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SPECIFIC RANK FOR SEVERAL INFRASPECIFIC TAXA IN THE GENUS *PINNULARIA* EHRENB.

A new specific status for some taxa belonging to *Pinnularia* Ehrenb. is proposed, due to taxonomic inconsistencies concerning their current infraspecific rank. The morphological differences from their nominate varieties appear too conspicuous for assuming conspecificity.

Key words : *Pinnularia* taxa, species, specific status, infraspecific status, revision .

The genus *Pinnularia* is one of the largest genera of freshwater diatoms, and may be found in a variety of different types of water bodies (Krammer, 2000). Species of this genus are abundant in *Sphagnum* bogs in Eurasia and dominate these special ecosystems together with representatives of *Eunotia* and *Aulacoseira* (Kulikovskiy, 2008a,b, 2009a,b).

Comprehensive revisions of the genus *Pinnularia* were made by some taxonomists, in particular Cleve (1895), Hustedt (1930), Cleve-Euler (1955) and Krammer (1992, 2000). However, our most recent studies have revealed that not all taxonomic difficulties were resolved in these past revisions (Kulikovskiy et al., 2010).

Krammer's revision of this genus includes mainly taxa from the temperate zone. Nevertheless, in the last decade species from the genus *Pinnularia* were studied, both from taxonomical and biogeographical perspectives, from a number of different regions, including tropical zones. In addition, taxa from the Ehrenberg collections as well as from other "classical" collections were reviewed (Reichardt, 1995; Moser et al., 1995, 1998; Lange-Bertalot, Metzeltin, 1996, 1999; Lange-Bertalot et al., 1996, 2003; Metzeltin, Lange-Bertalot, 1998, 2002, 2007; Rumrich et al., 2000; Van de Vijver et al., 2002; Werum, Lange-Bertalot, 2004; Siver et al., 2005; Metzeltin et al., 2005; Kulikovskiy, 2009b; Sar et al., 2009; Kulikovskiy et al., 2010). Although these studies have revealed moderate morphological variability within various species,

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the independence of several infraspecific taxa from their nominate varieties appears evident. This corresponds to the use of a narrow species concept currently adopted for other genera (Mann, 1999; Droop et al., 2000; Mann et al., 2004).

Taxonomically, the genus *Pinnularia* includes species with very similar morphology among their infraspecific taxa such as e.g. *Pinnularia borealis*, *P. rabenhorstii*, *P. divergentissima*, *P. brebissonii*, *P. acrosphaeria*, *P. divergens*, *P. microstauron*.

The species complex including *P. borealis* and *P. rabenhorstii*

The taxonomic interpretation of the *P. borealis* – group is indeed problematic. In many cases it is very difficult to find populations with a high enough number of specimens for morphometric analyses and interpretation of the infraspecific range of taxa included in this group (Kulikovskiy, 2009b). Krammer's suggestions concerning the taxonomy of the *P. borealis* – group appear to be relevant (Krammer, 2000). Another closely related group is that including the *P. rabenhorstii* – taxa. Intraspecific taxa of *P. rabenhorstii* are easily distinguishable from the nominate variety by the shape, number of striae, central area and geographical distribution (Krammer, 2000). In the following section new combinations or new taxonomic ranks are proposed :

***Pinnularia boreoelegans* Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov., nom. nov.**

Replaced synonym: *P. borealis* var. *elegans* Hustedt in A. Schmidt et al. 1934. Atlas der Diatomaceenkunde, fig. 385: 26.

Synonym: *P. rabenhorstii* var. *elegans* (Hustedt) Krammer 2000, p. 23.

A new name is necessary to avoid a younger homonym of *P. elegans* (W. Smith) Krammer 1992.

***P. franconica* (Krammer) Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov.**

Basionym: *P. rabenhorstii* var. *franconica* Krammer 2000. Diatoms of Europe. Vol. 1, p. 209, fig. 5: 5-9, 6: 1-4. Fig. 5: 9 is selected representing the holotype.

Synonym: *P. borealis* var. *thuringiaca* sensu Krammer 1992, pro parte, figs 10: 5-7 (non fig. 1-3).

***P. neocuneata* Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov., nom. nov.**

Replaced synonym: *P. rabenhorstii* var. *cuneata* Krammer & Lange-Bertalot 2000. Diatoms of Europe. Vol. 1, p. 209, fig. 5: 10, 11. Fig. 5: 10 is selected representing the holotype.

