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RESEARCH ARTICLE

# Epipelic diatoms flora of Kordan river, Alborz province in Iran

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## Abstract

Epipelic diatoms flora of Kordan River in Iran were investigated from September 2017 through September 2018. Sampling from 7 stations was conducted in three repetitions along the river. Simultaneously physiochemical analysis, temperature, DO, pH and EC, $Na^{+}$, $Ca^{2+}$, $Mg^{2+}$, $SiO_2$, $NO^{3-}$ and $PO_4^{3-}$ were measured. In this study, 91 species from 30 genera of diatoms were identified. High species diversity was seen in Navicula with 16 and Nitzschia with 11 species. Melosira varians was the most abundant taxon. The high population density of epipelic diatoms during this study was 14.19 × 103 cell/$cm^2$. The study revealed that species diversity has demonstrated a relationship with $SiO_2$, DO and temperature. The effect of physicochemical factors on species richness was also evaluated. Investigating the relationship between the physico-chemical factors of water at different stations with species showed that chlorine had the greatest impact on the diversity of rivers' diatoms. The results of ANOVA analysis showed that the effect of time and sampling station on the biomass of the epipelic diatoms were shown significant ($p<0.5$). This study is the first knowledge of the diatoms flora on this river and provides a basis for future investigations.

**Keywords:** Epilelic, diatom, Kordan river

## Introduction

Algae are constantly present in aquatic environments and they increase rapidly in a short period of time due to changing environmental conditions and they are one of the most appropriate groups for the monitoring and control of the ecological status of aquatic ecosystems (Garrido and et al., 2013). Algae are the main producers of organic matter in aquatic environments, and so most of the aquatic production is directly dependent on their existence (Lieth and Whittaker, 2012). Also, algae produce oxygen through their photosynthesis and oxygenation, enabling their surroundings to be oxygenated and favorable to aquatic life (Martin and Allen, 2018). Diatoms are single-cell algae with silica walls that are very different in shape. They have been reported in sediments during the Miocene period (Ognjanova-Rumenova and Pipik, 2013). Diatoms are identified routinely by the shape of their silicon walls, which have several shapes (Meeravali et al., 2017). Depending on their habitat, they can be planktonic, benthic or in both forms of benthic and planktonic (Snyder et al., 2013). Diatoms are an important part of the benthic communities of the rivers (Stancheva et al., 2007). There are more than 200 genera and 100,000 species of diatoms are known, the diatom is derived from the Greek word and consists of two parts: dia='through' + temnein='to cut', i.e. 'Cut in half' and diatom means' cut in two (Snyder et al., 2013). When diatoms die, their frustules accumulate in the sediment called diatomaceous earth, which is widely used in industry (Meeravali et al., 2017).

Classification of diatoms is usually based on the morphology of their siliceous perforations and the specific shape and structure of the perforations seen by light microscopy to the genera and species. The specificity of cellular contents, physiology, biochemistry or reproductive behavior have received less attention as a taxonomic criterion, but it is now known that information in these areas is very important in the taxonomic relevance of diatoms. Therefore, this information is used for re-evaluation to classify species based on light microscopy studies (Snyder et al., 2013). In recent years' new genera and species have been identified, and in some cases, old genera have been reclassified. Planktonic diatoms usually have a thin and small frustule that can facilitate flotation (Round, 1960). One of the ecological characteristics of diatoms is that they can exist in different substrates, which allows them to be used as indicators in quality of water, pH diagnosis, the electrical conductivity of water, salinity and trophic conditions (Round, 1960; Kauppila et al., 2002). They are known to respond to salinity, many of which refer to them as freshwater species, marine species, and damaged water species (Bate et al., 2013). According to species preference the diatom cells like to exist and live in a special environment, therefore the flora of these single-cell algae can play an important role in determining the water quality of rivers (Tokatli and Dayioglu, 2011).

Kurdan the name of the area is a beautiful and pleasant climate. The city of Kordan is 25 kilometers from Karaj and 65 kilometers west of Tehran. The historic village of Kordan is part of Chandzar section of Savojbolagh city, at an altitude of 1350 meters above sea level, to the north by Kuhsar and Barghan roads, to the west by Seifabad and Banzahra lands, to the south by the Karaj-Qazvin highway, and to the east by the adjacent Karaj city. The residential area of Kordan is 104 hectares, with a distance of 15 km from Hashtgerd, 5 km from Kohsar and 22 km from Karaj. The area has a river called the Kordan River, which originates from the Karaj highlands. The route runs from northeast to southwest. The tributaries of this river are vegetation. The length of the route was 7.72 km and each sampling station was identified with an approximate distance of 1 km. Due to the lack of information about Kordan river diatoms, the purpose of this study is to study the diatomaceous communities in this river.

