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Actinellopsis murphyi gen. et spec. nov.: A new small celled freshwater diatom (Bacillariophyta, Eunotiales) from Zambia

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Abstract

In this paper we describe *Actinellopsis murphyi gen. et spec. nov.* a small heteropolar and dorsiventral diatom from a seep habitat in Zambia. This novel taxon has the chief distinguishing characteristic, along with its cell symmetry, of having the raphe positioned wholly in the valve face and not extending onto the mantle. It is further placed within the Peroniaceae as it possesses a straight raphe on the valve face and rimoportulae, and the frustules are heteropolar with regard to the length of the raphe. We also transfer the fossil diatom *Actinella giraffensis* to *Actinellopsis* as the morphological characteristics of this taxon are consistent with those of the generitype.

Key words: Zambia, Africa, new genus, *Actinella, Peronia*

Introduction

Given the size and diversity of climatic and geomorphological features, the diatom flora of (sub)tropical Africa has been poorly investigated. This holds true in particular for Zambia with only one detailed study of a section of its diatom flora (Cholnoky 1970). This country has a relatively high rainfall for the region and there are a multitude of aquatic resources and habitats including lakes, swamps (wetlands), streams and rivers, often having waterfalls, which in turn are responsible for the creation of a variety of moist sub-aerial habitats. All of these water bodies provide a varied and diverse habitat for diatoms. From 2010 to 2012 a project was undertaken to survey and document various aquatic organisms from rivers and streams around Zambia. The SAFRASS project (www.safrass.com) has as its main aim the development of capacity building tools for river quality monitoring in Zambia. Diatoms were one of the water quality indicator groups chosen for this project and as such were sampled from more than 150 localities around the country forming the most complete survey of the diatom flora of Zambia to date. Although rivers were the primary target habitat for sample collection, periodically wetted and sub-aerial habitats were also sampled and it is in this type of habitat in which an interesting member of the Eunotiales was found.

The order Eunotiales P.C. Silva (1962: 835) is a well-defined lineage of raphe bearing diatoms, the only known group to possess both a raphe system along with one or more rimportulae (Round *et al.* 1990). The order has two families, the Eunotiaceae Kützing (1844: 32), which includes the vast majority of the described diversity of the order (Round *et al.* 1990), and the Peroniaceae (G. Karsten) Topachevs'kyj & Oksiyuk (1960: 301; basionym: Peronioideae G. Karsten 1928: 203,268), a small group into which a single genus, *Peronia* Brébisson & Arnott ex Kitton (1868:16), is placed. *Peronia*, like members of the Eunotiaceae, has a raphe system and rimoportulae, but unlike the members of that family, *Peronia* has a raphe system completely on the valve face (as opposed to having a short portion of the raphe on the valve face, and the majority of the raphe on the valve mantle) and the valves are dissimilar, with one having a longer raphe system than the other (Hustedt 1930, Patrick & Reimer 1966).

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References

Anonymous (1975) Proposals for a standardization of diatom terminology and diagnoses. *Nova Hedwigia Beihefte* 53: 323–354.

Benson, M.E., Kociolek, J.P., Spaulding, S.A. & Smith, D.M. (2012) Pre-Neogene (>23.8 MA) biochronology of non-marine diatoms, with an account of the late Eocene flora of the Florissant Formation, central Colorado, USA. *Stratigraphy* 9: 131–152.

Burliga, A.L., Kociolek, J.P., Salomoni, S.E. & Figueiredo, D. (2013) A new genus and species in the diatom family Eunotiaceae Kützing (Bacillariophyceae) from the Amazonian hydrographic region, Brazil. *Phytotaxa* 79: 47–57.
http://dx.doi.org/10.11646/phytotaxa.79.2.1

Chaney, R.W. (1948) The bearing of the living *Metasequoia* on problems of Tertiary paleobotany. *Proceedings of the National Academy of Sciences* 34: 503–515.
http://dx.doi.org/10.1073/pnas.34.11.503

Cholnoky, B.J. (1970) Bacillariophyceen aus den Bagweolo-Sümpfen. *Hydrobiological Survey of the Lake Bangweulu Luapula RiverBasin* 5: 1–71.

