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New Records for the Turkish Freshwater Algal Flora in Twenty Five River Basins of Türkiye, Part I: Bacillariophyta

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ABSTRACT

The present study aimed to contribute to the algal flora of Türkiye by Bacillariophyta (diatom) as new records for the Turkish freshwater. Phytobenthos and phytoplankton were sampled three times (spring, summer, and autumn) a year between 2017 and 2019. Samples of the phytoplankton were collected with a water sampler from three depths, and samples of diatoms were obtained as epiphytic in the littoral zone of the lakes. However, if macrophytes were absent, epilithic or epipelic diatoms were sampled in lakes. Also, samples of phytobenthos were preferred as epilithic in rivers. However, if stones were absent, epiphytic or epipelic diatoms were sampled. During the studied period, a total of 895 diatom taxa were determined as planktonic (378 taxa) and benthic (860 taxa) in lakes and rivers of 25 river basins of Türkiye, and a total of 39 new records were identified. The highest diatom taxa were determined in the Fırat-Dicle, Konya, Antalya, and Büyük Menderes basins with 11, 11, 10, and 6 taxa, respectively. On the other hand, new records were not detected in 10 basins.

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Türkiye'deki 25 Nehir Havzasından Türkiye Tatlı Su Alg Florası İçin Yeni Kayıtlar, Bölüm I: Bacillariophyta

ÖZET

Bu çalışma, Türkiye'nin tatlı su alg florası için Bacillariophyta (diatom) ait yeni kayıt olarak katkıda bulunmayı amaçlanmıştır. Fitobentoz ve fitoplankton örneklemeleri, 2017 ve 2019 yılları arasında yılda üç kez (ilkbahar, yaz ve sonbahar) yapıldı. Göllerdeki Fitoplanktonun örneklemesi, üç derinlikten su örnekleyici ile toplanırken, diatom örnekleri göllerin littoral bölgesinde epifitik olarak elde edildi. Bununla birlikte, makrofitin bulunmadığı göllerde diatom örneklemeleri epilitik ve epipelik olarak yapıldı. Ayrıca, nehirlerdeki fitobentoz örneklemesi epilitik olarak yapılırken, taşın bulunmadığı nehirlerde epifitik veya epipelik olarak örneklenmiştir. Çalışma süresince, Türkiye'nin 25 nehir havzasına ait göl ve nehirlerde planktonik (378 takson) ve bentik (860 takson) olmak üzere toplam 895 belirlenmiş ve toplam 39 yeni kayıt teşhis edilmiştir. En yüksek diatom taksonlarının sırasıyla 11, 11, 10 ve 6 taksonla; Fırat-Dicle, Konya, Antalya ve Büyük Menderes havzalarında belirlenmiştir. Bununla birlikte, 10 havzada yeni kayıta rastlanılmamıştır.

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INTRODUCTION

Diatoms (unicellular siliceous algae, Bacillariophyta) are the most diverse photosynthetic eukaryotic microorganisms that are distributed worldwide in nearly all aquatic ecosystems (Round et al., 1990; Taxböck et al., 2020). Their ecological requirements are very different (Round et al., 1990), and their diversity can alter according to the environmental conditions (Ács et al., 2004). They are the important indicators in studies of climate change, acidic precipitation, water pollution, and water quality (Smol and Stoermer, 2010). For most of the diatom species it was thought that they are widespread, and even cosmopolitan in their spatial distribution (Kristiansen, 1996; Finlay and Clarke, 1999). However, in recent studies, a lot of studies support that they exhibit a biogeography (Bouchard et al., 2004; Vyverman et al., 2007). Diatom diversity can be influenced by several factors such as habitat availability, habitat area, the evolutionary history of lineages and regions, geogenic variables, hydrological stability, dispersal limitation, migration, and the cumulative effects of stochastic variation (Hubbell, 2001; Martiny et al., 2006; Cantonati and Lange-Bertalot; 2006, Telford et al., 2006; Cantonati and Spitale, 2009; Karger et al., 2011; Kraft et al., 2011; Lessard et al., 2012; Teittinen et al., 2017). The number of studies should be increased for the better understand of the biogeography of diatoms and the factors affecting their distribution.

In Türkiye, more than 300 taxonomical and ecological studies about diatoms have been reported (Solak et al., 2012; Taşkın et al., 2019). In these studies, planktonic diatoms in lakes have received more attention, while epilithic and epipelic communities were other mostly studied groups especially in rivers (Solak et al., 2012). In recent years, due to the increase of water quality assessment projects, several studies were done using diatom indices (e.g., Sevindik and Kucuk, 2016; Çelekli et al., 2018; Şanal and Demir, 2019; Çetin and Demir, 2019; Tokatlı et al., 2019; Solak et al., 2020; Maraşlıoğlu and Bektaş 2022). Until now, 1848 diatom taxa including brackish water species were recorded in the freshwater algal flora of Türkiye (Taşkın et al., 2019; Maraşlıoğlu and Gönülol, 2021), and 101 new diatom records were given in recent years (Baykal et al., 2009; Sevindik et al., 2011; Solak et al., 2016; Maraşlıoğlu and Soylu, 2018; Şahin and Akar 2018; Varol et al., 2018; Ayça Oğuz et al., 2020; Solak et al., 2021; Şahin 2022).

Due to Türkiye's European Union accession process, several projects have been implemented and funded by Directorate-General for Water Management (DGWM) and the General Directorate of State Hydraulic Works (DSİ) of the Ministry of Agriculture and Forestry specified for biological quality components. This study is one of the outcomes of the "Establishment of Reference Monitoring Network in Türkiye" project, financially and technically supported by DGWM. In this project, 275 lakes and 586 rivers in 25 river basins were studied, and a total of 1363 phytoplankton taxa and 860 phytobenthos taxa were detected. A total of 895 diatoms (Bacillariophyta) taxa were recorded as planktonic (378 taxa) and benthic (860 taxa). The present study aimed to contribute to the algal flora of Türkiye by describing 39 taxa in Bacillariophyta as new records for the Turkish freshwater algal flora. By contributing to the diatom flora in Türkiye together with the data obtained from this study, a database will be established for future diatom biogeography studies. For this reason, the distribution of the newly identified taxa in the Turkish basins was also given.

