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The Qualitative and Quantitative Composition of Epiphytic Algae on *Ceratophyllum demersum* L. in Tigris River within Wassit Province, Iraq

Teba A. Abdalhameed ***Jinan S. Al Hassany****

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Abstract:

The present research was performed to study the qualitative and quantitative composition of epiphytic algae on the aquatic host plant *Ceratophyllum demersum* L. Four sites in Tigris River, at Wassit Governorate were covered, during the seasons of Autumn 2017, winter 2018, Spring 2018, and Summer 2018. The study also included measuring the physiochemical parameters (temperature of air and water, pH , water level, EC, salinity, TDS, TSS, dissolved oxygen, BOD5, alkalinity, total hardness, calcium, magnesium, total nitrogen, total phosphourus). The total number of species of epiphytic algae was145 species, 98 species belonging to Bacillariophyceae, followed by 27species of class Cyanophyceae, 19 species of class Chlorophyceae, 4 species of class Euglenophyceae, and only 1 species for each of Chrycophyceae and Rhodophceae. The total number of epiphytic algae ranged from 1681×10^4 cell/gm in Winter to 2014.95×10^4 cell/gm in Spring. The range of biodiversity indices was (1-8.2) for Richness index, (1.5-3.2) for Shannon index and (0.3-0.65) for Evenness index.

Key words: *Ceratophyllum demersum* L.**,** Epiphytic Algae, Tigris River, Wassit Province.

Introduction:

Epiphytic algae are attached to the surface of the aquatic plants. They play a very important role in the freshwater ecosystems; because they are source of the primary production, considered as a rich nutrition source for aquatic living organisms, they move the energy from the sediment to the water column(1), and make a balanced case between the aquatic organisms (2,3,4). Furthermore, algae contribute to oxygen production via the photosynthesis process(5). Human activities in agriculture, industry, and urbanization produce large amount of pollutants that affect the aquatic livings, making it necessary to use these livings especially the algae as indices for evaluating the water quality(6,7,8) *Ceratophyllum demersum* is considered a native plant all over the world. It is characterized by its forked appearance and exists as submerged, or might be anchored to the soil by the rhizoidal shoot which are the buried branched ends of the stem. The stems are slim and branched with one branch emerges from each node. The leaves of the plant are sessile with margins of toothed appearance, with 5 to 12 leaves branching out from each node(9).

Department of Biology, College of Science for Women, University of Baghdad, Baghdad, Iraq.
*Corresponding author: JinanShawai@gmail.com

Plenty of studies about the epiphytic algae were previously conducted(2,10, 11,12, 13)**.** This study aimed to screen the community of epiphytic algae on the aquatic plant *C. demersum* and applying diversity indices in Tigris River at this province.

Materials and Methods:

The samples of water and plant were collected from four sites (Table1) (Site1: The end of Al-Aziziyah, Site2: Zubaidiyah Electricity plant, Site3: Zubaidiyah Concrete Bridge, Site4: After Zubaidiyah Concrete Bridge) selected along Tigris river in Wassit Province in the south of Iraq (Fig.1). Samples were collected on monthly basis from October_2017, to July_2018. According to previously described methods, water physiochemical parameters were measured for EC, TDS, TSS, pH, DO, BOD (14), total alkalinity, total hardness, calcium, magnesium, total nitrogen (15), total phosphorus (16), and reactive silicate (17). Plant samples were collected in plastic bags with small amount of river's water. The shaking and scraping method was applied to separate the epiphytic algae from the plant surface. Plant samples were cut into parts of a 2-3cm length, these plant parts of the plant were shaken with 50-100ml of the environment water, then the surface of the plant was scrapped by smooth brusher. Samples

were preserved in a container with Lugol's solution for the qualitative study. For the quantitative study, samples were preserved for 10-15 days in cylinders (100ml) by using Lugol's solution for precipitation. The precipitates (20-30ml) were stored with some drops of Lugol's solution in containers that are marked with date and site. Permanent slides were prepared for the purpose of diatoms identification and the examination by light microscope (40x-100x), while temporary slides were prepared for the non-diatom identification on (100 x). The micro transect method was applied for the counting of diatom cells (100x) and the Hemocytometer (40x) was used to count the non-diatoms cells. (18, 19).Key references(20,21, 22,23).