Cox, E.J. (1979) Symmetry and valve structure in naviculoid diatoms. *Nova Hedwigia Beihefte* 64: 193–206.

Dawson, M.R., Marivaux, L., Li, C.-K., Beard, K.C. & Métais, G. (2006) *Laonastes* and the "Lazarus Effect" in Recent mammals. *Science* 311: 1456–1458.
http://dx.doi.org/10.1126/science.1124187

Eberle, J.J. & Greenwood, D.R. (2012) Life at the top of the greenhouse Eocene world-A review of the Eocene flora and vertebrate fauna from Canada's High Arctic. *Geological Society of America Bulletin* 124: 3–23.
http://dx.doi.org/10.1130/b30571.1

Fraiser, M.L. & Bottjer, D.J. Fossil preservation during the aftermath of the end-Permian mass extinction: taphonomic processes and palaeoecological signals. *In:* Oliver, D.J., Morrow, J.R. & Wignall, P.B. (Eds.) *Understanding Late Devonian and Permian-Triassic Biotic and Climate Events: Towards an Integrated Approach*. Elsevier, pp. 299–311.
http://dx.doi.org/10.1016/s0920-5446(05)80011-1

Friedman, M., & Coates, M.I. (2006) A newly recognized fossil coelacanth highlights the early morphological diversification of the clade. *Proceedings of the Royal Society B* 273: 245–250.
http://dx.doi.org/10.1098/rspb.2005.3316

Hustedt, F. (1930) *Süsswasser-Flora von Mitteleuropas. Heft 10. Bacillariophyta (Diatomeae)*. Gustav Fisher, Jena, 466 pp.

Hustedt, F. (1952) Neue und wenig bekannte Diatomeen III. Phylogenetische Variationen bei den rhaphidioiden Diatomeen. *Berichte der Deutsche Botanische Gesellschafte* 65: 133–144.

Hustedt, F. (1965) Neue und wenig bekannte diatomeen. IX. Süßwasserdiatomeen aus Brasilien, insbesondere des Amazonasgebietes. *Internationale Revue der gesamten Hydrobiologie* 50: 391–410.
http://dx.doi.org/10.1002/iroh.19650500305

Jablonski, D. (1986) Causes and consequences of mass extinction: A comparative approach. *In:* Elliott, D.K. (Ed.) *Dynamics of Evolution*. Wiley, New York, pp. 183–229.

Karsten, G. (1928) Abteilung Bacillariophyta (Diatomeae). *In:* Engler, A. & Prantl, K. (Eds.) *Die Natürlichen Pflanzenfamilien, Peridineae (Dinoflagellatae), Diatomeae (Bacillariophyta), Myxomycetes. Vol. 2* Wilhelm Engelmann, Leipzig. Zweite Auglage, pp. 105–303.

Kitton, F. (1868) Description of a new genus of Diatomaceae, and observations on the costae of *Pinnularia peregrina*. *Quarterly Journal of Microscopical Science, new series* 8: 16–17.

Kociolek, J.P. (2000) Valve ultrastructure of some Eunotiaceae (Bacillariophyceae), with comments on the evolution of the raphe system. *Proceedings of the California Academy of Sciences* 52: 11–21.

Kützing, F.T. (1844) *Die Kieselschaligen. Bacillarien oder Diatomeen.* Nordhausen, 152 pp. http://dx.doi.org/10.5962/bhl.title.64360

Lewis, F.W. (1864) On some new and singular intermediate forms of Diatomaceae. *Proceedings of the Academy of Natural Sciences of Philadelphia* 15: 336–346.

Medlin, L.K. (1991) Evidence for parallel evolution of frustule shape in two lines of pennate diatoms from the epiphyton. *Diatom Research* 6: 109–124. http://dx.doi.org/10.1080/0269249x.1991.9705150

Medlin, L.K. & Round, F.E. (1986) Taxonomic studies of marine gomphonemoid diatoms. *Diatom Research* 1: 205–225. http://dx.doi.org/10.1080/0269249x.1986.9704970

Metzeltin, D. & Lange-Bertalot, H. (1998) Tropical diatoms of South America I. About 700 predominantly rarely known or new taxa representative of the Neotropical Flora. *Iconographia Diatomologica* 5: 1–695.