A new name is necessary to avoid one more younger homonym of *P. cuneata* (Østrup) Cleve-Euler 1915 and *P. cuneata* Meister 1932.

The species complex including *P. divergentissima*.

Taxa from *P. divergentissima* – group are differentiated by the shape of valve (triundulate in *P. divergentissima* var. *triundulata* Krammer), never rostrate ends as in *P. divergentissima* var. *ardnamurchan* Krammer, size and dimensions as in *P. divergentissima* var. *minor* Krammer. In an earlier work we suggested new taxonomical rank for *P. divergentissima* var. *subrostrata* Cleve-Euler sensu Krammer 2000 and discussed problems with its taxonomy (Kulikovskiy et al., 2009). Below several new combinations are proposed:

***P. perminor* Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov., nom. nov.**

Replaced synonym: *P. divergentissima* var. *minor* Krammer 1992. Bibliotheca Diatomologica, 26, p. 63, fig. 12: 11-14. Fig. 12: 13 is selected representing the holotype.

A new name is necessary to avoid a younger homonym of *P. minor* Skvortzow 1971.

***P. pertriundulata* Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov., nom. nov.**

Replaced synonym: *P. divergentissima* var. *triundulata* Krammer 2000. Diatoms of Europe. Vol. 1, p. 212, fig. 11: 26-30. Fig. 11: 27 is selected representing the holotype.

A new name is necessary to avoid a younger homonym of *P. triundulata* Cleve-Euler 1934.

***P. ardnamurchan* (Krammer) Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov.**

Basionym: *P. divergentissima* var. *ardnamurchan* Krammer 2000. Diatoms of Europe. Vol. 1, p. 212, fig. 11: 31.

The species complex including *P. divergens*.

Several of the currently infraspecific taxa of *P. divergens* W. Smith and likewise of *P. brebissonii*, *P. microstauron*, *P. acrosphaeria* and some others differ considerably from the nominate varieties in terms of the shape of the valves, number of striae in 10 µm and shape of the central area. These characters were found to be constant during their life cycles when we studied various populations occurring in different ecosystems (rivers, ponds, lakes, sphagnum bogs) of European Russia (Kulikovskiy 2008, 2009, unpubl. data; Kulikovskiy et al., 2009). Consequently they should be considered as taxa with species rank; at least unless experiments with live material give evidence that they can interbreed.

***P. media* (Krammer) Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov.**

Basionym: *P. divergens* var. *media* Krammer 2000. Diatoms of Europe. Vol. 1, p. 215, fig. 34: 1-5. Fig. 34: 3 is selected representing the holotype.

***P. linearidivergens* Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov., nom. nov.**

Replaced synonym: *P. divergens* var. *linearis* øestrup 1910. Meddel. Groenland. 43, p. 243, pl. 14: fig. 11.

Synonym: *P. parallela* var. *crassa* øestrup 1910, fig. 3: 64; *P. divergens* var. *parallela* Cleve-Euler 1934, p. 58.

A new name is necessary to avoid one more younger homonym of *P. linearis* Gregory 1856 and *P. linearis* Steinecke 1916.

***P. biconstrictoides* Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov., nom. nov.**

Replaced synonym: *P. divergens* f. *biconstricta* Cleve-Euler 1939, Soc. Sci. Fennica, Comment. Biol. 4, p. 15, fig. 27.

Synonym: *P. divergens* var. *biconstricta* (Cleve-Euler) Cleve-Euler 1955, p. 53, fig. 1071i; *P. divergens* var. *linearis* sensu Krammer 1992, fig. 27: 4.

A new name is necessary to avoid a younger homonym of *P. biconstricta* Cleve-Euler 1955.

***P. peragalli* Kulikovskiy, Lange-Bertalot & Metzeltin comb. nov., nom. nov.**

Replaced synonym: *Navicula divergens* var. *bacillaris* M. Peragallo 1908. Tempère & Peragallo, p. 58, no. 105, 106.

Synonym: *P. divergens* var. *bacillaris* (M. Peragallo) Mills 1934, p. 1280; *P. divergens* var. *subbacillaris* Krammer 2000. Diatoms of Europe. Vol. 1, p. 215, fig. 34: 7, 11, 12.

