Pseudostaurosira ellipticolanceolata, a new araphid diatom (Bacillariophyta) from Flanders, Belgium

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During the analysis of a sediment core collected in Aardenburg (Flanders, Belgium), species of a species of *Pseudostaurosira* that could not be identified using the currently available literature was observed. The genus *Pseudostaurosira* D.M.Williams & Round (1987: 276) contains mostly species with an elliptic, linear to linear-lanceolate valve outline, possessing uniseriate striae composed of one to only a few small, circular areolae, occluded by usually branched volae, a broad sternum, small, reduced apical pore fields, that occasionally are absent, and the absence of rimoportulae (Williams & Round 1987, Cejudo-Figueras *et al.* 2011). Recent taxonomic advances in the genus *Pseudostaurosira* (Cejudo-Figueiras *et al.* 2011, Garcia *et al.* 2021, Grana *et al.* 2018, Li *et al.* 2018, Morales *et al.* 2015, 2019, 2021) markedly increased our knowledge of this group. Morales *et al.* (2021) illustrated and discussed many newlyspecies of *Pseudostaurosira*, providing a detailed overview of a large number of species in this genus. To date, however, the morphological delineation of the genus *Pseudostaurosira* is still debated (see e.g. Marquardt *et al.* 2021), and its exact molecular phylogenetic status and position are as yet unresolved, with the genus being potentially paraphyletic (Li *et al.* 2018). We here adopted the above-mentioned list of features as being diagnostic of the genus *Pseudostaurosira*, and have therefore decided to assign the new species to this genus.

Despite extensive comparison with morphologically similar *Pseudostaurosira* species worldwide, the unknown species in the Aardenburg sediment core could not be identified and therefore most likely represents a new species that is described here based on light (LM) and scanning electron microscopy (SEM) observations: *Pseudostaurosira ellipticolanceolata* André, Sabbe & Van de Vijver, *sp. nov*. As we are dealing with subfossil material, the valves are partly eroded obscuring some details such as spine shape and areola occlusions. Nevertheless, the combination of observed features enabled to separate the new species from all previously described *Pseudostaurosira* species. The associated diatom flora is used to provide an ecological profile of the new species.

New species description

***Pseudostaurosira ellipticolanceolata* André, Sabbe & Van de Vijver, sp. nov.** (Figs 1–21 LM, 22–28 SEM)

Valves lanceolate to linear-lanceolate in larger specimens, becoming elliptic-lanceolate to elliptic in smallest valves (Figs 1–21). Valve margins parallel in longer valves to distinctly convex in the smaller range of the cell diminution series. Apices very weakly protracted (Figs 1–3), subrostrate, to non-protracted, broadly rounded in smaller specimens. Valve dimensions (n=40): valve length 4–20 µm, valve width 3.5–4.0 µm. Sternum broad, lanceolate. Striae uniseriate, parallel to weakly radiate throughout the entire valve length, 16–18 in 10 µm, composed of 1–2, rarely 3 areolae, on valve face (Figs 22, 25), and 1–2 areolae on valve mantle. Areolae at valve face/mantle junction markedly larger, becoming smaller towards sternum (Figs 22, 24). Mantle areolae separated from those on valve face by short linking spines (Figs 22, 25). Interdigitating spines originating from vimines, spatulate with broad tip (but probably broken and eroded) (Fig. 23, white arrows). Areola occlusions eroded, vestiges partly visible in some areolae, suggesting volate occlusion type (Fig. 28, black arrows). Apical pore field reduced to a handful of very small pores (Figs 27, 28, white arrows). Internally, sternum flat with raised virgae between striae (Fig. 26). Rimoportula absent. Girdle structure not observed due to severe erosion of the frustules.

Type:—BELGIUM. Aardenburg sediment core, sample 85, coll. date 1st of March 2019, leg. C. André (holotype slide BR-XXXX= Fig. XXX, isotype slide XXXX, University of Antwerp, Belgium). Sample 85 is part of a silty clay layer.
PhycoBank registration: —https://phycobank.org/XXXX

