*Research Article*

# Distribution of Benthic Diatom (Phytobenthos) Composition in Küçük Menderes River Basin

# Küçük Menderes Nehir Havzası'nda Bentik Diyatome (Fitobentoz) Kompozisyonunun Dağılımı

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**Abstract**

Although there are many studies on the diatoms, the most important represantatives of phytobenthos, the distribution of diatom composition is still a new issue in Turkey. This study aims to investigate the distribution of benthic diatom composition in Küçük Menderes River Basin. Samples were collected from epilithon and epipelon substrates of 7 river water bodies and 3 dams (Tahtalı, Beydağı and Alaçatı) on a seasonal basis in 2014. Hydrogen peroxide and hydrochloric acid were used to remove the organic matter from frustules and permanent slides were mounted with Naphrax solution. In total, 94 benthic diatom taxa were identified. *Nitzschia palea* (Kützing) W.Smith, *N. inconspicua* Grunow, *N. umbonata* (Ehrenberg) Lange-Bertalot, *Craticula accomoda* (Hustedt) DG Mann, *C. subminuscula* (Manguin) C.E.Wetzel & L.Ector and *Navicula veneta* Kützing were the most common taxa as an indicator of polluted waters. *Achnanthidium eutrophilum* (Lange-Bertalot) Lange-Bertalot, *A. minutissimum* var. *jackii* (Rabenhorst) Lange-Bertalot, *Navicula simulata* Manguin, *N. vandamii* Schoeman & Archibald, *Nitzschia archibaldii* Lange-Bertalot, *N. desertorum* Hustedt and *Sellaphora saprotolerans* Lange-Bertalot, Hofmann & Cantonati were the new records for Turkish diatom flora.
***Keywords:*** *Diatom, Küçük Menderes, new records, phytobenthos*

**Öz**

Fitobentozun en önemli temsilcisi olan diyatomeler ile ilgili pek çok çalışma olmasına rağmen diyatome kompozisyonun dağılımı Türkiye'de halen yeni bir konudur. Bu çalışma ile Küçük Menderes Nehir Havzası'nda bentik diyatome kompozisyonunun dağılımının araştırılması amaçlanmıştır. Örnekler 2014 yılında mevsimsel olarak 7 nehir suyu kütlesinden ve 3 baraj gölünden (Tahtalı, Beydağı ve Alaçatı) epiliton ve epipelon substratlardan alınmıştır. Organik maddenin früstüllerden uzaklaştırılması maksadıyla hidrojen peroksit ve hidroklorik asit kullanılmış ve daimi preparatlar Naphrax solüsyonu ile hazırlanmıştır. Toplamda 94 bentik diyatome taksonu teşhis edilmiştir. Kirli suların indikatörü olan *Nitzschia palea* (Kützing) W.Smith, *N. inconspicua* Grunow, *N. umbonata* (Ehrenberg) Lange-Bertalot, *Craticula accomoda* (Hustedt) DG Mann, *C. subminuscula* (Manguin) C.E.Wetzel & L.Ector ve

*Navicula veneta* Kützing en yaygın taksonlar olmuştur. *Achnanthidium eutrophilum* (Lange-Bertalot) Lange-Bertalot, *A. minutissimum* var. *jackii* (Rabenhorst) Lange-Bertalot, *Navicula simulata* Manguin, *N. vandamii* Schoeman & Archibald, *Nitzschia archibaldii* Lange-Bertalot, *N. desertorum* Hustedt ve *Sellaphora saprotolerans* Lange-Bertalot, Hofmann & Cantonati ise Türkiye diyatome florası için yeni kayıtlar olmuştur.

***Anahtar sözcükler:*** *Diyatome, Küçük Menderes, yeni kayıtlar, fitobentoz*

## Introduction

After the implementation of European Union Water Framework Directive (WFD) (2000/60/EC) (Anonymous, 2000) in 2000, ecological assessment came to the forefront in water quality monitoring studies conducted in Europe. European Member States have started to monitor a number of biological quality elements in their water bodies such as phytobenthos, phytoplankton, macrophyte, fish, macroinvertebrate, macroalgae and angiosperms. The harmonization process of the WFD in Turkey has been accelerated since 2011 with the establishment of the Ministry of Forestry and Water Affairs, General Directorate of Water Management (Anonymous, 2011). Biological monitoring studies were carried out in many river basins in Turkey (Anonymous, 2013; Anonymous 2014a; Demir et al. 2017) and are being carried out (Anonymous, 2017) on an ecological basis within the scope of By-law on Monitoring Surface and Ground Waters (Anonymous, 2014b).

The phytobenthos is an obligatory biological quality element to be monitored in rivers and lakes according to the WFD. Phytobenthos contains all phototrophic organisms from microscopic unicellular organisms to macrophytes longer than 2 meters (Anonymous, 2010). Due to the lack of practical methods, EU Member States mostly monitor diatoms in river and lake water bodies as a part of their biological monitoring studies to assess phytobenthos quality element within the scope of the WFD.

Biological monitoring of river basins significantly contributed to the study of flora and fauna in Turkey. Biological data has been obtained from many water bodies that were not studied until today and environmental needs of the taxa were determined (Anonymous, 2016; Toudjani, 2017) with the chemical samples taken at the same time with biological samples. There are number of studies carried out for algal flora in Turkey (Gönülol et al. 1996; Aysel, 2005; Solak et al. 2016) and more than 800 diatom taxa were reported.

Regarding the algal flora studies of Küçük Menderes River Basin, the algal flora of Oğlananası Lake (Gaziemir, İzmir) was identified by Aysel et al. 1998. 40 diatom

taxa were identified and 10 of them were new records for Turkey. With another study, 86 diatom taxa were identified as a result of sampling on a seasonal basis in 1994 in Barutçu Lake (Selçuk, İzmir). 12 diatom taxa were new records for Turkish flora (Aysel et al. 2002). In addition, the algal flora of Laka River was identified by Aysel et al. 2001. It was found that the river can be used for drinking purposes based on the distribution of the taxa according to algal divisions. This study aims to investigate the distribution of benthic diatom composition and to prepare the taxa catalogue according to the diatom taxa obtained from the water quality monitoring study in the Küçük Menderes River Basin, and to benefit from the results for future monitoring studies carried out in the other river basins of Turkey.

## Method

### Study Site

Küçük Menderes River Basin is placed in the west of Turkey between Büyük Menderes and Gediz River Basins and its waters flow into the Aegean Sea. River basin is located between 38° 41' 05" and 37° 24' 08" northern latitudes with 28° 24' 36" and 26° 11' 48" eastern longitudes. Surface area of this basin is 702.931 ha and it corresponds to 0.9% of the surface area of Turkey (Anonymous, 2014c).

### Sampling

Samples were collected from 7 river water bodies and 3 dams (Table 1) in Küçük Menderes River Basin (Figure 1) in May, July and September in 2014. Epilithic samples were taken by brushing the submerged stones, and epipelic samples were taken by using a pipette aspirator from the sediment.


*Figure 1.* Distribution of sampling points in Küçük Menderes River Basin

Table 1

*The Coordinates of The Sampling Points of The Water Bodies in Küçük Menderes River Basin*

| Stations | Water Bodies | Coordinates | |
|---|---|---|---|
| K1 | Keleş Creek | 38°09'55.27" N | 28°13'10.55" E |
| K2 | Küçük Menderes River | 38°09'56.39" N | 27°57'51.15" E |
| K3 | Ilıca Creek | 38°09'11.05" N | 27°40'56.53" E |
| K4 | Fetrek Creek | 38°04'23.92" N | 27°24'52.89" E |
| K5 | Küçük Menderes River | 37°58'41.05" N | 27°22'44.02" E |
| K6 | Küçük Menderes River | 38°05'46.76" N | 27°23'45.49" E |
| K7 | Sangı Creek | 38°11'47.24" N | 27°09'59.25" E |
| K8 | Tahtalı Dam | 38°05'26.38" N | 27°02'58.32" E |
| K9 | Alaçatı Dam | 38°17'03.24" N | 26°24'28.46" E |
| K10 | Beydağ Dam | 38°06'32.42" N | 28°13'11.18" E |

**Sample Processing, Observation and Identification**

Samples were boiled with $H_2O_2$ and HCl to remove the organic matter from frustules. After washing three times of diatoms with distilled water, the material was air-dried on cover glasses and mounted with Naphrax solution. Diatoms were observed with a Nikon Ci Light Microscope (LM) in Dumlupınar University, Turkey.

The diatoms were identified according to Hofmann et al. (2011); Krammer and Lange-Bertalot (1998, 1991); Lange-Bertalot (2001); Levkov et al. (2013); Wojtal (2009) and Wojtal and Kwandrans (2006). Reported dimensions (length, width, number of striae/10 µm) of each taxa were based on the measurements performed in this study.

**Diatom Distribution**

Description of the distribution of Turkish diatom flora was made according to Gönülol (2017). The taxa reported from Turkey by Gönülol (2017) which cover 10% of the literature are categorized as "*common*" diatoms, the ones cover less than 10% are noted as "*rare*" diatoms. For each station, about 400 valves were counted and then relative abundances were calculated. If the taxon exists in 1 or 2 sampling station(s), it was named as "rare" and if it exists in more than 2 stations, it was named as "common" in this study.

## Results

A total of 94 taxa were identified and 7 of those were recorded as new taxa for Turkish diatom flora. The taxa identified in Küçük Menderes River Basin and indicated by Gönülol (2017) for Turkey as a whole are listed in Table 2 and brief notes, dimensions and distribution of each diatom are provided.

