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A QUALITATIVE STUDY OF THE PHYTOPLANKTON IN THE EUPHRATES RIVER (MIDDLE EUPHRATES), IRAQ

Dunia Bahel Gadaan Al- Ghanimy* and HussainYousif Kalaf Al-Rekabi**

*Department of Biology, College of Education, Al-Qadisiyah University, Iraq.

** Department of Community Health, Technical Institute, South technical university, Al-Nassiriah, Thi- Qar, Iraq

Dunia.Gadaan@qu.edu.iq

Abstract

The current study has applied on the Euphrates River for a full year from May 2013 until April 2014. Four sites selected along the river within three provinces; Babylon, Najaf, Al-Qadisiyah.The number of diagnosed species of Phytoplankton was 295 species, belonging to 74 genera. The Diatoms (Bacillariophyceae) won the biggest part of it as it formed 160 species- 35 genera (54.24%), followed by green algae (70 species belonging to 24 genera) and blue green algae (52 species belonging to 11 genera) then Euglenophyceae (10 species belonging to two genera). While golden brown algae and Pyrrophyceae were, less algal groups registered two species. Some types of phytoplankton existed in most of the duration of the study, including *Bacillaria paxillifera, Cocconies placentula, Cyclotella meneghiniana, Diatoma elongatum, Fragilaria virescence, Melosira ambigua, Synedra acus.*

***Keywords*:** phytoplankton , Euphrates River (Middle Euphrates) ,Iraq.

Introduction

Phytoplankton is the first part in the food chain and has used extensively by many scientists to monitor the quality and health of aquatic ecosystems as used to assess the effectiveness of water monitoring programs (Eyo *et al*., 2013). Phytoplankton is highly sensitive to environmental changes and is low in cost when combined. Their Samples can be preserve for a long time and this sample remains with the same analysis results if new samples are collected. In addition, preserved samples require little space to store them (Kane, 2004; Al-Gahwari, 2003; Schindler, 1987). Phytoplankton has also distinguished from other organisms that used in water quality indices by shortening their life cycle, their re-growth and their rapid response to human changes (Wu *et al*., 2012). Phytoplankton is the main source of energy in aquatic ecosystems. Zooplankton is the link between the primary product and fish (Tátrai *et al*., 1997). The abundance, distribution, composition, and diversity of phytoplankton are the most bioindicators of water status (Townsend *et al*., 2000). Phytoplankton reflects nutrient status in the environment and because of its limited movement, it has frequently used as evidence of the state of water systems (Barnes, 1980).

Abagair *et al*. (2011); Leelahakriengkrai & Peerapornpisal (2010) emphasis on the role of plankton as evidence of water quality because of the limit of their life cycle and their ability to respond to changes in the environment, thus their quantitative and qualitative composition is reflective to the quality of water. The abundance and types of phytoplankton vary due to many factors such as discharge rates, hydrological properties, nutritional status and abundance of light (Kolayli & Sahin, 2009; Reynolds, 2006).

Some algae species used evidence of heavy element contamination for their ability to accumulate these elements (Al-Gahwari, 2003). Diatom has promised good environmental evidence in estimating the environmental status of different water bodies, including rivers, because of their widespread abundance and being a major food source for many invertebrates and fish larvae that found in the water system (Blinn & Herbst, 2003; Stevenson & Pan, 1999).

There is some study in the world that use phytoplankton as bioindicator to estimate the environmental state of the water body. In southern Brazilian, Phytoplankton has used to detect organic and inorganic pollutants in Tibagi river. Since the distribution of these organisms depends on the quality of the water. The samples have collected from six sites in a quarterly manner. The number of phytoplankton species was 202, Zygophyceae (Desmidiales) was the highest (48.5%) followed by Bacillariophyceae (25.0%), Chlorophoccales (Chlorophyceae) (10%) and the other groups (Euglenophyta, Cyanophyta, Volvocales-Chlorophyceae, Chrysophyceae, and Tribophyceae) (16.5%). It has found that light was the most important physical factor affecting the distribution and composition of the plankton. The effect of the plants near-river on the plankton did not show (Bittencourt & Nascimento, 2001).