MATERIALS and METHODS

Study Area

As a consequence of the intersection of different climate types, noticeable altitude differences, and the position of the mountains relative to the Mediterranean, Aegean, and Black Seas, there are 7 different climatic zones in Türkiye (Solak et al., 2012). Therefore, the average annual temperature and precipitation values are very diverse in different regions (Anonymous, 2004). For instance, the average annual precipitation ranges from 200 mm in Central Anatolia to 2500 mm in the north-eastern coastal area of the Black Sea (Şensoy et al., 2008). Thus, water availability varies in the basins depending on the geographical size of the river basins and the average annual precipitation and temperature values (Akın and Akın, 2007). The Fırat-Dicle Basin is the largest single volume of available exploitable freshwater resources (28.5%) (Foreign Relation Office of DSİ 2014).

Türkiye has 25 river basins (Figure 1), and the names of the basins are usually referred to by the name of the greatest river they contain. Türkiye has 107 major rivers (Solak et al., 2012). Most of Türkiye 's rivers are

found in the Black Sea Region. These are Çoruh, Yeşilırmak, Kızılırmak, and Sakarya. All these rivers flow into the Black Sea. The longest river (1,355 km) in Türkiye is Kızılırmak. The most important streams flowing into the Mediterranean Sea are the Asi, Seyhan, Göksu, and Ceyhan rivers. Meriç, Küçük Menderes, and Büyük Menderes are the rivers flowing into the Aegean Sea (Şahin, 2010). River basins in Türkiye consist of 200 natural lakes, 806 reservoirs, and 1000 ponds (Foreign Relation Office of DSİ, 2014). Burdur, Susurluk, Van Lake, and Konya are important basins where the natural lake numbers are high (Hoşgören, 1994). However, in the last century, as a result of climate change and improper usage of groundwaters, decreases have been observed in the area and depth of natural lakes (i.e. Tuz, Akşehir, Beyşehir) (Solak et al., 2012).

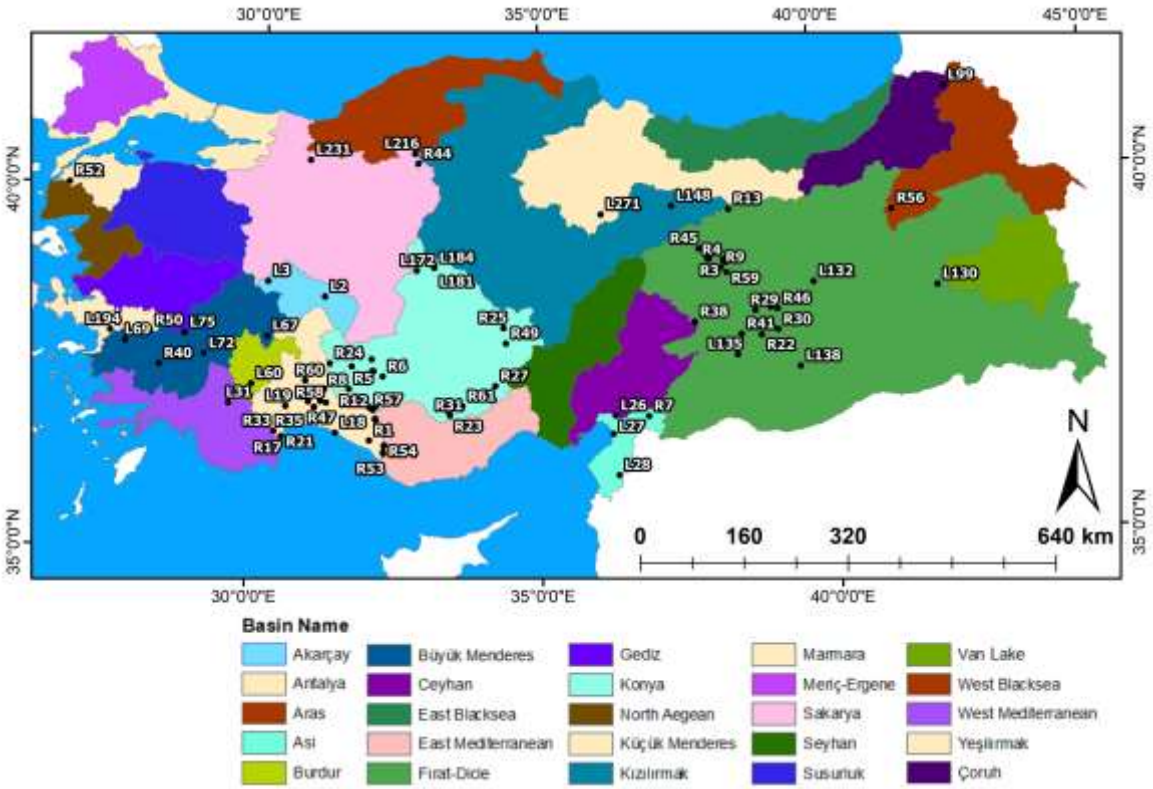

Figure 1. River Basins of Türkiye (L: Lake, R: River) and locations of the newly described taxons
Şekil 1. Türkiye'nin nehir havzaları ve yeni tanımlanan taksonların yerleri (L: Göl, R: Nehir)

Sampling and Identification:

Phytoplankton was sampled three times (spring, summer, and autumn) a year in 2017, 2018, and 2019 at the one, two, or three monitoring stations in each lake. The number of stations to be sampled were determined as one station for lakes that have a surface area smaller than 50 ha, two stations for lakes having a surface area between 50 and 500 ha, and three stations for lakes with a surface area higher than 500 ha (Anonymous, 2015). One of the selected stations was determined at the deepest point of the lake. In 275 lakes, samples of the phytoplankton were collected with a 1 L Hydrobios water sampler from the euphotic zone (Secchi disk depth × 2.5). Plankton net with a pore diameter of 50 µm was also used for collecting quantitavive samples of phytoplankton. All samples were fixed with Lugol's solution.

