Using Diatoms as Bioindicators to Assess AL-Diwaniya River/ Iraq

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Abstract

The present study aims to assess AL-Diwaniya river by using diatoms as bioindicators And using Palmer Pollution index.Water samples were collected monthly during the period March 2015 to February 2016, Three sites were selected in AL-Diwanhya river. the investigation was to study the physical, chemical and biological characters in the river, The water of the river was good oxygenated, oligohaline, very hard and alkalinity returned to the bicarbonate, and results also showed an increase of pollutants especially in third site. It is concluded that the sewage had an dilution effect for the total hardness, alkalinity, electrical conductivity and salinity of river.

Diatoms species which were identified during study period 170 belong to 34 genera, Centrales12 species which returned to 5 genera, while Pennales158 species belong to 32 genera, The species that have highs numbers are (*Achnanthes, Cymbella, Nitzschia, Navicula*). Other types are dominant in their existence and number during study period (*Cycltella comta, C. Kutzingana, C. meneghiniana, C. Ocellata, Diatoma elongatum* and *Cocconeis Placentula*), according to Palmer Index the water of river was moderate pollution.

Keywords, Diatoms, Bioindicators and River.

Natural History - Biology Classification QH 540-549.5

INTRODUCTION

River water is one of the most important and widely distributed natural resources which is considered as supplemental resource to meet the domestic, agricultural and industrial requirements [1].AL-Diwaniya River is one of the oldest and largest reservoirs, a branch of the Euphrates river, in the middle of Iraq, is the major water resource for the AL-Diwaniya city. This river is 120 Km long, which runs through the city of AL-Diwaniya, is the main source of drinking water and irrigate farmland and is thus penetrates the population centers and agricultural land and pour in the water, industrial and human waste that have an impact cumulative , also disposal of sewage, heavy water, which poses a direct to river, which lead to many infections such as pollution microbiological and heavy metals that influenced categorize water quality[1], [2].

Diatoms are photosynthetic organisms, a major group of algae and form one of the most common forms of phytoplankton, Diatoms live in almost all types of superficial waters, depending on their habitats, diatoms are either planktonic (living suspended on the water), benthic (growing associated to a substrate), or both planktonic and benthic[2], [3]. diatoms live any and everywhere, they are found in rivers, oceans, lakes and streams. Algae are the base of food webs in most aquatic ecosystems, drivers of biogeochemical cycling, and represent significant proportions of biodiversity [3],[4]. Protecting natural levels of algal productivity in aquatic ecosystems is important to support food webs and biogeochemical cycling. Maintaining algal biodiversity may be important for have several advantages over the animal (fish and aquatic macroinvertebrates).

component of streams and rivers. Diatoms are an abundant, diverse and important component of algal assemblages in freshwater bodies. are known to be good indicators of pollution of many types for the following reasons.

Diatoms have wide temporal and spatial distribution, many algal species are available all the year, response quickly to the charges in the environment due to pollution, diatoms are diverse group of organisms found in large quantities, easier to detect and sample, The presence of some diatoms are well correlated with particular type of pollution particularly to sustaining ecosystem function, especially under the threat of regional and global change in environmental conditions [5],[6].

Diatoms are important as they, provide the basis of the food chain for both marine and freshwater, are major source of atmospheric oxygen responsible for 20-30 % of all carbon fixation on the planet and can act as environmental indicators of climate change, and are sensitive to the physical and chemical variations of a body of water, Diatoms often reflect water quality better than other organisms [7].

Diatoms (Bacillariophyceae) are cosmopolitan, unicellular, microscopic algae, which occur in many different ecosystems (mainly water), their characteristic feature is a cell wall made of silica with a richly carved surface and specific construction of a frustules. They are sensitive to a variety of environmental factors needed for optimal growth: light, temperature, salinity, the presence of biogens, etc. In this way they are used as excellent indicators of changes taking place in water ecosystems, especially eutrophication, increased pollution and acidification [6],[8]. Hence use diatoms as bioindicators.

Bioindicators are organisms such as diatoms that are used to monitor the health of the environment, they are monitored for changes that may indicate a problem within their ecosystem, they can be chemical, physiological or behavior, bioindicators are biological processes species, communities used to assess the environment and how it changes through time. diatoms organic pollution. Diatoms of many kinds are really good indicators of water quality and many lakes are characterized based on their dominant phytoplankton groups[9],[10].

Materials and methods

Water samples were collected from three sites monthly beginning from March 2015 to February 2016. For all studied sites (Figure -1, Table1). Physico-chemical and biological characteristics study were accomplished by using the following resources. (Table 2).