Vuuren & Pieterse (2005) studied the relationship between spatial changes in the composition of phytoplankton and the change of environmental factors in the Vaal River in South Africa. The most important environmental factors affecting algae abundance are Turbidity, conductivity, nutrient concentration, and nutrients (phosphates, nitrogen, and silica). Conductivity has spatially changed in concentrations as nutrients concentration decreased downstream while connectivity increased.

In China, phytoplankton has adopted as a bioindicator for determining the environmental condition of the Yongjiang River. The results showed that the state of the river was good especially at the beginning of the river (Teng *et al*., 2014).

Local studies also use the phytoplankton for the same purpose above. Maulood *et al*. (2011) applied phytoplankton to estimate the environmental status of several marshes, southern Iraq.

Al-Janabi (2011) used phytoplankton in the index of biological integrity, which has applied to the Tigris River. It identified 223 species of phytoplankton and Bacillariophyceae (64.12%). The IBI has calculated using eight units and the value of the guide ranged from poor-marginal.

This study has applied on Euphrates River to explain the algal species present in this river and to know the factors affecting them greatly.

Material and Method

The Euphrates River is one of the longest rivers in the Middle East and ranks 24th among the longest rivers in the world and stems from the mountainous region of southeastern Turkey. It was estimated to be about 2290 km long (Al-Massoudi, 2000) and has carried out within Iraqi territory for a distance of 1159 km without any tributaries. In these study four sites have selected on the Euphrates River to collect the study samples according to Figure (1).

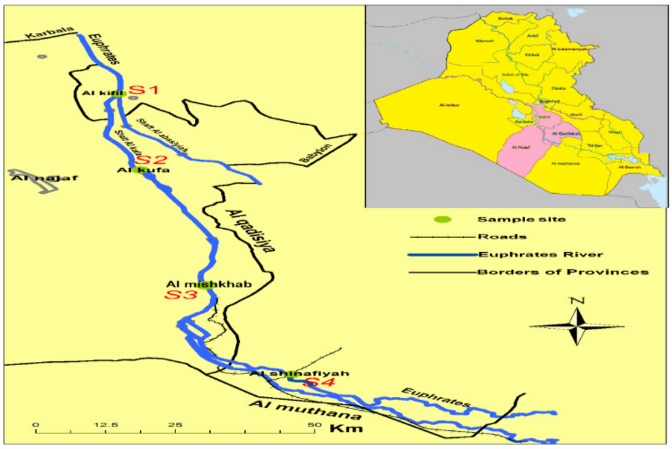

Fig. 1 : A map showing sampling sites

The phytoplankton collection by the net with pores 20 micrometers in a diameter it used by towing in a direction opposite to the current of the water stream for 10-15 minutes. The filtration process has then taken and 250 ml was taken and placed in plastic bottles in refrigerated containers after have been saved by Lugol's solution in the field as explained by (Vollenweider 1974)

Temporary slides were prepared on X40 for the diagnosis of non-diatomic algae by using an optical microscope (type CYAN, Belgian) using some diagnostic sources including:(Wehr & Sheath, 2003; Belcher & Swale, 1976; Prescott, 1973; Desikachary, 1959)

The diatomic algae have diagnosed after dissolving the organic matter and explaining the diatom structures using concentrated nitric acid. The test has performed on 100X and the diagnosis was based on the diagnostic sources (Lavoie *et al*., 2008; Germain 1981).

Results and Discussion

The number of species identified in this study was 295 species, belonging to 74 genera. The predominance of Bacillariophyceae was the highest number of species, with 160 species belonging to 35 genera (54.24%) While Chlorophyceae was the second and recorded, 70 species of 24 genera (23.73%) followed by Cyanophyceae, 52 species returning to 11 genes, (17.63%). While Euglenophyceae reached 10 species belonging to two genera (3.39%). Chrysophyceae algae Pyrrhophyceae has fewer species compared to other varieties and two species were returning to one genus (0.68%) and one species back to one genus (0.34%) respectively (Table 1).

