Journal homepage www.jzs.univsul.edu.iq
Journal of Zankoy Sulaimani
Part-A- (Pure and Applied Sciences)

A Phytoplankton Distribution study of Dukan basin in Sulaimani district -Kurdistan Region of Iraq

Trifa Kamal Farkha[1]&Adil Othman Fatah[1]

[1]Faculty of Science and Science education-University of Sulaimani, Kurdistan Region of Iraq
E-mail: trifakamal_57@yahoo.com
adil.fatah@univsul.edu.iq

Article info

Original: 01.07.2015
Revised: 22.10.2015
Accepted:28.01.2016
Published online: 20.06.2016

Key Words:
Surface water, Dukan basin, Physico-chemical parameters, Phytoplankton

Abstract

The Phytoplankton species composition have been studied at eight stations from four selected streams: Tabin, Charmaga, Chamirezan and Surqawshan in Dukan basin within Sulaimani district during August 2010 to July 2011. Some physical and chemical properties of the streams water were determined. Air and water temperature values were varied between (3 to 43 ^{o}C) and (5 to 29 ^{o}C) ,respectively. Upon investigation, the pH range of the sites was 7-9.4 indicating alkalinity of the water bodies. Calcium concentrations always dominated over the other ions. Calcium values were varied between (10 to 74 mg/l). Sodium and potassium concentration ranged between (0.66 to 16.5 mg/l) and (0.3 to 3.4 mg/l) respectively. Chloride concentrations never fall below 10 mg/l and never exceed 58 mg/l. throughout the studied period. A total of 136 phytoplankton taxa were identified which belong to six divisions , the majorities were belonged to Bacillariophyta (92 taxa), making up 67.65 % of the total, followed by Chlorophyta (19 taxa), making up 14.7 %, Cyanophyta (19 taxa) which make up 14 %,(2 taxa) for each of Pyrophyta and , Euglenophyta and (1 taxon) of chrysophyta make up 3.75% . The most diverse genera that were investigated in this study were: *Navicula* (13 taxa) ,*Nitizschia* (15 taxa),*Fragilaria*(9 taxa) , *Cymbella* and Gomphonema (8 taxa).

Introduction

Water forms the most important factor in all living activities and biological reactions. The environment of organisms living in fresh water is affected by abiotic (physical and chemical factors of water) and activities of organisms (biotic factors). Monitoring of an aquatic ecosystem is influential for both long-term and short-term examination of water ***[1].*** Water quality fluctuation depends on a number of factors including location and climatic circumstances ***[2].*** The existence of nutrients and micronutrients in water can be integrated with the biogeochemical cycle, as well as agricultural and industrial activities ***[3].***

Algae are considered to be the main producers and they form the first level in the food chain, there for qualitative and quantitative determination of the algal flora are quite essential. The qualitative and quantitative pattern of algal distribution varies significantly between the localities ***[4].*** Algae are an important component of aquatic ecosystems like springs, streams, rivers, ponds, lakes, because they reflect the health of their environment through their distribution, abundance, and productivity there are many streams and rivers in Kurdistan region of Iraq, which are flowing from the high mountains and foothills, providing a perennial source of water for numerous towns and villages ***[5].*** Algae have a vital role in indicating water pollution and cleaning

wastewater ***[6, 7, 8*** and ***9].***Water pollution decrease diatom assemblages, species richness and diversity ***[9].*** Many studies have shown that the community and distributions of some algae are correlated with the concentration of cations and anions, ***[10].*** Consequently, the goal of the present study is to determine some physical and chemical properties, and algal composition of the selected streams of Dukan basin water.

Materials and methods

This study was conducted in four selected streams of Dukan basin , eight stations were established : Tabin upstream (Kanyshok village) ,Tabin dowenstream (Saburawa kon village), Charmaga upstream (Hassan tapa village),Charmaga dowenstream (Koka village) , Chamirezan upstream, Chamirezan downstream Surqawshan upstream and Surqawshan downstream on Dukan basin which are located at the North of Sulaimani city and to the west of Dukan town within Sulaimani district/ Kurdistan region of Iraq,(Figure: 1). The actual point of these stations of water samples were determined by Global Position System (GPS) model (GARMIN e-Map) as shown in (Table :1). The climate of the area is characterized by a wide diurnal and annual range of temperature which is closely related to Irano-Turanian type ***[11].*** Water samples were collected monthly during August 2010 to July 2011. In each sampling station some parameters were recorded such as: air and water temperature and pH were measured in the field using portable multimeter instrument (90FLT-T, Field Lab Analyzers). Cations and anions including Ca2+was determined by EDTA Titrimetric method , Na+ and K+ were determined using Flame Photometeric method (Gallenhamp Manufacture- Digital Flame Analyzer) instrument and Cl- were estimated by Argentometric method according to methods described at [12]. For phytoplankton identification, water samples were collected using plankton net of 20 mm pore diameter. The samples were fixed with formalin (40%). Quantitative study was made by sedimentation method using Lugol's solution as described by [13]. The classifications of algae were made up species level in most of the cases depending on the following references ***[14, 15, 16, 17, 18*** and ***19]***. Statistical analysis was carried out by using SPSS software (Ver. 17), and the means were compared by using Duncan test multiple ranges at level 0.05 ***[20].***

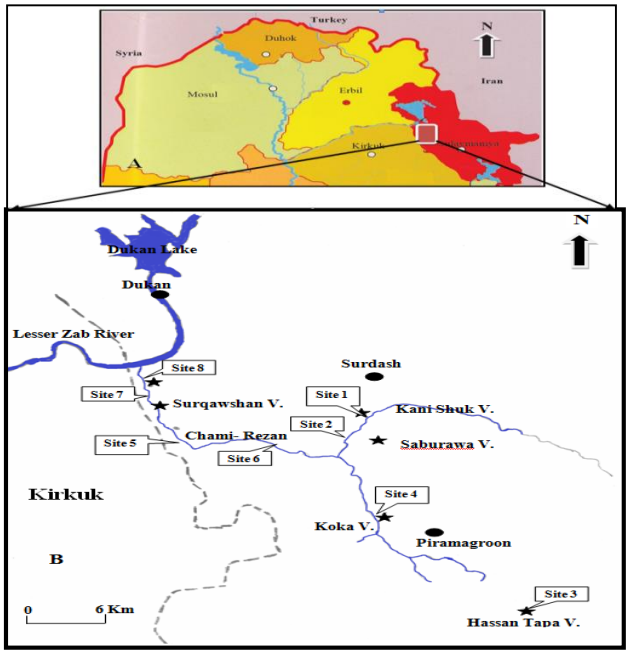

Figure -1: Location of the studied areas within Sulaimani province, Iraqi Kurdistan region[9]