A new name is necessary to avoid one more younger homonym of *P. bacillaris* Ehrenb. 1854 and *P. bacillaris* Cleve-Euler 1934.

***P. canadodivergens* Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov., nom. nov.**

Replaced synonym: *P. divergens* var. *sublinearis* Cleve 1895. K. Svenska Vet. Akad. Handl., 27, p. 79.

Synonym: *P. divergens* f. *linearis* Fontell 1917, p. 36, fig. 1: 9; *P. divergens* var. *fontellii* Cleve-Euler 1955, p. 52, figs 1071 b, c; *P. divergens* var. *elliptica* sensu Krammer 1992, figs 27: 1, 3.

A new name is necessary to avoid one more younger homonym of *P. sublinearis* (Grunow in Van Heurck) Cleve 1895 and *P. sublinearis* (Grunow) Schaarschmidt 1881.

***P. undulatodivergens* Kulikovskiy, Lange-Bertalot & Metzeltin comb. nov., nom. nov.**

Replaced synonym: *Navicula divergens* var. *undulata* M. Peragallo et Héribaude in Héribaude 1893. Libr. des Sci. Nat. Paris, p. 89, fig. 2: 33.

Synonym: *P. divergens* var. *undulata* (Peragallo & Héribaud) Hustedt 1914, p. 145, fig. 2: 33.

A new name is necessary to avoid one more younger homonym of *P. undulata* Gregory 1854 and *P. undulata* Pantocsek & Greguss in Greguss 1913.

***P. perundulatodivergens* Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov., nom. nov.**

Replaced synonym: *P. divergens* var. *perundulata* Krammer 2000. Diatoms of Europe. Vol. 1, p. 215, fig. 32: 2, 3. Fig. 32: 2 is selected representing the holotype.

A new name is necessary to avoid a younger homonym of *P. perundulata* Cleve-Euler 1948.

***P. rhombundulata* (Krammer) Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov.**

Basionym: *P. divergens* var. *rhombundulata* Krammer 2000. Diatoms of Europe. Vol. 1, p. 215, fig. 39: 4.

***P. microstauropsis* Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov., nom. nov.**

Replaced synonym: *P. microstauron* var. *angusta* Krammer 2000. Diatoms of Europe. Vol. 1, p. 217, fig. 51: 4-7. Fig. 51: 6 is selected representing the holotype.

A new name is necessary to avoid a younger homonym of *P. angusta* (Cleve) Krammer 1992.

***P. nanomicrostauron* Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov., nom. nov.**

Replaced synonym: *P. microstauron* var. *rostrata* Krammer 2000. Diatoms of Europe. Vol. 1, p. 217, fig. 51: 8-18.

A new name is necessary to avoid more younger homonym of *P. rostrata* Gregory 1856, *P. rostrata* Cleve-Euler in Sundelin 1917, and *P. rostrata* Heiden & Kolbe 1928.

***P. acutobrebissonii* Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov., nom. nov.**

Replaced synonym: *P. brebissonii* var. *acuta* Cleve-Euler 1955. Die Diatomeen von Schweden und Finland, p. 54, fig. 1072.

Synonym: *P. microstauron* var. *brebissonii* sensu Hustedt 1930, fig. 584 (excl. description); *P. brebissonii* MT 5 sensu Krammer 1992a, p. 97, figs 32: 2-4.

A new name is necessary to avoid a younger homonym of *P. acuta* W. Smith 1853.

***P. bicuneata* (Grunow) Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov.**

Basionym: *P. brebissonii* var. *bicuneata* Grunow 1880. Van Heurck, Types du Synopsis No. 59.

Synonym: *Navicula notata* M. Peragallo & Héribaud 1893, p. 87, fig. 4: 11; *P. brebissonii* var. *notata* (M. Peragallo & Héribaud in Héribaud) Cleve 1895, p. 78; *P. brebissonii* morphotype 4. iKrammer 1992, p. 96, figs 31: 11-17.

The combination *P. notata* Heiden & Kolbe 1928 exists and hence *N. notata* Peragallo & Heribaud cannot be combined with *Pinnularia* in order to avoid a younger homonym.

***P. ammerensis* Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov., nom. nov.**

Replaced synonym: *P. brebissonii* var. *minuta* Krammer 2000. Diatoms of Europe. Vol. 1, p. 216-217, fig. 47: 7-9. Fig. 47: 9 is selected representing the holotype.

