Journal of Environmental Biology
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31 343-350 (**May** 2010)
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Phytoplankton composition of Euphrates River in Al-Hindiya barrage and Kifil City region of Iraq

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(Received: August 08, 2008; Revised received: May 10, 2009; Accepted: August 08, 2009)

Abstract: *Seasonal variations in phytoplankton abundance and their composition were studied at five stations in the middle region (between Al-Hindiya barrage to Kifil City) of the Euphrates River in Iraq between March, 2004, and February, 2005. A total 151 taxa of phytoplankton were identified, belonging to Bacillariophyceae (98), Chlorophyceae (33), Cyanophyceae (14), Euglenophyceae (2), Xanthophyceae (2), and Dinophyceae (2). The total abundance of phytoplankton cells varied from 136 to 5312 cells l^{-1} with maxima in spring and fall. Bacillariophyceae were the most abundant group at all stations. Some species of phytoplankton occurred continuously during the study period (Cyclotella ocellata, C. meneghiana, Cocconeis placentula, Nitzchia spp, Meringosphaera spinosa). The study recorded four species as new records for Iraqi. The phytoplankton was indicative of oligotrophic conditions although it showed some signs of organic pollution near cities.*

Key words: *Algae, Phytoplankton, Seasonal variation, Euphrates river*
PDF of full length paper is available online

Introduction

Some investigations have been conducted on the phytoplankton composition of the upper region of the Euphrates River in Iraq (Kassim *et al*., 2000; Al-Saadi *et al*., 2000) and some studies of the lower region in the Mesopotamia marshes of southern Iraq are underway. The middle region of the Euphrates inside Iraq has received less attention (Hassan *et al*., 2007). There is a need to determine the environmental conditions and water quality of Euphrates River at its mid region. Scott (1995) had mentioned that no recent information was available in this region of the river, although he reported the area around Al-Hindiya barrage to be an important breeding area for waterfowl. No previous studies have been recorded for the algal flora of Euphrates River in the region between Al-Hindiya and Kifil City. Herein we report on the phytoplankton composition and seasonal dynamics.

Materials and Methods

The studied area is located in the mid region of the Euphrates River in Iraq, about 292 km from station 1 up to station 5. Station 1 was at the Hindiya barrage about 5 km south of Al- Mussaiyab city and 65 km south of Baghdad. Station 2 was located 15 km downstream from station 1, while the third and fourth stations were located before and after Hindiya City. The last station (Station 5) is located at Kifil City (Fig 1).

The phytoplankton of the Euphrates River was observed monthly at the five stations from March, 2004, to February, 2005. Water samples (1 l) were taken from the surface (0-20 cm). They were fixed and preserved with Lugol's Iodine solution, then concentrated by settling to 10 ml (Furet and Benson-Evans, 1982). Phytoplankton net samples were also taken and used to assist identification. The identification of phytoplankton was made according to Desikachary (1959), Prescott (1973), Foged (1976), Germain (1981), Hadi *et al*. (1984) and Hustedt (1985).

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Results and Discussion

A list of phytoplankton collected from the present study area is presented in Table 1. The phytoplankton consisted of 145 taxa belonging to Bacillariophyceae (98), Chlorophyceae (33), Cyanophyceae (14), Euglenophyceae (2), Xanthophyceae (2), and Dinophyceae (2). The highest number of taxa (87) was recorded at station 2, while 63 taxa were observed at stations 1 and 3. Stations 4 and 5 had 56 and 49 taxa, respectively (Table 2). There were seventeen taxa common to all study stations.

Bacillariophyceae (Diatoms) were dominant, representing 64.9% of the phytoplankton community. This has been observed in other studies of phytoplankton in Iraq (Hadi *et al*., 1984; Maulood *et al*., 1993; Hassan and Al-Saadi, 1995; Hassan, 2004). Most of the diatoms were pennate, while some species belonging to order Centrales were important quantitatively in June and October.

