New Combinations in North American *Schoenoplectiella* (Cyperaceae)

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Abstract. An investigation of taxonomic diversity in the North American members of *Schoenoplectus* (Rchb.) Palla and *Schoenoplectiella* Lye indicates the need to relocate species and varieties from *Schoenoplectus* sect. *Actaeogeton* (Rchb.) J. Raynal to *Schoenoplectiella*. A transfer of four taxa is proposed here: *Schoenoplectiella purshiana* (Fernald) Lye var. *williamsii* (Fernald) Shiels & Monfils, *S. smithii* (A. Gray) Shiels & Monfils var. *smithii*, *S. smithii* var. *leviseta* (Fassett) Shiels & Monfils, and *S. smithii* var. *setosa* (Fernald) Shiels & Monfils.

Key words: bulrush, Cyperaceae, *Schoenoplectiella*, *Schoenoplectus*, systematics, taxonomy.

Schoenoplectus (Rchb.) Palla s.l. has four sections designated by morphological and ecological data (Raynal, 1976; Smith & Hayasaka, 2001): *Schoenoplectus* sect. *Schoenoplectus*, *Schoenoplectus* sect. *Malacogeton* (Ohwi) S. G. Sm. & Hayasaka, *Schoenoplectus* sect. *Actaeogeton* (Rchb.) J. Raynal, and *Schoenoplectus* sect. *Supini* (Cherm.) J. Raynal. Species within *Schoenoplectus* sect. *Schoenoplectus* and *Schoenoplectus* sect. *Malacogeton* are perennials and have yellow to dark brown smooth achenes. Species within *Schoenoplectus* sect. *Actaeogeton* and *Schoenoplectus* sect. *Supini* are annuals or perennials and have light brown to black striate achenes. Species in *Schoenoplectus* sect. *Schoenoplectus* have stout rhizomes and floral scales with distinctly emarginate apices, while species in *Schoenoplectus* sect. *Malacogeton* have slender rhizomes often terminating in fleshy tubers and floral scales with entire or minimally emarginate apices. Species in *Schoenoplectus* sect. *Supini* often display amphicarpy and all have one or two nodes with cauline leaves, while species in *Schoenoplectus* sect. *Actaeogeton* never display amphicarpy and have nodeless culms with basal leaves. According to Govaerts et al. (2012), there are 76 species in *Schoenoplectus* s.l.; ca. 25 of these are not assigned to a section in the sectional accounts of Raynal (1976) and Smith and Hayasaka (2001).

Lye (2003) recognized the polyphyly of *Schoenoplectus* and proposed a revision resulting in a more narrowly defined *Schoenoplectus* and a newly erected genus, *Schoenoplectiella* Lye. This revision relied heavily on the molecular phylogenetic analyses of Muasya et al. (1998, 2000), which, combined, included two species of *Schoenoplectus* sect. *Schoenoplectus* (*Schoenoplectus lacustris* (L.) Palla and *Schoenoplectus triqueter* (L.) Palla) and two species from *Schoenoplectus* sect. *Supini* (*Schoenoplectiella juncea* (Willd.) Lye and *Schoenoplectiella articulata* (L.) Lye). Muasya et al. (2000) found *Schoenoplectus lacustris* (the type species for *Schoenoplectus*) more closely related to *Actinoscirpus* (Ohwi) R. W. Haines & Lye and *Bolboschoenus* (Asch.) Palla than to the sampled congeners from *Schoenoplectus* sect. *Supini*. In 2003, Lye transferred 26 species from *Schoenoplectus* s.l. into *Schoenoplectiella*: 23 species from *Schoenoplectus* sect. *Supini* and three from *Schoenoplectus* sect. *Actaeogeton* (*Schoenoplectiella juncoides* (Roxb.) Lye, *Schoenoplectiella purshiana* (Fernald) Lye, and *Schoenoplectiella wallichii* (Nees) Lye). Lye did not recognize sections in his treatment.

Lye's (2003) generic description of *Schoenoplectiella* relies on the presence of amphicarpy, tropical to subtropical distribution, and the "smaller" annual habit. Amphicarpy is present in *Schoenoplectus* sect. *Supini* but not in the three transferred species from *Schoenoplectus* sect. *Actaeogeton*. In addition, three species that Lye (2003) moved to *Schoenoplectiella* are restricted to North America and can occur in a temperate climate (*Schoeonoplectiella hallii* (A. Gray) Lye, *Schoenoplectiella purshiana*, and *Schoenoplectiella saximontana* (Fernald) Lye). *Schoenoplectiella juncoides* was transferred and is a perennial species with individuals that can reach 70 cm in height (Koyama, 1958). As currently described, not all species in *Schoenoplectiella* fit Lye's (2003) description.