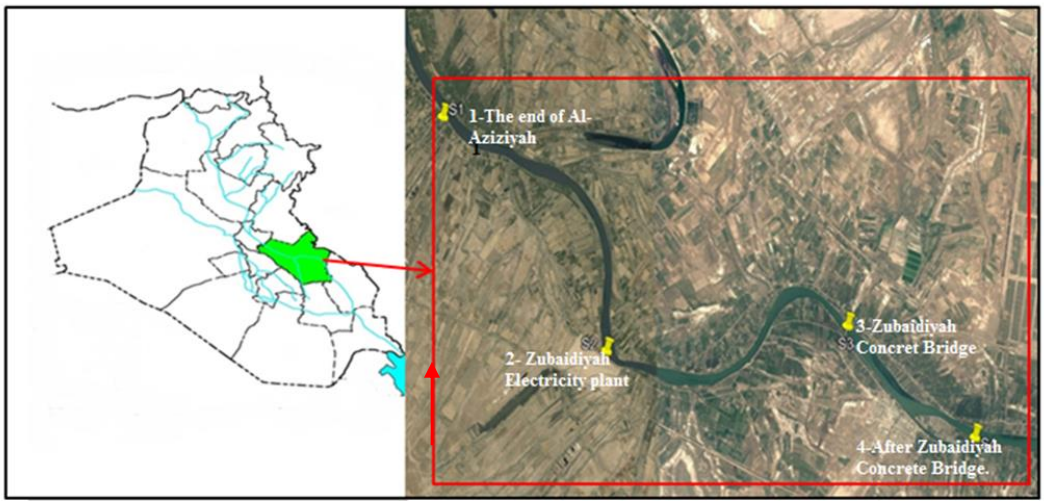

Figure 1. Study sites in Wasit province

Table 1. The geographical position of the study sites

Site No.	Site	The Coordinates
1	The end of Al-Aziziyah.	32°49'31.44" 45°02'26.49"
2	Zubaidiyah Electricity plant.	32°46'31.26" 45°05'15.81"
3	Zubaidiyah Concret Bridge.	32°46'42.41" 45°09'36.30"
4	After Zubaidiyah Concrete Bridge.	32°45'15.01" 45°11'49.87"

Table 2. The Seasonal number of epiphytic algae species in classes on *Ceratophyllum demersum*.

Year	2017		2018	
Classes	Autumn	Winter	Spring	Summer
CHLOROPHYCEAE	5	2	7	13
CHRYSOPHYCEAE	-	-	-	1
BACILLARIOPHYCEAE	45	50	43	47
EUGLENOPHYCEAE	-	0	3	3
CYANOPHYCEAE	8	4	12	20
RHODOPHYCEAE	-	-	-	1
Total	58	56	65	84

Results and Discussion:

The biodiversity results are illustrated in Tables 2, 3, and Fig. 1,3,4. This study recorded 145 identified species of epiphytic algae on *Ceratophyllum demersum* that belong to 48 genera as previously classified (24). 98 species belong to 24 genera were recorded for Bacillariophyceae, 27 species belong to 11 genera for Cyanophyceae, 16species belong to 9 genera of Chlorophyceae, 4 species belong to 2 genera for Euglenophyceae, while each of Chrycophyceae and Rhodophceae recorded only 1 species. The highest number of species was 85 recorded in Summer, followed by 65 species in Spring, 58 species in Autumn, with a lower number of 56 species in Winter. The spatial variations in the number of species were as follows: the highest number of 106 species was recorded in Site 4, followed by 103 species in Site1, 73 species in Site 3, and the lowest number of species was 68 in Site 2.

In the quantitative study, the most important class was also Bacillariophyceae, as it accounted for 90 % of the total number of epiphytic algae. Chlorophyceae had the second highest percentage of 6%, each of Cyanophyceae and Rhodophyceae recorded 2% only, while the rest of classes did not show a significant percentage. The highest total number of epiphytic algae occurred in Spring season (2014.955×10^4 cell/gm), followed by Autumn (1985.55×10^4 cell/gm), Summer (1711.13×10^4 cell/gm), and finally Winter (1681×10^4 cell/gm). The Spatial differences were obvious in the quantitative study results; the total number of epiphytic algae was the highest in Site 4 (5759.6×10^4 cell/gm), followed by Site1 (4201.64×10^4 cell/gm), Site3 (3045×10^4 cell/gm), and the lowest total number of epiphytic algae was in Site2 (1803.2×10^4 cell/gm).