The genera *Navicula*, *Nitzchia*, *Cymbella*, *Synedra*, and *Scenedesmus* were represented by several species; 13, 13, 11, 9, and 7, respectively. Some species of phytoplankton were observed throughout the study period, such as; *Cyclotella ocellata*, *C.*

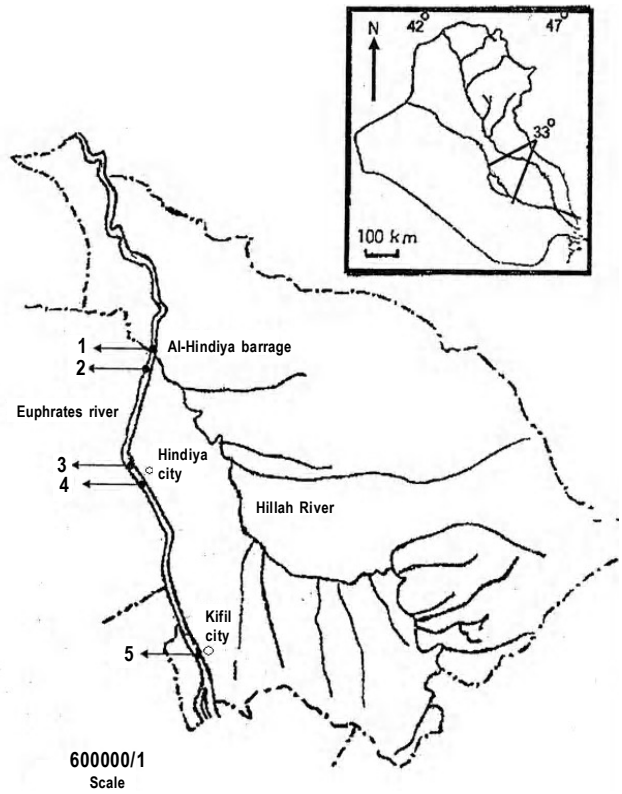

Fig. 1: Map of the study area in Euphrates River at its mid region

meneghiana, *Cocconeis placentula*, *Nitzchia* spp. and *Meringosphaera spinosa*.

The abundance of phytoplankton cells were 611-3934, 448-4456, 285-4296, 322-5312, and 136-3500 cells l^{-1} at stations 1, 2, 3, 4, and 5, respectively (Fig. 2). The total cell numbers recorded in this study were found to be less than recorded in the upper region of the river (Al- Saadi *et al*., 2000), and in the lower region (Saad and Kell, 1975; Maulood *et al*., 1993), and in the major tributary, the Hilla River (Hassan, 1997).

Quantitative counts showed clear seasonal variation in phytoplankton cell numbers with maxima during early summer and autumn. Seasonal variations in abundance and composition of river phytoplankton are usually affected by the discharge, morphometry, hydrology, trophic status, and light availability (Kumari *et al*., 2006; Reynolds, 2003; Reynolds, 2006; Leveque, 2006; Indra and Sivaji, 2006; Shiddamallayya and Pratima, 2008; Kolayli and Sahin 2009).

The Bacillariophyceae comprise most of the total abundance at all stations studied and ranged from 20 cells l^{-1} in August at station 5 to 4380 cells l^{-1} at station 4 in June. Other groups of phytoplankton appeared in some months only. High cell numbers of Chlorophyceae (1594 cells l^{-1}) were recorded at station 4 in November 2004, while Cyanophyceae were recorded (690 cells l^{-1}) at stations 1 and 2 in June 2004 and January 2005 (Fig. 2). Highest numbers for other groups; 1230 cells l^{-1} for Xanthophyceae at station 2 in October 2004, 23 cells l^{-1} for Dinophyceae at station 4 in August 2004 and 95 cells l^{-1} for Euglenophyceae at Station 1 in November 2004 (Fig. 2).

Cyclotella ocellata and *C. meneghiana* were the dominant taxa at all stations and were found during most of the studied period. The abundance of *C. ocellata* changed during the study period, being highest in June, making up 65% of the total number of phytoplankton, decreasing until August and then increasing again in October 2004 to contribute 75 % of phytoplankton abundance. *C. meneghiana* was observed in high numbers in October at station 1 and in November 2004 at station 2.

Many authors have considered *Cyclotella* as an indicator for oligotrophic environments (Willen *et al*., 1990; Tas *et al*., 2002; Stoermer and Julius 2003). It was also recorded as the dominant species in other studies (Talling, 1980; Al-Lami *et al*., 1996; Al-Saadi *et al*., 2000; Hassan *et al*., 2001; Hassan, 2004). *C. meneghiana* is not only euplanktonic, but can also be benthic or potamoplanktonic (Krammer and lange-bertalot, 1991; Murakami *et al*., 1992).

