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Seasonal species diversity, dominance and density of diatomic phytoplankton in Tigris River, Baghdad Province, Iraq

Bashar Tareq Al-Shandah[1*], Trifa Kamal Jalal[2], Muhanned Remzi Nashaat[3]

1. Department of Biology, College of Science, University of Tikrit, Iraq
2. Department of Biology, College of Science, University of Sulaimani, Iraq
3. Agricultural Research Directorate, Ministry of Science & Technology, Baghdad, Iraq

** Corresponding author's E-mail: bashar.t.ismael@tu.edu.iq*

ABSTRACT
Phytoplankton plays a key role in solving some environmental problems, studying photosynthesis, understanding aquatic ecosystems and the production of useful substances. In the present study, monthly analysis of diatomic phytoplankton communities as well as diatomic algae distribution, total count, annual density, density percentage, diversity and dominance of different species were carried out to assess the phytoplankton structure of Tigris River, a major source of fresh water in Iraq. Water samples were collected on a monthly basis from four sites of the river in the Iraqi Capital, Baghdad. The study period was one year from January to the end of December 2021. In this study, 125, 130, 123, and 141 fresh water algal species belonging to class Bacillariophyceae were identified reporting from stations 1, 2, 3 and 4 respectively. In this study, *Cyclotella ocellata* was the most dominant in all sampling stations. The highest total annual density of phytoplankton during the study period was at St. 3 (34416 ind $\times 10^3$ L^{-1}), followed by (34306.85 ind $\times$ 10^3 L^{-1}) at St. 1, and (33335.8 ind $\times$ 10^3 L^{-1}) at St. 4, finally, the lowest at St. 2 (29121.5 ind $\times$ 10^3 L^{-1}). Seasonal phytoplankton diversity was investigated based on Shannon Diversity Index (H) exhibiting the highest diversity index in summer (3.041), followed by winter (2.606), spring (2.22) and the lowest in autumn (1.355). Eventually, the study area within Tigris River is classified as moderate mostly based on Shannon Diversity Index for Water quality classification. Finally, seasonal diatomic phytoplankton dominance was investigated based on Simpson's Index (D) exhibiting the highest dominance index in autumn (0.549), followed by spring (0.35), winter (0.23) while the lowest in summer (0.12). These last results confirmed the inverse relationship between Simpson's Index for the dominance and Shannon diversity index for the biodiversity.

Keywords: Tigris River, Diatomic phytoplankton, Total count, Annual density, Diversity, Dominance.
Article type: Research Article.

INTRODUCTION
Phytoplankton are important primary producers for freshwater and marine aquatic habitats. They provide biomass that is the base of various food chains in lots of lakes and rivers (Bellinger & Sigee 2010). Phytoplankton plays significant role in material mobility and energy flow in aquatic ecosystems (Ariyadej *et al.* 2008; Khatun & Rashidul Alam 2020; Khaliullina 2021). Aquatic ecosystems are affected by several health stressors that significantly deplete biodiversity (Kulshrestha & Sharma 2006). The plankton communities (phytoplankton and zooplankton) response quickly to slightly alterations in the physical and chemical properties of any water body. These organisms are one of the most sensitive groups used in bio-assessment and monitoring aquatic environment, since the fluctuation affect their abundance and diversity which is used to estimate the water quality. In freshwater like Tigris River, the main photosynthetic algal groups of the phytoplankton include the diatoms, cyanobacteria,

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dinoflagellates and green algae, among these the diatoms are usually the dominant assemblage in the aquatic environment. Various studies on phytoplankton communities in aquatic systems have concluded that diatoms are the most important taxonomic groups, either in terms of abundance or in terms of diversity or both (Adolf *et al.* 2006; Gameiro 2007). The presence of diatoms is characteristic of freshwater systems especially in spring, however, they are also dominant and frequently abundant in large slowly flowing rivers from early spring to autumn. Therefore, this is an important group of primary producers and water quality indicators (Kiss *et al.* 2012). Algae's number increases or decreases depending of the aquatic environmental variables. The total amount and the structure of phytoplankton describe trophic conditions of the laces better than total phosphorus, e.g., since algae's abundance and diversity represent in cumulative way how the physico-chemical factors affect the phytoplankton communities (Brettum & Andersen 2005). Quantitative and qualitative variables of the phytoplankton are an example of organism's adaptation to the alterations in environment (Kozak 2005). Diversity, dominance, a count of phytoplankton, and variation in the biotic parameters provide a good indication of energy turnover in aquatic environments (Forsberg 1982). Species diversity responds to alterations in environmental gradients and may characterize many interactions that can establish the intricate pattern of community structure. Our present investigation focuses on study of phytoplankton diversity, dominance, their species composition, and population density. All these factors are important bio-indicators for determining, identification and assessment of biodiversity composition of a river.

MATERIALS AND METHODS

Study Area and stations

Tigris is the second-longest river in southwest Asia after Euphrates River. It is one of the most important twin rivers in Iraq, sharing with Euphrates as the main sources for human use, especially for drinking water, since they pass through the major cities in Iraq. Four sites were selected from Tigris River in Al- Karkh side within a capital of Iraq, Baghdad Province. The first station (St. 1) is located beside Jadriyah Bridge, followed by the second (St. 2), with approximately 4 km distance, beside the Durah Power Plant, then the third (St. 3), about 3 km from the last station, and finally the fourth (St. 4) adjacent to Al-Tabiqien Bridge. The study area covers about 10 km from Tigris River (Fig. 1).

Fig. 1. Maps of Iraq, including Baghdad Province and locations of sampling stations.

Samples collection

Samples were collected, on a monthly basis for a period of one year from the higher superficial layer of 20-30 cm deep from the river during January to the end of December 2021.

Phytoplankton analysis

Qualitative analysis (algal identification)

Diatoms were identified by preparing slides after dissolving the organic matter using nitric acid and examined under 100 X magnification by a compound microscope depending on Hustedt (1930) and Hustedt (1959).

Quantitative analysis

Total number count of diatomic phytoplankton was performed using the sedimentation method (Furet & Benson 1982). One liter of each sample taken was poured in graduated cylinder (1000 mL). The samples were preserved by adding drops of Lugol's solution and left in stand place. After seven days, 900 mL were sucked by siphon method. The rest was transported to another cylinder (100 mL) and left by the same method to seven days, afterward, 90 mL was withdrawn and the rest (10 mL) placed in covered glass container, then adding two drops of Lugol's solution. A clean slide was left on a hot plate at 75-80 °C and a 1 mL of the preserved concentrated sample was placed in the middle of the slide and dried. Thereafter, a drop of concentrated nitric acid was placed on the dried drop and after evaporation of the acid drop, Canada Balsam was placed on a cover slide and put on the dried sample and pressed to remove any air bubbles. The calculation was performed by the following equations:

Number of diatomic phytoplankton in 1-mL original sample = Number of cells in one transmitted section × conversion factor.
Conversion factor = Sample concentration factor × Number of transmitted section in1ml of sample.
Sample concentration factor = 0.01 mL of sample concentrated from1000 mL to 10 mL
Number of transmitted section in 1 mL of concentrated sample = (Drop area / area of one transmitted section) × 20 concentrated sample.

Diversity and Dominance
Shannon Index (H) and Simpson Index (D) were used to calculate species diversity and dominance respectively. The values of Shannon index are divided into five qualitative classes (Marques *et al.* 2009; Table 1). Shannon Index and Simpson are calculated by the following formulas:

Shannon Index (H) = $-\Sigma^{s}$ Pi × ln Pi
Simpson Index (D) = 1 / Σ^{s} Pi ^{2}

In Shannon and Simpson index, **P** is the proportion (n/N) of individuals of one particular species found (n) divided by the total number of individuals found (N), **ln** is the natural log, **i** =1, **Σ** is the sum of the calculations, and **s** is the number of species.

Table 1. Water quality classification, based on Shannon Diversity Index.

Rating water quality	Shannon Index
Excellent	>4
Good	3–4
Moderate	2–3
Poor	1–2
bad	0–1

RESULTS AND DISCUSSION

Qualitative and quantitative of diatomic phytoplankton
In this study, 125, 130, 123, and 141 fresh water algal species belonging to class Bacillariophyceae were identified and reported in stations 1, 2, 3 and 4 respectively during the period of study from the sampling area (Table 2). At the selected sampling stations pertaining to different seasons it was observed that there is a clear similarity of the species of algae in the studied stations, with the presence of species in some stations and absence of these species in other stations, mainly due to the continuous mixture of the river water column (Seu-Anoï *et al.* 2017). The percentage distribution of diatomic phytoplankton communities in the sampling stations by species for four species which have the highest count as follows: at St. 1, *Cyclotella ocellata* (59%), *Cyclotella meneghiniana* (7%), *Nitzchia palea* (5%), *Aulacoseira granulata* (2%), and others species (27%); at St. 2, *Cyclotella ocellata* (56%), *Cyclotella meneghiniana* and *Nitzchia palea* (5%) for both, *Aulacoseira granulata* (4%), and other species (30%); at St. 3, *Cyclotella ocellata* (59%), *Cyclotella meneghiniana* and *Aulacoseira granulata* (7%) for both, *Nitzchia palea* (4%), and others species (23%); finally, at St. 4, *Cyclotella ocellata* (59%), *Nitzchia palea* (7%), *Cyclotella meneghiniana* (5%), *Diatoma vulgare* (3%) and other species (26%) as shown in Fig. 2 and Table 2. Through these results, the dominance of *Cyclotella ocellata* followed by *Cyclotella meneghiniana* clearly appears in all the current study stations, since the planktonic diatom’s genus *Cyclotella* is widely distributed throughout Europe, North America and Asia (Werner & Smol 2006).

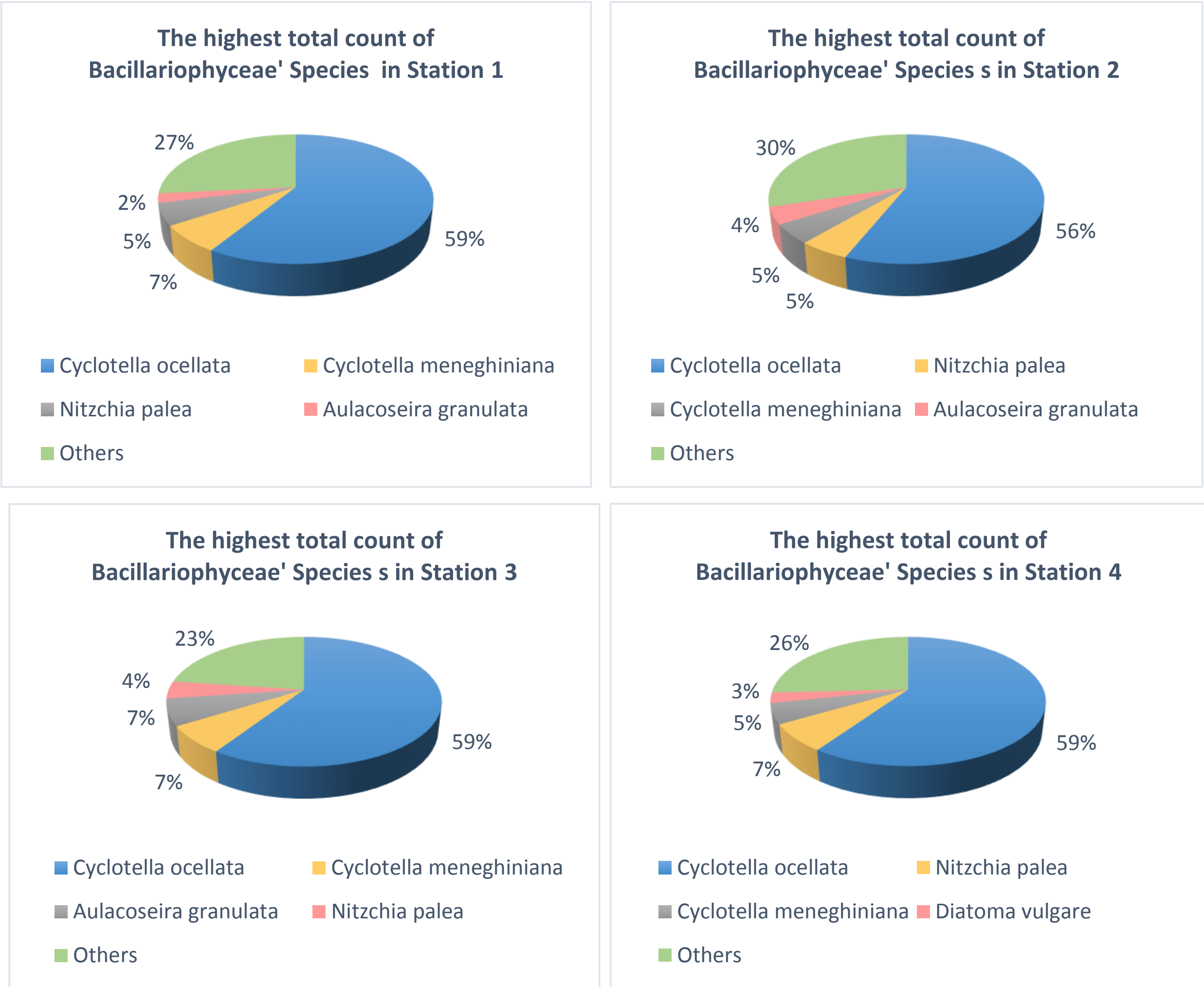

Fig. 2. Total count of Bacillariophyceae's species in the sampling stations.

