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Qualitative and Quantitative study of Epipelion algal community in Euphrates River (Al-Hussainya), Karbala Province-Iraq

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Abstract: A seasonal study of Epipelion algal community (epipelic algae) was conducted in Euphrates River (Al-Hussainya) for the period from October 2012 to September 2013. A total of 203 taxa of Epiplion algae were identified which belonging to five classes of algae. The algal community dominated by Bacillariophyceae was (79.3%) followed by Cyanophyceae (10.84%) and Chlorophyceae (6.9%). Euglenophyceae and Dinophyceae were constituted 1.48% of the total number. The total number of Epipelic algal cells ranged from 9924.5 x 10^4 cell/cm^2 in the autumn to 10.02 x 10^4 cell/cm^2 in the summer. Some genera of algae were dominated during this study in the term of number of species, these genera include *Nitzsche, Navicula, Cymbella, Fragilaria* and *Oscillatoria.* These algae might be indicated that the river under the impact of organic pollution.

Keywords: Euphrates River, Al- Hussainya River, Benthic algae, Epipelion algae, Karbala, Iraq

Introduction

Algae in aquatic ecosystem is the source of dissolved organic materials, these materials supported the growth of other organisms such as heterotrophic protists and prokaryotic communities (Graham *et al*., 2009). Epipelion algae are that algae found in inorganic or organic sediment (Stevenson, *et al*., 1996). The benthic assemblage of algae depends on the substrate surface that the surface has characterized by releasing nutrient (Whorley and Francoeur, 2013). Rimet (2009) reported that benthic algae assemblage in the river is affected by two types of environmental factors; the first group is not affected by human activity such as the geology of the river basin, sites altitude, and the sampling sites distance from the source while the second type are those affected by human activity such as; nutrient load into the river and its concentration. Epipelic algae play an important role in aquatic ecosystem through a number of functions that include bio-stabilization of sediments, regulation of benthic–pelagic nutrient cycling, and primary production (Poulickova *et al*., 2008). Many studies used the Epipelic algae in river biomonitring (Rimet, 2009; Bere and Tundisi, 2010; Abed El- Karim, 2014; Hassan and Shaawait, 2015). Many studies were conducted on the epipelic algal community in the Iraqi's river (Hassan *et al*., 2014; Alasady *et al*., 2009; Salman *et al*., 2013; Kadhim *et al*., 2013). Hassan *et al*. (2014) revealed that epipelic algae in the Euphrates River was dominated by Bacillariophyceae (diatom) and followed by Cyanophyceae, Chlorophyceae, Euglenophyceae and Pyrrophyceae, respectively. The total number of the epipelion algal cells reached their peak during the spring. Many other studies were conducted in different aquatic systems in Iraq showed the dominance of Bacillariophyceae (Alasady *et al*., 2009; Salman *et al*., 2013; Kadhim *et al*., 2013). Also, the dominance of epipelic diatoms was noticed in different regions. Kolayli *et al*. (1998) studied Sana river epipelic algae in Turkey and noticed the dominance of Bacillariophyceae followed by Chlorophyceae, Cyanophyceae and Euglenophyceae, respectively. Diatoms dominance was observed in other different regions (Spackova *et al*., 2009; Buragohain *et al*., 2012; Otene and Davies, 2013).

This study was conducted on epipelion algae in Euphrates River (Al-Hussainya) for the first time, and aimed to provide the information about the epipelion algal community in middle of Iraq surface water.

Materials and Methods

Study area description

Euphrates River (Al-Hussainya) is an important source of water in the province of Holy Karbala, and

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considered one of the Euphrates branches in Iraq, which is passed through the agricultural area before the entrance to Karbala city. Sampling was collected from six sites along the river to study the epipelion algal community in this river (Fig. 1).

