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Description of *Gomphonella saldanensis* sp. nov. (Bacillariophyceae) from hydromagnesite stromatolites in Salda Lake, Turkey

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Lake Salda has a unique environment due to the presence of hydromagnesite stromatolites. Samples collected from the stromatolites contained a new diatom species, *Gomphonella saldanensis* sp. nov., which is described based on light and scanning electron microscopy. The main character of the taxon is its linear-lanceolate outline with a rostrate headpole and narrowly rounded footpole. The striae are strongly radiate mid-valve, becoming parallel to slightly radiate towards the poles. Elliptical Fourier and Linear Discriminant analyses indicate that there are different shape forms within the same taxon. Based on LM observations, *G. saldanensis* is similar to *Gomphonema lagerheimii* f. *simplex*, *G. geisslerae, Gomphonella calcarea, G. olivacea, G. acsiae* and *G. coxiae*. However, *G. lagerheimii* f. *simplex* differs with slightly radiate striae throughout the valve. *Gomphonella geisslerae* has a slightly undulate raphe and linear apices. Larger specimens of *G. acsiae* are lanceolate, clavate in smaller specimens. The remaining *Gomphonella* species, *G. calcarea, G. coxiae* and *G. olivacea* have broader outlines and lower stria densities.

Keywords: Gomphonella*, hydromagnesite, linear discriminant analysis, Salda Lake, stromatolites*

Introduction

Gomphonemoid diatoms are a highly diversified group, initially included in a single genus, *Gomphonema* Ehrenberg, but presently comprising a dozen different genera from both freshwater and marine environments (Li et al. 2020), which seem to be particularly prone to endemicity (You et al. 2015, Stancheva et al. 2016). Their most distinctive morphological feature (heteropolar valve outline) seems to be distributed across the entire order Cymbellales (Kermarrec et al. 2011, Jahn et al. 2019), and both current concepts of the Gomphonemataceae and the genus *Gomphonema* sensu lato are clearly not monophyletic (Kermarrec et al. 2011, Nakov et al. 2014). Gomphonemoid and cymbelloid diatoms have a common ancestor (Pappas 2005), and many 'transitional forms' between the morphological groups have been described as separate genera e.g., *Gomphocymbella* O. Müller *Kurtkrammeria* Bahls, *Krsticiella* Levkov.

In a study including *Gomphoneis minuta* (J.L.Stone) Kociolek & Stoermer, Kermarrec et al. (2011) showed that there is currently no phylogenetic evidence to separate the genera *Gomphonema* and *Gomphoneis* Cleve. In addition, the significance of the presence of astigmate species in these genera has been extensively debated in the scientific literature (e.g., You et al. 2013, Kociolek et al., 2015). These astigmate taxa (probably tens of distinct species), have traditionally been treated as an uncategorized group within *Gomphoneis*, 'highly derived members' of this genus (You et al. 2013). More recently, this group of taxa have been placed in the reinstated genus *Gomphonella* Rabenhorst (Jahn et al. 2019). According to Tuji (2020), taxa within *Gomphonella* can also have tetrastigmate

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forms; thus this genus may predate all *Gomphoneis* and *Gomphosinica* Kociolek Q.-M. You, Q.-X. Wang & Q. Liu (Zhang et al. 2020) assuming that stigmata in *Gomphonella* are ontogenetically homologous with those found in the other genera. Molecular data currently confirms that *Gomphonella* belongs to the Cymbellaceae rather than to the Gomphonemataceae, whilst its recognition as a distinct genus containing astigmatic members (Jahn et al. 2019) also rendered *Gomphoneis* and *Gomphonema* monophyletic. While some *Gomphonella* species are known to be cosmopolitan, many taxa exhibit restricted geographic distributions (Levkov & Williams 2011, You et al. 2013), reported mostly from the Southern Hemisphere (Kociolek et al. 2004) or ancient lakes (Levkov et al. 2007, Kociolek et al. 2013).

Gomphonella have wedge-shaped frustules in girdle view, heteropolar in valve view, with bi- to triseriate striae formed of small, rounded, unoccluded areolae. Stigmoids or stigmata are usually absent. The raphe is linear, with a proximal end externally small and internally slightly curved unilaterally. Internally, the distal ends terminate in thick helictoglossae at some distance from the apices.

This paper describes a new *Gomphonella* species from Lake Salda (Turkey). Salda Lake has been studied by different researchers (Küçük et al. 2013, Yoğurtçuoğlu & Ekmekçi 2015, İnnal et al. 2019, 2020, Yoğurtçuoğlu 2019) and contains an endemic fish species (*Aphanius saldae*), described by Akşiray (1955). With respect to the diatoms, Braithwaıte & Zedef (1996) identified some at generic level using SEM images, but since then, there have been no taxonomical investigations on diatoms. In broader terms, gomphonemoid diatoms across the inland waters of the western Asian Ecoregion (Antatolia), are dominataed by *Gomphonema* taxa, with 75 recorded species, while *Didymosphenia geminata* (Lyngbye) M. Schmidt has been reported from different parts of Anatolia and two *Gomphosphenia* Lange-Bertalot taxa have also been recorded (Solak et al. 2021).

Material and methods

Study area

Lake Salda is located at an elevation of 1140 m a.s.l. in southwestern Anatolia (Turkey) (Fig. 1). The lake is the deepest soda lake (max. depth of ∼200 m.) in the world, with a surface area of 45 km^2 (Lise et al. 2013, Kaiser et al. 2016). Lake Salda has highly Mg-rich, alkaline (pH > 9) waters and is characterized by the presence of living hydromagnesite stromatolites along the coastal zone (Braithwaıte & Zedef 1996). According to Hammer (1986) and Bulger et al. (1993), the lake is a carbonate-type saline lake and is classified as mixo-oligohaline, and alpha oligohaline. It is fed by springs of various size.

Diatom analyses

In total, 23 diatom samples were collected from four stations between 2016 and 2020 (Fig. 1, Table 1). Epilithic samples were collected using a toothbrush (Taylor et al. 2006) from a depth of 25–30 cm, and fixed with 60% ethanol prior to transport to the laboratory at +4°C.

The samples were boiled in a mixed solution of 30% hydrogen peroxide (H_2O_2) and concentrated HCl to remove organic matter. The residual peroxide and HCl solution was removed through a series of de-ionzed water washes. Subsamples of the cleaned material were dried onto coverglasses and then, mounted using Naphrax® synthetic resin. Diatom observations were performed with a Nikon Ci Light Microscope (LM) at Dumlupınar University (Turkey) under1000 × magnification (1.3 N.A.) and brightfield. Scanning electron microscope (SEM) observations were made using a Hitachi SU 8010 at the University of Rzeszów (Poland) with secondary electron and backscatter excitation. For this purpose, samples were placed on polycarbonate membrane filters with a 3 μm mesh. The membranes were left to dry and then attached to aluminium stubs with double-sided carbon tape, and sputter coated with ca. 20 nm gold using a Turbo–Pumped Quorum Q 150OT ES coater.