According to several authors (e.g., Houk *et al.* 2010) *Cyclotella ocellata* seems to have an extremely broad tolerance of nutrient status, extending (in rare cases) from ultra-oligotrophic to eutrophic. Cremer & Wagner (2003) suggested that the *Cyclotella ocellata* complex should comprise several different species or ecological groups, exhibiting contrasting ecological preferences for nutrient status which may in part relate to the biogeographic region in which they grow. Also *Aulacoseira granulata* was recognized as a freshwater planktonic and Bacillariophyceae species, common in eutrophic water of higher silica and temperature (Kilham *et al.* 1986), characteristics of the Iraqi water. Table 2 shows the total number of algal species identified in the stations, and from them, the aforementioned percentages, e.g., the total counts of *Cyclotella ocellata* recorded in current study were 20184 × 10^3, 16332.5 × 10^3, 20401.5 × 10^3 and 19894 × 10^3 (cells L^{-1}) for stations 1, 2, 3 and 4 respectively, followed by *Cyclotella meneghiniana*, *Nitzchia palea* and *Aulacoseira granulate* etc. The highest total algal count in the study stations were recorded during the autumn mainly and then in the spring, while the lowest mostly in summer and winter (Fig. 3). The highest cell abundant which may be due to the environmental conditions during autumn and spring, led to the growth in these seasons. Diatoms exhibited the highest density, which could be attributed to the mediate in water temperature. Different researchers have reported that temperature was an important factor in fluctuations in the composition of phytoplankton and alterations in phytoplankton population by change in the season and temperature (Heydari *et al.* 2018). High density of the phytoplankton is a result of the high concentration of nitrogen and phosphorus, which elevates in nutrient concentration in the spring and autumn making it environmentally predictable (Kozak *et al.* 2014). In addition to the moderate temperature, salinity, pH, increased turbidity, low transparency, strong currents and clear sunshine may be the reasons for the dominance in these seasons (Adesakin *et al.* 2019). The results of annual density for diatomic phytoplankton within quantitative study in the sampling stations (Fig. 4; Table 3), exhibited that the highest total annual density of diatomic phytoplankton during the study period was at St. 3 (34416 ind × 10^3 L^{-1}), followed by (34306.85 ind × 10^3 L^{-1}) at St. 1, and (33335.8 ind × 10^3 L^{-1}) at St. 4. The lowest total density was recorded at St. 2 was 29121.5 ind × 10^3 L^{-1} as shown in Table 3 and Fig. 4. From these results, it was noted that the results of total annual density were very close in all sampling stations except in St. 2. The reason for this convergence may be mainly due to the continuous mixture of the water column, and the source of water was one in all these sites (Al-Shandah 2016), while the lowest at St. 2, which may be due to thermal effluents of Durah Power Plant (DPP) that elevates the water temperature. Thus, the density of diatoms declined in the summer, which is in agreement with many studies for the same reasons (Radhi & Abbass 2009; Nashaat 2010).

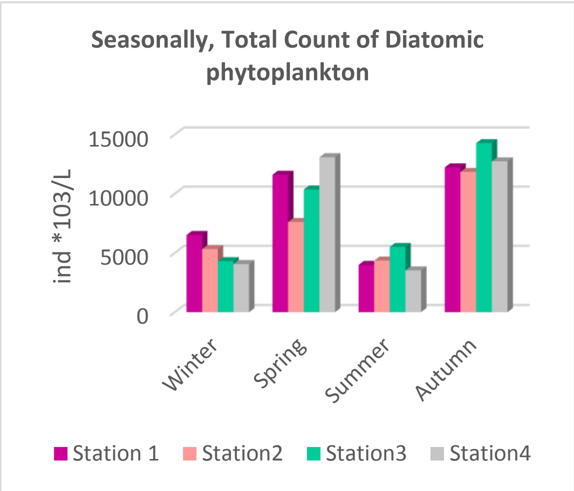

Fig. 3. Total count of diatomic algal classes in four seasons.

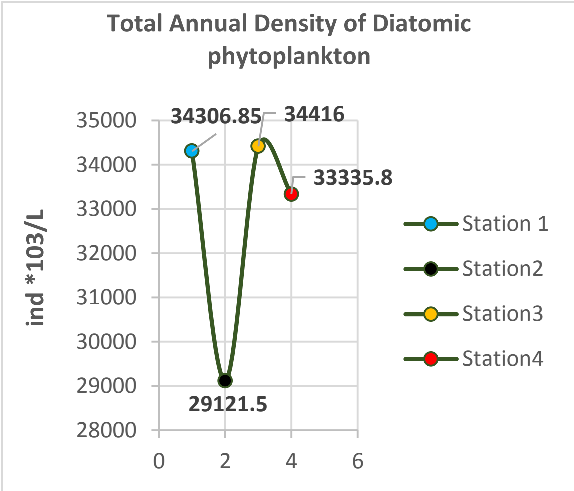

Fig. 4. Total annual density of diatomic algal classes in sampling stations.

Table 2. Number of identified Diatomic phytoplankton in St. 1, and their species and total count of each class (ind $\times 10^3$ L^{-1}).

TAXA	Winter			Spring			Summer			Autumn			∑Sum
	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	
BACILLARIOPYCEAE													
Centrales													
Aulacoseira granulata (Ehr.) Simensen	-	-	-	-	14.5	14.5	72.5	72.5	29	362.5	232	14.5	812
Aulacoseira italica	-	-	-	-	14.5		-	-	-	-	-	-	14.5
Aulacoseira varians	-	-	-	14.5	58	14.5	-	-	-	-	-	-	87
Coscinodiscus lacustris Grun.	14.5	14.5		-	29	14.5	14.5	-	-	-	-	-	87
Cyclotella kuetzingiana Thw.	-	-	-	14.5	-	14.5	87	-	-	-	-	-	116
Cyclotella meneghiniana Kutz.	145	14.5	14.5	362.5	-	652.5	333.5	145	101.5	145	333.5	101.5	2349
Cyclotella ocellata Pant.	725	420.5	2508.5	203	87	6597.5	319	174	275.5	681.5	7250	942.5	20184
Cyclotella stelligera	-	-	-	-	-	-	-	-	-	-	188.5	-	188.5
Stephanodiscus astrea (Ehr.) Grun.	14.5		14.5	-	-	-	-	14.5	-	-	14.5	14.5	72.5
Pennales	-	-	-	-	-	-	-	-	-	-	-	-	0
Achnanthes lanceolata	14.5	-	-				14.5	-	14.5		-	-	43.5
Achnanthes minutissima	14.5	-	14.5	14.5	29	101.5	14.5	-		14.5	14.5	-	217.5
Achnanthes sp.	14.5	14.5	-	-	-	-	-	-	-	-	14.5	14.5	58
amphiprora alata	-	-	-	14.5	-	-	-	-	-	-	-	-	14.5
Amphora coffeaeformis (Ag.) Kutz.	14.5	-	-		29	14.5		12.9		-	-	-	70.9
Amphora ovalis		-	-	14.5	-	14.5	14.5	-		-	-	-	43.5
Amphora ovalis var. lypica	-	-	-	-	-	-		-	14.5	-	-	-	14.5
Amphora perpusilla	-	-	-	-	-	-		14.5		-	14.5	-	29
Amphora sp.	-	-	-	14.5	14.5	14.5	14.5	14.5		-		-	72.5
Amphora veneta	14.5	-	-	14.5	14.5	14.5	14.5	-	14.5	-	-	-	87
Anomoeoneis exilis Kutz.	29	14.5	14.5	-	-	29		-	43.5	29	14.5	14.5	188.5
Bacillaria paxillifer (Mull.) Hend.	14.5	14.5		14.5	14.5	14.5		14.5		-	14.5		101.5
Caloneis bacillum	-	-	-		-	14.5		-		-	-	-	14.5
Caloneis ventricosa	-		14.5	14.5	-	-	-	-		-	-		29
Ceratoneis arcus	-	-	-	-	14.5	-	-	-	-	-	-	-	14.5
Cocconeis pediculus Ehr.	14.5		14.5	14.5	14.5	14.5	14.5		14.5	-	14.5		116
Cocconeis placentula Ehr.	14.5	14.5	29	14.5	14.5	14.5	14.5	14.5	14.5	-	14.5	14.5	174
Cocconeis placentula var. euglypta (Ehr.) Cl.	14.5	14.5	14.5	43.5	43.5	116	29	14.5	14.5	-	14.5	14.5	333.5
Cocconeis placentula var. lineata			14.5	-	-	-	-			-	14.5		29
Coscinodiscus lacustris Grun.		-	-	-	-	-	-	14.5	14.5	-		43.5	72.5
Cymatopleura elliptica	14.5	-	-	-	-	-	-	14.5		-			29
Cymatopleura solea		-	-	14.5	14.5	14.5	-	14.5	14.5	-		14.5	87
Cymbella affinis Kutz.		14.5	14.5	14.5	29	43.5	-	-	14.5	-	14.5		145

Cymbella amphicephala var. intermedia	-	-	-	-	-	14.5	-	-	-	-	-	-	14.5
Cymbella caespitosa var. auerswaldii		-		14.5	-	-	-	-		-			14.5
Cymbella cistula (Hemp.)	14.5	-	14.5		-	-	-	-		14.5		14.5	58
Cymbella microcephala Grun.	-	14.5	-		-	-	14.5	-	14.5	-	-		43.5
Cymbella pusilla Grun.	14.5	14.5			-	-	-	-		-	14.5	14.5	58
Cymbella sinuata W. Gregory	-		-	14.5		14.5	14.5	-		-	-	-	43.5
Cymbella tumida Van Heurck	-	14.5	-	14.5	14.5	14.5	14.5	-	14.5	-	-	-	87
Cymbella ventricosa Kutz.	14.5	29	14.5		14.5		14.5	-		-	-	-	87
Denticula sp.	-	-	14.5	-	14.5	-	-	-	14.5	-	-	-	43.5
Diatoma elongatum (Lyngb.) Ag.	-	14.5	203	14.5		14.5	14.5	-	-	-	-	-	261
Diatoma vulgare Bory.	14.5	29	333.5	101.5	130.5	58	14.5	29	14.5	14.5	14.5	14.5	768.5
Diploneis ovalis		-	-	-	14.5	14.5			14.5				43.5
Diploneis pseudovalis	14.5	-	-	-		14.5						14.5	43.5
Epithemia zebra (Ehr.) Kutz.	-		-			14.5		-		-	-	14.5	29
Fragilaria acus Kutz.	-	-	-	-	-	-	-	14.5	14.5	29	29	-	87
Fragilaria acus var. radians	58	-	14.5	-	-	-	-		-	-	-		72.5
Fragilaria brevistriata Van Heurck	-	-	-	-	14.5	-	145	87	-	-	188.5	-	435
Fragilaria construens (Ehr.) Grun.	-	-	-	-				14.5	-	-	-	-	14.5
Fragilaria fasciculate		-	-	14.5	-	-	-		-	-	-	14.5	29
Fragilaria ulna (Nitz.) Ehr.	14.5	-	58	-	29	130.5	29	29	14.5	14.5	43.5	14.5	377
Fragilaria ulna var. biceps	14.5	-	-	14.5	29	-	-		-	-	-	14.5	72.5
Fragilaria ulna var. oxyrhynchus (Kützing)		-	14.5	-	14.5	14.5	-	14.5	-	-	-		58
Fragilaria vaucheriae (Kutz.) Peters.	43.5	-	14.5	-	-	14.5	-	14.5	-	14.5	29		130.5
Frustulia rhomboides		-	-	-	14.5		-	-	-	-	-	-	14.5
Gomphoneis olivacea (Lyngb.) Daw.	29	-	-	72.5	14.5	-	-	14.5	-	-	-		130.5
Gomphonema angustatum (Kutz.) Rabh.	14.5	-	-	-	72.5	-	-	-	-	-	-	14.5	101.5
Gomphonema angustatum var. producta	-	-	-	-	14.5	-	-	-	-	-	-		14.5
Gomphonema constrictum var. capitata	-	-		-	-	-	-	14.5	-	-	-		14.5
Gomphonema gracile	-	-		-	14.5	-	-	14.5	-	-	-		29
Gomphonema parvulum	-	14.5			-	-	-	-	-	-	-	-	14.5
Gomphonema sp.	-	-	-	-	-	-	-	-	-	-	-	14.5	14.5
Gomphonema tergestinum	-	-	14.5	-	-	-	-	-	-	-	-		14.5
Gyrosigma acuminatum (Kützing)	-	-	14.5	14.5	-	14.5	-	14.5	14.5	-	-		72.5
Gyrosigma pensions	14.5	-		-	14.5	-	-	-	-	-	-		29
Gyrosigma scalproides	-	-	-	14.5	-	14.5	-	-	-	-	-		29
Gyrosigma spencerii	-	-	-	1.45	14.5	14.5	-	-	-	-	14.5	14.5	59.45
Hantzchia amphioxys (Her.) Grun.	-	14.5	14.5	-	14.5	14.5	14.5	14.5		14.5	14.5	14.5	130.5
Navicula atomus	-	-		14.5		-	-	-	-	-	-		14.5

