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Four newly recorded species of Bacillariophyta from the mangroves in China

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Abstract Four species of diatoms from the mangroves in Fujian Province and Shenzhen City of China are described. They are *Cymbella cucumis* A. Schmidt, *Navicula elegantoides* Hustedt, *N. platyventris* Meister, and *N. tenera* Hustedt. They represent new records for China. Detailed description of the taxonomic characters of the four species and of their ecological behavior is given. *Cymbella cucumis* was defined as a freshwater and brackish water species for it occurred, though occasionally, where water salinity was more than 15.
Key words Diatom, mangroves, new record, China.

Mangroves are woody plant communities which occur in the intertidal zones of tropical and subtropical coastlines of the world (Lin, 1984). Mangrove algae constitute a significant food source for various organisms in the mangrove ecosystem (Nicholas et al. , 1988). Taxonomic studies of diatoms from mangrove environments have been carried out in many countries (Foged, 1979；Navarro, 1982；Nagumo & Hara, 1990；Sequeiros-Beltrones & Castrejon, 1999). In China, however, such studies have been less reported (Du & Jin, 1983), especially for benthic diatoms (Fan et al. , 1993; Chen et al., 2005).

Benthic diatoms serve as a common food for certain mangrove fishes (Beumer, 1978) and diatoms were abundant in phytoplankton in mangroves (Liu & Chen, 1997). In this paper, four newly recorded species of diatoms from the mangroves in China were reported. They are *Cymbella cucumis* A. Schmidt, *Navicula elegantoides* Hustedt, *N. platyventris* Meister and *N. tenera* Hustedt.

1 Material and methods

Samples were collected from water and mudflat in mangroves in Fujian Province and Shenzhen City, China, respectively. All samples were treated with 10% HCl to remove the calcareous matter, and treated with 30% H_2O_2 to destroy the organic material. Each sample was diluted by adding distilled water until no acid was left in the sample. Treated samples were identified and photographed under an Olympus BH-2 microscope (1000×) and a JEM-100CX II transmission electron microscope (TEM).

2 Description of species

1. Cymbella cucumis A. Schmidt in A. Schmidt et al., Atlas Diatomaceenkunde 9, pl. 9, figs. 21, 22. 1885; Cleve, Kongliga Svenska Vetenskaps-Akademiens Handlingar 26: 165. 1894；Hustedt in A. Schmidt et al., Atlas Diatomaceenkunde 375. 1931.

瓜形桥弯藻 Fig. 1

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Valve broad, with convex dorsal and almost straight or slightly convex ventral margin. Ends rostrate-truncate, 70 μm long, 22 μm wide (79–90 μm long and 24 μm wide in Cleve (1894)). Axial area narrow, slightly dilated around the central nodule. Raphe slightly arcuate. Striae 9 (dorsal) to 10 (ventral) in 10 μm; areolae 12–14 in 10 μm.

This species is similar to *Cymbella lata* Grunow and *C. ehrenbergii* Kützing, but *C. lata* has dense areolae, approximately 30 in 10 μm, valve 40–60 μm long, 16–18 μm wide, raphe slightly eccentric, slightly curved, with dorsally reflexed apical fissures, and occurs in fresh and slightly saline water. *Cymbella ehrenbergii* has narrow, slightly protracted ends, almost straight raphe, axial area moderately wide, lanceolate, roundishly widened around the central nodule, valve 50–220 μm long, 19–50 μm wide, and occurs in freshwater, brackish water and sea water (Cleve, 1894).

Habitat: Freshwater and brackish water. Cleve (1894) pointed out that *Cymbella cucumis* is a freshwater species, but we found it occurred where water salinity ranged from 5.0 to 26.1 sampled from January 2001 to January 2003.

Distribution: Our samples were collected from mudflat in mangroves in Yunxiao County, Fujian Province, China. This species has been previously found in Bengal and Cameroon (Cleve, 1894).

2. Navicula elegantoides Hustedt in A. Thienemann, Die Binnengewasser 16 (2): 76, fig. 142. 1942; Prowse in Garden's Bull., Singapore 19: 42. 1962.

拟优美舟形藻 Fig. 2

Valve elliptical-lanceolate with rostrate, produced apices, 60 μm long, 23 μm wide (60–85 μm long and 22–26 μm wide in John (1983)). Axial area broad, narrowing towards the apices, central area broadly lanceolate, slightly asymmetrical. Raphe branches broad. Striae costate, radiate towards the middle, becoming convergent towards the apices, 7 in 10 μm.

This species is similar to *Navicula yarrensis* Grunow and *N. elegans* W. Smith, but valve of *N. yarrensis* has 4–4.5 striae in 10 μm, 80–162 μm long, 26–35 μm wide, with the striae radiate in the middle, parallel to slightly convergent at the apices, and that of *N. elegans* has 9–11 striae in 10 μm, approximately parallel margins and large orbicular central area, 75–80 μm long, 18–21 μm wide, with the striae strongly curved, radiate towards the middle and parallel to convergent towards the apices (John, 1983).

