

## A limnological study in Euphrates River from Al- Hindiya Barrage To Al-Kifil city – Iraq –

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### Abstract:

The present study was conducted on the Euphrates River at its mid region starting from Al-Hindiya to Al-Kifil city in five selected sites along the river during July 2005 to June 2006. The present study was revealed that the river water is slightly alkaline, very hard and well oxygenated. The results were recorded values between ( 1104 – 204.5 -5 mg/l ),( 170.6 – 5885 mg/l ), (68.88– 682 mg/l ),(54.65mg/l-145.95 mg/l ), ( 0 . 001 – 0 . 06 mg/l ), ( 0 . 02 –1.32 mg / l ) and ( 1 . 15 – 332. 6 ) for TSS , TDS , sulphate , chloride , Total phosphorous, Total Nitrogen and TN / TP respectively. The 145 taxa of algae were identified and belong to Bacillariophyceae (94 taxa ), Chlorophyceae ( 25 taxa ), Cyanophyceae (20 taxa ), Chrysophyceae (3 taxa ), Euglenophyceae (2 taxa ) and 1 taxa for Xanthophyceae . The high number was recorded at sites 2 and 4 (109 taxa ) followed by sites 3 and 5 ( 91 taxa ) and 88 taxa at site 1 . The community genera at all sites were *Chlamydomonas*, *Oscillatoria*, *Chlorella*, *Cyclotella*, *Cocconeis*, *Englena* and *Phacus*. The qualitative study showed the fluctuation in the number of phytoplankton between ( $3492 \times 10^3$  cell/ L ) at site 4 during Nov – 2005 and ( $207 \times 10^3$  cell / L ) recorded at site 5 during June 2006 .

### Introduction

Euphrates River is one of the important rivers in southwestern Asia which has its springs in Turkey and runs through three countries (Turkey, Syria and Iraq) and its downstream in Arab Gulf. In Iraq the river enters its delta between Hitt and Ramadi. Hindiya barrage was built on the left of Euphrates where it ramifies into two branches: Al-Hindiya river and Al-Hilla river a bout (292 Km ) south of Ramadi barrage and (135 Km ) south of Fallujah barrage to regulate the distribution of water (1). Unreasonably since twenty years, the Iraqi

government decided to build many military factories in this green region instead of development and conservation their environment (2). A few researchers were focused on this region (3, 4, 5, 6). The present study was attempted to give further basic information about physical – chemical properties and phytoplankton distribution of this part of river.

### Materials and Methods

Five sites were selected along the river starting from Al-Hindiya barrage to Al- Kifil city a bout (292 km). Site 1 is located on the main Euphrates river before ramifying into

Al-Hindiya and Al-Hilla rivers, site 2 is situating in agricultural areas after Al-Hindiya barrage city, site 3 about 45 Km a way from site 2, site 4 located in the southern of Al-Hindiya city adjacent to populated area, and site 5 located in center of Al-Kifil city and affected by human and agricultural activities (Fig 1). Monthly subsurface samples (30cm) were collected from sites for period from July 2005 to June 2006. Temperature, pH, and conductivity were measured in the field using a thermometer, pH-meter (model HANNA) and E.C. meter (Model Bischof L17). Dissolved oxygen was determined by Modified Winkler method, Total Alkalinity, Total Hardness, Calcium, Magnesium, Sulphate, Chloride were measured according to APHA (7), TDS and TSS were determined according to Smith (8), Total Nitrogen according to Mackereth et al. (9) and Total phosphorous according to Eisenreich et al (10). Qualitative study of phytoplankton was done according to Al-Zubaidy (11), while phytoplankton was identified according to Germain (12), Hadi et al. (13), Prescott (14) and Desikachary (15).

## Results and Discussion

The water temperature was highly coincided with the surrounding air temperature as confirmed by positive correlation between air and water temperature ( $r = 0.9783$ ,  $p < 0.01$ ) so variation in water temperature related to many environmental factors as water flow, water depth, bottom material, temperature of inlet water and exposure to direct sun light and degree of shading (16, 17). Its values ranged between  $15^{\circ}\text{C}$  to  $35^{\circ}\text{C}$  for water temperature (Fig 2, A, B). The water flow values were