Navicula cincta (Ehrenberg)	14.5	-	-	-	14.5	14.5	14.5	14.5	29	14.5	14.5	-	130.5
Navicula clausii	-	14.5			14.5	-	-	-	-	-	14.5	-	43.5
Navicula crucicula (W. Smith.) Donkin.	14.5	-		14.5		-	-	-	-	-	-		29
Navicula cryptocephala Kutz.	29	-	-	14.5	14.5	29	14.5	-	-	-	-	-	101.5
Navicula cryptocephala var intermedia	-	-		14.5		29			-	-	14.5	-	58
Navicula cryptocephala var. perminuta	-	-	-	-	-	-	14.5	14.5	-	-	-	-	29
Navicula cryptocephala var. veneta	14.5	-	14.5	14.5	14.5	14.5		29	-	-	-	-	101.5
Navicula gracilis	14.5	14.5		14.5	14.5	14.5	14.5	14.5	-	-	-	-	101.5
Navicula lubia	14.5	-	14.5			-	-	-	-	-	-		29
Navicula mutica	-	-		14.5	14.5	-	-	-	-	-	-		29
Navicula parva	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	29			14.5	159.5
Navicula placentula	-	-	-					14.5		-	-	-	14.5
Navicula pygmeae	-	-			14.5	-	-	-	-	-	-		14.5
Navicula radiosa Kutz.	14.5	-	-	14.5	14.5	-	-	-	-	-	-	-	43.5
Navicula radiosa var. tenella	14.5	14.5	-	14.5	14.5		14.5	-	-	-	-	-	72.5
Navicula rhynchocephala Kutz.	-	-		14.5		14.5	-	-	-	-	-	-	29
Navicula romana	-	-	-	14.5	-	-	-	-	-	-	-	-	14.5
Navicula schroeteri		-	14.5			-	-	14.5	14.5			14.5	58
Navicula sp.	-	-		14.5		-	-	-	-	-	-	14.5	29
Navicula spicula (Dickie.) Cl.		-	-	14.5	14.5	-	-	-	-	-	-	-	29
Navicula viridula (Kützing)	14.5		14.5			-	-	-	-	-			29
Navicula viridula var. rostellata (Kützing)		-	-	-	-	14.5	14.5	14.5		-	29	14.5	87
Nitzchia acicularis W. Smith	-	-	-			14.5	-	-	-	-	14.5	-	29
Nitzchia dissipatae Grun.	-	14.5	87	58	101.5	87	-	-	-	-		14.5	362.5
Nitzchia frustulum (Kutz.) Rabh.	14.5	-	-	-	-	-	-	-	14.5	-	-	14.5	43.5
Nitzchia palea (Kutz.) W. Smith	188.5	43.5	87	145	72.5	87		232	391.5	406	145	72.5	1870.5
Nitzchia sigma (Kutz.) W. Smith	14.5		43.5	29	14.5		14.5		14.5			14.5	145
Nitzschia angustata	-	-	-	-	-	14.5					-	-	14.5
Nitzschia angustata var. acuta	-	-	-	-	-		14.5		14.5	14.5	-	-	43.5
Nitzschia apiculata (W. Gregory)	14.5	-	14.5	-	-	14.5	29	-	-	-		14.5	87
Nitzschia circumsula	-	-	-	-	14.5	-	-	-	-	-	-	-	14.5
Nitzschia clausii			14.5	29	-	-	-	-		-	-		43.5
Nitzschia filiformis	-	-	-	-	-	-	-	14.5	-	-	-	-	14.5
Nitzschia hungrica	14.5	14.5	14.5	-	14.5	-	-	14.5	14.5		-	-	87
Nitzschia intermedia	-	-	-	-	-	-	-	-		14.5	-	-	14.5
Nitzschia longissima	87	-	14.5	14.5	14.5	72.5	-	-	14.5	14.5	14.5	-	246.5
Nitzschia lubia	-	-				14.5	-	-	-	-	-	-	14.5
Nitzschia microcephala	-	-	-	-	-	29	-	-	-	14.5	-	14.5	58

Nitzschia obtusa	-	14.5	-	14.5	-	-	-	14.5	-	-		-	43.5
Nitzschia punctata var. coarctata	-	-	-	-	-	-	-	-	-	-	14.5	-	14.5
Nitzschia sigma var. rigidula	-	-	-	-	-			14.5			-	-	14.5
Nitzschia sigmoidea	-	-	-	14.5	14.5	14.5	-	-	-	-	14.5	-	58
Nitzschia tryblionella	-	-		-	-	-	-	-	-	-	-	14.5	14.5
Nitzschia tryblionella var. debilis	-	-	-	-	-	-	-	-	-	-	14.5	-	14.5
Nitzschia tryblionella var. levidensis	-	-	-	-	-	-	-	14.5	-	-		-	14.5
Pinnularia borealis	-	-	-	-	-	-	-	14.5	-	-	-	-	14.5
pleurosigma angulatum	-	-	-	-	-	-	-	-	14.5	-	-	-	14.5
pleurosigma delcatum	-	-	-	-	-	-		-		-	14.5	-	14.5
pleurosigma delicatulum	-	-	-	-	14.5	-	-	-	14.5	-	-	-	29
pleurosigma salinarum	-	-	-	-	-	14.5	-	-		-	-	-	14.5
Rhoicosphenia curvata (Kutz.) Grun.	14.5	14.5	14.5	14.5	29	14.5	-	-	-	-	-	14.5	116
Surirella capronii	14.5	-	-	-		-	-			-	-	-	14.5
Surirella ovalis	-	-		-		-	-	14.5	14.5	-	-	-	29
Surirella ovata Kutz.	14.5	14.5	29	-	14.5	-	-	29	14.5	-	-	-	116
Surirella ovata var. africana		-	-	-	-	14.5	-	-	-	-	-	-	14.5
	Total count of Bacillariophyceae phytoplankton = 34321.35												
Total count of all Species for each month	1870.5	855.5	3784.5	1610.95	1348.5	8642	1392	1303.4	1290.5	1812.5	8816	1595	34321.35
Total count of all Species for each season	6510.5			11601.45			3985.9			12223.5			

Table 2 (Continued). Number of identified diatomic phytoplankton in St. 2, and their species and total count of each class (ind ×10^3 L^{-1}).

TAXA	Winter			Spring			Summer			Autumn			∑Sum
	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	
BACILLARIOPYCEAE													
Centrales													
Aulacoseira granulata (Ehr.) Simensen	14.5	-	-	14.5	14.5	246.5	14.5	406	116	29	362.5	14.5	1232.5
Aulacoseira italica	-	-	-		14.5			-	-	-	-	-	14.5
Aulacoseira varians	-	-	-	29	14.5	14.5	14.5	-	-	-	-	-	72.5
Cyclotella kuetzingiana Thw.	-	-	-	-	-	-	29	-	14.5	-	14.5	-	58
Cyclotella meneghiniana Kutz.	14.5	87	-	87	29	275.5	145	101.5	130.5	130.5	348	43.5	1392
Cyclotella ocellata Pant.	594.5	246.5	1116.5	464	72.5	3161	449.5	551	580	449.5	8256	391.5	16332.5
Stephanodiscus astrea (Ehr.) Grun.	-	-	-	-	-	29	-	-	-		-	-	29
Pennales													0
Achnanthes delicatula	-	14.5	-	-	-	-	-	-	-	-	-	-	14.5
Achnanthes lanceolata	-	-	-	-	-	-	-	14.5	-	-	-	-	14.5
Achnanthes minutissima	43.5	87	725	101.5	14.5	14.5	-	-	14.5	-	14.5	29	1044
Achnanthes sp.	-	14.5	-	-	-	-	-	-	-	-	14.5	-	29
amphiprora alata		-	-	-	-	-	-	-	-	-	14.5	-	14.5

Amphora coffeaformis		14.5	-	-	-	14.5	14.5	-	-	-	-	-	43.5
Amphora ovalis	-	14.5	-	14.5	-	14.5	14.5	14.5	-	-	-	-	72.5
Amphora perpusilla	14.5	-	-	14.5	-	-	-	-	-	-	-	-	29
Amphora sp.	-	-	-	-	-	14.5	14.5	-	14.5	-	-	-	43.5
Amphora veneta Kützing	-	-	-	14.5	14.5	-	-	14.5	14.5	-	-	-	58
Anomoeoneis exilis Kutz.	-	14.5	14.5	-	14.5	14.5	-		14.5	14.5	72.5	-	159.5
Bacillaria paxillifer (Mull.) Hend.	14.5	29	-	-	14.5	29	-	14.5	43.5	-	14.5		159.5
Caloneis amphicephalal	-	-	-	14.5	-	-	-	-	-	-	-	-	14.5
Caloneis ventricosa	-	14.5	-	-	-	-	-	-		-	-	-	14.5
Cocconeis pediculus Ehr.	14.5	-	-	43.5	29	145	14.5	14.5	29	-	-	14.5	304.5
Cocconeis placentula Ehr.	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	174
Cocconeis placentula var. euglypta (Ehr.) Cl.	-	29	29	58	58	87	14.5	14.5	14.5	14.5	14.5	14.5	348
Cocconeis placentula var. lineata	-		-	-	-	-	-	-	14.5	14.5		-	29
Coscinodiscus lacustris	14.5	-	-	-	-	14.5	-	14.5	14.5	-	-	14.5	72.5
Cymatopleura elliptica	-	-	-	-	-	-	-	14.5	-	-	-		14.5
Cymatopleura solea	-	14.5			14.5	14.5	14.5	14.5	-	14.5	14.5	14.5	116
Cymbella affinis Kutz.	14.5	-	14.5	14.5	14.5	43.5	14.5	14.5	-	14.5	-	-	145
Cymbella amphicephala	-	-	-	-	-	-	-	-	-		-	14.5	14.5
Cymbella amphicephala var. intermedia	-	-	-	-	-	-	-	14.5	-		-	-	14.5
Cymbella aspera	-	-	-		-	29	-	-	-	-	-	-	29
Cymbella cistula (Hemp.)	14.5		14.5	-	14.5	14.5	-	-	-	14.5	-	-	72.5
Cymbella delicatula	-	-	-	-	-	14.5	-	-		-	-	-	14.5
Cymbella microcephala Grun.	14.5	14.5	14.5	14.5	-	14.5	-	-	-	14.5	14.5	-	101.5
Cymbella prostrata	14.5	-	-	-	-	-	-	-	-	-	14.5	-	29
Cymbella pusilla Grun.	14.5	-	14.5	-	-	29	14.5	14.5	14.5	-	14.5	14.5	130.5
Cymbella sinuata	-	-	-	-	-	14.5	-	-	14.5	-	-	-	29
Cymbella tumida Van Heurck	14.5	14.5	-	-	-	14.5	14.5	-	-	-	14.5	-	72.5
Cymbella turgida	-	14.5	-	-	-		-	-	-	-	-	-	14.5
Cymbella ventricosa Kutz.	-	-	-	14.5	-	43.5	-	-	14.5	-	-	-	72.5
Denticula sp.	14.5	-	-	14.5	29	14.5	14.5	-		14.5		-	101.5
Diatoma elongatum (Lyngb.) Ag.		14.5	145	14.5		29	14.5		29	-		-	246.5
Diatoma vulgare Bory.	43.5	43.5	290	14.5		58	29	14.5	14.5	-	14.5	14.5	536.5
Diatoma vulgare var. linearis	-	-	14.5		58	-	-	-	-	-	-	-	72.5
Diploneis ovalis	14.5	-	-	-		-	-	-	-	-	-	-	14.5
Diploneis pseudovalis	-	-	-	14.5		-	-	-	-	14.5	-	-	29
Eunotia pectinalis		-	-	-	-	-	-	-	-	-	14.5	-	14.5
Fragilaria acus Kutz.	-	-	-	-		-	-	14.5	29	87	14.5	-	145
Fragilaria acus var. radians	-	-	-	-	14.5	-	-					43.5	58

