ARTICLE / INVESTIGACIÓN

Classification of Some Species Algae in the Tigris River within the City of Baghdad- Iraq

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Abstract. Algae were diagnosed in three stations at three seasons for 2018-2019 in the Tigris River. It was diagnosed with 158 species for five main divisions (Chlorophyta, Bacillariophyta, Cyanophyta, Pyrrhophyta and Euglenophyta). Chlorophyta division represented 14 genera and 33 species with a percent of 20.88%, Bacillariophyta division was 22 genus and 84 species with a percent of 53.16%, division Cyanophyta was14 genus and 41 species with 25.94%, pyrrhophyta division was four genus and four species with 2.53%, and the Euglenophyta division was one species with 0.63%. The study also showed the essential common species for quantitative and qualitative studies within the study stations: Chlorella vulgaris, Oscillatoria lemmetica, Amphiprora alata, Nitzschia clausii and Navicula enigmatica. In conclusion, the study showed an abundance of algae densities within the study sites.
Keywords: Classification, Algae, Tigris River.

Introduction

The aquatic environment is essential, covering nearly 71% of the total area of the earth's surface, containing many living organisms such as bacteria, plants, phytoplankton and zooplankton., Freshwater represents 1% of the water area compared to salt water, as it represents a percentage of the total water and is unsuitable for drinking [1].

Inland water is limited in size and closed, strongly affected by the climate in the land around it. Due to its small size and lack of depth, the regular changes in the physical properties, chemical and distribution of organisms depends on these changes do not only get within the range is too narrow compared with what is happening in the sea, so the diversity of life in land waters far below as it owns inland water bodies a limited number of neighborhoods compared to marine water and because of the environmental changes in nature and that do not allow to remain only for those species that can adapt to these changes [2].

Algae generally live on the surface of the water and at different depths and are found in all water sources that are exposed to sunlight, phytoplankton plays an essential role in the food chain in the water as the photosynthesis process which produces food and carbohydrates that are used in metabolic processes or stored often in the form of starch or oils, so generally, phytoplankton and algae are primary products in many water systems. Its main sources of feeding fish, larvae, and other aquatic organisms, such as crustaceans and mollusks, are considered the most important food sources for humans [3].

In addition, algae are affected by many environmental conditions that help them to grow and reproduce, like temperature, pH, and other factors; therefore, the study of classification and diagnosis of algae is important for understanding species as inductor pollution or indicated to a high value of some elements[2].

The study aims to diagnose phytoplankton in the Tigris River and the city of Baghdad in the selected study stations and identify the species that may be considered as an indicator to the quality of water by placing the numbers and types of algae present in the water.

Materials and Methods

The study area

Conducted the current study on the Tigris River, selected three sites because of the pollutants that supply the Tigris River in those locations, as shown in Figure 1 (S1, north of Baghdad: near Al-Wathbaa station, is an industrial area and S2, south of Baghdad: near Jadiriyah brigade and S3, near the Al-Douraa refinery, is agricultural areas).

Sample Collection

Samples were collected during autumn 2018, winter and summer of 2019 by using glass bottles sterile with liter in size, taken from a depth of approximately 30 cm and three sites for each study station; samples were directed to the laboratory to conduct chemical measurements and by three replicates for each model and to complete the quantitative study proved by some drops of a local solution, then left to tow week in a sterile cylinder.

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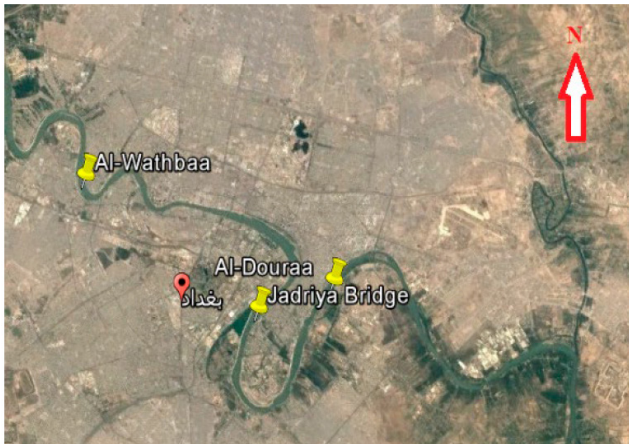

Figure 1. study stations on the Tigris

The qualitative study

Non-Diatoms were diagnosed through preparing temporary slides and examined using a microscope with a strength of 400X depending on the many sources in the diagnosis [4, 3, 5]. Diatoms were detected after treatment dissolved organic matter to clarify its structure and strongly 1000X[6].