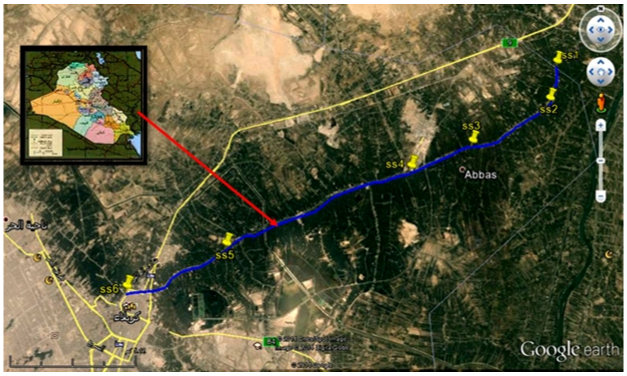

Fig. 1: The map of Al – Hussainya River, middle of Iraq.

Epipelion algal analysis

Epipelion algae (EA) were isolated from sediment, according to Bere and Tundisi, (2011). The EA samples were taken by spatula after removing the surface of the sediment (2-3 mm depth with 50m^2 surface area) in each site and stored in a clean bags after adding a little of the stream water and transferred to the lab by cool box and kept away from light. In lab, the samples were mixed vigorously, a 40g was weighted from each EA sample and moved into a petri dish, covered with lens tissue and stored in place a way of direct sunlight for overnight. The lens tissue was taken off and transferred into vial with a few Lougle's solutions. The quantitative and qualitative study was done according to Vollenweider (1974), algae were identified according to the following taxonomic references (Prescott, 1973; Desikachary, 1959; Foged, 1976; Foged, 1977; Germain, 1981; Hadi *et al*., 1984; Hustedt, 1985).

Results and Discussion

The physicochemical characteristics of the stream were already studied (Hassan *et al*., 2014). The stream was dominanted by carbonate ions, very hard and well areated. A total of 203 species and 59 genera of EA were identified. Bacillariophyceae (Diatoms) was recorded as the dominant group of EA (79.3%) with 161 species and 35 genera. Cyanophyceae was represented as 10.84% with 22 species and 12 genera and followed by Chlorophyceae (6.9%) with 14 species and 8 genera. Euglenophyceae and Dinophyceae were constituted the lowest percentage (1.48%) for each (Tab. 1 and Fig. 2). Some genera were existed in all sites with the higher number of species than other algae found during the study period, such as; *Nitzschia*, *Navicula*, *Cymbella*, *Fragillaria* and *Oscillatoria* (Tab. 2).

Tab. 1: Number of species (S) and genera (G) for identifying Epipelion algal in the study sites (S) during the study period in Al-Hussainya River.

Algal Taxa	S1		S2		S3		S4		S5		S6	
	S	G	S	G	S	G	S	G	S	G	S	G
Bacillariophyceae	118	28	113	30	114	29	102	32	108	26	106	26
Centrales	9	3	8	3	9	3	9	3	7	3	10	3
Pennales	109	25	105	27	105	26	93	29	101	23	96	23
Chlorophyceae	5	5	7	2	2	2	2	5	8	3	3	3
Cyanophyceae	12	6	12	7	14	8	10	8	11	5	8	5
Euglenophyceae	3	2	2	2	3	0	0	2	2	1	1	1
Dinophyceae	3	1	1	1	1	1	1	1	1	1	1	1
Total	141	42	135	42	134	40	115	48	130	36	119	36

The dominance diatoms due to their ability to tolerate a wide range of environmental alteration (Alakananda *et al*., 2010), in addition to presence of hard siliceous wall (Bellinger and Sigee, 2010). The dominance of diatoms has been recorded in many other studies (Hassan *et al*., 2014, Alasady *et al*., 2009, Salman *et al*., 2013; Kadhim *et al*., 2013; Buragohain *et al*., 2012; Otene and Daveis, 2013; Hassan *et al*., 2017). The sequences of the main group of the epipelion algae noticed in many studies, Hassan *et al*. (2014 and 2017) and Salman *et al*. (2013) found this sequence in the Euphrates river while Hassan and Abdulameer (2014) and Al-Hassany and Hindi (2016) in the Tigris river.