Bacillariophyceae was most abundant class. This phenomenon is common in the Iraqi internal

water due to their ability for wide range of environmental conditions and because of the availability of the silica in the Iraqi basins which is an important component in the Diatoms' frustule(25, 26, 27). Cyanophyceae was more abundant than Chlorophyceae in the number of species and such result was expected since it is consistent with previous reports (28). Seasonal and spatial variations were due to the different environmental conditions and the response of epiphytic algae to these conditions(29). The highest number of species was recorded in Summer and the largest biomass occurred in Spring. These results can be due to the increase in temperature and photic zone during these two seasons. This explanation is supported by the results of the present study which recorded water temperature of 29 and 21 Cº and Photic zone of 89 and 87cm in Summer and Spring, respectively. Other possible reasons can be related to day length and elevated levels of essential nutrient resulting from increase in the metabolism processes of the aquatic plants (30, 31). These results agree with those of previous studies (32).

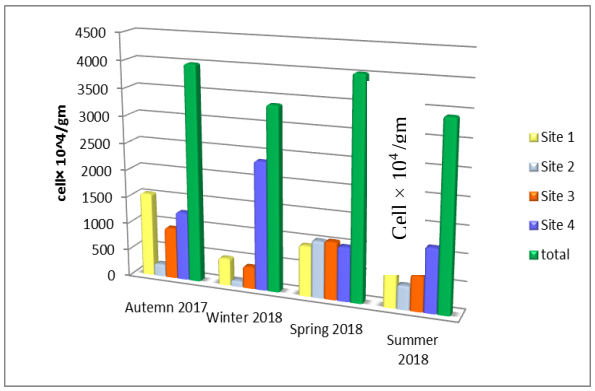

Figure 2. seasonal variation in the total number of epiphytic algae on *C. demersum* inhabiting Tigris River in all study sites within Wassit Province during the study period.

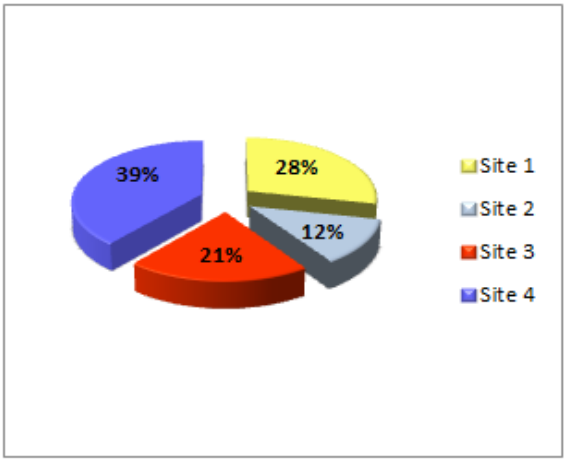

Figure 4. The percentage of total number of epiphytic algae on *C. demersum* in the study sites in Tigris River in Wassit province.

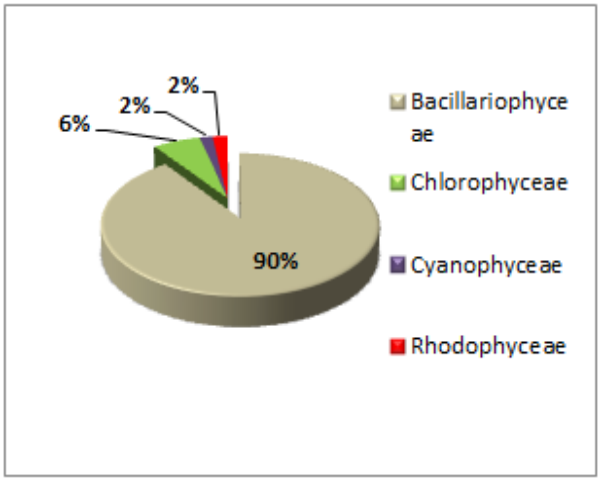

Figure 3. The percentage of epiphytic algae classes on *C. demersum* inhabiting Tigris River in Wassit province.

Winter season showed low diversity and biomass of epiphytic algae because the plant was not present in all the study sites during this season. This absence of the host plant was due to the rainfall caused erosion of *C.demersum*, where this plant is free floating and has no roots (9).