Approved sources for the classification and wrote a list of algae

It has been relying on local and international authorities in the diagnosis and arranged a list of algae depending on Division, orders, classes, families and species, according to [7,8] in the arrangement of Diatoms depend on [9, 10,11,12] in the collection of green algae according to [8,12] in the order and structure of blue-green algae. At the same time, it relied on references [13] and [14] in the order and performance of Pyrrhophyta and Euglenophyta.

Results and Discussion

Phytoplankton is classified in the Tigris River within the city of Baghdad, in three selected sites in the three stations, as shown in Table (1).

Table (2) show the density of algal species amounting to158 species found within the five central Division in the world of algae, biomass in all stations of all species of algal 35.054 cell/l, including Chlorophyta, Bacillariophyta, Cyanophyta, Pyrrhophyta and Euglenophyta with density amounting 14.907, 11.949, 7106,1040 and 53 cells / l, respectively. The density of algal species is different in all stations and seasons values studied, where the highest recorded density is Chlorella Vulgaris 1903 cells / l. Less density of 430 cells /l, at the St1 in the winter and summer, respectively, either the highest density of 423 cells / l in St1 to Oscillatoria lemnetica and less density was 42 cells / l in the St2 through the autumn season.

The study showed the presence of 9 classes of 19 orders and included 36 families containing 55 species, which comprises 158 species. The majority of algae diagnosed as belonging to the division Bacillariophyta are 22, and the no. of species 84 in percent is 53.16%. In contrast, the Division of Chlorophyta contains a species of 33 and belongs to the 14 species with a percent of 20.88%, the blue,-green algae includes 41 species which belong to 14 species with a percent of 25.94%. Study agreement with [17] in the arrangement of dominant Division of algae, Division of Pyrrophyta includes four genera which contain four species with percent 2.53%. Finally, Euglenophyta has one Division that belongs to 1 genus with a percent of 0.63%, as shown in (Table3).

Results showed that the dominant bacillarophate on other algae appeared during the study seasons due to its ability to tolerate various environmental conditions [15] or maybe due to the silica [16]. As well as considering primary products in the ecosystem and food enrichment or cause intolerable acidity and salinity 18, also noted the dominance of pinnules Bacillariophyceae on central Bacillariophyceae, which is regarded as an organic pollution indicator as Nitzschia sp. on the all-season and stations. The study was completed with [19]. On the other hand, Cyclotella sp. appears in the autumn in all stations, a central Bacillariophyceae indicator of sewage contamination [20]. The blue-green algae also seem to have a high diversity in the water, including O. Lemnetica, which was available in all seasons and stations and, despite the few prepared and features, tolerate high pollution levels [21.]
Figure 2. Dominant algae species

Conclusions

The study also showed the essential common species for quantitative and qualitative studies within the study stations, namely Chlorella vulgaris, Oscillatoria lemmetica, Amphiprora alata, Nitzschia clausii and Navicula enigmatica. It showed an abundance of algae densities within the study sites.