Light microscope images were used to evaluate valve shape among specimens. Valve outline and shape harmonics were determined for each valve using DiaOutline and elliptic Fourier analysis (EFA) as described in Wishkerman & Hamilton (2018). Valve outlines were extracted using manual removal of the background, following Otsu's threshold method (Otsu 1979). Statistical analyses using Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA) for both shape descriptors were performed to visualize relationships among specimens. A MANOVA test was also used to evaluate the degree of difference among the valve shape forms.

Results

Water parameters

Salda lake has a relatively stable chemical composition. During this study, pH ranged from 9.7–9.9, and water temperature from 23.0–28.2°C. Electrolyte conductivity was between 1384 and 1712 µS cm^{-1}, while oxygen concentration ranged between 6.6 and 7.5 mg L^{-1}. Water temperature and conductivity values were lowest in the winter, with 23.0°C in November 2016 and the highest temperature was 28.2°C in June 2020, alongside the highest conductivity value (1712 µS cm^{-1}). The lowest conductivity reading was 1384 µS cm^{-1} in October-2017 (Table 1).

Specimen observations

During the study, three different populations of *G. saldanensis* sp. nov. Were observed. The first population was

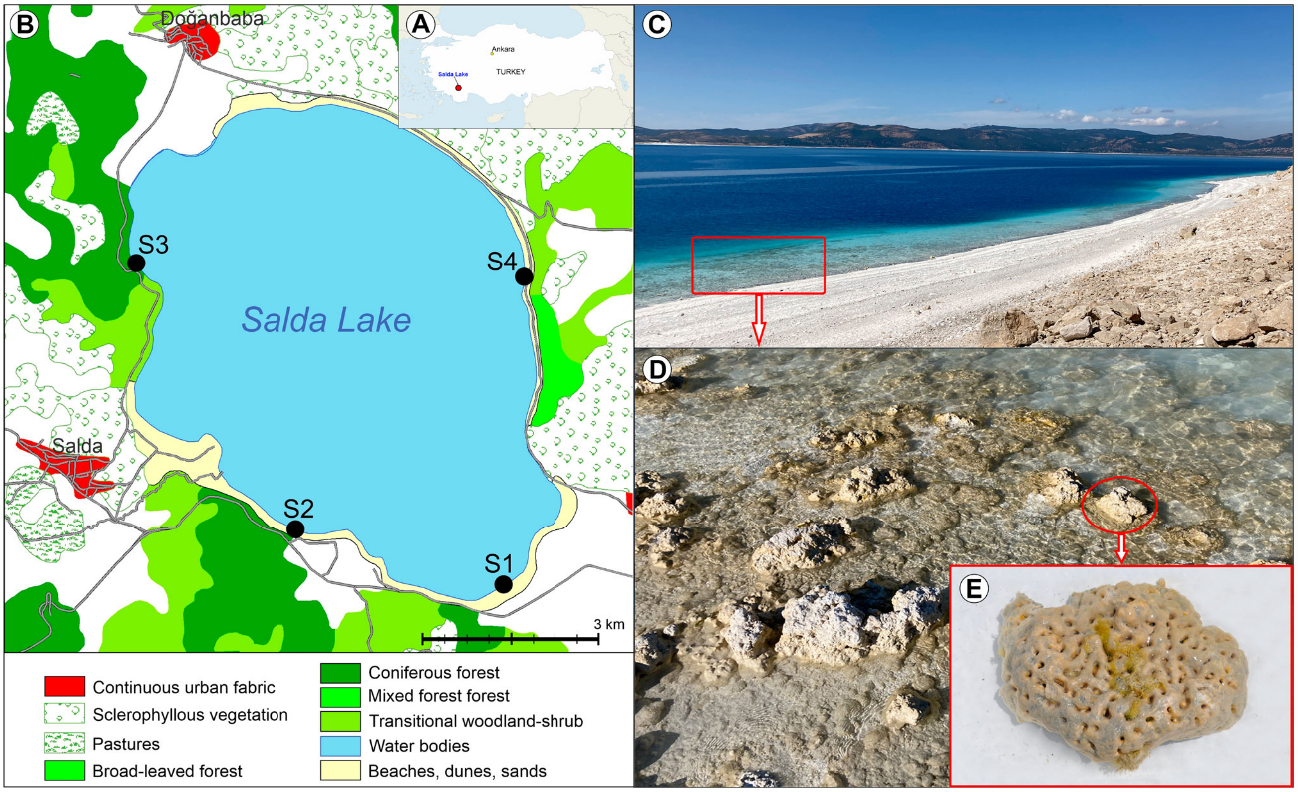
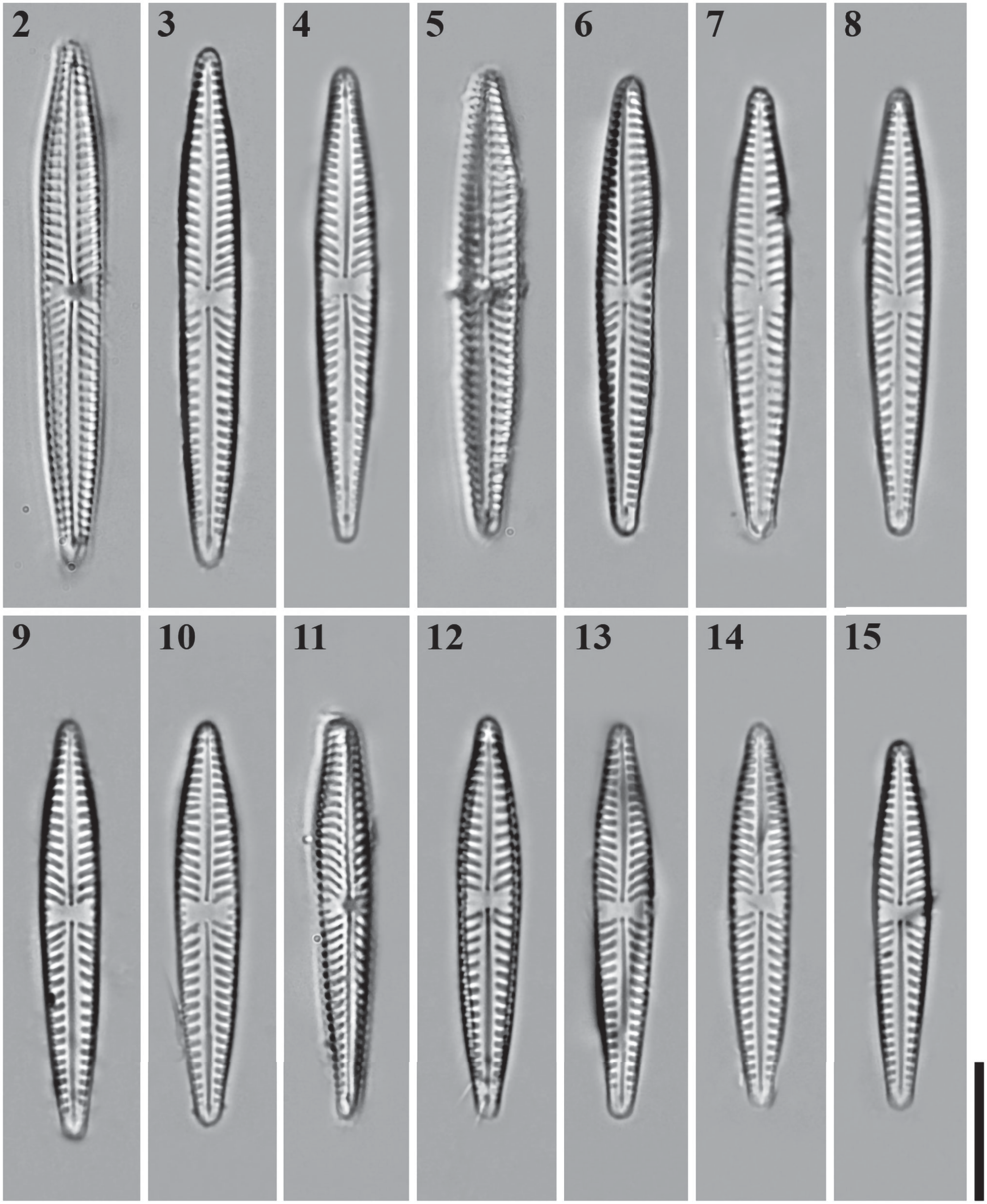