The highest diversity and total numbers of epiphytic algae were recorded in the sites 4 and 1, possibly because these sites were surrounded by agriculture areas and grazing activities, rendering that they were vulnerable for the organic pollution as explained in previous studies (33). Lower number of species and biomass was recorded in the Site3, which is likely due to the swimming and fishing activities. The reduction in the site 2 has possibly resulted from the polluted drainages from the adjacent electricity plant. Some genera such as, *Cocconies*, *Rhoicosphenia*, *Gomphonema*, *Navicula*, *Nitztchia* and *Synedra* existed continuously during the period of the study due to their tolerance to the surrounded environmental conditions and their position of steady means for attaching on the hosted aquatic plants. The genus *Cocconies* attaches by the encrusting form, *Rhocosphenia* and *Gomphonema* by the short or long stalk, *Navicula* and *Nitztchia* by the mucilaginous tube, and *Synedra* by the mucilage pads (32, 34).

Table 3. the seasonal total number of epiphytic algae on *C. demersum* and their percentages.= not found

Season / Taxa	Aut. 2017	%	Wint. 2018	%	Spri. 2018	%	Sum. 2018	%
CHLOROPHYCEAE								
Cladophora glomerata (L.) Kützing	0.01	0.00	0.4	0.02	0.55	0.02	15.35	0.89
Cladophora sp.	0.6	0.03	-	-	0.05	0.00	-	-
Cosmarium botrytis Meneghinii	0.2	0.01	-	-	-	-	3	0.17
Mougeotia sp	-	-	-	-	-	-	8.575	0.50
Oedogonium undulatum (de Bréb.) A. Braun	-	-	-	-	-	-	26.2	1.53
Oedogonium spp.	-	-	-	-	0.2	0.00	64.4	3.76
Oedogonium sp.	0.7	0.04	0.4	0.02	0.4	0.01	-	-
Pediastrum boryanum (Turp.) Meneghinii	-	-	-	-	-	-	0.3	0.01
P. duplex var. *clathratum* (A. Braun) Lagerheim	-	-	-	-	-	-	0.05	0.00
P. simplex Meyen	-	-	-	-	-	-	0.75	0.04
Scenedesmus arcuatus Lemmermann	-	-	-	-	-	-	1.95	0.11
S. bijuga (Turp.) Lagerheim	0.05	-	-	-	0.2	0.00	3.95	0.23
S. opoliensis P.Richter	-	-	-	-	-	-	0.56	0.03
S. quadricauda (Turp.) de Brébisson	2.55	0.13	-	-	0.085	0.00	-	-
Spirogyra sp.	-	-	-	-	0.1	0.00	233.25	13.63
Staurastrum gracile Ralfs	-	-	-	-		-	0.25	0.01
Stigeoclonium stagnatile (Haz.) Collins	-	-	-	-		-	93.85	5.48
Ulothrix sp.	-	-	-	-	-	-	0.7	0.04
CHRYSOPHYCEAE								
Dinobryon sp.	-	-	-	-	-	-	2.05	0.11
BACILLARIOPHYCEAE								
A-CENTRALES								
Aulacoseira granulata(Ehr.) Ralfs	51.55	2.65	-	-	8.65	0.42	126.15	7.37
Aulacosira italicum (Ehr.) Kutzing	-	-	46.25	2.75	20.65	1.02		
Aulacoseira varians Agardh	49	2.52	92.45	5.50	151.75	7.53	39.9	2.33
Coscinodiscus sp.	9.65	0.50	-	-	8.15	0.40	-	-
Cylotella comta Kützing	-	-	-	-	13.1	0.65	-	-
Cyclotella meneghiniana Kützing	113.4	5.82	18.75	1.11	35.3	1.75	39.9	2.33
C. striata (Kütz.) Grunow	60.65	3.11	7.25	0.43	16.55	0.82	-	-
B-Pennales								
A. hungarica Grunow	22.4	1.15	10.9	0.64	-	-	-	-
A. microcephala (Kütz.) Grunow	35.315	1.81	151.4	9.01	9.05	0.44	215.9	12.61
A. minutissima Kützing	81.25	4.17	170.3	10.13	13.6	0.67	177.85	10.39
Amphora veneta Kützing	-	-	1.3	0.07	-	-	2.25	0.13
Bacillario paradoxa Gmelin	-	-	-	-	11.6	0.57	-	-
Caloneis bacillum (Grun.)Mereschkowsky	-	-	-	-	-	-	6.25	0.36
Cocconeis pediculus Ehrenberg	36.35	1.87	67.85	4.03	200.85	9.96	75.95	4.43
C. placentula Ehrenberg	158.05	8.12	153.45	9.13	237.5	11.78	20.25	1.18
C. placentula var. *euglypta (*Ehr.) Cleve	226.34	11.66	149.85	8.92	234.45	11.63	65.55	3.83
C. placentula var. *lineata* (Ehr.) Cleve	38.05	1.95	88.25	5.25	-	-	-	-
Cymatopleura solea (Brbisson)W.Smith	1	0.05	-	-	-	-	-	-
Cymbella affinis Kützing	-	-	-	-	19	0.94	0.25	0.01
C. aspera (Ehr.) Cleve	8.7	0.45	-	-	-	-	-	-
*C. cistula (*Hemp.) Grunow	-	-	-	-	-	-	3.65	0.21
C. tumida (Bréb.)V. Heurck	12.35	0.63	-	-	-	-	0.9	0.05
C. turgida (Greg.) Cleve	5.195	0.27	-	-	-	-	-	-
Diatoma elongota (Lyngbya)C. Agardh	60.75	3.12	26.1	1.55	52.4	2.60	109.9	6.42
D. elongata var. *minor* Grunow	-	-	12.7	0.75	-	-	-	-
D. elongata var. *tenuis* C.Agardh Van Heurck	-	-	5.1	0.30	-	-	-	-
Diatoma vulgaris Bory	43.05	2.21	33.65	2.00	31.9	1.58	39.65	2.31
Diatoma vulgaris var. *brevis* Grunow	-	-	0.8	0.04	-	-	-	-
Diatoma vulgaris var. *ovalis* (Fricke) Hustedt	-	-	0.95	0.05	-	-	-	-