Since Lye established *Schoenoplectiella* in 2003, five phylogenetic studies have been published that include modest sampling of species from *Schoenoplectus* s.l. (Yano & Hoshino, 2005; Simpson et al., 2007; Muasya et al., 2009a, 2009b; Jung & Choi, 2010). These studies include up to 13 species, utilize additional genetic markers, and include sampling from several close relatives in the Fuireneae. In all analyses, species in *Schoenoplectus* sect. *Actaeogeton* and *Schoenoplectus* sect. *Supini* are in a clade separate from species in *Schoenoplectus* sect. *Schoenoplectus* and *Schoenoplectus* sect. *Malacogeton*.

Citing molecular and morphological evidence, Jung and Choi (2010) transferred five species from

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Schoenoplectus sect. *Actaeogeton* to *Schoenoplectiella*. Jung and Choi (2010) point to some inconsistencies in Lye's 2003 description of *Schoenoplectiella* and advocate for revising the genus and subsuming all species from *Schoenoplectus* sect. *Supini* and *Schoenoplectus* sect. *Actaeogeton* into *Schoenoplectiella*. The molecular evidence for the revision is strong; however, further revisions of the generic descriptions are needed to reflect global morphological diversity in *Schoenoplectus* s. str. and *Schoenoplectiella*.

We propose to transfer the remaining North American species and varieties of *Schoenoplectus* sect. *Actaeogeton* into *Schoenoplectiella*; this is consistent with Lye's (2003) initial transfer of species and Jung and Choi's (2010) revision of *Schoenoplectiella*. The following combinations are proposed: *Schoenoplectiella purshiana* (Fernald) Lye var. *williamsii* (Fernald) Shiels & Monfils, *S. smithii* (A. Gray) Shiels & Monfils var. *smithii*, *S. smithii* var. *leviseta* (Fassett) Shiels & Monfils, and *S. smithii* var. *setosa* (Fernald) Shiels & Monfils. The nomenclatural changes proposed here are in preparation for a molecular and morphological study of biodiversity in the North American species of *Schoenoplectus* and *Schoenoplectiella*.

New Combinations in *Schoenoplectiella*

1. Schoenoplectiella purshiana (Fernald) Lye, Lidia 6(1): 26. 2003. Replacement name: *Scirpus purshianus* Fernald, Rhodora 44: 479. 1942. Replaced syn.: *Scirpus debilis* Pursh, Fl. Amer. Sept. 1: 55. 1814 [Dec. 1813], non *Scirpus debilis* Lam., Tab. Encycl. 1: 141. 1791, nec *Scirpus debilis* (Kunth) Kuntze, Revis. Gen. Pl. 2: 757. 1891, nom. illeg. *Schoenoplectus juncoides* (Roxb.) Palla subsp. *purshianus* (Fernald) Soják, Čas. Nár. Mus., Odd. Přír. 141: 62. 1972. *Schoenoplectus purshianus* (Fernald) M. T. Strong, Novon 3: 202. 1993. TYPE: U.S.A. Pennsylvania: "in wet meadows, Pennsylvania," *Muhlenberg s.n.* (lectotype, designated by Strong ["as designated on sheet by Schuyler"], [1993: 203], Hb. Muhlenberg 345–75 [no. 65, m. 33 in sched.] not seen, PH-00031652-3 photo).

1a. Schoenoplectiella purshiana (Fernald) Lye var. **purshiana.**

Habitat and distribution. The autonymic variety of *Schoenoplectiella purshiana* has been suggested to be associated with acidic substrates and stable water level conditions (Schuyler, 1972; Strong, 1994; Smith & Hayasaka, 2002). It has been collected from freshwater shores, ponds, and ditches in eastern North America, with collections from Ontario and Quebec in Canada. In the United States, plants have been documented from Alabama, Connecticut, Delaware, Washington, D.C., Georgia, Illinois, Indiana, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, Tennessee, Virginia, West Virginia, and Wisconsin (Smith & Hayasaka, 2002).