Cocconeis placentula an epiphytic alga (Demir and Kirkagac, 2005), was observed at all studied stations during this study, although it was at low abundance and absent from some stations in August (Fig. 3).

Nitzchia spp were observed at most stations but in low numbers. It increased at station 2 in June and station 4 in May and June and decreased during July to October 2004. It increased again in November at stations 2 and 4 (Fig 3). There was a tendency for *Nitzchia* to be slightly more abundant at stations near cities, which may indicate organic enrichment in the river (Palmer, 1969; Lowe, 1974; Stoermer and Julius, 2003; Shashi Shekhar *et al*., 2008).

Chlorophyceae were the second most important group. They contributed a large number of species (21.9%) but lower cells numbers compared with Bacillariophyceae. This group is the most abundant flora from November to February, which may be due to their preference for moderate temperatures as has been found by other studies (Temponeras *et al*., 2000; Tas *et al*., 2002). Other factors may include higher efficiency of light absorption and nutrient uptake (Szelag-Wasielewska, 2003).

Other classes of phytoplankton (Cyanophyceae, Xanthophyceae, Dinophyceae and Euglenophyceae) were present only seasonally and with minor numerical importance.

Meringosphaera spinosa Prescott is a newly recorded Iraqi flora according to the new check list (Maulood and Toma, 2004). This was present in most months of the year, but most abundant in May at station 5, in June at stations 3 and 4, and in October at stations 2 and 3 (Fig 3). *Dactylococcopsis smithii*, *Oedogonium microgonium*, and *Cocconeis disculus* were also recorded in the present study as new records for Iraq.

The overall results of this study indicate that the mid regions of the Euphrates River in Iraq have phytoplankton indicative of oligotrophic conditions, with perhaps some indication of organic pollution near the cities.

