New Combinations within North American Schoenoplectus smithii and S. purshianus (sect. Actaeogeton, Cyperaceae) and Comparison with Eastern Asian Allies

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ABSTRACT. The new combinations Schoenoplectus purshianus (Fernald) M. T. Strong var. williamsii (Fernald) S. G. Smith, S. smithii (A. Gray) Sojak var. setosus (Fernald) S. G. Smith, and S. smithii var. levisetus (Fassett) S. G. Smith are made. Diagnostic features, mainly from spikelet dimensions, perianth bristles, and achenes, are provided that distinguish the eastern North American S. smithii and S. purshianus, and the eastern Asian and Pacific island S. hotarui (Ohwi) Holub, S. juncoides (Roxburgh) Palla, and S. komarovi (Roshevitz) Sojak, all five of which have been confused with each other. A description of Schoenoplectus sect. Actaeogeton is provided mostly on North American and eastern Asian species.

Key words: Asia, Cyperaceae, North America, Schoenoplectus, Schoenoplectus sect. Actaeogeton.

This paper derives from the senior author’s work on his treatment of Schoenoplectus (Reichenbach) Palla for the upcoming volume 23, Cyperaceae, of the Flora of North America (FNA), during which he studied numerous herbarium specimens from about 52 herbaria (Smith, 1995), as well as from the junior author’s ongoing work toward a monograph of Schoenoplectus, during which he studied numerous herbarium specimens from the herbaria listed in the acknowledgments.

Scirpus L. s.l. has been segregated worldwide in recent years based on embryo as well as vegetative and reproductive characters (Bruhl, 1995; Goethgebeur & Simpson, 1991; Hayasaka & Ohashi, 2000; Smith & Hayasaka, 2001; Smith & Yatskievych, 1996; Wilson, 1981). Nine segregate genera will be recognized for the upcoming Flora of North America: Amphiscirpus, Blysmus, Bolboschoenus, Isolepis, Oxyccaryon, Schoenoplectus, Scirpus, Trichophorum, and Websteria. The largest of these in North America is Schoenoplectus with about 70 species worldwide and 17 in North America.

Schoenoplectus is diverse morphologically and has been divided into several infrageneric taxa (Oteng-Yeboah, 1974; Raynal, 1976; Smith & Hayasaka, 2001). Smith and Hayasaka (2001) recognized and provided a key to four sections within Schoenoplectus: sect. Schoenoplectus, sect. Actaeogeton (Reichenbach) J. Raynal, sect. Malacoculus (Ohwi) S. G. Smith & Hayasaka, and sect. Supini (Chernezon) J. Raynal.

Upon their transfer from Scirpus to Schoenoplectus, the infraspecific taxa of the two native North American species of Schoenoplectus sect. Actaeogeton, S. purshianus (Fernald) M. T. Strong and S. smithii (A. Gray) Sojak, require new combinations. These species also have been confused with each other as well as with three species of eastern Asia and adjacent western Pacific islands (Koyama, 1958, 1962). In addition, the section Actaeogeton has never been clearly delineated. This paper addresses these nomenclatorial and taxonomic problems.


Muhlenberg first published the name Scirpus de-
bils is without a description in his 1813 catalog, and Pursh apparently appropriated Muhlenberg’s earlier name. The lectotype and duplicate sheet may have been seen by Pursh (Merrill & Hu, 1949), or the specimens may even have been collected by Pursh (C. E. Smith, 1962: 458). A. E. Schuyler and J. Macklin at PH have kindly provided us with photographs of the types and closely examined the specimens. On the lectotype sheet, “Scirpus debilis lupulinus Sm.” is written on the label; “345–74” is at the bottom of the sheet. The annotation directly on the sheet reads “Scirpus purshianus Fern. Type of Scirpus debilis Pursh, AE Schuyler 1976”; this sheet bears 15 inflorescence-bearing culms, 3 of which are attached together at their bases, and 12 are without bases. A second sheet bears labels and annotations similar to those on the lectotype with “345–75” written at the bottom of the sheet, and the annotation on the sheet reads “Scirpus purshianus Fern. TYPE MATERIAL of Scirpus debilis Pursh, Fl. Am. Sept. 1: 55. 1813[1814]. AES 1976.” It bears 14 culms with inflorescences, and is evidently part of the same collection as the lectotype. All culms on both sheets are very similar, and several bear achenes with attached bristles, which are typical of Schoenoplectus purshianus (A. E. Schuyler & J. Macklin, pers. comm. 2001).