Discussion. *Schoenoplectiella purshiana* is an herbaceous annual with tufted culms displaying a pseudolateral inflorescence and an erect or divergent involucral bract. The inflorescence consists of one to 12 sessile spikelets. Flowers contain a perianth of six bristles equaling to slightly exceeding the achene or, rarely, are missing perianth bristles; each bristle is distinctly wider proximally. Achenes are widest near the middle and contain a central bulge on the abaxial surface (Smith, 2002). *Schoenoplectiella purshiana* has two varieties designated morphologically by presence or absence of perianth bristles: *S. purshiana* var. *purshiana* and *S. purshiana* var. *williamsii*. *Schoenoplectiella purshiana* var. *purshiana* always has six well-developed perianth bristles.

1b. Schoenoplectiella purshiana var. **williamsii** (Fernald) Shiels & Monfils, comb. nov. Basionym: *Scirpus debilis* Pursh var. *williamsii* Fernald, Rhodora 3: 252. 1901, as "Williamsii." *Scirpus smithii* A. Gray var. *williamsii* (Fernald) Beetle, Amer. J. Bot. 29: 655. [Oct.] 1942. *Scirpus purshianus* fo. *williamsii* (Fernald) Fernald, Rhodora 44: 479. [Dec.] 1942. *Scirpus juncoides* Roxb. var. *williamsii* (Fernald) T. Koyama, Canad. J. Bot. 40: 914. 1962. *Schoenoplectus purshianus* (Fernald) M. T. Strong var. *williamsii* (Fernald) S. G. Sm., Novon 12(1): 107. 2002. TYPE: U.S.A. Massachusetts: [Norfolk Co.] "sandy border of Massapoag Lake, Sharon," 7 Sep. 1901, *E. F. Williams & M. L. Fernald s.n.* [Plantae Exsiccatae Grayanae 26] (holotype, GH-00027993; isotypes, BRIT not seen, CAS-0005832 photo, GH-00027994 not seen, GH-00027995 not seen, GH-00027996 not seen, ILL not seen, MO-208586 not seen, MT, NEBC not seen, SAPS not seen, UC not seen, WTU not seen).

Habitat and distribution. *Schoenoplectiella purshiana* var. *williamsii* has been associated with acidic substrates and fluctuating water level conditions (Schuyler, 1972; Strong, 1994; Smith & Hayasaka, 2002). Collections have been found on sandy shores of freshwater lakes, muddy terraces along

streams, disturbed areas with gravel pits, and small ponds and marshy areas in the eastern United States from Indiana, Massachusetts, Michigan, and Wisconsin (Smith & Hayasaka, 2002).

Discussion. *Schoenoplectiella purshiana* var. *williamsii* is identical to the autonym in all aspects, including involcural bract divergence and the presence of a central bulge on the abaxial surface of the achene, but it lacks perianth bristles.

2. Schoenoplectiella smithii (A. Gray) Shiels & Monfils, comb. nov. Basionym: *Scirpus smithii* A. Gray, Manual (ed. 5), 563. 1867. *Schoenoplectus smithii* (A. Gray) Soják, Čas. Nár. Mus., Odd. Přír. 141: 62. 1972, non *Schoenoplectus smithii* (A. Gray) J. Raynal, Adansonia, n.s., 16(4): 530. 1977, nom. illeg. TYPE: U.S.A. New Jersey: in tidal mud on NJ shore of the Delaware below Red Bank opposite River Schuylkill, July 1865, *C. E. Smith s.n.* (holotype, GH-00028048; isotype, PH-0002818 photo).

2a. Schoenoplectiella smithii (A. Gray) Shiels & Monfils var. **smithii.**

Habitat and distribution. The autonymic variety of *Schoenoplectiella smithii* is found in coastal, freshwater tidal flats and inland sandy or muddy shores with large fluctuations in water levels. The taxon has been reported from Ontario and Quebec in Canada as well as from the eastern United States, from the states of Connecticut, Delaware, Indiana, Massachusetts, Michigan, Minnesota, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, and Wisconsin (Smith & Hayasaka, 2002).

Discussion. The type collections of *Scirpus smithii*, GH-00028048 and PH-0002818, are assigned holotype and isotype status, respectively. There is some ambiguity with the 1867 protologue in the details that are limited to: "July," C. E. Smith, "in tidal mud," and "Delaware Bay." The holotype and isotype agree on collector, collection site, and "July," and are otherwise compatible with the protologue. A second sheet from GH (GH-00028049) was collected by C. E. Smith and looks like the holotype in many regards but does not contain a date or mention of July and was collected at a nearby but different site ("on the shores of the Schuylkill at Penrose Ferry") from the holotype's locality. This collection would not be a duplicate and there is not enough evidence to consider it a syntype.