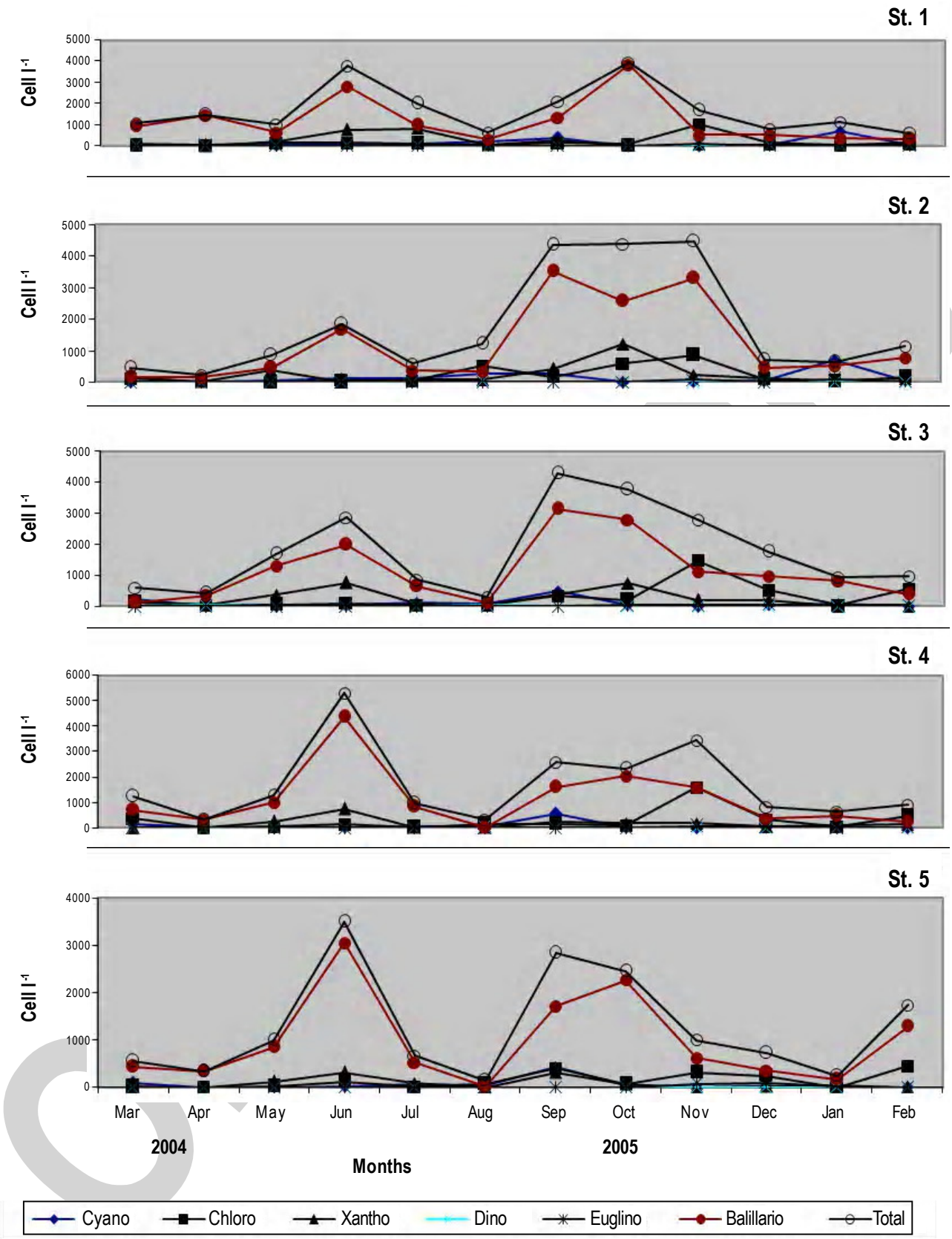

Fig. 2: Seasonal variation of phytoplankton in the study area of Euphrates River

Table - 1: List of phytoplankton taxa identified and occurrence at the study stations of Euphrates River during the study period

Taxa	Stations				
	1	2	3	4	5
Cyanophyceae					
Anabaena spp	+	+	-	-	-
Aphanocapsa rivularis (Carm.) Rabenhorst	-	-	-	+	-
Chroococcus minor (Ktz.) Naegeli	+	+	-	+	-
Chroococcus limneticus Lemmermann	+	+	+	+	-
Chroococcus turgidus (Ktz.) Naegeli	+	+	-	-	-
**Dactylococcopsis smithii* Chodat & Chodat	+	+	+	+	+
Gloeocapsa punctata Naegeli	-	+	-	-	-
Microcystis aeruginosa Kuetzing	-	-	+	+	-
Merismopedia elegans A. Braun	_	+	+	-	-
Merismopedia glauca (Ehr.) Naegeli	+	+	+	+	-
Merismopedia tenuissima Lemmermann	+	-	+	+	+
Nostoc spp	+	+	+	+	-
Oscillatoria spp	+	+	+	+	+
Spirulina sp	-	-	-	-	+
Chlorophyceae					
Actinastrum gracillimum G.M. Smith	-	-	+	-	-
Actinastrum hantzschii Lagerheim	-	+	-	-	-
Acanthosphaera zachariasi Lemmermann	-	-	+	-	-
Ankistrodesmus convolutes Corda	+	+	+	+	+
Ankistrodesmus falcatus (Corda) Ralfs	-	+	-	-	-
Asterococcus superbus (Cienkowski) Scherffel	-	+	-	-	-
Asternococcus limneticus G.M. Smith	+	-	-	+	+
Basicladia chelonum (Collins) Hoffman & Tilden	-	+	-	-	-
Carteria klebsii (P.A. Dangeard) Francé	+	+	-	-	-
Chlamydomonas sp.	+	+	+	+	+
Chlorella spp.	+	+	+	+	+
Closteriopsis longissima (Lem.) Lemmermann	-	+	+	+	+
Geminella spp.	+	+	+	+	-
Kirchneriella contorta (Schmidle) Bohlin	-	-	-	+	-
**Oedogonium microgonium* Prescott	-	-	+	-	-
Pediastrum duplex Meyen	-	+	+	+	-
Pediastrum simplex Meyen	+	+	+	-	+
Pediastrum boryanum (Turp.) Meneghini	-	-	-	-	+
Pediastrum sculptatum Smith	-	+	-	-	-
Pediastrum spp.	+	+	+	+	+
Scenedesmus dimorphus (Turp) Ktz.	+	-	-	+	-
Scenedesmus bijuga (Turp.) Lagher	+	-	-	-	-
Scenedesmus armatus Chodat	-	+	-	-	-
Scenedesmus quadricauda (Turpin) Brébisson	-	-	-	-	+
Scenedesmus longus Meyen	-	+	-	-	-
Scenedesmus acuminatus (Lag.) Chodat	-	-	+	-	-
Scenedesmus spp.	-	-	+	+	+
Spirogyra spp.	-	-	+	+	+
Staurastrum gracile Ralfs ex Ralfs	-	+	-	-	-
Tetraedron hastatum (Reisch) Hansg.	-	+	-	+	-
Tetraedron regulare Ktz.	-	-	-	+	-
Tetraedron trigonum (Naeg.) Hansg.	+	-	+	-	-
Ulothrix spp.	+	+	+	+	-
Xanthophyceae					
**Meringosphaera spinosa* Prescott	+	+	+	+	+
Pleurogaster lunaris Pascher	+	+	-	-	-
Dinophyceae					
Ceratium hirundinella (Muell.) Du Jardin	-	+	+	+	-
Peridinium spp.	-	+	+	-	-
Bacillariophyceae					