Diploneis. ovalis var. *oblongella* Naegeli	-	-	-	-	-	-	1.15	0.06
Epithemia. zebra (Ehr.) Kützing	-	-	-	-	-	-	2.05	0.11
Fragillaria.bidens Heiberg	-	-	-	-	62.35	3.09	-	-
F.brevistriata Grunow	-	-	-	-	68.55	3.40	-	-
F.construens(Ehr.) Grunow	-	-	26.4	1.57	-	-	5.75	0.33
F. copucina Desmazieres	-	-	-	-	76	3.77	-	-
Gomphonema acuminatum Ehrenberg	-	-	13.2	0.78	-	-	-	-
G. augur Ehrenberg	-	-	1.95	0.11	-	-	-	-
G. constrictum var.*capitata* (Ehr.) Cleve	-	-	8.25	0.49	-	-	0.65	0.03
G. bohemicum Reichelt & Fricke S.	-	-	-	-	7.4	0.36	-	-
G. gracile Ehrenberg	-	-	-	-	-	-	1.25	0.07
G. lanceolatum Ehrenberg	-	-	14.85	0.88	-	-	1.6	0.09
G. longiceps Ehrenberg	-	-	29.7	1.76	-	-	-	-
*G. olivaceum (*Lyng.) Kützing	43.75	2.25	42.2	2.51	68.75	3.41	0.4	0.02
G. parvulum (Ehr.) Grunow	42.65	2.19	57.65	3.43	146.2	7.25	0.75	0.04
G. sphaerophorum Ehrenberg	13.3	0.68	40.9	2.43	-	-	4.45	0.26
G.truncatum Ehrenberg	-	-	-	-	26.6	1.32	-	-
Mastogloia braunii Grunow	-	-	-	-	-	-	3	0.17
Mastogloia smithii Thwaites	-	-	-	-	-	-	1.15	0.06
Navicula cincta (Ehr.) Kützing	42.5	2.18	-	-	13.2	0.65	4.75	0.27
N. cryptocephala Kützing	51.25	2.63	1.15	0.06	12.65	0.62	7.95	0.46
N. cuspidata Kützing	30.05	1.54	9.9	0.58	-	-	1.9	0.11
N.granulata Grunow	-	-	-	-	-	-	-	-
N.gracilis Hantzsch	11.8	0.61	-	-	-	-	-	-
N.gregaria Donkin	-	-	-	-	9.05	0.44	-	-
N. halophila (Grun.) Cleve	-	-	-	-		-	0.4	0.02
N. inflata Donkin	23.85	1.22	7.9	0.47	4.95	0.24	4.45	0.26
N.oblonga (Kütz.) Kützing	-	-	-	-	-	0	0.55	0.03
N. radiosa Kützing	23.65	1.21	7.25	0.43	-	-	-	-
*N.recta J.*Brun & Heribaud	-	-	0.95	0.05	-	-	-	-
N. rhyncocephala Kützing	10.25	0.53	-	-	8.25	0.40	-	-
N. spicula (Dick.) Cleve	-	-	-	-	-	-	0.05	0.00
Navicula sp.	-	-	-	-	-	-	0.15	0.00
Nitzschia amphibia Grunow	37.05	1.90	83.9	4.99	-	-	1.55	0.09
N. apiculata (Greg.) Grunow	18.05	0.93	-	-	-	-	-	-
N. clausii Hantzsch	-	-	-	-	3.3	0.16	-	-
N. dissipata (Kütz.) Grunow	-	-	11.9	0.70	-	-	-	-
N. filiformis (W. Smith) Hustedt	-	-	2.95	0.17	4.45	0.22	1.75	0.10
N. fonticola Grunow	-	-	7.75	0.46	-	-	-	-
N. frustulum Kützing	-	-	-	-	-	-	6.75	0.39
N. granulata Grunow	35.4	1.82	-	-	-	-	-	-
N. hanitzchia Rabenhorst	-	-	1.15	0.06	17.75	0.88	-	-
N. microcephala Grunow	-	-	-	-	-	-	0.1	0.00
N. obtusa W. Smith	28.95	1.49	22.95	1.36	13.65	0.67	1.65	0.09
N. palea (Kütz.) W. Smith	-	-	37.45	2.22	-	-	1.25	0.07
N romana Grunow	7.6	0.39	-	-	-	-	-	-
N. scalaris (Ehr.) W. Smith	15.5	0.80	17.15	1.02	-	-	-	-
N. sigma (Ehr.) W. Smith	-	-	1.3	0.07	-	-	0.25	0.01
N. sigmoidea (Ehr.) W. Smith	110.5	5.67	-	-	18.55	0.92	-	-
N. sublinearis Hustedt	-	-	0.65	0.03	-	-	-	-
pinnularia subcapitata	-	-	-	-	32.5	1.61	-	-
pinnularia virids(Nitzs.) Ehrenberg	-	-	-	-	3.7	0.18	-	-
Pleurosigma salinarum Grunow	38.45	1.97	-	-	-	-	-	-
Rhoicosphenia curvata (Kütz.) Grunow	64.35	3.30	32.65	1.94	105.65	5.24	-	-
Rhopalodia gibba (Ehr.) *Müller*	-	-	-	-	-	-	2.5	0.14
Synedra acus var. *radians* Kützing	-	-	-	-	16.1	0.79	0.75	0.04
S. affinis Kützing	59.7	3.07	13	0.77	-	-	-	-
S. capitata Ehrenberg	7.65	0.39	-	-	-	-	4	0.23
S. fasciculata (Kütz.) Grunow	4.3	0.22	16.35	0.97	-	-	-	-
S.filliformis Grunow	-	-	-	-	7.85	0.38	-	-
S.nana F.Meister	-	-	-	-	8.25	0.40	-	-
S.tabulata (C.Agardgh)Kützing	-	-	14.55	0.86	-	-	-	-
S. ulna (Nitz.) Ehrenberg	99.5	5.11	43.45	2.58	170	8.43	10.1	0.59