Synonym: *P. brebissonii* morphotype 3 sensu Krammer 1992, p. 96, figs 32: 5-7.

We propose a new name for this taxon that refers to its type local ity in the Ammer Mts. because of two species described earlier, these being *P. minuta* Zanon 1941 and *P. minuta* østrup (1918) 1920, both with invalid names (VanLandingham, 1978).

A new name is necessary to avoid one more younger homonym of *P. minuta* Zanon 1941 and *P. minuta* (Østrup) Cleve-Euler 1955.

Species complex including *P. acrosphaeria*.

The large, distinctive mottled area surrounded by marginal shortened striae without separation between axial and central area appears as prominent but somewhat overestimated taxonomical features. In contrast, valve outlines, numerical characters and biogeographic occurrence of current infraspecific taxa were undervalued in the past.

***P. peracrosphaeria* Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov., nom. nov.**

Replaced synonym: *P. acrosphaeris* var. *parva* Krammer 2000. Diatoms of Europe. Vol. 1, p. 213, fig. 22: 3-6. Fig. 22: 4 is selected representing the holotype.

A new name is necessary to avoid a younger homonym of *P. parva* (Ehrenb.) Schaarschmidt 1881.

***P. tumidula* (Krammer) Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov.**

Basionym: *P. acrosphaeria* var. *tumidula* Krammer 2000. Diatoms of Europe. Vol. 1, p. 214, fig. 21: 8, 9. Fig. 21: 9 is selected representing the holotype.

Synonym: *P. acrosphaeria* morphotype 2 sensu Krammer 1992, p. 81, fig. 19: 6.

***P. turgidula* (Krammer) Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov.**

Basionym: *P. acrosphaeria* var. *turgidula* Grunow ex Cleve 1895. K. Svenska Vet. Akad. Handl. 27, p. 86.

The species complex including *P. rhomboelliptica* Krammer 2000.

It is somewhat confusing that Krammer designated the type and type locality of *P. rhombelliptica* var. *rhombelliptica* as originating from New Zealand (fossil) in his Latin diagnosis but as Lake Thun, Switzerland in the English diagnosis. The first one has to be considered as valid. Moreover, he does not illustrate any of the specimens from New Zealand as representative of the nominate variety, whereas var. *novazealandica* and var. *rhombica* originate from the type material "IOK 827" likewise for the nominate variety. We presume that they all belong to a single taxon because no convincing criteria can be found for infraspecific differentiation. On the other hand, var. *inflata*, var. *zuricana* and also the nominate variety as far as originating from Europe represent other, independent taxa. With focus on var. *inflata* from the type locality "Vogtendorf" near Erlangen, central Franconia (i.e. the northern part of Bavaria). The specimens are less distinguished by the inflated central part than by a narrow central area, broader rounded, hardly cuneate shaped ends and a distinctly semicomplex course of the raphe; size dimensions, length-to-breadth ration and stria density hardly differ.

***P. mediofranconica* Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov., nom. nov.**

Replaced synonym: *P. rhomboelliptica* var. *inflata* Krammer 2000. Diatoms of Europe. Vol. 1, p. 233, fig. 152: 3-5; 153: 1-4. Fig. 152: 3 is selected representing the holotype.

The epithet refers to the type locality in central Franconia, Germany.

A new name is necessary to avoid one more younger homonym of *P. inflata* (Kützing) Rabenhorst 1853 and *P. inflata* Cleve-Euler 1934.

Other taxa

***P. acoricolatoba* Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov., nom. nov.**

Replaced synonym: *P. acoricola* var. *lanceolata* Hustedt 1934, in A. Schmidt et al., fig. 390: 17-19, description in Hustedt 1935, p. 154, fig. 3: 24 C.

Questionable synonym: *P. bicuspidata* Cleve-Euler 1955, p. 57, fig. 1075A. Questionable since the Scandinavian taxon possesses larger size dimensions. In case of confirmed synonymy Cleve-Euler's name would have priority. A new name is necessary to avoid more younger homonym of *P. lanceolata* Ehrenberg 1843, *P. lanceolata* (Agardh) Studnicka 1888, *P. lanceolata* Heiden & Kolbe 1928, and *P. lanceolata* Cleve-Euler 1955.