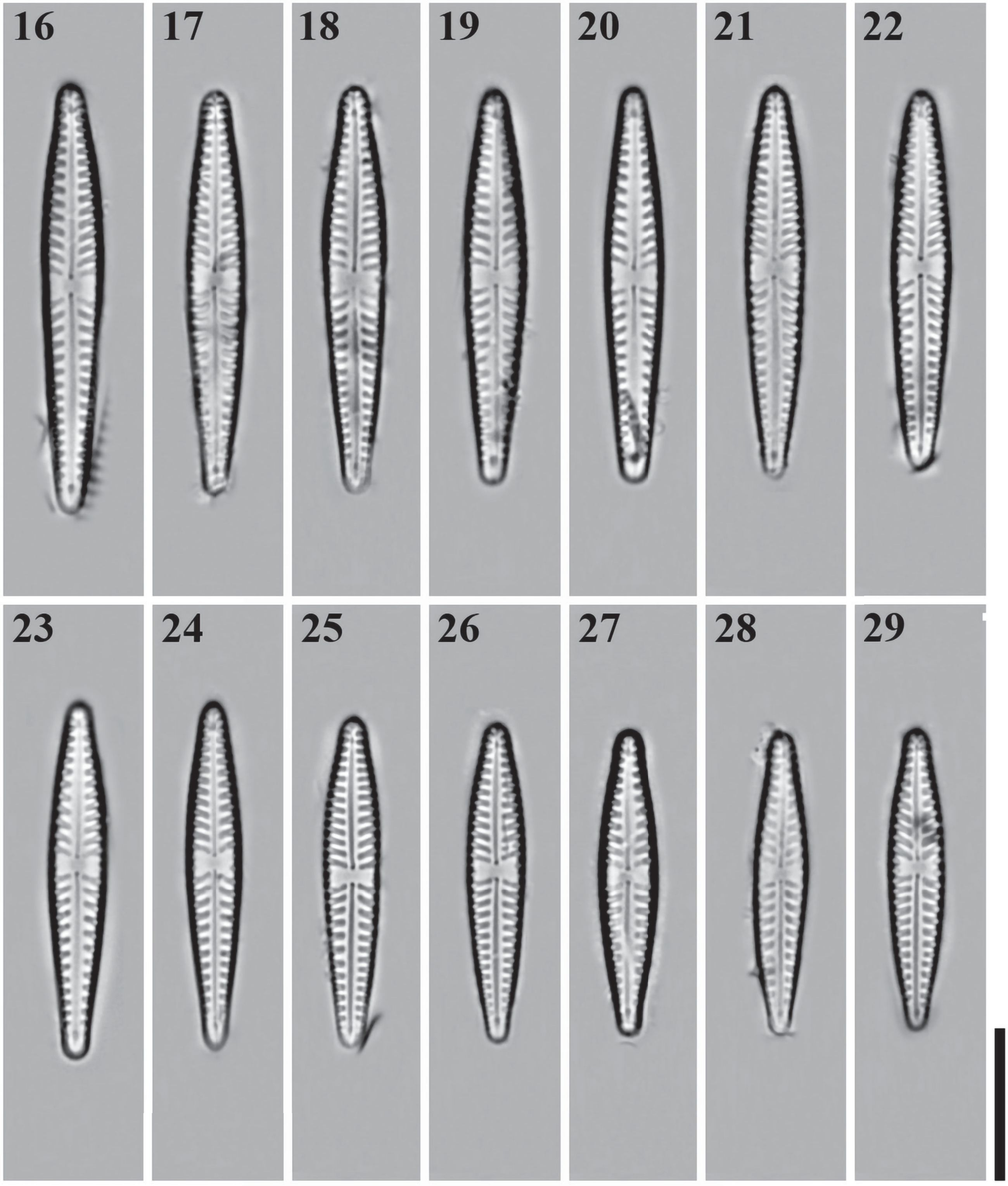
Fig. 1. (A) Location of Lake Salda. (B) Location of sampling stations (S1–S4). (C) General view of the lake. (D, E) Hydromagnesite stromatolites.

Table 1. Sampling periods, substratum and environmental data for *Gomphonella saldanensis* sp. nov.