The predominant of the diatom is a common condition in Iraqi waters such as (Hassan *et al*., 2010 a, b; Al-Saadi *et al*., 2000; Al-Lami *et al*., 1998) on the same river under study. Leelahakriengkrai & peapornpisal, (2010), Moonsyn *et al*. (2009) noted that the dominance of diatoms is due to its ability to bear harsh environmental conditions such as lack of light as well as its ability to grow in different aquatic environments due to the silica cell wall. Because of the close relationship between them (Eyo *et al*., 2013) and the effect of some physical and chemical factors on the growth and distribution of diatoms directly such as pH, electrical conductivity, oxygen and dissolved ions and turbidity (Hassan *et al*., 2010a). Some species achieved significant dominance in some months of study such as *Microcystis aeruginosa* in the first site in August and *Bacillaria paxillifera* in the third and fourth sites in December and *Gomphonema lanceoatum* in third place in December and *Nitzschia sp*. In the fourth site in January and April and *Cocconeis sp*. In the first site in February and the first and second sites in April and *Melosira sp*. in the second, third and fourth sites in April and *Cyclotella sp*. In the fourth site in April.

Table 1 : Number, types, and percentages of phytoplankton species recorded in the study sites

The total number of species recorded in the study			**4**			**3**			**2**			**1**			**Sites**
%	Sp.	G.	%	Sp.	G.	%	Sp.	G.	%	Sp.	G.	%	Sp.	G.	**Groups**
17.63	**52**	**11**	**16.31**	**23**	**9**	**21.14**	**37**	**10**	**16.86**	**29**	**11**	**13.24**	**27**	**10**	Cyanophyta
23.73	**70**	**24**	**17.02**	**24**	**13**	**22.86**	**40**	**19**	**21.51**	**37**	**17**	**23.53**	**48**	**22**	Chlorophyta
3.39	**10**	**2**	**2.84**	**4**	**2**	**1.71**	**3**	**1**	**2.91**	**5**	**1**	**1.96**	**4**	**2**	Euglenophyta
0.34	**1**	**1**	**0.71**	**1**	**1**	**-**	**-**	**-**	**0.58**	**1**	**1**	**0.49**	**1**	**1**	Pyrrophyta
0.68	**2**	**1**	**0.71**	**1**	**1**	**0.57**	**1**	**1**	**0.58**	**1**	**1**	**-**	**-**	**-**	Crysophyta
54.24	**160**	**35**	**62.41**	**88**	**27**	**53.71**	**94**	**28**	**57.56**	**99**	**25**	**60.78**	**124**	**33**	Bacillariophyta
100	**295**	**74**	**100**	**141**	**53**	**100**	**175**	**59**	**100**	**172**	**56**	**100**	**204**	**68**	Total

The presence of some diatom species such as *Cyclotella*, *Nitzschia*, *and Gomphonema* indicates the presence of organic pollution and an increase in human activity and its negative effect (Albagair *et al*., 2011) this is consistent with the study Hassan *et al*. (2010b) they reached the same results in a study of them on the river itself. Lind, (1979), confirmed that the increase of *Cyclotella meneghiniana* might be due to the presence of high concentrations of H2S gas. *Melosira* is also blooming to increase sulfate and silica (Mustapha, 2010).

Some of the phytoplankton recorded dominance in the number of species in some study sites, such as blue-green algae *Oscillatoria*, (20) species and green algae (*Pediastrum, Scenedesmus, Spirogyra*) recorded (6, 10, 8), respectively. *Euglena* recorded nine species, while diatoms showed seven species, including, *Melosira* (Centrales), which recorded seven species and species (*Cymbella, Gomphonema, Navicula, Nitzschia, Surirella, Synedra*) include (17, 12, 21, 27, 6, and 6) species respectively (Table 2).

The increase in blue-green algae is due to its ability to compete with important nutrients such as phosphates and their ability to withstand temperatures (Kadhim, 2005) while Euglenophyta algae are associated with increased organic matter (Hassan *et al*., 2014).

Most of the phytoplankton species found in the present study have a benthic origin, where they migrate with the water column by water currents, causing a large number of species, such as *Cymbella*, *Navicula*, *Nitzschia*, *Fragilaria*, *Cymbella Surirella*, *Oscillatoria*, and *Cymatopleura*. (Hosmani & Mruthunjaya, 2013; Udayashankara *et al*., 2013; Karacaoglu *et al*., 2004; Al-Lami *et al*., 2000).