This taxon differs from the nominate variety by much larger size dimensions, rhombic-lanceolate area (vs. elliptical to elliptical-lanceolate) and more widely spaced central raphe endings.

***P. erraticofossilis* Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov., nom. nov.**

Replaced synonym: *P. erratica* var. *fossilis* Krammer 2000. Diatoms of Europe. Vol. 1, p. 221, fig. 73: 8.

A new name is necessary to avoid a younger homonym of *P. fossilis* Krammer 2000.

Taxon differs from nominate variety by ends that are only slightly protracted, as opposed to broadly capitate and swollen.

***P. amaniana* (Krammer) Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov.**

Basionym: *P. appendiculata* var. *amaniana* Krammer 2000. Diatoms of Europe. Vol. 1, p. 225, fig. 91: 10, 11. Fig. 91: 10 is selected representing the holotype.

This taxon differs from nominate variety by narrow valves with a more rhombic-lanceolate shape, and distribution in the tropical region.

***P. unduliformis* Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov., nom. nov.**

Replaced synonym: *Navicula legumen* f. *major* A. Schmidt 1875. A. Schmidt et al. Atlas der Diatomaceenkunde, fig. 44: 47.

Synonym: *Pinnularia undula* var. *major* (A. Schmidt) Krammer 2000. Diatoms of Europe. Vol. 1, p. 123, fig. 93: 2, 3; (?)*P. undula* var. *mesoleptiformis* Krammer 2000. Diatoms of Europe. Vol. 1, p. 226, fig. 93: 1; (?)*P. legumen* var. *cuneata* Hustedt 1934. A. Schmidt et al. Atlas der Diatomaceenkunde, figs 392: 6, 7, 11; Hustedt 1943, fig. 183; (?) *Pinnularia undula* var. *cuneata* (Hustedt) Krammer 2000. Diatoms of Europe. Vol. 1, p. 123, fig. 93: 4.

A new name is necessary to avoid more younger homonym of *P. major* Brébisson in Rabenhorst 1864, *P. major* Dippel 1905, *P. major* Mayer 1912, and *P. major* Skvortzow 1928. This taxon differs from *P. undula* by much larger, more strongly undulate valves.

***P. polyoncoides* Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov., nom. nov.**

Replaced synonym: *P. mayeri* var. *similis* Krammer 1992. Bibl. Diatomol. 26, p. 115, 173, fig. 42: 1.

Synonym: *P. polyonca* var. *similis* (Krammer) Krammer 2000. Diatoms of Europe. Vol. 1, p. 91, fig. 96: 1-3.

A new name is necessary to avoid a younger homonym of *Pinnularia similis* Hustedt 1937.

This taxon differs from *P. mayeri* Krammer by lacking undulate margins, sometimes weakly convex and a lower number of striae in 10 µm.

***P. salina* (Krammer) Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov.**

Basionym: *P. stomatophora* var. *salina* Krammer 2000. Diatoms of Europe. Vol. 1, p. 226, fig. 99: 7-9. Fig. 99: 8 is selected representing the holotype.

This taxon differs from nominate variety by shape, absence of crescent-shaped markings and the central area.

***P. ventricodecrescens* Kulikovskiy, Lange-Bertalot & Metzeltin stat. nov., nom. nov.**

Replaced synonym: *P. krasskei* var. *ventricosa* Hustedt 1934. A. Schmidt et al. Atlas der Diatomaceenkunde, fig. 391: 9, 10. Fig. 391: 10 is selected representing the holotype.

Synonym: *P. decrescens* var. *ventricosa* (Hustedt) Krammer 2000. Diatoms of Europe. Vol. 1, p. 65, fig. 41: 3, 4.

A new name is necessary to avoid a younger homonym of *P. ventricosa* Hustedt in Schmidt et al. 1934.

This taxon differs from *P. decrescens* (Grunow) Krammer s.l. by its smaller size, by broadly rounded, clearly off-set ends, lack of triundulate valve margins and more densely spaced striae. It differs from *P. decrescens* var. *ventricosa* (Hustedt) Krammer by the shape (valves not triundulate, truncate ends) and dimensions.

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PINNULARIA EHRENB.

Pinnularia Ehrenb.