Table -1: Number, name, altitude and intersectional point of the studied sites:

Site No.	***Site name***	***Altitude (m.a.s.l)***	***Latitude and longitude***
1.	Tabin Upstream	*767*	*35° 50' 00.9" N 045º 06' 21.5 "E*
2.	Tabin Downstream	*700*	*35° 48 ' 06.9 N 045º 05 ' 06.4 'E'*
3.	Charmaga Upstream	*827*	*35° 40 ' 04.9" N 045º 11 ' 31.4 E"*
4.	Charmaga Downstream	*729*	*35° 44 ' 33.4" N 045 º 06 ' 21.5 'E'*
5.	Chamirezan Up stream	*646*	*35° 48 ' 32.2" N 045 º 01 ' 18 . E"*
6.	Chamirezan Down stream	*575*	*35° 48 ' 12.4" N 044º 58 ' 38.8 E"*
7.	Surqawshan Upstream	*464*	*35° 51 ' 06.0" N 044º 56 ' 57.4 E"*
8.	Surqawshan Downstream	*453*	*35°52 ' 12.2" N 044º 56 ' 18.0 'E'*

Result and Discussion

According to the values of physico-chemical parameters obtained during the studied period which are presented in (Table :2), air temperature values ranged from (3 to 43 ºC), the minimum temperature was recorded during January 2011 in station .1 which was significantly different from all the other studied stations ,while the maximum air temperature value was recorded during August,2010.Water temperature values ranged between (5 to 29 ºC).Temperature of water in Iraq is always affected by air temperature, depending on the climate of the area which is characterized by Irano-Turanian type ***[21]*** maximum value of temperature was recorded in summer months and minimum value in winter months, this variation depends on predominant climate of each area. This is related to many environmental factors like wind, direction of sun light, current velocity of water, elevation and annual ranges of atmosphere temperatures ***[22].***

Table -2: Maximum and Minimum value, Mean +SE of physical and chemical parameters in the studied sites during August 2010-Jauly 2011

parameters	Tabeen		Charmaga		Chamirezan		Surqawshan	
	St. 1	St. 2	St. 3	St. 4	St. 5	St. 6	St. 7	St. 8
Air temperature (ºC)	(3-33) 19.04±1.16 d	(7-34) 21.88±1.51 c	(14-37) 24.22±1.27 b	(3-34) 22.01±1.64 c	(10-37) 24.63±1.55 b	(13-38) 24.42±1.5 b	(12-40) 26.21±1.74 a	(13-43) 26.82±1.71 a
Water temperature (ºC)	(5-18) 15.9±0.54 f	(11.26) 17.92±0.86 cd	(15-23) 18.21±0.35 bc	(9-26) 17.14±0.91 de	(8-25) 24.63±1.55 b	(8-26) 17.09±0.98 de	(8.5-29) 18.9±1.07 a	(8.5-27) 18.1±0.94 a
pH	(7.4-9.4) 8.4±0.15 a	(7.7-8.5) 7.76±0.09 d	(7-9.3) 7.84±0.12 c	(7.7-8.4) 7.71±0.94 d	(7-8.3) 7.84±0.08 c	(7.9-8.5) 7.95±0.07 b	(7-8.9) 8.20±0.07 a	(7-8.6) 7.94±0.08 b
Calcium mg/l	(14-74) 29.06±2.53 b	(11-36) 24.82±1.42 cd	(10-32.4) 25.03±1.25 c	(10-32.4) 25.03±1.25 c	(10.7-40) 21.74±1.42 ef	(12-31) 21.0±1.04 f	(14.7-31) 21.76±0.92 ef	(16-29) 22.48±0.75 e
Sodium mg/l	(0.66-3.4) 1.45±1.16 i	(3-7.5) 4.7±0.24 f	(2.4-9.2) 5.1±0.29 e	(5-16.5) 9.95±0.56 a	(4.9-11.3) 7.66±0.36 c	(0.7-10.6) 6.33±0.49 d	(1.4-9.3) 6.16±0.42 d	(3.4-12.9) 8.57±0.48 b
Potassium mg/l	(0.3-1) 0.47±0.04 g	(0.76-1.4) 1.03±0.04 de	(0.3-1.5) 0.74±0.06 f	(0.9-3.4) 1.86±0.11 a	(1.1-1.5) 1.31±0.04 c	(0.3-1.5) 1.1±0.06 d	(0.76-2.8) 1.42±0.1 b	(0.3-1.8) 1.33±0.07 c
Chloride mg/l	(10-40.7) 26.65±1.65 d	(17-32.7) 27±1.01 d	(15-37.9) 28.7±1.15 c	(26-42) 35.2±1.06 a	(23-45.7) 34.76±1.41 a	(17-55.7) 33.1±1.3 b	(24.7-57) 35.02±1.78 a	(23-58) 35.38±1.8 a

***Similar letters mean that there are no significant differences.**

***Different letters mean that there are significant differences**

pH is an important factor in determining the chemical and biological properties of water. It affects the chemical forms of many chemical substances in water. pH also influences dissolving and precipitation of many metals and the degree of ionization, volatility, and toxicity to aquatic life of certain dissolved substances

[22].Throughout the sampling periods, hydrogen ion concentration were shifted toward the alkalinity, this might have happened due to geological formation, soil and minerals properties of the studied areas which composed mainly from $CaCO_3$ as indicated by all of ***[23, 24, 25*** and ***26]***. The lowest mean value of pH was recorded in June at station 4 which was significantly different from all other studied stations except station. 2, the low level and flooding brought high allochthonous materials to the stream which causes decreasing in the pH value ***[27]*** or might happened because the reaction of acidic components and humic acids with pollutants in the river ***[28]*** and ***[29].*** In contrast the highest mean value (9.35) recorded in January, at station.1 this may be due to the high rain level and increasing of carbonate concentration ***[30, 31, 32*** and ***33]***.