Table 2 : List of algae species identified in study sites

4	3	2	1	Taxa / Sites
Cyanophyta				
-	-	+	+	*Anabaena affinias* Lemmermann.
+	+	+	-	*Anabaena sp.*
+	-	+	+	*A.variabilis* Ktz.
-	+	+	+	*Aphanocapsa endophytica* G.M.Smith.
-	+	-	+	*A.rivularis* (Carm.) Rabenhorst.
-	+	+	+	*Chroococcus dispersus* (Keissl) Lemmermann.
+	+	+	+	*C.dispersus var.minor* G.M.Smith.
-	+	-	-	*C.limneticus* Lemmermann.
-	-	+	+	*C.minutus* (Kutz.) Naegeli.
-	-	+	-	*C.varius* A.Braun.
+	-	+	-	*Gloeocapsa aeruginousa* (Garm) Keutzing.
-	+	+	-	*Lyngbya major* Meneghini.
-	-	-	+	*L.hieronymusii* Lemmer.
+	-	+	-	*L. nordgardhii* Wille.
-	-	+	-	*L.taylorii* Drouet & Strickland.
-	+	-	-	*L.versicolor* (Wartmann) Gomont.
-	-	-	+	*Merismopedia convolute* de Brebison.
+	+	+	+	*M.elegans* A.Braun.
-	+	+	+	*M.glauca* (Ehr.) Naegeli.
+	+	+	+	*M.punctata* Heyen.
+	+	+	+	*M.tenussima* Lemmermann.
-	+	+	+	*Microcystis aeruginosa* Kuetzing.
-	-	+	-	*Nostoc commune* Vaucher.
+	+	+	+	*N. linckia* (Roth) Bornet & Thuret.
+	+	-	+	*Oscillatoria amoena* (Ktz.) Gomont.
-	+	+	+	*O.amphibia* Agardh.
-	+	-	-	*O.angusta* Koppe.
-	+	+	-	*O.angustissima* West and West.
-	+	+	-	*O.chalybea* Mertens.
+	+	-	+	*O.curviceps* Agardh.
+	+	+	+	*O.formosa* Bory.
+	+	-	+	*O.granulata* Gardner.
+	+	-	+	*O.lacustris* (Klebahn) Geitler.
+	+	-	+	*O.limnetica* Lemmermann.
-	+	-	-	*O.limosa* Roth Agardh.
+	+	-	-	*O.minima* Gicklhorn.
+	+	-	-	*O. nigra* Vaucher.
-	+	-	-	*O.princeps* Vaucher.
-	+	-	-	*O.rubescens* de Candolle.

