina* (Chod.) G.M. Smith

S. sempervirens Chodat

S. spinosus Chodat

S. subspicatus Chodat

S. sp.

Genus: *Didymocysistis* Korshikov

D. bicellularis Korshikov

D. planctonica Korshikov

Genus: *Tetradesmus* G.M. Smith

T. wisconsinensis G.M. Smith

Genus: *Tetrastum* Chodat

T. glabrum (Roll) Ahlstrom & Tiffany

T. heteracanthum (Nordstedt) Chodat

Genus: *Tetrachlorella* Korshikov

T. alternans (G.M. Smith) Korsikov

Family: Hydrodictyaceae

Genus: Pediastram Meyen

P. biwae Negoro

P. clathratum (Schroeter) Lemmer

P. duplex Meyen

P. simplex Meyen

P. Simplex var. *radians* Lemmer

P. Simplex var. *sturmii* (Reinsch) Wolle

P. tetras (Ehr.) Ralfs

Family: Dictyosphaeriaceae Kuetzing

Genus: *Botryococcus* Kuetzing

B. braunii Kuetzing

Genus: *Dictosphaerium* Naegeil

D. ehrenbergianum Naegeil

D. elegans Bachman

D. pulchellum Wood

D. subsolitarium Van Goor

Genus: *Errurella* Lemmermann

E. bornhemensis Lemmermann

Family: Micractiniaceae

Genus*: Golenkinia* Chdat

G. paucispina West & G.S. West

G. radiata Chodat

Genus: *Micractinum* Fresenius

M. pusillum Fresenius

M. quadrisetum (Lemmer.) G.M Smith.

Family: Chlorococcaceae

Genus: *Ankyra* G.M.Smith

A. judayi G.M.Smith

Genus: *planktosphaeria* G.M.Smith

P. gelatinosa G.M.Smith

Genus: *Schroederia* Lemmer

S. setigera (Schroeder) Lemmer

Genus*:* *Coenochloris* Korshikov

C. ovalis Korshikov

C. pyrenoidosa Korshikov

Genus: *Eutetramorus* Komarek

E. fottii (Hindak) Komarek

Genus: *Gloeotila* Kutzing

G. sp.

Genus: *Koliella* Hidak

K. spicliformis (Vischer) Hindak

Genus: *Planctococcus* Korshikov

P. sphaerocystiformis Korshikov

Genus*:* *Tetraedron* Kutz

T. caudatum (Corda) Hansg

T. minimum (A. Br.) Hansg.

T. triangulare Korshikov

Family: Oocystaceae

Genus: *Ankistrodesmus* Corda Ralfs

A. convulatus Corda

A. falcatus (Corda) Ralfs

A. falcatus var. spirillformis G.S. West

A. fusiformis Corda

A. nitzschiod G.S. West

A. spiralis (Turner) Lemmermann

Genus: *Chlorella* Beyerinck

C. vulgaris Beyerinck

Genus: *Franceia* Lemmer

F. dreoscheri (Lemmer) G.M. Smith

F. ovalis G.M. Smith

Genus: *Kirchneriella* Schmidle

K. contorta (Schmidle) Bohlin

K. lunaris (Kirch.) Moebius

K. obesa (W. West) Schmidle

K. subsolitaria (Schmidle) Bohlin

Genus: *Legerheimia* Lemmermann

L. ciliata (Lag.) Chodat

L. citriformis (Lag.) Snow

L. longiseta (Lemmer) Wille

L. quadriseta (Lemm.) G.M Smith

L. subsalsa Lemm.

Genus: *Monoraphidium* Kormarkova-Legenerova

M. contortum (Thuret) Kormarkova-Legenerova

M. dybowskii (Woloszynska) Hindak

M. griffithii (Berkeley) Kormarkova-Legenerova

M. minutum (Nageli) Kormarkova-Legenerova

M. mirabile (W.&G.S. West) Pankow

Genus: *Nephrocytium* Naegeli

N. limneticum (C.M.Smith) G.M. Smith

N. limneticm W. West

N. agardhianum Nageli

N. obesum (G.S. West) Korshikov

Genus: *Oocystis* (Nageli)

O. borgei Snow

O. crassa Wittrocle

O. ellaptica W. West

O. gigas Archer

O. lacustris Chodat

O. marssonii Lemmer

O. nodulosa W. West

O. parva G.S. West

O. solitaria Wittrock

O. submarina Lagerheim

Genus: *Quadrigula* Printz

Q. closterioides (Bohlin) Printz

Genus: *Radiococcus* Schmidle

R. nimbatus (De Wildemann) Schmidle

Genus*: Selenastrum* Reinsch

S. bibraianum Reinsch

S. capricornutum Printz

S. gracile Reinsch

Genus: *Treubaria* Bernard

T. triappendiculata (Berand) Will

Genus: *Westella* De Wilaemann

W. botryiodes (West) De Wildemann

Family: Palmellaceae

Genus: *Sphaerocystis* Chodat

S. Schroeteri Chodat

Family: Coccomyxaceae

Genus: *Elakatothrix* Will

E. gelatinosa Will

E. genevensis (Reverdin) Hindak

Genus: *Keratococcus* Pascher

K. suecicus Hindak

Order: Zygnematales

Family: Desmidiaceae

Genus: *Closterium* Nitzsch ex Ralfs

C. acutum Bredisson

C. acutum Var. Variabile (Lemmer) W. Krieger

C.parvulum Brebisson

Genus: *Staurastrum* Meyen

S. cingulum Var. obesum G.M.

S. chaetoceras (Schroder) Comb. Nov.

S. paradoxum Meyen

S. sebaldi var. ornatum Reinsch Nordstedt

Family: Zygnemataeeae

Genus: *Mougeotia* C.A. Agardh

M. sp.

Order: Volvocales

Family:Polyblepharidaceae

Genus: *Pyramimonas* Schmarda

P. orientalis Butcher

Family: Chlamydomonadaceae

Genus: *Carteria* Diesing

C. globosa Korsch

Genus*: Chlamydomonas* Ehrenberg

C. clathrata (Korschikov) Pascher

C. conferta Korsch

C. globosa Snow

C. gracilis Snow

C. reinhardii Dang

C. snowiae Printz

C. sp. Ehrenberg

Family: Phacotaceae

Genus: *Dysmorphococcus* Taked

D. globosus Bold & Starr

Genus: *Phacotus* Perty

P. lenticularis (Ehr.) Stein

Genus: *Gonium* Mueller

G. Sociale (Dujardin) Warming

Genus: *Pandorina* Bory

P. morum (Mueller) Bory

P. charkowiensis Korshikov

Order:Tetrasporales

Family: Cloeocystaceae

Genus: *Chlamydocapsa* Fott

C. planctonica (W. & G.S. West)

Order: Ulotrichales

Family:Ulotrichaceae

Genus: *Planktonema* Schmidle

P. lauterbornii Schmidle

1.2.1.2. **Bacillariophyceae:**

In general, diatoms occupied the second predominant position (32.73 %) except in autumn when diatoms and green algae showed nearly the same evolution. The major peak of diatoms crop (1095×10^4 cells L^{-1}) was recorded in autumn, while the minor one (122×10^4 cells L^{-1}) was observed in spring. Its annual average value was 593×10^4 cells L^{-1}.

During the investigation period, a total of 63 species of diatoms belonging to 16 genera, 8 families, and 7 orders were identified.

Dominant genera of diatoms:

The most dominant genera of diatoms are shown in Table (9) and can be summarized as follows:

1.2.1.2.1. *Melosira* C. A. Agradh:

Melosira was found to be the most dominant diatom, constituting 50.97 % of the total diatoms crop. This genus was represented by three species; *M. granulata, M. granulata var. angustissma*, and *M. varians.*
Its major population density of 860 × 10^4 cells L^{-1} was observed in autumn (Table 9), followed by summer season (260 × 10^4 cells L^{-1}), while its minor crop of 44 × 10^4 cells L^{-1} occurred in winter and spring.

***Melosira granulata* (Ehr.) Ralfs:**

It represents 85.93 % of the total genus crop. *M. granulata* attained the highest density of 830 × 10^4 cells L^{-1} in autumn, while the lowest density of 38 × 10^4 cells L^{-1} occurred in winter.

***M. granulata* var. *angustissma* Muller**:

This species contributed 13.41 % of the genus. Its highest density (120 × 10^4 cells L^{-1}) was found during summer and disappeared during winter.

***M. variants* C. A. Agaradh:**

M. varians showed a slight gradual increase from 2 × 10^4 to 6 × 10^4 cells L^{-1} during autumn and winter but it disappeared during spring and summer.

1.2.1.2.2. *Cyclotella* Kutz.

Cyclotella was the second important diatom where it constituted 27.81 % of the total diatom number. *Cyclotella* was found in the plankton of the studied area during autumn, spring, and summer seasons. Its crop increased from 14 × 10^4 cells L^{-1} in spring to 449 × 10^4 cells L^{-1} in winter. Its average crop amounted to 165 × 10^4 cells L^{-1}.

The population density of the different species of *Cyclotella* and their percentage abundance to the genus are presented in Table (11) and can be described as follows.

***Cyclotella ocellata* Pant:**

Its standing crop was abruptly decreased from 370 × 10^4 cells L^{-1} during winter to 4 × 10^4 cells L^{-1} in spring. Its average density during the studied period was 105 × 10^4 cells L^{-1}.

***C. operculata* Kutz:**

C. operculata was the second dominant species, constituted 28.83 % of the genus number. *C. operculata* decreased gradually from its maximum crop of 80 × 10^4 cells L^{-1} during autumn to the minimum of 8 × 10^4 cells L^{-1} during spring but it increasing again during summer (24 × 10^4 cells L^{-1}). Its annual average value was 48 × 10^4 cells L^{-1}.

C. glomerata Bachmann and *C. meneghianiana* Kutz appeared as rare forms constituting 3.95 % and 3.79 % of the genus respectively.

1.2.1.2.3. *Syndra* (Ehr.):

Syndra, the third dominant genus, contributed 16.08 % of the total Bacillariophyceae. It was flourished during summer and winter while its crop was declined in spring. *Syndra* was represented by 12 species as shown in Table (12).

***S. ulna* (Nitzsch) Ehr.:**

S. ulna was the most abundant species of the genus (71.92 %). Its maximum density was recorded during summer (160 × 10^4 cells L^{-1}), while the minimum density occurred during winter (28 × 10^4 cells L^{-1}).

***S. actinastriodes* Lemmermann:**

It formed 17.85 % of the total genus density. Its major peak was noticed during winter (58 × 10^4 cells L^{-1}), while it was not recorded in summer.

***S. delicatissma* W. Smith:**

S. delicatissma formed 3.15 % of the genus. It recorded only during winter and summer (4 × 10^4 and 8 × 10^4 cells L^{-1} respectively).

***S. acus* Kitz:**

Here again, this species was observed only during winter and summer (7×10^4 cells L^{-1} and 2×10^4 cells L^{-1}).

***S. ulna* var. *donica* (Kutz):**

This species was found during autumn (8×10^4 cells L^{-1}) and formed 12.12 % of the total genus crop.