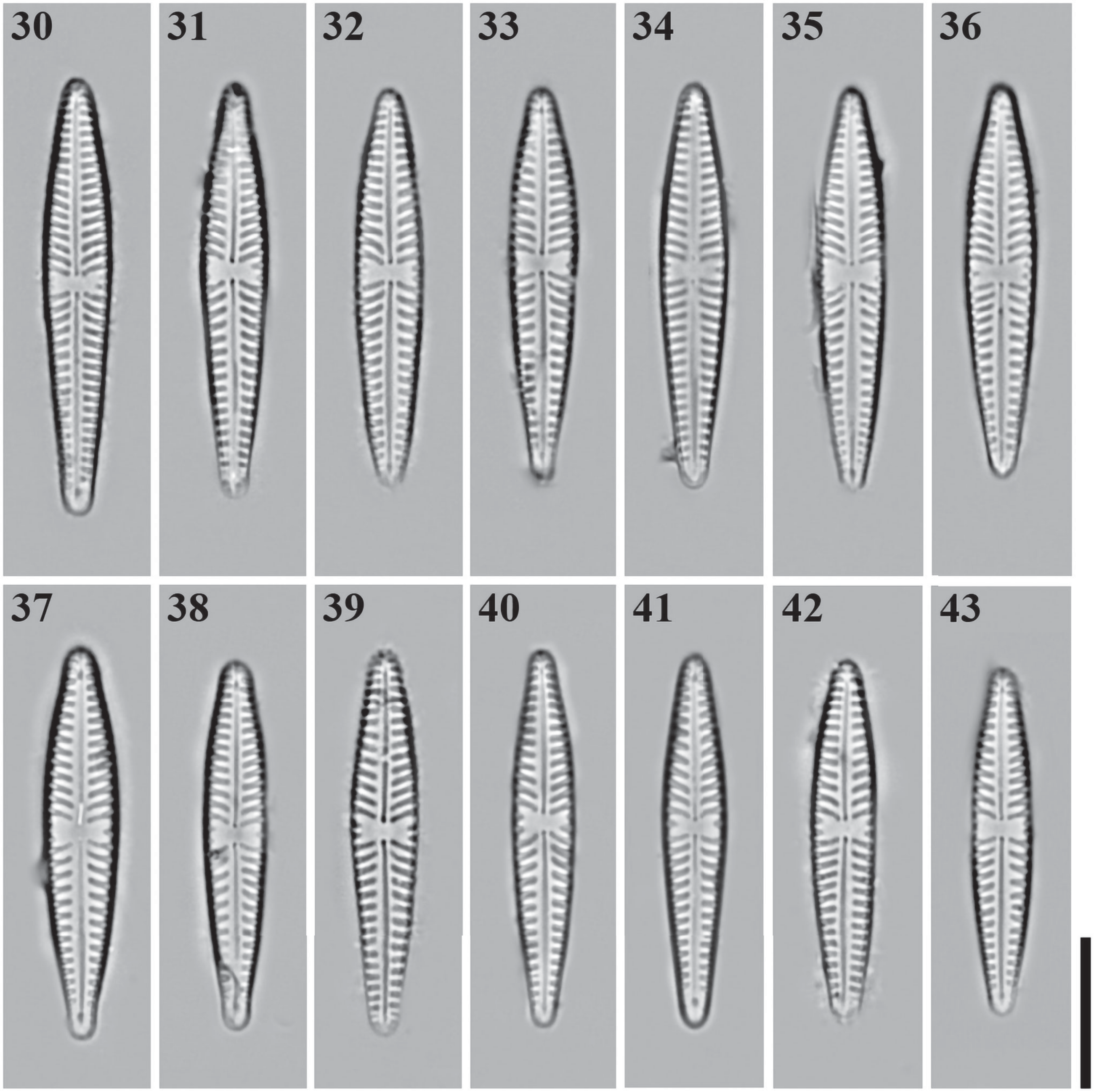
Location	Coordinates	Sampling period	Substrate	pH	TEMP (°C)	COND ($\mu S.cm^{-1}$)	DO (mg O_2 L^{-1})
1st station	37°30′41.43″N; 29°42′41.78″E	November 2016	Epilithic Epipelic	9.6	24.1	1434	7.2
		October 2017	Epipelic	9.6	24.2	1549	7.0
		September 2018	Epipelic	9.7	25.7	1682	6.8
		November 2019	Epipelic	9.8	23.0	1489	6.6
		Febraury 2020	Epipelic	9.9	23.6	1448	7.3
		June 2020	Epiphytic	9.7	28.2	1527	6.9
2nd station	37°31′13.47″N; 29°40′24.44″E	November 2016	Epilithic	9.6	25.8	1679	7.5
		October 2017	Epilithic	9.8	26.7	1384	7.0
		September 2018	Epiphytic	9.9	25.9	1704	6.9
		November 2019	Epipelic	9.8	23.9	1438	7.2
		February 2020	Epipelic	9.7	23.1	1641	7.5
		June 2020	Epipelic	9.8	27.9	1712	6.7
3rd station	37°33′42.68″N; 29°38′33.84″E	February 2020	Epiphytic	9.8	23.6	1403	7.4
		June 2020	Epiphytic Epilithic	9.7	27.8	1698	6.9
4th station	37°33′37.88″N; 29°43′1.94″E	October 2017	Epilithic Epiphytic	9.8	25.9	1599	7.3
		November 2019	Epilithic Epiphytic	9.9	24.6	1405	7.4
		February 2020	Epilithic	9.9	23.2	1671	7.1
		June 2020	Epiphytic Epilithic	9.8	27.8	1591	6.6



Figs 2–15. The type population of *Gomphonella saldanensis* sp. nov., LM micrographs. Scale bars = 10 µm.



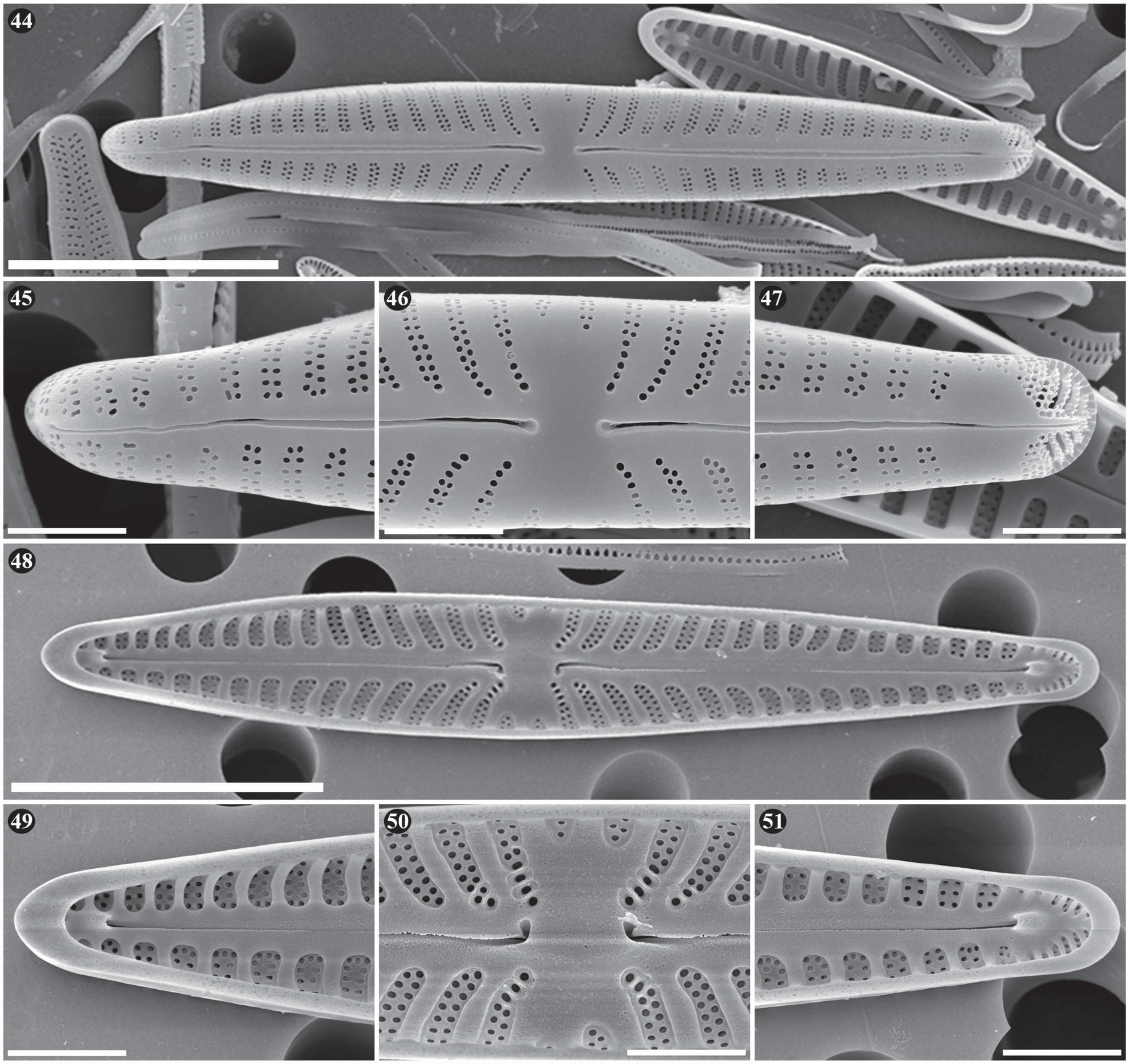
Figs 16–29. The second population of *Gomphonella saldanensis* sp. nov., LM micrographs. Scale bars = 10 μm.