## Materials and Methods

### Location

Kordan is located 25 km from Karaj and 65 km away from the west of Tehran. Kordan Historical Village is located in the ward of Savojbolagh, at a height of 1350 meters above the sea level. It is located on the north side of Koohsar and Barghan road, west with Saif Abad and Banveshra, from the south by Karaj-Qazvin highway and from the east by the neighboring Karaj city. This area has a river called Kordan River, which originates from Karaj Highlands. The route is from the northeast to the southwest, with a geographical distance of 50° 49 '9.179' and a geographical distance of 35° 56 '27.018'. The source branches of this river are Barghan and Duran.

### Sampling method

Along the river route, 7 stations were identified and epipelic diatoms were collected at these 7 stations from September 2017 through September 2018 at intervals of 30 days. Epipelic diatoms were removed from river sediments by plate and preserved in plastic bottles (Marcoglise et al., 2015). The suspension was fixed with 3% formalin after collection (Ganjian et al., 2010).

### Preparing a permanent slide

To provide a permanent slide for diatoms identification the cell's internal organelles should be eliminated. For this purpose, 0.5 cc diatomaceous suspension was poured on to the slurry to evaporate water at the existing laboratory temperature. Then place the coverslip on a hot plate underneath the hood to burn the organic material in the cells, then a few drops of concentrated nitric acid together with one drop of $H_2O_2$ was heated, place the glue on the slide and place on the hot plate and then put the coverslip on it and slowly pulled out air bubbles. The slide was placed in the laboratory for several hours so that the adhesive is completely dry. The identification of diatoms was performed using the OLYMPUS optical microscope CX31 with a magnification of 1000 X and identification keys (Maraşlıoğlu and Soylu, 2018). The diatoms were count using the Sedgwick-Rafter slide. The frequency of diatoms was calculated based on the division of species on the total number of species during the period of study. Charts were plotted using EXCEL software. Statistical analysis was performed using SPSS and ANOVA. In ANOVA, the difference between the meanings is significant if the Sig is less than 0.05. Eta indicates the degree of continuity between the two variables. The value between 0.25-0 is weak, 0.5-0.25 is moderate, and 0.75-0.5 shows a strong correlation with 0.100-0.75. Eta squared indicates that the independent variable, sampling date or station, has affected several percents of the dependent variable, ie biomass of epipelic diatoms (Fig. 1).

## Results and Discussion

In this study, 91 species belonging to 30 genera of Bacillariophyta (diatoms) were identified. *Navicula* with 16 species, *Nitzschia* with 12 species, *Cymbella* and *Gomphonema* with 8 species, *Diatoma, Surirella, Achnanthidium* and *Fragillaria* with 4 species, *Encyonema* with 3 species, *Achnanthes* and *Amphora, Pinnularia, Cocconies, Cymbopleura, Synedra* and *Cymatopluera* each with 2 species, *Melosira, Tabellaria Stauroneis, Rhoicosphenia, Microcostatus, Meridian, Karayevia, Gyrosigma, Fragilariforma, Diploneis, Diatomella, Brachysira,* *Bacillaria, Cyclotella*, each with 1 species that picture of some identified species are shown in Fig. 2 and 3. *Melosira varians, Nitzschia palea, Nitzschia paleacea* and *Cocconeis pediculus, Achnanthidium minitisimum* and *Diatoma vulgar* (Fig. 4) were seen as dominant species in the epipelic diatoms (Tab. 1).