In each lake, phytobenthos was sampled three times (spring, summer, and autumn) a year in 2017, 2018, and 2019 at the one, two, or three monitoring stations. Samples were obtained in the littoral zone of the lakes, near the stations which were selected for phytoplankton sampling. Epiphytic diatoms were preferred, however, if macrophytes were absent, epilithic or epipelic diatoms were sampled. In each river, phytobenthos was sampled three times (spring, summer, and autumn) a year in 2017, 2018, and 2019. Epilithic diatoms were preferred in rivers, however, if stones were absent, epiphytic or epipelic diatoms were sampled. For epilithic diatoms, at least five stones were randomly selected and the upper surface of the stones was brushed with the bristle brush in 100 mL of distilled water. For epiphytic diatoms, generally, hard-surfaced macrophytes such as reeds were selected, and submerged leaves or stems were brushed in 100 mL of distilled water. For epipelic diatoms, samples were collected from the most superficial layer (~10mm in depth) of the sediment using a core sampler (3 cm in diameter) (EN 15708, 2004). All samples were fixed with Lugol's solution.

Laboratory Analysis:

In the laboratory, diatom samples were cleaned with hydrochloric acid and hot hydrogen peroxide, and permanent slides were mounted with Naphrax according to EN 15708 (2004). The diatom taxa were identified by using different types of compound microscopes (1000 × magnifications) in different laboratories according to the identification books of Krammer and Lange-Bertalot (1986; 1991a; 1991b; 1999) and Krammer (2003). Identified taxa were checked with the checklist of Aysel (2005), Taşkın et al. (2019), and the database of Turkish algae (Maraşlıoğlu and Gönülol, 2021), and then determined as new taxa for Turkish freshwater algal flora. The currently accepted nomenclature and distribution of taxa have been given according to Guiry and Guiry (2021). The new records were photographed with the cameras attached to the microscopes.

RESULTS and DISCUSSION

During the studied period, a total of 895 diatom taxa were recorded as planktonic (378 taxa) and benthic (860 taxa), and 39 of them were found as new records (Table 1). The information about their dimensions, habitat, ecology and locations were given in Table 2. Their images were shown in Figure 2-4.

During the three years, 39 new records in 21 genera have been identified in the 15 basins among 25 river basins in Türkiye. The genera best shown in terms of species richness were *Gomphonema* (6) and *Pinnularia* (4). The majority of the new records were determined to belong to the Cymbellales (13 taxa) and Naviculales (16 taxa) orders, respectively. On the other hand, Cocconeidales and Eunotiales members were represented with 4 and 2 taxa, respectively. Moreover, species belonging to each of the Surirellales, Thalassiosirales, and Thalassiophysales orders have been identified.

In the basins, 19 taxa were only found in lakes, while 10 of them were found only in rivers and 10 of them were distributed in both lakes and rivers. The insufficient diatom research in lakes compare to river studies in **Türkiye** (Solak et al., 2012) is probably the main reason why more new records were found in lakes during in this study.

Rare species constituted 36.4% of 39 new records, while 63.6% of them are the species that are widely distributed in the world. *Achnanthidium rostropyrenaicum*, *Cocconeis pseudolineata*, *Craticula paramolesta*, *Cymbella exigua*, *Encyonema bipartitum*, *Encyonema lapponicum*, *Fallacia gemmifera*, *Gomphonema angustivalva*, *Gomphonema parvuliforme*, *Gomphonema pratense*, *Halamphora paraveneta*, *Navicula supergregaria*, *Pinnularia neohalophila*, *Sellaphora japonica*, *Surirella lacrimula* were identified as rare taxa (Guiry and Guiry, 2021). Rare species were distributed in Antalya, Fırat-Dicle, Konya, Marmara, Burdur, Sakarya, Yeşilırmak, Büyük Menderes, Küçük Menderes and Kızılırmak basins. 10 rare species were found only in one station, while 4 of them were distributed in different stations in one basin. Only *C. pseudolineata* and *G. angustivalva* were reported in different stations of the Antalya, Konya, and Fırat-Dicle basins. Therefore, we can conclude that the distribution area of these two species is wider in Türkiye.

The highest number of new records were found in both river and lake habitats with freshwater features in Fırat-Dicle (11 taxa), Konya (11 taxa), Antalya (10 taxa), and Büyük Menderes (6 taxa) basins. Due to its large geographical area and high-altitude differences (Şahin, 2010), the number of new records was found higher in the Fırat-Dicle basin. Moreover, relatively less studies were done in that region previously (Solak et al., 2012; Taşkın et al., 2019; Maraşlıoğlu and Gönülol, 2021). Although the majority of the species were detected in freshwater habitats, *Fallacia gemmifera*, *Navicula supergregaria*, and *Thalassiosira baltica* were found in brackish lake habitats. These species have been reported in marine and brackish habitats of Europe, Asia, the Arctic, North America, South America, the Atlantic Islands, and Australia (Rumrich et al., 2000; Guiry and Guiry, 2021). *T. baltica* has also been reported as a short life span, fast-growing, high environmentally tolerant, and invasive species (Ricciardi and Rasmussen, 1998; Edlund et al., 2000).

Seven species (*Brachysira neglectissima*, *Cymbopleura kuelbsii*, *Encyonema bipartitum*, *Encyonema lapponicum*, *Navicula supergregaria*, *Neidium densestriatum*, *Pinnularia grunowii*) identified in this study have been reported as sensitive in terms of water quality indicators (Van Dam et al., 1994; Wojtal, 2009; Hofmann et al., 2011). However, the majority of the species that were reported as new records in this study have been indicated as tolerant or resistant to pollution (Van Dam et al., 1994; Wojtal 2009; Hofmann et al., 2011). The distribution of the diatoms in different water quality levels of the lakes or rivers in the basins must be investigated.

CONCLUSION

As a result, 39 new records were reported for the freshwater algal flora of **Türkiye** with this study, and it was observed that these taxa were distributed in different regions in the world. The number of new diatom records for the algal flora of **Türkiye** is expected to increase in the future.