: *Pinnularia*, , , -

- Cleve P.T. Synopsis of the Naviculoid Diatoms. Pt. II // Kongl. Svenska Vet. Akad. Handl. – 1895. – **27**(3). – P. 1-219.
- Cleve-Euler A. Die Diatomeen von Schweden und Finnland. Pt. IV. *Biraphideae*. 2 // Ibid. – 1955. – **5**(4). – P. 1-232.
- Cleve-Euler A. Bacillariaceen-Assoziationen im Nördlichsten Finnland Acta Societatis Scientiarum Fennicae. Nova Ser. B // Acta Bot. Fenn. – 1939. – **2**(3). – P. 1-41.
- Droop S.J.M., Mann D.G., Lokhorst G.M. Spatial and temporal stability of demes in *Diploneis smithii* / *D. fusca* (Bacillariophyta) supports a narrow specie concept // Phycologia. 2000. – **39**(6). – P. 527-546.
- Foged N. Diatoms in Alaska // Bibliot. Phycol. – 1981. – **53**. – P. 1-317.
- Fontell C.W. Süßwasserdiatomeen Ober-Jämtland // Schwed. Arkiv Bot. – 1917. – **14**(21). – P. 1-68.
- Héribaud J. Les Diatomées d'Auvergne // Librair. Sci. Natur. (Paris). – 1893. – P. 1-255.
- Hustedt F. Bacillariales aus den Sudeten und einigen benachbarten Gebieten des Odertales // Arch. Hydrobiol. und Plankton (Stuttgart). – 1914. – **10**. – P. 1-128.
- Hustedt F. *Bacillariophyta* (Diatomeae) // Die Süßwasserflora Mitteleuropas. – Jena: Gustav Fischer, 1930. – Vol. 10. – 466 S.
- International code of botanical nomenclature (Vienna Code), adopted by the Seventeenth Intern. Bot. Congr. (Vienna, Austria, July 2005). – Ruggell, Liechtenstein: A.R.A. Gantner Verlag, 2006. – 568 p.
- Krammer K. *Pinnularia* eine Monographie der europäischen Taxa // Bibliot. Diatom. – 1992. – **26**. – P. 1-353.
- Krammer K. The genus *Pinnularia* // Diatoms of Europe. – 2000. – **1**. – 703 p.
- Kulikovskiy M.S. The species composition and distribution of diatoms in Sphagnum bogs of European Russia: Ecosystems of the Volga Upland // Inland Water Biol. – 2008a. – **4**. – P. 347-355.
- Kulikovskiy M.S. History of diatom studies in Sphagnum bogs of Russia and some adjacent countries // Nov. System. Plant. Non Vascular. – 2008b. – **42**. – P. 36-54.
- Kulikovskiy M.S. The species composition and distribution of diatoms in Sphagnum bogs of European Russia: The Polistovo-Lovatskii Land Tract // Inland Water Biol. – 2009a. – **2**(2). – P. 135-143.
- Kulikovskiy M.S. Species of the genus *Pinnularia* Ehr. (Bacillariophyta) from sphagnum bogs of Privolzhskaya Hills and the Polistovo-Lovatsky tract (Russia) // Intern. J. Algae. – 2009b. – **11**(1). – P. 34-56.
- Kulikovskiy M.S., Lange-Bertalot H., Witkowski A. et al. Diatom assemblages from Sphagnum bogs of the world. I. Nur bog in northern Mongolia // Bibliot. Diatom. – 2010. – **55**. – P. 1-326.
- Lange-Bertalot H., Cavacini P., Tagliaventi N., Alfinito S. Diatoms of Sardinia. Rare and 76 new species in rock pools and other ephemeral waters // Iconograph. Diatom. – 2003. – **12**. – P. 1-438.
- Lange-Bertalot H., Külbs K., Lauser T. et al. Dokumentation und Revision der von Georg Krasske beschriebenen Diatomeen – Taxa // Ibid. – 1996. – **3**. – P. 1-358.
- Lange-Bertalot H., Metzeltin D. Indicators of oligotrophy // Ibid. – **2**. – P. 1-390.
- Mann D.G. The species concept in diatoms // Phycologia. – 1999. – **38**(6). – P. 437-495.
- Mann D.G., McDonald S.M., Bayer M.M. et al. The *Sellaphora pupula* species complex (Bacillariophyceae): morphometric analysis, ultrastructure and mating data provide evidence for five new species // Ibid. – 2004. – **43**(4). – P. 459-482.