ranged from 4cm / sec in Jan 2006 at site 5 to 133.33 cm/sec in March 2006 at sites 2 and 3 (fig.2.C). The variation in the period of precipitation may be produce the variation in runoff rates and affect the rate of water flow (18). Also, the construction of barrage and discharge rate may affected the water flow behind the barrage (19). The pH values were within the narrow range (6.66 – 8.6) (Figure 2,D) and tend to be alkaline inland waters which are high with calcium bicarbonate (5, 2, 20). EC were ranged between (423.66 – 998.66  $\mu\text{S}/\text{cm}$ ) recorded in May 2006 and Nov 2005 at site 1 respectively. Similar trends were shown in salinity values (0.26 % - 0.62 %) and the water considered as oligohaline (fig 2 -E, F). Total alkalinity was ranged between (74.6 to 175.33mg  $\text{CaCO}_3 / \text{l}$ ) recorded in Jan – 2006 at site 4 and April 2006 at site 2 respectively (fig 3, c). The values were within the range of Iraq inland water (18, 19, 20). According to the values of Total Hardness (292.98– 693.30 mg /l) (Fig. 3D), the water may considered as very hard as it is common in Iraq inland water (21, 3). Due to the values of Ca and Mg ions (figure3, E, F) in addition to higher concentration of total hardness was recorded in comparison to concentration of total alkalinity; other ions may contribute to the total hardness in addition to Ca and Mg ions. This result was agreed with study of Salman (5). Also increase in the concentrations of total hardness causes increase in EC concentrations (22). This is confirmed by positive correlation between EC and total hardness ( $r = 0.394$ ,  $p < 0.01$ ). The TSS and TDS values were ranged between (11.4 – 204.5 mg/l) and (170.6 – 5885 mg/l) respectively. The fluctuation of

the levels of TSS and TDS (fig 4-A, B) may be related to evaporation during autumn and Summer and shallow depth, while precipitation rate and dilution factor in winter and end of autumn cause the decrease in levels of TSS & TDS (23). Sulphate ion were ranged between (68.88 – 682 mg/l ) recorded at sites 1 and 5 respectively (fig,4.C). The variation of sulphate levels among the study period may due to lithology of area which common in gypsums nature (24) and anthropogenic release of sulphate into atmosphere followed by deposition into water (16). Our results were comparable to the results of other studies (5, 25). The mean value of chloride ion was 100 mg/l with higher value recorded at site 5 in April 2006 (figure 4, D) due to soil leaching and additional inputs from agricultural land nearby (25). The fluctuation in the concentration of total phosphorous (Figure 4, E) may due additional input from agricultural land nearby or due to activity of phytoplankton (3, 27) and human and industrial effluent loads. The results of statistical analysis showed significant differences among months ( $P < 0.01$ ) and not significant among the sites. The total nitrogen level were fluctuated between (0.015 – 1.32 mg /l) recorded at site 1 and site 4 during Nov-2005 (fig 4, f). Statistical analysis results showed significant differences among the study months ( $P < 0.01$ ). Positive correlation was recorded for Total nitrogen with water flow ( $r = 0.340, P < 0.01$ ) and sulphate ion ( $r = 0.457, P < 0.01$ ), while negative correlation was observed with EC ( $r = -0.344, P < 0.01$ ) and calcium ion ( $r = -0.352, P < 0.01$ ). This result was may be due to

change in water temperature and degradation processes, also depend on the amount of nitrogen uptake by phytoplankton and autochemotrophic bacteria (27). The ratios of TN: TP recorded in some study periods referred to phosphorous as limiting factor (figure 5) this result agree with other Iraqi studies (27, and 28, Hassan et al 2001).

A total of 145 taxa were identified during the study period (Table-2). They belong to classes, Bacillariophyceae (94 taxa), Chlorophyceae (25 taxa), Cyanophyceae (20 taxa), Euglenophyceae (2 taxa), Chrysophyceae (3 taxa ) and 1 taxa for Xanthophyceae. Diatom found to be the most abundant and most pronounced in the term of cell number reaching 80 – 61 % of the total number followed by Chlorophyceae (11 – 7 %), Euglenophyceae (4.9 %) and Chrysophyceae (1.45 %), Euglenophyceae (0.79 %) and Xanthophyceae (0.04 %). Higher number of taxa was recorded at sites 2 and 4 (109 taxa) followed by sites 3, 5 (91 taxa ) and site 1 (88 taxa ). Diatoms recorded in this study as the most abundant phytoplankton. Similar finding was reported in different Iraqi inland waters (27 , 21, 3 , 29). The dominance of diatoms may be related to their tolerance range to different environmental condition and the availability of silica. Also the physico-chemical properties as pH, EC, dissolved ions, oxygen, and turbidity may affect directly the growth and distribution of Diatoms (17). There is a seasonal fluctuation in the number of Chlorophyceae and Cyanophyceae recorded during the study period due to the change in the environmental condition and seem to occur during the warm months with some