Table 1. Number of studied lakes and rivers in 25 river basins
Çizelge 1. 25 nehir havzasında incelenen göl ve nehir sayısı

	River Basins	Number of Locations		Number of Taxa		New Records			Locations of New Records	
		Lakes	Rivers	Lakes	Rivers	Lakes	Rivers	Number of Taxa*	Lakes**	Rivers***
2017	**Antalya**	9	36	144	236	5	23	10	L12, L15, L17, L18, L19	R1, R8, R14, R15, R16, R17, R18, R19, R21, R32, R33, R34, R35, R37, R39, R43, R44, R48, R54, R55, R59, R61
	Büyük Menderes	13	32	150	170	5	2	6	L67, L68, L69, L72, L75	R51, R40
	Gediz	6	28	63	101	-	-	-	-	-
	Konya	18	39	208	248	7	13	6 (11)	L4, L6, L10, L12, L13, L27, L28, L38	R5, R6, R10, R11, R12, R23, R24, R25, R27, R31, R50, R58, R62
	Küçük Menderes	6	13	98	101	1	-	1	L194	-
	North Aegean	5	19	198	158	-	-	-	-	-
	Susurluk	9	23	63	60	-	-	-	-	-
	Western Mediterranean	13	44	108	132	1	-	1	L31	-
2018	**Akarçay**	10	17	153	157	2	-	2	L2, L3	-
	Burdur	6	11	86	63	1	-	1	L60	-
	East Blacksea	7	18	47	57	-	-	-	-	-
	Kızılırmak	23	23	122	79	1	-	1	L148	-
	Marmara	9	9	113	84	-	1	1	-	R53
	Meriç-Ergene	5	6	96	65	-	-	-	-	-
	Sakarya	23	36	79	76	5	1	3	L19, L39	R45
	Yeşilırmak	14	21	89	41	1	-	1	L271	-
	West Blacksea	14	19	117	97	-	-	-	-	-
2019	**Aras**	3	16	66	71	-	1	- (1)	-	R56
	Asi	8	21	162	149	3	3	1 (2)	L26, L27, L28	R2, R7, R52
	Ceyhan	18	33	104	94	-	-	-	-	-
	Çoruh	8	12	79	51	1	-	- (1)	L99	-
	East Mediterranean	12	32	105	104	-	-	-	-	-
	Fırat-Dicle	17	39	153	174	6	19	5 (11)	L130, L132, L135, L138	R3, R4, R9, R13, R20, R22, R28, R29, R30, R36, R38, R41, R46, R47, R49, R57, R60, R63
	Seyhan	12	33	70	107	-	-	-	-	-
	Van Lake	7	6	89	41	-	-	-	-	-
	Total	**275**	**586**	**895**		**39**	**63**	**39**	**-**	

*has been shown in parentheses, the total number of new records in the basin
** The codes of the lake points are stated in Maraşlıoğlu et al., (2021)
***R1:** Akçay Creek, **R2:** Algana Creek, **R3:** Armutağaç Creek, **R4:** Aşağıdecde Creek, **R5:** Bendboğazı Creek, **R6:** Bıçakçı Creek, **R7:** Bostanlık Creek, **R8:** Boyalıçay Creek, **R9:** Büyük Creek, **R10:** Çamurluiret Creek, **R11:** Çarşamba Creek, **R12:** Çarşamba Creek, **R13:** Çelikler Creek, **R14:** Değirmen Creek, **R15:** Dim Creek, **R16:** Dim Creek, **R17:** Düzlübel Creek, **R18:** Eğreğin Creek, **R19:** Fabrika Creek, **R20:** Gazel Creek, **R21:** Göynük Creek, **R22:** Gurik Creek, **R23:** Güdet Creek, **R24:** Huzur Creek, **R25:** Ilısu River, **R26:** İnasar Creek, **R27:** İvriz Creek, **R28:** Kaldırma Creek, **R29:** Karaçamur Creek, **R30:** Karagedik Creek, **R31:** Karagöz Creek, **R32:** Karagöz Creek, **R33:** Karaman Creek, **R34:** Kargı Creek, **R35:** Karpuz Creek, **R36:** Kartal Creek, **R37:** Kartal Creek, **R38:** Kavurma Creek, **R39:** Kelmen Creek, **R40:** Kızılıçukur Creek, **R41:** Komikan Creek, **R43:** Kuru Creek, **R44:** Kürkgeçit Creek, **R45:** Kütüklü Creek, **R46:** Mağaracık Creek, **R47:** Mutolar Creek, **R48:** Natıflar Creek, **R49:** Norsil Creek, **R50:** Okçu Creek, **R51:** Ovacık Creek, **R52:** Pekmez Creek, **R53:** Menderes Stream, **R54:** Sapadere Creek, **R55:** Sapadere Creek, **R56:** Seyran Creek, **R57:** Simirtas Creek, **R58:** Sülek Creek, **R59:** Utice Creek, **R60:** Yalnızkaz Creek, **R61:** Yazılı Creek, **R62:** Yeşil Creek, **R63:** Yoncalık Creek

Table 2. List of Bacillariophyta taxa identified as new records in 25 basins in Türkiye
Çizelge 2. 25 havzada yeni kayıt olarak tanımlanan Bacillariophyta takson listesi