S. ulna var. *biceps* Kützing	49.6	2.55	51.85	3.08	-	-	-	-
S. vaucheria Kützing	59.3	3.05	19.8	1.17	28.75	1.42	-	-
Surirella delicatissma F.W *Lewis*	-	-	0.3	0.01	-	-	-	-
S. robusta Ralfs *ex* Pritchard	-	-	-	-	-	-	0.3	0.01
S.minuta Brebisson ex Kützing	-	-	-	-	8.65	0.42	-	-
S. ovata Kützing	-	-	-	-	-	-	0.5	0.02
EUGLENOPHYCEAE								
Euglena spirogyra Ehreenberg	-	-	-	-	0.005	0.00	-	-
Euglena sp.	-	-	-	-	0.005	0.00	0.6	0.03
Phacus orbicularis Hubner	-	-	-	-	0.01	0.00	0.2	0.01
Phacus sp.	-	-	-	-	-	-	0.95	0.05
CYANOPHYCEAE								
Anabaena sp.	-	-	-	-	0.05	0.00	0.85	0.04
Aphanocapsa elasticha West&G.S.West	-	-	-	-	-	-	0.26	0.01
Aphanothece sp	0.35	0.02	-	-	-	-	-	-
Chroococcus dispersus (Keis.) *Lemmermann*	-	-	-	-	-	-	0.325	0.01
C. limneticus Lemmermann	0.05	-	-	-	-	-	14.9	0.87
*C. turgidus (*Kütz.) Nägeli	-	-	-	-	-	-	14.41	0.84
Chroococcus sp	-	-	-	-	0.01	0.00	-	-
Lyngbya sp.	-	-	-	-	-	-	0.555	0.03
Merismopedia elgans Braun ex	-	-	-	-	0.05	0.00	4.4	0.25
M. glauca Nägeli	-	-	-	-	-	-	8.6	0.50
M. tenuissima Lemmermann	-	-	-	-	-	-	5.15	0.30
Microcystis sp.	-	-	-	-	-	-	5.9	0.34
Nostoc sp	-	-	-	-	-	-	0.4	0.02
Oscillatoria boryana Bory ex Gomont	-	-	-	-	-	-	-	-
O. chlyba Mertens in Jurgens	-	-	-	-	-	-	0.25	0.01
O. curviceps Agardh	-	-	-	-	-	-	0.8	0.04
O. formosa Bory	-	-	-	-	0.05	0.00	-	-
O. limnetica Lemmermann	-	-	0.155	0.00	2.5	0.12	14.95	0.87
O. limosa (Roth.) Agardh	-	-	-	-	0.55	0.02	0.8	0.04
O. princeps Vaucher	-	-	0.015	0.00	0.19	0.00	0.8	0.04
O. proflica Gomont	-	-	-	-	0.15	0.00	0.45	0.02
O. tenuis Agardh	-	-	0.05	0.00	1.5	0.07	24.1	1.40
Oscillatoria sp.	-	-	-	-	0.2	0.00	-	-
Phormidium sp.	-	-	-	-	0.05	0.00	0.3	0.01
Spirulina laxa G.S.Smith	-	-	-	-	0.05	0.00	-	-
S. major (Witter)Kützing	-	-	-	-	0.05	0.00	-	-
Spirulina sp.	-	-	-	-	-	-	14.5	0.84
RHODOPHYTA								
Compsopogon sp.	-	-	-	-	-	-	143.3	8.37
Total	1985.55	100	1681	100	2014.95	100	1711.13	100