The spatial and temporal variation of the EA was observed. Their values ranged from 9924.5 cell /cm^2 at site 2 in autumn 2012 and 10.02 x 10^4 cell/ cm^2 at site 3 in summer 2013. The three peaks of biomass in term of total number of epipelion algae noticed, two peaks noticed in both in autumn and winter, the other peak was the highest recorded in the summer, all these peaks recorded at site 3 (Fig. 3).

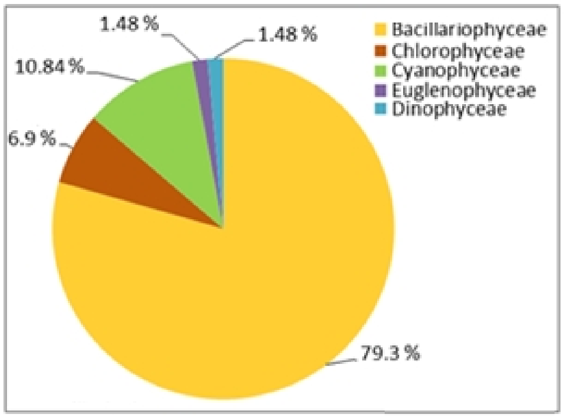

Fig. 2: The percentage of Epipelion algal taxes During this study.

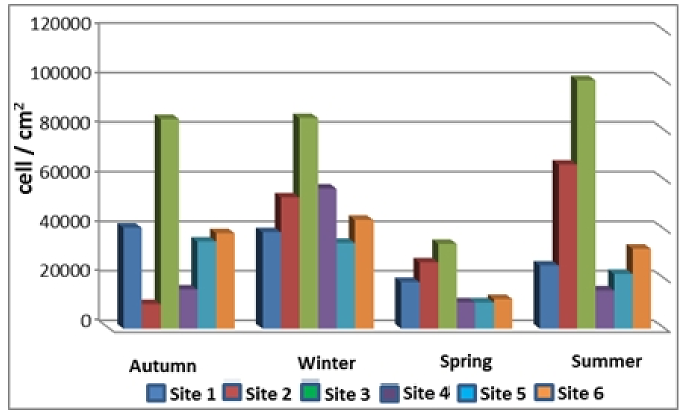

Fig. 3: Seasonal variation in the total number of appealing algal cells (cells/cm$^{2)}$ during the period of study.

Tab. 2: The total numbers of appealing algal cells (cells /cm^2) in the Al - Hussainya river during the study period.