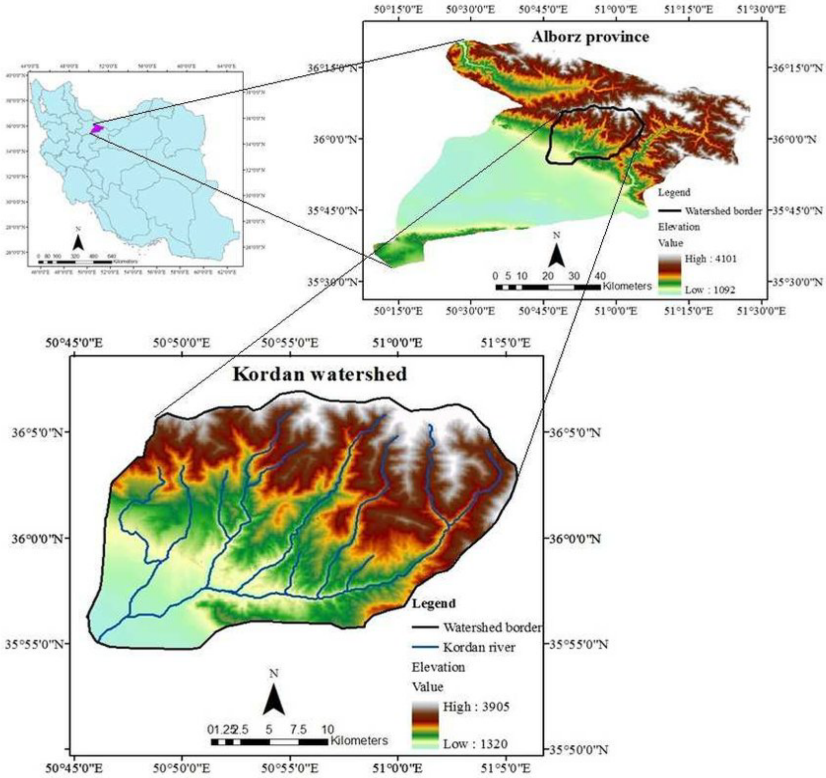


**Figure 1.** Study area and selected stations.

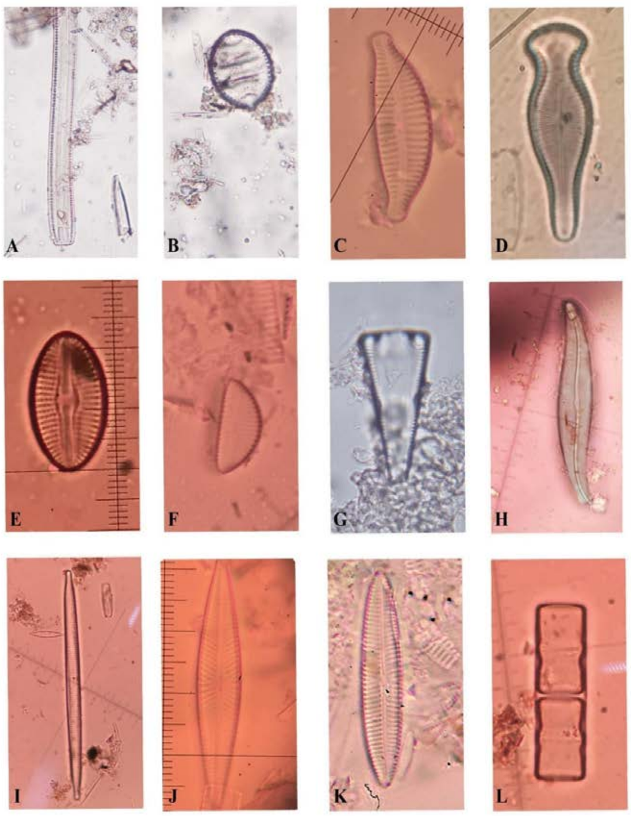


**Figure 2.** A: *Nitzschia vermicularis*; B: *Cymatopleura elliptica*; C: *Cymbella affinis*; D: *Gomphonema capitatum*; E: *Diploneis smithi*; F: *Encyonema minutum*; G: *Gomphonema ventricosum*; H: *Gyrosigma acominotum*; I: *Ulnaria biceps*; J: *Navicula cryptotenella*; K: *Navicula tripuncta*; l: *Melosira varians*. Scale bar=10 µm.

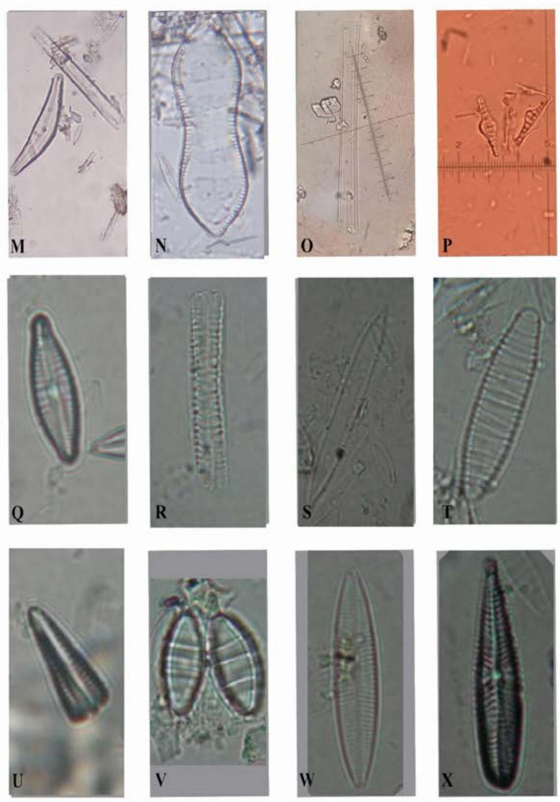


**Figure 3.** M: *Cymbella neocistula*; N: *Cymatopleura solea*; O: *Fragilaria virescenc*; P. *Nitzschia sinnuta* var.*tabellaria*; Q: *Gomphonema angustatum*; R: *Fragilaria virescens*; S: *Nitzschia angustata*, T: *Diatoma vulgare*; U: *Gomphonema ventricosum*; V: *Diatoma hiemale var.mesodon*; W: *Navicula tripunctata*; X: *Gomphonema olivaceum*. Scale bar=10 µm.

