



## Valve morphology of four species of *Frustulia* (Bacillariophyta), including two described as new

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### Abstract

We present here descriptions and light and scanning electron micrographs for four species of *Frustulia*. Two of the species, *F. rexii* and *F. cf. saxonica*, were collected from the northern portion of the lower peninsula of Michigan, U.S.A. The third, *F. cf. krammeri*, can be found on at least two islands in Hawaii, U.S.A., while the fourth, *F. lacrima*, was collected from lakes in Brasil. We refer to the four species as “typical” *Frustulia* because their longitudinal rib systems resemble that seen in the generitype, *F. saxonica* Rabenh., and they share other valve features with this group. The new species differ from congeners in valve shape, organization and density of the striae, and degree of physical integration between the longitudinal ribs and helictoglossae. In both well-studied (Michigan) and less-studied (Hawaii, Brasil) parts of the world it appears there is more work to do to document the diversity of the genus *Frustulia*.

**Key words:** Amphipleuraceae, Bacillariophyceae, Brasil, *Frustulia*, Hawaii, Michigan, porte-crayon, taxonomy, valve morphology

### Introduction

Species of *Frustulia* Rabenh. are commonly reported in collections from fresh and brackish waters. Relationships of the genus have been explored by Cleve (1894), Hustedt (1935) and Reid & Williams (2007). Diagnoses of the genus have shifted over the last 10+ years. The simplest and most inclusive modern definition of the genus is provided by Lange-Bertalot (2001) who suggests that species of *Frustulia* possess longitudinal ribs. This definition, however, does not distinguish *Frustulia* from other genera that also possess longitudinal ribs, including other genera in the same family Amphipleuraceae Grunow (Reid & Williams 2007, Round *et al.* 1990).

Round *et al.* (1990) offer a much more precise definition of the genus, where *Frustulia* taxa have a flat valve face, a shallow valve mantle, uniserate striae comprised of round, oval, or lanceolate slit-like poroids, and full longitudinal ribs that fuse both with the helictoglossa to form a porte-crayon structure and with the central nodule. This relatively complex definition is relevant because it describes a large portion of the *Frustulia* species, outlines the major morphological features of the generitype, *F. saxonica* Rabenh. (1850: Nr. 42 in Rabenh. 1848–1860), and allows one to distinguish *Frustulia* from most members of the Amphipleuraceae that also have longitudinal ribs, excluding *Amphipleura*, which shares most morphological valve features with *Frustulia* (Round *et al.* 1990, Reid & Williams 2007, Hustedt, 1959). Additional characters that are common but not always present in *Frustulia* are a linear-lanceolate-rhomboidal valve shape (Lange-Bertalot 2001, Round *et al.* 1990) and some degree of longitudinal organization of the striae (Patrick & Reimer 1966, Siver & Baskette 2004, Metzeltin & Lange-Bertalot 2007). A folded valvocopulum with a notch mid valve has also been confirmed in at least one species of *Frustulia* (Round *et al.* 1990: 538).