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The Effect of River Lesser – Zab on the Phytoplankton of River Tigris, Iraq

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ABSTRACT

Three localities were selected in Lesser – zab and Tigris rivers to collect water samples monthly during the period between January to October 1999. Total cell counts of phytoplankton and its chlorophyll – a concentration was determined. A total of 231 taxa were identified and 41 species of which new record to Iraq. Bacillariophyceae was dominated especially the pennate types. Followed by chlorophyceae and cyanophyceae. The other classes were very spare and did not affect the total cell counts. Few species comprised as more than 10% of the total counts *(Stephanodiscus astrea, Cyclotella ocellata, Achnanthes minutissima, Cymbella kutzingiana)*. Both species *S. astrea* and *C. ocellata* were dominated in Lesser – zab and added a large number of cells to the river Tigris. Lower cells in the number of phytoplankton in the river Lesser – zab were recorded, so it has shown a dilution effect on the phytoplankton population density of the river Tigris during most of the study period.

KEYWORDS: Phytoplankton, Rivers, Tigris, Lesser-zab.

INTRODUCTION

Lesser-zab is one of the main tributaries of the river Tigris; about 175km long and 200m wide. Few studies were published on the phytoplankton of Tigris River and related environmental factors (Al-Lami *et al*., 1998; Kassim and Sabri, 2001), whereas only one study was made on Lesser-zab river (Abdul-Jabar, 1983).

The present study aimed at studying the phytoplankton composition of Lesser-zab and their effects phytoplankton of river Tigris.

MATERIALS AND METHODS

Monthly samples were taken from three selected sites, the first one (Z) in Lesser – zab, 5 km away from its inlet to Tigris river, and two sites (T_1) 1.5 km upstream and (T_2), 16 km downstream of the junction point in Tigris river (Fig. 1), during the period from January to October 1999.

Water samples were taken using plankton net (20 µm in pore diameter) for algal identification. The direct method by nitric acid being used to removed the organic matter of diatoms (Patrick and Reimer, 1975). The algae identified using several references (Desikachary, 1959; Prescott, 1973; Patrick and Reimer, 1975; Hustedt, 1985). Sedimentation method was used for total cell counts of phytoplankton (Furet and Benson – Evans, 1982). Diatoms were counted after cleaning with nitric acid using microtransect method (Hadi, 1981). The non – diatoms being counted in a haemocytometer as described by Martinez *et al*. (1975). Chlorophyll- a concentration was determined according to Parnsons *et al*. (1984).

RESULTS AND DISCUSSION

The limnological characteristics of both rivers were studied by Kassim *et al*.(in press). Both rivers were fresh to oligohalin, alkaline and very hard. Close values were determined in total suspended solids in both rivers with pronounce increase during rainfall period and high discharge.Water was well areated and oversaturation was recorded in several occassions.Dissolved oxygen values of Tigris river were influenced by Lesser – zab. Cations were more dominant than anions in both rivers. The

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concentration of plant nutrients were fluctuated during the study period in Lesser – zab and their effects were clear on Tigris river. N: P ratio values indicated the deficiency of nitrogen in both rivers.

This study revealed the presence of 231 taxa in both rivers, of which 41species were new records to the Iraqi flora (Table 1). The Bacillariophyceae comprised 62% of the total taxa (142 species) the pennate types were the most dominant (56%). Similar results were reported for the same two rivers by Abdul-Jabar (1983) and Al-Lami *et al*.(2000). The other groups of phytoplankton composed of Chlorophyceae (25%), Cyanophyceae (9%), Euglenophyceae (1.5%), Dinophyceae (1.3%), Chrysophyceae (0.8%) and Rhodophyceae (0.4%). Similar results were reported by Al-Saadi *et al*.(1996); Kassim *et al*.(1999); Al-Saadi *et al*.(2000) for other Iraqi aquatic ecosystems. Few species appeared only for four months or less (Table 1). A total of 46 taxa were identified in Lesser-zab samples, with very low population.