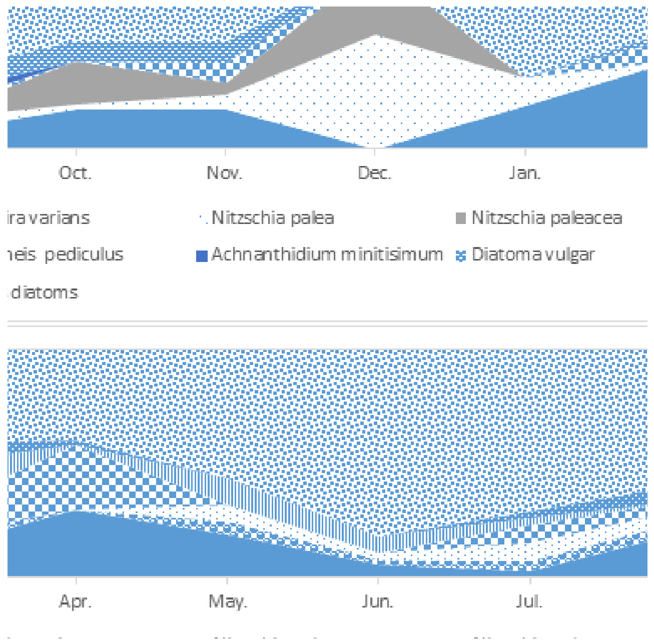


**Figure 4.** The abundance of epipelic diatoms during the sampling period.

## Biomass of epipelic diatoms

The density of the total population of Epipelic diatoms in 7 different stations during the sampling period is demonstrated in (Tab. 2 and Fig. 5). The density of epipelics in this study is calculated according to cells per square centimeter. The highest density of epipelic diatoms was $14.19 \times 10^3$ cells/cm$^2$ and $0.72 \times 10^3$ respectively on Jun 2017 in station 1 and in September 2018 in station 5.

## Physico-chemical factors

The relationship between physicochemical factors and a number of epipelic diatoms is presented in Tab. 3. In the measured factors, a negative correlation was found between the temperature and density of diatoms, so that with increasing temperature, the diatoms decreased. This relationship was found between E.C and the density of diatoms. There was a positive correlation between silica and D.O with the density of epipelic diatoms so that by decreasing them, the density of epipelic diatoms

**Table 1.** List of epipelic diatoms of Kordan River in four seasons.

| Species | Spring | Summer | autumn | Winter |
|---|---|---|---|---|
| *Achnanthes rostellata* A. Cleve | | | * | |
| *Achnanthes swazi* Cholnoky | | | | * |
| *Achnanthidium exiguum* (Grunow) Czarnecki | | | * | |
| *Achnanthidium gracillimum* (F. Meister) Lange-Bertalot. | | | * | |
| *Achnanthidium latecephalum* H. Kobayasi | | | | * |
| *Achnanthidium minutissimum (*Kützing) Czarnecki | * | * | | * |
| *Amphora minutissima* W. Smith | | | | * |
| *Amphora pediculus* (Kützing) Grunow | | * | * | * |
| *Bacillaria paradoxa* J.F. Gmelin, nom. illeg. | * | | * | |
| *Brachysira styriaca* (Grunow) R. Ross | | | * | * |
| *Cocconeis pediculus* Ehrenberg. | * | | * | * |
| *Cocconeis placentula* Ehrenberg. | * | * | * | * |
| *Cyclotella meneghiniana* Kützing | * | | | * |
| *Cymbopleura angustata* (W. Sm.) Krammer | | | * | |
| *Cymbopluera amphicephala* (Nägeli) Krammer | | | | * |
| *Cymatopleura elliptica* (Brébisson) W. Smith | | | | * |
| *Cymatopleura solea* (Brébisson) W. Smith | * | * | * | * |
| *Cymbella affiniformis* Krammer. | | | * | * |
| *Cymbella affinis* Krammer | * | | | * |
| *Cymbella cymbiformis* C. Agardh | * | * | | |
| *Cymbella excisiformis* Krammer | * | * | | * |
| *Cymbella minuta* var.*minuta* Hilse ex Rabenhorst | * | * | | |
| *Cymbella prostrata* (Berkeley) Cleve | | * | | |
| *Cymbella proxima* Reimer. | | * | | |
| *Cymbella ventricosa* (C. Agardh) C. Agardh | | | | * |
| *Diatoma hyemalis* (Roth) Heiberg. | * | * | * | * |
| *Diatoma moniliformis* (Kützing) D.M. Williams | * | | | * |
| *Diatoma tenuis* C. Agardh | | | | * |
| *Diatoma vulgaris* Bory | * | * | * | * |
| *Diatomella balfouriana* Greville. | * | | * | * |
| *Diploneis smithii* (Brébisson) Cleve | | | | * |
| *Encyonema auerswaldii* Rabenhorst | | | | * |
| *Encyonema hamsherae* D. Winter and Bahls | * | | | |
| *Encyonema minutum* (Hilse) D.G. Mann. | | * | * | * |
| *Fragilaria crotonensis* Kitton | * | * | * | * |
| *Fragilaria bicapitata* A.Mayer. | | | * | |
| *Fragilaria pinnata* Ehernberg. | * | * | | * |
| *Fragilaria synegrotesca* Lange-Bertalot | | | | * |