Algal Taxa	Sites					
	S1	S2	S3	S4	S5	S6
Cyanophyceae						
Anabaena sp.	1.94	8.74	8.74	1.94	2.91	-
Chamaesiphon sp.	-	-	-	2.91	2.91	20.39
C. minor (Kützing) Nägeli	-	-	2.91	1.94	75.73	6.8
UnknownFilament blue green algae	3.88	-	1.94	12.62	5.83	-
Johannesbaptistie pellucid (Dickei)Taylor et Brout	31.07	524.25	338.82	-	2.91	-
Lyngbya aestuarii Liebman ex Gomont	49.51	1.94	3.88	7.77	-	-
L. limnetica Lemmermann	-	442.7	464.06	-	-	-
L. perelegans Lemmermann	-	11.65	-	-	-	-
Leptolyngbya perelegans (Lemmermann) Anagnostidis & Komárek	-	-	-	-	-	1.94
Merismopedia convolute Brébisson ex Kützing	-	-	-	-	1.94	-
M. elegans A.Braun ex Kützing	-	-	-	-	2.91	-
M. glauca (Ehrenberg) Kützing	-	1.94	-	2.91	-	-
Microcystis aeruginosa (Kützing) Kützing	-	-	-	-	1.94	-
Nostoc sp.	6.8	135.92	5.83	11.65	5.83	1.94
O. minima Gicklhorn	3.88	-	-	11.65	-	-
O. princeps Vaucher ex Gomont	1.94	-	-	-	-	-
O. splendid Greville ex Gomont	328.14	147.57	154.36	3.88	128.15	41.75
O. subbrevis Schmidle	-	1.94	11.65	-	-	-
O.tenuis C. Agrdh ex Gomont	21.36	-	-	-	-	80.58
O. sp.	1.94	1.94	16.5	-	-	-
Spirulina major Kützing ex Gomont	7.77	153.39	97.08	3.88	9.71	-
S. meneghiniana Zanardini ex Gomont	-	1.94	1.94	-	-	1.94
Euglenophyceae						
Euglena sp.	1.94	1.94	5.83	-	-	-
E. spirogyra Ehrenberg	5.83	1.94	9.71	-	5.83	4.85
Trachelomonas sp.	2.91	-	2.91	-	2.91	-
Dinophyceae						
Glenodinium quadridens (Stein) Schiller	1.94	-	-	-	-	-
Peridinium cinctum (.Müller) Ehrenberg	3.88	-	-	-	-	-
P. sp.	4.85	8.74	5.83	5.83	1.94	1.94

Tab. 2: continued.

Algal Taxa	Sites					
	S1	S2	S3	S4	S5	S6
Chlorophyceae						
Ankistrodesmus falcatus (Corda) Ralfs	-	2.91	-	-	-	-
Colastrum retticulatum (Dangeard) Senn	2.91	2.91	2.91	-	2.91	-
C. granatum Brébisson ex Ralfs	3.88	-	-	-	-	-
Mougeotia sp.	-	1.94	-	-	-	-
Pediastrum simplex Meyen	1.94	-	-	-	-	-
P. simplex var. clathratum Schröter	-	-	-	-	1.94	-
Scenedesmus acuminatus (Lagerheim) Chodat	-	1.94	-	1.94	1.94	-
S. bijuga (Turpin) Lagerheim	2.91	4.85	-	-	2.91	-
S. quadricauda (Turpin) Brébisson	3.88	6.8	-	-	1.94	1.94
Staurastrum natator West	-	-	-	-	2.91	-
S. paradoxum Meyen ex Ralfs	-	-	-	-	2.91	-
S. sp.	-	-	-	-		1.94