Fragilaria brevistriata Van Heurck	-	-	-	-	-		14.5		14.5	-	14.5	-	43.5
Fragilaria fasciculata	14.5	14.5		14.5	-	-	-	-	-	-		-	43.5
Fragilaria sp.	-	-	-	-	-	14.5	-	-	-	-	-	-	14.5
Fragilaria ulna (Nitz.) Ehr.	14.5	14.5	14.5	-	-	101.5	14.5	14.5	29	14.5	14.5	14.5	246.5
Fragilaria ulna var. biceps	14.5	14.5	-	14.5	43.5			-	-	-		14.5	101.5
Fragilaria ulna var. oxyrhynchus (Kützing)		-	-	-	-		14.5	-	-	-			14.5
Fragilaria vaucheriae (Kutz.) Peters	14.5	-	14.5	-	-		14.5	-	-	-	14.5		58
Gomphoneis olivacea (Lyngb.) Daw.	-	-	14.5	29	29	14.5	14.5	-	-	-	-	-	101.5
Gomphonema angustatum (Kutz.) Rabh.	-	-	-	-	-	-	-	-	14.5		-	-	14.5
Gomphonema gracile	-	-	-	-	-	-	14.5	-	-	-	-	-	14.5
Gomphonema parvulum	-	-	-	-	-	-	-	-	-	-	14.5	-	14.5
Gomphonema sphaerophorum	-	-	-					14.5		14.5	-	-	29
Gomphonema tergestinum	-	-	-	14.5		14.5		-	-	-	-	-	29
Gyrosigma acuminatum (Kützing)	14.5	-	-	14.5	14.55	14.5	14.5		14.5	-		-	87.05
Gyrosigma attenuatum (Kützing)	-	-	-	14.5		14.5	14.5	-	-	-	-	-	43.5
Gyrosigma pensions	-	-	-	-	-	14.5		-	-	-	-	14.5	29
Gyrosigma scalproides	-	-	-	-	-	14.5		-	-	-	-		14.5
Gyrosigma spencerii	-	-	-	-	-	14.5	14.5	-	-	-	-	14.5	43.5
Hantzchia amphioxys (Her.) Grun.	14.5	14.5	14.5	14.5	14.5	14.5	14.5	-	-	14.5	14.5	14.5	145
Mastogloia elliptica	-	-	-	-	-	-	-	14.5	-	-	-	-	14.5
Navicula cincta (Ehrenberg)	14.5	-	-	14.5	29	43.5	14.5	14.5		14.5	14.5	-	159.5
Navicula clausii	-	-	-	-	-	-	-	-			14.5	-	14.5
Navicula crucicula (W. Smith.) Donkin.		-	-	-	-			-		14.5		-	14.5
Navicula cryptocephala Kutz.	14.5	-	-	-	-	14.5	14.5	-		-	43.5	-	87
Navicula cryptocephala var intermedia	14.5	-		-	-			-		-	-	-	14.5
Navicula cryptocephala var. veneta	14.5	14.5	14.5	-	-	14.5		-	14.5	-	-	-	72.5
Navicula gracilis Ehr.	-	-	14.5	14.5	14.5	58	14.5	14.5	14.5	-	-	14.5	159.5
Navicula gremmi	-	-		-	-	-	-	-	14.5	-	-	-	14.5
Navicula mutica	-	-	14.5	-	-	-	-	14.5	-	-	-	-	29
Navicula parva	-	-	14.5	14.5	14.5	14.5	-	-	-	14.5	-	-	72.5
Navicula placentula	-	-	-	14.5		-	-	-	14.5	-	-	-	29
Navicula placentula var.rostrata	-	-	-			-	-	-		-	14.5	-	14.5
Navicula pygmeae	-	-	-	-		14.5	-	-	-	-	-	-	14.5
Navicula radiosa Kutz.	-	-	-		14.5	-	14.5	-		-	-	-	29
Navicula radiosa var. tenella	-	14.5	-	14.5		-	14.5	-		-	-	-	43.5
Navicula rhynchocephala Kutz.	-	-	14.5	-	14.5		-	-	-	-	-	-	29
Navicula romana	-	-	-	-		-	-	-	14.5	-	-	-	14.5
Navicula schroeteri	-	-	14.5	-	-	-	-	-	-	-	-	14.5	29

Navicula sp.	-	-	29	-	-	-	-	-	-	14.5	-	14.5	58
Navicula spicula (Dickie.) Cl.	-	-		-	14.5	29	-	-	-	-	-	-	43.5
Navicula trivalis	-	-	-	-	14.5	-	-	-	-	-	-	-	14.5
Navicula tuscula	-	14.5	-	-		-	-	-	-	-	-	-	14.5
Navicula viridula (Kützing)	14.5	-	-	-	-	-	14.5	-	-	-	-		29
Navicula viridula var. rostellata (Kützing)	14.5	-	-	-	-	-		-	-	-	-	14.5	29
Neidium iridis	-	-	-	-	-	-	14.5	-	-	-	-	-	14.5
Nitzchia acicularis W. Smith	-	-	14.5	-	-		-	-	-	-	14.5	-	29
Nitzchia dissipatae Grun.	-	14.5	101.5	14.5	-	29	-		-	-	-	-	159.5
Nitzchia frustulum (Kutz.) Rabh.	-	14.5	-	-	-	-		14.5	-	-	-	-	29
Nitzchia lorenziana var. subtilis	-	-	14.5	-	-		-		-	-	-	-	14.5
Nitzchia palea (Kutz.) W. Smith	130.5	145	87	188.5	72.5	188.5	-	14.5	232	304.5	72.5	43.5	1479
Nitzchia sigma (Kutz.) W. Smith	14.5	-	-	-	-	14.5	14.5	-	29	-	14.5	-	87
Nitzschia amphibia	-	14.5	-	-	-		-	-	-	-	-	-	14.5
Nitzschia angustata var. acuta	-	-	-	-	-	58	-	14.5	-	-	-	-	72.5
Nitzschia apiculata (W. Gregory)	-	14.5	-	-	-	43.5	-	-	-	14.5	-	-	72.5
Nitzschia clausii	-	-	-	14.5	-	-	-	-	-	-	-	-	14.5
Nitzschia commutata	-	-	-	-	14.5		-		-	-	-	-	14.5
Nitzschia filiformis	-	-	-	-	-	14.5	-	-	-	-	-	-	14.5
Nitzschia gracilis	-	-	-	-	-		-	-	-	-	-	14.5	14.5
Nitzschia granulata	-	-	-	-	-		-	14.5	14.5	-	-	-	29
Nitzschia hungarica Grun.	14.5	14.5	-	-	14.5		14.5	14.5	-	-	-	14.5	87
Nitzschia ignorata	-	14.5	-	-	-		-	-	-	-	-	-	14.5
Nitzschia intermedia	-	-	-	-		-	-	-	-	-	14.5	-	14.5
Nitzschia linearis	-	-	-	-	-	14.5	-	-	-	-	-	-	14.5
Nitzschia longissima	29	58	-	14.5	-	87	14.5	14.5	14.5	29	14.5	14.5	290
Nitzschia lubia	-	14.5	-		-	-	-	-	-	-	-	-	14.5
Nitzschia obtusa	-	-	-	-	-	-	-		-	14.5	-	14.5	29
Nitzschia ralea	-	-	-	-	-	-	14.5		-	-	-	-	14.5
Nitzschia sigmoidea	14.5	-		-	-	14.5	-	-	-	-	-	-	29
Nitzschia tryblionella	-	-	-	-	-	-	14.5	14.5	14.5	-	-	-	43.5
Nitzschia tryblionella var. levidensis	-	-	14.5	-	-	14.5	-	14.5	-	-	-	-	43.5
Nitzschia tryblionella var. victoriae	14.5		-	-	-	-	-	-	-	-	-	-	14.5
Pleurosigma angulatum	-	-	-	-	-	-	-		-	-	14.5	-	14.5
pleurosigma delicatulum	-	-	-	-	-	-	-		-	-	-	14.5	14.5
Rhoicosphenia curvata (Kutz.) Grun.	14.5	14.5	14.5	14.5	29	14.5	29	14.5	14.5	-	14.5	14.5	188.5
Rhopalodia gibba		-	-	-	-	14.5	-	-	-	-			14.5
Stauroneis agrestis	-	-	14.5	-	-	-	-	-	-	-	-	-	14.5

Stauroneis microstauron	-	-	-	-	-	-	-	-	-	-	-	14.5	14.5
Surirella ovalis	14.5	-	-	-	-	14.5	-	-	-	-	-	-	29
Surirella ovata Kutz.	14.5	14.5	14.5	14.5	14.5	14.5	-	14.5	14.5	14.5		14.5	145
Surirella sp.	-	-	-	-	-	-	14.5	-	-	14.5	-	-	29
	Total count of Bacillariophyceae phytoplankton **= 29121.55**												
Total count of all Species for each month	1334	1131	2856.5	1421	812.05	5379.5	1218	1508	1624	1334	9575.5	928	29121.55
Total count of all Species for each season	5321.5			7612.55			4350			11837.5			

Table 2 (Continued). Number of identified Diatomic phytoplankton in St. 3, and their species and total count of each Class (ind $\times 10^3$ L^{-1}).

TAXA	Winter			Spring			Summer			Autumn			∑Sum
	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	
BACILLARIOPYCEAE													
Centrales													
Achnanthes delicatula	-	-	-	14.5	-	-	-	-	-	-	-	-	14.5
*Aulacoseira granulate (*Ehr.) Simensen	14.5	-	-	14.5	14.5	667	116	14.5	290	406	609	145	2291
Aulacoseira italica	-	-	-	14.5	14.5	-	-	-	-	-	-	-	29
Aulacoseira varians	-	-	-	14.5	29	14.5	14.5	-	-	-	-	-	72.5
Coscinodiscus lacustris Grun.	14.5	14.5	-	-	-	-	14.5	29	-	-	-	14.5	87
Cyclotella comta (Her.) Kutz.	14.5	-	-	-	-	-	29	-	-	-	-	14.5	58
Cyclotella kuetzingiana Thw.		-	14.5		14.5	14.5	58	-	-	-	-	14.5	116
Cyclotella meneghiniana Kutz.	14.5	174	-	87	116	232	130.5	413.5	174	290	710.5	29	2371
Cyclotella ocellata Pant.	942.5	58	1102	362.5	14.5	6206	362.5	275.5	913.5	1058.5	8120	986	20401.5
Cyclotella stelligera	-	-	-	-	-		-	-	-	-	14.5	-	14.5
Stephanodiscus astrea (Ehr.) Grun.	-	-	-	-	-	14.5	-	14.5	14.5	-	14.5	14.5	72.5
Pennales													0
Achnanthes lanceolata	-	-	-	-	-	-	-	-	29	-	-	-	29
Achnanthes minutissima Kutz.	14.5		14.5	101.5	101.5	72.5	-	-	43.5	-	14.5	101.5	464
Achnanthes sp.	-	-	-	-	-	-	14.5	14.5		-	14.5	14.5	58
*Amphora coffeaeformis (*Ag.) Kutz.	-	-	-	-	-	-	14.5	-		-	14.5	14.5	43.5
Amphora ovalis	-	14.5	-	14.5	-	14.5	14.5	-	14.5	-	14.5	-	87
Amphora perpusilla	-	-	-		-	14.5	-	14.5		14.5	-	-	43.5
Amphora sp.	-	14.5	-	14.5	-	14.5	29	-		-	14.5	-	87
Amphora veneta Kutz.	14.5	-	-	-	-		-	-	29	-		-	43.5
Anomoeoneis exilis Kutz.	14.5	-	-	-	14.5	14.5	-	-	43.5	-	29	14.5	130.5
Anomoeoneis sphaerophora		-	-	-	14.5		-	-		-			14.5

Bacillaria paxillifer (Mull.) Hend.	14.5	-	29	14.5	14.5	14.5	-	-	14.5	14.5		14.5	130.5
Caloneis amphicephala1	-	-	-		-	-	-	14.5	-	-	-	-	14.5
Caloneis permagna	-	-	-			14.5	14.5		-	-	-	-	29
Caloneis silicula	-	14.5	-	14.5	-	-	-	-	-	-	-	-	29
Campylodiscus clypeus	-	-	-	-	-	-	-	14.5	-	-	-	-	14.5
Cocconeis pediculus Ehr.	14.5	14.5	-	14.5	29	14.5	14.5	14.5	14.5	-	-	14.5	145
Cocconeis placentula Ehr.	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	174
*Cocconeis placentula var. euglypta (*Ehr.) Cl.		14.5	14.5	29	14.5	72.5	43.5	14.5	14.5	14.5	14.5	14.5	261
Cocconeis placentula var. lineata	14.5	-	-	-	14.5	-	-	-	-	-	-	-	29
Cymatopleara solea		-	-	14.5	14.5	14.5	14.5	14.5	14.5	-	-	-	87
Cymatopleura elliptica	-	-	-	-	14.5	-		-	-	-	-	-	14.5
Cymbella affinis Kutz.	14.5	14.5	14.5	29	14.5	14.5	-	14.5	-	29	-	-	145
Cymbella affinis var. excisa	14.5	-	-	-	-	-	-	-	-	-	-	-	14.5
Cymbella amphicephala Näegeli ex Kützing	-	-	-	-	-	-	14.5	-	-	-	-	-	14.5
Cymbella amphicephala var. intermedia	-	-	-	-	14.5	14.5	-	14.5	-	-	-	-	43.5
Cymbella aspera	-	-	-	-	-	14.5	-	-	-	-	-	-	14.5
Cymbella caespitosa	-				-	14.5		-	-	-	-	-	14.5
Cymbella caespitosa var. auerswaldii	-				14.5	-		-	-	-	-	-	14.5
Cymbella cistula (Hemp.)	-	14.5	14.5		14.5		14.5	14.5	-	-	-	-	72.5
Cymbella cymbiformis	-		-	-	-		14.5		-	-	-	-	14.5
Cymbella microcephala Grun.	29	14.5	-	-	-	14.5	14.5	14.5	14.5				101.5
Cymbella perpusilla	-	-	-	-	-	14.5	-	-	-	-	-	-	14.5
Cymbella pusilla Grun.	14.5	14.5	-	-	-	14.5	43.5		14.5		14.5	14.5	130.5
Cymbella sinuata W. Gregory	-	-	-	-		-	14.5	-	-	-	-	-	14.5
Cymbella sumatrensis	-		14.5			-		-	-	-	-	-	14.5
Cymbella tumida	-	14.5	14.5		-	14.5	14.5		14.5	14.5			87
Cymbella ventricosa Kutz.	-			29	-	14.5		14.5	-	-	-	14.5	72.5
Denticula sp.	-	14.5	14.5		-	-	14.5		-	-	-	-	43.5
Diatoma elongatum	-	14.5	116	14.5	-	-			14.5		-	-	159.5
Diatoma vulgare Bory.	14.5	14.5	145	29	14.5	-		29	14.5	14.5	14.5	14.5	304.5
Diploneis ovalis	-	-	-	14.5	-	-	-	-		-	-	-	14.5
Diploneis pseudovalis			-	-	-	-	-	-	-	-	-	14.5	14.5
Epithemia zebra (Ehr.) Kutz.		-	-	-	-	-	14.5			14.5			29
Eunotia arcus	-	-	-	-	14.5	-		-	-	-	-	-	14.5
Fragilaria acus Kutz.		-	-	-	-	29	14.5	14.5	43.5	14.5			116