The total cell counts in river Tigris at site (T_1) ranged from 274.3 x 10^3 – 12363.8 x 10^3 cell/l, and from 2770.9 x 10^3 – 10688.7 x 10^3 cell/l at site (T_2). While in river Lesser-zab (Z) were 1615.0 x 10^3 – 7582.1x10^3 cell/l (Fig.2). The total counts of phytoplankton and the abundance of the main groups and species depended on the different regional conditions. Wetzel (1983) reported that there may be great horizontal variation in phytoplankton population within one body of water. Such variations are related to many environmental factors such as nutrients, current, turbidity, grazing by zooplankton and other animals (Hutchinson, 1975). In general, the total cell counts in river Tigris decreased at (T_2) for seven months (Fig.2). That indicates that the river Lesser-zab had a dilution effect on the river Tigris due to its lower cells number. This may result from the high speed of its water current. (Abdul- Jabar, 1983). Saad and Antonie (1978) found that the rate of current flow is more or less inversely related to the development of total algae in river Tigris.

The amount of chlorophyll - a was not consecutive within the total counts of phytoplankton cells in some months (Fig.2). This may be related to the dominance of centrate diatoms species in both rivers (*Cyclotella kutzingiana* in river Tigris and *Stephanodiscus astrea* and *Cyclotella ocellata* in river Lesser-zab). These species contain a little amount of chlorophyll-a because of their small size (Kassim *et al*., 2001).

Bacillariophyceae exhibited monthly changes, similar to that of the total counts (Fig.2), due to its dominancy. The Chlorophyceae seemed to flourish during the summer season in both rivers. The Cyanophyceae was observed at maximum number in July and August. The highest cells number of the Chlorophyceae and Cyanophyceae in summer might be correlated with the high temperature and dissolved organic matter (Kassim and Sabri, 2001). Saad and Antonie (1978) and Al-Lami *et al*. (2000) found high amounts of dissolved organic matter in the river Tigris in April, which was attributed mainly to the floods which brought large quantities of allochthonous organic matter to the river. The other studied classes were very spare and did not affect the total cell counts.

Four important species were recorded in both rivers (Fig.3) which constituted of more than 10% of the total cell counts. Three of them were observed in river Lesser-zab: *Stephanodiscus astrea* (17.4%) *Cyclotella ocellata* (12.7%) and *Achnanthes minutissma* (14.8%), while *Cyclotella kuetzingiana* (47.3%) was recorded in river Tigris. Similar species dominance sequence was recorded in Tigris and other Iraqi rivers (Al-Saadi *et al*., 1996; Kassim *et al*., 2001).The effects of these two species (*S.astrea* and C.*ocellata*) is by adding a large number of cells to the river Tigris at (T_2). The monthly variation and distribution of *Achnanthes minutissima* fluctuated in the two rivers. Such variations are attributed to a wide range of temperature tolerance of these species. The species *Cyclotella kutzingiana* was dominant in river Tigris, while its presence in the river Lesser-zab did not exceed more than 0.5% of the total counts.

Table (1): Phytoplankton species identified in Tigris (T_1, T_2) and Lesser-zab (z) Rivers. N=species number (cell x 10^3/1), T_1, T_2, Z= Sampling stations, A=Appearance during the study period. *= New record to the Iraqi flora.