Table 2

*The Distribution of The Diatom Taxa in Turkey (Gönülol, 2017) and in This Study*

| | Status in Turkey (Gönülol, 2017) | In This Study | |
|---|---|---|---|
| | | Status | Station(s) |
| *Achnanthidium eutrophilum* **(Lange-Bertalot) Lange-Bertalot** | NR | R | K10 |
| *Achnanthidium exiguum* **(Grunow) Czarnecki** | R | R | K5 |
| *Achnanthidium minutissimum* **(Kützing) Czarnecki** | C | C | K7, K8, K9 |
| *Achnanthidium inutissimum* var. *jackii* **(Rabenhorst) Lange-Bertalot** | NR | R | K8 |
| *Adlafia minuscula* **(Grunow) Lange-Bertalot** | C | R | K1 |
| *Amphora pediculus* **(Kützing) Grunow ex A.Schmidt** | C | R | K1, K7 |
| *Aulacoseira ambigua* **(Grunow) Simonsen** | R | R | K10 |
| *Cocconeis pediculus* **Ehrenberg** | C | C | K1, K7, K9 |
| *Craticula accomoda* **(Hustedt) DG Mann** | C | C | K1, K3, K4, K5, K8, K10 |
| *Craticula cuspidate* **(Kützing) DG Mann** | C | R | K7 |
| *Craticula melostiformis* **(Hustedt) Mayama** | R | C | K2, K3, K9 |
| *Craticula subminuscula* **(Manguin) C.E.Wetzel & L.Ector** | C | C | K1, K2, K3, K5, K9, K10 |
| *Cyclostephanos dubius* **(Hustedt) Round** | R | C | K6, K9, K10 |
| *Cyclostephanos invisitatus* **(Hohn & Hellermann) Theriot, Stoermer & Håkasson** | R | R | K10 |
| *Cyclotella atomus* **Hustedt** | R | R | K2 |

Table 2 (continue)

*The Distribution of The Diatom Taxa in Turkey (Gönülol, 2017) and in This Study*

| | Status in Turkey (Gönülol, 2017) | In This Study | |
|---|---|---|---|
| | | Status | Station(s) |
| *Cyclotella meneghiniana* **Kützing** | C | C | K3, K5, K7 |
| *Cymbella cymbiformis* **C. Agardh** | C | R | K8 |
| *Cymbella excise* **Kützing** | R | R | K8, K9 |
| *Cymbella lange-bertalotii* **Krammer** | R | R | K8 |
| *Cymbella parva* **(W. Smith) Cleve** | C | R | K7 |
| *Cymbopleura amphicephala* **Näegeli** | C | R | K7 |
| *Diatoma moniliformis* **(Kützing) D.M.Williams** | C | R | K4, K5 |
| *Encyonema caespitosum* **Kützing** | C | R | K8 |
| *Encyonema ventricosum* **(C.Agardh) Grunow** | C | C | K1, K6, K7 |
| *Encyonopsis microcephala* **(Grunow) Krammer** | C | R | K6, K7 |
| *Encyonopsis minuta* **Krammer & Reichardt** | R | C | K6, K7, K8 |
| *Encyonopsis subminuta* **Krammer & Reichardt** | R | C | K6, K7, K8, K10 |
| *Fallacia pygmeae* **(Kützing) Stikle et Mann** | C | R | K10 |
| *Fragilaria capucina* var. *vaucheria* **(Kützing) Lange-Bertalot** | C | R | K8, K10 |
| *Fragilaria mesolepta* **Rabenhorst** | C | R | K8 |
| *Fragilaria perminuta* **(Grunow) Lange-Bertalot** | R | R | K8, K9 |
| *Geissleria decussis* **(Østrup) Lange-Bertalot & Metzeltin** | C | R | K1 |
| *Gomphonema olivaceum* **(Hornemann) Brébisson** | C | R | K7, K8 |
| *Gomphonema parvulum* **(Kützing) Kützing** | C | C | K1, K4, K5 |
| *Gomphonema pumilum* **(Grunow) E.Reichardt & Lange-Bertalot** | R | C | K1, K6, K7 |

Table 2 (continue)

*The Distribution of The Diatom Taxa in Turkey (Gönülol, 2017) and in This Study*

| | Status in Turkey (Gönülol, 2017) | In This Study | |
|---|---|---|---|
| | | Status | Station(s) |
| *Halamphora montana* **(Krasske) Levkov** | R | C | K3, K5, K10 |
| *Halamphora veneta* **(Kützing) Levkov** | C | C | K1, K2, K5, K9 |
| *Hantzschia amphioxys* **(Ehrenberg) Grunow** | C | R | K1 |
| *Hippodonta capitate* **(Ehrenberg) Lange-Bertalot, Metzeltin et Witkowski** | C | R | K10 |
| *Luticola goeppertiana* **(Bleisch) D.G.Mann** | R | R | K5 |
| *Luticola ventricosa* **(Kützing) D.G.Mann** | R | R | K5 |
| *Mayameae permitis* **(Hustedt) K.Bruder & L.K. Medlin** | R | C | K2, K3, K4, K10 |
| *Melosira varians* **Agardh** | C | R | K10 |
| *Navicula antonii* **Lange-Bertalot** | R | R | K1, K7 |
| *Navicula capitatoradiata* **Germain** | C | C | K4, K7, K8, K9 |
| *Navicula cryptocephala* **Kützing** | C | C | K4, K7, K8, K9 |
| *Navicula cryptotenella* **Lange-Bertalot** | C | R | K9 |
| *Navicula cryptotenelloides* **Lange-Bertalot** | R | R | K8 |
| *Navicula erifuga* **Lange-Bertalot** | R | R | K10 |
| *Navicula gregaria* **Donkin** | C | C | K1, K2, K3, K10 |
| *Navicula notha* **Wallace** | R | R | K10 |
| *Navicula radiosa* **Kützing** | C | R | K8 |
| *Navicula reichardtiana* **Lange-Bertalot** | R | R | K1 |
| *Navicula simulate* **Manguin** | NR | R | K2, K9 |
| *Navicula trivialis* **Lange-Bertalot** | C | R | K9 |

Table 2 (continue)

*The Distribution of The Diatom Taxa in Turkey (Gönülol, 2017) and in This Study*

| | Status in Turkey (Gönülol, 2017) | In This Study Status | Station(s) |
|---|---|---|---|
| *Navicula vandamii* **Schoeman & Archibald** | NR | R | K2, K9 |
| *Navicula veneta* **Kützing** | C | C | K1, K2, K4, K5, K6, K10 |
| *Navicula viridula* var. *germainii* **(Wallace) Lange-Bertalot** | R | R | K2, K10 |
| *Navicula viridula* var. *rostellata* **(Kützing) Cleve** | C | R | K10 |
| *Nitzschia amphibia* **Grunow** | C | R | K4, K5 |
| *Nitzschia archibaldii* **Lange-Bertalot** | NR | C | K2, K3, K10 |
| *Nitzschia capitellata* **Hustedt in A. Schmidt** | C | C | K2, K3, K4, K10 |
| *Nitzschia desertorum* **Hustedt** | NR | R | K2 |
| *Nitzschia dissipata* **(Kützing) Grunow** | C | R | K9 |
| *Nitzschia dissipata* var. *media* **(Hantzsch) Grunow** | C | R | K9 |
| *Nitzschia filiformis* **(W.Smith) Van Heurck** | C | R | K9 |
| *Nitzschia fonticola* **(Grunow) Grunow in Van Heurck** | C | R | K1, K3 |
| *Nitzschia frustulum* **(Kützing) Grunow** | C | R | K9, K10 |
| *Nitzschia inconspicua* **Grunow** | C | C | K1, K4, K8, K9, K10 |
| *Nitzschia linearis* **(C.Agardh) W. Smith** | C | R | K1 |
| *Nitzschia palea* **(Kützing) W.Smith** | C | C | K1, K2, K3, K4, K5, K6, K7, K10 |
| *Nitzschia sociabilis* **Hustedt** | R | R | K9 |
| *Nitzschia umbonata* **(Ehrenberg) Lange-Bertalot** | C | C | K1, K2, K4, K5, K6 |
| *Pantocsekiella ocellata* **(Pantocsek) K.T.Kiss & Ács** | C | R | K8 |
| *Planothidium lanceolatum* **(Brébisson ex Kützing) Lange-Bertalot** | C | R | K1, K8 |

Table 2 (continue)

*The Distribution of The Diatom Taxa in Turkey (Gönülol, 2017) and in This Study*

| | Status in Turkey (Gönülol, 2017) | In This Study | |
|---|---|---|---|
| | | Status | Station(s) |
| *Pseudofallacia monoculata* **(Hustedt) D.G.Mann** | R | R | K3, K10 |
| *Pseudostaurosira brevistriata* **(Grunow) D.M.Williams & Round** | C | R | K8 |
| *Reimeria sinuate* **(Gregory) Kociolek et Stoermer** | C | C | K1, K2, K7 |
| *Sellaphora pupula* **(Kützing) Mereschkovsky** | C | C | K1, K2, K3, K10 |
| *Sellaphora radiosa* **(Hustedt) H.Kobayasi** | R | R | K5 |
| *Sellaphora saprotolerans* **Lange-Bertalot, Hofmann & Cantonati** | NR | C | K1, K2, K10 |
| *Sellaphora saugerresii* **(Desmazières) C.E.Wetzel & D.G.Mann** | C | C | K1, K2, K3, K4 |
| *Sellaphora seminulum* **(Grunow) D.G.Mann** | R | R | K4, K5 |
| *Stephanodiscus hantzschii* **Grunow** | C | R | K10 |
| *Surirella brebissonii* **Krammer et Lange-Bertalot** | C | C | K1, K2, K5 |
| *Surirella minuta* **Brébisson** | C | R | K2 |
| *Surirella robusta* **Ehrenberg** | C | C | K1, K2, K10 |
| *Tryblionella apiculate* **Gregory** | C | R | K2 |
| *Tryblionella calida* **(Grunow) D.G.Mann** | R | R | K2 |
| *Ulnaria acus* **(Nitzsch) P.Compère** | C | R | K8 |
| *Ulnaria biceps* **(Kützing) P.Compère** | C | C | K5, K7, K8 |
| *Ulnaria capitate* **(Ehrenberg) Compère** | C | R | K8 |
| *Ulnaria delicatissima* **(W.Smith) M.Aboal & P.C.Silva** | C | R | K6, K8 |
| *Ulnaria ulna* **(Nitzsch) P.Compère** | C | R | K1 |

*Note. NR: New Record, C: Common, R: Rare*

***Achnanthidium eutrophilum* (Lange-Bertalot) Lange-Bertalot** (Figure 2)
Basionym: *Achnanthes eutrophila* Lange-Bertalot
Ref: Hofmann et al. 2011 p.80-pl.23: 30-35
Dimensions: Valve 9.4-10.2 µm length, 3.2-3.7 µm width and 25-26 striae in 10 µm
Distribution in Küçük Menderes River Basin: K10

***Achnanthidium exiguum* (Grunow) Czarnecki** (Figure 3)
Basionym: *Achnanthes exigua* Grunow
Ref: Hofmann et al. 2011 p.70-pl.22: 14-20
Dimensions: Valve 11.8-12.9 µm length, 4.2-4.8 µm width and 25-26 striae in 10 µm
Distribution in Küçük Menderes River Basin: K5

***Achnanthidium minutissimum* (Kützing) Czarnecki** (Figure 4)
Basionym: *Achnanthes minutissima* Kützing
Ref: Hofmann et al. 2011 p.83-pl.23: 15-21
Dimensions: Valve 9.5-11.2 µm length and 2.5-3.1 µm width
Distribution in Küçük Menderes River Basin: K7, K8, K9