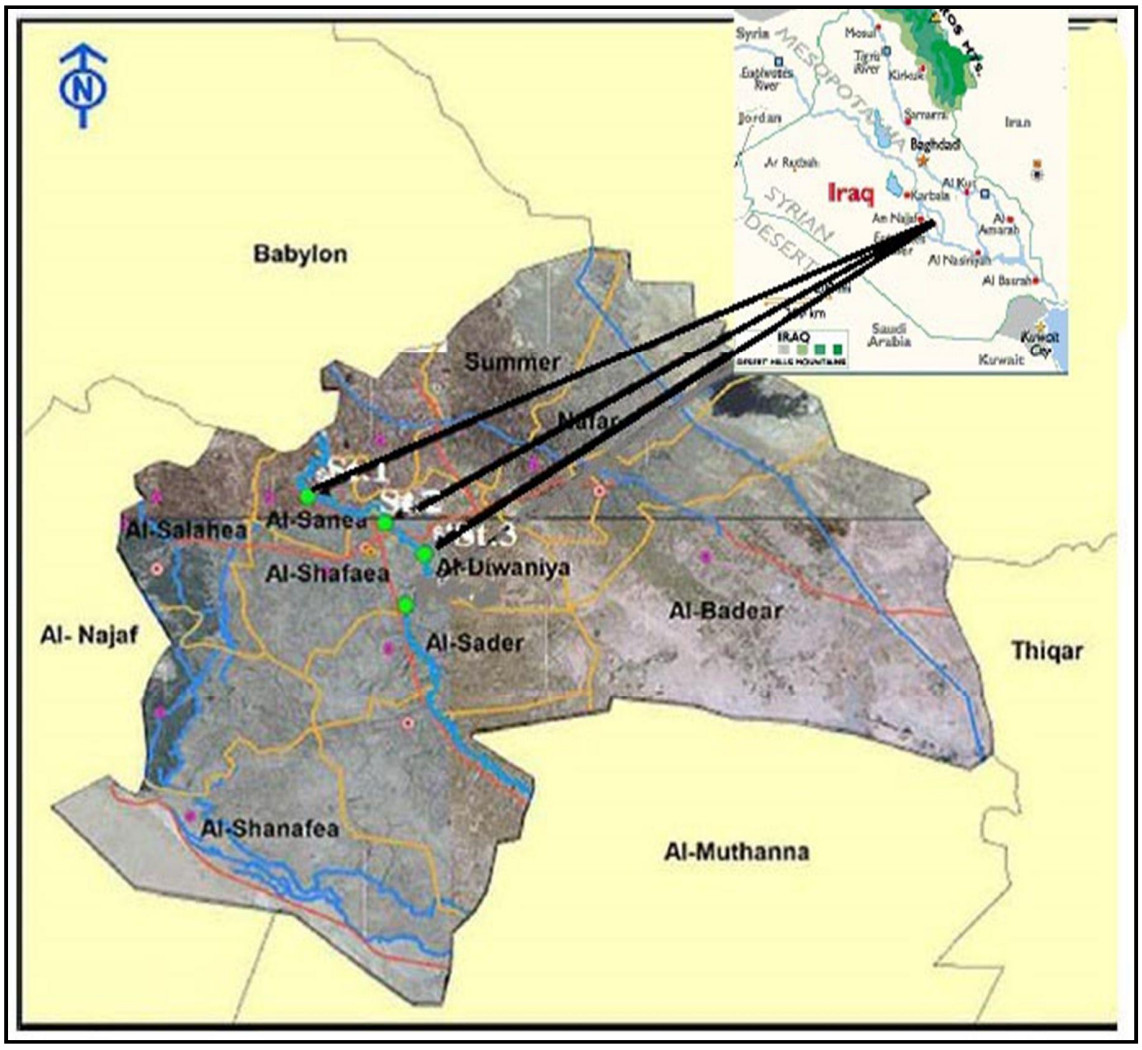

Figure 1:-Map showed locations of the sampling sites in the study area.

Table 1:- The locations of the sampling sites in the study area.

Sits	Longitude East	Doairalard North
S.1 North of city	32,1,16	44,49, 32
S.2 Center of city	31, 59,14	44, 54,56
S.3 South of city	31,55,56	44, 58,7

Table2:- Parameters, Methods, Reference and unites were used of study.

Parameters	**Methods**	**Reference**	**Units**
Water Temperature	Mercury thermometr		^{o}C
Current Velocity	M/S		m/s
Light Penetration	Welch,1952	Stirling,1985	cm. Secchi disc
Turbidity	Turbidmeter		NTU
pH	pHmeter		
Electrical Condyuctivity	E.C.meter		µs/cm
Total Dissolved Solids	APHA,2003	T.D.S.	mg/l
Total Suspended Solids	APHA,2003	T.S.S.	mg/l
Dissolved Oxygen	APHA,2003	Azid Modification	mg/l
Biological Oxygen Demand	APHA,2003	BOD_5	mg/l
Total Hardness	Lind, 1979	APHA,2003	$mgCaCo_3$ /l
Reactive Nitrite	Parsons *et al.,*1984		µg/l
Reactive Nitrate	Parsons *et al.,*1984	In Wood *et al,.*1967	µg/l
Reactive Phosphate	Parsons *et al.,*1984	Murphy & Riely,1962	µg/l
Reactive Silicate	Mullin & Riely, 1955	Parsons *et al.,*1984	µg/l
Identify Diatoms	Germain, 1981 and Hadi *et al*., 1984		1000XCell/L
Palmer Index	Palmer, 1969		

Results and Discussion

Rivers are of the most important renewable and vital resources of fresh water consumed for agricultural, industrial and drinking purpose [10],[11]. Water quality is the main factor controlling healthy and diseased states in both humans and animals. Surface water quality is an essential component of the natural environment and matter of serious concern today.

The AL – Diwaniya river at warm water in a relatively General has water temperature exceeded 36°C in the current study and will not fall below 18°C and in third site treatment station factories , rubber and village educates buffalo this pearls thermal Properties of water and increasing disintegration and decomposition returns organic third site . while the air temperature ranges shown in all sites ranged between 23- 42°C(Table-3)

The changes in three sites in the electrical conductivity values , did not exceed 1475 µS/cm compared to the third as the site reached running water like rivers few values at electrical conductivity and soured articles at association at

In general ,range change values at the area studied high organizational capacity bicarbonate ،carbonate ,silicate and phosphate ، an important influence in keeping pH at natural water. pH value of river water samples varied between 8.5 to 7.2 (Table-2). Electrical conductivity varied between 1475 to 1115 µm/cm. Total dissolved solids indicate the salinity behavior of river water. The DO values indicate the degree of pollution in water bodies. It varied from 9.5 to 7.1 mg l¯1. The sampling station S3(Table-3, Figure3) showed low DO during the study period. The dissolved oxygen of important environment factors that control the actions of vital organisms that Iraqi waters rarely of dissolved oxygen sufficient . this show in the current study because its values have not fallen for 7.5mg/l while the water third site valuable and sessile, reaching recorded 7.1mg/l this may be due to the processes at organic the soluble salty at sail organic matter resulting from the organisms[12].