List of taxt	N			A
CYANOPHYCEAE	T_1	T_2	Z	
Anabaena constricta(Szafer) Geitl	-	+	-	1
Chroococcus tenax(Kirch.)Hieron	-	+	-	1
Chroococcus sp.	+	+	-	1
Calothrix sp.	-	+	+	1
Gomphospheria aponina Kütz	-	-	+	1
Lyngbya limnetica Lemm.	+	15.6	-	2
Lyngbya spp.	+	+	-	3
Merismopedia elegans A.Br.	15.6	23.4	46.8	6
M. glauca(E hr.)Naeg.	-	23.4	15.6	1
M. punctata Meyen	-	-	54.6	1
Myxosarcina burmensis Skuja	-	+	-	1
Oocystis sp.	-	+	-	1
Oscillatoria curviceps C.A.Agardh	15.6	+	-	4
O. granulata Gordner	+	+	-	2
O. limosa (Roth) C.S.Agardh	-	15.6	15.6	5
O.subbrevis Schmidle	-	-	+	1
O.willei Gordener en Drouet	62.4	15.6	-	2
Oscillatoria spp.	15.6	+	15.6	5
Phormidium sp.	-	-	+	1
Spirulina major Kütz	-	+	-	2
EUGLENOPHYCEAE				
**Euglena oxyuris* var. *minor* Prescott	-	-	+	1
Euglena spp.	31.2	15.6	15.6	7
**Phacus orbicularis* Huebner	-	+	-	2
Phacus sp.	31.2	23.4	15.6	1
DINOPHYCEAE				
Dinobryon divergens Imhof	31.2	19.5	50.3	6
D. *sertularia* Ehr.	52.0	38.2	46.8	9
PYRROPHYCEAE				
Ceratium hirundinella (O.F.Müll.) E hr.	15.6	15.6	+	2
Glenodinium quadridens (Stein) Schiller	78.0	49.4	+	6
Peridinium cinctum (Müll.) E hr.	+	15.6	36.4	5
RHODOPHYCEAE				
Comsopogon sp.	-	+	-	1
BACILLARIOPHYCEAE				
Centrales				
**Aulacosiera ambigua* O.Mü ller	-	-	+	1
A. granulata (E hr.) Simonsen	183.8	112.8	585.8	10
A. granulata var. *angustissima*	+	+	-	3
A. italica (E hr.) Simonsen	86.4	+	+	8
A. varians C.A.Agardh	129.5	67.6	+	10
**Coscinodiscus lacustris* Grun.	-	-	+	1
Cyclotella comta (E hr.) Kütz.	28.9	25.1	129.5	8
C. kuetzingiana Thw.	4507.5	3703.5	44.8	10
**C. meduanae* Nova	64.8	-	-	1
C. meneghiniana Kütz.	+	+	+	8
C. ocellata Panto.	660.9	721.5	519.6	10