Ecology & associated diatom flora:—*P. ellipticolanceolata* has a relative abundance of almost 10% in the type sample. The sample is part of sediment core and dates back to the Holocene. The first indications show a possible age between the 4th and 10th century AD (André, unpubl. res.). Other species with a relative abundance greater than 3% include (in decreasing abundance) *Epithemia adnata* (Kützing 1833: 544) Brébisson (1838: 16), *Staurosira venter* (Ehrenberg 1854: 13, pl. XIV) Cleve & J.D.Möller (1879: no. 242) sensu Lange-Bertalot *et al.* (2017), *Eunotia minor* (Kützing 1844: 39) Grunow (in Van Heurck 1881: pl. 33, figs 20, 21), *Cymatosira belgica* Grunow (in Van Heurck 1881: pl. 45: figs 38–41), *Navicula cincta* (Ehrenberg 1854: pl. 10/2: fig. 6a-e) Ralfs (in Pritchard 1861: 901), *Epithemia turgida* (Ehrenberg 1832: 80) Kützing (1844: 34), *Nanofrustulum sopotensis* (Witkowski & Lange-Bertalot 1993: 67) E.Morales *et al.* (in Morales *et al.* 2019: 275), *Paralia sulcata* (Ehrenberg 1838: 170) Cleve (1873: 7) and *Gomphonema exilissimum* (Grunow in Van Heurck 1880: pl. 25: fig. 12) Lange-Bertalot & E.Reichardt (in Lange-Bertalot & Metzeltin 1996: 70). This diatom flora points to a brackish, eutrophic environment (Lange-Bertalot *et al.* 2017). Both *Epithemia* species are typically epiphytic and may point to the presence of submerged vegetation, but are also salinity-tolerant and often occur in aquatic conditions with higher electrolyte contents (Lange-Bertalot *et al.* 2017). McQuoid & Nordberg (2003) observed *Paralia sulcata* to be dominant in well-mixed upwelling zones with high salinities and high phosphorus levels. *Paralia* and *Cymatosira* often co-occur. Both taxa are considered marine/marine-brackish tychoplanktonic and observed typically in tidal inlets and large tidal channels (Vos & de Wolf, 1988). The presence of *Eunotia minor* is more difficult to explain but most likely the result of the influx of foreign material.

Taxonomic comments:—Morales *et al.* (2021) discuss a large number of *Pseudostaurosira* species that are known worldwide when they described several new species from Bolivia. Based on valve outline and valve dimensions, the new *P. ellipticolanceolata* shows some similarity with the group of *Pseudostaurosira subsalina* (Hustedt) E.A.Morales (2005: 115) and *P. polonica* (M.Witak & Lange-Bertalot in Witkowski *et al.* 1995: 736) E.A.Morales & M.B.Edlund (2003: 235). *Pseudostaurosira occulta* E.A.Morales, C.E.Wetzel & Ector (2021: 40) shows comparable valve dimensions (length 7–35 µm, width 3.5–4.0 µm) and, at least in the longer range of the size diminution series, a comparable valve outline with almost parallel margins. However, differences can be noted in the shape of the apices (squarish in *P. occulta*, more broadly rounded in *P. ellipticolanceolata*), stria density (14–16 in 10 µm in *P. occulta* versus 16–18 in 10 µm in P. *ellipticolanceolata*) and stria structure. In *P. occulta*, striae are usually composed of 3–4 areolae whereas striae with 3 areolae are rather rare in *P. ellipticolanceolata*. Due to the high degree of erosion, it was not possible to comment on the structure and shape of the apical pore field (covered by an external flap in *P. occulta*) and the linking spines. *Pseudostaurosira subsalina* has broader valves (valve width 4.0–5.5 µm), a lower stria density (13–14 in 10 µm), a higher number of areolae per stria, a larger apical pore field (compared to the reduced pore field in *P. ellipticolanceolata*), and a broader transition step between valve face and mantle, excluding possible conspecificity (Cejudo-Figueiras *et al.* 2011). *Pseudostaurosira zolitschkae* M.L.García *et al.* (2021: 265) differs in having acutely protracted

valve apices and a much lower stria density (11–14 in µm) (García *et al.* 2021). Other taxa in this group differ by the shape of the areolae (*P. polonica* has only one, transapically elongated areola per striae), valve dimensions or valve outline. *Pseudostaurosira oliveraiana* Grana *et al.* (2018: 63) has longer valves (19–39 µm) and typically capitate to rostrate apices throughout its entire cell diminution series (Grana *et al.* 2018, figs 2–15). Smaller taxa such as *P. alvareziae* Cejudo-Figueiras, E.A.Morales & Ector (2011: 69) and *P. oblonga* E.A.Morales, C.E.Wetzel & Ector (2021: 41) have a more elliptic to elliptic-lanceolate valve outline with strictly convex margins, whereas elongated, more linear-lanceolate valves are so far not observed, in contrast to *P. ellipticolanceolata* where longer valves usually have parallel margins.