Recorded salinity high values in the third site either other sites ranging values in order to display the water in the third site pearls droppings , mills, factories and household waste . where salinity values recorded at both sites 1 and 2 higher that help alit is considered as brackish as classified Read[13].

The majority of Iraqi water alkalinity was showed during the study , with values exceeded (379 mg/l) from bicarbonate in the river sites , and the Iraqi water qualities and the source of bicarbonates. water the third site recorded high values of total alkalinity ranged from (255-379 mg/l) while no more than (260 mg/l) at Both site 1 , and 2 , that are not reflected clear rise in total alkalinity , in the third site categorize results pH at Euphrates rivers indicates anther categorize organizational capacity in water basic river and the fact that on the hand of bicarbonate and these high values in the third compared to the 1, 2 sites of signatories indicates direct influence of the river[14].

matter[15],[16]. Dissolved oxygen is important parameter in water quality assessment and reflects the physical and biological processes prevailing in the water. The values of BOD recorded high values in the site 3 exceed 5.3mg/l(Table-3, Figure- 2) and this expected and simultaneously with high values of salinity and brackish , as these waters contain large a mounts of waste has reached its values of both sites 1 and 2 2.8mg/l while not exceeding 5.3mg/l in the 3 rd site this confirms the direct impact of the waters at the third site[16].

Total hardness It indicates in the brackish water of the river values as ten as rain water has caused an increase in the Iraq water, and increases the severity of the impact of water sources casing hardness and salinity[16],[17].

Table 3: Range of mean values of Physicochemical Parameters in Al-Diwaniya River during the study period.

Parameter	Mean S1	Mean S2	Mean S3
Air temp. (˚C)	23 – 40	23 - 41	24 -42
Water temp. (˚C)	18 – 35	18 – 36	20 - 36
Water flow (m/min)	0.40 – 0.98	0.28 – 0.60	0.31 – 0. 61
Turbidity (NTU)	18 – 70	21 – 52	23 - 57
Light penetration (cm)	42 – 70	30 – 58	38 - 61
Electric Conductivity (µs/cm)	1170 – 1475	1115 - 1289	1280 – 1675
Salinity ‰	0.75 – 0.94	0.71 - 0.82	0.82 – 1.1
Total dissolved solids (mg/l)	973 – 1275	1006 – 1343	1139 - 1343
Total suspended solids (mg/l)	26 – 62	33 - 66	39 - 78
pH	7.2 – 8.15	7.8 – 8.5	7.5 – 8.2
Dissolved oxygen mg/l	7.5 – 9.5	7.5 – 8.6	7.1 – 8.3
Biochemical oxygen demand mg/l	1.5 – 2.9	2.7 – 3.5	2.9 – 5.3
Alkalinity mg CaCO3/l	180 – 247	192 – 260	255 - 379
Hardness mg CaCO3/l	350 – 488	314 – 485	368 - 504
Calcium mg/l	86 – 145	87 – 138	89 - 183
Magnesium mg/l	66 – 105	87 – 104	87 - 115
Nitrite µg/l	1.30 – 2.10	1.32 – 2.7	1.31 – 2.7
Nitrate µg/l	153 – 270	255 – 390	167 - 275
Phosphate µg/l	N.D – 0.9	N.D – 0.65	N.D – 2.85
Silicate µg/l	117- 183	110 – 156	115 -137
Number of cell diatoms x 1000/cm^2	3.37 – 9.66	3.63 – 7.61	3.06 – 7.05

Table 4:- Number of Diatoms genera and species in the studied sites.

	S1			S2			S3		
	Genera	Species	Percent	Genera	Species	Percent	Genera	Species	Percent
Centales	5	6	6.4%	5	10	6.6%	4	10	7.8%
Pennales	27	88	93.6%	27	141	93.4%	27	118	92.2%
Total	32	94		32	151		31	128	

Nitrogen (Nitrite and Nitrate) is one of the most important limiting nutrients in the river environment[17], results showed low values 1.3 µg/l of nitrite, high values2.7 µg/l while values of nitrate low 153 µg/l, high 390 µg/l (Table -3, Figure- 4,5).

Phosphore (phosphate) is yet another essential nutrient for diatoms growth[16], low values N.D., high values 0.85 µg/l (Table -3, Figure- 6), increase some of them may return to the concentrations of nutrients from household and industrial waste[16] [17].

The addition of various kinds of pollutants and nutrients through the agency of sewage, industrial effluents, and agricultural run off etc. in to the water bodies brings about a series of changes in the physico-chemical and biological characteristics of fresh water which have been the subject of several investigations [18],[20].

The dominance of diatoms in the river was well known, this dominance may be due to their ability to adapt in altering environment with less available light intensity, this dominance is also referred to in other studies of aquatic ecosystems in Iraq. Clean water has relatively low populations of many different species of diatoms as water becomes polluted, the variety of diatoms decreases, but the population of pollution tolerant species increases[18],[20].

