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Cocconeis sawensis sp. nov. (Bacillariophyceae) from a saline lake (Sawa Lake), South Iraq: comparison with allied taxa

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Abstract

A new species of the genus *Cocconeis* is described. *Cocconeis sawensis* sp. nov. was observed as epiphyte on the macrophyte *Chara* Linn. sp., collected from a saline lake in Iraq (Sawa Lake). Description of the new species is based on details observed with light and scanning electron microscopy. *Cocconeis sawensis* belongs to a group of taxa similar to *Cocconeis euglypta* Ehrenberg, but differs in a number of fine ultrastructural features including stria density and hymenes, raphe, valve shape and rim, valvocopula, hymen perforations and fimbriae shape as well as a presence of a pore-like structure reminiscent of a vestigial raphe in the sternum valve. A comparison with closely related taxa is given.

Keywords: Sawa Lake, saline lake, diatoms, Cocconeidaceae, Iraq

Introduction

Sawa Lake (Fig. 1) is located at the eastern edge of the southern desert of Iraq, 22 km to the west of Euphrates River (31º 18' N, 45º 00' E). The lake is 5 km long and 1 to 2 km wide, completely surrounded by arid area, with an altitude of 18.6 m above sea level (Naqash *et al.* 1977). Water depth ranges between 3.0 to 5.5 m. The only water source to the lake is underground water flows through springs in the lake's center. According to Jamil (1977), the Euphrates aquifer feeds the lake through a system of cracks and fissures. Salinity of the lake, however, far exceeds that of the Euphrates River and has fluctuated remarkably through the last two decades.

The only work devoted to diatoms of Sawa Lake was that of Al-Handal (1994), where 116 brackish water taxa were recorded, mostly dominated by *Achnanthes brevipes* C. Agardh (1824:1) . Two other works were conducted on the phytoplankton of the Lake, the first by Hassan *et al.* (2006) and the other by Al-Saadi *et al.* (2008), where 59 and 33 diatom species, respectively, were recorded. Few other works were done on water chemistry (e.g. Maulood & Al-Mousawy 1989; Mohammad 2005; Hassan 2007; Alkam *et al.* 2002) and the geophysical properties of the lake (Al-Quraishi 2013).

The present work is part of a larger project which has as its goal to investigate the diatoms of Sawa Lake after two decades from the first taxonomical study, to examine diatom population change following the remarkable shift in salinity and other salts. 95% of the diatoms encountered in 1994 (Al-Handal 1994) have been replaced by other taxa, some of them have not been seen elsewhere and may be new species, and some others have been recorded thousands kilometers away, e.g., *Envekadea* sp. Van de Vijver, Gligora, Hinz, Kralj & Cocquyt in Gligora *et al.* (2009:124). One interesting species, very common as epiphyte on *Chara* sp. Linnaeus (1753:1156), *Cocconeis sawensis* sp. nov. is described in detail in the present study.

Material and Methods

Study site

Sawa Lake represents a unique, closed water body in Iraq (Fig.1). It lies on a bed of limestone rocks and has no surface water source, but is fed merely by underground water which flows through cracks and fissures, carrying high concentration of salts, particularly gypsum. The lake is surrounded by salt barrier mainly composed of gypsum and

taxa, where areolae of *C. shikinensis* are separated by undulated hyaline areas that are visible externally (Suzuki *et al.* 2001, fig. 11), a feature not found in *C. sawensis*. Silification in the area between valve apices and the helictoglossae is clearly seen in *C. shikinensis* and is absent in *C. sawensis* which possess a complete but irregular ring of raised silicified layer on the inner side of the RV.

LM and SEM illustrations of the SV of *C. nagumoi* are similar to that of C. *sawensis,* except for the presence of a row of larger areolae on each side of the SV sternum (axial area) in *C. sawensis*. The RV internal irregular rim is also in common to *C. sawensis* and *C. nagumoi*. On the other hand, several other features are dissimilar, particularly the RV valvocopula (Table 1). SV hymenes perforations in *C. nagumoi* are coarse, parallel but arranged irregularly (Suzuki & Tanaka 2006, fig. 22) while it is very fine and parallel in *C sawensis* (Fig. 22).

A characteristic and distinctive feature of *C. sawensis* and absent in all other related taxa is the presence of a small structure in the sternum of SV (Figs 12, 13, 15, 32–37). Some valves also have this structure in the middle of the valve which may also elongate longitudinally (Fig. 36). In some specimens, but rarely, the structures are present on both sides of the SV, it is more commonly seen on the external side. The function of these structures or pores is not clear but may be reminiscent of a vestigial raphe, more or less filled, and sometimes (but rarely, cf. Fig. 21) opened as a real pore, thus possibly giving communication between internal and external sides of the cell. Vestigial raphe slits, however, are seen in several species of monoraphid and araphid diatoms (Le Cohu & Maillard 1983; Lange-Bertalot & Le Cohu 1985; Kociolek & Rhode 1998) and may represent remnants of SV raphe.

The habitat of *Cocconeis sawensis* is characterized by extreme environmental conditions such as high concentration of sulphate and carbonate salts. Salinity of the lake reaches values similar to that of sea water (35 psu). Such conditions may be responsible for some teratological features observed in *C. sawensis* (Figs 38–41). Three commonly observed features are the deflection of the raphe (Fig. 39), abnormalities in valve outline (Figs 38,40) and distortion of areola structure (Fig. 39). High salinity in inland water, however, is known to cause abnormal valve outline and unusual length-breadth ratio of many diatom species (Cox 1995). Teratological features are not uncommon in *Cocconeis* and attributed to environmental stresses. Such features were reported in *C. euglyp*ta (Antoine & Benson-Evans 1983; Al-Handal & Abdulla 2010).

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