Tetraedron caudatum	-	-	1.94	-		
T. minimum (Corda) Hansgirg	-	2.91	-	-	1.94	1.94
Bacillariophycaeae						
- Centrales -						
Aulacoseira granulate (Ehrenberg) Simonsen	1500.91	512.29	2363.71	997.61	1339.1	755
A. italica(Ehrenberg) Simonsen	179.75	35.95	44.94	107.85		53.93
Melosira varians Agardh	107.85	143.8	17.98	98.86	35.95	17.98
Coscinodiscus lacustris Grunow	107.85	71.9	197.73	143.8	188.74	53.93
Cyclotella atomus	-	-	-	-	-	17.98
C. comta Hustedt	-	-	26.96	17.98	-	17.98
C. kuetzingiana Thwaites	26.96	44.94	71.9	35.95	71.9	17.98
C. meneghiniana Kützing	1536.86	566.21	925.71	1096.5	889.76	512.3
C. ocellata Pantocsek	1842.44	1554.84	2165.99	1393.1	961.66	1061
C. stelligera Cleve & Grunow	71.9	44.94	152.79	17.98	116.84	17.98
Stephanodiscus astrea (Ehrenberg) Grunow	17.98	-	-	-	-	-
- Pennales -						
Achnantheiopsis hauckiana (Grunow) Lange-Bert	26.96	-	-	-	17.98	-
Achnanthidium minutissimum (Kützing) Czarnecki	844.83	404.44	584.19	575.2	350.51	431.4
Achnanthes sp.	-	35.95	44.94	17.98	-	-
Amphipleura alata (Ehr.) Kuetzing	-	-	-	-	-	44.94
A. pellucid Kützing	-	17.98	26.96	-	35.95	
Amphora coffeaeformis (C.Agardh) Kützing	152.79	35.95	17.98	152.79		161.8
A. mexicana Schmidt	-	-	26.96	-	296.59	-
A. ovalis (Kützing) Kützing	80.89	80.89	17.98	17.98	26.96	53.93
A. veneta Kützing	107.85	62.91	197.73	89.88	80.89	35.95
A. sp.	98.86	71.9	89.88	80.89	62.91	143.8
Anomoeoneis exilis (Kützing) Cleve	161.78	170.76	314.56	53.93	314.56	143.8
A. sphaerophora Pfitzer	161.78	0	-	512.29	-	-
Bacillaria paxillifer (Müller) Marsson	476.34	233.68	503.3	-	116.84	215.7
Caloneis amphisbaena (Bory de Saint Vincent) Cleve	-	35.95	-	-	17.98	-
C. bacillum (Grunow) Cleve	-	-	17.98	17.98		260.6
C. permagna (Bailey) Cleve	53.93	17.98	44.94	-	98.86	-
Cocconeis pediculus (Ehrenberg) Chmielevski	970.65	305.58	377.48	170.76	395.45	332.5
C. placentula Ehrenberg	1204.33	287.6	548.24	377.48	350.51	512.3
C. placentula var euglypta (Ehrenberg) Grunow	1294.2	683.05	853.81	449.38	224.69	71.9
C. placentula var lineata (Ehrenberg) van Heurck	125.83	125.83	134.81	107.85	35.95	17.98
Cylindrotheca gracilis (Brébisson ex Kützing) Grunow	62.91	98.86	44.94	17.98	80.89	17.98

