

## *Fogedia giffeniana* (Foged) Witkowski, Lange-Bertalot, Metzeltin & Bafana a benthic diatom new to the Turkish Aegean Sea

Ege Denizinden yeni bentik diyatom *Fogedia giffeniana* (Foged) Witkowski, Lange-Bertalot, Metzeltin & Bafana

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**Özet:** Bu çalışmada Homa lagünü'nden (Ege Denizi, Türkiye) toplanan materyalden bentik diyatom türü *Fogedia giffeniana*'nın varlığı rapor edilmiştir. Türler ışık mikroskopu altında incelenerek, türün morfolojik karakteristikleri ayrıntılı olarak açıklanmıştır. Orijinal fotoğrafların yanında, ayrıca türün coğrafik dağılımı ve bulunduğu substratum hakkında bilgi verilmiştir.

**Anahtar kelimeler:** *Fogedia*, Morphometik data, Homa Lagünü, Doğu Akdeniz

**Abstract:** The study documents the occurrence of benthic diatom *Fogedia giffeniana* collected in the Homa lagoon (Aegean Sea, Turkey). Specimens were examined under the light microscope and morphological characteristics of this species were given in detail. Apart from the photo documentation, some information on the species geographical distribution patterns and the type of the substratum are also provided.

**Keywords:** *Fogedia*, Morphometric data, Homa Lagoon, Eastern Mediterranean

### INTRODUCTION

Coastal lagoon ecosystems are a particular type of estuarine systems which varies from freshwater media to excessive salty water media. The present study is conducted in Homa Lagoon, where there was a wide spectrum of ecologically different biotopes and this allows the formation of marine, brackish water and fresh water to form in the region. The taxonomic composition of phytoplankton community in the study area was examined only once during the last ten years (Cirik *et al.*, 1991) whereas benthic diatom surveys have been conducted recently (Çolak Sabancı 2010; 2011; 2012a, b; 2013). The studies on microphytobenthos are very limited in comparison to pelagic component, and especially the taxonomic literature on brackish water diatoms is quite scattered. The detailed description of the taxonomy, ecology and distribution of species obtained in this study will help both the correct species to be recognised for future studies and the development of a comprehensive diatom flora of the Aegean coast.

The genus of *Fogedia* was established towards the end of the 1990s based on the transfer of several taxa originally described as *Navicula* s.l. by e.g. Foged (1975) (cf. Witkowski *et al.*, 1997; 2000). In *Fogedia* the most important characters allowing it to be separated from *Navicula* s.str. include the internal raphe slit being straight vs. strongly oblique in *Navicula* s.str. and the presence of short, simple apical external raphe endings instead of strongly hooked in the same side as in *Navicula* s.str., e.g., Cox (1979), Lange-Bertalot (2001), Witkowski *et al.* (2010). In addition, the valve face of most *Fogedia* species bears a lateral area differing from those observed either in *Fallacia* A. J. Stickle & D. G. Mann in F. E. Round *et al.* (1990) or in *Lyrella* Karayeva (cf. Round *et al.*, 1990; Witkowski *et al.*, 1997).

### MATERIALS AND METHODS

The study area is located in Gediz Delta region (38°30' N, 26°55' E). The samples originate from Izmir. Gediz Delta (20400 ha), which consists of fresh water and salt water

marshes (5000 ha), bays and salt pans (3300 ha) and the lagoony areas which form the typical Mediterranean delta ecosystem. The average rainfall and temperature of the area are 544.2 mm and 16.8°C respectively. In the Gediz Delta region, which includes the study area, there are four lagoons: Homa (1800 ha), Çilazmak (725 ha), Tas (500 ha) and Kirdeniz (450 ha). Homa Lagoon (38° 33', 10" N, 26° 49', 50", E) is located 25 km northwest of the Gulf of Izmir and bordered by the town of Menemen (Fig. 1). Located adjacent to Çamaltı Saltpan and Izmir Bird Sancturay, the lagoon has a surface area of 1800 hectares (ha) and its depth ranges between 0.5 and 1.5 meter. Homa lagoon is one of the most important lagoons on the Aegean coast of Turkey, being a biodiversity hotspot. Because of its enormous species diversity and natural habitats, the lagoon was included in the important wetlands list in the Ramsar Convention.

