

Navicula pierre-comperei sp. nov. (Bacillariophyta), a small benthic diatom recently observed in several Central European rivers

Horst Lange-Bertalot^{1,2} & Gabriele Hofmann^{3,*}

¹Goethe-University, Grüneburgplatz 1, DE-60323 Frankfurt am Main, Germany

²Silberweg 3, DE-61350 Bad Homburg, Germany

³Hirtenstraße 19, DE-61479 Glashütten, Germany

*Author for correspondence: gm.hofmann@t-online.de

Background and aims – An unidentifiable naviculoid diatom was found in several small rivers of Germany over some years of routine water monitoring. Since it occurred rather abundantly in places taxonomical and ecological definition is required.

Methods – Acid-cleaned diatom material, mounted in Naphrax, was observed and photographed in a light microscope with PlanAPO objectives, for SEM analysis gold-sputtered on stubs using Hitachi S 4500 field emission techniques.

Key results – *Navicula pierre-comperei* is described and proposed as a new species. It is compared in particular to *Navicula claytonii* J.R. Carter, a similar taxon from the British Isles, currently absent from Central Europe.

Key words – Bacillariophyta, Naviculaceae, *Navicula* s. str., section Alinea, *Navicula pierre-comperei* sp. nov., Europe.

INTRODUCTION

The genus *Navicula* Bory sensu stricto was represented by 150 taxa in the European freshwater diatom flora in a comprehensive monograph (Lange-Bertalot 2001). A majority of 128 taxa belong to the nominate section *Navicula*, characterized by central raphe ends and the final endings of the distal raphe fissures deflected to the secondary side of the valve, i.e. the same side as the Voigt discontinuity; in common with the neotypus generis *Navicula tripunctata* (designated by R. Patrick 1959) based on Van Heurck, Type de Synopsis no. 81 (see Cox 1979, and 1999 for a fuller account). Lange-Bertalot (2001) recognised a species-poor section, Alinea, consisting of only 22 taxa that are distinguished by central raphe ends deflected to the primary, i.e. the opposite, side. Thus, presumably unknown taxa belonging to the latter section are much easier to compare to established ones. In the meantime, with respect to Central Europe, a single additional species, *Navicula antverpiensis* Van de Vijver & Lange-Bert. (Van de Vijver & Lange-Bertalot 2009) has been described from the Nethe River in Belgium; a few more have been described from Scandinavia or elsewhere. The subject of this paper is the second new species in this section from Central Europe.

MATERIAL AND METHODS

The sampling location lies in the southeastern corner Rheinland-Pfalz, Germany close to the border with Luxembourg, near the mouth of the rivulet 'Enz' into the River Prüm at Holsthum (Gauss-Krüger-coordinates H 5528293 R 2529422). The sample was taken on 9 Aug. 2003, and the associated epilithic diatom assemblage consisted of common taxa such as *Cocconeis placentula* Ehrenb., *Amphora pediculus* (Kütz.) Grunow, *Melosira varians* C.Agardh, *Navicula capitatoradiata* Germain, *N. gregaria* Donkin, *N. tripunctata* (O.F.Müll.) Bory, indicating eutrophic to polytrophic and β-mesosaprobic conditions.

The samples for diatom analysis were treated using hydrochloric acid (25%) and sulphuric acid (95–97%) and repeatedly washed in distilled water. The obtained suspension was prepared for permanent slides with Naphrax high resolution mountant. Light photomicrographs were taken under oil immersion with a PlanAPO objective at magnification x1000, num. aperture 1.4, using a Nikon Eclipse E600 and Zeiss Scope A1. For SEM analyses, material was sputter coated with gold on stubs and observed using a Hitachi S 4500 (field emission).

RESULTS

Navicula pierre-comperei Lange-Bert. & G.Hofm., sp. nov.
Fig. 1

Type: holo-: Praep. Mo-N-64 in Coll. Lange-Bertalot Naturmuseum Senckenberg (FR) represented by LM fig. 1F; iso-: Coll. G. Hofmann 834. – Type locality: River Enz at Holsthum, near its entry into the River Prüm, a secondary tributary of the Moselle River, Rheinland-Pfalz, Germany (9. Aug. 2003 collected by Doris Stelzer). This is treated as part of the upper Moselle River ('Obermosel').