Calcium ion concentrations shown in (Table :2) ranged from (10 to 74 mg/l). The minimum value of Calcium ions was 10 mg/l measured in May 2011 at station.4, while the maximum value was 74mg/l measured in March 2011 at station. 1. This wide range of calcium concentration may be due to the effect of rain and runoff limestone from surrounding areas, Calcium ion also contributes to the total hardness of water ***[34]*** and ***[35].*** Calcium ions are important factor that affect diatoms interact with different substrates ***[36].***

Sodium ion concentration on the other hand, did not fall below 0.66 mg/l and did not exceed 16.5 mg/l, (Table: *2*). The lowest mean value of the sodium ion concentration in the studied stations was 1.45 mg/l at station 1 which was different significantly from other studied stations, while the highest mean value was 9.95 mg/l at station 4. Variation in concentration of main cations is dependent on the distance from the source of the river and geology of the catchment area ***[37]*** and ***[38].*** Increasing of sodium ion concentration is sometimes resulted from pollution [33].Potassium ion concentrations ranged between (0.3 to 3.4 mg l/l). The lowest mean value was 0.47 mg/l at station 1, which was significantly different from all the other studied stations, while the highest mean value was 1.86 mg/l at station 4; variation between sodium and potassium concentration values could be related to soil formation of the studied area ***[34].***

Results of Chloride ions during the studied period were presented in (Table: 2). The lowest value of chloride ion was10 mg/l in December 2010 at station1, while highest value was 58mg/l recorded at station 8 in September 2010.No significant difference was observed between many stations such as station1, 2, 4, 5, 7 and stion.8 .Low value of chloride in December month may be related to rainfall which have diluting effect on chloride ions concentration ***[37]*** and ***[38].***

All 136 identified taxa of algae throughout the entire studied period from various stations were listed taxonomically in (Table: 3). systematically, the algal taxa were found to belong to six divisions. Bacillariophyta (92 taxa), making up 67.65 %, Chlorophyta (19 taxa), which make up 14.7 %, Cyanophyta (19 taxa), which made up 14 %, while other algae Pyrophyta (2 taxa),Euglenophyta (2 taxa) and chrysophyta(1taxa) were make up 3.75%.

Cyanophyta, especially *Oscillatoria sp* was found to be most frequent algae at each of the stations 1, 2 and 3 ***[38] and [39]*** concluded that *Oscillatoria sp*. were found in organic polluted water. Most of algal taxa disappear during rainy season may be due to high water turbidity and suspended solids ***[38, 40 and 41].***

In this survey a total of 92 diatoms were identified they belong to 24 genera; Pinnate diatoms make up almost all of the main bulk of Bacillariophyta. In most aquatic ecosystems Bacillariophyceae species community, diatoms density, diversity and their association with environmental variables used as biological indicators for the assessment of water quality ***[42].***Many local and global studies concluded that river Phytoplanktons were dominated by bacillariophyta *species* ***[7, 33, 38, 40,43,44, 45, 46, 47 and 48]***this dominancy is related to that diatoms tolerate broad range of light, temperature and other ecological factors, ***[41]*** and ***[49].***The most common and diverse genera that identified in the present study were: *Nitzschia*(15 taxa), *Navicula*(13 taxa), *Gomphonema* (8 taxa), *Fragilaria* (9), *Cymbella* (8 taxa), *Amphora* (4 taxa), *Achnanthes* (4 taxa), *Surirella* (4 taxa), these genera considered calcareous (alkaliphilous) and were rich in studied water bodies due to the geological nature of the studied area and high $CaCO_3$ content, these results were in agreement with the results

obtained by **[*38, 45 and 50*]**. *Nitzschia* and *Navicula* were the most represented genera at all of these studied stations because of their wide environmental condition tolerance range.

Overall throughout the studied periods minimum algal taxa were identified in both station 2 and 3, while maximum algal taxa were identified at station 8 this may be due to geological nature and availability of nutrients. **[*51*]** Stated that different seasons also strongly influence the distribution pattern and constituents of algal community.

Tabel -3: List of phytoplanktons identified in the studied stations (Ind 10^3/l) (A), Density Percentage (%) (B), Number of Frequency (C)

