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Surirella subrotunda sp. nov. and *Surirella parahelvetica sp. nov.*, two new diatom (Bacillariophyta) species from Lake Prespa, Macedonia

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Abstract

The genus *Surirella* is highly diverse and many taxa are reported as endemic, especially from ancient lakes and tropical continental regions. In ancient Lake Ohrid, 25 different *Surirella* species have been identified by different authors, five are considered to be endemic for the lake. In contrast, research on its sister Lake Prespa has been less rigorous and data for recent and fossil species of *Surirella* is very sparse. The number of *Surirella* taxa reported from Lake Prespa is 11; only one is considered an endemic for both lakes, Ohrid and Prespa. In this study, taxa from the genus *Surirella* were observed in a number of recent and fossil samples from Lake Prespa. Two taxa possess unique characters that distinguish them from known species. Their formal descriptions, based on detailed LM and SEM observations, are presented here. *Surirella subrotunda* sp. nov. is differentiated from other similar species by its valve outline, size, and shape of median area; it has been observed only in fossil diatom samples from core Co1215 recovered from Lake Prespa. *Surirella parahelvetica* sp. nov. is distinguished by its size, valve outline, number of alar canals and stria density.

Key words: *Surirella subrotunda*, *Surirella parahelvetica*, Lake Prespa, Lake Ohrid, diatoms

Introduction

The genus *Surirella* Turpin (1828: 362, 363) is one of the oldest diatom genera described; the name appears for the first time as "*Surirelle*" in the generic description (Turpin 1828: 362, 363) and as *Surirella striatula* (Turpin 1828: 363, pl. 15, figs 1–8) in the discussion of the generitype. *Surirella* comprises more than 500 taxa described worldwide (Fourtanier & Kociolek 2011) and is characterized by a circumferential marginal raphe system, raised or not raised within a keel. Detailed ultrastructural observations were undertaken by Ruck & Kociolek (2004) and used to propose some preliminary phylogenetic relations among the different genera within the family Surirellaceae. Taxa from this genus are found in marine, brackish and freshwater environments (e.g. Van Heurck 1880, Cleve-Euler 1952, Krammer & Lange-Bertalot 1988, Hartley *et al.* 1996). In the past few decades, a number of studies have focused on the re-examination, typification and description of *Surirella* taxa from ancient lakes and other regions remarkable for their high diversity and endemism. Examples include lakes Malawi, Victoria and Tanganyika in East Africa (Cocquyt 1998, Cocquyt & Jahn 2005, 2007, Cocquyt *et al.* 2008), the Western Ghats in India (Karthick 2009, Karthick *et al.* 2012) and the Malili lakes in Indonesia (Bramburger *et al.* 2008).

On the Balkan Peninsula, the unique system of the two sister lakes Ohrid and Prespa, older than 2 Ma (Stankovic 1960), has been the focus of intensive diatom research since the first half of the 20th century. The primary focus has been the modern diatom assemblages (Fott 1933, 1935, Hustedt 1945, Jurilj 1948, 1954, 1956a, b) and, more recently, the fossil diatom flora (Reed *et al.* 2010, Cvetkoska *et al.* 2012) from Lake Ohrid. Diatom research on Lake Prespa was more or less neglected, until the beginning of the 21st century with the publication of comprehensive studies between both lakes (Levkov *et al.* 2007, Levkov & Williams 2012, Cvetkoska *et al.* in press). *Surirella* has been more extensively studied in Lake Ohrid (Jurilj 1948, 1954). Information about *Surirella* in the recent diatom flora of Lake Prespa is found in Levkov *et al.* (2007) and Levkov & Williams (2012), while there is no data concerning any fossil *Surirella* taxa in the lake.

