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A morphometric diagnosis using continuous characters of *Pinnunavis edkuensis, sp. nov.* (Bacillariophyta: Bacillariophyceae), a brackish-marine species from Egypt

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Abstract

Pinnunavis edkuensis is reported as a new diatom species from Egypt from brackish and marine habitats. Its description and diagnoses focus on 12 continuous morphological characters: valve breadth, valve mantle shape and surface area, axial-central area shape and surface area, axial area breadth, distal and proximal interstriae distances, striae slopes, magnitude and position of maximal slope along a semivalve transect, and inter-raphe distance. These characters are considered along their ontogenetic trajectories, using a size vector, by means of regression analyses. Shape was assessed using geometric morphometric methods. Diagnostic comparisons of *P. edkuensis* were made with *P. yarrensis*, for which a lectotype was chosen and Grunow's unpublished description and drawings presented, and *P. zalatii*, a new name replacing the illegitimate name, *Navicula aegyptiaca*. *P. edkuensis* was demonstrated to be a distinct group compared to these two similar species using 11 of the 12 characters. The diagnoses emphasize species recognition by means of anova, regression and randomization analyses and specimen determination primarily by means of regression-based prediction intervals. Additional comments are made on the statistical nature of gaps associated with characters described by discrete or continuous variables, the importance of reporting sample sizes as part of diatom diagnoses and other comparisons, and the role of size in specimen comparability and taxon identification. The generic distinctness of *Pinnunavis* and *Pinnularia* is discussed based on a preliminary cladistic analysis of morphological characters.

Key words: continuous characters, diagnosis, geometric morphometrics, shape analysis, semaphoronts, prediction intervals, *Pinnunavis edkuensis*, comparable individuals

Introduction

During a survey of the diatom flora of Egypt, one of us (A.I. Saleh) encountered in a series of samples from brackish and marine environments specimens (Figs 1–6) strongly resembling *Pinnunavis*[1] *yarrensis* (Grunow) Okuno (1975: 111; basionym: *Navicula yarrensis* Grunow in A.W.F. Schmidt *et al.* 1876: pl. 46, figs 1–6), an occasionally reported and globally distributed species from these habitats (Cleve 1895, Witkowski *et al.* 2000), but their determination as such by us was uncertain. This study originated as a simple effort to make a light microscope-based species-level determination of this set of specimens.

There were several important sources of our uncertainty. One source was that *Navicula yarrensis* had no type. Grunow never published a written description or diagnosis of it, only a few illustrations as part of its protologue (Grunow in Schmidt 1876), so it was unclear to which group the name properly applied and its relation to subsequent and present-day descriptions of this species.

1. The correct name for this genus is *Pinnunavis* Okuno (1975: 109), not the "inadvertently misspelled" *Pinnuavis* Okuno (Moe & Silva 2011).

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