Stations / taxa	St.1			St.2			St.3			St.4			St.5			St.6			St.7			St.8		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Cyanophyta																								
Anabaena sp				1	0.375	1.613							1	0.125	0.426	1	0.125	0.469	1	0.125	0.459	3	0.500	0.592
Aphanocapsa sp.	1	0.125	0.389				1	0.250	1.639							1	0.250	0.939	2	0.500	1.835	1	0.125	0.148
Aphanotheca sp.							2	0.625	4.098				2	2.625	8.936		0.000	0.000	1	0.625	2.294	1	0.250	0.296
Calothrix sp.							1	0.125	0.820								0.000	0.000		0.000	0.000		0.000	0.000
Chamaesiphon sp.	1	0.125	0.389				1	0.125	0.820	2	0.250	0.877	1	0.125	0.426	2	0.250	0.939	1	0.125	0.459	1	0.125	0.148
Chroococcusdispersus	2	0.250	0.778								0.000	0.000				1	0.125	0.469		0.000	0.000	1	0.125	0.148
C.limneticus	2	1.375	4.280	1	0.500	2.151	1	0.125	0.820		0.000	0.000				1	0.625	2.347		0.000	0.000	1	0.750	0.888
Lyngbya sp.											0.000	0.000	1	0.125	0.426		0.000	0.000		0.000	0.000		0.000	0.000
L.limnitica	1	0.125	0.389							1	0.125	0.439				1	0.125	0.469	1	0.625	2.294	1	0.125	0.148
L.perelegans	2	0.250	0.778	2	0.250	1.075	1	0.375	2.459		0.000	0.000					0.000	0.000		0.000	0.000		0.000	0.000
Merismopediaglauca	2	0.500	1.556	1	0.125	0.538					0.000	0.000	1	0.250	0.851		0.000	0.000	1	0.125	0.459	2	0.250	0.296
M.tenuissima	1	0.125	0.389								0.000	0.000					0.000	0.000		0.000	0.000	1	0.125	0.148
Nostoc sp.	1	0.125	0.389				1	0.125	0.820		0.000	0.000				1	0.500	1.878	1	0.250	0.917	1	0.125	0.148
Oscillatoriaagardhii	1	0.250	0.778	1	0.125	0.538					0.000	0.000					0.000	0.000		0.000	0.000		0.000	0.000
O.chalaybeum											0.000	0.000					0.000	0.000		0.000	0.000		0.000	0.000
O.limnitica	2	0.250	0.778	5	1.000	4.301	5	1.250	8.197		0.000	0.000	4	1.375	4.681		0.000	0.000	2	0.250	0.917	3	0.625	0.740
O.minima	4	0.500	1.556	3	0.375	1.613	2	0.375	2.459	3	0.500	1.754	3	1.375	4.681	2	0.500	1.878	5	1.250	4.587	3	1.000	1.183
O.princeps										2	0.625	2.193		0.000	0.000	1	0.125	0.469		0.000	0.000	1	0.125	0.148
O.tenuis	1	0.125	0.389								0.000	0.000	1	0.125	0.426	1	0.125	0.469	1	0.125	0.459	1	0.125	0.148
Chlorophyta								0.000			0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000
Ankistrodesmusfalecatus				1	0.125	0.538		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000	2	0.250	0.917	2	0.250	0.296
Chlorella vulgaris	5	0.750	2.335	1	0.250	1.075	6	2.375	15.574	2	0.250	0.877	3	0.375	1.277		0.000	0.000	4	0.625	2.294	4	1.625	1.923
Coelastrumastroideum	1	0.125	0.389	1	0.375	1.613	1	0.125	0.820	5	3.500	12.281	1	0.125	0.426		0.000	0.000	1	0.125	0.459	1	0.125	0.148
C. microporum	2	0.250	0.778					0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000	2	0.250	0.296
Cladophora sp.	1	0.375	1.167				1	0.250	1.639		0.000	0.000	1	0.125	0.426		0.000	0.000	1	0.125	0.459		0.000	0.000
Cosmarium sp.								0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000	1	0.125	0.148
C.granutum	2	0.375	1.167					0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000	1	0.125	0.148
C.leave								0.000	0.000		0.000	0.000	1	0.125	0.426		0.000	0.000		0.000	0.000	1	0.125	0.148
Kirchneriella sp.							1	0.125	0.820		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000	3	0.875	1.036
K.obesa								0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000
Mougeotia sp.	2	0.250	0.778					0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000	1	0.125	0.459	2	0.250	0.296
Oocystis sp.								0.000	0.000					0.000	0.000		0.000	0.000	1	0.250	0.917		0.000	0.000
Pediastrumboryanum	3	0.375	1.167					0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000	1	0.125	0.459	2	0.250	0.296
Stigeoclonium sp.								0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000
Scendesmusacuminatus				1	0.125	0.538		0.000	0.000	1	0.250	0.877	1	0.125	0.426		0.000	0.000		0.000	0.000	2	0.375	0.444
S.arcuatus								0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000	1	0.125	0.459		0.000	0.000
S. bijuga	1	0.125	0.389	2	0.250	1.075	1	0.125	0.820		0.000	0.000	1	0.125	0.426		0.000	0.000	1	0.125	0.459		0.000	0.000
S.quadricauda	1	0.125	0.389	1	0.125	0.538	1	0.125	0.820		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000	1	0.250	0.296
Tetraedron minimum				2	0.250	1.075	1	0.125	0.820		0.000	0.000	1	0.125	0.426		0.000	0.000		0.000	0.000		0.000	0.000
Bacillarophyta								0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000
Centrales								0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000
Aulacoseiragranulata				2	0.375	1.613	1	0.125	0.820		0.000	0.000	1	0.625	2.128	4	0.625	2.347	1	0.125	0.459		0.000	0.000
A.itlica								0.000	0.000		0.125	0.439	2	0.625	2.128		0.000	0.000		0.000	0.000		0.000	0.000
A.varians	1	0.125	0.389					0.000	0.000		0.000	0.000	1	0.125	0.426		0.000	0.000		0.000	0.000		0.000	0.000
Cyclotellameneghiniana	4	0.625	1.946	1	0.125	0.538		0.000	0.000		0.000	0.000	2	0.500	1.702		0.000	0.000	1	0.750	2.752	1	0.125	0.148
C. ocellata	3	1.500	4.669	1	0.125	0.538	2	0.250	1.639	1	0.125	0.439	3	0.625	2.128	4	2.625	9.859	1	0.250	0.917	4	1.750	2.071
Pennales								0.000	0.000	2	0.500	1.754		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000
Achnanthesmicrocephala	1	0.125	0.389				1	0.125	0.820		0.000	0.000	3	0.875	2.979		0.000	0.000	2	0.250	0.917	2	0.250	0.296
A.hungrica	1	0.125	0.389	1	0.125	0.538		0.000	0.000	4	1.125	3.947		0.000	0.000		0.000	0.000		0.000	0.000	1	0.125	0.148
A.linearis								0.000	0.000	1	0.125	0.439		0.000	0.000		0.000	0.000	1	0.125	0.459		0.000	0.000
A. minutissima	7	5.375	16.732	5	3.750	16.129	4	1.250	8.197	1	0.125	0.439	5	1.250	4.255	3	1.375	5.164	4	0.875	3.211	7	8.000	9.467
Amphora sp.								0.000	0.000	5	2.250	7.895	1	0.125	0.426	1	0.125	0.469	1	0.125	0.459		0.000	0.000
A.coffeaeformis	1	0.125	0.389					0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000
A. ovalis	1	0.125	0.389					0.000	0.000	1	0.125	0.439	1	0.125	0.426	2	0.250	0.939	2	0.375	1.376		0.000	0.000
A. veneta	1	0.250	0.778				1	0.125	0.820		0.000	0.000	2	0.250	0.851	5	0.625	2.347	2	0.250	0.917	4	3.500	4.142
Amphipleurapellucida					0.000	0.000		0.000	0.000	1	0.125	0.439	1	0.125	0.426		0.000	0.000		0.000	0.000	2	0.250	0.296
Anomoeoneisexilis	2	0.250	0.778		0.000	0.000		0.000	0.000	1	0.125	0.439		0.000	0.000	3	5.250	19.718	2	0.250	0.917	6	10.750	12.722
Bacillariapaxillifel	2	0.250	0.778		0.000	0.000		0.000	0.000	1	0.125	0.439	1	0.375	1.277		0.000	0.000		0.000	0.000	2	0.375	0.444
Cocconeisplacentula	4	1.000	3.113		0.000	0.000	2	0.375	2.459		0.000	0.000	4	1.625	5.532	3	0.375	1.408	2	0.375	1.376	6	1.875	2.219
C.pediculus					0.000	0.000		0.000	0.000	5	1.625	5.702	4	0.500	1.702	1	0.250	0.939	2	0.250	0.917	3	0.625	0.740
Cylindrothecagracilis	2	0.250	0.778		0.000	0.000		0.000	0.000	2	0.250	0.877		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000
Cymbella sp.					0.000	0.000	1	0.125	0.820		0.000	0.000	1	0.125	0.426		0.000	0.000		0.000	0.000		0.000	0.000
C. affinis	6	2.250	7.004	1	0.125	0.538	2	0.500	3.279		0.000	0.000	5	1.250	4.255	4	0.500	1.878	5	0.625	2.294	7	3.625	4.290
C.cistula	2	0.250	0.778		0.000	0.000	1	0.125	0.820	6	1.125	3.947	2	0.250	0.851	3	0.375	1.408	3	0.500	1.835	7	1.125	1.331
C.cysptosa					0.000	0.000		0.000	0.000	3	0.750	2.632	1	0.125	0.426	1	0.125	0.469	1	0.125	0.459		0.000	0.000
C.microcephala	5	0.625	1.946	1	0.125	0.538	2	0.250	1.639		0.000	0.000	1	0.125	0.426	2	0.250	0.939	1	0.125	0.459	3	0.500	0.592
C.tumida					0.000	0.000		0.000	0.000	5	0.875	3.070	1	0.125	0.426		0.000	0.000		0.000	0.000		0.000	0.000
C.turgida					0.000	0.000		0.000	0.000		0.000	0.000	1	0.125	0.426		0.000	0.000	1	0.125	0.459	1	0.125	0.148