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in addition, transferred *Surirella spiralis* Kützing (1844: 60, fig 3: 64) into a new monotypic genus, *Spirodiscus* Jurilj (1948: 185). At that time, Jurilj attempted to explain evolutionary and phylogenetic relations between the genus *Surirella* and *Campylodiscus* Ehrenberg ex Kützing (1844: 59) by the existence of intermediate forms with different degrees of torsion and crossing of the valves. Jurilj found these intermediate forms in Lake Ohrid and placed them in newly described genera: *Helisella* Jurilj (1948: 182), *Iconella* Jurilj (1948:184), *Plagiodiscus* Jurilj (1948: 189, 190) and *Klinodiscus* Jurilj (1948: 193). Later, Jurilj (1954) re-evaluated his original hypothesis and transferred *Helissela glabra* Jurilj (1948: 182) and *Iconella variabilis* Jurilj (1948:185) to *Surirella* as *Surirella helisella* Jurilj (1954: 164) and *Surirella iconella* Jurilj (1954: 163). Although his phylogenetic hypothesis has been criticized (Hustedt 1959, Ruck & Kociolek 2004), the taxonomic value of Jurilj's work remains. The recognition of the endemic and relict character of Lake Ohrid diatoms and the similarity of the *Surirella* and *Campylodiscus* taxa he described with some of the fossil forms found across the Pannonia Basin (Köpecz, Káránd, Bory, Bodos) were the basics for Jurilj's hypothesis about the Miocene origin of Lake Ohrid.

Levkov *et al.* (2007) identified 11 taxa from *Surirella* in Lake Ohrid and the same number of species from Lake Prespa. The number of shared taxa between the lakes is 7 (Levkov & Williams 2012). During the study of the sediment sequence Co1202, which spans the last ca. 140 cal ka BP, Cvetkoska *et al.* (2012) identified five different *Surirella* species present in the fossil diatom assemblages from Lake Ohrid. Ongoing research on fossil diatom assemblages will provide more detailed information of taxonomic and distributional character, although at present *S. subrotunda* appears to be only present in the fossil record for Lake Prespa.

The importance and the diversity of taxa within the genus *Surirella* and other genera which are primarily considered as being more diverse in marine and brackish habitats, such as *Diploneis* (Ehrenberg) Cleve (1894: 76), *Amphora* Ehrenberg ex Kützing (1844: 107) and *Campylodiscus* has already been mentioned in Levkov *et al.* (2007). Thus, further investigation of Lake Prespa recent and fossil diatom flora and in particular taxa within the genus *Surirella* is necessary for revealing patterns of evolution and speciation, not just within the lake, but also between both lakes, Ohrid and Prespa.

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References

Aufgebauer, A., Panagiotopoulos, K., Wagner, B., Schäbitz, F., Viehberg, F.A., Vogel, H., Zanchetta, G., Sulpizio, R., Leng, M.J., Damaschke, M. (2012) Climate and environmental change in the Balkans over the last 17 ka recorded in sediments from Lake Prespa (Albania/F.Y.R. of Macedonia/Greece). *Quaternary International* 274: 122–135. http://dx.doi.org/10.1016/j.quaint.2012.02.015

Björck, S., Walker, M.J.C., Cwynar, L., Johnsen, S.J., Knudsen, K-L., Lowe, J.J., Wohlfarth, B., INTIMATE Members. (1998) An event stratigraphy for the Last Termination in the North Atlantic region based on the Greenland Ice Core record: a proposal by the INTIMATE group. *Journal of Quaternary Science* 13: 283–292. http://dx.doi.org/10.1002/(SICI)1099-1417

Bramburger, A.J., Hamilton, P.B., Hehanussa, P.E., Haffner, D.G. (2008) Processes regulating the community composition and relative abundance of taxa in the diatom communities of the Malili Lakes, Sulawesi Island, Indonesia. *Hydrobiologia* 615: 215–224. http://dx.doi.org/10.1007/s10750-008-9562-2

Brun, J. (1880) Diatomées des Alpes et du Jura et de la région Suisse et Française des Environs de Genève. *Imprimerie Ch. Schuchardt*, Genève, 146 pp.

Catalogue of Diatom Names, California Academy of Sciences, On-line Version updated 19 Sep 2011. Compiled by Elisabeth Fourtanier & J. Patrick Kociolek. Available online at http://research.calacademy.org/research/diatoms/names/index.asp.