Latin description – Valvae elliptico-lanceolatae vel plus minusve aliquid rhombico-lanceolatae apicibus non protractis sed simpliciter obtuse rotundatis. Longitudo 16–24 µm, latitudo 5.5–6 µm. Ratio longitudo/latitudo circiter 3–4. Raphe filiformis recta extremis centralibus aliquid indistincte deflexis ad latus primum valvae fere distanter sitis inter se. Area axialis angusta paene linearis vel parum expansa proximaliter. Area centralis distincte separata transverse dilatata interdum paene rectangulata plerumque plus minusve papilionacea ad instar propter 4–5 strias hic irregulariter abbreviatis sed non alternantes breviores longioresque. Alterae striae transapicales fortius radiales et interdum curvatae sigmoidae proximaliter tum minus radiales denique subparallelae (fere perpendiculares) sub apices, 13–14 in 10 µm. Areolae interdum difficulter discernendae microscopio photonico, > 35 in 10 µm. Aspectus ultramicroscopicus externus internusque vide fig. 1K–M. Externus: Depressiones pororum centralium leviter deflexae ad latus primum id est ex adverso positae ubi disordinatio Voigtii et fissurae terminales dupliciter curvatae terminant. Foramina areolarum singulariter isodiametrica circiter circularia in striis proximalibus sed apicaliter elongata in striis distalibus ut typica in genere *Navicula* sensu stricto. Internus: Areolae oclusae hymenibus circulares proximaliter et elongatae distaliter. Raphe sita in modo ut typica in genere *Navicula*. Areolae 36–40 in 10 µm.

Diagnosis differens – Species similissima, *Navicula claytonii* J.R.Carter (Carter 1987) differt proprie dimensionibus circiter minoribus 8.7–18 µm longis, 4–5.5 µm latis, striis modice densius sitis 15–16 in 10 µm minus radiantibus et numquam curvatis sigmoidis in media parte valvarum etiam areolis distantius sitis inter se 26–30 in 10 µm. *Navicula microcari* Lange-Bertalot differt valvis angustioribus et lineolis densius sitis, 40–45 in 10 µm, extremis centralibus raphis leniter deflexis ad latus secundum valvae.

LM: description – Valves elliptical-lanceolate to approximately rhombical-lanceolate, ends obtusely rounded, not protracted. Length 16–24 µm, breadth 5.5–6 µm. Length-to-breadth ratio c. 3–4. Raphe filiform, straight, central pores appear, somewhat indistinctly, slightly deflected to the primary side, rather widely spaced. Axial area narrow, almost linear or very slightly expanded proximally. Terminal areas distinct. Central area very clearly defined, large, transapically expanded, c. 2/3–3/4 of the valve width, sometimes rectangular but mostly bowtie-shaped due to 4–5 irregularly shortened striae, however, not alternately shorter and longer. Other striae strongly radial and sometimes sigmoidally curved subproximally (fig. 1D–G & K) becoming less radial distally, not curved and finally subparallel towards the apices, 13–14

in 10 µm. Areolae barely resolved in LM even with oblique lighting.

SEM: description – External view, see fig. 1K–M. The slightly expanded central pores are slightly deflected to the primary side of the raphe, the opposite side to the Voigt discontinuity and the final (apical) part of the double-curved terminal raphe fissure. Areola foramina are almost circular in proximal stria pairs, becoming gradually elongated apically towards the ends. This is a characteristic feature of this new small-celled *Navicula* taxon. Internally (fig. 1N–P) the raphe slit appears less twisted than in the majority of other *Navicula* spp. sensu stricto, but almost straight (see fig. 1N). As far as observed in other central areas free from particles the slit is never interrupted, a particular nodule is lacking. The areolae are occluded by hymenes, varying in apical expansion like the external foramina, 36–40 in 10 µm.

Etymology – This species is dedicated to our colleague Pierre Compère (Botanic Garden Meise) on the occasion of his 80th birthday.

Distribution and ecology – At present the distribution is poorly known. It was not recorded during our routine observations of European rivers over the past century. It is currently recorded as an uncommon element of diatom assemblages in several German rivers and may occur elsewhere. Thus, it has been found in the River Dhünn, in the Lower Rhine watershed, Nordrhein-Westfalen; the River Saale near Camburg-Stöben and the River Weisse Elster downstream of Gera, both in the River Elbe watershed in Thuringia. Its abundance is rather to very high in the recorded habitats, which are eutrophic to polytrophic but not more than moderately β-mesosaprobic. Our colleague E. Coring photographed it in very high abundance from the River Lenne, Lower Rhine watershed (E. Coring, Hardegsen, Germany, pers. comm.).