C. ventricosa	4	0.625	1.946		0.000	0.000	2	0.375	2.459	1	0.125	0.439	2	0.250	0.851	4	0.500	1.878	4	0.500	1.835	6	1.125	1.331
Cylindrothecagracilis	1	0.125	0.389		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000	2	0.500	1.878	1	0.125	0.459	3	0.875	1.036
Cymatopleurasolea					0.000	0.000		0.000	0.000	1	0.125	0.439	1	0.125	0.426		0.000	0.000		0.000	0.000		0.000	0.000
Diatomavulgare	4	0.750	2.335	1	0.125	0.538		0.000	0.000		0.000	0.000	1	0.125	0.426	3	0.500	1.878	4	1.750	6.422	4	1.625	1.923
D.elongatum	2	0.500	1.556		0.000	0.000		0.000	0.000	1	1.125	3.947		0.000	0.000	2	0.250	0.939	3	0.500	1.835	2	0.250	0.296
Diploneis sp.					0.000	0.000		0.000	0.000	1	0.125	0.439	1	0.125	0.426		0.000	0.000	1	0.500	1.835	1	0.125	0.148
D. ovalis					0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000
Denticula sp.	1	0.250	0.778	1	0.250	1.075	4	0.500	3.279		0.000	0.000	2	0.250	0.851	2	0.250	0.939	3	0.750	2.752	5	5.750	6.805
Eunotiapectinalis				1	0.125	0.538		0.000	0.000	2	0.375	1.316	1	0.125	0.426	1	0.125	0.469	1	0.125	0.459	2	0.750	0.888
Fragilariaacus	2	1.000	3.113		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000	1	0.125	0.469		0.000	0.000	1	0.125	0.148
F.brevistriata					0.000	0.000		0.000	0.000	1	0.125	0.439	1	0.125	0.426		0.000	0.000	1	0.250	0.917	1	0.125	0.148
F.crotoneinsis					0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000	1	0.125	0.148
F. capitata					0.000	0.000		0.000	0.000	2	1.000	3.509		0.000	0.000	1	0.125	0.469	1	0.375	1.376	3	1.250	1.479
F.affinis					0.000	0.000	1	0.125	0.820		0.000	0.000	1	0.125	0.426		0.000	0.000	1	0.250	0.917	1	0.125	0.148
F.fasciculata					0.000	0.000		0.000	0.000		0.000	0.000	1	0.125	0.426		0.000	0.000		0.000	0.000	2	0.250	0.296
F.nana					0.000	0.000	1	0.125	0.820	2	0.250	0.877		0.000	0.000		0.000	0.000	1	0.125	0.459	1	0.375	0.444
F. ulna	3	0.500	1.556	1	9.500	40.860	3	0.625	4.098		0.000	0.000	4	0.750	2.553	3	0.625	2.347	2	0.250	0.917	5	1.125	1.331
F.vaucheria	2	0.250	0.778		0.000	0.000		0.000	0.000	4	0.875	3.070	1	0.125	0.426	1	0.125	0.469	1	0.125	0.459	1	0.250	0.296
Gomphonemasp					0.000	0.000		0.000	0.000	2	0.250	0.877		0.000	0.000		0.000	0.000		0.000	0.000	2	0.375	0.444
G.angustatum	3	0.375	1.167	1	0.125	0.538	1	0.125	0.820		0.000	0.000	3	0.375	1.277	2	0.750	2.817		0.000	0.000	1	0.250	0.296
G.constrictum	1	0.125	0.389		0.000	0.000		0.000	0.000	3	0.625	2.193	1	0.375	1.277	1	0.125	0.469	2	0.250	0.917	2	0.750	0.888
G.gracile				1	0.125	0.538		0.000	0.000	1	0.125	0.439		0.000	0.000		0.000	0.000		0.000	0.000	2	0.250	0.296
G.lanceolatum					0.000	0.000		0.000	0.000	1	0.125	0.439	1	0.125	0.426		0.000	0.000		0.000	0.000	1	0.250	0.296
G. olivaceum	1	0.125	0.389	1	0.125	0.538		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000	1	0.125	0.459	2	0.250	0.296
G.parvulum				1	0.125	0.538	2	0.250	1.639	1	0.125	0.439	1	0.125	0.426	1	0.250	0.939		0.000	0.000	2	0.625	0.740
G.sphaerophoruns					0.000	0.000	1	0.125	0.820		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000	1	0.250	0.296
Gomphoneisolivacea					0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000	1	0.125	0.469		0.000	0.000	2	0.625	0.740
Gyrosigmaacumimatum					0.000	0.000		0.000	0.000		0.000	0.000	3	0.375	1.277	2	0.500	1.878	1	0.250	0.917	2	0.250	0.296
G.spencerii					0.000	0.000		0.000	0.000	1	0.125	0.439	1	0.125	0.426	1	0.125	0.469		0.000	0.000	1	0.125	0.148
G.peisonis					0.000	0.000		0.000	0.000	1	0.125	0.439		0.000	0.000	1	0.125	0.469	3	0.625	2.294	1	0.125	0.148
Hantzschiaamphioxys	2	0.250	0.778	1	0.125	0.538		0.000	0.000		0.000	0.000	2	0.250	0.851	3	0.375	1.408	1	0.125	0.459	1	0.125	0.148
Navicula sp.	1	0.125	0.389	1	0.125	0.538		0.000	0.000	4	0.500	1.754		0.000	0.000		0.000	0.000	2	0.375	1.376		0.000	0.000
N. inflata	2	0.250	0.778		0.000	0.000	1	0.125	0.820		0.000	0.000		0.000	0.000		0.000	0.000	1	0.125	0.459	1	0.625	0.740
N.cryptocephala	4	0.750	2.335	1	0.250	1.075	2	0.875	5.738		0.000	0.000	4	0.875	2.979	3	0.500	1.878	3	1.250	4.587	5	3.625	4.290
N.cincta	1	0.125	0.389	1	0.125	0.538		0.000	0.000	4	1.000	3.509	2	0.250	0.851	3	0.375	1.408	1	0.125	0.459	3	0.625	0.740
N.gracilis					0.000	0.000		0.000	0.000		0.000	0.000	2	0.250	0.851	1	0.125	0.469		0.000	0.000	2	2.250	2.663