| | | | | |
|---|---|---|---|---|
| *Fragilariforma virescens* (Ralfs) D.M. Williams and Round | * | | * | * |
| *Gomphonema angustatum* (Kützing) Rabenhorst | * | * | | * |
| *Gomphonema minutum* (C. Agardh) C. Agardh | | | | * |
| *Gomphonema capitatum* Ehrenberg. | | | * | |
| *Gomphonema olivaceum* (Hornemann) Brébisson | * | | | * |
| *Gomphonema parvulum* (Kützing) Kützing | | * | | |
| *Gomphonema subclavatum* (Grunow) Grunow | | * | | |
| *Gomphonema ventricosum* W. Gregory. | * | | * | * |
| *Gyrosigma acuminatum* (Kützing) Rabenhorst | | | | * |
| *Karayevia nitidiformis* (Lange-Bertalot) Bukhtiyarova | * | | | |
| *Melosira varians* C. Agardh | * | * | * | * |
| *Meridion circulare* (Greville) C. Agardh | | | * | |
| *Microcostatus krasskei* (Hust.) J.R. Johansen and Sray. | * | | | |
| *Navicula capitatoradiata* H. Germain ex Gasse | * | | | * |
| *Navicula cascadensis* Sovereign | * | * | | |
| *Navicula cryptocephala* Kützing. | | * | | |
| *Navicula margalithii* Lange-Bertalot | | | | * |
| *Navicula minusculla* var. *minusculla* Grunow. | * | | | * |
| *Navicula notha* J.H. Wallace | | | | * |
| *Navicula odiosa* J.H. Wallace | * | | | * |
| *Navicula radiosa* Kützing | | | | * |
| *Navicula recens* Lange-Bertalot | | | * | |
| *Navicula rhynchocephala* Kutzing. | | | * | |
| *Navicula rostellata* Kützing. | * | | | |
| *Navicula staffordiae* Bahls | | | | * |
| *Navicula supleeorum* Bahls | | | | * |
| *Navicula tripunctata* (O.F. Müller) Bory | * | | | * |
| *Navicula vilaplanii* (Lange-Bertalot and Sabater) Lange-Bertalot and Sabater | | * | * | |
| *Navicula weberi* L.L. Bahls. | * | | | |
| *Nitzschia thermalis* (Ehrenberg) Auerswald | * | | | * |
| *Nitzschia angustata* (W. Smith) Grunow | * | | * | * |
| *Nitzschia columbiana* Sovereign. | | | | |
| *Nitzschia communis* Rabenhorst | | | * | |
| *Nitzschia dissipata* (Kützing) Rabenhorst. | * | * | | |
| *Nitzschia exilis* Sovereign. | | | * | |
| *Nitzschia linearis* W. Smith | * | * | | * |
| *Nitzschia palea* (Kützing) W. Smith | * | * | * | * |
| *Nitzschia paleacea* (Grunow) Grunow | * | | * | * |
| *Nitzschia sinuata* var. *tabellaria* (Grunow) Grunow | | | | * |
| *Nitzschia sublinearis* Hustedt | * | | | |
| *Nitzschia vermicularis (Kützing)* Hantzsch. | | * | | |
| *Pinnularia rabenhorstii* (Grunow) Krammer | * | | | |
| *Pinnularia saprophila* Lange-Bert., H. Kobayasi and Krammer | * | | | * |
| *Rhoicosphenia abbreviata* (C. Agardh) Lange-Bertalot. | * | | | * |
| *Stauroneis smithii* Grunow | | | | * |
| *Surirella salina var. angustata* Pantocsek | | | * | * |
| *Surirella arctica* (R.M. Patrick and Freese) J. Veselá and Y Potapova | | | * | * |
| *Surirella brebissonii* Krammer and Lange-Bertalot | * | * | | |
| *Surirella linearis* W. Smith | | | | * |
| *Synedra goulardi var. acus* (Kützing) Frenguelli | | | | * |
| *Synedra parasitica* (W. Smith) Hustedt | | | | * |
| *Tabellaria fenestrata* var. *asterionelloides* Grunow. | | * | * | * |
| *Ulnaria biceps* (Kützing) Compère | | | | * |
| *Ulnaria biceps var. acus (*Kützing) Lange-Bertalot | | | | * |

was also determined. Phosphate and nitrate also had a negative correlation with diatomaceous biomass. There was no meaningful and regular correlation between sodium chloramine and pH. Using PAST software, the relationship between different species diversity with physicochemical factors of water in four seasons of the year was investigated. The species that had the most relationship with the elements were determined.

### Relationship between different species diversity with physicochemical factors in four seasons Sampling period

Using PAST software, the relationship between different species diversity with physicochemical factors of water in four seasons of the year was investigated. The species that had the most relationship with the elements were determined, which resulted in the Tab. 4.