-	+	-	-	*O.sancta* (Ktz.) Gomont.
-	+	+	+	*Oscillatoria sp.*
+	+	+	-	*O.subbrevis* Schmidle.
+	+	+	+	*O.tenuis* Agardh.
+	+	-	-	*O.tenuis var. tergestina* Rabenhorst.
+	-	-	+	*Phormidium ambiguum* Gomont.
-	+	-	-	*P. inundatum* Ktz.
-	-	+	-	*P. tenue (*Menegh) Gom.
-	+	-	-	*Spirulina laxa* G.M.Smith.
+	+	+	+	*S. major* Ktz.
+	-	-	-	*S.nordstedtii* Gom.
-	-	-	+	*S.platensis* (Nordst.) Geitler.
-	-	+	-	*S. subsalsa* Oersted.
Chlorophyta				
+	+	+	+	*Actinastrum hantzschii* Lagerheim.
-	-	+	+	*Ankistrodesmus falcatus* (Corda.) Ralfs.
+	-	+	+	*A.falcatus var. mirabilis* G.S.West.
-	+	+	+	*Asterococcus limneticus* G.M.Smith.
-	-	-	+	*Chlorella vulgaris* Bejerinck.
-	-	-	+	*Cladophora crispate* (Roth.) Ktz.
-	-	+	+	*C. fracta* (Dillw.) Ktz.
+	+	+	+	*C.glomerata* (L.) Ktz.
-	+	+	-	*C.insignis* (Ag.C.A) Kg**.**
-	-	+	-	*Clamydomonas epiphytica* G.M.Smith**.**
-	-	-	+	*C.polypyreoideum* Prescott.
-	+	+	+	*C.snowiae* Printz.
-	+	-	+	*Closterium acerosum* (Schrank.) Ehrenberg.
-	+	-	-	*C.acutum* Brébisson.
+	-	-	-	*C. lunula* (Muell) Nitzsch.
-	+	+	+	*Coelastrum microporum* Naeg.
-	-	-	+	*C.reticulatum* (Dang.) Senn.
+	+	+	+	*Cosmarium granatum* de Brebisson.
-	-	-	+	*Crucigenia irregularis* Wille.
-	-	-	+	*C.quadrata* Morren.
+	+	+	-	*C. rectangularis* A.Braun.
-	+	-	-	*Gonium sp.*
-	+	+	+	*Microspora stagnorum* (Ktz.) Lagh.
-	+	-	-	*Mougeotia genuflexa* (Dillwyn.) C.Agardh.
+	+	+	-	*M. scalaris* Hassal.
-	-	-	+	*Mougeotia sp.*
-	+	-	-	*M.viridis* (Ktz.) Wittrock.
-	-	-	+	*Mougeotiopsis calospora* Palla.
+	+	+	+	*Oedogonium crissum* (Hass.) Wittrock.
-	+	-	-	*O.gracilius* (Wittr.) Tiffany.
-	+	+	-	*O.intermedium* Wittrock.
-	-	-	+	*O.varians* Wittrock &Lundell.
-	-	-	+	*Oocystis borgei* Snow.
+	-	-	-	*O.solitaria* Wittrock.
-	-	-	+	*Pediastrum duplex* Meyen.
+	-	-	-	*Pediastrum duplex var.gracillimum* West & G.S.West.
-	-	+	+	*P. duplex var reticulatum* Lagerh.
+	+	+	+	*P.simplex* Meyen.
-	+	-	+	*P.simplex var. duodenarium* (Bailey) Rabenh.
-	-	+	+	*P.simplex var. radians* Lemm.
-	-	-	+	*Scenedesmus abundans* (Kirch.) Chodat.
-	-	+	-	*Scenedesmus abundans var. longicauda* G.M.Smith
+	+	-	+	*S.acuminatus* (Lag.) Chodat.
+	+	+	+	*S.bijuga* (Turp) lagher.
+	+	+	+	*S.dimorphus* (Turp) Ktz.
+	+	+	+	*S. quadricauda* (Turp.) de Brebisson.
+	+	+	+	*S. quadricauda var. longispina* (Chodat) G.M.Smith.