Centrales					
Aulacoseira granulata(Ehrenberg) Simonsen	+	-	-	-	-
Cyclotella ocellata Pant	+	+	+	+	+
Cyclotella atomus Hustedt	+	+	+	-	-
Cyclotella meneghiniana Kutz.	+	+	+	+	+
Cyclotella comta (Ehrenberg) Kutz.	-	-	-	+	+
Melosira juergensii C.Agardh	+	-	-	-	-
Melosira distance (Ehr.) Kutz.	-	+	-	-	-
Stephanodiscus niagarae (Her. Grun.)St. Niagarae	-	-	-	+	-
Pennales(without raphes)					
Diatoma vulgare Bory	+	+	+	+	+
Diatoma hiemale (Roth.) Heiberg	+	+	+	+	+
Fragilaria crotonensis Kitton	+	-	-	-	+
Fragilaria capucina Desmazieres	+	-	+	-	-
Fragilaria intermedia Grunow	-	+	+	-	-
Synedra acus Kutz.	-	+	+	-	-
Synedra tabulate (Agardh) Kützing	+	-	-	-	-
Synedra capitata Ehr.	-	-	+	-	-
Synedra incisa Boyer	-	+	-	+	-
Synedra ulna (Nitzs.) Ehr	+	-	-	-	-
Synedra pulchella (Ralfs) Kuetzing	+	-	-	-	-
Synedra rumpens Kg.	-	+	-	-	-
Ulnaria delicatissima (W.Smith)M. Aboal & P.C. Silva	-	-	+	+	-
Pennales(with raphes)					
Achnanthes bioreti Germain	+	-	-	-	-
Achnanthes lanceolata (Breb.) Grunow	-	-	-	-	+
Achnanthes minutissima Kutz.	-	+	-	-	-
Amphora ovalis kutz.	+	+	-	-	+
Amphora veneta Kutz.	-	-	-	-	+
Amphora sp	-	-	-	-	+
Bacillaria paxillifer (Muell.) Hendey	-	+	+	-	-
Caloneis amphisbaena (Bory) Cleve	-	+	-	-	+
Caloneis permagna (Bail.) Cleve	-	-	+	-	-
Cocconeis placentula Ehr.	+	+	+	+	+
Cocconeis pediculus Ehr.	+	+	+	+	+
**Cocconeis disculus* (Schumann) Cleve	-	-	+	-	-
Cymatoplurea solea (Breb.) Smith	+	-	-	-	-
Cymbella leptoceros (Ehr.) Grunow	+	-	-	-	+
Cymbella tumida (Breb.) van Heurck	-	-	+	-	+
Cymbella helvetica Kuetzing	-	-	+	-	-
Cymbella affinis Kuetzing	+	-	-	+	-
Cymbella ventricosa Kuetzing	+	-	-	-	-
Cymbella tumidula Gruow	+	-	-	-	+
Cymbella parva (Smith) Kitchn	+	-	-	-	+
Cymbella naviculiformis Auersw	+	-	-	-	-
Cymbella ehrenbergii Kuetzing	-	+	-	+	-
Cymbella cesatii (Rabenhorst) Grunow	-	+	-	-	-
Cymbella cistula (Ehr.) Kitchn	-	+	-	-	-
Cymbella amphicephala Naegeli	-	+	+	-	-
Cymbella minuta Hilse ex Rabenhorst	+	-	-	-	-
Epithemia sorex Kutz.	-	+	-	-	-
Gomphonema longiceps Ehr.	+	+	-	-	+
Gomphonema constrictum Ehr.	+	+	+		+
Gomphonema subtile Ehr.	+	-	+	+	+
Gomphonema spp	+	+	+	+	+
Gomphoneis olivaceum (Hornemann) Dawson ex Ross & Sims	-	+	-	-	-
Gomphoneis herculaeana (Ehr.) Cleve	-	+	-	-	-
Gyrosigma acuminatum (Kutz.) Rabenhorst	-	-	+	-	+
Gyrosigma scalproides (Rabenhorst) Cleve	-	-	-	-	+
Gyrosigma balticum (Ehr.) Cleve	-	-	-	+	-
Gyrosigma sp	+	+	-	-	+