DISCUSSION

Since living cells have not yet been observed, the shape of plastids – either two plate-like, girdle-appressed as in *Navicula* s. str. or one H-shaped, as in *Sellaphora* – remains unknown. This new taxon could have been mistaken in the past as a member of *Sellaphora* Mereschkowsky, being left undescribed like so many others because of the difficulties in differentiation. Indeed, the majority of *Sellaphora* spp. that are more closely related to the type species *Sellaphora pupula* (Kütz.) Mereschk. are not that similar and misidentification is unlikely, given the entire complex of morphological characteristics. However, a few critical taxa in *Sellaphora*, such as *S. seminulum* (Grunow) D.G.Mann and *S. joubaudii* (H.Germ.) Aboal appear morphologically more similar to our new taxon than to *S. pupula* in a wide sense. *S. joubaudii* resembles in size dimensions, stria position and density, shape of central area, widely spaced central raphe ends. Other *Sellaphora* taxa possess similar valve shapes and slight transversal thickening near the apices.

Nevertheless, the possibility of misinterpretation in the past remains hypothetical. It appears more likely that it was either not recorded or was absent from European diatom assemblages. It was never found during our own monitoring activities over 45 years in numerous European waters. Thus it

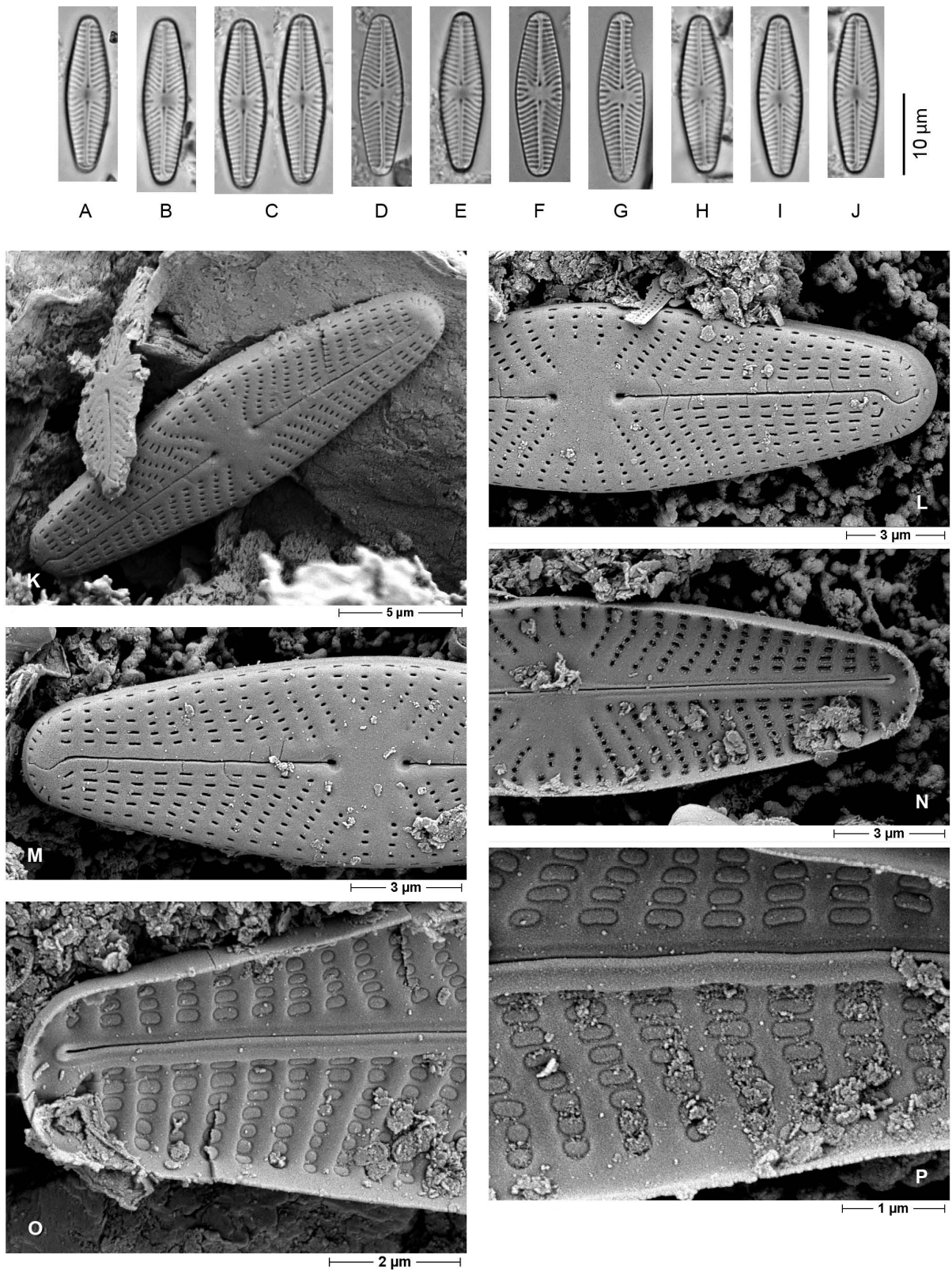


Figure 1 – *Navicula pierre-comperei*: A–J, images in light microscopical view, F holotype; K–M, images in SEM external view; note short to almost isodiametric areola foramina in proximal parts, becoming elongate (‘lineolae’) only in distal and/or adaxial parts of the valve face; central raphe pores are slightly more expanded to the primary valve side, i.e. opposite Voigt discontinuity (particularly distinct in K, M) and opposite final curve of terminal fissures. Subproximal striae are sometimes sigmoidly curved (K); N–P, internal view; note non-twisted, almost straight course of raphe slit from centre to small helictoglossa; closing membranes (hymenes) of areolae corroded (N) or intact (O, P).

may be that it is an invasive species, as for instance the prominent *Gomphoneis minuta* (J.L.Stone) Kociolek & Stoermer or *Encyonema triangulum* (Ehrenb.) Kütz. in French and few German rivers, both originating from North America. However, where might *N. pierre-comperei* have come from? We have never previously observed such a *Navicula* from any biogeographic realm, including extra-European regions of the Holarctic – irrespective of the question to which