Figs 30–43. The third population of *Gomphonella saldanensis* sp. nov., LM micrographs. Scale bars = 10 μm.

characterized by linear-lanceolate valves with a strongly rostrate headpole. The second and third populations had relatively broader linear-lanceolate valves. However, the second population had a distinct rostrate headpole and the third population had a strongly rostrate headpole.

Specimen outlines were evaluated using EFA and differentiated using both PCA (data not shown) and LDA analyses. The LDA analysis highlighted three populations of *G. saldanensis* sp. nov. İn shape space (Fig. 68), the LDA plots explaining 67.9% and 32.1%. of the variation across the first two components. Pairwise MANOVA comparisons indicated that the shape groups were dissimilar to each other (the first population vs. the second population, $p < 0.01$; the first population vs. the third population $p < 0.1$; the second population vs. the third population $p < 0.1$). Although the populations differed in outline, detailed SEM observations showed that the shapes of the central and axial areas were the same, so, they are considered as belonging to the a single taxon. Based on valve morphology, the taxon presented in this work is



Figs 44–51. The type population of *Gomphonella saldanensis* sp. nov., SEM micrographs. **Fig. 44.** External view of entire valve. **Figs 45, 47.** External view showing the terminal fissures. **Fig. 46.** Details of the central area showing drop-like recessed proximal raphe endings. **Fig. 48.** Internal view of entire valve with distinct pseudosepta at the headpole and smaller pseudosepta at the foot pole. **Figs 49, 51.** Internal view of distal raphe endings showing broad thickened helictoglossae. Fig. 50. Internal view of the central area showing distinctly curved like crocket-hooks proximal raphe endings and partially recessed areolae around the central area. Scale bars = 10 µm (Figs 44, 48), 2 µm (Figs 45–47, 49–51).

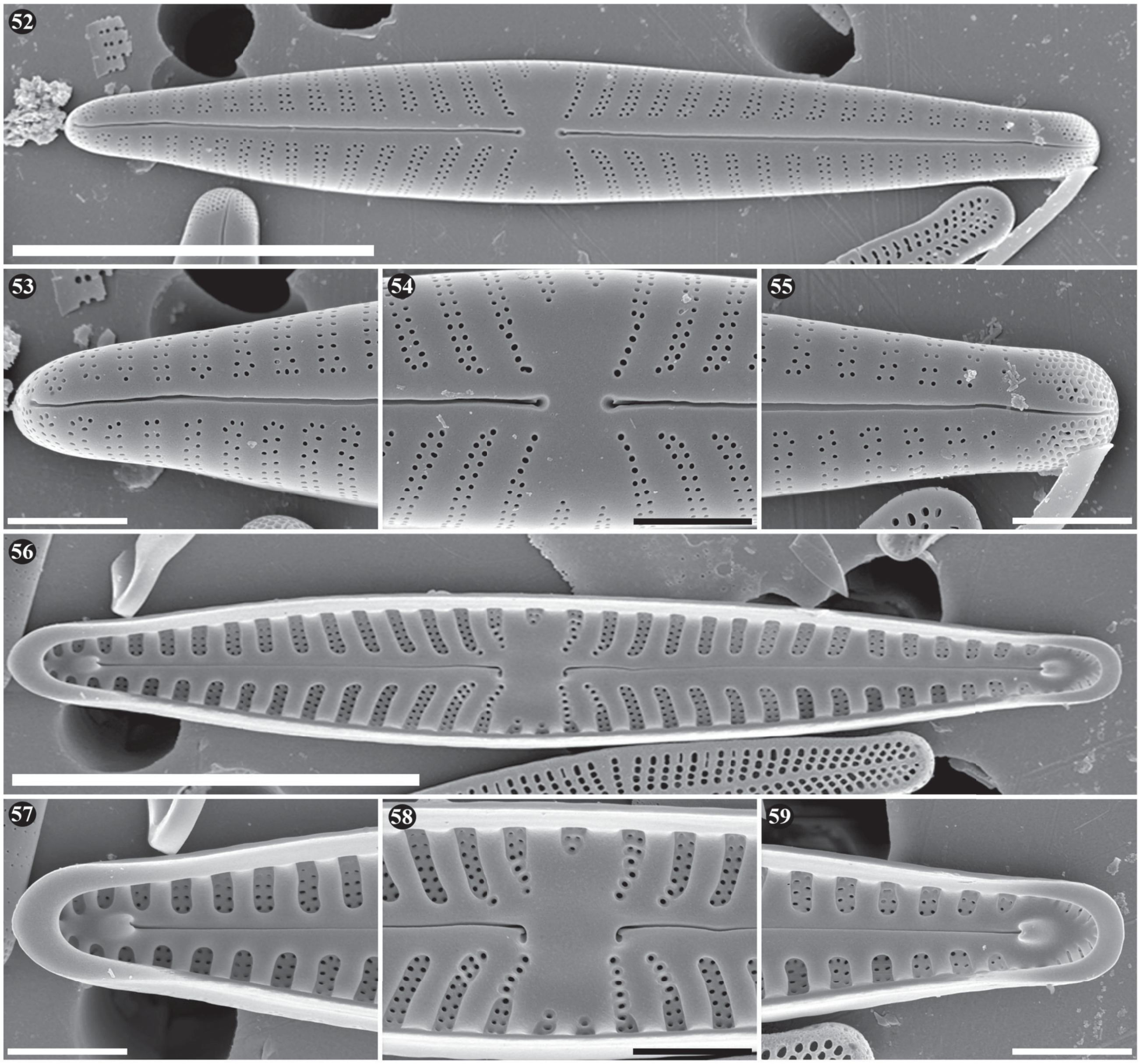
characterized by its outline, rostrate headpole and bow-tie-shaped central area.

Gomphonella saldanensis C.N. Solak, S. Blanco, Levkov & P.B. Hamilton sp. nov. (Figs 2–67)

The species was observed in September 2018, October 2017, November 2016, 2020 and February 2020 from four stations. In total, 25 specimens of the first population, 38 specimens of the second population and 51 specimens of the third population were observed.

Holotype specımen: Slide number #27293 (microscope slide designated as the holotype) in the collection of Andrzej Witkowski at the University of Szczecin (Poland)

Isotype specımen: Slide no. TR_BRD_Salda Lake_2_EPL _Nov2016 deposited at Kütahya Dumlupınar University (Turkey).