List of taxa	N			A
	T_1	T_2	Z	
C. stelligera C1. E*l* Grun.	82.4	126.6	48.4	6
C. striata (Kütz.) Grun.	-	-	+	1
Stephanodiscus astrea (E hr.) Grun.	50.7	240.8	711.4	10
Pennales				
**Atheya zachariasi*.J Brun.	-	+	23.5	2
Achnanthes affinis Grun.	734.2	51.0	242.3	4
A. hungarica Grun.	46.1	25.5	32.9	8
A. linearis W.Smith	-	-	+	1
A. minutissima Kütz.	618.8	533.3	544.9	10
Achnanthes sp.	+	+	-	2
Amphipleura pellucida Kütz.	23.5	28.9	22.1	8
Amphora ovalis Kütz.	56.3	48.1	23.5	8
A. pediculus. Kütz.	23.5	68.7	+	6
A.perpusilla Grun.	-	+	-	2
Amphora sp.	70.6	131.0	29.9	6
Anomoeoneis exilis (Kütz.) C1.	47.9	63.9	66.1	6
Bacillaria paxillifer (Müll,) hendey	-	-	+	2
* *Caloneis amphisbaena* (Bory) C1.	+	-	+	3
**C.bacilum* (Grun.) Mer.	-	-	51.0	1
**C.permagna*(Bailey.) C1.	+	+	+	6
**C. ventricosa* (E hr.) Meister	-	-	+	1
Caloneis sp.	-	-	+	1
Cambylodiscus clypeus E hr.	+	-	-	1
C. *clypeus* var. *bicostata* (W.Sm.)Hust.	-	-	+	1
Ceratoneis arcus Kütz.	39.3	23.5	-	4
Cocconeis pediculus E hr.	52.9	54.5	29.7	9
C. placentula var. *euglypta* (E hr.) C1.	193.9	117.2	22.9	9
C. placentula var. *lineata*(E hr.) C1.	-	-	+	2
Cymatopleura elliptica (de Br.) W.Smith	+	43.2	+	6
C. solea de Br.	23.5	36.3	+	9
C. affinis Kütz.	139.9	123.3	99.3	10
C.amphicephala Naeg.	-	117.8	178.6	1
Cymbella amphicephala var. *intermidea* A.C1.	+	335.7	58.9	3
C. aspera (E hr.) C1.	78.5	22.2	39.3	10
C. differta (A. Cleve.) Krieger	33.4	31.4	33.1	8
C. cistula Grun.	+	39.3	+	6
C. helvtica Kütz.	93.9	143.4	70.6	1
C. lanceolata (E hr.) Van Heurck	+	+	-	5
C..microcephala Grun.	135.6	163.6	322.2	10
C. prostrata Bre.	23.5	30.1	+	7
C. sinuata Gregory	23.5	49.7	52.25	7
C. tumida (Breb.) Van Heurck	27.5	23.5	+	6
C. ventricosa Kütz.	41.2	42.8	32.1	9
**C. ventricosa* var. *silesiaca* Bleish A.C1.	-	-	+	1
Diatoma elongatum (Lyng.) Agardh.	316.47	650.8	206.9	10
**D. hiemale var. mesodon* (E hr.) Grun.	-	+	-	1
D. vulgare Bory	78.9	72.6	82.4	10
Diploneis ovalise Hilse	-	-	+	2
D. pseudovalis (Hust.) Part.& Rei	-	35.3	25.5	4
Fragilaria acus Kütz.	44.5	97.1	59.8	7
F. acus var.*angustissima*	79.8	159.4	316.3	7
F.capitata E hr.	+	-	+	2
F. ulna (Nitzsche) E hr.	62.8	46.5	56.9	9
F. ulna var. *biceps* (Kütz.). Schonf.	65.7	88.8	60.4	9