one of the two sections it may belong. Rather than the above-mentioned questionable *Sellaphora* species, *Navicula claytonii* J.R.Carter (Carter 1987), discussed and amended by Kelly et al. (2009), is the most similar species. A higher magnification of the valve ends in Carter's (1987) line drawing shows lineolate striae with c. 26–30 areolae in 10 µm, characteristic of *Navicula* s. str. and unlike the circular areolae in *Sellaphora*. Carter's taxon has been widely recorded from the British Isles (Britain and North Ireland) but not from elsewhere in Europe (Kelly et al. 2009). It differs from our taxon mainly by its smaller size, 8.7–18 µm long, 4–5.5 µm broad, with slightly more densely spaced, less radial and never sigmoidly curved striae, 15–16 in 10 µm. Moreover, the areola density is considerably lower, with 26–30 (vs. 36–40) areolae in 10 µm. *Navicula microcari* Lange-Bert. (see Lange-Bertalot 2001) has narrower valves and a higher length-to-breadth ratio, 3.7–4.7; lineola density is higher, 40–45 in 10 µm, and the central pores are slightly deflected to the secondary valve side as seen in the majority of taxa in *Navicula* s. str.

ACKNOWLEDGEMENTS

The authors thank Manfred Ruppel, Biologikum, Goethe-University Frankfurt a. M. for cooperation with light and electron microscopy.

REFERENCES

- Carter J.R. (1987) *Navicula claytonii*, a new diatom. *Microscopy* 35: 633–635.
- Cox E.J. (1979) Taxonomic studies of the diatom genus *Navicula* Bory. *Bacillaria* 2: 137–153.
- Cox E.J. (1999) Studies on the diatom genus *Navicula* Bory. VIII. Variation in valve morphology in relation to the generic diagnosis based on *Navicula tripunctata* (O. F. Müller) Bory. *Diatom Research* 14: 207–237. <http://dx.doi.org/10.1080/0269249X.1999.9705467>
- Kelly M., Juggins S., Yallop M. (2009) Distribution and ecology of *Navicula claytonii* (J.R. Carter) M.G. Kelly, comb. nov. in Britain and Ireland. *Diatom Research* 24: 237–244. <http://dx.doi.org/10.1080/0269249X.2009.9705795>
- Lange-Bertalot H. (2001) *Navicula sensu stricto*, 10 genera separated from *Navicula sensu lato*, Frustulia. *Diatoms of Europe*, vol. 2.
- Patrick R. (1959) New subgenera and two new species of the genus *Navicula* (Bacillariophyceae). *Notulae Naturae* 324: 1–11.
- Van de Vijver B., Lange-Bertalot H. (2009) New and interesting *Navicula* taxa from Western and Northern Europe. *Diatom Research* 24: 415–429. <http://dx.doi.org/10.1080/0269249X.2009.9705811>

Manuscript received 4 Aug. 2014; accepted in revised version 3 Sep. 2014.

Communicating Editor: Bart Van de Vijver.