***S. acus* var. *radians* (Kutz) Hust:**

Here again, this species was noticed only during autumn (4×10^4 cells L^{-1}), forming 6.06 % of its genus density.

The other species of *synedra* occurred only during autumn with the same population density (1×10^4 cells L^{-1}), forming 1.52 % of the total genus crop.

1.2.1.2.4. Other genera of diatoms:

The other genera constituted 7 % of the diatom numbers; they were represented by 13 genera. The seasonality of these genera is shown in Table (9).

The leading species of Bacillariophyceae:-

The population density of the most leading species of Bacillariophyceae and its percentage abundance to total diatoms during different seasons are clearly noticed in Table (13).

Melosira granulata (Ehr.) Ralfs was the main dominant diatom constituting 53.03 % of the class. It followed by *Syndra ulna (Nitzsch)* Ehr. and *Cyclotella ocellata* Pant which represented by 17.86 % and 17.40 % of the class respectively.

Cyclotella operculata Kutz. and *Melosira granulata* var. *angustissma* Muller represented by 7.73 % and 7.32 % of the diatoms respectively.

The list and systematic positions of diatoms species are presented as follows:

Division: Bacillariophyceae

Class: Bacillariophyceae

Order: Centrales

Family:Cosinodiscaceae (Melosiraceae)

Genus: *Melosira* C.A. Agradh

M. granulata (Her.) Ralfs

M. granulata Var. angustissma Muller

M. Varians C.A Agradh

Genus: *Cyclotella* Kutz

C. glomerata Bachmann

C. meneghiniana Kutz

C. ocllata Pant

C. operculata Kutz

Order: Fragilariales

Family: Fragilariaceae

Genus: *Fragilaria* Lyngbye

F. construens (Ehr.) Grun.

F. construens var. venter (Her.) Grun.

Genus*: Opephora* Petit

O. martyi Heriband

Genus: *Synedra* (Her.)

S. actinastriodes Lemmermann

S. acus Kutz

S. acus var. angustissma (Kutz) Hust

S. acus var. radians (Kutz) Hust

S. delicatissma W. Smith

S. ulna (Nitzsch) Her.

S. ulna var. biceps (Kutz) Kirchn.

S. ulna var. donica (Kutz) Grun.

S. ulna var. equalis (Kutz) Van Heurck

S. ulna var. ramesi (Herib.) Hust

S. nana (Ehr.) Kutz

S. tenera W. S.M.

Order: Eunotiales

Family: Eunotiaceae

Genus: *Eunotia* Ehrenberg

E. sp.

Order: Achnanthales

Genus: Cocconies Ehr.

C. placenetula (Ehr.)

Order: Naviculales

Family: Naviculaceae

Genus: *Pleurosigma* W. Smith

P. elongatum W. Smith

Genus: *Navicula* (Bory)

N. capitata

N. exigua Gregory ex Grun

N. pupula (Kutz.)

N. pygmea

N. salnarum var. intermedra

N. tuscula (Ehr.) Grun

Family: Gomphonemaceae

Genus: *Gomphonema* C.A. Agardh

G. olivaceum (Langb.) Kutz

Family: Cymbellaceae

Genus: *Amphora* Ehr.

A. ovalis Kutz

A. sp.

Genus*:* *Cymbella* Agardh

C. cistula Hempr.

Order: Nitzschizles

Family: Nitzschiaceae

Genus: *Bacillaria* Gmelin

B. paradoxa Gmelin

Genus: *Nitzschia* Hassall

N. acicularis Smith

N. cloterium (Eer.) W. Smith

N. dissipata (Kutz) Grun.

N. filiformis W.S. Smith

N. fonticla Grun.

N. fustulum (Kutz.) Grun.

N. gracilis Hant Zsch

N. holastica Hust

N. kutzingiana Hilse

N. linearis W. Smith

N. longissma W. Smith

N. obtuse W. Smith

N. ovalis Arnot

N. paleacea (Kutz.) W. Smith

N. paleacea Grun

N. paradoxa (Ehr.) W. Smith

N. recta Hantz.

N. rostellata Hustedt.

N. sublinearis Hust.

N. vitrea Norman

Genus: *Surirella* (Ehr.)

S. tenera Gregory

Order: Epithemiales

Family: Epithemiaceae

Genus: *Rhopalodia*

R. gibba (Ehr.) O.F. Muller

R. gibbrula (Ehr.) O.F. Muller

Genus : *Cymatopleura*

C. solea (Bribisson) W. Smith

1.2.1.3. **Cyanophyceae:**

In general, blue green algae occupied the third predominant position where it contributed 10.10 % of the total phytoplankton crop. It is well noticed that, the green and blue green algae attained the highest crop in winter. Its population density ranged from a minimum value of 87 $\times 10^4$ units L^{-1} during summer 2003 to a maximum of 336 $\times 10^4$ units L^{-1} in winter 2003; with annual average value of 183 $\times 10^4$ units L^{-1}. Percentage composition indicated the dominance of blue green algae over the diatoms in spring when its value reached the climax. Percentage composition of blue-greens fluctuated between a minimum of 5.52 % and a maximum of 20.57 % of the total phytoplankton crop during summer and spring seasons respectively.

A total of 35 species, belonging to 13 genera, 2 families, and 2 orders were identified during the course of investigation.

Dominant genera of Cyanophyceae

The most leading genera of Cyanophyceae during the period of study were *Microcystis*, *Merismopedia*, *Chrococcus*, *Cylindrospermopsis*, and *Lyngbya*.

1.2.1.3.1. *Microcystis* Kutz.

Microcystis was the most important genus of blue greens inhabiting the studied area. This genus attained the highest density of 259 $\times 10^4$ units L^{-1} during winter and constituted 77.12 % of the total blue green algal units. The lowest density of *Microcystis* being 41×10^4 units L^{-1} occurred in summer and contributed 47.13 % of the total blue green algae. *Microcystis* was usually recorded during all seasons. Six species of *Microcystis* were recorded during this study and they are shown in Table (15).

M. elachista **(W. & G.S. West) Starmach:**

M. elachista was the most important blue green algal species and contributed 47.69 % of the total genus crop. The density of this species showed an obvious increase from autumn to winter, followed by a decrease during spring and summer.

M. aeruginosa **Kutzing**:

It formed 43.57 % of the genus. Its highest density of 113×10^4 units L^{-1} was observed during spring while the lowest density of 18×10^4 units L^{-1} occurred in autumn.

M. gravillei **(Hassall) Elenkin:**

M. gravillei was recorded only during winter and spring seasons. Its maximum crop being 20×10^4 units L^{-1} occurred during winter.

M. flos – aquae **Kirch:**

This species was not recorded in winter, while its highest crop of 11×10^4 units L^{-1} was noticed in summer and formed 26.83 % of the genus during this period.

M. reinboldii (Richter) Forti and *M. wesenberqii* (Komarek) Starmach were irregularly distributed and constituted totally 0.82 % of the genus.

1.2.1.3.2. *Merismopedia* Meyen:

It was the second important genus, forming 14.27 % of the total blue green algae. Its highest density of 82 × 10^4 unitsL^{-1} was recorded during autumn and formed 55.03 % of the total Cyanophyceae. This genus was not observed in summer. *Merismopedia* was represented by five species, as shown in Table (16).

M. gluce **(Ehernberg) Nageh:**

It constituted 88.46 % of the total genus density. The maximum crop of this species was recorded in autumn (80 × 10^4 units L^{-1}), while it was not observed during winter or summer.

M. elegans **A. Braun:**

M. elegans constitute 8.03 % of the total genus crop. It was observed in winter (7 × 10^4 units L^{-1}) and spring (1x10^4 units L^{-1}), while it disappeared completely during autumn and summer.

The last three species; *M. punctata*, *M. major*, *and M. warmingiana* formed only 3.84 % of the genus.

1.2.1.3.3. *Chrococcus* Naegeli

This genus formed 7.52 % of the total blue green algal population. Its maximum crop of 35 × 10^4 units L^{-1} was observed during winter. It disappeared during autumn. *Chrococcus* was representing by three species, as shown in Table (17).

C. dispersus **(Keissler) Lemmermann:**

It constituted 91.07 % of the total genus crop. Its highest population density was noticed during winter (34 × 10^4 units L^{-1}), while it was not recorded during autumn.

C. turgidus (Kutzing) Nageli and *C. minutes* (Kutzing) Nageli contributed 5.36 % and 1.79 % of the genus respectively.

1.2.1.3.4. *Cylindrospermopsis* Woloszynska:

This genus occupied the fourth predominant position of the blue green algal population, forming 4.65 % of the total Cyanophyceae. It was represented by only one species (*C. raciboroskii*).

C. raciboroskii attained the maximum density of 26 × 10^4 unitsL^{-1} in winter, while it was not existed in spring.

1.2.1.3.5. *Lyngbya* C. Agardh:

It constituted 2.42 % of the total blue green algae. Its maximum density occurred during summer (10 × 10^4 units L^{-1}), and disappeared during spring. It was represented by only one species (*L. limnetica*).

1.2.1.3.6. Other genera of Cyanophyceae:

There were 9 rare genera of Cyanophyceae represented totally about 4 % of total blue green algae (Table 14).

The leading species Cyanophyceae:

Generally, three species; *Microcystis aeruginosa*, *Microcystis elachista*, and *Merismopedia glauca* were the most dominant species in Cyanophyceae at all (31.86 %, 23.16 %, and 15.31 % of the total blue green algal population respectively), while *Chrococcus dispersus*, *Microcystis flos-aquae*, *Cylindrospermopsis raciboroskii*, and *Lyngbya Limnetica* were recoded as common species in the calls, and represented totally 19.48 % of the total Cyanophyceae as shown in Table (18).

The system used for classification for Blue green algae was that reported by Bourrelly (1968) which can be summarized as follows:

Phylum: Cyanophyta
Class: Cyanophyceae
Order: Chroococcales
Family: Chrococaceae

Genus: *Chrococcus* Naegeli

C . dispersus (Keissler) Lemmer.

C . minutus (Kutz) Nageli

C . turgidus (Kutz) Nageli

Genus :*Coelosphaerium* Nageli

C . dubium Grunow

Genus: *Gomphosphaeria* Kutz .

G . aponiana Kutz.

G. fusca Kutz.

G. naegeliana (Unger) Lemmermann

G. Lacustris Chodat var. lacustris Chodat

Genus: *Merismopedia* Meyen

M. glauca (Ehr.) Naegeli

M. punctata Meyen

M. warmingiana Lagerheim

M. elegans (Ehrenberg) Nageli

M. major (G.M. Smith) Geitler

Genus: *Microcystis* Kutz

M. aeruginosa Kutz

M. flosaquae (Wittr) Elenkin

M. gravillei (Hassall) Elenkin

M. elachista (W.& G.S. West) Starmach

M. reinboldii (Richter) Forti

M. Wesenbergii (Komarek) Starmaeh

Order: Oscillatoriales

Family: Oscillatoriaceae

Genus: *Anabaena* Bory

A.circinalis Rabenhors

Genus: *Pseudoanabaena*

P. catenata Lauterban

Genus: *Anabenopsis*

A. elenkinii V. Miller

A. arnoldii Aptekari

Genus: Rhabdoderma

R. lineare var. unicellulare Hollerbach

Genus: *Cylinarospermopsis* Wolosz

C. raciboroskii Wolosz

Genus: *Lyngbya* C. Agardh

L. limnetica Lemmer.

Genus: *Oscillatoria* Vaucher

O. agardhii Gomont

O. obliquaeacuminata Skuja

O. planctonice Woloszynska

Genus*: Phormidium* Kutz.