List of taxa	N			A
	T_1	T_2	Z	
F. ulna var. oxyrhynchus Kütz.	+	-	-	1
F. vaucheria (Kütz.) Pet.&Rei.	94.2	113.8	19.6	8
Fragilaria spp.	19.6	+	21.6	3
Gomphoneis olivaceum (Horn.)P. Dawson	237.5	249.2	62.8	9
Gomphoneis angustatum (Kütz)Rabh.	+	+	+	5
G. angustatum var. *propducta* Grun.	-	+	-	1
G. constrictum var. *capitata* (E hr.) Grun.	+	+	+	3
G. gracile E hr.	-	+	-	1
G. intricatum (Kütz.)	-	-	+	1
G. intricatum var. *pumil*a Grun.	104.4	80.7	57.1	10
G.lanceolatum E hr.	-	-	+	1
**G. lanceolatum* var. *turris* (E hr.) Hust.	-	+	-	1
G.parvulum (Kütz.).	+	-	+	2
G.sphaerophorum E hr.	21.6	23.5	23.5	5
Gyrosigma peisonis (Grun.) Hust.	47.1	30.7	23.5	9
G.spencerii (W.Smith)C1.	23.5	29.4	25.5	9
G. scalproides (Rabh) C1.	+	-	-	1
Hantzschia amphioxys (E hr.) Grun.	31.4	22.6	39.3	7
Mastogloia smithi var. amphicephala Gurn.	-	-	+	3
Navicula cryptocephala (Kütz.).	136.6	161.3	85.9	10
N. cryptocephala var. *exilis*(Kütz.).	99.3	100.4	94.8	6
N. cryptocephala var.*intermedi*a (Kütz.).	129.3	68.7	53.2	10
N. cryptocephala var. *minuta* Boy-p	+	+	-	2
N. cryptocephala var. *veneta*. ((Kütz.). Grun.	116.8	108.3	101.7	10
**N. cuspidata* (Kütz.).	-	-	+	1
**N. cuspidata* var. *ambigua* (E hr.) C1.	-	-	+	1
**N.decussis* Oestrup	-	-	51.0	1
N.gracilis E hr.	91.4	68.8	23.5	9
N. graciloides A.Mayer	-	-	+	1
**N. imbricata* Block.	-	-	+	1
**N.koeiei* Foged	-	-	+	1
N. parva (Mene.) C1. – E1.	-	19.6	21.6	3
**N. pseudotuscula* Hust.	-	-	+	1
N.pygmaea (Kütz.).	27.5	16.7	25.5	7
N.radiosa (Kütz.).	-	23.5	25.5	6
N. rhynchocephala (Kütz.).	-	25.5	+	2
**N.soodensis* KraBke.	-	-	+	2
N.spicula(Hick.)C1.	-	-	43.2	3
**N.trivilis* Lange-Bertalat	-	-	+	1
Navicula sp.	-	-	23.5	1
**Neidium affine* (E hr.) C1.	-	-	+	2
**N.binode* (E hr.) Hust.	-	-	25.5	1
N. dubium (E hr.) C1.	+	+	+	4
**N.productum* (W.Smith) C1.	-	+	+	3
Nitzschia acicularis (E hr.) W.Smith	111.2	189.4	106.6	10
N. amphibia Grun.	34.0	74.3	79.6	8
**N.angustata* var.*acuta* Grun.	-	-	21.6	1
N. apiculata(Grun.) Grun.	53.6	58.2	36.3	7
N.denticula Grun.	-	-	64.7	1
N.dissipata(Kütz) Grun.	297.2	280.1	84.8	10
N.fasciculata Grun.	+	+	-	2
N.filformis (W.Sm.) Hust	93.5	130.7	+	8
N.frustulum Kütz.	-	-	21.6	1
N. frustulum var.*perminuta* Grun.	-	+	19.6	2

**N. frustulum* var. *subsalina* Hust.	-	-	+	1
N. hungarica Grun.	-	-	19.6	2
N.linearis W.Smith	157.0	127.6	98.1	2
N.microcephala Grun.	+	21.6	12.6	2
N.palea (Kütz.) W.Smith	348.6	358.5	235.3	10
N.sigmoidea (E hr.) W.Smith	78.5	19.6	+	9
N.sinuata *var.*tabellaria *Grun.*	+	+	+	2
N.tryblionella Hantz.	-	+	-	1
N.tryblionella var.*victoria* Grun.	23.5	-	-	1
Nitzschia sp.	-	21.6	-	2
Pinnularia brebessonii(Kütz.) Rabh.	-	-	+	1
P.borealis E hr.		-	+	6
**P.fasciata* Lagersted	-	+	+	2
**P.karelika* Cleve	-	+	-	1
*Pleurosigm*a sp.	-	-	+	1
Rhoicosphenia curvata (Kütz.)Grun.	39.3	58.9	+	7
**Stauroneis anceps* fo.*linearis* (E hr.)Rabh.	+	-	-	1
**S.phoenicenteron* E hr.	-	-	19.6	1
Surirella angustata (Kütz.)	-	21.6	+	1
S.capronii Breb.	27.5	+	+	7
S.linearis W.Smith	-	25.5	+	4
S.ovalis de Breb.	+	+	+	3
S.ovata (Kütz.)	80.5	39.3	43.2	6
CHLOROPHYCEAE				
**Actinastrum gracilimum* G.M.Simth	-	31.2	-	1
A.hantzschii Lagerheim	-	15.6	-	1
**Botrycoccus braunii* (Kütz.)	15.6	+	-	1
B.sudeticus Lemm.	15.6	+	-	4
Cerasterias staurastroides West & West	-	31.2	+	5
*Chlamydomona*s sp.	301.7	238	191.2	4
Cladophora glomerata (L.) Kütz.	+	-	31.2	6
Clostrium moniliferum (Bory) E hr.ex Ralfs	-	15.6	-	2
C.parvulum var.*maius* (Schmidle)Krieg.	+	-	+	3
Closterium sp.	-	15.6	13.6	4
Closteriopsis longissima var. *tropica* West & West	-	-	+	1
**Coelastrum astroideum* DeNot	15.6	-	-	1
C.microporum Naegeli	31.4	+	+	4
C.reticulatum (Dang.) Senn	+	-	-	1
C. scabrum	-	+	-	1
C.sphaericum Naegeli	+	15.6	-	1
Crucigenia rectangularis (A.Braun.) Gay.	+	-	+	3
**Cosmarium contractum var. ellipsodeum* (E1fv,) W.&W.	46.8	-	-	1
C.hammeri Reinsch	15.6	+	-	1
C.formosulum Hoff	23.4	15.61	31.2	9
**C.formosuiforme* (Wille) Gutwinski	-	31.2	15.6	5
**C. reniforme* (Rales) Arch.	+	-	-	1
C.vexatum W.West	+	-	+	
Cosmarium sp.	-	31.2	15.6	5
Desmidium swartzii C.A.Ag.	-	-	+	1