Mastogloia elliptica (Ag.) Cleve	-	-	+	-	-
Mastogloia smithii Thwaites	+	-	-	-	-
Neidium affine (Ehr.) Pfitz	-	+	-	-	-
Navicula gastrum (Ehr.) Kutz.	-	-	-	+	-
Navicula halophila (Grun.) Cleve	-	+	-	-	+
Navicula pupula Kutz.	-	+	-	-	-
Navicula radiosa Kutz.	-	+	-	+	-
Navicula viridula (Kutz.) Ehr.	-	-	+	-	-
Navicula gregaria Donkin	-	+	-	-	-
Navicula graciloides Mayer	-	+	-	+	-
Navicula schroeteri Meister	-	-	+	-	-
Navicula crucicula (Smith) Donkin	-	+	-	-	-
Navicula pusilla Smith	-	+	-	+	-
Navicula humerosa de Brebisson	-	+	-	-	-
Navicula jaernefeltii Hustedt	-	-	-	+	-
Navicula caspidata	-	+	-	+	-
Nitzschia tryblionella F.Minor	-	-	-	-	+
Nitzschia hungarica Grunow	-	+	+	-	-
Nitzschia linearis Smith	+	+	+	+	+
Nitzschia dissipata (Kutz.) Grunow	-	-	-	+	-
Nitzschia palea (Kutz.) Smith	-	+	-	+	-
Nitzschia subcapitellata Hustedt	-	+	-	-	-
Nitzschia closterium (Ehr) Smith	-	-	-	+	-
Nitzschia acicularis (Kutz.) Smith	+	+	+	-	+
Nitzschia longissima (Breb.) Ralfs	-	+	-	-	-
Nitzschia sigmoidea (Kutz.) Smith	-	+	-	-	+
Nitzschia vermicularis (Kutz.) Hantzsch	+	+	+	+	+
Nitzschia capitellata Hustedt	-	+	+	-	-
Nitzschia hantzschiana Rabenhorst	-	+	+	-	-
Rhoicosphenia curvata (Kutz.) Grunow	+	-	-	-	-
Surirella ovalis de Brebisson	-	+	+	+	+
Surirella ovata Kutz.	+	+	-	-	-
Surirella spp	+	-	-	-	-
Synedra acus Kutz.	-	+	+	-	-
Synedra tabulate (Agardh) Kützing	+	-	-	-	-
Synedra capitata Ehr.	-	-	+	-	-
Synedra incisa Boyer	-	+	-	+	-
Synedra ulna (Nitzs.) Ehr	+	-	-	-	-
Synedra pulchella (Ralfs) Kuetzing	+	-	-	-	-
Synedra rumpens Kg.	-	+	-	-	-
Euglenophyceae					
Euglena spp	+	+	+	+	+
Phacus sp.	-	+	+	+	+

Symbols: + present; - not identified, Items with an asterisk (*) are new recorded to Iraq

Table - 2: Number of identified species and genera of the phytoplankton groups in the study stations of the Euphrates River

Group	Station										Total	
	1		2		3		4		5			
	Sp	G	Sp	G	Sp	G	Sp	G	Sp	G	Sp	%
Cyanophyceae	9	6	10	7	8	6	9	7	4	4	14	9.3
Chlorophyceae	11	9	17	13	14	15	14	13	11	8	33	21.9
Xanthophyceae	2	2	2	2	1	1	1	1	1	1	2	1.3
Dinophyceae	-	-	2	2	2	2	1	1	-	-	2	1.3
Euglenophyceae	1	1	2	2	2	2	2	2	1	1	2	1.3
Bacillariophyceae	-	-	-	-	-	-	-	-	-	-	-	-
Centrales	5	3	3	1	3	1	4	2	3	1	8	5.3
Pennales	34	15	48	15	31	12	24	8	28	13	90	59.6
Total	**55**	**36**	**67**	**42**	**51**	**39**	**49**	**34**	**44**	**28**	**151**	**-**