P. dictyothallum Skuja

P. interruptum Kutz

P. Laminosa (Agerdh.) Gomot

P. molle

P. papila

P. sp.

Genus: *Spirulina* Turpin

S. major Kutz

1.2.1.4. Other Classes:

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.

1.2.1.4.1. Chrysophyceae: were completely disappeared during autumn season while its crop attained the maximum value of 12 x 10^4 cells L^{-1} in spring. A total of 6 species belonging to 4 genera were identified during the course of investigation.

***1- Malomonas* Perty:**

This genus was represented by three species; *M. acuroides, M. caudata,* and *M.* sp.

***2- Chrysococcus* Klebs:**

It was represented by only one species (*C. rufescens*), forming 6.25 % the total Chrysophyceae.

***3- Bitrichia* Wolos Zynsk** and ***Chromulina* Cienkowaki**:

They formed about 4.2 % of the total Chrysophyceae, each of them was represented by only one species, *B. ollula* and *C. nebulosa* respectively.

The list of systematic position of Chrysophyceae is present as follows:-

Divison: Chrysophyta

Chass: Chrysophyceae

Order: Chrysomonodales

Family: Chromulinaceae

Genus: *Chrysococcus* Klebs

C. rufescens Klebs

Family: Euehromulinaceae

Genus: *Chromulina* Cienkowaki

C.nebulosa Cienkowaki

Family: Mallomonadaceae

Genus: *Mallomonas* Perty

M. acuroides Perty

M.caudata Lwaneff

M. sp.

Family: Ochrormonadaceae

Genus: *Bitrichia* Woloszynska

B. ollula (Fott) Bourrelly

1.2.1.4.2. Cryptophyceae were observed during all the investigated period and its crop varied between 2×10^4 cells L^{-1} in winter & spring and 5×10^4 cells L^{-1} in autumn. It was represented by 10 species included in three genera as shown in Table (20).

1- *Cryptomonas* Ehrenberg constituted 53.85 % of the total Cryptophyceae. This species was not recorded in spring and it attained its maximum crop of 3×10^4 cells L^{-1} during autumn and summer.

2- *Chromonas* Hansgirg contributed 38.46 % of the total Cryptophyceae It was not existed during winter or summer. Its maximum population density of 2×10^4 cells L^{-1} was recorded during autumn and spring.

***3-Rhodomonas* Karsten** appeared only during summer season (1×10^4 cells L^{-1}).

The list and systematic position of Cryptophyceae is present as follows:

Phylum: Cryptophyta

Class: Cryptophyceae

Order: Cryptomonodales

Family: Cryptophyceae

Genus: *Chromonas* Hansgirg

C . acuta Utermohl

C. nordstedii Hansgirg

C. marssonii Skuja

Genus: *Cryptomonas* Ehrenberg

C. erosa Ehr.

C. gracilis Skuja

C. obovata Skuja

C. ovata Ehr.

C. phaselous Skuja

C. reflexa Skuja

C. rostrata Troitzkaja

Genus: *Rhodomonas* Karsten

R. lacustris Pascher & Ruttner

1.2.1.4.3. Dinophyceae were scarcely occurred during all seasons and its crop nearly the same during most period of study. Its numerical density ranged from 1×10^4 cells L^{-1} to 2×10^4 cells L^{-1}. This class was represented by three species included in two genera as shown in Table (21).

***1*- Ceratium Schrank** contributed 20.0 % of the total Dinophyceae. It was represented by *Ceratium hirundinella*. This species occurred only during spring (1×10^4 cells L^{-1}).

2- *Peridinium* Ehr. formed 76.92 % of the Dinophyceae. It was represented by two species, *Peridinium cinctum* O. F. Muller and *P*. sp., the first one occurred during autumn (1×10^4 cells L^{-1}) and winter (1×10^4 cells L^{-1}) respectively, and disappeared during spring and summer. The second one occurred during spring (1×10^4 cells L^{-1}) and summer (1×10^4 cells L^{-1}) and disappeared during autumn and winter.

The list and systematic position of dinoflagellates are given as follow:

Phylum: Pyrrhophyta

Class: Dinophyceae

Order: Denokonates

Family: Piridiniaceae

Genus: *Peridinium* Ehr.

P. cinctum O. F. Muller

P. sp.

Family: Ceratiaceae

Genus: *Ceratium* Schrank

C. hirdinulla (O. F. M.) Dujardin

1.2.1.4.4. Euglenophyceae were disappeared during the studied period except in summer when its crop was 1×10^4 cells L^{-1}. The results revealed that Euglenophyceae were represented by only one genus *Euglena* Ehr. containing only one species *E. gracilis* Klebs. *E.* gracilis was recorded only during summer season (1×10^4 cells L^{-1}).

The systematic position of this species is given as follow:

Phylum: Euglenophyta

Class: Euglenophyceae

Order: Euglenales

Family: Euglenaceae

Genus: Euglena Ehr.

E. gracilis Klebs

Chlorophyll *a*:

Chlorophyll *a* is the common indicator of phytoplankton biomass. The results of total chlorophyll *a* and its fractions (netplankton, nanoplankton, and picoplankton) are given in Table (22) and Figure (4). They can be summarized as follows:

The highest chl. *a* values was recorded in winter (59.49 μgL^{-1}), followed by summer (52.90 μgL^{-1}), while the least value was found in spring (26.0 μgL^{-1}).

Netplankton constituted the major fraction of chlorophyll *a* compared with nanoplankton and picoplankton. Chlorophyll *a* of net plankton attained the maximum value during winter (34.04 μgL^{-1}), while the minimum of 9.91 μgL^{-1} occurred in spring.

Chlorophyll *a* of nanoplakton appeared its maximum value in summer (10.81 μgL^{-1}), while the minimum value was recorded in spring (2.97 μgL^{-1}).

For picoplankton, the highest value was measured during winter (19.71 μgL^{-1}), while the lowest value was measured during summer (12.28 μgL^{-1}).

1.2.2. Zooplankton

Community composition and community dynamics

Zooplankton assemblages in the River Nile during the present study comprised species belonging to genera they are categorized in three main groups (Rotifer, Cladode, and Copepod) in addition to some rare groups as shown in Table (23) and Figure (5 and 6).

The annual average value of the standing crop of total zooplankton number in the River Nile was 2613 organisms L^{-1}

Rotifera were the most dominant organisms in the area of study (95.79 % of the total zooplankton). They contributed majority to the overall zooplankton. River Nile harbored an average number of 2503 organisms L^{-1} of rotifera. The highest values were recorded during summer (5525 organisms L^{-1}), while the lowest values were recorded during winter (170 organisms L^{-1}).

Cladocera were the second important element of zooplankton in the River Nile. They constituted numerically 2.15 % of the total zooplankton population with an annual average number of 56 organisms L^{-1}. The highest density of Cladocera was observed in spring (150 organisms L^{-1}), while the lowest one was occurred during winter (5 organisms L^{-1}).

Copepoda, the third group, constituted 1.05 % of the total zooplankton population with an annual average of 28 organisms L^{-1}. Its highest density occurred during spring and summer (50 organisms L^{-1}).It disappeared completely in winter.

Others formed only 1.00 % of the total zooplankton population with an annual average of 26 organisms L^{-1}. Its highest density was recorded in spring (50 organisms L^{-1}), while it was not noticed in winter.

Species composition and species dynamics of the different groups.

1.2.2.1. Rotifera

Rotifera were the first important group of the zooplankton in the area of study. 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 (Table 24) .

1.2.2.1.1. *Keratella* (Vincent)

Keratella was found to be the most dominant rotifer. It contributed 45.50 % of the total rotifer counts (average of 1139 organisms L^{-1}). The seasonality of *Keratella* showed a decrease from autumn (490 organisms L^{-1}) to an increase during spring (1900 organisms L^{-1}) and summer (2025 organisms L^{-1}). The genus was represented by two species as shown in Table (25).

***Keratella cochlearis* (Gosse):**

It constituted 66.41 % of genus *Keratella.* With regard to seasonality of *K. cochlearis*, the species was flourished during spring (1500 organisms L^{-1}) followed by summer (950 organisms L^{-1}). During winter, the counts diminuted to 135 organisms L^{-1}.

Keratella tropica **(Apstein):**

K. tropica was the second important species of the genus *Keratella*, constituted 33.59 % of the total genus number (average 383 organisms L^{-1}). The highest population density of *K. tropica* was recorded during summer season while few organisms were noticed during winter (only 5 organisms L^{-1}).

1.2.2.1.2. *Conochillus* Ehrenberg

It was the second important genus of rotifera. It formed 22.23 % of the total rotifera with an average of (556 organisms L^{-1}). This genus was represented by only one species (C. *unicrnis).*

C. unicrnis Rousslet was recorded during summer (1250 organisms L^{-1}), spring (625 organisms L^{-1}), and autumn (350 organisms L^{-1}), while it disappeared completely during winter.

1.2.2.1.3. *Brachionus* Pallas

Brachionus, the third important rotifer genus, constituted 19.78 % of its total numbers with an average of (495 organisms L^{-1}). Its highest density was observed in summer (1750 organisms L^{-1}), while the lowest one was recorded during autumn (60 organisms L^{-1}) and winter (20 organisms L^{-1}). The genus was represented by four species, *B. calyciflorus* Pallas, *B. caudatus* Barrois, *B. plicatilis* (Muller) and *B. falcatus* Zacharias (Table 26).

Brachionus calyciflorus **Pallas:**

B. calyciflours, the most dominant species of the genus, constituted 79.29 % of the genus number with an annual average of (393 organisms L^{-1}).

With regard to the seasonal variations (Table 26), its peak of occurrence was recorded during summer (1450 organisms L^{-1}), while the lowest counts were recoded during winter season (20 organisms L^{-1}).

***B. caudatus* Barrios and Daday:**

It was recorded during summer (175 organisms L^{-1}) and spring (50 organisms L^{-1}) while it disappeared during autumn and winter.

***B. plicatilis* (Muller) and *B. falcatus* Zacharias:**

These two species represented 9.34 % of the genus. The first one occurred in spring (50 organisms L^{-1}) and autumn (10 organisms L^{-1}), while the second one was observed only during summer (125 organisms L^{-1}).

1.2.2.1.4. Other genera of Rotifera:

The others of rotifera constituted a total of 12.49 % of the rotifer numbers. They were represented by 14 genera (Table 24).

1.2.2.2. Cladocera:

Cladocera constituted 2.15 % zooplankton number in the River Nile. They comprised three species belonging to two genera. Genera of this group are shown in Table (27).