Metzeltin, D. & Lange-Bertalot, H. (2007) Tropical diatoms of South America II. Special remarks on biogeographic disjunction. *Iconographia Diatomologica* 18: 1–876.

Patrick, R.M. & Reimer, C.W. (1966) *The Diatoms of the United States exclusive of Alaska and Hawaii.* Monograph 13, Academy of Natural Sciences of Philadelphia, 688 pp.

Renner, S. (2004) Plant dispersal across the tropical Atlantic by wind and sea currents. *International Journal of Plant Science (Supplement)* 165: 523–533.

Ross, R., Cox, E.J., Karayeva, N.I., Mann, D.G., Paddock, T.B.B., Simonsen, R. & Sims, P.A. (1979) An amended terminology for the siliceous components of the diatom cell. *Nova Hedwigia Beihefte* 64: 513–533.

Round, F.E., Crawford, R.M. & Mann, D.G. (1990) *The Diatoms. Biology and Morphology of the genera.* Cambridge University Press, Cambridge, 747 pp.

Sabbe, K., Vanhoutte, K., Lowe, R.L., Bergey, E.A., Biggs, B.J.F., Francoeur, S., Hodgson, D. & Vyverman, W. (2001) Six new Actinella (Bacillariophyta) species from Papua New Guinea, Australia and New Zealand: further evidence for widespread diatom endemism in the Australasian region. *European Journal of Phycology* 36: 321–340.

Silva, P.C. (1962) Appendix A. Classification of algae. *In:* Lewin, R.A. (Ed.) *Physiology and Biochemistry of Algae.* Academic Press, Inc., New York, pp. 827–837.

Sims, P.A., Mann, D.G. & Medlin, L.K. (2006) Evolution of the diatoms: insights from fossil, biological and molecular data. *Phycologia* 45: 361–402.

Siver, P.A., Wolfe, A.P. & Edlund, M.B. (2010) Taxonomic descriptions and evolutionary implications of Middle Eocene pennate diatoms representing the extant genera Oxyneis, Actinella and Nupela (Bacillariophyceae). *Plant Ecology and Evolution* 143: 340–351.

Taylor, J.C., de la Rey, P.A. & van Rensburg, L. (2005) Recommendations for the collection, preparation and enumeration of diatoms from riverine habitats for water quality monitoring in South Africa. *African Journal of Aquatic Sciences* 30: 65–75.

Topachevs'kyj, A.V. & Oksiyuk, O.P. (1960) *Význachnŷk prisnovodnŷkh vodorostei Ukrayins'koyi RSR.* Vol. 11 Diatomovi vodorosti Bacillariophyta (Diatomeae) Kiyiv: Vidavnitstvo Akademyii Nauk Ukrayins'-koyi R.S.R.

Vyverman, W., Sabbe, K., Mann, D.G., Kilroy, K., Vyverman, R., Vanhoutte, K. & Hodgson, D. (1998) Eunophora gen. nov. (Bacillariophyta) from Tasmania and New Zealand: description and comparison with Eunotia and amphoroid diatoms. *European Journal of Phycology* 33: 95–111.

Wetzel, C.E., Lange-Bertalot, H., Morales, E.A., Bicudo, D.C., Hoffmann, L. & Ector, L. (2012) Bicudoa amazonica gen. nov. et sp. nov. (Bacillariophyta)-a new freshwater diatom from the Amazon basin with a complete raphe loss in the eunotioid lineage. *Phytotaxa* 75: 1–18.

Wolfe, A.P. & Siver, P.A. (2009) Three extant genera of freshwater thalassiosiroid diatoms from Middle Eocene sediments in northern Canada. *American Journal of Botany* 96: 487–497.

Wornardt, W.W., Jr. (1969) Diatoms, past, present, future. *In:* Brönnimann, P & Renz, H.H. (Eds.) *Proceedings of the First International Conference on Planktonic Microfossils.* E.J. Brill, Leiden, pp. 690–714.