exception. *Cyclotella ocellata* was the most common taxa in the all Euphrates river sites. This may be related to high silicate concentrations present in high concentrations in most Iraqi inland water (3). *Synedra* sp highly abundant in site 4 which is located nearby Al-Hindiya city center and some species belong to this genus indicated the pollution (3). Site 4 also was distinguished by the high numbers of *Nitzschia* sp. , *Navicula* sp. , *Cymbella* sp. Results referred to the presence of some genera at all sites including *Chlamydomonas* sp., *Chlorella* sp, *Oscillatoria* sp., *Scenedesmus* sp, *Euglena* sp. and *Phacus* sp. Some species of these genera seem to bloom in polluted water (16). The higher number of total phytoplankton population ( $3492 \times 10^3$  cell / l ) was recorded at site 4 during Nov 2005 , while the lower number ( $207 \times 10^3$  cell / l ) was observed at site 5 during June 2005. The high number of cell were recorded at site 4 which located nearby Al-Hindiya city centre and may be affected by sewage and domestic effluent in addition to the drainage from agricultural area. Also this site is characterized by the density of aquatic plants which providing suitable habitat for algae growth and release them during flood plain period .This situation was agreed with other studies (9, 3). Similar finding was reported in different Iraqi inland water (3, 25, 3, 22, 27) and in other parts of the world (28, 29). The higher phytoplankton numbers recorded during autumn and spring may be related to optimum temperature and light, low turbidity (30). Also removing of phytoplankton attached to the surface due to high water flow causes an increase in the number of phytoplankton (31).In the present

study, fluctuation in the concentration of different factors were possibly related to change in water discharge rate that is controlled by Al-Hindiya barrage, sewage and domestic effluent loads and rate of precipitation. The water quality of Euphrates River under the study was considered to be: Slightly alkaline, very hard, well oxygenated. There was a fluctuation in the concentration of total phosphorous and total nitrogen and the ratio of TN/TP referred to phosphorous as limiting factor for phytoplankton growth. The high number of cells and taxa was recorded at site 2 near agriculture area and site 4 which located near Al-Hindiya city center and may affected by domestic sewage effluent.

at all sites were, in cyanophyceae, *Oscillatoriasp*, in chlorophyceae, *Chlamydomonas* sp. and *Chlorella* sp., in Bacillariophyceae *Cyclotellaocellata* and *Cocconies placentula* and in Euglenophceae, *Euglena* and *Facus* sp. and some species of these genera indicated the pollution (2).The higher number of total phytoplankton population ( $3492 \times 10^3$  cell / L ) was recorded at site 4 during Nav-2005 , while the lower number ( $207 \times 10^3$  cell / L ) was observed at site 5 during June 2005 respectively.The high number of cell were recorded at site 4 which located near by Al-Hindiya city centre and may be affected by sewage and domestic effluent in addition to receive from agricultural area near by .Also the speciality of Environment condition at this site that is characterized by the density of a qualic plants which providing suitable habitat for algae growth and release them during flood plain period .This situation was agreed with other studies (9,3,21 ). Similer finding was reported

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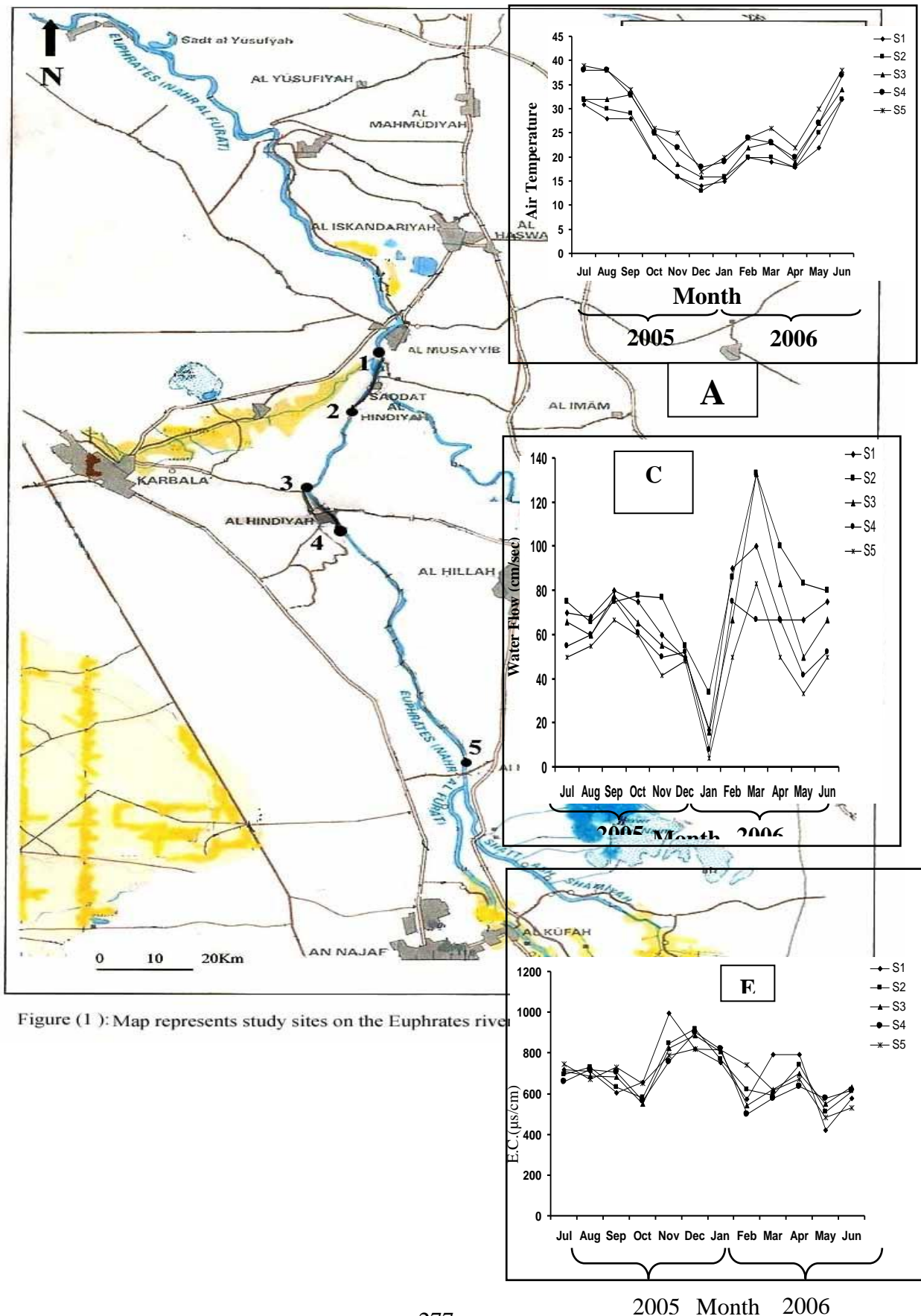