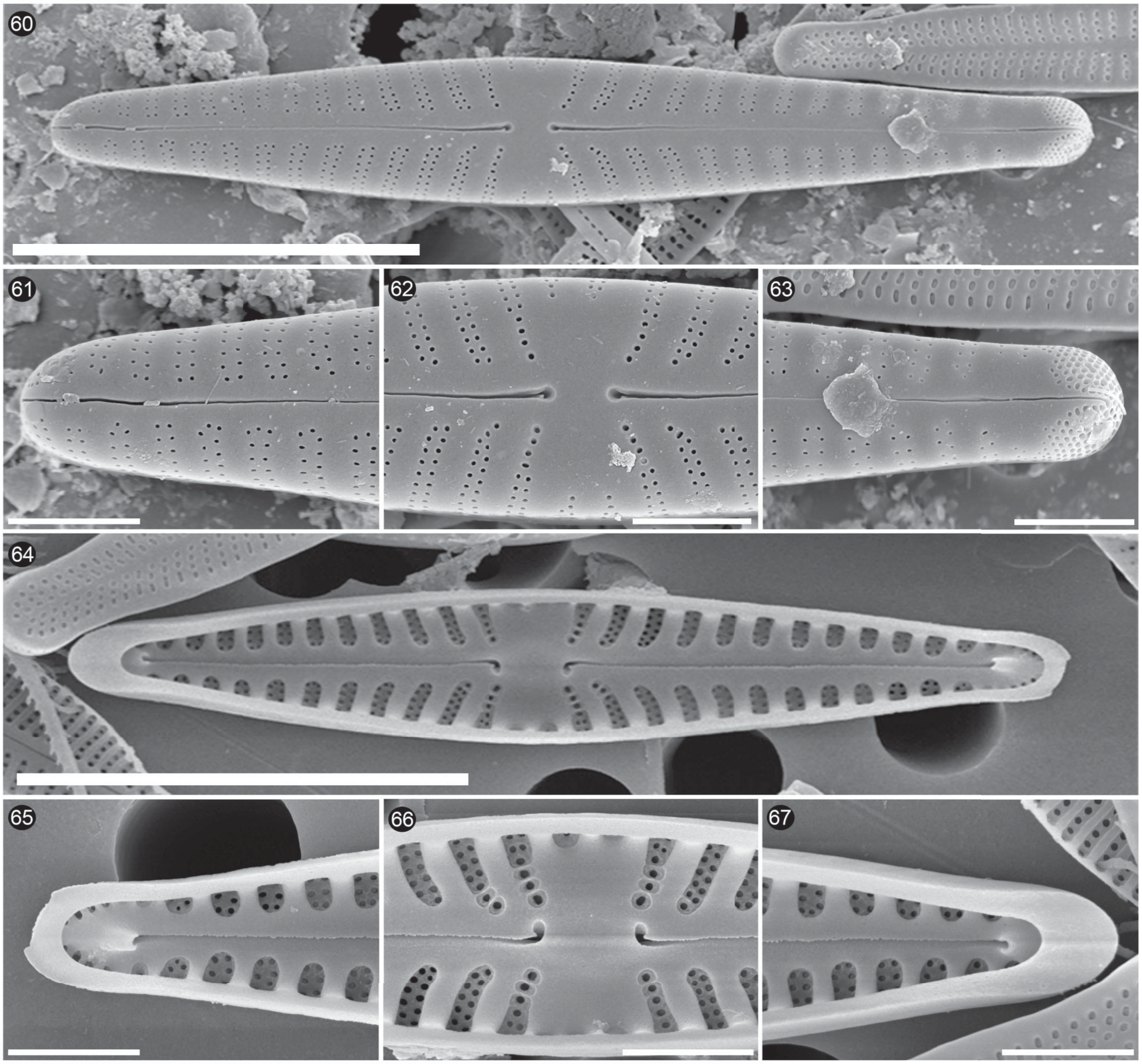
Figs 52–59. The second population of *Gomphonella saldanensis* sp. nov., SEM micrographs. **Fig. 52.** External view of entire valve. **Figs 53, 55.** External view showing the terminal fissures. **Fig. 54.** Details of the central area showing silicate tongues protruding into the drop-like recessed central pores. **Fig. 56.** Internal view of entire valve with distinct pseudosepta at the headpole and smaller pseudosepta at the foot pole. **Figs 57, 59.** Internal view of distal raphe endings showing thickened helictoglossae. **Fig. 58.** Internal view of the central area showing distinctly curved like crocket-hooks proximal raphe endings and partially recessed areolae around the central area. Scale bars = 10 µm (Figs 52, 56), 2 µm (Figs 53–55, 57–59).

Type localıty: Turkey, Lake Salda (37°31′13.47″ N; 29°40′24.44″ E, 1.316 m. a.s.l.). Collector: Cüneyt Nadir Solak 14.11.2016.

Registration: http://phycobank.org/103823

Etymology: The species was named for the place where it was found, namely Salda Lake.

Assocıated dıatom flora: In the sample, *Achnanthidium barlasii* Solak, Wojtal, S. Blanco, Peszek & M. Rybak and *Encyonema lacustre* (C. Agardh) Mills were the dominant taxa. Unidentified species of *Diatoma* Bory de Saint-Vincent, *Nitzschia* Hassall and *Parlibellus* E.J. Cox were frequent in the sample and are currently under further study to determine their identity.



Figs 60–67. The third population of *Gomphonella saldanensis* sp. nov., SEM micrographs. **Fig. 60.** External view of entire valve. **Figs 61, 63.** External view showing the terminal fissures. **Fig. 62.** Details of the central area showing silicate tongues protruding into the drop-like recessed central pores. **Fig. 64.** Internal view of entire valve with distinct pseudosepta at the headpole and smaller pseudosepta at the foot pole. **Figs 65, 67.** Internal view of distal raphe endings showing thickened helictoglossae. **Fig. 66.** Internal view of the central area showing distinctly curved like crocket-hooks proximal raphe endings and partially recessed areolae around the central area. Scale bars = 10 µm (Figs 60, 64), 2 µm (Figs 61–63, 65–67).