1.2.2.2.1. *Bosmina* Muller:

It was the most dominant Cladocera genus with population reaching 66.67 % of the total Cladocera numbers with an annual average number of 38 organisms L^{-1}. The maximum count of the genus was recorded during spring (75 organisms L^{-1}), while the minimum count was recorded in winter (5 organisms L^{-1}). This genus was represented by only one species (*Bosmina longirostris* Muller).

1.2.2.2.2. *Diaphanosoma* Sars

It was the second genus of Cladocera, contributing 33.33 % of the total cladoceran numbers with an annual average number of (19 organisms L^{-1}). As shown in Table (27), *Diaphanosoma* occurred only during spring (75 organisms L^{-1}) and was represented by only one species (*D. excisum* Sars).

1.2.2.3. Copepoda:

Copepoda were the third group of zooplankton inhabiting the River Nile. It was represented by one species (*Thermocyclops* sp.). The average count of *Thermocyclops* sp. was 19 organisms L^{-1} and formed 75.00 % of the total Copepoda. This species occurred in spring (50 organisms L^{-1}) and summer (25 organisms L^{-1}) as in Table (28).

The copepodite stages represented 25.00 % of the total Copepoda with an average number of 6 organisms $L^{-1.}$ These stages observed only during summer (25 organisms L^{-1}).

1.2.2.4. Other zooplankton groups were recorded as very rare groups. They were represented by protozoa, the larva of Chironomus, nematoda, and fish eggs. They constituted totally 1 % of the total zooplankton density.

The most leading species of zooplankton during this study are shown in Table (29).

The systematic position of the recorded species as following:

Phylum: Arthropoda

Class: Crustucea

Subclass: Branchiopoda

Family: Sididae

Genus: *Diaphanosoma*

D. excisum Sars

Family: Bosminidae

Genus: *Bosmina*

B. longirostris (O.F. Muller)

Family: Daphnidae

Genus: *Ceriodaphnia*

C. cornuta Richard

C. quadrangula (O.F. Muller)

Subclass: Copepoda

Order: Cyclopoidae

Genus: *Thermocyclops*

T. sp.

Phylum: Rotifera

Class: Digononta

Order: Bdelloidea

Family: Philodinidae

Genus: *Philodina*

P. sp

Genus: *Rotatoria*

R. sp.

Class: Monogononta

Order: Ploima

Genus: *Scaridium*

S. longicadum (O.F. Muller)

Family: Trichocercidae

Genus: *Trichocerca*

T. stylata Gosse

T. longiseta Schrank

Family: Synchaetaedae

Genus: *Synchaeta*

S. oblonga (Ehrenberg)

Genus: *Polyarthra*

P. vulgaris (Carlin)

Family: Testudinellidae

Genus: *Filinia*

F. longiseta (Ehrenberg)

F. sp.

Family: Hexarthridae

Genus: *Hexarthra*

H. mira (Hudson)

Family: Conochillidae

Genus: *Conochilus*

C. unicornis Rousselet

Family: Brachionidae

Genus: *Keratella*

K. cochlearis (Gosse)

K. tropica (Apstein)

K. quadrata (O. F. Muller)

K. valga Gosse

Genus: *Brachionus*

B. calyci florus (Pallas)

B. caudatus (Barrois and Dady)

B. angularis (Gosse)

B. plicatilis (O. F. Muller)

B. falcatus (Zacharias)

B. bidentatus (O. F. Muller)

Genus: *Anuraeopsis*

A. fissa (Gosse)

Genus: *Platyas*

P. patulus (O. F. Muller)

P. quadricornis (Ehrenberg)

Family: Epiphanidae

Genus: *Trichotria*

T. tetractis (Ehrenberg)

Genus: *Tetrasiphon*

T. hydroccora (Ehrenberg)

Family: Colurillidae

Genus: *Colurella*

C. adriatica (Ehrenberg)

Genus: *Lepadella*

L. patella (O.F. Muller)

L. ovalis (O. F. Muller)

Family: Lecanidae

Genus: Lecane

L. luna (O. F. Muller)

L. laudwigii Hauer

Genus: Monostyla

M. bulla Gosse

M. lunaris (Ehrenberg)

M. sp.

M. closterocerca Shmarda

Genus*: Macrochaetus*

M. serica Gosse

Family: Notmmatidae

Genus: *Cephalodella*

C. catelirna (Muller)

C. megalocephala Donner

C. exigue (Gosse)

C. gibba (Ehrenberg)

C. sp.

2. In situ grazing experiments

Three grazing experiments were performed during autumn 2002, spring 2003, and summer 2003 in addition to one predation experiment during December 2003.

2.1. First grazing experiment (autumn 2002)

2.1.1. The abiotic factors:

The results of abiotic factors are shown in Table (30) and can be described as follows:

2.1.1. 1. Water temperature:

Water temperature during the first grazing experiment varied within a narrow range and fluctuated from 21.6°C to 24.3°C.

2.1.1. 2. Hydrogen ion concentration (pH):

pH values had gradually increased with increasing time at the three sets of the experiment. Its values increased from 8.16 to 8.42.

2.1.1. 3. Water conductivity:

The grazing experiment study during autumn revealed a distinct decrease in electrical conductivity values after 24 hours, but its values had slightly increased after 48 hours at all samples. Its minimum value of 332 µmohs Cm^{-1} was observed after 24 hours in control enclosures while its maximum value of 411 µmohs Cm^{-1} was found at the 2 X at the beginning of experiment.

2.1.1. 4. Nutrients:

2.1.1.4.1. Ammonium (NH_4 – N):

Ammonium concentrations decreased after 48 hours in all enclosures. Its values ranged from 24.7 μgL^{-1} to 48.8 μgL^{-1}.

2.1.1. 4.2. Nitrite (NO_2 – N):

Overall, nitrite concentrations recorded during this experiment were much lower than the corresponding values of ammonium and nitrate.

Nitrite values had significantly increased after 24 hours followed by an obvious drop at all groups. Its values varied from 2 μgL^{-1} to 7.6 μgL^{-1}.

2.1.1. 4.3. Nitrate (NO_3 – N):

As mentioned before, nitrate is the most stable from of inorganic nitrogen in natural water. Also, nitrate is final oxidation product of nitrogen compound in aquatic environment. It was found that, nitrate levels showed a gradual decrease with increasing time excluding the little increase at 2X after 48 hours. Also, its concentrations at zero time were much higher than those recorded after 24 & 48 hours. Its values decreased from 178.7μgL^{-1} to 24.7μgL^{-1}.

2.1.1. 4.4. Total organic nitrogen (TON):

The results gained during this investigation showed that, TON exhibited a different pattern in each enclosure, but its values were usually low after 48 hours from the beginning of experiment. It attained the maximum value of 14.5 mgL^{-1} in 2X enclosures after 24 hours while its minimum value of 1.2 mgL^{-1} occurred in control enclosure after 48 hours.

2.1.1. 4.5. Phosphorus:

Phosphorus is considered as one of the growth-limiting nutrient in natural water. It in usually found in two forms namely inorganic orthophosphate and organic phosphorus.

2.1.1. 4.6. Orthophosphate (PO_4 – P)

PO_4–P values decreased after 48 hours in all groups of enclosures except a sharp increase at the last day of the last set. Its values showed a strong variation between the minimum value of 1.4$\mu g\ L^{-1}$ and the maximum of 16.3 $\mu g\ L^{-1}$.

2.1.1. 4.7. Total organic phosphorus (TOP)

Total organic phosphorus showed an irregular distribution at most set of this experiment. TOP attained the maximum value of 88.1μgL^{-1} at 2X set after 24 hours while its minimum value of 11.5μgL^{-1} occurred at the same set after 48 hours.

2.1.1. 4.8. Silicate (SiO_2-Si)

Silicate concentrations during this experiment had gradually decreased with increasing time. Its values fluctuated between 0.1 and 0.8 mgL^{-1}.

2.1.2. The biotic factors:

2.1.2.1. Phytoplankton

The population density of the different classes of phytoplankton varied with time and zooplankton concentration in each enclosure.

Phytoplankton classes and their dominant species are given in Table (31).

2.1.2.1.1. Chlorophyceae:

In general, green algal crops were obviously increased after 48 hours in the X and 2X enclosure. This finding was not observed in control set. The standing crop of Chlorophyceae attained the highest value of 5722 × 10^4 cells L^{-1} after 48 hours from the beginning of the experiment at the last group (2X), while the lowest density of 528 × 10^4 cells L^{-1} was found at zero time of the same enclosure.

The population density of the leading species of the green algae can be described as follows:

1- *Dictosphaerium pulchellum* Wood:

Overall, the numerical densities of *Dictosphaerium pulchellum* were decreased at all times of X and 2X compared with the corresponding values of control except its abnormal increase at the last day of 2X. The maximum peak of *D. pulchellum* was found in 2X set after 48 hours (620 $\times 10^4$ cells L^{-1}) as it increased with time in these enclosures, while it reached the minimum density (70 $\times 10^4$ cells L^{-1}) in X enclosures after 24 hours.

2- *Planktonema lauterbornii* Schmidle

In X enclosures, numerical densities of this species were much higher than the corresponding values of control enclosure. This finding was not recorded in 2X set except the obvious increase after 48 hours of incubation. Its crop varied between 8 $\times 10^4$ cellsL^{-1} and 280 $\times 10^4$ cellsL^{-1}.

3- *Oocystis parva* W. & G. S. West:

The standing crops of *Oocystis parva* had significantly decreased at the last day of experiment of the three sets particularly at 2X enclosures. Its crop showed a wide variation between the minimum crop of 5 $\times 10^4$ cells L^{-1} and the maximum of 108 $\times 10^4$ cells L^{-1}.

4- *Coelastrum reticulatum* (Dang) Senn

C. reticulatum was the most abundant species that showed an intensive blooming at the last day of 2X enclosure. Its numerical density at 2X group increased abruptly from 100 $\times 10^4$ cells L^{-1} to 1310 $\times 10^4$ cells L^{-1}.

2.1.2.1.2. Bacillariophyceae:

Members of this class constituted a significant part of the phytoplankton population in the studied area. Diatoms showed a gradual increase with time at 2X set. This finding was not found at control enclosures as it reached the minimum density of 264 $\times 10^4$ cells L^{-1} after 48 hours from the beginning of experiment. However, its maximum number was recorded in X enclosures after 48 hours (2090 $\times 10^4$ cells L^{-1}).

The most dominant species among Bacillariophyceae are:

1- *Melosira granulata* (Ehr.) Ralfs:

Numerical density of this species increased at the last day of experiment at X and 2X enclosures compared to the control. Its minimum crop of 150×10^4 cells L^{-1} was observed at control set after 48 hr., while the maximum value of 1756×10^4 cells L^{-1} occurred at 2 X after 24 hours.

2- *Melosira granulata var. angustissma* Muller

In general, the standing crops of this species were less observed compared with the previous species. Its numerical density was usually decreased with time. It was also disappeared after 24 and 48 hours in X enclosures, as well as in 2 X after 48 hours, while its maximum crops was 38×10^4 cells L^{-1}

3- *Syndra ulna* (Nitzsch) Ehr.:

The standing crops of *Syndra ulna* decreased gradually with time except at 2 X enclosures at the last day when it increased again. Its crop ranged from 2×10^4 cells L^{-1} to 45×10^4 cells L^{-1}.