**Table 2.** Biomass of epipelic diatms of Kordan River.

| No | January | February | March | April | May | June |
|---|---|---|---|---|---|---|
| Station 1 | 156 ± 14.19 | 158 ± 5.70 | 130 ± 2.97 | 72 ± 1.79 | 57 ± 2.55 | 167 ± 2.74 |
| Station 2 | 112 ± 6.60 | 153 ± 3.84 | 148 ± 2.46 | 46 ± 2.11 | 187 ± 2.67 | 82 ± 2.27 |
| Station 3 | 134 ± 6.95 | 53 ± 4.28 | 65 ± 2.82 | 269 ± 1.54 | 104 ± 2.59 | 140 ± 1.48 |
| Station 4 | 155 ± 6.83 | 106 ± 4.61 | 124 ± 2.92 | 66 ± 2.38 | 106 ± 2.36 | 111 ± 2.96 |
| Station 5 | 144 ± 6.36 | 89 ± 3.29 | 140 ± 2.22 | 169 ± 2.69 | 25 ± 2.21 | 82 ± 2.15 |
| Station 6 | 114 ± 4.43 | 71 ± 2.93 | 129 ± 3.22 | 123 ± 2.70 | 167 ± 2.33 | 120 ± 1.85 |
| Station 7 | 185 ± 5.41 | 142 ± 3.52 | 38 ± 2.37 | 168 ± 2.49 | 100 ± 3.41 | 120 ± 2.04 |
| | **July** | **August** | **September** | **October** | **November** | **December** |
| Station 1 | 88 ± 1.48 | 162 ± 2.26 | 83 ± 1.02 | 96 ± 1.38 | 85 ± 2.32 | 106 ± 2.35 |
| Station 2 | 81 ± 1.77 | 130 ± 1.80 | 85 ± 1.20 | 84 ± 1.03 | 113 ± 2.27 | 41 ± 2.75 |
| Station 3 | 76 ± 1.56 | 129 ± 2.04 | 86 ± 1.14 | 153 ± 1.37 | 59 ± 2.22 | 38 ± 1.97 |
| Station 4 | 77 ± 2.34 | 126 ± 2.53 | 95 ± 1.16 | 69 ± 1.76 | 48 ± 3.34 | 13 ± 1.75 |
| Station 5 | 73 ± 1.61 | 91 ± 2.42 | 3 ± 0.72 | 85 ± 1.51 | 81 ± 1.87 | 73 ± 2.60 |
| Station 6 | 58 ± 1.68 | 109 ± 1.88 | 13 ± 0.85 | 71 ± 1.96 | 30 ± 2.42 | 113 ± 2.47 |
| Station 7 | 92 ± 1.92 | 66 ± 2.43 | 4 ± 1.14 | 87 ± 1.60 | 70 ± 3.05 | 174 ± 2.34 |

**Table 3.** Physico-chemical factor of water during the sampling.

| | Minimum | Maximum | Mean |
|---|---|---|---|
| (Mg/l) $Na^{+}$ | 5.3 | 11.9 | 8.56 |
| (Mg/l) $Cl^{-}$ | 0.08 | 1.9 | 0.83 |
| (Mg/l) $Ca^{++}$ | 7 | 10.6 | 9.17 |
| (Mg/l) $Mg^{++}$ | 3.8 | 11.8 | 7.38 |
| (Mg/l) $NiO_3$ | 2.1 | 5.7 | 3.60 |
| $Po_4$(Mg/l) | 0.001 | 0.009 | 0.006 |
| Si(Mg/l) | 3.2 | 12.8 | 7.89 |
| D.O )s/cm) µ | 8.9 | 19.5 | 15.50 |
| T (C) | 5 | 23 | 12.11 |
| pH | 7 | 8.2 | 7.51 |
| E.C )s/cm) µ | 1.004 | 3.878 | 2.57 |

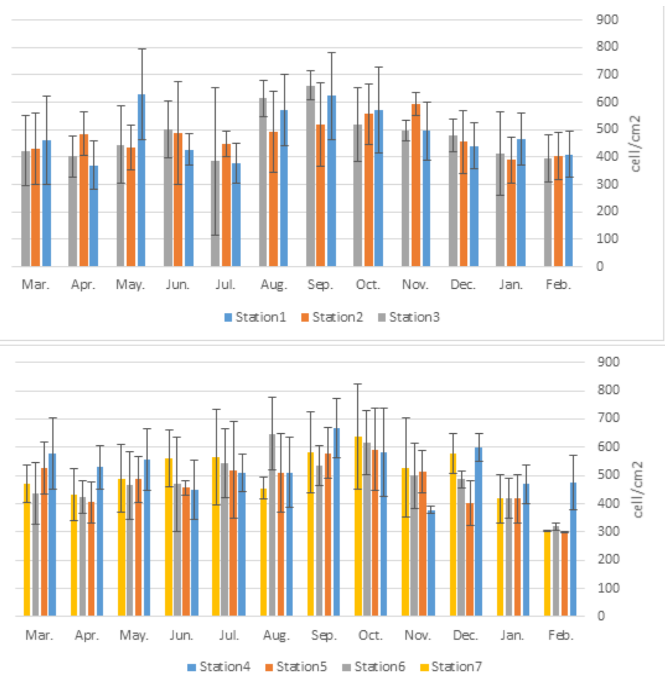


**Figure 5.** Biomass of epipelic diatoms of Kordan River.

**Table 4.** Relationship between different species diversity with physicochemical factors in four seasons sampling period: The species related to the physico-chemical factors of water were identified in each sampling season. In autumn and winter, the highest relationship was observed.