***Achnanthidium minutissimum* var. *jackii* (Rabenhorst) Lange-Bertalot** (Figure 5)
Basionym: *Achnanthidium jackii* Rabenhorst
Ref: Hofmann et al. 2011 p.84-pl.23: 22-29
Dimensions: Valve 9.5-11.2 µm length and 2.5-3.1 µm width
Distribution in Küçük Menderes River Basin: K8

***Adlafia minuscula* (Grunow) Lange-Bertalot** (Figure 6)
Basionym: *Navicula minuscula* Grunow
Ref: Hofmann et al. 2011 p.91-pl.42: 76-80
Dimensions: Valve 10.2-11.4 µm length and 3.1-3.7 µm width
Distribution in Küçük Menderes River Basin: K1

***Amphora pediculus* (Kützing) Grunow ex A.Schmidt** (Figure 7)
Basionym: *Cymbella pediculus* Kützing
Ref: Hofmann et al. 2011 p.98-pl.91: 29-33
Dimensions: Valve 8.3-12.4 µm length and 2.6-3.1 µm width
Distribution in Küçük Menderes River Basin: K1, K7

***Aulacoseira ambigua* (Grunow) Simonsen** (Figure 8)
Basionym: *Melosira crenulata* var. *ambigua* Grunow
Ref: Krammer & Lange-Bertalot 1991 p. 25-pl.21: 1-16
Dimensions: Valve 4.7-5.5 µm length, 8.5-14.3 µm width, 15-18 interstriae in 10 µm
Distribution in Küçük Menderes River Basin: K10

***Cocconeis pediculus* Ehrenberg** (Figure 9)
Ref: Hofmann et al. 2011 p.132-pl.19: 17-19
Dimensions: Valve 23.4-31.4 µm length, 21.8-24.2 µm width, 18-21 striae in 10 µm
Distribution in Küçük Menderes River Basin: K1, K7, K9

***Craticula accomoda* (Hustedt) DG Mann** (Figure 10)
Basionym: *Navicula accomoda* Hustedt
Ref: Lange-Bertalot 2001 p.108-pl.93: 1-6
Dimensions: Valve 18.3-23.2 µm length, 5.8-7.1 µm width and 23-25 striae in 10 µm
Distribution in Küçük Menderes River Basin: K1, K3, K4, K5, K8, K10

***Craticula cuspidata* (Kützing) DG Mann** (Figure 11)
Basionym: *Frustulia cuspidata* Kützing
Ref: Lange-Bertalot 2001 p.111-pl.82: 1-3; 82: 1, 2
Dimensions: Valve 73.8-85.3 µm length, 5.8-7.1 µm width and 23-25 striae in 10 µm
Distribution in Küçük Menderes River Basin: K7

***Craticula molestiformis* (Hustedt) Mayama** (Figure 12)
Basionym: *Navicula minusculoides* Hustedt
Ref: Lange-Bertalot 2001 p.115-pl.93: 7-15
Dimensions: Valve 14.5-16.7 µm length and 3.1-3.7 µm width
Distribution in Küçük Menderes River Basin: K2, K3, K9

***Craticula subminuscula* (Manguin) C.E.Wetzel & L.Ector** (Figure 13)
Basionym: *Navicula subminuscula* Manguin
Ref: Lange-Bertalot 2001 p.202-pl.42: 45-50
Dimensions: Valve 7.9-11.4 µm length, 3.1-3.6 µm width and 20-22 striae in 10 µm
Distribution in Küçük Menderes River Basin: K1, K2, K3, K5, K9, K10

***Cyclostephanos dubius* (Hustedt) Round** (Figure 14)
Basionym: *Stephanodiscus dubius* Hustedt
Ref: Krammer & Lange-Bertalot 1991 p. 64-pl.67:8a-9b; Wojtal & Kwandrans 2006 p.196-pl.15: 8, 16: 1-11
Dimensions: Valve diameter 9.9-11.2 µm. The valve has 8-11 interstriae in 10 µm
Distribution in Küçük Menderes River Basin: K6, K9, K10

***Cyclostephanos invisitatus* (Hohn & Hellermann) Theriot, Stoermer & Håkasson** (Figure 15)
Basionym: *Stephanodiscus invisitatus* Hohn & Hellermann
Ref: Krammer & Lange-Bertalot 1991 p.63-pl.67: 3, 4; Wojtal & Kwandrans 2006 p.198-pl.15: 9, 16: 12-14, 17
Dimensions: Valve diameter 9.8-11.3 µm. The valve has 9-13 interstriae in 10 µm
Distribution in Küçük Menderes River Basin: K10

***Cyclotella atomus* Hustedt** (Figure 16)
Ref: Krammer & Lange-Bertalot 1991 p.53-pl.51: 19-21; Wojtal & Kwandrans 2006 p.184-pl.4: 13-15, 6:1-6
Dimensions: Valve diameter 6.1-12.4 µm. There are 16-19 interstriae in 10 µm
Distribution in Küçük Menderes River Basin: K2

***Cyclotella meneghiniana* Kützing** (Figure 17)
Ref: Krammer & Lange-Bertalot 1991 p. 44-pl.44: 1-10; Wojtal & Kwandrans 2006 p.186-pl.4: 18-21, 7: 1-13, 9:1-8, 10:1-5
Dimensions: Valve diameter 11.3-15.4 µm. There are 6-8 interstriae in 10 µm
Distribution in Küçük Menderes River Basin: K3, K5, K7

***Cymbella cymbiformis* C. Agardh** (Figure 18)
Ref: Hofmann et al. 2011 p.148-pl.80: 1-11
Dimensions: Valve 47.8-75.4 µm length, 13.5-15.4 µm width and 8-9 striae in 10 µm
Distribution in Küçük Menderes River Basin: K8

***Cymbella excisa* Kützing** (Figure 19)
Ref: Hofmann et al. 2011 p.150-pl.77: 23-28
Dimensions: Valve 19.8-34.5 µm length, 7.5-9.8 µm width and 9-12 striae in 10 µm
Distribution in Küçük Menderes River Basin: K8, K9

***Cymbella lange-bertalotii* Krammer** (Figure 20)
Ref: Hofmann et al. 2011 p.154-pl.78: 1-5
Dimensions: Valve 50.7-71.6 µm length, 11.2-14.5 µm width and 9-11 striae in 10 µm
Distribution in Küçük Menderes River Basin: K8

***Cymbella parva* (W. Smith) Cleve** (Figure 21)
Basionym: *Cocconema parvum* W.Smith
Ref: Hofmann et al. 2011 p.156-pl.77: 29-34
Dimensions: Valve 35.4-39.5 µm length, 8.5-9.7 µm width and 10-11 striae in 10 µm
Distribution in Küçük Menderes River Basin: K7

***Cymbopleura amphicephala* Näegeli** (Figure 22)
Ref: Hofmann et al. 2011 p.160-pl.83: 11-15
Dimensions: Valve 24.1-31.5 µm length, 7.9-8.3 µm width and 13-15 striae in 10 µm
Distribution in Küçük Menderes River Basin: K7

***Diatoma moniliformis* (Kützing) D.M.Williams** (Figure 23)
Basionym: *Diatoma tenue* var. *moniliforme* Kützing
Ref: Hofmann et al. 2011 p.174-pl.2: 11-15
Dimension: Valve 18.4-27.8 µm length, 3.5-3.9 µm width and 6-9 transapical partitions in 10 µm
Distribution in Küçük Menderes River Basin: K4, K5

***Encyonema caespitosum* Kützing** (Figure 24)
Ref: Hofmann et al. 2011 p.186-pl.86: 5-9
Dimension: Valve 25.4-32.8 µm length, 8.3-11.5 µm width and 10-11 striae in 10 µm.
Distribution in Küçük Menderes River Basin: K8.

***Encyonema ventricosum* (C.Agardh) Grunow** (Figure 25)
Basionym: *Frustulia ventricosa* C.Agardh
Ref. Hofmann et al. 2011 p.192-pl.87: 18-22
Dimensions: Valve 15.4-21.2 µm length, 6.8-7.3 µm width and 12-15 striae in 10 µm
Distribution in Küçük Menderes River Basin: K1, K6, K7

***Encyonopsis microcephala* (Grunow) Krammer** (Figure 26)
Ref: Hofmann et al. 2011 p.197-pl.89: 35-39
Dimensions: Valve 13.1-16.7 µm length, 3.0-3.7 µm width and 24-25 striae in 10 µm
Distribution in Küçük Menderes River Basin: K6, K7

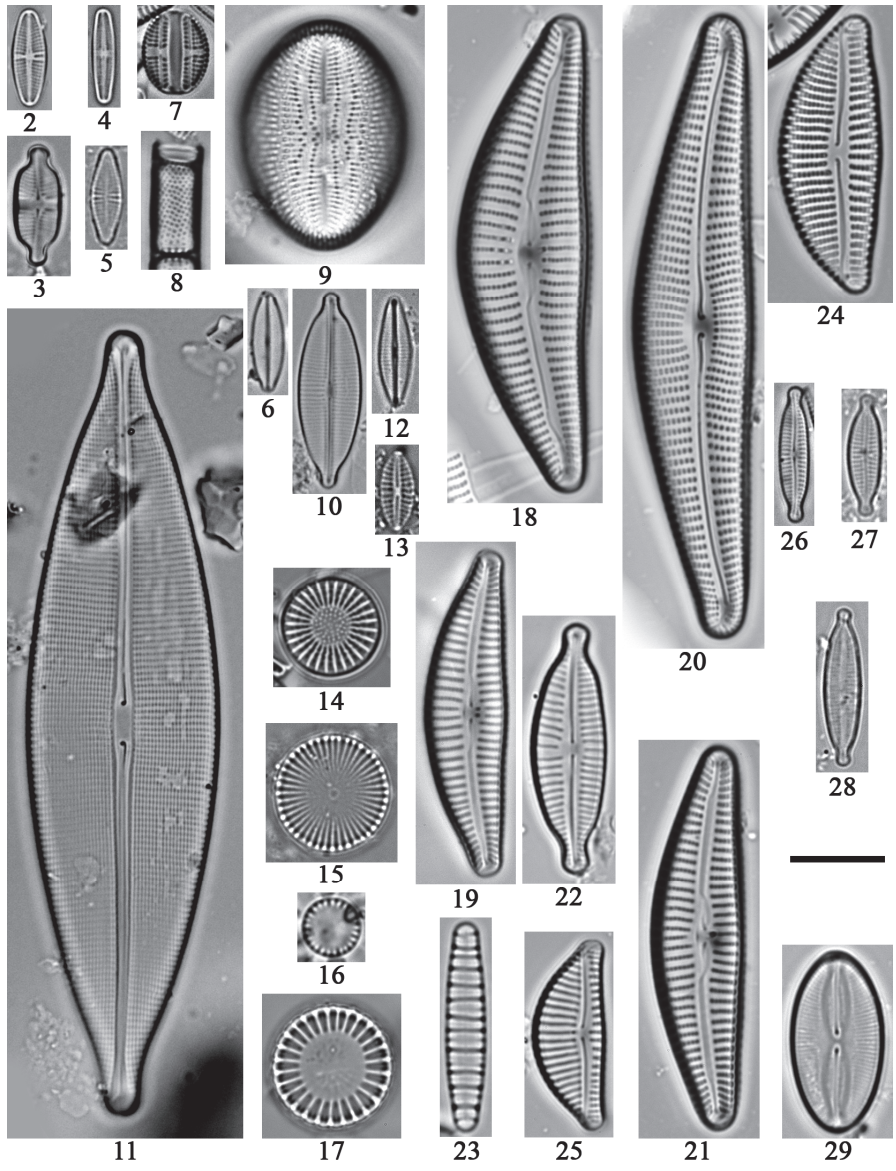
***Encyonopsis minuta* Krammer & Reichardt** (Figure 27)
Ref: Hofmann et al. 2011 p.198-pl.89: 25-34
Dimensions: Valve 9.3-15.2 µm length, 2.9-3.8 µm width and 24-25 striae in 10 µm
Distribution in Küçük Menderes River Basin: K6, K7, K8