Tab. 2: continued.

Algal Taxa	Sites					
	S1	S2	S3	S4	S5	S6
Cymatopleura elliptica (Brébisson) Smith	17.98	-	-	17.98	-	-
C. solea (Brébisson) Smith	71.9	80.89	80.89	17.98	62.91	-
Cymbella affinis Kützing	278.61	224.69	152.79	152.79	170.76	188.7
C. affinis var excisa (Kützing) Grunow	-	17.98	-	26.96	-	-
C. aspera (Ehrenberg) Cleve	35.95		26.96	53.93	-	-
C. cistula (Ehrenberg) O.Kirchner	107.85	53.93	53.93	35.95	35.95	17.98
C. cistula var maculata (Kützing) Van Heurck	-	17.98	17.98	-	-	35.95
C. cymbiformis Agardh	17.98	35.95	-	-	-	-
C. differta (Cleve-Euler) Krieger	-	35.95	17.98	44.94	17.98	53.93
C. helvetica Kützing	116.84	35.95	71.9	17.98	107.85	17.98
C. microcephala Grunow	431.4	314.56	224.69	143.8	341.53	314.6
C. obtusiuscula Kützing	17.98	35.95	35.95	17.98	71.9	143.8
C. prostrata (Berkeley) Grun	62.91	17.98	17.98	89.88		1456
C. pusilla Grunow	296.59	907.74	3505.13	1626.7	736.98	
C. sinuate Gregory	35.95	62.91	-	35.95	17.98	17.98
C. sp.	26.96	-	-	-	-	-
C. tumida (Brébisson) van Heurck	17.98	-	80.89	35.95	35.95	17.98
C. turgid Gregory	53.93	-	53.93		17.98	0
C. ventricosa (Agardh) Agardh	170.76	53.93	179.75	71.9	125.83	53.93
Denticula sp.	17.98	-	17.98		17.98	-
Diatoma elongatum (Lyngbye) Agardh	-	-	26.96	71.9	17.98	-
*D. tenue var elongatum*Patrick and Reimer	125.83	-	17.98	-	17.98	17.98
D. vulgare (Grunow) Bukhtiyarova	377.48	1213.31	1420.03	557.23	431.4	305.6
Diploneis ovalis (Hilse) Cleve	35.95	35.95	53.93	-	44.94	35.95
D. pseudoovalis Hustedt	179.75	143.8	152.79	98.86	17.98	53.93
Epithemia sorex Kützing	-	-	-	-	17.98	26.96
Fragilaria acus (Kützing) Lange-Bertalot	134.81	35.95	-	44.94	62.91	-
F. capucina Desmazières	287.6	-	-	-	-	17.98
F. construens (Ehrenberg) Grunow	62.91	26.96	89.88	-	-	35.95
F. crotonensis Kitton	-	-	-	-	17.98	
F. fasciculata (Agardh) Lange-Bertalot	503.3	116.84	125.83	413.43	260.64	161.8
F. intermedia Grunow	-	-	134.81	-	53.93	-
F. pinnata Ehrenberg	35.95	-	80.89	-	71.9	-
F. pulchella (Ralfs ex Kützing) Lange-Bertalot	107.85	-	-	17.98	0	-
F. sp.	17.98	-	35.95	-	-	17.98
F. ulna (Nitzsch) Lange-Bertalot	871.79	233.68	422.41	332.54	242.66	242.7
F. ulna var. biceps (Kützing) Compère,	71.9	35.95	17.98	26.96	107.85	35.95
F. virescens (Ralfs) Williams and Round	287.6	161.78	1159.39	215.7	683.05	
F. vaucheriae (Kützing).Petersen	71.9	-	-	-	-	1186
Gomphoneis olivacea (Hornemann) P. A. Dawson ex R. Ross & P. A. Sims	188.74	53.93	-	89.88	17.98	53.93
Gomphonema angustatum (Kützing) Rabenhorst	179.75	35.95	134.81	17.98		17.98
G. intricatum Kützing	-	-	-	35.95	17.98	-
G. lanceolatum Kützing	17.98	17.98	-	-	17.98	-
G. parvulum(Kützing) Kützing	17.98	-	-	17.98	-	17.98
G. tergestinum (Grunow) Fricke		-	-	-	-	35.95
Gyrosigma acuminatum (Kützing) Rabenhorst	17.98	98.86	476.34	44.94	188.74	71.9
G. attenuatum (Kützing) Cleve	-	-	98.86	-	-	-
G. parkeri (Harrison) Elmore	-	-	-	-	44.94	-
G. peisonis Grunow		17.98	35.95	17.98	35.95	35.95