Fragilaria acus var.radians	14.5	14.5	14.5	-	-	-							43.5
Fragilaria brevistriata Van Heurck				-	-	-	14.5	145	14.5		14.5		188.5
Fragilaria pulchella		14.5				-	-	-	-	-	-		14.5
Fragilaria ulna (Nitz.) Ehr.	29		14.5	14.5	14.5	-	29	14.5	43.5	14.5	14.5	14.5	203
Fragilaria ulna var. biceps	14.5	14.5	14.5	14.5	29	-	-	-	-	-	-	14.5	101.5
Fragilaria ulna var. oxyrhynchus	-	-	14.5	14.5		-	14.5	-	-	-	-	-	43.5
*Fragilaria vaucheriae (*Kutz.) Peters	14.5	-	14.5		14.5	14.5	29	14.5	14.5	14.5	43.5	14.5	188.5
Gomphoneis olivacea (Lyngb.) Daw.		-	-	29	72.5	-	-	-	-	-	-	-	101.5
Gomphonema angustatum (Kutz.) Rabh.	-	29	-	-	-	-		-	-	-	-		29
Gomphonema intricatum		-					14.5	-	-	-	-		14.5
Gyrosigma acuminatum (Kützing)		-		14.5	14.5	14.5	14.5	-	-	-	-	14.5	72.5
Gyrosigma attenuatum (Kützing)	14.5	-	-		14.5	-	-	-	-	-	-	-	29
Gyrosigma pensions	14.5	-	-	14.5	-	14.5	14.5	-	14.5		14.5	-	87
Gyrosigma scalproides		-	-	14.5	-		14.5	-				-	29
Gyrosigma spencerii	14.5	29	-	14.5	14.5	29	14.5	-		14.5	14.5	-	145
Hantzchia amphioxys (Her.) Grun.	14.5	14.5	-	-	14.5	14.5	14.5	14.5	-	-	-	-	87
Navicula cincta	-	-	-	-		43.5				14.5	14.5	-	72.5
Navicula clausii	-	-	-	-	-	-	-	-	-		14.5	-	14.5
Navicula cryptocephala Kutz.	-	-	-	-		58	14.5	14.5	43.5			-	130.5
Navicula cryptocephala var intermedia	-	-	-	14.5			-	-	-	-	14.5		29
Navicula cryptocephala var. minuta	-	-	-	-	-	14.5		-	-	-	-		14.5
Navicula cryptocephala var. perminuta	-	-	-	-	-			-	-	-	-	14.5	14.5
Navicula cryptocephala var. veneta	-	-	14.5	-	-		14.5	-	-	-	-	14.5	43.5
Navicula gracilis	14.5	-	14.5	14.5	29		14.5	29	14.5	-	14.5	14.5	159.5
Navicula inflata		-		-	-	-	14.5		-	-			14.5
Navicula lubia	-	14.5	-	-	-	-	-	-	-	-	-	-	14.5
Navicula parva	29	14.5	-	-	14.5	43.5		14.5	-	-	14.5	14.5	145
Navicula pygmeae	-	-	-	-	14.5			-	-	-	-	-	14.5
Navicula radiosa Kutz.	14.5	-	14.5	-	-	-			-	-		14.5	43.5
Navicula radiosa var. tenella		-	14.5	-	-	-			-	-			14.5
Navicula rhynchocephala Kutz.		-	-	14.5	14.5			-				-	29
Navicula schroeteri	-	14.5	-	-	-			-	-	-	-	14.5	29
Navicula sp.	14.5	-	-	-			-	-	-	14.5		14.5	43.5
Navicula spicula (Dickie.) Cl.	-	-	14.5	14.5	43.5	14.5	-	-	-	-	-	-	87

Navicula viridula (Kützing)	-	14.5	-	-	-	-	-		-	-	-		14.5
Navicula viridula var. rostellata (Kützing)	-	-	-	-	-	-	14.5	43.5	-	-	14.5	14.5	87
Navicula virudula		-	-	-		14.5	-	-	-	-			14.5
Nitzchia acicularis W. Smith	-	-	-	-	-	14.5		-	-	-	-	14.5	29
Nitzchia dissipatae Grun.	-	14.5	43.5	14.5	29	29	-	14.5	-	-	-	14.5	159.5
Nitzchia frustulum var. perminuta	-	-	-	-	14.5			-	-	-	-		14.5
Nitzchia lorenziana	14.5	-	-	-	-	-				-	-	-	14.5
Nitzchia palea (Kutz.) W. Smith	87	130.5	14.5	43.5	-	-	14.5	29	594.5	348	232	-	1493.5
Nitzchia sigma (Kutz.) W. Smith	14.5	-	29	29	14.5	14.5	14.5	-		-	-	-	116
Nitzschia angustata var. acuta	-	-	-	14.5	-	14.5	14.5	-	14.5	-	14.5	14.5	87
Nitzschia apiculata (Greg.) Grun.	14.5	-	14.5	14.5	-	14.5	14.5	-	-	-	-	14.5	87
Nitzschia clausii	-	-	-	-	14.5	14.5	-		-	-	-	-	29
Nitzschia fasciculata Grun.	-	-	14.5	-	14.5	-		-		-	-	14.5	43.5
Nitzschia gracilis	-	-	14.5	-	-	14.5		-	14.5	14.5	-	-	58
Nitzschia hungarica Grun.	29	-	14.5	-	-	-	14.5	-	-	-	-	-	58
Nitzschia ignorata	14.5	-	-	-	-	-	-	-	-	-	-	-	14.5
Nitzschia longissima	14.5	29	-	58	-	-	-	-	-	14.5	14.5	14.5	145
Nitzschia lubia	-	-	14.5	-	-	14.5	-	-	-	-	-	-	29
Nitzschia microcephala	-	-	-	-	-	-	-	-	116	-	-	-	116
Nitzschia obtusa	14.5	-	-	14.5	-	-	-	-	14.5	-	-	-	43.5
Nitzschia ralea	-	-	-	-	43.5			-	-	-	-		43.5
Nitzschia scalaris	-	-	-	-	14.5	-	-	-	-	-	-	-	14.5
Nitzschia sigmoidea	-	-	14.5	-	-	-	-	-	-	-	-	-	14.5
Nitzschia tryblionella	14.5	-	-	-	-	-		14.5	14.5	-	-	-	43.5
Nitzschia tryblionella var. levidensis	-	-	-	-	-	14.5		14.5		-	-	14.5	43.5
Pinnularia borealis	-	-	-		-	-	-	-	-	-	14.5	-	14.5
Pleurosigma angulatum	-	-	-	-	-	-			14.5	-	-	-	14.5
pleurosigma delicatulum	-	-	-	-	-	-	14.5	-	-	14.5	-	-	29
Rhoicosphenia curvata (Kutz.) Grun.	14.5	-	-	14.5	29	14.5	29	14.5	14.5	14.5	14.5	14.5	174
Surirella angustata	-	-	-	-	-	-	-	-	-	-	-	14.5	14.5
Surirella ovalis	14.5	-	-	-	-	-	-	-	-	-	-		14.5
Surirella ovata Kutz.	-	14.5	14.5	14.5	14.5	29		14.5	14.5			-	116
Tabellaria fenestrata		-	-		14.5	-	-	-	-	-	-	-	14.5
	Total count of Bacillariophyceae phytoplankton = 34430.5												
Total count of all Species for each month	1638.5	812	1856	1261.5	1044	8047.5	1435.5	1370.5	2697	2378	10106.5	1783.5	34430.5

Total count of all Species for each season	4306.5	10353	5503	14268	

Table 2 (Continued). Number of identified Diatomic phytoplankton in St. 4, and their species and total count of each Class (ind ×10^3 L^{-1}).

TAXA	Winter			Spring			Summer			Autumn			∑Sum
	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	
BACILLARIOPYCEAE													
Centrales													
Aulacoseira granulate (Ehr.) Simensen	-	14.5	-	-	14.5	14.5	-	14.5	87	391.5	14.5	58	609
Aulacoseira italica	-	-	-	14.5	72.5	-	-	-	-	-	-	-	87
Aulacoseira varians	-	--	14.5	14.5	14.5	29	29	--	14.5	-	-	14.5	130.5
Chaetoceros sp.	14.5	-	-	-	-	-	-	-	-	-	-	-	14.5
Coscinodiscus lacustris Grun.	14.5	14.5	-	-	-	29	14.5	14.5	-	-	14.5	14.5	116
*Cyclotella comta (*Her.) Kutz.	-	-	-	-	14.5	-	-	-	-	-	-	14.5	29
Cyclotella kuetzingiana Thw.	14.5	-	-	-	-	-	-	-	-	-	58	14.5	87
Cyclotella meneghiniana Kutz.	29	232		304.5	72.5	290	246.5	159.5	14.5	72.5	188.5	87	1696.5
Cyclotella ocellata Pant.	493	29	1073	884.5	101.5	6989	406	261	304.5	1450	6829.5	1073	19894
Cyclotella stelligera	-	-	-	-	-	-	-	-	-	-	29	-	29
Stephanodiscus astrea (Ehr.) Grun.			-	-	14.5	14.5	29		14.5	29	-	14.5	116
Pennales													0
Achnanthes delicatula	14.5	-	-	-	-	-	-		-	-	-	-	14.5
Achnanthes minutissima Kutz	14.5	-	14.5	58	-	14.5	14.5	14.5	-	-	14.5	58	203
Amphipleura pellucida	-	-	-	-	-	14.5	-	-	-	-	-	-	14.5
Amphora coffeaeformis (Ag.) Kutz.	14.5	-	-	14.5	-	-	14.5	14.5	-	-	-	-	58
Amphora ovalis	14.5	14.5	-	-	14.5	14.5	-	14.5	-	14.5	-	-	87
Amphora ovalis var. lyprica		-	-	-	-	-	-	14.5	-	-	-	-	14.5
Amphora perpusilla	-	14.5	-	-	-	43.5	-	-	-	-	-	-	58
Amphora sp.	14.5	-	-	14.5	14.5	14.5	-	14.5	-	-	14.5	14.5	101.5
Amphora veneta Kützing	-	14.5	-	-	-	14.5	14.5	14.5	-	14.5	-	14.5	87
Anomoeoneis exilis Kutz.	14.5	14.5	-	-	-		-	-	14.5	14.5	14.5	14.5	87
Anomoeoneis sphaerophora	-	-	-	14.5	-		-	-	-	-		-	14.5
Bacillaria paxillifer (Mull.) Hend.	14.5	-		14.5		43.5	14.5	14.5	-	14.5	14.5		130.5
Caloneis bacillum	-	-	-	-	14.5	14.5	-	-	-	-		-	29
Caloneis silicula	-	-	14.5	-	-	-	-	-	-	-	-	-	14.5
Ceratoneis arcus	-				29	-	-	-	-	-	-	-	29
Cocconeis pediculus Ehr.	14.5	14.5	14.5	58	14.5	14.5	14.5	14.5	-	14.5	14.5		188.5
Cocconeis placentula Ehr.	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	14.5	174
Cocconeis placentula var. lineata	-	14.5		-	-			-	-	-	-		14.5
Cocconeis placentula var.euglypta (Ehr.) Cl.	29	14.5	14.5	14.5	43.5	43.5	43.5	14.5	14.5	14.5	14.5	14.5	275.5

