



Gyrosigma rostratum sp. nov. (Bacillariophyta) from the low intertidal zone, Xiamen Bay, southern China

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Abstract

Gyrosigma rostratum, sp. nov., a new diatom species from the low intertidal zone, Xiamen Bay, southern China, was studied with light and scanning electron microscopy. The valves are lanceolate with protracted rostrate apices, symmetrical to both apical and transapical axis, not sigmoid. The raphe is straight, with a raphe angle of approximately two degrees. The external central raphe endings turn in the same direction and are isomorphic. The unique characteristic of the valve is that a conopeum (a lunate flap of silica, approximately 0.8–1.1 µm wide by 4.4–4.8 µm long) covers the terminal axial area and two rows of areolae near each apex. *Gyrosigma rostratum* is epipsammic and lives in marine habitats.

Key words: Benthic diatom, diatom flora, ecotone, intertidal sand-flats, symmetrical biraphid

Introduction

Reid (2012) gave the number of currently accepted species in *Gyrosigma* Hassall (1845: 435) as a little over 200. From the 19th century through to today, and especially in more recent decades, delimitation of the generic boundaries for *Gyrosigma* have been studied (Reid 2012). Earlier, Thaler and Kaczmarek (2009) were able to summarize the salient morphological features to allow identification of species placed in *Gyrosigma*. These characters included the longitudinal to transapical striae ratio (Sterrenburg 1991, 1994, 1995), the deflection of the central raphe endings (Sterrenburg 1993), the structure of the central bars of silica (Cardinal *et al.* 1989, Reid and Williams 2003) and the presence or absence of a crescent of apical micropores above the terminal raphe endings (Sterrenburg 1991, Reid and Williams 2003). Based on these features, Thaler and Kaczmarek described the new species *Gyrosigma orbitum* from eastern Canada (Thaler and Kaczmarek 2009).

Round *et al.* (1990) placed *Pleurosigma* W. Smith (1852: 2) and *Gyrosigma* in the family Pleurosigmataceae, pointing out clear differences in the stria systems of both genera (one longitudinal and one transversal for *Gyrosigma*; one transversal and two oblique for *Pleurosigma*) and in plastid morphology and raphe-sternum structure between *Gyrosigma* and *Pleurosigma*: two large plate-like plastids per cell and, internally, the raphe-sternum thickening on one side of the raphe for *Gyrosigma*; two or four ribbon-like plastids per cell and the raphe-sternum thickening internally approximately equally on both sides of the raphe for *Pleurosigma*. Thus, these morphological features should be included in the identification of species in *Gyrosigma*.

Diatom studies in China lack international exposure. There is little information on China's marine littoral diatom flora, including, among others, species in the genera *Gyrosigma* and *Pleurosigma*. Jin and Liu (1979) reported some new species and new records in *Pleurosigma* and *Gyrosigma*. The only comprehensive Chinese marine diatom flora was published by Jin *et al.* (1982, 1992); however, their images are not of good quality. *Gyrosigma* ('*sinensis*') *sinense* (Ehrenberg) Desikachary (1988: 11; basionym: *Navicula sinensis* Ehrenberg 1847: 485) was typified by Jahn and Sterrenburg, Ehrenberg's type material being from China ("Blumenerde Canton A aus China (Potting soil A from Canton, China)", Jahn and Sterrenburg 2003: 62). They discussed the species limits of *G. sinense* using additional material from the coast of Cameroon and Guinea-Bissau, West Africa, and the coast of Brazil, but were not able to

(1975: 207) but the poles were not shown in detail (Montgomery and Miller 1978: plate 110, figs. C–D). *Gyrosigma rostratum* is different from *G. inflatum* in the outline of its valve (straight vs. sigmoid), length of valve (57–93 µm vs. 200–220 µm) and the location of the conopeum (this does not appear in the central area for *G. rostratum*). Conopea have also been found in other genera such as *Fallacia* Stickle & D. G. Mann in Round *et al.* (1990: 554), *Mastogloia* Thwaites ex W. Smith (1856: 63), *Microcostatus* Johansen & Sray (1998: 93), *Nitzschia* Hassall (1845: 435) and *Sellaphora* Mereschowsky (1902: 186). Details of the conopea are best viewed with the SEM but may be visible with the light microscope as longitudinal lines near the raphe (*e.g.* Mann & Trobajo 2014) or as unornamented areas of the valve face (*e.g.* Potapova 2011). The conopeum in *G. rostratum* is discernible in the bright-field photographs (Figs. 3–4) but its unique shape can only be confirmed with SEM (Fig. 14). The functions of the conopeum need further study (some conopea have been found to contain symbiotic nitrogen-fixing cyanobacteria, Round *et al.* 1990); it is highly unlikely that all structures that have been named or interpreted as conopea are homologous and further investigation of the nature of various these structures is needed.

Homolateral deflection of external central raphe fissures appears to be rare in *Gyrosigma*. From external views of an epitheca and a hypotheca of *G. rostratum* (Figs. 12–13, 15–16), it is easy to notice that the epitheca and hypotheca are mirror images. The external proximal raphe fissures of the two valves (*i.e.* epitheca and hypotheca) are superimposed one above the other in a frustule. Therefore, *G. rostratum* is an isomorphic species according to Sterrenburg (1993). At least four species have this homolateral deflection which have been confirmed in SEM, including *G. rostratum*, *G. fagedii*, *G. littorale* (W. Smith) Griffith & Henfrey (1856: 303; basionym: *Pleurosigma littorale* (*litorale*) W. Smith 1852: 10; see Sterrenburg 1992) and *G. macrum* (W. Smith) Griffith & Henfrey (1856: 303; basionym: *Pleurosigma macrum* W. Smith 1853: 67; see Cardinal *et al.* 1989). *Gyrosigma rostratum* could not be confused with *G. littorale* and *G. macrum* but it bears some resemblance to *G. fagedii* as both have fairly straight valve outlines.

Of all our 32 sampling sites (29 of which will be reported later), *G. rostratum* is only found in three low sand intertidal zones, two of which (Huizhan Centre and Zengcuo Village) yielded a small number of specimens of *G. rostratum*. To discern whether it occurs in middle or high intertidal zones, a further distributional survey is needed.

Acknowledgements

We are very grateful to Frithjof A. S. Sterrenburg for consultations, to the editor and reviewers for helpful comments, to Ming Li for assistance with SEM, to Hua Long for assistance with LM. This work was joint supported by National Basic Research Program (2011CB403603) and the SOA Ocean Research Project, China (Grant Nos. 201005015 and 201105021-03).

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