4- *Cyclotella ocellata* Pant :

A sever drop of its numerical density was observed at the second day (24 hours) of 2X set followed by a distinct increase at the same set. Its lowest density was 1×10^4 cells L^{-1} while the highest number was 50 $\times 10^4$ cells $L^{-1.}$

5- *Cyclotella operculata* Kutz:

Here again a sharp decreasing in *C. operculata* counts was observed after 24 hours at control and 2X groups, where it reached the minimum number of 2 and 3×10^4 cells L^{-1}. At X set, after 48 hours its crop increased gradually reaching the maximal density of 155×10^4 cellsL^{-1}.

2.1.2.1.3. Cyanophyceae

The standing crops of blue green algae were much low compared to green algae and diatoms. Its highest crops were observed at the last day of the experiment of the two sets (X & 2X). The maximum peak of this class was observed in 2X group (488×10^4 units L^{-1}) in the second day of the experiment, while the minimum one (175×10^4 units L^{-1}) was found in the same containers during the first day. These foundations were not observed at X (as it increased gradually) and control sets.

The population density of the dominant species of the blue green algae can be summarized as follows:

1- *Microcystis aeruginosa* Kutzing

M. aeruginosa was numerically the most important species of the blue green algae. Its crop showed an irregular distribution in control and 2X enclosure. Its crop increased from 6×10^4 units L^{-1} to 342×10^4 units L^{-1}.

2- *Microcystis elachista* (W. & G. S. West) Starmach

Its density increased gradually with time in all sets except in 2 X, where it remained constant after zero time (69×10^4 units L^{-1}).

3- *Merismopedia glauca* (Ehrenberg) Nageli

The standing crop of *Merismopedia glauca* was significantly high at X set compared to the corresponding values of control enclosures. This finding was reversed at 2X group. Its crop fluctuated between 26×10^4 units L^{-1} and 129×10^4 units L^{-1}.

2.1.2.1.4. Chrysophyceae

Member of this class was disappeared at all samples of X set and at the last one of 2X. Otherwise, the population density of this class is very low even at control enclosures.

Mallomonas sp. was observed as the dominant Chrysophyta. This taxon attained its maximum crop of 6 × 10^4 cells L^{-1} after 48 hours in control enclosures.

2.1.2.1.5. Cryptophyceae:

In general, members of this class were numerically higher than the previous class. The results indicated an obvious increase in the total count of Cryptophyceae in all enclosures after 24 and 48 hours except in X enclosures, where it sometimes disappeared.

The dominant species of Cryptophyceae can be summarized as follows:

1- *Cryptomonas ovata* Ehrenberg :

Overall, standing crop of this species increased after 24 hours at all sets. Moreover, it disappeared after 48 hours in X and 2X enclosures. Its maximum crop reached 6 × 10^4 cells L^{-1}.

2- *Chromonas acuta* Utermohl

This species was occasionally disappeared at X and 2X set in spite of its occurrence at all enclosure of control. Its maximum peak amounted to 14 × 10^4 cells L^{-1}.

3- *Chromonas nordstedtill* Hansgirg

This species was scarcely occurred during most period of study. Its crop ranged from a complete disappearance to 2 × 10^4 cells L^{-1}.

2.1.2.1.6. Dinophyceae

Only one species of this class was found during this experiment (*Peridinium cinctum* O.F. Muller). Its crop had fairly high at the last day of X enclosure (10 × 10^4 cells L^{-1}) but it usually disappears at 2 X set.

2.1.2.1.7. Euglenophyceae

Only one species of this class was observed in autumn experiment (*Phacus curvicauda* Swirenko). It was noticed only in control enclosures while it disappeared in other enclosures.

2.1.2.2. Zooplankton

The results showed that, zooplankton number during autumn grazing experiment was 1867 organisms L^{-1} in all X sets and 2373 organisms L^{-1} in all 2X enclosures. Zooplankton was represented by three groups (Rotifera, Cladocera, and Copepoda).

2.1.2.2.1. Rotifera:

Total Rotifera were 1773 organisms L^{-1} in all X groups and 2237 organisms L^{-1} in 2X enclosures as shown in Table (32).

The dominant species of rotifera during this experiment are:

1- *Keratella cochlearis* (Gosse):

The number of *K. cochlearis* was 467 organisms L^{-1} in X enclosures and 777 organisms L^{-1} in 2X sets.

2- *Conochillus unicrnis* Rousslet

The count of *C. unicrnis* was 587 organisms L^{-1} in X sets and 783 organisms L^{-1} In 2X enclosures.

2.1.2.2.2. Cladocera:

Cladocera was the second group. Their count was 37 organisms L^{-1} in X enclosures and 63 organisms L^{-1} in 2X enclosures. The dominant species of cladocera are:

1- *Ceriodaphnia cornuta* Richard

It was 17 organisms L^{-1} in X group and 26 organisms L^{-1} in 2 X enclosures.

2- *Alona intermedia* Sars

There were 4 organisms L^{-1} of this species in X sets and 17 organisms L^{-1} in 2 X enclosures.

2.1.2.2.3. Copepoda:

It was the third group, amounted to 7 organisms L^{-1} in X enclosures and 15 organisms L^{-1} in 2 X sets. This group was represented by only one species (*Thermocyclops* sp.) during autumn grazing experiment.

Grazing rate (GR) during the autumn grazing experiment

The results of GR are shown in Table (33) and can be summarized as follows:

In general, zooplankton grazing rate on different species of phytoplankton was obviously high during the last day compared to the first one of the first grazing experiment.

Grazing rate on Chlorophyceae revealed the preference of zooplankton grazing on *Planktonema lauterbornii* and *Dictosphaerium pulchellum* where its values reached respectively 0.0599/hour and 0.0174/hour at 2X & X enclosures of the second day of experiment. Also, grazing rate on diatoms indicated the tendency of zooplankton grazing on *Cyclotella oprculata* and *Syndra ulna*. Its values were respectively 0.0530/hour and 0.0371/hour in X and 2X enclosures. The dependence of zooplankon on Cyanobacteria was low compared to the previous two groups. These animal organisms grazed to large extent on *Microcystis aeruginosa* and *Merismopedia glauca*. The grazing rates on these blue green algae were 0.0504 and 0.0105/hour in 2X and X enclosures during the second and first day respectively.

It was also evident that grazing rate of zooplankton on the other groups of phytoplankton was very low except on *Chromonas acuta* (0.0251/ hour) and *Peridinium cinctum* (0.0230/hour) during the first day of this experiment.

Feeding rate (F) during the autumn experiment:

The results of the feeding rate in the first and second day of the experiment are presented in Table (34) and can be described as follows:

Feeding rate revealed the preferences of zooplankton organisms to feed in Chlorophyceae, Bacillariophyceae and Cyanobacteria rather than the other classes of phytoplankton. Its values in X enclosures of the first day were much higher than the corresponding values in others enclosures of experiment.

Feeding rate indicated that, zooplankton feed efficiently on most common species of Chlorophyceae especially during the first day in X enclosures. Feeding rate on *Planktonema lauterbornii* reached the maximum value of 491 cell/ org./h. Also, *Oocystis parva* and *Coelastrum reticulatum* were important food items for zooplankton organisms.

2.2. Second grazing experiment (spring 2003)

2.2.1. The abiotic factors

The results of abiotic factors during spring 2003 are shown in Table (35) and can be described as follows:

2.2.1.1. Water temperature:

Water temperature during the second grazing experiment was slightly high compared to the first one in autumn where it varied from 20.5°C to 31.0°C.

2.2.1.2. pH values:

pH attained its lowest value of 7.91 at zero time of control set while its highest of 8.40 was observed at the last set after 24 hours.

2.2.1.3. Water Conductivity

The grazing experiment during spring revealed that, there was nearly no change after 24 hours but decreased after 48 hours especially at X and 2X enclosures. Its minimum value of 347 µmohs Cm^{-1} was observed after 48 hours in X enclosures while its maximum value of 353 µmohs Cm^{-1} was found at the same set at the beginning of experiment.

2.2.1.4. Nutrients:

2.2.1.4.1. Ammonium (NH_4 – N)

In this experiment, ammonium concentration at X set showed an obvious increasing after 24 hours followed by a sharp decreasing after 48 hours. While it showed a gradual decreasing at 2X with increasing time. Its values varied from 29.8 μgL^{-1} to 91.3μgL^{-1}.

2.2.1.4.2. Nitrite (NO_2 – N)

Nitrite concentrations showed an irregular distribution at most set of this experiment. It attained the maximum value of 14.5μgL^{-1} at control set at the beginning of the experiment while its minimum value of 8.5µgL^{-1} occurred at X set after 24 hours.

2.2.1.4.3. Nitrate (NO_3 - N)

As mentioned before, nitrate is the most stable form of inorganic nitrogen in natural water. It was found that, Nitrate-N contents showed a gradual increase with increasing time at X and 2X sets excluding a little decrease after 24 hours at X enclosures. This finding was reversed at control set, as its values decreased from 23.8 µgL^{-1} to 12.1µgL^{-1}.

2.2.1.4.4. Total organic Nitrogen (TON)

The results gained during this investigation showed that, its values were often high after 48 hours from the beginning of experiment. It attained the maximum value of 10.6 mgL^{-1} in X enclosures at zero time while its minimum value of 2.6 mgL^{-1} occurred in 2X enclosure at the same time.

2.2.1.4.5. Orthophosphate (PO_4–P)

Orthophosphate concentration during spring experiment showed an obvious increasing with increasing time at X and 2X enclosures. This finding was not recorded in control set. Its values showed a strong variation between the minimum value of 17.0 µgL^{-1} and the maximum of 49.2 µgL^{-1}.

2.2.1.4.6. Total organic phosphorus (TOP)

TOP values in this experiment were gradually decreased with time in control and X sets. The vice versa was true in the case of 2X enclosures where its values were increased after 24 & 48 hours of incubation period. Its values showed a strong variation between the minimum value of 87.4 µgL^{-1} and the maximum of 220.8 µgL^{-1}.

2.2.1.4.7. Silicate (SiO_2-Si)

Silicate concentrations in control enclosures were obviously high compared to the corresponding values in X and 2X sets. Its contents decreased to the lowest value of 0.03 mgL^{-1} after 48 hours at 2 X set while it attained the maximum of 1.55 mgL^{-1} after 24 hours at control one.

2.2.2. The biotic factors

2.1.2.2.1. Phytoplankton

The population density of the different phytoplankton classes of and their dominant species are shown in Table (36) and can be summarized as follows:

2.2.2.1.1. Chlorophyceae

In general, green algal crops were obviously increased with increasing time at all sets of the experiment except a little decrease at X enclosures after 48 hours. Its crop showed a wide variation between the minimum crop of 336×10^4 cells L^{-1} at control set at zero time and the maximum of 2522×10^4 cells L^{-1} at 2X set after 48 hours. The populating density of green algae varied due to the variations of the following live species.