| | Spring | |
|---|---|---|
| **DO** | **$PO_4$** | **Mg** |
| *Cymbella cymbiformis* | *Nitzschia angustata* | *Cyclotella meneghiniana* |
| *Navicula cascadensis* | *Nitzschia sublinearis* | *Fragilaria pinnata* |
| *Navicula.rostellata* | $NO_3$ | *Gomphonema angustatum* |
| *Navicula tripunctata* | *Bacillaria paradoxa* | *Navicula weberi* |
| *Rhoicosphenia.abbreviata* | *Navicula minusculla* | *Simatopleura solea* |
| pH | *Navicula odiosa* | Na |
| *Pinularia saprophila* | Si | *Bacillaria paradoxa* |
| EC | *Cocconeis pediculus* | *Navicula minusculla* |
| *Pinularia saprophila* | *Encyonema hamsherae* | *Navicula odiosa* |
| T | *Nitzschia dissipata* | Cl |
| *Fragilaria pinnata* | Ca | *Nitzschia angustata* |
| | *Cyclotella meneghiniana* | *Nitzschia sublinearis* |
| | *Nitzschia thermalis* | |
| Summer | | |
| DO | T | Na |
| *Encyonema minutum* | *Cymbella minuta* | *Cymbella minuta* |
| *Navicula vilaplanii* | *Diatoma hyemale* | *Encyonema minutum* |
| *Simatopleura solea* | *Diatoma vulgare* | *Simatopleura solea* |
| pH | *Encyonema minutum* | |
| *Fragilaria crotonensis* | $PO_4$ | |
| EC | *Diatoma vulgare* | |
| *Diatoma hyemale* | Si | |
| *Encyonema minutum* | *Cymbella proxima* | |
| *Navicula vilaplanii* | *Navicula cryptocephala* | |
| *Simatopleura solea* | Cl | |
| | *Diatoma vulgare* | |
| Autumn | | |

| | | |
|---|---|---|
| DO | T | Na |
| *Achnanthidium exiguum* | *Diatomella balfouriana* | *Fragilaria bicapitata* |
| *Navicula recens* | *Nitzschia paleacea* | Ca |
| *Nitzschia columbiana* | $PO_4$ | *Brachysira styriaca* |
| pH | *Achnanthes rostellata* | *Cymatopleura solea* |
| *Cocconeis placentula* | *Diatomella balfouriana* | *Cymbopleura angustata* |
| EC | *Navicula vilaplanii* | *Diatoma hyemal* |
| *Achnanthes rostellata* | *Nitzschia paleacea* | *Flagiliforma virescens* |
| *Brachysira styriaca* | *Surirella angustata* | *Navicula vilaplanii* |
| *Cymatopleura solea* | $NO_3$ | *Nitzschia paleacea* |
| *Cymbella affiniformis* | *Achnanthidium exiguum* | *Surirella angustata* |
| *Cymbopleura angustata* | *Navicula recens* | *Surirella arctica* |
| *Diatoma hyemal* | *Nitzschia paleacea* | *Tabellaria fenestrata* |
| *Diatomella balfouriana* | Si | Cl |
| *Flagiliforma virescens* | *Achnanthes rostellata* | *Achnanthes rostellata* |
| *Navicula vilaplanii* | *Diatomella balfouriana* | *Diatomella balfouriana* |
| *Surirella angustata* | *Nitzschia paleacea* | *Navicula vilaplanii* |
| *Surirella arctica* | Mg | *Nitzschia paleacea* |
| *Tabellaria fenestrate* | *Nitzschia paleacea* | *Surirella angustata* |
| Winter | | |
| DO | T | Na |
| *Amphora minutissima* | *Cymbella excilioformis* | *Diatoma moniliformis* |
| *Cymbella excilioformis* | $PO_4$ | *Fragilara ulna* |
| *Fragilaria synegrotesca* | *Achnanthes swazii* | *Navicula odiosa* |
| *Navicula margalithii* | *Amphora pediculus* | *Navicula tripunctata* |
| *Navicula minuscula* | *Navicula radiosa* | *Nitzschia sinuate* |
| *Navicula notha* | $NO_3$ | *Synedra parasitica* |
| *Navicula staffordae* | *Diatoma moniliformis* | Cl |
| *Simatopleura solea* | *Fragilara ulna* | *Achnanthidium minitisimum* |
| *Synedra goulardi* | *Navicula odiosa* | *Melosira variance* |
| *Tabellaria fenestrate* | *Nitzschia sinuate* | Mg |
| pH | *Synedra parasitica* | *Achnanthidium minitisimum* |
| *Achnanthidium. latecephalom* | *Navicula tripunctata* | *Encyonema auerswaldii* |
| *Amphora minutissima* | Si | *Fragillaria crotonensis* |
| *Diatoma tenuis* | *Diatoma tenuis* | *Gomphonema angustatum* |
| *Diatomella balfouriana* | *Fragillaria crotonensis* | *Melosira variance* |
| *Fragilaria synegrotesca* | *Gomphonema angustatum* | *Nitzschia angustata* |
| *Navicula margalithii* | *Surirella linearis* | |
| *Navicula minuscula* | Ca | |
| *Navicula notha* | *Diatoma tenuis* | |
| *Stauroneis smithii* | *Fragillaria crotonensis* | |
| *Surirella linearis* | *Gomphonema angustatum* | |
| *Synedra goulardi* | *Nitzschia thermalis* | |
| *Tabellaria fenestrata* | | |