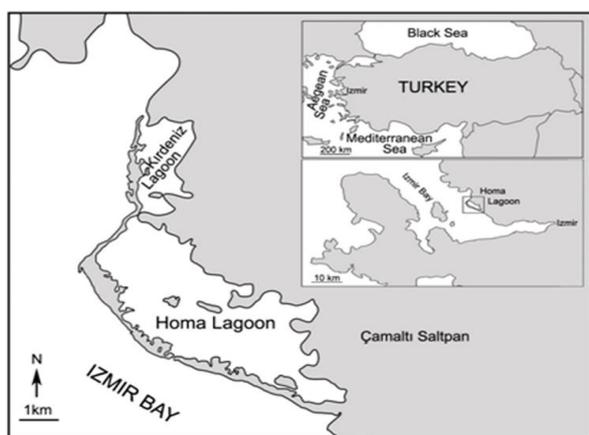


Figure 1. Map of the research area (Homa Lagoon, Turkey)

Periphyton sampling included epipelagic algae, epiphytic algae, and epilithic algae. Epipelagic diatom samples were taken by using cylindrical plexiglas corers (13 cm long × 6.1 cm i.d.). The sediment corers were left undisturbed for 24 h. During the exposure period, the corers were artificially illuminated for 2 h. After the waiting period, the sample from the upper part of 0–2 cm was taken and transferred to 250 ml polythene bottles containing distilled water (Ribeiro *et al.*, 2003). For the collection of epiphytic diatom samples, the macroalgae *Ulva lactuca* Linnaeus was chosen in the research region. Specimens of *Ulva lactuca* were placed in a large 1l sample container until it was about half full and 100–200 ml of distilled water was added. After that, the sealed container was shaken vigorously for ca. 60 seconds. The substrate was then brushed gently to remove the remaining attached diatoms and the suspension was decanted in a 250 ml bottle (Aligizaki and Nikolaidis, 2006). For the identification of epilithic diatoms, stones sized between 15–20 cm in diameter were collected. The stones were chosen as randomly as possible. From them, only those that were not smothered with filamentous algae and had an obvious diatom film were taken into consideration. The selected stones were placed in a plastic bath of 1l filled

with 200 ml of distilled water. The upper parts of the stones were brushed with a hard toothbrush and finally the mixture was decanted into the 250 ml polythene bottles (Winter and Duthie, 2000). Finally, all bottles containing epipelagic, epiphytic and epilithic diatom samples were fixed with formaldehyde solution (4% final concentration). Permanent slides for the identification of diatoms were prepared from the same sample. The cleaning of the diatoms involved 10% HCl, 30% H<sub>2</sub>SO<sub>4</sub>, KMnO<sub>4</sub> and oxalic acid (Christiansen, 1988). Cleaned diatoms were mounted permanently on slides with Naphrax and identified at 1000× magnification by means of phase-contrast optics with OLYMPUS × 100 Plan-apochromatic oil immersion objectives. Identification at species level was made following descriptions of Witkowski *et al.* (2000) and Witkowski *et al.* (2010).

## RESULTS AND DISCUSSION

*Fogedia giffeniana* (N. Foged) Witkowski, Lange-Bertalot, Metzeltin & Bafana in Witkowski, Metzeltin, Lange-Bertalot & Bafana 1997

Original publication: Witkowski, A., Metzeltin, D. Lange-Bertalot, H. & Bafana, G. (1997). *Fogedia* gen. nov. (Bacillariophyceae), a new naviculoid genus from the marine littoral. *Nova Hedwigia* 65: 79-98, 92 figs, 2 tables.

Basionym: *Navicula giffeniana* Foged

Homotypic Synonym: *Navicula giffeniana* Foged 1975

Description: Valves broadly lanceolate with slightly protracted apices, 22.45 to 27.20 µm long, 8.35 to 9.55 µm wide (Fig. 2).

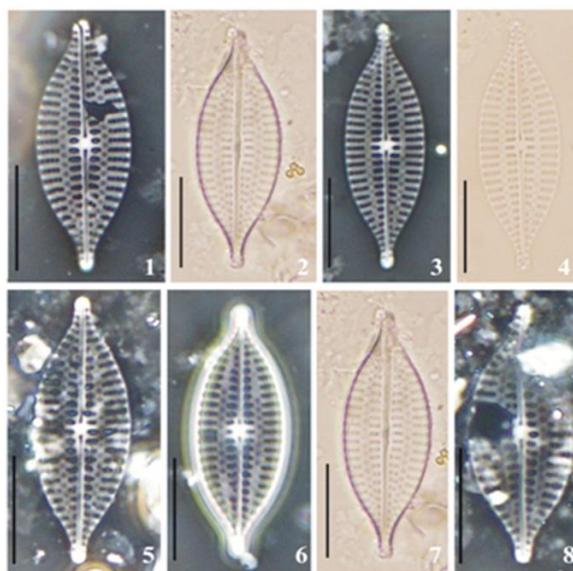


Figure 2. Micrographs of *Fogedia giffeniana* showing valve view. Scale bar = 10 µm.

