



Nomenclatural priority of the diatom name *Fryxelliella sepulvedana* over *Fryxelliella pacifica* (Triceratiaceae, Bacillariophyta)

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Abstract

In 2008 two new species belonging to the genus *Fryxelliella* were described: *F. sepulvedana* and *F. pacifica*. They were based on material collected in the Pacific Ocean and were both different from *Fryxelliella floridana*, the type species of the genus. Examination of holotype and additional material for *F. sepulvedana* and *F. pacifica* was carried out. Comparisons confirmed that *F. sepulvedana* and *F. pacifica* are both the same species. Only one valid name can be assigned to any taxon and reasons are given to demonstrate that the valid name should be *Fryxelliella sepulvedana*.

Key words: diatom, *Fryxelliella*, nomenclature, ocelli, Pacific Ocean, priority, synonymy

Introduction

The genus *Fryxelliella* A.K.S. Prasad, K. Riddle & Livingston (1997: 306) was erected by Prasad *et al.* (1997) for two species of diatoms they considered similar to *Eupodiscus* Bailey (1851: 39). Until 2007 *Fryxelliella* was monotypic as one of the two species, *Fryxelliella inconspicua* (Ratray) A.K.S. Prasad in A.K.S. Prasad, K. Riddle & Livingston (1997: 309; basionym: *Eupodiscus inconspicuus* Ratray 1888: 911), had been removed to *Praetriceratium* P.A. Sims (2001: 404). Subsequently, Prasad & Nienow (2008) provided an emended description of *Fryxelliella* and in 2008 two further species were described from the Pacific Ocean, Salina Cruz coast in the Gulf of Tehuantepec, Mexico: *F. sepulvedana* Meave, Zamudio & Fernandez (Meave *et al.* 2008: 179) and *F. pacifica* Hernández-Becerril & Barón-Campis (Hernández-Becerril & Barón-Campis 2008: 150).

In *Fryxelliella sepulvedana* the position and size of the ocelli was noted as the most distinctive character that differentiated it from *Fryxelliella floridana* A. K. S. Prasad (1997: 306), the type species of the genus. Other characters, such as the structure of cribra, density of the sub-triangular apertures, and continuity of the siphon marginalis were also mentioned (Meave *et al.* 2008). *Fryxelliella pacifica* was differentiated from *F. floridana* by the size and shape of the cell, size location and morphology of ocelli, shape and density of the sub-triangular marginal apertures and the external morphology of rimoportulae (Hernández-Becerril & Barón-Campis 2008). These data justified the creation of a new species different from *F. floridana* but they describe one species not two. As both *F. sepulvedana* and *F. pacifica* were published in the same year, neither set of authors was aware of the duplication. This paper reviews the evidence and type material of both *Fryxelliella sepulvedana* and *F. pacifica*.

Material and methods

Type material of *Fryxelliella sepulvedana* and *F. pacifica* is present in MEXU (National Herbarium at Biology Institute of Autonomous National University of Mexico).

Slides were observed using a compound microscope (Olympus BX50) in bright field and phase contrast with integrated digital camera (light microscopy = LM). Photographs were obtained at 40x and 100x magnifications. Measurements were made with a calibrated ocular at 10x, 40x and 100x in a compound microscope (Zeiss).

Material collected from Los Cabos, Baja California Sur, México in October 2006, was rinsed to remove salts and fixatives and the specimens were then mounted for scanning electron microscope (SEM) using a JEOL JSM-5900LV.

Comparisons of morphological characters and diagnostic features were made using data from the literature as well as new observations on holotype and isotype specimens.

The *International Code of Nomenclature for algae, fungi, and plants (Melbourne Code)* was consulted for the current rules of priority and effective and valid publication (McNeill *et al.* 2012; <http://www.iapt-taxon.org/nomen/main.php>) so as to establish the priority of either *Fryxelliella sepulvedana* or *F. pacifica* as the valid name.

Abbreviations used: Light microscopy (LM); scanning electron microscopy (SEM).