Conflict declare

There are no conflicts

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Taxa	Autumn 2018			Winter 2019			Summer 2019		
1- Chlorophyta	St1	St2	St3	St1	St2	St3	St1	St2	St3
1-Class Chlorophyacea									
1-Order Chlorococcus									
1-Family Oocystaceae									
Kirchnerilla elongate	-	-	-	-	222*	-	-	-	-
K. lunaris	-	-	-	-	169*	-	-	-	-
K.lunaris(kirchner)mobius									255*
K.. obesa	-	85*	-	-	-	-	-	-	-
Oocysits ellprica	-	-	-	-	-	-	-	53	-
2-Family Chlorophaceae									
Monoriphidium sp.	-	253	-	-	-	-	-	-	-
M. contortum thuret									42
2-Order Volvocales									
1-Family Volvocaceae									
Pandoruna sp.	127	-	-	-	-	-	-		
2-Family Haematococcaceae									
H. lacustris	85	-	42	-	-	-	-		
3-Family Chlamydomonadaceae									
Chlamydomonas angulesa	-	-	-	-	-	-	241*		
Chl. dinobryoni	338*	-	-	-	-	-	-		
Chl. dinobryoni. Smith	465*	-	-	-	-	-	-		
Chl. epiphytiea	127*	-	-	-	42	-	-		
Chl. globosa	-	-	-	42	-	42	-		
Chl. sp.	127*	-	-	-	-	-	-	53	
Chl. polypyreoideum	-	-	-	-	-	212	-		
Chl. pseudopertyi	-	-	-	-	-	42*	-		
Chl. sonwii	-	-	-	-	-	-	85*		
3-Order Scenedesmacea									
1-Family Scenedesmaceae									
Scenedesmacemus bijua	-	-	127*	-	-	-	-	-	
S.quadricanda	-	-	-	-	-	-	-	42	
S.quadricanda var.quadrispina	254	-	-	-	-	-	-		
2-Class Trebouxiophyaceae									
1-Order Chlorellales									
1-Family Chlorellaceae									
Ankistrodesmus facatus	127*	-	42*	-	42	-	-	-	-
A. facatus var. acicularis	42*	-	42	-	-	-	-	-	-
A. facatus var . stipitatus	211*	-	-	-	-	-	-	-	-
A. facatus (Corda)Ralfs	-	-	-	-	-	-	14	-	-
Chlorella ellipsoidea	667	-	-	-	-	-	-	-	-
Ch. vulgaris	1311	1312*	1395*	1903*	549*	1565*	440*	340	-
Ch. sp.	-	127	-	-	-	-	-	112	-
Chl. polypyreoideum	-	-	-	-	-	212	-		
Chl. pseudopertyi	-	-	-	-	-	42*	-		
Chl. sonwii	-	-	-	-	-	-	85*		
2-Order Incertaesedis									
1-Family Incertaesecae									
Crucigenia tetrapedia	42	-	-	-	-	-	-	-	-
3-Order Chlamydomonadales									
1-Family incertaesedis									

Golenkinia pavcispina	-	-	-	-	42	-	-	-	-
3-Class Zygnematophyaceae *1-Order Desmidales* *1-Family Demidiaceae*									
Chrysidiastrumcatenatum	-	42	-	-	-	-	-	-	-
Cosmiarium reniforme	-	-	-	-	-	-	-	-	-
C. subcrenatum	-	634	-	127*	-	127*	-	-	-
Dactylococcopsis fasciccularis	42*	-	-	-	-	-	-	-	-
Total	14907								
2-Bacillariophyta **1-Class Diatomatae** **1-Order Centrales** **1-Family Centtralacea**									
Cyclotella ctenat *(A.Brau)Bachmann*	42*	-	-	-	-	-	-	-	-
C. meneghiniana	-	-	317*	-	-	-	-	-	-
C. meneghiniana Kutzing	-	-	-	-	-	-	73*	-	24
Cy. sp.	-	42	-	-	-	-	-	-	-
2-Family Stephanosiscaceae									
Stephanodicus dubius	85	-	-	-	-	-	-	-	-
2-Order Pennales **1-Family Achanthaceae**									
Achanthes affinis(Kutz). Cleve	85	-	-	-	-	-	42	-	-
A. affinis Grunow	-	-	-	-	-	-	-	84	-
A. minutissima.epiralve	42*	-	-	-	-	-	-		-
A. microcephala	-	-	-	-	-	42	-	42	-
A. minutissima kutzing	42*	-	-	-	-	-	-	-	-
2-Family Amphipleuroraceae									
Amphiprora alata	-	*	-	338*	-	254	54	254	-
A. venta	-	-	-	-	-	-	54	-	-
3-Family Bacillariaceae									
Bacillaria paxillifer	-	-	84	-	-	-	-	-	-
B .paradox Gmelin	-	-	-	-	-	-	-	-	24
Nitzschia acicularis	-	-	218*	-	-	-	-		-
Nit. clausii	-	*	-	42*	-	42*	-	42*	-
Nit. fruticosa	-	-	-	-	84*	-	-	-	-
Nit. gracile	-	-	42*	-	-	-	-	339*	-
Nit. longissima	211*	-	-	-	-	-	-	-	-
Nit. obtusa N. Smith	-	-	--	-	-	-	-	-	218*
Nit. minutula	-	-	-	-	-	-	-	196*	-
Nit. palea	-	-	85*	-	-	-	-	-	211*
Nit. sigma	-	-	85*	-	-	-	-	-	-
Nit. trybionella	-	-	-	-	-	42*	-	42*	-
Nit. rostetlata	169*	-	-	-	-	-	-	-	-
Nit. umbonata	-	-	-	-	-	-	50*	-	-
Taxa	**Autumn 2018**			**Winter 2019**			**Summer 2019**		
4-Family Cymbellaceae									
Cymbella affinis kutzing	-	-	-	-	-	-	-	54	-
C. bybrida	-	-	-	-	-	-	42*	-	-
C. caespitosa	-	-	-	-	-	255*	-	255*	-
C. cistula (Her.) O.	-	-	-	-	-	-	-	-	169
C. gracilis (Rabh.)Cleve	-	-	-	-	-	-	-	211	-
C. prostate	-	-	-	211*	-	211	-	-	-