1- *Dictosphaerium pulchellum* Wood

Overall, the numerical densities of *Dictosphaerium pulchellum* were significantly increased at X and 2X sets compared with the corresponding values of control. The maximum peak of *D. pulchellum* was found in X set after 24 hours (192×10^4 cells L^{-1}), while it reached the minimum density (30×10^4 cells L^{-1}) in control enclosures at the same time.

2- *Planktonema lauterbornii* Schmidle

The standing crops of *P. lauterbornii* had significantly decreased at the first day of experiment of the two sets (X & 2X) particularly at X enclosures and increased remarkably at the last day especially at enclosures of 2X. Its crop showed a wide variation between the minimum crop of 2×10^4 cells $L^{-1}$and the maximum of 68×10^4 cells L^{-1}.

3- *Oocystis parva* W. & G. S. West.

O. parva disappeared completely after 24 and 48 hours at X set, while it increased gradually at 2X enclosures. Its lowest density was 2×10^4 cells L^{-1}while the highest number was 28×10^4 cells L^{-1}.

4- *Coelastrum reticulatam* (Dang) senn

Its count increased after 24 hours in control and X enclosures and disappeared after 48 hours. Moreover, at 2 X enclosures, it decreased obviously after 24 hours reaching 2×10^4 cells $L^{-1}$and increased again after 48 hours reaching 16×10^4 cells L^{-1}.

5- *Scendesmus ecorins* (Ehr.) Chodat

The numerical density of this species was increased at the first and second day of all sets excluding a slight decrease at X enclosures after 48 hours. Its lowest density was 20×10^4 cells L^{-1} while the highest number was 194×10^4 cells L^{-1}.

2.2.2.1.2. Bacillariophyceae

The population density of this class showed an obvious increase with increasing time in all enclosures of spring experiment except a little decreasing at X set in the last day. Its minimum density of 122×10^4 cells L^{-1} was found at X set at zero time and the maximum number of 964×10^4 cells L^{-1} was recorded at 2X enclosures after 48 hours. The population densities of the dominant species of diatoms are shown as follows:

1- *Melosira granulata* (Ehr.) Ralfs

The number of cells of *M. granulata* increased after 24 hours at all sets of the experiment. It disappeared completely at 2X set in the second day, while the maximum value of 44×10^4 cells L^{-1} occurred at control set of the same day.

2- *Melosira granulata var. angustissma* Muller

In general, it increased gradually with increasing time at all enclosures especially at X and 2X enclosures. Its crop fluctuated between 4×10^4 cells L^{-1} and 164×10^4 cells L^{-1}.

3- *Syndra ulna* (Nitzsch) Ehr.

S. ulna was numerically the most important species of the diatoms. Its crop showed an obvious increasing with time in all sets. Its crop increased from 24×10^4 cells L^{-1} to 260×10^4 cells L^{-1}.

4- *Cycotella ocellata* pant

The numerical densities of this species at X & 2X were much higher than the corresponding values of control enclosure. Its crop varied between 4×10^4 cells $L^{-1}$and 68×10^4 cells L^{-1}.

5- *Cycotella operculata* kutz

The standing crop of *C. operculata* was significantly high at X set after 24 hours compared to the corresponding values of control and 2X enclosures. Also, it increased at all enclosures after48 hours. Its crop fluctuated between 8×10^4 cells $L^{-1}$and 44×10^4 cells L^{-1}.

2.2.2.1.3. Cyanophyceae:

Blue-greens increased gradually with time excluding a slight decrease in the first day at 2X enclosures. The maximum peak of this class was observed in control group (410×10^4 units L^{-1}) in the second day of the experiment, while the minimum one (140×10^4 units L^{-1}) was found in 2X set during the first day. The dominant species of blue green algae during spring experiment were:

1- *Microcystis aeruginosa* kutzing

A sever drop of its numerical density was observed at the first day of X & 2X set followed by a distinct increase at the same sets. Its lowest density was 1 × 10^4 units L^{-1} while the highest crop was 123 × 10^4 units L^{-1}.

2- *Microcystis elachista* (W. & G. S West) Starmach

M. elachista was the most abundant species that showed an obvious flourishing at the last day of all enclosures. Its numerical density at X group increased from 20×10^4 units L^{-1} to 194 × 10^4 units L^{-1} through 75 × 10^4 units L^{-1}.

3- *Merismopedia glauca* (Ehrenberg) Nageli

The standing crop of *Merismopedia glauca* decreased after 24 hours at control & 2X set. This finding was reversed at X group at the same time while showed a remarkable increase after 48 hours. Its crop fluctuated between 6 × 10^4 units L^{-1} and 75 × 10^4 units L^{-1}.

4- *Chroococcus dispersus* (Keissler) lemmermann

This species was usually disappeared at 2X set and showed a distinct increasing at X in the first day but decreased slightly in the second day. This observation was not found at control group where it decreased gradually with time. Its crop ranged from a complete disappearance to 89 × 10^4 units L^{-1}.

2.2.2.1.4. Chrysophyceae:

In general, members of this class were numerically lower than the previous classes. The results indicated an obvious increase in the total count of Cryptophyceae in all enclosures of X and 2X after 24 hours while in control enclosures, it remained constant at this time. After 48 hours, this class exhibited three patters of occurrence, as it wasn't changed at 2X, obviously decreased at X, and slightly increased at control set. This class attained its minimum crop of 1 × 10^4 cells L^{-1} at 2X set at zero time and its maximum of 22 × 10^4 cells L^{-1} after 24hours in X enclosures.

The dominant species of Chrysophyceae during spring experiment were:

1-*Mallomonas acuroides* Perty

It was observed as the dominant Chrysophyta. Its distribution followed its class except at X set after 48 hours where it wasn't recorded. Its crop ranged from a complete disappearance to 16 × 10^4 cells L^{-1}.

2- *Mallomonas caudata* Lwaneff

This species was disappeared at control and 2X set in spite of its occurrence at all enclosure of X. Its maximum peak amounted to 4 × 10^4 cells L^{-1}.

3- *Mallomonas* sp.

Also, this species was disappeared at control and 2X set in spite of its occurrence at enclosure of X at zero time and after 24 hours. Its maximum peak amounted to 4 × 10^4 cells L^{-1}.

2.2.2.1.5. Cryptophyceae:

This class increased after 24 hours at all groups and disappeared after 48 hours. Its maximum crop reached 8 × 10^4 cells L^{-1}.

Chromonas acuta utermohl, was observed as the dominant Cryptophyta. This taxon was occasionally disappeared at control and X sets but it constantly disappeared at 2 X enclosures. Its maximum crop amounted to 4 × 10^4 cells L^{-1}.

2.2.2.1.6. Dinophyceae:

Its numerical density increased after 24 at control and X containers but it disappeared at 2 X set. Its maximum crop reached 4×10^4 cells L^{-1}.

The dominant species of Dinophyceae during spring experiment were:

1-*Peridinum cinctum* O. F. Muller

It occurred only in control enclosures. In these enclosures, it increased after 24 hours (4×10^4 cells L^{-1}) and remained constant after 48 hours.

2-*Peridinium* sp.

This species was scarcely occurred during most period of study. Its crop ranged from a complete disappearance to 4×10^4 cells L^{-1}.

2.2.2.2. Zooplankton

Total zooplankton number was 3008 organisms L^{-1} in X set and 4771 organisms L^{-1} in 2 X enclosures during spring experiment as shown in Table (37). Zooplankton was represented by three groups; Rotifera, Cladocera, and Copepoda.

2.2.2.2.1. Rotifera was 2650 organisms L^{-1} in X group and 4199 organisms L^{-1} in 2 X enclosures. The dominant species of rotifera during spring experiment are:

1- *Keratella cochlearis* (Gosse)

The number of *K. cochlearis* was 1417 organisms L^{-1} in X enclosures.

2- *Conochilus unicrnis* Rousslet

The count of *C. unicrnis* was 666 organisms L^{-1} in X set and 1111 in 2X group.

3- *Brachionus calyciflorus* (Pallas)

It was 34 organisms L^{-1} in X set and 169 organisms L^{-1} in 2X enclosures.

4- *Keratella tropica* (Apstein)

It was 317 organisms L^{-1} in X enclosures and 503 organisms L^{-1} in 2X enclosures.

2.2.2.2.2. Cladocera was 183 organisms L^{-1} in X set and 350 organisms L^{-1} in 2X enclosures. The dominant species of cladocera during this experiment are:

1- *Diaphanosoma excisum* Sars

The number of *D. excisum* was 52 organisms L^{-1} in X enclosures and 67 organisms L^{-1} in 2X group.

2- *Ceriodaphnia cornuta* Richard

It was 59 organisms L^{-1} in X set and 180 organisms L^{-1} in 2X enclosures.

3- *Alona intermedia* Sars

Its number was 9 organisms L^{-1} in X enclosures and 19 organisms L^{-1} in 2X set.

2.2.2.2.3. Copepoda:

The count of Copepoda was 42 organisms / L in X enclosures and 61 organisms / L in 2X group. This group was represented by only one species *(Thermocyclops* sp.*)*

Grazing rate (GR) during the spring grazing experiment :

In general, grazing rate (Table, 38) during this experiment was low compared to the first experiment. Phytoplankton communities in control were sometimes lower than that recorded in the grazed enclosures either in the first or second day. The grazing rate during the first day was higher than that recorded in the last day. The present results revealed that, zooplankton diets on many species of green algae especially, *Oocystis parva* and *Dictosphaerium pulchellum*. Its values were respectively 0.01676/h. and 0.001693/h. in 2X and X enclosures. Also, grazing rate on diatoms revealed the preference of zooplankton, grazing on *Cyclotella ocellata* (0.02031 in X enclosures) and *Cyclotella operculata* (0.00193 in

X enclosures). Their grazing rate on different species of phytoplankton was obviously high on blue green algae such as *Chroococcus dispersus* (0.03165 / h. in X enclosures). On the other hand, its values on the other groups of phytoplankton were very low except *Mallomonas acuroides* from Chrysophyceae (0.0069/hour) and *Chromonas acuta* from Cryptophyceae (0.00553/hour) during the first day of this experiment.

Feeding rate (F) during the spring grazing experiment:

The results of feeding rate are presented in Table (39) and can be described as follows:

Feeding rate revealed the preferences of zooplankton organisms to feed in Chlorophyceae, Bacillariophyceae and Cyanophyceae more than the other classes of phytoplankton. Its values in X enclosures of the second day were much higher than the corresponding values in others enclosures of experiment. However, its values on blue green algal species were distinctly high in 2X enclosures of the first day. Feeding rate revealed that, zooplankton feed strongly on *Dictosphaerium pulchellum* & *Planktonema lauterbornii* from green algae, and *Cyclotella ocellata* from diatoms. At the same time, they prefer feeding on *Microcystis aeruginosa* and *Merismopedia glauca* (33cell/ org. /h. and 30 cell/ org. /h. respectively) from Cyanophyceae.