No	Taxa	Synonym(s)	Dimensions (µm)				Habitat	Type of Life	Water Quality Indication**	Basin(s) in Türkiye***		Distribution in the World*
			L	W	D	S (10 µm)				Basin	Location	
1	*Achnanthidium rostropyrenaicum* Jüttner and Cox	-	18	4.5	-	20	(Fre)-L, R	Epl	T	AN	R16, R35, R53	R
2	*Brachysira neglectissima* Lange-Bertalot	-	18	4.5	-	35	(Fre)-R	Epl	S	AN, FD	R15, R21, R26, R34, R36, R39	W
3	*Caloneis strelnikovae* Levkov and Williams	-	51	14	-	17	(Fre)-L	Epp	S/T	AK	L3	W
4	*Cocconeis euglyptoides* (Geitler) Lange-Bertalot	-	11	6	-	20	(Fre)-L, R	Phy-Epl	T	AN, KO	L12, L15, L19, L169, L181, L185, R11, R12, R15, R16, R23, R25, L26, R27, R31, R33, L38, R49, R53, R54, R58, R60	W
5	*Cocconeis pseudolineata* (Geitler) Lange-Bertalot	*Cocconeis placentula* var. *pseudolineata* Geitler	28	14	-	23	(Fre)-L, R	Epl	S/T	AN, FD, KO	L12, R20, R24, R27, R49, R59	R
6	*Craticula paramolesta* Lange-Bertalot, Cavacini, Tagliaventi and Alfinito	-	12	3.5	-	23	(Fre)-R	Epl	S/T	FD	R3, R9, R29, R62	R
7	*Cymbella affinis var. neoprocera* Silva	*Cymbella excisa* var. *procera* Krammer	31	8.5	-	10	(Fre)-L, R	Epl-Epp	S/T	AS, FD	L26, R2, R7, R22, R30, R41, R52,	W
8	*Cymbella cantonatii* Lange-Bertalot	-	37	10	-	10	(Fre)-L, R	Epl-Epp	S/T	FD	L138, R4, R45, R56	W
9	*Cymbella exigua* Krammer	-	19	8.5	-	15	(Fre)-L	Epp	T	MA	R52	R
10	*Cymbopleura kuelbsii* Krammer	-	30	7.5	-	10	(Fre)-L, R	Epl-Epp	S	AN, FD	L130, L132, L135, R37, R47	W
11	*Encyonema bipartitum* (A. Mayer) Krammer	*Cymbella bipartita* Mayer	17	5	-	11	(Fre)-R	Epl	S	FD	R38	R
12	*Encyonema lapponicum* (A. Cleve) Krammer	*Cymbella aequalis* var. *lapponica* (A. Cleve) Krammer	38	8	-	8	(Fre)-L	Epp	S	BU	L60	R
13	*Encyonopsis krammeri* Reichardt	-	12	3	-	28	(Fre)-L	Epl-Epp	S/T	AN, KO	L12, L169, L182, R1, R17, R18, R39, R43	W
14	*Eunotia circumborealis* Lange-Bertalot and Nörpel	*Eunotia septentrionalis* var. *bidens* Hustedt	45	7	-	13	(Fre)-L	Epp	S/T	SA	L231	W
15	*Eunotia ruzickae* Bílý and Marvan	-	60	6	-	13	(Fre)-L	Epp	S/T	SA	L216	W

Abbreviations; For Basin(s); AK: Akarçay, AN: Antalya, AR: Aras, AS: Asi, WM: Western Mediterranean, EM: Eastern Mediterranean, WB: Western Black Sea, EB: Eastern Black Sea, BU: Burdur, KM: Küçük Menderes, BM: Büyük Menderes, CE: Ceyhan, CO: Çoruh, FD: Fırat Dicle, GE: Gediz, KI: Kızılırmak, KO: Konya, NA: North Aegean, MA: Marmara, ME: Meriç Ergene, SA: Sakarya, SE: Seyhan, SU: Susurluk, VL: Van Lake, YE: Yeşilırmak. **For Habitat;** Fre: Freshwater, Bra: Brackish, R: River, L: Lake. **For Dimensions;** L: Length, W: Weight, D: Diameter, S: Striae number. **For Life Type;** Phy: Phytoplankton, Epl: Epilithic, Epp: Epiphytic. **For Water quality indicator;** S: sensitive, T: tolerant, S/T: indifference. **For Distribution;** R: Rare, W: Widely.

Table 2. Continued
Çizelge 2. Devamı

No	Taxa	Synonym(s)	Dimensions (µm)				Habitat	Type of Life	Water Quality Indication **	Basin(s) in Türkiye***		Distribution in the World*
			L	W	D	S (10 µm)				Basin	Location	
16	*Fallacia gemmifera* (Simonsen) D.G.Mann	*Navicula gemmifera* (Simonsen) D.G.man	15	4	-	20	(Bra)-L	Phy	S/T	KI	L148	R
17	*Gomphonema acutiusculum* (O.Müller) A.Cleve	*Gomphonema lanceolatum var. acutiusculum* O.Müller	43	10	-	9	(Fre)-L	Phy-Epl	S/T	WM	L31	W
18	*Gomphonema angustivalva* Reichardt	-	13	3.5	-	15	(Fre)-L, R	Phy-Epl	T	AN, FD, KO	L18, L19, R8, R10, R13, R14, R16, R32, R42, R57, R58, R61	R
19	*Gomphonema cymbelliclinum* Reichardt and Lange-Bertalot	-	37	6.5	-	10	(Fre)-L, R	Epl	T	AN, KO	R5, R14, R19	W
20	*Gomphonema parvuliforme* Levkov	-	23	8	-	10	(Fre)-L	Epl	T	KM	L194	R
21	*Gomphonema pratense* Lange-Bertalot and Reichardt	-	60	9.5	-	8	(Fre)-R	Epl	S/T	KO	L174	R
22	*Gomphonema procerum* Reichardt and Lange-Bertalot	-	38	6	-	11	(Fre)-L	Epp	S/T	AS	L27, L28	W
23	*Halamphora paraveneta* (Lange-Bertalot, Cavacini, Tagliaventi and Alfnito) Levkov	*Amphora paraveneta* Lange-Bertalot, Cavacini, Tagliaventi & Alfinito	40	20	-	11	(Fre)-L	Epl	T	BM	L75	R
24	*Navicula supergregaria* Rumrich and Lange-Bertalot	-	28	8	-	13	(Bra)-L	Epl	S	BM	L69, L72	R
25	*Navicula vilaplanii* Lange-Bertalot and Sabater	*Navicula longicephala* var. *vilaplanii* Lange-Bertalot & Sabater	15	5	-	19	(Fre)-R	Epl	S/T	BM, KE	R40, R50	W
26	*Neidium densestriatum* (Østrup) Krammer	*Caloneis ladogensis* var. *densestriata* Østrup	24	12	-	26	(Fre)-L, R	Phy-Epl	S	KO	L181, L184	W
27	*Pinnularia grunowii* Krammer	-	38	8	-	11	(Fre)-L	Epl	S	BM	L68	W
28	*Pinnularia neohalophila* Kulikovskiy, Genkal and Mikheeva	*Pinnularia rhombarea* var. *halophila* Krammer	52	11.5	-	10	(Fre)-L	Epl-Epp	S/T	YE	L271	R
29	*Pinnularia sinistra* Krammer	-	17	4	-	11	(Fre)-L, R	Phy-Epl-Epp	T	AN, CO, KO	L17, L99, L174, R33	W
30	*Pinnularia subanglica* Krammer	-	53	8	-	11	(Fre)-L	Epl	S/T	BM	L68	W