C. ventricosa kutzing	-	-	-	-	-	-	-	85	-
C. prostate (Berk.)Cleve	-	-	-	-	-	-	-	211*	-
Cymatopleura hybrida	-	-	-	-	-	-	*		-
C. solea	-	-	-	-	-	-	85*		-
5-Family Fragilariaceae									
Fragilaria brevistriata	-	-	-	169*		169*	-		-
F.copucina Desmazieres	-	-	-	-	-	-	21		-
F. products	-	-	-	-	-	-	-	21	-
Fragilaria vaucheriae				-	-	42*	-		-
Fragilaria sp.	-	85*	-	-	-	-	-		-
Ditoma elongate	-	-	-	-	-	-	-		85*
D.elongate Bory	-	-	-	-	-	-	123*		-
D.vulgaris		127*	-	-	-	-	-		-
Synedra tabulate	-	-	42	-	-	-	-		-
S. ulna var.biceps (Kut.z)	-	-	-	-	-	-	-		42
6-Family Gomphonemataceae									
Gomphonema fanensis	-	-	42	-	-	42	-		-
G. lanceolatum Ehrenberg	-	-	-	-	-	-	-		24
G.olivaceum (Lung.) kutzing								42	
G. paravalum (Kuz.) Grunow								85	
7-Family Eunotiaceae									
Eunotia tenella	-	42	-	-	-	-	-		-
8-Family Mastogloiaceae									
Mastogioa smith. Grunow	254	-	-	-	-	-	34		-
9-FamilyPleuroigmataceae									
Gyrosigma attnatum	-	-	-	-	-	-	85*	-	-
10-Family Naviculaceae									
Naviculla Americana	42*	-	-	-	-	-	-	-	-
N. dissipata	-	-	-	-	-	-	*	-	-
N. enigmatica	42*	-	-	42*	-	42*	109*	-	*
N.halophile var.robusta fo	-	-	-		-	-	-	-	20
N. goppertiana (Grun.) Cleve	-	-	-	-	-	-	-	-	-
N. gracilaides A.Mayer	-	-	-	-	-	-	-	42	-
N. gracilaides Hantzch	-	-	-	-	-	-	-	42*	-
N. minuscula Grunow	-	-	-	-	-	-	-	42	-
N. mutica Kutzing	-	-	-	-	-	-	-	-	42
N. radiosa	-	211	-	-	-	-	-	-	-
N. resola	-	-	42	-	42	-	-	-	-
N. schroeteri	-	-	-	1251*	-	254	-	-	-
N. schroeteri Meister	-	-	-	-	-	-	-	42	-
N. sigma	-	85	-	-	-	-	-	-	-
N. phyllepta	-	42*	-	-	-	-	-	-	-
Na. sp.	-	-	-	-	-	-	-	127*	-
Caloneis bacillum	-	42	-	-	-	-	-	-	-
11-Family Cocconeisdisculus									
Cocconeis pediculus Ehrenberg	42*	-	-	-	-	-	-	-	42
C. placentula	-	-	-	-	-	-	77*	-	-
C. placentula Ehrenberg	-	-	-	-	-	-	-	-	77*