Habitat: Freshwater and brackish water, benthic and planktonic. Water salinity ranges from 2.2 to 35.6 in John (1983) and from 5.0 to 26.1 in our samples, respectively.

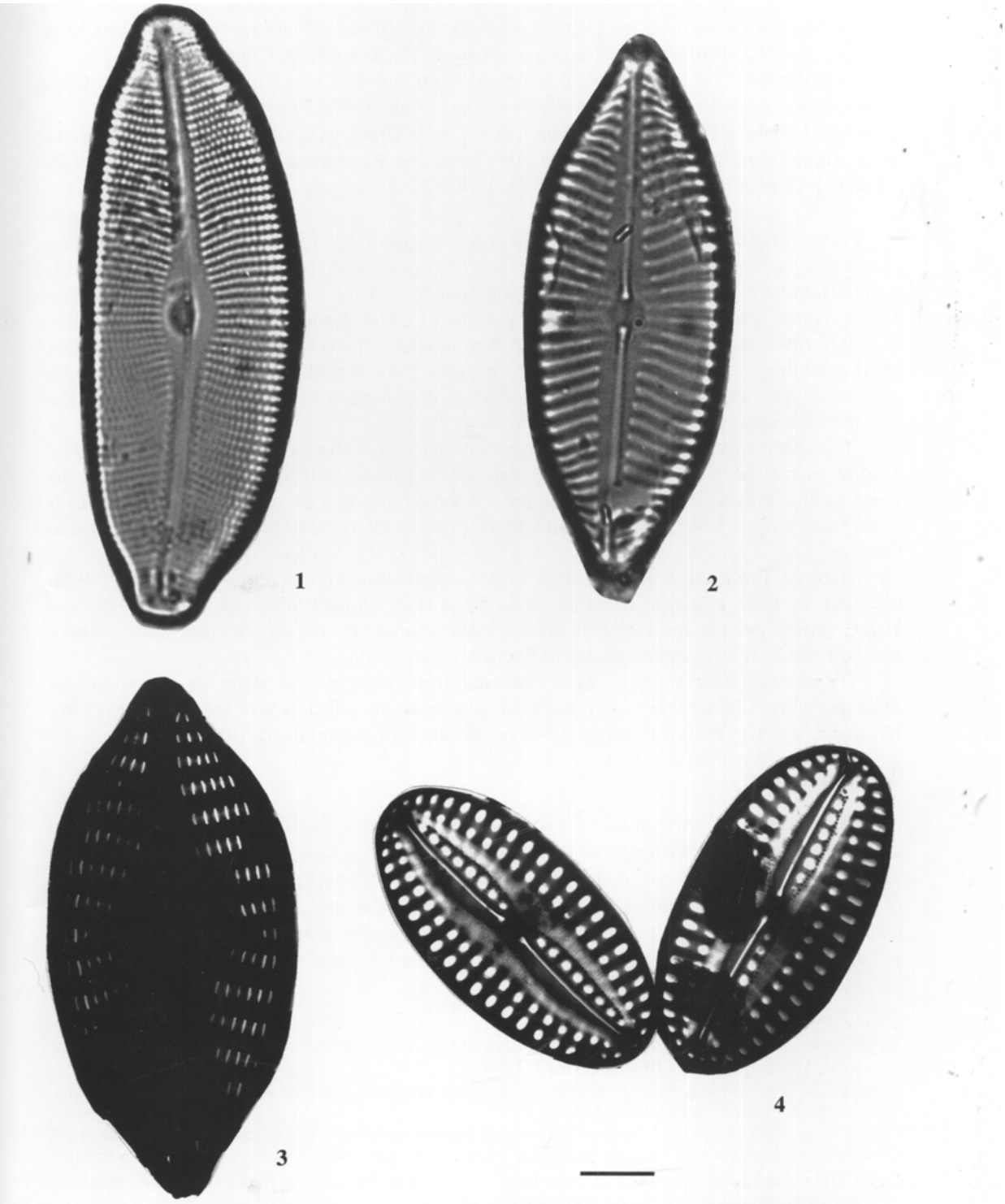
Distribution: Our samples were collected from mudflat in mangroves in Yunxiao County, Fujian Province, China. This species has been previously found in Sri Lanka (Foged, 1976) and estuarine of Swan River in Australia (John, 1983).

3. Navicula platyventris Meister in Bibl. Diatom. 44: 95, fig. 33. 1935.

侧偏舟形藻 Fig. 3

Valve long elliptical, 2-rostrate, 17 μm long and 4.5 μm wide (11–22 μm long and 5–7 μm wide in Navarro (1982)). Striae radiate with short bar areolae, 27 in 10 μm. Axial area narrowing towards the apices, central area orbicular, with a short stria on each side.