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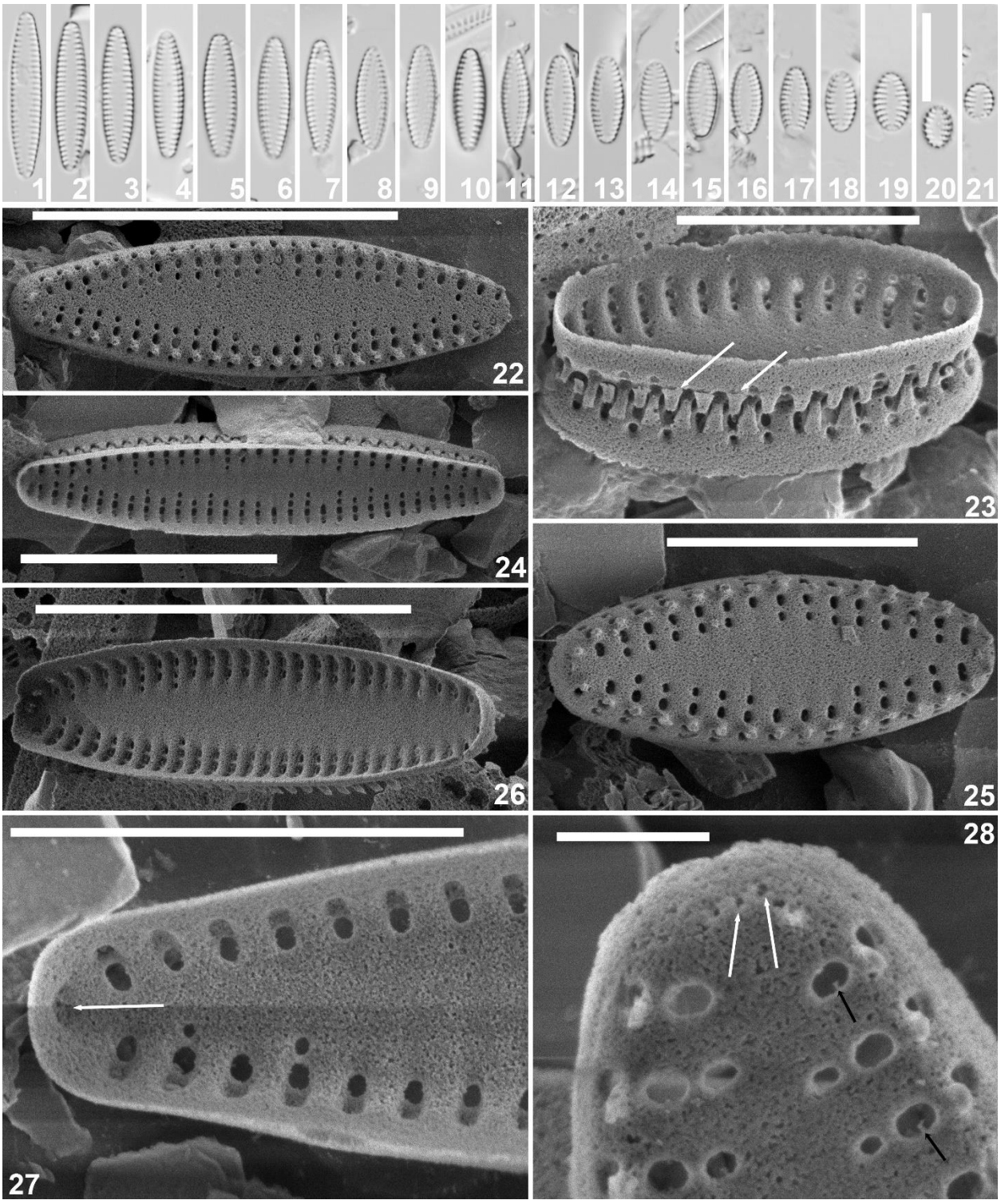
Figure captions

Figures 1–35. *Pseudostaurosira ellipticolanceolata* André, Sabbe & Van de Vijver, sp. nov. LM and SEM pictures taken from the holotype material (BR-XXX, Aardenburg sediment core, depth 85 cm, Belgium). Figs 1–21. LM views of several specimens arranged in decreasing size. Fig. 22. SEM external view of an entire valve. Fig. 23. SEM view of two valves with interdigitating spines (white arrows). Fig. 24. SEM internal view of an entire valve, connected to another. Fig. 25. SEM external view of an entire valve. Fig. 26. SEM internal view of an entire valve. Note the raised virgae bordering the flat sternum. Fig. 27. SEM internal detail of the valve apex. The white arrow indicates the apical pore field. Fig. 28. SEM external detail of the valve apex. The white arrows indicate the eroded apical pore field. The black arrows indicate the presence of vestiges of the areola coverings. Scale bars represent 10 µm except for Figs 23, 25 & 27 where scale bar = 5 µm and Fig. 28 where scale bar = 1 µm.



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