1a. Schoenoplectus purshianus var. purshianus

Perianth bristles 6, stout, tapered distally, about equaling achene, densely spinulose. Reported habitats: shores of inland ponds and ditches. Distributed throughout the range of the species in northeastern North America from Quebec to Georgia westward to Minnesota, eastern Missouri, and northern Louisiana.

1b. Schoenoplectus purshianus var. williamsii

(Fernald) S. G. Smith, comb. nov. Basionym: Scirpus debilis Pursh var. williamsii (Fernald) Beetle, Amer. J. Bot. 29: 655. Oct. 1942. Scirpus purshianus Fernald f. williamsii (Fernald) Fernald, Rhodora 44: 479. Dec. 1942. Scirpus juncoides Roxburgh var. williamsii (Fernald) T. Koyama, Canad. J. Bot. 40: 914. 1962. Schoenoplectus smithii (A. Gray) S. B. Mead s.n. (holotype, GH; isotype, PH). The names Scirpus smithii A. Gray var. williamsii (Fernald) Beetle and Scirpus juncoides Roxburgh var. williamsii (Fernald) T. Koyama were misapplied by their authors to the entire species S. purshianus. Koyama (1963: 457) stated that his new combination Scirpus juncoides Roxburgh var. digynus (Böckler) T. Koyama has priority over Scirpus debilis var. williamsii. As Koyama referred to his 1962 paper, he apparently intended his new varietal combination to apply to the whole species S. purshianus. Böckler’s type of the basionym Scirpus supinus L. [var.] digynus Böckler needs to be examined to determine the specific and varietal identity of Scirpus juncoides var. digynus (Böckler) T. Koyama.


2a. Schoenoplectus smithii var. smithii

Perianth bristles absent. Reported habitats: shores of lakes, reportedly with substantial water-level fluctuations. This variety is known only from the type locality in eastern Massachusetts, several counties in southwestern Michigan, one county in adjacent Indiana, and two counties in Wisconsin.

2b. Schoenoplectus smithii var. setosus


Perianth bristles 4 to 6, equaling or slightly exceeding achene, densely spinulose. Chromosome number n = 19 (Schuyler, 1972). Reported habitats: wet places with little fluctuation in water level such as mires and shores of small lakes or ponds. This variety is known from Quebec (near Quebec...
City) to Delaware and western North Carolina westward to Wisconsin and Minnesota. In Michigan, Wisconsin, and Minnesota it is much more common than S. smithii var. smithii.


Perianth bristles 1 to 3 (4), mostly much shorter than achene, mostly without spinules. Chromosome number n = 19 (Schuyler, 1972). Habitat: restricted to fresh-water (or slightly brackish?) tidal muddy or rocky shores of rivers. This variety is very locally distributed but sometimes locally common (Schuyler, 1972). Smith has seen specimens from New Brunswick (Northumberland Co.), Quebec (Portneuf Co., near Quebec City), Connecticut (New Haven), Massachusetts (Middleton Co.), Maine (Penobscott and Sagadahoc Cos.), and Virginia (Fairfax Co.). It is known to be extirpated from Virginia (Strong, 1994).

Koyama (1962: 919) treated the eastern Asian Schoenoplectus komarovii (Roshevitz) T. Koyama, = Schoenoplectus smithii subsp. levisetus (Komarov) Sojak, basionym Scirpus supinus L. var. levisetus Komarov (other synonyms and type given by Koyama, 1958, 1962). However, our herbarium observations and published descriptions (Koyama, 1958, 1962; Ohwi, 1965) indicate that, pending a revision of the S. juncoides complex, S. smithii var. levisetus should be treated as the distinct species S. komarovii following Ohwi (1965). Although S. komarovii is similar to S. smithii var. setosus in most characters, including those of perianth bristles and achene shape and surface, it differs from S. smithii in its smaller achenes and its frequently compound inflorescences (Table 1).