In this study the identification of species about 170 from the Centrales 12 and pennales158 Belonging to 34 genera Diatoms in the Al-Dwaniya river (Table – 4,5) in the three sites.

where the number of centrals 12 species belonging to 5 genera and 10.42% of the total species either number pennales has reached 158 species belong to 29 genera pennales 89.58% of the first site 88, second site 141 species and the third site 116 species(Table – 4,5).

As the number of Diatoms diagnosed in the first site 94 species belong to 34 genera where the number of centrals 6 species of the 5 genera and by 13.25% and pennales 88 species returned to 29 genera and by 86% at the total species in this site(Table – 4,5) .

Site second recorded 151 species belonging to 39 genera where the number of centrals 10 species belong to 5 genera and increased by 11.76% and pennales 141 species belonging to 34 genera and increased by 88% , While the third site diagnosed 126 species returned to 38 genera where the number of centrales 10 species to 4 genera and the a number of pennales 116 species belonging to the 29 genera species has been a centrales rate of 10.81% , And the ratio of pennales 89.1% of the total of species(Table – 4,5) .

Also recorded some genera at the highest number of species in the first site has recorded 4 species of the genera and 5 species while the following alliteration *Cyclotella, Achanthes* and *Cocconeis* and either species *Cymbella* has scored his 15 species and species *Frayilaria* has scored his five species while the recoded of the genera .

The current study indicate that diatoms dommance on the centrales where the number of species was of pennales 130 while the centrales to species agree this case in terms of the rule pennales on the centrales in the current study with alot of studies that have pointed to increasing the number of species of pennales six-fold centrales . That the rule of pennales on the centrales water proof health .

Attitudes varied in the sites of the number of species was found that the second site has recorded highest number of species which

amounted to 151 species may return to the concentrations of nutrients from household and agricultural run off. The addition of various kinds of pollutants and nutrients through the agency of sewage, industrial effluents, etc. while the first site of least a few species while swallow 94 species. Genus (*Nitzschia, Navicula, Cymbella, Achnanthes*) which more represented in this study and this agree with [1],[2],[12] *Cocconaes placentula, Cyclotella comta,* C. menghinana*, C. ocellata, C. kuetzingiana ,Diatoma elongatum* when presented more frequently in all study stations because, they are tolerance to environment factors (such as temperature and nutrient decrease) more than other species, and this species live in alkalin water [6], [7]. this species represent in AL-Diwaniya River because the river water was alkalinity.

The increase in the second site may be due to differences in the availability of plant nutrients mar first in a residential villages form located thus exposing to the flow of water from agricultural drainage on both sides of the river as well as the human waste that poses to the river which leads to increased concentrations of nutrients either lower number of species in the first site was back to being the same polluted by doing what it is offered area located near the site.

This study also Showed the dominance of some genera of diatoms over other genera which *(Navicula , Nitzshia*) , the number of species belonging amounted to geneus *Navicala* [9],[10]. while geneus *Nitzsehia* in sites the first, second and third for both have this study agreed with El-Hamdaoui (2009) on Dagharah river and (Ghanimi 2003 on Diwaniya river, this may be an indication of the an abundance of organic matter caused by human waste and agricultural hand to the river .

Rivers with weak water currents always contain *Cyclotella* and *Melosira* are usually found in clean water, whereas *Nitzschia* and *Aphanizomenon* are usually found in polluted water and *Aphanizomenon* is usually found in high phosphate waters[16].

It may also explain the presence of some diatoms with the presence of some heavy metals studied as observed from the results of the current study the presence of the large number of genera (*Surirella , Nitzschia*) in the study sites and this an be attributed to the fact that the water in the study area is contaminated with cadmium, copper and lead.

The present study showed 15 pollution tolerant genera were found at all sites, The presence of *Nitzschia*, which is a little less dominating than *Gomphonema* indicates organic pollution in the river. It is also noticed that both sites 1and 2 have similar dominating genera, hence similar level of pollution[21], [22].

Palmer, (1969) made the first attempt to identify and prepare a list of genera and species of algae tolerance to organic pollution. He prepares a list of 60 genera and 80 species tolerant to organic pollution[23]. By using palmer's index of pollution to rating of water samples as high or low organically polluted at three site of river , The total score of Diatoms Genus pollution index of site 1, 2 and third were 10 (table 5,6),these values referred to moderate pollution, similar results were observed in the AL-Shamyah river[24]. Bacillariophyceae *Synedra, Melosira, Cyclotella, Navicula.* Sampling points S3 showed high organic pollution, *Nitzchia* was present in the river water which indicate organic pollution [11], [16].

Following numerical values for pollution classification of Palmer (1969)

0 - 10= Lack of organic pollution

10 – 15 = Moderate pollution

15 – 20 = Probable high organic pollution

20 or more = Confirms high organic pollution[23].

Table 5:- Diatoms (genera and species) were diagnosed of AL-Diwaniya River during study period.