This species is different from *Navicula rhaphoneis* (Ehr.) Grunow by its short striae and areolae (Cheng et al., 1993). In *N. rhaphoneis*, the valve is 11.5–35 μm long and 5–11 μm wide, the apical endings turn to the same side, the central area is expanded, with 2 short striae on each side (only 2 areolae), striae radiate towards the middle, becoming parallel or slightly convergent near the apices, 11–12.5 in 10 μm.



Figs. 1–4. Photomicrographs of four newly recorded species of Bacillariophyta. **1.** *Cymbella cucumis* (LM). **2.** *Navicula elegantoides* (LM). **3.** *Navicula platyventris* (TEM). **4.** *Navicula tenera* (TEM). Scale bar=3 μm for Figs. 3, 4 and 10 μm for Figs. 1, 2.

Figs. 1–4. Photomicrographs of four newly recorded species of Bacillariophyta. **1.** *Cymbella cucumis* (LM). **2.** *Navicula elegantoides* (LM). **3.** *Navicula platyventris* (TEM). **4.** *Navicula tenera* (TEM). Scale bar=3 μm for Figs. 3, 4 and 10 μm for Figs. 1, 2.

Habitat: Sea water and brackish water, planktonic. Water salinity ranges from 25 to 40 in Navarro (1982) and from 17.6–21.8 in mangroves in Shenzhen City, China, respectively.

Distribution: Our samples were collected from water in mangroves in Shenzhen City, China. This species has been previously found in Florida, USA (Navarro, 1982).

4. Navicula tenera Hustedt in A. Schmidt et al., Atlas Diatomaceenkunde 405, pl. 405. 1936；et in Archiv Hydrobiologie, suppl.-Bd. 15 (Tropische Binnengewasser, Bd. 7): 259. 1937; Prowse in Garden's Bulletin, Singapore 19: 48. 1962.

柔弱舟形藻 Fig. 4

Valve elliptical with broadly rounded poles, 12 μm long, 5.5 μm wide (9–14.5 μm long and 4–6.5 μm wide in Archibald (1983), 9–27 μm long and 4–9 μm wide in Krammer & Lange-Bertalot (1986)). The raphe is slightly arcuate, and the axial area is a wide lanceolate region made asymmetrical on account of the row of isolated pores on one side of the raphe. The axis rib is out of the axial area, with fine areolae. The transapical striae are relatively short extending a third of the valve width inwards from the margin. A curved longitudinal costa on either side of the raphe divides the striae into a smaller pore on the inner side of the costa, with a larger areole on the outer side.

The species has a row of isolated pores on one side of the raphe in the axial area. In its closely related species, such as *Navicula insociabilis* Krasske and *N. monoculata* Hustedt, the pores lie just outside the axial rib or slightly indented into it. The valve of *N. monoculata* is 6.5–11 μm long, 2.5–4.7 μm wide, with 30 axis ribs in 10 μm, and the apical endings turn to the same side.

Habitat: Freshwater and brackish water, planktonic and benthic. Archibald (1983) reported *Navicula tenera* to occur in estuarine of river, though Wujek & Rupp (1980) and Foged (1976) pointed out that it is a freshwater species. In our samples the water salinity ranged from 17.6–21.8 in mangroves of Shenzhen City, China.

Distribution: Our samples were collected from mudflat and water of mangroves in Shenzhen City, China. This species has been previously recorded in Sri Lanka (Foged, 1976), Michigan of USA (Wujek & Rupp, 1980) and South Africa (Archibald, 1983).

3 Discussion

Former studies have ascribed *Cymbella cucumis* to only freshwater species (Cleve, 1894；Prowse, 1962). We observed that it occurred, though occasionally, where water salinity was more than 15, suggesting that it was also a brackish water species. *Navicula elegantoides*, *N. platyventris* and *N. tenera* occurred in both freshwater and brackish water. Though *N. elegantoides* and *N. platyventris* were rare, *N. tenera* was common, ranging from 2.0×10^3–2.6×10^5 cells/L from Jan. 2001 to Jan. 2003 in the samples.

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红树林下中国新记录的四种硅藻

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摘要 报道了来自福建和深圳红树林下中国首次记录的4种硅藻, 即瓜形桥弯藻*Cymbella cucumis* A. Schmidt、拟优美舟形藻*Navicula elegantoides* Hustedt、侧偏舟形藻*N. platyventris* Meister 和柔弱舟形藻*N. tenera* Hustedt, 同时描述了每个种类的细胞形态特征和生态分布特点。作者认为淡水硅藻瓜形桥弯藻*C. cucumis*在半咸水和海水的环境中也有分布(盐度>15), 应属于淡水和半咸水种。

关键词 硅藻; 红树林; 新记录; 中国