The transapical striae (11-12 in 10 µm) vary from parallel in the valve centre to strongly radiate at apices. Morphometric data determined for *F. giffeniana*, especially valve length and striae density (number of transapical striae in 10 µm) showed differences with Witkowski *et al.* (2000). The valve length for *F. giffeniana* was smaller in our samples than that reported by Witkowski *et al.* (2000) (26-37 µm long). Likewise, the stria density for this species in our samples was less in comparison to that given by Witkowski *et al.* (2000) (12-14 in 10 µm).

**Ecology and Distribution:** *Fogedia giffeniana* was found only in epipellic and epiphytic diatom assemblages. It has not been reported from epilithic samples so far. When the distributions of this species according to the stations were examined, *F. giffeniana* occurred only at stations 1 and 2. The station 1 is the deepest station and throughout the sampling period the water depth is approximately 1.5 m. The station is exposed to the wave action and the sea floor is covered with gravel and sand. The station 2 is located in the region where the sea water is mixing with the lagoon water. This station is a little more sheltered than station 1 and has soft sediment substrate. Station 3 and 4 are less affected by sea water in comparison to the other stations and this species has not been reported there. This species originates from warm waters (Witkowski *et al.*, 2010). It has been reported thus far from the western Indian Ocean (Oman, Yemen, Kenya) and from the Mediterranean Sea (Witkowski *et al.*, 2000; Witkowski, A. unpubl.).

*Fogedia giffeniana* from Bacillariophyceae were reported for the first time from Turkish coastal waters. The species identified in this study is relatively uncommon species. Similarly, there have been no records of the genus *Fogedia* predominance in diatom assemblages in the entire world, only except in *F. geisslerae*, which was found in the North Sea at Rm Island, Denmark (Witkowski, unpubl.). So far, eight

species belonging to genus *Fogedia* were recorded and presently twelve *Fogedia* species are known (Park *et al.*, 2013). Focusing on the worldwide distribution of species of the genus *Fogedia* examined, they found that (I) *F. acuta* England (Salah, 1955), Oregon (Witkowski *et al.*, 2000); (II) *F. christensenii* Fiji (Witkowski *et al.*, 1997); (III) *F. coreana* Korea (Park *et al.*, 2013); (IV) *F. densa* China (Park *et al.*, 2013), Korea (Park *et al.*, 2013); (V) *F. elliptica* China (Park *et al.*, 2013), Korea (Park *et al.*, 2013); (VI) *F. finmarchia* Norway (Cleve and Grunow, 1880), England (Salah, 1955), Chile (Rivera, 1968), Greenland (Foged, 1973), Canary Islands (van den Heuvel and Prud'homme van Reine, 1985), Greek Island of Kos and Kalymnos (Foged, 1985), Fiji (Foged, 1987), Baltic Sea (Witkowski, 1994), North Croatia (Galović and Bajraktarević, 2006), Korea (Joh, 2013); (VII) *F. geisslerae* Baltic Sea (Witkowski, 1994); Wadden Sea (Witkowski *et al.*, 1997); (VIII) *F. giffeniana* Tanzania (Foged, 1975), Fiji (Foged, 1987), Oman (Witkowski *et al.*, 1997), Korea (Joh, 2013); (IX) *F. giffeniana* var. *yementica* Yemen (Witkowski *et al.*, 1997); (X) *F. heterovalvata* Baltic Sea (Simonsen, 1959), Caribbean Sea (Witkowski *et al.*, 2000), Korea (Joh, 2013); (XI) *F. krammeri* California (Witkowski *et al.*, 2010), Korea (Joh, 2013); (XII) *F. lyra* Korea (Park *et al.*, 2013), Japan (Park *et al.*, 2013). While the species have been reported to inhabit many different places of the world, a majority of the recorded taxa were the only member of the genus found in one location studied. A genus *Fogedia* is distributed in tropical regions (Witkowski *et al.*, 1997), temperate zone (Witkowski *et al.*, 2000), cold water (Witkowski *et al.*, 2010), however, rarely in the polar seas (Hendey, 1964; Witkowski *et al.*, 2000). The occurrence of this species for the first time in this study may be related to the lack of adequate studies in this region. In addition, there is generally less scientific expertise and research conducted on benthic diatoms compared with corresponding studies in phytoplankton.

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