Bacilariphyceae	S-1	S-2	S-3
Centrales			
Aulacusira granulate Kuetzing	+	+	-
Cosindiscus lacustris Grunow	+	+	+
Cyclotella glomerata Bachmann	+	+	+
C.comta (Ehr.) Kuetzing	-	+	-
C.meneghiana Kuetzing	-	+	+
C. ocellata Pantocsek	-	-	+
C.stelligera Cleve et Grunow	+	+	+
Melosira granulate (Ehr.)	+	+	+
*M.dicikiei (*Thwaites) Kuetzing	-	+	+
M. distance (Ehr.) Kuetzing	-	-	+
Stephanodiscus hantzschi Grunow	+	+	+
S.asterea (Ehr.)Grunow	-	+	+
Pennales			
Achnanthes affinis Grunow	+	+	+
A.conspicua A.Mayer	+	+	+
A.hungarica Grunow	+	+	+
A.microceophala(Kuetzing) Grunow	+	+	-
A.mintussima kuetzing	-	+	+
A.linearis Grunow	+	+	+
A. saxonica Krasska	-	-	+
Amphora alata Kuetzing	+	+	+
A.coffeaeformis Agardh	+	+	+
A.holsatica Husted	+	+	+
A. normanii Rabh	+	-	+
A.ovalis Kuetzing	+	+	+
A.veneta Kuetzing	+	+	+
A.pediculus Kut.	+	+	+
A. sp.	-	+	-
Amphiprora alata Kuetz.	+	+	+
A.costata Hust.	+	+	+
Anomoeonies sp.	+	+	+
Bacillariapaxillifer (Muller) Hendy	+	+	+
Calloneis bacillum Cleve	+	+	+
C.silicula Cleve	-	+	+
C.ventricosa Meister	-	+	-
Cocconies pedicalis Ehrenberg	+	+	+
C.placentula Ehrnberg	+	+	+
Cymbella affinis Kuetzing	+	+	+
C. aspera	-	+	+
C.caespitosa (Kuetzing) Brun.	+	-	+
C.gracilis (Rabh.)Cleve.	+	+	+
C.helvetica Kuetzing	+	+	+
C.laevis Naegeli	-	+	+
C.lanceaolata(Ehr.)Van.Heurck	+	+	-
C. leptoceros Grunow	-	-	+
C.microcephala Grunow	+	+	+
C.tumida(Breb.) V.Heurck	+	+	+
C.tumidula Grunow	+	+	+
C.turgida (Greg.)Cleve	-	+	+
C.ventricosa (Greg.)Cleve	+	-	-
Cymatopleura solea (Breb.)	+	+	+
Denticula sp.	-	+	-

Diatomaelongata (Lyngb.)Agardh	-	+	-
D. vulgare Bory	+	-	-
Dipolneis minuta (Petersen)Cleve	+	+	+
D.ovalis (Hisle)Cleve	+	+	+
D.puella Cleve	-	+	+
Epithemai turgid(Ehr.)Kuetzing	+	+	+
E.zebra (Ehr.)Kuetzing	+	+	+
Eunotia sp.	-	+	+
*E.pectinalisvar.undula*Rabenhorst	+	+	+
Fragilaria brevist riata Grunow	+	+	+
F.capucina Desmazieres	-	+	-
F. constunes Grunow	-	+	+
F.crotonesis Kitton	-	+	-
F.intermrdia Grunow	+	+	+
F.virescens Ralfs	+	+	+
Gomphonema acuminatavarin Ehr.	+	+	+
G.angustatum(Kuetzing) Rabh	-	+	+
G.augur Ehrenberg	+	+	+
G.consrictum Ehrenberg	-	+	+
G.gracile Ehrenberg	+	+	+
G.intricatum Kuetzing	+	+	+
G.intricatum Kuetvar.lunata Nov.	-	+	-
G.parvulum (Kuetzing)Grunow	-	+	-
G. olivaceum (Lyng.)	-	+	+
Gyrosigma acuminatu (Kuetzing) Rabenhorst	+	+	+
G.attenuatum (Kuetz.) Rabenhorst	-	+	+
G.peisonis Husted	-	+	-
Hantzschia amphioxys Grunow.	-	+	+
Mastogloia elliptica Cleve	+	+	+
M.muradi Voigt	+	+	-
M.smithii Thw.Ex.W.S.	-	+	+
M.smithii var . amphiceohal Grun.	-	+	-
Navicula angilica Ralfs	+	+	+
N.atomus (*Kuetzing)Grunow.*	-	+	+
N.bacliium Ehrenberg	+	+	+
N.cincta (Ehr.)Kuetzing	+	+	+
N.cocconiformis Gregory	-	+	-
N. creptocyphala Kuetzing	+	+	+
N.cuspidata Kuetzing	-	+	+
N.decussis Oestrup	-	+	-
N.dicephala W.Smith	-	+	+
N.gastrum (Ehr.) Kuetzing	+	+	+
N.graciloides A.Mayar	+	+	+
N.gracilis (Ehr.)	+	+	+
N. gregaria Donkin	-	+	+
N.grimmei Krasske.	+	+	+
N.halophila (Grun.)Cleve.	+	+	+
N.lanceolata (Ag.)Kuetzing	-	+	+
N.phyllepta Kuetzing	-	+	+
N.placentula (Ehr.)Grunow.	-	+	+
N.pupula Kuetzing	-	+	-
N.radiosa Kuetzing	-	+	+
N.rhynchocephala Kuetzing	-	+	+
N.salinarum Grunow	+	+	+
N.shroeteri Meister	+	+	-
N.vitrea Hustedt	-	+	+
Neidium affi (Kuetzing) W.Smith	+	+	-
N.iridis (Ehr.)Cleve	-	+	-
Nitzschia acicularis (Kuetzing)W.Smith	+	+	+-