***Encyonopsis subminuta* Krammer & Reichardt** (Figure 28)
Ref: Hofmann et al. 2011 p.198-pl.89: 17-21
Dimensions: Valve 14.3-21.4 µm length, 3.6-4.1 µm width and 24-26 striae in 10 µm
Distribution in Küçük Menderes River Basin: K6, K7, K8, K10

***Fallacia pygmaea* (Kützing) Stikle et Mann** (Figure 29)
Basionym: *Navicula pygmaea* Kützing
Ref: Hofmann et al. 2011 p.245-pl.46: 31-34
Dimensions: Valve 18.1-24.8 µm length, 9.2-14.6 µm width and 22-25 striae in 10 µm
Distribution in Küçük Menderes River Basin: K10

***Fragilaria capucina* var. *vaucheriae* (Kützing) Lange-Bertalot** (Figure 30)
Basionym: *Exilaria vaucheria* Kützing
Ref: Hofmann et al. 2011 p.277-pl.9: 1-7
Dimensions: Valve 15.1-22.3 µm length, 4.7-5.2 µm width and 9-10 striae in 10 µm
Distribution in Küçük Menderes River Basin: K8, K10

***Fragilaria mesolepta* Rabenhorst** (Figure 31)
Ref: Hofmann et al. 2011 p.267-pl.8: 22-27
Dimensions: Valve 22.3-26.7 µm length, 3.4-4.1 µm width and 16-18 striae in 10 µm
Distribution in Küçük Menderes River Basin: K8




*Figures 2-29.* 2- *Achnanthidium eutrophilum*; 3- *A. exiguum*; 4- *A. minutissimum*; 5- *A. minutissimum* var. *jackii*; 6- *Adlafia minuscula*; 7- *Amphora pediculus*; 8- *Aulacoseira ambigua*; 9- *Cocconeis pediculus*; 10- *Craticula accomoda*; 11- *C. cuspidata*; 12- *C. melostiformis*; 13- *C. subminuscula*; 14- *Cyclostephanos dubius*; 15- *C. invisitatus*; 16- *Cyclotella atomus*; 17- *C. meneghiniana*; 18- *C. cymbiformis*; 19- *C. excisa*; 20- *C. lange-bertalotii*; 21- *C. parva*; 22- *Cymbopleura amphicephala*; 23- *Diatoma moniliformis*; 24- *Encyonema caespitosum*; 25- *E. ventricosum*; 26- *Encyonopsis microcephala*; 27- *E. minuta* Krammer & Reichardt; 28- *E. subminuta* Krammer & Reichardt; 29- *Fallacia pygmaea* (Kütz.) Stikle et Mann. Scale bar: 10µm.

***Fragilaria perminuta* (Grunow) Lange-Bertalot** (Figure 32)
Ref: Hofmann et al. 2011 p.271-pl.8: 28-31
Dimensions: Valve 11.2-21.2 µm length, 2.6-3.1 µm width and 17-18 striae in 10 µm
Distribution in Küçük Menderes River Basin: K8, K9

***Geissleria decussis* (Østrup) Lange-Bertalot & Metzeltin** (Figure 33)
Basionym: *Navicula decussis* Østrup
Ref: Hofmann et al. 2011 p.284-pl.51: 40-44
Dimensions: Valve 18.1-23.4 µm length, 6.9-7.8 µm width and 15-16 striae in 10 µm
Distribution in Küçük Menderes River Basin: K1

***Gomphonema olivaceum* (Hornemann) Brébisson** (Figure 34)
Basionym: *Ulva olivacea* Hornemann
Ref: Hofmann et al. 2011 p.310-pl.95: 1-6
Dimensions: Valve 14.0-21.3 µm length, 4.8-5.9 µm width and 9-12 striae in 10 µm
Distribution in Küçük Menderes River Basin: K7, K8

***Gomphonema parvulum* (Kützing) Kützing** (Figure 35)
Basionym: *Sphenella parvula* Kützing
Ref: Hofmann et al. 2011 p.312-pl.99: 1-5
Dimensions: Valve 10.2-15.3 µm length, 4.5-4.9 µm width and 16-18 striae in 10 µm
Distribution in Küçük Menderes River Basin: K1, K4, K5

***Gomphonema pumilum* (Grunow) E.Reichardt & Lange-Bertalot** (Figure 36)
Basionym: *Gomphonema intricatum* var. *pumilum* Grunow
Ref: Hofmann et al. 2011 p.315-pl.97: 10-20
Dimensions: Valve 17.6-18.5 µm length, 4.1-4.9 µm width and 11-13 striae in 10 µm
Distribution in Küçük Menderes River Basin: K1, K6, K7

***Halamphora montana* (Krasske) Levkov** (Figure 37)
Basionym: *Amphora montana* Krasske
Ref: Hofmann et al. 2011 p.328-pl.92: 12-14
Dimensions: Valve 14.1-16.1 µm length and 3.1-3.6 µm width
Distribution in Küçük Menderes River Basin: K3, K5, K10

***Halamphora veneta* (Kützing) Levkov** (Figure 38)
Basionym: *Amphora veneta* Kützing
Ref: Hofmann et al. 2011 p.330-pl.92: 20-25
Dimensions: Valve 15.2-18.3 µm length, 4.1-4.4 µm width and 17-19 striae in 10 µm
Distribution in Küçük Menderes River Basin: K1, K2, K5, K9

***Hantzschia amphioxys* (Ehrenberg) Grunow** (Figure 39)
Basionym: Eunotia *amphioxys* Ehrenberg
Ref: Hofmann et al. 2011 p.333-pl.102: 1-5
Dimensions: Valve 16.1-38.4 µm length, 5.1-6.2 µm width and 19-22 striae in 10 µm
Distribution in Küçük Menderes River Basin: K1

***Hippodonta capitata* (Ehrenberg) Lange-Bertalot, Metzeltin et Witkowski** (Figure 40)
Basionym: *Navicula capitata* Ehrenberg
Ref: Hofmann et al. 2011 p.335-pl.51: 1-6
Dimensions: Valve 21.3-24.2 µm length, 5.5-6.9 µm width and 8-9 striae in 10 µm.
Distribution in Küçük Menderes River Basin: K10

***Luticola goeppertiana* (Bleisch) D.G.Mann** (Figure 41)
Basionym: *Stauroneis geoppertiana* Bleisch
Ref: Hofmann et al. 2011 p.346-pl.45: 22-26
Dimensions: Valve 17.2-21.3 µm length, 6.8-7.3 µm width and 17-20 striae in 10 µm
Distribution in Küçük Menderes River Basin: K5

***Luticola ventricosa* (Kützing) D.G.Mann** (Figure 42)
Basionym: *Stauroneis ventricosa Kützing*
Ref: Levkov et al. 2013 p.250-pl.190: 1-57
Dimensions: Valve 12.4-17.5 µm length, 6.2-7.1 µm width and 18-20 striae in 10 µm
Distribution in Küçük Menderes River Basin: K5

***Mayamaea permitis* (Hustedt) K.Bruder & L.K. Medlin** (Figure 43)
Basionym: *Navicula permitis* Hustedt
Ref: Lange-Bertalot 2001 p.136-pl.104: 7-13
Dimensions: Valve 6.5-7.3 µm length and 3.1-3.4 µm width
Distribution in Küçük Menderes River Basin: K2, K3, K4, K10

***Melosira varians* Agardh** (Figure 44)
Ref: Krammer & Lange-Bertalot 1991 p.7-pl.4:1-8, Wojtal 2009 p.238-pl.1: 1-4
Dimensions: Valve diameter 8.5-10.9 µm
Distribution in Küçük Menderes River Basin: K10

***Navicula antonii* Lange-Bertalot** (Figure 45)
Ref: Lange-Bertalot 2001 p.15-pl.13: 1-15
Dimensions: Valve 15.5-23.2 µm length, 5.9-6.8 µm width and 12-14 striae in 10 µm
Distribution in Küçük Menderes River Basin: K1, K7

***Navicula capitatoradiata* Germain** (Figure 46)
Ref: Lange-Bertalot 2001 p.22-pl.29: 15-20
Dimensions: Valve 30.3-35.7 µm length, 6.9-7.6 µm width and 12-14 striae in 10 µm
Distribution in Küçük Menderes River Basin: K4, K7, K8, K9

***Navicula cryptocephala* Kützing** (Figure 47)
Ref: Lange-Bertalot 2001 p.27-pl.17: 1-10
Dimensions: Valve 25.4-35.2 µm length, 5.9-6.4 µm width and 15-17striae in 10 µm
Distribution in Küçük Menderes River Basin: K4, K7, K8, K9

***Navicula cryptotenella* Lange-Bertalot** (Figure 48)
Ref: Lange-Bertalot 2001 p.28-pl.26: 17-32
Dimensions: Valve 18.3-27.5 µm length, 5.3-6.2 µm width and 15-17 striae in 10 µm
Distribution in Küçük Menderes River Basin: K9

***Navicula cryptotenelloides* Lange-Bertalot** (Figure 49)
Ref: Lange-Bertalot 2001 p.29-pl.18: 1-8
Dimensions: Valve 12.7-21.2 µm length, 3.9-4.1 µm width and 17-18 striae in 10 µm
Distribution in Küçük Menderes River Basin: K8

