Typification of *Chara connivens* Salzmann ex A.Braun f. *brevifolia* Vilhelm, *C. crinita* Wallroth and *C. glomerulifera* Ruprecht and clarification of conflicting species concepts for *C. arcuatifolia* Vilhelm (Charales, Charophyceae)

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The original material for three charophyte species and one form described by Wallroth (1815), Ruprecht (1845) and Vilhelm (1928, 1930) was located in the Herbarium of the Komarov Botanical Institute of the Russian Academy of Sciences (LE) in attempt to clarify their nomenclature and taxonomy. Study of the original material allowed designation of lectotypes here in accordance with ICN Art. 9.3 (Turland & al., 2018) and clarification of conflicting species concepts in case of *C. arcuatifolia* (cf. Wood & Imahori, 1965; Hollerbach & Krassavina 1983; Han & Li, 1994). The specimens are mostly stored in paper envelopes, but the envelope labels are usually not the original ones, and both labels are cited below for cases if they are different. Russian text in labels is reproduced with a translation in brackets. LE barcodes are indicated for each studied specimen.

*Chara arcuatifolia* Vilhelm 1928: 23 (‘arcuatofolia’)


Comments: This species was described under name ‘Chara arcuatifolia’ and is here corrected to ‘arcuatifolia’ in accordance with ICN Art. 60.10 (Turland & al. 2018). The printed label of original material was reproduced by Vilhelm, although it included all the sites visited by Androschow. The locality ‘Сzelkar, fl. Kauldzhur’ was specifically underlined, indicating the type locality for *C. arcuatifolia* (Hollerbach, 1950). *Chara arcuatifolia* was described as monoecious in the protologue, although the gametangia were described as ‘solitary in different whorls’ (‘antheridia et cystocarpia solitaria in verticillis singulis’, Vilhelm, 1928: 23), which could be interpreted as formation of antheridia and oogonia in different whorls of the same plant. The original material of *C. arcuatifolia* is consisted of entangled thalli of two species – more abundant dioecious *C. connivens* and less abundant monoecious *C. globularis* (LE!). The results
of a study of original material could be interpreted as evidence of an opinion of Vilhelm that he had specimens of a single species having oogonia and antheridia at different whorls of the same plant. The entangled male and female thalli of *C. connivens* were interpreted by him as monoecious plants. Such a pattern of gametangial formation is entirely unknown for extant charophytes. The less-abundant material of *C. globularis* was overlooked by Vilhelm. The part of original material received as a loan in 1958 by Wood and Imahori (LE A0001543) consisted of dioecious plants only. Thus, although not all original material was available to Wood, he was closer to correct interpretation by Vilhelm than Hollerbach (see below) and the typification suggested by Wood is correct. Therefore, a neotype of *C. arcuatifolia* selected by Wood (Wood & Imahori 1965: 179) is correctly a lectotype and accepted as such here. *Chara arcuatifolia* differs from *C. connivens* in the smaller number of branchlet segments (Wood & Imahori, 1965), which seems to be insufficient for its maintenance as a separate species. The presence of both conjoined and sejoined gametangia at the same plant was suggested as the most important trait for evaluation of *C. arcuatifolia* as a species by Hollerbach but resulted in erroneous species concept (Hollerbach & Krassavina, 1983). It can be easily explained by presence both dioecious *C. connivens* and *C. globularis* in original material of *C. arcuatifolia*. The species concept of Hollerbach & Krassavina (1983) cannot be confirmed with thorough morphological studies in many populations as well as with original material (Romanov, unpubl. data). The presence of two similar species in original material resulted in merging of traits of both species (Hollerbach & Krassavina, 1983). A study of plants with the morphology of *C. arcuatifolia* according to the description by Hollerbach & Krassavina (1983) from a wide spectrum of Eurasian regions, i.e., between the Baltics, Central Asia and Baikal Siberia implemented by the author, suggests that the morphotype of *C. globularis* having arcuate branchlets was reported as *C. arcuatifolia* from the territory of the former USSR, mostly occurring at excessive insolation, especially in wave-exposed habitats.

*Chara connivens* Salzmann ex A.Braun f. *brevifolia* Vilhelm 1930: 593


Comments: See above for *C. ‘arcuatofolia’, C. arcuatofolia* and *C. connivens* f. *brevifolia* Vilhelm, described from the same original material (Vilhelm, 1928, 1930), are based on the same species and, therefore, should be recognized as a synonyms. The syntype from Gatchina belongs to *C. globularis*, as indicated by Luther in his *determinavit* slip (Luther, 1979; LE A0001547). The
Lectotype was selected among two other syntypes, storing in the envelopes labelled as *C. connivens f. brevifolia* by Vilhelm.

**Chara crinita** Wallroth 1815: 190

**Lectotype (here designated):** *In stagno Koelmensi pone Halam. cop. / no date / Wallroth / Hb. Schrader (LE A0001536).


Specimen in the protologue: ‘*In stagno Kölmensi uberrime: passim quoque ad Wansleben’.*


Comments: Wood selected a neotype for *C. crinita* because he had failed to locate original Wallroth material; however, original material for this name has been found thus superseding neotype designation in accordance with ICN Art. 9.19 of the Code. Both specimens of the original material include female plants only belong to this species. The more abundant specimen with the label closer to the protologue was selected as a lectotype.

**Chara glomerulifera** Ruprecht 1845: 7


Specimen in the protologue: ‘*In aquis pigris deserti Cumani (Hb. M. Bieb. [Bieberstein])’.


Comment: Original material was discovered in the personal collection of F.A. Marschall von Bieberstein (1768–1826) stored separately at LE. It contains three small sheets of contemporaneous paper with specimens of *C. glomerulifera*. They are mounted on a single herbarium sheet together with the envelope containing fragments of male and female plants of *Nitella opaca* (Bruzelius) C.Agardh without indication of a species name for the latter. All plants of *C. glomerulifera* were treated with acid and pressed again in 1845 according to Ruprecht’s notes, which allowed for keeping them in excellent condition over time. Handwritten *determinavit* slips are also mounted on this sheet, which the specimens are determined as *Chara flexilis* Thuillier and *C. translucens* Persoon and published by Marschall a Bieberstein (1808: 377). These specimens agree with the description of Ruprecht (1845), but the locality given on the label is briefer than that given in the protologue. It is reasonable to assume that the two species, *C. glomerulifera* and *N. opaca*, were collected from the same freshwater locality. Precise georeferencing is impossible but seems to be located within a drainage basin of the Kuma River, a tributary of the Caspian Sea. *Chara glomerulifera* is a junior synonym for *C. glomerata* Desvaux, the basionym for the current name *Tolypella glomerata*.

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