N.acuta Hantzsch	+	+	+
N.amphibian Grunow	-	+	+
N.angustata (W.Sm.) Grunow.	-	+	+
N.apiculata (Greg.)Grunow	-	+	+
N.closterium (Ehr.)W.Smith	-	+	+
N.cluasii Hantzsch	+	+	+
N.dissipata (Kuetzing)	+	+	+
N.dubia W.Smith	+	+	+
N.fasciculata Grunow	-	+	+
N.filiformiss (W.Smith)Hustedt	+	+	+
N.fonticola Grunow	+	+	+
N.frustulum (Kuetzing)Rabh	+	+	+
N.gracilis Hantzsch	-	+	+
N.hantzschiana Rbh	+	-	-
N.heufleriana Grunow	-	+	+
N.hungarica Grunow	+	+	+
N. inconspicua Grunow	-	+	+
N.ignorata Krasskae	-	+	+
N.linearis W.Smith	-	+	+
N.longissima Ralfs.	+	+	+
N.lorenziana Grunow	+	+	-
N.microcephala Grunow	-	+	+
N.palea (Kuetzing)W.Smith	+	+	+
N.paleacea Grunow	-	+	+
N.pusilla (Kuetzing)Grunow	-	+	+
N.obtus W.smith	+	+	+
N.recta Hantzsch	+	+	+
N.romana Grunow	-	+	+
N.rostellata Hustedea	-	+	+
N.sigma W.smith	+	-	-
N.sigmoidea (Ehr.)W.smith	+	+	-
N.vermicularis Hantzsch	+	+	+
Pinnuluria borealis Ehrenberg	+	+	+
P.leptosome (Grun.)Cleve	+	+	-
Pleurosigma angulata W.Smith	-	+	+
Rhopaladia gibba (Ehr.)Muller	+	+	+
Rhoicospheni curvata (Kuetzing) Grunow	+	+	+
R.marina Grunow	+	+	-
Stauroneis sp.	-	+	-
Surirella linearis W.Smith	+	+	-
S.ovalis De Brebission	-	+	+
S.robusta Ehrenberg	+	+	-
S. tenera Gregory	+	+	+
Synedra acus Kuetzing	+	+	+
S.capitata Ehrenberg	+	+	-
S.pulchella (Ralfs.)Kuetzing	-	+	+
S.rumpens Kg.	+	+	+
S.tabulat fasciculate Agadh	-	+	-
S.ulna (Kuetzing) Ehrenberg	+	+	+
S.vaucheriae Kuetzing	+	+	+

Table 6 : Pollution index of Diatoms genera according to palmer, (1969) at three sites .

Bacillariophyceae genera	Pollution index	sites		
		1	2	3
Melosira	1	1	1	1
Cyclotella	1	1	1	1
Synedra	2	2	2	2
Navicula	3	3	3	3
Gomphonema	1	1	1	1
Nitzschia	3	3	3	3
Total Score		10	10	10

Table7-Pollution index of Algae genera according to Palmer, 1969.

Genus	Index	Genus	Index
Anacystis	1	*Micractinium*	1
Ankistrodesmus	2	*Navicula*	3
Chlamydomanas	4	*Nitzschia*	3
Chlorella	3	*Oscillatoria*	5
Clostrium	1	*Pandorina*	1
Cyclotella	1	*Phacus*	1
Euglena	5	*Phormidium*	1
Gomphonema	1	*Scenedesmus*	4
Lepocinclis	1	*Stigeoclonium*	2
Melosira	1	*Syndra*	2

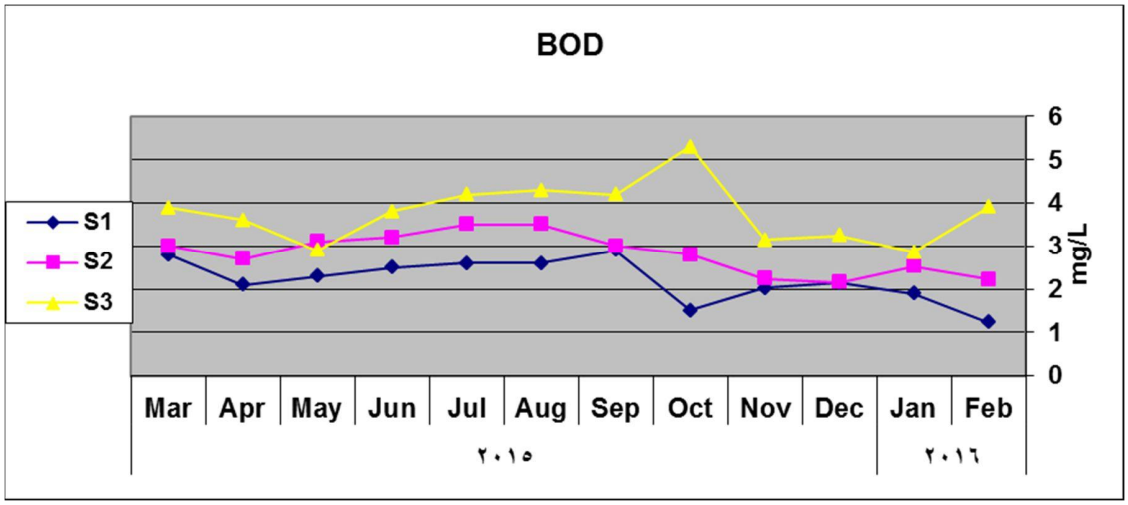

Figure 2 :- Values BOD of AL-Diwaniya River during study period.