Cymatopleara solea	-	-	14.5	-	-	14.5	14.5	-	-	-	-	14.5	58
Cymatopleura elliptica	-	-	-	-	-	14.5	-	14.5				-	29
Cymatopleura solea	14.5	-	-	-	-	-	-	14.5	14.5			-	29
Cymbella affinis Kutz.	14.5	-	14.5	14.5	72.5	58	14.5	14.5	14.5	29	43.5	-	290
Cymbella amphicephala var. intermedia	-	-	-	-	-	14.5	14.5		-	-	-	-	29
Cymbella aspera	-	-	-	-	14.5	14.5	-		-	-	-	-	29
Cymbella caespitosa var. auerswaldii	-	-	-	-	14.5				-	-	-	-	14.5
Cymbella caespitosa var. tuerswardii	-	14.5	-	-	-	-	-					-	14.5
Cymbella cistula (Hemp.)	14.8	-	14.5	14.5	14.5	14.5	-	14.5	-	-	-	-	87.3
Cymbella cistula var. maculata	-	-	-	14.5	-		-		-	-	-	-	14.5
Cymbella differta	-	14.5	-	-	-		-	-	-	-		-	14.5
Cymbella microcephala Grun.	-	-	-	-	-	58	-	14.5		14.5	-	-	87
Cymbella prostrata	-	-	-	-	-		-	-	-	-	14.5	-	14.5
Cymbella pusilla Grun.	-	14.5	-	-	-	14.5	-	14.5	-	-	14.5	14.5	72.5
Cymbella sinuata W. Gregory	-	-	-	14.5	14.5	14.5	-		-	-	-	-	43.5
Cymbella tumida Van Heurck	-	14.5	-	14.5	14.5	14.5	-		-	-	-	-	58
Cymbella ventricosa Kutz.	-	-	-	14.5	14.5	-	14.5	14.5	14.5	-	-	-	72.5
Denticula sp.	-	-	-	-	-		-				14.5	-	14.5
Diatoma elongatum	-	14.5	130.5	29	14.5	29	-	-	-	-	-	-	217.5
Diatoma vulgare Bory.	-	29	348	217.5	130.5	29	43.5	14.5	14.5	14.5	29	14.5	884.5
Diploneis pseudovalis	14.5	-	-	-	14.5		-	14.5	-	-	14.5	14.5	72.5
Epithemia turgida	-	-	-	-	-	14.5	-	-	-	-	-	-	14.5
*Epithemia Zebra (*Ehr.) Kutz. *turgida*	-	-	-	-	-		-	-	14.5	-	-	-	14.5
Fragilaria acus Kutz.	-	-	-	-	-	14.5	-	29	14.5	-	-	-	58
Fragilaria acus var.radians	-	-	-	-	14.5		-	-	-	-	-	14.5	29
Fragilaria acus var.radiosa	-	-	-	-	-		-	-	-	-	14.5	-	14.5
Fragilaria affinis	-	-	14.5	-	-		-	-	-	-	-	-	14.5
Fragilaria brevistriata Van Heurck	14.5	-	-	-	-	-	14.5	14.5	14.5	-	-	-	58
Fragilaria construens (Ehr.) Grun.	-	-	-	-	-	14.5	-	-	-	-	-	-	14.5
Fragilaria fasciculate	-	-	-	14.5	-	-	-	-	-	14.5	-	14.5	43.5
Fragilaria ulna (Nitz.) Ehr.	14.5	-	29	14.5	-	14.5	14.5	43.5	14.5	-	43.5	14.5	203
Fragilaria ulna var. biceps	14.5	14.5	-	29	14.5	-	-	-	-	-	-	14.5	87
Fragilaria ulna var. oxyrhynchus	-	-	-		29	-	-	-	-	-	-	14.5	43.5
Fragilaria vaucheriae (Kutz.) Peters	14.5	14.5	14.5	14.5	29	-	14.5	14.5	-	-	14.5	14.5	145
*Gomphoneis olivacea (*Lyngb.) Daw.	-	14.5	14.5	43.5	43.5	-	-	-	-	14.5	14.5	-	145
Gomphonema angustatum (Kutz.) Rabh.	-	-	-	14.5	14.5	-	-	-	14.5	-	-	-	43.5
Gomphonema gracile	-	-	-	-	-	-	-	-	14.5	-	-	-	14.5
Gomphonema intricatum	-	-	-	-	-	-	-	-	-	-	14.5	-	14.5

Gomphonema lanceolatum	-	-	-	-	-	-	-	-	-	-	14.5	-	14.5
Gomphonema parvulum	-	-	43.5	-	-	14.5		-	-	-	-	-	58
Gomphonema sphaerophorum	-	-	-	-	-			14.5		-	-	-	14.5
Gomphonema tergestinum	-	-		-	-	14.5		-	-	-	-	-	14.5
Gyrosigma acuminatum (Kützing)	14.5	-	29	14.5	-	14.5	14.5	-	-	-	-	-	87
Gyrosigma attenuatum (Kützing)	-	-	-	-	-	14.5		-	-	-	-	-	14.5
Gyrosigma macrum		-	-	-	14.5			-	-	-	-		14.5
Gyrosigma peisone	-	-	-	-	14.5	-	-	-	-	-	14.5	-	29
Gyrosigma scalproides		-	-	-	-	14.5	14.5	-	-	-	-		29
Gyrosigma spencerii	14.5	-	-	-	14.5		14.5	-	-	-		-	43.5
Gyrosigma tenuirostrum	14.5	-	-	-	-			-	-	-	-		14.5
Hantzchia amphioxys (Her.) Grun.	-	14.5	14.5	-	14.5	14.5	43.5	-	-	-	14.5	-	116
Mastogloia braunii	-	-	-	-	-	-	-	-	-	-	-	14.5	14.5
Mastogloia smithii	-	-	-	-	-	-	-	-	-	-	-	14.5	14.5
Navicula atomus	-	-	-	14.5		-	-	-	-	-	-	-	14.5
Navicula cincta	-	-	-	14.5	14.5	58	-	-	-		14.5	-	101.5
Navicula clausii	14.5	14.5	-	14.5	-	-	-	-	-			14.5	58
Navicula crucicula (W. Smith.) Donkin.	-	-	-	14.5	-	14.5	-	14.5	-	14.5	14.5	-	72.5
Navicula cryptocephala	14.5	-	-	-	-	29	14.5		-	14.5		14.5	87
Navicula cryptocephala var intermedia	14.5	14.5		14.5	-	14.5	-	-	-	-	-	-	58
Navicula cryptocephala var. minuta	-	-	-	-	-	14.5	-	-	-	-	-	-	14.5
Navicula cryptocephala var. veneta	14.5		14.5	29	14.5	-	-	14.5	-		14.5		101.5
Navicula cuspidata Kutz.	-	-	-	-	-	-	14.5	-	-	-	-	-	14.5
Navicula gracilis Ehr.	14.5	14.5		14.5	29	29	14.5	43.5	14.5	14.5	14.5	14.5	217.5
Navicula menisculus	-	-	-	-	-		-	-	-	14.5	-	-	14.5
Navicula parva (Menegh.) Cl.	14.5	14.5	14.5		14.5	14.5	14.5			14.5	14.5	14.5	130.5
Navicula placentula	-	-	-	-	-	-	-	14.5	-	-	-	-	14.5
Navicula pygmaea	-	-	-	-	-	14.5				14.5	-	14.5	43.5
Navicula radiosa Kutz.	-	-	14.5		-	-	-	-	-		-	-	14.5
Navicula radiosa var. tenella	-	-	14.5	-	-			-	-	-	-	-	14.5
Navicula rhynchocephala Kutz.	-	-	14.5	14.5	-		14.5	-	-	-	-	-	43.5
Navicula schroeteri	-	-	-	-	-	14.5		-	-	-	-	14.5	29
Navicula sp.	-	-	-	29	14.5	-	-	-	-	-	-	-	43.5
Navicula spicula (Dickie.) Cl.	-	-	-	14.5	14.5	14.5	14.5	-	-	-	-	-	58
Navicula trivalis	-	-			14.5	-		-	-	-	-		14.5
Navicula tuscula	-	-	-	-	-	14.5		-	-	-	-	-	14.5
Navicula viridula	-	-	-	-	-	-	-	-	-	14.5	-	14.5	29
Navicula viridula var. rostellata (Kützing)	-	-	-	-	-	14.5	-	14.5	-	-	14.5	29	72.5

Nitzchia abtusa	-	-	-	-	-	-	14.5	-	-	-	-		14.5
Nitzchia acicularis W. Smith	-	-	14.5	14.5	-	14.5		14.5	-	-	-	14.5	72.5
Nitzchia dissipatae Grun.	-	-	29	101.5	43.5	14.5	-	-	-	-	-	14.5	203
Nitzchia frustulum (Kutz.) Rabh.	-	14.5		-	-	14.5	-	-	-	-	-	-	29
Nitzchia lorenziana	-	-	-	-	-		14.5		14.5	-	-	14.5	43.5
*Nitzchia palea (*Kutz.) W. Smith	116	29	72.5	261	159.5	319		130.5	290	551	203	174	2305.5
*Nitzchia sigma (*Kutz.) W. Smith	-	14.5	14.5				14.5	14.5	-	14.5		-	72.5
Nitzschia angustata var. acuta	-		14.5	14.5		29	14.5		-	-	14.5	-	87
Nitzschia apiculata (W. Gregory)	14.5	-	29	14.5	14.5	14.5	-	-	-	-	-	14.5	87
Nitzschia dissipata	14.5	-	-	-	-	-	-	-	-	-	-	-	14.5
Nitzschia dubai	14.5	-	-		-		-	-	-	-	-	-	14.5
Nitzschia gracilis	-	-	-	-	-		-	-	-	-	-	29	29
Nitzschia granulata	-	-	-	-	-		14.5	14.5	-	-	-	-	29
Nitzschia hungrica	-	14.5		14.5	14.5	14.5	-	-	14.5	-	-	14.5	87
Nitzschia longissima	14.5	14.5	14.5	14.5	-	87	-	-	-	14.5	-	-	159.5
Nitzschia lubia	-	-	14.5	-	-	-	-	-	-	-	-	-	14.5
Nitzschia microcephala	-	-	-	-	-	14.5	-	-	-	-	-	-	14.5
Nitzschia obtusa	14.5	-	-	14.5	-	14.5	-	14.5	14.5	-	-	-	72.5
Nitzschia ralea	-	-	-		-		14.5	-	-	-	-	-	14.5
Nitzschia romana	-	-	-	-	-	14.5			-	-	-	-	14.5
Nitzschia scalaris	-	-	-	-	-		-	14.5	-	-	-	-	14.5
Nitzschia sigma	-	-	-	-	-	43.5	-	-	-	-	-	14.5	58
Nitzschia sigmoidea	-	-	14.5	14.5	14.5		14.5	-	-	-	-	-	58
Nitzschia tryblionella	-	-	-	-	-	14.5	-	-	14.5	-	14.5	14.5	58
Nitzschia tryblionella var. levidensis	-	-	14.5	-	-	29	14.5	-	-	-	-		58
Nitzschia vermicularis	-	-	-	-	-		-	-	-	-	-	14.5	14.5
Pinnularia borealis	-	-	-	-	-	-	-	14.5	-	-	-	-	14.5
pleurosigma delicatulum	-	-	-	-	14.5		-	-	-	-		-	14.5
pleurosigma elongatum	-	-	-	-	-	-	-	14.5	14.5	-	-	-	29
Rhoicosphenia curvata (Kutz.) Grun.	-	14.5	-	29	29	43.5	14.5	14.5	-	-	14.5	14.5	174
Surirella angustatum	-	-	-	-	14.5	14.5	-	-	-	-	-	-	29
Surirella biserata	-	-	-	-	-	14.5	-	-	-	-	-	-	14.5
Surirella ovalis	-	14.5	-	-	-	43.5	14.5	-	-	-	-	-	72.5
Surirella ovata Kutz.	-	-	14.5	14.5	14.5	29	-	-	14.5	-	14.5	-	101.5
Surirella sp.	-	-	-	-	-	14.5	-	-	-	-	-	-	14.5
	Total count of Bacillariophyceae phytoplankton = 33364.8												
Total count of all Species for each month	1160.3	739.5	2160.5	2581	1406.5	9091.5	1319.5	1189	1015	2813	7859	2059	33364.8
Total count of all Species for each season	4060.3			13079			3523.5			12731			

Table 3. List of diatomic phytoplankton identified in the sampling stations. (A) = Annual Density (ind ×10^3 L^{-1}), (B) = Density percentage (%), (C) = Number of frequency, - = absence.