***Navicula erifuga* Lange-Bertalot** (Figure 50)
Ref: Hofmann et al. 2011 p.382-pl.38: 12-16
Dimensions: Valve 21.4-32.5 µm length, 5.2-6.9 µm width and 12-14 striae in 10 µm
Distribution in Küçük Menderes River Basin: K10

***Navicula gregaria* Donkin** (Figure 51)
Ref: Hofmann et al. 2011 p.384-pl.39: 5-11
Dimensions: Valve 17.8-27.4 µm length, 6.1-7.2 µm width and 16-19 striae in 10 µm
Distribution in Küçük Menderes River Basin: K1, K2, K3, K10

***Navicula notha* Wallace** (Figure 52)
Ref: Hofmann et al. 2011 p.390-pl.31: 19-23
Dimensions: Valve 24.2-28.4 µm length, 4.7-5.4 µm width and 16-17 striae in 10 µm
Distribution in Küçük Menderes River Basin: K10

***Navicula radiosa* Kützing** (Figure 53)
Ref: Lange-Bertalot 2001 p.59-pl.8: 1-7
Dimensions: Valve 54.2-67.4 µm length, 9.1-11.4 µm width and 10-12 striae in 10 µm
Distribution in Küçük Menderes River Basin: K8

***Navicula reichardtiana* Lange-Bertalot** (Figure 54)
Ref: Lange-Bertalot 2001 p.63-pl.13: 13-25
Dimensions: Valve 13.0-17.4µm length, 5.1-6.2 µm width and 15-18 striae in 10 µm
Distribution in Küçük Menderes River Basin: K1

***Navicula simulata* Manguin** (Figure 55)
Ref: Hofmann et al. 2011 p.400-pl.38: 6-11
Dimensions: Valve 30.2-35.4 µm length, 6.2-7.0 µm width and 14-16 striae in 10 µm
Distribution in Küçük Menderes River Basin: K2, K9

***Navicula trivialis* Lange-Bertalot** (Figure 56)
Ref: Lange-Bertalot 2001 p.73-pl.29: 1-6
Dimensions: Valve 32.8-42.4 µm length, 9.3-11.4 µm width and 11-12 striae in 10 µm
Distribution in Küçük Menderes River Basin: K9

***Navicula vandamii* Schoeman & Archibald** (Figure 57)
Ref: Hofmann et al. 2011 p.406-pl.29: 15-19
Dimensions: Valve 19.4-25.9 µm length, 4.7-5.1 µm width and 15-16 striae in 10 µm
Distribution in Küçük Menderes River Basin: K2, K9

***Navicula veneta* Kützing** (Figure 58)
Ref: Lange-Bertalot 2001 p.78-pl.14: 23-30
Dimensions: Valve 15.4-21.9 µm length, 4.9-5.7 µm width and 14-15 striae in 10 µm
Distribution in Küçük Menderes River Basin: K1, K2, K4, K5, K6, K10

***Navicula viridula* var. *germainii* (Wallace) Lange-Bertalot** (Figure 59)
Basionym: *Navicula germainii* Wallace
Ref: Hofmann et al. 2011 p.383-pl.37: 5-9
Dimensions: Valve 28.7-34.3 µm length, 6.9-7.8 µm width and 13-14 striae in 10 µm
Distribution in Küçük Menderes River Basin: K2, K10

***Navicula viridula* var. *rostellata* (Kützing) Cleve** (Figure 60)
Basionym: *Navicula rostellata* Kützing
Ref: Hofmann et al. 2011 p.397-pl.37: 10-14
Dimensions: Valve 37.9-42.5 µm length, 8.7-9.9 µm width and 11-12 striae in 10 µm
Distribution in Küçük Menderes River Basin: K10

***Nitzschia amphibia* Grunow** (Figure 61)
Ref: Hofmann et al. 2011 p.433-pl.117: 9-15
Dimensions: Valve 21.5-27.4 µm length, 3.9-4.7 µm width and 15-17 striae and 7-8 fibulae in 10 µm
Distribution in Küçük Menderes River Basin: K4, K5

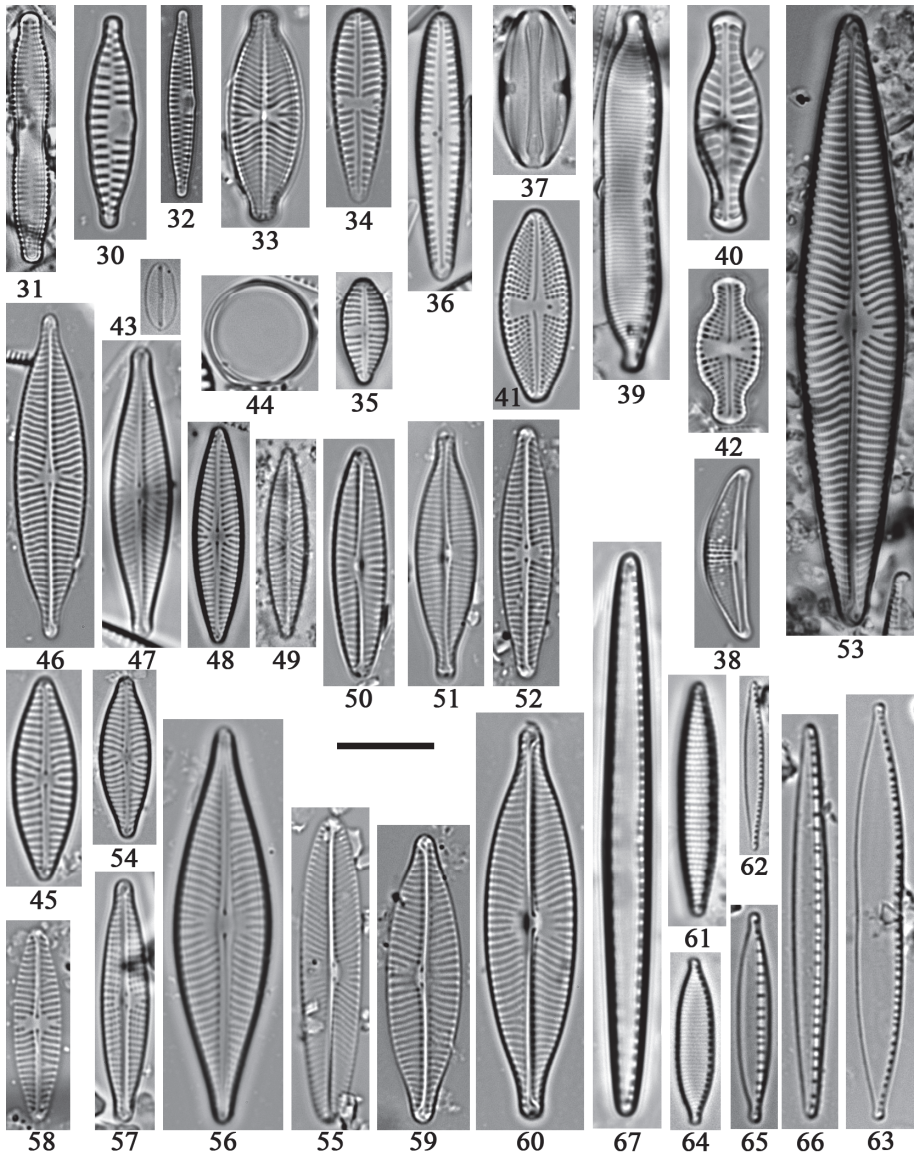
***Nitzschia archibaldii* Lange-Bertalot** (Figure 62)
Ref: Hofmann et al. 2011 p.438-pl.113: 11-16
Dimensions: Valve 14.7-25.4 µm length, 1.8-2.3 µm width and 16-19 striae and 7-8 fibulae in 10 µm
Distribution in Küçük Menderes River Basin: K2, K3, K10

***Nitzschia capitellata* Hust. in A. Schmidt** (Figure 63)
Ref: Hofmann et al. 2011 p.438-pl.113: 11-16
Dimensions: Valve 37.4-45.9 µm length, 3.9-5.1 µm width and 10-14 fibulae in 10 µm
Distribution in Küçük Menderes River Basin: K2, K3, K4, K10

***Nitzschia desertorum* Hustedt** (Figure 64)
Ref: Krammer & Lange-Bertalot 1988 p.98-pl.70: 10-13
Dimensions: Valve 16.4-17.1 4 µm length, 3.7-4.3 µm width and 25-26 striae and 14-15 fibulae in 10 µm
Distribution in Küçük Menderes River Basin: K2

***Nitzschia dissipata* (Kützing) Grunow** (Figure 65)
Ref: Hofmann et al. 2011 p.442-pl.109: 8-13
Dimension: Valve 13.4-23.2 µm length, 3.3-4.7 µm width and 8-10 fibulae in 10 µm
Distribution in Küçük Menderes River Basin: K9

***Nitzschia dissipata* var. *media* (Hantzsch) Grunow** (Figure 66)
Basionym: *Nitzschia media* Hantzsch
Ref: Hofmann et al. 2011 p.442-pl.109: 14-18
Dimensions: Valve 47.2-61.5 µm length, 4.2-5.1 µm width and 8-10 fibulae in 10 µm
Distribution in Küçük Menderes River Basin: K9




*Figures 30-67.* 30- *Fragilaria capucina vaucheriae*; 31- *F. mesolepta*; 32- *F. perminuta*; 33- *Geissleria decussis*; 34- *Gomphonema olivaceum*; 35- *G. parvulum*; 36- *G. pumilum*; 37- *Halamphora montana*; 38- *H. veneta*; 39- *Hantzschia amphioxys*; 40- *Hippodonta capitata*; 41- *Luticola geoppertiana*; 42- *L. ventricosa*; 43- *Mayamaea permitis*; 44- *Melosira varians* Agardh; 45- *Navicula antonii*; 46- *N. capitatoradiata*; 47- *N. cryptocephala*; 48- *N. cryptotenella*; 49- *N. cryptotenelloides*; 50- *N. erifuga*; 51- *N. gregaria*; 52- *N. notha*; 53- *N. radiosa*; 54- *N. reichardtiana*; 55- *N. simulata*; 56- *N. trivialis*; 57- *N. vandamii*; 58- *N. veneta*; 59- *N. viridula* var. *germainii*; 60- *N. viridula* var. *rostellata*; 61- *Nitzschia amphibia*; 62- *N. archibaldii*; 63- *N. capitellata*; 64- *N. desertorum*; 65- *N. dissipata*; 66- *N. dissipata* var. *media*; 67- *N. filiformis* Scale bar: 10µm.