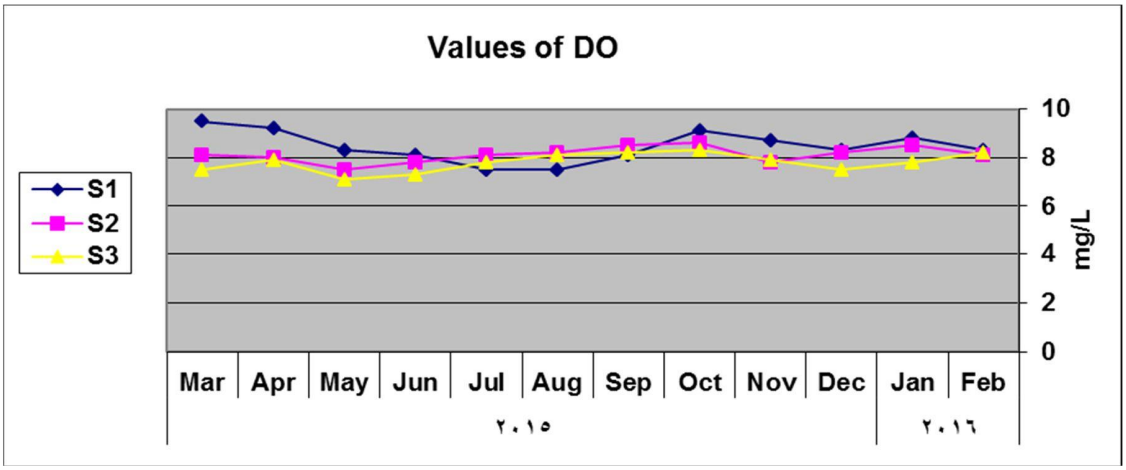

Figure 3 :- Values DO of AL-Diwaniya River during study period.

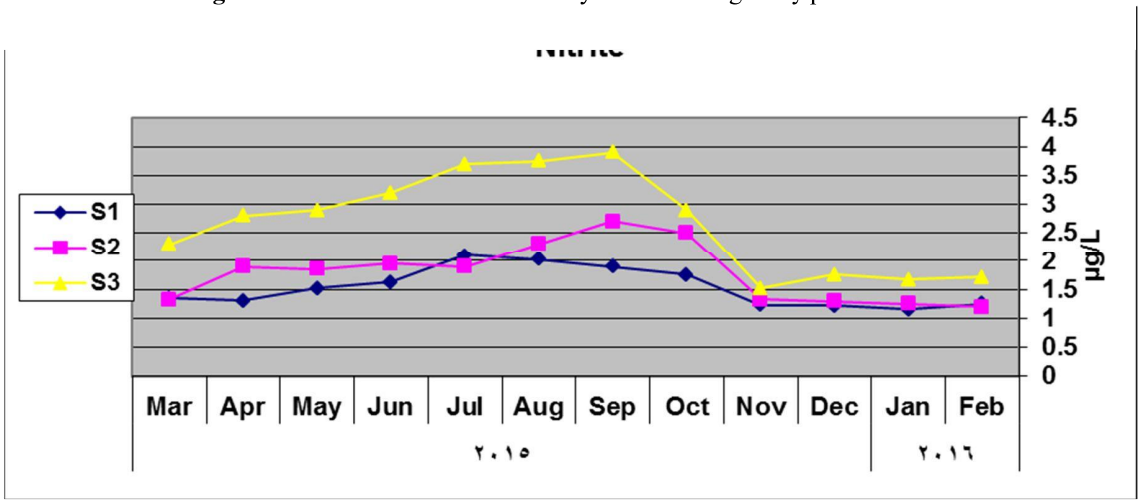

Figure 4 :- Values Nitrite of AL-Diwaniya River during study period.

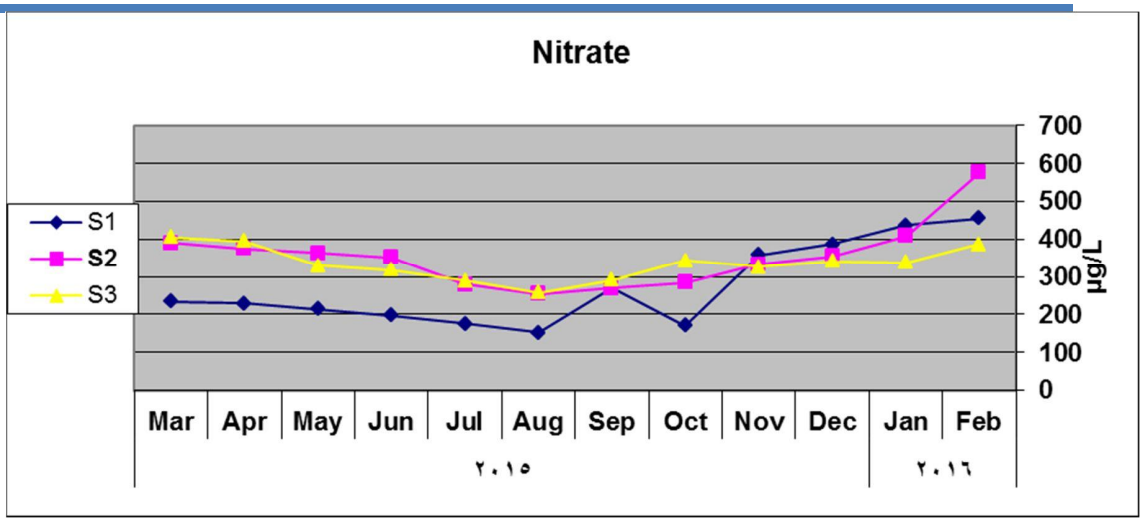

Figure 5 :- Values Nitrate of AL-Diwaniya River during study period.