Cleve, P.T. (1894) Synopsis of the Naviculoid Diatoms, Part I *Kongliga Svenska-Vetenskaps Akademiens Handlingar* 26, 2: 1–194.

Cleve-Euler, A. (1952) Die Diatomeen von Schweden und Finnland. Part V. (Schluss.) Kongliga Svenska Vetenskaps-Akademiens Handligar, 4, 3, 3: 1–153.
Cocquyt, C. & Jahn, R. (2005) Rare *Surirella* taxa (Bacillariophyta) from East Africa described by Otto Müller: typifications, recombinations, new names, annotations and distributions. *Willdenowia* 35: 359–371. http://www.jstor.org/stable/3997670
Cocquyt, C. & Jahn, R. (2007) *Surirella nyassae* O. Müller, *S. malombae* O. Müller, *S. chepurnovii* Cocquyt & R. Jahn *sp. nov.* (Bacillariophyta) - Typification and variability of three closely related East African diatoms. *Nova Hedwigia* 84: 529–548. http://dx.doi.org/10.1127/0029-5035/2007/0084-0529
Cocquyt, C. (1998) Diatoms from the Northern Basin of Lake Tanganyika. *Bibliotheca Diatomolologica* 39: 1–276.
Cocquyt, C., Kusber, W-H., Jahn R. (2008) Otto Müller's *Surirella* taxa (Bacillariophyta) from East Africa, based on a historical collection kept at the Botanic Garden and Botanical Museum Berlin-Dahlem (B). *Afrika Focus* 21, 1: 65–75.
Cvetkoska, A., Hamilton, P.B., Ognjanova-Rumenova, N., Levkov, Z. Observations of the genus *Cyclotella* (Kützing) Brébisson in ancient lakes Ohrid and Prespa and a description of two new species *C. paraocellata* spec. nov. and *C. prespanensis* spec. nov. *Nova Hedwigia*, in press.
Cvetkoska, A., Reed, J.M., Levkov, Z. (2012) Diatoms as indicators of environmental change in ancient Lake Ohrid during the last glacial-interglacial cycle (ca. 140 ka). *Diatom Monographs* 15: 220 pp.
Damaschke, M., Sulpizio, R., Zanchetta, G., Wagner, B., Böhm, A., Nowaczyk, N., Rethemeyer, J., Hilgers, A. (2013) Tephrostratigraphic studies on a sediment core from Lake Prespa in the Balkans. *Climate of the Past* 9: 267–287. http://dx.doi.org/10.5194/cp-9-267-2013
Ehrenberg, C.G. (1843) Verbreitung und Einflufs des mikroskopischen Lebens in Süd- und Nord Amerika. *Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin* 1841: 291–445.
Foged, N. (1981) Diatoms in Alaska. *Bibliotheca Phycologica* 53: 317 pp.
Fott, B. (1933) Die Schwebeflora des Ohrid-Sees. *Bulletin de l'institut et du Jardin Botaniques de l'Universite de Beograd* 2: 153–175.
Fott, B. (1935) Phytoplanktonproduktion des Ohridsees. *Verhandlungen der Internationalen Vereinigung für Theoretsiche und Anfewandte Limnologie* 7: 229–236.
Gaul, U., Geissler, U., Henderson, M., Mahoney, R., Reimer, C.W. (1993) Bibliography on the fine-structure of diatom frustules (Bacillariophyceae). *Proceedings of the Academy of Natural Sciences of Philadelphia* 144: 69–238.
Güttinger, W. (1991) Collection of SEM micrographs of diatoms, Series 5, 48 pls. self published.
Haeckel, E. (1878) Das Protistenreich. Eine Populäre Uebersicht über das Formengebiet der Niedersten Lebewesen. Ernst Günther's Verlag, Leipzig 104 pp.
Hartley, B., Barber, H.G., Carter, J.R., Sims, P.A. (1996) An Atlas of British Diatoms. *Biopress Limited,* Bristol 601pp.