Schoenoplectiella smithii is an herbaceous annual with tufted culms displaying a pseudolateral inflorescence and an erect (very rarely divergent) involcural bract. The inflorescence consists of one to 15 sessile spikelets. Flowers contain a perianth of one to six bristles much shorter than to two times longer than the achene or are missing perianth bristles; if present, each bristle is slender throughout. Achenes have convex to slightly angled abaxial surfaces with no central bulge (Smith, 2002). *Schoenoplectiella smithii* has three varieties designated morphologically by presence, number, and character of perianth bristles: *S. smithii* var. *smithii*, *S. smithii* var. *leviseta*, and *S. smithii* var. *setosa*. *Schoenoplectiella smithii* var. *smithii* does not contain perianth bristles or, if present, the bristles are rudimentary.

2b. Schoenoplectiella smithii var. **leviseta** (Fassett) Shiels & Monfils, comb. nov. Basionym: *Scirpus smithii* var. *levisetus* Fassett, Rhodora 23: 42. 1921. *Scirpus smithii* fo. *levisetus* (Fassett) Fernald, Rhodora 44: 479. 1942. *Schoenoplectus smithii* (A. Gray) Soják var. *levisetus* (Fassett) S. G. Sm., Novon 12(1): 108. 2002. TYPE: U.S.A. Maine. [Sagadahoc Co.], Bowdoinham and at its mouth in Merrymeeting Bay, tidal flats of the Cathance River, 31 Aug. 1920, *N. C. Fassett 26* (holotype, GH-00028050; isotype, NY-00051663 photo).

Habitat and distribution. *Schoenoplectiella smithii* var. *leviseta* is found in coastal, freshwater tidal flats or rocky shores of rivers in eastern Canada, collected from New Brunswick and Quebec, and in the northeastern United States from Connecticut, Massachusetts, Maine, and Virginia, where it is presumed to be extirpated (Smith & Hayasaka, 2002).

Discussion. Type material of *Scirpus smithii* var. *levisetus* agrees on collection number and collection date, which falls within the date range listed in the protologue, and are maintained here despite no collection number provided in the protologue. The sheets GH-00028050 annotated as "Type" and NY-00051663 noted as "CoType" are interpreted as holotype and isotype, respectively.

Schoenoplectiella smithii var. *leviseta* is identical to the autonym in all aspects, including an erect involcural bract and achene shape, except for the presence of perianth bristles. The perianth contains from one to four slender bristles that are much shorter than to equaling the achene and contain barbs at the tips of the bristles or are otherwise lacking barbs (Strong, 1994). *Schoenoplectiella smithii* var. *leviseta* bristles will be more than one fourth of the achene height, while *Schoenoplectiella smithii* var. *smithii* bristles, if present, will not reach past one fourth of the achene's height and *S. smithii* var.

setosa bristles will exceed the achene's height and contain barbs throughout.

2c. Schoenoplectiella smithii var. **setosa** (Fernald) Shiels & Monfils, comb. nov. Basionym: *Scirpus smithii* var. *setosus* Fernald, Rhodora 3: 252. 1901. *Scirpus smithii* A. Gray fo. *setosus* (Fernald) Fernald, Rhodora 44: 479. 1942. *Schoenoplectus smithii* (A. Gray) Soják var. *setosus* (Fernald) S. G. Sm. Novon 12(1): 107. 2002. TYPE: U.S.A. Illinois: Augusta, 1845, *S. B. Mead s.n.* (holotype, GH-00028051; isotypes, NY-00051662 photo, PH-00022819 photo).

Habitat and distribution. *Schoenoplectiella smithii* var. *setosa* is found in freshwater, sandy, or muddy shores with relatively stable water levels, floating mats, and bogs. The variety occurs in Canada from Ontario and Quebec and in the eastern United States from Connecticut, Delaware, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New York, North Carolina, Ohio, and Wisconsin (Smith & Hayasaka, 2002).

Discussion. *Schoenoplectiella smithii* var. *setosa* is identical to the autonym in all aspects, including an erect involcural bract and achene shape, except for the presence of perianth bristles. This taxon has slender perianth bristles like *S. smithii* var. *leviseta* but differs in containing four to six perianth bristles equaling to twice as long as the achene and each bristle contains barbs throughout (Strong, 1994).

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