Taxonomic results

Fryxelliella sepulvedana Meave, Zamudio & L. F. Fernandes (2008: 179)

Synonym: *Fryxelliella pacifica* Hernández-Becerril & Barón-Campis (2008: 150)

Type:—MEXICO: Salina Cruz coast in the Gulf of Tehuantepec, Pacific Ocean (MEXU 1837!, holotype of *Fryxelliella sepulvedana*; MEXU 1838!, MEXU 1839!, MEXU 1840!, MEXU 1841!, isotypes of *Fryxelliella sepulvedana*; MEXU 1705!, holotype of *Fryxelliella pacifica*).

Diagnostic character: Valve with 3 large ocelli separated from valve margin by 3–6 areolae (Figs 1, 2, 4, 5, 8; characters observed easily by LM).

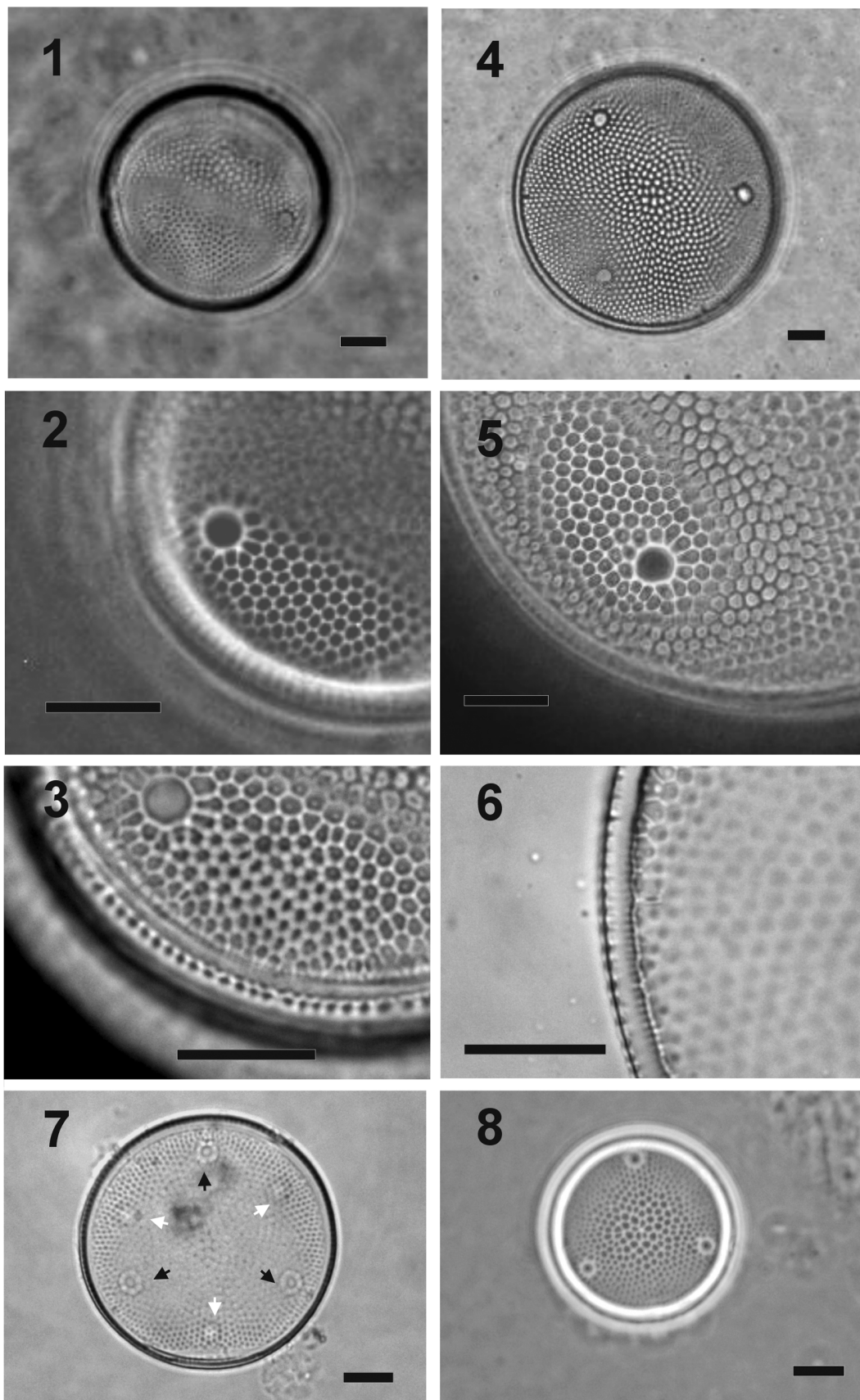
General description (LM): Valves circular with diameter of 37–75 µm (Figs 1, 4, 7, 8). Central areolae larger than elsewhere on valve; areolae radiate from centre of valve to margin. 3 ocelli with diameter of 2.5–5 µm (Figs 4, 8), separated from margin by 5–10 µm (or 3–6 areolae) (Figs 2, 5). Three rimoportulae adjacent to siphon marginalis, each equally spaced between ocelli (Figs 4, 7). Sometimes 2 rimoportulae occur between ocelli (slide MEXU 1840). Siphon marginalis visible as hyaline ring (Figs 2, 3, 5, 6, 8) with sub-triangular holes, density of 8–11 in 10 µm (Figs 3, 6). Ocelli of epivalve coinciding with rimoportulae of hypovalve (Fig 7). All 6 ocelli distinguishable in complete frustule in valve view (Fig. 7); frustules less broad in girdle view.