***Nitzschia filiformis* (W.Smith) Van Heurck** (Figure 67)
Basionym: *Homoecladia filiformis* W.Smith
Ref: Hofmann et al. 2011 p.443-pl.116: 1-6
Dimensions: Valve 48.4-61.7µm length, 4.5-5.7 µm width and 8-10 fibulae in 10 µm
Distribution in Küçük Menderes River Basin: K9

***Nitzschia fonticola* (Grunow) Grunow in Van Heurck** (Figure 68)
Basionym: *Nitzschia palea* var. *fonticola* Grunow
Ref: Hofmann et al. 2011 p.444-pl.108: 9-15
Dimensions: Valve 27.2-35.4 µm length, 4.0-4.9 µm width and 24-28 striae in 10 µm
Distribution in Küçük Menderes River Basin: K1, K3

***Nitzschia frustulum* (Kützing) Grunow** (Figure 69)
Basionym: *Synedra frustulum* Grunow
Ref: Hofmann et al. 2011 p.445-pl.112: 28-34
Dimensions: Valve 14.7-21.3 µm length, 2.9-3.5 µm width and 21-24 striae and 10-12 fibulae in 10 µm
Distribution in Küçük Menderes River Basin: K9, K10

***Nitzschia inconspicua* Grunow** (Figure 70)
Ref: Hofmann et al. 2011 p.445-pl.112: 35-40
Dimensions: Valve 6.4-10.5 µm length, 2.5-2.9 µm width and 26-28 striae and 13-14 fibulae in 10 µm
Distribution in Küçük Menderes River Basin: K1, K4, K8, K9, K10

***Nitzschia linearis* (C.Agardh) W. Smith** (Figure 71)
Basionym: *Frustulia sociabilis* C.Agardh
Ref: Hofmann et al. 2011 p.558-pl.126: 1-5
Dimensions: Valve 45.4-62.7 µm length, 5.5-6.1 µm width and 10-12 fibulae in 10 µm
Distribution in Küçük Menderes River Basin: K1

***Nitzschia palea* (Kützing) W.Smith** (Figure 72)
Basionym: *Synedra palea* Kützing
Ref: Hofmann et al. 2011 p.454-pl.111:1-9
Dimensions: Valve 37.5-50.4 µm length, 3.6-3.9 µm width and 10-12 fibulae in 10 µm
Distribution in Küçük Menderes River Basin: K1, K2, K3, K4, K5, K6, K7, K10

***Nitzschia sociabilis* Hustedt** (Figure 73)
Ref: Hofmann et al. 2011 p.461-pl.111: 35-40
Dimensions: Valve 27.3-35.4 µm length, 3.2-3.7 µm width and 10-11 fibulae in 10 µm
Distribution in Küçük Menderes River Basin: K9

***Nitzschia umbonata* (Ehrenberg) Lange-Bertalot** (Figure 74)
Basionym: *Navicula umbonata* Ehrenberg
Ref: Hofmann et al. 2011 p.558-pl.126: 1-5
Dimensions: Valve 45.2-65.7 µm length, 6.5-7.8 µm width and 9-10 fibulae in 10 µm
Distribution in Küçük Menderes River Basin: K1, K2, K4, K5, K6

***Pantocsekiella ocellata* (Pantocsek) K.T.Kiss & Ács** (Figure 75)
Basionym: *Cyclotella ocellata* Pantocsek
Ref: Krammer & Lange-Bertalot 1991 p. 51-pl.50: 1-11; Wojtal & Kwandrans 2006 p.188-pl.7: 26-27
Dimensions: Valve diameter 8.2-10.4 µm. Valves have 16-18 interstriae in 10 µm
Distribution in Küçük Menderes River Basin: K8

***Planothidium lanceolatum* (Brébisson ex Kützing) Lange-Bertalot** (Figure 76)
Basionym: *Achnanthidium lanceolatum* Brébisson ex Kützing
Ref: Hofmann et al. 2011 p.510-pl.24: 41-47
Dimensions: Valve 15.1-18.4 µm length, 4.5-7.8 µm width and 12-14 striae in 10 µm
Distribution in Küçük Menderes River Basin: K1, K8

***Pseudofallacia monoculata* (Hustedt) D.G.Mann** (Figure 77)
Basionym: *Navicula monoculata* Hustedt
Ref: Hofmann et al. 2011 p.244-pl.46: 13-17
Dimensions: Valve 9.2-13.5 µm length, 4.2-5.1 µm width and 21-25 striae in 10 µm
Distribution in Küçük Menderes River Basin: K3, K10

***Pseudostaurosira brevistriata* (Grunow) D.M.Williams & Round** (Figure 78)
Basionym: *Fragilaria brevistriata* Grunow
Ref: Hofmann et al. 2011 p.258-pl.9: 25-29
Dimensions: Valve 13.2-17.8 µm length, 3.9-4.8 µm width and 14-16 striae in 10 µm
Distribution in Küçük Menderes River Basin: K8

***Reimeria sinuata* (Gregory) Kociolek et Stoermer** (Figure 79)
Basionym: *Cymbella sinuata* Gregory
Ref: Hofmann et al. 2011 p.526-pl.89: 50-61
Dimensions: Valve 12.5-15.4 µm length, 3.9-4.7 µm width and 12-15 striae in 10 µm
Distribution in Küçük Menderes River Basin: K1, K2, K7

***Sellaphora pupula* (Kützing) Mereschkovsky** (Figure 80)
Basionym: *Navicula pupula* Kützing
Ref: Hofmann et al. 2011 p.536-pl.41: 1, 2
Dimensions: Valve 21.4-27.5 µm length, 6.7-7.8 µm width and 20-24 striae in 10 µm
Distribution in Küçük Menderes River Basin: K1, K2, K3, K10

***Sellaphora radiosa* (Hustedt) H.Kobayasi** (Figure 81)
Basionym: *Navicula seminulum* var. *radiosa* Hustedt
Ref: Hofmann et al. 2011 p.533-pl.42: 27-31
Dimensions: Valve 10.5-13.7 µm length, 3.5-3.9 µm width and 19-21 striae in 10 µm
Distribution in Küçük Menderes River Basin: K5

***Sellaphora saprotolerans* Lange-Bertalot, Hofmann & Cantonati** (Figure 82)
Ref: Hofmann et al. 2011 p.536-pl.41: 6-10
Dimensions: Valve 27.2-28.4 µm length, 8.2-8.4 µm width and 18 striae in 10 µm
Distribution in Küçük Menderes River Basin: K1, K2, K10

***Sellaphora saugerresii* (Desmazières) C.E.Wetzel & D.G.Mann** (Figure 83)
Basionym: *Navicula suagerresii* Desmazières
Ref: Hofmann et al. 2011 p.201-pl.42: 37-43
Dimensions: Valve 4.5-10.8 µm length, 2.5-3.2 µm width and 26-32 striae in 10 µm
Distribution in Küçük Menderes River Basin: K1, K2, K3, K4

***Sellaphora seminulum* (Grunow) D.G.Mann** (Figure 84)
Basionym: *Navicula seminulum* Grunow
Ref: Hofmann et al. 2011 p.537-pl.42: 22-26
Dimensions: Valve 9.2-12.5 µm length, 3.5-4.2 µm width and 19-21 striae in 10 µm
Distribution in Küçük Menderes River Basin: K4, K5

***Stephanodiscus hantzschii* Grunow** (Figure 85)
Ref: Krammer & Lange-Bertalot 1991 p.73-pl.74:12-16, 75:4-11; Wojtal & Kwandrans 2006 p.199-pl.18: 3-8, 19: 1-9
Dimensions: Valve diameter 7.4-12.3 µm. There are 9-11 interstriae in 10 µm
Distribution in Küçük Menderes River Basin: K10

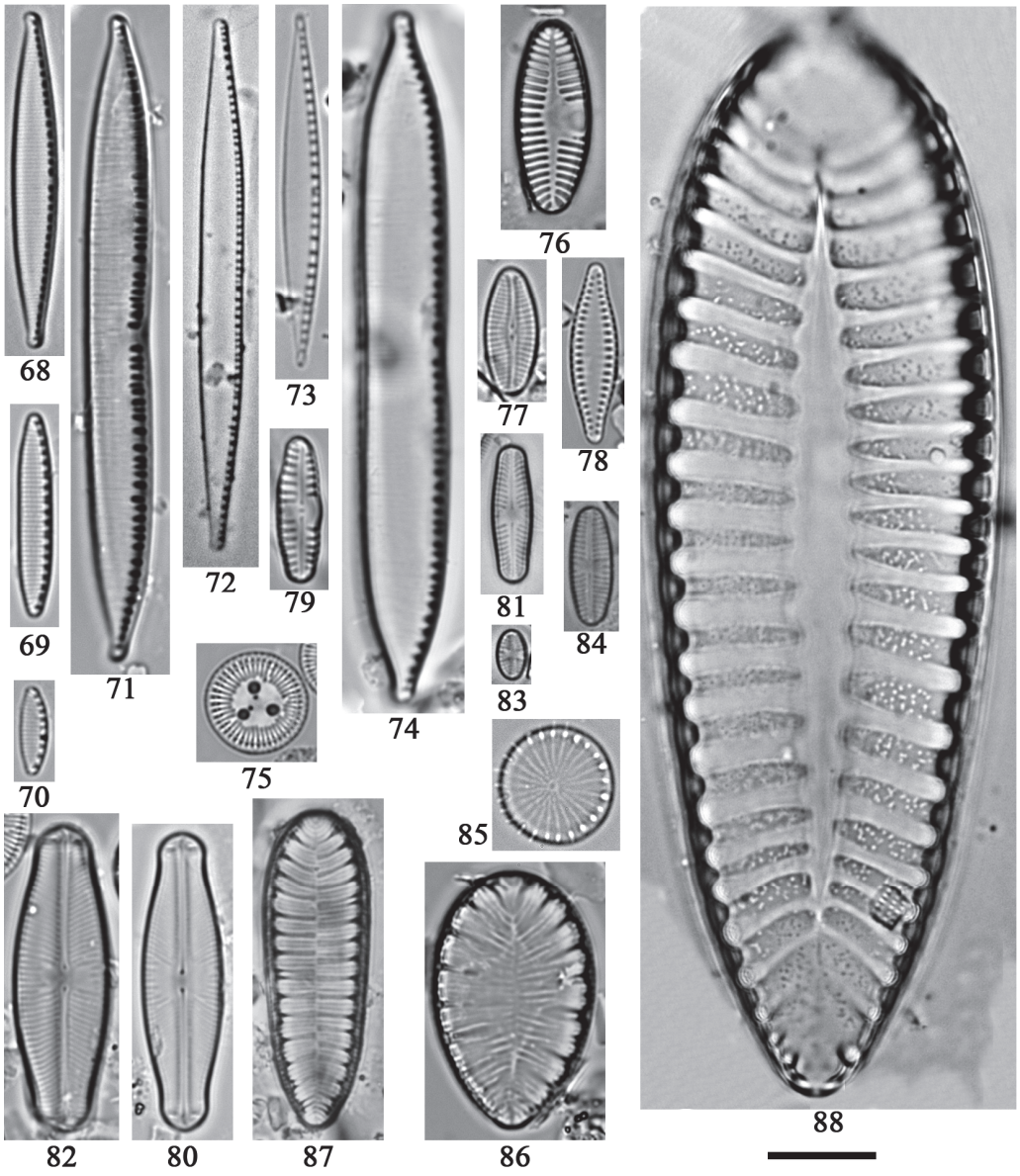
***Surirella brebissonii* Krammer et Lange-Bertalot** (Figure 86)
Ref: Hofmann et al. 2011 p.556-pl.130: 11-16
Dimensions: Valve 19.2-25.4 µm length, 13.2-15.4 µm width and 4-5 fibulae in 10 µm
Distribution in Küçük Menderes River Basin: K1, K2, K5