Table 2. Continued
Çizelge 2. Devamı

No	Taxa	Synonym(s)	Dimensions (µm)				Habitat	Type of Life	Water Quality Indication**	Basin(s) in Türkiye***		Distribution in the World*
			L	W	D	S (10 µm)				Basin	Location	
31	*Placoneis paraelginensis* Lange-Bertalot	-	11	7	-	12	(Fre)-R	Epl	S/T	AN, AR, FD	L17, R4, R55	W
32	*Planothidium biporomum (Hohn and H*ellerman) Lange-Bertalot	*Achnanthes biporoma* M.H.Hohn & J.Hellerman	10	3.5	-	12	(Fre)-L, R	Epl	T	KO	R10, R24	W
33	*Sellaphora atomoides* (Grunow) Wetzel and Van de Vijver	*Navicula atomoides* Grunow	9.5	3.5	-	30	(Fre)-R	Epl	S/T	FD	R20, R28, R29, R38, R45, R48, R59	W
34	*Sellaphora japonica* Kobayasi	*Stauroneis japonica* H.Kobayasi	20	5.5	-	24	(Fre)-R	Epl	S/T	SA	R44	R
35	*Sellaphora nigri* (De Notaris) Wetzel and Ector	*Navicula nigri* De Notaris	5	3	-	26	(Fre)-R	Epl	S/T	FD	R46	W
36	*Stauroneis amphicephala* Kützing	*Stauroneis anceps* var. *amphicephala* Kützing	35	11	-	19	(Fre)-L, R	Phy-Epl	T	KO	L175, R5	W
37	*Staurophora tackei* (Hustedt) Bahls	*Navicula tackei* Hustedt	20	5.5	-	24	(Fre)-L	Epl	S/T	BM	L67	W
38	Surirella lacrimula English	*Surirella neglecta* E.Reichardt	24	10	-	27	(Fre)-R	Epl-Epp	T	KO	L172, R6, R10, R24, R61	R
39	*Thalassiosira baltica* (Grunow) Ostenfeld	*Coscinodiscus polyacanthus* var. *balticus* Grunow			30 diam		(Bra)-L	Epp	S/T	AK	L2	W

*Distribution has been evaluated according to AlgaeBase (Guiry and Guiry 2021)
**has been given according to Van Dam et al. (1994); Wojtal (2009); Hofmann et al. (2011)
*** The codes of the lake points are stated in Maraşlıoğlu et al. (2021)

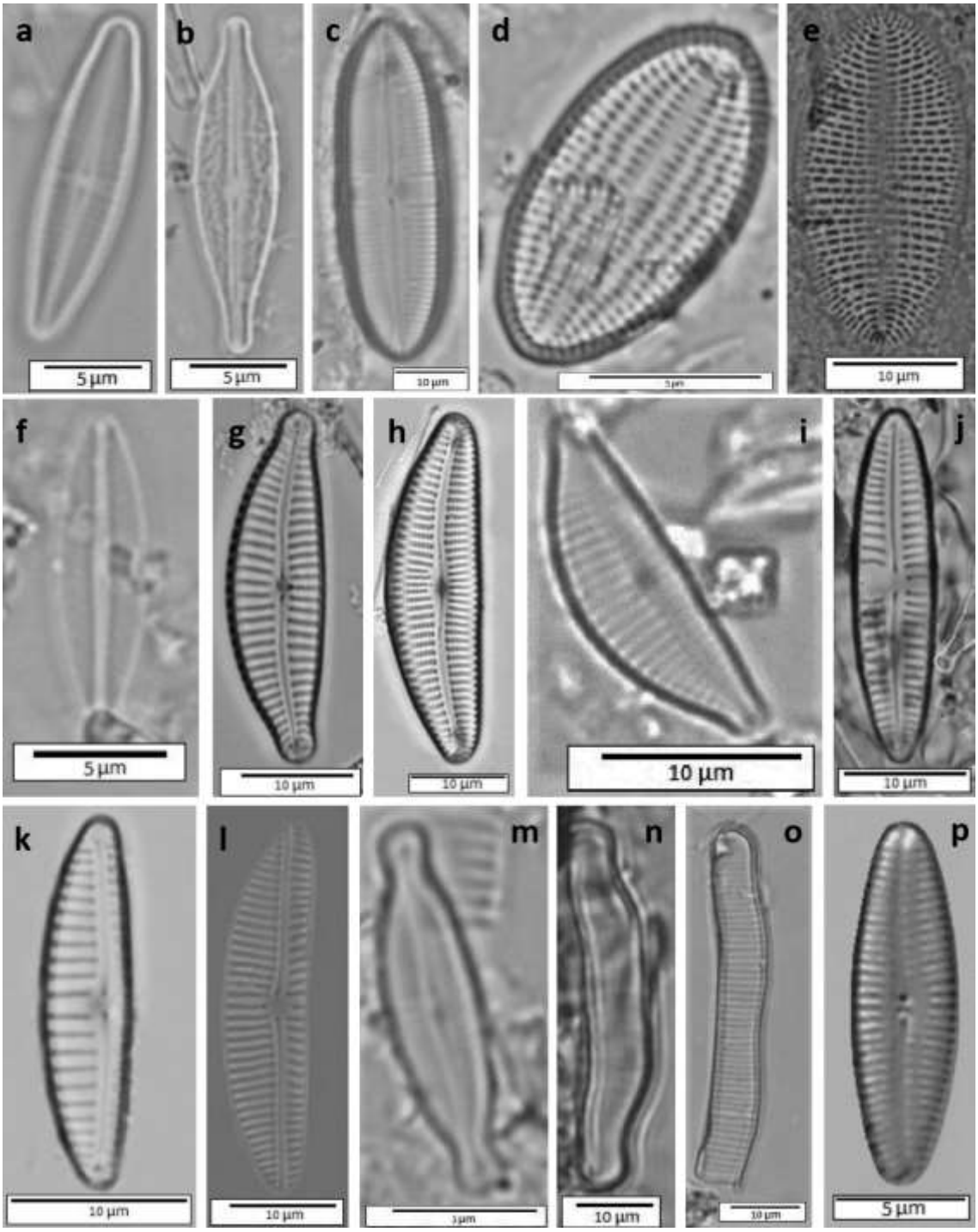

Figure 2. **a)** *Achnanthidium rostropyrenaicum*, **b)** *Brachysira neglectissima*, **c)** *Caloneis strelnikovae*, **d)** *Cocconeis euglyptoides*, **e)** *Cocconeis pseudolineata*, **f)** *Craticula paramolesta*, **g)** *Cymbella affinis* var. *neoprocera*, **h)** *Cymbella cantonatii*, **i)** *Cymbella exigua*, **j)** *Cymbopleura kuelbsii*, **k)** *Encyonema bipartitum*, **l)** *Encyonema lapponicum*, **m)** *Encyonopsis krammeri*, **n)** *Eunotia circumborealis*, **o)** *Eunotia ruzickae*, **p)** *Fallacia gemmifera*