- Metzeltin D., Lange-Bertalot H.* Tropical diatoms of South America I: about 700 predominantly rarely known or new taxa representative of the neotropical flora // *Iconograph. Diatom.* – 1998. – **5**. – P. 1-695.
- Metzeltin D., Lange-Bertalot H.* Diatoms from the “Island Continent” Madagascar // *Ibid.* 2002. – **11**. – P. 1-286.
- Metzeltin D., Lange-Bertalot H.* Tropical diatoms, II: Special remarks on biogeographic disjunction // *Ibid.* – 2007. – **18**. – P. 1-879.
- Metzeltin D., Lange-Bertalot H., Garcia-Rodriguez F.* Diatoms of Uruguay // *Ibid.* – 2005. – **15**. – P. 1-737.
- Mills F.W.* An index to the genera and species of the diatomaceae and their synonyms. – London: Wheldon & Wesley, Ltd., 1934. – P. 1241-1320.
- Moser G., Lange-Bertalot H., Metzeltin D.* Insel der Endemiten. Geobotanisches Phänomen Neukaledonien // *Bibliot. Diatom.* – 1998. – **38**. – P. 1-464.
- Moser G., Steindorf A., Lange-Bertalot H.* Neukaledonien. Diatomeenflora einer Tropininsel. Revision der Collection Maillard und Untersuchung neuen Materials // *Ibid.* – 1995. – **32**. – P. 1-340.
- Øestrup E.* Diatoms from North-East Greenland. (Pt. 1. Mar. Diatoms. Pt. 2. Freshwater Diatoms). – Kjøbenhavn: Meddel. Grønland, 1910. – **43**. – P. 199-256.
- Patrick R.M., Reimer C.W.* The Diatoms of the United States exclusive of Alaska and Hawaii . V. 1. *Fragilariaceae, Eunotoniaceae, Achnantheaceae, Naviculaceae.* Monogr. Acad. Natur. Sci. Philadelphia, 1966. – Vol. 13. – 688 p.
- Reichardt E.* Die Diatomeen (*Bacillariophyceae*) in Ehrenbergs Material von Cayenne, Guayana Gallica (1843) // *Iconograph. Diatom.* – 1995. – **1**. – P. 1-99.
- Rumrich U., Lange-Bertalot H., Rumrich M.* Diatomeen der Anden (von Venezuela bis Patagonien / Tierra del Fuego) // *Ibid.* – 2000. – **9**. – P. 1-671.
- Tempère J., Peragallo H.* Diatomées du Monde Entier. Ed. 2, 30 fascicules. Fascicule 2-7. – Tempère, etc.: Chez J., 1908. – P. 17-112.
- Sar E.A., Sala S.E., Sunesen I. et al.* Catalogue of the genera, species, and infraspecific taxa erected by J. Frenguelli // *Diatom Monographs.* – 2009. – **10**. – P. 1-419.
- Schmidt A.* Atlas der Diatomaceen-kunde. Aschersleben, Commissions-Verlag Von Ludwig Siever's Buchandlung. – 1876. Ser. **I** (Heft 11-12), pls. 41-48.
- Schmidt A.* Atlas der Diatomaceen-kunde. – Leipzig: O.R. Reisland, 1934. – Ser. VIII, Heft 97-98, pls. 385-392.
- Siver P.A., Hamilton P.B., Stachura-Suchoples K., Kociolek J.P.* Freshwater diatom flora of North America: Cape Cod, Massachusetts, USA // *Iconograph. Diatom.* – 2005. – **14**. – P. 1-463.
- Van de Vijver B., Frenot Y., Beyens L.* Freshwater diatoms from Ile de la Possession (Crozet Archipelago, Subantarctica) // *Bibl. Diatom.* – 2002. – **46**. – P. 1-412.
- VanLandingham S.* Catalogue of the fossil and recent genera and species of diatoms and their synonyms. Pt. VI. Neidium through Rhoicosigma. – Braunschweig, 1978. – . 2960-3606.
- Werum M., Lange-Bertalot H.* Diatoms in springs from Central Europe and elsewhere under the influence of hydrogeology and anthropogenic impacts // *Iconograph. Diatom.* – 2004. – **13**. – P. 1-417.

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