Tab. 2: continued

Algal Taxa	Sites					
	S1	S2	S3	S4	S5	S6
G. scalproides (Rabenhorst) Cleve	44.94	-	44.94	71.9	-	53.93
G. spencerii (Bailey ex Quekett) Griffith & Henfrey	368.49	71.9	134.81	35.95	53.93	-
Hantzschia amphioxys (Ehrenberg) Grunow	89.88	53.93	71.9	-	71.9	17.98
M astogloia elliptica (Agardh) Cleve	53.93	-	-	-	-	-
M. elliptica var dansei (Thwaites) Cleve	35.95	26.96			35.95	17.98
M. smithii Thwaites ex W.Smith	-	-	-	53.93	-	-
Navicula anglica Ralfs	26.96	35.95		-	17.98	-
N. atomus(Kützing) Grunow	53.93	-	62.91	-		17.98
N. bacillum Ehrenberg	143.8	35.95	-	-	-	-
N. cincta (Ehrenberg) Ralfs	727.99	826.85	3765.76	-	611.15	1546
N. crucicula (Smith) Donkin	323.55	287.6	53.93	449.38	-	35.95
N. cryptocephala Kützing	692.04	2004.21	5967.7	107.85	2615.4	1222
N. cryptocephala var intermedia	287.6	152.79	179.75	2228.9	62.91	17.98
N. cryptocephala var veneta	1339.14	2507.51	5653.14	71.9	1833.5	1564
N. cuspidata (Smith) Donkin	17.98	35.95	-	-	-	-
N. gracilis Ehrenberg	161.78	107.85	242.66	1887.4	53.93	89.88
N. inflata Donkin	17.98	35.95	53.93	-	17.98	-
N. menisculus Schumann	-	-	17.98	-	-	-
N. minuscula Grunow	-	17.98		-	-	
N. mutica Kützing	-	-	17.98	-	-	44.94
N. oblonga (Kützing) Kützing	-	-	-	-	17.98	26.96
N. parva (Ehrenberg) Ralfs	89.88	89.88	143.8	134.81	197.73	215.7
N. placentula (Ehrenberg) Kützing	17.98	-	-	-	-	-
N. pygmaea Kützing	269.63	179.75	539.25	197.73	125.83	35.95
N. radiosa Kützing	35.95	89.88	125.83	71.9	197.73	71.9
N. radiosa var tenella (Brébisson ex Kützing) Van Heurck	17.98	17.98	98.86	-	44.94	-
N. rhynchocephala	35.95	89.88	35.95	116.84	35.95	35.95
N. schroeteri Kützing	467.35	206.71	161.78	134.81	161.78	53.93
N. spicula (Hickie) Cleve		53.93	26.96	80.89	17.98	-
N. sp.	17.98	17.98	-	-	-	-
N. trivialis Lange-Bertalot	-	-	-	-	-	17.98
N. tuscula Ehrenberg	-	-	71.9	26.96	53.93	-
Nitzschia acicularis (Kützing)Smith	53.93	143.8	143.8	26.96	71.9	17.98
N. amphibia Grunow	107.85	17.98	251.65	35.95	-	215.7
N. angustata (Smith) Grunow	26.96	17.98	-	53.93	17.98	-
N. angustata var acuta Grunow	215.7	62.91	-	125.83	53.93	35.95
N. apiculata (Gregory) Grunow	116.84	844.83	620.14	386.46	260.64	152.8
N. clausii Hantzsch	296.59	35.95	17.98	-	98.86	80.89
N. dissipata (Kützing) Rabenhorst	683.05	431.4	1375.09	449.38	62.91	449.4
N. dubia Smith	-	17.98	17.98	-	-	-
N. fasciculata (Grunow) Grunow	44.94	17.98	-	-	-	-
N. filiformis (Smith)Hustedt	233.68	305.58	305.58	35.95		71.9
N. frustulum(Kützing) Grunow	251.65	215.7	1815.48	143.8	503.3	332.5
N. frustulum var perminuta Grunow	934.7	431.4	1518.89	287.6	152.79	332.5
N. gracilis Hantzsch	62.91	719	467.35	449.38	206.71	107.9
N. granulata (Grunow) Mann	-	35.95	35.95	35.95	242.66	-
N. hungarica Grunow	251.65	341.53	799.89	-	-	98.86
N. ignorata Krasske	0	-	0	179.75	-	-
N. longissima (Brébisson) Ralfs	143.8	179.75	979.64		53.93	386.5
N. lorenziana var subtilis Grunow	26.96	17.98	0	170.76		-
N. microcephala Grunow	80.89	89.88	332.54	26.96	80.89	116.8
N. obtuse Smith	26.96	359.5	449.38	53.93	323.55	278.6
N. palea (Kützing) Smith	2884.99	14209.2	25767.2	3891.6	5743	12286
N. punctata (Smith) Grunow	26.96	-	-	98.86	-	197.7
N. punctata var coarcata (Grunow) Hustedt	602.16	35.95	413.43	35.95	-	17.98
N. romana Grunow	161.78	17.98	98.86	89.88	17.98	71.9
N. sigma (Kützing) Smith	152.79	988.63	521.28	242.66	89.88	278.6
N. sigma var rigidula (Peragallo & Peragallo) Grunow	53.93	98.86	125.83	17.98	17.98	206.7