Stations	St. 1			St. 2			St. 3			St. 4		
Taxa	A	B	C	A	B	C	A	B	C	A	B	C
BACILLARIOPHYCEAE (Total)	34306.85	%100	456	29121.5	%100	441	34416	%100	447	33335.8	%100	485
Centrales (Total)	23910.5	69.696	49	19131	65.694	42	25527.5	74.174	59	22808.5	68.42	60
Achnanthes delicatula	-	-	-	-	-	-	14.5	0.042	1	-	-	-
Aulacoseira granulata (Ehr.) Simensen	812	2.367	8	1232.5	4.232	10	2291	6.657	10	609	1.827	8
Aulacoseira italica	14.5	0.042	1	14.5	0.050	1	29	0.084	2	87	0.261	2
Aulacoseira varians	87	0.254	3	72.5	0.249	4	72.5	0.211	4	130.5	0.391	7
Chaetoceros sp.	-	-	-	-		-	-	-	-	14.5	0.043	1
Coscinodiscus lacustris Grun.	87	0.254	5	-	-	-	87	0.253	5	116	0.348	7
Cyclotella comta (Her.) Kutz.	-	-	-	-	-	-	58	0.169	3	29	0.087	2
Cyclotella kuetzingiana Thw.	116	0.338	3	58	0.199	3	116	0.337	5	87	0.261	3
Cyclotella meneghiniana Kutz.	2349	6.847	11	1392	4.780	11	2371	6.889	11	1696.5	5.089	11
Cyclotella ocellata Pant.	20184	58.834	12	16332.5	56.084	12	20401.5	59.279	12	19894	59.678	12
Cyclotella stelligera	188.5	0.549	1	-	-	-	14.5	0.042	1	29	0.087	1
Stephanodiscus astrea (Ehr.) Grun.	72.5	0.211	5	29	0.100	1	72.5	0.211	5	116	0.348	6
Pennales (Total)	**10396.35**	**30.308**	**407**	**9990.5**	**34.325**	**399**	**8888.5**	**25.815**	**388**	**10527.3**	**31.542**	**425**
Achnanthes delicatula	-	-	-	14.5	0.050	1	-		-	14.5	0.043	1
Achnanthes lanceolata	43.5	0.127	3	14.5	0.050	1	29	0.084	1	-		-
Achnanthes minutissima Kutz.	217.5	0.634	8	1044	3.585	9	464	1.348	8	203	0.609	8
Achnanthes sp.	58	0.169	4	29	0.100	2	58	0.169	4	-		-
Amphipleura pellucida	-	-	-	-		-	-		-	14.5	0.043	1
amphiprora alata	14.5	0.042	1	14.5	0.050	1	-		-	-		-
Amphora coffeaeformis (Ag.) Kutz.	70.9	0.207	4	43.5	0.149	3	43.5	0.126	3	58	0.174	2
Amphora ovalis	43.5	0.127	3	72.5	0.249	5	87	0.253	6	87	0.261	4
Amphora ovalis var. lypica	14.5	0.042	1	-		-	-		-	14.5	0.043	1
Amphora perpusilla	29	0.085	2	-		-	-			-	-	-
Amphora perpusilla	-	-	-	29	0.100	2	43.5	0.126	3	58	0.174	2
Amphora sp.	72.5	0.211	5	43.5	0.149	3	87	0.253	5	101.5	0.304	7
Amphora veneta	87	0.254	6	58	0.199	4	43.5	0.126	2	87	0.261	6
Anomoeoneis exilis Kutz.	188.5	0.549	8	159.5	0.548	7	130.5	0.379	6	87	0.261	6
Anomoeoneis sphaerophora	-	-	-	-	-	-	14.5	0.042	1	14.5	0.043	1
Bacillaria paxillifer (Mull.) Hend.	101.5	0.296	7	159.5	0.548	7	130.5	0.379	8	130.5	0.391	7
Caloneis amphicephala1	-	-	-	14.5	0.050	1	14.5	0.042	1	-	-	-
Caloneis bacillum	14.5	0.042	1	-	-	-	-	-		29	0.087	2

Caloneis permagna	-	-	-	-	-	-	29	0.084	2	-	-	-
Caloneis silicula	-	-	-	-	-	-	29	0.084	2	14.5	0.043	1
Caloneis ventricosa	29	0.085	2	14.5	0.050	1	-	-	-	-	-	-
Campylodiscus clypeus	-	-		-	-	-	14.5	0.042	1	-	-	-
Ceratoneis arcus	14.5	0.042	1	-	-	-	-	-	-	29	0.087	1
Cocconeis pediculus Ehr.	116	0.338	8	304.5	1.046	8	145	0.421	9	188.5	0.565	10
Cocconeis placentula Ehr.	174	0.507	11	174	0.597	12	174	0.506	12	174	0.522	12
Cocconeis placentula var. euglypta (Ehr.) Cl.	333.5	0.972	11	348	1.195	11	261	0.758	11	-	-	-
Cocconeis placentula var. lineata	29	0.085	2	29	0.100	2	29	0.084	2	14.5	0.043	1
Cocconeis placentula var.euglypta (Ehr.) Cl.	-	-		-	-	-	-	-	-	275.5	0.826	12
Coscinodiscus lacustris Grun.	72.5	0.211	3	72.5	0.249	5	-	-	-	-	-	-
Cymatopleura elliptica	29	0.085	2	14.5	0.050	1	14.5	0.042	1	29	0.087	2
Cymatopleura solea	87	0.254	6	116	0.398	8	87	0.253	6	58	0.174	4
Cymbella affinis Kutz.	145	0.423	7	145	0.498	8	145	0.421	8	290	0.870	10
Cymbella affinis var. excisa	-	-		-	-	-	14.5	0.042	1	-	-	-
Cymbella amphicephala Näegeli ex Kützing	-	-		14.5	0.050	1	14.5	0.042	1	-	-	-
Cymbella amphicephala var. intermedia	14.5	0.042	1	14.5	0.050	1	43.5	0.126	3	29	0.087	2
Cymbella aspera	-	-		29	0.100	1	14.5	0.042	1	29	0.087	2
Cymbella caespitosa	-	-		-	-	-	14.5	0.042	1	-	-	-
Cymbella caespitosa var. auerswaldii	14.5	0.042	1	-	-	-	14.5	0.042	1	14.5	0.043	1
Cymbella caespitosa var. tuerswardii	-	-	-	-	-	-	-	-	-	14.5	0.043	1
Cymbella cistula (Hemp.)	58	0.169	4	72.5	0.249	5	72.5	0.211	5	87.3	0.262	6
Cymbella cistula var. maculata	-	-	-	-		-	-		-	14.5	0.043	1
Cymbella cymbiformis	-	-	-	-		-	14.5	0.042	1	-		-
Cymbella delicatula	-	-	-	14.5	0.050	1	-		-	-		-
Cymbella differta	-	-	-	-	-	-	-		-	14.5	0.043	1
Cymbella microcephala Grun.	43.5	0.127	3	101.5	0.349	7	101.5	0.295	6	87	0.261	3
Cymbella perpusilla	-	-	-	-		-	14.5	0.042	1	-	-	-
Cymbella prostrata	-	-	-	29	0.100	2	-	-	-	14.5	0.043	1
Cymbella pusilla Grun.	58	0.169	4	130.5	0.448	8	130.5	0.379	7	72.5	0.217	5
Cymbella sinuata W. Gregory	43.5	0.127	3	29	0.100	2	14.5	0.042	1	43.5	0.130	3
Cymbella sumatrensis	-	-	-	-		-	14.5	0.042	1	-		-
Cymbella tumida Van Heurck	87	0.254	6	72.5	0.249	5	87	0.253	6	58	0.174	4
Cymbella turgida	-	-	-	14.5	0.050	1	-	-	-	-	-	-
Cymbella ventricosa Kutz.	87	0.254	5	72.5	0.249	3	72.5	0.211	4	72.5	0.217	5
Denticula sp.	43.5	0.127	3	101.5	0.349	6	43.5	0.126	3	14.5	0.043	1
Diatoma elongatum (Lyngb.) Ag.	261	0.761	5	246.5	0.846	6	159.5	0.463	4	217.5	0.652	5
Diatoma vulgare Bory.	768.5	2.240	12	536.5	1.842	10	304.5	0.885	10	884.5	2.653	11

Diatoma vulgare var. linearis	-	-	-	72.5	0.249	2	-	-	-	-	-	-
Diploneis ovalis	43.5	0.127	3	14.5	0.050	1	14.5	0.042	1	-	-	-
Diploneis pseudovalis	43.5	0.127	3	29	0.100	2	14.5	0.042	1	72.5	0.217	5
Epithemia turgida	-	-	-	-		-	-	-	-	14.5	0.043	1
Epithemia zebra (Ehr.) Kutz.	29	0.085	2	-		-	29	0.084	2	14.5	0.043	1
Eunotia arcus	-	-	-	-		-	14.5	0.042	1	-	-	-
Eunotia pectinalis	-	-	-	14.5	0.050	1	-	-	-	-	-	-
Fragilaria acus Kutz.	87	0.254	4	145	0.498	4	116	0.337	5	58	0.174	3
Fragilaria acus var. radians	72.5	0.211	2	58	0.199	2	43.5	0.126	3	29	0.087	2
Fragilaria acus var.radiosa	-	-	-	-	-	-	-	-	-	14.5	0.043	1
Fragilaria affinis	-	-	-	-	-	-	-	-	-	14.5	0.043	1
Fragilaria brevistriata Van Heurck	435	1.268	4	43.5	0.149	3	188.5	0.548	4	58	0.174	4
Fragilaria construens (Ehr.) Grun.	14.5	0.042	1	-	-	-	-	-	-	14.5	0.043	1
Fragilaria fasciculata	29	0.085	2	43.5	0.149	3	-	-	-	43.5	0.130	3
Fragilaria pulchella	-	-	-	-	-	-	14.5	0.042	1	-		-
Fragilaria sp.	-	-	-	14.5	0.050	1	-	-	-	-		-
Fragilaria ulna (Nitz.) Ehr.	377	1.099	9	246.5	0.846	10	203	0.590	10	203	0.609	9
Fragilaria ulna var. biceps	72.5	0.211	4	101.5	0.349	5	101.5	0.295	6	87	0.261	5
Fragilaria ulna var. oxyrhynchus	-	-	-	-	-	-	43.5	0.126	3	43.5	0.130	2
Fragilaria ulna var. oxyrhynchus (Kützing)	58	0.169	4	14.5	0.050	1	-	-	-	-	-	-
Fragilaria vaucheriae (Kutz.) Peters	130.5	0.380	6	58	0.199	4	188.5	0.548	10	145	0.435	9
Frustulia rhomboides	14.5	0.042	1	-	-	-	-	-		-	-	-
Gomphoneis olivacea (Lyngb.) Daw.	130.5	0.380	4	101.5	0.349	5	101.5	0.295	2	145	0.435	6
Gomphonema angustatum (Kutz.) Rabh.	101.5	0.296	3	14.5	0.050	1	29	0.084	1	43.5	0.130	3
Gomphonema angustatum var. producta	14.5	0.042	1	-		-	-		-	-		-
Gomphonema constrictum var. capitata	14.5	0.042	1	-		-	-		-	-		-
Gomphonema gracile	29	0.085	2	14.5	0.050	1	-		-	14.5	0.043	1
Gomphonema intricatum	-	-	-	-		-	14.5	0.042	1	14.5	0.043	1
Gomphonema lanceolatum	-	-	-	-		-	-		-	14.5	0.043	1
Gomphonema parvulum	14.5	0.042	1	14.5	0.050	1	-		-	58	0.174	2
Gomphonema sp.	14.5	0.042	1	-	-	-	-		-	-	-	-
Gomphonema sphaerophorum	-	-	-	29	0.100	2	-		-	14.5	0.043	1
Gomphonema tergestinum	14.5	0.042	1	29	0.100	2	-		-	14.5	0.043	1
Gyrosigma acuminatum (Kützing)	72.5	0.211	5	87	0.299	6	72.5	0.211	5	87	0.261	5
Gyrosigma attenuatum (Kützing)	-	-		43.5	0.149	3	29	0.084	2	14.5	0.043	1
Gyrosigma macrum	-	-	-	-	-	-	-	-	-	14.5	0.043	1
Gyrosigma peisone	-	-	-	-	-	-	-	-	-	29	0.087	2
Gyrosigma pensions	29	0.085	2	29	0.100	2	87	0.253	6	-	-	-

Gyrosigma scalproides	29	0.085	2	14.5	0.050	1	29	0.084	2	29	0.087	2
Gyrosigma spencerii	59.45	0.173	5	43.5	0.149	3	145	0.421	8	43.5	0.130	3
Gyrosigma tenuirostrum	-	-	-	-	-	-	-	-	-	14.5	0.043	1
Hantzchia amphioxys (Her.) Grun.	130.5	0.380	9	145	0.498	10	87	0.253	6	116	0.348	6
Mastogloia braunii	-	-	-	-	-	-	-		-	14.5	0.043	1
Mastogloia elliptica	-	-	-	14.5	0.050	1	-		-	-	-	-
Mastogloia smithii	-	-	-	-		-	-		-	14.5	0.043	1
Navicula atomus	14.5	0.042	1	-		-	-		-	14.5	0.043	1
Navicula cincta (Ehrenberg)	130.5	0.380	8	159.5	0.548	8	72.5	0.211	3	101.5	0.304	4
Navicula clausii	43.5	0.127	3	14.5	0.050	1	14.5	0.042	1	58	0.174	4
Navicula crucicula (W. Smith.) Donkin.	29	0.085	2	14.5	0.050	1	-	-		72.5	0.217	5
Navicula cryptocephala Kutz.	101.5	0.296	5	87	0.299	4	130.5	0.379	4	87	0.261	5
Navicula cryptocephala var intermedia	58	0.169	3	14.5	0.050	1	29	0.084	2	58	0.174	4
Navicula cryptocephala var. minuta	-	-	-	-		-	14.5	0.042	1	14.5	0.043	1
Navicula cryptocephala var. perminuta	29	0.085	2	-		-	14.5	0.042	1	-	-	-
Navicula cryptocephala var. veneta	101.5	0.296	6	72.5	0.249	5	43.5	0.126	3	101.5	0.304	6
Navicula cuspidata Kutz.	-	-	-	-	-	-	-	-	-	14.5	0.043	1
Navicula gracilis Ehr.	101.5	0.296	7	159.5	0.548	8	159.5	0.463	9	217.5	0.652	11
Navicula gremmi	-	-	-	14.5	0.050	1	-	-	-	-	-	-
Navicula inflata	-	-	-	-		-	14.5	0.042	1	-	-	-
Navicula lubia	29	0.085	2	-		-	14.5	0.042	1	-	-	-
Navicula menisculus	-	-	-	-	-	-	-		-	14.5	0.043	1
Navicula mutica	29	0.085	2	29	0.100	2	-		-	-	-	-
Navicula parva (Menegh.) Cl.	159.5	0.465	10	72.5	0.249	5	145	0.421	7	130.5	0.391	9
Navicula placentula	14.5	0.042	1	29	0.100	2	-		-	14.5	0.043	1
Navicula placentula var.rostrata	-	-	-	14.5	0.050	1	-		-	-	-	-
Navicula pygmaea	14.5	0.042	1	14.5	0.050	1	14.5	0.042	1	43.5	0.130	3
Navicula radiosa Kutz.	43.5	0.127	3	29	0.100	2	43.5	0.126	3	14.5	0.043	1
Navicula radiosa var. tenella	72.5	0.211	5	43.5	0.149	3	14.5	0.042	1	14.5	0.043	1
Navicula rhynchocephala Kutz.	29	0.085	2	29	0.100	2	29	0.084	2	43.5	0.130	3
Navicula romana	14.5	0.042	1	14.5	0.050	1	-	-	-	-	-	-
Navicula schroeteri	58	0.169	4	29	0.100	2	29	0.084	2	29	0.087	2
Navicula sp.	29	0.085	2	58	0.199	3	43.5	0.126	3	43.5	0.130	2
Navicula spicula (Dickie.) Cl.	29	0.085	2	43.5	0.149	2	87	0.253	4	58	0.174	4
Navicula trivalis	-	-	-	14.5	0.050	1	-		-	14.5	0.043	1
Navicula tuscula	-	-	-	14.5	0.050	1	-	-	-	14.5	0.043	1
Navicula viridula (Kützing)	29	0.085	2	29	0.100	2	14.5	0.042	1	29	0.087	2
Navicula viridula var. rostellata (Kützing)	87	0.254	5	29	0.100	2	87	0.253	4	72.5	0.217	4