Lagerheimia citriforimis (Snow). G.M.Smith	35.1	33.8	-	4
L. quadriseta (Lemm.) G.M.Smith	36.4	+	-	3
Moeugotia spp.	+	+	39.0	6
List of taxa	**N**			**A**
	T1	**T2**	**z**	
Monoraphidium arcuatum (Kors.) Hind	54.6	31.2	31.2	5
M. contractum (Thur.)Kom-Legn.	-	+	+	2
Oedogonium cardiacum Wittrock	+	-	+	2
Oedogonium sp.	+	+	-	2
Pediastrum duplex var. *calthratum*(A.Braun)	15.6	15.6	+	9
P. integrum Naegeli	15.6	+	+	5
P.sculptatum G.M.Simth	+	15.6	+	5
P. simplex var.*duodenarium* (Bail)Rabh.	18.7	32.9	+	10
P.tetras (E hr.)Ralfs.	15.6	-	+	3
P.tetras var. *tetraodron*(Corda) Rabh.	-	+	-	1
Scenedesmus abbundans var. *longicauda* G.M.Smith	-	+	-	1
S.bijuga (Turp.)Lag.	50.7	32.9	28.9	9
*S. *bijuga* var. *alternan*s (Reinsch) Hansg.	-	-	46.8	1
S.*dimorphus* (Turp.) Kütz.	42.2	28.1	21.8	8
*S. *incrassatulus* Bohlin	+	+	-	1
S.*opoliensis* P.Richter	88.4	48.8	25.4	8
S.*quadricauda* (Turp.) de Br.	39.0	31.2	-	8
S. *quadricaud*a var.*maxima* West&West	15.6	+	31.2	1
S.*spinous* Chodat	-	+	-	1
Scenedesmus sp.	15.6	15.6	-	1
Spirogyra aequinoctialis G.S.West	+	15.6	-	1
**S.gratiana* Transeau	-	-	+	1
Spirogyra spp.	+	39.0	31.2	8
**Sphaerocystis schroeteri* Chodat	15.6	+	-	2
Staurastrum natator West	35.1	15.6	+	3
Staurastrum sp.	-	-	+	1
Stigeoclonium lubricum (Dillw.) Kütz.	-	+	-	1
Tetraedron minimum (A.Braun)Han.	31.2	15.6	23.4	6
**Trachelomonas armata* fo. *inevoluta* Deflandre	-	+	-	1
Ulothrix subtilissima Robh.	-	+	-	1