Figure (1) : Map represents study sites on the Euphrates river

Figure(2): Air and water temp, water flow, water pH, Euphrates river sites during the study period

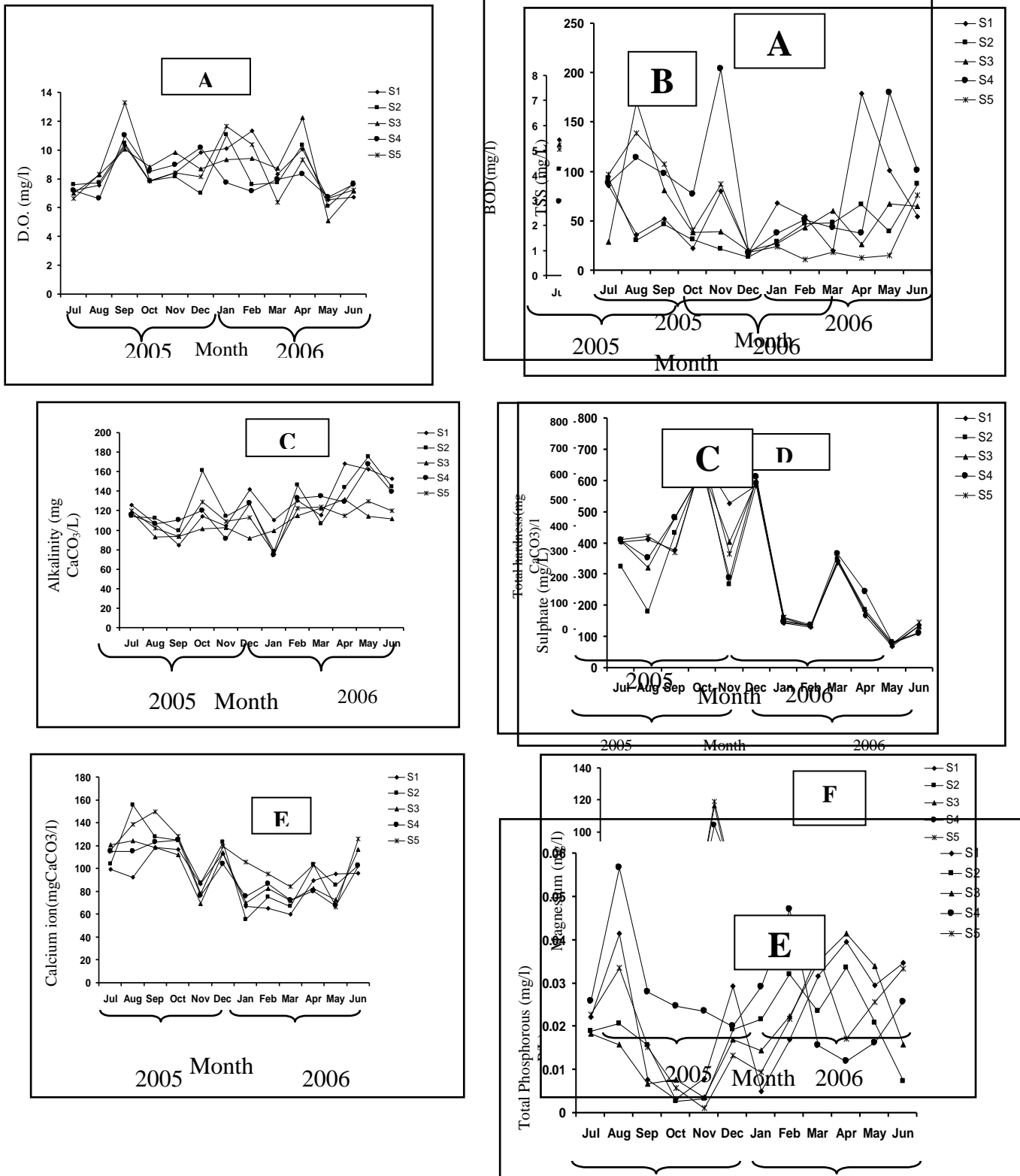
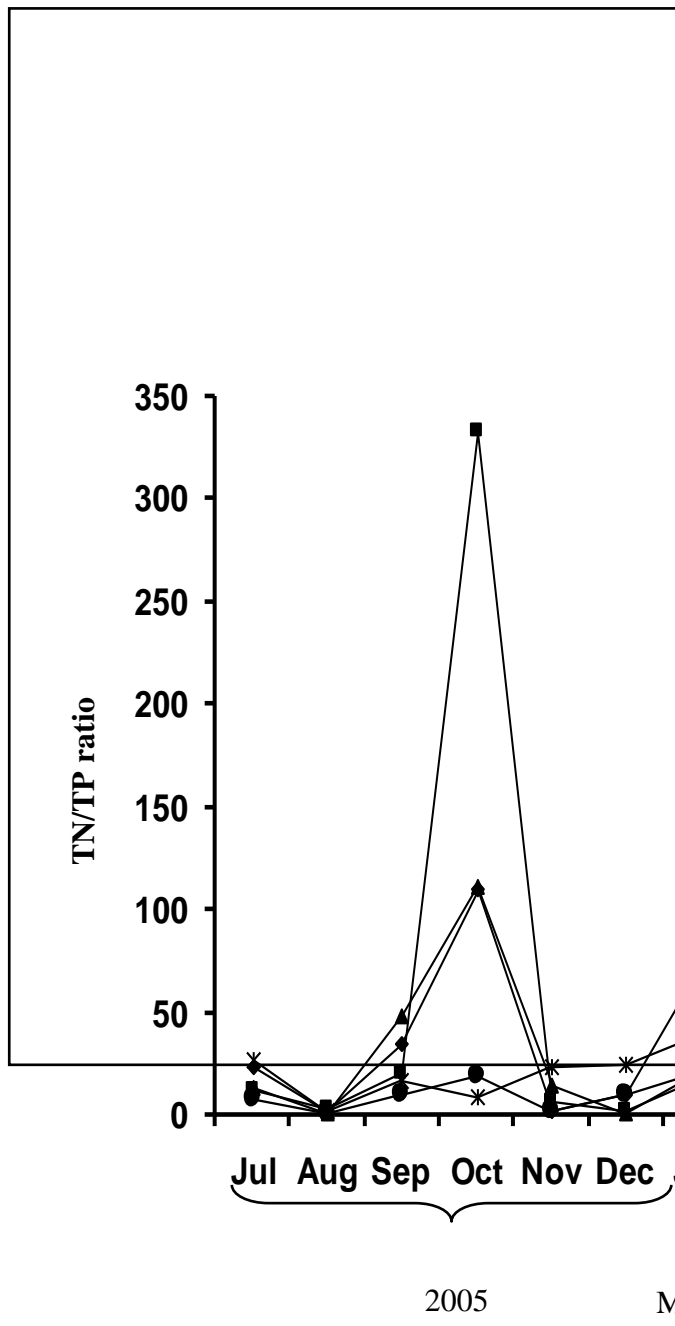


Figure (3): Do,BOD,Alkalinity,Total Hardness ,Calcium and Magnesium ions salinity recorded at Euphrates river sites during the study period

Figure (4):TSS ,TDS ,Sulphate ,Chloride  
Total phosphorous and Total Nitrogen  
recorded at Euphrates river sites during  
the study period

Table (1):The range and Mean ± S.D. of  
some phsico-chemical properties of water  
samples of Euphrates river sites during the  
study period(Jul.2005 –Jun.2006).