## Conclusion

In most studies on the Running waters, the genera *Cymbella, Nitzschia, Navicula* have been introduced as obvious species. Ivarson and colleagues introduced *Cymbella, Nitzschia, Diatoma* in studies on metropolitan diatomaceous artifacts in Stockholm. Ognjanova and his colleagues introduced *Cymbella, Fragillaria, Surirella* and ... as dominant genus in 2013 in a review of the flora of the Neogene lake diatoms in Slovakia. In our taxonomic study during September 2018 to August 2018, it was found that 94 species of 31 genus epipelic diatoms, which are *Melosira varians, Nitzschia palea, Nitzschia paleacea*, and *Cocconeis pediculus, Achnanthidium minitisimum* and *Diatoma Vulgar*, were seen as dominant species among epipelic diatoms. The genus identified in this study is very similar to those identified earlier in 2016 on the Ganga and Allahabad rivers. The *Melosira varians* was introduced as one of the dominant diatoms in the study of the Flora of the Berlin Diatoms as well as in Cildir Lake. Ganjiam in a study of the Caspian Sea *Cocconeis placentula* and *Melosira varians* present in all season. Diatoms communities are directly affected by their habitat. Physicochemical factors are one of the effective factors in the diversity and density of the diatoms population, and changes in the sampling stations and even in different regions cause changes in the diatomaceous flora of that area and station. The abundance of diatoms in all sampling stations suggests that diatoms are capable of growing in different concentrations of nitrate, phosphate, silica, etc., and other physico-chemical agents. Of course, this growth can be influenced by the temperature, water velocity, light, shadow, and other factors. Different physico chemical factors especially temperature were effective on diatom density and diversity. The factors affecting the flora of epipelic diatoms are chemistry and nutritional status of water, pH (alkaline pH), water depth, light, wave activity, and wind, feeding organisms from macrophytes, Water flow velocity, type of bed and type of land around wetlands and lakes or ponds. It seems that all of these factors are also effective on the Flora of the Epipelic Diatoms. In this study on the Kordan River, increasing in temperature caused a decrease in the density of diatoms. This result is in accordance to the studies of J.A. Snyder and colleagues.

*Synedra* and *Melosira* is the most common diatom found in planktonic flora between the identified diatomaceous species, which can also be found on sediments or other substrates. Also, genera such *as Surirella, Cymbella, Gomphonema, Amphora, Cocconeis, Melosira, Nitzschia* and *Navicula* are more frequent in cold months. In this study, these species were more observed in cold months and more densities. Some studies shown diatoms such *as Melosira, Fragilaria, Eunotia* were diatomaceous, which were fastened sequentially. *Diatoma* and *Tabellaria* come in the form of silhouetting colonies, and *Navicula, Cymbella*, and *Nitzschia* live in mucilage tubes. In studies on the Cauvery


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River in India, *Nitzschia*, *Gomphonema* and *Fragillaria* were identified as resistant to environmental conditions. Generally, the origin of river plankton and lake shores and wetlands is from epiphyte and epithelium communities. In a study on the Kordan River in this study, *Nitzschia* was one of the most abundant and most prevalent genera and observed in different stations and different months indicating its tolerance to environmental conditions. In this study Some species such as *Achnanthidium swazi*, *Achnanthidium latecephalum*, *Cymbopleura amphicephala*, *Cymbella ventricasa*, *Dipneis smithii*, *Encyonema auerswaldii*, *Fragilaria ulna*, etc were observed only in winter when the lowest temperature was recorded, while some species such as *Cymbella prostra*, *Cymbella* proxima, *Gomphonema parvalum*, *Gomphonema subclavatum*, *Navicula cryptocephala* and *Nitzschia vermicularis* were present only in summer when the highest temperature was recorded. The number of cold-specific species is higher than the heat-specific number, because the greatest growth of diatoms is in cold months, especially in winter. The t-test ($p<0.5$) analysis on our study showed that the time and sampling stations are significant, which is consistent with the research. Considering the amount of Sig in this study, we find that station and time factors have a significant effect on density.

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