Tab. 2: continued

Algal Taxa	Sites					
	S1	S2	S3	S4	S5	S6
N. sigmoidea (Nitzsch) W.Smith	35.95	17.98	26.96	35.95	35.95	44.94
N. tryblionella Hantzsch	233.68	269.63	844.83	116.84	278.61	224.7
N. tryblionella var debilis (Arnott) Hustedt	17.98	-	17.98	-	-	-
N. tryblionella var levidensis (Smith) Grunow	44.94	53.93	125.83	17.98	44.94	53.93
N. tryblionella var victoriae (Grunow) Grunow	0	35.95	143.8	107.85	44.94	134.8
Pinnularia lundii Hustedt	26.96	-	17.98	-	-	-
Pleurosigma delicatulum Smith	-	-	-	71.9	-	17.98
P. obscurum Smith	-	89.88	134.81	-	35.95	-
P. salinarum (Grunow) Grunow	-	17.98	-	-	-	17.98
Planothidium lanceolatum (Brebisson ex Kutzing) Lange-Bertalot	-	17.98			17.98	17.98
Rhoicosphenia curvata (Kützing) Grunow	449.38	269.63	413.43	53.93	179.75	341.5
Rhopalodia gibba var ventricosa (Kützing) H.Peragallo & M.Peragallo	80.89	-	17.98	17.98	26.96	-
R. musculus (Kützing) Müller	-	-	-	368.49	-	-
Stauroneis phenicenteron (Nitzsch) Ehrenberg	17.98	-	-	17.98	-	-
S. sp.	-	35.95	-	-	17.98	-
Surirella angusta Kützing	-	-	-	-	17.98	-
S. capronii Brébisson ex F.Kitton	-	17.98	17.98	-	17.98	53.93
S. ovata Kützing	-	17.98	17.98	-	17.98	-
S. ovata var africana Cholnoky	26.96	17.98	35.95	17.98	26.96	17.98
S. ovata var Salina (Smith) Rabenhorst	71.9	179.75	467.35	26.96	35.95	53.93
S. ovalis Brébisson	-	17.98	89.88		-	17.98
S. sp.	-	-	-	116.84	-	-

The results showed that the diatom *Nitzschia palea* recorded the highest number of the cells (10.8 x 10^2 cells / cm^2) during this study compared with other species. The highest number of algal cells noticed in site 3 attributed to the pollutants and nutrients from the municipal, agricultural and industrial activities, though the direct discharge of wastes, many studies referred to the effect of the pollution by different sources in elevation of algal cells (Otene and Davies, 2013; Alakananda *et al*., 2010). Some species also showed a high density in this site, such as *Aulacoseira granulate, Cyclotella ocellata, C. stelligera, Diatoma vulgare, Gyrosigma acuminatum, Navicula cryptocephala, N. cryptocephala var veneta, N. pygmaea, Nitzschia dissipata, N. Frustulum, N. frustulum var perminuta, N. Microcephala, N. palea, N. Tryblionella and Surirella ovate,* these algae have the capability to tolerate the high level of organic pollution (Onuohe and Wim, 2010). The growth, dominance and diversity of algae affect also by several factors such as the nature of the media in which they grow (Bere, 2010), and other environmental conditions such as temperature, light, dissolved ions, nutrients, water current (Hassan *et al*., 2017; Zebek, 2013).

Conclusion

The results showed dominance of Bacillariophyceae followed by Cyanophyceae, Chlorophyceae, Eugleno-phyceae and Dinophyceae, resepectively. The exist-ence of some genera in term of number of species or total number of cells indicated that the river might be under the impact of the organic pollution.

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