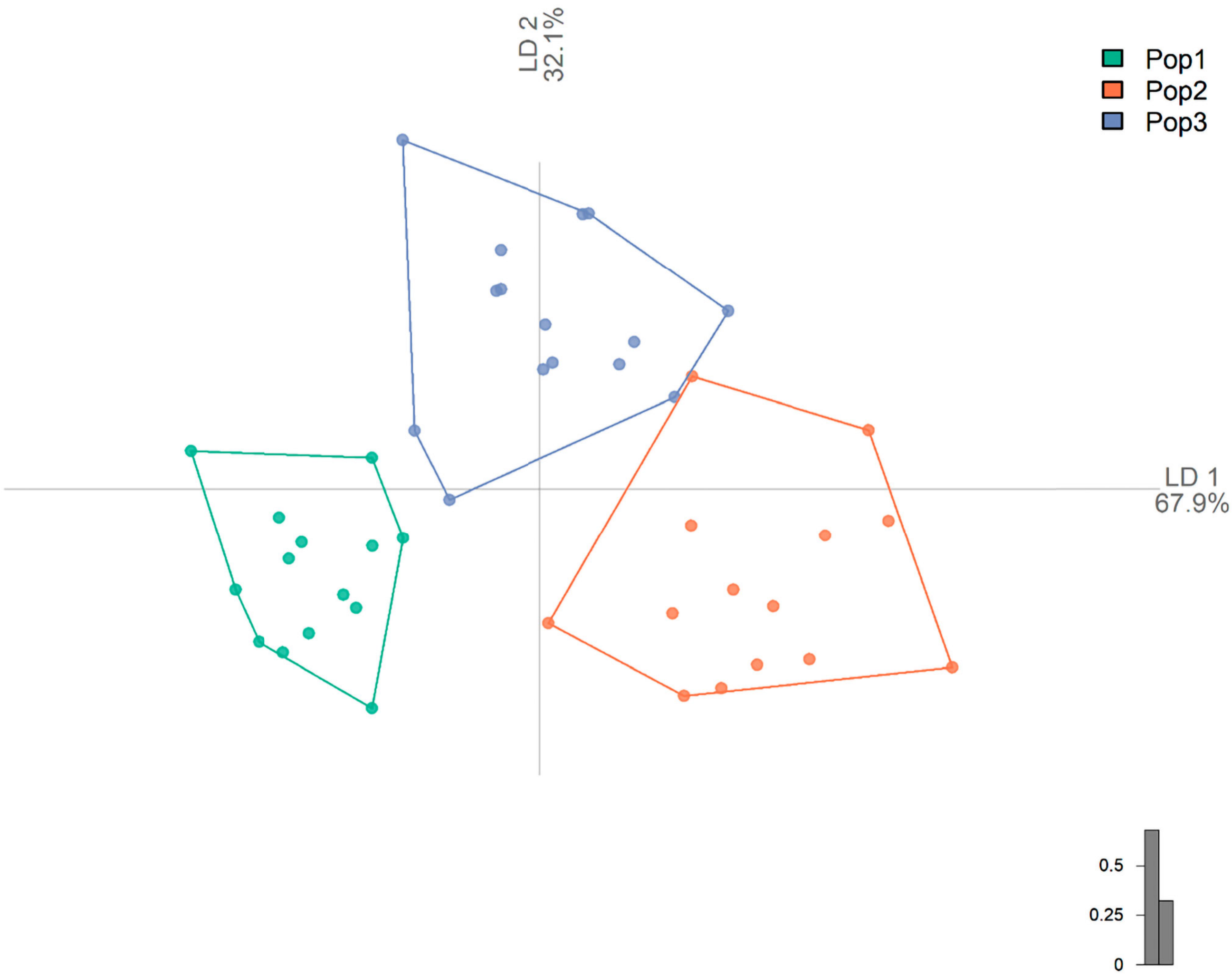
Description

Light microscopy: Cells solitary. Frustules wedge-shaped in girdle view. Valves linear-lanceolate with rostrate headpole and narrowly rounded footpole (Figs 2–43). Valve dimensions of first population ($n = 25$): length 25.5–38.5 µm, width 4.0–4.5 µm; second population ($n = 38$): length 20.0–28.5 µm, width 3.0–4.0 µm and third population ($n = 68$): length 23.0–33.0 µm, width 3.5–5.0 µm (Table 2). Axial area linear-lanceolate from mid-valve to apex. Central area bow-tie-shaped, bordered by two or three shortened striae on both sides. Raphe filiform. Transapical striae in LM radiate in the mid-valve, 11–14 in 10 µm, becoming parallel to slightly radiate and denser towards poles, 13–16 in 10 µm.

Scanning electron microscopy (Figs 44–51, 52–59, 60–67): Striae biseriate, composed of two rows of small rounded areolae. Striae in mid-valve become uniseriate

Table 2. Morphological characteristics of *Gomphonella saldanensis* sp. nov. and *Gomphonema* and *Gomphonella* species with similar morphological features.

	Gomphonella saldanensis sp. nov.										
	Population 1 (n:25)	Population 2 (n:38)	Population 3 (n:68)	*Gomphonella xinjiangiana*	*Gomphonella rostratoides*	*Gomphonema geisslerae*	*Gomphonema lagerheimii* f. *simplex*	*Gomphonella acsiae*	*Gomphonella calcarea*	*Gomphonella coxiae*	*Gomphonella olivacea*
Valve length (µm)	25.5–38.5	20.0–28.5	23.0–33.0	22.4–32.7	35.8–45.0	18.0–27.5	25.0–36.0	13.0–44.5	18.5–57.0	35.5–55.7	14.3–42.2
Valve breadth (µm)	4.0–4.5	3.5–4.0	3.5–5.0	5.3–6.3	5.9–6.0	2.6–3.8	5.0–6.0	4.5–8.8	4.5–7.5	6.7–8.6	5.5–8.7
Stria density (in 10 µm)	11–14	12–14	12–14	14–16	12–14	13–15	12	11–15	10–11	9–11	8–15
Areolae	Biseriate, generally ending uniseriate at the centre striae, rounded			Biseriate, uniseriate by the central area, rounded	Biseriate, uniseriate by the central area, rounded	Biseriate, c-shaped	–	Biseriate, uniseriate by the central area, rounded	–	Biseriate, generally uniseriate near the central area, rounded	Biseriate, generally uniseriate near the central area, rounded
Striae	Strongly radiate in the mid-valve, becoming parallel to slightly radiate towards poles			Radiate, becoming parallel toward headpole, slightly radiate toward the footpole	Strongly radiate, becoming parallel toward headpole and footpole	Strongly radiate in the mid-valve, becoming parallel to slightly radiate towards poles	Slightly radiate throughout the valve	Slightly radiate in the mid-valve, becoming parallel towards poles	Strongly radiate in the mid-valve, becoming parallel to slightly radiate towards poles	Slightly radiate in the mid-valve, becoming parallel towards poles	Strongly radiate in the mid-valve, becoming slightly radiate towards poles
Raphe	Filiform			Undulate	Filiform	Slightly undulated	Filiform	Filiform	Filiform	Filiform	Filiform
Valve shape	Linear-lanceolate with strongly rostrate headpole and narrowly rounded footpole			Lanceolate-clavate with narrowly rounded headpole and slightly broader rounded footpole	Lanceolate-clavate with rounded headpole and footpole	Linear to linear-lanceolate with narrowly rounded headpole and footpole	Linear-lanceolate in larger specimens to, clavate to rhombic-lanceolate in smaller specimens with rostrate headpole and rounded, sometimes subrostrate more constricted than footpole	Lanceolate in larger specimens to clavate in smaller specimens with narrowly rounded headpoles and acutely rounded footpole	Linear-laneolate in larger specimens and clavate to rhombic-lanceolate in smaller specimens	Lanceolate in larger specimens to clavate in smaller specimens with narrowly rounded headpoles and acutely rounded footpole	Clavate with broadly rounded headpole and acutely rounded footpole
Central area	Distinctly bow-tie-shaped			Bow-tie-shaped	Round to elliptic	Small, transversely elongated	Small	Bow-tie-shaped	Strongly dilated, shape of bow-tie	Bow-tie-shaped to rectangular	Bow-tie-shaped to elliptic
Axial area	Very narrow, rounded			Narrow, linear	Narrow	Very narrow, linear	Very narrow	Narrow, rounded	Narrow	Narrow, rounded	Narrow, rounded
References	This study			You et al. (2013)	You et al. (2013)	Reichardt (1997), Levkov et al. (2016)	Foged (1973)	Jahn et al. (2019)	Bey et al. (2013)	Jahn et al. (2019)	Jahn et al. (2019)