SEM: Details recorded in Meave *et al.* (2008) and Hernández-Becerril & Barón-Campis (2008). Careful observations of the external structure of the rimoportulae indicate that these are single tubes without ornamentation and with the base surrounded by granules (Figs 9, 10).

Discussion

Taxon characters: Comparison of the morphological characters for species of *Fryxelliella* shows that the characters of *F. sepulvedana* and *F. pacifica* describe the same species. Examination of the two slides labeled for the holotypes of *F. sepulvedana* (MEXU 1837) and *F. pacifica* (MEXU 1705) was limited to one valve per species. Measurements made on these specimens confirmed the information provided in the original descriptions, although for *Fryxelliella pacifica* (MEXU 1705) the diameter was larger than that of the figure indicated as iconotype: 47 µm for the specimen in figures 2 and 3 (Hernández-Becerril & Barón-Campis 2008); 75 µm for the actual holotype specimen on MEXU 1705. Examination of material labeled as isotypes (MEXU 1838, MEXU 1839, MEXU 1840, MEXU 1841) corresponded to the reported size ranges. It should be noted that these slides are not isotypes as they are not duplicates of holotype (Art. 9.4, McNeill *et al.* 2012); these specimens are from different localities, one is from the same locality but collected in a different year.

Observations made with SEM corroborate the characters previously described in Meave *et al.* (2008) and Hernández-Becerril & Barón-Campis (2008). However, the rimoportula ornamentation described as a “crown” structure (Hernández-Becerril & Barón-Campis 2008) was not observed in our specimens. This ornamentation may not be constant and therefore not useful as a diagnostic character. Resolution by LM is sufficient to distinguish the species from others.



FIGURES 1–8: LM images of *Fryxelliella sepulvedana*. Figs 1–3: Image of valve labeled holotype for *F. sepulvedana* on MEXU 1837. Figs 4–6: Image of valve labeled holotype for *F. pacifica* on MEXU 1705. Figs 1, 4: General valve morphology. Figs 2, 5: Detail of ocelli. Figs 3, 6: Detail of siphon marginalis with sub-triangular apertures. Fig. 7: Image of frustule from MEXU 1841; black arrows indicate ocelli on one valve; white arrows indicate ocelli on other valve. Fig. 8: Small valve from slide MEXU 1841. Scale bars= 10 μ m.