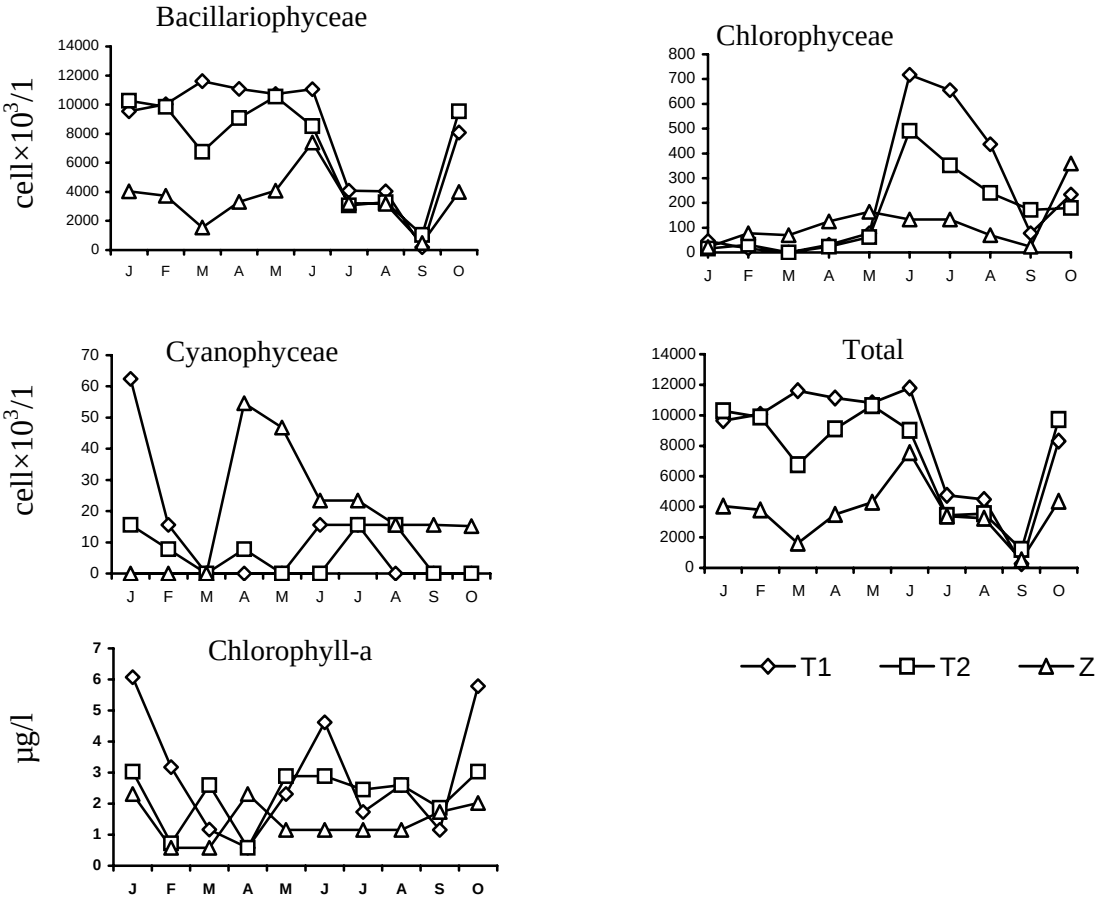

Fig.3: Monthly distribution of phytoplankton total cells numbers and chlorophyll-a concentration in Tigris and Lesser-Zab rivers.