While Smith has not detected morphological differences between the varieties other than those of the perianth bristles as given above, in his opinion these five infraspecific taxa should be treated as varieties rather than forms because the perianth bristle differences appear to be correlated with habitat differences, and thus these taxa can be interpreted as ecotypic varieties and may be valuable ecological indicators. Also, form status implies that the morphological differences are completely trivial.

Schoenoplectus smithii var. setosus, S. smithii var. levisetus, and S. purshianus var. williamsii were first described with no mention of ecological differences except for S. smithii var. levisetus, for which Fassett (1921) found the fresh-water tidal habitat remarkable. When Fernald (1942: 483) reduced the varieties to forms he merely stated: “... their differences are in the presence or absence of perianth-bristles, or in the case of S. smithii, forma levisetus, the lack of retrorse barbs on the bristles.” However, Schuyler (1972: 398–399) stated: “In both S. purshianus and S. smithii the presence or absence of barbed bristles appears to be correlated with the stability of the habitat. For example in eastern New York, New Jersey, eastern Pennsylvania and Delaware, S. smithii f. smithii is almost completely restricted to the specialized conditions of fresh inter-tidal zones of the Hudson, Raritan and Delaware Rivers while in the same area f. setosus occurs in and around lakes, ponds and quagmires. ... Thus it appears that plants of S. smithii which lack barbed bristles are better adapted to the periodic fluctuations in water levels which are characteristic of the estuarine environment than are those which have barbed bristles. ... S. smithii f. levisetus is common along the estuaries of the Kennebec River in Maine and the St. Lawrence River in Quebec.” Ferren and Schuyler (1980) and Strong (1994) essentially repeated these statements for S. smithii var. smithii and S. smithii var. setosus and provided more detailed ecological information for S. smithii var. smithii.

The few data Smith have seen on herbarium labels support these reported habitat differences. For S. smithii var. smithii, in addition to coastal estuaries, reported habitats include protected beaches of the very large Lakes Huron, Erie, Cayuga (New York), Oneida (New York) and Champlain. In contrast, reported habitats for S. smithii var. setosus are “bog” pools and peaty quagmires, marsh edges, sandy or muddy lake and river shores, marshy shore of drying shallow seepage lake, recently scraped road through wet meadow near lake shore, floating muck in lake in center of bog, mill pond, and muck of small drying-up alkaline lake.

Schoenoplectus purshianus and S. smithii have been widely confused. Many specimens are misidentified, and some authors have treated S. purshianus and S. smithii as conspecific (Beetle, 1942; Gleason, 1963; Gleason & Cronquist, 1963; Voss, 1972). Most published distributions are therefore erroneous, and the distributions given here are based almost entirely on specimens that the senior
Table 1. Morphological comparison of *Schoenoplectus purshianus*, *Schoenoplectus smithii*, and their eastern Asian allies.