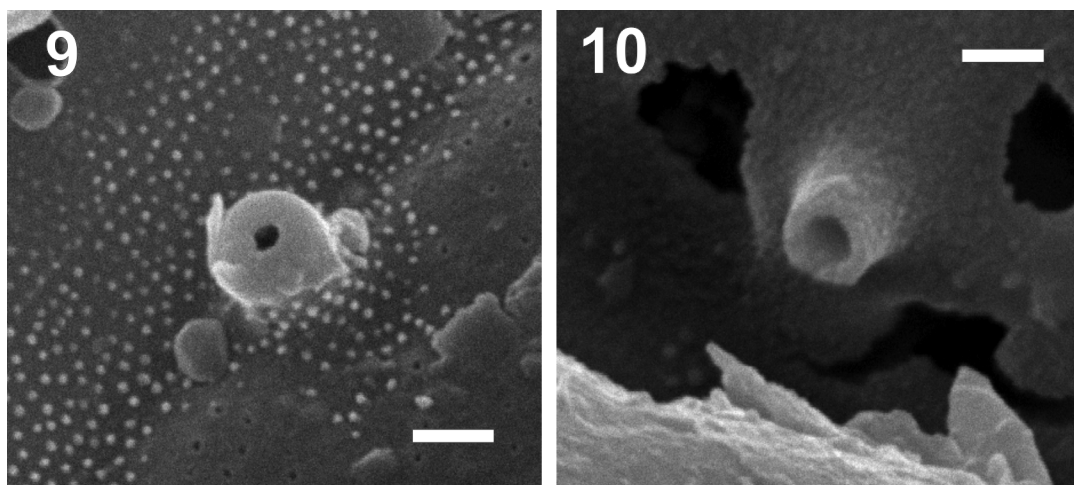
TABLE 1. Comparison of measurements in species of *Fryxelliella*; data taken from original descriptions of the types and the slides labelled holotypes for *F. sepulvedana* and *F. pacifica*.

Species	<i>F. floridana</i>	<i>F. sepulvedana</i>	Holotype MEXU 1837	<i>F. pacifica</i>	Holotype MEXU 1705
Diameter (µm)	19–48	41.7–68.3 ^a	47	39–60 ^b	75
Ocelli					
Number	3	3	3	3	3
Diameter	1.4–1.6 µm	3.3–5.5 µm	4 µm	3.5–4.3 µm	5 µm
Distance from margin	close to marginal tube	4–5 areolae	5 µm	3–5 areolae	10 µm
Valve	Convex at centre	Slightly convex	Slightly convex	Flat at centre	Flat
Areolae in 10 µm	12–13	6–9	7–8	5.5–7	6–8
Marginal apertures of siphon marginalis in 10 µm	4	(6–8) 10–11	8	9–10	8
Rimoportula	3, external tube: surrounded by granules; each one between ocelli, close to marginal tube. Sometimes two between two ocelli	3, each one between ocelli (rarely 2 between ocelli); external tube surrounded by granules	3, adjacent to the margin between ocelli	3, alternating with ocelli, external tube ending in divided sections as a crown	3, adjacent to the margin between ocelli
Cribra/cribal pores	External, one ring of pores: 7–19 pores	External, two circular rings: 24–34 pores, with a larger marginal pore	External with pores	17–27 poroids without particular arrangement	External with pores
Central area	Larger areolae and spaced: 6–7/10 µm, 2–3 sunken circles: 19–23 cribal pores	Larger areolae: 5–7 in 10 µm	Larger areolae: 6	Rosette: 4–5 in 10 µm	Larger areolae: 6
Mantle	1 µm, hyaline strip interrupted by triangular holes and juxtaposed quadrangular plates with fine granules	Many quadrangular plates (scutellum) with granules and silica ridge	Very shallow, areolae smaller than in valve	Consisting of juxtaposed rectangular plates (scutella) and small granules	Very shallow, areolae smaller than in valve
Girdle	Two bands, valvocopula areolated, copula ligulate	Valvocopula thin, adjacent band ligulate	No information ^c	4 bands	No information ^c
Siphon marginalis	Inside diameter 0.9–1.3 µm, uniform except at sites of internal openings of ocelli	Continuous, 2.2 µm width	2.5 µm width	2.8–3.4 µm, Figs 15, 21, 28	2.4 µm width
Reference	Prasad <i>et al.</i> (1997)	Meave <i>et al.</i> (2008)	This study	Hernández-Becerril & Barón-Campis (2008)	This study

a. Not derived from figs 2–10 in Meave *et al.* (2008) as these are at the wrong scale.

b. Iconotype (figs 2 and 3 in Hernández-Becerril & Barón-Campis 2008) is c. 47 µm in diameter, not corresponding to the measurement of the holotype specimen.

c. No information as holotypes are one valve



FIGURES 9, 10: SEM images of rimoportulae from two different specimens from Los Cabos, Baja California Sur, Mexico. Fig 9: Rimoportula without ornamentation, surrounded by granules at base. Fig 10: Rimoportula without ornamentation, specimen different to Fig. 9. Scale bars= 0.5 μ m.