Henderson, M.V., Reimer, C.W. (2003) Bibliography on the fine structure of diatom frustules (Bacillariphyceae). II. In: Witkowski, A. (Ed.). A.R.G. Gantner Verlag, Ruggell, Germany. *Diatom Monographs* 3: 372 pp.
Hollis, G.E., Stevenson, A.C., (1997) The physical basis of the Lake Mikri Prespa systems: geology, climate, hydrology and water quality. *Hydrobiologia* 35: 1–19. http://dx.doi.org/10.1023/A:1003067115862
Hustedt, F. (1959) Die Diatomeenflora des Salzlackengebietes im österreichischen Burgenland Österreichischen Akademie der Wissenschaften, *Mathematische und Naturwissenschaftliche, Kl. Abt*. 1,168, 4/5: 387–452.
Hustedt, F. (1945) Diatomeen aus Seen und Quellgebieten der Balkan-Halbinsel. *Archiv für Hydrobiologie* 40: 867–973.
Jurilj, A. (1948) Nove diajtomeje- Surirellaceae - iz Ohridskog jezera i njihovo filogenetsko znacenje. Jugoslovenska Akademija, Zagreb. *Prirodnoslovnih Istrazivanja* 24: 171–260.
Jurilj, A. (1954) Flora i vegetacija dijatomeja Ohridskog jezera. Jugoslovenska Akademija, Zagreb. *Prirodnoslovnih Istrazivanja* 26: 99–190.
Jurilj, A. (1956a) Osobitosti mikroflore Ohridskog Jezen (The peculiarities of the microflora from Lake Ohrida in Yugoslavia). *Godisnjak Bioloskog Instituta u Sarajevu (Annuaire de l'Institut Biologique a Sarajevo)* 1–2: 177–184.
Jurilj, A. (1956b) La phylogénése spécifique d'un groupe de diatomeés – Camplidiscoideae – et sa cause. *Hydrobiologia* 8: 1–15.
Karthick, B. (2009) Hemendrakumar Prithivraj Gandhi (1920–2008). *Diatom Research* 24: 509– 520. http://dx.doi.org/10.1080/0269249X.2009.9705820
Karthick, B., Hamilton, P.B., Kociolek, J.P. (2012) Taxonomy and biogeography of some *Surirella* Turpin (Bacillariophyceae) taxa from Peninsular India. *Nova Hedwigia* 141: 81–116.
Krammer, K., Lange-Bertalot, H. (1988) Bacillariophyceae. 2. Teil: Bacillariaceae, Epithemiaceae, Surirellaceae. in Ettl, H., Gerloff, J., Heynig, H. and Mollenhauer, D. (eds) *Süsswasserflora von Mitteleuropa* 2/2, 596 pp.
Kützing, F.T. (1844) Die Kieselschaligen. Bacillarien oder Diatomeen. Nordhausen: Förstemann 152 pp.
Leclercq, L. (1983) Description et écologie de nouveaux taxons de diatomées des genres *Surirella* et *Achnanthes*. *Bulletin du Jardin Botanique National de Belgique* 53, 3–4: 491–505.
Levkov, Z., Krstic, S., Metzeltin, D. & Nakov, T. (2007) Diatoms of Lakes Prespa and Ohrid (Macedonia). *Iconographia Diatomologica* 16: 1–613.
Levkov, Z., Williams, D.M. (2012) Checklist of diatoms (Bacillariophyta) from Lake Ohrid and Lake Prespa (Macedonia), and their watersheds. *Phytotaxa* 45: 1–76.
Matzinger, A., Jordanoski, M., Veljanoska-Sarafiloska, E., Sturm, M., Müller, B. & Wüest, A. (2006) Is Lake Prespa jeopardizing the ecosystem of ancient Lake Ohrid? *Hydrobiologica* 553: 89–109. http://dx.doi.org/10.1007/s10750-005-6427-9
Medlin, L.K. & Kaczmarska, I. (2004) Evolution of the diatoms: V. Morphological and cytological support for the major clades and a taxonomic revision. *Phycologia* 43: 245–270.