+	+	+	+	*S.quadricauda var.maximus* West &West.
-	+	-	+	*S.quadricauda var. parvus* G.M.Smith.
-	+	+	-	*S.quadricauda var. quadrispina* (Chodat) G.M.Smith.
-	+	-	-	*Spirogyra crassa* Ktz.
-	-	+	-	*S.collinsii* (Lewis) Printz.
+	-	+	+	*S.deadaloides* Czurda.
-	+	-	+	*S.pratensis* Transeau.
+	+	-	+	*S.porticalis* (Muell.) Petit.
+	+	+	+	*Spirogyra sp.*
-	+	+	+	*S. subsalina* Cederereutz.
+	+	+	+	*S.varians* (Hassall) Ktz.
-	+	-	+	*Staurastrum gracile var. nanum.* Wille.
-	-	+	+	*S. paradoxum* Meyen.
-	-	+	-	*Tetraedron minimum* (A.Braun) Hansg.
+	-	+	+	*T.muticum* (A. Braun.) Hansg.
+	+	-	+	*T. regulare* Ktz.
-	+	-	-	*Ulothrix cylindricum* Prescott.
-	-	-	+	*Ulothrix sp.*
-	-	+	-	*Ulothrix subtilissima* Rabenhorst.
+	+	+	+	*U.variabilis* (Ktz.) Kirchner.
-	+	+	-	*U.zonata* (Weber & Mohr.) Ktz.
-	+	-	-	*Volvox aureus* Ehren.
-	-	-	+	*Zygnema pectinatum* (Vauch.) Agardh.
Euglenophyta				
-	+	+	-	*Euglena acus* Ehrenberg.
-	-	+	-	*E.convoluta* Korshikov.
-	-	-	+	*E. deses* Ehrenberg.
-	-	+	-	*E.elastica* Prescott.
+	-	-	-	*E. grcilis* Klebs.
-	+	-	-	*E.oxyuris var. minor* De Flandra.
+	-	-	+	*E.polymorpha* Dangeread.
+	+	+	+	*E.proxima* Dangeread.
-	-	+	-	*Euglena sp.*
+	-	-	+	*Phacus acuminatus* Stoken.
Pyrophyta				
+	-	+	+	*Ceratium hirundinella* (Muell.) Du Jardin.
Chrysophyta				
+	-	+	-	*Dinobryon sertularia* Ehrenberg.
-	+	-	-	*D. sociale* Ehrenberg.
Bacillariophyceae				
Centrales				
+	+	+	+	*Aulacoseria ambigua* O.Muller.
+	+	-	+	*A.distans* (Ehr.) Kuetzing.
+	+	+	+	*A. granulata* Her. Ralfs.
+	+	+	+	*A.granulata var. angustissima* Mueller.
+	+	+	+	*A. italic* (Ehr.) Kutz.
-	+	+	+	*Coscinodiscus lacustris* Grunow.
+	+	+	+	*Cyclotella comta* (Ehr.) Kuetzing.
-	+	+	+	*C. glomerata* Bachmann.
+	+	+	+	*C. meneghiniana* Kuetzing.
+	+	+	+	*C.ocellata* Pantocsek.
+	-	+	+	*C.stelligera* (Cl.Et Grun.)Van Heurck.
-	+	-	+	*Melosira jurgensis* Agardhi.
-	+	+	+	*M.varains* Agardh.
+	-	-	+	*Rhizosolenia longiseta* Zacharias.
+	+	-	+	*Stephanodiscus astaea* (Ehr.) Grun.
-	-	-	+	*Cyclostephanos novaezeelandiae* (Cleve) Round Zacharias.
-	-	-	+	*S.hantzschii* Grunow.
-	+	+	+	*Thalassiosira weissflogii* (Grunow) G.Fryxell & Hasle.
Pennales				
+	+	+	+	*Achnanthes affine* (Grunow) Zarnecki.