Properties	Site(1)	Site(2)	Site(3)
Air temperature	14-32 21.92±6.29	13-32 22.58±6.73	11-31 24.7±6.5
Water temperature	15-29 21.08±5.04	15-28 19.13±7.42	14-27 22.6±6.8
Water flow	17-100 68.2±20.77	34-133.3 78.5±23.78	16-100 65.9±20.5
Water pH	7.14-8.1 7.69±0.27	7.54-8.3 7.85±0.26	7.5-8.3 7.7±0.2
Electrical conductivity	423.66-998.66 685.85±148.6	513.33-919.33 689.26±118.3	543.33-1000 683.3±150
Salinity	0.26-0.62 0.42±0.09	0.31-0.61 0.44±0.09	0.3-0.6 0.4±0.08
Dissolved Oxygen	6.56-11.36 8.7±1.59	6.13-11.01 8.3±1.52	5.1-11.0 8.7±1.5
BOD5	4.3±1.32	1.76-7.13 4.09±1.36	1.4-7.1 4.5±1.3
Total alkalinity	84.66-168.66 126.69±25.53	78.66-175.33 127.21±27.7	92.66-175.33 108.6±27.7
		568±80.1	296±60.1
	455.7±55.55	1	468.3±55.5

Figure (5): Total Nitrogen/Total Phosphorous ratio recorded at Euphrates river sites during the study period

Site( 1)							67	3	55.3-155.96	6
Date	Cy	Ch l	B	X	Ch r	E	Calcium ion	60.39-118.63 91.7819.6	97.85± 23.75	12 90 2
Jul	31	16 5	16 94	9	-	-	Magnesium ion	29.21-72.73 54.95± 13.27	35.57-78.02 52.84±13.03	2 1 55.0
Aug.	17 9	25 3	13 24	18	4	4	Total suspended solid	18.26-179.6 64.65±44.9	13.7-93 46.34±24.82	20 55.7
Sept	45	20 2	14 32	-	-	18	Total dissolved solid	709.3-2565 1155.8±494	272.8-5885 1286±1471. 3	469. 1430 945. 95
Oct.	28 1	19 7	25 95	18	4	13	Sulphate ion	54.65-139.95 93.1±25.29	62.65- 121.96 87.35±16.44	60.9 119. 82.8
Nov.	49	31 3	13 66	89	-	22	Chloride ion	54.65-139.95 93.1±25.29	62.65- 121.96 87.35±16.44	60.9 119. 82.8
Dec.	17	22 3	77 1	-	9	22	Total phosphorous (TP)	0.003-0.04 0.022±0.014	0.003-0.034 0.018±0.01	0.00 0.02
Jan.	95	14 8	87 7	-	9	4	Total nitrogen (TN)	0.02-0.84 0.41±0.24	0.023-0.90 0.43±0.31	0.03 0.48
Feb.	-	42 8	77 3	-	-	22	TN/TP	1.9-110.6 30.73±32.17	2.34-332.6 46.36±91.35	1.48 29.2
Mar	54	66	13 66	-	-	-				
Apr.	22	12 5	13 61	-	-	13				
May	82	27 6	20 95	14 7	-	-				
Jun.	18 2	19 2	11 72	94	13	4				

Table(2): Monthly changes in the number of phytoplankt and total number detected at river sites during the study

Note: Cy=Cyanophyceae, Ch=Chlorophytcea, B=B  
Chr=Chrysophyceae, E=Eugleno

Site( 5)						
Date	Cy	Ch l	B	X	Ch r	E
Jul	49	93	60	45	4	4
Aug.	34	13	96	18	-	-
Sept.	22	23	12	25	4	-
Oct.	15	14	15	67	-	31
Nov	17	43	23	-	18	36
Dec.	14	14	63	89	4	27
Jan.	4	11	63	-	-	22
Feb.	13	66	48	9	-	-
Mar	11	15	46	58	4	18
Apr	35	14	11	-	8	22
May	9	18	10	67	4	8
Jun.	31	19	96	80	13	9

Site( 2)						
Date	Cy	Ch l	B	X	Ch r	E
Jul	40	61	10	8	-	-
Aug.	53	84	76	10	31	9
Sept.	-	14	87	25	9	4
Total						
Date	S. 1	S.2	S.3	S.4	S.5	
Jul	13	18	16	79	18	81
Aug.	22	17	13	18	17	13
Sept.	13	16	16	19	24	16
Oct.	22	31	22	18	23	18
Nov	23	18	30	28	34	17
Dec.	17	19	16	98	94	79
Jan.	58	11	34	77	62	76
Feb.	47	22	46	75	92	74
Mar	4	14	18	84	21	14
Apr	15	15	18	15	16	13
May	9	20	10	12	12	12
Jun	24	18	94	22	14	20