C. placentula Ehrenberg	-	-	-	-	-	-	-	-	77*
12-Family Surirellaceae									
Stavroneis pseudosubbtusoides	-	-	-	-	42	-	65	-	-
Surirella delicatissima	-	-	-	254*	-	296	-	-	-
S.ulna (Nitz.)Ebrenbery	-	-	-	-	-	-	-	24	-
S. W.Smith	-	-	-	-	-	-	-	85	-
13-Family pinnulariaceae									
Peronia fibula	-	127*	-	-	-	-	-	-	
P.leptosome (Grun) Cleve	-	-	-	-	-	-	-	-	127*
Pinnularia acoricola	254	-	-	-	169*	-	-	-	-
P. appendiculata	-	-	-	-	-	-	96*	-	-
P. globicepes	-	42*	-	-	-	-	-	-	-
P. lundii	-	85*	-	-	-	-	-	-	-
P. mesolepta	-	-	-	-	-	-	57	-	-
Total	11949								
3-Divison Cyanophyta **1-Class Myxophtceae** **2-Order Chroococcales** **1-Family Chroococcaceae**									
Chroococcus cohaerens	42	-	-	-	-	-	-	-	-
Chr.. disperses	-	211*	42*	-	-	-	-	-	-
Chr. minor	-	42	-	-	-	-	-	-	-
Chr. pallidus	-	-	-	-	42*	-	-	42*	-
Chr. turgidus	-	-	42	-	-	-	*	-	-

Taxa	Autumn 2018			Winter 2019			Summer 2019		
Gloeocapsa indicus	-	169	-	175	-	211	-	-	-
Glo. montanuas	-	42*	-	-	-	-	-	-	-
Gloeothca rhodochamyes	-	42	-	-	-	-	-	-	-
2-Order Hormogonales **1-Family Oscillatoriaceae**									
Oscillatoria acutissima Kufferath	-	-	-	-	-	-	-	-	196
O. amphibian	42*	-	-	-	-	-	-	-	-
O. claricentora	42	-	-	-	-	-	-	-	-
O. curviceps Agardh	-	-	-	-	-	-	-	-	75*
O. curviceps. Gardner	-	-	-	-	-	-	75*	-	-
O. lemmetica	423*	42	168	85	169	85	-	169	-
O. lemmermanni	-	-	-	687*	-	720*	-	-	678*
O. limnetica lemmermann	-	-	-	-	-	-	23	-	-
O. limosa (Roth.) Agardh.	-	-	-	-	-	-	-	-	85
O. sancta(Kutz.). Gomont	-	-	-	-	-	-	-	-	42
O. subbrevis. Schinidle	137*	-	-	-	-	-	-	-	-
O. subbrevis Vaucher	-	-	-	-	-	-	20*	-	-
O. tenuis	211*	-	-	-	-	-	-	85	-
O. tenuis Agardh	-	-	-	-	-	-	12*	24	42
Dactylococcopsis fascicularis	42*	-	-	-	-	-	-	-	-
2-Class Cyanophyaceae **1-Order Synechococcales** **1-Family Synechococcaceae**									
Synechococcus aeruginosus	42	-	-	-	-	-	-	-	
Dermocarpalla hemisphaeriea	-	169	-	-	-	-	-	-	-