***Surirella minuta* Brébisson** (Figure 87)
Ref: Hofmann et al. 2011 p.558-pl.131: 6-12
Dimensions: Valve 25.4-29.3 µm length, 9.2-10.8 µm width and 6-7 fibulae in 10 µm
Distribution in Küçük Menderes River Basin: K2

***Surirella robusta* Ehrenberg** (Figure 88)
Ref: Hofmann et al. 2011 p.559-pl.127: 1, 2
Dimensions: Valve 98.8 µm length, 31.3 µm width and 3 fibulae in 10 µm
Distribution in Küçük Menderes River Basin: K1, K2, K10

***Tryblionella apiculata* Gregory** (Figure 89)
Ref: Hofmann et al. 2011 p.439-pl.104: 18-22
Dimensions: Valve 32.4-41.3 µm length, 4.9-6.1 µm width and 15-18 striae in 10 µm.
Distribution in Küçük Menderes River Basin: K2

***Tryblionella calida* (Grunow) D.G.Mann** (Figure 90)
Basionym: *Nitzschia calida* Grunow
Ref: Hofmann et al. 2011 p.437-pl.103: 5-8
Dimensions: Valve 34.3-37.5 µm length, 6.2-7.4 µm width and 12 fibulae in 10 µm
Distribution in Küçük Menderes River Basin: K2




*Figures 68-88*. 68- *Nitzschia fonticola*; 69- *N. frustulum*; 70- *N. inconspicua*; 71- *N. linearis*; 72- *Nitzschia palea*; 73- *N. sociabilis*; 74- *N. umbonata*; 75- *Pantocsekiella ocellata*; 76- *Planothidium lanceolatum*; 77- *Pseudofallacia monoculata*; 78- *Pseudostaurosira brevistriata*; 79- *Reimeria sinuata*; 80- *Sellaphora pupula*; 81- *S. radiosa*; 82- *S. saprotolerans*; 83- *S. saugerresii*; 84- *S. seminulum*; 85- *Stephanodiscus hantzschii*; 86- *Surirella brebissonii*; 87- *S. minuta*; 88- *S. robusta*. Scale bar: 10µm.

***Ulnaria acus* (Nitzsch) P.Compère** (Figure 91)
Basionym: *Bacillaria ulna* Nitzsch
Ref: Hofmann et al. 2011 p.256-pl.5: 1-5
Dimensions: Valve 80.5-92.3 µm length, 3.9-4.2 µm width and 13-15 striae in 10 µm
Distribution in Küçük Menderes River Basin: K8

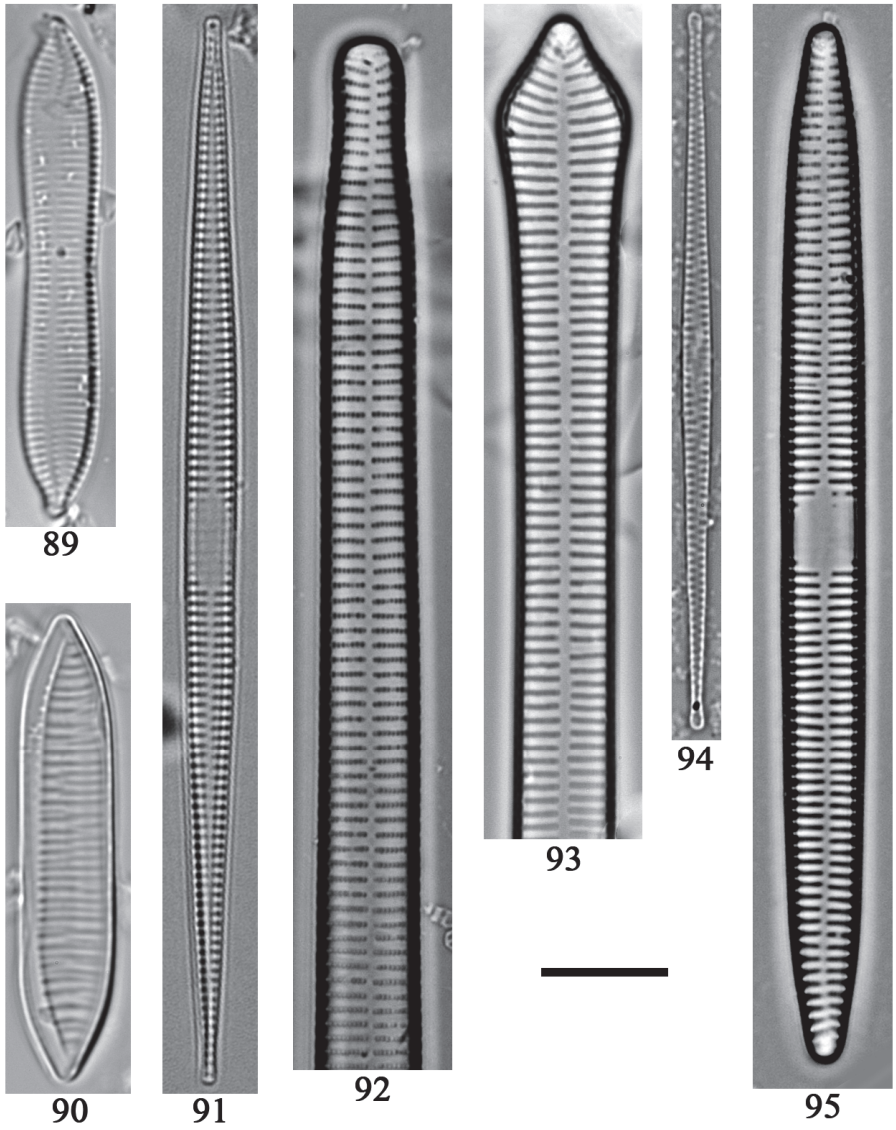
***Ulnaria biceps* (Kützing) P.Compère** (Figure 92)
Basionym: *Synedra biceps* Kützing
Ref: Krammer & Lange-Bertalot 1991 p.146-pl.121: 1-5
Dimensions: Valve 7.3-7.9 µm width and 8-9 striae in 10 µm
Distribution in Küçük Menderes River Basin: K5, K7, K8

***Ulnaria capitata* (Ehrenberg) Compère** (Figure 93)
Basionym: *Synedra capitata* Ehrenberg
Ref: Hofmann et al. 2011 p.277-pl.6: 1-3
Dimensions: Valve 7.2-7.6 µm width and 8-10 striae in 10 µm
Distribution in Küçük Menderes River Basin: K8

***Ulnaria delicatissima* (W.Smith) M.Aboal & P.C.Silva** (Figure 94)
Basionym: *Synedra delicatissima* W.Smith
Ref: Hofmann et al. 2011 p.262-pl.7: 1-6
Dimensions: Valve 47.2-58.4 µm length, 2.3-3.1 µm width and 14-15 striae in 10 µm
Distribution in Küçük Menderes River Basin: K6, K8

***Ulnaria ulna* (Nitzsch) P.Compère** (Figure 95)
Basionym: Bacillaria ulna Nitzsch
Ref: Hofmann et al. 2011 p.276-pl.5: 6-11
Dimensions: Valve 64.3-82.4 µm length, 5.7-6.5 µm width and 10-12 in 10 µm
Distribution in Küçük Menderes River Basin: K1

Among the taxa, *Nitzschia palea* was abundant in K1 and K3 stations; *Sellaphora pupula* was abundant is K2 station; *Navicula veneta* was abundant in K4; *Craticula accomoda* and *C. subminuscula* were abundant in K5 station; *Achnanthidium minutissimum* was abundant in K7; *Ulnaria delicatissima* was abundant in K8; *Cymbella excisa* was abundant in K9, *Melosira varians* and *Nitzschia frustulum* were abundant in K10.




*Figures 89-95.* 89- *Tryblionella apiculata*; 90- *T. calida*; 91- *Ulnaria acus*; 92- *U. biceps*; 93- *U. capitata*; 94- *U. delicatissima*; 95- *U. ulna*. Scale bar: 10µm.

Regarding to the ecological status of the water bodies investigated in this study, abundant taxa like *Craticula accomoda, Navicula veneta* or *Nitzschia palea* were found as good indicators for polluted waters (Lange-Bertalot et al. 2017) and the presence of these taxa indicated that the most of the sampling stations were affected by pollution.

On the other hand, there are some differences between Turkish inland waters and water bodies in this study in terms of the distribution of the taxa. *Craticula melostiformis, Cyclostephanos dubius, Encyonopsis minuta, E. subminuta, Gomphonema pumilum, Halamphora montana* and *Mayameae permitis* were rarely found in Turkey (Gönülol, 2017) but commonly encountered in this study. Similarly, *Craticula melostiformis, Gomphonema pumilum* and *Mayamaea permitis* were newly recorded for Turkish freshwater diatom flora. The results point out that the taxa mentioned above might be common in Turkish waters but further studies might be needed to present the distribution of these taxa in Turkish freshwaters in detail and reveal the big picture.

In Turkey, common diatoms are given in the articles in the studies. However, hardly any results for rare taxa can be found in the articles. On the other hand, new records and rare species are important to observe the community structure and flora of a country and to uncover the potential indicator values of the species for monitoring studies (Potapova and Charles, 2004). In this regard, some taxa were found as new records for Turkish diatom flora namely *Achnanthidium eutrophilum, A. minutissimum* var. *jackii, Navicula simulata, N. vandamii, Nitzschia archibaldii, N. desertorum* and *Sellaphora saprotolerans*.