The results of biodiversity indices are illustrated in table4. Richness index seasonal values varied between 1and 8.2 in winter and summer respectively. This result agrees with the recorded numbers of species in these seasons and sites. Shannon index values were higher than 1 for all sites and seasons which indicate a high diversity and the dominance of a wide range of species (35).

Evenness index values exceed 0.5 in all seasons and sites except in the Site 2(adjacent to the electricity station) where the value was 0.47 indicating the distribution of biomass among species within the community was not moderate (36). Both of Richness index and Shannon index showed high diversity of epiphytic algae in the study sites, reflecting the suitable quality of Tigris river water for the life of aquatic livings according to a previous study (37).

Table 4. Seasonal average of diversity indices of epiphytic diatom on C.demersum during the study period.

Indices	Season Site	Autumn	Winter	Spring	Summer
Richness Index	St.1	5.1	5.1	4.6	8.2
	St.2	3.1	1	3.4	8
	St.3	3.5	4	4.5	7.5
	St.4	6	5	4.3	9
Shannon Index	St.1	3.1	2.7	2.7	2.9
	St.2	2.2	1.5	1.5	2.8
	St.3	2	2.8	2.8	2.5
	St.4	3.2	3.2	3.2	2.9
Eveness Index	St.1	0.6	0.55	0.53	0.58
	St.2	0.4	0.3	0.5	0.51
	St.3	0.42	0.5	0.58	0.52
	St.4	0.6	0.65	0.48	0.58

The physiochemical factors are illustrated in table5. Temperatures recorded high values in Summer while the lowest values were in Winter according to climate variations in Iraq (38). Values of electrical conductivity, salinity, and total dissolved solids were elevated in Summer in accordance to temperatures, because of salts dissolving increase, where the low values in these parameters occurred by the dilution resulted from increasing water level (10) . Total suspended solids were increased in Spring due to the increasing of water level and drainages from rounded areas(38). pH values showed a slight change since the aquatic ecosystems in Iraq are characterized by the buffer feature (39).

The dissolved oxygen values were increased in Winter and decreased in Summer, because the increasing temperatures reduce the dissolved oxygen (40).