N.parva	1	0.125	0.389	1	0.125	0.538	2	0.250	1.639	1	0.125	0.439		0.000	0.000		0.000	0.000	1	0.250	0.917	2	0.250	0.296
N.pygmaea					0.000	0.000		0.000	0.000	2	0.250	0.877		0.000	0.000		0.000	0.000		0.000	0.000	2	0.250	0.296
N.pupula					0.000	0.000		0.000	0.000		0.000	0.000	1	0.125	0.426	1	0.125	0.469		0.000	0.000		0.000	0.000
N.radiosa	4	0.750	2.335		0.000	0.000	1	0.125	0.820		0.000	0.000	1	0.250	0.851		0.000	0.000	2	0.250	0.917	3	0.625	0.740
N.rhynchocephale				1	0.125	0.538	1	0.125	0.820	2	0.375	1.316	2	0.375	1.277	1	0.125	0.469	2	0.250	0.917	1	0.375	0.444
N.schroeter					0.000	0.000	1	0.125	0.820	1	0.125	0.439		0.000	0.000		0.000	0.000		0.000	0.000	2	0.375	0.444
N.trivalis	2	0.250	0.778		0.000	0.000		0.000	0.000		0.000	0.000	1	0.125	0.426	1	0.125	0.469		0.000	0.000		0.000	0.000
N.viridula	1	0.125	0.389		0.000	0.000	2	0.250	1.639	1	0.125	0.439	3	0.375	1.277	1	0.125	0.469		0.000	0.000		0.000	0.000
Nitzschiaacicularis	3	0.375	1.167	1	0.500	2.151	1	0.125	0.820	1	0.125	0.439	1	0.125	0.426		0.000	0.000	2	0.250	0.917	4	1.250	1.479
N.apiculuta	1	0.125	0.389		0.000	0.000		0.000	0.000					0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000
N.clausii				1	0.250	1.075		0.000	0.000		0.000	0.000	1	0.125	0.426		0.000	0.000	1	0.125	0.459		0.000	0.000
N.amphibia					0.000	0.000		0.000	0.000	4	0.750	2.632	1	0.125	0.426		0.000	0.000		0.000	0.000		0.000	0.000
N. dissipata	3	0.750	2.335	2	0.375	1.613	2	0.250	1.639	1	0.125	0.439	4	1.500	5.106	2	1.375	5.164	2	1.250	4.587	4	4.875	5.769
N.tryplionella					0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000	1	0.125	0.459		0.000	0.000
N.gracilis					0.000	0.000		0.000	0.000	5	1.125	3.947		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000
N.hungarica	1	0.125	0.389	1	0.125	0.538		0.000	0.000				2	0.250	0.851	1	0.125	0.469	2	0.375	1.376	3	0.875	1.036
N.longissima					0.000	0.000	1	0.125	0.820		0.000	0.000	1	0.125	0.426		0.000	0.000		0.000	0.000	1	0.250	0.296
N.microcephale					0.000	0.000		0.000	0.000	2	0.250	0.877		0.000	0.000		0.000	0.000	1	0.250	0.917	1	0.125	0.148
N.palea	5	1.250	3.891	5	1.000	4.301	1	0.125	0.820	1	0.125	0.439	4	0.875	2.979	3	0.875	3.286	6	1.625	5.963	5	3.500	4.142
N.pupula				1	0.125	0.538	1	0.250	1.639		0.000	0.000	1	0.125	0.426	1	0.125	0.469		0.000	0.000		0.000	0.000
N.sigma	2	0.375	1.167	1	0.125	0.538	1	0.125	0.820		0.000	0.000	3	0.625	2.128	2	0.375	1.408	4	0.500	1.835	1	0.500	0.592
N.sigmoidea	1	0.125	0.389		0.000	0.000		0.000	0.000	3	0.875	3.070	2	0.250	0.851	2	0.625	2.347	3	0.375	1.376	2	0.375	0.444
Pinnularia sp.					0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000
P. lundii	1	0.125	0.389		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000
Pleurosigmadelicalulum	2	0.375	1.167		0.000	0.000		0.000	0.000	1	0.125	0.439	1	0.125	0.426		0.000	0.000		0.000	0.000		0.000	0.000
Rhoicosphenіacurvata	2	0.250	0.778	1	0.250	1.075		0.000	0.000	2	0.250	0.877	4	0.625	2.128	2	0.250	0.939	1	0.125	0.459	4	1.875	2.219
Surirellaangustata					0.000	0.000		0.000	0.000	1	0.125	0.439		0.000	0.000		0.000	0.000		0.000	0.000	1	0.125	0.148
S.capronii					0.000	0.000		0.000	0.000		0.000	0.000	1	0.125	0.426		0.000	0.000	1	0.125	0.459		0.000	0.000
S.ovala					0.000	0.000		0.000	0.000	2	0.750	2.632	1	0.125	0.426		0.000	0.000		0.000	0.000		0.000	0.000
S.ovata					0.000	0.000		0.000	0.000		0.000	0.000	1	0.125	0.426	1	0.125	0.469	1	0.375	1.376	1	0.250	0.296
Euglenophyceae					0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000
Phacus sp.	1	0.125	0.389		0.000	0.000		0.000	0.000	1	0.125	0.439		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000
Trachelomonas sp.	1	0.125	0.389		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000	1	0.125	0.148
Pyrophyta					0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000
Ceratiumhirdnella	1	0.250	0.778		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000	2	0.250	0.939		0.000	0.000		0.000	0.000
Peridiniumcinctum	1	0.125	0.389	1	0.125	0.538	1	0.125	0.820		0.000	0.000	1	0.125	0.426		0.000	0.000	1	0.250	0.917	3	0.375	0.444
Chrysophyta																								
Dinobryonsertularia	1	0.125	0.389		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000		0.000	0.000	2	0.500	1.835	2	0.250	0.296