http://dx.doi.org/10.2216/i0031-8884-43-3-245.1
Meister, F. (1912) Die Kieselalgen der Schweiz. Beiträge zur Kryptogamenflora der Schweiz. K.J. Wyss. Bern. 4(1): 254pp, 48 pls.
Migula, W. (1907) Kryptogamen-Flora von Deutschland, Deutsch-Osterreich und der Schweiz im Anschluss an Thome's Flora von Deutschland, Osterreich und der Schweiz. (Band VI, Kryptogamen-Flora). Friedrich von Zenzschwitz, Gera. *Band II, Algen, Teil 1, Cyanophyceae, Diatomaceae, Chlorophyceae.* 918 pp.
Panagiotopoulos, K., Aufgebauer, A., Schäbitz, F. & Wagner, B. (2013) Vegetation and climate history of the Lake Prespa region since the Lateglacial, *Quaternary International* 15.
http://dx.doi.org/10.1016/j.quaint.2012.05.048
Pantocsek, J. (1892) Beiträge zur Kenntnis der Fossilen Bacillarien Ungarns. 3 Teile. Julius Platzko, Nagyy-Tapolcsany. Teil III, *Susswasser Bacillarien. Anhang-analysen 15 neuer Depots von Bulgarien, Japan, Mahern, Russland und Ungarn.* Nagy-Tapolcsány, Buchdrucherei von Julius Platzko, 42 pls.
Reed, J.M., Cvetkoska, A, Levkov, Z., Vogel, H. &. Wagner, B. (2010) The last glacial-interglacial cycle in Lake Ohrid (Macedonia/ Albania): testing diatom response to climate. *Biogeosciences* 7: 3083–3094.
http://dx.doi.org/10.5194/bg-7-3083-2010
Renberg, I. (1990) A procedure for preparing large sets of diatom slides from sediment cores. *Journal of Paleolimnology* 4: 87–90.
http://dx.doi.org/10.1007/BF00208301
Ruck, E.C. & Kociolek, J.P. (2004) Preliminary phylogeny of the family Surirellaceae (Bacillariophyta). *Bibliotheca Diatomologica* 50: 1–236.
Schmidt, A. (1874–1959) Atlas der Diatomaceen-kunde. R. Reisland, Leipzig. [Pls. 1–212, 1874–1897, A. Schmidt ; 213–216, 1899, M. Schmidt; 217–232, 1899–1902, F. Fricke; 233–240, 1902, F. Fricke; 241–244, 1903, H. Heiden; 245–246, 1904, Otto Müller; 247–248, 1904, M. Schmidt & F. Fricke; 249–252, 1904, F. Fricke; 253–256, 1905, F. Fricke; 257–264, 1905–1906, H. Heiden; 265, 267–268, 1906, F. Fricke; 266, 1906, M. Schmidt & F. Fricke; 269–480, 1911–1959, F. Hustedt].
Smith, W. (1853) Synopsis of British Diatomaceae. John Van Voorst, London, 1: 89 pp.
Stanković, S. (1960) The Balkan Lake Ohrid and its living world. *Monographie Biologicae* 9, Uitgeverij Dr Junk, Den Haag, 357 pp.
Turpin, P.J.F. (1828) Observations sur le nouveau genre Surirella. *Mémoires du Museum d'Histoire Naturelle* 16: 361–368.
Van Heurck, H. (1880) Synopsis des Diatomées de Belgique. Atlas. Ducaju & Cie., Anvers., pls 1–30.
Wagner, B., Aufgebauer, A., Vogel, H., Zanchetta, G., Sulpizio, R., Damaschke, M. (2012) Late Pleistocene and Holocene contourite drift in Lake Prespa Albania/ F.Y.R. of Macedonia/Greece. *Quaternary International* 274: 112–121.
http://dx.doi.org/10.1016/j.quaint.2012.02.016.