The increase of BOD5 in Spring was related to the activities of the organism, and increasing of organic materials (1). Alkalinity was increased in Spring due to the increase of the decomposition processes(40). The results of the total hardness showed that the river is very hard according to previous limits (41). This result agrees with this of a previous study (42). The recorded concertation of calcium was higher than that of magnesium, which is a normal feature of waters (43). Total phosphorus concertation was elevated in Summer and decreased in Spring.

The concentration of total nitrogen was increased in Winter due to the eroding drainages from the surrounded areas, while the low concentration in Summer might be due to the decrease of the flows that contain nitrogen (44,45).

Table 5. Physicochemical characteristics of Tigris River's water during study seasons

Season	Autumn 2017	Winter 2018	Spring 2018	Summer 2018
Parameters				
Air Temp.(Cº)	25.8 ±5	22.5 ±5.6	25 ±4.2	37 ±5
Water Temp.(Cº)	19.3 ±2.2	17 ±2.1	21 ±3.8	29±2
Light intensity(cm)	65.12±12.14	60±9.3	87±8	89.3±6.2
Electrical conductivity E.C(µs/cm)	1087.12±31	1029±142.5	888.6±141	1217±101
Salinity (‰)	0.6±0.01	0.6±0.08	0.5±0.08	0.7±0.06
T.D.S (mg/l)	695.7±20	658±91	568±90	778.9±64
T.S.S(mg/l)	0.4±0.2	0.8±0.6	2±0.7	0.6±0.3
pH	7.4±0.07	7.7±0.19	7.15±0.4	7.4±0.2
Dissolved oxygen (mg/l)	9.4±1.05	10±0.7	6.6±1.7	4±1.5
BOD	2.05±1.05	1.7±0.5	2.5±0.6	2.3±1
Total Alkalinity	125±85	202±42.3	254±18	136.8±65
Total Hardness	333±113.4	382±97	367.5±110	342±89
Calcium(mg/L)	123.9±29.9	134.7±33.5	96.3±25.2	68.1±6.5
Magnesium (mg/L)	12.2±3.4	41.7±20.2	23±14.1	18.6±17
Total phosphate (mg/L)	0.5±0.28	0.74±0.26	1±0.2	1.6±0.9
Total Nitrogen (mg/L)	2.8±1.6	4.5±1	3.3±0.4	2.1±0.6

Conclusion:

The results revealed that the variations of Epiphytic algae was affected by the type of activities in the nearby areas and with the seasonal variations in the factors of temperature, transparency, and nutrients. Bacillariophyceae was the most dominant class.

Conflicts of Interest: None.

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التركيب الكمي والنوعي للطحالب الملتصقة على نبات الشمبلان في نهر دجلة ضمن محافظة واسط / العراق

طيبة علاء عبد الحميد **جنان شاوي الحساني**

قسم علوم الحياة، كلية العلوم للبنات، جامعة بغداد، بغداد، العراق.

الخلاصة:

تضمنت الدراسة الحالية الدراسة النوعية والكمية للطحالب الملتصقة على النبات المائي الغاطس الشمبلان في اربع مواقع مختارة ضمن نهر دجلة/محافظة واسط في فصول الدراسة (من خريف 2017الى صيف2018)تم قياس العوامل الفيزيائية والكيميائية (درجة حرارة الماء والهواء و الاس الهيدروجيني و مستوى الماء و التوصيلية الكهربائية والملوحة و المواد الذائبة الكلية والمواد العالقة الكلية و الاوكسجين الذائب و المتطلب الحيوي للأوكسجين و القاعدية و العسرة و تركيز الكالسيوم و تركيز المغنيسيوم و النتروجين الكلي والفسفور الكلي) بلغ العدد الكلي للأنواع المصنفة 145 نوع، 98 نوع من الطحالب العصوية، تبعت بالطحالب الخضر المزرقة 27 نوع، 19 نوع من الطحالب الخضر، 3 انواع من الطحالب اليوغلينية، ونوع واحد فقط لكل من الطحالب البنية الذهبية و الطحالب الحمر. عدد الانواع تغاير حسب مواقع الدراسة حيث كان 103 ، 68، 73 و 106 في مواقع الدراسة 1، 2،3 و 4 على التوالي. العدد الكلي للطحالب الملتصقة تراوح بين 1803.2-5759.6×10^4 خلية/غم(وزن رطب). تم تطبيق ادلة التنوع الحيوي دليل الغنى، شانون، ودليل التكافؤ.

الكلمات المفتاحية: نبات الشمبلان، الطحالب الملتصقة، نهر دجلة، محافظة واسط.