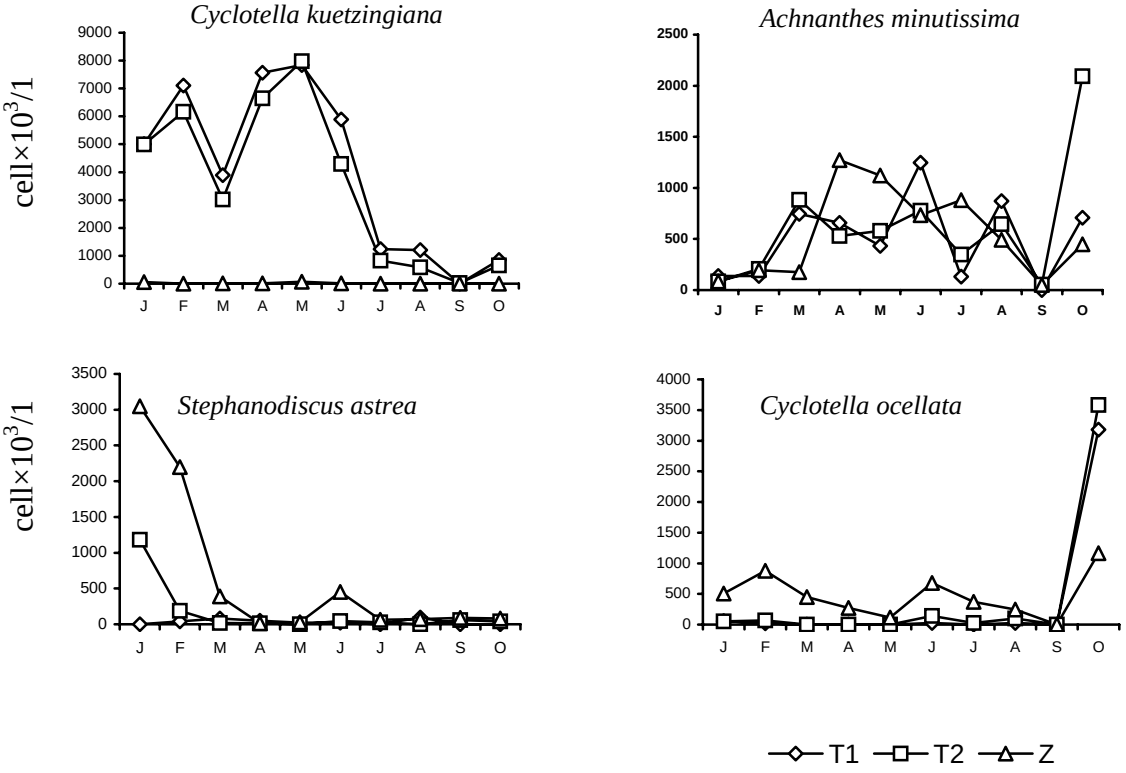

Fig.3: Monthly distribution of the most dominant phytoplankton species in Tigris and Lesser-zab rivers.

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تأثير نهر الزاب الأسفل على الهائمات النباتية في نهر دجلة، العراق

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ملخص

تم اختيار ثلاثة مواقع في نهري الزاب الأسفل ودجلة لجمع نماذج الماء شهريا خلال المدة بين كانون الأول ولغاية تشرين الأول 1999، وحسب من خلالها العدد الكلي للهائمات النباتية وقدر تركيز الكلوروفيل – أ. شخص ما مجموعه 231 نوعا، ظهر 41 نوعا منها لاول مرة في العراق. سادت الطحالب العصوية (الديتومات) بقية المجاميع وخصوصا الريشية منها. وتلتها كل من الطحالب الخضر ثم الخضر المزرقة. وسجلت بقية المجاميع بأعداد قليلة جدا لم يكن لها تأثير في العدد الكلي للهائمات النباتية. كونت بعض الانواع اكثر من 10% من العدد الكلي وهي *Stephanodiscus astrea* و *Cyclotella ocellata* و *Achnanthes minutissima* و*Cymbella kutzingiana*. ساد كلا النوعين *S. astrea* و*C. ocellata* في نهر الزاب الأسفل وأضيفت أعداد كبيرة منها إلى نهر دجلة. كان العدد الكلي للهائمات النباتية في نهر الزاب الأسفل اقل مما جعل تأثيره مخففا لمجتمع الهائمات النباتية في نهر دجلة خلال معظم مدة الدراسة.

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