References

[1] Adakole, J. A. and Annue, P. A. *"Benthic Macro invertebrates as indicators of Environmental quality of an urban stream, Zaria, Northern Nigeria"*. Journal of Aquatic Science. Vol. (18), No. 2, pp. 85-92. (2003).

[2] Pallerano, R. G.; Lezcano, C. A.; Marchevsky, E. and Vazquez, F. A. *"A Physico-chemical Characterization of the Mirinay River, Argentina, By Graphical Methods"*. Journal of Environmental Hydrology.Vol. 10, pp. 1-4 (2002).

[3]Enache, I.; Birghila, S. and Dumbrava, A. *"The Danuba River Quality Characteristics inthe Braila Town"*. Ovidius University Annuals of Chemistry. Vol. (20), No. 2, pp. 146-152. (2009).

[4] El-Awamri, A. A.; Shaaban, A. M. and Saleh, A. I. *"Diatom Flora from Different Aquatic Habitat in the Greater Cairo (Egypt)"*. International Journal of Agriculture and Biology. Vol. (7), No. 2, pp. 230-239. (2005).

[5] Al-Shaheen, F. A. *"Some Ecological Studies on Saprolegniaceae and Their Pathogenicity to Some Fish in Dukan Basin"*. M.Sc. Thesis, University of Sulaimani. (2012).

[6] Leghari, M. K.; Shah, M. and Leghari, M. Y. *"Ecological Study of Algal Flora of Jhelum River-Azad Kashmir"*. Journal of Drainage and Water Managment. Vol. (6), No. 2, pp. 33-48. (2002).

[7] Soylu, E. N. and Gonulol, A. *"Phytoplanktons and Seasonal Variations of the River Yesilrmark, Amasya, Turkey"*. Turkish Journal of Fisheries and Aquatic Sciences. Vol. (3), pp. 17-24. (2003).

[8] Sigee, D. C. *"Freshwater Microbiology, Biodiversity and Dynamic Interactions of Microorganisms in the Aquatic Environment"*. John Wiley and Sons, LTD, British Library Cataloguing in publishing data.U.K. (2005).

[9] Omar, W. M. W. *"Perspectives on the use of algae as biological indicators for monitoring and protecting aquatic environments, with special reference to Malaysian freshwater ecosystems"*. Tropical Life Sciences Research, Vol. (21), No. 2, pp. 51–67. 2010.

[10] Potapova, M. and Charles, D. F. *"Distribution of Benthic Diatoms in U.S. Rivers in Relation to Conductivity and Ionic Composition"*. Freshwater Biology. Vol. (48), pp. 1311–1328. (2003).

[11] Al-Shalash, A. H. *"The Climate of Iraq"*. The Cooperative Printing Presses Workers Socity. Amman. Jordan. 85pp. (1966).

[12] A.P.H.A., *"Standared Methods for the Examination of Water and Waste water"* 20th.Ed. American Public Health Association.1015 Fifteenth Street.NW.Washington, DC.20005-2605. (1999).

[13] Bartram, J. and Ballance, R. *"A practical Guide to the Design and Immplementation of Freshwater Quality Studies and Monitoring Programs"*. United Nations Environment Program and the World Health Organization.ISBN 0 419 22320 7. (1996).

[14] Desikachary, T.V. *"Cyanophyta"*.Indian Council of AgricultureResearch, New Delhi, India. (1959).

[15] Patrick, R. and Reimer, C.W. *"The Diatoms of United States"*. 1. Monger. Acad. Nat. Sci. New York, U.S.A. (1966).

[16]Patrick, R.; Reimer, C. W. and Su-ing, Y. *"The Diatoms of the United State Exclusive of Alaska and Hawai, Monographs"*. The Academy of Natural Science Philadelphia, vol. (2), Part 1. (1975).

[17] Prescott, G.W. *"Algae of the Western great lakes area"*. Otto KoeltzSci.Pub. W. Germany. pp. 979. (1982).

[18] Hustedt, F. *''the Pennate Diatoms''*. Strauss and Gramer GmbH, 6 Hirschberg2. germany. (1985).

[19] Germain, H. *"Flora Des Diatomophycees"*. Societe Nouvelle Des Editions Boubee. Paris, France. (1981).

[20] Duncan,B.D . Multiple ranges and multiple F-Testes Biometrics,11:1-42..(1955).

[21] Zohary, M. *"The flora of Iraq and its phytogeographical subdivision"*.Departmanet of Agriculutre. Iraq. (1950).

[22]Fattah, A.O. *"Phyco-limnological study on KhabourRiver"*. M.Sc. Thesis. University of Duhok- Duhok, Iraq. (2010).

[23] Toma, J. J. *"Limnological study of Dokan Lake, Kurdistan region, Iraq"*.M.Sc. Thesis, University of Salahaddin – Erbil. (2000).

[24] Toma, J. J. *"Physical and Chemical Proparties and Algal Composition of DerbendikhanLake,Sulaimani,Iraq"*.Current World Environment .Vol. (6), No. 1, pp. 17-27. (2011).