2-Family Schizotrichaceae									
Schizothrix lacustris	42	-	-	-	-	-	-	-	-
2-Order Oscillatoriale 1-Family Oscillatoriaceae									
Blue green filaments algae	-	-	296*	-	-	-	32*	-	-
Lyngbya aestuarii Lemmermann	85*	-	-	-	-	-	-	-	85*
L. limneetica. lemm	85*	-	-	-	-	-	-	-	-
L. sp.	-	-	-	-	-	-	-	-	85*
Phormidium ambiguum Gomont	42	-	-	-	-	-	-	-	42
Ph. tennes	42	-	-	-	-	-	-	-	-
Ph. Tennes (Meenegh.) Gomont	-	-	-	-	-	-	-	-	76
Ph. unciatum	-	-	-	-	-	-	34*	-	-
Ph. sp.	-	-	-	-	-	-	-	-	42
Spiralina major Kuetizng	42	-	-	-	-	-	80*	-	-
Sp. major Kuetizng (Witter.)	-	-	-	-	-	-	-	85	-
3-Order Chroococcales 1 -Family Microcystaceae									
Microcystis aeruginosa	-	-	-	42*	-	84*	-	-	-
M. flosquae	42	-	-	-	-	-	-	-	-
4-Order Nostocales 1-Family									
Nostoc muscorum Agarda	-	-	-	-	-	-	76*	-	-
Aulosira sp.	-	-	-	-	-	-	-	-	11
Total	7106								
4- Division Euglenophyta 1-Class 1-Order Euglenales 1- Family Euglenaceae									
Euglena elongate	-	-	-	-	-	-	11*	-	42
Total	53								
5-Division Pyrrhophyta 1-Class Chrysophyaceae 1-Order Chromulinales 1-Family Dinobryaceae									
Dinobryon calciformis	42	-	-	-	-	-	-	211	-
2-Class Dinophyaceae (dinoflagellates) 1-Order Peridiniales 1-Family Peridiniaaceae									
Glenodiniumgymnodinium	-	-	-	-	127	-	-	-	-
Peridinium pusillum	-	534	-	-	-	-	-	-	-
2-Order Gymnodiniale 1-Family Gymnodinialacea									
Gymnodoinium sp.	-	84*	-	-	42	-	-	-	-
Total	1040								

Table 1. Classification of the Algae in Three Stations

Algae	Class	Order	Family	Genes	Species	Percentage %
1-Chlorophyta	3	7	10	14	33	20.88
2Bacillariophyta	1	2	15	22	84	53.16
3- Cyanophyta	2	6	7	14	41	25.94
4- Pyrrhophy	2	3	3	4	4	2.53
5-Euglenophyta	1	1	1	1	1	0.63
Total	9	19	36	55	158	100

Table 2. Biomass and No. of total algae cell/l

Station	Algae / Seasons	Chlorophyta	Bacillariophyta	Cyanophyta	Pyrrhophyta	Euglenophyta	Total
ST1	Autumn	3965	1310	1361	42	-	6678
	Winter	2072	2357	989	-	-	5418
	Summer	780	1067	352	-	11	2210
ST2	Autumn	2453	930	717	618	-	4718
	Winter	1066	337	211	169	-	1783
	Summer	638	2195	405	-	-	3238
ST3	Autumn	1648	957	548	-	-	3153
	Winter	1988	1691	1100	-	-	4779
	Summer	297	1105	1417	211	42	3072
Biomass		14907	11949	7106	1040	53	35.054

Table 3 A general classification for species within the classes

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Scenedesmus

Chroococcus

Oscillatoria

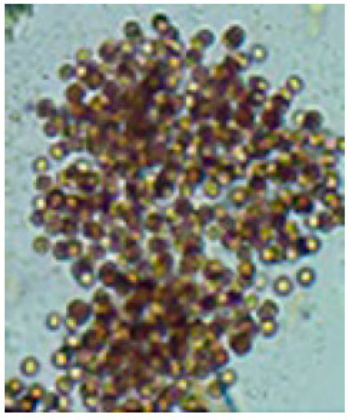
Nitzschia

Euglena

Stephanodicus dubius

Spiralina

Naviculla



Microcystis

Figure 2. Dominant algae species

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