2.3. Third grazing experiment (summer 2003)

2.1.3.1. The abiotic factors

The results of abiotic factors of summer grazing experiment are shown in Table (40) and can be described as follows:

2.3.1.1. Water temperature:

The major peak of water temperature was recorded during summer while the minor one was observed in autumn season. Its values fluctuated from 29.8°C to 33.6°C.

2.3.1.2. Hydrogen ion concentration (pH):

pH values was low at zero times at grazed and ungrazed sets but it increased at the other enclosures. Its values increased from 8.1 to 8.8.

2.3.1.3. Water conductivity:

The grazing study during summer season revealed a distinct decrease in electrical conductivity values after 24 & 48 hours at all sets of experiment. Its minimum value of 297 µmohs Cm^{-1} was observed after 48 hours in 2X enclosures while its maximum value of 393 µmohs Cm^{-1} was found at the same set at the beginning of experiment.

2.3.1.4. Nutrients:

2.3.1.4. 1. Ammonium (NH_4 – N)

In general, ammonium values in summer experiment were much higher than other values in autumn and spring experiments. Ammonium concentrations decreased with increasing times at the grazed sets, while in control enclosures, its values were more or less similar at zero time and after 24 hours. Its values ranged from 96.8 μgL^{-1} to 124.3 μgL^{-1}.

2.3.1.4. 2. Nitrite (NO_2 – N)

Nitrite concentrations in this experiment were lower than the corresponding values recorded during other grazing experiments. Overall, nitrite concentrations recorded during this experiment were much lower than the corresponding values of ammonium and nitrate. Nitrite values had significantly increased after 24 & 48 hours. Its values varied from 1.6 μgL^{-1} to 3.5 μgL^{-1}.

2.3.1.4. 3. Nitrate (NO_3 – N)

It was found that: Nitrate-N contents showed a gradual decrease with increasing time at ungrazed set, while at the other sets its values were irregularly distributed. Its concentration ranged between 570.3 μgL^{-1} and 650.6 μgL^{-1}.

2.3.1.4. 4. Total Organic Nitrogen (TON)

The results gained during this investigation showed that, its values were usually low after 48 hours from the beginning of experiment except at control set as it increased gradually with time. It attained the maximum value of 23.3 mgL^{-1} in control enclosures after 48 hours while its minimum value of 1.4 mgL^{-1} occurred at the same set at the beginning of the experiment.

2.3.1.4. 5. Orthophosphate

PO_4–P values showed a distinct decreasing after 24 hours at control and 2X group, while it decreased slightly at the other set. Its values showed a strong variation between the minimum value of 41.5 μgL^{-1} and the maximum of 106.5 μgL^{-1}.

2.3.1.4. 6. Total Organic Phosphorus (TOP)

During this experiment, Total organic phosphorus showed an irregular distribution at most set of this experiment. TOP attained the maximum value of 479.4 μgL^{-1} at control set after 24 hours while its minimum value of 94.9 μgL^{-1} occurred at the same set after 48 hours.

2.3.1.4. 7. Silicate (SiO_2-Si)

During this experiment, silicate concentrations had gradually decreased with increasing time excluding control set. Its values fluctuated between 0.9 and 2.3 mgL^{-1}.

2..3.2. The biotic factors

2..3.2.1. Phytoplankton

The population density of the different classes of phytoplankton varied with time and zooplankton concentration in each enclosure.

The density of the different classes of phytoplankton and their dominant species are given in Table (41).

2.3.2.1.1. Chlorophyceae:

In general, green algal crops were obviously increased with time at all sets especially at 2X as it showed an abnormal abundance after 48 hours. The standing crop of Chlorophyceae attained the highest value of 8044 × 10^4 L^{-1} after 48 hours from the beginning of the experiment at the last group, while the lowest density of 353 × 10^4 L^{-1} was found at zero time at control enclosure.

The population density of the leading species of the green algae can be described as follows:

1- *Dictosphaerium pulchellum* Wood

Numerical densities of this species during the first day were much higher than the corresponding values at zero time. Also, a sever drop was recorded at control and X sets during the second day. Its crop varied between 1 6× 10^4 cells L^{-1} and 312 × 10^4 cells L^{-1}.

2- *Planktonema leuterbornii* Schmidle

The standing crops of *P. leuterbornii* decreased significantly after 24 hours and increased remarkably after 48 hours at all sets of the experiment. Its crop ranged from 2×10^4 cells L^{-1} to 120×10^4 cells L^{-1}.

3- *Oocystis parva* W. & G. S. West

The standing crops of *Oocystis parva* at the grazed enclosures were high compared to control set except a distinct decrease at the last day of the two grazed sets particularly at X enclosures. Its crop showed a wide variation between the minimum crop of 2×10^4 cells L^{-1} and the maximum of 220×10^4 cells L^{-1}.

4- *Coelastrum reticulatum* (Dang.) Senn

C. reticulatum was the most abundant species that showed huge flourishing at the last day of all groups especially at 2X set. Its numerical density increased abruptly from 224×10^4 cells L^{-1} to 768×10^4 cells L^{-1} at the last group.

2.3.2.1.2. Bacillariophyceae

Members of this class constituted a significant part of the phytoplankton population in River Nile water even under grazing pressure in X and 2 X enclosures. In general diatoms occupied the second predominance position. Its crop showed a gradual increase with time at X set. This finding was not found at control and 2x enclosures. It reached the minimum density of 93×10^4 cells L^{-1} after 24 hour at control. However, its maximum number was recorded in 2 X enclosures at the same time (1682×10^4 cells L^{-1}).

The dominant species among Bacillariophyceae were:

1- *Melosira granulata* (Ehr.) Ralfs

Overall, the numerical densities of *M. granulata* were strongly increased in grazing enclosures compared to ungrazed one. Its crop decreased after 48 hours at X and 2X sets and disappeared completely at control set. Its maximum peak was found in 2X set at zero time (660×10^4 L^{-1}).

2- *Melosira granulata var. angustissma* Muller

Here again, its crops at the grazed sets were much higher than those recorded at control enclosures. Its crop ranged from 2×10^4 cells L^{-1} to 460×10^4 cells L^{-1}.

3- *Syndra ulna* (Nitzsch) Ehr.

In general, its numerical density increased after 48 hours with little exception where its crop was slightly decreased after 48 hours at the last set. Its crop fluctuated between 22×10^4 L^{-1} and 260×10^4 L^{-1} .

4- *Cyclotella ocellata* Pant

A sharp decreasing in *C. ocellata* counts was observed at control and X groups after 24 hours, where it reached the minimum number of 2 and 10×10^4 L^{-1} , while it increased at 2X set at the same time. Its lowest density was 2×10^4 L^{-1} while the highest number was 40×10^4 L^{-1}.

5- *Cyclotella operculata* kutz

Overall, the leader species of diatoms during this experiment were obviously high at the grazed sets compared to the corresponding values of ungrezed enclosures. The major peak of *Cyclotella operculata* was found in 2X set at the beginning of the experiment (32×10^4 cells L^{-1}), while it reached the minor one (2×10^4 cells L^{-1}) in control enclosures after 24 hours.

2.3.2.1.3. Cyanophyceae

The standing crops of blue green algae were much low compared to green algae and diatoms. Also, its crops at ungrazed set were much lower than that found in autumn and spring. Its highest crops were observed at the last day of the experiment of the last set (503×10^4 units L^{-1}), while the lowest one (46×10^4 units L^{-1}) was found in the same containers at the beginning of the experiment.

The population density of the dominant species of the blue green algae can be summarized as follows:

1- *Microcystis aeruginosa* Kutzing

The units of *M. aeruginosa* increased gradually with increasing time at 2X enclosures, while a severe drop was occurred until disappearance at X group. Its maximum peak of 30×10^4 units L^{-1} was found in 2X set after 48 hours.

2- *Microcystis elachista* (W. & G. S.West)

Its crops were usually high at control set compared to the grazed sets. A distinct rising in the count of *M. elachista* was observed during the first day of the experiment at all sets. *M. elachista* attained the highest number of 167×10^4 units L^{-1} at control set, while its lowest density of 2×10^4 units L^{-1} was found at 2X group at zero time.

3- *Lyngbya limnetica* Lemmermann

Standing crops of *Lyngbya limnetica* decreased obviously after 24 hours excluding 2X enclosures and increased after 48 hours at the different sets. Its crop fluctuated between 1×10^4 units L^{-1} and 29×10^4 units L^{-1}.

2.3.2.1.4. Chrysophyceae:

Member of this class was disappeared at all samples of 2X set. Otherwise, the population density of this class is very low even at ungrazed enclosures.

Mallomonas Caudata Lawaneff was observed as the dominant Chrysophyta. This taxon attained its maximum crop of 4×10^4 cells L^{-1} after 24 hours in X enclosures.

2.3.2.1.5. Cryptopyceae

The results indicated that, population density of Cryptophyceae is very low as the previous class.

Cryptomonas ovata Ehrenberg and *cryptomonas acuta* utermohl were recorded as the only Cryptoplyta species occurred during summer experiment. These algae were scarcely occurred during the whole period of experiment.

2.3.2.1.6. Dinophyceae:

Two species of this class was found during this experiment (*Peridinium cinctum* O.F. Muller and *Peridinium* sp.). These algae were completely disappeared at control set and rarely observed at grazed one.

2.3.2.1.7. Euglenophyceae:

Only one species of this class was observed in summer experiment (*Trachelomonas volvocinopsis* Swirenko). It was noticed only in X enclosures especially after 48 hours (4×10^4 cells L^{-1}).

2.3.2.2. Zooplankton

The results showed that, zooplankton number during summer grazing experiment are 5684 organisms L^{-1} in all X sets and 15415 organisms L^{-1} in all 2X groups as shown in Table (42).

Zooplankton was represented by three groups (Rotifera, cladocera, and Copepoda). Total Rotifera were 5490 organisms L^{-1} in X enclosures and 13246 organisms L^{-1} in 2X sets.

2.3.2.2.1. Rotifera:

The dominant species of Rotifera during this experiment are:

1- *Keratella cochlearis* (Gosse):

The number of *K. cochlearis* was 906 organisms L^{-1} in X set and 1678 organisms L^{-1} in 2 X enclosures.

2- *Keratlla tropica* (Apstein) count was 953 organisms L^{-1} in X set and 2345 organisms L^{-1} in 2 X enclosures.

3- *Conochilus unicrnis* (Rousslet) was 1792 organisms L^{-1} in X enclosures and 3834 organisms L^{-1} in 2 X set.

4- *Brachionus calyciflorus* (Pallas) number was 1026 organisms L^{-1} in X set and 3345 organisms L^{-1} in 2 X enclosures.

2.3.2.2.2. Cladocera:

The count of Cladocera was 28 organisms L^{-1} in X enclosures and 101 organisms L^{-1} in 2 X enclosures. The dominant species of Cladocera was *Bosmina Longirostris* Muller. Its count was 28 organisms L^{-1} in X group and 43 organisms L^{-1} in 2 X enclosures.

2.3.2.2.3. Copepoda:

Copepoda was the third group (5 organisms L^{-1} in X enclosures). The dominant species of Copepoda is *Thermocyclops* sp. The number of this species was 28 organisms L^{-1} in X set and 1968 organisms/L in 2 X enclosures.