Neidium iridis	-	-	-	14.5	0.050	1	-	-	-	-	-	-
Nitzchia abtusa	-	-	-	-	-	-	-		-	14.5	0.043	1
Nitzchia acicularis W. Smith	29	0.085	2-	29	0.100	2	29	0.084	2	72.5	0.217	5
Nitzchia dissipatae Grun.	362.5	1.057	6	159.5	0.548	4	159.5	0.463	7	203	0.609	5
Nitzchia frustulum (Kutz.) Rabh.	43.5	0.127	3	29	0.100	2	-	-	-	29	0.087	2
Nitzchia frustulum var. perminuta	-	-	-	-		-	14.5	0.042	1	-	-	-
Nitzchia lorenziana	-	-	-	-		-	14.5	0.042	1	43.5	0.130	3
Nitzchia lorenziana var. subtilis	-	-	-	14.5	0.050	1	-	-	-	-	-	-
Nitzchia palea (Kutz.) W. Smith	1870.5	5.452	11	1479	5.079	11	1493.5	4.340	9	2305.5	6.916	11
Nitzchia sigma (Kutz.) W. Smith	145	0.423	7	87	0.299	5	116	0.337	6	72.5	0.217	5
Nitzschia amphibia	-	-	-	14.5	0.050	1	-	-	-	-	-	-
Nitzschia angustata	14.5	0.042	1	-	-	-	-		-	-	-	-
Nitzschia angustata var. acuta	43.5	0.127	3	72.5	0.249	2	87	0.253	6	87	0.261	5
Nitzschia apiculata (W. Gregory)	87	0.254	5	72.5	0.249	3	87	0.253	6	87	0.261	6
Nitzschia circumsula	14.5	0.042	1	-	-	-	-	-	-	-	-	-
Nitzschia clausii	43.5	0.127	2	14.5	0.050	1	29	0.084	2	-	-	-
Nitzschia commutata	-	-	-	14.5	0.050	1	-	-	-	-	-	-
Nitzschia dissipata	-	-	-	-	-	-	-	-	-	14.5	0.043	1
Nitzschia dubai	-	-	-	-		-	-		-	14.5	0.043	1
Nitzschia fasciculata Grun.	-	-	-	-		-	43.5	0.126	3	-	-	-
Nitzschia filiformis	14.5	0.042	1	14.5	0.050	1	-	-	-	-	-	-
Nitzschia gracilis	-	-	-	14.5	0.050	1	58	0.169	4	29	0.087	1
Nitzschia granulata	-	-	-	29	0.100	2	-	-	-	29	0.087	2
Nitzschia hungarica Grun.	87	0.254	6	87	0.299	6	58	0.169	3	87	0.261	6
Nitzschia ignorata	-	-	-	14.5	0.050	1	14.5	0.042	1	-	-	-
Nitzschia intermedia	14.5	0.042	1	14.5	0.050	1	-	-	-	-		-
Nitzschia linearis	-	-	-	14.5	0.050	1	-		-	-	-	-
Nitzschia longissima	246.5	0.719	8	290	0.996	10	145	0.421	6	159.5	0.478	6
Nitzschia lubia	14.5	0.042	1	14.5	0.050	1	29	0.084	2	14.5	0.043	1
Nitzschia microcephala	58	0.169	3	-	-	-	116	0.337	1	14.5	0.043	1
Nitzschia obtusa	43.5	0.127	3	29	0.100	2	43.5	0.126	3	72.5	0.217	5
Nitzschia punctata var. coarctata	14.5	0.042	1	-	-	-	-	-	-	-	-	-
Nitzschia ralea	-	-	-	14.5	0.050	1	43.5	0.126	1	14.5	0.043	1
Nitzschia romana	-	-	-	-		-	-	-	-	14.5	0.043	1
Nitzschia scalaris	-	-	-	-		-	14.5	0.042	1	14.5	0.043	1
Nitzschia sigma	-	-	-	-		-	-		-	58	0.174	2
Nitzschia sigma var. rigidula	14.5	0.042	1	-		-	-		-	-	-	-
Nitzschia sigmoidea	58	0.169	4	29	0.100	2	14.5	0.042	1	58	0.174	4

Nitzschia tryblionella	14.5	0.042	1	43.5	0.149	3	43.5	0.126	3	58	0.174	4
Nitzschia tryblionella var. debilis	14.5	0.042	1	-	-	-	-	-	-	-	-	-
Nitzschia tryblionella var. levidensis	14.5	0.042	1	43.5	0.149	3	43.5	0.126	3	58	0.174	3
Nitzschia tryblionella var. victoriae	-	-	-	14.5	0.050	1	-	-	-	-	-	-
Nitzschia vermicularis	-	-	-	-	-	-	-		-	14.5	0.043	1
Pinnularia borealis	14.5	0.042	1	-	-	-	14.5	0.042	1	14.5	0.043	1
pleurosigma angulatum	14.5	0.042	1	14.5	0.050	1	14.5	0.042	1	-	-	-
pleurosigma delicatulum	29	0.085	2	14.5	0.050	1	29	0.084	2	14.5	0.043	1
pleurosigma elongatum	-	-	-	-		-	-		-	29	0.087	2
pleurosigma salinarum	14.5	0.042	1	-		-	-		-	-	-	-
Rhoicosphenia curvata (Kutz.) Grun.	116	0.338	7	188.5	0.647	11	174	0.506	9	174	0.522	8
Rhopalodia gibba	-	-	-	14.5	0.050	1	-		-	-		-
Stauroneis agrestis	-	-	-	14.5	0.050	1	-		-	-		-
Stauroneis microstauron	-	-	-	14.5	0.050	1	-		-	-		-
Surirella angustata	-	-	-	-		-	14.5	0.042	1	-		-
Surirella angustatum	-	-	-	-		-	-		-	29	0.087	2
Surirella biserata	-	-	-	-		-	-		-	14.5	0.043	1
Surirella capronii	14.5	0.042	1	-		-	-		-	-	-	-
Surirella ovalis	29	0.085	2	29	0.100	2	14.5	0.042	1	72.5	0.217	3
Surirella ovata Kutz.	116	0.338	6	145	0.498	10	116	0.337	7	101.5	0.304	6
Surirella ovata var. africana	14.5	0.042	1	-	-	-	-	-	-	-	-	-
Surirella sp.	-	-	-	29	0.100	2	-		-	14.5	0.043	1
Tabellaria fenestrata	-	-	-	-	-	-	14.5	0.042	1	-	-	-
Total Density (ind $\times 10^3$ L^{-1})	34306.85	-	-	29121.5	-	-	34416	-	-	33335.8	-	-

Diversity and Dominance of diatomic Phytoplankton

The relative high dominance and diversity of phytoplankton recorded in Tigris River could be due to the availability of basic simple organic chemical nutrients such as phosphate and nitrate that support their growth. In addition to sunlight energy, oxygen and carbon in the form of carbon dioxide (CO_2; Balogun & Ajani 2015), the most dominant phytoplankton abundant recorded during this study were mentioned at the beginning of the discussion above. Seasonally, the Shannon diversity index (H) values varied between 1.355 to 3.041, the minimum value (1.355) was observed during autumn, while the maximum value (3.041) during summer. The Shannon diversity index (H) values recorded in the winter and spring seasons were 2.606 and 2.220 respectively (Fig. 5). According to Marques *et al.* (2009) Tigris River is classified as moderate class mostly (Table 1). Temperature seems to be an important seasonal factor that controls the biological processes of phytoplankton communities, therefore the highest number of diatomic phytoplankton diversity was recorded in summer (Vereshchaka & Anokhina 2014). Seasonally too, diatomic phytoplankton dominance was investigated based on Simpson's Index in the present study exhibiting the most dominance index in autumn (0.549), followed by spring (0.35), winter (0.23) and the least index in summer (0.12; Fig. 6). Simpson's index range between zero and one, where zero represents an infinite diversity and one indicates no diversity. Through the Figs. 5 and 6, the inverse relationship between the Shannon and Simpson indices appeared very clear. These results were confirmed using the statistical analysis by the negative correlation (-0.998) at ($p \leq 0.01$) between seasonal diversity and seasonal dominance (Table 4). These results were in agreement with many studies such as Lawson *et al.* (2008) and Ogamba *et al.* (2004).

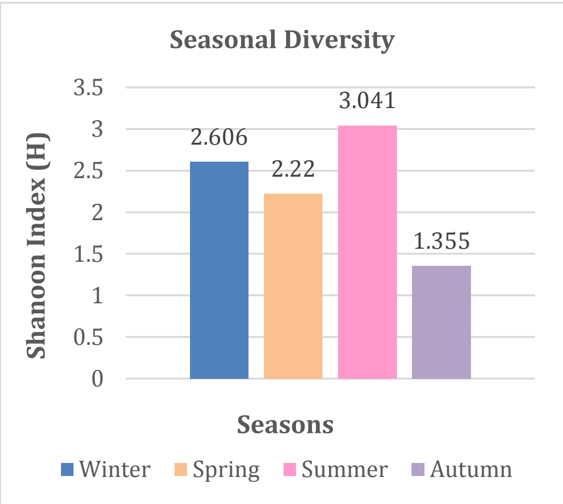

Fig. 5. Seasonal diversity of diatoms.

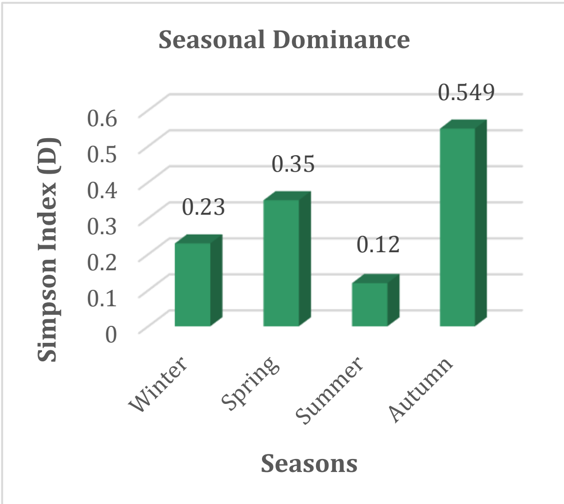

Fig. 6. Seasonal dominance of diatoms.

Table 4. Pearson correlation between some studied factors during the study period.

Factors	**Season**	**Station**	**Total Count of Diatomic phytoplankton**	**Seasonal Diversity**
Station	0.000			
Total Count of Diatomic phytoplankton	0.494	0.019		
Seasonal Diversity	-0.528*	0.000	-0.881**	
Seasonal Dominance	0.511	0.000	0.897**	-0.998**

CONCLUSION

Diatomic phytoplankton abundance was high and diversity along the stations in Tigris River. In this study, 125-141 fresh water algal species belonging to class Bacillariophyceae were identified and reported in sampling stations. Depending on the total count of cells, *Cyclotella ocellata* was the most dominant, followed by *Cyclotella meneghiniana* in all sampling stations. Diversity and abundance of diatomic phytoplankton of Tigris River may be related to the water quality parameters, especially temperature factor, obvious from the variation between seasons. The present basic information of the diatomic algae distribution, total count, annual density, density percentage, diversity and dominance would form a useful tool for further ecological assessment and monitoring fresh water in general and for Tigris River in particular.

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