Taxa	S.1	S.2	S.3	S.4	S.5
<b>Cyanophyceae</b>					
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<i>Oscillatoria</i> sp. (Vaucher)	+	+	+	+	+
<i>Microcystis aeruginosa</i> (Kütz)	+	+	+	+	+
<i>Haematococcus</i> sp (Agardh)	-	+	+	+	+
<i>Spirulina</i> sp. (Turpin)	-	+	-	+	-
<i>Nostoc</i> sp. (Vaucher)	+	+	+	+	+
<i>Merismopedia elegans</i> (Smith)	+	+	+	+	+
<i>Merismopedi tenuissima</i> (Lermm.)	+	+	+	+	+
<i>Gomphospheria aponina</i> (Küetzing)	-	+	+	+	+
<i>Aphanotheca</i> sp. (Naegeli)	+	+	+	+	-
<i>Chroococcus minutus</i> (Kütz)	+	-	-	+	-
<i>Chroococcus minor</i> (Kütz)	-	-	-	+	-
<i>Chroococcus limneticus</i> (Lermin)	+	-	-	-	+
<i>Aphanocapsa elachista</i> (West & West)	+	+	-	+	+
<i>Aphanocapsa endophytica</i> (Smith)	+	+	+	-	+
<i>Gloeocapsa punctata</i> (Naegeli)	-	-	-	+	+
<i>Gloeocapsa aeruginosa</i> (Garm)Kutz	+	+	+	-	-
<i>Gloeocapsa raphidoides</i>	-	-	+	-	-
<i>Dactylococcopsis smithii</i> (Lermm.)	-	-	-	+	+
<i>Dactylococcopsis acicularis</i> (Lermm)	-	+	+	-	-
<i>Lynghya nordardii</i> (Wille)	-	-	+	+	+
<b>Chlorophyceae</b>					
<i>Chlamydomonas</i> sp (Ehrenbreg)	+	+	+	+	+
<i>Chlorella</i> sp. (Beysrinck)	+	+	+	+	+
<i>Chlorococcum humicola</i> (Naeg.)	+	+	+	+	-
<i>Asterococcus limneticus</i> (Smith)	-	+	+	+	-
<i>Ulothrix</i> sp (Küetzing)	+	-	+	+	+
<i>Ankistrdesmus falcatus</i> (Corda)	+	+	+	+	+
<i>Ankistrdesmus convolutes</i> (Corda)	-	-	+	+	-
<i>Kirchneriella contorta</i> (Schmidte)	-	+	+	+	+
<i>Scendesmus quadrucauda</i> (Turp.)	-	+	+	+	+
<i>Scendesmus ecornis</i> (Turp.)	-	+	+	+	-
<i>Scendesmus</i> sp. . (Meyean)	+	+	-	+	+
<i>Scendesmus dimorphus</i> (Turp.)	+	+	-	+	-
<i>Scendesmus acuminatus</i> var. <i>minor</i> (Smith)	+	-	-	+	-
<i>Tetraedron muticum</i> (Braun)	-	+	-	+	-
<i>Tetraedron minimum</i> (Braun)	-	+	+	+	-
<i>Tetraedron enorme</i> (Ralf)	-	+	+	-	+
<i>Tetraedron trigonum</i> (Naeg)	-	-	+	-	-
<i>Pediastrum simplex</i> (Meyean)	+	+	+	+	+
<i>Pediastrum duplex</i> (Meyean)	+	-	-	-	+
<i>Eudorina elegans</i> (Ehrenbreg)	+	+	+	+	+
<i>Arthrodesmus</i> sp (Turp.)					

**Table(3 ) :List of phytoplankton and cell numbers (cell\*1000/l) in the Euphrates river at selected sites during the study period**

Followed

<i>Cyclotella glomerata</i> (Bachman)	+	+	+	-	+
<i>Stephanodiscu dubius</i>	-	-	-	+	+
<i>Stephanodiscu sp.</i> (Ehrenbreg)	+	+	+	+	+
<i>Stephanodiscu hantzschii</i> (grun)	+	+	-	-	-
<i>Stephanodiscu intermedia</i>	-	-	+	-	-
<i>Aulacoseria granulate</i> (Ehr)	+	+	-	+	+
<i>Melosira ambigua</i> (Grun.) Muller	+	+	+	+	+
<i>Diatoma elongatum</i> (Lyngbey)	+	+	+	+	+
Agardh					
<i>Diatoma vulgare</i> (Bory)	+	+	-	+	+
<i>Amphora ovalis</i> (Kütz)	+	+	-	+	+
<i>Amphora holastica</i> (Hustt)	+	-	-	-	+
<i>Amphora veneta</i> (Kutz)	-	+	-	-	-
<i>Calonies placentula</i>	-	-	-	+	-
<i>Achnanthes delicatula</i> (Kütz) Grun.	+	+	+	+	+
<i>Achnanthes minutissima</i> (kutz)	-	+	+	-	-
<i>Calonies ladogensis</i>	-	-	-	-	+
<i>Mastigloia elilptica</i> (Agardh)	-	-	-	+	-
<i>Gyrosigma acuminatus</i> ((Kütz) Rabh	+	+	+	+	-
<i>Gyrosigma peionis</i> 9Grun)	-	+	+	-	+
<i>Gomphonema fanesis</i> (Maillard)	+	+	+	+	+
<i>Gomphonema parvulum</i> (Kütz)	+	+	-	+	+
Küetzing					
<i>Gomphonema constrictum</i> Ehr	+	+	-	+	-
<i>Gomphonema gracile</i> (Ehr)	-	+	-	+	-
<i>Gomphonema intricatum</i> (Kutz)	+	+	+	-	+
<i>Gomphonema angustrartum</i> (Kutz)Rabh	-	-	-	-	+
<i>Gomphonema accuminatum</i> (Eer)	-	+	-	-	-
<i>Gomphonema exigua</i> (Her)Hustedt	-	+	+	-	-
<i>Gomphoneis olivacea</i> (Lyngbye)	+	+	+	+	+
Dowson					
<i>Suirella robusta</i> (Ehr)	-	+	-	+	-
<i>Suirella ovata</i> (Kutz)	-	+	-	-	+
<i>Fragilaria capusina</i> (Demazieres)	+	+	-	+	+
<i>Fragilaria intermedia</i> (Grun.)	+	+	+	+	+
<i>Fragilaria brevisriata</i> (Grun.)	+	+	+	+	+
<i>Fragilaria crotonesis</i> (Kitton)	+	+	-	+	+
<i>Fragilaria consruens</i> (Ehr) Grun.	-	-	-	+	-
<i>Fragilaria virescens</i>	-	+	-	-	-
<i>Cocconies placentula</i> (Ehr)	+	+	+	+	+
<i>Nedium binode</i> (Kutz)	-	+	-	-	-
<i>Cocconies pediculus</i> (Ehr)	+	+	+	+	+
<i>Navicula radiosa</i> (Kütz)	284	+	-	+	+
<i>Navicula halophila</i> (Grun.) Cleve	+	+	+	+	+
<i>Navicula sobrensis</i>			+		+