<table>
<thead>
<tr>
<th>Species</th>
<th>S. purshianus</th>
<th>S. smithii</th>
<th>S. juncoides</th>
<th>S. hotarui</th>
<th>S. komarovi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Involucral bract</td>
<td>erect or often divergent</td>
<td>erect, rarely divergent</td>
<td>erect, sometimes divergent</td>
<td>erect</td>
<td>erect single head, or often compound with peduncles 1–5 mm long</td>
</tr>
<tr>
<td>Inflorescence</td>
<td>single head</td>
<td>single head</td>
<td>single head</td>
<td>single head</td>
<td>single head</td>
</tr>
<tr>
<td>Spikelet dimensions</td>
<td>5–12 × 3–4 mm</td>
<td>5–12 × 3–4 mm</td>
<td>6–20 × 4–6 mm</td>
<td>6–15 × 4–6 mm</td>
<td>5–10 × 3–4 mm</td>
</tr>
<tr>
<td>Perianth bristles</td>
<td>present, rarely absent, distinctly broader proximally</td>
<td>present or often absent, slender for whole length</td>
<td>present, slender for whole length</td>
<td>present, slender for whole length</td>
<td>present, slender for whole length</td>
</tr>
<tr>
<td>Stigma number</td>
<td>2 or a few 3</td>
<td>2 or a few 3</td>
<td>2 or a few 3</td>
<td>3 or a few 2</td>
<td>2</td>
</tr>
<tr>
<td>Achene</td>
<td>biconvex, sometimes plano-convex or a few obscurely trigonous, abaxial angle broadly mounded, obscure</td>
<td>biconvex or a few trigonous, abaxial angle narrow, distinct</td>
<td>biconvex</td>
<td>trigonous, abaxial angle narrow, distinct</td>
<td>plano-convex, sometimes biconvex</td>
</tr>
<tr>
<td>Cross-section shape</td>
<td>mostly obpyriform, mostly widest at the middle</td>
<td>mostly cuneate, mostly widest above the middle</td>
<td>mostly cuneate, mostly widest above the middle</td>
<td>mostly obpyriform, mostly widest at the middle</td>
<td>mostly cuneate, mostly widest above the middle</td>
</tr>
<tr>
<td>Outline</td>
<td>evenly tapered, rarely with a neck-like constriction, base 0.3–0.4 mm wide</td>
<td>evenly tapered, rarely with a neck-like constriction, base 0.3–0.5 mm wide</td>
<td>evenly tapered, rarely with a neck-like constriction, base 0.4–0.5 mm wide</td>
<td>evenly tapered, rarely with a neck-like constriction, base 0.2–0.3 mm wide</td>
<td>evenly tapered, rarely with a neck-like constriction, base 0.2–0.3 mm wide</td>
</tr>
<tr>
<td>Base</td>
<td>abruptly contracted, with a distinct neck-like constriction, base 0.3–0.4 mm wide</td>
<td>abruptly contracted, with a distinct neck-like constriction, base 0.4–0.5 mm wide</td>
<td>abruptly contracted, with a distinct neck-like constriction, base 0.4–0.5 mm wide</td>
<td>abruptly contracted, with a distinct neck-like constriction, base 0.2–0.3 mm wide</td>
<td>abruptly contracted, with a distinct neck-like constriction, base 0.2–0.3 mm wide</td>
</tr>
<tr>
<td>Surface</td>
<td>clearly rugulose at 10–20×, not longitudinally striate</td>
<td>clearly to obscurely rugulose at 10–20×, finely longitudinally striate at 30×</td>
<td>obscurely rugulose at 10–20×, obscurely longitudinally striate at 30×</td>
<td>clearly rugulose at 10–20×, finely longitudinally striate at 30×</td>
<td>obscurely rugulose or nearly smooth at 10–20×, finely longitudinally striate at 30×</td>
</tr>
<tr>
<td>Dimensions</td>
<td>1.6–2.2 × 1.2–1.5 mm</td>
<td>1.5–2 × 1.2–1.5 mm</td>
<td>2–2.4 × 1.5–1.9 mm</td>
<td>1.8–3 × 1.5–2.2 mm</td>
<td>1.2–1.6 × 0.8–1.1 mm</td>
</tr>
<tr>
<td>Habit</td>
<td>annual</td>
<td>annual</td>
<td>perennial</td>
<td>annual</td>
<td>annual</td>
</tr>
<tr>
<td>Distribution</td>
<td>eastern North America</td>
<td>eastern North America</td>
<td>eastern Asia</td>
<td>eastern Asia</td>
<td>eastern Asia</td>
</tr>
</tbody>
</table>
author has seen. The taxonomic confusion is due to
the subtle nature of the diagnostic characteristics
of achenes and perianth bristles as illustrated by
Strong (1994), Blondeau et al. (1996), and in the
upcoming volume 23 of the Flora of North America,
and is summarized in Table 1 herein. Confusion is
also caused by the presence in both species of
plants with or without perianth bristles as well as
plants with erect proximal involucral bracts. Plants
without bristles may be identified to species using
the differences in achene shape and surface sculpt-
uring as given in Table 1.

Our herbarium studies and the literature indicate
that Schoenoplectus purshianus and S. smithii
should be treated as distinct species restricted to
eastern North America and distinct from their rela-
tives, which are found in eastern Asia and the
Pacific islands. Some authors, however, have treat-
ed S. purshianus and S. smithii as conspecific with
eastern Asian species of the “S. juncoides complex”
(Koyama, 1958, 1962, under Scirpus), which is
comprised of perhaps 10 taxonomically difficult
species of eastern Asia and the Pacific islands. The
distinguishing characteristics of S. purshianus and S.
smithii and the eastern Asian relatives with which they have been confused are summarized in
Table 1.