SP = Species, G = Genera, - = Not identified

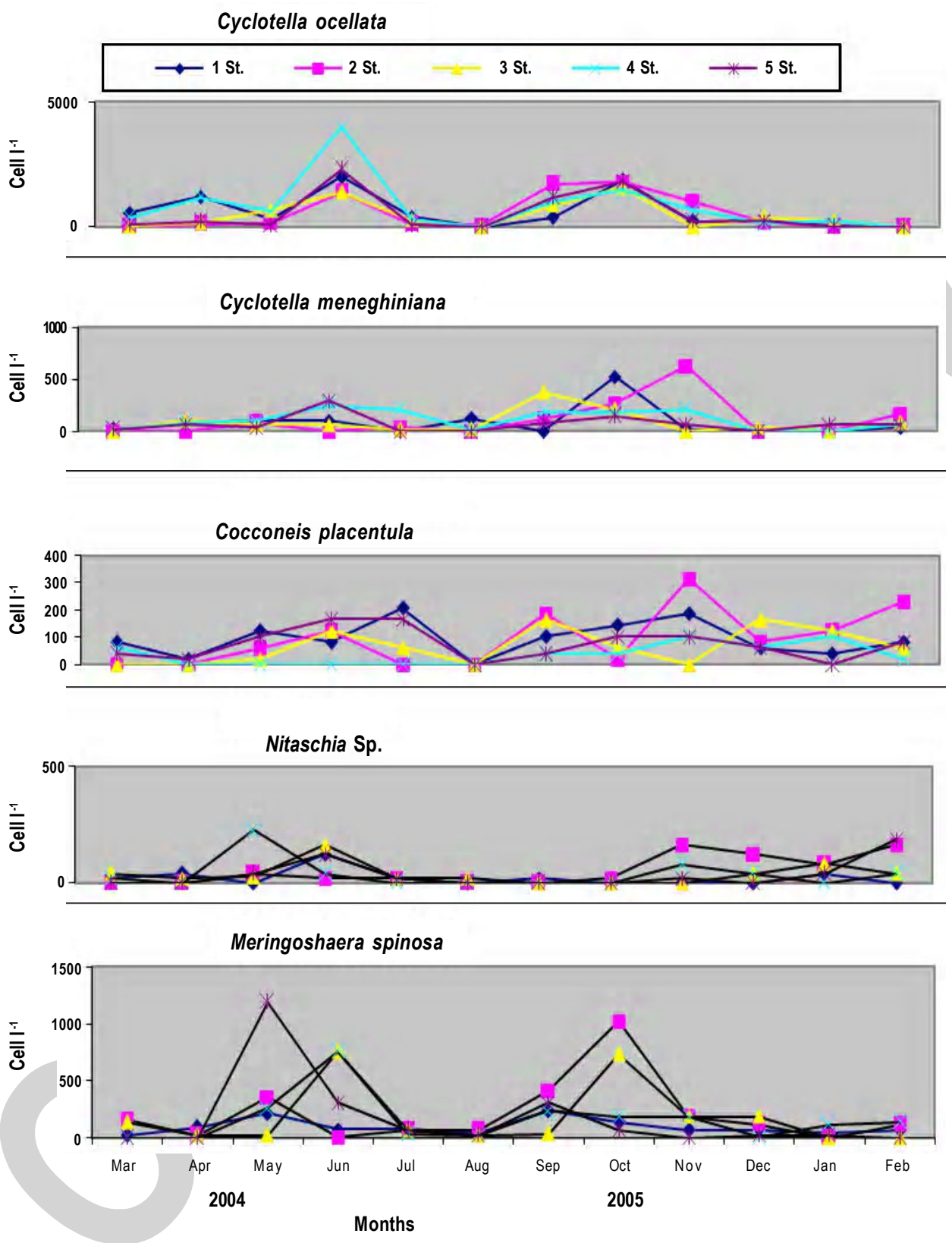

Fig. 3: Seasonal variation of some dominant species at the study area of Euphrates River

Acknowledgments

The authors would like to thank the Department of Biology, College of Science, University of Babylon for their supports the project.

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