-	+	-	+	*A.conspica* A.Mayer.
-	+	-	-	*A.delicatula* (Ktz.) Grunow.
+	+	+	+	*Amphipleura pellucida* (Ktz.) Kuetzing.
+	+	-	-	*Amphiprora alata* (Ehr.) Kuetzing.
-	-	+	-	*Amphora ovalis* (ktz.) Kuetzing.
-	-	-	+	*A. pediculus* kuetz.
+	+	+	+	*A. veneta* Kuetzing.
-	+	-	+	*Asterionella Formosa* Hass.
-	-	-	+	*A. japononica* Cl.And Mueller.
+	+	+	+	*Bacillaria paxillifer* (Muell.) Hendey.
+	+	+	+	*Caloneis amphisbaena* (Bory) Cleve.
+	-	-	-	*C. bacillum* (Grun.) Cleve.
+	+	+	-	*C.permagna* (Bail.) Cleve.
-	-	+	-	*C.ventricosa* (Ehr.) Meister.
+	+	+	+	*Cocconeis disculus* (Schumann) Cleve.
-	+	+	+	*C. pediculus* Ehrenberg.
+	+	+	+	*C.placentula* Ehrenberg.
-	+	+	+	*C.placentula var.euglypta* (Ehr) Cleve.
+	+	+	+	*C.placentula var. lineata* (Ehr.) Cleve.
+	-	-	+	*Cymatopleura elliptica* (Breb.) W.Smith.
+	+	+	+	*C.solea (*Berb.) W.Smith.
+	+	+	+	*Cymbella affinis* Kuetzing.
-	-	+	+	*C.amphicephala* Naegeli.
-	-	+	-	*C.caespitosa* Kuetzing.
+	-	+	+	*C.cesati* Grun.
+	+	+	+	*C.cistulal* (Ehr.)Kirchn.
+	-	-	-	*C. cymbiformis* (Ktz.) Van Heurck.
-	-	+	+	*C.gracilis* (Rabenhorst) Cleve.
+	-	-	+	*C.helvetica* Kuetzing.
+	+	+	+	*C.lanceolata* (Ehr.)
+	+	+	+	*C.leptoceros* (Ehr.) Grunow.
-	+	+	+	*C.microcephale* Grunow.
-	+	+	+	*C.obtusiucula* Kutz.
+	+	+	+	*C.parva* (W.Smith) Kitchn.
-	-	-	+	*C.prostrate* (Hrek.) Cleve.
+	+	+	+	*C.tumida* (Breb.) van. Heurck.
-	+	+	+	*C.turgida* (Greg.) Cleve.
+	+	+	+	*C.ventricosa* Kuetzing.
+	+	+	+	*Diatoma elongatum* (Lyngb) Agardh .
-	+	-	+	*D.hiemale var. mesodon* (Her.) Grum.
+	+	+	+	*D. vulgare* Bory.
-	-	+	+	*D.vulgare var. producta* Grunow.
+	+	+	+	*Diploneis ovalis* (Hilse) Cleve.
-	+	-	+	*Eunotia pectinalis var. undulata* (Ralfs) Rabenhorst.
+	+	+	+	*Fragillaria capucina* Desmazieres.
-	-	+	+	*F.construnes var. subsinalia* Hustedt.
+	+	+	+	*F. crotonensis* Kitton.
-	-	+	-	*F.intermedia* Grunow.
+	+	+	+	*F.virescens* Ralfs.
-	-	-	+	*Gomphoneis olivaceum* (Horne) P.Dawson ex Ross et sims.
-	-	+	-	*Gomphonema abbreviatum* C.Agardh.
+	-	+	+	*G. angustatum* (Ktz) Rabenhorst.
+	+	+	+	*G.angustatum var.productum* Grunow.
+	-	+	+	*G.constrictum* Ehrenberg.
-	-	+	+	*G.constrictum var. capitata* (Ehr.) Grunow.
-	-	-	+	*G. fanesis* Maillard.
+	-	-	-	*G. gracile* Ehrenberg.
-	+	+	+	*G. intricatum* Kuetzing.
-	-	+	+	*G. intricatum var. lunata* nov.
+	+	+	+	*G.lanceolatum* Ehr.
-	+	-	+	*G.longiceps* Her.