Grazing rate (GR) during the summer grazing experiment:

The results of (GR) in the first and last day of the experiment are shown in Table (43).

In spite of decrease grazing rate of zooplankton on different species of phytoplankton, but its values were relatively high during the first day compared to the second one of the third grazing experiment. Blue green alga *Chroococcus dispersus* (0.011/h. in X enclosures and 0.0091 in 2X enclosures) was the best food item for zooplankton organisms. Also, they prefer the green algae *Planktonema lauterbornii* and *Dictosphaerium pulchellum* (0.0077/h. and 0.0057/h. in X enclosures respectively). Moreover, grazing rate on diatoms indicated the tendency of zooplankton grazing on *Cyclotella oprculata*. Its value was 0.0084/h. in X enclosures.

Feeding rate (F) during the summer grazing experiment:

The results of the feeding rate in the first and last day on different classes of phytoplankton and their dominant species are shown in Table (44) and can be summarized as follows:

It was evident that feeding rate of zooplankton on the different groups of phytoplankton was higher during the first day especially in case of Chlorophyceae in X enclosures (381 cells/org. /h.). It was more obvious on *Dictosphaerium pulchellum* and *Oocystis parva* in X enclosures (405 cell/org./h. and 106 cell/org./h. respectively). Also, feeding rate on diatoms indicated the tendency of zooplankton feeding on *Melosira granulata* (88 cell/org. /h. in X and 97cells/org./h. in 2 X enclosures) and *Melosira granulata var. angustissma* (270 cell/Org./h. in 2 X enclosures).

3. Predation experiment (December 2003)

3.1. The abiotic factors:

The results of the abiotic factors during the predation experiment (December 2003) are shown in Table (45) and can be described as follows:

3.1.1. Water temperature

Water temperature was more or less similar at all aquariums during the whole period of experiment. Its values varied from 19.1°C to 20.4°C.

3.1.2. pH values

In general pH values decreased slightly in fish aquarium not only with increase of time but also with fish densities. It attained its lowest value of 8.16 after 48 hours in fourth aquarium while the highest value of 8.41 was observed in the first one at the beginning of the experiment.

3.1.3. Water Conductivity

The predation experiment revealed that, water conductivity increased gradually with time at all aquariums. Its minimum value of 422 µmohs Cm^{-1} was observed at zero time in control aquariums while its maximum value of 475 µmohs Cm^{-1} was found in the third one during the second day of the experiment.

3.1.4. Nutrients:

3.1.4.1. Ammonium (NH_4 – N)

In this experiment, ammonium values increased substantially with increasing fish densities and time. In all predation aquariums, it increased gradually after 24 and 48 hours especially with high densities of fish and attained the highest concentration of 1764.93 μgL^{-1} in the fourth aquarium during the second day. Its lowest value of 39.69 μgL^{-1} was found at control aquarium at the beginning of the experiment.

3.1.4.2. Nitrite (NO_2 – N)

It was found that, Nitrite-N contents had gradually increased with time at all aquariums particularly with small densities of fish (first aquarium). Its values increased from 1.75µgL^{-1} to 32.30 µgL^{-1}.

3.1.4.3. Nitrate (NO_3 – N)

The results gained during this investigation showed that, nitrate concentrations were usually high in all fish aquariums compared to the corresponding values in control aquarium. Its values varied from 51.80 µgL^{-1} to 476.10 µgL^{-1}.

3.1.4.4. Total Organic Nitrogen (TON)

TON exhibited a different pattern in each aquarium, but in general its values at the last day of fish aquaria were high in comparison with control aquarium. It attained the maximum value of 4.29 mgL^{-1} in the third aquariums after 24 hours while its minimum value of 0.33 mgL^{-1} occurred in control aquarium after 48 hours.

3.1.4.5. Orthophosphate

Its concentrations after 48 hours from the beginning of this experiment were often higher than those observed at zero time. Its values showed a strong variation between the minimum value of 2.95µgL^{-1} and the maximum of 53.50 µgL^{-1}.

3.1.4.6. Total organic phosphorus TOP

Total organic phosphorus showed an irregular distribution at most aquariums of this experiment, but its values were usually high after 48 hours from the beginning of experiment excluding the values in control one. TOP attained the maximum value of 153.80µgL^{-1} at the fourth aquarium after 24 hours while its minimum value of 53.92µgL^{-1} occurred at the third one at the same time.

3.1.4.7. Silicate (SiO_2-Si)

In general, silicate concentrations increased after 24 hours either in absence or presence of fish while after 48 hours its values varied from aquarium to another. Its values fluctuated between 0.32 and 0.80 mgL^{-1}.

3.2. The biotic factors

3.2.1. Phytoplankton

The impact of stocking density of *Oreochromis niloticus* on plankton communities inhabiting freshwater was the main goal of this experiment.

Phytoplankton classes and their dominant species are presented in Table (46) and Figure (7).

3.2.1.1. Chlorophyceae

In all aquariums, green algal crops decreased after 24 hours but they were slightly increased after 48 hours. The standing crop of Chlorophyceae attained the highest value of 1576×10^4 cells L^{-1} at the beginning of the experiment in the first fish aquarium, while the lowest density of 220×10^4 cells L^{-1} was found in the third one after 24 hours .

The leader species of green algae can be described as follows:

1- *Dictosphaerium pulchellum* Wood

The population density of *D. pulchellum* decreased after 24 hours and began to increase after 48 hours at all aquariums. The minor peak of 64×10^4 cells L^{-1} was observed in the fourth aquarium after 24 hours, while the major one of 756×10^4 cells L^{-1} occurred at zero time of the first fish aquarium.

2- *Planktonema lauterbornii* Schmidle

The population density of this species was obviously decreased at the last aquarium with increasing *Oreochromis niloticus* densities. Its crop varied between 26×10^4 cells L^{-1} and 304×10^4 cells L^{-1}.

3- *Oocystis parva* W. & G. S. West

In all aquariums, the count of *O. parva* decreased obviously after 24 hours and increased after 48 hours especially at the first and second aquariums as shown in table (46). Its crop decreased from 66×10^4 cells L^{-1} to 2×10^4 cells L^{-1}.

4- *Coelastrum reticulatum* (Dang.) Senn

Its numerical density decreased abruptly after 24 hours at the 2nd and 3rd fish aquarium until it completely disappeared at the third one. Its maximum crop of 200×10^4 L^{-1} was observed at zero time of the second aquarium.

5- *Scenedesmus ecornis* (Ehr.) Chodat

The standing crop of this species had significantly increased at the fish aquariums compared to the control one. Their maximum crop was 110×10^4 cells L^{-1}, while it's minimum density was 2×10^4 cells L^{-1}.

3.2.1.2. Bacillariophyceae

Diatoms crop showed a remarkable decrease after 24 & 48 hours at all predating aquarium compared to control. It reached the minimum density of 70×0^4 cells L^{-1} after 24 hours from the beginning of experiment in the third aquarium, while its maximum number was recorded in the second one at zero time.

The most dominant species of Bacillariophyceae were as follows:

1- *Melosira granulata* (Ehr.) Ralfs:

This species decreased severely at all aquariums in comparison with control. In addition, it wasn't recorded at the 3rd one, but it attained highest number of 144×10^4 cells L^{-1} after 48 hours at control set.

2- *Syndra ulna* (Nitzsch) Ehr.

Standing crops of this species was decreased obviously with all densities of fish at all times. Its crop varied between a complete disappearance and 66×10^4 cells L^{-1}.

3- *Cyclotella ocellata* Pant

Numerical densities of *Cyclotella ocellata* were significantly low at the last day of experiment compared to first one, of the five sets. Its crop showed a wide variation between the minimum crop of 56×10^4 cells L^{-1} and the maximum of 760×10^4 cells L^{-1}.

4- *Cyclotella operculata* Kutz

Here again, *C. operculata* follow to large extent the distribution pattern of *Cyclotella ocellata* where it decreased with time at all sets of experiment. Its minimum crop was 10×10^4 cells L^{-1}, while the maximum value was 356×10^4 cells L^{-1}.

3.2.1.3. Cyanophyceae

The standing crops of blue green algae were usually much lower than the green algae and diatoms. Its highest crops were observed at zero time of all aquariums. The major peak of this class was observed in the third set (1639×10^4 units L^{-1}) at the beginning of the experiment, while the minimum one (104×10^4 units L^{-1}) was found in the fourth group at the last day.

The most dominant species among blue-greens were:

1- *Microcystis aeruginosa* Kutzing

This species decreased gradually with time in all aquariums. Its population density ranged from a complete disappearance at the last day of the first aquarium to 512×10^4 units L^{-1} at zero time of the third set.

2- *Microcystis elachista* (W. & G. S. West) Starmach

M. elachista was numerically the most important species of the blue green algae. Its numerical density showed a significant drop at the third and fourth aquariums. The standing crop decreased from 1029×10^4 units L^{-1} to 12×10^4 units L^{-1}.

3- *Cylindrospermopsis raciboroskii* Woloszynska

This species was less occurred especially at the last two days of experiment. Its maximum crop of 49×10^4 units L^{-1} was observed at zero time of control.

Chrysophyceae, Cryptophyceae and Dinophyceae were recorded as rare groups during the predation experiment. The dominant species of these classes were very low even at control enclosures as shown in Table (46).

3.2.2. Zooplankton:

Zooplankton was represented by the main groups of holoplankton during the predation experiment. They were Rotifera, Cladocera, and Copepoda as in Table (47) and Fig. (8).

3.2.2.1. Rotifera:

Rotifera was the main dominant group during the predation experiments. It was dominated by *Keratella cochlearis*. In control aquarium, the number of total rotifera increased greatly after 24 hours and decreased after 48 hours (735 organisms L^{-1}). In the first aquarium, it decreased after 24 hours and increased again after 48 hours reaching 160 organisms L^{-1}. In the second aquarium, it decreased gradually with time reaching 50 organisms L^{-1} after 48 hours. In the third and fourth aquariums, it decreased after 24 hours and increased again after 48 hours reaching 225 and 235 organisms L^{-1}.

The dominant species of rotifera is *Keratella cochlearis* (Gosse). This species increased greatly after 24 hours in control aquarium and decreased again after 48 hours and attained 550 organisms L^{-1}. In the first and the third aquariums, it decreased after 24 hours and increased again after 48 hours reaching 150 and 220 organisms L^{-1}. In the second aquarium, it decreased gradually with time reaching 45 organisms L^{-1} after 48 hours. In the fourth aquarium, it decreased after 24 hours and increased again after 48 hours reaching 220 organisms L^{-1}.

3.2.2.2. Cladocera:

Cladocera was recorded as rare group. It was dominated by *Bosmina longirostris* (O. F. Muller). In control aquarium, it increased with time reaching 20 organisms L^{-1} after 48 hours. While in the first and third aquariums, it disappeared completely after 48 hours. It disappeared in the second and fourth aquarium.

3.2.2.3. Copepoda:

Copepoda was recorded as very rare group during the experiment and observed only in control aquariums at zero time.