Priority Considerations: According to the *International Code of Nomenclature for algae, fungi, and plants* both *Fryxelliella sepulvedana* and *Fryxelliella pacifica* are validly published (Art. 32) but if the two are considered synonyms, only one name can be applied, the correct name being that which was first published (Art. 11.4). As both names appeared in 2008, some further publication facts are required.

Fryxelliella pacifica: the manuscript describing this species was received by the editor of *Phycological Research* on 9th June, 2007 and was accepted on November 23rd, 2007 (Hernández-Becerril & Barón-Campis 2008); the manuscript was assigned a DOI (Digital Object Identifier) on 19th August 2008. Publication of that issue of *Phycological Research* was September 2008, according to the date on the cover.

Fryxelliella sepulvedana: the manuscript describing this species was received by the editor on 28th November, 2007 and was accepted on January 10th, 2008 (Meave *et al.* 2008). Publication of that issue was after January but before June 2008, according to the date on the cover (“Jan/Jun. 2008”); the journal editor has confirmed that the publication date was June 2008 (pers. comm.).

Thus, *Fryxelliella sepulvedana* is considered to have been first published June 2008 and *Fryxelliella pacifica* first published three months later in September 2008 (if the valid publication date is taken as that of the electronic version, the DOI document was available on August 19th): thus the correct name for this taxon is *Fryxelliella sepulvedana*.

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References

- Bailey, J.W. (1851) Microscopical observations made in South Carolina, Georgia, and Florida. *Smithsonian Contributions to Knowledge* 2[8], 48 pp., pl. 1–3.
- Hernández-Becerril, D.U. & Barón-Campis, S.A. (2008) New species of the diatom genus *Fryxelliella* (Bacillariophyta), *Fryxelliella pacifica* sp. nov., from the tropical Mexican Pacific. *Phycological Research* 56: 149–155.
<http://dx.doi.org/10.1111/j.1440-1835.2008.00496.x>
- McNeill, J., Barrie, F.R., Buck, W.R., Demoulin, V., Greuter, W., Hawksworth, D.L., Herendeen, P.S., Knapp, S., Marhold, K. Prado, J., Prud'homme Van Reine, W.F. Smith, G.F., Wiersema, J.H. & Turland, N.J. (2012) *International Code of Nomenclature for algae, fungi, and plants (Melbourne Code) adopted by the Eighteenth International Botanical Congress Melbourne, Australia, July 2011. Regnum Vegetabile* 154. Koeltz Scientific Books, Koenigstein, Germany
- Meave del Castillo, M.E., Zamudio-Resendiz, M.E. & Fernandes, L.F. (2008) *Fryxelliella sepulvedana* sp. nov. (Triceratiaceae, Bacillariophyta), a rare species from the Mexican Pacific coasts. *Iheringia (Série Botânica)* 63: 177–185.
- Prasad, A.K.S.K. & Nienow, J.A. (2008) Transfer of the extant marine diatom *Pseudoauliscus radiatus* (Eupodiscaceae) to the forgotten genus *Mastodiscus* Bailey and an emended generic description of *Fryxelliella*. *Beihefte zur Nova Hedwigia* 133: 251–267.
- Prasad, A.K.S.K., Riddle, K.A. & Livingston, R.J. (1997) Fine structure, taxonomy, and systematics of the centric diatom *Fryxelliella* gen. nov. (Eupodiscaceae, Bacillariophyta) having a new valve structure, the circumferential marginal tube, with descriptions of *F. floridana* sp. nov. and *F. inconspicua* (Ratray) comb. nov.. *Phycologia* 36: 305–323.
<http://dx.doi.org/10.2216/i0031-8884-36-4-305.1>
- Ratray, J. (1888) A revision of the genus *Auliscus* Ehrenberg and of some allied genera. *Journal of the Royal Microscopical Society* 1888: 861–920.
<http://dx.doi.org/10.1111/j.1365-2818.1888.tb05838.x>
- Sims, P.A. (2001) The genus *Praetriceratium* gen. nov.: a survey of eupodiscoid genera with a siphon marginalis. *Diatom Research* 16: 399–416.
<http://dx.doi.org/10.1080/0269249X.2001.9705527>