[25] Al-Naqishbandi, L. M. A. *"Limnological studies on the water treatment plant in Efraz, Erbil, Kurdistan region, Iraq"*. M. Sc. Thesis, University of Salahaddin – Erbil. (2002).

[26] Hamasalh, N. Y. *"Limnological and Hygienic Studies on Tanjaro River within Sulaimaniyah city, Kurdistan region-Iraq"*. M. Sc. Thesis University of sulaimaniyah. (2008).

[27] Abowei, J. F. N. and George, A. D. I. *"Some Physical and Chemical Characteristics in Okpoka Creek, Niger Delta, Nigeria"*. Research Journal of Environmental Earth Science. Vol. (1), No.2, pp. 45-53. (2009).

[28] Shashi; Singh, J. and Dwivedi, A. K. *"Numerical Interdependence in pH, Acidity and Alkalinity of Polluted River Water"*. Journal of Environmental Biology. Vol. (30), No. 5, pp. 773-775. (2009).

[29] Olajire, A. A. and Imeokparia, F. E. *"Water Quality Assessment of Osun River: Studies on Inorganic Nutrients"*. Environmental Monitoring and Assessment. Vol. (69), pp. 17-28. (2001).

[30] Goran, S.M.A. *"Limnological and non-diatom phytoplankton composition of Dilope spring and Kesnezan impoundment"*. M.Sc. Thesis. University of Salahaddin - Hawler, Iraq. (2006).

[31] Abdulwahid, S.J. *"Aphycolimnological study on some springs within Harir sub-district.Hawler-Kurdistan Region of Iraq"*. M.Sc. Thesis. University of Salahaddin – Hawler, Iraq. (2008).

[32] Ibrahim, A. M. K. "A study on the algal ecology of springs in Sulaimany province". M.Sc. Thesis, University of Sulaimany, Iraq. (1981).

[33] Al-Nakshabandi, I.Y.R. *"A Phycolimnological study on Duhok impoundment and its main watershed"*. Ph.D. Thesis, University of Duhok. (2002).

[34] Bapeer, U. H. K.; Al-Naqishabandi, L. A.; Toma, J. J. and Ismail, H. A. *"Study some Physico-Chemical and Bacteriological Variables of both Drinking Water Purification Projects (Ifraz and Ainkawa) in Erbil, Iraq"*. Journal of Pure and Applied Sciences. Vol. (18), No. 3, pp. 19-32. (2006).

[35] Elewa, A. A. *"Influence of Oxidation reductionPotential in the water environmental of Aswan High Dam Reservior*". Water Research Development. Vol. (4), No. 3, pp. 184-190. (1988)

[36] Geesey, G. G.; Cooksey, B. W. and Cooksey, K. E. *"Influnce of Calcium and other Cations on Surface Adhesion of Bacteria and Diatoms"*. A Review.Biofouling. Vol. (15), No., 1-3, pp 195-205. (2000).

[37] Johnson, W. D. and Muir, G. L. *"Chemistry of the Castlereagh River, New South Wales"*.Australian Journal of Marine and Freshwater Research. Vol. (28), No. 6, pp. 683-692. (1977).

[38] Fattah, A.O. *"Phyco-limnological study on KhabourRiver"*. M.Sc. Thesis. University of Duhok- Duhok, Iraq. (2010).

[39] Wu, J. T. and Suen, W. C. *"Change of Algal Association in Relation to Water Pollution"*. Botanical Bulletin Academia Sinica. Vol. 26, pp. 203-212. (1985).

[40] Perez, M. C.; Maidana, N. I. and Comas, A. *"Phytoplankton composition of the Ebro River Estuary, Spain"*. ActaBotanicaCroatica. Vol. (68), No. 1, pp. 11-27. (2009).

[41] Kara, H. and Shahin, B. *"Epipelic and Epilithic Algae of Degirmendere River (Trabzon-Turkey)"*. Turkish Journal of Botany. Vol. 25, pp. 177-186. (2001).

[42] Singh, M.; Lodha, P. And Singh, G. P. *"Seasonal diatom variations with reference to physico-chemical properties of water Mansagar lake of Jaipur, Rajisthan*". Research Journal of Agriculture Science. Vol. (1), No. 4, pp. 451-457. (2010).

[43] Abdul Jabar, R. A. *An Ecological Study on Lesser Zab River.* M. Sc. Thesis University of Sulaimaniyah-Iraq. (1981)

[44] Al-Nimma, B.A.B. and Maulood, B.K. *"A study on the distribution of algae in some thermal springs in Ninevah province, Iraq"*. Journal of Ibin al-Haitham. Vol. (3), No. 2, pp. 1-9. (1992).

[45] Muhammad, S. A. *"An Ecological Study on the Aquatic Life of Sarchnar Spring, Chaq-Chaq and Kliassan Streams. Sulaimany, Kurdistan Region of Iraq"*.M.Sc. Thesis, University of Sulaimany. (2004).

[46] Farkha, T. K. *"A study of the Distribution of Phytoplankton and Aquatic Fungi in the Lotic Water in Baghdad District and the Effect of Environmental Factors"*. Ph. D. Thesis College of Science University of Al-Mustansrya. (2006).

[47] Hassan, F. M.; Kathim, N. F. and Hussein, F. H. *"Effect of chemical and properties of river water in Shatt Al-Hilla on phytoplankton communities"*. E. Journal of Chemistry. 5(2): 323-330. (2008).

[48] Zewayee, F. A. Q. *"A phycolimnological study on some springs and streams within Erbil province"*. M.Sc. Thesis. University of Salahaddin-Erbil/Iraq. (2011).

[49] Kolayli, S.; Baysal, A. and Sahin, B. *"A Study on the Epipelic and Epilithic Algae of Sana River (Trabzon/Turkey)"*. Turkish Journal of Botany. Vol. (22), pp. 163-170. (1998).

[50] Celekli, A. and Kulkoyluoglu, O. *"On the Relationship between Ecology and Phytoplankton Composition in a Karstic Spring (Cepni, Bolu)"*. Ecological Indicators. Vol. (7), pp. 497-503. (2007).

[51] Wu, J. T. and Suen, W. C. *"Change of Algal Association in Relation to Water Pollution"*. Botanical Bulletin Academia Sinica. Vol. 26, pp. 203-212. (1985).