Şekil 2. ***a)*** *Achnanthidium rostropyrenaicum,* ***b)*** *Brachysira neglectissima,* ***c)*** *Caloneis strelnikovae,* ***d)*** *Cocconeis euglyptoides,* ***e)*** *Cocconeis pseudolineata,* ***f)*** *Craticula paramolesta,* ***g)*** *Cymbella affinis var. neoprocera,* ***h)*** *Cymbella cantonatii,* ***i)*** *Cymbella exigua,* ***j)*** *Cymbopleura kuelbsii,* ***k)*** *Encyonema bipartitum,* ***l)*** *Encyonema lapponicum,* ***m)*** *Encyonopsis krammeri,* ***n)*** *Eunotia circumborealis,* ***o)*** *Eunotia ruzickae,* ***p)*** *Fallacia gemmifera*

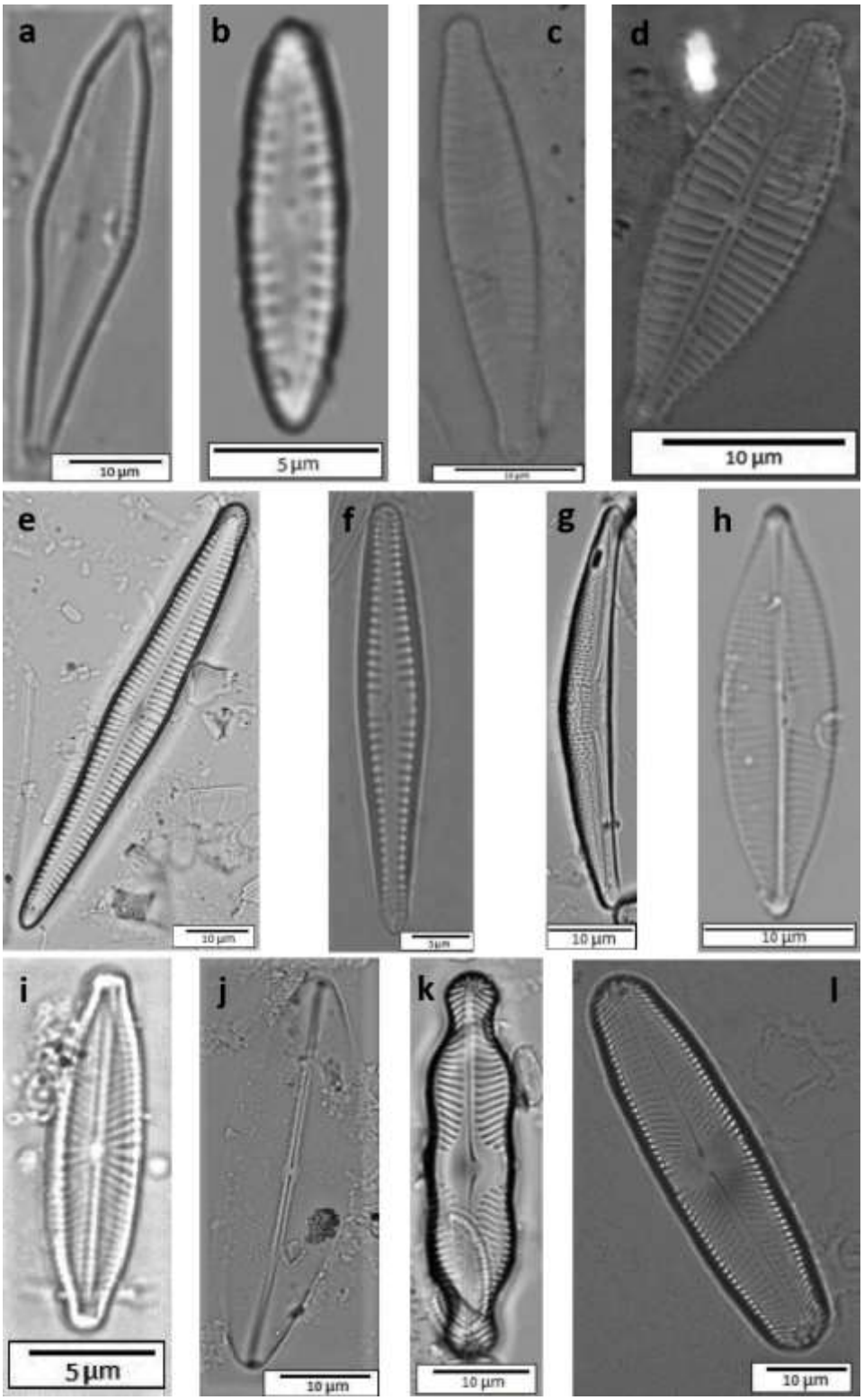

Figure 3. **a)** *Gomphonema acutiusculum*, **b)** *Gomphonema angustivalva*, **c)** *Gomphonema cymbelliclinum*, **d)** *Gomphonema parvuliforme*, **e)** *Gomphonema pratense*, **f)** *Gomphonema procerum*, **g)** *Halamphora paraveneta*, **h)** *Navicula supergregaria*, **i)** *Navicula vilaplanii*, **j)** *Neidium densestriatum*, **k)** *Pinnularia grunowii,* **l)** *Pinnularia neohalophila*