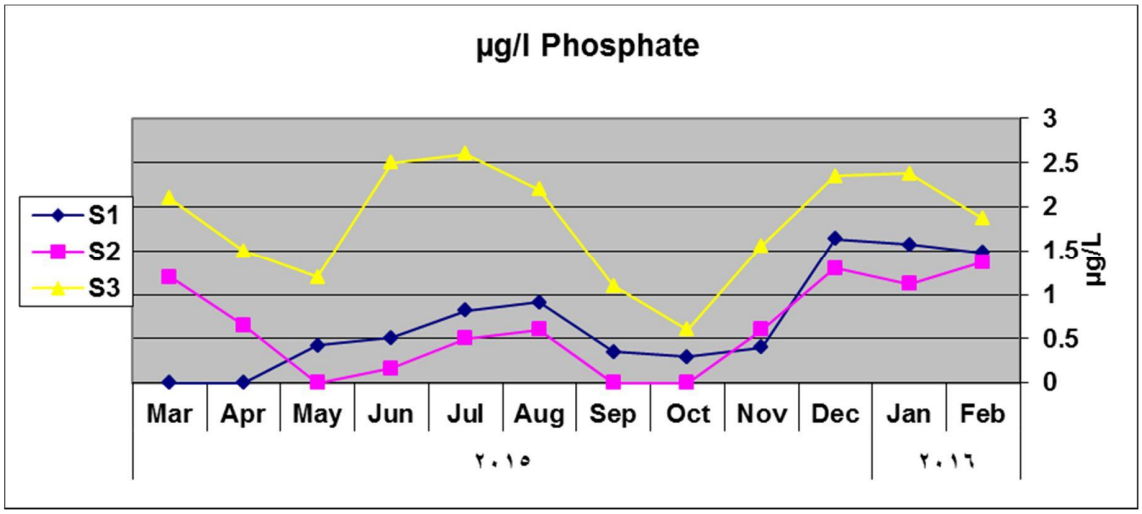

Figure 6 :- Values Phosphate of AL-Diwaniya River during study period.

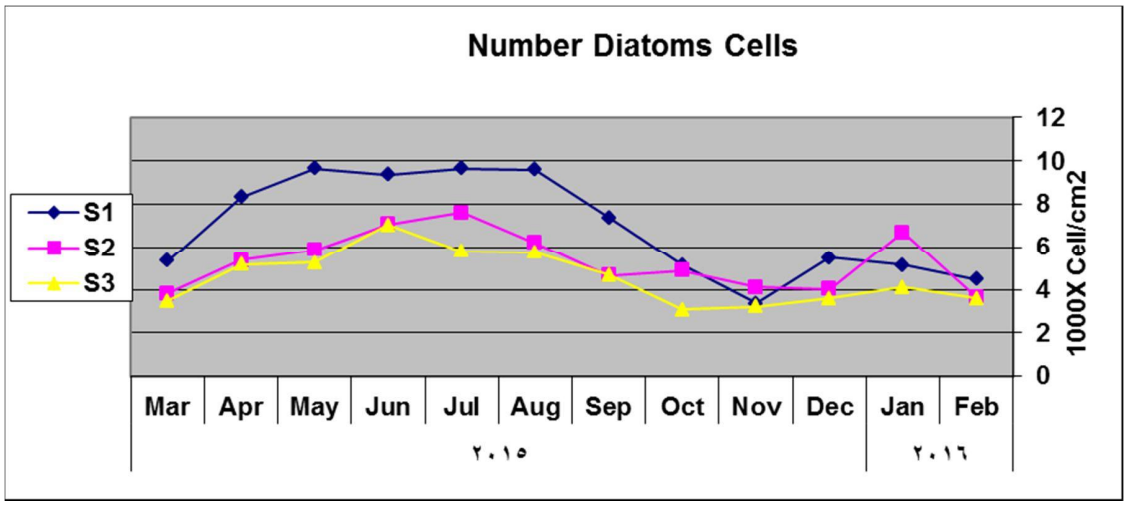

Figure 7 :- Values Number Diatoms Cells of AL-Diwaniya River during study period.

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استخدام الطحالب الدايتومية كأدلة تلوث لتقييم مياه نهر الديوانية/ العراق

تاريخ الاستلام 2016/3/15 تاريخ القبول 2016/6/21

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الخلاصة

يهدف البحث الحالي لتقييم مياه نهر الديوانية باستخدام الطحالب الدايتومية كمؤشرات حيوية فضلا عن استخدام دليل بالمر للتلوث، جمعت عينات المياه والطحالب الدايتومية شهريا من آذار 2015 حتى شباط 2016، اختيرت ثلاث مواقع على نهر الديوانية ودرست فيها الخصائص الفيزيائية والكيميائية والحياتية ، وأظهرت النتائج أن مياه النهر جيدة التهوية، قليلة الملوحة، عسرة جدا، وقاعدية وقاعديتها تعود للبيكاربونات، كما بينت النتائج زيادة في بعض الملوثات خاصة في الموقع الثالث ويعود ذلك مياه الفضلات المنزلية ومياه المجاري والمخلفات الزراعية والصناعية الواصلة إلى النهر ويؤثر ذلك على العسرة الكلية، القاعدية، التوصيلية الكهربائية والملوحة لمياه النهر.

كانت الطحالب الدايتوميه المشخصة خلال فترة الدراسة 170 نوع تنتمي لـ 34 جنس، الأنواع المركزية منها 12تعود لـ 5أجناس، بينما الأنواع الريشية 153تنتمي لـ 32جنس، لوحظ زيادة في أعداد بعض الأجناس (*Achnanthes, Cymbella, Nitzschia,* *Navicula*). وزيادة في بعض الأنواع (*Cycltella comta, C. Kutzingana, C. meneghiniana, C. Ocellata,* *Pediastrum somplex, Diatoma elongatum* and *Cocconeis Placentula*) وتبعا لدليل بالمر للتلوث كانت مياه النهر معتدلة التلوث أو ملوثة إلى حد ما.

الكلمات المفتاحية: الطحالب الدايتومية، الأدلة الحيوية ،نهر.

Natural History - Biology Classification QH 540-549.5