Figs 68. LDA plot. pop1: the first population of *Gomphonema saldanensis* sp. nov., pop2: the second population of *Gomphonema saldanensis* sp. nov., pop3: the third population of *Gomphonema saldanensis* sp. nov.

towards axial and central aresa (Figs 45–47, 53–55, 61–63). Areolae only distinguishable in electron microscopy, 5–6 in 1 µm. Externally, central raphe fissures within drop-like depressions (Figs 46, 54, 62) and terminal raphe fissures straight, with deep slit extending onto mantle (Figs 45, 47, 53, 55, 61, 63). Apical striae extend in a random manner down mantle. Footpole pore field dense and variable, some pores similar to areolae on valve face changing to larger recessed pores (Figs 47, 55, 63). Internally, central pores distinctly curved, like crocket-hooks, and terminal pores merge into broad rounded helictoglossae. Areolae recessed between thickened virgae, except uniseriate areolae around central area, with narrow vimenes on internal valve face (Figs 50, 58, 66).

Discussion

The limnology of the Salda Lake was investigated in detail by Kazanci et al. (2004). In their study, conductivity was between 2470 and 2910 µS cm^{-1}, pH between 8.3 and 9.7, calcium concentrations were high with 20.04 and 120.2 mg L^{-1}, and inorganic carbon was abundant, mainly as bicarbonate (1.0–4.5 mg L^{-1}) and carbonate (8–16 mg L^{-1}). Inorganic nitrogen was mainly in the form of nitrate (0–0.7 mg L^{-1}), while ammonia concentrations were < 0.89 mg.L^{-1}. Nitrite and phosphate concentrations were low and remained below detection limits for the duration of their study. Based on chlorophyll-*a* content the lake was oligotrophic with very limited phyto- (15 taxa) and zooplankton (7 taxa) diversity (Kazanci et al. 2004). According to that investigation, there was no benthic fauna because of the extreme physical and chemical conditions in the lake. However, in the years covered by our study (2016–2020), we recorded higher pH and conductivity values.

With LM, the new species is superficially similar to many *Gomphonema* sensu stricto species, such as *Gomphonema geisslerae* E. Reichardt & Lange-Bertalot in Reichardt and *Gomphonema lagerheimii* f. *simplex* Foged. It is also similar to *Gomphonella acsiae* R. Jahn & N.

Abarca, *Gomphonella calcarea* (Cleve) R. Jahn & N. Abarca, *Gomphonella coxiae* R. Jahn & N. Abarca, *Gomphonella olivacea* (Hornemann) Rabenhorst, *Gomphonella rostratoides* (Q.M. You & Kociolek) R. Jahn & N. Abarca, and *Gomphonella xinjiangiana* (Q.M. You & Kociolek) R. Jahn & N. Abarca.

Gomphonema geisslerae has a similar valve outline to *G. saldanensis* sp. nov. but *G. geissleriae* is smaller (18.0–27.5 µm long, 2.6–3.8 µm wide) than *G. saldanensis* (20.0–38.5 µm long, 3.5–5.0 µm wide). Moreover, *G. geisslerae* has biseriate, c-shaped areolae (not rounded as in *G. saldanensis*), and the raphe is slightly undulate (not linear). Furthermore, *G. geisslarae* has a smaller foot pole pore field with fewer pores (Levkov et al. 2016, plate 162: 50). The central area is also different, small and transversely elongated in *G. geisslerae* (not distinctly bow-tie-shaped). On the other hand, *G. lagerheimii* f. *simplex* is almost lanceolate in shape with more acuminate poles while *G. saldanensis* sp. nov. has a linear-lanceolate outline. Another distinctive feature is the stria structure. The striae are nearly parallel with a small central area in *G. lagerheimii* f. *simplex* but strongly radiate in the mid-valve with a distinctly bow-tie-shaped central area in *G. saldanensis* sp. nov. All *Gomphonema* have stigmoids while G. *saldanensis* does not.

Gomphonella acsiae is weakly heterovalvar to almost lanceolate in outline with an acutely rounded footpole and broad valve (4.5–8.8 µm). In contrast, *G. saldanensis* sp. nov. has a linear-lanceolate valve that is narrower (3.5–5.0 µm) with narrow rounded apices. *Gomphonella acsiae* has slightly radiate striae at mid-valve, becoming parallel towards the poles. In contrast, *G. saldanensis* has strongly radiate striae at mid-valve with slightly radiate striae towards poles. *Gomphonella calcarea* and *G. coxiae* are also similar to *G. saldanensis* sp. nov., but *G. calcarea* and *G. coxiae* populations have larger valves (18.5–57.0 µm long, 4.5–7.5 µm wide and 35.5–55.7 µm long, 6.7–8.6 µm wide respectively) than *G. saldanensis* (20.0–38.5 µm long, 3.5–5.0 µm wide). They also have lower stria densities (9–11 in 10 µm) and are linear-laneolate in larger specimens but clavate in smaller specimens.

Gomphonella olivacea sensu stricto is another similar taxon, however, its valves are broader (5.5–8.7 µm) than in *G. saldanensis*. Additionally, it has a different valve shape (clavate with broadly rounded headpole and acutely rounded footpole). Some varieties of *Gomphonella olivacea* (Hornemann) Rabenhorst (= *Gomphonema olivaceum* (Hornemann) Ehrenberg) are also worthy of comparison. *Gomphonema* (*olivaceum* var.?) *angustum* Kützing (Van Heurck 1880, fig. 25: 25) and *G. olivaceum* var. *balticum* (Cleve) Grunow in Van Heurck (Van Heurck 1880, figs 25: 24a–c) are similar in valve outline (lanceolate), valve length (26.0–35.0 µm and 29.0–41.0 µm, respectively) and in stria density (11–13 in 10 µm) (Levkov & Williams 2011). Nevertheless, both varieties have broader valves (5.9–6.5 and 5.9–8.3 µm) than *G. saldanensis.* Finally, *G. rostratoides* and *G. xinjiangiana* have a lanceolate-clavate valve outline and the valves are larger than *G. saldanensis* (> 5.1 µm) (Table 1).

Salda Lake has a unique benthic environment due water chemistry conditions and the presence of hydromagnesite stromatolites (Braithwaite & Zedef 1996), with a distinct diatom flora on this unique stromatolite substratum (C.N. Solak, unpublished data). Moreover, these hydromagnesite stromatolites are an excellent analogue for exobiological microbial biomes on other planets, such as Mars (Russell et al. 1999). For these reasons, the lake will be investigated more intensively and considered for future protection from recreational and tourism activities to save and maintain this unique environment.

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No potential conflict of interest was reported by the author(s).

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