Followed

<i>Nitzschia intermedia</i> (Grun.)	-	+	+	+	+
<i>Nitzschia hantzchiana</i>	+	+	+	+	+
<i>Nitzschia apiculata</i>	-	-	+	+	+
<i>Nitzschia romana</i>	+	+	+	+	+
<i>Nitzschia rostellata</i>	-	-	-	+	+
<i>Nitzschia hungarica</i> (Grun.)	+	-	+	+	+
<i>Nitzschia pusila</i> (Smith)	-	+	+	+	-
<i>Nitzschia acicularis</i>	+	+	+	+	-
<i>Nitzschia dissipata</i>	+	+	+	+	-
<i>Nitzschia linearis</i> (Smith) Schmidt	-	-	+	+	-
<i>Nitzschia fruticosa</i>	-	+	+	-	-
<i>Rhoicosphenia marina</i> (Kütz)	-	+	-	+	-
<i>Rhoicosphenia curvata</i> (Kütz)	-	-	+	-	-
<i>Cymatoplyrea solea</i> (Breb) Smith	+	+	-	+	-
<i>Synedra acus</i> (Kütz)	+	+	+	+	+
<i>Synedra ulna</i> (Nitzsche) Ehr	+	+	+	+	+
<i>Synedra pulchella</i> (Ralfs) Kütz	+	+	-	+	+
<i>Synedra parasitica</i> (Smith) Hustedt	+	+	+	+	+
<i>Synedra rumpens</i> (Kütz)	+	+	-	+	+
<i>Synedra tabulata</i>	+	+	+	+	+
<i>Cymbella prostate</i> (Berkeley) Cleve	+	+	+	+	+
<i>Cymbella affinis</i> (Kütz)	+	+	+	+	+
<i>Cymbella gracilis</i> (Raben.) Cleve	-	+	-	+	+
<i>Cymbella leptoceros</i> (Ehr) Grun.	+	+	+	+	+
<i>Cymbella ventricosa</i> (Kütz)	+	+	+	+	+
<i>Cymbella parva</i> (Smith) Kitehn	+	-	-	+	+
<i>Cymbella helvetica</i> (Kütz)	+	-	+	+	-
<i>Cymbella abtusiuscula</i>	-	-	-	+	-
<i>Cymbella cistula</i> (Hemprien)	+	-	+	+	+
<i>Peroni fibula</i> (Brebisson) Ross	-	+	+	+	+
<i>Diploneis ovalis</i> (Hilse) Cleve	+	+	+	+	-
<b>Euglenophyceae</b>					
<i>Euglena</i> sp. (Ehrenberg)	+	+	+	+	+
<i>Phacus</i> sp. (Dujardin)	+	+	+	+	+
<b>Xanthophyceae</b>					
<i>Meringosphaerea spinosa</i>	+	+	+	+	+
<b>Chrysophyceae</b>			+	-	-
<i>Dinobryon</i> sp. (Ehrnberg)	+	+	+	-	-
<i>Mallomonas acaroides</i> (Perty)	+	+	+	+	+
<i>Mallomonas alpina</i> (Pascher & Ruttner)	286 -	+	+	+	+

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