Delimitation of Schoenoplectus sect.
Actaeogeton

The species of Schoenoplectus sect. Actaeogeton
and section Supini were all included in Scirpus
sect. Actaeogeton by Beetle (1942), Fernald (1942),
and Koyama (1958, 1962). Raynal (1976) segre-
gated Schoenoplectus sect. Supini from other sec-
tions based on the perianth bristles reduced or ab-
sent, and the ability to produce amphicarpic flowers
in the basal leaf sheaths. Although species of
Schoenoplectus sects. Actaeogeton and Supini are
mostly very similar in both vegetative and sexual
structures, our studies support their treatment as
separate sections based mainly on the ability for
amphicarpy and the usual presence of a node above
the basal leaves in the latter (Smith & Hayasaka,
2001). All plants of the North American species of
these two sections can be distinguished by these
characters (Smith & Yatskievych, 1996), but some
Old World species of Schoenoplectus sect. Supini,
e.g., S. supinus (L.) Palla, lack a cauline leaf.

The following description of Schoenoplectus sect.
Actaeogeton is based on about 300 specimens of
the North American species and about 500 speci-
mens of eastern Asian species as well as the de-
scriptions and illustrations in Koyama (1958, 1962)
and Ohwi (1965). The achene SEM micrographs
provided by Oh and Ham (1998) show that the epi-
dermal surface sculpturing of S. hotarui (Ohwi)
Holub, S. lineolatus (Franchet & Savatier) T. Koy-
ama, S. triangulatus (Roxburgh) Sojak, and S. wal-
lichii (Nees) T. Koyama, all of which we include in
section Actaeogeton (Smith & Hayasaka, 2001), are
very similar to each other, sharing longitudinally
oriented, linear epidermal cells.

Schoenoplectus (Reichenbach) Palla sect. Ac-
taeogeton (Reichenbach) J. Raynal, Adanso-
Reichenbach, Fl. Germ. Excurs.: 78. 1830.
Schoenoplectus subg. Actaeogeton (Reichen-
muuronatus (L.) Palla.

Annuals or perennials, culms densely tufted, ca.
5–200 cm; rhizomes present or apparently absent,
very short, hidden among culm bases and roots, or
rhizomes long and horizontally creeping and culms
single (in S. lineolatus). Culms cylindric or trigon-
ous, ca. 1–200 cm long × 1–8 mm thick. Leaves
all basal, ½ to very rarely ca. equaling culm, ca. 2
leaves well developed; ventral band hyaline or
membranous; ligules minute; blades from a mere
mucro to ca. 8 cm long × 0.5–1 mm wide, cross
section C-shaped or trigonous. Inflorescence of a
single spikelet or usually capitate; spikelets 2 to
20; involucral bracts 1 to 2, the proximal erect to
divergent, channeled-subcylindric or trigonous,
usually greatly exceeding the inflorescence. Floral
scales elliptic to ovate; membranous with thicker
midrib, often faintly many-nerved; margins cilio-
late; apices entire, mucronate. Perianth present or
absent, of 6 (or fewer) bristles that are retrorsely to
spreading spinulose or rarely smooth. Styles bifid
or trifid. Achenes dark brown to blackish when
ripe, obovoid, lenticular to trigonous, abruptly
short-beaked, prominently to obscurely rugose or
nearly smooth at 10 to 20×. Reported chromosome
numbers n = 19, 20, 21, 22, 30, 36, 37.

Habitats and distribution. Fresh-water wet-
lands, often emergent; worldwide, with the main
center of diversity in eastern Asia.

This description is tentative pending further
study of species, especially from Asia and Africa,
where a taxonomic revision is needed. Fourteen
species that we include in Schoenoplectus sect. Ac-
taeogeton from North America and eastern Asia are
listed in Smith and Hayasaka (2001), but it is pos-
possible that more species would be included after fur-
ther study. Although S. lineolatus has long, hori-
zontally creeping rhizomes in sharp contrast to the short, hidden rhizomes of all of the other species we include in Schoenoplectus sect. Actaeogeton. S. lineolatus closely resembles the other species in its leaves, floral scales, achenes, rhizomes, and pericarp internal structure (Hayasaka, unpublished data). In addition, hybrids between S. lineolatus and both S. hotarui and S. triangulatus have been reported from Japan (Koyama, 1958; Hayasaka & Ohashi, 2000).

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