Biological monitoring studies that carried out in different river basins of Turkey are important in terms of ecosystem based evaluation of water quality. On the other hand, these studies make a great contribution to flora and fauna studies. Biological, physicochemical and chemical monitoring is carried out simultaneously in many water bodies which have not been monitored until today and getting information on the distribution and environmental needs of the species. Establishment of visual catalogues of the species which including information about dimensions and distrubiton for each river basin will greatly contribute to monitoring studies. In this way, identification process will be easier and ecological status of the water bodies can be assessed more quickly.

## Discussion and Conclusion

In this study, 94 taxa were identified in total. Among the taxa; *Achnanthidium minutissimum, Adlafia minuscula, Amphora pediculus, Cocconeis pediculus, Craticula accomoda, C. cuspidata, C. subminuscula, Cyclotella meneghiniana, Cymbella cymbiformis, C. parva, Cymbopleura amphicephala, Diatoma moniliformis, Encyonema caespitosum, E. ventricosum, Encyonopsis microcephala, Fallacia pygmeae, Fragilaria capucina* var. *vaucheria, F. mesolepta, Geissleria decussis, Gomphonema olivaceum, G. parvulum, Halamphora veneta, Hantzschia amphioxys, Hippodonta capitata, Melosira varians, Navicula capitatoradiata, N. cryptocephala, N. cryptotenella, N. gregaria, N. radiosa, N. trivialis, N. veneta, N. viridula var. rostellata, Nitzschia amphibia, N. capitellata, N. dissipata, N. dissipata var. media, N. filiformis, N. fonticola, N. frustulum, N. inconspicua, N. linearis, N. palea, N. umbonata, Pantocsekiella ocellata, Planothidium lanceolatum, Pseudostaurosira brevistriata, Reimeria sinuata, Sellaphora pupula, S. saugerresii, Stephanodiscus hantzschii, Surirella brebissonii, S. minuta, S. robusta, Tryblionella apiculata, Ulnaria acus, U. biceps, U. capitata, U. delicatissima* and *Ulnaria ulna* were common taxa in Turkish diatom flora (Gönülol, 2017).

## Acknowledgement

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## Extended Turkish Abstract
## (Genişletilmiş Türkçe Özet)

### Küçük Menderes Nehir Havzası'nda Bentik Diyatome (Fitobentoz) Kompozisyonunun Dağılımı

Avrupa Birliği Su Çerçeve Direktifi'nin (2000/60/AT) (SÇD) Avrupa'da 2000 yılında yürürlüğe girmesiyle birlikte su kalitesinin geleneksel yöntemlerle fizikokimyasal ve kimyasal olarak izlenmesi anlayışı yerini biyolojik izlemenin ön planda yer aldığı ekosistem esaslı izlemeye bırakmıştır. Avrupa Birliği Üye Devletleri fitobentoz, fitoplankton, makrofit, balık, makroomurgasız, makroalg ve angiosperm gibi birçok biyolojik kalite bileşenini nehir, göl, kıyı ve geçiş suyu kütlelerinde ekosistem esaslı değerlendirme maksadıyla izlemeye başlamıştır. Fizikokimyasal ve kimyasal izleme çalışmaları ile su kütlesinin sadece ölçüm yapılan andaki kalitesi belirlenirken, biyolojik kalite bileşenleri ile yapılan izleme çalışmaları sonucunda su kütlesinin uzun süreli durumu hakkında bilgi edinilebilmektedir.

Türkiye'de Su Çerçeve Direktifi'nin uyumlaştırılması çalışmaları 2011 yılında Orman ve Su İşleri Bakanlığı Su Yönetimi Genel Müdürlüğü'nün kurulmasıyla birlikte hız kazanmıştır. Türkiye'de ilk defa SÇD kapsamında havza bazında izleme çalışmaları Su Yönetimi Genel Müdürlüğü tarafından yürütülmüş "Havza İzleme ve Referans Noktaların Belirlenmesi Projesi" ile Akarçay, Meriç-Ergene, Susurluk, Gediz ve Sakarya nehir havzalarında gerçekleştirilmiş ve ardından bu çalışmanın kaynağını oluşturan Küçük Menderes Nehir Havzası ve ayrıca Kızılırmak, Marmara, Antalya ve Konya nehir havzaları ile izleme çalışmalarına devam edilmiştir. "Ülkemize Özgü Su Kalitesi Ekolojik Değerlendirme Sisteminin Kurulması Projesi" ile Türkiye'nin farklı coğrafi ve iklim koşullarına sahip nehir havzalarında (Batı Akdeniz, Batı Karadeniz, Doğu Karadeniz, Kuzey Ege, Ceyhan, Sakarya, Aşağı Fırat ve Aras) yapılan izleme çalışmaları ile ülkemize özgü indeksler belirlenmiştir. "Türkiye'de Referans İzleme Ağı'nın Kurulması Projesi" ile Türkiye'nin 25 nehir havzasının tamamında yapılacak izlemeler ile referans izleme noktalarının belirlenmesi çalışmalarına devam edilmektedir.

Küçük Menderes Nehir Havzası, Türkiye'nin batısında Büyük Menderes ile Gediz nehir havzaları arasında yer almaktadır. Türkiye'nin yüzey alanının yaklaşık %1'ini oluşturan havzanın sularını Ege Denizi'ne ulaştırması sebebiyle kıyı ve geçiş suyu kütleleri bulunmaktadır. SÇD kapsamında fitobentoz kalite bileşeninin sadece nehir ve göl suyu kütlelerinde izlenmekte olup, bu çalışmada Küçük Menderes Nehir Havzası'nda bulunan 7 nehir suyu kütlesi ve 3 baraj gölünde (Tahtalı, Beydağı, Alaçatı) yapılan fitobentoz izlemesi gerçekleştirilmiştir.

Fitobentoz, mikroskobik ve tek hücreli canlılardan 2 m'den uzun makrofitlere kadar tüm fototrofik canlıları kapsamaktadır. Fitobentoza yönelik pratik değerlendirme metotlarının eksikliğinden dolayı Avrupa Birliği Üye Devletleri fitobentozun en önemli göstergesi olan diyatomeleri izlemektedir. Fitobentozun en önemli göstergesi olan diyatomeler ile ilgili pek çok çalışma olmasına rağmen diyatome kompozisyonun dağılımı Türkiye'de halen yeni bir konudur. Bu çalışmada, Küçük Menderes Nehir Havzası'nda bentik diyatome kompozisyonunun dağılımının araştırılması amaçlanmıştır. 2014 yılı içerisinde Mayıs, Temmuz ve Eylül aylarında mevsimsel olarak epilitik ve epipelik diyatome örnekleri toplanmıştır. Epilitik diyatomeler nehir yatağında yer alan taşların fırçalanmasıyla, epipelik örnekler ise pipet yardımıyla sedimentten örneklenmiştir. Diyatome früstüllerinden organik maddenin uzaklaştırılması maksadıyla $H_2O_2$ ve HCL kullanılmış ve Naphrax solüsyonu kullanılarak daimi preparatlar hazırlanmıştır. Diyatomeler mikroskop yardımıyla incelenmiş ve taksonomik literatüre göre teşhis edilmiştir. Her bir preparatta ortalama 400 birey sayılmıştır. Teşhis edilen türlerin uzunluk,

genişlik ve 10 µm'deki stria sayıları raporlanmış ve türlerin görsel katalogları oluşturulmuştur. Türlerin Küçük Menderes Nehir Havzası'nda yer alan istasyonlardaki durumu ve Türkiye florasındaki durumu karşılaştırılmıştır.

Toplamda 94 bentik diyatome türünün teşhis edildiği çalışmada kirli suların indikatörü olan *Nitzschia palea* (Kützing) W.Smith, *N. inconspicua* Grunow, *N. umbonata* (Ehrenberg) Lange-Bertalot, *Craticula accomoda* (Hustedt) DG Mann, *C. subminuscula* (Manguin) C.E.Wetzel & L.Ector ve *Navicula veneta* Kützing en yaygın türler olmuştur. Türkiye diyatome florasında yaygın olarak bulunan *Achnanthidium minutissimum, Cocconeis pediculus, Craticula accomoda, C. subminuscula, Cyclotella meneghiniana, Encyonema ventricosum, Gomphonema parvulum, Halamphora veneta, Navicula capitatoradiata, N. cryptocephala, N. gregaria, N. veneta, Nitzschia capitellata, N. inconspicua, N. palea, N. umbonata, Reimeria sinuata, Sellaphora pupula, S. saugerresii, Surirella brebissonii, S. robusta* türlerinin Küçük Menderes Havzası'nda yaygın olarak teşhis edilmesi sebebiyle Türkiye diyatome florası ile benzerlik göstermiştir.

Diğer yandan, *Craticula melostiformis, Cyclostephanos dubius, Encyonopsis minuta, E. subminuta, Gomphonema pumilum, Halamphora montana* ve *Mayameae permitis* türleri Türkiye'de nadir olarak bulunan türler olurken bu çalışmada yaygın olarak teşhis edilmiştir. *Achnanthidium eutrophilum* (Lange-Bertalot) Lange-Bertalot, *A. minutissimum* var. *jackii* (Rabenhorst) Lange-Bertalot, *Navicula simulata* Manguin, *N. vandamii* Schoeman & Archibald, *Nitzschia archibaldii* Lange-Bertalot, *N. desertorum* Hustedt ve *Sellaphora saprotolerans* Lange-Bertalot, Hofmann & Cantonati türleri ise Türkiye diyatome florası için 7 yeni kayıt olmuştur. Bu türler arasında yer alan *Achnanthidium eutrophilum* ve *Nitzschia archibaldii* türleri Merkez Avrupa'da ve Almanya'da yaygın olarak görülürken *Navicula vandamii* türüne Almanya'da bulunan durgun sularda sık rastlanmaktadır.

Türkiye'de nehir havzalarında yürütülen biyolojik izleme faaliyetleri, su kalitesinin ekosistem esaslı olarak değerlendirilmesi açısından önemli çalışmalardır. Bu çalışmalar diğer bir yandan Türkiye flora ve faunası çalışmalarına da büyük katkı sağlamaktadır. Bugüne kadar izleme yapılmamış birçok su kütlesinde biyolojik, fizikokimyasal ve kimyasal izleme eş zamanlı olarak yapılmakta ve türlerin dağılımı ile türlerin çevresel istekleri hakkında bilgi edinilmektedir. Biyolojik izleme çalışmaları neticesinde teşhis edilen türlere ait ölçüm bilgilerinin ve havza bazında görsel katalogların oluşturulması izleme çalışmalarına büyük katkı sağlayacaktır. Bu sayede havza bazında yürütülen teşhis çalışmaları biraz daha kolaylaşacak ve böylece su kalitesinin ekolojik durumu daha hızlı bir şekilde değerlendirilebilecektir.