Şekil 3. ***a)*** *Gomphonema acutiusculum,* ***b)*** *Gomphonema angustivalva,* ***c)*** *Gomphonema cymbelliclinum,* ***d)*** *Gomphonema parvuliforme,* ***e)*** *Gomphonema pratense,* ***f)*** *Gomphonema procerum,* ***g)*** *Halamphora paraveneta,* ***h)*** *Navicula supergregaria,* ***i)*** *Navicula vilaplanii,* ***j)*** *Neidium densestriatum,* ***k)*** *Pinnularia grunowii,* ***l)*** *Pinnularia neohalophila*

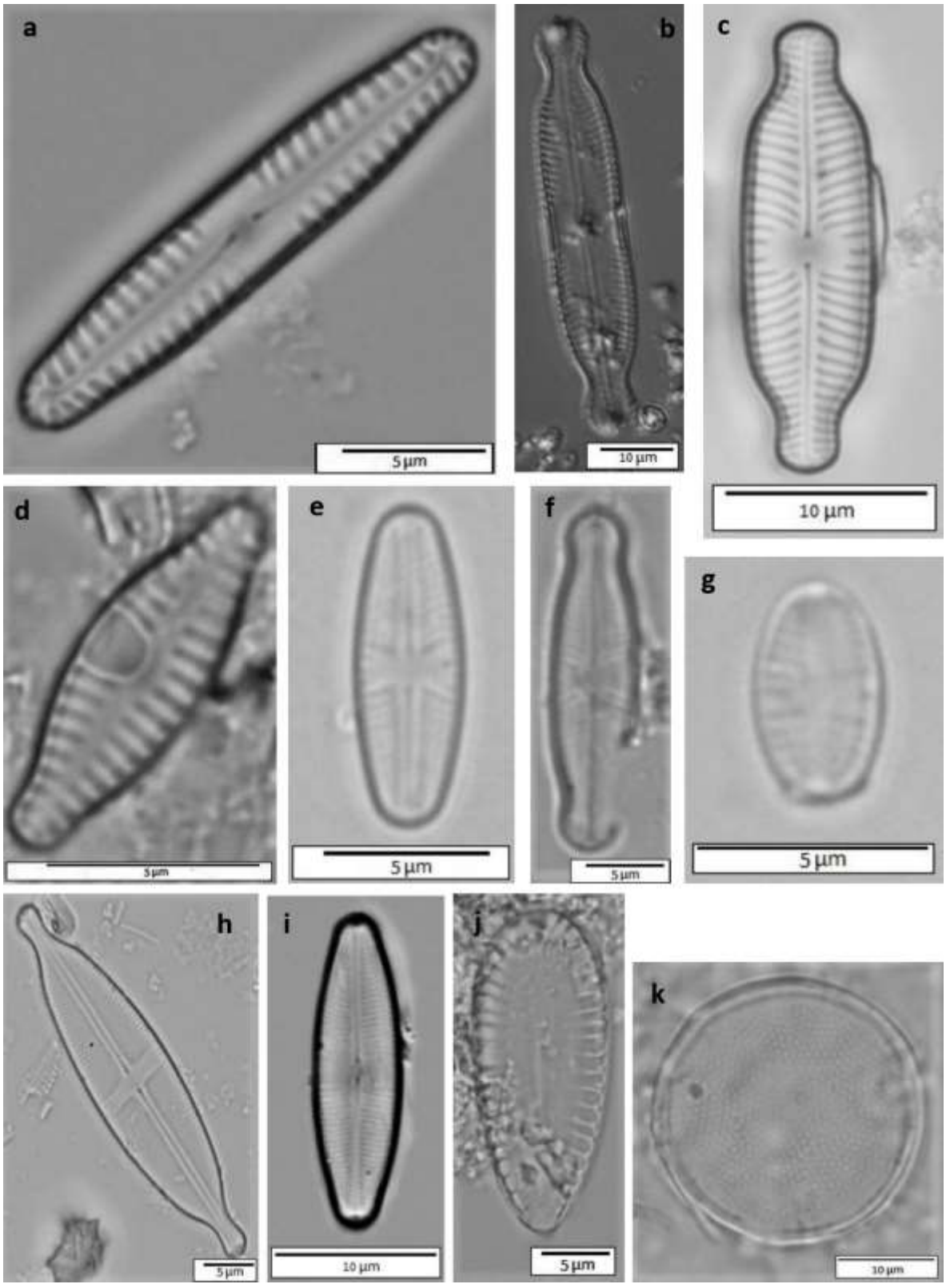

Figure 4. **a)** *Pinnularia sinistra*, **b)** *Pinnularia subanglica*, **c)** *Placoneis paraelginensis*, **d)** *Planothidium biporomum*, **e)** *Sellaphora atomoides*, **f)** *Sellaphora japonica*, **g)** *Sellaphora nigri*, **h)** *Stauroneis amphicephala*, **i)** *Staurophora tackei*, **j)** *Surirella lacrimula*, **k)** *Thalassiosira baltica*

Şekil 4. ***a)*** *Pinnularia sinistra,* ***b)*** *Pinnularia subanglica,* ***c)*** *Placoneis paraelginensis,* ***d)*** *Planothidium biporomum,* ***e)*** *Sellaphora atomoides,* ***f)*** *Sellaphora japonica,* ***g)*** *Sellaphora nigri,* ***h)*** *Stauroneis amphicephala,* ***i)*** *Staurophora tackei,* ***j)*** *Surirella lacrimula,* ***k)*** *Thalassiosira baltica*

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Researchers' Contribution Rate Statement Summary

First Author: Conceptualization, Writing-review, editing, Data Curation, Formal Analysis, Investigation, Methodology, Visualization

Second Author: Data Curation, Formal Analysis, Investigation, Visualization

Third Author: Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Visualization

Fourth Author: Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Visualization

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Sixth Author: Data Curation, Formal Analysis, Investigation, Visualization

Seventh Author: Data Curation, Formal Analysis, Investigation, Methodology, Visualization

Eighth Author: Funding Acquisition, Project Administration, Resources

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Twelfth Author: Data Curation, Investigation

Thirteenth Author: Data Curation, Investigation

Fourteenth Author: Data Curation, Investigation

Fifteenth Author: Data Curation, Investigation

Sixteenth Author: Data Curation, Investigation

Conflict of Interest Statement

The article's authors declare that they do not have any conflict of interest.

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