+	+	-	+	*G.tergestinum* (Grun.)
+	+	+	+	*Gyrosigma acuminatum* (Ktz) Rabenhorst.
+	+	+	-	*G. attenuatum* (Ktz.) Rabenhorst.
+	-	-	-	*G. balticum* (Ehr.) Cleve.
+	+	-	+	*G.macrum* (W.Smith) Griff et.Henfr.
+	+	+	+	*G.spenceri var. nodifera* Grunow.
+	-	-	-	*G.strigilis* (W.Smith). Griff et. Henfr.
+	-	-	-	*Mastogloia smithii* Thw. Ex W.Sm.
+	-	+	+	*Navicula anglica* Ralfs.
-	-	+	+	*N.cincta* (Ehr).
-	-	-	+	*N. cincta var. houfleri* Grunow.
-	+	-	-	*N. crucicula* (W.Smith) Donkan.
+	+	+	+	*N.cryptocephala* Kuetzing.
+	-	-	-	*N. cymbula* Donk.
+	+	-	+	*N. dicephala* Ehrenberg.
-	+	+	-	*N. fraglaroides* Krasska.
-	+	-	+	*N.gastrum* (Ehr.) Kuetzing.
+	-	-	-	*N.gracilis* (Ehr.).
+	-	+	+	*N.grimmei* Krasske.
+	+	+	+	*N.halophila (*Grun.) Cleve.
-	+	+	-	*N.lanceolata* (Ag.) Kuetzing.
-	-	+	-	*N.pupula* Kuetzing.
-	-	+	-	*N.pygmaea* Kuetzing**.**
+	+	+	+	*N.radiosa var. tenella* (Breb.) Grunow.
+	+	-	+	*N.rhycocephala* Kuetzing.
-	+	-	+	*N. spicula* (Hickie) Cleve.
-	+	-	+	*N. travials* Betalot.
+	-	-	-	*N. tuscula* Ehr***.***
+	+	+	+	*N.viridula var. rostellata* Kutz.
-	+	+	+	*Neidium affine* (Ehr.) Pfitz.
+	-	-	-	*N.iridis (*Ehr.) Cleve.
-	+	+	+	*Nitzschia acicularis* (Ktz.) W. smith.
-	-	-	+	*N.apiculata* (Greg.) Grunow.
+	-	+	-	*N.clausii* Hantzsch.
-	+	-	-	*N.closterium* (Ehr.) W.Smith.
-	+	+	+	*N.dissipata* (Ktz) Grunow.
-	-	-	+	*N.dubia* W.Smith.
-	-	-	+	*N. fasciculate* (Grun.) Grunow.
-	-	-	+	*N.fonticola* Grunow.
-	-	-	+	*N.frustulum* (Ktz.) Grunow.
+	-	-	-	*N.gracilis* Hantzsch.
-	-	-	+	*N.hantzschiana* Rabenhorst.
-	+	+	+	*N.hungarica* Grunow.
+	+	+	+	*N.ignorata* Krasske.
+	-	-	-	*N.intermedia Hantzsch* ex Cleve et Grun.
-	+	-	+	*N.linearis* W.Smith.
+	+	+	+	*N.longissima* (Breb.) Ralfs.
-	-	-	+	*N. microcephala* Grunow.
+	+	+	+	*N.navicularis* (Breb. ex Ktz.) Grun.
+	+	+	+	*N. obtusa* W.Smith.
-	+	+	+	*N.palea* (Ktz.)W.Smith.
+	-	-	-	*N. pusilla* (Ktz.) Gruno.
+	+	-	+	*N.romana* Grunow.
-	-	+	-	*N.sigma* (Kutz.)W.Smith.
+	+	+	+	*N. sigmoidea* (Ehr.) W. Smith.
+	-	+	+	*N.trybionella* Hantzsch.
-	-	+	+	*N.trybionella var. levidensis* (W.Smith) Grunow.
+	+	+	+	*N. vermicularis* (Ktz.). Hantzsch.
-	-	+	+	*Peronia fabula* Ross.
+	-	-	-	*Pinnularia biceps* Gregory***.***
-	+	-	+	*P. gentilis* (Donk.) Cleve.

-	+	-	-	*P.viridis* (Nitzcsh.) Ehrenberg.
+	+	+	+	*Rhoicosphenia curvata* (Ktz.) Grunow.
-	-	-	+	*R.curvata var. marina* (W.smith) Grunow.
+	-	-	+	*Rhopalodia gibba* (Ehr.) O. Mueller.
-	-	+	-	*R. gibberula* (Ehr.) O.Mueller.
-	-	-	+	*Stauroneis anceps* Ehrenberg.
+	-	+	-	*Surirella capronii* de Brenisson ex.Ktz.
+	+	-	+	*S.ovata* Ktz.
-	-	+	-	*S.ovalis* de Brebisson.
+	+	+	+	*S.robusta* Ehrenberg.
+	+	+	+	*S.robusta var. splendida* (Ehr.) Van Heurck.
-	+	-	-	*S.tenera* Gregory.
+	+	+	+	*Synedra acus* Kuetzing.
-	-	+	+	*S.affinis* Kutz.
+	+	+	+	*S.capitata* Ehrenberg.
+	+	+	+	*S.pulchella* (Ralfs) Kuetzing.
+	+	+	+	*S.ulna* (Nitzs.) Ehrenberg.
-	-	+	+	*S.ulna var. danica* (Ktz) Van Heurck.
-	-	-	+	*Tabellaria fenestrata* (Lyng.) Kuetzing.

((+ species present, - species not found))

The results emphasis that the first site obtained the highest number of species, 204 species belonging to 68 genera, while the fourth site has recorded the lowest number of species, 141 species belonging to 53 genera. This may be due to different environmental conditions such as the presence of aquatic plants that help the growth of varied numbers of algae that attached to them and their separation cause increase in the number of phytoplankton. The density of residential, industrial plant, wind and deep of water bodies also effect on the variety of phytoplankton. (Karacaoglu *et al*., 2004).

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